# First record of blue-pigmented Calanoid Copepod, *Acrocalanus* sp. in the whale shark habitat of Cendrawasih Bay, Papua - Indonesia

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**Abstract**. Cendrawasih Bay is famous as a habitat of whale shark. One of the main foods of the whale shark in the bay is the blue-pigmented calanoid copepods. The presence of the blue-pigmented copepod has never been reported in Indonesia. This study was aimed to report the occurrence of a blue-pigmented calanoid copepod (*Acrocalanus* sp.) from Cendrawasih Bay, Papua as new record. The specimens were collected by means of bongo net, and preserved with 5% sea-buffered formaldeyide. Sample collection was conducted from October to December 2016. Morphological characters of the species are illustrated and described. This finding enhances marine biodiversity list of micro-crustacean in Indonesia, and add more distribution information of the species in the world.

**Key Words**: blue-pigmented copepod, conservation, crustacea, new record, zooplankton.

**Introduction**. Copepods are small aquatic crustaceans and their habitats range from freshwater to hyper saline condition. Copepod is an important link in the aquatic food chain especially for small fish to large fish like whale shark. Kamal et al (2016), Hacohen-Domene et al (2006) and Clark & Nelson (1997) reported that Copepoda was the dominant food of the whale shark (*Rhincodon typus*). As the largest fish, the occurrence of the wale shark is believed to be related to the high abundance of plankton including copepods, crab larvae, squids and small fishes (Compagno 1973; Clark & Nelson 1997). Nelson & Eckert (2007) found that 85% of the whale shark food was copepod in Bahia de Los Angeles. Meanwhile the main food in Ningaloo reef was *Pseudophausia latifrons,* portuniid megalopod, stomatopod larvae, copepods, chaetognatha and schooling small fish.

Actually research on crustacean diversity in Indonesia has currently been increasing. However, most of the reports were about the record of the occurrence of Indonesian macro crustacean both marine and freshwater species, such hippoid crabs (Wardiatno et al 2015a, b; Mashar et al 2014, 2015; Ardika et al 2015), lobsters (Wahyudin et al 2016, 2017a, b; Wardiatno et al 2016a, b, c), and crayfish (Patoka et al 2016). Nevertheless, current records on the existence and distribution of micro-crustacean such as copepod are restricted, e.g. Mulyadi (2014). Although some years ago, numerous records on copepods in Indonesian waters were published, e.g. Mulyadi & Ueda (1996), Mulyadi (2003, 2005, 2009). However, among the published papers there is no report on the occurrence of blue-pigmented copepod in Indonesia yet. This study reports the occurrence of a blue-pigmented calanoid copepod (*Acrocalanus* sp.) in Cendrawasih Bay, Papua - Indonesia as first record. The bay is inhabited by whale shark, especially in the region, so-called Kwatisore and Sowa (Wilson et al 2006).

## Material and Method

***Description of the study sites***. The specimens were collected in October to December 2016 from Kwatisore and Sowa District, Papua, Indonesia. Research location is shown in Figure 1. Sample collection was conducted by means of bongo net and plankton. The two nets were towed by a fisherman boat with 2 knots speed. The collected samples were kept in 500 mL volume bottle and preserved with sea-buffered 5% formaldehyde. In laboratory identification of the specimens was conducted following characteristic description and taxonomic keys in Yamaji (1979), i.e. segment, posterodosal segment, antennules, and spines. The identification process was helped by copepod taxonomy expert of Indonesia, Prof. Mulyadi. The specimens are deposited in Laboratory Microbio, Department of Aquatic Resources Management, Bogor Agricultural University, Indonesia.

