



Monitoring Coastal
Sand Dunes

- an introduction

WHY MONITOR SAND DUNES?

Many of our coastal sand dunes are severely degraded where uncontrolled use and development, spread of invasive weeds and impact of grazing animals has seen loss of native vegetation cover and substantial changes in dune morphology (refer to human-induced impacts on the natural form and function of sand dunes in Section 10 of the Dunes Trust Handbook). Coast Care groups and management agencies are actively involved in restoration of sand dunes aimed at improving indigenous biodiversity and natural dune form and function.

Most monitoring of dune condition and vegetation cover undertaken by community Coast Care groups is based on non-quantitative observations by members (Bergin 2013). This often anecdotal

information is sometimes collected over long timeframes and over substantial areas of dunes and beaches, but seldom formally recorded other than, for example, comparing earlier photographs with current states of the dunes. Little quantitative data is collected on a formal or regular basis, especially on vegetation cover on coastal dunes or on monitoring the performance of restoration programmes.

Assessing the state of the beach and dune system and monitoring changes over time are essential requirements for any dune restoration programme. This article provides a brief introduction to assessment and monitoring that should be considered in coastal dune management and restoration programmes.



Assessment and monitoring

Effective restoration of dunes requires a staged process of assessment and monitoring:

Assessment – Undertaking an evaluation of the current state of the beach and dune system (e.g. type and extent of vegetation cover);

Determining key factors influencing dune degradation (e.g. ongoing pest animal damage; dominance of weed species);

Design and implementation of a prioritised restoration plan that addresses key factors (e.g. weed and pest animal control, planting natives); and

Monitoring – Systematic recording change over time to determine whether restoration initiatives are meeting objectives (e.g. measuring performance of planted seedlings).

ESSENTIAL STEPS

There are several essential requirements to consider in undertaking an assessment of vegetation cover and dune characteristics or setting up a monitoring programme. These include:

- **Background information.** Collation of any relevant material (e.g. earlier restoration plans, species lists) is likely to provide valuable insights into planning and implementing dune surveys and monitoring programmes.
- **What, when and where?** Documentation of the site and activities undertaken will provide a valuable record for future monitoring. A brief project history sheet can include:
 - description of activities undertaken (e.g. site preparation, species planted, weeds removed);
 - log of subsequent activities (e.g. ongoing monitoring and maintenance);
 - sketch diagram or aerial photograph to allow easy relocation.
- **Photographs.** Photographs taken before and at intervals after planting particularly from fixed photopoints provide a visual record of changes and progress of restoration.

Date	Activity
10 April 2012	Site prep: 100 sites using glyphosate at approx. 2 m spacing (see map for planting sites)
23 May 2012	Plant 100 native trees and shrubs - 20 each of karo, pohutukawa, ngaio, koromiko, totara
20 June 2012	Check on planted seedlings for rabbit damage, weed growth. Rabbit damage minor
9 November 2012	Release of native seedlings planted 6 months ago by knapsack with glyphosate
16 March 2013	Weed control - started removing standing waste seedlings from planted area as indicated on map. Check planted natives for weed growth.

An example of a Project History Sheet that can be used to record brief details of dune assessment surveys and monitoring of restoration programmes. Documenting what, when and where will provide an invaluable record of activities undertaken.



Assessment of dune vegetation cover is best carried sampling across the different zones that typically run parallel to the shoreline from seaward to landward. Placing transects or plots perpendicular will provide an indication of the different zones.

DUNE ASSESSMENT

Dune vegetation is characteristically governed by proximity to sea resulting in zones of different vegetation types that run parallel to the coastline – seaward foredune zone of sand binders, mid-dune zone with ground covers, backdune zone with shrubs and trees (refer to Dunes Trust Handbook Article No. 2.4 – Zonation and Succession).





