

CHAPTER 11

Restoration of a Diversity of Ecosystems on Coney Island Park

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Introduction

Coney Island Park, which was opened to the public in October 2015, is an 87-hectare park (Fig. 1) that supports a wide variety of habitats, consisting predominantly of *Casuarina* woodlands, coastal forests, grasslands, mangroves and intertidal zones (Fig. 2). To showcase Coney Island Park as an example of sustainable development in conservation and ecological restoration, the National Parks Board (NParks) commenced several habitat enhancements and restoration projects on the island in 2015. The effort is ongoing with further enhancement works being carried out progressively. The main objectives were to improve the existing *Casuarina* woodlands so that Coney Island Park would have more diverse native coastal forest habitats and to increase the canopy cover and understorey species composition. The native species planted on the island were carefully selected (1) to safeguard the ecological value of native coastal plants, (2) to restore the island's ecological function by providing more conducive habitats for the diverse flora and fauna to thrive, and (3) to allow natural succession to occur with minimum intervention.

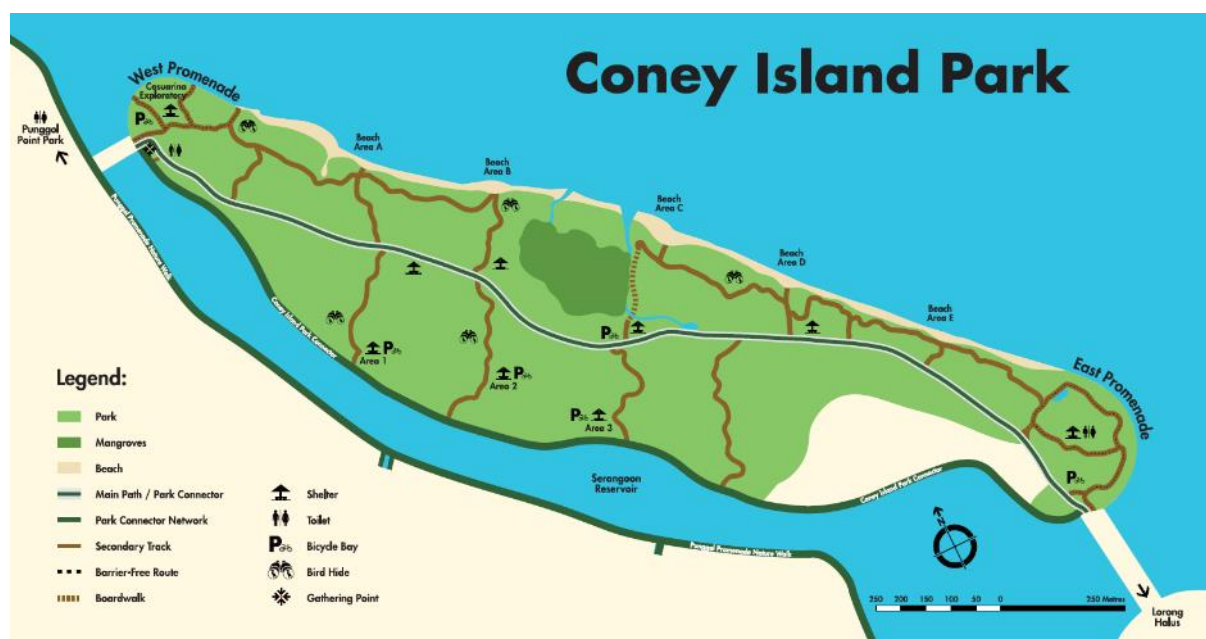


Fig. 1. Map of Coney Island Park.



Fig 2. Variety of habitats on Coney Island Park.

Floral Biodiversity

To enhance the floral biodiversity of Coney Island Park, a landscape planting palette was specially curated for various localities on the island. For example, each of the five beach areas in the park was meant to be home to plants of a particular habitat or theme (Fig. 3). The existing vegetation and relationship with sea level were carefully analysed to determine the species of native coastal plants and trees that would be reintroduced into the areas.



Fig. 3. Location of the five beaches and their themes.

