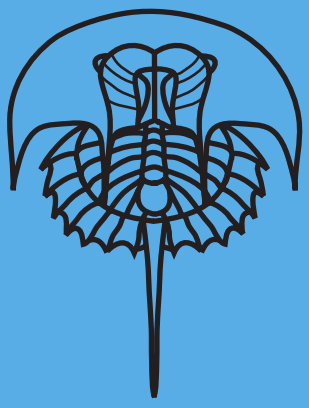

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Part F, Revised, Volume 2, Chapter 14: Systematic Descriptions of the Scleractinia Family Dendrophylliidae

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PART F, REVISED, VOLUME 2, CHAPTER 14: SYSTEMATIC DESCRIPTIONS OF THE SCLERACTINIA FAMILY DENDROPHYLLIIDAE

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INTRODUCTION

The Dendrophylliidae is one of the largest and most diverse scleractinian families, consisting of 33 genera and approximately 370 valid species (CAIRNS, 2001, updated herein). Twenty-six of its 33 genera are either exclusively known as fossil (12 genera) or consist of genera having both fossil and extant species (14 genera). Only seven genera are as yet known exclusively from the Holocene. About two hundred of the 370 species are known as exclusively fossil, the remaining approximately 170 as extant, making this the third most species-rich and fourth most genus-rich among the Holocene families.

Dendrophylliids are worldwide in distribution (except from off continental Antarctica) and occur at depths of 0–2165 m (CAIRNS, 2001). Adult specimens range from the solitary *Notophyllia,* only five mm in calicular diameter, to shallow- and deep-water framework builders such as *Explanaria* and *Enallopsammia,* respectively, which may exceed one meter in height. Most Holocene dendrophylliids are azooxanthellate, only two genera (*Duncanopsammia* and *Explanaria*) being shallow-water, reef-forming zooxanthellates, and *Heteropsammia* apparently being aposymbiotic. The history of the higher classification of the family has been summarized by CAIRNS (2001), major contributions having been made by MILNE EDWARDS and HAIME (1848, 1850), DUNCAN (1884), VAUGHAN and WELLS (1943), ALLOITEAU (1952, 1957), WELLS (1956), CAIRNS (2001), and ARRIGONI and others (2014). CAIRNS (2001) also included a phylogenetic analysis of the dendrophylliid genera based on morphology, and ARRIGONI and others (2014) and LUZ and others (2015) introduced molecular sequencing to the classification.

The Dendrophylliidae is one of the few families for which the monophyly is uncontested (see ROMANO & PALUMBI, 1996; CAIRNS, 2001; FUKAMI & others, 2008; KITAHARA & others, 2010; ARRIGONI & others, 2014; LUZ & others, 2015). Monophyly is based on synapomorphies including its porous theca, unique mesenterial cnidocysts (PICCIANI, PIRES, & SILVA, 2011), and—most recently discovered—corallum microstructure (ARRIGONI & others, 2014), i.e., the presence of clusters of nano-granular-fibrous Rapid Accretion Deposits (RAD) of approximately five µm diameter that occur on the growing distal and axial edges of the septa and patches of smaller fibers of only a few µm in diameter termed Thickening Deposits (TD) that occur on the lateral septal flanks (Fig. 1) (see ARRIGONI & others, 2014). ARRIGONI and others (2014) also applied molecular sequencing technology to study species of 11 of the 21 extant dendrophylliid genera, concluding that the traditional macromorphology approach was insufficient to establish true monophyletic genera. In six cases (*Cladopsammia, Explanaria* [=*Turbinaria sensu* ARRIGONI & others, 2014], *Rhizopsammia, Dendrophyllia, Balanophyllia* subgenera, and *Tubastraea*),

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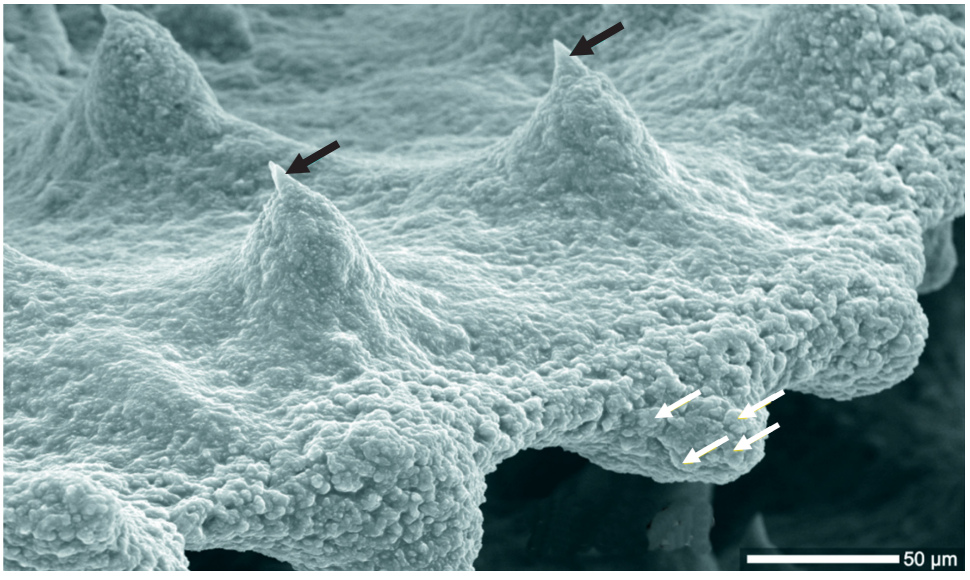

Fig. 1. Micromorphological features in *Heteropsammia,* showing clusters of nano-ganular-fibrous deposits on low septal teeth (*black arrows*) termed Rapid Accretion Deposits (RAD), and bundles of fibers on septal faces (*white arrows*) termed Thickening Deposits (TD), forming small patches (Arrigoni & others, 2014, fig. 3l; image, courtesy of Jarek Stolarski).

they analyzed more than one species in a traditional morph-genus and in four of these six cases, the genus was found to be para- or polyphyletic, suggesting that a more integrated approach of morphology (especially micromorphology) and molecular approaches be used in future phylogenies of the family.

This chapter is organized in the following manner: the diagnosis of the family is followed by the description of its type-genus, and descriptions of the other genera are given in alphabetical order. Table 1 (p. 22–26) provides a synopsis of dendrophylliid genera, including their geographic distributions and stratigraphic ranges. Table 2 (p. 27) provides a comprehensive overview of the key characteristics of dendrophylliid genera. Figure 2 illustrates the septal insertion pattern (Pourtalès plan), which is unique to dendrophylliid genera.

Family DENDROPHYLLIIDAE Gray, 1847

[Dendrophylliidae Gray, 1847, p. 128 [=Gemmiporidae Dana, 1846a, p. 115, *nom. oblit.;* =Eupsammiidae Milne Edwards & Haime, 1848, p. 65, *nom. transl. et correct.* Vaughan & Wells, 1943, p. 233, *ex* Eupsammidae Milne Edwards & Haime, 1851, p. 132, *pro* Eupsammides Milne Edwards & Haime, 1848, p. 65; =Explanariinae Milne Edwards & Haime, 1850, p. liv, *nom. correct.* herein, *pro* Explanarinae Milne Edwards & Haime, 1850, p. liv; =Turbinariidae Milne Edwards & Haime, 1851, p. 140, *nom. transl. et correct.* Brüggemann, 1877, p. 415, *ex* Turbinarinae Milne Edwards & Haime, 1851, p. 140; =Lobopsammiidae Michelotti, in Sismonda, 1871, p. 30, *nom. tranls. et correct.* herein, pro Lobopsammiens Michelotti, in Sismonda, 1871, p. 30; =Eupsammiinae Alloiteau, 1952, p. 679, *nom. correct.* herein, *pro* Eupsamminae Alloiteau, 1952, p. 679, junior synonym and junior homonym of Eupsammiinae Milne Edwards & Haime, 1851, p. 132; =Tubastraeinae Alloiteau, 1952, p. 680].

Corallum solitary or colonial, free or attached; most extant species azooxanthellate; colonies form by extracalicular and various types of intracalicular budding, including mono- to polystomodaeal types as well as by transverse division; septa laminar, composed of one fan system of numerous, irregularly spaced, simple trabeculae, resulting in smooth axial margin, at least in lower-cycle (S_1–S_2) septa, and porous septum; septa strongly granulated laterally; wall synapticulothecate, porous; secondary septothecal thickenings present or absent; endothecal dissepiments thin, sparse or abundant, vesicular, tabular, or cellular; synapticulae sparse or abundant; septa usually hexameral, often arranged in Pourtalès plan; pali present or absent; columella lamellar, variably shaped-trabecular (e.g., spongy, papillose, made of

varying number of segments, mesh-like), or absent; exotheca vesicular, reticulate, or absent; epitheca *sensu lato* or holotheca present or absent. [Description emended from VAUGHAN & WELLS, 1943, p. 233; WELLS, 1956, p. 433; and CAIRNS, 2001, p. 9.] [CAIRNS (2001) provided a revision and phylogenetic analysis of the genera of this family; additional phylogenetic information of some Holocene forms is given in ARRIGONI and others, 2014.] *Lower Cretaceous (Valanginian)–Holocene*.

Dendrophyllia BLAINVILLE, 1830, p. 319 [**Madrepora ramea* LINNAEUS, 1758, p. 797; SD MILNE EDWARDS & HAIME, 1850, p. liii; lectotype (designated by ZIBROWIUS, 1980, p. 169); type deposited in University of Bologna, see POTTS (1995, p. 143)] [=*Brasseyia* WRIGHT, 1882, p. 77 (type, *B. radians,* M)]. Colonial, dendroid, subphaceloid, forming arborescent to bushy colonies; extant species azooxanthellate; vesicular or reticulate exothecal coenosteum absent or present, and resulting in plocoid to cerio-plocoid-like corallite integration; budding extracalicular; epitheca *sensu lato* or holotheca present or absent; septa arranged according to Pourtalès plan, subcompact with irregularly occurring pores, granular laterally; costae present or absent; columella irregularly developed, generally spongy or mesh-like, often large, filling most or all of corallite center; endothecal dissepiments thin, vesicular to subtabulate; wall thick, synapticulothecal or parasynapticulothecal, and irregularly porous; secondary septothecal thickenings present or absent**.** [Plocoid to cerio-plocoid-like corallite integration is demonstrated in material described from the Miocene of New Zealand in *Dendrophyllia boschmai* VAN DER HORST, 1926 and in SQUIRES, 1958, p. 70, pl. 16,*5*. Wall structures demonstrating epitheca *sensu lato* or holotheca have not yet been reported for the type species, but numerous species, showing all skeletal features of *Dendrophyllia* and having an epithecal *sensu lato* or holothecal wall have been described, e.g., CHEVALIER, 1962, p. 479–486. Based on the sequencing of three genes, two mitochondrial and one nuclear, ARRIGONI and others (2014) considered this genus to be polyphyletic.] *Upper Cretaceous (Campanian)–Holocene:* East Asia, *Campanian–Maastrichtian;* Caribbean, western Europe, *Maastrichtian;* Australasia, eastern, northern, and southern Europe, North Africa, North America, northern Asia, sub-Saharan Africa, *Paleocene;* Australasia, eastern and southern Europe, North and South America, *Eocene;* North and South America, Southeast Asia, sub-Saharan Africa, western Europe, *Oligocene;* cosmopolitan, *Miocene;* Australasia, Caribbean, North America, Southeast Asia, southern Europe, *Pliocene;* Melanesia, North America, Southeast Asia, southern Europe, *Pleistocene;* North and southwest Atlantic, off South Africa, all regions of Indian and Pacific Oceans, 1–1200 m depth, *Holocene.*——FIG. 3,*1a–d.* **D. ramea* (LINNAEUS, 1758); *a–b,* USNM 48497, Holocene (extant), 4°45´N, 2°33´W, 61–64 m depth (Pillsbury Station 30), eastern Atlantic Ocean; *a,* lateral view of colony produced by extracalicular budding (*arrows*) (Cairns, 2001, pl. 11,*g*); *b,* calicular view of corallite showing septa arranged in well-developed Pourtalès plan (compare with Fig. 2) (Cairns, 2001, pl. 11,*h*); *c–d,* topotype, USNM sample 196 (Weinberg collection), Holocene (extant), Mediterranean Sea; *c,* calicular view of corallite, close-up of *d,* showing mesh-like columella that occupies large parts of the corallite center (*arrow*) (Baron-Szabo, 2002, pl. 54,*4*); *d,* lateral view of colony (Baron-Szabo, 2002, pl. 54,*3*).

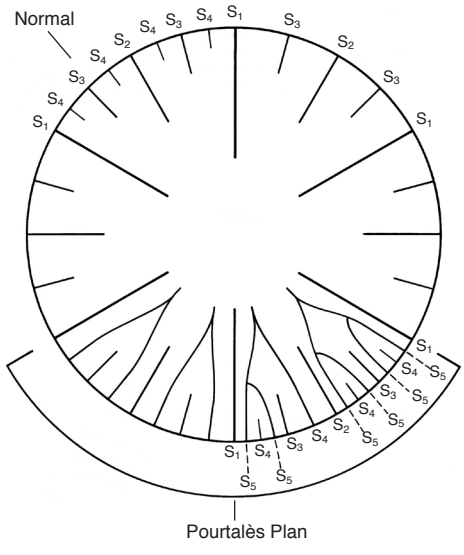

FIG. 2. Comparison of Pourtalès plan vs. normal septal arrangement. S_1, S_2, S_3, etc. = septal cycles (adapted from CAIRNS, 1994).

Areopsammia DIETRICH, 1917, p. 307 [**A. mastrichtensis* DIETRICH, 1917, p. 307; M; holotype MB K.1303] [=*Porosmilia* UMBGROVE, 1925, p. 113, *non* DE FROMENTEL, 1860, p. 46 (type, *Cyclolites alacca* MORREN, 1828, p. 49, OD)]. Solitary or bowl-shaped; costosepta irregularly porous, strongly granulated laterally, basally reduced to granulations; septa arranged in normal insertion (not following Pourtalès plan); columella feebly developed, papillose; epitheca *sensu lato* absent; endothecal dissepiments thin and poorly developed; wall synapticulothecal, thick, and porous; septothecal developments absent or present. [Holotype MB K.1303 and topotype are described by CAIRNS (2001, p. 11, pl. 1,*b–d*) and BARON-SZABO (2002, p. 77, pl. 56,*1–2*); type species is described by BARON-SZABO, (2008, p. 34–35, pl. 1,*5*); possible close relationship with *Rhabdopsammia* discussed in

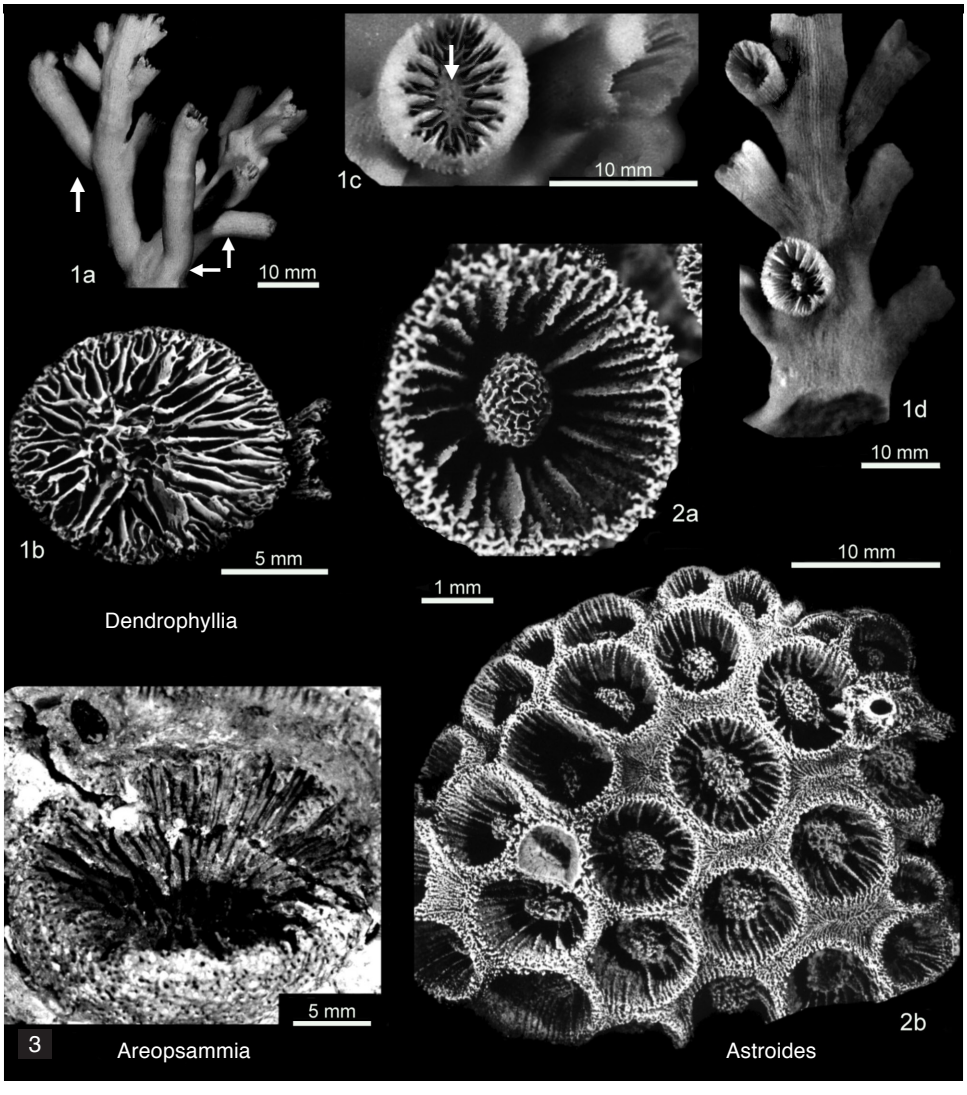

Fig. 3. Dendrophylliidae (p. 3–5).

