

Short Note



First occurrence of the genus *Bathelia* (Anthozoa, Scleractinia) from the Mediterranean Pliocene

Valeriano SPADINI

V. Spadini, Via A. Toti 4, I-52046 Lucignano (Arezzo), Italy; spadini@inwind.it

A rich Pliocene scleractinian fauna is well known in the Siena area (central Italy), and has been first described by Spadini (2015). Although most of this scleractinian fauna, which includes more than fifty species, is well known, due to its poor condition and preservation part of it is still waiting to be classified at species rank. In particular, one of the studied species has not been attributed to a genus rank, and had been assigned to the Oculinidae Gray, 1847 family of colonial corals on the basis of skeletal macroscopic characteristics (Spadini, 2015).

Oculinidae is a family of scleractinians widespread all over the world (Vaughan & Wells, 1943; Wells, 1956). The colony formation is generated by extratentacular budding, in which dendroid colonies, united basally and thickened by a dense, smooth, costate or granulated coenosteum, tend to alternate with corallites. Oculinidae includes many very common genera such as *Madrepora* Linnaeus, 1758, *Oculina* Lamarck, 1816, *Sclerhelia* Milne Edwards & Haime, 1850 and other less common or localized azooxanthellate and zooxanthellate corals (Vaughan & Wells, 1943; Wells, 1956). Based on literature, it is possible to assign the above species to the genus *Bathelia* Moseley, 1881 (Vaughan & Wells, 1943; Wells, 1956; Chevalier & Beauvais, 1987; Cairns & Kitahara, 2012).

The genus *Bathelia* (type species *Bathelia candida* Moseley, 1881) is monotypic and the only living species

is distributed along the Atlantic and Pacific coasts of South America (Moseley, 1881; Cairns, 1982; Kitahara, 2007; Zamponi, 2008; Cairns & Polonio, 2013). Interestingly, Chevalier et al. (1989) report a *Bathelia* sp. - without description and illustration - from the Pliocene of Corcoué-sur-Logne (Loire-Atlantique, France).

The material studied in the present report was found at the Monte Calcinaio site (altitude 732 m; Long. 52°54'55"N, Lat. 11°48'59"E) near Radicofani district in the Radicofani basin (Tuscany, Italy) (Fig. 1). Marine sedimentation in this area started during the Zanclean with deposition of deep-sea clays covering continental Miocene sediments (Bonini & Sani, 2002). The microfaunal association in the Radicofani clays has been attributed to the *Globorotalia margaritae/puncticulata* Biozone of the Early Pliocene (Zanclean) (Bossio et al., 1992; Pascucci et al., 2006), and indicates a deep-sea depositional environment.

SYSTEMATIC PALEONTOLOGY

Class ANTHOZOA Ehrenberg, 1834
Subclass HEXACORALLIA Haeckel, 1866
Order SCLERACTINIA Bourne, 1900
Family OCULINIDAE Gray, 1847