Thematic beach plantings – rare and extinct trees at Beach Area C

The curated planting palette for Beach Area C included trees with rare or extinct conservation status in the wild. Examples of some of the rare plants that can be found near Beach Area C are shown below.

i. Cycads or Paku Rajah (*Cycas edentata*)

The cycads near Beach C were rescued from a site in Katong that was slated for development and were replanted here in their native beach habitat. Locally rare in the wild, cycads have a long fossil history and typically grow very slowly. Some specimens are believed to have lived for as long as 1,000 years. Cycads do not produce flowers, but instead are cone-bearing.



Fig. 4. Cycads on Coney Island Park.

ii. Sea-hearse or Buah Keras Laut (*Hernandia nymphaeifolia*)

The Sea-hearse is an evergreen seashore tree that grows up to 22 m tall. It has long-stalked leaves with somewhat fleshy, leathery blades with yellowish veins and midribs. Growing most commonly along sandy and rocky coasts, the tree bears fragrant, yellowish white flowers. The species is presumed to be extinct in Singapore, and Coney Island Park is the first location where it is being reintroduced into the natural environment.



Fig. 5. Sea-hearse (*Hernandia nymphaeifolia*).

iii. Pokok Rukam Gajah (*Scolopia macrophylla*)

Native to Singapore, the Pokok Rukam Gajah is a small thorny tree with tooth-edged leaves. The flowers are greenish-white and the fruit matures from orange to black. This is the only species of *Scolopia* that occurs in Singapore. Once presumed to be locally extinct, it was rediscovered at Coney Island Park in 2014.



Fig. 6. Pokok Rukam Gajah (*Scolopia macrophylla*).

Other rare/extinct trees planted near Beach Area C include the following:

Trees	Shrubs
<i>Melaleuca cajuputi</i>	<i>Pluchea indica</i>
<i>Ormosia sumatrana</i>	<i>Pemphis acidula</i>
<i>Pongamia pinnata</i>	<i>Sophora tomentosa</i>
<i>Syzygium syzygioides</i>	<i>Tarenna fragrans</i>
<i>Serianthes grandiflora</i>	

The key species that were planted in the other beach areas, namely Beach Areas A, B, D and E, are presented below:

Table 1: Key species planted in Beach Areas A, B, D, and E.

Beach Area	Habitat/ Theme	Endangered/ Extinct plant(s)	Remarks
A	Back mangrove trees	Penaga Laut (<i>Calophyllum inophyllum</i>) (Status: Critically Endangered)	As it is naturally occurring on Coney Island, <i>Calophyllum inophyllum</i> is the main species planted in this area.
		Dungun (<i>Heriteria littoralis</i>) (Status: Critically Endangered)	The Dungun tree produces durable timber that is used for making telegraph poles in the past.
B	Beachfront shrubs and coastal climbers	Pink-Eyed Pong Pong (<i>Cerbera manghas</i>) (Status: Critically Endangered)	It resembles another congeneric species, <i>Cerbera odollam</i> , and can be readily told apart by the yellow-centred flowers. <i>Cerbera manghas</i> has red- to pink-centred flowers and is much rarer locally, and is only known from populations in Pulau Semakau, Pulau Ubin, and St. John's Island.
		Twin-Apple (<i>Occhrosia oppositifolia</i>) (Status: Presumed Nationally Extinct)	The plant resembles a more neatly branching frangipani (<i>Plumeria</i> species or hybrids), and grows on rocky and sandy seashores, in beach vegetation, coastal forests, and the edge of mangrove forests. This is the first time that the <i>Occhrosia oppositifolia</i> is being planted in its natural environment after being classified as locally extinct.
D	Coastal hill forest trees	Jeliti (<i>Planchonella chartacea</i>) (Status: Critically Endangered)	First reported to occur in Singapore in 1997 from Lazarus Island, it was subsequently also found in Chek Jawa.

E	Beachfront trees	Jelawi (<i>Terminalia subspatulata</i>) (Status: Critically Endangered)	Jelawi has a rather open and tiered crown that large birds of prey use as nesting sites.
		Badam (<i>Terminalia copelandii</i>) (Status: Native to Malaysia)	The Badam looks similar to the Sea Almond (<i>Terminalia cattapa</i>). However, the leaves of this tree are much larger, and it is found in inland forests.

