CIFOA Monitoring Program

Prioritising recommendations for species surveys and habitat models

Final Report to the NSW Natural Resources Commission

June 2024

Disclaimers

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Front page photograph: Marbled Frogmouth (Mick Todd, http://wildlifing.smugmug.com/)

Acknowledgements

Thank you to the following people for contributing to the development of this framework: Mina Bassarova, Todd Maher, Millie Sutherland Saines and Michael Parsons (NRC), and the TWG and associates - Chris Slade (FCNSW), Scott Seaman, John Samuel, Bradley Law (DPI), Peter Higgs, Chris Fraser (EPA) and Jane DeGabriel, Steve Cox, Allen McIlwee, Krystyna Jordan, Natasha Robinson (DCCEEW).

Citation

This report should be cited as Munks, S.A and Bell, P.J. (2024) Coastal Integrated Forestry Operations Approval Monitoring Program - Prioritising recommendations for species surveys and habitat models. Report to Natural Resources Commission, NSW

Summary

- A recent evaluation of Coastal Integrated Forestry Operations Approval conditions and protocols for pre-harvest surveys and associated models and record-keeping (Munks and Bell, 2024) resulted in recommendations for improvements. A qualitative ranking method is described in this report to prioritise these recommendations according to their importance, likelihood of success (impact) and effort.
- The objective of the prioritisation was to bring focus to the most useful actions for improving the effectiveness of species and habitat survey and modelling conditions and practices in identifying the presence and location of native species and habitats that require protective measures under the CIFOA. The transparent nature of the process means it is open to feedback and regular review so the priority list can be regularly updated as new information becomes available.
- The recommendations were grouped according to whether they related to CIFOA conditions and protocols more generally (i.e., policy and process) or were more specifically related to targeted species and habitat surveys, habitat models or records and record-keeping. All recommendations in the general policy and process group were considered to be equally important and were therefore removed from the prioritisation. Significant recommendations included the adoption of Species Management Plan approach for some species and the development of a CIFOA condition for continual improvement agreed by all stakeholders. The 5-year review of the CIFOA starting in late 2024 provides an opportunity to consider the recommendations relating to policy changes in the CIFOA.
- Some of the recommendations are either currently being initiated or are already linked to CIFOA monitoring program activities. These recommendations were therefore not included in this prioritisation (see Appendix A).
- Three criteria, Importance, Impact and Effort and defining sub-criteria enabled an assessment of the value of the remaining recommendations from a purely ecological and technical perspective. Assessments were undertaken by the project team with input from relevant technical experts (CIFOA monitoring program, Technical Working Group). The resource and logistical costs (in $'s) of implementing recommendations were uncertain or unknown and were therefore not included in the assessment. Costing (in $'s) of implementation may be applied at a later stage following further relevant expert input.
- The top five priorities and attributes for each group of recommendations are presented in the body of this report. A full list of recommendations ranked by priority for each group are provided in the Appendices.
- The highest priorities for action across all groups were, evaluate existing flora species habitat models and update where necessary to better focus pre-operational surveys, training and consistent guidance material for identification of key habitat features, and immediate adoption of existing new models where fit for purpose. Recommendations to engage with species experts and recommendations relating to further training and monitoring were also a priority.
- It was noted by the Technical Working Group that an evaluation of recently adopted pre-harvest survey conditions for the greater glider, *Petauroides volans* would be worthwhile, following a similar approach to that taken in Munks and Bell (2024). This would include assessment of whether the revised greater glider conditions influence any of the other (related) recommendations prioritised in this report (e.g. broad area habitat survey recommendations, training recommendations etc.).
- As noted in Munks and Bell (2024), addressing these recommendations should not take emphasis and resources away from the broader monitoring component of the CIFOA.

Recommendations relating to monitoring were in the top five priority across all groups. These encompassed all types of monitoring (implementation, effectiveness and trend) as well as more targeted research to address questions relevant to informing improvement of the CIFOA survey conditions and protocols.

Contents

1. Introduction

The Coastal Integrated Forestry Operations Approval (CIFOA) was the result of a comprehensive review of previous Integrated Forest Operations Approvals (IFOAs) that led to a landscape-based approach with more emphasis on monitoring (State of New South Wales and Environment Protection Authority, 2014). This approach requires targeted pre-harvest surveys for some species and habitat features using specified protocols and these were evaluated as part of the CIFOA monitoring program, required under Chapter 8 of the CIFOA conditions and Protocol 38.3. The evaluation addressed the following questions using a mixed method design:

1. *'Are the species and habitat survey and modelling conditions and practices effective in identifying the presence and location of native species and habitats in the area covered by the CIFOA?'*
2. *'Do the species and habitat survey and modelling conditions and practices contribute to ensuring that protections and management actions are implemented to reduce the impact of the forestry operation?'*

Other parts of the CIFOA monitoring program evaluate the success of management actions and are outside the scope of the current evaluation and recommendations.

The outcomes of the evaluation are presented in four Interim Reports (Munks et al., 2022, Munks and Bell, 2023, Proud et al., 2023, Bell and Munks, 2023). The Final Report (Munks and Bell, 2024) provides a synthesis of these evaluation outcomes and recommendations to improve models, methods and training, and for further research and monitoring. Some recommendations are discrete tasks which have already been initiated (ie., expert reviews for species surveys and habitat models) and some are already linked to other CIFOA monitoring program activities (Appendix A). However, additional work is required to prioritise the remaining recommendations based on highest need and impact given their extent and range and implications for resourcing.

This report outlines a framework using criteria to prioritise the recommendations in a consistent and transparent manner, ensuring that decisions are clearly justified. The outputs of this method are provided. The approach considers the likely effort, resourcing, and timing to implement the recommendations.

2. Prioritisation Method

2.1. Background

The method used to prioritise the recommendations from the current evaluation is based on a review of approaches used elsewhere to prioritise projects and/or recommendations and behaviours. Methods reviewed included: multi-step processes which involve both qualitative and quantitative assessment using multiple criteria and performance measures (e.g., Leadbeater's Possum Advisory Group, 2014); application of an impact-likelihood prioritisation matrix (e.g., Kneebone et al., 2017, Boulet et al., 2023) and ranking using assessments of importance/benefit, effectiveness/feasibility and cost (e.g., DPIPWE, 2010, Lynch et al., 2021, Forest Practices Authority, 2013, Leadbeater's Possum Advisory Group, 2014, Koch et al., 2022).

A variation of the qualitative ranking method was selected for the current prioritisation, drawing on elements of the Project Prioritisation Protocol (eg., DPIPWE, 2010, Joseph et al., 2008) and the methodology used for identifying priority projects for biodiversity effectiveness monitoring in the Tasmanian forest practices system described in Forest Practices Authority (2013) and Koch et al. (2022). All these methods provide a consistent and transparent approach for prioritising projects (recommendations in this case) based on their importance, likelihood of success (impact) and cost-

efficiency in meeting objectives as determined by relevant experts using the best available information. The number of criteria used was kept to a minimum and a clear objective defined to measure benefit and/or impact to ensure that the prioritisation of recommendations is clear and easy to understand.

The prioritisation comprised the following four steps:

(1) Defining the objective
(2) Grouping recommendations according to topic and determining whether they related more to CIFOA conditions and protocols (i.e., policy and process) or to on-ground practice.
(3) Identifying the criteria
(4) Assessing and ranking the recommendations using the criteria

2.2. Objective

Prioritisation of the recommendations made in the final evaluation report by Munks and Bell (2024) was undertaken on the basis of their importance, likelihood of success (impact) and effort required in meeting the following objectives (from outcome statements, Natural Resources Commission, 2020):

1. To improve the effectiveness of species and habitat survey and modelling conditions and practices in identifying the presence and location of native species and habitats that require protective measures under the CIFOA.
2. To enhance the contribution of species and habitat survey and modelling conditions and practices in ensuring that protections and management actions are implemented to reduce the impact of the forestry operation.

2.3. Grouping recommendations according to topic

The recommendations in Munks and Bell (2024) were grouped according to whether they related to CIFOA conditions and protocols more generally (i.e., policy and process) or were more specifically related to targeted species and habitat surveys, habitat models or records and record-keeping. A topic area was then allocated to each recommendation in the group. These groups of recommendations are presented (not in priority order) in Tables 1, 2, 3 and 4.

Some of the recommendations are either currently being initiated or are already linked to CIFOA monitoring program activities. These recommendations were therefore not included in this prioritisation (see Appendix A).

Table 1 Recommendations from Munks and Bell (2024) for general improvement to CIFOA conditions and protocols (Not in priority order).

* Note that the recommendations highlighted in bold italics are either currently being initiated or are already linked to CIFOA monitoring program activities. These recommendations are therefore not included in this prioritisation (see Appendix A for more details).

