

THE DINOFLAGELLATE GENUS *AMPHISOLENIA* STEIN FROM NORTH ARABIAN SEA SHELF OF PAKISTAN

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Abstract

The present paper reports nine species of the dinoflagellate genus *Amphisolenia* Stein from the North Arabian Sea shelf of Pakistan, three of which viz., *Amphisolenia schroederi* Kofoid, *A. thrinax* Schütt and *A. truncata* Kofoid et Michener are new records in the area.

Introduction

Amphisolenia Stein is a planktonic marine dinoflagellate genus which occurs preferably in tropical seas. It has been studied from various parts of the world (Abé, 1967; Böhm, 1936; Ballantine, 1961; Halim, 1965, 1967; Kofoid & Skogsberg, 1928; Massuti & Margalef, 1950; Rampi, 1940; Saifullah & Hassan, 1973; Silva, 1955; Steidinger & Williams, 1970; Wood, 1954, 1963, 1968; Yamaji, 1966), but information from the Pakistan's water is scanty. Saifullah & Hassan (1973) made an intensive study for one complete year in polluted Karachi harbour and described seven taxa out of which two species and one subspecies were new. Later, Mansoor & Saifullah (1995) described *A. nizamuddinii* Mansoor et Saifullah and *A. schroederi* var. *pakistanensis* Mansoor et Saifullah from Pakistan's shelf. The present study adds eight more species to the list from the shelf out of which three are new records.

Material and Methods

Samples were collected mostly through horizontal surface net hauls and a few vertical and oblique hauls of mesh size 40 µm from the continental shelf of Pakistan during the Norwegian Fridtjof Nansen Cruise carried out in 1977. The method of sampling and the number and locations of stations have already been described in detail earlier (Anon., 1978; Saifullah, 1979; Chaghtai & Saifullah, 1988). In all 100 samples from different stations were studied which were collected during the period 15th March to 26th April 1977 including the transition period between NE and SW monsoon season.

Observations and Discussion

Saifullah & Hassan (1973) and Saifullah (1999) described seven species from a strictly coastal environment of Karachi harbour. They are *Amphisolenia taylorii* Saifullah et Hassan, *A. taylorii* subsp. *manorensis* Saifullah et Hassan, *A. biprojecta* Saifullah et Hassan, *A. bidentata* Schröder, *A. palmata* Stein, *A. rectangulata* Kofoid, *A. hispinosa* Kofoid and *A. elongata* Kofoid et Skogsberg. Later, Mansoor & Saifullah (1995) described one new species *A. nizamuddinii* Mansoor et Saifullah and one new variety *A. schroederi* var. *pakistanensis* Mansoor et Saifullah from Pakistan shelf. The present paper reports further eight species including three new records viz., *A. schroederi* Kofoid, *A. thrinax* Schütt and *A. truncata* Kofoid et Michener.

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Following is a key for identification of all the taxa recorded on the shelf including the new ones already described (Mansoor & Saifullah, 1995) and also those from the inshore waters of Karachi (Saifullah & Hassan, 1973). Characteristic features and figures of only three species are given which are new records to the area and also have not been described earlier by the fore mentioned authors. Their measurements are given collectively in Table 1 alongwith those of the remaining species recorded from the shelf only for quick comparison and assessment.

Key to the species

1. Antapical unbranched ----- 2
Antapical branched ----- *A. thrimax*
2. Antapex bifurcate into two lobes ----- 3
Antapex not bifurcated ----- 4
3. Antapex with two symmetrical lobes ----- *A. taylorii*
Antapex with two asymmetrical lobes ----- *A. taylorii* subsp. *manorensis*
4. Antapex with heel like projection ----- 5
Antapex without any heel like projection ----- 7
Antapex with subterminal projections at the antapex ----- *A. nizamuddinii*
5. Antapex with two heel like projection ----- *A. biprojecta*
Antapex with one heel like projection ----- 6
6. Antapex with 2 spinules ----- *A. bidentata*
Antapex with 3 spinules ----- *A. palmata*
Antapex with 4 spinules ----- *A. rectangulata*
7. Antapex with spinules ----- 8
Antapex without spinules ----- 10
8. Mid body one third the entire length ----- *A. hispinosa*
Mid body half of the entire length ----- 9
9. Antapex with 2 spinules ----- *A. schroederi*
Antapex with 3 spinules ----- *A. schroederi* var. *pakistanensis*
10. Antapex curved and clubshaped ----- *A. elongata*
Antapex straight and truncated ----- *A. truncata*

