Pacific Science (1995), vol. 49, no. 3: 221–226
© 1995 by University of Hawai'i Press. All rights reserved

# Rediscovery of *Labordia triflora* (Loganiaceae)[1]

TIMOTHY J. MOTLEY[2]

ABSTRACT: *Labordia triflora* Hillebr. is resurrected as a species distinct from *L. tinifolia* A. Gray based on its rediscovery on the island of Moloka'i in the Hawaiian Islands. It differs from *L. tinifolia* in its scandent habit, cordate leaf base, shorter petioles, slightly larger flowers and fruits, and fewer flowers per inflorescence on pistillate plants. *Labordia triflora* is endemic to Moloka'i, whereas *L. tinifolia* occurs on all major islands in the archipelago. The two taxa maintain allopatric populations on Moloka'i that are isolated by the physical and spatial barriers of a mountain range. Distinct morphology and allopatric distributions of the two taxa support resurrection of *L. triflora* as a separate species.

BEFORE ITS REDISCOVERY in 1990, the only known material of *Labordia triflora* Hillebr. was the type collection made by Wilhelm Hillebrand in Mapulehu Valley, Moloka'i, in 1870 (Hillebrand 1888). Without additional material, Wagner et al. (1990) chose not to recognize *L. triflora* as a distinct species. Rather, they surmised that the single Hillebrand collection from Moloka'i was an anomalous specimen of *L. tinifolia* A. Gray var. *lanaiensis* Sherff, a taxon from the island of Lāna'i. The rediscovery in 1990 by Joel Lau (botanist, The Nature Conservancy of Hawai'i) of eight individuals of *L. triflora* (two staminate and six pistillate plants) in Kua Gulch on southeastern Moloka'i has provided ample material to demonstrate the distinctiveness of the species, as well as its reproductive isolation from *L. tinifolia*. *Labordia triflora* differs from *L. tinifolia* primarily by having a scandent shrublike habit, a cordate leaf base, shorter petioles (leaves nearly sessile), slightly larger flowers and fruits, and fewer flowers per inflorescence on the pistillate individuals.

The two *Labordia* species considered here are contrasted in the following key and treatment:

Leaf petioles 1–3 mm long, base cordate, blade lanceolate to elliptic-lanceolate; peduncles 40–50 mm long, elongating to 70–80 mm in fruit; pedicels 10–25 mm long, elongating to 30 mm at maturity; plants often scandent in habit ..... 1. *L. triflora*

Leaf petioles 6–22(–40) mm long, base cuneate, blade elliptic to elliptic-oblanceolate; peduncles 9–22 mm long, elongating to 13–25(–35) mm in fruit; pedicels 8–11 mm long, elongating to 23 mm at maturity; plants treelike in habit ..... 2. *L. tinifolia*

1. *Labordia triflora* Hillebr., 1888:293, Fl. Hawaiian Isl. Type: "Mopulehu [Mapulehu], Molokai," *Hillebrand s.n.*, July, 1870 (B, holotype [destroyed in 1943]; BISH 510969!, GH, US, isotypes). Sherff, 1939, Field Mus. Nat. Hist., Bot. Ser. 17:528.

Scandent shrubs or small trees, 2–6 m tall; stems dichotomously branched, young branches terete, glabrous. Leaves dark green, membranous, lanceolate to elliptic-lanceolate, 7–14 cm long, 2–4 cm wide, veins not impressed on upper surface, glabrous, margins flat, apex acuminate, base cordate, ± asymmetrical, petioles 1–3 mm long, stipules completely connate, forming a truncate sheath 1–4 mm long, sometimes splitting with age,

[1] Manuscript accepted 1 September 1994.
[2] Botany Department, University of Hawai'i at Mānoa, Honolulu, Hawai'i 96822.

