



Report on fauna monitoring objectives, targets and performance measures – 2018

In order to ensure that the fauna monitoring program is effective, it is essential to review progress against the performance indicators and measures that were established at the beginning of the program. This allows the evaluation of progress towards achieving the objectives of the program and the identification of any areas requiring modification or improvement. Table 1 summarises the objectives, targets and performance measures that have been established for the fauna monitoring program, as well as an evaluation of progress against these.

Table 1: Evaluation of progress against the objectives, targets and performance measures, following implementation of the fauna monitoring program in 2017/2018.

Objective	Target	Performance Measure	Progress as at June 2018
Objective 1: To determine the presence of threatened or priority listed species within areas of karri forest planned for timber harvesting;	Continue to implement a fauna monitoring program that maximises detection probability for species likely to be present within coupes.	Fauna monitoring program implemented prior to areas being harvested in 2017/2018.	The program was implemented in 2017/2018 (September 2017-June2018) prior to areas being harvested. The species considered likely to occur within the karri forest and the monitoring strategies applied are presented in Table 2.
Objective 2: To use the outcomes of surveys to assist with development of management objectives;	Use outcomes from fauna surveys to refine management responses in consultation with Department of Biodiversity Conservation and Attractions (DBCA).	Management actions modified as necessary to reduce impacts on threatened species.	Threatened species were detected in all of the surveyed coupes (18). Management actions were recommended for each of these coupes and included requirements such as: protection of riparian habitat, post-harvest pig and predator control, exclusion of critical elements of habitat for cockatoos including feeding areas and nesting trees, retention of areas of Banksia and Marri dominated woodlands (See Table 3 for full details).



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Table 1: Continued

Objective	Target	Performance Measure	Progress as at June 2018
Objective 3: To improve the functionality of the Fauna Distribution Information System;	Implement the agreed upon process for using fauna survey outcomes to improve and/or validate FDIS	Provision of fauna capture data as a geo-referenced spreadsheet to allow upload of this data into threatened species data sets, prior to the end of 2018.	All capture records were provided in the required format to DBCA Warren Region's Nature Conservation Leader at the completion of the fauna survey program.
Objective 4: To build and maintain internal knowledge and skills relevant to fauna monitoring and biodiversity management within proposed harvest areas.	Maintain a record of skills, experience and competency levels of trained personnel.	Record system updated to reflect training and competencies, consistent with FPC requirements.	A record of competencies has been completed for all trainees involved in the 2018 fauna monitoring program.
	Actively address personnel skill and experience shortfalls through targeted training.	Delivery of field training or formal training sessions relevant to the 2018 fauna monitoring program.	Multiple field training sessions have been delivered between Sept 2017 and June 2018 to enable individuals and their competencies to be targeted. Two trainees are now able to operate independently, with a high level of competency.
Objective 5: To ensure approaches to monitoring remain contemporary, relevant and credible.	Evaluation of monitoring procedures annually, including review of target species and new literature	Summary to be included in annual review of the fauna monitoring program, with a focus on areas requiring modification.	The monitoring procedures were effective at detecting the species identified in Table 3. These procedures are still consistent with best practice and contemporary approaches in the literature for the survey of threatened species. The fauna lists have been reviewed and modifications made in relation to nomenclature changes and conservation status changes that have occurred in the past 12 months.



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Table 1: Continued

Objective 5: To ensure approaches to monitoring remain contemporary, relevant and credible.	Evaluation of effectiveness of training	Field evaluation of skills in habitat tree retention, camera trap establishment, indirect fauna monitoring techniques and call surveys.	Two trainees were evaluated in the field and informal competency assessments completed.
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Table 2 presents a summary of the threatened fauna species that were considered most likely to occur in the karri forest for the 2017/2018 survey. This list was prepared following review of threatened species lists and in consultation with personnel from DBCA. The list of target species for survey is updated annually to reflect any changes to the threatened species lists or knowledge of species occurrences and habitat preferences. There has been a single nomenclature change to the threatened species list in the past 12 months, including the taxonomic revision of *Macropus*, which has split Tammar Wallaby and Brush Wallaby out into the genus *Notamacropus*. In addition, Carnaby’s Cockatoo (*Calyptorhynchus latirostris*) has been added to the target list due to recent sightings of the species in the southern karri forest.



