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Several records of alien species new to the flora of the United Arab Emirates (UAE)

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Keywords: alien species, Arabian Peninsula, chorology, Euphorbiaceae, Fujairah, Malvaceae s. l. (Tiliaceae), plant geography, Primulaceae, Rubiaceae, Sapindaceae, the United Arab Emirates.

Summary. The article presents new records for five alien species previously unknown from the flora of United Arab Emirates (UAE): *Euphorbia cyathophora* Murr. (Euphorbiaceae), *Samolus valerandi* L. (Myrsinaceae), *Oldenlandia umbellata* L. (Rubiaceae), *Cardiospermum halicacabum* L. (Sapindaceae), and *Corchorus aestuans* L. (Malvaceae s. l. / Tiliaceae). All of them have been recorded for the first time from the emirate of Fujairah in eastern part of the UAE. *Euphorbia cyathophora*, which is rare in the country, was found only in "Green Oasis Nursery" at Al Dibba town, *Oldenlandia umbellata* – found at the beginning of the seefront at Fujairah City, and they are new for the flora of the Arabian Peninsula. *Samolus valerandi* was found only in the "Desert Nurseries Group store 1 (palms)" at village Al Bidiya, *Corchorus aestuans* – in private nursery at Al Dibba town, and *Cardiospermum halicacabum* was found in the Masafi friday market, they are new for the flora of Fujairah and UAE.

Accepted names, synonyms, spatial distribution, habitat preferences, and species taxonomy with remarks on identification and differentiation from the most similar taxa occurring in the study area, as well as the list of localities are presented. The herbarium materials were transferred to the Herbarium of the Komarov Botanical Institute (LE, Saint-Petersburg, Russia), the duplicates – to the Herbarium of Altai State University (ALTB, Barnaul, Russia) and the Scientific Herbarium of Fujairah (FSH, Wadi Wuraya national park, Fujairah, United Arab Emirates).

Несколько новых чужеродных видов для флоры Объединенных Арабских Эмиратов

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Ключевые слова: Аравийский полуостров, география растений, Объединенные Арабские Эмираты, Фуджейра, хорология, чужеродные виды, Euphorbiaceae, Malvaceae s. l. (Tiliaceae), Primulaceae, Rubiaceae, Sapindaceae.

Аннотация. В статье представлены новые находки пяти чужеродных видов, ранее неизвестных во флоре Объединенных Арабских Эмиратов (ОАЭ): *Euphorbia cyathophora* Murr. (Euphorbiaceae), *Samolus valerandi* L. (Primulaceae), *Oldenlandia umbellata* L. (Rubiaceae), *Cardiospermum halicacabum* L. (Sapindaceae) и *Corchorus aestuans* L. (Malvaceae s. l. / Tiliaceae). Все они зарегистрированы впервые в эмирате Фуджейра в восточной

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части ОАЭ. *Euphorbia cyathophora* была обнаружена только в «питомнике Green Oasis» в городе Аль-Дибба, но в большом количестве, *Oldenlandia umbellata* – на кольцевой развязке в начале набережной в городе Фуджейра, они являются новыми также для флоры Аравийского полуострова в целом. *Samolus valerandi* обнаружен только в «Desert Nurseries Group store 1 (palms)» в пос. Аль-Бидия, *Corchorus aestuans* – в частном питомнике в городе Аль-Дибба, а *Cardiospermum halicacabum* – на территории «Masafi friday market» в окр. г. Мазафи, они являются новыми для флоры Фиджейры и ОАЭ в целом.

This research is a part of the project "Flora of Fujairah, United Arab Emirates", under a cooperation agreement between the Office of the Crown Prince of Fujairah and the Komarov Botanical Institute of the Russian Academy of Sciences, St. Petersburg (Byalt, Korshunov, 2020a, b, c, 2021a, b; etc.). During the field investigations in 2017–2022, the authors have clarified information on the distribution of alien plant species new to the territory of the Emirate of Fujairah, United Arab Emirates (UAE). The article presents new records for *Euphorbia cyathophora* Murr. (Euphorbiaceae), *Samolus valerandi* L. (Myrsinaceae / Primulaceae), *Oldenlandia umbellata* L. (Rubiaceae), *Cardiospermum halicacabum* L. (Sapindaceae), and *Corchorus aestuans* L. (Malvaceae s. l. / Tiliaceae).

