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Rare & Endemic Plants

Jewel in the Crown of Gunung Tahan

Towering to 2,187 m above sea level, Gunung (G.) Tahan (4° 38' N, 102° 14' E) is the highest peak in Peninsular Malaysia. It sits on a sandstone plateau ridge that is the watershed of two major rivers, Sungai Kelantan to the north and Sungai Pahang to the south. G. Tahan is located in the Taman Negara National Park, formerly known as King George V National Park.

Glimpses of G. Tahan's rare and narrowly endemic plants.

G. Tahan is home to many endemic species–on two recent trips, we recorded 39 species at its summit plateau and ridges. Twelve of these are hyper-endemic and confined to G. Tahan, these include *Begonia longicaulis* and *B. rheifolia* (Begoniaceae), *Rhododendron seimundii* (Ericaceae) and *Tristaniopsis fruticosa* (Myrtaceae). Another six species are confined to two localities in Peninsular Malaysia. For example, *Agathis flavescens* (Araucariaceae) and *Ilex tahanensis* (Aquifoliaceae) are confined to G. Tahan and the neighboring G. Rabong in Kelantan. Species such as *Medinilla scortechinii* (Melastomataceae) and *Korthalsella dacrydii* (Viscaceae) are found only at G. Tahan but they also occur in other countries.

▲ *Nepenthes gracillima* (Nepenthaceae) is one of the most conspicuous and eye-catching plants in the Padang scrubland. Elsewhere, this endemic species has only been recorded from G. Tapis in Pahang. As far as the eye can see, thousands of slender white pitchers dot the waist-high shrubby Padang vegetation, creating speckles of colour in the heath vegetation.

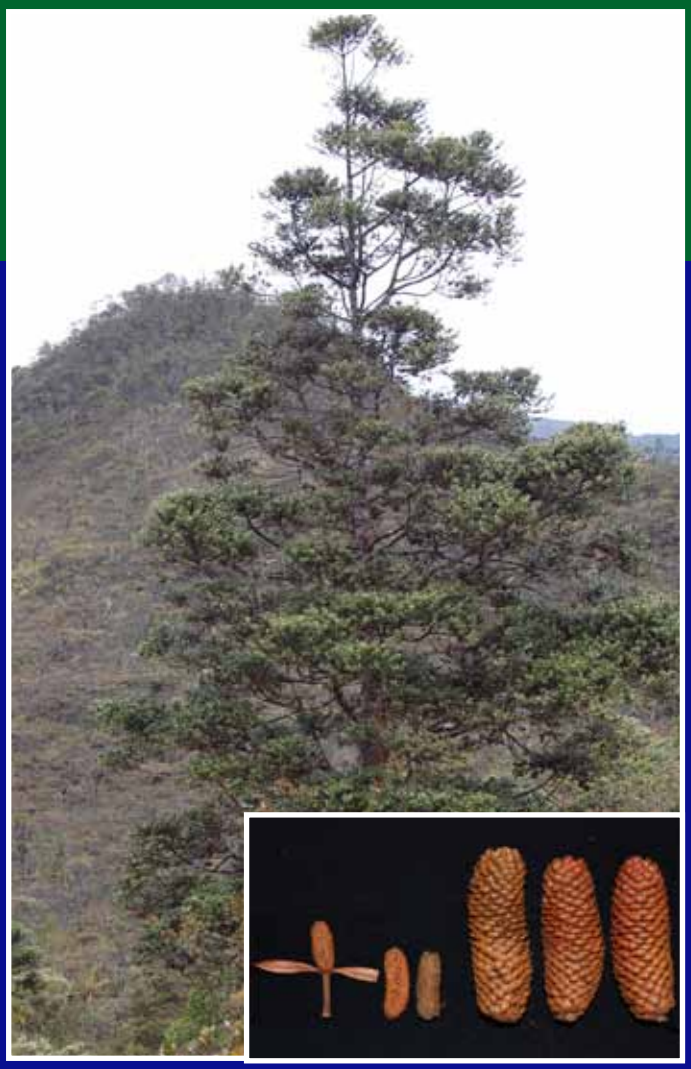
▲ *Begonia longicaulis* (Begoniaceae) with delicate pink flowers makes its home on the two highest peaks in Peninsular Malaysia, i.e., G. Korbu, Perak, and G. Tahan. At G. Tahan, it lives in deeply shaded slopes covered with loamy soil in deep gullies.

▼

▲ *Utricularia vitellina* (Lentibulariaceae) is another montane herbaceous species with a peculiar two-location distribution on G. Korbu and G. Tahan. In Padang Woods, a heavily-wooded riverine area on the pleateau of G. Tahan, it carpets shaded stream-beds. During the flowering season, the plants produce bursts of golden yellow flowers.

▲ *Livistonia tahanensis* (Palmae) is confined to exposed ridges at 1,100–1,400 m a.s.l. between Tangga Lima Belas and Pangkin camps. This garden of *L. tahanensis* is dominated by plants growing up to 8 m tall, with large, often-overarching, umbrella-like fronds shimmering in the sun providing essential shade to the understorey flora.

Giant in the kingdom of hobbits, *Agathis flavescens* (Araucariaceae) towers to an average height of 10-15 m among the low shrubby Padang vegetation and the ridges of G. Tahan. The species is only known from G. Tahan and G. Rabong, Kelantan, earning it a Rare category in the Malaysia Plant Red List. On G. Tahan, it (inset, left) co-exists with its closest relative, *A. borneensis* (inset, right). However, populations of both species do not overlap as *A. flavescens* is only found above 1,500 m while the latter is found below 1,100 m altitude. It has a Rare (RA) category in the Malaysia Plant Redlist.



