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Taxonomic additions of the genus *Carex* (Cyperaceae) in Taiwan

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ABSTRACT: New taxonomic data for the genus *Carex* (Cyperaceae) in Taiwan are presented based on field and herbarium investigations. Five new species, *C. chamaecyparicola*, *C. hsinchuensis*, *C. leongii*, *C. orthorhyncha* and *C. pseudorhynchachaenium*, and two reinstated species, *C. matsudae* and *C. mokkwaensis*, are proposed, accompanied by comprehensive morphological descriptions and color plates. The taxonomic affinities, systematic placements, chorology and ecology of these species are also briefly discussed.

KEY WORDS: Cyperoideae, Cariceae, new species, reinstated species, sedges, taxonomy.

INTRODUCTION

The genus *Carex*, comprising more than 2000 species with cosmopolitan distribution, is one of the largest angiosperm genera in the world (Roalson *et al.*, 2021; POWO, 2025). In Taiwan, 61 species were recorded in the latest comprehensive regional treatment (Koyama *et al.*, 2000). Since then, at least eleven native species, i.e., *C. borealifujianica* Y.F. Lu & X.F. Jin, *C. canina* Dunn, *C. daxinensis* Y.Y. Zhou & X.F. Jin, *C. dimorpholepis* Steud., *C. echinata* Murray, *C. kagoshimensis* Tak. Shimizu, *C. laticeps* C.B. Clarke ex Franch., *C. mollicula* Boott, *C. scaposa* C.B. Clarke, *C. tsushimensis* (Ohwi) Ohwi and *C. tumida* Boott, and one naturalized species, *C. longii* Mack., were further added (Yang and Chen, 2005; Jin and Zheng, 2013; Liao *et al.*, 2016; Hsu and Chung, 2017a,b; Hsu, 2022, 2026). In addition, several taxonomic alterations involving species occurring in Taiwan have been proposed over the past two decades (Dai *et al.*, 2010; Jin and Zheng, 2013; Cen *et al.*, 2016; Hsu and Chung, 2017a; Hoshino *et al.*, 2020; Jin *et al.*, 2020). Nonetheless, the diversity of this megadiverse genus in Taiwan is still not fully understood, and many taxonomic issues remain unresolved.

The present study is a continuation of the author's previous and ongoing research (Hsu and Chung, 2017a,b; Hsu, 2022, 2026) focusing on the taxonomy and chorology of the sedges in Taiwan. Based on extensive examinations of fresh materials, herbarium specimens and relevant literature, new taxonomic data for the genus *Carex* are herein proposed. Five new endemic species, *C. chamaecyparicola* T.C. Hsu, *C. hsinchuensis* W.C. Leong & Kuoh *ex* T.C. Hsu, *C. leongii* T.C. Hsu, *C. orthorhyncha* T.C. Hsu and *C. pseudorhynchachaenium* T.C. Hsu, are formally described. Two additional endemic species, *C. matsudae* (Hayata) Hayata ex Makino & Nemoto and *C. mokkwaensis* Akiyama, which have long been treated as synonyms or overlooked, are also reinstated alongside updated morphological descriptions. With these additions, the total number of *Carex* species in Taiwan reaches approximately 79, retaining its status as the largest genus of vascular plants in the country (Hsieh, 2002).

MATERIALS AND METHODS

Field surveys were conducted in Taiwan by the author and colleagues between 2008 and 2026. The primary voucher specimens collected by the author were deposited in the herbarium of Taiwan Forestry Research Institute (TAIF). Images of the TAIF specimens are currently available or will soon be accessible via its online database (https://taif.tfri.gov.tw/search/). For taxonomic study, specimens preserved in HAST, K, TAI, TAIF and TNM and digitized specimen images provided by E, KYO, MICH, NY, P and TI are examined; regional treatments of Taiwan and neighboring areas (Ohwi, 1936; Akiyama, 1955; Koyama, 1978; Kern and Nooteboom, 1979; Koyama *et al.*, 2000; Liang *et al.*, 2000; Dai *et al.*, 2010; Hoshino and Masaki, 2011; Katsuyama, 2015; Hsu and Chung, 2017a; Hoshino *et al.*, 2020) are also consulted. Examined specimens and morphological data of additional taxa mentioned in this study are detailed in Appendix 1. For the descriptions, the morphological terminology used by Roalson *et al.* (2021) is primarily adopted, which differs partially from that used in the Flora of Taiwan series (Koyama, 1978; Koyama *et al.*, 2000). Specifically, inflorescence units are referred to as spikes, involucral bracts as bracts, floral bracts as scales, flower prophylls as utricles, and fruits as nutlets. Additionally, outgrowths between the nutlet bodies and style bases (stylopodia) are collectively termed appendages, when present. Regarding measurements, scale lengths exclude awns, while nutlet lengths include the basal stipes and apical appendages but exclude the stylopodia.

TAXONOMIC TREATMENT

Carex chamaecyparicola T.C. Hsu, ***sp. nov.***

Figs. 1 & S1

Type: TAIWAN. Yilan County: Datong Township, Tsuifeng Lake, ca. 1900 m, 20 May 2016, *T.C. Hsu 8469* (holotype: TAIF [herbarium no.: 551720]; isotypes: TAIF [herbarium no.: 551721]; TNM).

Diagnosis: This new species is closely allied to *Carex orthostemon* Hayata but distinguished in having broadly ovate (vs. ovate), muticous pistillate scales (vs. at least lower pistillate scales apparently aristate), boldly veined (vs. slenderly veined) utricles that are not constricted (vs. slightly constricted below the beak) when dried, very short (0.2–0.3 vs. 0.5–0.7 mm) and usually oblique (vs. straight) nutlet stipes, and discoidal, nearly flat (vs. cupular) nutlet apical appendages.

Description: Herbs perennial, tufted, ca. 15–30 cm tall in nature. Rhizome short, clothed with dark brown sheaths and fibers formed by degenerated sheaths. Culms consistently lateral, slender, ascending, usually ± recurved, 1–10(–20) cm long, obtusely trigonous, surpassed by tussock, base clothed with yellowish brown sheaths. Leaves many, clustered; blades narrowly linear, up to 15–30 cm long, 3–7 mm wide, margin minutely scabrous; sheaths 2–3 cm long, yellowish brown, with dark reddish brown veins. Bracts sheathed; proximal 1–2 bracts with 1–3.5 cm long leafy blades, distal bracts bladeless or bristle-like; sheaths 2–5 mm long. Spikes 2–4, racemose, 1 spike per node, suberect, usually approximate, sometimes proximal spike spaced; terminal spike staminate, linear-oblong, 2–8 mm long, ca. 1 mm in diam.; lateral spikes pistillate, ovoid, 5–10 mm long, 3–5 mm in diam. when fruiting, peduncles 2–5 mm long, enclosed within bract sheaths, sublaxly 2–5-flowered. Staminate scales tubular due to adnate lateral margins, ovate-oblong when expanded, 2–2.5 mm long, 1.8–2.2 mm wide; costa green, 3-veined; sides pale stramineous, membranous, apex obtuse, muticous, minutely erose. Pistillate scales broadly ovate, ca. 2 mm long, ca. 1.5 mm wide; costa green, 3–5-veined; sides pale greenish white, slightly tinged with pale brown, thick-membranous; apex acute or apiculate, muticous, minutely erose. Utricle suberect or ascending, ovoid-fusiform, much surpassing scale, 3.5–4.5 mm long, 1.5–1.8 mm wide, pale greenish, obtusely trigonous, thick-membranous, wholly sparsely minutely pubescent, boldly many-veined, base cuneate, apex gradually narrowed to a short erect beak, not constricted, orifice shallowly bidentate. Style ca. 1 mm long, base swollen and persistent, forming a conical stylopodium; stigmas 3, ca. 1.5 mm long, caducous. Nutlet tightly enveloped, rhomboid-ellipsoid, 2.5–3.2 mm long, 1.3–1.6 mm wide, castaneous, trigonous, angles not contracted, faces slightly concave below, nearly flat above, base cuneate and shortly stipitate, apex subtruncate, abruptly constricted and appendaged; stipes 0.2–0.3 mm long, ± oblique; appendage discoidal, rather flattened, appressed to nutlet body, ca. 0.7 mm in diam. when dried.

Distribution and ecology: *Carex chamaecyparicola* is endemic to northeastern Taiwan. So far, it has only been found in the Taipingshan area in Datong Township, Yilan County, where it grows exclusively under primary *Chamaecyparis* montane mixed cloud forests (Li *et al.*, 2013) at elevations of 1800–2100 m. Flowering and fruiting culms were observed from June to August.

Etymology: The specific epithet is derived from *Chamaecyparis*, a gymnosperm genus, and *-cola*, dweller, alluding to the remarkable habitat preference of this new species. Its vernacular name is given as "檜林薹", following Hsu and Chung (2017a: 288).

Paratypes: TAIWAN. Yilan: Taipingshan Forest Recreation Area, ca. 2000 m, 14 Aug 2001, *Leong 2376* (HAST); Taipingshan, ca. 2000 m, 23 Jun 2017, *Hsu 9293* (TAIF); Tsuifeng Lake, 1800–1900 m, 3 Jun 2015, *Hsu 7739* (TAIF); same loc., ca. 1950 m, 19 Aug 2021, *Hsu 13546* (TAIF).

Notes: This new species was first introduced by Hsu and Chung (2017a) as "*Carex* sp.", accompanied by a brief Chinese description and some photographs. It is formally described here as studies of both fresh and dried materials (Appendix 1) consistently support its distinction from the closely related *C. orthostemon* by several delicate but constant characteristics in their reproductive organs (see ***Diagnosis*** and Fig. S1). *C. chamaecyparicola* may also be confused with the widespread East Asian species *C. tristachya* Thunb. and its variety *C. tristachya* var. *pocilliformis* (Boott) Kük., as they share similar congested spikes, tubular staminate scales (in var. *pocilliformis*), and discoidal nutlet apical appendages. However, *C. tristachya* is clearly distinguishable by its consistently central culms that usually surpass the tussock, longer (1–4 cm) spikes, and smaller utricles (2.5–3.2 mm long) and nutlets (2–2.5 mm long).

Carex chamaecyparicola could be classified under sect. *Mitratae* in traditional systems (e.g., Dai *et al.*, 2010; Hoshino *et al.*, 2020). Phylogenetically, this species supposedly belongs to the "Tristachya Clade" defined by Roalson *et al.* (2021) considering its morphological affinity with *C. orthostemon*.

Carex hsinchuensis W.C. Leong & Kuoh ex T.C. Hsu, ***sp. nov.*** **Fig. 2**

Type: TAIWAN. Hsinchu County: Wufong Township, Wufong, ca. 350 m, 12 Mar 2025, *T.C. Hsu 15881* (holotype: TAIF [herbarium no.: 551725]; isotypes: TAIF [herbarium no.: 551726]; TNM).

Diagnosis: This new species is morphologically similar to *Carex breviaristata* K.T. Fu but distinguished in having densely pubescent (vs. sparsely puberulent) utricles and ovate-elliptic (vs. obovate-oblong) pistillate scales with retuse (vs. rounded to obtuse) apices and shorter (0.5–1.5 vs. 1.5–2.5 mm) awns.

