The Vital Role of Native Plant Diversity in the Conservation of Native Wildlife

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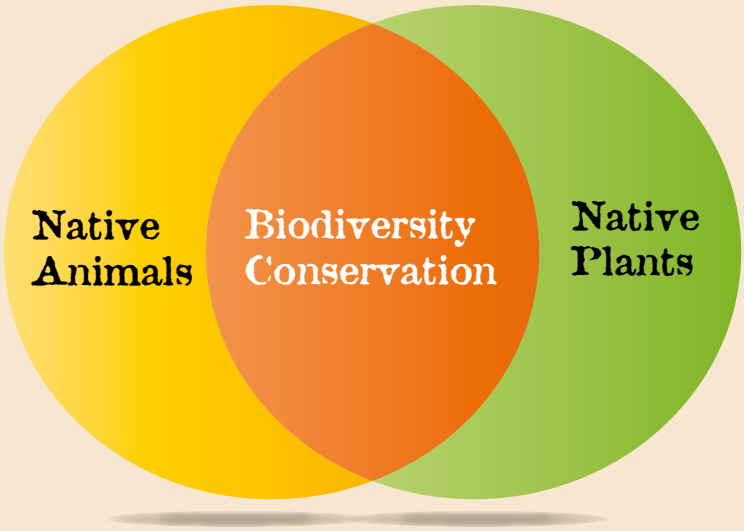
The conservation of native animals is impossible without the preservation of native plants (1,2).

Therefore, the primary objective of biodiversity conservation is to protect natural ecosystems that support both native plants and animals (3,4).

However, few regions on Earth today remain entirely unaffected by human mediated modification (5). Consequentially, a second objective of biodiversity conservation is to facilitate the natural regeneration of surviving native plants and animals in degraded and disturbed habitats to restore as much functional ecosystem integrity as possible (3,4).



Over the past 50 years, tree-planting initiatives have become popular as a means to enhance and accelerate natural regeneration processes. However, despite good intentions, many tree-planting efforts are less effective than they could be in restoring beneficial habitats for wildlife (6).

Recommendation:

Tree-Planting Areas Must be Wildlife Friendly

Studies of orangutan survivorship in fragmented and degraded habitats have shown that forests left to natural regeneration, without extensive silvicultural management to remove of natural vines, retain high value as habitat for orangutans and other forest-dependent wildlife (7,8,9,10).

Thus, restoration efforts should not be so intrusive that they disturb native wildlife that depend on the already existing native plants that still remain in areas designated for habitat enrichment (3).

Examples of tree-planting practices that disturb wildlife trying to survive in smaller and fragmented habitats are (11,4):

1. Excessive clearing of natural habitat to "prepare" for planting.
2. Overzealous control of so-called "weeds" across too wide an area.
3. Access that facilitates ease of human use at the expense of wildlife.
4. Irresponsible waste management, such as leaving behind cigarette butts, food packaging, plastic bags, strings, and wires that are dangerous to wildlife health and safety.
5. Intolerance of the full range of local wildlife presence and activity in replanted areas.
6. Planting a single high-value species that attracts animals at above normal levels, resulting in increased likelihood of conflict between wildlife and between humans and wildlife.

Second Recommendation:

The purpose of "tree planting" for biodiversity conservation should be to support natural habitat regeneration processes (13,14,15).

Enrichment planting efforts should support natural regeneration processes by incorporating a variety of native plants, tailored to different soil types and conditions (16).

Planting monocultures and invasive non-native plant species are inadequate habitat restoration as these approaches are unlikely to properly address the habitat needs of native wildlife (12,13).

A food provisioning approach that focuses on providing for a single animal species or planting only one type of plant is not habitat restoration. Food is only one component of the habitat needs necessary for wildlife survival (17).

Other essential habitat requirements include:

1. Adequate shelter and resting areas that are suitable for use year-round, meaning trees of sufficient height (e.g., at least 10-20 meters) to serve as nesting sites.
2. Reliable security, allowing species to conduct their normal activities and foster appropriate inter- and intra-species dynamics.
3. Sufficient refuge for wildlife to maintain a safe distance from human disturbances, as most wildlife tend to avoid human contact whenever possible.

We found that the pressure to supply large numbers of plants often leads tree-planting nurseries to rely on a narrow range of species that are the hardiest and easiest to acquire. This practice typically results in monoculture plantings, and/or the use of plants that may be unsuited to site conditions Therefore, these labour-intensive efforts often have less impact than hoped (14,15).

To effectively support wildlife and promote natural forest regeneration processes, enrichment planting programs must address both the biological and social needs of the wildlife. This requires greater effort to cultivate a broader variety of native species that are appropriate for different habitats and conditions. Such actions are essential for ensuring that various animal species can coexist with humans within mixed-use landscapes (16).