slightly adnate to the base of the petioles, margins entire, sometimes ciliolate. Flowers 3–14 (♀, 3–5[–7]; ♂, 3–14) in pendulous, open, paniculate cymes, fragrance semenlike, glabrous throughout, peduncles weakly recurved, 40–50 mm long, elongating to 70–80 mm long in fruit, pedicels 10–25 mm long, elongating to up to 30 mm in fruit, bracts and bracteoles subulate, 1–2 mm long; calyx lobes connate to ca. one-half their length, imbricate, ovate-deltate, 1–4 mm long, 1–2.5 mm wide, margins hyaline, ± ciliolate; corolla pale yellowish green or greenish yellow, urceolate, 7–12 mm long, the tube 6–10 mm long, 1.5–2 mm in diameter (♀ slightly enlarged at base 3.5–4 mm in diameter), sparsely pilose within, lobes deltate-ovate, 1.5–2.5 mm long, apex short acuminate to rounded; ovary glabrate. Capsules broadly ovoid to subglobose-ovoid or ellipsoid-ovoid, 9–20 mm long, two-valved, valves transversely wrinkled, not keeled, apex beak 1–2 mm long. Seeds brown, 2–2.5 mm long.

DISTRIBUTION: Rare in mesic forest, southeastern Moloka'i. Recorded from Kua Gulch, ca. 800 m elevation, on west-facing slopes of ravine, with well-drained, loose, rocky substrate, and Mapulehu Valley.

SPECIMENS EXAMINED: Hawaiian Islands: Moloka'i, "Kua Gulch: 800 m, west-facing slope near the back of gulch by a large emergent *Tetraplasandra*," 24 Oct. 1991, *Motley 1057*; "under *Pouteria*," *Motley 1058*; "plant with large fruits, rat damaged," *Motley 1059*; "plant very scandent, trailing down slope," *Motley 1060*; "plant near the back of the gulch, where stream bed rises, by *Cyanea mannii*," *Motley 1061*; "by emergent *Tetraplasandra*," 7 July 1992, *Motley 1149*; 1 May 1993, *Motley 1256*; "by *Cyanea mannii*," *Motley 1257*; "male individual near #1256," *Motley 1258*; *Lau 3419* (BISH), *3420* (BISH), *3421* (BISH), *3423* (BISH) [Lau's specimens duplicate collections of the same individuals collected by Motley, Kua Gulch].

2. *Labordia tinifolia* A. Gray, 1860, Proc. Am. Acad. 4:322. Type: "Sandwich Islands," Maui and Hawai'i, 1851–1855, *Remy 360* (GH, holotype).

*Labordia decurrens* Sherff, 1938, Am. J. Bot. 25:581. Type: "Oahu," May 1864–May 1865, *Mann & Brigham 610* (BISH 56659!, holotype).

*Labordia tinifolia* var. *euphorbiodea* Sherff, 1938, Am. J. Bot. 25:583. Type: "East Maui, Makawao, in lower forest, 2500 ft," Oct. 1910, *Rock 8616* (BISH 510965!, holotype; BISH 56671!, GH, W, isotypes).

*Labordia tinifolia* var. *forbesii* Sherff, 1938, Am. J. Bot. 25:583. Type: "Molokai, Wailau, on slopes of Olokui," Sept. 1912, *Forbes 553-Mo* (BISH 51135!, holotype; BISH 56700!, 56676!, 510713!, B, F, GH, K, MO, isotypes).

*Labordia tinifolia* var. *honolulensis* Sherff, 1938, Am. J. Bot. 25:584. Type: "Oahu, Pacific Heights Ridge," Aug. 1916, *Forbes 2388-O* (BISH 511344!, holotype; BISH 56675!, B, F, isotypes).

*Labordia tinifolia* var. *leptantha* Sherff, 1938, Am. J. Bot. 25:582. Type: "Molokai, Kalae," May 1918, *Rock 14062* (BISH 510972!, 56699!, holotypes [Sherff designated two sheets as types]).

*Labordia tinifolia* var. *parvifolia* Sherff, 1938, Am. J. Bot. 25:583. Type: "Molokai, central northern coast, Kalaupapa Pali," *Hillebrand s.n.* (B, holotype).