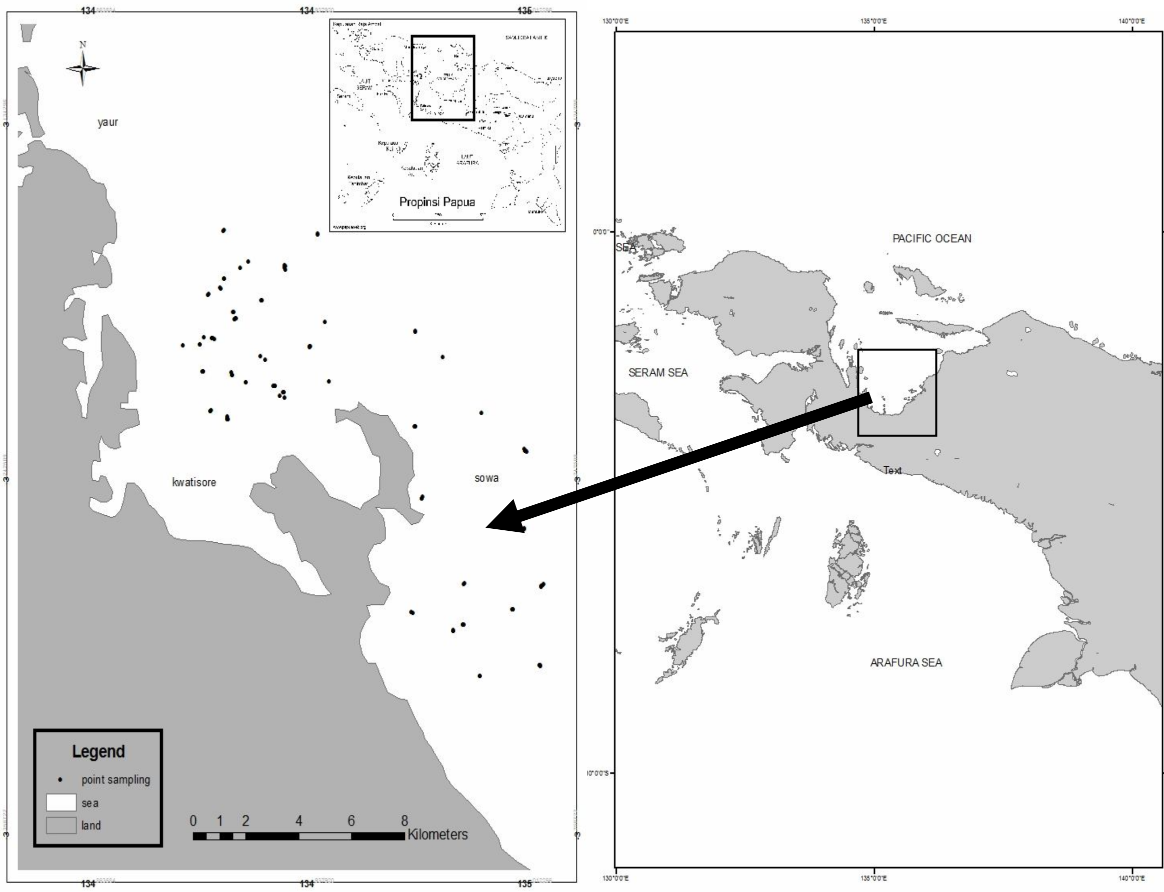


Figure 1. Map showing the location of Kwatisore and Sowa, Cendrawasih Bay, Papua, Indonesia, where the copepod sample was collected (the black dots).

**Results and Discussion**. The classification of the blue-pigmented calanoid copepod is as follow:

Kingdom Animalia
Phylum Arthropoda
Subphylum Crustacea
Class Hexanauplia
Subclass Copepoda
Ordo Calanoida
Family Paracalanidae Giesbrecht, 1983
Genus *Acrocalanus* Glesbrecht, 1888 (Figure 2)

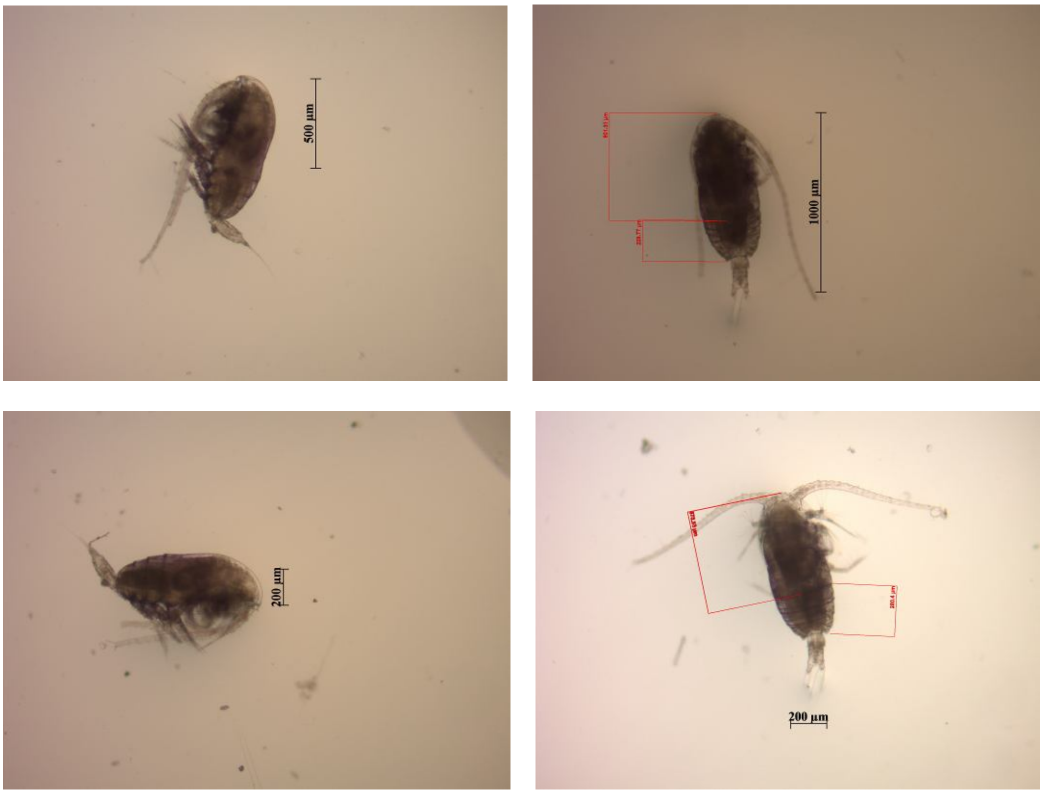


Figure 2. The blue-pigmented calaniod copepod, *Acrocalanus* sp. collected from Cendrawasih Bay, Papua - Indonesia (the pigment was dissolved because of preservation and storage duration).

