BIRDS AND BUILDINGS

John Gelder

SUMMARY OF

ACTIONS TOWARDS SUSTAINABLE OUTCOMES

Environmental Issues/Principal Impacts

- Human habitats intrude upon those of native bird species, often to birds' detriment. Habitat loss, to the extent that some species are endangered, is the most obvious intrusion, but others include more direct threats to bird health and safety, such as collision with structures, and electrocution.
- Birds may suffer from this intrusion, but loss of contact with native birds in daily life also diminishes the human experience.
- Some bird species, both native and introduced, intrude on the human habitat in unwelcome ways, such as noise, mess and damage.

Basic Strategies

In many design situations, boundaries and constraints limit the application of cutting EDGe actions. In these circumstances, designers should at least consider the following:

- Provide suitable native bird habitats as a routine part of all development, through birdscaping with indigenous plants around buildings to provide food and shelter.
- Design and detail buildings so that birds find it difficult to roost or nest on them, e.g. avoid deep, flat-topped ledges. Spikes, wires and other intrusive physical deterrents should be regarded as avoidable and trapping and killing must be the last resort.
- Design windows using tinted glass and screens so that they are visible to birds.
- Make wire structures (fences, guys, power lines) visible to birds, using, for example, coloured wire and coloured disks.
- For tall structures such as buildings, communications towers and wind generators on bird migration routes, carefully consider siting, lighting and management, or ideally, locate to avoid the route altogether.
- Consider alternative sites to wetlands for development – these are often very important to many bird species, especially migrants.

Cutting EDGe Strategies

- Consider developing wall and roof gardens using indigenous plants.
- Provide ponds with edible fish and plants.
- Provide nest boxes and artificial roosting sites for native birds.
- Control pigeons through construction of dovecotes, and the provision of associated management techniques, such as egg collection.

Synergies and References

- Biodiversity – see *BDP Environment Design Guide notes:* GEN 1, GEN 3, GEN 26, GEN 28, GEN 39, DES 15, DES 18, DES 45
- Environmental impact assessments – see *BDP Environment Design Guide notes:* GEN 16 , DES 15, DES 29
- Light pollution – see *BDP Environment Design Guide note:* GEN 24
- Native landscaping – see *BDP Environment Design Guide notes:* GEN 3, GEN 39, DES 40, DES 45, DES 48, DES 53
- Principal sources of advice are:
  - Birds Australia (www.birdsaustralia.com.au); and
  - Society for Growing Australian Plants (farrer.riv.csu.edu.au/ASGAP).

BIRDS AND BUILDINGS

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Although sustaining biodiversity features in the environment policies of BDP members, few EDG notes have addressed the issue directly, yet buildings and associated structures can have a very direct impact on wildlife. Birds are perhaps the best example of affected fauna. This note explores the interaction of birds with buildings and other structures.

We are curiously ambivalent about wild birds. Often we want to encourage them on and around our buildings, but equally often we want to discourage them. To some extent, attitudes vary depending on the species – small attractive native species such as parrots are generally desired, where larger, less attractive alien species, such as pigeons, are not. Conversely, buildings themselves are potentially attractive to some species such as pigeons and gulls, but less attractive to others like parrots. Likewise different forms of landscape e.g. trees versus grassland attract some species and not others.

As buildings and other structures can also pose dangers to birds, the challenge is to tackle the three issues of encouraging birds, deterring birds and bird safety, in an integrated manner. This note discusses each issue in turn, and concludes with a quick look at integration.

Impact on bird health is not discussed. Examples include the effects on behaviour of light pollution (see GEN 24) and noise pollution ('Birds hit the high notes in cities', BBC News website, 16 July 2003).

1.0 ENCOURAGING WILD BIRDS

1.1 Reasons

Reasons to encourage wild birds in human settlements include:

- the need to encourage biodiversity (diversity of species, and protection and encouragement of rare species)
- our obligation to offset habitat destruction through development, e.g. by providing 'oases' to facilitate movement of wildlife through built-up areas
- birds' simple right-to-exist
- protection in law, e.g. of critically endangered species such as the azure kingfisher (Garnett & Crowley, 2000)
- rescue, e.g. of once-common species in decline, such as the house sparrow in the UK (Westminster Biodiversity Partnership, 2002)
- pleasure (birdsong, colour and movement) and the flow-on effects of this, e.g. attracting businesses
- fertilisation of plant species
- natural pest control, e.g. raptors control rodents
- exploitation, e.g. encouraging tourism, acquiring fertiliser from guano.

Use of wild birds for food is a special case – we have exploited pigeons, ducks, geese, swans, and many other birds, and their eggs, for centuries. They have been encouraged to visit during migrations, or to permanently reside in settlements, through the provision of:

- ponds (for water birds)
- shelters (for pigeons or sparrows)
- landscape management (i.e. game keeping, for ground-nesting birds such as pheasant, grouse and quail).

The use of Australian species in this way is not yet widely accepted (galah pie, emu steaks?).

Birds are also held captive (not always legally), in zoos and aviaries, for a variety of reasons including scientific study, breeding (e.g. of endangered species), pleasure, food (e.g. chickens, being virtually flightless, need the protection captivity brings), pest control (e.g. raptors used to control pest birds at airports), sport (racing pigeons, falconry) and communications (pigeon post). Eccentricity comes into it occasionally – as in the case of the Londoner who shared his basement flat with 250 free-flying pigeons (reported on the BBC's *Animal Hospital*, with Rolf Harris).

