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BRING BACK THE BIRDS! PLANNING FOR TREES AND OTHER PLANTS TO SUPPORT SOUTHEAST ASIAN WILDLIFE IN URBAN AREAS

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ABSTRACT. — Life for human populations in high-density urban areas can be considerably enriched by being in closer contact with nature, leading to many benefits for psychological well-being. The movement, colours and sounds of birds can be particularly attractive and the steps taken to create suitable and sustainable habitats for them in urban landscapes can make city-life much more attractive for a significant part of the human population. The challenges set by the ecology of a humid tropical environment are examined. Based on fundamental ecological principles guidance is provided for the landscaping design and species planting for cities in SE Asia. The conservation of wild refuges, wise park planting, and well-laid out ecological corridors are all critical components which need to play together. Advice is provided on the types of species, both indigenous and exotic, which can be used and how these interact with particular bird species in the Malay Peninsula. As the ecosystems of tropical SE Asia rapidly change in the face of large-scale resource exploitation such activities in cities are increasingly important in keeping alive a public awareness of the dependence of economic development upon environmental sustainability.

KEY WORDS. — birds, plants, trees, landscaping, Southeast Asia, towns, urban conservation

INTRODUCTION

Origins. — The work that is reported in this paper derives from two major conservation programmes. In Singapore, over the period 1984 to 1987, work was carried out in a ground-breaking programme by the Singapore Ministry of National Development on the habitat requirements and management of wild birds with the goal of enhancing the birds' populations as an attractive public amenity in the republic (Hails, 1985, 1987). Since then, the Ministry has continued to implement most of the recommendations with great success. Urban plantings in Singapore are now much richer in biodiversity and natural reservoirs of wildlife are much more appreciated for their recreational and intrinsic values. The connecting corridors (now called "park connectors") have amenity, recreational and biodiversity value. Bird watching, nature study and nature photography are now significant leisure-time activities for many people, as are cycling, roller-blading and jogging along connectors.

In Malaysia, commencing in 1981, conservation work was inspired by the World Conservation Strategy that was produced by WWF, IUCN and UNEP in 1980. WWF joined forces with the governments of nine states, plus those of the Federal Territory of Kuala Lumpur and the Economic Planning Unit of the Prime Minister's Department to produce multi-sectoral state and national conservation strategies. These strategies were an early initiative at what is now termed "sustainable development". At a time when conservation was often felt to be opposed to national economic growth (reviewed in Jackson & Rudner, 1979; Jomo & Ng, 1996), they aimed to show the need for conservation as a basis for successful development and to make specific recommendations for the management of natural resources (Furtado et al., 2013). In the course of this work, Singapore's example of urban bird conservation work was quoted and adapted as a recommendation for Malaysian urban areas, based on the example of Kuala Lumpur. It was later released as a separate unpublished report that could be applied in many different urban and suburban settings (Hails et al., 1990).

The intention of this paper is to make the work more widely available, in the belief that it is as applicable today as it was nearly a quarter of a century ago.

Value of nature in urban settings. — It is a commonly held belief that the quality of human life is enriched when there is daily contact with nature. The behaviour of city-dwelling communities in Malaysia, Singapore, and other countries in Southeast Asia certainly seems to support this. Taking the Klang Valley as an example, parks, such as Taman Tasik Perdana and Taman Titiwangsa in Kuala Lumpur and Taman Jaya in Petaling Jaya, are usually crowded at weekends and holidays; and Taman Rimba Templer is always packed at such times even though most visitors have to drive for an hour or more to reach it. Informal parks, such as Taman Rekreasi Kelana Jaya and Bukit Gasing Green Belt in Petaling Jaya, are no less popular. Elsewhere in Malaysia, urban people flock to places like Taman Negara, Taman Kinabalu, Taman Negara Bako and so on. And the most expensive places to live in almost every urban area are those with plenty of space for big gardens and tree-lined roads.

It is generally accepted that towns that lack parks and other green, open spaces are incomplete in relation to public needs. All this is well known to national planners, and the Malaysian Town and Regional Planning Department (JPBD) has long ago drafted a set of planning standards that are applicable to various types of public open spaces, ranging from children's playgrounds to national parks (Latifah & Wee, 1983). These have also been incorporated into the Malaysian Manual of Planning Standards (Manual Piawaian Perancangan: JPBD, 1986).

When the Malaysian Conservation Strategy was initiated by a series of activities at State level (Furtado et al., 2013), urban nature had little part in the initial State coverage. This changed progressively, and changed greatly when the conservation strategies reached the Federal Territory of Kuala Lumpur (Kavanagh et al., 1988) and Selangor (WWF-Malaysia, 1989). Since those days, the approaches adopted by governments have greatly advanced and become more sophisticated, a trend partly enforced by the dramatic growth of cities. In Malaysia the Structure Plans and Local Plans have played a part in this, and an entirely new government agency, the National Landscape Department, was set up under the Ministry of Housing and Local Government. A National Landscape Policy has recently been published (National Landscape Dept., 2011).

Purpose of report. — One contribution arising from the Malaysian conservation strategies was the report titled 'Bring Back the Birds' (Hails et al., 1990). In that report we set out to show how wildlife, especially birds, can be brought back in to Malaysia's urban areas to provide sights and sounds that will enrich the lives of townsfolk and visitors alike. The report set out a number of fundamental yet straightforward principles to be considered in urban design. Although the report is now almost a quarter of a century old, the principles are still valid, and because they deserve wider dissemination we have taken this opportunity both to celebrate the role of Gathorne, Earl of Cranbrook, in the conservation strategies as well as to update the report.

It is obvious that over the past decades, local authorities have invested heavily in greening their cities with parks and tree-lined avenues. The approach towards greening a city has focused mainly on providing greenery, shade, and pleasing visual effects (ornamental plantings). The purpose of this report has been to integrate the principles mentioned above into a plan for taking this process a step further: to make provision for urban wildlife, principally birds.

The birds must be free. — The actions recommended in this paper should not be confused with any aviary project or captive breeding of birds and other wildlife. It is concerned with a strategy to enhance the free and wild populations of attractive birds throughout a city or town. Since the report was first published, additional considerations have arisen, such as human-animal interactions, and avian-borne diseases. Without underplaying their significance, we believe that negative consequences of wildlife in a city can be minimised, and are outweighed by a wide range of benefits.

WHY BIRDS?

Species for towns. — The presence of wildlife in urban vegetation is the ultimate testimony to the quality of the environment. It is an indicator that we have achieved some balance between the natural and the built environment. Some species are clearly not desirable in a city (e.g., aggressive large mammals, or poisonous snakes). Others may be quite acceptable, but require far more natural habitat than some cities can provide. Some other species do very well in urban settings (e.g., mynas, crows, rats and mice), but many of these are regarded as pests.

In order to bring back desirable wildlife to the city, it is therefore necessary to concentrate on those species that people like to have around them and for which it is possible to provide suitable habitat. Birds are the obvious animals with which to start because they are relatively easy to spot, people tend to like them, and enough research has been done to generate an action plan for bringing many species back into a town or city.

Bringing back the birds can improve a city's amenities by bringing in an additional dimension—of complex movements, colour and sound. This amenity will not only be appreciated by the people who live and work in the city, but also by tourists and other visitors. It is worth noting that although birdwatching (including photography) has been an essentially western pursuit until fairly recently, it is now very popular in many Asian countries (e.g., Hails, 1987a).

The possibilities of enhancing the populations of attractive small mammals (e.g., squirrels), amphibians (e.g., frogs) and insects (e.g., brightly coloured butterflies) need not be ignored; this should be considered as the next logical step once the birds are getting established.