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Table 2: Fauna species targeted for fauna monitoring in the karri forests, with a summary of their ecology and strategies for maximising detection.

Species	Cons Status	Ecological attributes of relevance to monitoring	Monitoring strategies
<i>Mammals</i>			
Brush-tailed Phascogale <i>(Phascogale tapoatafa wambenger)</i> 	CD	The brush-tailed phascogale is a nocturnal, solitary, medium-sized dasyurid that forages mostly in the canopy between sunset and sunrise (Traill and Coates 1993; Scarff <i>et al.</i> 1998, Scarff and Bradley 2006). Phascogales rarely forage on the ground (Scarff and Bradley 2006). Individuals use multiple nest trees within their variable home range of 5-150 ha, with nests generally located in trees >80 cm diameter at breast height (Soderquist 1995, van der Ree <i>et al.</i> 2001, 2006). Breeding season varies little throughout their range, with most births occurring in July. Young are carried with the mother for the first 48 days and are thereafter left in the nest (van der Ree <i>et al.</i> 2006).	Arboreal camera surveys and search for tree hollows.
Chuditch (<i>Dasyurus geoffroi</i>) 	VU	Chuditch utilise horizontal hollow logs or earth burrows as dens or refuge. To be suitable as den sites, logs must have a diameter > 30 cm and a hollow with 7-20 cm diameter and a minimum length of 1 m (Serena and Soderquist 1989, Dunlop and Morris 2008, McGregor <i>et al.</i> 2014). Annually, an adult female Chuditch will utilise an estimated average of 66 logs and 110 burrows within her home range (Orell and Morris 2004).	Camera survey and indirect surveys for faecal material and dens.
Numbat (<i>Myrmecobius fasciatus</i>) 	EN	The numbat is a small termitivorous marsupial, with a distribution currently limited to two naturally occurring remnant populations in WA and to several smaller re-introduced populations in NSW, SA and WA (Friend and Thomas 2003). This species nests in hollow logs or in burrows (Friend 1989) and is most likely to occur in mixed jarrah/ karri forest. There are few records of this species in the karri forest (Peacock 2006) and an abundance of termites appears to be a prerequisite for the occurrence of this species (Friend and Thomas 2003).	Camera survey and indirect surveys for faecal material, feeding patterns in termite mounds and dens.



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Table 2: continued

Species	Cons Status	Ecological attributes of relevance to monitoring	Monitoring strategies
<i>Mammals continued</i>			
Quenda <i>(Isoodon obesulus fusciventer)</i>  Photo: K. Bain Walpole	P4	Quenda inhabit a variety of habitats including forests, woodlands, shrub and heath (Van Dyck and Strahan 2008). The main habitat requirement is for dense cover at ground level (Maxwell et al. 1996, Van Dyck and Strahan 2008). For shelter this species builds a nest consisting of leaf litter over a shallow depression concealed next to or under logs, shrubs or piles of debris. They will also use burrows of other species (Braithwaite 1995, Long 2009).	Camera survey and indirect surveys for diggings and runnels.
Quokka <i>(Setonix brachyurus)</i>  Photo K. Bain Walpole	VU	Quokkas inhabit a variety of habitats in the southern forest, including woodland, forest, coastal heath, thicket and riparian vegetation. Low density of woody debris, complex vegetation structure (minimum of 3 layers) and habitat heterogeneity are important factors driving occupancy in the karri forest (Bain <i>et al.</i> 2015). This species can be readily detected through faecal pellets (Bain <i>et al.</i> 2014).	Camera surveys and indirect surveys for faecal material and runnels.
Tammar Wallaby <i>(Notamacropus eugenii derbianus)</i>  Photo DBCA	P4	The Tammar Wallaby is currently known from several sites in the southern forests including forests near Perup, east of Manjimup (reintroduced) and north of Walpole (reintroduced) (Parks and Wildlife 2012). The species inhabits heath, dry sclerophyll forest and thickets in mallee and woodland (Poole <i>et al.</i> 1991) and there are currently no records of occurrence within the wet karri ecotypes (Naturemap 2015).	Camera survey and indirect surveys for faecal material.



