

A new species of *Sphenotrochus* (Scleractinia: Turbinoliidae) from the Late Miocene (Tortonian) of Chile

S.D. Cairns

Cairns, S.D. A new species of *Sphenotrochus* (Scleractinia: Turbinoliidae) from the Late Miocene (Tortonian) of Chile.

Zool. Verh. Leiden 345, 31.x.2003: 79-84, figs 1-2.— ISSN 0024-1652/ISBN 90-73239-89-3.

Stephen D. Cairns, Department of Systematic Biology (Invertebrate Zoology), Smithsonian Institution, P. O. Box 37012, Washington, D.C. 20013-7012, U.S.A.

Key words: Scleractinia; Turbinoliidae; Miocene; Tortonian; Navidad Formation; *Sphenotrochus denhartogi* spec. nov.; Chile.

A new species of azooxanthellate Scleractinia, *Sphenotrochus denhartogi*, is described from the Late Miocene (Tortonian, Navidad Formation) of Chile. Comparisons are made to three other closely related species which, based on their distinctive costal morphology, form a species complex: *S. clai-bornensis*, *S. senni*, *S. denhartogi*, and *S. auritus*. This is the first record of *Sphenotrochus* from the west coast of South America.

Introduction

Thirty-four species in the genus *Sphenotrochus* are considered to be valid (Cairns, 1997, 2000), occurring from the Middle Eocene to the Recent, the latter at depths of 7-403 m. They occur worldwide in both the fossil record and Recent, except for Antarctica. Wells (1935) established the subgenus *S. (Eusthenotrochus)* for those species having costae composed of short segments (termed “granular”) instead of the more common continuous costal ridges (termed “linear”), the latter having costae that extend from the corallum base to the calice. However, Cairns (2000) discarded this subgeneric distinction, noting that several species had an intermediate costal architecture that included both granular and linear costae. Three of the 34 species, as well as the new species described below, have this distinctive intermediate costal architecture. This constitutes the first record of this genus for the west coast of South America.

Abbreviations used in this paper include: Cx, Sx - costae or septa, respectively, of cycle designated by numerical subscript; GCD - greater calicular diameter; GCD:LCD - ratio of greater calicular diameter to lesser calicular diameter; GCD:HT - ratio of greater calicular diameter to height of corallum; USNM = United States National Museum, Washington, D.C. (now the National Museum of Natural History).

Systematic part

Order Scleractinia

Suborder Caryophylliina

Family Turbinoliidae Milne Edwards & Haime, 1848

Genus *Sphenotrochus* Milne Edwards & Haime, 1848

Diagnosis.— Corallum cuneiform, with a rounded or fish-tail shaped base and a calice elliptical in cross-section, rarely over 10 mm in GCD. Costae variable in orna-

