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Description of the Gonyaulacoid Dinoflagellate *Alexandrium hiranoi* sp. nov. Inhabiting Tidepools on Japanese Pacific Coast[1)2)]

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Abstract

A new species *Alexandrium hiranoi* sp. nov. (Dinophyceae) is described using modified Taylor's designation of thecal plates. The species is characteristic in that 1) cell is round, 2) polar plate A contacts plate B, but not preequatorial plate 2, 3) ventral pore is round, invading both polar plate A and secondary preequatorial plate 1u, 4) resting cyst is smooth-walled, and has chasmic archeopyle. *A. hiranoi* sp. nov. differs from *A. pseudogonyaulax* in cell shape, shape and position of ventral pore, and shape of plate 1u.

A gonyaulacoid dinoflagellate sometimes blooms in rockpools around high tide level along the Pacific coast of Japan during spring and summer. The unique life cycle and ecology of this species were previously reported (KITA et. al. 1985). It easily transforms b etween planktonic and benthic forms, and in the latter it divides into two or four cells. Through such a process this species can maintain its population. In the previous report the authors tentatively identified this species as *Goniodoma pseudogonyaulax* Biecheler (KITA et al. 1985). (The original spelling of the epithet *pseudogoniaulax* is altered here to *pseudogonyaulax* in order to correct its orthographic error according to I.C.B.N Art. 73.1). But after detailed investigation this species was revealed to be different from *G. pseudogonyaulax*, which was transferred to the genus *Alexandrium* by HORIGUCHI (1983), and has enough characteristics to create a separate taxon. The purpose of this paper is to describe this organism as a new species, comparing it with the original description of *A. pseudongonyaulax* (Biecheler) Horiguchi.

Modified Taylor's system (EVITT 1985) was adopted for plate designation in this paper. In this system species are classified according to homology of thecal plates. The most underlying plate, located in the ventral area of epitheca, corresponds to the key plate to determine plate designation (TAYLOR 1979, 1980). The key plate is always named as the secondary ulter preequatorial plate (1u). On the contrary, Kofoid's system is based on plate arrangement, and therefore the name of key plate varies depending on contact to a plate located at the apex. The key plate which contacts a plate located at the apex is designated as the first apical plate (1′), and the plate which does not contact is the first precingular plate (1″). It follows that

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2) 日本太平洋岸の潮だまりより採集された渦鞭毛藻の1新種 *Alexandrium hiranoi* sp. nov.（ゴニオラックス科）の記載

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Taylor's system is more convenient than the conventional Kofoid's system for discussing taxonomical relationship among armored dinoflagellates, especially gonyaulacoid genera such as *Protogonyaulax*, *Alexandrium* and *Pyrodinium* because of uniformity of designation of the key plate (TAYLOR 1979, EVITT 1985). In the former system designation of the key plate is 1u and same in the three genera, although in the latter that of the key plate differs among them: 1′ in *Protogonyaulax* and 1″ in *Alexandrium* and *Pyrodinium*.

Description

Division PYRRHOPHYTA Pascher
Class DINOPHYCEAE Fritsch
Order PERIDINIALES Haeckel
Family GONYAULACACEAE Lindemann
Genus *Alexandrium* Halim sensu Taylor non Balech & Tangen

Alexandrium hiranoi sp. nov.
(Fig. 1, a-f)

Synonyms:

Goniodoma pseudogonyaulax: SILVA 1965, p. 12, figs. 1-4; KITA et al. 1984, p. 646, fig. 3; non BIECHELER 1952, p. 55, figs. 30-32.

Alexandrium pseudogonyaulax: HORIGUCHI 1983, fig. 10.

Diagnosis: Cellula globula. Lamina A laminam B continget, autum non laminam 2. Ventrali areo circulare, in medio suturae (A/1u) situm. Restans cysta simulata discus, germinans porta simulata chasma; longitudo 40 μm (18-75 μm), transdiameter 37 μm (18-75 μm).

Iconotype: Fig. 1, a-f.

Type locality: Jogashima Island, Kanagawa, Japan (35°7′43″N, 139°38′31″E).

