Conservation Malaysia
Issue No 30 (2019)
A Bulletin Supporting Plant and Animal Conservation in Malaysia
ISBN 1823-7975

Managing Production Forest of Peninsular Malaysia

Through Intensive Forest Management

Wan Mohd Shukri Wan Ahmad (shukri@frim.gov.my), Samsudin Musa & Nur Hajar Zamah Shari

INTRODUCTION

Malaysian forests have been acknowledged to be amongst the most complex ecosystems and species-rich communities in the world (Whitmore, 1984). The flora is estimated to comprise 7500 species of seed plants, of which 4100 are woody species. Malaysia has relatively large tracts of natural tropical forests that are rich in timber and other forest products. Consequently, the timber and timber products industries are very important contributors to Malaysia's economy. As Malaysia is one of the major global suppliers of hardwood products, these forests are expected to continue to provide raw materials required by its forest industries.

Malaysia is at a cross roads in terms of its timber supplies. Currently, almost all timber supplies from natural forests come from the second or third cut production forests, which are less productive and contain fewer commercially valuable species. This situation is exacerbated by the increasing need to protect the environment and high compliance standards for forest certification. Also, management of production forest faces many challenges in meeting sustained yield requirements, while maintaining environmental stability and protection of biodiversity. Although plantation forests are able to provide greater timber yields, the conversion of natural forest to plantation forest is not encouraged.

Currently, in Peninsular Malaysia, all the inland dipterocarp forests are managed under the Selective Management System (SMS) (Wan Mohd Shukri *et al.*, 2007). In this respect the production forests within the Permanent Reserved Forest are managed based on a selective felling system with a 30-year cutting cycle. The SMS involves the selection of a management (felling) regime based on inventory data instead of arbitrary prescription, which is equitable to both logger and forest owner, while ensuring ecological balance, environmental stability and quality (Thang,1987).

HOW DID THE INTENSIVE FOREST MANAGEMENT (IFM) CONCEPT ARISE?

In a small experiment conducted on the forest stands in FRIM (Forest Research Institute Malaysia), it was estimated that the potential stocking of trees >40 cm dbh for Kapor (*Dryobalanops aromatica*), Meranti tembaga (*Shorea leprosula*) and Keruing (*Dipterocarpus* spp.) were 132, 102, and 96 trees ha^{-1}, with an average volume of 350, 300 and 290 m^3 ha^{-1}, respectively. The high volume was attributed to the good tree heights and high stocking of the final crop. Under intensive tree farming, a 300% to 500% wood yield can be realised (as indicated by the forest plantations at FRIM).

This finding prompted us to take a second look at our stocking standards used in SMS. The current required minimum stocking standard of 32 trees ha^{-1} for the residual stand with an expectation of 25 trees ha^{-1} at final crop far exceeds the potential capacity of the stand to yield the desired timber in terms of yield and composition for the next rotation. Hence, intensive forest management (IFM) was introduced. This concept has been tested in Tekai-Tembeling Forest Reserve (FR), Jerantut, Pahang, and currently in Besul FR, Terengganu, under collaboration with the State Forestry Department.

WHAT IS IFM AND WHY IFM?

IFM ensures that total yield from the production area is maintained sustainably, management of the forest simplified, and greater protection given to conserving biodiversity and the environment. The underlying concept of IFM is to manage about 30% of a production forest for timber with the remaining 70% managed for non-timber products and services including water, carbon, herbal medicines and eco-tourism (Figure 1). The 30% set aside for timber production will be managed intensively, similar to plantation forestry, based on a 15-year rotation for fast-growing species and a 30-year rotation for slower growing species of high commercial value. The total yield and commercial benefit of managing the 30% through IFM is expected to be higher than that of managing 100% of the area under the current SMS.

