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New records of *Gamochaeta* (Asteraceae) in the Hawaiian Archipelago

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Specimens of *Gamochaeta* (Asteraceae/Compositae) in the *Herbarium Pacificum* (BISH) of the Bishop Museum were examined in July 2011, and three previously overlooked species and one species commonly subsumed in a broader circumscription were observed. Additional specimens were observed at MO, PTBG, and UC by electronic correspondence and photos, and duplicates were inferred at US via an internet database (Wagner *et al.*, 2005 onwards).

Gamochaeta is a genus of about 50–80 species that are native primarily to South America, but several species are naturalized weeds in North America, Europe, Australia, New Zealand, and elsewhere (Nesom, 2004b, 2006). Once placed in a broadly circumscribed *Gnaphalium*, *Gamochaeta* is most easily differentiated by having heads arranged in spiciform arrays and pappus that is deciduous as a single unit due to the fusion of bristles into a basal ring (Nesom, 2006).

The *Manual of the flowering plants of Hawai'i* (Wagner *et al.*, 1999) included one species, *Gnaphalium purpureum* L., that is currently recognized in the genus *Gamochaeta*. This taxonomic change to *Gamochaeta* was noted by Wagner *et al.* (1997), and a key was provided to all of the taxa formerly placed in *Gnaphalium*. Wagner *et al.* (1999) included *Gnaphalium peregrinum* Fernald [= *Gamochaeta pensylvanica* (Willd.) Cabrera] in synonymy, considering it conspecific with *Gnaphalium purpureum*, as did many older treatments (*e.g.*, Gleason & Cronquist, 1991). More recently, the narrower circumscriptions of Nesom (2006) have been followed and are followed here, especially because the species are delimited by unique combinations of putatively non-linked morphological characters (*e.g.*, features of vestiture, leaf shape, phyllary shape and color, and cypselae). Nesom's (2006) treatment was followed by preliminary genetic work, and all six of the tested species have unique genetic markers (Cameron, 2010; Alford & Cameron, unpubl. data).

Five species of *Gamochaeta* are recognized for the Hawaiian Archipelago: *G. americana*, *G. argyrinea*, *G. pensylvanica*, *G. purpurea*, and *G. simplicicaulis*. Two species, *G. purpurea* and *G. pensylvanica*, have been present for more than 100 years. They occur on several islands and in a wide variety of habitats. *Gamochaeta argyrinea* was first collected after World War II but now occurs on three islands. The other two species, *G. americana* and *G. simplicicaulis*, are known from only one collection each, both collected in the last 30 years.

Only seven specimens collected after 1991 were observed. Continued accession of specimens and additional collecting is likely to augment these records. In addition to the species reported below, one specimen was observed which could not be identified with certainty due to size and immaturity of the inflorescence (MAUI: Lihau, 9 Jul 1991, *Welton & Haus 897* [BISH]).

Asteraceae

Gamochaeta purpurea (L.) Cabrera **New circumscription**

Gamochaeta purpurea is found on the islands of Hawai‘i, Maui, Mokapu Islet (Moloka‘i), Moloka‘i, and O‘ahu. Habitats include dry, disturbed forest, dry shrubland, pasture, grasslands, and lava flows at elevations of (65–)465–2440 m. The species is presumably native to North America but is also known from Central and South America and the West Indies (Nesom, 2006). Hillebrand (1888: 201) reports this species from near Diamond Hill, O‘ahu, as early as 1871, but specimens at BISH date only from 1920. Although Hillebrand (1888) could have been referring to any of the species reported here, his detailed description clearly matches *G. purpurea*. A diagnostic feature of *G. purpurea* is the presence of glass-like (or sand-like or cystolith-like) trichome base remnants on the adaxial surface of the leaves. This feature is rather obvious in well-pressed, clean plants, but may be obscured in specimens with dirty leaves (*i.e.*, where sand and trichome bases could be confused) or poorly pressed leaves where the adaxial surface is neither flat nor easy to examine. *Gamochaeta purpurea* was reported for Lehua Islet, Ni‘ihau (Wood & LeGrande, 2006), but that collection is here circumscribed under *G. pensylvanica*. The illustration labeled as *Gnaphalium purpureum* in Wagner *et al.* (1999: Plate 27) actually represents *G. pensylvanica*.

