

THE APOCYNACEAE OF THE CROCKER RANGE NATIONAL PARK SABAH

David J. Middleton¹

ABSTRACT

The genera and species of Apocynaceae sensu stricto for the Crocker Range National Park in Sabah are presented. The taxa included are based on fieldwork done in the area plus an examination of the herbarium material in the major Malaysian, other Asian, European and American herbaria. A key to the genera for the whole of Borneo and keys to the species in the Crocker Range are given.

INTRODUCTION

The family Apocynaceae as currently recognised has 424 genera in five subfamilies: Rauvolfioideae, Apocynoideae, Periplocoideae, Secamonoideae and Asclepiadoideae. The last three subfamilies have traditionally been placed in the separate family Asclepiadaceae but this division into two families has become more and more untenable with increasing evidence (Endress & Bruyns, 2000). However, traditionally the two families have been studied separately with the result that our understanding of the species diversity in the two groups is quite uneven, particularly in Asia. In recent years many works have been published on the Apocynaceae *sensu stricto* (i.e. subfamilies Rauvolfioideae and Apocynoideae) by Ngan (1965), Leeuwenberg (1985, 1991, 1998), Beentje (1982), Rudjiman (1986), Sidiyasa (1998), Hendrian & Middleton (1999) and Middleton (1993, 1995a, 1995b, 1996a, 1996b, 1996c, 1997a, 1997b, 1999, 2000) with the result that accounts for Flora Malesiana and the Tree Flora of Sabah and Sarawak are well on their way to completion if one treats the Apocynaceae only in the traditional narrower sense. The "Asclepiadaceae" are much less well known and it will be some time before these can be completed for the two Floras and could be published separately at some future date as Apocynaceae part 2. The same holds true for an account of the family for the Crocker Range mountains. This account is for the Apocynaceae subfamilies Rauvolfioideae and Apocynoideae for which the information is available to publish this work. The remaining subfamilies are very poorly known and in need of much further work.

The species included in this account are those that were found in the Crocker Range by David Middleton, Stuart Davies and Swee Peck Quek as part of the Crocker Range Expedition organised by Sabah Parks in October 1999, and those observed by the author in Malaysian and international herbaria as having been collected in the area. Species descriptions have not been given but should be identifiable from the keys. As this area has not been well surveyed in the past there are undoubtedly species occurring there which are not yet known. For this reason, and because one does not already exist, the key to the genera includes all the genera occurring in Borneo rather than just those known from the Crocker Range. The species lists contain some taxa which have not yet been collected in the Crocker Range but the probability that they occur there is rather high (these are marked with an asterix). Species which may or may not occur are

discussed in notes. Rather more taxa are known to occur on Mt. Kinabalu which has been better explored. It may well be expedient to first check those taxa listed in the forthcoming inventory of the Apocynaceae for Mt. Kinabalu (Beaman & Middleton, *in press*) when taxa collected in the Crocker Range cannot be keyed out from this account. Also literature citations to revisions can be found in the references at the end for some of the genera not yet collected at all from the Crocker Range. The generic descriptions given apply to the genera only as they are found in Borneo. This is particularly true of *Alstonia* and *Alyxia*.

THE APOCYNACEAE

Trees, shrubs or climbers, rarely herbs; latex present. *Leaves* simple; opposite or, more rarely, verticillate or spirally arranged. *Inflorescence* cymose, rarely fasciculate or solitary; terminal or axillary. *Flowers* hermaphrodite; 5-merous, rarely 4-merous (in *Leuconotis*); actinomorphic or, very rarely, slightly zygomorphic. *Sepals* often with colleters inside. *Corolla* sympetalous; salverform, infundibuliform, urceolate or rotate; lobes overlapping to the left or right, more rarely valvate. *Stamens* inserted on the inside of the corolla tube; completely included or exerted; anthers sagittate or ovate, free or adnate to the pistil head; sometimes with the base and apex sterile. *Disk* present or absent. *Ovary* superior or, rarely, semi-inferior; of 2 separate caels united into a common style, a single bilocular ovary or a unilocular ovary; pistil head with a stigmatic base and a 2-cleft apex. *Fruit* a drupe, berry, capsule or follicle. *Seeds* simple, arillate, winged, with a ciliate margin or with an apical and/or basal coma.

KEY TO BORNEAN APOCYNACEAE

The following key has all the genera of Apocynaceae *s.s.* which occur in Borneo. The genera known to have species which occur in the Crocker Range have a number before them, referring to the number the genus is given in the text. Those genera without a number are known to occur in Borneo but no species have as yet been collected in the Crocker Range (these are not discussed further). I have seen *Cerbera odollam* cultivated on the edge of the National Park but it is not known to be native there.