Amphisolenia bidentata Schröder

Saifullah & Hassan, 1973; 151, Fig. 1 & 2

Local distribution:

Pakistan Shelf, Station #: 194, 198, 209, 210, 211, 212, 213, 215, 216, 225, 226, 233, 234, 235, 236, 237, 238, 240, 241, 242, 243, 245, 248, 250, 251, 252, 254, 255, 256, 257, 258, 260 & 261.

Amphisolenia hispinosa Kofoid

Saifullah & Hassan, 1973; 151, Fig. 6

Local distribution:

Pakistan Shelf, Station #: 241 & 251.

Table 1. Measurement of different parts of the species in μm .

Species	Length of the body μ	Length of head μ	Width of head μ	Length of neck μ	Width of neck μ	Width of midbody μ	Length of midbody μ	Length of antapex μ	Width of antapex μ
<i>A. schroederii</i>	440	3.75	12.5	50	3.7	26	225	161	5
<i>A. thrimax</i>	875	6.25	31.2	50	8.75	42.5	200	618.75	---
<i>A. truncata</i>	615	6.25	16.25	37.5	5	22.5	175	396.25	10
<i>A. palmate</i>	815	7.5	20	50	7.5	27.5	162.5	578.75	11.25
<i>A. nizamuddinii</i>	425	6.25	11.2	55	5	20	225	139	7.5
<i>A. schroederii</i> var. <i>pakistanensis</i>	670	7.5	16.25	37.5	6.25	20	150	475	7.5
<i>A. elongata</i>	710-790	6.25-7.5	15-17.5	40-46	5-6.25	15-22.5	160-175	468.7-551	6.25-7.5
<i>A. bispinosa</i>	675	8	14.5	50	7.5	20	212.5	405	8
<i>A. bidentata</i>	759-800	5-6.25	12.5-16.25	45-47.5	6-7.5	20-22	150-175	498.7-576	---
<i>A. rectangularata</i>	655	6.25	16.25	47.5	5	18.7	150	451	7.5

