

Rapid Communication

The first record of the white-spotted Australian jellyfish *Phyllorhiza punctata* von Lendenfeld, 1884 from Maltese waters (western Mediterranean) and from the Ionian coast of Italy

Alan Deidun^{1,*}, Jeffrey Sciberras², Arnold Sciberras², Adam Gauci¹, Paolo Balistreri³, Angelo Salvatore³ and Stefano Piraino⁴

¹Physical Oceanography Research Group, Department of Geosciences, University of Malta, Msida, Malta MSD 2080

²Animal Kingdom Limited, 136, Ditch Street, Paola, Malta

³Vicolo Giotto 6, 91023 Favignana, Italy

⁴Dipartimento di Scienze e Tecnologie Biologiche ed Ambientali, Università del Salento, via per Monteroni, 73100, Lecce, Italy

*Corresponding author

E-mail: alan.deidun@um.edu.mt

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Abstract

The occurrence of the white-spotted Australian jellyfish *Phyllorhiza punctata* Lendenfeld, 1884, an Indo-Pacific scyphozoan species mainly restricted to the Levantine Basin, is hereby reported for the first time from Maltese waters (western Mediterranean) and from the Ionian coast of Italy. Considerations on possible vectors of introduction of the jellyfish species to this part of the Mediterranean are made.

Key words: scyphozoan, new introduction, citizen science

Introduction

At least five non-indigenous species of scyphomedusae of Erythraean or Indo-Pacific origin have been recorded to date from the Mediterranean Basin: *Cassiopea andromeda* (Forsskål, 1775); *Rhopilema nomadica* Galil, 1990; *Phyllorhiza punctata* von Lendenfeld, 1884; *Marivagia stellata* Galil and Gershwin, 2010; and *Cotylorhiza erythraea* Stiasny, 1920. An additional cryptogenic species candidate, *Pelagia benovici*, has been discovered for the first time in the Adriatic sea (Piraino et al. 2014) as a likely result of ship-borne transport.

Phyllorhiza punctata is indigenous to the tropical western Pacific (Kramp 1965, 1970), and its native range is considered to extend from Australia to Japan (Heeger et al. 1992). The species was not recorded outside the Indo-Pacific Ocean until the mid 20th century, when it was first recorded (as its synonym *Mastigias scintillae* Moreira, 1961) off southern Brazil. Since then, the species has spread

across vast tracts of the Atlantic, edging progressively north within the Gulf of Mexico in the summer of 2000 and up to the coasts of Florida (as summarised in Galil et al. 2009). The fishery losses due to that invasion were estimated at several million dollars, primarily due to net damage, a significant reduction in the shrimp harvest, and predation on pelagic fish eggs and bivalve larvae (Graham et al. 2003).

Within the Mediterranean, until 2005, *P. punctata* was considered as a casual (non-established) non-indigenous marine species because its occurrence within the Basin consisted of a single record off the Israeli coast dating back to 1965 (Zenetos et al. 2005). Since then, the species has progressively moved west within the Mediterranean Sea, being successively recorded in 2005–2006, both as ephyrae and as adult medusae, from the Greek Ionian Sea (Abed-Navandi and Kikinger 2007) and in 2009, as a single adult (bell diameter 35 cm), off the north-east coast of the Italian island of Sardinia in the western

Table 1. Summary of the sightings of *P. punctata* within Maltese coastal waters during 2016.

Date	Locality name	Coordinates		Notes
late-October	Salini salt pans – outer reservoir	35.948328°N	14.425425°E	Tens of individuals observed – no photographic evidence collected
02 November	Salini salt pans – outer reservoir			15 individuals observed and photographed; bell diameter ranged between 3.5cm and 12.0cm
03 November	Salini salt pans – outer reservoir			38 individuals observed and photographed; bell diameter ranged between 3.5cm and 12.0cm
06 November	St. Paul's Bay	35.949951°N	14.400052°E	Single individual observed and photographed
07 November	Qawra Point	35.958673°N	14.426643°E	Single individual observed and photographed

