

Coastal IFOA: Monitoring plan
Species occupancy

October 2020



Monitoring strategy summary	
Monitoring strategy	Species occupancy
Version 1.0	8 October 2020

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Part 1: Monitoring strategy details	
1.1 Strategy title	
Monitoring species occupancy	
1.2 Protocol 38 requirement	
Protocol 38.3 (1)(a) Monitor and evaluate the effectiveness of the Coastal IFOA conditions, including but not limited to: (i) the multi-scale landscape protections	
1.3 Coastal IFOA condition and associated outcome statements	
C63 (Tree retention clumps) and C64 (Retained trees)	
Important trees are retained and protected for shelter and food resources for native species, and to support their persistence.	
C49 (Category 1 and 2 Environmentally Significant Areas) and C51(Large forest owl landscapes)	
Habitat and environmental features are identified and retained to provide refuge, connectivity, and to support forest regeneration.	
C76 (Nest, roost or den), C78 (Bat roost tree protection), C79 (Flying-fox camps) and C80 (Subterranean bat roosts)	
Site-specific measures are implemented to mitigate the impact of the forestry operation on fauna species and their habitat, and to support their persistence.	
C57 (Broad area habitat searches)	
Environment features, habitat and risks are identified to ensure that protections and management actions are implemented to mitigate the impact of the forestry operation.	
1.4 Monitoring questions	
<ul style="list-style-type: none"> ▪ To what extent do the Coastal IFOA conditions maintain species occupancy in the landscape?¹ ▪ To what extent do the conditions maintain the population status of focal species? 	

¹ For the purpose of effectiveness monitoring, landscape only refers to state forests within the Coastal IFOA.
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1.5 Monitoring objectives

Design a fauna monitoring program that targets focal species that will test the effectiveness of the combined multi-scale landscape protections in the Coastal IFOA and link in with the key habitat features and forest structure and health monitoring strategies

Design a fauna monitoring program, in conjunction with the broader state-wide occupancy monitoring where possible, using passive remote sensors that can effectively monitor the occupancy of the focal species, including koalas and other arboreal mammals, hollow dependant bats, nectivores, ground-dwelling mammals, forest owls and frogs

1.6 Strategy summary

The Coastal IFOA requires that the monitoring program assess the effectiveness of the Coastal IFOA conditions, particularly the multi-scale landscape protections, to maintain species occupancy and the population status of focal species. Species occupancy data will link in with the key habitat features and forest structure and health monitoring strategies, to evaluate the effectiveness.

The program will monitor trends and model across landscapes and regions for focal fauna species using occupancy modelling. Where species overlap, this information can feed into the cross-tenure, state-wide fauna occupancy monitoring being undertaken for the Forest Monitoring and Improvement Program (FMIP), for state forest areas.

Data on presence/absence of focal species across the Coastal IFOA areas is required using repeat fauna surveys to measure occupancy and detect trends over time. The use of fauna group activity levels, to analyse trends over time for key fauna groups e.g. nectivorous birds or microbats, may also be investigated as part of this strategy.

Data will be captured through a field-based monitoring program, mainly consisting of remote survey methods throughout the various forest management zones. This will include the use of infrared cameras and acoustic devices but will also require some species-specific methods, including spotlighting for the greater glider.

Covariates for the analysis representing relevant IFOA Conditions, management and environmental variation will be collected and measured at different scales as part of the *forest structure, health and regeneration monitoring strategy, key habitat features monitoring strategy* and from the FCNSW operational plans. Data collected for fauna occupancy monitoring will assist, in combination with other targeted research, in evaluating the efficacy of the species-specific Coastal IFOA conditions, ensuring that species occupancy and population status is maintained in the landscape.