Baron-Szabo (2014, p. 46–47).] *Upper Cretaceous (Maastrichtian):* western Europe.——Fig. 3,*3*. **A. mastrichtensis*, upper surface of holotype, MB K.1303, the Netherlands (Cairns, 2001, pl. 1,*d*).

Astroides Quoy & Gaimard, 1827, p. 187 [**A. luteus;* M; (type specimens should be in Quoy & Gaimard collection in MNHNP, but not located in 1999] [=*Astreoides* Blainville, 1830, p. 332, *nom. null. lapsus calami pro Astroides* Quoy & Gaimard, 1827, p. 187; =*Astroitis* Dana, 1846b, p. 405–406, according to ICZN, "demonstrably intentional" unjustified emendation (ICZN, 1999, Article 33.2.1) Colonial, cerioid, plocoid, or variably branching (e.g., dendroid, phaceloid, subfaciculate); extant species azooxanthellate; vesicular or reticulate exothecal coenosteum absent or present and resulting in plocoid to cerioid corallite integration; budding extracalicular; epitheca *sensu lato* or holotheca absent, or corallites may be covered by fibrose layers genetically unrelated to corallite walls, representing either epitheca *sensu lato* of early ontogenetical stages of individual corallites or early astonic holotheca when group of corallites is enclosed; septa normally arranged (not according to Pourtalès plan), subcompact with irregularly occurring pores, granular laterally; axial edges of septa coarsely dentate; costae present or absent; columella irregularly trabecular-spongy, connected

to septa or discrete; endothecal dissepiments thin, subtabulate to cellular; wall generally thick, synapticulothecal or parasynapticulothecal, irregularly porous; secondary septothecal thickenings present or absent. [The type species is best described by Zibrowius (1980, p. 198–201).] *Miocene–Holocene:* eastern Europe, *Miocene;* southern and western Europe, *Pleistocene;* northeast Atlantic Ocean, 0–30 m depth, *Holocene.*——Fig. 3,*2a–b. A. calycularis* (Pallas, 1766, p. 318), Holocene (extant), off Zembra Island, Tunisia, 3 m depth; *a,* USNM 48459, calicular view of corallite (Cairns, 2001, pl. 10,*c*); *b,* USNM 78767, upper surface of colony (Cairns, 2001, pl. 10,*a*).

Balanophyllia Wood, 1844, p. 11 [**B. calyculus;* M; neotype, USNM 94469 (designated by Cairns, 2001, p. 14–15, pl. 1,*e,h*)] [=*Blastopsammia* Klunzinger, 1879, p. 80 (type, *Balanophyllia gemmifera* Klunzinger, 1879, p. 55, SD Wells, 1986, p. 10); =*Ceratopsammia* Alloiteau, 1958, p. 199 (type, *C. besairiei*, OD); =*Clonotrochus* Schafhäutl, 1863, p. 32 (type, *C. vermicularis*, M); =*Eupsammia* Milne Edwards & Haime, 1848, p. 77 (type, *Madrepora trochiformis* Pallas, 1766, p. 305, SD Milne Edwards & Haime, 1850, p. li); =*Ilerdosmilia* Reig Oriol, 1997, p. 24 (type, *I. vilellai* Reig Oriol, 1997, p. 24, OD); =*Osteodes* Conrad, 1855, p. 263 (type, *Turbinolia caulifera* Conrad, 1847, p. 296, SD Wells, 1986, p. 43); =*Rhodopsammia* Semper, 1872, p. 257 (type, *Balanophyllia parallela* Semper, 1872, p. 258, SD Wells, 1936b, p. 129)]. Corallum solitary, variably conical (often trochoid, ceratoid, turbinate), attached or unattached, having base that is polycyclic (when attached) or monocyclic (when unattached); synapticulotheca complete or incomplete, costate, porous; epitheca *sensu lato* absent or present; septa subcompact to porous; Pourtalès plan present; columella spongy and elongate; endothecal dissepiments thin, vesicular to subtabulate, sparse or absent; extant species azooxanthellate. [The type species is best described and illustrated by Milne Edwards & Haime (1850, p. 9–10, pl. 1,*3a–d*). *Balanophyllia* is discussed, monographed, and phylogenetically analyzed, based on morphology provided by Cairns (2001). Type *Madrepora trochiformis,* has been considered independent from *Balanophyllia* by some authors due to the presence of an unattached, monocyclic base (e.g., see discussion in Cairns, 2001), but merged with *Balanophyllia* based on recent paleontological observations by Baron-Szabo (2008, p. 42), which supports earlier conclusions resulting from examination of extant species by Durham (1949, p. 139–147) The type material described from the Campanian of northern Spain by Reig Oriol (1997, p. 24) as *Ilerdosmilia vilellai* appears to be characterized by a solitary, conical corallum, the occurrence of synapticulae, septa arranged in Pourtalès plan, and spongy columella, and is, therefore, included here. Based on the sequencing of three genes, two mitochondrial and one nuclear, Arrigoni and others (2014) considered this genus to be polyphyletic]. *Upper Cretaceous (Santonian)–Holocene:* western Europe, *Santonian;* Indian Ocean, south and west Asia, southern Europe, *Campanian;* Australasia, Indian Ocean, *Maastrichtian;* eastern and western Europe, North America, sub-Saharan Africa, *Paleocene;* Australasia, Caribbean, Central, North and South America, eastern and western Europe, *Eocene;* Australasia, eastern, southern, and western Europe, North America, *Oligocene;* cosmopolitan, *Miocene;* Central and North America, northern, southern, and western Europe, Southeast Asia, *Pliocene;* Australasia, Central and North America, East Asia, Melanesia, Southeast Asia, southern Europe, *Pleistocene;* cosmopolitan, 0–1150 m depth, *Holocene.*——Fig. 4,*1a–c.* **B. calyculus; a–b,* neotype, USNM 94469, upper Pliocene, Red Crag, Suffolk, England; *a,* calicular view of corallum; *b,* lateral view of corallum; *c,* topotype, USNM M156433, polycyclic base of corallum (*a–c,* Cairns, 2001, pl. 1,*e,* 1,*h,* and 1,*g,* respectively).——Fig. 4,*1d–e. B. trochiformis* (Pallas), USNM M369877, middle Eocene (Lutetian), France (Le Vivray, Oire); *d,* calicular view of corallum (Cairns, 2001, pl. 2,*e*); *e,* lateral view of corallum showing solitary-trochoid corallum, which is characterized by a basal angle of ~40° (Cairns, 2001, pl. 2,*a*).——Fig. 4,*1f–g. B. besairiei* (Alloiteau), syntype, MNHN Mo5028, Campanian–Maastrichtian, Madagascar; *f,* calicular view of corallum (Baron-Szabo, 2008, pl. 3,*6b*); *g,* lateral view of corallum (Baron-Szabo, 2008, pl. 3,*6a*).——Fig. 4,*1h. B. vermicularis* (Schafhäutl), SNSB-BSPG 1873 III 945, calicular view of syntype, middle Eocene, Germany (new, courtesy of Georg Jannsen, formerly at SNSB-BSPG).

Balanopsammia Ocaña & Brito, 2013, p. 89 [**B. wirtzi;* OD; holotype, MMC–009]. Corallum solitary or colonial, the latter produced by extracalicular budding from edge zone of parent corallite, forming colony with compact closely adjacent corallites; basal epitheca *sensu lato* present, synapticulotheca weakly costate: septa subcompact to porous, arranged in Pourtalès Plan of up to 5 cycles of septa (in type species); columella spongy, pali absent: endothecal dissepiments present or absent; azooxanthellate. [*Balanopsammia* is transitional between *Balanophyllia* and *Cladopsammia,* differing from the former by being colonial, and differing from the latter in having closely adjacent corallites and a different cnidome]. *Holocene:* northeast Atlantic Ocean, 0–10 m depth.——Fig. 5,2. **B. wirtzi*, upper surface of holotype, MMC–009, Holocene (extant), Cape Verde Islands, northeast Atlantic, 0–10 m depth (new, courtesy of O. Ocaña).

Bathypsammia Marenzeller, 1907, p. 8 [**Thecopsammia tintinnabulum* Pourtalès, 1868, p. 138; OD; lectotype, MCZ 2768 (designated by Cairns, 1979, p. 190)]. Corallum solitary, turbinate, and attached by slender peduncle; extant species azooxanthellate; epitheca *sensu lato* well developed; wall thick, synapticulothecate; coenosteum distal to epitheca *sensu lato* not costate, covered with

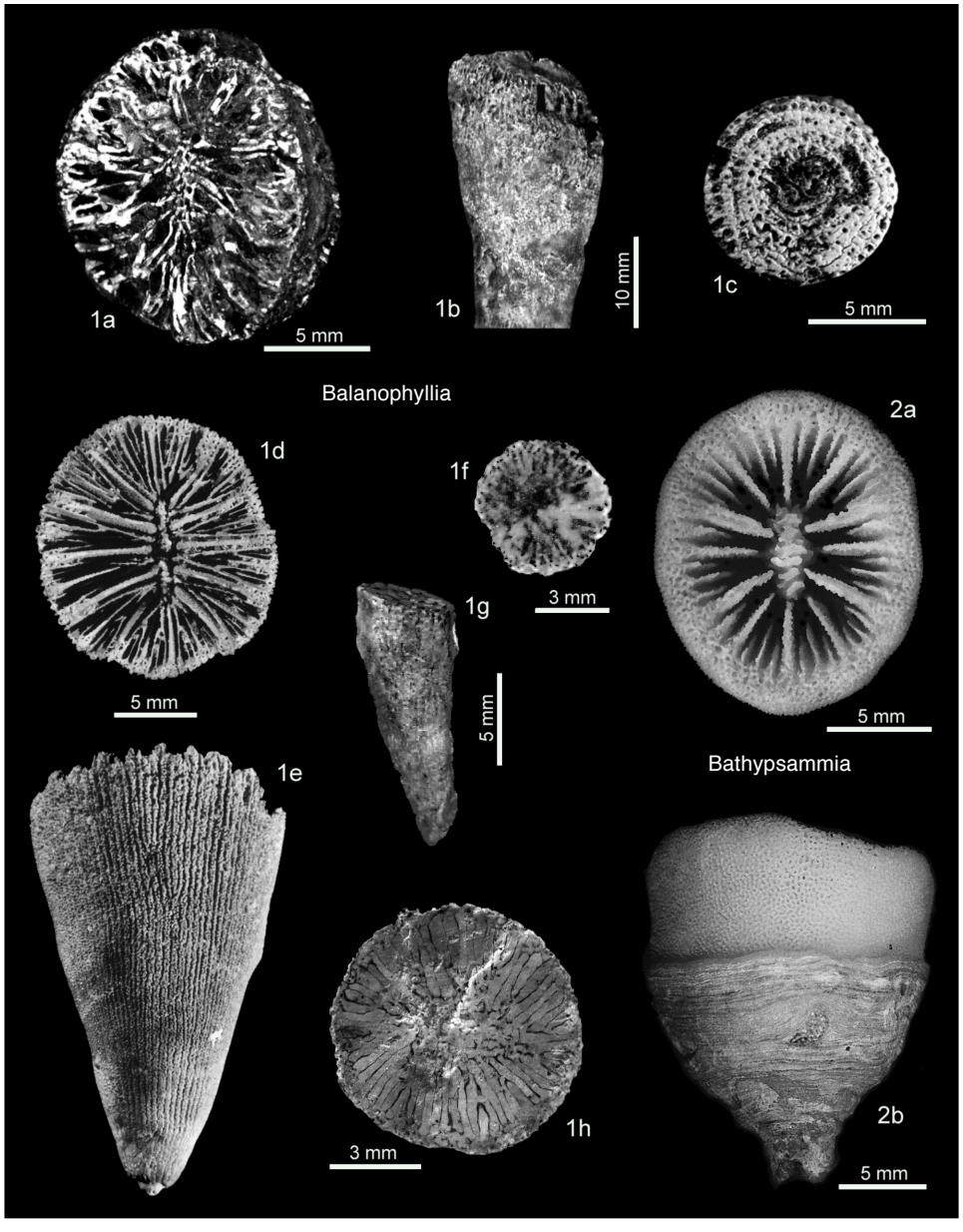

FIG. 4. Dendrophylliidae (p. 5–7).

finely hispid anastomosing ridges; septa compact, arranged in normal insertion pattern (not Pourtalès plan); 4 cycles of non-exsert septa present in type species; columella variable in size, discrete, spongy; endothecal dissepiments and paliform structures absent. [Type species is best described by CAIRNS, 1979, p. 190. Additional paralectotypes are housed at MCZ, NHMUK, and YPM. In having features such as endothecal dissepiments, pali, and a parathecal to synapticulothecal wall, BARON-SZABO (2008, p. 38) transferred the only fossil species of *Bathypsammia* (=*B. cleopatrae* YUSSUF & SALAMA, 1969) described from the Maastrichtian–Paleocene of Egypt to the genus *Palaeopsammia* WANNER, 1902]. *Holocene:* northwest Atlantic Ocean, 183–805 m depth.——FIG. 4,*2a–b*. **B.*

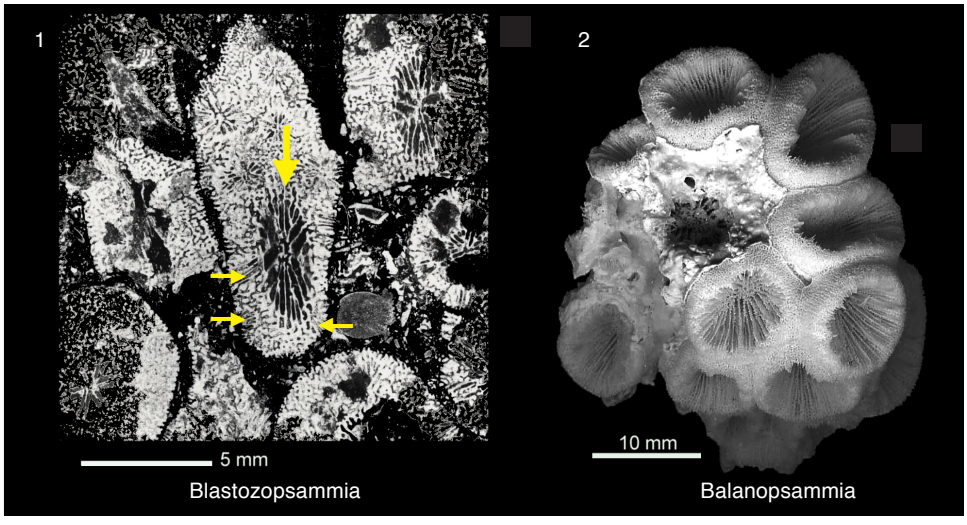

FIG. 5. Dendrophylliidae (p. 5–7).

tintinnabulum (POURTALÈS) Holocene (extant), Northwest Atlantic, off Florida, USA, 183–549 m depth; *a,* calicular view of corallum (Cairns, 2001, pl. 4,*c*); *b,* lateral view, showing solitary-turbinate corallum which is characterized by a basal angle of 60°–80°, measured from above the slender peduncle (Cairns, 2001, pl. 4,*b*).

