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Short communication

Widespread occurrence of the Southern Hemisphere ascidian *Corella eumyota* Traustedt, 1882 on the Atlantic coast of Iberia

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Abstract

The Southern Hemisphere unitary ascidian *Corella eumyota* was discovered in 2002 in France and is now widespread on the southern coast of England and in Ireland. It has also been reported from seabed surveys in Ría de Vigo, north-west Spain. Surveys of marinas in February 2008 and June-July 2009 identified additional localities in Ría de Vigo and revealed widespread occurrence of *C. eumyota* on the Atlantic coast of the Iberian Peninsula. The species was very abundant on some structures built less than two years before the surveys, indicating a capacity for very rapid colonization and population increase. This suggests that the species is a potential threat to biodiversity and aquaculture interests. Records of the non-native ascidians *Styela clava*, *S. plicata*, *Perophora japonica*, *Botrylloides violaceus*, and *Didemnum vexillum* are also reported.

Key words: *Corella eumyota*, ascidian, invasive species, non-native species

Along with other marine taxa, ascidians are transported around the globe via anthropogenic activities, establishing and dispersing in non-native areas. Depending on the species and location, some become invasive: they may cause serious ecological problems by competing and interfering with native fauna (Lambert and Lambert 1998; Lambert 2001; McDonald 2004; Locke and Carman 2009), and can also disturb bivalve aquaculture, causing financial loss by competing for space and food resources, and reducing water flow and oxygen (Lodeiros and Himmelman 1996; Taylor et al. 1997; LeBlanc et al. 2003; Lutz-Collins et al. 2009). For example, the mussel industry in Prince Edward Island in Canada has been severely affected by the invasive ascidians *Styela clava* Herdman, 1881 and *Ciona intestinalis* (Linnaeus, 1767) (Lutz 2007; Lutz-Collins et al. 2009).

The ascidian *Corella eumyota* Traustedt, 1882 (Phylum Chordata, Subphylum Tunicata, Order Phlebobranchia) was originally described from Valparaiso, Chile (Traustedt 1882) and is native to the Southern Hemisphere, where it has a circumpolar distribution within the temperate and sub-polar regions (Chile, Antarctic Peninsula, South Africa, Australia, New Zealand) (Lambert 2004). It was first reported in the Northern Hemisphere in 2002 in two marinas in Brittany, France (Lambert 2004), with additional sites noted in Brittany in 2004 and 2005 (Dupont et al. 2007), and was found during a trawl survey in Ría de Vigo, north-west Spain, in 2003 (Varela et al. 2008). The first records in the British Isles were from rapid assessment surveys along the south coast of England in 2004 (Arenas et al. 2006) and in Ireland in 2005 and 2006 (Minchin 2007).

Its broad distribution in western Europe (Arenas et al. 2006; Varela et al. 2008; Minchin 2007) indicates that *Corella eumyota* is likely to spread within a region once established. The aims of these surveys were 1) to assess whether the documented presence on the sea-bed of Ría de Vigo, Spain (Varela et al. 2008) relates to an isolated population, or whether *C. eumyota* is widespread in the Ría, including artificial habitats typical of the records elsewhere, and 2) to investigate the species' presence and range along the Atlantic coast of Iberia.

Corella eumyota is a solitary (unitary) ascidian that lays flat on the substrate attached along its right side, and as an adult generally measures 2-4 cm (Lambert 2004). Individuals

have been found in the Northern Hemisphere measuring up to 8 cm (authors' pers obs), and the species may attain considerably larger size in the Southern Hemisphere (e.g. an Antarctic or Subantarctic specimen 15cm long noted by Kott 1969). The coloration and shape of *C. eumyota* can vary significantly (Figure 1). In the non-native range it can be transparent, white, brown, or various shades of orange; its siphons are usually orange, although not always. The tunic is smooth and often clean, but can be covered in microbial film or overgrown by other species, including compound ascidians. The shape of the body can mould into the available space between the adjoining sessile fauna, however on open substrate it will grow into an oval shape. The inhalant siphon is normally at the extreme end of the body and the exhalant siphon is characteristically between a quarter and half-way down the body, and slightly on the right. The direction in which the siphons point, and their length, vary. As described by Lambert (2004), *C. eumyota* cannot retract its siphons. The hind-gut forms a simple curve following the contour of the posterior end of the body (Kott 1969). The oviduct and sperm duct are unusually short, opening on the surface of the gonad at the posterior end of the body, and the embryos are brooded far from the exhalant siphon (Lambert 2004). We suggest the English vernacular name "Orange-tipped Sea-squirt" for this species, referring to the common orange coloration of the siphons.

We visited coastal marinas where *Corella eumyota* might be found on suitable substrates that could be accessed from pontoons, which included the submerged surfaces of the pontoons themselves, sea-walls at low tide, and any submerged objects. The biofouling communities on underwater surfaces were inspected, if necessary with the aid of a long-handled scraper and net to obtain samples. Objects such as tyres, submerged ropes, nets, and cages were pulled out for examination. Large clumps of mussels were pulled apart to search for individuals growing inside. When *C. eumyota* was found, we continued to search, and collected it across the marina for intended phylogeographic studies. See Table 1 for a list of the localities surveyed (sites visited that did not harbour marine life due to heavy freshwater influence were not included in this study).

