

## Newly recorded aquatic plants from Myanmar

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**Abstract** In an expedition to study the aquatic flora of Myanmar, two noteworthy aquatic plants were collected. The first is *Sagittaria* sp. (Alismataceae), which is considered to differ from any previously described taxa in terms of having bulbils on the cylindrical organ and other vegetative characters. The second is *Najas malesiana* (Hydrocharitaceae), which have not previously been reported in Myanmar.

**Key words** : aquatic plant, Myanmar, *Najas*, *Sagittaria*.

Myanmar covers the northeast of the Indo–Burma (Myanmar) biodiversity hotspot, where abundant and significant biodiversity can be found (van Dijk *et al.*, 2004). Kress *et al.* (2003) reported ca. 11,800 spermatophyte species of Myanmar as a checklist. However, many new or newly recorded plant species have since been reported (Tanaka Nb. *et al.*, 2007; Tanaka Nb. *et al.*, 2010; Peng *et al.*, 2014; Tanaka Nb. *et al.*, 2015), so it appears that some of the plant diversity of this area has not yet been revealed.

We attempted to establish an inventory of the aquatic vascular plants at Kachin State, Mandalay State, Sagaing State, and Yangon State in Myanmar in December 2016. In a field expedition, 113 samples, consisting of around 40 genera and 30 families, were collected. Among them, in this paper we report two noteworthy species: *Sagittaria* sp. (Alismataceae) and *Najas malesiana* (Hydrocharitaceae).

### ALISMATACEAE

*Sagittaria* sp.

The plants collected from Sagaing State,

Myanmar, are likely to be a new species. The plants inhabited the edge of a small pond. All mature leaves are emergent, the leaf blade is sagittate, and the lateral lobe is acuminate with an obtuse tip, and it produces many bulbils (Fig. 1A–C). These morphological characters are similar to those of *Sagittaria aginashi* Makino, which has only been found in Japan and the Korean Peninsula (Tanaka Nr., 2015). Their bulbils are conical ellipsoid and about 5 mm in length, which common to both; however, they differ from each other in the position of the bulbils, in that the bulbils are enclosed by the sheaths in *S. aginashi* but arranged around the cylindrical organ, 45–55 mm in length and ca. 4 mm in wide, standing out from the base of leaves, in the newly discovered *Sagittaria* sp.

The *Sagittaria* species previously reported in Myanmar are *S. sagittifolia*, *S. guayanensis* (Kress *et al.*, 2003), and *S. trifolia* (Ito and Barfod, 2014). *S. sagittifolia* is generally recognized as a synonym of *S. trifolia* (Wang *et al.*, 2010) and *S. guayanensis* has no emerging leaves. As a result, in the Asian *Sagittaria* species, the only three species have common characters to the col-

