

Action Statement

Flora and Fauna Guarantee Act 1988

No. 166

Squirrel Glider *Petaurus norfolcensis*

Description and Distribution

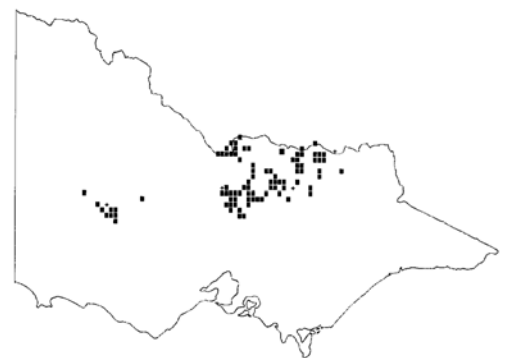
The Squirrel Glider *Petaurus norfolcensis* (Kerr 1792) is an arboreal, nocturnal, gliding possum occurring in northern and central Victoria, and through eastern New South Wales and eastern Queensland, to the southern Cape York Peninsula. An adult Squirrel Glider has a mean body length of 210mm, tail length of 270mm and body weight of 200–260g (Suckling 1995). It is grey to brown-grey above, with a dark stripe from the nose to at least the mid-dorsal region; the belly fur is distinctly white or cream; and the tail is fluffy and wide at the base, then tapering slightly to the tip (Rowley 1997, J. Seebeck *pers. comm.*). The Squirrel Glider attains almost double the average body weight of its congener, the Sugar Glider *P. breviceps*, which occurs throughout the same areas and can be distinguished by its less bushy, often white-tipped tail, and shorter, more rounded snout (Traill 1998). The Squirrel Glider appears to lack a characteristic contact call (Menkhorst 1995, Traill 1998).

In Victoria, the Squirrel Glider is patchily distributed north of the Great Dividing Range, from the northern tip of the Grampians National Park, in the west, to near Wodonga, in the east. It extends through the box-ironbark region of the gentle inland slopes, and through the central and northern riverine plains, mostly at sites below 250m in altitude and having an

average annual rainfall of about 345–920mm. A major break in the distribution occurs between Stawell and Colbinabbin, with only one locality record (Stuart Mill) known from within this span of 185km (Menkhorst 1995).



Squirrel Glider *Petaurus norfolcensis*
(Photo: Peter Menkhorst)



Distribution in Victoria (+ before 1970, ■ since 1970)

[source: Atlas of Victorian Wildlife, DSE 2004]

Habitat

Squirrel Gliders in Victoria occur in River Red Gum *Eucalyptus camaldulensis* forests, and mixed-species dry forests (including 'box-ironbark' forests) and woodlands. Both of these general habitat types typically contain many mature trees and characteristically include a substantial understorey of Silver Wattle *Acacia dealbata* or Black Wattle *Acacia mearnsii*. However, on mixed-species sites, Golden Wattle *Acacia pycnantha* - or sometimes Lightwood *Acacia implexa* - may also occur (Menkhorst 1995, Rowley 1997, van der Ree 2000).

River Red Gum forests containing Squirrel Glider colonies occur from Gunbower State Forest to the Kiewa Valley, in association with major rivers or well-watered creeks. These sites typically carry uneven-aged stands, sometimes with other associated eucalypts, such as Grey Box *Eucalyptus microcarpa*, Black Box *Eucalyptus largiflorens* and Yellow Box *Eucalyptus melliodora* (Rowley 1997).

Where Squirrel Gliders occur in mixed-species stands, both gum-barked and box species are usually present, sometimes with ironbarks or stringybarks. Tree species commonly occurring at these sites include River Red Gum (or Blakely's Red Gum *Eucalyptus blakelyi*), Yellow Gum *Eucalyptus leucoxylon*, Red Ironbark *Eucalyptus tricarpa*, Grey Box, Red Box *Eucalyptus polyanthemus*, White Box *Eucalyptus albens*, Yellow Box, Long-leaved Box *Eucalyptus goniacalyx*, Apple Box *Eucalyptus bridgesiana* and Red Stringybark *Eucalyptus macrorhyncha* (Rowley 1997). In the north-east (notably in the Warby Ranges State Park, incorporating the Killawarra State forest and Boweya Flora and Fauna Reserve, north-west of Wangaratta), Mugga Ironbark *Eucalyptus sideroxylon* is an important nectar and pollen source for Squirrel Gliders (Menkhorst 1995). Yellow Gum, White Box, Long-leaved Box and Red or Mugga Ironbark are significant because they are winter-flowering species, providing alternative food sources when many other species are not flowering (Menkhorst 1995, Rowley 1997).

