Development of community-based monitoring methods for coastal dunes of the Bay of Plenty Region

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Papamoa College students surveying vegetation cover on the foredunes along a transect, Papamoa Beach

A contract report prepared for the Bay of Plenty Regional Council by Environmental Restoration Ltd.

This project has been undertaken in collaboration with the Coastal Restoration Trust of New Zealand and their research partners.

For the Bay of Plenty coastal dunes, monitoring methods were developed with assistance and in collaboration with Chris Ward, Shay Dean, Courtney Bell and Hamish Dean of the Bay of Plenty Regional Council.

Scope and content of this report

The Bay of Plenty Regional Council (BOPRC) was one of the first councils to adopt a community-based approach to dune management in New Zealand following programmes that were initiated widely in New South Wales in the 1980s and expanded to other parts of Australia (Dahm et al. 2005). Extensive programmes now operate in many regions throughout New Zealand.

In the Bay of Plenty region there are currently community Coast Care groups located from Waihi Beach in the west to Whangaparaoa on the east of the region involved in various aspects of dune restoration and management (Figure 1). They are formed by partnerships between the local community, iwi, district councils, the Department of Conservation and BOPRC working together to protect and restore beaches and coastal dunes (www.boprc.govt.nz/residents-and-communities/care-groups/coast-care/).

The Coast Care groups around the BOP region are involved in a wide range of activities to help protect the coastline, restore natural dune form and function, and are increasing awareness of coastal hazards and climate change in local communities. The most common activities include planting and protecting native dune plants, building access ways, installing signs to keep people informed, and controlling pest plants and animals in dune areas.

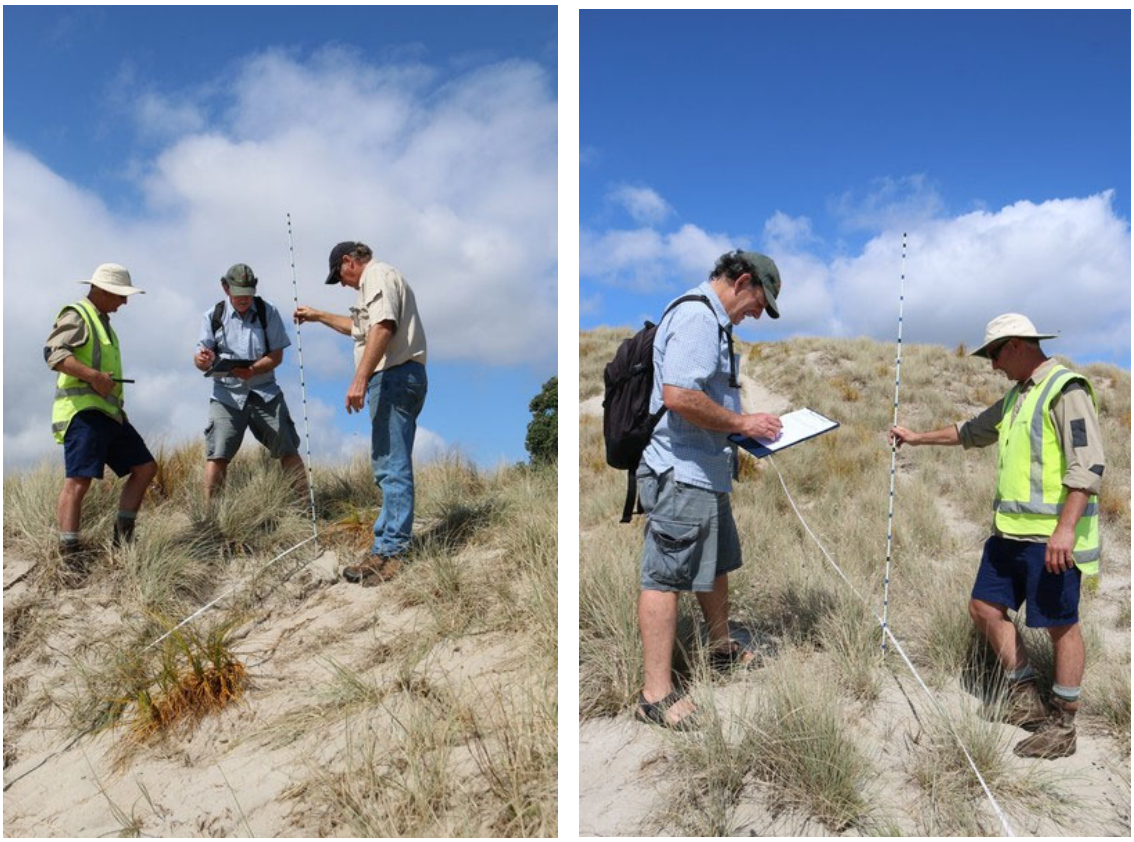
With the regional council many Coast Care groups have exhibited long-term commitment and are keen on some form of ongoing monitoring and maintenance of dune condition that can measure the success of their dune restoration activities, and highlight changes or problems that may need their attention.

The BOPRC therefore is keen to work with the Coast Care groups to set up rapid easy-to-use monitoring methods. This is in collaboration with and supporting the establishment of a nationwide monitoring network by the Coastal Restoration Trust of New Zealand (www.coastalrestorationtrust.org.nz).

This report covers the development and evaluation of monitoring methods at several beaches and Coast Care programmes in the Bay of Plenty region. There are three components:

1. ***Guidelines for community-based monitoring of coastal dunes in the Bay of Plenty region -*** A guide for communities and councils to undertake surveys of coastal dunes with a focus on vegetation has been developed comprising:
    - A rapid point intercept sampling method along transects across the dune for quantifying vegetation cover by major species;
    - Easy to use method for surveying dune profile along transects;
    - Field data recording for site and transects;
    - Establishing photopoints; and
    - Coastal species plant identification guide and protocols for consistent data recording during monitoring surveys.
2. ***Coastal dune transects in the Bay of Plenty region -*** A network of monitoring transects has been initiated in the region comprising:
    - Set-up of transects and testing of monitoring methodology at 9 sites along 7 beaches in the western part of the Bay of Plenty region; and
    - For each beach, a list of transects with maps illustrating the hierarchy required for uniquely identifying location, site and transects, as well as field data collection.

3. ***Online data processing system for coastal dune vegetation*** **-** In collaboration with website designer for the Coastal Restoration Trust, the Bay of Plenty dune transects have been used to help develop user-friendly online processing of field data including:
    - Background information on the importance and essential components of monitoring of dunes;
    - Guidelines for setting up transects, undertaking point sampling, dune profile measurements, photopoints, and recording of information in the field;
    - Guide for users to load and store their field data at location, site and transect levels with regional and national mapping, and to allow easy retrieval to individual transect level for subsequent remeasurements; and
    - An insight into the data processing system being developed that provides automated data analysis and presentation of summaries from field data as requested by users.



Establishing and testing vegetation monitoring transects, Mount Maunganui, Bay of Plenty.

1. Guidelines for community-based monitoring of coastal dunes in the Bay of Plenty Region

Introduction

These guidelines have been developed for the BOPRC Coast Care groups in the Bay of Plenty region with easy-to-use methods for monitoring changes in vegetation cover on their dunes. They are part of national guidelines on monitoring of dunes being developed by the Coastal Restoration Trust.

The basis of monitoring is the use of transects located across dunes comprising sample points that will allow Coast Care groups to monitor changes in abundance of native plant species including those threatened or culturally significant. It also surveys presence and abundance of pest plant species and the area of dune not in vegetation.

The aim is to provide groups involved in restoration programmes with the methodology to quantify information on the indigenous biodiversity value, cultural value and pest management requirements of their dunelands.

The guidelines provide opportunities to monitor other characteristics in relation to restoration planting and management undertaken by Coast Care groups such as natural character and amenity values, as well as any changes in dune profile as part of natural cycles of erosion and repair.

The monitoring methodology can be undertaken by any Coast Care group in collaboration with BOPRC staff with minimal training and supervision. These guidelines provide step-by-step methods for undertaking monitoring of dune vegetation and profile, field data collection sheets, a basic duneland plant identification guide, and the option of establishing photopoints.

The monitoring method is repeatable, comparable over time and between locations, and is relatively rapid (no more than 45 minutes per transect for trained participants). These guidelines on easy-to-use monitoring methods will be available online via the Coastal Restoration Trust's website and freely accessible by council and Coast Care groups involved in monitoring.

This section covers the following aspects related to monitoring dunes including:

- Why monitor dunes?
- Basic requirements for monitoring
- The importance of zonation and vegetation for both surveying vegetation and dune morphology;
- Transect monitoring method focused on vegetation cover comprising:
    - Location and number of transects
    - Identifying your site and transect;
    - Setting up transects - both standard and split transect methods;
    - Technique for rapid point sampling;
    - Technique for mapping dune profiles;
    - Access and guide to using field forms for recording data;
    - Establishing photopoints; and
    - Equipment required for monitoring.

- Coastal species plant identification guide and protocols for consistent data recording during monitoring surveys;
- Information sources; and
- List of the coastal plant species likely to be found on Bay of Plenty dunes.

Developing dune vegetation monitoring method by the Coastal Restoration Trust of NZ.

Why monitor dunes

Coastal dunes are amongst the most modified and degraded of all the major ecosystems in New Zealand, including the beaches of the Bay of Plenty region. Modification has included almost total removal of original dune forests, extensive disruption and loss of other native dune vegetation, introduction of a wide range of competing exotic plant species, human-induced disruption of stabilising vegetation, grazing and browsing animals, and extensive coastal subdivision and development.

Restoration of coastal dune ecosystems has largely focused on restoring native vegetation by planting key native species, weed and pest animal control, and management of beach users. While considerable progress has been made with restoring degraded dunes, there has been little monitoring of the success of restoration efforts. A scientifically robust and easily implemented monitoring programme enables Coast Care communities to measure and illustrate the success of their work, gain an understanding of their dune systems and the importance of appropriate plant species communities, and to provide the basis upon which to continually improve best practices for their particular sites.

