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## Re-discovering *Entzia*, an agglutinated foraminifer from the Transylvanian salt marshes

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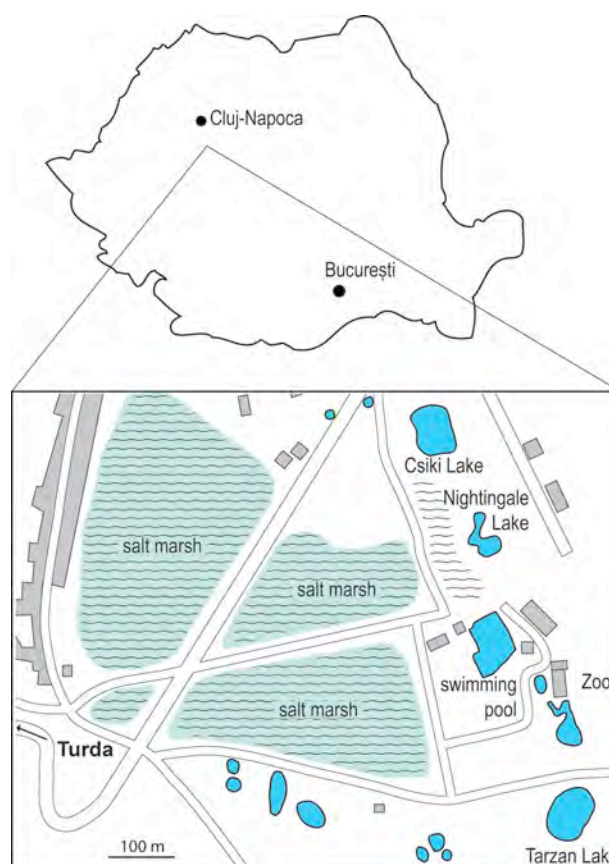
### ABSTRACT

Following the original description of the foraminifer *Entzia tetrastomella* made by Jenő (Eugen) von Daday in 1883-1884, a number of salt marshes in Transylvania were sampled with the intention of recovering additional specimens. *Entzia* specimens from the salt march at Turda are small, with thin, flexible, very lightly agglutinated walls with a preference for dark mineral grains, and the tests usually collapse upon drying. We document the apertural characteristics of these new specimens and compare them with published illustrations of specimens of *Jadammina* from other European marshes. The genus *Entzia* was recognised as valid by Loeblich & Tappan (1987) and placed into the family *Trochamminidae*, Subfamily *Jadammininae*. Its relationship to the type genus of the subfamily *Jadammina* is here critically re-examined. Based on morphological and ecological criteria, we hereby regard the genus *Entzia* to be the senior synonym of *Jadammina*.

### INTRODUCTION

Modern salt marshes world-wide contain abundant and sometimes diverse foraminifera belonging to the superfamily Trochamminacea. One of the most widely distributed species from the high salt marsh environment is the species commonly known as *Jadammina macrescens*. Originally described as *Trochammina macrescens* by Brady (1870) from the River Dee in England, Bartenstein (1938) placed the species in his new genus *Jadammina*. In his original description of the genus, Bartenstein compared his specimens collected from the Jade estuary in NW Germany to a species first described in Transylvania as *Entzia tetrastomella*: a species only known from a single report published by von Daday in 1884.

The main purpose of our study was to search the reported type locality of *Entzia tetrastomella* and other nearby localities in Transylvania to recover new specimens in order to determine the relationship of the species to *Jadammina macrescens*. Although the original site described by Daday (1884) in Deva no longer exists, we visited a number of salt marshes in Transylvania (Ocna Sibiului, Turda, Cojocna) with the hope of recovering additional specimens, documenting their apertural characteristics and comparing them with specimens of *Jadammina* from other European marshes. In this paper we report the new finding of living specimens from Turda (Fig. 1).



