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The jellyfish *Rhizostoma luteum* (Quoy & Gaimard, 1827): not such a rare species after all

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Abstract *Rhizostoma luteum* was first described in 1827 by Quoy and Gaimard under the name *Orythia lutea*, based on nine specimens collected from the Strait of Gibraltar (southern Iberian Peninsula). After 60 years of no scientific records existing for this species, in 2013, a phylogenetic analysis confirmed that *R. luteum* differed from *Rhizostoma pulmo* and *Rhizostoma octopus*. In the present study, we report historical and recent records of living and stranded specimens of *R. luteum* since 1998. We reviewed historical accounts and photographic and videographic materials taken by citizens from the northeastern Atlantic Ocean and the Alboran Sea. Because of its similarity with the closely related Mediterranean *R. pulmo*, *R. luteum* was frequently misidentified in the Alboran Sea and, likewise, with another medusa from the order Rhizostomeae, *Catostylus tagi*, in the adjacent Atlantic Ocean coastal regions in the last two decades. The results of this investigation confirm the existence of the scyphomedusa *R. luteum* in the coastal waters of the west and south coasts of the Iberian Peninsula and west and north shores of Africa. Through a citizen science initiative and our own observations, we were able to confirm more than 150 observations of *R. luteum* over the past 17 years, demonstrating that this medusa is not such a rare species after all.

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Introduction

The Scyphozoa constitutes one of the four classes of Cnidaria, containing almost 200 species (Mayer 1910; Kramp 1961; Russell 1970; Arai 1997). This group is found in all oceans and resides in pelagic habitats from the surface to the abyss. Medusae in the order Rhizostomeae are characterised by the absence of marginal tentacles, the structure of the manubrium and its lips branching to form eight oral arms with numerous mouths openings (Mayer 1910; Russell 1970). The systematic division of the genus *Rhizostoma* has been a subject of much discussion in the past and there has been a lot of controversy about the rare species *Rhizostoma luteum*. At present, three species of the genus *Rhizostoma* are recognised (Stiasny 1921; Russell 1970; Holst et al. 2007; Lilley et al. 2009; Fuentes et al. 2011; Prieto et al. 2013): *R. pulmo* (Macri, 1778), *R. octopus* (Linnaeus, 1788) and *R. luteum* (Quoy & Gaimard, 1827). *Rhizostoma pulmo* exists in the eastern and western Mediterranean Sea, mainly the Adriatic Sea, the Ionian Sea, the Ligurian Sea, the Tunisian waters and the Black Sea (reviewed in Mariottini and Pane 2010), and the Balearic Sea (Fuentes et al. 2011), while *R. octopus* is established in northwest Europe, being found in shallow coastal hotspots in the Irish Sea (Houghton et al. 2006), in the southern North Sea and the English channel (Lilley et al. 2009) and along the French Atlantic coasts (Lee et al. 2013). *Rhizostoma luteum* is found in the Strait of Gibraltar (Quoy and Gaimard 1827; Grenacher and Noll 1876), off the coasts of southern Portugal (Stiasny 1931, 1936), the west coast of Africa (Ranson 1949; Kramp 1955, 1959), from the Gulf of Cadiz and the Alboran Sea (west and east of the Strait of

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Gibraltar) and on the Atlantic coast of Morocco (Prieto et al. 2013). Until this present study, *R. luteum* was always referred to as a rare species and only on eight occasions have samples of this jellyfish been collected (Grenacher and Noll 1876; Kramp 1961; Prieto et al. 2013) (see Supplementary Material ST1).

In 2013, Prieto et al. (2013) reported the first record of *R. luteum* in the past 60 years. The authors presented reports of live sightings and beached specimens on the Atlantic coast of Morocco and along the south shore of the Iberian Peninsula during summer 2012 and winter 2013 from the Gulf of Cadiz to the Alboran Sea. This was the first account of this species in the southwestern Mediterranean Sea, describing also the genetic signature and confirming the existence of this species.

In the present study, we reviewed the scientific and popular literature (e.g. Underwater Field Guides) for records of *R. luteum*. We also made field observations for *R. luteum* between 2013 and 2015. Sightings were compiled focusing mainly on the Alboran Sea and the adjacent Atlantic Ocean coastal regions: Portuguese, Spanish and Moroccan coasts.

Materials and methods

Species identification

To identify the target species in each photograph and video, we used the list of parameters compiled in Table 1, applying morphological characteristics defined in the literature.

Historical scientific literature review

To get a better understanding of where the species has previously been reported, we reviewed all historical references to *R. luteum* by examining the scientific literature since Quoy and Gaimard first described this species in 1827 (see a summary of the historical scientific literature in Supplementary Material ST1).

Sourcing of photographs of *R. luteum*

To acquire both past and present data from the public regarding the presence of *R. luteum*, we launched a citizen science programme. We provided posters with information and contacted professional and amateur photographers and videographers in the study area. They were able to provide opportunistic observations. Additionally, sightings of the three target species (*R. pulmo*, *R. luteum* and *C. tagi*) were compiled from different sources: the media and both national and regional agencies. These included social media sites such as YouTube, Flickr, Facebook and blogs. Also, sightings of these three species were analysed from four open access databases: JellyWatch (http://www.jellywatch.org), PERSEUS (Policy-

Table 1 List of parameters used to identify target species

Species	Colour	Shape of mouth arms	Terminal appendages	References
R. luteum	Umbrella milky bluish-white, with reddish-brown warts. Oral arms bluish with yellowish mouths frills. Terminal appendages deep purple-brown.	The upper arms are longer and more robust than the weaker lower arms and fused throughout, forming a thick manubrium.	Terminal appendages with very long, slender basal stalk and with bean-shape protuberance.	Grenacher and Noll (1876); Mayer (1910); Stiasny (1921); Kramp (1961)
R. pulmo	Umbrella milky-yellow, occasionally reddish. Marginal lappets dark violet-blue. Mouth frills orange-yellow to brownish-red or violet. Terminal appendages milky-transparent.	Total length of mouth arms about equal to disc diameter.	Terminal appendages shorter than or equal to upper arm, widest near base, no basal stalk.	Haeckel (1879); Mayer (1910); Stiasny (1921); Kramp (1961)
C. tagi	Umbrella opalescent yellowish or milky bluish-white, sometimes brown. The dendritic ridges of the exumbrellae are reddish or brownish-purple.	The eight oral arms longer than the bell diameter, arm disc wider than bell radius. Terminal end of mouth arms pointed, without appendages.	Without terminal appendages.	Grenacher and Noll (1876); Mayer (1910); Kramp (1961)

oriented marine Environmental Research in the Southern European Seas; http://www.perseus-net.eu/en/jellyfish_map/index.html), Observadores del Mar (http://www.observadoresdelmar.es/index.php) and iNaturalist (https://www.inaturalist.org). Finally, we examined photographic materials from popular literature referring to the target species present in the Alboran Sea and the northeastern Atlantic Ocean.

All sightings were compiled and geo-referenced (see Supplementary Material ST2). By having photographic material from each jellyfish, we were able to determine, to the best of our ability, that all sightings close in time and space were actually different specimens. Samples for which there was any doubt were eliminated.

Shoreline surveys for *R. luteum*

Over a 2-year period (from October 2013 to October 2015), daily beach surveys and weekly snorkelling surveys (weather permitting) were conducted to record the presence or absence of gelatinous organisms along the beach of La Herradura, the Alboran Sea (36.72111° N, 3.72666° W) and inside the marina (Puerto Deportivo Marina del Este, La Herradura) (see Fig. 1). We measured the bell diameter across the lappets of the collected jellyfish to the nearest cm (oral side facing up), weighed to the nearest 100 g when possible and the terminal appendage length measured when present. To be sure not to recollect the same specimen on the following days, we marked each collected jellyfish with a zip tie attached to its marginal bell.

