

**POTENTILLA (ROSACEAE) IN NEW GUINEA:
CENSUS, KEY, AND SOME NEW TAXA**

C. KALKMAN

Rijksherbarium, Leiden, The Netherlands

SUMMARY

A renewed study has been made of the *Potentilla* species of New Guinea. Fourteen species are recognized, twelve of which are endemic. Distribution data are given and a census of the taxa. A key to species and varieties is added. Four new species and two new varieties are described.

INTRODUCTION

New concepts and new taxa

Since the publication of my paper on Malesian *Potentilla* (Kalkman, 1968) much new material of the genus has been collected on the mountains of New Guinea, providing us with a much more adequate, although still incomplete, picture of the taxa and their areas of distribution.

Renewed study led me to change the concept of *P. foersteriana* Laut. In 1968 three varieties were recognized: var. *foersteriana*, var. *ima* Kalkman, and var. *brassii* (Merr. & Perry) Kalkman. Now having a better view of the variation, I decided to restore var. *brassii* to its original rank of species. In *P. brassii* Merr. & Perry two new varieties, entirely based on recent collections (var. *simplex* Kalkman and var. *strigosa* Kalkman) can be distinguished.

Potentilla brassii plants form dense rosettes with small leaves and the rosettes are often branching and growing into sometimes large cushions. This growth habit is also found in two newly described species, which may superficially look alike, but of which the characters of leaf and flower (epicalyx) show clear differences. They are called *P. irianensis* Kalkman and *P. manganii* Kalkman.

On re-examination also var. *ima* appeared to hide a few specimens that can better be recognized as a taxon different on the specific level from *P. foersteriana*. It is here described as *P. gorokana* Kalkman.

In his Alpine Flora of New Guinea, Van Royen (1983) described *P. wilhelminensis* Royen, based on three old specimens (1913, 1936) from two mountains in Irian Jaya, that I had tentatively put together as '*Potentilla* prob. nov. spec.' Most remarkable is that neither Brass nor Mangan later collected the species on Mt Trikora (= Mt Wilhelmina) and that neither Raynal nor Hope collected it later on Mt Jaya (= Mt Carstensz).

Van Royen (1983) also described *P. linilaciniata* Royen, based on a number of specimens that I did not dare to distinguish in a formal way in 1968. More collections have now become available and I agree with Van Royen about their status as species. New collections have also confirmed the status of *P. habbemana* Merr. & Perry.

An undoubtedly new taxon, called *P. indivisa* Kalkman, is regrettably based on only one collection. It differs from related species by its \pm undivided leaflets, a character that in New Guinea is further only found in the quite different *P. brassii*.

Lastly, *P. simulans* Merr. & Perry, based on one fragmentary specimen and placed with doubt in the synonymy of *P. foersteriana* Laut. in my 1968 revision, can now on the strength of two new collections be recognized as a valid species in its own right.

Distribution

All this brings the number of *Potentilla* species in New Guinea to 14, one with two and one with three varieties. Twelve of the species are endemic to the island, making the latter a minor centre of distribution for the genus. Australia and New Zealand have only one (possibly) native species, Malesia west of New Guinea has 6 species including the two that also occur in New Guinea. So there is no reason to postulate a southern connection for the New Guinea *Potentilla* species and the genus conforms to the common picture of Malesian Rosaceae. Except for *Acaena* and for *Rubus* subg. *Micranthobatus* (see Kalkman, 1987) the genera of Rosaceae that are represented in Malesia have a distinct Northern-temperate connection.

Table 1 summarizes the distribution of the taxa within the island. Only six of the taxa (species and varieties) have been found in Irian Jaya as well as in Papua New Guinea, eight as yet only in the western part, three as yet only in the eastern part. Although collections have considerably increased over the last twenty years, the increase has been uneven. In Irian Jaya actually only Mt Jaya and Mt Trikora have been explored further, in Papua New Guinea many more mountains have been visited by botanists. Botanical exploration of Mt Mandala (Mt Juliana) and the Star Mts on the border is especially desirable.

With further exploration the number of eleven taxa that now seem to respect the completely artificial boundary across the island, will diminish and it can be expected that a number of taxa will eventually be found over a larger area. However, local endemics may well remain a reality and not only an artefact.

Dispersal

As in any mountain range, the subalpine and alpine habitats in New Guinea do not form a continuum and migration is often slow. The dispersal methods of the *Potentilla* species involved are not anything special. The species with long erect inflorescences will be unspecialized ballistochores, as far as can be judged from morphology. The fruits are ripening within the persistent epicalyx and calyx, the petals normally falling very early. When completely ripe and loose from the torus, the fruits can be thrown out when the old inflorescences are moved by wind and rain. In the species that have their flowers not on long stems but low on the rosette, dispersal

Table. 1. Distribution of the New Guinean taxa of *Potentilla*.

