NSW GOVERNMENT

Natural Resources Commission

NSW Coastal Integrated Forestry Operations Approval Monitoring Program

Annual Progress Report

July 2022

This document has been prepared by the NSW Natural Resources Commission on behalf of the **NSW Forest Monitoring Steering Committee**.

Enquiries

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Acknowledgement of Country

The Natural Resources Commission acknowledges and pays respect to traditional owners and Aboriginal peoples. The Commission recognises and acknowledges that traditional owners have a deep cultural, social, environmental, spiritual and economic connection to their lands and waters. We value and respect their knowledge in natural resource management and the contributions of many generations, including Elders, to this understanding and connection.

Acronyms

DPE	Department of Planning and Environment
DPI	Department of Primary Industries
EPA	Environment Protection Authority
FCNSW	Forestry Corporation of NSW
IFOA	Integrated Forestry Operations Approval
LiDAR	Light Detection and Ranging (remote sensing method)
NPWS	National Parks and Wildlife Service
NSW	New South Wales

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Executive summary

The Coastal Integrated Forestry Operations Approval (Coastal IFOA) Monitoring Program (the program), overseen by the NSW Forest Monitoring Steering Committee (the Committee) and independently chaired by the Natural Resources Commission (the Commission), evaluates the effectiveness of conditions in meeting the Coastal IFOA objectives and outcomes.

This annual report outlines program achievements and progress for 2021-22. A separate annual report outlines progress for the broader NSW Forest Monitoring and Improvement Program. The Commission will also publish a report synthesising findings to date across both programs.

Cross-agency collaboration on forestry matters is effective

The Coastal IFOA monitoring program has delivered new data and insights to improve the evidence base for forest management in NSW's coastal state forests, much of which has been facilitated by effective cross-agency collaboration.

For example, staff from the Forestry Corporation of NSW, Environment Protection Authority (EPA), Department of Primary Industries and the Department of Planning and Environment have worked together to review and identify improvements for Species Management Plans. The Commission has overseen this work and recommended improvements for these plans to the EPA, which has adopted all suggestions.

In another example, a consortium of scientists from NSW agencies and universities delivered a landmark biodiversity assessment for the Coastal IFOA region, recognised as the largest and most significant project of this type in the history of NSW forest management.

Authoritative baselines to evaluate forestry practices are in place

Environmental and wood supply baselines have been established for state forests and other tenures in the Coastal IFOA region to support ongoing evaluation of Coastal IFOA effectiveness, including for:

- **forest extent and condition** – forest extent remained relatively stable across both state forests and national parks between 1998 and 2018, with some increases on private land.

  However, forest condition was significantly impacted by the 2019-20 wildfires – for example, forest canopy cover extent was around 6.6 percent (95,845) lower on state forests post-fire in 2020 compared with the 1998 baseline.

- **biodiversity** – fauna species were found to exhibit a range of divergent responses across the IFOA region with some more or less sensitive to changes in forest structure, climate, and other disturbance events. For example, the Powerful Owl and Sooty Owl recovered significantly after several major disturbances in the forests south of Eden for over two decades from a near-zero base in 1988. During the same period, the Greater Glider declined significantly and did not recover in the survey period.

  Few plant species have been adversely impacted by native timber harvesting. However, nine rainforest and wet sclerophyll forest species were identified as likely to be sensitive to timber harvesting.

- **wood supply -** declined overall between 2003 to 2019 across the IFOA region, with the volume of pulp logs and low quality logs decreasing by around 40 percent and high quality sawlogs decreasing by around 15 percent.

  There are substantial differences in trends between subregions. For the North Coast, high and low quality supply declined by around 20 percent, while on the South Coast and Eden high quality levels were maintained but there were significant declines for other products. All product volumes in the Tumut subregion varied considerably.

Selective harvesting has not impacted koala densities

The Commission's Koala Research Program found that the selective harvesting rates applied at research sites under Coastal IFOA conditions and protocols did not adversely impact koala density. Tree species composition, not tree size, was identified as the key determinant of habitat nutritional quality for koalas, and was not significantly changed by selective harvesting at the treatment sites. Overall, koala density was higher than anticipated in the surveyed forests and was mostly similar between state forest and nearby national park sites.

Recent research at the same sites after the 2019-20 wildfires found that areas with a greater extent of medium or high fire severity experienced larger declines in koala density than areas with only low severity fire severity.

Future fire is a key risk to achieving desired Coastal IFOA outcomes

Research commissioned under the program found that Coastal IFOA objectives and outcomes are at risk following the 2019-20 wildfires. These fires changed the fire regimes in affected forests, and a large proportion of forested areas across all tenures have now shifted into the 'vulnerable' and 'too frequently burnt' categories. Only 8 percent of forested areas in state forests are currently within their recommended fire frequency thresholds. Researchers found nearly 30 percent of the threatened species analysed are predicted to have their area of suitable habitat reduced by over 75 percent by 2070 as a result of changing climate and fire regimes.