- | | |
|--|-----------------|
| 1a. Trees or shrubs. | 2 |
| b. Climbers. | 18 |
| 2a. Leaves spirally arranged. | Cerbera |
| b. Leaves opposite or verticillate. | 3 |
| 3a. Leaves verticillate. | 4 |
| b. Leaves opposite. | 9 |
| 4a. Small seaside tree with spatulate leaves and large fibrous fruits. | Ochrosia |
| b. Inland trees or shrubs with variable leaves; fruit a small drupe or follicles. | 5 |
| 5a. Secondary leaf veins parallel and \pm straight. | 6 |
| b. Secondary leaf veins arcuate ascending. | 8 |
| 6a. Large unbuttressed tree; corolla tube much shorter than lobes; fruit a follicle with winged seeds. | Dyera |

b.	Shrubs to large trees, mostly with buttresses or trunk fluted; corolla tube longer than lobes; fruit a drupe or a follicle with ciliate seeds.	7
7a.	Ovary syncarpous; fruit a drupe.	15. Rauvolfia
b.	Ovary of 2 separate follicles; fruit of paired follicles.	1. Alstonia
8a.	Corolla lobes overlapping to the right in bud; fruit of paired follicles; seeds ciliate.	1. Alstonia
b.	Corolla lobes overlapping to the left in bud; fruit or paired drupes; seeds not ciliate.	15. Rauvolfia
9a.	Shrubs or small trees armed with thorns.	Carissa
b.	Shrubs to large trees without thorns.	10
10a.	Small intrapetiolar stipule-like ocrea present.	11
b.	Small intrapetiolar stipule-like ocrea absent.	12
11a.	Calyx lobes connate into a tube for at least half their length.	Voacanga
b.	Calyx lobes not connate into a tube.	16. Tabernaemontana
12a.	Leaves with domatia on the undersurface.	10. Kibatalia
b.	Leaves without domatia on the undersurface.	13
13a.	Corolla lobes overlapping to the left in bud.	14
b.	Corolla lobes overlapping to the right in bud.	15
14a.	Stamens not adnate to the pistil; corolla without a corona, fruit a drupe.	15. Rauvolfia
b.	Stamens adnate to the pistil; corolla with or without a corona; fruit a follicle.	Wrightia
15a.	Small seaside tree with spatulate leaves and large fibrous fruits [rare form of <i>Ochrosia</i> without verticillate leaves].	Ochrosia
b.	Shrubs to large trees, generally inland, generally without spatulate leaves; fruits not fibrous.	16
16a.	Shrub; corolla infundibuliform widening around the middle.	Spirolobium
b.	Tree; corollas salverform.	17
17a.	Flowers in fascicles; stamens adnate to the pistil; fruit of paired follicles.	10. Kibatalia
b.	Flowers not in fascicles; stamens not adnate to the pistil; fruit of paired drupes.	11. Kopsia
18a.	Climbers with tendrils.	18. Willughbeia
b.	Climbers without tendrils.	19
19a.	Leaves in whorls of three or more.	2. Alyxia
b.	Leaves opposite.	20
20a.	Leaves punctate beneath.	21
b.	Leaves not punctate beneath.	23
21 a.	Leaves with a strong intramarginal vein.	22
b.	Leaves without a strong intramarginal vein.	3. Anodendron
22a.	Flowers 4-merous; fruit not dehiscent; seeds without a corky aril.	12. Leuconotis
b.	Flowers 5-merous; fruit dehiscent; seeds with a corky aril.	5. Chilocarpus
23a.	Domatia present in the axils of the secondary veins with the midrib.	24
b.	Domatia absent.	26
24a.	Corolla lobes overlapping to the left in bud.	13. Parameria
b.	Corolla lobes overlapping to the right or valvate in bud	25
25a.	Sepals with collectors on the inside surface; seeds glabrous, long and	4. Baharuia

narrow.	
b. Sepals without collectors on the inside surface; seeds pubescent, ellipsoid.	
26a. Sepals connate for a third of their length or more.	
b. Sepals free or only connate at base.	
27a. Corolla with a corona in the throat.	27
b. Corolla without a corona in the throat.	28
28a. Stamens not adnate to the pistil; corolla lobes not drawn out into long tails; fruit with a hard pericarp and simple seeds.	29
b. Stamens adnate to the pistil; corolla lobes drawn out into long tails or not; fruit a follicle; seeds with a coma at both ends.	
29a. Corolla lobes overlapping to the left in bud; fruit of paired drupes or follicles.	30
b. Corolla lobes overlapping to the right or valvate in bud; fruit of paired follicles.	31
30a. Stamens free from the pistil; fruit of paired drupes, often moniliform; seeds ruminant, simple.	
b. Stamens adnate to the pistil; fruit of paired follicles, weakly or strongly torulose; seeds not ruminant, with a coma at one end.	
31a. Corolla tube 2 cm long; seeds with or without a coma.	
b. Corolla tube < 2 cm long; seeds with a coma.	
32a. Leaves with 12 — 22 pairs of secondary veins and a clear intramarginal vein; stamens only weakly adnate to the pistil; seeds without a coma.	
b. Leaves with up to 11 pairs of secondary veins and an indistinct or no intramarginal vein; stamens strongly adnate to the pistil; seeds with a coma.	
33a. Stamens exerted from the throat of the corolla.	
b. Stamens completely included within corolla.	
34a. Anthers only slightly exerted from corolla mouth; anthers subsessile; ovary apocarpous.	
b. Anthers completely exerted from corolla mouth; filaments long, often spiral or strongly bent; ovary syncarpous.	
35a. Sepals almost as long as or longer than corolla tube; leaves with a very strong intramarginal vein.	
b. Sepals shorter than corolla tube; leaves without or with an indistinct intramarginal vein.	
36a. Ovary pubescent.	
b. Ovary glabrous.	
37a. Stamens not inserted at very base of corolla tube; seeds glabrous apart from coma.	
b. Stamens inserted at very base of corolla tube; seeds pubescent on grain.	
38a. Inflorescence flat-topped and umbel-like; corolla tube > 1 cm long; seeds with an unstalked coma at the end.	
	17. Urceola
	6. Chonemorpha
	27
	28
	29
	Melodinus
	Strophanthus
	30
	31
	2. Alyxia
	13. Parameria
	32
	33
	8. Eucorymbia
	7. Epigynum
	34
	35
	Trachelospermum
	14. Parsonsia
	Aganosma
	36
	37
	38
	9. Ichnocarpus
	17. Urceola
	7. Epigynum