***Description***. Cephalosome and first pedigerous sominte fused. Fourth and fifth pedigerous somite partly fused. Anal somite is longer than any somite between it and genital somite. Rostrum of 2 filaments. Antenna exopod 7-segmented with the first exopod and second exopod each baring 2 setae, segment 7 elongate. Mandible first endopod without prominent lobe. Swimming legs 1-4 exopod 3 segmented; the first swimming legs basis inner marginal setae; second to forth endopods 3-segmented, second endopod posterior surface ornamented with spinner; second to forth swimming legs exopod 2-3 external edges serrated. Terminal spines of second to forth swimming legs exopod smooth. Fifth swimming legs absent or vestigial (Bradford-Grieve et al 1999).

A few copepod has blue pigmented, such as *Pontella fera* Dana, 1849 (Herring 1965), *Labidocera glauca* Smith, 1941 (Smith 1941), *Labidocera acutifrons* Dana, 1849 (Zagalsky & Herring 1972), *Corycaeus amazonicus* Dahl, 1894 (Johnson & Allen 2012) and the last is *Acartia erythraea* Giesbrecht, 1889 (Nakajima et al 2013). For the first time, blue-pigmented calanoid copepod was found in Papua waters.

*Acrocalanus* sp. of Cendrawasih Bay, Papua had length of 1,054-1,131 micron (see Figure 2). Antenna 1 long. Prosome are longer than urosome. The first swimming leg and cephalon fused. The first pair of swimming legs until 4 pairs of swimming legs other has hairs. Urosomite have 4 segments. Pedigerous segments 4 and 5 incompletely separated.

***Bioecological information***. Copepod was known to be capable of metabolically transforming β-carotene into astaxanthin via echinenone and canthaxanthin (Goodwin 1971). According to Mojib et al (2014), *Acartia fossae,* and *Oikopleura dioica* in the Red Sea could synthesize astaxanthin from β-carotene, ingested from dietary sources via 3-hydroxy-echinenone, canthaxanthin, zeaxanthin, adonirubin or adonixanthin. Several environmental factos may influence caretenoid metabolism (Herring 1968; Hairston 1979a, b; Byron 1982). In general as zooplankton, copepod needs to feed in surface layers (Lampert 1989) and it takes the risk to staying on the surface for food because there is an increase-risk of biological stressor such as ultraviolet radiation (UVR) and predation (Johnsen & Jakobsen 1987). To adapt with that, one of their physiological adaption is accumulation of either UVR absorbing compound such as mycosporine like amino acids or carotenoid pigments such as astaxanthin which give red or blue color depending on the bound or free form (Hairston 1976; Persaud et al 2007). The red color was caused by caratenoid astaxanthin and its esters (Hairston 1976), while blue color was developed from union with protein (Zagalsky 1976). Generally in many crustaceans astaxanthin is accumulated mostly as esters and not free astaxanthin, particularly throughout ontogenetic growth (Yamada et al 1990; Petit et al 1991; Dall et al 1995).

In accordance with Hairston (1980), Byron (1982), Hays et al (1994) and Hansson (2000) food and light had important roles on carotenoid natural coloring in zooplankton. In terms of depth, more pigmented zooplankton are frequently found to inhabit deeper layer of ocean (Herring 1972) and to elude the surface of the ocean (< 6 m) especially on the daytime (Hays et al 1994). Concentration of astaxanthin esters declined once the copepod famished in the dark, but combination of food and light would bring about an increase of esterifies astaxanthin (Sommer 2006). Regarding the time, high concentration of carotenoid in zooplankton in general would occur around midnight (Hallegraeff et al 1978; Kleppel et al 1985).

The function of carotenoids in zooplankton could lessen the photooxidative stress stimulated by short-wave length solar radiation, however increase their defencelessness to predators (Schneider et al 2012). Zooplankton manufactures astaxanthin to protect in contradiction of high energy irradiance, from predecessors in their food (Sommer et al 2006). Blue pigment in copepod appear because of carotenoprotein containing astaxantihin as the protect group (Zagalsky & Herring 1972; Mojib et al 2014). Mojib et al (2014) found that in tropical oligotrophic marine ecosystem, mesozooplankton are commonly discovered to be blue pigmented, since the ecosystem are depicted by great transparency and annual solar radiation.

**Conclusions**. The blue-pigmented calanoid copepod inhabiting the Cendrawasih Bay is *Acrocalanus* sp. This finding would be strengthening the fact that Indonesia is a hotspot in marine diversity. The presence of this copepod species is new record for Indonesia, and would add the distribution record of blue-pigmented record in the world.

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