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Squirrel Glider *Petaurus norfolcensis*

Review of Current Information in NSW

August 2008

Current status:

The Squirrel Glider *Petaurus norfolcensis* is currently listed as Threatened in Victoria under the *Flora & Fauna Guarantee Act 1988* (FFG Act; Endangered on the Advisory List), and Endangered in South Australia under the *National Parks and Wildlife Act 1972* (NPW Act). This species is not listed under Commonwealth legislation. The NSW Scientific Committee recently determined that the Squirrel Glider meets criteria for listing as Vulnerable in NSW under the *Threatened Species Conservation Act 1995* (TSC Act), based on information contained in this report and other information available for the species. Two Endangered Populations of Squirrel Gliders are also listed in NSW; one on the Barrenjoey Peninsula, and one in the Wagga Wagga Local Government Area.

Species description:

The Squirrel Glider is a medium-sized glider, with a thick furry tail, almost twice the size of the Sugar Glider *Petaurus breviceps*; head-body length 17-24 cm, tail 22-30 cm, weight 190-330 g. The upperparts are grey with a black dorsal stripe from crown to rump, black markings around the ears, and a black border to the gliding membrane; the terminal third to half of the tail is black, and the underparts are white. The smaller Sugar Glider is very similar (head-body 16-20 cm, tail 17-21 cm, weight 90-150 g), but is more snub-nosed with less bold black markings, has pale grey or cream rather than clean white underparts, and the less tapered tail is black on the terminal quarter, sometimes with a white tip. The Squirrel Glider's common call is a deep resonant grunt, readily distinguishable from the Sugar Glider's yapping call. The Yellow-bellied Glider *Petaurus australis* is larger and darker, with a yellow or cream belly, and complex shrieking and gurgling calls. The much larger Greater Glider *Petauroides volans* is either black dorsally and white ventrally, or light grey dorsally with a white head and tail, and has bright eyeshine as opposed to the weak eyeshine of *Petaurus* gliders.

Taxonomy:

Petaurus norfolcensis (Kerr 1792) (Petauridae), is monotypic (*i.e.* no subspecies) and an endemic Australian species in an endemic Australasian genus and family.

Distribution and number of populations:

The Squirrel Glider is distributed from north Queensland to western Victoria, with a few records in extreme south-east South Australia where it may still persist. Its core range is in north-east NSW and south-east Queensland (Quin *et al.* 1996), but it is generally rare and patchy in NSW (Kavanagh 2004). In NSW, it occurs on the North Coast and on the inland slopes, probably as two populations as it is sparse or absent on the higher elevations of the tablelands. There are

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hotspots in the Clarence and lower Richmond Valleys, and the Central Coast (Kavanagh 2004), and some parts of the western slopes support good populations (*e.g.* the Nandewar Bioregion, which is considered an inland conservation stronghold for the species: expert advice). The glider is rare on the coast south of Sydney; records for the south coast have been questioned as possibly misidentified Sugar Gliders.



Figure 1. Records of the Squirrel Glider since 1980 (NSW Wildlife Atlas)

Ecology:

Most aspects of biology and ecology of the Squirrel Glider are generally well understood following recent studies (Quin 1995; Rowston 1998; Sharpe & Goldingay 1998; Millis & Bradley 2001; Rowston *et al.* 2002; van der Ree 2002; Smith & Murray 2003; van der Ree & Bennett 2003; van der Ree *et al.* 2003; 2004; Claridge & van der Ree 2004; Eyre 2004; Goldingay & Jackson 2004; Goldingay & Sharpe 2004; Kavanagh 2004; Sharpe 2004; Holland *et al.* 2007; Crane *et al.* 2008; Van Dyck & Strahan 2008).

Key habitat requirements

The Squirrel Glider requires hollow-bearing, floriferous eucalypt open forests and woodlands with a *Banksia* or *Acacia* shrub layer, that provide den sites in tree cavities and a good winter supply of nectar. Large trees with abundant hollows are critical elements (Holland *et al.* 2007; Crane *et al.* 2008). Preferred hollows are those with a large cavity that can house multiple gliders in a large nest, yet with a small entrance that protects the group from predators like goannas. Habitat types are specific, and subject to extensive fragmentation (Goldingay & Jackson 2004). Prime habitat on richer soils and gentle terrain has been targeted for agricultural clearing, logging, firewood harvesting, conversion to pine plantations, and urbanisation. Habitat degradation is continuing. Inland, some of the best remnant habitat (*e.g.* ironbark-box communities) is in travelling stock routes and reserves now being increasingly used for agistment by neighbouring landholders (rather than purely for travelling livestock), and targeted for freeholding.