- b. Inflorescence axillary or paniculate, not umbel-like; corolla tube < 1 cm long; seeds with a stalked coma at one end.

3. Anodendron

1. ALSTONIA R.Br., Asclep. 64. 1810.

Revision: Sidiyasa, K. (1998). Taxonomy, Phylogeny, and wood anatomy of *Alstonia* (Apocynaceae). *Blumea* suppl. 11:1-230

Shrubs or trees. Leaves verticillate (in Borneo). Inflorescence terminal or axillary, frequently in whorls or umbel-like. Sepals without colleters inside; ovate. Corolla lobes overlapping to the left or right in bud; corolla lobes spreading. Stamens inserted around the middle or upper half of corolla tube, completely included in tube; anthers lanceolate, without appendages, fertile entire length; free from the pistil. Disk small and annular or absent. Ovary of two separate carpels united into a common style; glabrous or pubescent; ovules numerous. Fruits of paired follicles. Seeds oblong, ends rounded or acuminate, flattened; pubescent or glabrous on faces of grain; long cilia around margin.

43 species from Central America, tropical Africa, and from the Himalayas and China to Australia and out into the Pacific. 3 species recorded from the Crocker Range.

- 1 a. Trunk without copious white latex from the inner bark; corolla lobes overlapping to the right; seeds acuminate at one end. ***Alstonia angustifolia***
- b. Trunk with copious white latex from the inner bark; corolla lobes overlapping to the left; seeds rounded at both ends. **2**
- 2a. Leaves with tertiary venation slightly raised above; corollas pubescent outside. ***Alstonia scholaris***
- b. Leaves without raised tertiary venation; corollas glabrous outside. ***Alstonia spatulata***

1. *Alstonia angustifolia* Wall. ex A. DC., Prodr. 8; 409. 1844.

2. *Alstonia scholaris* (L.) R. Br., Asclep. 65. 1810.

3. *Alstonia spatulata* Blume, Bijdr. F1. Ned. Ind. 1037. 1826.

Notes: *A. macrophylla* Wall. ex G. Don and *A. iwahigensis* have not been collected in the Crocker Range but are quite probably present. *A. macrophylla* can be distinguished from *A. angustifolia* by its glabrous or only laxly puberulent sepals. *A. iwahigensis* can be distinguished from *A. scholaris* by the lack of raised tertiary veins and the glabrous outside to the corolla, and from *A. spatulata* by the elliptic to slightly obovate leaves as opposed to the strongly spatulate leaves of *A. spatulata*.

2. ALYXIA R.Br., Prod. 470. 1810.

Revision: Middleton, D.J. (2000). Revision of *Alyxia* (Apocynaceae). Part 1: Asia and Malesia. *Blumea* 45: 1-146

Climbers, scramblers or shrubs. Branches sometimes with large corky protuberances. Leaves opposite or in whorls of 3 - 7, more or less equal in size within a whorl but often of extremely

different sizes and shapes on different parts of the plant; colleters present in the axils. Inflorescences axillary and/or terminal, consisting of solitary flowers or of simple cymes. Flowers 5-merous. Corolla generally salverform; lobes contorted to the left in bud. Stamens inserted mostly in the upper half of the corolla tube, not exerted from corolla throat; filaments straight, short and thin; anthers ovate, fertile for most of length; free from pistil head. Disc absent. Ovary of two separate carpels united into a common style. Fruit a pair of drupes from each flower, very frequently with one aborted, consisting of one or more articles with one seed, when more than one then forming a moniliform chain. Seeds simple; endosperm ruminant.

106 species from the Himalayas and China through Southeast Asia to Australia and New Caledonia and out into the Pacific Islands. 2 species recorded from the Crocker Range.

- 1a. Leaves in whorls of 3, blade thickly coriaceous, often fleshy; flowers somewhat fleshy. ***Alyxia oleifolia***.
 b. Leaves in whorls of 3-5, blade coriaceous to papery; flowers not fleshy. ***Alyxia reinwardtii***

1. *Alyxia oleifolia* King & Gamble, J. Asiat. Soc. Bengal 74(2): 419. 1908.
2. *Alyxia reinwardtii* Blume, Catalogus 43. 1823.

Notes: There have been several other species of *Alyxia* recorded from Sabah but only *A. ganophylla* Markgr., and possibly *A. angustifolia* Ridl., are likely to also occur in the Crocker Range. *A. ganophylla* can be recognised by the pubescence on the outside of the corolla and in mostly having pubescent leaves, and *A. angustifolia* in having flowers rather like *Alyxia oleifolia* but with narrow leaves which are generally pubescent beneath. All 4 species mentioned here are rather closely related and can be difficult to distinguish.

