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A TAXONOMIC AND PHYLOGENETIC ANALYSIS OF RHYSOTOECHIA (SAPINDACEAE)

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SUMMARY

This study comprises a taxonomic revision of *Rhysotoechia* (Sapindaceae) preceded by a phylogenetic analysis. Fifteen species are recognised and three imperfectly known species are discussed. Five new species from New Guinea are described. Two species from the Philippines, Borneo and one species from Australia are reduced. There are no excluded species. A key, based on both flower and fruit characteristics, gives access to the species. The study was restricted to the macromorphological characters, leading to a data matrix with 25 characters. The cladistic analysis was run with the computerprogram HENNIG86. Eventually one cladogram has been accepted.

INTRODUCTION

Radlkofer (1879) described the genus *Rhysotoechia,* choosing this name because of the wrinkling of the fruits when open and dry (rhysos, Gr. = wrinkled, shrivelled). In this new genus he placed two species, *R. mortoniana* and *R. robertsonii*, originally described in *Cupania* (Mueller, 1866). He also described five new species, of which two were included earlier in *Cupania robertsonii* (Mueller, 1875): *R. flavescens* and *R. bifoliolata.*

Sixteen years later Radlkofer (1895) described the new species *Rhysotoechia gracilipes*. Twelve years after that he described the new species *R. koordersii* (1907). The latter had been identified earlier as *R. mortoniana* by Koorders (1898). Maiden & Betche (1908) described the new species *Cupania dunnii*, which turned out to be a synonym of *R. bifoliolata.*

Merrill (1921) referred to the species *R. grandifolia*, but he misspelled the name as *R. grandiflora.*

Domin (1927) described the new species *R. contermina.*

Between 1913 and 1933 Radlkofer described several more new species. In 1933 a complete revision of *Rhysotoechia* appeared in his posthumous monograph of the family Sapindaceae.

After Radlkofer's death (in 1927) a few more species and one subspecies were described, viz. *R. longipaniculata* and *R. momiensis* by Kanehira & Hatusima (1943), *R. florulenta* and *R. bifoliolata* subsp. *nitida* by Reynolds (1991). Reynolds had already published a revision of the Australian species of *Rhysotoechia* (1984).

As a first result of the present study five new species from New Guinea are described: *R. applanata, R. bilocularis, R. congesta, R. multiscapa* and *R. obtusa*. Both *R. acuminata* and *R. striata* are reduced to *R. ramiflora*; *R. contermina* is reduced to *R. robertsonii*. Herbarium material was seen of all species treated in this revision, except for the imperfectly known species nos. 17 and 18.

MATERIALS AND METHODS

This revision of *Rhysotoechia* is based on herbarium specimens only. The material is kept in the Rijksherbarium at Leiden (L), unless stated otherwise.

The criterion used to distinguish species is the presence of at least two characters in which two species differ from each other. In this way species are characterized by a monothetic set of characters.

MORPHOLOGY

Habit

Small to medium-sized shrubs or trees. Highest tree: 25 m. The diameter of the flowering twigs is measured just below the lowest inflorescence.

Indumentum

The vegetative parts of *Rhysotoechia* have little indumentum. Only in one species, *R. robertsonii*, simple, solitary, appressed hairs are found on the leaves. Laxly scattered hairs can be observed on rachis, petiole, petiolule, pulvinus and both sides of the leaflets.

Young parts are usually densely puberulous in all species. Simple appressed hairs are found on the scapes, more densely towards the tops of the inflorescences.

Leaves

The leaves are always paripinnate, with one to five pairs of leaflets. The petiole is absent in only one species, *R. congesta*, in which the first pair of leaflets grows at the base of the rachis. In the other species the petiole has a basal pulvinus. The petiole or rachis may be inconspicuously winged. This is best seen near the apical pair of leaflets, where the rachis is the thinnest. The petiole or rachis is sometimes angular, i.e., showing a slender raised line.

Leaflets

The leaflets are glossy above and dull below (the leaflets of *R. bifoliolata* subsp. *nitida* and *R. florulenta* are vernicose on the upper surface), opposite to alternate. They show a wide range in form, size and thickness. The base can be symmetric or slightly oblique, acute or attenuate, seldom rounded. The margin is always entire, and can be recurved to flattened. The apex shows a wide range from slightly emarginate to caudate and can be abruptly narrowed or not. On the lower surface of the leaflets all cells are slightly globular and under a microscope they are visible as bright

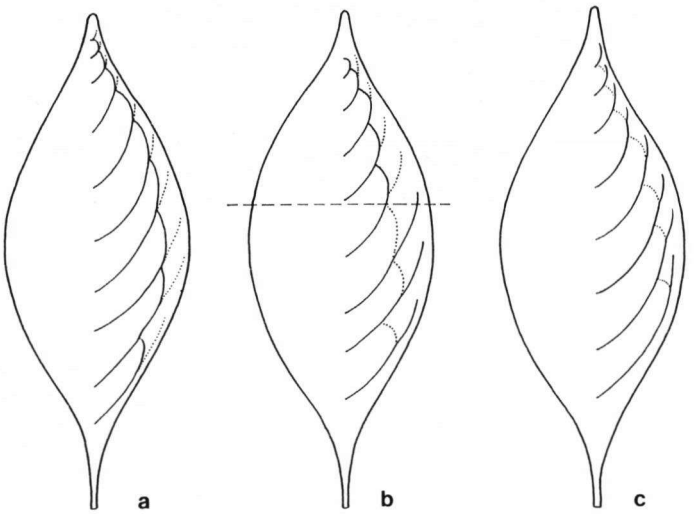

Fig. 1. Venation of leaflets: (a) looped; (b) open towards the base, looped towards the apex; (c) open.

spots. This is regarded an apomorphic character state for *Rhysotoechia* compared to *Cupaniopsis*, the sister group. The venation is usually slightly raised above and raised below. Three types of nervation are observed: open, looped and open towards the base, and looped towards the apex (Fig. 1). The distance between the nerves is always measured in the middle of the leaflet. Veins vary from densely to laxly reticulate. The length of the leaflet includes the petiolule and the pulvinus.

Inflorescences

The inflorescences sometimes branch at the base when two to many scapes are fascicled or they are solitary and branch higher on the scape. Panicles, racemes and thyrses have been found, and also thyrses with cymules consisting of one flower (in *R. multiscapa* in some cases two flowers) instead of many flowers.

Bracts and bracteoles

The bracteoles, at the base of the pedicel, sometimes are somewhat smaller than the bracts, although this difference is 0.5 mm at most. The bracts and bracteoles are triangular with the margins strongly incurved, i.e. cymbiform. The abaxial side is always strigose, especially towards the margins. The adaxial side is glabrous.

Flowers

All flowers are regular with a zygomorphic calyx. The plants are monoecious with flowers unisexual (stamens well developed and stigma not or vice versa) or may appear hermaphrodite though actually functionally male or female. The pedicels are glabrous.

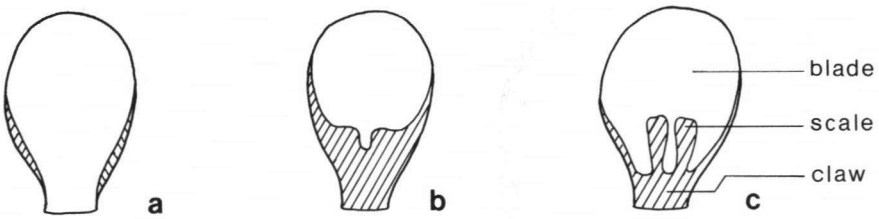

Fig. 2. Petal scales: (a) absent; (b) folded margins of petals; (c) free.

— *Sepals:* five, dimorphic with the outer two distinctly smaller than the inner three. The margin is (laxly) ciliate to almost glabrous. Often they are persistent in the fruit.
— *Petals:* five, smaller than the sepals, consisting of a blade and a claw. In a number of species a pair of scales just above the claw against the blade may sometimes be present. In some they occur as folded margins of the petal, in others they are free and well developed, or they may be absent (Fig. 2). In one species, *R. florulenta*, the scales are furnished with distinct crest-like appendages. The blade can have various forms, from elliptic to broadly ovate or broadly obovate. All three parts (blade, claw and, if present, scales) have in every species their own typical indumentum, which consists of simple or pluricellular hairs, pilose, velutinous, or woolly.
— *Disc:* complete, slightly lobed, glabrous (except for the hairy disc of *R. bifoliolata*).
— *Stamens:* eight, with the filament more or less velutinous from the middle towards the base. The anther is basifixed [although Endress & Stumpf (1991) describe it as dorsifixed] and latrorsely opening. In some species a few simple, solitary hairs can be observed on the anther.
— *Pistil:* the ovary is ovoid and in most species 3-lobed, 3-locular, and mostly densely covered with long appressed hairs. The style is glabrous, elongating in fruit. In *R. flavescens* and *R. bilocularis* the ovary is 2-lobed, 2-locular. There is always one ovule per locule.

Fruit

The fruit is always a capsule, obcordate to reniform and 2- or 3-lobed, but not all lobes always develop. The dried fruits are often rugose to ribbed. They are sometimes laxly pubescent, but presumably glabrescent. Inside, the fruit wall is set with papillae, except in one species, *R. flavescens*. *Rhysotoechia elongata* has fruits with sutures densely setose inside. The length of the stipe of the fruits varies conspicuously. The length of the fruits includes the stipe (Fig. 3).

Seed

The seeds are obovoid or ellipsoid, usually black, smooth and shiny when dry. At the base they are covered by a cup-shaped arillode, except for *R. applanata,* where a sarcotesta is found. The pseudohilum and hilum are orbicular and the diameter was measured. The length of the seed does not include the arillode when the latter is expanded downwards.

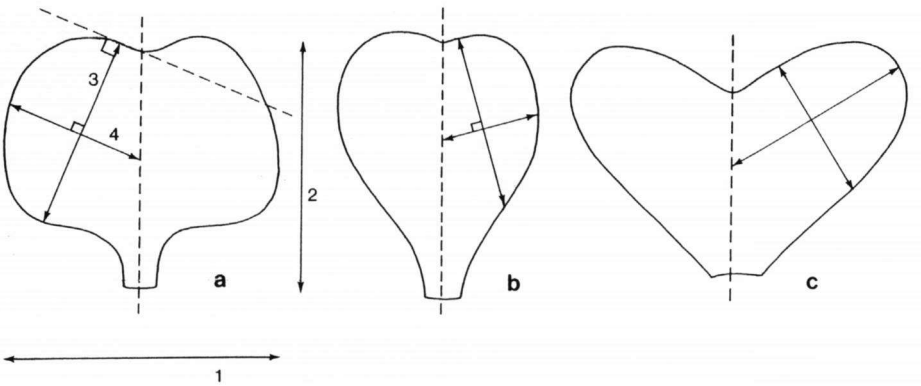

Fig. 3. Measurements of the fruits were taken as shown by the arrows: 1 = width of fruit; 2 = length of fruit; 3 = width of lobe; 4 = length of lobe.

PHYLOGENETIC ANALYSIS

Rhysotoechia: a monophyletic group?

Muller and Leenhouts (1976: 424) placed *Rhysotoechia* among the most primitive genera in Sapindaceae–Cupanieae, closely related to *Cupaniopsis*. Both *Rhysotoechia* and *Cupaniopsis* are thought to be derived from *Cupania*. It seemed to these authors that *Dictyoneura* is derived from *Rhysotoechia*, with a tendency towards reduction of the flower parts, especially of the petals. If this is true and the derivation is from an ancestral species within *Rhysotoechia*, then the genus will be paraphyletic; however, when *Dictyoneura* shares an ancestral species with *Rhysotoechia*, the latter may be monophyletic.

There are several indications that *Rhysotoechia* is a monophyletic group. The genus is very homogeneous in the following character states.

1) leaves glabrous or subglabrous; upper surface glossy, lower surface dull (also in dried leaves), cells domed;
2) domatia absent;
3) bracts and bracteoles triangular, adaxially glabrous, abaxially strigose;
4) flowers with unequal sepals; sepals glabrous except for the margins, inner three with petaloid margin;
5) crest absent on petal scales (except for *R. florulenta*);
6) disc complete, slightly lobed;
7) stamens 8; filament velutinous from the middle towards the base; anthers basifixed, latrorsely opening;
8) fruit a capsule, outside wrinkled, inside papillose (except for *R. flavescens*);
9) seeds black, shiny, glabrous;
10) arillode yellow, cup-shaped;
11) cotyledons secondarily beside each other.

