

## Revision of *Goodyera rubicunda* (Orchidaceae: Goodyerinae)

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### Abstract

The *Goodyera rubicunda* complex has broad morphological variation of the floral parts. A revision of the *G. rubicunda* complex was conducted and three intraspecific groups were recognised; *G. rubicunda* var. *rubicunda* which is the widespread variety, *G. rubicunda* var. *triandra*, and *G. rubicunda* var. *australis* var. nov. Herein, we propose the variety *G. rubicunda* var. *australis* from Australia and Papua New Guinea as newly described.

### Introduction

*Goodyera* R.Br. is classified as belonging to subfamily Orchidoideae, tribe Cranchideae, subtribe Goodyerinae (Pridgeon 2003), containing approximately 98 species that are currently recognised as belonging to the genus ([www.theplantlist.org](http://www.theplantlist.org), accessed 2 Jan 2014). Schlechter (1911) classified *Goodyera* as part of subfamily Monandreae, division Acrotonae, subdivision Polychondreae, and group Physurinae (subtribe Goodyerinae, Dressler and Dodson 1960; Pridgeon et al. 2003).

*Goodyera* species are characterised by their terrestrial habit, horizontal creeping stems, a rhizome about as thick as the stem, rather thick pubescent roots, leaves either in rosettes or spread laxly along the stem, a terminal, often pubescent inflorescence, and a generally pubescent, saccate labellum often with internal fleshy hair-like glands (Comber 1990; Dockrill 1992). However, some of these characters are not useful for differentiation of genera within subtribe Goodyerinae, and for this reason delimitation within the subtribe still remains problematic. Members of the genus are widely distributed throughout North America, Europe, Africa, South Asia, South East and East Asia including Japan, New Guinea, Pacific islands and Australia (Brown 1813; Blume 1825; Thwaites 1858; Ridley 1886; Hooker 1894; Schlechter 1906, 1932; Smith 1905, 1917; Ohwi 1937; Seidenfaden and Smitinand 1959; Garay and Sweet 1974; Halle 1977; Cornell 1978; Kores 1989; Lewis and Cribb 1989; Comber 1990; Lewis and Cribb 1991; Dockrill 1992; Seidenfaden and Wood 1992; Cribb and Whistler 1996).

Robert Brown (1813) first described *Goodyera* and included it under *Neottia pubescens* Willd. (North America), and *Satyrium repens* L. (Europe). Soon after, the genus was expanded with addition of other species described from the tropics and subtropics (Wallich 1822; Loddiges 1824; Blume 1825; Lindley 1839). Blume (1825) described seven species for the genus *Neottia* Guett., section 3 *Erporchis*. In the generic treatment of Lindley (1839), *Neottia rubicunda* was transferred to *Goodyera* (as *G. rubicunda*) based on similarity of its habit and floral characters with *G. procera* (Ker Gawl.) Hook. from Nepal (Wallich 1822). Lindley (1839) noted that all

two species within *Neottia* sect. 3 *Erporchis* belonged to *Goodyera*, although a type for the genus had not been designated. Of the original two species *G. repens* (L.) R.Br. and *G. pubescens* from North America, Britton and Brown designated *G. repens* as the lectotype.

In the treatment of the orchids of former German New Guinea (now part of Papua New Guinea), Schlechter (1911) divided *Goodyera* into the two sections *Eu-Goodyera* (=sect. *Goodyera*) and *Otosepalum*. The diagnostic character separating these two sections is the position of the lateral sepals, which are parallel in section *Goodyera*, and widely spreading in section *Otosepalum*. Jones and Clements (2004) designated *Goodyera rubicunda* (Blume) Lindl. as lectotype of section *Otosepalum*. At least 15 species in *Goodyera* share the character of spreading lateral sepals, although for several vegetative characters, taxa such as *G. procera* (Ker-Gawl.) W.J.Hook., *G. scripta* (Rchb.f.) Schltr., and *G. viridiflora* (Blume) Lindl. ex D.Dietr. appear to be distantly related to each other (LSJ pers. observation). Further morphological and molecular studies are needed in *Goodyera* to determine whether Schlechter's sectional divisions require further refinement, or whether they should be abandoned. Clements and Jones (2006a), with limited transfers, placed section *Otosepalum* in a reinstated *Salacistis* Rchb.f., whilst also accepting *Eucosia* Blume as a genus for *G. viridiflora* and allied taxa (Clements and Jones 2006b).

The most widespread and taxonomically complex member of section *Otosepalum* is *Goodyera rubicunda*. It has been reported from north eastern India, South West China, Vietnam, Taiwan, Japan, the Philippines, Malaysia, Indonesian New Guinea, north eastern Australia, Solomon Islands, Vanuatu, Fiji, Samoa, Tonga, and Tahiti (Blume 1825, 1858; Thwaites 1858; Ridley 1886; Hooker 1894; Schlechter 1906; Ohwi 1937; Seidenfaden and Smitinand 1959; Garay and Sweet 1974; Hallé 1977; Kores 1989; Lewis and Cribb 1989, 1991; Comber 1990; Dockrill 1992; Seidenfaden and Wood 1992; Cribb and Whistler 1996). It is also expected that its distribution may extend into Bhutan, Thailand, Laos, and Cambodia (Pearce and Cribb 2002; Schuiteman and de Vogel 2000).

The primary aim of the present study is to clarify the patterns of variation found within *G. rubicunda* as interpreted in the broad sense. Taxonomic descriptions for all three varieties of the *G. rubicunda* complex are provided along with a key to aid identification. Here, we also attempted to resolve problems regarding typification, and propose recognition of a new variety for *G. rubicunda* based on the overall labellum structure and the shape of the base of the labellum.

