

ANNALES

Anali za istrske in mediteranske študije
Annali di Studi istriani e mediterranee
Annals for Istrian and Mediterranean Studies
Series Historia Naturalis, 35, 2025, 2





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Series Historia Naturalis, 35, 2025, 2

ISSN 1408-533X
e-ISSN 2591-1783

UDK 5

Letnik 35, leto 2025 številka 2

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Založništvo PADRE d.o.o.

Založnika/Editori/Published by:Zgodovinsko društvo za južno Primorsko - Koper / Società storica del Litorale - Capodistria®
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e-mail: annalesSHN@nib.si, internet: www.zdjp.si

Redakcija te številke je bila zaključena 6. 12. 2025.

**Sofinancirajo/Supporto finanziario/
Financially supported by:**

Javna agencija za znanstveno-raziskovalno in inovacijsko dejavnost Republike Slovenije (ARIS)

Annales - Series Historia Naturalis izhaja dvakrat letno.**Naklada/Tiratura/Circulation:**

300 izvodov/copie/copies

Revija Annales, Series Historia Naturalis je vključena v naslednje podatkovne baze / La rivista Annales, series Historia Naturalis è inserita nei seguenti data base / Articles appearing in this journal are abstracted and indexed in: BIOSIS-Zoological Record (UK); Aquatic Sciences and Fisheries Abstracts (ASFA); Elsevier B.V.: SCOPUS (NL); Directory of Open Access Journals (DOAJ).

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received: 2025-10-06

DOI 10.19233/ASHN.2025.33

NEW FINDINGS OF THE CUP-SHAPED DEMOSPONGE *CALYX NICAENSIS* (RISSE, 1826) ON THE ROCKY OUTCROPS IN THE GULF OF TRIESTE (NORTHERN ADRIATIC SEA)

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ABSTRACT

The cup-shaped demosponge Calyx nicaeensis (Risso, 1826) is an endemic Mediterranean species. It is considered to be a rare species, which needs to be included into international conservation protocols. Between 2023 and 2025, 17 specimens were recorded on the rocky outcrops in the Gulf of Trieste for the first time, within a Site of Community Importance (SCI) of the European Natura 2000 network.

Key words: Cup-shaped sponge, northern Adriatic Sea, rocky outcrops, SCI, Natura 2000

NUOVE SCOPERTE DELLA SPUGNA CALICE *CALYX NICAENSIS* (RISSE, 1826) SUGLI AFFIORAMENTI ROCCIOSI NEL GOLFO DI TRIESTE (ALTO ADRIATICO)

SINTESI

La spugna calice Calyx nicaeensis (Risso, 1826) è una specie endemica del Mediterraneo. Viene considerata una specie rara, la quale dovrebbe essere inclusa all'interno dei protocolli internazionali per la conservazione. Tra il 2023 e il 2025, 17 esemplari di questa specie sono stati trovati per la prima volta sugli affioramenti rocciosi nel Golfo di Trieste, all'interno di un Sito di Importanza Comunitaria (SIC) della rete Natura 2000.

Parole chiave: spugna calice, Alto Adriatico, affioramenti rocciosi, SIC, Natura 2000

INTRODUCTION

The cup-shaped demosponge *Calyx nicaeensis* (Risso, 1826) (Haplosclerida: Phloeodictyidae) is an endemic Mediterranean species, as suggested by its specific name, with the type locality in the Gulf of Nice in France. It is widely regarded as a rare species undergoing regression in the NW Mediterranean (Pronzato, 2003; Cerrano *et al.*, 2013). Within the EU Marine Strategy Framework Directive, it has been identified as an epimegazoobenthic structuring species in coralligenous habitats (Trainito *et al.*, 2020). In some areas of the eastern Mediterranean Sea, the sponge is still fairly common, and old sponge fishermen employ a small piece of *C. nicaeensis* moistened in seawater: simply scrubbing the small piece on the inside of the mask ensures prevent mask fogging during dives (Baldacconi, 2010).