Sites for bird management. — Having made the decision to try to enhance the birdlife of a city, it is necessary to decide

on the localities and methods to be used. In this context, three particular types of area need to be considered:

1) Natural areas that are currently rich in birdlife that may act as 'reservoirs' for populating urban parks. These reservoirs need not necessarily be within the urban area itself but it must be possible to connect them to urban parks via vegetated passageways through which the birds can move in safety (see below);
2) Areas where improvements would be of immediate benefit to the bird population. These include public parks where the existing habitat is not particularly suitable for birds; and
3) Vegetated passageways along which birds may move between the reservoirs and the areas that are to be enhanced. These passageways can be areas of low density housing, with tree-lined avenues and large gardens, or carefully planted reserves alongside roads, railways, rivers, electricity lines, etc.

The ecology of birds. — Before embarking on an action plan, it is necessary to understand a little avian ecology. In centuries gone by, virtually all areas in Southeast Asia that are now urban were once covered in tropical rain forest. This is a very complex ecosystem encompassing a myriad of inter-relationships between animals and plants. Throughout the course of evolution, the species of the rain forest have become very specialised, with each of them utilising only a small segment of the total resources available. In this way, many different species can co-exist in the forest without directly competing.

The entire system is architecturally dominated by the form of the plant life: the trees, bushes, shrubs and herbs, their multiple layers and interlocking structure. As the plant life has evolved, so the animal life has co-evolved to take advantage of the different niches provided by the plants. In a continuing feedback process, the plants too have evolved to take advantage of the services offered by the animals (pollination, seed dispersal, etc.); and all the plants and animals have evolved strategies that minimise their chances of being eaten or destroyed by other species. At the same time, the architecture of the forest has created its own climate, so that all of the species that live below the canopy are adapted to conditions of continuous dampness, relatively cool air and low light intensity.

The birds' survival requirements. — Because of these specialised conditions, most forest birds are very poorly adapted to survive once the forest is removed and open country created. All of the birds that are commonly seen in cities today seem to have originated in coastal scrub, river flood bank areas, mangroves, or other areas outside the main dryland dipterocarp forest environment. This background knowledge must be used in the approach that is taken to parkland planting. Simply providing dense stands of trees in an attempt to recreate rain forest is not sufficient.

Neither is it sufficient to provide for the birds' needs in only a small area of land. In recent years, biologists have provided a wealth of information to show that small patches of forest—even if otherwise undisturbed—cannot retain all of their plant and animal species if they are isolated from major forest blocks. This applies on a grand scale whereby even the biggest islands in the world tend to suffer more species extinctions than continents, and on a local scale whereby, for example, a forest patch the size of Bukit Nanas in Kuala Lumpur could not possibly sustain viable populations of most of the animals and plants that live in, say, Taman Negara.

The practical result of this is that ways must be found to link up a city's bird conservation areas to give them greater effective size. There are various ways in which this might be encouraged.

PARKS FOR BIRDS

Habitat requirements. — Detailed work that has been done in Singapore has identified several habitat features that must be present in a park in order to provide good bird habitat (Hails, 1985, 1987b). The most important habitat features can be summarised as:

1) Plant species diversity;
2) Good ground cover and low vegetation; and
3) Structural complexity and tree density (including small and medium trees with some tall emergents)

It is a common misconception that because most birds can fly, they can survive largely by living in trees and flying between them, across whatever space is present. In fact, most Southeast Asian birds are not strong fliers and many of them spend a lot of time at or near the ground level. For bird species that can be attracted to parkland habitat, long grass and herbaceous ground cover are the most important elements of their habitats.

Also of vital importance to the birds are the presence of medium sized trees, tree density (numbers) and the heterogeneity of the habitat. As with ground cover, the importance of medium sized trees is again related to those birds that can survive in a non-forest parkland habitat: i.e., the birds that are the most likely to be attracted into urban parks. Most parks do not have enough large trees for the large-tree-dependent bird species to survive, so providing for the small and medium sized tree users is an important tactic.

The heterogeneity of the habitat refers to its structural complexity. This is a factor that has long been recognised as responsible for animal diversity in a given area. Ecologists also recognise an 'edge effect' in animal distribution: an increase in diversity that occurs where two habitats meet (e.g., forests/grassland; tall trees/thickets; riverine forest/dryland forest, etc.), but this is accompanied by an aversion to such edges by species that depend upon large areas of only one of the two habitat types. Heterogeneity of habitat has the same effect, with multiple 'edges' created where different types of plants are in contact with each other.

Tree density correlates with good numbers of birds because the greater the density, or total basal area, of standing vegetation, the more are the feeding opportunities for those birds that live in woodland or forest areas.

Canopy height (i.e., the heights of tree crowns that form a joined block) is also an important consideration. For those birds that feed in tree crowns, the complexity of the canopy is an all important factor. Where it has a distinct layering or stratification, there will be more of these birds.

Finally, the presence of large, emergent trees is still important in parkland areas. Their crowns fill what would otherwise be empty space with vegetation that birds can use. They serve as high perches, nest sites, look-out points, and may attract birds that are flying from one area to another.

Park design and layout. — Having identified several habitat features that must be incorporated into parkland planting, it is possible to design a hypothetical park to satisfy the needs of both birds and people. The factors that support good numbers of bird species will be allowed for if the park includes the following:

1) Refuges of dense vegetation
   These should be small patches within the park where trees are planted very close together in a manner that would prevent access by the public. Tree species must be carefully chosen to ensure a high density of vegetation throughout the refuge. Shade tolerant, small and medium sized species must be planted in the centre, with species tolerant of bright sunshine planted on the edge and used as tall emergents (Fig. 1). Shade tolerant shrubs, palms and small plants should be planted between the taller trees to provide good low-level vegetation. Initially these areas will have to be created with ornamental species, but once dense shade is produced, species from the forest could be used to form the core of the vegetation. Species of dipterocarp trees may be able to develop in the shade so that eventually some of the large trees could be the giant hardwoods of the native forest. The growth of lianes and rattans should be encouraged in order to increase the structural complexity of the refuge. To provide colour and to make these patches visually stimulating, they could be fringed with some of the more popular ornamentals. Only the outer edge of these patches would require maintenance; the interior, out of sight of the public, would be best left without maintenance other than tree inspections, or receive at the most an annual removal of excess debris.

2) Transition zone
   The transition zone around the edge of the dense refuges would be one that would provide the long grass, bushes and herbaceous part of the environment. The long grass can be provided in two ways (Fig. 2). One would have it in front of the bushes with a sharp divide before the short grass, rather like the division from fairway to rough on a golf course. The alternative would be to screen the long grass with a line of bushes or tall herbaceous plants. These would not be a bird obstacle but may provide a more pleasing visual impact if long grass is deemed to be unsightly. The long grass must be allowed to seed

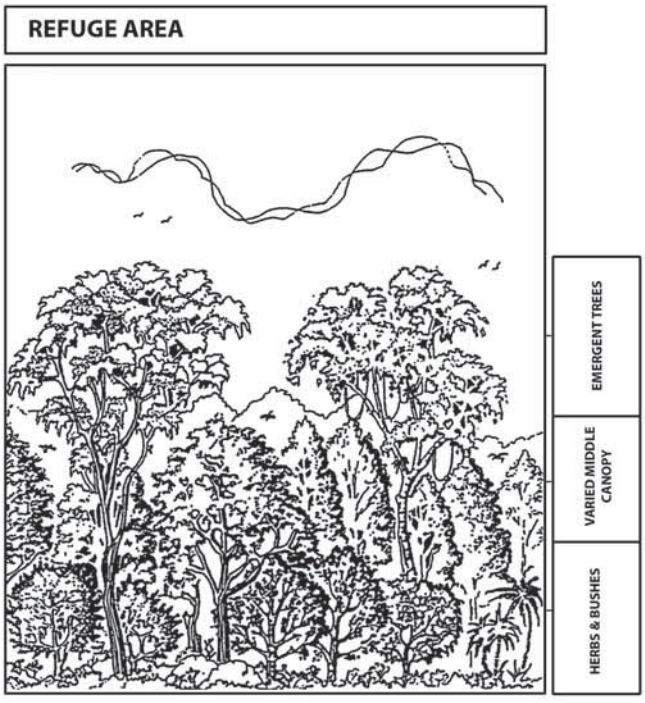

Fig. 1. Diagrammatic cross-section through a refuge area showing dense undergrowth with a well-layered canopy and emergent trees which together provide much structural variety.

