DEC Inter-divisional Workshop on Research and Management of the Forest Fauna in the South-West of WA

Kensington

8th & 9th September 2009

Workshop discussion and outputs

Objectives:

To provide forest managers with an overview of recent (6 years) research findings, current understandings and synthesis of knowledge relevant to the management of forest fauna, in particular the impacts of the major disturbances of timber harvesting and fire.

To identify recent research findings and current understanding that need to be considered for incorporation into policy and practice, and the mechanisms to achieve this.

To identify high priority research requirements, particularly those that relate to the impacts of the major disturbances of timber harvesting and fire.

Scope:
SW forest area covered by the Forest Management Plan**)** whilst also considering the implications of the broader context of fauna conservation and threats in surrounding lands.

Day 1 – Symposium: Overview of understanding and management of forest fauna

0805 – 0810	Welcome	Keith Morris
0810 – 0835	Setting the scene and overview of fauna conservation strategies in current FMP.	Geoff Stoneman
0835 – 0910	Mammals	Keith Morris
0910 – 0945	Birds	Mike Craig
0945 – 1020	Reptiles	Duncan Sutherland
1020 – 1050	MORNING TEA (provided)	
1150 – 1125	Frogs	Dale Roberts
1125 – 1200	Terrestrial invertebrates	Paul van Heurck
1200 – 1300	LUNCH (provided)	
1300 – 1335	Aquatic invertebrates	Melita Pennifold
1335 – 1410	Impact of introduced predators	Paul de Tores
1410 – 1445	Impact of timber harvesting and mining	Adrian Wayne
1445 – 1520	Impact of climate change	Colin Yates / Lesley Gibson
1520 – 1550	AFTERNOON TEA (provided)	
1550 – 1625	Impact of dieback	Giles Hardy
1625 – 1700	Impact of fire	Neil Burrows
1700 – 1715	Synthesis of research and management Issues	Ian Abbott
1715 – 1730	Closing remarks	Bob Hagan

Day 2 – Workshop: Identify recent research findings, current understanding and issues associated with forest fauna.

Attendees – day 2

Science Division	Keith Morris, Adrian Wayne, Ian Abbott, Janet Farr, Melita Pennifold, Paul van Heurk.
Nature Conservation Division	Ken Atkins, Peter Mawson, Peter Orell, John Asher.
Regional Services Division	Brad Barton, Roger Hearn.
Sustainable Forest Management Division	Geoff Stoneman, Bob Hagan, Martin Rayner, Deidre Maher, Greg Strelein, David Swain, Dave Tarrant, , Peter Murray, Tony Mennen, Tony Raudino.
External	Mike Craig (Murdoch University), Dale Roberts (UWA).
Facilitators	Amanda van Loon, Cathy Birch.

Workshop Intent

1. To identify recent research findings, current understanding and issues that need to be considered for incorporation into policy and practice, and the mechanisms to achieve this.

A list of relevant policy documents is at Attachment 1.

2. To identify high priority research requirements, particularly those that relate to the impacts of the major disturbances of timber harvesting and fire.

3. The outcomes of the day will feed into:
   - the current and next Forest Management Plan and subsidiary documents and guidelines;
   - best practice approaches;
   - future monitoring and research;
   - training requirements; and
   - determining the need for the establishment of working groups to progress the issues that have been identified into changes in draft documents that guide policy and practice.

Question 1 - What do you see are the key forest fauna conservation challenges?
Question 2 – Does the current *Forest Management Plan* and other subsidiary documents address these challenges (from question 1)?
Question 3 – What new strategies are required to address these challenges?
Question 4: What are the research priorities to address the challenges outlined in question 1.

Outcomes

Question 1 - What do you see are the key forest fauna conservation challenges?

Challenges identified by groups

Group 1
Management for climate change – further modelling and monitoring predictions.
Systematic and broad biodiversity monitoring across the SW
More invertebrate monitoring – systematic program, improved taxonomy, knowledge of ecological roles/ functions.
New information on habitat type to be incorporated into prescriptions and what's needed for minimum viable populations maintenance.
Application of more updated monitoring techniques.
Resourcing and capacity to undertake more/ better research/ monitoring is limited/ absent. Look to external/ tertiary linkages.
Data buried internally but not disseminated or incorporated into management actions. Lack of analysis/ publications in a timely manner.
Missing data on uncommon but not yet threatened species.
Defined sampling framework for Resource Condition Monitoring.
Feral/ predator control re: utility of habitat type.
Insufficient burning to be more targeted to biodiversity outcomes.
FMP lacks clarity of purpose/ scope re application of boundaries of the plan.
KPI's –measuring outcomes to be better focused
Integration – FMP seen as a SFM / FMB issue rather than a whole of department plan.

Group 2
Fire management
Climate change – increase resilience
Feral animal control – getting it right
Management of phytophthora cinnamomi (P.c)
What can we do to arrest decline of threatened species
Are our actions for fauna conservation at a landscape scale effective? Can we test this via adaptive management?
Is the scale of patch management appropriate for invertebrates?
Reducing pressures on fauna (bees hollow competition).
Getting enough information to inform management in a timely way.
Increasing utilization of wood for biomass energy – Do we need new strategies to conserve fauna?

Group 3
Managing so as to facilitate ecosystem resilience i.e. connectivity, scale of disturbance, with aim to ensure ecosystem functions.
Understanding of dieback impacts and ecosystem changes over long-term – implications for fauna and ecosystem process.
Ensure all ecosystem elements considered – broaden focus from mammals to others, raise effort of neglected taxa such as invertebrates.
Management of new threats – prioritized. P.c and diseases more broadly, fire, climate change, predators.
Monitor, interpret, learn, respond – all management actions; provisions to adopt (flexible management framework to respond).
Fundamentals of ecosystem function – ecosystem elements – vegetation structure, floristics (?) – habitat elements – logs, dead trees, litter.

Group 4
Human pressure
Introduced fauna/ flora
Disease
Lack of knowledge – mosaic patch size – target structural attributes – domain size – definition.
Climate change
Political / community expectations
Ethical challenge how far do we go protecting unviable species
Resources / funding / database / information sharing.