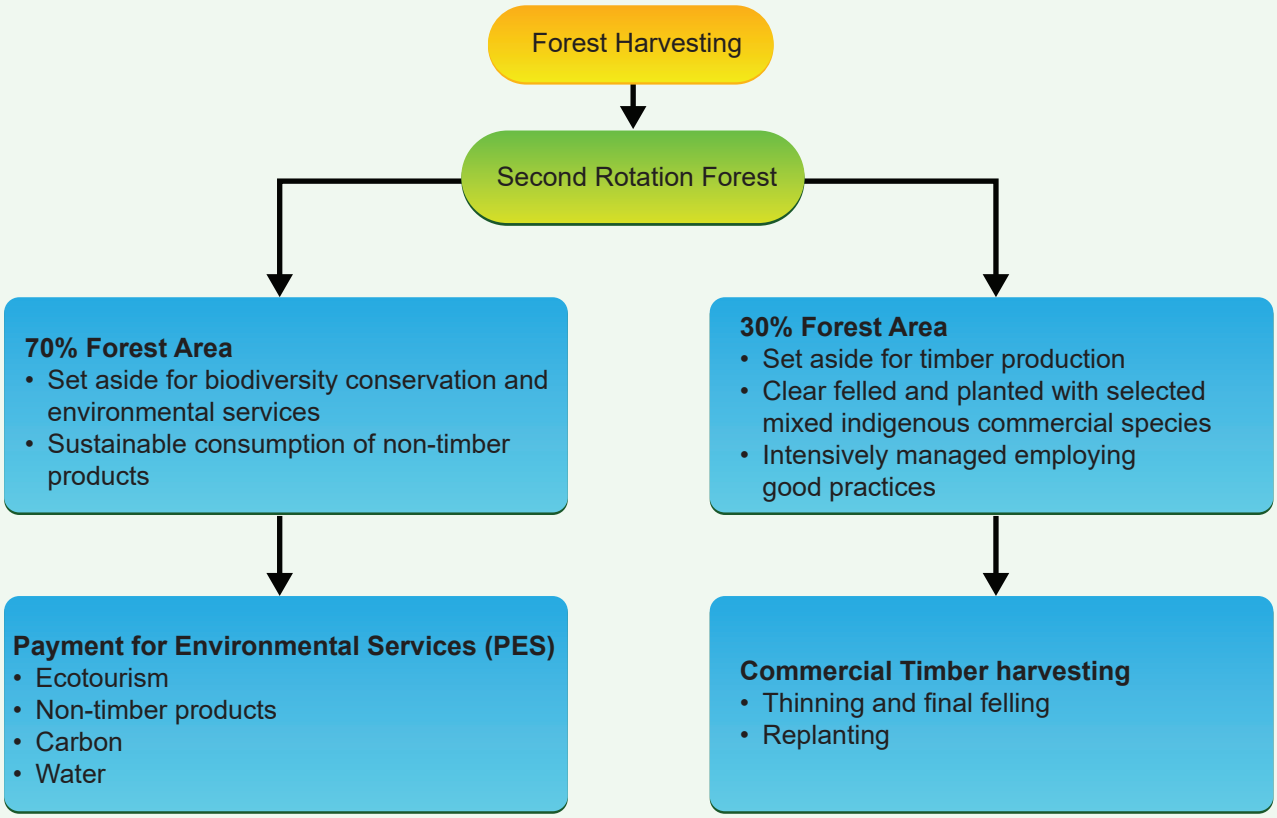


Figure 1: Intensive Forest Management Concept

Another benefit of IFM is that wood production from the production forest can be tailored for sustainable and timely supply of adequate volume of specific timber species, to the targeted wood based industrial mills. These measures will provide for the long-term sustainable development of these industries in the State, thus providing steady revenue to the State government. In addition, the job opportunities created will further support development in the State.

Through IFM less overall disturbance to the stand is expected in the long run as the disturbed area can be fixed at 30% and determined from the beginning compared to that under SMS which is reported to be around 40-50% (Chung, 1992), and which changes with each cutting cycle. IFM is also better in addressing issues related to forest resilience such as genetic erosion resulting from removal of the best trees, and changes in species composition and forest structure. We hope that this new management technique can be tested in other areas and compared with the current management practice to select the best management approaches that comply with international standards of sustainable forest management.