<i>Potentilla</i>	alt. range	Irian Jaya	Papua New Guinea
<i>adinophylla</i>	3100–4100	Doorman	eastern part
<i>brassii brassii</i>	3400–4250	Jaya, Trikora	Star, Giluwe
<i>brassii simplex</i>	3350–4000	Jaya, Trikora, Valentijn	–
<i>brassii strigosa</i>	3340–3500	Valentijn	–
<i>foerst. foerst.</i>	3225–4150	Trikora	wide
<i>foerst. ima</i>	()2700–3350()	–	wide
<i>gorokana</i>	2650–3200	–	Goroka
<i>habbimana</i>	3225–4000	Trikora	–
<i>hooglandii</i>	2440–3560	Jaya, Trikora	wide
<i>indivisa</i>	3100	Trikora	–
<i>irianensis</i>	3850–4600	Jaya, Trikora	–
<i>linilaciniata</i>	2700–3800	–	eastern part
<i>manginii</i>	4090–4100	Trikora	–
<i>papuana</i> +)	()2600–3900	Trikora	wide
<i>parvula</i> +)	()2600–3800()	wide	wide
<i>simulans</i>	3225–4350	Jaya, Trikora	–
<i>wilhelminensis</i>	4000–4600	Jaya, Trikora	–

+) also outside New Guinea.

() exceptional range omitted, see the Census.

will be mainly by rain. Large drops falling on a more or less open calyx throw out the fruits and heavy rains may transport them to lower places. These methods of dispersal are not very effective in the sense that large distances could be covered. Normally the distances traveled by the diaspores can be measured in metres. It must be remembered, however, that any experiment or even observation is missing in this case. As far as I know, nothing has been published on the dispersal in any New Guinea *Potentilla* species, nor is there any indication on the herbarium labels that I have seen. My plea for more attention to these aspects (Kalkman, 1979) remains valid also for this genus.

Relationships

The present approach to the specific delimitation in the New Guinea *Potentillas* is more cautious than my former one, which has resulted in more taxa than were earlier recognized. The existing diversity is in my opinion now better taxonomically formalized.

One group of species comprises *P. parvula* and *P. papuana*. This group is characterized by having long inflorescences, protruding beyond the leaves of the rosette, and by having the up to 30 stamens in two or more whorls. Related to *P. papuana*