1.2 Buildings as life support

What is it about a building that attracts some species? Buildings provide all sorts of surfaces, nooks, crannies, ledges, and enclosed yet accessible spaces (e.g. attics) which can be used for roosting or nesting[1]. Some species are partial to using buildings this way, e.g. cliff dwelling species such as gulls and some raptors, but ground dwelling species are not.

Migratory species generally won't use buildings – their destinations tend not to be cities. One exception is the storks of Germany, which famously nest on chimneys and other high places, while welcome swallows and fairy martins are more routine exceptions. Generally, migrants don't touch down *en route* but, in an emergency, they will: in 1998 a two-storey house in Pasadena, California was infested by more than 1000 migratory swifts, taking shelter during stormy weather, entering down the chimney while the owners were away (anon, 1998a).

Other species prefer to use groundcover, trees and shrubs for nesting and roosting. Yet others nest and roost well away from people. Not all have adapted to urban, or even suburban, life, even if their traditional ranges overlap ours. For many native species, their ranges are remote from the main centres of habitation.

[1] Even non-conventional buildings, e.g. a bridge with a tensile fabric canopy, over a waterway in the harbour of Baltimore, have birds nesting in the 'pockets' formed by the fabric at the ends of the struts

1.3 Methods

There are two basic strategies for attracting wild birds – provision of shelter and of food. While structures can provide shelter, permanent food supplies can be provided through landscaping. The two can be complementary, or not!

Shelter

Shelter can be provided integral to the building. For example, in the UK woodcrete nesting boxes may be built into walls. Swallows and martins traditionally nest under eaves, so eaves can be provided. Sparrow terraces and fairy martin cups can be fixed on suitable walls. Birds are opportunists – if shelter is not provided on purpose, they will use shelter inadvertently provided, maybe to the detriment of function by, for example, nesting in chimneys or overflow outlets.

Nest boxes substitute for the nesting hollows found in old or dead trees, which are getting scarce, and are virtually non-existent in built-up areas. The larger hollow-nesting birds, such as black cockatoos and large owls, are particularly vulnerable. Nest boxes can be used as much to encourage particular local species of birds to visit as to encourage them to not nest using the building fabric itself. They can be made species-specific by adjusting size and position of openings (bird species can be very fussy about this), nest box location, and general size and shape of the box. Many native bird species are known to use nest boxes, including most parrots, lorikeets, corellas, cockatoos, pardalotes, kookaburras, and boo book owls.

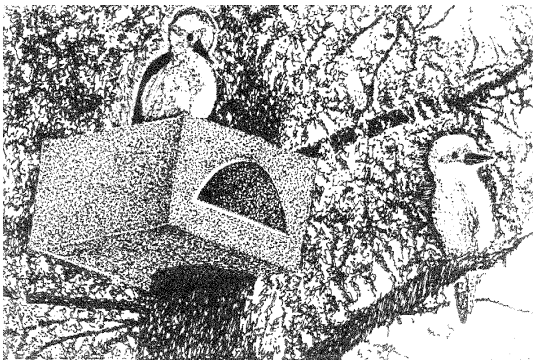

Figure 1. Nest box

Usually made of wood, a traditional French solution is a custom-made terracotta pot – durable, insulating and easily cleaned. Management is critical, as nest boxes will be targeted by starlings, mynas, feral honeybees, and black rats, all at the expense of native species. To some extent, however, nest boxes can be designed to exclude these pests.

Nest boxes can be free-standing, or attached to buildings or trees, and may be for single pairs or many pairs of birds. Some species prefer to nest in colonies, so it is important to provide a number of nest boxes. Placement is critical, sheltered from direct summer noon sun and prevailing winds, and inaccessible to cats (*Birds Australia Information Sheet 5*).

Within cities, where nest boxes for large species may not be practicable, roosts for owls can be provided instead.

Feeding

Many people go out of their way to attract birds with regular feeding, but indiscriminate feeding may well attract unwanted species, such as pigeons. Some species have foraging systems based around improperly managed city refuse. This doesn't always go down well with the authorities (hence a sign in Baltimore: 'Please do not feed the pigeons. Their droppings foul the pavement'), and seen recently with Mayor Ken Livingstone's controversial war on feeding the pigeons of Trafalgar Square in London[2]. In any case, creating dependence on feeding is not advisable – it is better to provide food through planting.

Planting (birdscaping)

The trick is to attract the native birds without also attracting pest species. The solution is in judicious multi-layer planting of trees, shrubs, flowers and grasses that are indigenous to the locale. Open areas of native flowering species will attract insects and insect-feeding birds (Delpratt, 1997). Seed-bearing plants will attract many smaller species, fruit-producing plants will attract fruit-eating birds, and nectar-producing plants will attract nectar-feeding birds such as parakeets. Stands of thick and prickly native shrubs protect smaller nesting birds from cats[3] and dogs, and from native harassers such as mynas and pied currawongs. These plants also provide the structural framework for nest building.

Native climbers trained up walls and fences can provide insects (attracted to flowers), edible fruit, and seeds, roosting and nesting sites. One example of a vertical garden is that by landscape architects Room 4.1.3 Pty Ltd (www.room413.com.au/Built/Filmmaker/Filmmaker.html), for a Sydney film producer (see also anon, 1998c). Window boxes provided on the sunny sides of a building, are a form of vertical garden. The association between birds, feeding on the Richmond birdwing butterfly, in turn feeding on a native vine (*Pararistolochia praevenosa*) once common around Brisbane, is a good example of a resource base for local birds (For other plant-butterfly linkages, see *Richmond Birdwing Conservation Project Newsletter*, April 2001, CSIRO.)

