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First record of *Myriophyllum oguraense* Miki (Haloragaceae) in Korea

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한반도 미기록식물: 긴동아물수세미

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ABSTRACT: Here we report a previously unrecorded species of Korean *Myriophyllum* L. (Haloragaceae). This taxon, *M. oguraense* Miki has been regarded as a Japanese endemic for some 60 years. *Myriophyllum oguraense* and its closely related *M. verticillatum* L. share the characteristic of having pectinate emergent leaves that are similar in shape to, but much smaller than, the submerged leaves. However, the primary characteristic that differentiates these taxa is the turion shape (club shaped in *M. verticillatum* and linear in *M. oguraense*). The common name, 'Gin-dong-a-mul-su-sae-mi' was also newly given considering its characteristic turion shape. Photographs and a key to Korean *Myriophyllum* species are provided in addition to complete descriptions including information on nomenclatural types, distributions and specimens examined.

Keywords: Haloragaceae, *Myriophyllum oguraense*, new record, Korea

적 요: 물수세미속(개미탑과) 1분류군을 국내 미기록종으로 보고한다. 이 분류군은 지금까지 일본에만 분포하는 것으로 알려졌던 *Myriophyllum oguraense* Miki로서, 근연종인 물수세미(*M. verticillatum* L.)와 같이 공기 중에서 발달된 잎이 빗살모양으로 갈라져 있으나 물 속에 잠겨있는 잎의 크기가 훨씬 작다. 무엇보다 동아가 곤봉 모양으로 발달하는 물수세미에 비해 얇고 가느다란 선모양의 동아를 지님으로서 뚜렷이 구분된다. 새로운 국명 역시 이러한 동아의 특징을 고려해 '긴동아물수세미'로 신칭하였다. 한국산 물수세미속 분류군의 검색키와 더불어 긴동아물수세미에 대한 생육지사진, 형태적 특징, 기준표본 정보, 국내 분포현황 및 관찰표본 목록을 제시하였다.

주요어: *Myriophyllum oguraense* 개미탑과, 긴동아물수세미, 미기록종, 한국

The genus *Myriophyllum* L. (Haloragaceae R. Br.) is among the most species-rich (ca. 68 species) of the aquatic core-eudicots (Moody and Les, 2010). These "watermilfoils" have a worldwide distribution (except Antarctica) with a center of diversity in Australia (42 spp.; 37 endemic) (Moody and Les, 2010). Among them, three species of *M. verticillatum* L., *M. spictatum* L., and *M. ussuriense* (Regel) Maxim. have been known from Korea up to date (Choi, 2007; Korea National Arboretum and The Korean Society of Plant Taxonomists, 2007).

In the present study, we report another uncertain taxon of Korean *Myriophyllum* as a previously unrecorded species. This taxon, *Myriophyllum oguraense* Miki has been regarded as a Japanese endemic for some 60 years (Miki, 1934; Kadono, 1994). Yu et al. (2002) newly reported this species as native from NE China and in the Chang Jian River basin (lower Yangtze valley). However, the previously reported record from NE china had proved to be a misidentification of herbarium specimens, the correct identity of which was *M. verticillatum*

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(Wang and Yu, 2007). In addition, the individuals collected from the lower Yangtze valley of China were newly described as *M. oguraense* subsp. *yangtzense* D. Wang by fruit morphology (Wang and Yu, 2007). This record of *M. oguraense* subsp. *oguraense* in Korea confirms a wider distribution in sympatry with its sister species, *M. verticillatum*, found at the limits of its range in Korea (Fig. 2) and Japan (Wang and Yu, 2007).

Taxonomic treatment

***Myriophyllum oguraense* Miki,** Bot. Mag. (Tokyo) 48: 335, 1934. Type: Japan, Honshu, Prov. Yamashiro (Kyoto Prefecture), Lake Ogura, 5 December 1925, *Miki s.n.* (lectotype: OSA!, isolectotypes: OSA!, designated by Shin et al., 2007). (Fig. 1).