Recommendation number	Topic	Recommendation
G1	Research for continual improvement	Undertake research projects to address key questions such as species' detectability, to inform review and improvement of survey protocols.
G2	Species Management Plans	Species Management Plan approach to meet the species conservation requirements. For species where pre-harvest surveys and species-specific protection are inherently inefficient, and/or their occurrence is largely outside the state forest estate (eg., Hastings River Mouse, Northern Corroboree Frog, Rufous Scrub-bird, Marbled Frogmouth).
G3	CIFOA condition, or pathway, for continual improvement agreed by all stakeholders	Develop a CIFOA condition, or pathway, to enable adaptation to new scientific information in a timely fashion and to allow flexibility in decision-making to facilitate continual improvement.
G4	Training for practitioners	Periodic scientific updates covering new information on the ecology of the species, new survey techniques and management requirements.
G5	Interpretation of the relevant CIFOA conditions and protocols	Develop additional guidance material for practitioners agreed by all key stakeholders. (eg., add species profiles and call identification guides to the survey tools).
G6	Implementation monitoring and reporting	Monitor and report annually on the implementation and outcomes of the pre-harvest surveys to assist in assessment of the effectiveness of survey conditions and protocols.

Recommendation number	Topic	Recommendation
G7	Monitoring - Continual improvement of Owl exclusion zones	Conduct cross-tenure, multi-jurisdictional monitoring of large forest owls to inform continual improvement of CIFOA conditions and protocols for these species.
G8	Model updating - Continual improvement	Include a requirement under the CIFOA for periodic review and updating of models and concomitantly, improving the effectiveness of the modelling conditions and practices. Develop a CIFOA process for the uptake of new models when they become available. This process would include validation of any new models in terms of their ability to predict species occurrence and demonstration of their appropriateness for the intended purpose.
G9	Records and record-keeping	Provide support and funding for centralised data management, analysis, reporting, feedback loops and appropriate long-term data storage facilities.
G10	***Effectiveness monitoring***	****Undertake post-harvest cross-tenure, multi-jurisdictional monitoring to inform the overall effectiveness of pre-harvest surveys in contributing to meeting conservation management objectives. (Consider integrating the FCNSW monitoring program with related programs (eg., Wildfish, AWC) to increase data and spread resources.)***

Table 2 Recommendations for improvement to specific pre-harvest surveys for species and habitat (from Munks and Bell, 2024) grouped by topic (Not in priority order).

* Note that the recommendations highlighted in bold italics are either currently being initiated or are already linked to CIFOA monitoring program activities (see Appendix A for more details). These recommendations are therefore not included in this prioritisation. ** Note all recommendations referring to Species Management Plans as an alternative approach are covered by General recommendation 2 (Table 1). *** Note this is not a comprehensive list of forest biodiversity research topics. These are recommendations for research to support the continual improvement of the CIFOA targeted species surveys, based on information gathered in the evaluation by Munks and Bell, 2024.

Species	Habitat descriptions and Models	Survey methods	Training	Research and monitoring***	Alternative approach and other recommendations
Hastings River Mouse	Review and update the description, particularly the inclusion of 'or fern' in the protocols and focus on drainage lines. ***Replace the existing model with the more recent DPI model for this species and update using any new known localities and habitat information post-fires, including LiDar data.***	Trial the use of new methods (eg., detection dogs, eDNA methods, camera traps) with the aim of increasing the efficiency of the surveys.	Initiate training by specialists to increase practitioner knowledge of species ecology, threats, survey methods, new technology and management requirements.	Continue studies into the impacts of harvesting and implement monitoring, including resampling of undisturbed sites surveyed previously.	**Consider taking a risk-based approach to management of habitat for this species through adoption of the draft Species Management Plan. This has an emphasis on monitoring rather than pre-harvest targeted surveys, expansion of monitoring sites and adoption of new models.
Koala	***Northern region – Review and improve the 'browse prescription model' and koala browse tree definition using new information on occurrence of food trees in CIFOA regions (see recommendations in Natural Resources Commission, 2022).***	***Trial alternative survey methods such as acoustic recorders, detection dogs, thermal cameras, and drones. These could supplement the methods already used in pre-harvest surveys.***	Initiate training for contractors covering new information on habitat and alternative survey techniques.		

Species	Habitat descriptions and Models	Survey methods	Training	Research and monitoring***	Alternative approach and other recommendations
	Southern region – Consider adoption of a map that identifies areas of koala habitat suitability and triggers tree retention and restoration rules. Up to date Koala browse tree lists should be a key input into the mapping. Supplement with targeted surveys in some areas but allow flexibility. Identify areas which require retention of trees used by koalas for purposes other than feeding, such as summer shelter trees, which could improve koala outcomes under the CIFOA. This might be particularly important where dramatic increases in temperature are predicted, with climate change (Natural Resources Commission, 2022).				
***Philoria* spp**.	****Review and update the habitat descriptions and models, considering individual species requirements.***	****Review and update the survey protocol for these species with a focus on the habitat descriptions and models, the timing of the surveys, the degree of survey effort (repeats) and individual species requirements (e.g., 'likely***	Conduct field days for surveyors to update knowledge of the species' ecology and alternative survey methods.	Test alternative survey methods with the aim of increasing the efficiency and effectiveness of the surveys.	

Species	Habitat descriptions and Models	Survey methods	Training	Research and monitoring***	Alternative approach and other recommendations
		high-calling activity' needs defining for each species).			
Pouched Frog	Review and update the habitat model taking into account new records. Encourage collaboration between modellers. Review and clarify the protocol wording – meaning of 'adjacent', the habitat description, wording of parts (iv) and (v) (see 3.3.1 in Munks and Bell (2023) for more information).	Include a requirement in the protocol to take known locality data into account when deciding on the need for a habitat assessment and include a requirement to record environmental conditions at the time of survey, to help with interpretation of the results. Provide the optimal conditions for surveys in the protocols or guidance documents to improve efficiency (eg., narrowing the survey season to September-January to make surveys more efficient and effective).	Conduct training for surveyors to update knowledge of the species' ecology and alternative survey methods. Build links with species specialists through field days.	Test alternative survey methods for detectability, accuracy, efficiency (eg., detection dogs, eDNA and remote acoustic recording devices).	
Northern Corroboree Frog		Clarify the 'extent' of the survey area in the protocol. Review the timing and frequency of the surveys to increase detectability and efficiency of the surveys. Allow flexibility in timing of the surveys to allow for		Quantify the impact of forestry activities on this species and its habitat to inform a reassessment of the need for management.	**Consider development of a Species Management Plan for this species as an alternative to the current 'survey and manage' approach.

Species	Habitat descriptions and Models	Survey methods	Training	Research and monitoring***	Alternative approach and other recommendations
		'seasonal factors and climate-change related factors' and based on expert advice.			
Albert's Lyrebird	Update the models to incorporate more recent location records and information on the species.	****Review the survey methodology with attention to probability of detection, considering duration, repeats and timing. Consider the potential of passive acoustic monitoring to assist in species detectability and survey coverage.*** ***Ensure that relevant habitat and environmental data are collected during pre-operational surveys to provide for adaptation of survey methodology and habitat models.***	Improve planning tools, and training in ecology, call and habitat identification and survey methodology.		Explore opportunities for collaboration with other agencies and specialists in pre-harvest surveys and assessment of the effectiveness of management actions to protect the species.
Rufous Scrub-bird	****Update the habitat models and consider modelling the two subspecies separately if/when data are available. Review the habitat definition including in a post-fire landscape.***	****Provide for specialist advice/input to decision making on where, when, and how to survey, and to assist in identification of the species. Consider detectability in interpretation of the***	Train field ecologists in call and habitat identification, and survey methodology.	Measure the effectiveness of the desk-top assessments and surveys using pre-harvest survey results.	Explore opportunities for collaboration with agencies/organisations/specialists in pre-harvest surveys and assessment of the effectiveness of management actions to protect the species.

Species	Habitat descriptions and Models	Survey methods	Training	Research and monitoring***	Alternative approach and other recommendations
		survey results and the likely proximity of territories. Consider the use of passive acoustic monitoring to increase the number of sites and geographical coverage of surveys, and species detectability.			
Marbled Frogmouth	Update the model to incorporate more recent location records and information on the species.	****Ensure that relevant habitat and environmental data are collected during pre-operational surveys to provide for adaptation of survey methodology and habitat models.*** ****Provide for specialist advice/input to decision making on where, when, and how to survey, and to assist in identification of the species.*** ****Consider the use of passive acoustic monitoring to increase the number of sites and geographical coverage of surveys, and species detectability.***		Re-assess detectability when following the CIFOA survey protocol and across seasons to ensure meaningful survey results.	**Consider development of a Species Management Plan for this species as an alternative to the current approach. Explore opportunities for collaboration with agencies/organisations/specialists in pre-harvest surveys and assessment of the effectiveness of management actions to protect the species.

Species	Habitat descriptions and Models	Survey methods	Training	Research and monitoring***	Alternative approach and other recommendations
		Review consistency of survey effort, including factors such a time of night, number of repeat surveys, season of the survey.			
***Flora* spp**	Evaluate existing flora species habitat models (eg., Kavanagh et al. 2021) and update where necessary to better focus pre-operational surveys.		Ensure field ecologists are suitably skilled and experienced in botanical survey and plant species and habitat identification. This may involve ongoing training and development of species-specific survey guidelines.	Re-survey record locations and undertake systematic surveys for expiring flora species' records.	Review prioritisation of flora species for targeted survey and sensitivity to forestry activities. Apply an adaptive approach to the survey and management of flora species which takes account of threat risk.

