Atlas of benthic foraminifera from coral reefs of the Raja Ampat Archipelago (Irian Jaya, Indonesia)

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ABSTRACT: Raja Ampat (Indonesia) is a remote archipelago west of Papua mainland and situated at the eastern edge of the Coral Triangle. The archipelago is considered one of the species-richest and most pristine localities and home to the world's most diverse coral reefs. For centuries, reefs of Raja Ampat have enjoyed natural protection and remained largely untouched due to their isolated location. The region represents a key area for evaluating richness and biogeographic patterns of tropical shallow-water organisms, yet the foraminiferal fauna of Raja Ampat is virtually unexplored.

Benthic foraminifera are an integral part of the reef fauna, prolific carbonate producers and essential for reefal accretion and substrate stability. Previous studies on Indo-Pacific benthic reef foraminifera indicate that diversity is highest in the Central Indo-Pacific and broadly correlates with diversity patterns of other tropical marine taxa.

This report presents the first illustrated catalog and comprehensive analysis of the structure, composition, and diversity of the species-rich benthic foraminiferal biotas of the Raja Ampat Archipelago including an assessment of local reef vitality with the Foraminifera in Reef Assessment and Monitoring (FoRAM) Index. We examined shallow-water sediment samples from fringing reefs, reef platforms, sheltered bays and reef-associated environments to cover the full range of existing micro- and macrohabitats. A total number of 421 species were recovered, among them five new species and one newly described genus of the porcelaneous Miliolida. The fauna is dominated by hyaline taxa but the Miliolida represent the species-richest order and are especially diverse in fine-grained sediments of deep fore-reef slopes. Extraordinary high diversity of the benthic foraminiferal communities indicates that the waters of Raja Ampat probably represent one of the world's biologically richest locations in reefs. We identified a total of 35 species of larger symbiont-bearing benthic foraminifera, a number that is among the highest reported so far for reefs in modern oceans. The analysis of the FoRAM Index revealed that water quality at all sites examined is suitable for reef growth and recovery. The results of our study show that the Raja Ampat Archipelago harbors unique and particularly diverse assemblages of modern benthic foraminifera and provides a protistan perspective for the hotspot of diversity in the Central Indo-Pacific.

INTRODUCTION

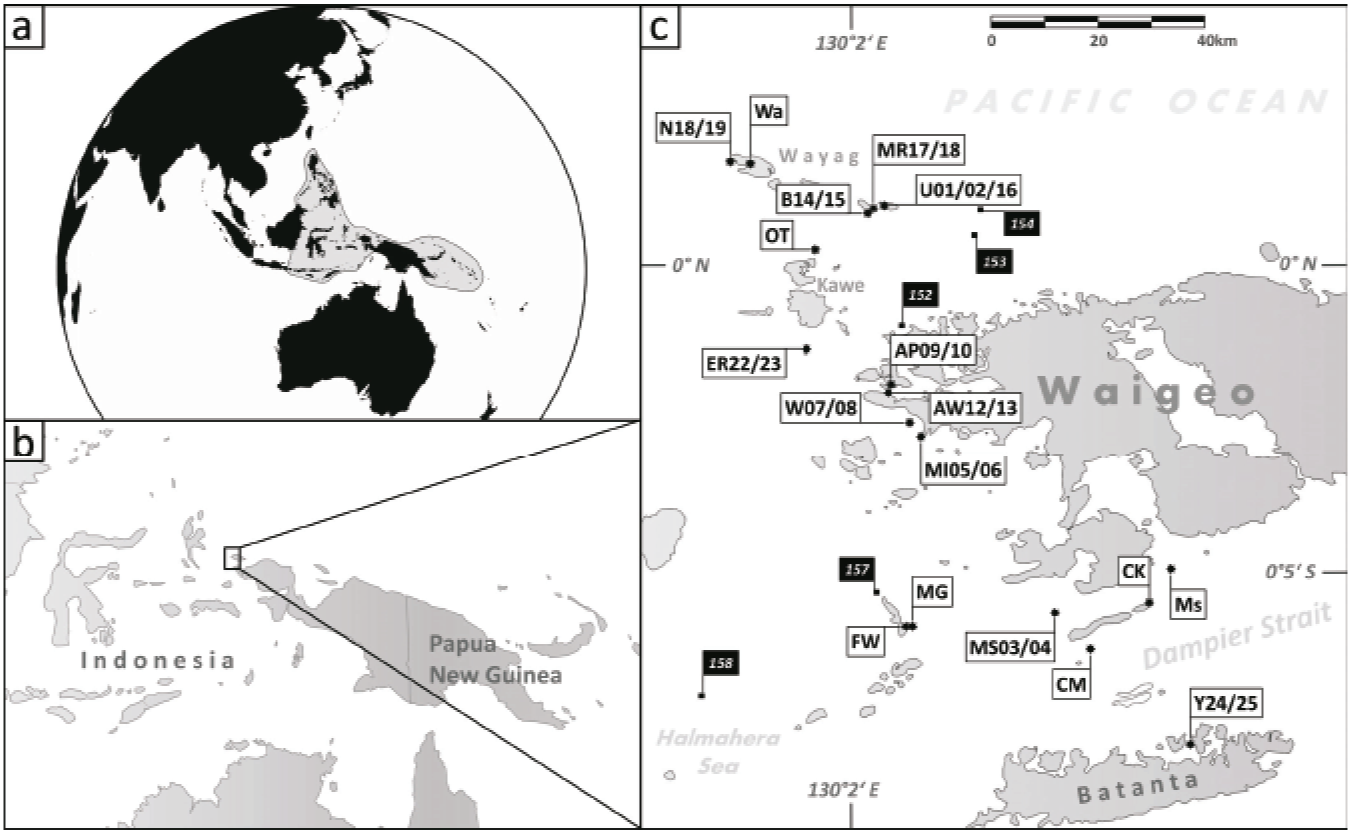
Since the early 1800s, the islands of the Raja Ampat Archipelago (Irian Jaya, Indonesia) have attracted the attention of naturalists and scientific expeditions including Alfred Russel Wallace, who is credited as the first to identify the Malay Archipelago as a center of biodiversity (Palomares and Heymans 2006). Raja Ampat is considered one of the most species-rich localities located within the heart of the most diverse tropical marine region, the Coral Triangle (e.g. McKenna, Allen and Suryadi 2002; Erdmann and Pet 2002; Veron et al. 2015). The archipelago's reefs are among the most pristine in the East Indies (McKenna, Allen and Suryadi 2002; Turak and Souhoka 2003) and characterized by extremely heterogeneous habitat typologies. As such they represent a cross-section miniature of the wide array of reef environments of the entire Malay Archipelago (Allen 2002), a biogeographic area that differs substantially from adjacent seascapes and ecoregions (DeVantier, Turak and Allen 2009).

To date, 566 species of scleractinian corals, representing 68.2% of the global total and 74.8% of the Indo-Pacific coral fauna, are known from the Raja Ampat Archipelago (Veron et al. 2016). Most of the coral species are widespread in the area and several taxonomic groups (e.g. corals, fish, clams etc.) apparently have panmictic populations (DeVantier, Turak and Allen 2009).

The reef fish fauna of Raja Ampat is one of the most species-rich of the world (at least 1,074 species) with a notable level of endemism and is strongly linked to habitat typologies (Allen 2002; Allen and Erdmann 2009).

Benthic foraminifera are a prominent faunal element of tropical shallow-water reefs all around the globe. They are vital producers of calcium carbonate and contribute substantially to reefal accretion and substrate stability (Langer, Silk and Lipps 1997; Langer 2008; Hohenegger 2006; Fujita et al. 2016; Thissen and Langer 2017). To date, a wealth of studies on foraminiferal biotas from the tropical Indo-Pacific Ocean has been published, yet the foraminiferal fauna of the remote region of Raja Ampat has remained largely unexplored.

Large-scale studies on benthic foraminifera from the Central Indo-Pacific region began with the rise of scientific marine explorations in the mid to late 1800s that focused on oceanography and deep-sea research (tab. 1). Among the early expeditions that crossed the Indonesian waters were the circumnavigating voyages of the British HMS *Challenger* (1872–76) and the German SMS *Gazelle* (1874–76). Even earlier, the Dutch *Cachelot* (1858) sampled in the Banda Sea, leading to the publication of Harting (1864) who examined the microscopical fauna of five deep-sea samples and reported 7 species of foraminifera (plank-



TEXT-FIGURE 1
Position of Raja Ampat in the Indo-Pacific Ocean and location of sampling sites. a. The Coral Triangle biodiversity hotspot (grey); b. Regional setting of the research area; c. Map of the sampling area with sample sites around the islands of Waigeo and Batanta. Numbers on black background indicate sites previously studied by Hofker (1927, 1930, 1951; see also table 1).

tonic and benthic). Brady (1884) recorded almost 1,000 species from the entire cruise of the *Challenger* expedition, representing the first comprehensive study on modern benthic foraminifera. Sampling, however, neither included material from the Raja Ampat Archipelago nor the Bird's Head Seascape of Papua. Yet, one sediment sample taken by the SMS *Gazelle* originated from shallow waters (3–55m) in the southern part of the archipelago. It was examined by Egger (1893), who reported 12 species of benthic foraminifera. Three of them are also reported in this study (tab. 2).

The Dutch *Siboga* expedition (1899–1900) also sampled around Raja Ampat from which Hofker (1927, 1930, 1951) documented 13 species of benthic foraminifera, of which seven also occur in the material of this study (tab. 2). Five of his sample stations are located close to the study sites examined here (text-fig. 1).

Several calcarinid species described and reported by d'Orbigny (1826) may have come from Raja Ampat. However, the given locality name "Rawack" may be synonymous with "Ravak", which refers to Rauki (Silva, Basson and Moe 1996), a district at the northern coast of the main island Waigeo.

Comprehensive research studies on benthic foraminifera in the region were later conducted by Millett (1898–1904) who studied bottom deposits of Durrand from the shallow waters of the southern Malay Archipelago. Unfortunately, several of the sample labels became illegible and their exact location remains uncertain. Around the same time, the American USS *Albatross* steamer investigated reef formations and islands in the Southern Pacific Ocean (1899–1900) but did not enter the Central Indo-Pacific. The material was later examined by Cushman (1932, 1933, 1942) and Todd (1965). Cushman (1921) also studied material of several hundred samples of the *Albatross* expedition (1907–10) collected around the Philippines and adjacent seas. Later cruises of the Dutch *Snellius* I and II (1929–30 and 1984–85) examined deeper waters in eastern Indonesia, and the foraminiferal material was examined by Hofker (1978) and van Marle (1988).

Since the second half of the 20th century, large-scale systematic surveys were conducted by Hada (1943) on shallow water sediment samples from the Java Sea, on diverse material from the Philippines (Graham and Militante 1959), the Papuan Lagoon near Port Moresby, Papua New Guinea (Haig 1988a, 1988b, 1993), the Great Barrier Reef (Collins 1958), shallow-water sediments of the South China Sea (Cheng and Zheng 1978; Zheng 1979, 1980), the warm-water fauna of the Ryukyu Islands in southern Japan (Hatta and Ujiié 1992), atolls and bays of the Solomon Islands (Hughes 1977, 1985), and extensive shallow and deep-sea deposits from the Timor Sea and Sahul Shelf (Loeblich and Tappan 1994). More recently, Langer and Lipps (2003) investigated the distribution and diversity of

TEXT-FIGURE 2
Landscape views of the sample localities show steep limestone walls and small, mushroom-shaped islets at Wayag surrounded by narrow fringing reefs and shallow sandy channels.

foraminifera from the Madang Lagoon, eastern Papua New Guinea and identified indicator species for reef, lagoon and nearshore environments. Langer (1992) also recorded two new genera and eight new species of smaller benthic taxa. Other studies from Madang included the analyses of the oxygen and carbon isotopic composition and the concentration of manganese (Mn II) in tests of larger symbiont-bearing foraminifera (Langer and Gehring 1994; Langer 1995). In 2009, Parker published a detailed taxonomic study on benthic foraminifera from the Ningaloo Reef off Western Australia. The foraminiferal fauna of the Chuuk Lagoon of the Caroline Islands was studied by Makled and Langer (2011). New Caledonia was extensively sampled over decades by Debenay and colleagues and resulted in the identification of an extraordinarily high number of more than 1,000 species, published in a catalog in 2012 (Debenay 2012). Environmental and biogeographic studies on larger symbiont-bearing benthic foraminifera in the tropical waters of the central Indo-Pacific were conducted by Langer and Hottinger (2000), Renema (2003, 2006a, 2006b, 2008, 2010), Renema and Troelstra (2001), Renema and Hohenegger (2005), Hohenegger (e.g. 2004, 2011), Weinmann et al. (2013a), and Prazeres, Uthicke and Pandolfi (2016).

Here we present the first illustrated catalog and comprehensive analysis of the species-rich benthic foraminiferal communities of the remote and pristine coral reefs of the Raja Ampat Archipelago. The foraminiferal fauna was analyzed at species-level. We quantified the number of species, the percent abundance, frequency and correlation of occurrence of individual taxa, determined the diversity and the structure of the assemblages, their preservation state and their relation to depth. In addition, this survey led to the description of five new species and a new genus that were previously published by Förderer and Langer (2016).

One focus of the faunal analyses is on symbiont-bearing larger benthic foraminifera (LBF) that dominate foraminiferal assemblages in tropical coral reefs (Hohenegger 2011; Langer and Hottinger 2000; Lipps and Stanley 2016a). Scleractinian corals and LBF show highly similar diversity patterns (Belasky 1996; Langer and Hottinger 2000; Förderer, Rödder and Langer 2018). Both taxa house photosymbionts and their shared environmental requirements make LBF an ideal tool as indicator taxa for reef monitoring. Coral reefs are threatened worldwide by global climate change and local perturbations (Burke et al. 2012; Spalding and Brown 2015; Lipps and Stanley 2016b). This includes the Raja Ampat Archipelago where most reefs were considered to be in excellent or good conditions in 2002, but 84.5% of them display signs of stress and damage (McKenna, Bolis and Allen 2002). Deterioration in water quality, extensive logging activities, and destructive fishing practices are on the rise (McKenna, Allen and Suryadi 2002; McKenna, Bolis and Allen 2002; Erdmann and Pet 2002; Turak and Souhoka 2003; Agostini et al. 2012). We applied the Foraminifera in Reef Assessment and Monitoring (FoRAM) Index (FI) as introduced by Hallock et al. (2003). The FI is a simple and effective measure that establishes whether water quality is suitable for reef growth or recovery, and is dependent on the relative abundance of LBF in the sediments.

Our study on the local fauna advances the knowledge on central Indo-Pacific benthic foraminiferal communities and contributes to the assessment of global diversity and biogeographic analyses. Examination of modern distribution patterns and community structure of tropical shallow-water benthic foraminifera also helps to interpret the fossil record by providing essential paleoenvironmental information on fossil reef and shelf deposits.

TABLE 1
Previous studies in Indonesian and adjacent seas. Chart showing a chronologically sorted selection of previous studies on benthic foraminifera (numbers usually include some planktonic species) from the Indonesian waters and adjacent diverse ecoregions. Note that the number of species refers to the information provided by the authors without being taxonomically revised. Circumnavigating voyages are not included.

Year	Author	Region	No. of samples	Depth (m)	No. of species
1898-1904	Millett	Malay Archipelago	31	22-26	> 200
1921	Cushman	Philippines (*Albatross*)	~600	~50-1,829	654
1927/30/51	Hofker	Eastern Indonesia (*Siboga*)	n/a	n/a	194
1943	Hada	Java Sea	31	21-153	43
1958	Collins	Great Barrier Reef	59	0-51	391
1959	Graham & Militante	Puerto Galera, Philippines	60	0-37	264
1968	Hofker	Bay of Jakarta	18	n/a	36
1977	Hughes	Honiara Bay, Solomon Islands	21	0-72	171
1985	Hughes	Otong Java, Solomon Islands	5	31-38	56
1978	Hofker	Eastern Indonesia (*Snellius* I)	78	85-5,138	462
1978/79	Cheng & Zheng/Zheng	Xisha Islands, South China Sea	59	≤ 50	410
1988a, b/93	Haig	Papuan Lagoon, PNG	125	0-53	161
1988	van Marle	Eastern Indonesia (*Snellius* II)	35	60-2,119	164
1992a, b	Hatta & Ujiié	Ryukyu Islands, Japan	62	3-350	139
1993	Langer & Lipps	Madang, Papua New Guinea	57	1-52	182
1994	Loeblich & Tappan	Sahul Shelf & Timor Sea	378	0-3,199	946
1997	Haig	Exmouth Gulf, West-Australia	68	5-30	236
2009	Parker	Ningaloo Reef, West-Australia	334	0-34	404
2011	Makled & Langer	Chuuk Lagoon, Carolines	5	18-34	104
2012	Debenay	New Caledonia	> 800	1-700	1,043

REGIONAL SETTING

Geographical setting and geological background

The Raja Ampat Archipelago is situated at the northwestern tip of Papua's Bird's Head Peninsula between latitude 0°20' North and 2°15' South, and longitude 129°35' and 131°20' East (text-fig. 1). It stretches approximately 280 km in north-south and 230 km in an east-west direction. The area (40,000 km²) comprises the four main islands Waigeo, Batanta, Salawati and Misool, and more than 600 of associated islets and reefs (McKenna, Allen and Suryadi 2002; Erdmann and Pet 2002). Steep limestone karst walls characterize the northern and southern part of the archipelago (Agostini et al. 2012). The coastal karst walls are elevated between 2 and 100 m, with a 20 percent gradient to steep slopes (Firman and Azhar 2006). The northern islands of Waigeo and Batanta rise up to 600 and 1,000 m and are densely covered with tropical rain-forest (McKenna, Allen and Suryadi 2002).

The islands of the archipelago are extensively surrounded by fringing and patch/platform reefs (McKenna, Allen and Suryadi 2002; Firman and Azhar 2006; DeVantier, Turak and Allen 2009). Based on oceanographic, bathymetric and physico-chemical parameters, as well as coral and reef fish habitats and communities DeVantier, Turak and Allen (2009) delineated 14 coral reefscapes comprising 75 reef habitats that showed moderate to high ecological similarity and biological connectivity. Small-scale differences in oceanographic parameters, predominantly the exposure to wave energy, are the major underlying drivers for coral species composition and differences in reef community structure (Turak and Souhoka 2003; DeVantier, Turak and Allen 2009). Type of substrate (i.e. karst vs. non-karst) represents a further key factor for coral community structure (DeVantier, Turak and Allen 2009). Regarding reef topology, habitat and community types of Raja Ampat are rather unusual and often without any predictable zonation that coral communities typically display (Turak and Souhoka 2003). Nearby habitats are occasionally strikingly different (DeVantier, Turak and Allen 2009) and thriving coral reefs and mangroves even mix in several areas (Turak and Souhoka 2003, and personal observation).

The geological history of the Raja Ampat Archipelago is highly complex and to date not fully resolved. According to Hall (2002) and Hill and Hall (2003), Waigeo, Batanta and the nearby Moluccan Halmahera Island were part of the southwestern margin of the Caroline Plate during the Eocene and then continuously shifted westwards to their modern-day position (Polhemus 2007). Today, the islands of the archipelago are situated on two different continental shelves with the southern part (Misool and Salawati) being separated from the northern part by a narrow strait south of the island of Batanta (Erdmann and Pet 2002). As Waigeo and Batanta joined the archipelago relatively recently (within the last 2 million years), the terrestrial fauna of these two islands reveals a high number of endemic species (Webb 2005).

Climate and oceanography

Raja Ampat is subjected to alternating northwest (November to March) and southeast (May to October) monsoon seasons which

TABLE 2
Sites and species of foraminifera listed in early studies from the Raja Ampat area. The table lists all taxa recorded by Egger (1893) from the *Gazelle* expedition and by Hofker (1927, 1930, 1951) from the *Siboga* material collected in the northern part of the Raja Ampat Archipelago. Taxa co-occurring in this study are indicated. Note that species names have been synonymized as follows: *Baculogypsina tetraedra* (Gümbel) = *Baculogypsinoides spinosus* (Yabe and Hanzawa); *Heterostegina suborbicularis* d'Orbigny = *Heterostegina depressa* d'Orbigny; *Siphonina reticulata* (Czjzek) = *Siphonina tubulosa* Cushman (same species as noted by Hofker 1951). The Peneroplidae are not listed as single species because Hofker (1930) considered all species of *Peneroplis* and *Dendritina* as varieties of *Peneroplis pertusus* (Forskål). *Siboga* stations 152, 153, 154, 157, and 158 are close to the sites sampled in this study as indicated in text-figure 1c.

	Station	Depth (m)	Latitude	Longitude	*Amphistegina radiata* (Fichtel & Moll)	*Baculogypsinoides spinosus* Yabe & Hanzawa	*Cycloclypeus carpenteri* Brady	*Heterostegina depressa* d'Orbigny	Peneroplidae	*Neorotalia calcar* (d'Orbigny)	*Siphogenerina columellaris* (Brady)	*Bolivina compacta* Sidebottom	*Reussella weberi* Hofker	*Siphonina tubulosa* Cushman	*Miniacina miniacea* (Pallas)	*Homotrema rubrum* (Lamarck)	*Elphidium craticulatum* (Fichtel & Moll)	*Quinqueloculina oblonga* (Montagu)	*Triloculina tricarinata* d'Orbigny	*Quinqueloculina cuvieriana* d'Orbigny	*Eggerelloides scaber* (Williamson)	*Bulimina aculeata* d'Orbigny	*Bolivina dilatata* Reuss	*Parabrizalina porrecta* (Brady)	*Discorbis rosacea* (d'Orbigny)	*Spirillina vivipara* Ehrenberg	*Lobatula lobatula* (Walker & Jacob)	*Turborotalia humilis* (Brady)	*Lamarckina scabra* (Brady)
Egger (1893)	104a	3-55	-1.766667°	131.083333°														x	x	x	x	x	x	x	x	x	x	x	x
Hofker (1927, 1930, 1951)	152	32	-0.090100°	130.282700°			x																						
	153	141	0.052222°	130.400833°											x														
	154	83	0.117228°	130.418061°	x		x				x				x														
	157	45	-0.535833°	130.235000°											x														
	158	391	-0.718056°	129.934722°												x													
	159	411	-0.983333°	129.800000°										x															
	160	31	-1.140194°	129.863322°				x																					
	164	32	-1.701389°	130.784722°	x	x			x	x		x	x				x												
	Recorded also in the present study				✓	✓		✓	✓	✓				✓			✓		✓							✓	✓		

are separated by short transition periods. During the northwest monsoon, sea surface temperatures (SSTs) are higher and winds are sometimes strong, whereas during the southeast monsoon SSTs are lower and winds are persistent (Mangubhai et al. 2012). The archipelago is located in the north of the Bird's Head seascape were ocean swelling is particularly strong during the northwest monsoon. In general, SSTs are relatively stable throughout the year with an average of 29°C (Mangubhai et al. 2012). Sea surface temperature drops around 0.05°C per meter water depth (Firman and Azhar 2006). Salinity of sea surface waters in open water conditions ranges between 30–35‰. In 10 m depth, it is slightly higher and ranges between 32–35‰. Salinity is also higher (32–35‰) in the waters around northern Waigeo due to the influence of the Pacific Ocean. The pH in the waters around Raja Ampat on average is 8.08 near the surface and 8.06 in 10 m depth. Dissolved oxygen varies between 4.0 and 10.5mg/l on the surface and between 4.3 and 10.5mg/l at 10 m depth (Firman and Azhar 2006). Precipitation is lower in the northern part of the archipelago (1,500 mm/year in Waigeo, highest from April to September) than on the southern islands and on the mainland of New Guinea (between 1,500 to 3,000 mm/year on the mainland; Webb 2005).

Ocean current system

Raja Ampat is bound by the tropical Western Pacific to the East and the North, and the Halmahera Sea to the West and the South. The archipelago is situated in the passage way of the Indonesian Throughflow (ITF), an important part of the global thermohaline circulation. The ITF provides a powerful inter-ocean exchange by transporting warm water from the western Pacific to the Indian Ocean while meandering its way through the Malay Archipelago. The total average volume of the ITF water masses transported into the Indian Ocean is about 15 Sv (Sverdrup; 1 Sv = 10^6 m^3 s^{-1}; Sprintall et al. 2014). Two retroflections, the Mindanao and the Halmahera eddy are drawing the water masses from the Pacific into the Malay Archipelago. The primary passage of the ITF is the Makassar Strait between Kalimantan and Sulawesi. This inflow originates from the Mindanao retroflection and mainly transports North Pacific water. Predominantly shallower South Pacific water is drawn southwards by the Halmahera retroflection into the Halmahera Sea. Due to the highly convoluted coastlines and complex seascape, the exact flow pattern around the Bird's Head Seascape including the Raja Ampat Archipelago is still not fully understood (Sprintall et al. 2014). The local sea surface currents are primarily tidally-induced and mainly southwards oriented with an average current velocity of 0.11m/sec. Tides are of a mixed, predominantly semidiurnal type with a tidal range of 1.15 to 1.8 m (Firman and Azhar 2006). Currents can be very strong and variable, especially through the larger straits, and they cause local upwelling; during the year seasonal reversals occur. Ocean swell was measured highest at the northern coasts of Waigeo with about 1.7 meters wave height. In sheltered bays and along southward coastlines, waves are commonly less than 1 m high (Firman and Azhar 2006). The north-facing coasts are relatively exposed to wave energy and differ from the more sheltered south-facing coasts and the very sheltered inlets. These unique and complex oceanographic conditions are considered driving factors that distinguish Raja Ampat from adjacent seascapes and ecoregions (DeVantier, Turak and Allen 2009).

TABLE 3
Sample site and sediment type information. Table listing sample sites, identifier used in this study, depth, site coordinates, and sediment character. Superscripted numbers are added for sediments where the carbonate content was determined using the Scheibler method. Carbonate content: [1] = 92.42%, [2] = 91.36%, [3] = 96.11%, [4] = 94.81%, [5] = 87.16%. In some of the finer sediments, coarse reef rubble is present (marked with an asterisk). All samples were collected by M. Langer in September 2011.

Sample	Sample identifier	Depth (m)	Latitude	Longitude	Sediment character
Aljui Pearl Farm 09	AP09	8	-0.188800°	130.257050°	medium[1]
Aljui Pearl Farm 10	AP10	17	-0.188800°	130.257050°	medium
Aljui Wall 12	AW12	48	-0.205667°	130.255550°	fine*
Aljui Wall 13	AW13	27	-0.205667°	130.255550°	fine[2]
Bag Island Y-Reef 14	B14	41	0.089555°	130.226468°	fine
Bag Island Y-Reef 15	B15	43	0.089555°	130.226468°	fine*
Cape Kree	CK	38	-0.556517°	130.690283°	fine*
Cape Mansuar	CM	36	-0.622669°	130.603683°	medium
Eagle Rock 22	ER22	24	-0.136983°	130.123600°	medium
Eagle Rock 23	ER23	24	-0.136983°	130.123600°	fine*
Fam Wall	FW	49	-0.588850°	130.295983°	fine
Magic Rock 17	MR17	12	0.096758°	130.236017°	medium
Magic Rock 18	MR18	18	0.096758°	130.236017°	very fine
Manare Island 05	MI05	32	-0.273853°	130.316442°	medium
Manare Island 06	MI06	32	-0.273853°	130.316442°	fine
Manta Sandy 03	MS03	16	-0.579967°	130.542233°	very fine
Manta Sandy 04	MS04	14	-0.579967°	130.542233°	coarse
Melissa Garden	MG	18	-0.589833°	130.315150°	fine
Mioskon Island	Ms	27	-0.497333°	130.727117°	fine
No 8 Island 18	N18	30	0.172983°	130.006217°	very fine
No 8 Island 19	N19	30	0.172983°	130.006217°	medium
One Tree Island	OT	26	0.027767°	130.143250°	medium
Uranie Island 01	U01	26	0.104117°	130.250044°	coarse
Uranie Island 02	U02	25	0.104117°	130.250044°	coarse
Uranie Island 16	U16	45	0.096981°	130.233078°	very fine[3]
Wayag	Wa	1	0.167642°	130.050047°	coarse[4]
Wofoh Island 07	W07	24	-0.256033°	130.292267°	medium[5]
Wofoh Island 08	W08	31	-0.256033°	130.292267°	medium
Yun Island 24	Y24	26	-0.785733°	130.757117°	fine
Yun Island 25	Y25	26	-0.785733°	130.757117°	medium

MATERIAL AND METHODS

Sample collection and preparation

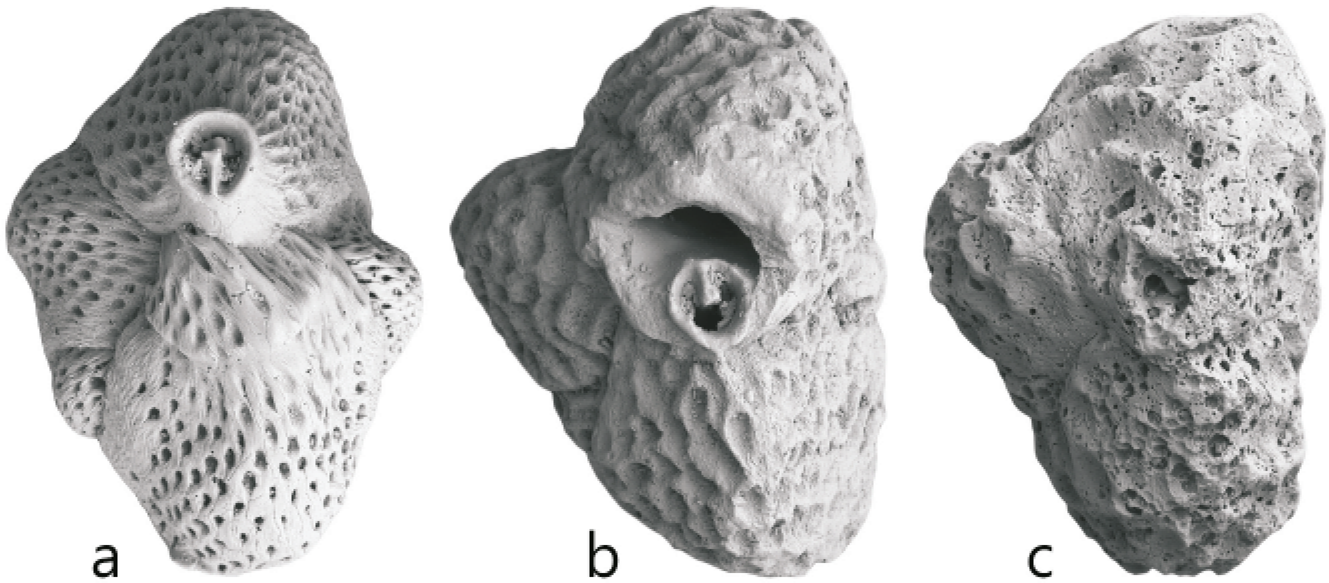
The sample material was collected in the northern part of the Raja Ampat Archipelago by M. Langer in September 2011. Eighteen different locations were sampled around the islands of Waigeo, Batanta, Kawe, Fam and adjacent small islets in an area that covers about 2,500 km² (text-fig. 1). The samples were taken from reef and nearshore environments that include patch/platform reefs, sandy channels with sparse coral cover, and the fore-reef slopes of fringing reefs. A total of 30 sediment surface samples were collected by snorkeling and scuba diving at depths between 1 and 49 m. The top 2 cm of sediment were scooped with plastic cups from small sand patches in coral reef formations or from the bottom layer of sandy channels. The samples were then air-dried on site. After being transferred to the laboratories of the Steinmann Institute in Bonn, all samples were wet-sieved with freshwater using a 63 µm mesh sieve and dried at 50°C in an oven. The sediments are predominantly carbonaceous (92% $CaCO_3$ in average; tab. 3) as determined by the Scheibler method (Hoffmann 1991).