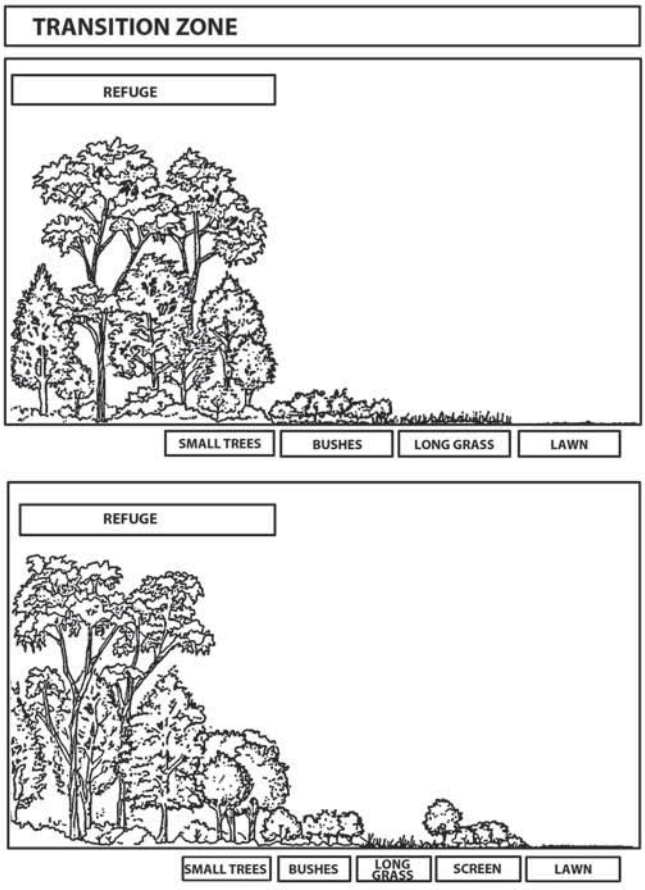

Fig. 2. Transition zone at the edge f a refuge showing successional phases and long grass either exposed (upper) or screened (lower).

before any cutting takes place. Trimming once a year with a rotary cutter will ensure vigorous growth and prevent the establishment of woody perennials.

3) Lawns and short grass
These can be maintained in the normal way and would separate the islands of dense vegetation. It would be desirable to have the short grass adjacent to long grass in certain places. Birds such as spotted dove *Streptopelia chinensis* and peaceful dove *Geopelia striata* would then be able to feed on seeds blown to the ground from the long grass nearby. Others, such as paddyfield pipit *Anthus rufulus*, feed on areas of short grass but require rougher grass in which to nest. The availability of short grass next to long grass would encourage the residence of such birds.

4) Connecting passageways
The densely vegetated islands within a park must not be isolated from each other but should be connected by passageways of trees and bushes so that birds may pass easily from one to another. Certain species of birds that will inhabit the dense growth and long grass are adapted to their way of life by having short wings (e.g., any of the tailorbirds *Orthotomus* spp. and the yellow-bellied prinia *Prinia flaviventris*). This means that their flight is weak and they will usually not fly long distances. Furthermore many species shun flight over open spaces and prefer to be close to vegetation. Vegetated passageways within and around a park would allow birds to roam over the whole area in search of food, mates or nesting sites. The passageways would not need to be as densely vegetated as the refuges, but should still contain several strata of ground cover, bushes, and trees of different species. Ornamental plant species may be used for visually pleasing effects. A cross-section of such a passageway is shown in Fig. 3. The medium sized trees and also the bushes should be planted close together so that crowns either interlock or touch.

These ideas are incorporated into the hypothetical park layout that is shown in Fig. 4. In this layout, the passageways are used to screen the park boundary, but that is not an essential feature of the scheme. The refuges could equally be connected via passageways running across the centre of the park. Actual planning of an area would require the inputs of landscape architects and horticulturalists to incorporate the natural features of the land and to allow for visitor amenities.

Detailed design principles. — The above park layout incorporates all the features that are necessary to make a park suitable for both human and bird use in a pleasing way. When it comes to real parks, the designers will be able to create many variations on the theme and yet provide good bird habitat so long as they adhere to the following design principles:

1) Structural diversity
The diversity or heterogeneity of vegetation structure is an important determinant of animal density and diversity. The layering or structuring of the vegetation is the most important factor affecting birds in urban areas. Any area should contain a ground or shrub layer of vegetation. Interlocking or overlapping crowns should lie above this up to the height of the majority of the trees. Finally, one or two emergent trees can stand clear of the rest. Diversity can also be achieved by planting as wide a range of species of trees and bushes as possible. Planting practice has sometimes led to an even canopy layer, often rather shallow, with no undergrowth and no emergent trees. This leaves little opportunity for diversification of the avifauna and actually provides much less in the way of vegetation for birds to live in.

2) Species diversity
Different types of birds feed on different items, including fruits and seeds, nectar from flowers, and a wide range of insects. Two things will be achieved by planting as diverse an array of trees, shrubs, climbers, herbs and grasses as possible. First, more bird species that are dependent on certain plant species will be catered for. Second, the plants will be less likely to flower and fruit all at the same time of year, which could eliminate some bird species by leaving them without food at other times (Appendix A). Conversely, a wide array of plant species makes it more likely that some food will be available at all times of year.

3) Use of long grass
This is an important component of open country habitats in the region which is absent from many parks and planted

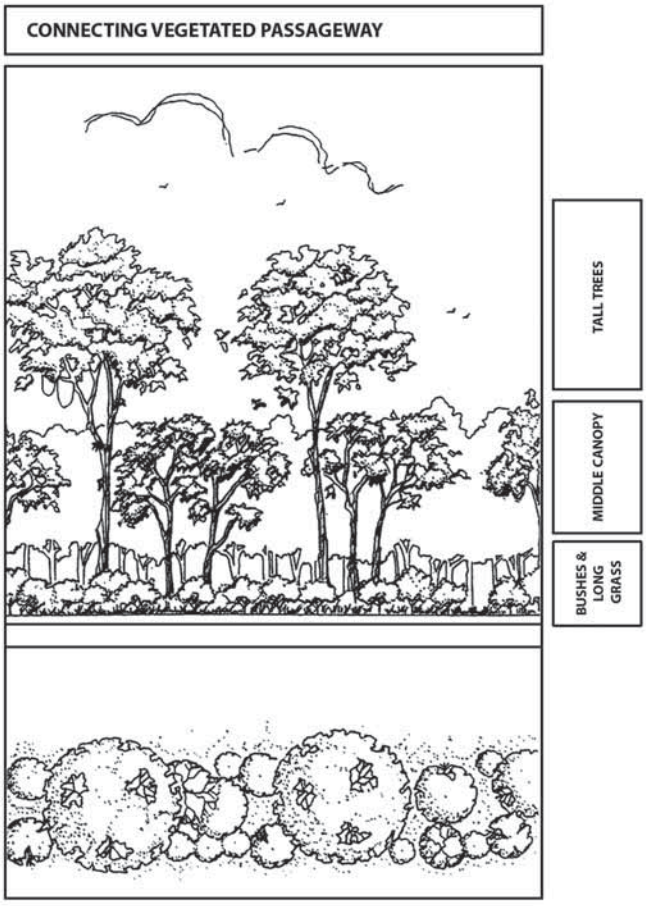

Fig. 3. Diagrammatic cross-section through a connecting corridor (upper) and an aerial view of the same (lower).

areas. Provision should always be made to leave a certain proportion of long grass in any planted area.