*Labordia tinifolia* var. *tenuifolia* Degener & Sherff, 1938, Am. J. Bot. 25:583–584. Type: "Molokai, Kahuaawi Gulch, erect, slender tree, 12 ft tall, in forest," May 1928, *Degener 10272* (F [two sheets], holotypes [Sherff designated two sheets as types]; BISH 511343!, 510966!, B, BM, G-DEL, GH, K, MO, W, P, US, isotypes).

*Labordia tinifolia* var. *waialuana* Sherff, 1938, Am. J. Bot. 25:583. Type: "Oahu, Waialuu Mountains," *Mann & Brigham 562* (GH, holotype; BISH 510968!, CU, F, NY, isotypes).

*Labordia tinifolia* var. *microgyna* Degener & Sherff, 1939, Field Mus. Nat. Hist., Bot. Ser. 17:537. Type: "Kauai, in rainforest, northeast of Kipu," June 1926, *Degener 10251* (F, holotype; BISH 56648!, B, isotypes).

*Labordia tinifolia* var. *haupuensis* Sherff, 1944, Am. J. Bot. 31:159. Type: "southernmost Kauai, Haupu," Feb. 1927,

*MacDanials 424* (BH, BISH 56673! [photo], holotype).

*Geniostoma tinifolia* (A. Gray) Conn, 1980, Blumea 26:269–272.

Shrubs or small trees (1.2–)2–8(–15) m tall; stems dichotomously branched, young branches terete or nearly so, glabrous. Leaves medium green, membranous, elliptic to elliptic-oblanceolate, sometimes narrowly elliptic, oblong-elliptic, or lanceolate, (3.8–)4.5–21 cm long, (1.4–)2–5(–7.3) cm wide, veins not impressed on upper surface, glabrous, margins entire, apex abruptly acuminate to acute, base narrowly to sometimes broadly cuneate, ± asymmetrical, petioles 6–22(–40) mm long, stipules completely connate, sometimes splitting somewhat with age, slightly adnate to base of petioles, margins sometimes ciliolate. Flowers (3–)9–12(–19) (♀ and ♂ do not differ), in pendulous, open, paniculate cymes, fragrance semenlike, glabrous throughout, peduncles weakly recurved, 9–22 mm long, elongating to 13–25(–35) mm long in fruit, pedicels 8–11 mm long, elongating up to 23 mm long in fruit, bracts and bracteoles subulate, 0.7–1.6 mm long; calyx lobes connate to ca. one-half their length, imbricate, ovate-deltate, 1.5–3 mm long, 0.7–1.6 mm wide, margins hyaline, ± ciliolate; corolla pale yellowish green or greenish yellow, narrowly urceolate, 6.5–19 mm long, the tube 5.5–7.8 mm long, 1.5–2 mm in diameter, sparsely white pilose within, the lobes deltate-ovate or ovate, 1.7–2.3 mm long, apex short-acuminate to rounded; ovary glabrate. Capsules broadly ovoid to subglobose-ovoid or ellipsoid-ovoid, 8–35 mm long, 2(3)-valved, valves transversely wrinkled, not keeled, apex beak 0.5–1.5 mm long. Seeds brown, ca. 1.8 mm long.

DISTRIBUTION: Occurring on ridges, slopes, or in understory of open canopy, mesic to wet forest, 300–920 m, on all the major islands.

Three varieties of *Labordia tinifolia* are currently recognized based on the following key:

Corollas 10 mm or less long
- Capsules 8–12 mm long ..... 2a. var. *tinifolia*
- Capsules 11–17 mm long ..... 2b. var. *lanaiensis*

Corollas 17–25 mm long ..... 2c. var. *wahiawaensis*

2a. *L. tinifolia* var. *tinifolia*

With capsules 8–12 mm long and corollas 10 mm or less long.

DISTRIBUTION: Predominately in mesic forest but extending into wet forest, 300–920 m, on Kaua'i, O'ahu, Moloka'i, Maui, and Hawai'i.

