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## First record of *Oculina patagonica* de Angelis D'Ossat, 1908 in the Pagasetic Gulf, Greece

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### Abstract

*Oculina patagonica*, a scleractinian coral species originally from the South Atlantic, has increasingly established itself in the Mediterranean Sea, where it is considered invasive. This study documents the first confirmed record of *O. patagonica* in the Pagasetic Gulf, near Volos, Greece, and compiles data on its broader expansion across Greek waters. The species was identified at a depth of 2 meters on rocky substrate, marking a new distribution point for the coral in Greece. Public expansion records from citizen science platforms and scientific reports indicate that the species has progressively spread across Greece, facilitated by rising sea temperatures and anthropogenic activities such as shipping and coastal development. Our findings suggest that *O. patagonica* could pose a significant threat to local marine biodiversity by outcompeting native benthic species and altering ecosystem dynamics. As its range continues to expand, ongoing monitoring and management strategies are critical to mitigate its ecological impact. This study highlights the need for continued research on the species distribution and its potential effects on Mediterranean marine ecosystems.

**Keywords:** *Oculina patagonica*, Pagasetic Gulf, Greece, invasive species, coral distribution, ecological impact

### Introduction

#### Overview of *Oculina patagonica*

*Oculina patagonica* is a species of scleractinian coral originally described in the South Atlantic. In recent decades, this species has been recorded in various locations across the Mediterranean Sea, where it is recognized as non-native (Streftaris 2005, European Alien Species Information Network [EASIN], n.d.) <sup>[1, 2]</sup> and possible invasive. *O. patagonica* demonstrates a tolerance for a wide range of environmental conditions, including fluctuating temperatures and salinities, which has facilitated its spread in regions such as the Western Mediterranean (Rubio-Portillo 2014) <sup>[3]</sup> and, more recently, the Eastern Mediterranean. It is typically found in shallow waters on hard substrates and artificial structures. Its resilience to environmental changes makes it a competitive colonizer in disturbed marine ecosystems. The species can be both zooxanthellate and azooxanthellate (Palomares 2024) <sup>[4]</sup>, with colonies forming clumps of short, thick, highly fused branches. The corallites are densely packed with neatly rounded, exert walls, and the colonies are usually yellowish-brown in color.

#### Invasive Nature

In the Mediterranean, *O. patagonica* has been reported to rapidly colonize anthropogenic structures such as harbors, marinas, and natural rocky substrates. Its expansion is particularly concerning due to its potential to outcompete native species and disrupt benthic ecosystems. The species has been associated with coral bleaching events, which can adversely affect the health of local coral communities and marine biodiversity. Given its ability to spread across different habitats, it is crucial to monitor its presence and assess its ecological impact.

#### Purpose of the Study

This study documents the first confirmed record of *O. patagonica* in the Pagasetic Gulf, located near Volos, Greece, at coordinates 39.3488°N, 22.9776°E, thereby expanding the known range of the species in the Eastern Mediterranean.

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Additionally, this study compiles public expansion records of the species in Greece and analyzes its spread over time. By presenting this data (GBIF 2024) [5], we aim to contribute to the growing knowledge on the distribution of non-native species in Greek waters and evaluate the implications of *O. patagonica*'s spread to local marine ecosystems.

### Materials and Methods Study Area

The Pagasetic Gulf is a semi-enclosed bay located in the Thessaly region of Greece, with an opening to the Aegean Sea through a narrow strait near the city of Volos. The gulf is characterized by a mix of natural mud, sand, and rocky substrates, as well as human-made structures such as piers and marinas. This diverse substrate composition creates varied habitats suitable for a range of marine species. The area experiences typical Mediterranean climatic conditions, with seawater surface temperatures (SST) ranging from 12 °C in the winter to 29 °C in the summer. Salinity levels in the gulf are relatively stable, averaging between 35.7 and 38.9 PSU (Practical Salinity Units) (Kormas 2014) [6]. The shallow depths near the shore and in marinas (1–20 meters) are conducive to coral colonization, which likely facilitated the establishment of *patagonica*. The site where *O. patagonica* was recorded is near the AGET cement factory, which also burns imported waste, potentially influencing local marine conditions.