Roof gardens, from collections of pot plants to integral systems, can create valuable wildlife habitat. For all this planting, indigenous native species are preferred – native birds are adapted to them, and there is no need for insecticides (Stephens ,1978; Reid, 1996; and Pipitone, 1999). The lack of connectivity of urban green elements is a major limitation in uptake by birds.

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2 Licensed feed sellers have been banned from the Square, and people are employed to scare off the birds with hawks and megaphones, and to vacuum up the seeds, but the public continue to scatter seeds, attracting thousands of pigeons to the Square.

3 For concerned cat owners, a 'cat bib' is available which prevents cats from catching birds (CatStop).

Ponds

Ponds contain fish, frogs and water weeds, all of which will be of interest to a range of bird species, such as kingfishers and ducks. Make sure the fish are edible, not ornamental! Reed beds and wetlands (e.g. for on-site wastewater treatment) will attract insects and hence other bird species. Pond location is important – ground ponds are less safe than bird baths, which in turn are less safe than tree hole ponds for some species.

Landscape management

Keeping out weed (alien) species is obvious, although some weed species (e.g. gorse, lantana) have been essential in maintaining some birds. Perhaps less obvious is the retention of dead standing trees – these provide important nesting and roosting sites – and dead branches and coarse woody debris at ground level. If an open grassy area is what you want, make sure that shrubs and trees are kept at bay – perhaps limited to 25 per cent of the garden area. Let seed-bearing plants stand so birds can harvest (don't dead-head flowers) and let fallen leaves remain on the ground. Leave bare patches of soil near shrubs. On a large scale, linkage between habitat pockets is also important – 'oases' on or around individual buildings can be important here.

2.0 DETERRING WILD BIRDS

2.1 Reasons

Reasons to discourage wild birds include:

- nuisance and distress (e.g. mobbing, magpies in the breeding season attacking passers-by, lapwings, kookaburras and butcherbirds[4])
- unsightly mess (e.g. droppings on cars, walls and pavements, and around ornamental lakes), though well-known UK birder, Bill Oddie, recently styled the pattern of kittiwake droppings on a facade 'artistic' and visually preferable to the use of netting
- disease (e.g. zoonoses such as chlamydiosis, salmonellosis, avian tuberculosis, cryptococcus and histoplasma)
- noise (e.g. bellbirds, currawongs, crows, wattlebirds, roosting corellas)
- damage to buildings, both inadvertent (chemical attack from droppings[5]) and deliberate. Cockatoos like to chew on materials of a particular texture and hardness. Unfortunately, softwoods such as western red cedar are particularly appealing, and over a few weeks, cockatoos can cause considerable damage. Noisy mynas have pulled the plastic caps off the lighting system at Melbourne's Arts Centre spire. In the UK, woodpeckers have been reported damaging softwood boards on a church bellcote, and blue tits apparently fancy blue window putty (Westbury, 2003)!
- damage to stored consumables (e.g. in agricultural and food industry buildings)
- competition (e.g. for fruit and other crops, by parrots, lorikeets, bowerbirds, currawongs and silvereyes)
- effect on native bird species (e.g. by mynas)
- damage to gardens (e.g. by lyrebirds, brush turkeys and scrub fowl searching for food in leaf litter and in the soil)
- consumption of ornamental fish in ponds (e.g. by herons, kookaburras and other kingfishers, and even cormorants if the body of water is big enough).

These factors may amount to 'public nuisance' in law, as in the 2001 *Railtrack* (UK) case involving pigeon-proofing of the railway bridge over Balham High Street (Lindsey, 2001). Indeed pigeons and seagulls feature strongly in the species-to-deter category. Even so, in terms of the number of premises treated, pigeons rate much lower than most other pests (BRE Digest 415, 1996).

2.2 Methods – accommodation

Barring birds from your building may simply make them somebody else's problem, as birds will make do with second best. Giving them alternative accommodation can solve the problem for everyone.

Enticing birds off buildings, by giving them somewhere else to roost or nest, was an option practised in the redevelopment of the Baltic Flour Mill Centre for Contemporary Art, on the River Tyne at Gateshead in the UK. Hundreds of kittiwakes used the facade of the

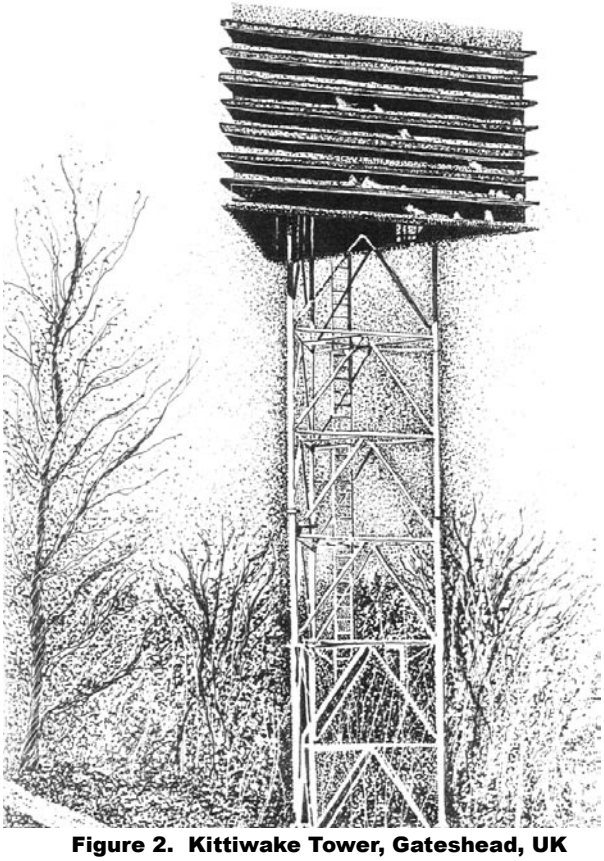

Figure 2. Kittiwake Tower, Gateshead, UK

4 And lately by crows, in Japan and Germany at least.

5 For example, pigeon droppings are blamed by the London authorities for causing £140,000 damage to Nelson's Column and to Trafalgar Square.