Table 3 Recommendations for improvement to the large forest owls exclusion zone approach and habitat surveys (from Munks and Bell, 2024) grouped by topic. (Not in priority order)

* Note that the recommendations highlighted in bold italics are either currently being initiated or are already linked to CIFOA monitoring program activities (see Appendix A for more details). These recommendations are therefore not included in this prioritisation.

Topic	Models	Surveys	Training	Monitoring, review and reporting
Large forest owls	Update the owl models used through the CIFOA. Conduct an expert review of the 'Large Forest Owl Exclusion Zones' considering new records and updated owl models.	Consider nocturnal surveys of nest sites, eg., as part of monitoring program. (see Appendix C, LF02)		
Broad Area Habitat Searches	***Explore the use of LiDar for habitat modelling (eg., hollow-bearing trees) to further increase efficiency of the BAHS.***	Develop guidance around search effort and methods for the identification of some key habitat features (eg., owl/glider nests, dens or sap feed trees) including consideration of nocturnal surveys in some areas, to detect and protect these features. Ensure consistency with other available information. Add a protocol allowing flexibility in identification of key habitat features at-risk from forestry activities and the option to seek expert advice.	Conduct annual training and/or field days with species and habitat specialists. Such training should include all involved in the planning, implementation and compliance monitoring of the BAHS (eg., forestry technicians, ecologists, auditors, planners and managers) to ensure consistent understanding and identification of habitat features, the risk from forestry operations and appropriate management.	Ensure monitoring and reporting of the implementation and effectiveness of the BAHS to increase confidence in the approach and inform continual improvement.

Table 4 Recommendations for improvement to models and records and record-keeping (from Munks and Bell, 2024) grouped by topic. (Not in priority order)

* Note that the recommendations highlighted in bold italics are either currently being initiated or are already linked to CIFOA monitoring program activities (see Appendix A for more details). These recommendations are therefore not included in this prioritisation.

Topic	General	Data management and analysis	Monitoring, review and reporting
Models	Adopt NRC species occupancy models and species-specific models (HRM and Koala) and discontinue use of RFA models.	Use independent survey data to validate new models (see Law et al., 2017). Remove or model spatial/temporal autocorrelation (see Law et al., 2014). Limit use of correlated covariates (Law et al., 2014) to improve inference of the significance of model covariates. Undertake power analysis, survey gap analysis and species detectability to inform survey design. Develop and add model covariates that describe the landscape at a scale relevant to species with large home ranges, or that more accurately reflect key habitat characteristics. Develop new environmental covariate layers that address significant disturbances (e.g. fire and logging), additional threats (eg., invasive species) and anticipated climate extremes (see Kavanagh et al., 2021). Develop new methods for highly mobile species (RFA/NRC/EES modelling is not appropriate for highly mobile species).	Include a requirement under the CIFOA for periodic review and updating of models and concomitantly, improving the effectiveness of the modelling conditions and practices. Develop a CIFOA process for the uptake of new models when they become available. This process would include validation of any new models in terms of their ability to predict species occurrence and demonstration of their appropriateness for the intended purpose.
Records and Record-keeping	***Provide ongoing support and funding for FCMapApp – an excellent FCNSW field based***	Review data checking processes regularly and ensure tools are operating and interrogating the correct data.	***Conduct regular, consistent survey/monitoring as a basis for adaptive management and to counter the diminishing***

Topic	General	Data management and analysis	Monitoring, review and reporting
	ecological planning and recording tool.* Include additional comments associated with records to assist with the interpretation of the record (eg., associated habitat data). Improve articulation of the method and frequency of data validation in the CIFOA conditions and protocols.	Provide support and funding for centralised data management, analysis, reporting, feedback loops and appropriate long-term data storage facilities. Capture historical data collected by FCNSW digitally - a huge amount remains on survey sheets in paper form. Years of data on more common species is not able to be interrogated and used to assess the impact of forestry practices over time. These larger data sets are important to help understand the impacts on ecosystems and functional changes that may have taken place. Resources are required for this data to be captured and uploaded.	***record dataset resulting from the 20-year invalidation period.**** ***Use historic records and records from ongoing surveys, projects and the biodiversity monitoring program to assist FCNSW to embrace adaptive management. **** The CIFOA could better articulate pathways for adaptive management according to an evidence-based approach and facilitate timely approvals for improvements to conditions and protocols. Review the quality of database records and undertake additional systematic species surveys. Diminishing records are reducing the value of records as triggers for 'survey and management'.

2.4. Identification of key criteria

The following criteria were used to assess and rank the recommendations in each group (Tables 1-4):

Importance

1. Assessed in terms of conservation status of individual species or conservation value of multiple species and/or habitat types
2. Assessed in terms of the value to CIFOA objectives
3. Magnitude of the risk of not implementing the recommendation (i.e., measure of urgency)

Impact

4. Proportion of operations or land area that may be affected by the recommendation
5. Expected effectiveness of the recommendation in terms of outcome (i.e., the capacity to make a difference)
6. Other biodiversity benefits
7. Other non-biodiversity benefits

Effort

8. Effort to implement the recommendation measured in time, personnel and logistics
9. Existing capacity/ability to implement the recommendation
10. Dependencies (i.e., what is the recommendation dependant on)

These three criteria, Importance, Impact and Effort, provide an initial assessment of the value of a recommendation from a purely ecological and technical perspective. The resource and logistical costs (in $'s) of implementing a recommendations are uncertain or unknown and were therefore not included in the assessment. However, costing may be applied at a later stage following further relevant expert input. The approach taken here avoids the resource components confounding the priority of recommendations from an ecological perspective.

The definition of each criterion and ratings to guide the prioritisation assessment are provided in Table 5.

Table 5 Definitions and classifications of the criteria used to prioritise recommendations in Munks and Bell (2024).

Criteria	Sub-criteria/Definition	Rating		
		High	Medium	Low
Importance	(MO) Importance to meeting the objectives of the species or habitat surveys. Includes benefits to multiple species and/or habitats.	A key action needed to improve the effectiveness of a species or habitat survey, and modelling conditions and practices, in identifying the presence of native species and habitats and hence ensure that protective measures are applied. This action may also benefit multiple species and/or habitats.	One of several actions needed to improve the effectiveness of the species or habitat survey, and modelling conditions and practices, in identifying the presence of native species and habitats and hence increase the likelihood that protective measures are applied. Alternative approaches may be	An action that would not necessarily improve the effectiveness of the current species or habitat survey, and modelling conditions and practices, in identifying the presence of native species and habitats (e.g., only a localised contribution). Alternative approaches may be an option to address recommendation.

Criteria	Sub-criteria/Definition	Rating		
		High	Medium	Low
			an option to address recommendation.	
	(CIFOA) Importance to the CIFOA more broadly. (i.e., improvement to process)	Important to the application of the CIFOA and associated procedures more broadly.	May improve some of the CIFOA conditions and protocols through improving procedures and interpretation.	Minor importance to the CIFOA conditions and protocols, procedures and interpretation.
	(MR) The magnitude of the risk of not addressing the recommendation (i.e., measure of urgency)	This is the primary or only action likely to improve the effectiveness of the species or habitat survey and modelling conditions and practices. If this recommendation is not implemented (or a suitable alternative approach not implemented) then protective measures will not be applied.	This action is one of several likely to improve the effectiveness of the species or habitat survey and modelling conditions and practices. If this recommendation is not implemented, then protective measures may be applied but may not be effective in meeting the conservation objectives for the species or habitat.	This action is not likely to improve the effectiveness of the species or habitat survey and modelling conditions and practices. If this recommendation is not implemented, then protective measures may still be applied.
Impact	(%plans) The estimated proportion of CIFOA land area likely to be impacted by the action	>70% of CIFOA area.	20–70% of CIFOA area.	<20% of CIFOA area.
	(REF) The likely effectiveness of the action to improve the outcome (i.e., the ability to make a difference)	The action is likely to meet its intent.	The action is likely to partially meet its intent.	The action is likely to make only a marginal contribution to meeting its intent.
	(OBB) Other biodiversity benefits	Multiple species and/or habitats. Multiple participants with increased collaboration and relationship building. Increased awareness of CIFOA conditions and protocols. Will help enhance other conservation	Some species and/or habitats.	Single species and/or localised habitat.