Material and methods

During botanical surveys in the UAE in 2017–2022, the specimens of *Euphorbia cyathophora*, *Samolus valerandi*, *Oldenlandia umbellata*, *Cardiospermum halicacabum*, and *Corchorus aestuans* (were collected by the authors in several localities in the territory of the Emirate of Fujairah (the United Arab Emirates – UAE) (Fig. 1). The following flora compendia and identification guides were used to identify specimens and determine their taxonomic status: local Floras and field guides for UAE (Western, 1989; Jongbloed et al., 2000, 2003; Karim, Fawzi, 2007) and Floras for neighbouring countries (Collenette, 1985, 1999; Daoud, Al-Rawi, 1985; Cornes C., Cornes M., 1989; Ghazanfar, 1992; Migahid, 1996;

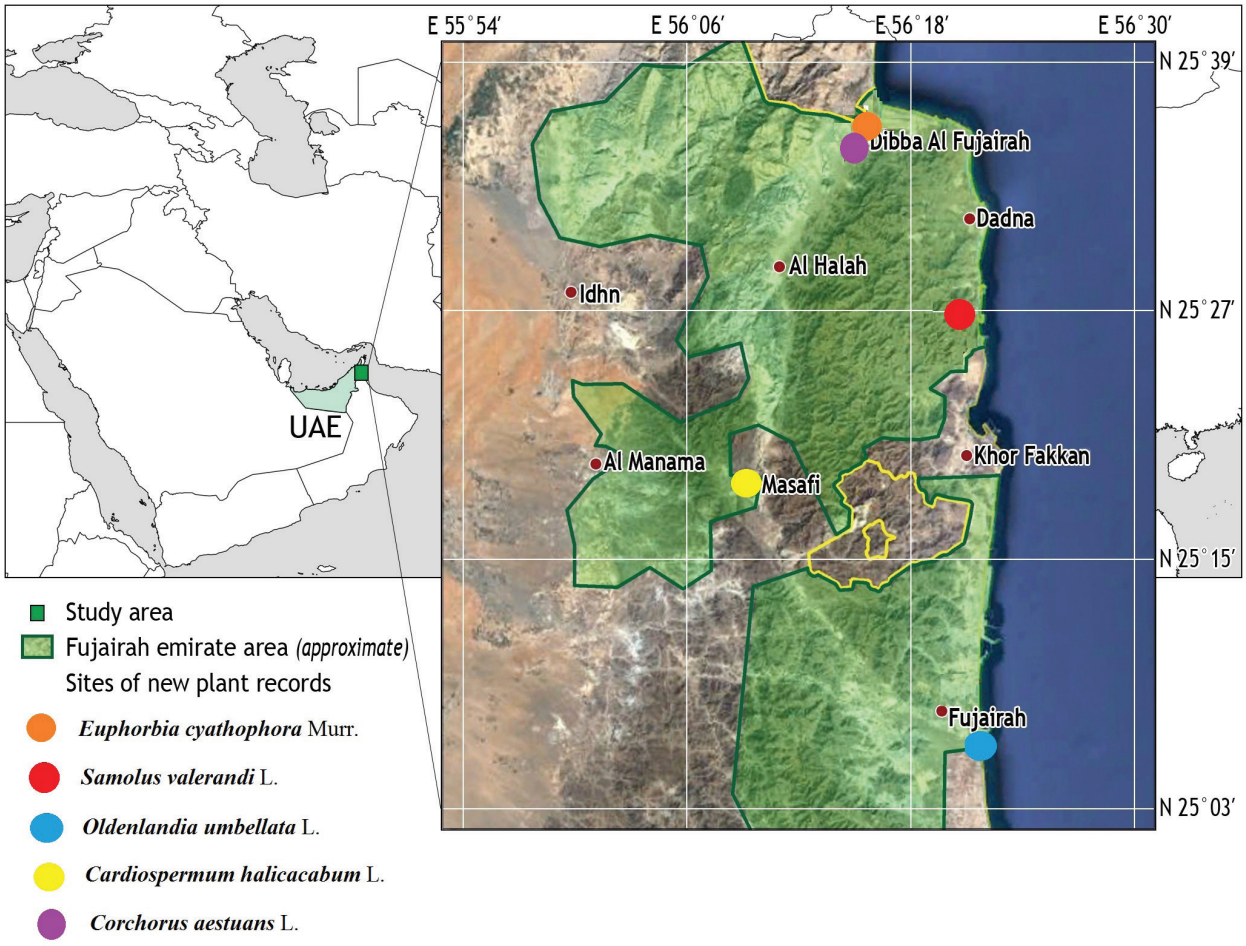

Fig. 1. Map of the distribution of new alien plants in Emirate of Fujairah (based on map of Google Earth).