empty building as a nesting site. When redevelopment began in 1998, the Kittiwake Tower was erected at the site, and that summer had 100 birds nesting on it. In 2001 it was relocated half a mile downstream, to an area of closely mown grassland (Saltmeadows), and within a few weeks hundreds of pairs of birds had moved to the tower in its new location. It is now a designated local nature reserve. The birds have not returned to the Baltic Flour Mill.

Dovecotes

Dovecotes or columbaria are a traditional form of accommodation in which the owners kept the birds for food[6]. Modern owners have other objectives. In July 2000, the London Borough of Barking and Dagenham opened a dovecote in Barking Park, with the expectation that it would take birds off the roofs of a neighbouring public convenience and houses. Kirklees Council built a thirty-pair dovecote in Huddersfield town centre, with a view to pigeon management. Other dovecotes, with the same purpose, have been built by Malvern Hills District Council in Worcestershire, Heath Park Hospital in Cardiff, and Nottingham City Hospital. PICAS (Pigeon Control Advisory Service), reckons that 'The dovecote is the way forward for large scale pigeon control in the 21st century'. However, dovecotes alone will not do the job. Eggs must be frequently removed from the dovecotes to keep the population down, and feeding pigeons outside designated 'feeding zones' must be discouraged, which in turn requires a public awareness campaign.

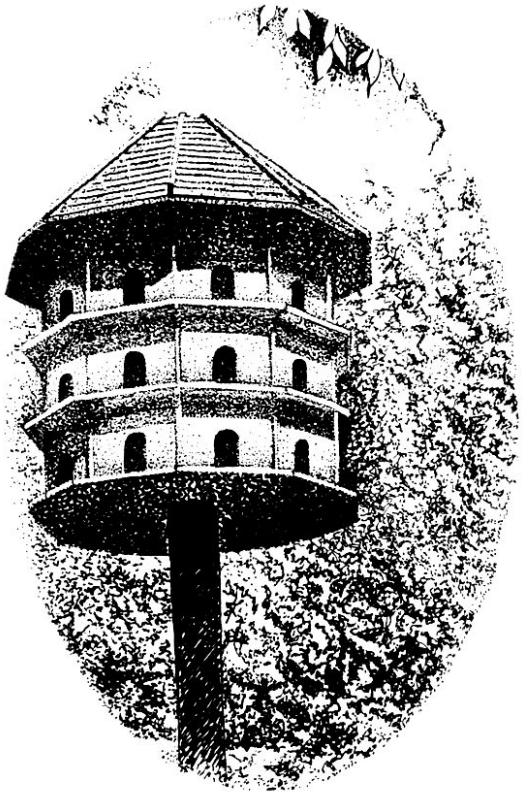

Figure 3. A traditional dovecote

It remains to be seen if dovecotes take off in Australia – if they do, this will be another architectural opportunity[7]. Meantime abandoned silos and the like fulfil this role.

2.3 Methods – deterrents

As a general rule, all native bird species are protected by state and territory legislation. Vulnerable and endangered species are protected at Commonwealth level (*Environment Protection and Biodiversity Conservation Act 1999*). On top of this, each state and territory has a *Prevention of Cruelty to Animals Act.* Accordingly deterrents must not trap, injure or kill a bird, nesting birds must not be prevented from accessing their nest, scaring devices must not be used near the nests of protected species, and deterred birds must have somewhere else to go, otherwise they will be pointlessly distressed. If native birds are persistent pests then advice should be sought from the local authority or state government conservation officers about action that can be taken.

Designing out birds

Buildings can be designed to make roosting and nesting difficult, without having to resort to unsightly physical deterrents. Nooks and crannies are easily avoided. Ledges can be steeply pitched rather than near-horizontal, and made shallow rather than deep. Trusses in areas with ready bird access (e.g. undercrofts, porches) could, with a little effort, be designed to be closed rather than open.

Roost inhibitors

The practice of using spikes to deter birds goes back a long way, as we see from the Sandwich (UK) church wardens' accounts for 1444 (quoted in Salzman, 1952, p290):

> *'for xxiij yryn pykys that were made for to sette up on the poynts of the crossis of the pynnacles of the stepyll for ravouns schuld not stond ther on to soyle the stepyll and goterie with bonys and other thyngs'.*

There is an even older example in the Temple Scroll, from Israel in the 2nd century BC (translated in Wise et al, 1996, p477):

> *'… No unclean bird is to fly over My temple, so you must make spikes on the court's wall and on the roofs of the gates belonging to the outer court. No unclean bird may ever be inside My temple, forever, all the days that I dwell among them.'*

This particular problem is ongoing – an old church in the UK was recently home to 100,000 starlings, roosting on the roof and pinnacles, doing serious damage to the stonework and carvings.

6 Roman examples held as many as 5000 birds – modern commercially available dovecotes might hold as many as 60. For more on the history of dovecotes, see Spanal, 1998.

