

# Occurrence of Caligid Copepods (Crustacea) in Plankton Samples Collected from Japan and Thailand, with the Description of a New Species

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Adults of four species of the genus *Caligus* (Copepoda: Caligidae) were found in plankton samples collected from the coasts of Japan and Thailand: *Caligus chistos* Lin and Ho, 2003 from the Gulf of Thailand; *C. latigenitalis* Shiino, 1954 from the Suo-nada basin of the Seto Inland Sea, Japan; *C. undulatus* Shen and Li, 1959 off the island of Mukaishima, Hiroshima, Japan; and *C. longiramus* sp. nov. from Amami Island, Kagoshima, Japan. The first two species respectively represent the first reported occurrences in plankton samples, although the third species has been encountered frequently in the pelagic fauna in Japanese waters. *Caligus chistos* also represents the first report of pelagic caligids from Thailand. The present study provides support to the hypothesis that some species of *Caligus* occurring in the plankton alternate between two life modes: on their host fish and free in the water column. *Caligus longiramus* sp. nov. can be distinguished from its congeners by the following combination of features: (1) antennule long with its distal segment twice as long as its proximal one; (2) denticiform process of proximal segment of antenna small and blunt; (3) sternal furca long with sharp tines; (4) exopod of leg 4 armed with I-0; I, III elements; and (5) proximal outer spine on exopod of leg 2 longer than next more distal spine and crossing over it posteriorly.

**Key Words:** *Caligus*, copepod, fish parasite, new species, plankton, sea lice.

## Introduction

The genus *Caligus* Müller, 1785 (Caligidae), well known as sea lice and belonging to the order Siphonostomatoida includes more than 250 species parasitizing marine fishes (Ho and Lin 2004a). Sea lice have a serious impact on cultured fishes around the world (Ho and Lin 2004a; Johnson *et al.* 2004; Rosenberg 2008), but their presence in plankton samples has only recently been highlighted by us (Venmathi Maran and Ohtsuka 2008; Venmathi Maran *et al.* in preparation).

There have been several schools of thought concerning the occurrence of caligid copepods in plankton. Such incidences have been regarded as either accidental, as escapes from the host or as host-switching (Venmathi Maran and Ohtsuka 2008). In particular, the discovery of adults of *Caligus chistos* Lin and Ho, 2003 occurred on *Thunnus maccoyii* (Castelnau, 1872) (Hayward *et al.* 2008) and *Caligus sclerotinosus* Roubal, Armitage and Rhode, 1983 on *Pagrus major* (Temminck and Schlegel, 1843) (Madinabeitia *et al.* in preparation), with no earlier developmental stages found on these hosts, suggested host-switching from different intermediate host fish.

Adults of Caligidae and related families have been reported repeatedly from marine plankton samples around the world (Gnanamuthu 1948; Shen and Li 1959; Heegaard

1972; Pillai 1985; Todd *et al.* 1996; Suárez Morales *et al.* 1998, 2003; Ho and Lin 2004b; Venmathi Maran and Ohtsuka 2008; Venmathi Maran *et al.* in preparation). Recently, three different genera, *Caligus*, *Lepeophtheirus* von Nordmann, 1832, and *Metacaligus* Thomson, 1949, were found in plankton samples off Japan (Venmathi Maran *et al.* in preparation). In addition, *Pandarus* Leach, 1819 (of the caligiform family Pandaridae) has also been recorded as a free-swimming form in Japanese oceanic waters (Venmathi Maran *et al.* in preparation).

In this paper we report on four species of planktonic *Caligus*, including a new species collected from off Amami Island, northern Ryukyu Islands, Japan, and we consider the ecological and adaptive significance of the free-swimming behaviour.

## Materials and Methods

Plankton samples were collected using plankton nets of various design at three stations in coastal and oceanic waters of Japan and one station in the Gulf of Thailand (Fig. 1). The collection from off Amami Island, Kagoshima, Japan, was made using a plankton net attached to a beam trawl (BT) (diameter 45 cm; mesh size 0.3 mm) towed along the bottom for 20 min. Samples from all other localities in Japan were collected with a sledge-net (mesh size 0.3 mm)