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IDENTIFICATION OF THE SPECIES OF DINOFLAGELLATES (ORDER DINOPHYSIALES) F.J.R. TAYLOR 1980 FROM SEBATU AND SUNGAI RAMBAI, MALACCA.

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ABSTRACT. *In the dinoflagellates, the order Dinophysiales is one of the groups in which many of the species have been implicated as diarrhetic shellfish poison (DSP) producers or red tide species. In identifying the species, the morphology of the cell such as the size, shape of the cell, the left sulcal list, presence and absence of chloroplast, plate pattern and thecal ornamentation are important morphological characteristic to look for.* Dinophysis caudata, *a potential red tide species identified from the Malacca Straits at Sebatu and Sungai Rambai, showed variation in forms and is similar to* D. tripos *by their dorsal-posterior projection and* D. miles *also by their dorsal-posterior projection and posterior projection. While* D. rotundata, *a potential DSP species, always confused with Phalacroma because the species does not show a striking features.*

KEYWORDS. Diarrhetic shellfish poisoning (DSP), *Dinophysis caudata*, *D. rotundata*, harmful algal bloom (HAB), red tides.

INTRODUCTION

Dinoflagellates are predominantly unicellular, eukaryotic,flagellated, photosynthetic and non-photosynthetic organisms. Approximately 2000 living and 2000 fossil species of dinoflagellates have been described worldwide (Fukuyo and Taylor, 1989). Some dinoflagellates are known as harmful algal bloom (HAB) species or red tide species which may be harmful to the aquatic environment in various ways, such as clogging fish gills, causing blood-induced hypotoxin, producing neurotoxins, causing oxygen depletion and creating anoxia in the water, producing noxious smells when the bloom collaps, changing surface water color (Bodeanu, 1993) and giving an unpleasant taste in bivalves (Parry et al., 1989).

The impact of HAB focuses on toxin production by the algae that find their way through the food chain to humans, causing a variety of gastrointestinal and neurological illnesses. Based on its effects and chemical composition, toxins produced by the algae are classified into six types viz. paralytic shellfish poison (PSP), diarrhetic shellfish poison (DSP), amnesic shellfish poison (ASP), ciguatera fish food poison, neurotoxin shellfish poison (NSP) and cynobacterial toxin poison (Shummway, 1995).

The order Dinophysiales is mainly implicated to DSP (Maclean, 1993). Species which produces DSP that were recorded in various countries are *Dinophysis fortii, D. acuminata, D. acuta, D. norvegica, D. mitra* and *D. rotundata.* Although no mortalities have been reported due DSP toxin, the toxin can promote stomach tumours and thus produce chronic problems in shellfish consumers as reported by Sagunama *et al*. in 1988 (Hallegraeff, 1993). Furthermore, *Dinophysis* is a cosmopolitan species in the water column can cause high risks of DSP in any place or region (Hallegraeff, 1993). Since the impact of these *Dinophysis* can resulted in a great economic losses and pollution of coastal water (Oda *et al*., 1992), the identification especially toxic species are given special attention (Hallegraeff, 1993). In this paper two species of *Dinophysis* which are classified as potential red tide species are identified and described. Proper and accurate identification of the genus is important in the event that these species bloom in the Malacca Straits causing chronic symptoms in humans.

MATERIALS AND METHODS

Dinoflagellate samples were taken from the shellfish growing area, Sebatu and Sungai Rambai, Malacca located from latitudes N 02, 05', 42.8" to N 02, 5', 57.2" and longitudes E 102, 28', 56.5" to E 102, 29', 26.1". Samples were concentrated using a 20 m mesh plankton net and were preserved with 2% formalin. Taxonomic identification of thecate species are based on the cell morphology and thecal plate arrangements under the light microscope with differential interference contrast. Thecal plates of the cell were dissected in 5% sodium hypochloride and stained with a staining solution (Lugol) to observe the plate pattern or arrangements.