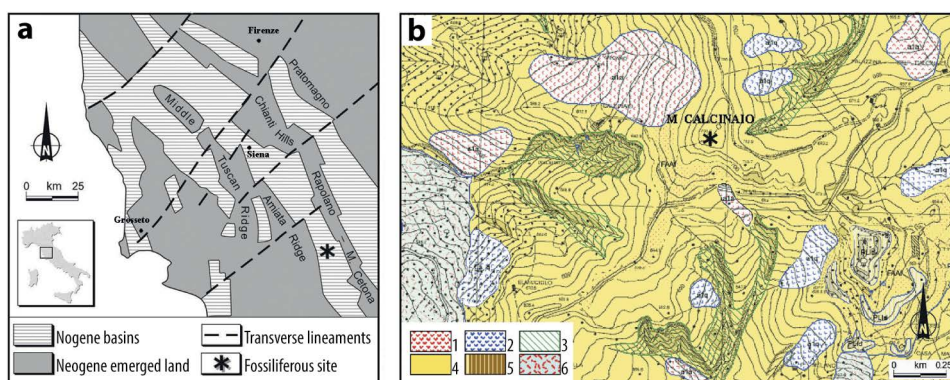


Fig. 1 - Location of the studied outcrop. a) Simplified structural setting of the studied area (Tuscany, Italy) showing the Monte Calcinaio fossiliferous site in the Radicofani basin (asterisk). Modified from Spadini & Manganelli, 2016. b) Simplified geological sketch of the area of Monte Calcinaio (asterisk). Modified from the Carta Tecnica Regionale 321060 (downloaded from <http://www502.regione.toscana.it/geoscopio/cartoteca.html>). 1: active landslide; 2: dormant landslide; 3: badlands; 4: Zanclean-Piacentian fossiliferous clays and silty clays; 5: Zanclean-Piacentian polygenic breccia; 6: Holocenic slope deposits.

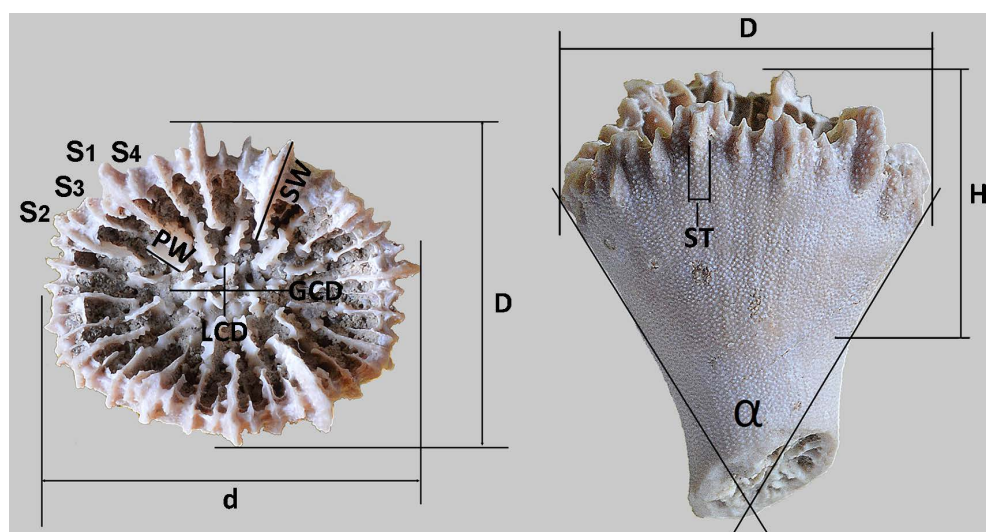


Fig. 2 - Morphometric parameters of the calice of *Bathelia* sp. from Monte Calcinaio fossiliferous site. D: larger calicular diameter; d: smaller calicular diameter; H: Calice height; GCD: larger columellar diameter; LCD: smaller columellar diameter; SW: maximum observed width of septa; ST: maximum observed thickness of septa; PW: width of P3; S1, S2, S3, S4: septa of cycles 1, 2, 3, 4; α : larger angle of calice. For distance (in mm) see Tab. 1.

Genus *Bathelia* Moseley, 1881

Type species *Bathelia candida* Moseley, 1881, by monotypy.

Diagnosis - Corallum arborescent, massive; calices disposed alternately in nearly straight rows on either side of several branches with very prominent margins. Coenenchym white, compact and dense, its surface is entirely covered by curved striae continuous with the costae. Calices deep and wide open with four cycles of septa, and a single crown of pali. Columella large, composed of numerous trabeculae (Moseley, 1881).

Geographic distribution - The type species lives in South America from Rio Grande (Brazil) to Cabo Tres Puntas (Argentina) and off Peninsula Tres Montes (Chile). Depth range: 500-1626 m (Cairns & Polonio, 2013 and references therein).

Ecology - *Bathelia candida* is a species that lives on rocks and hard substrates where it forms small aggregates or coral gardens (Laprida et al., 2014).