Sample sites

The samples sites examined (tab. 3) are situated in five different reef scapes as delineated by DeVantier, Turak and Allen (2009).

Wayag reef scape (samples Wa, N18, N19, B14, B15, MR17, MR18, U01, U02, U16)

Ten samples were collected from Wayag (Wa), Number 8 Island (N), Bag (B) and Uranie (U) in the Wayag Islands group, that is known for its picturesque landscape with steep limestone walls and small, mushroom-shaped islets (text-fig. 2). Habitat variability is huge and includes mangrove stands, exposed drop-offs, and highly sheltered reefs (McKenna, Allen and Suryadi 2002). Submerged patch reefs, many inlets, channels,



TEXT-FIGURE 3
Example for test preservation categories. Specimens of *Quinqueloculina philippinensis* illustrating the three preservation categories: a) intact, b) medium damaged/abraded, c) heavily damaged/abraded.

and undercuts with clear water and healthy corals were reported by DeVantier, Turak and Allen (2009).

Kawe reef scape (samples OT, ER22, ER23)

Three samples have been collected from low island fringing reefs at the small rocky islets One Tree (OT) and Eagle Rock (ER) around the island of Kawe that is located south of Wayag.

Waigeo West reef scape (samples AW12, AW13, AP09, AP10, W07, W08, MI05, MI06)

Four samples were taken from reefs in the Aljui Bay in the northwestern part of the main island of Waigeo. Aljui Bay is a large bay subjected to strong currents with an oyster pearl farm at one side (AP) and a steep reef wall on the opposite side (AW). Western Waigeo south of Aljui Bay has a semi-protected coastline with fringing reefs in clear water (Veron et al. 2009). One of the surveyed sites is Wofoh Island (W) where two samples were collected. This site represents a fringing reef with undercut limestone around an island (McKenna, Bolis and Allen 2002) with sheltered as well as very exposed sectors. Fenner (2002) listed this site as the second richest coral site surveyed in Raja Ampat with more than 100 stony coral species. McKenna, Bolis and Allen (2002) found that the reef around Wofoh Island shows one of the best reef conditions of all sites examined. Wofoh Island is part of the West Waigeo Marine Protected Area (MPA). Two more samples were taken from a reef close to Manare Island (MI), which is also part of the West Waigeo MPA.

Dampier Strait reef scape (samples CK, CM, MS03, MS04, Ms, FW, MG)

The Dampier Strait has extensive fringing and patch reefs that are subject to frequent upwelling and strong currents (Mangubhai et al. 2012). Sightings of manta rays, cetaceans and dugongs are common and crocodile populations occur at several sites (Mangubhai et al. 2012). One sample was taken at Mioskon Island (Ms), a platform reef exposed to moderate wave energy (McKenna, Bolis and Allen 2002). Mioskon is listed among the ten richest coral, mollusk, and reef fish sites (Fenner 2002; Wells 2002; Allen 2002). South of Mioskon lays Kri Island, where one sample was taken at the eastern tip at Cape Kri (CK). The site is a fringing reef in very good condition characterized by slight turbidity and exposure to occasional strong currents (McKenna, Bolis and Allen 2002; DeVantier, Turak and Allen 2009). Cape Kri had the highest number of reef fishes (283 species) ever recorded on a single dive (Allen 2002). This site is listed among the three richest coral sites (Fenner 2002) and the twelve richest mollusk sites (Wells 2002) surveyed in Raja Ampat.

One sample was taken from Cape Mansoer (CM), south of the island of Mansoer. The area is characterized by its deltaic reef patches with healthy corals in clear water (DeVantier, Turak and Allen 2009). Two samples were taken from Manta Sandy (MS), a sand channel located between south Waigeo and Mansoer Island with offshore reef patches (DeVantier, Turak and Allen 2009) known as a popular manta ray "cleaning station".

Two samples (FW, MG) were collected from reef sites at the northernmost island of the Fam Islands group in the western part of the Dampier Strait reef scape. The islands have steep karst walls surrounded by narrow fringing reefs (DeVantier, Turak and Allen 2009) and are situated in clear water and rich in marine life (McKenna, Allen and Suryadi 2002). According to McKenna, Bolis and Allen (2002), local reefs show one of the best reef conditions of all sites examined. One of the sampled sites, Melissa Garden (MG), is a sheltered fringing reef known for its exceptional coral diversity (Veron 2002; McKenna, Bolis and Allen 2002).

Batanta reef scape (samples Y24, Y25)

Batanta's northern coast faces the Dampier Strait and is characterized by its highly convoluted coastline with numerous inlets and sheltered habitats (DeVantier, Turak and Allen 2009). Here, two samples were taken from a reef site around Yun Island (Y).

Data compilation

A total number of 11,494 specimens of foraminifera were picked from the 30 samples using a standard binocular microscope at the Steinmann Institute of the University of Bonn. Between 243 and 822 benthic specimens were picked for identification from each sample, and the best-preserved specimens of each species were imaged using a Tescan VEGA MV2300 scanning electron microscope after gold sputtering with a Cressington 108 Auto Sputter Coater. Scanning electron and light microscopic images of the foraminiferal fauna are illustrated on 51 plates. Digital plates were assembled using Adobe Photoshop CS6 (Pls. 1–51). Micro-computer tomography scan imaging using a phoenix v|tome|x s computed tomography system at the Steinmann Institute was used to reveal the internal structure of the genus *Dentoplanispirinella* that has been described and published separately (Förderer and Langer 2016). Visualization was carried out with Avizo 7.1.0. Species were identified using comprehensive standard works of benthic foraminifera from the Indo-Pacific realm and a large number of additional references (see systematic section). All benthic foraminifera were identified to species level wherever possible and individuals were counted. A total number of 421 species of benthic foraminifera belonging to 159 genera, 70 families, and 10 orders were identified with 129 species listed under open nomenclature (app. 1; see also Systematics and Taxonomy). Among the 421 species identified, 16 taxa were recovered through selective picking after counting was completed. The material is deposited in the micropaleontological collection at the Steinmann Institute of the University of Bonn.

Analyses of foraminiferal assemblages

The numerical analyses of foraminiferal biotas are based on the total (live plus dead) assemblages and represent time-averaged data. Time-averaged faunal accumulations tend to reflect dominant, long-term environmental conditions, eliminate short-term fluctuations (Martin 2000) and are useful in paleoenvironmental studies (Glenn-Sullivan and Evans 2001). All statistics and analyses were either computed with PAST: Paleontological Statistics software package for education and data analysis, ver. 3.18 (Hammer, Harper and Ryan 2001) or Microsoft Excel.

Species richness and diversity

The number of species was recorded for each sample. Species diversity was determined with Fisher's alpha (α or S_{Fisher}), Shannon's H (or *H'*) and Equitability (*J*). The logarithmic series model of Fisher, Corbet and Williams (1943) mathematically describes the relationship between the number of species and the total number of individual specimens and assumes that species abundance follows a log distribution. The Shannon H diversity index takes into account the number of individuals and the number of species. It varies from 0 for assemblages that contain a single species to higher values for species-rich assemblages. Equitability or evenness measures how equally distributed the individuals in the community are among the species. The value ranges between 0 and 1, with a value of 1 meaning complete evenness.

Fauna composition and structure

The relative abundances of the three different wall types agglutinated (subclass Textulariia), porcelaneous (order Miliolida), and hyaline (orders Buliminida, Rotaliida, Spirillinida, Lagenida, and Robertinida) was recorded and plotted into a ternary diagram for wall type composition, as introduced by Murray (1973). This method has been widely applied in foraminiferal studies to differentiate major shallow-water environments and to compare the structure of foraminiferal biotas from different habitat typologies.

To analyze the structure and composition of foraminiferal assemblages the relative abundances (RA) and frequency of occurrence (FO) of the different orders, genera, and species were recorded and calculated. The RA was calculated as $RA = n*(100/T)$, where n is the number of individuals of a taxon and T is the number of all benthic foraminiferal specimens in the sample. For determining the distribution of each taxon, the FO was calculated as $FO = p*(100/P)$, where p is the number of samples containing the taxon and P is the total number of samples.

The relative abundances of symbiont-bearing larger benthic foraminifera (LBF) at individual localities were examined. The species abundances and distributions of the most important LBF families, the Amphisteginidae and the Calcarinidae, are investigated and addressed in more detail.

Cluster and correlation analyses

In the present material, a minority of species is present in large numbers but the majority of species are represented by low abundance values. Thus, prior to Q-mode and R-mode cluster analyses, the species abundance dataset was converted using a logarithmical transformation. Log transformation is recommended in these cases, as the difference between 0 and 1, i.e. presence or absence of a taxon is more important than minor numerical differences in dominant taxa (Parker and Arnold 1999). The transformation puts more weight on the smaller numbers. To run a log transformation, a constant small value of 0.1 was added as a substitute for each 0 entry in the data set.

Hierarchical clustering was performed using the Euclidean distance measure and Ward's Method. Cluster analysis is a multivariate data exploration technique to divide entities (taxa, samples) into "natural" clusters based on their similarity/distance. Q-mode cluster analysis was performed for revealing similarities among samples and to identify distinct habitats. For this analysis, species with less than 3 occurrences have been omitted. R-mode cluster analysis was performed for revealing affinities or co-occurrences of taxa; for reasons of clarity, only the 35 most abundant (15 genera and 20 species) were included in this analysis. Additionally, correlation (rank Spearman or Spearman's r_s) of the 29 most abundant species (RA > 0.5%) plus the recently described smaller miliolid genus and species *Dentoplanispirinella occulta* was calculated (representing altogether 65.5% of the total counted specimens). The possible range for r_s is from -1 for the strongest negative correlation to +1 for the strongest positive correlation between variables. The values of Spearman's r_s are interpreted as follows: r_s 0.00–0.19 = very weak, r_s 0.20–0.39 = weak, r_s 0.40–0.59 = moderate, r_s 0.60–0.79 = strong, and r_s 0.80–1.0 = very strong monotonic relationship among variables.

Test preservation state

An index for test preservation state was established to assess potential reworking and transport of individuals. The reef habitats in the Raja Ampat Archipelago are mainly current-dependent and many of them are subject to strong wave action. These circumstances may cause transport and reworking of foraminiferan tests as indicated by a high proportion of broken/abraded tests (Murray 1994; Weinmann and Langer 2017). The preservation status can thus be used as an indicator for water energy and environmental conditions (Yordanova and Hohenegger 2002). Three different categories were established for test preservation: (1) "Intact" = specimens that show no obvious abrasion or damage; (2) "Medium damaged/abraded" = around 25% of the test is damaged/lacking, easy to identify; (3) "Heavily damaged/abraded" = more than 25% of the test is damaged/lacking, at times hard to identify on species level (text-fig. 3). However, slight damage affecting tests for Category 1 might not be recognizable under the binocular dissection microscope.

Reef assessment

To assess the status and environmental conditions of reefal sites at Raja Ampat, the Foraminifera in Reef Assessment and Monitoring (FoRAM) Index (FI) was calculated (Hallock et al. 2003). Three functional groups of foraminifera are considered in the calculations: 1) Mixotrophic symbiont-bearing larger foraminifera (LBF) which indicate clear, nutrient-deficient water conditions, suitable for calcification and coral growth, 2) smaller heterotrophic foraminifera, also referred to as "other small taxa", which increase in number with rising nutrient supply in still well-oxygenated environments, and 3) opportunistic taxa that tolerate high-stress environments and rapidly increase in number under nutrient overload (eutrophication) and hypoxic conditions.

For calculating the FI, the proportion (P) of each group is calculated by dividing the total amount of foraminifera (T) through the number of individuals of the respective group (N): $P = N/T$. The proportional amount is then multiplied by a specific weighting factor generated for each group. In the equation, S stands for symbiont-bearing taxa, O for opportunistic taxa and H for other small taxa: $FI = (10 \times P_S) + (P_O) + (2 \times P_H)$.

The FI is based on empirical values. A minimum of 25% LBF is requested to ensure suitable conditions for reef growth and corresponds to an FI value of 4.

Results can be interpreted as follows: 1) FI > 4 indicates environmental conditions suitable for reef growth and accretion, and water quality supporting calcification; in case of sediments containing 100% LBF shells, the FI equals 10 (the highest value possible), 2) FI 2–4 stands for unfavorable conditions for recovery of already damaged coral reefs and only marginal conditions for coral reef growth; these samples contain only a few larger benthic specimens (< 25%) and indicate first signs of environmental changes, 3) FI < 2 indicates an environment which lacks LBF ($P_S = 0$) and stands for conditions which neither promote coral growth nor recovery; in this case, reefs are fully degraded (Hallock et al. 2003).

RESULTS

Structure of foraminiferal assemblages

Species richness and diversity

A total number of 421 benthic foraminiferal species were identified from 10,721 picked specimens. Among them are five new species (*Miliolinella moia, Miliolinella undina, Triloculina kawea* and *Siphonaperta hallocki*) and one new genus (*Dentoplanispirinella occulta*) of the porcelaneous Miliolida.

The most species-rich assemblage consists of 168 species (N18), while the lowest diversity was found at Wayag (Wa) with 26 species.

Fisher's alpha diversity computations were found to cover a wide range between 6.3 (Wa) and 86.1 (U16; tab. 4). Shannon's H values vary between 1.6 (Wa) and 4.6 (U16). A diversity plot reveals that the assemblages can be classified into three different diversity categories (text-fig. 4): (1) low diversity ($\alpha < 10$), (2) moderate to high diversity ($\alpha = 15–43$), and (3) very high diversity ($\alpha > 59$).

The majority of the assemblages (25 out of 30 sites) belong to Category 2. Category 1 is represented by one assemblage (Wa), and Category 3 by four assemblages (B15, MR18, N18, U16). Assemblages of the latter category range in depth between 18 and 45 m. Diversity appears to be rather randomly distributed over the entire depth range, although a slight trend towards higher diversity with increasing depth can be noted (text-fig. 5).

Besides depth, species richness appears to correlate with grain size of the carbonaceous sediments. Four general grain size sediment types can be distinguished: (1) very fine-, (2) fine-, (3) medium-, and (4) coarse-grained carbonaceous sand (tab. 3). Several of the fine-grained sediments contain a considerable amount of coarse reef rubble. The majority of the substrates is of fine to medium grain size and display a moderate to high diversity. The lowest diversity was recorded in coarse-grained sediment from a shallow and current-exposed coastal habitat at Wa (1m) and contained mostly strongly abraded tests of calcarinid foraminifera. Highest species richness mainly occurs in very fine sediment (tabs. 3, 5). The highest diversity of all samples was recorded at site U16, where sediments have the finest grain size. The foraminiferal biota at this site is characterized by numerically abundant tests of thin-shelled taxa and all specimens (including LBF) are of particularly small size.

Equitability values among samples range between 0.49 for Wa and 0.9 for U16 (tab. 4). Moderate to high diversity assemblages are distributed throughout the survey area. The very high diverse assemblages, as well as the least diverse, are located in the northern part of the Raja Ampat Archipelago.

Composition and structure of the fauna

The ternary diagram for wall type composition (Murray 1973) relates percent abundances of wall structure types (agglutinated, porcelaneous, hyaline) to characteristic environments. The resulting ternary diagram reveals that the foraminiferal assemblages comprise comparatively similar percent abundances of wall structural types and plot near the hyaline corner of the diagram (text-fig. 6).

Hyaline taxa represent 73.5%, porcelaneous 13.9%, and agglutinated 12.6% of the total fauna (tab. 5). This distribution of percent abundance within the ternary diagram reflects normal shelf to marginal marine (e.g. lagoonal) conditions. The latter is characterized by higher percent abundances of porcelaneous individuals as recorded in samples from Uranie and Magic Rock (U16, MR18) with 33.5% and 34.4%, respectively. The lowest abundance of porcelaneous wall types was found in samples Wa (4.7%) and W07 (5.7%). The highest abundance of hyaline wall types (94.7%) was in the sample from Wayag (Wa) at 1 m depth. The fauna at this site is composed almost entirely (90.5%) of large calcarinid tests and represents a typical star sand (Lee 1995). The highest abundance of agglutinated wall types was found in samples CM (23.1%) and CK (21.6%), the lowest in Wa (0.5%), MS04 (3.6%), and U16 (4.6%).

Ten different orders of foraminifera were found within the total fauna of 10,721 specimens: the agglutinated Astorhizida, Lituolida, Loftusiida, and Textulariida, the porcelaneous Miliolida, and the hyaline perforate Rotaliida, Buliminida, Lagenida, Spirillinida, and Robertinida. Individuals of the Rotaliida constitute the highest percent abundances (66.2%; 141 species), followed by the porcelaneous Miliolida (13%; 180 species) that are the most diverse order. Within the hyaline perforate group, the Buliminida (1.8%; 21 species), Lagenida (0.4%; 15 species), Spirillinida (0.4%; 14 species), and Robertinida (0.01%; 1 species) are least abundant. Among the four orders of the agglutinated subclass Textulariia, the Textulariida are the most abundant (11%; 36 species) and speciose order, followed by the Lituolida (0.3%, 10 species), the Loftusiida (0.6%; 2 species), and the Astorhizida (0.01%; 1 species).

The species with the highest relative abundance (RA) are the symbiont-bearing *Amphistegina lessonii* (14.5%), *A. radiata* (8.4%), *Heterostegina depressa* (4.8%), *Calcarina spengleri* (4.6%), and the symbiont-free *Eponides repandus* (3.9%; app. 1). All of them belong to the hyaline-perforate Rotaliida. The quinqueloculine *Lachlanella parkeri* (0.8%) was found to be the most abundant porcelaneous species, followed by *Triloculina tricarinata* (0.4%). Among the agglutinated taxa, *Sahulia* cf. *S. kerimbaensis* is the most abundant species (2.6%). At generic level, *Amphistegina* shows the highest RA (27.5%), followed by *Calcarina* (11.2%), *Heterostegina* (5.2%), and *Sahulia* (5.1%).

Based on the frequency of occurrence (FO), *Amphistegina lessonii* and *Eponides repandus* were found to be the most ubiquitous (100%) and occurred in each of the 30 samples analyzed (Appendix 1). Among the 405 species identified, 38 are very common (FO > 50%), 72 are common (FO > 25%), and 86 occur occasionally (FO > 10%). The remaining 209 species are considered rare (FO = 3.3–10%) and their occurrence corresponds to a maximum of 3 sites. A total of 96 species (24% of the fauna), is represented by a single individual only.

The relative abundance of planktonic specimens varies between 0% (sample Wa from 1m) and 24% (sample B15 from 43m; tab. 6) and was found to increase with depth (text-fig. 8).

Symbiont-bearing larger foraminifera

The functional group of symbiont-bearing larger benthic foraminifera (LBF) is represented by 6 different families that belong to either the order Miliolida (Alveolinidae, Soritidae, Peneroplidae) or Rotaliida (Amphisteginidae, Calcarinidae, Nummulitidae). The LBF families comprise 18 different genera and 35 different species. Four of them were so rare and were obtained through selective picking (*A. quoyi*, *A. complanata*, *C. hispida*, *D. zhengae;* tab. 7). They are not included in the statistical analyses.

The larger Rotaliida are more abundant in the sediments than the larger Miliolida and contribute between 96.7% and 3.3% to the total number of LBF specimens. In 28 of the 30 samples examined, the larger Rotaliida represent more than 90% of the LBF specimens (text-fig. 44). In only two of the samples (MS04, MR18), the larger Miliolida contribute more than 10% to the total LBF fauna. The latter samples were collected in 14 and 18 m depth. Larger symbiont-bearing Miliolida are absent in samples AW12, OT, U02, and W07. With exception of sample AW12, the abundance of larger and smaller porcelaneous specimens is low in these samples (<8%). The most abundant representatives of the larger Miliolida are the Peneroplidae, followed by the Soritidae. A single specimen of *Laevipeneroplis bradyi* was found in sample MS03. This species, originally described from the Caribbean, is extremely rare in the Indo-Pacific and has previously been reported only from the Great Barrier Reef (Baccaert 1987). A record from the Tuamotu Islands in the southern tropical Pacific (Bicchi, Debenay and Pagès 2002) cannot be confirmed, as the corresponding figure shows a specimen of *Parasorites orbitolitoides.* Juvenile specimens of *P. orbitolitoides* were also found in samples MR18 and U16. Both samples consist of fine-grained, sandy sediment and contain a comparatively high number of porcelaneous specimens (34%). A preference for sandy substrates for *P. orbitolitoides* was reported from the Ryukyu Islands (Japan; Hohenegger et al. 1999). Fragments and abraded tests of *Marginopora vertebralis* were found in samples CM, MR18, Wa, and Y24. Such preservation indicates that *Marginopora* specimens are probably transported from their life habitats.

The Alveolinidae are represented by the two species: *Borelis pulchra* and *Alveolinella quoyi. Borelis pulchra* was found in low numbers in sample Y24 and abraded specimens of *A. quoyi* were recovered in samples MS03 and MS04.

Among the larger Rotaliida, the Amphisteginidae were the most abundant and dominant LBF family in 25 out of 30 samples. The remaining five samples (Wa, MS04, MS03, Y24, B14) were dominated by specimens of the Calcarinidae.

The Amphisteginidae are represented by 7 species and one genus (*Amphistegina*). They are present at all sample sites and their abundance varies between 1.6% (Wa) and 55.1% (MI05). Assemblages containing the largest number of amphisteginids are MI06 (55.1%), N19 (51.7%), and OT (41.5%).

The most abundant and widespread amphisteginid species is *A. lessonii* (RA = 14.5%). This species was recorded at all sample sites (FO = 100%) and constitutes the most abundant amphisteginid taxon at 25 out of 30 sample locations. At the remaining five sample sites (ER22, ER23, AW12, AW13, OT), the most abundant amphisteginid is *A. radiata. Amphistegina lessonii* constitutes 41% of the benthic fauna in sample MI05 and only 1% at Wa. The species is reported to have a broad depth distribution and can extend its depth range down to 100m (Hallock 1984, 1999; Hallock and Glenn 1986; Renema 2002). *Amphistegina lessonii* was also reported to be the most abundant larger foraminifer in the Spermonde Archipelago (Indonesia; Renema 2002).

The second most abundant species, *A. radiata* (RA = 8.4%; FO = 96.7%), was not found at the very shallow collection site at Wayag, where the percentage of amphisteginids is lowest (1.6%). Its highest abundance was recorded at sample sites N19 and OT, where it constitutes 24% and 23% of the benthic foraminiferal fauna. In other studies, *A. radiata* has been reported to occupy deeper habitats than *A. lessonii* (Hallock 1984; Hallock and Glenn 1986). *Amphistegina radiata* has a preference for solid substrates and is less abundant in soft sands (Renema 2002; Hohenegger et al. 1999). In the Spermonde Archipelago, *A. radiata* occupies the same depth range as *A. lessonii* (Renema 2002). In the Ryukyus, *A. radiata* avoids high energetic environments (Hohenegger et al. 1999). In our material, *A. radiata* occurs with very low abundance values in samples from sandy channel habitats (Wa, MS03, MS04) that are dominated by calcarinid species.

Abundance values of *Amphistegina lobifera* (RA = 0.7%; FO = 56.7%) were generally low and range between 0.1% (B14) and 5% (MS04). Specimens of this taxon were recovered from depth as deep as 41m with highest abundance in shallower waters between 14–16m. This observation agrees well with the abundance-depth pattern recorded from the Ryukyus (Hohenegger et al. 1999; Hohenegger 2000). *Amphistegina lobifera* was also rare in the Spermonde Archipelago but restricted to the upper 12m (Renema 2002). In the Gulf of Aqaba, it is found down to 80m (Reiss and Hottinger 1994). The thick-shelled species is characterized by its spheroid morphology considered to be an adaption to high light intensities and strong wave energy (Hallock 1981; Reiss and Hottinger 1994; Hohenegger et al. 1999). Amphisteginids with flattened tests are generally more abundant in deeper habitats, where low light intensities and weaker water energy levels prevail (Reiss and Hottinger 1994; Hohenegger 1994).

Two species of "deep-dwelling" amphisteginid foraminifers were found among all members of the Amphisteginidae: *A. bicirculata* and *A. papillosa*. Both taxa are characterized by their flat lenticular morphology (Reiss and Hottinger 1994). *Amphistegina bicirculata* (RA = 0.8%; FO = 46.7%) was most abundant in samples ER22 (10%), OT (5%), and ER23 (4%), at depth between 24–26m. In other areas, living specimens of *A. bicirculata* were reported from depths below 80m (Hawaii; Hallock and Glenn 1986) and down to 135m (Gulf of Aqaba; Reiss and Hottinger 1994). Highest abundances of the other deep-dwelling amphisteginid species, *Amphistegina papillosa* (RA = 0.3%; FO = 46.7%) were recorded at site U01 at 26m depth, where it constitutes 4% of the total assemblage. The FO for *A. bicirculata* and *A. papillosa* is too low to identify species-specific depth trends.

Little is known about the environmental preferences of *A. madagascariensis* (RA = 0.05%; FO = 6.7%) which occurs in two samples only (MG, MI05) covering a depth range between 18–32 m. Cushman (1921) considered *A. madagascariensis* to be a variant of *A. lessonii* and to prefer similar environmental conditions.

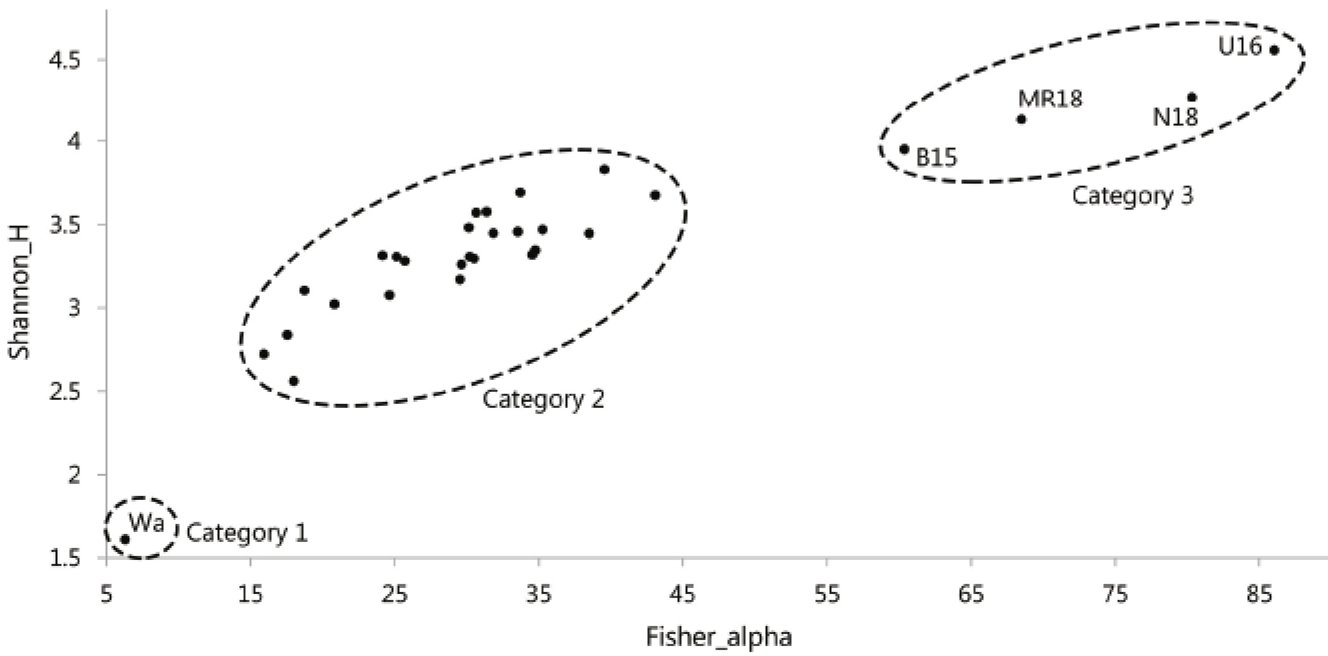
Amphistegina sp. (RA = 1%; FO = 53.3%) resembles *Amphistegina* sp. 1 as illustrated in Parker and Gischler (2011) and *A. quoii* in Debenay (2012). The yet to be identified species appears to avoid very shallow waters as its first occurrence is at 18 m (MG). *Amphistegina* sp. is most abundant at 31 m (W08) where it constitutes more than 30% of all amphisteginid specimens. *Amphistegina quoii* of Debenay from New Caledonia and *Amphistegina* sp. from the Maldives were also reported to be most abundant at deeper water sites (~30 and 45–72 m respectively; Parker and Gischler 2011, Debenay 2012).

Calcarinidae were found to be the second most abundant family of symbiont-bearing larger foraminifera in the sediments from Raja Ampat. The family is represented by 8 species belonging to 4 genera. Their abundance varies between 0.4% in the deepest sample FW (49 m; one specimen of *Calcarina spengleri*) and 90.5% in the shallowest sample Wa (1 m) and they were recorded in all samples. They were also found to be particularly abundant at Y24 (48.5%), MS03 (39.2%), and MS04 (34.3%). Site FW has the lowest abundance of Calcarinidae but the Nummulitidae show their highest abundance (14.4% of the total fauna). The Nummulitidae are primarily *Heterostegina depressa* and are the third most abundant group of LBF. All of the three major LBF families show variable abundances with depth (text-fig. 9).

The Calcarinidae are most abundant in shallow habitats but display fluctuating abundances with increasing water depth. Specimens of *Baculogypsina sphaerulata* and *Calcarina gaudichaudii* were found to be most frequent in shallow water settings, while highest abundances of *Calcarina spengleri* were recorded at greater depths. Amphisteginid foraminifera were most frequent at depths between 25 and 35 m and the abundance of nummulitids increases slightly with increasing water depth.

The most abundant and widespread calcarinid species is *Calcarina spengleri* (RA = 4.6%; FO = 93.3%) followed by *C. gaudichaudii* (RA = 3.1%; FO = 36.7%). The tests of the latter species are among the largest within the calcarinid family commonly reaching a size of 3 mm (Renema and Hohenegger 2005). *Calcarina gaudichaudii* is not as widespread as *C. spengleri* but usually occurs in large quantities. The species prefers hard substrates, and living individuals occur in large numbers in shallow habitats dominated by strong wave action (Röttger and Krüger 1990; Hohenegger et al. 1999; Renema 2002). *Calcarina gaudichaudii* occupies similar environments as *Baculogypsina sphaerulata* and both taxa occur with high abundances on reef crests in the Ryukyus (Hohenegger 1994) and in the South Pacific (Fujita et al. 2016). At reef sites around Raja Ampat, *C. gaudichaudii* occurs in depths up to 43 m, twice as deep as in the Ryukyus (Hohenegger 1994; Hohenegger 2000). *Baculogypsina sphaerulata* (RA = 2.4%; FO = 33.3%) occurs in depths up to 45 m (U16). It occurs together with *Neorotalia calcar* and *C. gaudichaudii* and was reported to live as an epiphyte on filamentous algae in shallow (20 m max.), high-energy environments of the Great Barrier Reef (Lobegeier 2002) and on reef flats in the Ryukyus (Hohenegger et al. 1999). The depth range of this species in our material is also deeper than previously recorded.