RESULTS

Family Dinophysiaceae Stein 1883
Dinophysis caudata Saville-Kent 1881
(Figure 1, 2 & 3)

Lebour, 1925, 82, Figure 21c: Böhm, 1935, 277, Figure 4a-I; 1976, 45, Table XXII, Figure 1-12: Tai and Skogsberg, 1934, 453, Figure 9 : Schiller, 1933, 153, Figure 145a-u: Taylor, 1976, 34, Plate 16, Figure 59: Larsen and Moestrup, 1992, 5, Figure 3a-b: Fukuyo et al., 1990, 37, Figure a-e: Steidinger and Tangen, 1996, 429, Plate 12.

Synonym : *Dinophysis homunculus* Stein (1883, Figure 1-2)

Highly variable in form, cell large, usually in pairs; connected at the dorsal-posterior part. Long posterior projection with notches at the end. Dorsal margin slightly concave in the anterior half before running parallel with ventral margin. Anterior cingular list wider than the posterior, supported by ribs and form a wide funnel, thus hiding the epitheca. Cingulum narrow. Left sulcal list contain 3 ribs. Posterior rib (R3) the longest and anterior rib (R1) the shortest. Thecal plates areolate. Size of 81 - 91 m long and 45 - 65 m wide.

Distributions: Fairly common throughout the year in Sebatu and Sungai Rambai, Malacca. *Dinophysis caudata* is widely distributed throughout the world from temperate to tropical waters (Larsen & Moestrup, 1992).

Remarks: This species has been recorded as an HAB species by Okaichi (1976) as cited in Fukuyo et al. (1990).

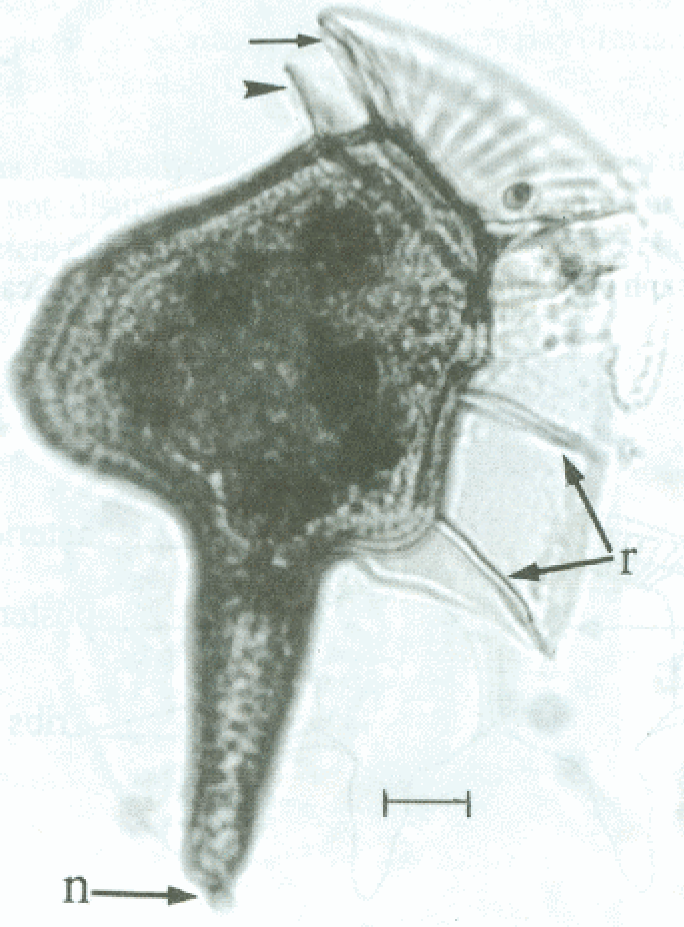

Figure 1. light micrograph of *Dinophysis caudate* showing one cell with anterior cingular list (arrow), posterior cingular list (arrow head), ribs (r) and notch (n) at the end of the cell.

