

THE JUWEL ANEMONE *CORYNACTIS VIRIDIS*, A NEW ORDER FOR THE NETHERLANDS (CNIDARIA: CORALLIMORPHARIA)

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During an expedition with scuba-divers to the Dutch part of the Brown Ridge in the central North Sea in June 2013, two colonies of the jewel anemone *Corynactis viridis* were found on the wreck Anna Graebe. With the jewel anemone both a new species and a new animal order, the Corallimorpharia, are added to the autochthonous fauna of the Netherlands. This species typically occurs in the Mediterranean and along the Atlantic coast from Portugal and the west British Isles up to Shetland. As other records of settled colonies of *C. viridis* in the North Sea were recently reported from Belgian, German and English waters, it is concluded that the jewel anemone, which used to be known as an occasional visitor, should now be considered autochthonous in the North Sea.

INTRODUCTION

On August 6th 1960 the jewel anemone *Corynactis viridis* Allman, 1846 was recorded as new to the Netherlands by den Hartog (1960). Four polyps were found attached to the roots of a thongweed, *Himanthalia elongata* (Linnaeus) S.F. Gray, washed ashore off Den Helder. Although this is

the first record of live *C. viridis* in the Netherlands, it was not proof of its autochthonous occurrence. Thongweed is a common species in drift assemblages, but is not known to be settled in Dutch waters. The individuals that commonly wash ashore therefore must come from abroad, most likely from the French or English coasts, drifting along with the south to north current.

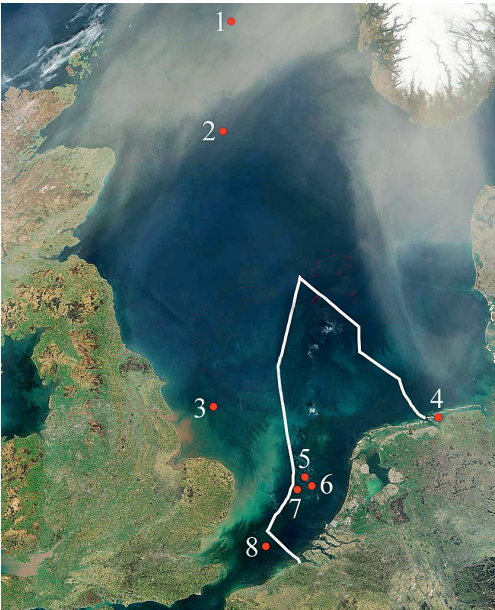


Figure 1. White colony of the jewel anemone *Corynactis viridis* on the wreck of the Anna Graebe. The polyps of *C. viridis* are much smaller than those of the white and reddish coloured sea anemones (*Metridium senile*) that have settled around the colony. Photo Cor Kuyvenhoven.

Figuur 1. Witte kolonie van de juweelanemoon *Corynactis viridis* op het wrak van de Anna Graebe. De poliepen van *C. viridis* zijn veel kleiner dan die van de witte en lichtrood gekleurde zeeanemonen (zee-anjelier *Metridium senile*) die zich rondom de kolonie gevestigd hebben. Foto Cor Kuyvenhoven.

Figure 2. Locations in the North Sea where settled *Corynactis viridis* colonies were recorded in the Dutch, Belgian, German and English territories. The border of the Dutch Continental Shelf is indicated by a white line. The new records in the Netherlands are published for the first time in the present paper. The sources of the Belgian, German and English records are respectively Vlierhuis (in press), Markert et al. (2010) and Guerin (2009). Location numbers: 1. Bruce offshore platform, 2. Andrew offshore platform, 3. Hoton offshore platform, 4. East Frisian Islands, Wadden Sea, 5. wreck of the Anna Graebe, 6. wreck of the Queensford, 7. wreck of the Tyche, 8. wreck of the Birkenfels.

Figuur 2. Plaatsen in de Noordzee waar gevestigde kolonies van *Corynactis viridis* werden gevonden op Nederlands, Belgisch, Duits en Engels grondgebied. De afgrenzing van het Nederlandse Continentale Plat is aangegeven met een witte lijn. De Nederlandse waarnemingen worden hier voor het eerst gepresenteerd. De bronnen bij de Belgische, Duitse en Engelse waarnemingen betreffen respectievelijk Vlierhuis (in press.), Markert et al. (2010) and Guerin (2009). Locatie nummers: 1. Bruce offshore platform, 2. Andrew



offshore platform, 3. Hoton offshore platform, 4. Oost-Friese eilanden, Waddenzee, 5. wrak van de Anna Graebe, 6. wrak van de Queensford, 7. wrak van de Tyche, 8. wrak van de Birkenfels.