7 It has been suggested that dovecotes are unlikely to succeed in Australia due to the large number of raptors, but this problem has always existed (e.g. for Roman, Mayan and Scottish dovecotes), and can be managed by keeping trees well clear of the dovecotes – once in the sky, pigeons will outfly their hunters.

Modern spikes may be metal or plastic, and are formed in rows on flexible polycarbonate bases adhered to the substrate. They can be coloured to be inconspicuous, though seen from below they tend to be in silhouette and conspicuous no matter how they are coloured. Quite a few may be needed – rows should be fixed 100mm apart, the spikes on a row are about 50mm apart, and are 120-150mm long – creating a veritable forest on a wide ledge. Trapped rubbish may render them ineffective as well as unsightly.

Figure 4. Blunted stainless steel rods installed on building ledge

Steel sprung wires are a less-conspicuous alternative for parapets, sills and the like. They are fixed using stainless steel eyelets. Low voltage wires are another option, but are prone to breakdown. Nylon line can also be used.

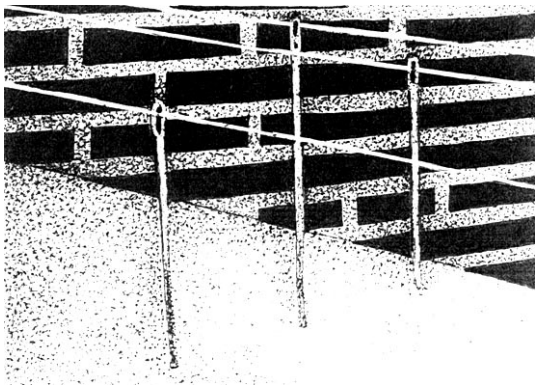

Figure 5. Spring-tensioned wire system

Netting is widely used, for example, to keep birds off capitals and recessed sculpture, to stop them flying through open trusses, and to keep them out of air intakes. Lakes and ponds at airports are meshed over so birds can't feed in them, e.g. at Kingsford Smith. For pigeons, 50mm gauge is used. BS 5502-30:1992 recommends 12mm anti-bird mesh over ventilation openings. Netting may be polypropylene (coloured to be inconspicuous) or galvanized wire, fixed using stainless steel eyelets. Birds often find themselves trapped behind the netting or tangled in it, resulting in RSPCA call outs. Birds are traditionally prevented from nesting in chimneys using wire mesh balloons.

Gel strips, sealed in a resinous coating, make ledges slippery and the birds uncomfortable, but they harden and need to be replaced regularly and this isn't easy. Gels can also ooze out of the coating and stick to birds' feet and feathers, so they are not recommended by the RSPB (Royal Society for the Protection of Birds) or PICAS.

Excluding birds from areas with vehicular access can be achieved using suspended proofing strips of heavy-duty clear PVC.

Visuals

These are a modern version of the classic scarecrow effect. Examples include 30 metre plastic strips imprinted with holograms of owls' eyes, and large balloons with a raptor's face (e.g. Guard'n'Eyes, Terror Eyes). A downside is that these deterrents are very visible!

Sounds

The Hirshhorn Museum in Washington USA uses taped bird alarm calls, playing continuously, to deter birds from using the sculpture garden and facade. Some alarm calls, such as gulls, are very noisy and so are not suitable for residential areas. A range of sonic and ultrasonic repellers is available, some targeting specific species such as geese. Many are not species specific and will deter all birds. And some bird species actually fly towards alarm calls!

Miscellany

Sydney Harbour Bridge is remarkably free of seagull droppings, thanks to a family of hawks that has set up home in one of the southern pylons. Set a bird to catch a bird! But using trained raptors can backfire, as when Nottingham City Council employed a falconer in 1999 to control pigeons in the city centre – the bird was seen by distressed children attacking and killing pigeons, resulting in bad press (and having no effect on the pigeon population). The use of raptors against pigeons can be successful in enclosed spaces, such as railway concourses, but is not very effective over open sites. Indeed, lethal controls (including poisons and shooting) generally fail against pigeons, according to PICAS.

Trapping is another option used occasionally, for example in Singapore, for crows, where large cages can be spotted around the city; in Hong Kong for cockatoos which are damaging city structures; and for Indian mynas (traps in two sizes have been developed by the Australian National University – birds caught are humanely destroyed [*Minimising Mynas – Feral Facts* No 4, 2002, ANU]). Permits are needed, of course.

To prevent chewing of softwood cladding, sacrificial softwood strips may be provided, or the facade can be covered by mesh (permanently) or shade cloth (rolled up when the house is occupied). Replacement with hardwood is another solution. Obviously the use of hardwood in the first place would avoid the problem altogether.

Damage to gardens can be reduced by the provision of coarse and heavy mulch to protect the ground surface, and by placing logs or bricks around newly-planted seedlings and over sprinkler lines.

Ornamental ponds can be protected using suspended netting, sufficiently high above the water, or fine in texture, to prevent long-beaked birds such as herons

getting to the fish and frogs. Shelter within the pond should also be provided. Bright-coloured wires strung across the pond just below the water surface may also be effective, even for larger areas of water, and are less conspicuous than netting.

Fruit trees are easily protected with bird-proof netting, though one tree should be left un-netted, to entice the birds away from the rest of the crop.

