

New Localities of Seed Plants Recorded from the Subtropical Ryukyus of Japan at Island Level Based on Herbarium Data

Goro Kokubugata^{1,*}, Atsushi Ebihara¹, Yukiko Saito², Masaharu Amano³, Atsushi Abe³, Koh Nakamura⁴, Akiyo Naiki⁵, Tadashi Kajita⁵ and Masatsugu Yokota⁶

¹ Department of Botany, National Museum of Nature and Science,
4–1–1 Amakubo, Tsukuba, Ibaraki 305–0005, Japan

² Department of Science Education, Faculty of Education, University of the Ryukyus,
Nishihara, Okinawa 903–0213, Japan

³ Okinawa Churashima Research Center, Okinawa Churashima Foundation,
888 Ishikawa, Motobu, Okinawa 905–0206, Japan

⁴ Botanic Garden, Field Science Center for Northern Biosphere, Hokkaido University,
3–8 Chuo-ku, Sapporo 060–0003, Japan

⁵ Iriomote Station, Tropical Biosphere Research Center, University of the Ryukyus,
870 Uehara, Yaeyama, Taketomi, Okinawa 907–1541, Japan

⁶ Laboratory of Ecology and Systematics, Faculty of Science, University of the Ryukyus,
1 Senbaru, Nishihara, Okinawa 903–0213, Japan

*E-mail: gkokubu@kahaku.go.jp

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Abstract We examined specimens of seed plant taxa collected from the subtropical Ryukyus in three herbaria at the Faculty of Education and at Science, University of the Ryukyus, and at National Museum of Nature and Science. This examination led to the discovery of 104 new localities for 79 taxa at island level, 19 of which are treated as Japanese-threatened plants.

Key words: conservation, herbarium specimen, island flora, Ryukyus, seed plant, taxonomy, threatened plants.

Introduction

The Ryukyu Archipelago (hereafter, the Ryukyus) comprises approximately 200 islands spanning 1,300 km between Kyushu of Japan and Taiwan. Biogeographically, the Ryukyus are divided into five areas based on floristic characters of each island (Tagawa and Miyagi, 1991; Yokota, 1997; Kokubugata *et al.*, 2010). These five areas are defined as the northern Ryukyus (the Osumi Islands and the majority of the Tokara Islands), the central Ryukyus (the remainder of the Tokara Islands and the Amami and Okinawa Islands), the southern Ryukyus (the

Miyako and Yaeyama Islands), the Daito Islands and the Senkaku Islands (Fig. 1). The northern Ryukyus are temperate, and belong to the Sino-Japanese floristic region; whereas the remaining four areas are subtropical, and belong to the Southeast Asiatic floristic region (Miyawaki, 1977).

Within the subtropical Ryukyus, some islands have been the subject of intensive floral surveys (e.g., Yokota *et al.*, 1997; Abe *et al.*, 2016; Saito *et al.*, 2019). On the other hand, comprehensive floristic surveys of the subtropical Ryukyus were also conducted by a number of botanists (Hatusima, 1975; Walker, 1976; Hatusima and Amano, 1994; Shimabuku, 1997), but no surveys have been conducted since the report produced

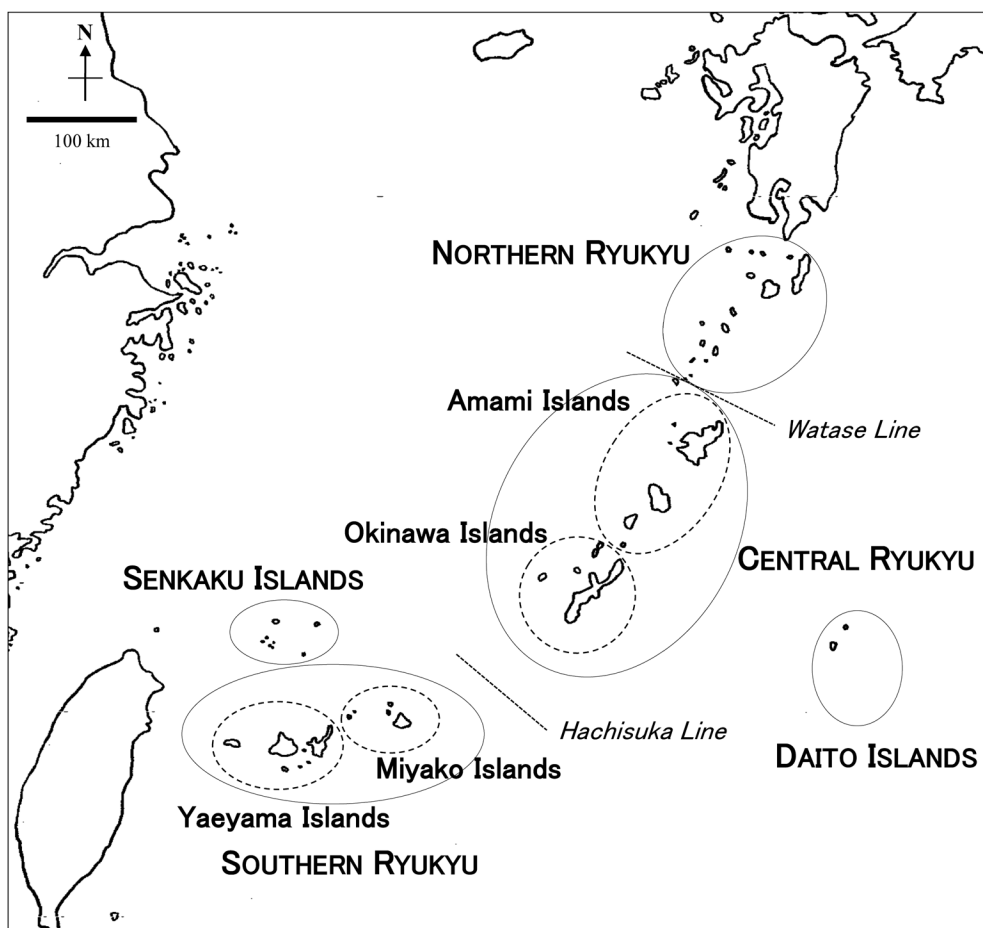


Fig. 1. Five biogeographical areas of the Ryukyu Archipelago of Japan.

by Shimabuku (1997). In 2015, we begun investigating and revising the flora of the subtropical Ryukyus, and completed a regional database, the Database of Ryukyu Plants (Ryukyu Plant Research Group, 2018 onward). Over the course of the herbarium examinations, we discovered new localities for seed plants at island level in the subtropical Ryukyus.

Materials and Methods

Specimens were identified in the herbaria at the Faculty of Education (URO) and Science (RYU) at the University of the Ryukyus and at the National Museum of Nature and Science (TNS). Following identification, we checked for

existing records in relevant major floristic publications (e.g., Hatusima, 1975; Hatusima and Amano, 1994; Shimabuku, 1997), and noted new island localities discovered for each taxon.

Results and Discussion

We examined 53,917 specimens of 2,168 native seed plant taxa (species, subspecies and varieties) from 187 families. Among all specimens collected in the subtropical Ryukyus, we found 104 new localities for 79 taxa in 44 families (Table 1).

