

# *Polycarpon tetraphyllum* (L.) L. (Caryophyllaceae) and *Arabis stelleri* DC. (Brassicaceae): two new records for the flora of Mainland China

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**Abstract.** In recent years, numerous botanical survey projects have been conducted across China, with accurate taxonomic identification being the primary objective of biodiversity research. Within this context, we report the discovery of *Polycarpon tetraphyllum* (L.) L. (Caryophyllaceae) and *Arabis stelleri* DC. (Brassicaceae) in Fujian, marking new records for the flora of mainland China. Furthermore, we provide detailed morphological descriptions, color photographs, and comparative taxonomic analyses with related species to scientifically substantiate the records of these two plant species.

**Key words.** Biodiversity research, coastal plants, floristic survey, geographical distribution, taxonomy

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## INTRODUCTION

Investigating the composition, geographic distribution, and phylogenetic relationships of angiosperm species is fundamental to understanding their diversity patterns (Qian et al. 2024). With the publication of the *Flora of China* (Wu et al. 1994), the number and distribution of angiosperm species in China have largely been addressed (Zhuang et al. 2021; Liu and Qin 2022). However, that work is far from complete. In fact, from time to time, ongoing ecological changes and frequent human activities necessitate continuous surveys of wild-plant resources. Despite the increased attention given to biodiversity, the data show that the Chinese flora increased in size at the rate of more than 200 taxa annually (Mi et al. 2021). Regional plant surveys are still needed, especially in areas in the southwest and on the southern islands (Du et al. 2020).

Fujian Province, located on the southeastern coast of China, is characterized by a subtropical monsoon climate, making it one of China's biodiversity hotspots with a rich plant diversity (Zhu et al. 2019; Xie et al. 2021). It is estimated that this region harbors approximately 6000 plant species (An et al. 2023). Nevertheless, the floristic composition of Fujian is dynamic, with new records being periodically documented. Within this context, our study reports, for the first time, two species of plant for mainland China: *Polycarpon tetraphyllum* (L.) L. and *Arabis stelleri* DC.

During recent botanical surveys of the islands in Fujian Province, we collected specimens of two previously unrecorded wild plants from coastal counties and cities. Detailed examination of fresh plant material, diagnostic characteristics of herbarium specimens, and a review of taxonomic literature led to the identification of these species as the alien *Polycarpon tetraphyllum* (L.) L., which is native to the Mediterranean region (Gereau and Marticorena 1995; Kool et al. 2007), and the endemic *Arabis stelleri* DC. from Taiwan (Huang et al. 1995). To scientifically validate our new records from mainland China, we provide comprehensive taxonomic descriptions and diagnostic microscopic photographs (Figures 1, 2) of the two species. This will facilitate easier field identification.

## METHODS

This study is based on multiple surveys of herbal resources and floristic investigations conducted in Fujian Province from October 2023 to May 2024. The plants were discovered in roadside wastelands on the islands.



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Extensive field tracking and observations were then performed to systematically assess the population status and phenological characteristics of the studied species. These initial investigations suggest that these two plants represent species not previously recorded in mainland China.

Key identification features, such as plant trichomes, were meticulously examined using a Leica M205a microscope (Leica Microsystems Ltd., Heerbrugg, Switzerland). Unique distinguishing characteristics were identified by comparing the specimens with those of closely related species and virtual herbarium images. Further verification was carried out by consulting relevant taxonomic literature (Schilling et al. 2022) and online electronic floras (eFloras 2008; POWO 2024) to ensure accurate species identification. A map showing the global distribution of each species was prepared based on occurrence data available at the Global Biodiversity Information Facility (GBIF 2001). Specimens of the two studied species were collected, dried, and processed and are now deposited in the Herbarium of Fujian University of Traditional Chinese Medicine (FJTCM) and Herbarium of Fujian Normal University (FNU).