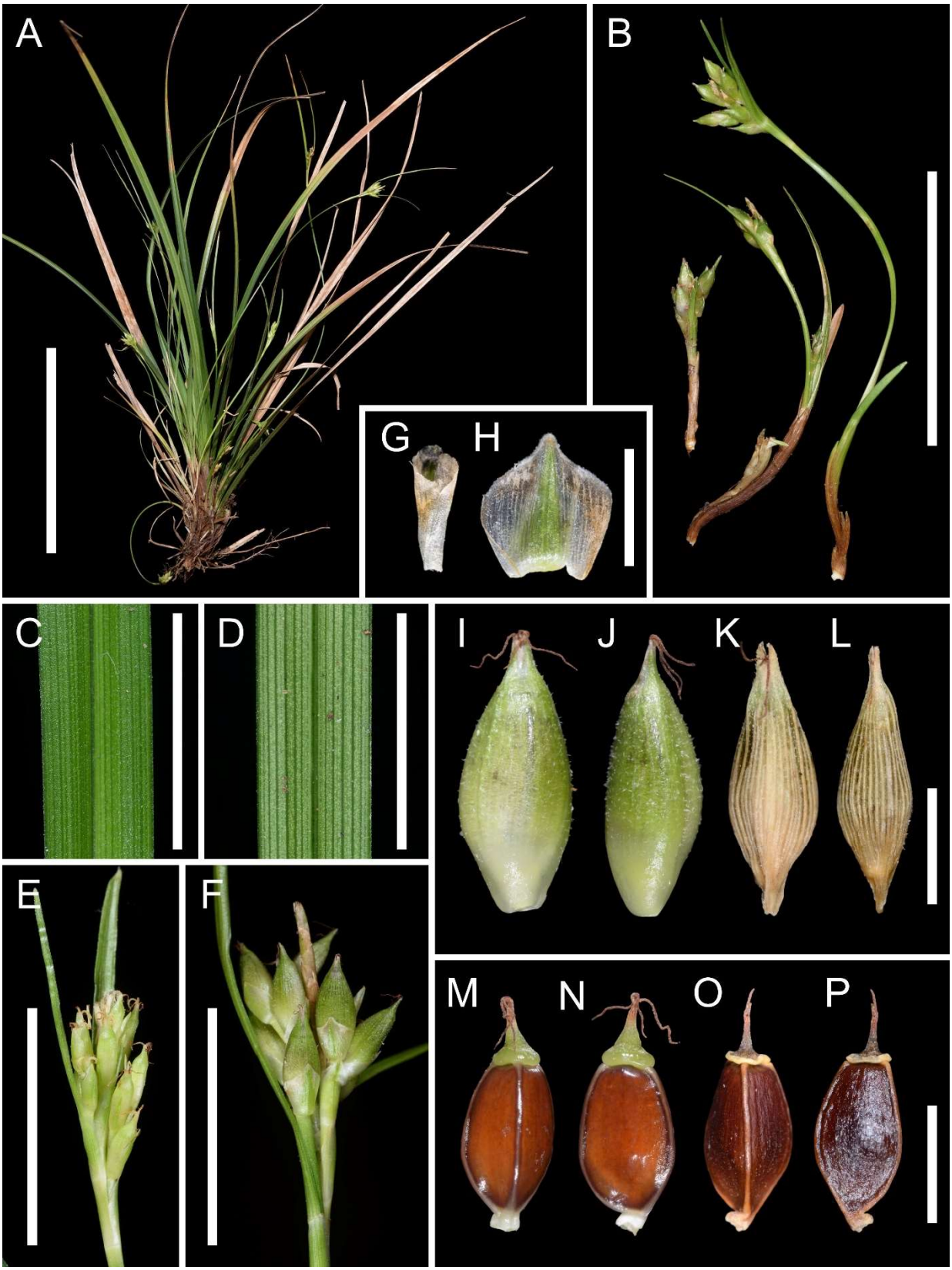

Fig. 1. Morphology of ***Carex chamaecyparicola*** T.C. Hsu, from *Hsu 8469* (type, TAIF). **A.** Habit. **B.** Culms. **C.** Adaxial surface of leaf blade. **D.** Abaxial surface of leaf blade. **E.** Inflorescence. **F.** Infructescence. **G.** Staminate scale. **H.** Pistillate scale. **I–J.** Fresh utricles. **K–L.** Dried utricles. **M–N.** Fresh nutlets. **O–P.** Dried nutlets. Scale bars: A = 10 cm; B = 3 cm; C–F = 1 cm; G–P = 2 mm.

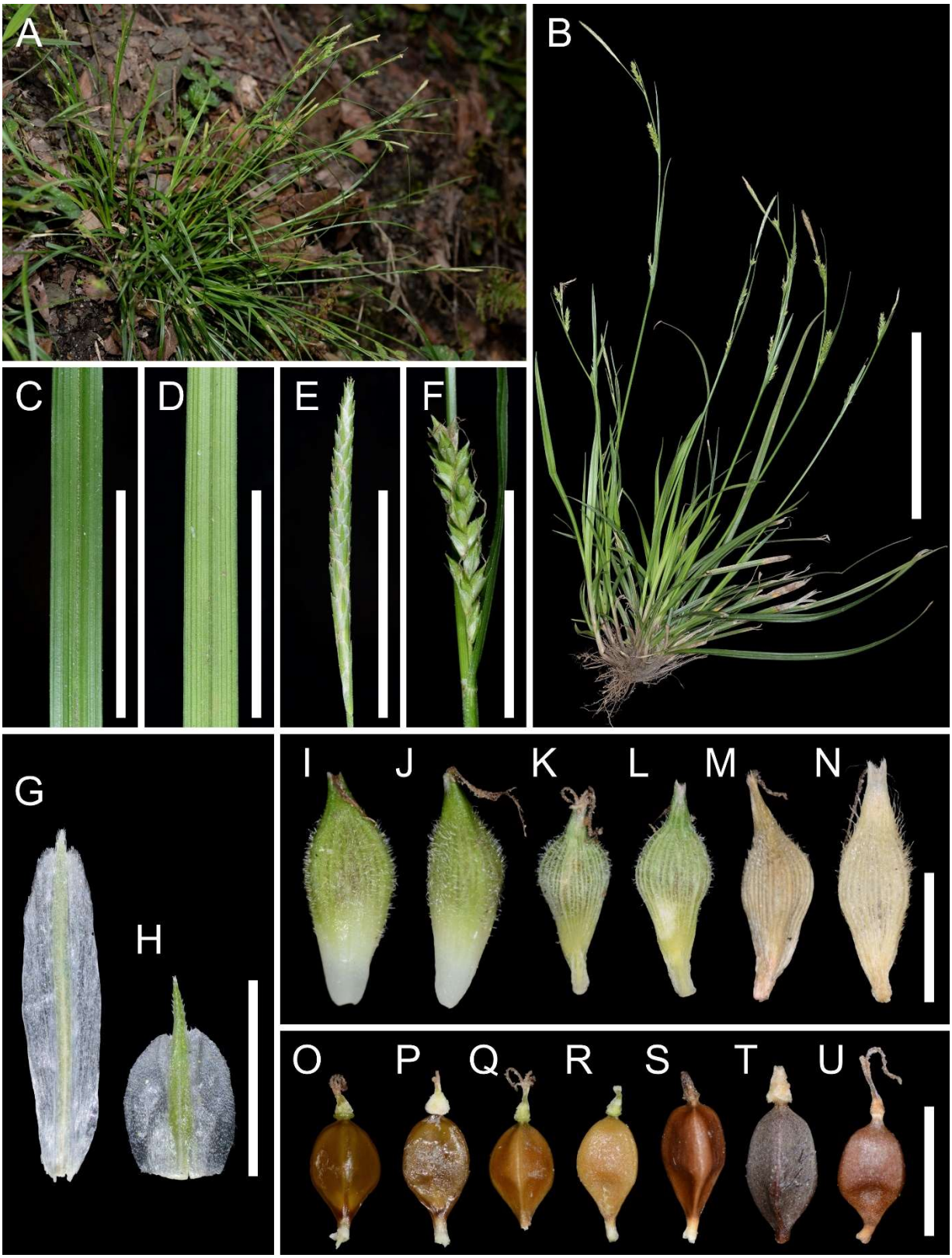

Fig. 2. Morphology of ***Carex hsinchuensis*** W.C. Leong & Kuoh ex T.C. Hsu. A–L & O–R from *Hsu 15881* (type, TAIF); M & U from *Hsu 10218* (TAIF); N & T from *Hsu 9020* (TAIF); S from *Lu 25115* (TAIF). **A–B.** Habits. **C.** Leaf blade, adaxial side. **D.** Leaf blade, abaxial side. **E.** Terminal staminate spike. **F.** Lateral pistillate spike. **G.** Staminate scale. **H.** Pistillate scale. **I–J.** Fresh utricles. **K–N.** Dried utricles. **O–P.** Fresh nutlets. **Q–U.** Dried nutlets. Scale bars: B = 10 cm; C–F = 2 cm; G–H = 3 mm; I–U = 2 mm.

Description: Herbs perennial, tufted, ca. 30–50 cm tall in nature. Rhizome short, clothed with dark brown fibers formed by degenerated sheaths. Culms central, erect or ascending, rather slender, 15–60 cm long, usually surpassing tussock, obtusely trigonous. Leaves many, clustered; blades linear, up to 20–50 cm long, 3–7 mm wide, margin obscurely scabrous; sheaths 2–4 cm long, yellowish brown, with dark purplish brown veins. Bracts sheathed; blades of proximal 1–2 bracts leaflike, up to 5–10 cm long; blade of distal bracts bristle-like, usually shorter than 3 cm; sheaths 0.5–2.5 cm long. Spikes 3–6, suberect, 1 spike per node, spaced or distal 2–3 spikes sometimes approximate; terminal spike staminate or occasionally with several pistillate flowers at base, linear-cylindrical, 1–3 cm long, 2–3 mm in diam.; lateral spikes pistillate or sometimes with several staminate flowers at apex, cylindrical, 1–3 cm long, 3–5 mm in diam. when fruiting, peduncles 0.5–4 cm long, subdensely to sublaxly 10–30-flowered. Staminate scales oblong, 4–5.5 mm long, 1.5–2 mm wide; costa green, 3-veined; sides translucent-whitish, membranous; apex obtuse or retuse, aristate, ciliate; awns 0.5–1 mm long, scabrous. Pistillate scales ovate-elliptic, 1.8–2.2 mm long, 1.5–1.8 mm wide; costa green, 3-veined; sides translucent-whitish, membranous; apex retuse, aristate, ciliate; awns 0.5–1.5 mm long, scabrous. Utricle ascending, elliptic-fusiform, surpassing scale, 3–3.5 mm long, 1.5–1.8 mm wide, yellowish green, obtusely trigonous, chartaceous, densely pubescent, slenderly many-veined, base cuneate (attenuate when dried), apex narrowed to a suberect ca. 0.5 mm beak, orifice shallowly bidentate. Style ca. 1 mm long, base distinctly swollen and persistent, forming a conical stylopodium; stigmas 3, ca. 1.5 mm long, usually caducous. Nutlet tightly enveloped, ellipsoid-obovate, 1.8–2 mm long, 1–1.2 mm wide, castaneous to dark brown, trigonous, angles not constricted, faces concave below, ± plane above, base cuneate and shortly stipitate, apex rounded and appendaged; stipes 0.1–0.3 mm, straight or slightly oblique; appendage neck-like, ca. 0.2 mm long, discoidal at top, 0.3–0.4 mm in diam., as broad as or slightly broader than stylopodium.