The new localities were reported from 27 islands of the subtropical Ryukyus: Kikai-jima (6 taxa), Kakeroma-jima (1 taxon), Tokuno-shima

(6 taxa), Okino-erabu-jima (1 taxon), Yoron-jima (2 taxa) in the Amami Islands; Okinawa-jima (10 taxa), Iheya-jima (9 taxa), Izena-jima (5 taxa), Ie-jima (5 taxa), Tokashiki-jima (5 taxa), Zamami-jima (1 taxon), Geruma-jima (2 taxa), Aka-jima (1 taxon), Tonaki-jima (1 taxon), Kume-jima (6 taxa) in the Okinawa Islands; Miyako-jima (4 taxa), Ohgami-jima (1 taxon), Irabu-jima (4 taxa), Shimoji-jima (1 taxon), Kuruma-jima (1 taxon), Tarama-jima (2 taxa) in the Miyako Islands; Ishigaki-jima (6 taxa), Kohama-jima (4 taxa), Iriomote-jima (5 taxa), Hateruma-jima (3 taxa), Yonaguni-jima (8 taxa) in the Yaeyama Islands; and Uotsuri-jima (4 taxa) in the Senkaku Islands.

Nineteen of the 79 taxa were listed on the Red List of the Japanese Ministry of Environment (2019; hereafter, RL2019; Table 1). Out of these, we describe and discuss here conservation, taxonomic and biogeographic features of 12 taxa: five critically endangered (CR), two endangered (EN), and five vulnerable (VU) species.

Deeringia polysperma (Roxb.) Moq. (Amaranthaceae; RL2019: CR; Fig. 2A)

This evergreen vine-shrub has been reported from the Miyako (Miyako-jima, Ohgami-jima and Kuruma-jima) and Yaeyama Islands (Ishigaki-jima, Iriomote-jima, Kohama-jima, and Hateruma-jima) in the southern Ryukyus; and from Taiwan, China, India, and Malaysia (Yokota *et al.*, 2018a). The populations found on the Miyako Islands represent the northernmost known distribution range of this species.

We report a new locality for this species on Yonaguni-jima of the Yaeyama Islands. Hatusima (1975) previously stated that the Ryukyus plants are morphologically distinct in terms of both leaf number and flower size from those found outside of Japan. It is taxonomically important to investigate these morphological characters on the plant from Yonaguni-jima being closest to Taiwan in the Ryukyus.

Rhus javanica L. var. **javanica** (Anacardiaceae; RL2019: CR; Fig. 2B)

This small deciduous tree was previously reported from Ishigaki-jima and Iriomote-jima in the southern Ryukyus; and from Taiwan, China, and the Himalayan region (Hatusima, 1975). A small number of populations are extant on Ishigaki-jima, although the present status of this species on Iriomote-jima is unclear (Tateishi and Iha, 2018).

We present a new finding of a specimen of this variety from Miyako-jima in the southern Ryukyus. This represents a range expansion for this taxon, as the previous northernmost occurrence was reported ca. 100 km southwest on Ishigaki-jima.

Conyza leucantha (D.Don) Ludlow et Raven (Asteraceae; RL2019: EN; Fig. 2C)

This annual or biennial herb has been reported from Iriomote-jima and Yonaguni-jima in the southern Ryukyus; and widely distributes in Taiwan, China, Southeast Asia, and Australia (Yokota and Ikehara, 2018).

We discovered a new occurrence of this species on Ishigaki-jima of the southern Ryukyus, which is the third record from Japan at island level, and represents the northernmost population of this species.

Cordia aspera G.Forst. subsp. **kanehirae** (Hayata) H.Y.Liu (Boraginaceae; RL2019: CR; Fig. 2D)

This small deciduous tree was previously reported from Ishigaki-jima, Iriomote-jima in the Yaeyama Islands, and Uotsuri-jima in the Senkaku Islands (Yonekura, 2017).

We report a new record of this subspecies from Yonaguni-jima in the Yaeyama Islands, which is situated near Taiwan. Some taxonomists treat the Ryukyu plants as *C. cumingiana* Vidal, which is distributed in Japan, Taiwan and the Philippines (e.g., Hatusima, 1975). Therefore, this record from Yonaguni-jima is important for determining the taxonomic and phylogeographical relationship between the Ryukyus and Taiwan.

Table 1. New record of seed plants at island level and their voucher specimens and locality information in the subtropical Ryukyus, Japan