Group 5
Climate change – over arching; drying climate, fire, impact on species, modelling.
Invasive species
Resourcing – staff, funds, priority setting, demonstrating value for $, selling the message.
Adaptive management
Developing appropriate scale of disturbance mosaics – fire, logging, and mining.
Interaction between disturbances, especially over the longer time scales – need to retain habitat integrity and ecosystem health.
Prioritising key species / habitats – lack of knowledge, resources
Reversing habitat loss – restoration.
Maintenance of ecosystem health and function as a basis for sustaining fauna population's in-situ and providing for future adaptation to drying climate conditions.
Development of control/ eradication measure for invasive species
Adequacy of comprehensive, adequate and representative (CAR) system in longer term (climate change).
Active monitoring framework – knowledge of species / taxa biology and responses to natural and anthropogenic disturbances (particularly invertebrates).

Key forest fauna challenges prioritised.

The number in brackets is the number of individual votes given to the particular individual challenges, and the cumulative summary for the groups. The groups are numbered in descending priority based on the cumulative number of votes assigned.

1.	**Ferals (22)**
▪	Predators, bees, galahs and other people. (12)
▪	Introduced – flora, fauna (cats etc) and disease. (5)
▪	Understanding of dieback impacts and ecosystem changes of the long term – implications for fauna and ecosystem processes.(3)
▪	Effective control of predators and invasive species.
▪	Feral animal / predator control – Can we get it right?

2.	**Managing to facilitate ecosystem resilience (22)**
▪	Connectivity, key habitat elements, scale of disturbance, full range of successional stages with the aim to ensure ecosystem functions (14).
▪	Are our strategies for fauna conservation at a landscape scale effective? Can we test this via adaptive management? (4).
▪	Increase resilience of species in presence of climate change. (4)

3.	**Monitoring (12)**
▪	Monitoring – framework, data management, outcomes. (12)

4.	**Climate Change (9)**
▪	Managing the impacts of climate change – ecosystem health and function, - CAR and informal reserve system. (9)

5.	**Knowledge (7)**
▪	Lack of knowledge – mosaic, target structural attributes, patch size, domain size / definition, species life cycle (4).
▪	Better understanding of fauna habitat requirements – habitat trees and modelling, prescriptions and guidelines, missing group – uncommon and invert (3)
▪	Knowledge gathering in an adaptive management framework.

5.	**Resourcing (7)**
▪	Resources and funding – database, information sharing, do we spend $ on human resources and project, over arching management. (5)
▪	Financial – skills / structures (including scope of FMP – SFM / Forest / Other geographic area.)
▪	Improved decision framework for prioritizing resources allocated to fauna conservation – value for money.

6.	**Fire (4)**
▪	Fire Management – Can we get the mosaic grain size right? Maintain fire as an opportunity rather than a threat - climate change (4).

7.	**Others**
▪	Human pressure – political / community expectations, ethical challenges – how far do we go protecting unviable species? (2)
▪	Increasing utilization of wood for biomass energy – do we need new strategies to conserve fauna?
▪	Emphasis on landscape scale ecosystem health and function.
▪	Appropriate scales for management of disturbance (on and off reserves).
▪	Ensure all ecosystem elements are considered – broaden focus from mammals to all fauna.

Question 2 – Does the current *Forest Management Plan* and subsidiary documents address these challenges (from question 1)?

Group 1

Challenge	Adequately (where)	Not adequately (why)	Not addressed
Ferals		18 No strategic approach, targets localized occurrences.	
Disease	18.1 – 18.6 PC only		
Resilience			
Monitoring	9.2.1/ KPI 2 & 3 Western Shield	9. KPI 2 Scale inappropriate, not addressing whole of forest KPI don't really address objective. Targets threatened species not other ecological functional groups.	Does monitoring get done? Is it appropriate?
Climate Change		23-1-3 Not specific / not measurable.	
Knowledge			
Resources		Not adequately addressed.	
Fire	17 Silviculture Prescription.	17.Ref in Plan to other doc. Inadequate in response to some biota. No legislation basis or policies for fauna (support doc not put into practice).	
Others			

Group 2

Challenge	Adequately (where)	Not adequately (why)	Not addressed
Ferals		Does not refer specifically to fauna conservation. More specific on invasive threats e.g. bees, pigs, deer.	
Disease			
Resilience			
Monitoring	Forest Check √ (may need modifying to include other than production forest).	Need a fauna monitoring program linked to Western Shield. Endemic taxa (other).	
Climate change (fauna impacts)		Knowledge was not adequate at time.	
Knowledge	Adequate. Needs biological survey of forest	Invertebrates, herps, distribution, key species, impacts.	
Resourcing and scope		Consider areas and management of areas outside of FMP area. Plus areas that are not production. forest within the FMP. Insufficient resources.	
Fire	But at high level 1.7 Fire		Tight mosaic scale concept. All invertebrates.
Others			

Group 3

Challenge	Adequately (where)	Not adequately (why)	Not addressed
Feral animals		Clearer prioritization on which feral species to manage in relation to fauna conservation.	
Disease			
Resilience - Ecosystem processes and provision for maintenance of habitat elements		Inclusion of guidance of CWD, standing dead trees and live, over mature trees.	
Monitoring			
Climate change		No clear strategies defined in relation to fauna conservation. Links between processes and fauna conservation not made.	
Knowledge			
Resources			
Fire			
Others			

Group 4

Challenge	Adequately (where)	Not adequately (why)	Not addressed
Ferals / Weeds/ Pests	Objective 18 FMP Dieback (KPI 18 FMP)	Forest Health Surveillance system not adequately recognized in Plan. Action 18.4 (FMP) relating to weeds and ferals too generic e.g. pigs, bees may not be specified. KPI 17 Does not address real issue of managing ecosystem for flora and fauna.	
Disease			
Resilience – Ecosystem resilience			No structural goals.
Monitoring (Adaptive management)	Section 9.2 FMP – Kingston Forest Check. Ministerial condition #2 – mid-term audit was required. 32.1	No link between monitoring and KPI's. Section 9.2 and Action 33.1 don't cover complete range and don't relate to KPI's.	Cross department integration of KPI's data collection
Climate change	Objective 23 (FMP)	Action 23.1 (FMP) too vague/ generic Mid-term audit does specify more actions	FMP needs to identify specific actions re fauna conservation and climate change. Current FMP lacks flexibility.
Knowledge			
Resources			