Description: Monoecious submerged herbs, perennial. Stems branched mainly at base, 10-150 cm long, 1-2 mm in diameter, upper part usually emergent. Leaves dimorphic. Submerged leaves in whorls of 4(-5), green, ovate to suborbicular in outline, 2.0-5.5 cm long, 2.0-5.3 cm wide, pectinate with 9-13 filiform pinnae; pinnae 0.6-3.0 cm long. Emergent leaves glaucous, light bluish-green, in whorls of 4(-5), oblanceolate in outline, 4.5-9.0 mm long, 1.3-2.5 mm wide, pectinate with 7-10 tightly congested pinnae; pinnae linear-subulate, very shortly apiculate at apex. Inflorescence a simple spike, 2.0-8.0 cm long, with unisexual flowers borne in axils of upper leaves; flower in whorls of 4(-5), upper ones staminate, lower ones pistillate. Bracts leaflike, trifid to pectinate with 2 or 3 pinnae. Staminate flowers 4-merous, sessile; sepals 4, green, deltoid, 0.5-0.7 mm long, 0.4-0.5 mm wide; petals 4, white to pale green, 1.7-2.5 mm long,

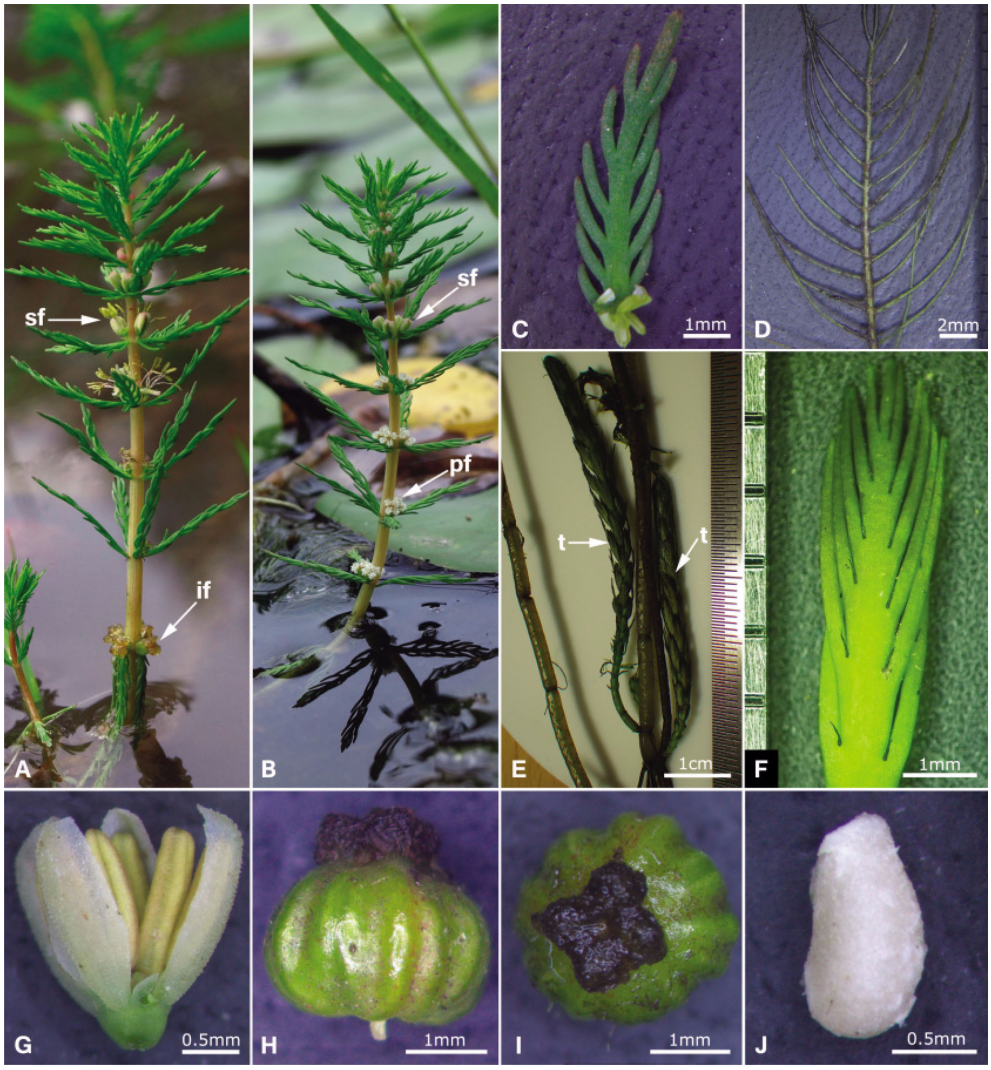

Fig. 1. *Myriophyllum oguraense* Miki from Korea. A, B. Habit (sf: staminate flower, pf: pistillate flower, if: immature fruit); C. Emergent leaf; D. Submerged leaf; E. Turion (t); F. Leaf of turion; G. Staminate flower; H, I. Fruit (H: side view, I: top view); J. Seed.

0.7-1.1 mm wide, hooded, weakly keeled at base; stamen 8; filaments elongating to 1.0-1.5 mm long at anthesis; anthers linear-oblong, yellow, 1.3-1.7 mm long, 0.2-0.4 mm wide; styles 4, vestigial. Pistillate flowers 4-merous, sessile; sepals 4, green, deltoid, 0.4-0.6 mm long, 0.3-0.5 mm wide; petals 4, white, 0.4-0.6 mm long, 0.3-0.4 mm wide, slightly hooded, weakly keeled at base; styles 4, short; stigmas shortly fimbriate, white, pinkish after anthesis; ovary 4-locular. Fruit sessile, green to olive brown, widely ovoid to subglobose, 2.8-3.1 mm long, 2.8-3.0 mm wide; styles persistent; mericarp separating readily at maturity, with 2 longitudinal smooth ridges abaxially. Flowering and fruiting from May to October. Turions (vegetative overwintering buds) formed from late autumn to early winter, linear, 2.5-7.0 cm long, densely covered with reduced, short submerged leaves.

Korean name: Gin-dong-a-mul-su-sae-mi 긴동아물수세미

Distribution and habitat: Japan (Tohoku; Kanto; Chubu; Kinki; Chugoku; Shikoku; Kyushu) and Korea (Gyeongnam: Changwon, Hapcheon; Daegu; Fig. 2). In ponds (It grows in abundance in favorable habitats).

