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A COPEPOD NEW TO THE CANARY ISLANDS: *CRITOMOLGUS ACTINIAE*, AN ASSOCIATE OF SEA ANEMONES

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With 1 figure

SUMMARY. The copepod *Critomolgus actiniae* (DELLA VALLE) (family Rhynchomolgidae, order Poecilostomatoida), an associate of sea anemones, is recorded for the first time from the Canary Islands, extending its known distribution about 1,450 km southwards. The protective colouration of an adult female, and its cryptic behaviour as it sheltered amongst the tentacles of a specimen of the sea anemone *Actinia equina* (LINNAEUS), are described for the first time. The known host range comprises the anemones *Actinia equina, Anemonia sulcata* (PENNANT) and *Anthopleura ballii* (COCKS).

RESUMO. Neste trabalho é feita a primeira referência para as Ilhas Canárias do copépode Critomolgus actininiae (Della Valle). Este registo alarga significativamente para Sul os limites de distribuição geográfica conhecidos para esta espécie. São ainda referidos, pela rimeira vez, alguns aspectos de colaboração e comportamento críptico da espécie relacionados com a associação típica desta espécie com várias espécies de anémonas marinhas.

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INTRODUCTION

The Lichomolgoidea are a superfamily of poecilostomatoid copepods, many of which live in association with other marine invertebrates. The taxonomy and the phylogenetic relationships between the families of the lichomolgoid complex have recently been examined by HUMES & BOXSHALL (1996).

The present paper provides the first record for the Canary Islands of the lichomolgoid copepod *Critomolgus actiniae* (DELLA VALLE), with notes on its protective colouration and cryptic behaviour on its actiniarian host. The species has previously been known as *Lichomolgus actiniae* DELLA VALLE, *L. anemoniae* CLÁUS, *L. fucicolus* (*sensu* CANU) or *Doridicola actiniae* (DELLA VALLE) (see HUMES & STOCK, 1973). It was assigned by HUMES & STOCK (1983) to the new genus *Critomolgus*, which was recently placed in the family Rhynchomolgidae by HUMES & BOXSHALL (1996).

GEOGRAPHICAL DISTRIBUTION

C. actiniae is an associate of sea anemones recorded so far from north-west Europe (Strangford Lough, Ireland; Plymouth, England; Gif-sur-Yvette, Grandcamp-les-Bains, Roscoff and Le Morbihan, France), the Mediterranean Sea (Banyuls, France; Naples, Italy) and the Adriatic Sea (Trieste, Italy; Split, Croatia) (see BRIGGS, 1973; BRIGGS & GOTTO, 1973; HUMES & STOCK, 1973; J. H. STOCK *in litt.*, 1996). The known distribution has now been extended southwards, by about 1,450 km, to the Canary Islands. On 7 November, 1992, I found an adult female living on a specimen of *Actinia equina* (LINNAEUS) at Playa de las Mujeres, Gran Canaria (27°44'N.15°36'W); it is now in the Crustacea collection of the Natural History Museum, London (reg. no. 1993.111). Fig. 1 shows the newly updated geographical distribution of records of *C. actiniae*.

COLOURATION OF THE COPEPOD AND ITS HOST

The specimen of *Actinia equina* on which *C. actiniae* was found was a distinctive colour variety that I have found only amongst the Canary Islands (Gran Canaria and Tenerife). The column was pale greenish-grey, peppered with tiny (<0.5 mm diameter) black or dark greenish-grey dots. The oral disk was pale pinkish-brown. The primary tentacles were the same colour as the disk, and the outer cycles of tentacles were the same greenish-grey as the ground-colour of the column. The acrorhagi were pale blue.

A striking feature of the associated specimen of *C. actiniae* was its colour, a pale greenish-grey, which was a perfect match with that of the column and outer cycles of tentacles of its host. The egg sacs of this mature female were of the same colour as its body. BRIGGS (1976) demonstrated that when *Paranthessius anemoniae* CLAUS, a copepod associate of the anemone *Anemonia sulcata* (PENNANT), was acclimated to *Actinia equina*, its colour changed from that of the original host to that of the new one; the colour change affected the

copepod's eggs and the nauplii hatched from them. Since *C. actiniae* and *P. anemoniae* can assume the colour of their hosts, it seems likely that they ingest the pigmented epidermis, as well as the mucus, of the anemones. The various chemical compounds that produce the colours of *Actinia* and *Anemonia* (see CHEESMAN *et al.*, 1967; GOODWIN, 1968; FOX, 1976) presumably remain unmetabolized after ingestion and absorption by associated copepods.