### Data Collection

The first confirmed presence of *O. patagonica* in the Pagasetic Gulf was recorded during a marine biodiversity survey conducted on September 24, 2021. The survey involved visual inspections and photographic documentation of benthic communities along the coastline near Volos, at depths ranging from 1 to 10 meters. Divers employed underwater cameras to photograph coral colonies for subsequent identification. The photographs were analyzed to confirm species identification based on morphological characteristics.

Additional data on *O. patagonica*'s public expansion in Greece were obtained from citizen science platforms, academic reports, and environmental monitoring projects. These sources provided records of sightings and confirmed occurrences of the species in various locations along the Greek coastline. Each record was verified by experts to ensure accurate species identification.

### Data Analysis

To analyze the spread of *O. patagonica* in Greece, a timeline of public records was compiled based on documented sightings from 2020 to the present. Geospatial analysis tools were used to map the distribution of the species in Greek waters. The distribution data were compared with environmental parameters such as sea surface temperature, salinity, and proximity to human infrastructure (e.g., ports and marinas) to identify potential drivers of the species' expansion. Statistical analysis was conducted to evaluate significant correlations between these factors and the observed distribution patterns.

## Results

### First Record in Pagasetic Gulf

The first confirmed presence of *O. patagonica* in the Pagasetic Gulf was recorded on September 24, 2021, near the coastal city of Volos. Three distinct colonies of *O. patagonica*

were observed, each situated approximately 1 meter apart from one another. The coral was found at a depth of 2 meters, attached to rocky substrates in the vicinity of Faraggi Beach, approximately 600 meters from the AGET cement factory's port. The largest colony observed measured about 25 cm in diameter, while the other two colonies were about 10 cm in diameter. All colonies displayed the characteristic morphological features of the species, including its branched, calcareous structure. During the survey, the water temperature at the site was recorded at 24 °C.

Photographic documentation (Fig.1 and Fig.2) confirmed the identification of *O. patagonica*, with species verification based on morphological characteristics. This finding marks the first record of the species in the Pagasetic Gulf, indicating an expansion of its known range in Greek waters.



Fig 1: *Oculina patagonica* near Volos

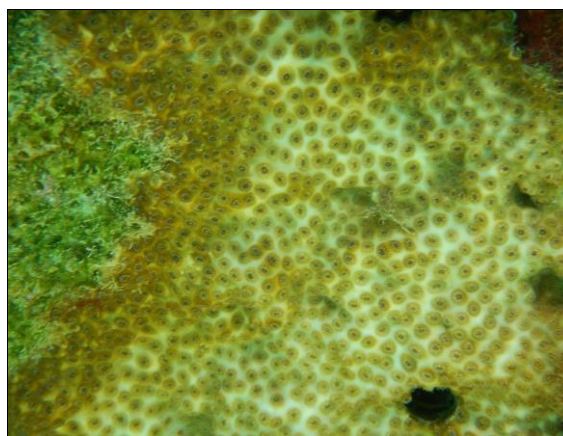


Fig 2: Another *Oculina patagonica* near Volos

### Expansion in Greece

Public records of *O. patagonica* in Greece, dating back to 2020, are summarized in Table 1 (GBIF 2024) [5], with confirmed records from the following locations:

Table 1: Public records of *Oculina patagonica* in Greece

Date	Region	Latitude	Longitude	Abundance
19/06/2020	Attica	37.8172	23.7629	1
24/09/2021	Thessaly	39.3488	22.9776	3
01/07/2022	Thessaly	39.3488	22.9776	2
11/08/2023	Thessaly	39.2888	22.8826	1
14/08/2023	Attica	37.7754	23.8987	1
02/11/2023	Central Greece	38.4984	23.4274	1

The expansion trend reveals a gradual movement from the southern parts of Greece towards the northern and eastern

regions. This trend is likely facilitated by rising sea surface temperatures and the species' ability to colonize artificial structures such as marinas and ports. Fig.3 illustrates the

geographic distribution of *O. patagonica* across Greece, highlighting the density of records in coastal areas near major shipping routes and touristic developments.