3. ANODENDRON A.DC. in DC., Prod. 8:443. 1844.

Revision: Middleton, D.J. (1996). A revision of *Anodendron* Roxb. (Apocynaceae). Blumea 41: 37-68

Climbers or scramblers. Leaves opposite, those of a pair equal. Inflorescence of axillary and/or terminal cymes, often forming panicles. Flowers 5-merous. Sepal lobes free; colleters on inside corners. Corolla: lobes in bud overlapping to the right; consisting of a narrow cylindrical tube which widens slightly at the point of stamen insertion into the upper tube and then with spreading lobes; lobes usually narrow oblong or narrow elliptic, rarely ovate, falcate. Stamens included in the corolla tube, attached in a ring to the pistil head; anthers narrow triangular, apex acuminate, base sagittate, sterile at apex and base. Disc annular, 5-dentate or 5-crenate. Ovary of 2 separate carpels united into a common style, superior, ovoid, glabrous; ovules numerous. Fruit of paired follicles; divergent or sub-divergent; wide at base, narrowing to end; longitudinally dehiscent. Seeds beaked, grain narrow ovate or elliptic, flattened; glabrous; coma pointing towards end of fruit.

17 species from India, Japan and China southwards to Vanuatu. 1 species recorded from the Crocker Range.

4. BAHARUIA D.J.Middleton, Blumea 40: 445. 1995.

Climbers or scramblers. Branches lenticellate or not. Leaves opposite; those of a pair equal in size; petiolate; blade papery, entire; lateral veins few, strongly ascending; hair-filled domatia in the axils on the lateral veins with the midrib. Inflorescence a terminal and/or axillary cyme; lax. Flowers 5-merous, actinomorphic, small. Sepals free, collectors in a row on the inside at the base. Corolla: lobes in bud overlapping to the right; mature corolla urceolate to salverform, consisting of a tube and somewhat spreading lobes; lobes narrow, strap-shaped, strongly bent to the right as viewed from inside. Stamens completely included within the corolla tube, attached in a ring to the pistil head; anthers with a short filament, narrowly triangular, apex acuminate, base sagittate, sterile at apex and base. Disk 5-dentate or 5-crenate, usually slightly shorter than ovary. Ovary of 2 separate carpels united into a common style, superior, ovoid, pubescent. Fruit of 2 parallel or slightly divergent follicles; narrow and torulose; longitudinally dehiscent. Seeds linear; glabrous; unbeaked apex bearing a cream-coloured coma.

1 species in Sumatra and Borneo.

1. *Baharuia gracilis* D.J. Middleton, Blumea 40 (1995) 445.

5. CHILOCARPUS Blume, Catalogus 22. 1823.

Climbers. Leaves opposite; with distinct or obscure punctae beneath; intrapetiolar stipules present. Inflorescence of axillary and/or terminal cymes. Sepals usually slightly connate at base; without collectors inside. Corolla lobes overlapping to the left in bud, bud drumstick shaped; mature corolla salverform; lobes asymmetrical with a slant to the left, acuminate. Stamens free from the pistil head; completely included in the corolla tube; inserted about middle or in lower half of corolla tube; filaments short and narrow; anthers ovate, base cordate, apex acute, fertile entire length. Disk absent. Ovary syncarpous; unilocular with 2 parietal placentas; ovules numerous; style filiform. Fruit a berry/capsule, fleshy when young; dehiscent into two when mature. Seeds with a corky aril; ovoid.

About 15 species in Southeast Asia. 4 species recorded from the Crocker Range.

- | | |
|---|--------------------------------|
| 1a. Leaves with strongly prominent secondary veins beneath, veins much clearer than parallel tertiary venation | Chilocarpus costatus |
| b. Leaves with secondary veins unclear or only weakly prominent beneath, tertiary venation not particularly distinct. | 2 |
| 2a. Inflorescence shorter than to as long as the subtending petiole. | Chilocarpus rostratus |
| b. Inflorescence longer than the subtending petiole. | 3 |
| 3a. Inflorescences forming a terminal panicle, fruit cylindrical and weakly torulose. | Chilocarpus beccarianus |
| b. Inflorescences not forming a terminal panicle, fruit ellipsoid. | Chilocarpus vernicosus |

1. *Chilocarpus beccarianus* Pierre, Bull. Soc. Linn. Paris II, 1:101.1898.
2. *Chilocarpus costatus* Miq., Fl. Ind. Bat. 2: 393. 1856.
3. *Chilocarpus rostratus* Markgr., Blumea 19: 165. 1971.
4. *Chilocarpus vernicosus* Blume, Mus. Bot. Lugd.-Bat. 1:152. 1850.

Notes: The species in this genus are still not clearly defined but a revision is currently under way by A.J.M. Leeuwenberg.

6. CHONEMORPHA G. Don, Gen. Syst. 4: 76. 1837.

Climbers. Leaves opposite; glands in the axils. Inflorescence a terminal panicle. Sepals often connate for large part of length; colleters inside. Corolla lobes overlapping to the right and twisted to the left in bud; lobes obovate, slightly asymmetrical; salverform in mature flower. Stamens inserted near base of corolla tube; anthers sessile, sagittate, with sterile area; adnate to the pistil head. Disk entire, 5-dentate; shorter than the ovary; glabrous. Ovary of two separate carpels united into a common style; ovules numerous; ovary glabrous. Fruit of paired follicles. Seeds with a long beak topped with a coma directed towards the fruit apex.