Miller, Cope, 1996; Wood, 1997; Chaudhary, 1999, Jongbloed et al., 2003; Miller, Moris, 2004; Norton et al., 2009, etc.). The status of the alien species was determined using mentioned above sources, as well as Norton et al. (2009) and GBIF (2019).

The alien plant status was determined by the following criteria (Egorov et al., 2016; Baranova et al., 2018): 1) an indication in the literature that the species has been introduced into the study area or a larger region encompassing the study area; 2) the

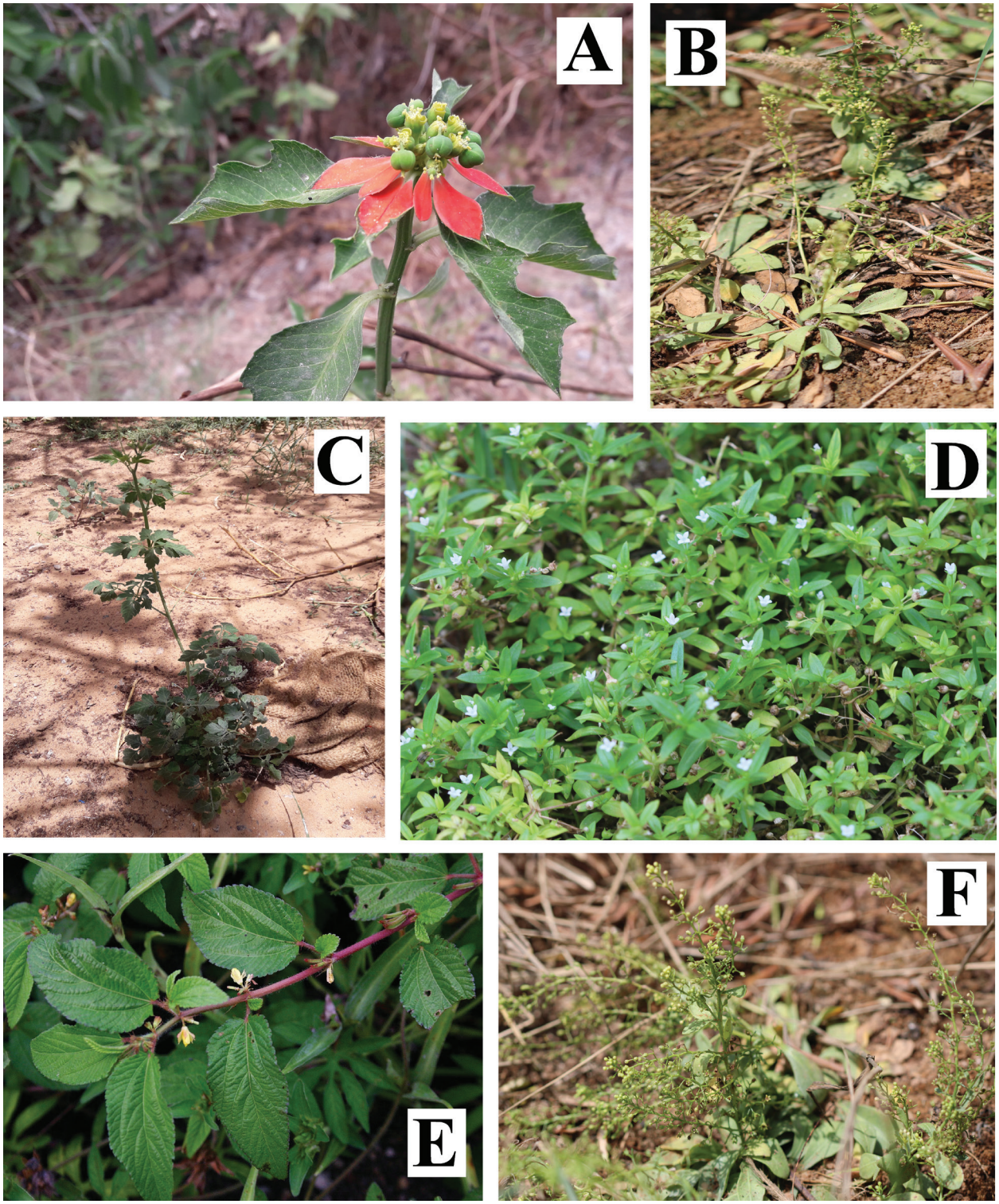

Fig. 2. New alien plants in Emirate of Fujairah: A – *Euphorbia cyathophora* Murr. grows as weed in private plant nursery in Dibba (photo by M. Korshunov); B, F – *Samolus valerandi* L. grows as weed in wet places in plant nursery in Al Bidiya (photo by V. Byal), C – *Cardiospermum halicacabum* L. as weed in Fraday Market in Masafi (photo by M. Korshunov); D – *Oldenlandia corymbosa* L. on irrigation on territory of hotel in Al Aqa (photo by V. Byalt), E – *Corchorus aestuans* L. as weed in plant nursery (photo by M. Korshunov).

species occurred only or mainly in ruderal and/or weedy habitats; 3) the species occurred in isolation from its main natural geographic range. The status of the alien species was determined to be casual, naturalized, or invasive, using the approach developed by Pyšek et al. (2004) and which is quite widely used in Western Europe (Galasso et al., 2018). However, because our observations were made only once, the alien species status that we give might not be correct.

Specimens were deposited in the following herbaria (acronyms according to B. Thiers, 2021): Herbarium of the Komarov Botanical Institute of the Russian Academy of Sciences, Saint-Petersburg (LE), and Wadi Wurraya National Park (FSH, not acronym yet).

A Garmin GPS 72H was used for the geographic coordinates of the collecting sites. The identification and corroboration were performed with different relevant floras. The location of the plants was determined using a GPS receiver or Google Maps. All coordinates use the WGS84 standard.