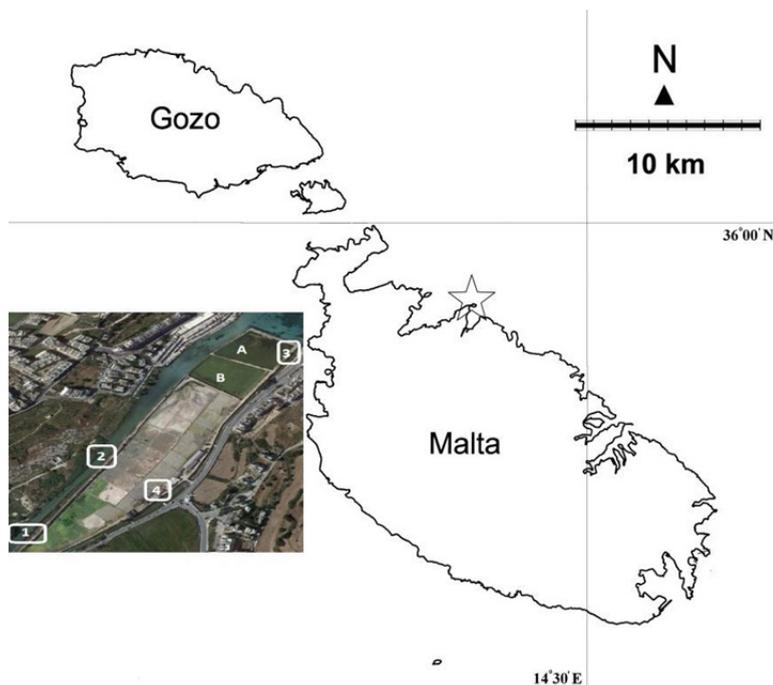


Figure 1. Location of the Salini salt pans. Inset: locations where water temperature and salinity were measured at Salini (1–4), and of the outer reservoirs (A, B) where *P. punctata* was observed (Aerial photograph by AD).

Mediterranean (Boero et al. 2009). Still within the western Mediterranean, reproducing populations of the same jellyfish were recorded during the summers of 2012 and 2013 within the Bizerte lagoon along the northern coast of Tunisia (Gueroun et al. 2014). Between 2005 and 2009, the species was regularly recorded within Israeli waters (Galil et al. 2009), with evidence that the species has established reproductive populations within the same waters. Here we report new records of *P. punctata* from the north coast of Malta and the Gulf of Taranto, along the Ionian coast of Italy.

Material and methods

Citizen sightings of *P. punctata* were made in October–November 2016 at three sites along the northern coast of Maltese (Table 1) and submitted to the Spot the Jellyfish database. The Spot the Jellyfish citizen-science campaign has been conducted by the

Physical Oceanography Research Group at the University of Malta since June 2010 through a dedicated web portal (<http://www.ioikids.net/jellyfish>), yielding multi-annual abundance data about previously-recorded jellyfish species and new species records for Maltese waters (e.g. *Rhopilema nomadica* – Deidun et al. 2011).

The main location where *P. punctata* was detected, the Salini salt pans, is characterised by an inlet which has been largely engineered into rectangular salt pans. There, several *P. punctata* individuals were sampled by means of a hand-held net and a bucket, and their bell diameter was measured. Water temperature and salinity were also measured using a hand-held digital probe within the outer Salini salt pans, at the salt pans – open sea interface, and within the inner drainage channels (Figure 1).

The changes in the surface water currents over the 28 October to 2 November 2016 period were investigated through data downloaded from the COPERNICUS