Family	Species	Japanese common name	RL2019 status*	Locality (personal no., herbarium no. of voucher specimen)	Collection date
Acanthaceae	<i>Hygrophila salicifolia</i> (Vahl) Nees <i>Lepidagathis inaequalis</i> C.B. Clarke ex Elmer	Ogino-tsume Ryukyu-urokomi		Southern Ryukyus, Miyako Islands, Miyako-jima. (Z. Nakasone s.n., TNS58115) Central Ryukyus, Okinawa Islands, Kume-jima, Gima-gawa River. (M. Yokota 15319, TNS1183783)	Nov 22, 1937 Nov 2, 2012
Amaranthaceae	<i>Deeringia polysperma</i> (Roxb.) Moq.	Indo-himo-kazura	CR	Southern Ryukyus, Miyako Islands, Kume-jima. (G. Ikeda 4219, RYU141616)	Sept 26, 1977
Anacardiaceae	<i>Rhus javanica</i> L. var. <i>javanica</i>	Taiwan-fushinoki	CR	Southern Ryukyus, Yaeyama Islands, Yonaguni-jima. (K. Shinjo 3273, URO105165) Southern Ryukyus, Miyako Islands, Miyako-jima, Shimajiri. (S. Issa s.n., RYU12792) Southern Ryukyus, Miyako Islands, Miyako-jima, Ohura. (Y. Inoue s.n., RYU18082)	July 4, 1967 Aug 16, 1969 July 15, 1970
Apocynaceae	<i>Tylophora tanakae</i> Maxim. var. <i>glabrescens</i> Hatus. ex T. Yamaz.	Kenashi-tsuumorinka	NT	Senkaku Islands Uotsuri-jima. (S. Tanaka & Y. Niino s.n., RYU5128) Senkaku Islands, Uotsuri-jima. (Y. Miyagi & S. Hatusima 39965, RYU36234)	Apr 3, 1971 Apr 16, 1975
Aquifoliaceae	<i>Ilex likienensis</i> Loes. <i>Ilex warburgii</i> Loes. <i>Hydrocotyle maritima</i> Honda	Ryukyu-mochi Oh-shibamochi No-chidome		Central Ryukyus, Okinawa Islands, Geruma-jima. (T. Tanazaki 624, TNS325236) Senkaku Islands, Uotsuri-jima. (Y. Miyagi & S. Hatusima 39975, RYU36217) Southern Ryukyus, Miyako Islands, Shimoi-jima, Kamiji (Y. Miyagi, E. Nakada & S. Hatusima s.n., RYU16196)	Oct 12, 1972 Apr 16, 1975 Dec 4, 1973
Araliaceae	<i>Hydrocotyle sibirhopioides</i> Lam. var. <i>tuberifera</i> (Ohwi) T.Yamaz.	Okinawa-chidomegusa		Central Ryukyus, Amami Islands, Kikai-jima. (K. Yoshinaga 423, RYU35159) Central Ryukyus, Okinawa Islands, Ie-jima, Ie-son Youth Village. (H. Ogawa, Y. Tateishi, M. Zen & Y. Nakamoto 820, URO116121)	June 21, 1975 Mar 9, 1995
Asteraceae	<i>Anisclaea macrocladoides</i> Hayata var. <i>okinawensis</i> (Hayata) Kitam. <i>Arenaria morrisonensis</i> Hayata <i>Blumea lanceolaria</i> (Roxb.) Druce <i>Carpesium cernuum</i> L. <i>Conyza leucantha</i> (D. Don) Ludlow et Raven <i>Sigsbeckia glabrescens</i> (Makino) Makino <i>Conia aspera</i> G. Forst. subsp. <i>kanehirae</i> (Hayata) H.Y.Liu <i>Cordia dichotoma</i> G. Forst. <i>Trigonotis peduncularis</i> (Trevir.) Benth. ex Hemsl.	Okinawa-haguma Nitiaka-yomogi Kozubaki-kozorina Ko-yabutaabako Nebari-izu-hahako Ko-menamomi Togemino-inuchisha Kakiba-chishanoki Kyuri-gusa		Central Ryukyus, Okinawa Islands, Tokashiki-jima. (Y. Miyagi & T. Kabashima 4450, RYU21836) Southern Ryukyus, Yaeyama Islands, Hateruma-jima, Takana-zaki. (K. Yasuda 6224, TNS1028706) Senkaku Islands, Uotsuri-jima. (Y. Niino & S. Tanaka s.n., RYU2698) Southern Ryukyus, Miyako Islands, Irabu-jima. (T. Amano s.n., RYU26592) Southern Ryukyus, Yaeyama Islands, Ishigaki-jima, Mt. Nosoko-dake. (E. Takamine s.n., RYU25654) Central Ryukyus, Amami Islands, Kikai-jima. (K. Yoshinaga 171, RYU46639) Southern Ryukyus, Yaeyama Islands, Yonaguni-jima. (T. Tanaka & Y. Niino s.n., RYU1550) Central Ryukyus, Amami Islands, Tokuno-shima, Omonawa. (H. Migo 26919, TNS373842) Central Ryukyus, Okinawa Islands, Izena-jima. (J. Miyagi s.n., RYU10564) Southern Ryukyus, Yaeyama Islands, Ishigaki-jima, Yonchira. (K. Yasuda, H. Setoguchi & N. Nomura 4006, TNS1029052) Southern Ryukyus, Yaeyama Islands, Ishigaki-jima, Yonchira. (K. Yasuda, H. Setoguchi & N. Nomura 4006, TNS1135143)	May 16, 1974 June 25, 2007 Apr 3, 1971 July 27, 1950 June 1947 May 5, 1975 Mar 27, 1972 Apr 14, 1966 Mar 9, 1971 Apr 14, 2005 Apr 14, 2005
Cannabaceae	<i>Humulus scandens</i> (Lour.) Merr.	Kana-mugura		Central Ryukyus, Okinawa Islands, Okinawa-jima. (T. Takara s.n., RYU41967)	June 4, 1978
Caprifoliaceae	<i>Lonicera affinis</i> Hook. et Arn.	Hamanindo		Central Ryukyus, Amami Islands, Kakeroma-jima, Takise. (H. Migo s.n., TNS73942) Central Ryukyus, Amami Islands, Kakeroma-jima, Akitoku. (G. Kokubugata & M. Tabata 18999, TNS1265821)	Apr 12, 1966 Jan 11, 2016
Celastraceae	<i>Celastrus kusano</i> Hayata	Ryukyu-tsuru-umemodoki		Central Ryukyus, Amami Islands, Yoron-jima. (Y. Jojani s.n., TNS829744) Central Ryukyus, Amami Islands, Yoron-jima. (Y. Jojani s.n., TNS829745) Central Ryukyus, Amami Islands, Yoron-jima. (Y. Jojani s.n., TNS829746) Central Ryukyus, Okinawa Islands, Kume-jima. (Y. Niino s.n., RYU118897) Southern Ryukyus, Miyako Islands, Irabu-jima. (S. Sakaguchi 18, TNS63609) Southern Ryukyus, Miyako Islands, Irabu-jima. (S. Sakaguchi s.n., TNS63610) Central Ryukyus, Okinawa Islands, Tonaki-jima. (H. Higa s.n., RYU28200) Southern Ryukyus, Miyako Islands, Tarama-jima. (Y. Miyagi 7079, RYU37379) Central Ryukyus, Okinawa Islands, Okinawa-jima, Naha-shi, Tonokura. (S. Nakamine s.n., S116456) Southern Ryukyus, Yaeyama Islands, Yonaguni-jima. (K. Shinjo 12782, URO101604) Southern Ryukyus, Yaeyama Islands, Iriomote-jima, Ohomi Forest Road. (Y. Kobana 10591, TNS1091824)	Dec 11, 1974 Dec 11, 1974 Dec 11, 1974 Dec 28, 1957 Aug. 1922 Aug. 1922 Oct 8, 1974 Sept 26, 1975 Aug 9, 1954 Mar 9, 1993 Apr 15, 1993
Convolvulaceae	<i>Erycibe henryi</i> Prain <i>Ipomoea imperati</i> (Vahl) Griseb.	Horutokazura Atsuba-asagao		Central Ryukyus, Amami Islands, Yoron-jima. (Y. Jojani s.n., TNS829744) Central Ryukyus, Amami Islands, Yoron-jima. (Y. Jojani s.n., TNS829745) Central Ryukyus, Okinawa Islands, Kume-jima. (Y. Niino s.n., RYU118897) Southern Ryukyus, Miyako Islands, Irabu-jima. (S. Sakaguchi 18, TNS63609) Southern Ryukyus, Miyako Islands, Irabu-jima. (S. Sakaguchi s.n., TNS63610) Central Ryukyus, Okinawa Islands, Tonaki-jima. (H. Higa s.n., RYU28200) Southern Ryukyus, Miyako Islands, Tarama-jima. (Y. Miyagi 7079, RYU37379) Central Ryukyus, Okinawa Islands, Okinawa-jima, Naha-shi, Tonokura. (S. Nakamine s.n., S116456) Southern Ryukyus, Yaeyama Islands, Yonaguni-jima. (K. Shinjo 12782, URO101604) Southern Ryukyus, Yaeyama Islands, Iriomote-jima, Ohomi Forest Road. (Y. Kobana 10591, TNS1091824)	Dec 11, 1974 Dec 11, 1974 Dec 11, 1974 Dec 28, 1957 Aug. 1922 Aug. 1922 Oct 8, 1974 Sept 26, 1975 Aug 9, 1954 Mar 9, 1993 Apr 15, 1993
Cucurbitaceae	<i>Trichosanthes kirilowii</i> Maxim. var. <i>japonica</i> (Miq.) Kitam.	Ki-karasi-uri		Central Ryukyus, Okinawa Islands, Okinawa-jima, Naha-shi, Tonokura. (S. Nakamine s.n., S116456)	Unknown
Cupressaceae	<i>Juniperus taxifolia</i> Hook. et Arn. var. <i>luchuenis</i> (Koidz.) Satake	Okinawa-haizuru		Central Ryukyus, Okinawa Islands, Okinawa-jima, Higashi-son, Kesuji Mangrove. (T. Amano 6696, TNS264876)	July 27, 1951
Cyperaceae	<i>Carex ischnostachya</i> Steud. var. <i>fastigiata</i> T. Koyama <i>Carex nemostachys</i> Steud. <i>Fimbristylis ferruginea</i> (L.) Vahl var. <i>sieboldii</i> (Miq. ex Franch. et Sav.) Ohwi	Okinawa-juzusuge Aki-kasasuge Isayama-tentsuki		Southern Ryukyus, Yaeyama Islands, Ishigaki-jima, Nagura-gawa River. (K. Yasuda 2980, TNS1028537)	Nov 4, 2004

Table. 1. Continued.