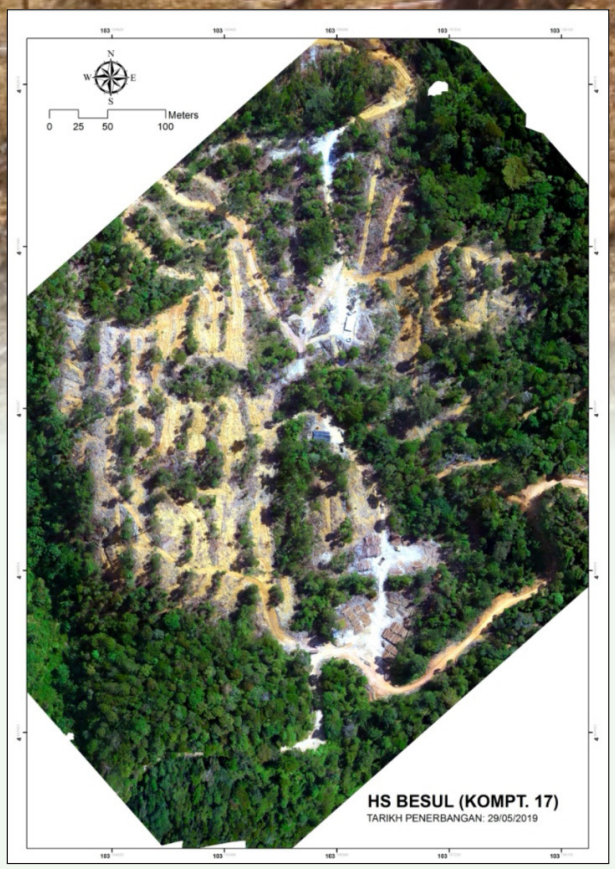
References:

Chung KS. 1992. A case study of the effects of silviculture treatments in Tropical Rainforests in Malaysia. *Proceedings of the Symposium on Harvesting and silviculture for sustainable forestry in the tropics,* pp. 15-23.

Thang HC. 1987. Forest Management Systems for the Tropical High Forests, with special reference of Peninsular Malaysia. *Forest Ecology and Management* 21:3-20.

Whitmore TC. 1984. *Tropical Rain Forests of the Far East*. (2nd edition). Oxford University Press, Oxford. 352 + xvi pages.

Wan Mohd Shukri WA & Wan Juliana WA. 2007. Impacts of the Selective Management System to the residual stand: a re-look at the management prescriptions. Pp. 226-228 in *Prosiding Kolokium Siswazah ke 7*. 26 June 2007, UKM Bangi.



Intensive Forest Management: Site preparation and planting of 48,000 saplings at a distance of 3m x 4m in Besul Forest Reserve (70 ha).

Monitoring plant growth after 3 and 8 years at Compartment 89B, Tekai-Tembeling (Tambahan) Forest Reserve (21.5 ha) where 18,000 saplings were planted. Depending on species, the average survival rate was 90% with a diameter growth of between 1.2 and 2.5 cm per annum. Among species planted at both study sites were *Dipterocarpus costulatus, Dyera costulata, Dryobalanops oblongifolia, Neobalanocarpus heimii, Shorea acuminata, S. leprosula, S. parvifolia* and *S. sumatrana.* The project targets to produce about 138 m^3 ha^{-1} and 450 m^3 ha^{-1} of commercial timber at the end of 15- and 30-year rotation periods, respectively.

Insect visitors of Beluno (*Mangifera caesia*) flowers in Sabah

Arthur Y.C. Chung (arthur.chung@sabah.gov.my), Deirdre M. Tann & John L. Yukang

Mangifera caesia Jack is a wild mango species from the family Anacardiaceae. Locally known as 'beluno', it is distributed in Peninsular Malaysia, Sumatra and Borneo. The tree is found in lowland mixed dipterocarp forests up to 400 m in altitude, often on alluvial soil. This deciduous tree with a large crown can usually grow up to 40 m in height. It fruits heavily almost every year and the sour variety is usually eaten as 'sambal' (Lamb, 2019) or with 'sambal'. During flowering, the whole tree is distinctively covered with lilac coloured inflorescences. This was observed in early June 2019 on two densely flowering beluno trees at the Gum Gum Forest Plantation Station, Mile 16, Sandakan, Sabah. Although much research has been conducted on insects pollinating cultivated mango, *M. indica* (e.g. Singh, 1989; Nurul Huda *et al*., 2015; Ramirez & Davenport, 2016), there is no information on insects visiting beluno flowers. Hence, this survey was carried out to observe insects that were attracted to beluno flowers. All photographs were taken using a mirrorless camera, Olympus OM-D E-M1 Mark II, with a 75-300 mm lens.