## RESULTS

### *Polycarpon tetraphyllum* (L.) L., Syst. Nat., ed. 10. 2: 881 (1759)

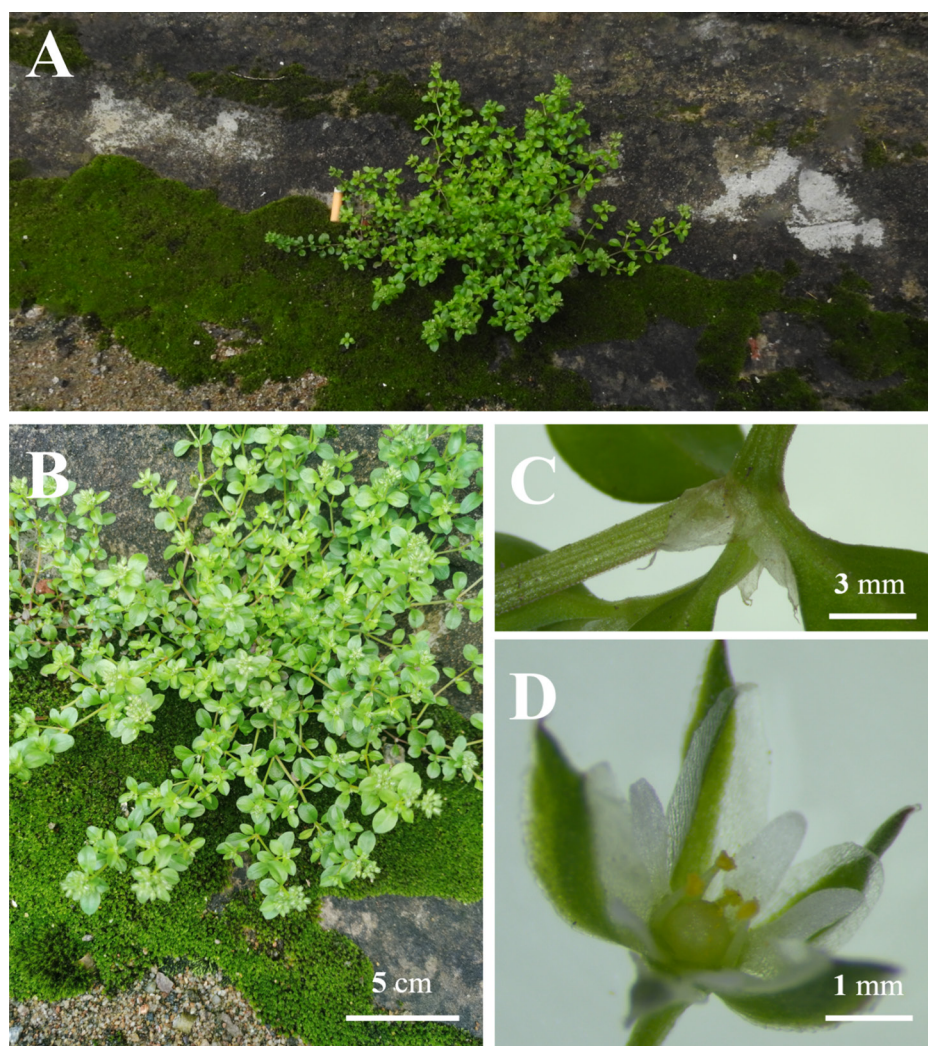
Basionyms: *Holosteum tetraphyllum* (L.) Thunb; *Polycarpaea tetraphylla* (L.) E.H.L.Krause; *Mollugo tetraphylla* L.

#### Figure 1

**New records.** CHINA – FUJIAN • Fuzhou, Lianjiang, Guantou, Huijiang island; 26°06'54"N, 119°38'41"E; 27 m alt.; 13.IV.2024; Guican Lin leg.; 3 spec., FNU, 35062220423001LY.

**Identification.** Annual herb, 10–15 cm tall. Stems decumbent, glabrous, much-branched. Leaves green or red, glabrous, whorled in fours or rarely opposite, herbaceous, petiolate, spatulate, oblanceolate, or elliptical, 5–8 mm long, approximately 3–8 mm wide, apex obtuse, base gradually narrowing. Each node with 2 stipules, membranous, lanceolate to triangular-ovate, 1.5–3.0 mm long, entire, base keeled, apex acuminate or some-

**Figure 1.** *Polycarpon tetraphyllum* in Lianjiang, Fujian, China. **A.** Habit. **B.** Flowering plant. **C.** Stipule. **D.** Dissected perianth, side view. Photographs: Guican Lin.



times awned. Terminal congested cymes, paniculate, occasionally axillary or lax, bracts paired, about 4 mm, resembling stipules in shape. Petals oblanceolate to oblong, minute, 5 in number, usually shorter than the sepals, white, apex slightly emarginate or rounded. Stamens 3–5, filaments scattered around the ovary, free. Ovary superior, styles 3, filiform, 0.1–0.3 mm long, nearly glabrous. Capsule ovoid to globose, 3-valved, pedicellate. Seed 8–15, white, 0.4–0.5 mm long, ovoid or triangular, surface papillose.