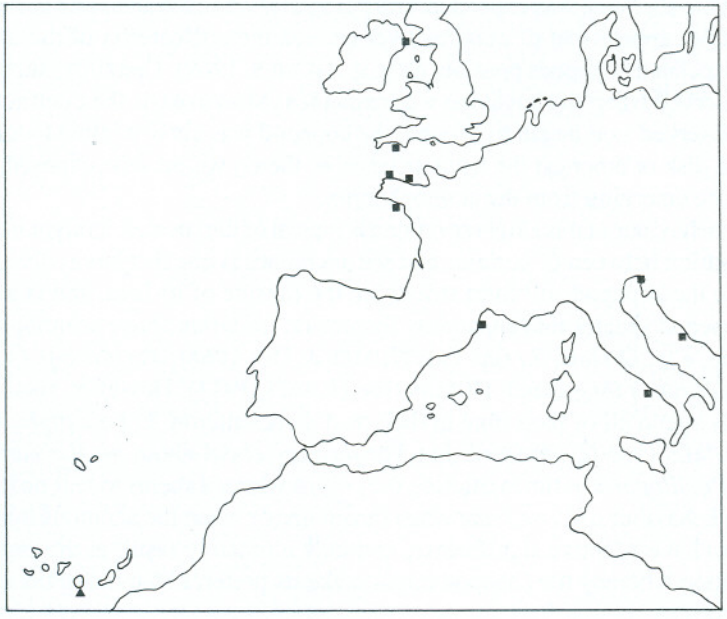

Fig. 1 - The known geographical distribution of *Critomolgus actiniae* (DELLA VALLE). ■ previous records; ▲ new record.

BEHAVIOUR OF THE COPEPOD ON ITS HOST

The *in situ* observations reported here on a living *C. actiniae* are particularly valuable, as a common method of obtaining copepods symbiotic with Cnidaria is to wash them from their hosts with ethanolic sea-water (*e.g.*, HUMES, 1982); hence the copepods' exact habitat is not usually ascertainable, nor is their natural behaviour observable. Apparently, only BOCQUET & STOCK (1959), CARTON (1963) and BRIGGS (1976) have previously examined any aspects of the behaviour of copepod associates of Actiniaria in detail.

The specimen of *C. actiniae* reported here spent much of its time on the oral disk of *Actinia equina*, particularly amongst the bases of the outer tentacles, making occasional sorties across the fosse for a short distance onto the upper column. Because of the perfect colour match, it was extremely difficult to see the copepod. Its remarkable cryptic behaviour

added to the protective effect. If, while the copepod was ranging over the upper column of the anemone, an attempt was made to touch it with a needle, it rapidly swam up to the tentacle bases, where it orientated itself head downwards, when the prominent egg sacs looked remarkably similar to the tips of partly retracted tentacles. Furthermore, if the copepod was on the column and the anemone started to contract, it always retreated onto the disk before the anemone could close completely. The copepod was therefore well protected, both visually when the anemone was expanded, and physically when the anemone was contracted.

It did not appear that *C. actiniae* ever entered the coelenteron of the anemone, as some other associated copepods possibly do (*e.g.*, HUMES, 1969). Certainly, such behaviour was never observed when the anemone was expanded. Moreover, if the contracted *Actinia* was closely observed as it began to expand, the copepod was always immediately revealed already on the disk or amongst the tentacle bases as the crown became exposed, but it was never seen to be emerging from the actinopharynx.

If the behaviour of this single specimen is typical of the species, it might be concluded that the association between *C. actiniae* and sea anemones is one that has evolved relatively recently, since the copepod still lives strictly on the outside of its host, and is a competent swimmer. Copepod species that apparently live inside cnidarians have seemingly lost their ability to swim, *e.g.*, *Orstomella* spp. (see HUMES & HO, 1968), *Xarifia* spp. (see HUMES, 1962) and *Mycoxynus longicauda* HUMES (see HUMES, 1973). However, such species do not necessarily spend all of their time in their host's coelenteron. For example, GERLACH, quoted by HUMES (1960), observed that *Xarifia* may crawl about on the surface of the scleractinian *Pocillopora*, at times entering the polyps where it seems to tear up the tissue of the coral. The behaviour of *C. actiniae* when threatened or when the anemone host contracts seems likely to have adaptive significance, and may ultimately result in the evolution of a closer association whereby the copepod might make its preferred habitat in the coelenteron of the anemone.