Challenge	Adequately (where)	Not adequately (why)	Not addressed
Fire			
Others			

Group 5

Challenge	Adequately (where)	Not adequately (why)	Not addressed
Ferals / introduced pests	Fox is ok via Western Shield	Ecosystem health and vitality FMP pg 44-45 (needs to be more explicit and recognize existing work)	Short comings of recovery via Western Shield → cats and meso-predator issues Interaction of pests/ disease etc on populations.
Disease			
Resilience		FMP contains elements. Needs to be addressed at an objective level.	
Monitoring and reporting	Forest Check Annual monitoring and reporting requirements	Western Shield Additional reporting would help	Forest Monitoring Guideline. FMP action 34.1.1 Appendix 1 pg 69
Climate change		Global carbon cycles FMP pg 52-53 more has been done in mid-term audit.	
Knowledge			
Resources			
Fire			
Others			

Question 3 – What new strategies are required to address these challenges?

Strategies identified through group activity

Ferals – Pests, weeds, disease
Identify broad list of potential and actual feral species, with provision to expand. Monitor ferals impact across forest. Develop KPI's that specify a measurable impact of control strategies.
Unified database to tie in this information and maintain its accessibility across divisions for both Forest management and research. This could be used as a measure of achievements.
Undertake risk analysis across all assets and threats to prioritise resources to spend more effectively. Includes issues arising from climate change and fire management to focus overall management actions not just nature conservation recovery programs.
DEC Policy statement supported by a series of species management strategies (in the absence of BAMA?) Don't waste money on basket cases
For each region / district have one set of priorities have a coordinated approach to the ferals across the landscape. Create positions in each area whose sole responsibility is feral animal control in a strategic manner.
Review adequacy and focus for monitoring effort and data management. Too much expenditure on increasing threats (PVS) diverted to NC.
Continue to monitor the KPI on P.c.
Increase the funding into DNA research to look at a way of introducing biological control or genetic modification of susceptible species.
Look at ways to improve harvesting techniques to minimize Pc spread.
Improve knowledge and training of people on the group to better learn and understand the impacts of the disease.
Progress specific biological control measure for fox, cat, bees etc.
Improve detection and monitoring methods for newly emerging invasive species (bees, corellas etc) and existing species – pigs, cats, to quantify scale of threat.
Increase funding for experimental trails e.g. bees, pigs and look at being strategic (big picture)
Include background (or reference to) on what is already known, what procedures are currently in place, and what we currently think are the gaps within the doc – e.g. List significant species, outline DEC programs for management.
Outline theory of what / why we are managing introduced spp. – e.g. outline interactions (logging creates situation where fauna are more susceptible to predation therefore increase baiting etc)
Commit to program to remove feral bees.
Reference to whole of DEC programs for introduced fauna – outcomes are species recovery, ecosystem function, reducing impacts of forest harvest. Puts this in context.
KPI's should include measure of pest species – but also measures that we have ameliorated impact of ferals.
Maintain funding of Western Shield
Eradicate feral pig populations from SW forests.
Consideration of dealing with potential new threats (Cane toads, ferrets).
Identify responses and actions to ameliorate the threat.
Potential of introduced species to transmit disease agents to native fauna.
Broad scale control of feral cats is a priority.
Focus on ferals that affect ecosystem function rather than individual species.
Identify species that are currently present in the forest and have impacts. Identify existing control strategies and programs. Identify gaps / inadequacies. Link KPI's and actions to these. Identify potential ferals likely to invade forest e.g. corellas, lorikeets.
Focus / direct research into impacts of climate change on ferals, pets and diseases and interactions to ecosystem processes.

Ferals – Pests, weeds, disease
Specific details/ management for the current known threats that we have not currently dealt with e.g. pigs, bees.
Monitor numbers and feed back to detailed plans.
Clearer goal – reduce population by 10% by (date) Monitor effect of control (Forest Check) pig numbers etc. Action items for each recognized threat. Clear goals for each.
Identify priority zones for management of threats.
Ensure district based data on control feeds into a central database for reporting – to allow state or forest wide distribution picture to be presented.
Map distribution of high priority species so that control action can be directed to where problem is critical to conservation of fauna.
Reduction in population of wild bees in SW forests.
Clear strategies to address declines (tuart, wandoo, marri)
Focus on key threats that are likely to have higher impact with climate change.
Nail fox / cat / dingo etc interactions get past anecdotes – get it off the agenda ???
Disease – model longer term impacts of disease sites – what comes in after P.c devastates a site – long term outcomes and how will that distort overall forest pattern / balance?
Identify emerging ferals – bees / lorikeets / corellas etc
Strategic management base on prioritization – can't do everything, everywhere.
Establish high-value refuges/ safe havens that receive intensive control – perhaps 3 levels of priority - Critical – e.g. predator free enclosures? - Important - General