Table 1. Characters and data matrix of the analysis.

1. Maximum thickness of flowering twig
   1. 5 mm
   2. 10 mm
   3. 15 mm
2. Number of jugae
   1. 1–3
   2. 1–5
3. Rachis length of leaf
   1. < 20 cm
   2. > 20 cm
4. Maximum length of leaflet
   1. 10 cm
   2. 20 cm
   3. 35 cm
5. Maximum width of leaflet
   1. 5 cm
   2. 10 cm
   3. 15 cm
6. Index of leaflet
   1. < 3.4
   2. > 3.5
7. Shape of leaflet
   1. usually obovate
   2. usually ovate
   3. usually elliptic
8. Apex of leaflet
   1. not abruptly narrowed
   2. abruptly narrowed
9. Margin of leaflet
   1. recurved
   2. recurved or flattened
   3. flattened
10. Base of leaflet, symmetry
    1. slightly to distinctly oblique
    2. symmetric
    3. usually slightly oblique, sometimes symmetric
    4. usually symmetric, sometimes slightly oblique
11. Base of leaflet, shape
    1. attenuate
    2. acute or attenuate
    3. rounded to obtuse
    4. acute
12. Lateral nerves
    1. at most 2.5 cm apart along the midrib
    2. at most 5 cm apart along the midrib
13. Nervation
    1. looped
    2. open towards the base, looped towards the apex
    3. open
14. Veins
    1. very laxly reticulate
    2. reticulate
    3. very densely reticulate
15. Minimum length of petiolule
    1. < 3 mm
    2. > 3 mm
16. Maximum length of petiolule
    1. 1 cm
    2. 2 cm
17. Inflorescence
    1. at least sometimes ramiflorous
    2. never ramiflorous
18. Branching of inflorescence
    1. not at the base
    2. sometimes at the base
    3. always at the base
19. Inflorescence
    1. panicles or thyrses
    2. thyrses with cymule of 1 flower
20. Margin of inner 3 sepals
    1. laxly ciliate
    2. ciliate
21. Petal
    1. outside pilose, inside glabrous
    2. inside pilose, outside glabrous
    3. both sides pilose
    4. both sides glabrous
22. Scales of petal
    1. absent or as folded margins of petal
    2. free
23. Anther
    1. glabrous
    2. pilose
24. Number of locules of fruit
    1. 3
    2. 2
25. Stipe of fruit
    1. < 3 mm
    2. > 3 mm

Taxon / Characters	1	2	3	4	5	6	7	8	9	10	11	12	13
Cupaniopsis anacardioides	1	2	1	2	2	1	1	1	3	4	1	1	1
Rhysotoechia applanata	2	1	1	2	2	1	3	1	1	2	4	2	3
bifoliolata	1	1	1	1	1	2	3	1	1	1	2	1	1
bilocularis	2	2	1	2	2	1	2	1	1	4	1	1	1
congesta	3	1	2	3	3	1	3	1	1	1	3	2	2
elongata	2	2	2	3	1	2	2	2	1	3	2	1	1
flavescens	2	2	1	3	2	2	3	2	1	3	1	1	1
florulenta	1	2	1	2	2	1	3	1	2	1	1	1	2
gracilipes	1	2	1	2	2	2	2	2	3	2	1	1	1
grandifolia	2	2	2	3	2	1	3	2	2	4	1	2	2
koordersii	2	2	2	3	3	2	1	2	2	4	2	2	2
mortoniana	1	1	1	2	2	1	2	1	1	1	1	1	1
multiscapa	2	1	1	2	1	2	3	1	2	2	1	1	2
obtusa	2	2	1	2	2	1	3	1	1	4	1	1	2
ramiflora	3	2	2	3	3	1	3	2	2	4	1	2	2
robertsonii	2	2	1	2	2	2	3	1	1	3	2	1	2

Taxon / Characters	14	15	16	17	18	19	20	21	22	23	24	25
Cupaniopsis anacardioides	1	1	1	2	1	1	2	4	2	2	1	1
Rhysotoechia applanata	2	1	1	2	3	2	1	3	1	2	1	1
bifoliolata	1	1	1	2	1	1	2	1	1	1	1	1
bilocularis	3	2	2	2	3	1	1	2	1	2	2	?
congesta	1	1	1	1	3	1	?	?	?	?	1	2
elongata	3	2	2	2	1	1	1	1	1	2	1	1
flavescens	3	1	2	2	1	1	1	2	1	2	2	2
florulenta	3	2	2	2	1	1	1	4	2	1	1	?
gracilipes	2	2	2	2	1	1	?	?	?	?	1	1
grandifolia	2	2	2	?	?	?	?	?	?	?	1	?
koordersii	2	1	1	2	3	2	2	3	1	2	1	2
mortoniana	1	1	2	2	2	1	1	1	2	1	1	2
multiscapa	2	1	1	2	3	2	1	3	1	2	1	?
obtusa	2	1	2	2	3	1	?	?	?	?	1	1
ramiflora	2	2	2	1	2	2	2	1	1	2	1	2
robertsonii	2	1	1	2	1	1	2	3	1	2	1	1

Although most of these character states also occur in closely related genera (e.g., *Cupaniopsis, Guioa*) and are therefore plesiomorphic, a few are apomorphic, i.e., the leaves being glossy above and dull below, cells domed, and the fruits being papillose inside.

Phylogenetic analysis

The phylogenetic analysis was carried out with HENNIG86. To select the most parsimonious tree(s) the 'branch-and-bound' option was chosen.

Following Muller & Leenhouts (1976), *Cupaniopsis* was selected as the outgroup. It has been represented in the analysis by *C. anacardioides*, since this species is regarded to contain the largest number of plesiomorphies and the fewest apomorphies (Adema, 1991).

Data matrix

A multistate coding is used for the character states in the data matrix. Missing data are indicated with a question mark. HENNIG86 was run using the unordered option for all characters.

Cladistic analysis

With the data matrix of Table 1, four equally parsimonious cladograms were obtained by using the options 'mhennig', followed by 'bb*' in HENNIG86.

This resulted in four trees (length 89, CI 0.43, RI 0.53), but after iterative character weighting only one of these remained with length 159, CI 0.51 and RI 0.67. This cladogram has been accepted here (Fig. 4).

Discussion of the results

The number of homoplasies is very high in the accepted cladogram; however, the subtrees are based on reliable characteristics and can be fairly well recognised. Most of the homoplasies were caused by parallelisms.

Within the tree, three main groups can be distinguished. The first group consists of three Australian species, *R. bifoliolata*, *R. mortoniana* and *R. florulenta*. This group is supported by one apomorphy and three parallelisms, anthers glabrous (23_1), petals outside pilose, inside glabrous (21_1), number of jugae 1–3 (2_1), and base of leaflets slightly to distinctly oblique (10_1). The second group is a geographically rather mixed group with species from Borneo, Philippines, Sulawesi, Moluccas and New Guinea. Here, there is support from six characters, two apomorphies and four parallelisms, maximum width of leaflet 15 cm (5_3), inflorescences at least sometimes ramiflorous (17_1), stipe > 3 mm (25_2), rachis of leaf > 20 cm (3_2), lateral nerves almost 5 cm apart (12_2), leaflet < 35 cm (4_3). The third and last group mainly occurs in New Guinea. It also includes one species from Australia. They are defined by a homoplasy that occurs also in *R. mortoniana* and *R. florulenta*, i.e., hairiness of margin of inner three sepals laxly ciliate (20_1). It is obvious that this group is only weakly supported. Two nodes lower, there is support from five characters, two apomorphies, two parallelisms and one reversal: veins very densely reticulate (14_3), petals inside pilose, outside glabrous (21_2), leaflet usually ovate (7_2), minimal length of petiolule > 3 mm (15_2), nervation looped (13_1). All the nodes that follow are based on reversals and parallelisms.

One species, *R. robertsonii*, is not connected with any of these groups. It splits off together with groups two and three and forms the intermediate between the 'primitive' Australian species and the 'newer' species in e.g. New Guinea, something that was already expected intuitively.

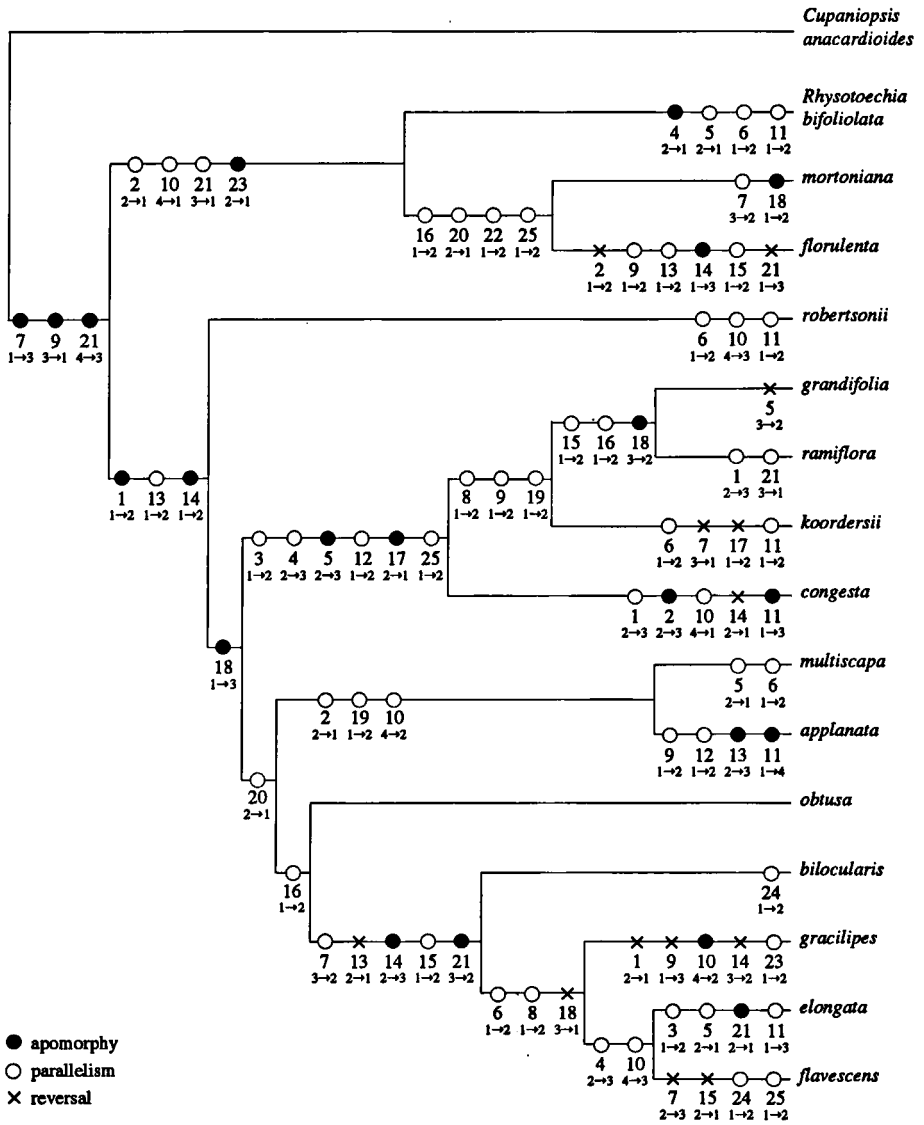

Fig. 4. Cladogram of *Rhysotoechia*.

The accepted cladogram is the best hypothesis about the phylogenetic relations among the species, with the data matrix at hand. However, this should be tested by studying more and better material, and other character complexes.

Note on distribution patterns

For a detailed biogeographical analysis it would be best to split up New Guinea and Australia into smaller areas. However, the problem is that most of the species

from New Guinea are based on two or even one collection only. The uncertainty whether these species really are restricted to small areas, or that they are overlooked in other areas makes the biogeographical analysis very unreliable.

By looking carefully at the cladogram, some remarks can still be made about the distribution patterns.

The ancestral species of *Rhysotoechia* occurred in Australia, and possibly in New Guinea too. A vicariance event, maybe preceded by dispersion, led to separation of the populations in Australia (group 1) and New Guinea (groups 2 and 3). *Rhysotoechia robertsonii,* as intermediate between the two clades, still occurs in both areas.