Distribution and ecology: *Carex hsinchuensis* is confined to lower mountainous regions (350–1100 m elev.) in Taoyuan City and Hsinchu County, where it grows around forest margins and is usually found on semi-open roadside slopes. Flowering and fruiting culms were observed from January to May.

Etymology: The specific epithet is derived from Hsinchu County, the type locality of this new species. Its vernacular name is given as "新竹薹", following Leong (2001) and Hsu and Chung (2017a).

Paratypes: TAIWAN. Taoyuan: Fuhua, 6 Mar 2010, *Chen 1245* (TAIF); Junghua, ca. 500 m, 26 Mar 2011, *Lu 21634* (TAIF); same loc., 18 May 2017, *Hsu 9092* (TAIF); same loc., 12 Apr 2018, *Hsu 10434* (TAIF); Kala Bridge, 5 Mar 2010, *Chen 1241* (TAIF); Kaopo, 6 Mar 2010, *Chen 1248* (TAIF); Ssuleng, ca. 1100 m, 18 May 2017, *Hsu 9094* (TAIF); Taiping Stream, 19 Jan 2011, *Chen 1481* (TAIF). Hsinchu: Chingchuen, ca. 600 m, 2 Mar 2001, *Leong 2227* (HAST); Chiangchunshi, ca. 500 m, 2 Mar 2001, *Leong 2226* (HAST); Jianshih, 400–500 m, 26 Jan 2013, *Lu 25115* (TAIF); Jianshi Township Office, 7 Oct 2010, *Chen 1286* (TAIF); Linchiachuang, ca. 350 m, 7 May 2020, *Hsu 12733* (TAIF); Wufong, 700–800 m, 6 May 2017, *Hsu 9062* (TAIF); same loc., ca. 750 m, 20 Feb 2018, *Hsu 10213* (TAIF); same loc., 11 Mar 2018, *T.C. Hsu 10218* (TAIF); Yufeng, 700–900 m, 20 Apr 2015, *Hsu 7609* (TAIF); same loc., 15 Apr 2017, *Hsu 9020* (TAIF).

Notes: Leong (2001) proposed two new species, "*Carex hsinchuensis* Leong & Kuoh" and "*Carex lanyuensis* Leong & Kuoh", in his thesis about the taxonomy of *Carex* sect. *Praecoces* in Taiwan. Unfortunately, both names are invalid since the thesis does not constitute effective publication (see Art. 30.8 of the ICN; Turland *et al.*, 2025). Additionally, neither Latin diagnoses nor indications of types, both of which were required for valid publication at that time, were presented (see Art. 39.1 and 40.1 of the ICN). Materials matching Leong's description of "*C. hsinchuensis*" closely resemble *C. breviaristata* from mainland China (Dai *et al.*, 2010). However, *C. breviaristata* is consistently described as having sparsely puberulent utricles (Fu, 1976; Liang *et al.*, 2000; Dai *et al.*, 2010), whereas all examined Taiwanese materials possess rather densely pubescent utricles (Fig. 2, I–N) and exhibit slight differences in their pistillate scales (see ***Diagnosis***). Consequently, the Taiwanese populations are herein treated as a distinct species, and the name *C. hsinchuensis* is formally validated.

Taxonomically, *Carex hsinchuensis* could be placed in sect. *Mitratae* under traditional systems (e.g., Dai *et al.*, 2010; Hoshino *et al.*, 2020), and it likely belongs to the "Conica Clade" within modern phylogenetic frameworks (Roalson *et al.*, 2021). Among the *Carex* species in Taiwan, *C. hsinchuensis* somewhat resembles the widespread and variable *C. sociata* Boott, but the two are readily distinguished by utricle size (3–3.5 vs. 2.5–3 mm long), nutlet shape (ellipsoid-obovate vs. rhomboid), and nutlet appendage morphology (neck-like vs. shortly cylindrical). Additionally, this new species shares morphological similarities with *C. satsumasendaica* Okih. Yano, Katsuy. & W. Ohnishi, a recently described species endemic to southern Japan (Yano *et al.*, 2024). Nevertheless, *C. hsinchuensis* can be differentiated by its leaf-like (vs. setaceous) proximal bracts, aristate (vs. muticous) staminate scales, and larger (3–3.5 vs. 2.5–3 mm long), ellipsoid-obovate (vs. roundish-rhombic) utricles with faces concave below and nearly plane above (vs. concave below and above).

Carex leongii T.C. Hsu, ***sp. nov.*** **Figs. 3 & S2**

Type: TAIWAN. Taitung County: Donghe Township, Mt. Tulan, ca. 850 m, 18 Jul 2018, *Hsu 10800* (holotype: TAIF [herbarium no.: 551722]; isotypes: TAIF [herbarium no.: 521516 & 551723]; TNM).

Diagnosis: This new species is similar to *Carex sociata* Boott in terms of utricle and nutlet morphology but is readily distinguished in having consistently lateral

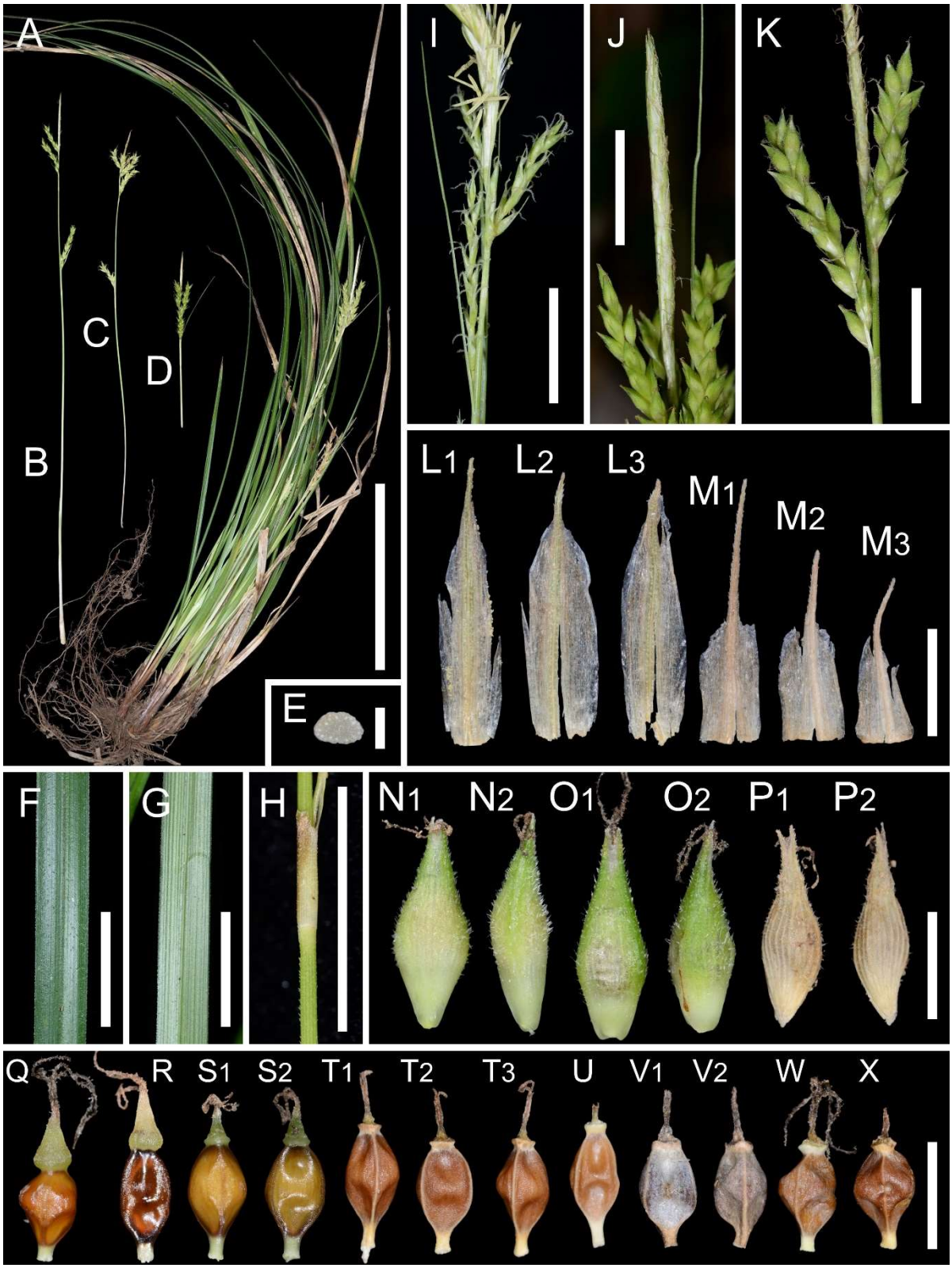

Fig. 3. Morphology of ***Carex leongii*** T.C. Hsu. A, F–N, P & S–T from *Hsu 10800* (type, TAIF); B from *Hsu 15816* (TAIF); C, R & U from *Hsu 15776* (TAIF); D–E, O, Q & W from *Hsu 15813* (TAIF); V from *Hsu 8324* (TAIF); X from *Hsu 2063* (TAIF). **A.** Habit. **B–D.** Culms. **E.** Culm, cross section. **F.** Leaf blade, adaxial side. **G.** Leaf blade, abaxial side. **H.** Bract sheath. **I.** Flowering spikes. **J.** Terminal staminate spike. **K.** Lateral pistillate spikes. **L.** Staminate scales. **M.** Pistillate scales. **N–O.** Fresh utricles. **P.** Dried utricles. **Q–S.** Fresh nutlets. **T–X.** Dried nutlets. Scale bars: A–D = 10 cm; E = 1 mm; F–K = 1 cm; L–X = 2 mm.

(vs. central or both central and lateral), compressed-terete (vs. trigonous) culms, sublaxly spirally arranged (vs. densely imbricate) pistillate flowers, longer utricles (3–4 vs. 2.5–3.5 mm) and longer (2–2.5 vs. 1.5–2 mm), ellipsoid or ovoid-ellipsoid (vs. rhomboid) nutlets.