The research concluded that previous timber harvesting did not increase the extent or severity of these fires. However, there is potential for cumulative impacts in harvested landscapes that are subject to fire. Further, larger areas of coastal NSW will be subject to more frequent and intense fires under predicted climate change, with increasing risks for forest health and biodiversity in eastern NSW forests.

Ongoing evidence for decision making and assurance is critical

As outlined above, recent research under this program has highlighted the significant risks to Coastal IFOA outcomes as a result of the 2019-20 wildfires, as well as increasing future risks from climate change and changing fire regimes. Accordingly, it is important that systematic evidence about the health of production forests, future risks and the effectiveness of management actions continues to be gathered to inform decisions about how state forests are managed.

Funding for the program ceases in June 2023. The Committee has agreed it is vital that it should continue. The Commission will work with relevant agencies to develop a business case for Government consideration to ensure the NSW Government has the necessary evidence to support its commitments under the *NSW Forestry Industry Roadmap* and to continue to meet its broader national and international obligations for ecological sustainable forest management.

1 Introduction

The Coastal Integrated Forestry Operations Approval (Coastal IFOA) sets out the rules for native timber harvesting in New South Wales (NSW) coastal state forests and establishes the environmental outcomes that must be achieved under the approval. The Coastal IFOA requires that the approval conditions are monitored to ensure they are effective in achieving the required objectives and outcome statements.[1]

The Environment Protection Authority (EPA) and Department of Primary Industries (DPI) have jointly approved the Coastal IFOA Monitoring Program proposed by the NSW Forest Monitoring Steering Committee (see **Section 1.1**). The program sets out the broad framework to evaluate the effectiveness of priority conditions in meeting the Coastal IFOA objectives and outcomes. It centres on strategies to monitor and research forest health, biodiversity, water quality and aquatic habitat, and wood supply. A set of detailed monitoring plans support the program.

This is the second annual progress report on the Coastal IFOA Monitoring Program.

1.1 Cross-agency collaboration

The design and implementation of the Coastal IFOA Monitoring Program is overseen by the NSW Forest Monitoring Steering Committee (the Committee), which is independently chaired by the Natural Resources Commission (the Commission).

The Coastal IFOA requires that the Committee include independent experts and agency representatives. **Table 1** sets out the agencies and experts involved, including:

- NSW agencies with responsibilities for natural resource and environmental policy, regulation, science and monitoring, and forest management
- five independent experts providing advice on biodiversity, forestry, soil and water, Aboriginal natural resource management and social sciences.

Table 1: NSW Forest Monitoring Steering Committee composition

NSW Government agencies	Independent experts
▪ Natural Resources Commission (Chair) ▪ Forestry Corporation of NSW (FCNSW) ▪ Environment Protection Authority (EPA) ▪ Department of Planning and Environment (DPE) ▪ Department of Primary Industries (DPI) ▪ Aboriginal Affairs ▪ National Parks and Wildlife Service (NPWS) ▪ Local Land Services	▪ Professor Patrick Baker ▪ Professor Phillip Gibbons ▪ Associate Professor Jacki Schirmer ▪ Dr Peter Hairsine ▪ Mr Bhiamie Williamson

[1] ..... Coastal IFOA Conditions (Chapter 8) and Coastal IFOA Protocols (Protocol 38).

1.2 Post-fire forestry operations

The 2019-20 wildfires impacted about 3.6 million hectares of forests across all tenures within the mapped Coastal IFOA region.[2] Of the 1.2 million hectares of forested State Forest area under the Coastal IFOA, 59 percent was burnt in the 2019-20 wildfires, almost half of which burnt at high or extreme severity.[3]

Forestry operations ceased in many areas following the 2019-20 fires. In early 2020, FNCSW undertook forestry operations firstly under *site specific operating conditions,* and subsequently under *voluntary measures*.

The monitoring program was proposed in December 2019, before the full extent of the 2019-2020 wildfires had been experienced. The timing and priorities of monitoring activities under the Coastal IFOA Monitoring Program have therefore been reconsidered and refined to account for and address wildfire related impacts. For example, **Section 2.2.1** and **Section 2.2.3** describe projects that relate to the impacts of the 2019- 2020 wildfires.

[2] Bradstock. R, Bedward, M., & Price, O. (2021), *Risks to the NSW Coastal Integrated Forestry Operations Approvals Posed by the 2019/2020 Fire Season and Beyond*, Centre for Environmental Risk Management of Bushfires, University of Wollongong and the NSW Bushfire Risk Management Research Hub, commissioned by the NSW Forest Monitoring Steering Committee, Sydney, NSW

[3] *Ibid.*

2 Progress and achievements in 2021-22

Table 2 outlines the status of the program delivery since its inception in 2019. The remainder of this section details the projects completed or commenced in 2021-22.

