Zitteliana 97, 2023, 89–147 | DOI 10.3897/zitteliana.97.113796

SNSB Bayerische Staatssammlung für Paläontologie und Geologie

ZITTELIANA
An International Journal of Paleontology and Geobiology

Middle Cenomanian coral fauna from the Roßsteinalmen (Northern Calcareous Alps, Bavaria, Southern Germany) – a revised and extended version

Hannes Löser[1], Winfried Werner[2], Robert Darga[3]

1 *Estación Regional del Noroeste, Instituto de Geología, Universidad Nacional Autónoma de México, Blvd. Luis Donaldo Colosio S/N y Madrid, 83250 Hermosillo, Sonora, Mexico*

2 *SNSB – Bayerische Staatssammlung für Paläontologie und Geologie and GeobioCenter[LMU], Richard-Wagner-Strasse 10, D-80333 München, Germany*

3 *Naturkunde- und Mammut-Museum Siegsdorf, Auenstraße 2, D-83313 Siegsdorf, Germany*

https://zoobank.org/D4564419-3213-4D38-96BB-E7CFE157E0F8

Corresponding author: Winfried Werner (werner@snsb.de)

Academic editor: A. Nützel ♦ **Received** 6 October 2023 ♦ **Accepted** 6 November 2023 ♦ **Published** 20 December 2023

Abstract

In the Northern Calcareous Alps, relics of a formerly widely distributed shallow marine facies belonging to the Branderfleck Formation (upper Albian to lower Turonian) crop out and contain locally abundant corals. The fauna described here derives from Middle Cenomanian sediments. This study complements a former revision. In total, the fauna includes 98 species in 46 genera, belonging to 16 scleractinian superfamilies and two octocorallian families. One species – *Enallhelia octasepta* – is described as new. The fauna that was formerly located at the northern part of the Apulian plate (Austroalpine unit), south of the Penninic Ocean, shows palaeobiogeographic relationships to Cenomanian faunas from the Basque-Cantabrian Basin, the Prebetic zone, the Pelagonium, and the Quillan Basin, indicating stronger connections to Tethyan rather than Boreal faunas. The fauna also shares species with Aptian and Albian, but also with Late Cretaceous faunas of the Gosau Basin. Eight genera experienced a range extension; five genera have their last occurrence in the Middle Cenomanian fauna, and three genera have their first occurrence. Although the fauna presents numerous genera that became widespread in the Late Cretaceous, its generic composition is more closely related to late Early Cretaceous corals than to post-Cenomanian corals. The faunal turnover at the Cenomanian/Turonian boundary was not marked by the sudden appearance of new faunal elements, but rather by the disappearance of taxa. Some faunal elements that constitute post-Cenomanian faunas already existed in the Cenomanian, but they were very rare. The increase of taxa after the Cenomanian/Turonian boundary took place during the Coniacian and Santonian.

Keywords

Cretaceous, Hexacorallia, Octocorallia, Branderfleck Formation, Taxonomy, Palaeobiogeography

Introduction

Only shortly after the appearance of the first publication on the corals from the Northern Calcareous Alps (Löser et al. 2013c), additional material from the same locality was discovered in the Bayerisches Landesamt für Umwelt - Geologie collections, and some further specimens were found in the collections of the Berliner Naturkundemuseum. The material in Berlin was collected by Josef Bruckmair and given to Werner Quenstedt (1893–1960) who worked as geologist and palaeontologist at the Friedrich-Wilhelms-Universität

in Berlin. The Munich specimens come from the same collector, Otto Hölzl, who also sold and donated material to the Bayerische Staatssammlung für Paläontologie und Geologie. Surprisingly, the material recently discovered at the Bayerisches Landesamt für Umwelt - Geologie encompasses material that is taxonomically different from that described in Löser et al. (2013c). It is impossible to speculate about the reasons. One reason may be that some individual picked out the material (that is now at the Bayerisches Landesamt für Umwelt - Geologie, formerly Bayerisches Geologisches Landesamt) from a larger collection, and that the Bayerische Staatssammlung für Paläontologie und Geologie has received the rest of the material. Within the new collection, there are very attractive and well-preserved specimens, whereas, the material at the Bayerische Staatssammlung für Paläontologie und Geologie is, for a large part, represented by bulk samples. Among the new material there are multiple genera and species that are not yet reported. In this compilation, we include, therefore, all species, and also the material described in Löser et al. (2013c), but species described in the first paper are not figured, described and provided with dimensions. The discussion encompasses all species.

Our first contribution to the Middle Cenomanian coral fauna from the Northern Calcareous Alps was published more than ten years ago, and since then much more data about Cenomanian coral faunas became available. In Löser (2014b), the Boreal coral fauna from the Elbtal-Group (Saxony, Germany) of Cenomanian age was revised and completed with more data. In Löser (2015a), the Cenomanian coral fauna from the Le Mans area was briefly revised. Löser and Bilotte (2017) described a Cenomanian platy coral association from Southern France. Löser et al. (2018) report a lower Cenomanian coral fauna from Central Greece with nearly 80 species. Löser and Callapez (2022) present small coral faunas from the Cenomanian/Turonian boundary of Portugal. Löser and Wilmsen (2022, 2023) recently began publication of a lower Cenomanian coral fauna from Cantabria (Spain) that encompasses around 140 coral species. Another contribution that helps to link the Cenomanian coral faunas to other upper Cretaceous faunas constitutes the taxonomic revision of the Coniacian-Santonian coral fauna from the Gosau Basin (Löser et al. 2019), with descriptions and illustrations of 360 coral species. The new taxonomic data shed a different light on Cenomanian coral faunas and the evolution of this group during the Cretaceous.

Geological setting

The Roßsteinalmen locality is situated in the Alpine Mountains about 50 km south of Munich, 9 km SE of the Lenggries community and 5 km W of the Kreuth community (Fig. 1). At this locality, a small series of mainly siliciclastic Cretaceous sediments crop out, which were for a long time generally called "Cenoman Serie" (e.g., Boden 1935). Outcrops of this lithostratigraphic unit are, generally, restricted to relatively small areas in the Northern Calcareous Alps.

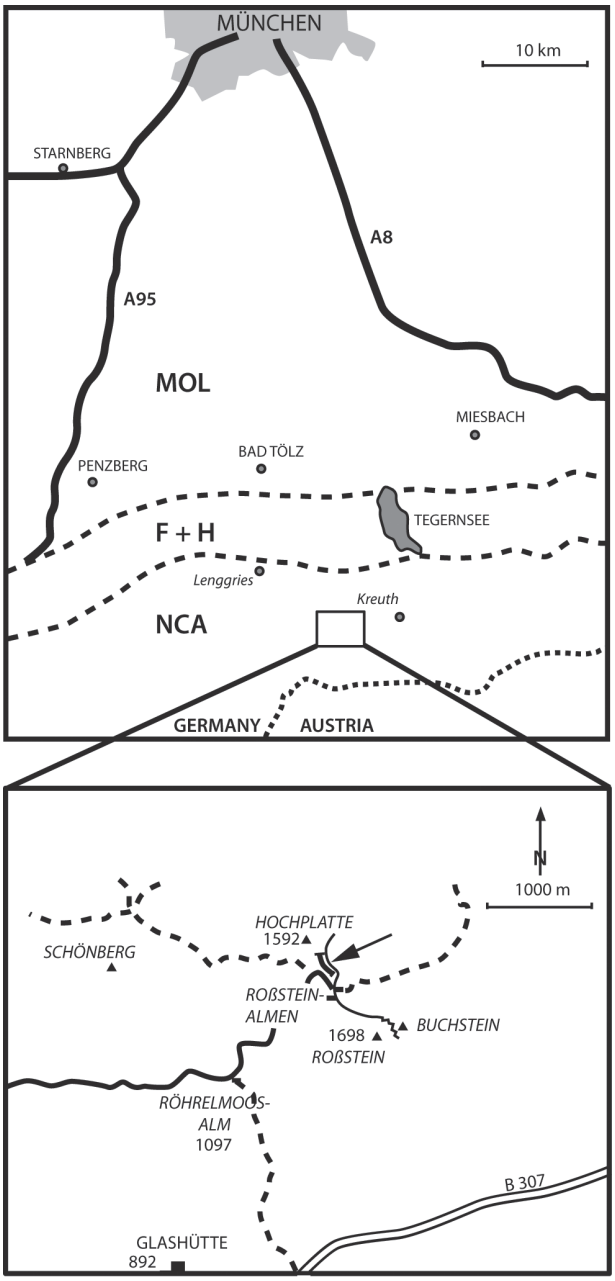

Figure 1. Location of the section Roßsteinalmen and tectonic units. NCA, Northern Calcaerous Alps, F + H, Flysch and Helvetic unit, MOL, Molasse. From Löser et al. (2013c).

They represent relics of a formerly more widely distributed facies, which have been protected from erosion by their tectonic position within synclinal structures. The "Cenoman Serie" is subdivided into two different formations, (1) the Losenstein Formation of Middle Albian to Lower Cenomanian age, consisting of silty marls, turbitic sandstones and deep water conglomerates with exotic pebbles, and (2) the Branderfleck Formation, consisting mainly of marls, calcareous sandstones, and breccias (?Upper Albian to Turonian; Gaupp 1980, 1982; Weidich 1984a, b; Faupl and Wagreich 2000). The Roßsteinalmen area belongs, tectonically to the northern part of the Lechtal nappe and here the Branderfleck Formation overlies Upper Jurassic radiolarites and limestones with slight angular unconformity (Steinberg 1980; Weidich 1984b).

The section at the Roßsteinalmen is about 150 m thick and consists of sandy marls and sandstones alternating with thick carbonaceous fine breccias (Fig. 2; Steinberg 1980; Weidich 1984b). The upper part is characterised by thick, coarse chaotic breccias that are interpreted by Weidich (1984b) as channel deposits cutting the marly series. The components of the breccias are mainly Triassic and Jurassic carbonates, as well as "Cenomanian" breccias and, therefore, they reflect synorogenetic reworking of local material (e.g. Boden 1935; Kuhn 1991; Steinberg 1980). For the base, micropalaeontological data, based on planctonic foraminifera (e.g., *Rotalipora cushmani* (Morrow, 1934)), indicate a Middle to lower Upper Cenomanian age. For the upper part (centre of the synclinal fold), the upper Cushmani zone and thus, an Upper Cenomanian age is confirmed (Weidich 1984b). The marls and sandstones of the section are partly rich in tests of orbitolinid foraminifera (Steinberg 1980). This important index fossil family did not reach the Late Cenomanian (Schroeder and Neumann 1985). The only species known from the Middle Cenomanian is *Conicorbitolina conica* (d'Archiac, 1837), which was also indicated in the Branderfleck Fm by Schlagintweit and Wagreich (2005). Orbitolinids were collected in the marls but thin sections revealed their poor state of conservation. The marls and sandstones are, therefore, of a Middle Cenomanian age.

Palaeogeographically, the Branderfleck Formation represents sediments deposited at the northern margin of the Austroalpine unit and, thus, at the southern border of the Penninic Ocean (see Dercourt et al. 2000; Faupl and Wagreich 2000; Pfiffner 2010). For the clastics of the lower Branderfleck Formation, palaeocurrent data give evidence of a source area located toward the south (Gaupp 1980). The uplift of the northern border of the Austroalpine unit may be linked to the formation of an accretionary wedge in the context of the nascent subduction of the Penninic Ocean (Pfiffner 2010). According to Weidich (1984b), the sediments at the Roßsteinalmen were deposited in water ranging from about 50 m deep on the inner shelf (base of the section) to about 100 m on a middle shelf area (upper part of the section).

The corals described in the first part (Löser et al. 2013c) come from the lower part of the section (Fig. 2). Only specimen 2012 X 1 originates from a higher level and probably has a lower Upper Cenomanian age. The labels of the new coral material described and depicted for the first time in this study do not indicate the exact position within the Roßsteinalmen section; however, based on the preservation and a general rareness of fossils in the upper part of the section, these corals certainly do all come from the lower part of the section.

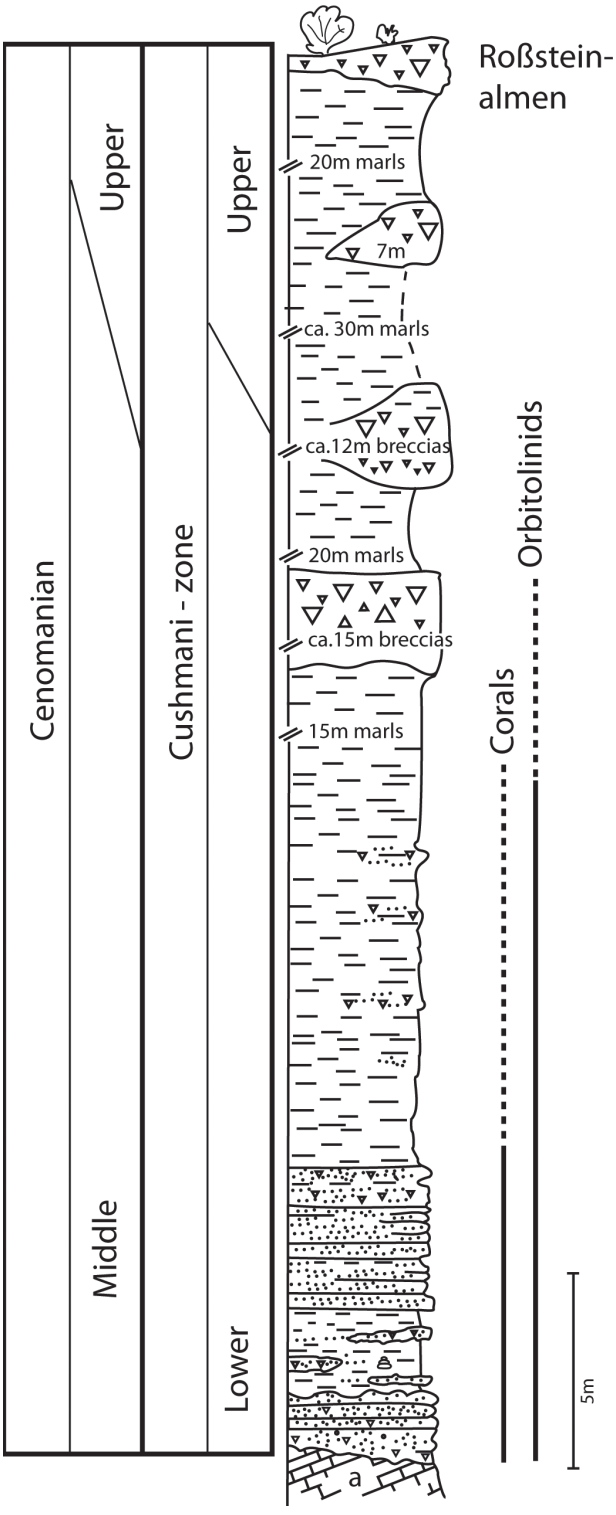

Figure 2. Section at the Roßsteinalmen. Planktonic foraminifera stratigraphy after Weidich (1984a, b), occurrence of corals and orbitolinid foraminifers after Steinberg (1980), Weidich (1984b), and personal observations. Scale only valid for the lower part of section. From Löser et al. (2013c).

Material and methods

In total, 240 coral specimens were included in this extended study; 220 of them could be identified at the species level. Nearly 200 thin sections in both transversal and longitudinal orientation were prepared. The coral material varies in its state of preservation, with exceptionally well-preserved specimens and others that are strongly recrystallised or fragmented.

Thin sections were scanned by passing light through them using a flatbed scanner with an optical resolution of

6,400 dpi. Scanned images were then transferred to grey scale bit maps. Their quality was amended by histogram contrast manipulation (contrast stretching) where possible.

To gain more insight into the intraspecific variation of fossil corals and to obtain a better strategy for comparing species, corallite dimensions of each specimen were systematically measured. To achieve statistical significance, the largest number of possible measurements was taken. This number was mainly controlled by the size and quality of the thin section and the size of the single corallites in relation to the size of the thin sections. Septa were counted for numerous corallites where the septal symmetry was not regular (in corals with a regular symmetry the number of septa is the same in all corallites). For each type of measurement (corallite diameter and distance, width and distance of corallite row) and count (principally septal counts) in one thin section, the following values were obtained:

n number of measurements or counts;
min–max lowest and highest measured or counted values (mm for measurements);
μ arithmetic mean (average);
s standard deviation;
cv coefficient of variation according to K. Pearson
μ±s first interval.

Measurements are always in millimetre. Thin sections were measured and values were calculated using the Palaeontological Database System PaleoTax, module PaleoTax/Measure (https://www.paleotax.de/measure); for details on the mathematical background, see Löser (2012b). Morphometric data of the corals were compared against the morphometric data of specimens in worldwide fossil coral collections, and an associated image database. The database encompasses approximately 28,920 coral specimens from Triassic to modern forms. Approximately 8,200 of them are type specimens, and 16,800 specimens are illustrated. The database is located in the Estación Regional de Noroeste (Instituto de Geología, UNAM), Sonora, Mexico. Data storage and processing were carried out using the PaleoTax database program (Löser 2004).

To compare the studied fauna with other coral faunas outside the study area, a computer database of about 3,100 worldwide coral localities with coral indications was used (Löser et al. 2002, 2005). To simplify the analysis, localities of the same age, belonging to the same basin, on the same continental margin or the same interoceanic platform, were grouped together into one palaeo-province (a type of large faunule, sensu Johnson 2007). Altogether, this produced 440 provinces, reaching from the Jurassic into the Palaeogene. Only firmly dated localities were assigned to a province in order to ensure that the subsequent analysis was valid, and that the studied locality was not included in any existing province. For the study area, an independent province was created to allow a clear comparison between the existing provinces and the new material. Interregional comparisons were carried out between the new province and existing provinces having at least three species in common with the fauna of the studied area. The comparisons were carried out using, exclusively, specimens that were available to the first author (H.L.), but not the indications in the literature. The literature does not offer precise morphometric data, that are necessary to separate species and to compare them to each other. For details, see also Löser (2008), and Löser and Minor (2007). Data analysis, statistics, and the creation of charts were all carried out using the Database System PaleoTax and the graphic module PaleoTax/Graph (www.paleotax.de). The material is kept in the Bayerisches Landesamt für Umwelt - Geologie/Paläontologie (Hof), the Bayerische Staatssammlung für Paläontologie und Geologie (Munich), and the Museum für Naturkunde der Humboldt-Universität (Berlin), all of which are located in Germany.

Systematic description

The distribution data (as reflected in the synonymy lists) are almost entirely based on material examined by the first author (H.L.). Material only mentioned in the literature, material not available, or insufficiently described and/or poorly illustrated in the literature, was not taken into account. To obtain better insight into the distribution patterns of the studied coral fauna, much unpublished material was included. Therefore, distribution data indicated under 'Other occurrences' could also be provided for species remaining in open nomenclature. As mentioned above, we include here all species, and also those species that are described in detail in Löser et al. (2013c), but measurements, descriptions, remarks, and illustrations are not repeated.

In scleractinian corals, the separation of superfamilies, families, and genera is based on qualitative characteristics, whereas the species are separated on the basis of morphometric data (corallite dimensions, septal counts, and septal density). The species of one genus are, more or less, alike and differ only in their measurements. For this reason descriptions of species are not given here. We provide for the taxonomic levels from superfamily to genus detailed descriptions, without repeating characteristics in lower levels. When a superfamily is characterised by large trabeculae, perforate septa, and the presence of synapticulae, this is also the case for all families and all genera. There are rare exceptions, but these are mentioned in the descriptions. When a superfamily encompasses only one family, the description is not repeated with the family.

The abbreviations used in the synonymy lists follow Matthews (1973): *****, earliest valid publication of the species name; **non**, the citation is excluded from the species; **p**, the described material belongs only in part to the species concerned; **v**, the specimen was observed by the first author (H.L.). The abbreviation **cf** indicates that the present species is similar to the species indicated in the concerned reference, but the assignment remains uncertain. A year in italics indicates that the quotation is provided with neither a description nor an illustration.

The following abbreviations are used to describe the dimensions of the corals: **c**, corallite diameter (outer diameter); **ccd**, distance between corallite centres; **clmax**, large lumen; **clmin**, small lumen; **cmax**, larger outer corallite diameter; **cmin**, smaller outer corallite diameter; **crd**, distance of corallite series; **crw**, width of corallite series; **md**, distance between crests in a hydnophoroid colony.

Collection abbreviations are as follows: **BSPG**, Bayerische Staatssammlung für Paläontologie und Geologie, München, Germany; **LFU**, Bayerisches Landesamt für Umwelt - Geologie, Hof, Germany; **NHMW**, Naturhistorisches Museum, Wien, Austria; **MNHN**, Muséum National d'Histoire Naturelle, Paris, France; **PU**, Museo di Geologia e Paleontologia dell' Università di Torino, Torino, Italy; **MB**, Museum für Naturkunde der Humboldt-Universität, Berlin, Germany.

Class Anthozoa Ehrenberg, 1834
Subclass Hexacorallia Haeckel, 1866
Order Scleractinia Bourne, 1900

Fossil scleractinian corals are described since the end of the 18th century. Since the late 20th century, they are examined using thin sections, leading to the discovery of hitherto unknown morphological elements and to changes in the classification. During former systematic revisions (Vaughan and Wells 1943; Alloiteau 1952; Wells 1956; Alloiteau 1957), the order Scleractinia was subdivided into suborders and families. The subdivision into suborders is now, up to 80 years later, not considered practical for various reasons, as explained by Löser et al. (2018), Löser and Callapez (2022), and Löser and Wilmsen (2023). Therefore, the classification system that was introduced by Löser (2016c) does not apply suborders, but rather applies superfamilies which group families together. This practical approach has the advantage that superfamilies are covered by the International Code of Zoological Nomenclature (ICZN 1999) and follow the type principle. This is not the case for the taxonomic level of orders, including suborders. Superfamilies clearly refer to a family, genus, type species, and a type. The characteristics of a superfamily are thus connected to a physical specimen that more precisely limits the characteristics of this higher rank taxon. Practically, suborders are, at the present time, replaced by superfamilies. Currently, 27 superfamilies with 56 families (or informal groups) are distinguished, that range from the Middle Jurassic to the Palaeogene, partly to the Neogene, and extant (Löser 2016c). Contrary to the former classification system based on suborders, the superfamilies may constitute monophyletic groups. The basic characteristics for the distinction of the superfamilies is the size of the trabeculae relative to the septa. Further distinction is based on the presence or absence of synapticulae and septal perforation.

Superfamily Actinastreoidea Alloiteau, 1952

Description. Cerioid, phaceloid, or plocoid colonies. Septa compact, mostly in a regular radial symmetry. Septa often connected to each other. Lateral faces with thorns, upper margin granulated. Microstructure of septa of medium-sized trabeculae. Lonsdaleoid septa present in one genus, main septa absent. Synapticulae absent. Pali in some genera present, columella in most genera. Endotheca varies, generally made of thin tabulae. Wall compact or subcompact, mainly septothecal. Marginarium in one genus. Coenosteum generally present, consists of isolated trabeculae or costae. Budding extracalicinal and intracalicinal.

Family Actinastreidae Alloiteau, 1952

Actinastrea d'Orbigny, 1849

Type species. *Actinastrea goldfussi* d'Orbigny, 1850.

Description. Plocoid colony with narrow coenosteum that is made of large isolated trabeculae. Corallites circular or polygonal. Septa in a regular radial symmetry, rarely bilateral. Septa of the first and second generation can be connected to the columella, younger septa can be connected to older septa. Columella styliform and large. No pali.

Actinastrea limbata Alloiteau, 1954b

*1954b *Actinastrea limbata* nov. sp. – Alloiteau: 89, text-fig. 17, pl. 2, fig. 5, pl. 10, fig. 7.

v2013 *Stelidioseris minima* (de Fromentel, 1857) – Löser, Werner and Darga: 44, pl. 1, figs 3, 4.

v2019 *Actinastrea limbata* Alloiteau, 1954 – Löser, Heinrich and Schuster: 42, figs 50a–c.

Material. BSPG 1947 XVI 26, 1947 XVI 61; two thin sections.

Remarks. The material does not belong to the genus *Stelidioseris* because it shows isolated trabeculae in the coenosteum as it is typical for *Actinastrea*. Therefore, the species name has been changed, compared to our publication from 2013.

Other occurrences. Upper Turonian of the Western Tethys (France), Coniacian to Santonian of the Central Tethys (Austria), lower Campanian of the Western Tethys (France), lower Maastrichtian of the Western Atlantic (Mexico).

Actinastrea polygonata Alloiteau, 1954b

Plate 1: figs 1–3

*v1954b *Actinastrea polygonata* nov. sp. – Alloiteau: 43, pl. 4, fig. 11, pl. 7, fig. 5.

v1989 *Actinastrea schizoformis* nov. sp. – Reig Oriol: 21, pl. 2, fig. 4, pl. 6, fig. 2.

v2019 *Actinastrea polygonata* Alloiteau, 1954 – Löser, Heinrich and Schuster: 45, figs 54a–c.

Material. LFU 8336SG015004#1; one thin section.

Dimensions. (LFU 8336SG015004#1).

	n	min–max	μ	s	cv	μ±s
clmin	20	1.25–1.60	1.44	0.09	6.6	1.35–1.54
clmax	20	1.53–2.06	1.70	0.14	8.7	1.56–1.85
ccd	27	1.37–2.02	1.73	0.18	10.6	1.54–1.91
septa	10+10					

Other occurrences. Upper Turonian of the Western Tethys (France), Coniacian to Santonian of the Central Tethys (Austria), Santonian of the Western Tethys (Spain).

Actinastrea subdecaphylla (Oppenheim, 1930)

v*1930 *Astrocoenia subdecaphylla* n. sp. – Oppenheim: 460, pl. 15, fig. 9.
1982 *Actinastraea subdecaphylla* (Oppenheim) 1930 – Beauvais: (1), 13, figs 1, 2.
v2013 *Actinastrea regularis* (de Fromentel, 1887) – Löser, Werner and Darga: 43, pl. 1, figs 1, 2.
v2019 *Actinastrea* ? *subdecaphylla* Oppenheim, 1930 – Löser, Heinrich and Schuster: 48, figs 58a–d.

Material. BSPG 1947 XVI 60; one thin section.

Remarks. In Löser et al. (2013c) this specimen was assigned to *Actinastrea regularis* (de Fromentel, 1887). After examining the type material of *Actinastrea subdecaphylla* this assignation was corrected. Both species are similar but differ in the corallite dimensions (see Löser et al. 2019: 40 for comparison).

Other occurrences. Coniacian to Santonian of the Central Tethys (Austria), upper Santonian of the Western Tethys (France), upper Campanian to lower Maastrichtian of the Arabian Peninsula (United Arab Emirates).

Superfamily Agaricioidea Gray, 1847

Description. In the Cretaceous only solitary corals. Septa compact, mostly in a subregular radial symmetry. Septa in places connected to each other. Lateral faces with thorns, upper margin smooth. Microstructure of septa of small trabeculae. Lonsdaleoid and main septa absent. Synapticulae present, mainly in the wall. Pali absent, columella by septal fusion. Endotheca generally made of thin tabulae. Wall compact, mainly septothecal with synapticulae. Marginarium absent. Coenosteum generally present, consists of costae. Budding intracalicinal.

Family Agariciidae Gray, 1847

Antilloseris Vaughan, 1905

Type species. *Turbinoseris eocaenica* Duncan, 1873.

Description. Solitary elliptical coral. Septa compact, in a regular radial symmetry. Septa of the first three cycles thicker in the corallite centre and free, septa of further cycles more regular in thickness and connected to each other. Septa lateral faces with thorns, directing to the corallite center. No pali. Columella styliform and small. Enthodeca absent. Wall perforated, with synapticulae.

Antilloseris sp.

Plate 1: figs 4–6

Material. LFU 8336SG015138#2; one thin section.

Dimensions. (LFU 8336SG015138#2).

c	16.8×23.8
septa	112

Remarks. The assignation of the present specimen to this genus is preliminary. It shares with *Antilloseris* the arrangement of septa, with the difference that the septa of the first three cycles are, in the present specimen, not thickened in the corallite centre. The columella is parietal and not styliform as in *Antilloseris*.

Trochoseropsis Söhle, 1897

Type species. *Trochoseropsis ettalensis* Söhle, 1897.

Description. Turbinate solitary coral with an elliptical or circular outline. The septa are in a regular radial symmetry, regularly connected to each other, and many of them are fused together in the centre of the corallite to form the columella.

Trochoseropsis ettalensis Söhle, 1897

*v1897 *Trochoseropsis Ettalensis* – Söhle: 45, pl. 7, figs 2, 2ab.
v1958 *Smilotrochus tarraconensis* nov. sp. – Alloiteau: 84, pl. 2, figs 7, 8.
v2013a *Trochoseropsis ettalensis* Söhle, 1897 – Löser: 16, figs 6b–i.
v2013 *Trochoseropsis ettalensis* Söhle, 1897 – Löser, Werner and Darga: 50, pl. 3, figs 7–9.

Material. BSPG 1947 XVI 15, 1947 XVI 16, 1947 XVI 24, 1947 XVI 28, 1947 XVI 29, 1947 XVI 73, 1947 XVI 74, 1991 X 63, LFU 8336SG015145, MB K2984#2, K2984#3; ten thin sections.

Other occurrences. Lower Albian of the Western Tethys (France), lower Cenomanian of the Central Tethys (Germany), Campanian of the Western Tethys (Spain).

Superfamily Caryophyllioidea Dana, 1846

Description. Mainly solitary, rarely colonial (phaceloid) corals. Septa compact, regular thickness, mostly in a regular radial symmetry. Septal upper margins smooth, lateral faces with few small thorns or granulae. Lonsdaleoid septa and main septum absent.

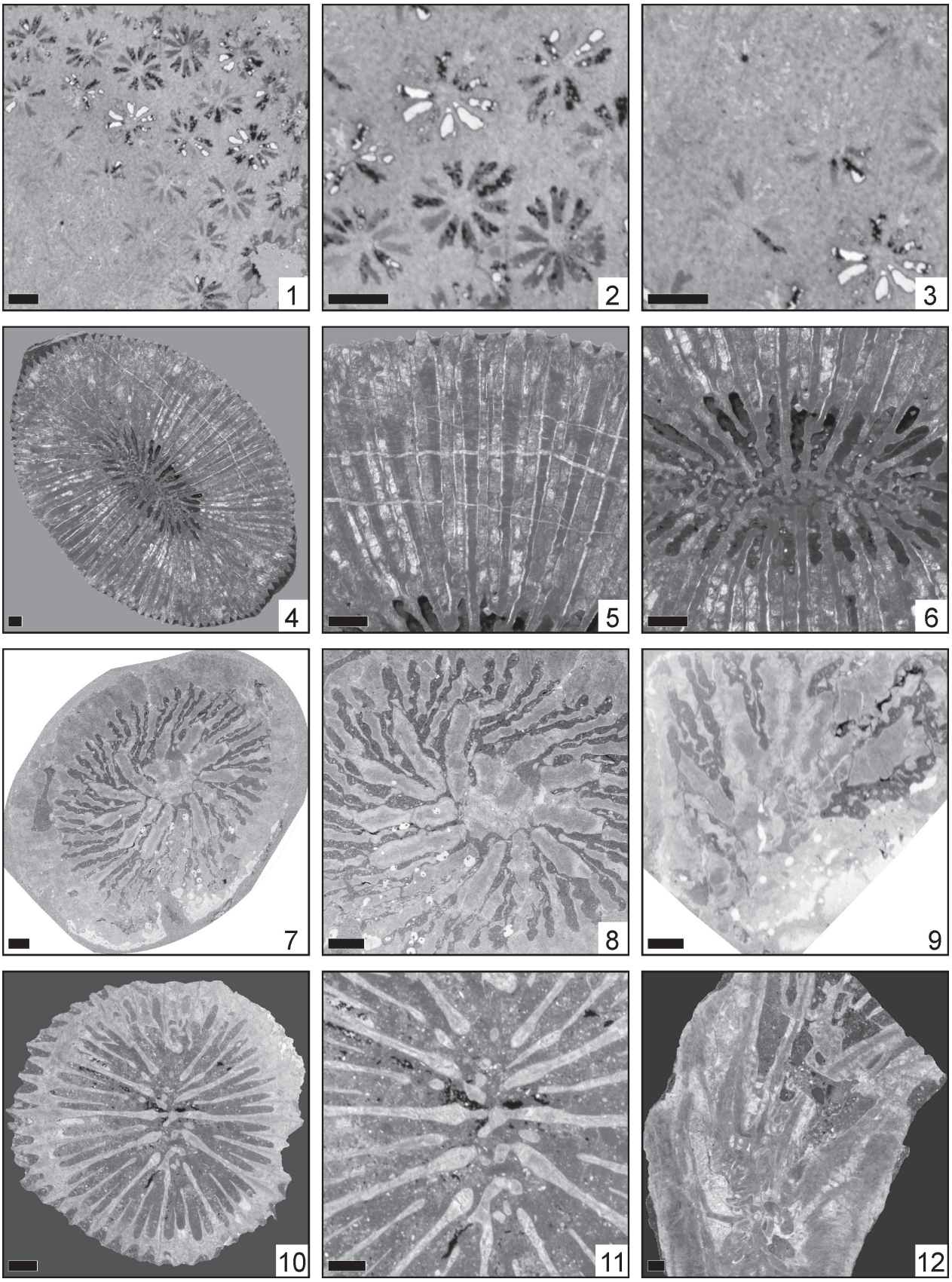

Plate 1. (1–3) *Actinastrea polygonata* Alloiteau, 1954. LFU 8336SG015004#1. **1**. Transversal thin section. **2**. Transversal thin section, detail. **3**. Transversal thin section, detail. **(4–6)** *Antilloseris* sp., LFU 8336SG015138#2. **4**. Transversal thin section. **5**. Transversal thin section, detail. **6**. Transversal thin section, detail. **(7–9)** Caryophylliidae indet. 1, LFU 8336SG015133#2. **7**. Transversal thin section. **8**. Transversal thin section, detail. **9**. Longitudinal thin section. **(10–12)** Caryophylliidae indet. 2, LFU 8336SG015099#2. **10**. Transversal thin section. **11**. Transversal thin section, detail. **12**. Longitudinal thin section. Scale bars: 1 mm.

Microstructure of probably very small trabeculae that can only be traced by a dark line. Synapticulae absent. Pali and columella can be present. The endotheca is variable, but generally poorly developed in solitary forms. Marginarium absent. Wall septothecal. Coenosteum absent.

Family Caryophylliidae Dana, 1846

The classification of the family is difficult. Their fossil members are generally poorly known, and particularly this is the case for many type species. The reason is that solitary corals have been – in contrast to colonial corals – much less studied using thin sections. Whereas large coral colonies often provide pieces to prepare thin sections, the preparation of thin sections from a solitary coral generally results in its complete loss. The study of solitary corals always demands specimen-rich populations. These populations are not always available. Therefore, not all material shown here can be assigned to a genus.

Caryophylliidae indet. 1

Plate 1: figs 7–9

Material. LFU 8336SG015133#2; two thin sections.

Dimensions. (LFU 8336SG015133#2).

c	11×14.5
septa	48

Description. Coral with an elliptical outline. Septa free, in a regular hexameral symmetry. Twelve septa with very strongly inflated inner margins (that can be interpreted as pali). Columella very large, styliform. Endotheca poorly developed.

Caryophylliidae indet. 2

Plate 1: figs 10–12

Material. LFU 8336SG015099#2, 8336SG015132#1; four thin sections.

Dimensions. (LFU 8336SG015099#2).

c	14.1×14.6
septa	48

Description. The solitary coral has a regular septal symmetry with four septal cycles. Only the third cycle bears occasionally pali. The columella consists of some small elements.

Parasmilia Milne Edwards & Haime, 1848c

Type species. *Madrepora centralis* Mantell, 1822.

Description. Turbinate solitary coral with circular outline. A columella is present, but difficult to distinguish from the septa. No pali. The endotheca is poorly developed.

Parasmilia centralis (Mantell, 1822)

Plate 2: figs 1, 2

*v1822 *Madrepora centralis* – Mantell: 159, pl. 16, figs 2, 4.

v2016c *Madrepora centralis* Mantell, 1822 – Löser: 510, figs P30a, b.

Material. LFU 8336SG015132#2, 8336SG015132#3, 8336SG015132#4, 8336SG015133#1; seven thin sections.

Dimensions. (LFU 8336SG015132#2).

c	9.9×11.4
septa	48

Remarks. The coral *Parasmilia centralis* is far more than one hundred times cited in the literature. Since most of these citations are not accompanied by proper illustrations and/or corallite measurements and septal counts, a synonymy list cannot be compiled. The distribution data are based on material observed by the first author (H.L.).

Other occurrences. Cenomanian of the European Boreal (UK), Coniacian to lower Santonian of the Central Tethys (Austria), upper Coniacian to Maastrichtian of the European Boreal (UK, Germany).