Blastozopsammia FILKORN & PANTOJA-ALOR, 2004, p. 505 [**B. guerreroterion;* OD; holotype IGM 6967]. Corallum colonial, ramose, plocoid; budding extracalicular; corallites monocentric, dimorphic, each branch consisting of one axial corallite with smaller secondary corallites budded laterally and arrayed radially from this branch axis; septa compact, typically hexamerally arranged in three complete cycles, with pairs of S_4 sometimes present in type species; septa in weakly developed or incipient Pourtalès plan; columella absent or weakly developed, appears as trabecular segments or small and spongy; pali (?) or paliform lobes (?) may be present on S_2; wall synapticulothecal; endothecal dissepiments sparse; coenosteum porous, reticulate with granular surfaces, weakly costate or striate, spinose; possibly zooxanthellate. [The type material is best described by FILKORN & PANTOJA-ALOR 2009, p. 105–109. According to the original description by FILKORN & PANTOJA-ALOR (2004), endothecal dissepiments are absent but, in contrast, a small number of thin vesicular dissepiments seem to be present in the type material, therefore noted as sparse herein. For more detail, see discussion in FILKORN & PANTOJA-ALOR, 2004, p. 502–504]. *Lower Cretaceous (upper Albian)–Upper Cretaceous (Cenomanian):* Central America.——FIG. 5,*1*. **B. guerreroterion*, IGM 6967, holotype, oblique cross-section view of colony, thin section, showing axial corallite (*large arrow*) from which secondary corallites branch (*small arrows*), Mexico (Mal Paso Formation) (new, image courtesy of Harry Filkorn).

Cahuzacopsammia CHAIX, 1999, p. 806 [**C. meandrinoides;* OD; holotype, Université de Bordeaux 32–6–33]. Colonial, massive; corallites arranged in meandroid series, formed by intracalicular budding; calicinal series generally ramified, separated by either tholiform collines or flat, porous coenosteum with disassociated costae; corallite centers distinct; subdistinct only during early budding stages; septa arranged in Pourtalès plan, compact to subcompact with sparsely occurring pores; lateral flanks smooth or covered by rounded to spiniform granules; septa of adjacent series subconfluent or nonconfluent; columella large, spongy-papillose, often occupying more than half of whole fossa; paliform structures probably absent; endothecal dissepiments sparse, thin, vesicular to subtabulate; synaticulothecal wall compact in some series and highly porous in others. *Oligocene:* western Europe.——FIG. 6,*1*. **C. meandrinoides,* holotype, Université de Bordeaux 32–6–33, upper surface of colony, showing corallites arranged in generally long, meandroid series (*arrows*), upper Oligocene (Chattian), France (new, image courtesy of Christian Chaix).

Cairnsipsammia BARON-SZABO, 2015, p. 223 [**C. merbeleri;* OD; holotype, wamu–464; Walsermuseum, wamu–464 (Merbeler collection). Corallum colonial, massive, plocoid to submeandroid; corallites mainly monocentric, occasionally di- and polycentric, irregularly distributed over the colony or arranged in wavy ramified or non-ramified series; corallite centers distinct or subdistinct; budding mainly intracalicular, occasionally extracalicular; costosepta compact or porous, confluent to nonconfluent, nearly smooth or covered by small (up to 50 µm) spiniform and rounded granules laterally, moniliform or irregularly granulated marginally;

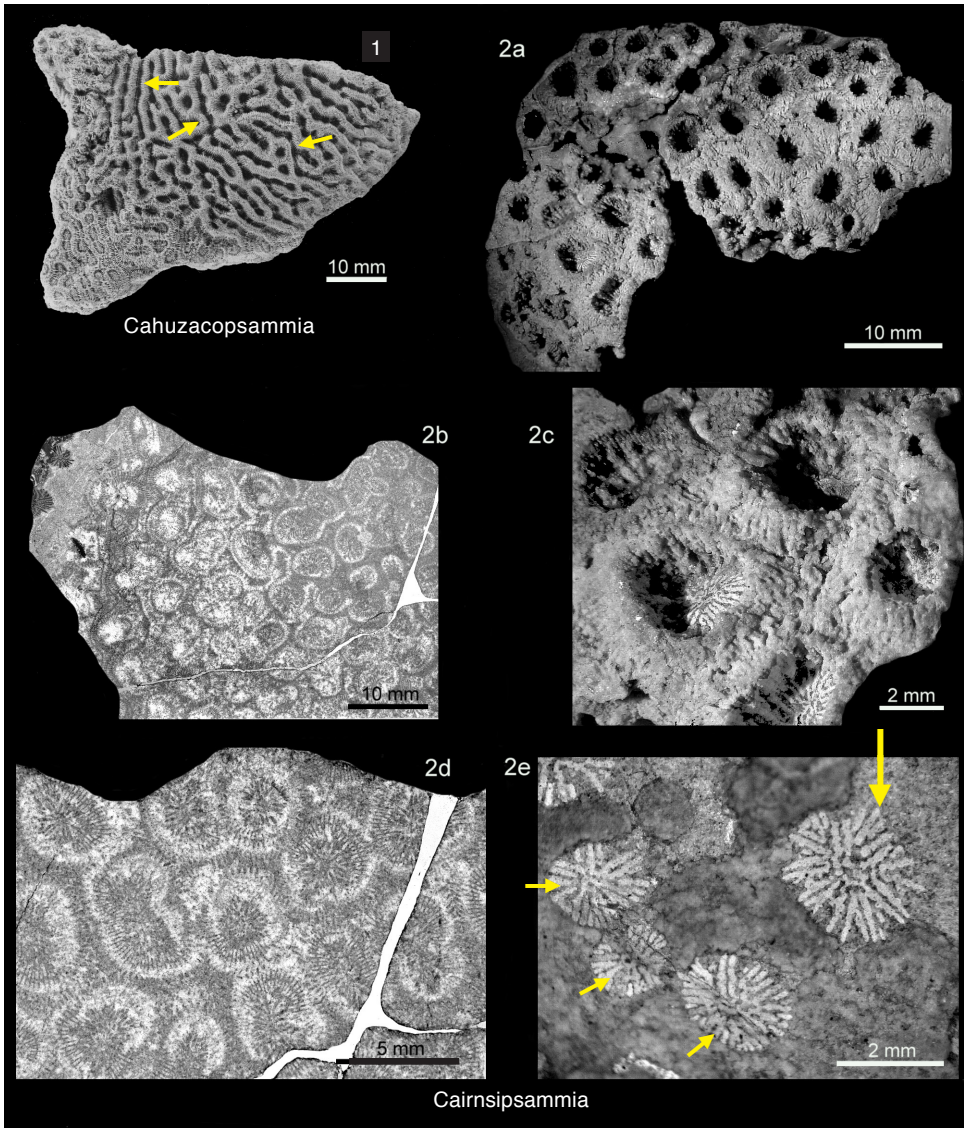

FIG. 6. Dendrophylliidae (p. 7–9).

Pourtalès plan irregularly present; columella well developed or nearly absent; when present spongy-papillose or made of twisted and elongate segments arranged in a lamellar fashion; columella discrete or connected to trabecular extensions of some axial edges of septa; pali present or absent; endothecal dissepiments thin, vesicular to subtabular, rather abundant; coenosteum absent or narrow (up to 2 mm wide), porous, reticulate with granular surfaces, and costate; wall synapticulothecal to synapticulo-parathecal, porous; secondary septothecal thickenings present or absent; possibly zooxanthellate. [See discussion in BARON-SZABO, 2015, p. 221–223]. *Lower Cretaceous (upper Barremian–lower Aptian):* western Europe.——FIG. 6,*2a–e;* 7,*2.* **C. merbeleri*, holotype, wamu–464 (Merbeler collection), upper Barremian–lower Aptian, Austria (Schrattenkalk Formation); 6,*2a,* upper surface of colony (Baron-Szabo, new); *b,* cross section of colony, thin section (new, courtesy of Michael Ricker, Senckenberg, Frankfurt); *c,* close-up *a; d,* close-up of *b; e,* upper surface of colony, showing corallites that are either isolated (plocoid polyp integration; *large arrow*) or arranged in short, submeandroid series (*small*

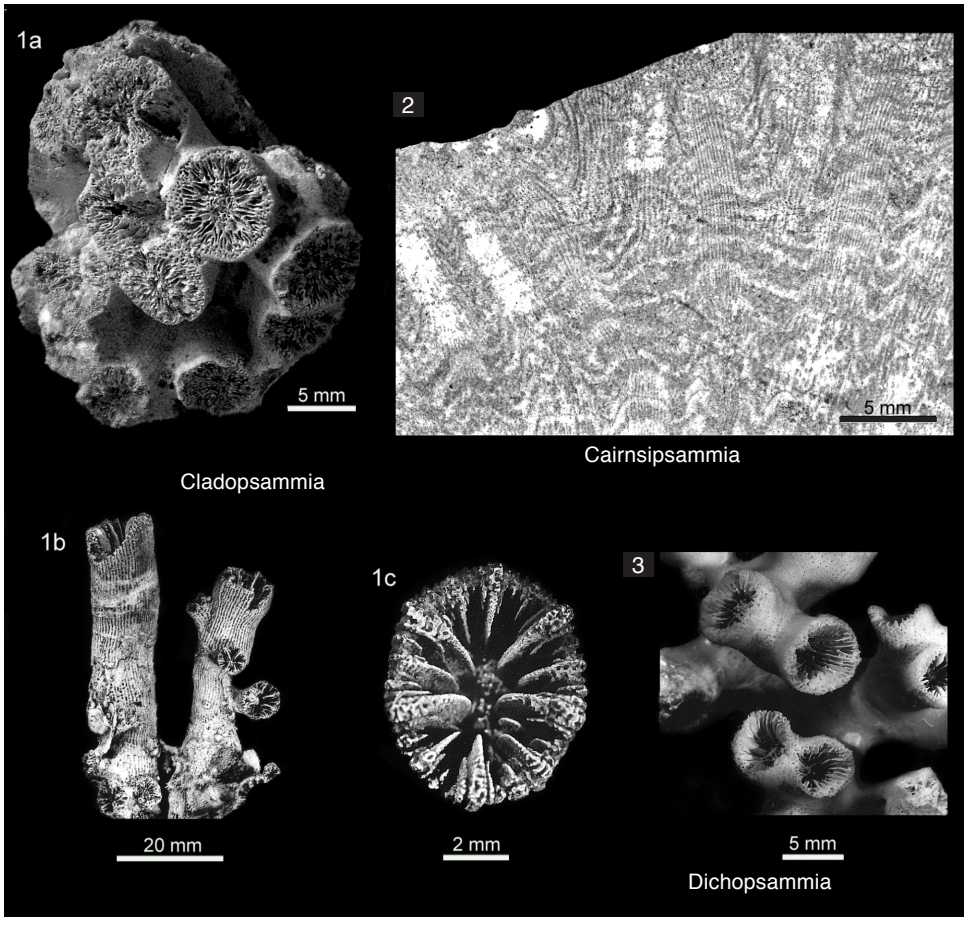

FIG. 7. Dendrophylliidae (p. 7–10).

arrows) (Baron-Szabo, new); 7,*2,* lateral view of holotype, thin section, (new, courtesy of Michael Ricker, Senckenberg, Frankfurt).

Cladopsammia LACAZE-DUTHIERS, 1897, p. 208 [**C. rolandi;* M]. Small, centimeter-size, bushy colonies formed by extracalicular budding from common basal coenosteum and occasionally from edge zone of larger corallites; septa subcompact to porous; costae well developed, granular; epitheca *sensu lato* present or absent; Pourtalès plan well developed; pali usually absent; columella spongy to papillose, often small; endothecal dissepiments vesicular; wall synapticulothecal; extant species azooxanthellate. [The type species is best described by ZIBROWIUS (1980, p. 179); additional information on type species provided by CAIRNS (2001, p. 27, pl. 9,*c–f*). Syntypes of *Cladopsammia* are deposited at MNHN. Based on the sequencing of three genes, two mitochondrial and one nuclear, ARRIGONI and others (2014) considered this genus to be polyphyletic]. *Miocene–Holocene:* western Europe, *Miocene;* sub-Saharan Africa, *Pleistocene;* all regions of Atlantic Ocean, and western, central, and southeastern Pacific Ocean, 0–470 m depth, *Holocene*.——FIG. 7,*1a. C. multigemmata subplana* (KÜHN, 1965) (ex. *Dendrophyllia*, new combination herein), paratype, SNSB-BSPG 1965 I 214, middle Miocene, southern Germany (new, Baron-Szabo).——FIG. 7,*1b–c. *C. rolandi; b,* USNM 48468, lateral view of colony, Holocene (extant), Mediterranean Sea, 37°19.2´ N, 11°02.5´ E, 30 m depth; *c,* USNM 78764, calicular view of corallite, Holocene (extant), Mediterranean Sea, Tunisia (off Zembra Island), 15 m depth (Cairns, 2001, pl. 9,*f* and 9,*e,* respectively).

Dichopsammia SONG, 1994, p. 213 [**D. granulosa;* OD; holotype, EWHA Ant. 800515] [=*Schizopsammia* CAIRNS, 1994, p. 94 (type, *S. songae,* OD)]. Corallum arborescent to dendroid, colonies produced by intracalicular budding; budding mainly distomodaeal, sometimes irregularly intracalicular-marginal, or by developing

new corallite in pocket-like enclosure inside parent corallite, similar to the Taschenknospung in some amphiastreid and heterocoeniid genera; epitheca *sensu lato* absent; wall mainly synapticulothecal, sometimes parathecal, costate near calices, uniformly granular on branches; costae covered with fine rounded granules; septa compact, arranged in weak Pourtalès plan; paliform structures absent; columella feeble, trabecular; endothecal dissepiments subtabulate and vesicular; extant species zooxanthellate. [Type species is well described and discussed by Cairns (2001, p. 35, pl. 12,*j–m*).] *Holocene:* northwest Pacific Ocean, 20–30 m depth.——Fig. 7,*3. *D. granulosa,* holotype of *Schizopsammia songae* (Cairns), USNM 15847, Holocene (extant), northwest Pacific (off Pusan, Korea) (Cairns, 2001, pl. 12,*j*).

Duncanopsammia Wells, 1936a, p. 547 [**Dendrophyllia axifuga* Milne Edwards & Haime, 1848, p. 101; OD; syntypes, NHMUK 46.7.30.38–39]. Flat-topped, arborescent colonies formed by unifacial (upward), extracalicular budding from lower, outer margins of parent corallites; coenosteum thick and not costate, instead covered with short, discontinuous, thin, parallel, finely serrate ridges not corresponding in number or position to septa; epitheca *sensu lato* absent; septa compact to subcompact, not exsert, arranged in Pourtalès plan; paliform structures absent; columella robust and discrete, composed of numerous finely serrate ridges linked together in mesh-like to labyrinthiform structure; endotheca absent; wall synapticulothecal; septothecal thickenings present or absent; zooxanthellate. [Based on its occurrence in reefal environments (e.g., see Veron & Kelley, 1988), *Duncanopsammia* is presumed to be zooxanthellate. The type species *D. axifuga* is well described by Veron & Pichon, 1980, p. 412–415.] *Pliocene–Holocene:* Melanesia, *Pliocene;* western Pacific, southeastern Indian Ocean, reef depths, *Holocene.*——Fig. 8,*1. *D. axifuga* (Milne Edwards & Haime), USNM 83501, species is characterized by flat-topped, arborescent colonies formed by unifacial (upward), extracalicular budding from lower, outer margins of parent corallites, Holocene (extant), Port Newry, Queensland, Australia (Cairns, 2001, pl. 12,*f*).

Eguchipsammia Cairns, 1994, p. 85, *nom. nov. pro Alcockia* Eguchi, 1968, p. 63, (type, *A. wellsi,* OD, lectotype, TIUS 58969 (designated by Cairns, 1994, p. 85), *non* Goode & Bean, 1895, p. 329, fish [**Dendrophyllia cornucopia* Pourtalès, 1871, p. 45; OD; syntypes MCZ 5442, 2752]. Colonial, producing irregular branches, resulting from sparse, irregular, extracalicular budding from axial corallite; commonly unattached (recumbent); third generation buds rare; intracalicular budding occurs infrequently; theca costate and hispid, usually partially covered with epitheca *sensu lato,* Pourtalès plan present; paliform lobes mainly absent; septa compact to subcompact; columella spongy, discrete, or fused to small number of axial ends of septa; wall synapticulothecal; endothecal dissepiments thin, vesicular extant species azooxanthellate. [*Alcockia wellsi* Eguchi, 1968 is best described by Cairns (1994, p. 85). Nine syntypes, plus one additional syntype of *E. cornucopia* (Pourtalès) are deposited at NMM; type specimens and type species discussed by Cairns (1979, p. 179–181, pl. xxxvi,1–4)]. *Miocene–Holocene:* Caribbean, *Miocene–Pliocene;* north and southwest Atlantic Ocean, western Indian Ocean, western and central Pacific Ocean, 25–1050 m depth, *Holocene.*——Fig. 8,*2a–b. *E. cornucopia* (Pourtalès), syntype, MCZ 2752, Holocene (extant), western Atlantic, 24°24´N, 81°52´W (Bibb Station 173), 220 m depth; *a,* lateral view of colony showing irregular branches and recumbent corallum; *b,* calicular view of corallite (Cairns, 2001, pl. 8,*c* and 8,*d,* respectively).