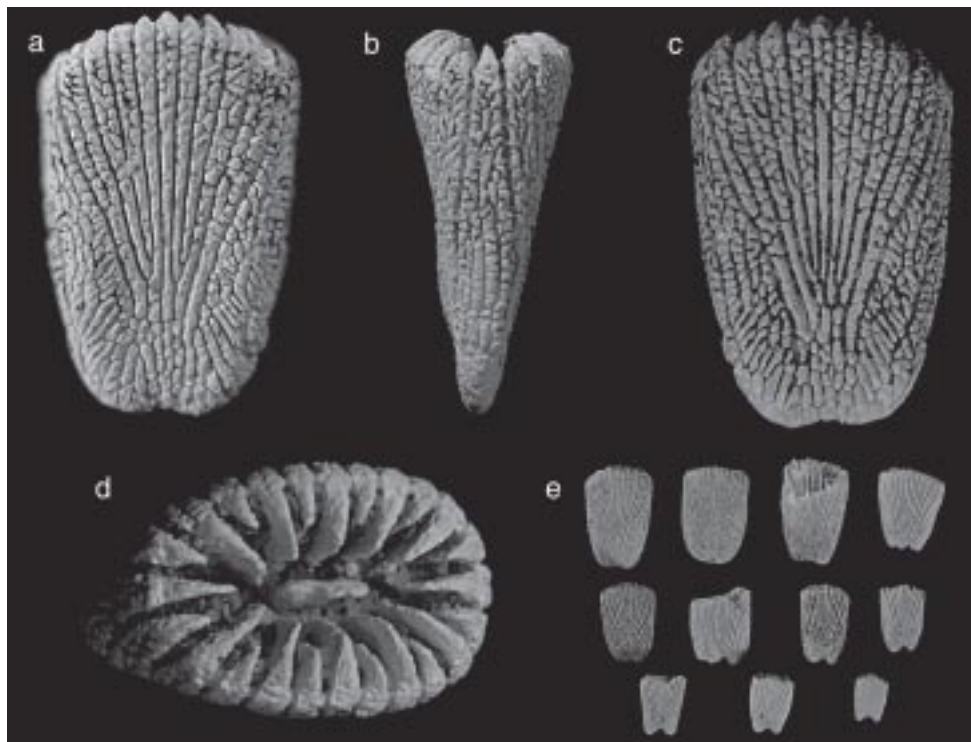


Fig. 1. *Sphenotrochus denhartogi* spec. nov.: a-b, d, holotype; c, e, paratypes, Museo Nacional de Historia Natural, Santiago: a, b, d, lateral, edge and calicular views, $\times 5.3$, $\times 5.3$, $\times 10.3$, respectively; c, lateral view of a large paratype, $\times 5.6$; e, an ontogenetic series of 11 coralla showing transition from juvenile fish-tail morphology to rounded base, $\times 1.4$.

mentation (smooth or granular) and length (continuous from base to calice, or fragmented into short, parallel ridges). Costae independent in origin, usually one costa corresponding to each septum but in several species two costae per septum. Septa hexamerally arranged in 3 to 4 cycles (24-48 septa), although 24 septa are most common. Pali and paliform lobes absent; columella lamellar.

Sphenotrochus denhartogi, spec. nov.
(figs 1-2)

Material.— Holotype and 51 paratypes, Museo Nacional de Historia Natural, Santiago de Chile, SGO.PL.6010 (holotype), SGO.PL.6011 (paratypes); 5 paratypes (including SEM stubs 979-980), USNM 1003482; 1 paratype, National Museum of Natural History, Leiden (formerly Rijksmuseum van Geologie en Mineralogie), RGM 212511.

Type horizon and locality.— Known only from type locality: Punta Perro, Chile, coarse gray sand (PPS); Late Miocene (Tortonian): Navidad Formation (S. Nielsen, pers. comm.). There is some doubt about the age of the Navidad Formation, some foraminiferan stratigraphers (e.g., Ibaraki, 1992) favouring a Late Miocene age, while

some mollusc stratigraphers (e.g., Tavera, 1979) favour an earlier age of Lower Miocene.

Etymology.— This species is named in honour of Koos den Hartog, our honoured colleague in coelenterate taxonomy.

Diagnosis.— *Sphenotrochus* having linear costae near base, grading to granular in upper half of corallum; C3 flanking the principal C1 produced into broad fishtail structures in juvenile coralla.

Description.— Corallum cuneiform, with planar thecal faces and rounded thecal edges. Face angle about 20°, the edge angle ranging from 0° (parallel) to 23°, resulting in a GCD:LCD of 1.36-1.49 and a GCD:HT of 0.61-0.79. Corallum base often “fish-tailed” in shape (figs 1e, 2c-d), becoming rounded with age as the spurs become worn. Largest intact specimen (the holotype) 6.81 × 4.58 mm in calicular diameter and 10.03 mm in height.