Description: Herbs perennial, tufted, ca. 15–50 cm tall in nature. Rhizome short, woody, clothed with dark brown fibers formed by degenerated sheaths. Culms consistently lateral, rather slender, usually ascending, compressed-terete, 4–30 cm long, 0.5–1 mm thick, usually surpassed by tussock, glabrous or sometimes distally scabrous. Leaves many, clustered; blades narrowly linear, up to 20–70 cm long, 3–7 mm wide, leathery, apex long tapering, margin scabrous; sheaths 2–4 cm long, dark brown, lustrous. Bracts bristle-like, up to 1 mm wide, sheathed at base; proximal bract blades 2–10 cm long; distal blades 3–10 mm long; sheaths 0.2–1.5 cm long, scabrous or glabrescent. Spikes 3–8, 1 spike per node, suberect; terminal spike staminate (occasionally intermixed with several pistillate flowers), linear-cylindric, 1–4 cm long, 1.5–3 mm in diam., 0.1–1 cm apart from adjacent spike; lateral spikes pistillate or with several staminate flowers at apex, cylindric, spaced or distal 2–3 spikes congested, 1–2.8 cm long, 4–6 mm in diam. when fruiting, sublaxly spirally 10–30-flowered; peduncles 0.3–2 cm, scabrous. Staminate scales oblong to ovate-oblong, 4.5–5.5 mm long, 1.5–2 mm wide, costa green, 3-veined; sides translucent white, gradually turning stramineous, membranous, obscurely veined; apex obtuse to acuminate, aristate, minutely ciliate; awns 0.5–1.5(–2.5) mm long, scabrous. Pistillate scales rectangular-elliptic to ovate, 2–2.5 mm long, 1.5–2 mm wide; costa green, 3-veined; sides translucent white, sometimes gradually turning stramineous, membranous; apex subtruncate to acute, aristate; awns 1–2(–3) mm long, scabrous. Utricle ascending, ovoid-fusiform, much surpassing scale (excluding awns), 3–4 mm long, 1–1.5 mm wide, pale green or pale yellowish green, obtusely trigonous, thick-membranous, wholly pubescent, slenderly many-veined, base cuneate, apex gradually narrowed to a short erect beak, orifice bidentate, teeth ca. 0.3 mm long. Style ca. 1 mm long, base thickened and persistent, forming a conical stylopodium; stigmas 3, ca. 2 mm long, usually caducous. Nutlet tightly enveloped, ellipsoid or ovoid-ellipsoid, 2–2.5 mm long, 0.9–1.3 mm wide, castaneous to dark brown, trigonous, angles obscurely to slightly constricted, faces excavated above and below, base cuneate and shortly stipitate, apex slightly constricted and appendaged; stipe ca. 0.3 mm long, straight; appendage coronal-annulate or shortly obconical, ca. 0.2 mm tall, 0.3–0.5 mm in diam. when dried.

Distribution and ecology: *Carex leongii* is endemic to Taiwan. So far it has been recorded throughout the main island though more frequently found in coastal and lowland regions of eastern Taiwan. Besides, it also occurs in Guishan Island, Lyudao (Green Island) and Lanyu (Orchid Island). This species has been found in various habitats such as coastal shrublands, roadside slopes, cliffs and forest gaps from sea level to ca. 2100 m elev. Flowering and fruiting culms have been observed throughout the year though more frequent between June and December.

Etymology: The specific epithet honors the cyperologist Wai-Chao Leong (梁慧舟) who first recognized the novelty of this species and attempted to describe it (see ***Notes***). The vernacular name is proposed as "梁氏薹".

Paratypes: New Taipei: Lailaipi, ca. 5 m, 3 Jan 2022, *Hsu 13783* (TAIF); Pitan, ca. 50 m, 23 Jun 2022, *Hsu 14223* (TAIF). Yilan: Guishan Island ("Insl. Kizan"), 2 Jul 1932, *Masamune & Suzuki s.n.* (TAI); same loc., ca. 50 m, 5 Jul 2011, *Hsu 4258* (TAIF); same loc., ca. 20 m, 8 Nov 2019, *Hsu 12274* (TAIF); same loc., ca. 3 m, 3 Sep 2024, *Hsu 15709* (TAIF); Neipi, 6 Sep 2008, *Chen 1107* (TAIF); Peikuan, 18 Jun 2008, *Kao 1019* (TAIF); Wuyen Cape, ca. 100 m, 7 Jun 2023, *Hsu 15024* (TAIF). Hualien: Chimei, ca. 100 m, 16 Jun 2020, *Hsu 12977* (TAIF); Chiumei Suspension Bridge, ca. 770 m, 15 Jul 2020, *Hsu 12964* (TAIF); Fengping, ca. 5 m, 9 Jun 2015, *Hsu 7789* (TAIF); Loshan Waterfall Trail, ca. 600 m, 31 Jul 2021, *Chen 6813* (TAIF); Lushuiheliu Trail, 21 Nov 2015, *Lu 28974* (TAIF); Lushui Trail, 27 Aug 2021, *Chen 1967* (TAIF); Meiyuan Jhutsun Trail, 28 October 2009, *Jung 4629* (TAIF); Qinbuzhizi Cliffs, ca. 50 m, 27 Jan 2021, *Hsu 13243* (TAIF); Shihchiu Island, 25 Nov 2014, *Chen 1354* (TAIF); Tzumu Bridge, 3 Nov 2008, *Chen 1174* (TAIF); Wantan to Changhung Bridge, ca. 110 m, 24 May 2025, *Hsu 16130* (TAIF). Taitung: Litao to Motien, 1000–1500 m, 4 Jun 2012, *Hsu 5837* (TAIF); Mt. Mali, 1300–1500 m, 5 Oct 2017, *Hsu 7321* (TAIF); Mt. Tulan, 700–1000 m, 23 Sep 2010, *Hsu 3213* (TAIF); same loc., 800–1000 m, 11 Dec 2016, *Lu 30156* (TAIF); same loc., ca. 800 m, 25 April 2025, *Hsu 16029* (TAIF); Lyudao Island ("Lutao"), 60–120 m, 25 Nov 2005, *Hsieh 2272* (TNM); Haisanping, ca. 130 m, 7 Aug 2002, *Leong 3290* (HAST); Mt. Amei, 150–300 m, 25 Nov 2005, *Lu 10801* (TAIF); Lanyu Island, Hsiaotienchih, ca. 190 m, 14 Oct 2001, *Leong 2540* (HAST); same loc., 11 Aug 2002, *Leong 3328* (HAST); same loc., 7 Jul 2009, *Jung 4098* (TAIF); Mt. Hsiangai, 250–350 m, 12 Mar 2016, *Hsu 8324* (TAIF); Wukungtung Stream, ca. 50 m, 25 Dec 2018, *Hsu 11181* (TAIF); same loc., 10 Dec 2024, *Hsu 15813* (TAIF). Pingtung: Chilu Tribe, ca. 1100 m, 15 Nov 2020, *Hsu 13121* (TAIF); same loc., 21 Oct 2024, *Hsu 15776* (TAIF); Hsuhai, 100–150 m, 4 Jul 2008, *Hsu 1445* (TAIF); same loc., ca. 180 m, 12 Oct 2019, *Hsu 12142* (TAIF). Nantou: Lele Shelter to Tuikuan, 1700–2100 m, 14 Dec 2011, *Hsu 5181* (TAIF). Yunlin: Mt. Shihpi, 1400–1700 m, 6 May 2010, *Hsu 2752* (TAIF).

Notes: This taxon was initially recognized as a new species in Leong's (2001) thesis under the name "*Carex lanyuensis* Leong & Kuoh". However, the name was invalid (see ***Notes*** under *C. hsinchuensis*) and was never effectively published. Although Leong (2001) recorded only a single population from Lanyu, subsequent investigations have revealed that this species is much more widespread. Because Lanyu is neither the type locality nor the sole known locality, a novel specific epithet is herein proposed.

Taxonomically, *Carex leongii* belongs to the traditionally defined sect. *Mitratae* and likely falls within the "Conica Clade" in the latest phylogenetic framework (Roalson *et al.*, 2021). The examined materials exhibit considerable variability in traits such as culm length (Figs. 3A–D & S2), leaf blade width (Fig. S2), nutlet shape, detailed morphology of the nutlet apical appendage, and

the degree of nutlet angle constriction (Fig. 3Q–X). Because no clear morphological boundaries can be drawn among populations, they are currently treated as a single polymorphic species. In addition to *Carex sociata*, *C. leongii* might be confused with *C. dolichostachya* Hayata, which features similar lateral culms and laxly arranged hairy utricles. However, *C. dolichostachya* clearly differs by possessing muticous staminate scales and nutlets that are neither excavated on their faces nor constricted at the angles. Regarding nutlet morphology, *C. leongii* shows a strong resemblance to *C. genkaiensis* Ohwi, a species distributed across East China, Korea, and Japan (Hoshino *et al.*, 2020), as both have nutlets that are constricted at the angles, excavated on the upper and lower surfaces, and bear short obconical or neck-like apical appendages (Katsuyama, 2015; Jin, 2017). Nonetheless, *C. leongii* is easily distinguished by its consistently lateral, compressed-terete culms and aristate staminate scales, whereas *C. genkaiensis* produces primarily central, trigonous culms and muticous staminate scales. Furthermore, while *C. sociata*, *C. dolichostachya*, and *C. genkaiensis* are all spring-flowering species (with culms typically appearing between March and May), *C. leongii* is notable for its inconsistent phenology, producing culms more frequently from June to December.

Carex matsudae (Hayata) Hayata ex Makino & Nemoto, Fl. Japan: 1353 (1925). ***Type***: TAIWAN. Kaohsiung City: Liouguei District, between Liouguei and Laonung ("Rokkiri-Rōnō"), 17 April 1917, *B. Hayata s.n.* (lectotype: TI [barcode: 00010363]; isolectotypes: TI [barcodes: 00010364 & 00010365]), designated by Yano *et al.* (2018: 368). ***Residual syntypes***: TAIWAN. Pingtung County ("Ako"): Paiwansha, June 1916, *Y. Matsuda 365* (TAI [herbarium no.: 257280]); *Y. Matsuda 366* (TAI [herbarium no.: 115068]). **Fig. 4.**

Diplocarex matsudae Hayata, Icon. Pl. Formosan. 10: 70, f. 47 (1921), as "*Matsudai*".

Carex dolichostachya auct. non Hayata: Ohwi, Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B, Biol. 11(5): 375 (1936), *p.p.*; Akiyama, Caric. Far East. Reg. As.: 204 (1955), *p.p.*; Koyama, Fl. Taiwan 5: 341 (1978), *p.p.*; Liang *et al.*, Fl. Reipubl. Popularis Sin. 12: 155 (2000), *p.p.*; Govaerts and Simpson, World Checkl. Cyperaceae: 82 (2007), *p.p.*; Dai *et al.*, Fl. China 23: 323 (2010), *p.p.*

Description: Herbs perennial, tufted, ca. 40–80 cm tall in nature. Rhizome short, clothed with dark brown fibers formed by degenerated sheaths. Culms central, ascending, usually arching, 50–100 cm long, much surpassing tussock, obtusely triquetrous, glabrous. Leaves many, clustered; blades linear, up to 50–80 cm long, 4–8 mm wide, margin scabrous; sheaths 3–8 cm long, dark brownish, glabrous. Bracts sheathed; blades of proximal 1–2 bracts leaflike, up to 10–20 cm long; blade of distal bracts bristle-like, usually shorter than 3 cm; sheaths 2–5 cm long, dark reddish brown, glabrous. Spikes 3–6, suberect, 1 spike per node, rather remote; terminal spike staminate, linear-cylindrical, 5–13 cm long, 2.5–3.5 mm in diam.; lateral spikes androgynous, cylindrical, 3–8 cm long, 4–6 mm in diam. when fruiting, peduncles 3–8 cm long; staminate zone 0.5–2.5 cm long, much shorter than pistillate zone; pistillate zone sublaxly spirally 20–40-flowered. Staminate scales ovate-oblong, 5.5–7.5 mm long, ca. 3 mm wide; costa pale stramineous, 3-veined; sides dark brownish distally, translucent proximally, thick-membranous; apex obtuse or rounded, muticous, minutely ciliate. Pistillate scales broadly ovate, 3–4 mm long, 2.5–3 mm wide; costa green, 3-veined; sides brownish distally, translucent proximally, thick-membranous; apex rounded, muticous, minutely ciliate. Utricle suberect, oblong-fusiform or oblong-oblanceolate, much surpassing scale, 5–7 mm long, 1–1.5 mm wide, pale yellowish green, compressed semiorbicular in cross section, chartaceous, pubescent except for base, slenderly many-veined, base cuneate, apex attenuate to a short beak, orifice minutely bidentate (teeth < 0.2 mm long). Style ca. 1 mm long, base slightly swollen; stigmas 4(–6), 1.5–4 mm long, caducous. Nutlet tightly enveloped, oblong-elliptic or oblong, 4–5.5 mm long, 1–1.4 mm wide, compressed-trapeziform in cross section, angles not constricted, faces slightly concave near base, base rather long stipitate, apex appendaged; stipes 1–1.2 mm, straight; appendage shortly cylindric when fresh, much shortened into an annulation when dried, 0.3–0.5 mm in diam.