Maximum length of branches	53.5 mm
Maximum diameter of branches	18.4 mm
Minimum diameter of branches	4.1 mm
Calice height (H)	7.5 mm
Greater calicular diameter (D)	10.1 mm
Lesser calicular diameter (d)	8.4 mm
d/D ratio	0.79 mm
Number of septa	48 mm
Depth of calice	~ 1.5 mm
Greater columellar diameter (GCD)	3.2 mm
Lesser columellar diameter (LCD)	1.1 mm
Maximum dominant septa width (SW)	~ 2.5 mm
Dominant septa thickness (ST)	0.43 mm
Width of P3 (PW)	0.7 mm
Greater angle of calice (α)	63°

Tab. 1 - Morphometric characteristics of the studied material (see also Fig. 2 for explanation).

Stratigraphic distribution - It is known as a fossil from the Late Pleistocene of La Plata Terrace and Ewing Terrace of the northern Argentine continental margin (Laprida et al., 2014). Fossil species of *Bathelia* were only reported in the northern hemisphere by Chevalier et al. (1989) (see above).

Bathelia sp.

2015 Gen. et spec. indet. SPADINI, p. 45-46, figs 29-31.

Material - Twelve fragments with calice.

Description - Colonial dendroid, branches formed by spaced extratentacular sympodial budding. Larger branches have a maximum diameter of about 18 mm. Those examined are divided into two branches with one calice between them (Fig. 3b, d-e). Thinnest branches slender with diameter of 4-6 mm. Intercalicular distance equal to about maximum diameter of a calice. Coenosteum highly developed in larger branches, reduced in smaller branches, finely granular or slightly costate on the surface. Corallites very short, calice large, elliptical (Tab. 1). New corallites bud at the edge-zone of the calice, generally one or rarely two buds per calice (Fig. 3b). The presence of fine grooves or fine ribs on the distal part of the calice (Fig. 3f) delimits flat or slightly convex costae bearing fine granules (Fig. 3c, f).

Septa slightly exserted, arranged regularly in four complete cycles and six systems making a total of 48 septa. There are three types of septa: dominant (S1 and S2), paliferous (S3), and secondary (S4). S1 and S2 have smooth, straight axial edges, S3 and S4 have very thin, not always integral, sometimes wavy, axial edges. The septa of the first two cycles are equal in size and reach the columella, S3 are less exserted with a crown of pali and S4 is smaller, close to dominant septa and generally more exserted than S3 (Fig. 2). The septa bear granules with a circular or elliptical base, generally conical in shape and arranged in neat rows parallel to the septal margin. The margin of the pali is seldom straight, often slightly sinuous with large tubercles. Granules borne by pali are subcylindrical with circular or elliptical base. The

