



Short Communication

# First record of *Lindernia dubia* (Linderniaceae) in Georgia, and note on *L. procumbens* in the South Caucasus

Vasily S. Vishnyakov

Papanin Institute for Biology of Inland Waters of the Russian Academy of Sciences, Borok 109, RU-152742 Yaroslavl Oblast, Russia

**Abstract** – *Lindernia dubia* (L.) Pennell, a species of American origin, is reported for the first time from the South Caucasus. In 2023, a relatively large population of *L. dubia* was found in the Chorokhi River floodplain in the Autonomous Republic of Adjara, Georgia, the South Caucasus. The species is considered to be intensively spreading around temperate and subtropical regions worldwide, commonly occupying disturbed wetland habitats. The new record further expands the introduced range of the species in the Caucasus, where it was first reported from rice-growing regions of the Krasnodar Territory in 2017.

**Keywords:** Adjara, alien species, Caucasus, neophyte, wetland annuals

## Introduction

The Georgian vascular flora includes approximately 4275 species from 1048 genera, including around 460 taxa of alien origin (Davlianidze et al. 2018), and there is ample evidence that there is a steady increase in the number of alien species. West Georgia, with its developed port infrastructure along the Black Sea coast, long-standing cultivation of various subtropical crops, and extensive landscape gardening, has long been regarded as a gateway for alien plant species into the Caucasus, particularly those found in aquatic and wetland habitats.

In this report, *Lindernia dubia* (L.) Pennell (Linderniaceae, formerly Scrophulariaceae) is recorded for the first time in the South Caucasus from Georgia. The species, native to the Americas (Lewis 2000), has been rapidly spreading across Europe, South, and East Asia in recent decades (Casper and Krausch 1981, Šumberová et al. 2012, Krishnasamy and Arumugam 2015, Schmotzer 2015, Hrivnák et al. 2016, etc.). This species commonly occupies disturbed wet habitats and is a noxious weed in rice-growing regions. The new record marks the second *Lindernia* All. species in the South Caucasus flora, where only the palearctic *L. procumbens* (Krock.) Philcox has previously been reported (as *L. pyxidaria* All. ex L.; Grossheim 1967).

The discovery of *L. dubia* further extends the introduced range of the species, filling the gap between its European and Asian distributions.

The study aims to provide new data on the distribution of both *Lindernia* species in the South Caucasus. The morphology of *L. dubia* is briefly described based on newly collected herbarium material.

## Material and methods

Field studies focusing on wetland flora were conducted in 2023 in the Chorokhi River floodplain, near the Black Sea coast, where a relatively large population of the alien *Lindernia* species was discovered. This area is part of the Kakhberi Lowland, a small alluvial plain in the southernmost part of the Kolkheti Lowlands, bordered by the foothills of the Lesser Caucasus. It is formed by the solid sediments deposited by the Chorokhi River, with wetland vegetation largely confined to swampy areas south of the delta. The Kakhberi Lowland is densely populated, being part of the Batumi and Khelvachauri municipalities of Adjara, with numerous disturbed or anthropogenically created habitats.

Specimens were collected by hand and pressed for herbarium storage. Measurements of quantitative features (N = 10) were taken from herbarium material. To further

investigate *Lindernia* distribution, specimens from the BATU, TBI, TGM, and BAK herbaria were examined. The herbarium vouchers were deposited in BATU, IBIW, and LE.

## Results and discussion

*Lindernia dubia* (L.) Pennell 1935, Monogr. Acad. Nat. Sci. Philadelphia 1: 141. ≡ *Gratiola dubia* L. 1753, Sp. Pl.: 17. ≡ *Ilysanthes dubia* (L.) Barnhart 1899, Bull. Torrey Bot. Club 26: 376 (Fig. 1): Georgia / Sakartvelo, Autonomous Republic of Adjara, Khelvachauri municipality, near Batumi, the Chorokhi River floodplain, quarry, 41.58935° N, 41.60387° E, 7 m a.s.l., in shallow water and on muddy substrate, *Schoenoplectus-Lindernia* community, coll.: Vishnyakov, Aug 5, 2023, <https://www.inaturalist.org/observations/176780187> (IBIW, BATU); *ibid.*, Aug 28, 2023, <https://www.inaturalist.org/observations/180643998> (IBIW, LE); *ibid.*, Sept 21, 2023, <https://www.inaturalist.org/observations/184639935> (IBIW, LE).

Glabrous plants with mostly erect stems rooting at lower nodes, 3–30 cm in height. Leaves opposite, sessile, 5 veined; ovate to ovate-linear, with slightly dentate margins, 9–20 × 5–10 mm. Flowers solitary, axillary; pedicels shorter, equal or slightly longer than the subtending leaves. Calyx deeply 5-lobed; sepals narrow, linear, 3.5–5 mm. Corolla zygomorphic, tubular, 7–8.2 mm long, white in color, with blue to violet tint; lower lip distinctly 3-lobed. Stamens in two pairs, one posterior fertile and one anterior rudimentary. Capsules ovate, tapering towards the apex, 4–5.5 mm long, containing numerous, dust-like, yellowish seeds less than 0.5 mm long.