Distribution: Jogashima Island and Arasaki, Kanagawa, Japan. Obidos in Portugal.

Description:

Cell usually round, sometimes slightly longer than wide. Epitheca and hypotheca nealy equal in altitude. Epitheca hemispherical with convex sides. Shape of hypotheca asymmetric; left half slightly longer than right. Ventral area impressed narrowly and shallowly; groove not extending to antapex.

Thecal plates thin, covered with delicate outer thecal membrane. Primary tabulation prepolar P, polar A-C, preequatorial 1-6, equatorial a-f, post equatorial I-VI and antipolar series X-Z (Fig. 1, a-d).

Prepolar plate P subdivided into inner Pi and circumferential Pc (Fig. 1, f, Pl. I, e). Pc rectangular, with large drop-shaped polar pore; numerous trichocyst pores lying around polar pore. Pi connecting with Pc on right ventral margin closing half of polar pore; the polar pore then turning into fishhook shape.

Polar plate A connected with plate B, but not with preequatorial plate 2. First preequatorial plate 1 subdivided into two platelets, 1u and 1i. Ventral pore (vp) conspicuous at the middle of suture between A and 1u, A/1u. Vp circular, located just on suture, invading both 1u and

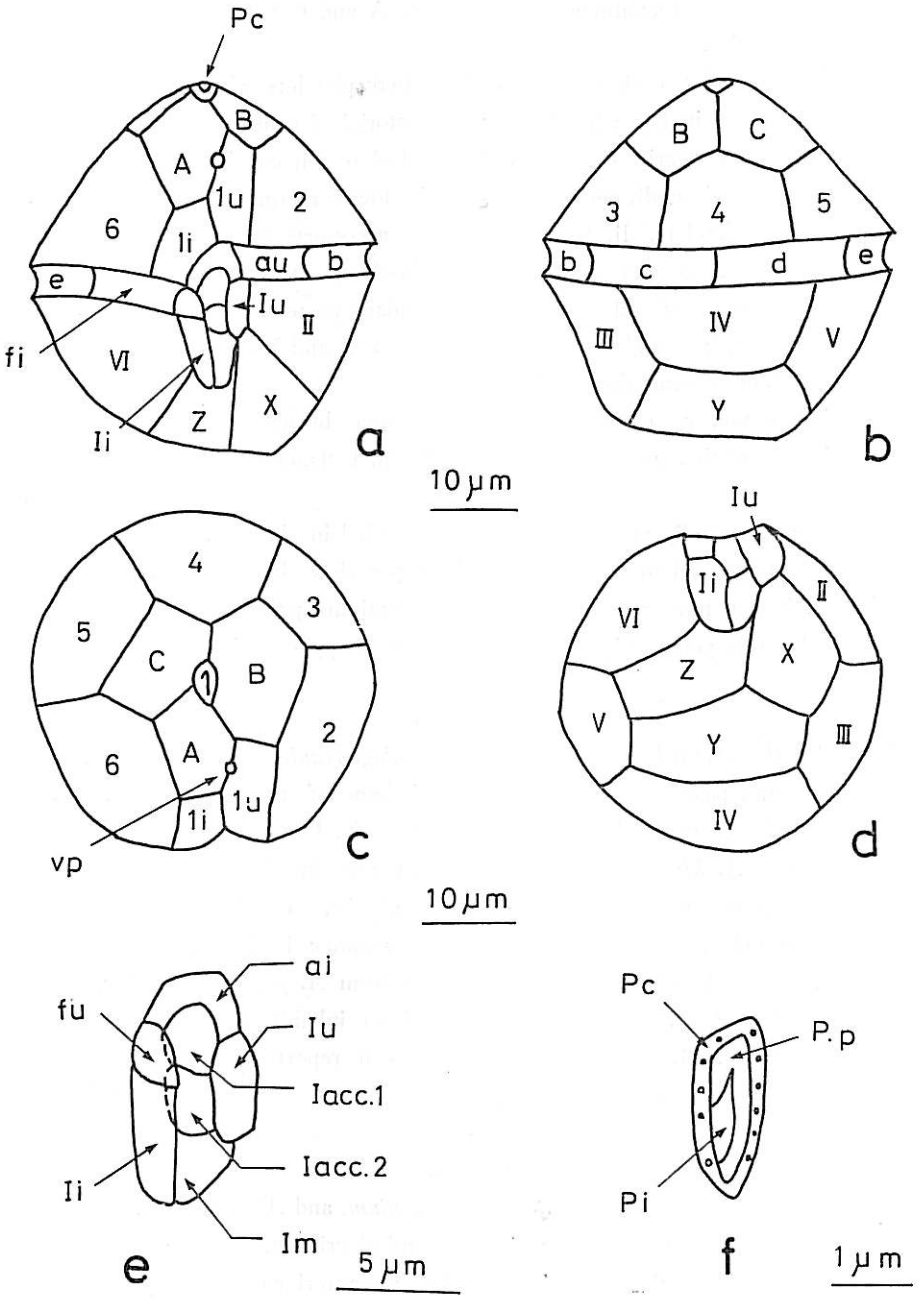

Fig. 1. Thecal plate configulation of *Alexandrium hiranoi* sp. nov. a: ventral view, b: dorsal view, c: epitheca, d: hypotheca, e: sulcal region, f: prepolor plate.
P.p: polar pore; Pc: circumferential prepolar plate; Pi: inner prepolar plate; A-C: polar plates; 2-6: preequatorial plates; 1i, 1u: secondary plates of preequatorial plate 1; b-e: equatorial plates; ai, au: secondary plates of equatorial plate a; fi, fu: secondary plates of equatorial plate f; I-VI: postequatorial plates; Ii, Im, Iu: secondary plates of I; X-Z: antipolar plates; Iacc. 1: accessary first plate of I; Iacc. 2: accessory second plate of I; vp: ventral pore.

A (Pl. I, c, d). 1u slender, rectangular. Polar plates A and C pentagonal; B hexagonal and largest in polar plate series.