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Breeding biology

The Squirrel Glider's den and nest sites are tree hollows insulated with a lining of leaves. Females can breed at one year old, and bear one or two (rarely three) young between April and November, with a peak in winter or spring; a second litter may be raised in a year. Pouch life is probably about 70 days and young may be left in the group nest for a further 40-50 days, after which they leave the nest to begin foraging for themselves at 110-120 day old (by analogy with other *Petaurus* gliders); young Squirrel Gliders are weaned at 140-160 days old, and are independent and disperse at 12-18 months old.

Diet

The Squirrel Glider feeds on nectar, pollen, plant exudates (*e.g.* wattle and eucalypt sap), invertebrates, and honeydew (sugary exudate from insects), and rarely small vertebrates such as nestling birds. The larger body size of the Squirrel Glider versus the Sugar Glider means that the latter can persist in habitat fragments where food resources are too low for viable Squirrel Glider populations.

Social biology

The Squirrel Glider lives in social groups of one or two adult males and females and their offspring, that occupy group dens and rotate among many hollow trees in their territory.

Territoriality/home range

The group occupies and defends (by scent-marking) a large territory that may have about 20 hollow trees used over a period of six weeks. Mean home range is 3-9 ha in coastal habitats and 3-4 ha in productive inland habitat fragments. Interspecific aggression toward Sugar Gliders occurs, but does not fully exclude the smaller species from Squirrel Glider territories.

Generation length

Age to maturity of the Squirrel Glider is one year and estimated longevity is seven years. The generation length (IUCN 2008) of the Squirrel Glider is estimated to be four years.

Ability to disperse/susceptibility to population fragmentation

Squirrel Gliders have limited ability to disperse across urban or agricultural land. Although capable and willing to cross open habitat on occasion (*e.g.* to reach heavily flowering trees), they more typically require sufficient connectivity of tree cover within their maximum gliding distance (70 m: van der Ree 2002; van der Ree *et al.* 2003). They are therefore susceptible to habitat fragmentation and hence population fragmentation.

Number of mature individuals:

The number of mature individuals of the Squirrel Glider is uncertain. Density is about 0.5-1 animals per ha in suitable habitat in coastal NSW and inland Victoria (Goldingay & Jackson 2004). Given that there are tens of thousands of square kilometres of potentially suitable habitat in NSW, the population is likely to exceed 10 000 mature individuals. However, the Squirrel

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Glider is rare or absent in the tall forests on public estate of the escarpment and eastern edge of the tablelands, and most of its population may occur on private land (Kavanagh 2004). Habitat modelling suggests that high densities occur on parts of the north and central coasts, but the inland slopes were excluded for lack of data (Kavanagh 2004). Subsequently, Squirrel Gliders were found at densities of about one animal per 8 ha of all forest and woodland surveyed in the Nandewar Bioregion, with higher densities in preferred habitat. They occurred in remnants down to 3 ha in size, with one aggregation of 20 animals drawn to 1 ha of flowering Mugga Ironbark (expert advice). In that survey Squirrel Gliders were about one-third as abundant as Common Brushtail Possums *Trichosurus vulpecular*, and detected about 15% more often than Sugar Gliders. Thus, Squirrel Glider densities in remnant woodland on fertile soils on the North-west Slopes are probably comparable to those in coastal hotspots.

Threats:

The main threats to the Squirrel Glider are loss and degradation of habitat, in inland areas as a result of agriculture, rural-residential development and mining, and in coastal areas as a result of human settlements (Eyre 2004; Claridge & van der Ree 2004; Kavanagh 2004; Rowston & Catterall 2004; van der Ree *et al.* 2004; expert advice). Habitat loss is incremental in already-cleared areas, and habitat degradation in remnants is continuing through loss of key shelter and dietary resources, *i.e.* tree hollows and *Acacia* or floriferous shrubs. Tree hollows are currently less abundant in forests managed for timber than in linear roadside fragments, and there is a net loss of large hollow trees, without adequate recruitment. The species is subject to cumulative loss of den sites from harvesting of forests or woodlands, gradual tree death on agricultural lands, and takeover of hollows by feral honeybees. The shrub layer is degraded by grazing, which limits regeneration, or is removed in urbanising areas. Other threats include road kill, frequent prescribed fire, wildfire, predation by foxes and cats, weed invasion, and collisions with barbed-wire fencing (Eyre 2004; Claridge & van der Ree 2004; Kavanagh 2004; van der Ree *et al.* 2004). 'Introduction of the Large Earth Bumblebee *Bombus terrestris*', 'Predation by the Feral Cat *Felis catus*', 'Predation by the European Red Fox *Vulpes vulpes*', 'Clearing of native vegetation', 'High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition', 'Loss of hollow-bearing trees', and 'Removal of dead wood and dead trees' are listed as Key Threatening Processes under the TSC Act in NSW.