Family	Species	Japanese common name	RL2019 status*	Locality (<i>personal no.</i> , herbarium no. of voucher specimen)	Collection date
Fagaceae	<i>Fimbrispilis tashiroana</i> Ohwi	Tsukushi-entsuki	VU	Southern Ryukyus, Yaeyama Islands, Ishigaki-jima, Nagura-gawa River. (<i>K. Yasuda 2980</i> , TNS1028538)	Nov 4, 2004
	<i>Gadnia tristis</i> Nees			Southern Ryukyus, Yaeyama Islands, Ishigaki-jima, Sakteda. (<i>E. Takamine 148</i> , TNS234709)	July 24, 1938
	<i>Lipocarpha chinensis</i> (Osbeck) Kern	Kurogaya		Central Ryukyus, Okinawa Islands, Higashi-son, Keshaji. (<i>T. Amano s.n.</i> , RYU27724)	July 22, 1951
	<i>Lipocarpha microcephala</i> (R.Br.) Kunth	Oh-hinji-gayatsuri Hinji-gayatsuri		Southern Ryukyus, Yaeyama Islands, Iriomote-jima, Mihara. (<i>T. Kikahara 6264</i> , TNS1113778)	July 6, 2007
				Southern Ryukyus, Yaeyama Islands, Kohama-jima. (<i>K. Shinjo & Y. Tateishi 10943</i> , URO102461)	Mar 26, 1998
Ericoalaceae				Central Ryukyus, Okinawa Islands, Izena-jima. (<i>E. Nakata s.n.</i> , RYU11654)	Jan 23, 1973
				Central Ryukyus, Okinawa Islands, Kume-jima, Shirase-gawa River. (<i>K. Yasuda 3354</i> , TNS1028546)	Jan 17, 2005
				Central Ryukyus, Okinawa Islands, Kume-jima, Shirase-gawa River. (<i>K. Yasuda 3354</i> , TNS1028547)	Jan 17, 2005
				Central Ryukyus, Okinawa Islands, Kume-jima, Shirase-gawa River. (<i>K. Yasuda 3354</i> , TNS1028548)	Jan 17, 2005
				Southern Ryukyus, Miyako Islands, Miyako-jima, Mt. Ohno-yama. (<i>S. Tanada 979</i> , TNS231834)	Aug 22, 1942
Fabaceae	<i>Machaerina rubiginosa</i> (Sol. ex G.Forst.) T.Koyama	Nebikigusa		Senkaku Islands, Uotsuri-jima. (<i>S. Tanada 75</i> , TNS101578)	Apr 16, 1952
	<i>Eriocaulon truncatum</i> Buch.-Ham. ex Mart.	Suisya-hoshikusa	CR	Central Ryukyus, Okinawa Islands, Iheya-jima, Dana. (<i>K. Shinjo 729</i> , URO102682)	Dec 29, 1956
				Central Ryukyus, Okinawa Islands, Izena-jima. (<i>E. Nakata s.n.</i> , RYU11652)	Aug 23, 1973
	<i>Caesalpinia bonduc</i> (L.) Roxb.	Shirotsubu		Central Ryukyus, Okinawa Islands, Okinawa-jima. (<i>T. Yamazaki & H. Usui 2086</i> , TNS161566)	Dec 20, 1963
				Southern Ryukyus, Yaeyama Islands, Yonaguni-jima, Higawa. (<i>G. Kokubugata & M. Yokota 14163</i> , TNS1140521)	Oct 19, 2001
Helwingiaceae				Central Ryukyus, Okinawa Islands, Okinawa-jima, Hentona. (<i>Y. Tateishi, S. Matsumura, T. Yamashiro & E. Tamaki 43517</i> , URO109947)	June 28, 1996
				Central Ryukyus, Okinawa Islands, Okinawa-jima, Hentona. (<i>Y. Tateishi, S. Matsumura, T. Yamashiro & E. Tamaki 43518</i> , URO109953)	June 28, 1996
				Southern Ryukyus, Miyako Islands, Ohgami-jima. (<i>G. Kokubugata, M. Yokota, A. Abe 15306</i> , TNS1183781)	Oct 22, 2012
	<i>Christia obcordata</i> (Poir.) Bakh.f. ex van Meeuwen	Hozuki-hagi		Southern Ryukyus, Miyako Islands, Irabu-jima, ground of Sawada Worker Recreation Center. (<i>Y. Tateishi, H. Ogawa & A. Takada 40298</i> , URO110037)	Sept 18, 1994
				Southern Ryukyus, Miyako Islands, Irabu-jima. (<i>E. Sugama s.n.</i> , URO110036)	Apr 12, 1996
Fagaceae	<i>Desmodium leptopus</i> A.Gray ex Benth.	Tokiwa-yaubhagi		Southern Ryukyus, Miyako Islands, Irabu-jima, Sabaoki Park. (<i>M. Amano 1466</i> , URO110034)	June 12, 2012
				Southern Ryukyus, Yaeyama Islands, Yonaguni-jima. (<i>S. Hatusima, H. Kanai, K. Shimabuku, Y. Miyagi, E. Nakata, & M. Furuse 732234</i> , TNS297054)	Sept 30, 1973
				Central Ryukyus, Anami Islands, Tokuno-shima, seaside of Ohisu-gawa River. (<i>G. Kokubugata, M. Yokota & H. Yamashita 12477</i> , TNS01103877)	Feb 7, 2010
				Central Ryukyus, Anami Islands, Kikai-jima. (<i>K. Yoshinaga 1327</i> , RYU140347)	Aug 9, 1977
				Central Ryukyus, Okinawa Islands, Iheya-jima. (<i>K. Shinjo 2036</i> , URO114592)	Aug 8, 1958
Helwingiaceae				Central Ryukyus, Okinawa Islands, Tokashiki-jima. (<i>Y. Miyagi & T. Kabashima 4452</i> , RYU21745)	Jan 8, 1958
				Central Ryukyus, Okinawa Islands, Kume-jima, Oh-dake. (<i>F. Maekawa s.n.</i> , TNS882512)	May 16, 1974
					Feb 15, 1974
				Southern Ryukyus, Yaeyama Islands, Kohama-jima. (<i>Y. Miyagi 6570</i> , RYU37685)	July 7, 1975
				Southern Ryukyus, Yaeyama Islands, Ishigaki-jima, Mt. Omoto-dake. (<i>K. Shinjo 1225</i> , URO108754)	Mar 2, 1957
Hydrocharitaceae				Central Ryukyus, Okinawa Islands, Tokashiki-jima. (<i>Y. Miyagi & S. Oyamadani 1265</i> , RYU9052)	May 6, 1973
				Central Ryukyus, Anami Islands, Kikai-jima. (<i>K. Yoshinaga 1427</i> , RYU40311)	Sept 15, 1975
				Central Ryukyus, Anami Islands, Tokuno-shima. (<i>Y. Miyagi & S. Hatusima 39551</i> , RYU34181)	Feb 12, 1975
				Central Ryukyus, Anami Islands, Tokuno-shima. (<i>Y. Joani & S. Masuda s.n.</i> , TNS829262)	July 12, 1975
				Central Ryukyus, Okinawa Islands, Kume-jima, Kunigami-son, Oku. (<i>Y. Iaira 385</i> , TNS231284)	Sept 26, 1938
Lamiaceae				Central Ryukyus, Okinawa Islands, Ie-jima, Ie Beach. (<i>S. Hatusima 33988</i> , RYU4630)	May 21, 1972
				Southern Ryukyus, Yaeyama Islands, Yonaguni-jima. (<i>S. Hatusima, Y. Miyagi & E. Nakata 35781</i> , RYU14850)	Sept 29, 1973
				Central Ryukyus, Okinawa Islands, Tokashiki-jima. (<i>Y. Miyagi & T. Kabashima 4789</i> , RYU22151)	May 16, 1974
				Southern Ryukyus, Yaeyama Islands, Hateruma-jima. (<i>Y. Miyagi 6722</i> , RYU35912)	July 9, 1975
				Central Ryukyus, Anami Islands, Kikai-jima. (<i>K. Yoshinaga 1415</i> , RYU40367)	Sept 15, 1975
Lauraceae					
Lecythidaceae					
Endemiaceae					