**Figure 1.** Location of the salt marshes in Turda and on the map of Romania.

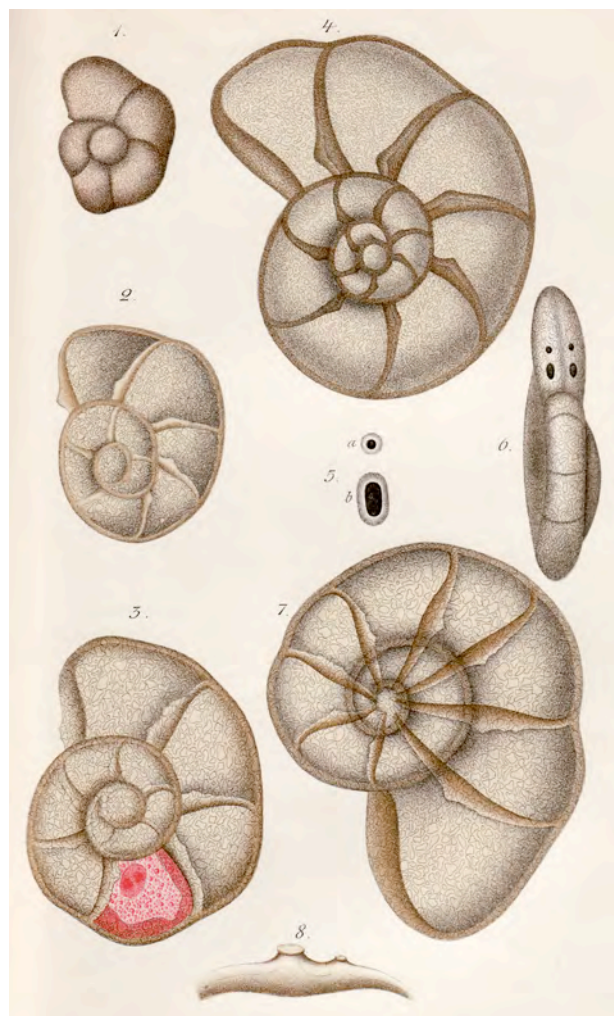


## PREVIOUS STUDIES

In 1883, Jenö (Eugen) von Daday, at that time professor at the University of Klausenburg (today Cluj-Napoca), described an enigmatic polythalamian from a salt marsh near Deva. Named *Entzia* after his professor Géza Entz, this species was only known from the colourful lithograph that followed his original description one year later (Fig. 2). Daday (1883) described his specimens as follows: “The test is made up of silica plates with different shapes and sizes embedded in a chitinous material. The chambers are coiling from left to right, and form a shape reassembling the shells of the flattened *Helix*. They are visible only on the convex side, whilst on the concave side they are obliterated. Pores are not visible on the surface of the test. Two larger, ovoidal, tubularly dragged out openings, and two smaller, circular openings are present on the front side of the last chamber [apertural face]. Similar openings can be found on the septa of the other chambers too, and the chambers are interconnected through these openings”. Unfortunately, the whereabouts of Daday’s type specimens are unknown. Other salt marshes, including those around the Caspian Sea have also yielded similar trochamminaceans. Schmalhausen (1950) described the new genus *Borovina* from Kazakhstan, and Shchedrina (1955) described *Trochamminisca* from the White Sea in the Russian Arctic. These genera were regarded as synonyms of the genus *Jadammina* by Loeblich & Tappan (1987). The majority of the foraminiferal workers currently use the name *Jadammina* (or *Trochammina*) *macrescens* to describe specimens from saline lakes and salt marshes around the world (e.g., Warren, 1957; Phleger, 1965; Boltovskoy & Lena, 1966; Tufescu, 1969; Jakovskaja & Mikhalevich, 1972; Saffert & Thomas, 1998; Gehrels & van de Plassche, 1999; Debenay et al., 2001; Javaux & Scott, 2003; Gehrels & Newman, 2004; Barbosa et al., 2005; Franceschini et al., 2005; Frenzel et al., 2005; Langer & Lipps, 2006; Pascual & Rodriguez-Lazaro, 2006; Vasquez Ribeiros et al., 2007; Wilson et al., 2008). However, in our opinion the relationship of Bartenstein’s *Jadammina* to Von Daday’s *Entzia* has never been fully resolved owing to the lack of type specimens.

## MATERIAL AND METHODS

Beginning in 1999, we visited the salt marsh in Turda (N46.57726 E23.80682) on several occasions, but our sampling strategy only achieved positive results since 2007. Samples were collected from surficial mud at various localities in the salt marsh. Initially, we used a randomised sampling approach by employing the enthusiasm of a group of UCL M.Sc. Micropalaeontology students who were instructed to collect mud



**Figure 2.** Original illustration of *Entzia* from Daday (1884).

samples. Initially, two of the samples proved to be positive, one from a shallow pool with live *Artemia* brine shrimp opposite the entrance to the swimming pool in Turda, and another from a small *Salicornia* marsh adjacent to a sewage outflow.