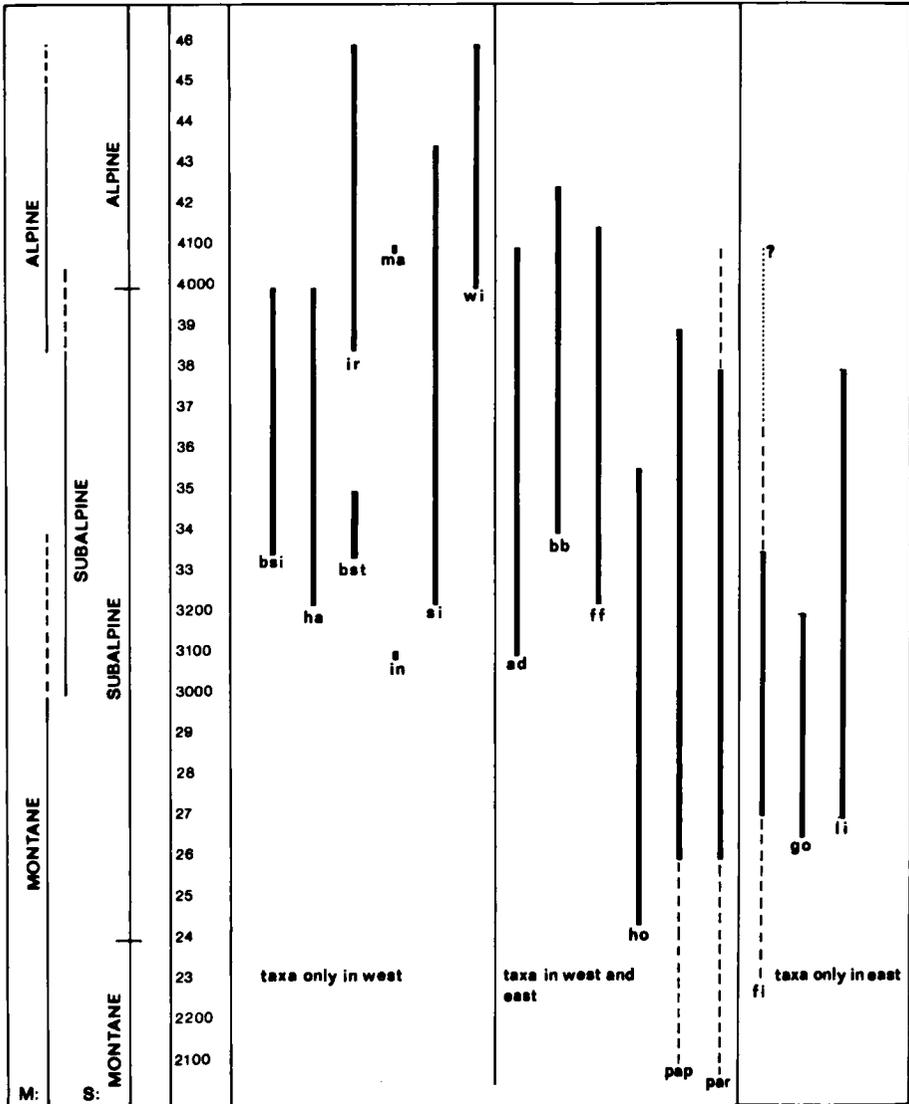


Fig. 1. Altitudinal limits of *Potentilla* taxa in New Guinea. M: zonation according to Mangen (1986); S: zonation according to Van Steenis (1984). The names of species and varieties are abbreviated as follows: ad = adinophylla, bb = brassii var. brassii, bsi = brassii var. simplex, bst = brassii var. strigosa, ff = foersteriana var. foersteriana, fi = foersteriana var. ima, go = gorokana, ha = habbimana, ho = hooglandii, in = indivisa, ir = irianensis, li = linilaciniata, ma = mangelii, pap = papuana, par = parvula, si = simulans, wi = wilhelminensis.

(leaflets silky below) seem to be *P. adinophylla* and *P. hooglandii*, related to *P. parvula* (leaflets not silky) are *P. linilaciniata* and *P. indivisa*. The six species are montane to subalpine in their altitudinal distribution (see below).

The other group that can be recognized centres around *P. foersteriana* and *P. brassii*. Their inflorescences are short and the flowers project very little or not at all above the sometimes very small rosette. The number of stamens is normally isomerous to the sepals, i.e. usually 5. This group contains species with a subalpine to alpine distribution with *P. foersteriana* var. *ima* as an exception. *Potentilla habbemana*, *P. irianensis*, *P. manganii*, *P. simulans*, and *P. wilhelminensis* belong to this group, together with the two already mentioned.

One species, viz. *P. gorokana*, although having short inflorescences, may be more related to the *parvula*-group because of the high number of stamens.

Vegetation

Not all species of *Potentilla* are, as is evident from the above, restricted to the high altitudes and some of them can be found as low as 2100 m. The altitudinal limits of the taxa, as known at present, have been entered in table 1, and pictorialized in figure 1. The two species with a wider distribution, *P. papuana* and *P. parvula*, appear to be montane-subalpine species and the same can be said for *P. foersteriana* var. *ima*, *P. gorokana* (only montane?), *P. hooglandii*, *P. indivisa*, and *P. linilaciniata*. More truly subalpine are *P. adinophylla*, *P. brassii* var. *simplex* and *strigosa*, and *P. habbemana*. Ranging from subalpine to alpine altitudes are *P. brassii* var. *brassii*, *P. foersteriana* var. *foersteriana*, and *P. simulans*. Finally, the species *P. irianensis*, *P. manganii*, and *P. wilhelminensis* seem to be restricted to the alpine zone which can explain their rarity in the herbarium.

In the previous paragraph the terms montane, subalpine, and alpine have been used as if the boundaries between these zones were a matter of consensus – which they clearly are not. The transitions in vegetation structure and composition do not, as is obvious from published accounts, in all places occur at the same elevations and with the same expression. In figure 1, left, the zonation is entered according to Mangan (1986) and to Van Steenis (1984). The first mentioned zonation (M) is based on the vegetational changes on Mt Trikora: at 3000(–3400) m the transition to the subalpine zone, at 3850(–4050) m that to the alpine zone. The zonation according to Van Steenis (S) is based on floristic data, although the author stated that it is also of vegetational value.

Recognition and description of vegetational units (plant communities) in the mountains of New Guinea has up till now been limited to very few places. Mt Jaya has been treated by Hope (1976), Mt Trikora by Mangan (1986), Mt Wilhelm by Wade & McVean (1969), and these are the most extensive studies in this field. Apart from these, several collectors have given less complete observations on the vegetation types in the localities they visited. A survey of them can be found in the bibliography in Hope (1980).

The role of *Potentilla* in the vegetation is usually of minor importance. They are very often present and, when flowering, not difficult to find and to recognize as members of the genus. However, the differences in the very small rosette-plants are



Fig. 2. Tower-like rosettes of *Potentilla brassii* Merr. & Perry var. *brassii*. Photo M.-J. Mangen.

