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## A New Species of *Cyrtandra* (Gesneriaceae) from Kaua'i, Hawaiian Islands

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**ABSTRACT.** A rare new species of the Pacific genus *Cyrtandra*, *C. paliku*, is described from the Hawaiian Islands. It is unique in its combination of thick stems with shaggy, reddish brown villous pubescence, leaves strongly inequilateral, petioles shaggy villous, and calyx weakly zygomorphic and persistent. Known from northeastern Kaua'i, *Cyrtandra paliku* occurs only on Mount Namahana and is restricted to north-facing rock faces. A single population of about 70 plants occurs on vertical saturated walls.

**Key words:** *Cyrtandra*, Gesneriaceae, Hawaiian Islands.

The intensive collecting effort by the National Tropical Botanical Garden (NTBG) collectors during the past decade has shown that Kaua'i was one of the least effectively collected Hawaiian islands. Kaua'i also is among the most interesting, because it has the highest level of single-island endemism in the archipelago (Wagner, 1991; Sakai et al., 1995; Wagner & Funk, 1995). Especially in need of intensive survey effort was the northeastern quadrant of Kaua'i. A number of new species and many range extensions have been discovered in the past several years of work in this region of the island (see Wagner & Herbst, 1999). One of these new species is a *Cyrtandra* with dense, long shaggy pubescence and a unique habit—restricted to wet cliffs. This species was discovered by Wood during a series of surveys of this region in 1993 carried out by NTBG collaboratively with the State of Hawaii Department of Land and Natural Resources, Division of Forestry and Wildlife and NTBG (Lorence & Flynn, unpublished report in 1993). Reasons that it may have gone undetected prior to these recent collections are the underexploration of the region and the specialized techniques of rock-climbing used by Wood for much of the exploration

of the rugged topography of this part of Kaua'i and elsewhere in the Hawaiian Islands. His collections were brought to the attention of Wagner and Lorence, who thought that it either represented a hybrid involving *C. oenobarba* H. Mann or a new species. Subsequent study of the site by Wood confirmed a uniform morphology, especially the diagnostic characters given below, among the approximately 70 individuals at this site. Natural regeneration has been observed at this site, although no additional populations have been located. Thus, we concluded that the plants represented a new species apparently restricted to a single wet cliff face. The site was visited again several times by Wood to ascertain the extent of the distribution and the total number of individuals of this distinctive new species. The additional fieldwork also was done to gather more specimens, data, and to take David Liittschwager and Susan Middleton to the site to photograph the species.

***Cyrtandra paliku*** W. L. Wagner, K. R. Wood & Lorence, sp. nov. TYPE: Hawaiian Islands (U.S.A.). Kaua'i: border of Kawaihau and Hanalei Districts, Makaleha Mountains, slopes below Kekoiki, N-facing cliffs, seeping basalt rock face [22°08'58"N, 159°25'22"W], with *Selaginella arbuscula* (Kaulfuss) Spring, 3 populations, approximately 50 plants, in *Metrosideros-Dicranopteris* lowland wet forest with *Gunnera*, *Anoectochilus*, *Cyanea hirtella* (H. Mann) Hillebrand, *C. fissa* (H. Mann) Hillebrand, *Cyrtandra heinrichii* H. St. John, *Pipturus*, *Sadleria squarrosa* (Gaudichaud-Beaupré) T. Moore, *S. pallida* Hooker & Arnott; threats [include] *Rubus rosifolius* Sm., *Paspalum conjugatum* Bergius, landslides, 800–850 m, 9 Feb. 1993, K. R. Wood 2353 (holotype, PTBG; isotypes, BISH, US). Figures 1–3.



Figure 1. *Cyrtandra paliku* W. L. Wagner, K. R. Wood & Lorence. Photographs by David Littschwager and Susan Middleton. —(Left). Habit, showing inflorescence. —(Right). Leaf, showing shaggy reddish brown villous petiole.



Figure 2. *Cyrtandra paliku*. Photographs by David Littschwager and Susan Middleton. —(Left). Corolla. —(Right). Inflorescence, showing calyx configuration post-anthesis.