## Materials and methods

Herbarium specimens of the *Goodyera rubicunda-grandis* complex were borrowed from A, BISH, BM, BO, BRI, CANB, E, K, KYO, L, LAE, NSW, NY, P, QRS, and US. Examination of about 100 herbarium specimens showed considerable variation of form.

Dried herbarium specimens were examined and vegetative and floral characters measured and recorded. Specimens with similar morphology were grouped with the relevant type specimen for assignment of the appropriate variety. In cases where the number of type specimens was greater than one, one name was accepted as having nomenclatural priority and the others as synonyms. To decide which nomenclatural rank was to be assigned, information on how much morphological variation existing within a group was recorded along with details on geographic distribution (Table 1).

## Results

Several characters vary within and between groups in the *Goodyera rubicunda* complex, however only three identified groups could be recognised based on several floral characteristics (Table 1; Figs 1, 3-5). Geographic distribution of the three designated groupings was examined to determine the taxonomic status of the groups (Table 1; Fig. 2). Taxa are recognised at variety rank because we regarded the morphological variation between them as minor, with two of the varieties found to be broadly sympatric in the Milne Bay Province of Papua New Guinea. We observed no significant between-group variation in general habit.

**Table 1. Morphological and geographic characters used to differentiate three varieties in the *Goodyera rubicunda* complex.**

Characters	<i>G. rubicunda</i> var. <i>rubicunda</i>	<i>G. rubicunda</i> var. <i>triandra</i>	<i>G. rubicunda</i> var. <i>australis</i>
Labellum shape	ovate to oblong	ovate	triangular
Shape of labellum base	obtuse	obtuse	cordate
Rostellum	well developed	well developed	not developed
Number of anthers	one	three	one
Labellum apex	recurved to revolute	recurved to revolute	recurved
Geographic distribution	Indonesia (Sumatra, Java, Borneo, Sulawesi), Pacific Islands region (Tahiti), Malaysia, India, Philippines, New Guinea, Taiwan, Japan	Pacific Islands region, as far East as Fiji, Samoa	Australia, Papua New Guinea

### Taxonomic History

Several names are available for taxa in the *Goodyera rubicunda-grandis* complex: *G. rubicunda* (Blume) Lindl., *G. yaeyamae* Ohwi, *G. hispidula* R.S.Rogers & C.T.White, *G. papuana* Ridl., *G. celebica* Blume, *G. rubens* Blume, *G. triandra* Schltr., and *G. grandis* King & Pantl. Types of *Goodyera grandis* (Blume) Lindl. ex. Dietr., *G. celebica* Blume, *G. rubens* Blume were loaned from (L). Those of *G. papuana* Ridl. and *G. grandis* King & Pantl. (BM), *G. triandra* Schltr. (K, AMES), *G. hispidula* R.S.Rogers & C.T.White (BRI), *G. rubicunda* (Blume) Lindl. (P), *G. yaeyamae* (KYO), and *G. anomala* Schltr. (W).

*Neottia rubicunda* was described by Blume (1825) based on specimens from Mount Salak and Mount Gede, however a type specimen could not be located during this study. Blume's specimens usually lack precise location and collection date details which caused some uncertainty regarding their exact status. Simultaneously, another name *Neottia grandis* was proposed by Blume (1825), with Smith (1905) subsequently determining that the two are conspecific, choosing the name *Goodyera rubicunda*.

Another entity, *Goodyera grandis* King & Pantl. was described from Sikkim, India by King and Pantling (1898). However, these authors overlooked the fact that this name was already in use by David Dietrich after he transferred *Neottia grandis* to *Goodyera* in his treatment (Dietrich 1852). Later, Pearce and Cribb (2001, 2002) noticed what they considered to be significant differences between *G. rubicunda* and *G. grandis*, renaming the latter *G. clavata*. Ormerod (2003) initially accepted *G. clavata* as distinct, based on the raised ventral callosity on the column. However, reexamination of other materials from Java, Sumatra, Borneo, the Philippines, and elsewhere convinced him that the thickening of the ventral callosity was variable across the material examined. This led to the conclusion that *G. clavata* was conspecific with *G. rubicunda* (Ormerod 2004). Garay and Sweet (1974) reduced *G. grandis* King & Pantl. to *G. rubicunda*, and the current study supports this placement. *Goodyera rubicunda* specimens from Sikkim appear to be geographically isolated, but Ormerod (2004) suggested that there are scattered records of the species from the Naga Hills (near the Myanmar border) in North East India, Yunnan Province in South West China, and Vietnam (specimens not examined).

Reichenbach (1857a) transferred *Neottia rubicunda* Blume to *Georchis rubicunda*, and at the same time described *Goodyera zollingeri* as a new species. However, based on our observations *G. zollingeri* and *G. rubicunda* appear to be conspecific (Reichenbach 1857b). Unfortunately, the type specimen of *G. zollingeri* could not be located, although its description indicates it is likely a synonym of *G. rubicunda* (LSJ pers. observation).

Blume (1858) described two more supposedly similar *Goodyera* species, *G. celebica* from Celebes (Sulawesi) and *G. taitensis*. The geographic origin of Blume's specimen of *G. taitensis* is unclear. Based on the voyage of Hombron 1837-1840 (Van Steenis 1950), there is no evidence that Hombron had ever collected in the Pacific Islands region. It is possible that the specimen was collected in Ambon, Maluku province, or somewhere where Hombron collected other specimens during the expedition. Both these specimens fit descriptions of material of var. *rubicunda* as circumscribed in the current study, but not with our var. *triandra* from the Pacific Islands.

*Goodyera papuana* was described by Ridley in 1886 from a collection from British New Guinea. The description of the type specimen (*Forbes 64*), fits the description of var. *rubicunda* (current study).

Rogers and White (1920) described *G. hispidula* using material from Papua New Guinea collected by C.T. White, but the isotype (deposited at BRI) confirmed its synonymy with *G. rubicunda*.