1 mm, entire, sometimes part of them (rarely all) bipartite, sparsely hairy outside or only with apical hairs. Sepals triangular, as long as or slightly longer than the epicalyx, acute, entire. Petals (ob)ovate, c. 2 by 1 mm, entire, glabrous, yellow. Stamens isomerous with sepals, filaments very short, glabrous; anthers c. $\frac{1}{2}$ mm. Pistils 6–15, on hairy flat bottom of hypanthium; ovaries glabrous on hairy stalk; style lateral. Achenes $1-1\frac{1}{4}$ mm long, on thick hairy stalk, red.

a. var. brassii – Fig. 2.

Potentilla foersteriana Laut. var. *brassii* (Merr. & Perry) Kalkman, Blumea 16 (1968) 343.

Leaflets 2–5(–8) pairs under the apical one, bipartite, usually to the base, rarely less deeply divided or some of them undivided, rarely with an additional third lobe, lobes $2\frac{1}{2}-3\frac{1}{2}$ by $\frac{1}{2}-\frac{3}{4}$ mm; sparsely hairy, sometimes only with apical tufts, to glabrous. Hypanthium c. 2 mm diam., sparsely hairy or glabrous outside. Epicalyx leaves mostly entire. Petals obovate. Pistils 6–15.

IRIAN JAYA. Mt Jaya; Mt Trikora; about 15 collections seen.

PAPUA NEW GUINEA. Star Mts: *Croft & Hope LAE 68071, Veldkamp 6430, 6599*; Mt Giluwe: *Wade & McVean 7792*.

Altitude 3400–4250 m, often collected from boggy places.

b. var. simplex Kalkman, *nov. var.*

A varietate typica in foliis lateralibus 1 vel 2-paribus omnibus indivisis, foliis epicalycis semper integris differt. — T y p u s: *Hope ANU 10832* (holo L, iso BO, CANB, K).

Leaflets 1–2 pairs under the apical one, lateral leaflets undivided, 3–5 by 1–2 mm, apical leaflet bifid or trifid, up to 6 by 3 mm; glabrous except few short hairs on apex, and sometimes also on the margin. Hypanthium c. 1½ mm diam., glabrous outside. Epicalyx leaves entire. Petals ovate. Pistils 9–12.

IRIAN JAYA. Mt Jaya: *Hope ANU 10832, 16044, Raynal 17523*; Mt Trikora: *Mangen 531, 1043, 1046*; Valentijn Mts: *Mangen 2009*.

Altitude 3350–c. 4000 m, cushion-forming in poor vegetation types. Plate 173 in Van Royen (1983) pictures this variety.

c. var. strigosa Kalkman, *nov. var.*

A varietate typica in foliorum rachis et foliolorum subtus longe appresse strigosa differt. — T y p u s: *Mangen 2011* (holo L, iso LUX).

Leaflets 3–5 pairs under the apical one, bipartite to the base, lobes unequal, larger one up to c. 3 by less than 1 mm; glabrous above, densely long appressed hairy below except near the margins. Petiole and rachis densely long semi-patently hairy. Hypanthium c. 2 mm diam., glabrous outside except near the rim. Epicalyx leaves entire or rarely bifid. Petals elliptic-ovate. Pistils 8–10.

IRIAN JAYA. Valentijn Mts: *Mangen 1821, 2011, 2294, 2333*.

Altitude 3340–3500 m, flat cushion-forming in boggy open places.

3. *Potentilla foersteriana* Laut.

Kalkman (1968) 341; Van Royen (1983) 2434; both excl. var. *brassii* (Merr. & Perry) Kalkman.

Rosettes loose to compact, single-growing or in (large) cushions. Taproot fleshy to woody. Rosette leaves pinnate, 2–5 cm long; petiole very short; petiole and rachis almost glabrous to densely hairy; rachis sometimes reported purple. Stipules membranous, usually long-hairy below. Leaflets (5–)8–12 pairs, elliptic to ovate, 3½–7 by 3–6 mm; base rounded to subcordate, often unequal; pinnatisect to pinnatipartite with (1–)2–7 incisions going to ¾ deep; sometimes almost glabrous but usually with long hairs at least on margins and apex; small intermediary leaflets rarely present. Flowering stems very short, at most 3 cm, usually with only one terminal flower, rarely 2 or 3, peduncle with 1 or 2 small leaves or membranous stipular bracts. Flowers (4–)5(–6)-merous. Hypanthium 3–4 mm diam., densely long-hairy outside. Epicalyx leaves elliptic to ovate, 2–4½ by 1–2½ mm, normally undivided, sometimes one notched apically or bifid, usually with long hairs at least on the margins, less often glabrous. Sepals triangular, 2–4½ by 1–3 mm, as long as or not very different from epicalyx, acute, entire, hairs as epicalyx. Petals elliptic to



Fig. 3. Cushions of *Potentilla foersteriana* Laut. var. *foersteriana*. Photo M.-J. Mangen.

obovate, (3-)4-6 by $1\frac{1}{2}$ - $3\frac{1}{2}$ mm, entire, glabrous, yellow. Stamens isomerous with sepals; filaments up to $1\frac{1}{2}$ mm, glabrous; anthers c. $\frac{3}{4}$ mm. Torus low, hairy. Pistils 12-32; ovaries glabrous, on short hairy stalk; style lateral. Achenes up to $1\frac{1}{2}$ mm long, brown to black.

a. var. foersteriana – Fig. 3.