C. nicaeensis exhibits a distinctive calyx morphology (Fig. 1) that is occasionally characterised by an irregular, massive shape with several thick extensions, each measuring 1–2 cm in diameter, and has a hard, fibrous consistency. It is notable that the diameter can reach up to 20 cm. The colour varies from beige to dark brown. The skeleton consists of a network of tiny siliceous needles (spicules)

that occur in two sizes: large and small (100–150 and 35–80 µm, respectively) (Baldacconi, 2010). *C. nicaeensis* shows a peculiar strategy of asexual reproduction by producing buds from the sponge base. The larval stage of this species has never been found, nor has that of any other species of this family (Maldonado, 2006). Cup-shaped sponges inevitably trap coarse sediments, and *C. nicaeensis* is thought to collapse its osculum when it is filled with sediment (Cerrano *et al.*, 2013).

C. nicaeensis occurs across a wide bathymetric range (up to 400 metres) (Vacelet, 1960), but it is most commonly found at depths between 5 and 55 m in many areas of the Mediterranean Sea. It inhabits both *Posidonia oceanica* meadows and coralligenous concretions. In shallower areas, it is found in pre-cave conditions (Cerrano *et al.*, 2013).

In the monograph on sponges of the Adriatic Sea (1862), Schmidt reported it as *Reniera calix* Nobis., although the author expressed uncertainty about the classification, as evident from the way he described the species (from the original German description): “Nardo classified it as *Esperia* but later informed me that it should form its own genus. It cannot be classified as an *Esperia* since the cupped sponge does not possess any of the characteristics