Finally, *G. yaeyamae* was described from Ryuku Islands by Ohwi in 1937. Although his specimen has a longer, spur-like labellum base than most other members, it fits within our circumscription of var. *rubicunda*.

The *Goodyera anomala* type is sterile so we were unable to examine floral morphology, however specimens of *G. triandra* are comparable to the description of *G. anomala* in most other respects. Type specimens of *G. triandra* were collected from the Pacific Islands, but the flowers and whole plants of *G. triandra* are smaller than those of *G. anomala*. Differences between *Goodyera rubicunda* and *G. triandra* include the number of anthers, and for this reason *G. triandra* is treated below the species level as *G. rubicunda* var. *triandra*.

In summary, after examination of available operational taxonomic units it is clear that the names in question should not be maintained at the species level. *Goodyera rubicunda* is the oldest legitimate name for the group, and comparison of floral parts among the available type specimens shows that specimens from Australia and Papua New Guinea represent an unnamed taxon and require description. This taxon has a triangular labellum, cordate labellum base, and an undeveloped rostellum, with these characters not occurring in the other groups. Based on these characters we here propose the new variety *Goodyera rubicunda* var. *australis*.

## Nomenclature

*Goodyera* R.Br. in W. Aiton & W.T. Aiton, Hortus Kewensis (ed. 2) 5: 197 (1813).

Lectotype: *Goodyera repens* (L.) R.Br. *Satyrium repens* L. Species Plantarum (1753); N.L. Britton & A. Brown, An Illustrated Flora of the Northern United States and Canada (ed. 2) 1: 569 (7 Jun 1913).

## Description of *Goodyera rubicunda* Lindl.

*Herb*, terrestrial, 20.5–42.7–(54) cm tall; *rhizome* decumbent, rooted at nodes; *stem* ascending, leafy in the proximal half, racemose above. *Leaves* with petiole and sheath, spreading; blade obliquely ovate-elliptic, 5.8–37.0 cm × 3.4–6.3 cm, apex acute or sub-acuminate; petiole 2.4–9.3 cm long. *Inflorescence* terminal, subdensely many-flowered, 8.0–23.0 cm long; peduncle 9.0–29.5 cm long with 2–3 remote sterile bracts. *Flowers* opening widely, brownish to whitish; *pedicel* with sessile ovary, 0.5–1.2 cm long; *floral bract* linear-lanceolate, 11–20 mm × 2–4.25 mm. *Sepals* hairy; lateral sepals spreading, cucullate, narrowly ovate or ovate-lanceolate, somewhat oblique, 5.5–10.3 mm long 1.8–4 mm wide, acute; dorsal sepal ovate-lanceolate, up to 5.8–9.3 mm long and (1.5)–1.8–3.3–(4) mm wide. *Petals* obliquely rhombic to narrowly spatulate, (4)–6–10.5 mm long, (0.9)–1–2.7 mm wide.

### 1. *Goodyera rubicunda* Lindl. var. *rubicunda*

*Goodyera rubicunda* (Blume) Lindl., Edwards's Botanical Register 25: Misc. 61 (1839).

**Basionym:** *Neottia rubicunda* Blume, Bijdragen tot de Flora van Nederlandsch Indië 8: 108 (1825).

**Synonyms:** *Georchis rubicunda* (Blume) Rchb. f., Bonplandia 5: 35 (1857a); *Rhamphidia rubicunda* (Blume) F. Müll., Fragment, 7: 30 (1869), [non (Rchb.f.) Rchb.f.] 1868]; *Orchiodes rubicundum* (Blume) Kuntze, Revision Generum Plantarum 2: 675 (1891); *Epipactis rubicunda* (Blume) A.A. Eaton, Proceeding of the Biological Society of Washington 21: 64 (1908). *Goodyera rubens* Blume, Collection des Orchidees les Plus Remarquable de l'Archipel Indien et du Japon nov. ser. 36, t. 9d, f. 1 (1858), *nom. illeg.* Type: Java, Mt. Salak and Mt. Gede, *Blume s.n.* (holotype: L!, isotypes: K not seen, P!).

*Neottia grandis* Blume, Bijdragen tot de flora van Nederlandsch Indië 8: 107 (1825); *Goodyera grandis* (Blume) Lindl. ex D. Dietrich, Synopsis Plantarum 5: 165, (1852); *Orchiodes grande* (Blume) Kuntze, Revision Generum Plantarum 2: 675 (1891). Type: Java, *Blume s.n.* (holotype: L!).

*Goodyera zollingeri* Rchb. f., Bonplandia 5: 36 (1857b) *syn. nov.* Type: Java, Bandung. *Zollinger* 196 (holotype: not found).

*Goodyera celebica* Blume, Collection des orchidees les plus remarquable de l'Archipel Indien et du Japon 43 (1858). *Orchiodes celebicum* (Blume) Kuntze, Revision Generum Plantarum 2: 675 (1891). *Goodyera rubicunda* var. *celebica* (Blume) Schltr., Repertorium Specierum Novarum Regni Vegetabilis 10: 9 (1911a). Type: In sylvis circa Tondano insulae Celebes, *Forsten s.n.* (holotype: L!).

*Goodyera taitensis* Blume, Collection des orchidees les plus remarquable de l'Archipe Indien et du Japon 44 (1858). Type: Tahiti, *Hombron s.n.* (holotype: L!).

*Goodyera papuana* Ridl., J. Bot. 24: 355 (1886). *Epipactis papuana* (Ridl.) A.A. Eaton, Proceedings of the Biological Society of Washington 21: 65 (1908). Type: New Guinea, *Forbes 64* (holotype: not seen).

*Goodyera rubicunda* var. *amboinensis* J.J.Sm., Philippine Journal of Science, C. Bot. 12: 254, 1917. Type: Indonesia, Maluku, Ambon, Mahija, 1913, *Robinson 1615* (holotype: L!).