Criteria	Sub-criteria/Definition	Rating		
		High	Medium	Low
		management programs.		
	(ONBB) Other non-biodiversity benefits	Many other non-biodiversity benefits (eg., multiple participants with increased collaboration and relationship building). Will help enhance other conservation management programs.)	Some other non-biodiversity benefits.	Limited other non-biodiversity benefits.
Effort	(EFF) Effort required to meet the intent of the action, measured in time, personnel and logistics	>12 months Expert team Outsource	>6 months Some expert input Project team Outsource and/or inhouse	<6 months Project officer Inhouse
	(CC) Current capacity/ability to implement the action	Little to no capacity to implement the action due to limited resources.	Some capacity to implement the action in the medium term with existing resources.	Capacity to implement the action with existing resources.
	(Dep) Dependencies (i.e., what is the action dependent on)	Dependent on availability of scientific and statistical expertise and data. Significant staff time to manage and coordinate the project. Multi-agency involvement.	Dependent on availability of technical expertise and some data. Need for some agency collaboration.	Part of existing work program including participation and resources. No external agencies/collaboration needed.

2.5. Assessment of recommendations

Prioritisation of the recommendations provided in the final evaluation report (Munks and Bell, 2024) was undertaken on the basis of their Importance, Impact and Effort in meeting the objectives (see 2.4, Table 5) as assessed by the project team and information from relevant technical experts (CIFOA monitoring program, Technical Working Group).

The defining sub-criteria (Table 5) was used to guide the assessment (for consistency). A numerical value (H=3, M=2, L=1) was given to the ranking of each sub-criteria. The sum of these values was used to rank the main criteria (Importance, Impact and Effort) into H, M or L, as follows:

- Where there are three sub-criteria, L=3-4, M=5-6, H=7-9
- Where there are four sub-criteria, L=4-6, M=7-9, H=10-12

Recommendations were ranked in the order that they should be initiated, based on sorting first by Importance (high to low), then Impact (high to low) and finally Effort (low to high). The final list of priorities, the reasons (attributes) for the ranking and the likely effort, resourcing, and timing are presented below.

3. Results

Following feedback from the technical experts (Technical Working Group) recommendations relating to CIFOA conditions and protocols more generally (Table 1) were removed from further prioritisation as they were all considered of equal priority in the context of the CIFOA review. While these recommendations are important, they are outside the scope of the current project and need further expert consideration from the perspectives of (non-ecological) risk, policy and costing. These are presented again in Table 6 along with an indication of the proposed next step in actioning the recommendations.

The top five priorities and attributes for each group of recommendations, following application of the prioritisation method with input from the technical experts, are provided in Table 7, 8 and 9. The full list of recommendations ranked by priority in each group are provided in Appendix B, C and D.

The scoring and rating for the sub-criteria and criteria used in the assessment were recorded in Supplementary Spreadsheets. These can be used for any future review or further analysis. Other grouping selections are also possible, for example by species or topic category. Comments made by the TWG are included in the Appendices B, C, D alongside each recommendation.

Table 6 Assessment of recommendations from Munks and Bell (2024) for general improvement to CIFOA conditions and protocols. (Note: While these recommendations are important, they were not prioritised as they were all considered of equal priority in the context of the CIFOA review. Consideration of these matters could occur via recommendations to the steering committee and then, if supported by the committee, to agencies for progression, consistent with protocol 38.

Recommendation number	Topic	Recommendation	Comments	Proposed Action/Next Step
G1	Research for continual improvement	Undertake research projects to address key questions such as species' detectability, to inform review and improvement of survey protocols.	Research and monitoring work by DPI, FCNSW and others is essential to ensure ongoing improvement of the protocols and to increase understanding of the risk of forestry operations and decisions on appropriate management.	NRC team consult with DPI Science on research projects proposed for funding (from those listed in Table 8 in Munks and Bell 2024 (also in Table 2 in this report)). NRC team then propose the priority research projects for funding in FY25 to NSW Forest Monitoring Steering Committee.
G2	Species Management Plans	Species Management Plan approach to meet the species conservation requirements. For species where pre-harvest surveys and species-specific protection are inherently inefficient, and/or their occurrence is largely outside the state forest estate (eg., Hastings River Mouse, Northern Corroboree Frog, Rufous Scrub-bird, Marbled Frogmouth)	Considered the highest importance in that it should provide real outcomes for threatened species of high importance. The Species Management Plan should take a precautionary/risk-based approach to the assessment of threats and maintenance of habitat.	HRM SMP to be approved by EPA. FCNSW develops new SMPs for approval by EPA.
G3	CIFOA condition for continual improvement agreed by all stakeholders	Develop a CIFOA condition, or pathway, to enable adaptation to new scientific information in a timely fashion and to allow flexibility in decision-making to facilitate continual improvement.	A key recommendation from the evaluation was the development of a new/or modify an existing CIFOA condition, or pathway, to ensure adaptation to new scientific information in a timely fashion and to allow	Identify existing enablers and barriers in the CIFOA to enable improved adaptive management and advise the NSW Forest Monitoring

Recommendation number	Topic	Recommendation	Comments	Proposed Action/Next Step
			flexibility in decision-making to facilitate continual improvement. A suggestion was made that there should be an annual or 3-year review that is less onerous than the current 5 year review.	Steering Committee how processes can be improved either now (via improvement to protocol) or whether a new condition in a revised CIFOA is needed, or both.
G4	Training for practitioners	Periodic scientific updates covering new information on the ecology of the species, new survey techniques and management requirements.		NSW Forest Monitoring Steering Committee to ensure CIFOA annual public reports include scientific updates covering new information on the ecology of the species, new survey techniques and management requirements. FCNSW and DPI consider initiating annual scientific updates/training days for practitioners.
G5	Interpretation of the relevant CIFOA conditions and protocols	Develop additional guidance material for practitioners agreed by all key stakeholders. (eg., add species profiles and call identification guides to the survey tools.)		EPA and FCNSW TWG members to advise on priority topics for new guidance material. NSW Forest Monitoring Steering Committee to oversee development with experts and agencies and recommend guidance material to EPA.

Recommendation number	Topic	Recommendation	Comments	Proposed Action/Next Step
G6	Implementation monitoring and reporting	Monitor and report annually on the implementation and management outcomes of the pre-harvest surveys to assist in assessment of the effectiveness of survey conditions and protocols.	Previously reported annually by FCNSW in a sustainability report. However, this was considered to have little value or impact, so importance downgraded. This would provide a list of what was detected, not if conditions work, just that species or habitat was there before a site was logged. It is an easy and somewhat worthwhile thing to do, given all records get reported in a database. However, it would be better to put effort into doing, and reporting of, the systematic monitoring that has now begun.	Ensure data from preharvest surveys is considered and analysed as part of the broader CIFOA fauna monitoring program now underway.
G7	Monitoring - Continual improvement of Owl exclusion zones	Conduct cross-tenure, multi-jurisdictional monitoring of large forest owls to inform continual improvement of CIFOA conditions and protocols for these species.	Consider an annual or every 3-year review informed by the monitoring data.	Note:Funding and mandate for cross tenure monitoring ceased under the NSW Forest Monitoring and Improvement Program including the CIFOA MER program in 2022. NSW Government request the NSW Forest Monitoring Steering Committee to undertake cross-tenure, multi-jurisdictional monitoring of large forest owls.
G8	Model updating - Continual improvement of	Include a requirement under the CIFOA for periodic review and updating of models and concomitantly, improving the effectiveness	Periodic review and updating of models would probably require a new CIFOA Condition. However, the process outlined in	TWG to advise if Protocol 34 provides sufficient scope and

Recommendation number	Topic	Recommendation	Comments	Proposed Action/Next Step
	Conditions and Protocols	of the modelling conditions and practices. Develop a CIFOA process for the uptake of new models when they become available. This process would include validation of any new models in terms of their ability to predict species occurrence and demonstration of their appropriateness for the intended purpose.	Protocol 34 may apply to replacement of the current spatial datasets, referred to in the CIFOA, with the new more reliable spatial models in a timely fashion.	direction to meet this outcome. Ensure the revised CIFOA monitoring program includes periodic reviews for models as improvement to the evidence base (also consider if a new condition and protocol is required under revised CIFOA).
G9	Records and record-keeping	Provide support and funding for centralised data management, analysis, reporting, feedback loops and appropriate long-term data storage facilities.		TWG to review recent advice from Spatial Vision and FLINTpro reports to ensure CIFOA data is publicly available, visible and integration tools are explored/utilised.

Table 7 Top five priorities and attributes from assessment of recommendations for **species and habitat survey**s. (see Appendix B for complete list)

Importance: MO=Meeting Objective, CIFOA = Importance for the CIFOA more generally, MR=Magnitude of risk.
Impact: %plans=Proportion of land area, REF=Recommendation effectiveness, OBB=Other biodiversity benefits, ONBB=Other non biodiversity benefits.
Effort: EFF=Effort required, CC=Current capacity, Dep=Dependencies (See Table 5 for definitions of criteria.)