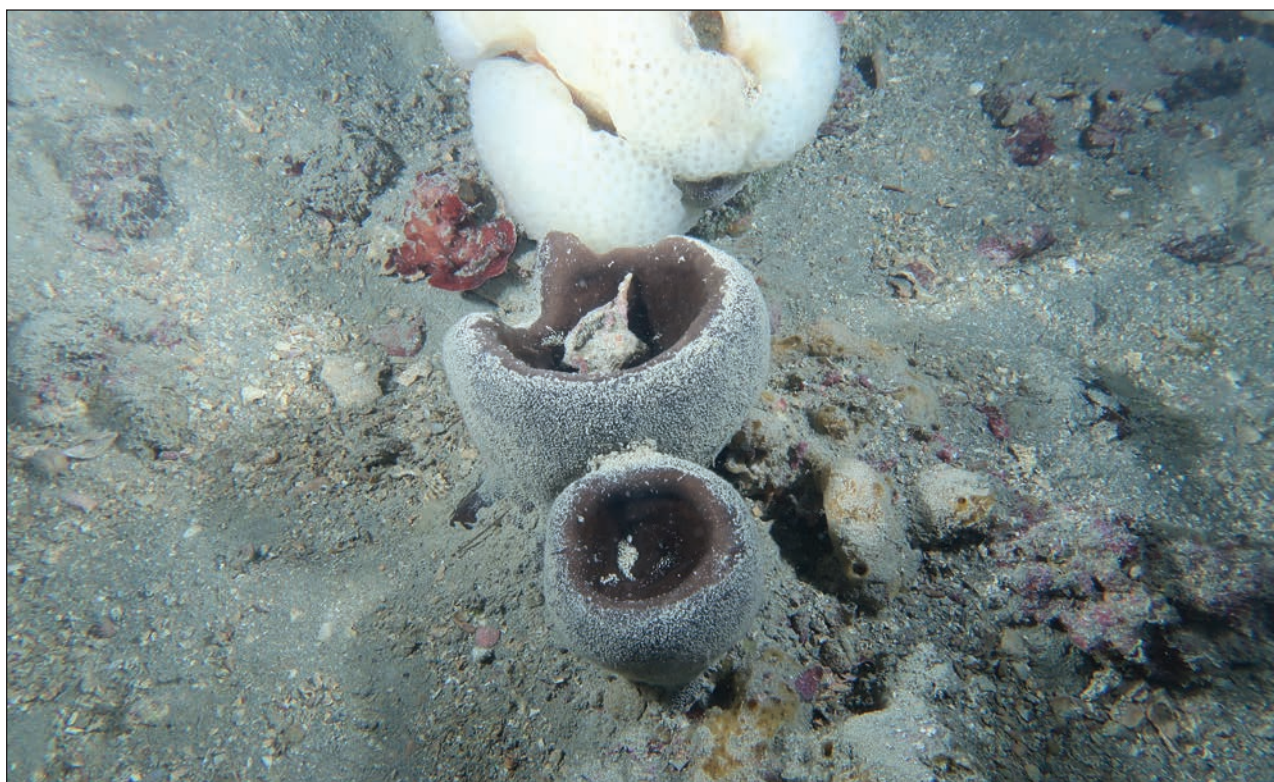


Fig. 1: *Calyx nicaeensis* on coarse sand in the Gulf of Trieste (photo: L. Faresi)

Sl. 1: *Calyx nicaeensis* na grobem pesku v Tržaškem zalivu (foto: L. Faresi)



Fig. 2: Study area with outcrops investigated and Sites of Community Importance (red polygons). The name of outcrops with *Calyx nicaensis* record are reported (map adapted by Google Earth).

Sl. 2: Obravnavano območje z raziskanimi osamelci in najdišči, pomembnimi za habitatno direktivo (rdeči poligoni). Navedena so imena skalnih osamelcev z najdbami primerkov vrste *Calyx nicaensis* (zemljevid prilagojen z Google Earth).

typical of the needle forms of that genus. However, its simple spicules, which are pointed at both ends, correspond to those of several species of *Reniera* and are connected by strong organic fibres. This mode of connection, however, is completely alien to other *Reniera*. Undoubtedly, *Reniera* is the genus to consider first, as the morphological relationship is undeniable: the large bowl cavity, into which individual outflow orifices flow, becomes a channel like that of *Reniera aquaeductus*, which, along its course, takes on the characteristics of aquifer openings". Nevertheless, he stated that this species was not rare in the Kvarner region of Croatia.

Cerrano *et al.* (2013) reported 30 localities where the species has been recorded since its description in a checklist of their findings along the Mediterranean coasts. The fragmented distribution in time and space highlights the need for closer attention to be paid to this species in order to better understand its life strategy and environmental role (Trainito *et al.*, 2020).

The rocky outcrops are regarded as one of the most peculiar features of the northern Adriatic Sea representing small-scale island-like geomorphological elements (Casellato *et al.*, 2007; Casellato & Stefanon, 2008). Since 2015, a limited number of biogenic outcrops in the Gulf of Trieste have been placed under legal protection according to the European Habitats Directive (92/43/CEE) (Bandelj *et al.*, 2020). To our knowledge, this represents the first recorded finding of *C. nicaensis* in the Gulf of Trieste.

MATERIAL AND METHODS

The study site, referred as "Trezze San Pietro e Bardelli" (IT3330009), is included in the European Natura 2000 network as a Site of Community Importance (SCI) under Commission Implementing Decision (EU) 2015/69 of 3 December 2014. Currently, regional legislation (D.G.R. of the Friuli Venezia Giulia Region no. 1701 of 4 October 2019) estab-

lishes conservation measures for the site, as well as monitoring the state of the habitats' conservation. Anthropogenic activities such as anchoring, trawling and hydraulic dredge fishing on the outcrops within the SCI are prohibited.

Since 2020, photographic monitoring of two rocky outcrops (identified as San Pietro and Sud Piastre) has been conducted seasonally using SCUBA equipment, while 8 outcrops outside and other 6 outcrops inside the SCI were monitored at least twice a year (Fig. 2). Specimens of *Calyx nicaensis* were identified based on the morphological description provided by Desqueyroux-Faúndez and Valentine (2002). All specimens were photographed, and calyx diameter was estimated using a measuring tape. In addition, a piece of sponge was collected from specimen A (Table 1) for spicules identification. The soft tissue was dissolved using 69% nitric acid, and the isolated spicules were observed under a microscope (40x magnification).

