CHAPTER 6
Enhancing Habitats in Bidadari

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Introduction

Bidadari Cemetery was one of the first cemeteries created following the founding of Singapore (Goh, 2002). Under the 1998 URA Masterplan, the cemetery was zoned for development as high-density housing. In 2003, the graves were exhumed and for the next 15 years, the site was left vacant.

Since the 1990s, the area has been well known as a site for nature appreciation. However, it shot to prominence in the early 2000s as a haven for birds, in particular as a stopover site for migratory landbirds. Bidadari's ease of access, coupled with the rise in popularity of nature photography in Singapore, meant that the site became a birdwatching hotspot for at least a decade right up to its current closure for development.

Background information

The core area of interest at Bidadari was the well-wooded area that was once the Muslim Cemetery. This green space of approximately 16 hectares consisted of two hillocks linked by an area of lower ground between them. A stream (canalised and overgrown) ran along the western boundary of the site parallel to Upper Serangoon Road. There was an additional canalised stream that ran from the southwestern to northeastern end of the site along the boundary between the woodland and grassy field.

In 2003, URA exhumed the tombstones in the area but left most of the extant vegetation in the area intact (Fig. 1). By 2013, the area of extant vegetation had recovered to such an extent that it appeared as a small area of secondary forest from the air (Fig. 2).

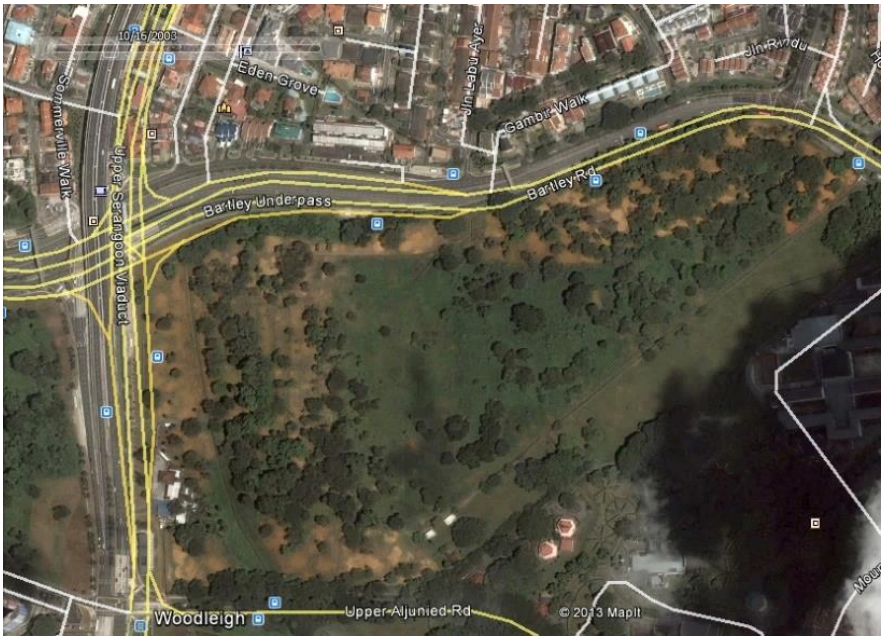

Fig. 1. Aerial view of the former Bidadari Muslim Cemetery just after the graves were exhumed in 2003. (Image credit: Google Earth)

Fig. 2. Aerial view of the former Bidadari Muslim Cemetery in 2012, a decade after the exhumation of the graves. (Image credit: Google Earth)

A preliminary survey of vegetation at the site in 2013, with a focus on trees, recorded 60 species of plants, of which 29 were native to Singapore. Of these 29 species, 15 were trees, seven were epiphytes, five were climbers and two were shrubs. With the exception of several uncommon mistletoe species, none of the native plants were of conservation concern.

The area rose to prominence in 2009, with more people getting into nature photography in Singapore; it was widely considered to be one of the most accessible birdwatching sites in Singapore. Woodleigh MRT is located at the southwest boundary of the site, while the entire region is served by a comprehensive network of buses.