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Table 2: continued

Species	Cons Status	Ecological attributes of relevance to monitoring	Monitoring strategies
<i>Mammals continued</i>			
Water Rat (<i>Hydromys chrysogaster</i>)  Photo: Narrandera Birding	P4	The Water Rat occupies a wide variety of freshwater habitats with a diversity of structural habitats, including dense riparian vegetation, sunken logs and roots (Smart <i>et al.</i> 2011; Speldewinde <i>et al.</i> 2013). They sleep in a burrow in the bank of a creek with the entrance hidden under roots or in a hollow log. They spend the majority of their life within and adjacent to riparian systems and feeding activities leave visible remains of crustaceans and molluscs (Cronin 1996).	Unlikely to occur within the forest, however camera survey and indirect survey for evidence of feeding will detect this species if it is present.
Western Brush Wallaby (<i>Notamacropus irma</i>) 	P4	The Western Brush Wallaby is found in open forest and woodland, particularly with open, seasonally-wet flats, low grasses and open scrubby thickets (Morris and Christensen 2008). It is less common in karri forest (Maxwell <i>et al.</i> 1996, Morris and Christensen 2008).	Camera survey and indirect surveys for faecal material.
Western False Pipistrelle (<i>Falsistrellus mackenziei</i>)  Photo: Lochman Transparencies	P4	The Western False Pipistrelle lives mainly in wet sclerophyll forests of Karri, Jarrah and Tuart. They roost in hollows in old trees, branches and stumps, in colonies of 5 to 30 bats (Start and McKenzie 1995, Churchill 1998).	Call surveys and search for tree hollows.



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Table 2: continued

Species	Cons Status	Ecological attributes of relevance to monitoring	Monitoring strategies
<i>Mammals continued</i>			
Western Ringtail Possum <i>(Pseudocheirus occidentalis)</i> 	CR	The Ringtail Possum occurs in the coastal strip between Bunbury and Albany and in the Upper Warren region (Perup Nature Reserve, Greater Kingston National Park and adjacent state forest) (Wayne <i>et al.</i> 2006, Parks and Wildlife 2014). The species mostly feeds and moves in the canopy (Wayne <i>et al.</i> 2005). The subpopulation in the southern forests occurs mainly in Jarrah, Marri or Karri dominated forests (Parks and Wildlife 2014), where animals feed on myrtaceous leaves (Smith 1983) and occupy tree hollows (Jones <i>et al.</i> 1994, Wayne <i>et al.</i> 2000, Wayne <i>et al.</i> 2005).	Arboreal camera surveys and search for tree hollows, leaf browsing, tree scratching and faecal material.
Woylie <i>(Bettongia penicillata ogilbyi)</i> 	CR	The range of the woylie has declined by more than 99%, and it is now restricted to four remnant natural populations in the south-west of Western Australia, two of which are associated with the Upper Warren (Start <i>et al.</i> 1995, Pacioni <i>et al.</i> 2010). Woylies are primarily mycophagous, feeding extensively on the hypogeous fruiting bodies of ectomycorrhizal fungi (Christensen 1980; Claridge and Barry 2000, Garkaklis <i>et al.</i> 2003). While foraging for underground fungi, woylies make numerous small diggings that are distinctive.	Camera survey and indirect surveys for faecal material and diggings.
<i>Birds</i>			
Barking Owl (<i>Ninox connivens connivens</i>) 	P3	The Barking Owl occurs in riparian forests and woodlands (Kavanagh <i>et al.</i> 1995, Shelly 2006). The species nests in large hollows (Schodde and Mason 1980, Shelly 2006) between July and October, with chicks hatching after 36 days (Robinson 1994, Clemann and Loyn 2003).	Call surveys and search for tree hollows.