Finally, droppings and debris from nesting welcome swallows or fairy martins can be caught by placing small platforms or trays immediately beneath the nests, removed at the end of the breeding season. These only need to be installed above points of conflict such as doors. Or, the droppings can be directed to fall into gardens. Alternatively the birds can be barred from nesting by treating attachment areas with vegetable oil or petroleum jelly.

3.0 BIRD SAFETY

3.1 Problems

Wild birds also have unsought interactions with buildings and structures, often with fatal consequences.

Lights

Buildings and associated structures can kill birds, often in large quantities. It has been estimated that lit-up buildings and smokestacks kill 100 million birds a year in North America, with peaks at the spring and autumn migrations, particularly on the coast or next to lakes. At this time many species fly at night and at low altitude. Migrants get confused by bright lights and glass and become trapped among the buildings. Some collide with the buildings; others drop from exhaustion (MacKenzie, 1997). Vulnerability seems to vary among species.

In Chicago, the Sears Tower alone kills 1500 birds a year. So-called vanity lights on the tops of towers take their toll on migratory songbirds flying 100 storeys high. The crown of bright multi-tiered lights at 311 South Wacker Drive, had workers cleaning dead birds off the roof with a shovel.

In Toronto 10,000 birds a year are estimated to die in the 70 hectares of the CBD. Indeed, the local seagulls have taken to herding visiting birds into the buildings, to increase the number of carcasses for the seagulls to feed on. Data collected by Toronto's Fatal Light Awareness Program (FLAP) shows that the number of fatal collisions and the number of birds entrapped by buildings increase with the number of windows lit at night. Building height itself was not significant (Ogden 2002). Low cloud or rain also increases fatalities, as it forces birds down among the buildings.

A prominent recent example of this problem was the temporary 'Tribute of Light' memorial at the World Trade Centre site in New York. The Audubon Society wanted to be able to turn off the two 7000 W skyward light beams if migrating birds were 'sucked downwards into [their] glare, putting them at risk of colliding with buildings and other structures' (Bone 2002).

In Australia, bird migration is both international (we have nine Ramsar sites in the East Asian-Australasian Flyway for shorebirds), and domestic. Many species move around the country seasonally, as shown in the Australian Bird Count conducted under the auspices of Birds Australia. Well-known migrants include the silvereye, fairy martin, welcome swallow, satin flycatcher, dollarbird and the rainbow bee-eater. Migration routes vary with species – for the red-tailed black cockatoo, it is along the Darling River, for example. Interaction between migrating birds and buildings and other structures is certainly possible, though probably not to anything like the degree indicated by the American examples given above.

Windows

Birds can be confused by reflections in glass, especially mirrored glass (anon, 1998b), and by its clarity – and not just at night when the lights inside the building are the source of the confusion. Collisions in flight, often fatal, are common – they occur irrespective of height, weather, season, orientation and age or fitness of the birds. High speed migratory birds die in such collisions. Even if not directly fatal, stunned birds are easy prey for predators.

It has been estimated that between 100 and 1000 million birds are killed in daytime collision with low-level windows in the USA alone (Ogden, 2002). In an Australian example, windows are a significant cause of mortality for the Tasmanian swift parrot, an endangered species (Hydro Tasmania, 2002). An informal study of bird casualties at a glazed link at the University of Tasmania observed around 11 deaths a year over a 4.5 year period, presumably from collisions with the glass (several were found stunned). Two-thirds of birds affected were native, including three swift parrots (Hermann, 2002).

Electricity wires

Birds can be electrocuted when their bodies act as a contact between phase wires, or between a phase wire and earth. The earth can be provided by metal supports. Generally contact has to be with soft tissue, but wet feathers will also conduct (APLIC, 1996). The risk is higher for distribution networks (e.g. under 25 kV) as the cables are closer together.

A two-year survey of Spanish eagles found that many young eagles (60 per cent) did not return to home territory to breed because they were killed when they flew into or landed on electricity wires (Ariza, 1998). A 1987 national survey of bird electrocution found that 15 raptor species (birds-of-prey) suffered fatalities. It is estimated that the power lines around Donana National Park may electrocute over 1200 raptors a year (Postelli, 2000).

In November-January 2002–03, 175 mute swans died after colliding with electricity pylons on the Isle of Thanet in Kent in the UK. The pylons are between fields where the birds live, and a lake. The swans couldn't see the pylons until it was too late for them to change course (being large birds' makes this difficult).

At Cheetham Wetlands, 20 kilometres south west of Melbourne, birds, including swans and ducks and a number of species migrating from Siberia (such as the curlew, marsh sandpiper and red-necked stint), collide

with power lines, and fall into the water and drown, or to the ground where they are preyed upon by cats and foxes. The collisions can also cause power outages (Powercor, 2002).

A 1990–02 study of 330 kV power lines at the Shortland Wetlands near Newcastle (NSW) estimated a water bird (e.g. ibis) mortality rate of 0.04 per 1000 flights (Winning & Murray, 1997).

Studies in the USA show that, along roads where trees have been cleared, raptors use pylons and wires as substitute hunting perches, rest, roost and nest sites. Electrocution is common as a result of this usage, and through collision while hunting. In Utah over an 18 month period 128 birds died, including 35 eagles. In Nebraska around 500 raptors, mostly eagles, were electrocuted each year over a six-year period (Meyer, 2001).

In Germany too, many birds rest on electricity pylons, often with fatal results. The most frequent cause of death of white storks is accidents at medium voltage (1–30 kV) pylons. Most dangerous are supporting and dead-end towers, and pylons with unsuitable dividers. Curiously, Polish white storks are shifting their roosts from rooftops to pylons (*'Storks' nest switch jolts scientists'*, BBC News website, 14 July 2003).