Priority	No.	Topic	Recommendation	Importance	Impact	Effort
1	Flora 1	Habitat descriptions and models	Evaluate existing flora models (eg., Kavanagh et al. 2021) and update where necessary to better focus pre-operational surveys.	**H** MO=H, CIFOA=H, MR=M	**H** %plans=H, REF=H, OBB=H, ONBB=H	**H** EFF=H, CC=H, Dep=H
2	Koala 1	Training	Initiate training for contractors covering new information on habitat and alternative survey techniques.	**H** MO=H, CIFOA=M, MR=H	**M** %plans=M, REF=M, OBB=M, ONBB=H	**M** EFF=M, CC=M, Dep=M
3	*Philoria* 2	Training	Conduct field days for surveyors to update knowledge of the species' ecology and alternative survey methods.	**H** MO=H, CIFOA=M, MR=M	**M** %plans=L, REF=M, OBB=H, ONBB=M	**M** EFF=L, CC=M, Dep=M
4	Rufous Scrub-bird 3	R&M	Measure the effectiveness of the desk-top assessments and surveys using pre-harvest survey results.	**H** MO=H, CIFOA=M, MR=M	**L** %plans=L, REF=M, OBB=L, ONBB=L	**M** EFF=L, CC=M, Dep=M
5	Northern Corroboree Frog 1	Habitat descriptions and models	Update the models to incorporate more recent location records and information on the species.	**M** MO=M, CIFOA=M, MR=M	**M** %plans=L, REF=M, OBB=M, ONBB=M	**L** EFF=L, CC=M, Dep=L

Table 8 Top five priorities and attributes from assessment of recommendations for **Owl conditions and BAHS**. (see Appendix C for complete list)
Importance: MO=Meeting Objective, CIFOA = Importance for the CIFOA more generally, MR=Magnitude of risk.
Impact: %plans=Proportion of land area, REF=Recommendation effectiveness, OBB=Other biodiversity benefits, ONBB=Other non biodiversity benefits.
Effort: EFF=Effort required, CC=Current capacity, Dep=Dependencies (See Table 5 for definitions of criteria.)

Priority	No.	Topic	Recommendation	Importance	Impact	Effort
1	BAH1	Surveys	Develop guidance around search effort and methods for the identification of some key habitat features (eg., owl/glider nests, dens or sap feed trees) including consideration of nocturnal surveys in some areas, to detect and protect these features. **Ensure consistency with other available information.**	**H** MO=H, CIFOA=M, MR=H	**H** %plans=H, REF=H, OBB=H, ONBB=M	**L** EFF=M, CC=L, Dep=L
2	LFO1	Models	Update the owl models used through the CIFOA. Conduct an expert review of the effectiveness of the Conditions and Protocols for Large Forest Owls, considering new records and updated owl models.	**H** MO=H, CIFOA=M, MR=M	**H** %plans=H, REF=H, OBB=H, ONBB=M	**M** EFF=M, CC=L, Dep=M
3	BAH3	Training	Conduct annual training and/or field days with species and habitat specialists. Such training should include all involved in the planning, implementation, and compliance monitoring of the BAHS (eg., forestry technicians, ecologists, auditors, planners and managers) to ensure consistent understanding and identification of habitat features, the risk from forestry operations and appropriate management.	**H** MO=M, CIFOA=H, MR=M	**H** %plans=H, REF=H, OBB=H, ONBB=M	**M** EFF=M, CC=M, Dep=M
4	BAH4	Monitoring review and reporting	Ensure monitoring and reporting of the implementation and effectiveness of the BAHS to increase confidence in the approach and inform continual improvement.	**H** MO=M, CIFOA=H, MR=H	**H** %plans=M, REF=M, OBB=H, ONBB=H	**H** EFF=M, CC=H, Dep=M

Priority	No.	Topic	Recommendation	Importance	Impact	Effort
5	BAH2	Broad area habitat searches	Add a protocol allowing flexibility in identification of key habitat features at-risk from forestry activities and the option to seek expert advice.	**M** MO=M, CIFOA=M, MR=M	**H** %plans=H, REF=H, OBB=H, ONBB=M	**L** EFF=L, CC=L, Dep=M

Table 9 Top five priorities and attributes from assessment of recommendations for Models and Record-keeping. (See Appendix D for complete list.)

Importance: MO=Meeting Objective, CIFOA = Importance for the CIFOA more generally, MR=Magnitude of risk.
Impact: %plans=Proportion of land area, REF=Recommendation effectiveness, OBB=Other biodiversity benefits, ONBB=Other non biodiversity benefits.
Effort: EFF=Effort required, CC=Current capacity, Dep=Dependencies (more details in Table 5)

Priority	No.	Topic	Recommendation	Importance	Impact	Effort
1	M1	Adoption of existing new models	Adopt NRC species occupancy models and other available and validated species-specific models (eg., HRM and Koala) where fit for purpose and discontinue use of RFA models.	**H** MO=H, CIFOA=M, MR=H	**M** %plans=M, REF=M, OBB=H, ONBB=M	**M** EFF=M, CC=M, Dep=M
2	M2	Development of new or updating existing models - Data management and analysis	Use independent survey data to validate new models (see Law et al., 2017) Remove or model spatial/temporal autocorrelation (see Law et al., 2014). Limit use of correlated covariates (Law et al., 2014) to improve inference of the significance of model covariates. Undertake power analysis, survey gap analysis and species detectability to inform survey design. Develop and add model covariates that describe the landscape at a scale relevant to species with large home ranges, or that more accurately reflect key habitat characteristics. Develop new environmental covariate layers that address significant disturbances (e.g. fire and logging), additional threats (e.g. invasive species) and anticipated climate extremes (see Kavanagh et al., 2021). Develop new methods for highly mobile species (RFA/NRC/EES modelling is not appropriate for highly mobile species).	**H** MO=H, CIFOA=L, MR=H	**M** %plans=M, REF=M, OBB=H, ONBB=M	**H** EFF=M, CC=M, Dep=H
3	M4	Record-keeping	Improve articulation of the method and frequency of data validation in the CIFOA conditions and protocols.	**M**	**M**	**L**

Priority	No.	Topic	Recommendation	Importance	Impact	Effort
				MO=M, CIFOA=L, MR=M	%plans=H, REF=M, OBB=H, ONBB=L	EFF=M, CC=L, Dep=L
4	M5	Record-keeping	Include additional comments associated with records recorded in FCMapApp to assist with the interpretation of the record (eg., associated habitat data).	**M** MO=M, CIFOA=M, MR=L	**M** %plans=H, REF=M, OBB=L, ONBB=M	**L** EFF=L, CC=L, Dep=L
5	M6	Record-keeping	Review data checking processes regularly and ensure tools are operating and interrogating the correct data.	**L** MO=L, CIFOA=L, MR=M	**M** %plans=H, REF=M, OBB=L, ONBB=L	**L** EFF=L, CC=L, Dep=L

4. Discussion

This report describes the approach taken to prioritise recommendations from Munks and Bell (2024), based on their importance, likelihood of success (impact) and effort required. The outputs of this process can be used to focus efforts to improve the effectiveness of the CIFOA species and habitat survey and associated models where needed, explore alternative approaches and ensure continual improvement. The transparent nature of the process means it is open to feedback and regular review so the priority list can be regularly updated as new information becomes available.

One group of recommendations were identified as relating to CIFOA conditions and protocols more generally (Table 1 and 6). These were considered all equally important and were therefore removed from the prioritisation. This group of recommendations require expert consideration from the perspectives of (non-ecological) risk, policy and costing. Significant recommendations included the adoption of a Species Management Plan approach for some species and the development of a CIFOA condition for continual improvement agreed by all stakeholders. The 5-year review of the CIFOA starting in late 2024 provides an opportunity to include consideration of these recommendations relating to policy changes in the CIFOA.

For the remaining recommendation groups (ie., species and habitat surveys, broad area habitat surveys and owls, models and record-keeping) the process identified recommendations that should be considered a priority for action. Some of these could be actioned immediately whilst others may require further consideration. The priorities could be further sorted by topic in each group for resourcing purposes (eg., training, research and monitoring, survey protocols etc.).

The highest priorities for action across all groups were, evaluate existing flora species habitat models and update where necessary to better focus pre-operational surveys, training and consistent guidance material for identification of key habitat features, and immediate adoption of existing new models where fit for purpose. Recommendations to engage with species experts and recommendations relating to further research and monitoring were also supported and seen as a priority.

The recent pre-harvest survey conditions for the greater glider, *Petauroides volans* were introduced after completion of the original evaluation (Munks and Bell, 2024). It was noted by the Technical Working Group that an evaluation of these conditions would be worthwhile, following a similar approach to that taken in Munks and Bell (2024). It would also be worth looking at whether the revised greater glider conditions influence any of the other (related) recommendations prioritised in this report (e.g. broad area habitat survey recommendations, training recommendations etc.).

One area needing attention that was considered beyond the scope of the original evaluation was the degree to which the survey requirements and outcomes were communicated to the broader community. The issue of lack of transparency and accessibility of information about planning and implementation of protocols was raised by many who participated in the evaluation. Increased awareness of the effort taken through the CIFOA for the protection of species at risk from forestry activities may increase confidence in the approach by stakeholders.

As noted in Munks and Bell (2024), addressing these recommendations should not take emphasis and resources away from the broader monitoring component of the CIFOA. The need for monitoring was raised by many who contributed to the original evaluation. All three types of monitoring are required (implementation, effectiveness and trend) as well as more targeted research to address questions relevant to informing improvement of the CIFOA survey conditions and protocols. Trend monitoring is particularly important to assess whether the CIFOA is working for large home range species such as large forest owls, gliders and koalas.