Table 2: Progress dashboard

PROGRESS DASHBOARD		
Effectiveness monitoring		
Monitoring plans	Completed (2020-21)	✓
Monitoring network implementation for forest regeneration and health and biodiversity (Note: includes monitoring of fire-affected sites)	**Pilots completed** **Roll out commencing**	✓ »
Research and evaluation projects		
Implications of changing fire intensity and regimes	**Completed**	✓
Koala response to selective harvesting[4]	**Completed** **Scoping (intensive harvesting)[5]**	✓ »
Hollow mortality and recruitment modelling	**Commenced**	»
Novel techniques to detect and monitor Hastings River Mouse	**Commenced**	»
Drones to detect cryptic species	**Commenced**	»
Review of drainage feature crossings and roading	**Commenced**	»
Monitoring of post-fire erosion	**Commenced**	»
Evaluation of species and habitat surveys	**Commenced**	»
Trend monitoring		
Landscape baselines and trends for forest extent and health	**Completed**	✓
Landscape baselines and trends for biodiversity	**Completed**	✓
Landscape baselines and trends for water quantity[6]	**Completed**	✓
Wood supply baselines and trends	**Under expert review**	»
Reporting and adaptive management		
Species management plan review	**Completed (4)[7]** **Commenced (1)**	✓ »
Community forums	**Ongoing**	»
Annual health check	**Ongoing**	✓
Annual report	**Completed**	✓

[4] ..... Part of the Commission's Koala Research Program, funded under the NSW Koala Strategy (2018-21)
[5] ..... As requested under the new NSW Koala Strategy
[6] ..... Note – insufficient data to determine reliable baselines and trends for water quality
[7] ..... 1 review completed in 2020-21 (yellow-bellied glider), 3 reviews completed in 2021-22 (**Section 2.4.1**)

2.1 Effectiveness monitoring: implementing a monitoring network

In 2021, the Commission worked with agencies and other experts to pilot a forest health monitoring approach for coastal state forests. The pilot assessed the scalability and robustness of the overall statistical design of the monitoring network and repurposing of existing permanent forest plots.

In addition, the Commission worked with FCNSW and other agencies to pilot a fauna monitoring program using remote sensing equipment, including cameras, songmeters and echometers.

Based on the pilot, the monitoring sampling strategy has been improved and the methods updated, including the production of field manuals to ensure consistency in data collection and management.

The implementation of the monitoring network in coastal state forests will be rolled out in stages commencing in mid-2022 (**Section 3.1**).

2.2 Effectiveness monitoring: research and evaluation projects

2.2.1 Implications of changing fire intensity and regimes

The Commission engaged the NSW Bushfire Risk Management Hub at the University of Wollongong to assess risks to the achievement of the Coastal IFOA objectives and outcomes from the 2019/20 fires and predicted changes to future fire regimes.

The research found that:

- of the 1.2 million hectares of forested State Forest area under the Coastal IFOA, around 59 percent (734,000 hectares) was burnt, almost half of which burnt at high or extreme severity (26 percent of total forested area, 323,000 hectares)
- previous timber harvesting did not increase the fire extent or severity of the 2019/20 fires, but there may be cumulative impacts in harvested landscapes that are subject to fire
- following the 2019-20 fires, only 8 percent of forested areas in state forests are within their recommended fire frequency thresholds (**Figure 1**)
- of all tenures, state forests experienced the largest increases in vegetation in the 'vulnerable' and 'too frequently burnt' categories that indicate a risk of decline in plant diversity (**Figure 1**)
- burnt areas are expected to be at higher risk from repeated disturbance, particularly in the next 5-10 years during the post-fire recovery phase
- Coastal IFOA objectives and outcomes for forest structure and regeneration, biodiversity and threatened species, water quality and soil erosion are at risk following the 2019/20 fires
- the outlook is expected to worsen under climate change, with larger areas of coastal NSW exposed to more frequent and intense fires.
- under the hotter temperatures/little change in rainfall climate change scenario, seven threatened species (out of 24 assessed) are predicted to have their area of suitable habitat reduced by over 75 percent by 2070.

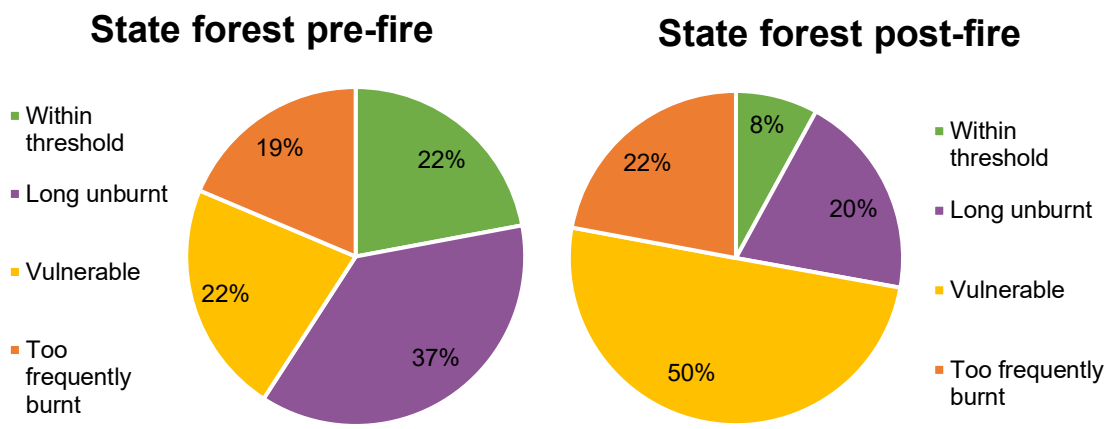

Figure 1: The status of 'threshold' categories indicating plant biodiversity responses to fire frequency for state forest and national parks in the Coastal IFOA area[8]

2.2.2 Koala response to harvesting

It is a requirement under Protocol 38 of the Coastal IFOA to monitor the effectiveness of koala conditions in the Coastal IFOA.