Managing so as to facilitate ecosystem resilience
FMP to take whole of ecosystem view that transcends tenure; i.e. not focus on production forest, inclusive of formal reserves and establish goals, actions that balance across tenure/ ecosystem.
Build on the landscape conservation units information i.e. use as primary landscape planning unit.
Determine disturbance scale appropriate in landscape – could be based on current productivity (crown cover from API' s as default/ surrogate) low productive ecosystems i.e. less than 40% crown cover – small scale disturbance regime. No harvesting disturbance greater than x hectares.
Define connectivity requirements – tree scale, mini catchment scale, fauna specific.
Define appropriate return periods for harvesting disturbance (time) for a range of fauna life types.
Match productivity gradient with appropriate functional type in order to build resilience e.g. herbivores invertebrates require moderate disturbance levels (freq or intensity) and not low or high levels of disturbance. Predators (e.g. insectivorous birds, spiders) require relatively low levels of disturbance.
Investigate the link between productivity gradients and potential fauna habitat requirements (e.g. size) for a range of fauna life types to determine the potential to use productivity as a scale measure for fauna habitat zones.
Decide if objective is to maintain all elements across range, or maintain functional examples (policy decision).
Target structure or variations that will promote diversity for increased resilience of the system.
Ensure mosaic of asynchromal disturbed patches in terms of time since fire and time since logging in every forest block (document scale and extent with remote sensing)
Set up Wungong type thinning trial in eastern jarrah forest so as to anticipate possible impacts of climate change on fauna in a regime where acidification will occur soon, causing trees to die.
Commence targeted monitoring of invert fauna in outlying patches of karri (these should be affected most by climate change) establish baseline and monitor regularly.
Undertake climate modelling for a range of fauna across life types to identify potential trends in ecosystem change and refugia.

Managing so as to facilitate ecosystem resilience
Use outcomes of modelling and disturbance trials to model new reserve design in light of planned disturbance and climate change.
Undertake greater research into hydrological issues of forest ecosystem with climate change and potential impact on susceptible fauna and habitat.
Whole of ecosystem research and sampling to establish current baseline irrespective of climate change, harvesting, fire… e.g. threats.
Set appropriate goals/ objectives/ actions/ KPI's to monitor against.
Management rules to maximize known attributes that aid fauna persistence – large logs, habitat trees. Fire regimes that across a landscape set maximize diversity (may not be true locally)??
Add artificial elements to augment limiting resources (nest boxes)
Can our threatened species be more thrifty in other areas / countries?
Identify resilient species, communities, parts of landscape etc and develop approaches to facilitate maintenance of this resilience.
How do you pick a resilient species? Develop measure to quantify or predict resilience – what properties are we dealing with?

Monitoring
Review adequacy of Forest Check design and frequency and data flows/ timing etc and modify to enhance value of data acquired "CAR" principles apply. Extend to management activities – change the focus to habitat management.
Need more monitoring data to give useful analysis for objectives.
Unified databases – GIS Document techniques and procedures to standardize – done? Develop framework to address required outcomes Compile all information into corporate systems
Develop strategy to adopt management from monitoring outcomes.
Forest health surveillance GLS, Jarrah Leaf miner, bull's eye borer (& other pests?) Using broad population information as a measure to feed into climate change effects.
Increase peoples training and understanding of other diseases.
Establish key monitoring strategies and locate them so all monitoring is done on the same/ similar template to allow improved comparison across site.
Expand Forest Check principles to examine other vegetation/ forest structures e.g. karri, wandoo.
Establish unified databases accessible to all DEC staff re monitoring information this would feed into a measurable KPI
Set monitoring priorities and dedicate budget.
Forest Check program to be extended to areas outside of FMP area and outside of production forest.
Forest Check to be linked with fauna file.
Establish a monitoring program to include all endemics (?)
Establish protocols for monitoring invasive animals and implement i.e. foxes, cats, pigs, deer, and horses.
Fauna monitoring program linked to Western Shield: systematic, comprehensive and strategic.
Further develop "Dieback" monitoring program and impacts on fauna conservation.
Ensure appropriate consideration for storage of monitoring data, and for this data to be available for analysis and review.
Adaptive management – monitoring and reporting and improving.
Monitoring climatic data – rainfall temp, evapotranspiration.
Monitoring of lotic (lakes) wetlands within the FMP area.
Define the questions that need to be answered. Do existing monitoring programs address or answer any of the questions? Can existing monitoring be tweaked to answer questions? What questions remain unaddressed by existing monitoring, what additional monitoring is required. Do we have the resources to implement additional monitoring? Questions that can't be answered by monitoring > research.

Monitoring
Develop and implement a series of adaptive management trials to address the range of assumptions made about the capacity of fauna to persist and the cumulative impact of different series and intensities of disturbance.
Identify the extremes of the most vulnerable populations for any impact and determine the nature of these impacts and then interpolate potential impact on intermediate populations – targeted monitoring maximizing return for given resourcing capacity.
Establish new monitoring framework that gives great continuity of information.
Specific KPI's that are integrated into work output works programs.
Whole of ecosystem monitoring rather than specific species.
Improved data collections and analysis systems.
Develop specific KPI and (works programs) based on adaptive knowledge collected from monitoring of biodiversity gradients.
Whole of ecosystem monitoring base-on "Meta-taxa" Forest Check?
Intensive sampling of sub-set of "ground–truthing" monitoring sites.
No link between monitoring and KPI's.
Forest Check and stream reserve monitoring don't cover all.
Identify KPI's relating to fauna conservation that requires monitoring.
Identify additional monitoring/ research activities needed to address Actions and Objectives in the FMP.
Investigate what existing monitoring programs in DEC that could address KPI's Actions and Objectives.
Fore those monitoring programs identify those that are adequate and those that need to be modified or enhanced to meet requirements.
Liaise to have existing monitoring programs meet FMP requirements.
Identify new monitoring programs required to fill gaps.
Investigate if these new monitoring programs can be initiated.
Review potential monitoring programs against KPI's and where deficient determine if KPI's are appropriate or need to be modified.
Where KPI's are essential and monitoring will not address, develop a business case for data acquisition.
Ensure data management systems are robust and fit for purpose to suit requirement.
Tighter control on allocating the ongoing data collection being built into works programs.
Map extremes of possible impacts and focus design on monitoring these impacts on biodiversity gradients e.g. monitor northern forests in comparison to southern; monitor western forest –compare it to the eastern. Then use monitoring information to adapt or change KPI standards (e.g. widen stream reserves or identify important habitats).
Require (through legislation) all information collected on biodiversity to be lodged with DEC – yes!! I agree - Start with Nature Base)
Build an information management system to facilitate electronic storage and retrieval of above information.
Ensure all monitoring information (not just Science or NC division) is entered into corporation information system.
Needs stringent quality control built in.
Maybe a "Wikipedia" approach to quality control of information can work?
Guidelines and standards for fauna data collecting activities to maximize opportunities for comparable data integration where possible / practical.
Centralised data management system to capture all current and past data to enable global assessments.
Annual reporting requirements (analogies to AEEC reporting?) of individual projects plus annual assessment and reporting of global (integrated) data.
Mechanisms to ensure assessment of annual reports to determine whether further/ new/ changes to management actions are required.
Explicit treatment/ identification of knowledge gaps in monitoring / research requirements as part of reporting process.
Access information collected by others (legislative change to require lodgement with DEC).
Define monitoring framework.