Equatorial plates a and f each subdivided into two platelets, ai, au, fi, fu, respectively. Plates au and fi remaining in line with five other equatorials forming cingulum. Seven constituent plates of cingulum nearly equal in size. Sulcal region consisting of ai, fu and postequatorial plate I. Plate ai small, rectangular, and its lower margin being cut roundly. Pate I subdivided into five platelets, Ii, Im, Iu and two accessory platelets, Iacc. 1 and Iacc. 2 (Fig. 1, e, Pl. I, c, d). Accessory plates small, ellipsoidal, surrounded by Ii, Im, Iu, ai and fu, and constituted bottom of sulcal groove. Secondary postequatorial plates Iu, Im and Ii slender, rectangular. Antipolar plate Z slender, rectangular, and X and Y distorted pentagonal. Antipolar plate Y largest among the antipolars.

Cell containing numerous round to ellipsoidal orange brown chromatophores; C-shaped nucleus located just beneath equatorial zone. Longitudinal flagellum about 1.5 times as long as cell length.

Resting cyst fundamentally discoidal, but looking varied in shape, i.e., circular, ellipsoidal, rectangular or other polygonal in optical section in upper view (Pl. I, h, i, j). Cell wall thick, bearing neither projection nor ornamentation. Cell containing pale or colorless microgranules, many globules and a few yellow pigmented bodies. Archeopyle of chasmic type (Pl. I, k).

Comparison

In camparison with the original description of *A. pseudogonyaulax*, *A. hiranoi* sp. nov. differs in cell shape, shape and position of ventral pore, and shape of the platelet 1u. *A. hiranoi* sp. nov. is round and sometimes slightly longer than wide, but *A. pseudogonyaulax* is wider than long. The vp of *A. hiranoi* sp. nov. is circular and invades both A and 1u, but that of *A. pseudogonyaulax* is semi-circular and invades only 1u. The 1u of *A. hiranoi* sp. nov. is slender and rectangular, but that of *A. pseudogonyaulax* is broad. According to these morphological differences *A. hiranoi* sp. nov. is distict from *A. pseudogonyaulax*.

In Japan *A. hiranoi* sp. nov. has been found to inhabit rockpools but not coastal waters. On the contrary, *A. pseudogonyaulax* has been reported to occur in coastal waters and not in rockpools (INOUE pers. comm.).