Kalkman (1968) 342; Van Royen (1983) 2435, fig. 717, pl. 172.

IRIAN JAYA. Mt Trikora; about ten collections seen.

PAPUA NEW GUINEA. Many mountains from Star Mts in the west to Mt Suckling in the east; about 25 collections seen.

Altitude 3225-4150 m, often in wettish places.

b. var. ima Kalkman – Fig. 4.

Kalkman (1968) 342; Van Royen (1983) 2436; both pro max. parte (collections now placed in *P. gorokana* formerly included in var. *ima*).

Solitary growing rosettes with firm taproot. Rosette leaves pinnate, 3–13 cm long; petiole up to c. 1½ cm; petiole and rachis densely long-hairy. Stipules membranous, at least the central part long-hairy on underside. Leaflets 12–16 pairs, elliptic to ovate, 6–11 by 3½–8 mm; base rounded to cordate; pinnatifid with 1–4 incisions on each side; with long hairs below, especially on midrib and nerves and near apex of lobes, glabrous or almost so on upper side. Flowering stems short, at most 5(–7) cm in the larger rosettes, usually with 2 flowers, peduncle with 1 or 2 small leaves. Flowers 5- or 6-merous. Hypanthium 3–5 mm diam., long-hairy outside. Epicalyx leaves elliptic to ovate, 2½–4 by 1–2½ mm, entire or notched at apex. Sepals triangular, 2–3 by 3 mm, slightly shorter than epicalyx, acute, entire. Epicalyx and sepals distinctly growing after anthesis, both long-hairy outside and sparsely hairy to glabrous inside. Petals elliptic to obovate, 3–7 by 2–3½ mm, entire, glabrous, yellow. Stamens 5–10, glabrous. Torus low, hairy. Pistils many (50 or more); ovaries glabrous, on hairy stalk; style lateral. Achenes up to 1½ by 1 mm, brown.

PAPUA NEW GUINEA. Several mountains from Southern Highlands to Milne Bay Prov.; about 12 collections seen.

Altitude (2300–)2700–3350(–4100) m. Often collected in grassland.



Fig. 4. Flat-lying rosettes with short inflorescences of *Potentilla foersteriana* var. *ima* Kalkman. Photo C. Kalkman.



Fig. 5. *Potentilla indivisa* Kalkman. Habit: rosette with erect leaves and long inflorescence. Drawn after type specimen, *Mangen 1163*.

4. *Potentilla gorokana* Kalkman, *nov. spec.*

Rosulae solitariae radice palari valida lignosa. Folia rosularia 5–11 cm longa petiolo rhachidi dense appresse sericee pubescens. Foliola 14–18-paribus pinnatisecta utrinque 2–5 incisuris 7–9 mm longa 4–6 mm lata infra dense sericea. Flores 1–4 pedunculo ad 3 cm longo 5- vel 6-meri. Folia epicalycis pinnatifida ad -secta incisuris 1–3, 3,5–4,5 mm longa sicut hypanthium sepala extus longe pilosa. Sepala 3–4 mm longa. Petala 5–7 mm longa. Stamina 10–15. Pistilla plurima. Achenia ca. 1 mm longa. – T y p u s: *Hoogland & Pullen 5513* (holo L).

Rosettes solitary growing, with stout, woody taproot. Rosette leaves pinnate, 5–11 cm long; petiole up to $\frac{1}{2}$ cm, petiole and rachis densely appressed-silky on all sides. Stipules membranous, silky in the middle of underside. Leaflets 14–18 pairs, elliptic, 7–9 by 4–6 mm; base rounded to cordate; pinnatisect with 2–5 incisions per side; sparsely long-hairy above, densely silky below (no leaf-surface visible); small intermediary leaflets rarely seen. Flowering stems short, up to 3 cm, with 1–4 flowers and few small leaves or membranous stipular bracts. Flowers 5- or 6-merous. Hypanthium 3–5 mm diam., densely long-hairy outside. Epicalyx leaves \pm elliptic, $3\frac{1}{2}$ – $4\frac{1}{2}$ by $1\frac{1}{2}$ –3 mm, all or most of them pinnatifid to pinnatisect with 1–3 mostly shallow incisions, long-hairy outside. Sepals triangular, 3–4 by $1\frac{1}{2}$ –3 mm, about as long as epicalyx and with same indumentum, acute, entire. Petals 5–7 by 3–4 mm, entire, glabrous, yellow. Stamens 10–15; filaments c. 1 mm, glabrous; anthers $\frac{1}{2}$ mm. Torus low, hairy. Pistils many (c. 100); ovaries glabrous, stalked; style lateral. Achenes c. 1 mm long, brown.