Results

Species identification

Rhizostoma luteum (Fig. 2a and video in the Supplementary Material) differs primarily from its congeners by its distinctive structure of the oral arms, its terminal appendages and its coloration. The umbrella is dome-shaped, milky bluish-white, with small reddish-brown warts. Oral arms are bluish with yellowish mouth frills and the eight terminal appendages are deep purple-brown (Fig. 2b). The bell margin is divided into eight short, oval velar lappets per octant and two smaller pointed rhopalar lappets, having a total of 80 marginal lappets. The proximal portions of the mouth arms are considerably longer and stronger than the distal portion, and throughout most of its length, merge into a thick manubrium. The eight terminal appendages are very long thin stalks and there is a bean-shaped protuberance (Fig. 2c) from the subumbrella wall in each subgenital pit (Grenacher and Noll 1876; Mayer 1910; Stiasny 1921; Kramp 1961).

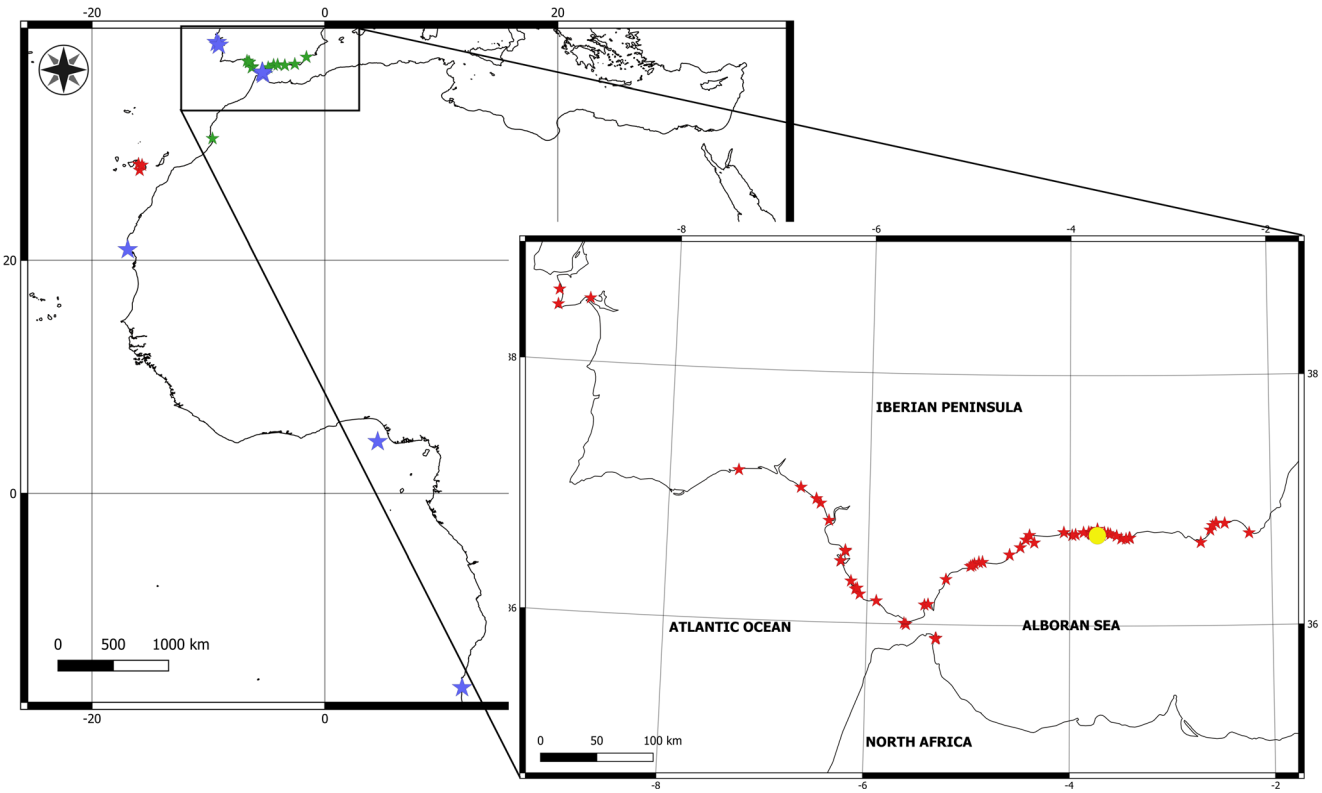

Fig. 1 Map of all the observations of *Rhizostoma luteum* compiled in this study: historical scientific data from 1827 to 1955 (*blue*), Prieto et al. (2013) (*green*), photographic material 1998–2015 (*red*) and location of shoreline surveys 2013–2015 (*yellow*)

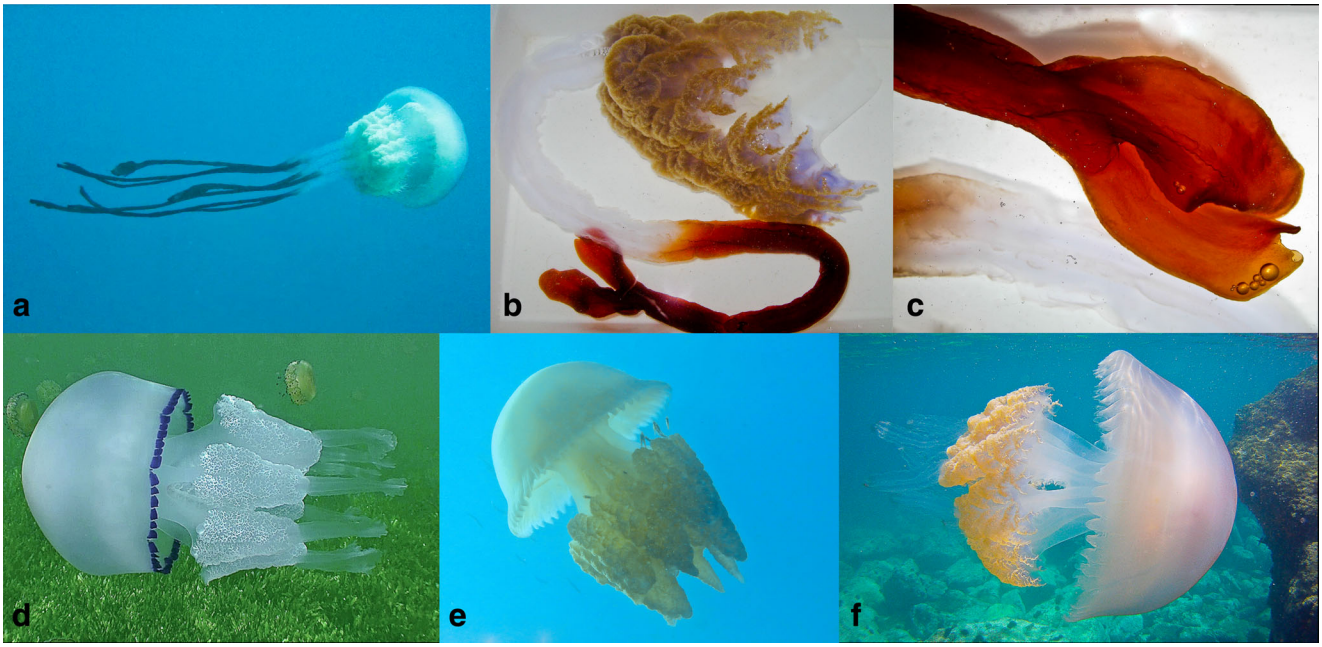

Fig. 2 **a** *Rhizostoma luteum* from La Herradura, northeastern Alboran Sea, photographed on September 23, 2014, bell diameter of 55 cm, longest terminal appendage 165 cm (record number 102, photo by D. Enayati). **b** A single oral arm of *R. luteum* with its terminal appendage collected on September 18, 2014, total length of the terminal appendage 65 cm (record number 94). **c** Bean-shaped protuberance of one terminal appendage of *R. luteum* of the same specimen as in photograph **b**. **d** *Rhizostoma pulmo* from Mar Menor, northwestern Mediterranean, photographed on August 11, 2011, visible are the dark blue marginal lappets and the short terminal appendages (the Mar Menor ecosystem is not included in the compilation of observations performed in this study due to the year-round presence of an isolated population of *R. pulmo*, photo by D. Enayati). **e** *Catostylus tagi* from Tarifa, Strait of Gibraltar photographed on October 6, 2014, with the characteristically pointy terminal ends of the mouth arms (record number 168, photo by E. Sánchez Castillo). **f** *Rhizostoma luteum* without any terminal appendages from La Herradura, northeastern Alboran Sea photographed on September 18, 2014 (record number 95, photo by D. Enayati)

The marginal lappets of *R. pulmo* (Fig. 2d) are typically dark cobalt or violet to blue. The umbrella is dome-shaped and milky-yellowish, occasionally even reddish. The surface of the exumbrella is finely granular, being covered with small nettling warts. In each octant, there are eight evenly rounded, velar lappets and two smaller rhopalar lappets, having a total of 80 marginal lappets. The mouth frills are orange-yellow or brownish-red or violet. The total length of the mouth arms are about equal to the disc diameter; the terminal appendages are about one-third of the total length of the arms, triangular in cross-section and widest near their base, and are without a thin basal stalk. The subgenital papillae are in the form of thickened valves on the marginal edges of the subgenital pits (Haeckel 1879; Mayer 1910; Stiasny 1921; Kramp 1961).