5. References

BELL, P. J. & MUNKS, S. A. 2023. CIFOA Monitoring Program – Evaluation of species and habitat survey and modelling. Records and record-keeping practices - Interim Report 4 Report to Natural Resource Commission, NSW.

BOULET, M., STOTT, A. & KNEEBONE, S. 2023. Which behaviours matter? Prioritising food waste reduction behaviours for targeted policy and program approaches. *Journal of Environmental Management,* 345**,** 118668.

DPIPWE 2010. Prioritisation of Threatened Flora and Fauna Recovery Actions. Nature Conservation Report 10/03. Threatened Species Section, Department of Primary Industries, Parks, Water & Environment, Hobart, Tasmania.

FOREST PRACTICES AUTHORITY 2013. Developing a biodiversity effectiveness monitoring program for the forest practices system: identifying priority projects. Report to the Federal Government and the Forest Practices Authority. Forest Practices Authority Scientific Report 17.

JOSEPH, L. N., MALONEY, R. T. & POSSINGHAM, H. P. 2008. Optimal allocation of resources among threatened species: a project prioritisation protocol. *Conservation Biology,* 23**,** 328-338.

KAVANAGH, R. P., LAW, B., DRIELSMA, M., GONSALVES, L., BEAUMONT, L., JENKINS, R., WILSON, P., BINNS, D., THINLEY, P., BULOVIC, N., LEMCKERT, F., BRASSIL, T. & REID, N. 2021. NSW Forest Monitoring and Improvement Program, Project 2: Baselines, drivers and trends for species occupancy and distribution, Final Report. NRC, NSW.

KNEEBONE, S., SMITH, L. & FIELDING, K. 2017. The Impact-Likelihood Matrix: A policy tool for behaviour prioritisation. *Environmental Science and Policy,* 70**,** 9-20.

KOCH, A., GARDNER, A., KAY, K., CHUTER, A. & WAPSTRA, M. 2022. *Prioritising effectiveness monitoring for the forest practices system: threatened flora*, FPA Scientific Report 33, report to the Board of the Forest Practices Authority. Hobart.

LAW, B., CACCAMO, G. & BRASSIL, T. 2014. Modelling the Distribution of Hastings River Mouse *Pseudomys oralis* in New South Wales. Draft Report to NSW Forestry Corporation. Forest Science Unit, NSW Primary Industries.

LAW, B., CACCAMO, G., ROE, P., TRUSKINGER, A., BRASSIL, T., GONSALVES, L., MCCONVILLE, A. & STANTON, M. 2017. Development and field validation of a regional, management-scale habitat model: A koala Phascolarctos cinereus case study. *Ecology and evolution,* 7**,** 7475-7489.

LEADBEATER'S POSSUM ADVISORY GROUP 2014. Technical Report. DEECA, Victoria.

LYNCH, E. A., LASSIG, C., TURNER, T., CHURILOV, L., HILL, K. & SHRUBSOLE, K. 2021. Prioritizing guideline recommendations for implementation: a systematic, consumer-inclusive process with a case study using the Australian Clinical Guidelines for Stroke Management. *Health Research Policy and Systems,* 19**,** 85.

MUNKS, S. & BELL, P. 2023. CIFOA Monitoring Program - Evaluation of species and habitat survey and modelling – Structured interview outcomes - Interim Report. Report to Natural Resource Commission, NSW.

MUNKS, S., TURNER, P. & BELL, P. 2022. CIFOA Monitoring Program - Evaluation of species and habitat survey and modelling – Online Survey Results - Interim Report. Report to Natural Resource Commission, NSW.

MUNKS, S. A. & BELL, P. J. 2024. CIFOA Monitoring Program - Evaluation of species and habitat survey and modelling – Final Report. . Report to Natural Resources Commission, NSW.

NATURAL RESOURCES COMMISSION 2020. Coastal IFOA: Monitoring plan. Independent evaluation of forestry practice. October 2020. NSW Government.

NATURAL RESOURCES COMMISSION 2022. Research program: Koala response to harvesting in NSW north coast state forests. Final report (updated). Department of Planning and Environment, NSW.

PROUD, R., TURNER, P., MUNKS, S. A. & BELL, P. J. 2023. CIFOA Monitoring Program – Model evaluation, Interim Report. Report to Natural Resource Commission, NSW.

STATE OF NEW SOUTH WALES AND ENVIRONMENT PROTECTION AUTHORITY 2014. Remake of the Coastal Integrated Forestry Operations Approvals Discussion paper. NSW Government

6. Appendices

Appendix A. Recommendations that are currently being implemented or funded or are linked to CIFOA monitoring program activities

(a): Recommendations currently being implemented	
Recommendation	**Work to date**
Hastings River mouse – replace the existing model with the more recent Department of Primary Industries model for this species (p. 59 in report)	EPA provided feedback through the TWG review that they are currently reviewing proposed habitat model changes for Hastings River mouse made by FCNSW
Koala (northern region) – review and improve the 'browse prescription model' and koala browse tree definition using new information on occurrence of food trees in CIFOA regions (p. 59 in report) **Koala (southern region)** - adoption of a map that identifies areas of koala habitat suitability and triggers tree retention and restoration rules. Up to date Koala browse tree lists should be a key input into the mapping.	The Commission has engaged two subject matter experts to review the koala browse tree list for the Coastal IFOA, as recommended in the Commission's updated 2022 report on koala response to harvesting in NSW north coast state forests. As part of work related to the Private Native Forestry (PNF) Codes, the Commission is also overseeing validation and improvement of the PNF koala prescription map. Once this is complete, the improvements can also be considered for use in CIFOA browse prescription mapping. DCCEEW comment: For koalas, under action 4.4 of the koala strategy we have reviewed and come up with a new food tree use classification. We have the new statewide SDMs for all species known to be eaten by koalas, and we have developed a range of tree species indices that attempt to map the differing value and quality of forests from a food use perspective. In collaboration with the NRC we are also developing an new statewide habitat suitability model which will be used to update the existing PNF prescription map, and we hope improve outcomes for Koalas under the CIFOA.
Monitoring and review – conduct regular, consistent survey/monitoring as a basis for adaptive management and to counter the diminishing record dataset resulting from the 20-year invalidation period (p. 66 in report)	Part of Coastal IFOA Monitoring Program – fauna occupancy monitoring and monitoring as part of Species Management Plans. FCNSW have plans in place to review data management and learnings for the fauna occupancy monitoring program. Based on this, the Commission will provide support to improve data management for the program.
Monitoring and review – use historic records and records from ongoing surveys, projects and the biodiversity monitoring program to	Part of Coastal IFOA Monitoring Program – 1990s baseline data and ongoing fauna occupancy monitoring, monitoring as part of

assist FCNSW to embrace adaptive management (p. 66 in report)	Species Management Plans, design of long-term monitoring for koalas and greater gliders.
Field recording – provide ongoing support and funding for FCMapApp – an excellent FCNSW field based ecological planning and recording tool (p. 66 in report)	FCNSW developed and continues to use this tool for surveys and harvesting planning. FCNSW funds this tool from own resources.

(b): Recommendations with links to CIFOA monitoring program activities	
Recommendation	**Existing data**
Koala – trial alternative survey methods such as acoustic recorders, detection dogs, thermal cameras, and drones to supplement the methods already used in pre-harvest surveys (p. 59 in report)	The Commission engaged DCCEEW (then DPE) to run trial surveys of koalas with thermal imaging from drones. A draft report with findings has been prepared and is due to be reviewed by the TWG.
Broad habitat assessment – explore the use of LiDAR for habitat modelling (for example, hollow-bearing trees) to further increase efficiency of the broad area habitat searches (p. 65 in report)	The Commission has engaged specialist to investigate models for predicting presence of hollows in trees. Current LiDAR data is not sensitive enough to detect hollows. DCCEEW comment: Support the exploration and use of Lidar for habitat modelling (eg.,hollow-bearing trees) to further increase efficiency of the BAHS. This needs to be matched with detailed full-floristic vegetation surveys and the capture of on-site environmental covariates that may account for variation in the distribution and or abundance of species being modelled.

(c) Initial recommended actions to fund in FY24		
	Recommendation	**Proposed action**
1	***Philoria spp.*** – Review and update the habitat descriptions and models, considering individual species requirements. (p.60 of the report) Review and update the survey protocol for these species with a focus on the habitat descriptions and models, the timing of the surveys, the degree of survey effort (repeats) and individual species requirements (e.g., 'likely high-calling activity' needs defining for each species)	Engage subject-matter expert to review habitat descriptions and models for each species and survey protocols (five species in total)
2	**Albert's Lyrebird** – Review the survey methodology with attention to probability of detection, considering duration, repeats and timing. Consider the potential of passive acoustic monitoring to assist in species detectability and survey coverage.	Engage subject-matter expert to review survey method for Albert's Lyrebird and report suggested improvements.