Hitchhiking along on drift assemblages of thongweed is a well-known natural distribution pathway into the North Sea for species occurring south of the English Channel. The jewel anemone *C. viridis* is one of those species. It is known to occur from the Mediterranean and along the Atlantic coasts from Portugal up to France and along the south and west coasts of the British Isles and Ireland up to Shetland (Wood 2005). The present paper describes a series of records which indicate that the species can be considered settled in the North Sea.

METHODS

In June 2013 an expedition with scuba-divers was organised to the Dutch part of the Brown Ridge in the central North Sea focusing on finding species that occur in association with the

wrecks in the area. During each dive three scientists rapidly assessed the biodiversity in an area of about 5 meters along both sides of a 50 meter long rope for as long as the dive time allowed it. Species that were encountered were scored on the standardized North Sea monitoring forms of the ANEMOON Foundation (www.anemoon.org).

Wreck	Date and time	Position	Depth (meter)
Anna Graebe	30.VI.13 18:27		
	04.VII.13 16:45	52°39.6'N 03°31.7'E	26
Queensford	07.VIII.13 19:45	52°33.3'N 03°43.3'E	27
Tyche	25.VIII.13 10:30	52°30.5'N 03°19.2'E	25

Table 1. Locations in the Dutch North Sea where colonies of the jewel anemone *Corynactis viridis* were found.
Tabel 1. Locaties op wrakken in de Nederlandse Noordzee waar gevestigde kolonies van de juweelanemone *Corynactis viridis* aangetroffen werden.

Figure 3. The North Sea population of *Corynactis viridis* contained three colour forms: a. a virtually completely translucent white form, b. a translucent white form with a prominent yellow-greenish line around the oral disk, c. a translucent white form with a pink line around the oral disk. In situ most colonies are somewhat pinkish. This colour tends to disappear on photos however, probably because of the high light intensity of the light bulbs used for underwater photography. Photos a & b, Wijnand Vlierhuis, c. Adriaan Gittenberger.

Figuur 3. Binnen de Noordzee-populatie van *Corynactis viridis* kunnen drie kleurvarianten onderscheiden worden: a. een vrijwel volledig witte, transparante variant, b. een witte, transparante variant met een duidelijk groen-gele lijn rondom de mondschijf, c. een wit transparante variant met een roze lijn rondom de mondschijf. In situ hebben de meeste kolonies een lichtroze kleur, die echter lijkt te verdwijnen op foto's, vermoedelijk door de sterke lichtintensiteit van de flitsers die bij onderwaterfotografie gebruikt worden. Fotos a & b. Wijnand Vlierhuis, c. Adriaan Gittenberger.

During one of the dives the coral anemone species *C. viridis* was discovered, the first record of its autochthonous occurrence in the Netherlands. To study the extend of its distribution a review of its known autochthonous occurrences in the North Sea was done.

DISTRIBUTION IN THE NORTH SEA

On June 30, 2013 the first settled colony of the jewel anemone *C. viridis* in the Netherlands was discovered at a depth of 26 meter on the wreck Anna Graebe (table 1, fig. 2). It was found on the ceiling in the wreck at a spot that appeared sheltered from currents and more or less free from sedimentation. A small part of the colony was collected and preserved on ethanol as reference material. This voucher will be deposited in the collections of Naturalis Biodiversity Center, Leiden, the Netherlands. During a second dive on the Anna Graebe on July 4 an additional colony was discovered relatively far from the first and much more exposed to the currents, on the hull