Material examined. **HAWAI‘I**: Ka‘ū, Hilini Pali, 9 May 1966, *Degener & Degener 31589* (BISH, MO [photo]). Kohala Mountains, trail from Waimea to Upper Hamakua Ditch, 3 Sep 1933, *Fosberg 10198* (BISH). Ka‘ū, Hawai‘i Volcanoes National Park, along Hwy 11, 58 km from Hilo towards Kona, 20 Jun 1974, *Herat et al. 670* (BISH). Humu‘ula Sheep Station, 13 Jun 1938, *Hosaka 2320* (BISH). Kīlauea Crater, May 1932, *Meebold s.n.* (BISH). Humu‘ula, lava flow at base of Pu‘u Huluhulu, 6 Aug 1935, *Neal & Hartt 674a* (BISH). ¼ mile east of Humu‘ula, 7 Aug 1935, *Neal & Hartt 709* (BISH). Kīlauea Volcano, Aug 1928, *Neal s.n.* (BISH). Hawai‘i Volcanoes National Park, 200 m on Hilina Pali Road from Chain of Craters Road, 15 Aug 1966, *Newell 407* and *409* (BISH). Hawai‘i Volcanoes National Park, 1.5 miles on Hilina Pali Switchback Trail from end of Hilina Pali Road, 18 Aug 1966, *Newell 427* (BISH); 22 Jun 1967, *Newell 953* (BISH). Hawai‘i Volcanoes National Park, 200 m west of rain shelter at end of Hilina Pali Road, 22 Jun 1967, *Newell 959* and *962* (BISH). Hawai‘i Volcanoes National Park, near roadside on Mauna Loa Strip Road, about 3 miles from intersection with Kona-Hilo highway, 23 Jun 1967, *Newell 972* (BISH). Hawai‘i National Park, on the floor of Kīlauea Crater, not far from steam crack, 18 Jul 1931, *von Loben Sels 596* (UC). **MAUI**: Near Ko‘olau Gap, Haleakalā, 27 Jun 1927, *Degener 27272* (BISH). Olowalu Valley, 10 May 1920, *Forbes 2298M* (BISH). Waihoi [*sic*, perhaps Waihou] Valley, 28 Sep 1972, *Harrison 35* (BISH). Ko‘olau Forest Reserve, along rim of Haleakalā crater, 9 Nov 1973, *Harrison 518* (BISH). Hana, Nu’u, Haleakalā National Park, Kaupo Gap, 27 May 1980, *Higashino & Holt 9014* (BISH). Hana, Kahikinui, south slope of Haleakalā, north of Manawainui Gulch, 19 Jun 1980, *Higashino & Holt 9220* (BISH). Wailuku, east slope of Hana‘ula, near pu‘u, north of Pohakea Gulch, 6 Mar 2001, *Oppenheimer H30108* (BISH). **MOKAPU ISLET**: occasional along northeast section, coastal dry shrubland, 8 Mar 2000, *Wood et al. 8323* (PTBG). **MOLOKA‘I**: Upper Maunahui Camp, 7 Oct 1938, *Cranwell et al. 2551* (BISH). Overlooking Waikolu Valley, 8 Apr 1928, *Degener 18452* (BISH, MO [photo]). Peninsula east of Wailau Valley, 4 Jul 1933, *Fosberg 9647* (BISH). **O‘AHU**: Near Koko Head, along crest of Mauna O Ahi Ridge, 20 Jun 1937, *Egler 37-39* (BISH, US [not seen]). Honouliuli, Wai‘anae Mountains near summit of Palikea, 30 Jun 1935, *Fosberg & Dunn 10948* (BISH). Kanehoa subpeak, 12 May 1946, *Kondo s.n.* (BISH). Mokulē‘ia, 22 Jun 1954, *Pearsall s.n.* (BISH). Honolulu, Apr 1909, *Rock 927* (BISH).

Gamochaeta americana (Mill.) Weddell **New naturalized record**

Gamochaeta americana is known from a single collection from Maui along a streambed at 1340 m. The species can be recognized by having subclasping to decurrent lower to mid-cauline leaves, a glabrous to glabrate adaxial leaf surface, and shiny, brownish,

glabrous involucres (Nesom, 2004a). *Gamochaeta americana* is probably native to Mexico to South America and the West Indies (Nesom, 2004a).

Material examined. **MAUI**: Kīpahulu Valley, Haleakalā National Park, along Koukouai [*sic*, Kaukauai] streambed, 10 Jul 1983, *Medeiros 462* (BISH).