Samples were preserved in ethanol and stained with Rose Bengal in order to separate living specimens. We managed to recover specimens of *Entzia* only during the warm season (April to October). The samples (200 to 300 grams each) were processed by standard micropalaeontological methods and the specimens were recovered from the 63 µm fraction. Specimens were imaged using an Olympus SZ61 stereomicroscope and a JSM-JEOL 5510 LV scanning electron microscope.

## SYSTEMATICS

Suborder TROCHAMMININA Saidova, 1981  
 Superfamily TROCHAMMINACEA Schwager, 1877  
 Family TROCHAMMINIDAE Schwager, 1877  
 Subfamily JADAMMININAE Saidova, 1981

*Entzia* von Daday, 1884

*Entzia* von Daday, 1883, p. 209.

*Jadammina* Bartenstein & Brand, 1938, p. 38.

*Borovina* Schmalhausen, 1950, p. 869; type species:

*Borovina zernovi* Schmalhausen, 1950; OD.

*Trochamminisca* Shchedrina, 1955, p. 7; type species:

*Trochamminisca cyclostoma* Shchedrina, 1955; OD(M).

Test free, a flattened trochospire that tends to be nearly planispiral in the adult, chambers increasing gradually in size as added, sutures radial to slightly curved, periphery rounded. Wall imperforate, finely and sparsely agglutinated on a proteinaceous base. Aperture multiple; primary aperture a low interior-marginal equatorial slit, with one or more supplementary areal openings in the lower portion of the apertural face, each bordered by projecting lip. M. to U. Eocene; Arctic Canada. Holocene; Romania, salt pools; Germany; FSU: White Sea, Kazakh SSR; North & South America, salt marshes.

*Entzia macrescens* (Brady, 1870), n. comb.

Plates 1, 2

*Trochammina inflata* (Montagu) var. *macrescens* Brady, 1870, p. 290.

*Entzia tetrostomella* von Daday, 1883, p. 209.

*Jadammina polystoma* Bartenstein & Brand, 1938, p.38.

*Borovina zernovi* Schmalhausen, 1950, p. 869.

*Trochamminisca cyclostoma* Shchedrina, 1955, p. 7.

**Description.** As in the genus.

**Remarks.** Specimens are small, with thin, flexible, very lightly agglutinated walls (plate 1), and with a preference for dark mineral grains. Specimens readily collapse upon drying (plate 1, fig. 3). Our specimens display variable apertural features: single and multiple apertures are present (plate 2, figs 1-3).

The generic description of *Jadammina* was emended by Brönnimann & Whittaker (1984) based on detailed study of Brady's syntypes of *Trochammina inflata* var. *macrescens* Brady, 1870, which were found to possess multiple supplementary areal apertures. The lectotype of *T. inflata* var. *macrescens* designated by Brönnimann & Whittaker (1984, p. 307), BMNH, ZF-4212, illustrated here in Plate 1, figs. 3-4, is stated to be conspecific with *Jadammina polystoma* Bartenstein & Brand, 1938.

**Distribution in Transylvania.** Salt marsh at Turda.

**ENTZIA ASSEMBLAGE**

The ecology of the salt marshes in Transylvania has been described by Ciobanu et al. (2004), and Ciobanu (2005). The flora consists of hydrophyle species of *Zannichellia*, *Potamogeton*, *Najas*, *Myriophyllum*, *Potamogeton*, *Ranunculus* etc. There is a low diversity and number of palustral taxa (species of *Phragmites*, *Butomus*, *Alisma*, *Oenanthe*). The microfauna include a low diversity community of nematodes feeding on

bacteria and plants (*Doryllium*, *Geocenamus*, *Laimydorus*, *Nagelus*, *Tylencholaimus*, *Boleodorus*, *Mesodorylaimus*, *Rotylenchus*, *Tylencholaimellus* etc.), enchytraeids (*Fridericia*, *Enchytraeus*), colembolids (*Entomobrya*, *Lepidocyrtus*, *Tomocerus*, *Sminthurus*, *Axenylloides* etc.), coleopteres (*Cicindela*, *Dyschirius* etc.). Locally, shells of small gastropods and ostracods can be found in the rich organic-rich mud.

