

Short communication

Widespread occurrence of the non-indigenous ascidian *Corella eumyota* Traustedt, 1882 on the shores of Plymouth Sound and Estuaries Special Area of Conservation, UK

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Abstract

The ascidian *Corella eumyota*, originally from the Southern Hemisphere, was first reported in the Northern Hemisphere in Brittany, France, in 2002. Since then, it has been recorded in Spain, Ireland, the south coast of England and South Wales. Most European records to date have been from artificial habitats such as marinas. In Plymouth, England, *C. eumyota* was first found in two marinas in 2005 but individuals were soon also detected in small numbers on nearby shores. Shore surveys in March and August of 2008 indicated that *C. eumyota* has established reproductive populations on natural and semi-natural shores of Plymouth Sound and the adjacent coastline, largely restricted to relatively sheltered sites in the lower reaches of estuaries. At these sites it is generally the most abundant non-colonial ascidian. The species clearly has the capacity to become a significant component of the biota of sheltered shores in the Northern Hemisphere.

Key words: *Corella eumyota*, Ascidians, Plymouth Sound, Shore survey, Marina

Corella eumyota Traustedt, 1882 is a solitary ascidian (Phylum Chordata, Subphylum Tunicata, Order Phlebobranchia) native to the Southern Hemisphere, found in South Africa, Australia, New Zealand, Antarctica, South America and several remote oceanic islands (Kott 1969; Lambert 2004). It broods its embryos, which are retained for some hours after hatching and not released until competent to settle (Lambert et al. 1995) which results in an extremely short free living larval life of usually only a few minutes. Reproduction by self fertilization appears to be common in this species, although cross-fertilization also occurs (Lambert 2004; Dupont et al. 2007).

C. eumyota was first recorded in the Northern Hemisphere in two small harbours in north-western France in 2002 (Lambert 2004), and was subsequently recorded in Spain in 2003 (Varela et al. 2008), southern England in 2004 (Arenas et al. 2006), and Ireland in 2005 (Minchin 2007), with additional sites noted in Brittany in 2005

(Dupont et al. 2007) and Milford Haven, South Wales in 2008 (pers. obs. JAO and J.S. Ryland). Most European records to date have been from artificial habitats such as marinas. *C. eumyota* was recorded as absent in Plymouth at Queen Anne's Battery Marina (QAB) in September 2004 (Arenas et al. 2006), but reproductive populations were present in summer 2005 at QAB and a second marina, Plymouth Yacht Haven (pers. obs. S. Nielsen & JDDDB). Scattered small individuals and occasional groups of individuals (Figure 1) were also detected on the lower shore under boulders on nearby natural coastline (Batten Bay in Plymouth Sound, and Wembury between the Sound and the Yealm estuary) in the summer of 2005 (pers. obs. JAO).

Here we report semi-quantitative observations in 2008 of the species' distribution and abundance on natural and semi-natural shores of the Plymouth Sound and Estuaries Special Area of Conservation (SAC, a protected area designated under the EC Habitats Directive). We

additionally confirm that the populations living outside artificial habitats such as marinas are reproductive.

On open substrate, *C. eumyota* generally lays flat on the substrate attached along its right side, and assumes an oval shape, with the inhalant siphon at the extreme end of the body and the exhalant siphon slightly on the right (Figures 1 and 2). The tunic is smooth and often clean. The siphons vary considerably in length, and cannot be retracted, as noted by Lambert (2004). The hind-gut forms a simple curve following the posterior end of the body (Kott 1969), and this character can be particularly useful for recognizing very small specimens.

Shore surveys consisted of half-hour searches along the intertidal zone during low spring tides, recording the number of *C. eumyota* seen. The first set of surveys took place during spring 2008, visiting 21 sites between February 23rd and May 7th, and repeat counts at eight of the spring sites at which *C. eumyota* had been recorded were made between August 2nd and August 20th 2008 (Table 1); a new site, Stonehouse, was also visited in August. *C. eumyota* broods from mid-September to the end of March in New Zealand (Brewin 1946) and has been observed to brood during the summer in NW Europe (Lambert 2004 and authors' observations). The spring surveys reported here thus recorded the abundance of *C. eumyota* prior to summer recruitment, while the August surveys provided data later in the presumed reproductive season.

C. eumyota was present in 16 of 21 sites in the spring survey and was still present in all of the eight sites to which a repeat visit was made in August (Table 1; Figures 3 and 4). The most numerous populations were found under boulder or cobble-sized rocks in muddy and rocky habitats, particularly but not exclusively where these substrates remained in puddles of standing water at low tide. However, *C. eumyota* was also observed growing on algae, discarded sheets of canvas, tyres and on oyster shells (Figure 2.). Despite the wealth of apparently suitable substrates within certain sites, distribution was not uniform and in some cases all *C. eumyota* observed during the search were found under a single rock. Specimens were mostly relatively small, and the largest seen was c. 30 mm long.