1.7 Outline of methods and approach

Occupancy monitoring

Occupancy monitoring is built on site-specific surveys repeated over short periods of time to determine the probability for a species to occupy an area and the probability that it would be detected during a survey. When repeated over many sites and years, this information allows for changes in area of occupancy or extent of occurrence to be identified, which can reflect changes in population size and thus population status. With occupancy modelling, presence or absence data is collected on multiple repeat visits (e.g. multiple nights of survey). The use

of remote survey methods reduces costs and time associated with detailed mark-recapture surveys required for population studies. The proposed method also yields data for alternative metrics for analysing species trends. For example, ultrasonic detection of bats yields activity levels, which is a more sensitive measure for describing change than species occupancy for that fauna group. Species occupancy will be the default for analysing change, unless other more sensitive metrics can be extracted efficiently from the data.

Site-specific data can be modelled out into areas of similar habitat, to account for different management practices using environmental and physical variables by identifying key co-variates that influence the likelihood of both occupancy and detection of a species at a site. Importantly, occupancy accounts for false absences or imperfect detection, and is therefore useful as no method has 100 percent detection. Occupancy modelled across a species range at points in time helps to visualise where changes are occurring. Sufficient visits are required to be able to estimate the probability of detection and the optimal number will vary by species and method.

Covariates for the analysis representing IFOA Conditions, such as Environmentally Sensitive Areas (ESAs), retained wildlife clumps and retained hollow-bearing trees and feed trees, management (i.e. silvicultural treatment, regeneration and fire history) and environmental variation, like vegetation type and climatic variation, will be collected and measured at different scales as part of the *forest structure, health and regeneration monitoring strategy* and *key habitat features monitoring strategy*. Refer to these strategies for details of data to be collected.

Occupancy monitoring is proposed for focal species that may be sensitive to harvesting due to being hollow-dependent or reliant on other landscape habitat resources, and therefore test the suitability for the multi-scale landscape protections. Where possible, focal species will be considered in conjunction with the FMIP priority species list, so that data collected can feed into the state-wide cross-tenure program.

Surveys will be completed in areas with different vegetation types, silvicultural treatments and regeneration (forest strata) and results modelled across the Coastal IFOA regions, where possible, based on co-variates from the environmental values monitoring. The environmental values monitoring will generate GIS-based variables for areas identified with similar habitat values, management practices and environmental values that will be gathered as part of the *key habitat features* and *forest structure, health and regeneration* monitoring strategies.

Changes in occupancy levels, including modelled spatial extent, will be monitored through time to determine if the Coastal IFOA multi-scale landscape protections are maintaining species occupancy and thus population status. Trends will be tracked at the local landscape area scale. Differences between Environmentally Sensitive Areas (ESAs), retained wildlife clumps, retained trees and harvest areas will be identified.

Collected data and modelling will be used to both monitor the collective success of the conditions (management actions – based on covariates investigated) and to identify downward trends where additional investigation may be needed to improve management or improve monitoring of that species. Trends will be analysed over time and compared, where appropriate, to cross-tenure monitoring like in NPWS estate, Crownlands and private estate in the state-wide program, ensuring that other drivers of change such as climate change and biosecurity issues are accounted for.

Focal fauna species

Table 1 presents a working list of fauna species for inclusion in the species occupancy monitoring program in coastal state forests. It is likely that this list will be reduced based on data availability for certain species.

Table 1: working list of species for consideration

Species	Habitat feature dependence	Included in the FMIP priority species list?	Recogniser being developed?
Barking owl*	Hollows	Yes	Yes
Masked owl*	Hollows	Yes	Yes
Powerful owl*	Hollows	Yes	Yes
Sooty owl*	Hollows	Yes	Yes
Boobook owl*	Hollows	No	Yes
Glossy black cockatoo	Hollows and feed trees	Yes	Yes
Brown treecreeper	Hollows	Yes	Yes
Rufous scrub-bird*	N/A	Yes	Yes
Noisy Friarbird	Nectar and pollen	No	No - but planned
Varied sittella	N/A	Yes	Yes
Giant barred frog*	Water bodies	Yes	Yes
Stuttering frog*	Water bodies	Yes	Yes
Eastern false pipistrelle	Hollows	Yes	Already developed
Eastern freetail bat	Hollows	Yes	Already developed
Greater broad-nosed bat	Hollows	Yes	Already developed
Southern myotis	Hollows	Yes	Already developed
Yellow-bellied sheath-tailed bat	Hollows	Yes	Already developed
Grey-headed flying fox	Nectar and pollen	No	Yes
Koala*	Eucalypts	Yes	Already developed