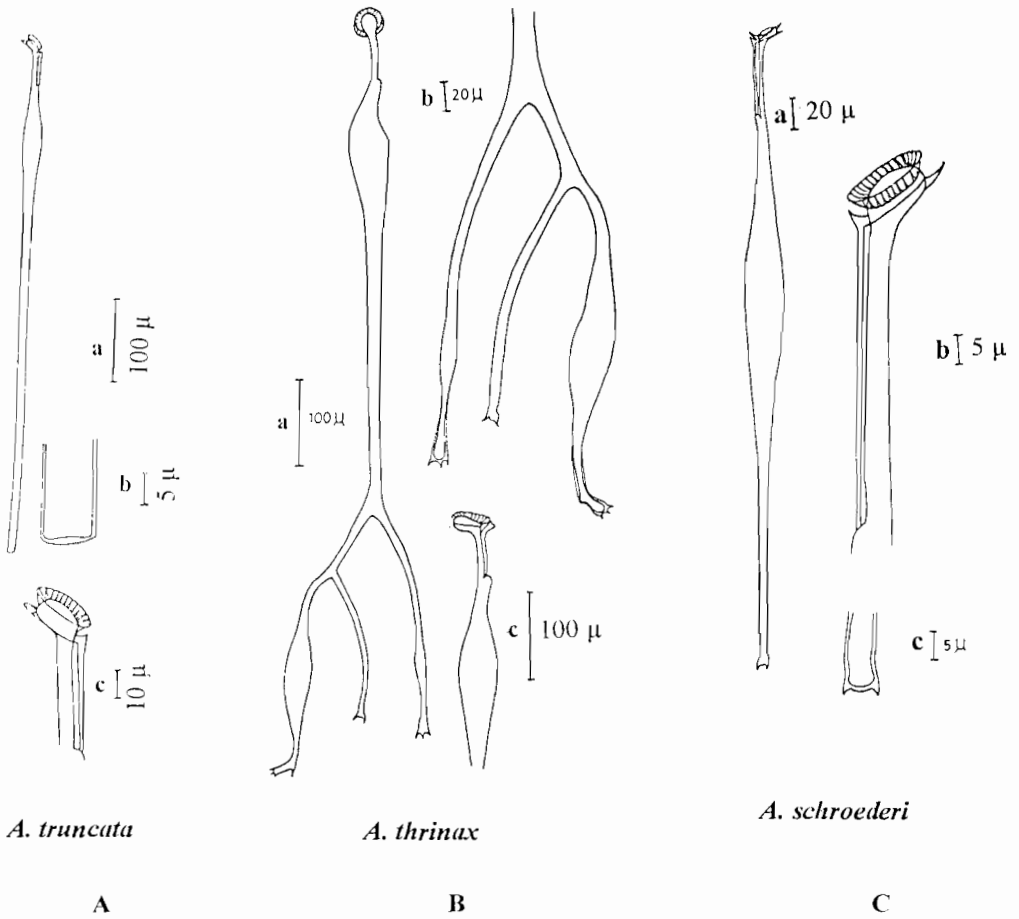


Fig. 1. A. *Amphisolenia truncata*; (a) entire specimen, (b) antapex, (c) head and neck

B. *Amphisolenia thrinax*: (a) entire specimen, (b) branched antapical portion, (c) head, neck and midbody;

C. *Amphisolenia schroederi*: (a) entire specimen (b) head and neck (c) antapex

Amphisolenia elongata Kofoid

Saifullah & Hassan, 1973; 151, Fig. 3

Local distribution:

Pakistan Shelf, Station #: 198,233,241,242 &256.

Amphisolenia nizamuddinii Mansoor et Saifullah

Mansoor & Saifullah, 1995: 6, Fig. 1

Local distribution:

Pakistan Shelf, Station #: 233.

Amphisolenia palmata, Stein

Saifullah & Hassan, 1973; 151, Fig. 5

Local distribution:

Pakistan Shelf, Station #: 233

Amphisolenia rectangulata Kofoid

Saifullah & Hassan, 1973; 151, Fig. 7

Local distribution:

Pakistan Shelf, Station #: 257 & 233.

Amphisolenia schroederi Kofoid
(Fig. 1C)

Kofoid & Skogsberg, 1928; 400, Fig. 2-4, pl. 10; Taylor, 1976; 30, Fig. 32, pl. 2

Diagnosis

Body straight; epitheca convex; midbody about half the entire length fusiform and merges gradually with the anterior process and antapical; antapical straight and posterior portion expanded slightly; in dorsoventral view of body 17:1; antapex straight and possesses two small spinules, one is ventral and other is dorsal.

Description

Body straight; head 3.3 times wider than long; anterior cingular list possesses simple ribs. The posterior cingular list inclined anteriorly; neck about 0.113 the length of body and 13 times longer than wide; the sulcal list ends at the flagellar pore and does not possess ribs. Midbody fusiform and gradually continuous into the anterior process and antapical. Its greatest width is 0.5 the length of neck, ratio between its length and greatest width 8.6:1. The antapical straight, unbranched and appears rounded in dorsoventral view. It is difficult to determine its approximate length owing to the fact that it merges gradually with midbody. The posterior part slightly widened and about 1.6 the width of neck, the antapex has two small, spinules.

Local occurrence:

Pakistan Shelf, Station No. 231 & 233.

General occurrence:

Mexican Current, Peruvian Current and South Equatorial Drift (Kofoid & Skogsberg, 1928); Eastern Indian Ocean (Wood, 1962); Bay of Bengal, Eastern Arabian Sea and Central Indian Ocean (Taylor, 1976; Subrahmanyam, (1958).