4) Successional phases
The natural succession from grasses to herbs to bushes and through to trees of various sizes should always be present in any area. Different species of birds will live in different sections of this succession or in the boundary zones between stages. The succession provides a grading of vegetation height that can easily be incorporated into plantings.

5) Tree spacing
In situations where only a limited number of trees can be incorporated into any area, it is normally far better (for wildlife) to clump the trees into dense refuges than to have them spaced evenly over a given area. Planting practice in urban parks is often to space ornamental trees evenly over an area to be planted. This spreads available resources very thinly and evenly. This may mean that birds have to expend much time and energy travelling between trees in order to obtain resources. It may also mean that territories may not contain sufficient resources, or may be too large to be defended (Fig. 5). Thus trees should always be grouped together rather than spaced out evenly. If proper structuring of the vegetation referred to above is to be achieved, planting trees in clumps is essential.

6) Physical continuity
Areas of prime bird habitat must be connected by vegetated passageways to ensure a matrix of habitat within which birds can move around. Where possible, these passageways should be along rivers, drains or other water-bodies, tracks and footpaths.

7) Size of planted area
The relationship between habitat size and numbers of bird species is not linear (Diamond, 1976). A doubling in size of a planted area will more than double the number of bird species that may occur there (Blake & Karr, 1984). With this in mind any area to be managed for birds should be made as large as possible in order to derive maximum benefit from this relationship.

8) Inclusion of water
Where possible, ponds, streams or drainage canals should be included in any areas designed for birds. These will ensure a water supply for wildlife and also a supply of those insects which require water in their life cycles. Some branches should overhang the water to provide perches for kingfishers and flycatchers. Footbridges should have small ledges inserted in the base to encourage nesting by swallows. Water bodies should have sloping, vegetated banks where possible (Fig. 6). Hard, vertical banks (e.g., concrete) render lakes, rivers or canals inaccessible to some bird species, and are also unfriendly to aquatic animals such as frogs and dragonflies that can provide

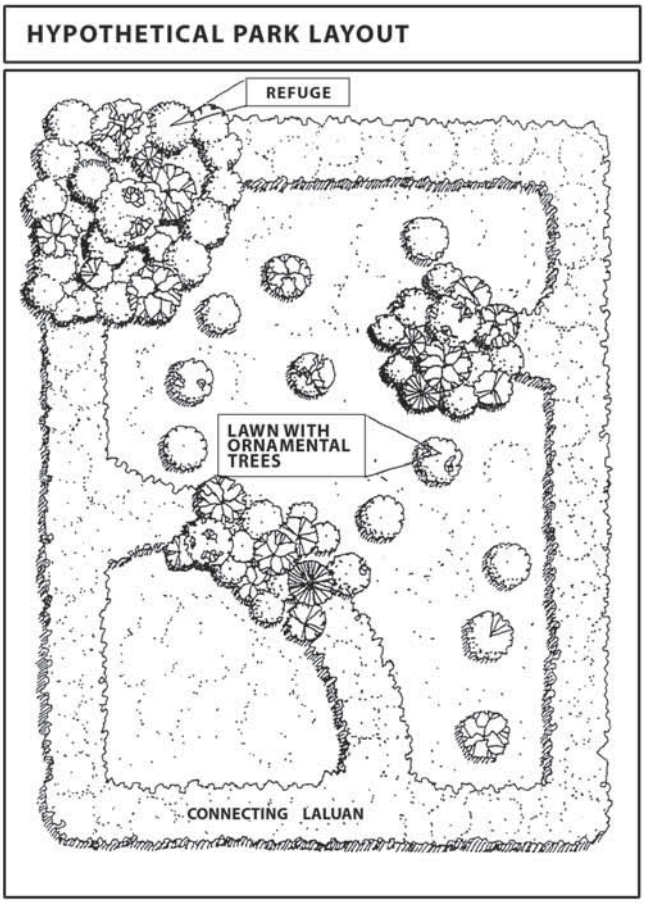

Fig. 4. Aerial view of a hypothetical park designed for birds showing refuges, lawns and connecting corridors.

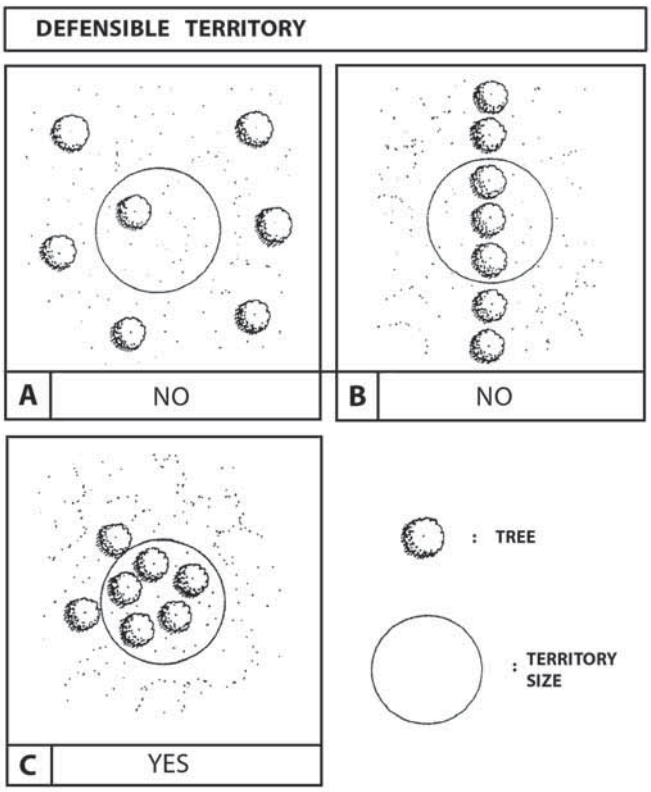

Fig. 5. Many birds have an upper limit to the size of territory which can be defended and within this they require a finite amount of resources. If the resource required in this example can only be met by five trees, only planting pattern C would enable the bird to live in this group of trees.

food sources. Also many species nest in waterside vegetation, such as patches of reeds.

Managing parklands for birds. — In addition to the above design principles, the following points should be taken into account if healthy bird populations are to be maintained in attractive parks:

1) Nesting materials
Birds' nests are frequently made of woven plant fibres and cobwebs, and lined with moss, lichens, feathers or other soft materials with good insulating properties. One favoured source of nest lining material is the seeds of the kapok tree *Ceiba pentandra* (kekabu). During the early part of the breeding season, those trees with ripe fruits that have burst open will be visited by an amazing variety of birds collecting clumps of the hairy seeds. An alternative is the wild kapok *Bombax ceiba* (kekabu hutan) which has pleasing red flowers, but it is not clear whether this will flower regularly in an urban climate. The provision of kapok trees at regular intervals in planted areas will assure birds of a supply of a vital commodity for nesting. If bird populations are to be sustained, successful reproduction is imperative.