Basic requirements for monitoring

In monitoring changes in vegetation cover and species composition several essential components ensure monitoring is repeatable, consistent, and accurate, allowing comparison of measurements over time. Using the same sampling method across a range of locations also allows comparison between locations within the same dune system, as well as making comparisons with other beaches in the Bay of Plenty region. Basic requirements of monitoring include:

- Map the overall area or use aerial photographs so those involved in future assessments can locate the site and sample points;
- Record details of site management, previous history, current monitoring method and date etc,
- Set up a permanent sampling point to mark landward end of each transect for easy relocation;
- Follow appropriate on-site training and initial supervision where practical, keeping to a consistent methodology of sampling and measurement so that data can be compared across sites and years;
- Use the plant species identification guide with photographs to identify plants;
- Ensure assessment is rapid and easy to implement by Coast Care members and council staff, otherwise monitoring becomes tedious and quality of data collection will be compromised;
- Record field data accurately on hard copy or mobile devices using standard templates ensuring backup copies of data are available;
- Transfer the field data to a computer as soon as practical to allow analysis and provide summaries of vegetation cover by species, comparing change from one measurement to the next.

Zonation and vegetation

A key feature of dune vegetation is the sequence of different vegetation communities or zones that occur with increasing distance landward (Figure 1). Each zone in the vegetation sequence has a different species composition that is related to the ability of plant species to withstand environmental factors prevailing in that zone.

These factors include proximity to the sea and the morphology, shape and extent of the dunes themselves. Other factors can also be important in determining zonation on dunes such as low-lying swales between dunes where the water table sometimes results in distinct dune slack vegetation communities.

Vegetation on dunes

Up to three broad vegetation types running parallel to the shoreline often occur naturally from the beach landward:

1. Seaward foredune zone of sand binders such as pingao and spinifex;
2. Mid-dune with ground covers such as sand coprosma and pohuehue; and
3. Backdune with shrubs (e.g. karo, taupata) and trees (e.g. houpara, pohutukawa, ngaio).

Sampling change in vegetation and dune form along transects perpendicular to the coast will provide an indication of the vegetation types and species in each zone. Re-measurement of these characteristics using consistent methods will show any changes that are occurring over time.

Monitoring method development including testing the point sampling within the backdune zone dominated by increasing numbers of shrubs and trees (above) and sampling to the edge of estuaries such as with the Maketu Spit (below).

Dune profiles

On fixed dunes, which were typical for most New Zealand beaches prior to human settlement, formations and zones tend to be parallel to the shore as key environmental stresses decrease with distance landward.

A practical method has been developed to map the contour of the dunes that aligns with the survey of vegetation cover.

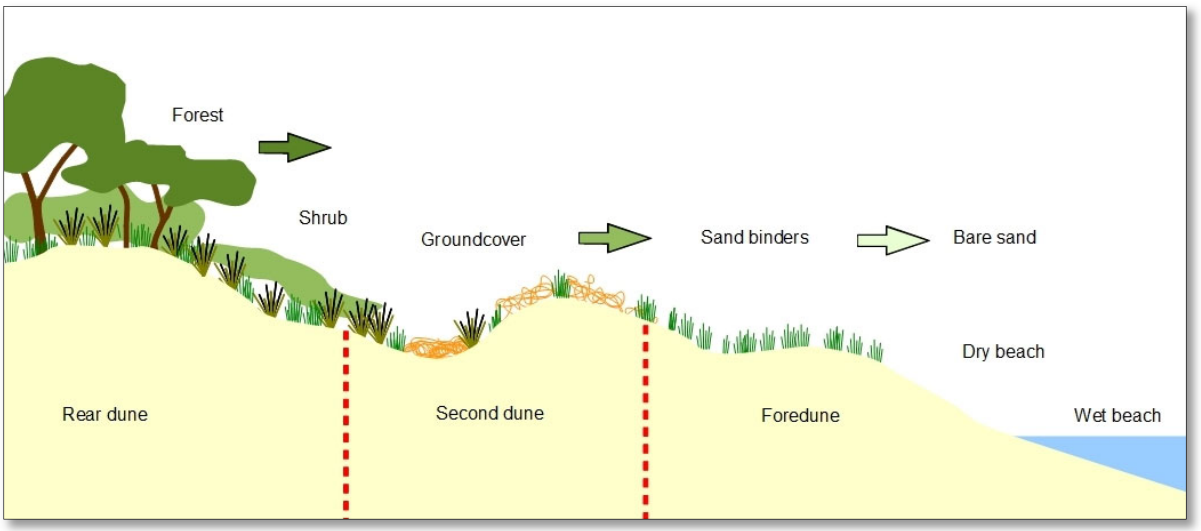


Figure 1: A dune profile from sand binding grasses on the most seaward foredune zone, to increasing ground cover and shrubs on the mid-dunes zone, to forests on the most landward zone. This continuum reflects the change in environmental conditions from seaward to landward across the dune. Sampling across the dunes using transects will therefore quantify the cover and composition of vegetation across these zones.

Transect monitoring method - vegetation cover

An easy-to-use Rapid-Point Intercept Transect method is used for quantifying dune vegetation cover and species composition across dune profiles. A survey of sand dunes across the range of zones from foredune to landward establishes a baseline in dune profile, vegetation cover and species composition, and then changes can be monitored over time. This will assist Coast Care groups and council staff in assessing the effectiveness of their interventions, and setting priorities for future restoration and management of their dunes.

Location and number of transects

- As zonation on sand dunes typically runs parallel to the sea, sampling vegetation is best undertaken by running transects perpendicular to the coastline;
- The number of transects to establish across your dune system will depend on the site characteristics and resources; the aim is to establish a minimum of 5 transects for each dune

system but further transects may be required where there is significant variation in dune vegetation and topography (Figure 2);

- Place transects within representative areas of the dune system avoiding any inconsistent areas such accessways, other development etc;
- Distance between transects will vary depending on length of beach to be surveyed but can vary from 20m to over 100m apart. Generally place transects at equal distances apart to reduce bias in selection of sites, e.g. for a 500m length of beach, place 5 transects at approximately 80m apart avoiding edge effects.

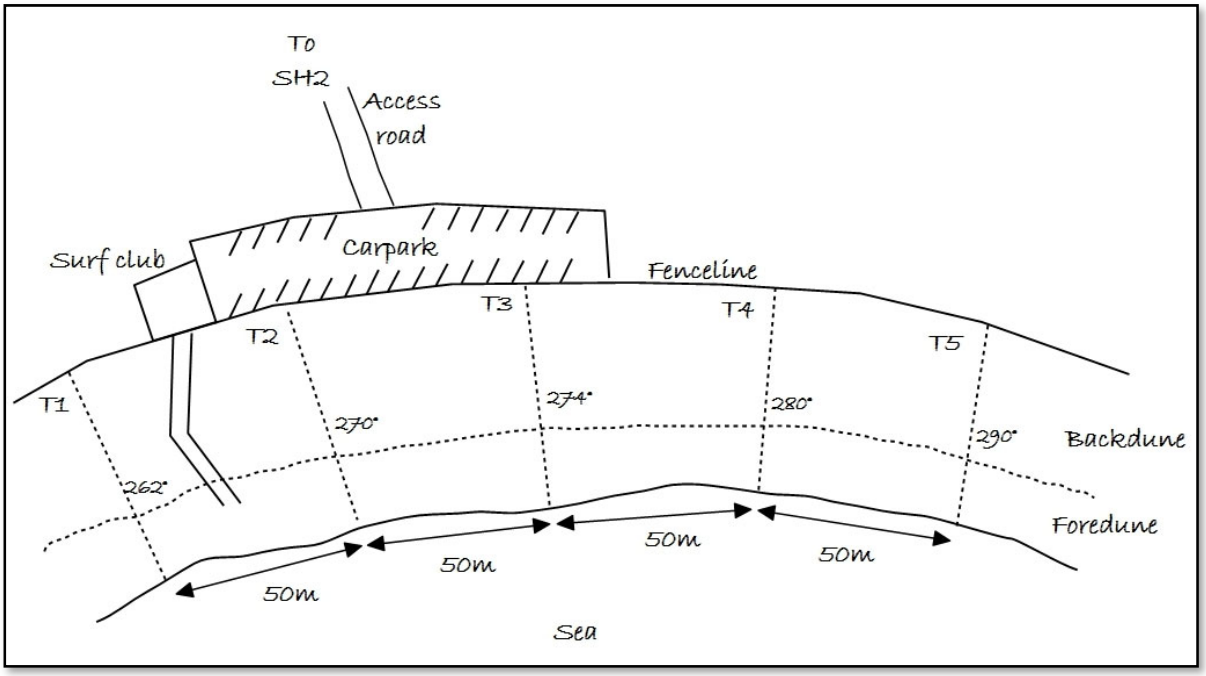


Figure 2: Example of a sketch diagram of a section of a dune area with the position and bearing of sampling transects as marked to assist relocation for future monitoring.

Identifying your site and transect

A hierarchy of information allows identification of individual transects. The data hierarchy for a beach in the Bay of Plenty region is as follows:

- ***Region*** **-** Bay of Plenty
- ***Location*** **-** Maketu Spit
- ***Site*** **-** one site is identified where several transects have been established
- ***Transect*** **-** A unique number for each transect starting at 1
- ***Survey*** **-** the year survey undertaken (allows for multiple surveys of each transect).