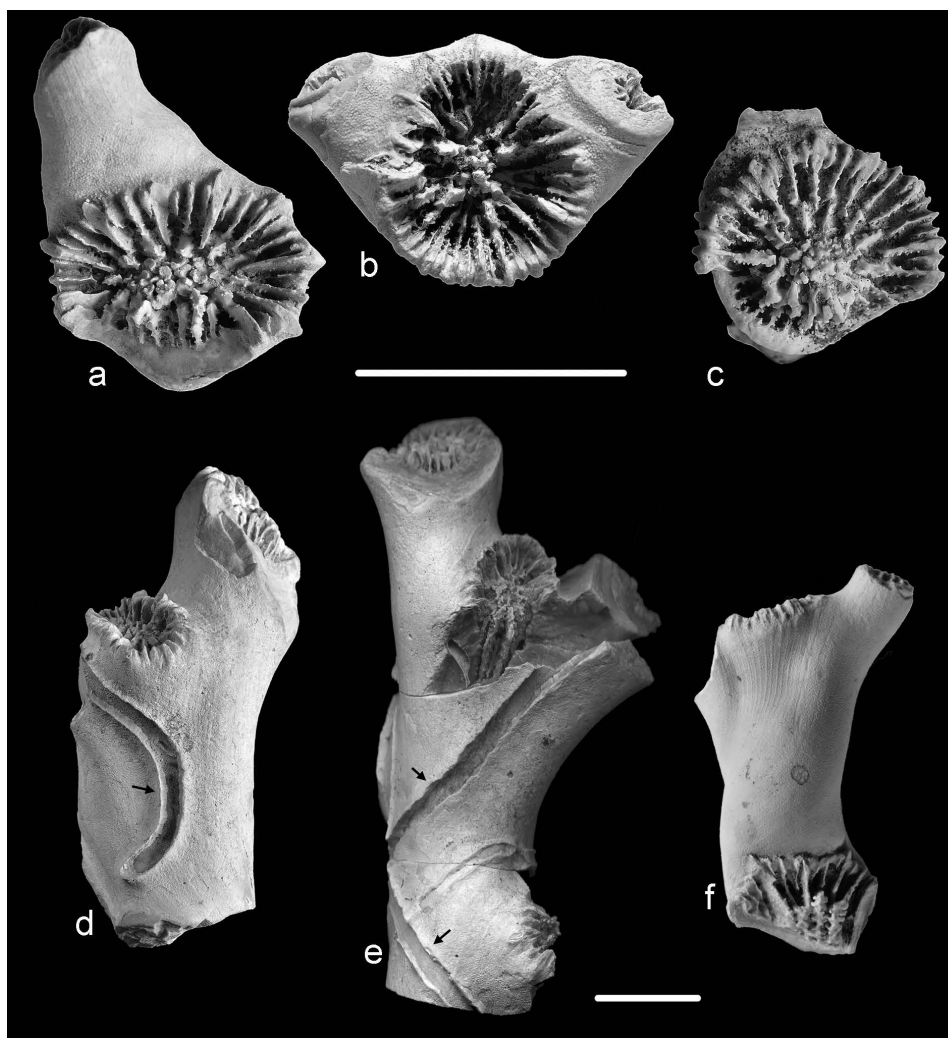


Fig. 3 - *Bathelia* sp., Zanclean of Monte Calcinaiio fossiliferous site. a, c) Calices of *Bathelia* sp. b) Calice with two broken budded corallites. d-e) Fragment of large branch. The black arrows indicate deep furrow in the surface. f) Fragment with one calice: costae result separated by thin ribs. Scale bars correspond to 10 mm.

fossa is very shallow. Columella elliptical consisting of numerous papillae.

Material - The repository of the studied materials is at the Museo di Storia Naturale dell'Accademia dei Fisiocritici, Geo-Paleontological Collections, MUSNAF/ GEO n. 7048.

Remarks - The materials recovered are incomplete, however, the specimens are in relatively good condition to permit to recognize the diagnostic characters.

Assignment to the family Oculinidae is based on macromorphological characteristics (Figs 2-3). According to the literature, *Bathelia* is the only colonial genus of scleractinian coral that buds in the edge-zone of the calice with one crown of pali or paliform lobes before S3 (Vaughan & Wells, 1943; Wells, 1956; Chevalier & Beauvais, 1987; Cairn & Kitahara, 2012; Cairns & Polonio, 2013). *Bathelia* sp. of Monte Calcinaiio site differs from *B. candida* by virtue of very short corallites and calices not projecting outside the branch, well differentiated septa, pali with large tubercles, columellar elements flat, consisting of simple papillae, or thin curled rods.

Bathelia sp. was found with other species of scleractinian coral typical of deep water, such as *Conotrochus typus* Seguenza, 1864, *Stenocyathus vermiformis* (Pourtales, 1874) and *Enallopsammia scillae* Seguenza, 1864, that can be used to validate the presence of these species in circalittoral or bathyal environments. This hypothesis is confirmed by the presence of gastropods *Mitrella thiara* (Brocchi, 1814), *Ficus ficoides* Lamarck, 1822 and *Buccinulum aduncum* (Bronn, 1831), the bivalve *Spondylus gussoni* Costa, 1829 and the scaphopods *Cadulus ovulum* (Philippi, 1844) and *Entalina tetragona* (Brocchi, 1814). The fragmentation of the studied material does not allow to determine the full size of the colonies. However, the diameter of the larger branches strongly suggests that they could reach a size similar to or larger than those of the living species colonies. Large branches have deep furrows with irregular margins probably due to the action of symbiotic or commensal worms. One of the fragments shows a borehole along its main axis, probably produced by a parasitic worm.