Birds of Bidadari

According to the Nature Society Singapore's Bird Group, this green space, which has been observed since 2009, had yielded 164 species of birds, or 39.6% of the 414 recorded species of birds in Singapore, as of October 2019. Of these, four are globally threatened species (Table 1).

Table 1. List of globally threatened bird species recorded at Bidadari.

IUCN Status	**Species**
Critically Endangered	Yellow-crested Cockatoo (*Cacatua sulphurea*) [Introduced]
Vulnerable	Long-tailed Parakeet (*Psittacula longicauda*) Javan Myna (*Acridotheres javanicus*) [Introduced] Brown-chested Jungle Flycatcher (*Cyornis brunneatus*)

Additionally, the area supported at least 13 species of nationally threatened resident birds including charismatic species such as the Oriental Magpie-Robin (*Copsychus saularis*) and Spotted Wood Owl (*Strix seloputo*) (Fig. 3).

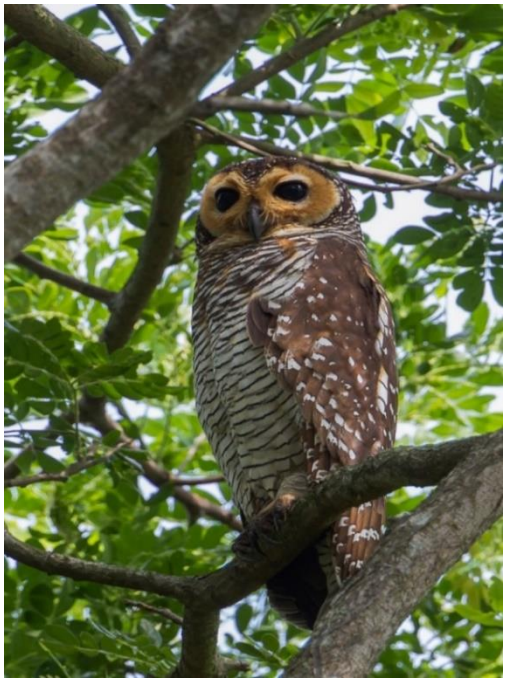

Fig. 3. A pair of charismatic Spotted Wood Owls are regularly observed roosting in the large fig trees around Bidadari. (Photo credit: Francis Yap)

Of the 164 species recorded for the area, 70 species (42.7% of Bidadari's bird list) were passage migrants or winter visitors such as the Oriental Dwarf Kingfisher (Fig. 4), and a further 94 species (57.3% of Bidadari's bird list) were residents.

Fig. 4. The stunning Oriental Dwarf Kingfisher (*Ceyx erithaca*) was one of 70 species of migratory birds that had been recorded at Bidadari. (Photo credit: Francis Yap)

In terms of dietary preference, insectivores comprised the most numerous feeding clade at Bidadari (Fig. 5). The area also supported an exceptionally high diversity of carnivorous avifauna as well, ranging from the resident Crested Goshawk (*Accipiter trivirgatus*) and migratory sparrowhawks (Fig. 6) that specialised in capturing birds to a wide variety of kingfishers and owls that consume terrestrial prey.

