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 June 9, 2023, 11:53 a.m.

X X New project, pending concept plan approval

Document endorsements and approvals as of June 9, 2023, 11:53 a.m.

X X
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

A warming and drying climate in southwestern Australia has, and increasingly will, 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 and habitats.

This project 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 2011-20 (Long-term stand dynamics of regrowth forest in relation to site productivity and climate), both of which will be closed. SPP 2000-003 provided an important, long-term record of the groundwater and stream flow responses of the jarrah forest (via the Yarragil catchments) to a drying climate and forest thinning. Hydrological responses to a recent thinning, in 2019, will continue to be monitored by this new project. Knowledge gaps remain regarding the coupling of the forest to groundwater and the unsaturated zone and there remains a need to develop ecohydrological models to support decision making regarding forest management for biodiversity and forest resilience outcomes. SPP 2011-20 demonstrated the effects of forest thinning on growth and inter tree competition in regrowth stands of jarrah and karri, and produced important information on thinning activities in relation to *Armillaria* root disease and organic matter build up. However, that project had a timber resource focus so did not address many of the ecological questions that we now need answered about forest health, fuel loads, fauna habitat and biodiversity responses. This new project will build on the outcomes of these previous projects and will help fill knowledge gaps regarding forest conservation and management under the challenges of ongoing and predicted climate change, as outlined in the FMP 2024-2033.

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 forest responds to climate variability under differing management treatments; 2) hydrology: how forest structure and health influence and in turn are influenced by the storage of water in the vadose and groundwater zones and how this in turn influences streamflow and evapotranspiration; and 3) thinning: can changing stem number (functional sapwood, 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.

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. Specifically, aims include:

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.
- Examine responses of thinned forest, riparian zones, dense regrowth, and old growth, during drought/ heatwaves using remote sensing (e.g., NDVI, i35, LAI).
- 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 (soil moisture, groundwater, surface water and evapotranspiration) to thinning and declining rainfall in experimental catchments and examine how forest structure regulates streamflow volumes/quality at landscape scales. Apply novel technologies, geophysics, remote sensing, water tracers and soil analyses to measure these responses.
- Develop models for landscape-scale assessment of ecohydrological responses to climate change and management such as thinning.
- Undertake research to understand water use and responses to thinning of key forest species.

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).
- Quantify herbicide residue following thinning operations.

Interactions

- Examine the vulnerability of thinned and unthinned forest blocks to high severity fire.
- 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 collection.

Social licence

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

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 State Government announced in September 2021 that from 2024, forest management activities would focus on conservation.

Through the End of Term Review (ETR) of the Forest Management Plan (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.

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

to | X | X | X |

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

to | X | X | X |

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