Urban Ecology of Sugar Glider *Petaurus breviceps*

1. Species background

The Sugar Glider is a wrist-winged member of the family Petauridae, with a head and body length approximating 170 mm and tail averaging 190 mm long. Males are slightly heavier than females, averaging 140 g and 115 g respectively (Suckling 1995).

The top of the body is typically pale grey, with a dark brown or black band extending from the muzzle over the head and down the middle of the back almost to the base of the tail. A black stipe passes through the eye, from the nose to ear. There is a whitish patch in front of and behind the ear, and a dark mark extending down the hind leg. The gliding membrane between the wrists and ankles is dark above with a white fringe, and the tail is grey, darkening towards the end, although sometimes with a white tip. The underside is light grey or yellowish-white (Thomas 1888; Smith 1973).

The closely related Squirrel Glider *Petaurus norfolcensis* is slightly larger than the Sugar Glider, has a longer, more pointed muzzle, and a bushier tail (hairs longer than 40 mm vs. shorter than 40 mm in the latter) (Smith 1973).

2. Distribution

Seven subspecies of Sugar Glider are recognised, with four recognised from New Guinea. The remainder are distributed in different locations in northern and eastern Australia, from the Kimberley, through Arnhem Land, along the east coast of New South Wales and through most of temperate Victoria (Smith 1973; Suckling 1995). It also occurs in the far south-eastern corner of South Australia (ALA 2020). It was introduced to Tasmania in 1835 and has since spread over most of the state (Gunn 1851).

The subspecies *P. b. breviceps* occurs through most temperate eucalypt forests and woodlands in Victoria, but is absent from the Mallee region north of the Little Desert, the Murray River north-west of Gunbower, and largely treeless areas of the Volcanic Plain west of Melbourne (Henry 1995).

Within the greater Melbourne, it is common in forested areas on the Mornington Peninsula and north-east of the city (Dixon 2006). It also occurs in remnant bushland in the other south-eastern suburbs (ALA 2020; DELWP 2020), and along Jacksons Creek at Organ Pipes National Park where it was reintroduced in 1989-1990 (Irvine and Bender 1997).

3. Habitat

The Sugar Glider typically inhabits wet or dry sclerophyll forests and woodlands (Smith 1973). In south-eastern Australia, populations tend to be most abundant in forested habitats supporting dense stands of *Acacia* (Suckling 1995). It is also capable of persisting in roadside remnants and fragmented forest in agricultural landscapes (Suckling 1984; 1995), and similarly in some urban areas (Menkhorst and Loyn 2011; Caryl *et al.* 2013).

In Victoria, the species prefers areas of stringybark, box, ironbark and gum eucalypts, with Acacias such as Black Wattle *Acacia mearnsii*, Silver Wattle *A. dealbata* and Golden Wattle *A. pycnantha* in the understorey. It is less abundant but nonetheless still occurs in forests dominated by Ash eucalypts (Henry 1995).

In urban situations, habitats with a lower density of surrounding houses and roads, and reduced gaps between trees (<20 m apart: Ball and Goldingay 2008), are likely to be as if not more important for sustaining populations than maintaining broader structural habitat connectivity (Caryl *et al.* 2012).

4. Life history and behaviour

In south-eastern Australia, Sugar Gliders usually begin breeding in June or July (Suckling 1995). Females typically produce two young between June and January (usually from August to October) (Suckling 1984; Henry 1985). The young remain in the pouch for approximately 70 days and nest for a further 50 days (Smith 1971), before venturing out to forage about four months old (Suckling 1984). Young males remain with their maternal group until they are forced to disperse at 10-12 months of age, whereas females may be recruited within the group if there are vacancies (Suckling 1984; Henry 1985).

Between two and up to seven adults may share a den site, although there may be up to 12 individuals when juveniles are present in summer (Suckling 1984; Henry 1985). In Victoria, sugar gliders construct ball-shaped nests of interwoven leaves that are enclosed in winter (Calder *et al.* 1983). They usually nest in tree hollows, and are very rarely recorded nesting on the ground (Calaby 1966; Platt 2016).

Scent marking is used to identify conspecifics and define territorial boundaries (Henry 1995). Density can vary between different sites and habitats, with home ranges averaging approximately 0.6 ha for populations on the Gippsland Plain (Suckling 1984), and 5 ha for those near Armidale in New South Wales (Quin *et al.* 1992).

A large part of the Sugar Glider's diet consists of gum from *Acacias* such as the Black Wattle, as well as some Eucalypts. This is particularly the case in late autumn and winter when little other food may be available, whereas flying insects and honeydew may be consumed more

frequently in late spring and early summer (Suckling 1984). Nectar and pollen also form part of the diet (Howard 1989; Suckling 1995).

Sugar Gliders are capable of gliding between trees for distances of at least 50 m (Suckling 1995), although average 20 m (Jackson 2015).

5. Use of nest boxes

The use of large numbers of nest boxes with entrances too small for larger possums and metal rings to prevent the entrance from being enlarged has been found to increase the abundance of Sugar Gliders (Traill and Lill 1997). It has been found that the species may be more likely to occupy nest boxes in areas with a high density of surrounding boxes, higher density of residential dwellings, higher density of Acacias, and low density of hollow-bearing trees (Durant *et al.* 2009). Sugar Gliders may also be more likely to occupy boxes placed on smaller trees and with a preference for box eucalypts (e.g. Red Box *Eucalyptus polyanthemos*) (Durant *et al.* 2009). Of 165 functional nest boxes inspected in the Bendigo region of Victoria, approximately 37% were found to be used by Sugar Gliders, and 25-28% of 'glider' boxes were found to be occupied at two sites in New South Wales (Goldingay *et al.* 2018).

6. Use of road-crossing structures

Despite their relatively small body size, the ability of Sugar Gliders to glide or volplane surprisingly long distances (at least 50 m; Suckling 1995) makes them ideally suited to crossing most collector and local roads without intervention, provided surrounding trees are at an appropriate height and distance from each other. The installation of overhead crossing structures is likely to be of greater benefit where wider arterial roads divide areas of habitat.

Sugar Gliders significantly favoured single rope bridges over mesh rope bridges during a trial of road crossing structures in northern New South Wales. No preference was shown, however, between mesh or ladder-style rope bridges with variable spacing between rungs (Goldingay and Taylor 2017). Individuals may also prefer traveling along the top of rope bridges where they are constructed to form a mesh tunnel (i.e. rather than passing through the middle) (Weston *et al.* 2011; Goldingay *et al.* 2013).

More recently, it was shown that the use of vertical glide poles by Sugar Gliders to cross a 26 m gap across the Oxley Highway deviation at Port Macquarie, NSW, greatly exceed that of a rope bridge spanning the road (Goldingay *et al.* 2019). Additionally, Sugar Gliders only used poles in favour of rope bridges to cross the Hume Freeway either side of the NSW-Victorian border (Soanes *et al.* 2015). It is therefore possible that a more beneficial outcome may be achieved by the more cost-effective installation of roadside poles rather than bridges.

When designing glide poles, horizontal glide beams should be orientated in the direction of the receiving pole or tree on the other side of the road, as individuals have been shown to prefer forward-pointing beams over perpendicular-facing beams (Goldingay and Taylor 2017). An average crossbeam glide height of 11.96 m is recommended, with maximum spacing of 20-30 m between the poles and nearby trees (Department of Main Roads 2000). Poles at a height of 23-25 m spaced 30-33 m from each other were used with success at Port Macquarie (Goldingay *et al.* 2019).

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