Table 1. Continued.

Family	Species	Japanese common name	RL2019 status*	Locality (personal no., herbarium no. of voucher specimen)	Collection date
Menispermaceae	<i>Pericampylus formosanus</i> Diels	Hori-tsurafuji	CR	Southern Ryukyus, Yaeyama Islands, Ishigaki-jima, Nagura-gawa River. (K. Yasuda, M. Yokota, S. Higa, H. Tomiyama, S. Matsushima & T. Kitahara 5260, TNS1114499)	Feb 4, 2007
Menyanthaceae	<i>Nymphoides coreana</i> (H. Lévl.) H. Hara	Hime-shiroasaza	VU	Southern Ryukyus, Miyako Islands, Irabu-jima, (T. Amano s.n., RYU25348)	July 27, 1950
Moraceae	<i>Ficus caulocarpa</i> (Miq.) Miq.	Ohba-ako		Central Ryukyus, Okinawa Islands, Okinawa-jima, Nakijin-son, Wakugawa. (T. Kanaziro s.n., RYU25419)	Apr 29, 1939
	<i>Ficus thunbergii</i> Maxim.	Hime-tabi		Central Ryukyus, Okinawa Islands, Tokashiki-jima, (K. Shimabuku 4188, RYU41284) Central Ryukyus, Okinawa Islands, Iheya-jima, (Y. Niino s.n., RYU19855)	July 8, 1978 Dec 28, 1958
				Southern Ryukyus, Yaeyama Islands, Yonaguni-jima. (S. Hatusima, H. Kanai, K. Shimabuku, Y. Miyagi & E. Nakata 722362, TNS318258)	Oct 3, 1973
Oleaceae	<i>Jasminum superfluum</i> Koidz.	Okinawa-sokoi	VU	Southern Ryukyus, Yaeyama Islands, Yonaguni-jima, (Y. Jotani 38537, TNS849315)	May 5, 1981
Onagraceae	<i>Ludwigia adscendens</i> (L.) H. Hara	Ke-mizukimhai	VU	Central Ryukyus, Okinawa Islands, Iheya-jima, (S. Kayo s.n., RYU10349)	Aug 29, 1970
Orchidaceae	<i>Micranis parviflora</i> R.Br.	Niraba-ran		Southern Ryukyus, Yaeyama Islands, Kohama-jima, (Y. Miyagi 6535, RYU37649)	July 7, 1975
				Central Ryukyus, Okinawa Islands, Iheya-jima, Mt. Kuba-yama. (K. Shinjo & Y. Tateishi 790, URO104569)	May 4, 1995
Papaveraceae	<i>Zuscine stratiotomatica</i> (L.) Schltr. <i>Corydalis heterocarpa</i> Siebold et Zucc. var. <i>brachystyla</i> (Koidz.) Ohwi	Kintu-ran Munin-kikeman		Central Ryukyus, Okinawa Islands, Izena-jima, (J. Miyagi s.n., RYU11178) Central Ryukyus, Amami Islands, Yoron-jima, (J. Haginiva 016754, TNS966754)	Mar 9, 1971 Dec 24, 1971
				Central Ryukyus, Amami Islands, Yoron-jima, (J. Haginiva 016755, TNS966755)	Dec 24, 1971
				Central Ryukyus, Amami Islands, Kikai-jima, Akaren, (H. Murakami 437, TNS689342)	Apr 19, 1998
Pentaptyl/lacaeae	<i>Eurya osimensis</i> Masam.	Amami-hisakaki		Southern Ryukyus, Yaeyama Islands, Iriomote-jima, Mt. Komi-dake. (G. Kokubugata, M. Yokota & K. Yasuda 5458, TNS9519088)	Dec 21, 2004
				Southern Ryukyus, Yaeyama Islands, Iriomote-jima, Aira-gawa River, (K. Yasuda 5376, TNS119995)	Mar 13, 2007
				Southern Ryukyus, Yaeyama Islands, Iriomote-jima, (S. Kurata & T. Nakaike 330, TNS369367)	June 1, 1973
				Southern Ryukyus, Yaeyama Islands, Iriomote-jima, Mt. Komi-dake. (G. Kokubugata, M. Yokota & K. Yasuda 5403, TNS9519036)	Dec 21, 2004
				Southern Ryukyus, Yaeyama Islands, Iriomote-jima, Mt. Komi-dake. (G. Kokubugata, M. Yokota & K. Yasuda 5404, TNS9519037)	Dec 21, 2004
				Southern Ryukyus, Yaeyama Islands, Iriomote-jima, Uda-gawa, River. (K. Yasuda, M. Yokota, G. Kokubugata, S. Higa, H. Tomiyama & T. Kitahara 5395, TNS119720)	Mar 24, 2007
				Southern Ryukyus, Yaeyama Islands, Iriomote-jima, Aira-gawa River, (K. Yasuda 5376, TNS119994)	Mar 13, 2007
				Southern Ryukyus, Yaeyama Islands, Iriomote-jima, Urauchi-gawa River. (G. Kokubugata 11151, TNS9543099)	Oct 24, 2008
Phrymaceae	<i>Microcarpaea minima</i> (K. D. Koenig ex Retz.) Merr.	Suzumeno-hakobe		Central Ryukyus, Okinawa Islands, Iheya-jima, (S. Hatusima & al. 35089, RYU11694)	July 23, 1973
Phyllanthaceae	<i>Glochidion lanceolatum</i> Hayata	Kirun-kankonoki		Central Ryukyus, Okinawa Islands, Iheya-jima, (S. Hatusima & al. 35085, RYU11698)	July 24, 1973
				Central Ryukyus, Okinawa Islands, Iheya-jima, (S. Hatusima & al. 35117, RYU11726)	July 24, 1973
				Central Ryukyus, Okinawa Islands, Aka-jima, (Y. Miyagi 7931, RYU42957)	Aug 12, 1977
				Central Ryukyus, Okinawa Islands, Aka-jima, (Y. Miyagi 7751, RYU44160)	Aug 12, 1977
Poaceae	<i>Cynococcum patens</i> (L.) A. Camus <i>Digitaria pruriens</i> (Fisch. ex Trin.) Büse <i>Leersia hexandra</i> Sw. <i>Lepochloa chinensis</i> (L.) Nees	Hime-chigozasa Hitotaba-mehishiba Taiwan-ashikaki Azegaya	NT NT	Southern Ryukyus, Yaeyama Islands, Hateruma-jima, (Y. Miyagi 6711, RYU38103) Central Ryukyus, Okinawa Islands, Zamami-jima, (Y. Niino & Y. Miyagi 3071, RYU3050) Central Ryukyus, Okinawa Islands, Ie-jima, (S. Kayo s.n., RYU20672) Central Ryukyus, Okinawa Islands, Okinawa-jima, Naha-shi, Tsuboya, (Y. Taira 278, TNS233978) Southern Ryukyus, Yaeyama Islands, Iriomote-jima, Hoshidate, (K. Yasuda 2720, TNS1028241)	Sept 14, 1973 Apr. 1971 June 19, 1938 June 10, 2004
	<i>Microstegium japonicum</i> (Miq.) Koidz.	Sasagaya		Central Ryukyus, Okinawa Islands, Okinawa-jima, Mt. Yonah-dake, (S. Tamaki s.n., RYU2887)	Nov 8, 1970
	<i>Sacciolepis indica</i> (L.) Chase var. <i>oryzatorum</i> (Makino) Ohwi	Numeri-gusa		Southern Ryukyus, Yaeyama Islands, Iriomote-jima, Shirahama, (M. Furuse 3012, RYU11158)	Apr 22, 1973
Polygonaceae	<i>Periscaria senticosa</i> (Meisn.) H. Gross	Mamkono-shirinuigui		Central Ryukyus, Okinawa Islands, Ie-jima, (S. Kayo s.n., RYU19560)	May 22, 1970
				Central Ryukyus, Okinawa Islands, Iheya-jima, (S. Kayo s.n., RYU19562)	Aug. 1970
Rosaceae	<i>Prunus zippelliana</i> Miq. <i>Rubus grayanus</i> Maxim.	Bakuchinoki Ryukyu-ehigo		Central Ryukyus, Amami Islands, Okino-erabu-jima, (S. Hatusima & al. 35004, RYU31399)	July 10, 1974
				Southern Ryukyus, Yaeyama Islands, Ishigaki-jima, Kabira, (T. Amano 7298, TNS116325)	Apr 19, 1954
				Central Ryukyus, Okinawa Islands, Iheya-jima, (S. Hatusima & al. 35107, RYU11730)	July 24, 1973
				Central Ryukyus, Okinawa Islands, Geruma-jima, (Y. Niino s.n., RYU2832)	Aug 15, 1960