The Commission is currently overseeing a separate Koala Research Program, funded under the Department of Planning and Environment's NSW Koala Strategy. Under this program, researchers at the Australian National University, Western Sydney University and the Forest Science Unit at the NSW Department of Primary Industries investigated how koalas and their habitat are responding to harvesting and other disturbances in state forests on the NSW North Coast.

The Commission has released a report synthesising the research findings in relation to koala response to selective harvesting. Overall, the research found the range of selective harvesting rates applied at the research sites consistent with the Coastal IFOA conditions and protocols did not adversely impact koala density.

Koala density was higher than anticipated in the surveyed forests and was mostly similar between state forest and national park sites.

Selective harvesting at the treatment sites did not significantly change canopy tree species composition and, therefore, is not expected to impact on nutritional quality of koala habitat. The research concluded tree species composition, not tree size, is the key determinant of habitat nutritional quality for koalas.

The Commission recommended its research program should be extended to investigate koala response to intensive harvesting. In addition, the Coastal IFOA koala browse tree list should be reviewed and updated with latest knowledge.

The research program is also using DNA and chemical analysis of koala faecal pellets to determine what tree species koalas are feeding on to inform target species for retention. The analysis was delayed at the time of publishing the synthesis report. However, researchers have delivered preliminary results that are undergoing expert review (**Box 1**).

[8] ..... Bradstock. R, Bedward, M., & Price, O. (2021), *Risks to the NSW Coastal Integrated Forestry Operations Approvals Posed by the 2019/2020 Fire Season and Beyond*, Centre for Environmental Risk Management of Bushfires, University of Wollongong and the NSW Bushfire Risk Management Research Hub, commissioned by the NSW Forest Monitoring Steering Committee, Sydney, NSW

Box 1: Preliminary findings from koala diet analysis

Researchers at the Western Sydney University applied a new molecular method to determine koala diet composition from the analysis of undigested plant DNA in koala faeces, and measured an index of koala nutritional status using chemical analysis of the concentrations of free nitrogen in the faeces.

Preliminary results suggest Koalas strongly favour browsing on species from the Eucalyptus subgenus *Symphyomyrtus* such as grey gum *(E. propinqua).* Koalas eat a variety of species and can adapt to changes in tree composition. Different individual koalas can consume different diets, even when living in close proximity. In summary, koalas have clear browsing preferences but eat what is available.

Early results suggest there may be some inconsistencies between koala tree preferences found in this study than those found in current feed tree lists. For example, the Coastal IFOA does not list spotted gum or ironbarks as either primary or secondary feed trees but appear to be positively preferred by koalas in the study area.

While species with high nutritional content were generally preferred and consumed by koalas to a greater extent, the research showed that koala diets can be diverse and influenced by the need to balance nutrients and toxins and trade-offs between diet and shelter requirements. Accordingly a diversity of species should be maintained within the NSW north coast forests tree retention guidelines.

In line with the recommendations above, work under the Koala Research Program has been extended to investigate koala response to intensive harvesting in state forests on the NSW North Coast (see **Section 2.2.3**). The monitoring plot network will also continue to monitor fauna occupancy in the region, including koala occupancy.

2.2.3 Ongoing research and evaluation projects

The Coastal IFOA Monitoring Program has commenced several other research and evaluation projects that respond to existing and emerging issues, details of which are provided in **Table 3**.

Table 3: Ongoing research and evaluation projects

Project	Overview	Status
Koala response to harvesting	Work under the Koala Research Program (**Section 2.2.2**) has been extended to investigate koala response to intensive harvesting in state forests on the NSW North Coast.	▪ Research plan expected by July 2022 ▪ Call for research proposals and researchers appointed by end September 2022
Hollow mortality and recruitment modelling	The Australian National University is engaged to explore approaches to model hollow retention and recruitment, and ongoing data collection to support such an approach. The work will draw on the best available data to date and on-ground expertise.	▪ Final report due in June 2022
Novel techniques to detect and monitor Hastings River Mouse	The Commission is partnering with the NSW Saving our Species program to test and compare the detectability of the Hastings River mouse using a range of novel survey methods and technologies. This will include testing the use of detection dogs and camera traps (with specific set-up for small mammals) against traditional trapping methods.	▪ Interim report by June 2022 ▪ Further field trials ▪ Final report by end September 2022 (subject to field access)