Both sets of surveys show a similar distribution pattern, with higher counts in estuaries or in close proximity to marinas and other artificial structures. In spring the highest numbers were found on the banks of the River

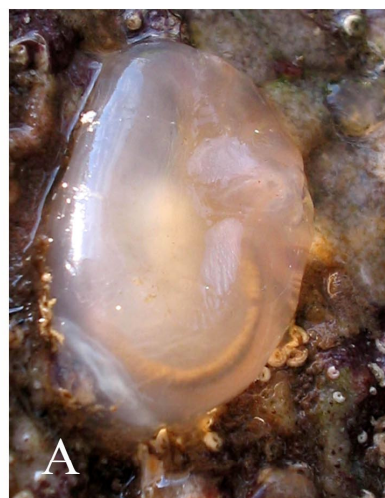


Figure 1. A - individual *Corella eumyota* under a boulder at Batten Bay, Devon, 10 July 2005, width of image c. 2 cm ; B - three *Corella eumyota* under a boulder at Wembury, Devon, 9 July 2005, width of image c. 6 cm. (Photographs by J. Oakley <http://www.oakleynaturalimages.com>).



Figure 2. Seven *Corella eumyota* on an oyster shell, Noss Mayo, Devon, 17th September 2009. Width of image c. 6 cm. (Photograph by J.D.D. Bishop).

Figure 3. Abundance of *Corella eumyota* on shores in the Plymouth Sound and Estuaries SAC, February-March 2008 (half-hour counts). QAB (Queen Anne's Battery) and Plymouth Yacht Haven: two marinas with populations of *C. eumyota*.

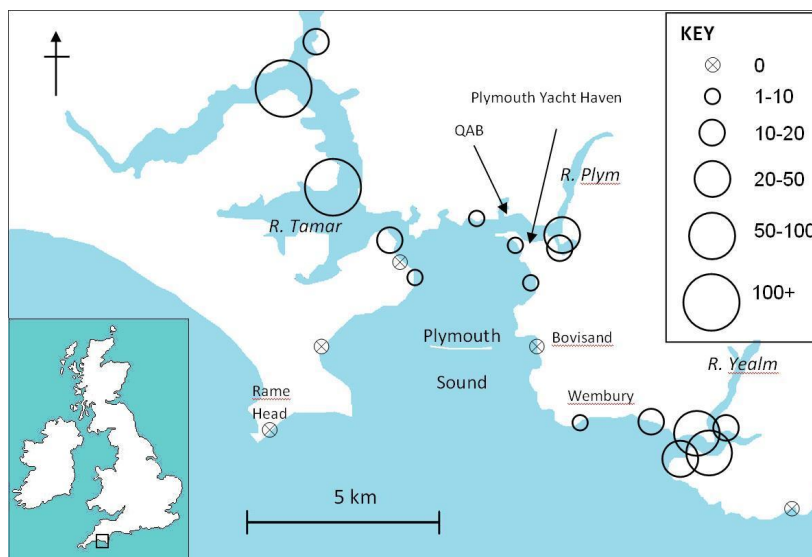
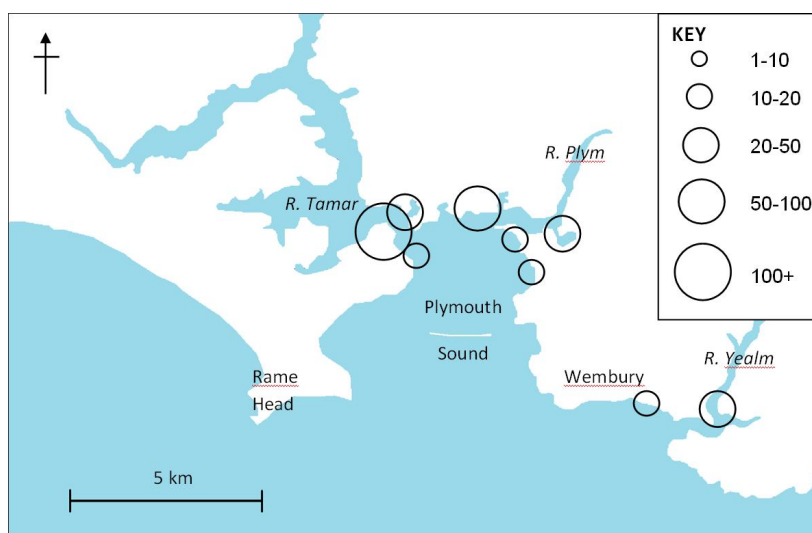


Figure 4. Abundance of *Corella eumyota* on shores in the Plymouth Sound and Estuaries SAC, August 2008 (half-hour counts).