Despite being locally abundant on mossy mounds along the quartzite ridge of Tangga Lima Belas, *Codonoboea rubiginosa* (Gesneriaceae) is highly localised. As an adaption to harsh, exposed conditions, its leaves are thickly leathery and covered with a thick layer of hairs that prevent moisture loss.

Codonoboea leucocodon (Gesneriaceae), so-called for its white bell-shaped flowers ("*leucocodon*"), is locally common on partially exposed to shaded niches on the Padang. It adorns the main trail with hundreds of little white bells during the flowering season in May.

Eriocaulon hookerianum (Eriocaulaceae) with its long-stalked inflorescence on tufted leaves is often seen in damp crevices on the Padang. In Malaysia, the only other place where this species occurs is G. Kinabalu.

Korthalsella dacrydii (Viscaceae) is a dwarf hemi-parasitic mistletoe only found on G. Tahan. It photosynthesizes but is dependent on the host plant *Dacrydium* for water and mineral nutrients. Reaching a maximum length of 3.5 cm, it stays hidden amidst the needle-like leaves of its host. Not surprisingly, it is rarely collected by botanists except for the determined ones who will need to hunt through each and every branch looking for this "hidden treasure".

The riverine lowland fringing Sungai Tahan and Sungai Teku habour the endemic *Rafflesia cantleyi* (Rafflesiaceae). Buds in varying developmental stages are common along the main trail, but sighting one in full bloom requires some luck. The cabbage-like bud goes through a nine-month gestation period before developing into a 45 cm flower that lasts between 3 to 5 days.

The rosette dark green leaves of *Tristaniopsis fruticosa* (Myrtaceae) subtending a cluster of glossy red fruits rivals a carefully arranged floral bouquet. This is another attractive bush endemic to Padang.

Bearing snow-white petals with red-tipped stamens, the large, almost 3.5 cm flowers of *Rhododendron seimundii* (Ericaceae) claim a place among the showy denizens of the Padang. This beautiful bush is a narrowly endemic species confined to G. Tahan only.

The richness of its flora makes G. Tahan a unique area within the Malay Peninsula floristic zone. In terms of conservation value, the intact stretch of protected forest ranging from the lowlands to montane habitats including the limestone hills nestled in between is invaluable. G. Tahan and its forest area totaling 4,343 km^2 have been conserved since 1938, long enough to guarantee the survival of many rare and endemic plants.

By Mariam Jutta (waldelf@gmail.com)

Cycad *ex situ* conservation – do weeny weevils hold the key?

Joseph Dalton Hooker is credited with being the first researcher to suggest that cycads must be entomophilous (Pearson, 1906), a notion picked up by Pearson himself during observations on African cycads around the turn of the 19th century. However, despite these records cycads were believed to be primarily anemophilous until recent research confirmed entomophily, with beetles and small bees the core pollinating agents (Oberprieler, 2004). Odour production in cones and the fact that cycad pollen is heavy with only limited capacity for wind dispersal (an observation already made by Pearson) more than support the argument for entomophily.

Weevils belonging to the families Erotylidae and Curculionidae constitute the main pollinating agents in Asian *Cycas* (Oberprieler, 2004; Tang *et al*., 1999), forming intimate and frequently highly specific relationships with the host plant. Mounting evidence points to each species of cycad having its own co-evolved weevil symbiont. Recent studies in weevil phylogeny show host specificity common in various weevil lines where taxon groups are restricted to particular host groups (Anderson, 1993; Marvaldi *et al*., 2002).

Cycad weevils appear to complete their entire lifecycle on male cycads with occasional 'pollen cargo' missions to female plants, with olfactory signalling playing an important role (Schneider, 1999). Adult beetles feed on pollen and cone tissues, deposit their eggs into developing somatic male cone tissues that also nourish the developing larvae (Fig. 1), and spend diapause on or close to the plant. The simple rule in this relationship is: no weevils – no pollination; no pollination – no seeds; no seed – no plant recruitment; but equally: no (male) cycad(s) – no weevil... effectively closing the cycle of interdependence between the two partners.

This intimate association between plant and pollinator explains the consistent failure of cycads in *ex situ* cultivation to independently produce viable seed; it may, however, also prove an unexpected ally in changing this "no go" *status quo* to the opposite. Bound to the host plant throughout their short lifecycles - feeding, breeding, reproducing and overwintering – beetles may well stay with an *ex situ* conservation planting once a population is successfully established. Observations on *Zamia furfuracea L.* indicate that beetle pollinator populations (here accidentally introduced with the wild-collected original plant materials) can be independently sustained in sufficiently large *ex situ* stands of cycads (Norstog *et al*., 1986) once established. The presence of several male cycads in an *ex situ* collection is important as these constitute the primary symbiotic partner. An *ex situ* collection of a minimum of 8-10 equally male and female adult plants may well be sufficient to maintain a healthy pollinator population as well as the production of viable seed material with a measure of genetic diversity.

Timing may present the biggest challenge in establishing an *ex situ* weevil population. Weevils need to be collected (preferably with their male host cones) from *in situ* male plants, and introduced to a coning *ex situ* male plant. The best time for this may need to be determined, but could well be during early development stages as this is when weevils oviposit into microsporophyll tissues to reproduce, and the male cycad produces the characteristic odours that serve as biochemical attractants for the weevils.

The successful establishment of *ex situ* pollinator populations together with their hosts may facilitate long-term independent production of viable seed material. Such seed stocks can then be applied in artificial recruitment, improvement of germplasm in other *ex situ* collections and reintroduction protocols to depleted natural localities, all without compromising existing wild populations.

