Investigating LiDAR for forest monitoring in NSW State Forests

This note summarises research to investigate the feasibility of remote sensing technologies to monitor forest structure in NSW native State Forests. This work was carried out by researchers at the University of Newcastle as part of the Coastal IFOA Monitoring Program.

Researchers developed and tested methods to determine if Light Detection and Ranging (**LiDAR**) data could be used to explore changes in forest structure over time in NSW forests under the Coastal Integrated Forestry Operations Approval (**Coastal IFOA**).

LiDAR offers avenue for enhanced forest monitoring

Using recently captured airborne LiDAR data and other spatial and non-spatial data, researchers assessed how forest structural diversity is influenced by natural and anthropogenic activities. The research explored the impact of management activities (such as harvesting, prescribed fire, areas set aside for conservation) and natural disturbances (such as wildfire), along with topographic position and forest type. Building on this work, researchers also analysed structural complexity, canopy gaps, harvested areas, and canopy foliage density.

LiDAR data was captured across 250,000 hectares of NSW state forest over three time periods (2012, 2016 and 2023). The survey area included 27 state forests in the Eden, Batemans Bay, Bulahdelah, Wauchope, Coffs Harbour, Styx River and Casino regions. An example of the kind of information generated by this project is provided as **Figure 1**, which shows a LiDAR-derived canopy height model for the Bulahdelah region.

This analysis provides insights into the dynamics of forest structure, composition, and regeneration following harvesting events in NSW State Forests. By integrating LiDAR with other spatial data and employing various analytical methods, this research offers a multifaceted understanding of forest ecosystems.

Using LiDAR to explore forest metrics

Researchers provided worked examples in several areas of NSW State Forests across the Coastal IFOA region. In these areas, the researchers examined:

- remote sensing metrics tailored for canopy height, canopy cover, canopy foliage density and skewness (vertical distribution of LiDAR points)
- the impacts of terrain and differences across Forest Management Zones within state forests on forest structural attributes.

The researchers also combined Fire Extent and Severity Mapping (**FESM**) data with LiDAR data to analyse the impact of the 2019/2020 wildfires on forest structure.

The research demonstrated that LiDAR metrics can reliably describe changes in forest height and canopy coverage. Modelling canopy top height recovery and incorporating slope types, harvesting practices and FESM classes can also describe the rate of recovery across these different factors. As an example, **Figure 2** shows changes in canopy foliage density over time in relation to harvesting events in the different forest regions.

For the sites analysed the researchers found:

- canopy top height and canopy coverage recovers after harvest events across a range of slope classes
- different areas show comparable rates of canopy regrowth over time despite variations in harvesting intensity
- potential similarities are seen in canopy structure between areas managed for timber production and areas managed for conservation
- differences in canopy top heights due to different fire severities can be observed via LiDAR
- harvesting influences vertical and horizontal distribution of biomass, but this returns to pre-harvest levels within a short period (less than ten years).

Additional repeated LiDAR captures over the same areas and other areas of interest would allow these findings to be further investigated.