**Flowering and fruiting.** Mostly September–November, sometimes as late as January.

**Habitat and global distribution.** Terrestrial. It tends to grow in disturbed, shady areas. It is commonly found as a weed growing in crevices in roads, gardens, and fields. Native to Southern Europe, the British Isles, the Mediterranean region, the Middle East, and the Indian subcontinent. It has been introduced to the Americas, Australia, New Zealand, and Southeast Asia (Figure 3).

**Taxonomic notes.** The genus *Polycarpon* comprises approximately 9–16 species, most of which are inconspicuous small herbs that seldom attract attention (Hernández-Ledesma et al. 2015). However, *P. tetraphyllum* has become a cosmopolitan weed and, as an invasive species with high reproductive potential, necessitates preliminary investigation and assessment for prevention and control. To distinguish native *Polycarpon* species and support future biological control efforts, if needed, we have provided a dichotomous key:

- 1 Annual or perennial, sprawling small herb, with branches usually less than 20 cm; stems, leaves, and sepals nearly glabrous to cobwebby. Leaves opposite or pseudovercillate ..... 2
- 2 Sepals 1.5–2.5 mm, keeled; stipules 1.8–2.8 mm; leaves in whorls of 4 or opposite .... *P. tetraphyllum* (L.) L.
- 2' Sepals 1–1.5 mm, flat or sometimes barely keeled; stipules 0.4–1.2 mm; leaves opposite, not whorled ..... *P. prostratum* (Forssk.) Asch. & Schweinf.

**Comments.** The precise native range of *P. tetraphyllum* (L.) L. remains undetermined; however, most authoritative sources posit its origin in southern Europe and the Mediterranean region. Furthermore, an examination of specimens from the Chinese Virtual Herbarium (CVH 2006) revealed that this species had previously been collected in Fuzhou, Fujian Province (voucher specimen no. CB09054, accession no. CSH0085729, CSH0085730, collected by Bin Chen, Fuzhou, Fujian, dated 14.04.2015). However, the collector had misidentified it as *P. prostratum*. Based on the present study, the genus *Polycarpon* is now represented by two species in China: *P. tetraphyllum* and *P. prostratum*.

### ***Arabis stelleri* DC. Syst. Nat. 2: 242. 1821**

**Basionyms:** *Arabis stelleris* DC. var. *japonica* (A. Gray) Fr. Schmidt, *Arabis alpina* Linnaeus var. *japonica* A. Gray; *Arabis fauriei* H. Léveillé; *Arabis japonica* (A. Gray) A. Gray; *Arabis kelunginsularis* Hayata; *Arabis lithophila* Hayata; *Arabis yokoscensis* Franchet & Savatier.

### **Figure 2**

**New records.** CHINA – FUJIAN • Pingtan, Dalian Island; 25°39'25"N, 119°42'36"E; 23 m alt.; 28.II.2024; Guican Lin leg.; 3 spec., FNU, 350128240228001LY.