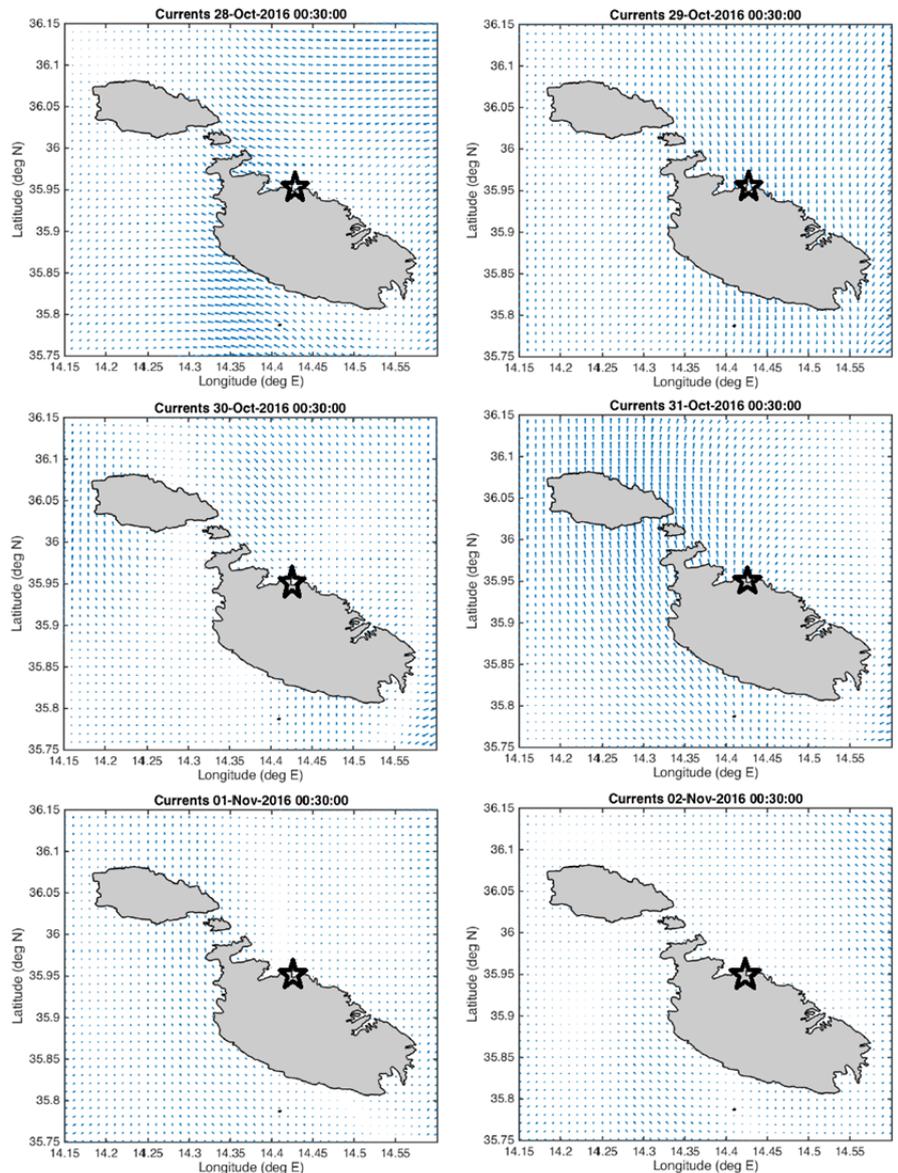


Figure 2. Direction and strength of surface water currents within Maltese coastal waters for the 28 October to 2 November 2016. The location of the three Maltese coastal sites from where *P. punctata* individuals were sighted is denoted by a star.

portal, the European Programme for the establishment of a European capacity for Earth Observation and Monitoring, based on a space component (e.g. the “SENTINEL 1” satellites) and on a ground truthing component (i.e., ocean monitoring buoys). Sea surface values were obtained from the Mediterranean Forecasting System available within COPERNICUS. Data for a depth of 0.5 m was extracted at a resolution of 0.125×0.125 degrees (roughly an area of $14 \text{ km} \times 14 \text{ km}$) at 3 h intervals (Copernicus services 2016).

An alert about the first occurrence of *P. punctata* in Maltese waters was posted on social media shortly

after the first field observations. This prompted the submission of citizen science reports from two other Maltese coastal water locations (Table 1). In addition, one of us (AS) provided photos of *P. punctata* observed in 2011 in Italian coastal waters (Mar Piccolo, Gulf of Taranto).

Results

The occurrence of small clusters of *P. punctata* individuals was recorded for the first time by citizen science sightings at different localities off the north-east coast