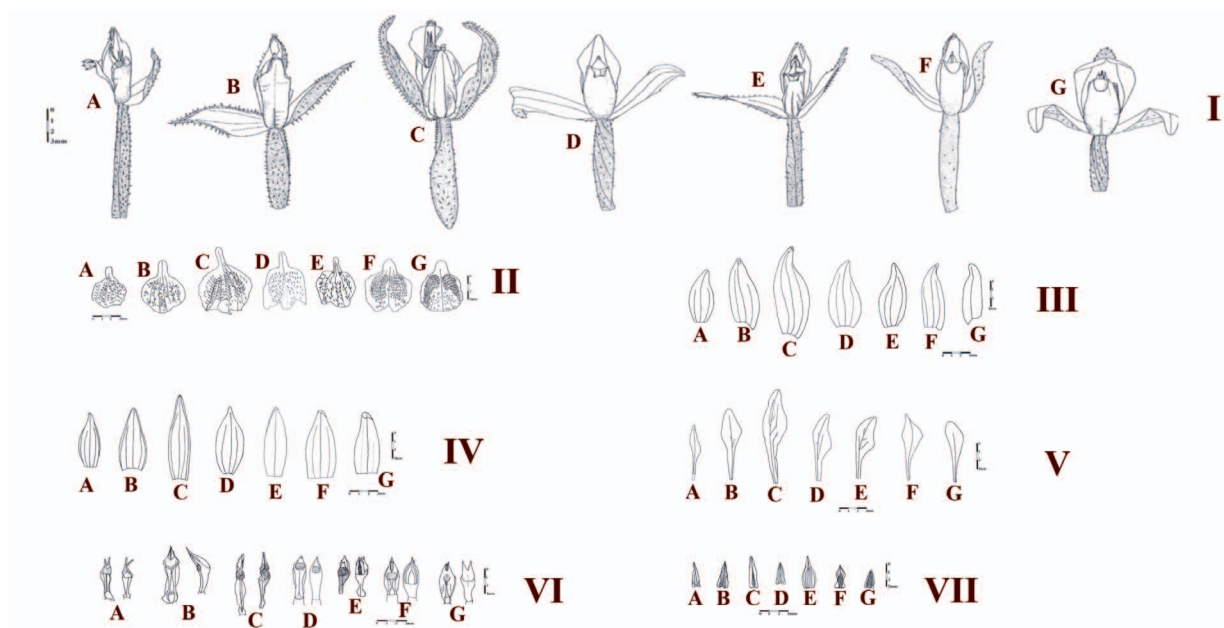
*Goodyera grandis* King & Pantl., Annals of the Royal Botanic Garden Calcutta 8: 284, plate 379 (1898), nom. illeg., non (Blume) Lindl. ex D. Dietr. (1852); *Epipactis grandis* (King & Pantl.) A.A. Eaton, Proceedings of the Biological Society of Washington 21: 64 (1908); *Goodyera clavata* N.Pearce & P.J.Cribb Edinburgh Journal of Botany 58, 1: 116, 2001. Type: India, Sikkim, at Rumtek in the valley of the Teesta, at an elevation of 4,000 feet, 1898, *Pantling 460* (holotype: CAL!, isotypes BM!, K!).

*Goodyera hispidula* R.S.Rogers & C.T.White, Transactions and Proceedings of the Royal Society of South Australia 44: 112-4, t. 6 (1920). Type: New Guinea, Dilava, *White 603*, Jul-Aug 1918 (holotype: AD n.v., isotype: BRI!).

*Goodyera yaeyamae* Ohwi, Journal Japanese Botany 13:439 (1937). Type: Japan, Ryukyu Islands, Yonakuni, *G. Koidzumi* (holotype: KYO!).

*Goodyera rubicunda* (Blume) Lindl. ex D. Dietr. var. *amboinensis* J.J. Sm. Philippine Journal of Science (1917). Type: Maluku, Ambon, Mahija, *Robinson 1615* (holotype: L, not seen).

**Description:** *Labellum* ovate to oblong, 3–7 mm long; base obtuse, rarely spur like, spur sometimes not present, if present up to 0.7 mm long from the back of the saccate labellum at the attachment to the pedicel to the lowest base of the spur; apex more or less recurved and revolute, triangular to linear and oblong; disc hairy inside. *Column* clavate, 4–7.5 mm long, 1–2 mm wide. *Rostellum* bifid. *Anther* 1, attached at its base to the apex of the column. **Fig. 1.**



**Fig. 1.** *Goodyera rubicunda* var. *rubicunda*: I, Flower, frontal view; II, labellum; III, lateral sepal; IV, dorsal sepal; V, petal; VI, column; VII, anther cap. Specimens used: A, Blume sn, dried specimen (L0061296); B, Blume sn, dried specimen (L0061167); C, Clements J & MS 26997 (=26832), dried specimen; D, Clements MA 6354c, living plant; E, Blume sn, dried specimen (L0061295); F, Samsul & Entim 86, spirit preserved; G, Forbes FR 38078, dried specimen. Scale bars shown. Illustration: L.S. Juswara.