Project	Overview	Status
Drones to detect cryptic species	NSW DPE are investigating the use of drones to improve detection for the cryptic koala and greater glider populations. Surveys will be undertaken in winter 2022. Drones will be fitted with thermal imaging cameras to provide information on the population density and distribution of koalas. These results will be compared to acoustic detection surveys being undertaken in the same area. Working with FCNSW, thermal imaging cameras will also be used in areas subject to spotlight surveys for the greater glider, with comparison of density estimates using the two techniques and ground validation in real time.	▪ Field trials complete by August 2022 ▪ Final report by October 2022
Review of drainage feature crossings and roading	This program will use remote imagery and surveys to assess the hydrological connectivity of the road and stream networks. Alluvium and the NSW Soil Conservation Services have been engaged to assist the Commission with this evaluation.	▪ Final report by end June 2022
Post-fire erosion monitoring	The program has engaged Jacobs to work collaboratively with FCNSW and University of Melbourne to develop a method for mapping post-fire erosion. This project will use aerial imagery collected pre- and post-fire in the catchment of the Tumut River and Blowering Dam Reservoir. This will improve our understanding of how future wildfires impact water quality and provide options to reduce those impacts. This is particularly important given the predicted increase in the frequency of intense rainfall and bushfires due to climate change.	▪ Final report by end June 2022
Species and habitat surveys evaluation	The program has engaged a team from the University of Tasmania and Biodiversity Maintenance Australia to evaluate the effectiveness of species and habitat survey and modelling conditions and practices used in the Coastal IFOA. Specifically, this evaluation will determine the effectiveness of practices used in the coastal native hardwood state forest in NSW to identify and protect species and habitat of importance.	▪ Final report due September 2022

2.3 Trend monitoring: landscape-scale baselines and trends

The Coastal IFOA requires the monitoring program to establish scientifically valid environmental and wood supply baselines to evaluate the effectiveness or impacts of the approval on environmental values and wood supply. In addition, the program must monitor trends in forest regeneration, biodiversity and water quality at the landscape scale.

The program has drawn upon extensive state and national datasets to assemble cross-tenure baselines and trends in the Coastal IFOA region for:

- forest extent and health
- biodiversity
- water quality and quantity
- wood supply.

The work has informed the suite of indicators and operational methods used to monitor landscape-scale baselines and trends as part of the broader NSW Forest Monitoring and Improvement Program.

2.3.1 Forest extent and health

Spatial Vision and the NSW DPI Forest Science Unit led a consortium including RMIT University, University of New England, PF Olsen, University of NSW, FCNSW and the NSW DPE to deliver baselines, drivers and trends for forest extent and health across all tenures in the IFOA region, including areas where historical forestry operations have occurred.

The project initially covered an assessment period of 1998 to 2018, though the consortium has recently updated the assessment to include the impacts of the 2019-20 wildfires.

The initial work found that state forests across the Coastal IFOA region have remained largely stable through the assessment period (1998 and 2018), with minimal change in forest cover observed over this time. Forest extent remained relative stable across both state forests and national parks within the region. Most increase occurred on private land (10.4 percent or 373,472 hectares) (**Figure 2, Table 4**).

However, the 2019-20 fires were found to have caused a significant reduction in forest canopy cover, disproportionately affecting state forests and national parks compared with forests on private land, particularly in coastal areas of NSW. After the fires, forest canopy decreased by 119,859 hectares across state forests under the Coastal IFOA and 320,593 hectares across national parks in the same region compared with 2018 values, with likely flow on effects on forest condition.

Overall, forest canopy cover extent was around 6.6 percent (95,845) lower on state forests and 8.7 percent (294,046) lower on national parks post-fire in 2020 compared with the 1998 baseline. In contrast, forest canopy extent increased on private land in this period by around 9 percent (963,774 hectares), despite there being some impacts on forest canopy cover extent observed following the 2019-20 fires (**Table 4**).