Wildlife depend on native plant species diversity

An example of the diversity of plant species required to support wildlife is found in our studies of orangutan feeding ecology over the past 25 years in Kinabatangan (7,8,9).

Orangutans depend on over 160 documented plant genera, many of which are not yet classified to the species level. Although they consume fruit as an energy source when available, orangutans also rely on leaves and other plant parts from various native trees and vines for survival (9).

Notably, native vines make up one-third of the diet of orangutans in Kinabatangan. Spatholobus spp., a native vine, is the most consumed species by orangutans in both degraded and primary forests (9, 18). This vine is also a component of elephant diets in the area (19). Additionally, native vines allow orangutans to travel efficiently through the forest canopy (9).

They typically select the tallest and most stable trees available for nesting (20,21), but tend to avoid often sleeping in fruiting trees (22).

This example above, highlights the necessity of a wide variety of native plant species to adequately support native animal species.

Inspiration – Call to Action:

Genuine habitat restoration work provides a real opportunity for the sustained development of new specialties and disciplines.

Historically, forestry research and practices have primarily concentrated on extracting commercially valuable plant species. However, with a transition toward a more holistic approach that emphasizes ecosystem services, the extensive skills and expertise within the field of forestry can play a crucial role in enhancing authentic habitat restoration efforts that promote the conservation of native plants and wildlife, even in fragmented mixed-use landscapes.

For instance, an excellent resources on nursery practices can be found here:
https://drive.google.com/file/d/1kAOcHqBuAywHob4ERuleluCFIlsoDx6j/view.

Additionally, there are existing projects dedicated to preserving a wide range of native plant diversity: **https://www.trcrc.org**.

To also assist in this process, we developed a priority list of important plant species based on an analysis of orangutan feeding ecology from 2000-2016 in Kinabatangan (9). We evaluated this dataset to refine it for broader relevance to forest-dependent wildlife in the region (14). This information is available in Appendix A of the Best Management Practices document (14) and is also attached below. Although this resource is most specifically relevant to North Borneo and those orangutans that live in alluvial mineral soil landscapes, the most productive habitat for orangutans compared to peat swamps (23), other studies and resources are available to help expand this to other areas and habitat types (24).

APPENDIX 1

Important natural food plants needed to support orang utans and other wildlife
RECOMMENDATIONS for Habitat restoration projects

WHAT ORANG UTANS EAT IS RELEVANT TO MANY OTHER FOREST ANIMALS.

Many forest animals eat fruit when it is available. This includes small mammals, many birds, most primates, sun bears, and even elephants. However, orang utans are the largest primates in Bornean and Sumatran forests that depend on forest fruits when in season. Therefore, what orang utans eat is also relevant to the survival of many other forest animals.

MOST TROPICAL FOREST ANIMALS WHO EAT FRUIT ALSO DEPEND ON OTHER PLANT PARTS.

Animals that mostly eat plants are known as herbivores. Herbivores are sometimes sub-classified as those that are more fruit-eating (frugivores) or more leaf-eating (folivores). However, fruit is a seasonal resource, so it is not always available. Therefore, most tropical forest frugivores rely on other plant parts as well. Some animals, including a few types of primates, particularly macaques, eat a broader range of food. They are known as omnivores, compared to the stricter plant-eaters (herbivores), meat (carnivores) or insect-eaters (insectivores).

ORANG UTANS AND MANY OTHER FOREST SPECIES:

- **Require different plants to provide food and shelter**
  Many animals, including orang utans, require a variety of plants to ensure a balanced diet. Wild orang utans studied for over 25 years in Kinabatangan consume various parts from at least 3-15 different genera per day, depending on the season (Oram, 2018). Therefore, to account for seasonal variation in plant-producing cycles and adequately meet nutritional needs, a diversity of species is required to provide food all year-round. Animals also require trees to provide shelter. In the case of orang utans, they require taller stable trees of at least 15-20 m as nest sites.

- **Depend on a various plant parts**
  For example, even though 60% of the overall orangutan diet in Kinabatangan and throughout their range consists of fruits that supply energy, they rely on young leaves and shoots (pucuk) for essential protein and consume these other plant parts daily (Oram, 2018). Orang utans also extract the sugars and minerals from the vascular layer (cambium) beneath the outer bark of trees and woody lianas. This is likely used as an energy source when the fruit is less available. Orangutans also eat flowers and insects (termites and ants).