Distribution and ecology: *Carex matsudae* is endemic to southern Taiwan (Chiayi, Tainan, Kaohsiung, Pingtung and Taitung). It grows on semi-open rocky cliffs, streamside slopes and under open woodlands at lower elevations (100–700 m). Flowering and fruiting culms were observed from January to May.

Etymology: The specific epithet is derived from Eiji Matsuda (松田英二), one of the collectors of the syntypes. The vernacular name is given as "四柱薹", following Hsu and Chung (2017a).

Additional specimens examined: TAIWAN. Chiayi: Zengwen Reservoir, 200–300 m, 20 Mar 1997, *Chiou 14625* (TAIF). Tainan: Tachukeng, 30 Mar 2016, *Chen 1361* (TAIF); same loc., 200–300 m, 3 Apr 2016, *Hsu 8379* (TAIF); same loc., 150–250 m, 16 Apr 2016, *Hsu 8382* (TAIF); same loc., 31 May 2016, *Chen s.n.* (TAIF). Kaohsiung: Mt. Shihpalohan, 220 m, 10 Sep 2018, *Hsu 10861* (TAIF); Tengchih Logging Trail, 500–600 m, 26 Jan 2016, *Hsu 8219* (TAIF). Pingtung: Chufengshan, 300–370 m, 1 Mar 2018, *Chung 13192* (TAIF); Lanjen Stream, 300 m, 9 Jan 2018, *Hsu 10079* (TAIF); Nanjenshan, 200–300 m, 2 Jan 1998, *Leong 723* (HAST); same loc., 3 Feb 1998, *Leong 736* (HAST); Nanjenshan Nature Reserve, ca. 250 m, 1 May 2008, *Huang et al. 3373* (HAST); Paiwan, 4 Jun 1917, *Matsuda s.n.* (TAIF); Wanliteshan, ca. 300 m, 7 Apr 1999, *Wu 263* (HAST); same loc., ca. 330 m, *Wu 269* (HAST). Taitung: Anshuo Stream, 650 m, 15 Apr 2022, *T. C. Hsu 14030* (TAIF); Tawu farm, 29 Apr 1957, *Kao & Chuang s.n.* (TAI).

Notes: As specified by Hayata (1921), *Carex matsudae* is unique among Asian *Carex* species in possessing usually four, and sometimes five or six, stigmas (Fig. 4F–G). Besides this species, the North American *C. concinnoides* Mack., belonging to sect. *Clandestinae* or "Concinna Clade" and only distantly related to *C. matsudae*, is likely the only other known *Carex* species with four stigmas (Roalson *et al.*, 2021). Given this distinctiveness, it is

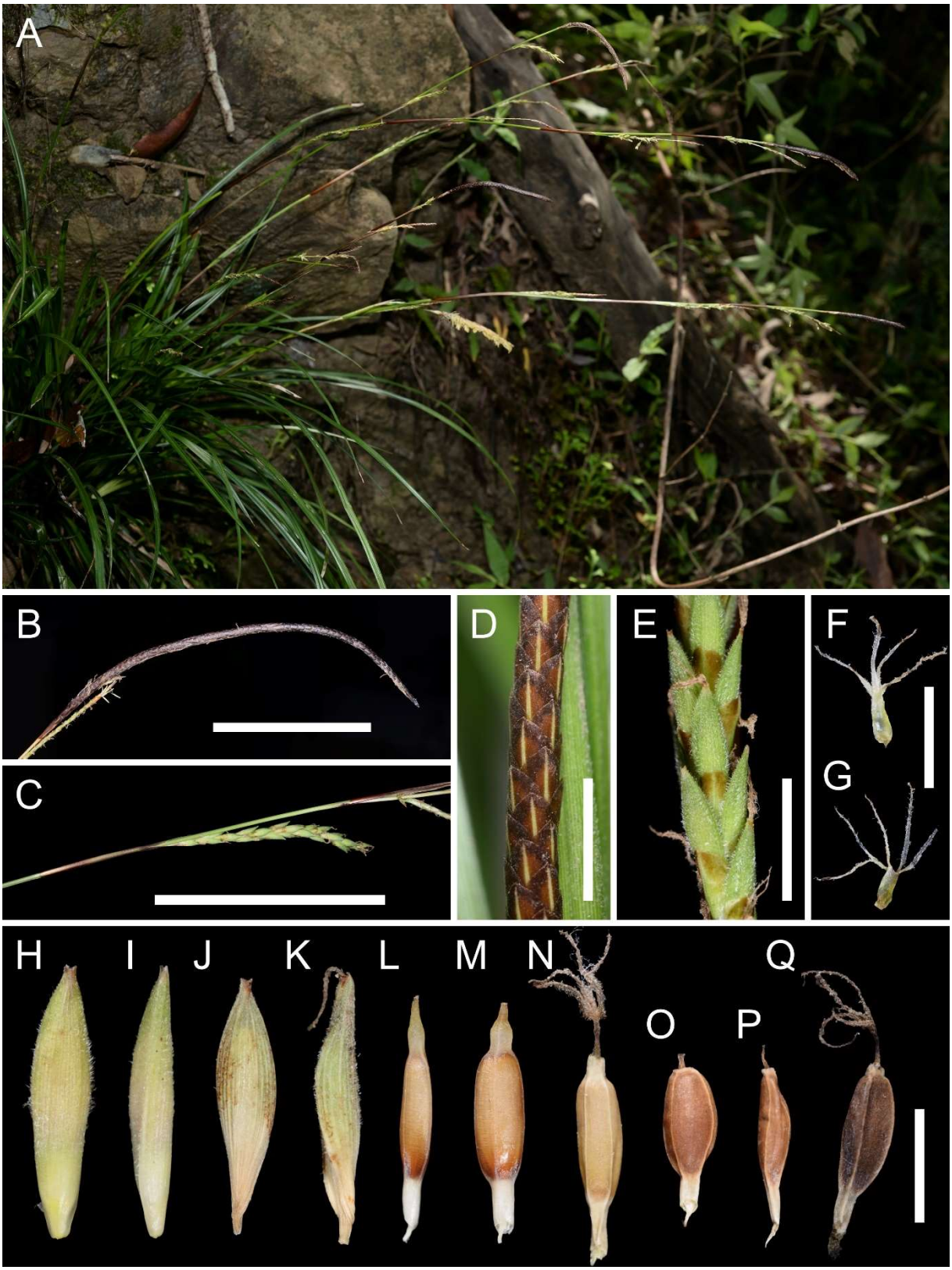

Fig. 4. Morphology of ***Carex matsudae*** (Hayata) Hayata ex Makino & Nemoto. A–C, E–I & L–Q from *Hsu 8382* (TAIF); D from *Hsu 8219* (TAIF); J–K from *Chung 13192* (TAIF). **A.** Habitat and habits. **B.** Terminal staminate spike. **C.** Lateral predominantly pistillate spike and bract. **D.** Staminate scales. **E.** Pistillate scales and utricles. **F–G.** Pistillate flowers. **H–I.** Fresh utricles. **J–K.** Dried utricles. **L–N.** Fresh nutlets. **O–Q.** Dried nutlets. Scale bars: B–C = 5 cm; D–E = 5 mm; F–G = 2 mm; H–Q = 3 mm.

puzzling that *C. matsudae* was treated as a synonym of *C. dolichostachya* in most previous studies (Ohwi, 1936; Akiyama, 1955; Koyama, 1978; Liang *et al.*, 2000; Govaerts and Simpson, 2007; Dai *et al.*, 2010), as the two species are significantly different. *C. matsudae* is characterized by central culms, dark brownish scales, 5–7 mm long utricles, 4(–6) stigmas, and 4–5.5 mm long nutlets with long basal stipes and annulate to shortly cylindrical apical appendages. It should be placed in sect. *Ferrugineae* or sect. *Aulocystis* subsect. *Ferrugineae* under traditional systems, and it likely belongs to the "Truncatigluma Clade" within the latest phylogenetic framework (Roalson *et al.*, 2021). In contrast, *C. dolichostachya* features consistently lateral culms, pale scales, 2.5–4 mm long utricles, three stigmas, and 2–2.5 mm long nutlets with short basal stipes and neck-like (i.e., abruptly contracted and then annulately dilated) apical appendages. It belongs to sect. *Mitratae* in traditional systems and the "Conica Clade" in the phylogenetic system (Roalson *et al.*, 2021).

In overall appearance, *Carex matsudae* most closely resembles *C. makinoensis* Franch., and many herbarium materials have been misidentified as such. Beyond its characteristic stigma number, however, *C. matsudae* can further be distinguished from *C. makinoensis* by its broader leaf blades (4–8 vs. 2–5 mm wide), remote (vs. subcongested) lateral spikes, reddish brown (vs. stramineous) bracts, obtuse to rounded (vs. acuminate to acute) staminate and pistillate scales, and shortly beaked (vs. rather long beaked) utricles with minute (vs. prominent) apical teeth.

