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Observations on Leaf Color, Epiphyll Cover, and Damage on Malayan Iguanura wallichiana

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Iguanura wallichiana (Wall. ex Mart.) Hook.f (formerly known as *I. geonomaeformis* Mart.) is a common palm throughout the lowlands of Malaya (Kiew 1972a, 1976) growing to about 2 m in height and bearing a crown of about seven to nine leaves.

A population of 18 plants of *Iguanura wallichiana* subsp. *malaccensis* (Becc.) Kiew in the Gombak Field Station, Selangor was observed over a period of 15 months and the age of leaves derived from weekly measurements of increase in length of the developing apical leaf until expansion, and the persistence of the old leaves on the stem (Kiew 1972b). Leaf production is regular and the average interval between leaf production is seven months, with a range of 5½–10½ months. The time span (plastochrone) between the emergence of the sword leaf (unexpanded leaf) and the expansion of the first leaf (leaf 1) was found to be seven months; successive leaves down the trunk are increasingly older by seven months, as shown in Table 1. This species of *Iguanura* has leaves which do not absciss but persist on the trunk until they rot. From the ninth leaf onward, the decaying leaves turn pale brown, droop but are still attached to the plant by the very fibrous leaf base. Eventually the lamina falls leaving the persistent leaf base. A few plants have up to 12 leaves in the crown.

To assess the increase with age in the amount of damage (including insect predation) and cover by macroscopic epiphyllae (lichens, algae, and bryophytes), a sample of ten plants was chosen at the Pasoh Forest Reserve, Negri Sembilan. A 10×10 cm grid of transparent plastic marked into 1 cm^2 squares was placed on one of each of the apical, middle and basal leaflets of each leaf in the crown and the percentage cover of the epiphyllae and the area of damage was estimated. Three types of damage were distinguished: 1) holes produced by falling twigs (these were large holes, wider than the space between two lateral veins, and in most cases the twig remained suspended in the hole); 2) small, almost circular holes (less than the width between the lateral veins) or small discrete brown patches attributed to insect damage; and 3) large irregular brown areas where the leaflet had lost its rigidity were attributed to fungal attack.

Color

The young leaves undergo a conspicuous color change; opening pale pink, rapidly becoming bronze-colored and, after about two weeks, turning bright rice green and finally, after another three weeks, turning dull green. During these five weeks the leaf increases in length by about 10 cm (Kiew 1972b).

Stone (1979) has suggested that the bronze color of the new leaves "mimics the drab color of dying or withered dead leaves" which he considers could be of adaptive value for avoiding predation from animals which rely on eyesight for recognition of suitable food plants. This is not supported by quantitative observations on *I. wallichiana* subsp. *malaccensis* (Table 1). The youngest leaf, whether a drab bronze color or conspicuously light green or dull green, does not show any damage. Significant damage (more than 5%) is observed in the sixth and lower leaves (which are about 3½ years old or older). The most common type of damage on the first six leaves is caused not by insect predation but by falling twigs which pierce the leaves. It seems more likely that the fibrous nature of the leaf rather than its color deters animal predation. The final necrosis of the lower leaves is caused by fungal attack.

1. First leaf (about 7 months old) of *Iguanura wallichiana* with lichen colonies.

Epiphyllae

A succession in the colonization of the macroscopic epiphyllae is conspicuous, beginning with lichens and algae, followed by bryophytes. Crustose lichens were more numerous than algae or bryophytes (Fig. 1, 2). Kappen (1973) reported there are 236 species of epiphyllous lichens (mostly crustose). Allan (1928 cited by Kappen 1973) recorded 45 different lichens on a large palm leaf in New Guinea. The two common macroscopic genera of algae in Malaysia both belong to the Trentopohliaceae (Tan 1976). One, *Trentepohlia* sp., produces a horizontal branched thallus attached to the edge of the leaf; the other, *Phycopeltis* sp., (Fig. 2) forms a dense round thallus up to 5 mm across on the upper surface of the leaf. Bryophytes include the leafy liverworts (Fig. 2), *Cololejeunea angulata* (Et.) Mizert, *C. floccosa* (Lehm. & Lindenb.) Schiffner var.