References:

Anderson, R.S. (1993). Weevils and plants: phylogenetic versus ecological mediation of evolution of host plant associations in Curculioninae (Coleoptera: Curculionidae). *Memoirs of the Entomological Society of Canada* 125: (165)197-232.

Marvaldi, A.E., Sequeira, A.S., O'Brien, C.W. & Farrell, B.D. (2002). Molecular and morphological phylogenetics of weevils (Coleoptera, Cucurlionoidea): do niche shifts accompany diversification? *Systematic Biology* 51(5): 761-785.

Norstog, K.J., Stevenson, D.W. & Niklas, K.J. (1986). The role of beetles in the pollination of *Zamia furfuracea* L.fil. (Zamiaceae). *Biotropica* 18(4):300-306.

Oberprieler, R.G. (2004). "Evil weevils" – the key to cycad survival and diversification? Lindstrom JA. (ed.) *The Biology, Structure and Systematics of the Cycadales.* Proceedings of the Sixth International Conference on Cycad Biology, Thailand. pp.170-194.

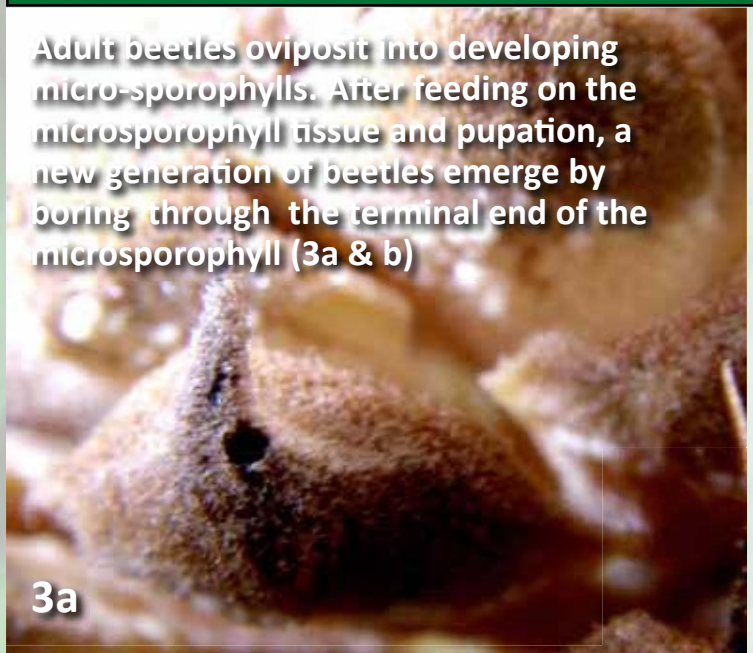
Pearson, H.H.W. (1906). Note on the South African cycads. I. *Trans. S African Philos.* Soc. 16: 341-354.

Schneider, D. (1999). Cycads - Palmferns - and their Insects (Herbivores and Pollinators). Oral presentation: *The 6th ESITO (European Symposium for Insect Taste and Olfaction,* Tutzing, Germany, 1999.

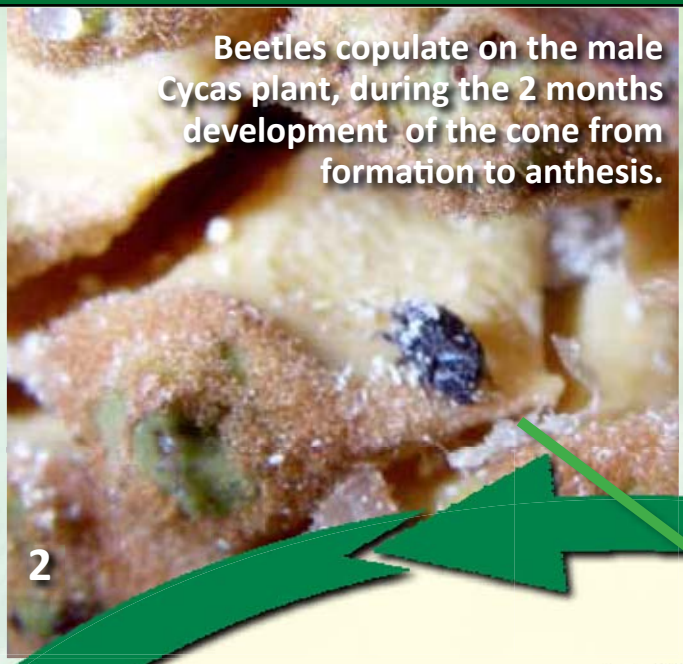
Tang, W., Oberprieler, R.G. & Yang, S.L. (1999). Beetles (Coleoptera) in cones of Asian *Cycas*: diversity, evolutionary patterns, and implications for *Cycas* taxonomy. Chen CJ. (ed.) *Biology and Conservation of Cycads.* Proceedings of the Fourth International Conference on Cycad Biology (Panzhihua, China). International Academic Publishers, Beijing, pp 280-297.