Climate Change
Develop predictive models of species responses (Nature Map can be used to assist).
Integrate north/ south connectivity (Could use a F.C. structure)
Identify indicator groups for monitoring (Inclusion of some principle known pests (GLS, JLM, BEB, PC) with potential for additional inclusions as environment changes.
Define data layers required for modelling various key / selected taxa response to change. Then design sampling strategy to acquire this data over a suitable timeframe.
Develop skills and expertise to predict likely change to key biodiversity assets/ processes and their threats – prioritise key issues that can be managed to increase resilience (Nature Map, knowledge acquisition).
Set up/ use existing monitoring plots / area to continue to obtain data to allow more accurate modelling of the forest ecosystem. Discontinue non valid sites and direct 100% funding into useful existing sites.
Identify key species that are sensitive to climate change and use them as a point of forest health.
Use 'Nature Map' to plot distribution of fauna, - invertebrates to determine forest fragmentation and range expansion/ contradiction.
Expand modelling approach to keystone/ focal species to prioritise future resource allocation.
Consider "radical" management responses
Modelling responses of quokka, western ring tail possum and water rat to climate change predictions, also inverts (Gondwanan relics).
Plan and implement amelioration management – connectivity, better introduced pest control, translocation (to islands?), ecological engineers e.g. cat.
Modelling responses of key pest species and native spp from adjacent areas e.g. galahs to climate change predictions and phytophthora.
Some forest habitat may become suitable for translocating more arid, threatened species into e.g. eastern woodlands.
Maintain a DEC process to ensure as many staff (public people) are aware of current climate change info – predictions/ forecasts of temp and rainfall changes etc – so this can be incorporated.
Establish monitoring programs of fauna spp (and lots of other stuff) to track and demonstrate various responses to climate change – e.g. move, locally extinct, behaviours (should be able to use lots of existing monitoring and analyse).
Communicate to public possible bad news stories resulting from climate change – i.e. modelling showing extinction of quokkas by 2070.
Incorporation of climate change consequence into the management of forest landscapes to sustain fauna values.
Review the extent distribution and habitat quality of existing reserve system for – geographic connectivity, inclusion of refuge and niche habitats, least disturbed areas for potential translocations.
Identify how climate change will modify forest structure and floristics and collect any information required.
Identify and investigate the interactions between climate change and other forest disturbances e.g. fire and pc
Holistic system reviews indicating what parts of which systems are potentially most vulnerable to adverse impacts of climate change.
Make provisions for adaptations of goals and actions (assuming next FMP period will be accelerating change).
Identify areas and species/ ecosystems most at risk to impacts of climate change – and assess whether change in management will reduce the impact.
Review reserve design network and adaptive management strategies to address perceived impacts of climate change on fauna life cycles.
Identify areas/ species/ ecosystems most at risk to impacts of climate change and assess whether change in management will reduce their impacts.
Prioritise species for protection.

Climate Change
Review the outcomes of current fauna management guidelines (and practices implemented) to ensure the assumed benefits/ results have been obtained, as a precursor to developing strategies for further adaptation.
Develop strategies for managing disturbances to maximize diversity (vegetation age and structure) within the landscape within ecological limits – resilience. Monitor outcomes.
Gain improved understanding of interactions between climate change and forest disturbances e.g. fire and pc.
Clear identification of what knowledge is required in order to be able to link climate change impacts, forest structural and floristic components and fauna conservation.
Identification of the key ecosystem processes that are needed for ecosystem sustainability and resilience and how to best maintain these processes.
Identification of how forest disturbances affect ecosystem processes, particularly P.c, and the collection of information to fill knowledge gaps.
Better linkage between monitoring and management (i.e. clear management interventions based on specific monitoring results) and ensuring monitoring programs are intensive enough to deliver the required information.
FMP to establish target / focus program area for research, even to specific research topics.
Confirm the high-level framework to be adopted to measure progress toward sustainable forest management – currently the Montréal process which has seven criteria (and > 60 indicators) for ESFM. Within this framework, define key ecosystem functions and process, then the knowledge gaps for the FMP region.
Establish monitoring process to reflect the climate changes as soon as they occur i.e. specific indicators (species).
Maintain a flexible / adaptive planning approach (not be too strict)
Develop management strategies / plans that deal with the expected/ predicted or modelled outcomes of climate change.
Design monitoring sites based on “possible” extreme impacts of climate change.
Stop planting timber species outside nature range (Karri – Jarrah sites).
Regenerate with more drought tolerant species (within Karri range)
Clearer goals
Clear baseline on current ecosystems
Change monitoring as flag for ecosystem health.
Determine zones where climatic parameters are forecast to change most and monitor both climate and key forest health/ habitat quality/ fauna distribution to ascertain whether system is changing in predicted way.
Clarify strategies by formulating conceptual models that mechanistically link the changed climate parameter with the characteristics of the fauna (by functional type e.g. canopy feeders, litter feeder, nectar –eater, seed eater, hollow-nester, log-dweller, under storey thicket dweller). These will assist with targeted monitoring of faunal response.
Identification of high value habitat as climate change refugia (e.g. Stirling Ranges, deep gullies etc) and species management provisions for these.
Be explicit that we will focus our resources on species etc where we are likely to be successful in sustaining their populations.
Additional work on predicted species “movement” subject to climate change.
Establish carbon balance for prescribed burning vs. wildfire for SW forests.
Management for (the promotion of) intrinsic resilience of forest ecosystems. Explicit conservation for dealing with movement of biota (plants and animals) – passive e.g. corridors – connectivity, promotion of nature seed dispersers, - active – translocations.
Adaptive manage type work on transforming ecosystems where likely to be needed.
Vulnerability and resilience assessment.
Adaptation action plan for biodiversity to address vulnerability and build on resilience.