Coastal meadows

Coastal meadows were created at two locations on the island (Fig. 7) to enhance species variety and support and increase the island's biodiversity. They contain a selection of free-flowering plants commonly found along the sandy, coastal beaches of Singapore (Fig. 8). These species are well-adapted to the harsh conditions of coastal areas, i.e., strong light exposure, salt spray, and very windy conditions. They serve as an educational tool as well as an enhancement to the island's floral and faunal biodiversity.



Fig. 7. Map location of the planted coastal meadows.



Fig. 8. One of the coastal meadows on Coney Island Park.

Thematic plantings at Coney Island Interim Park

The area to the south of the main path was also curated with a thematic planting palette when the area was redeveloped in 2018. There were three new nodes (rest points with shelters), with each focussing on the main parts of a plant that botanists use to identify a plant: fruits, bark, and leaves (Fig. 9). Each of these nodes highlights unique types of leaves, fruits, and bark of some native plant species.

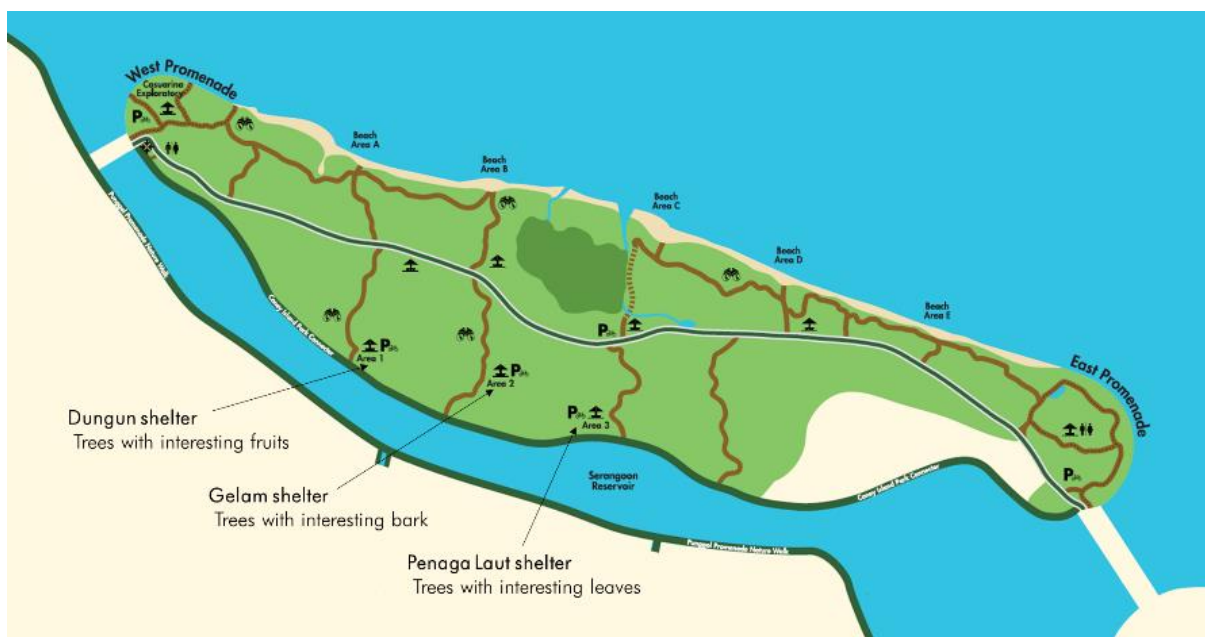


Fig. 9. Location of three new nodes with thematic planting.

- i. Thematic Planting for area around Dungun Shelter: Interesting Fruits (Fig. 10)
- Mangrove Dungun (*Heritiera littoralis*) – Its egg-shaped fruit has a ridge across the length, which looks like the keel of a boat. Inside is a single seed.
 - Simpoh Air (*Dillenia suffruticosa*) – Its fruit is a sphere when closed, and opens into a red star shape with about eight sections. In each section are black seeds, covered with a red flesh (aril). Many birds like the Yellow-vented Bulbul eat these seeds and help to disperse them.
 - Sea Pong Pong (*Cerbera manghas*) – Its fruit looks like a mango, green when unripe, turning red as it ripens. Within it, there is a fibrous ‘husk’ that enables the fruit to float and be carried away by sea.
 - Manggis Hutan (*Garcinia celebica*) – Its bright red fruit looks like an apple. The fruit is edible, but sour.
 - Katong Laut (*Cynometra ramiflora*) – Its pod is brown and wrinkled.