Neorotalia calcar (RA = 1.8%; FO = 50%) reaches test diameters of up to 1 mm (Hohenegger et al. 1999) and was particularly abundant in samples Y24 and Y25 at 26 m water depth. Due to its comparatively small size, *N. calcar* can settle between finer filamentous thalli of macroalgae than larger calcarinids (Hohenegger 1994) but no substrate preference was reported in Indonesia's Spermonde Archipelago for this species (Renema 2002). *Neorotalia calcar* is most likely to be confused with the similar sized *Calcarina* cf. *C. hispida* (RA = 2.6%; FO = 50%), especially when the tests are highly abraded. *Calcarina*



TEXT-FIGURE 4
Diversity plot. The x-axis shows the Fisher's alpha values, the y-axis shows the Shannon's H values. Categories of assemblages (1, 2, and 3) are encircled according to diversity values (see text). Sample site information is provided for assemblages for Category 1 and 3. Diversity index values of all samples are listed in appendix 1.

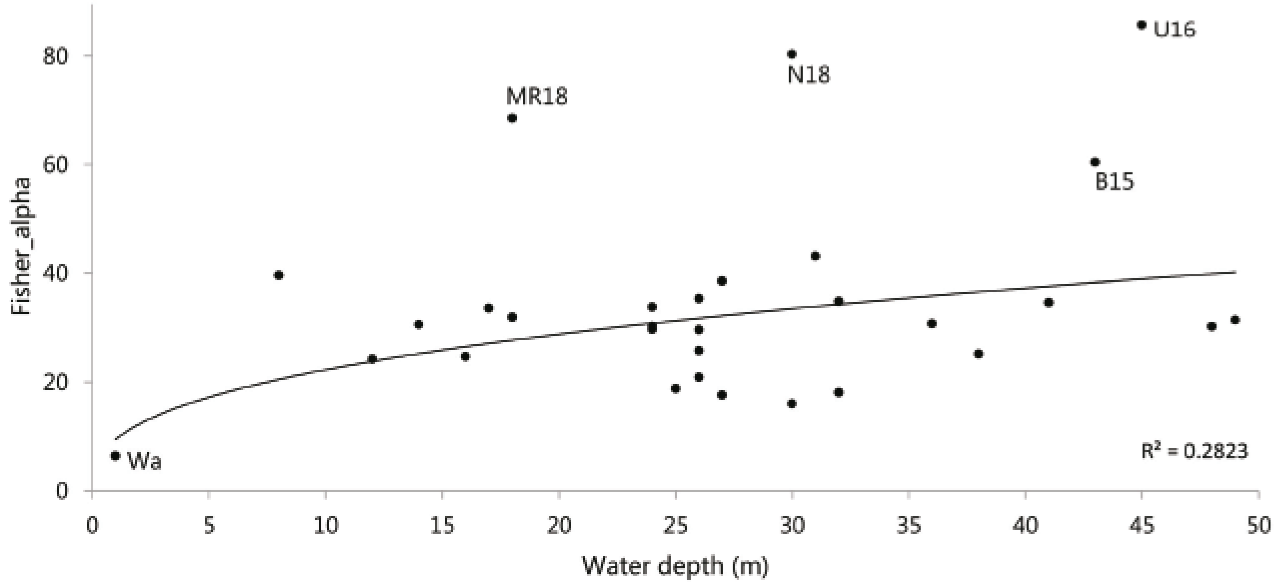
hispida occurs at both shallow (Wa) and deep water sampling sites (U16). It is comparatively rare in our material but abundant/common around the Spermonde Archipelago, where it appears to tolerate higher nutrient levels (Renema 2002). *Calcarina mayori* (RA = 0.2%; FO = 26.7%) resembles *C. hispida* but is characterized by long and club-shaped thick spines. It was found at depths between 24 m (W07) and 45 m (U16). It is the only calcarinid species that was absent at all shallow sample sites. Hohenegger et al. (1999) noted that *C. mayori* (identified as *C. hispida* form *defrancii*) becomes abundant at 20 m and reaches highest abundance values at 30 m. The deepest record in the Ryukyus was 70 m (Hohenegger et al. 1999). *Calcarina defrancei* (RA = 0.04%; FO = 13.3%) and *Baculogypsinoides spinosus* (RA = 0.05%; FO = 16.7%) are the least abundant and least common calcarinids in our material. *Baculogypsinoides spinosus* was deep-dwelling in the Ryukyus with a preference for calm water conditions as reflected by highest density values at 40 to 50 m (Hohenegger et al. 1999). In the material from Raja Ampat, it covers a depth range between 12 m (MR17) and 41 m (B14). *Calcarina defrancei* occurs from 8 m (AP09) to 48 m (AW12). In the Ryukus, this species prefers hard substrates with occurrence maxima at depths between 20 and 30 m (Hohenegger et al. 1999).

Q-mode cluster analysis

The Q-mode cluster analysis resulted in three major clusters (text-fig. 10). Based on the number of symbiont-bearing taxa, LBF play a prominent role in the delineation of cluster groups. Analysis of the depth distribution shows that Cluster A has the highest median depth with 41 m representing sheltered (low energy) habitats of the deep fore-reef. Cluster B has a shallow median depth of 16 m covering current-exposed (high energy) shallow reef habitats and sandy shoals. The sample locations of Cluster C have a median depth of 26 m representing fore-reef habitats exposed to waves and currents.

Cluster A includes five samples (B14, B15, MR18, N18, U16; depth range 18–45 m) located in the northern part of the archipelago. These samples contain the largest number of taxa and fall into the highest diversity category (except B14; text-fig. 4). A number of 188 species account for 57% of this assemblage while the remaining eight species constitute 43% of the total number of individuals. The most abundant species in Cluster A is *Amphistegina lessonii* (13%), followed by *Calcarina spengleri* (10%), *Amphistegina radiata* (6%), *Eponides repandus* (4%), *Heterostegina depressa* (4%), *Sahulia* cf. *S. kerimbaensis* (2%), *Asanonella tubulifera* (2%), and *Baculogypsina sphaerulata* (2%). These taxa are indicative of fore-reef zones in coastal fringing reef areas (Langer and Lipps 2003).

Cluster B includes five samples (Ms, Y24, MS04, MS03, Wa; depth range 1–27 m). The assemblages of Cluster B are generally characterized by large numbers of calcarinids, except for sample Ms (Mioskon Island), which contains abundant specimens of *Amphistegina*. Samples Wa, MS03, and MS04 are from sandy channels with strong currents. Among all clusters identified, cluster B reveals the lowest amount of *Heterostegina depressa* (2%). Seven species of Cluster B account for 63% of the total number of specimens and the remaining 154 species account for 37%. The most abundant species is *Calcarina gaudichaudii* (14%), followed by *Calcarina* cf. *C. hispida* (13%), *A. lessonii* (12%), *Baculogypsina sphaerulata* (11%),



TEXT-FIGURE 5
Correlation of diversity with depth. The x-axis represents increasing water depth, the y-axis shows the Fisher's alpha diversity value. Samples belonging to the highest and lowest diversity categories are labeled. A power trendline is added to illustrate the correlation between water depth and diversity.

Neorotalia calcar (7%), *Amphistegina radiata* (4%), and *Heterostegina depressa* (2%).

Cluster C includes twenty samples (AP09, MI05, U01, U02, CK, CM, AP10, ER23, MR17, N19, MI06, OT, MG, Y25, W07, W08, ER22, FW, AW12, AW13; depth range 8–49m). The assemblages are characterized by the dominance of amphisteginids (>30%) and a comparatively large number of agglutinated taxa (~13%). Ten species of Cluster C account for 57% of the assemblage, and 218 species account for the other 43% of all specimens. The most abundant species are *Amphistegina lessonii* (18%), *Amphistegina radiata* (12%), *Heterostegina depressa* (7%), *Eponides repandus* (5%), *Calcarina spengleri* (4%), *Sahulia* cf. *S. kerimbaensis* (3%), and *Siphoniferoides siphoniferus*, *Planorbulinella larvata*, *Heterolepa subhaidingeri*, *Asanonella tubulifera* (all 2%). These taxa are indicative of fore-reef zones and coastal fringing reefs (Langer and Lipps 2003).

R-mode cluster analysis

The R-mode cluster analysis includes the 35 most abundant taxa (15 genera and 20 species) representing 80% of the total fauna. The resulting diagram shows two major clusters (Cl. 1, Cl. 2) and four subclusters (Cl. 1a, b; Cl. 2a, b; text-fig. 11).

Cluster Cl. 1 comprises a total of 11 taxa of which the majority is known to be adapted to shallow reef zones (reef crest, lagoon) and/or high energetic environments (Glenn et al. 1981; Hohenegger 2000; Debenay 2012). The cluster comprises all calcarinid species except for the deeper dwelling *Calcarina spengleri*. Cluster 1 also includes the large and robust *Elphidium craticulatum* and *Amphistegina lobifera*, *Peneroplis* spp. and *Cymbaloporetta* spp. Specimens of *Ammonia* spp. and *Bolivina* spp., are also part of this cluster. Subcluster Cl. 1.a is characterized by mostly smaller heterotrophic and opportunistic taxa (e. g. *Anomalinella rostrata*, *Cymbaloporetta* spp., *Ammonia* spp.). Subcluster Cl. 1.b contains most of the calcarinid species and *A. lobifera* reflecting similar habitat requirements.

Cluster Cl. 2 has most species from fore-reef and deep fore-reef environments. It includes a total of 24 taxa, most of them characterized by high relative abundance values (>3% RA). This includes *Amphistegina lessonii* (RA = 14.5%), *Amphistegina radiata* (RA = 8.4%), *Heterostegina depressa* (RA = 4.8%), the most abundant calcarinid species, *Calcarina spengleri* (RA = 4.6%), *Eponides repandus* (RA = 3.9%), the miliolid genus *Quinqueloculina* (RA = 2.9%) and the agglutinated genera *Sahulia* (RA = 5%) and *Textularia* (RA = 3.9%).

Subcluster Cl 2.a includes most of the taxa that are characteristic for fore- and fringing reefs and Subcluster Cl 2.b comprises taxa that prefer deeper water settings (smaller miliolids, *Assilina ammonoides*, *Amphistegina bicirculata* and *Amphistegina* sp.).

Most relevant species correlation and distribution

The Spearman correlation coefficient (r_s) was calculated for 30 species of benthic foraminifera (tab. 8) including the 29 most abundant species (RA > 0.5%) and the new species *Dentoplanispirinella occulta*. The 30 species account for 65.5% of the benthic foraminiferal tests. The r_s values are interpreted as follows: r_s 0.00–0.19 = very weak, r_s 0.20–0.39 = weak, r_s 0.40–0.59 = moderate, r_s 0.60–0.79 = strong, and r_s 0.80–1.0 = very strong monotonic relationship among variables.

Strong, positive relationships were observed between *Baculogypsina sphaerulata* and *Neorotalia calcar* (r_s = 0.792), followed by *D. occulta* and *Ammonia* cf. *A. tepida* Type 1 (r_s = 0.761), *Amphistegina* sp. and *Textularia* sp. 2 (r_s = 0.723), *Textularia corrugata*? and *Eponides repandus* (r_s = 0.660), *Cibicides mabaheti* and *Textularia* sp. 2 (r_s = 0.610) , *Heterolepa subhaidingeri* and *Eponides repandus* (r_s = 0.603), *Baculogypsina sphaerulata* and *Calcarina gaudichaudii* (r_s = 0.579), *Siphoniferus siphoniferoides* and *Eponides repandus* (r_s = 0.561), and *Cibicides mabaheti* and *Assilina ammonoides* (r_s =0.577).

Computational analysis revealed no strong, negative relationships. Moderate, negative relationships were observed for *Amphistegina radiata* and *Calcarina* cf. *C. hispida* (r_s = -0.552), followed by *C.* cf. *C. hispida* and *Eponides repandus* (r_s = -0.534), *Sahulia neorugosa* and *Elphidium crispum* (r_s = -0.512).

Distribution patterns

The distribution, abundance, and depth range for each of the species selected for correlation analysis are illustrated (text-figs. 12–42). Abundance values are categorized as follows: 0% = absent, <1% = rare, 1–3% = few, 4–7% = abundant, 8–20% = very abundant, >20% = dominant.

Test preservation state

In most samples, the number of tests that are damaged or abraded exceeds the number of intact and well-preserved tests (tab. 9). On average, 25.8% of all tests were found to be intact and about 74.2% showed signs of damage and abrasion. The sample with the largest number of intact tests (>50%) was collected at Eagle Rock (ER23, 24 m). Moderate to strongly damaged and abraded tests were most abundant at Wayag (Wa, 1 m) and Yun Island (Y24, 26 m). Both sample sites are dominated by calcarinid specimens. Here, more than 90% of the tests are moderate to strongly abraded and/or damaged. Typical features of test damage among the calcarinids include broken spines and various degrees of ornamentabrasion. The shape and size of the calcarinids, however, still allow species-specific identifications. The degree of abrasion and damage is related to depth (text-fig. 43). In general, the number of well-preserved, intact tests rises with increasing water depth and heavily damaged and abraded tests are numerically more abundant at shallow sample locations.

Reef monitoring

The status of the coral reef sites was assessed by applying the FoRAM Index (Hallock et al. 2003). The index is based on three functional groups: symbiont-bearing larger benthic foraminifera (LBF), heterotrophic, and opportunistic taxa. Representatives of every functional group of foraminifera are present in each of the 30 samples from Raja Ampat. A total of 160 genera were identified in the sample material and categorized according to Hallock et al. (2003). Sixteen genera represent symbiont-bearing LBF with abundances ranging between 96.3% (sample Wa) and 22.9% (MR18; text-fig. 44), 13 genera represent opportunistic taxa, of which *Elphidium* is the most abundant genus followed by *Ammonia*, and the majority of 131 genera belongs to the group of heterotrophic foraminifera. Other opportunistic taxa include *Rotaliammina*, *Paratrochammina*, *Septotrochammina*, *Trochammina*, *Virgulopsis*, *Nonionides*, *Nonionella*, *Neocassidulina*, *Loxostomina*, *Sigmavirgulina*, and *Bolivina*. Relative abundances of the opportunistic group range between 0.7% (N19) and 18.8% (AW12) and heterotrophics constitute between 2.6% (Wa) and 65.9% (U16).

The calculated FI values range between 9.7 (Wa) and 3.6 (MR18) with an average value of 6 (tab. 4). Of the 30 samples, 28 are above the threshold of 4, indicating supportive conditions for reef growth and recovery (Hallock et al. 2003). Two samples (U16 and MR18) reveal FI values below 4. Sample MR18 is relatively fine-grained and characterized by abundant specimens of *Ammonia* and lowest numbers of LBF. Sample U16 yielded a similar FI value but contains numerically abundant heterotrophic foraminifera (65.9%). However, samples in immediate vicinity (MR17 and U01, 02) show favorable FI values. The sample collected at Wayag (Wa) shows an FI value of 9.7 but contains mostly abraded tests of calcarinids (tab. 4, 9). The FI values can be sorted in 4 categories: FI < 4 = marginal support for reef growth, FI 4–6 = good support for reef growth, FI 6–8 = strong support for reef growth, FI > 8 = very strong support for reef growth. The high FI values calculated for the majority of sample sites show that the water quality at all sampled sites around Raja Ampat, including sand channels with sparse coral cover (Wa, MS03, and MS04), are supportive of settlement and growth of coral populations.

DISCUSSION

This large-scale survey provides the first comprehensive faunal inventory and environmental analysis of recent benthic foraminiferal biotas from shallow reef- and nearshore habitats of the northern Raja Ampat Archipelago (Indonesia). A total of 421 benthic species were recovered from 30 samples at depths between 1 and 49 meters. The foraminiferal assemblages contained 49 agglutinated, 180 porcelaneous, and 192 hyaline perforate species.

The number of 421 species from shallow waters of Raja Ampat compares to 182 species of from reefal and lagoonal sites at Madang (Papua New Guinea; Langer and Lipps 1993). Our records indicate that only 71 species are shared among both localities (< 20%; as noted in the Systematics and Taxonomy section). The number of 421 species from Raja Ampat further compares to 168 species reported from over 800 samples in the size fraction >0.5 mm collected in the southwestern lagoon and on the southern shelf of New Caledonia (Debenay 2012, p. 29). Only 169 taxa from Raja Ampat are identical with the more than 1,000 species recorded from New Caledonia (Debenay 2012). The 421 species from Raja Ampat compare to 264 taxa reported from the Philippines (Graham and Militante 1959), to >200 species from the Malay Archipelago (Millett 1898–1904), to 161 taxa from Papua (Haig 1988a, b,1993), and to 104 species reported from the Chuuk Lagoon (Caroline Islands; Makled and Langer 2012; see tab. 1). Parker (2009) documented 404 species from the Ningaloo Reef at Australia's western coast, and Haig (1997) 236 species from the nearby Exmouth Gulf. Our list of foraminiferal species shows that 136 species from Raja Ampat also occur in the tropical western Australian region. The studies given above are directly comparable as they cover similar shallow-water depth ranges within the photic zone and comparable habitat typologies in the tropical Central Indo-Pacific. With respect to the relatively low number of samples, the narrow depth range and small sample area examined (~ 2.500 km²), the number of identified species highlights the Raja Ampat Archipelago as home to the world's highest known species richness of reef foraminifera.

Most of the Raja Ampat assemblages revealed moderate to high diversity Fisher's α values ranging between 15 and 43 (tab. 4). Particularly high diversity values of Fisher's α (60 and 86) were recorded in four assemblages and may represent some of the highest values ever recorded at reef sites. Almost equally di-

TABLE 4
Species richness, diversity and Foram Index measures. Samples are listed alphabetically with information on depth, number of species, number of specimens, Shannon H diversity, equitability (J), Fisher alpha diversity and Foram Index values.

Sample	Depth (m)	No. of species	No. of specimens	Shannon H	Equitability J	Fisher alpha	Foram Index
AP09	8	84	291	3.827	0.8636	39.57	5.1
AP10	17	75	280	3.454	0.8001	33.56	5.2
AW12	48	73	309	3.48	0.8111	30.17	5.2
AW13	27	53	341	2.837	0.7146	17.57	6.7
B14	41	111	822	3.316	0.704	34.58	6.7
B15	43	129	451	3.949	0.8125	60.38	5.0
CK	38	63	283	3.303	0.7972	25.14	6.4
CM	36	72	290	3.567	0.834	30.68	5.9
ER22	24	68	264	3.257	0.772	29.66	5.9
ER23	24	71	243	3.69	0.8656	33.74	4.8
FW	49	71	270	3.574	0.8385	31.39	4.9
MR17	12	61	277	3.31	0.8053	24.19	5.0
MR18	18	113	288	4.128	0.8732	68.51	3.6
MI05	32	101	600	3.343	0.7244	34.78	6.2
MI06	32	52	305	2.559	0.6477	18.01	7.8
MS03	16	66	334	3.073	0.7336	24.65	7.1
MS04	14	73	303	3.293	0.7674	30.53	6.7
MG	18	74	293	3.446	0.8005	31.87	5.4
Ms	27	87	330	3.444	0.7713	38.53	6.5
N18	30	168	570	4.271	0.8335	80.33	4.6
N19	30	47	288	2.721	0.7068	15.94	7.3
OT	26	58	316	3.02	0.7438	20.84	6.9
U01	26	67	322	3.278	0.7795	25.73	5.5
U02	25	54	315	3.101	0.7774	18.76	5.1
U16	45	159	460	4.556	0.8988	86.05	3.8
Wa	1	26	379	1.609	0.4938	6.327	9.7
W07	24	72	297	3.304	0.7724	30.23	6.5
W08	31	91	313	3.673	0.8143	43.09	5.4
Y24	26	92	635	3.166	0.7001	29.55	7.7
Y25	26	74	252	3.466	0.8053	35.29	6.3

verse assemblages have only been reported from Madang (max. $\alpha = 53$; Langer and Lipps 2003) and Tobago, Caribbean ($\alpha = 50$; Radford 1976a, b). Other recent reef studies on foraminifera reported a maximum of $\alpha = 27$ for a lagoonal assemblage in the Maldives (Parker and Gischler 2011), and maximum $\alpha > 30$ for reef sites at Pemba (Zanzibar; Thissen and Langer 2017) and around Moorea (French Polynesia; Fajemila, Langer and Lipps 2015).

Diversity measures of the Fisher's alpha (α) and Shannon's H diversity index revealed the presence of three different diversity categories to which the assemblages can be attributed (text-fig. 4). The lowest diversity category (Category 1) is represented by the shallowest sample from a current-exposed sandy channel within the islands at Wayag (1m; $\alpha = 6.3$). Medium to high diversity (Category 2; $\alpha = 15.9 – 43.1$) records characterize most of the samples from moderately deep to deep local fore-reef slopes, and particularly high diversity (Category 3; $\alpha = 60.4 – 86.1$) was registered in four assemblages with a depth range from moderately deep to deep fore-reef slopes (18 to 45 meters). Diversity varies over the entire depth range, with a slight trend towards higher diversity with increasing depth (text-fig. 5).

In the least diverse sample Wa, equitability is very low due to the high dominance of two large and robust calcarinid species: *Calcarina gaudichaudii* and *Baculogypsina sphaerulata*. The high percentage of damaged and abraded calcarinids in this assemblage (tab. 9) indicates current-exposed environments and suggests common reworking of the sediments. Low diversity and equitability values are typical indicators for unstable environmental conditions (Murray 1991).

The high diversity of benthic foraminifera recorded in this study corroborates the global species-wide biodiversity patterns that highlight the Coral Triangle as the tropical marine biodiversity hotspot (Roberts et al. 2002; Hoeksema 2007; Veron et al. 2015). On a local level, however, species richness differs from site to site and is constrained by habitat-specific parameters in-

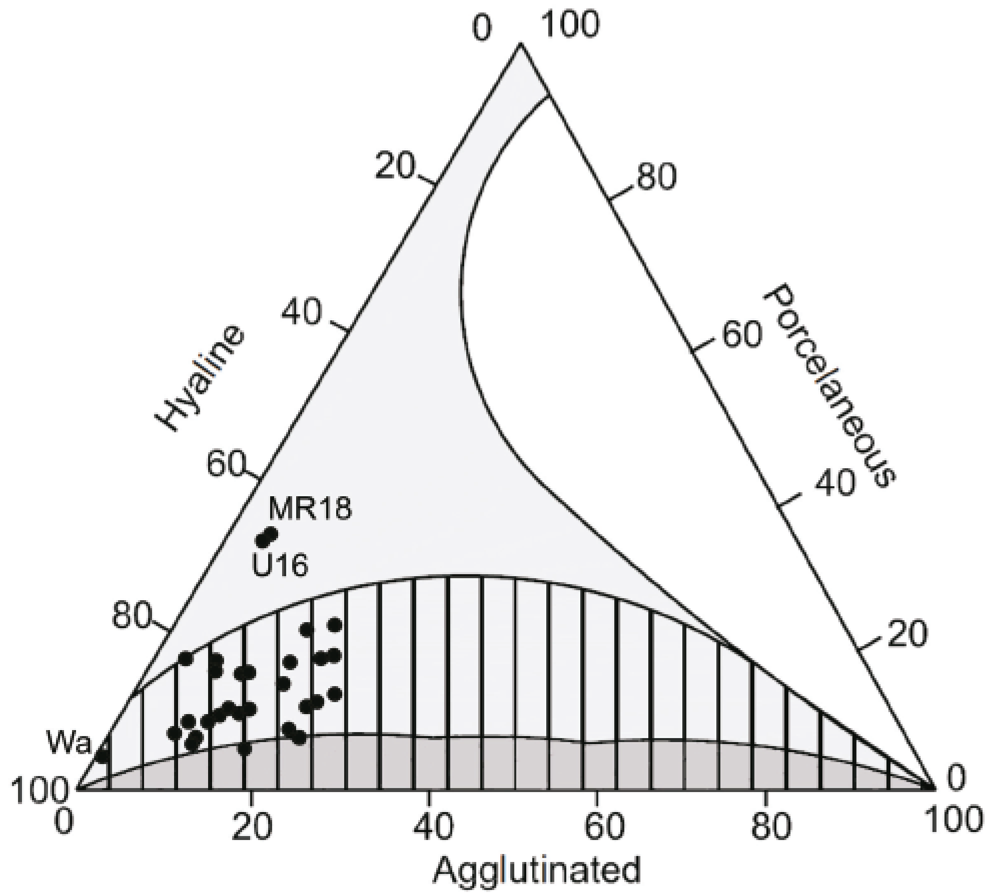
TABLE 5
Foraminiferal wall type abundances. Percent abundances of the three main wall types (agglutinated, porcelaneous, hyaline) are given for each sample.

Sample	Agglutinated (%)	Porcelaneous (%)	Hyaline (%)
AP09	16.5	14.4	69.1
AP10	20.7	11.4	67.9
AW12	14.2	11.0	74.8
AW13	7.3	7.9	84.8
B14	11.3	10.2	78.5
B15	11.8	16.0	72.3
CK	21.6	12.0	66.4
CM	23.1	13.1	63.8
ER22	13.3	10.6	76.1
ER23	18.5	22.2	59.3
FW	19.3	17.8	63.0
MG	20.5	18.1	61.4
MI05	13.5	10.5	76.0
MI06	10.2	6.6	83.3
MR17	15.9	17.3	66.8
MR18	5.2	34.4	60.4
MS03	7.8	16.2	76.0
MS04	3.6	17.8	78.5
Ms	7.3	17.6	75.2
N18	15.6	21.8	62.6
N19	10.4	9.4	80.2
OT	10.1	7.3	82.6
U01	20.2	8.4	71.4
U02	21.9	7.3	70.8
U16	4.6	33.5	62.0
Wa	0.5	4.7	94.7
W07	16.5	5.7	77.8
W08	11.8	11.2	77.0
Y24	8.0	9.4	82.5
Y25	11.1	15.9	73.0
Total	**12.6**	**13.9**	**73.5**

TABLE 6
Percent abundance of planktonic foraminifera. The abundance varies between 0 (sample Wa) and 23.9% (sample B15).

	Depth (m)	Planktonic (%)
AP09	8	6.7
AP10	17	5.1
AW12	48	3.4
AW13	27	1.2
B14	41	7.7
B15	43	23.9
CK	38	7.5
CM	36	4.3
E22	24	11.7
ER 23	24	16.8
FW	49	12.3
MG	18	8.7
MI05	32	3.8
MI06	32	2.2
MR17	12	4.5
MR18	18	7.1
Ms	27	2.1
MS03	16	0.3
MS04	14	0.0
N18	30	11.9
N19	30	3.0
OT	26	3.1
U01	26	3.3
U02	25	0.6
U16	45	10.0
Wa	1	0.0
W07	24	6.6
W08	31	12.3
Y24	26	0.5
Y25	26	8.4

cluding substrate, depth, currents, and nutrients. As outlined by Sen Gupta (1999) for habitats of the inner shelf, diversity commonly increases with depth. A moderate increase in Fisher's α values has been recorded in this study and some particularly high diverse samples were noted at the deepest collection sites (text-fig. 5). An increase of tropical benthic taxa from coastal settings towards the deeper fore-reef area is a common pattern in reefs of the Indo-Pacific (Thissen and Langer 2017; Langer and Lipps 2003; Langer et al. 2013a; Fajemila, Langer and Lipps 2015). Deviations from this general trend, however, were also observed in the material from Raja Ampat and are probably related to grain size, a feature that is intrinsically linked to wave energy and the current regime. All high diverse assemblages were recovered from fine-grained sediments and contained abundant thin-shelled taxa, while shallow reef and channel samples yielded a lower number of species and abundant tests of



TEXT-FIGURE 6
Ternary diagram of wall structure. The corners of the triangle represent 100% of the type of wall structure: agglutinated, porcelaneous, hyaline. Environments are discriminated as follows: marsh (*whole field*), marginal marine (*light grey*), shelf seas (*hatched*), deep-sea (*dark grey*). The black dots represent the 30 samples examined in this study. Outlier samples MR18, U16 and Wa are labeled (modified from Saraswati and Srinivasan 2016, after Murray 2006).

thick-shelled forms. In addition, smaller heterotrophic foraminifera were particularly abundant in some of the most diverse samples (MR18, U16). Fine-grained sediments may possibly represent suitable substrates for heterotrophic foraminifera (Boltovskoy and Wright 1976). Interestingly, all foraminiferal specimens, including LBF, in those very fine-grained samples were of considerably small size. The underlying causes for this kind of "dwarfism" (Boltovskoy and Wright 1976) are unkown but they may be related to optimal conditions for early reproduction (Lankford 1959; Phleger 1960).

Highest species richness values were found within the northernmost areas of the archipelago, an area that is less densely populated and affected by human impact and home to some of the most pristine coral reefs. Further studies are required, however, to verify whether this pattern holds true for other remotely located areas of the Raja Ampat Archipelago or if specific habitat typologies or environmental features imbricate our observations.

Composition and functional groups

Computational analysis of wall structural groups revealed that hyaline perforate taxa dominate the foraminiferal biotas around Raja Ampat (text-fig. 6). The recorded percentages are typical for shelf areas and reef habitats in modern tropical oceans (Murray 2006). The dominance of hyaline taxa is mainly driven by the abundance of larger rotaliid symbiont-bearing taxa, in particular Amphisteginidae and Calcarinidae. Among the group of hyaline perforate foraminifera, the Rotaliida are the most prolific order while the Buliminida, Spirillinida, Lagenida, and Robertinida merely contribute a marginal fraction to the total foraminiferal fauna. The second most abundant order is represented by the porcelaneous Miliolida, followed by almost equally abundant agglutinated Textulariida. The abundance and the number of species among the Rotaliida and the Miliolida vary distinctly (text-fig. 7) with the Rotaliida representing about 40 percent of the total fauna while the Miliolida are the species-richest order (180 species). Some of the miliolid species are extremely rare, but in a few samples porcelaneous miliolids constitute up to 40% of the total number of specimens (e. g. sample U16). Apart from their wall structure and phylogenetic relationship, shallow-water benthic foraminifera can be classified into three major functional groups (mixotrophic symbiont-bearing, heterotrophic, and opportunistic taxa).

Mixotrophic symbiont-bearing larger benthic foraminifera (LBF) are common constituents of shallow, tropical warm oligotrophic waters (Hallock 1999; Hohenegger 2011; Langer and Hottinger 2000). In the material from Raja Ampat, 14 samples out of 30 are dominated by LBF (> 50%) and in 16 samples smaller heterotrophic taxa including a few stress-tolerant opportunistic taxa represented more than 50% of the total number of specimens (text-fig. 44).

The LBF recorded in our material comprise six different families, 18 genera and 35 species. In addition, Hofker (1927) has previously documented the presence of *Cycloclypeus carpenteri* in Raja Ampat. The samples from Wayag and Magic Rock revealed the highest number of LBF (21 species). Compared to previous and other studies from the tropical Central Indo-Pacific and adjacent high-diverse ecoregions, the number of LBF genera and species identified from Raja Ampat is among the highest recorded so far (tab. 10). As shown in Table 9, studies from New Caledonia (Debenay 2012), the Ryukyus (Hatta and Ujiié 1992; Gudmundsson 1994; Hohenegger 1994; Hohenegger et al. 1999; Yordanova and Hohenegger 2002, 2004), and the Philippines (Cushman 1921, Förderer unpubl. data) exceed this number. Among the localities listed in Table 9, New Caledonia and the Ryukyu Islands have been most extensively studied. The LBF data, including those compiled for Raja Ampat, document that the Coral Triangle and associated ecoregions currently harbor the maximum number of LBF and constitute the center of diversity in reefs of modern tropical oceans species.