Climate Change
Needs to work towards explicit strategies – avoid broad statements! How do you assess vulnerability and resilience? Climate modelling? Genetic diversity? History? Range?
More sophistication in climate modelling – average warming doesn't deal with seasonality, insulation etc and including extreme climate events.
Looking backwards – what has fauna / flora coped with historically. Reasonable models of rain / temp historically – global climate surface.
Using species impact projections to aid identification of critical areas.
Explicit consideration of interacting factors – i.e. identification of additional threats that may not be adequately considered in dealing with climate change alone e.g. fire, predators.

Resourcing
Review funding models
Change Annual Report KPI's to more realistically demonstrate our performance in managing threats and conserving biodiversity. Royalties were used to fund management – perhaps we should be charging more for all usage including Rec and Tourism, BRM etc.
Look at developing over arching management work in with Uni etc. t do the work provide guidance to the project by 2020.
Redirect 75% of PVS budget into conservation issues.
Increase linkages across departments and across universities to share work load. Manage the projects not the individual.
SFM to adequately resource non- production related fauna management on the "Forest Estate" not defer to NC to fund.
Adequate training and recruitment of appropriately skilled staff.
Better linkage across various forest tenures, incorporating NP, NR – rather than focus on State Forest.
Demonstrate value for $
Consideration of adjacent areas e.g. South Coast Region, Wheatbelt Region.
Clearly outline scope of FMP re the above.
Increase buy in and role of whole of DEC i.e. NC, SFM, PVS – (maybe need to restructure Dept?)
Biological survey of forest
Determine distribution – survey (transects?) sections of forest for invertebrates, reptiles to determine distribution - $, historical records.
Determine key species / Endemics and disturbance impacts on species – Use survey results (from distribution above?) and historical records to determine key species / endemics.
Develop understanding of what fauna species distributions and assemblages mean for management. – We (might not) need to know all invertebrate spp. But we might need to know what general changes or trends mean, (including what is normal variation).
Similarly need more info/ testing of the hypothesis that "fine" scale mosaics in veg, fire, age etc maintain species and diversity. → we need more examples that this is (or isn't) the case.
Need processes and structure to enable collation and consideration of data/ info/ knowledge from different sources.
Establish collaborative arrangement with other organization, universities etc.
Provide intranet facility for Districts and other sections of DEC to share knowledge, project results.
Improve our knowledge of disease as agents of fauna decline.
Improve knowledge and impact of ferals (other than foxes and cats) on fauna distribution.
FMP to be prefaced/ include by extended consultative process.
FMP to clearly scope management actions, (costs,) strategies e.g. identifying achievable and non-achievable objectives/ actions.
FMP to prioritise objectives, actions.
FMP to link explicitly challenges and outcomes from actions.
More targeted outcomes.

Resourcing
Background discussion papers to support FMP 'motherhood' papers which enable wider public involvement in developing over arching FMP strategy development.
FMP to outline whether priorities be in filling knowledge gaps across aspirational goals (i.e. goals are prioritized and gaps within those goals filled first) or whether knowledge gaps are prioritized within goals (i.e. gaps are filled in all aspirational goals).
Build links with research institutions – optimize opportunities for post grad research projects to tag onto actions and monitoring.

Knowledge
Establish shared positions in Uni's with coordinated research program involving Hons level and post grad students. Will require $ but less than if work was done within DEC.
Develop model to prioritise funding and effort.
Pool current knowledge across agencies first and support knowledge to be published/ made available.

Fire
Extend investigations key and selected invertebrates??
Extend "fire grain mosaics to other landscapes within the "forest" estate.
Refocus on habitat management and mosaic at reduced scale.
Identify scales required by biota – spatial and temporal.
Develop fire-scale mosaic burning regime to a functional level
Remove minimum hectare targets from fire funding allocation. Burn based on ecological considerations.
Incorporate burning for specific reasons and fauna/insects.
Adequate weighting to stated goals for fauna management when burning
Developing and implementing of small scale mosaic burning. Determine appropriate scale for patch size.
Specific species fire management/ ecology requirements – Fire Management Guidelines to be further developed and tested and adapted. Landscape scale fire management across forest tenure.
Identify likely impacts of drier and warmer climate on prescribed burning regimes – fire behaviour, intrusion into moist refuges, change in forest structure.

Others
Data Management and Sharing – Improve capture of existing data sets into core datasets to maximize value and improve decision-making capacity (will require better corporate support).
Validation of fauna habitat zone concept – Implement survey/ monitoring to demonstrate adequacy (or not) of FHZ's and modify as required. - Not really required.
Recognise existing strategies where appropriate.
Identify and list all actions relevant. May reduce duplication and feed symbiosis.

Using the strategies identified above the workshop participants were requested to vote for their top strategy. The following list was developed by the workshop participants using this voting method.

Top strategies
▪ Mechanisms to ensure assessment of annual reports to determine whether further / new/ changes to management are required.
▪ Management rules to maximize known attributes that aid fauna persistence.
▪ Better understand interactions between climate change and other forest disturbances.
▪ Review adequacy and focus of monitoring effort and associated data management.
▪ Undertake risk analysis of biodiversity and threats to review priority of resource allocation – decrease nature conservation threat from Parks and Visitor Services activity to reduce human use impacts.
▪ Develop and test hypothesis relating to mosaics scale of prescribed burns, and changes due to climate change in an adaptive management framework.
▪ Develop KPI's to measure the increase in fauna abundance and diversity as a result of effective control of introduced species.
▪ Ensure mosaic of different aged patches in terms of time since fire and time since logging in every forest block in "whole of forest".
▪ Clarify strategies by formulating conceptual models that mechanistically link the changed climate parameters with the characteristics of the fauna (by functional type e.g. canopy feeders, litter feed). These will assist with targeted monitoring of faunal response.