The morphology of the collected plants closely matched published descriptions (Casper and Krausch 1981, Lewis 2000, Aybeke 2016). *L. dubia* differs from the reported

*L. procumbens* by having mostly chasmogamous flowers, a rudimentary pair of stamens, a longer corolla, shorter pedicels, and toothed leaves (at least the upper ones), which have 5 veins (Škondrić et al. 2023). In the absence of flowers, the species can be distinguished by the morphology of the capsules (Molnár et al. 2000). Additionally, *L. dubia* typically branches in the middle and upper parts, unlike *L. procumbens*, which branches at the base (Zelenskaya 2020).

The *Lindernia* population was found in a shallow quarry, created a year earlier on the left bank of the Chorokhi River, which is no longer in use. The locality was revisited multiple times since spring (May), when the quarry was completely filled with rainwater, and pioneer communities of charophytes and pondweeds had developed. The *Lindernia* plants were first observed in early August as the water receded. By that time, the species had formed the lower tier of a sparse *Schoenoplectus triquetra* (L.) Palla community in the shallowest parts. By September, the quarry had dried up and was fully occupied by the *Lindernia* community, which also included various wetland annuals, with a prominent role being taken by Cyperaceae species: *Cyperus difformis* L., *C. flavescens* L., and *Fimbristylis bisumbellata* (Forssk.) Bubani. A few isolated plants were also observed along the bank of the Chorokhi channel below the quarry in September 2023: <https://www.inaturalist.org/observations/184639702>.

This is the first record of the species in Georgia and the South Caucasus. The nearest known localities are in the Krasnodar Territory, Russia, almost 500 km northwest of Adjara, where the species has become a common weed in rice fields of the Kuban River valley since 2017 (Zelenskaya 2020). Other nearby localities belong to southwest Romania (Neacșu et al. 2021), northwest Turkey (Aybeke 2016), and India (Krishnasamy and Arumugam 2015). It was demonstrated that the recent range expansion of this species is linked to human activity, particularly fish farming and



**Fig. 1.** *Lindernia dubia* (L.) Pennell from Georgia: A – group of plants collected for herbarium vouchers from the quarry Aug 5, 2023, note veins clearly visible from the abaxial side of leaves; B – plants from the Chorokhi channel observed Sept 21, 2023, note toothed upper leaves and short axillary pedicels.

shipping, as well as to hydrochory and avichory (Tzonev and Šumberová 2004, Šumberová et al. 2012, Schmotzer 2015). In the case of the Georgian locality, the exact mode of introduction remains unclear. It is possible that the species invaded the region only recently, as its distribution in the Chorokhi floodplain appears limited. However, due to the species' known invasive potential and high likelihood of further spread from the already invaded area, monitoring of the *L. dubia* population is essential. The quarry is frequented by humans and livestock, and *L. dubia* seeds can easily be transported by mud particles on rubber boots and hooves. Spring floods of the Chorokhi River may also facilitate seed dispersal.

The new locality is part of the region dominated by Colchis flora, which includes several endemic species restricted to wetland habitats. Among them, *Rhamphicarpa medwedewii* Albov was found growing alongside *L. dubia*, though it was represented by only a few scattered plants (IBIW). The invasion of *L. dubia* could pose a threat to this rare species of low abundance.

Herbarium search confirmed that the genus *Lindernia* was previously represented in the South Caucasus by a single species, *L. procumbens*. Notably, the most recent collection from the region dates back to 1917 (for Azerbaijani specimens). In Georgia, the species was last collected in 1910: Russian Lazistan, swampy bank of the Malyi Chorokh, coll.: G. Woronow no. 2679, Aug 27, 1910, TGM 40879!, TGM 40885!. Woronow's plants originate from the same area as *L. dubia*, i.e., south of the Chorokhi River delta in the Kakhaberi Lowland. However, no *L. procumbens* plants were found in this area in 2023. One possible explanation is that the species has gone unobserved for a long time or may be extinct. A decline in localities of this species has been observed in Europe, making it locally threatened. The invasion of *L. dubia* also presents a competitive disadvantage for the species (Šumberová et al. 2012, Schmotzer 2015). Another possibility is that *L. procumbens* only emerges from the soil seed bank during favorable conditions that occur intermittently (cf. Kaplan et al. 2016).

The findings of this study highlight the need for targeted searches for new localities of both *Lindernia* species in order to resolve the issue of *L. dubia* invasiveness and the current status of *L. procumbens* in the South Caucasus.

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