Survey Standards: Yellow-bellied Glider, *Petaurus australis*

1 Purpose

This document is one of a series that outlines the standards required for surveying fauna species listed under the *Flora and Fauna Guarantee Act* 1988 (FFG Act), along with selected other species that are the subject of forest prescriptions in particular Forest Management Plans. These standards detail acceptable survey methods and the minimum survey effort to determine the likelihood of the species' occurrence at a site. They also detail appropriate record keeping and reporting standards.

There are two main purposes of these standards.

1. To document the information required to determine if a record is valid. The standards provide the information that is required to enable an assessment to be made as to whether a record can be accepted as a valid record. All records, irrespective of how they are obtained, need to adhere to these standards.
2. To describe the acceptable level of survey effort required to infer presence/absence, or relative abundance where applicable. These minimum standards are required to be met by any organisation/group undertaking a presence/absence or relative abundance survey.

Executing and reporting a survey to these standards will support the Department of Sustainability and Environment (DSE) to make an assessment of the validity of a claim to species occurrence at a site. Subject to DSE approval, alternative survey methods may be applied where the proponent provides an evidence-based rationale for the approach and a detailed description of the survey technique(s) and where the standards are considered to exceed those set out below.

In the context of timber harvesting operations these standards should be read in conjunction with the Code of Practice for Timber Harvesting and Forest Management Plans. As further information about the species and survey techniques becomes available, these standards will be reviewed and updated.

2 Introduction

The Yellow-bellied Glider is a medium-sized, highly mobile, hollow-dependent species found in open forest and woodlands. In Victoria, the Yellow-bellied Glider strongholds are the continuous forests of East Gippsland and the Eastern Highlands, with substantial populations also in the Otway Range and south-western Victoria. It inhabits a range of forest types, typified by a predominance of smooth barked eucalypts as well as a mixture of eucalypt species (Menkhorst 1995).

Yellow-bellied Gliders eat invertebrates, eucalypt sap, nectar, pollen, manna and honeydew. Their foraging behaviour is strongly influenced by forest phenology, especially eucalypt flowering and bark shedding (Menkhorst 1995). Yellow-bellied Gliders predominantly forage in larger trees. Studies in south-eastern Queensland show that they preferentially select larger trees of certain species for sap feeding (Eyre and Buck 2005). Large trees also provide increased flower cover and are more likely to flower, hence providing a more reliable nectar source (Wilson and Bennett 1999, Eyre and Buck 2005).

Yellow-bellied Gliders live in family groups, with group size reflecting the availability of food, and communicate using a complex array of distinctive, loud calls (Menkhorst 1995). They have a home range of approximately 60 ha (Goldingay and Kavanagh 1993).

The Yellow-bellied Glider is considered sensitive to intensive logging (Eyre and Buck 2005). In Victoria they are generally associated with mature forest (Menkhorst 1995; Loyn 2004), and prescriptions have been developed to conserve the species in forest subject to timber harvesting in East Gippsland (Department of Natural Resources and Environment 1995). The prescriptions are intended to conserve areas with high populations of the species (Department of Natural Resources and Environment 1995).

3 Requirements to demonstrate occurrence

Current prescriptions in East Gippsland refer to relative abundance (Department of Natural Resources and Environment 1995) not to presence-absence. Areas with high relative abundance of Yellow-bellied Gliders are defined as those where more than five individuals are detected per kilometre of spotlight transect, or > 0.2 per hectare, or > 7 per hour of spotlighting (Department of Natural Resources and Environment 1995). Although a range of techniques may be suitable for denoting the presence of Yellow-bellied Gliders, e.g. records by logging crews while on-coupe (e.g. Braithwaite *et al.* 1988), hair-tubing, predator scat analysis (e.g. Lunney *et al*. 1990, Claridge *et al*. 2010), cage trapping (e.g. Goldingay 1992), and V-shaped incisions in sap trees, spotlighting transects constitute the only practical way to assess relative abundance, especially to meet the first and third criterion above. Accurate population estimates are hampered by their tendency to move long distances relatively quickly (Menkhorst 1995) hence the second criterion could only be determined with more resource intensive studies such as those involving radio tracking of individuals.

3.1 Acceptable records

Observations of individuals by sight or sound using the spotlighting methods described below are acceptable records. Loud calls of the Mountain Brushtail Possum *Trichosurus cunninghami*, Common Brushtail Possum *T. vulpecula* or Koala *Phascolarctos cinereus* are occasionally misidentified as Yellow-bellied Gliders, but only by inexperienced observers. Visual identification requires care to avoid confusion with the Greater Glider *Petauroides volans*, but several features serve to distinguish the two species (notably the active behaviour, medium size, creamy belly, dark dorsal stripe, long ears and relatively weak eye-shine of Yellow-bellied Gliders).