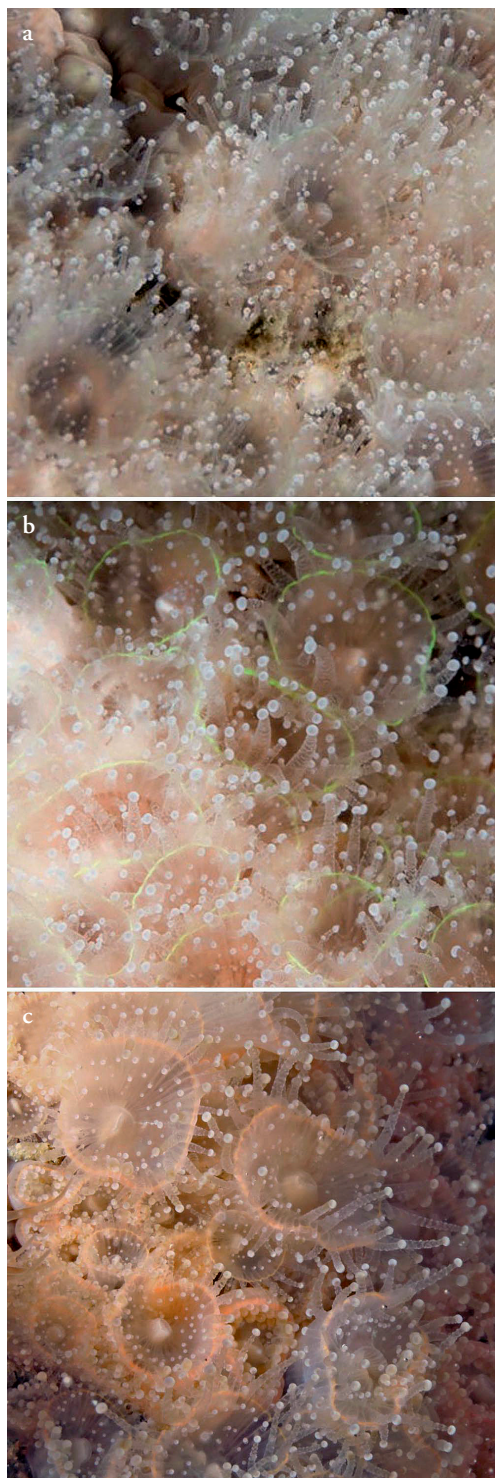
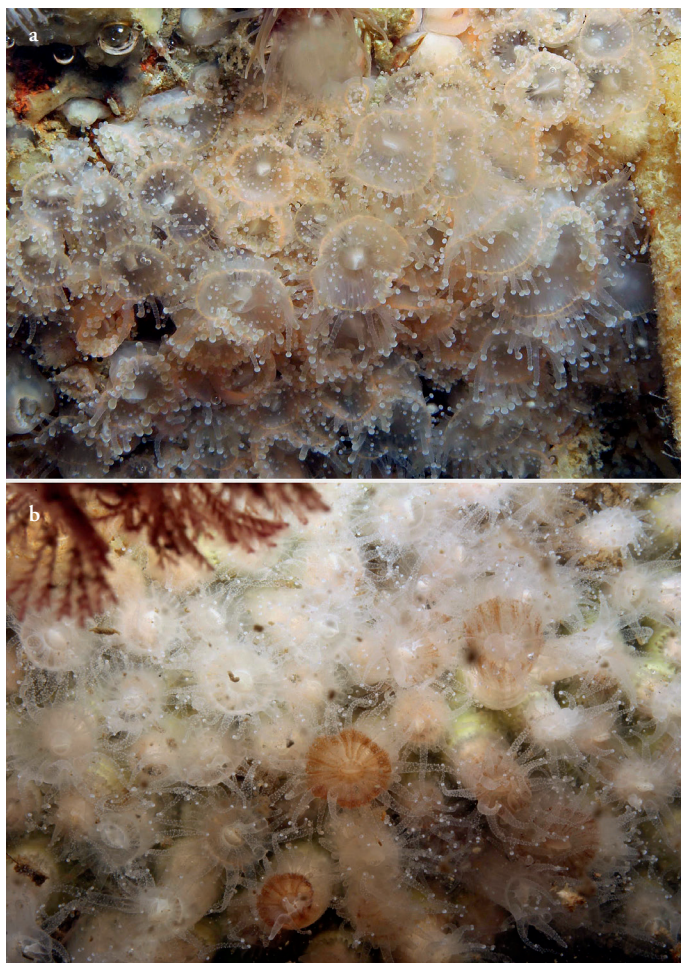


Figure 4. The orders Corallimorpharia and Scleractinia, a. *Corynactis viridis* (Corallimorpharia) colony from the Dutch North Sea, b. *Astrangia poculata* (Scleractinia) colony from the West Atlantic off Rhode Island, USA. The polyps in both species are about one centimetre in diameter. The shape of the colony and the morphology of the tentacles of these species resemble each other. Photos Adriaan Gittenberger.