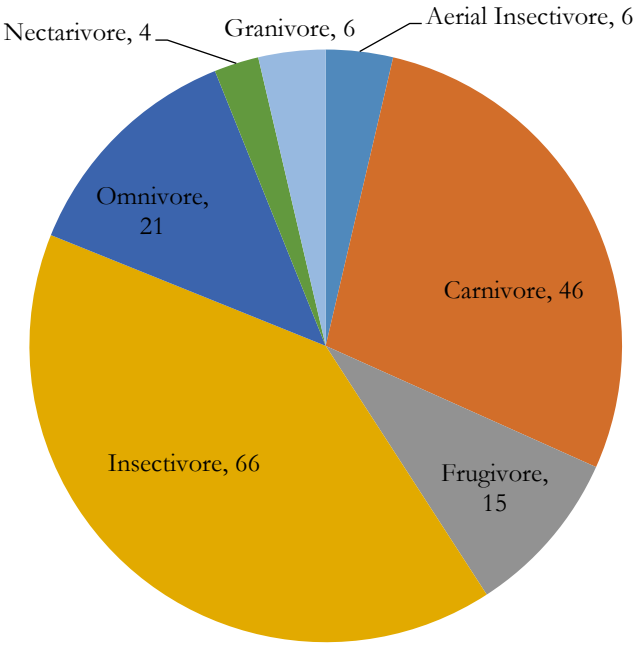

Fig. 5. Dietary preferences of the birds recorded at Bidadari.

Fig. 6. The migratory Japanese Sparrowhawk (*Accipiter gularis*) is a ferocious hunter of smaller birds regularly seen at Bidadari. (Photo credit: Francis Yap)

With regard to activity zones, habitat complexity at Bidadari had developed to the point where it was able to sustain a range of bird species that inhabit every vegetation layer (Fig. 7). The proliferation of Albizia (*Falcataria moluccana*) resulted in the formation of a viable canopy which also encouraged further growth of the shade-dependent epiphytes and other understorey species in addition to the extant Tembusu (*Cyrtophyllum fragrans*) and other trees that were not felled during the grave exhumation.

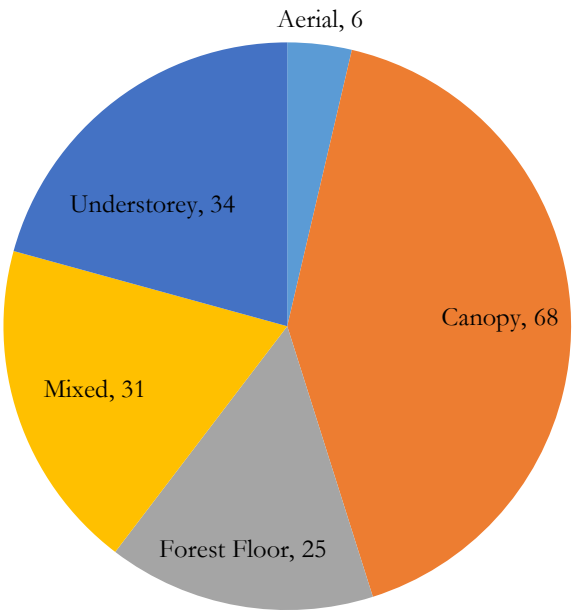

Fig. 7. Preferred activity strata of the various bird species recorded at Bidadari.

Many migratory species used Bidadari as a transit point on their way to their main wintering grounds in Indonesia and beyond. Peak avian diversity and abundance were observed from September through November during autumn migration and again from March to April during the return journey in Spring. A small number of species spent the entire winter at the green space. It was unclear why Bidadari was such an attraction to migratory birds; however, research from other urban cities such as Chicago and Toronto suggested the following:

1. Location – The wooded area at the Muslim cemetery was elevated compared to the surrounding landscape. This feature, combined with the low-rise land use of the surrounding landscape (Mt Vernon Columbarium, Cedar Girls Secondary School, Maris Stella High School and private housing), suggested that the area stood out to migratory birds as a sufficiently large green space for transit.

2. Land Use – It was fortuitous that the present land use around the site was restricted either to diurnal hours (schools) or was temporary in nature (funerals). This meant that at night when most of these birds migrated, the area was a dark(er) patch surrounded by a sea of lights. Studies in other highly built-up areas such as New York's Central Park had shown that migratory birds associate areas of darkness with areas of natural habitat and were drawn to it, especially during periods of bad weather.