Gamochaeta argyrinea G.L.Nesom **New naturalized record**

Gamochaeta argyrinea is found on the islands of Hawai‘i, Maui, and O‘ahu. Habitats include grassy slopes, dry ridges, and dry *Sophora chrysophylla* woodland over ash at 760–2410 m. *Gamochaeta argyrinea* is perhaps native to the eastern United States and was first collected in the Hawai‘ian Archipelago, based on these specimens, in 1948. This species can be recognized by its small involucres (3.0–3.5 mm high) and persistent basal rosette of leaves that are yellowish-green and sparsely pubescent adaxially.

Material examined. **HAWAI‘I**: Pu‘u La‘au, near hunter’s cabin, 18 Jan 1975, *Herbst 5186* (BISH). Hāmākua, Ka‘ohe, western slope of Mauna Kea, north of Ahumoa, Pu‘u ‘Ula‘ula, Pu‘u Manao, 21 Jan 1981, *Warshauer & McEldowney 3142* (BISH). **MAUI**: Hana, Kahikinui, south slope of Haleakalā, trail 0.5 km south of Skyline Drive, 19 Jun 1980, *Warshauer & McEldowney 2669* (BISH). Rim of Ukumehame, 25 Aug 1991, *Wood & Periman 1174* (MO [photo], PTBG [not seen]). **O‘AHU**: Wai‘anae Mountains, east facing knoll on Kamaileuna [?] Ridge, 16 Apr 1972, *Gagne 623* (BISH). Wai‘anae Range, South Kaaikukai Gulch, 26 Mar 1948, *Wilbur 536* (BISH).

Gamochaeta pensylvanica (Willd.) Cabrera **New naturalized record**

[syn. *Gnaphalium peregrinum* Fernald]

Gamochaeta pensylvanica is found on the islands of Hawai‘i, Kaho‘olawe, Kaua‘i, Lāna‘i, Lehua Islet (Ni‘ihau), Maui, Mokapu Islet (Moloka‘i), Moloka‘i, Molokini Islet (Maui), and O‘ahu. Habitats include gardens, pasture, roadsides, along railroad tracks, and dry scrub at sea level to 1190(–1710) m. *Gamochaeta pensylvanica* is possibly native to South America but is found as a weed in many parts of the world (Nesom, 2004b). It was first collected in the Hawaiian Archipelago, based on these specimens, in 1895. *Gamochaeta pensylvanica* can be distinguished from the other species by its leaves, which are softly pubescent on both surfaces and are usually obovate to spathulate. Harold St. John recognized the presence of this species in the Hawaiian Archipelago in 1983 and annotated a number of specimens as *Gnaphalium pensylvanicum* (some with H.St.J. and others with no name but identical handwriting), but his identification/circumscription was not adopted by Wagner *et al.* (1999). The illustration in Wagner *et al.* (1999: Plate 27) actually represents *G. pensylvanica*, although it is labeled *G. purpurea*.

Material examined. **HAWAI‘I**: Hawai‘i National Park, CCC Camp, 2 Nov 1942, *Fagerlund & Mitchell 73* (BISH). South Kohala District, east of Queen Ka‘ahumanu Highway between Mauna Lani Drive and Puako turn-off, 4 Feb 1991, *Funk s.n.* (BISH). Pu‘u Wa‘awa‘a, base of cliffs below Pu‘u Huluhulu, 2 May 1975, *Herbst 5295* (BISH). By visitor center and main ruins of Pu‘uhonua o Hōnaunau National Historical Park, 8 Apr 1984, *Higashino et al. 10326* (BISH). Pu‘u Papapa paddock, Waiki‘i, South Kohala, 24 May 1938, *Hosaka 2080* (BISH). North Kohala, below Kohala Ranch house, 11 Jun 1929, *Hosaka 2301* (BISH). Kaluamakani, slopes of Mauna Kea, 1 Jul 1909, *Rock 3133* (BISH). Paauhau 3, Parker Ranch, 6 Jul 1909, *Rock 4619* (BISH). Holokaiea Gulch, 9 Jul 1909, *Rock 4621* (BISH). South Kona, Kealakekua, Tr 60(35), western slopes of Mauna Loa, 3-4 km south of Kipuka Mamani and Waiio Kipuka, 4 Aug 1978, *Warshauer & McEldowney 2052* (BISH). **KAHO‘OLAWE**: Grassland on way to Moa‘ula, 21 Nov 1978, *Char 78.015* (BISH). Along the coast from Maka‘alae to Honoko‘a Bay, 21 Apr 1980, *Clarke & Corn 366* (BISH). Northwestern part of island above Maka‘alae Point, 21 Apr 1980, *Cuddihy & Char 326* (BISH). Lua ‘O Kealialalo, 22 Apr 1980, *Cuddihy & Char 353* (BISH) and *355* (BISH, 2). **KAUA‘I**: Nā Pali Coast, along trail between

