

# Pathogens and Related Diseases in Non-European Cephalopods: Asia. A Preliminary Review

# 18

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## Abstract

Parasitic diseases and other abnormalities play critical roles in causing morbidity in the majority of Cephalopoda. However, to date, reports of cephalopod diseases from Asia are scarce and lack detailed information on the description of specific characters. This paper presents a brief overview of various pathogens and produced diseases in Asian cephalopods, including coccidiosis by *Aggregata*, Anisakiasis, infection by the copepods *Octopicola*, and other abnormalities such as edema and broken skin. The coccidian *Aggregata* sp. that infects the definitive host *Amphioctopus fangsiao* is a heteroxenous parasite transmitted through the food web. Anisakids play an important role in Asia as parasitic disease for cephalopods and it is even transmitted to humans. Concerning the infection by copepods, *Octopicola* sp. is the only species of the family Octopicolidae reported from North Pacific waters. Other abnormalities like edema or broken skin may have been the result of bacterial infections, so that abnormalities could cause the degeneration and death observed in *A. fangsiao*.

## Keywords

Cephalopoda • Pathology • Diseases • *Amphioctopus fangsiao* • *Aggregata* • Anisakis • *Octopicola* • Asian waters

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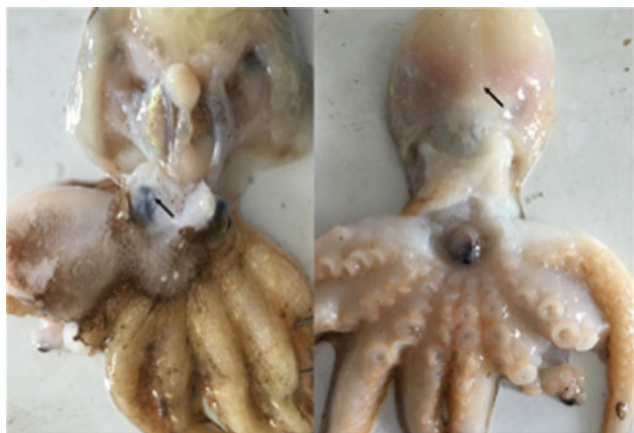
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## 18.1 Introduction

Cephalopoda is the most complex in the invertebrate phyla. Cephalopods include exclusively marine animals that live in all oceans of the world except the Black Sea. In Asia, many cephalopods are important economic species for human beings. Octopods were reported the highest production for 2010, at 217,506 tones, while European production of octopuses was only 42,945 tones (Norman et al. 2014), which are also one of the most important commercial cephalopod groups in China (Zheng et al. 2014; Xu and Zheng 2018). Cuttlefish, such as *Sepia pharaonis* and *Sepiella japonica*, were also an important fishery in the northern part of the Indian Ocean and southeastern Asia



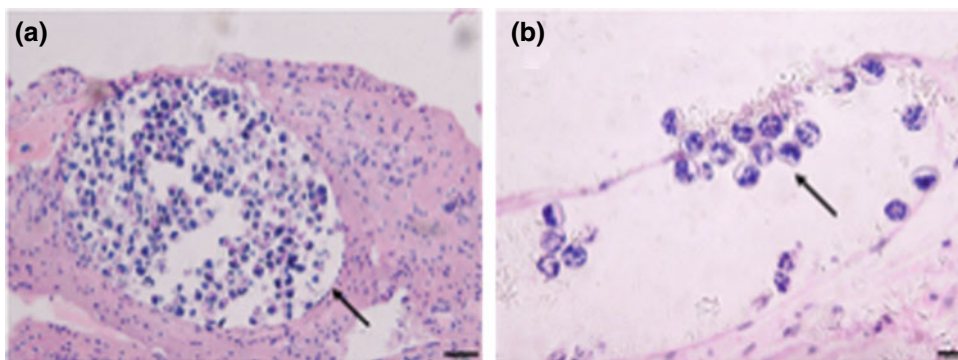
**Fig. 18.1** Distribution of parasites on *Amphioctopus fangsiao*. Arrows showing disseminated cysts in the epidermis

(Nesis, Yin et al. 2018). However, to date, reports of cephalopod diseases from Asia are scarce and lack of detailed information on the description of specific characters.