RESULTS AND DISCUSSION

A total of 17 *Calyx nicaensis* specimens were recorded at 4 of the 16 monitored outcrops. All individuals occurred within the SCI area (Fig. 2) at depths of 16–19.9 m (Tab. 1), either on rocky substrate or adjacent coarse sand. Sponge diameters ranged from 2.5 to 23 cm. The first record was made on 16 March 2023 (specimen A), and some specimens were observed repeatedly. This was the case for specimen L, a 23-cm massive form with nine cups, first recorded on 7 February 2024 (Fig. 3a). It was photographed again on 16 December 2024 and 5 March 2025, when the calyx appeared damaged (Fig. 3b–c) and a ghost gillnet was detected nearby. On 3 September 2025, the calyx had regenerated, although one cup was missing (Fig. 3d). Spicules were oxeas; the length of the largest oxeas ranged from 170.5 to 190.4 µm.

Tab. 1: Specimens of *Calyx nicaensis* recorded on the rocky outcrops in the Gulf of Trieste.

Tab. 1: Primerki vrste *Calyx nicaensis*, zabeleženi na skalnih osamelcih v Tržaškem zalivu.

date	outcrop site	depth (m)	specimens	major diameter (cm)
16.03.2023	Mina	17,5	A	8
23.03.2023	Mina	17,5	A	8
17.08.2023	Sud Piastre	19,9	B, C, D (2 cups)	B 5, C 8, D 15
17.08.2023	S. Pietro	16	E	9
7.02.2024	Sud Piastre	19,9	F, G, H, I, L (9 cups)	F 5, G 8, L 23 (n.d. for H and I)
9.07.2024	Sepa	17,7	M, N	M 13, N 6
12.08.2024	Sud Piastre	19,7	O, P	O 5, P 9
16.12.2024	Sud Piastre	19,9	L (9 cups)	23
5.03.2025	Sud Piastre	19,5	L (9 cups), O, P	L 23, O 5, P 9
19.07.2025	Mina	17	Q	4.5
3.09.2025	Sud Piastre	19,5	L (9 cups)	23
3.09.2025	Sepa	17,3	M, N, R, S	R 2.5, S 5

Tab. 2: Records of *Calyx nicaeensis* in the Adriatic Sea (note reports number of individuals and/or depth). N.B. past records are based on Trainito *et al.* (2020).

Tab. 2: Zapisi o pojavljanju vrste *Calyx nicaeensis* v Jadranskem morju (opomba navaja število osebkov in/ali globino). Opomba: pretekli zapisi o pojavljanju temeljijo na viru Trainito in sod. (2020).

Author	Year	Site	Nation	Note
Schmidt	1862	Kvarner Gulf	Croatia	
Vitale	2011	Otranto	Italy	10 m
Vitale	2011	Otranto	Italy	18 m
Molinari & Bernat	2011	Lustica Peninsula	Montenegro	14 m
Mačić & Molinari	2012	Lustica Peninsula	Montenegro	12 m
Frijsinger & Vestjens	2012	Kvarner Gulf, Selce	Croatia	
Mescalchin P.	2014	Tegnue di Chioggia	Italy	1 ind.
Mačić & Trainito	2014	Verige Strait, Boka Kotorska	Montenegro	2 ind.
Faresi	2018	Orlec, Cres	Croatia	1 ind. 18 m
Terlizzi	2019	Giovinazzo	Italy	14 m
Mačić	2019	Opatovo	Montenegro	2 ind. 18 m
Mačić	2019	Opatovo	Montenegro	1 ind. 21 m
this work	2023-2025	Gulf of Trieste	Italy	17 ind. 16-19,9 m

The *C. nicaeensis* specimens found on outcrops in the Gulf of Trieste represent the northernmost records in the Adriatic Sea and the Mediterranean. Except for the first record by Schmidt (1862) in the Kvarner Gulf, most Adriatic records come from Montenegro or the Apulia region of the southern basin (Tab. 2). Nevertheless, our findings represent the most numerous records of this species in the Adriatic Sea in recent times and probably in the Mediterranean as well.