The former Victorian range of the Squirrel Glider contained extensive mixed-species woodlands on soils well-suited for farming, as well as less fertile and more elevated box-ironbark forests. As a consequence of land clearing, remnants that could support gliders often persist only along roadsides and watercourses. While a proportion of Squirrel Glider colonies today persist in the larger remaining forest blocks and river reserves, the majority are located in low-lying remnant roadside (or road-creekside) woodland associations, where the removal of mature, hollow-bearing trees has been discouraged or precluded by reservation for

other purposes (Menkhorst et al. 1988, Traill 1993a, Rowley 1997).

Tree-hollows are essential to Squirrel Gliders for den and breeding sites, and hollows with a tight-fitting entrance hole (<50m) are preferred (Menkhorst 1995, Traill & Lill 1997). In a study of the denning behaviour of Squirrel Gliders occupying road reserves at Euroa, individuals radiotracked for an average of 44 days used from 1-15 den sites, but the average was around 5-6 (van der Ree 2000). Importantly, the number of den sites occupied by individuals continued to increase as the study progressed. In areas where hollows are scarce, gliders may shelter in sub-optimal hollows in the rotting bases of coppice stumps (Traill & Lill 1997). In a study of Squirrel Gliders on the (sub-tropical) central north coast of New South Wales, average population density was estimated at 0.89-1.54ha⁻¹ (Quin 1995), while, in box-ironbark regrowth forest at (temperate) Chiltern, Victoria, the figure was 0.49ha⁻¹ (Traill 1995). At Euroa, the population density of Squirrel Gliders in extensive, well-connected woodland along roadsides was 0.95-1.54ha⁻¹ (van der Ree 2002). Average home range size was between 2.5-4ha in the New South Wales study, between 6-17ha at Chiltern, and between 1.3-2.8ha at Euroa (Quin 1995, Traill 1995, van der Ree & Bennett 2003). Home ranges generally overlap and Squirrel Gliders may travel over distances of up to 2.6km to forage (van der Ree & Bennett 2003).

Life history and ecology

In Victoria, Squirrel Gliders feed on arboreal arthropods, particularly beetles and caterpillars, supplemented with plant products including honeydew, acacia gum, eucalypt pollen, nectar and sap. The proportion and importance of each food item in the diet may vary seasonally and between habitats, with pollen and nectar supplies being more predictable in the mixed-species forests and woodlands than in River Red Gum forests, where acacia gum and eucalypt sap may provide alternative winter energy sources (Menkhorst & Collier 1988, Menkhorst 1995). Rowley (1997) noted that most remaining Squirrel Glider sites in Victoria are associated with reliable sources of soil moisture (either from run-off, soil-soakage or rainfall), and postulated that the resultant high productivity (in terms of plant and invertebrate food resources) and inherent drought-resistance of these sites may provide reliable food sources.

Recorded predators of the Squirrel Glider include the Barking Owl *Ninox connivens* (Menkhorst 1995), Masked Owl *Tyto novaehollandiae* (Debus 1993), Powerful Owl *Ninox strenua* (Traill 1993b), introduced Red Fox *Vulpes vulpes* and feral Cat *Felis catus* (Fleay 1947, van der Ree 2002), and possibly Tree Goanna *Varanus varius* (Quin 1995).

Conservation status

DSE (2003) Endangered in Victoria

Maxwell et al. (1996) classified the Squirrel Glider (nationally) as 'Lower risk (near threatened)' under IUCN guidelines, indicating that the taxon does not qualify as 'Threatened', but is close to qualifying as 'Vulnerable'. In Victoria, the Squirrel Glider has been listed as a threatened taxon under the Flora and Fauna Guarantee Act 1988.

Decline and threats

Squirrel Gliders are patchily distributed across central and northern Victoria, with a major gap in distribution between western and eastern populations. In Victoria, Squirrel Gliders are now largely confined to isolated habitat remnants which are often severely degraded and ill-managed (Maxwell et al. 1996). The major threat to the species in Victoria has been, and remains, the process of habitat loss and fragmentation. Other threats include habitat changes associated with timber and firewood harvesting, the effects of grazing on habitat regeneration, and mineral extraction methods which remove potential habitat. Predation by introduced predators, and collisions with barbed-wire fencing, may be significant threats, at least in more disturbed sites near farmland. Rowley and Robinson (1996) identified recreational pressure along the Murray river as a threat to the animal in north central Victorian riverine forests.

