# Parasitic caligid copepods of farmed marine fishes in the Philippines

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## ABSTRACT

Recently, heavy infestation of caligid copepods occurred among farmed rabbitfish *Siganus guttatus*, pompano *Trachinotus blochii* and sea bass *Lates calcarifer* in the Philippines. In *S. guttatus* broodstock, *Caligus epidemicus*, *Pseudocaligus uniartus* and *Lepeophtheirus sigani* concurrently caused severe erosion and hemorrhaging of the body surface, fins and eyes of affected fish occurring at 95.78%, 1.52% and 0.70% of the parasite load, respectively, and with associated mortality of the host fish. In marketable-sized *T. blochii*, *L. spinifer* caused body lesions that considerably reduced the market value of harvested fish. In *L. calcarifer* juveniles, infestation with *C. epidemicus* resulted to loss of appetite, lethargy and stunted growth of affected fish. Because of its pathogenicity, low host specificity and tolerance to brackish water, *C. epidemicus* poses the highest threat to farmed marine fish in the Philippines. *Lates calcarifer* and *T. blochii* are new host records for *C. epidemicus* and *L. spinifer*, respectively. This is also the first record of *L. spinifer* in the Philippines.

**Key words**: caligid, rabbitfish, pompano, sea bass, sea lice

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## INTRODUCTION

Marine fishes including rabbitfish (*Siganus guttatus*), pompano (*Trachinotus blochii*) and sea bass (*Lates calcarifer*) are widely cultured in Southeast Asian countries. In the Philippines, the nursery and grow-out phases of culture of marine fishes are conducted in floating net cages or earthen ponds. With the intensification of the aquaculture industry in the region, heavy losses due to diseases including viral, bacterial and parasitic infections have become one of the current major concerns (Leong, 1998; APEC/SEAFDEC, 2001; Ho *et al*., 2004; Moravec, Cruz-Lacierda and Nagasawa, 2004; Nagasawa and Cruz-Lacierda, 2004).

One parasitic problem consistently observed in marine and brackish water fish culture throughout the world is the infestation with copepods belonging to family Caligidae or commonly known as sea lice. The impacts of sea lice infection in farmed marine fishes have been recently reviewed, with reported disease outbreaks and high mortalities (Johnson *et al*., 2004; Lester and Hayward, 2006). The problem of parasitic copepods as disease causing agent has become not only more frequent but also more intensive. In this paper, we report three disease cases associated with caligid infestation on cultured *S. guttatus*, *T. blochii* and *L. calcarifer* in the Philippines.

## MATERIALS AND METHODS

***Siganus guttatus*.** Recently, an extremely heavy infestation of caligid copepods with associated mortality occurred among tank-reared broodstock of rabbitfish *S. guttatus* at the Aquaculture Department of the Southeast Asian Fisheries Development Center (SEAFDEC AQD) in Iloilo, Philippines. The fish were being used for nutritional requirement studies when the infestation occurred. Twenty five fish each (total length [TL] = 26-29 (mean 28) cm; body weight [BW] = 250-500 (mean 400) g) were reared in two 10-tonne circular, canvas tanks. The fish were a mixture of wild-caught and hatchery-reared broodstock. Fish were fed twice daily at 3% of body weight with formulated diet and supplied with flow through sand-filtered water and aeration. Water temperature and salinity ranges recorded during the experiment were 27-29°C and 30-32 ppt, respectively. Five months into the experiment, the experimental fish developed severe erosion and hemorrhaging of the body surface with associated mortality. Two severely affected fish were sacrificed, body measurements were taken, and examined for external and internal parasites. Live caligids were observed microscopically and measurements were taken. The rest of the caligids were fixed in 70% ethanol. The remaining infected rabbitfish broodstocks were subjected to flow through freshwater for four hrs as an immediate control measure.

