

## Taxonomic changes in Hawaiian ferns and lycophytes<sup>1</sup>

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This article touches briefly on taxonomic changes that are occurring in vascular plants. It also summarizes some needed changes in nomenclature for Hawaiian ferns and lycophytes. The two nomenclatural innovations (see below) are *Asplenium dielpallidum* N. Snow, **nom. nov.**, *Asplenium xlauii* (W.H. Wagner) N. Snow, **comb. nov.**, and *Cyclosorus pendens* (D.D. Palmer) N. Snow, **comb. nov.**

Families of flowering plants (angiosperms) in the *Herbarium Pacificum* of the Bishop Museum presently are organized following a system developed by Cronquist (1981). Thousands of papers published in the intervening three decades have clarified many aspects of the classification of plants at all taxonomic levels. The sources of data for the changes have varied, but most studies have relied heavily on DNA sequence data.

The field of systematics also has developed new methods for data analysis, including evolutionary models that can specify the probabilities associated with changes in DNA sequences at the base-pair level. These models are incorporated in software programs that taxonomists use to infer the phylogenies (= evolutionary histories) on which classifications are based. A relative strength of these approaches is the ability to place confidence estimates on each branch of the evolutionary trees. Generally speaking, most systematists do not propose or accept changes in classifications and nomenclature unless branches in the phylogenetic trees are well supported. It is neither possible nor desirable in this article to discuss details behind the methodological advances. However, it is important at some point for botanists to incorporate the new scientific data into their classifications and have them be reflected in how herbaria are organized internally.

A series of papers for angiosperms (cited in APG III 2009) and a dictionary of plant genera (Mabberley 2008) summarize taxonomic changes at the ordinal (e.g., Asterales) and familial (e.g., Asteraceae) levels. Together, these resources (and others) provide a workable basis to taxonomically reorganize a herbarium in a manner that reflects the extensive new data. Many herbaria are in the process of reorganizing their holdings to reflect the newer classification of flowering plants, including many of the world's larger institutions in the US, United Kingdom, Switzerland, France, and the Netherlands (APG III 2009: 106).

This paper, however, concerns the taxonomic reorganizations for Hawaiian ferns and lycophytes. A recent paper by Smith *et al.* (2006) synthesized a large body of data that clarified many of the generic, familial, and ordinal boundaries of ferns. This system of classification, or something similar, already has been adopted by some workers (e.g.,

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Gómez and Arbeláez 2009). As with nearly all studies of generic- and specific-rich families, some of the studies cited by Smith *et al.* (2006) had somewhat limited sampling breadth, and modifications in their proposed classification no doubt will be proposed by various authors in the future. Hawai'i, with its rich diversity of ferns, is fortunate to have the recent treatment by Palmer (2003).

In this paper we propose two new combinations and one new name for Hawaiian ferns. The changes largely reflect the familial classification of Smith *et al.* (2006). Some changes suggested by Ebihara *et al.* (2006) for Hymenophyllaceae are also followed. Classification and organization of the world ferns in the *Herbarium Pacificum* also will largely follow the families and genera recommended by Smith *et al.* (2006).

### Aspleniaceae

The genus *Diellia* Brack., considered endemic to Hawai'i (Palmer 2003), will be included in *Asplenium*. Fortunately, many of the necessary combinations in *Asplenium* were made previously (Viane & Reichstein 1991). The names used by Palmer (2003) are indicated as synonyms; more complete synonymies for each taxon can be found in Palmer (2003). The new name *Asplenium dielpallidum* (below) is proposed for *Diellia pallida*, as this was apparently overlooked by Viane & Reichstein (1991). As molecular-based phylogenetic studies and fieldwork of the *Asplenium dielrectum* complex are currently in progress, the status of the forms of *Diellia erecta* Brack. will be addressed in a forthcoming publication.

#### *Asplenium dielfalcatum* Viane

Syn. *Diellia falcata* Brack.