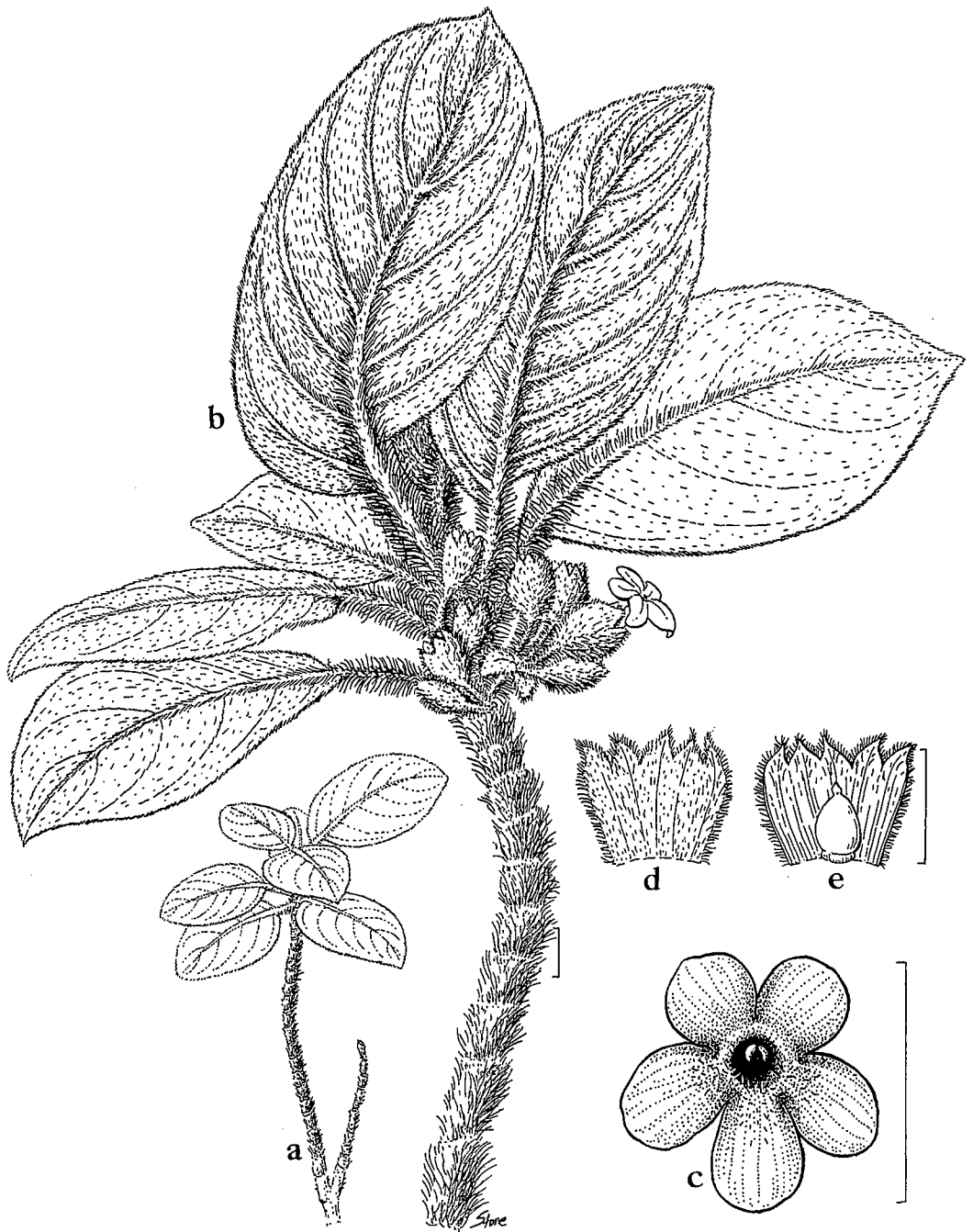
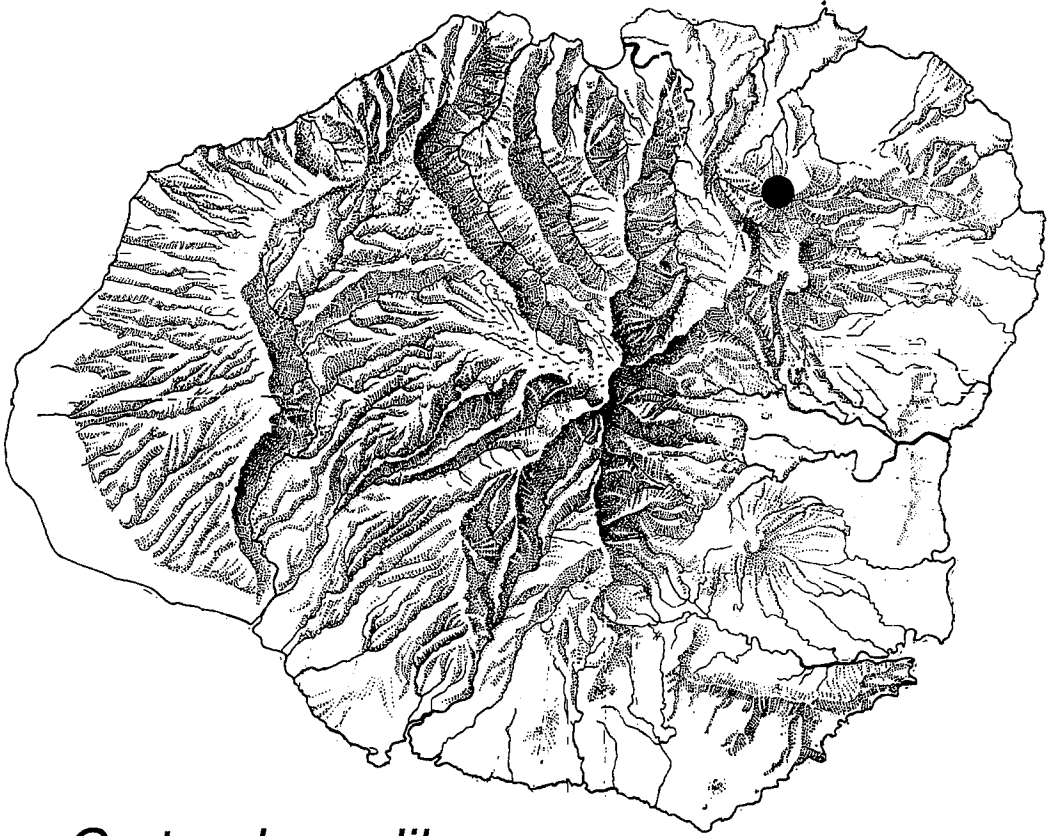


