Barbed Wire Fencing as a Hazard for Wildlife

Rodney van der Ree[1]

Abstract
Anecdotal reports from landholders and biologists suggest that the entanglement and subsequent death of animals on barbed wire fences is widespread in Australia. In this report, I collate records of at least 62 species of wildlife that have become entangled on barbed wire fences in Australia. This paper is divided into two components; the first focuses on an area near Euroa in northern Victoria as a case study, and the second lists records from throughout Australia. In the Euroa study area, the species most commonly encountered on fences were gliding marsupials (Sugar Glider *Petaurus breviceps* and Squirrel Glider *P. norfolcensis*) (26 individuals), followed by birds (7 individuals). On a continental scale, species found entangled in barbed wire include gliding marsupials, flying-foxes, aquatic birds, night birds and birds of prey. Records were collected from a wide range of habitats and localities, including the urban-rural fringe, forests and woodlands, agricultural landscapes, semi-arid areas and around water bodies. All individuals were found entangled with barbed wire, and more than 95% of entanglements occurred on standard height farm fencing. Recommendations for alternatives to barbed wire fencing are discussed. (*The Victorian Naturalist* **116** (6), 1999, 210-217.)

Introduction

During a study of the ecology of arboreal marsupials in a network of roadside and streamside vegetation near Euroa, Victoria, a number of Squirrel Glider *Petaurus norfolcensis* and Sugar Glider *P. breviceps* carcasses were discovered suspended from barbed wire fences (Fig. 1). There have been several incidental observations of such deaths for a range of species in Australia and overseas (Russell 1980; Allen and Ramirez 1990; Andrews 1990; Krake 1991; Nero 1993; Land for Wildlife 1994; Platt and Temby 1994; Johnson 1995; Anonymous 1996; Tischendorf and Johnson 1997; van der Ree 1997; Campbell 1998; Johnson and Thiriet 1998) but the extent of this problem is still relatively unknown. The aim of this study was to quantify the extent of the situation by collecting records from a range of sources and describing the actual event (e.g. species, fence type, which strand of wire, location).

Study area and methods

Case study – Euroa, Victoria

The study area lies within the northern plains of Victoria and is bounded by the towns of Euroa, Violet Town, Nagambie, Avenal and Murchison. Formerly dominated by open eucalypt woodland, there is now 3.6% remnant vegetation cover, approximately 85% of which occurs as linear strips along roads and streams (van der Ree, *unpubl. data*). The remaining 15% is made up of small patches of woodland. The major land use is agriculture, with extensive dryland cropping and grazing (Bennett *et al.* 1998).

Observations of animals caught on barbed wire fences were made opportunis-

Fig. 1. Dead Squirrel Glider *Petaurus norfolcensis* caught in a barbed wire fence. Photo by R. van der Ree.

[1] School of Ecology and Environment, Deakin University, Rusden Campus, 662 Blackburn Rd, Clayton, Victoria 3168.

Table 1. Observations of wildlife entangled with barbed-wire fencing from the Euroa case study area. Species listed in taxonomic order according to Christidis and Boles (1994) (birds) and Menkhorst (1995) (mammals).

Species	Scientific name	Number of individuals	Fence type	Wire type
Mammals				
Squirrel Glider	*Petaurus norfolcensis*	15	f	b
Sugar or Squirrel Glider	*Petaurus* sp.	11	f	b
Birds				
Spoonbill	*Platalea* sp.	1	f	b
Rock Dove	*Columba livia*	1	f	b
Galah	*Eolophus roseicapilla*	1	f	b
Southern Boobook	*Ninox novaeseelandiae*	1	f	b
Australian Magpie	*Gymnorhina tibicen*	2	f	b
White-winged Chough	*Corcorax melanorhamphos*	1	f	b

Fence type: f = standard height farm fence. Wire type: b = barbed wire.

tically while undertaking fieldwork on the ecology of arboreal marsupials. Additional records were obtained from local landholders. There was no systematic searching to detect entangled animals, and consequently the results of this study are likely to underestimate the severity of the problem.