2) Nest boxes
A special case can be made for putting up nest boxes for certain birds, such as barn owls *Tyto alba*. These birds were rare in Southeast Asia prior to the spread of oil palm cultivation, but have become relatively common (Duckett, 1982, 1984). They feed almost entirely on rats, which make up more than 98% of their diet, and may range more than 5 km from the nest site while foraging. Since a pair of owls and their offspring typically consume about 2000 rats per year, they can play a very significant role in pest control. There is no obvious reason why they should not be as successful in a city as they are in oil palm plantations, although they would not necessarily reach the same population densities. Barn owls have been seen in the city centre of Kuala Lumpur and Singapore. It would, however, be necessary for urban authorities to avoid the use of so-called 'second generation' anti-coagulant rat poisons (e.g., Difenacoum, Brodifacoum, Bromadialone) which may be highly toxic not only to the rats themselves but also to animals that eat rats, such as owls, dogs and cats (Duckett, 1984: see also (6) below). Whilst the owls—being nocturnal and rather 'ghostly' in appearance—may not be seen as an attractive parkland feature, their effect on rat populations and pest control budgets may well be appreciated. Other parkland birds such as Oriental magpie-robins *Copsychus saularis*, and even Oriental pied hornbills *Anthracoceros albirostris* and possibly woodpeckers (Brush, 1983), can benefit from nest-boxes of an appropriate design.

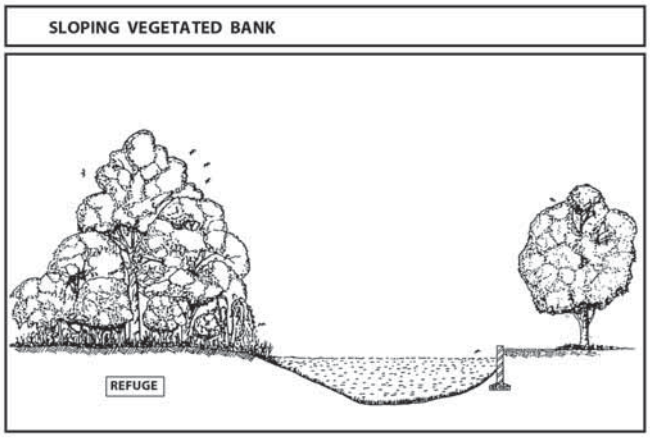

Fig. 6. A cross-sectional view of a lake with a sloping vegetated bank and a vertical concrete bank.

3) Dead snags and branches
Where they do not pose a danger, dead snags and branches should be left in place for use by many different bird species. Woodpeckers feed by breaking into dead wood for the larvae of boring insects. They excavate nesting cavities in dead wood and these cavities in turn may be used by other hole-nesting species once they are abandoned by the woodpeckers. Dead trees and branches are also favoured perching sites for aerial feeding birds such as the dollarbird *Eurystomus orientalis*, blue-throated bee-eater *Merops viridis* and blue-tailed bee-eater *Merops philippinus*, especially if the branch is elevated and exposed. This is probably because of the clear view afforded by the lack of leaves.

4) Cutting and pruning
If at all possible, cutting and pruning should avoid the main breeding season from March to June inclusive. Nests can often be knocked down or exposed to the elements as a result of pruning, thus causing nestlings to chill in a rainstorm or overheat and dehydrate from exposure to the sun. Parent birds will often abandon nests that have undergone any type of disturbance. The same philosophy must apply to areas of long grass. Annual trimming is all that is desirable to keep them free from invasion by woody trees or shrubs. This should only be done during the months of September to November, when fewest birds are likely to be breeding. During other months these areas will be used by various breeding species.

5) Continuity
Management of parks is a long term endeavour. Once a plan is decided upon, it should wherever possible be implemented without major changes that would disrupt the vegetation. It has been shown in Singapore that the parks with the greatest bird species diversity are those that have the most mature vegetation. Changes of planting patterns disrupt bird populations.

6) Use of pesticides
Pesticide use is controlled by national legislation. Special considerations apply to the use of insecticides in parks that are designed for birds as well as people, because the birds need to have insects to feed upon. In any case, widespread prophylactic spraying as a precautionary measure is both expensive and counter-productive. It is counter-productive because most predators of insects are themselves insects, and it is almost invariably the pest

species population that recovers most quickly after heavy spraying. This is not surprising in view of the fact that the few surviving pest insects (after the spraying) will have lots of plant food to help them grow and multiply, whereas the surviving predators will not have a plentiful food supply until the pests build up in numbers. Thus the desirable predators are always likely to lag behind the undesirable pests, to the general detriment of pest control. Insecticide spraying, if done at all, should be done judiciously and in a specific targeted manner to combat specific pest outbreaks, which will be less likely to occur if natural populations of insect pests are continuously kept in check by natural populations of insect predators and insectivorous birds. Likewise, rat populations should be kept in check by good management (such as avoiding the creation of likely hideaways) and the careful use of 'first generation' anti-coagulants (such as Warfarin, Fumarin, Coumachlor) which—although they can kill cats—are far less toxic than the 'second generation' rat baits which kill species that eat them directly (e.g., chickens and red junglefowl *Gallus gallus*, dogs, cats, goats, sheep and possibly even buffalo) plus those that eat rats (e.g., barn owls, black-shouldered kites *Elanus caeruleus*, dogs and cats; Duckett, 1984).

7) Epiphytes and climbers
The need for heterogeneity or complexity in vegetation holds right down to the detail of the trees themselves. Epiphytic growths and climbers increase the degree of complexity of tree surfaces, providing more hiding places for insects and more foraging niches for birds. A covering of the fern *Drymoglossus piloselloides* or a climbing aroid such as *Philodendron* sp. can convert a plain tree trunk into a haven for insects and provide perches for foraging birds. Likewise the epiphytic ferns which grow in the tree crown such as the birds' nest fern *Asplenium nidus* or the stagshorn fern *Platycerium coronarium* will increase the complexity of a tree crown. Although less common, epiphytic orchids such as the pigeon orchid *Dendrobium crumenatum* will serve a similar purpose, as well as adding colour when in flower. Certain authorities claim that these epiphytic growths, while not being parasites, are still able to damage trees, but the general opinion among botanists is that epiphytes do no harm to a healthy tree.

Parklands and other wildlife. — The principles that have been outlined in this section are derived specifically for birds. Nevertheless, they would be beneficial to other attractive animals such as squirrels. On a large scale, they could also be beneficial to species such as mouse-deer and langurs (leaf-monkeys, *Presbytis* spp.). Initially such benefits could be regarded as bonuses, but at a later stage in a strategy to bring back the birds – once the bird habitat is established—it would be appropriate for a local authority to look into ways of enhancing non-avian species in the parks.

BIRD CORRIDORS

General principles. — As pointed out above, ways must be found to link up an urban area's bird conservation areas (the 'reservoirs' and the parklands) to give them greater effective size. A system has been described whereby parks may have refuges that are connected to each other by passageways of vegetation. A similar view can be taken of the town or city as a whole; its parklands and bird reservoirs may be interconnected by means of vegetated corridors that will help to prevent the isolation of small patches of good bird habitat.

Such corridors would promote the free exchange of individual birds between areas; and the larger, better structured corridors would become significant bird habitats in themselves. The very poor bird population of Bukit Nanas in Kuala Lumpur is an example of what happens when a small area of suitable habitat becomes isolated.

Selecting corridors. — It is necessary to be opportunistic in selecting corridors, but the relatively green nature of most Southeast Asian towns makes the job very much easier than would otherwise be the case. Roadside planting is a common opportunity that can often be taken up; in many case, bird corridors could be created simply by selecting tree and understorey species from Appendix A and planting as suggested for vegetated passageways in the descriptions above. The same principles can be applied to rail, river and electricity reserves; and green suburban areas, with large gardens and old trees alongside roads, may form corridors in some cases without any modification.