Photo: K. Bain Walpole



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Table 2: continued

Species	Cons Status	Ecological attributes of relevance to monitoring	Monitoring strategies
<i>Birds continued</i>			
Baudin's Cockatoo (<i>Calyptorhynchus baudinii</i>) 	EN	Baudin's cockatoo occurs in tall forests and woodlands, where it feeds mainly on Marri seeds and various Proteaceous species (Johnstone and Kirkby 2011). The species breeds in large hollows (Chapman 2008, Johnstone and Kirkby 2008) with peak breeding season occurring in October-December. Incubation lasts for about 29 days and chicks remain in the nest for up to 16 weeks (Bohner 1984, Johnstone and Kirkby 2008). To be suitable, hollows need to have an entrance diameter of 30–40 cm (Saunders 1979, Johnstone and Storr 1998).	Call surveys and search for tree hollows.
Photo: Johnstone and Kirkby 2015 Carnaby's Cockatoo (<i>Calyptorhynchus latirostris</i>) 	EN	Carnaby's cockatoo occurs in eucalypt woodlands, forest and in shrubland dominated by hakea, dryandra, banksia and grevillea species. (Saunders 1979). Breeding activity is documented in the wheatbelt, the jarrah-marri forests of the Darling Scarp and the tuart forests of the Swan Coastal Plain (Johnstone et al. 2006). The species breeds in large eucalypt hollows from July to December (Saunders 1979, Whitford 2002). After breeding, flocks tend to migrate coastward in search of food.	Call surveys and search for tree hollows.
Photo: Johnstone and Kirkby 2015			



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Table 2: continued

Species	Cons Status	Ecological attributes of relevance to monitoring	Monitoring strategies
<i>Birds continued</i>			
Masked Owl <i>(Tyto novaehollandiae novaehollandiae)</i>  Photo: DBCA Walpole	P3	The Masked Owl occurs in open forests and woodlands and riparian woodlands (Debus 1993). Nests are usually in large hollows within the trunk or near-vertical spouts of tall eucalypt trees (Kavanagh 1996, D’Ombra 2002). Breeding for this species has been documented in March-October with chicks hatching after an incubation of 35-42 days (Kavanagh 1996).	Call surveys and search for tree hollows.
Forest Red-tailed Black Cockatoo <i>(Calyptorhynchus banksii naso)</i>  Photo: Tony Kirkby	VU	The Forest Red-tailed Black Cockatoo occurs in Marri, Karri and Jarrah forests, woodlands and remnants in the south-west of Western Australia and feeds mainly on the seeds of Marri, Jarrah, Sheoak, and Snottygobble (Chapman 2008, Johnstone <i>et al.</i> 2013a). The species has an obligate dependence on hollows in live standing trees (Abbott 1998, Johnstone <i>et al.</i> 2013a, b) and birds tend to select hollows that are high and deep, with a mean entrance diameter of 30 cm (Johnstone <i>et al.</i> 2013a). Breeding has been recorded in every month with peaks in April-June and August-October (Johnstone <i>et al.</i> 2013b). The female incubates for about 29 days and chicks remain in the nest for about 48 days (Johnstone <i>et al.</i> 2013b).	Call surveys and search for tree hollows.



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Table 2: continued

Species	Cons Status	Ecological attributes of relevance to monitoring	Monitoring strategies
Invertebrates			
Western Pygmy Trapdoor Spider' (<i>Bertmainius opimus</i>) 	P3	The Tingle spider is found in mesic habitats including karri and tingle forests in the south west of WA (Main 1991). The species makes shallow burrows in the bark of karri and tingle trees an in the mossy banks of creeks. Moggridgea is currently undergoing a taxonomic revision and will be renamed to Bertmainius, whereupon the species will be split into seven species, one of which (<i>B. opimus</i>) is restricted to the karri forests between Walpole and Augusta (Harvey <i>et al.</i> in press).	Burrow searches

Photo: K. Bain



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Table 3 provides a summary of the threatened species that were detected during the 2017/2018 surveys and the management actions that were recommended to reduce potential impact on these species.

Table 3: Threatened species detected during the 2017/2018 fauna monitoring program and actions recommended to minimise impacts from timber harvesting activities.

Coupe Report ID	Threatened species found	Recommended management action (extracted from the survey report)
Big Brook 03 (Mature)	Forest Red-tailed Black Cockatoo (VU) were detected feeding within the coupe. Quokka (VU) were detected during indirect surveys and Quenda (P) were detected during indirect surveys and camera surveys.	<p>Cockatoos - Forest Red-tailed Black Cockatoos were detected feeding within marri forest in the southern part of the coupe. The area where the cockatoos were actively feeding has been mapped in the survey report and is recommended for exclusion from harvesting. The area contains a number of mature hollow bearing marri trees that are also potential nesting trees for the cockatoos.</p> <p>Quokka - Evidence of quokkas was found throughout the coupe in a range of ecotypes, including riparian, mature and first thinnings forest. Quokkas have a large home range in their southern forest habitats (70ha) and are capable of moving significant distances. They are known to feed in disturbed areas, as long as adequate shelter and protection from predators is available. Protection of riparian habitat and post-harvest predator baiting will contribute to these requirements. Feral pig activity has also been detected within the coupe. Post-harvest control may be needed to reduce impacts of feral pigs on soil integrity, vegetation cover and forest structure as the area recovers.</p> <p>Quenda - Fresh quenda activity was detected within first thinnings, near the southern boundary of the coupe. There is good connectivity between the coupe boundary and nearby mature riparian systems, such that this species will have available refuge during and following harvesting activities. Post-harvest fox baiting could contribute to better protection for quenda, as could feral pig management.</p>