3.2 Non-acceptable records

The following are not considered acceptable records in the context of timber harvesting prescriptions:

- Sightings of individuals by inexperienced individuals, without supporting evidence.
- Brief visual observations where characteristic features are unable to be confirmed.
- Yellow-bellied Glider remains obtained from predator (dog or fox) scats as the location where the glider was consumed may be some distance from the site where the remains were found.

- The Yellow-bellied Glider can be reliably identified by hair analysis (Lobert *et al.* 2001). While hair tubing can provide positive, site-specific records of the species, they can not be used to meet prescription thresholds in Forest Management Plans, which require the observation of individuals.
- V-shaped incisions in the bark of large eucalypts are a classic sign of the presence of Yellow-bellied Gliders (Menkhorst 1995). While evidence of feed trees can provide positive records of the species, they can not be used to meet prescription thresholds.
- Cage trapping – trapped Yellow-bellied Gliders are readily identifiable by experienced individuals but this method is not envisaged to provide data which are suitable for inferring prescription thresholds.

3.3 Survey effort and resulting level of certainty

Not all individual Yellow-bellied Gliders that occur at a site will be detected during surveys. To determine the likelihood of detecting Yellow-bellied Gliders at occupied sites, Wintle *et al*. (2005) calculated detection probability using spotlighting in wet and dry sclerophyll forests near Eden, south-eastern New South Wales. Yellow-bellied Glider vocalizations were the primary means by which the species was detected; glider vocalizations were recorded within a 300 m radius of the centre of the survey site, such was their reach. Under ideal conditions single-visit detection probability for Yellow-bellied Gliders in the Eden region was ~ 90% and under average conditions three visits were required to obtain an equivalent level of detection probability within their 40 min / 28 ha search area. Wintle *et al*. (2005) also modelled the influence of environmental and weather variables on the detection probability of the Yellow-bellied Glider. This modelling indicated that the probability of detection was positively related to temperature, slope of the survey site, wetness index of the survey site and habitat quality, and that it was negatively associated with time since dusk and the presence of rain during the survey.

The Yellow-bellied Glider is active all times of year, thus spotlight transects can be effective at any time of year, with little seasonal variation in effectiveness providing the weather conditions are suitable. The presence of Yellow-bellied Gliders is often revealed by their distinctive vocalisations whereas visual detections are sometimes difficult because of their spotlight shyness and poor reflective eyeshine (Wintle *et al.* 2005).

A standardised approach is recommended whereby observers conduct spotlight transects on foot covering a total distance of 1 km. Transects should be positioned in a way that maximizes coverage of the study site. Depending on the dimensions of the study site it may be more suitable to change the configuration of the transect to enable more complete coverage the target area, for example several (independently located) 200 m transects rather than a single 1 km transect (Table 1). Transects can be either along a track, or off track. When undertaking off-track transects, access needs to be checked during the day and reflective tape installed at 25 m intervals to aid navigation. It is recommended that these 25 m intervals are marked with a GPS so that the transect location can be accurately recorded.

The observer should begin each survey with a 10-minute listening period and record any observations. This should be followed by a call playback session of pre-recorded calls at the start of the transect. A typical call sequence comprises a 3-minute broadcast of Yellow-bellied Glider calls, followed by a 2-minute listening period, then a 3-minute broadcast of

Powerful Owl *Ninox strenua* calls to elicit a response (Kavanagh and Rohan-Jones 1982), again followed by 2-minute listening period. Playback of owl calls has been found useful for encouraging Yellow-bellied Gliders to call and reveal their presence (Eyre and Buck 2005).

Table 1: Example of transect configurations.

Recommended widths (m) of detection bands either side of transect line	Transect length (m)	Duration (mins) if transect is along a track	Duration (mins) if transect is off track
50, 100, 200, 300	200	10 mins	20 mins
50, 100, 200, 300	400	20 mins	40 mins
50, 100, 200, 300	500	25 mins	50 mins
50, 100, 200, 300	1000	50 mins	100 mins

For each transect the location of Yellow-bellied Gliders should be estimated by recording the observers position on a GPS unit and estimating the perpendicular distance to the glider within bands 50 or 100 m wide (Table 1). Whilst Yellow-bellied Gliders calls can heard up to 300 m (Wintle *et al*. 2005) it is more difficult to estimate the number of individuals over those distances. Effective detection distances also vary with vegetation density (Wintle *et al*. 2005) and topography, e.g. survey effort will be greater per kilometre in more open forest compared to closed forest where thick vegetation reduces the reach of a spotlight.

Where transects are located along roads the observer walks slowly, covering approximately 100 m in 5 mins and pausing at 25 m intervals to listen for movement. Transects located off roads or tracks require approximately 10 mins per 100 m length of transect to accommodate navigation through rough terrain. Observers should use spotlights with minimum 30 W power to locate gliders, thoroughly searching each tree.