Squirrel glider	Hollows	Yes	Yes
Yellow-bellied glider*	Hollows	Yes	Yes
Sugar glider	Hollows	No	Yes
Greater glider*	Hollows	No	N/A - spotlighting
Rufous bettong	Understorey	Yes	N/A - camera
Long-nosed bandicoot	Understorey	Yes	N/A - camera
Southern brown bandicoot*	Understorey	No	N/A - camera
Spotted-tail quoll*	Logs	Yes	N/A - camera
Long-nosed potoroo	Understorey	Yes	N/A - camera

*Denotes species with species/group specific Coastal IFOA conditions and/or SMPs

Monitoring methods

It is proposed that monitoring will be undertaken in 'clusters' across local landscape areas (LLAs) where suitable habitat for multiple species overlap (where possible), therefore reducing the sampling effort and cost, by collecting data for multiple species. Clusters will be stratified within the LLAs, with consideration of the state-wide cross-tenure fauna monitoring program methods, and the location of plots being undertaken as part of the *forest structure, health and regeneration monitoring strategy*.

To ensure that the occupancy monitoring is cost-effective and fit-for-purpose, it is proposed that this monitoring will occur within a rotating schedule of LLAs.

In any given year, there will be a minimum of local landscape areas monitored, spread across the IFOA sub-regions in the following way:

- Three LLAs in the Upper North East
- Three LLAs in the Lower North East
- Two LLAs in Eden
- Two LLAs in Southern

The local landscape areas will be rotated on a five-year cycle so that the monitoring will return to each validation area every five years.

As part of the rotating LLA monitoring, high density LiDAR and ground plot data will be collected for use in State-wide plot network, and monitoring approaches deployed from the following Coastal IFOA monitoring strategies:

- Forest structure, health and regeneration
- Key habitat features

- Species occupancy
- Waterway and wetland health

The number of LLAs, as well as the intensity in field monitoring conducted will be determined during the experimental design of the whole monitoring program following the steering committee endorsement of the Coastal IFOA monitoring plans.

Replication requirements and monitoring locations for species occupancy within the LLAs will be determined by a statistician and experienced fauna ecologist. For some focal species, sites may be based on existing information of known species occurrence, particularly where deployed for frogs.

Remote devices will be deployed consistent with the method employed for the FMIP, if appropriate, allowing data collected to be shared across the programs for more specific analysis. In general, this will include the following at each site (within an LLA):

- 2 x infrared motion-activated cameras (appropriate configuration and baiting to be determined)
- 2 x ultrasonic detectors
- 2 x Songmeters/audiomoths.

Remote devices will be left out for a 14-day period so that all devices can be deployed at the same time. Data will be analysed using recogniser software, where possible. Call recognisers are being developed for a range of species, as identified in **Table 1**.

In addition to these remote methods, species-specific surveys may be required for some species, e.g. spotlight surveys for the greater glider. The details around these surveys will be identified as part of the experimental design.

Resultant monitoring data from the sampled clusters will form the basis for analysing trends in occupancy across local landscape areas and modelled into similar habitat and treatment areas across the wider Coastal IFOA regions.

2.6 Summary of approach to develop baselines and benchmarks for adaptive management

Condition effectiveness baseline:

Baselines for metrics related to species occupancy and distribution are being developed as part of the baselines, drivers and trends in species occupancy and distribution project. It is anticipated that the first three years of data will be used to establish baselines for the implementation of the Coastal IFOA.

Benchmarks:

A key objective for this monitoring strategy would be to set benchmark for occupancy for each of the priority species investigated.