Table. 1. Continued.

Family	Species	Japanese common name	RL2019 status*	Locality (personal no., herbarium no. of voucher specimen)	Collection date
Rubiaceae	<i>Dampiernia indica</i> Gaertn.f. var. <i>indica</i>	Aridoshi	NT	Central Ryukyus, Okinawa Islands, Iheya-jima, Mt. Kayo-san. (M. Kugai s.n., RYU6327)	Aug 29, 1970
Rutaceae	<i>Psychotria rubra</i> (Lour.) Poir.	Bochoji		Southern Ryukyus, Miyako Islands, Miyako-jima. (T. Ito 168, TNS382406)	Aug 9, 1894
	<i>Citrus tachibana</i> (Makino) Tanaka	Tachibana		Southern Ryukyus, Yaeyama Islands, Yonaguni-jima. (S. Hatusima, Y. Miyagi & E. Nakata 35809, RYU14685)	Sept 29, 1973
				Southern Ryukyus, Yaeyama Islands, Yonaguni-jima. (S. Hatusima, Y. Miyagi & E. Nakata 35517, RYU15847)	Sept 29, 1973
Schoepfiaceae	<i>Glycosmis citrifolia</i> (Willd.) Lindl.	Hana-shinbogi		Southern Ryukyus, Miyako Islands, Tarama-jima. (Y. Miyagi s.n., RYU37424)	Sept 26, 1975
	<i>Zanthoxylum beccheyianum</i> K.Koch	Iwa-zansho		Central Ryukyus, Amami Islands, Tokuno-shima. (Y. Jotani & S. Masuda s.n., TNS825502)	July 11, 1973
	<i>Schoepfia jasminodora</i> Siebold et Zucc.	Boroboronoki		Central Ryukyus, Amami Islands, Tokuno-shima. (Y. Jotani & S. Masuda s.n., TNS825515)	July 11, 1973
	<i>Smilax bracteata</i> C.Presl var. <i>vernuculosa</i> (Merr.) T.Koyama	Aragata-sankirai		Southern Ryukyus, Yaeyama Islands, Kohama-jima. (K. Shinjo & Y. Tateishi 10954, URO112873)	Mar 26, 1998
Smilacaceae				Central Ryukyus, Okinawa Islands, Ie-jima. (S. Hatusima & Y. Miyagi 37400, RYU121898)	May 4, 1974

Fimbristylis dichotoma (L.) Vahl subsp. **podocarpa** (Nees et Meyen) T.Koyama (Cyperaceae; RL2019: VU; Fig. 3A)

This perennial sedge has been reported from Okinawa-jima in the central Ryukyus and Ishigaki-jima in the southern Ryukyus; from Kyushu of Japan; and is widely distributed in India, Malaysia, and the Pacific Islands (Yokota and Nakata, 2018). Three and one populations are respectively known from Okinawa-jima and Ishigaki-jima at present (Yokota and Nakata, 2018).

We report a new locality for this species on Iriomote-jima in the southern Ryukyus. Some taxonomists treat the Ryukyu plants as *F. tashiroana* Ohwi being endemic to Japan (Ohwi, 1931). Therefore, further study is required to investigate the endemism of the plants from Japan including Iriomote-jima.

Eriocaulon truncatum Buch.-Ham. ex Mart. (Eriocaulaceae; RL2019: CR; Fig. 3B)

This helophyte grass was previously reported from Tokuno-shima, Okinawa-jima, Kume-jima in the central Ryukyus, Ishigaki-jima, Iriomote-jima and Yonaguni-jima in the southern Ryukyus (Tateishi *et al.*, 2018a); and from Taiwan, China, Indochina, the Philippines and Thailand (Miyamoto, 2015). Although several populations occur in the northern and central parts of Okinawa-jima, the majority of populations have been destroyed by anthropogenic development (Tateishi *et al.*, 2018a). A few populations are known from Ishigaki-jima and Iriomote-jima, but the present status of populations occurring on other islands is unclear (Tateishi *et al.*, 2018a).