Specimens examined: KOREA: Gyeongnam - Toechon-sansoryugi, Changwon-si, 30 August 2012, *H. J. Choi & T. Shiga 120001* (Changwon National University); Toechonsansoryugi, Changwon-si, 2 November 2012, *H. J. Choi 120002* (Changwon National University), Necheonsryugi, Hapcheon-gun, 10 November 2012, *H. J. Choi 130001*(Changwon National University). Gyeongbuk - Bisan-dong, Daegu, 17 August 1934, *S. Owari s.n.* (OSA). **JAPAN:** Tohoku - Akayuyachi, Yamagata Prefecture, 16 October 1927, *S. Miki s.n.* (OSA). Kanto - Namegata-shi, Ibaraki Prefecture, August 1931, *Y. Tsurumachi s.n.* (OSA). Chubu - Sasakami-mura, Niigata Prefecture, 12 October 2002, *T. Shiga 3326*; Joetsu-shi, Niigata Prefecture, 22 July 2001, *T. Shiga 2938* (OSA); Joetsu-shi, Niigata Prefecture, 20 November 2001, *T. Shiga 2878* (OSA); Joetsu-shi, Niigata Prefecture, 11 October 2002, *T. Shiga 3321* (OSA); Takaoka-shi, Toyama Prefecture, 19 August 1933, *T. Otaya s.n.* (OSA); Iiyama-shi, Nagano Prefecture, 8 July 1933, *S. Maruyama s.n.* (OSA); Kakamigahara-shi, Gifu Prefecture, 2 September 1934, *S. Kawata s.n.* (OSA). Kinki - Kaya in Omatsu, Shiga Prefecture, 14 September 1927, *S. Miki s.n.* (OSA); Kaya in Omatsu, Shiga Prefecture, 13 November 1932, *S. Miki s.n.* (syntype: OSA); Kaya in Omatsu, Shiga Prefecture, 20 August 1933, *S. Miki s.n.* (OSA); Lake Ogura, Kyoto Prefecture, 24 September 1922, *S. Miki s.n.* (syntype: OSA); Lake Ogura, Kyoto Prefecture, 28 May 1923, *S. Miki s.n.* (syntype: OSA); Lake Ogura, Kyoto Prefecture, 7 July 1923, *S. Miki s.n.* (syntype: OSA); Lake Ogura, Kyoto Prefecture, 29 October 1923, *S. Miki s.n.* (syntype: OSA); Lake Ogura, Kyoto Prefecture, 4 November 1925, *S. Miki s.n.