Superfamily Cladocoroidea d'Orbigny, 1851

Description. Solitary and (cerioid, phaceloid, plocoid) colonial corals. Septa compact and with regular thickness. Septal symmetry radial, regular or sub-regular. Septa often connected to each other. Septal lateral faces with thorns and/or granulae, septal upper margin with fine granulations. Lonsdaleoid septa and main septum absent. Microstructure of medium-sized trabeculae. Synapticulae absent. Pali present in some genera. Columella present in most genera, styliform, lamellar, parietal, or by septal fusion. Endotheca generally present. Marginarium absent. Wall present, septothecal (by septal thickening) or as tabulotheca. Coenosteum present in plocoid genera. Budding extracalicinal (cerioid, plocoid) or intracalicinal (phaceloid).

Family Cladocoridae d'Orbigny, 1851

Description. Phaceloid colonies. Septal symmetry sub-regularly radial. Pali present in some genera. Columella styliform, lamellar or parietal.

Procladocora Alloiteau, 1952

Type species. *Calamophyllia gracilis* d'Orbigny, 1850.

Description. Phaceloid colony. Corallites with a small diameter (< 6 mm). Septa in a sub-regular radial symmetry; but systems can be recognised. The number of septa increases with the corallite diameter. The septa of the first two cycles have pali. The columella is lamellar.

Procladocora simonyi (Reuss, 1854)

Plate 2: figs 4–6

*v1854 *Cladocora Simonyi* – Reuss: 112, pl. 12, figs 5–7.
v1930 *Cladocora libidinum* n. sp. – Oppenheim: 362, pl. 38, fig. 14.
v1936 *Cladocora jamaicaënsis* Vaughan 1899 – Hackemesser: 38, pl. 5, fig. 3.
v2000 *Procladocora jamaicaensis* (Vaughan 1899) – Löser: 52, pl. 3, figs 1–5.

Material. LFU 8336SG015082#3, 8336SG015162; three thin sections.

Dimensions. (LFU 8336SG015082#3).

c	4.1×5.7
septa	45

Other occurrences. Lower Albian of the Western Tethys (Spain), upper Cretaceous of the Central Tethys (Greece, Austria).

Procladocora sp.

Plate 2: fig. 3

v1997 *Pleurocora* cf. *alternans* Milne-Edwards and Haime, 1849 – Baron-Szabo: 77, pl. 10, figs 4, 6.

Material. LFU 8336SG015140#1; four thin sections.

Dimensions. (LFU 8336SG015140#1).

c	3.8×4.1
septa	28

Other occurrences. Upper Cenomanian of the Western Tethys (France), lower Coniacian of the Central Tethys (Austria).

Family Columastreidae Alloiteau, 1952

Description. Plocoid colonies. Septal symmetry regular radial and mostly hexameral. Pali present in some genera. Columella varies: styliform, styliform and double, lamellar, or absent. Coenosteum with costae.

Eocolumastrea Löser & Zell, 2015

Type species. *Columnocoenia bucovinensis* Morycowa, 1971.

Description. Plocoid coral with septa in a regular hexameral or decameral symmetry. Columella lamellar or small and styliform. Irregular pali at the first septal cycle, not very pronounced. Coenosteum narrow.

Eocolumastrea sp.

Plate 2: figs 7, 8

Material. LFU 8336SG015079#4; one thin section.

Dimensions. (LFU 8336SG015079#4).

	n	min–max	μ	s	cv	μ±s
clmin	10	1.55–2.03	1.76	0.16	9.0	1.60–1.92
clmax	10	1.87–2.30	2.10	0.16	7.6	1.94–2.26
ccd	13	2.22–3.72	2.91	0.36	12.5	2.55–3.27
septa	8	16–22	19.38	2.33	12.0	17–22

Remarks. The septal symmetry is particular in this specimen. Whereas in *Eocolumastrea* the septal symmetry is normally a multiple of six or ten, the present specimen shows varying systems such as eleven and ten.

Neocoenia Hackemesser, 1936

Type species. *Neocoenia renzi* Hackemesser, 1936.

Description. Plocoid colony with circular or elliptical corallites. Symmetry regular hexameral. The first two septal cycle bear pali; the columella is lamellar and small.

Neocoenia exsculpta (Reuss, 1854)

*v1854 *Astraea exsculpta* – Reuss: 114.
v1957 *Stephanaxophyllia Casterasi* nov. sp. – Alloiteau: 73, figs 20, 21, pl. 9, fig. 8, pl. 16, fig. 1.
vp2013 *Neocoenia* cf. *casterasi* (Alloiteau, 1957) – Löser, Werner and Darga: 44.
v2019 *Neocoenia exsculpta* (Reuss, 1854) – Löser, Heinrich and Schuster: 77, figs 107a, b.

Material. BSPG 1947 XVI 33, 1947 XVI 65, 1991 X 73, 1991 X 77, LFU 8336SG015079#1, 8336SG015079#3; nine thin sections.

Remarks. This material was formerly assigned to *Neocoenia* cf. *casterasi* (Alloiteau, 1957). After studying the type material of *Neocoenia exsculpta*, the determination could be improved.

Other occurrences. Upper Turonian to Santonian of the Central Tethys (Austria), Santonian of the Western Tethys (France).

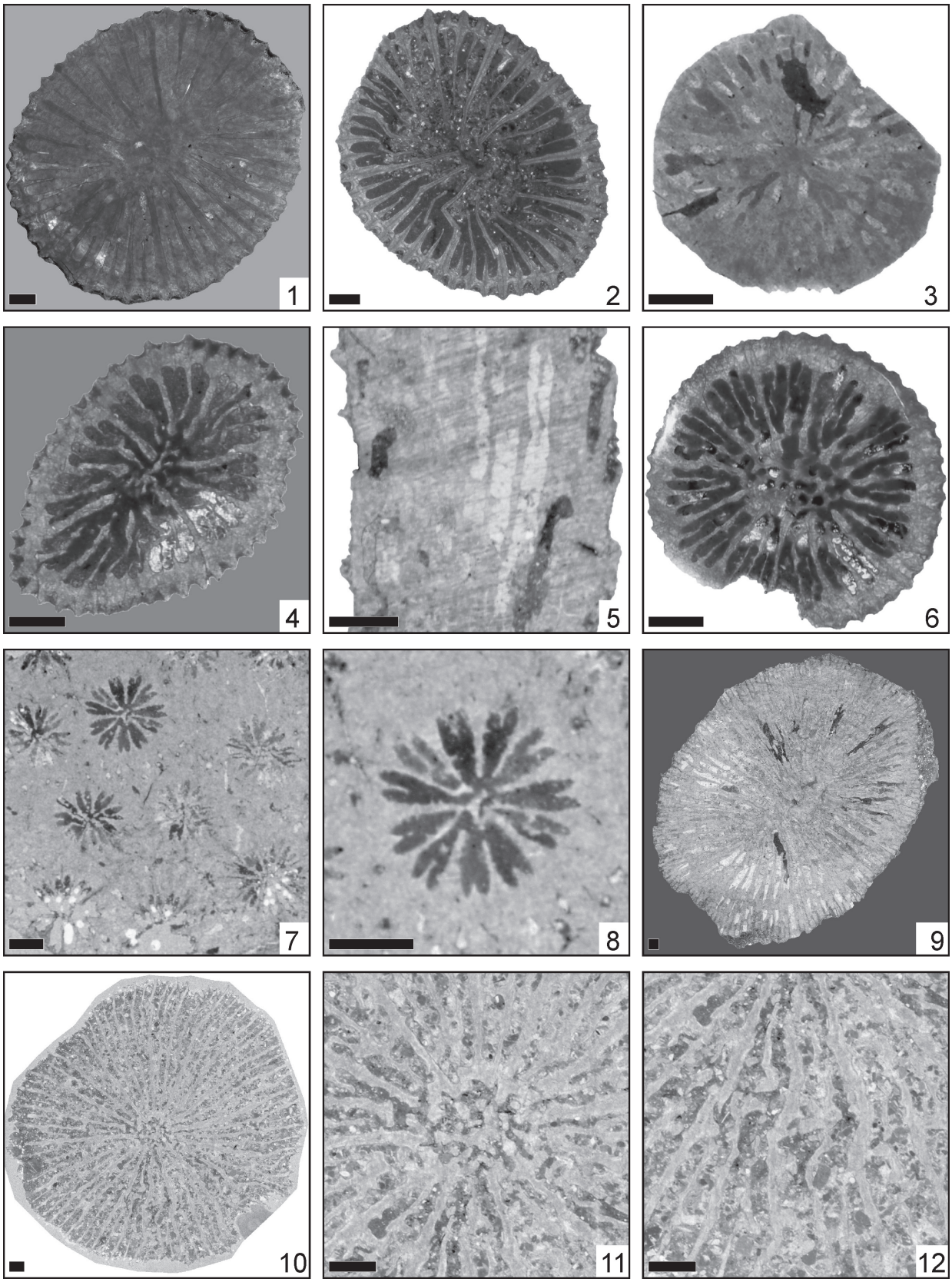

Plate 2. (1, 2) *Parasmilia centralis* (Mantell, 1822). **1**. LFU 8336SG015132#2, Transversal thin section. **2**. LFU 8336SG015132#4, Transversal thin section. **3**. *Procladocora* sp., LFU 8336SG015140#1. Transversal thin section. **(4–6)** *Procladocora simonyi* (Reuss, 1854). LFU 8336SG015082#3. **4**. Transversal thin section. **5**. Longitudinal thin section. **6**. LFU 8336SG015162, Transversal thin section. **(7, 8)** *Eocolumastrea* sp., LFU 8336SG015079#4. **7**. Transversal thin section. **8**. Transversal thin section, detail. **9**. *Aulosmilia inflexa* (Reuss, 1854). BSPG 1947 XVI 72. Transversal thin section. **(10–12)** *Cyclastraea* sp., BSPG 1947 XVI 87. **10**. Transversal thin section. **11**. Transversal thin section, detail. **12**. Transversal thin section, detail. Scale bars: 1 mm.

Neocoenia kuehnii (Oppenheim, 1930)

v*1930 *Pleurocora kuehnii* n. sp. – Oppenheim: 371, pl. 38, fig. 13, pl. 40, fig. 9.
1982 *Barycora kuehnii* (Oppenheim) 1930 – Beauvais: (1), p. 99.
vp2013 *Neocoenia* cf. *casterasi* (Alloiteau, 1957) – Löser, Werner and Darga: 44, pl. 1, figs 7–9.

Material. BSPG 1991 X 48, 1991 X 74, 1991 X 75, 1991 X 76, 1991 X 78, 2012 X 4, LFU 8336SG015005#1; four thin sections.

Remarks. This material was assigned to *Neocoenia* cf. *casterasi* by Löser et al. (2013c). In 2016, it was possible to study the type material of Oppenheim (1930) and to clarify the taxonomy of the present material.

Other occurrences. Santonian of the Central Tethys (Austria).

Neocoenia renzi Hackemesser, 1936

v*1936 *Neocoenia renzi* n. g. n. sp. – Hackemesser: 24, pl. 3, figs 4–6.
v2013 *Neocoenia renzi* (Hackemesser, 1936) – Löser, Werner and Darga: 46, pl. 1, figs 10–12.
v2016c *Neocoenia renzi* Hackemesser, 1936 – Löser: 471, figs N4a, b.
v2019 *Neocoenia renzi* (Hackemesser, 1936) – Löser, Heinrich and Schuster: 77, fig. 105, figs 108a–c.

Material. BSPG 1947 XVI 10, 1947 XVI 46, 1947 XVI 8, LFU 8336SG015077, 8336SG015079#2; four thin sections.

Other occurrences. Middle Turonian to Santonian of the Central Tethys (Greece, Austria), upper Campanian of the Western Tethys (Spain), undefined Cretaceous of the Central Tethys (Greece).

Superfamily Cyclolitoidea Milne Edwards & Haime, 1849

Description. Solitary and colonial corals. Septa either with regularly distributed perforations, with perforations only in certain parts of the septa, or almost compact. Septa generally thick, without notable symmetry (except Negoporitidae). Septa often connected to each other. Septal lateral faces with pennulae and thorns. Septal distal margin with large granulae. Both lonsdaleoid septa and main septum absent. Microstructure of large trabeculae. Synapticulae present. Pali in some genera probably present but difficult to distinguish from the perforated inner margins of the septa. Columella poorly defined. Endotheca present or absent. When present, mostly thin tabulae. Marginarium absent. Wall poorly developed. Coenosteum varies depending on the organisation type. Budding varies.

Family Latomeandridae de Fromentel, 1861

Description. The family encompasses numerous solitary and colonial coral genera that show septa with perforations which are concentrated on the inner margin of the septa. The septa are thinner than in the Synastraeidae and less perforated than in the Microsolenidae. The thickness of septa and the space between them are similar.

Astraeofungia Alloiteau, 1952

Type species. *Astrea decipiens* Michelin, 1846.

Description. Thamnasterioid colony, with mostly only at the inner margin perforated septa, that barely differ in length and thickness. The corallites are regularly distributed, generally not in rows, or only when juvenile. Costae run between all corallites. There is no wall.

Astraeofungia decipiens (Michelin, 1846)

*1846 *Astrea decipiens* – Michelin: 200, pl. 50, fig. 13.
v1891 *Thamnastraea Crespoi* – Felix: 146, pl. 22, fig. 5.
v1951 *Thamnasteria jezoensis* Eguchi, n.sp. – Eguchi: 54, pl. 18, figs 5, 6.
v1957 *Astrea decipiens* Michelin – Alloiteau: 213, figs 153–155, pl. 3, fig. 3, pl. 14, fig. 5, pl. 18, fig. 6.
v1963 *Thamnasteria crespoi* (Felix) – Reyeros Navarro: 4, pl. 1, figs 1, 4.
v1994 *Thamnasteria cotteaui* Fromentel – Liao and Xia: 127, pl. 32, figs 6, 7.
v1996 *Synastrea* cf. *dubia* Fromentel, 1861 – Baron-Szabo and Steuber: 25, pl. 14, figs 1, 7.
v2013b *Astraeofungia tenochi* (Felix, 1891) – Löser: 20, fig. 3.2.
v2013 *Astraeofungia tenochi* (Felix, 1891) – Löser, Werner and Darga: 58, pl. 7, figs 4–6.
v2016c *Astrea decipiens* Michelin, 1841 – Löser: 181, figs A50a–c.
v2023 *Astraeofungia decipiens* (Michelin, 1841) – Samaniego-Pesqueira et al.: 123, fig. 5E.

Material. BSPG 1947 XVI 27; two thin sections.

Remarks. In Löser et al. (2013c) this specimen was assigned to *Astraeofungia tenochi* (Felix, 1891). Improved and more systematic measurements show that *Astraeofungia tenochi* has larger dimensions and higher septal counts than the present specimen.

Other occurrences. Valanginian to Aptian of the Western Atlantic (Mexico), lower Hauterivian of the European Boreal (Germany, France), Barremian of the Western Atlantic (Mexico), lower Aptian of the Western Tethys (France) and Central Tethys (Greece), upper Aptian of the Western Pacific (Japan), Aptian to lower Albian of the Central Tethys (Greece, Hungary), lower Albian of the Western Tethys (Spain) and Western Atlantic (Mexico), upper Aptian to Albian of the Eastern Tethys (Iran), middle Albian of the Western Atlantic (Mexico), middle Cenomanian of the European Boreal (France).

Astraeofungia schmidti (Koby, 1898)

*v1898 *Thamnastraea Schmidti* – Koby: 77, pl. 18, fig. 3.
v1935 *Synastrea Tombecki* d'Orb. – Cottreau: 39, pl. 75, fig. 4.
v2014b *Astraeofungia bellula* (Orbigny, 1850) – Löser: 35, fig. 5h.
v2015a *Astraeofungia bellula* – Löser: appendix.
v2015 *Astraeofungia* sp. – Löser, Arias and Vilas: 55, figs 6g–6i.
v2023 *Astraeofungia schmidti* (Koby, 1898) – Löser and Wilmsen: 283, figs 4.1, 4.2.

Material. BSPG 1991 X 79; one thin section.

Other occurrences. Valanginian to Aptian of the Western Atlantic (Mexico), lower Hauterivian of the European Boreal (France), and the Western Tethys (France), upper Barremian to lower Aptian of the Central Tethys (Switzerland), upper Aptian of North Africa (Algeria), and the Western Tethys (Spain), lower Albian of the Western Atlantic (USA, Mexico), Albian of the Western Tethys (Spain), lower Cenomanian of the Western Tethys (Spain), middle Cenomanian of the European Boreal (France), and upper Cenomanian of the European Boreal (Germany).

Dimorphastrea d'Orbigny, 1850

Type species. *Dimorphastrea grandiflora* d'Orbigny, 1850.

Description. Thamnasterioid colony with corallites arranged in concentric rows. The colony surface is plane, the corallite centres may be slightly depressed. Septa are more often connected between corallites of neighboured rows than with corallites of the same row. No wall. *Dimorphastrea* is similar to *Astraeofungia* and juvenile colonies of *Astraeofungia* and *Dimorphastrea* are difficult to distinguish.

Dimorphastrea cf. *hiraigaensis* (Eguchi, 1951)

cf1951 *Meandraraea hiraigaensis* Eguchi, n. sp. – Eguchi: 37, pl. 6, figs 5, 7, pl. 7, fig. 7.
v2013b *Dimorphastrea insignis* (Fromentel, 1887) – Löser: 20, fig. 3.3.
v2013 *Dimorphastrea regularis* (de Fromentel, 1857) – Löser, Werner and Darga: 60, pl. 6, figs 5–6.
v2015 *Dimorphastrea* sp. – Löser, Arias and Vilas: 56, figs 7a–c.

Material. BSPG 1947 XVI 11, 1947 XVI 9; two thin sections.

Remarks. The present material differs from *Dimorphastrea hiraigaensis* by a clearly higher number of septa.

Other occurrences. Lower Hauterivian of the European Boreal (France), Albian to lower Cenomanian of the Western Tethys (Spain), middle Cenomanian of the European Boreal (Germany).

Leptophyllaraea Alloiteau, 1952

Type species. *Leptophyllia granulata* de Fromentel, 1863b.

Description. Solitary cylindrical coral. Corallite outline elliptical, centre slightly depressed. Septa irregularly perforated, more common in the central part of the septal blade. Symmetry of septa irregular radial. Septa of younger generations are with their inner margins occasionally connected to septa of older generations. Synapticulae abundant. Columella absent or as some small elements, presumably trabecular extensions of septal inner margins.

Leptophyllaraea cf. *granulata* (de Fromentel, 1863b)

cf1863 *Leptophyllia granulata* – de Fromentel: 303, pl. 61, fig.1.
v2013 *Leptophyllaraea* cf. *granulata* (de Fromentel, 1863) – Löser, Werner and Darga: 60, pl. 7, figs 7–9.

Material. BSPG 1991 X 67, 1991 X 88; one thin section.

Microphyllia d'Orbigny, 1849

Type species. *Meandrina soemmeringi* Goldfuss, 1829.

Description. Meandroid colony with distinct corallites. Symmetry of septa irregular. Costae absent. Wall compact, synapticulothecal. Limits of rows tectiform.

Microphyllia cf. *oldhamiana* (Stoliczka, 1873)

cf1873 *Comoseris Oldhamiana*, Stoliczka – Stoliczka: 46, pl. 10, fig.3.
vp1935 *Meandraraea somalica* – Thomas: 34.
v1964 *Microphyllia acuta* (Solomko, 1888) – Morycowa: 90, pl. 27, fig. 2, pl. 29, fig. 3.
v2013 *Microphyllia* cf. *oldhamiana* (Stoliczka, 1873) – Löser, Werner and Darga: 62, pl. 7, figs 10–12.

Material. BSPG 1991 X 49, 1991 X 50, 1991 X 51; three thin sections.

Other occurrences. Bathonian of the Southern Tethys (Somalia), upper Kimmeridgian of the European Boreal (Germany), lower Aptian of the Central Tethys (Poland).

Placoseris de Fromentel, 1863b

Type species. *Placoseris patella* de Fromentel, 1863b.

Description. Solitary cylindric coral. Corallite outline circular or elliptical, centre slightly depressed. Symmetry of septa irregular radial. Synapticulae moderately common. Columella absent or developed as some small elements, presumably trabecular extensions of septal inner margins. Endotheca consists of numerous dissepiments. Wall absent or epithecal.

Remarks. As already explained in Löser et al. (2021b), in the historic literature the genus *Placoseris* was considered synonymous with *Acrosmilia* d'Orbigny, 1849.

Acrosmilia is a conceptual genus; the type specimen of the type species is available but so poorly preserved that important diagnostic features, such as the presence or absence of pennulae or the amount of septal perforation, cannot be observed. For this reason, the genus *Leptophyllia* Reuss, 1854 was applied (Löser et al. 2019) in place of *Acrosmilia*. *Leptophyllia* was for a long time considered to be a junior synonym of *Acrosmilia*. The study of type specimens and topotypical material has shown that *Leptophyllia* belongs to the mainly Late Cretaceous family Synastraeidae and is restricted to the Late Cretaceous, whereas *Placoseris* belongs to the Jurassic and mainly Lower Cretaceous family Latomeandridae. *Leptophyllia* has thicker and less perforate septa, whereas in *Placoseris* the septa are thinner and more perforate at the inner margin. Moreover, the septa are often connected to each other in the latter, a characteristic that is less common in *Leptophyllia* (see Löser et al. 2019 for details).

Placoseris eturbensis (de Fromentel, 1857)

Plate 3: figs 1, 2

*v1857 *Trochoseris Eturbensis* – de Fromentel: 19, pl. 1, fig. 8.
v1897 *Leptophyllia patellata* – Söhle: 44, pl. 6, fig. 5.
v1941 *Thecoseris cenomanensis* n.sp. – Alloiteau: 22, pl. 1, figs 18, 19.
v1989 *Acrosmilia patellata* (Michelin 1845) – Löser: 131, text-fig. 34, pl. 26, fig. 1.
v2015a *Acrosmilia* sp. – Löser: appendix.
v2018 *Placoseris eturbensis* (Fromentel, 1857) – Löser, Steuber and Löser: 42, pl. 4, figs 1–3.
v2023 *Placoseris eturbensis* (Fromentel, 1857) – Löser and Wilmsen: 293, figs 10.7–10.9.

Material. LFU 8336SG015085; six thin sections.

Dimensions. (LFU 8336SG015085).

c	26×31.8
septa	154

Other occurrences. Valanginian to Aptian of the Western Atlantic (Mexico), lower Hauterivian of the European Boreal (France), lower Albian of the Western Tethys (Spain), lower Cenomanian of the Central Tethys (Greece), the Western Tethys (Spain), and the European Boreal (Germany), middle Cenomanian of the European Boreal (France), upper Cenomanian of the European Boreal (Germany).

Placoseris cf. *eturbensis* (de Fromentel, 1857)

Plate 3: figs 3–5

cf1857 *Trochoseris Eturbensis* – de Fromentel: 19, pl. 1, fig. 8.
v2013 *Acrosmilia* sp. – Löser, Werner and Darga: 58, pl. 7, figs 1–3.
v2014b *Acrosmilia baumbergeri* (Koby, 1898) – Löser: 34, fig. 5d.

Material. BSPG 1947 XVI 4, 1947 XVI 5, 1991 X 64, 1991 X 65, 1991 X 66, 1991 X 68, 1991 X 69, LFU 8336SG015091; four thin sections.

Dimensions. (LFU 8336SG015091).

c	19.4×30.1
septa	202

Remarks. The present material differs from *Placoseris eturbensis* by a higher number of septa.

Other occurrences. Hauterivian to Cenomanian of the European Boreal (France, Germany), upper Cenomanian of the Western Tethys (France) and the European Boreal (Germany).

Polyastropsis Alloiteau, 1957

Type species. *Polyastropsis arnaudi* Alloiteau, 1957.

Description. Thamnasterioid-cerioid colony. Corallite outline irregular with corallite centres slightly depressed. Symmetry of septa irregular. Costae confluent or sub-confluent. Synapticulae occasional, mainly in the space between corallites. Columella consists of isolated trabeculae or one more solid element. Wall subcompact, made of synapticulae. *Polyastreopsis* differs from *Thalamocaeniopsis* by a poorly defined corallite outline, and a more incomplete wall.

Polyastropsis cf. *fascigera* (Felix, 1909)

cf1909 *Isastraea fascigera* – Felix: 172, pl. 7, fig. 2.
v2013 *Thalamocaeniopsis* sp. – Löser, Werner and Darga: 63, pl. 8, figs 7–9.

Material. BSPG 1947 XVI 56; two thin sections.

Remarks. In Löser et al. (2013c) this specimen was assigned to the genus *Thalamocaeniopsis*. This is changed here. *Thalamocaeniopsis* has polygonal corallites and a marked wall, even if thin and incomplete, whereas *Polyastreopsis* has no wall at all and the corallite outline is irregular. The specimen differs from *Polyastropsis fascigera* by having smaller distances of the corallites and a higher number of septa.

Other occurrences. Upper Aptian of the Western Tethys (Spain), lower Albian of the Western Atlantic (Mexico), lower Cenomanian of the European Boreal (Germany).

Thalamocaeniopsis Alloiteau, 1954a

Type species. *Thalamocaeniopsis ouenzensis* Alloiteau, 1954a.

Description. Cerioid colony. Corallite outline polygonal with centres slightly depressed. Symmetry of septa irregular. Synapticulae occasional, mainly in the space between corallites. No costae. Columella consists of isolated trabeculae or one more solid element. Wall subcompact, made of synapticulae. Budding extracalicinal.

Thalamocaeniopsis cf. *taramellii* (d'Achiardi, 1880)

Plate 3: figs 6–8

cf1880 *Latimeandra taramellii* – d'Achiardi: 249: pl. 17, fig. 7.
v2004 *Isastrea minima* Prever, 1909 – Löser and Mohanti: 583, fig. 2c.
v2018 *Thalamocaeniopsis* sp. – Löser, Steuber and Löser: 44, pl. 4, figs 10, 11.

Material. BSPG 1947 XVI 75; two thin sections.

Dimensions. (BSPG 1947 XVI 75).

	n	min–max	μ	s	cv	μ±s
clmin	10	1.55–2.03	5.71	1.17	20.5	4.54–6.88
clmax	10	5.65–10.3	8.00	1.69	21.1	6.31–9.69
ccd	10	3.84–8.71	5.82	1.58	27.2	4.24–7.40
septa	10	36–63	45.80	8.57	18.7	37–54

Remarks. The specimen differs from *Thalamocaeniopsis taramellii* by a lower number of septa.

Other occurrences. Lower Aptian of the Western Tethys (Spain), lower Cenomanian of the Central Tethys (Greece), Cenomanian of the Southern Tethys (India).

Thalamocaeniopsis sp. 1

Plate 3: figs 9–11

v1909 *Isastraea Hörnesi* – Prever: 95, pl. 7, fig. 7.
vp2015 *Thalamocaeniopsis* sp. – Bonilla González: 94, pl. 11, figs 4–6.

Material. BSPG 1948 III 2; two thin sections.

Dimensions. (BSPG 1948 III 2).

	n	min–max	μ	s	cv	μ±s
clmin	12	3.53–4.98	4.23	0.45	10.7	3.78–4.68
clmax	12	4.10–7.24	5.79	1.07	18.4	4.73–6.86
ccd	15	3.59–6.69	4.54	0.78	17.2	3.76–5.32
septa	8	45–57	49.13	3.68	7.5	45–53

Other occurrences. Lower Hauterivian of the European Boreal (France), lower Aptian of the Central Tethys (Italy), lower Albian of the Western Atlantic (Mexico).

Thalamocaeniopsis sp. 2

Plate 4: figs 1, 2

v1909 *Isastraea morchella* Reuss – Prever: 96, pl. 8, fig. 3.
v1996 *Latiastrea* cf. *kaufmanni* (Koby, 1897) – Baron-Szabo and Steuber: 25, pl. 15, figs 1, 2.
vp2008 *Microphyllia elevata* sp. n. – Roniewicz: 121.
vp2015 *Thalamocaeniopsis* sp. – Bonilla González: 94.
v2023 *Thalamocaeniopsis* sp. – Löser and Wilmsen: 299, figs 13.10–13.12.

Material. BSPG 1947 XVI 76; three thin sections.

Dimensions. (BSPG 1947 XVI 76).

	n	min–max	μ	s	cv	μ±s
clmin	7	4.71–6.21	5.58	0.46	8.3	5.12–6.04
clmax	8	5.80–8.44	6.86	0.89	12.9	5.97–7.75
ccd	8	5.46–8.35	6.40	20.90	14.1	5.49–7.30
septa	9	42–56	46.6	4.67	10.0	42–51

Other occurrences. Valanginian to lower Aptian of the Central Tethys (Bulgaria, Italy), lower Aptian of the European Boreal (UK) and the Central Tethys (Greece), lower Albian of the Western Tethys (Spain) and the Western Atlantic (Mexico), lower Cenomanian of the Western Tethys (Spain).

Family Microsolenidae Koby, 1889

Description. Solitary (not in the Cretaceous) and colonial (cerioid, hydnophoroid, meandroid, phaceloid, plocoid, thamnasterioid) colonies. Septa completely and regularly perforated. Interseptal space larger than or equal to septal thickness.

Dimorpharaea de Fromentel, 1861

Type species. *Microsolena koechlini* Milne Edwards, 1860.

Description. Thamnasterioid colony with corallites arranged in rows. The corallites are well separated from each other. Septa run mostly between neighboured corallite rows, less between adjacent corallites. A central corallite may be present.

Dimorpharaea williamsonensis (Wells, 1944)

*v1944 *Microsolena williamsonensis* Wells, n.sp. – Wells: 100, pl. 20, figs 1–4.
v2013 *Dimorpharaea japonica* Eguchi, 1951 – Löser, Werner and Darga: 63, pl. 8, figs 10–12.
v2017 *Dimorpharaea japonica* Eguchi, 1951 – Löser and Bilotte: 9, figs 7g–i.

Material. BSPG 1991 X 80; two thin sections.

Remarks. In Löser et al. (2013c), this specimen was assigned to *Dimorpharaea japonica* Eguchi, 1951. *Dimorpharaea japonica* and *Dimorpharaea williamsonensis* have very similar dimensions but differ in the septal counts.

Other occurrences. Upper Aptian of the Western Tethys (Spain), Albian to lower Cenomanian of the Western Atlantic (Mexico, USA), lower Cenomanian of the European Boreal (Germany), upper Cenomanian of the Western Tethys (France).

Eocomoseris Melnikova et al., 1993

Type species. *Eocomoseris gurumdyensis* Roniewicz, 2011.

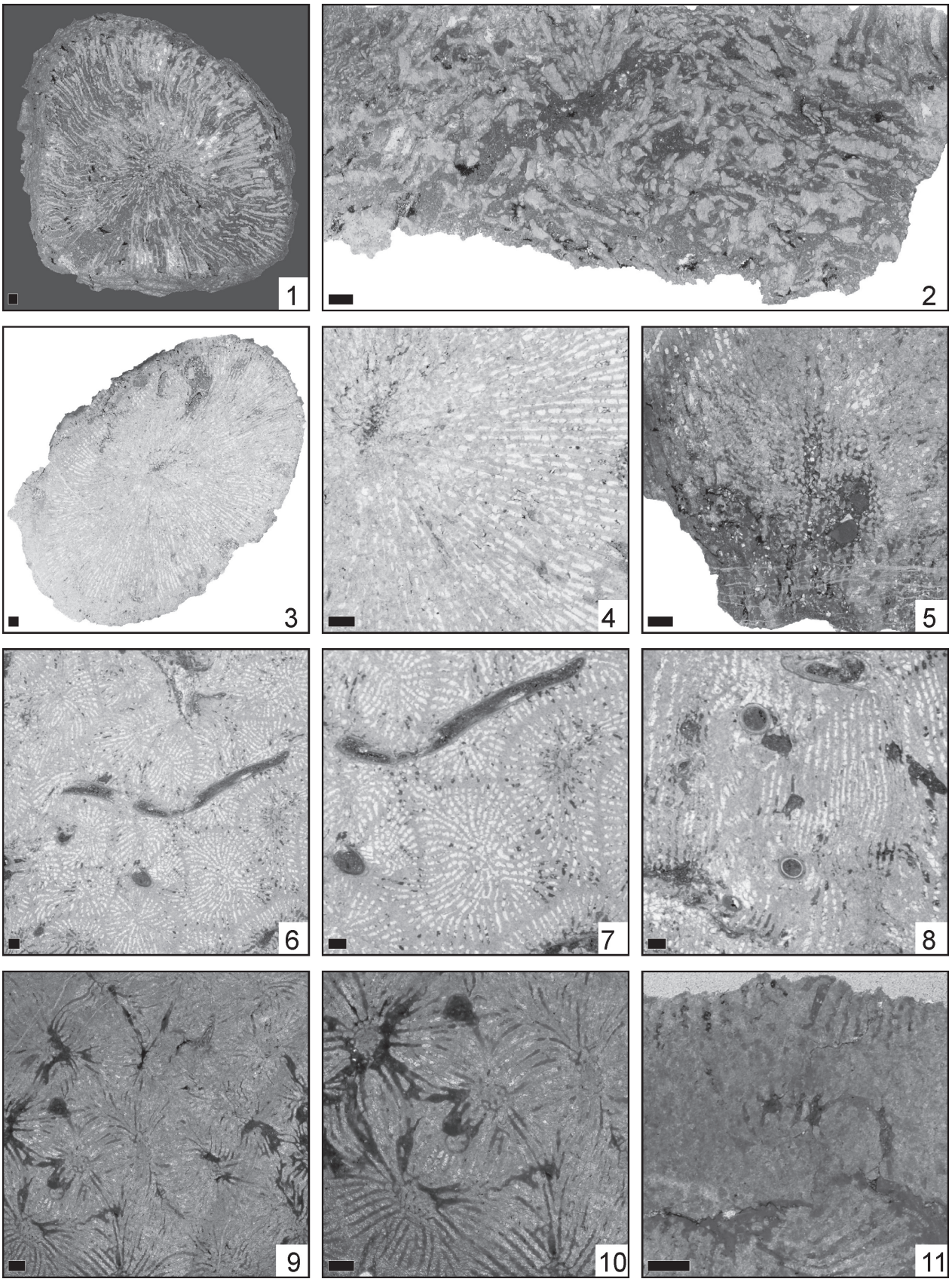

Plate 3. (1, 2) *Placoseris eturbensis* (de Fromentel, 1857). LFU 8336SG015085. **1**. Transversal thin section. **2**. Longitudinal thin section. **(3–5)** *Placoseris* cf. *eturbensis* (de Fromentel, 1857). LFU 8336SG015091. **3**. Transversal thin section. **4**. Transversal thin section, detail. **5**. Longitudinal thin section. **(6–8)** *Thalamocaeniopsis* cf. *taramellii* (d'Achiardi, 1880). BSPG 1947 XVI 75. **6**. Transversal thin section. **7**. Transversal thin section, detail. **8**. Longitudinal thin section. **(9–11)** *Thalamocaeniopsis* sp. 1, BSPG 1948 III 2. **9**. Transversal thin section. **10**. Transversal thin section, detail. **11**. Longitudinal thin section. Scale bars: 1 mm.

Description. Astreoid colony with small corallites. Symmetry of septa irregular, but two size orders can be distinguished. Number of septa up to 30. Septa occasionally connected to each other. Costae sub-confluent to non-confluent. Synapticulae fairly common. Columella styliform. Endotheca and wall absent. Coenosteum narrow.

Eocomoseris sp.

Plate 4: figs 3, 4

v2012 *Eocomoseris raueni* Melnikowa et al., 1993 – Bover Arnal, Löser and Moreno Bedmar: 58, figs 11I–K.
v2013 *Eocomoseris raueni* Melnikova et al. 1993 – Löser, Castro and Nieto: 25, pl. 8, figs 11, 12.
v2021 *Eocomoseris* sp. 1 – Löser, Nieto, Castro and Reolid: 25, figs 27.1–3.

Material. LFU 8336SG015094#3; one thin section.

Dimensions. (LFU 8336SG015094#3).

	n	min–max	μ	s	cv	μ±s
clmin	6	1.64–2.16	1.90	0.19	9.8	1.71–2.08
clmax	6	1.84–2.32	2.15	0.18	8.4	1.97–2.33
ccd	10	1.82–3.89	2.65	0.64	24.3	2.01–3.30
septa	7	19–28	23.9	3.63	15.2	20–27

Remarks. The difficulty of species separation was already discussed in Löser et al. (2021b).

Other occurrences. Lower Valanginian of the Western Tethys (Spain), Valanginian to Aptian of the Western Atlantic (Mexico), lower Aptian to middle Cenomanian of the Western Tethys (Spain, Portugal), Albian to lower Cenomanian of the European Boreal (UK).

Family Negoporitidae Eliášová, 1995

Description. Colonial (plocoid) corals. Septa with perforations. Septal symmetry bilateral. Septa connected to each other. Pali and columella present. Endotheca with tabulae. Wall incomplete, synapticulothecate. Coenosteum extended, with isolated trabeculae. Budding extracalicinal.