Corella eumyota was widespread on the Atlantic coast between Gijón (N Spain) and Oeiras (Portugal) (Figure 2). It was present in 17 of the 22 coastal marinas surveyed during the three surveys (February 2008, June and July 2009), including all of those in Ría de Vigo (Table 1). The pontoons at Muros had recently been cleaned of biofouling, and did not provide suitable submerged objects, hence its presence or absence prior to the removal of the biofouling communities remains unknown.

The main target of these surveys was *Corella eumyota*, but some other non-native ascidians were encountered. Two nearby colonies of *Perophora japonica* Oka, 1927 were discovered in Baiona. This colonial ascidian was not seen anywhere else throughout the surveys and this is the first known record from Iberia (and southern Europe). The invasive species *Didemnum vexillum* Kott, 2002, which is possibly native to the northwestern Pacific Ocean (Stefaniak et al. 2009), was sighted in Santander (marina deportiva), Baiona, Moaña, Corme-Porto, and Gijón. *Botrylloides violaceus* Oka, 1927 was seen in Bueu, Nazaré, and Santander. *Styela clava* Herdman, 1881 was encountered (two specimens only) at Sines, a slight range extension from the previous southern limit of Cascais and Lisboa (Davis and Davis 2005). *Styela plicata* (Lesueur, 1823) was seen at Nazaré, Peniche and Albufeira.

In Ría de Vigo *Corella eumyota* is widespread and was found in all sufficiently marine sites visited (judged from the other fauna present). This non-native ascidian was very abundant in Cangas and Moaña, two marinas that are in close proximity to mussel farms in the area. The Porto Deportivo de Moaña had been built approximately two years before the visit. Despite its age, the submerged sides of the pontoon harboured large numbers of mussels and *Corella eumyota*, diverse sessile fauna, and associated motile macrofauna. The ready settlement of *C. eumyota* on, around, and inside clumps of mussels and its presence in the proximity of mussel farms suggest that this ascidian might have been transported to the Northern Hemisphere via the mussel farming trade, one of the possibilities listed by Lambert (2004). Transport to major ports by hull fouling in sea chests, with subsequent local spreading by fouling of small boats and/or aquaculture transfers, is also possible (Wasson et al. 2001; Lambert 2009).

Corella eumyota is now widespread along the Atlantic coastline of Iberia. Its abundance in the marinas ranged between rare and highly abundant. At the sites where other solitary ascidians including *Ciona intestinalis* and *Ascidiella aspersa* (O.F. Müller 1776) were rare,

Figure 1. Photographs of some morphological varieties of *Corella eumyota*. The top right image shows the species, here with orange-tipped siphons, dominating the submerged surface of a concrete pontoon (Vila Praia de Âncora, Portugal 2008). Photographs by A. El Nagar.

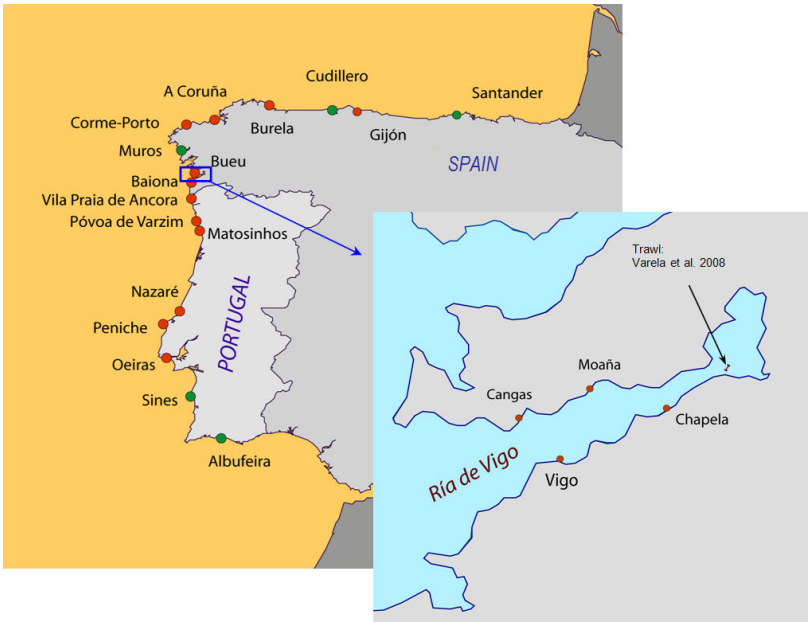

Figure 2. Map with localities of surveyed marinas. Red dots are where *Corella eumyota* was recorded, while green are marinas where the species was not found. (The base maps were generated on http://www.planiglobe.com).