Enallopsammia Michelotti in Sismonda, 1871, p. 31 [**Coenopsammia scillae* Seguenza, 1864, p. 125; M] [=*Anisopsammia* Marenzeller, 1904, p. 314 (type, *Amphihelia rostrata* Pourtalès, 1878, p. 204, M)]. Corallum arborescent to subdendroid, produced by extracalicular budding; distinct costae covered with hispid granules may be present (as in type species), or coenosteum may be uniformly covered with small spines; epitheca *sensu lato* absent; synapticulotheca porous only near calicular edge; corallites sympodially or unifacially directed, resulting in bushy or planar coralla, respectively; costoseptal rostra often present; septa normally arranged (no Pourtalès plan, although S_3 often fused to common S_2), compact to subcompact; usually only three cycles of septa present; paliform lobes before S_2 sometimes present; columella papillose, often small; endotheca absent; extant species azooxanthellate. [According to Chevalier (1962, p. 492), type material of type species (probably referring to material in the Seguenza collection in Italy) is missing, maybe lost, but type material (350 specimens), given as a deed of gift to the Natural History Museum Vienna, Austria, in 1864 by Seguenza himself, is available under series NHMW 1864/0021 (verification of material data by Thomas Nichterl, NHMW, December 3, 2014). Revisions of this genus were carried out by Zibrowius (1973, p. 37–41) and Cairns (2001, p. 34–35) using the syntype NHMW 1864/0021/0240 from the Miocene of Rometto, Messina, Sicily, Italy. For establishing the genus *Enallopsammia,* Michelotti (in Sismonda, 1871, p. 31) used his own material (not specimens from the Seguenza collection), which is deposited at the University of Rome, Italy, under MPUR 2988. Michelotti's material was derived from the Upper Miocene of Messina, Italy. Seguenza's specimens were most likely derived from strata of both the Miocene and Pliocene of Sicily, Italy, and in contrast to Michelotti, Seguenza probably used Pliocene material to describe the species *Coenopsammia scillae* (e.g., see Cairns, 2001, p. 35)]. *Eocene–Holocene:* Polynesia, *Eocene;* Australasia, eastern, southern, and western Europe, *Miocene;* southern Europe, *Pliocene;* all regions of Atlantic, Indian, and Pacific Oceans, except for northeastern Pacific and northeastern Indian

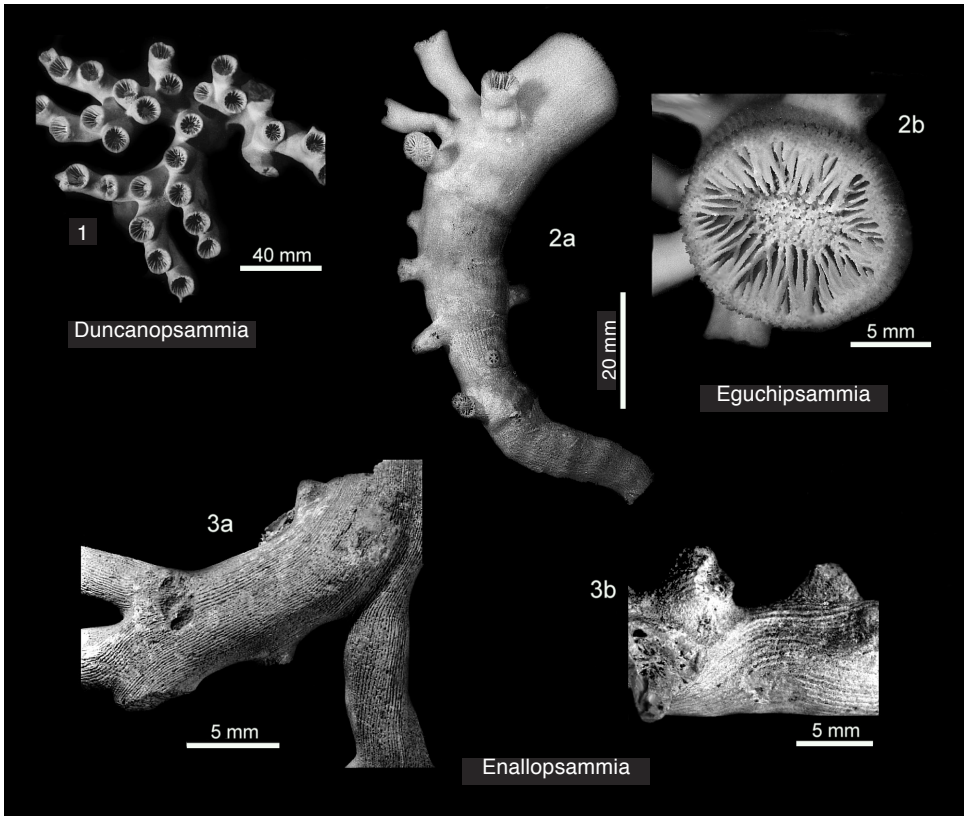

FIG. 8. Dendrophylliidae (p. 10–11).

Ocean, 110–2165 m depth, *Holocene*.——FIG. 8,*3a–b.* **E. scillae* (SEGUENZA), syntype, NHMW 1864/0021/0240, Miocene, Italy (Rometto, Messina); *a,* costae on posterior side of branch; *b,* two corallites with rostra (Cairns, 2001, pl. (12,*b* and 12,*a,* respectively).——Fig. 9,*1a–c.* **E. scillae* (SEGUENZA), MPUR 2988 (number corresponds to a set of five specimens, three of which are figured here), upper Miocene, Italy (Rometto, Messina); *a,* lateral view of colony of specimen #1; *b,* calicular view of corallite of specimen #2; *c,* lateral view of colony of specimen #3 (*a–c,* new, Baron-Szabo).

Endopachys LONSDALE, 1845, p. 514 [**E. alatum;* SD WELLS, 1975, p. 173; deposition of holotype unknown; =*Turbinolia maclurii* LEA, 1833, p. 193 (type species designation discussed by CAIRNS, 2001, p. 25)] [=*Rhectopsammia* VAUGHAN, 1900, p. 183 (type, *R. claibornensis,* M)]. Corallum solitary and free; usually asexually budding by transverse division from basal anthocaulus; corallum usually cuneiform, some species with edge crests; epitheca *sensu lato* absent; Pourtalès plan present; septa subcompact to porous; columella spongy and discrete, but can be connected to trabecular extensions of some axial edges of septa; shape of corallum variable, including cuneiform, compressed-cylindrical, and flabellate; some species with 6 or 12 robust ridges or flanges (paracostal ridges of WELLS, 1975) aligned with C_1 and C_2. Base of corallum covered with spines arranged without order; spines usually aligned in narrow costae toward calice; up to 5 cycles of septa present in type species; paliform lobes as P_3 or P_4 usually present; endotheca sparse or absent; wall synapticulothecal; extant species azooxanthellate. *Eocene–Holocene:* North America, *Eocene–Miocene;* Australasia, *Miocene;* east and Southeast Asia, *Pleistocene;* off South Africa, all regions of Indian and Pacific Oceans except for northeastern Indian Ocean, 37–386 m depth, *Holocene.*——FIG. 9,*2a–b.* **E. maclurii* (LEA), Eocene, Alabama (Claiborne), USA; *a,* USGS 2391, calicular view of corallum, showing edge crests (*arrows*), typically developed in this genus (Cairns, 2001, pl. 7,*a*); *b,* USNM M158412, oblique basal view of corallum (Cairns, 2001, pl. 7,*b*).

Endopsammia MILNE EDWARDS & HAIME, 1848, p. 91 [**E. philippensis;* M; holotype, ?MNHM 1076 or ?MNHUK BM 1855.12.77.25]. Corallum solitary, ceratoid to cylindrical, firmly attached; epitheca *sensu lato* covers most of synapticulotheca; epitheca

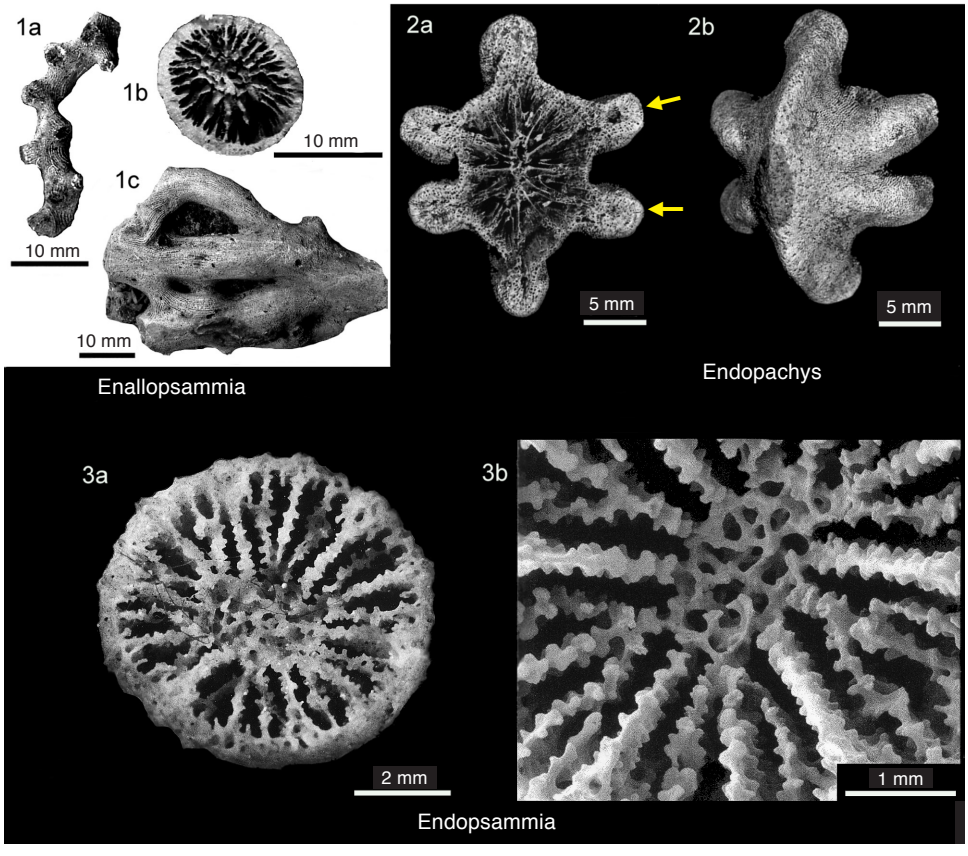

FIG. 9. Dendrophylliidae (p. 10–12).

sensu lato thin, weakly costate, covered with low granules; septa subcompact to porous, arranged in normal insertion pattern (not Pourtalès plan); up to 4 cycles of septa present in type species; axial edges of all septa coarsely dentate to laciniate; columella spongy, non-discrete; tabular endothecal dissepiments present in elongate coralla; paliform structures absent; azooxanthellate. [See CAIRNS (2001, p. 22–23) for comments on type specimen. [According to CAIRNS & ZIBROWIUS (1997, p. 188), the specimen MNHUK BM 1855.12.77.25 from the historic Stokes collection is labeled as the holotype of *E. philippensis*. Later, in 1999, another specimen was found at the MNHM (=MNHM 1076) of precisely the same dimensions of the holotype and bearing the label giving the exact original information of the holotype (p. 91, pl. 1,*5*). Both of the specimens were examined (see CAIRNS, 2001, p. 23, pl. 5, *f–i*). No information regarding the latter specimen is given on the MNHN collection website "colhelper.mnhn.fr" (last accessed February, 2019). Therefore, the holotype situation remains uncertain.] *Holocene:* northern Indian Ocean, and western, central and southeastern Pacific Ocean, 0–73 m depth.——FIG. 9,*3a–b*. **E. philippensis; a,* ?holotype, MNHUK BM 1855.12.77.25, calicular view, Holocene (extant), Philippines (Cairns, 2001, pl. 5,*f*); *b,* USNM 83006, detail of columella and axial septal edges, Holocene (extant), Australia (Heron Island, Queensland) (Cairns, 2001, pl. 5,*h*).

Explanaria LAMARCK, 1816, p. 254 [**E. mesenterina;* SD WELLS, 1986, p. 26; formerly placed as a junior synonym of *Turbinaria* OKEN, 1815, p. 67, but according to ICZN Opinion 417, 1956, the names proposed by OKEN (1815) are rejected] [=*Gemmipora* BLAINVILLE, 1830, p. 352 (type, *Madrepora crater* PALLAS, 1766, p. 332, SD WELLS, 1986, p. 28); =*Turbinacis* QUENSTEDT, 1880, p. 905 (type, *Explanaria mesenterina* LAMARCK, 1816, p. 255; SD QUENSTEDT, 1880, p. 905), *nom, van.,* also a senior homonym of *Turbinacis* GREGORY, 1900, p. 38; =*Turbinaria* OKEN, 1815, p. 67 (type, *Madrepora crater* PALLAS, 1766, p. 332; SD VAUGHAN, 1918, p. 147), *nom. null.,* name rejected by ICZN Opinion 417, 1956; =*Turbinaria* EHRENBERG, 1834, p. 305 (type, *Madrepora crater* PALLAS, 1766, p. 332; SD LÖSER, 2016, p. 678;

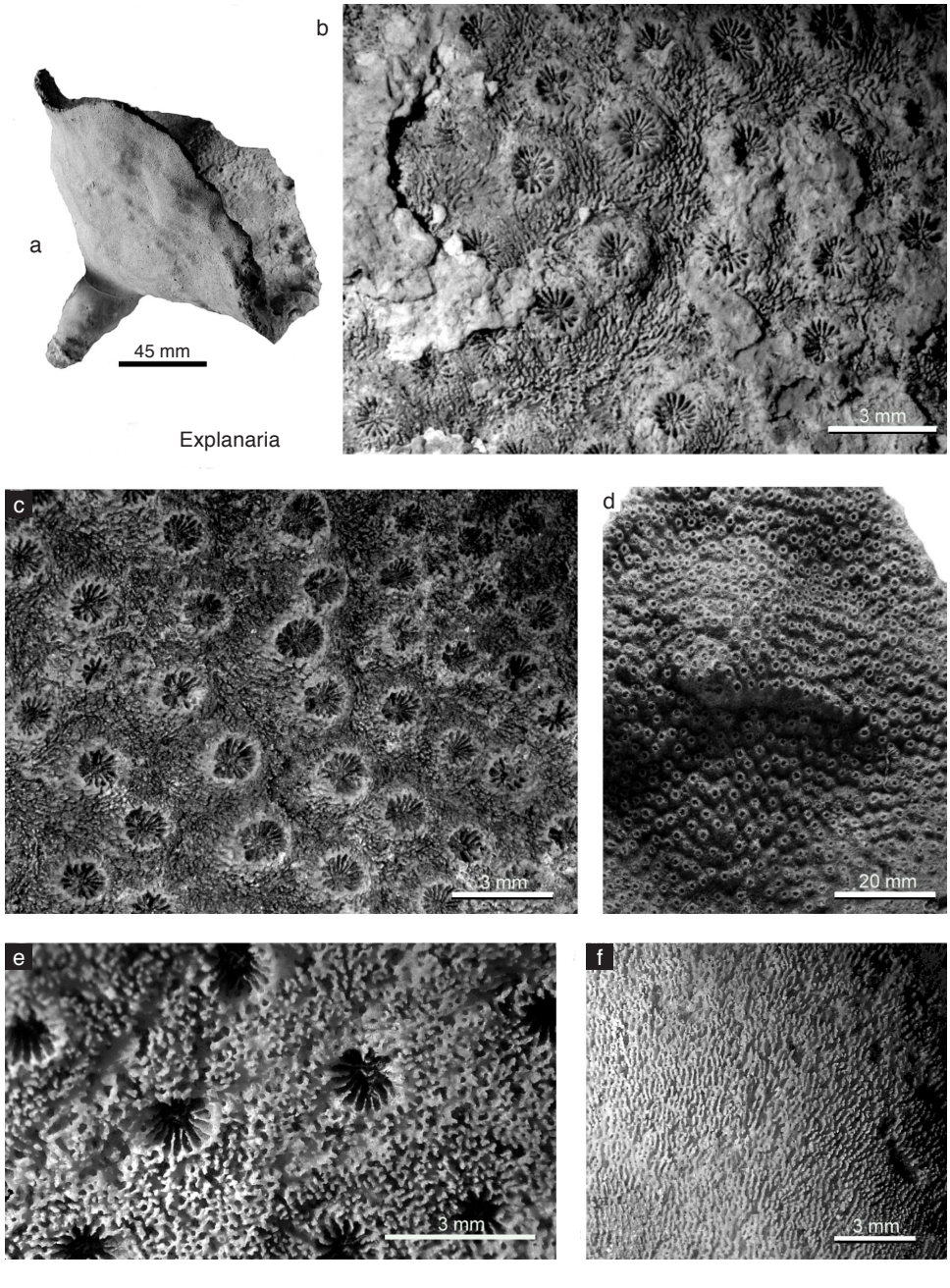

FIG. 10. Dendrophylliidae (p. 12–15).

