

**Rapid Communication****First record of the non-native jellyfish *Chrysaora* cf. *achlyos* (Cnidaria: Pelagiidae) in the Mediterranean Sea**Joachim Langeneck<sup>1,\*</sup>, Fabio Crocetta<sup>2</sup>, Nikolaos Doumpas<sup>3</sup>, Ioannis Giovos<sup>3</sup>, Stefano Piraino<sup>4</sup> and Ferdinando Boero<sup>4,5</sup><sup>1</sup>Dipartimento di Biologia, Università di Pisa, via Derna 1, 56126 Pisa, Italy<sup>2</sup>Department of Integrative Marine Ecology, Stazione Zoologica Anton Dohrn, Villa Comunale, I-80121 Napoli, Italy<sup>3</sup>Sea, Environmental Organization for the Preservation of the Aquatic Ecosystems, Thessaloniki, Greece<sup>4</sup>DiSTeBA, Università del Salento, 73100 Lecce, Italy<sup>5</sup>CNR-ISMAR, Via De Marini 6, 16129 Genova, ItalyAuthor e-mails: [jlangebeck@biologia.unipi.it](mailto:jlangebeck@biologia.unipi.it) (JL), [fabio.crocetta@szn.it](mailto:fabio.crocetta@szn.it) (FC), [nikolaos.doumpas@isea.com.gr](mailto:nikolaos.doumpas@isea.com.gr) (ND), [ioannis.giivos@isea.com.gr](mailto:ioannis.giivos@isea.com.gr) (IG), [stefano.piraino@unisalento.it](mailto:stefano.piraino@unisalento.it) (SP), [ferdinando.boero@unisalento.it](mailto:ferdinando.boero@unisalento.it) (FB)

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**OPEN ACCESS****Abstract**

A single specimen of a Pelagiidae jellyfish (Scyphozoa) referable to the genus *Chrysaora* Péron and Lesueur, 1810 is reported from the port of Elefsina (Saronikos Gulf, Greece) on the basis of photographic evidence. Despite the absence of a voucher and the impossibility to check fine morphological features of diagnostic value, its recognizable features (coloration, umbrellar and oral arms morphology, number of tentacles, and squared shape of marginal lappets) are consistent with the group of the “Pacific” *Chrysaora*, and in particular with *Chrysaora achlyos* Martin, Gershwin, Burnett, Cargo and Bloom, 1997. The specimen is therefore identified here as *Chrysaora* cf. *achlyos*, a candidate as a new non-indigenous species in the Mediterranean Sea. Although this rare species has been often observed as single specimens even in its native range (northeastern Pacific Ocean), the occurrence of additional individuals cannot be excluded due to possible misidentifications with the native *Chrysaora hysoscella* (Linnaeus, 1767). Citizen science proved again to be a useful tool for NIS detection and monitoring, which overall calls for the necessity of focused and joint programmes along the whole Mediterranean coastline.

**Key words:** alien species, gelatinous plankton, scyphomedusae, citizen science**Introduction**

The introduction and spread of non-indigenous species (NIS) in marine habitats represents one of the crucial topics in current environmental management. The issue is so relevant that the EU Marine Strategy Framework Directive, in its definition of Good Environmental Status, prescribes in Descriptor 2 that “non indigenous species do not adversely alter the ecosystem” ([http://ec.europa.eu/environment/marine/good-environmental-status/index\\_en.htm](http://ec.europa.eu/environment/marine/good-environmental-status/index_en.htm)). One of the most striking examples of highly impacting marine NIS is represented by gelatinous planktonic species, that especially in the Mediterranean Sea gave rise to population blooms whose effects were strong environmental pressures and substantial