Setting up transects

Standard transect method

There are several easy steps to set up a permanent transect located from a fixed landward datum point (Figure 3):

1. Place a minimum of 5 transects perpendicular to the coast at a fixed interval (e.g. transects 20 m or 50 m apart) to sample a representative section of the vegetation and dune morphology to high water mark.
2. Start each transect at the landward end of the dune system at a fixed point that can be easily relocated for repeat surveys such as a fence post or other permanent feature. Alternatively place a peg to be the fixed landward point.
3. Note location of the fixed point with GPS coordinates, sketched map or aerial photograph.
4. Take a bearing perpendicular to the coastline (gauged by viewing along the coastline, or from aerial photographs or maps) and record it
5. 0n the recorded bearing, run a 30, 50 or 100m measuring tape across the dune from the fixed landward point to the sea.
6. The tape is to follow the contour of the dune profile within approximately 1 m of the ground surface allowing for vegetation.

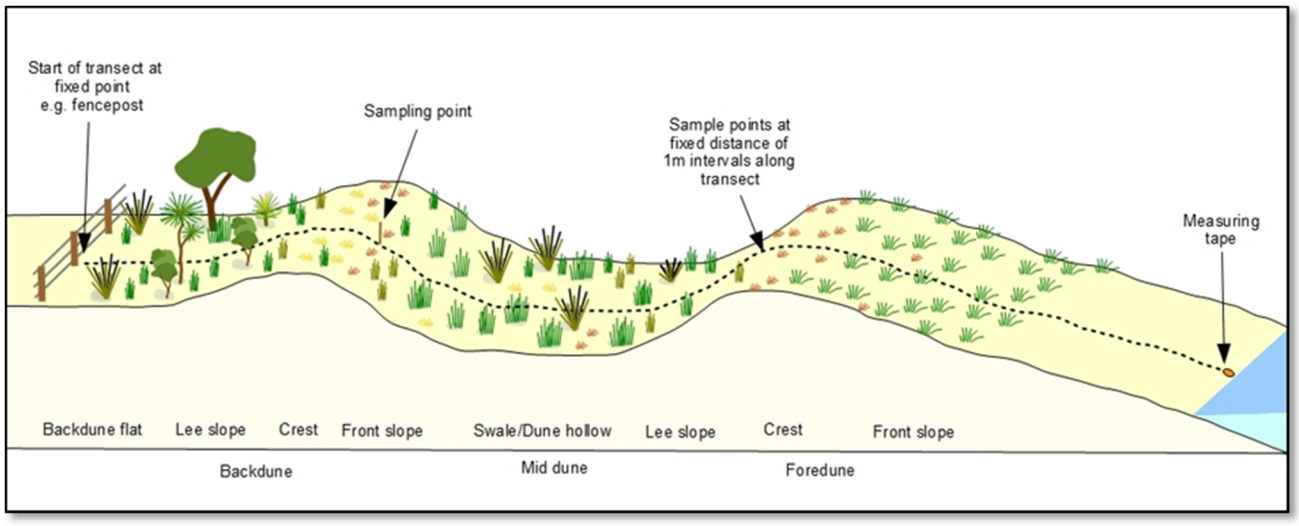


Figure 3: Set up a transect by running a tape across the dune along a bearing perpendicular to the coast from a fixed landward marker (e.g. peg, fencepost) to high water mark.

Split transect method

For transects across sand spits where there are moving shorelines at either end of the transect, or where there is a preference for surveying only the seaward dunes that are likely to be more dynamic than landward dunes, use the following methods to set up the transect (Figure 4):

- Establish a fixed datum point using a permanent peg placed within the dune system;

- This datum point (peg) becomes the 0 point;
- Sampling points along the seaward transect are identified as points 1, 2, 3 etc…;
- Sampling points along the landward transect are identified as a sub-transect with points 1, 2, 3 etc… running landward;
- The vegetation is not sampled at the 0 point;
- A line of datum points can be set up parallel to the shore that become the start points for several transects along a dune system;
- There is the option to survey the landward transect less often but which can only be matched with data from the seaward transect measured at the same time.

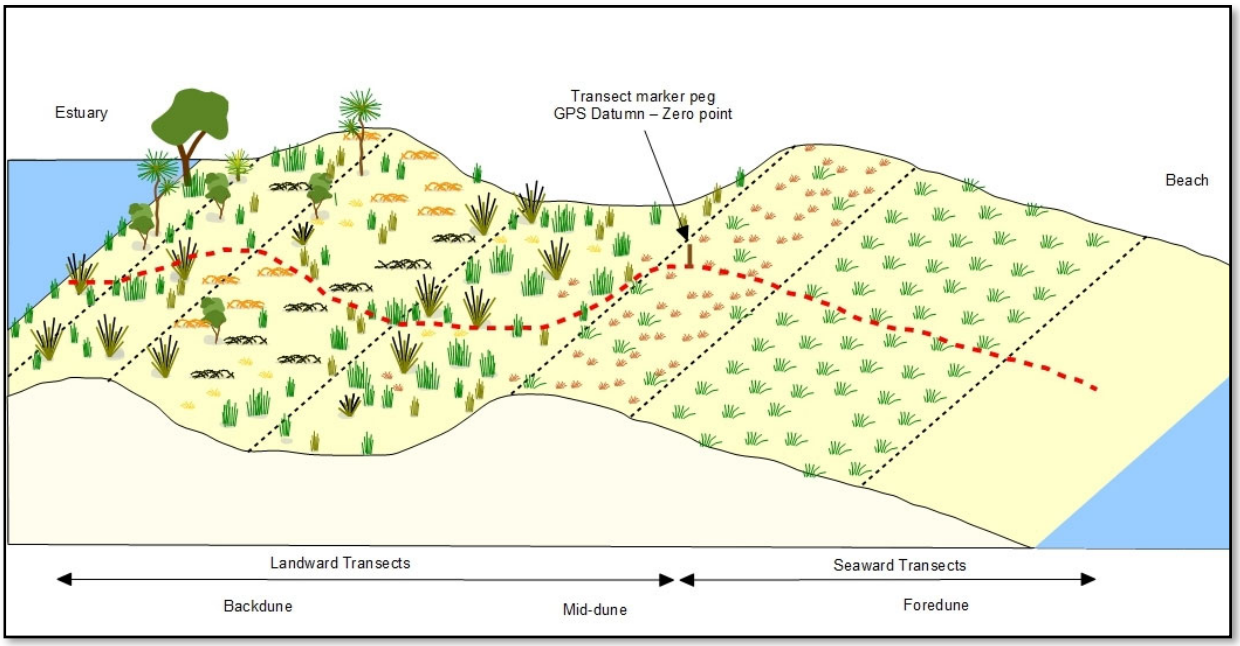


Figure 4: Split-transect sampling working from a datum point placed within the dune system more suited to sand spits where fixed points are not practical at either end of the transect due to changes in shoreline position. This method is also suitable where there is more interest in surveying only the seaward dunes that are likely to be more dynamic than the landward dunes which may be surveyed less often.

Rapid-point sampling

An easy-to-use Rapid-Point sampling method is used for sampling the vegetation cover and species composition along each transect:

- The sampling interval along the transect tape will generally be 1 m as most transects are less than 100 m in length. For longer transects the sampling interval could be increased to 2m or more. The fixed point at 0 is not a sampling point;
- At the first sampling point drop the sampling pole (refer to monitoring equipment below) as close as possible, avoiding excessive disturbance. Avoid shifting the pole once it has been dropped;
- Continue along the tape dropping the rod at the prescribed interval;
- At each sampling point (refer Figure 5):

1. Record the uppermost species **touching** the sampling pole (1); then
2. Record the species and height of the **upper most plant within the 30 cm diameter of the sampling pole** (2) (ignore any vegetation outside the 30 cm column around the sampling pole); and

- Enter data on the customised form (refer later section).

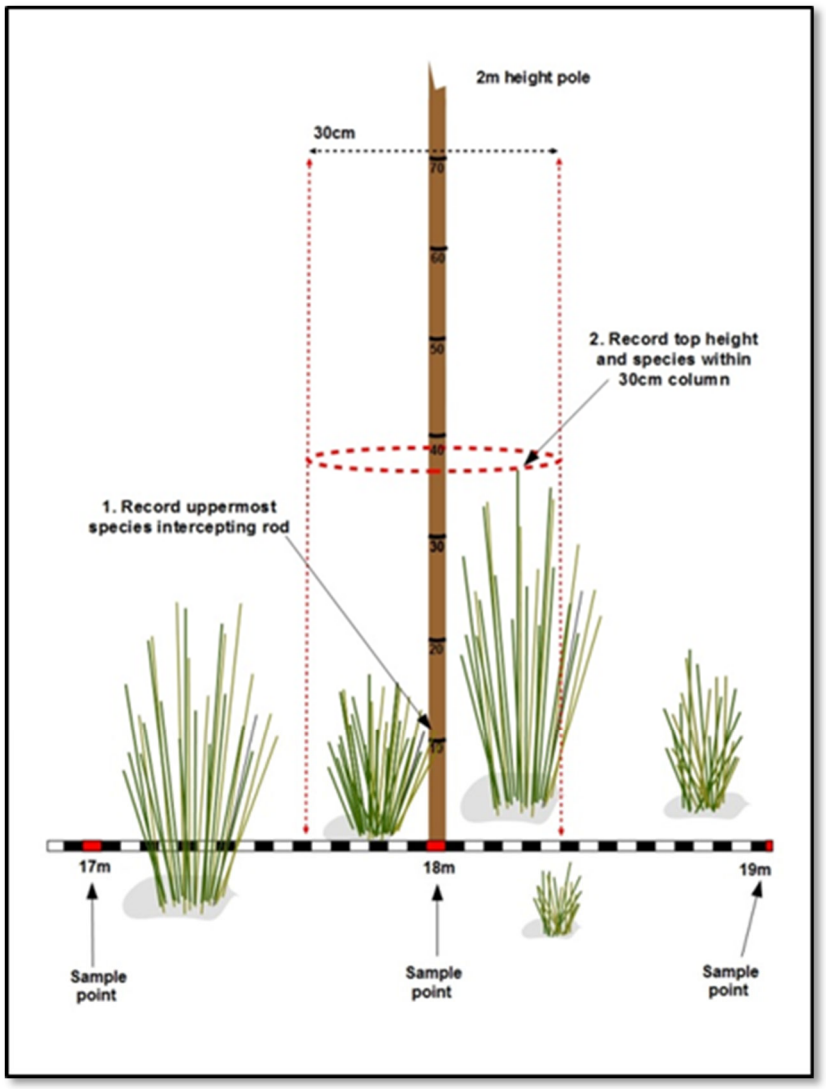


Figure 5: Drop the sampling rod at 1m intervals along the transect tape. Record uppermost species touching the vertical sampling pole (1); and then record top height of vegetation and the species within a 30cm diameter column around the pole (2).