Carex mokkwaensis Akiyama, Caric. Far East. Reg. As.: 101, pl. 79 (1955); Govaerts and Simpson, World Checkl. Cyperaceae: 135 (2007). ***Type*****:** TAIWAN. Hualien ("Karenko"): Hsiulin Township, between Banbien and Tungmen ("inter Sakahen et Domon"), 31 July 1938, *S. Akiyama s.n.* (holotype: SAPS). **Fig. 5**

Carex hattoriana auct. non Nakai ex Tuyama: Koyama, J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot. 8: 164 (1962), *p.p.*; Koyama, Fl. Taiwan 5: 320 (1978), *p.p.*

Description: Herbs perennial, tufted, ca. 30–70 cm tall in nature. Rhizome short, ligneous, clothed with dark brown scale-like sheaths. Culms central, ascending, slender, usually arching, 40–100 cm long, much surpassing tussock, triquetrous, glabrous, basally clothed with several brown bladeless sheaths up to 10 cm long. Leaves many, clustered; blades linear, up to 20–80 cm long, 2–4 mm wide, surface and margin scabrous; sheaths 5–16 cm long, brownish, glabrous, membranous parts usually disintegrating into reticulate fibers. Bracts sheathed; proximal bracts with leaflike or bristle-like blades up to 12 cm long; distal bracts bladeless; sheaths 0.5–3 cm long, glabrous. Spikes numerous, ascending to pendulous, 1–3 in a bract sheath, usually 2 or 3 racemes composed of several spikes borne in lower bract sheaths; terminal spike staminate, linear, 2–3 cm long, ca. 1 mm in diam.; lateral spikes androgynous, linear-cylindrical, 1–4 cm long, 3–5 mm in diam. when fruiting, peduncles 0.5–6 cm long; staminate zone usually much shorter than pistillate zone, rarely subequal to pistillate zone, 0.2–1(–2) cm long; pistillate zone densely spirally 5–20-flowered. Staminate scales ovate-elliptic, 3–4 mm long, ca. 2 mm wide; costa green and rapidly turning pale brown, 1-veined; sides yellowish brown, membranous; apex acuminate or acute, muticous, minutely ciliate. Pistillate scales ovate, 2–2.5 mm long, 1.5–2 mm wide; costa green and rapidly turning pale brown, 1-veined; sides membranous, translucent white and rapidly turning brown; apex acute or obtuse, muticous. Utricle ascending, elliptic-fusiform, much surpassing scale, 3.5–4.5 mm long, 1.5–1.7 mm wide, yellowish green or brownish green, plano-convex, membranous, minutely hispidulous, coarsely 9–11 veined on each side, base cuneate, apex contracted into a ca. 1 mm long beak, orifice sharply bidentate. Style ca. 1 mm long, base slightly swollen; stigmas 2, 2–3 mm long, caducous. Nutlet tightly enveloped, elliptic, 2–2.2 mm long, 1–1.3 mm wide, compressed-biconvex, stipe and appendage obscure.

Distribution and ecology: *Carex mokkwaensis* is endemic to Taiwan and confined to the northern mountainous areas of Hualien County. It grows on limestone-rich mountain slopes, forest margins and under open woodlands at elevations of 100–1300 m. Flowering and fruiting culms were recorded from May to November.

Etymology: The specific epithet is possibly derived from Mukua Stream, the stream near the type locality. Its vernacular name is proposed as "花蓮二柱薹".

Additional specimens examined: TAIWAN. Hualien: Chiumei Suspension Bridge, ca. 770 m, 15 July 2020, *Hsu 12965* (TAIF); Chuilu, 600–700 m, 25 August 1987, *Lu 22677* (TAIF); Chuilu Ancient Trail, 600–900 m, 16 June 2011, *Hsu 4166* (TAIF); Chungte, ca. 100 m, 14 July 2020, *Hsu 12952* (TAIF); same loc., ca. 300 m, 14 July 2020, *Hsu 12955* (TAIF); same loc., 6 May 2021, *Hsu 13441* (TAIF); Lushui to Holiu Trail, ca. 450 m, 13 August 2002, *Huang 1155* (HAST); same loc., 27 June 2006, *Huang 2542* (HAST, TNM); Shihkungtsai Trail, 10–100 m, 29 November 2008, *Lu 17409* (TAIF); Tzmuuchiao, 22 August 1987, *Lu 22711* (TAIF); Wenshan to Tianxiang, 12 June 1988, *Chen s.n.* (TAIF); Yenhai Forest Road, 1200–1300 m, 22 May 2005, *Lu 9742* (HAST); Yuehwangtyng, 17 August 1987, *Lu 22709* (TAIF); same loc., ca. 380 m, 7 July 2022, *Hsu 14310* (TAIF).

Notes**:** *Carex mokkwaensis* belongs to sect. *Graciles* in both traditional classifications and modern phylogenetic systems (Roalson *et al.*, 2021). Its taxonomic status was somewhat controversial, as Koyama (1962; 1978; 2010) synonymized it under *C. hattoriana* Nakai ex Tuyama, whereas Govaerts and Simpson (2007) retained it as an independent species. Furthermore, this name was omitted from several modern floristic treatments (Koyama *et al.*, 2000; Liang *et al.*, 2000; Dai *et al.*, 2010). Following a detailed examination of the protologue and the newly collected materials cited above, I agree with Akiyama (1955) and Hoshino *et al.* (2020) that *C. mokkwaensis* is readily distinguishable from *C. hattoriana* by its staminate terminal spikes,

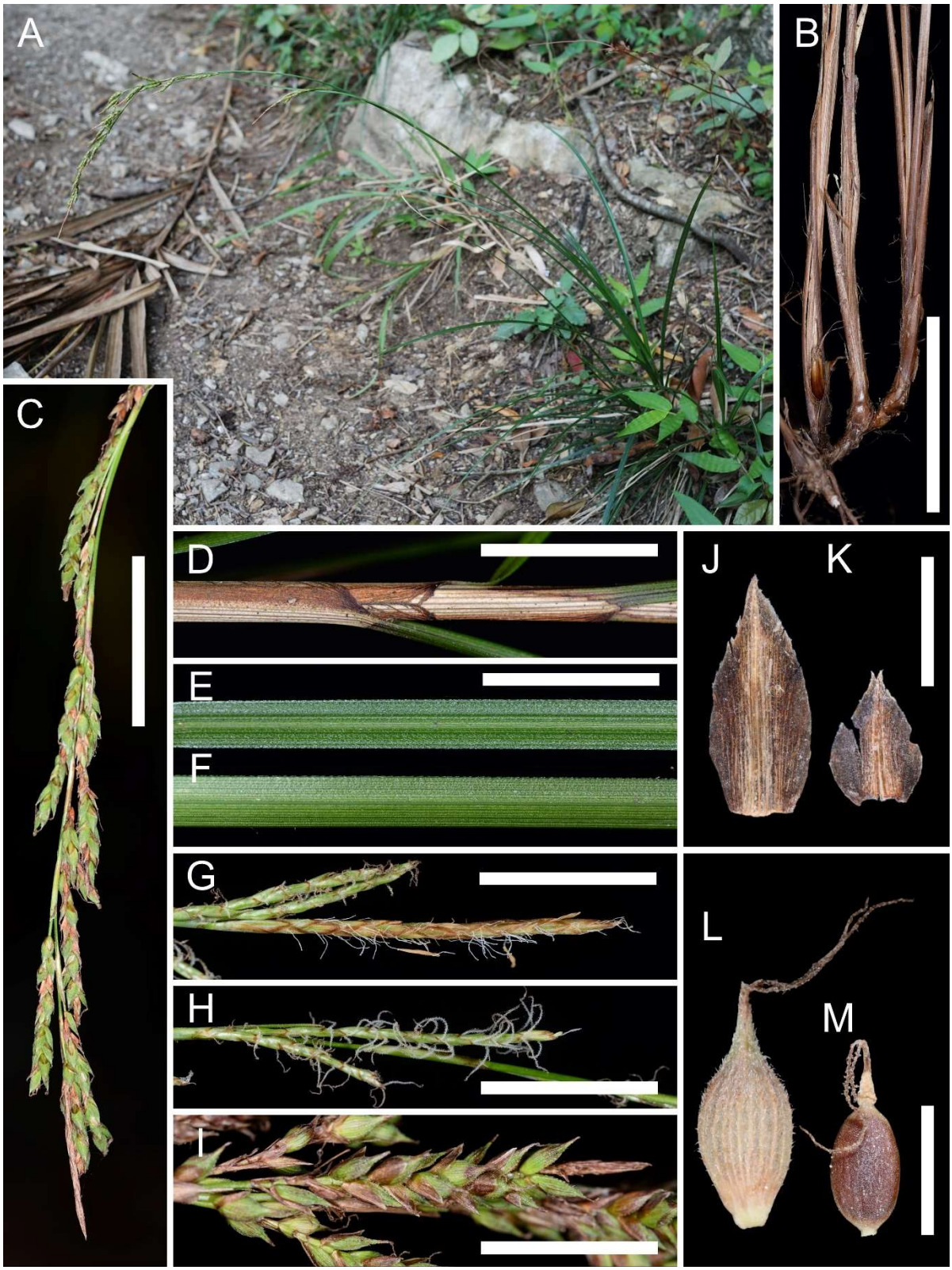

Fig. 5. Morphology of ***Carex mokkwaensis*** Akiyama. A from *Hsu 4166* (TAIF); B–H, J–K & M from *Hsu 12955* (TAIF); I & L from *Hsu 12965* (TAIF). **A.** Habitat and habit. **B.** Rhizome and bladeless sheaths at culm bases. **C.** Infructescence. **D.** Leaf sheaths. **E.** Adaxial surface of leaf blade. **F.** Abaxial surface of leaf blade. **G.** Terminal staminate spike. **H.** Lateral predominantly pistillate spike in flower. **I.** Lateral predominantly pistillate spike in fruit. **J.** Staminate scale. **K.** Pistillate scale. **L.** Dried utricle. **M.** Dried nutlet. Scale bars: B = 5 cm; C = 2 cm; D–I = 1 cm; J–M = 2 mm.

Table 1. Morphological comparison of ***Carex mokkwaensis*** and related taxa. Data of ***C. mokkwaensis*** are based on the present study and Akiyama (1955); data sources of the other species are detailed in Appendix 1.

Characters	*C. mokkwaensis*	*C. autumnalis*	*C. hattoriana*	*C. stipitinux*
Leaf blade width	2–4 mm	2–3 mm	1.5–3.5 mm	4–5 mm
Length of bladeless sheaths at culm base	up to 10 cm	up to 10 cm	up to 2 cm	up to 15 cm
Terminal spike sexuality	staminate	staminate	androgynous	staminate
Pistillate flowers arrangement	dense	lax	dense	dense
Pistillate scale length	2–2.5 mm	1.5–2.5 mm	3–4 mm	ca. 2.5 mm
Utricle length	3.5–4.5 mm	2.5–3 mm	4–5 mm	2.5–3 mm
Hairiness of utricle faces	hispidulous	glabrous or sparsely hispidulous on veins	hispidulous	hispidulous only on upper part around beak
Stigma length	2–3 mm	2–2.5 mm	4–5 mm	1.5–2 mm

smaller pistillate scales, and distinctly shorter stigmas. Instead, this species exhibits a close affinity with *C. autumnalis* Ohwi and *C. stipitinux* C.B. Clarke ex Franch. These taxa share some notable characteristics, including staminate terminal spikes (Fig. 5G), long bladeless sheaths embracing the culm bases (Fig. 5B), and membranous parts of the sheaths that usually disintegrate into reticulate fibers (Fig. 5D). However, *C. mokkwaensis* can still be diagnosed by its relatively large, densely arranged and hispidulous utricles. A detailed comparison of these species is provided in Table 1.

Following the reinstatement of *Carex mokkwaensis*, the occurrence of *C. hattoriana* in Taiwan has also been reappraised. Current data reveal that *C. hattoriana* does not occur on Taiwan Island, as the specimens once cited under this name (e.g., Koyama, 1978) are exclusively misidentifications of *C. mokkwaensis* or other species in sect. *Graciles*. Nonetheless, plants whose morphology generally matches that of *C. hattoriana* from the type locality, the Ogasawara Islands (Tuyama, 1935), can be found on Lanyu Island off the southeastern coast of Taiwan Island (see Appendix 1). Beyond Taiwan, differing opinions regarding the global distribution of *C. hattoriana* still exist (e.g., Koyama, 2010; Hoshino *et al.*, 2020), and further clarification remains necessary.