Amphisolenia schroederi var. *pakistanensis* Mansoor et Saifullah

Mansoor & Saifullah, 1995: 7, Fig. 2

Local distribution:

Pakistan Shelf, Station #: 234.

Amphisolenia thrinax Schütt

(Fig. 1B)

Kofoid & Skogsberg, 1928; 438, Fig. 2 & 6, pl. 12; Taylor, 1976; 30, Fig. 2, pl. 2

Diagnosis

It is characterized by its two lateral antapical branches arising from the main antapical stem, usually in a plane almost at right angle to the deflection of the anterior head.

Description

Head shows a slight anterior inclination. Its length 0.13 the length of neck and 4.9 times wider than long; epitheca convex anteriorly, the cingular list with simple ribs. Neck relatively short, 0.06 the length of body and 5.7 times longer than wide; sulcal lists without ribs.

Midbody fusiform and merges gradually with anterior process and antapical. Ratio between its length and width 4.7:1 and 4 times longer than neck. Its width about 0.85 times the length of neck. Ratio between length and greatest width of body 21:1.

The antapical has two branches; the first is generally slightly longer and the second somewhat shorter than the posterior portion of the antapical stem that is behind the second branch; however, relative lengths of branches and portion of the antapical stem that is behind the second branch are somewhat variable. The antapical stem behind the second branch is swollen in its middle portion, about 28µm wide; the second branch is of uniform width throughout its whole length; the distal part of both the first branch and the main antapical stem is foot shaped and has the same number and arrangement of spinules as in *A. palmata* i.e., a heel spinule at some distance from the tip and three spinules at the tip. The foot shaped part is longer than wide; the second branch in our specimen has 2 spinules at the tip and no "heel spinule". The antapical portion of our specimen resembles much with specimen illustrated by Kofoid & Skogsberg (1928) as the second branch possesses 2-3 spinules at the tip but no "heel spinule".

Synonymy:

This genus was established by Schütt (1893). Many authors have used this name. The specimen described by Zacharias (1906) under the name of *A. thrinax* is a later homonym and has fallen under the synonymy of *A. bifurcata*.

Local occurrence:

Pakistan Shelf, Station No. 242.

General occurrence:

Mexican Current, Eastern Island Eddy, Western part of South Equatorial Drift (Kofoid & Skogsberg, 1928); Indian Ocean (Wood, 1963); Mozambique Channel (Sournia, 1970); Sagami Bay (Abé, 1967); Bay of Bengal and Northern Indian Ocean (Taylor, 1976).

Amphisolenia truncata Kofoid et Michener.

(Fig. 1A)

Kofoid & Skogsberg, 1928: 406. Fig. 1 & 12, pl. II

Diagnosis

Body straight; head 2-2.5 times wider than long; epitheca convex; midbody fusiform; antapical straight and without spinules; ratio between length and greatest width of body 27.3:1.

Description

Head slightly inclined anteriorly, its length is about 0.2 the length of neck and 2.6 times wider than long; cingular lists present with simple ribs; neck 8 times longer than wide and its length 0.06 the length of body; sulcal list present.

Midbody fusiform and merges gradually with anterior process and antapical, its greatest width 0.6 the length of neck. The antapical, unbranched and straight. Its posterior part is straight and twice the width of neck. Its length about 0.64 the length of body. Antapex truncate in lateral view and without spinules. Total length 27 times the maximum width of midbody.

Local occurrence:

Pakistan Shelf, Station No. 257.

General occurrence:

South Equatorial Drift (Kofoid & Skogsberg, 1928).

As regards the distribution of the nine species of *Amphisolenia* it is evident that *A. bidentata* is the most common one. It has been reported frequently from other areas and is circumtropical in occurrence (Wood, 1963). All other species except *A. elongata* are extremely rare occurring at either one or two stations only. It is surprising that *A. truncata* was not reported by Taylor (1975) from the Indian Ocean. Wood (1964) also does not mention its name in his checklist of dinoflagellates from the Indian Ocean. However, Kofoid & Skogsberg (1928) report its occurrence in Eastern Tropical Pacific and Mediterranean.

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