Negoporites Eliášová, 1989

Type species. *Porites michelini* Reuss, 1846.

Description. Plocoid colony. Corallite outline circular, corallites small (generally below 3 mm in diameter). Septa irregularly perforated. Symmetry of septa bilateral. Septal cycles differ in length, but hardly at all in thickness. Septa of younger cycles often and regularly connected to the septa of preceding cycles. Not well-separated pali irregularly present. Costae non-confluent. Synapticulae fairly common, mainly in the wall. Columella small, substyliform. Endotheca consists of numerous thin tabulae. Wall subcompact, synapticulothecal. Coenosteum moderately broad, consists of trabeculae and tabulae.

Negoporites cf. *quartus* Eliášová, 1995

cf1995 *Negoporites quartus* sp. n. – Eliášová: 28, pl. 2, fig. 2, pl. 3, figs 1, 2.
v2013 *Negoporites* cf. *quartus* Eliášová, 1995 – Löser, Werner and Darga: 62, pl. 8, figs 1–3.

Material. BSPG 1947 XVI 45; one thin section.

Other occurrences. Lower Cenomanian of the Western Tethys (Spain).

Negoporites sp.

v2013 *Negoporites* sp. – Löser, Werner and Darga: 62, pl. 8, figs 4–6.

Material. BSPG 1947 XVI 53; one thin section.

Paractinacis Löser & Heinrich, 2018

Type species. *Paractinacis uliae* Löser & Heinrich, 2018.

Description. Astreoid colony with strong, at the inner margin slightly perforated septa, that stand in a bilateral symmetry. The septal lateral faces are ornamented with pennulae. The columella is small and styliform. The wall is synapticulothecate, in places septothecal, subcompact. Endotheca with tabulae.

Paractinacis uliae Löser & Heinrich, 2018

Plate 4: figs 5–7

v2018 *Paractinacis uliae* spec. nov. – Löser and Heinrich: 131, fig. 4.
v2019 *Paractinacis uliae* Löser and Heinrich, 2018 – Löser, Heinrich and Schuster: 92, figs 126, 129a–c.

Material. BSPG 1947 XVI 69, LFU 8336SG015157; three thin sections.

Dimensions. (LFU 8336SG015157).

	n	min–max	μ	s	cv	μ±s
cmin	7	2.58–3.69	3.20	0.36	11.4	2.84–3.57
cmax	6	2.96–4.04	3.46	0.51	14.7	2.95–3.97
ccd	9	2.60–4.07	3.07	0.51	16.5	2.56–3.58
septa	24–32					

Other occurrences. Coniacian to Santonian of the Central Tethys (Austria).

Family Synastreidae Alloiteau, 1952

Description. Solitary and (astreoid, meandroid, thamnasterioid) colonial corals. Septa almost compact with few perforations at the inner margins. Interseptal space smaller than septal thickness.

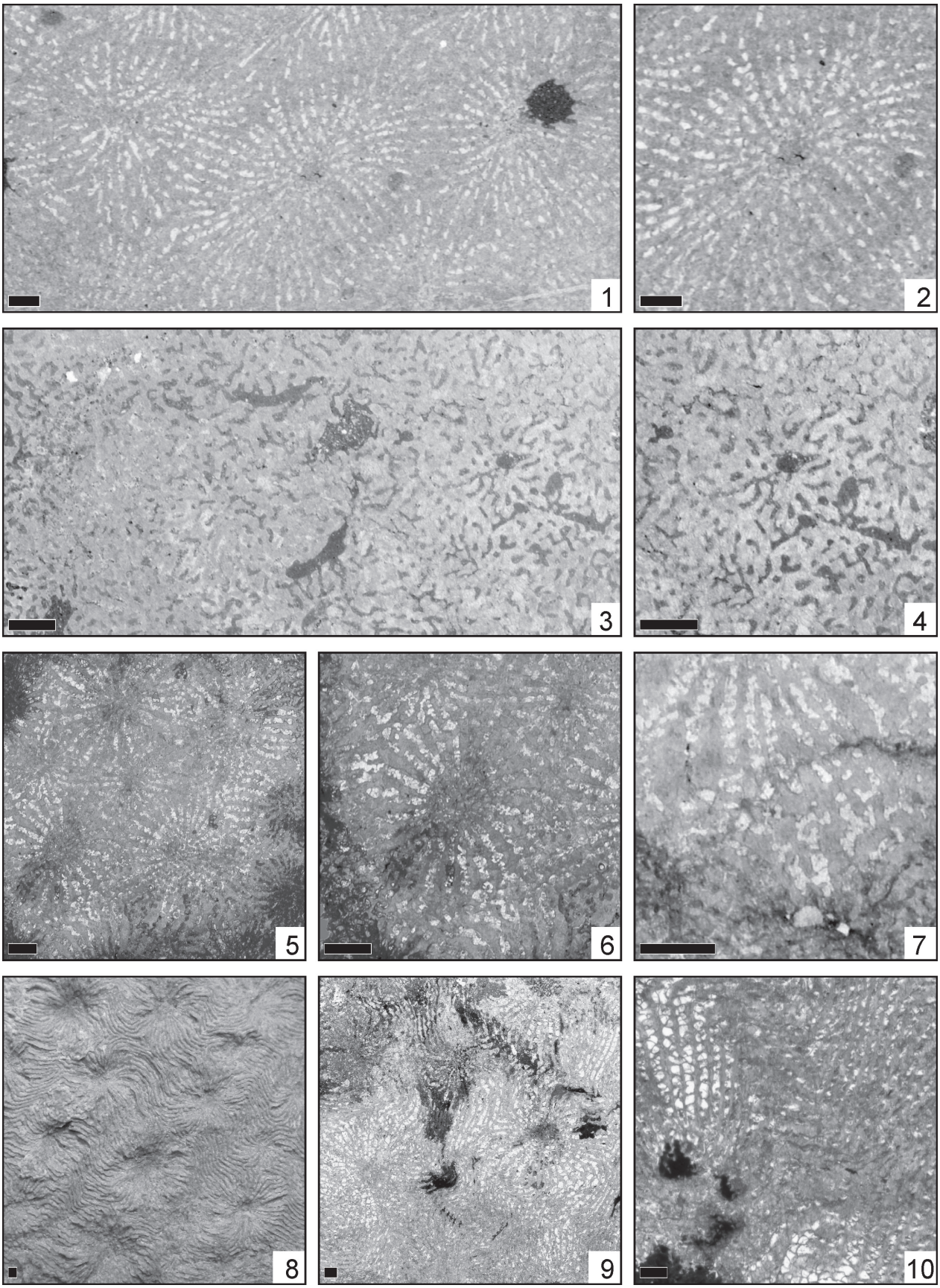

Plate 4. (1–2) *Thalamocaeniopsis* sp. 2, BSPG 1947 XVI 76. **1**. Transversal thin section. **2**. Transversal thin section, detail. **(3–4)** *Eocomoseris* sp., LFU 8336SG015094#3. **3**. Transversal thin section. **4**. Transversal thin section, detail. **(5–7)** *Paractinacis uliae* Löser & Heinrich, 2018. LFU 8336SG015157. **5**. Transversal thin section. **6**. Transversal thin section, detail. **7**. Longitudinal thin section. **(8–10)** *Brachycoenia* aff. *composita* (Sowerby, 1832). BSPG 1955 XIX 34. **8**. Colony surface. **9**. Transversal thin section. **10**. Longitudinal thin section. Scale bars: 1mm.

Brachycoenia Beauvais, 1982

Type species. *Adelastrea leptophylla* Reuss, 1854.

Description. Thamnasterioid colony, where – in contrast to *Synastrea* – the corallites are clearly marked and slightly elevated. The septa are bent outside the corallite.

Brachycoenia aff. *composita* (Sowerby, 1832)

Plate 4: figs 8–10

v2019 *Brachycoenia* aff. *composita* (Sowerby, 1832) – Löser, Heinrich and Schuster: 95, figs 135a–c.

Material. BSPG 1955 XIX 34; two thin sections.

Dimensions. (BSPG 1955 XIX 34).

	n	min–max	μ	s	cv	μ±s
cmin	10	6.50–8.36	7.26	0.62	8.5	6.64–7.87
cmax	10	6.32–8.58	7.24	0.80	11.1	6.43–8.04
ccd	10	8.33–10.1	9.11	0.65	7.1	8.46–9.76
septa	10	36–49	42.3	3.40	8.0	39–46

Remarks. The specimen has smaller corallite dimensions compared to *Brachycoenia composita*. Since the type material of *Brachycoenia composita* is not available and a correct comparison is not possible, a new species cannot be established for this specimen.

Other occurrences. Coniacian to Santonian of the Central Tethys (Austria).

Leptophyllia Reuss, 1854

Type species. *Leptophyllia clavata* Reuss, 1854.

Description. Turbinate or trochoid solitary coral with circular, elliptical or irregular outline. The septa are numerous, thick, slightly perforated at the inner margin and rarely connected to each other. The endotheca is well developed.

Leptophyllia sp.

Plate 5: figs 1–3

vp1854 *Leptophyllia clavata* – Reuss: 101.

v2019 *Leptophyllia* sp. 2 – Löser, Heinrich and Schuster: 137, figs 203a–c.

Material. LFU 8336SG015155#1; two thin sections.

Dimensions. (LFU 8336SG015155#1).

c	10.6×12.9
septa	140

Remarks. This specimen marks the first stratigraphical occurrence of the genus.

Other occurrences. Coniacian to Santonian of the Central Tethys (Austria).

Synastrea Milne Edwards & Haime, 1848b

Type species. *Astrea agaricites* Goldfuss, 1826.

Description. Thamnasterioid colony with strong, only at the inner margin perforated septa, that barely differ in length and thickness. The corallites are regularly distributed, often slightly depressed. Costae run between all corallites.

Synastrea agaricites (Goldfuss, 1826)

Plate 5: figs 4–6

*v1826 *Astraea Agaricites* – Goldfuss: 66, pl. 22, fig. 9.

v1854 *Thamnastraea procera* – Reuss: 120, pl. 5, figs 1, 2.

v2019 *Synastrea agaricites* (Goldfuss, 1826) – Löser, Heinrich and Schuster: 142, fig. 212, figs. 214a–c.

Material. LFU 8336SG015099#1; two thin sections.

Dimensions. (LFU 8336SG015099#1).

	n	min–max	μ	s	cv	μ±s
ccd	30	3.76–5.75	4.73	0.63	13.3	4.10–5.36
septa	10	49–61	53.9	3.81	7.1	50–58

Other occurrences. Upper Turonian to Santonian of the Central Tethys (Austria).

Synastrea cf. *catadupensis* (Vaughan, 1899)

Plate 5: figs 7–9

cf1899 *Mesomorpha catadupensis*, n. sp. – Vaughan: 246, pl. 41, figs 1-3.

v2019 *Synastrea* cf. *catadupensis* Vaughan, 1899 – Löser, Heinrich and Schuster: 144, figs 216a–c.

Material. BSPG 1947 XVI 70, LFU 8336SG015088; six thin sections.

Dimensions. (BSPG 1947 XVI 70)

	n	min–max	μ	s	cv	μ±s
ccd	25	4.29–7.38	5.98	0.79	13.2	5.19–6.76
septa	12	38–56	45.25	5.51	12.2	40–51

Remarks. *Synastrea catadupensis* has higher septal counts compared to the present material.

Other occurrences. Coniacian to Santonian of the Central Tethys (Austria).

Synastrea exaltata (Reuss, 1854)

Plate 5: figs 10–12

*1854 *Thamnastraea exaltata* – Reuss: 118, pl. 19, figs 5, 6.

v2019 *Synastrea* ? *exaltata* (Reuss, 1854) – Löser, Heinrich and Schuster: 146, figs 220a–c.

Material. LFU 8336SG015090#1; two thin sections.

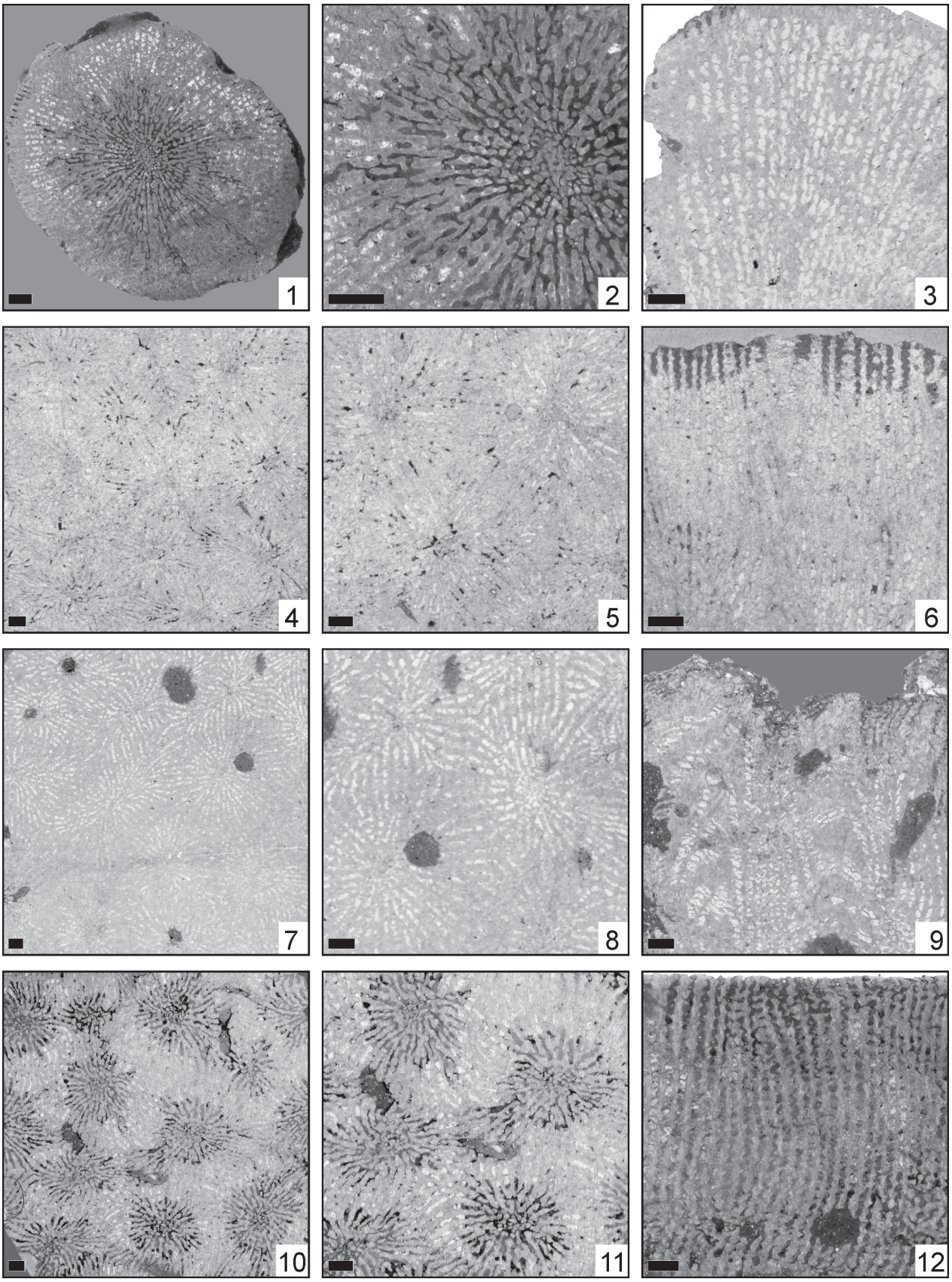

Plate 5. (1–3) *Leptophyllia* sp., LFU 8336SG015155#1. **1**. Transversal thin section. **2**. Transversal thin section, detail. **3**. Longitudinal thin section. **(4–6)** *Synastrea agaricites* (Goldfuss, 1826). LFU 8336SG015099#1. **4**. Transversal thin section. **5**. Transversal thin section, detail. **6**. Longitudinal thin section. **(7–9)** *Synastrea* cf. *catadupensis* (Vaughan, 1899). BSPG 1947 XVI 70. **7**. Transversal thin section. **8**. Transversal thin section, detail. **9**. Longitudinal thin section. **(10–12)** *Synastrea exaltata* (Reuss, 1854). LFU 8336SG015090#1. **10**. Transversal thin section. **11**. Transversal thin section, detail. **12**. Longitudinal thin section. Scale bars: 1 mm.

Dimensions. (LFU 8336SG015090#1).

	n	min–max	μ	s	cv	μ±s
ccd	15	4.16–6.39	5.35	0.77	14.3	4.59–6.12
septa	11	33–54	44.0	7.44	16.9	37–51

Other occurrences. Coniacian to Santonian of the Central Tethys (Austria), Campanian to Maastrichtian of the Western Atlantic (Jamaica).

Synastrea heberti (Alloiteau, 1952)

Plate 6: figs 1–3

*v1952 *Uxacalcaraea Heberti* All. – Alloiteau: 665.
v1957 *Uxacalcaraea Heberti* nov. gen., nov. sp. – Alloiteau: 221, pl. 8, fig. 7, pl. 9, fig. 12.
v1997 *Thamnaraea cladophora* Felix, 1903 – Baron-Szabo: 80, pl. 13, fig. 1.
v2012a *Astraeofungia siva* (Stoliczka, 1873) – Löser: 28, figs 2.11–2.12.
v2016c *Uxacalcaraea heberti* Alloiteau, 1952 – Löser: p. 681, figs U1a–c.
v2019 *Synastrea heberti* Alloiteau, 1952 – Löser, Heinrich and Schuster: 147, figs 221a–c.

Material. BSPG 1947 XVI 67; two thin sections.

Dimensions. (BSPG 1947 XVI 67).

	n	min–max	μ	s	cv	μ±s
ccd	15	3.71–5.20	4.41	0.47	10.7	3.93–4.88
septa	8	31–46	38.6	5.18	13.4	33–44

Other occurrences. Upper Turonian of the Western Tethys (France), upper Turonian to Santonian of the Central Tethys (Austria), lower Coniacian of the Western Tethys (Spain), lower Campanian of the Central Tethys (Austria, Turkey).

Synastrea ?*salisburgensis* (Beauvais, 1982)

Plate 6: figs 4, 5

?*1982 *Fungiastraea salisburgensis* nov. sp. – Beauvais: (2), p. 75, pl. 27, fig. 5, pl. 28, fig. 1.
v2018 *Synastrea* sp. – Löser, Steuber and Löser: 46, pl. 6, figs 1–3.
v2019 *Synastrea salisburgensis* (Beauvais, 1982) – Löser, Heinrich and Schuster: 151, figs 226a–c.

Material. LFU 8336SG015227#2, 8336SG015228#3, 8336SG015228#5; three thin sections.

Dimensions. (LFU 8336SG015228#5).

	n	min–max	μ	s	cv	μ±s
ccd	20	4.33–6.90	5.69	0.85	14.9	4.85–6.54
septa	10	29–42	34.6	5.25	15.2	29–40

Remarks. As already mentioned in Löser et al. (2019), the type material of the species is not available and the morphometric data provided in the literature do not allow a clear separation from other species.

Other occurrences. Aptian to Santonian of the Central Tethys (Greece, Austria), Campanian to Maastrichtian of the Western Atlantic (Jamaica).

Synastrea sp.

v2013 *Synastrea* sp. – Löser, Werner and Darga: 63, pl. 9, fig. 1.

Material. BSPG 1991 X 95; one thin section.

Superfamily Dendrogyroidea Alloiteau, 1952

Description. Colonial corals. Septa strong, compact. Symmetry irregular. Septa often connected to each other. Septal distal margins smooth, lateral faces smooth or with thorns, inner margins slightly swollen. Lonsdaleoid septa absent. Main septum absent. Microstructure of very small trabeculae, only marked by a dark line. Synapticulae and pali absent. Columella by septal fusion. Endotheca mostly present, consisting of tabulae or dissepiments. Marginarium absent. Wall generally present, septothecal. Coenosteum present in some genera. Budding varies.

Family Dendrogyridae Alloiteau, 1952

Hydnophoraraea Oppenheim, 1930

Type species. *Monticularia styriaca* Michelin, 1847.

Description. Hydnophoroid colony. Corallite centres can be recognised in places. Septa straight, free, often alternating in length and thickness. Their lateral faces bear thorns or are smooth. The columella is rudimentarily developed; it is difficult to assign the elements between the crests to any morphological unit. Endotheca well developed.

Remarks. Formerly, this genus was assigned to the family Eugyridae (Löser 2016c, Löser et al. 2019). But it differs from this family by the less regular endotheca and thinner septa. Moreover, all other members of the Eugyridae became extinct before the Turonian. *Hydnophoraraea* shows certain similarities to the family Dendrogyridae, but there is also material that differs from this concept such as, for instance, by having a dissepimental instead of a tabular endotheca, or showing the lateral faces ornamented with thorns instead of being smooth. It is also possible that *Hydnophoraraea* encompasses heterogeneous material and it is also possible that further studies could reveal that the material assigned to *Hydnophoraraea* may belong to different genera. Further, it is also problematic that the type material of *Monticularia styriaca* Michelin, 1847, type species of *Hydnophoraraea*, is not available (despite being registered in the catalogue of the MNHN in Paris).

Hydnophororaraea aff. *digitata* (de Fromentel, 1877)

Plate 6: figs 6, 7

Material. LFU 8336SG015224; three thin sections.

Dimensions. (LFU 8336SG015224).

	n	min–max	μ	s	cv	μ±s
md	20	2.57–3.89	3.21	0.44	13.6	2.77–3.65
septa	15	17–22	19.73	1.75	8.9	18–21

Remarks. The present specimen differs from *H. digitata* by larger distances between the crests. Moreover, the crests are polygonal in *H. digitata*, but conical in the present specimen.

Hydnophororaraea obliqua (Reig Oriol, 1992)

v*1992 *Hydnophora obliqua* n. sp. – Reig Oriol: 26, pl. 1, fig. 6, pl. 5, figs 4, 5.

vp2012a *Hydnophora obliqua* Reig Oriol, 1992 – Löser: 26.

vp2013 *Hydnophora* cf. *obliqua* Reig Oriol, 1992 – Löser, Werner and Darga: 50, pl. 3, figs 4–6.

Material. BSPG 1947 XVI 21, 1947 XVI 22, 1963 VI 190, 1991 X 59, 1991 X 60; two thin sections.

Other occurrences. Middle Santonian of the Central Tethys (Austria), Early Campanian of the Central Tethys (Turkey), Campanian of the Western Tethys (Spain).

Hydnophororaraea parviconus Oppenheim, 1930

*v1930 *Hydnophororaraea parviconus* Oppenheim n. sp. – Oppenheim: 227, pl. 18, figs 3–5, 8.

v1930 *Hydnophororaraea aconus* n. sp. – Oppenheim: 232, pl. 18, fig. 2, pl. 19, fig. 4.

v1989 *Hydnophora minima* nov. sp. – Reig Oriol: 17, pl. 5, fig. 4.

vp2012a – *Hydnophora obliqua* Reig Oriol, 1992 – Löser: 26, figs 3.1–3.3.

vp2013 *Hydnophora* cf. *obliqua* Reig Oriol, 1992 – Löser, Werner and Darga: 50.

v2013 *Hydnophora* sp. – Löser, Werner and Darga: 48, pl. 4, figs 8, 9.

v2019 *Hydnophororaraea parviconus* Oppenheim, 1930 – Löser, Heinrich and Schuster: 159, figs 235, 236, 240a–c.

Material. BSPG 1963 VI 189, 1991 X 106; two thin sections.

Remarks. In Löser et al. (2013c) this material was assigned to *Hydnophora* cf. *obliqua* Reig Oriol, 1992 and, respectively, *Hydnophora* sp. After having been able to study the type material of Oppenheim (1930) in Jerusalem in 2016, it was possible to correct this assignation.

Other occurrences. Coniacian to Early Campanian of the Central Tethys (Austria, Turkey), Campanian of the Western Tethys (Spain).

Hydnophororaraea rapulum Oppenheim, 1930

Plate 6: figs 8, 9

v1877 *Hydnophora Styriaca* – de Fromentel: 468, pl. 120, fig. 2. [non *Monticularia styriaca* Michelin, 1847]

*v1930 *Hydnophororaraea rapulum* n. sp. – Oppenheim: 230, pl. 14, fig. 3, pl. 18, fig. 7.

1992 *Hydnophora dissimilis* n. sp. – Reig Oriol: 27, pl. 1, figs 4, 5, pl. 5, fig. 6.

v2019 *Hydnophororaraea rapulum* Oppenheim, 1930 – Löser, Heinrich and Schuster: 160, figs 242a, b.

Material. LFU 8336SG015087#1; two thin sections.

Dimensions. (LFU 8336SG015087#1).

	n	min–max	μ	s	cv	μ±s
md	15	1.97–2.55	2.31	0.20	8.5	2.11–2.51
septa	13	8–12	9.92	1.55	15.6	8–11

Other occurrences. Upper Cenomanian of the Western Tethys (France), Coniacian to Santonian of the Central Tethys (Austria), upper Santonian of the Western Tethys (France), Santonian to Campanian of the Western Tethys (Spain).

Hydnophororaraea aff. *rapulum* Oppenheim, 1930

Plate 7: figs 1–3

v2018 *Hydnophororaraea styriaca* (Michelin, 1847) – Löser, Steuber and Löser: 47, pl. 6, figs 4–6.

Material. LFU 8336SG015012#1; two thin sections.

Dimensions. (LFU 8336SG015012#1).

	n	min–max	μ	s	cv	μ±s
md	15	1.85–2.57	2.23	0.26	11.8	1.97–2.49
septa	20	10–14	12.20	1.47	12.1	11–14

Remarks. Compared to *Hydnophororaraea rapulum*, the distances between crests are lower but the septal counts are higher.

Other occurrences. Cenomanian of the Central Tethys (Greece).

Superfamily Eugyroidea d'Achiardi, 1875

Description. Colonial (cerioid, flabelloid, hydnophoroid, meandroid, phaceloid, plocoid) corals. Septa compact. Septal symmetry regular and in various systems, in size orders or irregular. Septa poorly ornamented. Septal microstructure of small trabeculae. Lonsdaleoid septa only in the Felixigyrids; main septa absent. Synapticulae and pali absent. Columella rare. Endotheca well-developed, generally as dense, thick and regular tabulae. Marginarium absent. Wall compact and tabulothecal or septothecal by thickening of septa. Coenosteum and budding varies.

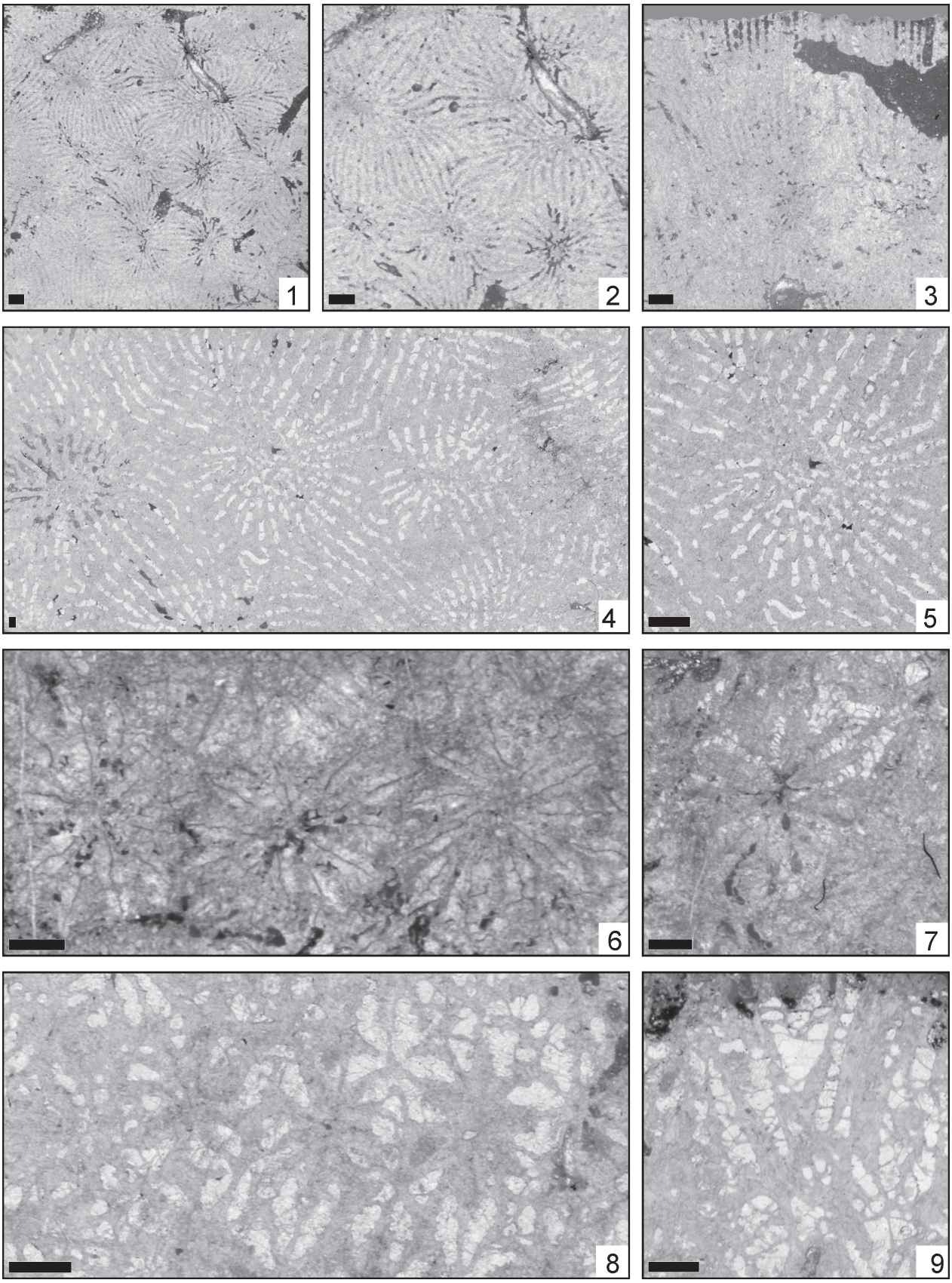

Plate 6. (1–3) *Synastrea heberti* (Alloiteau, 1952). BSPG 1947 XVI 67. **1**. Transversal thin section. **2**. Transversal thin section, detail. **3**. Longitudinal thin section. **(4–5)** *Synastrea* ? *salisburgensis* (Beauvais, 1982). LFU 8336SG015228#5. **4**. Transversal thin section. **5**. Transversal thin section, detail. **(6–7)** *Hydnophoraraea* aff. *digitata* (de Fromentel, 1877). LFU 8336SG015224. **6**. Transversal thin section, detail. **7**. Transversal thin section. **(8–9)** *Hydnophoraraea rapulum* Oppenheim, 1930. LFU 8336SG015087#1. **8**. Transversal thin section. **9**. Longitudinal thin section. Scale bars: 1 mm.

Family Eugyridae d'Achiardi, 1875

Description. Colonial (cerioid, flabelloid, hydnophoroid, meandroid or hybrid) corals. Septa in size orders. Columella rare. Wall compact and septothecal by thickening of septa.

Columellophora Eliášová, 1989

Type species. *Columellophora velimensis* Eliášová, 1989.

Description. Hydnophoroid-cerioid colony with distinct corallites. Corallite outline irregular, centres depressed. Symmetry of septa radial and irregularly hexameral. Pali or paliform lobes absent. Costae absent. Columella styliform or by septal fusion in the centre of the corallite. Endotheca consists of regular tabulae and occasional dissepiments. Wall compact, septothecal. Coenosteum absent.

Columellophora velimensis Eliášová, 1989

*v1989 *Columellophora velimensis* n.sp. – Eliášová: 114, pl. 1, fig. 1, pl. 3, fig. 2.

v2013 *Columellophora* cf. *velimensis* Eliášová, 1989 – Löser, Werner and Darga: 48, pl. 2, figs 1–3.

v2016c *Columellophora velimensis* Eliášová, 1989 – Löser: 247, figs C38a–c.

Material. BSPG 1947 XVI 54, 1991 X 105; four thin sections.

Other occurrences. Upper Cenomanian of the Western Tethys (France), upper Cenomanian to lower Turonian of the European Boreal (Czech Republic).

Columellophora sp.

v2013 *Columellophora* sp. – Löser, Werner and Darga: 48, pl. 2, figs 4–6.

Material. BSPG 1947 XVI 51; two thin sections.

Other occurrences. Cenomanian of the European Boreal (Czech Republic).

Felixigyra group

Description. Colonial (hydnophoroid, meandroid) corals. Septal symmetry irregular. Septal inner margins swollen. Lonsdaleoid septa in *Rhipidomeandra*. Columella absent. Wall compact and septothecal.

Felixigyra Prever, 1909

Type species. *Felixigyra deangelisi* Prever, 1909.

Description. Hydnophoroid colony. Crests conical, thick, often connected to each other. Corallites distinct. No septal symmetry, but size orders can be distinguished. Pali or paliform lobes absent. Costae unknown. Columella absent. Endotheca consists of thin tabulae and dissepiments. Wall compact, septothecal. Coenosteum absent.

Felixigyra deangelisi Prever, 1909

*v1909 *Felixigyra Deangelisi* – Prever: 118, pl. 12, figs 7, 8.

v2013 *Felixigyra deangelisi* Prever, 1909 – Löser, Werner and Darga: 54, pl. 3, figs 1–3 [= with detailed synonymy].

Material. BSPG 1947 XVI 62, 1991 X 81, 1991 X 98, 1991 X 99; three thin sections.

Other occurrences. Lower Aptian of the Central Tethys (Italy).

Family Solenocoeniidae Roniewicz, 2008

Description. Cerioid and plocoid colonies. The septa are generally short. No columella. Wall compact and tabulothecal.

Confusaforma Löser, 1987

Type species. *Confusaforma weyeri* Löser, 1987

Description. Cerioid colony. Corallite outline irregular. Septa very short, with a triangular outline. Symmetry of septa irregular. Pali, costae, synapticulae, and columella absent. Endotheca consists of numerous and regular tabulae. Wall compact, probably tabulothecal.

Confusaforma weyeri Löser, 1987

Plate 7: figs 4–6

*v1987 *Confusaforma weyeri* n.sp. – Löser: 234, pl. 1, figs 1–3.

v2016c *Confusaforma weyeri* Löser, 1987 – Löser: 254, figs C49abc.

v2018 *Confusaforma weyeri* Löser, 1987 – Löser, Steuber and Löser: 48, pl. 6, figs 10–12. [here more detailed synonymy]

Material. BSPG 2016 XXII 1; two thin sections.

Dimensions. (BSPG 2016 XXII 1).

	n	min–max	μ	s	cv	μ±s
clmin	20	0.54–0.99	0.75	0.13	16.9	0.62–0.87
clmax	20	0.87–1.18	1.02	0.11	10.4	0.91–1.12

Remarks. The only specimen is poorly preserved and did not allow septal counts.

Other occurrences. Lower Aptian of the Central Tethys (Slovenia, Italy), lower Albian of the Western Atlantic (Mexico), lower Cenomanian of the Central Tethys (Greece)

and the Western Tethys (Spain), upper Cenomanian of the European Boreal (Germany, Czech Republic).

Cryptocoenia d'Orbigny, 1849

Type species. *Astrea alveolata* Goldfuss, 1826

Description. Plocoid colony. Corallite outline circular. Symmetry of septa radial and regularly hexameral or decameral. Septa very short, free. Pali or paliform lobes absent. Costae present, sub-confluent to non-confluent. Columella absent. Endotheca consists of regular tabulae and occasional dissepiments. Wall compact, as tabulotheca. Coenosteum moderately broad, consists of costae and tabulae.

Cryptocoenia aguilerai (Reyeros Navarro, 1963)

*v1963 *Procyathophora aguilerai* n.sp. – Reyeros Navarro: 8, pl. 3, figs 3, 5.
v2013 *Cryptocoenia aguilerai* (Reyeros Navarro, 1963) – Löser, Werner and Darga: 64, pl. 9, figs 4–6 [with more detailed synonymy].
v2016 *Cryptocoenia aguilerai* (Reyeros Navarro, 1963) – Löser and Zell: 14, figs 5.1–3.

Material. BSPG 1991 X 70; two thin sections.

Other occurrences. Tithonian to lower Berriasian of the European Boreal (Czech Republic), Valanginian to Aptian of the Western Atlantic (Mexico), upper Barremian to lower Aptian of the Central Tethys (Germany, Greece), lower Aptian of the Western Tethys (Spain) and the Central Tethys (Greece), upper Aptian of the Western Tethys (Spain), upper Aptian to lower Albian of the Western Tethys (Spain, France), lower Albian of the Western Tethys (Spain, France), upper Albian of the European Boreal (UK).