#### *Asplenium leucostegioides* Baker

Syn. *Diellia leucostegioides* (Baker) W.H. Wagner

#### *Asplenium dielmannii* Viane

Syn. *Diellia mannii* (D.C. Eaton) W.J. Rob.

#### *Asplenium dielpallidum* N. Snow, **nom. nov.**

Syn. *Diellia pallida* W.H. Wagner, Contr. Univ. Michigan Herb. 19:66. 1993. – Type: Hawai'i: Kaua'i, Mahanaloa Valley, 10 Aug 1949, *W.H. Wagner, Jr. 5805* (holotype: MICH (sheet no. 1259996)).

The new name is necessary given the existence of *Asplenium pallidum* Blume. The new specific epithet suggests the phylogenetic group to which this species evidently belongs.

#### *Asplenium unisorum* (W.H. Wagner) Viane

Syn. *Diellia unisora* W.H. Wagner

#### *Asplenium xlauii* (W.H. Wagner) N. Snow, **comb. nov.**

Syn. *Diellia xlauii* W.H. Wagner, Contr. Univ. Michigan Herb. 22: 171. 1999. –Type: Hawai'i: Honolulu, Wai'anae Mts, Honouliuli Preserve, South Palawai Gulch, 17 Jun 1991, *J. Lau & G. Uchida 3395* (holotype: MICH (sheet no. 1287204)).

### Cibotiaceae

Cibotiaceae Korall was recently elevated from subfamilial status under Dicksoniaceae to the family level (Smith *et al.* 2006). Palmer (2003) also treated members of *Cibotium* in Dicksoniaceae, which are transferred to Cibotiaceae. The transfer of binomials can be made between families without changes in authorship. The species recognized for Hawai'i are unchanged from Palmer (2003) and Imada (2008), the latter of which can be consulted for island occurrences.

**Dicksoniaceae**

The circumscription of *Dicksonia* L'Her. is narrowed in Smith *et al.* (2006), but it includes the naturalized alien species *Dicksonia fibrosa* Col. (Lorence & Flynn 2006; Imada 2008), which was discovered after publication of Palmer (2003). In contrast, members of *Cibotium* are transferred to Cibotiaceae (see above).

**Dryopteridaceae**

The genus *Nothoperanema* (Tagawa) Ching has been synonymized under *Dryopteris* Adans. (Smith *et al.* 2006), which affects only one species in Hawai'i. The genus *Elaphoglossum* Schott ex J. Sm. was included by Palmer (2003) in Lomariopsidaceae and by Imada (2008) in Elaphoglossaceae. Smith *et al.* (2006) also placed *Elaphoglossum* in Dryopteridaceae, but no changes in Latin binomials are required. *Tectaria* Cav. has been transferred to Tectariaceae (see below).

***Dryopteris rubiginosum*** (Brack.) H. Mann

Syn. *Nothoperanema rubiginosum* (Brack.) A.R. Sm. & D.D. Palmer

**Hymenophyllaceae**

The study of Ebihara *et al.* (2006) summarized different classifications of Hymenophyllaceae, proposed recognition of nine genera, and indicated the generic placement of all taxa based on their basionyms. Species that remain unchanged include *Callistopteris baldwinii* (D.C. Eaton) Copel., *Vandenboschia cyrtotheca* (Hillebr.) Copel., *V. davalloides* (Gaudich.) Copel. Ebihara *et al.* (2006) noted the combination *Vandenboschia tubiflora* F.S. Wagner (p. 280) but did not include it among the recognized taxa for that subgenus (pp. 241–242). Changes to the Hawaiian ferns include transfers from *Gonocormus*, *Mecodium*, *Sphaerocionium*, and *Vandenboschia* (Palmer 2003).

***Crepidomanes draytonianum*** (Brack.) Ebihara & K. Iwats.

Syn. *Trichomanes draytonianum* Brack.; *Vandenboschia draytoniana* (Brack.) Copel.