Catostylus tagi (Fig. 2e) differs from the genus *Rhizostoma* by its distinctive structure of the oral arms. The eight oral arms are as long as the bell diameter and the arm disc is slightly wider than the bell radius. The terminal end of the oral arms is pointed and without appendages. The entire medusa is opalescent yellowish or milky bluish-white, sometimes brown, and the dendritic ridges of the exumbrellae are reddish or brownish-purple. The gonads are yellowish. Each octant has four pairs of oval, pointed velar between two small, pointed, ocular lappets, not half as wide or long as the velar lappets, with a total of 80 marginal lappets (Grenacher and Noll 1876; Mayer 1910; Kramp 1961).

Table 1 summarises the parameters used in this study to identify the three different medusae. The two most important visual morphological differences between *R. luteum* and its sister species *R. pulmo* are the colour of the marginal lappets and whether the terminal appendages have a long slender basal stalk or not.

Historical scientific literature review

Rhizostoma luteum was described for the first time in 1827 under the name *Orythia lutea* by Quoy and Gaimard. They examined three young medusae captured in the Strait of Gibraltar near Ceuta and six from the Bay of Algeciras; the largest specimen was only two thumbs of diameter (taken from the original French description by Quoy and Gaimard and translated by the authors). They described these new species with an umbrella convex, rounded, more than half spherical and very slightly denticulate. Having a thick stalk, and the manubrium divided into four arms, which soon divided to form eight, in which the end of each is slightly forked. In 1862, Agassiz (1862) differentiated this new *Rhizostoma* species from the other ones due to the peculiar

shape of the arms; this is the reason why he defined a new genus *Stylonectes*, although he still suggested that *R. luteum* may possibly be a young *R. pulmo*. A few medusae collected from Gibraltar were described and drawn in detail by Grenacher and Noll (1876), leading to an enhanced knowledge about this species. *Rhizostoma luteum* differed primarily from *R. pulmo* and *R. octopus* by its distinctive structure of the oral arms and its terminal appendages. The upper arms are longer and more robust than the weaker lower arms and fused throughout, forming a thick manubrium. Nevertheless, Mayer (1910) recognised only one valid species, *R. pulmo*, referring to the medusae from the Strait of Gibraltar and *R. pulmo* var. *octopus*, referring to those of the Atlantic coast of Europe to be local variation. More thorough studies conducted by Stiasny (1921, 1931, 1936) established that all three species of *Rhizostoma* were valid and indicated some real differences (construction of the oral arms, terminal appendages, coloration etc.). Until 1931, this species was only documented from the Strait of Gibraltar; Stiasny (1931) thoroughly described a specimen taken in 1901 near Cezimbra on the Portuguese coast, south of Lisbon, and later on (1936), three specimens were taken in the mouth of the river Tagus (Tejo). Subsequently, in 1949, for the first time, two samples of *R. luteum* were collected from the west coast of Africa. Ranson collected one young specimen from the 'Baie des Tigres,' southern Angola, and another one from Mauritania (Port Etienne), similarly concluding that *R. luteum* differs from the other two species. Furthermore, Kramp (1955, 1959) collected various specimens from the west coast of Africa (Gulf of Guinea). He accepted *R. luteum* as a valid species (1961) but recorded *R. octopus* as a local variation. The legitimacy of the three *Rhizostoma* species was finally established by the molecular results performed on the mitochondrial cytochrome c oxidase I (COI) by Prieto et al. (2013), further confirming that morphological identification (Russell 1970) can be considered valid between the three species (for a summary, see Supplementary Material ST1).

Sourcing of photographs of *R. luteum*

This study includes only Rhizostomeae photographs and videos that are clearly identifiable as *R. luteum*, *R. pulmo* or *C. tagi* from the northeast Atlantic Ocean, the Strait of Gibraltar and the Alboran Sea (southwestern Mediterranean Sea). A total of 155 *R. luteum*, six *R. pulmo* and ten *C. tagi* sightings from June 1993 to December 2015 were compiled and geo-referenced (Fig. 1 and see Supplementary Material ST2). One hundred and fifteen photographs were taken from swimming specimens observed by scuba divers and 56 sightings were from beached medusae. Our results include: 106 photographs provided by professional and amateur underwater photographers and videographers, three sightings compiled from the project 'Campaña Medusas' by the Spanish Ministry of Environment, 18 found in media reports, 16 photos and videos sourced from searching social media and four observations downloaded from open access databases (see ST2). The first citizen science observation of *R. luteum* occurred in October 1998 (record number 1, see ST2), from the dive spot known as 'Peñon de las Caballas,' Alboran Sea (36.721111° N, 3.72666° W).

Reviewing the popular literature, referring to the scyphomedusa present in this region, we have been able to confirm the frequent misidentification of *R. luteum* in the past. The following books referred exclusively to *R. pulmo*; however, they were illustrating pictures of *R. luteum*: *Atlas submarino de la Costa del Sol* by Schick (1998), p. 12 (photo p. 13, Fig. 5); *Guía Submarina de Invertebrados No Artrópodos* by Ocaña Martín et al. (2000), p. 77 (photo p. 80); *Fondos Marinos de Murcia* by Calvín (2003), photo p. 168 (photo 410); *Bucear en el último confín de Europa, La Isla de Tarifa* by García Gómez and Magariño Rubio (2010), photo p. 327 (Figs. 4, 8, 9). Furthermore, Hofrichter (2003) in his book: *Das Mittelmeer* (2003), p. 526, photos *P. pulmo* (p. 512, Fig. 12.27 and p. 528, Fig. 12.42), photo *R. luteum* p. 527 (Fig. 12.41 h), displayed pictures of both species, however, referring to them only as *R. pulmo*. To our knowledge, only one guide refers to *R. luteum*, *Fauna Submarina Atlântica* by Saldanha (1997), p. 72, though, without any photographic illustration.

Shoreline surveys for *R. luteum*

A total of 15 *R. luteum* were sampled throughout a 2-year period in the region of La Herradura (see ST2): four medusae were beached, two were swimming near the shore, four were caught inside the marina and five were directly measured during snorkel surveys. All free-swimming medusae were actively swimming horizontally between 0 and 8 m, and we observed on, various occasions, that they were swimming against the current. All 15 jellyfish were measured across their widest point as having a diameter between 23 and 58 cm, and a mean diameter of 45.8 cm. There was a tendency of smaller samples during December–January and larger sizes in autumn. The biggest specimen was 58 cm in bell diameter, which was collected on October 12, 2015 (record number 150, Supplementary Material ST2). Additionally, we weighed eight jellyfish: three beached, four collected inside the marina and one swimming near the shore, with a mass range of 1.25–13 kg (record numbers 84, 85, 86, 94, 101, 102, 122 and 152, see ST2).