Communications towers

It was estimated (based on sketchy data) in 1979 that 1.2 million birds were killed each year across the USA by communications towers. The mortality figure could now be over 5 million birds a year, as there are now many more towers. The two causes are blind collision (both into the tower itself and associated guy wires), and collisions arising from the so-called phototactic mechanism. The former is a problem for fast-flying birds such as water birds or shorebirds, and arises in both daytime (in fog) and at night-time, especially if the tower is unlit.

The latter effect occurs with towers lit for aviation safety, when there is low cloud or fog. The tower lights reflect off water vapour, creating a large illuminated zone which confuses migrating birds, such as songbirds, flying nearby. They tend to accumulate around the tower, colliding with it and each other. This is similar to the problem with building lights.

Fatalities among night-migrating songbirds increase with tower height, though absolute height is also a factor. An average of 3250 birds died per annum over a 37 year period at a 305 metre tower in Wisconsin; 1700 per annum over a 25 year period at a 308 metre tower in Florida; 540 per annum over a 37 year period at a 417 metre tower in Tennessee; 375 per annum over a 20 year period at a 259 metre tower in New York (state); and 105 per annum over an 8 year period at a 161 metre tower in West Virginia (TowerKill website, 2002).

Bird collisions with wind turbines can also be problematic (see for example Appendix 1 to the EIS for the Pacific Hydro Wind Farm at Ngoorantook in southwest Victoria). The fauna assessment for the Heemskirk Wind Farm transmission line looked at bird-strike (incidence likely to increase), and impact on threatened species (including swift parrot, wedge-tailed eagle and masked owl), on 'species of concern' (including the Australian owlet nightjar), and on non-listed bird species (impacts all assessed as minimal). Likewise, studies by the Victorian Department of Sustainability and Environment on the interaction between birds and wind turbines (Portland Wind Energy Project) suggest potential conflict (Lane).

Fences

A study in Scotland found that hundreds of rare capercaillie (population of 2200 in 1994) and thousands of red and black grouse are killed every year when they fly into high wire fences erected to protect threatened native pine forests from deer. For an Australian example, wire mesh fences are a significant cause of mortality for the Tasmanian swift parrot (Hydro Tasmania, 2002).

Roads

Raptors are attracted to roads for a variety of reasons, and often fall victim to vehicle collisions (Postelli 2000). Some species seem to be more affected than others – in Spain 82 per cent of non-natural deaths of the little owl were caused by car collisions. Attractions include availability of digestive grit, standing water puddles, carrion (from road kill), nest and perch sites, and solar radiance during winter months. To give some idea of the scale of the problem, in the south west of Western Australia from January 1984 to December 1985 the corpses of 127 birds of 32 species were collected during routine journeys along secondary roads in an area of approximately 40 km^2. Peak months were November to March and 57 per cent of the casualties were juveniles (Brown et al, 1986).

For another effect, the wider the road the greater the reduction in bird species diversity along the road.

Bird feeding

Even friendly intentions can be destructive. Well-stocked bird tables and feeders, by attracting large numbers of birds to a small area, create the perfect environment for the rapid transmission of infectious agents, leading to death by lung or liver disease, or by the local cat. James Kirkwood, in *Veterinary Record* (cited in Nuttall, 1998 and May 1999), examined sixty cases in which people reported bird deaths in their gardens. The amount of food provided had a direct impact on the rate of death by infectious disease. Where daily food provision was 570mL or more, up to 95 per cent died of infectious disease.

Greenfield sites

All green-field building projects have the potential to put at risk birds using the site. The bigger the project the greater the potential, and the more important it is to carry out an environmental impact study to look at this issue (among many others). A recent large-scale project overseas which will have a widespread effect on birdlife is the construction of a new airport in the Texcoco Lake, near Mexico City. Birds using the lake will have nowhere else to go if the lake is destroyed or, if the lake is retained in part, birds will affect aircraft safety.

The construction of a 33 kilometre sea dyke at the South Korean coastal mudflats at Saemangeum on the Yellow Sea, one of Asia's most important wetlands, is worrying conservationists. The site is a critical part of the East Asian-Australasian Flyway, which boasts more endangered species of birds than any other migratory flyway globally (Parrish, 1994). Some two million birds will be affected by the project. The site is not listed under the Ramsar Convention, though South Korea is a signatory.

3.2 Some solutions

Lights

In the mid-1980s, Toronto's CN Tower turned its floodlights off for eight weeks in the middle of each migration season, following complaints from visitors. The number of bird deaths fell dramatically. Managers of 85 other buildings in Toronto, responding to requests from FLAP, have asked tenants to turn off their lights and close their blinds, but in buildings where people work night shifts, the tenants can be hard to convince. The 16 participants in FLAP's Bird Friendly Building Program installed or reprogrammed automatic timer systems to reduce the number of night-time hours that lights are left on (so reducing bird fatalities, energy consumption, CO_2 emissions and light pollution). Some have installed motion-sensitive lighting, and others have a staggered switch-on of lights in the morning.

Chicago's Lights Out program has participating building managers (operating 14 of the tallest towers) turning off their lights during migration seasons – this has significantly reduced fatalities. The program is part of a wider bird-friendly strategy, the *Treaty for Birds* in which habitat at migratory stopover sites will be improved, a bird-protection policy will be formulated, and trees and shrubs will be tested for their food and shelter value to birds.