Costal arrangement and ornamentation distinctive. Most costae radiate from a region 2-3 mm above the base of the corallum on each thecal face. Proximal to this region short, discontinuous costae radiate downward to the corallum base. Distal to this region, each face bears nine smooth, continuous costae arranged in the following manner: one central costa (corresponding to the central S2), a triad of costae on either side of the central costa (corresponding to two S3 and one medial S1), and two more costae (C2) each of which flank the triads (fig. 2f-g). These costae are smooth and continuous, extending upward 3-5 mm, above which each costa transforms into a double row of smooth, rectangular to trapezoidal granules. These granules are rarely more than 0.4 mm in greater length (usually averaging 0.3 mm) and most commonly oriented with their greater axes aligned vertically, but occasionally aligned horizontally, and sometimes even diagonally arranged, altogether forming a linear mosaic pattern (fig. 2h). Peripheral to the two outer C2 are two more uniquely-shaped costae (C3), which are covered entirely by granules. Near the calicular edge these costae are the same width as other costae, bearing two granules across their width, but proximally they widen to two to three times the average costal width and are covered with longer (up to 0.6 mm) granules that are obliquely oriented (fig. 2a, h). These costae form the bulk of the downward projecting fish-tails of young specimens. Finally, the principal costae (those C1 associated with the calicular edges) are also covered with granules, of average width near the calicular edge, but gradually widen to twice that width (about four granules across) toward the base, these costae covering the edges of the corallum (fig. 1b). Intercostal grooves are deep and uniformly narrow (i.e., 0.06-0.10 mm). One aberrant corallum has an incipient pair of C4 in one of the end half-systems, resulting in 26 costae, but there were no associated septa with these two extra costae.

Septa hexamerally arranged in three cycles (24 septa) according to the formula: S1-2>S3. S1-2 moderately exsert, having vertical axial edges that extend about 0.8 the distance to the columella in upper fossa, but all of which fuse to the columella not far down into the fossa. S3 also have vertical axial edges, extending about half distance to the columella, and do not fuse with the columella. Fossa shallow, containing a robust, lamellar columella, often twice the width of a septum (i.e., up to 0.8 mm wide).

Discussion.— One of the most diagnostic features that distinguishes the species in the genus *Sphenotrochus* are the characteristics of their costae, including their length, width, and shape; pattern of insertion; and surface texture. As mentioned above, only three previously described species of *Sphenotrochus*, as well as *S. denhartogi*, have an