Papamoa College students surveying vegetation cover on the foredunes along a transect, Papamoa Beach

Mapping dune profiles

A practical method for mapping the dune profile involves recording angles between changes in contour along each transect. This is easily done as vegetation sampling progresses. The method involves:

- Download the free *Extras* application onto a mobile device (phone or ipad); this app includes an inclinometer for recording slope, and a compass useful for recording bearing of the transect during setup;
- Identify the nearest sampling point to each major change in angle of the dune profile;
- Record angle between the first and next identified sampling point using the inclinometer function on the mobile device by holding the device at the same angle (Figure 6);
- Enter angle on the customised field data sheet.

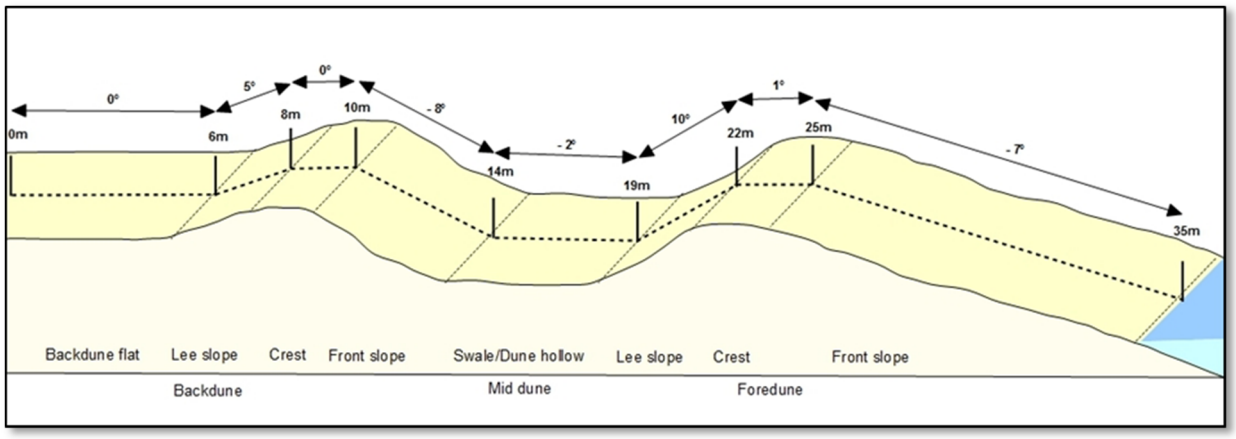


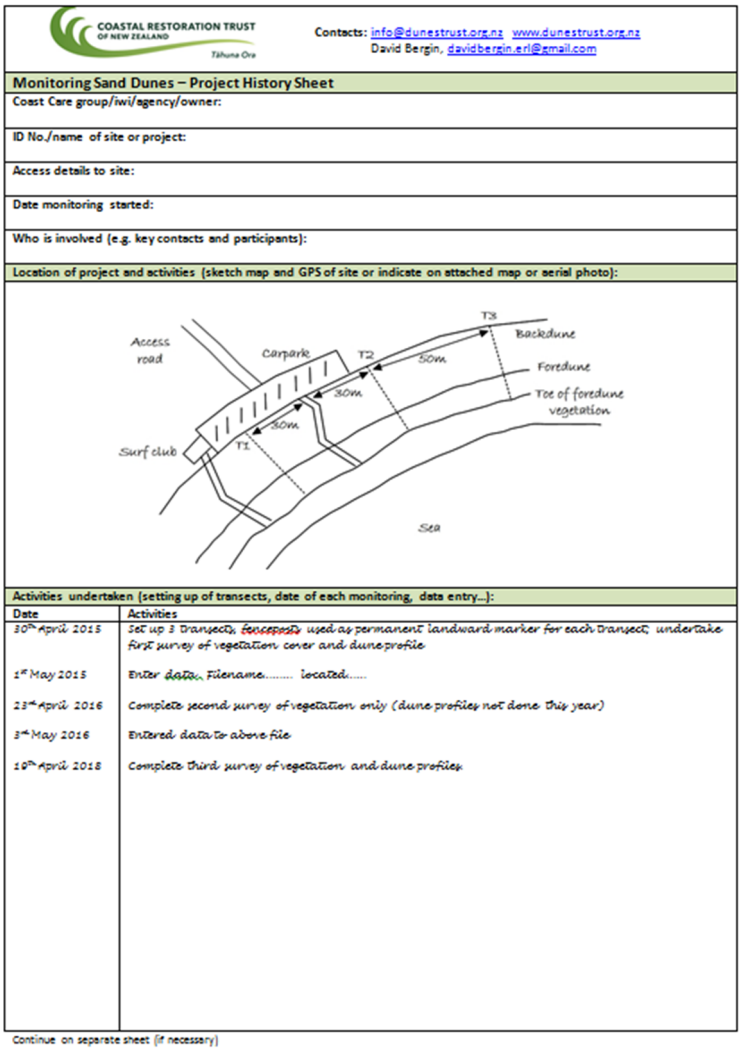
Figure 6: Typical coastal dune profile showing several site types such as dune crest, seaward and landward facing slopes, swales, etc…; use an inclinometer application available on mobile phones to record angle at each major change in slope.

Field forms

Project History Sheets provide information on the identity, location and history of management for each site. Maps or aerial photographs can be attached. Information includes:

- Identifiers including region (Bay of Plenty), location (beach) and site (specific area at that beach);
- Coast Care group name and/council contact, tenure;
- Map of transect locations with GPS coordinates if available, description of start points (e.g. pegs, fenceposts) and bearings;
- Site characteristics such as elevation;
- Previous monitoring undertaken, when and by whom;
- Location of photopoints;
- Any other relevant information such as site access, local contacts;
- Field observers and recorders

Figure 7 provides an example of a Project History Sheet with site and contact details, sketch of dune section where transects are located, and running record of monitoring undertaken.



COASTAL RESTORATION TRUST OF NEW ZEALAND
Tāhuna Ora

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David Bergin, davidbergin.erl@gmail.com

Monitoring Sand Dunes – Project History Sheet

Coast Care group/iwi/agency/owner:

ID No./name of site or project:

Access details to site:

Date monitoring started:

Who is involved (e.g. key contacts and participants):

Location of project and activities (sketch map and GPS of site or indicate on attached map or aerial photo):

Activities undertaken (setting up of transects, date of each monitoring, data entry...):

Date	Activities
30th April 2015	Set up 3 transects, ~~fenceposts~~ used as permanent landward marker for each transect; undertake first survey of vegetation cover and dune profile
1st May 2015	Enter data. Filename..... located.....
23rd April 2016	Complete second survey of vegetation only (dune profiles not done this year)
3rd May 2016	Entered data to above file
19th April 2018	Complete third survey of vegetation and dune profiles

Continue on separate sheet (if necessary)

Figure 7: Example Project History Sheet with site and contact details, sketch of dune section where transects are located, and running record of monitoring undertaken.

For new transects, a generalised print-ready survey field sheet for a site can be downloaded so that the identification information can entered for each transect (Figure 8). Field data sheets allow recording of:

- Transect identifier including region, location and site linked to the Project History Sheet;
- Transect ID number;
- GPS landward datum ID/No. for each transect;
- Transect bearing;
- Field observers and recorders;
- Date of monitoring;
- Sample point interval
- For survey of vegetation highest plant intercept with sampling pole by species and top height of vegetation cover by species within a 30 cm column;
- Dune angle at each major change in slope;
- Photopoint locations along transect including distance from datum point and direction; and
- Any comments on dune management, condition of the vegetation (e.g., browsing by rabbits), or site characteristics at or in the vicinity of the sampling point.

For re-surveying of existing transects, pre-filled print-ready survey field sheets can be downloaded with the established identification data.

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Rapid-Point sampling for sand dunes – Field Data Sheet

Dune site name/identifier: (same as on Project History Sheet)			Page: of
Transect ID No.:	GPS landward datum:	Transect bearing (degrees):	
Notes on transect location:			
Date of monitoring:		Field observers and recorders:	
Sample point interval: (usually 1m)			

Sample point No.	Distance along transect (m)	Plant touching sampling rod (uppermost plant touching)		Top height of vegetation (within 30cm diameter column of rod)		Dune angle (degrees - taken at each major change in slope)	Comments (e.g. rabbit sign, fence, vehicle track, photopoint location...)
		Species (one only)	Height (to nearest .5cm)	Species (one only)	Height (to nearest .5cm)		
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4							
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Environmental Restoration Ltd, field sheet revised February 2017

Figure 8: Field Data Sheet for recording plant intercept with sampling pole and top height of vegetation at each sampling point, as well as dune angle at changes in slope across the dune profile.

Photopoints

It can be useful to take photographs along each transect. Photopoints can give a quick graphical record of progress. They are just a series of before, during and after shots that document visible changes over time. They are extremely useful for demonstrating project progress to other group members, funders and agencies, and for media releases.