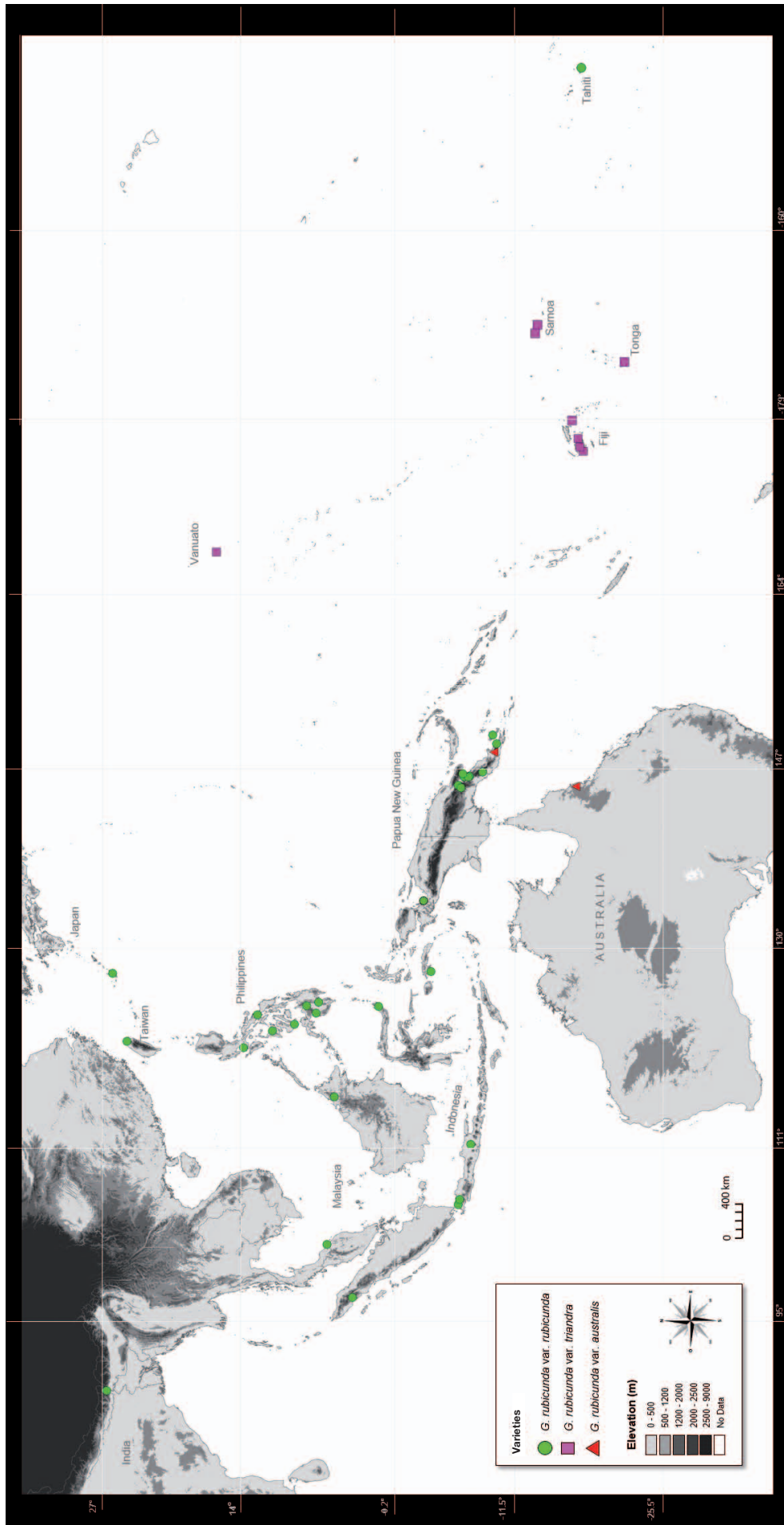


Fig. 2. Distribution of the three varieties of *Goodyera rubicunda*. Key to varieties shown on map.

**Additional specimens examined:** INDONESIA: WEST PAPUA PROVINCE: Division Geelvinkbay, Wandamen Peninsula, Mt. Wondiwoi, *Schram 10745*, 28 Feb 1962 (L, LAE). WEST JAVA: Karang Gelekung, *Blume 45* (L). SUMATRA: W. Helling Talomun elevation 700 m, *Bunnemeijer 463*, 27 Apr 1917 (BO, L); CENTRAL ACEH: *Samsul & Entim 86* (CANB). MALAYSIA: NORTH BORNEO: Near Dalas, *Carr 3757*, Aug 1933 (K); KINABALU: Dallas, *Clemens 26896*, Nov 1931 (BO, BM, E, K, L, NY); SABAH: Keningau, Near Laing Cave Apin-Apin, elevation 700 m, *Lajangah 44565*, 4 Aug 1965 (K); Keningau, Interior zone, *Lamb & Lohok 1158/89*, Aug 1989 (K); Pun Batu Interior zone, elevation 600 m, *Vermeulen 448*, Sep 1986 (L); Bukit Maripit, elevation 600 m, *Winkler 111028*, Dec 1924 (E). PAPUA NEW GUINEA: CENTRAL PNG: Dilava, *White 603*, Jul-Aug 1918 (BRI); EAST PAPUA: Milne Bay District, c. 8 miles W of Rabaraba, *Pullen 7724*, 5 Jul 1969 (CANB, LAE); Milne Bay Province, Agamoia, Fergusson Isl., *Brass 27250*, 20 Jun 1956 (L); EASTERN HIGHLANDS DISTRICT: Kassam Pass, Kainantu Subdistrict, *Dockrill & Coode 34167*, 12 Jan 1968 (LAE); ILAFO: about 2 miles SE of Okapa, *Brass 31784*, 28 Sep 1959 (L, LAE, NY, US); Kaiser Wilhelmsland In den Waldern am Kaulo, *Schlechter 16873*, Sep 1904 (L, NSW); Morobe District, Wau Sub district, Kauli Creek Waterfall, *Womersley & A. Dockrill 24977*, 3 Jun 1967 (LAE); Schumann River, 300 m, *Schlechter 13844*, Jan 1902 (AMES, BRI); Morobe District, Bulolo to Wau road, *Woods 104*, 13 Oct 1962 (E); Morobe District, Trans-Busu Timber Lease near LAE, *Floyd 5743*, 17 Jun 1954 (BRI, LAE). PHILIPPINES: BABUYANES: Camiguin Is., Mt. Malabsing, *Edano 79590*, Mar 1930 (AMES). LUZON: Province Sorsogon, Irozin, Mt. Bulusan, *Elmer 14867*, Nov 1915 (AMES, BM, L, NSW, NY); Tagaytay, R.S. *Davis 49-12*. JAMINDAN: Capiz Province, Panay, *Ramos & Edano 31096*, Apr-May 1918 (AMES). MINDANAO: Cottabato Umbungan, *Weber 201*, (AMES); DISTRICT OF DAVAO: Todaya, Mt. Apo, *Elmer 11150*, Jul 1909 (AMES, NY); BUKIDNON: Mt. Katanglad-S slope of middle peak, upper source of Alanib R. Vicinity of Bo Songes, *Sulit 10207*, 16 Apr 1949 (AMES). NEGROS Is.: Province of East Negros, Dumaguete, Cuernos Mt., *Elmer 10173*, May 1908 (AMES, NY). TAIWAN: TAIPEI COUNTRY: forest on steep slope near Cascade, *Van Steenis 20589*, - (L).