No Victorian population estimate is available for the Squirrel Glider, but the number is probably less than 10 000 individuals. The minimum viable population size for most vertebrate species will vary according to many factors, and is best determined for any given population using population viability analysis (PVA) (Soulé 1987). Since, in the absence of suitable data, a PVA has not yet been performed for the Squirrel Glider in Victoria, a tentative minimum target of 1 000 breeding females is adopted in this Action Statement for short- to medium-term viability of the Victorian metapopulation (Shaffer 1981, Soulé 1987). Such a minimum population, in Victoria, would probably need to consist of several sub-populations.

In its Final Recommendation on listing the Squirrel Glider as a threatened taxon in Victoria, the Scientific Advisory Committee determined (SAC 1991) that the species is significantly prone to future threats which are likely to result in extinction; and very rare in terms of abundance or distribution.

While the gross distribution of the Squirrel Glider in Victoria has probably contracted little since settlement, the habitat within that range has been

drastically reduced and fragmented. Forest cover across the range of the Squirrel Glider is estimated to have declined by over 38% of pre-European levels (based on DEST 1995). The resultant metapopulation of Squirrel Gliders comprises at least 18 geographically discernible sub-populations, many of which have little or no prospect of genetic interchange with other sub-populations. Cessation of interchange between sub-populations not only increases the risk of inbreeding and loss of genetic variability, but precludes recolonisation in the event of local extinction.

Areas supporting apparent sub-populations (or 'strongholds') include the Stawell-Dadswells Bridge area, Gunbower State Forest, the Goulburn River between Murchison and the Murray River, Barmah-Nathalia, Colbinabbin, Bailieston-Graytown, Seymour-Puckapunyal, Longwood-Locksley, Euroa-Violet Town, Reef Hills State Park-Warrenbayne, Lurg-Greta West, Dookie-Tarnook, Warby Ranges State Park, the Lower Ovens River between Killawarra and the Murray River, Chiltern-Pilot National Park, King Valley, and the Kiewa River around Kergunyah (Menkhorst et al. 1988, Rowley 1997, NRE 1999, van der Ree 2000).

Squirrel Gliders occur in a number of State forests available for timber production. Timber harvesting has the potential to alter the species mix, although the objective of forest management is to regenerate with species and provenances native to the area, or general locality, in order to maintain the local genetic pools and species mixes. Timber harvesting also alters the age-class distribution of trees in production forests. Both of these factors could potentially limit the distribution and abundance of Squirrel Gliders. Forest Management Plans (FMPs) contain provisions to zone for modification or exclusion of harvesting in areas containing threatened fauna such as the Squirrel Glider. In State forest, timber harvesting prescriptions and guidelines can specify the number and size of trees (living and dead) to be retained per hectare in order to meet current and future wildlife needs, and outline measures to maintain the original balance of species representation in mixed stands during thinning operations. Ecological studies are now needed to determine whether existing forest management plans and prescriptions (including the abundance of trees with hollows) are adequate to conserve the Squirrel Glider within production forests. Squirrel Gliders occur in or adjacent to State forest in the Horsham, Bendigo and Mid-Murray Forest Management Areas (FMAs), and it is possible that they may occur in State forest in the North-East and Midlands Forest Management Areas (FMAs). In the Benalla-Mansfield FMA, the species appears to occur only in rural remnant habitats.

Wider conservation issues

Habitat fragmentation within the range of the Squirrel Glider has left a rural landscape with numerous small woodland remnants (generally < 30ha), many roadside and streamside strips and a few large remnants (> 200ha) (Bennett et al. 1994). Most remnant patches have become degraded due to various factors, such as edge effects (from adjacent cleared land), dieback, fire, pest or weed invasion, reduced dispersal of native species, decline in species diversity, changes in vegetation structure, altered groundwater regimes, salinity, nutrient inputs, erosion, overgrazing and firewood removal (Bennett 1993, ECC 1997). Subdivision often exacerbates these processes (Davidson 1996). Although Squirrel Gliders persist in many remnants of greatly varying area, the capacity of such disjunct habitats to sustain glider sub-populations in the long-term is not assured.