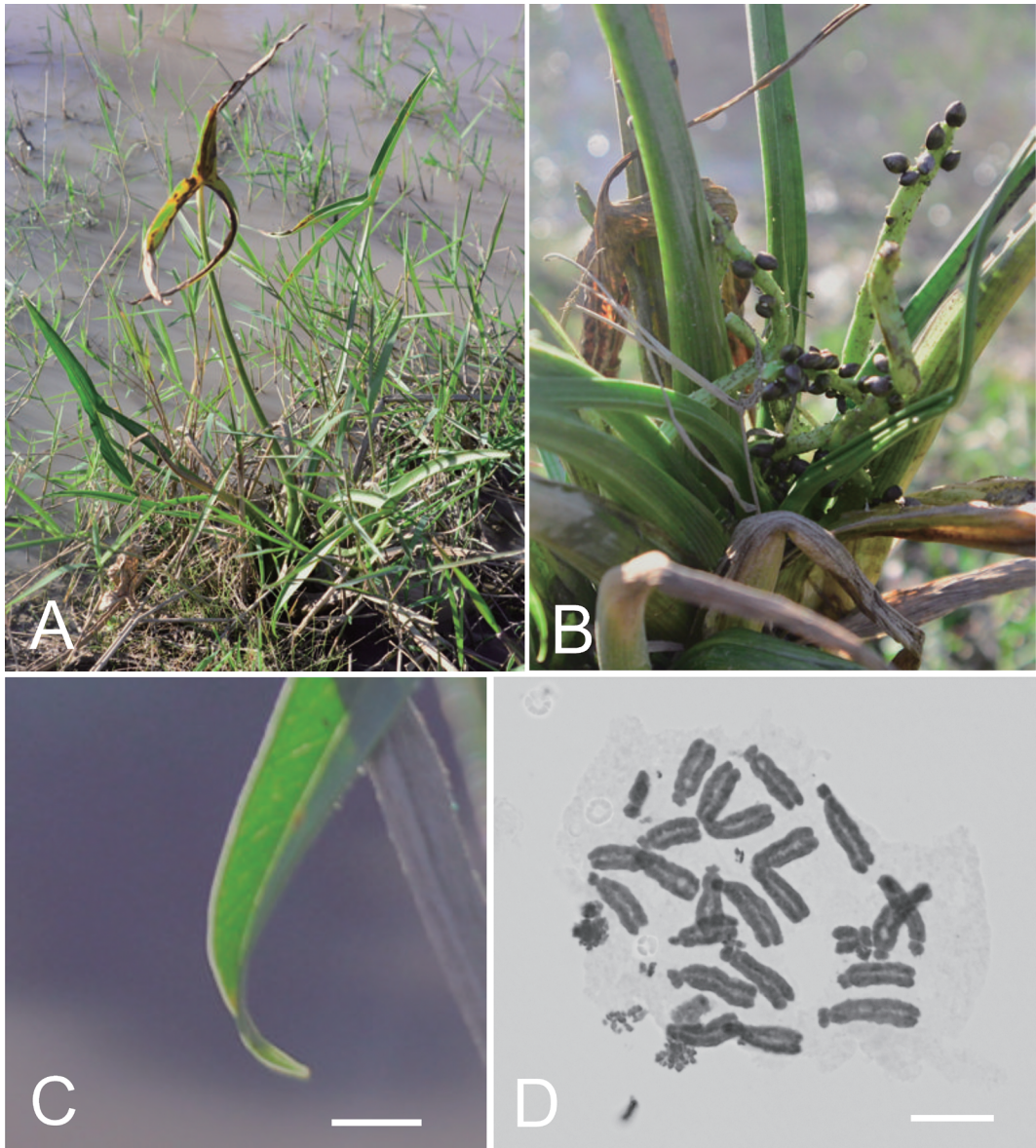


Fig. 1. *Sagittaria* sp. A. Whole plant in the habitat of Sagaing State, Myanmar. B. Cylindrical organs with bulbils. Scale bar = 10 mm. C. Obtuse tip of lateral lobe. Scale bar = 5 mm. D. Somatic metaphase chromosome ( $2X = 22 = 2m + 18t + 2st$ ). Scale bar =  $10\mu\text{m}$ .

lected plants, i.e. life forms are emergent and leaf blades are sagittate (Rataj, 1972; Cook, 1996; Haynes, 2001; Yang *et al.*, 2001; Wang *et al.*, 2010; Tanaka *Nr.*, 2015). Among them, *S. trifolia*, which is widely distributed throughout Asia, has no bulbils and the lateral lobe is acuminate with a needlelike tip; *S. potamogetonifolia*,

which is known to exist in Southern China, has no bulbils and the tip of the lobe is described as acuminate; and *S. lichuanensis*, which is known to exist in Southern China, has bulbils enclosed by sheaths (Liu *et al.*, 2010) and the tip of lobe is like that of *S. potamogetonifolia* (Wang *et al.*, 2010). In this study, the reproductive characters

cannot be discussed because the collected plants have no flowers or fruits. However, the cylindrical organ with bulbils, although its embryologic origin is not clear, is a unique character of the collected plants not only among Asian *Sagittaria*, but also in the whole genus. Therefore, the plant collected in this study is considered to differ from any previously described taxa.