Tamar and the Yealm estuary. In August the largest populations were found at Cremyll and Tinside on the Hoe seafront; these two sites also recorded the largest increase in population size between spring and August. Overall, the counts of *C. eumyota* increased from spring to August (*t*-test for paired comparisons, 8 df, $t = -2.67$, $P = 0.032$).

C. eumyota was not observed during the 2008 surveys on more exposed stretches of coastline, for example Rame Head and Bovisand, despite the presence of apparently suitable substrates.

In addition to its known occurrence in two marinas (QAB and Plymouth Yacht Haven),

C. eumyota was noted in Torpoint Marina on 7th May 2008. On 23rd August 2009, two small specimens were found during a 40-minute search of a boulder shore on the western side of the mouth of the River Erme, to the east of the Plymouth Sound and Estuaries SAC. The Noss Mayo site of the spring 2008 survey was revisited on 17th September 2009, and a count of 184 *Corella eumyota* was obtained in 30 minutes by examining unattached small clumps of Pacific oyster (*Crassostrea gigas*) at low water.

On 20th August 2008, *C. eumyota* were collected from the shoreline at two sites (Wembury, 5 specimens and Oreston, 10 speci-

Table 1. Counts from half-hour searches for *Corella eumyota* on shores in the Plymouth Sound and Estuaries SAC, Devon, UK

Location	Geographic coordinates		Dates (2008)	Spring count	August count
	Latitude, N	Longitude, W			
Batten Bay	50°21'25.35"	4°07'39.06"	21 Feb & 3 Aug	10	11
Jennycliff Bay	50°21'02.75"	4°07'21.04"	10 Mar & 2 Aug	2	17
Bovisand Bay	50°20'07.96"	4°07'17.06"	10 Mar	0	-
Wembury East	50°18'55.97"	4°04'54.52"	25 Feb & 20 Aug	15	14
Wembury West	50°18'59.72"	4°05'56.26"	5 Mar	10	-
Yealm West Bank	50°18'47.91"	4°03'37.01"	8 Apr	54	-
Newton Ferrers	50°18'50.36"	4°03'08.62"	9 Mar & 2 Aug	16	44
Noss Mayo	50°18'33.93"	4°03'22.67"	9 Mar	72	-
Cellar Beach	50°18'34.94"	4°03'54.68"	9 Mar	40	-
Stoke Beach	50°18'09.94"	4°00'44.58"	6 Apr	0	-
Oreston	50°21'39.13"	4°06'41.50"	5 May & 20 Aug	34	39
Hooe Lake	50°21'26.71"	4°06'44.41"	5 May	15	-
Tinside	50°21'48.96"	4°08'28.16"	23 Mar & 3 Aug	1	83
Stonehouse	50°21'56.45"	4°09'52.60"	4 Aug	No Count	27
Cremyll	50°21'33.11"	4°10'19.18"	24 Mar & 4 Aug	16	173
Mt Edgecumbe	50°21'00.43"	4°09'59.56"	25 Mar & 4 Aug	3	12
Cawsand Bay	50°19'48.13"	4°12'00.64"	25 Mar	0	-
Rame Head	50°18'50.20"	4°13'14.22"	23 Feb	0	-
Torpoint	50°22'12.99"	4°11'44.20"	7 May	136	-
Tamar Bridge (Devon side)	50°24'26.06"	4°12'04.27"	6 May	11	-
Beggar's Island	50°23'33.95"	4°13'08.26"	7 May	106	-
Barn Pool	50°21'19.15"	4°10'18.78"	25 Mar	0	-

mens) to assess their reproductive status. The samples were placed in separate tanks of aerated seawater containing floating Petri dishes, and exposed to a day/night light cycle. The underside of the Petri dishes and the walls of the tanks were examined after six days for the presence of settled metamorphs, indicating the release of larvae. Both sets of samples had produced larvae, indicating that the populations of *C. eumyota* on these shores were reproductive.

Therefore, *C. eumyota* has established reproductive populations on natural and semi-natural shores throughout Plymouth Sound and Estuaries SAC, including the Yealm estuary to the east of the Sound proper. A Rapid Assessment Survey of marinas in 2004 (Arenas et al. 2006) recorded *C. eumyota* in Brighton, Gosport and Weymouth, but not further west along the south coast of England, and the Plymouth marinas where it was subsequently found in 2005 had been the subject of regular visits during the preceding years. This

suggests that the species was absent, rather than overlooked, in Plymouth marinas prior to 2005.

Population levels appeared to be higher in more sheltered environments, in particular estuaries. In more exposed sites like Rame Head and Bovisand, *C. eumyota* was either absent or present in only small numbers; relatively exposed coasts possibly have the potential to act as local barriers to the natural spread of *C. eumyota* along coasts.