An intensive survey of the Radicofani Basin could provide more morphological details and new insight of the habitat of this species in order to clarify its relations with

Bathelia candida, the only species currently belonging to this genus.

ACKNOWLEDGEMENTS

I am grateful to Stephen D. Cairns (National Museum of Natural History, Washington) for indications that allowed this species to be described; Giuseppe Manganelli (Università di Siena) for help with bibliographical research; Francesco Pizzolato (Arezzo) for help in the search for material; Helen Ampt for revising the English. Thanks are due to the reviewers A. Vertino (Università Milano Bicocca) and M. López Correa (University of Erlangen-Nürnberg) for their comments.

REFERENCES

- Bonini M. & Sani F. (2002). Extension and compression in the northern Apennines (Italy) hinterland: evidence from the late Miocene-Pliocene Siena-Radicofani Basin and relations with basement structures. *Tectonics*, 22: 1-35.
- Bossio A., Cerri R., Costantini A., Gandin A., Lazzarotto A., Magi M., Mazzanti R., Mazzei R., Sagri M., Salvatorini G. & Sandrelli F. (1992). I bacini distensivi neogenici e quaternari della Toscana. In Guida alle escursioni post-congresso (Società Geologica Italiana, 76° Riunione estiva "L'Appennino Settentrionale" and Società Italiana di Mineralogia e Petrologia, Convegno "Minerogenesi appenninica", Firenze 21-23 settembre 1992): 199-277.
- Bourne G.C. (1900). The Anthozoa. In Lankester E.R. (ed.), *A Treatise on Zoology. Part II. The Porifera and Coelenterata*. 84 pp. Adam & Charles Black, London.
- Brocchi G. (1814). Conchiologia fossile subappennina con osservazioni geologiche sugli Appennini e sul suolo adiacente. Vol. 2, Dalla Stamperia Reale, Milano: 241-712.
- Bronn H.G. (1831). Übersicht der Fossilien Überreste in den tertiären subappenninischen Gebirgen. Italiens Tertiär-Gebilde und deren organische Einschlüsse. 176 pp. Karl Gross, Heidelberg.
- Cairns S.D. (1982). Antarctic and subantarctic scleractinia. *Antarctic Research Series*, 34: 1-74.
- Cairns S.D. & Kitahara M.V. (2012). An illustrated key to the genera and subgenera of the Recent azooxanthellate Scleractinia (Cnidaria, Anthozoa), with an attached glossary. *ZooKeys*, 227: 1-47.
- Cairns S.D. & Polonio V. (2013). New records of deep-water Scleractinia off Argentina and the Falkland Islands. *Zootaxa*, 3691: 58-86.
- Chevalier J.P. & Beauvais L. (1987). Classification en sous-ordres des Scléractiniaires. *Traité de Zoologie*, 3: 679-764.
- Chevalier M., Borne V., Brebion P., Buge E., Chaix C., Courbouleix S., Delanoe Y., Estéoule-Choux J., Farjanel G., Lauriat-Rage A., Margerel J.P., Pouit D., Roman J., Trauth N. & Viaud J.M. (1989). Le complexe cénozoïque de Corcoué-sur-Logne (Loire-Atlantique). Études sédimentologiques, paléontologiques et premières reconnaissances géophysiques. *Géologie de la France*, 1-2: 153-170.
- Costa O.G., ed. (1829). Osservazioni Zoologiche intorno ai testacei dell'Isola di Pantelleria. 12 pp. Tipografia della Minerva, Napoli.
- Ehrenberg C.G. (1834). Beiträge zur physiologischen Kenntniss der Corallenthiere im allgemeinen, und besonders des rothen Meeres, nebst einem Versuche zur physiologischen Systematik derselben. *Abhandlungen der Königlichen Akademie der Wissenschaften*, 1: 225-380.
- Gray J.E. (1847). An Outline of the Arrangement of Stony Corals. *The Annals and Magazine of Natural History*, 19: 120-128.