Field observations indicated that blooming of mango flowers peaked between 0900 and 1100 hours (Nurul Huda *et al*., 2015). From our one-week daily daytime observations (from 0900 to 1000 hours), more than 20 species from various insect orders were recorded visiting beluno flowers. They included Lepidoptera (butterflies and moths), Diptera (flies) and Hymenoptera (ants, bees and wasps). Butterflies spotted fluttering among the flowers were *Papilio demoleus* (Lime Butterfly), *Hypolimnas bolina* (Great Eggfly), *Moduza procris* (Commander), *Athyma nefte* (Colour Sergeant), *Junonia iphita* (Chocolate Pansy), *Cupitha* sp. (Dart) and two unidentified lycaenid butterflies (Blues). Of these, *H. bolina* and *J. iphita* were more frequently seen visiting the flowers. Two day-flying moth species were also sighted, namely *Dysphania transducta* (Geometridae) and *Aethaloessa calidalis* (Crambidae).

Flies were the most abundant insect group visiting beluno flowers. They were seen in almost all inflorescences. Bluebottle flies of the genus *Chrysomya* were frequently encountered. The house fly, *Musca domestica*, was also sighted but was not as abundant as the former. Nurul Huda *et al*. (2015) highlighted that flies are the most important pollinators for *M. indica*. Large-sized flies, such as *Chrysomya* spp., visited the flowers more than other insects and these flies were found to be effective pollen carriers. Hence, it was not surprising that they were also the most significant pollinators for *M. caesia*.

The common weaver ants, *Oecophylla smaragdina*, were spotted foraging on a few of the inflorescences. Although they don't fly, they move diligently from one inflorescence to another in search of nectar. Hence, they could be important pollinators too. A few wasp species were also sighted hovering among the flowers and most of them were solitary. Stingless bees and honey bees (*Apis cerana*) were seen as well although they didn't occur in high abundance compared to the bluebottle flies.

This brief survey has provided a glimpse of some of the insects visiting beluno flowers which had not been documented previously. It also highlights the importance of certain insects in beluno pollination, especially the bluebottle flies.

Acknowledgements

We thank Lenim Jamalung and Yusof Wahab for information on the beluno trees at the plantation station. Chris Bloom and Ashley Shaji kindly identified the Crambidae moth.

References

Lamb A. 2019. *A Guide to Wild Fruits of Borneo*. Natural History Publications (Borneo), Kota Kinabalu, Sabah. 296 pp.

Nurul Huda A, Che Salmah MR, Abu Hassan A, Hamdan A & Abdul Razak MN. 2015. Pollination services of mango flower pollinators. *Journal of Insect Science*15(1): 113. doi: 10.1093/jisesa/iev090.

Ramirez F & Davenport TL. 2016. Mango (*Mangifera indica* L.) pollination: a review. *Scientia Horticulture* 203: 158-168.

Singh G. 1989. Insect pollinators of mango and their role in fruit setting. *Acta Horticulturae.* 231: 629-632.

Part of a densely flowering beluno tree in Gum Gum Station, Sandakan with lilac coloured inflorescences.

Chrysomya sp.
(Diptera, Calliphoridae)

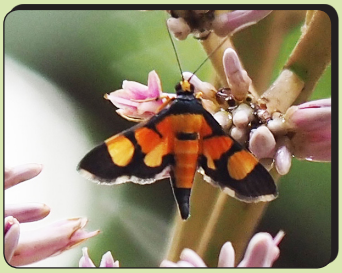
Hypolimnas bolina
(Lepidoptera, Nymphalidae)

Moduza procris
(Lepidoptera, Nymphalidae)

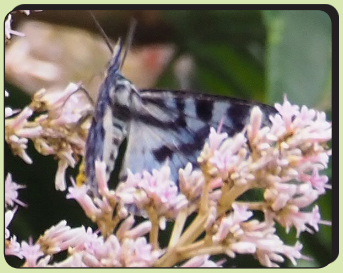
Cupitha sp.
(Lepidoptera, Hesperiidae)

Athyma nefte
(Lepidoptera, Nymphalidae)

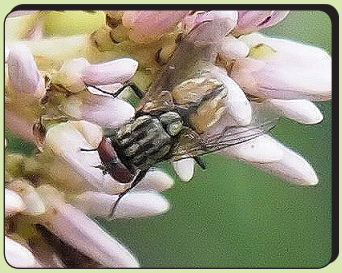
Papilio demoleus
(Lepidoptera, Papilionidae)



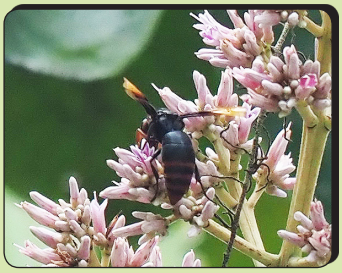
Aethaloessa calidalis
(Lepidoptera, Crambidae)