The locations of the study sites Emirate of Fujairah: Al Dibba town, environs of Masafi, Fujairah City and village Al Bidya.

Accepted abbreviations: United Arab Emirates – UAE, spp. – species, fl. – with flowers, fr. – with fruits, veg. – in a vegetative state, juv. – young, underdeveloped. LE – Herbarium of BIN RAS, FSH [not yet acronym] – Fujairah Scientific Herbarium (Byalt et al., 2020). The labels are in English as in the original. The numbers in square brackets indicate the place of our research, recorded by GPS "[point 776] and others." They are given on the labels for the convenience of working with the herbarium.

Results and discussion

Euphorbia cyathophora Murr. (*E. heterophylla* var. *cyathophora* (Murray) Griseb.) (Euphorbiaceae): "Fujairah Emirate, Al Dibba town, 0.6 km South-West from Street Number 35, or 0.8 km North from Federal Electricity and Water Authority, 25°36'5.21"N, 56°15'45.67"E, Elevation 10 m [point 769]: weed without irrigation on abandoned land, on path side, 3 V 2020, fl., fr., V. V. Byalt, M. V. Korshunov 2664" (LE). – Ergasiophyte, colonophyte (Fig. 2A). According to the GBIF website, it is recorded as alien in 35 countries (*Euphorbia cyathophora* ..., 2021); reported as invasive in Australia (Randall et al., 2020), India (Reddy, 2008; Reddy et al., 2008), Japan (Ikeda et al., 2021), South Africa (Foxcroft et al., 2020), etc. A new species for Fujairah and the UAE as a whole. For the Arabian Peninsula, it was also not recorded (Collenette, 1985, 1999; Cornes C., Cornes M., 1989; Ghazanfar, 1992; Migahid, 1996; Miller, Cope, 1996; Wood, 1997; Jongbloed et al., 2003; Ghazanfar, 2007; Norton et al., 2009; Checklist of Flora ..., 2011; Pahlevani, 2017; etc.). It has been found only in a single plant nursery ("Green Oasis Nursery") in Dibba, but it is represented there in a large number of individuals, apparently, is a *potentially* invasive species.

Euphorbia cyathophora differs from the closely related species *Euphorbia pulcherrima* Willd. ex Klotzsch and *E. heterophylla* L. in the following features (Radclif-Smith, 1986) (see Table 1).

Table 1

Comparative features of closely related species to *Euphorbia cyathophora* Murr.