Cryptocoenia antiqua d'Orbigny, 1850

*v1850 *Cryptocoenia antiqua* – d'Orbigny: (2), p. 92.
v1964 *Cyathophora steinmanni* Fritzsche 1924 – Morycowa: 24, pl. 3, fig. 2, pl. 5, figs 2, 3.
v1996 *Pentacoenia elegantula* d'Orbigny, 1850 – Baron-Szabo and Steuber: 8, pl. 3, fig. 3.
v1996 *Pseudocoenia annae* (Volz, 1903) – Baron-Szabo and Steuber: 8, pl. 2, fig. 1.
v2010 *Cryptocoenia atempa* (Felix, 1891) – Löser: 591, fig. 3.4.
v2013 *Cryptocoenia bulgarica* (Toula, 1884) – Löser, Werner and Darga: 64, pl. 9, figs 2–3.
v2016 *Cryptocoenia atempa* (Felix, 1891) – Löser and Zell: 15, figs 5.7–9.

Material. BSPG 1947 XVI 48, 1991 X 71; two thin sections.

Remarks. The material was in Löser et al. (2013c) identified as *Cryptocoenia bulgarica* (Toula, 1884). After this publication the type of *Cryptocoenia antiqua* became available and could be measured. The present material is much closer to *Cryptocoenia antiqua*; *Cryptocoenia bulgarica* has smaller dimensions.

Other occurrences. Lower Hauterivian of the European Boreal (France), upper Barremian of the Western Tethys (France), upper Barremian to lower Aptian of the Central Tethys (Poland, Greece), upper Aptian of the Western Tethys (Spain).

Cryptocoenia bernensis (Etallon, 1864)

Plate 7: figs 7–9

v*1864 *Stylina bernensis* – Etallon: 366, pl. 51, fig. 5.
1964 *Adelocoenia biedai* n.sp. – Morycowa: 26, text-fig. 2, pl. 4, fig. 2, pl. 5, fig. 5.
v1992 *Cyathophora regularis* Fromentel, 1875 – Eliášová: 402, pl. 2, figs 2, 3, pl. 8, fig. 8.
v2004 *Adelocoenia desori* (Koby, 1897) – Löser and Mohanti: 580, figs 2a, b.
v2008 *Solenocoenia sexradiata* (Goldfuss, 1826) – Roniewicz: 131, figs 16j–m.
v2010 *Cryptocoenia ramosa* Toula, 1889 – Löser: 595, fig. 3.9.
v2013a *Cryptocoenia bulgarica* (Toula, 1884) – Löser: 33, figs 11d, e.
v2015c *Cryptocoenia biedai* (Morycowa, 1964) – Löser: 19, figs 2D–F.
v2018 *Cryptocoenia* cf. *biedai* (Morycowa, 1964) – Löser, Steuber and Löser: 48, pl. 7, figs 1–3.

Material. LFU 8336SG015076#1; two thin sections.

Dimensions. (LFU 8336SG015076#1).

	n	min–max	μ	s	cv	μ±s
clmin	15	1.38–1.87	1.64	0.14	8.6	1.50–1.78
clmax	15	1.52–2.09	1.79	0.15	8.5	1.64–1.94
septa	6+6					

Other occurrences. Lower Callovian of the Southern Tethys (Madagascar), Valanginian of the Central Tethys (Bulgaria), upper Barremian of the Western Tethys (France), upper Barremian to lower Aptian of the Central Tethys (Poland, Greece), Aptian to Lower Albian of the Western Atlantic (Mexico), lower Albian of the Western Tethys (France), Cenomanian of the Central Tethys (Greece) and the Southern Tethys (India), Middle Cenomanian of the European Boreal (Germany, Czech Republic).

Cryptocoenia waltoni (Milne Edwards & Haime, 1851)

v*1851 *Convexastrea waltoni* – Milne Edwards and Haime: 109, pl. 23, figs 5, 6.
v1873 *Astrocoenia Reussiana*, Stoliczka – Stoliczka: 27, pl. 5, figs 3, 4.
v1947 *Cyathophora Fontserei* Bataller 1944 – Bataller: 48, text-fig.
v1966 *Stylina elegans* Beauvais – Beauvais: 121, pl. 1, fig. 1.

v1974 *Cyathophora pygmaea* Volz – Turnšek and Buser: 12, 33, pl. 4, fig. 1.

v1981 *Cyathophora pygmaea* Volz 1903 – Turnšek and Mihajlovic: 18, pl. 13, figs 1, 2.

v1994 *Adelocoenia pygmaea* (Volz 1903) – Löser: 10, text-figs 4, 5, pl. 12, figs 1, 2.

v2013 *Cryptocoenia fontserei* (Bataller, 1947) – Löser, Werner and Darga: 66, pl. 9, figs 7–9.

v2015c *Cryptocoenia reussiana* (Stoliczka, 1873) – Löser: 21, figs 3D–F.

Material. BSPG 1947 XVI 12, 1947 XVI 20, 1947 XVI 23, 1947 XVI 49, 1947 XVI 6, 1947 XVI 77, 1991 X 43, LFU 8336SG015013#1, 8336SG015107, 8336SG015228#4; eight thin sections.

Remarks. In Löser et al. (2013c) this material was assigned to *Cryptocoenia fontserei* Bataller, 1947. Afterwards, it was possible to examine the types of *Cryptocoenia waltoni* and *Cryptocoenia fontserei*. It transpired that both species are synonymous.

Other occurrences. Aalenian to Callovian of the European Boreal (UK), Callovian of the Central Tethys (Tunisia), Kimmeridgian of the European Boreal (Germany), upper Barremian to lower Aptian of the Central Tethys (Bulgaria, Serbia, Slovenia), lower Aptian of the Western Tethys (Spain), lower Albian of the Western Atlantic (Mexico),

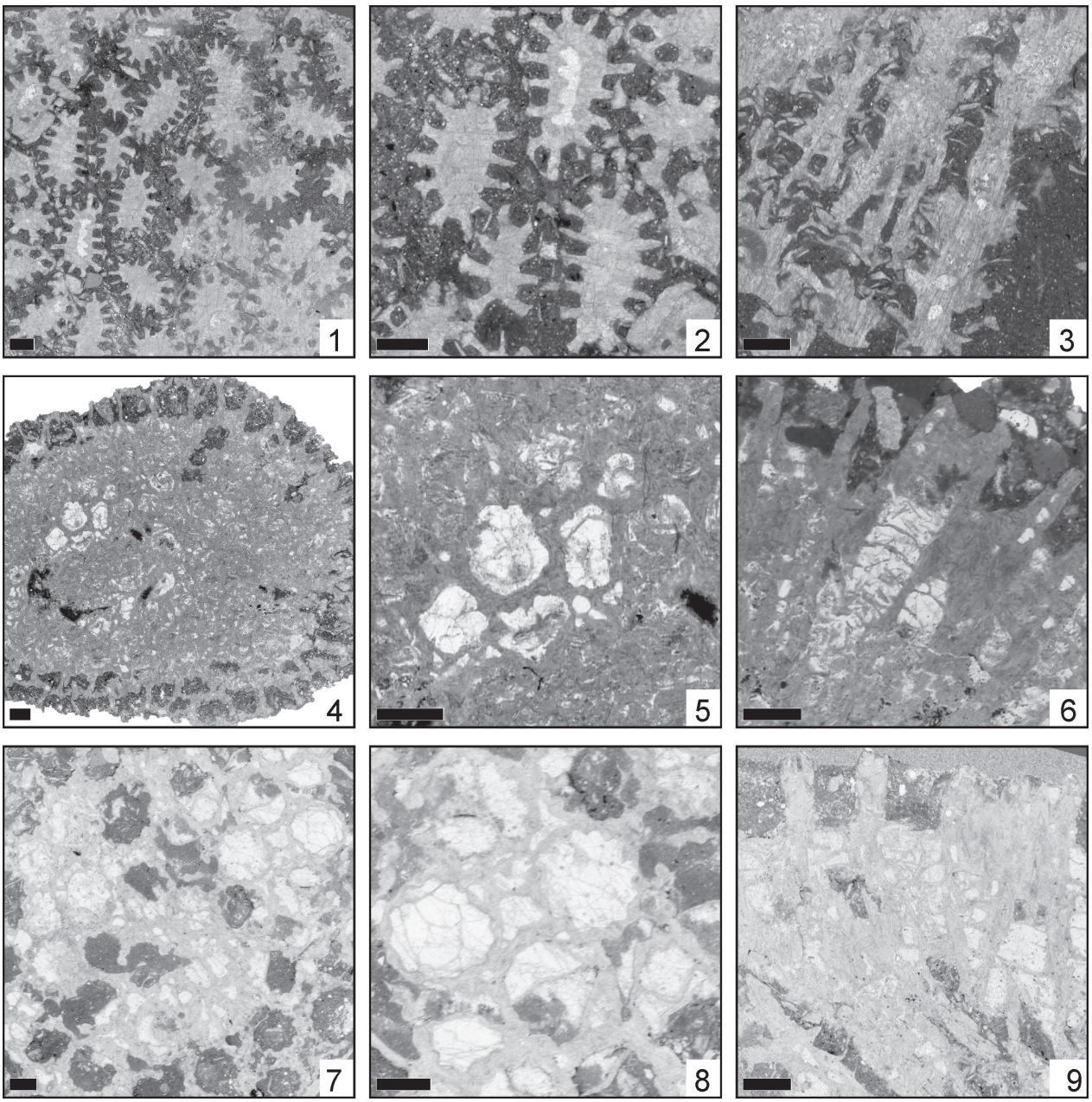

Plate 7. (1–3) *Hydnophoraraea* aff. *rapulum* Oppenheim, 1930. LFU 8336SG015012#1. **1**. Transversal thin section. **2**. Transversal thin section, detail. **3**. Longitudinal thin section. **(4–6)** *Confusaforma weyeri* Löser, 1987. BSPG 2016 XXII 1. **4**. Transversal thin section. **5**. Transversal thin section, detail. **6**. Longitudinal thin section. **(7–9)** *Cryptocoenia bernensis* (Etallon, 1864). LFU 8336SG015076#1. **7**. Transversal thin section. **8**. Transversal thin section, detail. **9**. Longitudinal thin section. Scale bars: 1 mm.

lower Albian to lower Cenomanian of the Western Tethys (Spain, France), upper Albian of the Southern Tethys (India) and the European Boreal (UK), lower Cenomanian of the Western Tethys (Spain), middle Cenomanian of the European Boreal (Belgium, Germany).

Cyathophoropsis Alloiteau, 1946

Type species. *Cyathophoropsis hupei* Alloiteau, 1946.

Description. Plocoid colony. Corallite outline circular. Symmetry of septa radial and regularly trimeral. Septa very short, free. Pali or paliform lobes absent. Costae present, sub-confluent to non-confluent. Columella absent. Endotheca consists of regular tabulae and occasional dissepiments. Wall compact, as tabulotheca. Coenosteum moderately broad, consists of costae and tabulae.

Cyathophoropsis sp.

Plate 14: figs 4, 5

Material. LFU 8336SG015227#1; one thin section.

Dimensions. (LFU 8336SG015227#1).

	n	min–max	μ	s	cv	μ±s
clmin	20	0.80–1.05	0.93	0.08	8.4	0.86–1.01
clmax	20	0.87–1.18	1.04	0.08	7.3	0.97–1.12
ccd	20	1.08–1.57	1.32	0.13	9.5	1.19–1.45
septa	3+3+6					

Remarks. This is so far the last occurrence of the genus.

Other occurrences. Lower Albian of the Western Tethys (Spain).

Superfamily Felixaraeoidea Beauvais, 1982

Description. Solitary and colonial (astreoid, meandroid, phaceloid) corals. Septa compact or perforated. Younger septal cycles have more perforations than older septal cycles. Septa very thick, those of the first cycles being the thickest. Septal symmetry regular or subregular radial. Septal upper margins with granulae, lateral faces with thorns. Lonsdaleoid septa and main septum absent. Microstructure of large trabeculae. Synapticulae common. Pali absent, columella parietal. Endotheca mostly absent. Marginarium and wall absent. Coenosteum in some genera. Budding extracalicinal.

Family Felixaraeidae Beauvais, 1982

Felixaraea Beauvais, 1982

Type species. *Felixaraea rennensis* Beauvais, 1982.

Description. Turbinate solitary coral with a circular outline. The septa are perforated, younger (thinner) septa more than older (thicker) septa.

Remarks. The present material of *Felixaraea* marks the first occurrence of the genus.

Felixaraea cf. *agassizi* (Vaughan, 1899)

Plate 8: figs 1–3

cf1899 *Leptophyllia agassizi* sp. nov. – Vaughan: 242, pl. 40, figs 1–4.

vp2013c *Felixaraea agassizi* (Vaughan, 1899) – Löser: 752.

Material. LFU 8336SG015135#1; two thin sections.

Dimensions. (LFU 8336SG015135#1).

c	29.2×38.1
septa	225

Remarks. The specimen is larger than *Felixaraea agassizi* and has a slightly higher septal count.

Other occurrences. Campanian to Maastrichtian of the Western Atlantic (Jamaica).

Felixaraea rennensis Beauvais, 1982

Plate 8: figs 4–6

vp1930 *Haplaraea reticularis* n. sp. – Oppenheim: 35, pl. 27, figs 11, 12. [non figs 8–10]

v1952 *Haplaraea rennensis* All. – Alloiteau: pl. 2, fig. 4, text-fig. 110. [without description]

v1957 *Haplaraea rennensis* n.sp. – Alloiteau: figs 278–280. [without description]

*1982 *Felixaraea rennensis* Alloiteau – Beauvais: (2), 25.

v2013c *Felixaraea rennensis* Beauvais, 1982 – Löser: 752, figs 1G–I.

v2016c *Felixaraea rennensis* Beauvais, 1982 – Löser: 339, figs F3a, b.

v2019 *Felixaraea rennensis* (Beauvais, 1982) – Löser, Heinrich and Schuster: 165, figs 247, 248, figs 253a, b.

Material. LFU 8336SG015135#2; one thin section.

Dimensions. (LFU 8336SG015135#2).

c	16.3×21.2
septa	100

Remarks. *Felixaraea rennensis* was only illustrated but not described by Alloiteau (1952, 1957). Illustrations alone do not constitute a valid first description of a species. Beauvais (1982) was the first to describe and illustrate the species.

Other occurrences. Coniacian to Santonian of the Central Tethys (Austria), upper Santonian to middle Campanian of the Western Tethys (France, Spain).

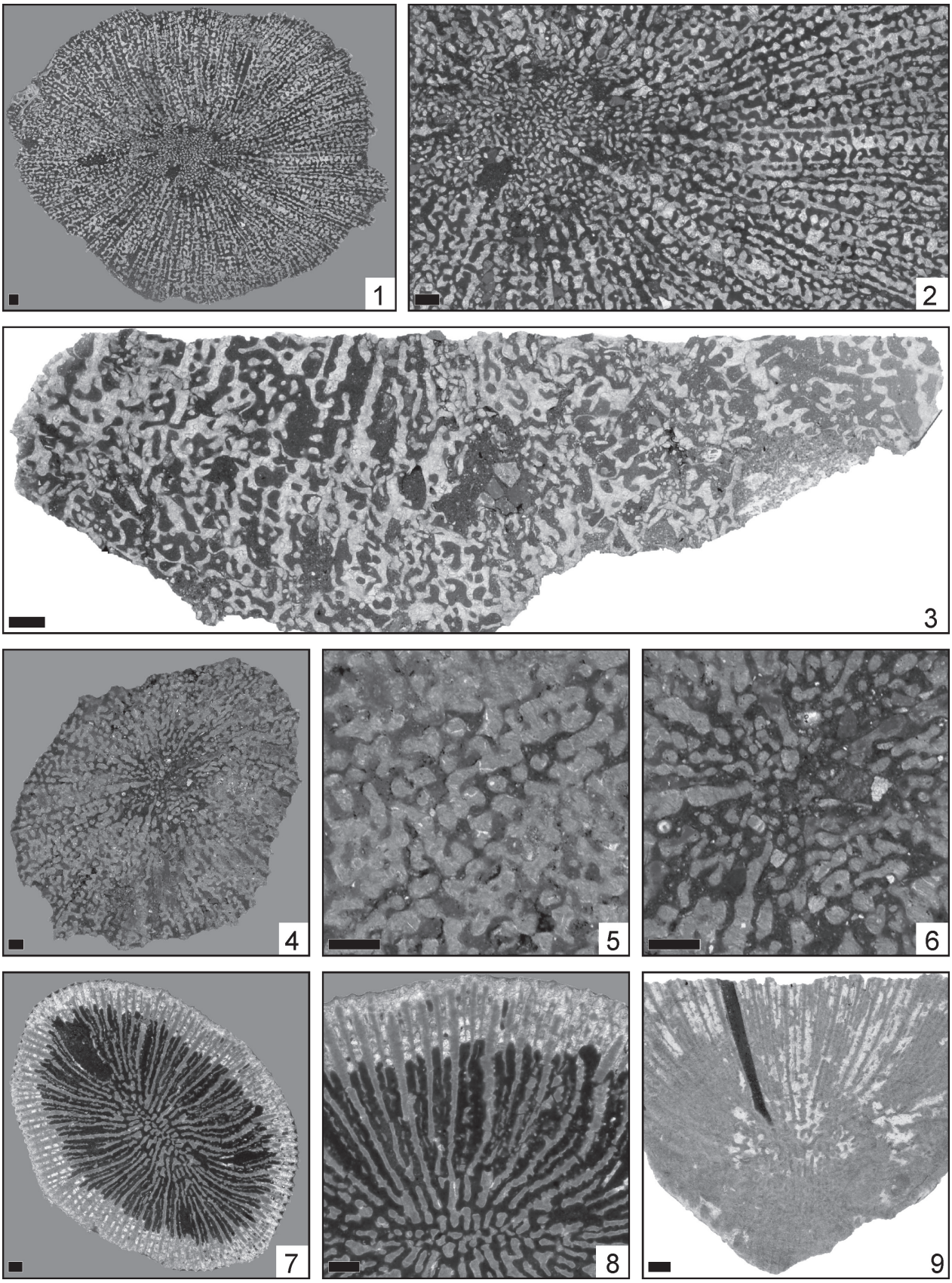

Plate 8. (1–3) *Felixaraea* cf. *agassizi* (Vaughan, 1899). LFU 8336SG015135#1. **1**. Transversal thin section. **2**. Transversal thin section, detail. **3**. Longitudinal thin section. **(4–6)** *Felixaraea rennensis* Beauvais, 1982. LFU 8336SG015135#2. **4**. Transversal thin section. **5**. Transversal thin section, detail. **6**. Transversal thin section, detail. **(7–9)** Felixaraeidae indet., LFU 8336SG015138#1. **7**. Transversal thin section. **8**. Transversal thin section, detail. **9**. Longitudinal thin section. Scale bars: 1 mm.

Felixaraeidae indet.

Plate 8: figs 7–9

Material. LFU 8336SG015138#1; two thin sections.

Dimensions. (LFU 8336SG015138#1).

c	16.4×22.1
septa	112

Description. Solitary turbinate coral with an elliptical outline. Septa made of large trabeculae. They are perforated, younger septa more than older septa. Septa rarely connected to each other. Symmetry irregular radial. Columella parietal. Wall with various rings of synapticulae. Endotheca absent.

Remarks. Even the position of the specimen within the family Felixaraeidae is uncertain. In the Felixaraeidae, the trabeculae are still larger, the septa are stronger and synapticulae are more frequent.

Superfamily Heterocoenioidea Oppenheim, 1930

Description. Solitary and colonial (cerioid, phaceloid, and plocoid) corals. Septa compact, thick, with ornamented lateral faces. Symmetry radial and bilateral. Lonsdaleoid septa may occur. Septal microstructure with small trabeculae, visible as a medium dark line. Synapticulae absent, pali absent. Columella rarely developed. Endotheca well-developed. Marginarium present in some genera. Wall trabecular or septothecal. Budding extracalicinal.

Family Agatheliidae Beauvais & Beauvais, 1975

Description. Solitary corals or (phaceloid, plocoid) colonies. Septa in a higher number as in the other families, generally in a radial symmetry with septal cycles generally regular, except for large corallites. No costae. Lonsdaleoid and main septa absent. Columella weak. Marginarium absent.

Agasmilia Löser, 2014a

Type species. *Agasmilia cantabrica* Löser, 2014a.

Description. Solitary cylindrical coral. Corallite outline circular, corallite pit depressed. Septa in cross section centrally thicker. Symmetry of septa radial and regularly hexameral. Endotheca consists of central tabulae and numerous lateral dissepiments. Wall compact, consists of horizontal trabeculae. Epitheca present.

Agasmilia cantabrica Löser, 2014a

Plate 9: figs 1–3

*v2014a *Agasmilia cantabrica* n. sp. – Löser: 302, figs 3.1–3.3.

v2016c *Agasmilia cantabrica* Löser, 2014 – Löser: 153, figs A15a–d.

Material. BSPG 1948 III 3, MB K2983#4; five thin sections.

Dimensions.

(BSPG 1948 III 3).

c	11.2×14.1
septa	24

(MB K2983#4)

c	12.5×14.2
septa	24

Other occurrences. Lower Cenomanian of the Western Tethys (Spain).

Eothelia Löser, Werner & Darga, 2013

Type species. *Eothelia hoelzli* Löser, Werner & Darga, 2013.

Description. Plocoid coral colony with circular corallites. Thick, compact septa in a regular septal symmetry. Septa in a regular hexameral symmetry. Septa of the first cycle attached to each other in the centre of the corallite forming the columella, septa of the second cycle shorter. Endotheca made of few tabulae, coenosteum consists of dissepiments and rare trabeculae.

Eothelia bavarica Löser, Werner & Darga, 2013

v2013 *Eothelia bavarica* n. gen., n. sp. – Löser, Werner and Darga: 52, pl. 5, figs 1–4.

Material. BSPG 1947 XVI 13, 1947 XVI 52, 1947 XVI 57, 1947 XVI 58, 1947 XVI 59, 1991 X 93; four thin sections.

Eothelia hoelzli Löser, Werner & Darga, 2013

v2013 *Eothelia hoelzli* n. gen., n. sp. – Löser, Werner and Darga: 52, pl. 4, figs 1–7.

Material. BSPG 1980 XIII 13, 1991 X 103, 1991 X 42; five thin sections.

Family Heterocoeniidae Oppenheim, 1930

Description. Only (phaceloid, plocoid) colonies. Symmetry radial, cycles subregular. A larger septum is often present. Lonsdaleoid septa and a marginarium can be present.

Heterocoenia Milne Edwards & Haime, 1848c

Type species. *Lithodendron exigua* Michelin, 1847.

Description. Plocoid colony with circular corallites. Septal symmetry regular in varying systems. A main septum can be present. A trabecular wall always exists. The coenosteum is granulated at its surface.

?*Heterocoenia* sp.

Plate 9: figs 4–6

Material. LFU 8336SG015102; four thin sections.

Dimensions. (LFU 8336SG015102).

	n	min–max	μ	s	cv	μ±s
clmin	5	2.11–3.46	2.81	0.55	19.6	2.26–3.36
clmax	5	2.36–3.57	3.03	0.60	19.8	2.43–3.63
septa	4	11–13	12.50	1.0	8.0	11–13

Remarks. The present material shares most characteristics with *Heterocoenia* but differs in having a septothecal wall instead of a trabecular wall.

Styloheterocoenia Löser, Steuber & Löser, 2018

Type species. *Styloheterocoenia hellenensis* Löser, Steuber & Löser, 2018.

Description. Plocoid colony. Corallite outline irregular circular. Symmetry of septa radial and in various symmetries. Cycles of septa regular. Septa not connected to each other. Costae non-confluent, with pali-like outgrowths (costal pali). Endotheca consists of numerous and regular tabulae. Wall subcompact, septothecal. The Coenosteum is moderately broad and it consists of tabulae and costal pali.

Styloheterocoenia sp.

v2013 *Heterocoenia* sp. – Löser, Werner and Darga: 54, pl. 3, figs 10–12.

Material. BSPG 1991 X 101; three thin sections.

Remarks. The material was formerly assigned to the genus *Heterocoenia*. Löser et al. (2018) established for this coral type the new genus *Styloheterocoenia*.

Other occurrences. Lower Cenomanian of the Western Tethys (Spain).

Heterocoeniidae indet. 1

Plate 9: figs 7, 8

Material. BSPG 1947 XVI 82, LFU 8336SG015148, 8336SG015152#1, 8336SG015152#2; four thin sections.

Dimensions. (LFU 8336SG015152#2).

c	8.4×9.5
septa	28

Description. Plocoid to sub–phaceloid small colonies. Septa in a subregular hexameral symmetry. No wall.

Remarks. The small colonies very probably represent a new genus within the family Heterocoeniidae, but the low number of specimens and their small size do not allow to establish a new species and genus.

Heterocoeniidae indet. 2

Plate 9: figs 9–11

Material. BSPG 2012 X 2; two thin sections.

Dimensions. (2012 X 2).

	n	min–max	μ	s	cv	μ±s
cmax	7	1.35–2.24	1.77	0.29	16.2	1.48–2.05
cmin	7	1.11–1.75	1.37	0.22	16.0	1.15–1.58
septa	7	6–9	8.29	1.11	13.4	7–9

Description. (?) Phaceloid coral. Corallites densely packed, with a polygonal outline. The compact septa are low in number. A main septum can be present. No septal symmetry. Endotheca probably with dissepiments.

Remarks. The material is questionable and its systematic position uncertain.

Superfamily Misistelloidea Eliášová, 1976

Description. Solitary and colonial (phaceloid, plocoid) corals. Septa compact, with varying thickness, in a subregular radial symmetry. Septa not connected to each other (Rayasmiliidae) or connected only in the centre of the corallite (Misistellidae). Lateral faces with fine granulae or smooth, upper margin smooth. Lonsdaleoid and main septa absent. Microstructure of septa of small trabeculae. Synapticulae absent. Pali absent, columella present in most genera, lamellar or by septal fusion. Endotheca present. Marginarium absent. Wall absent, but an epitheca is often present (when preserved). Coenosteum varies. Budding intracalicinal.

Family Rayasmiliidae Löser, 2022

Description. Solitary and phaceloid corals. The septa are always free. A lamellar columella is present in some genera. One or two septa may be connected to the columella.

Ceratosmilia Alloiteau, 1957

Type species. *Ceratosmilia arnaudi* Alloiteau, 1957.

Description. Solitary turbinate coral. Corallite outline circular. Symmetry of septa radial and irregularly hexameral. Septa rarely connected to each other. Pali absent. Costae present. Columella absent.

Ceratosmilia arnaudi Alloiteau, 1957

*v1957 *Ceratosmilia Arnaudi* nov. sp. – Alloiteau: 116, 421, fig. 74, pl. 3, fig. 7.

v2013 *Ceratosmilia arnaudi* Alloiteau, 1957 – Löser, Werner and Darga: 56, pl. 5, figs 7–9.

Material. BSPG 1947 XVI 38, 1947 XVI 39, 1947 XVI 44, 1991 X 104, 1991 X 47, 1991 X 52, 1991 X 89, 1991

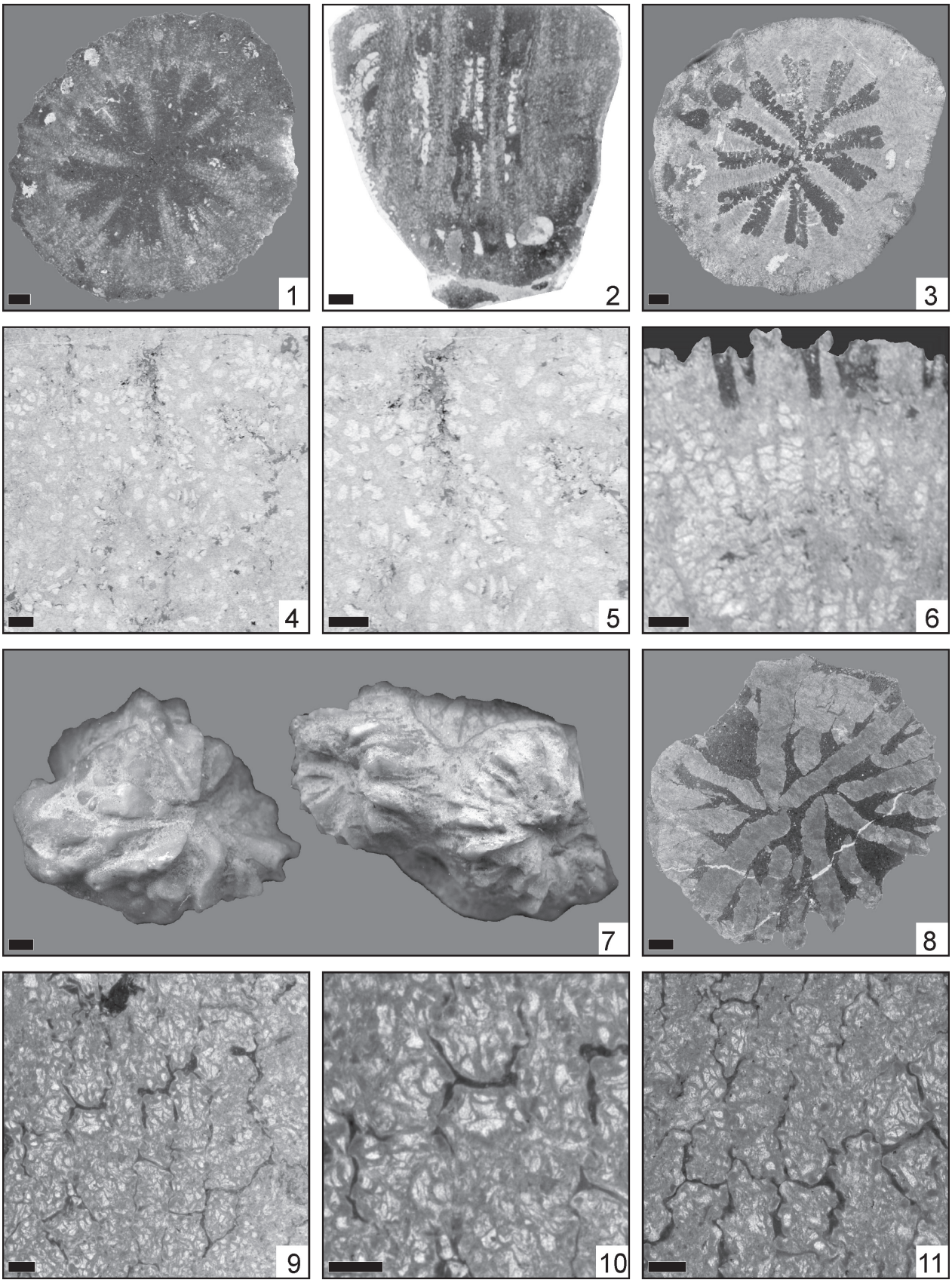

Plate 9. (1–3) *Agasmilia cantabrica* Löser, 2014. BSPG 1948 III 3. **1**. Transversal thin section. **2**. Longitudinal thin section. **3**. MB K2983#4, Transversal thin section. **(4–6)** ?*Heterocoenia* sp., LFU 8336SG015102. **4**. Transversal thin section. **5**. Transversal thin section, detail. **6**. Longitudinal thin section. **(7–8)** Heterocoeniidae indet. 1, LFU 8336SG015148. **7**. colony surface. **8**. LFU 8336SG015152#1; Transversal thin section. **(9–11)** Heterocoeniidae indet. 2, BSPG 2012 X 2. **9**. Transversal thin section. **10**. Transversal thin section, detail. **11**. Transversal thin section. Scale bars: 1 mm.

X 90, 1991 X 91, 2012 X 3, LFU 8336SG015082#1, 8336SG015137#2, 8336SG015153; two thin sections.

Other occurrences. Lower Cenomanian of the Western Tethys (France), upper Cenomanian of the European Boreal (Czech Republic), Turonian of the Central Tethys (Bulgaria).

Rayasmilia Löser, 2022

Type species. *Rayasmilia salvata* Löser, 2022.

Description. Solitary turbinate coral. Septa compact, not connected to each other, in a regular radial symmetry. Septa can be connected with the columella. Wall absent. Epitheca present. Endotheca well developed. Columella lamellar.

?*Rayasmilia* sp.

Plate 10: figs 4–6

Material. LFU 8336SG015082#2; two thin sections.

Dimensions. (LFU 8336SG015082#2).

c	11.7×16.2
septa	82

Description. Solitary turbinate coral with an elliptical outline. Septa made of small trabeculae, in a regular hexameral symmetry, not connected to each other. Septal lateral faces strongly dentated. Columella parietal. Wall septothecal. Endotheca unknown.

Remarks. The assignation of this specimen to the Rayasmiliidae is preliminar. It differs from this family by strongly ornamented lateral septal faces and the septothecal wall, but coincides in the septal outline, septal microstructure, and regular symmetry.

Trochophyllia Alloiteau, 1952

Type species. *Montlivaltia melania* de Fromentel, 1861.

Description. Cylindric or turbinate solitary coral with circular or slightly elliptical outline. No columella, no pali. Endotheca made of large dissepiments. No wall, just a thin epitheca that is often not present.

Trochophyllia aprutina (Prever, 1909)

v*1909 *Coelosmilia aprutina* – Prever: 109, text-fig. 14, pl. 10, fig. 25.

v2013 *Paramontlivaltia ruvida* (Prever, 1909) – Löser, Werner and Darga: 56, pl. 6, figs 10–12.

Material. BSPG 1947 XVI 30, 1947 XVI 31, 1947 XVI 32; two thin sections.

Remarks. This material was described as *Paramontlivaltia ruvida* (Prever, 1909) by Löser et al. (2013c). This species is very similar to *Trochophyllia aprutina* and differs only by smaller corallite dimensions. It is possible that the species are synonyms.

Other occurrences. Lower Aptian of the Central Tethys (Italy), lower Cenomanian of the Western Tethys (Spain, France).

Trochophyllia melania (de Fromentel, 1861)

Plate 10: figs 1–3

*v1861 *Montlivaltia melania* – de Fromentel: 116.

v2016c *Montlivaltia melania* Fromentel, 1861 – Löser: 672, fig. T25.

Material. BSPG 2016 XXII 4, LFU 8336SG015109; three thin sections.

Dimensions. (LFU 8336SG015109).

c	36.9×42.15
septa	92

Other occurrences. Middle Oxfordian of the Western Tethys (France).

Trochophyllia ruvida (Prever, 1909)

*v1909 *Epismilia ruvida* – Prever: 113, text-fig. 19.

v1909 *Trochosmilia polymorpha* – Prever: 108, text-figs 12, 13, pl. 10, figs 5–23.

vnon2013 *Paramontlivaltia ruvida* (Prever, 1909) – Löser, Werner and Darga: 56, pl. 6, figs 10–12.

Material. LFU 8336SG015137#3; one thin section.

Remarks. The specimens assigned in Löser et al. (2013c) to *Paramontlivaltia ruvida* belong to *Trochophyllia aprutina*. Both species are similar in their number of septal cycles but *T. aprutina* has a larger corallite diameter (13–15 mm) compared to *T. ruvida* (8–11 mm).

Other occurrences. Aptian to Santonian of the Central Tethys (Italy, Greece, Austria).

Superfamily Montlivaltioidea Felix, 1900

Description. Solitary and (astreoid, cerioid, flabelloid, meandroid, phaceloid, thamnasterioid) colonial corals. Septa compact. Septal thickness regular, septa in an irregular radial symmetry, but septal generations can be distinguished. Septa not connected to each other. Septal lateral faces with vertical keels, upper margins with granulae. Lonsdaleoid septa and main septum absent. Microstructure of large trabeculae. Synapticulae absent. Pali rarely present. Columella in some genera, generally lamellar. Endotheca well-developed. Marginarium absent. Wall poorly defined, generally only with an epitheca. Coenosteum present,

depending on the organisation form. Budding generally extracalicinal.

Family Montlivaltiidae Felix, 1900

Description. The ornamentation of septal lateral faces is more pronounced in this family. Generally no columella.

Kobyphyllia Baron-Szabo & Fernández Mendiola, 1997

Type species. *Kobyphyllia recta* (Koby, 1884).

Description. Solitary turbinate coral. Corallite outline elliptical. Symmetry of septa irregular radial. Septa free. Pali absent. Columella lamellar, short. Endotheca not well observable but marginal dissepiments exist. Wall absent but epitheca present.

Kobyphyllia sp.

Plate 10: figs 7–9

Material. LFU 8336SG015137#1; two thin sections.

Dimensions. (LFU 8336SG015137#1).

c	14.2×17.5
septa	98

Superfamily Phyllosmilioidea Felix, 1903b

Description. Solitary and (astreoid, flabelloid, meandroid, phaceloid, plocoid) colonial corals. Septa compact. First septal generation thicker than all others. Symmetry irregular or subregular radial. Septa in some genera connected to each other. Septal distal margins smooth, lateral faces with fine thorns, inner margins often swollen or T-shaped. Lonsdaleoid septa very rare. Main septum absent. Microstructure of very small trabeculae, only marked by a dark line. The costae are made by medium-sized trabeculae that result in granulated costal surfaces. Synapticulae and pali absent. Columella present or absent. Endotheca mostly present. Marginarium absent. Wall generally present, septothecal. Coenosteum present in some genera. Budding varies.