Carex orthorhyncha T.C. Hsu, ***sp. nov.***

Figs. 6 & S3

Type: TAIWAN. Taitung: Tashuiku, ca. 820 m, 14 June 2022, *T.C. Hsu 14195* (holotype: TAIF [herbarium no.: 548460]; isotypes: TAIF [herbarium no.: 548459]; TNM).

Diagnosis: This new species is morphologically similar to *Carex rhynchophysa* Fisch., C.A. Mey. & Ave-Lall. but distinguished in having 2–3 (vs. 3–7) staminate spikes, slightly thickened persistent style bases, rhomboid (vs. obovoid) utricles, and stiff and erect (vs. slender and flexuous) nutlet appendages.

Description: Herbs perennial, colonial. Rhizomes stoloniferous, 3–5 mm in diam., clothed with brown sheaths; internodes 1–1.5 cm long. Culms central, remote, 40–80 cm tall, triquetrous, smooth, clothed with purple-brown sheaths at base. Leaves longer than culm, up to ca. 150 cm long; blades 7–18 mm wide, glabrous, margin scabrous, inverted W-shaped in cross section, 2 lateral veins distinct, with shortly transverse septate nodes between veins, yellow-green long-sheathed at base. Bracts leaflike, longer than spikes; proximal bract much exceeding inflorescence, 30–70 cm long, base shortly (2–8 mm) sheathed; other bracts much shorter, base usually not sheathed. Spikes 5–7, 1 spike per node; terminal 2–3 spikes staminate, erect, linear-cylindric, 1.5–8 cm long, 3–4 mm in diam., subsessile, 0.5–1 cm apart from each other, 1–3 cm apart from adjacent pistillate spike; remaining 3–4 spikes pistillate (sometimes distal 1–2 spikes androgynous, with 0.3–1.5 cm long staminate zone), ascending or slightly arching, cylindric, 2–6 cm long, 1–1.5 cm in diam., densely many-flowered, sessile at upper spikes, shortly pedunculate at lowermost spike, 1–5(–10) cm apart. Staminate scales lanceolate-oblong, 5–6 mm long, 1.5–2 mm wide, membranous; costa green and rapidly turning brownish, 3–5-veined; sides translucent and rapidly turning pale brownish; margin scarious, sometimes scabrous near apex; apex acuminate, muticous. Pistillate scales ovate, 2.5–3.5 mm long, 1.5–2 mm wide, membranous; costa green and gradually turning pale brown, 3-veined; sides translucent; margin scarious, sometimes scabrous near apex; apex acuminate, muticous. Utricle tightly imbricate, yellowish green (pale yellowish brown when dried), horizontally spreading (distal ones ± obliquely spreading), much surpassing scale, ovoid to ovoid-ellipsoid, inflated, 6–8 mm long, thinly leathery, glabrous, nitid, distinctly 15–20-veined, base rounded, apex abruptly narrowed to a ca. 2 mm long beak, orifice slightly long 2-toothed. Stigmas 3, ca. 3 mm long; style slightly thickened at lower part, persistent, forming a conical-cylindrical stylopodium. Nutlet yellowish brown to reddish brown, loosely enveloped, rhomboid, trigonous, 4–5.5 mm long (body 2.5–3 mm long); angles not constricted; faces rather flat above and below; base cuneate and shortly stipitate; apex attenuate and appendaged; appendage narrow-columnar, obtusely triquetrous, erect, straight, 2–2.5 mm long, slightly dilated at apex when fresh (sometimes obscurely so when dried).

Distribution and ecology: *Carex orthorhyncha* is endemic to Taiwan and currently known from two localities: Hsiaopi (ca. 70 m elev.), Yilan and Tashuiku

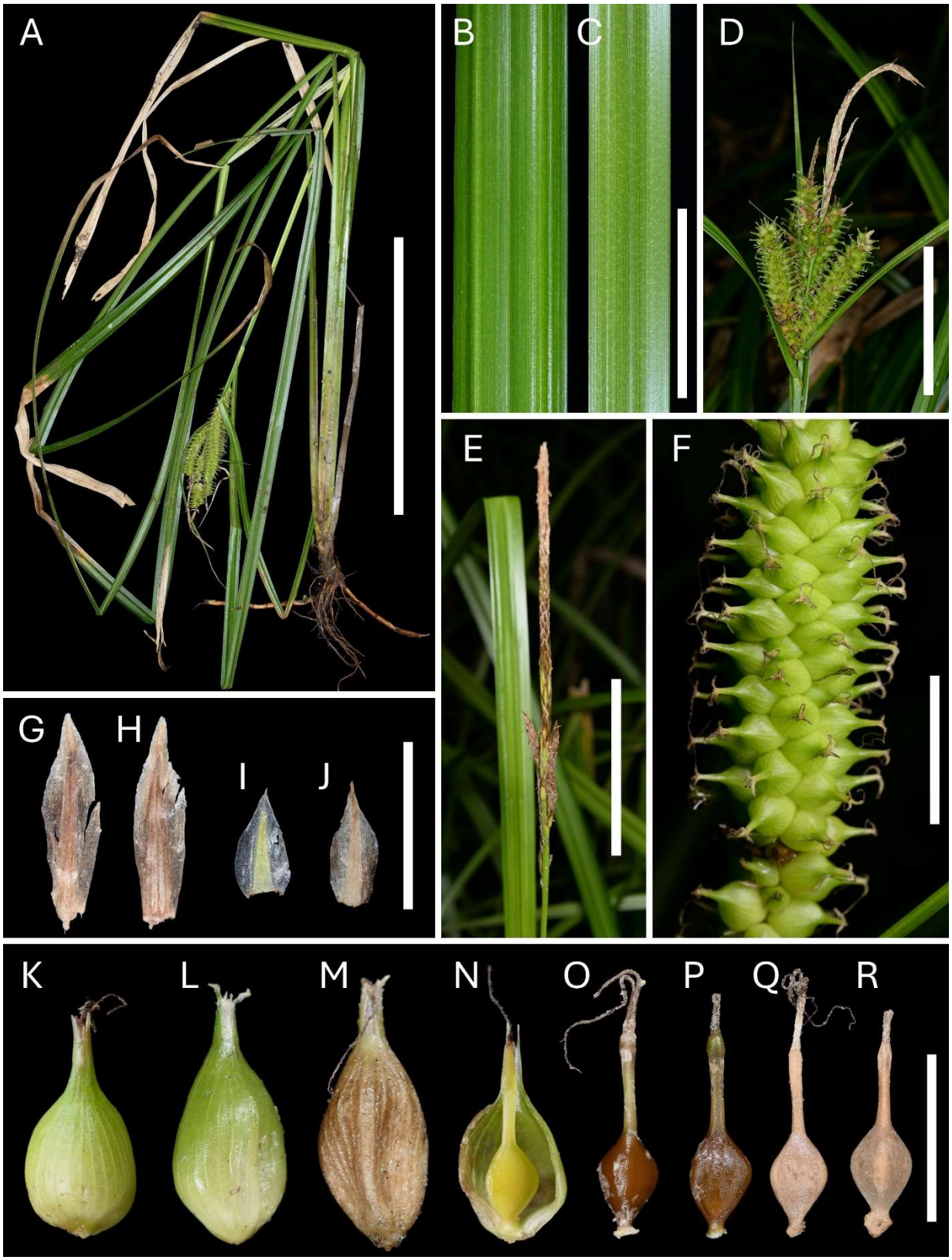

Fig. 6. Morphology of ***Carex orthorhyncha*** T.C. Hsu. A–D, G–J, O & P from *Hsu 14195* (type, TAIF); E–F, K & N from *Hsu 7566* (TAIF); Q–R from *Hsu 16181* (TAIF). **A.** Habit. **B.** Abaxial surface of leaf. **C.** Adaxial surface of leaf. **D.** Infructescence. **E.** Staminate spikes. **F.** Pistillate spike. **G–H.** Staminate scales. **I–J.** Pistillate scales. **K–M.** Utricles. **N.** Opened perigynium. **O–P.** Fresh nutlets. **Q–R.** Dried nutlets. Scale bars: A = 20 cm; B–E = 3 cm; F = 1 cm; G–R = 5 mm.

Table 2. Morphological comparison between ***Carex orthorhyncha*** and related taxa. Data of ***C. orthorhyncha*** are based on the present study; data sources of the other species are detailed in Appendix 1.

Characters	*C. orthorhyncha*	*C. dickinsii*	*C. idzuroei*	*C. rhynchophysa*	*C. vesicaria*
Leaf blade width	7–18 mm	4–10 mm	4–9 mm	8–15 mm	2–8 mm
Staminate spike number	2–3	1	1(–2)	3–7	2–3
Pistillate spike length	2–6 cm	1.5–3 cm	1.5–3 cm	3–10 cm	3–7 cm
Utricle orientation (in middle of spike)	horizontally spreading	horizontally spreading	ascending	horizontally spreading	ascending
Utricle length	6–8 mm	8–10 mm	9–12 mm	6.5–7 mm	4–8 mm
Utricle shape	ovoid to ovoid-ellipsoid, apex abruptly narrowed to a long beak	broadly ovoid to ovoid, apex gradually narrowed to a long beak	oblong-ovoid, apex gradually narrowed to a long beak	ovoid, apex abruptly narrowed to a long beak	oblong-ovoid, apex attenuate to a short beak
Nutlet body length (excluding appendage)	2.5–3 mm	2–3 mm	3.5–4 mm	2–3 mm	2–3 mm
Nutlet shape	rhomboid	rhomboid	obovoid	obovoid	obovoid
Nutlet appendage morphology	stiff and straight	slender and flexuous	stiff and straight	slender and flexuous	slender and flexuous

(ca. 820 m elev.), Taitung. Both habitats are late successional freshwater ponds adjacent to broadleaved forests, with *C. orthorhyncha* plants forming large clumps around the semi-shaded pond edges (Fig. S2). Flowering culms were recorded from March to early April and fruiting culms from April to July.

Etymology: The specific epithet is derived from *orthos*, straight, and *rhynchos*, beak, referring to the characteristic straight nutlet appendage of the new species. The vernacular name is proposed as "直喙薹".

Paratypes: TAIWAN. Yilan: Hsiaopi, ca. 70 m, 5 Jul 2005, *Huang et al. 2153* (HAST; TNM); Shiaupi, 0–50 m, 21 Apr 2002, *Lin 2054* (TAIF); Siaopi, 50–100 m, 12 Apr 2015, *Hsu 7566* (TAIF); same loc., 72 m, 12 Apr 2015, *Hoshino 24136* (TAIF); same loc., 15 Apr 2015, *Chen 6018* (TAIF); same loc., 16 Jul 2019, *Jung 6168* (TAIF); same loc., 27 Apr 2022, *Hsu 14083* (TAIF); same loc., 20 Jun 2025, *Hsu 16181* (TAIF); Tungshan, 21 Apr 2002, *Lin 488* (TAIF). Taitung: Tashuiku, 820 m, 14 Jun 2022, *Hsu 14194* (TAIF).