obj. junior synonym of *Gemmipora* BLAINVILLE, 1830)]. Colonial, occurring in various shapes, including explanate or crateriform, vasiform, contorted foliaceous, encrusting, hemispherical, plocoid to phaceloid in exsertness; extant species zooxanthellate; budding mainly extracalicular; intracalicular budding rare or absent in some colonies; corallites long, unifacially disposed in non-branching coralla and embedded in extensive, porous coenosteum covered with discontinuous, hispid ridges; costosepta compact to subcompact, usually arranged normally in larger corallites,

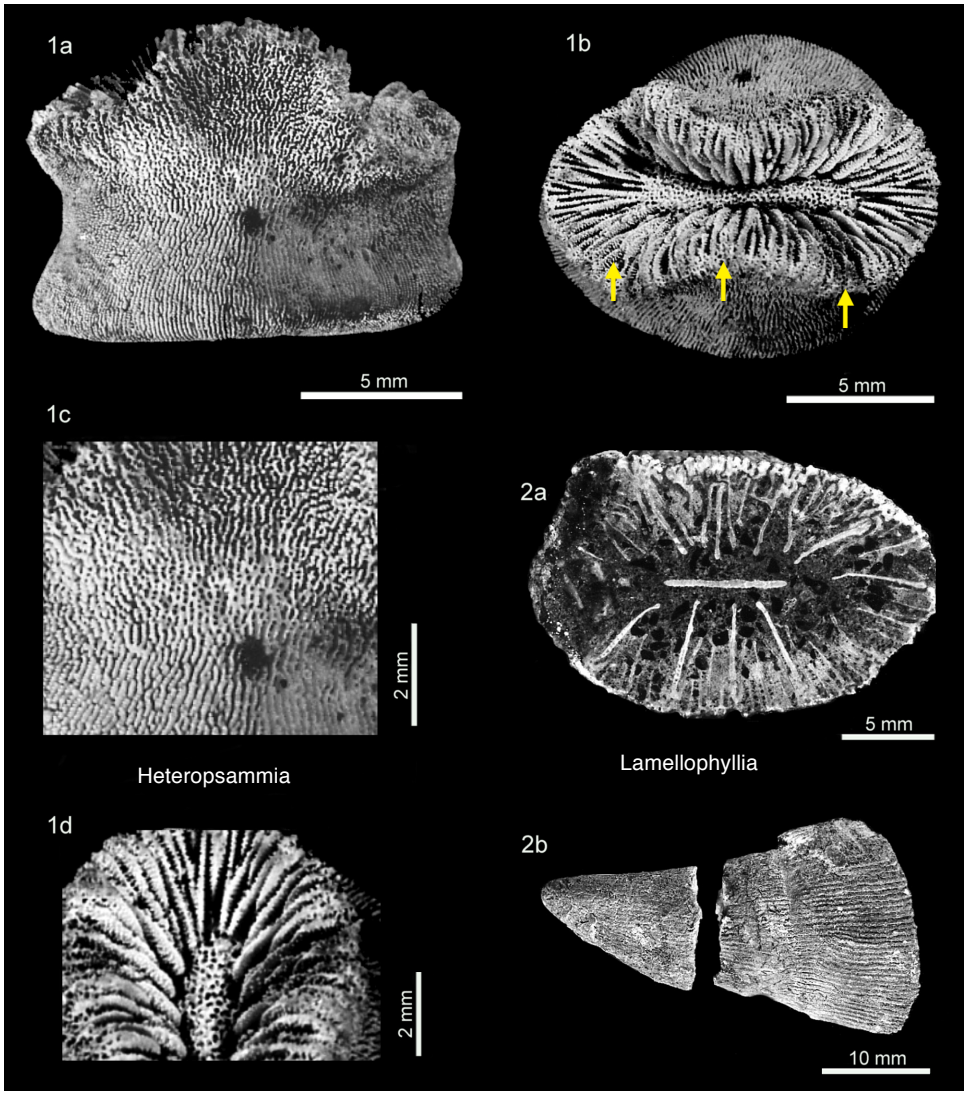

FIG. 11. Dendrophylliidae (p. 15).

but occasionally some systems show remnants of Pourtalès plan arrangement, especially common in small corallites; columella usually well developed, solid, spongy or labyrinthiform, occupying large percentage of relatively shallow fossa; pali generally absent; endothecal dissepiments sparse; wall synaticulothecal to synapticuloparathecal, porous; epitheca *sensu lato* absent. [Based on the sequencing of three genes, two mitochondrial and one nuclear, ARRIGONI and others (2014) considered this genus to be polyphyletic]. *Upper Cretaceous–Holocene:* western Europe, *Santonian;* Central America, South Asia, southern and western Europe, *Oligocene;* Australasia, Melanesia, eastern and southern Europe, south, Southeast, and west Asia, *Miocene;* Australasia, East and Southeast Asia, *Pleistocene;* Indo-West Pacific, reef depths, *Holocene.*——FIG. 10,*a–f. E. crater* (PALLAS); *a–d,* holotype, SMF–5579, Holocene (extant), region of Indo-West Pacific Oceans; *a,* lateral view of colony (new, Baron-Szabo); *b,* calicular view of colony (Baron-Szabo, 2015, fig. 5H); *c,* upper surface, calicular view of colony (new, Baron-Szabo); *d,* upper surface, calicular view of colony, with plocoid (circular) corallites arranged in chain-like series (Baron-Szabo, 2015, fig. 5F); *e–f,* paratype, SMF–5580; *e,* upper surface, calicular view of colony, with plocoid (circular) corallites irregularly

disposed over the colony (new, Baron-Szabo); *f,* upper surface, lateral view of colony (new, Baron-Szabo).

Heteropsammia Milne Edwards & Haime, 1848, p. 89 [**H. michelinii;* M; holotype, MNHN 1080]. Corallum solitary (monostomous) or colonial (polystomous), latter condition achieved by intracalicular budding and resulting in flabello-meandroid series of up to 40 contiguous corallites; adult corallum free and mobile, globular in shape, juvenile coralla usually attached to small gastropod shells, subsequently overgrown; each specimen apparently in obligate symbiosis with a sipunculid worm, which lives in base of corallum; epitheca *sensu lato* absent; wall synapticulothecal, covered with finely serrate ridges; usually 1–3 ridges per corresponding septum, thus not considered to be conventional costae; septa compact to subcompact; Pourtalès plan present; paliform lobes present or absent; columella spongy or made of irregular segments, fused to axial edges of septa; endotheca largely absent; extant species zooxanthellate or azooxanthellate, depending on depth and latitude. [Holotype of the type species is well described by Hoeksema & Borel-Best (1991, p. 221–223, 233–240) and Cairns (2001, p. 19–20).] *Miocene–Holocene:* Southeast Asia, *Miocene–Pleistocene;* **East** Asia, *Pliocene–Pleistocene;* sub-Saharan Africa, *Pleistocene;* northern and southeastern Indian Ocean, and western and central Pacific Ocean, 1–622 m depth, *Holocene.*——Fig. 11,*1a–d.* **H. michelinii*, holotype, MNHN 1080, Holocene (extant), China (Wanpoa); *a,* lateral view of corallum (Cairns, 2001, pl. 2,*h*); *b,* calicular view of corallum, showing colonial (polystomous) condition, resulting in flabello-meandroid corallite series (*arrows*), note, the basal part of the corallum is substantially enlarged, giving it a globular shape (Cairns, 2001, pl. 2,*i*); *c,* close-up of *a; d,* close-up of *b.*

Lamellophyllia Chevalier, 1962, p. 491 [**L. alloiteaui;* M, holotype MNHN R10483]. Corallum solitary, ceratoid, free, and slightly curved; epitheca *sensu lato* absent; wall synapticulothecal, costate, granular; Pourtalès plan present in early ontogenetic stages, becoming increasingly lost in adult stages; five cycles of septa present in type species; septa compact; paliform lobes present; endotheca sparse, mainly restricted to peripheral parts of corallum; columella lamellar. [The holotype of the type species is well described by Cairns (2001, p. 19, pl. 2,*c–d*).] *Miocene:* southern Europe.——Fig. 11,*2a–b.* **L. alloiteaui*, holotype, MNHN R10483, middle Miocene, Italy (Turin); *a,* calicular view of corallum (Cairns, 2001, pl. 2,*d*); *b,* lateral view of broken corallum (Cairns, 2001, pl. 2,*c*).

Leptopsammia Milne Edwards & Haime, 1848, p. 90 [**L. stokesiana;* M, holotype, NHMUK 1855.12.27.1.] Corallum solitary, ceratoid to subcylindrical, firmly attached; epitheca *sensu lato* present basally; synapticulotheca costate proximally; septa compact, arranged normally (not Pourtalès plan); usually 4 to 5 cycles of septa present; axial edges of S_1–S_2 smooth, those of S_3–S_4 dentate to

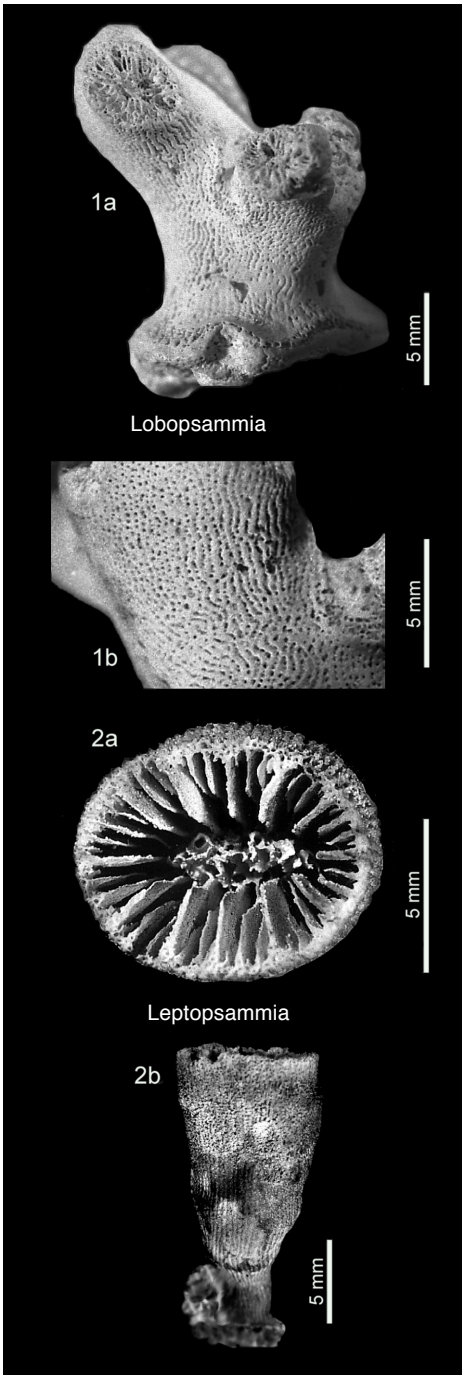

Fig. 12. Dendrophylliidae (p. 15–16).

laciniate; columella spongy, usually discrete; tabular endothecal dissepiments present or absent; extant species azooxanthellate. [See Cairns (2001, p. 23) for comments on type specimen. Type species is best described by Cairns & Zibrowius (1997, p. 186)]. *Miocene–Holocene:* southern Europe, *Miocene;* northern Atlantic, southeastern Indian Ocean, and western Pacific Ocean, 3–900 m depth, *Holocene*.——Fig. 12,*2a–b*. **L. stokesiana*, holotype, NHMUK 1855.12.27.1, Holocene (extant), Philippines; *a,* calicular view of corallum (Cairns, 2001, pl. 6,*d*); *b,* lateral view of corallum (Cairns, 2001, pl. 6,*a*).

Lobopsammia Milne Edwards & Haime, 1848, p. 105 [**Lithodendron cariosum* Goldfuss, 1826, p. 45; SD Milne Edwards & Haime, 1850, p. liii; holotype, IPB 159-Goldfuss collection] [=*Placopsammia* Reuss, 1859, p. 486 (type, *P. dichotoma,* M)]. Colonial, dendroid, forming small arborescent colonies by di- and tristomodaeal intracalicular budding; corallites often irregularly shaped or elongate in outline; septa subcompact to porous; wall synapticulothecal, costate; costae granular and serrate by deep intercostal furrows; septa arranged in Pourtalès plan; columella trabecular, mesh-like or made of twisted and elongate segments; endotheca sparsely present or absent; epitheca *sensu lato* present at base. [The type species is described and discussed by Cairns (2001, p. 36, pl. 13,*a–c*).] *Eocene–Oligocene:* eastern, southern, and western Europe, *Eocene–Oligocene;* northern Europe, *Oligocene*.——Fig. 12,*1a–b*. **L. cariosa* (Goldfuss), holotype, IPB 159–Goldfuss collection, Eocene, France; *a,* lateral view of colony; *b,* lateral view of colony, close-up (*a–b,* new, Baron-Szabo).

Notophyllia Dennant, 1899, p. 285 [**N. semivestita*; OD; holotype, NMV P27078] Corallum solitary, cuneiform to compressed cylindrical; asexually budding by transverse division, although attached anthocyathus-stage not observed; anthocyathus free, usually with remnant of basal scar; bands of epitheca *sensu lato* present (as in type species) or absent; costae present in some species (including type species), replaced by small spines in others; septa compact, arranged in normal insertion pattern (not Pourtalès plan) in hexameral (as in type species) or decameral symmetry; columella spongy (as in type species) or lamellar (most other species); endtheca absent; wall synapticulothecal; extant species azooxanthellate. [The holotype of the type species was revised and discussed in Cairns (2001, p. 25–26, pl. 7,*f, h–i;* pl. 8,*a–b*)]. *Miocene–Holocene:* Australasia, *Miocene;* southeastern Indian Ocean, and southwestern Pacific Ocean, 22–458 m depth, *Holocene*.——Fig. 13,*1a–b*. **N. semivestita*, holotype, NMV P27078, Middle Miocene, Australia (Gellibrand River, Victoria); *a,* calicular view of corallum (Cairns, 2001, pl. 7,*f*); *b,* lateral view of corallum (Cairns, 2001, pl. 7,*i*).

Palaeopsammia Wanner, 1902, p. 104 [**P. multiformis;* SD Wells, 1936b, p. 122; lectotype, NRM PZ–Cn 47549, from the Danian of Egypt (Babel Jasmund), designated herein; type species best described and illustrated by Baron-Szabo (2008, p. 35–39, pl. 2, fig. 5–6,8); discussions of the genus, including its proposed junior synonyms given by Cairns (2001), Baron-Szabo (2002, 2008), and Jell, Cook, & Jell (2011)] [=*Diegosmilia* Alloiteau, 1958, p. 153 (type, *Microseris complanata* Collignon, 1931, p. 48, OD Alloiteau, 1958, p. 153); =*Kumbiopsammia* Alloiteau, 1958, p. 201 (type, *K. besairiei,* OD); =*Pachycyathus* Alloiteau, 1958, p. 96 (type, *P. cylindratus,* OD); originally grouped with Thecocyathidae Vaughan & Wells, 1943, but study of holotype, MGSB 15700, from the Campanian of northern Spain by Baron-Szabo in 2005 (unpublished data) revealed that it showed skeletal structures typical of *Palaeopsammia;* =*Patellocyathus* Reig Oriol, 1995, p. 21 (type, *P. princeps,* OD); originally grouped with Caryophylliidae Dana, 1846, but holotype, MGSB 55845, from the Campanian of northern Spain shows skeletal structures typical of *Palaeopsammia*; =*Sakalavicyathus* Alloiteau, 1958, p. 194 (type, *S. collignoni*, OD)]. Solitary, variably conical to patellate-subdiscoid; costosepta irregularly porous, not arranged in Pourtalès plan, but higher cycle septa (S_4) frequently merge with those of lower cycle (S_3); paliform structures present, variable in number and shape; costae poorly developed, but represented by linear arrangement of coarse granules; columella generally well developed, parietal, spongy-papillose; endothecal dissepiments thin, vesicular; wall (para-) synapticulothecal, (?pseudo-) septothecal when secondarily thickened; epithecal *sensu lato* wall present or absent. *Lower Cretaceous (Valanginian)–Paleocene:* eastern Europe, *Valanginian;* southern Europe, *Barremian–Aptian;* North America, Indian Ocean; Caribbean, *Upper Cretaceous;* Indian Ocean, *Cenomanian;* Australasia, southern Europe, *Campanian;* North Africa, central, south, and west Asia, Maastrichtian; central Asia, North Africa, North America, *Paleocene*.——Fig. 13,*2a–b*. **P. multiformis* Wanner, 1902, lectotype, NRM PZ–Cn 47549 (designated herein), Danian of Egypt (Babel Jasmund); *a,* calicular view of corallum (Baron-Szabo, 2008, pl. 2,*5a*); *b,* oblique view of base of corallum (Baron-Szabo, 2008, pl. 2,*5b*).