In terms of total numbers of individuals, larger Rotaliida are more abundant than the larger Miliolida (tab. 7). Among the perforate LBF, Amphisteginidae are the most abundant rotaliid family followed by the Calcarinidae. Both families are characteristic faunal elements in western Pacific reef sediments where LBF frequently constitute major portions of the sediments (Lee 1995; BouDagher-Fadel 2008; Langer, Silk and Lipps 1997; Fujita et al. 2014). While amphisteginids are common in reefs and shallow carbonate environments around the globe, Calcarinidae are largely restricted to the tropical western and central Indo-Pacific (Todd 1960; Hallock 1981; Hohenegger et al. 1999; Renema 2002; Lobegeier 2002; Hohenegger 2006; Fujita and Fujimura 2008; Fujita et al. 2016; Langer and Hottinger 2000; Weinmann et al. 2013a). Among all LBF's, the Amphisteginidae display the widest environmental tolerance and are currently expanding their distributional range as a result of rising temperatures and global climate change (Langer and Hottinger 2000; Langer et al. 2012; Langer et al. 2013a; Weinmann et al. 2013a, b). They are the most prolific LBF carbonate producers in reefs worldwide and often act as ecosystem engineers (Langer et al. 2012; Langer and Mouanga 2016).

Seven species of *Amphistegina* occur at Raja Ampat. One species, *Amphistegina* sp., resembles *A. radiata*, but is considerably smaller and has a more flattened test shape and is therefore tentatively listed under open nomenclature. The taxon is possibly identical with *Amphistegina* sp. 1 as reported from New Caledonia and the Maldives (Parker and Gischler 2011; Debenay 2012). Individual species of *Amphistegina* were previously shown to have specific depth preferences (e. g. Hohenegger 2000). The individual depth ranges recorded in the material from Raja Ampat are in agreement with previous observations from Indonesia and Japan. *Amphistegina* sp. from Raja Ampat was found slightly deeper than *A. radiata*, a species that has been reported to co-occur (Parker and Gischler 2011). The trend towards deeper habitat preferences at Raja Ampat is also documented in the R-mode cluster analysis, where the deeper dwelling amphisteginids *Amphistegina* sp. and *A. bicirculata* cluster together (Subcluster 2.b; text-fig. 11).

An adaptation to shallow high energy habitats is most pronounced in *A. lobifera*, a species that shares its environmental preferences with Calcarinidae, *Peneroplis* spp., and *Cymbaloporetta* spp.. Both calcarinid species and *Cymbaloporetta* spp. were reported to live as epiphytes on filamentous thalli of algae and seagrasses (e. g. Langer 1993; Debenay, Sigura and Justine 2011). *Amphistegina lessonii* and *A. radiata,* the two most abundant species of *Amphistegina*, co-occur with the nummulitid *Heterostegina depressa* and the agglutinated genera *Textularia* and *Sahulia* (text-fig. 11).

Our analysis shows that the abundance of the nummulitid *Heterostegina depressa* is positively correlated to that of *A. radiata* (tab. 8). Their preference for firm substrate (Hohenegger 2000) and sheltered microhabitats (Hallock & Glenn 1986) may account for their close affinity. In addition, *Heterostegina depressa* was recorded as the most abundant nummulitid at Raja Ampat. Nummulitids have occurrence minima in high energy environments dominated by calcarinids but their abundance slightly increases in deeper waters (text-fig. 9). Visual inspection showed that *H. depressa* specimens recovered from coarse sediments had commonly thicker and larger test centers with thinner peripheries compared to their counterparts in finer grained sediments and greater depths. As previously observed, the thickness of *Heterostegina* tests increases in current-exposed habitats to provide mechanical strengthening and to resist entrainment (Briguglio and Hohenegger 2011; Eder, Hohenegger and Briguglio 2018).

As outlined above, the Calcarinidae are characteristic foraminiferal faunal elements in agitated and highly dynamic shallow-water environments (Hohenegger 1994). The calcarinid family is represented by eight species and four genera (tab. 7). So far, we were unable to find *Schlumbergerella,* a calcarinid genus that is present in adjacent areas (Philippines, Indonesia, Bali, Java Sea, Lesser Sunda Islands; Hofker 1927; Renema 2003). *Schlumbergerella* displays one of the most restricted distributions among calcarinids (Langer and Hottinger 2000; Renema 2018), but the reason for its absence around Raja Ampat requires further study. Restricted dispersal capabilities and/or specific environmental requirements may possibly account for the limited distribution range (Lessard 1980; Langer and Hottinger 2000).

The most widespread and abundant calcarinid recorded in this study is *Calcarina spengleri*, a finding that agrees with previous reports that this species (as well as *Neorotalia calcar*) occupies a comparatively wide range of habitats (Renema 2002). The two largest representatives of the Calcarinidae, *Baculogypsina sphaerulata* and *Calcarina gaudichaudii,* are not as common as *C. spengleri*, but reach high abundances at the sampling sites Wayag and Manta Sandy.

The depth range of both species ranges up to 43–45 m, which is deeper than at the Ryukyu Islands (Hohenegger 1994; Hohenegger et al. 1999), but in agreement with observations

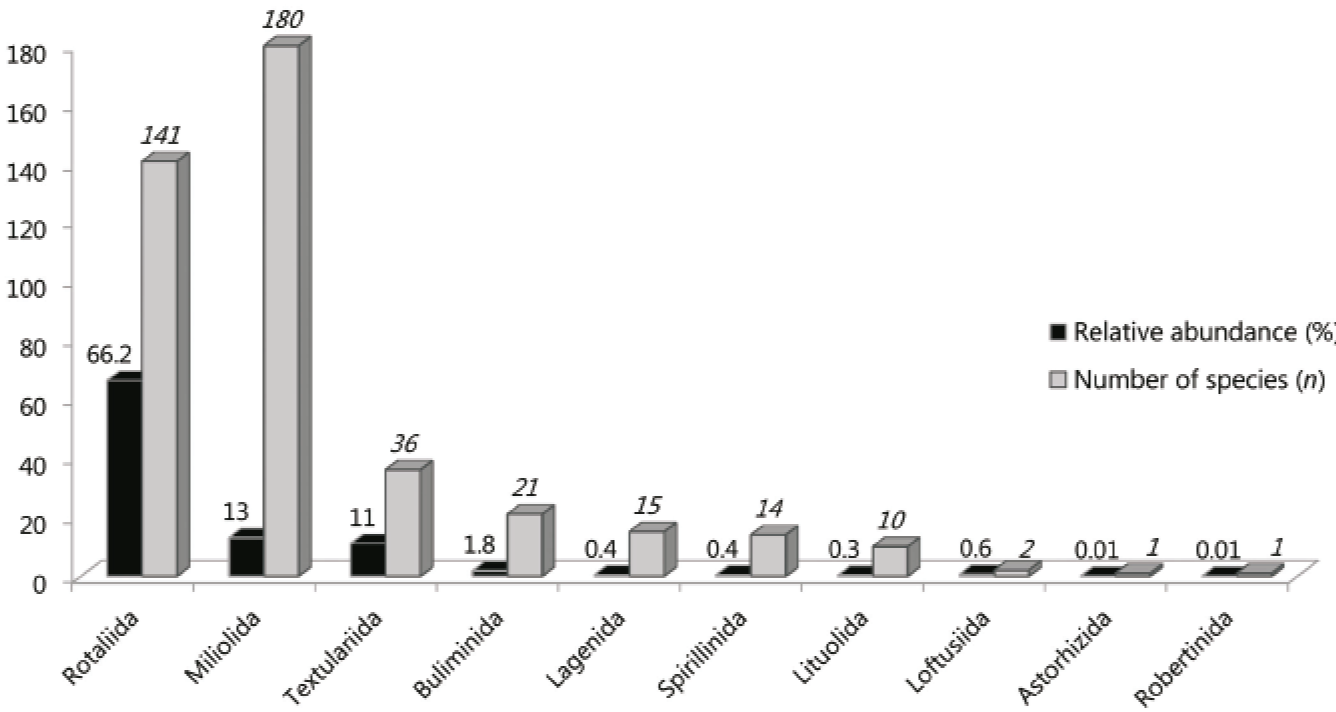
TABLE 7
Symbiont-bearing larger foraminifera of Raja Ampat. All symbiont-bearing families, genera, and species are listed with their relative abundance (RA) in the total assemblage and type of symbiont according to Lee and Anderson (1991), Hallock and Peebles (1993), Hallock (1999), and Hohenegger et al. (1999). Species obtained through selective picking are indicated with a star symbol.

	Family	Genus	Species	Photosymbiont	RA (%)
Larger Miliolida	Alveolinidae	*Alveolinella* ★	*A. quoyi* ★	Diatom	-
		Borelis	*B. pulchra*	Diatom	0.035
	Soritidae	*Amphisorus*	*A. hemprichii*	Dinoflagellate	0.105
		Marginopora	*M. vertebralis*	Dinoflagellate	0.035
		Parasorites	*P. orbitolitoides*	Chlorophyte	0.026
		Sorites	*S. orbiculus*	Dinoflagellate	0.297
	Peneroplidae	*Dendritina* ★	*D. zhengae* ★	Rhodophyte	-
		Laevipeneroplis	*L. bradyi*	Chlorophyte	0.009
			L. malayensis	Chlorophyte	0.079
		Monalysidium	*M. acicularis*	Rhodophyte	0.009
			M. okinawaensis	Rhodophyte	0.026
		Peneroplis	*P. antillarum*	Rhodophyte	0.270
			P. pertusus	Rhodophyte	0.262
			P. planatus	Rhodophyte	0.279
Larger Rotaliida	Amphisteginidae	*Amphistegina*	*A. bicirculata*	Diatom	0.759
			A. lessonii	Diatom	14.519
			A. lobifera	Diatom	0.681
			A. madagascariensis	Diatom	0.052
			A. papillosa	Diatom	0.332
			A. radiata	Diatom	8.376
			A. sp.	Diatom	1.030
	Calcarinidae	*Baculogypsina*	*B. sphaerulata*	Diatom	2.382
		Baculogypsinoides	*B. spinosus*	Diatom	0.052
		Calcarina	*C. defrancei*	Diatom	0.044
			C. gaudichaudii	Diatom	3.054
			C. hispida ★	Diatom	-
			C. cf. *C. hispida*	Diatom	2.548
			C. mayori	Diatom	0.209
			C. spengleri	Diatom	4.624
		Neorotalia	*N. calcar*	Diatom	1.797
	Nummulitidae	*Assilina*	*A. ammonoides*	Diatom	0.733
			A. complanata ★	Diatom	-
			A. discoidalis	Diatom	0.017
		Heterostegina	*H. depressa*	Diatom	4.816
		Nummulites	*N. venosus*	Diatom	0.279

from the Mahakam Delta and the Philippines (Langer and Hottinger 2000).

The R-mode cluster analysis revealed that calcarinids form a homogenous group with similar habitat preferences and environmental requirements (Subcluster 1.b; text-fig. 11). An exception to this general pattern is *Calcarina spengleri,* a species that shows a negative correlation with some of the most abundant calcarinids (e.g. *C.* cf. *C. hispida*; tab. 8) but higher affinities to some of the smaller Rotaliida, agglutinated taxa, and the very common *Amphistegina lessonii*, *A. radiata*, and *Heterostegina depressa* (text-fig. 11). Renema and Hohenegger (2005) noted that *C. spengleri* occurs on coral rubble at depths between 1 and 45 meters, whereas *C. hispida* is commonly found as an epiphyte around reef flats.

The larger Miliolida are represented by three different families: Alveolinidae, Peneroplidae, and Soritidae. The Alveolinidae are the least abundant, followed by the Soritidae (RA = 0.5%) and the Peneroplidae (RA = 1%). Among the alveolinids, specimens of *Borelis pulchra* were rarely observed during regular picking and only a very few abraded specimens of *Alveolinella quoyi* were recovered by selected picking in samples from Manta Sandy (MS03, MS04). In contrast, *A. quoyi* is frequent in samples from the lagoon at Madang, Papua (Langer and Lipps 2003) and at Motupore Island, southwest Papua (Lipps and Severin 1986). In the Ryukyus, *A. quoyi* exhibits strong preferences for firm substrates in shallow depths (Hohenegger et al. 1999). Abraded/broken tests and rare occurrences were also noted for *Marginopora vertebralis*, a large representative of the miliolid family Soritidae and a species that has been frequently encountered in reefal sites from Madang (Papua; Langer and Lipps 2003). Around Raja Ampat, the Soritidae are generally not abundant and the specimens recovered are comparatively small in size. Most soritid species live as epiphytes in shallow seagrass or algal habitats (Langer and Hottinger 2000; Murray 2006) and are less abundant on sandy substrates (Hohenegger et al. 1999). Seagrass beds occur around the islands of Raja Ampat but extensive meadows are rare (Agostini et al. 2012).



TEXT-FIGURE 7
Structure and composition of the foraminiferal fauna based on order level. The relative abundance of each of the ten orders is shown in comparison to the number of species within each order.

Most species of larger symbiont-bearing foraminifera recovered in this study are widely distributed and well documented for the Indo-Pacific. For some of them, only few and scattered records exist and their full distribution requires further study (e.g. some Peneroplidae). The peneroplid *Laevipeneroplis bradyi* recorded in this study is among the species with an enigmatic distribution. It is common in the Caribbean region and prior to this study only a single record existed from the Great Barrier Reef (Lizard Island; Baccaert 1987). Another record from the Tuamotu Islands in the southern tropical Pacific is questionable (Bicchi, Debenay and Pagès 2002), as the corresponding text-figure illustrates a specimen of *Parasorites orbitolitoides*. New distributional range extensions can also be reported for the peneroplid *Monalysidium okinawaensis*. This species has originally been described from the Ryukyu Islands (southern Japan) and has also been recorded from the Ningaloo Reef area on Australia's western coast (Hatta and Ujiié 1992a; Parker 2009). Around Raja Ampat, abraded specimens of *M. okinawaensis* were present in samples from Wayag, Mioskon, and Cape Mansoer but additional well-preserved specimens have been found in material from Palawan (Philippines, Förderer unpubl. data).

Some of the deep-dwelling foraminifera like *Cycloclypeus*, *Planostegina*, and *Planorperculina*, and the large soritid *Cyclorbiculina* are rare or absent as the sample range around Raja Ampat was limited to 49m. *Cycloclypeus* has previously been recorded from Raja Ampat by Hofker (1927). He reported specimens from localities off the northern coast of Waigeo at 32 and 83m depth (tab. 2). It also occurs abundantly off the Great Barrier Reef at deep depths and off Port Moresby at 50–55 m (Song, Black and Lipps 1994). *Planoperculina* and *Planostegina* were documented from some locations in Indonesia, including Madang (Papua) and the southern part of Raja Ampat, where they commonly occur in habitats deeper than 30m (Hofker 1927, 1930, 1978; Hohenegger 1996, 2000; Renema 2003, 2006a, b; Langer unpubl. data). For the large soritid *Cyclorbiculina*, originally described from the Caribbean by d'Orbigny (1839), only a single record from 57m depth in the Timor Sea existed (Loeblich and Tappan 1994). It is highly likely that these species are also present around Raja Ampat but additional sampling at greater depths is necessary to verify their presence.

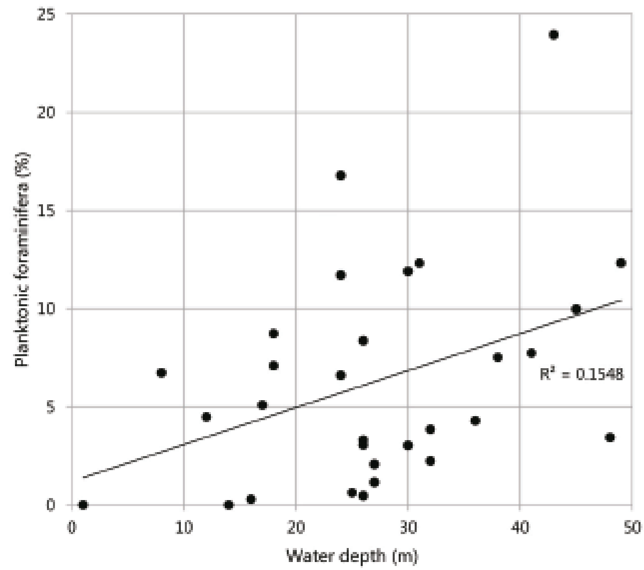
Smaller heterotrophic taxa comprise the majority of the species identified in this study. They include abundant smaller hyaline, porcelaneous and agglutinated taxa. The most abundant smaller porcelaneous taxa reveal similar habitat preferences as documented in the R-mode cluster analysis (text-fig. 11, Subcluster 2b). The larger nummulitid *Assilina ammonoides* is the only symbiont-bearing species that clusters within the group of miliolids. *Assilina ammonoides* is widely distributed throughout the Indo-Pacific, is known to tolerate a comparatively wide range of environmental conditions and has been reported from soft substrates in low energy environments (Hohenegger 1994; BouDagher-Fadel 2008). High abundances *A. ammonoides* were documented from the Ryukyus between fore-reef and lagoonal environments (Hohenegger 1994).

Highest abundances of miliolid foraminifera (34.4%) were observed in very fine-grained sediments at the Magic Rock sample site (MR18). This site is also characterized by the presence of abundant specimens of *Ammonia*. A correlation between high abundances of miliolids and *Ammonia* has been also reported from the Maldives and from Rodrigues in the Indian Ocean (Montaggioni 1981; Parker and Gischler 2011). The presence of abundant specimens of *Ammonia* is commonly interpreted to result from higher nutrient levels. Interestingly, abundances of the newly described species *Dentoplanispirinella occulta* strongly correlate with the presence of *Ammonia* (tab. 8). The environmental preferences of *D. occulta* are yet unknown, however, its occurrence is not restricted to fine-grained sediments where *Ammonia* was most abundant. The highest number of smaller heterotrophic specimens was in fine-grained sediments from Uranie (U16) but only modest numbers of *Ammonia* were recorded. The R-mode cluster analysis shows that Subcluster 1.a contains most of the opportunistic taxa (text-fig. 11). Some species of *Elphidium*, however, show higher affinities to other taxon groupings and indicate that the general assignment of elphiids as opportunistic foraminifers, requires revisions.

Reef status assessment: FoRAM Index

The status of reefal environments around Raja Ampat was analyzed using the Foraminifera in Reef Assessment and Monitoring (FoRAM) Index (FI; Hallock et al. 2003). The FI index is a measure to assess the environmental suitability for carbonate accretion and growth of calcifying organisms in reefs. Previous studies concluded that the majority of reefs in the archipelago were in good to excellent condition, but declining fish stocks and water quality were reported for several sites (McKenna, Bolis and Allen 2002; Palomares and Heymans 2006; Ainsworth, Pitcher and Rotinsulu 2008; Agostini et al. 2012). Abundance records of functional groups (symbiont-bearing, heterotrophic, and opportunistic foraminifera) and FI computations show that values range between 9.7 and 3.6 with an overall average of 6 (text-fig. 44; tab. 4). Moreover, out of 30 samples, 28 are above the threshold of 4, indicative of conditions that support reef growth (Hallock et al. 2003). The two samples with values below 4 (U16, MR18) were taken from one of the most pristine regions within the archipelago and samples from immediate proximity (U01, U02, MR17) indicate very supportive conditions (FI = 5). The highest FI value (FI 9.7) was calculated for Wayag (Wa), an assemblage that almost entirely consists of the shells of the symbiont-bearing Calcarinidae (100% symbiont-bearing taxa would result in an FI of 10). Since abraded tests are very abundant, this exceptional high FI has to be interpreted with caution, as this might indicate an accumulation of dead larger foraminiferal tests over time (Hallock 2012). The sample material examined covered a wide range of habitat typologies (shallow coastal sites to fore-reef) and sediment types (texture, grain size) and FI values were found to be high throughout the sampling area. This supports the notion that strong environmental stressors (e.g. eutrophication, pollution) are not yet effective to significantly impact mixotrophy (algal symbiosis) and coral reef growth (at least for the sites examined). Our survey is thus in line with observations that the pristine coral reefs of Raja Ampat are generally in good condition, in contrast to rampant reef destruction in other areas of Southeast Asia.

Large-scale logging activities, soil erosion, increasing rates of siltation and illegal fishing practices continue to threaten the integrity of Raja Ampat's coral reef ecosystem (McKenna, Allen and Suryadi 2002; McKenna, Bolis and Allen 2002; Erdmann and Pet 2002; Turak and Souhoka 2003), but in 2015, West Papua was declared Indonesia's first "conservation province" by the West Papuan government. Our research on benthic



TEXT-FIGURE 8
Scatter plot showing the percent abundances of planktonic foraminifera in relation to depth. Note that the abundance slightly increases with depth.

foraminifera provides a comprehensive baseline survey and the first protist perspective on the status of reefs around Raja Ampat. The quantitative data can be used to monitor rising influences of natural events and anthropogenic activities. Future changes can be compared to our baseline data and the development of changes can be determined over time. Quantitative data on foraminiferal assemblages including computations of FI index values may thus preserve environmental information as ecological tracers in coral reef ecosystems.

SUMMARY AND CONCLUSIONS

A total number of 421 species were recorded in this first comprehensive study on modern shallow-water benthic foraminifera from reef and nearshore environments from the Raja Ampat Archipelago (Indonesia). Five new species of Miliolidae were described in a previous study, including the new genus *Dentoplanispirinella* Förderer and Langer. Analysis of the assemblages shows that the area contains an exceptionally rich biota of benthic taxa with some of the highest diversity values reported to date for foraminiferal reef faunas. This provides strong support for previous observations that the archipelago represents one of the world's biologically richest locations for reefs in modern oceans. Porcelaneous Miliolida are particularly species-rich and constitute the most diverse foraminiferal order in coral reef environments of Raja Ampat. Diversity, in general, depends on sediment characteristics and is higest in very fine-grained sediments where small, thin-shelled taxa are most abundant.

Symbiont-bearing larger foraminifera contribute a substantial portion to the foraminiferal fauna. A total of 35 species and 18 genera of LBF were recovered at depths between 1 and 49 meters, indicating that the Raja Ampat Archipelago is an integral part of the area of maximum diversity for larger foraminifera.

The foraminiferal fauna of the sites surveyed is dominated by hyaline taxa with the most relevant species being representatives of the symbiont-bearing families Amphisteginidae and Calcarinidae. Species of these families reveal environmental preferences in terms of depth, substrate, and water energy that match observations from other localities in the Indo-Pacific realm. Both Amphisteginidae and Calcarinidae are ubiquitous components of the sediments and constitute 40.5% of the total fauna.

The clear and pristine waters of Raja Ampat, the homogenous composition of sediments and the lack of stable and pronounced thermoclines resulted in comparatively similar foraminiferal faunal assemblages in the region. Depth preferences of individual species, as recorded from other reefal areas of the Indo-Pacific, are less pronounced and individual habitats and faunal assemblages only weakly correlate with depth. Discrete geographical patterns of individual faunal assemblages were not detected and the lateral connectivity of habitats and assemblages appears to be high. The importance of hydrodynamic forces in structuring foraminiferal biotas has been recognized and account for compositional differences in assemblages collected from sheltered and wave exposed habitats. This is generally in agreement with previous observations on coral communities from the Raja Ampat area, showing that the reef habitats are highly interconnected and mainly controlled by exposure to wave energy levels. The analysis of the Foraminifera in Reef Assessment and Monitoring (FoRAM) Index revealed favorable water quality conditions suitable to support calcifying symbiosis and reef carbonate accretion at all surveyed sites. This conclusion is in line with on-site dive observations of high ratios of abundant live coral cover and abundant and varied associated fish, indicating that, overall, reefs at Raja Ampat are in very good condition.

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SYSTEMATICS AND TAXONOMY

Systematic concepts are of transitory nature, subject to permanent modifications and reflect the current state of our knowledge and techniques. Almost all modern and fossil foraminifera have been described on the basis of morphological characters but the recognition of species has been subject to continuous reconsideration. With the advent of molecular techniques, taxonomic endeavors in foraminifera have shifted from classic morphology-based to molecular approaches. The vast number of fossil taxa, however, represents a severe limitation, as fossil specimens can only be defined on their morphological test features and cannot be characterized by molecular techniques. Because of the current contrast between molecular and morphological lines of evidence, a fusion of molecular and morphological systematics with type material has recently been suggested (Roberts et al. 2016). To date, molecular 18S rDNA barcodes are inventoried for ~560 species or phylotypes (http://forambarcoding.unige.ch) but comprise only a fraction of the true diversity of foraminifera in modern oceans. Over the last decade, molecular techniques have resolved the relations among major rhizarian groups (Burki et al. 2010; Burki and Keeling 2014; He et al. 2016, Sierra et al. 2013, 2016), provided a new supraordinal classification scheme for foraminifera (Pawlowski et al. 2013) and a phylogeny of the Rotaliida with 3 new superfamilies and 10 new families (Holzmann and Pawlowski 2017). Over the next years, the inventory of foraminiferal barcodes will expand, but the status of benthic foraminiferal taxonomy is currently still debatable. For the systematic concept applied here, we, therefore, follow the suprageneric classification of Loeblich and Tappan (1992, 1994) and Kaminski (2004) for agglutinated foraminifera.

The main references used for the identification of species include the work of Loeblich and Tappan (1994) from the Sahul Shelf and Timor Sea, Debenay's (2012) catalogue of foraminifera from New Caledonia, the work of Haig (1988) and Parker (2009) on foraminifera from the Papuan Lagoon (New Guinea) and Western Australia's Ningaloo Reef, and the monograph by Hottinger, Halicz and Reiss (1993) on modern foraminifera from the Gulf of Aqaba (among many others, see synonomy list and the mention of previous studies in the Introduction).

A total of 421 species were identified and 419 are illustrated by high-resolution scanning electron microscope pictures and/or light microscopic images (Pls. 1–51). For most species, three or more pictures are provided to portray the relevant morphological test features. In addition, growth stages for a few species and test preservation changes are illustrated to show the range of test variability. Among the 178 species of the superfamily Milioloidea Ehrenberg (1839), five were described as new and published separately (Förderer and Langer 2016). For numerous species, a tentative (cf.) identification or open nomenclature (sp.) is used. Some of them may represent new species, for others, the material was insufficient or modern revisions of type material are not yet available.

For each species, a comprehensive synonymy is given. This includes material from well-illustrated monographs from the entire Indo-Pacific Ocean realm, literature from nearby regions and material from unpublished localities. To reflect the biogeographic range and occurrence of each taxon, information on collection areas is provided for records listed in the synonymy. Notes on morphological key features are given for those species that have not yet been formally described in the literature. This includes a brief description of the coiling mode, chamber arrangement, ornamental and apertural features, sutures, form of the test, and characteristics of the test wall. Re-

TABLE 8
Spearman's r_s correlation matrix. Correlation values are shown for the 29 most abundant species (RA > 0.51%) and the recently described species *Dentoplanispirinella occulta* (RA = 0.24%). Spearman's r_s correlation values are provided in the lower triangle. Moderate (0.40-0.59) to strong (0.60-0.79) r_s values are boldfaced. The two-tailed probability values are given in the upper triangle with small values indicating significant correlation.