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Table 3: Continued

Coupe Report ID	Threatened species found	Recommended management action (extracted from the survey report)
Channybearup 01 (Mature)	Forest Red-tailed Black Cockatoo (VU), Carnaby's Cockatoo (EN), Baudin's Cockatoo (EN), Quokka (VU), Quenda (P), Water Rat (P).	<p>Cockatoos - All three species of Forest Black Cockatoos were detected within the coupe area. Red-tailed Black Cockatoos and Baudin's Cockatoos were detected flying through and feeding throughout the coupe in areas of Marri associated with Jarrah and Banksia ecotypes. A small amount of feeding debris from Carnaby's Cockatoos was also found in similar habitat. All feeding activity detected for this species was more than 12 months old. Recommendation: Where it is practical to do so, retain areas of Banksia and Marri dominated woodlands and forest that are associated with cockatoo feeding activity. These areas are mapped in the survey report.</p> <p>Quokka - Quokkas have a large home range in the southern forest (ca 70ha) and are capable of moving significant distances. They are known to feed in disturbed areas, as long as adequate shelter and protection from predators is available (Bain et al. 2016). Protection of riparian habitat and post-harvest predator baiting will contribute to these requirements.</p> <p>Quenda and Rakali - All quenda and rakali activity was recorded within and adjoining riparian systems. These animals are likely to be protected within the riparian buffers. Post-harvest fox baiting is likely to contribute to better protection for these species as the surrounding areas regenerate.</p>



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Table 3: Continued

Coupe Report ID	Threatened species found	Recommended management action (extracted from the survey report)
Treenbrook 08 (Mature)	Baudin’s Cockatoo (EN) were detected in riparian habitat west and north east of the coupe. Quokka (VU) and Quenda (P) were detected within the coupe during indirect surveys and camera surveys.	<p>Quokka - Evidence of quokkas was found throughout the coupe in riparian and in forest that was harvested in the 1930s. Quokkas have a large home range in their southern forest habitats (70ha) and are capable of moving significant distances. They are known to feed in disturbed areas, as long as adequate shelter and protection from predators is available. Protection of riparian habitat and post-harvest predator baiting will contribute to these requirements.</p> <p>Quenda - All fresh quenda activity was recorded within and adjoining riparian systems, which will be protected in riparian buffers during harvesting. Some older diggings were detected in a ridgeline area within forest that was harvested in 1934. These diggings extended to the south and east, where there were higher levels of fresh activity. This suggests that animals living in the riparian systems to the south and east of the coupe have been foraging in this area. The riparian systems will provide refuge for this species during and following harvesting activities. Post-harvest fox baiting is likely to contribute to better protection for quenda as the harvested areas regenerate</p>