The marsh at Turda has been highly altered by human activities: mud is collected from the marsh for use in balneotherapy, a swimming pool has been dug, and domestic animals graze on the vegetation surrounding the marsh. However, small pools of salty water containing *Artemia* brine shrimp can be found at the southern edge of the main marsh area. These pools are surrounded by living halophytic and tolerant halophytic plants (*Salicornia europaea* ssp. *prostrata*, *Suaeda maritima* ssp. *pannonica*, *Atriplex bastata*, *Spergularia marina*, *Aster tripolium*, *Puccinellia peisonis*, *Aster tripolium*, *Triglochin maritima*, *Artemisia santonicum* ssp. *santonicum*, *Festuca pseudovina* etc.). It is in this area that the living specimens of *Entzia* were first discovered by members of the UCL MSc Micropalaeontology class in the autumn of 2007. *Entzia* was the only living foraminiferal species encountered in the samples.

Other agglutinated taxa are present. We identified a few irregularly coiled tubular and trochospiral forms, but their taxonomical position will be the subject of further investigations.

**DISCUSSION**

After the first description of the genus, the name *Entzia* was still in use. In their paper describing the new genus *Jadammina*, Bartenstein & Brand (1938) referred to *Entzia*, but incorrectly stated that the apertural characteristics of the latter are different. Schmalhausen (1950) also referred to *Entzia tetrostomella* when describing the new genus *Borovina* (considered a junior synonym of *Jadammina* by Loeblich & Tappan, 1987).

The genus *Entzia* was recognised as valid by Loeblich & Tappan (1987) and placed into the Family *Trochamminidae*, subfamily *Jadammininae*. However, its relationship to the genus *Jadammina*, remained unresolved. Some of our colleagues, including John Whittaker (personal communication to SF & MAK), have always suspected that the genus *Entzia* may be the senior synonym of *Jadammina*. This is likely due the similarities in their habitats. Comparisons are now possible owing to access to new material from Transylvania.

In our opinion, specimens illustrated by Daday and the specimens we recovered in 2007-2008 fit within the morphological variability of *Jadammina* as described by Bartenstein & Brand (1938). Although

Daday figured a specimen with four supplementary apertures (Fig. 2), Bartenstein (1969) illustrated specimens that possess 3 to 7 supplementary apertures (Fig. 3). We document specimens having between 1 and 3 supplementary apertures in our samples from Turda. Daday's specimen fits within the variability of *J. macrescens* from the British and German marshes. We therefore regard the genus *Entzia* to be the senior synonym of *Jadammina*, while the species name *macrescens* (*Trochammina macrescens* Brady, 1870) has priority over *tetrastomella* (*Entzia tetrastomella* Daday, 1883). Therefore, the correct new combined name is *Entzia macrescens* (Brady, 1870).

The name *J. macrescens* is also used for specimens from saline lakes around the world: North America, Europe, South Africa, Asia (Boltovskoy & Lena, 1966; Debenay, 2001; Frenzel *et al.*, 2005; Gehrels & van de Plassche, 1999; Gehrels & Newman, 2004; Javaux & Scott, 2003; Jakovskaja & Mikhalevich, 1972; Pascual & Rodriguez-Lazaro, 2006; Pflieger, 1965; Saffert & Thomas, 1998; Tufescu, 1969; Warren, 1957). The form described by Schmalhausen (1950) from Kazakhstan (Fig. 3c) is also regarded here as synonymous.

## CONCLUSIONS

Our new finding confirms the occurrence of living agglutinated foraminifera in continental environments in Transylvania, and specifically from the salt marsh in Turda. To our knowledge, this is the first report of "*Entzia*" since it was first described in 1883-1884. The species is here regarded as a junior synonym of *Trochammina macrescens* Brady, 1870. Based on comparison of their morphological features, we regard the genus *Jadammina* Bartenstein & Brand, 1938 to be a junior synonym of *Entzia* Daday, 1884.