We recorded a first occurrence of *E. truncatum* from Dana, Iheya-jima in the central Ryukyus. The locality includes a wetland habitat, and many helophyte species have been reported from this area (Niuro and Shinzato, 1978). However, these wetlands are threatened by ongoing development and the spread of naturalized plant species. Some taxonomists treat the Ryukyu plants as *Eriocaulon nigrum* Lecomte var. *suishaense* (Hayata) Hatusima et T.Koyama distributed in

the Ryukyus, Taiwan, China and Indochina (e.g., Hatusima, 1975; Walker, 1976; Tateishi *et al.*, 2018a). Therefore, further studies are required to understand the taxonomy of the plants from the Ryukyus and in particular from Iheya-jima.

Enhalus acoroides (L.f.) Rich. ex Steud. (Hydrocharitaceae; RL2019: VU; Fig. 3C)

This submerged growing seagrass has been reported from Ishigaki-jima, Iriomote-jima and Yonaguni-jima in the Yaeyama Islands; and is widely distributed from Indochina to Australia and Africa (Yokota and Yasuda, 2018). Some populations of this species are known from Ishigaki-jima and Iriomote-jima, while the present status of population in Yonaguni-jima is not clear (Yokota and Yasuda, 2018).

We report a new locality from Kohama-jima in the Yaeyama Islands. Kohama-jima is situated between Ishigaki-jima and Iriomote-jima, and treated as one of the Sekisei Lagoon Islets with other eight islets (Chinen, 1993). Given this finding, we suspect that this species may occur on other islets in the Sekisei Lagoon Islets too.

Torenia concolor Lindl. (Linderniaceae; RL2019: EN; Fig. 3D)

This trailing perennial herb was previously reported from Amami-ohshima, Uke-jima, Okinawa-jima in the central Ryukyus, and Miyako-jima in the southern Ryukyus; and from Taiwan, China, Southeast Asia, India and Sri Lanka (Ohashi, 2017). We confirmed that several populations persist on Amami-ohshima by our recent field survey conducted in 2019, but we could not confirm the population on Kikai-jima in our field survey conducted in 2017 (details not shown). It is likely that the populations on Okinawa-jima and Miyako-jima in the Ryukyus have become extinct (Tateishi *et al.*, 2018b).

We report a new record of this species from Kikai-jima, which is the third record from the Amami Islands in the central Ryukyus. However, this species may have come from a population that is now extirpated, as we did not find any other plant of this species during our detailed

surveys on Kikai-jima conducted in 2009 (details not shown). Some taxonomists treat the Ryukyus plants as *T. concolor* var. *formosana* Yamazaki distributing in only the Ryukyus and Taiwan (Tateishi *et al.*, 2018b). Therefore, comparative surveys including plants from Southeast Asia, India and Sri Lanka are necessary to understand its taxonomic status.

Pericampylus formosanus Diels (Menispermaceae; RL2019: CR; Fig. 4A)

This perennial vine was previously reported from only Miyako-jima in the southern Ryukyus; and from Taiwan and southern part of China (Hatusima, 1975), but the present status of this species on the Miyako population is unclear (Shinjo and Kawakami, 2018).

We report a new record of this species from Ishigaki-jima, which is the second record from Japan at island level.

Nymphoides coreana (H.Lév.) H.Hara (Menyanthaceae; RL2019: VU; Fig. 4B)

This floating aquatic has been reported from Miyako-jima, Ishigaki-jima, Iriomote-jima, Kayama-jima, and Yonaguni-jima in the southern Ryukyus; from Honshu, Shikoku, and Kyushu of Japan, Korea and China (Tateishi *et al.*, 2018c). The present status of populations in Miyako-jima are not clear, while some populations of this species are known from the reminder islands (Tateishi *et al.*, 2018c).

We report a new locality for this species on Irabu-jima, which is the second recorded occurrence from the Miyako Islands.

Jasminum superfluum Koidz. (Oleaceae; RL2019: VU; Fig. 4C)

This woody vine has been reported from Kikai-jima, Yoron-jima, Okinawa-jima in the central Ryukyus, Miyako-jima, Irabu-jima, and Ishigaki-jima in the southern Ryukyus; and from Taiwan (Hatusima, 1971). This species was also found from Sesoko-jima of the central Ryukyus (Shimabuku, 1973).

We report a locality from Iheya-jima being an



Fig. 2. Voucher specimen for new record at island level in the subtropical Ryukyus. A. *Deeringia polysperma* (Amaranthaceae; RYU). B. *Rhus javanica* var. *javanica* (Anacardiaceae; RYU). C. *Conyza leucantha* (Asteraceae; RYU). D. *Cordia aspera* subsp. *kanehirae* (Boraginaceae; RYU). Scale bars = 3 cm.