The problem of gaps. — It is essential, however, to remember one obvious, but golden, rule. Just as an electric current cannot flow along a wire that has a single break in it, so birds cannot pass along a corridor that contains a single, insurmountable barrier. What constitutes an insurmountable barrier varies from species to species (e.g., a forest babbler would be unlikely to attempt to cross a wide road that a parakeet might cross on a regular basis) so in order to maximise the effectiveness of a corridor, breaks must be minimised in frequency and size.

Summary. — Bird 'reservoirs' are relatively large forest blocks that are known to have resident, multi-species bird populations. Their value depends not only upon their actual bird populations but also upon their links into the city via bird corridors.

Such 'reservoirs' should be identified on the basis of their being relatively large and less disturbed. Smaller areas of secondary forest known for their unusual richness in birdlife (e.g., Bukit Gasing in Petaling Jaya) could also serve as reservoirs.

PLANT SPECIES FOR PARKS AND CORRIDORS

Background to plant choice. — In order to decide which trees and other plants will attract and support birds, it is necessary to consider the specific uses that birds make of plants. They use them for food, shelter and nesting. Of these, food is the most important consideration for urban plant species selection, if the goal is to maximise the number of bird species present. Non-migratory species require year-round food supplies and migratory species require food throughout the time that they spend in urban parks.

Some of the Southeast Asian bird species of open and semi-open habitats feed on the ground, on bare soil or amongst long grass. Of the birds that feed in trees, those that feed on fruit or nectar will be attracted to those food sources, but the majority of the birds that may be maintained in city parks feed at least in part on insects.

Plants for insectivorous birds. — Perhaps the single best group of trees for birds is that of the figs, especially beringin or waringin *Ficus benjamina* and jejawi *Ficus microcarpa*. The convolutions of the trunk and the complexity of the aerial roots make them almost an ecosystem in themselves. They bear edible fruits and hold significantly more insects than other species of ornamental trees, including highly specialised small wasps that grow up within the fig fruits to the mutual benefit of both the trees and the wasps.

Plants with finely divided leaves are also especially good for insectivorous birds, presumably because the insects find lots of nooks and crannies in which to live. Trees that are especially good for insects for this reason include jemerlang or batai laut *Peltophorum pterocarpum*, rhu laut *Casuarina equisetifolia*, pokok pukul lima *Samanea saman*, semarak api *Delonix regia*, bataui *Albizia falcataria*, and *Caesalpinia ferrea*.

There are also many plants that attract insects to their flowers, and the insects in turn may be eaten by the birds. Nearly 50 Southeast Asian species are listed in Appendix A, including 11 that also provide bird food for other reasons.

There is one slight drawback to managing plants for insectivorous birds. Some leaf damage has to be accepted, due to the depredations of insect larvae (caterpillars, etc.). However, most healthy plants can withstand a certain amount of insect attack and most trees have their own defence mechanisms (e.g., poisons in leaves that ward off some insect larvae). The end result is that the plants, the insects and the birds can be allowed to find their own balance if insecticides are used only to combat specific pest outbreaks (i.e., not prophylactically) and only in ornamental areas (i.e., not within refuge areas). This tactic also has the major advantage of saving on the insecticide budget.

Plants for frugivorous birds. — Although frugivorous birds are in the minority in a city, in terms of numbers of species, they are the type of birds that will flock to fruit sources and large numbers will build up in suitable trees (Appendix A). The figs are the best plants at attracting these birds. *Ficus benjamina* has to be allowed to grow big before it will fruit; but after that it will fruit every two or three months, giving an excellent food supply. *Ficus microcarpa* will fruit when smaller but it is not quite so attractive to frugivorous birds. As there are dozens of native fig species in the Southeast Asian region, it is desirable that the genus be further investigated for ornamental planting.

Some caution should be exercised in planting fruit trees because they can attract large flocks of Asian glossy starlings *Aplonis panayensis* and white-vented mynas *Acridotheres javanicus*. These birds usually prefer to feed in the taller fruit trees such as tembusu *Fagraea fragrans*, salam *Syzygium polyanthus* or the big figs. Large concentrations of starlings and mynas could cause inconvenience in terms of noise and droppings, so big bird-fruit trees should not be planted as shade trees in car parks and hawker centres.

Among shrubs, senduduk *Melastoma malabathricum* is heavily used by bulbuls, flowerpeckers and green pigeons when in fruit. Unfortunately it tends to be regarded as a wasteland weed. If it could be selectively bred for greater flower size and more bushy growth, without sacrificing fruit quality, it would make an ideal ornamental. Natural variation within the species suggests a ready potential in this direction. An advantage of shrubs and small trees that give good fruit is that they can attract colourful birds to convenient human eye level.

Special mention should be made of the relationship between birds and mistletoes of the family Loranthaceae. These plants are prime examples of ones that have evolved in close association with birds. The flowers produce copious nectar that attracts sunbirds which are the plants' main pollinators, and the fruits are a major food of flowerpeckers. Birds that are likely to be seen around mistletoes include brown-throated sunbird *Anthreptes malacensis*, scarlet-backed flowerpecker *Dicaeum cruentatum* and orange-bellied flowerpecker *Dicaeum trigonostigma*.

Although mistletoes are hemiparasites that can reduce the growth of timber trees and reduce fruit production in orchards, they appear to do little damage to ornamentals and it would be worthwhile to allow some to remain on the trees in parklands.

Plants for nectarivorous birds. — Very pleasing effects can be achieved by selecting plants that provide a nectar source for certain birds that specialise in this food. This is because such plants typically have bright, showy flowers, e.g., dedap *Erythrina orientalis*, bunga raya *Hibiscus rosa-sinensis*, jarum-jarum *Ixora* spp., or gapis *Saraca* spp. Shrubs and small trees in this group (Appendix A) make particularly attractive screens for areas of long grass or dense vegetation.

It should be noted that it is the wild type of *Hibiscus rosa-sinensis* that is the most attractive to nectarivorous birds, not the cultivated hybrids. There are also varieties of *Ixora* with and without nectar.

APPENDIX A: PLANTS THAT PROVIDE FOOD FOR BIRDS

The most important factors to bear in mind in selecting plants to 'bring back the birds' to a city are structural diversity and species diversity. Even if a landscape architect or gardener picks plants only from this list for, say, a park, he or she will not achieve much if large areas are planted with only a few species and the plants (especially trees) tend to be of roughly uniform size. Additional information may be found in Chaniago & Mohd. Saufi (1980) and Grey & Deneke (1978).

Table 1. Plants that attract insects to their flowers, bear fruits that are attractive to birds, and bear flowers that attract nectarivorous birds.

Native/Introduced Species	Scientific Name	Common Name	Habit
Native	*Fagraea fragrans*	tembusu	Tree
	Syzygium grande	jambu laut, sea apple	Tree
	Vitex pinnata	leban, Malayan teak	Tree

Table 2. Plants that attract insects to their flowers and bear fruits that are attractive to birds.

Native/Introduced Species	Scientific Name	Common Name	Habit
Native	*Melastoma malabathricum*	senduduk	Shrub
	Rhodamnia trinervia	poyan, silverback	Tree
	Syzygium longiflorum	kelat	Tree
Introduced	*Lantana cammara*	bunga tahi ayam	Shrub
	Passiflora foetida	timun dendang	Climber
	Ptychosperma macarthurii	MacArthur palm	Solitary palm

Table 3. Plants that attract insects and nectivorous birds to their flowers.

Native/Introduced Species	Scientific Name	Common Name	Habit
Native	*Cocos nucifera*	kelapa, coconut	Solitary palm
	Ixora javanica	jarum-jarum	Shrub
	Lonicera spp.	honeysuckle	Climbers
	Musa spp.	pisang, banana	Giant herbs
	Syzygium malaccensis	jambu bol, malay apple	Tree
Introduced	*Calliandra surinamensis*	powderpuff tree	Small tree
	Dictyosperma album	princess palm	Solitary palm
	Duranta plumieri	golden dewdrop	Shrub
	Moringa pterygosperma	meringgai, horseradish tree	Tree
	Samanea saman	pokok pukul lima, raintree	Tree

Table 4. Plants that attract nectarivorous birds to their flowers and bear fruits that are attractive to birds.