3. Disturbance – In contrast to many other urban green spaces in Singapore, human disturbance at this site was very low. The only concrete path through the area started from the western boundary (visible from Fig. 1) and skirted around the south-western boundary of the site before running along the distinct boundary between the woodland and the open grassy area and then rejoining Bartley Road in the north-east near Bartley Station.

   Away from the footpath, the ground was overgrown and uneven with numerous potholes created during grave exhumation. As expected, most of the birds and wildlife were concentrated around the more heavily wooded west and south-western region of the site, with edge effects and noise pollution from the busy Bartley Road a likely deterrent to biodiversity at the eastern end of the site.

Other wildlife

While birds were the main attraction at Bidadari, the well-wooded site was also home to a wide variety of other animals. A summary of notable fauna records is outlined below.

Insects

A 3-month survey of the site in 2012 uncovered 31 species of crickets, grasshoppers and katydids (Tan, 2012). Notably, Bidadari was found to be the only locality in Singapore for two species of cricket (*Tarbinskiellus portentosus* (Fig. 8) and *Trigonidium* sp.) and one species of katydid (*Euconocephalus mucro*), of which the latter was also locally abundant.

Fig. 8. Bidadari is the only known site in Singapore where the cricket *Tarbinskiellus portentosus* has been recorded. (Photo credit: Tan Ming Kai)

Besides that, forest-dependent and colourful butterfly species such as the Common Rose (*Pachliopta aristolochiae*) had been observed in the area.

Reptiles

Reptiles observed at the site included the distinctive Green Crested Lizard (*Bronchocela cristatella*) (Fig. 9) and Equatorial Spitting Cobra (*Naja sumatrana*). The presence of Green Crested Lizard was particularly notable as this native species co-existed with the invasive Changeable Lizard (*Calotes versicolor*) at Bidadari, one of the few urban green spaces where this occurred. The Green Crested Lizard used to be abundant throughout Singapore until the 1980s, when the introduction of the invasive Changeable Lizard subsequently outcompeted and pushed the former species back into our nature reserves and remaining fragments of mature woodland.

Fig. 9. Bidadari was one of the few urban green spaces in Singapore where the handsome Green Crested Lizard could be found. (Photo credit: Francis Yap)

Mammals

The Variable Squirrel (*Calloscirus finlaysonii*) was one of the most conspicuous mammals in the area. Introduced to the area 30 years ago, the species has increased in population in line with the improving quality of habitat. The species did not appear to be highly invasive. In the 30 years since its introduction, it had not spread too far from Bidadari, with its main stronghold centred around the wooded areas to the south and west of the site including Woodleigh Park.

Of greater interest was the small population of native Common Palm Civets (*Paradoxurus hermaphroditus*) (Fig. 10) that inhabit the site too, although their exact numbers and movements were presently unknown.

Fig. 10. A small population of Common Palm Civet inhabits the well-wooded environs around Bidadari. (Photo credit: Francis Yap)

Bidadari housing master plan

In 2013, HDB announced the master plan for a housing estate of over 90 hectares at the site of the former Bidadari Cemetery. In the master plan proposal, Upper Aljunied Road was realigned, and three new roads – Bidadari Park Drive, Alkaff Crescent, Woodleigh Link – were planned to serve the upcoming estate. A regional park of 10 hectares was planned in the heart of the estate. Under the masterplan, the park had to include a stormwater detention pond which would help prevent downstream flooding of the adjacent estate. Besides that, a greenway which extended north and south out from the park, and served as recreational connectivity to other housing plots within Bidadari, was also planned. One of the key urban challenges was to integrate an underground service reservoir together with the park to regulate supply to homes and boost water pressure during periods of high demand. The service reservoir tank was planned beneath a community lawn in the Bidadari Park to optimise land use.

Under the larger masterplan development, the HDB plots would change the original topography of area to optimise platform levels, and most trees in the district plots had to be removed. As a result, the greenery loss would be inevitable and impact the migratory birds hotspots adversely. To mitigate this, the park boundary was discussed and adjusted together with Nature Society to incorporate key areas with clusters of bird observations.