Whenever possible, the following parameters were obtained for each entanglement:

- date found;
- approximate time since death or entanglement;
- species, sex and approximate age (the approximate age of *Petaurus* species was determined using the level of upper incisor wear (refer Suckling 1984; Quin 1995);
- location (latitude and longitude), and description of site;
- the point of entanglement on the animal's body (e.g. wing, neck, tail, gliding membrane);
- the fence characteristics (fence type, barbed or plain wire strand, strand position in the fence).

Australia-wide Perspective

This section is a preliminary report of records from a wide range of people across Australia and is intended to highlight the issue and present initial findings. I collated the same information as that collected for the Euroa study area, from sources including Field Naturalist groups, Landcare groups, landholders and biologists, between 1996 and the present. I also requested records from members of the Ecological Society of Australia, Australasian Wildlife Management Society, Field Naturalist Club of Victoria, and Birds Australia via their electronic mail discussion lists and newsletters. The wildlife atlas data-bases from Victoria and New South Wales were investigated, as was the Wildlife Information and Rescue Service (WIRES) data-base.

Results

Euroa study area

Number and type of species entangled

A total of 33 animals was recorded entangled on barbed wire between 1994 and 1998 in the Euroa study area (Table 1). Fifteen were positively identified as Squirrel Gliders and 11 gliders could not be reliably identified to species and are referred to as *Petaurus* sp. (this group includes only Sugar Gliders and Squirrel Gliders). Other species entangled with barbed wire fencing included the Australian Magpie *Gymnorhina tibicen* (2 individuals) (Fig. 2), and a single Rock

Fig. 2. Ausralian Magpie *Gymnorhina tibicen* caught on barbed wire fence. Photo by R. van der Ree.

Table 2. Point of entanglement of gliders found on barbed wire fences in the Euroa study area, 1994-1998. No. = number of gliders found.

Point of entanglement	No.
Tail only	11
Tail and gliding membrane	4
Gliding membrane and leg	2
Unable to tell (decomposed too far)	3
Not recorded	6
Total found	**26**

Dove (Feral Pigeon) *Columba livia*, Spoonbill *Platalea* species, Southern Boobook *Ninox novaeseelandiae,* White-winged Chough *Corcorax melanorhamphos* and Galah *Eolophus roseicapilla*.

Fence characteristics

All individuals were entangled with barbed wire on standard farm fences approximately one metre high. The apparent point of entanglement of the animal was with the barb on the wire. Where entanglement position was recorded (n=17), 12 entanglements occurred on the top strand of the fence, one occurred on the second strand from the top, and four occurred on the third strand from the top. Once caught on the barbed wire, it appeared that many gliders and birds became further entangled as they struggled to free themselves. On one occasion, the strand of wire was cut and the glider taken, with the wire *in-situ*, to a wildlife shelter for removal and rehabilitation. In the Euroa study area, all 33 records occurred where fences were positioned between cleared paddocks and vegetated roadsides.

Carcass characteristics

The advanced decomposition of many carcasses limited observations on the sex and age of the animals. Four female and one male Squirrel Glider were identified; the sex of 21 gliders and seven birds was not determined. Using the degree of tooth wear on the upper incisors of the gliders as an index of age, four individuals were identified as juvenile and four as adults. Age was not determined for the remaining 18 gliders or seven birds.

For gliders, the most common point of entanglement was the tail (11 records) (Table 2), followed by a combination of the tail and gliding membrane (four records) and the gliding membrane and leg (two records). Three gliders were too decomposed to determine the point of entanglement, and point of entanglement was not recorded for six individuals. Only two gliders were found alive and released, and these were entangled by the tail only. One magpie was entangled by a combination of wing and neck, and the feral pigeon was caught by its leg ring; the point of entanglement was not recorded for the remaining birds.