***Trachinotus blochii*.** Marketable-sized cage-cultured pompano *T. blochii* exhibited disease signs such as loss of appetite, weakening, thinning and with areas of scale loss on the body surface. The affected fish (mean BW=350 g, n=10) had been cultured for one year, prior to the observation of disease signs, in 5 x 5 x 5 m floating net cages in a commercial farm located in Morong, Bataan, west of Bataan province in Central Luzon, Philippines.

Fish were fed twice daily at 1.5-5% of body weight with a commercial diet. Affected stocks showing disease signs were immediately harvested and iced prior to marketing. During this time, iced fish exhibited obvious hemorrhagic lesions on the body surface, with heavy infestation of parasites on affected areas. The parasites were collected, preserved in 10% formalin and submitted to one of the authors (E.R. Cruz-Lacierda) for identification. Water temperature and salinity prior to fish harvest were 29-30°C and 30 ppt, respectively. The remaining stocks, upon our recommendation, were bathed in freshwater for 15 min as an immediate control measure. Two weeks after the incidence, ten fish were brought to the laboratory and examined for the presence of caligids. Collected caligids were preserved in 70% ethanol and examined under the microscope for morphological study.

***Lates calcarifer.*** Sea bass *L. calcarifer,* cultured in 3 x 2 x 1.3 m floating net cages installed inside an earthen pond at Dumangas Brackishwater Station of SEAFDEC AQD, with stocking density of 40 fish per sq. m., exhibited disease signs such as loss of appetite, weakening and stunted growth during an experiment on formulated diets for grow-out culture of *L. calcarifer* in ponds. Affected fish (TL=8.6-11.7 (mean 10.4) cm; BW=8-13 (mean 10.9) g, n=10) were collected, transported live to the laboratory and examined for external and internal parasites.

## RESULTS

***Siganus guttatus.*** The fish showed severe erosion and hemorrhaging of the skin on the ventral side of the body, particularly below and between the pectoral and pelvic fins (Fig. 1). The eyes and fins also show hemorrhagic lesions. A 10% mortality was recorded among the affected stock. Continuous heavy rains that made incoming water turbid were also noted a few days before manifestation of disease signs.

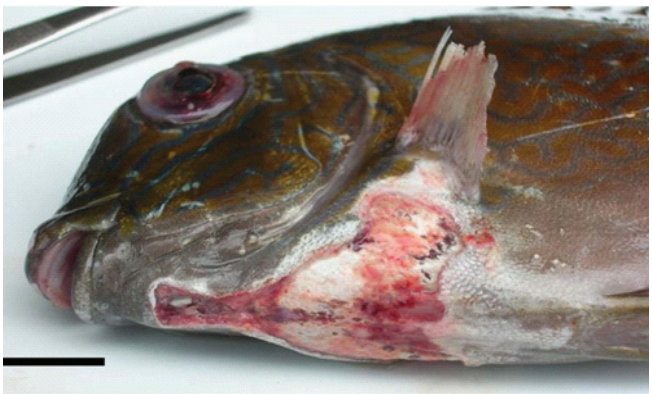

**Figure 1.** *Siganus gutattus* infested with caligid copepods showing extensive areas of erosion and hemorrhages on the antero-ventral side. Note hemorrhagic eye with caligid copepod.

The affected fish showed heavy infestation of caligid copepods. They were attached to the body surface (Fig. 2), eyes and fins of the host fish. Further examination of the collected parasites revealed three species of caligids, *Caligus epidemicus* Hewitt, 1971, *Pseudocaligus uniartus* Ho, Kim, Cruz-Lacierda and Nagasawa, 2004 and *Lepeophtheirus sigani* Ho, Kim,

**Figure 2.** *Siganus gutattus* with caligid copepods on body surface.

Cruz-Lacierda and Nagasawa, 2004, with *C. epidemicus* occurring at 95.78% of the parasite load (Table 1). Most of the *C. epidemicus* were pre-adult, adult and ovigerous females. Adult females (n=20) and males (n=20) of *C. epidemicus* were 2.14 mm (range: 2.03-2.33) and 1.47 mm (range: 1.35-1.55) in mean body length (MBL), respectively. *Pseudocaligus uniartus* occurred at 1.52% and the adult females (n=4) and males (n=7) were 2.10 mm (range: 1.85-2.30) and 1.99 mm (range: 1.90-2.05) in MBL, respectively. A lower percentage of *L. sigani* occurred at 0.70% and the adult females (n=2) and adult males (n=4) were 2.37 mm (2.28-2.45) and 1.58 mm (1.40-1.75) in MBL, respectively. A few chalimus larvae (1.99%) were also collected from the fins. As the majority of the caligids recovered were identified as *C. epidemicus*, we presume that the chalimus larvae recovered belong to *C. epidemicus*.