Objectives and strategies of landscape master plan

Two key objectives of the landscape master plan were to enhance habitats within Bidadari for biodiversity, with birds as the key indicator species, and to enrich the living environment through planned greenery weaving between the urban forms. Strategies were discussed amongst urban planners, architects, landscape architects and avifauna experts to design the district such that Bidadari would be able to continue to serve as a stopover site for migratory birds after development.

One of the key macro strategies or coarse level landscape treatment was to conserve the higher topography of the park such that it could remain as a landmark to the birds (Fig. 11). In terms of larger greenery connectivity, several Nature Ways would also be planned into the new town (Fig. 12).

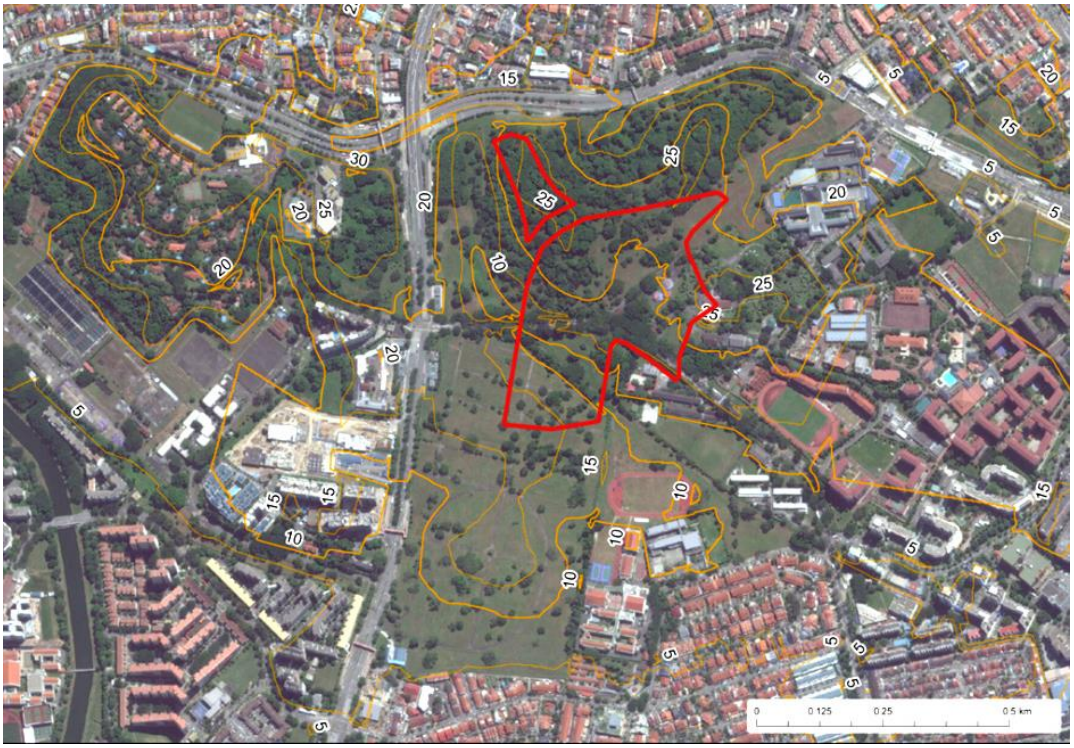

Fig. 11. The park boundary and hillock occupy most of the higher topography of the land.

Fig. 12. Nature Ways serve as larger greenery connections to the new town.