- **Rely on food sourced from native lianas (woody vines) as well as trees**
  In addition to trees, about a third of the orangutan diet in Kinabatangan is from vine sources (Oram, 2018). Vines are usually more widely distributed and often fruit in less synchronised patterns than trees. These characteristics make vines especially beneficial when overall forest size is greatly reduced. Lianas are also an underappreciated food resource for many other tropical forest animals in Sabah, from birds to elephants. - About a third of the orangutan diet in Kinabatangan is from vine sources (Oram 2018). Vines are especially important as they are well distributed and often fruit in less synchronised patterns than many trees. This is especially important when the forested landscape is greatly reduced in overall size and highly fragmented. Lianas are also an underappreciated food resource for many other tropical forest animals in Sabah, from birds to elephants.

- **Do not depend on commercial timber species as food sources**
  To provide adequate habitat enrichment for most wildlife species; commercial timber species must not be overrepresented. These generally slow-growing species contribute little to support wildlife in the critical early stages of habitat restoration work. Also, non-native timber varieties, being introduced species, are not relevant for use in replanting projects aimed at habitat restoration to support natural-occurring local wildlife. Orang utans use native timber species for nesting, but only if they are above 15-20 m tall. Therefore, the value of timber species in restoration schemes is longer term.

- **Given the above, to achieve habitat restoration that truly provides resources useful to wildlife:**
  - ✓ Only native plant species should be used in habitat restoration projects if the goal is to support native wildlife.
  - ✓ Growing appropriate native trees and lianas is more important than just planting them.
  - ✓ Monoculture plantings of a single genus and/or species are not recommended.
  - ✓ Planting a wide variety of native plants of documented use to local wildlife is recommended.

CHALLENGE

Throughout the PONGO Alliance – Kinabatangan project, we found a limited range of natural species in most plant supply nurseries. We found that some of the reasons for this were a lack of knowledge of what would be useful to wildlife and a lack of skill to identify, source and grow a more comprehensive variety of native species.

RECOMMENDATION

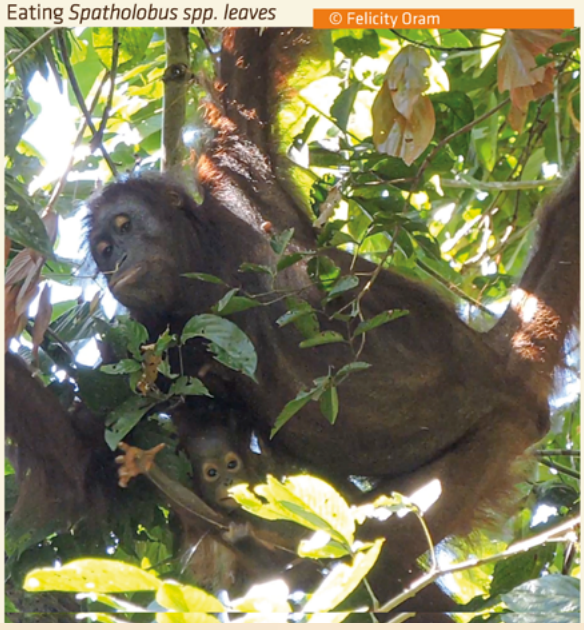
The following table lists recommended native plants for habitat restoration based on a PhD synthesis of 22 years of orangutan feeding ecology data in Kinabatangan (Oram, 2018). The list consists of plants that are consistently and most frequently relied on by orang utans locally. However, this is only a partial list of all the over 300 plant varieties orang utans use locally. Though this study focused on orang utans, we selected those relevant to other forest wildlife based on our observations over time.

This list below aims to serve as a starting point to broaden the range of native species diversity in reforestation projects.