* (syntype: OSA); Lake Ogura, Kyoto Prefecture, 10 November 1925, *S. Miki s.n.* (syntype: OSA); Lake Ogura, Kyoto Prefecture, 27 November 1925, *S. Miki s.n.* (syntype: OSA); Lake Ogura, Kyoto Prefecture, 2 December 1925, *S. Miki s.n.* (syntype: OSA); Lake Ogura, Kyoto Prefecture, 5 December 1925, *S. Miki s.n.* (syntype: OSA); Lake Ogura, Kyoto Prefecture, 21 December 1925, *S. Miki s.n.* (syntype: OSA); Lake Ogura, Kyoto Prefecture, 3 July 1926, *S. Miki s.n.* (syntype: OSA); Lake Ogura, Kyoto Prefecture, 2 August 1926, *S. Miki s.n.* (syntype: OSA); Lake Ogura, Kyoto Prefecture, 2 September 1926, *S. Miki s.n.* (syntype: OSA); Lake Ogura, Kyoto Prefecture, 21 September 1926, *S. Miki s.n.* (syntype: OSA); Lake Ogura, Kyoto Prefecture, 6 July 1927, *S. Miki s.n.* (syntype: OSA); Pond Takaragaike, Kyoto Prefecture, 8 November 1925, *S. Miki s.n.* (OSA); Pond Takaragaike, Kyoto Prefecture, 9 November 1925, *S. Miki s.n.* (syntype: OSA); Pond Takaragaike, Kyoto Prefecture, 11 Augusut 1926, *S. Miki s.n.* (OSA); Pond Takaragaike, Kyoto Prefecture, 2 September 1926, *S. Miki s.n.* (OSA); Pond Takaragaike, Kyoto Prefecture, 10 November 1935, *S. Miki s.n.* (OSA); Pond Midorogaike, Kyoto Prefecture, 21 September 1923, *S. Miki s.n.* (OSA); Pond Midorogaike, Kyoto Prefecture, 7 July 1925, *S. Miki s.n.* (OSA); Pond Midorogaike, Kyoto Prefecture, 9 September 1925, *S. Miki s.n.* (OSA); Pond Midorogaike, Kyoto Prefecture, 20 September 1927, *S. Miki s.n.* (OSA); Kyoto-shi, Kyoto Prefecture, 27 October 1933, *S. Miki*

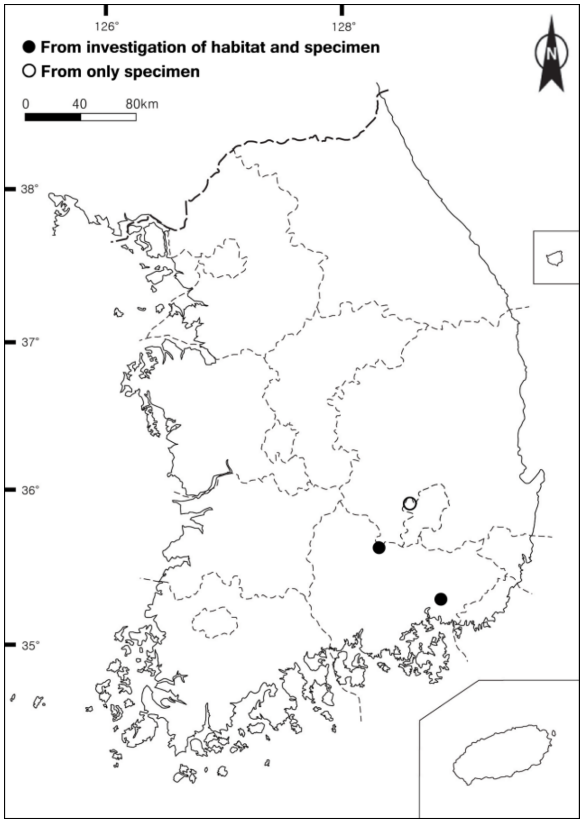

Fig. 2. Distribution of *Myriophyllum oguraense* Miki in Korea.