With the topography secured, the next step was to identify the potential habitat types in the estate. A core habitat area that had existing mature trees and *Ficus* clusters was identified within the regional park. The plan was to surround this core area with complementary and supplementary habitats areas around the estate (Fig. 13). In the planned network of greenery and habitats, other than the dominant greenway and streetscape greenery, plots of HDB precinct greenery and the various green roofs of HDB multi-storey carparks were considered as additional supplementary habitats to be planted with appropriate plants. The proposed stormwater detention pond, with its natural banks, was planned to be an additional supplementary habitat type previously not present in Bidadari Cemetery. Marshes, wet grassy areas, snags and rocks were planned for the pond area. A hillock was allocated as an additional complementary habitat, an area in which several sighting 'hotspots' were present due to the higher topography and more complex vegetation structure. The boundary of the hillock was refined in discussion with Nature Society to ensure that it was wide enough to provide a conducive environment for the birds to rest and refuel.

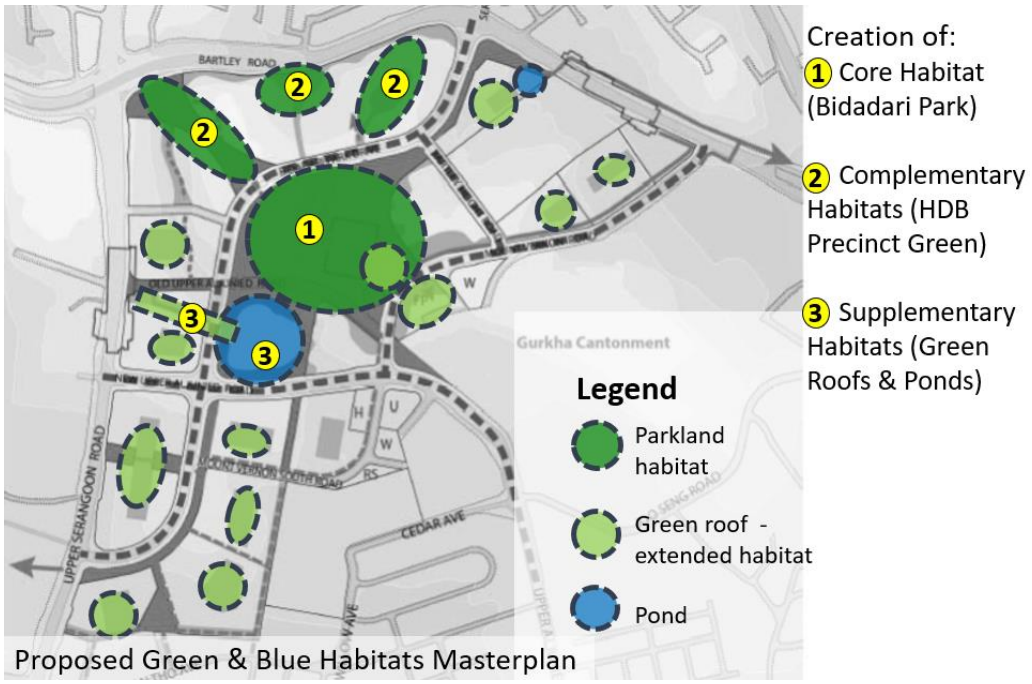

Fig. 13. Proposed green and blue habitats in the town.

Fine scale landscape strategies

At a finer scale, different landscape mosaics were considered within the park. These mosaics had a mixed vegetation structure in which birds could rest or move freely between different zones. The aforementioned *Ficus* clusters would serve as key stepping stones between the different landscape

mosaics (Fig. 14). These landscape mosaics were carefully planned to ensure that park users could still use the park easily and safely, with active-passive zones identified and circulation planned through the park (Fig. 15–16). A more naturalistic and layered planting approach would be applied, and the core area would eventually be minimally lighted at night to remain a conducive migratory stopover for the birds.

Figs. 14. *Ficus* trees were identified for conservation and plotted as part of the park's landscape.