Family Phyllosmiliidae Felix, 1903b

Aulosmilia Alloiteau, 1952

Type species. *Trochosmilia archiaci* de Fromentel, 1863b.

Description. Solitary coral with an elliptical outline. Costae are not pronounced. The septal symmetry is quite regular, but not all septa reach the upper margin. The columella is lamellar, but generally deep in the corallite. The endotheca is poorly developed.

Aulosmilia cristata Beauvais, 1982

Plate 10: figs 10, 11

vp1921 *Placosmilia bofilli*, n. sp. – Vidal: 4, pl. 4, figs 6, 7.

*1982 *Aulosmilia cristata* nov. sp. – Beauvais: (1), 224, pl. 19, fig. 9.

v1997 *Peplosmilia fromenteli* Angelis d'Ossat, 1905 – Baron-Szabo: 72, pl. 8, fig. 1.

v2019 *Aulosmilia cristata* Beauvais, 1982 – Löser, Heinrich and Schuster: 239, figs 378a, b.

Material. LFU 8336SG015006#1; two thin sections.

Dimensions. (LFU 8336SG015006#1).

c	20.4×28
septa	133
sd	9/5mm

Remarks. *Placosmilia bofilli* Vidal, 1921 is based on two syntypes that belong to different species: *Aulosmilia inconstans* and *Aulosmilia cristata*. Only one specimen was illustrated. A lectotype has so far not been selected.

Other occurrences. Coniacian to Santonian of the Central Tethys (Austria), Santonian of the Western Tethys (Spain).

Aulosmilia inconstans (de Fromentel, 1862b)

v*1862b *Trochosmilia inconstans* – de Fromentel: 266, pl. 30, fig. 1, pl. 33, fig. 1.

v1862b *Trochosmilia heterophyllia* – de Fromentel: 272, pl. 35, fig. 1.

vp1921 *Placosmilia bofilli*, n. sp. – Vidal: 4.

v1952 *Aulosmilia archiaci* de From. 1862 – Alloiteau: 636, fig. 92, pl. 7, fig. 2.

v1952 *Strotogyra* (*Rhipidogyra*) *granulata* All. – Alloiteau: pl. 3, fig. 3.

v1957 *Phragmosmilia crassa* nov. sp. – Alloiteau: 86, figs 35, 36, pl. 2, fig. 1, pl. 19, fig. 9.

v2013 *Aulosmilia* ? *inconstans* (de Fromentel, 1862) – Löser, Werner and Darga: 55, pl. 6, figs 7–9.

v2016c *Trochosmilia inconstans* Fromentel, 1862 – Löser: 522, figs P45a, b.

v2019 *Aulosmilia inconstans* Fromentel, 1862 – Löser, Heinrich and Schuster: 240, figs 373–375, figs 379a–c.

Material. BSPG 1947 XVI 36, 1947 XVI 37, 1991 X 41, 1991 X 53, 1991 X 54, 1991 X 55, 1991 X 56, 1991 X 57, 1991 X 58, 1991 X 85, 1991 X 86, 1991 X 87; four thin sections.

Remarks. During the systematic revision of the Coniacian and Santonian corals of the Gosau Group, the genus *Aulosmilia* was profoundly investigated (Löser et al. 2019) and much Upper Cretaceous coral type material was studied. The present material can now clearly be assigned to *Aulosmilia inconstans*.

Other occurrences. Upper Cenomanian to Santonian of the Western Tethys (France), Coniacian to Santonian of the Central Tethys (Austria), Santonian to middle Campanian of the Western Tethys (Spain, France).

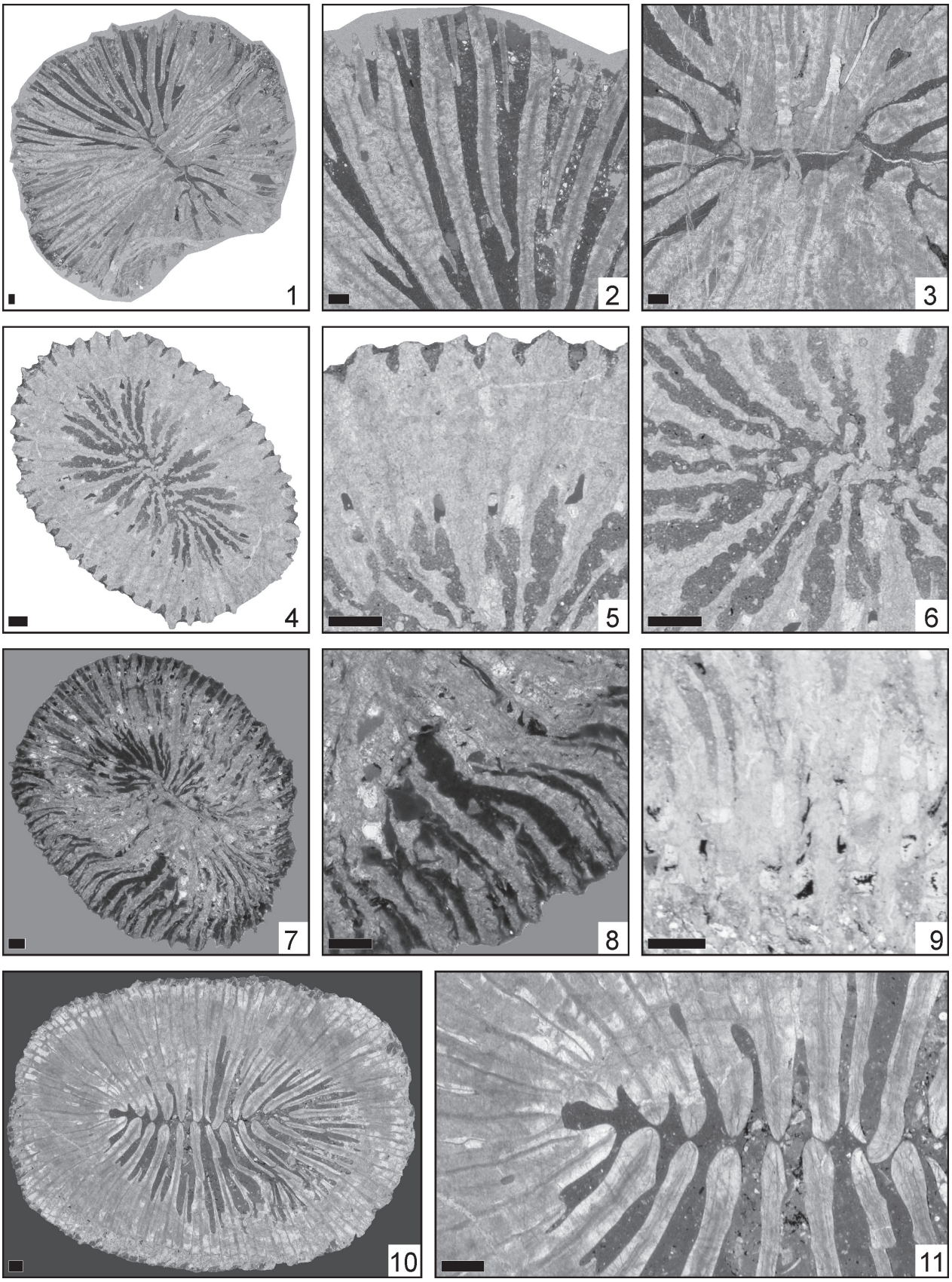

Plate 10. (1–3) *Trochophyllia melania* (de Fromentel, 1861). LFU 8336SG015109. **1**. Transversal thin section. **2**. Transversal thin section, detail. **3**. Transversal thin section, detail. **(4–6)** ?*Rayasmilia* sp., LFU 8336SG015082#2. **4**. Transversal thin section. **5**. Transversal thin section, detail. **6**. Transversal thin section, detail. **(7–9)** *Kobyphyllia* sp., LFU 8336SG015137#1. **7**. Transversal thin section. **8**. Transversal thin section, detail. **9**. Longitudinal thin section. **(10–11)** *Aulosmilia cristata* Beauvais, 1982. LFU 8336SG015006#1. **10**. Transversal thin section. **11**. Transversal thin section, detail. Scale bars: 1 mm.

Aulosmilia inflexa (Reuss, 1854)

Plate 2: fig. 9

*v1854 *Trochosmilia inflexa* – Reuss: 86, pl. 5, figs 3–5.
v2019 *Aulosmilia inflexa* (Reuss, 1854) – Löser, Heinrich and Schuster: 240, figs 380a, b

Material. BSPG 1947 XVI 72; one thin section.

Dimensions. (BSPG 1947 XVI 72).

c	21.6×27.3
septa	156

Other occurrences. Coniacian to Santonian of the Central Tethys (Austria), middle Eocene of the Eastern Pacific (Mexico).

Aulosmilia aff. *magnifica* (Duncan, 1870)

Plate 11: figs 1, 2

Material. LFU 8336SG015003; two thin sections.

Dimensions. (LFU 8336SG015003).

c	51.8×75.4
septa	160

Remarks. The specimen differs from *Aulosmilia magnifica* by much higher septal counts.

Other occurrences. Lower Cenomanian of the Western Tethys (Spain, France).

Aulosmilia parkinsoni (Milne Edwards & Haime, 1848c)

*v1848c *Placosmilia Parkinsonii* – Milne Edwards and Haime: 235.
v1854 *Placosmilia consobrina* – Reuss: 84, pl. 5, figs 17–19.
v1862a *Placosmilia angulata* – de Fromentel: 225, pl. 18, fig. 3.
v1903b *Platysmilia multicincta* Felix (Reuss sp.) – Felix: 285, pl. 20, figs 2–5.
v1903b *Trochosmilia chondrophora* nov. sp. – Felix: 327, pl. 24, fig. 12.
v1921 *Trochosmilia osensis*, n. sp. – Vidal: 4, pl. 3, figs 4–6.
v1930 *Trochosmilia chondrophora* Felix – Oppenheim: 483, pl. 31, fig. 8.
v2006 *Aulosmilia cuneiformis* (Milne-Edwards and Haime, 1848) – Baron-Szabo: 69, pl. 14, figs 2, 4.
v2013 *Aulosmilia* ? *bipartita* (Reuss, 1854) – Löser, Werner and Darga: 54, pl. 6, figs 1, 2.
vp2013 *Aulosmilia* ? *consobrina* (Reuss, 1854) – Löser, Werner and Darga: 55.
v2019 *Aulosmilia parkinsoni* (Milne Edwards and Haime, 1848) – Löser, Heinrich and Schuster: 241, figs 381a, b.

Material. BSPG 1947 XVI 18, 1947 XVI 19, 1991 X 82, 1991 X 83, 1991 X 84; three thin sections.

Remarks. In Löser et al. (2013c) this material was assigned to *Aulosmilia* ? *bipartita* and *Aulosmilia* ? *consobrina*. More recent research on the very variable genus (e.g. Löser et al. 2019) has shown that species must be understood in a much wider concept. Hence, the material is now nearly entirely assigned to *Aulosmilia parkinsoni*.

Other occurrences. Lower Coniacian of the Western Tethys (France), upper Turonian to Santonian of the Central Tethys (Austria), Coniacian to Santonian of the Western Tethys (France), Santonian of the Western Tethys (Spain, France), Maastrichtian of the Western Atlantic (Jamaica), Paleocene to Eocene base of the Central Tethys (Austria).

Aulosmilia sp.

vp2013 *Aulosmilia* ? *consobrina* (Reuss, 1854) – Löser, Werner and Darga: 55.
v2019 *Aulosmilia* sp. – Löser, Heinrich and Schuster: 241, figs 383a, b.

Material. BSPG 1947 XVI 17; two thin sections.

Other occurrences. Upper Turonian to Santonian of the Central Tethys (Austria), middle Campanian of the Western Tethys (Spain).

Pachygyra Milne Edwards & Haime, 1848a

Type species. *Lobophyllia labyrinthica* Michelin, 1847.

Description. Meandroid colony with long, straight or sinuous corallite rows, that are separated by a mostly wide coenosteum. Individual corallites cannot be distinguished. The corallite rows can be in the same level as the coenosteum, or can be elevated. In the latter case, the coral appears flabelloid. Columella lamellar.

Pachygyra cucullata (Zuffardi-Comerci, 1930)

v*1930 *Eugyra cucullata* n. sp. – Zuffardi-Comerci: 15, pl. 3, figs 3, 8.
v2013 *Pachygyra krameri* Oppenheim, 1930 – Löser, Werner and Darga: 55, pl. 5, figs 5, 6.
v2019 *Pachygyra cucullata* (Zuffardi-Comerci, 1930) – Löser, Heinrich and Schuster: 274, figs 442a, b.

Material. BSPG 2012 X 1; five thin sections.

Remarks. In Löser et al. (2013c) this specimen was assigned to *Pachygyra krameri* Oppenheim, 1930. In 2016 it was possible to study the type specimen of this species and it transpired that it has much smaller dimensions as discernable from the publication of Oppenheim (1930).

Other occurrences. Turonian to Santonian of the Central Tethys (Italy, Austria), upper Santonian of the Western Tethys (France).

Superfamily Poritoidea Gray, 1842

Description. Colonial (astreoid, plocoid) corals. Septa irregularly perforated. Symmetry of septa irregular radial or bilateral. Septa connected to each other. Septal distal margin coarsely dentated, lateral face with rare granulae, inner margin slightly swollen in places. Lonsdaleoid septa and main septum absent. Microstructure of medium-sized trabeculae. Synapticulae abundant. Pali present in some genera. Columella and endotheca present. Marginarium absent. Wall varies. Coenosteum generally present. Budding extracalicinal.

Family Actinacididae Vaughan & Wells, 1943

Description. Astreoid colonies. Septa in a regular radial or bilateral symmetry.

Actinacis d'Orbigny, 1849

Type species. *Actinacis martiniana* d'Orbigny, 1849.

Description. Astreoid colony. The corallites are small, elliptical, well marked, and with large distances to each other. Septal symmetry is between radial and bilateral. Septa often and regularly connected to each other. Pali present but because of the septal perforations not well visible.

Actinacis ? *remesi* Felix, 1903a

Plate 11: figs 3–5

?*1903a *Actinacis Remesi* – Felix: 567, text-figs 1, 2.
v1911 *Actinacis Remesi* – Trauth: 75, text-fig. 4, pl. 4, fig. 1.
v1921 *Actinacis Remesi* Felix – Zuffardi-Comerci: 11, pl. 2, figs 1, 2.
v1957 *Actinacis vignyensis* n.sp. – Alloiteau: pl. 18, fig. 9 [= nom. nud.].
v2000 *Actinacis remesi* Felix, 1903 – Baron-Szabo: 119, pl. 10, figs 3, 6.
v2013 *Actinacis magna* Alloiteau 1958 – Löser, Castro and Nieto: 27, pl. 9, figs 5, 6.
v2019 *Actinacis* sp. 2 – Löser, Heinrich and Schuster: 306, figs 499a, b.
v2022 *Actinacis* ? *remesi* Felix, 1903 – Löser and Callapez: 157, figs 7.j–l.

Material. LFU 8336SG015228#2; one thin section.

Dimensions. (LFU 8336SG015228#2).

	n	min–max	μ	s	cv	μ±s
clmin	5	1.53–2.05	1.76	0.21	12.1	1.55–1.98
clmax	5	1.78–2.54	2.16	0.29	13.5	1.86–2.45
septa	5	24–31	28.2	2.77	9.8	25–31

Remarks. The material can clearly be assigned to the genus *Actinacis*, but could not be assigned to an existing species with certainty. Closely related is material labelled as "Actinacis vignyensis Alloiteau, 1957" (MNHN; but never formally described) and material labelled as *Actinacis remesi* Felix, 1903 (NHMW, coll. Trauth; PU, coll. Zuffardi-Comerci) from the Eocene of Klokocov (Moravia, Czech Republic) and the Turonian of Libya, but the type of *Actinacis remesi* itself is unknown.

Other occurrences. Upper Albian of the Western Tethys (Spain), Turonian of North Africa (Libya), Turonian to lower Coniacian of the Western Tethys (Portugal, Spain), middle Santonian of the Central Tethys (Austria), upper Campanian to Maastrichtian of the Arabian Peninsula (United Arab Emirates), Palaeocene to Eocene of the European Boreal (France, Czech Republic).

Actinacis sp.

Plate 11: figs 6, 7

v1997 *Actinacis martiniana* d'Orbigny, 1849 – Baron-Szabo: 79, pl. 11, figs 2, 5, 6.

Material. BSPG 1947 XVI 78; one thin section.

Dimensions. (BSPG 1947 XVI 78).

	n	min–max	μ	s	cv	μ±s
clmin	5	1.44–1.76	1.60	0.14	8.8	1.46–1.74
clmax	5	1.78–2.22	1.96	0.19	9.6	1.77–2.15
septa	8+8+16					

Other occurrences. Lower Cenomanian of the Western Tethys (Spain), upper Turonian to lower Coniacian of the Central Tethys (Austria).

Superfamily Rhizangioidea d'Orbigny, 1851

Description. Solitary and colonial (astreoid, cerioid, plocoid, reptoid, and thamnasterioid) corals. Septa almost not perforated. Normal septal thickness, septal symmetry regular radial or irregular, septa often and regularly connected to each other. Upper septal border and lateral faces with granulations. No lonsdaleoid septa, no main septum. Microstructure of medium-sized trabeculae. Synapticulae present. Pali absent. Columella present, styliform or by septal fusion. Endotheca present. Marginarium absent. Wall absent or present. Coenosteum depending on the colony type. Budding extracalicinal.

Family Cyclastraeidae Alloiteau, 1952

Description. Only cyclolitid forms. Septa (younger more than older) at the inner margins perforated. Symmetry radial and irregular hexameral, often connected to each other. Synapticulae not common.

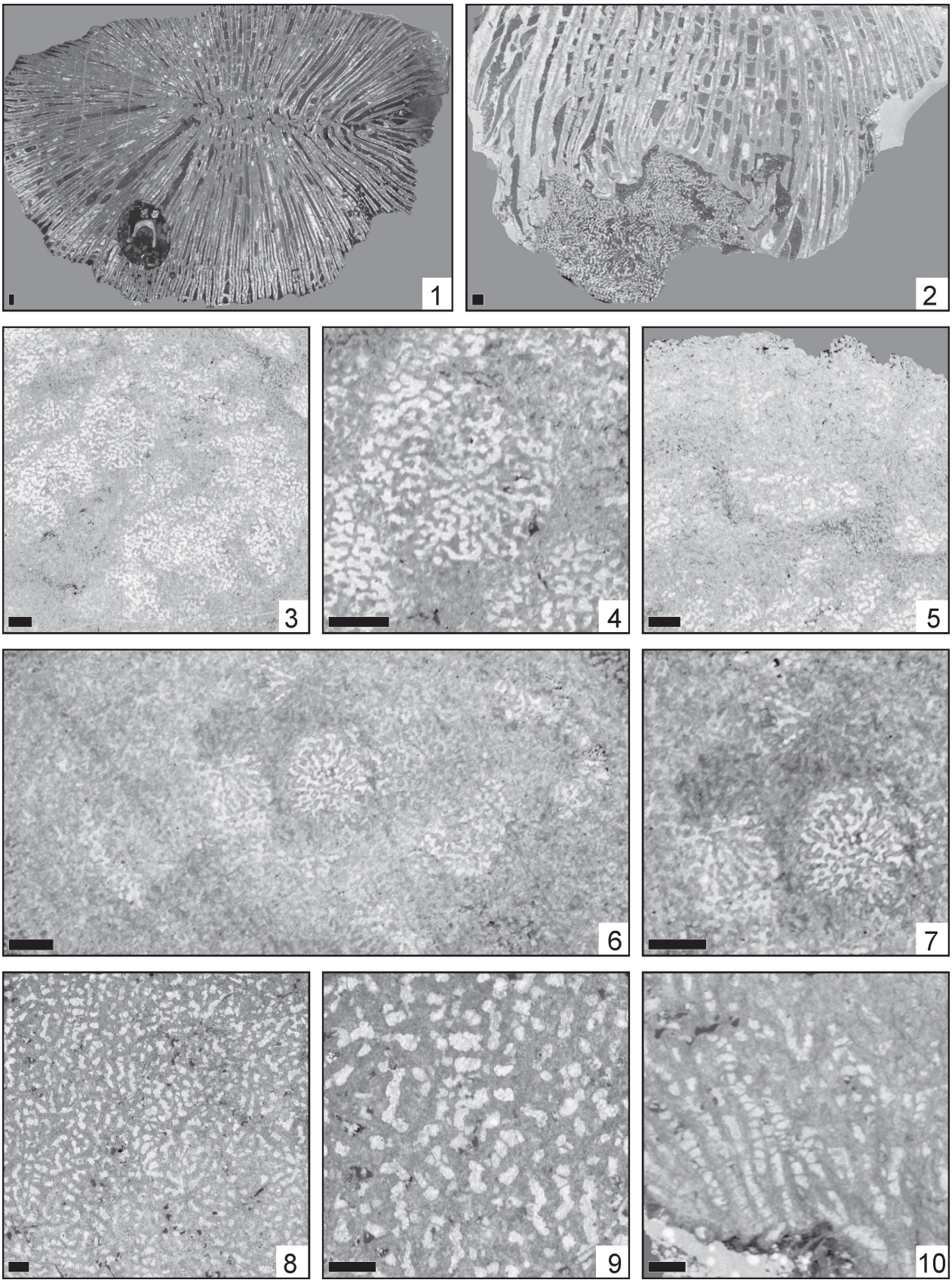

Plate 11. (1–2) *Aulosmilia* aff. *magnifica* (Duncan, 1870). LFU 8336SG015003. **1**. Transversal thin section. **2**. Longitudinal thin section. **(3–5)** *Actinacis* ? *remesi* Felix, 1903. LFU 8336SG015228#2. **3**. Transversal thin section. **4**. Transversal thin section, detail. **5**. Longitudinal thin section. **(6–7)** *Actinacis* sp., BSPG 1947 XVI 78. **6**. Transversal thin section. **7**. Transversal thin section, detail. **(8–10)** Aulastraeoporidae indet. 1, BSPG 1947 XVI 66. **8**. Transversal thin section. **9**. Transversal thin section, detail. **10**. Longitudinal thin section. Scale bars: 1 mm.

Cyclastraea Alloiteau, 1952

Type species. *Cyclolites spinosa* de Fromentel, 1863a.

Description. Solitary patellate coral with a circular outline. Septa in a regular radial symmetry, regularly connected to each other.

Cyclastraea sp.

Plate 2: figs 10–12

Material. BSPG 1947 XVI 87; one thin section.

Dimensions. (BSPG 1947 XVI 87)

c	17×19
septa	91

Family Rhizangiidae d'Orbigny, 1851

Description. Astreoid, cerioid, plocoid, reptoid, and thamnasterioid colonies. The symmetry is regular or subregular radial in varying systems, or irregular. The columella is formed by septal fusion.

Eosiderastrea Löser, 2016a

Type species. *Siderastrea cuyleri* Wells, 1932.

Description. Astreoid colony with large corallites. Septal symmetry irregularly radial, in various systems. Septa are quite regularly connected to each other. In the corallite centre, septa of the first cycles fuse to form the columella.

Eosiderastrea cf. *glomerata* (Reuss, 1854)

cf1854 *Brachyphyllia glomerata* – Reuss: 104, pl. 2, figs 11, 12.
v2013 ?*Diploastrea* sp. – Löser, Werner and Darga: 48, pl. 1, figs 5, 6.
v2016b *Eosiderastrea* sp. 5 – Löser: 397, pl. 7, figs 1–3.

Material. BSPG 1991 X 97; two thin sections.

Remarks. This specimen is very closely related to *Eosiderastrea glomerata* in showing a decameral septal symmetry and four septal cycles, but differs from this species clearly in smaller corallites.

Other occurrences. Lower Cenomanian of the Central Tethys (Greece).

Eosiderastrea stefani Löser, 2016b

v2013 ?*Diploastrea tanohataensis* (Eguchi, 1951) – Löser, Werner and Darga: 46, pl. 2, figs 7–9.
2014 *Diploastrea crassa* Kuzmicheva, 1980 – Baron-Szabo: pl. 69, figs 2, 3.
v2015a "*Diploastrea*" *tanohataensis* (Eguchi, 1951) – Löser: 281, fig. B.
v*2016b *Eosiderastrea stefani* n. sp. – Löser: 394, pl. 2, figs 7–9.
v2018 *Eosiderastrea stefani* Löser, 2016 – Löser, Steuber and Löser: 69, pl. 19, figs 10, 11.
v2023 *Eosiderastrea* cf. *stefani* Löser, 2016c – Samaniego-Pesqueira et al.: 142, figs 14H, I.

Material. BSPG 1947 XVI 47; two thin sections.

Remarks. In Löser et al. (2013c), this specimen was assigned to ?*Diploastrea tanohataensis*. In Löser (2016a) the new genus *Eosiderastrea* was established and in Löser (2016b) systematically revised.

Other occurrences. Upper Barremian to lower Aptian of the Central Tethys (Germany), upper Aptian to lower Albian of the Western Tethys (Spain), middle Albian of the Western Atlantic (Mexico), lower Cenomanian of the Western Tethys (France, Spain) and the Central Tethys (Greece), middle Cenomanian of the European Boreal (France). Lower Cretaceous without specification of the Central Tethys (Israel).

Eosiderastrea sp.

Plate 13: figs 7–9

Material. LFU 8336SG015227#3; two thin sections.

Dimensions. (LFU 8336SG015227#3).

	n	min–max	μ	s	cv	μ±s
cmin	5	8.10–9.99	8.84	0.84	9.5	8.00–9.67
cmax	5	9.91–10.8	10.5	0.44	4.2	10.0–10.9
ccd	8	5.99–11.7	8.73	1.71	19.6	7.02–10.4
septa	4	36–45	42.5	4.36	10.3	38–47

Remarks. The present specimen has a decameral septal symmetry with three septal cycles. All other *Eosiderastrea* with such a symmetry and large corallite dimensions (as the present specimen) have four septal cycles. Hence, the present specimen is very probably a new species.

Siderohelia Löser et al., 2021a

Type species. *Siderohelia aquilai* Löser et al., 2021a.

Description. Phaceloid. Corallite circular to elliptical. Septa in a regular radial symmetry and varying systems. Younger septa attached to older septa in a regular plan. Costae short. Columella by septal fusion. Synapticulae rare, only close to the wall. Wall compact, septothecal. Endotheca absent.

Siderohelia sp.

Plate 14: figs 1–3

Material. LFU 8336SG015150; two thin sections.

Dimensions. (LFU 8336SG015150).

c	10.3×11.3
septa	67

Remarks. The septal symmetry is difficult to decipher and is probably hexameral.

Superfamily Stylinoidea d'Orbigny, 1851

Description. Solitary and colonial corals. Septa compact. Septal symmetry mainly regular, radial, or bilateral. First septal cycle (or cycles) generally thicker than later cycles. Septal lateral faces ornamented. Septal inner margins with auriculae. Lonsdaleoid septa present in two families. No main septa. Microstructure of small trabeculae. Synapticulae and pali absent. Columella present in two families. Endotheca well-developed. Marginarium absent. Wall compact, septothecal. Coenosteum present in some genera. Budding varies depending on the colony type.

Family Aulastraeoporidae Alloiteau, 1957

Description. Solitary and colonial (astreoid, cerioid, phaceloid, plocoid) corals. Septal symmetry regularly radial. Lonsdaleoid septa common. Columella absent. Budding extracalicinal or intracalicinal (septal budding).

Aulastraeoporidae indet. 1

Plate 11: figs 8–10

Material. BSPG 1947 XVI 66; two thin sections.

Dimensions. (BSPG 1947 XVI 66).

	n	min–max	μ	s	cv	μ±s
ccd	25	2.62–3.71	3.15	0.31	10.1	2.83–3.47
septa	15	10–18	14.9	2.03	13.6	13–17

Description. Astreoid colony with small corallites. No septal symmetry. The wall is incomplete, septothecal. Endotheca well developed with numerous small dissepiments.

Remarks. The assignation of the unique specimen to a genus is difficult. It can be compared to *Preverastraea* Beauvais, 1976. Although *Preverastraea* varies in its corallite arrangement, it has always a wall that is incomplete in the present material.

Aulastraeoporidae indet. 2

Plate 12: figs 1–3

Material. LFU 8336SG015115#1; two thin sections.

Dimensions. (LFU 8336SG015115#1).

	n	min–max	μ	s	cv	μ±s
crw	15	0.35–0.46	0.41	0.03	8.1	0.38–0.44
crd	10	1.66–3.13	2.22	0.49	22.1	1.73–2.72

Description. Meandrinoid colony with straight and parallel rows. Rows very narrow, coenosteum wide. In places large isolated corallites are present. Septa in rows short and irregular, in isolated corallites well developed, in a hexameral symmetry. Endotheca well developed.

Remarks. The single specimen does not allow to establish a new genus and species.

Kozaniastrea Löser, Steuber & Löser, 2018

Type species. *Kozaniastrea pachysepta* Löser, Steuber & Löser, 2018.

Description. Cerioid colony. Corallite outline irregularly polygonal, with a small diameter. Symmetry of septa radial and irregularly hexameral. Septa not connected to each other. Pali absent. Costae hardly present, confluent. Endotheca consists of numerous tabulae. Wall subcompact, septothecal. Coenosteum absent.

Kozaniastrea sp.

Plate 12: figs 4–6

Material. BSPG 2016 XXII 2; two thin sections.

Dimensions. (BSPG 2016 XXII 2).

	n	min–max	μ	s	cv	μ±s
ccd	7	2.15–3.48	3.03	0.46	15.0	2.57–3.48
septa	4	9–18	15.0	4.08	27.2	11–19

Family Stylinidae d'Orbigny, 1851

Description. Colonial (phaceloid, plocoid) corals. Septal symmetry radial, in varying systems, bilateral in one genus. Lonsdaleoid septa absent. Columella well-developed, styliform or lamellar. Wall septothecal.

Enallhelia Milne Edwards & Haime, 1849

Type species. *Lithodendron compressa* Goldfuss, 1829.

Description. Plocoid colony growing in the form of branches which show corallites only on one face. Corallite outline circular. Symmetry of septa radial and regularly hexameral, rarely octameral. Pali absent. Costae present, non-confluent. Columella styliform. Endotheca consists of thin tabulae. Coenosteum broad.

Enallhelia octasepta sp. nov.

https://zoobank.org/6D68644E-A87C-43A7-9995-91D5DB8D8284

Plate 12: figs 7, 8

Derivatio nominis. The new species has a remarkable octameral symmetry of septa.

Holotype. LFU 8336SG015215#1 with one thin section.

Locus typicus. Germany, Bavaria, community of Lenggries, Roßsteinalmen.

Stratum typicum. Cretaceous, middle Cenomanian, Branderfleck Fm.

Paratype. LFU 8336SG015215#2 with one thin section.

Material. Holotype and paratype.

Diagnosis. *Enallhelia* with an octameral septal symmetry, two septal cycles, a small corallite diameter of 1.1–1.2 mm and a larger corallite diameter of 1.4 -1.7 mm.

Description. Plocoid colony growing in the form of branches which show corallites only on one face. Corallite outline slightly elliptical. Symmetry of septa radial and regularly octameral, two septal cycles. Septa of the first cycle are thicker and longer than septa of the second cycle. Septa compact, with occasional auriculae at their inner margins. Pali absent. Costae present, non-confluent. Columella styliform. Endotheca consists of thin tabulae. Wall compact, probably septothecal. Coenosteum broad.

Remarks. The genus has, to date, a stratigraphical range from the Oxfordian to the lower Albian. It is more common in the Upper Jurassic than the Lower Cretaceous. The present two specimens constitute the youngest occurrence of the genus.

Relationship. *Enallhelia* has generally a hexameral septal symmetry. There are no formally established species with an octameral septal symmetry as in the present material.

Dimensions. (LFU 8336SG015215#1).

	n	min–max	μ	s	cv	μ±s
clmin	13	1.05–1.23	1.13	0.07	6.0	1.07–1.20
clmax	13	1.32–1.87	1.57	0.16	10.5	1.40–1.73
ccd	15	1.28–2.25	1.97	0.24	12.0	1.73–2.21
septa	8+8					

Stylina de Lamarck, 1816

Type species. *Stylina insignis* de Fromentel, 1861.

Description. Plocoid colony. Corallite outline circular. Symmetry of septa regular radial. Costae non-confluent. Columella styliform. Endotheca consists of thin tabulae. Wall compact, septothecal. Coenosteum broad, consisting of costae and exothecal dissepiments.

Stylina arborea d'Achiardi, 1880

Plate 13: figs 1–3

*v1880 *Stylina arborea* – d'Achiardi: 290, pl. 19, fig. 8.

vnon1897 *Stylina arborea* d'Achiardi – Ogilvie: 169, pl. 17, fig. 1.

v2009 *Stylina* cf. *parviramosa* Beauvais, 1964 – Reolid, Molina and Löser: 581, fig. 5b.

v2021 *Stylina arborea* Achiardi, 1880 – Löser, Nieto, Castro and Reolid: 39, figs 49.1–3

Material. BSPG 1991 X 44, LFU 8336SG015223; three thin sections.

Dimensions. (LFU 8336SG015223).

	n	min–max	μ	s	cv	μ±s
clmin	15	0.92–1.28	1.10	0.13	11.7	0.97–1.23
clmax	15	1.10–1.48	1.24	0.09	7.4	1.14–1.33
ccd	20	2.09–3.32	2.68	0.33	12.3	2.35–3.01
septa	10	14–17	15.70	0.82	5.2	15–17

Remarks. The septal symmetry is octameral with two septal cycles. The species is, to date, only known from the middle Jurassic to the Valanginian.

Other occurrences. Bathonian of the Southern Tethys (Madagascar), Aalenian to lower Valanginian of the Western Tethys (Spain), Kimmeridgian of the European Boreal (Germany), lower Tithonian of the Central Tethys (Italy).

Stylina inwaldensis (Ogilvie, 1897)

v1880 *Stylina bernardana* ? – d'Achiardi: 288. [non *Stylina bernardana* Etallon, 1859]

v*1897 *Diplocoenia inwaldensis* – Ogilvie: 165, pl. 18, figs 7, 8.

v2013 *Stylina inwaldensis* (Ogilvie, 1897) – Löser, García-Barrera et al.: 396, figs 4g–i . [here more detailed synonymy]

v2015 *Stylina inwaldensis* (Ogilvie, 1897) – Löser, Arias and Vilas: 59, figs 3h, i.

v2019 *Stylina inwaldensis* (Ogilvie, 1897) – Löser, Arias and Vilas: 281, figs 11.1–3.

Material. BSPG 1947 XVI 42, 1991 X 45, 1991 X 46, 2010 VI 1; three thin sections.

Other occurrences. Lower Tithonian of the Central Tethys (Italy), Tithonian to lower Berriasian of the European Boreal (Czech Republic), Berriasian of the Central Tethys (Ukraine), upper Valanginian of the Western Tethys (Spain), lower Hauterivian of the Central Tethys (Ukraine) and the European Boreal (France), upper Barremian to lower Aptian of the Western Atlantic (Mexico, Venezuela), Aptian of the Central Tethys (Greece), upper Albian to lower Cenomanian of the Western Tethys (Spain).

Stylina sp.

Plate 13: figs 4–6

Material. BSPG 1947 XVI 35; three thin sections.

Dimensions. (BSPG 1947 XVI 35).

	n	min–max	μ	s	cv	μ±s
clmin	15	0.73–1.08	0.88	0.11	12.2	0.77–0.99
clmax	10	0.91–1.19	1.07	0.10	9.5	0.97–1.17
ccd	20	1.60–2.72	2.19	0.37	17.1	1.82–2.56
septa	8					

Other occurrences. Lower Hauterivian of the European Boreal (France).

Subclass Octocorallia Haeckel, 1866

The classification of the octocorals follows McFadden et al. (2022).

Order Malacalcyonacea McFadden et al., 2022
Family Isididae Lamouroux, 1812

Moltkia Steenstrup, 1847

Type species. *Moltkia isis* Steinmann & Döderlein, 1890.

Remarks. The genus was revised by Löser (2015b).

Moltkia sp.

Plate 13: figs 10, 11

Material. MB K2983#1.

Remarks. The specimen represents a holdfast of an octocoral with an approximate diametre of 15 mm.

Order Scleralcyonacea McFadden et al., 2022

Family Helioporidae Moseley, 1876

Description. The family encompasses genera that form small plocoid colonies. The corallites are small (generally below 2 mm in diameter). The structure is simple because it is only made up of trabeculae and tabulae. The so-called septa are just short wing-like extensions of the trabeculae that reach into the corallites. Pali, a columella or synapticulae do not exist. The tabulae cross corallites and coenosteum in the same level. The coenosteum is formed by trabeculae and is granulated on its surface.