SPECIMENS EXAMINED: Hawaiian Islands: (738), May 1864–May 1865, *Mann & Brigham 610*. Hawai'i: "Kohala Forest Reserve," Aug. 1926, *Degener 9481*; "land of Manuka, Kau District, 2500 ft," Feb. 1933, *Degener & Bryan 10878*. Kaua'i: "Haupu Haiku, in moist woods below cliff, 900 ft," Nov. 1936, *Hosaka 1675*; "north side of Haupu, 350 m," Feb. 1916, *MacDanials 729*; "Haupu, talus near foot of cliff, 400 m," Feb. 1927, *MacDanials 897*; "Limahuli Valley, close to junction of chute 2 & 3," June 1979, *Perlman & Wichman 455*; "Hoalulu Valley, Hanakapiai, 600 ft," *St. John et al. 23180*. Maui: E. Maui: "Haleakala, 1000," Aug. 1909, *Faurie 536*; "Kahikinui, Wailaulau drainage, 3800 ft," Dec. 1985, *Hobdy 2461*; "Honomanu," May 1911, *Rock s.n.* (two sheets). W. Maui: "Mauka of McGregor," Mar. 1952, *Degener et al. 22033*; "1/2 mi. north of Keahikauo," July 1927, *Degener 10206*; "central ridge of Olowalu Valley," May 1920, *Forbes 2306.M*; "Poelua Ridge, 1800 ft," July 1984, *Hobdy 2140*; "Manawainui Plant Sanctuary, lower Hanaula, 3000 ft," Apr. 1981, *Hobdy 1059*; "Holono," *Lygate 95*; Aug. 1910, *Rock 8169*. Moloka'i: May 1928, *Degener s.n.* (two sheets); "Wailau, growing on ridge, west of beach leading to Olokui, 1700 ft," Mar. 1989, *Hobdy 3033* (two sheets); *Rock 14062* (two sheets); "Olokui-Wailau, 2500 ft," Feb. 1948, *St. John & Wilbur 23313*. O'ahu: 1852, *Anderson s.n.*; "Lyon Arboretum, from nose