All sampled medusae had a dome-shaped, milky bluish-white umbrella with small reddish-brown warts. They had eight oval, pointed marginal lappets per octant and one smaller lappet on each side of the rhopalar. The terminal appendages were very long and had the shape of thin stalks with a bean-shaped protuberance (Fig. 2b, c), to be noted that most

jellyfish were missing or had partly dismembered appendages. The longest terminal appendage measured was 210 cm, with a well-developed terminal protuberance; its bell diameter was 47 cm and was sampled on September 5, 2014, during a snorkel survey (record number 91, see ST2). We believe that, since the terminal appendages are very long in adult animals, they might sever easily, as seen in Fig. 2f.

Additionally, on two occasions, January 19 and August 14, 2012, stranded individuals of *R. pulmo* (record numbers 160 and 161, see ST2) were collected during seashore surveys in the Doñana National Park (the Gulf of Cadiz).

Seasonal variation

R. luteum

Observations of *R. luteum* between 1998 and 2015 indicate that there was a higher abundance of *R. luteum* during the years 2015 and 2014, with 39 and 33 observations, respectively (see Supplementary Material ST2). To study the seasonality of this species in the different geographic areas, all the observations have been combined per month and are represented in a single plot where the accumulative number of sightings is relative to the size of the symbol (Fig. 3). During these two decades of recordings, the data indicate a higher seasonal occurrence during autumn for the coast of Portugal, the Gulf of Cadiz and the Strait of Gibraltar (Fig. 3). Meanwhile, all sightings took place during spring for the northwest coast of Africa. In the case of the Alboran Sea, sightings occurred between April and January, covering almost the whole year around (Fig. 3). Moreover, most observations (total number 123) occurred in the geographic area of the Alboran Sea.

R. pulmo and C. tagi

The reviewed data revealed only four confirmed observations of *R. pulmo* by scuba divers between 1993 and 2015; all sightings were from the northeastern coast of the Alboran Sea during summer (see record numbers from 156 to 159, Supplementary Material ST2). There were more spottings in the 1990s, however, without photographic records (personal communication). Our field sampling revealed one sighting in summer and another in winter in the Gulf of Cadiz (record numbers 160 and 161, see ST2).

Catostylus tagi was observed all year around (record numbers 162–171, see ST2), mostly in the northeast Atlantic Ocean (the Portuguese coast and the Strait of Gibraltar) and only once inside the Mediterranean Sea in summer (August 2009, number 164).

Discussion

The results of this investigation confirm that the existence of the scyphomedusa *R. luteum* is not that rare in the coastal waters of the west and south coasts of the Iberian Peninsula and the northwest shore of Africa. Over the past two decades, we were able to confirm 155 observations, through photographic and videographic identification and field sampling. However, many additional reports were received in which we were not always able to make conclusive identifications; these sightings were not included in this study. Therefore, *R. luteum* may have been even more frequently present over the last two decades. Moreover, the absence of observations during four years (2002–2005) might simply reflect a lack of photographic material, rather than an absence of the jellyfish. On the other hand, the increase of jellyfish sightings over the last five years could be due to the fact that, nowadays, cheaper underwater cameras are available to the public and the participation in citizen science projects is growing, which increase the opportunities of reported observations. Using citizen science is optimal to seek large volumes of field data over a wide geographical area (Silvertown 2009). Moreover, our results show that citizen science is a useful tool to document the past and present presence of gelatinous macroplankton. Due to their relatively large size and fragile body, traditional methods of sampling often fails, as often, jellyfish caught by conventional plankton nets are strained through the mesh and lost or damaged beyond recognition, or even some are fast swimmers and can usually avoid the nets (Hamner et al. 1975). There

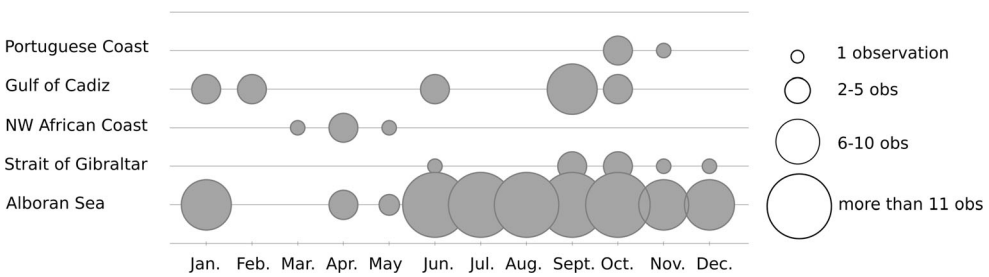

Fig. 3 Seasonal occurrence of *R. luteum* from 1998 to 2015 in the different geographic areas. All the observations have been combined per month. The accumulative number of sightings is relative to the size of the bubble: small bubble, one observation; medium bubble, 2–5 observations; big bubble 6–10 observations and large bubble, more than 11 observations

have been some very successful citizen science programmes in the past, like the CIESM JellyWatch (2009–2013), the results of which led to the records of new species from the Mediterranean Sea and to a better evaluation of the distribution of native species (Boero 2013). However, citizen science is, in most cases, limited to coastal areas (beach or near shore observation), except for the rare occasions of information provided by boat owners. To overcome this, observation from cruise boats or aircraft (or nowadays even drones) may be used as a complementary method of observation. As in the Irish Sea, the use of visual surveys from ships of opportunity or aircraft has provided novel insight on *R. octopus* (Doyle et al. 2007; Houghton et al. 2006). Such techniques could provide a rapid way for assessing the broad-scale distribution of *R. luteum*, perhaps identifying coastal and open sea hotspots.

There has been a reappearance of another large scyphomedusa, *Drymonema dalmatinum* (Bayha and Dawson 2010; Malej et al. 2014), from the Adriatic Sea and eastern Mediterranean Sea, which was similarly described as a rare species; however, in the last 15 years, observations of *D. dalmatinum* have been more frequent. The authors speculate that the increase may be due to the proliferation of their prey, *Aurelia* sp., in the last decade (Kogovšek et al. 2010). Maybe there has also been a comparable increase in the prey of *R. luteum* in the last two decades in the western Mediterranean Sea. However, nothing is known about the diet of *R. luteum*.

In comparison to the other two species studied in the present work (*R. pulmo* and *C. tagi*), the number of sightings has only increased in the case of *R. luteum*. It must be noted that most of the observations of *R. luteum* were made in the region of La Herradura, the northeastern Alboran Sea. This region may have an actual greater abundance or it could be that it has a higher occurrence of sightings because of the year-round presence of scuba divers. The limited data obtained in our survey on the occurrence of *R. pulmo* shows that this species was present during 2012 in the Gulf of Cadiz and seemed to have been more abundant in the 1990s in the Alboran Sea. Our results indicate that, at least in the last several decades, the abundance of *R. luteum* was greater than that of *R. pulmo* in the Gulf of Cadiz and the Alboran Sea, although this issue needs further investigation.

Our data show the almost year-round presence of adult *R. luteum* in the Alboran Sea. Comparing our observation of *R. luteum* with that of *R. pulmo* by Fuentes et al. (2011), they observed juvenile *R. pulmo* along the Catalan coast at the beginning of May and adults disappearing at the end of August/September. However, in the Mar Menor (northwestern Mediterranean), ephyrae appeared at the end of May/June and adult medusae normally disappeared during January to March.

We believe that, because of its similarity with the closely related Mediterranean *R. pulmo*, *R. luteum* was frequently misidentified in the past and possibly the same misidentification of *R. luteum* occurred in the adjacent Atlantic Ocean coastal regions with the very similar *C. tagi*, as this Rhizostomeae is very abundant during summer on the shores of Portugal and, furthermore, can be found on the west coast of Africa and in the Strait of Gibraltar (Grenacher and Noll 1876; Mayer 1910; Kramp 1955, 1961). Nonetheless, the past misidentification of *R. luteum* with *R. pulmo* could explain the lack of scientific records citing *R. luteum* in the southwestern Mediterranean Sea up until 2012 (Prieto et al. 2013). Stiasny, in 1936, previously mentioned this possibility of confusion in the region of the Mediterranean Sea. He mentioned the unexpected slow northern movement of the species, expanding its habitat from the Strait of Gibraltar to the Portuguese coast (Stiasny 1931, 1936), and pointed out the lack of records from the Alboran Sea.