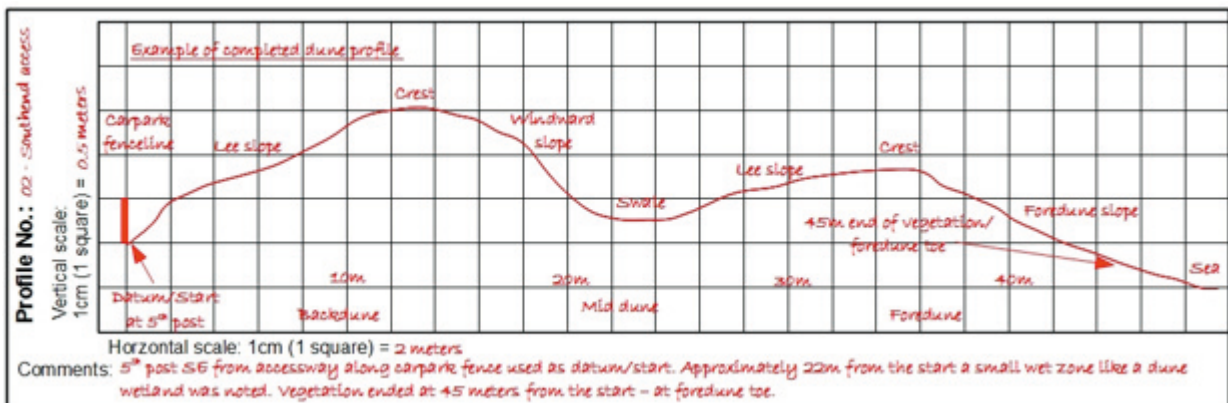
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Determining the state of vegetation cover on sand dunes in relation to dune morphology and proximity to the sea are useful indicators of the degree of modification. Dune assessment also establishes a baseline so that changes in vegetation cover and species composition can be monitored over time.

Key components to include in an assessment of the current state of dunes are:

- **Vegetation cover** – Sampling change in vegetation cover and species composition (both native and exotic) along transects located perpendicular to the coast will provide an indication of the vegetation types and species in each zone.
- **Dune form** – Linking vegetation cover to dune morphology (e.g. foredune slope, dune crest, swale, lee slope...) and distance to the sea will assist in determining both the characteristics and the drivers of vegetation pattern and species composition.

Assessing dune vegetation cover in relation to dune morphology and proximity to the sea improves our understanding of the importance of zonation that invariably occurs in all coastal dune systems. It assists in developing appropriate restoration actions such as selection of the best species for specific zones.



Boundaries between major vegetation cover types and changes in dune profile and vicinity to the sea help to define the broad vegetation zones, e.g. *spinifex* foredune, dune slopes and swales, and landward woody ground cover, shrub and tree zones.



MONITORING DUNES

There are some easy ways in which Coast Care groups can evaluate the success of their restoration efforts on both foredunes and backdunes. Using consistent repeatable methods to assess your dunes will highlight changes that may be occurring such as an increase in the presence of aggressive weeds.

Monitoring will also assist Coast Care groups in setting and adjusting priorities for restoration and management of their dunes. Monitoring performance of restoration activities such as planting native seedlings or carrying out weed control is essential to determine whether intended goals are being met and to provide valuable insights into ways of improving restoration outcomes.

Restoration planting

The most common restoration activity undertaken by Coast Care groups is the planting of natives on foredunes and backdunes. Guidelines for monitoring the success of planting initiatives will need to be tailored to each site and to each Coast Care group. Objective assessments of plant growth and factors that influence growth and the environment depend on good planning and frequent monitoring (Miller and Paul 2007).

Monitoring guidelines will need to consider:

- **Scale of monitoring** – Methods for sampling large scale planting programmes vs more intensive monitoring of smaller projects.
- **Planting pattern** – Options for practical planting patterns such as establishing seedlings in groups or in marked larger blocks to enable easy re-location.
- **Identification** – Practical methods for identifying where activities are undertaken on the dunes essential for rapid relocation of planted seedlings, transects and plots.
- **Assessment of seedlings** – Options for quantifying plant performance is essential including plant survival, growth, plant vigour or health, and noting other factors influencing performance such as rabbit or frosting damage.