Photographs taken from fixed points (photopoints) can systematically capture changes of the vegetation and dune morphology over time. Tips for effective photopoints:

- Locate each photopoint on a high point on the dunes along the transect to best cover a representative section of the dune.
- Where possible site the camera from a fixed point such as a permanent structure on or near the transect such as a fence post or peg; use the landward datum point if this provides a representative photograph of the transect.
- Select a view that will show change in dune vegetation over time due to your restoration efforts; frame the view so that it will be easy to repeat in future.
- If possible position the camera to the north of the subject area to minimise shadows and sun glare; minimise the need to zoom.
- Repeat photographs annually preferably at the same time of the year using the same camera angle.

If possible, have a copy of the last photograph you took from each photopoint, to help replicate previous photos as closely as possible.

An example of photos taken from fixed photopoints of a newly restored dune. Repeated over time, they are an excellent method to illustrate change in vegetation cover

Refer to New Zealand Landcare Trust (2012) or www.landcare.org.nz/wetmak for more detail on setting up photopoints.

Equipment required for monitoring

Other than a GPS unit, equipment required for monitoring dune profiles is relatively inexpensive and can be easily sourced. Equipment includes:

- 50 m or 100 m plastic tape for running out each transect from fixed point to high water mark (inexpensive tapes available from hardware merchants);
- Clip board, customised field sheets downloaded from website, pens/pencils;
- iPad or iPhone with Extras App - compass for bearings, and inclinometer for measuring slope angle;
- A 2 m high fibreglass pole or similar that is 1 cm in diameter for point sampling, with height marked at 10 cm intervals; this can include a 30 cm wide guide attached to the pole to indicate a 30 cm diameter column for recording the uppermost height of the vegetation at each sample point; and
- GPS unit and/or maps/diagrams to identify transect locations, altitude, or other information useful for linking to GIS capability.

Some of the equipment required for setting up dune transects.

Identifying your plants

The aim is to identify the key native and exotic plants by species during surveys of your dunes. The exception is for most exotic grasses and herbaceous species unless users are competent at identifying species that can dominate some dunes such as kikuyu.

A guide for selected coastal plant species, both native and exotic, has been developed by Moniqua Nelson-Tunley to assist in plant identification. Most species found growing on your dunes are likely to be listed.

Two sand binding species on foredunes that can sometimes be difficult to identify - the native spinifex (front) and the exotic marram grass (back).

About this guide

This guide is intended for people restoring dunes and covers the basics of plant names, identifying features and management. For further information on plant ecology, distribution, history, etc. refer to plant identification options in Resources Information below.

This guide uses the most commonly-used Maori and/or common name(s) at the top of the species ID cards, then the scientific name, and a 6-letter National Vegetation Survey code. When entering data from transect surveys, users are required to enter this unique 6-letter species code.

Most common name(s) are in **bold**, with any other names listed as well. Following convention, scientific names are *italicized* and the NVS codes are in uppercase.

Plant identification

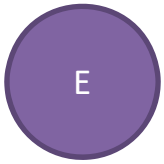
A set of plant species identification cards are available sponsored by the coastal plant nursery Coastlands (www.coastalands.co.nz). A photograph and basic identifying features are noted for each species on the cards as well as species of similar appearance. If further assistance with identifying a plant is required, refer to the resources section.

Conservation plant status

We have divided plant status into four categories: Native threatened, Native not threatened, Exotic, and Exotic weed. Look for these symbols on the cards:

Native threatened

Native not threatened



Exotic

Exotic weed

Recommended management provides suggestions on how to protect the plant if native, or how to control it if exotic. We follow recommendations provided by the Department of Conservation and local councils so check with your local offices for details. In general, we encourage the following management:

- **Native threatened** species should be proliferated within their natural distribution through in-situ protection and cultivation of eco-sourced plants.
- **Native not threatened** species should be protected in-situ and reintroduced where absent.
- Some **Exotic** species have few negative environmental effects. We provide advice on their control for practitioners who want to restore a site to as close to a native ecosystem as possible.
- Other **Exotic weed** species can cause significant negative environmental effects and so we encourage control and eradication of these species where possible. The possible exception is marram, where control must be balanced with replacement using a native sand-binder.

Coastal plant species are provided in the Appendix where many are found in the Bay of Plenty region. Each has a unique 6-letter code recommended for entering on field data sheets. A plant ID card system is being developed by the Coastal Restoration Trust in collaboration with Coastlands Nursery. The New Zealand Plant Conservation Network www.nzpcn.org.nz provides detailed plant descriptions and photographs for all species, both native and exotic.

Information sources

Technical Handbook

The Coastal Restoration Trust provides a comprehensive list of resources including the Coastal Restoration Trust's *Restoration of Coastal Sand Dunes Using Native Plants, a Technical Handbook*. This has been produced as an essential 'easy-to-read guide' for coastal communities, landowners, agencies and interest groups involved in restoration and management of the coastline.

Refer to www.coastalrestorationtrust.org.nz/resources/publications

Reference Database

The Coastal Restoration Trust has created a Coastal Reference Database to help researchers and enthusiasts search for published and unpublished articles, books, newspaper articles, academic papers etc. The database includes references from many sources including local and central government agencies, industry groups and private collections.

Refer to www.coastalrestorationtrust.org.nz/resources/coastal-reference-database

Plant identification

Other sources for plant identification include:

- New Zealand Plant Conservation Network www.nzpcn.org.nz
- Coastal Restoration Trust of New Zealand www.coastalrestorationtrust.org.nz
- The Weed Control Handbook. 2011. Weed Busters New Zealand. New Holland Publishers (NZ) Ltd. ISBN: 978 1 86966 321 6. www.weedbusters.org.nz

Most dunes, and particularly foredune and mid-dunes where most surveying is likely to be undertaken, have a limited range of species present so it should not take long to become familiar with the key species.

2. Coastal dune transects in the Bay of Plenty Region

Monitoring transects have been established at 9 sites along 7 beaches in the western part of the Bay of Plenty region (Figure 9).

A total of 46 transects were established with transects ranging in length from approximately 12 m to over 83 m in length.

Details on transects including locations are shown in tables and aerial photographs below for each beach surveyed.

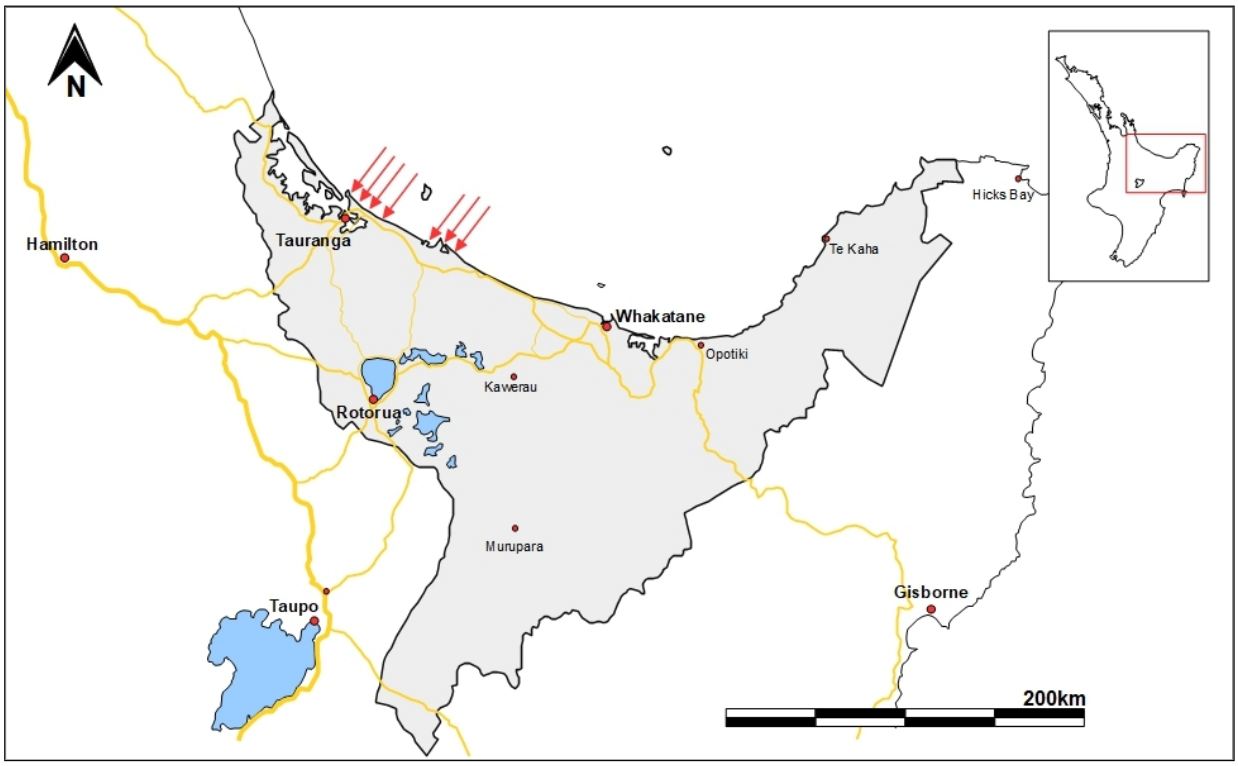


Figure 9: Transects have been established at 6 beaches in the western Bay of Plenty region from Mount Maunganui to Maketu.

Mt Maunganui Beach - Access 0.8 to Access 1.0

Three transects established 30 m apart from beach Access 0.8 to Access 1.0 along Marine Parade, representing a high use beach from foredune to a significant area of mid-dune.