To conclude, this study provides an extended revision of the scientific literature, popular literature and field data confirming the more frequent appearance of the jellyfish *R. luteum* over the past two decades in the Alboran Sea and the adjacent Atlantic Ocean coastal regions. Furthermore, in this framework, citizen science campaigns are an effective tool to study the past occurrence of gelatinous macroplankton.

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ST1 Summary of historical literature review.

Name	Reference	Page Nr.	Figure and/or plate	Number of specimens collected and location
Orythia lutea	1827, Quoy & Gaimard	175	IV B, Fig. 1	3 individuals near Ceuta and 6 from the Bay of Algeciras (Strait of Gibraltar)
Rhizostoma lutea	1829, Eschscholtz	51		
R. lutea	1843, Lesson	413		
Stylonectes luteus	1862, Agassiz	151		
Rhizostoma luteum	1876, Grenacher & Noll	160	Fig. XVIII - XX	A few specimens collected near Gibraltar (Strait of Gibraltar)
Stylonectes orithyia	1877, Haeckel			
Pilema orithyia	1878, Haeckel			
P. sylonectes	1879, Haeckel	595		
Rhizostoma luteum	1888, Vanhöffen	43		
R. pulmo var. lutea	1910, Mayer	703		
R. luteum	1921, Stiasny	159		
R. luteum	1931, Stiasny	164	Fig. 4 - 6	1 individual from Cezimbra (Portuguese coast)
R. luteum	1936, Stiasny	1	Fig. 1 - 2	3 individuals from Tejo (Portuguese coast)
R. luteum	1949, Ranson	147		1 individual from the Bay of Tigres, south Angola and 1 from Port Etienne, Mauritania (west coast of Africa)
R. luteum	1955, Kramp	304		1 individual from the Gulf of Guinea (west coast of Africa)
R. luteum	1959, Kramp	26	Fig. 5	5 individuals from different locations on the west coast of Africa
R. luteum	1961, Kramp	378		
R. luteum	1970, Russel	172		
R. luteum	2013, Prieto et al.		Fig. 2	27 individuals from the Gulf of Cadiz, 1 individual from Agadir (west coast of Africa) and 41 individuals in the Alboran Sea

ST2 Records of *R. luteum*, *R. pulmo* and *C. tagi* from 1993 to 2015. Abbreviation: s – swimming; b – beached.

Records of *R. luteum* between 1998 to 2015						
Record No.	**Record date**	**Location**	**Obser-vations**	**Latitude**	**Longitude**	**References**
1	October 4, 1998	Peñon de las Caballas, La Herradura, Granada, Alboran Sea	s	36,7261	-3,7250	Present study (photo credit J. C. Moreno Robledo, Red de Vigilantes Marinos)
2	September, 2000	Marina del Este, La Herradura, Granada, Alboran Sea	s	36,7203	-3,7281	Present study (photo credit M. Campillo)
3	October, 2001	La Herradura, Granada, Alboran Sea	s	36,7319	-3,7553	Present study (photo credit M. Campillo)
4	October, 2006	La Garita, Tarifa, Strait of Gibraltar	s	35,9972	-5,6122	Present study (photo credit V. Pérez)
5	April 20, 2007	Malaga, Alboran Sea	b	36,6614	-4,3547	http://www.todosurf.com/foro/viewtopic.php?f=1&t=6397
6	July 18, 2007	Caleta de Velez, Malaga, Alboran Sea	b	36,7453	-4,0603	Campaña Medusas - Ministerio de Medio Ambiente
7	September 8, 2007	La Barrosa, Cadiz, Gulf of Cadiz	b	36,3709	-6,1188	Campaña Medusas - Ministerio de Medio Ambiente
8	December 3, 2007	La Herradura, Granada, Alboran Sea	s	36,7319	-3,7553	Present study (photo credit L. Sanchez Tocino)
9	January 31, 2008	La Herradura, Granada, Alboran Sea	s	36,7319	-3,7553	Present study (photo credit L. Sanchez Tocino)
10	July 27, 2008	Fuengirola, Malaga, Alboran Sea	s	36,5639	-4,5983	http://www.panoramio.com/photo/19335251
11	July, 2009	La Herradura, Granada, Alboran Sea	s	36,7319	-3,7553	Present study (photo credit M. Campillo)
12	September, 2009	La Herradura, Granada, Alboran Sea	s	36,7319	-3,7553	Present study (photo credit M. Campillo)
13	October 4, 2009	Calahonda, Granada, Alboran Sea	s	36,7017	-3,4044	Present study (photo credit A. Exposito)
14	November, 2009	Punta Entinas-Sabinar, Almeria, Alboran Sea	s	36,6631	-2,7000	Present study (photo credit A. Terrón, Asociación Hombre y Territorio)
15	November 15, 2009	Marina del Este, La Herradura, Granada, Alboran Sea	s	36,7203	-3,7281	https://m.flickr.com/#/photos/8783763@N04/4856852420/
16	June 21, 2010	Chorillo, Ceuta, Strait of Gibraltar	s	35,8852	-5,3206	http://elfarodigital.es/ceuta/medio-ambiente/11241-los-barcos-de-limpieza-encuentran-un-aguamala-de-casi-diez-kilos.html
17	June 26, 2010	Fuengirola, Malaga, Alboran Sea	b	36,5639	-4,5983	https://www.youtube.com/watch?v=5lqKUyr2ZCE
18	July 10, 2010	Malaga, Alboran Sea	b	36,6614	-4,3547	http://objetivomalaga.diariosur.es/fotos-JuanjoFernandez/playas-malaga/medusa-gigante-691657.html
19	September 29, 2010	Torrox Costa, Malaga, Alboran Sea	b	36,7283	-3,9442	Campaña Medusas - Ministerio de Medio Ambiente
20	July, 2011	Almuñécar, Granada, Alboran Sea	s	36,7250	-3,6856	Present study (photo credit R. Bermejo Lacida)
21	July 25, 2011	Roquetas del Mar, Almeria, Alboran Sea	s	36,8178	-2,5484	Present study (photo credit A. Perez, Aquatours Almeria)
22	August 7, 2011	Marina del Este, La Herradura, Granada, Alboran Sea	s	36,7203	-3,7281	http://delmontealamar.wordpress.com/2011/09/13/snorkel-en-playa-de-los-berengueles-punta-de-la-mona/
23	August 12, 2011	Aguadulce, Almeria, Alboran Sea	s	36,8176	-2,5458	Present study (photo credit A. Perez, Aquatours Almeria)
24	August 13, 2011	Playa Cabria, Almuñécar, Granada, Alboran Sea	s	36,7250	-3,6856	http://www.surfcastinggranada.com/t1875-foto-de-medusa-en-cabria-almunecar