Remarks

In gonyaulacoid genera such as *Protogonyaulax*, *Pyrodinium*, and *Alexandrium*, thecal plate configuration and cyst morphology are important taxonomical criteria.

The thecal plate configuration of this species has the anterior equatorial plate 1u contacting with two anterior polar plates (A, B) and not with the prepolar plate P. This feature is "metasert" (EVITT 1985), which is the generic characteristic of *Pyrodinium* and *Alexandrium*, but not of *Protogonyaulax*. We classified this species into *Alexandrium* by the following reasons.

The cyst of this species is smooth-walled without any ornamentation, and has chasmic

archeopyle. This feature differs from those in *Pyrodinium*, which produces a spiny walled cyst with epicystal archeopyle, but resembles those in *Alexandrium monilatum* (=*Gessnerium mochimaensis*, and *Gonyaulax monilata*) (WALKER & STEIDINGER 1979). The latter is the only species among *Alexandrium*, the cyst of which is previously known. Therefore, this species should be included in *Alexandrium*.

There is supplemental evidence that this species should not be included in *Pyrodinium*. *Pyrodinium* has spiny and thick thecal plates, but this species has smooth and thin thecal plates like *Alexandrium*. The Pi of *Pyrodinium* covers the entire polar pore, but that of this species half of the pore.

This species is named after Dr. REIJIRO HIRANO who first reported the unique ecology of a dinoflagellate living in a tidepool (HIRANO 1967).

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Literature Cited

BIECHELER. B., 1952. Recherches sur le Péridiniens. *Bull. Biol. Suppl.* **36**: 1-149.

EVITT, W.E., 1985. *Spolopollenin Dinoflagellate Cysts. Their Morphology and Interpretation.* Amer. Assoc. stratigr. Palynol. Found., 333 pp.

HIRANO, R., 1967. Mechanism of development of red tide in estuarine waters. *Inform. Bull. Planktol. Japan, Commem. No. Dr. Matsue*: 25-29.

HORIGUCHI, T., 1983. *Life History and Taxonomy of Benthic Dinoflagellates* (*Pyrrhophyta*). Ph. D. Thesis, Univ. Tsukuba, 141 pp.

KITA, T., Y. FUKUYO, H. TOKUDA, & R. HIRANO, 1985. Life cycle and ecology of *Goniodoma pseudogoniaulax* (Pyrrhophyta) in a rockpool. *Bull. mar. Sci.* **37**: 643-651.

SILVA, E.S., 1965. Note on some cytophysiological aspects in *Prorocentrum micans* Erh. and *Goniodoma pseudogoniaulax* Biech. *Notas e Estudos, Inst. Biol. mar.* No. 30: 6-60.

TAYLOR, F.J.R., 1979. The toxigenic gonyaulacoid dinoflagellates, pp. 47-56. In *Toxic Dinoflagellate Blooms* (eds. TAYLOR, D.L. & H.H. SELIGER). Elsevier North Holland, N.Y.

TAYLOR, F.J.R., 1980. On dinoflagellate evolution. *BioSystems* **13**: 65-108.

WALKER, L.M. & K.A. STEIDINGER, 1979. Sexual reproduction in the toxic dinoflagellate *Gonyaulax monilata*. *J. Phycol.* **15**: 312-315.

Explanation of Plate I

Alexandrium hiranoi sp. nov.

a-b: planktonic cell; a: ventral view; b: antapical view; c-g: thecal plates; c: prepolar and polar plates, arrow showing the edge of ventral pore; d: secondary preequatorial plate 1u, arrow showing the edge of ventral pore; e: prepolar plate; f: part of sulcal region, focused on secondary equatorial plate fu and secondary postequatorial plate Ii; g: part of sulcal region, focused on secondary equatorial plate ai, accessory first plate of I (Iacc. 1), accessory second plate of I (Iacc. 2), and postequatorial plate Im; h-j: resting cyst; h: upper view; i: side view; j: upper view; k: empty cyst, arrow showing the chasmic archeopyle.

PLATE I