PAPUA NEW GUINEA. Only from Goroka Subprov., viz. Mt Kerigomna: *Hoogland & Pullen 5513*, *Stevens & Grubb LAE 54619*; Mt Marafunga: *Millar & Garay NGF 18742*.

Altitude 2650–3200 m, collected in open places.

5. *Potentilla habbemana* Merr. & Perry

Kalkman (1968) 349, incomplete descr.; Van Royen (1983) 2452, fig. 720, complete descr.

IRIAN JAYA. Mt Trikora: *Brass 9553, 9590, 9594, Mangen 441, 783, 917*.

Altitude 3225–4000 m, boggy places and heath-like vegetation.

6. *Potentilla hooglandii* Kalkman

Kalkman (1968) 339, fig. 1; Van Royen (1983) 2444, pl. 174.

IRIAN JAYA. Mt Jaya: *Raynal 17343, 17543*; Mt Trikora: *Mangen 421*.

PAPUA NEW GUINEA. Several mountains from Star Mts to Sarawaket Range; about 20 collections seen.

Altitude 2440–3560 m, often collected in grassland, marshy or not, also in open places.

7. *Potentilla indivisa* Kalkman, *nov. spec.* – Fig. 5.

Rosulae solitariae radice palaria valida. Folia rosularia 9–10 cm longa. Foliola 10–12-paribus indivisus, 6–8 mm longa 3–4 mm lata glabra. Flores usque ad 7 pedunculo usque ad 16 cm longo

5-meri. Folia epicalycis elliptica vel triangulare-elliptica simpla 2–2,5 mm longa 1–1,5 mm lata. Sepala 4 mm longa. Petala 10 mm longa. Stamina 20. Pistilla 20–25. Achenia ca. 1,5 mm longa. T y p u s: *Mangen 1163* (holo L, iso LUX).

Rosette plants with stout taproot. Rosette leaves pinnate, 9–10 cm long; petiole up to 2½ cm long; petiole and rachis with only few long soft hairs; sticky when living? (small sand grains adhering in herb.) Stipules membranous, densely long-hairy outside. Leaflets 10–12 pairs, sessile, elliptic-ovate, oblique, 6–8 by 3–4 mm, base rounded, apex acute, undivided and entire (rarely bifid with one smaller lobe), apical leaflets bifid, glabrous except few short hairs at apex, leathery. Flowering stems up to 16 cm, longer than the leaves, branched, with c. 4 reduced leaves and a number of bracts, bearing up to 7 flowers; peduncle and pedicels sparsely hairy. Flowers 5-merous. Hypanthium c. 4 mm in anthesis, hairy outside. Epicalyx leaves elliptic to triangular-elliptic, 2–2½ by 1–1½ mm in anthesis, afterwards growing out and up to 5 by 2½ mm, obtuse, entire, hard, outside with few hairs, especially in the lower part. Sepals triangular, longer than epicalyx, 4 by 2½ mm in anthesis, after anthesis up to 6 by 3½ mm, acute, entire, indumentum as epicalyx. Petals obovate, 10 by 7 mm, glabrous, entire, yellow. Stamens 20; filaments c. 1 mm long, glabrous; anthers c. ¾ mm long. Torus hairy. Pistils 20–25; ovaries glabrous, on hairy stalk; style lateral, c. 1 mm. Achenes c. 1½ mm long, brown.

IRIAN JAYA. North of Mt Trikora, Baliem–Wamena River watershed: *Mangen 1163*.

Altitude 3100 m, in tussock grassland.

N o t e. The entire lateral leaflets distinguish this species clearly from the related *P. parvula* which has been collected in different places in the Mt Trikora/Baliem area. When more specimens become available, the distinction might become obscured making the varietal level more appropriate.

8. *Potentilla irianensis* Kalkman, *nov. spec.*

Pulvini ad 40 cm diam. Folia rosularia 0,5–1,5 cm longa. Foliola 3–6-paribus tripartita ad pinnatisecta vel -partita utrinque incisuris 1–3, 2–3 mm longa 1–2,5 mm lata pilis paucis. Flores 1 vel 2 pedunculo maxime 1,5 cm longo 5-meri. Folia epicalycis ex apice tri- vel quadripartita incisa 1,25–1,5 mm longa 0,75–1 mm lata pilis paucis. Sepala 1–1,5 mm longa ca. 0,75 mm lata. Petala ca. 2 mm longa ca. 1 mm lata. Stamina 5(–7). Pistilla 8–12. Achenia ca. 1,25 mm longa. – T y p u s: *Hope ANU 16027* (holo L, iso BO, CANB, vide sub *P. simulans*).