Figuur 4. De ordes Corallimorpharia en Scleractinia, a. *Corynactis viridis* (Corallimorpharia), kolonie van de Nederlandse Noordzee, b. *Astrangia poculata* (Scleractinia), kolonie in de buurt van Rhode Island, in het westen van de Atlantische Oceaan. De doorsnede van de poliepen in beide soorten bedraagt ongeveer één centimeter. De groeivorm van de kolonie en de vorm van de tentakels van deze soorten lijken sterk op elkaar. Foto's Adriaan Gittenberger.



of the wreck (fig. 1). The polyps in this colony were virtually translucent white, while the polyps in the first colony had a prominent pink line around the oral disk (fig. 3). These two colour patterns support the hypothesis that the colonies are genetically different. Therefore there may have been at least two separate settlement events of *C. viridis* on the Anna Graebe. Within two months after recording the jewel anemone on the Anna Graebe, it was also found on the Dutch wrecks the Queensford and the Tyche, on August 7 and August 15 respectively. These records of a very conspicuous species in a relatively short time-span strongly suggests that it has only relatively recently settled on these wrecks. Since far offshore wreck

diving is uncommon and because most wreck divers do not recognize *C. viridis*, it is assumed that the species may be more widespread in the Dutch North Sea, and possibly the whole North Sea.

The jewel anemone was discovered on September 7, 2012 in Belgium, on the wreck the Birkenfels (Vlierhuis in press.). In the German Wadden Sea its settlement was observed on an oyster reef in March 2005 (Markert et al. 2010) and Guerin (2009) published on the colonies that were found on oil and gas platforms in the British part of the North Sea (fig. 2). All together these records indicate that *C. viridis* has become more than an oc-

casional visitor to the North Sea and should now be considered autochthonous there. This is not an exceptional case, as over the last decade several species that were only known from south of the English Channel and the west coasts of the British Isles, have pushed north into the North Sea. Another example is the snail *Xandarovula patula* (Pennant, 1777), which was previously only known from south of the Channel en west of Britain, while Høisæter et al. (2011) and Rowley (2008) reported it from England to Sweden, Norway and Denmark. Schrieken et al. (2011) reported the first records for the Netherlands, i.e. on the Cleaver Bank and Dogger Bank. At present *X. patula* is therefore considered autochthonous and probably widely distributed in the North Sea.

The recent northern range expansions of allegedly typically southern European species like *Xandarovula patula* and *C. viridis* may be linked to global warming and thereby rising water temperatures in the North Sea. However, because *C. viridis* was already known from the northern border of the North Sea off Shetland (Guerin 2009, Wood 2005), other changing environmental factors may also have played a role like current directions and strengths, and sedimentation rates.

THE ORDER CORALLIMORPHARIA

Corallimorpharians are corals without a skeleton (Wood 2005). They resemble scleractinians in many respects, from their internal anatomy to their colonial growth form and the morphology of the tentacles (Daly et al. 2003, Robson 2004, Wood 2005). This is shown in figure 4, where the jewel anemone *C. viridis* is illustrated next to the northern star coral *Astrangia poculata* (Ellis & Solander, 1786). The tentacles and growth forms of these two species are similar. Now that *C. viridis* has settled in the North Sea, the environment may also have become suitable for hard coral species that occur in temperate waters, like *A. poculata*. The latter species occurs in the NW Atlantic in a wide range of temperatures from the warm waters in the Gulf of Mexico up to the cold

waters off the coast of New England (Weiss 1995). As it is commonly found in harbours on floating docks, it may cross the Atlantic in the hull-fouling community of a boat or ship. It would be more logical however, if a scleractinian species that already occurs in Europe south of the English Channel settles in the North Sea in the near future. This concerns a handful of mostly solitary, hard coral species.

CONCLUSION

The jewel anemone *C. viridis*, which was known as an occasional visitor in the North Sea, should now be considered autochthonous to this area. Next to global warming and rising water temperatures in the North Sea, other environmental factors have probably played a role in the settlement of this southern European species. With the jewel anemone *C. viridis* both a new species and a new animal order, the Corallimorpharia, are added to the autochthonous fauna of the Netherlands.

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LITERATURE

Daly, M., D.G. Fautin & V.A. Capola 2003. Systematics of the Hexacorallia (Cnidaria: Anthozoa). – Zoological Journal of the Linnean Society 139: 419-437.