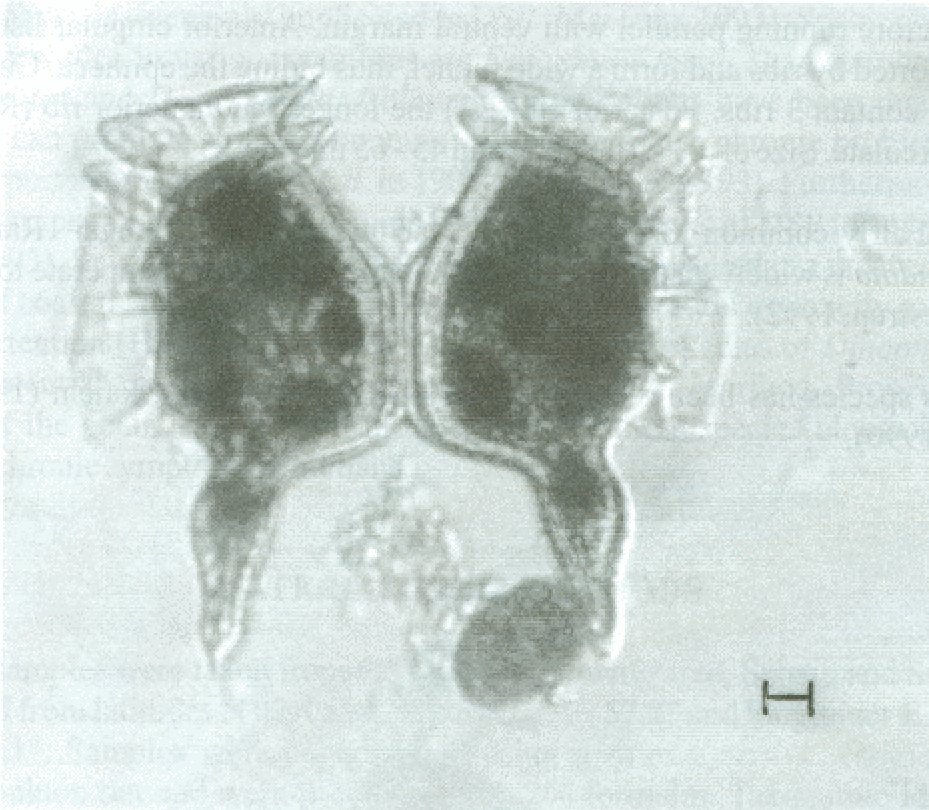

Figure 2. Light micrograph of *D. caudate* showing two pair of cells. Scale bar = 10 μm.

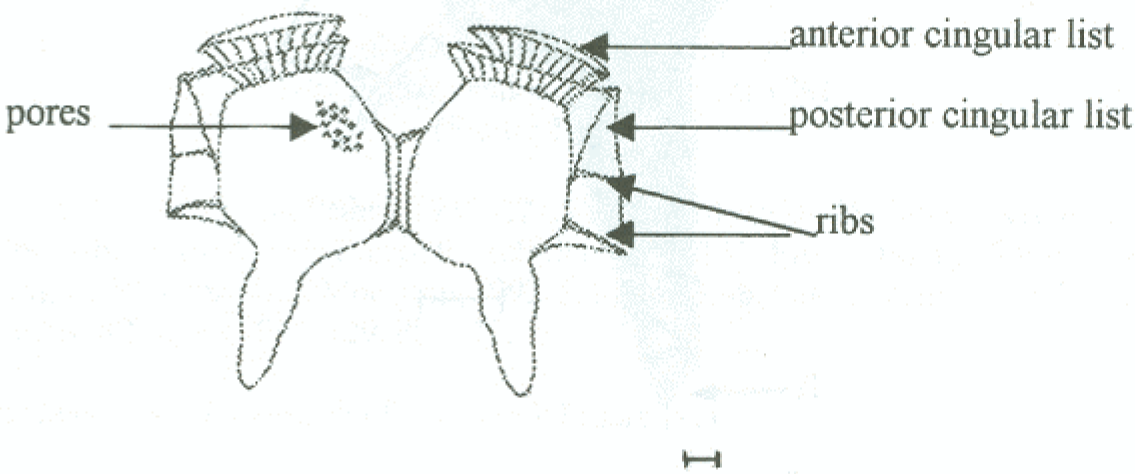

Figure 3. *Dinophysis caudate.* A pair of cell showing anterior cingular list, posterior cingular list, ribs and pores on the thecal plates. C. 10 μm .