economic losses (Boero 2013). Although the ctenophore *Mnemiopsis leidyi* A. Agassiz, 1865 is unanimously considered the most impacting gelatinous NIS in the Mediterranean Sea (Boero et al. 2009), the impact of scyphozoan taxa on Mediterranean assemblages and anthropic activities should not be underestimated. Nine alien or cryptogenic scyphozoan have been recorded in the Mediterranean Sea to date, namely the Cassiopeidae *Cassiopea andromeda* (Forsskål, 1775), the Catostylidae *Catostylus tagi* (Haeckel, 1869), the Cepheidae *Marivagia stellata* Galil and Gershwin, 2010, the Mastigiidae *Phyllorhiza punctata* von Lendenfeld, 1884, the Pelagiidae *Pelagia benovici* Piraino, Aglieri, Scorrano and Boero, 2014, the Rhizostomatidae *Rhizostoma luteum* Quoy and Gaimard, 1827 and *Rhopilema nomadica* Galil, 1990, and the Ulmariidae *Aurelia coerulea* von Lendenfeld, 1884 and *Aurelia solida* Browne, 1905 (Scorrano et al. 2017; Zenetos et al. 2017). All these species have been reported as potential bloomers, and at least *R. nomadica* has been responsible of relevant economic losses along the southern and eastern coasts of the Mediterranean Sea (Purcell et al. 2007). For this reason, alien scyphozoans deserve careful monitoring, and the quick report of newcomers is crucial for the introduction of management and mitigation practices.

The role of citizen science in this scenario is of paramount importance. The Jellywatch Programme, conceived in 2001 by the Mediterranean Commission (CIESM) (Boero and Briand 2001), has proved to be a useful tool to monitor both the spreading of gelatinous NIS and the occurrence of local blooms of native species (Boero et al. 2009, 2016). So far, this is the most successful citizen science initiative in the marine environment and its example has been taken by many other projects (e.g. Bariche and Azzurro 2016; Kletou et al. 2016; Crocetta et al. 2017; Langeneck et al. 2017; Zenetos 2017). Hence, the use of social networks allows the ready gathering of distributional data to fill gaps in species distributions and track the spreading of NIS in the Mediterranean Sea. Citizen science often allows the record of “strange” specimens, stimulating the attention of specialists that can subsequently provide further validation of the records. This procedure proved particularly fruitful for jellyfish since they are rather conspicuous and people are immediately aware of their presence. In fact, new species such as *Pelagia benovici* and *Aurelia relictata* Scorrano, Aglieri, Boero, Dawson and Piraino, 2017 have been described stemming from citizen science records (Piraino et al. 2014; Scorrano et al. 2017), and the same accounts for Records of NIS such as *Mnemiopsis leidyi*, *Phyllorhiza punctata*, *Rhizostoma luteum*, *Catostylus tagi*, and *Cassiopea andromeda* (Boero et al. 2016).

The project “Is it Alien to you? Share it!!!” designed and launched in 2016 by iSea, a Greek Environmental Organisation, allowed the gathering of a massive amount of data about NIS, cryptogenic, thermophilic and poorly known native species in Greek and other eastern Mediterranean



**Figure 1.** *Chrysaora cf. achlyos* observed in the port of Elefsina (Saronikos Gulf) on the 5<sup>th</sup> April 2018. Photo by Georgios Georgiadis.

countries, among which records of the three species so far unknown for the Mediterranean Sea (Giovos et al. 2018). Citizen scientists can easily upload information through an online data repository along with a clear picture of the unknown species submitted to the community. A Google Form and a Group on Facebook have been also set up for facilitating the reports. The project's group on Facebook numbers 5688 members to date, with 2679 actively engaged. Furthermore, 50 articles and three press releases have been published in local and national press and nine scientific publications expanded the known distribution of focused species. Although Cnidaria represented less than the 1% of all validated records (i.e. records substantiated by useful pictures) of the iSea project, these data provided the first Mediterranean record of an unknown *Chrysaora* hereby identified as *Chrysaora cf. achlyos* Martin, Gershwin, Burnett, Cargo and Bloom, 1997, a new possible NIS in the Mediterranean Sea.

## Results

On the 5<sup>th</sup> April 2018 an individual of a large jellyfish (TL including tentacles ~ 150 cm, umbrella diameter ~ 15–20 cm) (Figure 1) was observed in the