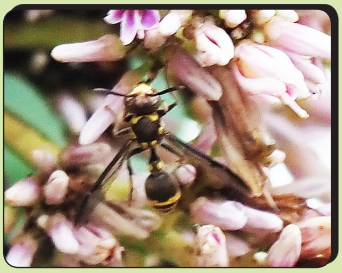
Dysphania transducta
(Lepidoptera, Geometridae)



Musca domestica
(Diptera, Muscidae)

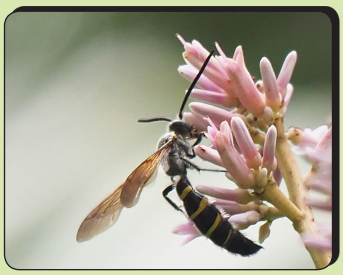


Vespa sp.
(Hymenoptera, Vespidae)



Ropalidia sp.
(Hymenoptera, Vespidae)

Heterotrigona itama
(Hymenoptera, Apidae)



Unidentified
(Hymenoptera, Tiphiidae)

Unidentified
(Hymenoptera, Vespidae)

Oecophylla smaragdina
(Hymenoptera, Formicidae)

Welcoming a New Butterfly to FRIM:

The Malayan Birdwing

Chooi-Khim Phon (phonchooikhim@frim.gov.my), Veronica Khoo, Laurence G. Kirton

About 2 weeks before Christmas 2018, our newly propagated *Aristolochia foveolata* vine in FRIM received a guest. It was just after our lunch break on a sunny day. While the second author was parking her car, the first author spotted a partly eaten leaf on the vine growing on a pergola. Our curiosity and a little bit of intuition led us to check out the vine. Upon closer inspection, we saw a 2- to 3-cm long, dark brown caterpillar with some orange coloured tubercles (soft tube-like filaments), hiding under one of the leaves near the partly eaten leaf.

Both of us were very excited, as we had never seen this caterpillar before. We took the caterpillar to our laboratory, did a literature search and then consulted a butterfly enthusiast — C.Y. Chong, who has a good library and vast experience with butterflies. Initially, we suspected it to be the caterpillar of the Rajah Brooke's Birdwing (*Trogonoptera brookiana*), because this birdwing caterpillar feeds solely on *A. foveolata*. However, Mr. Chong pointed out that the caterpillar we had collected didn't have the pale saddle-like mark of the Rajah Brooke's Birdwing. After checking a reference book on Birdwings authored by Matsuka (2001), Mr. Chong confirmed that our caterpillar was that of the Malayan Birdwing, *Troides amphrysus ruficollis*, which is a beautiful, large black-and-yellow butterfly with a red collar on the upperside of its thorax. This was the first time a Malayan Birdwing caterpillar had ever been found in the grounds of FRIM!

However, this encounter with the Malayan Birdwing was not the first time that we had seen the species on the FRIM campus; an adult male was observed near the same pergola by the first and third authors several weeks earlier on 5th November 2018. It was flying around this and another pergola and had landed a few times. We snapped some photos from a distance with our smartphones, and the photos were just about clear enough for us to identify it as a Malayan Birdwing.

The caterpillar we collected was in its third instar, an instar being the period (or stage) between each shedding of its skin that enables the caterpillar to grow. We bred it in captivity in our laboratory at a temperature range of 24–26 ℃. Initially, it walked in a peculiar jerking manner from the tip of the leaf that we provided, towards the stalk. We are not sure why it behaved in this manner, which it did only once, but perhaps it was because of the sudden change of environment. As the caterpillar grew and moulted, it became very selective in its diet. It preferred to eat stems rather than leaves. When it fed on leaves, it only chose certain leaves of mixed ages and fed near the stalk. It had a peculiar behaviour of cutting off all the leaves from the stem. The caterpillar behaved as if it was trying to kill its own food source! We were unsure whether it fed on the leaves before or after cutting them off. This leaf cutting behaviour was unusual in that it was much more pronounced than we had seen in two similar species, the Common Birdwing, *Troides helena*, and the Golden Birdwing, *T. aeacus*.