Native/Introduced Species	Scientific Name	Common Name	Habit
Native	*Adinandra dumosa*	tiup-tiup	Tree
	Sterculia rubiginosa	rusty sterculia	Tree

Table 5. Plants that provide food for frugivorous and insectivorous birds.

Native/Introduced Species	Scientific Name	Common Name	Habit
Native	*Ficus benjamina*	beringin, waringin fig	Tree
	Ficus caulocarpa	ara	Tree
	Ficus heteropleura	ara	Tree
	Ficus microcarpa	jejawi	Tree
	Ficus variegata	ara	Tree
	Ficus virens	ara, grey fig	Tree
Introduced	*Ficus bengalensis*	Indian banyan	Tree
	Ficus religiosa	bodhi tree	Tree

Table 6. A tree that is excellent for providing nesting material and which bears flowers that attract nectarivorous birds.

Native/Introduced Species	Scientific Name	Common Name	Habit
Introduced	*Bombax ceiba*	kekabu hutan	Tree
	Ceiba pentandra	kekabu, kapok	Tree

Table 7. Plants that attract insects to their flowers.

Native/Introduced Species	Scientific Name	Common Name	Habit
Native	*Ardisia elliptica*		Shrub
	Areca catechu	pinang, betelnut palm	Solitary palm
	Asystasia intrusa		Straggling herb
	Averrhoea carambola	belimbing, starfruit	Tree
	Bhesa paniculata	Malayan spindle tree	Tree
	Bulbophyllum macranthum		Epiphytic orchid
	Cassia biflora	bushy cassia	Tree
	Castanopsis spp.	berangan (some introduced)	Tree
	Casuarina equisetifolia	rhu laut	Tree
	Citrus spp.	limau (some introduced)	Tree, shrub
	Cleome rutidosperma	(possibly introduced)	Shrub
	Dendrobium anosmum		Epiphytic orchid
	Derris thyrsiflora	(possibly introduced)	Climber
	Dillenia indica	peradun, elephant's apple	Shrub
	Durio zibethinus	durian	Tree
	Elaeocarpus griffithii		Tree
	Heritiera sp.	dungun	Tree
	Impatiens ridleyi	balsam	Herb
	Indorouchera griffithiana		Woody climber
	Ixora javanica	jarum-jarum, ixora	Shrub
	Melaleuca leucadendron	gelam, paperbark tree	Tree
	Nephelium lappaceum	rambutan	Tree
	Nephelium mutabile	pulasan	Tree
	Osimum basilicum	selaseh	Shrub
	Peltophorum pterocarpum	jemerlang, yellow flame	Tree
	Pittosporum ferrugineum	belalang puak, splayberry	Tree
	Porana spp.	(some introduced)	Herbs, climbers
	Pterocarpus indicus	angsana	Tree
	Scyphiphora hydrophyllacea	cengam	Tree
	Sesamum orientale	bijan (possibly introduced)	Tree
	Sindora spp.		Trees
	Syzygium jambos	jambu mawar, rose apple	Tree
	Vernonia cinerea	tumput tahi babi	Tree
	Xanthophyllum griffithii		Tree
	Zoysia matrella		Grass
Introduced	*Acacia cincinnata*	silver acacia	Tree
	Albizia falcataria	Albizia, batawi	Tree
	Ananas comosus	nanas, pineapple	Herb
	Antigonon guatamalense	Mexican creeper	Climber
	Antigonon leptopus	Honolulu creeper	Climber
	Aristolochia elegans	catico	Climber
	Aristolochia gigas	pelican flower	Climber
	Asystasia coromandeliana		Straggling herb
	Callistemon speciosa	bottlebrush	Tree
	Camellia sinensis	pokok the, tea plant	Tree
	Cassia fistula	indian laburnum	Tree
	Chrysalidocarpus lutescens	butterfly palm	Clustering palm
	Cinnamomum verum	kayu manis, cinnamon	Tree
	Coffea liberica	coffee	Shrub

Table 7. Cont'd.

Native/Introduced Species	Scientific Name	Common Name	Habit
	Coffea robusta	coffee	Shrub
	Dracaena fragrans		Shrub
	Duranta spp.		Shrubs
	Elaeis guineensis	kelapa sawit, oil palm	Solitary palm
	Hevea brasiliensis	getah, rubber	Tree
	Isotoma spp.		Herbs
	Jacaranda filicifolia	jambul merah, jacaranda	Tree
	Jacquemontia violacea		Creeper
	Jatropa pandurifolia		Tree
	Leucaena leucocephala	petai belanda	Tree
	Manihot glaziovii	ubi gajah, tree tapioca	Tree
	Mimosa pudica	malu malu, sensitive plant	Shrub
	Mussaenda erythrophylla		Climber
	Oreodora regia	royal palm	Solitary palm
	Psidium guajava	jambu batu, guava	Tree
	Solidago virgaurea	golden rod	Shrub
	Stachytarpheta jamaicensis	selasih dandi, snakeweed	Herb
	Tecoma stans	yellow bells	Tree
	Tridax procumbens	kancing baju, coat buttons	Herb
	Veitchia merrillii		Solitary palm
	Vitex negundo	lagundi, horseshoe vitex	Shrub
	Zea mays	jagung, maize	Grass

Table 8. Plants which bear fruits attractive to birds.

Native/Introduced Species	Scientific Name	Common Name	Habit
Native	*Anisophyllea disticha*	kayu pacat, leechwood	Tree
	Antidesma ghaesembilla	guncak, blackcurrant	Tree
	Antidesma montanum		Tree
	Ardisia crispa	mata ayam	Tree
	Ardisia elliptica	mata pelanduk	Tree
	Cinnamomum iners	kayu manis, cinnamon	Tree
	Clerodendrum villosum	panggil, no-good	Tree
	Dysoxylon cauliflorum	stem dysoxylon	Tree
	Embelia ribes	common embelia	Climber
	Fagraea auriculata		Epiphyte
	Flacourtia rukam	rukam, Indian prune	Tree
	Gardenia carinata	randa, kedah gardenia	Tree
	Glycosmis pentaphylla	nyerapeh, village rhu	Shrub
	Gynotroches axillaris	mata keli	Tree
	Jackia ornata	merbuloh merah	Tree
	Macaranga conifera	mesepat, hairy mahang	Tree
	Macaranga hypoleuca	mahang putih	Tree
	Macaranga meynei	mahang biru	Tree
	Macaranga tanarius	hairy mahang	Tree
	Medinilla hasselti	lokan jantan	Epiphyte
	Melastoma polyanthum		Shrub
	Memecylon amplexicaule	nipis kulit	Tree
	Memecylon coeruleum	nipis kulit	Tree
	Memecylon edule	nipis kulit	Tree
	Michelia champaka	cempaka	Tree
	Morinda elliptica	mengkudu kecil	Tree
	Myrica esculenta	telur cicak	Tree
	Myristica cinnamomea	cinnamon nutmeg	Tree
	Oncosperma tigillarium	nibong	Clustering palm

Table 8. Con'td.