**Habitat and Ecology:** Stony, limestone soil near river banks within rain-forests.

**Distribution:** India, Indonesia (Sumatra, Java, Borneo, and Celebes), Malaysia, Papua New Guinea, Philippines, Taiwan, Japan, and Pacific Islands (e.g., Tahiti) (Fig. 2).

**Notes:** This variety is variable in the shape of the labellum and labellum apex and for this reason there remains some doubt as to whether it is a single entity. Further research is needed on living and pickled specimens from Indonesia, Papua New Guinea, Philippines, Malaysia, India, Taiwan, and Japan.

## 2. *Goodyera rubicunda* var. *triandra* (Schltr.) N. Hallé.

*Goodyera rubicunda* var. *triandra* (Schltr.) N. Hallé. Flore de la Nouvelle Calédonie. Depend. 8: 532, 1977.

**Basionym:** *Goodyera triandra* Schltr., Bulletin De l'Herbier Boissier Ser. II, 6: 298 (1906); *Epipactis triandra* (Schltr.) A.A. Eaton, Proceeding of the Biological Society of Washington 21: 66 (1908).

**Type:** New Hebrides: Efate: near Mt. MacDonald, *Morrison s.n.*, 18 Aug 1896 (Holotype: B†, isotype: AMES!, K!).

**Synonym:** *Goodyera anomala* Schltr., Repertorium Specierum Novarum Regni Vegetabilis 9:86 (1910). Type: Savai'i, Samoa: *Vaupel 405* (syn B†). Samoa: Sassina, 1905, *K. & L. Rechanging 96* (isosyntype: W!).

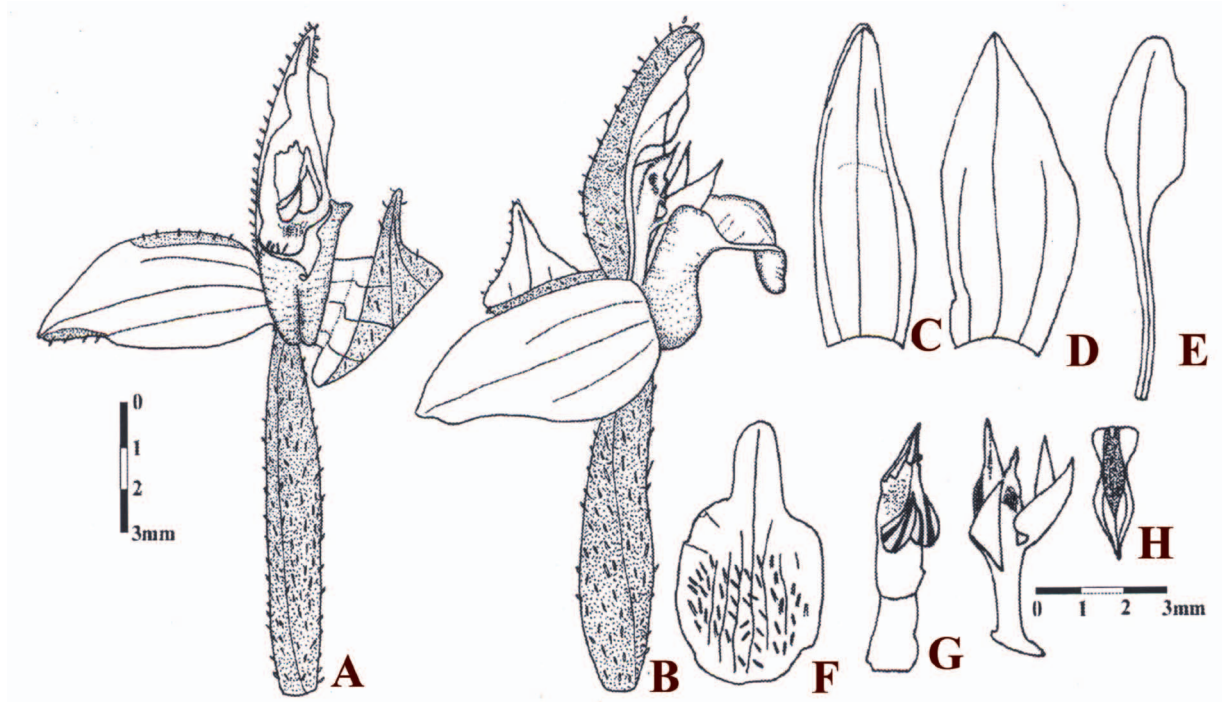
**Description:** *Labellum* ovate, to 2.5–4.5 mm long; base obtuse, mentum not visible; apex linear recurved to revolute; disc hairy inside. *Column* clavate, up to 3.5–5.5 mm long, 1.5–2.5 mm wide. *Rostellum* bifid. Anthers 3; the median anther attached at its base to the apex of the column; lateral anthers attached at their bases on the distal half of the column. **Fig. 3.**