Van Welzen (1989) found that *Guioa* species occupy three different geographical areas in eastern Australia, divided by vicariance boundaries. The species of group 1 occupy the same areas, possibly as a result of the same historical biogeographical mechanisms: Cape York Peninsula (*R. bifoliolata* subsp. *nitida*), Atherton Plateau (*R. florulenta* and *R. mortoniana*), SE Queensland and NE New South Wales (*R. bifoliolata* subsp. *bifoliolata* and *R. mortoniana*). In New Guinea, probably as a result of dispersion, many species originated, all occupying small areas.

Subsequently, dispersion occurred to Sulawesi, Borneo, the Philippines and the Moluccas, followed by speciation. Finally, travelling in the opposite direction from its ancestors, the ancestor of *R. flavescens* and *R. elongata* dispersed back to Australia, giving rise to the present species.

INFRAGENERIC CLASSIFICATION

The infrageneric classification of Radlkofer (1933) is rejected, mainly because presently more herbarium material is available. For example his character 'laxly/densely flowering' is very questionable, since it depends on the quality of the material.

In my opinion, infrageneric classification is only useful in genera larger than *Rhysotoechia* or in those cases where it makes the recognition of species or groups of species easier.

Although four distinct groups occur in the cladogram given here, I do not present a subgeneric classification. The apomorphies and homoplasies that define these groups do not make the recognition of species or groups of species easier. Most of these characters are useful for phylogenetic analysis, but are not distinctive enough for taxonomic delimitation.

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DESCRIPTIONS AND KEYS

RHYSOTOECHIA

Rhysotoechia Radlk., Sapind. Holl.-Ind. (1879) 61, 62, 98; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 484, 485, 489, 541, 656–658; 10 (1890) 264, 291; in Engl., Pflanzenr. 98 (1933) 1209–1216; S.T. Reynolds, Austrobaileya 2 (1984) 41; Fl. Australia 25 (1985) 63–65. — *Rhysotoechia* sect. *Eurhysotoechia* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 656, 657, nom. illeg. (ICBN Art. 22.1). — *Rhysotoechia* sect. *Leptostigma* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 657. — *Rhysotoechia* sect. *Clitostigma* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 657, 658. — Lectotype species (Reynolds, 1984): *Rhysotoechia mortoniana* (F. Muell.) Radlk. (based on *Cupania mortoniana* F. Muell.).

Trees, small to medium-sized, or shrubs. *Branchlets* terete, rough to smooth. *Indumentum* if present mostly of simple, appressed hairs. *Leaves* paripinnate; petiole and rachis terete, below the leaflets semi-terete or angular, slightly winged or not, glabrous to very laxly puberulous; petiole pulvinate. *Leaflets* opposite to alternate, symmetric, (chartaceous to) pergamentaceous to coriaceous (to cartilaginous); base symmetric to slightly oblique, acute to attenuate, rarely rounded; margin entire, strongly recurved to flattened; apex obtuse to caudate; upper surface (slightly) glossy, gla-

brous, rarely laxly puberulous; lower surface dull, the cells domed, rarely very laxly puberulous; domatia absent; venation on upper surface (slightly) raised to almost flattened, raised below; midrib slightly prominent above, smooth to ribbed; nervation open towards the base and looped towards the apex or looped throughout, rarely open throughout (*R. applanata*); veins laxly to densely reticulate; petiolule often grooved towards the pulvinus, sometimes absent, pulvinate, glabrous, rarely laxly puberulous. *Inflorescences* axillary, subterminal or ramiflorous, branching at the base or not, (very laxly) puberulous, rarely glabrous, paniculate, thyrsoid, sometimes with cymules of 1 flower, laxly to densely flowered. *Bracts* and *bracteoles* (narrowly) triangular to cymbiform, usually not persistent in fruit, abaxially strigose, especially towards the margins, adaxially glabrous. *Flowers* regular, with a zygomorphic calyx, hermaphrodite, but presumably functionally unisexual. *Sepals* 5, subpersistent in fruit, the outer 2 slightly to distinctly smaller than the inner 3, the margin (laxly) ciliate, rounded to broadly obovate; inner sepals with a petaloid margin. *Petals* 5, broadly ovate to broadly obovate, (distinctly) clawed, margin and usually outside or inside or both pilose, sometimes only towards the base; scales absent to well developed, either completely free or with lower part of margin connate to petal or appearing as folded margins of petal, with margins and sometimes outside pilose; crest absent. *Disc* complete, slightly lobed, glabrous (puberulous in *R. bifoliolata*). *Stamens* 8 (very seldom 7); filament especially towards base pilose or velutinous; anther basifixed, latrorsely opening, often with a few hairs. *Pistil:* ovary 3- or sometimes 2-locular, with one ovule per locule, sericeous; style usually glabrous, elongating in fruit. *Fruit* a capsule, obcordate to reniform, with one to all lobes developing, outside rugose to ribbed, often laxly pubescent, inside (densely) papillose or smooth, glabrous (except for *R. elongata* with fruit with densely setose sutures); stipe absent to distinct; style sometimes persistent on fruit. *Seed* obovoid to orbicular, covered by a cup-shaped arillode (except for sarcotesta in *R. applanata*), apically open; hilum round; pseudohilum round to reniform. *Embryo:* cotyledons secondarily laterally besides each other, equal or subequal.

Distribution – 15 species in Australia and Malesia: Borneo, Philippines, Sulawesi, Moluccas, New Guinea.

Habitat & Ecology – Rain forest in often coastal lowlands, to high mountains.

Note – Typical for *Rhysotoechia* are the glabrous leaves, glossy above, slightly dull below, and the fruits which are densely papillose inside.

KEY TO THE SPECIES

1a. Leaves 2–5-jugate, sometimes 1-jugate 2
b. Leaves 1-jugate, rarely 2-jugate ..... **2. R. bifoliolata**
2a. Ovary 2-locular 3
b. Ovary 3-locular 4
3a. Inflorescences not branching at the base. Margin of leaflets recurved; apex acuminate to cuspidate ..... **6. R. flavescens**
b. Inflorescences branching at the base. Margin of leaflets flattened to very slightly recurved; apex acuminate, sometimes acute ..... **3. R. bilocularis**

4a. Leaves petiolate. Flowering twigs to 13 mm thick. Leaflets papery to coriaceous 5
b. Leaves sessile. Flowering twigs 10–15 mm thick. Leaflets cartilaginous **4. R. congesta**
5a. Specimen flowering 6
b. Specimen fruiting 13
6a. Petal scales absent 7
b. Petal scales present, free or as folded margins 10
7a. Flowers 4–5 mm diam. Petals with both sides pilose towards base; margins glabrous or pilose. Lateral nerves of leaflets 0.5–1.8 cm apart. Petiole 1.3–6 cm long 8
b. Flowers 6–8 mm diam. Petals outside pilose, inside glabrous or very laxly pubescent; margins pilose. Lateral nerves of leaflets 0.5–3 cm apart. Petiole 2–17 cm long 9
8a. Inflorescences panicles. Margin of leaflets (slightly) recurved. Leaflets opposite to alternate. Petiolule a pulvinus only, rarely to 4 mm long. Margin of petals pilose ..... **15. R. robertsonii**
b. Inflorescences thyrses with cymules of 1 or 2 flowers. Margin of leaflets flattened to slightly recurved. Leaflets opposite, sometimes subopposite. Petiolule of leaflets 5–10 mm long. Margins of petals glabrous .. **12. R. multiscapa**
9a. Leaflets ovate to elliptic, pergamentaceous to coriaceous. Petiolule 7–22 mm long, if shorter, then always ramiflorous ..... **14. R. ramiflora**
b. Leaflets obovate to elliptic, coriaceous. Petiolule a pulvinus only or up to 10 mm long. Inflorescences axillary ..... **10. R. koordersii**
10a. Inflorescences panicles or thyrses. Petals outside pilose, inside glabrous. Leaflets ovate, rarely elliptic 11
b. Inflorescences thyrses with cymules of 1 flower. Petals on both sides pilose. Leaflets elliptic ..... **1. R. applanata**
11a. Petal scales free. Flowers 6–9 mm diam. Index of leaflets 2–3.2 12
b. Petal scales as folded margins. Flowers c. 5 mm diam. Index of leaflets 3.2–4.5 ..... **5. R. elongata**
12a. Petal scales without crest-like appendages. Leaves 1–3 jugate **11. R. mortoniana**
b. Petal scales with crest-like appendages. Leaves 2–4-jugate **7. R. florulenta**
13a. (5) Fruit sutures glabrous inside 14
b. Fruit sutures densely setose inside ..... **5. R. elongata**
14a. Stipe of fruit absent or up to 3 mm long 15
b. Stipe of fruit 3 mm or longer 18
15a. Stipe of fruit present. Apex of leaflets acute to caudate; midrib prominent above 16
b. Stipe of fruit absent. Apex of leaflets obtuse with a slightly emarginate tip; midrib flattened to slightly sunken above ..... **13. R. obtusa**
16a. Petiolule a pulvinus only or up to 8 mm long. Apex of leaflets acute to cuspidate 17
b. Petiolule 9–18 mm long. Apex of leaflets caudate ..... **8. R. gracilipes**

17a. Fruit 1.7–2.5 cm high, 2–2.5 cm broad, reniform to depressed globose. Arillode present. Pulvinus of leaflets 1–4 mm long ..... **15. R. robertsonii**
b. Fruit 1.2–1.5 cm high, 1.2–1.7 cm broad, obcordate. Sarcotesta present. Pulvinus of leaflets 5–13 mm long ..... **1. R. applanata**
18a. Fruit 1.8–2.5 cm high; stipe 0.5–1 cm long 19
b. Fruit < 1.7 cm high; stipe 3–5 mm long. — Fruit inside densely papillose. Seed rounded to obovoid ..... **11. R. mortoniana**
19a. Leaflets ovate to elliptic, pergamentaceous to coriaceous. Petiolule 7–22 mm long, if shorter, then always ramiflorous ..... **14. R. ramiflora**
b. Leaflets obovate to elliptic, coriaceous. Petiolule a pulvinus only or up to 10 mm long ..... **10. R. koordersii**

Note – *Rhysotoechia grandifolia* is not included in the key to the species, since flowers nor fruits were observed.

1. Rhysotoechia applanata Etman, *spec. nov.*

Foliis supra venatione applanata vel parum elevata, nervis lateralibus 1–3.2 cm inter se distantibus, costa interdum parum impressa, petiolulo ad pulvinum redacto; semininas sarcotesta endotesta mesotestaque tenuissimis. — Typus: *Floyd & Hoogland 3834*, Papua New Guinea, Northern Prov. (L holo; iso A, CANB, LAE, US).

Tree. *Branchlets* slightly rough, reddish brown with green dots to greyish black; flowering twigs 5–6.5 mm thick. *Leaves* 1–3-jugate, sometimes with a terminal leaflet; petiole 2.5–7 cm long, terete to flattened above, sometimes slightly winged below the lowest pair, slightly ribbed, glabrous; rachis 3.5–7 cm long, terete to angular, slightly winged below the leaflets, slightly ribbed, glabrous. *Leaflets* opposite to subopposite, 9.5–20 by 4–8.5 cm, index 2.1–2.8, elliptic, pergamentaceous; base symmetric, usually acute, sometimes slightly attenuate; margin (slightly) recurved; apex acuminate; both sides glabrous; venation on upper surface flattened to slightly raised; midrib prominent, slightly ribbed to smooth; lateral nerves 1–3.2 cm apart, sometimes slightly sunken above, nervation open; intercalated veins curved towards the base; veins laxly reticulate; petiolule a pulvinus only; pulvinus 5–13 mm long, grooved, prominent, glabrous. *Inflorescences* axillary, branching at the base, 1–3 cm long, densely puberulous; thyrses with cymules of 1 flower. *Bracts* and *bracteoles* to 1 mm long. *Pedicels* 1–1.5 mm long. *Flowers* in bud. *Sepals* with both sides glabrous, outer ones ovate, margin glabrous to very laxly ciliate; inner ones orbicular, margin laxly ciliate. *Petals* broadly elliptic; claw very short, glabrous; margins coarsely lobed; pilose towards the base; apex rounded; outside pilose only at the base, inside pilose towards the base; scales as folded margins of petal, thickened, velutinous. *Disc* glabrous. *Stamens* 8; filament velutinous; anther laxly puberulous. *Pistil:* ovary 3-locular, sericeous; style and stigma very immature. *Fruits* with 1–3 well developed lobes, obcordate, 1.2–1.5 cm high, 1.2–1.7 cm broad; outside rugose, very wrinkled, glabrous; inside densely papillose; stipe 2–3 mm long; lobes 1.2–1.4 by 0.6–0.7 cm; style 0.5–1 mm long. *Seeds* ellipsoid to obovoid, 1–1.3 by 0.7–0.8 cm; sarcotesta covering the lower part of the seed, endotesta and mesotesta very thin; hilum 0.5–1 mm diameter; pseudohilum 1–1.2 mm diameter.