C. eumyota was usually more numerous. For example, in Oeiras this non-native was common, and the typical native marina inhabitant ascidian *Ascidiella aspersa* was not found. Such apparent changes in community structure suggest that *C. eumyota* may be capable of out-competing species with similar habitats, but this needs further observation or experimentation for confirmation. The abundance of *C. eumyota* appeared to have a negative correlation with that of the non-native red bryozoan *Watersipora* sp., being rarer when the bryozoan was abundant. There may also be a seasonal trend in abundance: *C. eumyota* was generally more common at sites visited in February than in June and July. This might be explained by its being a

Table 1. Localities surveyed in Spain and Portugal. Abundance of *Corella eumyota* is reported as an approximate estimate where absent = 0, present = 1-30, frequent = 31-60, and abundant = >60 individuals per square metre of suitable substrate.

Location	Description of Marina	Geographic coordinates		Abundance	Date/s visited
		Latitude	Longitude		
Spain					
Vigo (Esquela de Velo Marina)	Recreational	42.227	-8.751	Present	04.02.2008
Puerto de Cangas	Recreational	42.260	-8.783	Abundant	06.02.2008
Porto Deportivo Moaña	Recreational	42.277	-8.735	Abundant	06.02.2008
Chapela	Recreational/fishing	42.268	-8.676	Frequent	07.02.2008
Baiona	Recreational/fishing	42.121	-8.847	Frequent	08.02.2008
Real Club Maritimo, Santander	Recreational	43.462	-3.794	Absent	13.06.2009
Marina deportiva de Santander, Santander	Recreational	43.428	-3.808	Absent	13.06.2009
Puerto Deportivo de Gijón	Recreational	43.545	-5.665	Frequent	13.06.2009
Puerto de Burela	Fishing	43.660	-7.355	Present	14.06.2009
Puerto de Cudillero	Recreational	43.567	-6.149	Absent	14.06.2009
Puerto de Muros	Recreational	42.776	-9.058	Absent	15.06.2009
Puerto de Corme-Porto	Recreational/fishing	43.262	-8.965	Frequent	15.06.2009
A Coruña	Recreational	43.369	-8.397	Frequent	16.06.2009
Bueu	Fishing	42.328	-8.786	Present	18.07.2009
Portugal					
Póvoa de Varzim	Recreational	41.370	-8.765	Abundant	09.02.2008
Vila Praia de Âncora	Fishing	41.815	-8.869	Abundant	09.02.2008/ 17.07.2009
Puerto de Matosinhos	Recreational/near port	41.186	-8.705	Present	10.02.2008/ 10.07.2009
Peniche	Recreational	39.352	-9.377	Frequent	14.07.2009
Nazaré	Recreational	39.584	-9.075	Present	14.07.2009
Oeiras	Recreational	38.676	-9.318	Frequent	15.07.2009
Sines	Recreational	37.950	-8.866	Absent	16.07.2009
Albufeira	Recreational	37.084	-8.267	Absent	16.07.2009

cool-temperate and sub-polar species, so perhaps it does not tolerate well the warmer summer surface temperatures though it may find deeper water refuges from which it can repopulate marina surfaces; such a phenomenon occurs every year in comparable species in southern California (Lambert and Lambert 1998, 2003).

C. eumyota was highly abundant in two recently-built marinas, the aforementioned Porto Deportivo de Moaña (Spain), and the pontoon in the fishing marina of Vila Praia de Âncora (Portugal). Both had been built two-three years previous to the surveys (pers comm; harbour master and local resident, respectively), showing that *C. eumyota* has the capacity to establish dense populations very rapidly. Its occurrence in Vila Praia de Âncora, Portugal in 2008 was particularly alarming: *C. eumyota* on the submerged surface of the pontoon was by far the dominant sessile species and formed an almost continuous carpet (see Figure 1). When this site was revisited in July 2009, *C. eumyota* remained the most abundant species, but other sessile fauna, including mussels, other ascidians, and large kelps were also present in substantial numbers. Observations at Moaña and Vila Praia de Âncora suggest that *C. eumyota* can be an early and rapid colonizer that continues to compete successfully for resources, but it may not actually prevent other sessile species from colonizing.

Ascidians are known to compete for resources, and to reduce water flow (Lodeiros and Himmelman 1996; Taylor et al. 1997; LeBlanc et al. 2003; Lutz-Collins et al. 2009). Lambert (2004) described *C. eumyota*'s habit of forming tight clumps by settling on conspecifics, and predicted that it may become a problem in mussel and oyster farms in its introduced range. *C. eumyota* has been found in association with mussels (and occasionally scallops) on this survey, and will possibly affect European bivalve aquaculture in the future. Additionally, this non-native was collected from the seabed in Ría de Vigo in 2003 (Varela et al. 2008), and is therefore capable of invading natural habitats,

which may have serious consequences for coastal ecosystems. Given that *Corella eumyota* is certainly spreading rapidly around W Europe, both in artificial and natural habitats, and is often abundant, it is becoming a significant invasive species in Europe.

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