Heliopora de Blainville, 1830

Type species. *Millepora coerulea* Pallas, 1766

Description. The genus forms small spheric, fingerlike or incrusting colonies. The corallites are circular and very regular. The septa are short. The coenosteum appears cellular with very fine pores and tiny spines, or is rarely vermiculate.

Remarks. As explained in Hernández Morales and Löser (2018), the genus *Polytremacis* is a junior synonym of the extant genus *Heliopora*. The corallite dimensions of the species of the study area are compared in Table 1.

Heliopora lindstroemi (Remeš, 1898)

Plate 14: figs 6, 7

1862 *Chaetetes radians* – Roemer: 617.

*1898 *Polytremacis Lindströmi* n. sp. – Remeљ: 7, pl. 1, figs 1a–c.

Material. LFU 8336SG015125#1; one thin section.

Dimensions. (LFU 8336SG015125#1).

	n	min–max	μ	s	cv	μ±s
clmin	13	0.99–1.43	1.20	0.11	8.9	1.09–1.31
clmax	13	1.16–1.56	1.40	0.12	8.8	1.28–1.52
septa	4	18–20	19.0	0.82	4.3	18–20

Remarks. The type material of this species is very probably based on specimens that were first reported by Roemer (1862) as "Chaetetes radians" from Carboniferous glacial drift material. The name "Chaetetes radians" was solely mentioned, without giving a description or illustration. Remeš (1898) has, therefore, the priority.

Other occurrences. Upper Albian of the European Boreal (UK), Turonian of the European Boreal (Poland), Coniacian of the Central Tethys (Austria), Danian of the European Boreal (France).

Table 1. Measurements of the *Heliopora* species in the studied fauna.

Clmax (mm)	Clmin (mm)	Septa	species
0.38–0.5	0.33–0.45	12–16	sp. 1
0.56–0.65	0.52–0.62	13–16	*ramosa*
0.68–0.81	0.6–0.74	13–16	*urgonensis*
0.86–0.95	0.75–0.89	14–16	*somaliensis*
1.11–1.34	1.02–1.2	18–22	*radiata*
1.27–1.48	1.18–1.35	19–23	sp. 2
1.28–1.52	1.09–1.31	18–20	*lindstroemi*
1.47–1.74	1.32–1.56	24–26	sp. 3

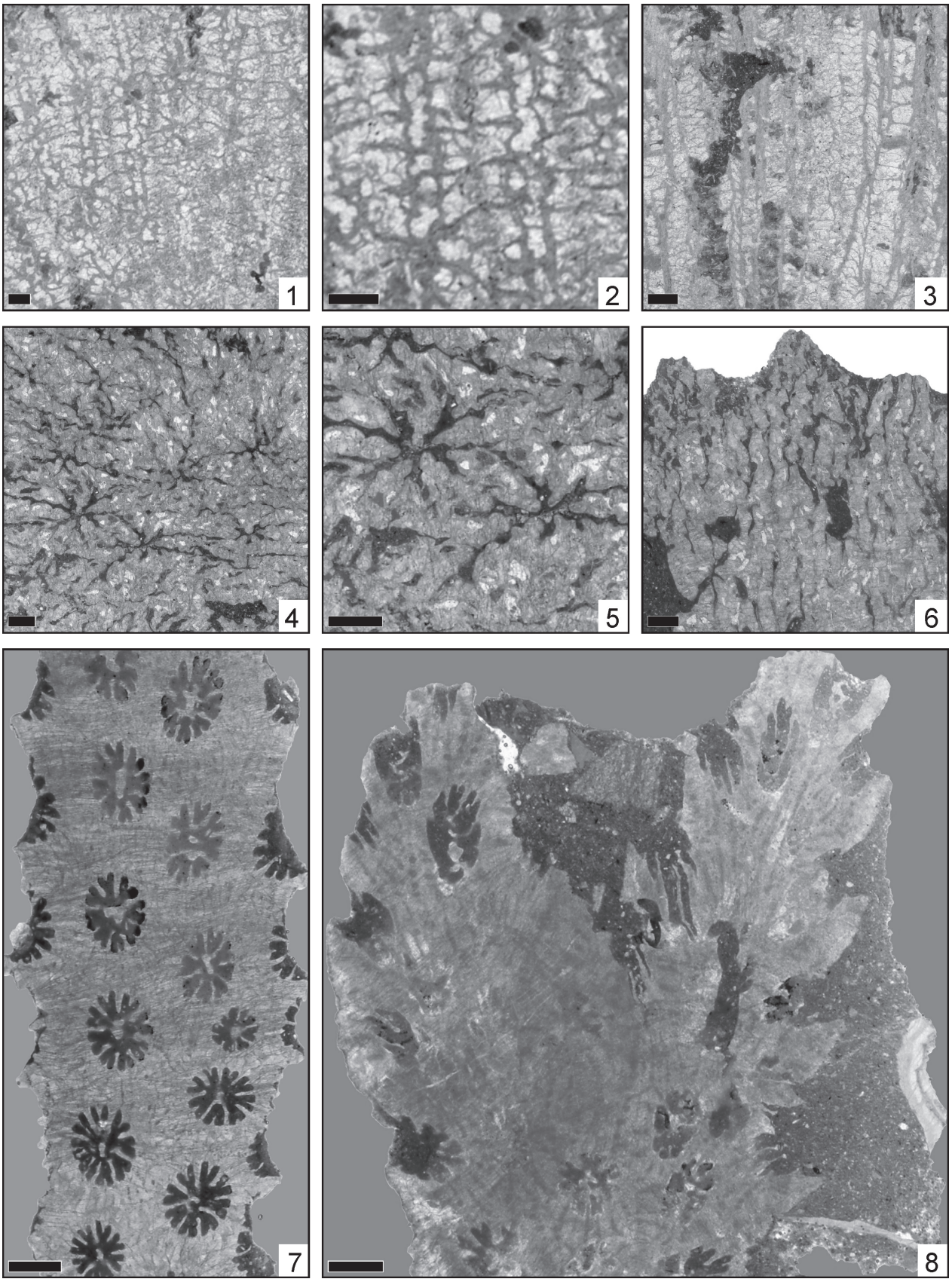

Plate 12. (1–3) Aulastraeoporidae indet. 2, LFU 8336SG015115#1. **1**. Transversal thin section. **2**. Transversal thin section, detail. **3**. Longitudinal thin section. **(4–6)** *Kozaniastrea* sp., BSPG 2016 XXII 2. **4**. Transversal thin section. **5**. Transversal thin section, detail. **6**. Longitudinal thin section. **(7–8)** *Enallhelia octasepta* sp. nov. **7**. Holotype LFU 8336SG015215#1, Transversal thin section. **8**. Paratype LFU 8336SG015215#2, Longitudinal thin section. Scale bars: 1 mm.

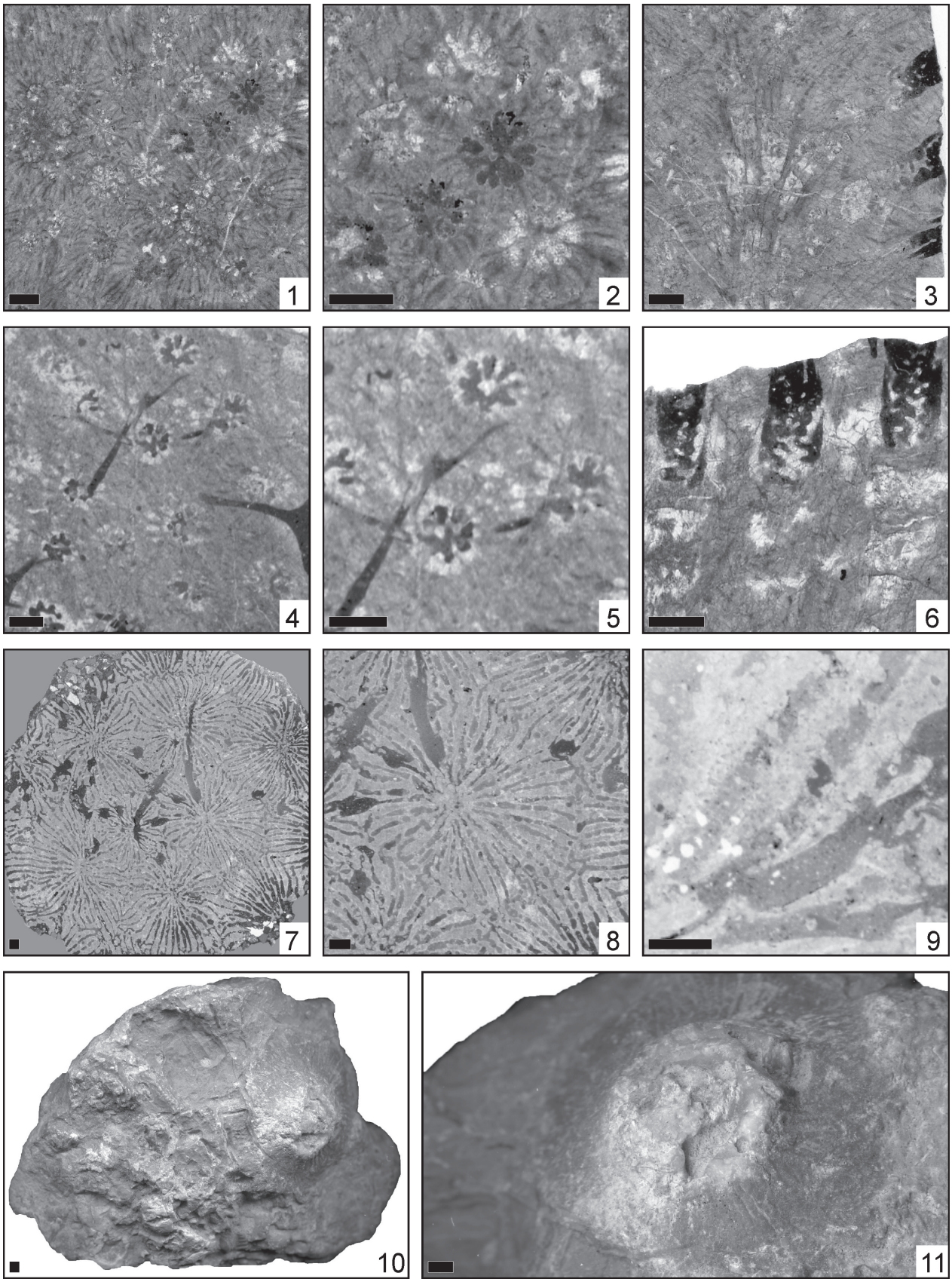

Plate 13. (1–3) *Stylina arborea* d'Achiardi, 1880. BSPG 1991 X 44. **1**. Transversal thin section. **2**. Transversal thin section, detail. **3**. Longitudinal thin section. **(4–6)** *Stylina* sp., BSPG 1947 XVI 35. **4**. Transversal thin section. **5**. Transversal thin section, detail. **6**. Longitudinal thin section. **(7–9)** *Eosiderastrea* sp., LFU 8336SG015227#3. **7**. Transversal thin section. **8**. Transversal thin section, detail. **9**. Oblique thin section. **(10–11)** *Moltkia* sp., MB K2983#1. **10**. surface. **11**. surface, detail. Scale bars: 1 mm.

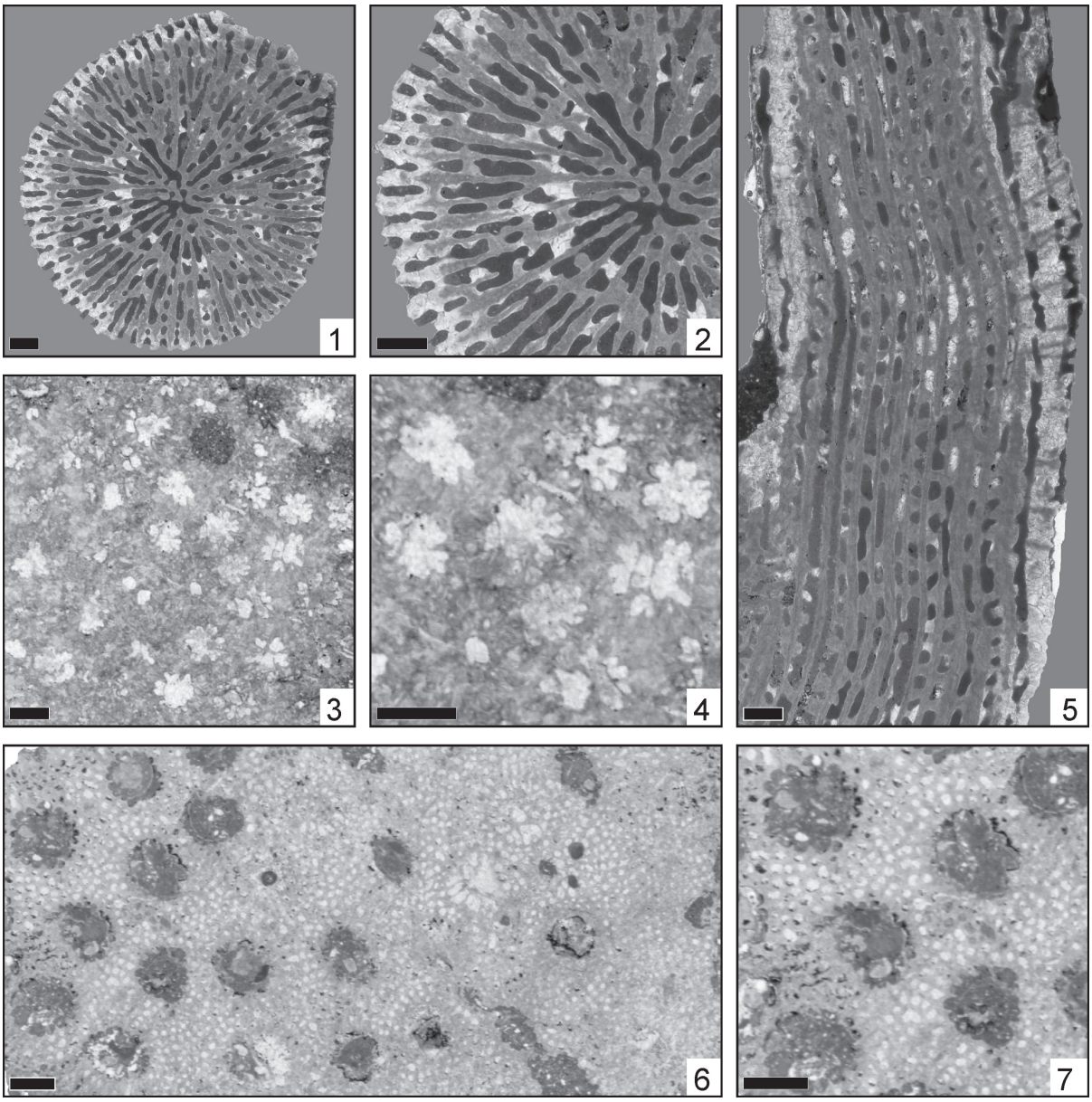

Plate 14. (1–3) *Siderohelia* sp., LFU 8336SG015150. **1**. Transversal thin section. **2**. Transversal thin section, detail. **3**. Longitudinal thin section. **(4–5)** *Cyathophoropsis* sp., LFU 8336SG015227#1. **4**. Transversal thin section. **5**. Transversal thin section, detail. **(6–7)** *Heliopora lindstroemi* (Remeš, 1898). LFU 8336SG015125#1. **6**. Transversal thin section. **7**. Transversal thin section, detail. Scale bars: 1 mm.

Heliopora radiata (d'Orbigny, 1850)

v1850 *Centrastrea radiata* – d'Orbigny: (2), p. 207.
v2013 *Polytremacis vermiculata* (Felix, 1903) – Löser, Werner and Darga: 67, pl. 10, figs 7–9.
v2018 *Heliopora radiata* (Orbigny, 1850) – Löser, Steuber and Löser: 69, pl. 20, figs 7–9.
v2019 *Heliopora radiata* Orbigny, 1850 – Löser, Heinrich and Schuster: 324, figs 529a–c.

Material. BSPG 1947 XVI 43, 1947 XVI 55; two thin sections.

Remarks. In Löser et al. (2013c), these specimens were assigned to *Polytremacis vermiculata* (Felix, 1903b), but afterwards it was possible to examine the type material of *Heliopora radiata* (d'Orbigny, 1850) and to take more detailed measurements in the (only) syntype of *Heliopora vermiculata* that show that both species differ in their dimensions.

Other occurrences. Upper Aptian to lower Cenomanian of the Western Tethys (Spain, France), lower Cenomanian of the Central Tethys (Greece) and the Western Tethys (Spain, France), Coniacian to Santonian of the Central Tethys (Austria), upper Santonian of the Western Tethys (France), Maastrichtian of the Arabian Peninsula (United Arab Emirates).

Heliopora ramosa (d'Orbigny, 1849)

Plate 15: figs 1–3

*v1849 *Dactylacis ramosa* – d'Orbigny: p. 11.
v1850 *Dactylacis ramosa* – d'Orbigny: (2), p. 183.

v2016c *Dactylacis ramosa* Orbigny, 1849 – Löser: 276, fig. D1.
v2018 *Heliopora ramosa* (Orbigny, 1849) – Hernández Morales and Löser: 357, fig. 2.6.
v2019 *Heliopora ramosa* (Orbigny, 1849) – Löser, Heinrich and Schuster: 325, figs 530a–c.

Material. LFU 8336SG015104; two thin sections.
Dimensions. (LFU 8336SG015104).

	n	min–max	μ	s	cv	μ±s
clmin	30	0.48–0.67	0.57	0.05	8.8	0.52–0.62
clmax	30	0.55–0.72	0.61	0.05	7.4	0.56–0.65
septa	20	12–16	14.4	1.10	7.6	13–16

Other occurrences. Lower Albian of the Western Atlantic (Mexico), Cenomanian to lower Coniacian of the Western Tethys (France, Spain), Coniacian to Santonian of the Central Tethys (Austria).

Heliopora somaliensis Gregory, 1900

Plate 15: figs 4, 5

v1882 *Polytremacis* cf. *blainvilleana* d'Orb. – Toula: 35, pl. 4, fig. 14.
*v1900 *Heliopora somaliensis*, n.sp. – Gregory: 298, pl. 2, figs 8 a–c.
v1911 *Heliopora tenera* – Trauth: 89, pl. 4, fig. 3, text-fig. 6.
v1932 *Eomontipora harrisoni*, sp.n. – Gregory: 93, pl. 3, figs 1–3.
v1948 *Heliopora japonica* n.sp. – Eguchi: 363, pl. 60, figs 1, 2, 5, 7.
v1981 *Polytremacis edwardsana* (Stoliczka 1873) – Turnšek and Mihajlovic: 39, pl. 48, figs 1–8.
v1997 *Polytremacis edwardsana* (Stoliczka, 1873) – Eliášová: 69, pl. 8, figs 1, 2.
v2006 *Pseudopolytremacis japonica* (Eguchi, 1948) – Löser and Ferry: 485, fig. 6.9.
v2013b *Polytremacis* ? *tenera* (Trauth, 1911) – Löser: 22, fig. 3.12.
v2019 *Heliopora tenera* Trauth, 1911 – Löser, Heinrich and Schuster: 326, figs 532a–c.
v2020 *Heliopora somaliensis* Gregory, 1900 – Löser, Mendicoa and Fernández Mendiola: 232, figs 8a–c.

Material. LFU 8336SG015228#1; one thin section.
Dimensions. (LFU 8336SG015228#1).

	n	min–max	μ	s	cv	μ±s
clmin	12	0.72–0.92	0.82	0.07	8.4	0.75–0.89
clmax	12	0.83–0.98	0.90	0.04	4.8	0.86–0.95
septa	5	13–16	14.8	1.30	8.8	14–16

Other occurrences. Lower Hauterivian of the European Boreal (France), upper Barremian of the Western Tethys (France), upper Barremian to lower Aptian of the Central Tethys (Bulgaria, Serbia), lower Aptian of the Central Tethys (Greece, Serbia) and the Western Tethys (Spain), upper Aptian of the Western Pacific (Japan), lower Albian of the Western Atlantic (Mexico), upper Cenomanian of the European Boreal (Czech Republic), Turonian of the Central Tethys (Somalia), Coniacian to Santonian of the Central Tethys (Austria), lower Eocene of the Central Tethys (Somalia) and the European Boreal (Czech Republic).

Heliopora urgonensis (Koby, 1898)

v*1898 *Polytremacis urgonensis* – Koby: 87, pl. 21, fig. 5.
v1936 *Heliopora edwardsana* Stoliczka 1873 – Hackemesser: 76, pl. 6, fig. 11.

Material. BSPG 1947 XVI 40, 1947 XVI 41, 1947 XVI 7, 1991 X 62; two thin sections.
Dimensions. (BSPG 1947 XVI 7).

	n	min–max	μ	s	cv	μ±s
clmin	25	0.56–0.78	0.67	0.07	9.9	0.60–0.74
clmax	25	0.63–0.86	0.74	0.07	8.9	0.68–0.81
septa	22	11–17	14.86	1.58	10.6	13–16

Other occurrences. Barremian of the Central Tethys (France), lower Albian of the Western Atlantic (Mexico), Coniacian to Santonian of the Central Tethys (Austria), Cretaceous without specification of the Central Tethys (Greece).

Heliopora sp. 1

v2013 *Polytremacis* sp. – Löser, Werner and Darga: 68, pl. 10, figs 10–12.

Material. BSPG 1947 XVI 63; one thin section.
Other occurrences. Coniacian of the Central Tethys (Austria), upper Eocene of the Western Atlantic (Panama).

Heliopora sp. 2

Plate 15: figs 6–8

v1997 *Pseudopolytremacis* cf. *spinoseptata* Morycowa, 1971 – Baron-Szabo: 89, pl. 15, fig. 6.

Material. LFU 8336SG015021#1, 8336SG015021#2; three thin sections.
Dimensions. (LFU 8336SG015021#2).

	n	min–max	μ	s	cv	μ±s
clmin	9	1.11–1.36	1.27	0.09	6.9	1.18–1.35
clmax	9	1.22–1.52	1.38	0.11	7.6	1.27–1.48
septa	3	19–23	21.33	2.08	9.8	19–23

Other occurrences. Lower Aptian of the Central Tethys (Italy), upper Cenomanian of the Western Tethys (France), upper Turonian to Santonian of the Central Tethys (Austria), Palaeocene of the European Boreal (Germany).

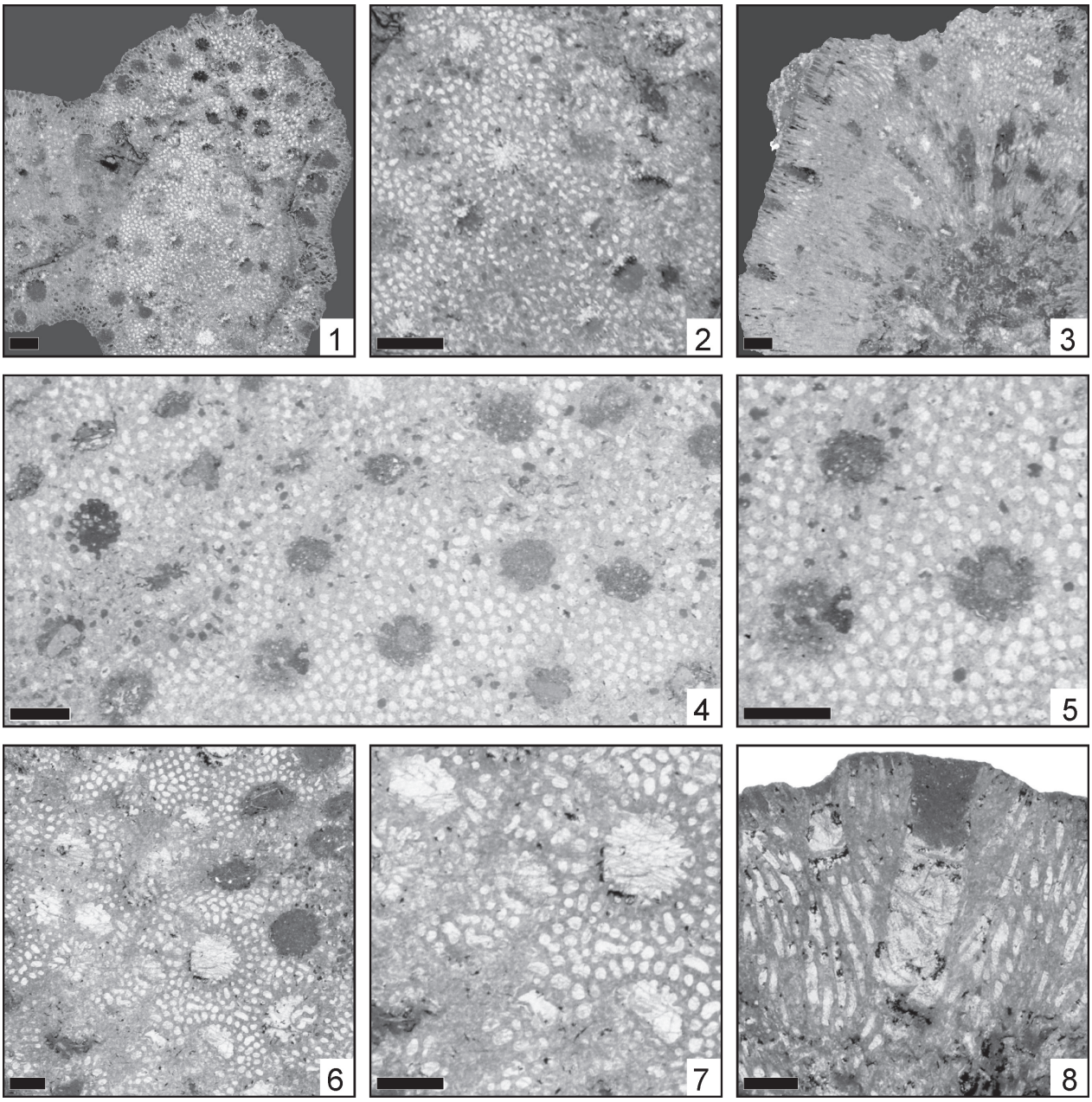

Plate 15. (1–3) *Heliopora ramosa* (d'Orbigny, 1849). LFU 8336SG015104. **1**. Transversal thin section. **2**. Transversal thin section, detail. **3**. Longitudinal thin section. **(4–5)** *Heliopora somaliensis* Gregory, 1900. LFU 8336SG015228#1. **4**. Transversal thin section. **5**. Transversal thin section, detail. **(6–8)** *Heliopora* sp. 2, LFU 8336SG015021#2. **6**. Transversal thin section. **7**. Transversal thin section, detail. **8**. Longitudinal thin section. Scale bars: 1 mm.

Heliopora sp. 3

v2013 *Polytremacis bofilli* (Bataller, 1936) – Löser, Werner and Darga: 67, pl. 10, figs 1–3.

vp2019 *Heliopora partschi* Reuss, 1854 – Löser, Heinrich and Schuster: 324.

Material. BSPG 1947 XVI 14, 1947 XVI 25, 1947 XVI 50, 1991 X 40, 1991 X 61, LFU 8336SG015015#1, 8336SG015015#2, 8336SG015096; seven thin sections.

Remarks. In Löser et al. (2013c), the material was assigned to *Polytremacis bofilli*. After more detailed measuring it transpires that the dimensions are larger than in *Heliopora bofilli*. *Heliopora bofilli* itself is probably a junior synonym of *Heliopora blainvilleana* Michelin, 1841. This is difficult to decide; the type material of *Heliopora blainvilleana* comes from Uchaux (Vaucluse, France) and is very poorly preserved. Therefore, *Heliopora blainvilleana* probably should be discarded. The type material of *Heliopora partschi* is available but did not deliver well-constrained morphometric data.

Other occurrences. Coniacian to Santonian of the Central Tethys (Austria), lower Santonian of the Western Tethys (France), Campanian to Maastrichtian of the Western Atlantic (Jamaica), Maastrichtian of the Western Tethys (France).

Discussion

In the first description of the coral fauna from the Roßsteinalm area, 39 species in 25 genera were described. This amount has more than doubled, now reaching 98 species in 46 genera. The new material from the Bayerisches Landesamt für Umwelt - Geologie/Paläontologie (Hof) and the Museum für Naturkunde der Humboldt-Universität (Berlin) is taxonomically very different from the formerly studied material kept at the Bayerische Staatssammlung für Paläontologie und Geologie (Munich). We can only speculate about the reasons. Most material (Hof and Munich) was sold or donated by the private collector Otto Hölzl, as aforementioned. It is possible that the Bayerisches Landesamt für Umwelt - Geologie/Paläontologie first picked out attractive material from his collection and the remaining material went to the Bayerische Staatssammlung für Paläontologie und Geologie. Another possibility is that the material was collected at different times and at slightly different places or horizons at the Roßsteinalmen, or that the attractive specimens were the first to be collected and later all of the rest were collected. For example, all of the material of the genus *Eothelia* (that is unattractive for collectors) is housed at the Bayerische Staatssammlung für Paläontologie und Geologie (Munich). No specimen was found in the other two collections. On the other hand, the (attractive) specimens of the genus *Felixarea* are all from the Bayerisches Landesamt für Umwelt - Geologie/Paläontologie (Hof).

The new material has enriched the fauna considerably but various taxonomic assignments – genera and species – of the first revision have changed (Table 2). This has different reasons:

1. After the publication, numerous collections in Europe and the USA were visited by the first author (H.L.) and much type material was studied. Of importance for the present revision was the study of the collections of Johannes Felix (Leipzig), Paul Oppenheim (Jerusalem), and August Emanuel Reuss (Vienna).
2. With the publication of the systematic revision of the Cretaceous corals on the genus level (Löser 2016c) an improved classification system was proposed. Therefore, the systematic position of many genera was modified, and many genera became synonyms.
3. The revision of the corals of the Conacian and Santonian corals of the area of Rußbach and Gosau (Austria) by Löser et al. (2019) has improved the knowledge on Late Cretaceous corals that also had influence on the taxonomy of Cenomanian corals.
4. Finally, the improved methods of recording and analysing morphometric data in Scleractinian corals changed the viewpoint at the species concept level and the way in which species are distinguished. Many type specimens were measured with more details and much more morphometric data became available overall.

Faunal composition

The present middle Cenomanian coral fauna encompasses 98 coral species, with 88 species belonging to the subclass Hexacorallia, and ten species belonging to the subclass Octocorallia. Compared to other Cretaceous coral faunas, this is a comparably high value which is so far only nearly reached or even exceeded by two Cenomanian coral faunas: Kozani (Greece; Löser et al. 2018) and Cantabria (Spain; Löser and Wilmsen 2022). There are two further upper Cretaceous species-rich faunas: the Turonian to Santonian coral faunas from Austria (Löser et al. 2019), and a Campanian fauna from Spain (e.g. Bataller 1937). Both coral faunas are allochthonous, in that the material was brought together from different areas and may also differ slightly in age. This is not the case for the present coral fauna.

With the exception of one specimen originating from the upper part of the Roßsteinalmen section, all other specimens certainly come from the marly facies of the lower part of this section. However, an attribution to single horizons and thus a separation of different palaeocommunities is not possible.

In our first compilation, published in 2013, we stated that solitary corals dominate the collection in number of specimens (80%), whereas colonial forms dominate in number of genera. The new material includes coral genera of various growth forms and although colonial coral genera still dominate the association, the number of solitary coral genera increased (Fig. 3). The new specimens - solitary and colonial corals - are also small, rarely exceeding 5 cm in their largest dimension. This may suggest - as already discussed in Löser et al. (2013c) - unfavourable

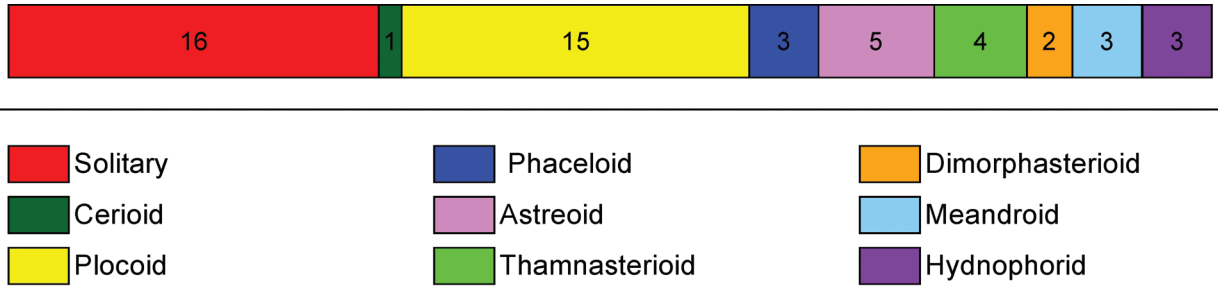

Figure 3. Distribution of the corallite integration types in the studied fauna. The total number of genera (50) is larger because all corals where included, also those not assigned to any genus.

Table 2. Changes in the taxonomy for the Roßsteinalmen coral fauna published in 2013.

Löser, Werner and Darga (2013)	This paper
Acrosmilia sp.	*Placoseris* cf. *eturbensis* (de Fromentel, 1857)
Actinastrea regularis (de Fromentel, 1887)	*Actinastrea subdecaphylla* (Oppenheim, 1930)
Astraeofungia tenochi (Felix, 1891)	*Astraeofungia schmidti* (Koby, 1898)
Aulosmilia ? *bipartita* (Reuss, 1854)	*Aulosmilia parkinsoni* (Milne Edwards & Haime, 1848)
Aulosmilia ? *consobrina* (Reuss, 1854)	*Aulosmilia parkinsoni* (Milne Edwards & Haime, 1848)
Aulosmilia ? *consobrina* (Reuss, 1854)	*Aulosmilia* sp.
Aulosmilia ? *inconstans* (de Fromentel, 1862)	*Aulosmilia inconstans* (de Fromentel, 1862)
Ceratosmilia arnaudi Alloiteau, 1957	*Ceratosmilia arnaudi* Alloiteau, 1957
Columellophora cf. *velimensis* Eliášová, 1989	*Columellophora velimensis* Eliášová, 1989
Columellophora sp.	*Columellophora* sp.
Cryptocoenia aguilerai (Reyeros Navarro, 1963)	*Cryptocoenia aguilerai* (Reyeros Navarro, 1963)
Cryptocoenia bulgarica (Toula, 1884)	*Cryptocoenia antiqua* d'Orbigny, 1850
Cryptocoenia fontserei (Bataller, 1947)	*Cryptocoenia waltoni* (Milne Edwards & Haime, 1851)
Dimorpharaea japonica Eguchi, 1951	*Dimorpharaea williamsonensis* (Wells, 1944)
Dimorphastrea regularis (de Fromentel, 1857)	*Dimorphastrea* cf. *hiraigensis* (Eguchi, 1951)
?*Diploastrea* sp.	*Eosiderastrea* cf. *glomerata* (Reuss, 1854)
?*Diploastrea tanohataensis* (Eguchi, 1951)	*Eosiderastrea stefani* Löser, 2016
Eothelia bavarica gen. nov. et sp. nov.	*Eothelia bavarica* (Löser et al., 2013)
Eothelia hoelzli gen. nov. et sp. nov.	*Eothelia hoelzli* (Löser et al., 2013)
Felixigyra deangelisi Prever, 1909	*Felixigyra deangelisi* Prever, 1909
Heterocoenia sp.	*Styloheterocoenia* sp.
Hydnophora cf. *obliqua* Reig Oriol, 1992	Hydnophoraraea obliqua Reig Oriol, 1992
Hydnophora cf. *obliqua* Reig Oriol, 1992	Hydnophoraraea parviconus Oppenheim, 1930
Hydnophora sp.	*Hydnophoraraea parviconus* Oppenheim, 1930
Leptophyllaraea cf. *granulata* (de Fromentel, 1863)	*Leptophyllaraea* cf. *granulata* (de Fromentel, 1863)
Microphyllia cf. *oldhamiana* (Stoliczka, 1873)	*Microphyllia* cf. *oldhamiana* (Stoliczka, 1873)
Negoporites cf. *quartus* Eliášová, 1995	*Negoporites* cf. *quartus* Eliášová, 1995
Negoporites sp.	*Negoporites* sp.
Neocoenia cf. *casterasi* (Alloiteau, 1957)	*Neocoenia exsculpta* (Reuss, 1854)
Neocoenia cf. *casterasi* (Alloiteau, 1957)	*Neocoenia kuehnii* (Oppenheim, 1930)
Neocoenia renzi (Hackemesser, 1936)	*Neocoenia renzi* (Hackemesser, 1936)
Pachygyra krameri Oppenheim, 1930	*Pachygyra cucullata* (Zuffardi-Comerci, 1930)
Paramontlivaltia ruvida (Prever, 1909)	*Trochophyllia aprutina* (Prever, 1909)
Paramontlivaltia ruvida (Prever, 1909)	*Trochophyllia ruvida* (Prever, 1909)
Polytremacis bofilli (Bataller, 1936)	*Heliopora* sp. 3
Polytremacis sp.	*Heliopora* sp. 1
Polytremacis vermiculata (Felix, 1903)	*Heliopora radiata* (d'Orbigny, 1850)
Stelidioseris minima (de Fromentel, 1857)	*Actinastrea limbata* Alloiteau, 1954
Synastrea sp.	*Synastrea* sp.
Thalamocaeniopsis sp.	*Polyastropsis* cf. *fascigera* (Felix, 1909)
Trochoseropsis ettalensis Söhle, 1897	*Trochoseropsis ettalensis* Söhle, 1897

substrate conditions and limited light. All of those limiting factors had no influence on the species richness.