Niitsu *et al.* (2004) reported that *Sagittaria* sp., named "Siam Aginashi" in Japanese, was collected from northern Thailand, which is similar to *S. aginashi* in terms of having bulbils inside the leaf sheaths. In that report, the chromosome number and karyotype of *Sagittaria* sp. "Siam Aginashi" were reported as  $2n = 2X = 22 = 2m + 18t + 2st$  ( $2m + 18sm + 2st$ ) from Pantong Palace, and  $2n = 3X = 33$  ( $3m + 4sm + 6st + 20t$ ) from Huai Pu Ling. In the present study, karyomorphological observation was undertaken on the somatic chromosomes of the collected plant using the root tips. The methods used for chromosome observation followed the work of Yano *et al.* (2016) and, for the chromosome forms, followed the work of Levan *et al.* (1964). The chro-

sosome number and chromosome forms of the collected plant in this study were observed to be as follows:  $2n = 2X = 22 = 2m + 18t + 2st$  (Fig. 1D, Table 1), confirming a previous report from Pantong Palace, northern Thailand (Niitsu *et al.* 2004). Further observation of the reproductive characters and DNA analysis on the plant should provide new insights with a view to describing it as a new taxon.

Voucher specimen: MYANMAR. Sagaing State; road side from Indawlay Lake to Mohnyin,  $24^{\circ}25'53''N$ ,  $96^{\circ}11'03''E$ , on wet sandy mud at the edge of small river, December 10, 2016, Nr. Tanaka *et al.* MY1871 (RAF, TNS).

## HYDROCHARITACEAE

*Najas malesiana* W. J. de Wilde, *Acta Bot. Neerl.* 10: 168 (1961)

This species is found for the first time in Myanmar. The specimens are similar to *Najas graminea* Delile. However, they have the following diagnostic features: small seed, 1.0–1.3 mm in long diameter, the testa is pitted with tetrago-

Table 1. Measurements of somatic metaphase chromosomes of *Sagittaria* sp. Chromosome forms were classified by arm ratio (long arm length/short arm length) following Levan *et al.* (1964): m = metacentric (1.0 to 1.7), sm = submetacentric (1.7 to 3.0), t = telocentric (more than 7.0)

Chromosome	Long arm ( $\mu\text{m}$ )	Short arm ( $\mu\text{m}$ )	Chromosome length ( $\mu\text{m}$ )	Relative length (%)	Arm ratio	Form
1	8.57	8.57	17.14	7.96	1.0	m
2	8.57	8.57	17.14	7.96	1.0	m
3	9.52	0.95	10.48	4.86	10.0	t
4	9.52	0.95	10.48	4.86	10.0	t
5	9.05	0.95	10.00	4.64	9.5	t
6	8.10	0.86	8.95	4.16	9.4	t
7	8.10	0.95	9.05	4.20	8.5	t
8	8.10	0.95	9.05	4.20	8.5	t
9	7.62	0.95	8.57	3.98	8.0	t
10	7.62	0.95	8.57	3.98	8.0	t
11	7.14	0.95	8.10	3.76	7.5	t
12	7.14	0.95	8.10	3.76	7.5	t
13	7.14	0.95	8.10	3.76	7.5	t
14	7.14	0.95	8.10	3.76	7.5	t
15	10.48	1.43	11.90	5.53	7.3	t
16	10.00	1.43	11.43	5.31	7.0	t
17	10.00	1.43	11.43	5.31	7.0	t
18	10.00	1.43	11.43	5.31	7.0	t
19	7.62	1.10	8.71	4.05	7.0	t
20	8.33	1.19	9.52	4.42	7.0	t
21	3.81	1.43	5.24	2.43	2.7	sm
22	2.86	1.05	3.90	1.81	2.7	sm



Fig. 2. *Najas malesiana*. A. Part of the plant. Scale bar = 10 mm. B. Seed. Scale bar = 0.25 mm.

nal to pentagonal areoles, and the leaf is filamentous, 0.5 mm wide, with about 20 teeth per side (Fig. 2). Based on these characters, the specimens are determined as *N. malesiana*.

Among the 35 *Najas* species, *N. graminea*, *N. indica*, *N. kingii*, *N. marina*, and *N. tenuis* were previously reported (Kress *et al.*, 2003; Ito and Barfod, 2014; Kress *et al.*, 2003). The genus *Najas* of Myanmar is composed of species widely distributed in the Old World, such as *N. graminea* and *N. marina*, and species widely distributed in the Asian tropics, such as *N. indica*, *N. kingii*, and *N. malesiana*.

Voucher specimen: MYANMAR. Mandaley State: pond on the southwest of Forest Research Institute, Forest Department, Yezin, Nay Pyi Taw, 19°50'31"N, 96°16'39"E, on sandy mud, 5 cm depth, December 13, 2016, Nr. Tanaka *et al.* MY1885 (RAF, TNS).

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