In Sumatra, the Rajah Brooke's Birdwing, *Trogonoptera brookiana trogon*, behaves in a similar manner (Straatman & Nieuwenhuis, 1961; d'Abrera, 1975). The final instar of this birdwing bites through the petioles of all the leaves from the top of the shoot downwards to about one meter, so that the leaves fall to the ground. The caterpillar then crawls back up to the shoot and chews the shoot downwards to the base where the green stem meets the hardened main stem (Straatman & Nieuwenhuis, 1961; d'Abrera, 1975).

On New Year's Eve, the caterpillar we collected pupated on the lower part of a stem of its provided host plant. After 3 weeks, an adult male Malayan Birdwing emerged. It was preserved and kept in the FRIM Entomological Reference Collection as a new record. In September 2019, we found caterpillars of the Malayan Birdwing feeding on a vine of *Aristolochia acuminata* that has been growing since 2010 near the recently planted *A. foveolata*.

J.D. Weintraub, in a personal communication with the late J.N. Eliot, said that the Malayan Birdwing feeds on several *Thottea* species in Peninsular Malaysia (Corbet & Pendlebury, 1992). In Borneo, the Malayan Birdwing is said

to feed on *Aristolochia tagala* (now known as *A. acuminata*) and *A. foveolata* (Igarashi & Fukuda, 1997). In Singapore, it is said to feed on *A. acuminata* (Khew, 2015). In FRIM, the Malayan Birdwing has been found feeding on both host plants growing about 20 metres away from each other. Both plants are woody climbers. The Rajah Brooke's Birdwing and the Malayan Birdwing seem to share *A. foveolata* in the wild and may compete for the same food resource, at least up to mid-elevations where both species co-exist.

Four species of black-and-yellow birdwings are recorded in Peninsular Malaysia, namely the Common Birdwing (*Troides helena*), Golden Birdwing (*T. aeacus*), Malayan Birdwing (*T. amphrysus*) and Great Mountain Birdwing (*T. cuneifer*) (Corbet & Pendlebury, 1992; Kirton, 2014). The first three birdwings are frequently found in forests in the lowlands and foothills, while the Great Mountain Birdwing, as the name implies, occurs only in highland forests. The Common Birdwing is sometimes found in montane forests too and may even occur in parks and gardens near forest (Kirton, 2014). With the arrival of the Malayan Birdwing in FRIM, three out of the four black-and-yellow Peninsular Malaysian birdwings have now been recorded and found breeding in FRIM's grounds (FRIM, 2016). The sole exception is the montane Great Mountain Birdwing. We are still awaiting the day when a magical moment will happen: to have our 'national butterfly,' the black-and-green Rajah Brooke's Birdwing, breeding in FRIM. We never thought that *A. foveolata* would attract a new birdwing other than the Rajah Brooke's Birdwing. The Malayan Birdwing is indeed a welcome new butterfly to FRIM!

Life history, from the day of collection on 14th December 2018	
Day 1	A caterpillar in its third instar was collected and raised in the laboratory.
Day 3-4	The caterpillar moulted into the fourth instar (by the morning of the 4th day).
Day 7	The caterpillar, with its head retracted, measured 3.8 cm in length.
Day 8	The caterpillar moulted into the fifth and final instar in the early morning hours, its head initially light yellowish brown. The head colour changed to black a few hours later, and by evening the larval skin had been consumed.
Day 11	The length was measured as 6.0 cm.
Day 13	The length was 7.5 cm. In the morning, the caterpillar started to behave as if it was preparing to pupate, wandering around in the breeding box, and ceased to feed.
Day 15	The caterpillar evacuated fluid from its body.
Day 16	A girdle was observed around its thorax, and by midday the caterpillar had attached itself to a stem.
Day 18	The pupa was observed on the lower part of the stem in the early morning, measuring about 5.5 cm long. Pupation very likely occurred on Day 17.
Day 42	The pupa darkened slightly before dawn and at 9.35 a.m. an adult male emerged.

Duration of the different stages: 4th instar — 4 to 5 days, 5th instar — 9 to 10 days, pupal period — 24 to 25 days. Adult wing length — 7.4 cm.

Acknowledgements
We thank Mr. Raymond Lim from Nature Science Malaysia for his horticultural help and advice. We also thank Mr. Chong Chow Yang for his willingness to share his knowledge and for helpful comments. We are grateful to Mr. Yao Tze Leong for confirming the plant species and providing information on host plants. Our sincere thanks also to Messrs. Nafaruding Che Nan, Shaiful Amri Mohd Som and Noor Baihaky Che Jamaludin from the Entomology Branch of FRIM for their assistance in rearing the caterpillar and in photography.