of ridge above sect. 10," June 1975, *Baker 125* (two sheets); "Pauoa Flats, open forest," Nov. 1925, *Degener 10254*; "trail to Nuuanu Pali, at hairpin turn," Nov. 1926, *Degener 10241*; "trail to Nuuanu Pali, NE of pali on exposed slope," Nov. 1926, *Degener 10255*; "Pupukea-Kahuku region," Apr. 1938, *Degener et al. 12019*; "Manoa Cliff trail," Nov. 1935, *Degener et al. 10065*; "Nuuanu Pali," Nov. 1909, *Faurie s.n.*; "Kalihi Pali," Feb. 1916, *Forbes 2293.O*; "Wailani Ridge," Oct. 1913, *Forbes 1844.O* (two sheets); "Moanalua Valley," Apr. 1909, *Forbes 245*; "east side of Nuuanu Valley," Oct. 1910, *Forbes 1602.O* (two sheets); "Tantalus, 430 m," July 1937, *Fosberg 14195*; "Castle trail, Punaluu Valley," Apr. 1937, *Fosberg 13737*; "Pupukea-Kahuku trail, Hanakaoe, 460 m," May 1937, *Fosberg & Hosaka 14001*; "Honolulu District, along NW slope of Waahila Ridge, north of Woodlawn, 1000–1200 ft," June 1968, *Herbst 1121*; "Tantalus, 500 m," May 1962, *Krajima s.n.*; "Pauoa," *Lygate s.n.*; "Tantalus, Manoa Cliff trail," Aug. 1933, *M.F.L. s.n. (Board of Agriculture)*; "off Waianae Kai-Makaha Ridge (Waianae saddle), slightly to Makaha side, about middle of saddle, slightly below ridge top, about 30 m below, 2400 ft," Apr. 1978, *Obata & Palmer s.n.*; "upper Makaha Valley, Waianae, off crest of Makaha-Waianae Kai on Makaha side, beyond the old trail coming up from Makaha Valley, 2400 ft," Feb. 1978, *Obata et al. 340*; "Manoa Cliff trail," Apr. 1955, *Osaki & Lamoureux 1498*; "Manoa Ridge trail," Apr. 1954, *Pearsall s.n.*; "near junction Tantalus no. 2 trail and Manoa Ridge trail, right side, 2000 ft," May 1959, *Pearsall 392*; "Waianae Mountains, Puu Kalena, on south side of Puu Kalena summit, in gully just east of trail to summit, 3350 ft," July 1986, *Perlman 4901*; "Waianae Kai, in Makaha Valley, below saddle crest, near old Kumaipo trail, 2450 ft," Mar. 1987, *Perlman 5475*; "Manoa Cliff trail," Jan. 1929, *Rock s.n.* (two sheets); "Nuuanu-Lanihuli, trail opposite falls," July 1933, *Rock s.n.*; "Puu Pane, Maile Ridge, Waialua," Oct. 1931, *Rock s.n.*; "Nuuanu Pali," Apr. 1930, *Russ s.n.*; "Pauoa Flats," July 1932, *Russell 169*; "Manoa Cliff trail, 1500 ft," Apr. 1932, *St. John 11623*; "Koolau, Palolo Valley, ridge above Palolo Stream," May 1960, *Stone 3500*; "upper Makiki, 1800 ft," July 1985, *Takeuchi & Tate 2278*; "Pukele, on colluvial rock, 1275 ft," July 1986, *Takeuchi & Shimabukuro 2711* (two sheets); "Kumaipo, in ohia-lama forest, 2100–2200 ft," July 1987, *Takeuchi 3629*; "Kamaileunu, on moderate slope, 2550 ft," May 1987, *Takeuchi & Tate 3566*; "upper Niu, central ridge, 1325 ft," Aug. 1985, *Takeuchi & Tate 2388*; "Manoa Cliffs," May 1984, *Takeuchi Koolau 174a, 175a*; "Palolo, near Kaau, on sun exposed slope, 1250 ft," Jan. 1986, *Takeuchi 2620*; "Wailupe, above stream bed, in kukuilama," June 1985, *Takeuchi et al. 2244*; "Manoa Cliffs," Mar. 1984, *Takeuchi Koolau 130a*; "Waialae Nui Ridge, 1 mi. from summit," Mar. 1984, *Takeuchi & Obata Koolau 123c*; "Paumalu, mauka in gully by *Tetraplasandra*," Apr. 1985, *Takeuchi et al. 2160*; "Waahila Ridge, ohia-koa forest, 500 m," May 1982, *Van Balgooy & Stuessy 4124*. All specimens at BISH.

2b. *Labordia tinifolia* var. *lanaiensis* Sherff, 1938, Am. J. Bot. 25:583. Type: "Lanai," July 1870, *Hillebrand s.n. L. tinifolia* var. γ, Hillebr., 1888:293, Fl. Hawaiian Isl. (excluding the Kaua'i or first cited material) (B, holotype [destroyed in 1943]). Lectotype, BISH 56678!, here designated: "Lanai, flowering Waiopaa 3/27/15," Mar. 1915, *Munro 35* (this sheet, BISH accession 56678, contains two specimens; the lectotype is the flowering material in the upper right-hand corner of the sheet just below the accession number and was designated by Sherff as ♂. The two components of fruiting material designated ♀ by Sherff represent "Lanai, Kaohai 4/2/14" and are not a portion of the lectotype).

*L. tinifolia* var. *lanaiensis* has capsules 11–17 mm long and corollas 10 mm or less long.

DISTRIBUTION: Occurring on ridges, slopes, or in understory of open canopy, mesic to wet forest, 760–920 m, on Lāna'i.