A genus of ca. 10 species from India and China to Indonesia. This genus is in need of revision.

*1. *Chonemorpha verrucosa* (Blume) D.J. Middleton, Novon 3: 455. 1993.

This species has not yet been collected in the Crocker Range but it is highly likely to be present considering its known distribution.

7. EPIGYNUM Wight, Ic. t.1308. 1848.

Climbers. Leaves opposite; glands in axils; secondary veins anastomosing before margin. Inflorescence a congested flat-topped panicle formed from terminal and axillary cymes; bracts small. Sepals with or, rarely, without colleters inside. Corolla in bud a narrow tube, bulging around the anthers, and an ovate head, lobes overlapping to the right; tomentose outside, pubescent inside; salverform when open; lobes obovate. Stamens with a short filament; inserted in lower half of tube; anthers narrowly triangular, apex acuminate or acute, base sagittate, with sterile area, adnate to the pistil head. Disk of 5 separate lobes or appearing annular; glabrous. Ovary of 2 separate carpels united into a common style; ovules numerous; style filiform; pistil head long cylindrical, with an acuminate apex. Fruit of paired follicles; fusiform. Seeds consisting of a flattened grain and a coma directed towards the fruit apex; glabrous.

A genus of ca. 6 species from the Himalayas to Borneo. 1 species recorded from the Crocker Range.

1. *Epigynum borneense* Merr., Journal of the Asiatic Society of Malaya 1: 27. 1923.

The only species unequivocally recorded in the Crocker Range is *Epigynum borneense*. Work still needs to be done on the basic taxonomy of this genus and some collections may turn out to need a new status after a revision.

8. EUCORYMBIA Stapf, Hook. Ic. Pl. ser. 4, 8 (1903) t.2764.

Climbers. Branches terete or weakly angled, lenticellate; branchlets glabrous. Leaves opposite. Inflorescence cymose; glabrous. Flowers 5-merous; actinomorphic. Sepals deciduous; colleters inside. Corolla lobes overlapping to the right in bud; open corolla salverform; tube narrow at base and widening at stamen insertion; lobes obovate, narrow at base, rounded at apex. Stamens sessile; anthers narrowly triangular, apex acute or acuminate, base sagittate, with sterile area; weakly adnate to the pistil head. Disk annular, 5-lobed. Ovary of two carpels united into a common style, ovules numerous; style filiform. Fruit a pair of follicles, fusiform, slightly

flattened, densely lenticellate. Seeds elliptic, flattened, without a terminal coma.

One species from Borneo, Sumatra, Malay Peninsula.

1. *Eucorymbia alba* Stapf, Hook. Ic. P1. ser. 4, 8: t.2764. 1903.

9. ICHNOCARPUS R. Br., Asclep. 50. 1810.

Revision: Middleton, D.J. (1995). A taxonomic revision of *Ichnocarpus* (Apocynaceae). *Blumea* 39: 73-94

Woody climbers or scramblers. Leaves opposite, those of a pair equal; colleters often present in leaf axils and on rim. Inflorescence of a terminal and / or axillary elongate rachis bearing sessile or short peduncled cymes (thyrsoid), of small axillary cymes or paniculate. Flowers 5-merous, actinomorphic. Sepal lobes free; colleters present or absent. Corolla: lobes in bud overlapping to the right; salverform; lobes falcate. Stamens included in the corolla tube or slightly exerted, attached in a ring to the pistil head; filament short, sometimes with small projections to the sides; anthers elliptic or narrow triangular, apex mucronate or acuminate, base short sagittate and sterile.

Disk of 5 narrow lobes as long as or longer than the ovary, often somewhat bulging on top, or entire and 5-dentate or 5-crenate, or of 5 wide separate lobes. Ovary of 2 separate carpels united into a common style, superior, ovoid, usually pubescent, very rarely glabrous. Fruit of 2 follicles; slightly spreading or not. Seeds narrow lanceolate or linear, glabrous and with an apical unbeaked coma.

12 species in South-East Asia, Malesia and the Solomon Islands. 1 species recorded from the Crocker Range.

1. *Ichnocarpus frutescens* (L.) W.T. Aiton, Hort. Kew ed. 2, 2: 69. 1811.

10. KIBATALIA G. Don, Gen. Syst. 4: 86. 1837.

Revision: Rudjiman (1986). A revision of *Beaumontia* Wallich, *Kibatalia* G. Don and *Vallariopsis* Woodson. Agricultural University of Wageningen Papers 86—5: 36. 1987.

Trees or large shrubs. Leaves opposite; glands in the axils present or absent. Inflorescence with a very short peduncle and appearing as a fascicle; lax; flowers often distinctly 5-angled. Sepals ovate; colleters inside. Corolla lobes in bud overlapping to the right; mature corolla salverform. Stamens sessile or subsessile; anthers narrowly triangular, apex acute or acuminate, base sagittate, with sterile area; adnate to the pistil head. Disk not as high as the ovary; 5-lobed; glabrous. Ovary of two separate carpels united into a common style; ovules numerous; style filiform; pistil head conical or ovoid. Fruit of paired follicles; narrowly ellipsoid or cylindrical; lenticellate or not. Seeds consisting of seed grain and a long basal beak with coma; hairs of coma directed down towards seed grain.