According to Trainito *et al.* (2020), its distribution in the Mediterranean extends across the entire basin; the species shows no depth preference and appears to be ecologically versatile. The rocky outcrops in the Gulf of Trieste are mesophotic biogenic habitats (Bandelj *et al.*, 2020) that are scattered across the seafloor in a mosaic pattern (Falace *et al.*, 2015) and are poorly connected to the different subregions of the Mediterranean Sea (Ingrosso *et al.*, 2018). A survey of benthic macrofauna on 45 outcrops between 2013 and 2015 (including those in the present study) recorded 58 Porifera species.

C. nicaeensis was not detected, consistent with earlier surveys (Bettoso *et al.*, 2023). The occurrence of this species exclusively on protected rocky outcrops, three years after the SCI site conservation measures came into effect, is unlikely to be coincidental. Yet, effective monitoring and protection of these sites located at least 3 nautical miles offshore remains challenging due to illegal activities. Besides the risks of mechanical damage or harvesting, the species may also be preyed upon by spongivorous sea slugs. For instance, *Umbraculum umbraculum* ([Lightfoot], 1786) feeds on *C. nicaeensis* at mesophotic depths in the Aegean Sea (Özalp & Evcen, 2025). Nevertheless, *U. umbraculum* is still considered rare in the northern Adriatic (Turk, 2000; Zenetos *et al.*, 2016) and has not yet been reported in the Gulf of Trieste (Lipej *et al.*, 2025). Therefore, the data here reported confirm: i) the unpredictability of the distribution of the species and ii) its actual rarity, despite a 22.3% increase in the number of specimens known for the Mediterranean basin (90). Trainito *et al.* (2020) concluded that the rarity of *C. nicaeensis*, combined with