s.n. (OSA); Toyonaka-shi, Osaka Prefecture, 19 July 1933, *N. Ui s.n.* (OSA); Toyonaka-shi, Osaka Prefecture, 29 July 1933, *N. Ui s.n.* (OSA); Hirakata-shi, Osaka Prefecture, 7 July 2008, *M. Kimura M01836* (OSA); Akashi-shi, Hyogo Prefecture, 28 October 1935, *S. Miki s.n.* (OSA); Nara-shi, Nara Prefecture, 27 October 1934, *S. Miki s.n.* (OSA). Chugoku - Saeki-cho, Okayama Prefecture, 3 October 2002, *T. Shiga* 3276 (OSA); Higashihiroshima-shi, Hiroshima Prefecture, 22 September 2013, *T. Shiga 7546*, *7548*, *7631-7634* (Niigata University). Shikoku - Ayagawa-cho, Kagawa Prefecture, 14 September 2001, *T. Shiga 3024-3025* (OSA); Higashikagawa-shi, Kagawa Prefecture, 14 September 2001, *T. Shiga 3026* (OSA).

Note: *Myriophyllum oguraense* and its closely related *M. verticillatum* share the characteristic of having pectinate emergent leaves that are similar in shape to, but much smaller than, the submerged leaves. However, the primary characteristic that differentiate these taxa is the turion shape (club shaped in *M. verticillatum* and linear in *M. oguraense*; Fig. 1E; Weber and Nooden, 1974; Kadono, 1988; Wang and Yu, 2007). *Myriophyllum oguraense* subsp. *yangtzens* was described as a Chinese endemic subspecies on the basis of its distinguishing bigger fruits (3.0-3.5 mm long, 2.9-3.4 mm wide) than subsp. *oguraense* and 2 longitudinal abaxial ridges on mericarp (*vs.* smooth in subsp. *oguraense*) (Wang and Yu, 2007). Nevertheless, all taxonomic observations of subsp. *yangtzens* (Wang and Yu, 2007) are overlapping (included in) the variation of subsp. *oguraense*, and we could not find any diagnostic character of the taxon in this study. Our re-examination of Japanese subsp. *oguraense* confirmed the mature fruits have clearly two longitudinal ridges on each mericarp as indicated in Fig. 1H, I and Miki (1937). Thus we propose the possibility of subsp. *yangtzens* as a synonym of *M. oguraense*. In this case, this species is distributed from Japan to lower Yangtze valley of China passing through Korea.

Key to *Myriophyllum* species in Korea.

1. Emergent leaves subtending flowers much reduced to 1.0-1.5 mm long, elliptic to narrowly oblong, sometimes spathulate or linear bracts; turions absent
   ..... *M. spicatum* 이삭물수세미
1. Emergent leaves not reduced to bracts; turions present in winter
   2. Plants dioecious (rarely monoecious); leaves distinctly dimorphic (submerged leaves pinnately compound, emergent leaves usually linear or lanceolate), 3 or 4 in a whorl; submerged leaves 1.5-2.5 cm long
      ..... *M. ussuriense* 선물수세미
   2. Plants monoecious (rarely dioecious); leaves not dimorphic (submerged and emergent leaves similarly pinnately compound), 4-6 in a whorl; submerged leaves 2.0-6.0 cm long
      3. Emergent leaves light- to dark-green; turions club shaped, 1.0-3.0 cm long, densely covered with many submerged leaves; bracts pectinate or absent
         ..... *M. verticillatum* 물수세미
      3. Emergent leaves glaucous or light bluish-green; turions linear, 2.0-7.0 cm long, densely covered with reduced, short submerged leaves; bracts tripid to pectinate
         ..... ***M. oguraense* 긴동아물수세미**

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