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Table 3: Continued

Coupe Report ID	Threatened species found	Recommended management action (extracted from the survey report)
Dombakup 09 and 16 (Karri Regrowth)	Forest Red-tailed Black Cockatoos (VU), Baudin’s Cockatoo (EN), Quokka (VU), Quenda (P)	<p>Cockatoos - Red-tailed Black Cockatoos and Baudin’s Cockatoos were detected flying through and feeding on the edge of both coupes in association with mature pockets of forest. These areas will not be directly disturbed during thinning operations.</p> <p>Quokka - Quokkas have a large home range in their southern forest habitats (70ha) and are capable of moving significant distances. They are known to feed in disturbed areas, as long as adequate shelter and protection from predators is available. Protection of riparian habitat and post-harvest predator baiting will contribute to these requirements. Feral pig activity has also been detected within these coupes. Post-harvest control may be needed to reduce impacts of feral pigs on soil integrity, vegetation cover and forest structure.</p> <p>Quenda - Quenda were detected within riparian systems in Dombakup 09. These animals are likely to be protected within the riparian buffers. Post-harvest fox baiting could contribute to better protection for quenda using these riparian systems and could improve the suitability of regenerating habitat.</p>
Gray 06 (Karri Regrowth)	Forest Red-tailed Black Cockatoos (VU), Baudin’s Cockatoo (EN), Quenda (P)	<p>Cockatoos - All cockatoo activity was recorded in mature forest associated with riparian systems. These areas will be protected in riparian buffers during harvesting activities.</p> <p>Quenda - Quenda were detected in low numbers in the south eastern corner within a riparian system and adjoining the coupe boundary. Their habitat will be protected in riparian buffers during harvesting activities. Post-harvest introduced predator control will contribute to better protection for this species, while the surrounding vegetation regenerates.</p>



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Table 3: Continued

Coupe Report ID	Threatened species found	Recommended management action (extracted from the survey report)
Mattaband 04, 05, 06 and 12 (Karri Regrowth)	Baudin’s Cockatoo (EN), Quokka (VU), Quenda (P)	<p>Cockatoos - Baudin’s Cockatoos were detected feeding in mature forest surrounding the coupes and within a mature pocket of karri-marri mixed forest on the NE corner of Mattaband 12. The mature pocket of karri-marri mixed forest should be protected during thinning operations. The area is shown on a map within the survey report.</p> <p>Quokka and Quenda - Quokka and quenda were located within and adjacent to riparian systems within the coupes. These animals are likely to be protected within riparian buffers. Post-harvest introduced predator control could contribute to better protection for quokka and quenda using these areas, while the surrounding vegetation regenerates.</p>
Nairn 03 and Poole 05 and 06 (Karri Regrowth)	Quokka (VU), Quenda (P)	<p>Quokka and Quenda - All indicators of activity for quokka and quenda occurred within riparian systems that will be protected within buffers during harvesting operations. A large proportion of the coupes contain dense woody debris on the forest floor. This has been shown to reduce habitat suitability for quokkas in this region. Post-harvest fox baiting programs will provide additional protection to these species as the harvested areas regenerate</p>



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Table 3: continued

Coupe Report ID	Threatened species found	Recommended management action (extracted from the survey report)
Sutton 06, 10, 13, 18 and 19 (Karri Regrowth)	Baudin’s Cockatoo (EN), Quokka (VU)-old activity only, Quenda (P)-old activity only, Western Brush Wallaby (P), Tammar Wallaby (P)	<p>Cockatoos - Baudin’s Cockatoos were detected flying through and feeding in mature forest surrounding the coupes and within riparian systems on the edge of Sutton 06, 10 and 18. These areas will not be directly disturbed during thinning operations.</p> <p>Quokka and Quenda - All indicators of activity for quokka and quenda were old and occurred within riparian systems that will be protected in buffers during harvesting operations. A large proportion of the coupes contain dense woody debris on the forest floor. This has been shown to reduce habitat suitability for quokkas in this region.</p> <p>Western Brush Wallaby - Western brush wallabies were detected in regrowth karri forest within Sutton 13, which is surprising given their preference for forest and woodland areas with an open and often grassy understorey. It has been documented that brush wallabies are absent in Karri forests, due to the dense understorey (Woinarski and Burbidge 2016). The area occupied by brush wallabies in Sutton 13 is relatively open, due to a heavy layer of woody debris on the forest floor. The habitat provides minimal opportunity for feeding and predator avoidance. Brush wallabies are known to favour recently burnt habitat and it is likely that regeneration activities associated with harvesting will improve the quality of the habitat for this species, particularly given the high proportion of retained riparian vegetation within the area. Post-harvest predator baiting will also benefit this species.</p> <p>Tammar Wallaby - Tammar wallabies were detected in a small pocket of Banksia woodland, immediately adjacent to riparian vegetation within Sutton 19. There was no evidence of the species found within the surrounding karri regrowth and there was an absence of shelter thickets and feeding opportunities for tammars in these areas. The riparian system provides good connectivity with areas of forest to the north and east that contain more suitable habitat. Protection of riparian habitat, diverse ecotype zones and post-harvest predator baiting will benefit this species.</p>