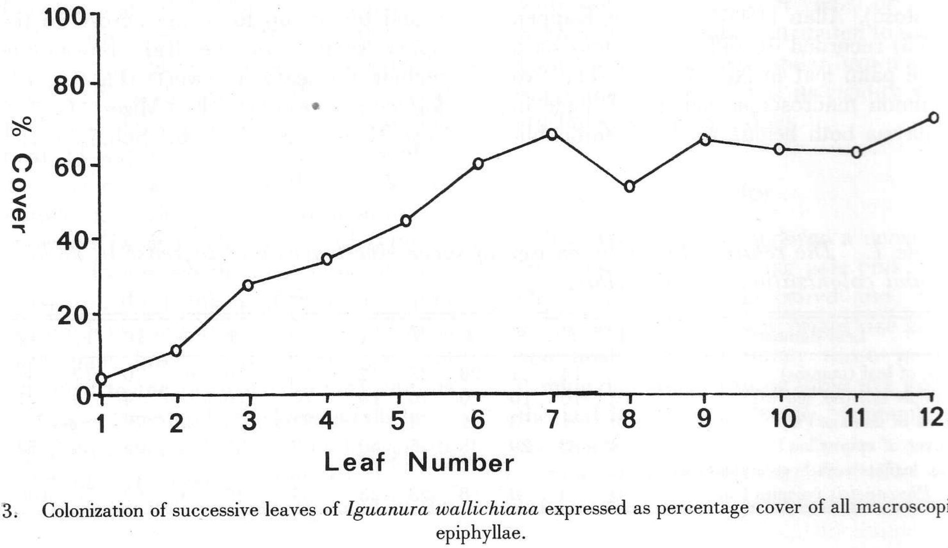
Table 1. The relationship between age of successive leaves and increase in damage and colonization by epiphyllae.

Leaf number	1	2	3	4	5	6	7	8	9	10	11	12
Age of leaf (months)	7	14	21	28	35	42	49	56	63	70	77	84
Sample size (no. leaves)	10	10	10	10	10	10	10	10	7	4	3	1
Area of damage (%)	0	½	3	½	4	5½	32½	25	45	78	dead	
Cover of epiphyllae (%)	2	12	29	35	45	60	68	53	67	65	64	73
No. leaflets with bryophytes and *Phycopeltis* colonies (%)	0	0	0	8	23	23	39	39	46	67	78	100

2. Old leaf (about 5 years old) of *Iguanura wallichiana* with lichen (L), bryophyte (B) and *Phycopeltis* (P) colonies.

aurita Benedix and less commonly *Drepanolejeunea spinistipula* Herzog which Dr. Masami Mizuntani of the Hattori Botanical Laboratory kindly identified.

Figure 3 shows that the percentage cover of living epiphyllae increases steadily with age up to the seventh leaf (about four years old), with an average of 68% cover, although initial establishment and/or growth is slow. After the seventh leaf, there is little increase and even a decrease in the percentage cover, which can be explained by the position of the leaf in relation to the amount of light it intercepts. The upper leaves are more or less horizontal and shade the lower leaves which probably retards the rate of growth of the epiphyllae. The importance of light for the growth of the epiphyllae is also shown by the difference between the percentage cover of epiphyllae on the apical leaflets (which are more exposed to light) than the middle and basal leaflets: 68% of the apical leaflets have more epiphyllae than the lower leaflets. Bryophytes and the discoid thallus of *Phycopeltis* are the latest to become established; they are apparently less affected by shading and



3. Colonization of successive leaves of *Iguanura wallichiana* expressed as percentage cover of all macroscopic epiphyllae.

their percentage cover of the leaf continues to increase with time, although the percentage cover for all epiphyllae is unchanged (Table 1).

Watson (1970) obtained similar results from another palm, *Euterpe globosa* Gaertn. in Costa Rica. He noted that lichens were more common on the first three leaves (up to 18 months old), but thereafter algae predominated. As in Malaysia, the common macroscopic algae included species of *Phycopeltis* and *Trentopohlia.* Bryophytes were less common. He counted the number of colonies rather than their percentage cover. This method showed the same broad results—the slow establishment on the first three leaves, a linear increase in the number of epiphyllous colonies from the third to the fifth leaf (aged 2½ years) followed by a decline as the lower leaves (up to 4 years old) are shaded by the upper. Epiphyllae succession on *I. wallichiana* is slower (6–7 years) compared with *E. globosa* (4 years).