Trees with Interesting Fruits



Mangrove Dungun
(*Heritiera littoralis*)



Simpoh Air
(*Dillenia suffruticosa*)



Sea Pong Pong
(*Cerbera manghas*)



Manggis Hutan
(*Garcinia celebica*)



Katong Laut
(*Cynometra ramiflora*)

Figs. 10. Trees with interesting fruits.

- ii. Thematic planting for area around Gelam Shelter: Interesting Bark (Fig. 11)
- Sea Tristania (*Tristaniopsis obovata*) – Its bark is flaky and bright orange (sometimes grey or green).
 - River Tristania (*Tristaniopsis whiteana*) – Its bark is flaky and orange/grey bark.
 - Gelam Tree (*Melaleuca cajuputi*) – Its Malay name, Kayu Putih or ‘white wood’, refers to its white, flaky bark, which in the past was used as material for boats, life vests, and filling pillows.
 - Kelat Merah (*Syzygium filiforme*) – Its bark is red, papery and flaky.
 - Kayu Arang (*Cratoxylum cochinchinense*) – Its bark is smooth and colourful with brown and yellow colouring that peels off in strips.

Trees with Interesting Bark



Sea Tristania
(*Tristaniopsis obovata*)



River Tristania
(*Tristaniopsis whiteana*)



Gelam Tree
(*Melaleuca cajuputi*)



Kelat Merah
(*Syzygium filiforme*)



Kayu Arang
(*Cratoxylum cochinchinense*)

Figs. 11. Trees with interesting bark.

- iii. Thematic Planting for area around Penaga Laut Shelter: Interesting Leaves (Fig. 12)
- Sea Gutta (*Planchonella obovata*) – Its oval leaves have two colours: green on the upper side, and reddish brown on the hairy underside.
 - Star Apple (*Chrysophyllum cainito*) – Its leaves have two colours: deep green and glossy on top, and golden brown with a satin sheen on the underside.
 - Penaga Laut (*Callophyllum inophyllum*) – Its leaves are oval and leathery, with many fine veins.
 - Tongkat Ali (*Eurycoma longifolia*) – Each of its leaves are 1 m long, with many leaflets, which are dark green on the upper side and lighter green on the underside.

Trees with Interesting Leaves



Sea Gutta
(*Planchonella obovata*)



Star Apple
(*Chrysophyllum cainito*)



Tongkat Ali
(*Eurycoma longifolia*)



Penaga Laut
(*Callophyllum inophyllum*)

Figs. 12. Trees with interesting leaves.

Mangrove rehabilitation efforts along the Mangrove Boardwalk

A patch of mangrove forest on Coney Island Park can be found between Beach Area B and Beach Area C (Fig. 13), where a rivulet brings in seawater to inundate the forest. Mangrove forests, although often regarded as ‘swamps’, are in fact a rich habitat with a high biodiversity. The water here is brackish, a mixture of seawater and freshwater. During the development of Coney Island Park in 2015, a mangrove boardwalk was constructed alongside the rivulet to connect the island’s main paths to Beach Area C.



Fig. 13. Location of the mangrove forest.

Mangrove rehabilitation efforts were carried out in 2019 to expand the existing mangrove forest and bring it nearer to the mangrove boardwalk for members of the public to appreciate the mangrove flora and fauna up close. To achieve this, the vegetated area between the rivulet and the boardwalk, that comprised mainly non-mangrove species (Fig. 14), was re-graded by removing the soil (Fig. 15) and creating earth channels for seawater to inundate the area along the boardwalk during high tide (Fig. 16). This would allow the planting of the true mangrove species along with back mangrove species (Fig. 17–19; Table 2), and hence creating a self-sustaining mangrove ecosystem with thriving mangrove flora and fauna.

Educational signs were installed so that the public can learn more about mangrove biodiversity and the ecological benefits contributed by this important ecosystem (Fig. 20).

The progression of the mangrove restoration and rehabilitation on Coney Island Park from November 2019 to June 2023 can be seen in Fig. 21.



Fig. 14. Clearing of terrestrial species along the rivulet.



Fig. 15. Regrading of soil to lower the ground level for more areas to be inundated.