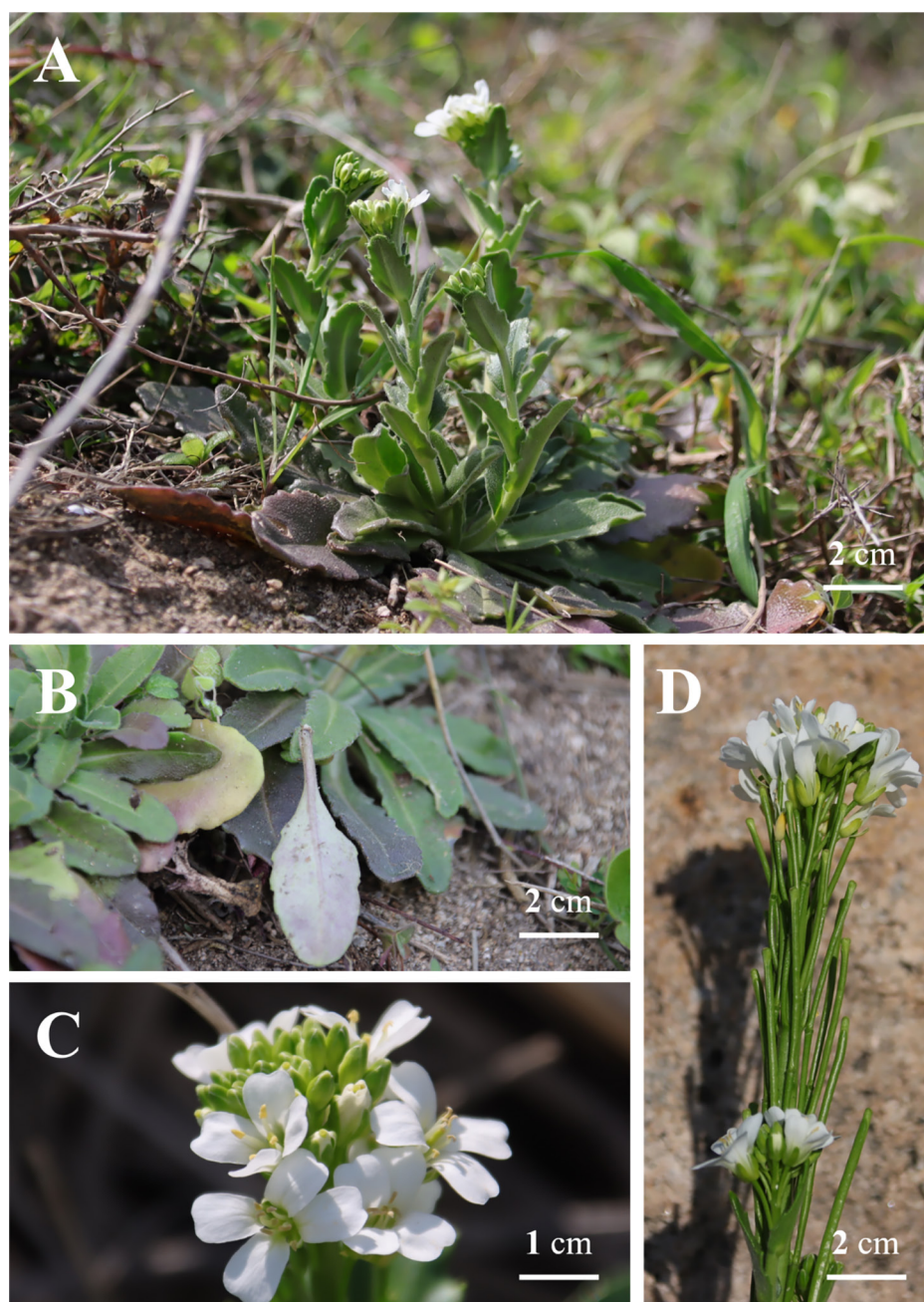
**Identification.** Perennial herbs, fleshy, measuring 20–45 cm in height, sparsely to densely pilose, featuring a combination of simple, stalked, forked, and 3- or 4-rayed stellate trichomes. Stems erect or ascending, either simple or branched at base, with primarily simple trichomes at base. Basal leaves forming a rosette; petioles 1–2 cm long, winged; leaf blades spatulate, oblanceolate, obovate, or oblong, measuring 2–7 × 1–3 cm with base attenuate, margins entire or occasionally denticulate, and apices rounded or obtuse. Middle cauline leaves sessile, oblong or ovate, pilose, with predominantly stellate and forked trichomes; base auriculate, cordate, or rarely amplexicaul, with margins dentate or entire and apex obtuse or rounded. Racemes ebracteate. Fruiting pedicels erect or rarely ascending, often subappressed to rachis, measuring 0.7–2.0 cm, slender, straight. Sepals oblong, measuring 4.0–5.0 × 1.5–2.0 mm, glabrous, with lateral pair of sepals saccate. Petals white, spatulate, measuring 7.0–10.0 × 3.0–4.0 mm, with apex shallowly emarginate. Filaments 3.5–6.0 mm long; anthers oblong, measuring 1.0–1.5 mm. Each ovary contains 34–60 ovules. Fruits 3.0–6.0 cm × 1.5–2.0 mm, erect and appressed to rachis; valves torulose, glabrous, with a prominent midvein extending full length; styles (0.1–)0.5–1.0(–1.5) mm long. Seeds brown, suborbicular or ovate-oblong, measuring 0.9–1.4 × 0.8–1.0 mm, uniseriate, narrowly winged distally, with wing to 0.1 mm wide.