Field notes – Tree c. 15–20 m high, bole 12 m high, dbh 45 cm. Wood soft. Outer bark dark brown. Inner bark orange-brown. Sapwood straw-coloured. Heartwood pinkish brown. Flowers greenish cream. Fruit orange. Seed black.

Distribution – Malesia: Papua New Guinea (Owen Stanley Range, Cape Sudest, Moikodi).

Habitat & Ecology – Coastal rain forest or hill forest. From sea-level up to 396 m altitude; fl., fr. Sept.

Vernacular name – Umbupu (Orokaiva language, Mumuni).

Note – Typical are the flattened and sometimes slightly sunken nerves of the leaflets; the upper side of the leaflets therefore looks very smooth.

2. **Rhysotoechia bifoliolata** Radlk.

Rhysotoechia bifoliolata Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 541, 656; in Engl., Pflanzenr. 98 (1933) 1211; Domin, Bibl. Bot. 89 (1927) 905; Francis, Austral. Rain-For. Trees, ed. 3 (1970) 252; S.T. Reynolds, Austrobaileya 2 (1984) 41; Fl. Australia 25 (1985) 63. — Type: *O'Shanesy 246*, Rockhampton (MEL holo).

Cupania (Cupaniopsis) dunnii Maiden & Betche, Proc. Linn. Soc. New South Wales 33 (1908) 305. — Type: *Dunn s.n.*, New South Wales, Acacia Creek via Killarney (M holo; iso BRI).

Cupania robertsonii auct. non F. Muell.: F. Muell., Fragm. 9 (1875) 94, p.p. (quoad specimen foliis 2-foliolatis, Rockhampton, coll. O'Shanesy).

Tree. *Branchlets* slightly rough, greyish black; flowering twigs 3–5 mm thick. *Leaves* 1-jugate, very rarely 2-jugate; petiole 0.3–2.6 cm long, terete to flattened above, slightly winged, ribbed, glabrous. *Leaflets* opposite to alternate, 4.5–10 by 1.5–4.5 cm, index 1.9–3.8, elliptic to obovate, (thick) pergamentaceous; base slightly oblique, acute to attenuate; margin strongly to slightly recurved; apex rounded to obtuse, sometimes emarginate; both sides glabrous; venation raised on both surfaces; midrib slightly prominent, smooth or ribbed; lateral nerves 0.5–1.5 cm apart, nervation distinctly looped; intercalated veins not distinctly curved towards the base; veins very laxly reticulate; petiolule 1–5 mm long, flattened above, glabrous; pulvinus 1–2 mm long, slightly grooved, not very distinct, glabrous. *Inflorescences* axillary, branching at the base, 1.5–9 cm long, puberulous; thyrses. *Bracts* and *bracteoles* 0.5–2 mm long. *Pedicels* 3–5 mm long. *Flowers* 4–7 mm in diam. *Sepals:* outer ones broadly ovate, 1.5–2 mm, outside laxly pilose, inside glabrous, margin laxly ciliate; larger ones broadly obovate, 2–2.5 mm, both sides glabrous, margin ciliate. *Petals* broadly obovate, c. 2 by 1–1.5 mm; claw c. 0.5 mm high, outside pilose, inside glabrous; margins distinctly lobed, thickened and recurved towards base, glabrous; apex rounded; outside pilose, inside glabrous; scales absent. *Disc* puberulous. *Stamens* 8; filament 1.5–2 mm long, laxly velutinous towards base; anther c. 0.8 mm long, glabrous. *Pistil:* ovary 3-locular, sericeous; style and stigma c. 1.5 mm long, glabrous. *Fruits* with 3 well developed lobes, obcordate to depressed globose, cuneate at the base, 2–2.5 cm high, 2.3–3.5 cm broad; outside ribbed, glabrous, inside densely papillose; stipe lacking; lobes 1.2–2 by 1.2–2 cm; style 1.5 mm long. *Seeds* ellipsoid, 0.9–1.2 by 0.6–0.7 cm; hilum c. 2 mm diameter; pseudohilum c. 7 mm diameter.

Two subspecies may be distinguished as follows:

— Petioles 1–2.6 cm long. Leaflets 1-jugate, very rarely 2-jugate, elliptic to obovate; margins (strongly) recurved; upper surface glossy; lateral nerves patent. Inflorescences 1.5–9 cm long. Flowers c. 7 mm in diam. ..... **a.** subsp. **bifoliolata**
— Petioles 0.3–1.2 cm long. Leaflets always 1-jugate, elliptic; margins slightly recurved; upper surface very vernicose; lateral nerves oblique. Inflorescences 6–9 cm long. Flowers c. 4 mm in diam. ..... **b.** subsp. **nitida**

a. subsp. **bifoliolata**

Field notes – Tree, 3.5–12 m high, multistemmed. Outer bark very smooth to rough, blotched, grey. Inner bark cream-pink. Branchlets light grey. Leaves rather dark green, glossy above, dull below. Flowers cream to creamy yellow. Fruit orange to yellow; seeds shiny black.

Distribution – Australia: Queensland (Moreton, Port Curtis, Wide Bay and Cook Districts, Rockhampton), New South Wales (Kemsey, Tumbulgum).

Habitat & Ecology – Reported from rain forests on low grounds and mountains; Araucarian notophyll vine forest; red soil among boulders; from sea-level up to 2700 m altitude; fl. May–Aug., fr. Oct.

b. subsp. **nitida** S.T. Reynolds

Rhysotoechia bifoliolata Radlk. subsp. *nitida* S.T. Reynolds, Austrobaileya 3 (1991) 490. — Type: *Ross s.n.*, Queensland, Cook District, northern slopes of Mt White, c. 2.8 km from Coen (BRI holo; iso BRI).

Field notes – Small tree, c. 3–4 m high.

Distribution – Australia: Queensland (Cook District).

Habitat & Ecology – Growing on scree slope on edge of thicket.

Notes – *Rhysotoechia bifoliolata* subsp. *nitida* is distinguishable from the typical subspecies in short petioles and petiolules, very vernicose upper surface of leaflets and oblique lateral nerves.

Although one specimen examined also came from Cook District, it did not have extremely short petioles (< 10 mm) as in *R. bifoliolata* subsp. *nitida*, nor very shiny leaflets.

3. Rhysotoechia bilocularis Etman, *spec. nov.*

Rhysotoechia flavescenti similis, sed apice foliolorum non abrupte attenuato, ovario biloculari, inflorescentiis basi ramosis differt. — Typus: *van Royen 4710*, New Guinea, Merauke District (L holo; iso A, CANB).

Small tree. *Branchlets* slightly rough, (reddish) brown; flowering twigs 4–5 mm thick. *Leaves* 4-jugate, sometimes with a terminal leaflet; petiole 6–8 cm long; rachis 13–19 cm long, very slightly winged below the leaflets; both terete to flattened

above, smooth, glabrous. *Leaflets* subopposite to alternate, 7–19.5 by 3–6.5 cm, index 2.3–3.1, ovate to elliptic, (thin) pergamentaceous; base usually symmetric to slightly oblique, attenuate; margin flattened to recurved; apex not abruptly narrowed, acuminate, sometimes acute; both sides glabrous; venation on upper surface slightly raised; midrib slightly prominent, angular; lateral nerves 0.5–1.5 cm apart, almost perpendicular to midrib towards base, nervation distinctly looped; intercalated veins not distinctly curved towards the base; veins very densely reticulate; petiolule 5–12 mm long, flattened, glabrous; pulvinus 2–4 mm long, grooved, distinct, glabrous. *Inflorescences* axillary, branching at the base, 1–7 cm long, laxly puberulous; thyrses copiously flowered. *Bracts* and *bracteoles* 0.5–1 mm long. *Pedicels* 1–2 mm long. *Flowers* in bud. *Sepals* with both sides glabrous, margin laxly ciliate; outer ones broadly elliptic; inner ones orbicular. *Petals* broadly ovate; claw distinct; margins coarsely lobed, thickened and recurved towards the base; pilose; apex rounded; outside glabrous, inside pilose; scales absent. *Disc* glabrous. *Stamens* 7 or 8; filament velutinous; anther puberulous. *Pistil*: ovary 2-locular, sericeous; style and stigma very immature. *Fruits* not observed.

Field notes – Small tree c. 4 m high, trunk to c. 2 m high, dbh c. 10 cm. Leaves dark green above, light green below. Flowers light yellow.

Distribution – Malesia: Irian Jaya (Central South coast, Merauke District).

Habitat & Ecology – Riverbank in primary rain forest; 70 m altitude; fl. Aug.

Vernacular name – Moekoel (Je dialect).

Note – See the note under *R. flavescens* about the similarities and differences of *R. flavescens* and *R. bilocularis*.

4. **Rhysotoechia congesta** Etman, *spec. nov.* — Fig. 5

Ramis robustis, ramulis floriferis 10–15 cm crassis, petiolo carenti, foliolis cartilagineis (in sicco). — Typus: *NGF 29309*, New Guinea, Eastern Highlands Prov., Kassam Pass (L holo; iso A, CANB, LAE).

Tree. *Branchlets* rough, greenish brown to greenish black; flowering twigs 10–15 mm thick. *Leaves* 1–3-jugate; petiole absent; rachis 7–20 cm long, terete to flattened below the leaflets, sometimes slightly winged below the leaflets, ribbed, glabrous. *Leaflets* opposite, 12–30 by 6–14 cm, index 1.6–2.8, elliptic to obovate, cartilaginous; base distinctly oblique, obtuse to rounded; margin (strongly) recurved; apex acute to obtuse; both sides glabrous; venation on upper surface slightly raised; midrib flattened, slightly sunken, ribbed; lateral nerves 2–5 cm apart, usually slightly sunken, nervation open towards the base, looped towards the apex; intercalated veins curved towards the base; veins very laxly reticulate; petiolule a pulvinus only; pulvinus 5–8 mm long, flattened above, prominent, glabrous. *Inflorescences* axillary or subterminal or ramiflorous, branching at the base, very laxly puberulous to glabrous when old; panicles. *Bracts, bracteoles, pedicels* and *flowers* not seen. *Fruits* with 1–3 well developed lobes, globular with an emarginate apex, attenuate at the base, 2–2.5 cm high, 1.8–2.3 cm broad; outside slightly rugose, glabrous; inside papillose; stipe 3–5 mm long; lobes 1.5–1.7 by 1–1.1 cm; style c. 1 mm long. *Seeds* ovoid, c. 1.2–1 cm; hilum c. 4 mm diameter; pseudohilum c. 6 mm diameter.