Fig. 16. Trenching of channels to bring in seawater for more areas to be inundated during high tide.



Fig. 17. Preparation for the planting of mangrove saplings.



Fig. 18. Planting works in progress.



Fig. 19. Newly planted mangrove saplings.



Fig. 20. Installation of educational signs.



Figs. 21. Progress of the rehabilitated mangrove area as seen through the photos taken at different dates. (A) November 2019; (B) August 2021; (C) June 2023.

Table 2: A list of mangrove and back mangrove species that had been planted on the restoration and rehabilitated mangrove area on Coney Island Park.

Species	Qty
<i>Avicennia rumphiana</i>	2
<i>Bruguiera gymnorhiza</i>	90
<i>Bruguiera hainesii</i>	10
<i>Bruguiera parviflora</i>	15
<i>Bruguiera sexangula</i>	15
<i>Sonneratia ovata</i>	6
<i>Rhizophora apiculata</i>	90
<i>Rhizophora mucronata</i>	7
<i>Rhizophora stylosa</i>	5
<i>Lumnitzera littorea</i>	1
<i>Lumnitzera racemosa</i>	46

Species	Qty
<i>Heritiera littoralis</i>	4
<i>Ceriops zippeliana</i>	65
<i>Xylocarpus granatum</i>	2
<i>Xylocarpus moluccensis</i>	65
<i>Rapanea porteri</i>	28
<i>Acanthus ilicifolius</i>	24
<i>Acanthus ebracteatus</i>	15
<i>Volkameria inermis</i>	50
<i>Pluchea indica</i>	30
<i>Acrostichum speciosum</i>	10
<i>Scaevola taccada</i>	20

Faunal Biodiversity

Four species of resident woodpeckers — Sunda Pygmy (*Dendrocopos moluccensis*), Laced (*Picus vittatus*), Rufous (*Micropternus brachyurus*) and Common Flameback Woodpeckers (*Dinopium javanense*) — have been recorded on Coney Island Park. The Collared Kingfisher (*Todiramphus chloris*) and White-throated Kingfisher (*Halcyon smyrnensis*) are residents on Coney Island Park. Due to woodpeckers' preference for nesting in tree holes, these species face a limited supply of natural nest sites. To increase the availability of suitable nesting sites for kingfishers and woodpeckers, nest boxes were installed on the island (Fig. 22). Bird boxes made from recycled timber were erected on tall trees in a few areas around Coney Island Park. These nest boxes also attracted kingfishers. Officers from NParks' Parks and Design divisions are currently discussing the design of new nest boxes and selection of trees that are most widely used by the birds based on monitoring observations.



Fig. 22. Nest box on a Casuarina (*Casuarina equisetifolia*).

Enhancement plots (GCF)

The Garden City Fund (GCF), a registered charity established by NParks, has fostered valuable partnerships with various corporations and individuals, allowing NParks to achieve our vision of transforming Singapore into a City in Nature. For example, GCF's partnerships through the Plant-A-Tree (PAT) programme resulted in the planting of more than 1,000 tree saplings, comprising more than 50 native coastal plant species. The partnerships not only brought about a big leap in progress to enhance the park, but also established strong collaborative efforts in other aspects of habitat enhancement, such as the collection and propagation of seeds and plants and the conducting of learning expeditions. The collection and propagation of seeds and plants in Coney

Island Park contribute towards safeguarding the gene pool of the native plants. Furthermore, educational outreach, made possible by the partnerships, has helped widen the reach of NParks' messaging of biodiversity conservation.

Success of efforts

Habitat restoration and enhancement efforts on the island resulted in the island being home to at least 157 fauna and 86 plant species, of which some are critically endangered and presumed nationally extinct in the wild. In particular, 10 species of fauna that were listed in *The Singapore Red Data Book* (Davison *et al.*, 2008) had been recorded.

