Minimising the swift parrot collision threat

Guidelines and recommendations for parrot-safe building design

Threatened Species Network

Australian Government

WWF

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Author: Stephanie Pfennigwerth, Melampus Media

WWF-Australia

Head office

Level 13, 235 Jones St

Ultimo NSW 2007

Tel: +612 9281 5515

Fax: +612 9281 1060

www.wwf.org.au

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For copies of this report please contact the TSN Coordinator, (03) 9669 1304, tsnvic@wwf.org.au.

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Summary

The swift parrot, *Lathamus discolor*, is listed nationally as Endangered. It is also listed under threatened species legislation in every State and Territory in which it occurs. Only about 1,000 breeding pairs remain in the wild.

The main threat to the swift parrot is habitat loss due to land clearing for agriculture, forestry, and urban and industrial development. As human development encroaches into nesting and foraging habitat, the birds are being forced into increasing contact with human-made structures. Up to 2% of the entire swift parrot breeding population is killed every year as a result of collisions with windows, fences (especially chain-link fences) and vehicles. Although this figure seems low, it assumes a greater significance considering the small number of birds in existence, and the increasing human encroachment into key swift parrot habitat. Each death signifies not just the loss of an individual, but also a threat to the long-term survival of the species: the death of a breeding adult, for example, may also represent the loss of up to six chicks each breeding season.

Measures employed in the planning, design and operation stages of buildings and other structures, particularly in areas identified as swift parrot 'collision hotspots', will do much to prevent bird injury and death. This report contains design-based guidelines and recommendations intended for use by planners, urban designers, developers, architects, landscape architects, building designers, builders and other construction industry stakeholders, homeowners, and the owners and operators of other buildings. The report discusses the swift parrot's behavioural ecology, collision threats and identifiable 'collision hotspots', and a variety of preventative and rehabilitative strategies to minimise collisions. Finally, it advocates for regulatory and educational initiatives, including improvements to existing regulatory processes, in order to secure better outcomes for this endangered species. The recommendations contained within will also be beneficial to a multitude of other bird species.

1.0 The workshop

'Close to Sydney it was not uncommon to note … groups of 200 or more birds. A flock of between five and six hundred individuals was recorded at west Pymble and it was estimated that, in some localities, thousands of birds were present throughout June and July. One of us … watched a movement at Lane Cove on June 29, and considered that more than 1,000 individuals passed between two clumps of trees, in which they were feeding, during a period of not more than twenty minutes.'[1]

K. A. Hindwood made the above observation of swift parrots in 1958. Just fifty years later, the swift parrot is an endangered species, with possibly less than 1,000 breeding pairs left in the wild.[2] While the greatest threat to the swift parrot is habitat loss and fragmentation, collisions with human-made structures kill sometimes dozens of birds every year.

'When around 2 per cent of an endangered species can be killed in collisions … in a short period, and the threat remains, then we have the makings of a serious conservation problem.'[3]

The Draft Swift Parrot Recovery Plan (2006-2010) discusses these threats in greater detail and identifies actions required to reduce them. One action is to develop and distribute guidelines on collision risk management to relevant planning authorities.

In February 2008 a group of professionals gathered to discuss collision risk management. They were:

- Matthew Webb, ornithologist, Threatened Species Section, Biodiversity Conservation Branch, Department of Primary Industries and Water Tasmania;
- Janneke Webb, ornithologist, Swift Parrot Project Officer, Tasmanian Conservation Trust;
- Linley Grant OAM, Vice President, Birds Tasmania;
- Leslie Gulson, Landscape Architect, Ferndene Studios, and President of the Australian Institute of Landscape Architects (Tasmania);
- Patricia Barwick, Landscape Architect, Barwick and Associates;
- Robert Vincent, Architect, Robert Vincent Architects;
- Ken Pearson-Smith, Lecturer, School of Architecture, University of Tasmania;
- Robyn McNichol, Graduate Architect, Lutrell Pyefinch Architects;
- James Dryburgh, Environmental Development Planner, Hobart City Council;
- Liz Quinn, Natural Resource Management Facilitator, Kingborough Council;
- Peter McGlone, Manager, Threatened Species Network (Tasmania), WWF-Australia; and
- Stephanie Pfennigwerth, Melampus Media.

Input was also received from:

- Chris Tzaros, Conservation Manager, Birds Australia;
- Belinda Cooke, Community Programs Officer / Swift Parrot Mainland Recovery Coordinator, Department of Environment and Climate Change, NSW;
- Natalie Holland, Victorian Coordinator, Threatened Species Network, WWF-Australia;
- Mina Bassarova, NSW and ACT Coordinator, Threatened Species Network, WWF-Australia;
- Niall Simpson, Landscape Architect, Launceston City Council;
- Andrew North, Consultant Biologist, North Barker Ecosystem Services;
- Dr Jenny Lau, Conservation Officer, Bird Observation and Conservation Australia;
- Alan Morris, Regent Honeyeater Recovery Team; Central Coast Regent Honeyeater Volunteer Operations Group; Coordinator, Central Coast Group, Birding NSW; and
- Raymond Brereton, Hydro Tasmania.

The following report summarises the best available knowledge and expertise of international and local experts on swift parrot ecology and existing collision management techniques at this point in time. However, it should be noted that there has been little research in Australia on preventing bird collisions, and therefore many of the recommendations remain untested in Australia.


Adult swift parrot, Oakleigh Golf Course, Melbourne, May 2002. © Chris Tzaros

2.0 Introducing the swift parrot

2.1 Bird basics

The swift parrot *Lathamus discolor* is a migratory parrot, endemic to Australia, and the only species in its genus. Up to 25 cm long and 65–77 g (larger than a budgerigar but smaller than a rosella), it is bright grass-green with a red throat, chin and forehead, bordered with yellow, and red splashes on the shoulders, tertials, under-wing and under-tail feathers. The crown and coverts are dark blue, the flight feathers are dark brown, and the long, finely-pointed tail is an unusual shade of maroon. It has a wide repertoire of calls. During flight it keeps contact with other birds with a clear, musical ‘kik kik kik’ or ‘chiwit chiwit chiwit’; during feeding it chatters with a high-pitched tinkling song, interspersed with trills and ringing notes.

The swift parrot is aptly named: its streamlined body and angular wings enable flight at speeds of 100 kph. Interestingly, it has a habit of ‘plummeting’ from its perch before swooping upwards and quickly gaining speed. It feeds in the outer canopy of flowering eucalypts, often hanging upside down to drink nectar. It also feeds on sugary lerps, psyllids, seeds, fruit and flowers.[4] Due to its high energy requirements (see Section 2.2.1) it takes a direct route between foraging trees. These routes usually take it high above rooflines in urban areas, but there are situations where it has to fly below or within the canopy. It may also feed on the ground.

2.2 Nesting and foraging habitat

Swift parrots have three major flyways, dictated by their breeding and foraging requirements:

- between mainland Australia and Tasmania;
- between foraging habitats; and
- between nest and foraging resource.

Distribution of the swift parrot.[5]

Swift parrots are endemic to southeastern Australia. They fly to Tasmania from early August to October each year and begin searching for suitable nest hollows soon after their arrival.

2.2.1 *Nesting trees*

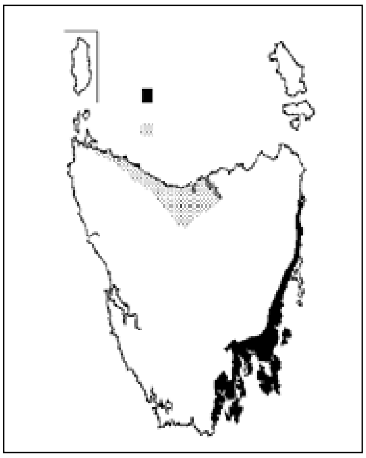
Nesting occurs in the hollows of live or dead eucalypts, predominantly in mature, older growth trees located in forest patches of greater than 100 hectares. Nest trees are typically characterised by having a diameter at breast height greater than 0.7 m, several visible hollows and other signs of senescence (aging). Swift parrots nest in many different tree species, with some of the more common being Stringybark (*Eucalyptus obliqua*), White Peppermint (*E. pulchella*), Tasmanian Blue Gum (*E. globulus*), White Gum (*E. viminalis*) and Gum-topped Stringybark (*E. delegatensis*). Most recorded nest sites have been found in dry and wet Stringybark forest, dry White Peppermint forest or dry Blue Gum forest, although nests have also been recorded in several other dry and wet eucalypt forest types. Nest sites can be found in all topographic positions.[6]

Swift parrots may either nest in isolated single-nest sites, or in close proximity to each other. Occasionally more than one breeding pair may nest in the same tree. Nesting hollows may be re-used, but not necessarily in successive years due to variable nature of blue gum flowering. The availability of foraging resources influences the parrots’ choice of nest sites. This is because swift parrots have high energy requirements, especially during the breeding season. The average clutch size is four eggs, but six-chick clutches have been recorded. During the incubation period the male feeds the incubating female every three to five hours, necessitating up to five foraging flights per day. Both parents then make regular flights to gather food for their chicks, which fledge at about six weeks of age. Swift parrots conserve energy by nesting as close to foraging resources as possible; no more than an estimated 10 km from the nest.[7] For this reason the prevalence of ‘old growth’ hollows and their proximity to food is more important than the forest type and tree species.

2.2.2 *Foraging trees*

Breeding starts in late September, although birds which are unpaired on arrival may not begin nesting until November, after they have found mates. The breeding season coincides with the flowering of Tasmanian Blue Gum, which provides the parrots with their main foraging resource at this time. As mentioned above, it is the distribution and intensity of Blue Gum flowering, rather than the location of the nesting hollow, that largely determines the distribution of nesting swift parrots. Aggregations of up to 50 nesting pairs covering more than 100 hectares have been recorded in areas where there is heavy Blue Gum flowering in association with abundant tree hollows.[8] In years of less significant Blue Gum flowering, the parrots may nest elsewhere.

The Black Gum (*E. ovata*) is also an important food source: since it flowers earlier than the Tasmanian Blue Gum, it is important to the parrots early in their breeding season, and in years when Blue Gum flowering is poor. Other key foraging habitats include any forest where Blue Gum or Black Gum is subdominant. Swift parrots also forage on non-Tasmanian native nectar sources including Red-flowering Gum (*E. ficifolia*) and fruit trees in suburban gardens.[9]



Breeding distribution of the swift parrot (solid box = high density, hatched box = low density).[10]

2.2.3 *Post-breeding habitat: Tasmania*

After breeding, and as blue gum flowering begins to decline, most of the parrot population on the east coast of Tasmania may fly westward to the Central Plateau and northwestern Tasmania to feed on flowering Stringybark, Alpine Ash (*E. delegatensis*), White Gum, Mountain White Gum (*E. dalrympleana*) and Cabbage Gum (*E. pauciflora*). The first migratory flocks may begin to gather between Launceston and Smithton, in the northwest of the State, from mid-February. While the primary flyway to the mainland terminates around Port Phillip Bay, some parrots may also fly directly to east Gippsland and southern NSW. Migration is usually complete by the end of April. It is the longest migration undertaken by any parrot in the world.[11]

2.2.4 *Post-breeding habitat: mainland Australia*

Swift parrots show site fidelity to certain areas or even specific stands of trees on the mainland; however, they do not necessarily return to these every consecutive year. Mainland distribution depends largely on food availability. While swift parrots have been shown to return to the same flowering street trees on the central coast of NSW, large numbers of the species would not travel that far if the box-ironbark woodlands of central Victoria had sufficient food.

In southern and cental Victoria and southwestern NSW the parrots' main food trees are in box-ironbark forests and woodlands dominated by Yellow Gum (*E. leucoxylon*), Red Ironbark (*E. tricarpa*), Mugga Ironbark (*E. sideroxylon*) and Grey Box (*E. microcarpa*). In coastal and northern NSW and southeast Queensland, the parrots forage in Swamp Mahogany (*E. robusta*), Forest Red Gum (*E. tereticornis*), Spotted Gum (*Corymbia maculata*) and Red Bloodwood (*C. gummifera*) forests. In some years small numbers of parrots are also recorded in the ACT and southeastern SA.[12] Overall, the swift parrot occurs in 6 States/Territories, 28 Natural Resource Management regions, more than 150 local government areas, and thousands of private properties.[13]

Community mural, Mount Nelson Reservoir. Mount Nelson, a suburb of Hobart, is recognised swift parrot habitat
© Stephanie Pfennigwerth

2.3 Important swift parrot habitat

2.3.1 *Tasmania*

Swift parrots breed only in Tasmania, and mostly within close proximity of their primary food source, the Tasmanian Blue Gum. For this reason the parrots' main breeding habitat coincides with all forest and/or woodland patches of Blue Gum habitat >50 ha within 10 km of the Tasmanian east coast, from Binalong Bay in the northeast to Ida Bay in the southeast, encompassing the Tasman and Forestier Peninsulas, Bruny Island and Maria Island. Within this range, most breeding parrots are concentrated from Little Swanport (north of Triabunna) to Cockle Creek (148 km south of Hobart). Between Orford and Sorell, habitat occurs within 15 km of the coast.