Records of *R. luteum* between 1998 to 2015						
Record No.	**Record date**	**Location**	**Obser-vations**	**Latitude**	**Longitude**	**References**
25	August 30, 2011	Punta de la Mona, La Herradura, Granada, Alboran Sea	s	36,7211	-3,7361	Present study (photo credit J. J. Merlos)
26	September 3, 2011	Roquetas de Mar, Almeria, Alboran Sea	s	36,8178	-2,5484	Present study (photo credit A. Perez, Aquatours Almeria)
27	September 6, 2011	Puerto Santa Maria, Gulf of Cadiz	b	36,5689	-6,2253	http://www.jellywatch.org/node/1054
28	September 11, 2011	Castell de Ferro, Granada, Alboran Sea	s	36,7017	-3,4044	Present study (photo credit J. M. Osorio Rodriguez)
29	October 16, 2011	Cabo Espichel, Setubal, Portuguese Coast	s	38,4425	-9,2203	Present study (photo credit M. Pereira)
30	November 21, 2011	Coast of Granada, Alboran Sea	s	36,7203	-3,7281	https://www.youtube.com/watch?v=FpmBxP3oOnw
31	November 27, 2011	Cabo Espichel, Setubal, Portuguese Coast	s	38,5056	-8,8950	Present study (photo credit S. Martins)
32	June 3, 2012	Almeria, Alboran Sea	b	36,8153	-2,4606	http://almeria360.com/actualidad/03062012_una-medusa-gigante-aterroriza-a-los-banistas-de-una-playa-de-almeria_23446.html
33	June 5, 2012	Agadir, Morocco, NW African Coast	s	30,4309	-9,6519	Prieto et al., 2013
34	June 12, 2012	Doñana National Park, Gulf of Cadiz	b	36,8124	-6,3990	Prieto et al., 2013
35	June 17, 2012	Marbella, Malaga, Alboran Sea	b	36,5044	-4,8660	http://www.laopiniondemalaga.es/malaga/2012/06/18/medusas-gigantes-costa-costa-malaga/513600.html
36	June 17, 2012	Malaga, Alboran Sea	b	36,7214	-4,4019	http://www.laopiniondemalaga.es/malaga/2012/06/19/lluvias-calor-alimento-medusas/513769.html
37	June 17, 2012	Algarrobo, Malaga, Alboran Sea	b	36,7460	-4,0604	http://www.laopiniondemalaga.es/malaga/2012/06/18/medusas-gigantes-costa-costa-malaga/513600.html
38	June 18, 2012	El Puerto de Santa Maria, Gulf of Cadiz	b	36,5769	-6,2277	Prieto et al., 2013
39	June 18, 2012	Caleta de Velez, Malaga, Alboran Sea	s	36,7228	-3,9775	https://www.youtube.com/watch?v=9E-rVu_jmZM
40	June 18, 2012	Torrenueva, Granada, Alboran Sea	s	36,6956	-3,4900	https://www.youtube.com/watch?v=dnv5IJ7Cjio
41	June 18, 2012	Salobraña, Granada, Alboran Sea	b	36,7322	-3,5981	http://waste.ideal.es/medusas-plaga-ideal.htm
42	June 19, 2012	Motril, Granada, Alboran Sea	b	36,6943	-3,4423	http://www.abc.es/20120619/sociedad/abci-medusa-playa-granada-201206191220.html
43	June 20, 2012	Almuñécar, Granada, Alboran Sea	b	36,7250	-3,6856	https://www.youtube.com/watch?v=2zOjX-Te13M
44	June 20, 2012	Fuengirola, Malaga, Alboran Sea	b	36,5639	-4,5983	https://www.youtube.com/watch?v=78d2fU7A_BY
45	June 21, 2012	La Herradura, Granada, Alboran Sea	s	36,7319	-3,7553	https://www.youtube.com/watch?v=9LfmY5ft2D0
46	June 24, 2012	Nerja, Malaga, Alboran Sea	s	36,7458	-3,8644	Present study (photo credit M. Martinez Peralta)
47	June 24, 2012	Malaga, Alboran Sea	b	36,7214	-4,4019	https://www.youtube.com/watch?v=Jj0shh2iATM
48	June 26, 2012	Marbella, Malaga, Alboran Sea	b	36,4897	-4,9456	https://www.facebook.com/10150127838175354/photos/a.10150454459120354.638245.10150127838175354/10151882101600354
49	June 28, 2012	Marbella, Malaga, Alboran Sea	s	36,5019	-4,9015	Present study (photo credit Y. Zamora Paneca, Observadores del Mar)
50	June 29, 2012	Malaga, Alboran Sea	b	36,7214	-4,4019	https://www.youtube.com/watch?v=dzsi6ma1p_8

Records of *R. luteum* between 1998 to 2015						
Record No.	**Record date**	**Location**	**Obser-vations**	**Latitude**	**Longitude**	**References**
51	June 30, 2012	Torremolinos, Malaga, Alboran Sea	b	36,6225	-4,4922	http://www.diariosur.es/20120630/local/malaga/medusa-gigante-aparece-playa-201206301259.html
52	July 1, 2012	Huelin, Malaga, Alboran Sea	b	36,6850	-4,4386	http://objetivomalaga.diariosur.es/fotos-NENE307/medusa-gigante-1196107.html
53	July 1, 2012	Aguadulce, Almeria, Alboran Sea	s	36,8176	-2,5458	Present study (photo credit A. Perez, Aquatours Almeria)
54	July 1, 2012	Torremolinos, Malaga, Alboran Sea	b	36,6226	-4,4929	http://www.diariosur.es/v/20120701/malaga/aparece-medusa-proporciones-gigantes-20120701.html
55	July 3, 2012	Malaga, Alboran Sea	b	36,6614	-4,3547	http://www.diariosur.es/20120703/local/malaga/aparecen-medusas-grandes-dimensiones-201207031704.html
56	July 7, 2012	Marina del Este, La Herradura, Granada, Alboran Sea	b	36,7203	-3,7281	Present study (photo credit J. Peralta)
57	July 7, 2012	Maro - Cerro Gordo, Malaga, Alboran Sea	s	36,7353	-3,7817	Present study (photo credit R. Carrapiso)
58	July 7, 2012	La Adelfa, Marbella, Malaga, Alboran Sea	b	36,4711	-4,9850	http://www.produnas.org/A/Noticias%202013_12.htm
59	July 8, 2012	Playa Rodeito, Marbella, Malaga, Alboran Sea	b	36,4778	-4,9664	https://www.youtube.com/watch?v=eq3t1Vt9mes
60	July 11, 2012	Roquetas de Mar, Almeria, Alboran Sea	b	36,7617	-2,6053	http://www.albamar.net/?p=1269
61	July 30, 2012	Motril, Granada, Alboran Sea	b	36,7181	-3,5356	https://motrildigital.blogia.com/2012/agosto.php
62	August 15, 2012	Almuñécar, Granada, Alboran Sea	b	36,7250	-3,6856	https://motrildigital.blogia.com/2012/agosto.php
63	January 24, 2013	Cortadura, Cadiz, Gulf of Cadiz	b	36,4947	-6,2726	Prieto et al., 2013
64	January 29, 2013	Cortadura, Cadiz, Gulf of Cadiz	b	36,4947	-6,2726	Prieto et al., 2013
65	February 6, 2013	Doñana National Park, Gulf of Cadiz	b	37,0697	-6,6888	Prieto et al., 2013
66	February 7, 2013	Doñana National Park, Gulf of Cadiz	b	36,9825	-6,5299	Prieto et al., 2013
67	March 31, 2013	Sardina, Gran Canaria, NW African Coast	s	28,1503	-15,7042	Present study (photo credit K. Machin)
68	April 1, 2013	Tenerife, NW African Coast	s	28,2444	-16,6075	Present study (photo credit I. Domingues)
69	April 11, 2013	Mogan, Gran Canaria, NW African Coast	s	27,7133	-15,9122	Present study (photo credit A. Telle Thiemann)
70	September 25, 2013	Bahia de Algeciras, Strait of Gibraltar	s	36,1614	-5,3979	Present study (photo credit J. and M. Longman)
71	October, 2013	Maro-Cerro Gordo, Malaga, Alboran Sea	s	36,7367	-3,7772	Present study (photo credit M. A. Marquez Navarrete)
72	October 2, 2013	Almada, Lisbon, Portuguese Coast	s	38,5611	-9,2167	Present study (photo credit L. Quinta)
73	October 12, 2013	Punta de la Mona, La Herradura, Granada, Alboran Sea	s	36,7183	-3,7339	Present study (photo credit E. Sánchez Castillo)
74	October 14, 2013	Playa Galera, Almuñécar, Granada, Alboran Sea	b	36,7456	-3,6572	Present study (photo credit A. Zipse)
75	October 16, 2013	La Herradura, Granada, Alboran Sea	s	36,7375	-3,7539	Present study (photo credit M. O'Gorman)
76	October 17, 2013	Maro - Cerro Gordo, Malaga, Alboran Sea	s	36,7353	-3,7817	Present study (photo credit A. Zipse)
77	October 21, 2013	Punta de la Mona, La Herradura, Malaga, Alboran Sea	s	36,7183	-3,7339	Present study (photo credit F. J. Nieto Vera)