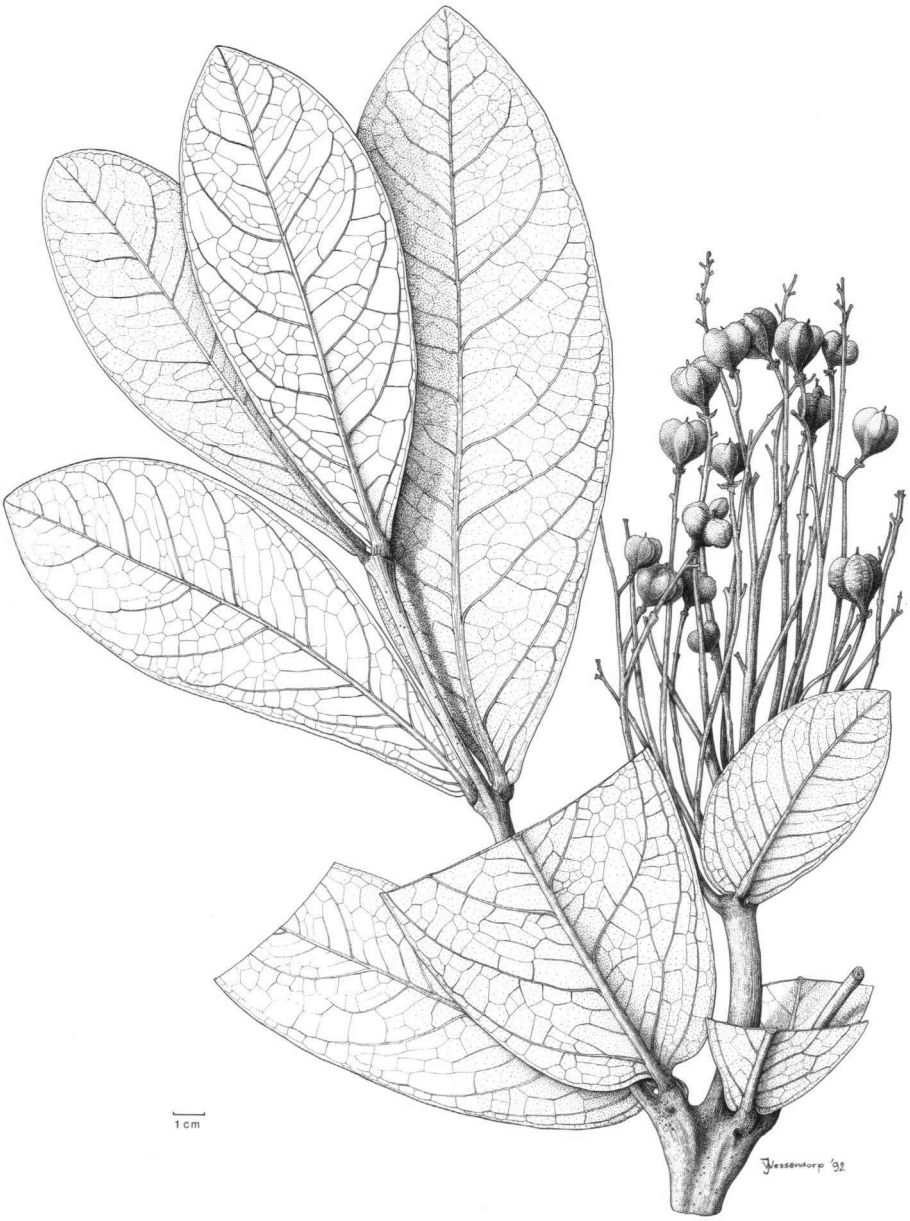

Fig. 5. *Rhysotoechia congesta* Etman. Habit (*NGF 29309*).

Field notes – Tree 6–21 m high, dbh 42 cm, not buttressed, with somewhat gnarled divided trunk, narrow crown of erect branches. Outer bark dark brown with minute fissures. Inner bark light brown. Wood dark straw-coloured. Leaves dark green, dull, crowded, upright on the erect branches. Fruit orange-red. Seed black, dark yellow aril.

Distribution – Malesia: Papua New Guinea (Eastern Highlands Prov., Kainantu Subprov., Kassam Pass; Morobe Prov., head of Gumi Creek).

Habitat & Ecology – Forest; 210–1260 m altitude; fl. Jan., fr. Nov.

Vernacular name – Owaia.

Note – Distinct is the lack of a petiole.

5. **Rhysotoechia elongata** Radlk.

Rhysotoechia elongata Radlk., Bot. Jahrb. 56 (1920) 291; in Engl., Pflanzenr. 98 (1933) 1211. — Lectotype (here chosen): *Fitzgerald s.n.*, New Guinea (M holo; iso M).

Tree or shrub. *Branchlets* smooth, greyish brown to greyish black; flowering twigs 2–6 mm thick. *Leaves* 2–4-jugate; petiole 4–12 cm long, terete to flattened above, sometimes ribbed, glabrous; rachis 4–34 cm long, angular, slightly winged below the leaflets, ribbed, glabrous. *Leaflets* opposite to subopposite, 10–27 by 3–7 cm, index 3.2–4.5, ovate, papery to thin pergamentaceous; base symmetric or slightly oblique, acute to attenuate; margin slightly recurved; apex usually abrupty narrowed but not very distinctly so, acute to cuspidate; both sides glabrous; venation on upper surface slightly raised; midrib prominent, angular; lateral nerves 0.6–2 cm apart, almost perpendicular to midrib towards base, nervation distinctly looped; intercalated veins not distinctly curved towards the base; veins very densely reticulate; petiolule 1–10 mm long, (slightly) grooved, glabrous; pulvinus 1–3 mm long, grooved, not very distinct, glabrous. *Inflorescences* axillary, not branching at the base, 1–2.5 cm long, puberulous; thyrses. *Bracts* and *bracteoles* 0.5–1 mm long. *Pedicels* 1–3 mm long. *Flowers* c. 5 mm in diam. *Sepals* with both sides glabrous, margin laxly ciliate; outer ones broadly ovate, c. 2 by 1.5 mm; inner ones elliptic, c. 3 by 2 mm. *Petals* obovate, 2–3 by 1–2 mm; claw c. 1 mm high, both sides densely velutinous; margins lobed, slightly recurved towards the base, glabrous; apex obtuse; outside velutinous, pubescent towards the base, inside glabrous; scales as folded margins of petal, lobed, 0.3–0.6 mm high, glabrous. *Disc* glabrous. *Stamens* 8; filament c. 2 mm long, velutinous; anther c. 1 mm long, laxly puberulous. *Pistil* immature: ovary 3-locular, sericeous; style and stigma not observed. *Fruits* with 3 well developed lobes, obcordate, 1–1.5 cm high, 1–1.2 cm broad; outside rugose, laxly puberulous, inside not papillose, along the sutures densely setose; stipe 1–3 mm high; lobes c. 0.6 by 0.5 cm; style not observed. *Seeds* not observed.

Field notes – Tree or shrub 1.5–2 m high. Leaves dull dark green above, lighter green below. Flowers cream to pale yellow, numerous.

Distribution – Malesia: Papua New Guinea (Owen Stanley Range, Milne Bay Prov., Raba Raba Subprov., Mt Suckling).

Habitat & Ecology – (Poor) lowland forest; 100–360 m altitude; fl. June–Sept., fr. July.

6. Rhysotoechia flavescens Radlk.

Rhysotoechia flavescens Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Wiss. Akad. München 9 (1879) 541; in Engl., Pflanzenr. 98 (1933) 1215; Domin, Bibl. Bot. 89 (1927) 905; S.T. Reynolds, Austrobaileya 2 (1984) 44; Fl. Australia 25 (1985) 64. — Type: *Dallachy s.n.*, Rockingham Bay (M holo; iso MEL).

Cupania robertsoni auct. non F. Muell.: F. Muell., Fragm. 9 (1875) 94, p.p.

Tree or shrub. *Branchlets* smooth, greenish brown to dark brown; flowering twigs 5–10 mm thick. *Leaves* 3- or 4-jugate, rarely 5-jugate with a subterminal leaflet; petiole 2.8–17 cm long, terete to flattened above, rarely angular, ribbed, glabrous; rachis 4–21 cm long, terete to flattened above, ribbed, glabrous. *Leaflets* opposite to subopposite, 6–32 by 2.4–8.5 cm, index 2.6–3.5, ovate to elliptic, (thin) pergamentaceous; base usually slightly oblique, attenuate; margin recurved; apex usually abruptly narrowed, acuminate to cuspidate; both sides glabrous; venation on upper surface slightly raised; midrib prominent to flattened towards the base, ribbed; lateral nerves 0.5–1.5 cm apart, almost perpendicular to midrib towards base, nervation distinctly looped; intercalated veins not distinctly curved towards the base; veins very densely reticulate; petiolule 3–14 mm long, flattened to slightly grooved above, glabrous; pulvinus 5–7 mm long, (slightly) grooved, distinct, glabrous. *Inflorescences* axillary or subterminal, not branching at the base, 3.5–35 cm long, laxly puberulous; panicles copiously flowered. *Bracts* and *bracteoles* 0.7–1 mm long. *Pedicels* 2–4 mm long. *Flowers* c. 6 mm in diam. *Sepals* with both sides glabrous, margin glabrous; outer ones broadly ovate, c. 2 by 1.5 mm; inner ones broadly obovate, c. 3 by 3 mm. *Petals* obovate, 2–3 by 1.5–2 mm; claw c. 0.2 mm high, outside and inside glabrous; margins lobed, thickened towards the base, velutinous to woolly; apex rounded; outside glabrous, inside woolly; scales absent. *Disc* glabrous. *Stamens* 8; filament c. 4 mm long, densely velutinous; anther c. 1 mm long, laxly puberulous. *Pistil:* ovary 2-locular, c. 3 mm high, sericeous; style and stigma 1.5–2 mm long, glabrous. *Fruits* with 2 well developed lobes, broadly obcordate, attenuate at the base, c. 2.5 cm high, c. 2.5 cm broad; outside rugose, glabrous, inside slightly ribbed; stipe c. 4 mm high; lobes c. 1.5 by 1.4 cm; style 1–1.5 mm long. *Seeds* not seen.

Field notes – Tree or shrub 6–10 m high, dbh c. 15 cm, multistemmed. Foliage dark green. Leaves light green. Flowers cream to pure white in large subterminal bunches and spikes of flowers in the axils of the leaves, with a definite to faint odour. Fruits 2-locular. Seed black, shining, with a pale yellow aril.

Distribution – Australia: Queensland (Cook District, S.F.R. 1073, Rockhampton, Coast Range, Rockingham Bay).

Habitat & Ecology – Rain forest; up to 440 m altitude; fl. Oct.–Mar., fr. Oct.

Notes – *Rhysotoechia flavescens* resembles *R. bilocularis*. Both have 2-locular ovaries and capsules, whereas all other species of *Rhysotoechia* have 3-locular ovaries and capsules; in many other characters the two species are also identical, making it hard to distinguish them.

However, the differences in the characters are constant between the species. In my opinion this is enough evidence to distinguish the species.

Rhysotoechia flavescens has been collected along the NE coast of Australia, *R. bilocularis* in Irian Jaya, Merauke District.

	Inflorescences	Margin of leaflets	Apex of leaflets
R. flavescens	solitary	recurved	abruptly narrowed
R. bilocularis	branching at the base	flattened to slightly recurved	not abruptly narrowed

7. **Rhysotoechia florulenta** S.T. Reynolds

Rhysotoechia florulenta S.T. Reynolds, Austrobaileya 3 (1991) 490. — Type: *Gray 5129*, Queensland, Cook District, S.F.R. 143, Parish of Kanawarra, Carbine L.A., Mt Lewis (BRI holo; iso BRI).

Tree. *Branchlets* (slightly) rough, reddish black; flowering twigs 2–4 mm thick. *Leaves* 2–4-jugate; petiole 3.5–4.5 cm long; rachis 6–9 cm long; both terete to slightly winged below the leaflets, ribbed, glabrous. *Leaflets* opposite or subopposite, 7.1–11.5 by 3.5–5.7 cm, index 2–3.2, elliptic, coriaceous; base slightly oblique, attenuate; margin scarcely recurved; apex obtuse, sometimes oblique; both sides glabrous; upper surface vernicose, lower one glossy; venation raised on both surfaces; midrib flattened, slightly ribbed; lateral nerves 1–1.5 cm apart, nervation open towards the base, looped towards the apex; intercalated veins not distinctly curved towards the base, veins densely reticulate; petiolule 10–17 mm long, slightly grooved, glabrous; pulvinus 3–7 mm long, slightly grooved, glabrous. *Inflorescences* axillary, not branching at the base, 10–34 cm long, panicles, copiously flowered. *Bracts* and *bracteoles* 0.5–1 mm long. *Pedicels* 4–5 mm long. *Flowers* 6–7 mm in diam. *Sepals* with both sides glabrous, margin laxly ciliate; outer ones broadly ovate, c. 3 by 2.5 mm; 3 inner ones elliptic-obovate, c. 4 by 3 mm. *Petals* broadly obovate, c. 2.5 by 3 mm; claw c. 1 mm high, both sides glabrous; margins scarcely lobed, pilose towards the base; apex rounded; outside laxly pubescent towards the base, inside glabrous; scales free, c. 2.5 mm long with distinct crest-like appendages, sparsely pubescent on surface and pilose on margins. *Disc* glabrous. *Stamens* 8; filament c. 2 mm long, velutinous towards the base; anther c. 1 mm long, glabrous. *Pistil:* ovary 3-locular, c. 1 mm high, subglabrous; style and stigma c. 1 mm high, glabrous. *Fruits* not seen.

Field notes – Tree, 15 m high. Flowers with green or creamy green calyx and cream corolla.

Distribution – Australia: Queensland (Cook District, Parish of Kanawarra, Carbine L.A., Mt Lewis).

Habitat & Ecology – Rain forest; 1100 m altitude; fl. Oct.