Figure 3. *Cyrtandra paliku*.—a. Habit. —b. Leafy flowering stem. —c. Corolla at anthesis, front view. —d. Opened calyx, external view. —e. Opened calyx, internal view showing ovary. [a from slide taken at type locality; b, d, e from Wood 2855; c from Wood 7307. Scale bar 1 cm in b, 1.8 cm in c, 1.5 cm in d and e.]

Species *Cyrtandrae oenobarbae* affinis, sed caulibus crassioribus villosis ex trichomatibus atrobrunneis vel castaneis 3–5 mm longis uniformiter foliarum petiolis villosis laminis basi inaequilateralibus; calyce viridi pallido vix zygomorfo persistenti differt.

Subshrub, 30–75 cm, 2- to 5-branched from base, each major stem erect, unbranched or vigorous plants with 2 or 3 additional branchlets each up to ca. 25 cm long, conspicuously shaggy villous

# Kaua`i



## ● *Cyrtandra paliku*

Figure 4. *Cyrtandra paliku*. Location of single known population on the island of Kaua'i.

with dark reddish brown trichomes 3–5 mm long; stems erect, thick, 6–8 mm diam., prominently ringed with leaf scars, densely shaggy long-villous. Leaves opposite, clustered at upper 3 to 7 nodes, thick, those of a pair usually unequal, one 30–50% larger than the other, the blades strongly asymmetrical, usually falcate, elliptic to oblanceolate, 7–18 × 4.5–9 cm, upper surface moderately villous, lower surface moderately long-villous, densely so along the veins, the hairs longer and more conspicuous toward the base, margins finely crenate-serrulate, the teeth widely spaced, apex acuminate, base attenuate to cuneate, inequilateral, one side (2–)10–25 mm shorter, petioles 2.5–4(–7) cm long, densely shaggy long-villous. Flowers (1 to)7 to 9 in cymes with 2 orders of branching, internodes, peduncle, and pedicels densely long-villous, peduncles 8–20 mm long, pedicels 11–15 mm long, lowermost bracts 4–10 mm long, ovate, usually obscured by the long-villous pubescence. Calyx weakly zygo-

