

Generic delimitation and a new infrageneric system in the genus *Holcoglossum* (Orchidaceae: Aeridinae)

XIAO-HUA JIN*

Kunming Institute of Botany, Chinese Academy of Sciences, Heilongtang, Ciba, Kunming, Yunnan 650204, China

Received March 2005; accepted for publication June 2005

Based on herbarium and field observations, we confirm the generic delimitation of *Holcoglossum* and present a new infrageneric system for the genus. Our work supports *Holcoglossum* as a natural group including *H. amesianum* (Rchb.f.) Christenson and *H. subulifolium* (Rchb.f.) Christenson. The new infrageneric system of *Holcoglossum* includes two subgenera: *Holcoglossum* subgen. *Brachycentron* subgen. nov. and *Holcoglossum* subgen. *Holcoglossum*, the latter comprising two new sections, *Holcoglossum* sect. *Holcoglossum* and *Holcoglossum* sect. *Sorotylos*. © 2005 The Linnean Society of London, *Botanical Journal of the Linnean Society*, 2005, 149, 465–468.

ADDITIONAL KEYWORDS: *Holcoglossum amesianum* – *H. subulifolium* – *Holcoglossum* subgen. *Brachycentron* – *Holcoglossum* subgen. *Holcoglossum* – *Holcoglossum* sect. *Holcoglossum* – *Holcoglossum* sect. *Sorotylos*.

INTRODUCTION

The orchid genus *Holcoglossum* was described by Schlechter (1919) based on *Saccolabium quasipinifolium* Hayata from Taiwan. Today, this genus comprises 12 species, i.e. *Holcoglossum amesianum* (Rchb.f.) Christenson, *H. flavestens* (Schltr.) Z.H. Tsi, *H. kimballianum* (Rchb.f.) Garay, *H. lingulatum* (Aver.) Aver., *H. omeiense* X. H. Jin & S. C. Chen, *H. quasipinifolium* (Hayata) Schltr., *H. sinicum* Christenson, *H. subulifolium* (Rchb.f.) Christenson, *H. tsii* Yukawa, *H. rupestre* (Hand.-Maz.) Garay, *H. weixiense* X. H. Jin & S. C. Chen and *H. wangii* Christenson. *Holcoglossum* has its distribution centre in south-west China with a few species extending to Malaysia, Myanmar, Thailand and Vietnam (Christenson, 1987, 1998; Seidenfaden, 1988, 1992; Tsi, 1999). Several species of *Holcoglossum* may be amongst the most endangered orchids of Asia. For example, only two small populations of *H. rupestre* are known.

Holcoglossum occupies an important position in the phylogeny of Aeridinae. Many taxonomists have studied it (Schlechter, 1919; Garay, 1972; Tsi, 1982; Christenson, 1987, 1998; Seidenfaden, 1988, 1992),

and several species were transferred between *Holcoglossum* and its relatives. Some delimitation, discussion and one infrageneric system of *Holcoglossum* have been proposed (Garay, 1972; Tsi, 1982, 1999; Christenson, 1987, 1998; Seidenfaden, 1988) but are considered here to be unnatural or unsatisfactory for lack of evidence.

TAXONOMY HISTORY

Although the Aeridinae is a natural subtribe in Orchidaceae (Dressler, 1993) it is difficult to distinguish some genera from their relatives, and *Holcoglossum* is one such genus (Garay, 1972, 1974; Tsi, 1982; Christenson, 1987; Seidenfaden, 1988). It remained a monotypic genus for more than 50 years after it was established, during which time many true species of *Holcoglossum* were put in related genera, such as *Aerides flavescens* Schltr. and *Vanda rupestris* Hand.-Mazz.

Garay (1972: p. 181) defined *Holcoglossum* as “characterized by the short footless column with prominent wings” and transferred *Vanda kimballiana* Rchb.f. and *Vanda rupestris* to *Holcoglossum*. Two years later, he transferred *Aerides flavescens* to *Papilionanthe* (Garay, 1974). After a careful comparison between *Holcoglossum* and related genera, Tsi (1982) delimited the genus in a similar way to Schlechter (1919) and

E-mail: xiaohuajin@mail.kib.ac.cn

Garay (1972). He also pointed out that the semiterete leaf is a useful generic character. Tsi included *Aerides flavescens* and treated a species of *Ascocentrum* as a species of *Holcoglossum*. Based in part on Tsi's table (Tsi 1982: table 1), Christenson (1987) founded the 'Vanda-Aerides alliance' including *Aerides*, *Ascocentrum*, *Holcoglossum*, *Neofinetia*, *Papilionanthe*, *Rhynchostylis* and *Vanda*, and delimited *Holcoglossum* in this alliance. Christenson (1987, 1998) further considered *Holcoglossum* to have a column foot and two kinds of spur, i.e. both saccate and cylindrical spurs, and transferred *Vanda subulifolia* Rchb.f. and *Vanda amesiana* Rchb.f. to *Holcoglossum*. Seidenfaden (1988) disagreed with Christenson's treatment of *Holcoglossum* somewhat, and even suggested that a new genus might be needed for *V. amesiana* and *V. subulifolia*. However, Seidenfaden (1988, 1992) followed Christenson's delimitation of *Holcoglossum* due to a lack of material (Seidenfaden, 1988: p. 304). The purpose of our study was precisely to define and to propose a natural infrageneric system of *Holcoglossum* based on recent investigation of specimens and fieldwork.