## 18.2 *Aggregata* Sp.

Cephalopods are specifically infected by coccidians of the genus *Aggregata*, which were heteroxenous parasites transmitted through the food web. Sexual stages (including gamogony and sporogony) occur inside the digestive tract of the definitive cephalopod host (Dobell 1925; Gestal et al. 2002). Coccidian infection at pathological level has not been previously reported in Asia and data of its prevalence and distribution are currently scarce. Protozoan parasites of the genus *Aggregata* affecting *Amphioctopus fangsiao* in natural environment have been associated with large-scale concentrated deaths occurred in the process of artificial temporarily culture facility in China. White cysts were found in the body surface representing the 43% of the total number of *A. fangsiao* inspected (95/220) (unpublished data) (Fig. 18.1).

**Fig. 18.2** Histological sections of *A. fangsiao* intestines infected by *Aggregata* sp. **a** Oocysts infecting the intestinal tissue. **b** Sporocysts inside the oocyst. Scale bars: A, 50  $\mu$ m B, 20  $\mu$ m



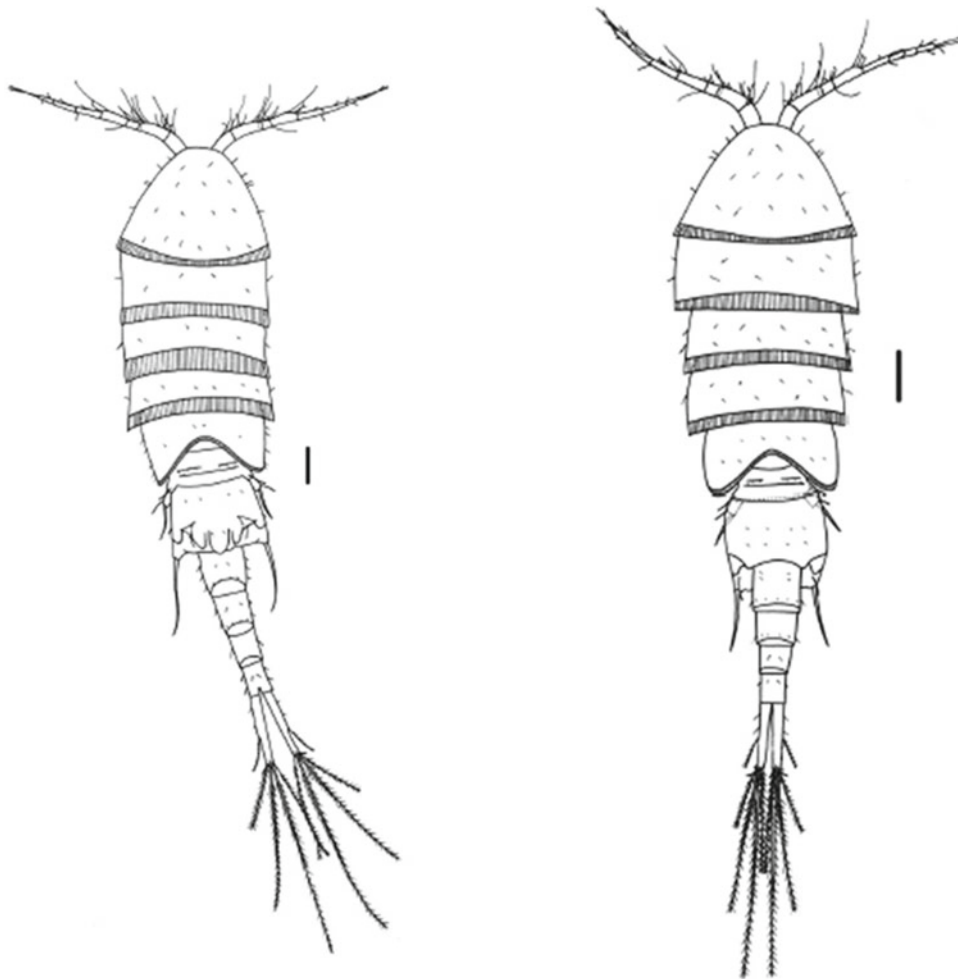
Histological sections of intestinal tissue revealed destruction of the organ architecture and substitution of the tissue by parasite cysts (Fig. 18.2a). Through histological sections observation, the oocysts were spherical, in the range of 249.75–501.75  $\mu$ m (mean 360.76  $\pm$  70.39  $\mu$ m) and 116.84–350.87  $\mu$ m (mean 231.67  $\pm$  74.89  $\mu$ m) ( $n = 20$ ) with plenty of sporocysts in each oocyst. The size of sporocysts was measured as follows: 17.69–20.72  $\mu$ m (mean 19.20  $\pm$  0.93  $\mu$ m) by 15.97–20.00  $\mu$ m (mean 18.31  $\pm$  1.19  $\mu$ m) ( $n = 20$ ). The surface of sporocysts was smooth. The histological results are shown in Fig. 18.2b (unpublished data).