**Additional specimens examined:** SAMOA: UPOLU: Lanutoa, Raunyebit, Erolbevoduer, *Rechanging 2506*, 1-11 Aug 1905 (BM). SAVAI'I: locally abundant in lower rain forest: Ssalailua, *Bryan 162*, 19 May 1924 (NY). TONGA: EUA ISLANDS: in forest near Mt. Esi-o-Moheofo, E of Pangai village, *Hotta 5272*, 3 Sep 1960 (KYO). NEW CALEDONIA: KONE: Mt. Tanji (Pente Sud), *Mackee 196*, 30 Jul 1976 (K). VANUATU: NEW HEBRIDES, *Morrison*, 20 Aug 1896 (K). FIJI: OVALAU: Slope of Mt. Korotolutolu, W of Thawathi, *Smith 8004*, 11 Jul 1953 (AMES, L, NY). TAVEUNI: Slope of Mt. Manuka, E of Wairiki, *Smith 8130*, - (AMES, L, NY). Southern portion of Seatovo Range, *Smith 1576*, 20 Apr-2 May 1934 (NY). VITI LEVU: Tholo West, Vicinity of Mbelo, near Vatukarasa, *Degener 15253*, 8-24 May 1941 (AMES); Mba, Slope of Mt. Nairoso, E flank of Mt. Evans Ranges, *Smith 4015*, 26 Apr-14 May 1947 (AMES); NANDRONGA & NAVOSA: North portion of Rairaimatuku Plateau, between Nandrau and Rewasau, *Smith 5623*, 31 Jul -11 Aug 1947 (AMES, BRI).

**Habitat and Ecology:** Dense rainforest, lowland forest.

**Distribution:** Pacific Islands: Vanuatu, New Caledonia, Tonga, Samoa and Fiji (Fig. 2).

**Notes:** This variety is confined to the Pacific Islands. It differs from the other varieties in having three anthers attached inside the bifid rostellum.



**Fig. 3.** *Goodyera rubicunda* var. *triandra*: **A**, flower, front view; **B**, flower, side view; **C**, dorsal sepal; **D**, lateral sepal; **E**, petal; **F**, labellum; **G**, column; **H**, anther cap. Scale bars shown. Illustration: L.S. Juswara, from *Morrison sn*, dried specimen (HUH 00070595).

### 3. *Goodyera rubicunda* var. *australis* Juswara var. nov.

**Type:** Australia: Queensland, Cook District, Wallicher Falls track, Palmerston National Park, *Jones 4150 & Clements*, 20 May 1989 (holotype CANB!).

**Synonyms:** *Goodyera rubicunda* auct. non (Blume) Lindl.; Dockrill, *Australian Indigenous Orchids* 1: 100–101, f. (1969).

*Goodyera grandis* auct non (Blume) Lindl. ex D.Dietr.: Dockrill, *Australian Indigenous Orchids* 1: 30–32, f. (1969).

**Description:** *Labellum* triangular, 5 mm long; base cordate, mentum not visible; apex linear, more or less recurved; disc hairy inside. *Column* clavate, up to 3 mm long, 0.6–1 mm wide. *Rostellum* absent. *Anther* 1, attached at its base to the apex of the column. **Figs 4, 5.**

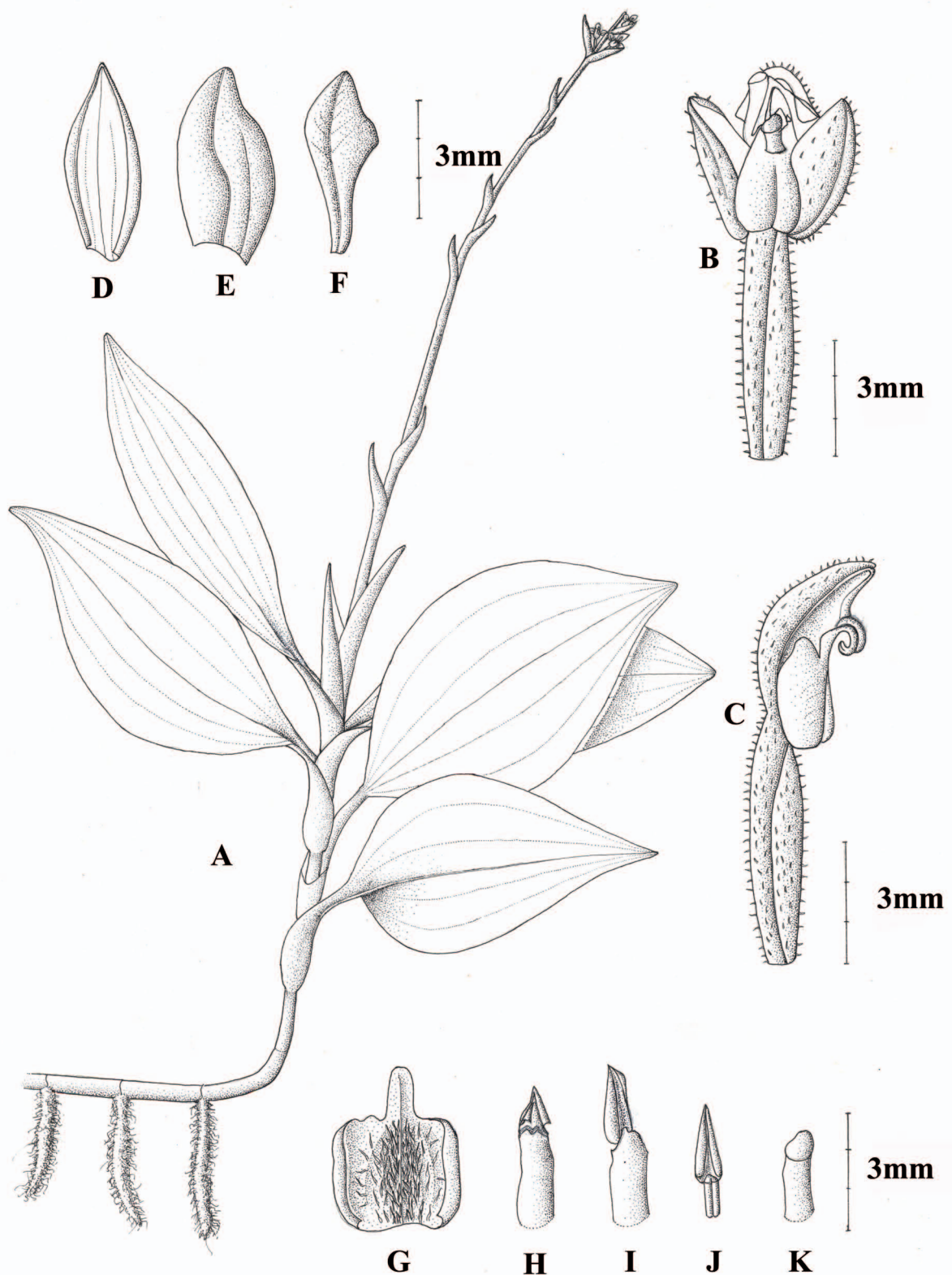
**Additional specimen examined:** PAPUA NEW GUINEA: EAST PAPUA: Milne Bay Province, 15 km WNW of Biniguni airstrip, East of Mount Suckling, Mayu River, *R. Pullen 8367*, 27 Jun 1972 (CANB).