Australia-wide perspective

Number and type of species entangled

Sixty-two species of wildlife have been observed entangled with barbed wire fencing across Australia (Table 3). The types of species include gliding marsupials, bats, ground-dwelling birds, water birds, night birds and birds of prey. The most numerous group reported entangled with barbed wire fencing were flying foxes from northern Australia. The Little Red Flying-fox *Pteropus scapulatus* appears particularly susceptible to entanglement in north Queensland, with a published report of over 450 individuals entangled in one year (Johnson 1995), and another respondent reported 200 individuals on one fence at the same time (Jon Luly, *pers. comm*.). Many respondents reported observing numerous macropods (Black Wallaby *Wallabia bicolor*, Eastern Grey Kangaroo *Macropus giganteus,* Western Grey Kangaroo *M. fuliginosus*, and Red Kangaroo *M. rufus)* and Emus *Dromaius novaehollandieae* with their legs entangled in the top two strands of fences but could not give detailed information about specific incidents because of the regularity with which they were observed. This problem is not specifically related to barbed wire, as plain wire also entraps kangaroos and Emus by their legs as they attempt to jump the fence, and hence these records have not been included in Table 3.

Mesh fencing may pose a barrier to those species that are too large to pass through the mesh and unable to jump or climb over the fence. Certain species of reptile appear to be particularly susceptible because their rear facing scales and body shape allows them to place their heads through the tightly fitting mesh – but does not allow the rest

Table 3. Observations of wildlife entangled with barbed-wire fencing from across Australia (excluding the Euroa case study records) as reported by volunteer observers. Species listed in taxonomic order according to Christidis and Boles (1994) (birds) and Menkhorst (1995) and Strahan (1983) (mammals).