## 18.3 Anisakidae

The life cycle of Anisakidae is rather complex involving small crustaceans as the first intermediate host; fishes and cephalopods as the second host; and marine mammals which act as the definitive host (Nesis et al. 1987; dos Santos and Howgate 2011; Sangaran and Sundar 2016). Thus, anisakiasis is a parasitic disease of cephalopods in Asia. In Japan, where raw squids are consumed as an integral part of the Japanese diet, Anisakid transmission to humans has been reported, producing a strong pathology (Oshima 1972; Tomoo and Kliks 1987; Sakanari and Mckerrow 1989). In China, natural infection of Anisakidae larvae was investigated in squids (2 species, 29 specimens) caught in the yellow sea and the East China Sea (Koyama 1969).

## 18.4 Octopicola

To date, the genus *Octopicola* contains five species parasitizing octopuses (Humes 1957, 1963, 1974; Du et al. 2018). *Octopicola huanghaiensis* (Fig. 18.3) is the first species reported in *A. fangsiao* and *Octopus minor*, and the only species of the family Octopicolidae known in Asia (Du et al. 2018).

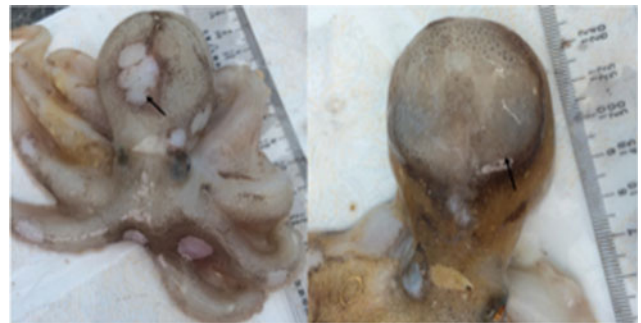


**Fig. 18.3** *Octopicola huanghaiensis* (Scale-bar: 100  $\mu$ m) (Du et al. 2018)

## 18.5 Other Abnormalities

There are some other abnormalities recorded in Asian octopuses (Fig. 18.4). During our study, wild specimens of *A. fangsiao* were caught in March 2017 in the Yellow Sea (off Lianyungang, Jiangsu Prov.). The specimens were temporarily reared indoors of the Ganyu Jiaxin Fishery Technical Development Co., Ltd. Individuals were placed in concrete tanks, under the conditions of 11.8 °C, natural photoperiod, as well as plastic suspensors for shelter.

From March 16 to April 2, 1303 dead *A. fangsiao* individuals were sampled in order to separate males and females. The total number of females was 836, accounting for 64% of all deaths. There were 467 males, accounting for 36% of the total deaths; the female death rate was much higher than that of the male in breeding season, which was extremely weird. Therefore, further examination by gross pathology of 220 dead individuals (body surface) was conducted from March 24 to April 2 to



**Fig. 18.4** Abnormalities of *A. fangsiao*. Arrows showing exfoliation of the mantle and edema

analyze the death situation. Eventually, it was found that skin surface of dead individuals includes mainly edema and edema with coccidian (individuals of edema only amount to 16% of the total number of inspection), broken skin (37% of the total number of inspection), and broken arms (4% of the total number of inspection). Those

abnormalities may have been the results of bacterial infection so that abnormalities could cause degeneration and death of the species.

## 18.6 Concluding Remarks

As summarized above, only handful studies have been documented for cephalopod diseases from Asia currently, including coccidiosis by *Aggregata* sp., Anisakiasis, *Octopicola*, edema, and broken skin. However, further characterization and functional studies are needed to confirm the effect of diseases on the cephalopods health. Finally, the results obtained in the chapter provide a brief overview of parasitic diseases in Asian waters.

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