Rosettes (always?) combined to cushions, up to 40 cm diam. and 30 cm high. Rosette leaves very small, pinnate, ½–1½ cm long; petiole up to 2 mm long, perpendicular to the stipule; rachis and petiole practically glabrous to long-hairy. Stipules membranous, sparsely to densely hairy outside. Leaflets 3–6 pairs, elliptic, up to 2–3 by 1–2½ mm; base rounded; tripartite to pinnatisect or -partite, with 1–3 incisions in each half; with few hairs on apex, or also on margin, rarely also on midrib below; intermediary leaflets sometimes present, small. Flowering stems very short, at most (in fruiting stage) 1½ cm, with 1 or 2 flowers and 1–3 reduced leaves below them. Flowers 5-merous, small. Hypanthium up to 2½ mm diam., almost glabrous outside. Epicalyx leaves ovate to obovate in outline, 1¼–1½ by ¾–1 mm, tri- or

quadripartite with the incisions from the top, with few apical hairs or also hairs on margin. Sepals triangular-ovate, entire, shorter than or equal to the epicalyx, 1–1½ by ¾ mm, with some apical hairs or glabrous. Petals elliptic, c. 2 by 1 mm, entire, glabrous, yellow. Stamens isomerous with sepals (once: 7), very small. Pistils 8–12, on the hairy bottom of the hypanthium; ovaries glabrous, on hairy stalk; style lateral. Achenes c. 1¼ mm long, brown when dry, on thick stalks.

IRIAN JAYA. Mt Jaya: *Hope 16027, Raynal 17521, Wissel 62, 79*; Mt Trikora: *Mangen 494, 927*.

Altitude c. 3850–4600 m, in grassland and old screes.

9. *Potentilla linilaciniata* Royen

Van Royen (1983) 2455, fig. 721.

As mentioned in the introduction, the existence of one or more species with pseudo-digitate leaflets, different from *P. habbimana* (which has truly digitate leaflets), was noted by me (1968: 349). Additional collections have confirmed the specific status of *P. linilaciniata*. However, its leaves are very variable and maybe this could become taxonomically formalized on the basis of more collections. Most of the specimens form one group with leaves up to 6 cm long and flowering stems up to 12 cm long. Four of the specimens, among which the holotype (*Van Royen 30113*), have leaves of 10–30 cm and flowering stems of 13–35 cm long. This recalls the situation in *P. parvula* (see Kalkman 1968: note on p. 337) which is also variable in habit and with which *P. linilaciniata* is obviously related, more than with *P. habbimana*. A slightly visible correlation with altitude (fig. 6) could become more pronounced when more collections become available.

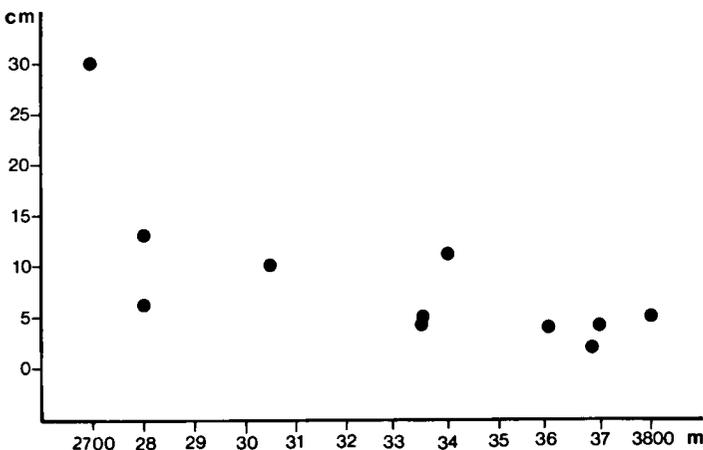


Fig. 6. Leaf-length and altitude in *Potentilla linilaciniata* Royen.

PAPUA NEW GUINEA. Several mountains in the eastern part (Central and Northern Prov.), c. 15 collections seen.

Altitude 2700–c.3800 m, mostly collected in grasslands, usually swampy or boggy.

10. *Potentilla mangelii* Kalkman, *nov. spec.*

Herba pulviniformis. Folia rosularia 1,5–2,5 cm longa. Petiolus rhachis foliorum pagina inferior et pedunculus dense sericee pubescens. Foliola 4- vel 5-paribus, 5–7 mm longa 3–3,5 mm lata pinnatisecta utrinque incisuris 1–3(–5). Flores solitarii pedunculo 1 cm longo 5-meri. Folia epicalycis elliptica 2–2,5 mm longi ca. 1 mm latis integra vel apice retuso. Sepala 2–2,5 mm longa. Petala ca. 3,5 mm longa ca. 1,5 mm lata. Stamina 5. Pistilla ca. 25. Achenia ca. 1,25 mm longa. – T y p u s: *Mangen 495 bis* (holo L, iso LUX).