Mature and hollow-bearing trees are essential resources for Squirrel Gliders. While suitably large, old trees are frequently retained in woodland remnants on private land, lack of regeneration (mostly due to grazing) often means that eventual loss of tree cover in these remnants is inevitable. In contrast, roadside stands often contain trees of various age-classes (Bennett 1993, van der Ree & Bennett 2001). In drier box-ironbark forest, past heavy cutting and silvicultural practices have left many stands dominated by regrowth in which hollow-bearing trees may be scarce or absent (Soderquist 1999). It has been suggested that, within areas dominated by regrowth forest, habitat for Squirrel Gliders, and other hollow-dependent fauna, may be enhanced by carefully-controlled thinning operations aimed at increasing average tree size (Rowley 1997, ECC 1997).

In addition to limiting regeneration, grazing also causes soil compaction, trampling of the vegetation, weed invasion and other effects (ECC 1997), which reduce habitat values for the Squirrel Glider. A natural understorey in Squirrel Glider habitat helps to ensure the availability of plant and invertebrate food sources. A disconcerting level of mortality in rural remnants arises from Squirrel Gliders colliding with barbed-wire stock fences, a loss which could be mitigated by the use of plain wire on at least the top two strands (van der Ree 1999).

The frequency, intensity and seasonality of fire can influence Squirrel Glider habitat in many ways, most notably by influencing regeneration rates and the abundance of hollow trees (ECC 1997, Sharpe & Goldingay 1998). However, suitable fire regimes to protect and conserve existing and potential Squirrel Glider habitat remain to be determined.

Exploration and mining activities occur in a number of areas containing Squirrel Gliders

(notably in the Stawell, Heathcote, Rushworth and Chiltern areas). Mining on larger public land remnants where Squirrel Gliders occur is likely to coincide in places with the habitat of 'stronghold' sub-populations. Open-cut and alluvial mining operations require vegetation removal and can result in major ecological disturbance, including loss of habitat and fragmentation of remaining habitat (ECC 1997). Roads, power-lines, pipelines, channels and impoundments can all contribute to fragmentation and affect habitat values at specific sites (Rowley 1997).

The Squirrel Glider is one of a number of faunal species threatened with extinction in dry forest and woodland habitats in Victoria. Other species include the Brush-tailed Phascogale *Phascogale tapoatafa*, Regent Honeyeater *Xanthomyza phrygia*, Bush Stone-curlew *Burhinus grallarius*, Grey-crowned Babbler *Pomatostomus temporalis*, Swift Parrot *Lathamus discolor* and Turquoise Parrot *Neophema pulchella* and a range of woodland birds that are under the Flora and Fauna Guarantee-listed 'Victorian temperate-woodland bird community'. Management actions outlined in this Action Statement may also benefit these other species.

Existing conservation measures

Biology and research

A status overview for the species in Victoria first arose out of a Latrobe University study (Alexander 1981), and stimulated a more comprehensive investigation of the status, distribution and occurrence of the Squirrel Glider by the (then) Department of Conservation, Forests & Lands. This study also highlighted the need for more rigorous protection of the species and further research (Menkhorst & Collier 1988, Menkhorst et al. 1988).

During 1993-95, the (then) Department of Conservation and Natural Resources (CNR) carried out a major study of remnant habitats on the Northern Plains, collecting information on hollow-bearing trees as a basis for understanding the distribution and numbers of hollow-dependent fauna. Results from this work confirmed the importance of large, hollow-bearing trees to the long-term conservation of arboreal mammals (including the Squirrel Glider) (Bennett et al. 1998). A subsequent study of woodland fauna in the box-ironbark region, commenced in 1995, and involving researchers from the Museum of Victoria, NRE, and Monash and Deakin Universities, provided further information on habitat requirements of the Squirrel Glider (Bennett et al. 1999).

A Monash University study into Squirrel Glider population dynamics and habitat use in box-ironbark habitat was carried out (1988-91) at

Chiltern Box-Ironbark National Park (Traill 1995, Traill & Lill 1997) and a similar study of the species was undertaken (1996–2000) in linear woodland remnants near Euroa (van der Ree 2000, van der Ree & Bennett 2001, van der Ree 2002, van der Ree & Bennett 2003). These studies provided valuable insight into the management requirements of the Squirrel Glider and may assist in estimating the extent and densities of colonies in similar habitats elsewhere.

