Carex longii (Cyperaceae), the First Naturalized *Carex* in Taiwan

龍氏薹(莎草科)：台灣第一種歸化之薹屬植物

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Abstract

Carex longii Mack. was recently discovered in Keelung City and represents the first naturalized species of the genus *Carex* in Taiwan. It could be distinguished from other known congeners in Taiwan by the combination of spicate inflorescence, glume-like involucral bracts, gynaecandrous spikes and appressed-ascending urticles. *C. longii* is native to America and was possibly introduced to Taiwan along with the materials used for vegetative restoration during roadside slope construction.

摘要

近日發現於基隆市的龍氏薹（*Carex longii* Mack.）爲台灣第一種歸化的薹屬物種。它可依下述特徵與其他同屬物種區分：花序穗狀，總苞穎片狀，小穗雌雄同穗且雌花位於上方，雄花位於下方，及伏貼狀斜出之果囊。此物種原產於美洲，可能是隨道路邊坡植生工程之植材所引進。

Key words: *Carex longii*, Cyperaceae, Naturalized plant, Taiwan.

關鍵詞：龍氏薹，莎草科，歸化植物，台灣。

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Introduction

With ca. 2000 species, *Carex* (Cariceae, Cyperaceae) is one the largest genera of vascular plants (Frodin 2004; The Global *Carex* Group 2016). It is also undoubtedly the largest genus of vascular plants in Taiwan (Hsieh 2003), with 61 species recorded in the *Flora of Taiwan* (Koyama *et al.* 2000) plus several recent additions (Yang and Chen 2005; Liao *et al.* 2016; Hsu and Chung 2016). Due to the great species number, rather similar outline and mostly microscopic diagnosing characters, *Carex* is also well known for its difficult taxonomy (The Global *Carex* Group 2016). The partially controversial treatments among recent regional studies (eg. Koyama *et al.* 2000; Leong 2001; Dai *et al.* 2010; Hashino *et al.* 2011; Liao 2014; Hsu and Chung 2016) imply an urgent overall revision of taxa occurring in Taiwan.

Although the sedge family has become one of the major donors of naturalized plants in Taiwan (Hwang *et al.* 2004; Chen and Wu 2007; Chen *et al.* 2008; 2009; Jung *et al.* 2008), none of the previously known *Carex* species in Taiwan were considered as adventive plants (Wu *et al.* 2010). Herein, we report the discovery of *Carex longii* in Keelung City which represents the first naturalized member of this substantial genus in the *Flora of Taiwan*. *C. longii* is native to North, Central and South America (Mastrogiuseppe *et al.* 2002) and has also been introduced to the Hawaii Islands (Strong and Wagner 1997), New Zealand (Healy and Edgar 1980) and Japan (Katsuyama 2013). In Taiwan, *C. longii* is currently only found in a roadside grassy area in the hilly region of Qidu District, where it has already established a dense and stably reproducing population.

According to the street view images available on Google Maps (Google Maps 2017), the habitat of *Carex longii* was formed after a roadside slope construction in 2012. *C. longii* is thus presumed to be introduced along with the materials used for vegetative restoration during the 2012 construction. Such vegetation restoration after water and soil conservation construction has been a major source of unexpected plant introduction to Taiwan as several naturalized plants, such as *Bromus* spp., *Indigofera pseudotinctoria* Matsum., *Rhus chinensis* Mill. var. *chinensis* and *Senecio*

inaequidens DC., were also speculated to be introduced this way (Jung *et al.* 2005; 2006; 2009; Hsu and Su 2013; Tseng *et al.* 2013; Z. H. Chen, pers. comm. in May 2017).

Systematically, *Carex longii* belongs to sect. *Ovales* of subg. *Vignea* (Hipp *et al.* 2006; The Global *Carex* Group 2016). Sect. *Ovales*, with ca. 85 species mainly distributed in North America and extended to Central, South America and temperate Eurasia (Mastrogiuseppe *et al.* 2002; Dai *et al.* 2010), is also first reported in Taiwan. A key to the morphologically similar sections/taxa under subg. *Vignea* recorded in Taiwan is provided here to aid identification.