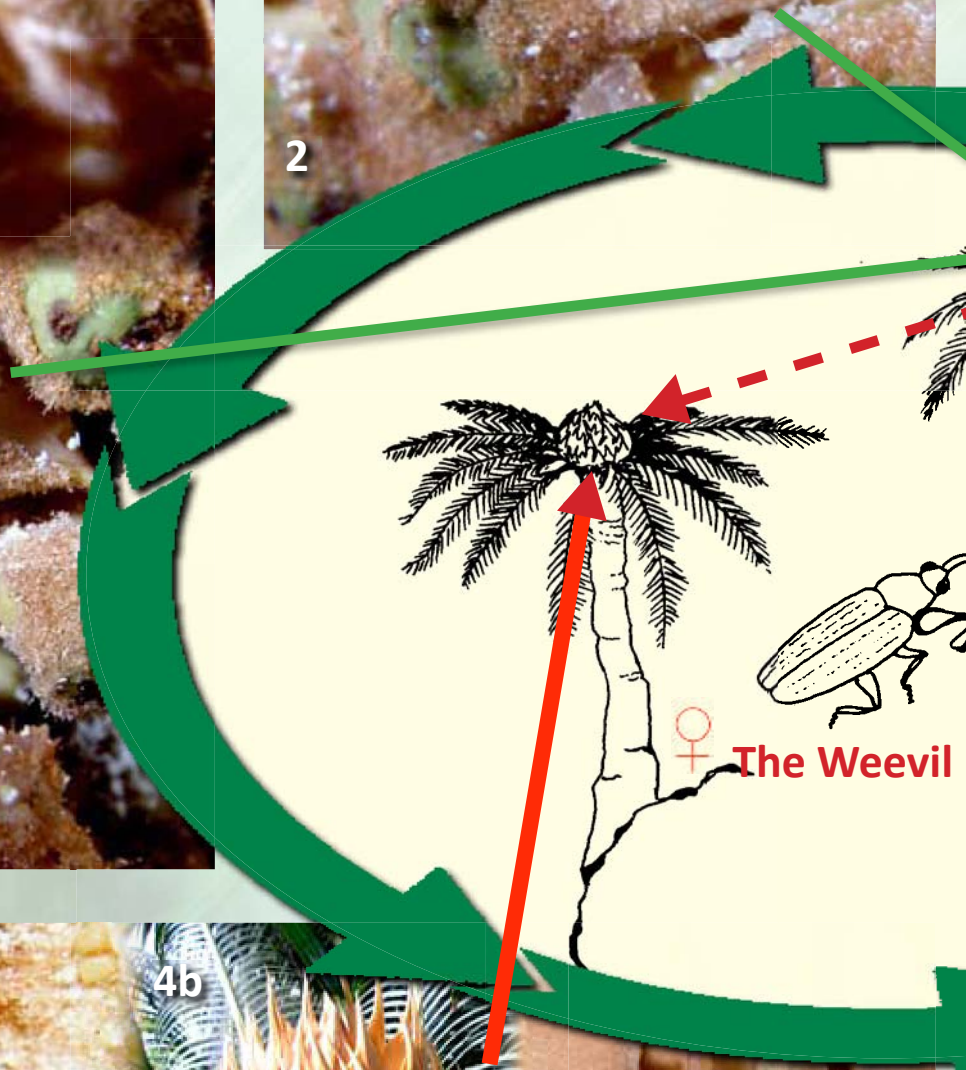
Cycas wee

Adult beetles oviposit into developing micro-sporophylls. After feeding on the microsporophyll tissue and pupation, a new generation of beetles emerge by boring through the terminal end of the microsporophyll (3a & b)



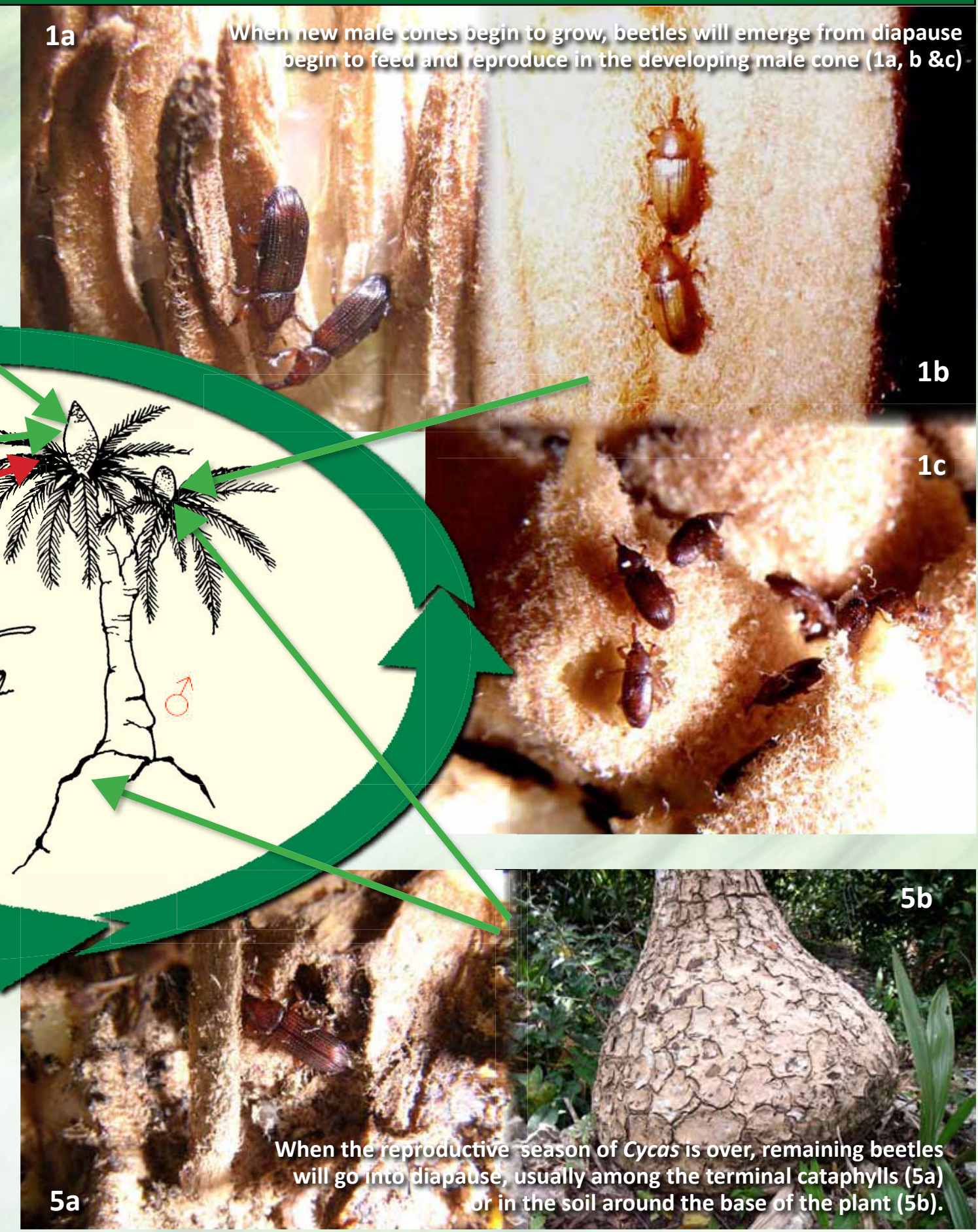
Beetles copulate on the male Cycas plant, during the 2 months development of the cone from formation to anthesis.