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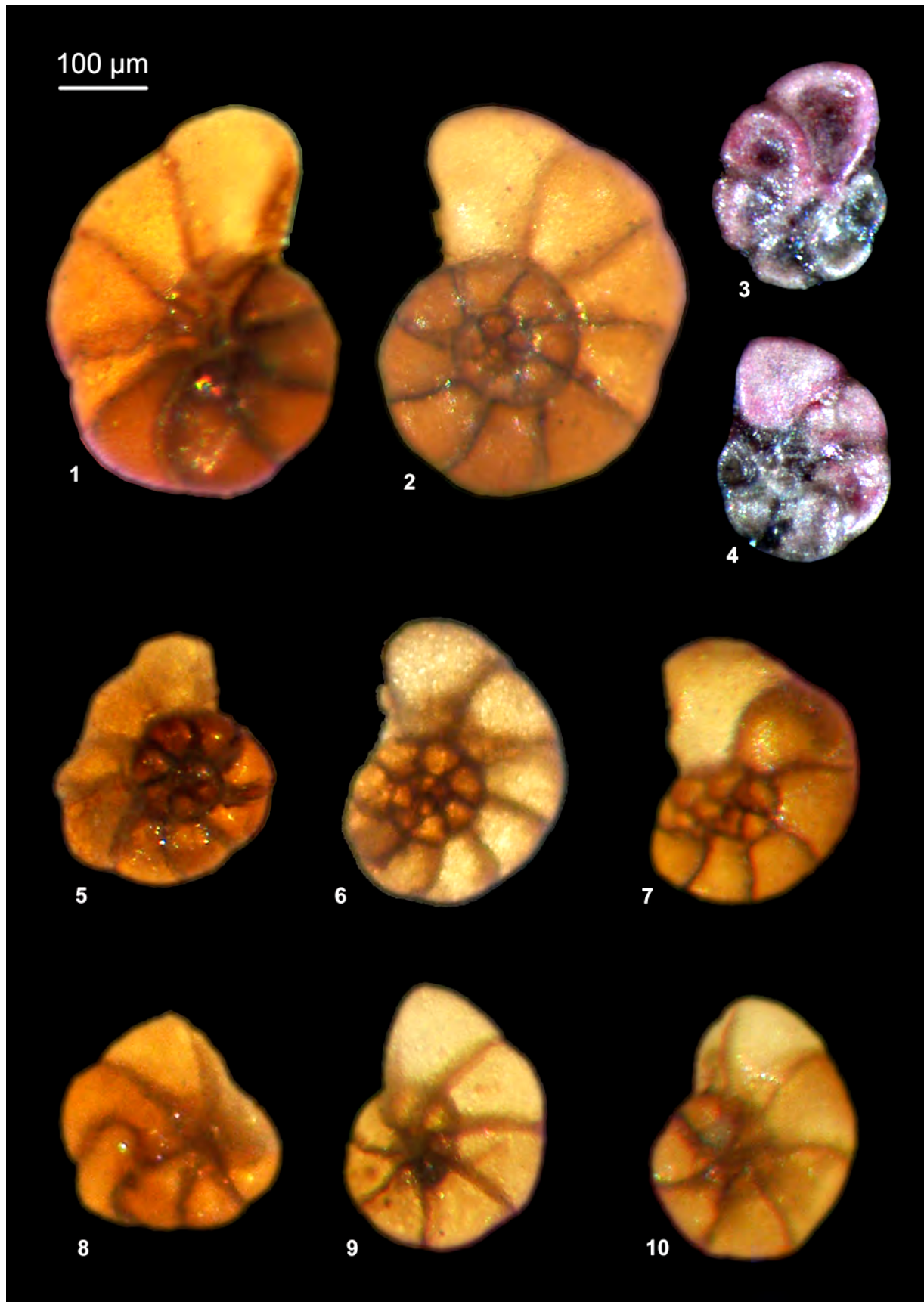
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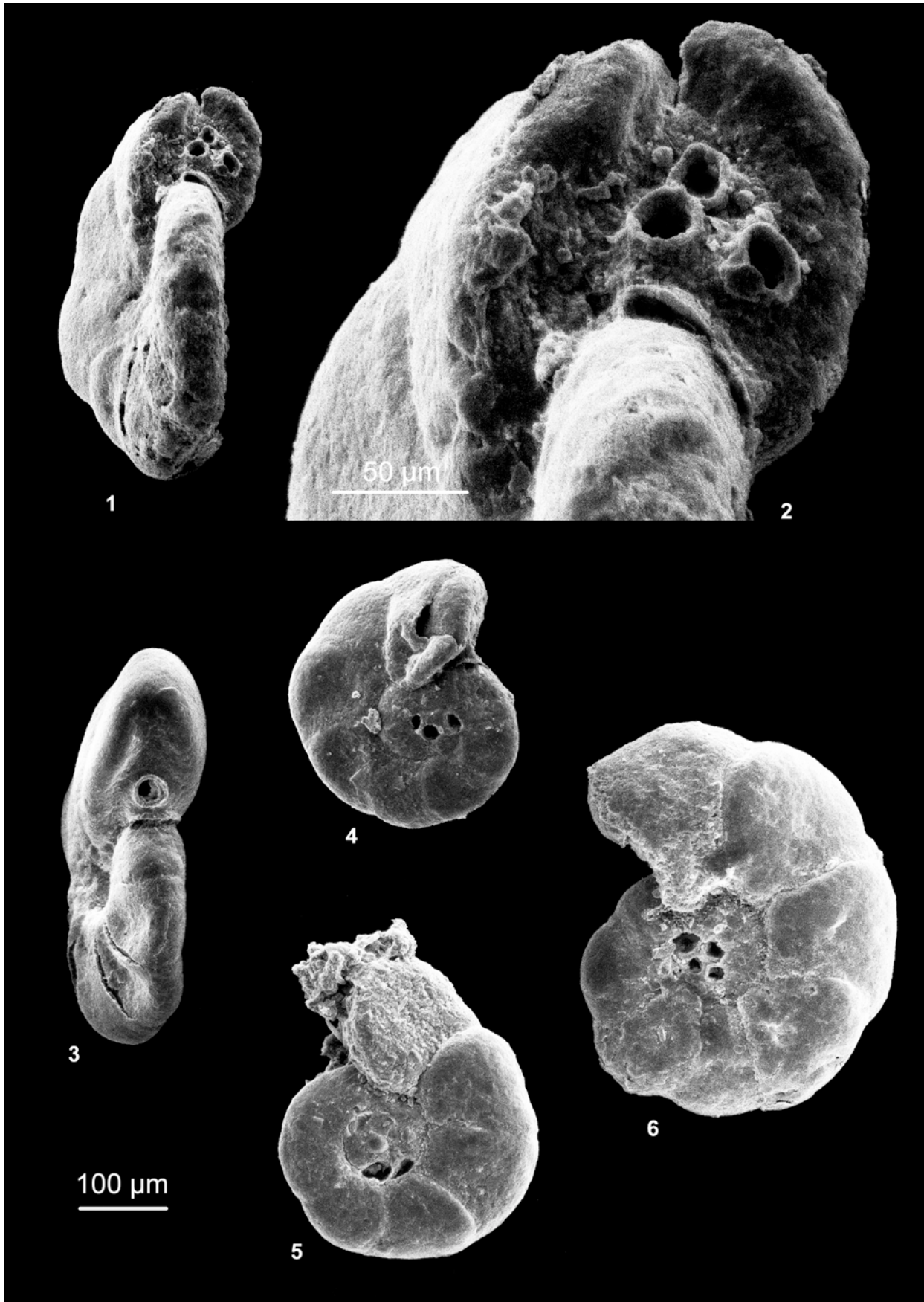
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**Plate 1.** Figs. 1-10. Stereomicroscope images of *Entzia* specimens collected from the Turda salt marsh. **1,2.** Large single aperture specimen (1. umbilical side; 2. spiral side); **3,4.** First specimen collected stained with Rose Bengal (3. umbilical side; 4. spiral side); **5-10.** Specimens showing the morphologic variability (5-7. spiral side; 8-10. umbilical side).





**Plate 2.** SEM images of *Entzia* specimens collected from the Turda salt marsh. **1-2.** Apertural views of the same specimen showing the low interiomarginal equatorial primary aperture and three supplementary areal apertures; **3.** Specimen with a single supplementary aperture; **4-6.** Spiral views of different specimens (cytoplasm extending out of the test and building a new chamber can be observed in specimen no. 5).