	Amphistegina lessonii	*Amphistegina radiata*	*Heterostegina depressa*	*Calcarina spengleri*	*Eponides repandus*	*Calcarina gaudichaudii*	*Sahulia* cf. *S. kerimbaensis*	*Calcarina* cf. *C. hispida*	*Baculogypsina sphaerulata*	*Neorotalia calcar*	*Heterolepa subhaidingeri*	*Siphoniferoides siphoniferus*	*Asanonella tubulifera*	*Planorbulinella larvata*	*Amphistegina* sp.	*Elphidium crispum*	*Sahulia neorugosa*	*Elphidium craticulatum*	*Cibicides mabahethi*	*Lachlanella parkeri*	*Amphistegina bicirculata*	*Assilina ammonoides*	*Amphistegina lobifera*	*N. [illegible]iformis*	*Anomalinella rostrata*	*Textularia* sp. 2	*Cymbaloporetta* sp. 1	*Ammonia* cf. *A. tepida* Type 1	*Textularia corrugata* ?	*Dentoplanispirinella occulta*
A. lessonii		0.061	0.912	0.009	0.041	0.266	0.021	0.182	0.749	0.462	0.689	0.039	0.814	0.023	0.114	0.189	0.033	0.486	0.702	0.944	0.508	0.923	0.019	0.734	0.009	0.205	0.479	0.468	0.121	0.225
A. radiata	0.346		0.004	0.011	0.011	0.137	0.201	0.002	0.358	0.489	0.448	0.033	0.041	0.002	0.407	0.437	0.544	0.154	0.129	0.147	0.421	0.011	0.483	0.852	0.076	0.705	0.653	0.275	0.535	0.089
H. depressa	-0.021	0.514		0.665	0.074	0.042	0.138	0.022	0.346	0.551	0.111	0.145	0.026	0.004	0.056	0.148	0.330	0.013	0.033	0.286	0.019	0.320	0.076	0.509	0.780	0.093	0.096	0.172	0.318	0.014
C. spengleri	0.472	0.457	0.082		0.522	0.734	0.305	0.082	0.750	0.619	0.702	0.078	0.775	0.005	0.628	0.270	0.704	0.537	0.705	0.921	0.675	0.601	0.815	0.940	0.060	0.696	0.200	0.405	0.333	0.802
E. repandus	0.374	0.456	0.331	0.122		0.294	0.005	0.002	0.731	0.657	0.000	0.001	0.008	0.048	0.353	0.047	0.079	0.952	0.418	0.308	0.110	0.856	0.245	0.074	0.025	0.299	0.930	0.529	0.723	0.094
C. gaudichaudii	0.210	-0.278	**-0.373**	0.065	-0.198		0.349	0.018	0.001	0.081	0.160	0.740	0.068	0.238	0.282	0.589	0.536	0.649	0.930	0.723	0.161	0.701	0.003	0.396	0.736	0.775	0.227	0.186	0.716	0.097
S. cf. *S. kerimbaensis*	0.418	0.240	0.277	0.194	0.497	0.177		0.010	0.318	0.150	0.164	0.042	0.002	0.254	0.420	0.021	0.007	0.205	0.017	0.122	0.306	0.454	0.587	0.359	0.334	0.051	0.073	0.716	0.025	0.256
C. cf. *C. hispida*	-0.251	**-0.552**	**-0.415**	-0.323	**-0.534**	0.429	**-0.461**		0.050	0.034	0.209	0.017	0.004	0.028	0.929	0.016	0.029	0.335	0.074	0.210	0.695	0.105	0.201	0.385	0.151	0.329	0.331	0.328	0.008	0.075
B. sphaerulata	0.061	-0.174	-0.178	-0.061	-0.065	**0.579**	0.189	0.362		0.002	0.911	0.809	0.767	0.619	0.615	0.603	0.893	0.855	0.622	0.612	0.862	0.652	0.377	0.854	0.380	0.382	0.971	0.880	0.796	0.601
N. calcar	0.140	-0.131	-0.113	-0.094	0.085	0.324	0.270	0.388	**0.792**		0.431	0.592	0.248	0.713	0.378	0.648	0.759	0.522	0.787	0.888	0.582	0.833	0.538	0.234	0.493	0.278	0.538	0.274	0.677	0.197
H. subhaidingeri	0.076	0.144	0.297	-0.073	**0.603**	-0.263	0.261	-0.236	-0.021	0.149		0.897	0.049	0.068	0.016	0.141	0.702	0.717	0.133	0.448	0.022	0.847	0.069	0.070	0.475	0.018	0.878	0.567	0.028	0.377
S. siphoniferus	0.379	0.390	0.273	0.327	**0.561**	-0.063	0.374	**-0.431**	0.046	0.102	0.025		0.179	0.002	0.900	0.077	0.018	0.923	0.454	0.380	0.199	0.603	0.300	0.198	0.052	0.391	0.592	0.005	0.003	0.027
A. tubulifera	0.045	0.375	0.407	0.055	0.476	-0.338	0.542	**-0.510**	0.056	0.218	0.362	0.252		0.587	0.409	0.007	0.002	0.201	0.006	0.702	0.004	0.094	0.342	0.036	0.130	0.066	0.116	0.386	0.143	0.014
P. larvata	0.413	0.543	0.510	0.502	0.364	-0.222	0.215	**-0.400**	-0.095	-0.070	0.337	0.551	0.103		0.035	0.467	0.441	0.029	0.858	0.526	0.094	0.968	0.426	0.388	0.373	0.047	0.560	0.238	0.009	0.297
Amphistegina sp.	0.295	0.157	0.352	0.092	0.176	-0.203	0.153	0.017	-0.096	0.167	0.436	-0.024	0.157	0.385		0.752	0.899	0.459	0.259	0.788	0.026	0.940	0.549	0.856	0.408	0.064	0.713	0.470	0.527	0.708
E. crispum	-0.247	-0.147	-0.271	-0.208	**-0.366**	0.103	**-0.419**	0.434	0.099	0.087	-0.275	-0.328	**-0.485**	-0.138	-0.060		0.004	0.556	0.132	0.270	0.029	0.795	0.592	0.033	0.067	0.369	0.186	0.928	0.114	0.111
S. neorugosa	0.390	0.115	0.184	0.072	0.325	-0.118	0.484	**-0.398**	-0.026	0.058	0.073	0.430	0.540	0.146	-0.024	**-0.512**		0.122	0.452	0.727	0.125	0.656	0.769	0.127	0.102	0.438	0.127	0.770	0.043	0.604
E. craticulatum	0.132	0.267	0.446	0.117	-0.011	0.087	0.238	-0.182	-0.035	-0.122	0.069	-0.018	-0.240	0.399	0.141	0.112	-0.288		0.526	0.008	0.405	0.877	0.980	0.020	0.943	0.521	0.892	0.675	0.843	0.732
C. mabahethi	-0.073	0.284	0.391	0.072	0.154	-0.017	0.433	-0.331	0.094	0.051	0.281	0.142	0.493	0.054	0.213	-0.282	0.143	0.121		0.008	0.064	0.001	0.018	0.134	0.795	0.000	0.910	0.914	0.509	0.195
L. parkeri	-0.013	0.271	0.201	-0.019	0.193	0.068	0.289	-0.236	0.097	-0.027	0.144	0.166	0.073	0.120	0.051	0.208	-0.066	0.476	0.476		0.818	0.018	0.148	0.907	0.665	0.154	0.381	0.842	0.896	0.700
A. bicirculata	-0.126	0.152	0.426	-0.080	0.297	-0.263	0.193	-0.075	-0.033	0.105	0.415	0.241	0.516	0.311	0.405	**-0.398**	0.287	-0.158	0.342	0.044		0.196	0.016	0.073	0.690	0.013	0.153	0.617	0.394	0.089
A. ammonoides	-0.019	0.457	0.188	0.099	0.035	-0.073	0.142	-0.302	0.086	0.040	-0.037	0.099	0.311	0.008	0.014	0.049	0.085	-0.029	**0.577**	0.430	0.243		0.126	0.129	0.986	0.256	0.308	0.494	0.240	0.176
A. lobifera	0.426	-0.133	-0.329	0.045	-0.219	0.521	0.103	0.240	0.167	0.117	-0.336	-0.196	-0.180	-0.151	-0.114	0.102	0.056	0.005	**-0.429**	-0.271	**-0.437**	-0.286		0.038	0.575	0.120	0.800	0.143	0.672	0.005
N. [illegible]iformis	0.065	-0.036	-0.125	-0.014	0.331	-0.161	0.173	-0.165	-0.035	0.224	0.335	0.246	0.383	-0.163	0.034	**-0.390**	0.285	**-0.423**	0.280	-0.022	0.333	0.284	**-0.381**		0.307	0.298	0.577	0.431	0.836	0.080
A. rostrata	0.471	0.329	0.053	0.348	0.409	-0.064	0.183	-0.269	0.166	0.130	0.136	0.358	0.283	0.169	-0.157	-0.339	0.304	0.014	-0.050	0.083	-0.076	-0.003	0.107	0.193		0.659	0.695	0.297	0.148	0.350
Textularia sp. 2	0.238	0.072	0.312	0.074	0.196	-0.054	0.360	-0.184	0.165	0.205	0.429	0.162	0.340	0.365	**0.723**	-0.170	0.147	0.122	**0.610**	0.267	0.449	0.214	-0.290	0.196	-0.084		0.445	0.463	0.339	0.765
Cymbaloporetta sp. 1	0.135	-0.086	-0.309	0.241	0.017	0.227	-0.332	0.184	0.007	-0.117	-0.029	-0.102	-0.293	-0.111	0.078	0.248	-0.285	-0.026	0.021	0.166	-0.268	-0.193	0.048	-0.106	0.075	0.145		0.013	0.889	0.003
A. cf. *A. tepida* Type 1	0.138	-0.206	-0.256	-0.158	-0.119	0.248	-0.069	0.185	-0.029	-0.206	0.109	**-0.497**	-0.164	-0.222	0.137	0.017	-0.056	0.080	0.021	0.038	-0.095	-0.130	0.274	-0.149	-0.197	0.139	0.448		0.810	0.010
T. corrugata ?	0.289	0.118	0.189	0.183	**0.660**	-0.069	0.410	**-0.477**	-0.049	-0.079	0.401	0.518	0.274	0.467	0.120	-0.295	0.372	-0.038	-0.126	0.025	0.161	-0.221	0.081	0.039	0.271	0.181	-0.027	-0.046		0.512
D. occulta	0.228	-0.316	**-0.443**	-0.048	-0.312	0.308	-0.214	0.330	-0.099	-0.242	-0.167	**-0.403**	**-0.442**	-0.197	0.071	0.297	-0.099	0.065	-0.243	0.073	-0.316	-0.254	0.502	-0.325	-0.177	-0.057	0.517	**0.761**	-0.125	

marks are given whenever necessary and include information on particular morphological features, notes on the preservation of the test, and comparisons with similar taxa.

Repository: All samples and illustrated specimens will be deposited in the micropaleontological collections of the Goldfuß Museum (Steinmann Institut), University of Bonn, Germany.

Class FORAMINIFERA d'Orbigny 1826
Subclass TEXTULARIIA Mikhalevich 1980 (based on Kaminski 2004)
Order ASTORHIZIDA Lankester 1885
Suborder SACCAMMININA Lankester 1885
Superfamily PSAMMOSPHAEROIDEA Haeckel 1894
Family PSAMMOSPHAERIDAE Haeckel 1894
Sorosphaera Brady 1879

***Sorosphaera* ? sp.**
Plate 2, figures 1-3

Description: Test large, consisting of a series of irregularly arranged subglobular chambers added without a distinct arrangement; wall agglutinated with loosely cemented coarse grains and at times sponge spicules; apertural features uncertain, openings surrounded by a rim.

Order LITUOLIDA Lancester 1885
Suborder LITUOLINA Lancester 1885
Superfamily LITUOLOIDEA de Blainville 1827
Family HAPLOPHRAGMOIDIDAE Maync 1952

Haplophragmoides Cushman 1910

***Haplophragmoides* sp.**
Plate 1, figures 4-6

Description: Test planispiral, partially involute, laterally slightly compressed, periphery rounded; six to seven chambers in the final whorl, slowly increasing in size, slightly inflated; sutures depressed and distinct, slightly curved; wall agglutinated with particles of different sizes (including spicules), very smoothly finished; aperture a low equatorial opening at the inner margin of the final chamber.

Suborder SPIROPLECTAMMININA Mikhalevich 1992
Superfamily SPIROPLECTAMMINOIDEA Cushman 1927
Family SPIROPLECTAMMINIDAE Cushman 1927a
Subfamily SPIROPLECTAMMININAE Cushman 1927a
Spiroplectinella Kisel'man 1972

***Spiroplectinella*? sp.**
Plate 7, figures 13, 14

Description: Test biserial in the later portion, large, elongate, presumably planispiral in the early portion; chambers gradually increasing in size as added, last chamber aberrant; sutures slightly depressed; wall coarsely agglutinated, smoothly finished, abraded; aperture obscure.

Remarks: The specimen recovered is heavily abraded. It also shows an aberrant growth in at least the final chamber. The initial stage appears to be planispiral and the taxon is tentatively assigned to *Spiroplectinella*.

Family NOURIIDAE Chapman and Parr 1936
Nouria Heron-Allen and Earland 1914

***Nouria armata*?** Collins 1958
Plate 1, figures 13, 14

? *Nouria textulariformis* Hada subsp. *armata* COLLINS 1958, p. 352, pl. 1, figs. 11a, b.

Occurrence: ? Great Barrier Reef (Collins 1958).

Suborder TROCHAMMININA Saidova 1981
Superfamily TROCHAMMINOIDEA Schwager 1877
Family TROCHAMMINIDAE Schwager 1877
Paratrochammina Brönnimann 1979

Paratrochammina globorotaliformis (Zheng 1988)
Plate 1, figures 1-3

Trochammina globorotaliformis ZHENG 1988, p. 83, 316, pl. 39, fig. 3.
Paratrochammina globorotaliformis (Zheng) – LOEBLICH and TAPPAN 1994, p. 23, pl. 23, figs. 1-12.

Occurrence: East China Sea (Zheng 1988), Timor Sea (Loeblich and Tappan 1994).

Trochammina Parker and Jones 1859

Trochammina carinata Cushman and McCulloch 1939
Plate 1, figures 7-9

Trochammina carinata CUSHMAN and MCCULLOCH 1939, p. 109, pl. 12, fig. 3. – DEBENAY 2012, p. 101, 258.

Occurrence: off Guadalupe, Baja California (Cushman and McCulloch 1939), New Caledonia (Debenay 2012).

***Trochammina* sp.**
Plate 1, figures 10-12

Description: Test planoconvex with low, trochospirally coiled chambers; chambers continuously increasing in size as added; six chambers in the final whorl; sutures distinct, strongly curved backwards; wall on the spiral side coarsely agglutinated, smoothly finished on the umbilical side; aperture umbilical, an interiomarginal arch bordered by a weakly developed rim.

Septotrochammina Zheng 1979

Septotrochammina gonzalesi (Seiglie 1964)
Plate 1, figures 17, 18

Remaneica gonzalesi SEIGLIE 1964, p. 500, pl. 1, figs. 7, 8.
Septotrochammina gonzalesi (Seiglie) – LOEBLICH and TAPPAN 1994, p. 25, pl. 28, figs. 1-5. – DEBENAY 2012, p. 93, 259.

Occurrence: Venezuela (Seiglie 1964), Timor Sea (Loeblich and Tappan 1994), New Caledonia (Debenay 2012).

Rotaliammina Cushman 1924

***Rotaliammina* sp.**
Plate 1, figures 15, 16

Rotaliammina chitinosa (Collins) – LOEBLICH and TAPPAN 1994, p. 24, pl. 27, figs. 7-9, not figs. 4-5.
Rotaliammina sp. 1 PARKER 2009, p. 22, fig. 17 a, b.

Remarks: This species shows more chambers (7-8) than *Rotaliammina chitinosa* (Collins) that shows 5-6 chambers, and is probably a new species. For remarks on the morphology see description and remarks in Parker (2009; p. 22).

Occurrence: Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009).

Suborder VERNEUILININA Mikhalevich and Kaminski 2004
Superfamily VERNEUILINOIDEA Cushman 1911
Family VERNEUILINIDAE Cushman 1911
Gaudryina d'Orbigny 1839

Gaudryina attenuata Chapman 1902
Plate 3, figures 1-3

Gaudryina attenuata CHAPMAN 1902, p. 409, pl. 36, fig. 10. – LOEBLICH and TAPPAN 1994, p. 21, pl. 18, figs. 1-13. – DEBENAY 2012, p. 81, 260.
Gaudryina attenuata Cushman – CUSHMAN 1921, p. 152, pl. 30, fig. 4.

Remarks: Loeblich and Tappan (1994) depict a high degree of variability in this species. Chapman (1902) illustrates a very distinctive specimen.

Occurrence: Funafuti (Chapman 1902), New Caledonia (Debenay 2012), Philippines (Cushman 1921).

Gaudryina quadrangularis Bagg 1908
Plate 3, figures 4, 5

Gaudryina quadrangularis BAGG 1908, p. 133, pl. 5, fig. 1. – LOEBLICH and TAPPAN 1994, p. 21, pl. 17, figs. 22, 23. – DEBENAY 2012, p. 81, 260.

Remarks: The species is tentatively placed in *Gaudryina* (not *Pseudogaudryina* Cushman) as there is no evidence of a canaliculated wall.

Occurrence: Hawaii (Bagg 1908), Timor Sea (Loeblich and Tappan 1994), New Caledonia (Debenay 2012).

Order LOFTUSIIDA Kaminski and Mikhalevich 2004
Suborder BIOKOVININA Kaminski 2004
Superfamily COSCINOPHRAGMATOIDEA Thalmann 1951
Family HADDONIIDAE Saidova 1981
Bdelloidina Carter 1877

Bdelloidina aggregata Carter 1877
Plate 2, figures 4, 5

Bdelloidina aggregata CARTER 1877, p. 201, pl. 13, figs. 1-8. – BRADY 1884, p. 319, pl. 36, figs. 4-6. – HOKFER 1968, p. 15, pl. 1, figs. 13-20. – LOEBLICH and TAPPAN 1994, p. 19, pl. 13, figs. 1-7.

Occurrence: Admiralty Islands (Brady 1884), Java (Hokfer 1968), Timor Sea (Loeblich and Tappan 1994).

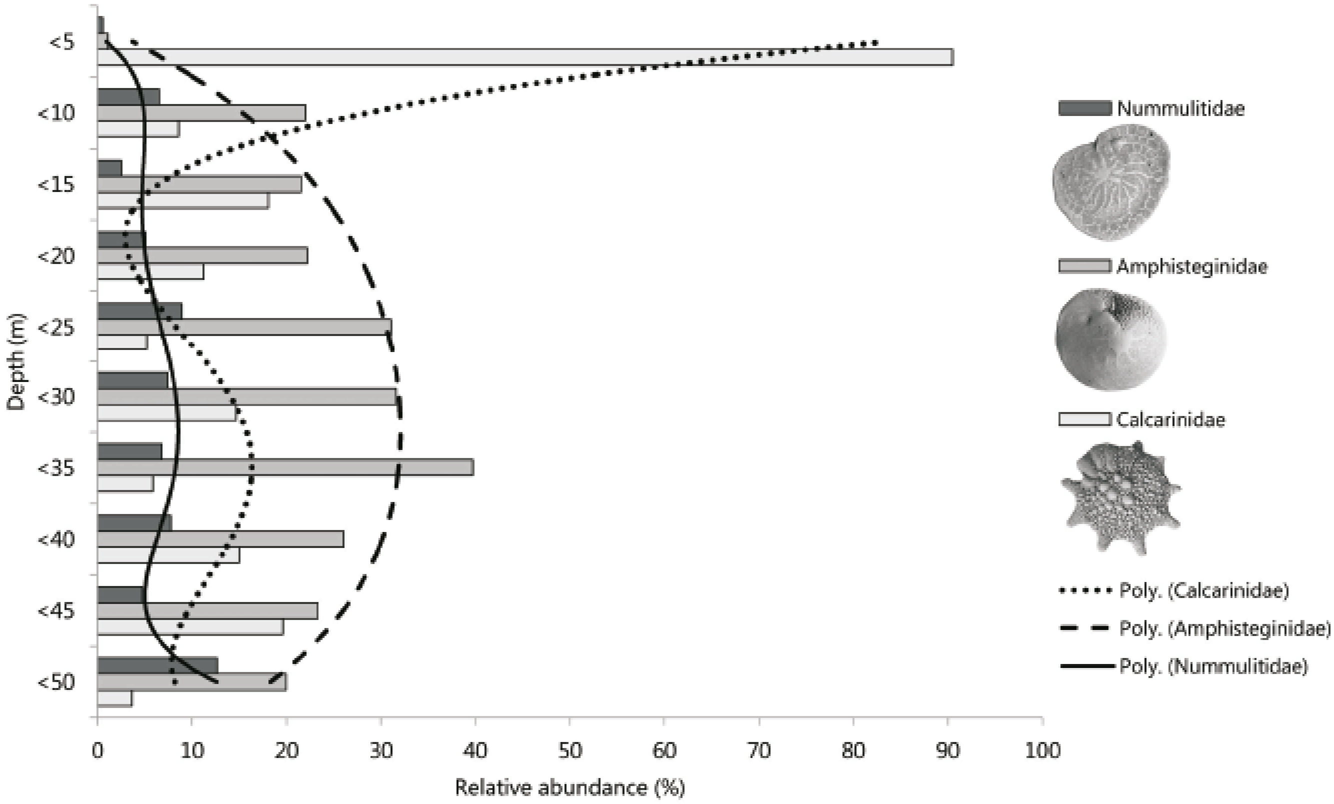
Haddonia Chapman 1898

Haddonia torresiensis Chapman 1898
Plate 2, figures 6-12

Haddonia torresiensis CHAPMAN 1898, p. 454, pl. 28, figs. 1-5. – CHENG and ZHENG 1978, p. 158, pl. 1, figs. 1, 2. – LOEBLICH and TAPPAN 1987, p. 92, pl. 84, figs. 1, 2. – LOEBLICH and TAPPAN 1994, p. 18, pl. 9, figs. 5,6; pl. 11, figs. 6-11. – LANGER and LIPPS 2003, p. 152, fig. 7B: c. – PARKER 2009, p. 32, fig. 24a-e. – DEBENAY 2012, p. 82, 261.

Remarks: The initial coiled stage is lacking and only fragments of the later uniserial stage have been found in our material.

Occurrence: Torres Strait (Chapman 1898), Xisha Islands (Cheng and Zheng 1978), Atlantic and Pacific, Eocene to Holocene (Loeblich and Tappan 1987), Timor Sea (Loeblich and Tappan 1994), Madang, Papua New Guinea (Langer and Lipps



TEXT-FIGURE 9
Percent abundances of the most frequent LBF families (Nummulitidae, Amphisteginidae, and Calcarinidae) in relation to water depth. The polynomial trendlines illustrate divergent fluctuations and trends in abundance patterns of individual families. The specimens depicted represent the most abundant species within each family. From top to bottom: *Heterostegina depressa*, *Amphistegina lessonii*, and *Calcarina spengleri*.

2003), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

Order TEXTULARIIDA Delage and Herouard 1896
Suborder TEXTULARIINA Delage and Herouard 1896
Superfamily EGGERELLOIDEA Cushman 1937
Family EGGERELLIDAE Cushman 1937
Rudigaudryina Cushman and McCulloch 1939

Rudigaudryina minor (Chapman 1901)
Plate 2, figures 19, 20

Haddonia minor CHAPMAN 1901, p. 384, pl. 36, figs. 1, 2. – COLLINS 1958, p. 352. – BACCAERT 1987, p. 11, pl. 4, figs. 1-5.
Rudigaudryina minor (Chapman) – PARKER 2009, p. 32, figs. 26a-k; 27a-k.

Occurrence: Funafuti (Chapman 1901), Great Barrier Reef (Collins 1958, Baccaert 1987), Ningaloo Reef (Parker 2009), Madang, Papua New Guinea (Langer unpubl. data).

Family PSEUDOGAUDRYINIDAE Loeblich and Tappan 1985
Subfamily PSEUDOGAUDRYININAE Loeblich and Tappan 1985
Pseudogaudryina Cushman 1936

Pseudogaudryina pacifica Cushman and McCulloch 1939
Plate 3, figures 6-10

Gaudryina (Pseudogaudryina) atlantica (Bailey) var. *pacifica* CUSHMAN and MCCULLOCH 1939, p. 94, pl. 9, figs. 1, 2.
Pseudogaudryina pacifica Cushman and McCulloch – LOEBLICH and TAPPAN 1994, p. 33, pl. 45, figs. 20-23. – DEBENAY 2012, p. 89, 262.
Gaudryina convexa (Karrer) – PARKER 2009, p. 31, figs. 23a-h.

Occurrence: San Benito Island (Cushman and Mcculloch 1939), Timor Sea (Loeblich and Tappan 1994), New Caledonia (Debenay 2012), Ningaloo Reef (Parker 2009).

***Pseudogaudryina* sp.**
Plate 3, figures 11, 12

Pseudogaudryina sp. A HOTTINGER, HALICZ and REISS 1993, p. 40, pl. 19, figs. 1-11.

Remarks: The test of this species is tapering in the initial portion of the test and thus differs from *P. pacifica* Cushman and McCulloch. However, it could also possibly represent a gamont or agamont of *P. pacifica*. For morphological details see description in Hottinger, Halicz and Reiss (1993).

Occurrence: Gulf of Aqaba (Hottinger, Halicz and Reiss 1993).

Subfamily SIPHONIFEROIDINAE Loeblich and Tappan 1985
Plotnikovina Mikhalevich 1981

Plotnikovina transversaria (Brady 1884)
Plate 3, figures 13-16

Textularia transversaria BRADY 1884, p. 359, pl. 113, figs. 3-5.
Gaudryina (Siphogaudryina) transversaria (Brady) – CHENG and ZHENG 1978, p. 165, pl. 2, fig. 18a-c.
Plotnikovina transversaria (Brady) – DEBENAY 2012, p. 87, 262.

Remarks: The generic assignment follows Debenay (2012).

Occurrence: Torres Strait (Brady 1884), Xisha Islands (Cheng and Zheng 1978), New Caledonia (Debenay 2012).

Siphoniferoides Saidova 1981

Siphoniferoides siphoniferus (Brady 1881)
Plate 3, figures 17-22

Textularia siphonifera BRADY 1881, p. 53. – BRADY 1884, p. 362, pl. 42, figs. 25-29. – CUSHMAN 1924, p. 115, pl. 21, figs. 4-7.
Gaudryina (Siphogaudryina) siphonifera (Brady) – GRAHAM and MILITANTE 1959, p. 30, pl. 2, figs. 12, 13. – CHENG and ZHENG 1978, p. 164, pl. 2, figs. 14a-c, 15-17.
Siphoniferoides siphoniferus (Brady) – LOEBLICH and TAPPAN 1994, p. 33, pl. 46, figs. 3-6 (not figs. 1, 2 and 7-10). – LANGER and LIPPS 2003, p. 153, fig. 7D: b. – PARKER 2009, p. 39, figs. 32a-h. – DEBENAY 2012, p. 93, 262.

Occurrence: Hawaii and Admiralty Islands (Brady 1881, 1884), Samoa (Cushman 1924), Philippines (Graham and Militante 1959), Xisha Islands (Cheng and Zheng 1978), Timor Sea (Loeblich and Tappan 1994), Madang, Papua New Guinea (Langer and Lipps 2003), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

Family VALVULINIDAE Berthelin 1880
Subfamily VALVULININAE Berthelin 1880
Clavulina d'Orbigny 1826

Clavulina pacifica Cushman 1924
Plate 2, figures 13-18

Clavulina angularis d'Orbigny – BRADY 1884, p. 396, pl. 48, figs. 22-24.
Clavulina pacifica CUSHMAN 1924, p. 22, pl. 6, figs. 7-11. – GRAHAM and MILITANTE 1959, p. 32, pl. 2, figs. 17 a, b. – BARKER 1960, pl. 48, figs. 22-24. – CHENG and ZHENG 1978, p. 166, pl. 3, fig. 11a, b. – BACCAERT 1987, p. 35, pl. 11, figs. 7, 8. – LOEBLICH and TAPPAN 1994, p. 34, pl. 47, figs. 16-24. – LANGER and LIPPS 2003, p. 152, fig. 7D: a. – PARKER 2009, p. 26, figs. 21a-f; 22a-i. – MAKLED and LANGER 2011, p. 236, fig. 3: 7-10. – DEBENAY 2012, p. 78, 262.

Remarks: For differences between *C. angularis* and *C. pacifica* see discussion in Parker (2009; p. 28).

Occurrence: Admiralty Islands (Brady 1884, Barker 1960), Samoa (Cushman 1924), Philippines (Graham and Militante 1959), Xisha Islands (Cheng and Zheng 1978), Great Barrier Reef (Baccaert 1987), Timor Sea (Loeblich and Tappan 1994), Madang, Papua New Guinea (Langer and Lipps 2003), Ningaloo Reef (Parker 2009), Caroline Islands (Makled and Langer 2011), New Caledonia (Debenay 2012).

Family TEXTULARIIDAE Ehrenberg 1838
Subfamily TEXTULARIINAE Ehrenberg 1838
Sahulia Loeblich and Tappan 1985

Sahulia barkeri (Hofker 1978)
Plate 4, figures 1-4

Textularia trochus d'Orbigny – BRADY 1884, p. 366, pl. 43, figs. 15, 16, 18.
Textularia n. sp. BARKER 1960, pl. 43, figs. 15, 16, 18.
Textularia barkeri HOFKER 1978, p. 27, pl. 1, fig. 3.
Sahulia barkeri (Hofker) – LOEBLICH and TAPPAN 1994, p. 27, pl. 32, figs. 1-8. – PARKER 2009, p. 35, fig. 28a-d. – DEBENAY 2012, p. 92, 263.

Occurrence: New Guinea (Brady 1884), Eastern Indonesia (Hofker 1978), Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Madang, Papua New Guinea (Langer unpubl. data).

Sahulia conica (d'Orbigny 1839)
Plate 4, figures 5-8

Textularia conica D'ORBIGNY 1839, p. 143, pl. 1, figs. 19, 20. – BRADY 1884, p. 365, pl. 43, figs. 13, 14. – CUSHMAN 1921, p. 123, pl. 25, figs. 2a, b. – CHENG and ZHENG 1978, p. 159, pl. 1, fig. 6a, b. – HATTA and UJIIÉ 1992, p. 58, pl. 2, figs. 5a, b. – SZAREK 2001, p. 94, pl. 8, figs. 19-21. – DEBENAY 2012, p. 96, 263.

Occurrence: Cuba (d'Orbigny 1839), Friendly Islands and Torres Strait (Brady 1884), Philippines (Cushman 1921), Xisha Islands (Cheng and Zheng 1978), Ryukyus (Hatta and Ujiié 1992), Sunda Shelf (Szarek 2001), New Caledonia (Debenay 2012).

Sahulia* cf. *S. conica (d'Orbigny 1839)
Plate 4, figures 9, 10

cf. *Textularia conica* D'ORBIGNY 1839, p. 143, pl. 1, figs. 19, 20.

Remarks: Our specimens resemble *Textularia truncata* Höglund as identified by Loeblich and Tappan (1994; p. 30, pl. 35, figs. 8-13).

Occurrence: *Sahulia conica* was originally described from Cuba.

Sahulia* cf. *S. kerimbaensis (Said 1949)
Plate 4, figures 15-20

cf. *Textularia kerimbaensis* SAID 1949, p. 6, pl. 1, fig. 8.
Sahulia kerimbaensis (Said) – THISSEN and LANGER 2017, p. 24, pl. 1, figs. 19-22.

Occurrence: Zanzibar (Thissen and Langer 2017), Madang, Papua New Guinea (Langer unpubl. data). *Sahulia kerimbaensis* was originally described from the Red Sea.

Sahulia* cf. *S. lutzei Langer 1992
Plate 4, figures 11, 12

cf. *Sahulia lutzei* LANGER 1992, p. 86, pl. 1, figs. 4-6.

Remarks: Our specimen may represent an early developmental stage of *S. lutzei* Langer.

Occurrence: *Sahulia lutzei* was originally described from Mandang, Papua New Guinea.

Sahulia neorugosa (Thalmann 1950)
Plate 4, figures 23, 24

Plecanium rugosum (not *Textularia rugosa* d'Orbigny 1826) REUSS 1869, p. 453, pl. 1, fig. 3a, b [*fide* Thalmann 1950].
? *Textularia corrugata* Heron-Allen and Earland – CUSHMAN 1932, p. 12, pl. 3, fig. 4a,b (not fig. 2).
Textularia rugosa (Reuss) – LALICKER and MCCULLOCH 1940, p. 139, pl. 16, figs. 21a-c.
Textularia neorugosa new name THALMANN 1950, p. 45, not figured. – CHENG and ZHENG 1978, p. 160, pl. 1, figs. 10a-c, 11, 12. – HATTA and UJIIÉ 1992, p. 59, pl. 2, figs. 8a, b.

Remarks: This species is very common in the material from Raja Ampat. It is characterized by an elongated test with an acute periphery, where early chambers are distinctly compressed and later chambers show deep indentations above the sutures. This species also resembles *Sahulia* cf. *S. kerimbaensis* Said reported from the Red Sea.

Occurrence: ? Fiji (Cushman 1932), Mexico and Gulf of California (Lalicker and McCulloch 1940), Xisha Islands (Cheng and Zheng 1978), Ryukyus (Hatta and Ujiié 1992).

***Sahulia*? sp. 1**
Plate 4, figures 25, 26

Description: Test biserial, slightly elongated, chambers gradually increasing in width, slightly inflated; sutures depressed, oblique, obscure in the early portion; wall coarsely agglutinated, roughly finished; aperture a straight slit at the base of the inner margin of the final chamber.

Remarks: The initial portion is broken. The specimen probably has internal partitions and is tentatively placed in *Sahulia* Loeblich and Tappan 1985.

***Sahulia* sp. 2**
Plate 4, figures 13, 14

Description: Test biserial, slightly broader than high; chambers rapidly increasing in height and width as added, somewhat constricted at the outer margins; sutures depressed, distinct; wall agglutinated with loosely cemented particles of various shapes and sizes, including spicules, smoothly finished; aperture a low slit at the inner margin of the final chamber.
Textularia Defrance 1824

Textularia agglutinans d'Orbigny 1839
Plate 5, figures 1, 2

Textularia agglutinans D'ORBIGNY 1839, p. 144, pl. 1, figs. 17, 18, 32-34. – CUSHMAN 1921, p. 106, pl. 20, fig. 8. – LE CALVEZ 1977, p. 13, 14, figs. 1-3. – CHENG and ZHENG 1978, p. 159, pl. 1, figs. 4, 5a-c. – HOTTINGER, HALICZ and REISS 1993, p. 36, pl. 13, figs. 1-9. – LOEBLICH and TAPPAN 1994, p. 27, pl. 33, figs. 8-12. – PARKER 2009, p. 44, fig. 33a-k. – DEBENAY 2012, p. 95, 263. – LANGER et al. 2013, p. 160, fig. 4: 8. – THISSEN and LANGER 2017, p. 26, pl. 2, figs. 1-4.

Occurrence: Cuba (d'Orbigny 1839, Le Calvez 1977), Philippines (Cushman 1921), Xisha Islands (Cheng and ZHENG 1978), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Bazaruto (Langer et al. 2013), Zanzibar (Thissen and Langer 2017).

Textularia candeiana d'Orbigny 1839
Plate 5, figures 3-5

TABLE 9
Test preservation state. Preservation of foraminiferal assemblages based on preservation categories (1 = heavily damaged/abraded, 2 = medium damaged/abraded, 3 = intact) is given in percent for each sample. Values above 40% are boldfaced.