	Ensure that relevant habitat and environmental data are collected during pre-operational surveys to provide for adaptation of survey methodology and habitat models. (p.62 of the report)	
3	**Rufous Scrub-bird** – Provide for specialist advice/input to decision making on where, when, and how to survey, and to assist in identification of the species. Consider detectability in interpretation of the survey results and the likely proximity of territories. Update the habitat models and consider modelling the two subspecies separately if/when data are available. Review the habitat definition including in a post-fire landscape. (p.62 of the report)	Engage subject-matter expert to review survey method and habitat models and definition for Rufous Scrub-bird, and report suggested improvements.
4	**Marbled Frogmouth** – Provide for specialist advice/input to decision making on where, when, and how to survey, and to assist in identification of the species. Ensure that relevant habitat and environmental data are collected during pre-operational surveys to provide for adaptation of survey methodology and habitat models. Consider the use of passive acoustic monitoring to increase the number of sites and geographical coverage of surveys, and species detectability. Review consistency of survey effort, including factors such a time of night, number of repeat surveys, season of the survey. (p.63 of the report)	Engage subject-matter expert to review survey method for Marbled Frogmouth, and report suggested improvements.

Appendix B Prioritisation of the species and habitat survey recommendations. (From Supplementary Spreadsheet)

Importance: MO=Meeting Objective, CIFOA = Importance for the CIFOA more generally, MR=Magnitude of risk.
Impact: %plans=Proportion of land area, REF=Recommendation effectiveness, OBB=Other biodiversity benefits, ONBB=Other non biodiversity benefits.
Effort: EFF=Effort required, CC=Current capacity, Dep=Dependencies (See Table 5 for definitions of criteria.)

Priority	Rec no.	Category	Species	Topic	Recommendation	IMPORTANCE	IMPACT	EFFORT	Summary of comments
1	Flora 1	Species and habitat	Flora spp	Habitat descriptions and models	Evaluate and update existing flora species habitat models (eg., Kavanagh et al. 2021) to better focus pre-operational surveys.	**H**	**H**	**H**	Spatial Insights Team could develop flora specific - individual species habitat models to better focus pre-operational surveys. Apply an adaptive approach to the survey and management of flora species, considering the sensitivity of species to forestry activities, and overall threat risk.

Priority	Rec no.	Category	Species	Topic	Recommendation	IMPORTANCE	IMPACT	EFFORT	Summary of comments
2	K1	Species and habitat	Koala	Training	Initiate training for timber harvesting contractors (if tasked with assessing trees for koalas pre-felling (condition 75.1) or in the course of harvesting operations (protocol 6.7). This training should cover new information on including primary/secondary tree species id skills, signs id skills etc	**H**	**M**	**M**	
3	Ph 2	Species and habitat	*Philoria* spp.	Training	Conduct field days for surveyors to update knowledge of the species' ecology and alternative survey methods.	**H**	**M**	**M**	
4	RSB3	Species and habitat	Rufous Scrub-bird	R&M	Measure the effectiveness of the desk-top assessments and surveys using pre-harvest survey results.	**H**	**L**	**M**	Use existing data and resources

Priority	Rec no.	Category	Species	Topic	Recommendation	IMPORTANCE	IMPACT	EFFORT	Summary of comments
5	NCF1	Species and habitat	Northern Corroboree Frog	Habitat descriptions and models	Update the models to incorporate more recent location records and information on the species.	**M**	**M**	**L**	Check availability of existing models
6	AL1	Species and habitat	Alberts Lyrebird	Habitat descriptions and models	Update the models with current modelling methods to incorporate more recent location records and information on the species.	**M**	**M**	**L**	Check availability of existing models
7	AL3	Species and habitat	Alberts Lyrebird	Training	Improve planning tools, and training in ecology, call and habitat identification and survey methodology.	**M**	**M**	**L**	
8	PF4	Species and habitat	Pouched frog	Survey methods	Provide the optimal conditions for surveys in the protocols or guidance documents to improve efficiency (eg., narrowing the survey season to September-January to make surveys more efficient and effective).	**M**	**M**	**L**	Expert input may be needed

Priority	Rec no.	Category	Species	Topic	Recommendation	IMPORTANCE	IMPACT	EFFORT	Summary of comments
9	MF1	Species and habitat	Marbled Frogmouth	Habitat descriptions and models	Update the model to incorporate more recent location records and information on the species.	**M**	**M**	**L**	Check availability of models
10	K3	Species and habitat	Koala	Habitat descriptions and models	Identify areas which require retention of trees used by koalas for purposes other than feeding, such as summer shelter trees, which could improve koala outcomes under the CIFOA. This might be particularly important where dramatic increases in temperature are predicted, with climate change (Natural Resources Commission, 2022)	**M**	**M**	**L**	Recent DPI radio-tracking identified turpentine as a key shelter tree in summer. These are widespread species, but are most common in gullies, which are protected by riparian buffers.

Priority	Rec no.	Category	Species	Topic	Recommendation	IMPORTANCE	IMPACT	EFFORT	Summary of comments
11	NCF2	Species and habitat	Northern Corroboree Frog	R&M	Quantify the impact of forestry activities on this species and its habitat to inform a reassessment of the need for management.	**M**	**M**	**L**	Existing long-term monitoring and collaboration underway with DCCEEW - chytrid fungus and introduced herbivores having large impact on the species. Assessment and reporting on results of the monitoring program is a priority.
12	PF5	Species and habitat	Pouched frog	Training	Conduct training for surveyors to update knowledge of the species' ecology and alternative survey methods. Build links with species specialists through field days.	**M**	**M**	**M**	Consider opening up training courses to environmental consultants/other agencies/NRM practitioners to share costs and standardise training.
13	HRM3	Species and habitat	Hastings River Mouse	Training	Initiate training by specialists to increase practitioner knowledge of species ecology, threats, survey methods, new technology and management requirements.	**M**	**M**	**M**	

Priority	Rec no.	Category	Species	Topic	Recommendation	IMPORTANCE	IMPACT	EFFORT	Summary of comments
14	HRM2	Species and habitat	Hastings River Mouse	Survey methods	Trial the use of new methods (eg., detection dogs, eDNA methods, camera traps) with the aim of increasing the efficiency of the surveys.	**M**	**M**	**M**	Trials are underway - some promise for both methods. While there is a lot of research currently underway on the use of sniffer dogs and eDNA for detection, these methods provide information on presence rather than population dynamics, so their potential use depends on the purpose of the survey.
15	HRM4	Species and habitat	Hastings River Mouse	R&M	Continue studies into the impacts of harvesting and implement monitoring, including resampling of undisturbed sites surveyed previously.	**M**	**M**	**H**	DPI initiated this research 10 years ago and published a paper in 2016. There is ongoing research in this area.
16	RSB2	Species and habitat	Rufous Scrub-bird	Training	Train field ecologists in call and habitat identification, and survey methodology.	**M**	**L**	**L**	

Priority	Rec no.	Category	Species	Topic	Recommendation	IMPORTANCE	IMPACT	EFFORT	Summary of comments
17	PF1	Species and habitat	Pouched frog	Habitat descriptions and models	Review and update the habitat model taking into account new records if available. Encourage collaboration between modellers.	**M**	**L**	**L**	The current model DPI developed is not that old and there probably aren't a whole lot of new records to include in an update.
18	PF2	Species and habitat	Pouched frog	Habitat descriptions and models	Review and clarify the protocol wording – meaning of 'adjacent', the habitat description, wording of parts (iv) and (v) (see 3.3.1 in Munks and Bell (2023) for more information).	**M**	**L**	**L**	

Priority	Rec no.	Category	Species	Topic	Recommendation	IMPORTANCE	IMPACT	EFFORT	Summary of comments
19	PF3	Species and habitat	Pouched frog	Survey Methods	Include a requirement in the protocol to take known locality data into account when deciding on the need for a habitat assessment and include a requirement to record environmental conditions at the time of survey, to help with interpretation of the results.	**M**	**L**	**L**	Use existing resources
20	Ph 3	Species and habitat	*Philoria* spp.	R&M	Test alternative survey methods with the aim of increasing the efficiency and effectiveness of the surveys.	**M**	**L**	**M**	
21	MF5	Species and habitat	Marbled Frogmouth	R&M	Re-assess detectability when following the CIFOA survey protocol and across seasons to ensure meaningful survey results.	**M**	**L**	**H**	

Priority	Rec no.	Category	Species	Topic	Recommendation	IMPORTANCE	IMPACT	EFFORT	Summary of comments
22	AL4	Species and habitat	Alberts Lyrebird	Other	Explore opportunities for collaboration with other agencies and specialists in pre-harvest surveys and assessment of the effectiveness of management actions to protect the species.	**L**	**M**	**L**	
23	PF6	Species and habitat	Pouched frog	R&M	Test alternative survey methods for detectability, accuracy, efficiency (eg., detection dogs, eDNA and remote acoustic recording devices).	**L**	**M**	**M**	