Species	Scientific name	State (Number of individuals)	Fence type	Wire type
Mammals				
Koala	*Phascolarctos cinerus*	NSW (2), QLD (4)	f	b, m
Greater Glider	*Petauroides volans*	Vic (2), NSW (6), Qld (4)	f	b
Yellow-bellied Glider	*Petaurus australis*	Vic (3), NSW (3), Qld (8)	f	b
Sugar Glider	*Petaurus breviceps*	Vic (25) NSW (9), Qld (44)	f, c	b
Squirrel Glider	*Petaurus norfolcensis*	Vic (24), NSW (12), Qld (5)	f	b
Sugar or Squirrel Glider	*Petaurus sp.*	Vic (12) NSW (1)	f	b
Mahogany Glider	*Petaurus gracilis*	Qld (5)	f	b
Brush-tailed Bettong	*Bettongia penicillata*	Qld (1)	f	b
Tasmanian Pademelon	*Thylogale billardierri*	Tas (1)	f	b
Grey-headed Flying-fox	*Pteropus poliocephalus*	Qld (4), NSW (3)	f, c	b
Little Red Flying-fox	*Pteropus scapulatus*	Qld (666^), NSW (5), NT (6), WA (1)	f, c	b
Black Flying-fox	*Pteropus alecto*	Qld (23), NSW (81), NT (20)	f, c	b
Spectacled Flying-fox	*Pteropus conspicullatus*	Qld (25)	f, c	b
Flying-fox	*Pteropus* sp.	NSW (4), Qld (2), NT (75)	f, c	b
Queensland Tube-nosed Bat	*Nyctimene robinsoni*	Qld (41)	f, c	b
Ghost Bat	*Macroderma gigas*	NT (1)	f	b
White-striped Freetail Bat	*Tadarida australis*	Vic (1)	f	b
Long-eared Bat	*Nyctiphilus* sp.	NSW (1)	f	b
Microchiropteran Bat	species unknown	NSW (1), Qld (2)	f	b
Grassland Melomys	*Melomys burtoni*	NSW (1)	f	b
Red Fox	*Vulpes vulpes*	Vic (1)	f	b
Birds				
Southern Cassowary	*Casuarius casuarius*	Qld (1)	f	b
King Quail	*Coturnix chinensis*	NSW (2)	f	b
Australian Wood Duck	*Chenonetta jubata*	Qld (1)	f	b
Pacific Black Duck	*Anas superciliosa*	NSW (3), Qld (1)	f	b
Hoary-headed Grebe	*Poliocephalus poliocephalus*	Vic (1)	f	b
Short-tailed Shearwater	*Puffinus tenuirostris*	Vic (<5)	f	b
Australian Pelican	*Pelecanus conspicillatus*	Vic (1)	f	b
White-faced Heron	*Egretta novaehollandiae*	Vic (1), NSW (3)	f	b
White-necked (Pacific) Heron	*Ardea pacifica*	Vic (1)	f	b
Nankeen Night Heron	*Nycticorax caledonicus*	NSW (1)	f	b
Royal Spoonbill	*Platalea regia*	Qld (2)	f	b
Wedge-tailed Eagle	*Aquila audax*	Vic (1)	f	b
Brown Falcon	*Falco berigora*	NSW (1)	f	b
Australian Hobby	*Falco longipennis*	NSW (1), Vic (1)	f	b
Peregrine Falcon	*Falco peregrinus*	Vic (1)	f	b
Sarus Crane	*Girus antigone*	Qld (1)	f	b
Buff-banded Rail	*Gallirallus philippensis*	Qld (4)	f	b
Little Button-quail	*Turnix velox*	NSW (2)	f	b
Red-chested Button-quail	*Turnix pyrrhothorax*	NSW (1)	f	b
Lathams Snipe	*Gallinago hardwickii*	NSW (1)	f	b
Bush Stone-curlew	*Burhinus grallarius*	Qld (2)	f	b
Black-fronted Dotterel	*Charadrius melanops*	Vic (1)	f	b
Masked Lapwing	*Vanellus miles*	Vic (1), Qld (1)	f	b
Silver Gull	*Larus novaehollandiae*	Vic (<5)	f	b
Little Corella	*Cacatua sanguinea*	Qld (1)	f	b
Sulphur-crested Cockatoo	*Cacatua galerita*	Qld (1)	f	b
Red-rumped Parrot	*Psephotus haematonotus*	Vic (1)	f	b
Southern Boobook	*Ninox novaeseelandiae*	NSW (1), Qld (1), Vic (3)	f	b
Masked Owl	*Tyto novaehollandiae*	NSW (2)	f	b
Barn Owl	*Tyto alba*	NSW (2), Qld (1), Vic (3)	f	b
Grass Owl	*Tyto capensis*	Qld (1), SA (1)	f	b
Tawny Frogmouth	*Podargus strigoides*	Qld (2), SA (2), Vic (4)	f	b
Australian Owlet-nightjar	*Aegotheles cristatus*	Vic (1)	f	b

Table 3 continued.

Species	Scientific name	State (Number of individuals)	Fence type	Wire type
Laughing Kookaburra	*Dacelo novaeguineae*	NSW (2), Vic (1)	f	b
Dollarbird	*Eurystomus orientalis*	Qld (1)	f	b
Eastern Spinebill	*Acanthorhynchus tenuirostris*	NSW (1)	f	b
Magpie-lark	*Grallina cyanoleuca*	Vic (1)	f	b
Willie Wagtail	*Rhipidura leucophrys*	Qld (1)	f	b
Australian Magpie	*Gymnorhina tibicen*	ACT (1), Qld (2), SA (2), Vic (1)	f, c, na	b
Silvereye	*Zosterops lateralis*	Vic (1)	f	b
Common Starling	*Sturnus vulgaris*	Vic (1)	f	b

^ = Includes records of 200 individuals (Jon Luly *pers. comm*.) and 450 individuals from Ravenshoe district, north Queensland Fence type: f = standard height farm fence, c = 6 to 8 foot cyclone wire mesh fence, na = not assessed Wire type: b = barbed wire, m = mesh.

of their bodies to pass through or retreat. Goats were reported to become entangled with mesh fencing as their horns prevent them from removing their heads from the wire mesh once pushed through. Electrified strands of wire too close to the ground may electrocute Short-beaked Echidnas *Tachyglossus aculeatus* if they attempt to push underneath the wire. Fatal collisions by various bird species with mesh fencing was frequently recorded.