SPECIMENS EXAMINED: Hawaiian Islands: Lāna'i: "Kapohaku gulch, dark forest, 2500 ft," Aug. 1963, *Degener & Degener 28363,*

*28364*; "head of Hulopoe gulch at Munro trail, 2500 ft," Aug. 1963, *Degener & Degener 28367b*; "north side of valley between Haalelepaakai and Puhielelu ridges," May 1982, *Flynn 212*; "south side of Haalelepaakai ridge, near top," May 1982, *Flynn 198*; "Kaiholena valley," June 1913, *Forbes 4.L*; "mountain near Koele," June 1909, *Forbes 79.L*; "east end of mountains," June 1913, *Forbes 281.L* (two sheets); June 1909, *Forbes 267.L*; "head of Waiakeakua Gulch, 900 m," Nov. 1935, *Fosberg 12416*; "north slope of Kaiholena Gulch, 2500 ft," June 1971, *Hobdy 240*; "head of Mauna Alii by Mahana," Mar. 1915, *Munro 432*; "Kalama," July 1914, *Munro 359*; "Aukuu," Mar. 1916, *Munro s.n.*; "Kaiholena," Mar. 1916, *Munro s.n.*; "pali above Waiopaa," Mar. 1915, *Munro 430*; "Mahana valley, damp forest," Aug. 1910, *Rock 8099*; "dry foothills of Mahana Valley, 2000 ft," *Rock 8000*; "Puu Aalii, Kaalia Aupu-Kaunolu, on moist ridge, 2700 ft," Apr. 1938, *St. John & Eames 18714*; "Awehi Gulch, Kaohai lower woods, 3000 ft," Apr. 1938, *St. John & Hosaka 18894*. All specimens at BISH.

2c. *Labordia tinifolia* var. *wahiawaensis* St. John, 1984, Bull. Torrey Bot. Club 111: 481–482. Type: "Kauai, Wahiawa Valley, deep shade, left side of stream, near *Nothocestrum*, on clay soil, slope 40°," Apr. 1980, *Perlman 500* (BISH 497713!, holotype; BISH 497523!, isotype).

*L. tinifolia* var. *wahiawaensis* has capsules 11–35 mm long and corollas 17–25 mm long.

DISTRIBUTION: Wet forest, 650–730 m, Wahiawa Valley, Kaua'i.

SPECIMENS EXAMINED: Hawaiian Islands: Kaua'i: "Lihue-Koloa Forest Reserve, NW of Wahiawa Bog, along tributary of Wahiawa Stream, NW of stream and SE of Hulua, 650–730 m," May 1988, *Flynn 2982*; "Koloa District, Lihue-Koloa Forest Reserve, north of main Wahiawa Stream, along unnamed tributary from dam toward connecting Hulua and Kapalaoa Peaks," July 1990, *Lorence et al. 6648*; "Wahiawa Mountains, NE of Hulua, along stream bank west of main Wahiawa Stream, 2200–2400 ft," June 1987, *Perlman 5976*; "first north fork of Wahiawa Stream, NW of Wahiawa Bog, 650–720 m," Apr. 1988, *Wagner et al. 6050*. All specimens at BISH. (*L. tinifolia* descriptions and distributions adapted from Wagner et al. 1990.)

## DISCUSSION

The nearly sessile leaves of *L. triflora* make it quite morphologically distinct from *L. tinifolia*, even during the juvenile stages of development. The two species are separated by physical barriers that prevent hybridization and gene flow between them. *Labordia triflora* and *L. tinifolia* var. *lanaiensis* occur allopatrically on separate islands, Moloka'i and Lāna'i, respectively. Moloka'i and Lāna'i are presently isolated by the 14- to 18-km expanse of the Kalohi Channel. The isolation of the islands took place ca. 0.4–0.8 million years ago when after a period of erosion the lower saddles of the large volcanic land mass, Maui Nui, became flooded by seawater to form the present-day islands of Maui, Moloka'i, Lāna'i, and Kaho'olawe (Macdonald et al. 1983). *Labordia tinifolia* var. *tinifolia* occurs on the northern half of the island of Moloka'i, but is separated from *L. triflora* by several intervening mountain ridges. Geographic and geologic separation has perhaps allowed rapid speciation of these *Labordia* populations.

