Concept Plan SP 2022-042

Forest ecosystem resilience and stand management

BCS Ecosystem Science

Project Core Team

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Project status as of Sept. 9, 2022, 4:47 p.m.

New project, pending concept plan approval

Document endorsements and approvals as of Sept. 9, 2022, 4:47 p.m.

Project Team	granted
Program Leader	granted
Directorate	required

Forest ecosystem resilience and stand management

Program

BCS Ecosystem Science

Departmental Service

Service 8: Implementation of the Forest Management Plan

Background

The State Government announced in September 2021 that from 2024, timber taken from native forests will be limited to forest management activities that focus on conservation.

In addition, through the End Term Review of the FMP 2014-2023, considerations for the next FMP (2024-2033) were that the Department will seek to continue to investigate the response of forest vegetation cover to climate change events, including drought and heatwaves, and to further investigate, with external agencies and research institutions, the ecological impacts of forest thinning.

This project supercedes and expands on SPP 2000-003 (Hydrological response to timber harvesting and associated stand management in the intermediate rainfall zone of the northern jarrah forest) and SPP 201120 (Long-term stand dynamics of regrowth forest in relation to site productivity and climate), which will be closed.

A warming and drying climate in southwestern Australia has, and will increasingly, put forest ecosystems under chronic and acute moisture and temperature stress. A decline in rainfall since the 1970s and increased frequency of heatwaves have resulted in declining groundwater levels, reduced streamflow and less plant-available water. Concurrently, past management of the forest for timber production have produced legacies of altered stand structure. Portions of the forests are currently characterised by dense stands of regrowth, which may be increasingly vulnerable to warming and drying because they use more water than a more mature forest. There may also be flow-on consequences of these changes in water availability and use for the biodiversity that the forest sustains, including for riparian ecosystems.

One of the main intervention techniques to help the forest adjust to a drying and warming climate is to alter forest stand structure via thinning to reduce competition for water. A range of thinning trials were established as part of harvesting for timber production in southwestern Australia in the past 50 years. These show that thinning can increase available water, increase protection of riparian zones and other habitats, and increase growth rates of remaining trees. However, the ecological implications of thinning for conservation outcomes are less well known.

To understand how thinning may assist in increasing the resilience of south-west forests to a drying and warming climate, this project will investigate three main components: 1) climate drivers and forest health: that is, how much resource enters the system or 'bucket' (i.e. moisture) and how the forest responds; 2) hydrology: how big is the 'bucket' (soil depth, groundwater) and how does the 'bucket' leak (streamflow and evapotranspiration) in response to climate, forest structure and health; and 3) thinning: can changing how many stems in the 'bucket' (functional sapwood, number of stems, basal area) increase resilience and what are the ecological responses to thinning. In addition, the forest, with and without thinning, will experience disturbance interactions such as fire, pests, pathogens, and thus these will also be investigated.

Previous social research suggests that in some areas thinning may not be palatable to the wider community. This requires further work to understand attitudes and perceptions to thinning and forest management.

Thus, the scope of research for forest thinning includes:

Climatic drivers and forest health

- Examine, using remote sensing and geophysics, depth to groundwater and bedrock, when and where forest cover changes are occurring, to identify key thresholds and inform stand management (some of this in 2022/23)
- Examine responses of thinned forest, riparian zones, dense regrowth, and old growth, during drought/ heatwaves using remote sensing (e.g., NDVI, i35, LAI) (underway: FEF).
- Mine FORESTCHECK data for relationships between biological diversity, composition and stand density, e.g., examine the temperature and precipitation gradient across the forest to show impacts of a drying and warming climate on forest structure, composition, and function.

- Maintain, periodically monitor (5–10yrs), and report on stand management measurements, e.g., population and health, for long-term trials in jarrah (Yarragil 4L, 4X, 6C, Wungong, Inglehope, Munro) and karri forest (Warren, Treen Brook, Sutton blocks).

Hydrology

- Quantify hydrological responses (groundwater, surface water and evapotranspiration) to thinning and declining rainfall in experimental catchments (underway) and examine how forest structure regulates streamflow volumes/quality at landscape scales (underway). Apply novel technologies, geophysics, remote sensing, water tracers and soil analyses to measure these responses.
- Develop models for landscape-scale assessment of ecohydrology responses to climate change and management such as thinning.

Thinning

- Examine habitat values and use (foraging, roosting, nesting) of thinned and unthinned catchments (e.g., Wungong) by fauna (key species and broader diversity measures) using novel techniques (e.g., eco-acoustics, camera traps, eDNA) and compare with traditional methods.
- Examine carbon dynamics of thinned and unthinned catchments and ForestCheck plots and clarify allometrics and provide more accurate above and below ground carbon accounting.
- Identify the effects of thinning on forest function (e.g., water, soil carbon, nutrients, microbes), and soil disturbance (movement, compaction), and understorey diversity (Wungong, Munro) (underway).
- Quantify herbicide residue following thinning operations (underway).

Interactions

- Examine the vulnerability of thinned and unthinned forest blocks to high severity fire (underway: DBCA/DFES collaborative project).
- Quantify fuel loads and fire potentials following different methods of thinning using standard and publishable fuels surveys, for older (e.g., Wungong) and newly thinned sites (e.g., Munro, Hamilton).
- Examine the responses of *Phytophthora cinnamomi*-affected forest, in thinned and unthinned areas using remote sensing techniques, validated with in situ data logging (underway).

Social licence

- Quantify current attitudes regarding forest thinning. Repeat the Beckwith et al. (2010) study from Wungong to determine attitudes to longer-term forest development after thinning (underway: FEF).
- Assist with demonstration sites to increase understanding of forest thinning (underway: FEF).

Note: FEF = Forest Enhancement Fund; DFES = Dept Fire and Emergency Services.

Aims

The aim of this project is to examine the potential of stand management such as thinning to maintain or increase forest ecosystem resilience and inform management for forest adaptation to climate change.

Expected outcome

A clearer understanding of the responses of forest ecosystems to climate change with and without intervention activities such as thinning. Findings will be shared with EHB and FMB as part of the FMP implementation via guidelines, manuals, and procedures. Outputs will include journal papers, presentations, science notes, etc., as required.

Strategic context

The project aligns with KPI's from the ETR of the current FMP. Furthermore, it aligns with the Science Strategic Plan (2022- 2025); Strategy: *Develop adaptive management tools to promote ecosystem resilience to the impacts of climate change and other threats.* The project will contribute to this Strategy by understanding the responses of forest ecosystems to climate change to inform management. Forest thinning is also a prominent management tool proposed under the 2024-2033 Forest Management Plan.

Expected collaborations

This project will be jointly implemented by Ecosystem Science and Remote Sensing and Spatial Analysis Programs. Collaborators within DBCA will include Fire Science program, Forest Management Branch, fire ecologists and foresters. Collaborations are expected with universities including through student supervision.

Proposed period of the project

July 25, 2022 – None

Staff time allocation

Role	Year 1	Year 2	Year 3
Scientist	1.2	1.2	1.2
Technical	0.55	0.55	0.55
Volunteer			
Collaborator			

Indicative operating budget

Source	Year 1	Year 2	Year 3
Consolidated Funds (DBCA) re-allocated from existing forest projects	29	4	4
External Funding	188	133	0