Sample	Preservation state 1	Preservation state 2	Preservation state 3
AP09	31.4	**40.1**	28.6
AP10	24.4	36.6	39.1
AW12	27.0	**41.0**	31.9
AW13	14.7	24.0	**61.3**
B14	17.9	**47.1**	35.0
B15	**40.4**	38.0	21.7
CK	31.4	36.5	32.1
CM	21.2	**43.9**	35.0
E22	23.0	**44.0**	33.1
ER 23	**55.9**	31.5	12.7
FW	39.3	33.0	27.7
MG	21.9	38.1	**40.0**
MI05	25.0	39.2	35.8
MI06	25.8	**43.7**	30.5
MR17	28.7	**44.0**	27.3
MR18	31.7	**50.2**	18.1
Ms	15.4	35.5	**49.3**
MS03	17.0	**44.5**	38.5
MS04	21.0	**40.3**	38.7
N18	**44.7**	**45.0**	10.4
N19	17.5	**56.6**	25.9
OT	20.1	**47.1**	32.8
U01	24.0	**40.9**	35.1
U02	34.5	**40.1**	25.4
U16	24.0	**56.3**	19.7
Wa	1.6	20.6	**77.8**
W07	**43.6**	39.1	17.3
W08	27.3	**51.9**	20.8
Y24	8.8	25.3	**65.9**
Y25	15.0	**41.7**	**43.3**

Textularia candeiana D'ORBIGNY 1839, p. 143, pl. 1, figs. 25-27. – HERON-ALLEN and EARLAND 1915, p. 627, pl. 47, figs. 10-16. – SAID 1949, p. 5, pl. 1, fig. 5. – COLLINS 1958, p. 352. – GRAHAM and MILITANTE 1959, p. 27, pl. 1, fig. 22. – PARKER 2009, p. 44, fig. 34a-f. – DEBENAY 2012, p. 96, 263. – MAKLED and LANGER 2011, p. 249, fig. 2: 13-16.
? *Textularia secasensis* Lalicker and McCulloch – LOEBLICH and TAPPAN 1994, p. 29, pl. 39, figs. 8-14.

Occurrence: Cuba (d'Orbigny 1839), Quirimbas (Heron-Allen and Earland 1915), Red Sea (Said 1949), Great Barrier Reef (Collins 1958), Philippines (Graham and Militante 1959), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Caroline Islands (Makled and Langer 2011), ? Timor Sea

(Loeblich and Tappan 1994), Madang, Papua New Guinea (Langer unpubl. data).

***Textularia corrugata*?** Heron-Allen and Earland 1915
Plate 5, figures 18-20

? *Textularia conica* var. *corrugata* HERON-ALLEN and EARLAND 1915, p. 629, pl. 47, figs. 24-27.

Occurrence: ? Quirimbas (Heron-Allen and Earland 1915).

Textularia crenata Cheng and Zheng 1978
Plate 6, figures 9-11

Textularia crenata CHENG and ZHENG 1978, p. 160, 256, pl. 1, figs. 7, 8a, b, 9a, b.
Gaudryina rugulosa (Cushman) – BACCAERT 1987, p. 32, pl. 11, figs. 2, 3.
Septotextularia rugosa? Cheng and Zheng – MAKLED and LANGER 2011, p. 248, fig. 2: 27-30.

Remarks: This very large species has been previously assigned to *Septotextularia rugosa* Cheng and Zheng and to *Gaudryina rugulosa* Cushman. However, it differs significantly from *S. rugosa*, with which it occurs regularly in our sample material, in the more roughly finished wall and the shape of the apertural face. It also differs from *G. rugulosa* (as also reported by Hottinger, Halicz and Reiss 1993 from the Gulf of Aqaba, p. 38, pl. 15, figs. 1-6) in the more inflated chambers and lacking an early triserial stage.

Occurrence: Xisha Islands (Cheng and Zheng 1978), Great Barrier Reef (Baccaert 1987), Caroline Islands (Makled and Langer 2011).

Textularia cushmani Said 1949
Plate 6, figures 14-17

Textularia cushmani SAID 1949, p. 7, pl. 1, fig. 13. – HOTTINGER, HALICZ and REISS 1993, p. 36, pl. 13, figs. 10-14. – LOEBLICH and TAPPAN 1994, p. 28, pl. 35, figs. 1-4. – PARKER 2009, p. 44, fig. 35a-e. – PARKER and GISCHLER 2011, pl. 1, figs. 5-7. – DEBENAY 2012, p. 96, 264. – LANGER et al. 2013, fig. 4: 10.

Occurrence: Red Sea (Said 1949, Hottinger, Halicz and Reiss 1993), Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), Maldives (Parker and Gischler 2011), New Caledonia (Debenay 2012), Bazaruto (Langer et al. 2013).

Textularia dupla Todd 1954
Plate 5, figures 6, 7

Textularia dupla TODD in CUSHMAN, TODD and POST 1954, p. 329, pl. 83, fig. 6. – CHENG and ZHENG 1978, p. 160, pl. 1, fig. 13a, b.

Remarks: The specimens from Raja Ampat also resemble *Textularia lutzei* Langer from Papua New Guinea.

Occurrence: Marshall Islands (Cushman, Todd and Post 1954), Xisha Islands (Cheng and Zheng 1978).

Textularia foliacea Heron-Allen and Earland 1915
Plate 6, figures 22, 23

Textularia foliacea HERON-ALLEN and EARLAND 1915, p. 628, pl. 47, figs. 17-20. – CUSHMAN 1932, p. 8, pl. 1, figs. 6-10. – SAID 1949, p. 6, pl. 1, fig. 9. – TODD 1957, p. 286, pl. 85, fig. 5. – COLLINS 1958, p. 353. – GRAHAM and MILITANTE 1959, p. 28, pl. 2, fig. 3. – LOEBLICH and TAPPAN 1994, p. 28, pl. 34, figs. 6-14. – PARKER 2009, p. 48, figs. 36a-q; 37a-k. – DEBENAY 2012, p. 97, 264. – THISSEN and LANGER 2017, p. 26, pl. 2, figs. 5-8.

Occurrence: Quirimbas (Heron-Allen and Earland 1915), Tropical Pacific (Cushman 1932), Red Sea (Said 1949), Mariana Islands (Todd 1957), Great Barrier Reef (Collins 1958), Philippines (Graham and Militante 1959), Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Zanzibar (Thissen and Langer 2017), Madang, Papua New Guinea (Langer unpubl. data).

Textularia occidentalis Cushman 1922
Plate 6, figures 20, 21

Textularia foliacea Heron-Allen and Earland var. *occidentalis* CUSHMAN 1922, p. 16. Plate 2; fig. 13. – HOTTINGER, HALICZ and REISS 1993, p. 37, pl. 14, figs. 6-11.
Textularia occidentalis Cushman – DEBENAY 2012, p. 97, 264.

Occurrence: Cuba (Cushman 1922), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), New Caledonia (Debenay 2012).

Textularia oceanica Cushman 1932
Plate 6, figures 18, 19

Textularia foliacea Heron-Allen and Earland var. *oceanica* CUSHMAN 1932, p. 8, pl. 1, figs. 11, 12. – SAID 1949, p. 6, pl. 1, fig. 10. – GRAHAM and MILITANTE 1959, p. 28, pl. 2, figs. 5, 6.
Textularia oceanica Cushman – CHENG and ZHENG 1978, p. 161, pl. 2, fig. 1a-c.
Textularia foliacea Heron-Allen and Earland subsp. *oceanica* Cushman – BACCAERT 1987, p. 22, pl. 7, figs. 3, 4.
Textularia foliacea oceanica Cushman – HOTTINGER, HALICZ and REISS 1993, p. 37, pl. 14, figs. 12-16.
Textularia oceanica (Cushman) – LANGER and LIPPS 2003, p. 153, fig. 7B: b.

Occurrence: Fiji (Cushman 1932), Red Sea (Said 1949, Hottinger, Halicz and Reiss 1993), Philippines (Graham and Militante 1959), Xisha Islands (Cheng and Zheng 1978), Great Barrier Reef (Baccaert 1987), Madang, Papua New Guinea (Langer and Lipps 2003).

***Textularia stricta*?** Cushman 1911
Plate 6, figures 12, 13

? *Textularia stricta* CUSHMAN 1911, p. 11, text fig. 13.
Textularia stricta Cushman – LOEBLICH and TAPPAN 1994, p. 30, pl. 38, figs. 1-9. – DEBENAY 2012, p. 98, 264.

Occurrence: ? North Atlantic (Cushman 1911), Timor Sea (Loeblich and Tappan 1994), New Caledonia (Debenay 2012).

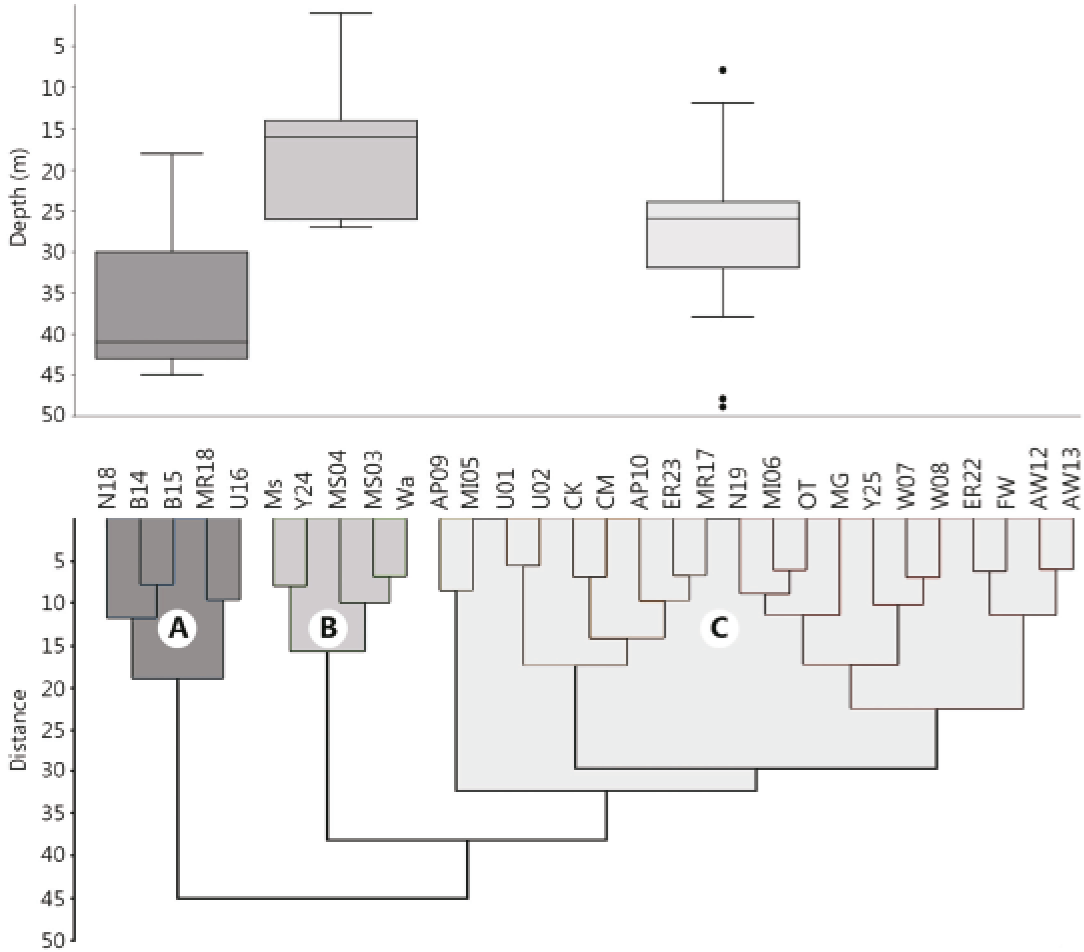
***Textularia truncata*?** Höglund 1947
Plate 5, figures 8, 9

? *Textularia truncata* HÖGLUND 1947, p. 195, pl. 12, figs. 8, 9, text figs. 147-149.
Textularia truncata Höglund – LOEBLICH and TAPPAN 1994, p. 30, pl. 35, figs. 8, 9, 12, 13 (not figs. 10, 11).

Occurrence: ? North Sea (Höglund 1947), Timor Sea (Loeblich and Tappan 1994).

***Textularia* sp. 1**
Plate 5, figures 21, 22

Description: Test biserial, about as high as broad, robust; chambers slightly inflated, increasing in size as added; sutures depressed, obscure; wall coarsely agglutinated with relatively large loosely cemented rounded grains of more or less the same size, roughly finished; apertural face subcircular, aperture a narrow slit at the inner margin of the final chamber.



TEXT-FIGURE 10
Q-mode cluster analysis. The cluster analysis was performed using the Ward's method. The samples plot in three different clusters (A, B, and C) and reveal a weak relation to water depth (as shown above).

***Textularia* sp. 2**
Plate 6, figures 24, 25; Plate 7, figures 1-3

Description: Test biserial, elongate; chambers increasing in size as added; sutures depressed, obscure; wall coarsely agglutinated with loosely cemented particles of various shapes and sizes, roughly finished; apertural face subquadrangular, somehow depressed, aperture a low slit at the inner margin of the final chamber, boardered by a lip at the upper margin.

***Textularia*? sp. 3**
Plate 7, figures 4-6

Description: Test small, elongated, biserial, slightly tapering, periphery broadly rounded; chambers slightly inflated, rounded, increasing in size as added; sutures of later chambers distinct and depressed; wall coarsely agglutinated with particles of different size and shape; aperture an arch-shaped opening at the inner margin of the final chamber.

***Textularia* sp. 4**
Plate 5, figures 10, 11

Description: Test biserial, elongate; chambers slowly increasing in height and width as added; sutures very slightly depressed, indistinct, obscure; wall agglutinated with particles of various shapes and sizes, roughly finished; aperture a low, broad slit at the inner margin of the final chamber.

***Textularia* sp. 5**
Plate 5, figures 14-17

Description: Test small, slightly elongated with biserially arranged chambers; chambers gradually increasing in size as added; sutures not depressed, obscure; wall coarsely agglutinated with particles of various shapes and sizes, roughly finished in the adult; apertural face laterally depressed, aperture an arch-shaped opening at the inner margin of the final chamber.

***Textularia* sp. 6**

Plate 7, figures 10-12

Description: Test with biserially arranged chambers, elongate, irregulary formed, twisted; upper half of the test turned about 90 degrees; chambers in the later portion more inflated; sutures depressed, obscure; wall agglutinated with particles of various shapes and sizes, roughly finished; apertural face oblique, aperture a broad slit at the inner margin of the final chamber.

***Textularia* sp. 7**
Plate 5, figures 27, 28

Description: Test small, very short, broader than high; last chambers rapidly increasing in size as added; sutures obscure, indistinct; wall coarsely agglutinated with particles of various shapes and sizes, rather roughly finished; apertural face laterally depressed, aperture a low slit at the inner margin of the final chamber.

Remarks: The species is comparatively small and has only few chambers.

***Textularia* sp. 8**
Plate 5, figures 12, 13

Description: Test with biserially arranged chambers, slightly broader than high, periphery rounded; chambers inflated, gradually increasing in height and width as added; sutures depressed, obscure; wall agglutinated with particles of various shapes and sizes, rather coarsely finished; apertural face laterally depressed, rounded, aperture a slit at the inner margin of the final chamber.

***Textularia* sp. 9**
Plate 7, figures 7-9

Description: Test with biserially arranged chambers, elongate; chambers irregularly formed and added in the later portion, increasing in size as added; sutures depressed, partially obscure; wall agglutinated with particles of various shapes and sizes, roughly finished; aperture a broad slit at the inner margin of the final chamber.

***Textularia* sp. 10**
Plate 5, figures 23-26

Textularia sp. 1 PARKER 2009, p. 56, figs. 42a-g, 43a-k.

Remarks: The species resembles *Textularia crenata* Cheng and Zheng and *Septotextularia rugosa* Cheng and Zheng. For details on the morphology see description and remarks in Parker (2009).

Occurrence: Ningaloo Reef (Parker 2009).

Subfamily SEPTOTEXTULARIINAE Loeblich and Tappan 1985
Septotextularia Cheng and Zheng 1978

Septotextularia rugosa Cheng and Zheng 1978
Plate 6, figures 1-8

Textularia rugosa (Reuss) – BRADY 1884, p. 363, pl. 42, figs. 23, 24. – CUSHMAN 1921, p. 114, pl. 23, figs. 3, 4.
Gaudryina (Siphogaudryina) rugulosa Cushman – GRAHAM and MILITANTE 1959, p. 30, pl. 2, figs. 11 a, b.
? *Textularia kerimbasensis* Said – GRAHAM and MILITANTE 1959, p. 28, pl. 2, figs. 5, 6.
Septotextularia rugosa CHENG and ZHENG 1978, ICZN Article 70 (b) (i) applying in 1978; Article 11. 10 of current ICZN code; new name for deliberate misidentification of "*Textularia rugosa* Brady, 1884 (not Reuss, 1869)" designated as type species of *Septotextularia* n. gen. – CHENG and ZHENG 1978, p. 167, 257, pl. 3, figs. 5a, b, 6a-d, 7, 8a, b, 9, 10. – LOEBLICH and TAPPAN 1985, p. 207, pl. 15, figs. 1-7. – HATTA and UJIIÉ 1992, p. 59, pl. 3, figs. 2a, b. – LOEBLICH and TAPPAN 1994, p. 32, pl. 43, figs. 9-15. – LANGER and LIPPS 2003, p. 153, fig. 7D: c. – PARKER 2009, p. 39, figs. 29a-i; 30a-f; 31a-f. – DEBENAY 2012, p. 93, 265.

Occurrence: Admiralty Islands (Brady 1884), Philippines (Cushman 1921, Graham and Militante 1959), Xisha Islands (Cheng and Zheng 1978), Ryukyu Islands (Hatta and Ujiié 1992), Sahul Shelf (Loeblich and Tappan 1985, 1994), Madang, Papua New Guinea (Langer and Lipps 2003), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

Order MILIOLIDA Lankester 1885
Superfamily CORNUSPIROIDEA Schultze 1854
Familiy CORNUSPIRIDAE Schultze 1854
Subfamily CORNUSPIRINAE Schultze 1854
Cornuspira Schultze 1854

Cornuspira planorbis Schultze 1854
Plate 8, figures 30, 31

Cornuspira planorbis SCHULTZE 1854, p. 4, pl. 2, fig. 21. – HAIG 1988, p. 218, pl. 1, fig. 14. – LOEBLICH and TAPPAN 1994, p. 37, pl. 56, figs. 1-7. – PARKER 2009, p. 95, fig. 67a-e. – DEBENAY 2012, p. 105, 266. – LANGER et al. 2013, fig. 4: 19.

Remarks: *C. planorbis* is likely the megalospheric form of *C. involvens/planorbis* (Murray 2013).

Occurrence: Mozambique (Schultze 1854), Papuan Lagoon (Haig 1988), Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Bazaruto (Langer et al. 2013).

Superfamily NUBECULARIOIDEA T.R. Jones 1875
Family FISCHERINIDAE Millett 1898
Subfamily FISCHERININAE Millett 1898
Dentoplanispirinella Förderer and Langer 2016

Dentoplanispirinella occulta Förderer and Langer 2016
Plate 9, figures 1-11

Dentoplanispirinella occulta FÖRDERER and LANGER 2016, p. 6, fig. 2:A-K.
Nummuloculina? sp. A THISSEN and LANGER 2017, p. 32, pl. 5, figs. 8, 9.

Occurrence: Zanzibar (Thissen and Langer 2017).

Planispirinella Wiesner 1931

Planispirinella involuta Collins 1958
Plate 8, figures 26, 27

Planispirinella involuta COLLINS 1958, p. 374, pl. 4, figs. 2a, b. – PARKER 2009, p. 158, figs. 111a-f. – DEBENAY 2012, p. 114, 266.
Planispirinella sp. HAIG 1988, p. 228, pl. 3, figs. 13-15.

Remarks: The circular outline and the involute coiling are indicative features for *P. involuta*.

Occurrence: Great Barrier Reef (Collins 1958), Papuan Lagoon (Haig 1988), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Madang, Papua New Guinea (Langer unpubl. data).

Subfamily FISCHERINELLINAE Saidova 1981
Fischerinella Loeblich and Tappan 1962

Fischerinella diversa McCulloch 1977
Plate 9, figures 15-17

TABLE 10
Compilation of generic and species-richness data of symbiont-bearing larger benthic foraminifera recorded in various studies from the Central Indo-Pacific and adjacent high diverse ecoregions. Note that the numbers given for these studies are based on extensive revisions (Förderer, Rödder and Langer in press and this study).

Locality	Authors	LBF genera	LBF species
Raja Ampat, Indonesia	Hofker 1927; This study	19	36
Madang, Papua	Langer and Lipps 2003; Langer unpubl. Data	15	20
Palau	Hallock 1977, 1984; Hohenegger 1996; Lessard 1980	18	28
Sesoko Jima, Ryukyu, Japan	Gudmundsson 1994; Hohenegger 1994; Hohenegger et al. 1999; Yordanova and Hohenegger 2002, 2004	19	44
Xisha & Zhongsha Isls, SCS	Cheng and Zheng 1978; Zheng 1979, 1980	17	25
Palawan (north), Philippines	Cushman 1921; Förderer unpubl. data	16	39
East Kalimantan, Borneo	Renema 2006a, b	14	30
Spermonde Shelf, Indonesia	Clearly and Renema 2007; Renema 2002, 2006a; Renema, Hoeksema and van Hinte 2001; Renema and Hohenegger 2005	16	27
Solomon Isls	Hughes 1977	13	19
Lizard Island, GBR	Baccaert 1987; Lee, Burnham and Cevasco 2004	18	24
Ningaloo Reef, W-Australia	Betjeman 1969; Parker 2009	14	20
New Caledonia	Debenay 2012	20	37
Chuuk Lagoon, Carolines	Langer et al. 2009; Makled and Langer 2011; Lessard 1980	11	15
Maldives	Hottinger 1980; Levy et al. 1996; Parker and Gischler 2011	16	23

Fischerinella diversa MCCULLOCH 1977, p. 587, pl. 248, figs. 9, 10. – LOEBLICH and TAPPAN 1994, p. 38, pl. 58, figs. 1-12. – DEBENAY 2012, p. 107, 266.

Occurrence: Galapagos (McCulloch 1977), Timor Sea (Loeblich and Tappan 1994), New Caledonia (Debenay 2012).

Fischerinella helix (Heron-Allen and Earland 1915)
Plate 9, figures 12-14

Fischerina helix HERON-ALLEN and EARLAND 1915, p. 591, pl. 46, figs. 10-14. – LOEBLICH and TAPPAN 1987, p. 318, pl. 329, figs. 10-12. – HAIG 1988, p. 218, pl. 1, figs. 22-24. – DEBENAY 2012, p. 107, 266.

Occurrence: Quirimbas (Heron-Allen and Earland 1915), Papuan Lagoon (Haig 1988), New Caledonia (Debenay 2012), Madang, Papua New Guinea (Langer unpubl. data).

***Fischerinella* sp.**
Plate 9, figures 18-20

Description: Test small, discoidal, planispiral; initial and early chambers obscure, followed by three whorls of tubular chambers; sutures indistinct, between five and seven chambers in the last whorl, the later whorls partially overlap the earlier whorls; wall smooth; aperture terminal (aperture broken).

Remarks: This species resembles *Fischerina pellucida* Millett as depicted by Loeblich and Tappan (1994). However, the outline is not as lobulate as in the original of Millett (1898b; p. 611, pl. 13, figs. 14, 15) and the specimen shown in Debenay (2012; p. 107).

Subfamily GLOMULININAE Saidova 1981
Glomulina Rhumbler 1936

***Glomulina*? sp. 1**
Plate 12, figures 10-12

Description: Test porcelaneous, slightly elongate, periphery rounded; surface smooth, unornamented; two chambers visible from the exterior, the last chamber forms a narrow tube that is less than one quarter coil in length; aperture terminal, a low arch-shaped opening without a rim and a tooth.

Remarks: The species resembles *Glomulina* (?) *duncanensis* McCulloch (1977; p. 585, pl. 224, figs. 12a, b). However, it differs in the more elongate shape, the shorter second tubular chamber and in the lack of an apertural flap and rim.

***Glomulina*? sp. 2**
Plate 12, figures 7-9

Description: Test porcelaneous, ovate, periphery rounded; surface rough, granular; two chambers visible from the exterior, the last chamber forms a narrow tube that is about a quarter coil in length; aperture terminal, aperture a large arch-shaped opening with a thick everted rim and without a tooth.

Remarks: The species resembles *Glomulina* (?) *duncanensis* McCulloch (1977; p. 585, pl. 224, figs. 12a, b). However it differs in the more ovate shape, the granular test surface, the shorter second tubular chamber and in lacking an apertural flap.

Subfamily NODOBACULARIELLINAE Bogdanovich 1981
Nodobaculariella Cushman and Hanzawa 1937

Nodobaculariella convexiuscula (Brady 1884)
Plate 10, figures 8, 9

Spiroloculina (?) *convexiuscula* BRADY 1884, p. 155, pl. 10, figs. 18-20. – CUSHMAN 1921, Philippines, p. 409, pl. 82, fig. 4.
Nodobaculariella convexiuscula (Brady) – BARKER 1960, pl. 10, figs. 18-20. – HAIG 1988, p. 224, pl. 3, figs. 3, 4. – LOEBLICH and TAPPAN 1994, p. 39, pl. 59, figs. 15-19.

Occurrence: Admiralty Islands (Brady 1884, Barker 1960), Philippines (Cushman 1921), Papuan Lagoon (Haig 1988), Sahul Shelf (Loeblich and Tappan 1994), Madang, Papua New Guinea (Langer unpubl. data).

Wiesnerella Cushman 1933

Wiesnerella auriculata (Egger 1893)
Plate 10, figures 5-7

Planispirina auriculata EGGER 1893, p. 245, pl. 3, figs. 13-15.
Wiesnerella auriculata (Egger) – HAIG 1988, p. 235, pl. 11, figs. 32, 33. – LOEBLICH and TAPPAN 1994, p. 239, pl. 62, figs. 1-3. – PARKER 2009, p. 384, figs. 275a-l, 276a-j. – MAKLED and LANGER 2011, p. 249, fig. 3: 21. – DEBENAY 2012, p. 140, 267. – FAJEMILA, LANGER and LIPPS 2015, fig. 2: 32.

Occurrence: Mauritius and Indian Ocean (Egger 1893), Papuan Lagoon (Haig 1988), Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), Caroline Islands (Makled and Langer 2011), New Caledonia (Debenay 2012), Moorea (Fajemila, Langer and Lipps 2015), Madang, Papua New Guinea (Langer unpubl. data).

Family NUBECULARIIDAE Jones, in Griffith and Henfrey 1875
Subfamily NODOBACULARIINAE Cushman 1927
Nubeculina Cushman 1924

Nubeculina advena Cushman 1924
Plate 29, figures 1, 2

Nubeculina advena CUSHMAN 1924, p. 53, pl. 19, figs. 1-4. – HAIG 1988, p. 228, pl. 3, figs. 5-7. – LOEBLICH and TAPPAN 1994, p. 38, pl. 59, figs. 1-12. – PARKER 2009, p. 148, figs. 104a-j; 105a-h. – MAKLED and LANGER 2011, p. 248, fig. 3: 14-19. – DEBENAY 2012, p. 112, 267.
Nubeculina divaricata Brady var. *advena* Cushman – BACCAERT 1987, pl. 13, figs. 6-8.

Occurrence: Samoa (Cushman 1924), Great Barrier Reef (Baccaert 1987), Papuan Lagoon (Haig 1988), Sahul Shelf (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), Caroline Islands (Makled and Langer 2011), New Caledonia (Debenay 2012), Madang, Papua New Guinea (Langer unpubl. data).

Superfamily MILIOLOIDEA Ehrenberg 1839
Family SPIROLOCULINIDAE Wiesner 1920
Adelosina d'Orbigny 1826

Adelosina litoralis Martinotti 1921
Plate 24, figures 10-12

Adelosina litoralis MARTINOTTI 1921, p. 326, pl. 4, figs. 17-20, text-figs. 167-169. – LOEBLICH and TAPPAN 1994, p. 41, pl. 65, figs. 1-3.
Quinqueloculina sp. 9 PARKER 2009, p. 303, figs. 219a-h, 220a-g.

Occurrence: Sahul Shelf (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009).

Spiroloculina d'Orbigny 1826

Spiroloculina angulata Cushman 1917
Plate 11, figures 3-5

Spiroloculina grata Terquem var. *angulata* CUSHMAN 1917, p. 36, pl. 7, fig. 5.
Spiroloculina angulata Cushman – CUSHMAN and TODD 1944, p. 50, pl. 7, figs. 18-22. – HAIG 1988, p. 234, pl. 10, figs. 1-7. – MAKLED and LANGER 2011, p. 248, fig. 3: 22-27. – DEBENAY 2012, p. 132, 268.
Spiroloculina antillarum d'Orbigny – PARKER 2009, p. 341, figs. 246a-l, 247a-l.

Remarks: Morphology very variable. See also remarks in Cushman and Todd (1944, p. 50, 51) and discussion in Parker (2009, p. 341).

Occurrence: Philippines (Cushman 1917), Papuan Lagoon (Haig 1988), Caroline Islands (Makled and Langer 2011), New Caledonia (Debenay 2012), Ningaloo Reef (Parker 2009), Madang, Papua New Guinea (Langer unpubl. data).

Spiroloculina* cf. *S. angulata Cushman 1917
Plate 11, figures 6-9

cf. *Spiroloculina grata* Terquem var. *angulata* CUSHMAN 1917, p. 36, pl. 7, fig. 5.
Spiroloculina sp. 2 DEBENAY 2012, p. 135, 270.

Occurrence: New Caledonia (Debenay 2012). *Spiroloculina angulata* is originally described from the Philippines (Cushman 1917).