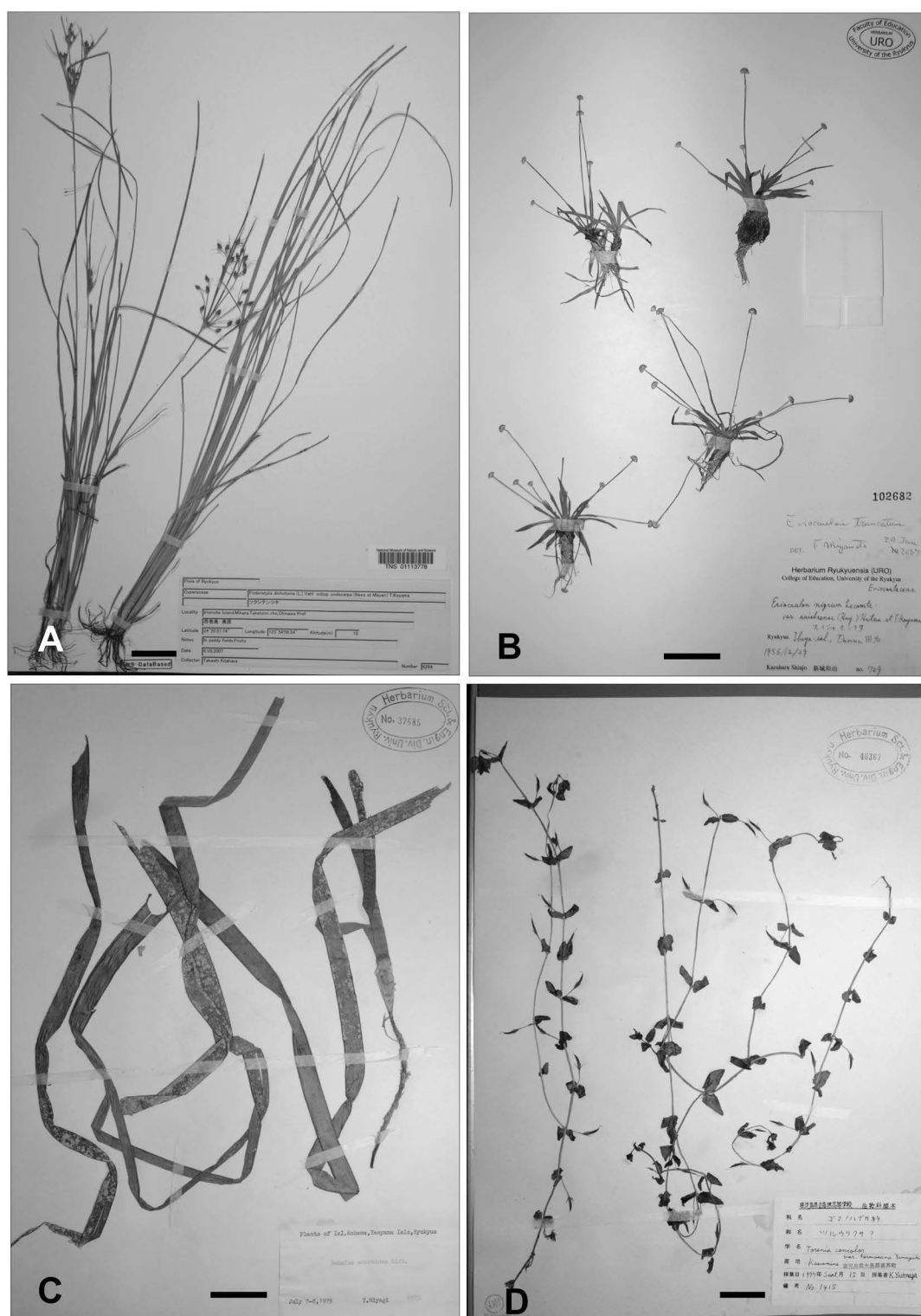


Fig. 3. Voucher specimen for new record at island level in the subtropical Ryukyus. A. *Fimbristylis tashiroana* (Cyperaceae; TNS). B. *Eriocaulon truncatum* (Eriocaulaceae; URO). C. *Enhalus acoroides* (Hydrocharitaceae; RYU). D. *Torenia concolor* (Linderniaceae; RYU). Scale bars = 3 cm.

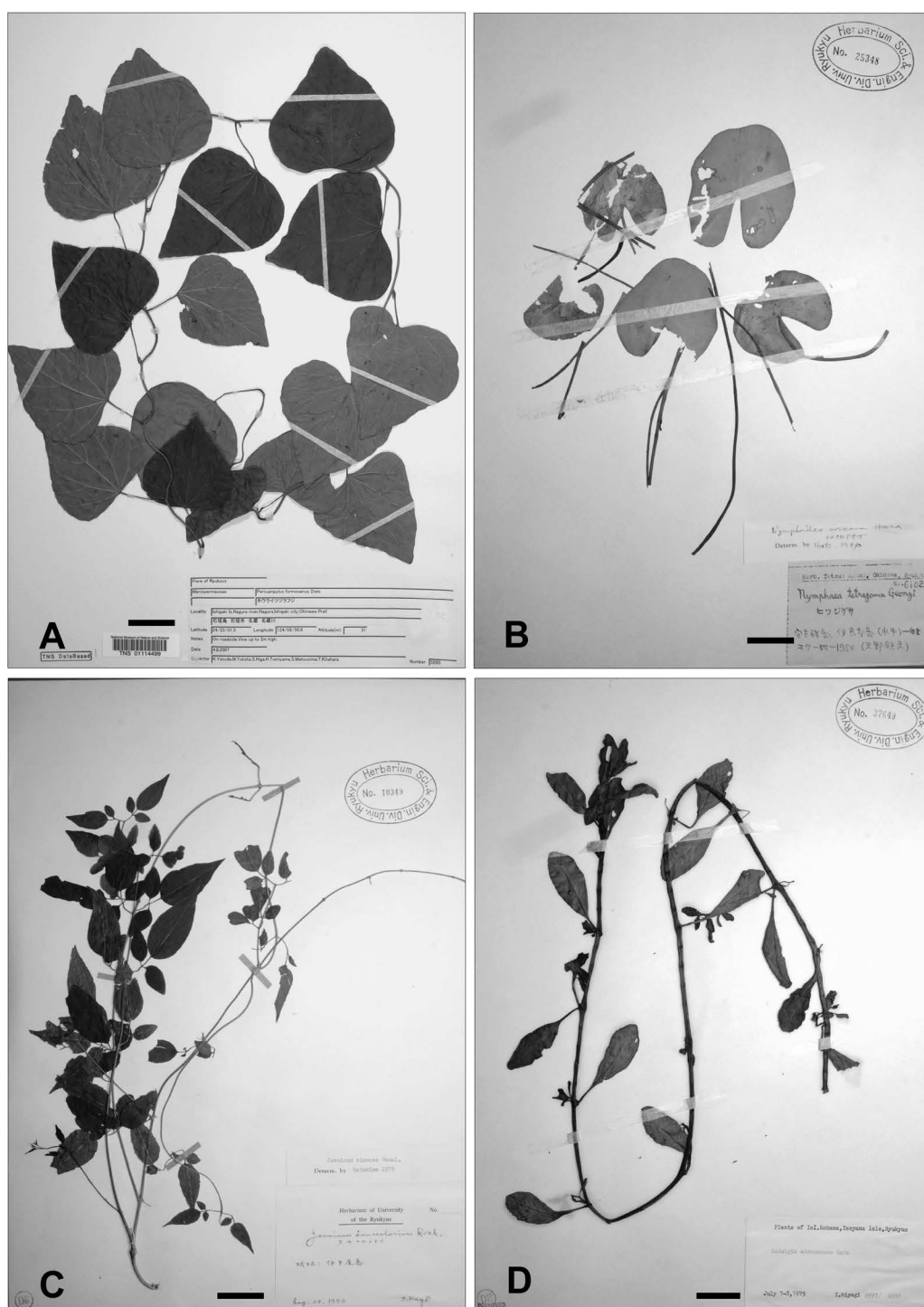


Fig. 4. Voucher specimen for new record at island level in the subtropical Ryukyus. A. *Pericampylus formosanus* (Menispermaceae; TNS). B. *Nymphoides coreana* (Menyanthaceae; RYU). C. *Jasminum superfluum* (Oleaceae; RYU). D. *Ludwigia adscendens* (Onagraceae). Scale bars=3 cm.

islet adjacent to Okinawa-jima, which is the third occurrence from the Okinawa Islands. Taxonomically, Hatusima (1975) treated the Ryukyus plants as *J. sinensis* Hemsl. distributed in the Ryukyus and southern part of China. Thus, further taxonomic studies based on the plants from the Ryukyu, Taiwan and China are required.

Ludwigia adscendens (L.) H.Hara (Onagraceae; RL2019: VU; Fig. 4D)

This hydrophyte herbaceous species has been reported from Okinawa-jima in the central Ryukyus, the Daito Islands, the Miyako Islands, and Ishigaki-jima in the southern Ryukyus; and is widely distributed in Taiwan and tropical areas of Asia (Hatusima, 1975). Populations on the Miyako Islands have declined because of anthropogenic activities, and only one population is known from Ishigaki-jima in the Yaeyama Islands (Yokota *et al.*, 2018b).

We report a new locality of this species on Kohama-Jima, which is the second record for the Yaeyama Islands. Given this finding on Kohama-jima, we suspect that this species may also occur on other islets in the Sekisei Lagoon Islets.

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