Transect ID	Length (m)	Bearing	Easting	Northing	Lat. S	Long. E
Mt.M-A01	55	22	1881160	5829907		
Mt.M-A02	65	22	1881169	5829890		
Mt.M-A03	83	22	1881186	5829857		

Typical managed foredunes dominated by spinifex (above) and mixed native and exotic species on mid-dunes (below), Mount Maunganui.

Mt Maunganui - Cenotaph

Comprises 5 transects each ranging from 23-40 m in length located 30 m apart with transects across the mid and foredunes seaward of the Mount Maunganui Cenotaph Reserve on Marine Parade opposite Pacific Avenue.

Transect ID	Length (m)	Bearing	Easting	Northing	Lat. S	Long. E
Mt.M-C01	26	22	1881046	5830039		
Mt.M-C02	27	22	1881055	5830029		
Mt.M-C03	40	22	1881054	5830012		
Mt.M-C04	34	22	1881065	5830010		
Mt.M-C05	23	22	1881079	5830010		

Mt Maunganui Beach - Rena-Wildlife Stone Memorial

Five transects established at the Rena-Wildlife Memorial on Marine Parade, each transect 30 m apart.

Transect ID	Length (m)	Bearing	Easting	Northing	Lat. S	Long. E
Rena01	21	4	1880981	4830085		
Rena02	22	4	1880961	5830096		
Rena03	23	4	1880948	5830105		
Rena04	27	352	1880926	5830124		
Rena05	25	352	1880908	5830129		

Mt Maunganui Beach - Hart Street

Four transects established 30 m apart on Marine Parade opposite Hart Street. Transects located across mid and foredunes immediately southeast of the viewing platforms. Backdune vegetation dominated by mostly spinifex where significant weed control has been undertaken.

Transect ID	Length (m)	Bearing	Easting	Northing	Lat. S	Long. E
Hart01	54	22	1882782	5827949		
Hart02	60	22	1882796	5827930		
Hart03	57	22	1882730	5828008		
Hart04	59	22	1882716	5828023		

Transects located across mid-dunes and backdunes dominated by exotic species before major restoration work has commenced, Mount Maunganui.

Mt Maunganui Beach - Access 5.0 Access 5.3

Four transects established 50 m apart from beach Access 5.0 to Access 5.3 along Marine Parade. Transects 40-50 m in length across foredune to back dunes dominated by dense cover of exotic species.

Transect ID	Length (m)	Bearing	Easting	Northing	Lat. S	Long. E
A5.0-5.3-01	44	18	1883982	5826863		
A5.0-5.3-02	47	18	1884022	5826826		
A5.0-5.3-03	37	18	1884187	5826700		
A5.0-5.3-04	37	18	1884167	5826819		

Parton Road, Papamoa Beach

Five transects established by students of Papamoa College. Each transect 50 m apart focused on the frontal dunes up to 40 m from high water mark.

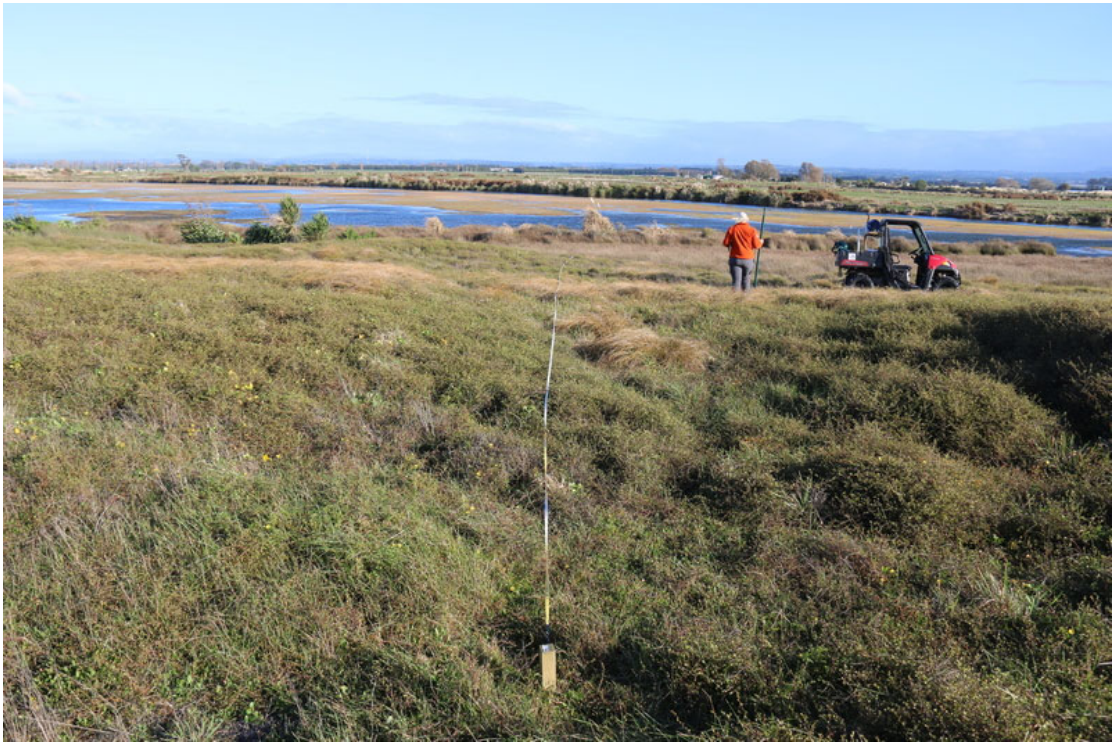
Transect ID	Length (m)	Bearing	Easting	Northing	Lat. S	Long. E
Parton01	36	24			37.70771	176.3186
Parton02	38	24			37.70779	176.3187
Parton03	25	24			37.70784	176.319
Parton04	38	24			37.70793	176.3192
Parton05	40	24			37.70798	176.3194

Foredune survey by students of Papamoa College at Parton Road site, south Papamoa Beach.

Maketu Spit, Maketu

Seven transects established along the length of the spit at approximately 300 m apart. Transects were located from estuary to foredunes.

Transect ID	Length (m)	Bearing	Easting	Northing	Lat. S	Long. E
Maketu01-a	12	348			37.75461	176.4464
Maketu01-b	18	168				
Maketu02-a	19	0			37.75457	176.4474
Maketu02-b	14	180				
Maketu03-a	24	345			37.75471	176.4497
Maketu03-b	48	165				
Maketu04-a	32	0			37.75388	176.4407
Maketu04-b	72	180				
Maketu05-a	59	0			37.75151	176.4286
Maketu05-b	41	180				
Maketu06-a	54	0			37.74907	176.4191
Maketu06-b	49	180				
Maketu07-a	56	0			37.74842	176.4167
Maketu07-b	49	180				



Split transects across the Maketu Spit from a centrally located peg for each transect

Newdicks Beach, Maketu

Three short transect established along the south eastern end of Newdicks Beach, Maketu, each approximately 200 m apart. Dunes dominated by native vegetation.

Transect ID	Length (m)	Bearing	Easting	Northing	Lat. S	Long. E
Newdicks01	21	60			37.75071	176.4746
Newdicks02	32	60			37.75232	176.4759
Newdicks03	37	60			37.75395	176.4772

Transect sampling from foredune to the fenceline with pohuehue dominating landward dunes of Newdicks Beach, Maketu.

Dotterel Point, Pukehina Beach

Three transects established near the distal end of Dotterel Point, Pukehina Beach. Transects approximately 150 m apart extending from harbour to foredune.

Transect ID	Length (m)	Bearing	Easting	Northing	Lat. S	Long. E
Puke01	32	22	1906879	5815107		
Puke02	48	20	1906729	5815236		
Puke03a	70	22	1906784	5824160		

Transects located across the distal end of the spit at Dotterel Point, Pukehina Beach.

3. Online data management system for coastal dune vegetation

Keeping Your Data Safe

Practical methods are required for safe-keeping and easy retrieval of project history sheets and field data sheets. Access to the history of restoration and management will be useful for future work at the same site.

Photograph, scan or enter hard copy information onto the computer as soon as possible to ensure information is not lost. Options for ensuring project records remain accessible include:

- Coast Care group to retain copy and ensure updates are recorded;
- Electronic copies including updates lodged with the Bay of Plenty Regional Council or other management agencies where involved such as Department of Conservation; and/or
- Updates circulated by email to group members and on Coast Care websites.

Web-based data processing

In collaboration with website designer Robin Sallis of Cerulean, the Coastal Restoration Trust is developing user-friendly methods for analysis and presentation of data to interpret vegetation cover and species composition in relation to dune morphology. This will show changes over time and assist in adjusting dune restoration and management priorities where required.

The dune transects established in the Bay of Plenty region are being used to help develop the online processing of field data including automated data analysis and result summaries from the data collected. These features are being developed to be robust, easy-to-use and freely accessible by council and Coast Care groups so they can enter monitoring data as it is collected and immediately see a summary of results that can be compared with previous surveys.

Back-end development

A summary of a number of back-end aspects that are under development include:

- ***Survey data structure***
  - The necessary data structure has been identified and created. The data hierarchy is as follows: Monitoring > Region > Location > Site > Transect > Survey.
  - The fields and field interfaces needed for administrators to enter data have been created.
  - Several dummy items at each level of the hierarchy have been created for testing purposes.

- ***Time-saving interface features***
    - Several custom interface features have been developed to support a streamlined workflow for administrators when creating new locations/sites/transects and when entering survey data.

- ***Species selection interface***
    - Dummy species data has been entered for use while the final species list is being prepared.
    - An auto-complete interface allows administrators to quickly select species from a predefined set.

- ***User roles and access controls***
    - Several user roles have been identified and custom access controls have been implemented, with each role having different privileges in the back-end.
        - Group-admin: the most restricted role. Each user with this role is assigned one or more groups they are allowed to administer. This role may only add or edit data relating to sites that are assigned to one of their groups.
        - Region-admin: This role may add and edit data relating to sites that are in a region they have been assigned. They may also create and edit group-admin users.
        - System-admin: May add and edit any data, and may create and edit both region-admin and group-admin users.