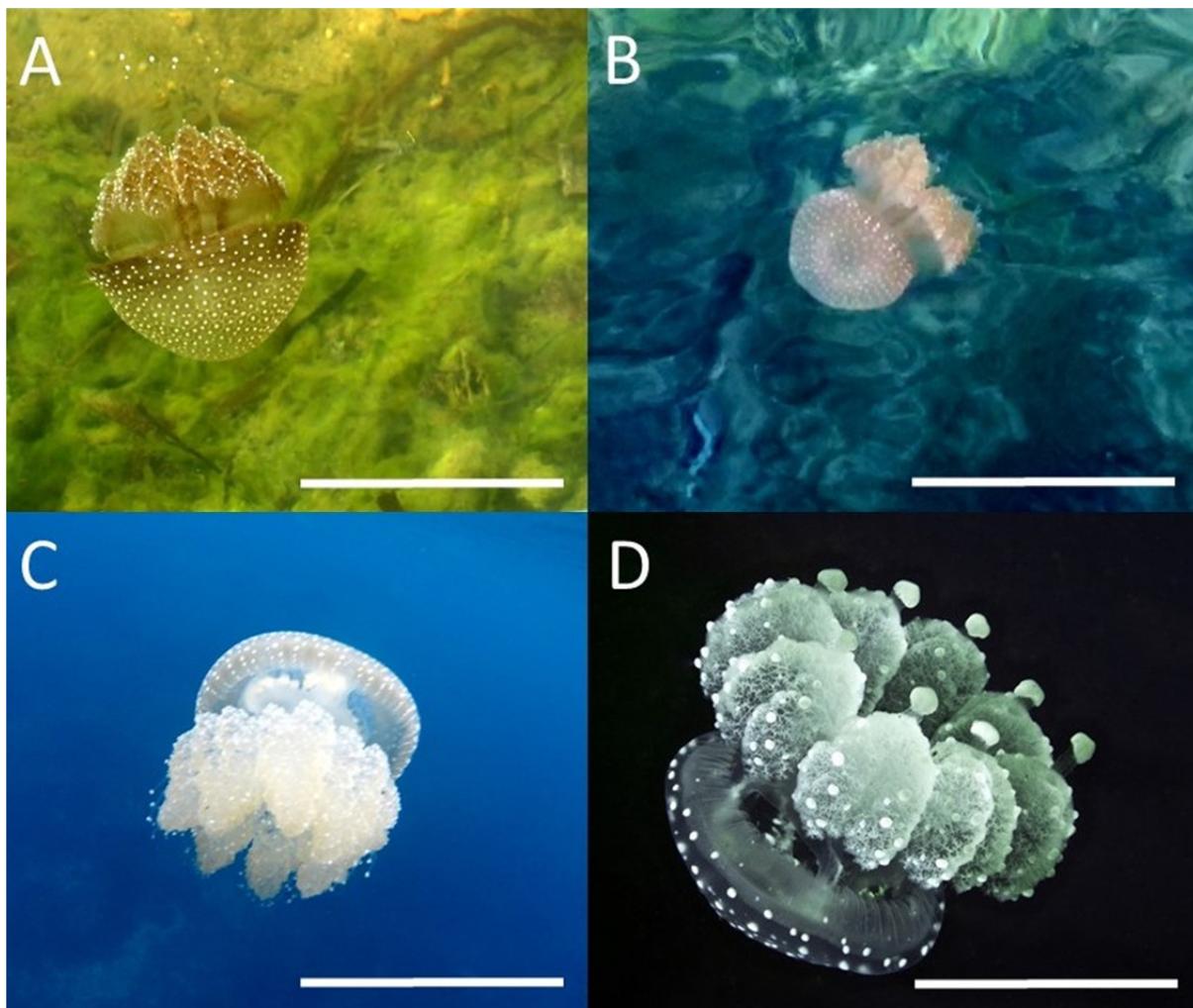


Figure 3. *Phyllorhiza punctata* individuals collected from different localities off the north-east coast of the island of Malta during 2016 (A–C, Salini outer reserve, St. Paul’s Bay, and Qawra Point), and from Mare Piccolo, Gulf of Taranto, Italy during 2011 (D). Scale bar: 4cm. (Photographs by: Jeffrey Sciberras (A), Mick Higgins (B), Bruno Rodrigues (C), Angelo Salvatore (D)).

of the island of Malta, and verified a few days later by dedicated sampling in October–November 2016 (Table 1, Figure 1). At the Salini salt pans, the jellyfish were always observed within the two outer reservoirs (sites A and B, Figure 1), which are connected through narrow channels with the open sea, and were not recorded from any inner station within the Salini salt pans.

The water temperature measured on the 3 November 2016 at different points within the Salini salt pans ranged between 14.6 and 16.7 °C (Table 2). Salinity station 3, adjacent to the two outer reservoirs where jellyfish were found (A, B in Figure 1), was 49.5 and was >100 at the three locations devoid of *P. punctata*. According to the <http://www.capemalta.net> website, an online portal for physical oceanography

Table 2. Water temperature and salinity values for the four sampling stations within the Salini coastal site.