Kalalau and Hanakoa Valleys, 9 Apr 1980, *Corn ESP 177* (BISH). Pacific Tropical Botanical Garden, Limahuli Valley, 12 Mar 1984, *Flynn 791* (BISH). Limahuli Garden, 0.4 mi from end of Hwy 56, 21 Dec 1983, *Wagner et al. 5157* (BISH). **LĀNA'I**: Lāna'i City, 21 Aug 1963, *Degener & Degener 28408* (BISH). Kiei Islet on north slope, 6 Apr 2006, *Starr 060406-15* (BISH). **LEHUA ISLET**: Weathered cinder cone, common herb, 10 Jan 1992, *Flynn et al. 4852* (BISH [not seen], PTBG). **MAUI**: 'Ulupalakua, 13 Apr 1937, *Hosaka 1797* (BISH). Lāhainā District, Olowalu, 21 Jan 2002, *Oppenheimer et al. H10211* (BISH). **MOKAPU ISLET**: North side of islet in open, sunny areas, locally common, 3 Apr 2009, *Oppenheimer & Penniman H40918* (PTBG). **MOLOKA'I**: Kualapu'u, 22 Feb 1948, *Fosberg 29561* (BISH). Mauna Loa, Pu'u Nana, 16 Apr 1937, *Hosaka 1847* (BISH). **MOLOKINI ISLET**: 14 Feb 1982, *Hobdy 1239* (BISH). Molokini, center of the islet, 5 Apr 2006, *Starr 060405-09* (BISH). **O'AHU**: Honolulu, University of Hawai'i campus, 21 Mar 1927, *Degener 18446* (BISH, US [not seen]). Puuiki, locally common along railroad tracks, 24 Mar 1937, *Degener & Topping 11119* (UC, US [not seen]). Honolulu, Kaimukī, Wilhelmina Rise, and Waialae Ave, 24 Mar 1937, *Egler 37-55* (BISH). Round Top on Tantalus Road, 7 Apr 1937, *Egler 37-241* (BISH). Honouliuli, Wai'anae Mountains, Pohakea Pass, 12 May 1933, *Fosberg 9475* (BISH). Mokapu Peninsula, Pyramid Rock, Hesia Flats, Heleloa, 25 Mar 1933, *Fosberg 10562* (BISH). Kailua, Mokulua, north islet, 16 Feb 1936, *Fosberg 12939* (BISH). At the base of Punchbowl, 25 Mar 1895, *Heller 2002* (UC, US [not seen]). Along Punahou Street, 7 Apr 1975, *Herbst & Ishikawa 5269* (BISH). Koko Crater, Maunalua, 28 Feb 1930, *St. John 10406* (BISH). Honolulu, University of Hawai'i, Mānoa Campus, 4 Jan 1976, *Swarbrick H-17* (BISH). Honolulu, Kaimukī, Mar 1925, *Topping 3071* (UC, US [not seen]). **Unclear locality**: (Mau'i or Hawai'i) *Hosaka s.n.* (BISH). 9 Mar 1945, *Van Zwaluenburg s.n.* (BISH). [Scribble] Annotated as "C.N. Forbes's handwriting, before 1920" (BISH 75342).

Gamochaeta simplicicaulis (Willd. ex Spreng.) Cabrera **New naturalized record**

Gamochaeta simplicicaulis is known from a single collection from Moloka'i. It was collected on a weedy, windswept slope at 300 m. *Gamochaeta simplicicaulis* is native to South America, but it has naturalized in the eastern United States, Australia, New Zealand, and Java (Nesom, 2004b, 2006) Based on this collection, it was first collected in the Hawai'ian Archipelago in 1987. *Gamochaeta simplicicaulis* can be distinguished from the other species by its large size and basal leaves; it is typically 50-85 cm tall and the basal and proximal leaves are withered at anthesis.