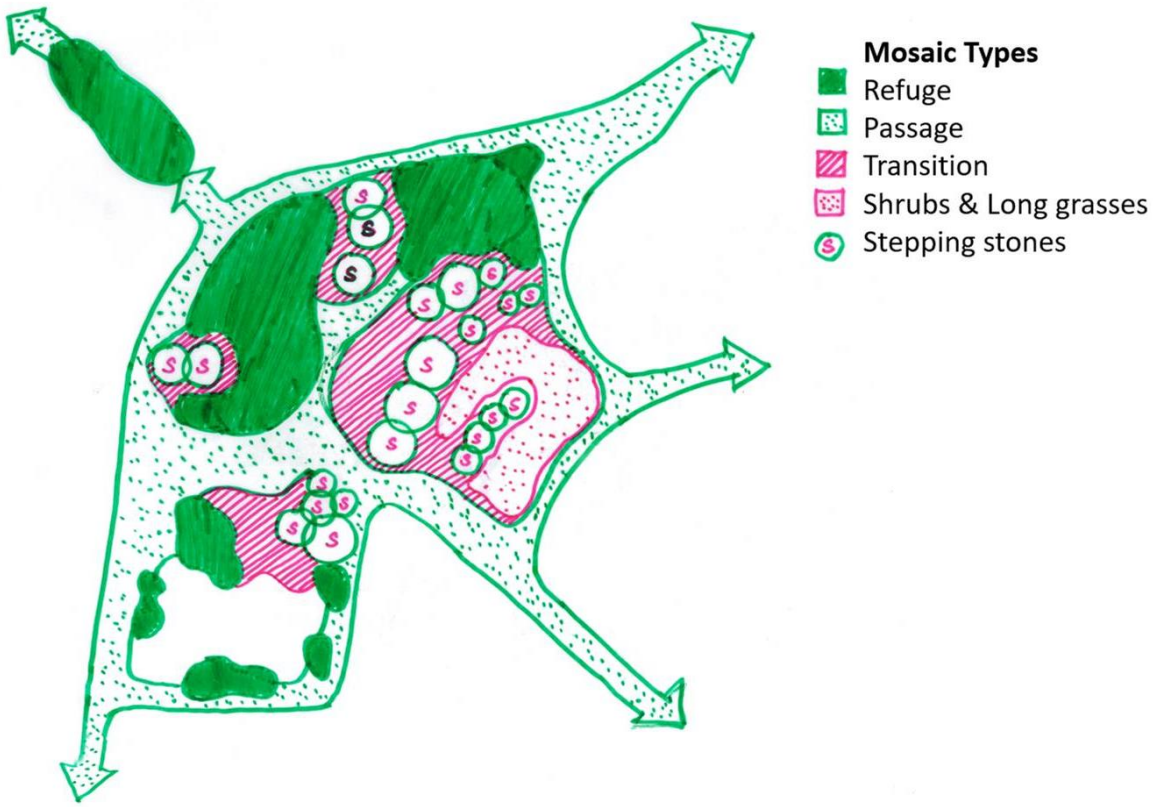

Fig. 15. Landscape mosaics planned in the park.

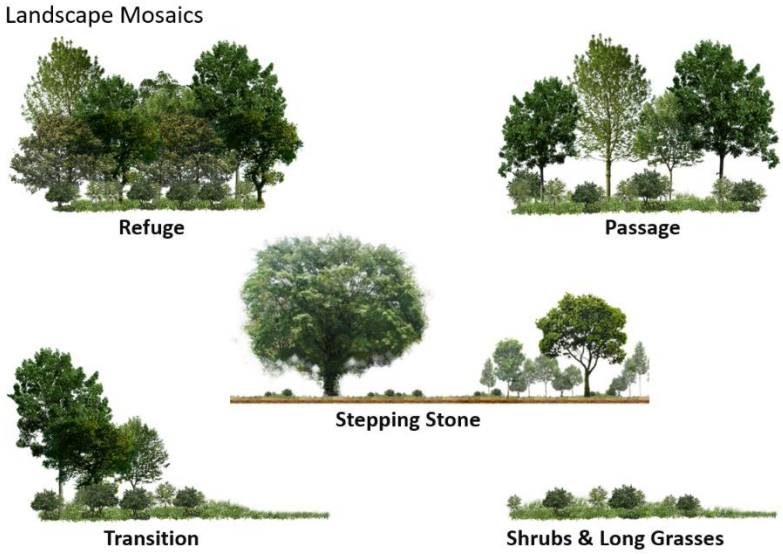

Fig. 16. Proposed landscape mosaic types for the park.