morphic, pale green, ellipsoid, 12–17 mm long, cleft to 1/3 its length, glabrous internally except a few hairs on the distal portion of the lobes, villous externally, persistent after anthesis, the tube 7–10 mm long, the lobes 5–7 mm long, triangular, slightly asymmetrical. Corolla white, the tube narrowly funnelform, slightly curved upward, 14–15 mm long, glabrous externally, glandular-puberulent internally on lobes and around throat, upper 2 lobes 5–10 mm long, lateral 2 lobes 8–12 mm long, lowermost lobe 8–12 mm long, ovate, subequal to slightly longer than the other 4 lobes. Ovary glabrous. Berries not seen, but immature fruit ca. 10 mm long, ellipsoid, glabrous. Seeds not seen.

*Distribution and phenology* (Fig. 4). Known only from the north-facing wet cliffs of Kekoiki in the Makaleha Mountains of northeastern Kauai, Hawaiian Islands. *Cyrtandra paliku* ranges in elevation from 800 to 850 m, and occurs only on the

Kekoiki summit area of Mount Namahana, where it is restricted to shaded north-facing basalt rock faces, which are windswept and often mist-shrouded. A single population of about 70 plants is known on vertical saturated walls with *Selaginella arbuscula*. This population extends for 0.1 km surrounded by patches of lowland wet forest. Flowering has been observed during February of 1993 and May of 1998. Fruits have been observed during November of 1993. Dominant tree species in this region include *Metrosideros polymorpha* Gaudichaud-Beaupré var. *glaberrima* (H. Léveillé) H. St. John, *M. polymorpha* Gaudichaud-Beaupré var. *dieteri* J. Wyndham Dawson & Stemmermann, and *Cheirodendron fauriei* Hochreutiner. Associated understory trees and shrubs include *Broussaisia arguta* Gaudichaud-Beaupré, *Dubautia knudsenii* Hillebrand, *Perrottetia sandwicensis* A. Gray, *Hedyotis terminalis* (Hooker & Arnott) W. L. Wagner & Herbst, *Hedyotis tryblium* Herbst & W. L. Wagner, *Freycinetia arborea* Gaudichaud-Beaupré, and *Lobelia hypoleuca* Hillebrand. Additional associates include the herbaceous *Peperomia hesperomannii* Wawra and pteridophytes such as *Dicranopteris linearis* (Burman f.) Underwood f., *Selaginella arbuscula*, *Sadleria pallida*, and *S. squarrosa*. *Machaerina angustifolia* (Gaudichaud-Beaupré) T. Koyama is the dominant sedge of this region. Major threats to *Cyrtandra paliku* include invasive introduced weeds such as *Clidemia hirta* (L.) D. Don, *Paspalum conjugatum*, and *Rubus rosifolius*, along with landslides, which are not uncommon along steep, wet-forested slopes and cliffs, especially during intense tropical storms.

**Etymology.** The specific epithet is the Hawaiian word *paliku*, meaning vertical cliff. It is a reference to the steep wet cliffs to which *Cyrtandra paliku* is restricted.

**Discussion.** *Cyrtandra paliku* is a member of *Cyrtandra* sect. *Verticillatae* in the classification of Wagner et al. (1990). It differs from other species of *Cyrtandra* in several characters, primarily in its distinctive shaggy villous pubescence of long dark reddish brown hairs, strongly asymmetrical leaf bases, and the weakly zygomorphic persistent calyx. It is also one of only two species in the Hawaiian Islands with a nearly herbaceous habit. Generally species of the genus in the Hawaiian Islands are 1–6 m tall with softly woody stems, but herbaceous *C. oenobarba* is usually nearly decumbent, and *C. paliku*, while more upright, has stems 30–75 cm tall. These two species differ from one another in several characteristics that had led us to first suspect hybridization. First, the leaves of *C. paliku* are thicker and have shorter petioles 2.5–4(–7) cm