**Habitat and Ecology:** Rain forest near rivers on stony terraces, in red clay loam.

**Distribution:** Australia and Papua New Guinea (Fig. 2).

**Notes:** In *Goodyera rubicunda* var. *australis*, the rostellum is absent. This variety also differs from the others in having a triangular labellum with cordate base and more or less recurved linear labellum apex. *Goodyera ochroleuca* (FM Bailey) M.A.Clem & D.L.Jones (2004) was claimed to be the same as var. *australis*. However, in *G. ochroleuca* a rostellum is present thus the two are not conspecific.





**Fig. 4.** *Goodyera rubicunda* var. *australis*: **A**, habit; **B**, front side of the flower; **C**, front side of the flower; **D**, dorsal sepal; **E**, lateral sepal; **F**, dorsal petal; **G**, labellum; **H-I**, column with the anther cap (note lack of rostellum); **J**, anther cap; **K**, column. Scale bars shown. Illustration: Anne Kusumawaty, based on sketches by L.S. Juswara from *Jones 4150* (dried specimen).

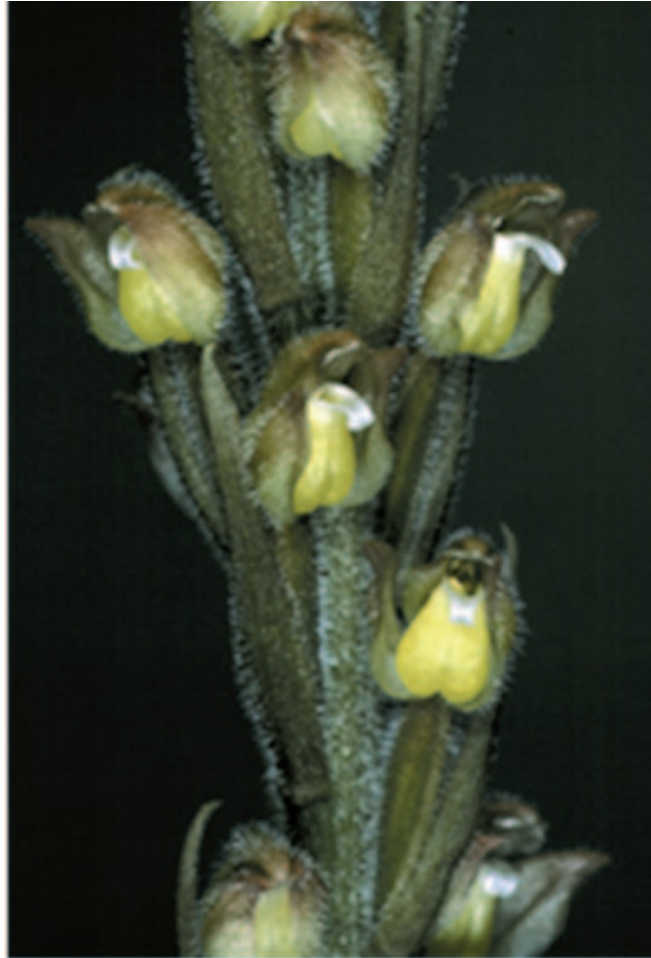


Fig. 5. *Goodyera rubicunda* var. *australis*, mid-region of inflorescences. Refer to description for scale. Image: M.A. Clements.

### Key to the varieties of *Goodyera rubicunda*

- 1a. Anthers 3; anther cap attachment on clinandrium with distinct dorsal filament and the rostellum well developed extending from the stigma; Pacific Islands ..... *G. rubicunda* var. *triandra*
- 1b. Anther 1 ..... 2
- 2a. Labellum triangular, base cordate, apex  $\pm$  recurved; anther cap attached on clinandrium by a dorsal filament without a well-developed rostellum; Australia and PNG ..... *G. rubicunda* var. *australis*
- 2b. Labellum ovate to oblong, base is  $\pm$  obtuse; the anther cap attached on clinandrium without a distinct filament and with a well-developed rostellum, extending from the stigma; Indonesia (Sumatra, Java, Borneo, Sulawesi), Malaysia, India, Philippines, New Guinea, Pacific Islands, Taiwan, and Japan ..... *G. rubicunda* var. *rubicunda*

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