Wildlife also became entangled with wire in non-fence situations; a Kookaburra *Dacelo novaeguineae* was found impaled on a protruding wire on a tree-guard, five White-throated Needletails *Hirundapus Caudacutus* and Black Swans *Cygnus atratus* were observed dead on overhead powerlines and a small insectivorous bat was impaled by a piece of wire on the top of a shed.

Records of fauna entangled with barbed wire were received from across the Australian continent. Wildlife were entangled with barbed wire fences in a wide range of habitats, including arid and semi-arid rangelands, temperate woodlands, forests, rainforest, wetlands, urban areas and the rural-urban interface.

Discussion

A localised and widespread problem

The most commonly encountered species entangled with barbed wire in the Euroa area was the Squirrel Glider. In parts of the study area, roadside vegetation supports high densities of the Squirrel Glider and other arboreal marsupials (van der Ree, *unpubl. data*). The total number of Squirrel Gliders that became entangled with barbed wire is probably much greater than that reported here because many carcasses could not be reliably identified. Moreover, this report only includes those individuals that have been found and reported. In Victoria, the Squirrel Glider is present in only a few large reserves (e.g. Chiltern National Park, Killawarra State Park) and is largely restricted to small patches of woodland habitat or linear reserves along roads and streams. This species has undergone a significant decline in abundance and in Victoria is classified as vulnerable to extinction (CNR 1995). The additional threat of mortality from barbed wire fences for small and isolated populations may be detrimental to their long-term persistence.

The records collated from across Australia indicate that the problem is widespread. Records were collected from all states of Australia, with most originating from the eastern mainland states. The absence of records from many areas may be due to a paucity of observers and entanglements going unreported rather than an absence of entanglements. As many entanglements undoubtedly go unobserved and unreported, the results of this study must be considered an underestimation. To realise the full extent of the problem, observations of entanglements need to be reported and systematically collated. Of the data-bases interrogated, only the New South Wales Wildlife Atlas was able to easily retrieve records of wildlife entangled with fences. It would be useful for other data-bases to include a specific code for records that originate from such entan-

glement so that in future the extent of the situation can be accurately described.

Wildlife behavior

In the Euroa area, 85% of remnant vegetation occurs along roads and streams, and the remaining 15% as small patches. The practice of fencing on both sides of roads, streams and around patches places wildlife at risk of encountering a fence. The movement patterns and behaviour of Squirrel Gliders (as revealed by radiotelemetry) in the Euroa area (van der Ree, *unpubl. data*) may increase the risk of becoming entangled with barbed wire fences. Squirrel Gliders, and probably other gliders, risk entanglement with barbed wire fencing when gliding to and from woodland vegetation in paddocks and along roads and streams. Gliders also glide diagonally across corners at 90° intersections to minimise travel distance and energy demands. These behaviours require the glider to regularly cross fencelines. The potential for entanglement also increases as gliding distance increases; the longer the glide, the lower the animal will land on its target tree and the closer it is to the height of the barbed wire fence.

The placement of barbed wire fences in activity paths of other species may also increase the rate of entanglement. In north Queensland, barbed wire fences in fruit bat flight paths regularly cause the entanglement and mortality of at least five species of fruit bat. Removal of bats from barbed wire fences may place humans at risk of infection with bat viruses, and extreme care should be taken when removing these animals[1]. New fencing erected in existing wildlife travel paths can cause the entanglement and death of many individuals. Many respondents reported that kangaroos appear to be highly susceptible to entanglement in new fencing, and that consideration to wildlife movements when designing fences can minimise the problem.