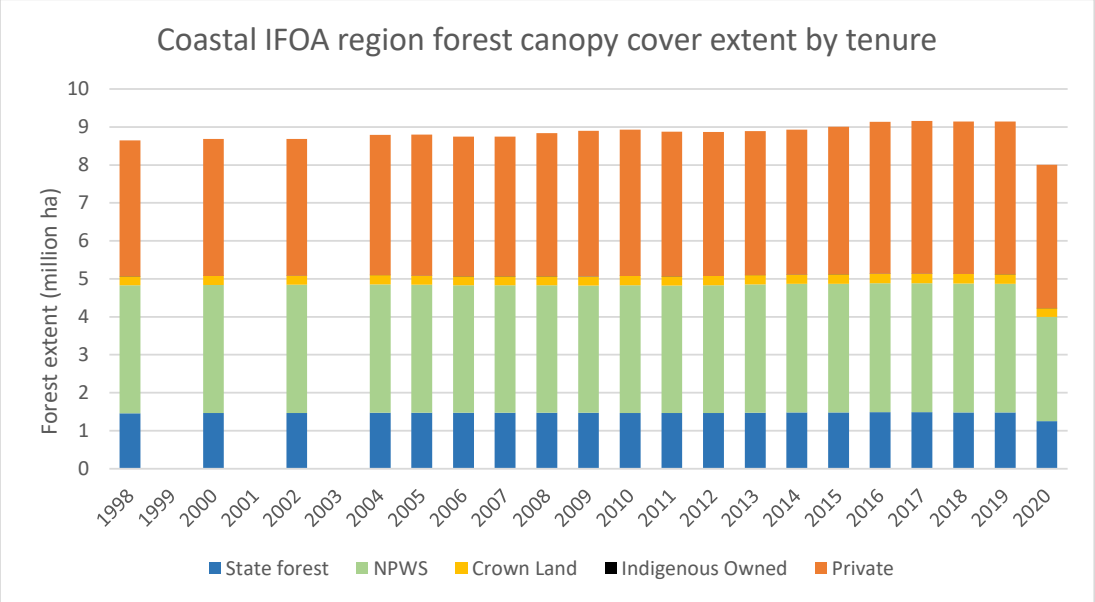

Figure 2: Forest canopy cover extent by tenure in the Coastal IFOA region[9]

Table 4: Average forest canopy cover extent (hectares) by major tenure for 5-year reporting periods in the Coastal IFOA region[10]

Tenure	1998	2003	2008	2013	2018	2020	Percentage Change 1998-2018	Percentage Change 1998-2020
State forest	1,459,399	1,465,944	1,474,171	1,468,296	1,483,413	1,363,554	1.65%	-6.57%
National Park	3,365,209	3,377,955	3,362,676	3,362,523	3,391,756	3,071,163	0.79%	-8.74%
Crown Land - Leasehold	88,942	89,921	91,302	92,207	95,195	91,137	7.03%	2.47%
Crown Land - Other	144,369	145,285	147,643	152,042	155,439	148,583	7.67%	2.92%
Indigenous Owned	542	553	547	559	578	564	6.72%	4.11%
Private	3,576,860	3,605,225	3,710,068	3,817,490	3,950,332	3,898,144	10.44%	8.98%
Total	8,635,322	8,684,883	8,786,408	8,893,117	9,076,714	8,573,145	5.11%	-0.72%

2.3.2 Biodiversity

The University of New England, Macquarie University and the NSW DPI Forest Science Unit and the NSW DPE delivered baselines for selected fauna species across the Coastal IFOA region.

The project located, collated and synthesised a range of data and spatial, temporal and analytical techniques (including historical baseline data collation, species occupancy and

[9] .....Spatial Vision (2022). *Forest Monitoring – Extent, Condition and Health – Overview Report*, unpublished report to the Natural Resources Commission

[10] .....Spatial Vision (2022). *Forest Monitoring – Extent, Condition and Health – Overview Report*, unpublished report to the Natural Resources Commission

environmental niche modelling, forecasting, survey gap analysis and power analysis) to establish baselines and context for future cross-tenure forest monitoring programs.

Occupancy modelling was undertaken for 28 priority fauna species across the north-east NSW region using data from systematic repeat surveys in the 1990s. Occupancy modelling was also undertaken separately for 16 priority species in the combined southern region (Southern and Eden). By undertaking occupancy modelling for the status of priority species in the late 1990s, the program has set a foundation for future monitoring to monitor the impact of different environmental factors on forest biodiversity.

In relation to harvesting activities on state forests, researchers found that few plant species have been adversely impacted by native timber harvesting, although many species were recorded too infrequently for rigorous analysis. Nine rainforest and wet sclerophyll forest species were identified as likely to be sensitive to timber harvesting (noting harvesting is excluded in mapped rainforest under the Coastal IFOA).

Looking forward, the researchers found that the combined effects of climate change and fire represent the most significant threat to biodiversity in eastern NSW forests. Identifying appropriate fire regimes and mapping the shifting mosaic of fires across the forest estate to conserve biodiversity remains a major challenge. Climate projections suggest that potential occupancy of 54 of the 78 (69 percent) assessed fauna species will decline by 2070, including the Powerful Owl and the Greater Glider.

2.3.3 Water

The Committee commissioned the University of Melbourne to deliver baselines, drivers and trends for water quality and quantity in the NSW Regional Forest Agreement areas. This research looked at all forests within the NSW Regional Forest Agreement areas, including national park, state forest and private land (23 percent, 11 percent and 64 percent of the region, respectively).

The researchers delivered a final report which found:

- annual flows have decreased in forested catchments over the last 35 years, with most significant decreases in south coast forests
- one third of coastal forest catchments had 10 to 20 percent flow decreases relative to long-term averages
- flow reductions were generally smaller for catchments with higher mean annual flow, greater area of national park, greater accumulated area harvested, or greater accumulated area burnt
- a lack of data led to mixed and inconclusive results across water quality indicators.

The University of Melbourne team was commissioned to carry out further work:

- extending the analysis to other forested catchments in NSW, and applying novel statistical approaches to identify flow responses to climate variability, catchment disturbance and forest management
- analysing post-fire data to assess the water quality and quantity impacts of the 2019-20 wildfires in the coastal region.

This additional work is largely completed, with researchers reporting large-scale declining flow trends in inland study areas outside of the Regional Forest Agreement region, with 42 of the 90 catchments analysed showing statistically significant decreases. The researchers found little evidence that the 2019-20 wildfire had a substantial impact on streamflow at the catchment scale compared with long-term historical conditions, with changes in flow generally driven by hydro-climatic factors.

