Short Paper

New record of *Heterocapsa circularisquama* (Dinophyceae) from Hong Kong

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**INTRODUCTION**

An armored dinoflagellate *Heterocapsa circularisquama* is notorious for forming harmful algal blooms that caused mass mortality of natural and cultivated bivalves such as oysters, pearl oysters and clams.¹ The species was first reported at Uranouchi Bay, Kochi Prefecture in August 1988 and, subsequently, appeared in several areas in western Japan.¹ Using samples collected at Ago Bay, Horiguchi described it as a new species in the genus *Heterocapsa* based on its circular body scale.² Red tides of this dinoflagellate have spread extensively in western Japan,¹ but occurrences have been reported only from the western Japanese coast until now. This dinoflagellate cannot grow at ≤10°C and optimum temperature for growth is 30°C in laboratory culture conditions.³ It is widely presumed to exist not only along the western Japanese coast but also in areas south of Japan.³ In the present study, we newly report the occurrence of *H. circularisquama* in a coastal area of Hong Kong, South China Sea.

We observed two red tide samples collected in Hong Kong waters. Samples were fixed with Lugol’s solution. These red tides occurred at Tai Po Kau in September 1986 and at Yung Shue Au in July 1987. These areas are situated in Tolo Harbour, New Territories of Hong Kong (Fig. 1). Cell density reached more than 500,000 cells/mL during the 1987 red tide, then many wild and cultivated fishes died. Preliminary bioassay using mice and juvenile fishes showed no harmful effect of the red tide, therefore the mortality of fishes was supposedly due to oxygen depletion.

To identify these dinoflagellates, we observed thecal plate arrangement and fine structure of body scales. The body scale is the cell covering that

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**Fig. 1** Sampling location of the *Heterocapsa circularisquama* in Hong Kong.
stained with 2% uranyl acetate for 1.5 min. The stained whole-mount preparations were examined on a transmission electron microscope (JEOL JEM1010, Tokyo, Japan).

Light microscopy revealed that the algae possessed conical epitheca and hemispherical hypotheca, 16–30 μm in length. A pyrenoid surrounded by large starch sheaths was situated in the upper part of the hypotheca (Fig. 2a). A nucleus elongated from the epitheca to the hypotheca. The thecal plate pattern of the species corresponded is situated immediately above the plasma membrane, and it is known in all Heterocapsa species.

For observation and analysis of the thecal plate arrangement, the fixed cells were stained with 1% fluorescent brightener 28 (Sigma, Japan) and examined under an epifluorescent microscope (Olympus BX60, Japan). For observation of the body scales, whole-mounts were prepared as follows. A drop of suspended materials was placed on a polyvinyl formvar-coated grid. The cells were dried and rinsed with distilled water and then stained with 2% uranyl acetate for 1.5 min. The stained whole-mount preparations were examined on a transmission electron microscope (JEOL JEM1010, Tokyo, Japan).

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Fig. 2  Heterocapsa circularisquama collected in 1987 (a–g), and in 1986 (h–i). (a) Cells showing a large pyrenoid; (b) ventral view; (c) antero-ventral view; (d) fluorescent outline in dorsoventral view; (e,f) dorsal view; (g–i) body scales. Py, pyrenoid; Po, apical pore plate; cp, canal plate; as, anterior sulcal plate; rs, right sulcal plate; small arrow, peripheral upright; arrowhead, central upright.
with that of the genus *Heterocapsa*, Po, cp, 5', 3a, 7", 6c, 5s, 5", 2" (Fig. 2b-f). Two types of 2a, hepta and hexa shown in Figs 2e and 2f, respectively, were observed. This variation was confirmed when the species was originally described, and it was also reported in several *Heterocapsa* species (e.g. *H. niei*, *H. rotundata*). Many body scales were found in the preserved samples using electron microscopy. The scale consisted of a basal plate and spine-like uprights (Fig. 2g-i). The basal plate of the scale had radial symmetry and was somewhat circular in outline. It consisted of fine reticulation and six radiate ridges (Fig. 2g). Seven vertical spines contacted with the basal plate: a long upright emerged from the center of the plate and six uprights from the rim were connected with the ridges. The latter six peripheral uprights possessed an arm at the distal part, which connected with the next arm, and then formed three pairs. The central upright spine and these pairs were connected by another bar.

These two red tide dinoflagellates exhibited exactly the same characteristics. The thecal plate arrangement, as well as the characteristics of possessing a pyrenoid and body scales, indicates that the species belongs to the genus *Heterocapsa*. Ultrastructure of the body scale is identical to *H. circularisquama*. These are new records of *H. circularisquama* from Hong Kong. As it was first reported in 1988 from the Japanese coast, the red tides occurring in 1986 are the oldest record of this species.

In Hong Kong waters, red tides caused by a similar species to *H. circularisquama* have been found in December 1983 at Tai Po Kau and Yim Tin Tsai in Tolo Harbour. We, hence, suppose that the red tide may be the first appearance of *H. circularisquama* in Hong Kong. However, unfortunately, no red tide sample collected in 1983 was available for re-examination. The species has occurred since then, but any other red tide caused by this species was not recorded until 1986.

Resting cyst or hypnozygote is not found in this species, so the method of overwintering is unclear in the population blooming in Japan. However, motile cells of the species were observed during winter, and it may exist through the year in Hong Kong. This record is older than the first report from Japan; therefore, it may be supporting evidence for algal transportation via bivalve consignment. However, only morphological observation was conducted in the present study, and there was no study of physiological and genetic properties of the Japanese and the Hong Kong populations. It is not clear whether the Hong Kong population has a harmful effect on bivalves. To clarify these matters, further investigation using live samples collected from South China Sea is required.

The presence of *H. circularisquama* in Hong Kong waters is newly confirmed in the present study using observation of body scale structures. Body scale observation was essential for identification of *Heterocapsa* species, especially in mingled preserved samples. For a distribution survey of *H. circularisquama*, additional research on samples collected from a wider area in western Pacific using this method is necessary, and will help the elucidation of the expansion mechanisms of this species.

### REFERENCES