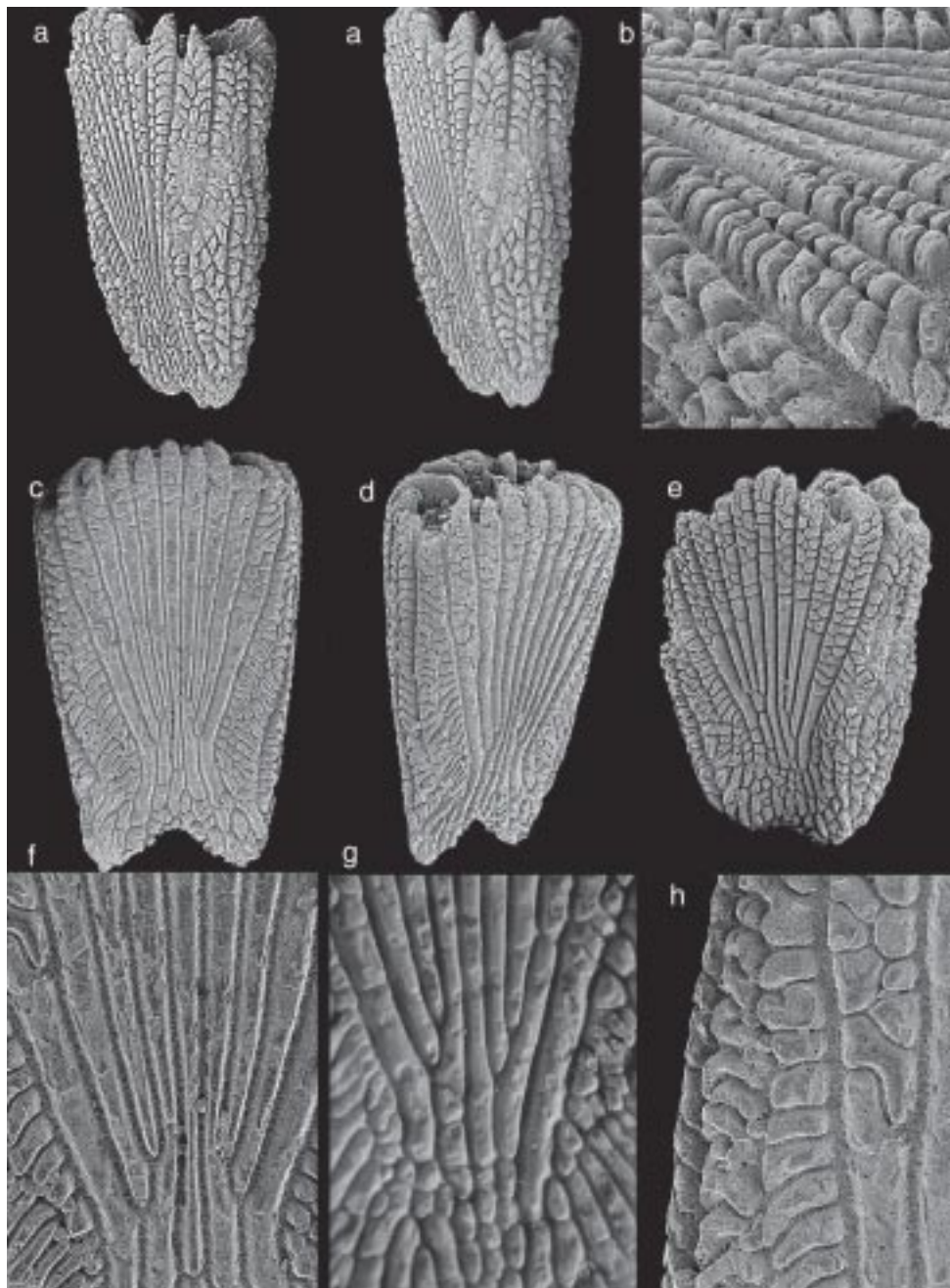


Fig. 2. *Sphenotrochus denhartogi* spec. nov.: a-b, e, paratype, USNM 1003482; c-d, f, h, paratype, USNM 1003482; g, holotype: a, oblique lateral stereo view of corallum, $\times 7.1$; b, oblique view of costal granules near calice, $\times 24$; c-d, lateral and oblique views of a paratype, $\times 7.5$, $\times 6.9$, respectively; e, lateral view of well-preserved corallum, $\times 7.8$; f-g, detail of costae near base of lateral face, both $\times 17.4$; h, detail of granulation of uniquely shaped C3 adjacent to principal costa, $\times 21$.

intermediate costal architecture consisting of linear costae near the base of the corallum face which grades into granular costae near the calice. All of these species also have four distinctively shaped C3 that flank the principal C1. These other three species are: *S. claibornensis* Vaughan, 1900 (Middle Eocene: Alabama), *S. senni* Wells, 1945 (Middle Miocene to Late Pliocene: Martinique, Dominican Republic, Jamaica), and *S. auritus* Pourtalès, 1874 (Recent: Suriname to Uruguay, 15-64 m). Although similar in costal morphology, *S. claibornensis* differs in having more septa (sometimes up to 48), a more compressed corallum (GCD:LCD often over 2.0), and a columella that is primarily lamellar but papillose at the top. *S. denhartogi* is quite similar to *S. senni*, especially those specimens later reported by Cairns & Wells (1987) from the Dominican Republic and Jamaica, the latter differing from *S. denhartogi* only slightly in the shape of the C3 that border the principal C1. *S. denhartogi* is also remarkably similar to the Recent western Atlantic *S. auritus*, the latter differing in having a flatter corallum (GCD:LCD = 1.56-1.80) and a corallum base that tends to have the fish-tail morphology in the adult stage, not the juvenile stage, which is the opposite of that in *S. denhartogi*. Altogether, these four species form a well-defined species complex that ranges from the Eocene to Recent, the earliest form, *S. claibornensis* (Middle Eocene) being replaced by *S. senni* and *S. denhartogi* in the Middle to Late Miocene by a reduction in number of septa and an enlargement of the calice, and finally *S. auritus*, a possible descendent of either of these two species.

Only one species of *Sphenotrochus*, *S. hancocki* Durham & Barnard, 1952, is known from the eastern Pacific: Miocene of Costa Rica and Recent off Baja California and Galápagos (Cairns, 1989, 1991). It is quite different from *S. denhartogi*, being much smaller; having continuous, equal-diameter costae; and an exsert columella. Thus, *S. denhartogi* is the first record of this genus from the west coast of South America. Several other Late Cenozoic azooxanthellate (deep-water) coral species have been reported from South America by: Philippi (1887) also from Chile, Angelis (1908) from Patagonia, and Squires (1963) from Argentina, but none of these are *Sphenotrochus*.