Dinophysis rotundata Claparede & Lachmann
(Figure 4 & 5)

Abe, 1927, 385, Figure 2 : Tai and Skogsberg, 1934, 426, Figure A-L : Balech, 1987, Figure 1-4 : Dodge, 1985, 27.

Synonym : *Prodinophysis rotundata* Balech (1944 : 429, Figure 7-9)
Phalacroma rotundatum Lebour (1925 : 78, Plate XI, Figure 3a-c)
Schiller (1933 : 67, Figure 60e)

Cell subcircular, chloroplast large. Epitheca gentle and evenly convex, highest in or near the center. Dorsal side of hypotheca moderately convex anteriorly and slightly less convex posteriorly. Ventral side gently convex. Anterior and posterior cingular list without ridge and narrow. Cingulum rather wide. Theca plates areolate with pore. Size of 40 m long and 35 m wide.

Distribution : Very rare species throughout the year at the sampling stations in Sebatu and Sungai Rambai, Malacca. This species was recorded around Monterey Bay (Tai and Skosberg, 1934) and in the Atlantic, Baltic and Mediterranean (Lebour, 1925).

Remarks : This species was found only once during the observations of the samples collected and the left sulcal list was not distinct, maybe due to the preservation or handling. However, the morphological caharacters clearly showed that the species is *D. rotundata*. This species is a potential DSP species (Larsen and Moestrup, 1992).

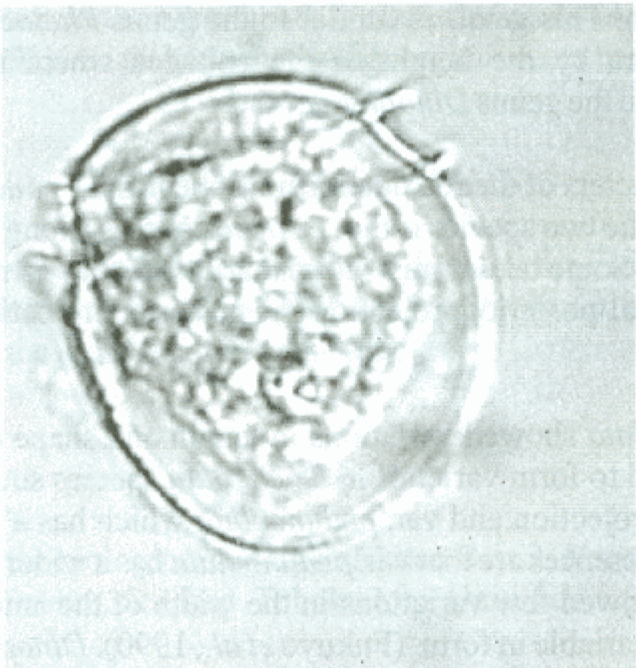

Figure 4. Light micrograph of *Dinophysis ratundata*. Scale bar = 10 μm.