Priority	Rec no.	Category	Species	Topic	Recommendation	IMPORTANCE	IMPACT	EFFORT	Summary of comments
24	HRM1	Species and habitat	Hastings River Mouse	Habitat descriptions and models	Review and update the description, particularly look at why 'or fern' is included in the protocols and the focus on drainage lines. Law et al. 2016, which identified a negative association of captures with fern.	**L**	**L**	**M**	Law et al. 2016 identified a negative association of captures with fern. Further investigation is underway. An SMP is recommended for this species under General recs. This would be a better use of resources than adjusting habitat descriptions. Use of the revised model would allow for improved and targeted resource. Action may need to be delayed until more reliable data available in 2025.
25	MF6	Species and habitat	Marbled Frogmouth	Other	Explore opportunities for collaboration with agencies/organisations/specialists in pre-harvest surveys and assessment of the effectiveness of management actions to protect the species.	**L**	**L**	**M**	

Priority	Rec no.	Category	Species	Topic	Recommendation	IMPORTANCE	IMPACT	EFFORT	Summary of comments
26	RSB4	Species and habitat	Rufous Scrub-bird	Other	Explore opportunities for collaboration with agencies/organisations/specialists in pre-harvest surveys and assessment of the effectiveness of management actions to protect the species.	**L**	**L**	**M**	

Appendix C Prioritisation of the Owl and BAHS recommendations. (From Supplementary Spreadsheet)

Importance: MO=Meeting Objective, CIFOA = Importance for the CIFOA more generally, MR=Magnitude of Risk.
Impact: %plans=Proportion of land area, REF=Recommendation effectiveness, OBB=Other biodiversity benefits, ONBB=Other non biodiversity benefits.
Effort: EFF=Effort required, CC=Current capacity, Dep=Dependencies (See Table 5 for definitions of criteria.)

Priority	**Rec no.**	**Category**	**Species**	**Topic**	**Recommendation**	**IMPORTANCE**	**IMPACT**	**Effort**	**Summary of comments**
1	BAH1	Broad area habitat searches	Habitat for multiple species	Surveys	Develop guidance around search effort and methods for the identification of some key habitat features (eg., owl/glider nests, dens or sap feed trees) including consideration of nocturnal surveys in some areas, to detect and protect these features. **Ensure consistency with other available information.**	**H**	**H**	**L**	Suggest reviewing existing guidance and field guide in development. Value of nocturnal surveys to determine habitat features is low for many species.

Priority	Rec no.	Category	Species	Topic	Recommendation	IMPORTANCE	IMPACT	Effort	Summary of comments
2	LFO1	Owl protocol	Owls	Models	Update the owl models used through the CIFOA. Conduct an expert review of the effectiveness of the Conditions and Protocols for Large Forest Owls, considering new records and updated owl models.	**H**	**H**	**M**	Link with the outcomes of the Fauna Monitoring Program which includes owl detections and occupancy. Owl exclusions are 'carry over' exclusions (from previous IFOA's) and capture areas long unharvested. There are multiple drivers that would inform policy changes to these rules, notwithstanding the value in reviewing owl habitat model veracity etc.
3	BAH3	Broad area habitat searches	Habitat for multiple species	Training	Conduct annual training and/or field days with species and habitat specialists. Such training should include all involved in the planning, implementation and compliance monitoring of the BAHS (eg., forestry technicians, ecologists, auditors, planners and managers) to ensure consistent understanding and identification of habitat features, the risk from forestry operations	**H**	**H**	**M**	Could build on existing training program. Annual refresher and ongoing training are occurring, material and packages could be reviewed.

Priority	Rec no.	Category	Species	Topic	Recommendation	IMPORTANCE	IMPACT	Effort	Summary of comments
					and appropriate management.				
4	BAH4	Broad area habitat searches	Habitat for multiple species	Monitoring, review and reporting	Ensure monitoring and reporting of the implementation and effectiveness of the BAHS to increase confidence in the approach and inform continual improvement.	**H**	**H**	**H**	Some could be done as part of current reporting using existing data
5	BAH2	Broad area habitat searches	Habitat for multiple species	Surveys	Add a protocol allowing flexibility in identification of key habitat features at-risk from forestry activities and the option to seek expert advice.	**M**	**H**	**L**	
6	LFO2	Owl protocols	Owls	Nest surveys	Consider nocturnal surveys of nest sites, eg., as part of monitoring program.	**M**	**M**	**H**	Suggest this is part of the monitoring to test effectiveness of protective measures, and not part of pre-harvest surveys. Nocturnal surveys will only sample a tiny portion of owl home range and identifying nest trees will be very challenging and high cost. Effort would be better directed to monitoring to enable an understanding of ongoing occupancy or nest / roost use. The actual effort to detect nest sites via nocturnal surveys is enormous and was considered as part of the CIFOA development which led to the hollow tree retention requirements. Trees with hollows suitable for owl nests are very

Priority	Rec no.	Category	Species	Topic	Recommendation	IMPORTANCE	IMPACT	Effort	Summary of comments
									identifiable and will always be detected and protected regardless of whether they are being used by owls as nests or roosts. If associated with BAHS, this exercise would be a very costly for very little outcome.

Appendix D Prioritisation of the Models and Record-keeping recommendations. (From Supplementary Spreadsheet)

Importance: MO=Meeting Objective, CIFOA = Importance for the CIFOA more generally, MR=Magnitude of Risk.
Impact: %plans=Proportion of land area, REF=Recommendation effectiveness, OBB=Other biodiversity benefits, ONBB=Other non biodiversity benefits.
Effort: EFF=Effort required, CC=Current capacity, Dep=Dependencies (See Table 5 for definitions of criteria.)

Priority	Rec no.	Category	Species	Topic	Recommendation	IMPORTANCE	IMPACT	Effort	Summary of comments
1	M1	Models and record-keeping	Multiple	Adoption of existing new models	Adopt NRC species occupancy models and other available and validated species-specific models (eg., HRM and Koala) where fit for purpose and discontinue use of RFA models.	**H**	**M**	**M**	RFA models are outdated and unreliable. These items would require a CIFOA change to implement; however, they have ecological imperatives and gaps that could be addressed via the CIFOA monitoring program. Clear elaboration of project goals and scope in the prioritisation project is warranted. NRC occupancy models already done and strongly supported for their value. Protocol 34 may allow for the new models to be used.

Priority	Rec no.	Category	Species	Topic	Recommendation	IMPORTANCE	IMPACT	Effort	Summary of comments
2	M2	Models and record-keeping	Multiple	Data management and analysis when developing new or updating existing models	Use independent survey data to validate new models (see Law et al., 2017) Remove or model spatial/temporal autocorrelation (see Law et al., 2014). Limit use of correlated covariates (Law et al., 2014) to improve inference of the significance of model covariates. Undertake power analysis, survey gap analysis and species detectability to inform survey design. Develop and add model covariates that describe the landscape at a scale relevant to species with large home ranges, or that more accurately reflect key habitat characteristics. Develop new environmental covariate layers that address significant disturbances (e.g. fire and logging), additional threats (e.g. invasive species) and anticipated climate extremes (see Kavanagh et al., 2021). Develop new methods for highly mobile species (RFA/NRC/EES modelling is not appropriate for highly mobile species).	**H**	**M**	**H**	Could be added to existing DPI research program or done in collaboration with relevant research provider. Depends on suitability of current available models. Individual surveys and the monitoring need to be linked to improving the models iteratively. Need improved site specific information on animal presence-absence (accounting for detectability) and relative abundance, ideally captured using multiple methods. It is not just a case of using independent survey data to validate new models – that validation data needs to be used in a new round of modelling with specific improvement objectives.
3	M4	Models and record-keeping	Multiple	Record-keeping	Improve articulation of the method and frequency of data validation in the CIFOA conditions and protocols.	**M**	**M**	**L**	

Priority	Rec no.	Category	Species	Topic	Recommendation	IMPORTANCE	IMPACT	Effort	Summary of comments
4	M5	Models and record-keeping	Multiple	Record-keeping	Include additional comments associated with records recorded in FCMapApp to assist with the interpretation of the record (eg., associated habitat data).	**M**	**M**	**L**	
5	M6	Models and record-keeping	Multiple	Record-keeping	Review data checking processes regularly and ensure tools are operating and interrogating the correct data.	**L**	**M**	**L**	
6	M7	Models and record-keeping	Multiple	Record-keeping-data analysis	Analyse historical data collected by FCNSW - a huge amount remains on survey sheets in paper form, but data from the 90s has been digitised. Years of data on more common species is not able to be interrogated and used to assess the impact of forestry practices over time. These larger data sets are important to help understand the impacts on ecosystems and functional changes that may have taken place. Resources are required for this data to be analysed.	**L**	**L**	**H**	All threatened species data from pre-harvest surveys in late 90s has been digitised and all the CRA data so additional digitising of paper reports may not be useful. Perhaps revisit to assess value, particularly for non-threatened species. Changes in survey methods over time will reduce value of data for comparative purposes. Data from pre-harvest surveys is difficult to analyse. Erratic, not systematic surveys. All data is in BioNet. HRM data already used. May be some value in the owl data.