Spotlight transects should commence soon after dusk, since the chances of detecting gliders are highest at this time, coinciding with emergence from dens, gliding activity and foraging (Goldingay 1994, Eyre and Buck 2005, Wintle *et al*. 2005).

To maximise the chances of detecting Yellow-bellied Gliders, surveys should be conducted under optimal weather conditions (warm temperatures, with no rain, fog or bright moonlight). The Wintle *et al*. (2005) study suggests that for a detection probability of ~90%, under ideal conditions only one visit is required, while if the conditions are less optimal, it will require three visits.

3.4 Reporting standards to show presence

To assess the adequacy of surveys conducted for Yellow-bellied Gliders, proper documentation of survey effort is essential. This is particularly the case for survey methods where reliable quantitative assessments of survey results (e.g. number of Yellow-bellied Glider records per spotlight hr or per spotlight km), and where data concerning survey effort

(number of spotlights and survey duration) are required to assess survey adequacy. The following data are required to support a record of a Yellow-bellied Glider:

- name and contact details of the observer (including a willingness to make themselves available to escort an independent validator to the site, if required);
- permit details of the surveyors where required (i.e. a research permit under the Wildlife Act, as well as a research permit under the National Parks Act if working within a Park and consent from DSE Land and Fire Division if working in State Forest);
- date and time of record;
- precise geographic location of record (written location and GPS coordinates);
- details of the species present and number of individuals detected;
- method of obtaining the record, including the sampling effort (i.e. length of spotlight transect, area sampled, amount of time spent spotlighting and number of spotlights; number of hair tube nights);
- supporting evidence, if required: Yellow-bellied Gliders may need to be distinguished from similar species, such as Greater Glider. A detailed description of the animal, and if possible clear photographs are to be submitted to allow independent confirmation of the identification;
- it is recommended that data on environmental variables (Table 2) are also recorded to help verify survey effort and interpret probability of detection.

This is the core information required for records to be entered onto the Victorian Biodiversity Atlas. Records of all other species observed at the site should also be submitted to the Atlas.

Table 2: Additional covariates to be recorded for each survey (adapted from Eyre and Buck 2005).

Description of covariates	**Categories or indices of covariate**
Moonphase – % moon out	0–100%
Nightlight	0 – No moonlight, or heavy cloud cover obscuring light
	1 – Low
	2 – Medium
	3 – High
Cloud cover-percent of sky covered	0–100%
Air temperature	0–30 °C
Estimate of wind velocity in canopy (Beaufort wind scale)	0: calm (< 1 km/h); smoke rises vertically
	1: light air (1-5 km/h); wind direction shown by smoke-drift, but not by wind vanes

Description of covariates	Categories or indices of covariate
	2: light breeze (6-11 km/h); wind felt on face; leaves rustle; ordinary vanes moved by wind
	3: gentle breeze (12-19 km/h); leaves, twigs in constant motion; wind extends light flag
	4: moderate breeze (20-28 km/h); raises dust and loose paper; small branches are moved
	5: fresh breeze (29-38 km/h); small trees in leaf begin to sway; crested wavelets form on inland waters
	Conditions > '5' are unsuitable to conduct spotlighting surveys
Precipitation	0 – No rain
	1 – Fog or periodic drizzle
	2 – Light rain
	3 – Medium rain
	4 – Heavy rain
Time after dusk	0–6 h
Total flower index of the overstorey (m^2 ha^{-1})	0 – No trees in flower
	1 – Light flowering
	2 – Medium flowering
	3 – Heavy flowering
Call playback survey effort	A – Standard call playback, Yellow-bellied Glider call followed by Powerful Owl call
	B – Inclusion of calls of other owl species
	C – Inclusion of Masked Owl and Barking Owl call
	D – Inclusion of other calls as well as all of the above
Powerful Owl presence	0 = Powerful Owl not recorded at the site
	1 = Powerful Owl recorded as present at the site
Access	1 – Easy: along roads, tracks or bare ground and /or low grassy understorey, no / gentle slope
	2 – Moderate: mixture of grassy and shrubby understorey / gentle

Description of covariates	Categories or indices of covariate
	or moderate slope / rocky material / isolated patches or wire grass
	3 – Difficult: larger patches of dense shrubs / logging slash / wire grass with very little open ground or grassy areas, and / or very steeply sloped
Visibility	1 – Excellent; middle storey is open, no / few / low shrubs steep slope allows canopy views, line of sight mostly > 30 m
	2 – Moderate; some shrubby patches and line of sight variable from 10 - 30 m
	3 – Poor: thick understorey e.g. 5 – 10 year old regrowth, very high canopy and line of sight mostly < 10 m

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