Success of planting programmes should be measured on the basis of what has survived and established at least two years after planting, rather than on how many seedlings were planted during the working bee!

Monitoring provides the means to determine success of restoration.

Monitoring of other factors

Weed and pest animal control, and management of beach users are other factors influencing the natural dune form and function in which Coast Care groups and management agencies are often actively involved in managing. Determining the influence of these factors on dune vegetation cover and as part of restoration programmes is essential.



Observation alone is not always satisfactory for assessing the influence of pest plant and animals as well the effect of human use on dune vegetation and stability. There are robust and easily implemented methods for measuring these effects over time. For instance, many local communities are involved in monitoring traplines for predator control on dunes for which there are established procedures of recording already in place.

Detailed guidelines on community-based methods to undertake systematic and repeatable monitoring of these other factors on sand dunes will be provided in further articles with Section 14 of this Handbook.



WHAT TO DO WITH THE DATA?

Practical methods are required for safe-keeping and easy retrieval of dune assessment and monitoring information, history sheets, maps, photographs, and plant and dune profile data. Options include a range of electronic and website based data storage methods. Consideration of the significance or usefulness of information that is collected from monitoring is an important part of dune assessment and monitoring (Miller and Paul 2007).

User-friendly methods are under development for Coast Care groups and management agencies to analyse and interpret data from dune survey assessments and monitoring of change over time. This includes user-friendly web-based tools that will provide graphical interpretation of results. This will allow Coast Care groups to quickly determine the characteristics of their dunes and the success or otherwise of their restoration effort and therefore guide improved practices in future work programmes.



Further articles in this section of the Handbook will provide Coast Care group and management agencies with options for handling of their dune assessment and monitoring data so that results can be used to plan and improve future management and restoration initiatives on their dunes.





COMMUNITY-BASED GUIDELINES

Further articles in this section within the Dunes Trust Handbook on assessment and monitoring of dunes will include community-based guidelines on:

- **Assessment of vegetation cover and species composition** – Details on sampling methods including use and location of transects and plots, intensity of sampling and identification of zonation and plant successions.
- **Assessment of dune morphology** – Methods for measuring dune profiles, changes in sand movement and proximity of vegetation sample points to the shoreline and vegetation zones.
- **Monitoring restoration programmes** – Methods for measuring performance of planted seedlings, impacts of pest weeds and animals and beach users, and changes in vegetation cover including natural regeneration and succession.
- **Database systems** – Development of systems for storage, retrieval, and updating of data from dune assessments and monitoring.
- **Analysis and interpretation of data** – Step by step process for processing data including annual plant measurements to provide insights into future and improved management and restoration practices.

The focus of these guidelines is on providing easy-to-use community-based methods for assessing and monitoring dunes that can be quickly undertaken by Coast Care groups. These rapid methods are derived and therefore complement more intensive vegetation and dune monitoring methods as well as data processing techniques used by councils and researchers.

CONCLUSIONS

Of interest to Coast Care groups and management agencies are easy-to-use methods for determining the status of their dune systems, whether restoration activities are achieving their restoration goals, and key threats that may be looming such as invading weeds or consequences of increased human use. Monitoring of coastal dunes also provides the opportunity for participating groups to learn of the environmental gradients and differences in vegetation pattern and sequences that are part of zonation that occurs on coastal dunes.

The resounding message from community representatives already involved in Coast Care is that a monitoring system has to be practical and rapid (Bergin 2013).

As stated by Atkinson (1994):

Important as monitoring is, if the procedure becomes too complex and, therefore, too demanding of time, it will not be done.

A future challenge is the development and promotion of dune monitoring and recording systems at a national level to allow comparisons between sites and regions and to encourage sharing of information on monitoring methods and success of restoration and management programmes.



REFERENCES

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