Species	Upper leaves	Lower leaves	Habit	Glands
Euphorbia cyathophora Murr.	Green with a basal red blotch	At least the lower leaves panduriform	Annual	Gland 1, saccate, dorsoventrally compressed, 1.5 mm across
Euphorbia pulcherrima Willd. ex Klotzsch	Uniformly bright scarlet	At least the lower leaves panduriform	Perennial softly woody plant	Gland solitary, cupular, 4.5 mm across, yellowish
Euphorbia heterophylla L.	Green	Elliptic-obovate, elliptic-lanceolate or lanceolate	Annual	Glands 1–2(3), stipitate, circular, concave

Samolus valerandi L. (Primulaceae s. l. / Samolaceae): "UAE, Fujairah Emirate, Al Bidiya, Desert Nurseries Group store 1 (palms), 0.9 km West from Bidiyah Association for Culture and Folklore, 25°26'9.61"N, 56°20'8.21"E, elevation 14 m [point 809]: weed on wet sand between irrigated lines near the garden fence, 16 VII 2020, fl., fr., V. V. Byalt, M. V. Korshunov 4187" (LE; FSH). – Naturalized. Ergaziophyte, colonophyte (Fig. 2B, F).

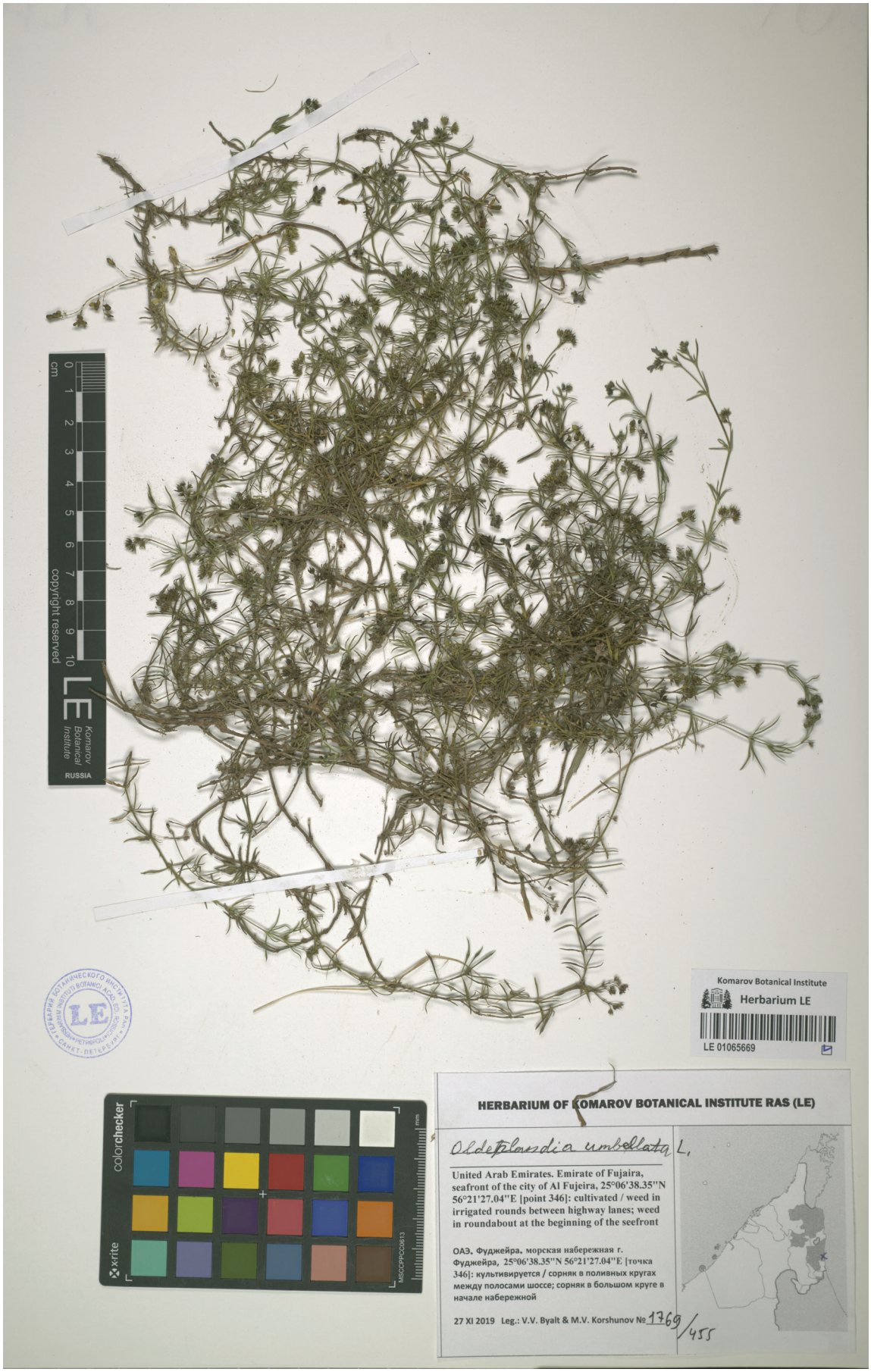

Fig. 3. Herbarium specimen of *Oldenlandia umbellata* L. collected in roundabout at the beginning of the seefront of the Fujairah City (photo by M. Legchenko).

The native range of the species is temperate and subtropical Old World to Tropical Mountains (POWO, 2022). Recorded as invasive in the USA, Australia, and Chile (Kraus et al., 2020; Pauchard et al., 2020; Randall et al., 2020; *Samolus valerandi* ..., 2022).

In the Arabian Peninsula, *Samolus valerandi* was found in Southern Oman (Ghazanfar, 1992), Saudi Arabia (Chaudhary, 1999; Collenette, 1999), Yemen (Wood, 1997; Al-Khulaidi, 2013). It has been recorded as a new to the Emirate of Fujeirah of the United Arab Emirates. It is rare weed plant of moist places on irrigation. Apparently, it is not a potentially invasive species due to it needs a lot of moisture.

Oldenlandia umbellata L. (Rubiaceae): "UAE. Emirate of Fujaira, seafront of the city of Al Fujeira, 25°06'38.35"N 56°21'27.04"E [point 346]: weed in roundabout at the beginning of the seefront. – ОАЭ, Фуджейра, морская набережная г. Фуджейра, 25°06'38.35"N 56°21'27.04"E [точка 346]: сорняк в большом круге в начале набережной. 27 XI 2019. V. V. Byalt, M. V. Korshunov No. 1769/455" (LE). – Naturalized. Ergaziophyte, colonophyte (Fig. 3).