Records of *R. luteum* between 1998 to 2015						
Record No.	**Record date**	**Location**	**Obser-vations**	**Latitude**	**Longitude**	**References**
78	October 25, 2013	La Herradura, Granada, Alboran Sea	s	36,7316	-3,7454	Present study (own observations)
79	November 1, 2013	Punta de la Mona, La Herradura, Granada, Alboran Sea	s	36,7193	-3,7264	Present study (photo credit M. Defat)
80	November 1, 2013	Marina del Este, La Herradura, Granada, Alboran Sea	s	36,7203	-3,7281	Present study (photo credit M. Defat)
81	November 2, 2013	La Herradura, Granada, Alboran Sea	b	36,7316	-3,7454	Present study (photo credit A. Jimenez)
82	December 5, 2013	Puerto Deportivo Marina del Este, La Herradura, Granada, Alboran Sea	b	36,7726	-3,7264	Present study (own observations)
83	December 9, 2013	Punta de la Mona, La Herradura, Granada, Alboran Sea	s	36,7193	-3,7264	Present study (photo credit H. Fernández)
84	January 8, 2014	Puerto Deportivo Marina del Este, La Herradura, Granada, Alboran Sea	s	36,7726	-3,7264	Present study (own observations)
85	January 12, 2014	Puerto Deportivo Marina del Este, La Herradura, Granada, Alboran Sea	s	36,7726	-3,7264	Present study (own observations)
86	January 13, 2014	Puerto Deportivo Marina del Este, La Herradura, Granada, Alboran Sea	s	36,7726	-3,7264	Present study (own observations)
87	January 15, 2014	La Herradura, Granada, Alboran Sea	b	36,7316	-3,7454	Present study (photo credit E. Carbajo Pereda)
88	January 24, 2014	Maro - Cerro Gordo, Malaga, Alboran Sea	s	36,7385	-3,7858	Present study (photo credit A. Zipse)
89	July 8, 2014	Motril, Granada, Alboran Sea	s	36,7181	-3,5356	Present study (photo credit E. Domínguez Díaz)
90	July 21, 2014	Calahonda, Granada, Alboran Sea	s	36,7017	-3,4044	Present study (photo credit M. Bustos Rodriguez)
91	September 5, 2014	Marina del Este, La Herradura, Granada, Alboran Sea	s	36,7203	-3,7281	Present study (own observations)
92	September 9, 2014	Marina del Este, La Herradura, Granada, Alboran Sea	s	36,7203	-3,7281	Present study (photo credit D. Enayati)
93	September 13, 2014	Maro-Cerro Gordo, Granada, Alboran Sea	s	36,7385	-3,7858	Present study (photo credit B. Waddell)
94	September 18, 2014	Puerto Deportivo Marina del Este, La Herradura, Granada, Alboran Sea	s	36,7726	-3,7264	Present study (own observations)
95	September 18, 2014	Marina del Este, La Herradura, Granada, Alboran Sea	s	36,7203	-3,7281	Present study (own observations)
96	September 18, 2014	Marina del Este, La Herradura, Granada, Alboran Sea	s	36,7203	-3,7281	Present study (photo credit V. Costa and J. M. Cabrera)
97	September 20, 2014	La Rijana, Maro-Cerro Gordo, Granada, Alboran Sea	s	36,7367	-3,7772	Present study (photo credit ScubAzul)
98	September 20, 2014	Torrox Costa, Malaga, Alboran Sea	b	36,7283	-3,9442	Present study (photo credit A. Paredes Arroyo)

Records of *R. luteum* between 1998 to 2015						
Record No.	**Record date**	**Location**	**Obser-vations**	**Latitude**	**Longitude**	**References**
99	September 21, 2014	Marina del Este, La Herradura, Granada, Alboran Sea	s	36,7203	-3,7281	Present study (photo credit P. Parra)
100	September 21, 2014	Calahonda, Granada, Alboran Sea	s	36,7019	-3,4108	Present study (photo credit M. Bustos Rodriguez and F. Lasarte Romero)
101	September 22, 2014	La Herradura, Granada, Alboran Sea	b	36,7375	-3,7539	Present study (own observations)
102	September 23, 2014	Marina del Este, La Herradura, Granada, Alboran Sea	s	36,7203	-3,7281	Present study (own observations)
103	September 23, 2014	Marina del Este, La Herradura, Granada, Alboran Sea	s	36,7203	-3,7281	Present study (photo credit Buceo La Herradura)
104	September 23, 2014	Puerto Deportivo Marina del Este, La Herradura, Granada, Alboran Sea	b	36,7726	-3,7264	Present study (own observations)
105	September 29, 2014	Punta de la Mona, La Herradura, Granada, Alboran Sea	s	36,7211	-3,7361	Present study (photo credit A. Connolly, Open Water La Herradura)
106	October 1, 2014	Cortadura, Cadiz, Gulf of Cadiz	b	36,4924	-6,2701	Present study (photo credit R. Jiménez Ramos)
107	October 4, 2014	Isla Tarifa, Strait of Gibraltar	s	35,9972	-5,6122	Present study (photo credit F. J. Zambrana)
108	October 4, 2014	Playa Fabriquilla, Cabo de Gata, Almeria, Alboran Sea	s	36,7356	-2,2186	Present study (photo credit J. L. Pérez Campos)
109	October 4, 2014	Playa Cañuelo, Maro- Cerro Gordo, Malaga, Alboran Sea	s	36,7431	-3,7892	Present study (photo credit C. Hita Suarez)
110	October 23, 2014	Punta de la Mona, La Herradura, Granada, Alboran Sea	s	36,7183	-3,7339	Present study (photo credit A. Zipse)
111	October 24, 2014	Maro-Cerro Gordo, Malaga, Alboran Sea	s	36,7385	-3,7858	Present study (photo credit C. Garcia, Open Water La Herradura)
112	October 26, 2014	Punta de la Mona, La Herradura, Granada, Alboran Sea	s	36,7193	-3,7264	Present study (photo credit C. Garcia, Open Water La Herradura)
113	November 13, 2014	Marina del Este, La Herradura, Granada, Alboran Sea	s	36,7203	-3,7281	Present study (photo credit P. Parra)
114	November 25, 2014	Fosa de San Felipe, Ceuta, Strait of Gibraltar	s	35,8881	-5,3183	Present study (photo credit E. Alvarez Paz)
115	December 18, 2014	Puerto Deportivo, Ceuta, Strait of Gibraltar	s	35,8917	-5,3136	Present study (photo credit E. Alvarez Paz)
116	December 30, 2014	Playa Cañuelo, Nerja, Malaga, Alboran Sea	s	36,7431	-3,7911	Present study (photo credit A. Zipse)
117	January 11, 2015	La Herradura, Granada, Alboran Sea	s	36,7281	-3,7542	Present study (photo credit A. Zipse)
118	January 14, 2015	La Herradura, Granada, Alboran Sea	s	36,7316	-3,7454	Present study (photo credit A. Zipse)
119	January 15, 2015	Bolonia, Gulf of Cadiz	s	35,0689	-5,7550	Present study (photo credit R. Bermejo Lacida)
120	February 15, 2015	Playa Rinconcillo, Algeciras, Strait of Gibraltar	b	36,1556	-5,4333	Present study (photo credit C. Serrano Lopez, Club de buceo CIES Algeciras)
121	April 3, 2015	La Herradura, Granada, Alboran Sea	s	36,7290	-3,7371	Present study (photo credit S. de la Camara)