8. **Rhysotoechia gracilipes** Radlk.

Rhysotoechia gracilipes Radlk. in Engl. & Prantl, Nat. Pflanzenfam. III, 5 (1895) 347; Bot. Jahrb. 56 (1920) 291; in Engl., Pflanzenr. 98 (1933) 1215. — Lectotype (here chosen): *MacGregor s.n.*, Lowland of British New Guinea (M holo; iso MEL).

Habit unknown. *Branchlets* smooth to slightly rough, reddish black to brownish black; flowering twigs c. 4 mm thick. *Leaves* 1–4-jugate; petiole 6.5–8 cm long; rachis 12–16 cm long; both terete, very slender, ribbed, glabrous. *Leaflets* opposite, 10–15 by 4.5–6.8 cm, index 2.1–3.5, usually ovate, sometimes elliptic, papery to thin pergamentaceous; base symmetric, attenuate; margin not recurved; apex abruptly narrowed, caudate; both sides glabrous; venation on upper surface slightly raised; midrib prominent, distally flattened, slightly ribbed to smooth; lateral nerves 9–18 mm apart, nervation looped; intercalated veins curved towards the base; veins densely reticulate; petiolule 1–1.8 cm long, flattened, glabrous; pulvinus 3–8 mm long, distinctly grooved, not very prominent, glabrous. *Inflorescences* subterminal, not branching at the base. *Bracts, bracteoles, pedicels* and *flowers* not observed. *Fruits* with 3 well developed lobes, obcordate, c. 1.5 cm high, c. 1.2 cm broad; outside rugose, laxly puberulous, inside densely papillose; stipe c. 3 mm high; lobes 0.8–1.5 by 0.5–0.8 cm; style c. 1 mm long. *Seed* obcordate, c. 1.2 by 1 cm; hilum c. 2 mm diameter; pseudohilum c. 3 mm diameter.

Distribution – Malesia: Papua New Guinea (Gulf Prov.).

Ecology – Fr. Dec.

Note – All the vegetative parts are delicate and slender. The rachis, petiole and petiolules are, in some specimens, only 1 mm thick.

9. **Rhysotoechia grandifolia** Radlk.

Rhysotoechia grandifolia Radlk., Sapind. Holl.-Ind. (1879) 62, 98; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 542, 657; in Engl., Pflanzenr. 98 (1933) 1212. — Lectotype (here chosen): *Korthals 11*, Borneo (L holo; iso L).

Rhysotoechia grandiflora Radlk. ex Merr., J. Str. Br. Roy. As. Soc., special issue (1921) 361, misspelled name.

Shrub. *Branchlets* slightly rough, reddish to brownish black; flowering twigs c. 6 mm thick. *Leaves* 2–4-jugate, rarely with a subterminal leaflet; petiole 4–10 cm long; rachis 3–20 cm long; both terete to flattened above, slightly ribbed, glabrous. *Leaflets* opposite, rarely subopposite, 13–24 by 6.5–9.5 cm, index 2.1–3, ovate to elliptic, cartilaginous; base symmetric, sometimes slightly oblique, usually abruptly narrowed, attenuate; margin not or only slightly recurved; apex abruptly narrowed, acuminate; both sides glabrous; midrib prominent, ribbed; lateral nerves 1.5–3 cm apart, nervation open towards the base, looped towards the apex; intercalated veins curved towards the base; veins laxly reticulate; petiolule 15–20 mm long, flattened to slightly grooved, glabrous; pulvinus 5–7 mm long, grooved, prominent to bulbously thickened, glabrous. *Inflorescences, flowers* and *fruits* not observed.

Field notes – Solitary shrub 2 m high. Fruits red.

Distribution – Malesia: Borneo (Kalimantan); Moluccas (Geben, Obi I., W part, Jikodolong).

Habitat & Ecology – Rather open coastal forest, transition zone between coral sand beach and red porous nickel soil; 30 m altitude; fr. Nov.

Notes – None of the three collections studied bore inflorescences or fruits (the fruits Radlkofer saw belonged to the Korthals collection). The leaf characters of the collection made by Korthals showed a remarkable similarity with *R. ramiflora*. Still,

the leaves in the other two collections (*de Vogel 4256* and *Teijsmann 7488*) of *R. grandifolia* were much thicker than in *R. ramiflora*, including the pulvini. According to Radlkofer, *R. grandifolia* has sessile fruits, in contrast with *R. acuminata* (now reduced to *R. ramiflora*) whose fruits are distinctly stipitate. Also, the pulvini of *R. grandifolia* are 'bulbously thickened' and not normally thickened as in *R. ramiflora*. The latter cannot be seen in the Korthals-collection.

Although I doubt that *R. grandifolia* can be separated from *R. ramiflora*, the absence of flowers and fruits in the specimens studied and the fact that the leaves are much thicker in *de Vogel 4256* and *Teijsmann 7488*, restrain me from concluding that *R. grandifolia* and *R. ramiflora* are the same species.

10. **Rhysotoechia koordersii** Radlk.

Rhysotoechia koordersii Radlk. in Engl. & Prantl, Nat. Pflanzenfam., Nachtr. 3 (1907) 206; in Koord.-Schum., Syst. Verz. 3 (Celebes) (1914) 75; in Fedde, Rep. 18 (1922) 343; in Engl., Pflanzenr. 98 (1933) 1213. — Type: *Koorders 18844*, Menado (M holo; iso BO, K, L).

Rhysotoechia mortoniana auct. non (F. Muell.) Radlk.: Koorders, Meded. Lands Plantentuin 19 (1898) 407.

Tree. *Branchlets* rough to smooth, greenish brown to greyish or reddish black; flowering twigs 3–6 mm thick. *Leaves* 1–4-jugate; petiole 2–11 cm long, slightly angular to terete, sometimes slightly winged below the lowest pair, (slightly) ribbed, glabrous; rachis 2.5–20 cm long, angular, slightly winged below the leaflets, ribbed, glabrous. *Leaflets* usually subopposite, sometimes opposite, 6–23 by 1–11 cm, index 2–3.7, obovate to elliptic, coriaceous; base sometimes very slightly oblique but never distinctly so, acute to attenuate; margin not or only slightly recurved; apex obtuse to distinctly acuminate, then always abruptly narrowed; both sides glabrous; venation on upper surface slightly raised; midrib prominent, smooth to angular; lateral nerves 0.5–3 cm apart, nervation open towards the base, looped towards the apex; intercalated veins curved towards the base; veins laxly reticulate; petiolule a pulvinus only or up to 10 mm long, slightly grooved, glabrous; pulvinus 2–5 mm long, grooved, slightly prominent to indistinctly so, glabrous. *Inflorescences* axillary, branching at the base, 1–19 cm long, laxly puberulous; thyrses with cymules of 1 flower. *Bracts* and *bracteoles* 0.5–1 mm long. *Pedicels* 4–9 mm long. *Flowers* c. 7 mm in diam. *Sepals* with both sides glabrous, margin ciliate; outer ones broadly ovate, 2.5–3 by 2.5 mm; inner ones orbicular, 3–3.5 by 3 mm. *Petals* broadly obovate, c. 2.5 by 2 mm; claw c. 0.8 mm high, both sides pilose; margins coarsely lobed, slightly thickened towards the base, densely pilose; apex rounded; outside pilose, inside laxly pilose; scales absent. *Disc* glabrous. *Stamens* 8; filament c. 3 mm long, velutinous towards base; anther c. 0.5 mm long, puberulous. *Pistil*: ovary 3-locular, c. 1 mm high, densely sericeous; style c. 2 mm long, laxly puberulous. *Fruits* with 1–3 well developed lobes, obcordate, attenuate at the base, 1.8–2.5 cm high, 1.3–1.5 cm broad; outside rugose, very laxly puberulous, inside not papillose; stipe 5–7 mm high; lobes 0.8–1 by 0.6–0.7 cm; style and stigma c. 0.5 mm long. *Seeds* not observed.

Field notes – Tree 3–19 m high, dbh 2–25 cm. Outer bark smooth, dark green to blackish brown. Inner bark yellowish to ochre, thin. Sapwood pale yellow to white

with bitter odour. Flowers creamy white. Immature fruits green to greenish yellow, mature ones orange-red. Seed black with a yellow aril.

Distribution – Malesia: Borneo (Kalimantan: Kota Belud District; Beluran District, Batu Kumpai), Sulawesi (Malili; Minahassa).

Habitat & Ecology – Forest; sea-level up to 700 m altitude; fl. Apr., fr. May.

Vernacular names – Osolemarto (Tabela), torusin tjoetoeng (Tontemboan).

Notes – *Rhysotoechia koordersii* shows an overall similarity to *R. ramiflora*; the differences are best observed in the specimens from Sulawesi.

	Leaflet form	Leaflet apex	Petiolule
R. ramiflora	ovate to elliptic	acute to cuspidate	7–22 mm
R. koordersii	obovate to elliptic	obtuse to acuminate	0–10 mm

The overlap in petiolule length is caused by the *R. koordersii* specimens from Kalimantan. The differences between *R. koordersii* and *R. ramiflora* are clear enough to keep the species separate.

11. **Rhysotoechia mortoniana** (F. Muell.) Radlk.

Rhysotoechia mortoniana (F. Muell.) Radlk., Sapind. Holl.-Ind. (1879) 62; in Engl., Pflanzenr. 98 (1933) 1212; Domin, Bibl. Bot. 89 (1927) 905; S.T. Reynolds, Austrobaileya 2 (1984) 42; Fl. Australia 25 (1985) 64. — *Cupania mortoniana* F. Muell., Fragm. 5 (1866) 177. — Type: *Dallachy s.n.*, Rockingham Bay (MEL holo; iso M, MEL).

Tree or shrub. *Branchlets* (slightly) rough, reddish to greyish black to light brown; flowering twigs 3–4 mm thick. *Leaves* 1–3-jugate; petiole 2.8–5 cm long; rachis 3–12 cm long; both terete to flattened above, usually slightly winged below the leaflets, ribbed, glabrous. *Leaflets* opposite to subopposite, 4.5–14 by 2.3–6.5 cm, index 2–3.2, usually ovate, sometimes elliptic, pergamentaceous; base slightly oblique, attenuate; margin scarcely recurved; apex rarely abruptly narrowed, acute to acuminate, sometimes obtuse; both sides glabrous; venation raised on both surfaces; midrib flattened, slightly ribbed; lateral nerves 0.5–1.5 cm apart, nervation distinctly looped; intercalated veins not distinctly curved towards the base; veins very laxly reticulate; petiolule 8–15 mm long, (slightly) grooved, glabrous; pulvinus 2–5 mm long, slightly grooved, not very distinct, glabrous. *Inflorescences* axillary or subaxillary, branching at the base or not, 4–17 cm long, laxly puberulous; panicles. *Bracts* and *bracteoles* 0.2–0.5 mm long. *Pedicels* 5–9 mm long. *Flowers* 8–9 mm in diam. *Sepals* with both sides glabrous, margin laxly ciliate; outer ones broadly ovate, 2–2.5 by 2–2.5 mm; inner ones orbicular, 4.5–5 by 4–5 mm. *Petals* broadly elliptic, c. 4 by 3 mm; claw c. 1 mm high, both sides velutinous; margins scarcely lobed, strongly recurved towards the base, glabrous; apex rounded; outside velutinous towards the base, inside glabrous; scales free, c. 0.7 mm high, velutinous towards the base, otherwise glabrous. *Disc* glabrous. *Stamens* 8; filament c. 5 mm long, laxly velutinous; anther c. 1.5 mm long, glabrous. *Pistil:* ovary 3-locular, c. 3 mm high, glabrous; style c. 1.5 mm long, glabrous; stigma c. 0.5 mm long, glabrous. *Fruits*

with 3 well developed lobes, broadly obcordate, 1.2–1.7 cm high, 1.5–2.5 cm broad; outside ribbed, glabrous, inside densely papillose; stipe 3–5 mm high; lobes c. 1 by 1.4 cm; style c. 1.5 mm long. *Seeds* obovoid to rounded, 1–1.5 by 1 cm; hilum 0.5–1 mm diameter; pseudohilum 3–4 mm diameter.

Field notes – Tree or shrub 5–10 m high, multistemmed, straight; dbh 7.5–10 cm. Foliage dark to pale green, glossy. Flowers white with a sweet perfume.

Distribution – Australia: Queensland (Cook District; Karumba; Rockingham Bay); New South Wales (Ballina, Bellingen).