A genus of 15 species in South-East Asia and Malesia. 1 species may be present in the Crocker Range.

*1. *Kibatalia arborea* (Blume) G.Don, Gen. Syst. 4: 86. 1837.

Note: *K. arborea* has not yet been collected in the Crocker Range but this widespread species has been collected in many other parts of Sabah.

11. KOPSIA Blume, Catalogus 12. 1823.

Shrubs or trees. Leaves opposite; with a large intermetiolar ridge and glands in the axils. Inflorescence cymose, sometimes raceme-like in appearance. Sepals without colleters inside. Corolla lobes overlapping to the right in bud; mature corolla salverform; lobes oblong or obovate, acute to rounded. Stamens free from the pistil head; completely included in the corolla tube; filaments short and narrow; anthers narrowly ovate, base cordate, apex acute, fertile entire length. Disk of 2 narrow lobes. Ovary of 2 separate carpels united into a common style, glabrous or pubescent; 2 ovules per carpel; style filiform with a collared style head. Fruit a drupe; solitary or paired; often with a large appendage. Seeds ovoid; flattened.

Ca. 20 species from Burma and China to Northern Australia. 1 species recorded from the Crocker Range.

1. *Kopsia pauciflora* Hook.f., Fl. Br. Ind. 3: 639. 1882

12. LEUCONOTIS Jack, Trans. Linn. Soc. 14: 121. 1823.

Climbers. Leaves opposite, usually with distantly spaced secondary veins; punctate beneath; glands absent in the axils. Inflorescence a cyme; axillary and/or terminal; flowers 4-merous. Sepals with or without colleters inside, outer pair and inner pair sometimes slightly different sizes. Corolla lobes overlapping to the left in bud; open corolla salverform. Stamens completely included in the tube; anthers lanceolate, rounded at the base, fertile entire length; filaments short, filiform. Disk absent. Ovary syncarpous, bilocular, with 2-3 ovules in each cell; style short. Fruit a berry, pulpy inside. Seeds with a membranous testa.

6 species in South-East Asia. 1 species recorded from the Crocker Range.

1. *Leuconotis eugenifolia* A.DC., Prod. 8: 331. 1844.

13. PARAMERIA Benth. in Benth. & Hook.f., Gen. Pl. 2: 715.

Revision: Middleton, D.J. (1996). A revision of *Aganonerion* Pierre ex Spire, *Parameria* Benth. and *Urceola* Roxb. (Apocynaceae). Blumea 41: 69-122

Climbers. Leaves opposite, those of a pair equal, very rarely in whorls of 3; with glands in axils; papery to subcoriaceous, entire. Inflorescence of terminal and/or axillary cymes often forming a panicle. Flowers 5-merous, actinomorphic. Sepal lobes free; colleters inside. Corolla: lobes in bud overlapping to the left, consisting of a narrow tube and a globose head or the whole bud is ovoid; open corolla salverform to campanulate; lobes falcate, broad and rounded or oblong and acute to obtuse. Stamens completely included within the corolla tube, attached in a ring to the pistil head; filament short; anthers narrowly triangular, base sagittate, sterile at apex and base. Disc 5-crenate to completely 5 separate lobes. Ovary of 2 separate carpels united into a common

style; ovules numerous. Fruit of paired follicles; long, narrow and strongly to weakly torulose; longitudinally dehiscent. Seeds hirsute; ellipsoid, flattened; with a coma pointing towards the end of the fruit.

3 species from India and southern China to western Indonesia. 2 species recorded from the Crocker Range

1. *Parameria laevigata* (Juss.) Moldenke, Rev. Sudamer. Bot. 6:176. 1940.
2. *Parameria polyneura* Hook.f., Fl. Brit. Ind. 3: 660. 1882.

14. PARSONSIA R. Br., Asclep. 53. 1810.

Revision: Middleton, D.J. (1997). A revision of *Parsonsia* R.Br. in Malesia. Blumea 42: 191-248.

Climbing shrubs. Leaves opposite or in whorls of 3 or more, equal; colleters in the axils and frequently in a ring around the stem. Inflorescence axillary or terminal, corymbose, pedunculate and several times branched or with flowers clustered at inflorescence ends. Flowers 5-merous. Sepals with colleters inside. Corolla lobes overlapping to right in bud, often so very slightly as to appear valvate; lobes reflexed, spreading or erect. Stamens exerted, inserted anywhere on the corolla tube from the base to near the throat; filaments straight, bent or strongly twisted; anthers usually narrowly triangular, sometimes oblong, apex acuminate, base sagittate, sterile at base and apex, adnate to the head of the pistil. Disc of 5 lobes, sometimes fused into an annular ring, often with complex development of teeth at the apex. Pistil glabrous. Ovary ovoid, of 2 connate carpels, often 4-toothed at apex. Ovules many. Fruit of one follicle clearly composed of two locules; linear to fusiform. Seeds roughly triangular in cross section, long and narrow, bearing a coma at the end towards the apex of the fruit.