Paleoastroides Chevalier, 1962, p. 487 [**P. michelini;* OD; holotype MNHN R8466]. Massive, plocoid coralla formed primarily by extracalicular budding, occasionally intracalicular budding; wall synapticulothecal, porous or in the form of a sharp ridge; costae appear as finely serrate ridges; Pourtalès plan present; septa compact to subcompact, developed in 4–5 cycles in type species; higher-order septa often irregularly fused; columella well developed, mesh-like, made of elongate wavy segments that fuse with elongate paliform lobes (P_1–P_3); exothecal dissepiments rare; endothecal dissepiments subtabulate to vesicular, rare. [The holotype of the type species is described, discussed, and illustrated by Cairns (2001, p. 27–28, pl. 9,*g–j*)]. *Upper Cretaceous (Maastrichtian)–Miocene:* Caribbean, *Maastrichtian;* eastern and southern Europe, North America, northern Asia, *Paleocene;* eastern and northern

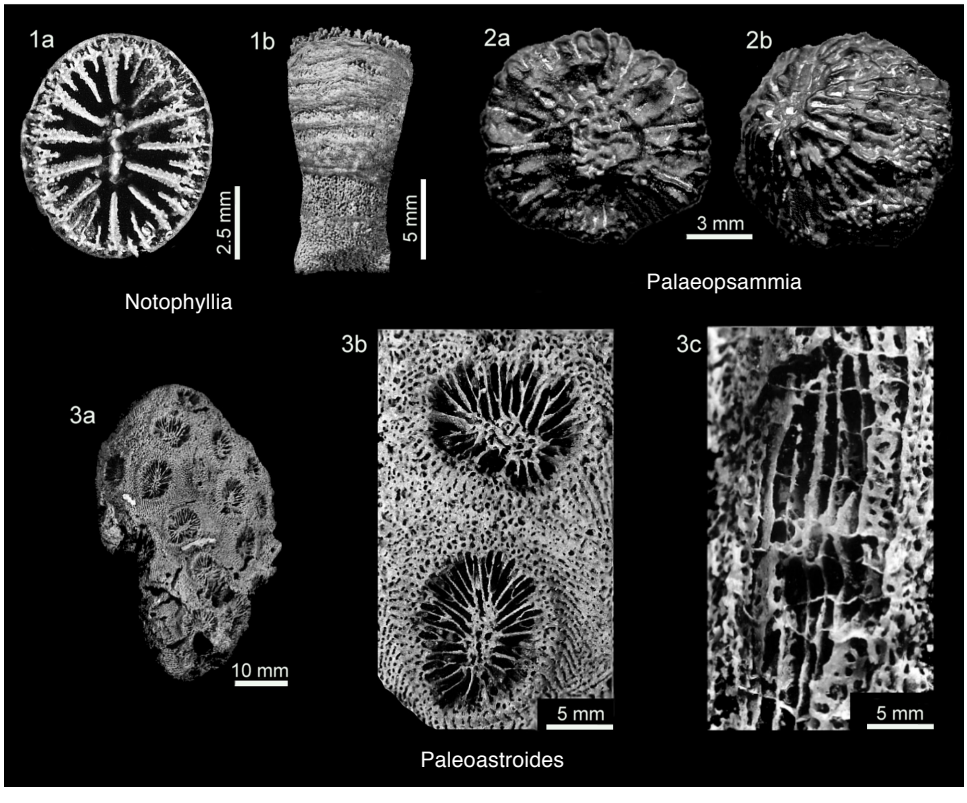

FIG. 13. Dendrophylliidae (p. 16–17).

Europe, *Eocene;* southern and western Europe, *Miocene.*——FIG. 13,*3a–c.* **P. michelini*, holotype, MNHN R8466, middle Miocene; *a,* upper surface of colon; *b,* close-up of *a; c,* lateral view of corallum showing tabular endothecal dissepiments (Cairns, 2001, pl. 9,*g, h,* and 9*j,* respectively).

Pourtalopsammia CAIRNS, 2001, p. 22 [**Balanophyllia togata* VAN DER HORST, 1927, p. 5; OD; holotype, NHMUK 1939.7.20.501]. Corallum solitary, variably conical to subcylindrical (sometimes scolecoid), and attached; epitheca *sensu lato* well developed, covering basal synapticulotheca; coenosteum distal to epitheca *sensu lato* covered with thin, hispid ridges; septa compact, arranged normally (not Pourtalès plan); three cycles of septa present in type species; axial edges of S_1 highly sinuous; columella absent; endothecal dissepiments absent; azooxanthellate. [A discussion of material later grouped with type species is provided by CAIRNS & KELLER (1993, p. 275–276); genus monographed and phylogenetic analysis based on morphology is provided by CAIRNS (2001)]. *Holocene* (extant): off South Africa, 155–775 m depth.——FIG. 14,*1a–c.* **P. togata*, USNM 91792, Holocene, Indian Ocean; *a,* calicular view of corallum, off South Africa, Meiring Naude Station, SM-226, 32°28.6′S, 28°58.8′E, 710–755 m depth (Cairns, 2001, pl. 4,*f*); *b,* USNM 91791, lateral view of corallum—typically dominated by faster rates of vertical rather than peripheral growth, resulting in subcylindrical (regularly elongate) or scolecoid (irregular, wormlike) shapes—covered by a well-developed epitheca *sensu lato* (*arrows*), off South Africa, Meiring Naude Station, SM–232, 32°14.9′S, 29°10.4′E, 620–650 m depth, (Cairns, 2001, pl. 4,*i*); *c,* close-up of *b.*

Reussopsammia WELLS, 1937, p. 75 [**Stereopsammia granulosa* REUSS, 1864, p. 204; OD]. Corallum produced by polystomodaeal intracalicular budding, resulting in flabello-meandroid arrangement of calices; costae granular; epitheca *sensu lato* absent; septa probably subcompact to porous, arranged normally (not Pourtalès plan), finely granulated laterally; endothecal dissepiments probably weakly developed or absent; columella absent; wall synapticulothecal, porous. [The type material could not be located between 1999 and 2017, and is presumed to be lost. The genus is discussed and included in a phylogenetic analysis based on morphology in CAIRNS (2001, p. 36–37). Up to the present, the only illustrations of this taxon are the original figures in REUSS (1864, pl. 1,*1a–2c*) and reproductions thereof in VAUGHAN & WELLS (1943, p. 342, pl. 50,*10,10a–10c*), WELLS (1956, p. 435, fig. 339,*3a–c*), and herein]. *Oligocene:* western

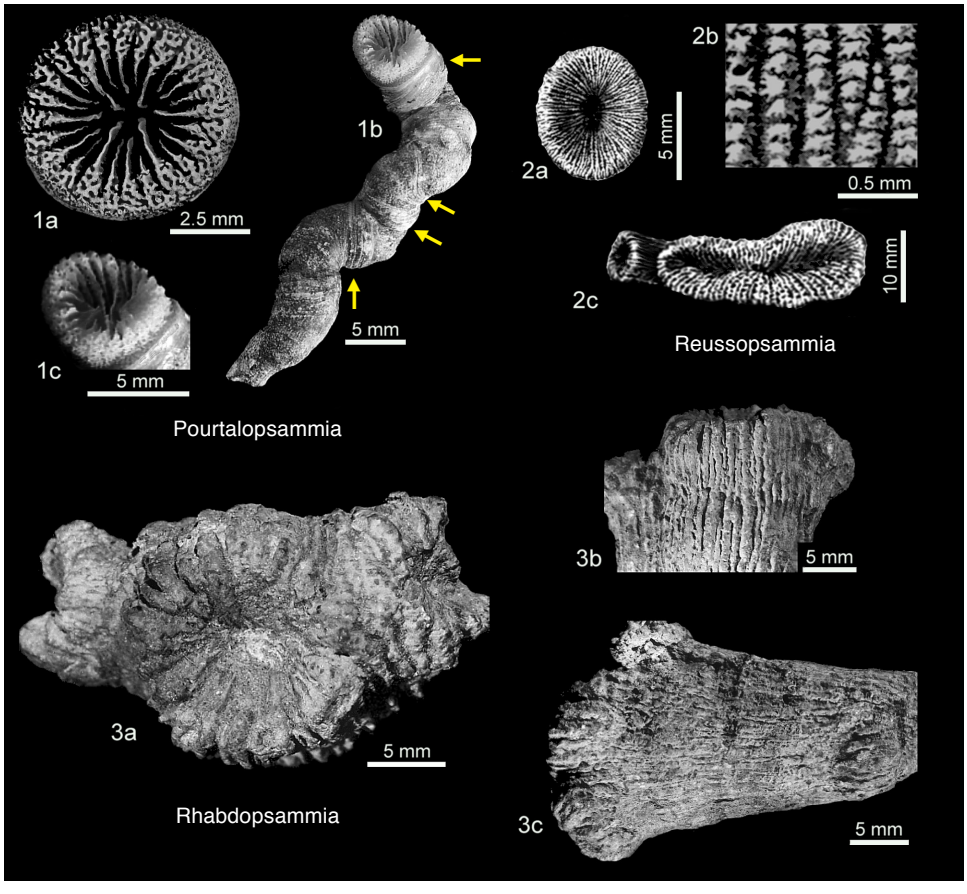

FIG. 14. Dendrophylliidae (p. 17–19).

Europe.——FIG. 14,*2a–c*. **R. granulosa* (REUSS), syntypes, Germany (Mainz area, marine sands of the Welschberg at Waldböckelheim); Reuss (1864, pl. 1,*1a–2c*) illustrated two specimens; dimensions of specimens herein are based on the original description and illustrations in Reuss, 1964, p. 209 of pl. 1,*1a–2c* and caption in Reuss, 1864, p. 209, pl. 1,*2a–c*); *a,* syntype #1, calicular view of one corallite (adapted from Reuss, 1864, pl. 1,*1b*); *b–c,* syntype #2; *b,* close-up view of lateral surface of colony of *c* (adapted from Reuss, 1864, pl. 1,*2c*); *c,* calicular view of colony (adapted from Reuss, 1864, pl. 1,*2b*).

Rhabdopsammia ALLOITEAU, 1952, p. 680 [**R. lanquinei;* OD; lectotype, MNHN R10960; lectotype designation by inference (ICZN, 1999, 74.6), ALLOITEAU (1957, pl. 4,*5a–b*); CAIRNS (2001, p. 40, pl. 13,*i–k*) did not regard this genus to be a dendrophylliid, but based on additional material and re-examination of the type material, BARON-SZABO (1999, p. 453–455, pl. 2,*4*; and 2014, p. 46–47, pl. 48,*4–5*) considered it to be a dendrophylliid based on the observations that its costal developments correspond to genera such as *Enallopsammia* and *Stichopsammia;* its septal arrangements resemble those of e.g., *Astroides, Enallopsammia,* and *Tubastraea;* its corallum morphology and thecal structures (endotheca and synapticulotheca) show affinities to *Tubastraea* and a possible close relationship with *Areopsammia*, as was discussed in BARON-SZABO (2014, p. 46–47)] [=*Elasmogyra* BEAUVAIS, 1982, vol. 2, p. 118 (type, *Aplosmilia crucifera* FELIX, 1903, p. 302, OD]. Solitary, cylindrical to turbinate (corallite diameter to around 18 mm in type species) and colonial, arranged in flabello-meandroid (intermediate astonic stages) to subdendroid clumps (adult stages); solitary stage probably with a corallite height to 25 mm in the type species; budding intracalicular; costosepta compact to subcompact, often much thicker near wall partly due to merging of adjacent septa (as in the presumably meandriniid genus *Dasmiopsis* OPPENHEIM, 1930); septal flanks covered with granules varying in size and shape (rounded, pointed, flat, crispate, and others); septa often normally arranged or weakly and irregularly following Pourtalès plan; endothecal dissepiments

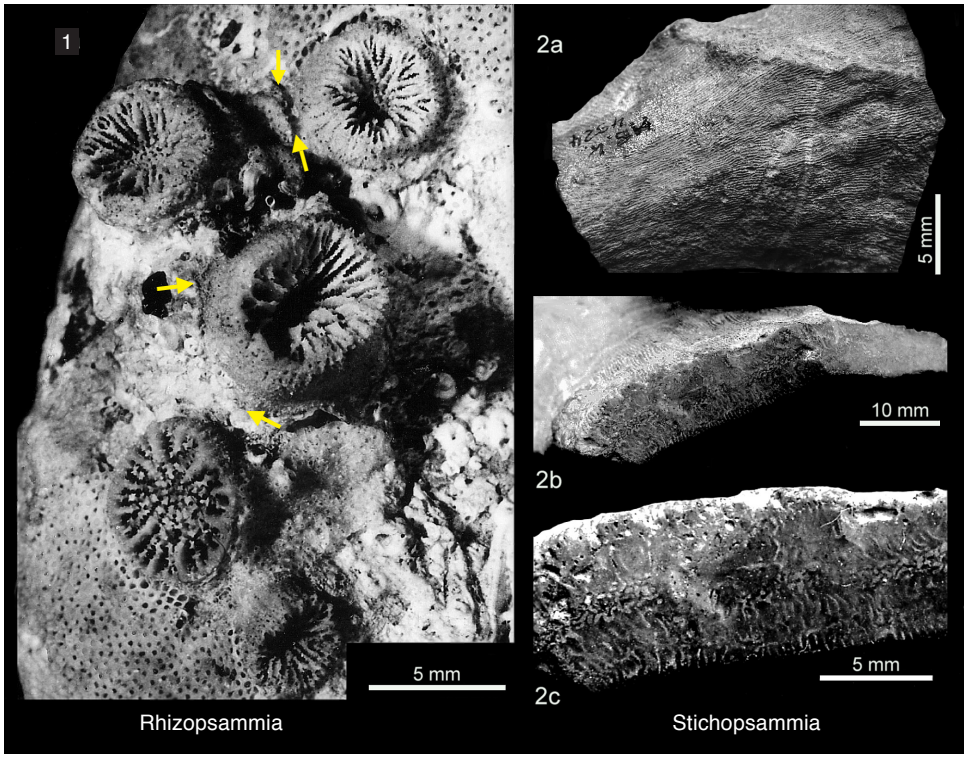

FIG. 15. Dendrophylliidae (p. 19–20).

vesicular, numerous; columella trabecular and in various spongy-papillose to segmented lamellar shapes; synapticulae present; wall synapticulothecal with sparsely occurring pores, in places secondarily thickened, forming a septotheca. [New data by BARON-SZABO (unpublished; material by Annemarie Gerhard, Hamburg) identifies Cenomanian origins of *Rhabdophyllia.* Also see BARON-SZABO (2014, p. 46–47, pl. 49,*1*–6 for more detailed discussion of synonyms and type species.] *Upper Cretaceous (Cenomanian–Campanian):* west Asia (Ajlun Mountains, northern Jordan), *Cenomanian;* western Europe, *Turonian–Campanian.*——FIG. 14,*3a–c.* **R. lanquinei*, lectotype, MNHN R10960, Coniacian, France (Mazaugues, Var); *a,* calicular view of corallum; *b,* detail of lateral view of corallum; *c,* lateral view of corallum (Cairns, 2001, pl. 13,*i, j,* and *k,* respectively).

Rhizopsammia VERRILL, 1870, p. 510 [**R. pulchra* VERRILL, 1870, p. 510; M; holotype, YPM 5375]. Corallum colonial, forming small reptoid colonies by extracalicular stoloniferous budding; costosepta compact; lateral flanks of septa finely granular; Pourtalès plan present; pali absent; columella spongy-papillose, usually small; synapticulothecal wall often made of single or small number of synapticular rings; small number of thin endothecal dissepiments present deeper in corallum or absent; extant species azooxanthellate. [Holotype of type species revised and discussed in CAIRNS (2001, p. 26–27, pl. 8,*g–h*). Based on the sequencing of three genes, two mitochondrial and one nuclear, ARRIGONI and others (2014) considered this genus to be paraphyletic]. *Pliocene–Holocene:* North America, *Pliocene;* Australasia, *Pleistocene;* North and Southwest Atlantic Ocean (South Africa), western and southeastern Indian Ocean, and western, central, and southeastern Pacific Ocean, 0–278 m depth, *Holocene.*——FIG. 15,*1.* **R. pulchra* VERRILL, 1870, upper surface of holotype, YPM 5375, showing corallites connected by stolon-like expansions from their basal parts (*arrows*), forming a reptoid colony, Holocene (extant), Pearl Islands, Gulf of Panama, (Cairns, 2001, pl. 8,*h*).