Twenty-seven superfamilies of the order Scleractinia were distinguished in Löser (2016c) for the Cretaceous. Another superfamily is introduced here (Dendrogyroidea) and one superfamily (Ficariastraeoidea) is put into synonymy with the Phyllosmilioidea. Of the resulting 27 superfamilies, 22 occur in the Middle Cenomanian. In the studied fauna, 15 of those superfamilies are present. For the remaining seven superfamilies Dendrophyllioidea, Fungioidea, Haplaraeoidea, Madreporoidea, Micrabacioidea, Orbicelloidea, and Stylophoroidea an occurrence in the Middle Cenomanian is confirmed, but they were not found in the study area.

Fig. 4 shows the comparison of the number of genera per superfamily for the Albian to Turonian on a global scale to the number of genera per superfamily in the study area (only order Scleractinia). Both global and local data are very similar, with the difference that in the present fauna the Caryophyllioidea, Eugyroidea, Montlivaltioidea and Phyllosmilioidea have less genera compared to the global data, whereas the Cyclolitoidea and Stylinoidea are represented by slightly more genera. The lower number of Caryophyllioidea genera in the present shallow water fauna can be explained by the preference of this superfamily for deeper marine environments. On the whole the faunal composition is comparable to other coral faunas of Cenomanian age.

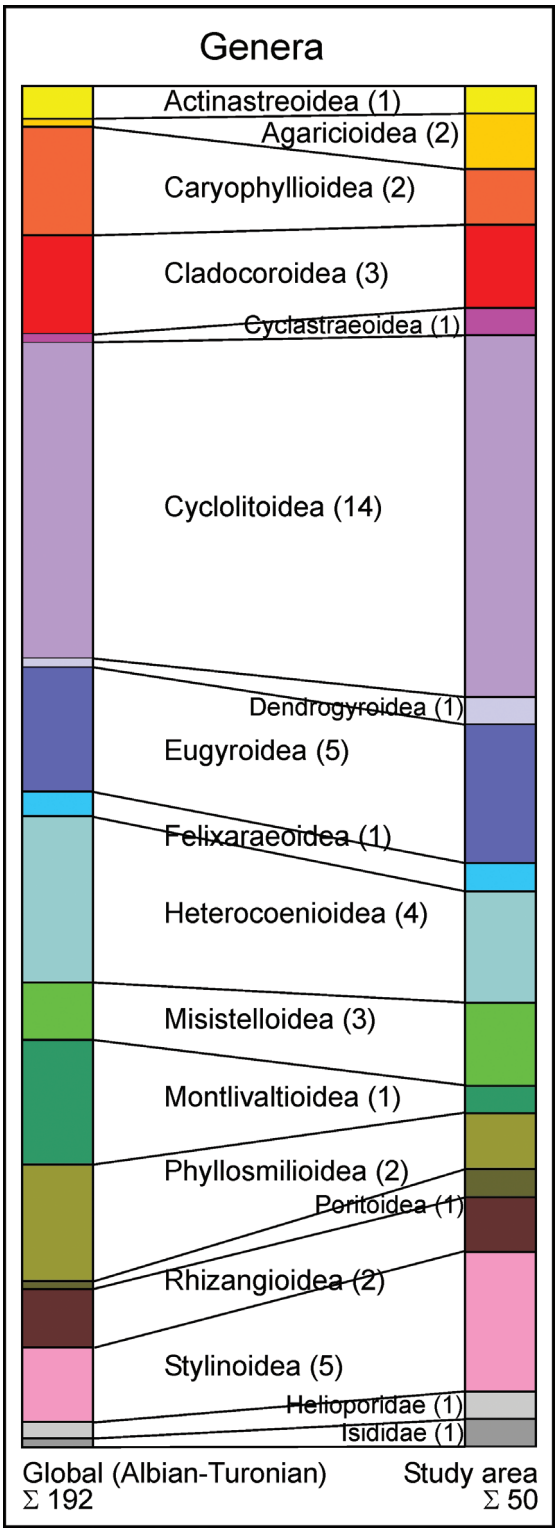

Figure 4. Distribution of genera of the studied fauna among superfamilies (order Scleractinia) based on verified stratigraphical ranges. These ranges were obtained through the observation of material and do not come from the literature. A comprehensive compilation of the ranges were published in Löser (2016c). The left bar shows the distribution of (192) genera worldwide that have an occurrence (at least partly) in the Cenomanian. Only those superfamilies are shown that occur also in the study area, resulting in 124 genera. The right bar shows the distribution of (50) genera of the studied fauna.

Stratigraphic distribution

Fig. 5 is an alphabetical chart that shows the stratigraphical distribution of the species of the study area in other areas. It can be observed that the species of the same genus have a comparable stratigraphical distribution. Some genera have their principal distribution in the Lower Cretaceous and others in the Upper Cretaceous. This is obvious for the lower Cretaceous genera *Astraeofungia*, *Cryptocoenia*, *Stylina* and the upper Cretaceous genera *Actinastrea*, *Aulosmilia*, *Hydnophoraraea*, *Synastrea*. Only a few genera are occurring throughout the whole Cretaceous, such as the octocoral *Heliopora*.

When looking directly at the stratigraphical distribution of the genera (Fig. 6), this polarisation is even more obvious: 15 genera occur in the Lower Cretaceous but have their last occurrence in the Cenomanian; 14 genera occur before and continue after the Cenomanian; eight genera occur only in the Cenomanian; nine genera originate in the Cenomanian and continue into the Upper Cretaceous.

The summarised data in Fig. 7 for both species and genera show that more taxa of this study have their stratigraphic distribution in the Lower Cretaceous than in the Upper Cretaceous. There are many genera that had their last occurrence in the Cenomanian, some were present in the whole Cretaceous and many others had their first occurrence in the Cenomanian. Some genera experienced a range extension with the present fauna; the most striking are *Cyathophoropsis*, *Enallhelia* and *Felixaraea*.

Palaeobiographic relationships

Fig. 8 shows the correlation of palaeo-provinces (faunules) based on (76) species of the study area that have a distribution in other areas. The number of joint species is generally low and, therefore, no clear pattern can be observed. The highest number of species (16 out of 76) shares the present fauna with the coral fauna from Cóbreces (Cantabria, Spain; Löser and Wilmsen 2022). Generally, the present fauna tends to correlate more with Tethyan faunas; Boreal faunas are in a separate cluster. Even if not shown in Fig. 8, the present fauna shares many species with the well-studied Coniacian to Santonian coral fauna of the area of Rußbach and Gosau (Austria); out of the 76 species that were indicated at other places, 27 occur also in the Rußbach/Gosau area. When comparing only coral faunas with a range in the Cenomanian (Fig. 9), the fauna from Cóbreces again shows the highest number of joint species. The correlation with other areas does not allow a clear conclusion; very probably because the number of joint species is too low.

Evolutionary aspects

Almost ten years have passed since the publication of the first part of the coral fauna from the Northern Calcar-

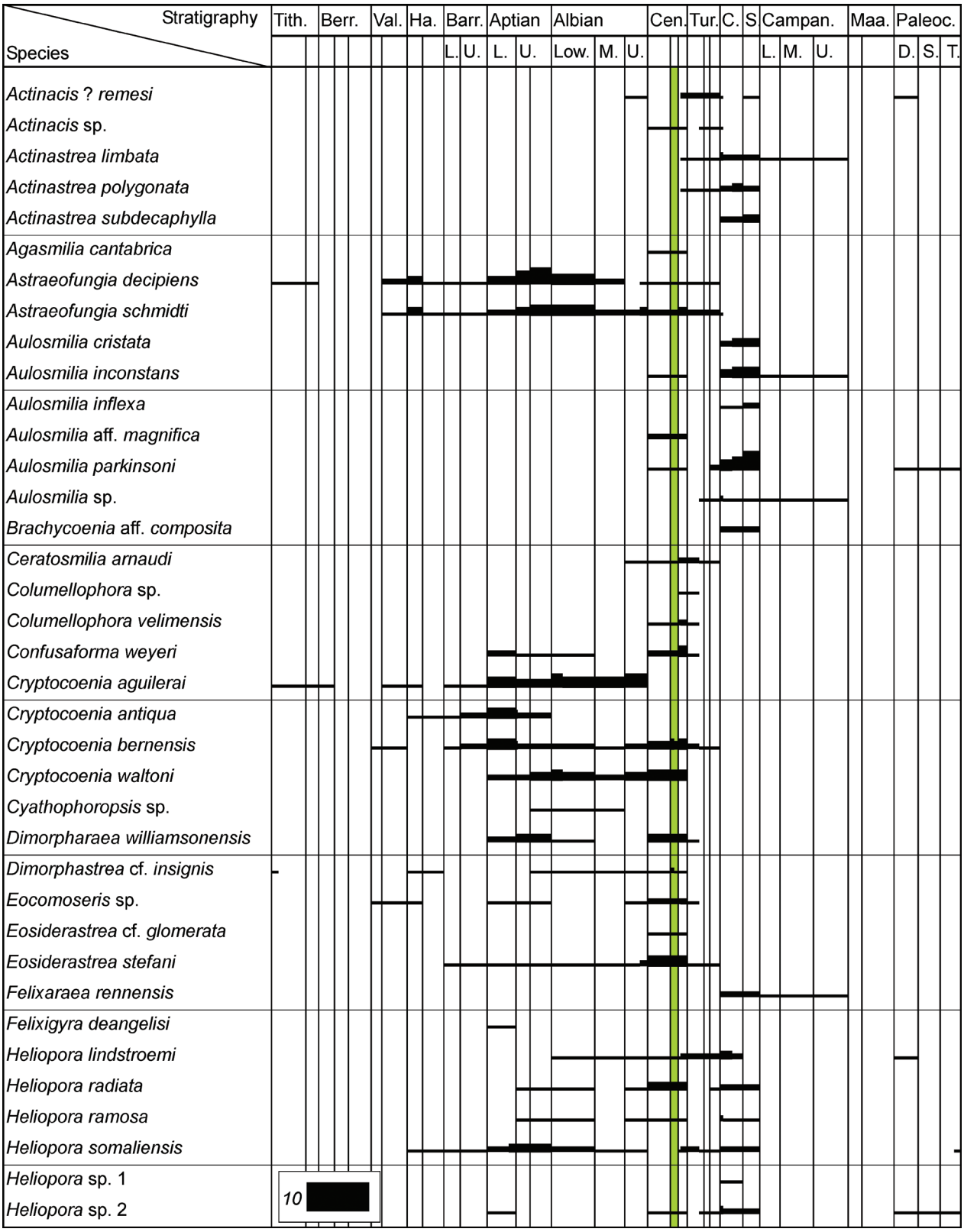

Figure 5. Distribution of species of the studied fauna in localities outside of the study area. The thickness of the horizontal bars corresponds to the number of localities where the species was found. The vertical green bar marks the age of the investigated coral fauna. Only Tithonian to Palaeocene is shown.

eous Alps . At the same time or afterwards, more large Albian to Cenomanian coral faunas were published (e.g. Löser 2013a, 2014b, 2015a; Löser et al. 2015; Löser et al. 2013a; Löser and Bilotte 2017; Löser et al. 2018; Löser and Wilmsen 2022, 2023). The Coniacian to Santonian coral fauna of the Gosau area was revised (Löser et al. 2019). All of these revisions have extended or limited the stratigraphical ranges of the coral genera. When correlat-

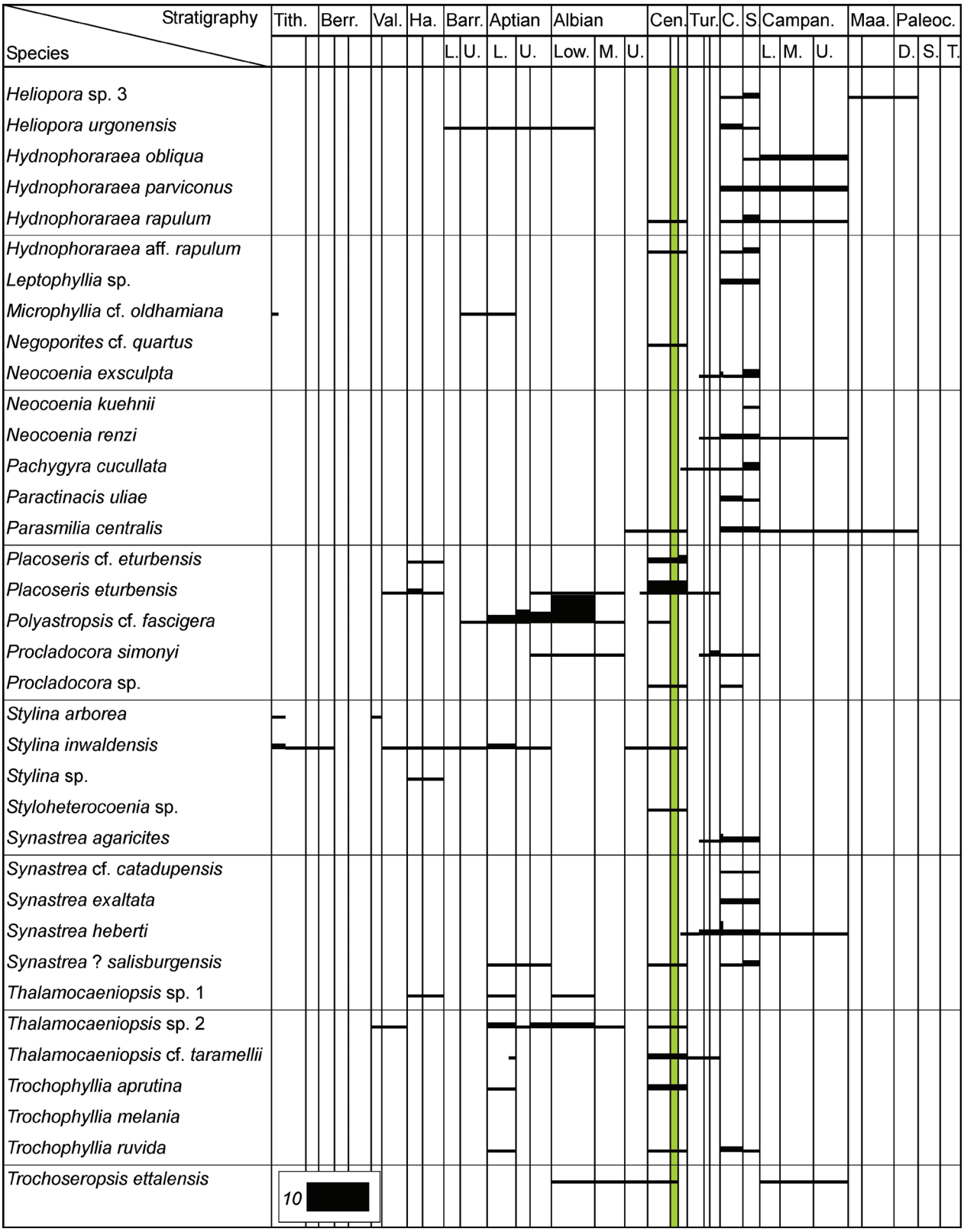

Figure 5. Continued.

ing the palaeo-provinces based on genera (Fig. 10), two major groups can be observed, the Lower Cretaceous plus Cenomanian and the Turonian to Santonian. There is one exception; the Quillan Basin of Cenomanian age is grouped together with the Turonian to Santonian provinces. The Quillan Basin province encompasses, principally, the locality of Prat-Périe (Sougraigne, Les Corbières, Aude, France) with an Uppermost Cenomanian age (*juddii*-zone; Bilotte 1985; Michel Bilotte personal communication). It is shown again that the faunal turnover (see

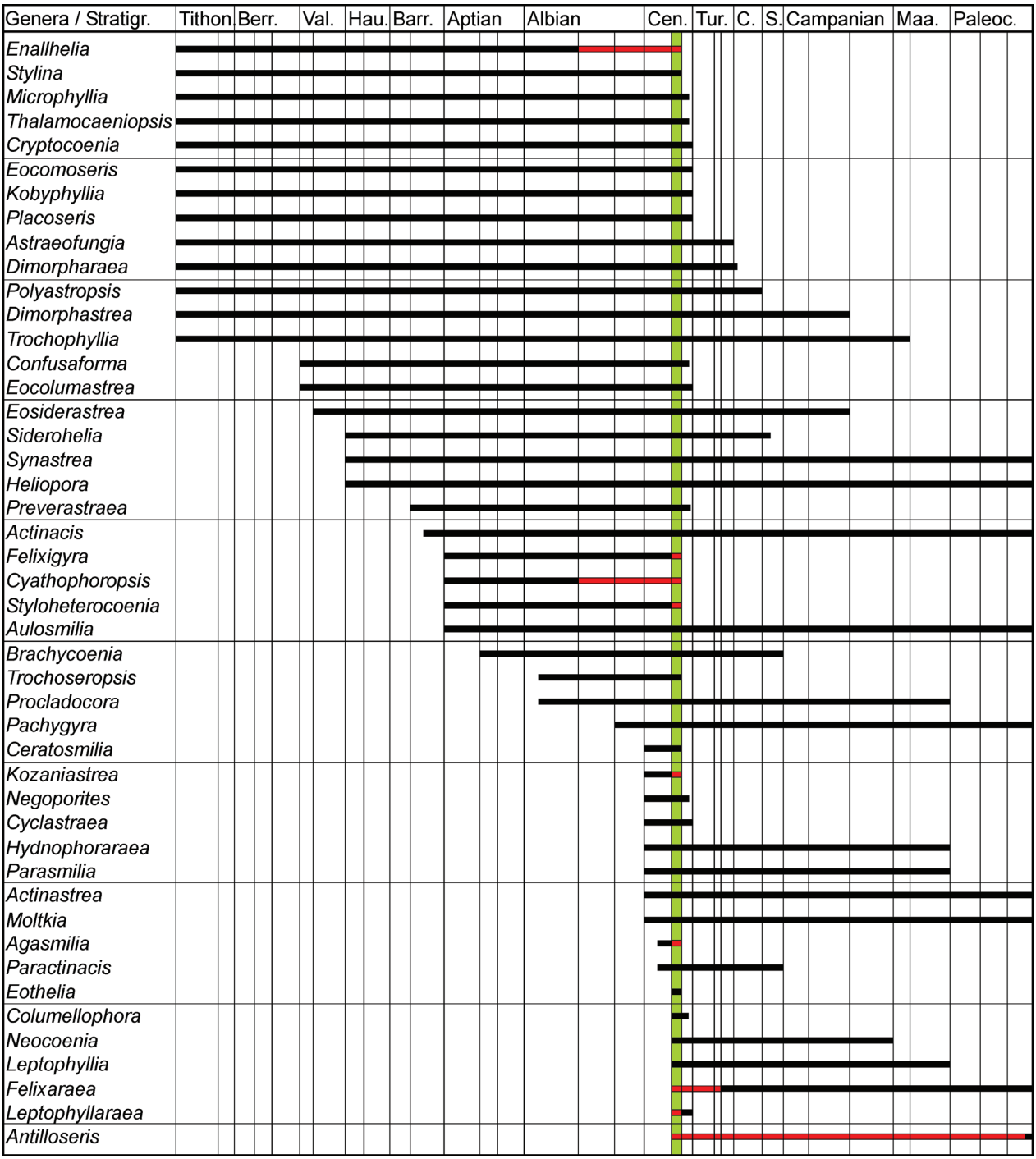

Figure 6. Verified stratigraphic ranges of the coral genera in the study area, sorted according to their occurrence. Ranges as above after Löser (2016c), but improved by newer data. Red lines mark range extensions as a result of this study. The vertical green bar indicates the age of the studied fauna. Only Tithonian to Palaeocene is shown; some genera may have longer ranges.

also Löser and Callapez 2022, fig. 9) from the Lower Cretaceous plus Cenomanian to the Turonian and younger strata was transitional and can only be partly connected to the sea level highstand and Ocean Anoxic Event 2 at the Cenomanian/Turonian boundary. When looking at the stratigraphic distribution of the superfamilies (that may represent monophyletic groups), the faunal turnover is less obvious (Fig. 11). Only three superfamilies became extinct during the Cenomanian, and three superfamilies originated.

Concluding remarks

During the Cenomanian, the general trend of a rising sea level continued (Haq et al. 2014). Whereas the lower Cenomanian is characterised by a sea level increase, the middle Cenomanian experienced a slight decrease. During the upper Cenomanian, the sea level increased again, reaching a high stand at the Cenomanian/Turonian boundary. Globally, nearly all precisely dated large Cenomanian coral faunas can be assigned either to the

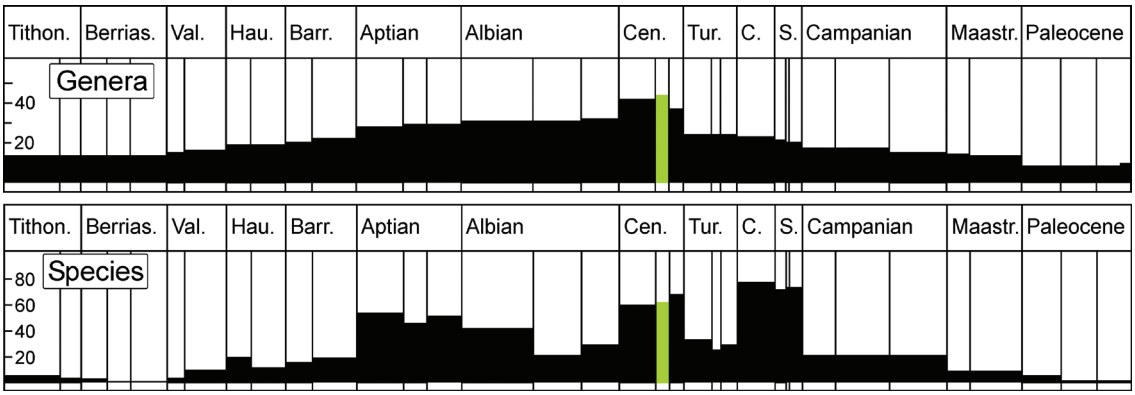

Figure 7. Summarised ranges of genera and species. The chart of genera shows the verified distribution of the genera of the study area (based on Löser 2016c with later precision). The chart of species shows the number of faunules where the species from the study area occurred (not localities). The new data obtained in the present study are not shown in both charts. The vertical green bar marks the time interval of the study area.

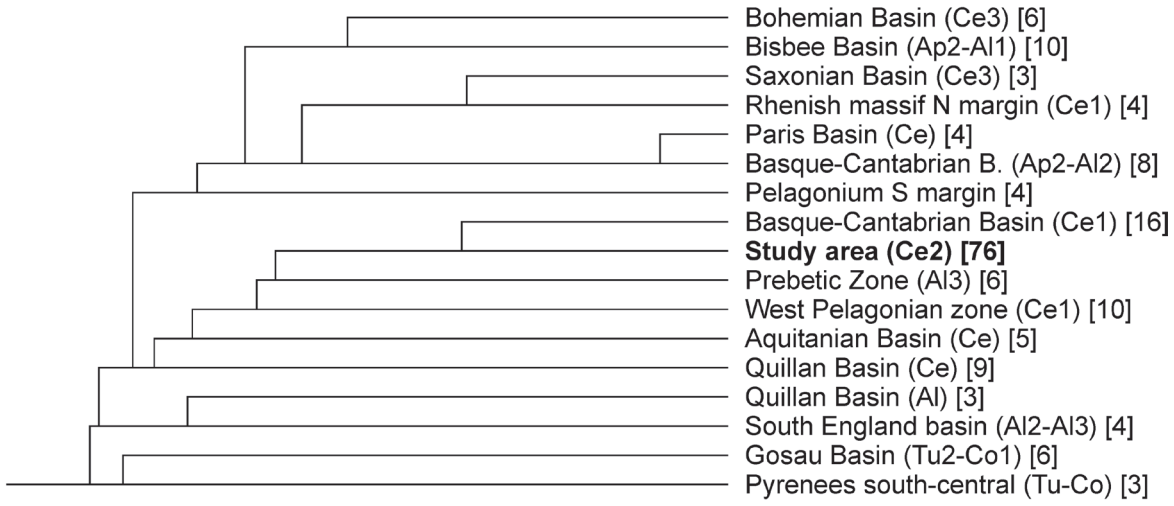

Figure 8. Correlation of the palaeo-provinces where species of the studied fauna occur. Only provinces with more than two species were included, and only the time period Albian to Turonian is considered. The Correlation Ratio coefficient was applied. Abbreviations: Ap, Aptian; Al, Albian; Ce, Cenomanian, Tu, Turonian, Co, Coniacian. The number 1. indicate lower, the number 2. middle, and the number 3. upper. The numbers in brackets are the numbers of joint species. The stratigraphy of the area Pelagonium S margin is uncertain. The study area is marked in bold letters.

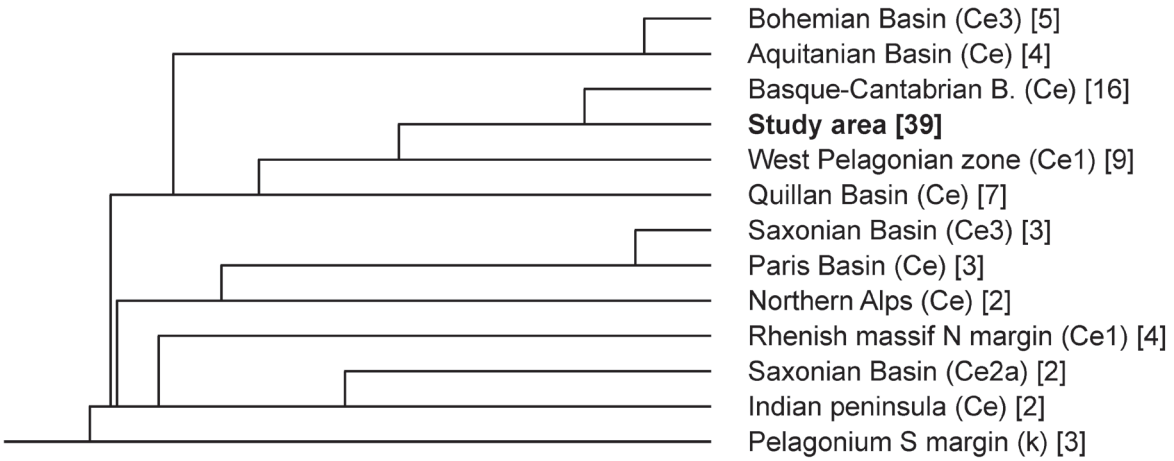

Figure 9. Correlation of the palaeo-provinces with a range in the Cenomanian where species of the studied fauna occur. Only provinces with more than one species were included. The Correlation Ratio coefficient was applied. Abbreviations: Ap, Aptian; Al, Albian; Ce, Cenomanian, Tu, Turonian, Co, Coniacian. Number 1. indicates lower, number 2. indicates middle and number 3. indicates upper. The numbers in brackets are the numbers of joint species. The stratigraphy of the area Pelagonium S margin is uncertain, but also clearly includes Cenomanian corals. The study area is marked in bold letters.

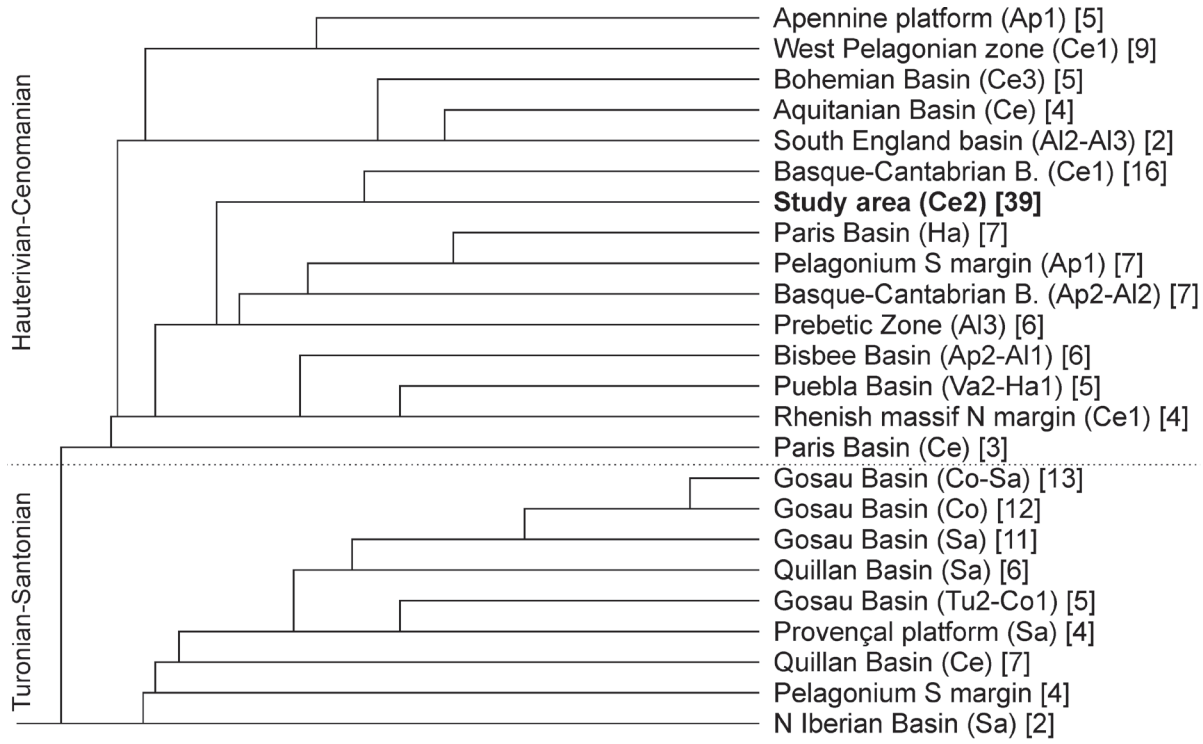

Figure 10. Correlation of the palaeo-provinces where genera of the studied fauna occur. Only provinces with more than two genera were included, and only the time period Hauterivian to Santonian was considered. The Correlation Ratio coefficient was applied. Abbreviations: Va, Valanginian; Ha, Hauterivian; Ap, Aptian; Al, Albian; Ce, Cenomanian, Tu, Turonian, Co, Coniacian; Sa, Santonian. Number 1. indicates lower, number 2. indicates middle and number 3. indicates upper. The numbers in brackets are the numbers of joint genera. The stratigraphy of the area Pelagonium S margin is uncertain. The study area is marked in bold letters. The dotted line separates Hauterivian to Cenomanian and Turonian to Santonian palaeo-provinces (with one exception).

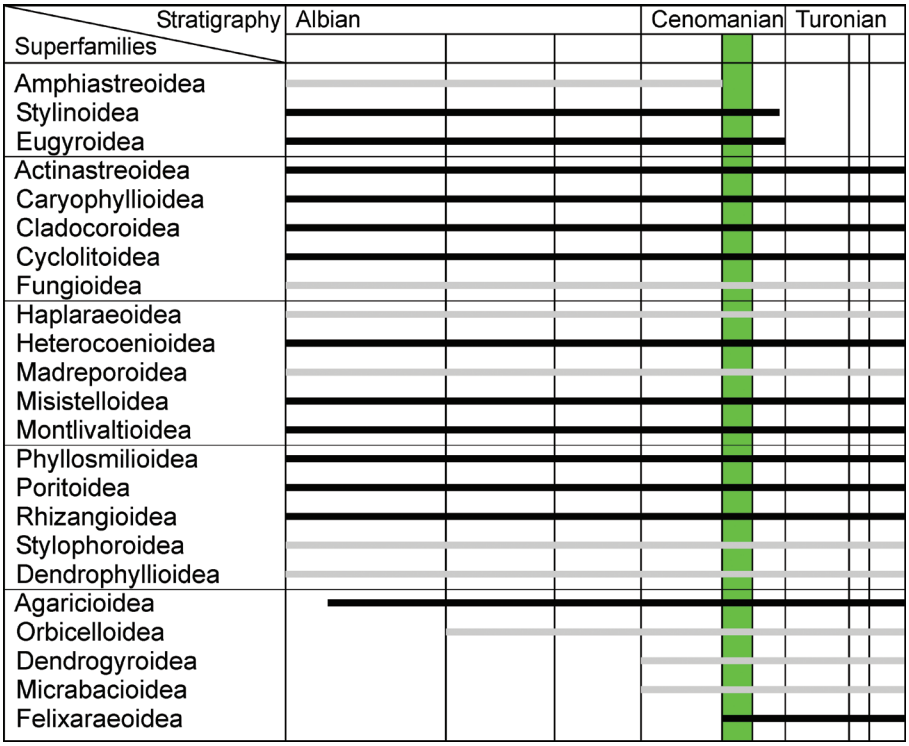

Figure 11. Verified stratigraphic distribution of the superfamilies. The ranges are based on the verified distribution data for the genera, as explained above. Only Albian to Turonian is shown. The vertical green bar marks the age of the studied fauna. All superfamilies are shown, as well as those superfamilies that do not occur in the studied fauna. Superfamilies that do not occur in the study area are shown as light grey bars.

lower or the upper Cenomanian (for example, for the Boreal regions see Löser 1994, for the Western Tethys Löser and Wilmsen 2022, for the Central Tethys Löser and Bilotte 2017, for the Eastern Tethys Löser et al. 2018, and literature cited therein). Shallow marine middle Cenomanian coral faunas are poorly reported. The classical Cenomanian outcrop area near Le Mans (Sarthe, France) can only be assigned to the middle to upper Cenomanian (Morel ed. 2015). Middle to Upper Cenomanian corals are mentioned from the Batna area in Algeria (Vila 1977). Some of these outcrops could be restricted to the middle Cenomanian. Unrevised coral faunas of a lower to middle Cenomanian age are reported from Tournai beds in Hainaut (Belgium; d'Archiac 1847) The Boreal coral fauna of the Meißen Fm (Saxon, Germany) has a lower middle Cenomanian age (Löser 2014b).

The present large coral fauna that can clearly be restricted to the middle Cenomanian is, therefore, an exceptional record. The duration of the lower, middle and upper Cenomanian is too short to allow the recognition of evolutionary changes, but the present fauna links together, even more solidly, the typical upper Lower Cretaceous coral faunas (Barremian to Albian) and the lower Upper Cretaceous (Turonian to Santonian). One reason may be the marly facies; other Cenomanian coral faunas are found in coastal transgressive areas with a considerable siliciclastic input, or in deposits of carbonate ramps. Other Cenomanian coral faunas in a marly facies such as from the study area are hardly known.

With the present study it can be confirmed that the shallow marine coral faunas experienced a transition that already started in the Lower Cretaceous and continued during the Cenomanian. The gap in the fossil coral record during the Turonian is just the lack of shallow marine sediments (and therefore outcrop areas; Löser 2016c, Fig. 6.3.5.3) due to the regression during the Turonian and the subsequent erosion. Coniacian coral faunas differ from Cenomanian faunas which concerns particularly the genus richness of vicariant families. As, for instance, Latomeandridae became reduced in the number of genera, Synastraeidae increased, or Montlivaltiidae were reduced in genera but Phyllosmiliidae were increased (cf. Löser 2016c, Fig. 6.2.2).

Acknowledgements

We are grateful to Erwin Geiss from the Bayerisches Landesamt für Umwelt and Dieter Korn from the Berliner Museum für Naturkunde for providing access to new material from the Roßsteinalmen. Preparation of thin sections by Aimée Orcí (Hermosillo) is kindly acknowledged. English text correction by Matthew Copley (Barcelona). Reviews by Ricardo Garberoglio (Buenos Aires) and Jacob Leloux (Leiden) helped to improve the manuscript.

References

Archiac EJA de (1837) Mémoire de la formation crétacé de Sud-Ouest de la France. Mémoires de la Société géologique de France 2: 157–192.

Archiac EJA de (1847) Rapport sur les fossiles du Tourtia. Mémoires de la Société géologique de France (2), 2, 7: 291–351.

Achiardi A de (1875) Coralli eocenici del Friuli. Parte 3. Atti della Società Toscana di Scienze naturali 1, 3: 147–222.

Achiardi A de (1880) Coralli giurassici dell' Italia settentrionale. Atti della Società Toscana di Scienze naturali 4, 2: 233–310.

Alloiteau J (1941) Révision de collection H.Michelin. Polypiers d'anthozoaires (1:) Crétacé. Mémoires du Muséum National d'Histoire Naturelle (N.S.) 16, 1: 1–100.

Alloiteau J (1946) Paléontologie. In: Hupé P, Alloiteau J (Eds) Polypiers du Gargasien aragonais. Anales de la Escuela de Peritos Agrícolas y de Especialidades Agropecuarias y de los Servicios Técnicos de Agricultura 6: 187–243.