Sampling location label (equivalent to labels in Figure 1)	Water temperature °C	Salinity
1	14.6	103.15
2	15.3	109.32
3	16.7	49.51
4	15.1	107.77

data for Maltese coastal waters, the surface water temperature and salinity values recorded during the first week of November for open waters off the Maltese coastline (i.e. not within the Salini salt pans) were 23.7 °C and 37.9, respectively (Capemalta 2017).

Surface-water currents recorded on 28–29 October had a south-westerly and westerly origin, with current

speeds ranging between 0.14 and 0.37 m/s. Surface currents recorded over the 30 October–2 November period originated mainly from the south-east, with current speeds ranging between 0.01 and 0.22 m/s (Figure 2).

Photographic records of the Maltese *P. punctata* jellyfish were taken in 2016 (Figure 3A–C). Also, in July 2011, a single individual of *P. punctata* was documented (Figure 3D) within the Mar Piccolo coastal sound, in the Gulf of Taranto, along the Ionian coast of Italy, within a mussel *Mytilus galloprovincialis* Lamarck, 1819 culture site (40.481395°N; 17.235006°E). The individual was found at a depth of 4.5 m and had an approximate bell diameter of 10 cm.

Discussion

The native habitat of *P. punctata* is in tropical western Pacific estuaries and lagoons (Rippingale and Kelly 1995). Tolerant of a wide range of salinity and water temperature, it has flourished when introduced to bodies of water of fluctuating salinities and temperatures and of high productivity (Garcia and Durbin 1993). This is consistent with its occurrence within the Salini salt pans, within which large seasonal fluctuations in physical and biogeochemical characteristics are expected by virtue of the very nature of the pans themselves (shallow water, extremely sheltered location with limited circulation), and with a number of other coastal, highly-sheltered Mediterranean locations which have harboured the same species (e.g. Mar Piccolo in the Gulf of Taranto, Bizerte Lagoon in Tunisia).

The *P. punctata* bell diameter sizes recorded from the Salini outer reservoirs are consistent with young adult stages, suggesting that the species is reproducing locally. The abnormally high water salinities recorded within the inner stations of the Salini salt pans are consistent with this typology of engineered coast, constraining *P. punctata* individuals to the outermost station of the salt pans. Evaluation of surface currents for the day immediately preceding the highest density of sightings made within Maltese coastal waters suggests that the species was carried to these waters by strong easterly surface currents, which in turn were fuelled by a prolonged period of sustained Grecale (North-east) winds. Since *P. punctata* bears endosymbiotic zooxanthellae (Galil et al. 2009), it is confined to an upper water column position, thus rendering it more susceptible to atmospheric and surface hydrodynamic phenomena.

The fact that established populations of *P. punctata* have been recorded from locations considerably further west (Bizerte lagoon in north-eastern Tunisia) than those recorded within the present study, and that the

record from the Ionian coast of Italy dates is from 2011, raises the prospect of a general under-detection of the species within the Mediterranean, strengthening further the case for citizen science as a valuable means of monitoring such a transient phenomenon as jellyfish occurrence. The “under-detection” hypothesis is further supported by observations made by fishermen, and reported in Abed-Navandi and Kikinger (2007), that *P. punctata* individuals probably occurred in the Greek Ionian localities for a number of years before they were formally recorded by the scientific community.

Although the pathway(s) of entry of *P. punctata* into the Mediterranean Sea are unknown, the pattern of geographical spread within the Basin exhibited by the species is typical of a Suez Canal-mediated entry (Galil et al. 1990). This could have happened either in the form of passive drift by adults, or through ephyrae within vessel ballast water, or through scyphistomae attached to vessel hulls. The ever-burgeoning volume of shipping traffic within the Mediterranean, with 90% of the same traffic traversing through the Malta–Sicily Channel (Deidun et al. 2016), is conducive to all of these dispersal modes. *Phyllorhiza punctata* might not pose a hazard to human health and to tourism by virtue of its almost non-stinging status, but it has already severely impacted fisheries in places like the Gulf of Mexico (Johnson et al. 2005). Regular blooming of the species in the Mediterranean could become an additional stressor to fish stocks, and it should be carefully monitored.

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