What high tech monitoring reveals about our coastline

In 2019, Cambridge Coastcare (CCC) managed a trial to determine how high precision aerial surveying technology could improve coastal dune monitoring. We acknowledge that the coastline is constantly moving with the tides, wind, waves and weather systems and we wanted to 'measure' the patterns of sand movement, vegetation success rates and other factors to be considered in the management of coastal dunes and adjacent infrastructure.

Background

The area of monitoring (300 metres along the coast X 134 metres wide) included an area of dunes with significant dune blowouts (degradation) between Floreat Coastal Paths CMB12 and CMB14, north of Floreat Surf Life Saving Club. Floreat beach, being a wave-dominated beach, is exposed to significant natural sand movement – accretion of sand with the strong SSW winds in summer, and erosion with strong NW winds and winter storms.

CCC volunteers had undertaken matting, planting and fencing of these areas since 2016. However, up to 45% of our efforts had been adversely impacted by sand deposition and some public vandalism during summer followed by erosion (with loss of fences, matting and plants) as a result of the severe winter storms of June 2018.

Funding from WA Coastwest in 2018-19 was critical for the aerial monitoring trial together with a 'treatment' trial of lateral fencing, at the dune base, in an effort to moderate sand movement. Both projects complemented our infill planting in the dune areas subject to erosion.

Methodology

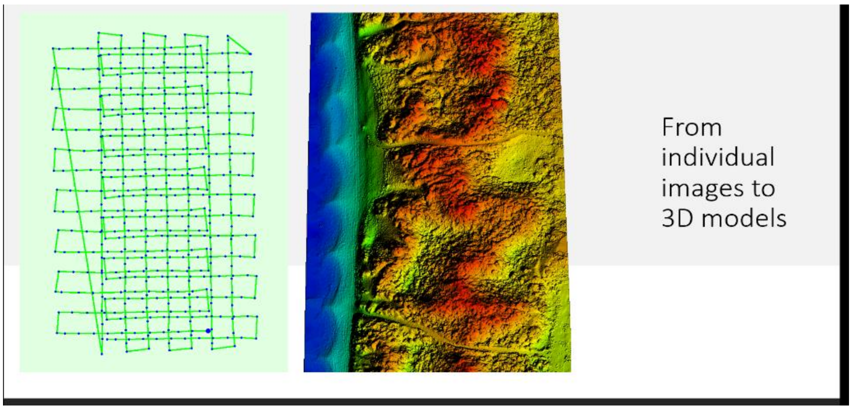
The monitoring trial was conducted over 12 months with four aerial surveys to capture seasonal variations from spring (2018) to summer, autumn and winter of 2019.

The camera used to capture the images – a SONY A7RII 42MP - provided an image resolution of 1 cm (on the ground) per pixel.

Flights were programmed to be fully autonomous at an altitude of 60 m AGL, travelling at 9m/sec, allowing the flights to be replicated to provide consistent data capture. The drone used to carry the camera was a DJI M600 using PPK GPS, recording the exact location of each image taken – the latitude, longitude and height.

Data outputs

A total of 250 images were taken per flight to capture the area. At least three flights were conducted per survey - one looking directly down, others at a camera angle of 30 degrees from directly down – which helped to add depth and height data for processing. Each flight took approximately 12 minutes flying in a grid pattern.



An image of a specific location may be compared across the 4 aerial surveys.


Oct 2018 – Before lateral fencing


Feb 2019 – After lateral fencing

Using Pix4D software, up to 1250 images from one survey can be processed to create a large orthomosaic image of the total area - a 2D coloured map with uniform scale of the mapped area.


Aerial survey Oct 2018


Aerial survey Aug 2019

In addition to high quality photographs and video animations (flyovers), other outputs included:

- LAS files presented as densified point clouds and 2.5D digital surface models – to view with spatial software such as QGIS, Cloud Compare
- Geotiff files presented as digital terrain models & orthomosaics – to view in QGIS, ER Viewer
- Contour lines – shape files to view in any GIS software
- 3D triangle mesh files – to view in Sketchfab
- HTML and KML files to enable orthomosaics to be viewed in Google Maps/Google Earth respectively
- Analysis of sand volume movement (cu metre) per unit of area (square metre) – Excel
- Green index (vegetation) analysis – Excel

The outputs are accessible to all via the WA government database: https://www.data.wa.gov.au/home and search for "Cambridge Coastcare" .

Conclusions

The data outputs provide a range of ways to document, analyse and visually present the natural sand movement (accretion and erosion) along the shoreline and the dunes, the positive impact of treatment measures (lateral fencing), vegetation success rates and the adverse impact of uncontrolled public access.

During the 12 months of the trial we experienced a mild winter which limited the extent of sand erosion, but the effectiveness of the lateral fencing and mature vegetation in trapping sand was able to be measured.

The real benefit of aerial monitoring would be in annual or biennial measurement of sand movement and vegetation over 5-10 years to observe coastline trends and interpret coastal management pressures. This could complement biannual on-ground photo monitoring before and after significant storm events

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Meg Anklesaria - Chair, Cambridge Coastcare (November 2020)