Ca. 82 species from India and Sri Lanka to China, southwards through Indochina and Malesia to the western Pacific Islands, Australia and New Zealand. 1 species recorded from the Crocker Range, others may be present.

1. *Parsonsia celebica* (Oliv.) Sleesen, Nova Guinea n.s. 9: 341. 1958.

Notes: In addition *Parsonsia alboflavescens* (Dennst.) Mabb. and *Parsonsia philippinensis* Merr. may also occur in the Crocker Range but have so far not been collected. *Parsonsia celebica* can be distinguished from both by the dense rufous-coloured hairs on the outside of the corolla, these are short and pale when, rarely, present at all in the other two species. *Parsonsia philippinensis* can be distinguished by having fleshy corolla lobes which are strongly overlapping in bud as opposed to the non-fleshy corolla lobes which are almost valvate in bud of *Parsonsia alboflavescens*.

15. RAUVOLFIA L., Sp. Pl. 208. 1753.

Revision: Hendrian & Middleton, D.J. (1999). A revision of *Rauvolfia* L. in Malesia. Blumea 44: 449-470

Shrubs, trees or sometimes rhizomatous undershrubs, with white latex. Leaves opposite or in

whorls of 3-7, often confined to the apices of the branchlets, sometimes opposite on the lower nodes, glabrous. Inflorescence terminal, sometimes seemingly lateral, lax or congested, a few- to many-flowered cyme, glabrous or pubescent. Corolla salverform; lobes in bud overlapping to the left. Stamens free from the pistil, included or slightly exserted; filaments short and narrow; anthers ovoid, obtuse, acute to cuspidate at the apex, cordate at the base, glabrous. Disc entire, glabrous. Pistil: ovary superior, composed of two free or completely fused carpels, glabrous; style filiform; pistil-head cylindrical with a membranous collar at the base. Fruit apocarpous to completely syncarpous drupes, often only one carpel developing, each camel contains a single seed. Seeds simple.

60 species, pantropical. 2 species recorded from the Crocker Range.

- 1a. Sepals 2 times as long as wide; corolla tube 9 mm long; anthers obtuse to acute; leaves with or without submarginal veins. **Rauvolfia verticillata**
- b. Sepals < 1.5 times as long as wide; corolla tube < 5 mm long; anthers cuspidate; leaves with submarginal veins. **Rauvolfia sumatrana**

1. *Rauvolfia sumatrana* Jack, Mal. Misc. 1, 5: 22. 1820.

2. *Rauvolfia verticillata* (Lour.) Baill., Bull. Mens. Soc. Linn. Paris 1: 768. 1888.

16. TABERNAEMONTANA L., Sp. Pl. 210. 1753.

Revision: Leeuwenberg, A.J.M. (1991). Revision of *Tabernaemontana* 1.

Shrubs or small trees. Leaves opposite, often a pair unequal in size; distinct stipule-like ocrea in the axils. Inflorescence a cyme or solitary flower, lax; 2 inflorescences at each ramification, occasionally with one missing; flowers usually fragrant. Sepals often with colleters inside. Corolla in mature bud with a narrow tube and globose to ovoid head; corolla lobes overlapping to the left; mature corolla salverform. Stamens subsessile or with short filaments; completely included in tube; anthers narrowly triangular to oblong, base cordate, apex acute, fertile entire length; free from the pistil. Disk absent. Ovary of two separate camels united into a common style; style filiform; pistil head short. Fruit of paired follicles; obliquely ellipsoid to somewhat elongated; ridged or smooth, sometimes torulose. Seeds covered in a fleshy aril, obliquely ellipsoid.

Circumtropical. 99 species. 2 species recorded from the Crocker Range, a third, *T. pandacaqui* likely to be present.

- 1a. Leaf blade coriaceous when dry, usually obtuse or rounded at the apex, rarely shortly acuminate; sepals not much longer than wide; fruit >5 cm wide. **Tabernaemontana macrocarpa**
- b. Leaf blade papery or subcoriaceous when dry, usually acuminate or caudate at the apex; sepal ratio variable; fruit <3cm wide. 2
- 2a. Head of mature corolla bud rounded or obtuse; tube glabrous inside; sepals minutely ciliate or not. **Tabernaemontana pandacaqui**
- b. Head of mature corolla bud acute or acuminate; tube pubescent inside; sepals usually not ciliate. **Tabernaemontana pauciflora**

1. *Tabernaemontana macrocarpa* Jack, Malay. Misc. 2.7: 80. 1822.
- *2. *Tabernaemontana pandacaqui* Poir. in Lam., Enc. 7: 529. 1806.
3. *Tabernaemontana pauciflora* Blume, Bijdr. 1028. 1876.

17. URCEOLA Roxb., Asiat. Res. 5:169. 1798.

Revision: Middleton, D.J. (1996). A revision of *Aganonerion* Pierre ex Spire, *Parameria* Benth. and *Urceola* Roxb. (Apocynaceae). Blumea 41: 69-122

Climbers. Leaves opposite; glands in axils or not. Inflorescence of axillary and/or terminal cymes forming a panicle. Sepals with or without colleters inside. Corolla lobes valvate or overlapping to the right in bud; urceolate or with lobes slightly spreading when open; lobes symmetrical to falcate. Stamens completely included, inserted near the base of the corolla tube; filaments short; anthers narrowly triangular, base sagittate; ovules numerous; stamens adnate to the pistil head. Disk annular or 5-dentate; glabrous. Ovary of 2 separate carpels united into a common style; ovules numerous; ovary pubescent on top; style very short. Fruit of paired follicles; stipitate or not; glabrous or pubescent. Seeds narrowly elliptic, somewhat flattened; brown pubescent with a terminal white coma.