Key to the species of *Carex* subg. *Vignea* (characterized by spicate inflorescence and cladoprophyll not present) in Taiwan:

1. Rhizome long creeping; culms remote; inflorescences mostly dioecious ..... *C. kobomugi* [sect. *Macrocephalae*]
1a. Rhizome inconspicuous or short creeping; culms tufted; inflorescences monoecious 2
2. Spikes androgynous ..... *C. nubigena* [sect. *Phleoideae*]
2a. Spikes gynaecandrous 3
3. Involucral bracts leaflike, conspicuously longer than inflorescence 4
3a. Involucral bracts glumelike or setaceous, shorter than inflorescence 5
4. Stigmas 3; urticles suborbicular to broadly ovate (Matsu Islands) ..... *C. gibba* [sect. *Gibbae*]
4a. Stigmas 2; urticles lanceolate to ovate-lanceolate (Taiwan) ..... *C. rochebrunii* [sect. *Remotae*]
5. Urticles spreading at maturity, not winged on margins, ovate (excluding beak)..... *C. echinata* [sect. *Stellulatae*]
5a. Urticles appressed-ascending at maturity, winged on margins, obovate (excluding beak) ..... *C. longii* [sect. *Ovales*]

Taxonomic Treatment

Carex longii Mack., Bull. Torrey Bot. Club 49(12): 373. 1923; Rothrock, Rhodora 93: 63. 1991; Mastrogiuseppe *et al.*, Flora of of North America North of Mexico 23: 368. 2002; Katsuyama, Bull. Kanagawa Prefect. Mus. (Nat. Sci.) 42: 10. 2013. Fig. 1

Type: USA. New Jersey: Cape May Co., Cold Spring, 24 Jul 1907, *B. Long s.n.* (holotype: PH, n.v.).

Morphology: Plants perennial. Rhizome inconspicuous or short creeping. Culms tufted, 20–90 cm. Leaves 2–5 per fertile culm; sheaths finely papillose (at 30x), green, with a Y-shaped hyaline region at collar; blades 8–20 cm × 2–4.5 mm. Inflorescences erect, 1–3 cm long; bracts glume-like, basalmost ones often with

short to long bristle tips and occasionally longer than inflorescence. Spikes 2–8, all gynaecandrous, sessile, ellipsoid to ovoid, 6–13 × 4–7 mm; staminate portion 2 mm or less. Staminate and pistillate glumes similar, white-hyaline, becoming pale silvery brown with age, with greenish center, ovate lanceolate, 2.5–3.5 mm, shorter and narrower than urticles, apex obtuse. Urticles appressed-ascending, green to drab brown, conspicuously 5–many-veined on each face, 3–4.5 × 2–3 mm, body obovate, flat except over achene, margin winged; beak green to brown at tip, flat, triangular, ciliate-serrulate, with conspicuous white hyaline margin, distance from beak tip to achene 1.5–2.2 mm. Achenes oblong, 1.3–1.7 × 0.7–1 mm, 0.4–0.5 mm thick, apiculum less than 0.4 mm; style straight.

Chinese name: 龍氏薹.

Ecology: *Carex longii* grows in open grassy areas along roadside at an elevation of ca. 200 m, accompanied by *Axonopus fissifolius* (Raddi) Kuhlm. (Poaceae), *Ageratum houstonianum* Mill. (Asteraceae), *Bidens pilosa* L. var. *radiate* (Sch. Bip.) J.A. Schmidt. (Asteraceae), *Cyperus brevifolius* Rottb. (Cyperaceae), *Juncus prismatocarpus* R. Br. (Juncaceae), *Phyllanthus hookeri* Müll. Arg. (Phyllanthaceae) and *Spiranthes sinensis* (Pers.) Ames (Orchidaceae).

Distribution: *Carex longii* is native to North, Central and South America, introduced and naturalized in the Hawaii Islands, New Zealand and Japan, and newly naturalized in Taiwan.

Specimens examined in Taiwan: Keelung City: Qidu District, Kunalun (空阿崙), ca. 200 m, 4 May 2017, *Hsu 9050*; *9051*; *9052* (TAIF).

Taxonomic remarks: Morphologically, *Carex* sect. *Ovales* is distinguished from other sections by the combination of tufted culms, spicate inflorescences without cladoprophylls, glumelike or setaceous involucral bracts usually shorter than inflorescence, gynaecandrous spikes, bifid stigma and appressed to ascending perigynia with beaked apices and glabrous surfaces (Mastrogiuseppe et al. 2002; Dai et al. 2010). *C. longii* could be further differentiated from other members of sect. *Ovales* by the combination of tufted culms, generally congested spikes, obtuse and beakless female glumes slightly shorter than urticles, urticles with obovate bodies, triangular beaks and winged margins, and pentagonal-ovate nutlets with straight persistent styles (Rothrock 1991; Mastrogiuseppe et al. 2002; Katsuyama 2013). Mastrogiuseppe et al. (2002) stated that "decumbent culms of *C. longii* can root at their nodes during the fall and produce flowering culms the following spring." Such remarkable growing pattern possibly also occurs in the Keelung population, because plants with culms rooting and branching at nodes have also been observed in field (voucher: *Hsu 9051*).