There were insufficient data to determine whether mortality by collision and entanglement with barbed wire is specific to age or sex in any group of species.

[1] Guidelines on how to handle bats are given at the following web address: http://www.bushnet.qld.edu.au/~melissa/ffnff/

Management implications

Habitat restoration and revegetation is a goal of many government agencies, conservation groups and landholders. Fencing is essential to control stock access in order to protect native vegetation and allow for natural regeneration of palatable species. Wildlife populations in many rural areas have already undergone considerable declines, and often exist in small isolated patches of habitat. The loss of individuals by entanglement with fencing is an avoidable and unnecessary additional threat. All fencing that utilises barbed wire to conserve or protect vegetation may conceivably place the fauna using that habitat at risk of local extinction.

High risk areas

It appears from these results that areas of potentially high risk can be identified:

- Highly fragmented areas where animals must regularly cross barbed wire fences to reach different parts of their habitat. This is particularly apparent in the Euroa study area and is probably true for many agricultural areas.
- Regular flight paths for bats and birds, and movement paths for mammals that may include areas of fragmented and continuous habitat.
- Areas with high density populations of species vulnerable to entanglement such as marsupial gliders in the Euroa case study and fruit bats in north Queensland.
- Wetland areas where barbed wire is exposed above the water level.

Fencing alternatives

For an alternative fencing style to be adopted, it must be of equal or greater benefit for stock management. Depending on the farming enterprise, a number of alternatives to barbed wire are available:

- Plain high-tensile fencing wire, if tensioned correctly, can contain most stock. When a fence is being constructed with new materials, consider using multiple strands of high tensile plain wire or plain wire and ringlock mesh (but beware using fine mesh which may also entrap animals or act as a barrier to movement).
- If additional security is required, investigate the option of electric fencing instead of barbed wire. However, beware of the potential risk of electrocution of wildlife.

- If using existing fenceposts, consider removing the existing strands of barbed wire and replacing them with plain wire. In addition, consider adding an electrified strand to the fence for increased security.
- If a plain wire or ringlock mesh option does not offer sufficient security, an electrified strand is not feasible, and the use of barbed wire can not be avoided, then consider avoiding barbed wire on the top two or three strands of the fence – this will reduce, but not eliminate the risk. In high-risk areas, use plain wire or sheath the barbed wire inside poly-pipe to protect animals from the barbs.
- Design the fence to avoid right angles where marsupial gliders may cross diagonally across the corner (Fig. 3), such as at the intersection of two road reserves. This would benefit other wildlife by creating extra habitat as well as reducing fencing costs.

Future investigation should consider:

- Documenting the extent of the problem more fully by government agencies and wildlife rehabilitation organisations through wildlife databases by specifically including 'entanglement with barbed wire' as the cause of death.
- Investigating alternative fence designs that contain stock, are cost-effective to erect and maintain, and do not pose a threat to wildlife.
- Education programs to ensure land managers are aware of the potential risk to wildlife and are able to identify high risk areas or 'hot spots'.

Government agencies and other bodies providing funds for fencing and revegetation projects should consider these findings and encourage the use of non-barbed wire alternatives as a condition for receiving funding. This will reduce the amount of barbed wire fencing being erected, and as old fences are gradually replaced with non-barbed wire alternatives, the loss of fauna to barbed wire fencing will be greatly reduced.

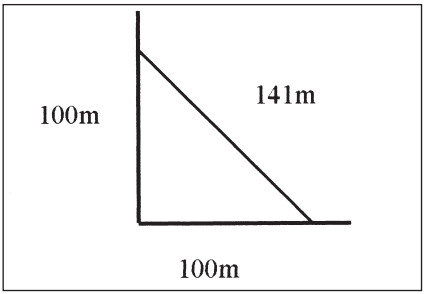

Fig. 3. Fencing diagonally at a 90° corner reduces the amount of fencing materials required, provides additional habitat for wildlife, and potentially minimises the risk of entanglement by wildlife.