Known nesting sites include Binalong Bay south to Chain of Lagoons, Maria Island, Wielangta, Tasman Peninsula, Nelsons Tier, Meehan Range, Mt Wellington and surrounds, the D'Entrecasteaux Channel area including Tinderbox and North and South Bruny Island, and from Huonville to Southport. Known and potential nesting and foraging habitat occurs in and around much of the Hobart city area.[14]

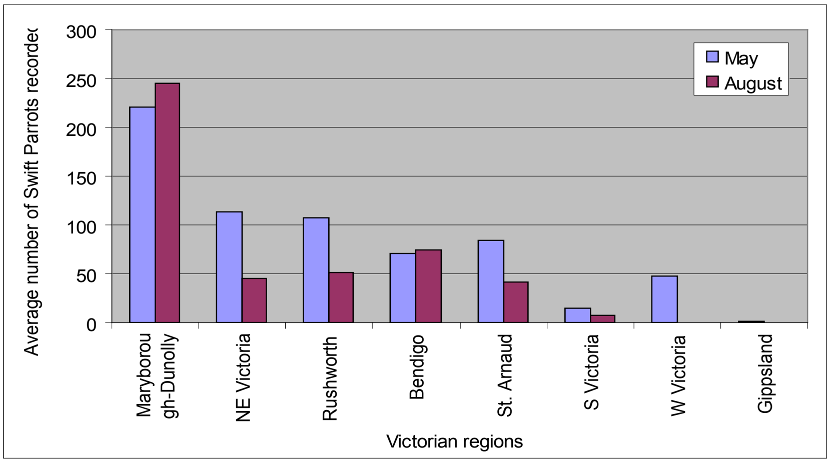
A much lower number of birds breed in the northwest of the State.[15] Known nesting sites include the Gog Range, Kelcey Tier, Badger Range, Mt Careless, Round Hill, and the Dial Range.[16]

Appendix 5 lists the local government areas in which known and/or potential swift parrot habitat occurs.

2.3.2 *Victoria*

Figure 1 below indicates that in Victoria, the Maryborough-Dunolly area is a key region for foraging parrots in the post-breeding season. The largest average number of recorded sightings over the past 11 years has come from this area. Several other regions, such as Rushworth, Bendigo and St Arnaud, also sustain a large proportion of the population. When conditions are favourable, some parrots target flowering eucalypts in the southern, western and Gippsland regions of Victoria.

Figure 1. Regional swift parrot records from volunteer surveys, Victoria 1995-2005.[17]

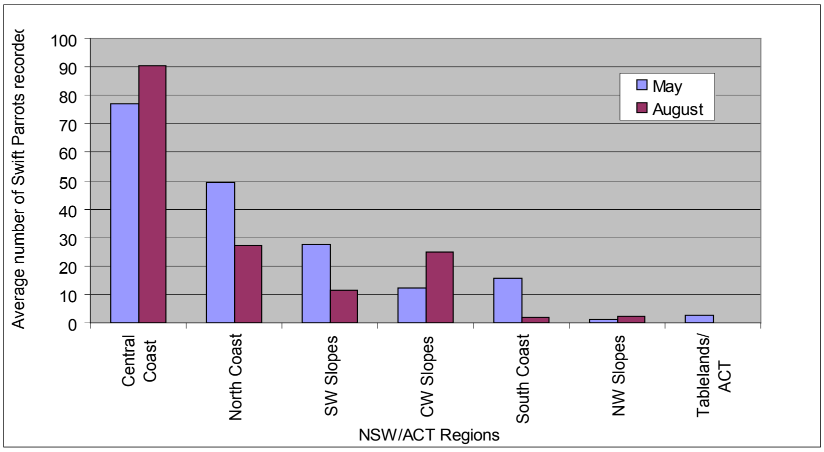


Appendix 5 lists the local government areas in which known and/or potential swift parrot habitat occurs.

2.3.3 *NSW and ACT*

Figure 2 indicates that the coastal regions of NSW are particularly important to swift parrots, particularly during drought years, the significance of which is discussed below. However, flowering eucalypts in regions such as the south and central-west slopes are also used regularly. Small numbers of parrots have been recorded in the ACT, mainly in the inner suburbs of Canberra, Gungahlin and Hall.[18]

Figure 2. Regional swift parrot records from volunteer surveys, NSW/ACT 1995-2005.[19]



Appendix 5 lists the local government areas in which known and/or potential swift parrot habitat occurs.

3.0 The collision threat

3.1 Why the swift parrot is endangered

The swift parrot is listed as Endangered on the IUCN Red List, and under the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* ('*EPBC Act*'). It is also listed as a threatened species in each State and Territory in its range:

- Tasmania: Endangered (*Threatened Species Protection Act 1995*);
- NSW: Endangered (*Threatened Species Conservation Act 1995*);
- Victoria: Listed as a threatened taxon (*Flora and Fauna Guarantee Act 1988*);
- ACT: Vulnerable (*Nature Conservation Act 1980*);
- Queensland: Endangered (*Nature Conservation Act 1992*); and
- South Australia: Vulnerable (*National Parks and Wildlife Act 1972*).

There approximately 1,000 breeding pairs remaining in the wild.

The main threat to the swift parrot is loss of foraging and nesting habitat due to land clearing for agriculture, forestry and urban and industrial development. In Tasmania, clearing has resulted in the loss of more than 50% of the original (pre-European) grassy Blue Gum and Black Gum forest.[20] Forestry operations and firewood collection have resulted in the loss of older trees, which provide a substantial food resource (older, larger trees provide more food and are favoured by the birds) as well as nesting hollows. Over 80% of swift parrot foraging habitat occurs on private land, and is therefore potentially subject to the impacts of production forestry or agriculture,[21] or clearing for urban development. Meanwhile, just 2% of known nests have been recorded in dedicated conservation reserves – the rest are located on private land or in State forests.[22]

On the mainland, only about 17% of original box-ironbark woodland, a vital food resource for parrots, remains today. While some of it is protected in parks and reserves, most of it occurs on private land.[23]

Remnant Blue Gum forest and artificially planted trees typically occur in small patches of less than one hectare,[24] including many solitary and scattered trees in pasture, parkland and urban streets and gardens. The loss and/or fragmentation of habitat are therefore directly linked to the second major threat to the swift parrot's survival: collisions with human-made structures.

3.2 The scale of the collision problem

In Tasmania, the swift parrot's restricted breeding habitat coincides with the largest concentration of the State's human population. The parrot's foraging habitat is similarly problematic: relatively well-watered street trees, garden plantings and remnant bushland in urban areas can provide a more reliable food source when Blue Gum flowering is poor in other areas, in areas of reduced natural habitat, or during drought. For example, an estimated 488 birds were recorded at 16 locations in the Hobart area between October 24 and November 4, 1997, a time of poor Blue Gum flowering. During the same 1997-98 breeding season, 34 adult parrots were retrieved, 23 of which were dead.[25] The parrots had hit obstacles they simply could not see: tinted and clear glass windows, vehicles and wire mesh fences.

The next breeding season (1998-99) saw the recovery of 11 dead and 6 injured birds, the lower number possibly due to improved Blue Gum flowering in bushland areas and consequently fewer parrots observed in the Hobart city area.[26] On average, 19 adult birds are recovered each year in Tasmania, with just 4 returned to the wild.[27]

The collision problem is not restricted to mature individuals, however. Appendices 1 and 2 indicate that juvenile birds are also killed or injured by collisions. This data supports a study conducted by Klem (1989), which concluded that there is no evidence to indicate that physical or learning deficiencies (i.e. flying ability, inexperience) of young or immature birds solely determines their ability to detect glass barriers: immature and adult birds are similarly vulnerable to collisions.[28]

On mainland Australia (see Appendices 2 and 3) collisions are much less frequently reported. This may be because the parrot population post-breeding occurs at a lower density, post-breeding behaviour differs to breeding behaviour with no multiple flights between foraging and nesting sites, and most foraging habitat occurs in less-populated areas. However, the drought of 2002 forced unusually high numbers of birds to seek refuge in urban areas, especially coastal NSW.[29] Correspondingly, 2002 was a year in which the numbers of post-breeding birds killed by collisions was higher than usual: The total number of fatal collisions reported by the public in 2002 exceeded the combined total number of collisions reported in the previous seven years of the swift parrot recovery program on mainland Australia.[30]

It must be stressed that the actual number of mortalities from collisions is probably much higher – possibly double – the numbers recorded, because fewer than half of dead birds are handed in by the public.[31] Concussed and otherwise injured birds, unable to fly, may be hidden from human view by vegetation surrounding buildings. They are vulnerable to cats and other predators, and after death their bodies are quickly scavenged.[32] **For this reason it is possible to estimate that around 1.5%–2% of the entire swift parrot breeding population is killed every year as a result of collisions.** Although this figure seems low, it assumes a greater significance considering the small number of birds

Swift parrot recovered from Oakleigh Golf Course, Melbourne. © Chris Tzaros

in existence, and the increase in development in key swift parrot habitat. Each death signifies not just the loss of an individual, but also threatens the long-term survival of the species: the death of a mature adult, for example, may also represent the loss of up to six eggs or dependent young each breeding season.

It is important to reiterate that the main threat to the swift parrot is habitat loss. But as habitat becomes smaller and increasingly fragmented, swift parrots may be forced into closer proximity with urban areas, where there is a higher risk of collisions.

3.3 Collision hotspots and high risk structures

Appendices 1, 2 and 3 were collated from data provided by Tasmanian DPIW, the Threatened Species Network (Tasmania), Chris Tzaros of Birds Australia, Belinda Cooke of the NSW Department of Environment and Climate Change, WIRES, and individuals in the Ozark carers network. Although there are gaps, the data nevertheless indicate that there are certain areas, at certain times of the year, where the potential for swift parrots to collide with human-made structures is high.

Unfortunately, many of these collisions occurred in close proximity to known nesting and foraging sites (see Section 2.3.1 above); for example, the area south of Kingston (i.e. Blackmans Bay, Tinderbox, Margate, Sandfly, Snug) in Tasmania appears to be a collision hotspot. Similarly, the number of collisions in the Hobart's Clarence City Council area (Bellerive, Rosny, Lindisfarne, Howrah etc) seemed to be linked to the parrots' flyway to habitat on the nearby Meehan Range.

The following subsections discuss the three obstacles that pose the highest collision risk to swift parrots.

3.3.1 *Windows*

Birds seem unable to detect or avoid glass. It does not register to them as a solid barrier in their flight path. Two types of glass are dangerous to birds:

Reflective glass

When seen from the outside of a building, glass often has a reflective quality, mirroring the sky, trees and other features. The reflectivity increases when glass is seen at an oblique angle, regardless of whether the glass is transparent or tinted. Birds do not understand that a reflection is false. Instead, they perceive a continuation of their habitat and try to fly to it, resulting in collisions.

Transparent glass

Birds cannot differentiate between clear glass and unobstructed airspace; it is invisible to them. Glass lobbies, balconies, windows or glass walls that meet at a corner, or aligned windows (windows installed parallel to each other, on opposite sides of the building) provide an unobstructed view of habitat and sky on the other side of the building and are particularly dangerous: birds perceive a passageway and attempt to fly straight through.[33] Also, transparent window panes mimic tinted reflective panes when little or no light is visible behind them.[34]

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What is real? What is a reflection?

© Stephanie Pfennigwerth

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An informal study of collisions at this site proves that birds do not perceive a walk-through as a solid obstacle (see Section 4.2.2).

Appendices 1, 2 and 3 indicate that windows are particularly dangerous to swift parrots, especially when windows are in close proximity to each other or to wire-mesh fences (note the two collisions at the Clarence City Council offices in the 1997/98 season). Parrots that were not killed instantly sustained injuries including broken wings, punctured sternums and head injuries. An American study of bird collision fatalities discovered that every fatality had sustained intercranial haemorrhaging, suggesting that the cause of death was ruptured blood vessels and brain damage.[35] There is no reason why an Australian species would not suffer similar trauma.

For injured swift parrots that have been rescued for rehabilitation, recovery can be slow. A punctured sternum, for example, can take three weeks to heal,[36] and it is likely that survivors also suffer intercranial haemorrhaging.[37]

3.3.2 *Wire-mesh fences*

To a fast-flying bird, wire-mesh fences are impossible to see. **Appendices 1, 2 and 3 indicate that fences around sporting facilities**, such as tennis courts and golf courses, and structures located near mature flowering eucalypts including university campuses, caravan parks and again, golf courses, are especially problematic for swift parrots. In Hobart, sporting facilities located in or adjacent to swift parrot habitat or flyways are notable collision hotspots: Bellerive (golf course), Rosny High School (tennis courts), Mount Nelson (tennis courts), Taroona (tennis courts), and Sandfly (tennis courts).

In Victoria, 43% of swift parrot deaths recorded since 1999 were due to collisions with wire fences at golf courses.

3.3.3 *Vehicles*

Many swift parrots are found dead or injured beside roadways indicating collisions with moving vehicles, or parked vehicles, including caravans. The number of bird deaths in Bellerive, Tasmania, due to vehicle collisions (recorded in

© Stephanie Pfennigwerth

Olinda Grove sports field, Mount Nelson, Hobart, is located near swift parrot habitat and/or flyway zones and is surrounded by chain-mesh fencing. The pavilion, which has large aligned windows, could also constitute a bird collision risk.

Appendix 1) may be connected to the birds' flyway to nesting sites in the nearby Meehan Range.