Stichopsammia FELIX, 1885, p. 417 [**S. gyrosa;* SD FELIX, 1925, p. 165, holotype, MB K.4524]. Colonial; corallum forming small, centimeter-sized colonies by polystomodaeal intracalicular budding; corallites linked in linear series (polycentric condition), resulting in flabellate branches; epitheca *sensu lato* absent; costae finely granular; septa subcompact to porous, arranged in Pourtalès plan; columella trabecular, made of lamellar segments that often appear in mesh-like pattern; endothecal dissepiments vesicular, paliform structures sparse; synapticulothecal wall compact to porous; septo-

thecal developments irregularly present or absent. [The genus is described and discussed by Cairns (2001, p. 36).] *Eocene–Miocene:* North America, western Europe, *Eocene;* southern Europe, *Eocene–Miocene.*——Fig. 15,*2a–c.* **S. gyrosa*, holotype, MB K.4524, Oligocene, Italy (Crosara); *a,* lateral view of colony; *b,* calicular view of colony, partially polished; *c,* close-up of *b* (*a–c,* new, Baron-Szabo).

Thecopsammia Pourtalès, 1868, p. 138 [**T. socialis;* SD Marenzeller, 1907, p. 8; syntypes, MCZ 5601, 2773 (five additional syntypes at NHM and one at YPM 4764)]. Corallum solitary, trochoid, firmly attached; septa compact, laterally covered by rounded and spiny granules; epitheca *sensu lato* always present, covering basal 20%–95% of synapticulotheca; synapticulotheca thick (3–4 mm) and hispid, not costate; Pourtalès plan present; paliform lobes present or absent; columella small (less than 20% of corallite diameter) to moderate in size; columella composed of several discrete lamellae that are often slightly twisted, swirled, or fused together; endotheca absent; azooxanthellate. [Type species is best described by Cairns (1979, p. 188); additional information on the genus with discussions provided by Cairns (2001, p. 23–24). In having endothecal dissepiments and porous costosepta that seem to be arranged in a normal pattern (not Pourtalès plan), the material described from the Eocene of Ukraine as *T. cyclindrica* by Kuzmicheva (1987, p. 151–152, pl. 26,*5–6*) differs from *Thecopsammia* but might represent a rhizangiid or fungiid taxon. Therefore, the Eocene material is excluded.] *Holocene* (extant): North and west Atlantic Ocean, southwest Pacific Ocean, 183–879 m depth.——Fig. 16,*1a–b.* **T. socialis; a,* calicular view of syntype, MCZ 5601, off Florida, 183–549 m depth (Cairns, 2001, pl. 6,*g*); *b,* USNM 61828, lateral view of topotype, showing firmly attached trochoid corallum (*arrow*), west Atlantic Ocean (Eastward Station 34952), 30°12´N, 79°50.1´W, 610 m depth (Cairns, 2001, pl. 6,*c*).

Trochopsammia Pourtalès, 1878, p. 208 [**T. infundibulum*, M; syntypes, NHMUK 1939.7.20.430–431 (two additional syntypes at MCZ 5607). Corallum solitary, trochoid, attached; epitheca *sensu lato* covering lower part of corallum; synapticulotheca thick (i.e., as wide as septal thickness at calicular edge), costate; septa compact; costae wide (i.e., over five times width of intercostal striae) and finely granular; septa arranged in normal insertion pattern (not Pourtalès plan); three cycles of septa in type species, all septa about same size; columella rudimentary or absent; endotheca present deeper in corallum, sparse; azooxanthellate. [The type species is best described by Cairns (1979, p. 194–195); genus monographed and phylogenetic analysis based on morphology provided by Cairns (2001).] *Holocene* (extant): North and west Atlantic Ocean, 532–1472 m depth.——Fig. 16,*2a–b.* **T. infundibulum,* syntype, MCZ 5607, off northwestern Cuba (Blake Station 25), 1161–1472 m depth; *a,* calicular view of corallum (Cairns, 2001, pl. 5,*c*); *b,* lateral view of corallum (Cairns, 2001, pl. 5,*b*).

Tubastraea Lesson, 1829, p. 93 [**T. coccinea;* M] [=*Agatheliopsis* Löser, 2014, p. 308 (type, *A. orientalis,* OD); =*Astropsammia* Verrill, 1869, p. 392 (type, *A. pedersenii;* M); =*Coenopsammia* Milne Edwards & Haime, 1848, p. 106 (type, *T. coccinea* Lesson, 1829, p. 93, SD Milne Edwards & Haime, 1850, p. liii, *nom. van.*; =*Pachysammia* Verrill, 1866, p. 30 (type, *P. valida,* M); =*Morabeza* Ocaña, Brito, & Espinoza, 2019, p. 65 (type, *M. benitoi* Ocaña & Brito, OD, Ocaña, Brito & Espinoza, 2019, p. 65); =*Pachypsammia* Cairns, 2001, p. 28, *nom. null., lapsus calami pro Pachysammia* Verrill, 1866, p. 30]. Colonial, cerioid, plocoid or variably branching (e.g., dendroid, phaceloid, subfaciculate); extant species azooxanthellate; budding extracalicular and rarely intracalicular (Boschma, 1953); corallum of most species plocoid (including type species) with corallites originating from thick, common basal coenosteum, but *T. micranthus* (Ehrenberg, 1834, p. 304) with large, erect, dendroid colonies; synapticulotheca thin and highly porous; granular costae usually present; epitheca *sensu lato* absent or ?present (see Stolarski, 1996, pl. 17,*4a–b*); corallites of plocoid coralla flush with coenosteum or highly exsert; coenosteum porous, reticulate or granular; corallites invariably over 4 mm in diameter; septa compact, normally arranged, but higher-cycle septa often having dentate or laciniate axial edges that are fused to lower-cycle septa (but not in Pourtalès plan); columella spongy to irregular trabecular (e.g., type species), often fused to axial ends of septa; endothecal dissepiments subtabulate, common; paliform structures absent. [Based on the sequencing of three genes, two mitochondrial and one nuclear, Arrigoni and others (2014) considered this genus to be monophyletic. The holotype is probably lost. According to Wells (1936b, p. 132), the holotype is deposited at MNHN, but could neither be found in 1999 nor has it been included in the collections database of the MNHN (colhelper.mnhn.fr), as of February 2019). The type species is well described by Cairns (2001, p. 28–29, pl. 10,*i–j*.] *Upper Cretaceous (Maastrichtian)–Holocene:* west Asia, *Maastrichtian;* Antarctica, North America, *Eocene;* western Europe, *Miocene,* Central America, sub-Saharan Africa, *Pleistocene;* west Atlantic (introduced), and all regions of Indian and Pacific Oceans, 0–110 m depth, *Holocene.*——Fig. 17,*1a–b.* **T. coccinea*, Holocene (extant); *a,* USNM 83660, upper surface of topotype, Tahiti (Atimaono Bay), 7 m depth (Cairns, 2001, pl. 10,*j*); *b,* topotype, USNM 46973, cross view of corallites, which are typically enclosed by a highly porous synapticulothecal wall (*arrows*), Bartolomé, Galápagos, 20–27 m depth, (Cairns, 2001, pl. 10,*k*).

Wadeopsammia Wells, 1933, p. 227 [**Trochosmilia nodosa* Wade, 1926, p. 26; OD; holotype, USNM I32703]. Corallum solitary, free, and trochoid, curved, with a small or slightly expanded base, which may enclose a small tabular cavity; upper

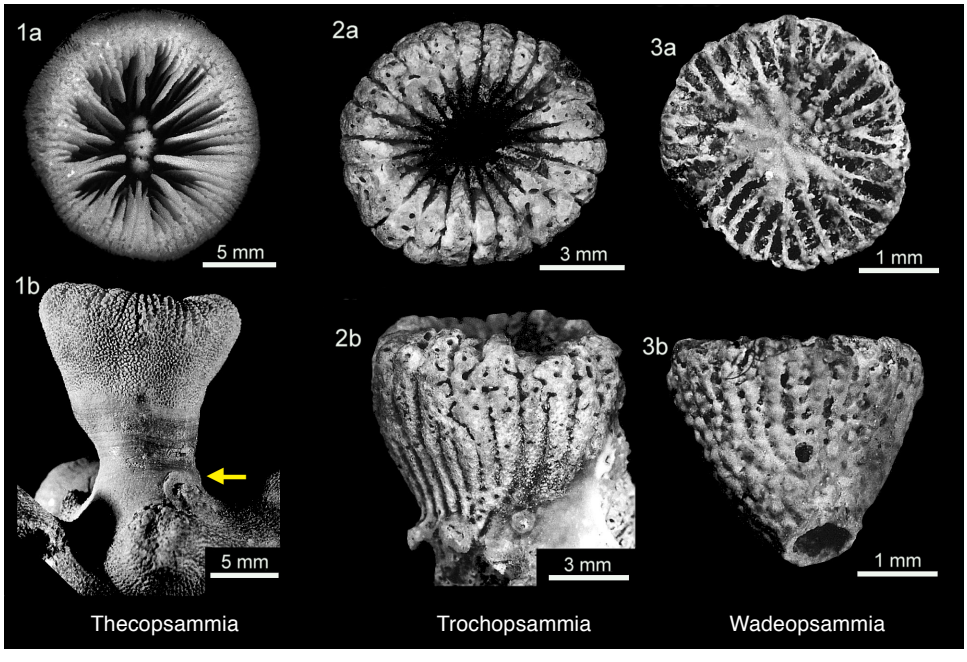

FIG. 16. Dendrophylliidae (p. 19–20).

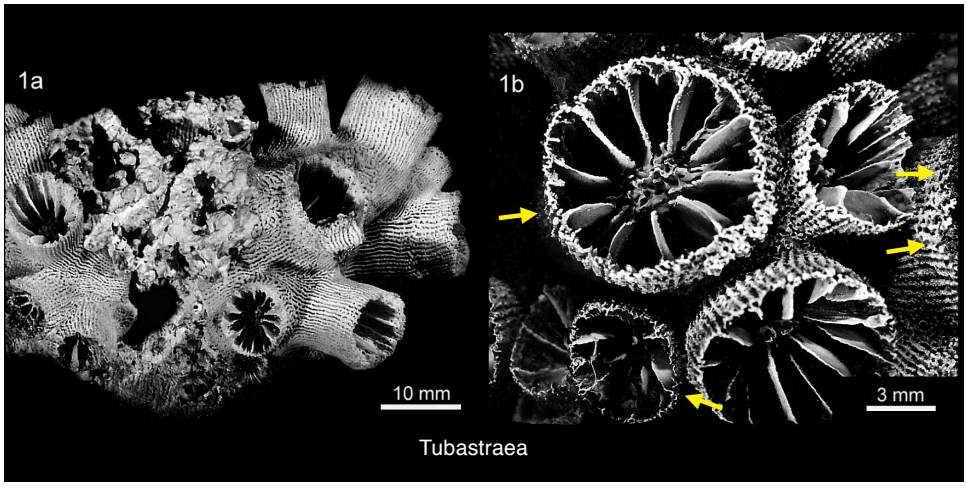

FIG. 17. Dendrophylliidae (p. 20).

surface broad, nearly flat; septa irregularly porous, margins beaded or dentate; lateral septal flanks covered by granules varying in size and shape (e.g., long spiny, small rounded); Pourtalès plan present; costae coarsely granular; columella solid, formed by cemented axial edges of septa; wall synapticulothecal, incomplete, irregularly internally thickened by stereome; endothecal dissepiments thin, few in number; epitheca *sensu lato* absent; small portions of septothecal patches irregularly present. [Holotype USNM I32703 is described by CAIRNS, 2001, p. 20–21, pl. 3,*f–i,* and by BARON-SZABO, 2002, p. 78–79, pl. 57,*3–4* and 2008, p. 40, pl. 3,*1a–b*.] *Upper Cretaceous (Maastrichtian):* North America.——FIG. 16,*3a–b*. **W. nodosa* (WADE), holotype, USNM I32703, USA (Tennessee, Coon

continued on p. 26

TABLE 1. Synopsis of dendrophylliid genera, including a short characterization and stratigraphic ranges.

Dendrophylliid genera	Geographic distributions	Stratigraphic ranges	Remarks
Dendrophyllia Blainville, 1830, p. 319 [**Madrepora ramea* Linnaeus, 1758, p. 797; SD Milne Edwards & Haime, 1850, p. liii]	Cretaceous: Caribbean, East Asia, western Europe; Paleogene: Australasia, Europe, North Africa, North and South America, northern and Southeast Asia, sub-Saharan Africa; Neogene: Australasia, Caribbean, Melanesia, North America, Southeast Asia, southern Europe (cosmopolitan in Miocene); Holocene: North and southwest Atlantic, off South Africa, all regions of Indian and Pacific Oceans, 1–1200 m depth	Upper Cretaceous (Campanian)–Holocene	Lectotype designation by Zibrowius (1980); contains junior synonym *Brasseyia* Wright, 1882; genus considered to be polyphyletic by Arrigoni and others (2014)
Areopsammia Dietrich, 1917, p. 307 [**A. mastrichtensis* Dietrich, 1917, p. 307; M]	Cretaceous: western Europe	Upper Cretaceous (Maastrichtian)	Contains the junior synonym *Porosmilia* Umbgrove, 1925; Cairns (2001) and Baron-Szabo (2008) provide additional information on the genus
Astroides Quoy & Gaimard, 1827, p. 187 [**A. luteus;* M]	Neogene: eastern, southern and western Europe; Holocene: northeast Atlantic Ocean, 0–30 m depth	Miocene–Holocene	Together with *Paleoastroides, Rhabdopsammia,* and *Tubastraea,* this genus has the best-developed endotheca of the dendrophylliids
Balanophyllia Wood, 1844, p. 11 [**B. calyculus;* M]	Cretaceous: western Europe, Indian Ocean, south and west Asia, southern Europe, Australasia, Indian Ocean; Paleogene: Australasia, Europe, Americas, sub-Saharan Africa; Neogene: Australasia, Central and North America, east and Southeast Asia, Melanesia, northern, southern, and western Europe, (cosmopolitan in the Miocene); Holocene: cosmopolitan, 0–1150 m depth	Upper Cretaceous (Santonian)–Holocene	Neotype established by Cairns (2001); contains the junior synonyms *Blastopsammia* Klunzinger, 1879; *Ceratopsammia* Alloiteau, 1958; *Clonotrochus* Schafhäutl, 1863; *Eupsammia* Milne Edwards & Haime, 1848; *Ilerdosmilia* Reig Oriol, 1997; *Osteodes* Conrad, 1855; and *Rhodopsammia* Semper, 1872; genus considered to be polyphyletic by Arrigoni and others (2014)
Balanopsammia Ocaña & Brito, 2013, p. 89 [**B. wirtzi;* OD]	Holocene: northeast Atlantic Ocean (Cape Verde Islands), 0–10 m depth	Holocene	Transitional between *Balanophyllia* and *Cladopsammia,* differing from former by being colonial, differing from latter in having closely adjacent corallites and a different cnidome
Bathypsammia Marenzeller, 1907, p. 8 [**Thecopsammia tintinnabulum* Pourtalès, 1868, p. 138; OD]	Holocene: northwest Atlantic Ocean, 183–805 m depth	Holocene	Lectotype designation and type best described by Cairns (1979)