***Crepidomanes minutum*** (Blume) K. Iwats.

Syn. *Trichomanes minutum* Blume; *Gonocormus minutus* (Blume) Bosch

***Crepidomanes proliferum*** (Blume) Bostock

Syn. *Trichomanes proliferum* Blume; *Gonocormus prolifer* (Blume) Prantl. Ebihara *et al.* (2006: 238) merge *C. minutum* under *C. proliferum*, but given that Palmer (2003: 160) indicated that the two taxa in Hawai'i are "quite distinct", we continue to recognize both taxa.

***Hymenophyllum recurvum*** Gaudich.

Syn. *Mecodium recurvum* (Gaudich.) Copel.

***Hymenophyllum lanceolatum*** Hook. & Arn.

Syn. *Sphaerocionium lanceolatum* (Hook. & Arn.) Copel.

***Hymenophyllum obtusum*** Hook. & Arn.

Syn. *Sphaerocionium obtusum* (Hook. & Arn.) Copel.

**Lomariopsidaceae**

*Nephrolepis* Schott, which in Hawai'i presently includes three species, two cultivars derived from two other wild species, and two hybrid taxa (Imada 2008), was placed in Nephrolepidaceae by Palmer (2003) and Imada (2008) but has been transferred into Lomariopsidaceae (Smith *et al.* 2006). Given the transfer of *Elaphoglossum* (Palmer 2003) out of Lomariopsidaceae (see above), *Nephrolepis* is now the sole generic member of Lomariopsidaceae in Hawai'i.

**Lygodiaceae**

Palmer (2003) and Imada (2008) placed *Lygodium* Sw. in Schizaeaceae. Smith *et al.* (2006) recognize Lygodiaceae as a separate family, with *Lygodium* as its sole genus. In Hawai'i this affects only *L. japonicum* (Thunb.) Sw. (Palmer 2003).

**Ophioglossaceae**

*Sceptridium* Lyon is merged into *Botrychium* (Smith *et al.* 2006). The one species in Hawai'i is probably extinct (Palmer 2003).

***Botrychium subbifoliatum* (Brack.) Lyon**

Syn. *Sceptridium subbifoliatum* Brack.; *Botrychium daucifolium* E. Bailey, non Wall.; *B. ternatum* (Thunb.) Sw. subsp. *australasiaticum* Milde forma *subbifoliata* Milde

**Polypodiaceae**

Smith *et al.* (2006) merged Grammitidaceae Newman (often misspelled as Grammitaceae) into Polypodiaceae. This decision has not met with universal acceptance (Parris 2009), and new genera are being described (Parris 2007) in Grammitidaceae. The justification (Smith *et al.* 2006) for merging Grammitidaceae into Polypodiaceae is because the recognition of Grammitidaceae makes Polypodiaceae paraphyletic, and the most generally accepted principles of classification now require the elimination of demonstrably paraphyletic taxonomic groups if an alternative, well-supported monophyletic alternative exists.

Some generic changes have been proposed for grammitids (Parris 2007; Ranker 2008). In Hawai'i this involves three genera (Palmer 2003; Imada 2008): *Adenophorus* (ca. 15 taxa), *Grammitis* (2 species), and *Lellingeria* (1 species). Although some of the genera proposed by Parris (2007, 2009) have some cladistic support from the DNA sequences from two chloroplast genes (Ranker, unpublished), many species are not fully resolved in phylogenetic trees, and greater sampling among Hawaiian taxa is desirable before additional changes are implemented. With the transfer of *Grammitis tenella* Kaulf. to *Adenophorus* (Ranker 2008), there are now three species of *Grammitis* in Hawai'i.

***Adenophorus tenellus* (Kaulf.) Ranker**

Syn. *Grammitis tenella* Kaulf.

**Pteridaceae**

*Haplopteris elongata* (Sw.) E.H. Crane, placed in Vittariaceae by Palmer (2003) and Imada (2008), is transferred into Pteridaceae by Smith *et al.* (2006).