Habitat & Ecology – Simple notophyll vine forest; hilly to mountainous terrain. Soil derived from granite; 700 m altitude; fl. June–July, fr. Aug.

Note – One specimen from Rockingham Bay had thicker and longer-stalked leaflets than any other specimen. This specimen bore neither flowers nor fruits.

12. **Rhysotoechia multiscapa** Etman, *spec. nov.* — Fig. 6

Rhysotoechia robertsonii similis sed thyrsis cymulis 1- vel 2-floribus munitis basi ramosis, petiolulis 5–10 mm longis, petalorum margine glabre differt. — Typus: *Carr 14999*, New Guinea, Boridi (L holo; iso CANB).

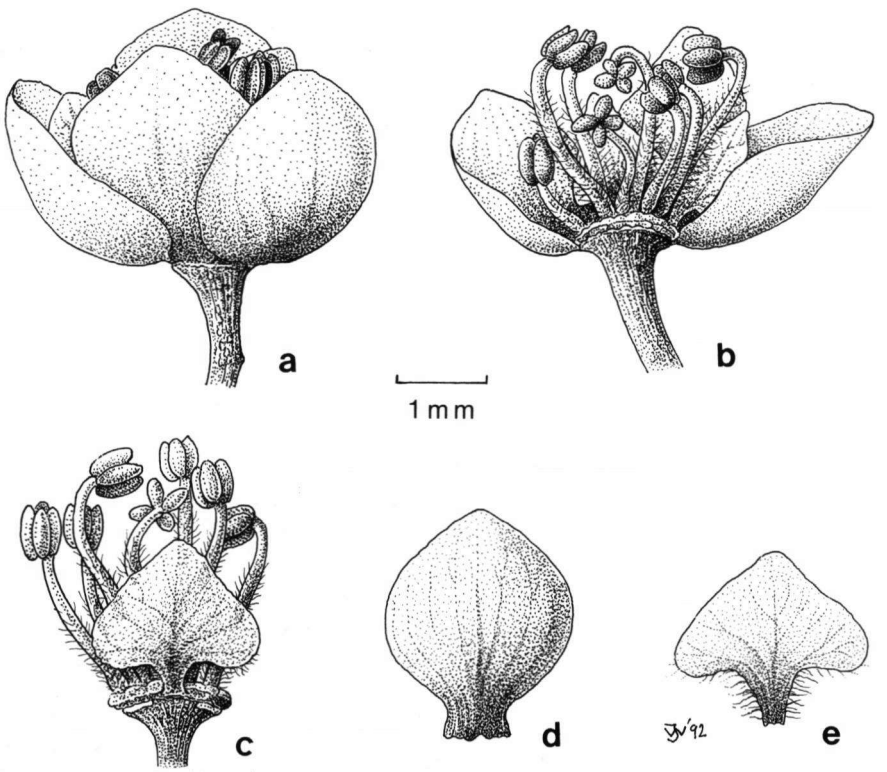

Fig. 6. *Rhysotoechia multiscapa* Etman. a. Male flower; b. ibid., one sepal removed; c. ibid., one petal left; d. sepal; e. petal (a–e: *Carr 14999*).

Tree. *Branchlets* rough, greyish black; flowering twigs 4–7 mm thick. *Leaves* 2–4-jugate; petiole 2–6 cm long; rachis 2–8.5 cm long; both terete to flattened above, ribbed, glabrous, sublignose. *Leaflets* opposite to subopposite, 8–14 by 2.5–5 cm, index 2.3–3.6, usually elliptic, sometimes obovate or ovate, coriaceous; base symmetric, not abruptly narrowed, acute to attenuate; margin not or only slightly recurved; apex acute to acuminate, then somewhat abruptly narrowed; both sides glabrous; venation on upper surface slightly raised; midrib prominent, smooth to angular, very laxly puberulous; lateral nerves 0.5–1.8 cm apart, nervation open towards the base, looped towards the apex; intercalated veins curved towards the base; veins densely reticulate; petiolule 5–10 mm long, flattened to grooved towards the pulvinus, glabrous; pulvinus 3–5 mm long, grooved, slightly prominent, glabrous. *Inflorescences* axillary or subterminal, branching at the base, 1–9 cm long, very laxly puberulous; thyrses with cymules of 1 or 2 flowers, copiously flowered. *Bracts* and *bracteoles* c. 1 mm long. *Pedicels* c. 2 mm long. *Flowers* c. 4 mm in diam. *Sepals* with both sides glabrous; outer ones broadly ovate, c. 1.5–1.7 by 1.8–2 mm, margin very laxly ciliate; inner ones orbicular, 2.2–2.5 by 2 mm, margin laxly ciliate. *Petals* broadly obovate, 1.8–2 by 2–2.4 mm; claw 0.5–0.6 mm high, inside glabrous, outside densely pilose; margins coarsely lobed, thickened towards the base, sometimes slightly recurved towards the base, glabrous; apex rounded; both sides pilose towards the base; scales absent. *Disc* glabrous. *Stamens* 8; filament 2.2–2.5 mm long, velutinous; anther c. 0.5 mm long, glabrous to very laxly puberulous. *Pistil* immature; ovary 3-locular, sericeous; style and stigma not observed. *Fruits* not observed.

Field notes – Tree c. 16.5 m tall. Flowers creamy yellow.

Distribution – Malesia: Papua New Guinea (Owen Stanley Range, Boridi).

Habitat & Ecology – Forest; 1280 m altitude; fl. Nov.

13. **Rhysotoechia obtusa** Etman, *spec. nov.*

Foliolorum apice obtuso distaliter parum emarginato, costa supra applanata vel parum impressa, capsulis estipitatis. — Typus: *NGF 27986*, New Guinea, Central District, Brown River (L holo; iso A, CANB, LAE).

Tree or shrub. *Branchlets* rough, greenish black to greyish or reddish black; flowering twigs 4–7 mm thick. *Leaves* 1–4-jugate, often with a terminal leaflet; petiole 2.5–6 cm long, terete to angular, usually slightly winged below the lowest pair, ribbed, glabrous; rachis 2.5–10.5 cm long, angular, slightly winged below the leaflets, ribbed, glabrous. *Leaflets* opposite to subopposite, 7–16 by 3–6 cm, index 2.6–3.1, ovate to elliptic, rarely obovate, (thick) pergamentaceous; base sometimes very slightly oblique, usually abruptly narrowed, attenuate; margin (slightly) recurved; apex obtuse, slightly emarginate; both sides glabrous; venation on upper surface slightly raised; midrib flattened to slightly sunken, angular; lateral nerves 0.7–2.5 cm apart, nervation open towards the base, looped towards the apex; intercalated veins curved towards the base; veins laxly reticulate; petiolule 6–11 mm long, grooved, glabrous; pulvinus 2–5 mm long, grooved, glabrous. *Inflorescences* axillary or subterminal, branching at the base, 1–4 cm long, puberulous; panicles. *Bracts* and *bracteoles* to 0.5–1 mm long. *Pedicels* 1.5–2 mm long. *Flowers* not observed. *Fruits* with 3 well developed lobes, 1.5–1.8 cm high, 2–2.5 cm broad; outside

smooth to slightly rugose, laxly strigose, laxly papillose; inside densely papillose; stipe absent; lobes 0.9–1.4 by 1.1–1.3 cm; style not observed. *Seeds* immature or ripe seeds for the greater part eaten, ellipsoid; hilum 0.5 mm diameter; pseudohilum 5 mm diameter.

Field notes – Tree or shrub 4–6 m tall. Outer bark grey to dark grey to light brown. Middle bark light green. Inner bark cream. Wood of medium hardness, straw-coloured. Leaflets elliptic, bluish to dark green to medium green above, light to pale green below. Flowers creamy. Fruit: valves reflexed, red. Seed black with striate coat on orange torus.

Distribution – Malesia: Papua New Guinea (Central Prov., Port Moresby Subprov., Brown River; north of Little Mt Lawes; Gauguri, Arona; Laloki River).

Habitat & Ecology – Low-lying country in or at the edge of mixed secondary forest; often subject to flooding; at sea-level; fl. Sept, fr. Dec.–Jan.

14. **Rhysotoechia ramiflora** Radlk.

Rhysotoechia ramiflora Radlk., Sapind. Holl.-Ind. (1879) 19, 62; Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 542, 657; in Engl., Pflanzenr. 98 (1933) 1214. — Type: *Beccari it. sec. 10.*, Sulawesi (M holo).

Rhysotoechia acuminata Radlk., Philipp. J. Sci. 8, Bot. (1913) 465, 466; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 510; Radlk. in Engl., Pflanzenr. 98 (1933) 1213. — Type: *Loher 5882*, Philippines, Luzon, Rizal Prov., Montalban (M holo; iso K).

Rhysotoechia striata Radlk., Philipp. J. Sci. 8, Bot. (1913) 466; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 510; Radlk. in Engl., Pflanzenr. 98 (1933) 1213. — Lectotype (here chosen): *Clemens 1067*, Philippinses, Mindanao (M holo; iso M).

Tree or shrub. *Branchlets* smooth to slightly rough, greyish black to reddish black to light brown; flowering twigs 4–13 mm thick. *Leaves* 1–4-jugate; petiole 3–17 cm long, terete to flattened above; rachis 4.5–22 cm long, terete to flattened above to slightly angular; both usually slightly winged below the leaflets, (slightly) ribbed, glabrous. *Leaflets* opposite to subopposite, rarely alternate, 9–31 by 4–12 cm, index 1.8–3.3, ovate to elliptic, rarely obovate, pergamentaceous to coriaceous; base symmetric, sometimes slightly oblique, attenuate, rarely acute; margin not to slightly recurved; apex often abruptly narrowed, usually acuminate, sometimes obtuse, acute or cuspidate, both sides glabrous; venation on upper surface slightly raised; midrib prominent, angular to ribbed; lateral nerves 1–3 cm apart, nervation open towards the base, looped towards the apex; intercalated veins curved towards the base; veins laxly reticulate; petiolule 7–22 mm long, flattened to slightly grooved, glabrous; pulvinus 3–10 mm long, grooved, (slightly) prominent, glabrous. *Inflorescences* axillary, subterminal or ramiflorous, branching at the base or not, to 7–13 cm long, very laxly puberulous to glabrous; thyrses with cymules of 1 flower. *Bracts* and *bracteoles* 0.5–1 mm long. *Pedicels* 2–4 mm long. *Flowers* 6–8 mm in diam. *Sepals* with both sides glabrous; outer ones broadly elliptic, c. 2.5 by 2 mm, margin laxly ciliate; inner ones broadly ovate, c. 3.5 by 2.5 mm, margin ciliate. *Petals* broadly obovate, 1.6–2 by 1.8–2 mm; claw 0.2–0.4 mm high, outside pilose, inside glabrous; margins lobed, pilose; apex rounded; outside (laxly) pilose, inside glabrous; scales absent. *Disc* glabrous. *Stamens* 8; filament 3–5 mm long, velutinous towards the base; anther c. 1 mm long, puberulous. *Pistil:* ovary 3-locular,

c. 1 mm long, densely sericeous; style and stigma c. 2 mm long, the first laxly puberulous. *Fruit* with 1–3 well developed lobes, obcordate, 1.8–2.5 cm high, 1.6–2.1 cm broad; outside rugose to ribbed, laxly puberulous, inside (densely) papillose; stipe 5–10 mm high; lobes 1–1.5 by 0.7–0.9 cm; style 0.5–1 mm long. *Seed* ellipsoid or ovate, 1–1.7 by 0.6–1 cm; hilum 2–3 mm diameter; pseudohilum 0.4–1.1 cm diameter.

Field notes – Tree, shrub or liana 2–8 m, dbh 3–30 cm, sparsely branched. Bark smooth, grey brown, thin. Living bark 4 mm thick, light brown. Wood white, centre black. Flowers, when immature, light yellow green. Fruits yellow to orange to crimson.

Distribution – Malesia: Borneo (East Kalimantan), Philippines (Luzon, Samar, Mindanao, Sulu), Sulawesi.

Habitat & Ecology – Mixed dipterocarp forest, in forest margins, riverbanks or forest slopes or limestone hills; 30–600 m altitude; fl. May–June and Oct.–Nov., fr. Feb.–May.

Notes – The present species is very variable in a number of characters, for example: form and thickness of the leaflets, smoothness of petiole and rachis, orientation of the inflorescences on the branches, form of the fruits, and length of the stipe.