Unfortunately, it is unlikely that improved driver awareness and education will assist in preventing collisions. Furthermore, a vehicle being driven at the speed limit or below can still injure or kill a highly manoeuvrable parrot which, even if flying at speeds lower than 100 kph, will have gathered sufficient momentum to be potentially fatal.

However, there may be the potential to influence bird behaviour by the strategic deployment of roadside barriers and other initiatives in vehicle collision hotspots. See Section 4.5.

4.0 Solutions

The following sections discuss recommendations for the planning for subdivisions; the planning, design and construction of new buildings; and the renovation and retrofit of existing buildings and other structures to minimise swift parrot collisions. The benefits, limitations and uncertainties (i.e. need for further research) of each recommendation are also described. The recommendations are based on the best available current knowledge. However, as many of the recommendations remain untested in Australia, the complete success of the techniques cannot be guaranteed.

For new and existing buildings and other structures (fences and roads), collision mitigation requires an assessment of a range of macro and micro conditions. These include evaluation of the site; the site's proximity to swift parrot habitat; habitat use, including the three flyways (see Section 2.2); building or fence height; glass coverage and glazing characteristics; and the amount of light required for interior building illumination,[38] particularly during the day when the parrots are most active. Obviously, the specific context of each development will influence the range of collision mitigation strategies used.

4.1 Regulatory solutions

Swift parrots are an endangered species mainly due to the loss or fragmentation of their habitat. As urban and industrial developments encroach into habitat, birds are increasingly forced into potentially dangerous situations. The most effective way to minimise habitat loss *and* bird collisions is to avoid building new developments in, and/or adjacent to, swift parrot nesting and foraging habitat.

However, the growing human population and the trend for semi-rural or bushland ('tree-change') habitation means the demand for new developments will remain constant, if not increase. Planning mechanisms must ensure that such developments do not destroy the very thing that attracts residents in the first place: the natural environment. Diligence on the part of legislators and strategic planners can ensure the two can coexist.

Planners need to consider more than lot density ratios and zonings. Liveable neighbourhood principles – for native fauna as well as people – should also be considered at every stage, from the subdivision design concept to the site plan. Issues to be assessed and addressed include:

- control over the loss of habitat;
- lot layout - to protect bird flyways, movement corridors and foraging/nesting habitat, and to ensure they are not obstructed;
- co-ordination of vegetation linkages, open space networks and buffer zones to ensure that habitat is retained, protected, and located away from potentially hazardous areas; and
- the location of roads, barriers, utilities and other infrastructure in order to minimise risk of collisions with vehicles, fences and power lines.[39]

It is imperative that a biodiversity assessment is conducted before a landscape plan for subdivision is prepared. Both the biodiversity assessment and landscape plan should be prepared before the subdivision and development applications are submitted for approval by the local government authority.

However, the litany of collisions recorded in Appendices 1, 2 and 3 indicate that in the meantime, sites have been developed, and will perhaps continue to be developed, without sufficient regard for potential impacts on endangered wildlife such as the swift parrot. This may be due to:

Knowledge gaps

Bird-friendly site strategies can only be developed as a result of understanding and/or anticipating where birds will be in relation to a particular site,[40] in relation to the structures on that site, and the type of structures which pose a hazard to birds. Some participants at the February 15 workshop indicated that local government authorities are unaware of where swift parrot habitat is located, and what sort of structures and situations constitute a collision risk. Furthermore, although biodiversity assessment tools such as the Natural Values Atlas (NVA) are online and available for use, it was uncertain whether such tools are regularly used during the development assessment process.

In short, there seems to be:

- insufficient or ineffective information transfer between State and local government agencies about swift parrot habitat location and habitat requirements; and/or
- insufficient or ineffective information uptake by local government authorities; and/or
- a dearth of consistent, co-ordinated procedures for assessing whether a proposed development may constitute a risk to swift parrots.

Regulatory gaps

Local government authorities administer and enforce planning schemes in accordance with legislation such as the *Environmental Planning Assessment Act 1979* in NSW, the *Planning and Environment Act 1987* in Victoria, and Tasmania's *Land Use Planning and Approvals Act 1993*. In Tasmania, these planning schemes are assessed and approved by the Resource Planning and Development Commission (RPDC).[41] Other States follow similar procedures.

In Tasmania, there exist Criteria for Reducing Bird Strikes[42] (formerly known as the Bird Collisions Code, see Appendix 4) which provide guidelines on how developments can be designed in order to minimise impacts on wildlife. These Criteria have been used to inform planning applications and planning appeals accepted by the Resource Management and Planning Appeals Tribunal, and have been incorporated into Conditions of Approval for planning permits for developments such as new subdivisions and re-zonings. However, the Criteria are informal, and compliance is not currently required: Although the planning approval process takes into account issues such as siting, maximum building height requirements (depending on the location) and bushland management (vegetation, fauna, water quality and potential bushfire hazards), there are currently no specific conditions for bird collisions.[43]

In short, there is:

- a lack of an enforceable provision for the assessment of bird collision risks as a condition of approval for developments; and
- a lack of consistency in the use of the current Criteria. For example, it may be used in the approvals process for new subdivisions, but possibly not for new developments in new and existing subdivisions, except in the case of planning appeals.

4.1.1 *Closing the knowledge gaps*

Planners could be supported and empowered in their decision-making by the creation of data sets that define the areas of swift parrot flyways and nesting and foraging habitat more tightly. For example, maps showing flyways and known habitat could be integrated into the planning process. However, these data sets would by necessity have to acknowledge the vagaries of swift parrot behaviour; i.e. their nesting and foraging behaviour is inextricably linked to the sometimes sporadic nature of flowering cycles.

In order to effect this:

- data could be collected and/or mapped and updated regularly by DPIW and its counterparts in mainland Australia, especially in areas on the urban fringe that are more likely to be considered for future subdivision;
- local government planners could be authorised and trained to use DPIW data layers including TasMaps and TasVeg (planners in mainland Australia could use their State or Territory equivalent); and
- other regularly updated tools for assessing biodiversity (such as the NVA and Important Bird Areas [IBA]) could be made available to all relevant State and local government agencies, planners, architects, landscape architects, builders, etc.

State planning authorities could also be resourced and empowered to ensure each local government authority is:

- implementing threatened species legislation;
- checking the NVA *before* the commencement of subdivision assessment; and
- aware of IBAs relevant to the swift parrot in their area.

Assessment 'triggers'

In conjunction with the initiatives outlined above, a checklist could be created to trigger a closer assessment and evaluation of a potential development. For example, a proposed development could be considered and assessed by planners with regard to the following checklist:

- proximity of swift parrot flyways such as between foraging habitats and/or between nest and foraging resources – see Section 2.2);
- presence or proximity of known nesting habitat (some examples of the tree species most important to the swift parrot are listed in Section 2.2.1; see also 2.3.1). It is worth considering that during the breeding season, swift parrots commute to foraging resources within an estimated 10 km radius of their nest (see Section 2.2.1);
- presence or proximity of known foraging habitat (some examples of the tree species most important to the swift parrot are listed in Section 2.2.4; see also 2.3.2 and 2.3.3);
- presence or proximity of potential nesting and foraging sites. Trees planted in bushland regeneration programs should be noted as they may provide nesting/foraging habitat when mature; and
- presence or proximity of an Important Bird Area (IBA).

Alternatively, such a checklist could be integrated into the current biodiversity assessment process. As mentioned above, the biodiversity assessment should be conducted before a landscape plan for the subdivision is prepared. Both the assessment and the plan should be prepared before the development application is submitted for approval.

A mechanism could also be provided so that, if the checklist indicates that the proposed development may impact on swift parrot habitat or flyways, the *EPBC Act* or *Forest Practices Act 1985* (or mainland equivalent) are triggered and a closer assessment undertaken.[44]

This checklist could also be integrated in the Australian Model Code for Residential Development (AMCORD) and relevant State codes such as the Tasmanian Code for Residential Development (TASCORD) to provide greater certainty in the decision-making process for local government authorities. However, since these Codes are not statutory documents the checklist would need to included in planning schemes to be truly effective.

4.1.2 *Enhancing current planning mechanisms*

Planning schemes are regulatory documents and in Tasmania, any amendment of planning scheme must seek to further the objectives set out in Schedule 1 of the *Land Use Planning and Approvals Act 1993*.[45] One of the objectives is the promotion of the sustainable development of natural and physical resources and the maintenance of ecological processes and genetic diversity.[46]

Local government authorities could be encouraged to seek any amendment of a planning scheme that would make it necessary for developers (and/or architects, building designers, builders etc) to demonstrate that any new development located in or adjacent to swift parrot habitat or flyways will not constitute a collision risk, be it:

- a new subdivision;
- a new development in a new subdivision;
- a new development in an existing subdivision; or
- a new extension, renovation or refurbishment to an existing building.

Alternatively, the current informal Criteria for Reducing Bird Strikes could be updated and strengthened by the inclusion of performance indicators (perhaps using information from this report), and formalised by being incorporated into one of the schedules being developed to support Tasmania's new, standardised planning scheme template. The formalised Criteria could also be included in planning schemes in mainland Australia. This could require developers to meet the Criteria's performance indicators, in conjunction with the checklist suggested above. AMCORD and its State equivalents could be updated to incorporate this requirement.

Another option to close the current regulatory gap could be a planning directive to ensure that all relevant local government authorities apply consistent approaches to bird collision minimisation by appropriately amending their planning scheme. This would ensure that birds occurring in different municipalities would receive the same level of protection.

State planning authorities could also be resourced to train planners, urban designers, architects and other personnel in the new or revised assessment procedures resulting from such amendments.

A note about renovations to existing buildings

Klem's 1989 study[47] demonstrated that birds hit windows regardless of whether the windows were installed in a place where no other buildings had previously existed, or in a building that had been part of the surrounding environment for a century and was therefore familiar to the local birds. Although conducted in the United States, this study is applicable to swift parrots because the birds' migratory behaviour and relative lack of site fidelity (see Section 2.2) means they may not become habituated to urban environments – and even if they did, they would only become accustomed to structures they could see. As mentioned above, and as Appendices 1, 2 and 3 indicate, swift parrots do not always see glass and certain fencing materials.

For this reason applications to extend or renovate existing properties should be subjected to the same approval conditions as those for new constructions: i.e. properties located in swift parrot habitat and/or flyways must incorporate bird-friendly materials or collision mitigation techniques.

4.1.3 *Incentives for bird-friendly initiatives*

The following recommendations for practical solutions (Section 4.2) could be incorporated into the technical provisions of the Building Code of Australia. Bird-friendly materials and applications could also be included as a sustainable planning 'target' in tools such as BASIX, used in NSW.[48]

The amendment of the Building Code of Australia to include bird-collision mitigation measures would prove effective in encouraging the uptake of acceptance and uptake of these initiatives. In the meantime, local government authorities are encouraged to implement new incentives to also help stimulate consumer acceptance. For example, since the following guidelines and recommendations may potentially increase construction costs, financial incentives similar to the rebates provided for the installation of water-saving devices could encourage the use of bird-friendly designs and materials.

Authorities could also 'lead by example' by implementing bird-friendly measures in all new government buildings and infrastructure, as well as public parks and other recreational facilities. There may even exist an opportunity for artists to creatively address bird-collision problems at public buildings (and simultaneously raise public awareness of the issue) through government Public Art programmes[49] and similar strategies (see Section 4.2.3)

Financial or other support could also be provided to university Schools of Architecture, Urban Design or Industrial Design to create and or/test existing and emerging techniques for bird collision mitigation, such as 'bio-mimetic glass' (see Section 4.2.4).

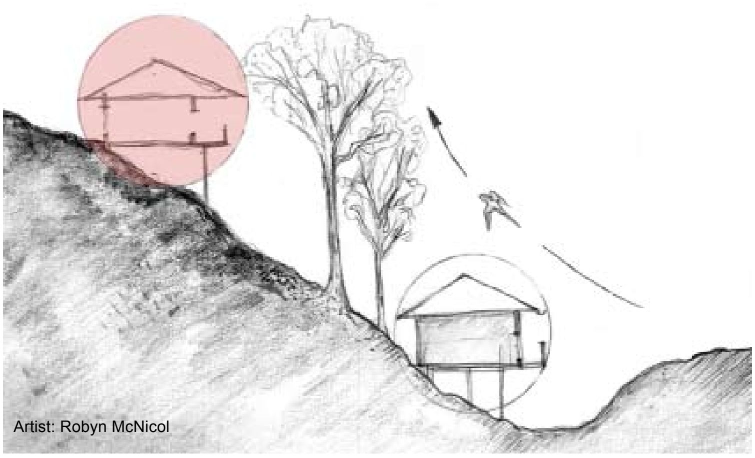
4.2 Practical solutions

4.2.1 *Building placement and layout*

New constructions should be thoughtfully designed and operated to minimise their impact. For example, new or existing landscaping should be designed or manipulated in order to orchestrate flight paths away from the building. Glazing and other potentially hazardous structures should be limited in areas that are predictable bird collision areas, or else designed to facilitate their visibility to the parrots (see Section 4.2.3). Site and landscape features that should be considered include:

Tree canopy

Since swift parrots fly above and within the tree canopy, new constructions should be positioned below the ridge line and the mature height of the tree canopy. If trees are currently immature, the anticipated height of the canopy at maturity should be calculated and the building located accordingly. Constructions upslope of foraging/nesting habitat (i.e. Blue Gums) should be avoided since this would bring canopies below or in the line of the construction, and potentially bring birds into danger.