As part of the planned strategy to harness the existing greenery in the development boundary, healthy trees of ecological value were transplanted into the core habitat zone of the park. Over 300 trees were transplanted into a 4-hectare area, turning an area of grassland into a wooded area. Migratory birds were observed to return to the newly created woodlands as soon as the transplanted trees became established. Selected flora species would also be planted during the park development to build up the mosaics and vegetation complexity (Fig. 17). Trees that did not survive transplanting were retained as snags and logs to provide habitat for decomposers like fungi and various insects.

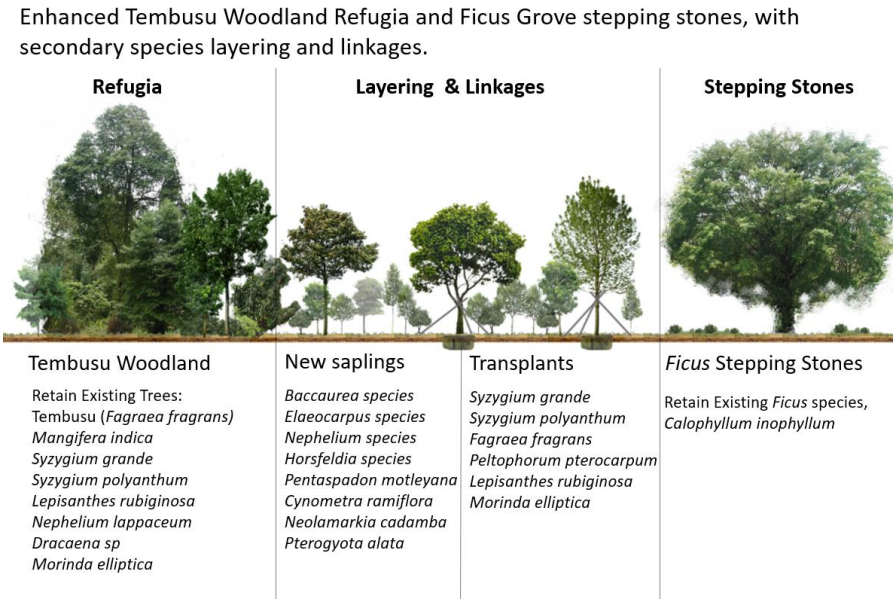

Fig. 17. Proposed refugia, layering, linkages and stepping stones for the park.

A 19 m-wide land bridge, which will serve as a link from Bidadari Park to Hillock Park and provide a safe passage for visitors and wildlife across Bidadari Park Drive, is being planted up (Fig. 18). Marshes and pond terraces are currently being created (Fig. 19). Structures such as raptor nest platforms will also be set up within the park as an interim measure for arboreal birds, while the layering of trees is shaping up.

Fig. 18. View of the land bridge linking the hillock (foreground) to the main park on 21 May 2023.

Fig. 19. View of the park and temporary pond towards the north, from Alkaff Lakeview on 25 May 2023.

Implementation – Park development

The park started construction at the end of 2019 and is targeted to be officially opened in 2024. A main heritage walk, observation deck, shelters, viewing sheds and woodlands nature trails are some of planned features of the future park. In due course, it is hoped that birdwatchers and nature enthusiasts will also be able to watch migratory birds at the new park. To determine the effectiveness of the landscape strategies, monitoring of the migratory birds will be conducted once the park is completed.

References

Goh SG (2002) Twilight for Bidadari. Nature Watch, 10(1): 14–15.

Tan MK (2012) Orthoptera of the exhumed Bidadari Cemetery, Singapore. Nature in Singapore, 5: 343–350.