The native range of this species occupies the area from East Asia (Hainan) to South and South-East Asia (POWO, 2022). The study of relevant literature (Western, 1989; Jongbloed et al., 2000, 2003; Karim, Fawzi, 2007) reveals that *O. umbellata* had not been recorded from the UAE previously (Western, 1989; Jongbloed et al., 2003; Karim, Fawzi, 2007; etc.) and Floras for neighbouring countries in Arabian Peninsula (Collenette, 1985, 1999; Cornes C., Cornes M., 1989; Ghazanfar, 1992, 2015; Migahid, 1996; Miller, Cope, 1996; Wood, 1997; Jongbloed et al., 2003; Norton et al., 2009; etc.). It was found in roundabouts at the beginning of the seefront at Fujairah City and is new for the flora of UAE and the Arabian Peninsula at the whole.

It differs from the closely related species, more widely distributed in UAE *Oldenlandia corymbosa*, in the following features (Nazimuddin, Qaiser, 2011; see Table 2).

Table 2

Comparative features of species of *Oldenlandia* L. in the UAE

Species	Calyx	Flowers	Corolla	Inflorescence
Oldenlandia umbellata L.	Calyx-teeth broadly triangular	Heterostylous	Corolla-tube 1–1.5 mm long	Inflorescence 3-many-flowered congested cymes
Oldenlandia corymbosa L.	Calyx-teeth narrowly triangular-subulate	Isostylous	Corolla-tube ca. 0.5 mm long	Inflorescence axillary and solitary, rarely many flowered

Note. Another species of the genus *Oldenlandia* – *O. corymbosa* was first recorded in 3 different areas in Dubai in 2014 year (Shahid, Rao, 2014; Gariola et al., 2016). It is the type species for the genus, which is native to Africa and South Asia and is naturalized in tropical and subtropical regions of the world (USDA, 2020). In the Arabian Peninsula, *O. corymbosa* is found in Oman (Ghazanfar, 1992), Saudi Arabia (Chaudhary, 2000), Yemen (Wood, 1997), and Qatar (https://www.floraofqatar.com/indexf.htm#Rubiaceae). We have found this plant as weed in different areas of Fujairah on irrigation, and it is really not rare here on irrigation (Fig. 3).