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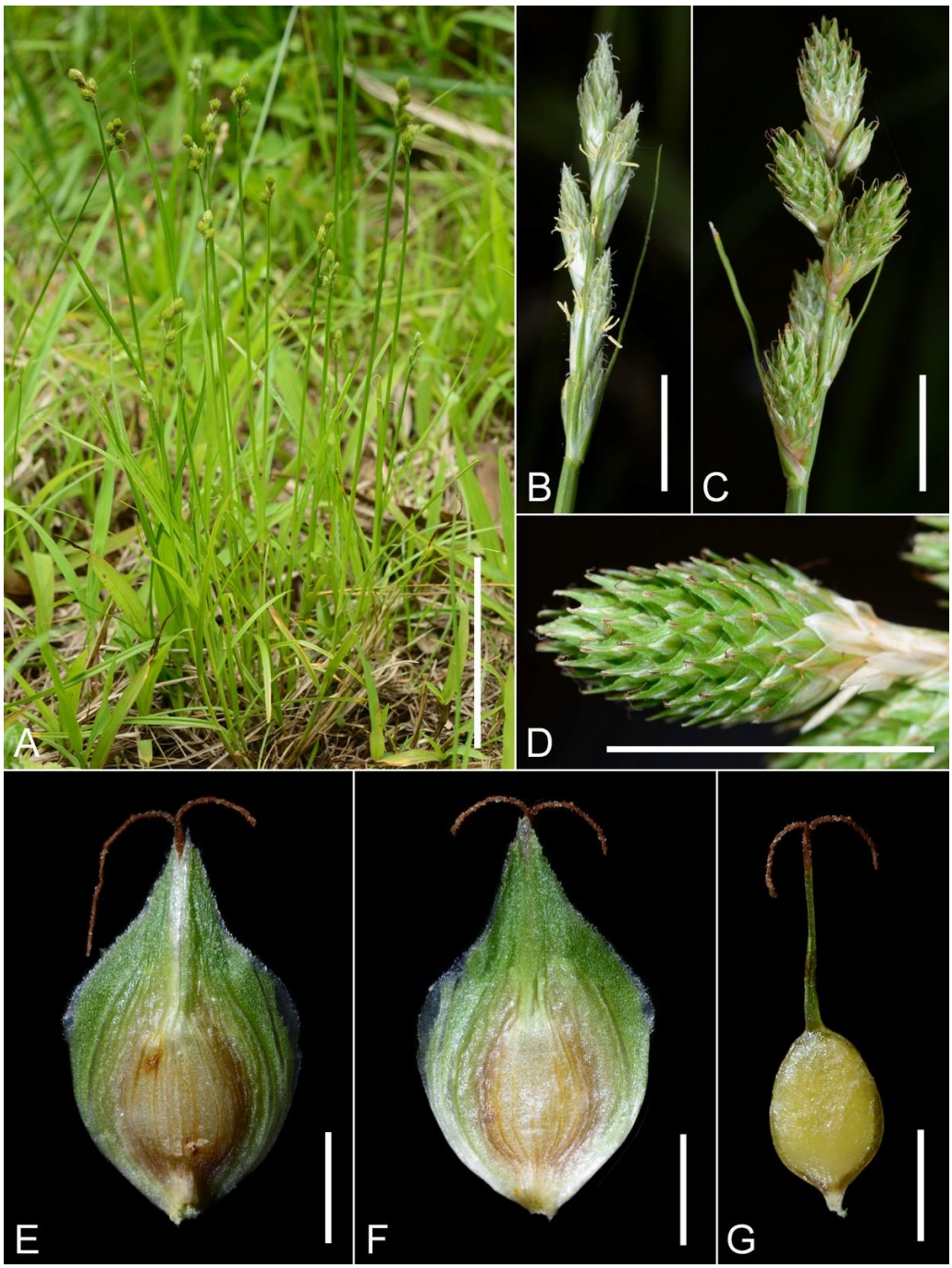

Fig. 1. *Carex longii* Mack. A, habit *in situ*; B, flowering inflorescence, note the bisexual and gynaecandrous spikes; C, fruiting inflorescence, note the appressed-ascending urticles; D, fruiting spike, note the urticles longer than pistillate glumes; E, abaxial face of urticle; F, adaxial face of urticle; G, nutlet. Scale bars: A = 10 cm; B–D = 1 cm; E–G = 1 mm. Photographed by T. C. Hsu.