Several of these characters were used by Radlkofer (1933) to distinguish *R. acuminata* and *R. striata*. He delimits the species as follows:

— Thyrses robust, as long as the leaves, solitary or two- or three-fasciculate; leaflets moderately large, broadly lanceolate, apex acuminate, chartaceous, green to pale yellow when dry; petiolule slightly thickened at the base; capsule moderately long stipitate ..... *R. acuminata*
— Thyrses small, mostly at lower parts of the branches, several-fasciculate; petiole and rachis clearly striate; leaflets big, elliptic, apex acute, subcoriaceous, upper side pale yellow, lower side green, with secretory cells; petiolule almost totally thickened and wrinkled; capsule rather stipitate ..... *R. striata*

Specimens with the characteristics of *R. acuminata* (as described by Radlkofer) have been collected mainly in Luzon (northern Philippines), whereas specimens with the characteristics of *R. striata* have been collected in Mindanao (southern Philippines). These are almost all type specimens.

For these specimens and a few others the characters as used by Radlkofer were diagnostic, especially the characters: thyrses solitary or in fascicles; petiole and rachis smooth or striate; apex of leaflets acute or acuminate.

However, most of the specimens cannot be placed with certainty. They have, for example, 4–6-fascicled thyrses and a smooth petiole and rachis, or in others the apex is acuminate and the petiole and rachis are both striate. There is a large overlap in the character states used. No character states can be found showing correlation between specimens. In my opinion this is enough evidence to place *R. acuminata* and *R. striata* in one species. Furthermore, there is a striking similarity between the type specimens of *R. ramiflora* and *R. acuminata*. The only difference is that *R. ramiflora* has a very short petiolule, something that is also observed in *R. koordersii* but not in *R. acuminata*. The fact that both *R. ramiflora* and *R. koordersii* have been collected

in Sulawesi would be another reason to suppose that these species are conspecific, since *R. koordersii* and *R. acuminata* are in most other characters identical. However, for two reasons I do not think that *R. ramiflora* and *R. koordersii* are conspecific:

a) The drawing that goes with the type specimen of *R. ramiflora* clearly shows an ovate leaflet. This is characteristic of *R. acuminata* and was never seen in *R. koordersii*.
b) The form and the nervature of the leaflets of the type specimen of *R. ramiflora* looks remarkably like one specimen of *R. acuminata* from Tawi-Tawi (Sulu Prov., July/Aug. 1924, *BS (Ramos & Edaño) 44023*).

The studied specimen of *R. ramiflora* contains only 2 leaflets and some fruits. As stated above, it shows similarity to *R. acuminata*, especially to one specimen from Tawi-Tawi. The only difference in these specimens is that *R. ramiflora* had shorter petiolules. The character state Radlkofer noticed, i.e. the inflorescences being ramiflorous, is now also seen in other specimens of *R. acuminata*, and can therefore no longer be the reason for separating these species.

See the note under *R. koordersii* for differences between that species and *R. ramiflora*.

One specimen from Borneo (Balikpapan, *Afriastini 140*) was described as a liana. Probably this is an error.

15. **Rhysotoechia robertsonii** (F. Muell.) Radlk.

Rhysotoechia robertsonii (F. Muell.) Radlk., Sitzungsber. Mat.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 9 (1879) 542, 657; in Engl., Pflanzenr. 98 (1933) 1214; Domin, Bibl. Bot. 89 (1927) 905; S.T. Reynolds, Austrobaileya 2 (1984) 42; Fl. Australia 25 (1985) 65. — *Cupania robertsonii* F. Muell., Fragm. 5 (1866) 146. — Type: *Dallachy s.n.*, Rockingham Bay (MEL holo; iso L, M, MEL).

Rhysotoechia contermina Domin, Bibl. Bot. 89 (1927) 905. — Type: *Domin s.n.*, Harvey's Creek.

Tree. *Branchlets* rough to smooth, greenish brown to greyish brown; flowering twigs 4–6 mm thick. *Leaves* 1–4-jugate; petiole 1.3–6 cm long, terete to flattened above; rachis 2.5–8 cm long, angular; both slightly winged below the leaflets, slightly ribbed, laxly puberulous to glabrous. *Leaflets* opposite to alternate, 6–20 by 2–7 cm, index 2.2–4.8, ovate to elliptic, pergamentaceous; base sometimes slightly oblique, acute to attenuate; margin (slightly) recurved; apex sometimes abruptly narrowed, acute to cuspidate; both sides very laxly puberulous; venation on upper surface slightly raised; midrib prominent, angular; lateral nerves 0.5–1.5 cm apart, nervation open towards the base, looped towards the apex; intercalated veins not very distinct; veins densely reticulate; petiolule a pulvinus only or to 4 mm long, flattened above, very laxly puberulous; pulvinus 1–2 mm long, slightly grooved, not very distinct, very laxly puberulous. *Inflorescences* axillary, not branching at the base, 10.5–17.5 cm long, laxly puberulous; panicles. *Bracts* and *bracteoles* 0.5–0.7 mm long. Pedicels 1–2 mm long. *Flowers* c. 4–5 mm in diam. *Sepals* with both sides glabrous, margin ciliate; outer ones broadly ovate, 1.5–2 by 1–1.2 mm; inner ones orbicular to elliptic, 2–2.5 by 1.5–2 mm. *Petals* obovate, 1.2–1.5 by 1–1.5 mm; claw c. 0.2 mm high, glabrous; margins lobed, thickened towards the base, pilose; apex rounded; outside

pilose only at the base, inside pilose towards the base; scales absent. *Disc* glabrous. *Stamens* 8; filament c. 3 mm long, velutinous towards the base; anther c. 0.8 mm long, sometimes with a few hairs. *Pistil:* ovary 3-locular, c. 2 mm high, laxly sericeous towards the style; style c. 1 mm long, laxly sericeous; stigma 0.5–0.7 mm long, laxly strigose. *Fruits* with 3 well developed lobes, reniform to depressed globose, 1.7–2.5 cm high, 2–2.5 cm broad; outside rugose, glabrous, inside densely papillose; stipe 2–3 mm high; lobes 1–1.2 by 1.2–2.2 cm; style c. 1 mm long. *Seeds* obovoid, 1–1.3 by 0.8–1 cm; hilum c. 0.5 mm diameter; pseudohilum c. 2 mm diameter.

Field notes – Tree 6–25 m high, dbh 10–75 cm, low buttressed; bole 10–12 m. Outer bark patchy grey to dark grey to brown to green, (moderately) smooth except for the fine cracking and stippling. Scrape red brown. Inner bark fibrous, cream. Wood pinkish straw to cream. Blaze fibrous, pink-brown to red with cream streaks. Leaves dark green to bright shining green to light green to dull green. Flowers white to yellow, calyx pale green. Fruits pale yellow to orange to red with an apricot blush on one side. Seed black with pale watery arillus, immersed in whitish glue-like pectin.

Distribution – Malesia: Papua New Guinea (Western Prov., Agu River branch of the middle Fly River; SE corner of Lake Murray). Australia: Queensland (Cook and N Kennedy Districts).

Habitat & Ecology – Found in rain forests on low hills and riverbanks. Soil alluvial, dark clay loam; vegetation with *Eugenia,* and *Callistemon* as dominant species; 21–450 m altitude; fl. July–Oct., fr. Oct.–Dec.

Note – Only two of the four specimens of the *Domin* collection proved to be *R. robertsonii.* The other two specimens of this collection belong to another genus, according to Reynolds (1984): *Diploglottis harpullioides* S.T. Reynolds.

IMPERFECTLY KNOWN SPECIES

16. Rhysotoechia sp.

Tree. *Branchlets* smooth to slightly rough, brownish black to greyish black; flowering twigs c. 5 mm thick. *Leaves* 3–5-jugate; petiole 5–10 cm long, terete, smooth, glabrous; rachis 8–17 cm long, terete, sometimes slightly winged below the leaflets, smooth, glabrous. *Leaflets* opposite to subopposite, 10–22 by 4–7 cm, index 2.3–3.1, elliptic, (thick) pergamentaceous; base symmetric, attenuate; margin not or only slightly recurved; apex abruptly narrowed, acuminate to cuspidate; both sides glabrous; venation on upper surface slightly raised; midrib flattened to prominent, smooth to ribbed; lateral nerves 0.5–2.5 cm apart, nervation open towards the base, looped towards the apex; intercalated veins curved towards the base; veins densely reticulate; petiolule 5–15 mm long, slightly grooved, glabrous; pulvinus 1–4 mm long, grooved, (slightly) prominent, sometimes wrinkled, glabrous. *Inflorescences* axillary, branching at the base, 1–8 cm long, very laxly puberulous; thyrses with cymules of 1 flower. *Bracts* and *bracteoles* 0.1–0.3 mm long. *Pedicels* 1–1.5 mm long. *Flowers* in bud. *Sepals* with both sides glabrous; outer ones broadly ovate, margin laxly ciliate; inner ones orbicular, margin (laxly) ciliate. *Petals* orbicular; claw absent to very short; margins lobed, glabrous; apex rounded; outside velutinous towards the base, inside

pilose towards the base; scales free, not very distinct, pilose. *Disc* glabrous. *Stamens* 8; filament densely velutinous towards the base; anther glabrous. *Pistil:* ovary 3-locular, glabrous; style and stigma very immature, glabrous. *Fruits* not observed.

Field notes – Tree c. 1.8 m. Leaves dark green above, light green below. Flowers pale yellowish green; anthers cream.

Distribution – Malesia: Irian Jaya (Radjah Ampat, Waigeo Island, Go Istmus).

Habitat & Ecology – Upper stretches of creek in primary forest; c. 30 m altitude; fl. Feb.

Note – This may be a new species, but the material is too scant to be certain. Known only from one specimen: *van Royen 5527.*

17. **Rhysotoechia longipaniculata** Kaneh. & Hatus.

Rhysotoechia longipaniculata Kaneh. & Hatus., Bot. Mag. Tokyo 57 (1943) 79, f. 8. — Type: *Kanehira & Hatusima 11534*, New Guinea, Nabire (n.v.).

18. **Rhysotoechia momiensis** Kaneh. & Hatus.

Rhysotoechia momiensis Kaneh. & Hatus., Bot. Mag. Tokyo 57 (1943) 81, f. 9. — Type: *Kanehira & Hatusima 14148*, New Guinea, Momi (n.v.).

IDENTIFICATION LIST

Reference numbers are those used for the species in the present paper; collections without a collector's number have not been mentioned in this list.

Afriastini 140: 14 — AQ 540113: 2.
Bäuerlen 1938a: 2 — Beaman 9314: 10 — Beccari it. sec. 10: 14 — Blake 14971: 11 — Boyland & Gillieatt 543: 15 — Brass 33498: 15 — BS series 778, 978, 1067, 13165, 17481, 24270, 34146, 44023, 45378, 45455, 49257: 14 — Burley & Tukirin 669: 14.
Carr 14999: 12 — Cel/III series 33, 180: 10 — Clemens 1067: 14 — Croat 52925: 5.
Dockrill 1082: 15 — Domin 6241, 6242: 15.
Edaño 8461: 14 — Endert 3544: 14.
FB series 21086: 14 — Flecker 11792: 15 — Floyd & Hoogland 3834: 1 — Forster 5063, 7486: 2 — Frodin 8094: 13.
Gibsen T10351: 2 — Gray 840: 15; 3423: 11; 5129: 7.
Hyland 8649, 8650: 6; 9209, 9257: 15.
Irvine 1726: 15.
Kartawinata 888: 10 — Kjellberg 2749: 10 — Koorders 18844: 10 — Korthals 11: 9 — Kostermans 4823, 6988, 13767: 14.
LAE series 56036: 5 — Leighton 726: 10 — Loher 5882: 14.
MacDonald 84: 2 — Moriarty 2175: 15.
NGF series 4562, 27986: 13; 28799: 5; 29309: 4 — N.Y. 94: 5.
O'Shanesy 246: 2.
Paijmans 113: 1 — PNH series 34452: 14 — Pullen 7407, 7455: 15.
Rau 216: 13 — van Royen 4710: 3.
SAN series 92985: 10 — Sankowsky & Sankowsky 409: 11 — Schodde 3301: 11; 3365: 2 — Smith 4273: 11 — Streimann 8678: 4.
Teijsmann 7488: 9.
de Vogel 4256: 9 — Volck 2213: 15.
Webb & Tracey 3748: 11; 6276, 13198: 15; 13210: 11 — White 772: 11.