Whilst *C. actiniae* has been shown here to spend most of its time on the disk of *Actinia equina*, only occasionally moving to the column, BOCQUET & STOCK (1959), GOTTO & BRIGGS (1972) and BRIGGS (1976) found that *P. anemoniae* spends much of the time on the column of *Anemonia sulcata*, where it is protected by the long, trailing tentacles, only occasionally visiting the oral disk. *Actinia* differs from *Anemonia* in having relatively short, mostly upwardly pointing tentacles that afford little protection to a copepod on its column. However, BRIGGS (1973) found that Irish *Anemonia sulcata* may serve as the host for *C. actiniae* and *P. anemoniae* simultaneously, when the former still chooses to live on the tentacles and the latter occupies the column. Curiously, though, GOTTO & BRIGGS (1972) observed that only the females of *P. anemoniae* live on the column of *Anemonia*, whilst the males and immatures live on the tentacles, at least when *C. actiniae* is not also present.

INFESTATION INTENSITY

Little information seems to be available on the numbers of copepods that may be

found on each anemone, and whether more than one species may share a host. The situation described here for *C. actiniae* is strikingly similar to that observed by BRIGGS & GOTTO (1973). They found *C. actiniae* on 7 (17%) out of 40 *Anemonia sulcata*, and each infested anemone harboured only a single ovigerous female. This is not universal, however, since BRIGGS (1973) found a total of 20 *C. actiniae* of both sexes amongst 75 *Anemonia*.

BRIGGS & GOTTO (1973) also found 3 *P. anemoniae* amongst the same 40 anemones on which they found *C. actiniae*; but they did not state how many of these copepods occurred on each infested *Anemonia*, nor whether any of the anemones was shared by both copepod species. BRIGGS (1973), however, recorded both copepod species on the same specimens of *Anemonia*.

BRIGGS (1976) found mean infestations of up to 5.9 *P. anemoniae* per *Anemonia sulcata*, but did not state the maximum number that lived on a single anemone, nor whether *C. actiniae* occurred on the same anemones. GOTTO & BRIGGS (1972), however, were able to ascertain that 60% of the *Anemonia* that they examined were infested with *P. anemoniae*, with up to 11 on a single anemone.

HOST SPECIFICITY

Since I found only a single *C. actiniae* on one specimen of *Actinia equina*, I can provide no observations on host specificity. BRIGGS (1973) found *C. actiniae* on *Anemonia sulcata*, but not on *Actinia equina*, in Strangford Lough (Irish Sea). However, CARTON (1963) found that *C. actiniae* infests *Anemonia sulcata* and *Actinia equina* in the Mediterranean Sea, whilst in the English Channel, it is found only on *Anemonia sulcata*. It may be that it is difficult for *C. actiniae* to colonize *Actinia equina* in the English Channel and further north because the anemones are left exposed to the air for long periods at low tide, whereas in the Mediterranean, *Actinia equina* is almost always submerged. It is notable that most Canary Island *Actinia equina* are also permanently submerged. I made no special search for *C. actiniae* on *Anemonia sulcata*, which is widespread in the Canary Islands, so it is not known whether they are associated there, as in the Irish Sea, the English Channel and the Mediterranean.

Besides being found on *Actinia* and *Anemonia*, *C. actiniae* may also occur on the anemone *Anthopleura ballii* (COCKS). There are two unpublished records, one by Professor J. H. STOCK and another by Dr. Y. CARTON, both from the Atlantic coast of France (J. H. STOCK *in litt.*, 12 May, 1996).

In contrast, according to BOCQUET & STOCK (1959), the host specificity of *P. anemoniae* appears to be restricted to *Anemonia sulcata*, but BRIGGS (1976) showed that, under experimental conditions, this copepod could be acclimated to *Actinia equina*. The observation of BRIGGS (1973), that when both copepod species simultaneously infest *Anemonia sulcata*, *C. actiniae* inhabits the tentacles and *P. anemoniae* occupies the column, might suggest that *Actinia equina* is the definitive host of *C. actiniae* and that *Anemonia sulcata* is the definitive host of *P. anemoniae*, if the tentacles are assumed to afford protection for the copepods.

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