Buildings positioned downslope of the ridgeline and tree canopy may prove less of a risk to approaching birds than buildings positioned level with or above them.

A better understanding of how swift parrots travel to foraging and/or nesting sites, such as their trajectory - whether they use updrafts to 'swoop' up the side of a hill or ridge to the trees on top, will help determine the height to which bird-friendly glass treatments should be applied. For example, a house positioned below a ridge-top may need to have bird-friendly windows on all of its storeys; or perhaps only the top storey, depending on the way the birds approach their habitat. However, in the absence of this detailed information and since swift parrots do occasionally feed on the ground, it is common sense to suggest that bird-friendly glass treatments applied throughout the building will be beneficial to the swift parrot, as well as to myriad other bird species which are also susceptible to collisions.

Window orientation

More detailed understanding of the three swift parrot flyways could also be beneficial in calculating the positioning of windows so as to best avoid collisions. For example, windows that cut across or face migratory flight directions could prove problematic: since the post-breeding population on the east coast of Tasmania flies westwards to the Central Plateau and northwestern Tasmania (see Section 2.2.3), it may be possible to predict that east or southeast-facing windows (i.e., the approach façades) in new constructions on the east coast of Tasmania may prove a collision risk from mid-February to April each year. Windows facing north or northwest may prove dangerous to parrots migrating from the mainland in early August to October. To lessen the risk posed by these windows, some temporary anti-collision measures could be deployed (see Section 4.3.1) during these months.

However, given the parrots' rapidly weaving and banking flight patterns it is equally possible to surmise that *all* windows in buildings in swift parrot habitat could prove a collision risk. Furthermore, a study of North American migratory species discovered that windows facing general migratory directions are no more hazardous than windows oriented in other directions.[50]

4.2.2 *Bird-friendly applications: whole building scale*

New glazing technologies have encouraged the trend for large expanses of glass in new buildings, particularly in bushland and ridge-top locations where homeowners wish to maximise the aesthetic and social/cultural potential of views and other scenery afforded by such surroundings ('bringing the outside inside'). This trend has been further encouraged by the motivation for energy performance improvements leading to greater environmental sustainability, such as passive solar heating, natural lighting and ventilation.

Capturing solar gain for heating is particularly attractive to new home owners in Tasmania's cooler climate. In mainland Australia, solar heating is often minimised by the use of heat-reflective glazing or tinting. Ironically, both kinds of initiatives may actually increase the threat of window collisions; for example, 'solar tinting' can increase window reflectivity.

Architects and designers devising buildings to be located in or adjacent to swift parrot habitat and flyways should seek to minimise large expanses of glazing as well as glass reflectivity and transparency (see Section 3.3.1). For example, reduced- or low-reflectivity glass (0–10% reflectivity)[51] should be used wherever possible and be integrated into the overall building design. Other applications that meet objectives for passive cooling/heating/lighting, views *and* bird safety include:

Avoiding throughways

Situations where windows create the false impression of an unobstructed passageway, such as windows that meet on a corner, glazed corridors, lobbies and links between buildings, should be avoided because birds will try to reach the habitat located beyond the glass. An informal study of bird casualties at a glazed link at one public building recorded about 11 deaths a year over a 4.5 year period, presumably as a result of window collisions. Three of the birds affected were swift parrots.[52] However, the actual number of deaths may be double that recorded (see Section 3.2).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Opposing views of glazed walkway. Adjacent vegetation increases the collision risk.


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The number of bird collisions with this glazed walkway is unknown.

Angling windows

Architects and designers are encouraged to install windows at an angle (i.e. angled in at their base) such that the glass pane reflects the ground instead of the surrounding habitat and sky in the birds' direct line of sight. Angles become effective at a minimum of 20 degrees from vertical, although 40-degree angles are known to be more effective.[53]

Skylights

Angled windows are particularly useful for minimising collisions of ground-feeding birds, but their value for preventing swift parrot collisions is not known. The use of skylights instead of windows may prove to be an effective alternative mitigation technique for parrots; however, skylights may compromise daylighting or view objectives.[54]

'Visual noise'

One proven technique of minimising bird collisions is to maximise a façade's 'visual noise'. Also called 'visual markers' or 'cues', visual noise is defined as readily visible differentiations of material, texture, colour, opacity or other features that help fragment window reflections and reduce overall transparency.[55] Visual noise need not compromise aesthetics. See Section 4.2.3 below.

Muting reflections

Extended rooflines can be employed to close off the angle of reflection of the sky. Highly patterned shading and/or shielding devices can also reduce reflections and provide birds with a visual indication of a solid obstacle. Devices such as screens, louvres and awnings can be coordinated with lighting and passive thermal control efforts[56] and, like visual noise, need not compromise aesthetics. See Section 4.2.3 below.

4.2.3 *Bird-friendly applications: micro scale*

Visual noise and the handprint rule

Visual noise makes visible what would otherwise be invisible; it transforms glass into obstacles that birds can recognise and avoid. Studies have demonstrated that birds begin to perceive vertical, reflective windows as objects to be avoided when the glass has features or patterns (i.e. visual noise) approximately 28 cm apart, with the most effective pattern distance 10 cm or less. This is because smaller birds can fly through any opening *they can see* that is larger than 5 cm high and 10 cm wide.[57] The swift parrot is probably no exception: as previously noted, it is a smaller, streamlined, highly manoeuvrable bird designed to weave, slice and otherwise navigate through small openings in branches and leaves at great speed.

Interestingly, Klem (1990a) found that visual noise was more effective a deterrent when oriented vertically rather than horizontally. He believes the difference in the effectiveness for these two orientations may be linked to a bird's adaptive response to its environment: in native habitat, vertical tree trunks are usually separated by greater distances than horizontal branches. These results indicate that birds in flight are more likely to give vertical objects wider clearance than horizontal ones.[58]

Since 10 cm is about the width of the average human hand, the placement of visual noise elements, oriented horizontally no further than 10 cm apart, is called 'the handprint rule'. The closer, denser and more uniform the visual noise in the design of the exterior, the more effective a building or window becomes in projecting itself as a solid object to birds. The further apart the visual noise is spaced, the less effective it becomes as a deterrent: birds will simply fly 'around' it, and into the glass.

Creating visual noise

Visual noise can be achieved in numerous ways:

- using acid-etched, opaque patterned, translucent, frosted, sandblasted, ribbed, corrugated, printed, stippled or fritted glass, or translucent polycarbonate sheets;
- installing tinted/coloured glass, or leadlight ('stained') glass windows;
- using glass with diachroic or plastic film coatings;
- attaching external screens to operable windows;
- attaching exterior decorative grilles, provided the sections are less than 28 cm wide (10 cm/handprint width being optimal);
- installing internal screens as close to the glass as possible so as to maximise the noise projected through the window (this technique works best on non-reflective glass);
- using smaller panes of glass, multiple-paned glass or glass bricks. The horizontal and vertical glazing and bars will create a matrix visible to birds, provided the panes are no more than 28 cm wide (10 cm/handprint width being optimal);
- designing façades with elements that are visually interesting and create a physical barrier. For example, vines will not only obscure reflections but also provide shading and reduced cooling loads in summer, and passive solar heating and lighting in winter;
- incorporating columns, balconies and lintels into building façades – but if balconies are to have glass balustrades, they too must feature visual noise; and/or
- installing artwork on the interior or exterior of windows, with any gaps or spaces no larger than a human handprint. This will not only ensure the work is an effective bird deterrent, but also allow natural light into the interior. Painted decorative patterns could also be used.[59]

Muting reflections further

In addition to the application of visual noise, window reflectivity can be further reduced by a variety of shading techniques. These include:

Glass bricks not only mute reflectivity, but create a matrix visible to birds.
Note: fritted glass (glass embedded with a visible image or abstract pattern) creates good visual noise, but is less effective at reducing reflectance because the ceramic frit is usually applied on the interior face of the glass. For this reason only non-reflective glass should be used in combination with fritted patterns.[60]

- awnings and overhangs;
- screens and louvres, provided the gaps are less than 28 cm wide (10 cm/handprint width being optimal); and
- sunshades. For example, fritted glass sunshades will reduce direct sunlight, thereby reducing the heating load, while simultaneously allowing indirect daylighting. They may also be designed (and aligned) to cast shadows on the glass, further rendering the windows visible to birds.[61]

4.2.4 *Emerging technologies*

Glass transparency and reflectivity could be further reduced by emerging 'bio-mimetic' applications, which seek to reconcile nature with technology.

Diurnal birds are able to perceive light in a spectral range between about 300–750 nanometers, including ultraviolet (UV-A) light (wavelengths from 315–380 nanometers). By contrast, humans can see only 'visible' light (ca. 400–750 nm). This means that diurnal birds see UV daylight as a separate, enhanced colour. They use it to distinguish between species and sexes (most birds have UV plumage invisible to humans), find food, and orientate during migration.[62]

One German company is already manufacturing glass with a UV-A-reflective coating that is visible to birds but invisible to humans. Such coatings would have obvious appeal to designers wishing to enhance the aesthetics of bird-friendly applications. Many other UV-A-reflecting or -absorbing materials are already in existence, albeit for use in other industries or situations. As outlined in Buer and Regner (2002), research on these products and their effectiveness in areas of high latitude (such as Tasmania) and altitude, as well as different seasons and weather conditions etc, could result in the emergence of a new bird friendly product.[63]

Meanwhile, photovoltaic panels can be incorporated into double-pane glass windows or skylights, with the exterior glass panel substituted for a semi-transparent photovoltaic film panel. These panels can be designed to generate visual noise for birds while also producing solar power.[64] Support should be provided for such initiatives as part of the drive for renewable energy and overall environmental sustainability. For example, rebates and other financial incentives should be available for those who incorporate such technology into new and pre-existing buildings.

4.3 Retrofitting existing buildings

The principles and options described above are of course applicable to any building, be it new, renovated, or pre-existing. However, for retrofitting existing buildings the viability of options will depend on the design of the building and site. Some options will be easier to implement than others.

Which buildings should be retrofitted?

It is reasonable to suggest that where there are windows, there is the potential for bird collisions. However, in terms of swift parrot conservation, the following recommendations are most applicable to buildings and other structures located in or near swift parrot nesting and/or foraging areas or flyways. Buildings along eucalyptus street-tree corridors or bordering parks and sport fields/facilities may also pose a danger to swift parrots. It may be possible to target retrofits to specific problem areas in individual buildings; for example, the windows facing a tennis court.

4.3.1 *Possible strategies*

Regardless of the age or design of the building, the basic objectives remain unchanged:

- minimise glass reflectivity and transparency; and
- create visual noise, using the handprint rule, remembering that matrixes and vertical patterns may be more effective than horizontal patterns.

This could be achieved using the techniques described in Section 4.2 above, plus:

- installing and operating reflective or perforated blinds, shades and curtains. Birds Tasmania members have found vertical blinds to be particularly useful.[65] (See Section 4.2.3 regarding Klem's findings of the effectiveness of vertical 'noise'.) Wider slats or sections provide more visual noise; however, they may also compromise view objectives. Venetian blinds cracked at a ¾ angle may also be effective;
- hanging artwork or ornaments, mobiles, streamers, 'twirlers', CDs and windsocks etc. close to glass, preferably on window exteriors. Note that the ornament etc. must be substantial enough to make the glass appear to the bird as a solid object;
- installing curtains and drapes, ideally those with a 'busy' print and hung as close to the glass as possible. Note that large expanses of dark colour will not make the window any less reflective;
- installing louvres, decorative grilles, sunshades, awnings;
- installing transparent or perforated, non-reflective window film. Some of these products are perforated for one-way viewing and are often used for display advertising on buses and bus shelters, but can also be printed with the client's own design and need not be used for advertising;
- sticking decals (transfers) to windows. They must be visible and cover the entire window, following the handprint rule. Decals applied to the exterior of windows seem to be more effective in reducing reflectivity than those stuck to the interior. Decals may be adhesive, or adhere to windows with 'static cling'; UV-reflective decals are commercially available in Australia (see Section 4.2.4);
- painting, decorative stencilling or etching on windows;
- dividing large expanses of glass into smaller panels using 'panes' of rice paper or opaque adhesive film;
- screening windows with lattice, plastic mesh or shade cloth. Since this might have negative impacts of lighting, passive heating/cooling and view objectives, they are best deployed on the windows nearest bird activity. Insect screens may also be effective, and more aesthetically pleasing;
- installing fine netting over window exteriors. Space should be allowed between the netting and the window, and the net tensioned so that birds are cushioned when they hit the net and bounced to safety;[66] and
- leaving windows dirty. 'Dirt' often contains pollen spores and spider webs, which either absorb or reflect UV-A wavelengths and are therefore visible to birds[67] (see Section 4.2.4).

Note: anti-collision measures attached to or near exterior windows of houses in bushfire-prone areas (i.e. 100 m from bushland edge) would need to deployed after due consideration of their potential to create additional fire hazards.