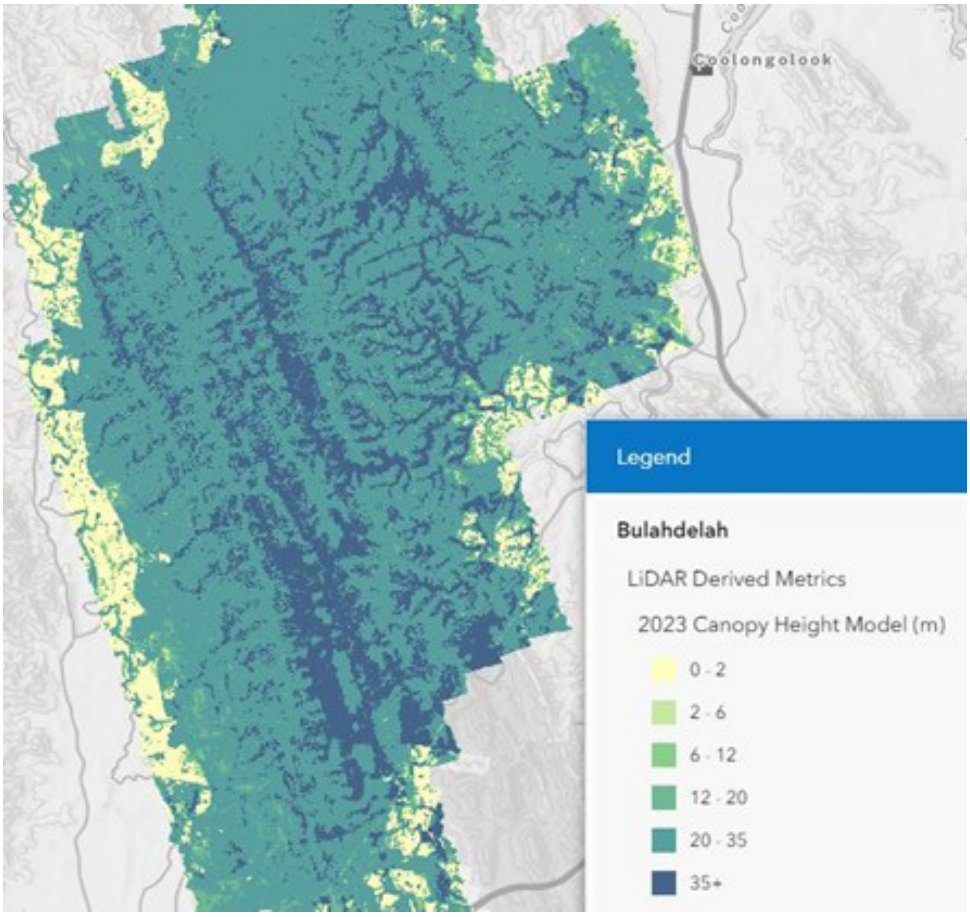

Figure 1: LiDAR-derived canopy height model for the Bulahdelah region

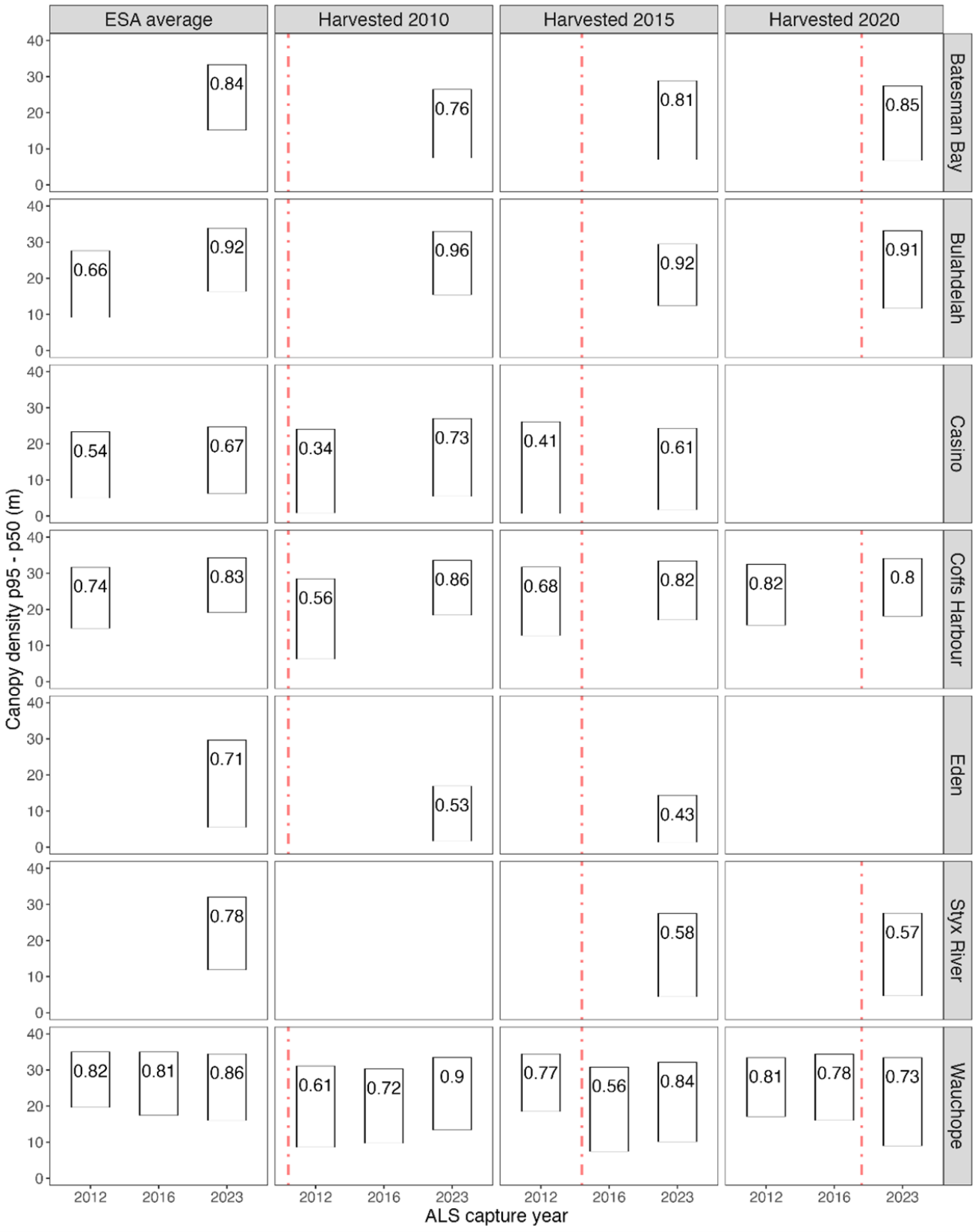

Figure 2: Canopy foliage density illustrated by combined metrics: top canopy (p95), canopy median height (p50), and canopy occupancy (canopy coverage %) across harvested areas (2010, 2015, 2020) and forest regions.

More information

This work is part of the monitoring forest structure and health strategy within the Coastal IFOA monitoring plan. This strategy is designed to:

- measure and establish benchmarks for landscape heterogeneity (age class, structure)
- analyse remote sensing data, LiDAR and multispectral imagery

The reports detailing the project findings can be found on the Commission's website. Webmaps displaying the case study datasets can be found on the NSW Spatial Collaboration Portal.

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