A benchmark would have to be set at a level that is appropriate for multiple-use native forests which are managed for both timber production and environmental values. To be consistent with ESFM ecological benchmarks developed for this monitoring, benchmarks need to relate to existing benchmarks and those emerging from the FMIP, as well as to the relevant species occupancy baselines established for coastal state forests.

The results of all Coastal IFOA monitoring strategies will be combined and analysed by a technical specialist team appointed by the FMIP Steering Committee to determine the adequacy of the monitoring, identify trends in the data and recommend benchmarks for adaptive management triggers.

Benchmarks will be established on completion of LLA assessments that comprise different area proportions and different spatial/temporal arrangements of silvicultural zones and informed by field assessments. It is likely that the program will require several years of data to establish benchmarks for management action triggers.

As part of the Coastal IFOA program, predictive occupancy maps will periodically assess the trajectory of focal species (changes in area of occupancy or extent of occurrence) within coastal state forests, modelling different scenarios including forest management practices and climate change. The exact modelling work will be identified as part of the species occupancy and distribution project currently underway.

Occupancy will be estimated, and trends plotted annually, as part of the monitoring programs annual review with the benchmarks set in the first program evaluation in 2024. Spatial modelling of occupancy completed, and trends will be analysed at 3- or 5-year intervals. Declines over a threshold (to be determined based on baselines) will be investigated in detail. Some short-term declines and fluctuations are to be expected with drought or fire, but any identified sustained declines will trigger a targeted program to investigate and, if appropriate, a change in management.

Adaptive management

As part of the decision-making framework being developed under the program's adaptive management strategy, the process to establish performance benchmarks, analyse the monitoring results and the adaptive management activities that are triggered to adapt the Coastal IFOA to better meet its desired outcomes for species occupancy will be described.

2.7 Existing programs and data that will inform the strategy

- DPI Forest Science Passive Acoustic Monitoring Program (Koala)
- DPI Monitoring Feasibility study
- DPIE EES - Saving our Species Program
- FCNSW historic monitoring and reporting under existing SMPs
- NPWS WildCount

2.8 How the data will be stored, analysed and presented

Data will be collected and initially stored on FCNSW systems to the standards set out in the Forest Monitoring and Improvement Program data management system, including analysis and presentation, then made available for integration with the state-wide forest monitoring program analysis platform. The Coastal IFOA requires all data and information is made publicly available on SEED or similar.

2.9 Expected strategy outcomes

Evidence that multi-scale landscape protections of the Coastal IFOA conditions adequately protect focal species and their habitat from forestry operations and support their occupancy and persistence in the landscape.

2.10 Linkages and uses with the overall NSW Forest Monitoring and Improvement Program Framework

The state-wide and Coastal IFOA landscape-scale environmental values work will collect data on occupancy trends. The State-wide/Coastal IFOA baseline species occupancy and distribution project, which is currently underway, will identify the indicators and metrics to monitor trends in species occupancy across time across tenures.

The state-wide program has the following evaluation questions that guide the program:

What is the occupancy and distribution of forest-dependent fauna and flora species, and what are the predicted trajectories?

Several forest dependent species, as prioritised for the Forest Monitoring and Improvement Program, will be sampled by the proposed monitoring methods. Priority species are still being determined in collaboration with the FMIP technical working group, and with consideration of the Coastal IFOA monitoring program technical working group or relevant design team(s).

Part 2: Timeline

Milestone description	Start date	End date
1. Experimental design for occupancy monitoring	October 2020	February 2021
2. Pilot program completed as part of the plot network pilot to finalise methods	Spring 2020	Summer 2021
3. Fauna priority fauna list finalised	December 2020	
4. Pilot data collection, analysis and reporting	Spring 2020	Ongoing
5. First year local landscape areas	Spring 2021	Summer 2021
6. Data analysis	December 2021	June 2022
7. Reporting	February 2022	ongoing