4.3.2 *Less effective strategies*

Klem's study (1990a)[69] of bird fatalities demonstrated that individual owl decoys, raptor silhouettes and wind chimes (still and active) do not significantly reduce bird collisions. This is partly because birds may become accustomed to the decoy or silhouette,[70] or because the silhouettes are not applied in sufficient numbers, and are not positioned in accordance with the handprint rule. However, Birds Tasmania members have reported that wind chimes can be effective.[71]

Birds Tasmania members report that the use of vertical blinds, 'twirlers' and other objects to block or interrupt views through parallel glass façades and corridors are effective in lowering the number of bird strikes.[68]

Well meaning but ineffective: this raptor silhouette is applied inconsistently and is too small and singular to reduce window reflectivity.

4.4 Fences

4.4.1 *Wire mesh fences*

Appendices 1, 2 and 3 indicate that wire mesh or chain-link fences are a significant cause of injury or mortality for the swift parrot.

However, existing wire mesh fences can be retrofitted, with positive outcomes. In Hobart, the tennis court at Mount Nelson Primary School has long posed a threat to swift parrots, with at least 7 deaths and 2 injuries recorded since 1987. (Five birds died on just one day in November 1998.) The tennis court is now festooned with streamers, which appear to be largely effective in warning off the birds.

Tennis court at Mount Nelson Primary School.

Nevertheless, the use of alternative fencing materials is encouraged. For example, synthetic netting, such as that used in cricket practice nets, might prove to be a satisfactory alternative if correctly tensioned. However, the net should not be too highly tensioned or the same negative consequences may result. Instead, the net could be tensioned so as to allow the bird to 'trampoline' to safety after impact.

Other measures could include:

- covering fences with shadecloth during the swift parrot 'season';
- tying or weaving 'orchard tape', flags or bunting to fences;
- using fences constructed of PVC-coated wire in different colours, such as blue/purple and yellow (colours thought to be biologically relevant to foraging parrots).[72] However, the use of green or black PVC coating is to be avoided since these colours will render the fence as invisible to the bird as uncoated wire; and
- planting and training of vines over fences. Such vegetation may create maintenance problems, however; fruit-bearing vines should be avoided as they will attract birds (and possibly bees and wasps) to the recreational facility. Alternative anti-collision measures would also need to be deployed while vines reach maturity.

Swift parrots have been spotted in the area in which these photographs were taken. The righ hand side fence image encompasses a building site; the other, on the opposite side of the road, is around a sports field. Which is easier to see and avoid?

4.4.2 *Clear glass fencing and balustrades*

The use of clear glass fencing, panelling or balustrading in swift parrot habitat or flyways should be avoided. Glass can be made more visible by the application of films, decals, frosting, sandblasting and so on. See Sections 4.2.3 and 4.3.1 above.

4.5 Roadways and street furniture

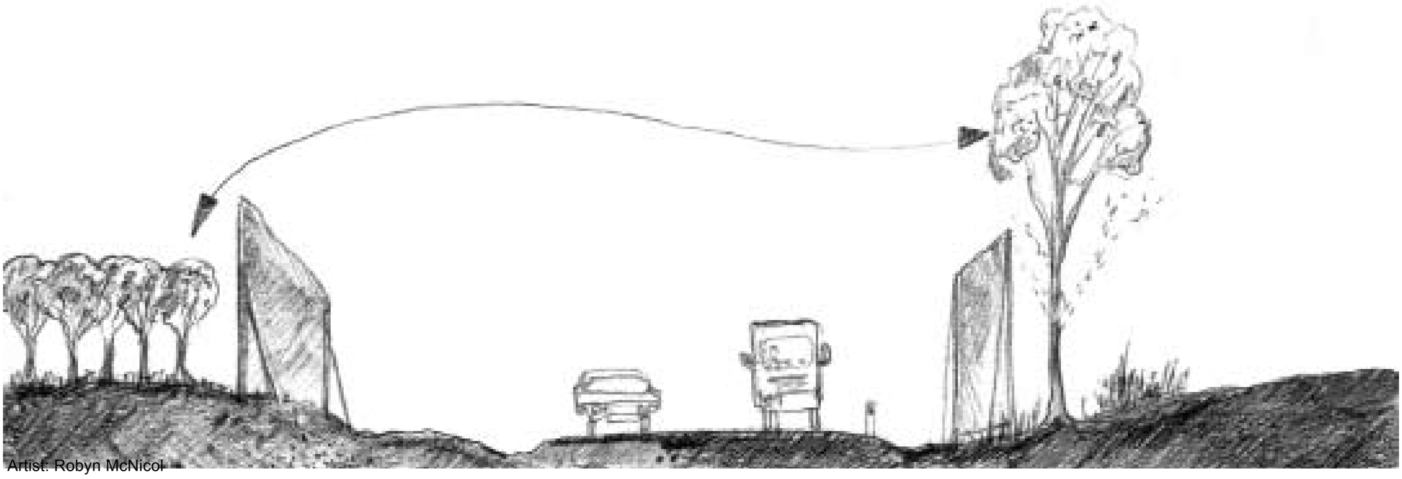
The construction of roads in new subdivisions in swift parrot nesting/foraging habitat and/or flyways should be subjected to the same level of assessment and scrutiny as that given to the construction of new buildings (see Section 4.1.1).

Roads should be built with due consideration of surrounding vegetation, especially the flight patterns and angles at which the birds may approach trees.

Existing roads

Foraging birds are at particular risk of collisions with vehicles if their food source is located close to or alongside a road. Ornithologists have observed musk lorikeets, the species most analogous to the swift parrot in terms of behaviour, swoop to a foraging resource – i.e. from tall trees on one side of the road to an orchard of smaller trees on the other – with catastrophic results.[73] Possible solutions include:

- erection of a fence at least 3 m high, covered with shadecloth, netting, mesh or other visual noise, on the side of the road with the foraging trees. This would encourage the birds to approach the food source at a higher altitude, thereby reducing the potential for vehicle collisions. In the case of orchards or other crops, the fence would not necessarily impact the growth and ripening of the fruit if the mesh was sufficiently coarse to allow filtered sunlight; however, more research may be required;
- removal of the drooping lower branches of the foraging trees, thereby raising the canopy and encouraging the birds to approach the food source at a higher angle; or
- removal of the high risk foraging trees. However, given that habitat trees in non-urban areas remain unsecured, and that Blue Gum flowering is intermittent, the removal of native and non-native swift parrot food sources (especially during times of drought) near roads should be considered **only on a case-by-case basis and as a last resort**.



The erection of fences adjacent to foraging trees may help manipulate birds' flight patterns, thereby reducing the potential for collisions with vehicles.

Other strategies for roads

The Bird Collisions Code[74] calls for traffic calming measures to be used to reduce vehicle speed and the risk of collisions. Although vehicles driven at the speed limit or below are still dangerous to a bird travelling at high velocity, speed humps and similar techniques in collision 'hotspots' may prove beneficial for the safety of other species as well as the swift parrot.

In Tasmania, traffic signs alerting motorists to the presence of swift parrots could be installed from September to March (when the birds are present in the State) in vehicle collision 'hotspots' such as the Meehan Range (in the Clarence City Council area). The temporary nature of these signs, combined with a seasonal public awareness campaign (see Section 5.0 below), may ensure that motorists do not become habituated, and thus inattentive to, their meaning.

Noise barriers, transparent bus shelters and public telephone booths

Transparent roadway noise barriers, such as those constructed with clear polymethyl methacrylate panels, are also dangerous to foraging or commuting swift parrots, since the panels are just as invisible to them as those made of glass. Alternative materials should be used; if this is not possible, the panels should be treated in accordance with the visual noise strategies outlined above.[75]

Transparent bus shelters and phone booths are designed to maximise public safety. However, they have been identified as a danger to swift parrots[76] because the panels appear to be a throughway, rather than a solid obstacle. Although visual noise applications such as one-way film and frosting, etc. would perhaps be unacceptable, the intelligent application of decals would render the structures more visible to birds without compromising public safety objectives.

4.6 Trees, landscaping and gardens

As discussed in Section 2.1, swift parrots forage primarily on flowering Blue Gums. They supplement their diet with the nectar of Black Gums and other eucalypts, plus lerps, seeds and fruit. Street trees and garden plantings in urban areas provide a more reliable food source when flowering is poor in other areas, or in areas of reduced natural habitat, or during drought.

Trees in urban areas can be effective offsets against habitat loss elsewhere. However, ill-sited vegetation may also be counterproductive, luring birds into potentially harmful situations.

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Revegetation initiatives near structures such as fences and windows can either create or increase collision risks.

Solutions could include:

- conducting further plantings of foraging trees in urban areas (either as street or park trees or as part of bushland regeneration programs) with due regard to flyways and potential collision risks;
- manipulating the canopy of mature trees. For example, where trees are surrounded by multistorey buildings, the removal of drooping lower branches may encourage the birds to approach the tree at a higher altitude, thereby helping them to avoid potential window collisions;
- discouraging nectar- or fruit-bearing vegetation being planted near or against windows – this is also necessary for fire safety and structural reasons. A public awareness product (i.e. a brochure or web page) to discourage further plantings near windows could be produced;
- possibly removing individual street and garden trees that contribute to a high collision risk, **after careful assessment and on a case-by-case basis**. However, given that habitat trees in non-urban areas remain unsecured, and that Blue Gum flowering is intermittent, the removal of potentially rich food sources in urban areas should be considered **only as a last resort**. Furthermore, local government authorities may need to create new by-laws or similar regulatory mechanisms to enact this.

These solutions could be integrated into plans for new landscapes in close proximity to new or existing buildings in urban areas. For example, new landscapes should be placed at sufficient distance from glazed building façades to minimise reflection.

Other considerations

Two experiments conducted by Klem (1989) demonstrated that even transparent and reflective glass not associated with human-made structures is lethal to birds. For this reason, the use of freestanding and hanging mirrors (currently popular with some landscape and garden designers) should be avoided.[77]

Windbreaks, solariums, conservatories, greenhouses and other glass structures should be treated in accordance with the visual noise strategies outlined above.

5.0 Public awareness

Human beings have a particular fondness for birds.[78] Combined with growing public interest in environmental sustainability, this appreciation for birdlife and concern for endangered species could be harnessed and enhanced by public awareness campaigns highlighting the issue of collisions. Strategies could include:

- production of educational materials (brochures, DVDs, etc) about bird-friendly products and practises: if necessary, these could be distributed to every home and school in swift parrot habitat (Appendix 5 lists which local government areas contain habitat important to swift parrots);
- update/enhancement of the existing Threatened Species Network brochure, with additional emphasis on the importance of reporting bird strikes;
- production of foyer displays, posters and so on for use in local government authority offices in swift parrot habitat, especially as before and during ‘swift parrot season’;

- production and distribution of free 'anti-collision kits' (containing window decals etc) to rate-payers in habitat areas;
- production of web pages regularly updated with sightings, 'season alerts' and other data;
- other means of encouraging the reporting of all swift parrot collisions, fatal or non-fatal, to DPIW and mainland counterparts, perhaps via Council/Shire correspondence such as rates notices;
- encouraging and facilitating revegetation with foraging trees after due consideration of potential collision risks;
- encouraging and facilitating the revegetation of high-risk areas with non-foraging trees;
- presentations on local radio and articles in local newspapers and community/specialist newsletters, especially before and during 'swift parrot season';
- articles in the magazines of motorists' organisations such as the RACT or NRMA, advising of the vehicle collision threat;
- articles in tourism material: i.e. a guide to bird watching could include advice about safe driving in habitat zones; and
- articles in birding journals and websites including *Wingspan* and Birds Australia.

Local government planners, urban designers, architects, landscape architects, designers, builders, members of environmental organisations and other interested persons could be encouraged to instigate and/or support planning scheme amendments. Academics in relevant disciplines, such as architecture, should be encouraged to include the issue of bird collision mitigation (such as the contents of this report) in their lecture material.

6.0 Further research

The public awareness campaigns could be informed by a deeper understanding of swift parrot movements, behaviour and other factors influencing collisions, such as the seasonal, often sporadic nature of Blue Gum flowering.

To this end, support is needed for:

- local conservation groups (WildCare, Birds Australia, Conservation Volunteers Australia etc.) and scientists to compile data on swift parrot sightings, habitat, Blue Gum flowering cycles, and post-collision casualties/fatalities;
- further study into the location of swift parrot flyways and nesting/foraging habitats to better identify and/or predict bird hazard zones;
- research into the impact of collision-related deaths on the overall recruitment and dynamics of local populations (i.e. swift parrots in Mount Nelson, Hobart); and
- further research into collision mitigation materials and methods.

Study into the latter points may help to identify other structures that may constitute a risk to swift parrots. For example, in Scotland the high wire fences used to keep deer from damaging native forests have been found to be a significant cause of injury and death in black grouse and capercaillie, both threatened species.[79] Since some deer farms in Tasmania may occur in or be adjacent to swift parrot habitat, such south of Hobart, the Gog Range and the Dial Range (see Section 2.3.1 above), it may be worthwhile studying what impact, if any, such fences may be having on the swift parrot population.[80]

7.0 Conclusion

This report outlined threats to the swift parrot posed by urban obstacles (especially glass windows, wire mesh fences and vehicles) and discussed recommendations for the planning of subdivisions; the planning, design and construction of new buildings and roads; and the renovation and retrofit of existing buildings and other structures to minimise collisions causing injury and/or death to the bird.

In new buildings, for example, the layout; positioning in relation to tree canopy; window orientation and angling; and choice of glazed surface treatment, such as those that provide 'visual noise' to reduce glass reflectivity and transparency, can be effective in minimising bird collisions.