- Guerin, A.J. 2009. Marine communities of North Sea Offshore Platforms, and the use of stable isotopes to explore artificial reef food webs. – University of Southampton, Faculty of Engineering, Science & Mathematics; School of Ocean & Earth Sciences. [PhD Thesis]
- Hartog, J.C. den 1960. *Corynactis viridis*, nieuw voor ons land. – Het Zeepaard 20: 47-49.
- Høisæter, T., J.-A. Snøli, C. Schander, H.T. Rapp & M. Berggren 2011. *Xandarovula patula* (Gastropoda: Ovulidae) new to Scandinavia. – Marine Biodiversity Records 4, e58: 1-4.
- Markert, A., A. Wehrmann & I. Kröncke 2010. Recently established *Crassostrea*-reefs versus native *Mytilus*-beds: differences in ecosystem engineering affects the macrofaunal communities (Wadden Sea of Lower Saxony, southern German Bight). – Biological invasions 12: 15-32.
- Robson, E.A. 2004. Cnidogenesis in the jewel anemone *Corynactis californica* (Carlagen, 1936) and *C. viridis* (Allman, 1846) (Anthozoa: Corallimorpharia). – Zoologische Mededelingen 78 (27): 461-476.
- Rowley, S. 2008. *Simnia patula*. A gastropod. MARLIN The Marine Life Information network. – www.marlin.ac.uk/speciesinformationa.php?speciesID=4343
- Schrieken, N., A. Gittenberger & W. Lengkeek 2011. First record of *Xandarovula patula* (Pennant, 1777) in the Dutch North Sea (Gastropoda, Ovulidae). – Basteria 75(4-6): 107-110.
- Vlierhuis, W. in press. Nieuwe vondsten van de juweelanemoon *Corynactis viridis* in Nederlandse wateren. – Het Zeepaard.
- Weiss, H.M. 1995. Marine animals of southern New England and New York. – The State Geological and Natural History Survey of Connecticut, Hartford.
- Wood, C. 2005. Seasearch guide to sea anemones and corals of Britain and Ireland. – Marine Conservation Society, Ross-on-Wye.

SAMENVATTING

De juweelanemoon *Corynactis viridis*, een nieuwe orde voor Nederland (Cnidaria: Corallimorpharia)

Tijdens een expeditie met duikers naar het Nederlandse gedeelte van de Bruine Bank in de centrale Noordzee in juni 2013, werden twee kolonies van de juweelanemoon *Corynactis viridis* ontdekt op het wrak van de Anna Graebe op 26 meter diepte. Deze koraalanemoon is vooral bekend van de Middellandse Zee, van de Atlantische kusten vanaf Portugal tot in Frankrijk en van de zuid- en westkust van de Britse eilanden en Ierland tot in Shetland. Hoewel de soort al eerder levend in Nederland was aangetroffen op aangespoelde wieren en andere drijvende objecten, gaat het bij de kolonies op de Bruine Bank om de eerste bevestiging van het autochtone voorkomen in Nederland. De juweelanemoon *C. viridis* is de eerste soort van de orde Corallimorpharia, de koraalanemonen, die zich in Nederlandse wateren gevestigd heeft. De Corallimorpharia lijken in vrijwel al hun kenmerken sterk op de Scleractinia, de harde koralen, maar missen het voor harde koralen karakteristieke, harde, interne skelet. In de afgelopen paar jaar zijn levende kolonies van *C. viridis* ook waargenomen in Belgische, Duitse en Engelse wateren, terwijl de soort binnen enkele maanden na de eerste waarneming voor Nederland op de Anna Graebe, op nog twee Nederlandse wrakken werd ontdekt. Deze resultaten ondersteunen de hypothese dat de juweelanemoon, die voorheen hooguit een incidentele bezoeker was, zich inmiddels in de Noordzee heeft gevestigd en daarom beschouwd moet worden als autochtoon. De opwarming van de aarde en de daardoor stijgende temperaturen in de Noordzee, lijken de meest logische verklaring voor de uitbreiding van het verspreidingsgebied van deze Zuid-Europese soort. *Corynactis viridis* was echter al bekend van Shetland, wat aangeeft dat er vermoedelijk nog meer veranderende omgevingsfactoren een rol hebben gespeeld zoals bijvoorbeeld veranderende stromingen en sedimentatiesnelheden en -samenstelling.

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