Acknowledgements

This is a contribution from the Landscape Ecology Research Group, Deakin University. The financial support of the Holsworth Wildlife Research Fund is gratefully acknowledged. I thank the 120 plus people who provided me with their observations on wildlife mortality associated with fencing and for discussions about fencing requirements. Thanks also to the landholders and residents of the Euroa district who initially alerted me to the problem and gave generously of their time and local knowledge. I thank Andrew Bennett, Jenny Wilson and Sally Kimber and an anonymous reviewer for comments on the manuscript.

References

Allen, G.T., and Ramirez, P. (1990). A review of bird deaths on barbed wire. *The Wilson Bulletin* **102** (3), 553-558.

Andrews, A. (1990). Fragmentation of habitat by roads and utility corridors: a review. *Australian Zoologist* **26** (3), 3-4.

Anonymous (1996). Wings and prayers. The Kookaburra. *Outdoor Australia* August - September, 23-24.

Bennett, A.F., Brown, G., Lumsden, L., Hespe, D., Krasna, S., and Silins, J. (1998). 'Fragments for the future. Wildlife in the Victorian Riverina (the Northern Plains)'. (Department of Natural Resources and Environment: East Melbourne.)

Campbell, J. (1998). More on fishing line - and another barbed hazard. *Victorian Wader Study Group Bulletin* **22** (July), 59.

Christidis, L., and Boles, W.E. (1994). 'The taxonomy and species of birds of Australia and its territories'. (Royal Australian Ornithologists Union: Melbourne.)

CNR (1995). Threatened Fauna in Victoria. (Department of Conservation and Natural Resources.)

Johnson, A. (1995). A real nightmare for little reds. *Newsletter of the Friends of the Far North Flying Foxes* **2** (October).

Johnson, A., and Thiriet, D. (1998). Barbed wire fences and flying foxes don't mix. *Animals Today* February - April, 10-11.

Krake, G. (1991). Observation of a dynastid beetle impaled on barbed wire. *Victorian Entomologist* **21**, 61.

Land For Wildlife (1994). Untitled. *Land for Wildlife News* **2** (3), 9.

Menkhorst, P.W. (ed.) (1995). 'Mammals of Victoria: Distribution, ecology and conservation'. (Oxford University Press: South Melbourne.)

Nero, R.W. (1993). Northern flying squirrel and red bat caught on barbed-wire. *Blue Jay* **51**, 215-216.

Platt, S., and Temby, I. (1994). Fencing wildlife habitat. Land for Wildlife Note Number 29, p. 4.

(Department of Conservation and Natural Resources.)
Quin, D.G. (1995). Population ecology of the Squirrel Glider (*Petaurus norfolcensis*) and the Sugar Glider (*P. breviceps*) (Marsupialia, Petauridae) at Limeburners Creek, on the central north coast of New South Wales. *Wildlife Research* **22**, 471-505.
Russell, R. (1980). 'Spotlight on Possums'. (University of Queensland Press: St Lucia, Queensland.)
Strahan, R. (1983). 'The Australian Museum Complete Book of Australian Mammals'. (The Australian Museum: Sydney.)
Suckling, G.C. (1984). Population ecology of the sugar glider, *Petaurus breviceps*, in a system of fragmented habitats. *Australian Wildlife Research* **11**, 49-75.
Tischendorf, J.W., and Johnson, C.L. (1997). Long-eared owl snagged on barbed-wire fence. *Blue Jay* **55**, 200.
van der Ree, R. (1997). Barbed wire a hazard to wildlife. *Land for Wildlife News* **3** (6), 11.