**Salviniaceae**

Azollaceae was recognized as a distinct family by Palmer (2003) and Imada (2008), but was submerged into Salviniaceae by Smith *et al.* (2006). In Hawai'i this affects only one species, *Azolla filiculoides* Lam.

**Tectariaceae**

The family as recognized by Smith *et al.* (2006) includes *Tectaria* Cav., which in Hawai'i includes two species (Palmer 2003; Imada 2008).

**Thelypteridaceae**

Following Smith *et al.* (2006) the genera *Christella* H. Lév. and *Pneumatopteris* Nakai are merged into *Cyclosorus* Link, and *Amauropelta* Kunze is merged into *Thelypteris* Adans. *Pseudophegopteris* Ching and *Macrothelypteris* (H. Itô) Ching are maintained as distinct genera.

***Cyclosorus boydiae*** (D.C. Eaton) W.H. Wagner

Syn. *Christella boydiae* (D.C. Eaton) Holttum; *Aspidium boydiae* D.C. Eaton; more synonymy in Palmer (2003).

***Cyclosorus cyatheoides*** (Kaulf.) Farw.

Syn. *Christella cyatheoides* (Kaulf.) Holttum; *Aspidium cyatheoides* Kaulf.; more synonymy in Palmer (2003).

***Cyclosorus dentatus*** (Forssk.) Ching

Syn. *Christella dentata* (Forssk.) Brownsey & Jermy; *Polypodium dentatum* Forssk.; *Thelypteris dentata* (Forssk.) E.P. St. John

***Cyclosorus hudsonianus*** (Brack.) Ching

Syn. *Pneumatopteris hudsoniana* (Brack.) Holttum; *Nephrodium hudsonianum* Brack; more synonymy in Palmer (2003).

***Cyclosorus xintermedius*** W.C. Shieh & J.L. Tsai

Syn. *Christella xintermedia* (W.C. Shieh & J.L. Tsai) D.D. Palmer; *Thelypteris xincesta* W.H. Wagner; more synonymy in Palmer (2003).

***Cyclosorus parasiticus*** (L.) Farw.

Syn. *Christella parasitica* (L.) H. Lév.; *Polypodium parasiticum* L.; more synonymy in Palmer (2003).

***Cyclosorus xpalmeri*** (W.H. Wagner) W.H. Wagner

Syn. *Christella cyatheoides* × *C. dentata*; *Thelypteris xpalmeri* W.H. Wagner

***Cyclosorus pendens*** (D.D. Palmer) N. Snow, **comb. nov.**

Syn. *Pneumatopteris pendens* D.D. Palmer, American Fern Journal 95(2): 81, fig. 1. 2005. —Type: Hawai'i, Hawai'i Island, Hawaii Volcanoes National Park, Puna District, Thurston Lava Tuba, ca 1158 m, 2 Apr 2003, *L.W. Pratt 3306* (holotype: BISH).

***Cyclosorus sandwicensis*** (Brack.) Copel.

Syn. *Pneumatopteris sandwicensis* (Brack.) Holttum; *Stegnogramma sandwicensis* Brack.; more synonymy in Palmer (2003).

***Cyclosorus waialele*** (Flynn) W.H. Wagner

Syn. *Christella waialele* (Flynn) D.D. Palmer; *Thelypteris waialele* Flynn

***Thelypteris globulifera*** (Brack.) C.F. Reed

Syn. *Amauropelta globulifera* (Brack.) Holttum; *Lastrea globulifera* Brack.; *Dryopteris globulifera* (Brack.) Kuntze; *Nephrodium globuliferum* (Brack.) Hook.

**Woodsiaceae**

Palmer (2003) and Imada (2008) included four genera in Athyriaceae (*Athyrium*, *Cystopteris*, *Deparia*, and *Diplazium*), all of which are treated under Woodsiaceae by Smith *et al.* (2006).

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