**Table 1**
Intensity of caligid copepods on the body surface of rabbitfish *Siganus gutattus* broodstocks kept in land-based tanks of SEAFDEC AQD in Iloilo.

| Fish no | TL (cm) | BW (g) | C. e. | P. u. | L. s. | Chal | Total |
|---|---|---|---|---|---|---|---|
| 1 | 29 | 350 | 660 | 10 | 6 | 17 | 693 |
| 2 | 26 | 270 | 157 | 3 | 0 | 0 | 160 |

TL, total length; BW, body weight; *C. e., Caligus epidemicus; P. u., Pseudocaligus uniartus; L. s., Lepeophtheirus sigani;* Chal, chalimus larvae

Examination of the internal organs revealed the camallanid nematode *Procamallanus guttatusi* (Andrade-Salas, Pineda-Lopez and Garcia-Magaña, 1994) in the stomach and intestine of one rabbitfish at an intensity of six and seven, respectively. No other external and internal parasites were observed.

The remaining infected stock when subjected to flow-through freshwater for four hrs dislodged and killed the caligids from the body surface of the rabbitfish. The fish when returned to full seawater with a salinity of 32 ppt recovered and no caligid infection was observed when fish were reexamined, thereafter.

***Trachinotus blochii.*** Examination of the collected parasites (n=60) from the body surface of *T. blochii* revealed that they belong to family Caligidae and was identified as

*Lepeophtheirus spinifer* Kirtisinghe, 1937 by the fifth leg of females overreaching the caudal rami and carrying three plumose setae on the dorsal side (Pillai, 1985). The adult males (n=10) and females (n=10) of *L. spinifer* measured 2.73 (range: 2.40-2.88) and 4.24 (range: 4.05-4.40) mm in MBL, respectively. The affected fish carried approximately 50 copepods per fish (n=10) (J. Nealaga, pers. comm.). The harvested stocks when marketed have considerably reduced market value because of the lesions on the body surface (J. Nealaga, pers. comm.). The remaining infected *T. blochii* that were bathed in freshwater for 15 min and examined (n=10 fish) two weeks after the infection also carried *L. spinifer* with a prevalence of infection of 100% and mean intensity of infection of 3.7 (range: 1-5).

***Lates calcarifer*.** Examination of affected *L. calcarifer* (n=10) showed 100% prevalence of *C. epidemicus* with a mean intensity of 12.7 (range: 6-35). Although there was no mortality involved, the fish manifested disease signs such as loss of appetite and lethargy with reduced growth rate as the most obvious (E. Coniza, pers. comm.). Adult females (n=10) and males (n=10) of *C. epidemicus* were 2.10 (range: 1.88-2.28) and 1.50 (range: 1.38-1.55) mm in MBL, respectively. No other parasite was recovered in all examined fish.

## DISCUSSION

Parasitic copepods belonging to family Caligidae, also known as sea lice, with those belonging to two genera *Caligus* and *Lepeophtheirus* are the most commonly reported species on marine and brackish water cultured and wild marine fish (Ho, 2000, 2004; Johnson *et al*., 2004). In the Asia-Pacific region, many caligid species have been reported to affect growth and survival of their hosts (e.g. Fujita, Yoda and Ugajin, 1968; Hewitt, 1971; Laviña, 1978; Jones, 1980; Lin and Ho, 1993; Lin, Ho and Chen, 1996b), especially in intensive aquaculture systems.