Question 4: What are the research priorities to address the challenges outlined in question 1.

Research priorities identified by groups.
Ferals – Pests / Weeds / Disease
Ferals - Modelling of projected spread weeds / invasive species.
Ferals - broad scale cat control.
Ferals - Monitoring protocols for feral animals – pigs, cats, cane toad, foxes, ferrets, bees.
Ferals - Effective cat bait in mesic areas
Ferals - Are hollows limiting. What control of competitors is required?
Ferals - Research designs for fish management e.g. fish ladders, methods for removal of feral fish.
Ferals - Impact of hive bees on nectar resource → Resource depletion, competition with native insects.
Ferals - Identify feral species
Ferals - Quantify impacts
Ferals - Determine effective control
Ferals - Interaction with other threats
Disease - Dieback spread and impact under projected climate scenarios
Disease - Research reconstruction of dieback affected land.
Disease - P.c impacts on habitat quality and fauna
Disease - Distribution and impact of other P.c and tree decline agents.
Resilience
Identifying key ecosystem elements that promote resilience.
Building resilience through translocation to gain understanding (transformation)
Research and monitoring of effective conservation and management at the landscape level / modelling habitat tree / log survival. Adaptive management at landscape scale. Effective of FHZ and stream zones.
Research to validate small scale mosaic will deliver biodiversity outcomes.
Effect on fauna persistence. Interaction between timing and size of harvest events in association with burn regimes (i.e. the role of TEAS in shelter wood systems).
Modelling and monitoring of the ongoing supply of CWD, hollows, dead standing trees, senescent trees (legacy resources).
Monitoring
Expand Forest Check framework → where? (suggest areas with large scale gradients)
Expand Western Shield - Expansion to include forest types and tenures.
Effective monitoring /control /delivery of conservation outcomes for ferals & incorporate into Western Shield.
Climate Change
Landscape level vulnerability analysis (including retrospective) in relation to climate change
Species modelling - high quality and finer resolution Ecosystem modelling and refugia identification Modelling interactions – fire, ferals, disease, weeds, pests.
Modelling of key species inn relation to threatening processes, fire, P.c.
Modelling of new threats / species as bio-security issues.
Modelling pests, invertebrates, threatened taxa and likely changes due to climate change.
Interaction with other impacts
Model vulnerable distribution
Identifying key ecosystem elements that promote resilience.
Model habitat structure
Identify and monitor structure
Identify and monitor extremes?
Identify and monitor impact in North and South
Identify high value climate change refuge sites.
Identify vulnerable ecological communities.
Knowledge

Research priorities identified by groups.
Evaluation of fauna assemblage structure and correlation to vegetation attributes currently used in reserve design to operations guidance.
Structured biological survey within LCU's – invertebrate, fungi cryptograms - infilling knowledge gaps
Systematic and centralized management of biological data – effective collation and reporting to deliver whole forest understanding.
Trend analysis to determine whether reserve system will be adequate (include framework for analysis of future disturbance).
Need to add to AWS to collect local weather data.
Knowledge – Research to understand what invertebrate assemblages and what these indicate for the forest. Small mosaic fire study testing the hypothesis.
Effectiveness of stream buffers in harvest areas (proportion of total extent disturbed at a point in time).
Ecosystem processes – establish fire of logging mosaics in "whole forest".
Resourcing
Resourcing – researching community attitudes and value for money for fauna conservation in the forest. Value and impact of human use (e.g. recreation, apiary sites) on fauna conservation values.
Fire
Grain size of the mosaic – any impact on biodiversity? One size fits all?
More accurate understanding of historical fire regimes (scale, interval, intensity, freq) for reference not for reinstatement by default i.e. modern context now different – including non-jarrah forest types e.g. karri, wandoo etc.
Continued development of fire mosaic.
Ecosystem response e.g. orchids, peat swamps, wetlands.
Monitor fire mosaic in north Vulnerable taxa habitat Adapt regime for vulnerable taxa Bushfire CRC – monitor using "multi-taxa" protocol. Appropriate scale, patchiness and interval – by ecosystem (LCU)
Other

Using the research priorities identified and the groups of key challenges identified by Question 1, the workshop participants were requested to vote for their top research strategy. The following list was developed by the workshop participants using this voting method. The number in brackets is the number of individual votes given to the particular research strategy;

Top research strategies (including prioritisation)
▪ Modelling and monitoring of the ongoing supply of CWD, hollows, dead standing trees, senescent trees (Legacy Resources) **(13)**
▪ The impact of fine grained fire mosaic on fauna biodiversity (include an understanding of historic fire regimes). **(10)**
▪ Climate Change – Identifying key ecosystem elements that promote resilience. **(10)**
▪ Effective, broad scale, inexpensive method of controlling feral cats. **(10)**
▪ Identifying and modelling the "drivers" of habitat structure and composition e.g. hydrology, fire, edaphic **(7)**
▪ Model the probable impact of climate change on vulnerable species and habitats **(6)**
▪ Investigate contribution of *grain – spatial, *variability – temporal, to the value of the mosaic for fauna **(5)**
▪ Invasive species, ferals, disease etc. Effective monitoring control and delivery of conservation outcomes (incorporate into Western Shield). **(5)**

Top research strategies (including prioritisation)
▪ Understanding at the landscape scale of; - interactions - fire and logging, size and timing - role of TEAS in SW and gaps **(5)**
▪ Modelling of projected spread of weeds and invasive species under climate change predictions. **(3)**
▪ Research phytophthora cinnamomi impacts on habitat quality and fauna. **(3)**
▪ Climate change - species modelling - ecosystem modelling - interactions – fire, ferals, disease, weeds, pests. **(1)**
▪ Fire research to define appropriate scale, patchiness and intervals by ecosystems (LCU) **(1)**
▪ Landscape level vulnerability analysis (including retrospective) in relation to climate change. **(1)**
▪ Effective cat bait **(1)**

Following the workshop a survey of the attendees was carried out by the facilitators. The summary of response from the surveys is provided as Attachment 2.