**Flowering and fruiting.** April to June.

**Habitat and global distribution.** Sandy coasts, roadsides, streamsides, forest margins; near sea level to 600 m. Native to Korea, Japan, Russia, and Taiwan (Figure 4).

**Taxonomic notes.** *Arabis* is an important taxonomically complex genus in Brassicaceae, with over 100 reported species (Koch et al. 1999). It is characterized by the existence of branched trichomes, and latiseptate siliques flattened parallel to the septum (Koch et al. 2008). In Mainland China, it is possible to confuse *A. stelleri* with *A. hirsuta* and *A. pterosperma*. Thus, to facilitate the identification and distinction of *A. stelleri*, we include a dichotomous key.

- 1 Fruit and often fruiting pedicels erect, appressed to rachis ..... 2
- 2 Petals (3.5–)4–5 mm; fruit 0.8–1.2 mm wide ..... *Arabis hirsuta* (L.) Scop.
- 2' Petals 6–10 mm; fruit 1.5–2 mm wide ..... 3



**Figure 2.** *Arabis stelleri* in Pingtan, Fujian, China. **A.** Habit. **B.** Leaf, adaxial and abaxial view. **C.** Flower, frontal view. **D.** Fruit. Photographs: Guican Lin.

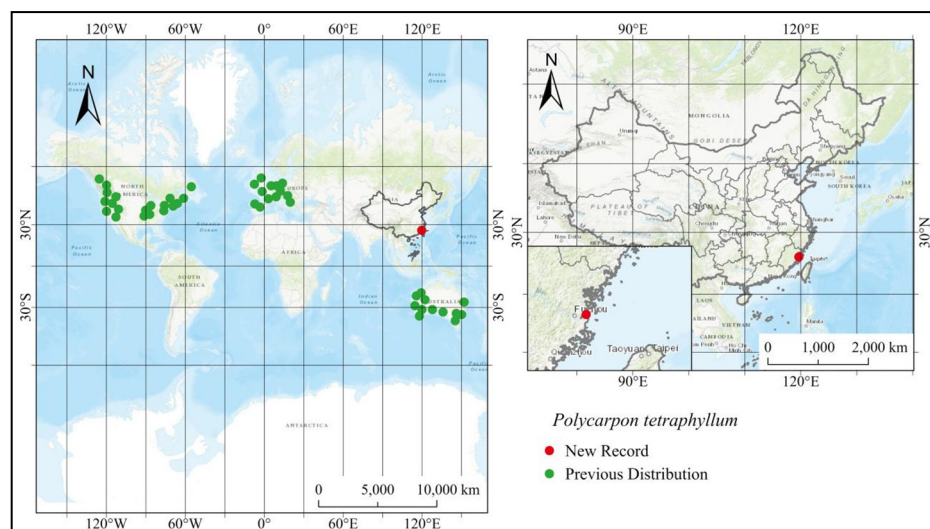
- 3 Petals white, 3–4 mm wide, apex shallowly emarginate; sepals 4–5 mm, lateral pair saccate; middle cauline leaves pilose with primarily branched trichomes; seeds narrowly winged distally ..... *A. stelleri* DC.
- 3' Petals purple, pink, or rarely white, 2–3 mm wide, apex rounded; sepals 2.5–3.5 mm, lateral pair not saccate; middle cauline leaves hirsute with predominantly simple trichomes; seeds broadly winged all around ..... *A. pterosperma* Edgew.

**Comments.** It is noteworthy that *A. stelleri* DC. is listed as Vulnerable (VU) in the “Red List of Vascular Plants of Taiwan,” published in 2017 (Moon et al. 2023). The newly discovered population comprises only about 30 individuals, necessitating enhanced conservation efforts.