Knowledge and consideration of swift parrot habitat, flyways and potential collision risks should also be incorporated into road design, and into the planting and management of foraging trees in urban areas, either as street or park trees or as part of bushland regeneration programs.

Most anti-collision techniques, many of which are simple and cost-effective, can also be used in existing buildings. Furthermore, these techniques will be beneficial to a multitude of other bird species as well as swift parrots.

However, the threat posed by windows, fences and vehicles is small compared to that posed by the loss of foraging and nesting habitat due to land clearing for agricultural, urban and industrial development. The most effective way to minimise habitat loss *and* bird collisions is to avoid building new developments in, and/or adjacent to, swift parrot habitat.

State and local government authorities can play a vital role in controlling the loss of habitat and safeguarding that which remains. There also exists opportunities to educate, encourage and in some cases, require planners, developers and the wider community to incorporate and deploy bird protection measures in urban design, building design, building construction and operation.

Some of these opportunities lie in the creation of new schedules in planning schemes, or the amendment of existing schemes. Other opportunities include education campaigns to raise public awareness and encourage initiatives to help bird life.

Since human interaction with the environment is constant, environmental concerns must be part of our everyday decision-making.[81] The recommendations in this report contribute to the implementation of the national Swift Parrot Recovery Plan and are intended to minimise the collision threat to swift parrots and assist in the conservation of this endangered species.


Swift parrot © Geoffrey Dabb

8.0 Further reading

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Klem, D. Jr. (1989) “Bird-Window Collisions.” *The Wilson Bulletin* 101.4: 606-620.

http://birdsandbuildings.org/docs/WB1989BirdWindowCollisions.pdf

Birds and Buildings Forum: Creating a Safer Environment. http://www.birdsandbuildings.org/index1024.html

(the ‘Information and Resources’ page has myriad links to research and products)

New York City Audubon Society Inc., May 2007: Bird-Safe Building Guidelines.

http://www.birdsandbuildings.org/docs/BirdSafeBuildingGuidelines.pdf

Doeker, R. (undated) Bird Safe Design Practices (a tutorial for architects and designers).

http://www.birdsandbuildings.org/docs/birdsafedesign.pdf

City of Toronto Green Development Standard, March 2007: Bird-Friendly Development Guidelines.

http://www.toronto.ca/lightsout/pdf/development_guidelines.pdf

City of Chicago: Bird-Safe Building: Design Guide for New Construction and Renovation.

http://www.birdsandbuildings.org/docs/ChicagoBirdSafeDesignGuide.pdf

Swiss Ornithological Institute / BirdLife Schweiz: Window Collisions.

http://www.windowcollisions.info/

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Swift Parrot Recovery Team (2001). Swift Parrot Recovery Plan 2001-05. Hobart: DPIWE.

http://www.environment.gov.au/biodiversity/threatened/publications/recovery/swift-parrot/pubs/swift-parrot.pdf

Appendix 1: Swift parrot collisions recorded in Tasmania 1987-2007

Date	Age and number	Location	Injury	Cause of injury	Outcome
Pre-1997	3	Sandfly (tennis courts)	Dead	Collision, chain-link fence	Death
21/9/87	1 adult male	Mt Nelson Primary School	Dead	Collision, chain-link fence	Death
30/9/87	1 adult male	New Town	Concussion	Collision, window	Released 30/9/87
8/10/87	1 adult female	Elwick	Broken wing, internal injuries	Collision, vehicle	Death - euthanised
26/10/87	1 adult male	Mt Nelson Primary School	Dead	Collision, chain-link fence	Death
26/10/87	1 adult male	Mt Nelson Primary School	Broken leg	Collision, chain-link fence	Released 25/11/87
27/1/88	1 juvenile		Concussion	Collision, window	Released
8/2/88	3 juveniles	Snug	Dead	Collision, window	Death
8/2/88	2 juveniles	Snug	Concussion	Collision, window	Death
8/2/88	2 juveniles	Snug	Concussion	Collision, window	Released 15/2/88
12/2/88	1 juvenile	Kingston	Dead	Collision, window	Death
15/2/88	1 juvenile	New Town	Concussion	Collision, vehicle	Released 15/2/87
25/2/88	1 adult	Margate	Caught by cat	Possibly concussed before capture (?)	Released 25/2/88
28/2/88	1 juvenile	Moonah	Concussion	Collision, window	Retained, sent to wildlife park
9/1/91	1 juvenile				Released 9/1/91
9/1/91	1 adult male		No tail, otherwise undamaged		Released 27/1/91
18/1/91	1 juvenile	Bacon Bay	Cannot fly		Released 27/1/91
25/1/91	1 juvenile	Blackmans Bay			Released 26/1/91
25/1/91	1				
31/7/91	1	Forest Industries Council			
12/8/91	6				Sent to Joe Forshaw
23/12/91	1	Kingston	Broken wing	Probable collision (?)	
18/9/91	1	Woodbridge			Released 1/10/91
3/10/91	1		On back		Released 15/8/92
7/10/91	1		“Bad legs”		Death
7/10/91	1		Bill removed		
18/10/91	1	Tinderbox		Collision, vehicle	Released 15/8/92
23/10/91	1	Huonville	Damaged bill, breast and wing		
14/11/91	1	Ferntree	Dislocated wing		Death
1/12/91	1 juvenile				Escaped 8/12/91
18/12/91	1 juvenile	Selfs Point	Concussed	Probable collision (?)	Death
30/12/91	1 adult male		Concussed	Probable collision (?)	Death
4/1/92	1				
6/1/92	1	Collinsvale			

7/1/92	1	West Hobart	Broken wing		Death
6/2/92	1 juvenile	South Hobart	"Stunned"	Probable collision (?)	Death
19/2/92	1	Chigwell	Injured wing		
5/7/92	1				Death
7/8/92	1	New Town	Concussed	Probable collision (?)	Released 8/8/92
19/8/92	1				Released 19/8/92
4/9/92	1 adult male	Bellerive	Concussed	Collision, vehicle	Released 29/9/92
4/9/92	1 adult male	Bellerive	Concussed	Collision, vehicle	Released 6/9/92
4/9/92	1	Bellerive	Broken wing and leg	Collision, vehicle	Death
9/9/92	8	Rosny High School	Dead	Collision, chain-link fence	Death
10/9/92	1 adult male	Mersyton	Injured wing		Released 11/10/92
17/9/92	1 adult male	Lindisfarne	Broken wing		Death
19/9/92	1 adult female	Rose Bay	Punctured sternum	Probable collision (?)	Released 11/10/92
25/9/92	1	New Norfolk Primary School	Concussion		Released 29/9/92
28/9/92	1 adult male	Rokeby			Death
14/10/92	1	Glenorchy	Injured back		Death - euthanised
15/10/92	1	Geilston Bay			Death
15/10/92	1	Howrah			Death
17/10/92	1	Clarendon Vale	Concussion		Released 23/10/92
20/10/92	1	Launceston	Injured wing		
18/11/92	1		Broken wing		
19/11/92	1	Kingston	Concussion		Released 5/6/93
23/11/92	1	Moorilla	Injured wing		Released 5/12/92
4/1/93	1	Bridgewater	Concussion		Death
5/1/93	1	Glenorchy	Head injuries		Released 23/5/93
9/1/93	1		Head injuries		Death - euthanised
8/9/93	1 adult male		Broken leg		Escaped 5/3/94
25/9/93	4	Taroona (tennis courts)	Dead	Collision, chain-link fence	Death
12/10/93	1		Broken wing		
8/12/93	1		Head injuries		Death
13/12/93	1 juvenile	Claremont			Released 4/1/94
3/3/94	1	Launceston	OK		Escaped 5/3/94
21/9/94	1	Hobart	Hit by vehicle	Collision, vehicle	Death
27/9/94	1	Richmond	Concussion		
2/10/94	1	Hobart CBD (Liverpool St)	Unable to fly		Released 3/10/94
8/10/94	1		Dead		Death
16/10/94	1	Taroona	Damaged wing		Released 29/12/94
19/11/94	1	South Hobart			
27/11/94	1	Launceston			
27/11/94	1	Launceston	Dead		Death
17/12/94	1		Injured wing, no beak		Released 29/12/94
10/1/95	1 adult female	Moonah	"Off its legs"	Collision, window	
11/1/95	1		Dead		Death

12/1/95	1 juvenile				Released 5/3/95
13/1/95	1 juvenile	Clarendon Vale		Fell from nest (?)	Released 5/3/95
1/3/95	1 juvenile		Broken leg		
31/3/95	1				
1994-95	1	Derwent Park	Dead		Death
1995-96	1	Mt Stuart	Dead		Death
1997-98	1	Bellerive Cottage School	Dead		Death
October 1997	1	New Norfolk Primary School	None apparent	Caught in wire fence	Released by students
October 1997	1	Lindisfarne	Dead	Collision, window	Death
Late 1997	1	Rosetta High School	Injured	Collision, tennis court fence	Collected by PWS
Late 1997	1	Sandy Bay Beach	Dead	Found under tree	Death
Late 1997	1	Kingston	Dead outside shop	Collision, window	Death
November 1997	1	Bellerive	Dead on road	Collision, vehicle (?)	Death
19/11/97	1	Bellerive	Dead on road	Collision, vehicle (?)	Death
December 1997	1	Clarence Council Offices, Bellerive	Dead beneath windows facing golf course	Collision, fence or window (found below windows facing golf course)	Death
24/12/98	1	Clarence Council Offices, Bellerive	Dead beneath windows facing golf course	Collision, fence or window (found below windows facing golf course)	Death
7/1/98	1	Blackmans Bay	Dead		Death
13/1/98	1	Howrah Beach	Dead, washed up on tide		Death
27/10/98	1	Cygnet Library	Dead on road	Collision, vehicle (?)	Death
27/10/98	1	Mt Nelson Primary School	Injured	Possible collision, tennis court fence	Collected by PWS
18/11/98	5	Mt Nelson Primary School	Dead	Possible collision, tennis court fence	Death
December 2006	1	Side of road		Collision, vehicle (?)	Released
December 2006	1			Collision, 'cyclone' fence	Released
2007	1	Lindisfarne	Dead	Collision, tennis court fence	Death
Late 2007	1	Side of road ??	Injured		Released
Late 2007 (October?)	1	Mt Nelson Primary School?	Injured	Collision, fence	Released
Late 2007 (October?)	2	Launceston, building site of new aquatic centre	Dead	Collision, fence	Death

Appendix 2: Swift parrot collisions recorded in NSW, 1991-2007

Date	Age and number	Location	Injury	Cause of injury	Outcome
1991	1	Sutherland (postcode 2232)			Death
1992	1	Baulkham Hills (postcode 2153)	Wing injury	"Entanglement"	Released
1992	1	Camden (postcode 2570)	Wing injury	Collision, vehicle	Death
1995	1	Castle Hill (postcode 2154)	Concussion	Collision	Permanent care
1995	1	Eagle Vale (postcode 2558)	Wing injury		Permanent care
1995	1	Keerrong (postcode 2480)		Bird attack (possibly concussed before attack?)	Death
1995	1	Parklea (postcode 2768)		Cat attack (possibly concussed before attack (?)	Death
12/8/95	1	Castle Hill (postcode 2154)	"Injured bird" found in urban environment"	Probable collision	
1998	1	Avalon (postcode 2107)	Concussion		Released
1998	1	Harbord (postcode 2096)		Cat attack (possibly concussed before capture (?)	Released
1998	1	Yamba (postcode 2464)	Nothing apparent	Collision, vehicle	Released
29/4/99	1	Newcastle Steelworks, Port Waratah area	Dead	? Found after storm; body in sound condition	Death
1999	1	Sadlier (postcode 2168)	Wing injury	Cat attack (possible collision before attack (?)	Death
Mid-2001	1 male	Colonial Surfside Caravan Park, Woolgoolga (20 km N of Coffs Harbour)	Serious enough to require more than 12 months' rehab	Collision, caravan?	Released in Tasmania 3/11/02
2002	1		Head injury	Bird attack (possible collision before attack?)	Death
May 2002	1	Budgewoi (30 km SSW of Newcastle)	Injured	Collision	Death
May 2002	1	South West Rocks (25 km NE of Kempsey)	Dead	Collision, window	Death
29/5/02	1 juvenile	Near Laurieton (20 km SW of Port Macquarie) public school/riverside park	Dead	Collision, vehicle	Death
May 2002	1	Toukley (35 km SSW of Newcastle)	Concussion	Collision, vehicle	Released
Mid-2002	1	Kilaben Bay (5 km S of Toronto)	Dead	Collision	Death
Mid-2002	1	Wyongah (5 km NE of Wyong)	Dead	Collision	Death
June 2002	1	Nelson Bay (50 km NE of Newcastle)	Injured	Collision	Released
June 2002	1	Shoal Bay (30 km NE of Newcastle)	Injured	Collision, caravan	Released
14/7/02	1	Shaws Creek (12 km SW of Richmond, Yarramundi region)	Dead	Collision, probably power line	Death
July 2002	1	Gosford (Newcastle Uni Central Coast campus)	Dead, found in driveway	Collision, probably vehicle	Death

July 2002	1	Lake Macquarie	Chest injury (punctured sternum?)	Collision, window	Death
July 2002	1	Sydney	Dead		Death
August 2002	1	Gosford	Dead	Collision, vehicle	Death
September 2002	1	Lake Macquarie	Dead	Collision, window	Death
13/6/03*	1	House near Penrith Hospital	Concussion	Collision, window	Released
2/7/03**	1	Londonderry	Wing injury	Collision, window	Death - euthanised
5/9/04	1	Valley Heights	Concussion	Collision	Released
2006	1		Nothing apparent		Released
13/7/07	1	Forster Beach Caravan Park, Forster (308 km NNE of Sydney)	Wing injury – bird had been kept in a cage for a month before being reported to PWS	Collision, caravan?	
22/9/07	1 adult	Bodalla	Fractured coracoid bone	Collision, window of house	Taken to WIRES, transferred to Sydney vet for treatment and care, later transferred to captive breeder as bird unable to fly properly

* There is some confusion – this may in fact be a bird recovered near Nepean Hospital in Kingswood, NSW, and released in Penrith after rehabilitation by Blue Mountains WIRES.