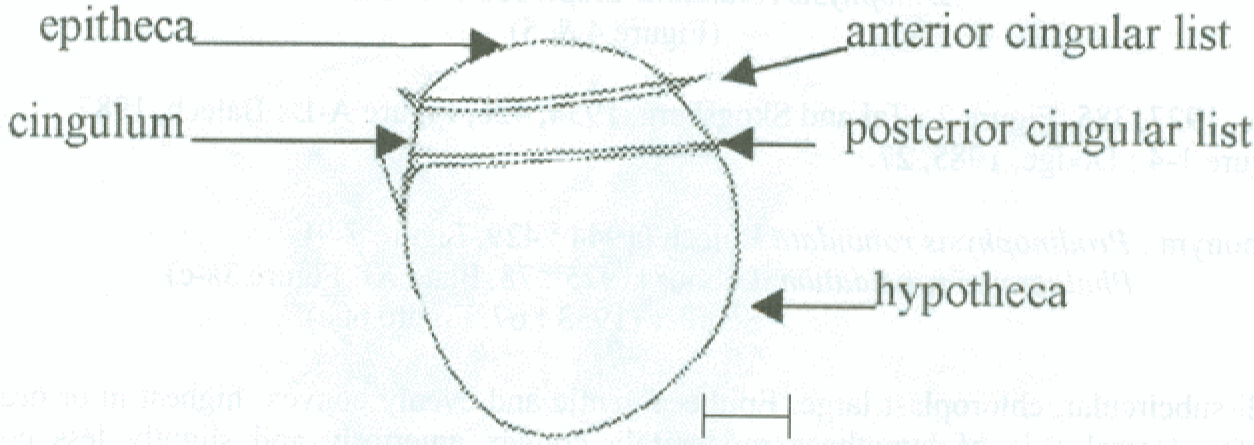

Figure 5. *Dinophysis rotundata* showing narrow anterior and posterior cingular list and cingulum. c. 10 μm.

DISCUSSION

In the identification of *Dinophysis*, the most important diagnostic features are the size and shape of the cell, morphology of the left sulcal list, presence and absence of chloroplast, plate pattern and thecal ornamentation. This genus is similar to the genus *Phalacroma*. Thus, Taylor (1976) separated the two genera by the height of the epitheca where the epitheca of the genus *Phalacroma* is higher than the genus *Dinophysis.*

The morphological characters of the red tide forming species, *D. caudata* is similar *to D. tripos*. The difference between the two species is that *D. tripos* posses a long dorsal-posterior projection compared to *D. caudata*. Some taxonomist claim that *D. caudata* is more similar to *D. miles*, but the later has a longer dorsal-posterior projection and posterior projection and these characters are clearly seen .

In the literature, *D. caudata* showed variations in length and shape of the posterior projection. These variations are used to form varieties in *D. caudata* species such as var. *abbreviata* which has a shorter posterior projection and var. *pedunculata* which has a longer posterior projection (Böhm, 1935). Other differences are that var. *pedunculata* has a wider cell breadth. In the samples observed, *D. caudata* showed few variations in the width of the anterior half of the hypotheca which made *D. caudata* variable in form (Fukuyo *et al.*, 1990). *Dinophysis caudata* can be found in pairs, triplets or quadruplets as a result of incomplete separation after reproductive fission (Taylor, 1976). These formations are difficult to observe in the samples collected due to the preservation or handling. Cells forming pairs were more common.

Dinophysis caudata is a non-DSP producer or a non-toxic species, but the bloom formed by the species can caused economic losses to the countries affected. For example, in Tuticorin Bay, India, *D. caudata* bloom caused the reduction of total fish catch to the lowest level (Santhanam and Srinivasam, 1996).

Dinophysis rotundata is rather difficult to identify as the group does not show striking features (Balech, 1976) as seen in *D. caudata*. In attempting to identify this species, it is confused with *Phalacroma.* Taxonomist have separated the two genera, although it overlaps in the morphology of characters with respect to the development and direction of the cingular list and the height and shape of the epitheca (Steidinger and Tangen, 1996).

Dinophysis rotundata is a potential DSP species. Although this species was rarely found at the study area, the occurrence of the species should not be overlooked. This is because the toxicity of DSP is not directly related to cell density. Even in low numbers, the cells can be very toxic (Belin, 1993). Besides human health, DSP can also caused economic losses such as in the Northen Andriatic Sea where fishing and selling mussels are prohibited during DSP occurrences (Boni *et al.*, 1993).

In conclusion, the identification of species in the order Dinophysiales is important because this group represents the majority of DSP species identified in this study. Although only one species from the group, viz. *D. rotundata,* is a DSP producer (Larsen and Moestrup, 1992) and the species was found only once during observation of the samples, the occurrence of this species can lead to potential DSP problems in future. Symptoms due to DSP poisoning can be easily confused with gastroentiritis and general stomach upsets associated with eating shellfish and contaminated shellfish (Shumway, 1990), which were the symptoms described in Sebatu and Sungai Rambai, Malacca. *Dinophysis caudata* on the other hand, is classified as a HAB species which does not produce toxin (Maclean, 1993) but are harmful to other organisms or the environment.

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