The combined research findings indicate declining water quantity over NSW driven by hydro-climatic factors, which has significant implications for future water security for NSW. In particular these findings highlight the need to consider potential responses to changing climate conditions in future.

Final reports are expected to be released in mid-2022 on the Commission's website and the data made publicly available.

2.3.4 Wood supply

The monitoring program has completed work to establish historical baselines and trends in wood supply from NSW coastal native state forests for the period 2003-2019, specifically:

- historic actual wood supply
- drivers of change in wood supply.

Many factors influence the quantity of wood supplied from coastal native state forests in any given year. These can be divided into three broad categories of primary drivers: resource availability, market forces and supply chain characteristics.

Primary drivers of resource availability include the area of forest available for timber production, forest productivity and species mix, environmental regulation, industry and regional policy, silviculture, and yield modelling constraints. Primary market force drivers include wood supply agreements, demand for timber products and industry economics. Primary drivers of supply chains include harvesting and haulage systems, and wood products processing and distribution systems.

The final report has recently been released, with the analysis finding that total wood supply across the Coastal IFOA region declined over the period 2003 to 2019 (**Figure 2**). Pulplogs and low quality logs saw the largest supply decrease of around 40 percent by volume, while high quality sawlog supply decreased by around 15 percent. Overall supply, and high-quality log supply, was aligned to wood supply agreement allocations.

There were substantial differences in trends between subregions. For the North Coast, high and low quality supply declined by around 20 percent, while on the South Coast and Eden high quality levels were maintained but there were significant declines for other products. All product volumes in the Tumut subregion varied considerably.

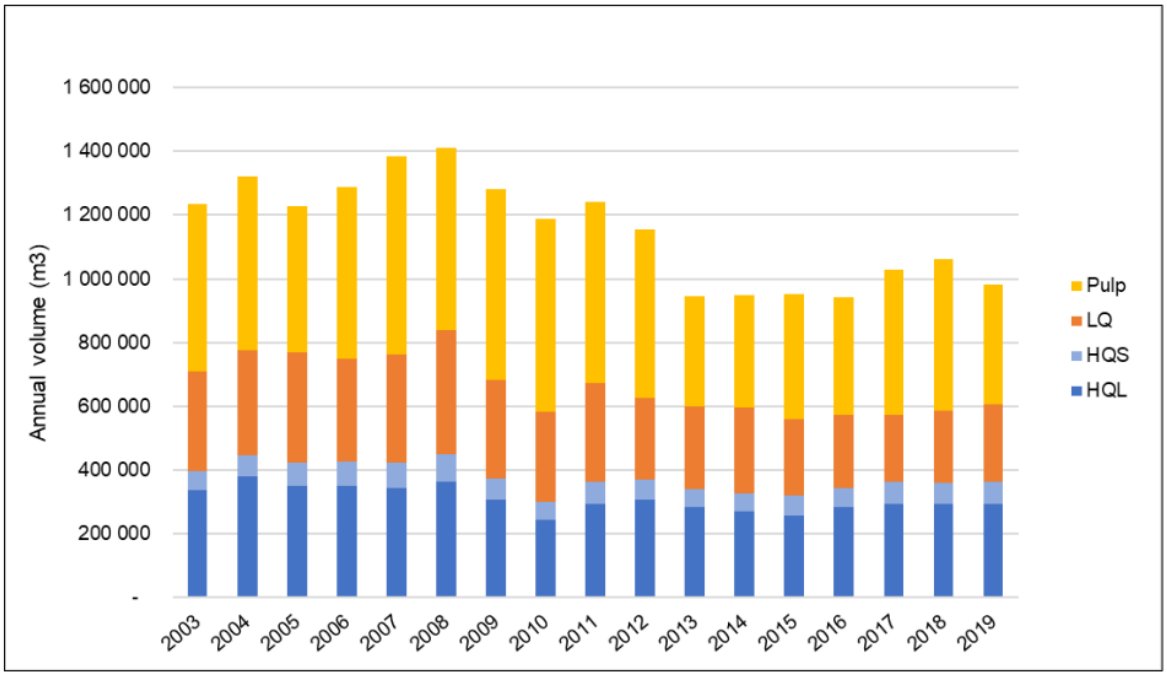

Figure 3: Total volume of all log products arising from CIFOA regions (2003-2019)[11]

[11] ..... Indufor (2022). *Coastal Integrated Forestry Operations Approval Monitoring Program - Monitoring wood supply baseline and trends*, report to the NSW Natural Resources Commission, commissioned by the NSW Forest Monitoring Steering Committee, Sydney, NSW

2.4 Reporting and adaptive management

2.4.1 Species management plan reviews

The Committee oversees annual reviews of species management plans under the program. The review team includes staff from EPA, FCNSW, DPI, the Commission and species experts. Professor Phillip Gibbons from the Committee also advised the group. After the Committee has considered findings of a review, the Commission – as independent chair of the Committee – Is required to advise the Environment Protection Authority (EPA) on opportunities to improve the plans.