** A total of five parrots were reported from NSW and Victoria in 2003. Although only some of the details are available, four of the birds were killed by window collisions and one (listed in the table immediately below) was killed after colliding with a vehicle.

This table does not include four captive birds cared for by WIRES in 1996 and 2001.

Appendix 3: Swift parrot collisions recorded in Victoria, 1999-2007

Date	Age and number	Location	Injury	Cause of injury	Outcome
May 1999	1			Collision, window	Released
6/5/02	2	Scotchmans Creek Reserve and Oakleigh Golf Course (15 km SE of Melbourne)	Dead	Collision, wire-mesh fence	Death
Early May 2002	1	Bendigo	Dead	Collision, window	Death
22/5/02	1	Deakin University, Waurn campus (7 km SW of Geelong)	Dead	Collision, window	Death
November 2002***	1	Portland (362 W of Melbourne)	Dead	Collision, vehicle	Death
1/7/03	1, possibly swift parrot	Muckleford area, Bendigo	Dead	Collision, probably window	Death
23/9/07	1	St James golf course, St James (48 km W of Shepparton)	Dead	Collision, wire mesh fence	Death

*** A total of five parrots were reported from NSW and Victoria in 2003. Although only some of the details are available, four of the birds were killed by window collisions and one (listed in the table immediately above) was killed after colliding with a vehicle.

NOTE: Swift parrot collisions also occur within the species' range in Queensland. For example, on 22 May 2002 an injured bird was recovered near Tugun, on the Gold Coast. Unfortunately it had to be euthanised a few days later, at Currumbin.

Appendix 4: Tasmanian Bird Collisions Code.

Note: the Code was first produced by Raymond Brereton in February 1998, then incorporated as “Criteria for Reducing Bird Strikes” in Bryant, S. and Jackson, J. *Tasmania’s Threatened Fauna Handbook.* Hobart, Threatened Species Unit/Parks and Wildlife Service, 1999: 246-47.

Bird Collisions Code

Intent of code

The aim of this code is to prevent birds colliding with man made structures, such as windows, chain-link fences, power lines, power poles, transmission masts, and vehicles. A large body of evidence has been compiled of bird collisions with man made structures. Collisions often result in the immediate death of the bird or the severity of their injuries prevents them being released back into the wild. Collisions are more likely to happen where developments occur across flight paths from roosting or nesting sites to feeding areas. Other high risk collision areas for bird collisions are next to bushland, where birds and problem structures are in close proximity.

In the United States of America it has been estimated that collisions with man made structures kill tens of millions of birds annually, over 60% of deaths are caused by windows. The impact of collisions on bird populations varies, although in some cases they can be acute. For example, at least 30 swift parrots per annum are killed by collisions with windows, chain link fences and vehicles. This is quite significant for a species in which the total population is estimated to be approximately 1000 pairs. There is a need to take measures to prevent birds from colliding with man made structures associated with new developments.

Planning Requirements

Birds at risk from collisions

- Waterbirds and seabirds which fly at night are at greater risk of collision, particularly with towers and power lines.

- Bush birds which inhabit the urban fringe are at risk from collisions with windows, chain-link fences, powerlines and vehicles.

Risk areas for bird collisions

The presence of structures associated with development in coastal areas, next to wetlands and in, or next to bushland, increases the likelihood of birds being killed or injured.

Table 1. Performance Measures and Criteria for preventing bird strikes

Objectives	Acceptable Solutions	Performance Criteria
Developments are not to obstruct flight paths (eg. between roosting or nesting sites and feeding areas), especially if rare and threatened species occur in the area.	a) Identify flight paths and movement corridors during the site assessment stage for subdivision and building. b) No structures to be sited so they obstruct flight paths and movement corridors.	a) Design and operation of any works or structures placed in flight paths or movement corridors are to include measures to prevent bird collisions. b) Applicants for use or development are to show that bird populations will not be adversely affected.
Developments are to be placed away from critical and significant habitats.	Buffer development from critical and significant habitats (eg. threatened species habitats, bird of prey nest sites, wetlands) to protect wildlife from risks of collisions and disturbance (eg. pets, lights, noise). The width of the buffer will depend on the species and/or the habitat and topography, which will influence the impact of noise and light. Expert advice* should be sought on appropriate buffer designs.	a) Design and operation of any works or structures adjacent to critical and significant habitats are to include measures to prevent bird collisions. b) Applicants for use or development are to show that bird populations will not be adversely affected.
Grounds design is not to include structures which are transparent to birds.	Fencing should be visible to birds. Do not use chain mesh fences which are invisible to them.	If chain mesh fencing is to be used it needs to made visible through the use of colour coated wire, alternatively they can be covered with shade cloth or similar materials.
Utilities should be sited so as to prevent bird collisions.	a) Roads should be sited away from wetlands or bushland to reduce the risk of birds being run over or colliding with vehicles. b) Power lines to be placed underground to prevent bird strikes and electrocution. Also reduces risk of bushfires, reduces need for tree trimming programs and improves the visual amenity. No overhead powerlines to cross bodies of water (dams, ponds, lagoons, rivers etc.). c) Use street lights that spill primarily downwards. Street lights can attract or disorientate birds that move at night (eg. waterbirds, seabirds) so that they collide with poles or wires.	a) If roads do pass through or close to habitats, traffic calming measures are to be used to reduce vehicle speed, reducing the risk of collisions. b) If powerlines are erected in high risk areas (eg. raptor nest sites, waterfowl flight paths, threatened species habitats) aerial bundled cabling (ABC) should be used to reduce the risk from electrocution and collision. c) If either a) and/or b) are adopted, applicants for use or development are to show that bird populations will not be adversely affected. d) Street lighting in developments in coastal areas or near wetlands may cause problems. Applicants for use or development are to show that bird populations will not be adversely affected.
Buildings are to be designed to prevent bird collisions.	No corner windows or sightlines through buildings from window to window. In large glassed areas the use of low-reflectance glass or install glass at an angle to reflect the ground and not habitat or sky.	If corner windows or windows which have sightlines through buildings are to be incorporated into buildings frosted and low reflectance glass is to be used to make the windows visible to birds.

*Advice on critical habitats and buffer zones may be sought from Parks and Wildlife Service.

Appendix 5: Local Government Areas in Tasmania, Victoria, NSW and the ACT in which swift parrots have been recorded, and known or potential swift parrot habitat occurs.

Tasmania

Burnie	Devonport	Latrobe
Break O'Day	Glamorgan/Spring Bay	Launceston City
Brighton	Glenorchy City	Meander Valley
Central Coast	Hobart City	Sorell
Circular Head	Huon Valley	Tasman
Clarence City	Kentish	Waratah-Wynyard
Derwent Valley	Kingborough	West Tamar

Victoria

Swift parrot habitat overlaps with numerous Victorian local government areas, including (but not limited to) the following:

Banyule City	Greater Dandenong City	Moonee Valley City
Bayside City	Greater Geelong City	Moreland City
Boroondara City	Hobsons Bay	Mornington Peninsula
Brimbank City	Hume City	Mount Alexander
Campaspe	Indigo Shire	Nillumbik
Cardinia Shire	Kingston City	Northern Grampians
Casey City	Knox City	Port Phillip City
Central Goldfields	Macedon Ranges	West Wimmera
City of Greater Shepparton	Manningham City	Whitehorse City
City of Stonnington	Maribyrnong City	Whittlesea City
Darebin City	Maroondah City	Wyndam City
East Gippsland	Melbourne City	Yarra City
Frankston City	Melton Shire	Yarra Ranges
Glenelg Shire	Moira Shire	
Greater Bendigo City	Monash City	

NSW and the ACT

ACT	Greater Hume	Pittwater
Albury	Gundagai	Port Stephens
Ashfield	Gunnedah	Randwick
Balranald	Guyra	Ryde
Baulkham Hills	Gwydir	Shoalhaven
Bega Valley	Harden	Singleton
Berrigan	Hastings	Sutherland
Blacktown	Hawkesbury	Sydney
Bland	Holroyd	Tamworth Regional
Blue Mountains	Inverell	Temora
Bombala	Junee	Tenterfield
Boorowa	Kempsey	Tumbarumba
Byron	Kogarah	Tumut
Camden	Ku-ring-gai	Unincorporated
Campbelltown	Kyogle	Upper Hunter
Canada Bay	Lake Macquarie	Uralla
Canterbury	Leichhardt	Urana
Carrathool	Lithgow	Wagga Wagga
Central Darling	Liverpool	Wakool
Cessnock	Lockhart	Warren
Clarence Valley	Mid-western Regional	Warringah
Coffs Harbour	Moree Plains	Warrumbungle
Cootamundra	Mosman	Weddin
Corowa	Murray	Wellington
Dungog	Newcastle	Wentworth
Eurobodalla	North Sydney	Wingecarribee
Forbes	Orange	Wollondilly
Gilgandra	Palerang	Wollongong
Gosford	Parkes	Wyong
Goulburn Mulwaree	Parramatta	Young
Great Lakes	Penrith	

* Information courtesy Belinda Cooke, Community Programs Officer / Swift Parrot Mainland Recovery Coordinator, Department of Environment and Climate Change, NSW.

Endnotes

1 Hindwood, K.A. and Sharland, M. (1964). "The Swift Parrot". *Emu* 63.4 (March): 319. Reference to observations made in 1958.

2 Swift Parrot Recovery Team (2001). *Swift Parrot Recovery Plan*. Hobart: DPIWE: 5-6. A survey conducted during the 1995/96 breeding season located an estimated 940 pairs.

3 Baker-Gabb, D. (1998). "Conservation Directions: Windows Update". *Wingspan* (September): 6. Note the figure is around 1.5%–2% of the population, or about 30–40 birds a year.

4 Parks and Wildlife Service Tasmania (2003). *Threatened Species Fact Sheet: Swift Parrot* Lathamus discolor. Hobart: DTPHA: np; Morcombe, M. (2000). *Field Guide to Australian Birds*. Archerfield: Steve Parish Publishing: 186-87; Chris Tzaros, Birds Australia, pers. comm., 11 February 2008.

5 Swift Parrot Recovery Team (2001). *ibid*: 6.

6 Webb, M. (in prep). *Nesting Habitat of the Swift Parrot* Lathamus discolor. Quoted in Commonwealth of Australia (2007a). *Draft National Recovery Plan for the Swift Parrot* Lathamus discolor. Canberra: Department of Environment and Water Resources: 11.

7 Matthew Webb, DPIW and Janneke Webb, Tasmanian Conservation Trust, pers. comm., 15 February 2008; Brereton, R. (1997). *Regional Forest Agreement - Tasmania: Management Prescriptions for the Swift Parrot in Production Forests*. Hobart: Joint Commonwealth and Tasmania RFA Steering Committee. Quoted in Commonwealth of Australia (2007a). *ibid*: 11.

8 Webb, M. (in prep). *ibid*. Quoted in Commonwealth of Australia (2007a). *loc. cit.*

9 Matthew Webb, DPIW and Janneke Webb, Tasmanian Conservation Trust, pers. comm., 15 February 2008.

10 Brereton, R. (1997). *ibid*: 8.

11 "Swift Action". *Natural Heritage* 28 (Winter 2006): 3.

12 The general parrot ecology information in this section is drawn from a variety of sources, including: Swift Parrot Recovery Team (2001). *ibid*: 5, 7-10; Commonwealth of Australia (2007). *Draft Background Document: National Recovery Plan for the Swift Parrot*. Canberra: Department of Environment and Water Resources: 4-5, 11; Nally, R.M. and Horrocks, G. "Landscape-scale Conservation of an Endangered Migrant: the Swift Parrot (*Lathamus discolor*) in its Winter Range". *Biological Conservation* 92.3 (March 2000): 335-43; Brereton, R. (1997). *ibid*: 7; and Parks and Wildlife Service Tasmania (2003). *ibid*: np.

13 Saunders, D., Brereton, R., Tzaros, T., Holdsworth M. and Price, R. (2007). "Conservation of the Swift Parrot *Lathamus discolour* – Management Lessons for a Threatened Migratory Species". *Pacific Conservation Biology* 13.2: 113.

14 Commonwealth of Australia (2007a). *ibid*: 10; Matthew Webb, DPIW and Janneke Webb, Tasmanian Conservation Trust, pers. comm., 15 February 2008; Andrew North, environmental consultant, North Barker Ecosystem Services, pers. comm., 28 February 2008.