Material examined. **MOLOKA'I**: Manuahi Ridge west and above Pelekunu Valley on windward side, 2 Aug 1987, *Wagner & Lorence 5754* (BISH, US [not seen]).

Key to the Species of *Gamochaeta* in the Hawaiian Archipelago

1. Leaves weakly bicolored, both surfaces pubescent and grayish-green, the abaxial surface only weakly or moderately more pubescent and grayer, obovate to spathulate; proximal bracts of the inflorescence axis extending beyond the heads, also typically obovate to spathulate; cypselae smooth with scattered papillate hairs (visible at 40×) ….. *G. pensylvanica*

1. Leaves strongly bicolored, the adaxial surface conspicuously greener than the abaxial surface, adaxial surface grayish-green, green, or yellowish-green, sparsely arachnose to glabrous, abaxial surface gray or white, pannose; proximal bracts of the inflorescence axis extending beyond the heads or not, linear-lanceolate to oblanceolate-obovate (infrequently spathulate); cypselae with alveolate (honeycombed) surface, also with scattered papillate hairs (visible at 40×)

    2. Plants (30–)50–85 cm tall; clusters of small leaves present in the lower leaf axils; inner phyllaries linear or narrowly oblong; apices of inner phyllaries acute-acuminate …. *G. simplicicaulis*

2. Plants 10–50 cm tall; clusters of small leaves absent in the leaf axils; inner phyllaries narrowly elliptic to oblong; apices of inner phyllaries acute, obtuse, or rounded, often apiculate

3. Basal leaves (rosette) usually persistent and healthy at anthesis; involucres 3.0–3.5 mm high …. *G. argyrinea*

3. Basal leaves often withered at anthesis, rosette sometimes not obvious; involucres 4.0–4.5 mm tall

4. Lower and midcauline leaves subclasping or decurrent; adaxial surface of the leaves usually glabrous to glabrate, lacking bumpy remnants of trichome bases …. *G. americana*

4. Leaves not subclasping or decurrent; adaxial surface of the leaves grayish-green, with remnants of trichome bases that resemble cystoliths, small pieces of sand, or glassy bumps …. *G. purpurea*

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Literature Cited

Cameron, **K**. 2010. DNA evidence for the recognition of several species of cudweeds (*Gamochaeta*, Asteraceae) in the eastern United States. Undergraduate Honors Thesis, University of Southern Mississippi. 25 pp.

Gleason, **H**.**A**. **& Cronquist**, **A**. 1991. *Manual of vascular plants of northeastern United States and adjacent Canada*. 2nd ed. New York Botanical Garden Press, New York. 910 pp.

Hillebrand, **W**. 1888. *Flora of the Hawaiian Islands: a description of their phanerogams and vascular cryptogams*. Williams & Norgate, London. 673 pp.

Nesom, **G**.**L**. 2004a. New species of *Gamochaeta* (Asteraceae: Gnaphalieae) from the eastern United States and comments on similar species. *Sida* **21**(2): 717–741.

———. 2004b. New distribution records for *Gamochaeta* (Asteraceae: Gnaphalieae) in the United States. *Sida* **21**(2): 1175-1185.

———. 2006. *Gamochaeta*. Pp. 431-438 IN: Flora of North America Editorial Committee. *Flora of North America*. Vol. 19: Magnoliophyta: Asteridae, part 6: Asteraceae, part 1. Oxford University Press, New York.

Wagner, **W**.**L**., **Herbst**, **D**.**R**. **& Sohmer**, **S**.**H**. 1999. *Manual of the flowering plants of Hawai'i*. Revised edition. 2 vols. University of Hawai'i Press & Bishop Museum Press, Honolulu. 1919 pp.

———., **Herbst**, **D**.**R**. **& Lorence**, **D**.**H**. 2005 onwards. Flora of the Hawaiian Islands website. http://botany.si.edu/pacificislandbiodiversity/hawaiianflora/index.htm [accessed 15 November 2011]

———., **Shannon**, **R**. **& Herbst**, **D**.**R**. 1997. Contributions to the flora of Hawai‘i. VI. *Bishop Museum Occasional Papers* **48**: 51–65.

Wood, **K**.**R**. **& LeGrande, M**. 2006. An annotated checklist and new island records of flowering plants from Lehua Islet, Ni‘ihau, Hawai‘i. *Bishop Museum Occasional Papers* **87**: 19–29.