Front-end development

The aim is to provide a seamless experience for users from Coast Care groups, Coast Care coordinators and council staff from data loading to providing summaries of dune surveys that allow comparison of transects, sites, locations and regions.

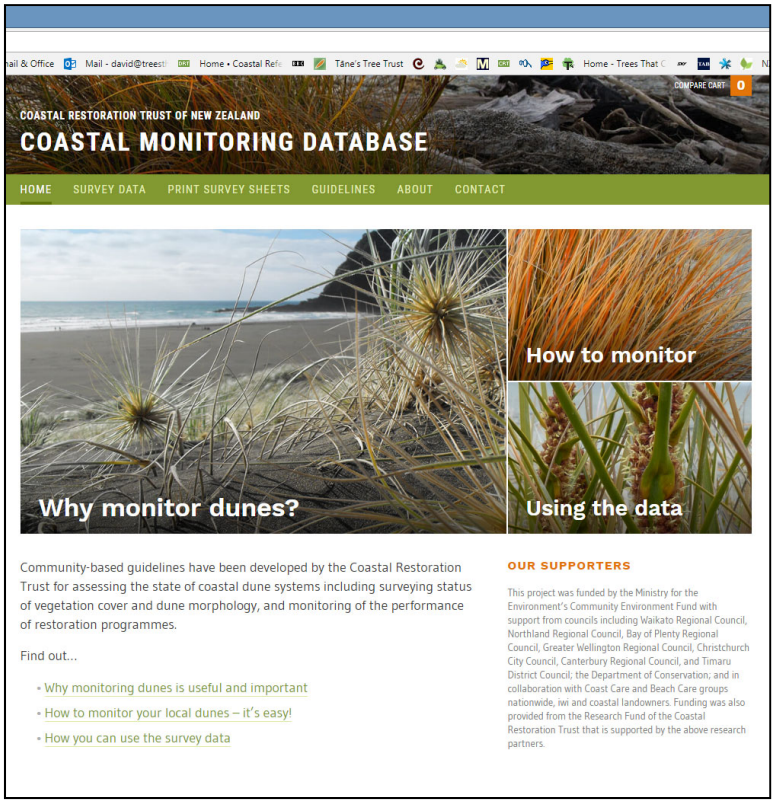
- **Template design and development**
    - The look and feel of the front-end has been designed and the basic template elements have been coded.
    - Below are screen shots of the monitoring database under development that will be available on the Coastal Restoration Trust's website which will be available as a link from the BOPRC website and any other options to ensure ready access for users.

- **Print-ready survey sheets**
    - An interface for drilling down from top-level regions to individual sites and transects has been implemented.
    - Front-end users may select an existing transect and view a print-ready survey field sheet, with the established identification data, number of transect points and point spacing pre-filled.
    - For new transects, a slightly more generalised print-ready survey field sheet for a site may be viewed.

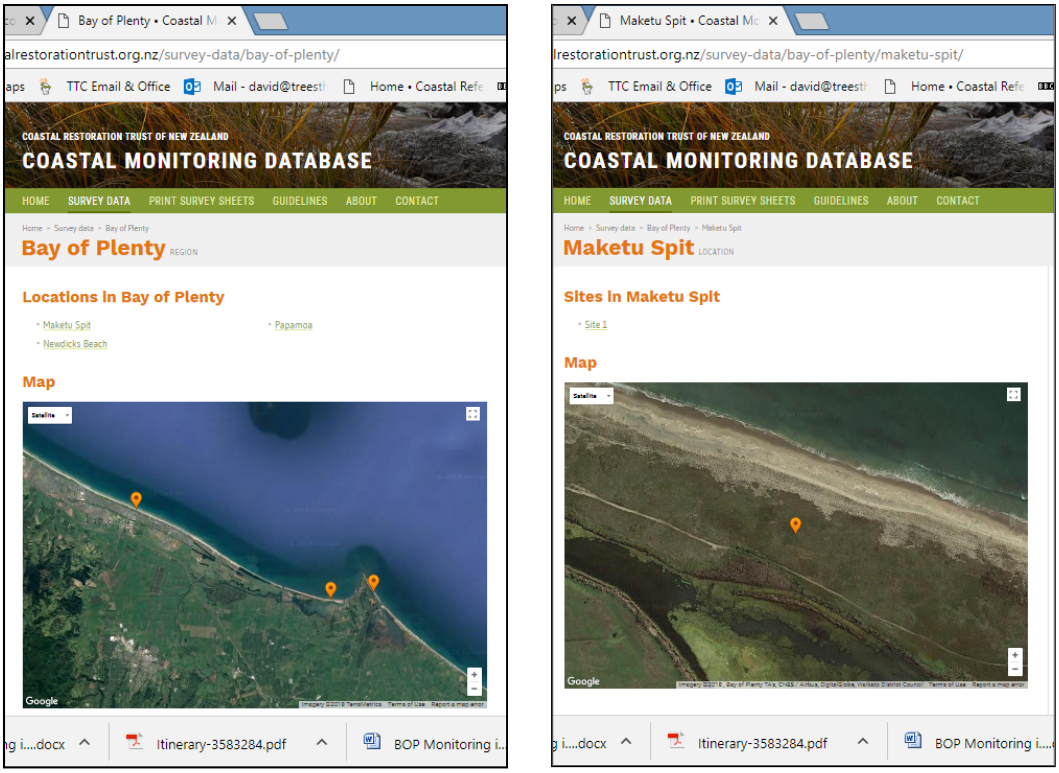
Ongoing improvement

Work is progressing to complete this initial data management system by mid-2018.

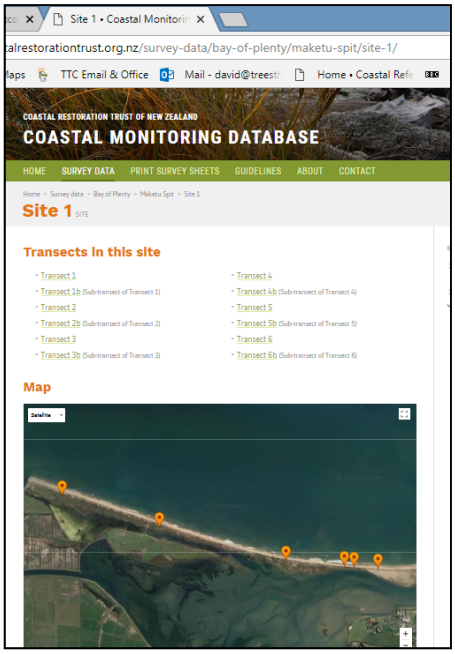
Refinement will be ongoing and a number of other features added to the data management system over time. Feedback from users will be encouraged via the Contacts Page of the Coastal Monitoring Database to assist in on-going improvements.

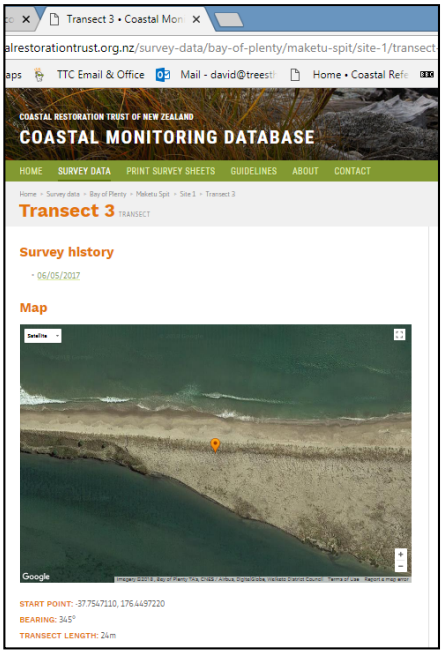


Home page for the Coastal Monitoring Database

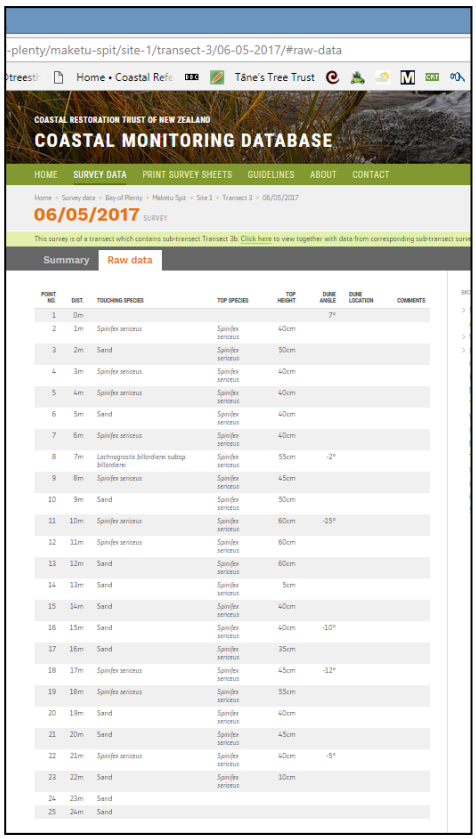


Users can access a map of the Bay of Plenty region showing the locations (beaches) where transects have been established and then an aerial photograph of their site (specified area of beach) where GPS points indicate start of several established transects. At Maketu Spit there are six sites shown where transects have been established.





Within each site the specific transects are easy to locate with coordinates for start point at a post or peg, transect bearing and sample point spacing specified.



Selection of a particular transect will show the raw data as loaded from the field survey forms. A summary of results is then displayed for users for this data for vegetation cover by species and for dune profile in tabulated and graphical options.