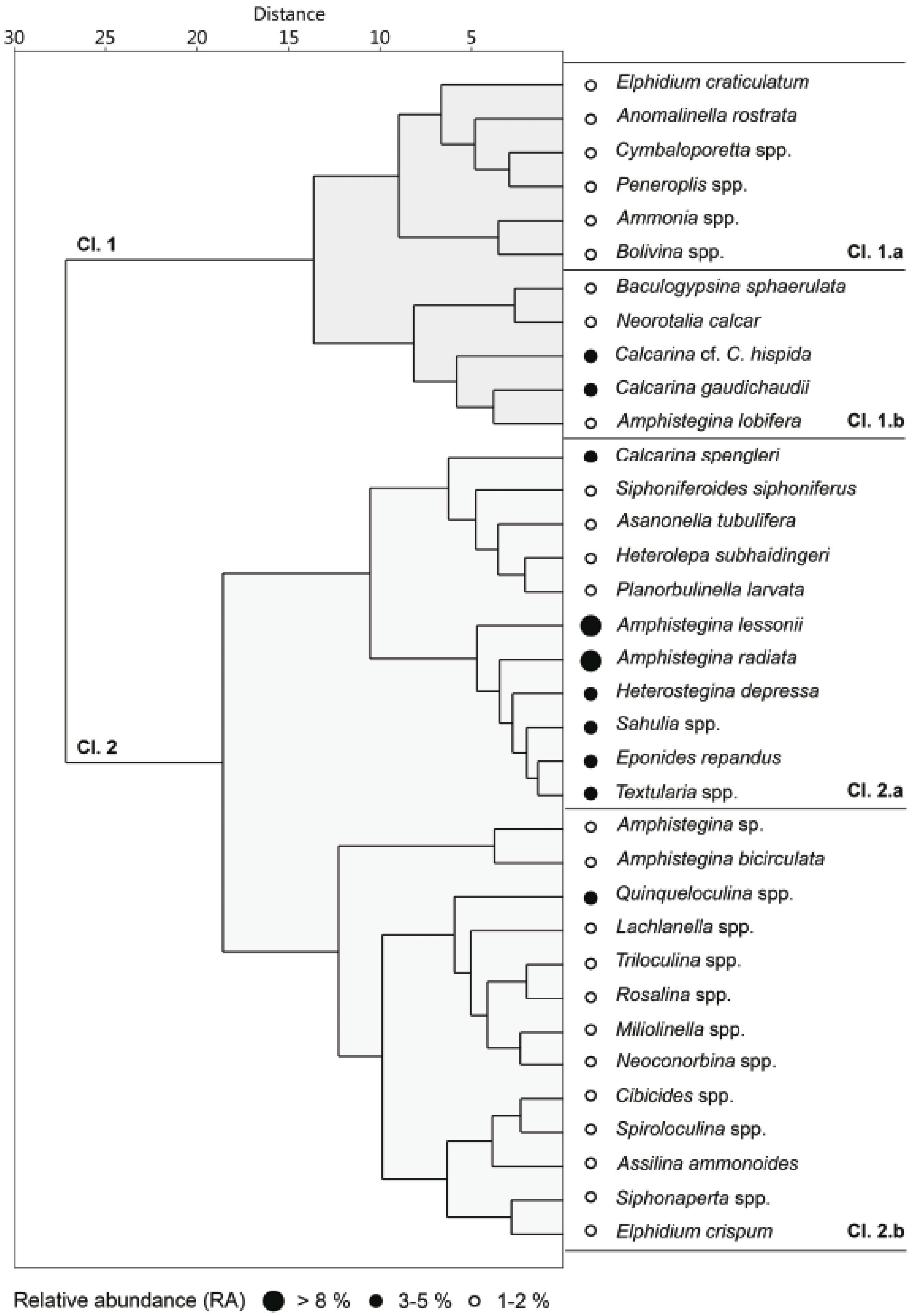
Spiroloculina antillarum d'Orbigny 1839
Plate 11, figures 1, 2

Spiroloculina antillarum D'ORBIGNY 1839, p. 166, pl. 9, figs. 3, 4. – HOTTINGER, HALICZ and REISS 1992, p. 45, pl. 24, figs. 15-17, pl. 25, figs. 1, 2. – DEBENAY 2012, p. 132, 269. – LANGER et al. 2013b, fig. 4: 23.

Occurrence: Cuba (d'Orbigny 1839), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), New Caledonia (Debenay 2012), Bazaruto (Langer et al. 2013).

Spiroloculina* cf. *S. caduca Cushman 1922
Plate 11, figures 10-13

cf. *Spiroloculina caduca* CUSHMAN 1922, p. 61, pl. 11, figs. 3, 4.
Spiroloculina samoaensis Cushman supsp. *acescata* Cushman – BACCAERT 1987, p. 124, pl. 55, figs. 5, 6.



TEXT-FIGURE 11
R-mode cluster analysis. The cluster analysis was performed using the Ward's method. It includes the 30 most abundant taxa. The taxa plot into 2 major clusters (Cl. 1, 2), and four subclusters (Cl. 1a, b, 2a, b). The relative abundance of each taxon is indicated (circles).

Occurrence: Great Barrier Reef (Baccaert). *Spiroloculina caduca* was originally described from the Tortugas, Caribbean (Cushman 1922).

Spiroloculina convexa Said 1949
Plate 11, figures 20-27

Spiroloculina communis Cushman and Todd var. *convexa* SAID 1949, p. 15, pl. 1, fig. 38.
Spiroloculina convexa Said – HOTTINGER, HALICZ and REISS 1993, p. 45, pl. 26, figs. 1-4.
Spiroloculina subimpressa Parr – PARKER 2009, p. 350, fig. 254a-k.
Spiroloculina sp. 1 PARKER and GISCHLER 2011, pl. 2, figs. 7-9.

Remarks: The species *Spiroloculina attenuata* Cushman and Todd, *S. convexa* Said, *S. communis* Cushman and Todd and *S. subimpressa* Parr are often confounded and may constitute a highly variable species complex.

Occurrence: Red Sea (Said 1949, Hottinger, Halicz and Reiss 1993), Ningaloo Reef (Parker 2009), Maldives (Parker and Gischler 2011).

Spiroloculina eximia Cushman 1922
Plate 12, figures 1-4

Spiroloculina eximia CUSHMAN 1922, p. 61, pl. 11, fig. 2. – CUSHMAN and TODD 1944, p. 46, pl. 6, figs. 36-38. – DEBENAY 2012, p. 133, 269.

Remarks: A similar species also occurs around southern Africa (Langer unpubl. data).

Occurrence: Tortugas, Caribbean, and tropical Pacific (Cushman 1922, Cushman and Todd 1944), New Caledonia (Debenay 2012).

Spiroloculina foveolata Egger 1893
Plate 10, figures 17-26

Spiroloculina foveolata EGGER 1893, p. 224, pl. 1, figs. 33-35. – CUSHMAN and TODD 1944, p. 48, pl. 7, figs. 7-12. – CUSHMAN, TODD and POST 1954, p. 335, pl. 84, fig. 14. – COLLINS 1958, p. 364. – CHENG and ZHENG 1978, p. 170, pl. 7, figs. 15-17. – BACCAERT 1987, p. 121, pl. 54, figs. 4-5. – HAIG 1988, p. 234, pl. 10, figs. 14-15. – LOEBLICH and TAPPAN 1994, p. 43, pl. 66, figs. 9, 10. – PARKER 2009, p. 346, fig. 250a-f. – MAKLED and LANGER 2011, p. 235, fig. 3, 36-41. – DEBENAY 2012, not figured.
Spiroloculina elegans Cushman – CUSHMAN 1921, p. 406, pl. 80, figs. 4a, b.

Remarks: The chamber arrangement of the specimens found in the material from Raja Ampat is not as evolute as in typical specimens of the *Spiroloculina*. The depicted specimens show different stages of development. Figures 17-20 may represent earlier developmental stages, which are comparatively small in size, have a longer neck and the typical reticulate ornamentation is less pronounced than in larger specimens. However, both forms show a characteristical furcate ornamentation on the side of the neck that is oriented towards the aboral end of the previous chamber.

Occurrence: Mauritius (Egger 1893), Philippines (Cushman 1921), Australia (Cushman and Todd 1944), Bikini and Marshall Islands (Cushman, Todd and Post 1954), Great Barrier Reef (Collins 1958, Baccaert 1987), Xisha Islands (Cheng and Zheng 1978), Papuan Lagoon (Haig 1988), Sahul Shelf (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), Caroline Islands (Makled and Langer 2011), New Caledonia (Debenay 2012), Madang, Papua New Guinea (Langer unpubl. data).

Spiroloculina* cf. *S. mayori Cushman 1924
Plate 11, figures 16-19

cf. *Spiroloculina mayori* CUSHMAN 1924, p. 56, pl. 20, figs. 5, 6.

Remarks: *Spiroloculina mayori* was originally described from Samoa.

Spiroloculina* cf. *S subimpressa Parr 1950
Plate 12, figures 5, 6

cf. *Spiroloculina subimpressa* PARR 1950, p. 291, pl. 6, figs. 12, 13.

Remarks: The wall is more roughly textured than in *S. convexa* Said. The specimen is tentatively placed in *S. subimpressa* Parr.

Occurrence: *Spiroloculina subimpressa* was originally described from Tasmania (Australia).

Spiroloculina cf. S. venusta Cushman and Todd 1944
Plate 11, figures 14, 15

cf. *Spiroloculina caduca* Cushman. CUSHMAN 1932, (not *S. caduca* Cushman 1922), p. 39, pl. 9, figs. 11, 12.
cf. *Spiroloculina venusta* CUSHMAN and TODD 1944, p. 60, pl. 8, figs. 16,17.

Remarks: The specimens from Raja Ampat differ from *S. venusta* s. str. in lacking the triangular openings along the median line and the occasional ribs on the last chamber. This species also resembles *Spiroloculina planoconvexa* Cheng and Zheng (1979; p. 205, pl. 4, fig. 8) but their species differs in the planoconvex shape.

Occurrence: Madang, Papua New Guinea (Langer unpubl. data). *Spiroloculina venusta* is originally described from the Caroline Islands (Cushman 1932, Cushman and Todd 1944).

***Spiroloculina* sp.**
Plate 10, figures 15, 16

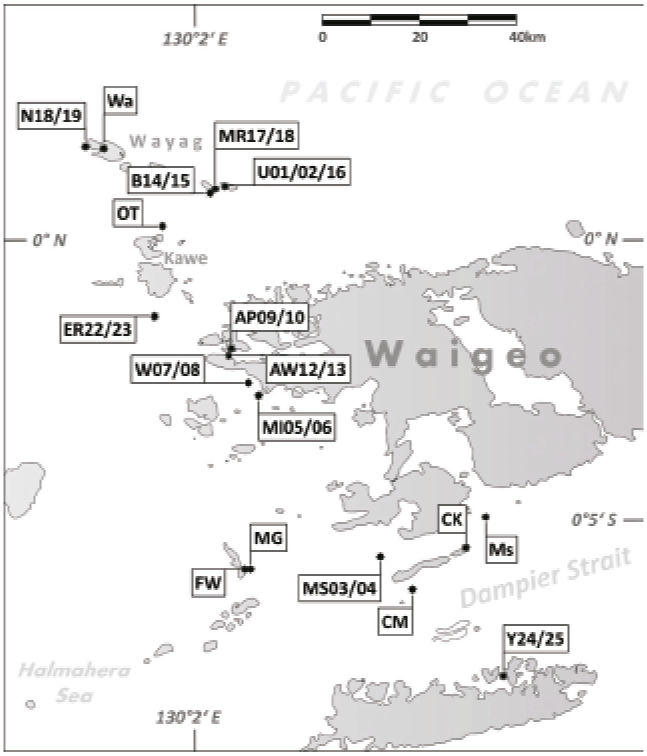
Description: Test porcelaneous, planispiral, semi-evolute, elongate and compressed, about two and a half times higher than broad; two chambers visible from the exterior, central part strongly depressed, periphery rounded; test ornamented with faint striae, deep irregular depressions at the aboral ends of the chambers; aperture a circular terminal opening with a small bifid tooth on a short neck.

Remarks: This species is similar to *Spiroloculina foveolata* Egger as recovered in our sample material and shows a semi-evolute spiroloculine chamber arrangement.

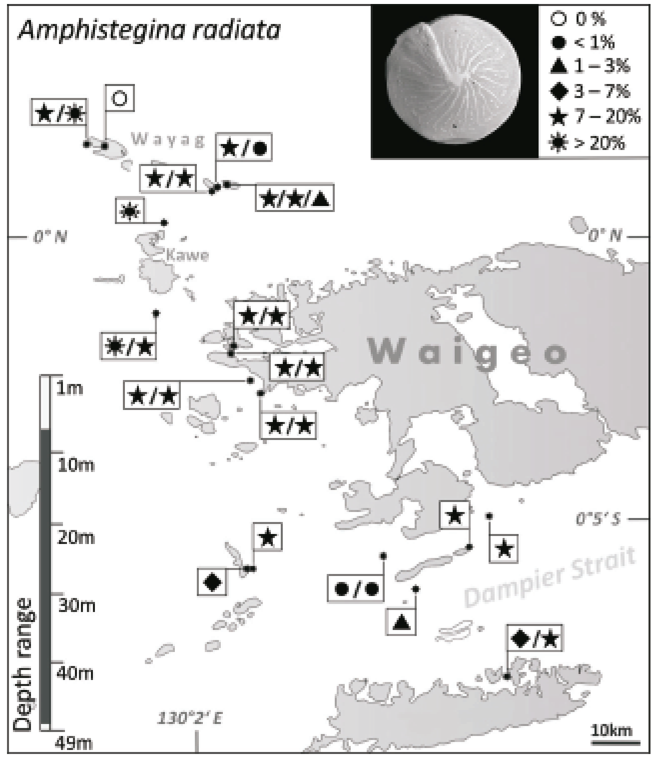
Family HAUERINIDAE Schwager 1876
Subfamily HAUERININAE Schwager 1876
Affinetrina Luczkowska 1972

Affinetrina bassensis (Parr 1945)
Plate 26, figures 25-27

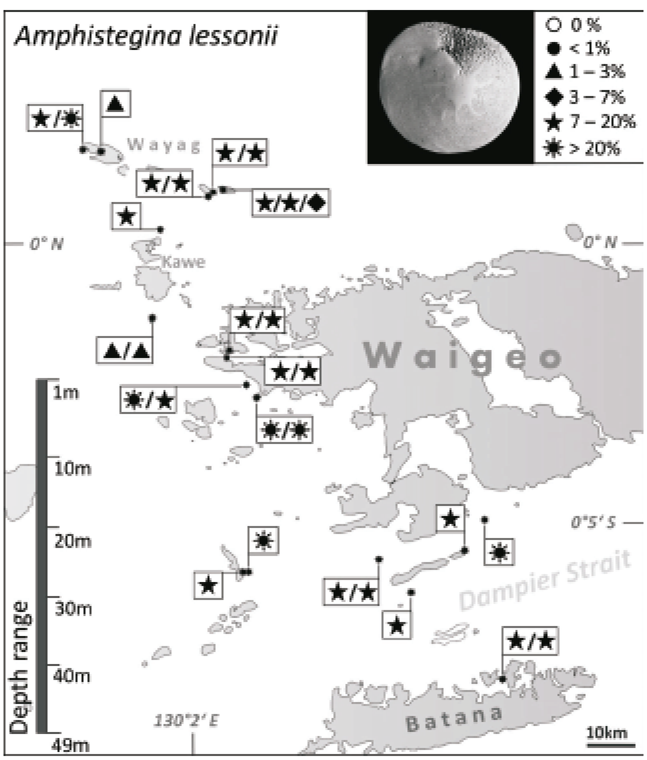
Triloculina irregularis (d'Orbigny) – CUSHMAN 1932, p. 54, pl. 12, fig. 2.
Triloculina bassensis PARR 1945, p. 198, pl. 8, fig. 7a-c.
Affinetrina cf. *A. quadrilateralis* (d'Orbigny) – HOTTINGER, HALICZ and REISS 1993, p. 47, pl. 28, figs. 9-15; pl. 29, figs. 1-4.



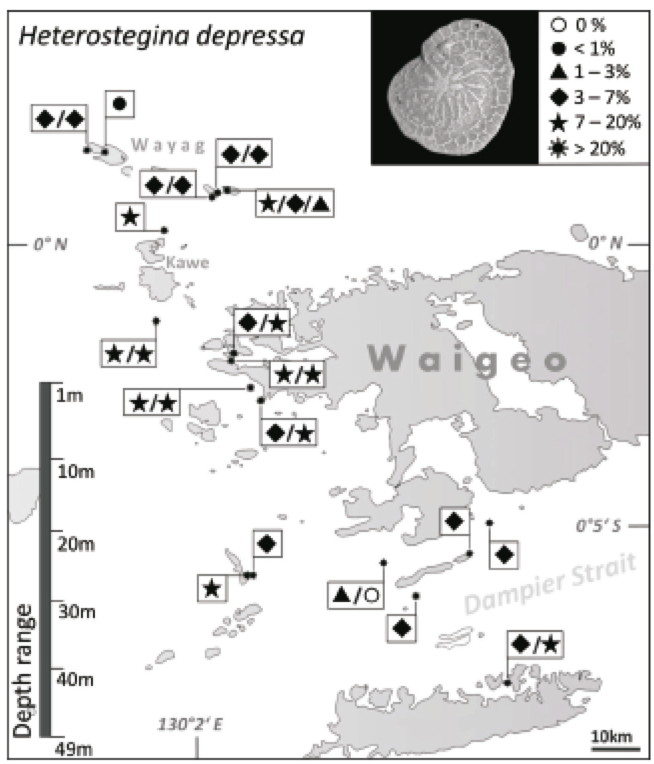
TEXT-FIGURE 12
Reference map with the location of sample sites.



TEXT-FIGURE 14
Distribution and abundance of *Amphistegina radiata*. Abundances vary between 0 and 24%. The depth range covers 8-49 m.



TEXT-FIGURE 13
Distribution and abundance of *Amphistegina lessonii*. Abundances vary between 1 and 41%. The depth range covers 1-49 m.



TEXT-FIGURE 15
Distribution and abundance of *Heterostegina depressa*. Abundances vary between 0 and 14%. The depth range covers 1-49 m.

Quinqueloculina bassensis (Parr) – PARKER 2009, p. 184, fig. 131a-g. – DEBENAY 2012, p. 119, 270.

Occurrence: Fiji (Cushman 1932), Barwon Heads, Australia (Parr 1945), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

Cycloforina Luczkowska 1972

Cycloforina granulocostata (Germeraad 1946)
Plate 25, figures 37-45

Miliolina linneiana d'Orbigny – BRADY 1884, p. 174, pl. 6, figs. 15, 17-20 (not fig. 16).
Quinqueloculina granulocostata GERMERAAD 1946, p. 63, figures as per Brady 1884. – BACCAERT 1987, p. 87, pl. 41, figs. 1-6 (not pl. 42, figs. 1, 2). – PARKER 2009, p. 211, figs. 150a-k, 151a-h. – MAKLED and LANGER 2011, fig. 6: 10-13.

Remarks: *Cycloforina granulocostata* differs from *Lachlanella subpolygona* (Parr) and *Quinqueloculina rebeccae* Vella by its distinct neck, the wide-oval shaped aperture and the wide u-shaped bifurcation at the tip of the tooth. The striae are not as projecting as in *L. subpolygona*, and not as numerous and straight as in *Q. rebeccae*. The three species are very similar. However, they are distinguishable in the material of Raja Ampat, and therefore accepted herein as distinct species.

Occurrence: Hawaii (Brady 1884), Great Barrier Reef (Baccaert 1987), Ningaloo Reef (Parker 2009), Caroline Islands (Makled and Langer 2011), around southern Africa (Langer unpubl. data).

Cycloforina tropicalis (Cushman 1924)
Plate 25, figures 25-27

Miliolina gracilis (d'Orbigny) – BRADY 1884, p. 160, pl. 5, figs. 3a-c.
Quinqueloculina tropicalis CUSHMAN 1924, p. 63, pl. 23, figs. 9, 10. – DEBENAY 2012, p. 127, 274.

Remarks: The specimens of Raja Ampat have a slightly more produced neck and a more circular aperture than the specimens depicted by Cushman.

Occurrence: off Papua, Pacific (Brady 1884), Samoa (Cushman 1924), New Caledonia (Debenay 2012), Madang, Papua New Guinea (Langer unpubl. data).

***Cycloforina* sp.**
Plate 24, figures 19-21

Quinqueloculina berthelotiana d'Orbigny – CHENG and ZHENG 1978, p. 173, pl. 3, figs. 16-18.
Quinqueloculina sp. 9 PARKER 2009, p. 303, figs. 219a-h, 220a-g.

Remarks: For details on the morphology see the description and discussion in Parker (2009).

Occurrence: Xisha Islands (Cheng and Zheng 1978), Ningaloo Reef (Parker 2009).

Hauerina d'Orbigny 1839a

Hauerina earlandi Rasheed 1971
Plate 30, figures 1-3

Miliolina circularis (Bornemann) var. *cibrostoma* HERON-ALLEN and EARLAND 1915, p. 558, pl. 41, figs. 12-16.
Hauerina earlandi RASHEED 1971, p. 54, pl. 16, fig. 7. – PARKER 2009, p. 107, fig. 74a-k. – DEBENAY 2012, p. 108, 270.
Hauerina cibrostoma (Heron-Allen and Earland) – BACCAERT 1987, p. 147, pl. 64, figs. 4-7.
Miliola earlandi (Rasheed) – HAIG 1988, p. 220, pl. 2, figs. 8, 9.

Occurrence: Quirimbas (Heron-Allen and Earland 1915), New Guinea (Rasheed 1971), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Great Barrier Reef (Baccaert 1987), Papuan Lagoon (Haig 1988).

Hauerina pacifica Cushman 1917
Plate 29, figures 11-17

Hauerina pacifica CUSHMAN 1917, p. 64, pl. 21, fig. 2. – PONDER 1975, p. 19, text-figs. 51-68. – BACCAERT 1987, p. 145, pl. 63, figs. 4-6. – HAIG 1988, p. 220, pl. 2, figs. 5-7. – PARKER 2009, p. 109, figs. 76a-c; 77a-m; 78a-j. – DEBENAY 2012, p. 108, 270.

Remarks: The specimens show the ontogenetic development of the aperture from lyre-shape to a full trematophore.

Occurrence: Hawaii (Cushman 1917), North Queensland (Ponder 1975), Great Barrier Reef (Baccaert 1987), Papuan Lagoon (Haig 1988), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Madang, Papua New Guinea (Langer unpubl. data).

Hauerina rugosa (Collins 1958)
Plate 29, figures 18-20

Hauerina pacifica Cushman subsp. *rugosa* COLLINS 1958, p. 367, pl. 3, fig. 11a-c.
Hauerina pacifica Cushman – HAIG 1988, p. 220, pl. 2, figs. 5-7.

Remarks: Ponder (1975) pointed out that *Hauerina rugosa* (Collins) may represent a morphological variety of *Hauerina pacifica* Cushman. For the time being and until additional material has been examined, we regard them as separate species.

Occurrence: Great Barrier Reef (Collins 1958), Papuan Lagoon (Haig 1988).

Lachlanella Vella 1957

Lachlanella barnardi (Rasheed 1971)
Plate 23, figures 25-27

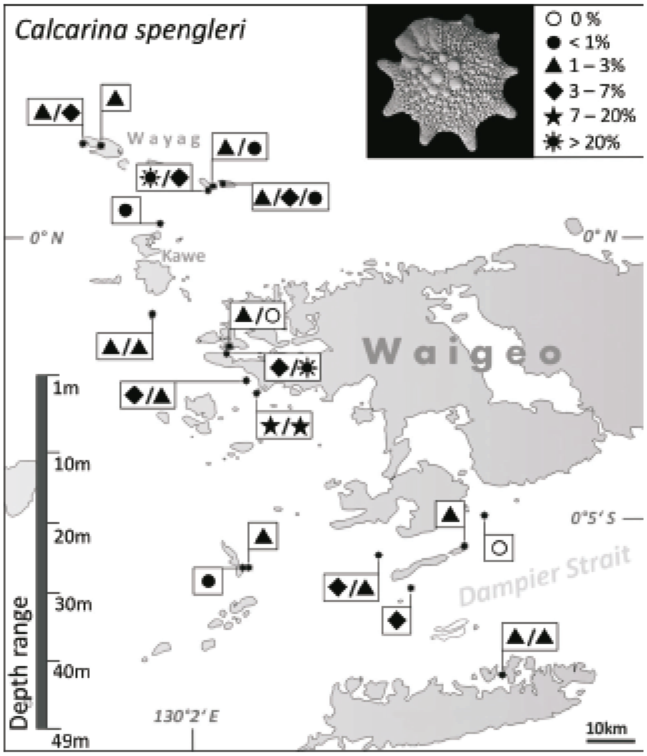
Quinqueloculina barnardi RASHEED 1971, p. 26, pl. 27, fig. 1. – HAIG 1988, p. 233, pl. 4, figs. 18-20. – PARKER 2009, p. 184, figs. 129a-f, 130a-k. – DEBENAY 2012, p. 119, 270.

Occurrence: Coral See (Rasheed 1971), Papuan Lagoon (Haig 1988), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Madang, Papua New Guinea, and around southern Africa (Langer unpubl. data).

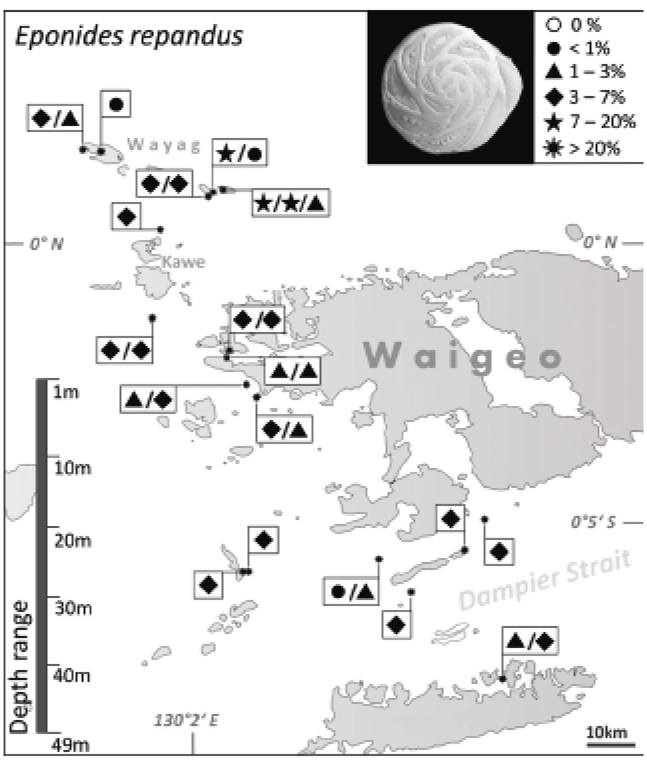
Lachlanella parkeri (Brady 1881)
Plate 27, figures 22-24

Miliolina parkeri BRADY 1881, p. 46, not figured. – BRADY 1884, p. 177, pl. 7, fig. 14. – HERON-ALLEN and EARLAND 1915, p. 574, pl. 43, figs. 11, 12.
Quinqueloculina parkeri (Brady) – CHENG and ZHENG 1978, p. 176, pl. 5, figs. 11-13. – HAIG 1988, p. 234, pl. 6, figs. 30-33. – PARKER 2009, p. 233, figs. 167a-g, 168a-j. – DEBENAY 2012, p. 124, 272.
Lachlanella parkeri (Brady) – LOEBLICH and TAPPAN 1994, p. 47, pl. 74, figs. 1-6. – LANGER and LIPPS 2003, p. 152, fig. 7 D: g.

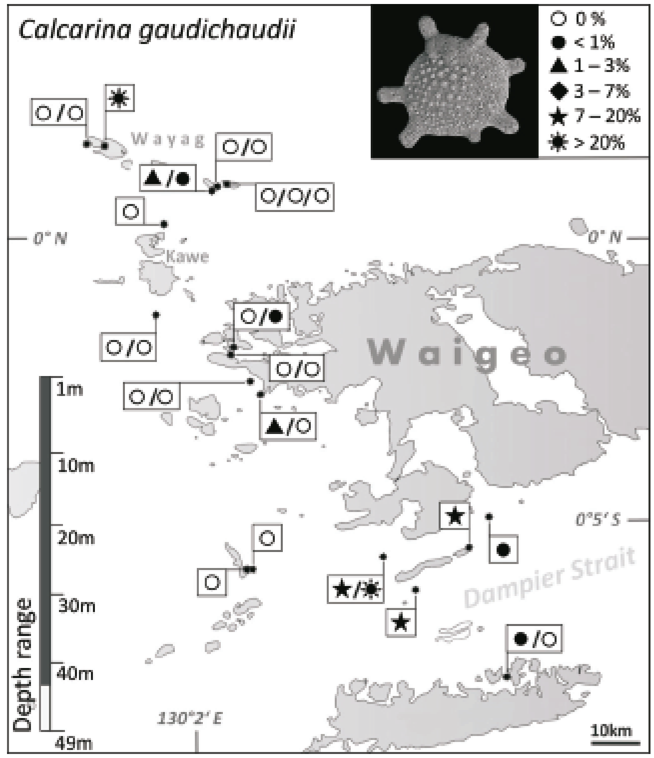
Occurrence: Admiralty Islands and Torres Strait (Brady 1884), Quirimbas (Heron-Allen and Earland 1915), Xisha Islands (Cheng and Zheng 1978), Papuan Lagoon (Haig 1988), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012),



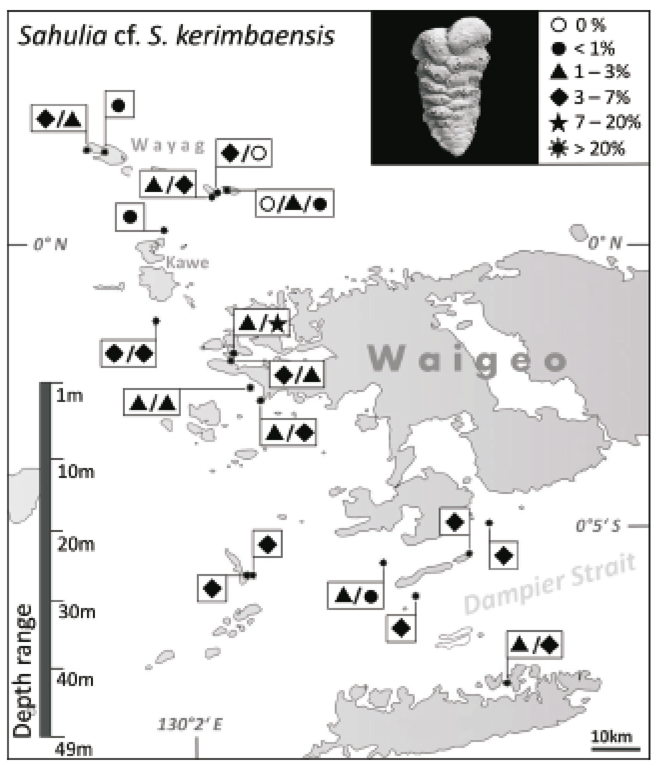
TEXT-FIGURE 16
Distribution and abundance of *Calcarina spengleri*. Abundances vary between 0 and 23%. The depth range covers 1-49 m.



TEXT-FIGURE 17
Distribution and abundance of *Eponides repandus*. Abundances vary between 0.3 and 16%. The depth range covers 1-49 m.



TEXT-FIGURE 18
Distribution and abundance of *Calcarina gaudichaudii*. Abundances vary between 0 and 39%. The depth range covers 1-43 m.



TEXT-FIGURE 19
Distribution and abundance of *Sahulia* cf. *S. kerimbaensis*. Abundances vary between 0 and 9%. The depth range covers 1-49 m.

Timor Sea (Loeblich and Tappan 1994), Madang, Papua New Guinea (Langer and Lipps 2003).

Lachlanella rebeccae Vella 1957
Plate 25, figures 34-36

? *Miliolina linneana* (d'Orbigny) – BRADY 1884, p. 174, pl. 6, fig. 16 (not figs. 15, 17-20).
Quinqueloculina (*Lachlanella*) *rebeccae* VELLA 1957, p. 25, pl. 5, figs. 84, 85, 88. – PARKER 2009, p. 248, fig. 178a-c.
Quinqueloculina granulocostata Germeraad – BACCAERT 1987, p. 87, pl. 42, figs. 1, 2 (not pl. 41, figs. 1-6).

Remarks: *Lachlanella rebeccae* resembles *L. subpolygona* (Parr) and *Cycloforina granulocostata* (Germeraad). It differs from *L. subpolygona* in having numerous straight and longitudinally oriented costae, and the more elongated test shape. It differs from *C. granulocostata* by its apertural features. The three species are very similar but distinguishable in the material of Raja Ampat and therefore accepted herein as independent species.

The species further resembles *Quinqueloculina limbata* d'Orbigny from the Red Sea as figured in Fornasini (1905; p. 66, pl. 3, fig. 9).

Occurrence: ? Admiralty Islands (Brady 1884), Cook Strait (Vella 1957), Ningaloo Reef (Parker 2009), Great Barrier Reef (Baccaert 1987).