DELIMITATION OF *HOLCOGLOSSUM*

Most characters used by Garay (1972), Tsi (1982, 1999) and Christenson (1987, 1998) to delimit *Holcoglossum*, e.g. bifid rostellum and two cleft pollinia, appear in all species of *Holcoglossum* including *H. amesianum* and *H. subulifolium*, but they are also appear in several other genera of the 'Vanda-Aerides alliance', e.g. *Ascocentrum* and *Neofinetia*. The channelled semiterete leaves also occur in some species of *Ascocentrum*, e.g. *A. himalaicum* (Deb, Sengupta & Malick) Christenson and *A. pumilum* (Hayata) Schltr. A column foot is also present in some species of *Aerides*, *Papilionanthe* and *Vanda*. Therefore it is difficult to define *Holcoglossum* in such a morphological continuum among *Holcoglossum* and its relatives. Traditionally, the delimitation of *Holcoglossum* and its relatives was mostly based on herbarium specimens. Some characters of the live plant, that may be important for such a highly adaptive group, such as the spotted tepals and the colour pattern of plant root tips, have been long neglected.

Dahlgren & Clifford (1982) stated that spotted tepals are absent in the Vandaeae, but they occur in some taxa of the Aeridinae, e.g. *Aerides flabellata* Rofle ex Downie and *Vandopsis gigantea* (Lindl.) Pfitz., and they were neglected by some authors in the taxonomy of the Vandaeae. The adaxial walls of the lateral lip lobes of all *Holcoglossum* are spotted, while those of most of its relatives are uniformly or gradually coloured. This particular colour pattern of the lateral lip lobes of *Holcoglossum* suggests that it can be used to define *Holcoglossum*.

The colour of the live root tips is sometimes used to define the leafless genera of the Vandaeae, e.g. *Dendrophylax* and *Campylocentrum*. The live root tips of *Holcoglossum* are reddish and this pattern is constant within *Holcoglossum*. The reddish root tip also occurs in some species of *Ascocentrum*, such as *Ascocentrum himalaicum*, but it is green or pale yellow in most species and genera of the 'Aerides-Vanda alliance'. The reddish root tip of epiphytic orchids may be an ecological adaptation to high solar radiation, drought and (or) cool temperature.

Channelled leaves only occur in two genera, i.e. *Holcoglossum* and *Ascocentrum*, in the 'Aerides-Vanda' alliance, but leaves of all species of *Holcoglossum* are fleshy and channelled.

The linear tapered stipe used by Garay (1972) to define *Holcoglossum* may have occurred independently several times in the Vandaeae, and it appears in most species of *Holcoglossum* (except *H. amesianum* and *H. subulifolium* whose stipes are nearly oblong) and in other genera, such as *Ascocentrum*. Although the character, that the stipe will be bent when taken from the rostellum, occurs in some genera of Vandaeae such as *Amesiella*, *Cleisostoma* and *Vanda* (e.g. *Vanda brunnea*), it occurs across the whole genus of *Holcoglossum*.

The column wing of *Holcoglossum*, used by Christenson (1987), Garay (1972), Seidenfaden (1988) and Tsi (1982) to delimit the genus *Holcoglossum*, is not equivalent to those in *Liparis* or *Coelogyne* but is rather the thinned wall of the column caused by the large stigmatic area occupying half the column. This phenomenon occurs across the whole genus of *Holcoglossum* but not in other genera of the 'Aerides-Vanda alliance'.

Schlechter (1919) defined *Holcoglossum* as being without a column foot, which was followed by Garay (1972) and Tsi (1982), but Christenson (1987) disagreed with this and delimited *Holcoglossum* as being with a column foot. Our observations show that lip spurs of *Holcoglossum* are formed by two lateral lobes, middle lobes and the extension of the column. The extension of the column, whether long or short, is the column foot. Therefore, all species of *Holcoglossum* have a column foot.