Visits to female plants by pollen-covered beetles (4a) effect pollination of the receptive ovules (4b) on a young female cone (4c)

vil lifecycle



Macrofungi of

Gunung Senyum Recreational Forest (RF) is located about 40 km from the town of Temerloh, Pahang. Officially opened in 1989, the 800 hectares complex lies in the Jengka Forest Reserve and is a favourite weekend recreational site. Visitors can surely recall the unique karst formation of G. Senyum, Gua Angin (*Angin* Cave), G. Jebak Puyuh, Gua Ular (*Ular* Cave) and many others apart from activities such as jungle trekking and enjoying nature.

These limestone hills, aged over 240 million years, are surrounded by a vast landscape of oil palm plantations. G. Senyum can be reached by road from Jengka 24 and Jengka 25, two of the many Federal Land Development Authority (FELDA) settlements. G. Senyum is located opposite the park office, whereas G. Jebak Puyuh is another 3.5 km walk. Both hills, and the numerous caves, are surrounded by freshwater swamp which is regularly flooded by the overflowing of rivers; inundation frequently happens during the monsoon season between October and February. Due to poorly drained soils, small ponds persist around the base of the hills even during drier months. In Peninsular Malaysia, this complex is perhaps one of the very few examples of freshwater swamp nested within the greater expanse of limestone. How the vegetation both inside and outside these hills are affected by the collective interactions of calcareous and peat elements remains anyone's guess.

Floristically, the vegetation surrounding G. Senyum and G. Jebak Puyuh has freshwater swamp features. Dipterocarps that typically reach main canopy height such as *Hopea sublanceolata, Shorea assamica* and *S. maxwelliana* are found here, but much smaller in size compared to those in the lowland forest. *Barringtonia* and the stilt-rooted *Dillenia* trees are abundant while herbaceous plants do not thrive here. Weather data gathered since 1982 from the nearby Batu Embun Meteorological Station show a monthly mean rainfall of 177 mm. In comparison, Taiping, the wettest town in Malaysia, receives 334 mm monthly.

In contrast, the limestone caves support plants that are restricted to limestone habitats and this includes several hyper-endemic species. Around and in the cave valleys are stands of smaller plants mostly herbs. Soil in a limestone forest contains a large amount of carbonaceous and argillaceous impurities derived from calcium carbonate and, to a lesser percentage, dolomite. Crevices support a variety of plants because of the litter accumulation. Extremely rare and endemic species are found here such as *Senyumia minutiflora* (see series No. 11, 2010), *Impatiens ridleyi* and *Sauropus calcareous.* At the base of hills, trees such as *Diospyros cauliflora* and *Goniothalamus macrophyllus* are common. In preferred niches, a community of herbs which include *Epithema saxatile, Monophyllaea horsfieldii* and *Cytandra pendula* can be found.

Another interesting but not obviously conspicuous flora is the macrofungi. The lack of information spurred us to do a quick survey of the macrofungi that can be found in the caves and surrounding forest. The collections were grouped according to the substrate where they were collected. These are separately the swamp or limestone or both areas. Most of the collections made in the swamp were collected close to the foothills. The majority grew on roots of trees or fallen rotting trunks, branches and twigs. Many of them are saprophytes and some are pathogens of trees. Most belong to the Basidiomycota while a few belong to the Ascomycota. These polypore and agaric macrofungi play an important role as litter decomposers and promote nutrient cycling in the forest. Examples of common species found here are *Ganoderma australe* and *Microporus xanthopus.*

Ganoderma australe

Ganoderma australe (Ganodermataceae) is a common species with a wide distribution in temperate and tropical areas. At G. Jebak Puyuh, it mostly grows on large, fallen tree trunks. In the lowland forests and plantations, however, it thrives on living, but old or declining trees and decaying wood and stumps. *Ganoderma australe* can attack dead heartwood and living sapwood causing white rot, a term depicting the white colour of the wood after degradation of lignin and cellulose from the cell wall. Nevertheless, it has antibacterial and antifungal properties.

Microporus xanthopus

Microporus xanthopus (Polyporaceae) is widely distributed in the paleotropics and prefers growing on small twigs and dead branches. At G. Senyum, and Jebak Puyoh, it was often found in clusters although occasionally a single fruiting body was produced.

Microporus species are highly variable. The cap colour can range from reddish brown to dark brown in distinctly concentric rings.

Microporus, which is another white rot fungus is an important wood-decay fungus and acts as a primary decomposer. It is a potential source for enzyme production in biopulping, bioremediation and bioethanol production. The Food and Agriculture Organization (FAO) has also listed *Microporus xanthopus* as a wild fungus with medicinal properties. In Malaysia, some indigenous communities use this species, locally known as *cendawan pengering* (drying mushroom), to wean a child off breast feeding and to repel mosquitoes.