*Caligus epidemicus* has been reported to be widely distributed and caused mass mortality in several species of fish in Australia (Hewitt, 1971) and in tilapia in Taiwan (Lin and Ho, 1993; Lin, Ho and Chen, 1996a). In the Philippines, *C. epidemicus* has been recorded on at least 12 host fishes, with a high prevalence rate and at high intensity (Natividad, Bondad-Reantaso and Arthur, 1986; Ho *et al*., 2004). However, *L. calcarifer* has not been previously recorded as host for *C. epidemicus*. Thus, *L. calacarifer* is a new host record for *C. epidemicus*.

Among the caligids reported here, *C. epidemicus* poses the highest threat to marine aquaculture in Asian waters because of its pathogenicity, low host specificity and tolerance to brackish water (Hewitt, 1971; Ho, 2000, 2004; Ho *et al*., 2004). The other caligids, *P. uniartus* and *L. sigani* have been reported to be host-specific to rabbitfishes (Ho *et al*., 2004) while *L. spinifer* so far has been recorded from *Chlorinemus* sp. in Sri Lanka (Kirtisinghe, 1937) and from *C. lysan*, *C. tala* and *Rachycentron canadus* in India

(Pillai, 1985). *Trachinotus blochii* is a new host record for *L. spinifer*. The checklist of parasites of fishes from the Philippines (Arthur and Lumanlan-Mayo, 1997) shows that this is also the first record of *L. spinifer* in the country.

The morphology of *C. epidemicus* has been previously described (Ho and Lin, 2004) as well as *P. uniartus* and *L. sigani* (Ho *et al*., 2004). The morphology of *L. spinifer* will be re-described in a separate paper.

In the present study, majority of the *C. epidemicus* were pre-adult, adult and ovigerous stages, with chalimus larvae comprising only two percent of the caligid population. It has been reported in previous studies that the highest proportion of pre-adult and adult *Lepeophtheirus salmonis* in sea trout (*Salmo trutta*) coincided with the lowest prevalence of chalimus larvae (Tully *et al*., 1993; Tingley, Ives and Russell, 1997; Schram *et al*., 1998) and that such pattern is an indication of low transmission rate of the parasite.

Although severe erosion of the skin was confined on the ventral portion of the head, many copepods were also observed on the whole body surface, fins and eyes of the rabbitfish, similar to *C. epidemicus* infection on yellowfin bream, *Acanthopagrus australis* (Roubal, 1994). The lesions on the body surface of affected fish could be attributed to the feeding activity of the parasite (Kabata, 1974; Urawa and Kato, 1991). Further, similar disease signs and mortality caused by two caligids (*L. atypicus* and *C. oviceps*) were reported on another rabbitfish, *S. fuscescens*, cultured in Taiwan (Lin, Ho and Chen, 1996b). Parasitic copepods have been reported to feed on host's mucus, tissues and blood (Johnson *et al*., 2004).

It is highly possible that the wild-caught rabbitfish broodstocks used in the experiment may have had prior infection. The turbid incoming water brought about by continuous heavy rains may have also contributed to the outbreak of caligids in rabbitfish. The pompano and sea bass seed stocks, however, were hatchery-produced. Thus, caligid infections may have originated from the wild fish present in the vicinity of culture area and/or from other cultured fish species in the same culture site.

As an immediate control measure, bathing the remaining infected rabbitfish in flow-through freshwater for four hrs prevented further infection and mortality. The fish recovered (J.B. Gonzaga, pers. comm.) and no subsequent caligid infection was observed. The use of freshwater to control caligids and other marine parasites has been previously recorded (e.g. Urawa and Kato, 1991; Zafran *et al*., 1998, 2000; Cruz-Lacierda *et al*., 2004).

The use of chemicals such as formalin and hydrogen peroxide has been reported against caligids on groupers (Zafran *et al*., 1998, 2000; Koesharyani *et al*., 2001; Cruz-Lacierda and Pagador, 2004). However, control methods to prevent settlement, molting, growth and maturation of caligids should be looked into.

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