Leisure craft are believed to play an important role in the secondary spread of *C. eumyota*, as suggested by the apparent rapid spread of the species between marina sites in NW Europe and the high population densities reached in such sites (Minchin 2007 and pers. obs.) and occasionally on hulls (Minchin 2007; the species has also been observed at lower density on hulls in QAB, C.A.Wood and JDDB pers. obs.). Because it is a brooder with the ability to self-fertilize (Lambert 2004; Dupont et al. 2007), the

introduction of even a single reproductive individual has the potential to result in the establishment of a new population. If the local pioneer populations in the Plymouth area were indeed those observed in marinas, the occupancy of natural and semi-natural shores reported here developed within just 3 years. The occurrence of a population in the Yealm estuary, where there is no marina as such, suggests that *C. eumyota* is capable of recruiting directly into the natural habitat, most probably from boat hulls, without first establishing a population in a nearby artificial habitat; the estuary has c. 700 moorings for leisure craft. However, there are also two moored pontoons, and moored rafts for research on antifouling coatings, potentially providing some artificial substrates for recruitment in the Yealm; we have not monitored these structures, although a visit to one of the rafts on 1st May, 2008 confirmed the presence of *C. eumyota*.

An increase in numbers was recorded between spring and August 2008 at those sites that were re-surveyed; at present it is not known whether this represents just a seasonal change or the ongoing build-up of populations during the early stages of colonisation. Re-survey is clearly necessary to resolve this.

Observed numbers of *C. eumyota* were higher than other species of solitary ascidians during the shore survey, with the exception of the occurrence of *Dendrodoa grossularia* at higher densities than *C. eumyota* at Cremyll. This suggests that *C. eumyota* is becoming an important component of littoral communities in this protected area. Some of the habitats involved approximate to the 'Estuarine Rocky Habitats' included in the UK Biodiversity Action Plan (BRIG 2008). The very wide latitudinal range of *C. eumyota* in the Southern Hemisphere suggests the potential for the species to occupy a wide geographical range in the Northern Hemisphere, where it apparently has the capacity to become a significant component of the biota of sheltered shores. The possible existence of sublittoral populations has not been addressed here by specific survey work. The species has been publicised locally amongst interested divers and no records have yet been forthcoming.

However, it should be noted that the species has been regularly dredged from the seabed of Ría de Vigo in Galicia, NW Spain at a depth of 12m (Varela et al. 2008) and occurs both intertidally and down to considerable depths in its Southern Hemisphere range (Kott 1969).

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References

- Arenas F, Bishop JDD, Carlton JT, Dyrinda PJ, Farnham WF, Gonzalez DJ, Jacobs MW, Lambert C, Lambert G, Nielsen SE, Pederson JA, Porter JS, Ward S, Wood CA (2006) Alien species and other notable records from a rapid assessment survey of marinas on the south coast of England. *Journal of the Marine Biological Association of the United Kingdom* 86: 1329-1337, doi:10.1017/S0025315406014354
- Brewin BI (1946) Ascidians in the vicinity of the Portobello Marine Biological Station, Otago Harbour. *Transactions of the Royal Society of New Zealand* 67: 87-131
- BRIG (2008) UK Biodiversity Action Plan; Priority Habitat Descriptions. <http://www.ukbap.org.uk/library/UKBAPPriorityHabitatDescriptionsfinalAllhabitats20081022.pdf> (Accessed 16 November, 2009)
- Dupont L, Viard F, David P, Bishop JDD (2007) Combined effects of bottlenecks and selfing in populations of *Corella eumyota*, a recently introduced sea squirt in the English Channel. *Diversity and Distributions* 13: 808-817, doi:10.1111/j.1472-4642.2007.00405.x
- Kott P (1969) Antarctic Ascidiacea. Antarctic Research Series 13: i-xv and 1-239
- Lambert C, Lambert IM, Lambert G (1995) Brooding strategies in solitary ascidians: *Corella* species from north and south temperate waters. *Canadian Journal of Zoology* 73: 1666-1671, doi:10.1139/z95-198
- Lambert G (2004) The south temperate and Antarctic ascidian *Corella eumyota* reported in two harbours in north-west France. *Journal of the Marine Biological Association UK* 84: 239-241, doi:10.1017/S0025315404009105h
- Minchin D (2007) Rapid coastal survey for targeted alien species associated with floating pontoons in Ireland. *Aquatic Invasions* 2: 63-70, doi:10.3391/ai.2007.2.1.8
- Varela MM, de Matos-Pita SS, Ramil F, Ramos-Espla AA (2008) New report of the Antarctic ascidian *Corella eumyota* (Tunicata: Ascidiacea) on the Galician coast (north-west Spain). *Marine Biodiversity Records* 1: e59 doi:10.1017/S1755267207006574