Apart from *Ganoderma* and *Microporus,* two species of *Polyporus* of considerable interest are also found at G. Senyum. *Polyporus tenuiculus* (Polyporaceae) causes white rot in dead hardwoods. It is an edible fungus having high fibre and protein content. This species is consumed by several ethnic groups in Central and South America but here in Malaysia, there is no record of it being eaten.

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Gunung Senyum


Polyporus tenuiculus

Polyporus cf. *grammocephalus* (Polyporaceae) has a short lateral stipe. It proliferates on decaying branches covered in humus in shady areas. It is another white rot fungus. The enzymes of *Polyporus* spp. are also used for decolorizing synthetic dyes in the textile industry.


Polyporus cf. grammocephalus

Amauroderma rugosum (Ganodermataceae) grows on both soil and decaying plant materials on the forest floor at the foothills of G. Jebak Puyuh. Its local name *cendawan budak sawan* aptly describes its use to reduce seizures and crying fits in children. Its hollow stem is threaded and worn as a necklace. Some *Amauroderma* species are eaten, for example, the fruiting body of *A. parasiticum*, while others have medicinal properties.


Amauroderma rugosum


Phellinus noxius

Phellinus noxius (Hymenochaetaceae), another woody polypore, grows on living trees in the limestone forest and flourishes in humid conditions. *Phellinus noxius* is pantropical and is a pathogenic fungus that causes brown root rot disease which may result in tree death. It is initially yellowish-white turning brownish-black with age.


Rigidoporus microporus

Rigidoporus microporus (Merilpilaceae) is a plant pathogen that causes white root rot and was found growing on fallen dead trunks in the limestone caves. In rubber plantations, *R. microporus* is a major disease pathogen.


Cookeina sulcipes

Cookeina sulcipes (Sarcoscyphaceae) is a common attractive cup fungus. As its name implies, the fruiting body of *Cookeina sulcipes* is cup-shaped, pinkish-orange with a short stalk. It is a wood-rotting fungus from the phyla Ascomycetes. The genus *Cookeina* is edible and is believed to have anti-cancer properties; in Peninsular Malaysia, the indigenous Temuan community consumes *Cookeina* and uses the cup as a fish bait.

Apart from polypores, other fungi such as *Auricularia* sp., *Marasmius* sp., *Filoboletus manipularis, Pleurotus pulmonarius* and *Oudemansiella canarii* were also collected in the limestone caves. Most of these are wood-inhabiting fungi.


Auricularia sp.

This jelly fungus, locally known as *cendawan telinga kera*, was found in the foothills near the swamp. *Auricularia* species commonly inhabit dead trees. In Sarawak, it is called *kulat kayu* (wood mushroom) or *kulat rendam* (soaked mushroom) and is sold in the markets. *Auricularia* species are widely cultivated, eaten and used as traditional medicine in Asia.

Marasmius sp.

Marasmius sp. (Marasmiaceae) grows amongst leaf litter in the limestone forest. They are litter-decomposing fungi, secreting enzymes that attack cell walls. *Marasmius* species have high levels of enzymes which catalyze the breakdown of lignin which can be utilised in biopulping, bioremediation and effluent biodetoxification.

Filoboletus manipularis

Filoboletus manipularis (Mycenaceae) is a tiny fungus with pores on its underside. It belongs to the order Agaricales and it grows gregariously on wood at the foothills of G. Jebak Puyuh. In the darkness of night, the luminous fruiting bodies produce a green fluorescent glow which is thought to attract spore-dispersing insects.

Pleurotus pulmonarius

Pleurotus pulmonarius (Pleurotaceae) is widespread in temperate and subtropical forests and is usually found growing on a variety of hardwoods. It grows on dead tree trunks and branches but rarely on living trees. Here it was found at the foothills on swampy ground. *Pleurotus* is saprophytic, sometimes behaving as a parasite. At the time of collection, *Pleurotus pulmonarius* was fruiting gregariously at G. Jebak Puyuh. It emits an odour that attracts insects especially flies to its fruiting bodies – this is believed to aid spore dispersal. Rich in protein, minerals and nutrients, several species, e.g., the oyster mushroom, are cultivated worldwide. Its polysaccharides xyloglucan and xylanprotein have anti-inflammatory and anti-tumor properties and are used to treat cancer.

Oudemansiella canarii

Oudemansiella canarii (Physalacriaceae) is saprophytic and degrades organic material. The cap is convex, pale cream and sticky. *Oudemansiella canarii* is edible and has anti-fungal and anti-microbial activities against pathogenic yeasts. It produces bioactive compounds such as strobilurin, oudemansin and ligninolytic enzymes that are widely used in the biodegradation of toxic compounds.

Towards Conserving RARE FERNS

By Joanne Tan (joannetan@frim.gov.my)

To the uninitiated, ferns may be regarded as boring weedy plants as they do not form pretty flowers or set fruits and, in many areas, aggressively carpet degraded areas, exposed slopes, buildings, oil palm trunks, drains, etc. These aside, ferns have a greater diversity in form compared to trees and herbs. They exhibit several different growth symmetries essentially either radially or tufted and have habits such as superficially palm-tree like, scandent vine, floating or submerged in water. Their leaves vary in shape, texture, venation, division of lamina, colour tone, thickness (thin, delicate filmy, one-cell thick to thickly leathery leaves). Together with different leaf arrangements and distribution of sori (spores in cluster), scales and hairs, ferns make excellent collage material and for use in horticulture and landscaping.