DSE-commissioned reports on the Squirrel Glider within the key habitats of Benwall, Guttrum and Gunbower forests (Rowley and Robinson (1996) and the North-East and Benalla-Mansfield FMAs (Rowley 1997) yielded useful ecological insights on the distribution of the species. DSE also prepared a report on the status and resource needs of threatened hollow-dependent fauna (including the Squirrel Glider) in box-ironbark forests of the Bendigo FMA (Alexander 1997).

Land use and management planning

In its Final Recommendations for public land use in the North Central Area, the former Land Conservation Council recommended management of road reserves in the Colbinabbin area specifically as 'sites of significant habitat' for the Squirrel Glider (LCC 1981).

In 1993, the Bendigo Field Naturalists Club undertook a study for CNR of sites on private and public land having potential 'drought refuge' benefit to box-ironbark fauna, including the Squirrel Glider. The study covered the Campaspe, Goulburn and Loddon catchments, and provided detailed recommendations for strategic habitat management in these areas (Robinson & Rowley 1994). In 1995, CNR mapped (from the air) a corridor of habitat potentially suitable for the Squirrel Glider along the Goulburn River (up to 200m from each bank), downstream of Murchison. This information has been used in forest management planning.

In 1996, the LCC commenced a special investigation of box-ironbark forests and woodlands in northern Victoria. The Environment Conservation Council (ECC), which replaced the LCC in 1997, has published the Final Recommendations from this investigation (ECC 2001). Draft Heritage River management plans, contain provisions that would improve and enhance Squirrel Glider habitation the Goulburn and Lower Ovens Rivers (NRE 1997).

Forest management plans for Midlands Forest Management Area (FMA) (NRE 1996), North East (2001) and Mid-Murray FMA (NRE 2002) include conservation guidelines that provide for the management of Squirrel Glider habitat.

Community information and education

A Victorian National Parks Association conference on Box and Ironbark Woodland Conservation was held at Benalla in 1993. This meeting proposed management measures of potential benefit to the Squirrel Glider. These were published in the Victorian Naturalist (February 1993).

During 1990-1996, Land for Wildlife program produced a range of advisory articles on the management of native vegetation on private land. Many of these are directly applicable to the conservation of Squirrel Glider habitat. In June 1997, a brochure about the Squirrel Glider was published by NRE.

Healesville Sanctuary (Zoological Parks and Gardens Board of Victoria) maintains a captive breeding colony of Squirrel Gliders, for education and display purposes.

Legislation

In 1991, Amendment S16 to the State Section of all planning schemes in Victoria placed controls upon the removal, destruction and disturbance of native vegetation.

'Predation of native wildlife' by Cats and by Red Foxes, respectively, have been listed under the Flora and Fauna Guarantee Act 1988 as 'potentially threatening processes', and Action Statements have been prepared for both. The 'loss of hollow-bearing trees from Victorian forests' and 'habitat fragmentation' are also listed, and Action Statements are in preparation.

Major Conservation Objectives

Long term objective

That the Squirrel Glider can survive, flourish and retain its potential for evolutionary development in the wild.

Objectives of this Action Statement

1. to prevent further decline of sub-populations, by protecting, enhancing and expanding suitable habitat;
2. to ensure security in the short-term of a Victorian metapopulation containing at least 1 000 breeding females in specified areas;
3. to determine parameters by which to characterise, in a longer-term context, viable sub-populations and a viable Victorian metapopulation;
4. to reinstate strategic habitat links, or establish other interim mechanisms for genetic interchange, or both, between currently discrete sub-populations.

Intended Management Actions

The intended management actions listed below are further elaborated in DSE's Actions for Biodiversity Conservation database. Detailed information about the actions and locations, including priorities, is held in this system and will be provided annually to land managers and other authorities.

Survey and monitoring

1. Determine the approximate size and extent of all known Victorian Squirrel Glider sub-populations and identify and document important Squirrel Glider sites (such as high-quality habitat within key sub-populations) on relevant databases and maps.

Responsibility: DSE (Biodiversity & Natural Resources Division)

2. Provide information, including maps of important Squirrel Glider habitat and guidelines for its management, to land managers and other authorities, especially Catchment Management Authorities and local government authorities.