Living specimens of *Sphenotrochus* are known to live interstitially in coarse sand from as deep as 403 m (Cairns, 1997); however, most species occur at depths of less than 100 m, which is assumed to have been the habitat of *S. denhartogi*.

Acknowledgements

I wish to thank Mr Sven Nielsen (Geologisch-Paläontologisches Institut und Museum, Universität Hamburg) for collecting the fossil corals from Chile, and acknowledge the German Science Foundation (project Ba675/25) for funding his fieldwork.

References

- Angelis d'Ossat, G. de, 1908. Altri Zoanthari del Tertiario della Patagonia.— An. Mus. Nac. Buenos Aires 16: 93-102, pl. 1.
- Cairns, S.D., 1989. A revision of the ahermatypic Scleractinia of the Philippine Islands and Adjacent Waters, Part 1: Fungiacyathidae, Micrabaciidae, Turbinoliinae, Guyniidae, and Flabellidae.— Smithsonian Contr. Zool. 486: 1-136, pls 1-42, figs 1-3.

- Cairns, S.D., 1991. A revision of the ahermatypic Scleractinia of the Galápagos and Cocos Islands.— *Smithsonian Contr. Zool.* 504: 1-32, pls 1-12.
- Cairns, S.D., 1997. A generic revision and phylogenetic analysis of the Turbinoliidae (Cnidaria: Scleractinia).— *Smithsonian Contr. Zoology* 591: 1-55, pls 1-10, figs 1-5.
- Cairns, S.D., 2000. A revision of the shallow-water azooxanthellate Scleractinia of the western Atlantic.— *Stud. Nat. Hist. Caribbean Region* 75: 1-231, figs 1-215.
- Cairns, S.D. & J.W. Wells, 1987. Neogene paleontology in the northern Dominican Republic: 5. The suborders Caryophylliina and Dendrophylliina (Anthozoa: Scleractinia).— *Bull. Amer. Pal.* 93:(328): 23-43, 52-55, 68-74, pls 8-11.
- Durham, J.W. & J.L. Bernard, 1952. Stony corals of the eastern Pacific collected by Velero III and Velero IV.— *Allan Hancock Pac. Exptd.* 16(1): 1-110, pls 1-16.
- Ibaraki, M., 1992. Planktonic foraminifera from the Navidad Formation, Chile: their geologic age and paleoceanographic implications. Pp. 91-95. In: Ishizaki, K. & I. Saito (eds), *Centenary of Japanese Micropaleontology*.— *Terra Scientific Pub. Co.*, Tokyo.
- Milne Edwards, H. & J. Haime, 1848. Recherches sur les polypiers, mémoire 2: Monographie des Turbinolides.— *Ann. Sci. Nat. Paris, Zool.*, (3)9: 211-344, pls 7-10.
- Philippi, R.A., 1887. Die Tertiären und Quartären Versteinerungen Chiles: 1-226, 58 pls.— *Leipzig*.
- Pourtalès, L.F. de, 1874. Zoological results of the Hassler Expedition. Deep-Sea corals.— *Illustr. Cat. Mus. Comp. Zool.*, Harvard 8: 33-49, pls 6-9.
- Squires, D.F., 1963. Madreporas rhizangidas fosiles y vivientes de la Argentina.— *Neotropica* 9(28): 9-16, figs 1-11.
- Tavera, J., 1979. Estratigraphía y paleontología de la Formación Navidad, Provincia de Colchagua (Lat. 30°50'-34° S).— *Bol. Mus. Hist. Nat. Chile* 36: 176 pages.
- Vaughan, T.W., 1900. The Eocene and Lower Oligocene coral faunas of the United States, with descriptions of a few doubtfully Cretaceous species.— *Mono. U. S. Geol. Surv.* 39: 263 pages, pls 1-24.
- Wells, J.W., 1935. Notes on some turbinolian corals.— *Ann. Mag. Nat. Hist.* (10)16: 529-535, pl 18.
- Wells, J.W., 1945. West Indian Eocene and Miocene corals, Part II in: Vaughan, T.W. & J.W. Wells (eds), *American Tertiary foraminifera and corals*.— *Mem. Geol. Soc. Amer.* 9: 1-25, pls 1-3.