*Labordia* species readily hybridize in controlled field crosses (unpubl. data), and field observations and herbarium investigations indicate that the flowering periods of *L. triflora* and *L. tinifolia* overlap. It is unlikely, however, that cross-pollination would occur between these allopatric species because of the geographic barriers separating them. The phenology of the taxa needs further study, as do the native pollinator(s) of *Labordia*, although introduced honey bees have been observed visiting the flowers of *L. tinifolia* var. *tinifolia* on O'ahu. Both *L. triflora* and *L. tinifolia* produce abundant fruit containing viable seed.

*Labordia triflora* appears to be in danger of extinction in the near future, a fate that has befallen many Hawaiian taxa (Howarth

et al. 1988). Only eight individuals are known to exist, all occurring in a single locality of $<0.5$ ha. The population consists of six pistillate and two staminate individuals, and because *Labordia* species are obligate outcrossers, the loss of the two "male" plants would effectively end sexual reproduction in the species. The ability of *Labordia* individuals to undergo "sex changes" has not been observed in field studies.

This small population is currently faced with many threats. Large populations of feral goats, which have heavily impacted the native flora of Hawai'i, inhabit the ridges above Kua Gulch. Rat damage has been observed on the fruit capsules of *L. triflora*. There also is evidence of past marijuana cultivation in the gulch. The pistillate plants in the population produce numerous fruits containing viable seed, but no seedlings were observed in the area. Seeds were collected that readily germinate and grow under greenhouse conditions, suggesting that the lack of seedlings in the area may be due to predation on the seeds or young plants, or the result of a lack of proper conditions for germination.

This rare species is in desperate need of protection to conserve the few remaining individuals. Further research, such as genetic analysis and biosystematic studies of *L. triflora* and *L. tinifolia* var. *lanaiensis*, is needed to elucidate the evolutionary patterns that have led to their speciation, as well as to yield a greater understanding of the factors limiting vitality of these species in their natural habitat.

ACKNOWLEDGMENTS

I thank Gerald Carr, Clyde Imada, Cliff Morden, Joel Lau, Steve Perlman, and Warren Wagner for their editorial and technical assistance in the preparation of this paper and Joel Lau for his expert field assistance. I am also grateful to Ernst Leuenberger at the Botanischer Garten und Botanisches Museum and especially the personnel of the Bernice P. Bishop Museum for the use of the collections and facilities.

## LITERATURE CITED

CONN, B. J. 1980. A taxonomic revision of the *Geniostoma* subg. *Geniostoma* (Loganiaceae). Blumea 26:245–364.

GRAY, A. 1860. Notes upon some Polynesian plants of the order Loganiaceaea. Proc. Am. Acad. Arts 4:319–324.

HILLEBRAND, W. F. 1888. Flora of the Hawaiian Islands. Lubrecht & Cramer, New York.

HOWARTH, F. G., S. H. SOHMER, and W. D. DUCKWORTH. 1988. Hawaiian natural history and conservation efforts. BioScience 38:232–237.

MACDONALD, G. A., A. T. ABBOTT, and F. L. PETERSON. 1983. Volcanoes in the sea, 2nd ed. University of Hawai'i Press, Honolulu.

SHERFF, E. E. 1938. Studies in the genus *Labordia* Gaud., with a new variety in *Megalodonta* E. L. Greene. Am. J. Bot. 25: 529–589.

———. 1939. Genus *Labordia*. Field Mus. Nat. Hist. Bot. Ser. 17:449–546.

———. 1944. Some additions to our plant knowledge of the flora of the Hawaiian Islands. Am. J. Bot. 31:151–161.

ST. JOHN, H. 1984. Novelties among the Phanerogamae, Hawaiian plant studies 123. Bull. Torrey Bot. Club 111:479–482.

WAGNER, W. L., D. R. HERBST, and S. H. SOHMER. 1990. Manual of the flowering plants of Hawai'i. University of Hawai'i Press and Bishop Museum Press, Honolulu.