Cushion-forming. Rosette leaves up to 1½–2½ cm long; petiole less than ½ mm long; petiole and rachis long and densely silky hairy. Stipules membranous, outside silky hairy. Leaflets 4–5 pairs, elliptic, up to 5–7 by 3–3½ mm; base rounded; apex acute; pinnatisect with 1–3(–5) incisions per half; glabrous above, densely silky hairy below. Flowering stems up to 1 cm, with a solitary flower and 2 reduced leaves under it, densely hairy. Flowers 5-merous. Hypanthium 3½ mm diam., long-hairy outside. Epicalyx leaves elliptic, 2–2½ by c. 1 mm, entire or some of them notched at apex, long-hairy outside. Sepals narrowly triangular, equal to or slightly shorter than the epicalyx, 2–2½ by 1¼ mm, hairy as the epicalyx. Petals elliptic, 3½ by 1½ mm, entire, glabrous, yellow. Stamens isomerous with sepals; filaments at most 1 mm, glabrous; anthers ½ mm. Pistils c. 25, on hairy bottom of hypanthium; ovaries glabrous, stalked; style lateral. Achenes 1¼ mm long, shining dark purple (dry).

IRIAN JAYA. Mt Trikora: *Mangen 495 bis*, 902.

Altitude 4090–4100 m, collected in dry alpine tundra.

11. *Potentilla papuana* Focke

Kalkman (1968) 334; Van Royen (1983) 2449, pl. 175.

IRIAN JAYA. Mt Trikora: *Brass 9543*, *Brass & Meijer Drees 9746*.

PAPUA NEW GUINEA. Many mountains from west to east; about 60 collections seen.

Also known from Celebes and Luzon.

Altitude in New Guinea (2100–)2600–3900 m, collected in all kinds of grassland, wet and dry, more rarely in shrubberies.

12. *Potentilla parvula* Hook. f. ex Stapf

Kalkman (1968) 336; Van Royen (1983) 2441.

IRIAN JAYA. Mt Jaya, Mt Trikora, Mt Wichman, Mt Goliath; about 20 collections seen.

PAPUA NEW GUINEA. Many places from Star Mts to Milne Bay Prov.; c. 100 collections seen. Also occurring in Borneo, Celebes and Luzon.

Altitude in New Guinea (2065–)2600–3800(–4100) m, mostly collected in grassland, wet and dry, and in alpine screes, more rarely in shaded places.

13. *Potentilla simulans* Merr. & Perry

Kalkman (1968) 341, with doubt in synonymy of *P. foersteriana*; Van Royen (1983) 2434 (ibid.).

Loose rosettes. Rosette leaves pinnate, up to 5 cm long; petiole up to 8 mm; petiole and rachis densely long-hairy, especially on the underside. Stipules membranous, hairy outside. Leaflets 8–13 pairs, bipartite to the very base; lobes divergent, elliptic, up to 3½ by 1½ mm, the lobe that lies parallel to the rachis usually smaller than the other one; apex rounded to obtuse; entire; glabrous above, with long appressed hairs underneath, especially in the middle part. Flowering stems up to 1½ cm long, densely hairy, bearing one flower and some small leaves. Flowers 5-merous. Hypanthium c. 2 mm diam., long-hairy outside. Epicalyx leaves elliptic, entire (or one of them shallowly notched), 1½–2 by 1 mm, with long hairs outside. Sepals triangular, entire, 1½–2 by 1½ mm, same indumentum as epicalyx. Petals broadly obovate, 2–3 mm long, apex rounded, entire, glabrous, yellow. Stamens isomerous with sepals; filaments ½ mm, glabrous; anthers ½ mm. Pistils 10–12, on the bottom of the hypanthium; ovaries glabrous, on hairy stalk; style lateral. Achenes c. 1¼ mm long, shining dark purple (dry), on thin stalk.

IRIAN JAYA. Mt Jaya: *Hope 16027A*, taken from 16027 which is *P. irianensis*; Mt Trikora: *Brass 9594A*, *Mangen 590*.

Altitude 3225–4350 m, in grassland on peaty soil.

14. *Potentilla wilhelminensis* Royen

Van Royen (1983) 2440, fig. 718; Kalkman (1968) 348, incompl. descr. as *P. prob. nov. spec.*

IRIAN JAYA. Mt Jaya: *Wissel 3, 57*; Mt Trikora: *Versteeg 2534*.

Altitude c. 4000–4600 m, no data on the habitat.

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