Windows

Glass must be made visible to birds, and less reflective. 3M's Scotchprint can be applied to the outside surface of clear glass, and has a life span of five years or more. Avoiding clear glass in the first place would assist: tinted glass is one option. External shutters and grilles, and netting, are another.

Electricity wires

In Spain, the percentage of young eagles killed dropped to ten per cent after local authorities moved the wires out of the birds' flight paths. For the swans in Kent, the responsible Electricity Board installed brightly-coloured deflectors (a series of discs and balls) on its pylons, and these seem to have worked. Parallel to this, in February 2002, Powercor Australia, Victoria's largest electricity distributor, attached 'bird flight diverters' to 800 metres of high voltage power lines in the Cheetham Wetlands. The diverters – orange reflector discs clamped to the lines at 6 metre intervals – act as a visual deterrent to birds (Powercor, 2002).

HawkWatch's (USA) Raptor Electrocution Reduction Program assists the industry's Avian Powerline Interaction Committee, by surveying and identifying lethal power poles for retrofitting, and raising public awareness. One recommendation is that utility rights-of-way run parallel to roads rather than cutting across country. Another is that pylons should be designed or altered to take into account the risk to birds, e.g. with 3 metre cross arms instead of 2.5 metre, where risk is high (identified by a survey of bird interactions).

The German standard for medium-voltage open-wire lines says: "*The transverse beams, insulator holders and additional components are to be formed so that there is no chance for birds to land and sit next to the electric parts.*" A suspended constructional form is preferred and, at dead-end towers, the distance from the edge of the transverse beam to components under voltage must be at least 600 mm. Existing pylons can be modified – dangerous pylons can be deactivated, or protective caps and seating bars can be added, and chain lengthening can be done at dead-end towers. Only one German state has instituted a comprehensive pylon-alterations program so far. Polish electricity companies provide custom-built circular metal platforms that fit on top of the pylons, to accommodate stork nests.

Communications towers

In the USA there is now a Communications Tower Working Group (CTWG), comprised of representatives from all sectors of the communications industry, the Federal Government, bird conservation groups, and ornithologists, trying to achieve the same kind of cooperative effort attained by the Avian Powerline Interaction Committee.

Towers should be lit, but flashing lights are preferred to steady lights, and there is some evidence to suggest that white lights are preferred to red (Ogden, 2002). However, lack of research hampers development of other recommendations for mitigation techniques. Accordingly, the US Fish and Wildlife Service which chairs the CTWG, has published conservative interim guidelines for the siting, construction, operation and decommissioning of communications towers, pending further research.

In the case of the Heemskirk Wind Farm, some mitigation measures were recommended in the fauna assessment.

Fences

The solution for the capercaillie seems to be to remove the fences and cull the deer instead – we have to get our priorities right. But generally, fences need to be visible to birds – perhaps green PVC covered wire mesh is not such a good idea.

Roads

In terms of biodiversity, narrow roads are preferred to wide ones.

Bird feeding

A UK study found that, where daily food provision was less than 570mL, the death rate due to infectious disease reduced to 55 per cent. Bird feeding platforms should be moved around the garden and cleaned regularly. Locate them near bushes (so shy birds have

somewhere to dash to if feeling threatened and can keep under cover on their way to the table). Avoid roofed tables (shy birds like a clear view overhead) and avoid materials that will rot. The table should be fairly large, with raised edges open at the corners for drainage. Metal (smooth) posts are best (making it hard for cats and rodents to access the platform). Provide separate birdbaths.

Greenfield sites

Recommendations in environmental impact assessments (EIAs) should be taken seriously by developers (for more on EIAs, refer to DES 15). In the case of the Mexican airport the solution seems to be to not proceed with the development. However, it is rare for developments to not proceed on environmental grounds.

Actions less drastic than no-build might also be suggested by the EIA. For example, EIAs should identify, where building or communications towers are proposed, and whether or not the site is on a bird migration route. If it is, the tower could be resited, or associated lighting and glazing should be carefully considered.

EIAs will also identify where particular species are put at risk by the development and how this risk might be mitigated. In one American example, the habitat of the endangered southwestern willow flycatcher was preserved around a levee and associated trails, using a commercial erosion control system and other measures (Ardito, 1995). In the case of the Heemskirk Wind Farm, some mitigation measures were recommended.

4.0 INTEGRATING ATTRACTION, DETERRENCE AND SAFETY

Managing birds affects the way we design our buildings, structures and landscapes, and even gives us the opportunity to design a new type of structure – the dovecote! Designers clearly have a contribution to make in the control of birds. We can resolve the apparent contradiction of wanting to attract birds and wanting to deter them by, at the same time, encouraging them to come near to buildings through:

- providing nest boxes
- planting or birdscaping
- providing ponds
- landscape management, and encouraging them to keep off the buildings and other structures, for example, through (in descending order of preference)
- providing alternative accommodation such as dovecotes
- careful detailing
- use of roost inhibitors, visuals and sounds
- trapping and hunting.

Birds can be managed sensitively. All these strategies are complementary, not contradictory. Dealing with bird safety is more complex. There *are* some contradictions here. Tall buildings and structures and their lighting, the use of windows, provision of electricity wires, fences, roads, and even bird feeding itself, can be harmful. At first glance these are unavoidable conflicts – we must have these things and so birds must suffer. But this note has shown that each of these hazards can be managed, often by the designer.

However, design alone is not enough. Management solutions will also be needed, such as controlled feeding by the public, egg collection from dovecotes, use of trained raptors, trapping, changing behaviour with respect to lighting, and respecting the needs of our avian friends.

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