Table 3. Faunal species listed in the 2nd edition of *The Singapore Red Data Book* (Source: Davison *et al.*, 2008)

<p><u>Birds</u></p> <p><i>(Nationally Critically Endangered)</i></p> <ul style="list-style-type: none"> - Black-crowned Night-Heron - Spotted Wood-Owl <p><i>(Nationally Endangered)</i></p> <ul style="list-style-type: none"> - Red Junglefowl - Changeable Hawk-Eagle - Red-wattled Lapwing <p><i>(Nationally Vulnerable)</i></p> <ul style="list-style-type: none"> - Grey Heron - Rusty-breasted Cuckoo 	<p><u>Dragonflies</u></p> <p><i>(Nationally Critically Endangered)</i></p> <ul style="list-style-type: none"> - Sultan - Lined Forest-Skimmer <p><u>Mammals</u></p> <p><i>(Nationally Critically Endangered / Globally Vulnerable)</i></p> <ul style="list-style-type: none"> - Smooth-coated Otter
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The globally threatened Smooth-coated Otter had also been sighted on the island, as well as in the surrounding waters. Furthermore, 81 species of birds had been observed since the habitat enhancement and restoration efforts. These included uncommon resident species such as the Rufous-tailed Tailorbird and Rufous Woodpecker, two species that are associated with forested areas. During the migratory season, uncommon migrants that had been recorded included Asian Drongo-Cuckoo, Large Hawk-Cuckoo, Chinese Goshawk and Pallas's Grasshopper Warbler.

In addition, the intensive planting of native coastal species on the island had increased the floral species diversity on the island. By ensuring the survival of these plants, Coney Island Park helps to safeguard the native gene pool for these species, hence, protecting and conserving our natural heritage. Increasing the floral species diversity of the island also aids in restoring the island's ecological function, including providing niches or habitats for fauna to forage or as breeding sites.

While woodpeckers were spotted on the island, it was difficult to confirm their utilisation of the nest boxes provided. This could be due to the locality of the nest boxes where the nest boxes were too high up the tree or the vegetation surrounding it were too dense. Nonetheless, the key takeaway is that protecting known natural cavities in trees as nesting sites is the most important conservation measure for these birds, and this could be supplemented by human-made replacement nest boxes.

Coney Island Park long-term monitoring reforestation project

Apart from the habitat enhancement efforts mentioned in the above sections, NParks also embarked on a coastal reforestation project for Coney Island Park. Two plots, totalling 11.1 hectares, adjacent to the mangrove area of the park were dedicated to reforestation (Fig. 23). One of the few long-term monitoring sites in Singapore, Coney Island Park presents a scientific opportunity for NParks to track the success of reforestation efforts over a long period of time.



Fig. 23. Reforestation plots on Coney Island Park.

The main method used for reforestation in Coney Island Park was the maximum diversity method, which is an active approach towards reforestation whereby forest succession is sped up by human intervention (Goosem & Tucker, 2012). Multiple climax species were planted while pioneer species was only a small proportion of the species planted. Moreover, seed dispersal into the island was limited as it was an isolated patch of coastal forest. Applying the maximum diversity method of reforestation helped overcome this limitation as it involved planting as many native coastal species as possible, reducing the need for seed dispersers coming to the island (Goosem & Tucker, 2012).

The two reforestation plots were *Casuarina* woodlands with little understorey species composition. As such, the objectives of the reforestation project were to (1) improve forest structure, (2) increase canopy cover, and (3) increase understorey species composition. More than 30 species of native coastal plants, totalling more than 8,000 individuals, were planted in the reforestation plots to help meet the project's objectives.

The reforestation plots would be monitored on a long-term basis to track the progress and success of the reforestation, and whether the objectives of the project were achieved. Floral and faunal surveys would be carried out over the years to monitor the change in biodiversity on the island. This would also create engagement opportunities with volunteers, including students and citizen scientists, where they can learn more about the biodiversity found on the island and hopefully, by extension, become stewards of conservation.

Conclusion

A landscape planting palette was specially curated for habitat enhancement efforts on Coney Island Park, which commenced in 2015. The habitat enhancement efforts have shown great success in the protection of the ecological value of native plants, as well as restoring the island's ecological function. This is evident by the increase in the number of fauna and flora species to 157 species of fauna and 86 species of flora that have been observed since the start of habitat enhancement efforts on the island. The planting of critically endangered and presumed nationally extinct floral species also helps to safeguard their native gene pool.

Moving forward, NParks will continue restoring and enhancing the habitats in Coney Island Park to strengthen the island's ecological functions and resilience through improving forest structure and species composition. Biodiversity surveys will also be conducted quarterly to monitor the species diversity on the island.

References

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