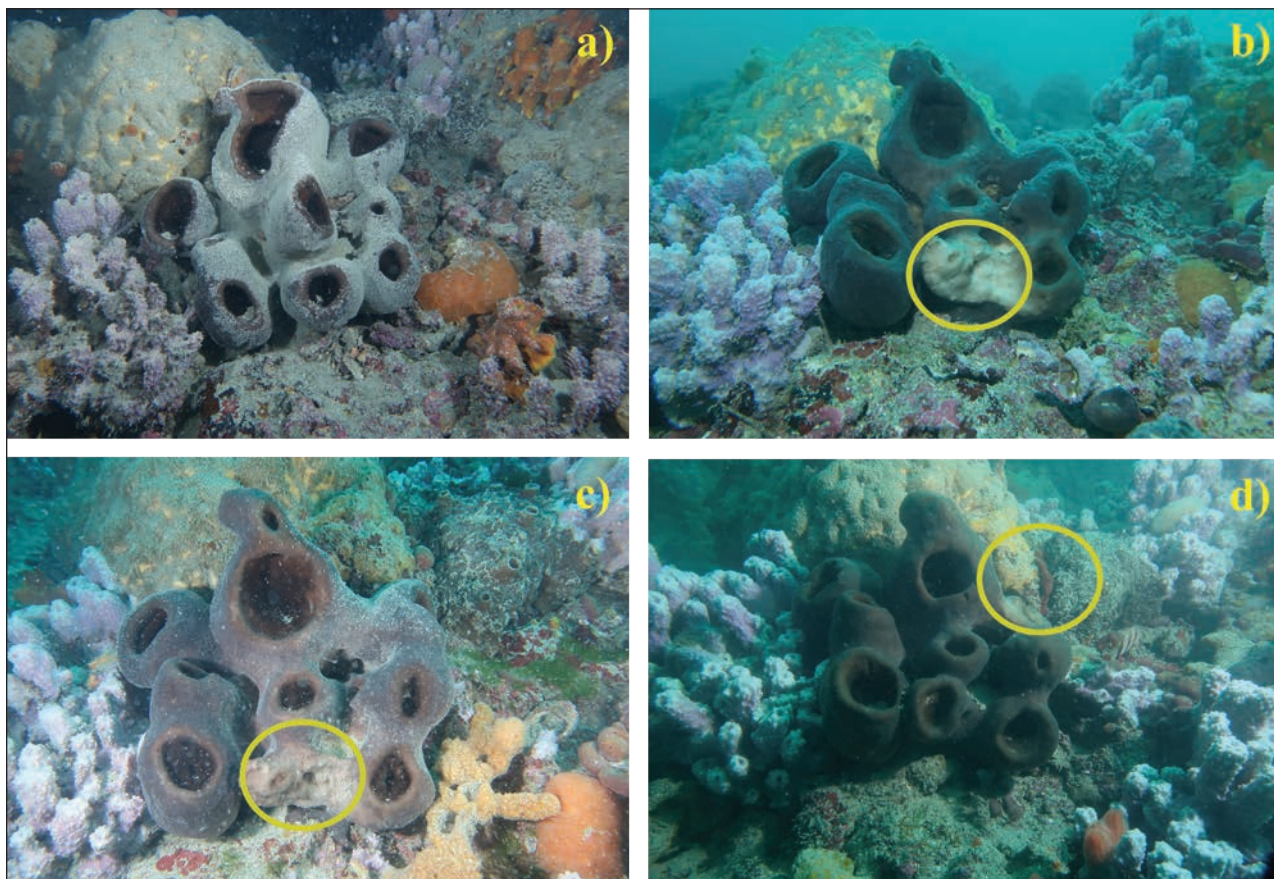


Fig. 3: A massive form of *Calyx nicaensis* with 9 cups (specimen L): yellow circles indicate the damaged cups (Photos: L. Faresi) a) 07 February 2024; b) 16 December 2024; c) 05 March 2025; d) 03 September 2025.

Sl. 3: Masivna oblika vrste *Calyx nicaensis* z 9 čašicami (vzorec L): rumeni krogi označujejo poškodovane čašice (fotografije: L. Faresi) a) 7. februar 2024; b) 16. december 2024; c) 5. marec 2025; d) 3. september 2025.

its unique characteristics, highlights the importance of including this species in international conservation protocols, as well as the need for further in-depth studies. Its finding on legally protected rocky outcrops in the Gulf of Trieste suggests that current measures may support habitat conservation in an area marked by unstable environmental conditions. Continued monitoring is therefore essential to better understand the species' dynamics in the whole Mediterranean Sea.

ACKNOWLEDGEMENTS

We thank the anonymous referees for their valuable suggestions, Stefano (Nino) Caressa for logistical support, and Dr. A. Acquavita for critical review. This work has been made possible thanks to the financial support provided by the Friuli Venezia Giulia Region to the Miramare Marine Protected Area for annual monitoring of the SCI.

NOVE NAJDBE MORSKEGA KELIHA *CALYX NICAENSIS* (RISSO, 1826) NA SKALNIH OSAMELCIH V TRŽAŠKEM ZALIVU (SEVERNO JADRANSKO MORJE)

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POVZETEK

Čašasta kremenasta spužva morski kelih *Calyx nicaeensis* (Risso, 1826) je endemična sredozemska vrsta. Smatrajo jo za redko vrsto, ki jo je treba vključiti v mednarodne protokole za ohranjanje. Med letoma 2023 in 2025 je bilo na skalnih osamelcih v Tržaškem zalivu prvič zabeleženih 17 primerkov te vrste znotraj območja, pomembnega za habitatno direktivo (SCI) evropskega omrežja Natura 2000.

Ključne besede: morski kelih, severni Jadran, skalni osamelci, SCI, Natura 2000

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