Since the last progress report, the cross-agency technical team has completed reviews of the Milky Silkpod, Rusty Plum and Southern Brown Bandicoot species management plans (review outcomes summarised in **Box 2**). On each occasion, the EPA has accepted the review recommendations. In addition, a review of the Giant Burrowing Frog species management plan in the Eden management zone is currently underway.

Box 2: Outcomes of the species management plan reviews

Rusty Plum and Milky Silkpod

To review the Rusty Plum and Milky Silkpod species management plans, the Commission engaged Dr. Doug Binns to review the plans and inform the group. The group identified potential improvements including steps to strengthen monitoring and data analysis to ensure scientifically robust results. These improvements were endorsed by the Committee.

Based on findings from the review, the Commission advised the EPA on ways to improve the plan including using latest technology to ensure scientifically robust results. The Commission also suggested FCNSW continue the current occupancy modelling over the next 2-3 years to assess population trends, impacts and recovery after the 2019/20 wildfire.

Southern Brown Bandicoot

The review of the Southern Brown Bandicoot found that the population had a 46 percent decline in occupancy over the 10 years of monitoring. This decline may be attributed to a range of factors, including feral animal predation and an extended drought in the area. These conclusions are, however, uncertain given the relatively low number of sites being monitored.

The Commission, on behalf of the Committee, advised that EPA could improve the SMP in several ways, including updating the plan objectives to include:

- monitoring of bushfire and harvesting impacts
- other adaptive management triggers, including new provisions under the Coastal IFOA
- implementing and monitoring the effectiveness of predator control on state forests
- increasing monitoring locations to include different harvest treatments and use of the Ben Boyd National Park dataset as a ‘control site’
- adding further data analysis that uses timber harvesting as the main driver of investigation.

2.4.2 Annual health check

The Coastal IFOA Monitoring Program commits to an annual review of the program, referred to as the ‘annual health check’. The annual health check:

- considers the results of the monitoring program
- identifies any implications for the IFOA conditions
- identifies priorities for further monitoring or research.

This process informs advice from the Commission, on behalf of the Committee, to the EPA and DPI on how the Coastal IFOA can better meet its objectives and outcomes.

The Commission team hosted the annual Coastal IFOA health check in August 2021 with the EPA, FCNSW and DPI. Four priority issues were reviewed – koala tree prescriptions, mature tree definition, operational guidance material, and tree retention clump configurations.

It was agreed that two issues should be addressed as a priority under the research and evaluation stream within the program's effectiveness monitoring component (**Section 2.2.3**):

- reviewing the use of temporary log crossings on coastal state forests
- determining the number and size of trees retained in clumps through analysis of existing data to support further hollow analysis.

Other priority issues will continue to be addressed and resolved by FCNSW and EPA in advance of the formal review of the Coastal IFOA in 2023.

2.4.3 Annual stakeholder forums

The Commission, with support from independent experts from the Committee hosted an interactive group session with stakeholders at the 2021 Institute of Foresters Australia National Conference. Program partners presented a range of work, including emerging findings from the IFOA monitoring program to date. Delegates from the government, industry, Aboriginal groups and the community attended the session, either in person or remotely. In addition, the Commission will soon host additional webinars, with question and answer sessions for interested stakeholders.

3 Priority next steps

3.1 Forest health and fauna monitoring

The Commission is now working with agencies and other experts to finalise the sampling design and approach for forest health and fauna modelling. This approach will be rolled-out in state forests to meet Coastal IFOA monitoring commitments.

It is anticipated that the sampling design will build on existing monitoring sites on state forests, using the Survey Gap Analysis tool developed by CSIRO and Department of Planning and Environment to optimise the location of up to 300 sampling sites. This aims to capture the variation in forest types across the region and other factors such as climate, geomorphology, disturbance (such as fire, harvesting), and management.

Field protocols are being finalised for monitoring forest structure, forest health and fauna. Data management processes are being established to efficiently collect and manage the large quantity of data that will be generated from field work, and to make this data publicly available.

3.2 Wood supply monitoring

Once the expert review of historical wood supply is completed, the program will assess the modelled sustainable yield volumes under the Coastal IFOA conditions applied to state forests after the 2019-20 wildfires. This will require new silvicultural field studies to assess the actual impact of the 2019-20 wildfires and how they interact with pre- and post-Coastal IFOA settings.

This work will include:

- review of industry supply commitments as reflected in Wood Supply Agreements under the Coastal IFOA
- production of an additional Net Harvest Area modifier that can compare the previous IFOA settings under post-2019/20 wildfire conditions
- latest remote sensing data including LiDAR for predicting the location of steep terrain and drainage features, as well as native forest inventory estimates and other yield estimates
- current inventory data for both native forests and hardwood plantations.

3.3 Species management plans

The Commission will continue to oversee the reviews of species management plans, including completion of the review for the Giant Burrowing Frog in the Eden management zone that is currently in progress. It is intended that the next reviews will focus on the Eastern Bristle Bird in the Northern Rivers region and Smoky Mouse in the Eden management zone.