Native/Introduced Species	Scientific Name	Common Name	Habit
	Olea brachiata	kelek, sea olive	Tree
	Pellacalyx axillaris	membuloh	Tree
	Piper caninum	sireh hutan	Climber
	Premna obtusifolia	buas buas	Tree
	Premna tomentosa	sarang burung	Tree
	Rhodomyrtus tomentosa	kemunting, rose myrtle	Shrub
	Scaevola frutescens	ambong ambong, sea lettuce	Shrub
	Scleria malaccensis		Shrub
	Streblus elongata	tempinis	Tree
	Sterculia coccinea		Tree
	Syzygium polyanthum	salam	Tree
	Syzygium spicata	kelat nenasi	Tree
	Tabernaemontana spp.	rosebays	Shrubs
	Trichosanthes spp.		Climbers
	Vitis hastata	akar asam riang	Tree
Introduced	*Anacardium occidentale*	gajus, cashewnut	Tree
	Antidesma bunius	buni, bignay	Tree
	Clidemia hirta		Shrub
	Cordia cylindristachya	string bush	Shrub
	Lantana mixta		Shrub
	Melia azedarach	mindi kecil, Persian lilac	Tree
	Melia indica	mambu, neem tree	Tree
	Mimusops elengi	tanjung	Tree
	Morus indica	mulberry	Tree
	Muntingia calabura	cherry tree	Tree
	Myrica javanica		Tree
	Myristica fragrans	pala, nutmeg	Tree
	Passiflora laurifolia	buah susu, passionfruit	Climber
	Piper nigrum	lada hitam, pepper	Climber
	Pithecellobium dulce	Madras thorn	Tree
	Polyalthia longifolia	mempisang, cemetery tree	Tree
	Quassia amara	quohia	Shrub
	Santalum album	sandalwood	Tree
	Syzygium cumini	jambolan	Tree
	Tamarindus indica	asam jawa, tamarind	Tree
	Zizyphus mauritiana	bedara, Indian jujube	Tree

Table 9. Plants that bear flowers attractive to nectarivorous birds.

Native/Introduced Species	Scientific Name	Common Name	Habit
Native	*Careya arborea*	putat kebung, tummywood	Tree
	Clerodendron paniculatum	panggil panggil, pagoda flower	Shrub
	Dendrobium secundum		Orchid
	Erythrina orientalis	dedap, Indian coral tree	Tree
	Erythrina variegata	dedap kuning	Tree
	Hibiscus rosa-sinensis	bunga raya (possibly introduced)	Shrub
	Hornstedtia spp.	wild ginger	Giant herbs
	Ixora spp.	jarum-jarum, ixora	Shrubs, tree
	Lumnitzera littorea	teruntum	Tree
	Lobelia spp.		Herbs
	Musa spp.	pisang, wild banana	Giant herbs
	Saraca declinata	gapis, red saraca	Tree
	Saraca palembanica	gapis, pink saraca	Tree
	Saraca thaipingensis	gapis, yellow saraca	Tree

Table 9. Cont'd.

Native/Introduced Species	Scientific Name	Common Name	Habit
	Sophora tomentosa		Tree
	Thespesia populnea	baru baru	Tree
	Zingiber spp.	wild ginger	Giant herbs
Introduced	*Acacia arabica*	babul	Tree
	Adhatoda vasica	adatodai (possibly native)	Shrub
	Amherstia nobilis	amherstia	Tree
	Andira inermis	brown heart	Tree
	Aphelandra sinclairiana		Shrub
	Bauhinia purpurea	purple bauhinia	Tree
	Bougainvillea spectabilis	bougainvillea	Shrub
	Calycopteris floribunda	pelawas	
	Canna indica	pisang setiak	Herb
	Clerodendron speciosum		Shrub
	Clerodendron thomsonae	bleeding heart	Shrub
	Delonix regia	flame of the forest	Tree
	Duranta plumieri	golden dewdrop	Shrub
	Erythrina glauca	dedap, coral tree	Tree
	Eucalyptus globulus	blue gum	Tree
	Gmelina arborea	Indian bulang	Tree
	Grevillea robusta	silky oak	Tree
	Heliconia rostrata	heliconia	Herb
	Millingtonia hortensis	Indian cork tree	Tree
	Sanchezia nobilis		Shrub
	Spathodea campanulata	African tulip tree	Tree
	Sterculia foetida	kelupang, great sterculia	Tree

Sunbirds and flowerpeckers are Southeast Asia's main nectarivores, and both require plant fibres to build their nests. Long grass areas may benefit them. Spiderhunters in dryland forest (where they feed at mistletoes, wild gingers and wild bananas) and white-eyes in mangroves (where they feed at mangrove tree blossoms) are other groups of nectarivores. There has recently been some concern that the extensive use of non-native *Heliconia* species in gardens and along roadsides in Singapore may preferentially attract sunbirds away from the few remaining native forest gingers, resulting in poor pollination and fruit-set, and adding to their conservation challenges posed by small, fragmented forest environments, trampling, and consumption or grubbing up by wild boar *Sus scrofa*. Deliberate propagation and planting of attractive native gingers instead of *Heliconia* could help to overcome this. A further possibility is the orchid *Dendrobium secundum*, unusual amongst its family in providing nectar that is taken by spiderhunters (Becking, 1989).

Plants for graminivorous birds. — Graminivorous birds will generally feed on a wide variety of grass seeds. Munias and weaverbirds will feed on at least the following grasses and sedges: *Axonopus compressus*, *Eleusine indica*, *Brochiaria mutica*, *Panicum maximum*, *Cyperus iria*, *Fimbristylis dichotomum* and *Digitaria* spp.

In addition, seeds of bamboos (which are also grasses) are always eaten when available. Planting of bamboo species that do not die after flowering should reduce maintenance problems.

Although munias are predominantly grain-eating birds, some also eat an aquatic green alga (*Spirogyra* sp.) from ponds and other water bodies (Avery, 1980). It therefore helps them if some water bodies in parks are left with algae rather than having it flushed away or manually removed.

Palms and swifts. — One rather unusual bird-plant interaction that should be noted is the association between the Asian palm swift *Cypsiurus balasiensis* and fan-palms of the genus *Livistona*. The birds use saliva to glue seeds (often seeds of kapok) into a nest cup on the downward hanging leaves of the palms (Hails & Turner, 1984). Such palms can therefore form the basis of an attractive nesting colony of swifts within a park.

Native or introduced species? — As shown in Appendix A, good bird-plants include both native and introduced species. Some of the introduced species, such as pokok pukul lima *Samanea saman*, bunga tahi ayam *Lantana cammara* and kapok *Ceiba pentandra*, are so widespread in the region and so well known that most people would be surprised to learn that they are not native. Nevertheless, planting policy should have a bias towards the use of truly native species for two reasons: 'character' and 'conservation'.

Firstly, the use of native species will help to give towns and cities a distinctive character that is unlikely to be duplicated elsewhere in the world. It can be something different, pleasing to both citizens and tourists, especially if

the concept is explained in newspapers and tourist brochures and by notices in parks.

Secondly, a town can become an arboretum for the conservation of native plant species. Local government authorities should be able to collaborate with research institutions to select and plant rare native species which may then be conserved and studied.

Nevertheless, where suitable native plant species are not available to provide a specific function, an introduced species may be very useful and there is no real objection to its use. Since the established parks already contain numerous introduced species, it is suggested that new parks, especially those that are going to be started from scratch, be selected for the planting of native plant species only.

CONCLUDING REMARKS

Diversity is the watchword. — It should be apparent by now that it is rarely the case that a particular tree can be planted to attract a particular bird. The bird species in question may not even be able to get near the tree unless the overall habitat structure is of a suitable type and it has corridors along which to move and refuges for shelter. The only way for a city to build up its populations of attractive small birds is to adopt 'diversity' as its watchword. There must be a multiplicity of plant species within architecturally complex vegetation.

The plant lists that are given in Appendix A are long and they include species that are currently used as ornamentals as well as those that are not. The lists should be carefully sifted to decide which are suitable for parkland and roadside use and which are not, bearing in mind that these plants have been selected with birds as the sole consideration.

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