Recently, molecular evidence has shown the extreme plasticity and convergence in floral morphology in Orchidaceae (Chase & Palmer, 1997; Whitten, Williams & Chase, 2000; Williams, Chase & Whitten, 2001). This may also be true in the highly adaptive subtribe Aeridinae. However, our fieldwork showed that this is not necessarily true in *Holcoglossum*. *Holcoglossum rupestre*, *H. sinicum* and *H. flavescens* are closely related species and most similar in floral traits, such as white and full-opening flowers, lip three-lobed, lip mid-lobe parallel with the column and

as long as the spur, lip lateral lobes erect and with purple stripes on the inner wall, calli greenish-yellow and thickened at the entrance to the spur, spur cylindrical and curved forwards. However, our observations show that *H. flavescens* is bee pollinated, *H. rupestre* is beetle pollinated (X.-H. Jin, S. C. Chen & H. N. Qin, unpubl. data) and *H. sinicum* is autogamous (X.-H. Jin, unpubl. data). It is therefore safer to use a combination of several characters that are constant within the genus, such as the fleshy and channelled leaves, colour of the live root tip, spotted lateral lobes, large stigmatic area etc. to define accurately the genus of *Holcoglossum*.

Holcoglossum, including *H. amesianum* and *H. subulifolium*, is defined as follows: epiphytic or litho-phytic; stem short; live root with reddish tip; leaves fleshy, often semiterete, adaxially channelled; inflorescence lateral, racemes or panicles, with two to many sparse flowers; flowers white, spread; lip three-lobed, spurred; lateral lobes, erect, adaxially spotted; mid-lobe spread, parallel with column; column margins wing-like; stigmatic area large; column foot short; pollinia two, porate; stipe bent in the middle when taken from the rostellum.

A NEW INFRAGENERIC SYSTEM OF *HOLCOGLOSSUM*

Based on the flower number per inflorescence and the plant form, Christenson (1987, 1998) divided the genus into two sections. In section *Kimballianum*, characterized by short- or long-stemmed plants with usually long-pedunculate and many-flowered inflorescences, he included *H. amesianum*, *H. kimballianum*, *H. rupestre*, *H. saprophyticum* and *H. subulifolium*, while sect. *Holcoglossum*, including all remaining species, was characterized by small, fan-shaped plants that bear one- to four-flowered inflorescences. Our investigation, based on abundant new collection material, shows this infrageneric system of *Holcoglossum* to be unnatural, e.g. the flower number in one inflorescence of *H. rupestre* and *H. wangii* varies from two to more than ten, and most plants of *Holcoglossum* are more or less fan-shaped.

A new infrageneric system of *Holcoglossum*, based on our studies of the morphology and phytogeography of the genus, is presented as follows.

HOLCOGLOSSUM SCHLTR

A. *Holcoglossum* subgen. *Brachycentron* X.H. Jin & S.C. Chen **subgen. nov.**

Sect. *Kimballianum* Christenson in *Notes Bot. Gard. Edinburgh* 44(2): 249–256. 1987 et *Lindleyana* 13(2): 121–124. 1998, p.p. quoad *H. amesianum* et *H. subulifolium*.

Lobus intermedius labelli callis funiformibus praeditus; calcar vadose saccatum vel breviter conicum; stipes oblongo-linearis, subaequilatus a basi ad apicem.

Type: *Holcoglossum amesianum*

Included species: *H. amesianum*, *H. subulifolium*

Both species are distributed in tropical alpine mountains, especially *H. subulifolium*, while *H. amesianum* is more widespread than *H. subulifolium* and can extend to 27°N along the hot and dry valley of the Yangtze River. Some floral characters of this subgenus are similar to those of related genera, such as ridged callus, saccate spur, oblong stipe etc. These morphological similarities partly led to earlier confusion between the genera, but they may also indicate a relationship between *Holcoglossum* and related genera.

B. *Holcoglossum* subgen. *Holcoglossum*

Lobus intermedius labelli callis lamellatis vel carnosotuberosis praeditus; calcar subcylindricum; stipes cuneatus, angustatus versus basin.

B1. *Holcoglossum* sect. *Holcoglossum*

Lobus intermedius labelli plus minusve undulatus vel denticulatus secus margiem, callis cristato-lamellatis praedatus; pes columnae praesens vel absens.

Sect. *Kimballianum* Christenson in *Notes Bot. Gard. Edinburgh* 44(2): 249–256. 1987, et in *Lindleyana* 13(2): 121–124. 1998, p.p. quoad *H. kimballianum*.

H. kimballianum (syn. *Vanda saprophytica* Gagnep.), *H. lingulatum* (syn. *H. tangii* Christenson) [E. A. Christenson (pers. comm.) agrees with placing his *tangii* in synonymy], *H. omeiense*, *H. quasipinifolium* and *H. wangii*.

Species of this section are distributed in subtropical to tropical alpine mountains.