Acknowledgements

This project was partially funded by the Bay of Plenty Regional Council to allow development and testing of dune monitoring methods across a range of beaches in the Bay of Plenty region. The project is aligned with a nationwide project to develop community-based guidelines for monitoring coastal sand dunes with funding from the Ministry for the Environment's Community Environment Fund with support from other councils, and the Department of Conservation; and in collaboration with Coast Care and Beachcare groups, iwi and coastal landowners nationwide.

Funding was also provided from the Research Fund of the Coastal Restoration Trust that is supported by research partners including Waikato Regional Council; Northland Regional Council; Bay of Plenty Regional Council; Auckland Council; Greater Wellington Regional Council; Christchurch City Council; Te Kohaka o Tuhaitara Trust, North Canterbury; Canterbury Regional Council; and Timaru District Council.

For the Bay of Plenty dunes in particular, monitoring methods were evaluated and refined in collaboration with Chris Ward, Coast Care contractor, and Shay Dean, Courtney Bell and Hamish Dean of the BOPRC. Jim Dahm, Coastal Restoration Trust of NZ, also provided substantial input into planning and field development and testing of monitoring methods. Moniqua Nelson-Tunley provided specific input into developing the species identification guidelines. The data management system and development of the online version of the monitoring package has been developed by Robin Sallis of Cerulean Design and Development (robin@cerulean.co.nz) in collaboration with the Coastal Restoration Trust.

References

Dahm, J.; Jenks, G.; Bergin, D. 2005: *Community-based dune management for the mitigation of coastal hazards and Climate Change effects - a guide for local authorities*. Prepared for the Climate Change Office, Ministry for the Environment. 36p.

Landcare Trust 2012 Wetlands monitoring and assessment kit (WETMAK). New Zealand Landcare Trust. http://www.landcare.org.nz/wetmak

Appendix - Coastal plant species identification list

List of coastal plant species within each of the colour coded categories for exotic and native and either threatened or non-threatened are listed where many are found in the Bay of Plenty region. Each has a unique 6-letter code to be used for entering on field data sheets. The zone or zones where each species is mostly found is indicated as follows: F=foredune, M=mid-dune, B=back dune, H=hollow.

Most exotic herbaceous species and exotic grass species are difficult to identify to the species level so can be recorded as these broad categories using the code EXHERB or EXGRAS respectively.

Refer to Plant ID cards and the NZ Plant Conservation Network http://www.nzpcn.org.nz/for plant description and photographs.

Coastal plant species identification list

Native threatened					
Common name	**Maori name**	**Scientific name**	**Code**	**Dune site**	**Comments**
golden sand sedge	pingao/pikao	*Ficinia spiralis*	FICSPI	F	
sand tussock	hinarepe	*Poa billadierei*	POABIL	F,M	
Sand coprosma		*Coprosma acerosa*	COPACE	M	
shore spurge, sea spurge, sand milkweed	waiu-atua	*Euphorpia glauca*	EUPGLA	F,M	
sand daphne	toroheke, autetaranga	*Pimelea villosa*	PIMVIL	F,M	
New Zealand spinach	kokihi, tutae-ikamoana	*Tetragonia tetragonaoides*	TETTET	M	
Cooks scurvy grass		*Lepidium oleraceum*	LEPOLE	F	
sand wind grass		*Lachnagrostis ammobia*	LACAMM	F	
New Zealand Hazel	tainui	*Pomaderris apetala subsp. maritima*	POMMAR	M,B	
	remuremu	*Sellaria radicans*		H	
Native not threatened					
Common name	**Maori name**	**Scientific name**	**Code**	**Dune site**	**Comments**
spinifex, silvery sand grass	kowhangatara	*Spinifex sericeus*	SPISER	F	
sand sedge		*Carex pumila*	CARPUM	M	
sand wind grass		*Lachnagrostis billardierei subsp. billardierei*	LACBIL	F,M	
shore bindweed, shore convolvulus	rauparaha	*Calystegia soldanella*	CALSOL	F,M	
knobbly club rush, ethel sedge	wiwi	*Ficinia nodosa*	FICNOD	F,M	
small-leaved pohuehue, scrub pohuehue, wire vine	pohuehue	*Muehlenbeckia complexa var. complexa*	MUECOM	M	
speckled sedge, trip me up		*Carex testacea*	CARTES	M	
toetoe	toetoe	*Austroderia toetoe*	AUSTOE	M	
toetoe	toetoe	*Austroderia fulvida*	AUSFUL	M	
toetoe	toetoe	*Austroderia spendens*	AUSSPE	M	Northern North Island
toetoe	toetoe	*Austroderia richardii*	AUSRIC	M	South Island
jointed wire rush	oioi	*Apodasmia similis*	APOSIM	H	
native spinach		*Tetragonia implexicoma*	TETIMP	M	
silver tussock		*Poa cita*	POACIT	F,M	

native ice plant, NZ ice plant, NZ ice plant	horokaka	*Disphyma australe subsp. australe*	DISAUS	F,M	More common on soft or rocky shores
tauhinu	tauhinu	*Ozothamnus leptophyllus*	OZOLEP	M,B	
pohutukawa	pohutukawa	*Metrosideros excelsa*	METEXC	B	
coastal five-finger, five finger	houpara	*Pseudopanax lessonii*	PSELES	B	
ngaio	ngaio	*Myoporum leatum*	MYOLEA	B	
mahoe, whitey wood, hinahina	mahoe, hiahina	*Melicytus ramiflorus*	MELRAM	B	
karo	karo	*Pittosporum crassifolium*	PITCRA	B	
taupata, coastal coprosma, mirror plant	taupata	*Coprosma repens*	COPREP	M,B	
mountain flax, whararikì	whararikì	*Phormium cookianum*	PHOCOO	M	
flax, harakeke	harakeke	*Phormium tenax*	PHOTEN	M,H	
cabbage tree, ti kouka	ti kouka	*Cordyline australis*	CORAUS	M,H	
akeake	akeake	*Dodonaea viscosa*	DODVIS	M,B	
hebe, koromiko	koromiko	*Veronica stricta var. stricta*	VERSTR	M	
Kanuka	kanuka	*Kunzea robusta*	KUNROB	M,B	
manuoea, titira, atitira	kanuka	*Kunzea ericoides*	KUNERI	M,B	Northern South Island only
manuka, tea tree, kahikatoa	manuka	*Leptospermum scoparium var. scoparium*	LEPSCO	M	
mingimingi, tall mingimingi	mingimingi	*Leucopogon fasciculatus*	LEUFAS	M	
kawakawa, pepper tree	kawakawa	*Piper excelsum subsp. excelsum*	PIPEXC	M	
coastal mahoe		*Melicytus novae-zelandiae*	MELNOV	M	
shrubby tororaro, mingimingi		*Muehlenbeckia astonii*	MUEAST	M	
coastal tree daisy		*Olearia solandri*	OLESOL	M	
totara	totara	*Podocarpus totara*	PODTOT	B	
Exotic					
Common name	**Maori name**	**Scientific name**	**Code**	**Dune site**	**Comments**
hares tail		*Lagurus ovatus*	LAGOVA	F,M	
sea rocket		*Cakile maritima subsp. maritima*	CAKMAR	F	
sea rocket		*Cakile edentula var edentula*	CAKEDU	F	
common red bottle brush, honey myrtle		*Melaleuca citrina*	MELCIT	M	
formosan lily		*Lilium formosanum*	LILFOR	M	
wavy-leaved fleabane		*Erigeron bonariense*	CONBON	M	
tasmanian ngaio, Boobialla		*Myoporum aff. Insulare*	MYOINS	B	
Norfolk Island Pine		*Araucaria heterophylla*	ARAHET	B	
Exotic herb			EXHERB	F,M,B	
Exotic grass			EXGRAS	F,M,B	
Exotic weed					
Common name	**Maori name**	**Scientific name**	**Code**	**Dune site**	**Comments**
marram		*Ammophila arenaria*	AMMARE	F,M	
kikuyu		*Cenchrus clandestinus*	CENCLA	F,M	
Sea spurge		*Euphorbia paralias*	EUPPAR	F	
pampas grass		*Cortaderia selloana*	CORSEL	M	
purple pampas grass		*Cortaderia jubata*	CORJUB	M	
tree lupin		*Lupinus arboreus*	LUPARB	F,M	
Monterey pine, radiata pine		*Pinus radiata*	PINRAD	M,B	
ponderosa pine, western		*Pinus ponderosa*	PINPON	B	

yellow-pine					
macrocarpa		*Cupressus macrocarpa*	CUPMAC	B	
purple groundsel		*Senecio elegans*	SENELE	M	
exotic ice plant, ice plant		*Carpobrotus edulis*	CAREDU	F,M	
exotic ice plant, ice plant		*Carpobrotus chilensis*	CARCHI	F,M	
dimorphotheca		*Osteospermum fruticosum*	OSTFRU	M	
arctotis		*Arctotis stoechadifolia*	ARCSTO	M	
agapanthus		*Agapanthus praecox subsp. Orientalis*	AGAPSO	M	
gorse		*Ulex europaeus*	ULEEUR	M	
climbing asparagus		*Asparagus scandens*	ASPSCA	M	
Italian evergreen buckthorn		*Rhamnus alaternus*	RHAALA	M	
alligator weed		*Alternanthera philoxeroides*	ALTPHI	M,H	
bone seed		*Chrysanthemoides monilifera subsp. monilifera*	CHRMON	M	
bur medic		*Medicago nigra*	MEDNIG	M	
white clover		*Trifolium pratense*	TRIPRA	M	
red clover		*Trifolium repens*	TRIREP	M	
buffalo grass		*Stenotaphrum secundatum*	STESEC	F,M	
sea couch		*Elytrigia pycnantha*	ELYPYC	F,M	
saltwater paspalum		*Paspalum vaginatum*	PASVAG	H	
mercer grass		*Paspalum distichum*	PASDIS	M	