16 species from the Himalayas and China and down through Malesia. 2 species recorded from the Crocker Range.

- 1 a. Corolla lobes in bud overlapping to the right, 1.5-2.9 mm long, tube 1.4-2.4mm long; leaves with 3-6 pairs of secondary veins. **Urceola rosea**
- b. Corolla lobes in bud valvate, 0.6-1.2 mm long, tube 1.2-3 mm long; leaves with 5-10 pairs of secondary veins. **Urceola brachysepala**

1. *Urceola brachysepala* Hook.f., Fl. Brit. Ind. 3: 659. 1882.
2. *Urceola rosea* (Hook. & Arn.) D.J. Middleton, Novon 4: 151. 1994.

In addition *Urceola elastica* Roxb. and *Urceola laevis* (Elmer) Merr. may also be present in the Crocker Range but have not so far been collected there. *Urceola elastica* is similar to *Urceola brachysepala* but can be distinguished from it by the sepals which are longer than the corolla tube. It is also generally much more pubescent. *Urceola laevis* is also similar to *Urceola brachysepala* but has a corolla tube which is not noticeably wider at the base as in *U. brachysepala* and a fruit which is dagger shaped rather than fusiform.

18. WILLUGHBEIA Roxb., Pl. Corom. 3, t.280. 1819.

Revision: Middleton, D.J. (1993). A taxonomic revision of *Willughbeia* Roxb. (Apocynaceae). Blumea 38:1-24

Woody climbers. Branches bearing tendrils formed from modified inflorescences. Leaves opposite, those of a pair equal; colleters absent from leaf axils. Inflorescence of axillary and, rarely, terminal cymes, often very short, appearing fasciculate. Flowers 5-merous, actinomorphic. Sepals without colleters. Corolla: lobes in bud overlapping to the left forming a cone or cylinder of erect lobes; tube cylindrical, somewhat inflated around the stamens, or short and inflated; lobes spreading and ovate, elliptic or oblong. Stamen insertion variable, completely

included within the tube; free from the pistil head; filament varying in length; anthers ovate to lanceolate, apex acute or obtuse, base rounded. Disk absent. Ovary single, unilocular, with 2 parietal placentas; glabrous. Fruit a fleshy berry; spherical, ellipsoid or pear-shaped; few to many seeded; indehiscent. Seed compressed ovoid; without a coma; smooth, with a very thin endosperm and thick horny cotyledons.

16 species in Indochina and western Malesia. 7 species recorded or likely to occur in the Crocker Range.

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|--|---------------------------|
| 1a. Corolla tube inflated, usually 3 mm long. | 2 |
| b. Corolla tube cylindric, inflated only around stamens, 3mm long. | 4 |
| 2a. Inflorescence axis shorter than or as long as subtending petiole. | 1. W. angustifolia |
| b. Inflorescence axis longer than subtending petiole. | 3 |
| 3a. Secondary veins in leaf almost at right angles to the midrib; leaves dull above and beneath. | 3. W. flavescens |
| b. Secondary veins at an angle of 55-75° to the midrib; leaves shiny above. | 5. W. lanceolata |
| 4a. Inflorescence brown pubescent; calyx lobes brown pubescent. | 5 |
| b. Inflorescence glabrous or white puberulent; calyx lobes normally glabrous. | 6 |
| 5a. Corolla tube 28-30 mm long. | 6. W. lunduensis |
| b. Corolla tube 4.8-6.2 mm long. | 7. W. sarawacensis |
| 6a. Leaves thickly coriaceous; tertiary venation clearly visible perpendicular to and connected between nerves; calyx lobes < 1 x as long as wide. | 4. W. gigantea |
| b. Leaves papery to coriaceous; tertiary venation faint or obscure; calyx lobes > 1 x as long as wide. | 2. W. coriacea |

1. *Willughbeia angustifolia* (Miq.) Markgr., Blumea 20: 414. 1972.
2. *Willughbeia coriacea* Wall., Pl. As. Rar. 3: 45. 1832.
3. *Willughbeia flavescens* Dyer ex Hook.f., Fl. Brit. India 3: 625.1882.
4. *Willughbeia gigantea* (Boerl.) Markgr., Blumea 20: 413. 1972
5. *Willughbeia lanceolata* (Markgr.) D.J.Middleton, Blumea 38: 15.1993.
- *6. *Willughbeia lunduensis* D.J.Middleton, Blumea 41: 123. 1996.
7. *Willughbeia sarawacensis* (Pierre) K. Schum. in Engl. & Prantl, Nat. Pflanzenfam. Nachtr. 2: 55. 1900.

Notes: *Willughbeia lunduensis* has only been collected twice, once from just outside the Crocker Range so it has been included in the assumption it can also be found there.

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¹ Harvard University Herbaria, Cambridge, Massachusetts 02138, USA.