Responsibility: DSE (Biodiversity & Natural Resources Division, Regions)

3. Establish and implement a protocol for monitoring the status of Squirrel Glider sub-populations, using standard, repeatable methods which can be readily undertaken by management personnel or local volunteers

Responsibility: DSE (Biodiversity & Natural Resources Division, Parks & Forests Division, Regions), Parks Victoria

Habitat protection, enhancement and restoration

4. Incorporate actions to protect, enhance and restore Squirrel Glider habitat into relevant Regional Catchment Strategies or their subordinate strategies via Biodiversity Action Plans. Implement these actions, according to priority, as resources become available, in conjunction with other agencies, community groups and landholders.

Responsibility: Catchment Management Authorities

5. Develop and implement programs to enhance riparian habitats on major riverine corridors between known Squirrel Glider sub-populations (notably, along the Goulburn, Broken, King, Ovens and Kiewa Rivers downstream of Yea, Swanpool, Whitfield, Myrtleford and Dederang, respectively, and along the Murray River, from Wahgunyah to Koondrook), taking into account any existing Heritage River management plans.

Responsibility: Goulburn Broken North Central and North East Catchment Management Authorities, DSE (North East and Northern Irrigation Regions)

6. Establish forest management zones and prepare appropriate prescriptions to conserve Squirrel Glider sub-populations and their habitat in State forests, addressing issues such as appropriate fire regimes, retention of large trees, firewood collection, grazing and management of recreational areas. Ensure that habitat trees are protected during fuel reduction or ecological burns.

Responsibility: DSE (Parks & Forests Division, Regions)

7. Conserve Squirrel Glider sub-populations and their habitat in parks and reserves through appropriate zoning and active management, addressing issues such as fire regimes, firewood collection, grazing and management of recreational areas. Ensure that habitat trees are protected during fuel reduction or ecological burns.

Responsibility: Parks Victoria

8. Develop and apply local planning schemes and overlays to conserve Squirrel Glider sub-populations and their habitat on private land.

Responsibility: local government authorities

9. Review grazing licences on public land (such as Bushland and Streamside Reserves, water frontages and unused roads) in key areas outside State forests and, in consultation with licensees, modify or exclude grazing where this may benefit Squirrel Gliders.

Responsibility: DSE Regions, Parks Victoria

10. Ensure that management of roadsides in or near Squirrel Glider sites protects or enhances existing habitat.

Responsibility: Vicroads, local government authorities

11. Ensure that mineral exploration, mining and extractive industry activities are planned and conducted to minimise impacts on important Squirrel Glider habitat. Where impacts are unavoidable, ensure that rehabilitation works enhance or restore important Squirrel Glider habitat.

Responsibility: DSE (Regions), Parks Victoria

12. Assess the threat posed by competition for hollows from introduced birds and feral honey bees and by predation by foxes and cats. Where a significant threat is identified, take appropriate mitigating action. Encourage landholders to participate in threat assessment and management.

Responsibility: DSE (Regions), Parks Victoria

13. Provide a range of incentives for landholders to protect, enhance or restore Squirrel Glider habitat. Options include covenants, the

BushTender program, rate relief and funding for habitat protection works.

Responsibility: Trust for Nature, Catchment Management Authorities, local government authorities, DSE (Regions)

Training and extension

14. Develop and deliver training and extension activities and products regarding the biology of the Squirrel Glider and the management of its habitat, targeting land management agency staff, community groups and landholders.

Responsibility: DSE (Biodiversity & Natural Resources Division, Regions)

Research

15. Conduct or encourage and support research into the Squirrel Glider, including the following priorities:

- Determine the characteristics of optimum habitat for the Squirrel Glider and ensure that subsequent management actions are appropriately targeted at such habitat.
- Conduct population viability analyses using data from studies and surveys to evaluate the viability of existing sub-populations and of the Victorian metapopulation; and to predict minimum viable colony sizes for various habitats.
- Investigate levels of genetic diversity within and between sub-populations and determine whether genetic interchange should be artificially facilitated between any sub-populations.
- Investigate the applicability of ecological stand-thinning as a management tool to enhance Squirrel Glider habitat, in conservation reserves dominated by regrowth forest.

Responsibility: DSE (Biodiversity & Natural Resources Division, Parks & Forests Division), Parks Victoria

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Further information can be obtained from Department of Sustainability and Environment Customer Service Centre on 136 186.

Flora and Fauna Guarantee Action Statements are available from the Department of Sustainability and Environment website: <http://www.dse.vic.gov.au>

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