B2. *Holcoglossum* sect. *Sorotylos* X.H. Jin & S.C. Chen **sect. nov.**

Sect. *Kimballianum* Christenson in *Notes Bot. Gard. Edinburgh* 44(2): 255. 1987 et in *Lindleyana* 13(2): 121–124. 1998, p.p. quoad *H. rupestre*.

Lobus intermedius labelli integer secus marginem, callis carnosotuberosis praeditus; pes columae plerumque praesens.

Type: *Holcoglossum sinicum* Christenson

Included species: *H. flavescens*, *H. rupestre*, *H. sinicum*, *H. tsii*, *H. weixiense*.

Species of this section are distributed in subtropical and temperate alpine mountains, mostly endemic to areas more than 2000 m in altitude on the south-eastern border of Qinghai-Xizang (Tibet) Plateau. Some species reach the elevation limit of Aeridinae in Asia. For example *Holcoglossum sinicum* grows at an elevation of 3300 m in Cangshan, about 26°N. Some char-

acters of this section, such as pendulous plant (e.g. *H. sinicum*, *H. weixiense*), small plant (all species of this section) and autogamy (e.g. *H. sinicum*), indicate that species of this section are strongly adapted to alpine conditions.

The entire infrageneric system of *Holcoglossum* is as follows.

Holcoglossum

- A. *Holcoglossum* subgenus *Brachycentron*
H. amesianum, *H. subulifolium*
- B. *Holcoglossum* subgen. *Holcoglossum*
 B1. *Holcoglossum* sect. *Holcoglossum*
H. kimballianum, *H. lingulatum*, *H. omeiense*,
H. quasipinifolium and *H. wangii*
 B2. *Holcoglossum* sect. *Sorotylos*
H. flavescens, *H. rupestre*, *H. sinicum*, *H. tsii*,
H. weixiense.

ACKNOWLEDGEMENTS

This research was supported by the Hong Kong Kadoorie Farm & Botanic Garden. Thanks are due to E. A. Christenson for his great help and also to the curators of AMES, E, IBSC, K, KUN, P and PE for the loan of specimens.

REFERENCES

- Chase MW, Palmer JD. 1997.** Leapfrog radiation in floral and vegetative traits among twig epiphytes in the orchid subtribe Oncidiinae. In: Givnish TJ, Sytsma KJ, eds. *Molecular evolution and adaptive radiation*. Cambridge: Cambridge University Press, 331–352.
- Christenson EA. 1987.** An infrageneric classification of *Holcoglossum* Schltr. (Orchidaceae: Sarcanthinae) with a key to the genera of the *Aerides-Vanda* Alliance. *Notes Royal Botanic Garden Edinburgh* **44**: 249–256.
- Christenson EA. 1998.** Two new species of *Holcoglossum* Schltr. (Orchidaceae: Aeridinae) from China. *Lindleyana* **13**: 121–124.
- Dahlgren RM, Clifford HT. 1982.** *The monocotyledons: A comparative study*. London: Academic Press, pp. 109–111.
- Dressler RL. 1993.** *Phylogeny and classification of the orchid family*. Cambridge: Cambridge University Press, pp. 205–207.
- Garay LA. 1972.** On the systematics of the monopodial orchids I. *Botanical Museum Leaflets Harvard University* **23**: 149–212.
- Garay LA. 1974.** On the systematics of the monopodial orchids II. *Botanical Museum Leaflets Harvard University* **23**: 369–376.
- Schlechter R. 1919.** *Orchideologiae Sino-Japonicae Prodrum. Fedde Repertorium Specierum Novarum Regni Vegetabilis Beih* **4**: 285.
- Seidenfaden G. 1988.** The orchid genera in Thailand XIV. Fifty-nine vandoid genera. *Opera Botanica* **95**: 304–308.
- Seidenfaden G. 1992.** The orchids of Indochina. *Opera Botanica* **114**: 441–443.
- Tsi ZH. 1982.** A study of the genus *Holcoglossum* of Orchidaceae. *Acta Phytotaxonomica Sinica* **20**: 439–444.
- Tsi ZH. 1999.** *Holcoglossum* Schltr. In: *Flora Reipublicae Popularis Sinicae* Vol. 19. Beijing: Science Press, pp. 420–427.
- Whitten MW, Williams NH, Chase MW. 2000.** Subtribal and generic relationships of Maxillariae (Orchidaceae) with emphasis on Stanhopeinae: combined molecular data evidence. *American Journal of Botany* **87**: 1842–1857.
- Williams NH, Chase MW, Whitten WM. 2001.** Phylogenetic positions of *Miltoniopsis*, *Caucaea*, a new genus, *Cyrtochiloides*, and *Oncidium phymatochilum* (Orchidaceae: Oncidiinae) based on nuclear and plastid DNA sequence data. *Lindleyana* **16**: 272–285.