Attachment 1: List of control documents for forest management

(* = key document of relevance to fauna conservation)

Document Type / Name	Web Address
Forest Management Plan 2004-2013*	(see pages 23-31 for biological diversity http://calmweb.calm.wa.gov.au/drb/sfm/fmb/doc_plans.php)
Guidelines	*(for complete list see http://calmweb.calm.wa.gov.au/drb/sfm/fmb/doc_guidelines.php)*
Phytophthora cinnamomi and disease caused by it. Volume 1 - Management guidelines (2003)	
Silvicultural practice in the jarrah forest (2004)*	
Silvicultural practice in the karri forest (2005)*	
Silvicultural practice in the wandoo forest and woodland (2004)	
Interim guideline for silvicultural practice in the jarrah forest of the Wungong catchment (2007)	
Guidelines under development	
Guidelines for protection of the values of informal reserves and fauna habitat zones*	
Guidelines for the selection of fauna habitat zones*	
Native forest timber harvest planning guidelines*	
Goals for understorey structural diversity*	
Forest monitoring guidelines	
Soil and water conservation guidelines	
Manuals and Procedures	*(for complete list see http://calmweb.calm.wa.gov.au/drb/sfm/fmb/doc_manuals.php)*
Protocols for the measuring and reporting on the key performance indicators of the Forest Management Plan 2004-2013 (2007)*	
Planning checklist for disturbance activities (2009)	
Growing stock and habitat element assessment of damage and potential damage (2008)	
Manual of procedures for the management of soils associated with timber harvesting in native forests (2009)	
Manual for the management of surface water (2009)	
Advisory notes	*(for complete list see http://calmweb.calm.wa.gov.au/drb/sfm/fmb/doc_advisory_note.php)*
Management of access in informal reserves and other protected areas within State forest and timber reserves* (2006)	
Procedures for the use of work improvement notices and management letters (2006)	
Salvage of logs in association with informal reserves (2007)	
Plans	
3 year timber harvest plans	(see http://www.dec.wa.gov.au/forests/forest-resources/three-year-indicative-timber-harvest-plan-for-native-forests.html)

Document Type / Name	Web Address
1 year timber harvest plan	(see http://www.fpc.wa.gov.au/content_migration/native_forests/harvest_plans/Default.aspx)
Dieback plans	
Coupe harvest plans	
List of control documents for fire management	
Fire management policy	(see https://internal.fms.wa.gov.au/documents/policies)
Code of practice for fire management	(see https://internal.fms.wa.gov.au/documents)
Fire management principles	(see https://internal.fms.wa.gov.au/documents/fire-management-guidelines-principles/fire-management-principles)
Fire management guidelines	(see https://internal.fms.wa.gov.au/documents/fire-management-guidelines-principles/fire-management-guidelines)
Fire operational guidelines	(see https://internal.fms.wa.gov.au/documents/fire-operational-guidelines)
Master burn plan manual	(see https://internal.fms.wa.gov.au/documents/manuals)
Burn checklists	(see https://internal.fms.wa.gov.au/documents/checklists)
Seasonal indicative burn program	(see http://www.dec.wa.gov.au/fire/prescribed-burning/planning-for-prescribed-burning/prescribed-fire-plan.html)
Indicative 6 season burn plan	(see http://www.dec.wa.gov.au/fire/prescribed-burning/planning-for-prescribed-burning/prescribed-fire-plan.html)
Also relevant	
Forest Management Plan 2004-2013, Mid-term audit of performance report (2008). Conservation Commission of Western Australia. Biological diversity chapter is pages 16-40.	(see http://www.conservation.wa.gov.au/media-centre.aspx)

APPENDIX 2

Department of
Environment and Conservation

Inter-divisional workshop
Research and management of the Forest Fauna in the South-West of WA

YOUR FEEDBACK

Please tick where you think most reflects the conference.

Content

1 **4** **17** **3**
|√……√……√| ……√…….|
Too little JAR ☺ Too much

Pace

1 **4** **16** **3**
| ……..……√…√…..√|……√……..|
Too fast JAR ☺ Too slow

Format

2 **18** **4**
|……√…..√|……√……..|
Too loose JAR ☺ Too structured

Comments - We're interested in;

What was most valuable to you?

- Syposium – information overview.
- Information sharing from topics on Day 1.
- Broad range of issues raised.
- Interaction and discussion, presentations and updates on current situation.
- The round robins – silent and non silent.
- Presentations on day 1
- Seeing how little we actually know about forest ecology. All talks fantastic.
- Learning research outcomes.
- Situation reports on first day.
- Presentations on day 1; interactive discussions on research priorities.
- Presentations/ Information Day
- Brainstorming ideas and then building on other's input.
- Informative overview of work being carried out.
- Group discussions
- Talks were okay – bit to much xxx?
- Group discussion
- All
- Identifying research priorities.
- Update of current knowledge.
- Confirmation a slow progress over last 10 years on understanding and details.

What could have been improved?

- Rotating the sessions was good but timeframe needed extension.
- Handouts for info presentations and or each presenter provide a 1 page summay on template as a handout. Workshop questions not quite right for this stage of FMP. With 5yrs to go, should be focus to questions and research prioritites going in the next FMP (what to do in next 4 years).

APPENDIX 2

Department of
Environment and Conservation

Inter-divisional workshop
Research and management of the Forest Fauna in the South-West of WA

YOUR FEEDBACK (continued)

What could have been improved? (continued)

- More background on definitions of "strategy" and "challenges".
- Needed someone to pull sections together bring bits into focus.
- Instructions may have been better explained.
- Operational staff involvement.
- Define strategy level that input was required. Went too high level without giving enough specific guidance.

Any other comments?

- Very valuable seminar
- Scope too loose.
- Adrian Wayne's talk was brilliant.
- Worked well for purpose.
- All good really enjoyed it.