Adding to a bewildering array of reproductive strategies, ferns complete a life-cycle without producing flowers and fruits. This begins with the formation of spores on leaves. Upon landing on suitable sites, these spores germinate to produce tiny, filmy, green heart-shaped individuals known as gametophytes. The gametophyte then goes on to produce both sperms and eggs. The next process is, naturally, sexual fertilization but here water is required for successful fertilization. Fertilization will result in the formation of an individual technically known as a sporophyte, or simply, the fern that we are all familiar with.

This life history strategy is highly efficient and adaptive and hence the fern flora has many extremely local and endemic species with restricted distribution. For example, Pulau Tioman is home to two endemic tree fern species, *Cyathea tripinnata* and *C. oosora* (Cyatheaceae), and is the only known locality in Malaysia for *Tectaria zeilanica* (Aspidiaceae). Maxwell Hill was home to the now extinct *Grammitis crispatula* (Gramimitidaceae). *Calciphilopteris alleniae* (Pteridaceae) is restricted to the limestone hills of Perak and Selangor with a recent new record in Pahang from Bukit Sagu and Bukit Tenggek.

Two habitats in Malaysia are particularly rich in fern flora–these are the upper montane forests and limestone hills. Limestone hills are much valued for marble and are more vulnerable compared to upper montane forests, which are largely protected as watershed areas for water supply. Thus, it is species in this habitat that require man's intervention for successful conservation. To this end, a training course was organized by Cecilia Koo Botanic Conservation Center (KBCC), in Pingtung's Gaoshu Township in Taiwan. KBCC is actively pursuing ex situ conservation of tropical and sub-tropical plants and has more than 15,000 taxa of tropical plants in its collection of which more than 1,100 are fern taxa (Fig. 1).

The fern training course was held in October 2010 for South East Asian botanic garden researchers and horticulturists. The course offered introductory lectures and hands-on training in greenhouse planting practices, spore sowing, identification and field work. The primary aim of the course was to enable botanic gardens to successfully grow ferns in an *ex situ* environment. This would then aid the conservation of rare and endemic ferns.

Fig. 1 Fern collection at KBCC, Taiwan.

Fern spores are highly productive and relatively easy to grow. Although plants arising from spores require a longer duration to mature, spore germination is the most cost effective method for producing a large number of offsprings.

To collect spores, first lay a fertile frond on a sheet of clean paper with the sorus embedded surface facing down. Next, place another sheet of paper above the frond (Fig. 2). These sheets are lightly pressed between several layers of newspaper and cardboard and left to dry indoors for one to two weeks.

After about a week, you will see the spore print on the paper (Fig. 3). Carefully fold the paper, tilt it at a slight downward angle and tap gently at the crease with a pen. This will remove debris and sporangium capsules which contaminate spore germination (Fig. 4). The spores that remain lightly stuck to the paper should be stored in small air tight bottles, properly labeled with species name, locality and date, and stored in a cool dark place while awaiting sowing.

Fig. 2

Fig. 3

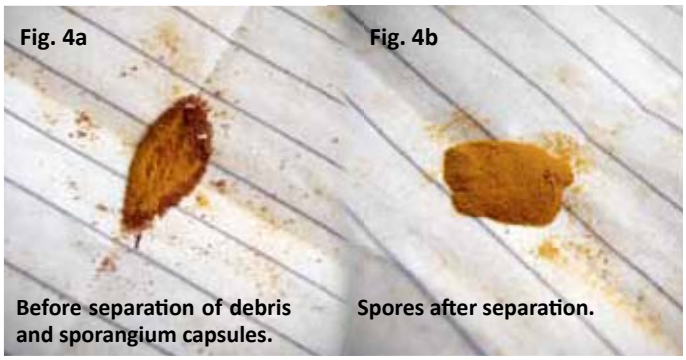

Fig. 4a

Fig. 4b

Before separation of debris and sporangium capsules.

Spores after separation.

The suggested spore growing media is a mixture of 2 parts vermiculite, 2 parts peat moss and 1 part perlite. The ideal growing container is a transparent PET plastic container without any holes; however, any other containers that allow light to penetrate, ensure high humidity and are tightly closed to prevent contamination can be used. Moisten the growing media with clean water and evenly sow spores on the growing media. Place the sown containers under bright cool conditions or on a windowsill with northern exposure.

The gametophyte can be observed as early as 10 days after sowing for some species, but a microscope is needed for this (Fig. 5). After two months, the gametophyte develops into a green heart-shaped membrane and this can be clearly seen under a 10-times magnifier (Fig. 6). Gently spray the gametophytes to supply moisture for the sperms to swim towards the eggs for fertilization. Thereafter young leaves of new fern plants can be seen with the naked eye (Fig. 7). Pot the new ferns once they are big enough to handle easily. Use potting media which retain moisture, avoid waterlogging and provide adequate nutrients. Potting mixtures which suit most terrestrial ferns consist of loam, charcoal and gravel; for epiphytic ferns a mixture of coconut husk chips and charcoal chips is preferable. Place the newly potted fern plant in shaded moist conditions or cover with a transparent plastic box for acclimatization.

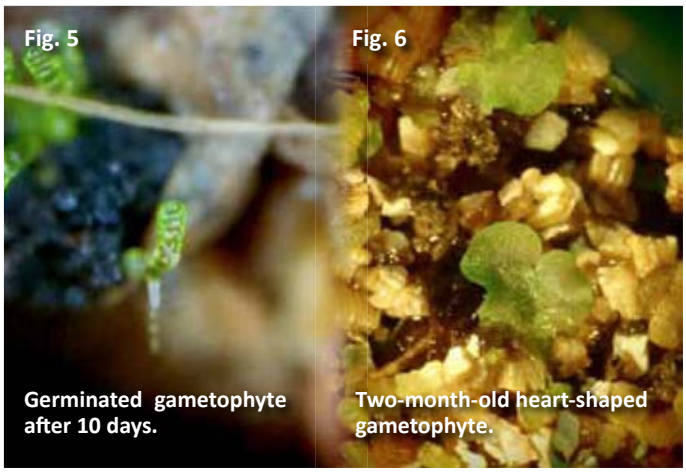

Fig. 5

Fig. 6

Germinated gametophyte after 10 days.