Records of *R. luteum* between 1998 to 2015						
Record No.	**Record date**	**Location**	**Obser-vations**	**Latitude**	**Longitude**	**References**
122	May 3, 2015	Puerto Deportivo Marina del Este, La Herradura, Granada, Alboran Sea	b	36,7726	-3,7264	Present study (own observations)
123	August 6, 2015	Los Molinos, Maro - Cerro Gordo, Malaga, Alboran Sea	s	36,7500	-3,8128	Present study (photo credit M. Carderelli, Buceo Natura La Herradura)
124	August 9, 2015	Punta de la Mona, La Herradura, Granada, Alboran Sea	s	36,7211	-3,7361	Present study (photo credit L. Belladonna, Buceo La Herradura)
125	August 16, 2015	Marina del Este, La Herradura, Granada, Alboran Sea	s	36,7203	-3,7281	Present study (photo credit P. Rebola)
126	August 16, 2015	Playa Cañuelo, Nerja, Alboran Sea	s	36,7431	-3,7911	Present study (photo credit M. Campillo)
127	August 26, 2015	Playa Calaiza, La Herradura, Granada, Alboran Sea	s	36,7344	-3,7450	Present study (photo credit A. Zipse)
128	August 27, 2015	Punta de la Mona, La Herradura, Granada, Alboran Sea	s	36,7183	-3,7339	Present study (photo credit P. Y. Losco and A. Paredes Arroyo)
129	September 6, 2015	El Palmar, Conil, Gulf of Cadiz	b	36,2320	-6,0748	Present study (photo credit S. Flecha)
130	September 10, 2015	La Herradura, Granada, Alboran Sea	s	36,7290	-3,7371	Present study (photo credit S. Harris)
131	September 10, 2015	Marina del Este, La Herradura, Granada, Alboran Sea	s	36,7203	-3,7281	Present study (own observations)
132	September 10, 2015	Isla Cristina, Huelva, Gulf of Cadiz	b	37,1922	-7,3150	Present study (photo credit C. Bordehore)
133	September 10, 2015	El Puerto de Santa Maria, Gulf of Cadiz	b	36,5769	-6,2277	Present study (own observations)
134	September 13, 2015	Sabinillas, La Duquesa, Malaga, Alboran Sea	b	36,3626	-5,2250	Present study (photo credit J. Prieto)
135	September 19, 2015	Marina del Este, La Herradura, Granada, Alboran Sea	s	36,7203	-3,7281	Present study (photo credit R. Sanchez)
136	September 19, 2015	Punta de la Mona, La Herradura, Granada, Alboran Sea	s	36,7193	-3,7264	Present study (photo credit P. Sierra)
137	September 20, 2015	Chorrillo, Conil, Gulf of Cadiz	b	36,2788	-6,1010	Present study (own observations)
138	September 20, 2015	La Herradura, Granada, Alboran Sea	s	36,7290	-3,7371	Present study (photo credit M. C. Pardial)
139	September 22, 2015	Playa del Puerco, Cadiz, Gulf of Cadiz	b	36,3344	-6,1643	Present study (own observations)
140	September 25, 2015	Maro - Cerro Gordo, Malaga, Alboran Sea	s	36,7331	-3,7750	Present study (photo credit A. Avile Tapia)
141	September 25, 2015	Los Lances, Tarifa, Strait of Gibraltar	b	36,1807	-5,6308	Present study (photo credit C. Villaescusa)
142	September 26, 2015	Punta de la Mona, La Herradura, Granada, Alboran Sea	s	36,7193	-3,7264	Present study (photo credit M. Campillo)
143	September 28, 2015	Salobreña, Granada, Alboran Sea	s	36,7394	-3,6222	Present study (photo credit V. Vermeulen)
144	October 4, 2015	Maro - Cerro Gordo, Malaga, Alboran Sea	s	36,7331	-3,7750	Present study (photo credit F. J. Diaz Masna)
145	October 4, 2015	Maro - Cerro Gordo, Malaga, Alboran Sea	s	36,7331	-3,7750	Present study (photo credit H. Fernández)

Records of *R. luteum* between 1998 to 2015						
Record No.	**Record date**	**Location**	**Obser-vations**	**Latitude**	**Longitude**	**References**
146	October 11, 2015	Barbate, Gulf of Cadiz	s	36,1807	-5,9090	Present study (own observations)
147	October 11, 2015	Maro Cerro-Gordo, Malaga, AlboranSea	s	36,7322	-3,7739	Present study (photo credit D. Romero Nuñez)
148	October 11, 2015	La Herradura, Granada, Alboran Sea	s	36,7308	-3,7442	Present study (photo credit D. Romero Nuñez)
149	October 12, 2015	Maro - Cerro Gordo, Malaga, Alboran Sea	s	36,7331	-3,7750	Present study (photo credit M. Cardarelli, Buceo Natura La Herradura)
150	October 12, 2015	Marina del Este, La Herradura, Granada, Alboran Sea	s	36,7203	-3,7281	Present study (own observations)
151	October 14, 2015	Tarifa, Strait of Gibraltar	b	35,9972	-5,6122	Present study (photo credit C. Gurrea)
152	October 27, 2015	Marina del Este, La Herradura, Granada, Alboran Sea	s	36,7203	-3,7281	Present study (own observations)
153	November 14, 2015	La Herradura, Granada, Alboran Sea	s	36,7227	-3.7272	Present study (photo credit R. Camacho, Buceo Natura La Herradura)
154	December 8, 2015	La Herradura, Granada, Alboran Sea	s	36,7290	-3.7371	Present study (photo credit A. Zipse)
155	December 26, 2015	La Herradura, Granada, Alboran Sea	s	36,7227	-3.7272	Present study (photo credit K. Funes)

Records of *R. pulmo* between 1993 and 2012						
Record No.	**Record date**	**Location**	**Obser-vations**	**Latitude**	**Longitude**	**References**
156	June 6, 1993	La Herradura, Granada, Alboran Sea	s	36,7300	-3,7631	Present study (photo credit J. C. Moreno Robledo, Red de Vigilantes Marinos)
157	July, 1997	La Herradura, Granada, Alboran Sea	s	36,7319	-3,7553	Present study (photo credit M. Campillo)
158	August 22, 1998	Maro - Cerro Gordo, Granada, Alboran Sea	s	36,7494	-3,8167	Present study (photo credit J. C. Moreno Robledo, Red de Vigilantes Marinos)
159	August 7, 2011	Calahonda, Granada, Alboran Sea	s	36,7017	-3,4044	Present study (photo credit J. M. Osorio Rodriguez)
160	January 19, 2012	Doñana National Park, Gulf of Cadiz	b	36,8124	-6,3990	Present study (own observations)
161	August 14, 2012	Doñana National Park, Gulf of Cadiz	b	36,9476	-6,4873	Present study (own observations)

Records of *C. tagi* between 2007 and 2015						
Record No.	**Record date**	**Location**	**Obser-vations**	**Latitude**	**Longitude**	**References**
162	November 29, 2007	Port Lisbon, Portuguese Coast	s	38,7117	-9,1183	https://www.flickr.com/photos/luisa/2074898433/in/photolist-qWCQmJ-qDoBnW-pyLt1m-r2rxcD-qJRLtq-qTPua1-qDFRJz-pY6s4t-oj1suA-okQBAY
163	November 23, 2008	Tagus River, Portuguese Coast	s	38,6272	-9,2475	Present study (photo credit A. Gonçalves)
164	August, 2009	La Herradura, Granada, Alboran Sea	s	36,7319	-3,7553	http://www.forobuceo.com/phpBB3/viewtopic.php?f=9&t=64856&view=next
165	December 4, 2013	Tagus River, Portuguese Coast	s	38,6272	-9,2475	Present study (photo credit M. Hilario)

Records of *C. tagi* between 2007 and 2015						
Record No.	**Record date**	**Location**	**Obser-vations**	**Latitude**	**Longitude**	**References**
166	January 9, 2014	Aveiro, Portuguese Coast	s	40,6411	-8,6536	Jellywatch http://jellywatch.org/node/4722
167	August 25, 2014	Isla de Tavira, Portuguese Coast	b	37,1000	-7,6125	Present study (photo credit M. Gil Lopez)
168	August 28, 2014	Lisbon, Portuguese Coast	s	38,6953	-9,1858	http://www.perseus-net.eu/en/jellyfish_map/index.html
169	September 1, 2014	Aveiro, Portuguese Coast	s	40,6411	-8,6536	https://www.inaturalist.org/observations/857063
170	October 6, 2014	Isla Tarifa, Strait of Gibraltar	s	36,0017	-5,6042	Present study (photo credit E. Sánchez Castillo)
171	August 21, 2015	Caparica, Lisbon, Portuguese Coast	b	38,6522	-9,2575	Present study (photo credit M. Pola)