harbour of Elefsina (Saronikos Gulf, Greece) (38.034471N; 23.531011E) at a depth of approximately 1 m. The general morphology of the specimen indicated the family Pelagiidae, but the dark colour or the number of marginal tentacles exclude representatives of the genus *Pelagia* Péron and Lesueur, 1810, namely *Pelagia noctiluca* (Forsskål, 1775), *P. benovici*, and the *nomina dubia* *Pelagia flaveola* Eschscholtz, 1829 and *Pelagia panopyra* Péron and Lesueur, 1810, suggesting instead an attribution to the genus *Chrysaora* Péron and Lesueur, 1810 (see Morandini and Marques 2010 for a revision of the genus). The only *Chrysaora* species reported in the Mediterranean Sea, the compass jellyfish *Chrysaora hysoscella* (Linnaeus, 1767), is similar to the reported specimen as regards size and general shape, but it is characterised by much shorter oral arms and by a colour pattern characterised by alternating brown and whitish (or dark brown and light brown) radial stripes; on the contrary, this specimen is characterised by a uniform dark brown colour, with purplish nuances. The combination of the following characters, i.e. the dark colour pattern, along with the presence of 24 marginal tentacles, with three tentacles—a primary tentacle central to a pair of lateral ones—and four marginal lappets of squared shape per octant (i.e. between two consecutive rhopalia), allowed to assign this specimen to *Chrysaora achlyos* Martin, Gershwin, Burnett, Cargo and Bloom, 1997 from the northeastern Pacific Ocean. In fact, although according to Morandini and Marques (2010) this taxon is indistinguishable from *Chrysaora plocamia* (Lesson, 1830) as regards the external morphology, the latter species is characterised by a light brown umbrella, while *C. achlyos* is characterised by a far darker colour. Due to the smaller size than known for adult specimens of *Chrysaora achlyos*, the individual recorded is probably a juvenile. Considering the absence of a voucher and the impossibility to check fine morphological features of diagnostic value, we record it here as *Chrysaora* cf. *achlyos*, pending a confirmation of our identification based on concrete samples.

## Discussion

Despite its large size and its striking appearance, *Chrysaora achlyos* has been described only recently, and is known from a relatively restricted area in the northeastern Pacific Ocean, with sporadic occurrence and localized massive blooms (Martin et al. 1997). This species is still poorly known even in its life cycle features. A further uncertainty about the identity of this species is due to the seemingly incomplete knowledge on the diversity of the genus *Chrysaora* (Morandini and Marques 2010). The diversity of *Chrysaora* has been well studied chiefly in the north-eastern Pacific and northern Atlantic Oceans, while records in several poorly-studied areas possibly refer to misidentifications and might hide a previously undetected diversity. Moreover, as shown by the case of *C. achlyos* itself, life cycles of

the genus *Chrysaora* are characterised by the possible occurrence of long-lasting lag times between massive blooms, which might account for the missed detection of undescribed species (Martin et al. 1997; Morandini and Marques 2010). Hence, we cannot also rule out at this stage the possibility that the recorded specimen might represent an undescribed species or even an overlooked native species. Just to mention, *Drymonema dalmatinum* Haeckel, 1880, the largest jellyfish of the Mediterranean Sea, remained unrecorded for decades and then suddenly became rather frequent for unknown reasons (Malej et al. 2014). The patterns of presence of *C. achlyos* in California have been rather erratic too, so an allied species might have similarly irregular occurrences in the Mediterranean Sea.

Despite the uncertain identification, *Chrysaora* cf. *achlyos* may represent the tenth large scyphozoan recorded as NIS in the Mediterranean Sea. So far, no species of the genus *Chrysaora* is known to occur in the Red Sea (Morandini and Marques 2010), and therefore the possibility of an arrival through the Suez Canal should be dismissed. In this line, the most likely possibility is represented by the arrival of propagules through ballast waters or with polyps attached to aquacultured molluscs or to ship hulls. Many jellyfish, including *Chrysaora* spp., have complex life cycles, with the occurrence of distinct benthic and pelagic life stages (i.e. the tiny sessile polyp and some cyst-like hidden propagules, the more conspicuous, free-living medusa and the almost invisible planula larva stage) and all species need to be considered as a whole comprising both benthic and planktonic stages when considering possible routes of introduction (see Boero et al. 2008). The visual detection of new jellyfish NIS may be not coincident with the real time of arrival, but it may be delayed considerably, pending on the time when the environmental triggers for polyp strobilation will take place (Morandini et al. 2017). Lastly, even if large *Chrysaora* species are often displayed in public aquaria, *Chrysaora achlyos* seems to be reared in captivity only in California close to its native range (Hall and Warmolts 2003), hence aquarium trade is not a likely introduction vector for this species. In spite of the limited available information corroborating its taxonomic identification, the photographed specimen does not correspond to any of the scyphozoan species known to inhabit the Mediterranean Sea so far, and appears more referable to *C. achlyos* than to any other known scyphozoan species. Citizen-based records become critically important especially if the recorded species, stemming from an early wave of colonization with few individuals, will become frequent and abundant in the basin.

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