Alloiteau J (1952) Madréporaires post-paléozoïques. In: Piveteau J (Ed.) Traité de Paléontologie (1), Paris, Masson, 539–684.

Alloiteau J (1954a) Sur cinq genres nouveaux de madréporaires post-paléozoïques. Bulletin de la Société géologique de France (6), 3: 873–887. https://doi.org/10.2113/gssgfbull.S6-III.9.873

Alloiteau J (1954b) Le genre Actinastrea d'Orbigny 1848 dans le Crétacé supérieur francais. Annales Hebert et Haug 4, 8: 1–104.

Alloiteau J (1957) Contribution à la systématique des Madréporaires fossiles. Paris, Centre National de la Recherche Scientifique, 2 vols., 462 pp.

Alloiteau J (1958) Nouveaux polypiers du crétacique d'Espagne. Anales de la Escuela Tecnica de Peritos Agrícolas y de Especialidades Agropecuarias y de los Servicios tecnicos de Agricultura 14: 79–108.

Baron-Szabo RC (1997) Die Korallenfazies der ostalpinen Kreide (Helvetikum: Allgäuer Schrattenkalk; Nördliche Kalkalpen: Brandenberger Gosau) Taxonomie, Palökologie. Zitteliana 21: 3–97.

Baron-Szabo RC (2000) Late Campanian-Maastrichtian corals from the United Arab Emirates-Oman border region. Bulletin of the natural History Museum London (Geology) 56, 2: 91–131.

Baron-Szabo RC (2006) Corals of the K/T-boundary: Scleractinian corals of the Suborders Astrocoeniina, Faviina, Rhipidogyrina, and Amphiastraeina. Journal of Systematic Palaeontology 4: 1–108. https://doi.org/10.1017/S1477201905001689

Baron-Szabo RC (2014) Scleractinian Corals from the Cretaceous of the Alps and Northern Dinarides with remarks on related taxa. Abhandlungen der Geologischen Bundesanstalt 68: 1–296.

Baron-Szabo RC, Fernández Mendiola PA (1997) Cretaceous scleractinian corals from the Albian of Cabo de Ajo (Cantabria Province, N-Spain). Paläontologische Zeitschrift 71, 1/2: 35–50. https://doi.org/10.1007/BF03022545

Baron-Szabo RC, Steuber T (1996) Korallen und Rudisten aus dem Apt im tertiären Flysch des Parnass-Gebirges bei Delphi-Arachowa. Berliner geowissenschaftliche Abhandlungen (E) 18: 3–75.

Bataller J (1937) La fauna coral·lina del Cretàcic de Catalunya i regions limítrofes. Arxius de l'escola superior d'agricultura (N.S.) 3, 1: 1–299.

Bataller J (1947) Sinopsis de las especies nuevas del Cretácico de España. Memorias de la Real Academia de Ciencias y Artes de Barcelona (3), 28, 12: 279–392.

Beauvais L (1966) Étude des madréporaires jurassiques du Sahara tunisien. Annales de Paléontologie (Invertébrés) 52, 2: 115–152.

Beauvais L (1976) Madréporaires du Jurassique (1:) Étude morphologique, taxonomique et phylogénétique du sous-ordre Amphiastraeida Alloiteau. Mémoires de la Société géologique de France (n.s.) 55, Mém. 126: 1–42.

Beauvais L, Beauvais M (1975) Une nouvelle famille dans le sous-ordre des Stylinida Alloiteau: les Agatheliidae nov. fam. (Madréporaires mésozoïques). Bulletin de la Société géologique de France (7) 17, 4: 576–581. https://doi.org/10.2113/gssgfbull.S7-XVII.4.576

Beauvais M (1982) Révision Systématique des Madréporaires des couches de Gosau. Paris, Comptoir géologique, 5 vols.

Bilotte M (1985) Le Crétacé supérieur des plates-formes est-pyrénéennes. Strata. Actes du Laboratoire de Géologie Sédimentaire et Paléontologie d l'Université Paul-Sabatier Toulouse (2) 5: 1–438.

Blainville HM (1830) Zoophytes. In: Defrance JLM (Ed.) Dictionnaire des sciences naturelles, Paris, Levrault, 60: 1–548.

Boden K (1935) Die geologische Aufnahme des Roßstein- und Buchstein-Gebietes zwischen Isar und dem Schwarzen-Bach. Abhandlungen der Geologischen Landesuntersuchung am Bayerischen Oberbergamt, 17: 7–42.

Bonilla González OA (2015) Taxonomía y paleoecología de los corales de la Formación Alisitos (Cretácico Inferior), Baja California, México. Tesis de Maestría. Ensenada, CICESE, 1–175 .

Bourne GC (1900) The Anthozoa. In: Lankester R (Ed.) Treatise on Zoology. Part 2: Porifera and Coelenterata, London, A. & C. Black, 59–79.

Bover Arnal T, Löser H, Moreno Bedmar JA, Salas R, Strasser A (2012) Corals on the slope (Aptian, Maestrat Basin, Spain). Cretaceous Research 37: 43–64. https://doi.org/10.1016/j.cretres.2012.03.001

Cottreau J (1935) Types du prodrome de paléontologie stratigraphique universelle (11). Annales de Paléontologie 24: 37–52 (33–48).

Dana JD (1846) Structure and classification of Zoophytes. United States Exploring Expedition during the years 1838, 1839, 1840, 1841, 1842 under the command of Charles Wilkes, U. S. N. Philadelphia, Penn., Lea & Blanchard, 1–132. https://doi.org/10.5962/bhl.title.4789

Dercourt J, Gaetani M, Vrielynck B, Barrier E, Biju-Duval B, Brunet MF, Cadet JP, Crasquin S, Sandulescu M (Eds) (2000) Atlas Peri-Tethys. Palaeogeographical maps. 24 maps and explanatory notes. Paris, CCGM/CGMW, I–XX, 1–269.

Duncan PM (1870) A monograph of the British fossil corals (2, 2:) Corals from the Upper Greensand of Haldon, from the Gault, and the Lower Greensand. Palaeontographical Society monographs 23: 27–46. https://doi.org/10.1080/02693445.1870.12113235

Duncan PM (1873) On the older Tertiary formations of the West-Indian Islands. Quarterly Journal of the Geological Society of London 29: 548–565. https://doi.org/10.1144/GSL.JGS.1873.029.01-02.49

Eguchi M (1948) Fossil Helioporidae from Japan and the South Sea Islands. Journal of Paleontology 22, 3: 362–364.

Eguchi M (1951) Mesozoic hexacorals from Japan. Science Reports of the Tohoku Imperial University (2: Geology) 24: 1–96.

Ehrenberg CG (1834) Beiträge zur physiologischen Kenntnis der Corallenthiere im allgemeinen, und besonderen des rothen Meeres, nebst einem Versuche zur physiologischen Systematik derselben. Abhandlungen der Königlichen Akademie der Wissenschaften (for 1832): 225–380.

Eliášová H (1976) Familles Placosmiliidae Alloiteau, 1952 et Misistellidae nov.fam. (Hexacorallia) des calcaires de Stramberk. Casopis pro Mineralogii a Geologii 21, 4: 337–347.

Eliášová H (1989) Genres nouveaux des Scléractiniaires du Crétacé de la Bohême (Tchécoslovaquie). Casopis pro Mineralogii a Geologii 34, 2: 113–121.

Eliášová H (1992) Archaeocoeniina, Stylinina, Astraeoina, Meandriina et Siderastraeidae (Scléractiniaires) du Crétacé de Bohême (Cénomanien supérieur-Turonien inférieur; Turonien supérieur, Tchécoslovaquie). Vestnik Ustredního ústavu geologického 67, 6: 399–414.

Eliášová H (1995) Famille nouvelle des Scléractiniaires du Crétacé supérieur de Bohême (Cénomanien supérieur - Turonien inférieur, République tchèque). Vestník Ceského geologického ústavu 70, 3: 27–34.

Eliášová H (1997) Coraux pas encore décrits ou redécrits du Crétacé supérieur de Bohême. Vestník Ceského geologického ústavu 72, 1: 61–80.

Etallon A (1859) Études paléontologiques sur le Haut-Jura. Rayonnés du Corallien. Mémoires de la Société d'émulation du département du Doubs (3), 3: 401–553.

Etallon A (1864) Classe des Polypes. In: Thurmann J, Etallon A (Eds) Lethaea bruntrutana. Études paléontologiques et stratigraphiques sur le Jura bernois et en particulier sur les environs de Porrentruy (3), Neue Denkschriften der allgemeinen schweizerischen Gesellschaft für die gesammten Naturwissenschaften 20: 357–412.

Faupl P, Wagreich (2000) Late Jurassic to Eocene palaeogeography and geodynamic evolution of the Eastern Alps. Mitteilungen der Österreichischen Geologischen Gesellschaft 92: 79–94.

Felix J (1891) Versteinerungen aus der mexicanischen Jura und Kreideformation. In: Felix J, Lenk H (Eds) Beiträge zur Geologie und Paläontologie der Republik Mexico (3), Palaeontographica 37: 140–194.

Felix J (1900) Über die Gruppe der Montlivaltiaceae. Sitzungsberichte der Naturforschenden Gesellschaft zu Leipzig (February, 6 1900): 20–24. https://doi.org/10.5962/bhl.title.137932

Felix J (1903a) Verkieselte Korallen als Geschiebe im Diluvium von Schlesien und Maehren. Zentralblatt für Mineralogie, Geologie und Paläontologie (for 1903): 561–577.

Felix J (1903b) Studien über die korallenführenden Schichten der oberen Kreideformation in den Alpen und den Mediterrangebieten (1) Die Anthozoën der Gosauschichten in den Ostalpen. Palaeontographica 49: 163–360.

Felix J (1909) Beiträge zur Kenntnis der Korallenfauna des Syrischen Cenoman. Beiträge zur Paläontologie und Geologie Österreich-Ungarns und des Orients 22: 169–175.

Fromentel E de (1857) Description des polypiers fossiles de l'étage Néocomien. Bulletin de la société des sciences historiques et naturelles de l'Yonne 1–78.

Fromentel E de (1861) Introduction à l'étude des polypiers fossiles. Mémoires de la Société d'émulation du Doubs (3) 5: 357 pp.

Fromentel E de (1862a) Zoophytes, terrain crétacé (2). Paléontologie française (A.d'Orbigny ed.) 8: 48–96.

Fromentel E de (1862b) Zoophytes, terrain crétacé (3). Paléontologie française (A.d'Orbigny ed.) 8: 97–144.

Fromentel E de (1863a) Zoophytes, terrain crétacé (5). Paléontologie française (A.d'Orbigny ed.) 8: 193–240.

Fromentel E de (1863b) Zoophytes, terrain crétacé (6). Paléontologie française (A.d'Orbigny ed.) 8: 241–288.

Fromentel E de (1877) Zoophytes, terrain crétacé (10). Paléontologie française (A.d'Orbigny ed.) 8: 433–480.

Fromentel E de (1887) Zoophytes, terrain crétacé (16). Paléontologie française (A.d'Orbigny ed.) 8: 609–624.

Gaupp RH (1980) Sedimentpetrographische und stratigraphische Untersuchungen in den oberostalpinen Mittelkreide-Serien des Westteils der Nördlichen Kalkalpen. Dissertation, Technische Universität München, 282 pp.

Gaupp RH (1982) Sedimentationsgeschichte und Paläotektonik der Kalkalpinen Mittelkreide (Allgäu, Tirol, Vorarlberg). Zitteliana 8: 33–72.

Goldfuss A (1826) Petrefacta Germaniae (1,1). Düsseldorf, Arnz, I–VIII, 1–76.

Goldfuss A (1829) Petrefacta Germaniae (1,2). Düsseldorf, Arnz, 77–164.

Gray JE (1842) Pocilloporidae. Synopsis of the Contents of the British Museum 44th edition, London, 1–308.

Gray JE (1847) An outline of an arrangement of the stony corals. Annals and Magazine of natural History 19: 120–128. https://doi.org/10.1080/037454809496460

Gregory JW (1900) Polytremacis and the ancestry of Helioporidae. Proceedings of the Royal Society of London 66: 291–305. https://doi.org/10.1098/rspl.1899.0104

Gregory JW (1932) Eomontipora - a new coral from the Cretaceous of Honduras and the affinities of the Montiporidae. Annals and Magazine of natural History (10) 7: 91–96. https://doi.org/10.1080/00222933108673283

Hackemesser M (1936) Eine kretazische Korallenfauna aus Mittel-Griechenland und ihre paläobiologischen Beziehungen. Palaeontographica (A) 84: 1–97.

Haeckel E (1866) Generelle Morphologie der Organismen. Allgemeine Grundzüge der organischen Formen-Wissenschaft, mechanisch begründet durch die von Charles Darwin reformirte Descendenztheorie. Berlin, D.Reimer, 2 vols. https://doi.org/10.5962/bhl.title.3953

Haq BU (2014) Cretaceous eustacy revisited. Global and Planetary Change 113: 44–58. https://doi.org/10.1016/j.gloplacha.2013.12.007

Hernández Morales H, Löser H (2018) Revision of the family Helioporidae (Coenothecalia, Anthozoa; Cretaceous - Extant). Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen 287, 3: 351–363. https://doi.org/10.1127/njgpa/2018/0722

International Commission on Zoological Nomenclature (1999) International code of zoological nomenclature. http://www.iczn.org/iczn/index.jsp.

Johnson KG (2007) Reef-coral diversity in the Late Oligocene Antigua Formation and temporal variation of local diversity on Caribbean Cenozoic Reefs. In: Hubmann B, Piller WE (Eds) Fossil corals and sponges., Schriftenreihe der Erdwissenschaftlichen Kommissionen der Österreichischen Akademie der Wissenschaften 17: 471–491.

Koby F (1884) Monographie des polypiers jurassiques de la Suisse (4). Abhandlungen der Schweizerischen Paläontologischen Gesellschaft 11: 149–212.

Koby F (1889) Monographie des polypiers jurassiques de la Suisse (9). Abhandlungen der Schweizerischen Paläontologischen Gesellschaft 16: 457–586.

Koby F (1898) Monographie des polypiers crétacés de la Suisse (3). Abhandlungen der Schweizerischen Paläontologischen Gesellschaft 24: 63–100.

Kuhn W (1991) Klastische Sedimente der Unteren und Mittleren Kreide westlich der Isar. In: K Doben, Erläuterungen zur Geologischen Karte von Bayern 1:25000, Blatt 8335 Lenggries. München, Bayerisches Geologisches Landesamt, 28–34.

Lamarck JBP de (1816) Histoire naturelle des animaux sans vertèbres (2). Paris, Verdière, 1–568.

Lamouroux JVF (1812) Extrait d'un mémoire sur la classification des polypiers coralligènes non entierement pierreux. Nouveau bulletin des sciences 3, 63: 181–188.

Liao Wei-hua, Xia Jin-bao (1994) Mesozoic and Cenozoic scleractinian corals from Tibet. Palaeontologia Sinica (Zhongguo-gushengwu-zhi) 184 [= B 31]: 1–252.

Löser H (1987) Zwei neue Gattungen der Korallen aus der Sächsischen und Böhmischen Oberkreide. Vestnik Ustredního ústavu geologického 62, 4: 233–237.

Löser H (1989) Die Korallen der sächsischen Oberkreide (1:) Hexacorallia aus dem Cenoman. Abhandlungen des Staatlichen Museums für Mineralogie und Geologie zu Dresden 36: 88–154, 183–186, 209–215.

Löser H (1994) La faune corallienne du mont Kassenberg à Mülheim-sur-la-Ruhr (Bassin crétacé de Westphalie, Nord Ouest de l'Allemagne). Coral Research Bulletin 3: 1–93.

Löser H (2000) Upper Cretaceous corals from the Ptoon Mountains (Central Greece). Abhandlungen und Berichte für Naturkunde und Vorgeschichte 21: 49–61.

Löser H (2002) [et al.] List of Citations. Catalogue of Cretaceous Corals 2: 1–784.

Löser H (2004) PaleoTax - a database program for palaeontological data. Computer & Geosciences 30, 5: 513–521. https://doi.org/10.1016/j.cageo.2004.03.009

Löser H (2005) [et al.] List of Localities. Catalogue of Cretaceous Corals 3: 1–366.

Löser H (2008) Early Cretaceous coral faunas from East Africa (Tanzania, Kenya; Late Valanginian-Aptian) and revision of the Dietrich collection (Berlin, Germany). Palaeontographica 285, 1/3: 23–75. https://doi.org/10.1127/pala/285/2008/23

Löser H (2010) The Barremian coral fauna of the Serre de Bleyton mountain range (Drôme, France). Annalen des Naturhistorischen Museums in Wien 112: 575–612.

Löser H (2012a) Campanian corals from Bayburt (Turkey). Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen 264, 1: 20–29. https://doi.org/10.1127/0077-7749/2012/0229

Löser H (2012b) Intraspecific variation in the genus Stelidioseris (family Actinastraeidae, suborder Archeocaeniina, order Scleractinia; Jurassic-Cretaceous). Geologica Belgica 15, 4: 382–387.

Löser H (2013a) An Early Albian shallow marine coral fauna from Southern France – insight into evolution and palaeobiogeography of Cretaceous corals. Palaeobiodiversity and Palaeoenvironments 93, 1: 1–43. https://doi.org/10.1007/s12549-012-0088-2

Löser H (2013b) Revision of the Hauterivian (Early Cretaceous) corals of the Paris Basin, France: a work in progress. Bulletin d'information des géologues du Bassin de Paris 50, 1: 17–24.

Löser H (2013c) Revision of the family Felixaraeidae (Scleractinia; Cretaceous). Geodiversitas 35, 4: 775–793. https://doi.org/10.5252/g2013n4a1

Löser H, García-Barrera P, Mendoza Rosales CC, Ortega-Hernández J (2013b) Corals from the Early Cretaceous (Barremian - Early Albian) of Puebla (Mexico) - Introduction and family Stylinidae. Revista mexicana de ciencias geológicas 30, 2: 385–403.

Löser H (2014a) Revision of the family Agatheliidae (Scleractinia; Cretaceous). Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen 273, 3: 299–318. https://doi.org/10.1127/0077-7749/2014/0432

Löser H (2014b) 3. Korallen / 3. Corals. In: Niebuhr B, Wilmsen M (Eds) Kreide-Fossilien in Sachsen, Teil 1, Geologica Saxonica 60, 1: 17–56.

Löser H (2015a) Les coraux. In: Morel N (Ed.) Stratotype Cénomanien., Paris, Muséum national d'Histoire naturelle, 280–282.

Löser H (2015b) Die Gattung Moltkia (Gorgonacea, Cnidaria) in der Sächsischen Oberkreide (Deutschland). Geologica Saxonica 60, 3: 427–434.

Löser H (2015c) The Cretaceous corals from the Bisbee Group (Sonora; Late Barremian-Early Albian): Solenocoeniidae. Paleontología mexicana 4, 2: 13–24.

Löser H (2016a) Early evolution of the coral family Siderastraeidae (Scleractinia). Paläontologische Zeitschrift 90, 1: 1–17. https://doi.org/10.1007/s12542-016-0292-x

Löser H (2016b) Taxonomy and distribution of the Cretaceous coral genus Eosiderastrea. Carnets de Géologie 16, 16: 383–416. https://doi.org/10.4267/2042/60677

Löser H (2016c) Systematic part. Catalogue of Cretaceous Corals 4: 1–710, 1763 figs.

Löser H (2022) A new coral family and three new genera (Scleractinia) from the Lower Cretaceous of Puebla and Sonora, Mexico. Revista mexicana de ciencias geológicas 39, 3: 220–229. https://doi.org/10.22201/cgeo.20072902e.2022.3.1698

Löser H, Arias C, Vilas L (2015) Aptian-Albian coral faunas from the Sierra del Carche (Prebetic, Murcia, Southern Spain). Spanish Journal of Palaeontology 30, 1: 43–63. https://doi.org/10.7203/sjp.30.1.17201

Löser H, Arias C, Vilas L (2019) Upper Valanginian to Lower Hauterivian coral faunas from the Sierra Larga (Prebetic zone, SE Spain). Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen 292, 3: 259–290. https://doi.org/10.1127/njgpa/2019/0820

Löser H, Bilotte M (2017) Taxonomy of a platy coral association from the Late Cenomanian of the southern Corbières (Aude, France). Annales de Paléontologie 103: 3–17. https://doi.org/10.1016/j.annpal.2016.10.005

Löser H, Callapez PM (2022) Upper Cenomanian and lower Turonian (Cretaceous) corals from the Tethyan West Portuguese Carbonate Platform. Journal of Iberian Geology 48, 2: 141–162. https://doi.org/10.1007/s41513-022-00186-3

Löser H, Castro JM, Nieto LM (2013a) Late Albian Scleractinian corals from the Prebetic Zone (SE Spain). Palaeontographica 301, 1/2: 1–62. https://doi.org/10.1127/pala/301/2013/1

Löser H, Fernández Mendiola PA, Pérez-Malo J, Domínguez Pascual S, Cahuzac B (2021a) Redefinition of the family Rhizangiidae (Scleractinia; Cretaceous to Recent) and description of a new genus from the Early Cretaceous of Spain. Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen 299, 3: 259–274. https://doi.org/10.1127/njgpa/2021/0968

Löser H, Ferry S (2006) Coraux du Barrémien du Sud de la France (Ardèche et Drôme). Geobios 39, 4: 469–489. https://doi.org/10.1016/j.geobios.2005.03.005

Löser H, Heinrich M (2018) New coral genera and species from the Rußbach/Gosau area (Late Cretaceous; Austria). Palaeodiversity 11: 127–149. https://doi.org/10.18476/pale.11.a7

Löser H, Heinrich M, Schuster U (2019) Korallen von Rußbach und Gosau (Coniac-Santon; Österreich). Dresden, CPress Verlag, VI, 1–367.

Löser H, Mendicoa J, Fernández Mendiola PA (2020) Early Aptian corals from Peñascal (Bilbao; N Spain). Spanish Journal of Palaeontology 35, 2: 209–228. https://doi.org/10.7203/sjp.35.2.18484

Löser H, Minor K (2007) Palaeobiogeographic aspects of Late Barremian to Late Albian coral faunas from Northern Mexico (Sonora) and the southern USA (Arizona, Texas). Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen 245, 2: 193–218. https://doi.org/10.1127/0077-7749/2007/0245-0193

Löser H, Mohanti M (2004) A Cenomanian coral assemblage from southern India. Neues Jahrbuch für Geologie und Paläontologie, Monatshefte 10: 577–594. https://doi.org/10.1127/njgpm/2004/2004/577

Löser H, Nieto LM, Castro JM, Reolid M (2021b) A Lower Valanginian coral fauna from the South Iberian Palaeomargin (Internal Prebetic, SE Spain). Palaeontologia Electronica 24, 1: 1–57. https://doi.org/10.26879/1030

Löser H, Steuber T, Löser C (2018) Early Cenomanian coral faunas from Nea Nikopoli (Kozani, Greece; Cretaceous). Carnets de Géologie / Notebooks on Geology 18, 3: 23–121. https://doi.org/10.4267/2042/66094

Löser H, Werner W, Darga R (2013c) A Middle Cenomanian coral fauna from the Northern Calcareous Alps (Bavaria, Southern Germany) – new insights into the evolution of Mid-Cretaceous corals. Zitteliana A53: 37–76.

Löser H, Wilmsen M (2022) Lower Cenomanian (Cretaceous) corals from Cóbreces (Cantabria, northern Spain). Part I: superfamilies Actinastreoidea, Amphiastreoidea, Caryophyllioidea. Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen 303, 2: 203–218. https://doi.org/10.1127/njgpa/2022/1043

Löser H, Wilmsen M (2023) Lower Cenomanian (Cretaceous) corals from Cóbreces (Cantabria, northern Spain). Part 2: family Latomeandridae. Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen 307, 3: 277–304. https://doi.org/10.1127/njgpa/2023/1127

Löser H, Zell P (2015) Revision of the family Columastraeidae (Scleractinia; Cretaceous). Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen 277, 2: 153–166. https://doi.org/10.1127/0077-7749/2008/0250-0045

Löser H, Zell P (2016) Late Aptian corals from the South Iberian Sub-Basin (Cretaceous; Eastern Spain). Revista de la Sociedad Geológica de España 29, 1: 3–20.

Mantell G (1822) The fossils of the South Downs; or illustrations of the geology of Sussex. London, L. Relfe, 1–327. https://doi.org/10.5962/bhl.title.44924

Matthews SC (1973) Notes on open nomenclature and on synonymy lists. Palaeontology 16, 4: 713–719.

McFadden CS, Ofwegen LP van, Quattrini AM (2022) Revisionary systematics of Octocorallia (Cnidaria: Anthozoa) guided by phylogenomics. Bulletin of the Society of Systematic Biologists 1, 3, 8735: 1–79. https://doi.org/10.18061/bssb.v1i3.8735

Melnikova GK, Roniewicz E, Löser H (1993) New microsolenid coral genus Eocomoseris (Scleractinia, Early Lias-Cenomanian). Annales Societatis Geologorum Poloniae 63: 3–12.

Michelin H (1841) Iconographie zoophytologique. Description par localités et terrains des polypiers fossiles de France (1). Paris, Bertrand, 1–40. https://doi.org/10.5962/bhl.title.11504

Michelin H (1846) Iconographie zoophytologique. Description par localités et terrains des polypiers fossiles de France (6). Paris, Bertrand, 185–248.

Michelin H (1847) Iconographie zoophytologique. Description par localités et terrains des polypiers fossiles de France (7). Paris, Bertrand, 249–328.

Milne Edwards H (1860) Histoire naturelle des coralliaires ou polypes proprement dits (3, Atlas). Paris, Librairie encyclopédique de Roret, 1–560.

Milne Edwards H, Haime J (1848a) Observations sur les polypiers de la famille des astréides. Comptes rendus hebdomadaires des séances de l'Académie des Sciences 27, 19: 465–469.

Milne Edwards H, Haime J (1848b) Note sur la classification de la deuxième tribu de la famille des astréides. Comptes rendus hebdomadaires des séances de l'Académie des Sciences 27, 20: 490–497.

Milne Edwards H, Haime J (1848c) Recherches sur les polypiers (4:) Monographie des Astréides (1:) Eusmiliens. Annales de Sciences naturelles (3) 10: 209–320.

Milne Edwards H, Haime J (1849) Mémoire sur les polypiers appartenant à la famille des oculinides, au groupe intermédiaire des Pseudoastréides et à la famille des Fongides. Comptes rendus hebdomadaires des séances de l'Académie des Sciences 29, 4: 67–73.

Milne Edwards H, Haime J (1851) A monograph of the British fossil corals (2:) Corals from the oolitic formations. Palaeontographical Society monographs 5: 74–146. https://doi.org/10.1080/02693445.1851.12113202

Morel N (Ed.) (2015) Stratotype Cénomanien. Paris, Muséum national d'Histoire naturelle, 1–384.

Morrow AL (1934) Foraminifera and Ostracoda from the Upper Cretaceous of Kansas. Journal of Paleontology 8, 2: 186–205.

Morycowa E (1964) Hexacoralla des couches de Grodziszcze (Néocomien Carpathes). Acta Palaeontologica Polonica 9, 1: 1–114.

Morycowa E (1971) Hexacorallia et Octocorallia du Crétacé inférieur de Rarau (Carpathes orientales roumaines). Acta Palaeontologica Polonica 16, 1/2: 1–149.

Moseley HN (1876) On the structure and relations of the alcyonarian Heliopora coerulea, with some account of the anatomy of a species of Sarcophyton; notes on the structure of species of the genera Millepora, Pocillopora, and Stylaster, and remarks on the structure of certain Palaeozoic corals. Philosophical Transactions of the Royal Society of London 156: 91–129. https://doi.org/10.1098/rstl.1876.0004

Ogilvie MM (1897) Die Korallen der Stramberger Schichten. Palaeontographica (suppl.2) 7: 74–282.

Oppenheim LP (1930) Die Anthozoen der Gosauschichten in den Ostalpen. Berlin, privately published, 1–604.

Orbigny A de (1849) Note sur les polypiers fossiles. Paris, Masson, 1–12.

Orbigny A de (1850) Prodrôme de Paléontologie stratigraphique universelle des animaux mollusques et rayonnés (1–2). Paris, Masson, 1–394, 1–428.

Orbigny A de (1851) Cours élémentaire de Paléontologie (3:) Polypiers ou Zoophytes. Paris, Masson, 2: 151–189.

Pallas PS (1766) Elenchus Zoophytorum sistens generum adumbrationes generaliores et specierum cognitarum succinctas descriptiones cum selectis auctorium synonymis. Haag, P.van Cleef, 1–451. https://doi.org/10.5962/bhl.title.6595

Pfiffner OA (2010) Geologie der Alpen. 2.edit. Bern-Stuttgart-Wien, Haupt, 360 pp.

Prever PL (1909) Anthozoa. In: Parona CF (Ed.) La fauna coralligena del Cretaceo dei Monti d'Ocre nell'Abruzzo Aquilano., Memorie descrittive della carta geologica d'Italia 5, 1: 51–147.

Reig Oriol J (1989) Sobre varios géneros y especies de escleractinias fósiles del Cretácico Catalán. Barcelona, privately published, 1–69.

Reig Oriol J (1992) Madreporarios cretácicos de España y Francia. Barcelona, privately published, 1–48.

Remeš M (1898) O zkamenelinách bludných balvanu z okolí Príbora. Vestnik Klubu prirodovedeckéko v Prostejove 1, 4: 5–10.

Reolid M, Molina JM, Löser H, Navarro V, Ruiz-Ortiz PA (2009) Coral biostromes of the Middle Jurassic from the Subbetic (Betic Cordillera, Southern Spain): facies, coral taxonomy, taphonomy and palaeoecology. Facies 55, 4: 575–593. https://doi.org/10.1007/s10347-009-0187-3

Reuss AE (1846) Die Versteinerungen der böhmischen Kreideformation (2). Stuttgart, Schweizerbart, 1–148.

Reuss AE (1854) Beiträge zur Charakteristik der Kreideschichten in den Ostalpen, besonders im Gosauthale und am Wolfgangsee. Denkschriften der Kaiserlichen Akademie der Wissenschaften, Mathematisch-Physikalische Classe 7: 1–157.

Reyeros Navarro MM (1963) Corales del Cretacico inferior de San Juan Raya, Estado de Puebla. Paleontología mexicana 17: 1–21.

Roemer F (1862) Über die Diluvialgeschiebe von Norddeutschen Sedimentärgesteinen. Zeitschrift der Deutschen Geologischen Gesellschaft 14: 575–637.

Roniewicz E (2008) Kimmeridgian-Valanginian reef corals from the Moesian platform from Bulgaria. Annales Societatis Geologorum Poloniae 78, 2: 91–134.

Roniewicz E (2011) Early Norian (Triassic) corals from the Northern Calcareous Alps, Austria, and the intra-Norian faunal turnover. Acta Palaeontologica Polonica 56, 2: 401–428. https://doi.org/10.4202/app.2009.0092

Samaniego-Pesqueira A, Löser H, Moreno Bedmar JA (2023) Middle Albian corals from the Espinazo del Diablo Formation (Cretaceous; Lampazos area, Sonora, Mexico). Bulletin of Geosciences 98, 2: 111–159. https://doi.org/10.3140/bull.geosci.1872

Schlagintweit F, Wagreich M (2005) Micropaleontology of "Orbitolina Beds" of Lower Austria (Branderfleck Formation, Lower Cenomanian). Jahrbuch der Geologischen Bundesanstalt 145, 1: 115–125.

Schroeder R, Neumann M (Eds) (1985) Les grands Foraminifères du Crétacé Moyen de la Région Méditerranénne. Geobios. Mémoire Spécial 7: 1–161.

Sowerby J (1832) [Corals]. In: Sedgwick A, Murchison RI (Eds) A Sketch of the Structure of the Eastern Alps; with Sections through the Newer Formations on the Northern Flanks of the Chain, and through the Tertiary deposits of Styria., Transactions of the Geological Society of London (2) 3, 2: 301–420. https://doi.org/10.1144/transgslb.3.2.301

Steenstrup J (1847) (On corals in the Cretaceous of Faxe.) Amtlicher Bericht der Versammlung deutscher Naturforscher und Ärzte in Kiel 24: 148–150.

Steinberg V (1980) Geologische Kartierung im Roß- und Buchstein-Schönberg-Gebiet, Bayer. Alpen, unter besonderer Berücksichtigung der Mikrofazies und Feinstratigraphie des Jura und der Kreide. Diplomarbeit, Institut für Paläontologie und historische Geologie der Ludwig-Maximilians-Universität München, 140 p.

Steinmann G, Döderlein L (1890) Elemente der Paläontologie. Leipzig, C.H.Reclam, 1–848.

Stoliczka F (1873) The corals or Anthozoa from the Cretaceous rocks of South India. Memoirs of the Geological Survey of India, Palaeontologia Indica (4) 8, 4/5: 130–202.

Söhle U (1897) Geologische Aufnahme des Labergebirges bei Oberammergau mit besonderer Berücksichtigung des Cenomans in den Bayerischen Alpen. Geognostische Jahreshefte 9: 1–66.

Thomas HD (1935) Jurassic corals and hydrozoa, together with a re-description of Astrea caryophylloides Goldfuss. In: The geology and palaeontology of British Somaliland, (2: The Mesozoic palaeontology of British Somaliland)., London, Government of the Somaliland Protectorate, 3: 23–39.

Toula F (1882) Grundlinien der Geologie des Westlichen Balkan. Denkschriften der Kaiserlichen Akademie der Wissenschaften, Mathematisch-Physikalische Klasse 44, 2: 1–58.

Toula F (1884) Geologische Untersuchungen im westlichen Theile des Balkans und in den angrenzenden Gebiete (10:) Von Pirot nach Sofia auf den Vitos, über Pernik nach Trn und über Stol nach Pirot. Sitzungsberichte der Mathematisch-Naturwissenschaftliche Classe der Kaiserlichen Akademie der Wissenschaften (1), 88: 1279–1348.

Trauth F (1911) Die oberkretazische Korallenfauna von Klogsdorf in Mähren. Zeitschrift des Mährischen Landesmuseums 11: 1–105.

Turnšek D, Buser S (1974) Spodnjekredne korale, hidrozoji in hetetide z Banjske Planote in Trnovskega Gozda. Razprave Slovenska akademija znanosti in umetnosti (4) 17, 2: 81–124.

Turnšek D, Mihajlovic M (1981) Lower Cretaceous Cnidarians from eastern Serbia. Razprave Slovenska akademija znanosti in umetnosti (4) 23, 1: 1–54.

Vaughan TW (1899) Some Cretaceous and Eocene corals from Jamaica. Bulletin of the Museum of Comparative Zoology 34, 1: 227–250.

Vaughan TW (1905) A critical review of the literature of the simple genera of Fungida, with a tentative classification. Proceedings of the United States National Museum 28, 1401: 371–424. https://doi.org/10.5479/si.00963801.1401.371

Vaughan TW, Wells JW (1943) Revision of the suborders, families and genera of Scleractinia. Special Papers. Geological Society of America 44: 1–363. https://doi.org/10.1130/SPE44-p1

Vidal LM (1921) Contribución a la Paleontología del Cretácico de Cataluña. Memorias de la Real Academia de Ciencias y Artes de Barcelona (3), 17, 2: 89–107.

Vila J-M (1977) Notice de la carte géologique au 1/50.000 Ain Yagout. Service la Carte géologique de l'Algérie et Sonatrach.

Weidich KF (1984a) Stratigraphie der Branderfleck-Schichten (Untercenoman - Untercampan) in den Bayerischen Kalkalpen. Schriftenreihe der Erdwissenschaftlichen Kommissionen 7: 221–261.

Weidich KF (1984b) Feinstratigraphie, Taxonomie planktonischer Foraminiferen und Palökologie der Foraminiferengesamtfauna der kalkalpinen tieferen Oberkreide (Untercenoman – Untercampan) der Bayerischen Alpen. Abhandlungen Bayerische Akademie der Wissenschaften, Mathematisch-naturwissenschaftliche Klasse, neue Folge 162: 1–151.

Wells JW (1932) Corals of the Trinity Group of the Commanchean of central Texas. Journal of Paleontology 6, 3: 225–256.

Wells JW (1944) A new coral from the Buda Limestone (Cenomanian) of Texas. Journal of Paleontology 18: 100.

Wells JW (1956) Scleractinia. In: Moore RC (Ed.) Treatise on Invertebrate Paleontology, University Press of Kansas, F: 328–444.

Zuffardi-Comerci R (1921) Coelenterati del Neo-Cretacico della Tripolitania. Memorie descrittive della carta geologica d'Italia 8, 1: 1–23.

Zuffardi-Comerci R (1930) Sulle Faune del sopracretacico in Puglia con particolare riguardo a quella di S.Cesarea. Bollettino del R.Ufficio Geologico d'Italia 55, 7: 1–35.