- Haeckel E. (1866). Generelle Morphologie der Organismen. Allgemeine Grundzüge der organischen Formen-Wissenschaft, mechanisch begründet durch die von Charles Darwin reformierte Descendenz-Theorie. Band 1. 574 pp. Reimer, Berlin.
- Kitahara M.V. (2007). Species richness and distribution of azooxanthellate Scleractinia in Brazil. *Bulletin of Marine Science*, 81: 497-518.
- Lamarck J.B.P. de, ed. (1816). Histoire naturelle des Animaux sans vertèbres. Vol. 2, Les Polypes. 568 pp. Verdière, Paris.
- Lamarck J.B.P. de., ed. (1822). Histoire naturelle des animaux sans vertèbres. 711 pp. Published by the Author, Paris.
- Laprida C., Bozzano G., Garberoglio R. & Violante R.A. (2014). Late Cenozoic fossil cold-water coral concentrations and mounds on the Argentine continental margin, Southwest South Atlantic. In Van Rooij D. & Rüggeberg A. (ed.), Book of Abstracts. 2nd Deep-Water Circulation Congress: The Contourite Log-book. Ghent, Belgium, 10-12 September 2014. Vlaams Instituut voor de Zee, Special Publication, 69: 121-122.
- Linnaeus C., ed. (1758). Systema Naturae per Regna tria Naturae, Secundum Classes, Ordines, Genera, Species cum characteribus, differentiis, synonymis, locis. Tomus I: Regnum animale. Editio Decima, Reformata. 824 pp. Holmiae: Impensis Direct. Laurentii Salvii, Stockholm.
- Milne Edwards H. & Haime J. (1850). Recherches sur les polypiers. Cinquième mémoire: monographie des Oculinides. *Annales des sciences naturelles, Zoologie*, 3: 63-110.
- Moseley H.N. (1881). Report on certain Hydroid, Alcyonarian, and Madreporarian Corals procured during the Voyage of H.M.S. Challenger, in the Years 1873-1876. *Report on the Scientific Results of the Voyage of H.M.S. Challenger during the Years 1873-76. Zoology*, 2: 1-248.
- Pascucci V., Costantini A., Martini I.P. & Dringoli R. (2006). Tectono-sedimentary analysis of a complex, extensional, Neogene basin formed on thrust-faulted, Northern Apennines hinterland: Radicofani Basin, Italy. *Sedimentary Geology*, 183: 71-97.
- Philippi R.A. (1844). Enumeratio Molluscorum Siciliae cum viventium tum in tellure terziaria fossilium, quae in suo itinere suo observavit. Vol. 2. 303 pp. Eduard Anton, Halis Saxonum, Halle.
- Portalès L.F. (1874). Zoological results of the Hassler Expedition. *Bulletin of the Museum of Comparative Zoology, Harvard*, 4: 33-50.
- Seguenza G. (1864). Disquisizioni paleontologiche intorno ai Corallarii fossili delle rocce terziarie del distretto di Messina. *Memorie della reale Accademia delle Scienze di Torino, Classe di Scienze Fisiche Matematiche e Naturali*, M2, 21: 399-560.
- Spadini V. (2015). Sclerattiniari del Pliocene senese. *Memorie Accademia delle Scienze di Siena detta dei Fisiocritici*, 13: 160.
- Spadini V. & Manganelli G. (2016). A megachasmid shark tooth (Chondrichthyes, Lamniformes) from the Zanclean (early Pliocene) of San Quirico d'Orcia, central Italy. *Bollettino della Società Paleontologica Italiana*, 54: 67-70.
- Vaughan T.W. & Wells J.W. (1943). Revision of the suborders, families and genera of the Scleractinia. *Geological Society of America, Special Papers*, 44: 1-394.
- Wells J.W. (1956). Scleractinia. In Moore R.C. (ed.), *Treatise on Invertebrate Paleontology, Part F: Coelenterata*. University of Kansas Press, Lawrence: F328-F444.
- Zamponi M.O. (2008). La Corriente de Malvinas: ¿Una vía de dispersión para cnidarios bentónicos de aguas frías? *Revista Real Academia Galega de Ciencias*, 27: 183-203.

Manuscript received 7 September 2016

Revised manuscript accepted 20 December 2016

Published online 30 December 2016

Editor Barbara Cavalazzi