15 Brereton, R. (1997). *ibid*: 7, Appendices 2, 3 and 5; Matthew Webb, DPIW, pers. comm., 18 March 2008.

16 Commonwealth of Australia (2007a). *ibid*: 10.

17 Commonwealth of Australia (2007). *ibid*: 8.

18 Environment ACT (2005). *Information Sheet: Threatened Species and Communities of the ACT: Swift Parrot* (Lathamus discolour): np.

19 Commonwealth of Australia (2007). *ibid*: 8.

20 Brereton, R., Mallick, S.A. and Kennedy, S.J. "Foraging Preferences of Swift Parrots on Tasmanian Blue-gum: Tree Size, Flowering Frequency and Flowering Intensity". *Emu* 104.4 (2004): 377.

21 Munks, S., Richards, K., Meggs, J. and Brereton, R. (2004). "The Importance of Adaptive Management in 'Off-reserve' Conservation for Forest Fauna: Implementing, Monitoring and Upgrading Swift Parrot *Lathamus discolor* Conservation Measures in Tasmania". In Lunney, D. (ed). *Conservation of Australia's Forest Fauna*. Mosman: Royal Zoological Society: 688-698. Quoted in Commonwealth of Australia (2007). *ibid*: 12.

22 Brereton, R. (1997). *ibid*: 4.

23 Threatened Species Network (2007). *Fact Sheet: Australian Threatened Species 2007: Swift Parrot* Lathamus discolour: 2.

24 Brereton, R., et al. (2004). *ibid*: 377.

25 Swift Parrot Recovery Team (2001). *ibid*: 12. However, the number could be higher: the Minutes of the June 1999 Meeting of the Swift Parrot Recovery Team state that 39 birds were recorded, a number repeated by Baker-Gabb (*ibid*: 6) who writes that 24 birds were dead and 15 injured.

26 Minutes of the June 1999 Meeting of the Swift Parrot Recovery Team: np.

27 Swift Parrot Recovery Team (2001). *ibid*: 12.

28 Klem, D. Jr. (1989). "Bird-Window Collisions". *The Wilson Bulletin* 101.4: 614.

29 Commonwealth of Australia (2007). *ibid*: 8; Tzaros, C. "Living in Suburbia: Opportunities and Dangers for Swift Parrots on Mainland Australia in 2002". *Eclectus* (December 2002): 13-14; Saunders, D., et al. (2007). *ibid*: 112, 113. Saunders et al. report that in 2002 a large proportion of the population, usually found in central Victoria, migrated up to 1,000 km further north than recorded in previous years, presumably due to drought conditions in central Victoria and western NSW.

30 Saunders, D., et al. (2007). *ibid*: 113.

31 Baker-Gabb, D. (1998). *ibid*: 6.

32 Klem, D. Jr., Keck, D.C., Marty, K.L., Miller Ball, A.J., Niciu, E.E. and Platt, C.T. (2004). "Effects of Window Angling,

Feeder Placement, and Scavengers on Avian Mortality at Plate Glass". *Wilson Bulletin* 116.1: 69-73.

33 Threatened Species Unit (nd; pamphlet). "Save Our Native Birds: Prevent Window Collisions". Hobart: Tasmanian DPIWE: np; Klem, D. Jr. (1990a). "Collisions Between Birds and Windows: Mortality and Prevention". *Journal of Field Ornithology* 61.1: 120-28; New York City Audubon Society Inc. (May 2007). *Bird-Safe Building Guidelines*: 5, 6

<http://www.birdsandbuildings.org/docs/BirdSafeBuildingGuidelines.pdf>; City of Toronto Green Development Standard (March 2007). *Bird-Friendly Development Guidelines*: 3-4 <http://www.toronto.ca/lightsout/pdf/development_guidelines.pdf>.

34 Klem, D. Jr. (1989). *ibid*: 611.

35 Klem, D. Jr. (1990). "Bird Injuries, Cause of Death, and Recuperation from Collisions with Windows". *Journal of Field Ornithology* 61.1: 115-16.

36 Chris Tzaros, Birds Australia, pers. comm., 11 February 2008.

37 Klem, D. Jr. (1990). *ibid*: 116.

38 New York City Audubon Society Inc. (May 2007). *ibid*: 14.

39 Niall Simpson, Landscape Architect, Launceston City Council, pers. comm., 12 February 2008; Brereton, R. (1998). *Bird Collisions Code*: np (see Appendix 4).

40 City of Toronto Green Development Standard (March 2007). *ibid*: 35.

41 The RPDC oversees Tasmania's planning system. Its functions include the assessment and approval of local government planning schemes and planning scheme amendments, and the assessment of public land use issues. <http://www.rpdc.tas.gov.au/about/moreinformation>

42 Bryant, S. and Jackson, J. (1999). *Tasmania's Threatened Fauna Handbook.* Hobart, Threatened Species Unit/Parks and Wildlife Service: 246-47.

43 Hobart City Council (2008). *Building, Planning and Plumbing* <http://www.hobartcity.com.au/HCC/STANDARD/PLANNING.html>.

44 In NSW development assessment takes place with reference to the *Threatened Species Conservation Act 1995*. Under this Act the Director General of the Department of Environment and Climate Change is responsible for identifying habitat that is critical for the survival of listed species, populations or ecological communities. If an application for development consent under the *Environmental Planning Assessment Act 1979* involves land that is part of critical habitat or is likely to significantly impact threatened species populations, then a species impact statement must be provided by the applicant. In the assessment process the *Environmental Planning Assessment Act 1979* stipulates that the relevant recovery plan or threat abatement plans for the species must be taken into account. The proposed checklist could be incorporated into a threat abatement plan for the swift parrot.

45 Resource Planing and Development Commission (March 2003). *Guide to the Resource Management and Planning System.* Hobart: RPDC: 16.

46 Government of Tasmania. *Land Use Planning and Approvals Act 1993 Schedule 1,* PART 1 - Objectives of the Resource Management and Planning System of Tasmania, clause 1(a). <http://www.thelaw.tas.gov.au/tocview/index.w3p;cond=;doc_id=70%2B%2B1993%2BJS1%40EN%2BSESSIONAL;histon=;prompt=;rec=;term=>.

47 Klem, D. Jr. (1989). *ibid*: 612, 613.

48 BASIX, the Building Sustainability Index, is a free online program produced by the NSW Government that sets energy and water reduction targets for residential buildings. It allows users to determine how they will meet targets from a wide range of options such as water-saving fixtures, rainwater tanks and improved insulation. The building design must pass specific targets before the user can print a BASIX Certificate. Bird collision minimisation could be included as a target in its own right, or incorporated as an 'added bonus' to enhance the 'value' of options such as passive solar orientation and natural lighting. From *BASIX: Building Sustainability Index:* <http://www.basix.nsw.gov.au/information/about.jsp>.

49 City of Toronto Green Development Standard (March 2007). *ibid*: 16.

50 Klem, D. Jr. (1989). *ibid*: 611.

51 New York City Audubon Society Inc. (May 2007). *ibid*: 29.

52 Hermann, W. (2002). *List of Bird Casualties at CODES, University of Tasmania, Sandy Bay.* (unpublished). Quoted in Gelder, J. (2003). "Birds and Buildings". In *BDP Environmental Design Guide* (August 2003) DES 56: 6.

53 Klem, D. Jr., et al. (2004). *ibid*: 69; City of Toronto Green Development Standard (March 2007). *ibid*: 17; New York City Audubon Society Inc. (May 2007). *ibid*: 29; City of Chicago (October 2007). *Bird-Safe Building: Design Guide for New Construction and Renovation*: 2

<http://www.birdsandbuildings.org/docs/ChicagoBirdSafeDesignGuide.pdf>.

54 New York City Audubon Society Inc. (May 2007). *ibid*: 28; Swiss Ornithological Institute / BirdLife Schweiz: *Window Collisions* <http://www.windowcollisions.info/>.

55 New York City Audubon Society Inc. (May 2007). *ibid*: 18; see also Doeker, R. (2005). *Birds and Buildings: Creating a Safer Environment*: 41, 43, *passim* <http://www.birdsandbuildings.org/docs/birdsafedesign.pdf>.

56 New York City Audubon Society Inc. (May 2007). *ibid*: 30.

57 Klem, D. Jr. (1990a). *ibid*: 120, 125; Doeker, R. (2005). *ibid*: 15, 16; City of Toronto Green Development Standard (March 2007). *ibid*: 10, 13.

58 Klem, D. Jr. (1990a). *ibid*: 125.

59 Klem, D. Jr. (1989). *ibid*: 611; Doeker, R. (2005). *ibid*: 60, 69, 70; City of Toronto Green Development Standard (March 2007). *ibid*: 11, 14, 15, 17; New York City Audubon Society Inc. (May 2007). *ibid*: 26, 29, 30, 46, 47; Swiss Ornithological Institute / BirdLife Schweiz: *ibid*; Niall Simpson, Landscape Architect, Launceston City Council, pers. comm., 19 February 2008.

60 Doeker, R. (2005). *ibid*: 53, 54; City of Toronto Green Development Standard (March 2007). *ibid*: 11; New York City Audubon Society Inc. (May 2007). *ibid*: 29.

61 Doeker, R. (2005). *ibid*: 48, 68, 71, 74; City of Toronto Green Development Standard (March 2007). *ibid*: 18; New York City Audubon Society Inc. (May 2007). *ibid*: 48.

62 Hultsch, H. and Todt, D. (1989). "Song Acquisition and Acquisition Constraints in the Nightingale, *Luscinia megarhynchos*". *Naturwissenschaften* 76: 83-85; Buer, F. and Regner, M. (2002). "With the 'Spider's Web Effect' and UV-absorbing Material against Bird-Death on Transparent and Reflecting Panes". Translated from the original article in German, in *Vogel und Umwelt* 13 (2002): 32-33 <http://www.spinnennetz-effekt.de/article.pdf>. Birds also have tetrachromatic, or four-dimensional colour vision, whereas humans only have trichromatic, or three-dimensional, colour vision. Increased dimensionality produces a qualitative change in the nature of colour perception. In short: things that are colourful to humans are even more colourful to birds, or colourful in different ways. Also, birds see colours that are unknown to humans. (University of Bristol Biological Sciences: *Ecology of Vision: Exploring the Fourth Dimension* <http://www.bio.bris.ac.uk/research/vision/4d.htm>.) It may be some years before humans are able to develop technological applications that take into account this aspect of bird vision – or it may not be possible at all.

63 Buer, F. and Regner, M. (2002). *ibid*: 33, 35-36, 39; New York City Audubon Society Inc. (May 2007). *ibid*: 45.

64 City of Toronto Green Development Standard (March 2007). *ibid*: 16.

65 Linley Grant, Vice President, Birds Tasmania, pers. comm., 30 March 2008.

66 Doeker, R. (2005). *ibid*: 62, 63, 64, 66, 82; 74; City of Toronto Green Development Standard (March 2007). *ibid*: 12, 13, 16; New York City Audubon Society Inc. (May 2007). *ibid*: 35, 36, 37, 38; Jones, E.R. (2007) "If You Have Windows, You Have Window Strikes". *The Tasmanian Conservationist* 310, (March 2007): 10-11 (first published in *Yellow Throat* 31 (December 2006): pages unknown; Linley Grant, Vice President, Birds Tasmania, pers. comm., 15 February 2008.

67 Buer, F. and Regner, M. (2002). *ibid*: 33-34, 36.

68 Linley Grant, Vice President, Birds Tasmania, pers. comm., 28 March and 30 March 2008.

69 Klem, D. Jr. (1990a). *ibid*: 122.

70 Jones, E.R. (2006). *ibid*: 11. A Tasmanian ornithologist reported sighting a pair of currawongs inspecting a cardboard raptor cut-out, and then one of the pair flying off with it in its bill!

71 Linley Grant, Vice President, Birds Tasmania, pers. comm., 28 March 2008.

72 This was mentioned during the workshop on 15 February, 2008.

73 Matthew Webb, DPIW and Janneke Webb, Tasmanian Conservation Trust, pers. comm., 15 February 2008.

74 Brereton, R. (1998). *ibid*: np.

75 City of Toronto Green Development Standard (March 2007). *ibid*: 36.

76 Chris Tzaros, Birds Australia, pers. comm., 9 January 2008.

77 Klem, D. Jr. (1989). *ibid*: 611-12; City of Toronto Green Development Standard (March 2007). *ibid*: 36.

78 New York City Audubon Society Inc. (May 2007). *ibid*: 10.

79 Summers, R.W. (1998). "Research Note: The Lengths of Fences in Highland Woods: the Measure of a Collision Hazard to Woodland Birds". *Forestry* 71.1: 73-76; The Forestry Commission Forest Research and the Royal Society for the Protection of Birds (August 2001). *Alternative Deer Fences in Core Capercaillie and Black Grouse Habitats: An Interim Best Guidance Note* <http://www.forestry.gov.uk/pdf/Fencing.pdf/$FILE/Fencing.pdf>; Baines, D. and Andrew, M. (2003). "Marking of Deer Fences to Reduce Frequency of Collisions by Woodland Grouse". *Biological Conservation* 110.2 (April): 169-76.

80 DPIW advises that deer farm boundary fences must be 2m high with post spacings of about 10m. "Deer Framing: Fencing": <http://www.dpiw.tas.gov.au/inter.nsf/WebPages/RPIO-4ZS9KL?open>

81 City of Toronto Green Development Standard (March 2007). *ibid*: 5.