Notes: This entity was probably first discovered by Chun-Chi Lin (林春吉) in 2000, who later reported it as *Carex dickinsii* Franch. & Sav. (Lin, 2005). It was subsequently referred to as "*Carex* sp." by Hsu and Chung (2017a: 284), and a second population was discovered by the present author in 2022. Field observations and specimen examinations have revealed that the two Taiwanese populations are identical to each other, yet they are readily distinguished from *C. dickinsii* in several features, including leaf width, the number of staminate spikes, spike and utricle lengths, and nutlet appendage morphology. Furthermore, these populations also show morphological similarities to several widespread species within the "Hirta Clade" (Roalson *et al.*, 2021) from temperate northeastern Asia, such as *C. rhynchophysa*, *C. vesicaria* L. and *C. idzuroei* Franch. & Sav., although they do not entirely correspond to any of them. Given that no existing name suitably applies to these Taiwanese materials, they are herein recognized as a novel species. A detailed morphological comparison between *C. orthorhyncha* and allied species is provided in Table 2.

Carex pseudorhynchachaenium T.C. Hsu, ***sp. nov.***

Figs. 7 & S4

Type: TAIWAN. Kaohsiung City: Namasia District, Mt. Kaoting, 1550 m, 17 November 2020, *T.C. Hsu 13136* (holotype: TAIF [herbarium no.: 533936]; isotypes: TAIF [herbarium no.: 551724]; TNM).

Diagnosis: This new species is morphologically similar to *Carex rhynchachaenium* C.B. Clarke but differs in having shorter utricles (3.5–5 vs. 5–6.5 mm) and slightly shorter nutlets (2.8–3.2 vs. 3.5–4 mm) with 0.3–0.6 mm long (vs. 1–1.5 mm long), obconical or bowl-shaped (vs. cylindric) apical appendages.

Description: Herbs perennial, tufted. Rhizome short, clothed with dark brown sheaths and fibers formed by degenerated sheaths. Culms central, slender, erect or ascending, 4–20 cm long, surpassed by tussock. Leaves many, clustered; blades narrowly linear, up to 15–40 cm long, 1.5–3 mm wide, apex long tapering, adaxial surface and margin minutely scabrous; sheaths 1–2 cm long, yellowish brown, glabrous, with dark reddish brown veins. Bracts sheathed; blades of proximal 1 or 2 bracts leaflike, much surpassing inflorescence, up to 10–20 cm long; blades of distal bracts bristle-like, usually shorter than subtending spikes; sheaths 3–8 mm long, scabrous. Spikes 3–4 (occasionally with 1 or 2 additional spikes arising from culm base), 1 spike per node, suberect; terminal spike staminate, linear, 1–3 cm long, ca. 1 mm in diam., 0.4–3 cm apart from adjacent spike; lateral spikes androgynous or pistillate, shortly cylindric, 1–2(–4) cm long, 3–5 mm in diam. when fruiting, peduncles 0.3–1.5 cm (sometimes up to 3–5 cm in proximal spikes); staminate zone usually much shorter than pistillate zone if present; pistillate zone laxly spirally 3–9-flowered. Staminate scales ovate-elliptic, membranous, 2.5–3 mm long, 1.5–2 mm wide; costa green, 1-veined; sides translucent and gradually turning pale stramineous, slenderly many-veined; apex obtuse or rounded, muticous, minutely erose. Pistillate scales ovate, membranous, 2.5–3 mm long, 1.5–2 mm wide; costa green, 3-veined; sides

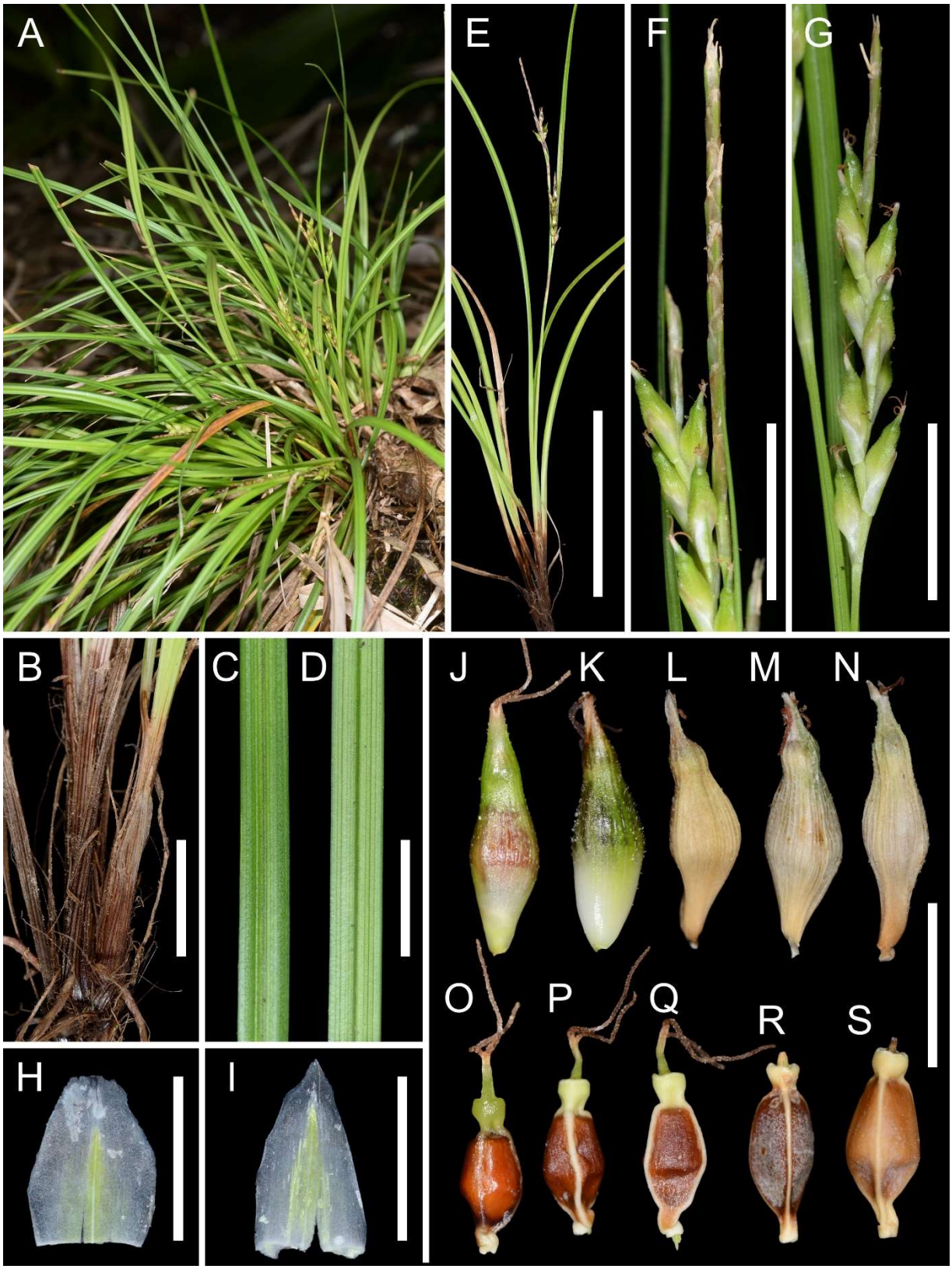

Fig. 7. Morphology of ***Carex pseudorhynchachaenium*** T.C. Hsu. A from *Hsu 8197* (TAIF); B–K, M & O–Q from *Hsu 13136* (type, TAIF); L & S from *Hsu 8450* (TAIF); N & R from *Hsu 2753* (TAIF). **A.** Habits. **B.** Plant base. **C.** Leaf blade, adaxial side. **D.** Leaf blade, abaxial side. **E.** Culm. **F.** Terminal staminate spike. **G.** Lateral androgynous spike. **H.** Staminate scale. **I.** Pistillate scale. **J–K.** Fresh utricles. **L–N.** Dried utricles. **O.** Fresh nutlet. **P–S.** Dried nutlets. Scale bars: B–D & F–G = 1 cm; E = 5 cm; H–S = 3 mm.

translucent and gradually turning pale stramineous, slenderly many-veined; apex acute or obtuse, muticous, entire. Utricle suberect, fusiform-lageniform, with weak constriction above middle, much surpassing scales, 3.5–5 mm long, 1.2–1.5 mm wide, obtusely trigonous, membranous, minutely pubescent except for base, slenderly many-veined, base cuneate or shortly stipitate, apex gradually narrowed to an erect short beak, orifice shallowly bidentate. Style ca. 1 mm long, base thickened and persistent; stigmas 3, ca. 1.5 mm long, caducous. Nutlet tightly enveloped, ovate-rhomboid, 2.8–3.3 mm long, trigonous; angles not constricted; faces concave below, flat or slightly convex above; base cuneate and shortly stipitate; apex obtuse, slightly contracted and appendaged; stipe ca. 0.3 mm long, slightly curled; appendage obconical or bowl-shaped, 0.3–0.6 mm long, ca. 0.5 mm in diam., concave at top when dried.

Paratypes: Nantou: Mt. Shuishe, 1600–2000 m, 17 Jun 2010, *Hsu 2833*; *Hsu 2835* (TAIF). Yunlin: Mt. Shihpi, ca. 1600 m, 21 Jul 2009, *Hsu 2253* (TAIF); same loc., 1400–1700 m, 6 May 2010, *Hsu 2753* (TAIF). Chiayi: Province Road #18, ca. 1700 m, 28 Oct 2000, *Leong 2125* (HAST); Shihcho to Shihtzulu, 1400–1500 m, 8 Jan 2016, *Hsu 8197* (TAIF); same loc., 1400–1600 m, 10 May 2016, *Hsu 8450*; *8451* (TAIF); same loc., 31 Jan 2026, *Hsu 16580* (TAIF); Kaohsiung: Mt. Kaoting, ca. 1550 m, 21 Nov 2021, *Hsu 13740* (TAIF).

Distribution and ecology: *Carex pseudorhynchachaenium* is endemic to Taiwan (Nantou, Yunlin, Chiayi and Kaohsiung). It is distributed in central and southwestern mountainous regions at 1400–1700 m elev., usually growing on semi-shaded slopes under broadleaved forests and sometimes in bamboo forests. Flowering and fruiting culms were observed from May to January.

Etymology: This species is named for its morphological similarity with *Carex rhynchachaenium*. The vernacular name is given as "擬喙果薹", following Hsu and Chung (2017a).

Notes: This new species was first introduced by Hsu and Chung (2017a) as "*Carex* sp." and is formally described herein. It could be placed in sect. *Lageniformes* or sect. *Mitratae* under traditional systems (Dai *et al.*, 2010; Hoshino *et al.*, 2020). Given its close morphological resemblance to *C. rhynchachaenium*, it presumably belongs to the "Truncatigluma Clade" in the latest phylogenetic framework (Roalson *et al.*, 2021). In gross appearance, the new species is mainly distinguished from *C. rhynchachaenium* by its generally more exposed culms (Fig. 7A & E) and slightly longer utricles (Fig. S4A–J). However, its short-obconical or bowl-shaped nutlet appendage (Fig. 7O–S & S4P–T) is definitively distinct from that of *C. rhynchachaenium*, which is characterized by an elongate, cylindrical nutlet appendage (Kern and Nooteboom, 1979; Koyama *et al.*, 2000; Katsuyama, 2006; Dai *et al.*, 2010; Fig. S4K–O). This diagnostic difference in nutlet structure remains stable and consistent across all examined specimens (Appendix 1). Furthermore, *C. rhynchachaenium* inhabits lower mountainous regions (100–1400 m elevation) in Taiwan, and the two species have not been observed growing sympatrically.

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