long, pedicels 11–15 mm long, calyx weakly zygomorphic, persistent after anthesis, cleft to  $\frac{1}{3}$  its length, glabrous internally except at the apex of the lobes, the tube 7–10 mm long, the lobes 5–7 mm long, well separated in anthesis vs. in *C. oenobarba* petioles 2.5–13 cm long, pedicels 3–8 mm long, calyx strongly zygomorphic, deciduous after anthesis, cleft  $\frac{1}{3}$ – $\frac{1}{2}$  its length, glabrous internally, the tube 10–18 mm long, the upper 3 lobes 7–17 mm long and the lower 2 lobes 6–16 mm long and tardily separating. The plants we describe here as *C. paliku* represent a distinctive reproductively stable species, although there is the possibility that it may have been formed by hybridization. The weakly zygomorphic calyx that is persistent and with short similar lobes that are well separated in anthesis suggests a possible hybrid origin. In fact, these same characters make *C. paliku* somewhat anomalous in *Cyrtandra* sect. *Verticillatae*, all members of which other than *C. paliku* have a strongly zygomorphic calyx that is quickly deciduous after anthesis.

If a hybrid origin is a possibility, which would be the putative parents? Certainly, *Cyrtandra oenobarba* would be one of them because of its similar subherbaceous habit, long dark reddish brown pubescence, and similar flowers. *Cyrtandra paliku* grows with or nearby several other species of *Cyrtandra*, including *C. heinrichii*, *C. kamooolaensis* H. St. John, *C. kealiae* Wawra subsp. *kealiae*, *C. longifolia* (Wawra) Hillebrand ex C. B. Clarke, *C. paludosa* Gaudichaud-Beaupré, *C. pickeringii* A. Gray, and *C. wainihaensis* H. Léveillé. In the same general vicinity, hybrids were noted by Lorence and Wood in the following two combinations: *C. longifolia*  $\times$  *C. heinrichii* and *C. pickeringii*  $\times$  *C. kealiae* subsp. *kealiae*. Neither of these have morphology at all similar to *C. paliku*. If *C. paliku* is derived via hybridization between *C. oenobarba* and another species, we would expect the other parent to contribute to the divergent features of *C. paliku*. From the above comparison between *C. paliku* and *C. oenobarba*, we would anticipate the other parent to possibly contribute shorter petioles, longer pedicels, persistent calyx, a weakly zygomorphic calyx with the inner surface pubescent toward the lobes, well-separated calyx lobes at anthesis, and a shorter calyx. None of the species observed growing in the general vicinity of *C. paliku* at the present time have all of these characteristics. From the above list, five of the seven species have at least some of the criteria for the second parent: *C. heinrichii*, *C. kamooolaensis*, *C. kealiae* subsp. *kealiae*, *C. pickeringii*, and *C. wainihaensis*. *Cyrtandra kamooolaensis* would seem unlikely, as it has long foliaceous calyx

lobes. Similarly, the calyx of *C. kealiae* subsp. *kealiae* is too large, but many of the other features make it a possible candidate. The other two possible candidates are *C. pickeringii* or possibly *C. wainihaensis*, although neither of these has all of the characteristics listed above either. Field studies and use of molecular markers may address this hybrid hypothesis and the actual parentage if an appropriate set of species-specific markers could be found. The genus *Cyrtandra* is very complex in the Hawaiian Islands with 514 names described for 58 currently recognized species (Wagner et al., 1999). Much of the variation exhibited by the genus in the Hawaiian Islands is the result of extensive sympatry and resultant hybridization (Wagner et al., 1990). To date, over 80 hybrid combinations have been identified (Wagner et al., 1990; Wagner, unpublished data). Recent use of RAPD markers has confirmed a number of the morphologically based hybrid hypotheses (Smith et al., 1996), including another Hawaiian species, *C. kaulantha* H. St. John & Storey, hypothesized to be of hybrid origin.

*Paratypes.* HAWAIIAN ISLANDS (U.S.A.). **Kaua'i:** border of Kawaihau and Hanalei Districts, Makaleha Mountains north-facing steep slopes below Kekoiki, 800–850 m, 10 Nov. 1993, *Wood 2855* (PTBG, US); 2750 ft. (838 m), 22°09'00"N, 159°25'39"W, 10 Aug. 1999, *Wood et al. 7951* (PTBG), *Wood et al. 7952* (PTBG).

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