Two-month-old heart-shaped gametophyte.

Fig. 7

From left to right – the different stages of the gametophyte developing into the sporophyte.

Another method to propagate ferns is to collect young saplings if any, because saplings are easier to acclimatize when established away from their natural habitat, therefore lowering the mortality rate. Keep the collected planting materials in zip lock bags and plant them as soon as possible.

Many fern species can be easily propagated using rhizomes, e.g. *Diplazium* sp. (Figs. 8 & 9), *Asplenium* sp., *Microsorum* sp., etc. With a sharp knife, divide an elongated or creeping rhizome into a few cuttings (Fig. 8). To ensure high survival of cuttings, make sure that the cut pieces have at least 3 to 4 growing points. If the cutting is made in the forest, it is important to find the reproductive part and collect the right sections to minimize injury. Next, place the rhizome cuttings on moist but not wet planting mix consisting of peat moss, perlite, with coconut husk chips and charcoal chips. Place the cutting with buds or growing points pointing upwards. Slightly cover the rhizome but do not bury it as it will rot. Keep the cuttings well drained but moist and in shade. When sprouts appear and are growing well, the pot can be placed in a more exposed area.

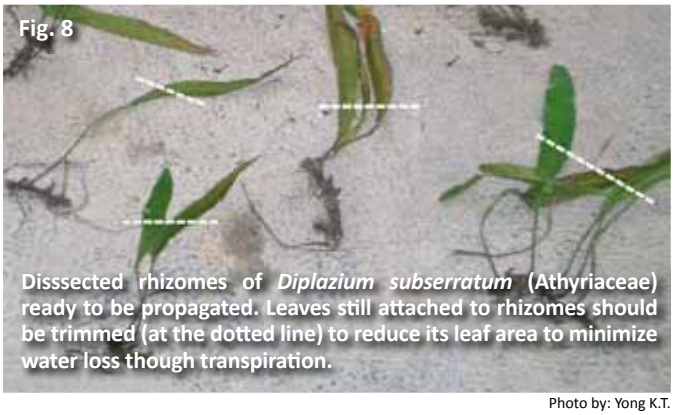

Fig. 8

Disssected rhizomes of *Diplazium subserratum* (Athyriaceae) ready to be propagated. Leaves still attached to rhizomes should be trimmed (at the dotted line) to reduce its leaf area to minimize water loss though transpiration.

Photo by: Yong K.T.

Layering is suitable for ferns with adventitious buds, for example, some *Adiantum* sp. (Adiantaceae) and *Lycopodium* sp. (Lycopodiaceae). Healthy adventitious buds with young growth can be pegged downwards into pots filled with planting mix. Suggested planting mix includes coconut husk chips, charcoal, tree bark chips, sand and perlite. Use bent wire to keep adventitious buds in contact with the planting mix. Usually after about 4 weeks, new roots will form and shoots will begin to grow. Then it's time to trim the new plant from its parent. This technique gives a high rate of success.

Besides roots, some species produce buds on the midrib of the lamina, for instance *Tectaria* sp. (Aspidiaceae) or pinnules on the upper surface, like *Woodwardia* sp. (Blechnaceae). Buds often grow into small plantlets while they are still attached to the parent. When these young plants have about 3 leaves, they should be removed for planting.

Fig. 9

Plantlets proliferate on leaf lamina of *Diplazium proliferum.*

The scale-like leaves of *Selaginella* (Selaginellaceae) can be easily propagated using leaves with a few branches (about 4 to 5 cm long) (Fig. 10). Place the leaf on moist planting mix or sand in an enclosed plastic container and place in a bright but not hot area. Water using fine mist daily until the underside of the leaf cutting has rooted.

Fig. 10

Rooted leaf cutting of *Selaginella intermedia* var. *intermedia.*

Calciphilopteris alleniae (Pteridaceae), a new fern record for Pahang, previously known only from the limestone hills of Perak and Selangor, rooted well using rhizome cuttings and produced newly coiled young leaves after one week in well-drained planting mix. This fern has thick, leathery, heart-shaped fronds attached to short black stipes and is fond of shaded areas in rock crevices (Fig. 11). This plant came from Bukit Tenggek, Pahang which is being extensively quarried. This is FRIM's first research attempt to rescue rare fern species from habitats that are severely threatened. Apart from being rare, *Calciphilopteris alleniae* struck us as being very pretty. Only time will tell whether this species warrants further work in domestication.

Fig. 11

Calciphilopteris alleniae growing in FRIM's nursery.

References:

Yesilyurt, J.C. & Schneider, H. (2010). The new fern genus Calciphilopteris (Pteridaceae). Phytotaxa 7: 52–59.

Piggot, C.J. (1988). Ferns of Malaysia in colour. Tropical Press, Kuala Lumpur.

Parris, B. S. (2010). Historry of botanical collecting and observations on ferns and lycophytes in Peninsular Malaysia in Parris, B.S., Kiew, R., Chung, R.C.K., Saw, L.G. & Soepadmo, E. (eds.) Flora of Peninsular Malaysia, Series 1: Ferns and Lycophytes, Vol. 1., Malayan Forest Records No. 48. Forest Research Institute Malaysia, Kepong, Malaysia. Pp. 25–35.

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