Dendrophylliid genera	Geographic distributions	Stratigraphic ranges	Remarks
Blastozopsammia Filkorn & Pantoja-Alor, 2004, p. 505 [**B. guerreroterion;* OD]	Cretaceous: Central America	Lower Cretaceous (Albian)–Upper Cretaceous (lower Cenomanian)	Type material best described by Filkorn & Pantoja-Alor (2009, p. 105–109); possibly zooxanthellate
Cahuzacopsammia Chaix, 1999, p. 806 [**C. meandrinoides;* OD]	Paleogene: western Europe	Oligocene	Has very irregularly developed synapticulothecal wall that is compact in some areas and highly porous in others
Cairnsipsammia Baron-Szabo, 2015, p. 223 [**C. merbeleri;* OD]	Cretaceous: western Europe	Lower Cretaceous (upper Barremian–lower Aptian)	Oldest known colonial dendrophylliid; possibly zooxanthellate
Cladopsammia Lacaze-Duthiers, 1897, p. 208 [**C. rolandi;* M]	Neogene: western Europe, Sub-Saharan Africa; Holocene: all regions of Atlantic Ocean, and western, central, and southeastern Pacific Ocean, 0–470 m depth	Miocene–Holocene	Type species best described by Zibrowius (1980); additional information on type species provided by Cairns (2001); genus considered to be polyphyletic by Arrigoni and others (2014)
Dichopsammia Song, 1994, p. 213 [**D. granulosa;* OD]	Holocene: northwest Pacific Ocean, 20–30 m depth	Holocene	Has the special feature of developing new corallites in pocket-like enclosures inside the mother/parent corallite, similar to the 'Taschenknospung' in some amphiastraeid and heterocoeniid genera; contains the junior synonym *Schizopsammia* Cairns, 1994
Duncanopsammia Wells, 1936a, p. 547 [**Dendrophyllia axifuga* Milne Edwards & Haime, 1848, p. 101; OD]	Neogene: Melanesia; Holocene: western Pacific, southeastern Indian Ocean, reef depths	Pliocene–Holocene	Type species well described by Veron & Pichon (1980); genus presumed to be zooxanthellate by Veron & Kelley (1988)
Eguchipsammia Cairns, 1994, p. 85, *nom. nov. pro Alcockia* Eguchi, 1968, p. 63, (type, *A. wellsi;* OD]	Neogene: Caribbean; Holocene: North and southwest Atlantic Ocean, western Indian Ocean, western and central Pacific Ocean, 25–1050 m depth	Miocene–Holocene	Lectotype designated and type species best described by Cairns (1994)
Enallopsammia Michelotti in Sismonda, 1871, p. 31 [**Coenopsammia scillae* Seguenza, 1864, p. 125; M]	Paleogene: Polynesia; Neogene: Australasia, Europe; Holocene: all regions of Atlantic, Indian, and Pacific Oceans, except for northeastern Pacific and northeastern Indian Oceans, 110–2165 m depth	Eocene–Holocene	Revisions of genus by Zibrowius (1973) and Cairns (2001); contains the junior synonym *Anisopsammia* Marenzeller, 1904
Endopachys Lonsdale, 1845, p. 514 [**E. alatum;* SD Wells, 1975, p. 173]	Paleogene–Neogene: North America; Neogene: Australasia, east and Southeast Asia; Holocene: off South Africa, all regions of Indian and Pacific Oceans except for northeastern Indian Ocean, 37–386 m depth	Eocene–Holocene	Contains the junior synonym *Rhectopsammia* Vaughan, 1900

Dendrophylliid genera	Geographic distributions	Stratigraphic ranges	Remarks
Endopsammia Milne Edwards & Haime, 1848, p. 91 [**E. philippensis;* M]	Holocene: northern Indian Ocean, and western, central and southeastern Pacific Ocean, 0–73 m depth	Holocene	See Cairns (2001) for comments on type specimen; type species best described by Cairns & Zibrowius (1997)
Explanaria Lamarck, 1816, p. 254 [**E. mesenterina* Lamarck, 1816, p. 254; SD Wells, 1986, p. 26]	Cretaceous: western Europe; Paleogene: Central America, south Asia, southern and western Europe; Neogene: Australasia, eastern and southern Europe, east, south, Southeast, and west Asia, Melanesia; Holocene: Indo-west Pacific, reef depths	Upper Cretaceous (Santonian) Oligocene–Holocene	Formerly placed as a junior synonym of *Turbinaria* Oken, 1815, but according to ICZN decision 417, 1956 the names proposed by Oken (1815) are rejected; contains the junior synonyms *Gemmipora* Blainville, 1830; *Turbinacis* Quenstedt, 1880; extant forms zooxanthellate; genus considered to be polyphyletic by Arragoni & others (2014)
Heteropsammia Milne Edwards & Haime, 1848, p. 89 [**H. michelinii;* M]	Neogene: east and Southeast Asia, sub-Saharan Africa; Holocene: northern and southeastern Indian Ocean, and western and central Pacific Ocean, 1–622 m depth	Miocene–Holocene	Adult corallum free and mobile, globular in shape; juvenile coralla usually attached to small gastropod shells; extant forms zooxanthellate or azooxanthellate, depending on depth and latitude; holotype of type species well described by Hoeksema & Borel Best (1991), and Cairns (2001)
Lamellophyllia Chevalier, 1962, p. 491 [**L. alloiteaui;* M]	Neogene: southeasterm Europe	Miocene	Holotype of the type species well described by Cairns (2001)
Leptopsammia Milne Edwards & Haime, 1848, p. 90 [**L. stokesiana;* M]	Neogene: southern Europe; Holocene; northern Atlantic, southeastern Indian Ocean, and western Pacific Ocean, 3–900 m depth	Miocene–Holocene	See Cairns (2001, p. 23) for comments on type specimen; type species best described by Cairns & Zibrowius (1997)
Lobopsammia Milne Edwards & Haime, 1848, p. 105 [**Lithodendron cariosum* Goldfuss, 1826, p. 45; SD Milne Edwards & Haime, 1850, p. liii]	Paleogene: Europe	Eocene–Oligocene	Type species described and discussed by Cairns (2001); contains the junior synonym *Placopsammia* Reuss, 1859
Notophyllia Dennant, 1899, p. 285 [**N. semivestita;* OD]	Neogene: Australasia; Holocene: southeastern Indian Ocean, and southwestern Pacific Ocean, 22–458 m depth	Miocene–Holocene	Holotype of type species revised and discussed in Cairns (2001)
Palaeopsammia Wanner, 1902, p. 104 [**P. multiformis* Wanner, 1902, p. 105; SD Wells, 1936b, p. 122]	Lower Cretaceous: eastern and southern Europe; Upper Cretaceous: Australasia Caribbean, central, south, and west Asia, Indian Ocean, North Africa, North America, southern Europe; Paleogene: Central Asia, North Africa, North America	Lower Cretaceous (Valanginian)–Paleocene	Lectotype designation herein; contains the junior synonyms *Diegosmilia* Alloiteau, 1958; *Kumbiopsammia* Alloiteau, 1958; *Pachycyathus* Alloiteau, 1958; *Patellocyathus* Reig Oriol, 1995; *Sakalavicyathus* Alloiteau, 1958; type species best described and illustrated by Baron-Szabo (2008)

Dendrophylliid genera	Geographic distributions	Stratigraphic ranges	Remarks
Paleoastroides Chevalier, 1962, p. 487 [**P. michelini;* OD]	Upper Cretaceous: Caribbean; Paleogene: Europe, North America, Northern Asia; Neogene: southern and western Europe	Upper Cretaceous (Maastrichtian)–Miocene	Together with *Astroides, Rhabdopsammia,* and *Tubastraea,* this genus has the best-developed endotheca of the dendrophylliids; holotype of type species described, discussed, and illustrated by Cairns (2001)
Pourtalopsammia Cairns, 2001, p. 22 [**Balanophyllia togata* van der Horst, 1927, p. 5; OD]	Holocene: off South Africa, 155–775 m depth	Holocene	Discussion of material later grouped with type species provided by Cairns & Keller (1993)
Reussopsammia Wells, 1937, p. 75 [**Stereopsammia granulosa* Reuss, 1864, p. 204; OD]	Paleogene: western Europe	Oligocene	The only illustrations of this taxon are the original figures in Reuss (1864), and reproductions thereof in Vaughan & Wells (1943), Wells (1956), and herein
Rhabdopsammia Alloiteau, 1952, p. 680 [**R. lanquinei;* OD]	Upper Cretaceous: west Asia western Europe	Upper Cretaceous (Cenomanian–Campanian)	Contains the junior synonym *Elasmogyra* Beauvais, 1982; together with *Astroides, Paleoastroides,* and *Tubastraea,* this genus has the best-developed endotheca of the dendrophylliids
Rhizopsammia Verrill, 1870, p. 510 [**R. pulchra;* M]	Neogene: Australasia, North America; Holocene: North and southwest Atlantic Ocean (South Africa), western and southeastern Indian Ocean, and western, central, and southeastern Pacific Ocean, 0–278 m depth	Pliocene–Holocene	Genus considered to be paraphyletic by Arrigoni & others (2014)
Stichopsammia Felix, 1885, p. 417 [**S. gyrosa;* SD Felix, 1925, p. 165]	Paleogene: North America, western Europe; Paleogene–Neogene; southern Europe	Eocene–Miocene	Type species described and discussed by Cairns (2001)
Thecopsammia Pourtalès, 1868, p. 138 [**T. socialis;* SD]	Holocene: North and west Atlantic Ocean, southwestern Pacific Ocean, 183–879 m depth	Holocene	Type species best described by Cairns (1979); additional information with discussions provided by Cairns (2001)
Trochopsammia Pourtalès, 1878, p. 208 [**T. infundibulum;* M]	Holocene: North and west Atlantic Ocean, 532–1472 m depth	Holocene	Type species best described by Cairns (1979)

Table 1 continued on p. 26

Dendrophylliid genera	Geographic distributions	Stratigraphic ranges	Remarks
Tubastraea Lesson, 1829, p. 93 [**T. coccinea;* M]	Upper Cretaceous: west Asia; Paleogene: Antarctica, North America; Neogene: Central America, sub-Saharan Africa, western Europe; Holocene: west Atlantic (introduced), and all regions of Indian and Pacific Oceans, 0–110 m depth	Upper Cretaceous (Maastrichtian)–Holocene	Type species well described by Cairns (2001); contains the junior synonyms *Agatheliopsis* Löser, 2014; *Astropsammia* Verrill, 1869; *Coenopsammia* Milne Edwards & Haime, 1848; *Morabeza* Ocaña, Brito, & Espinoza, 2019; *Pachysammia* Verrill, 1866; *Pachypsammia* Cairns, 2001; genus considered to be monophyletic by Arrigoni and others (2014); together with *Astroides, Paleoastroides,* and *Rhabdopsammia,* this genus has the best-developed endotheca of the dendrophylliids
Wadeopsammia Wells, 1933, p. 227 [**Trochosmilia nodosa* Wade, 1926, p. 26; OD]	Upper Cretaceous: North America	Upper Cretaceous (Maastrichtian)	Holotype described by Cairns (2001) and Baron-Szabo (2002, 2008)

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Creek); *a,* calicular view of corallum (Cairns, 2001, pl. 3,*i*); *b,* lateral view of corallum (Cairns, 2001, pl. 3,*f*).

UNCERTAIN POSITION

The following were originaly considered dendrophylliid but are of uncertain position.

Aplopsammia Alloiteau, 1958, p. 146 [**A. colligноni;* OD; holotype, MNHN M05014]. Corallum solitary, ceratoid, free; theca finely granular; columella spongy-papillose; synapticulae and sparsely occurring, thin, vesicular endothecal dissepiments present; dendrophylliid wall structures present; Pourtalès plan septal development unclear (see discussion in Cairns, 2001, p. 37).

Calostylopsis Alloiteau, 1958, p. 148 [**C. sakalavensis;* OD; holotype MNHN-F-M05021]. Not a scleractinian; belongs to the Spongiomorpha (personal communication, Baba Senowbari-Daryan, 2004).

Desmopsammia Reis, 1889, p. 108 [**Desmophyllum subcylindricum* Philippi, 1851, p. 81; SD Felix, 1925, p. 158; type material not located]. Septa in Pourtalès plan; unclear whether corallum is colonial or solitary; could be closely related to the colonial genus *Cladopsammia* or to the solitary genus *Balanophyllia* (see discussion in Cairns, 2001, p. 37).

Makridinophyllia Kuzmicheva, 1987, p. 152 [**M. makridini;* OD; holotype, MGU N185/880, not located]. According to original description, solitary, mushroom-like corallum attached; septa arranged in Pourtalès plan; costae numerous; columella elliptical in shape; original illustration of holotype differs significantly from description in matters of coloniality and septal arrangement (see Cairns, 2001, p. 38 for discussion).

Spongiopsammia Kuzmicheva, 1987, p. 153 [**S. amitrovi;* OD; holotype, MGU N185/885, not located]. Not a scleractinian; although described as a dendrophylliid, aspects of features described as septa and columella suggest probably coralline demosponge (see Cairns, 2001, p. 41 for discussion).

Stereopsammia Milne Edwards & Haime, 1850, p. liii [**S. humilis;* OD; holotype, NHMUK 49580]. Similar to *Tubastraea* Lesson, 1829, but holotype badly damaged, impossible to properly characterize (see Cairns, 2001, p. 37 for discussion).

ABBREVIATIONS FOR MUSEUM REPOSITORIES

EWHA: Department of Biology, College of Natural Sciences, Ewha Womans University, Seoul, Republic of Korea

IPB: Institut für Paläontologie der Universität Bonn, Bonn, Germany

IGM: Museo de Paleontologia de Instituto de Geologia, Universidad Nacional Autonoma de Mexico, Mexico City

MB: Museum für Naturkunde, Berlin, Germany

MCZ: Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, USA

MMC: Museo del Mar de Ceuta, Ceuta, Spain

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TABLE 2. Key characteristics of dendrophylliid genera. Present (x); present or absent (+/-); abundant (++); weakly developed (--); character absent (empty box).

Key characteristics of the Dendrophylliid genera	Corallum				Budding		Wall				Septa			Endothecal dissepiments	Exotheca	Costae	Columella			Paliform structures	Symbionts
	solitaary	colonial																			
		branching	polyp integration high (flabellate, meandroid)	polyp integration low (plocoid, ceroid)	extracalicular	intracalicular	epitheca *sensu lato*/ holotheca	(para-) synapticulotheca	septotheca	paratheca	compact	subcompact to porous	Pourtalès plan				spongy and/or papillose	variably shaped segments or solid (s)	lamellar		azooxanthellate (AZ) zooxanthellate (Z)
Dendrophyllia		×		×	×		+/-	×	+/-			×	×	×	+/-	+/-	×	×			AZ
Areopsammia	×							×	+/-			×		--			--				?
Astroides		×		×	×		+/-	×	+/-			×		×	+/-	+/-	×				AZ
Balanophyllia	×						+/-	×				×	×	+/-		×	×				AZ
Balanopsammia	×	×			×		×	×				×	×	+/-		--	×				AZ
Bathypsammia	×						++	×			×				×		×				AZ
Blastozopsammia		×		×	×			×			×		--	--	×		--			+/-	(?) Z
Cahuzacopsammia			×			×		×			×	×	×			×	×			?	?
Cairnsipsammia			×	×	+/-	×		×	+/-		×	×	×	++	+/-	×	×	×		+/-	(?) Z
Cladopsammia		×			×		+/-	×				×	++	×		++	×			+/-	AZ
Dichopsammia		×				×		×		×	×		--	×		×	--				Z
Duncanopsammia		×			×			×	+/-		×	×	×		×			×			Z
Eguchipsammia		×			×	+/-		×			×	×	×	×		×	×			+/-	AZ
Enallopsammia		×			×			×			×	×			+/-	+/-	×			+/-	AZ
Endopachys	×							×				×	×	+/-		×	×			×	AZ
Endopsammia	×						×	×				×		+/-		--	×				AZ
E×planaria		×		×	×	+/-		×			×	×	+/-	--	+/-	×	×	×		+/-	Z
Heteropsammia	×		×			×		×			×	×	×	--			×	×		+/-	AZ, Z
Lamellophyllia	×							×			×		+/-	--		×			×	×	?
Leptopsammia	×						×	×			×			+/-		×	×				AZ
Lobopsammia		×				×		×				×	×	+/-		×	×	×			?
Notophyllia	×						+/-	×			×					+/-	×		×		AZ
Palaeopsammia	×						+/-	×	×			×		×		--	++			×	?
Paleoastroides				×	×	+/-		×			×	×	×	--	--	×		++		×	?
Pourtalopsammia	×						++	×			×				×						AZ
Reussopsammia			×			×		×				×		+/-		×					?
Rhabdopsammia	×	×	×			×		×	×		×	×	--	+/-		×	×	×			?
Rhizopsammia		×			×			×			×		×	+/-		×	×				AZ
Stichopsammia			×			×		×	+/-			×	×	--		×		×		--	?
Thecopsammia	×						×	×			×		×					×		+/-	AZ
Trochopsammia	×						×	×			×					×	+/-				AZ
Tubastraea		×		×	×	+/-	?	×			×			×	×	×	×	×			AZ
Wadeopsammia	×							×	+/-			×	×	--		×		×			?

NMNH: National Museum of Natural History, Smithsonian Institution, Washington, D.C., USA
MNHN: Museum National d'Histoire Naturelle, Paris, France
MPUR: Museo di Paleontologia, Università di Roma, Rome, Italy
NHM: Natural History Museum of Los Angeles, California, USA
NHMUK: The Natural History Museum, London, UK
NHMW: Naturhistorisches Museum Wien, Vienna, Austria
NMV: National Museum of Victoria, Melbourne, Australia (now the Museum of Victoria)
NRM: Naturhistoriska Riksmuseet, Stockholm, Sweden
SMF: Forschungsinstitut Senckenberg, Senckenberg Museum, Frankfurt, Germany
SNSB-BSPG: Bayerische Staatssammlung für Paläontologie und historische Geologie, Munich, Germany
TIUS: Institute of Geology and Paleontology, Tohoku (Imperial) University, Sendai, Japan
USNM: United States National Museum, Washington, D.C., USA (collections of which are now in the NMNH
wamu: Walsermuseum Riezlern, Riezlern, Vorarlberg, Austria
YPM: Yale Peabody Museum, New Haven, Connecticut, USA

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