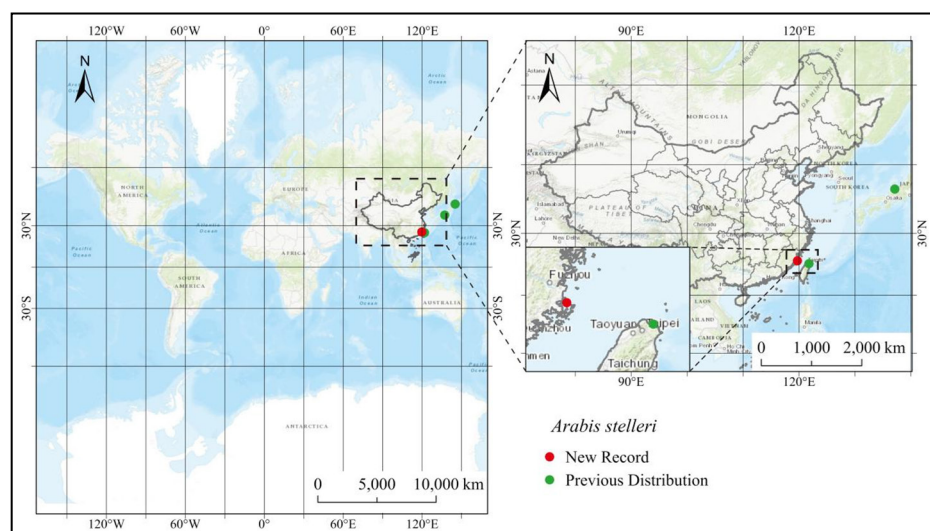
## DISCUSSION

Our new records are for two species, *Polycarpon tetraphyllum* and *Arabis stelleri*, both small herbaceous plants growing in coastal areas or on islands, which are easily overlooked. These species are extremely difficult to detect, especially for individuals without systematic taxonomic training. *Arabis stelleri* is an endangered species in Taiwan Province. Our discovery of this species outside of Taiwan extends its known distribution range, which is important for the conservation of its population. Additionally, *P. tetraphyllum* is a widespread weed of culti-

**Figure 3.** Geographical distribution map of *Polycarpon tetraphyllum*. The green circles represent previous distribution; the red circle represent new record from Mainland China.



**Figure 4.** Geographical distribution map of *Arabis stelleri*. The green circles represent previous distribution; the red circle represent new record from Mainland China.



vated and waste areas, thought to be originally native to the Mediterranean region. It is regarded as an invasive species in Australia, New Zealand, Japan, parts of South America, and the USA. This highlights the importance of monitoring and managing plant species to prevent potential invasions and ensure ecological balance.

Island plant communities are renowned for their morphological characteristics and exhibit notable examples of trait evolution (Barajas Barbosa et al. 2023). As isolated continental entities, islands are influenced by maritime and terrestrial climates, and their small area often supports simple plant communities with small population sizes, low reproductive rates, and weak defenses. Consequently, their ecosystems are simpler and more vulnerable compared to other regions (Wardle et al. 1997; Médail 2017). Given this fragility, it is crucial to adopt effective conservation strategies. Therefore, we propose the following actions: (1) continuously conduct biodiversity surveys and monitoring in island regions, particularly focusing on biological groups that have been underexplored or previously unstudied; (2) regularly survey to detect new invasions and implement measures to eradicate newly introduced species; (3) strengthen research in biology, ecology, and environmental science to address biodiversity conservation and ecological restoration in the context of human disturbances and global changes. These measures will help protect the unique and sensitive ecosystems of island regions, ensuring their sustainability for future generations.

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## ADDITIONAL INFORMATION

### Conflict of interest

The authors declare that no competing interests exist.

### Ethical statement

No ethical statement is reported.

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### Author contributions

Conceptualization: MC. Data curation: GL. Formal analysis: HZ. Funding acquisition: CY. Investigation: BN. Methodology: GG. Supervision: CA. Writing – original draft: CA. Writing – review and editing: CA.

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### Data availability

All data that support the findings of this study are available in the main text and Supplementary materials

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