References

Corbet AS & Pendlebury HM. 1992. *The Butterflies of the Malay Peninsula*. Fourth Edition. Revised by Eliot JN. Malayan Nature Society, Kuala Lumpur. 595 pp.

D'Abrera B. 1975. *Birdwing Butterflies of the World*. Lansdowne Press, Melbourne. 260 pp.

FRIM. 2016. Bringing Back Swallowtails. Forest Research Institute Malaysia, Kepong. 8 pp. (Also available in Malay as, "Kembalikan Kupu-kupu Swallowtail").

Igarashi S & Fukuda H. 1997. *The Life Histories of Asian Butterflies*. Volume 1. Tokai University Press, Tokyo. 549 pp.

Khew SK. 2015. *A Field Guide to the Butterflies of Singapore.* Second Edition. Ink on Paper Communications Pte. Ltd., Singapore. 375 pp.

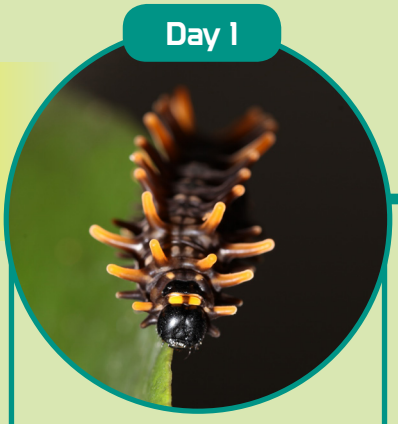
Kirton LG. 2014. *A Naturalist's Guide to the Butterflies of Peninsular Malaysia, Singapore and Thailand*. John Beaufoy Publishing Limited, England. 176 pp. (2nd edition published in 2018 as "A Naturalist's Guide to the Butterflies of Malaysia — Peninsular Malaysia, Singapore and Southern Thailand").

Matsuka H. 2001. *Natural History of Birdwing Butterflies*. Matsuka Printing Co., Tokyo. 368 pp.

Straatman R & Nieuwenhuis EJ. 1961. Biology of certain Sumatran species of *Atrophaneura*, *Trogonoptera*, and *Troides* (Lepidoptera, Papilionidae). *Tijdschrift voor Entomologie* 104(3): 31–41.

The Life Cycle of the Malayan Birdwing

Day 1



Third instar caterpillar with orange-tipped tubercles. Some tubercles were fully orange.

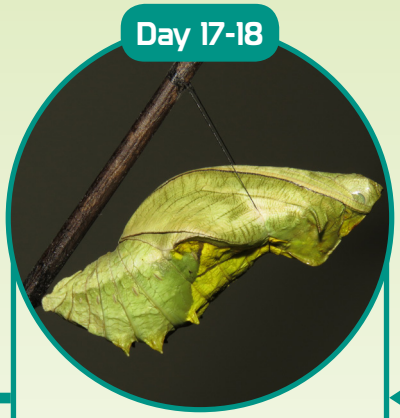
Day 3-4

The orange colour of the tubercles became less apparent in the 4th instar; the tubercle tips became dull yellowish orange.

Day 8

The last instar turned into a darker brown colour. Some tubercle tips remained a non-contrasting shade of dark orange-brown.

Day 17-18



The pupa, in shades of green, was attached to the lower part of a stem and supported by a silken girdle.

Day 42

The freshly emerged male rested on the stem to pump body fluids into its wing veins to expand the wings fully. It did not fly until the wings were fully hardened.

Remnants of leaves and a stem that had been fed on by the caterpillar. Some leaves were little eaten except for the stalks and regions near the midribs.

We welcome articles on new research information on flora or fauna and discussions related to biodiversity or conservation. Please send articles to:

The Editor,
Conservation Malaysia Bulletin,
Forest Research Institute Malaysia,
52109 Kepong, Selangor.

(attn: Dr. Lillian Chua, lilian@frim.gov.my).

Conservation Malaysia is published twice a year and hardcopies are free upon request. Please contact The Editor for queries or comments. Past issues are available at: https://www.mybis.gov.my/one/publication.php?menu=27&g=1. Funded by the Ministry of Water, Land and Natural Resources. Editorial team: Dr. Lee Su See, Dr. Lillian Chua and Dr. Chan Yoke Mui.