Extreme fluctuations:

One population of Squirrel Gliders declined by about 80% over a poor flowering spring when usually dependable food sources failed; however, the decline was 55% in the total population and 42% in the adult population, compared with the preceding four-year mean (Sharpe 2004). The decline was regionally widespread, and the population had not recovered 10 months later; fluctuations of this magnitude reduce the effective population size, and can lead to an overestimate of population viability (Sharpe 2004). This fluctuation illustrates the susceptibility

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of the glider to variation in its food supply, a vulnerability that is increased in small, fragmented populations (Sharpe 2004).

Population reduction and continuing declines:

It is not possible to demonstrate a population reduction, because of the previous lack of knowledge of the species and possible confusion with the Sugar Glider. There is a recent increase in records as a result of greater familiarity with the Squirrel Glider's appearance and call and greater survey effort in the species' habitat. The species is data deficient on population trends across its range (Eyre 2004; Kavanagh 2004; van der Ree *et al.* 2004), but a population reduction and continuing declines are inferred or predicted from trends in the species' habitat extent and quality, and intensifying threats (Claridge & van der Ree 2004; Goldingay & Sharpe 2004; expert advice). The decline of the Common Brushtail Possum and Common Ringtail Possum *Pseudocheirus peregrinus* on the inland slopes and plains of NSW, especially the box-ironbark woodlands (Kerle 2004; Paull & Kerle 2004), may indicate a decline of the Squirrel Glider in inland NSW based on the similar requirement of tree hollows, although diet is very different. Declines of the large possums in inland NSW are associated with a 70% reduction in box-ironbark habitat, a 90% reduction in the proportion of large trees with hollows, and loss of a shrubby understorey in remnant habitat (Kerle 2004), and fox predation and loss of ironbarks and hollows in the Pilliga forests (Paull & Kerle 2004). Box-ironbark with an *Acacia* understorey is likely to be a key habitat for inland NSW populations of the Squirrel Glider, as in parts of Victoria (Traill & Lill 1997). Recent data confirm that in the Nandewar Bioregion, Yellow Box, Mugga Ironbark, and especially White Box on fertile soils, support high densities of Squirrel Gliders. These habitat types have been extensively cleared and the glider now occurs in small fragments and roadside strips subject to degradation and decreasing connectivity (expert advice). Population viability analysis (PVA) predicts a high probability of extinction within 100 years in fragmented habitat (up to 40-60%, depending on the scenarios modelled: Goldingay & Sharpe 2004), and the species is predicted to decline rapidly in urbanising coastal areas (Rowston & Catterall 2004). For instance, the probability of extinction in 100 years is about 40% if there are only three remnants in the metapopulation, 20% for five remnants and less than 10% for seven remnants; and less than 10% at low adult mortality (of less than 0.35 per annum), 30% for adult mortality of 0.40, and more than 60% for adult mortality of 0.45 (Goldingay & Sharpe 2004). With inclusion of catastrophes, the probability of extinction in 100 years is about 20% at a frequency of one event in 20 years, and 40% at one event in 10 years.

Extent of Occurrence (EOO) & Area of Occupancy (AOO):

Conservatively, the Squirrel Glider's EOO is approximately the eastern one-quarter of NSW or about 200 000 km². AOO is unknown, but if only 1% of EOO then it would be 2 000 km².

Severe fragmentation:

The Squirrel Glider's habitat is severely fragmented, with severe population fragmentation in rural areas because of the Glider's limited dispersal ability, and hence inability to recolonise

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isolated patches if it is extirpated (Eyre 2004; Claridge & van der Ree 2004; Goldingay & Sharpe 2004; Kavanagh 2004; van der Ree *et al.* 2004). Severe fragmentation may reduce gene flow and lead to inbreeding depression in remnant populations (van der Ree *et al.* 2004). In rural areas, much of the Glider's remaining habitat consists of linear roadside strips and paddock trees subject to continuing degradation. PVA indicates that metapopulations in fragments must be functionally linked to large remnants, for long-term population persistence (Goldingay & Sharpe 2004). These PVA models were especially sensitive to variation in the number of habitat fragments in the metapopulation, to inclusion of catastrophes such as wildfire, and to variation in adult mortality.

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Explanatory note

Between 2007 and 2009 the NSW Scientific Committee undertook a systematic review of the conservation status of a selection of plant and animal species listed under the Threatened Species Conservation Act. This species summary report provides a review of the information gathered on this species at the time the Review was undertaken.

The Scientific Committee's report on the Review of Schedules project and final determinations relating to species that were either delisted or had a change in conservation status can be found on the following website: www.environment.nsw.gov.au .

The Committee gratefully acknowledges the past and present Committee members and project officers who ably assisted the Committee in undertaking the Review of Schedules Project. Information on the people involved in the project can be found in the Acknowledgement section of the project report entitled "Review of the Schedules of the Threatened Species Conservation Act 1995. A summary report on the review of selected species" which is available on the abovementioned website.

This species summary report may be cited as:

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