	Scientific	Malay	Type	Notes
1.	*Spatholobus* spp. Leguminosae	Akar remus	liana	This genus is the most commonly consumed plant by orang utans in degraded habitat (Kinabatangan) and primary forest (Danum Valley). This is also an underappreciated food source for other animals as well from birds to elephants.
2.	*Ficus* spp. Moraceae	Kayu aru	tree and liana (hemi-epiphyite)	Especially *F. benjamina* (Waringin) because it is used even more often for feeding on young leaves than for seasonal fruit, and *F. racemosa* * (Tangkol merah) though slow growing is a riparian edge specialist species. There is one Ficus species that is NOT consumed by orang utans or any other primates, *Ficus abgyramidata* locally known as Tangkol hijau. The only animal species observed to eat *Ficus abgyramidata* is the Flying fox (*Pteropus* spp). However, because this soecies is a common ornamental or perhaps because it is confused with Tangkol merah, it is planted in restoration sites.
3.	*Diospyros* spp. Ebenaceae	Kayu malam	tree	Orang utans consume many species. *Diospyros elliptifolia* - kayu malam kulit nipis is especially good as it is quicker growing than some others and will grow in more swampy areas
4.	*Dracontomelon* spp. Anacardiaceae	Sengkuang or Assam - Assam	tree	Top exclusively fruit source for orang utans *D. costatum* (smaller fruits) and *D. dao* (larger fruits) are consumed in Kinabatangan
5.	*Neolamarckia cadamba* Rubiaceae	Laran	tree	This quick growing species is not only important as a food source (fruit, cambium) it is the most preferred nesting tree species for orang utans in degraded habitat so it is of key value to restoration
6.	*Xanthophllium* spp. Polygalaceae	Minyak beruk	tree	Leaves, shoots and fruits are consumed
7.	*Lophopyxis maingii* Celastraceae	Akar tatu	liana	Leaves, shoots, fruits and cambium are consumed
8.	*Gnetum gnemoides* Gnetaceae	Akar Gnetum	liana	Fruits, leaves, shoots and cambium are consumed.
9.	*Eugenia cerassifimis* (is just one of many) Myrtaceae	Obah merah	tree	Fruits in order of frequency consumed – Obah merah > Obah putih > Obah nasi Obahs generally fruit at least once a year in the degraded forests of the Kinabatangan. Note: Obah jangkang (*Syzgium fastigiatum*) is often found in nurseries but it is not as important a food species for orang utans– Obah jangkang is used as a nest species, however. *Giochidion borneensis* - fast growing and and will grow near rivers, but not in standing water
	Dimorphocalyx murinus (is just one of many) Euphorbiaceae	Obah putih	tree	
	Giochidion borneensis Phylianthaceae	Obah nasi	tree	
10.	*Nauclea orientalis* Rubiaceae	Bangkal daun besar	tree	Many community nurseries do stock Bangkal daun besar. This species does well when in flood prone areas based on HUTAN experience. The other two Bangkal species at left do not do as well Bangkal daun besar in flooded areas.
	Nauclea sabdita Rubiaceae	Bangkal Ais Krem/Bangkal Kuning	tree	
	Ludikea borneensis Rubiaceae	Bangkal Merah	tree	
11.	*Bauhinia borneensis* Leguminosae	Akar Tapak kerbau	liana	Leaves, shoots, fruits, cambium are consumed.
12.	*Symplocos fasciculate* Symplocacea	Jiak	tree	Leaves, shoots, fruits, flowers - this is one of the few species that orang utans have been observed to also eat mature leaves
13.	*Bridelia stripularis* Eurphorbiaceae	Balatotan	liana	Fruits, leaves, flowers are consumed.

	Scientific	Malay	Type	Notes
14.	*Madhuca* sp *Pauteria cf malaccensis* - Sapotaceae	Nyatoh Nyatoh tipu	tree	Fruits, leaves, cambium are consumed.
15.	*Pterospermum elongatum* Malvaceae	Bayur	tree	This species is not much used as a food source by orang utans but it along with Laran the predominate nest species selected by orang utans in degraded habitats - since orang utans spend up to 11 hours a day in a nest in a tree this species is an critical component to effective habitat restoration for them.
16.	*Cananga odorata* Annonaceae	Bunga gadong	tree	Fruits and leaves are consumed.
17.	*Entada reheedii* Leguminosae	Akar Bantal Pipit	tree	Seeds - often found on river banks are consumed.
18.	*Dimocarpus longan* - (besar) *Dimocarpus fumatus* - (kecil) Sapindaceae	Mata Kucing	tree	Fruits and cambium are consumed.
19.	*Sandoricum koetjape* Meliaceae	Sentul Hutan	tree	Fruits are consumed.
20.	*Microcos crassifolia* Tilaceae	Kerodong damaak damak	tree	Fruits are consumed
21	*Uvaria surgonensis* Annonaceae	Akar pisang-pisang	liana	Fruits are consumed.
22.	*Maranthes corymbosa* Chysobalanaceae	Bengkawang	tree	Flowers are consumed
23.	*Mallotus muticus* Euphorbiaceae	Mallotus Paya	tree	Fruit, leaves, cambium are consumed
24.	*Colona sirratifolia* Tiliaceae	Lamba	tree	Cambium is consumed - This is also a species that grows readily in flooded areas. It is used sometimes as a nest species.
25.	*Vitex Pinnata* Lamiaceae	Kulimpapa	tree	Fruit and flowers are consumed
26.	*Poikilospermum* sp Urticaceae	Seringkalang	liana	Fruit, leaves, flowers, cambium are consumed

Eating *Spatholobus spp. leaves* © Felicity Oram



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