Cardiospermum halicacabum L. (Sapindaceae): "UAE, Fujairah Emirate, Masafi friday market, E88 Al Dhaid – Masafi road, 5.2 km to Masafi. 25°17'28.28"N, 56° 6'48.62"E, elevation 370 m [point 732a]: weed in plant nursery, on sandy pathside. 2 VI 2020. Veg. V. V. Byalt, M. V. Korshunov 3368" (LE). – Casual. Ergaziophyte, ephemerophyte (Fig. 2C).

This species's native range occupies tropics and subtropics (POWO, 2022). Recorded as invasive in 35 countries, including the USA (Kraus et al., 2020), Brazil (Ziller et al., 2020), Australia (Randall et al., 2020; *Cardiospermum halicacabum* ..., 2022).

For the Arabian Peninsula, it was cited for Oman, Saudi Arabia, Yemen, and neighboring Iraq (Townsend, Guest, 1980; Ghazanfar, 1992; Wood, 1997; Collenette, 1999; Mosti et al., 2012). A new alien species for the Emirate of Fujairah and the UAE as a whole. It was found as a weed in a small number of individuals on sandy pathside on the territory of the private plant nursery in the environs of town Mazafi.

It differs from the closely related species *Cardiospermum grandiflorum* Sw. in the following features, as indicated in table 3 (see) (Henderson, 2001; Weckerle, Rutishauser, 2005).

Corchorus aestuans L. (Tiliaceae / Malvaceae s. l.): "UAE, Fujairah Emirate, Al Dibba town, private nurseries, 0.2 km South from Al Amerey Nursery,

25°34′24.07″N, 56°14′6.39″E, Elevation 48 m [point 776]: weed in nursery. 7 V 2020. Fr., fl. V. V. Byalt, M. V. Korshunov 2726" (LE). – Casual. Ergaziophyte, ephemerophyte (Fig. 2E).

This species's native range occupies tropics and subtropics (POWO, 2022). Recorded as invasive in 22 countries, including the USA (Kraus et al., 2020), Australia (Randall et al., 2020), India (Reddy, 2008; Reddy et al., 2008) and others (*Corchorus aestuans* ..., 2022). For the Arabian Peninsula, it was reported only for Oman (Ghazanfar, 1992; Mosti et al., 2012). A new alien species for the Emirate of Fujairah and the UAE as a whole.

It differs from the closely related species more or less common in UAE *Corchorus olitorius* L. and *C. trilocularis* L. in the following features as indicated in table 4 (see) (Ghafoor, 1974; Tang et al., 2007).

Table 3

Comparative features of closely related species *Cardiospermum halicacabum* L. and *C. grandiflorum* Sw.

Species	Habit	Flowers	Fruits	Seeds	Pubescence
Cardiospermum halicacabum L.	Small, not woody and commonly annual climber 1–3 m long	2–3 mm in diam.	Compact, 2.5–3.0 cm in length. Fruit structures consist of three dorsally keeled membranous capsules each consisting of three internal blades	With a kidney shaped hilum	The leaves and stems have not small reddish hairs
Cardiospermum grandiflorum Sw.	Large, semi-woody perennial climber 2–5 m long	7–11 mm in diam.	Elongated, 4.5–6.5 cm in length. The fruit are septifragal with the capsules breaking away from each other when fruit are ripe	With a round hilum	The leaves and stems have small reddish hairs

Table 4

Comparative features of alien species of *Corchorus* L. in the UAE

Species	Stamens	Carpels	Capsule	Leaf blade
C. aestuans L.	Stamens numerous (more than 20)	Carpels 5	Capsule cylindrical, angled, 3–5-valved, 3-winged, 4-6 mm across	Leaf blade abaxially sparsely pilose, glabrescent, petiole 0.5–4 cm long, purple
C. olitorius L.	Stamens numerous (more than 20).	Carpels 5	Capsule cylindrical, slightly curved, 10-angled, robust, 5–6-valved, ca. 4–5 mm across	Leaf blade margin serrulate, petiole 0.8–3.5 cm, green
C. trilocularis L.	Stamens 15–20	Carpels 3	Capsule triangular, 3-loculed, ca. 2.5 mm across	Leaf blade margin crenate, petiole 0.5–1 cm, green

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