Conditions of high relative humidity in the undergrowth of the tropical forest are important in supporting this flora of epiphyllae. In Costa Rica, Odum et al. (1970) recorded the relative humidity above the forest where *Euterpe globosa* grows as usually about 95% (with a range of 89–97%) with slightly higher values recorded within the forest. At Pasoh the relative humidity is usually above 95% and rarely falls to 90% (Aoki et al. 1978). Epiphyllae are able to grow in deep shade for at Pasoh at 4 m above the ground the average light intensity is only 1% of full sunlight (although the variance may be very great) (Yoda 1978).

Epiphyllae on *Iguanura* must be detrimental to the growth of the palm as they increase the shading of the palm leaves. The fifth leaf has almost half its surface covered by epiphyllae and this must seriously reduce the light penetrating the leaf for photosynthesis. The effective life of a leaf is probably about three years, during which it contributes as a photosynthesizing unit; after this (sixth leaf onwards) there is a noticeable increase in the amount of fungal damage which might indicate that the leaf is functionally dead. Senescence of leaves is marked by a loss of chlorophyll and protein (Baddeley 1971) and it is expected that the degree of shading by these epiphyllae will hasten the loss of chlorophyll. The rapid increase in damage from the sixth leaf onwards (which is caused mostly by fungi) could be caused by the increase of leachates from the senescent leaf which encourages the growth of saprophytic fungi (Kerling 1964 cited by Sinha 1971).

Against epiphyllae this species apparently has no defense such as hairs or an unwettable surface. It is noticeable that the algae and bryophytes tend to become established along the veins where water collects after rain. The steady increase in initial establishment of colonies on the leaf surface probably results from increasing deposition of propagules with time. For long-lived leaves, such as those of *Iguanura wallichiana*, epiphyllae are probably more damaging than is insect predation.

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PALM BRIEF

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Geonoma tenuissima*

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Geonoma tenuissima H. E. Moore, **sp. nov.**

Ab omnibus speciebus *Geonomae* foliis anguste cuneatis inflorescentiis latioribus quam longis rachillis tenuissimis alveolis bilabiatis remotis spiraliter dispositis differt.

Stems cespitose, slender, to ca. 1.8 m high, 0.6 cm in diam. Leaves undivided laterally; petiole 15 cm or more long, deeply channeled above, rounded beneath; rachis 25–31 cm long, rounded and glabrous beneath, angled above and margined toward base with translucent, glistening, mostly branched scales, the branches inflated distally; blade narrowly cuneate in outline, divided ca. ⅓ at the apex with acuminate lobes 14–15 cm long on inner margin, 11.2–12.8 cm wide at apex of rachis, primary ribs ca. 22 at an angle of 19–24° with the rachis. Inflorescences wider than long, paniculate, 16–20 cm long, 21–28 cm wide, glabrous, but all axes more or less minutely tuberculate; peduncle short, 2.4–3.2 cm long; prophyll and peduncular bract not seen; rachis 11–13 cm long, with ca. 13–16 branches, the lower 3 times branched into very slender rachillae ca. 0.5 mm wide, to 6.5 cm long, spinose-tipped, bearing widely dispersed pits in a spiral, the pits about twice as thick as rachillae, bilabiate, the lips entire, the orifice ca. 1 mm long and wide. Flowers tinged orange, ca. 1.5 mm long: staminate flowers with sepals ca. ¾ as long as petals; stamens 6, filaments spreading, locules borne at an acute angle with the filament, the sterile base short: pistillate buds acute; staminodial tube truncate. Fruit globose, blue-black at maturity, ca. 5 mm diam., not drying pebbled.

* This description was beside Hal's dissecting scope when he died in October 1980. He had asked for a photo (Fig. 1) of the specimen and the manuscript was marked for the printer. It is one of several of his unpublished papers that we have included in this memorial volume.—N. W. Uhl.