**Fig 3:** Observations of *Oculina patagonica* in Greece

## Discussion

### Comparison with Other Mediterranean Locations

The record of *O. patagonica* in the Pagasetic Gulf represents a significant eastward extension of its known distribution in the Mediterranean (Zibrowius 1974) [7]. Previous studies have documented the species' spread along the coasts of the western Mediterranean, including Spain and Italy. In these regions, *O. patagonica* has become well-established in both natural and artificial environments, often colonizing marinas, breakwaters, and rocky substrates in shallow waters.

In Greece, the species has been recorded in various coastal regions, particularly in the Aegean Sea (Zenetos 2005) [8]. However, its presence in the Pagasetic Gulf is a new addition to this expanding range. This pattern aligns with the broader Mediterranean trend, where the species has extended its range in response to warmer sea temperatures and increased human activities, such as shipping and coastal development.

### Possible Causes of Spread

The spread of *O. patagonica* in Greece appears to be influenced by both environmental and anthropogenic factors. Analysis of sea surface temperature (SST) data indicates that warmer waters, particularly during the summer months, have likely supported the species's establishment in new areas.

Additionally, the species's frequent occurrence near ports and marinas suggests that human-mediated transport, such as through ballast water or hull fouling, may have facilitated its spread (Serrano 2023) [9].

### Ecological Impact

The presence of *O. patagonica* in the Pagasetic Gulf raises important questions about its potential impact on local ecosystems. As an aggressive colonizer, the species can outcompete native corals and benthic species, altering community structures and potentially reducing biodiversity. Its resilience to thermal stress makes it particularly suited to thrive in the warming waters of the Mediterranean, where other species may struggle due to climate change.

A key concern surrounding the spread of *O. patagonica* is its association with coral bleaching. Although coral bleaching is typically a tropical phenomenon, it has been observed in Mediterranean ecosystems, particularly in response to rising sea temperatures. *O. patagonica* is known for its resistance to bleaching, which could provide it with a competitive advantage over more vulnerable species. This may lead to changes in coral reef health and shifts in the composition of benthic communities, potentially causing cascading effects on the broader marine ecosystem.

### Conservation and Management

Given the ecological risks associated with the spread of *O. patagonica*, it is essential to develop strategies for monitoring and managing its presence in Greek waters. Regular surveys and citizen science initiatives can aid in tracking its distribution and identifying potential hotspots of colonization. Additionally, efforts to minimize human-mediated transport, such as stricter ballast water regulations and hull cleaning protocols, could help slow the spread of this and other invasive marine species, particularly in semi-enclosed bays like the Pagasetic Gulf.

Collaboration between marine scientists, environmental agencies, and local communities will be crucial in managing the ecological impacts of *O. patagonica*. Awareness campaigns aimed at divers, boaters, and fishermen could also help reduce the inadvertent spread of the species and encourage the reporting of sightings.

### Conclusion

The first confirmed record of *O. patagonica* in the Pagasetic Gulf near Volos represents an extension of the species' known range in Greek waters, contributing to the ongoing expansion of this coral species throughout the Mediterranean. *O. patagonica*'s ability to colonize diverse habitats, particularly those associated with human infrastructure, along with its resilience to environmental stressors such as rising sea temperatures, underscores its potential to become a dominant species in the region.

This study not only documents the initial appearance of the species in the Pagasetic Gulf but also provides a broader understanding of its distribution across Greece. The increasing number of records in various locations highlights the need for enhanced monitoring and management to mitigate the ecological impacts of this invasive species. The potential for *O. patagonica* to disrupt local ecosystems, outcompete native species, and alter benthic community structures makes it an important subject for further research and conservation efforts.

Future research should focus on long-term monitoring of the species' spread, investigating its ecological interactions with native species, and implementing preventive measures to minimize human-mediated transport. Addressing these challenges will be crucial for managing the ecological balance of Greek marine ecosystems in the face of invasive species like *O. patagonica*.

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### Statements & Declarations

Nil

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