Lachlanella* cf. *L. spiralis (Cushman 1917)
Plate 24, figures 34-36

cf. *Quinqueloculina spiralis* CUSHMAN 1917, p. 54, pl. 20, fig. 1.

Remarks: The species differs from the original in having a rough surface and an overall more robust appearance.

Occurrence: *Lachlanella spiralis* was originally described from Guam.

Lachlanella subpolygona (Parr 1945)
Plate 25, figures 28-33

Quinqueloculina subpolygona PARR 1945, p. 196, pl. 12, figs. 2a-c.

Remarks: The specimen from Raja Ampat strongly resembles the original of Parr. *Lachlanella subpolygona* differs from *Cycloforina granulocostata* (Germeraad) and *L. rebeccae* Vella in having a distinct *Lachlanella*-like aperture and the robust, strongly projecting, sometimes undulate, carinae. *Lachlanella rebeccae* is also ornamented with robust carinae, but they are straight and longitudinal, and not as numerous and projecting. The test shape is also more elongated. Hottinger, Halicz and Reiss (1993; p. 51, 55) regard *L. rebeccae* and *L. subpolygona* as synonymous. However, they are distinguishable in the material of Raja Ampat, and therefore accepted herein as independent species.

Occurrence: Victoria, Australia (Parr 1945).

***Lachlanella* sp.**
Plate 25, figures 10-12

Description: Test porcelaneous, elongate and laterally compressed, about two times higher than broad; five chambers visible from the exterior; chambers slightly inflated; sutures distinct, incised; periphery subacute with rounded angles; test ornamented with longitudinally oriented, numerous short irregular faint striae, that are at times anastomosing; oral end produced; *Lachlanella*-like aperture (aperture broken).

Massilinoides McCulloch 1977

Massilinoides baccaerti Langer 1992
Plate 25, figures 19-21

Massilinoides baccaerti LANGER 1992, p. 88, pl. 2, figs. 1-3.

Occurrence: Madang, Papua New Guinea (Langer 1992).

Quinqueloculina d'Orbigny 1826

Quinqueloculina bicarinata d'Orbigny 1826
Plate 23, figures 19-21

Quinqueloculina bicarinata D'ORBIGNY 1826, p. 302, no. 35. – HAIG 1988, p. 233, pl. 4, figs. 27-28, pl. 5, figs. 1-5. – MAKLED and LANGER 2011, p. 248, fig. 6: 3-8. – DEBENAY 2012, p. 120, 270.

Occurrence: Adriatic Sea (d'Orbigny 1826), Papuan Lagoon (Haig 1988), Caroline Islands (Makled and Langer 2011), New Caledonia (Debenay 2012), Madang, Papua New Guinea (Langer unpubl. data).

Quinqueloculina* cf. *Q. bicarinata d'Orbigny 1826
Plate 23, figures 10-15

cf. *Quinqueloculina bicarinata* D'ORBIGNY 1826, p. 302, no. 35.

Occurrence: *Quinqueloculina bicarinata* was originally described from the Adriatic Sea.

Quinqueloculina* cf. *Q. bradyana Cushman 1917
Plate 24, figures 16-18

cf. *Quinqueloculina bradyana* CUSHMAN 1917, p. 52, pl. 18, fig. 2.
Quinqueloculina bradyana Cushman – DEBENAY 2012, p. 120, 271.

Occurrence: New Caledonia (Debenay 2012). *Quinqueloculina bradyana* was originally described from Hawaii.

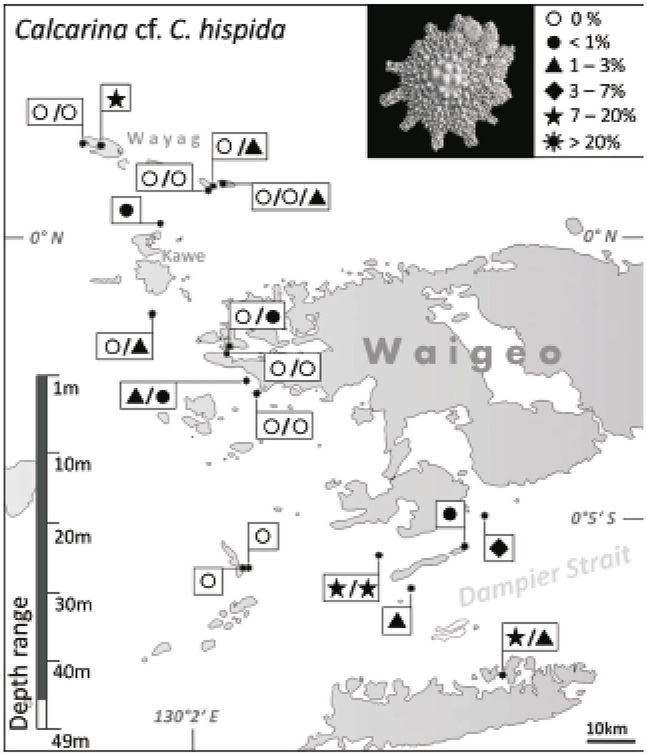
Quinqueloculina carinatastriata (Wiesner 1923)
Plate 24, figures 4-6

Adelosina milletti Wiesner var. *carinatastriata* WIESNER 1923, p. 76, pl. 14, figs. 190-191.
Adelosina carinala-striata Wiesner – CIMERMAN and LANGER 1991, p. 28, pl. 20, figs. 1-4.
Quinqueloculina funafutiensis (Chapman) – HATTA and UJIIÉ 1992, p. 66, pl. 7, figs. 5a, b.
Quinqueloculina carinatastriata (Wiesner) – PARKER 2009, p. 188, figs. 133a-h, 134a-h. – DEBENAY 2012, p. 120, 271.

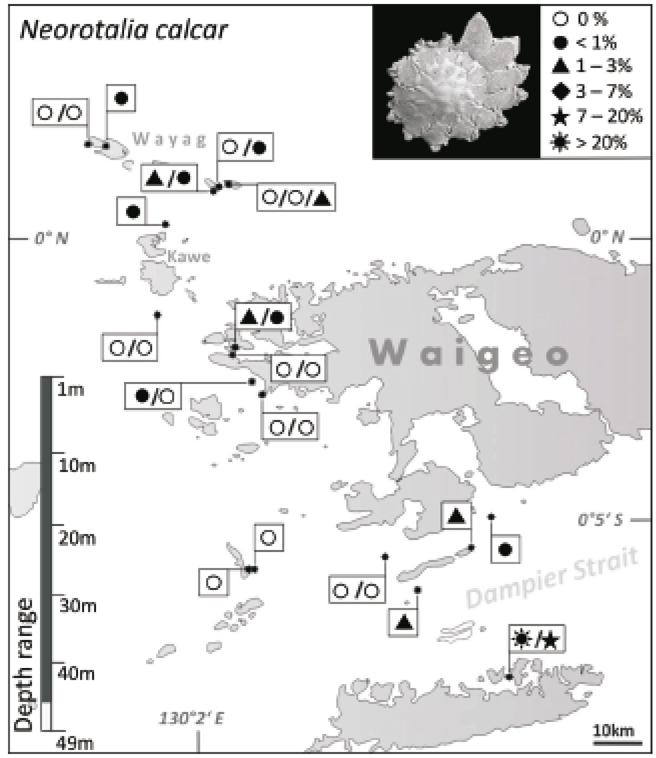
Remarks: This species probably belongs to a species complex that unites specimens with very variable apertural features, such as elongate apertures with a simple tooth and rounded apertures with a bifid tooth, and probably also includes *Quinqueloculina undulata* d'Orbigny (see also figures of *Q. undulata* in Loeblich and Tappan 1994 and Langer et al. 2013).

Occurrence: Adriatic Sea (Wiesner 1923), Mediterranean (Cimerman and Langer 1991), Ryukyus (Hatta and Ujiié 1992), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), around southern Africa (Langer unpubl. data).

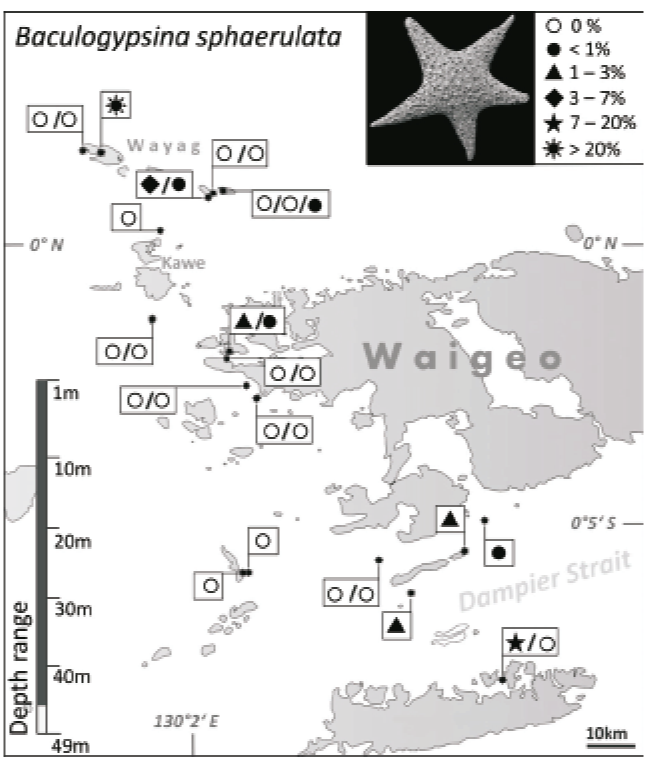
Quinqueloculina* cf. *Q. carinatastriata (Wiesner 1923)
Plate 24, figures 1-3



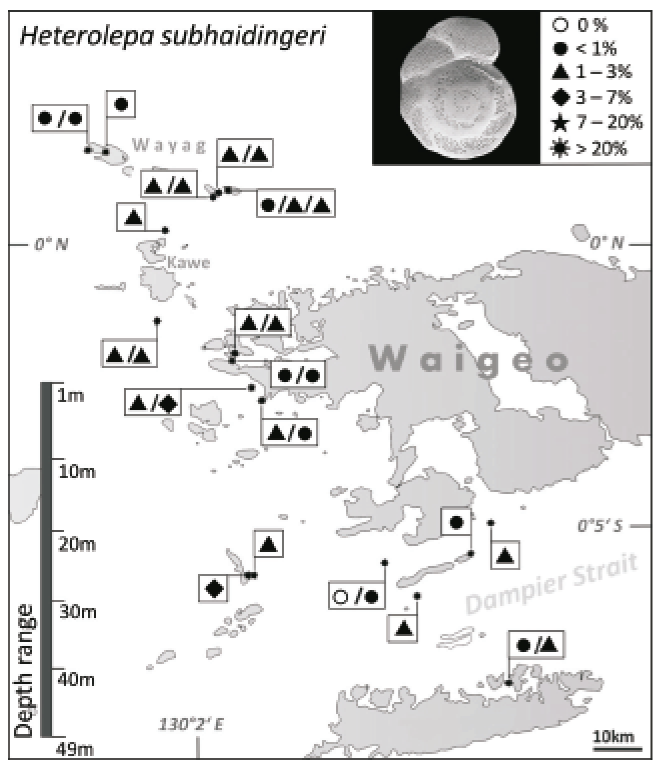
TEXT-FIGURE 20
Distribution and abundance of *Calcarina* cf. *C. hispida*. Abundances vary between 0 and 17%. The depth range covers 1-45 m.



TEXT-FIGURE 22
Distribution and abundance of *Neorotalia calcar*. Abundances vary between 0 and 21%. The depth range covers 1-45 m.



TEXT-FIGURE 21
Distribution and abundance of *Baculogypsina sphaerulata*. Abundances vary between 0 and 36%. The depth range covers 1-45 m.



TEXT-FIGURE 23
Distribution and abundance of *Heterolepa subhaidingeri*. Abundances vary between 0 and 5%. The depth range covers 1-49 m.

cf. *Adelosina milletti* Wiesner var. *carinatastriata* WIESNER 1923, p. 76, pl. 14, figs. 190-191.
Quinqueloculina funafutiensis (Chapman) – CUSHMAN 1932, p. 22, pl. 5, figs. 9, 10.

Remarks: This species also resembles *Quinqueloculina sidebottomi* (Rasheed).

Occurrence: Fiji (Cushman 1932). *Quinqueloculina carinatastriata* was originally described from the Adriatic Sea.

Quinqueloculina* cf. *Q. chathamensis McCulloch 1977
Plate 24, figures 7-9

cf. *Quinqueloculina chathamensis* MCCULLOCH 1977, p. 484, pl. 208, fig. 2.

Occurrence: *Quinqueloculina chathamensis* was originally described from Galapagos.

Quinqueloculina crassa d'Orbigny 1826
Plate 23, figures 4-6

Quinqueloculina crassa D'ORBIGNY 1826, p. 301, modèle no. 14. – FORNASINI 1905, d'Orbigny's material, p. 65, pl. 3, fig. 5.
Miliolina crassa (d'Orbigny) – HERON-ALLEN and EARLAND 1915, p. 572, pl. 42, figs. 37-41.
Quinqueloculina tubus Todd – HAIG 1988, p. 234, pl. 8, figs. 25-28. – PARKER 2009, p. 276, figs. 198a-l, 199a-g, 200a-i.
Quinqueloculina cuvieriana d'Orbigny – LOEBLICH and TAPPAN 1994, p. 48, pl. 78, figs. 4-6 (not figs. 1-3, 7-9).
Quinqueloculina crassa (d'Orbigny) – LANGER et al. 2013, p. 163, fig. 5: 1, 2.

Remarks: This species resembles and is often reported as *Quinqueloculina tubus* Todd. However, it differs significantly from the original description and figures of *Q. tubus*. In the "Prodrome", d'Orbigny (1850, vol. 2, p. 409, no. 1369) describes *Q. crassa* as "espèce suborbiculaire, renflée, striée". However, the deeply incised grooves in the specimens from Raja Ampat (as well as from the Sahul Shelf, the Papuan Lagoon, Ningaloo Reef and Bazaruto) appear to be more prominent and less numerous, and are not as ubiquitous as in the specimens illustrated by Fornasini and Heron-Allen and Earland but are rather restricted to the outer margins of the chambers.

Occurrence: France (d'Orbigny 1826), Quirimbas (Heron-Allen and Earland 1915), Papuan Lagoon (Haig 1988), Sahul Shelf (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), Bazaruto (Langer et al. 2013).

Quinqueloculina cuvieriana d'Orbigny 1839
Plate 23, figures 1-3

Quinqueloculina cuvieriana D'ORBIGNY 1839, p. 190, pl. 11, figs. 19-21. – LE CALVEZ 1977, p. 70, 71, figs. 1, 2 and 3 (lectotype). – PARKER 2009, p. 193, fig. 136f-j. – FAJEMILA, LANGER and LIPPS 2015, fig. 2: 37.

Remarks: The specimens from Raja Ampat appear to have a more rounded periphery than the lectotype selected by Le Calvez 1977. Egger's (1893) specimens of *Miliolina cuvieriana* d'Orbigny from Indonesia (pl. 2, figs. 47-49; pl. 4, figs. 22-24) appear to be different.

Occurrence: Cuba (d'Orbigny 1839, Le Calvez 1977), Ningaloo Reef (Parker 2009), Moorea (Fajemila, Langer and Lipps 2015).

Quinqueloculina* cf. *Q. cuvieriana d'Orbigny 1839 **Type 1**
Plate 23, figures 16-18

cf. *Quinqueloculina cuvieriana* D'ORBIGNY 1839, p. 190, pl. 11, figs. 19-21.
Quinqueloculina cuvieriana d'Orbigny – DEBENAY 2012, p. 121, 270.

Remarks: The depicted specimen is abraded.

Occurrence: New Caledonia (Debenay 2012). *Quinqueloculina cuvieriana* was originally described from Cuba.

Quinqueloculina* cf. *Q. cuvieriana d'Orbigny 1839 **Type 2**
Plate 23, figures 22-24

cf. *Quinqueloculina cuvieriana* D'ORBIGNY 1839, p. 190, pl. 11, figs. 19-21.

Remarks: The test is ornamented with numerous small and short striae, and appears to be more robust than *Quinqueloculina* cf. *Q. cuvieriana* Type 1. The aperture is a wide arch-shaped opening. The aperture is broken and the tooth morphology is not known.

Occurrence: *Quinqueloculina cuvieriana* was originally described from Cuba.

Quinqueloculina debenayi Langer 1992
Plate 26, figures 22-24

Quinqueloculina laevigata d'Orbigny – GRAHAM and MILITANTE 1959, p. 45, pl. 5, fig. 13 (not fig. 12).
Quinqueloculina debenayi LANGER 1992, p. 90, pl. 2, figs. 7, 8. – DEBENAY 2012, p. 121, 271.

Remarks: The specimen appears to be abraded.

Occurrence: Philippines (Graham and Militante 1959), Madang, Papua New Guinea (Langer 1992), New Caledonia (Debenay 2012).

Quinqueloculina* cf. *Q. exsculpta (Heron-Allen and Earland 1915)
Plate 21, figures 28-30

cf. *Miliolina exsculpta* HERON-ALLEN and EARLAND 1915, p. 567, pl. 42, figs. 23-26.
Quinqueloculina exsculpta (Heron-Allen and Earland) – HAIG 1988, p. 224, pl. 6, figs. 5-7.

Occurrence: Papuan Lagoon (Haig 1988). *Quinqueloculina exsculpta* was originally described from the Quirimbas.

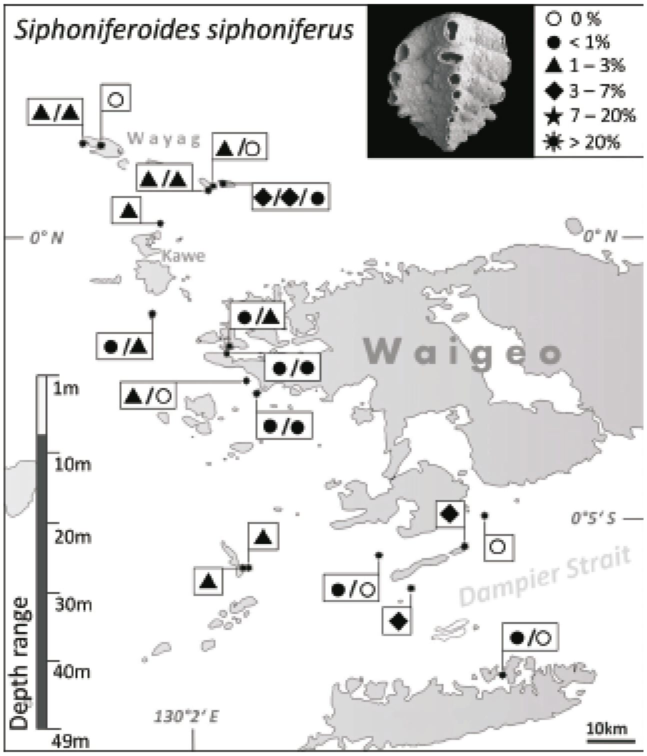
Quinqueloculina* cf. *Q. incisa Vella 1957
Plate 26, figures 19-21

cf. *Quinqueloculina* (*Quinqueloculina*) *incisa* VELLA 1957, p. 24, pl. 6, figs. 118-121.
Quinqueloculina incisa Vella – LOEBLICH and TAPPAN 1994, p. 49, pl. 80, figs. 13-15.

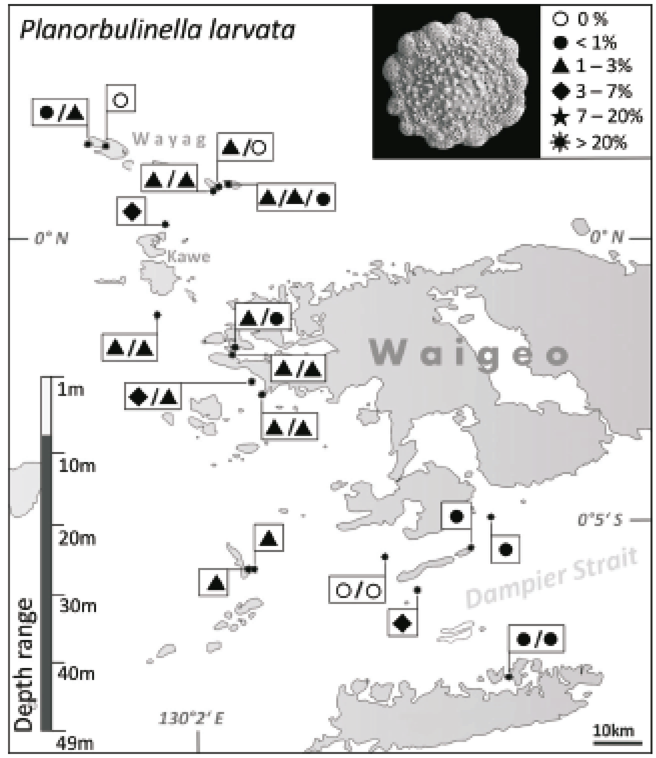
Occurrence: Timor Sea (Loeblich and Tappan 1994). *Quinqueloculina incisa* was originally described from New Zealand.

Quinqueloculina lizardi Baccaert 1987
Plate 21, figures 19-24

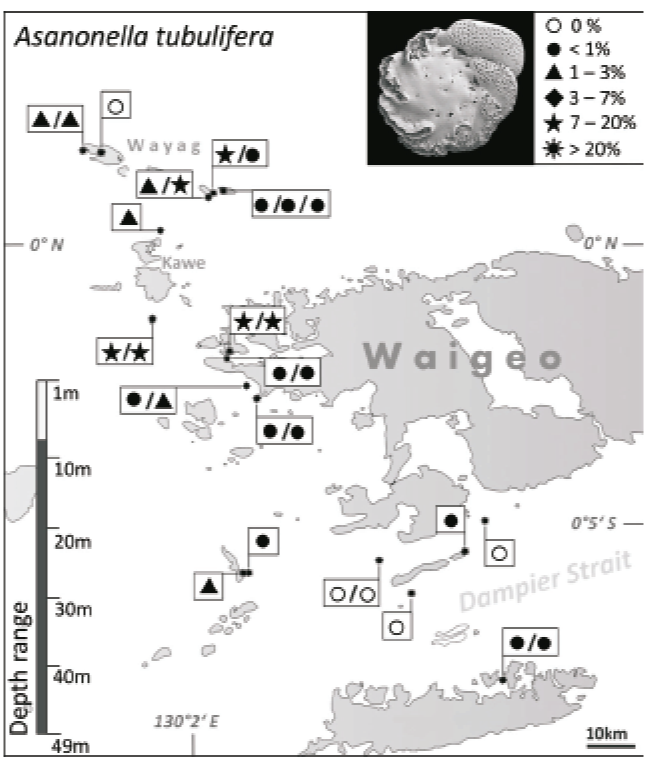
Quinqueloculina oblonga (Montagu) subsp. *lizardi* BACCAERT 1987, p. 100, pl. 46, fig. 6; pl. 47, fig. 1.
Quinqueloculina cf. *Q. semireticulosa* (Cushman) – HAIG 1988, p. 274, pl. 8, figs. 6, 7 (not figs. 8, 9).
Quinqueloculina sp. 21 PARKER 2009, p. 319, fig. 232a-i.



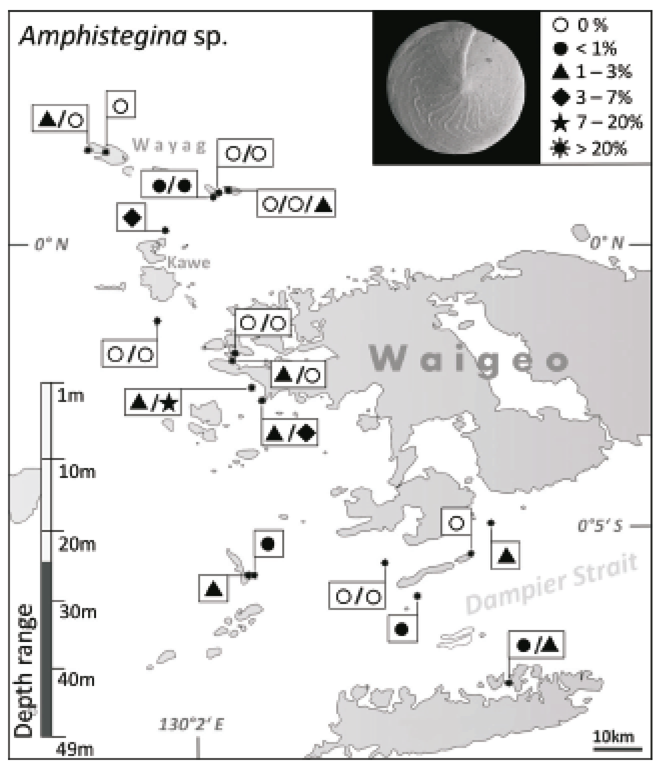
TEXT-FIGURE 24
Distribution and abundance of *Siphoniferoides siphoniferus*. Abundances vary between 0 and 5%. The depth range covers 8-49 m.



TEXT-FIGURE 26
Distribution and abundance of *Planorbulinella larvata*. Abundances vary between 0 and 4%. The depth range covers 8-49 m.



TEXT-FIGURE 25
Distribution and abundance of *Asanonella tubulifera*. Abundances vary between 0 and 5%. The depth range covers 8-49 m.



TEXT-FIGURE 27
Distribution and abundance of *Amphistegina* sp.. Abundances vary between 0 and 10%. The depth range covers 18-49 m.

Quinqueloculina lizardi Baccaert – DEBENAY 2012, p. 123, 272.
Quinqueloculina cf. *Q. semireticulosa* Cushman – FAJEMILA, LANGER and LIPPS 2015, fig. 2: 33.

Remarks: Figures 19-21 show a juvenile specimen. The name *lizardi* is unavailable since Baccaert did not publish his thesis. See also discussion and remarks in Parker (2009).

Occurrence: Great Barrier Reef (Baccaert 1987), Papuan Lagoon (Haig 1988), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Moorea (Fajemila, Langer and Lipps 2015).

Quinqueloculina* cf. *Q. multimarginata Said 1949
Plate 23, figures 28-30

cf. *Quinqueloculina multimarginata* SAID 1949, p. 10, pl. 1, fig. 34.
Quinqueloculina cf. *Q. multimarginata* Said – HOTTINGER, HALICZ and REISS 1993, p. 59, pl. 55, figs. 7-10.

Occurrence: Gulf of Aqaba (Hottinger, Halicz and Reiss 1993). *Quinqueloculina multimarginata* was originally described from the Red Sea.

Quinqueloculina neostriatula Thalmann 1950
Plate 24, figures 28-33

Quinqueloculina striatula CUSHMAN 1932, p. 27, pl. 7, figs. 3, 4.
Quinqueloculina neostriatula THALMANN 1950, new name for *Q. striatula* Cushman 1932, p. 45. – BACCAERT 1987, p. 91, pl. 43, figs. 1-6. – HAIG 1988, p. 234, pl. 6, figs. 22-25. – PARKER 2009, p. 225, figs. 162a-j, 163a-i. – DEBENAY 2012, p. 124, 272.

Occurrence: Fiji (Cushman 1932), Great Barrier Reef (Baccaert 1987), Papuan Lagoon (Haig 1988), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

Quinqueloculina* cf. *Q. patagonica d'Orbigny 1839
Plate 21, figures 10-15

cf. *Quinqueloculina patagonica* D'ORBIGNY 1839, p. 74, pl. 4, figs. 14-16.

Occurrence: *Quinqueloculina patagonica* was originally described from Patagonia, Argentina.

Quinqueloculina philippinensis Cushman 1921
Plate 28, figures 10-21

Miliolina reticulata (d'Orbigny) – BRADY 1884, (not *Triloculina reticulata* d'Orbigny, 1826), p. 177, pl. 9, figs. 2, 3 (not fig. 4).
Quinqueloculina kerimbatica (Heron-Allen and Earland) var. *philippinensis* CUSHMAN 1921, p. 438, pl. 89, figs. 2, 3. – CUSHMAN 1924, p. 61 (not figured). – GRAHAM and MILITANTE 1959, p. 55, pl. 8, figs. 1-3c (not fig. 4).
Quinqueloculina cf. *pseudoreticulata* Parr – MCCULLOCH 1977, p. 504, pl. 219, figs. 6, 9.
Quinqueloculina philippinensis Cushman – WHITTAKER and HODGKINSON 1979, p. 27, pl. 2, figs. 2-6. – HAIG 1988, p. 234, pl. 7, figs. 1-8. – LOEBLICH and TAPPAN 1994, p. 50, pl. 81, figs. 1-10.
Quinqueloculina gr. *Q. pseudoreticulata* Parr – PARKER 2009, p. 243, fig. 174a-j (not fig. 175a-h).

Remarks: This species reveals a high morphological variability (figs. 19-21 are strongly abraded).

Occurrence: off New Guina (Brady 1884), Philippines (Cushman 1921, Graham and Militante 1959, McCulloch 1977), Samoa (Cushman 1924), Malaysia (Whittaker and Hodgkinson 1979), Papuan Lagoon (Haig 1988), Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009).

Quinqueloculina pittensis Albani 1974
Plate 27, figures 28-30

Quinqueloculina pittensis ALBANI 1974, p. 34, pl. 1, figs. 1-3.
Quinqueloculina cf. *Q. pittensis* Albani – HAIG 1988, p. 234, pl. 7, figs. 9-11.
Quinqueloculina pittensis Albani – PARKER 2009, p. 236, figs. 169a-h, 170a-h, 171a-j. – DEBENAY 2012, p. 125, 273.

Occurrence: Broken Bay, New South Wales (Albani 1974), Papuan Lagoon (Haig 1988), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

Quinqueloculina planata (Cushman 1932)
Plate 25, figures 13-15

Massilina planata CUSHMAN 1932, p. 31, pl. 8, fig. 8.
Quinqueloculina planata (Cushman) – HAIG 1988, p. 233, pl. 7, figs. 12-14.

Occurrence: Guam (Cushman 1932), Papuan Lagoon (Haig 1988).

Quinqueloculina quinquecarinata Collins 1958
Plate 25, figures 4-6

Quinqueloculina quinquecarinata COLLINS 1958, p. 360, pl. 2, fig. 8. – BACCAERT 1987, p. 103, pl. 48, fig. 1. – HAIG 1988, p. 234, pl. 7, fig. 21-25. – LOEBLICH and TAPPAN 1994, p. 50, pl. 79, figs. 13-18. – PARKER 2009, p. 248, figs. 176a-i, 177a-g. – DEBENAY 2012, p. 125, 273. – LANGER et al. 2013b, fig. 5: 15, 16.

Occurrence: Great Barrier Reef (Collins 1958, Baccaert 1987), Papuan Lagoon (Haig 1988), Sahul Shelf (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Bazaruto (Langer et al. 2013), Madang, Papua New Guinea (Langer unpubl. data).

Quinqueloculina schlumbergeri Wiesner 1923
Plate 25, figures 1-3

Quinqueloculina stelligera SCHLUMBERGER 1893, p. 68, pl. 2, figs. 58, 69; p. 68, tf. 17.
Miliolina schlumbergeri WIESNER 1923, new name for *Q. stelligera* Schlumberger 1893, p. 49, pl. 6, fig. 73.
Quinqueloculina stelligera Schlumberger – CIMERMAN and LANGER 1991, p. 38, pl. 34, figs. 13-15.

Remarks: The similar *Quinqueloculina exmouthensis* Parker, which is also present in southern Africa (Langer unpubl. data), differs from the species found in Raja Ampat in the more compact test shape and the slightly striated ornamentation on the test surface.

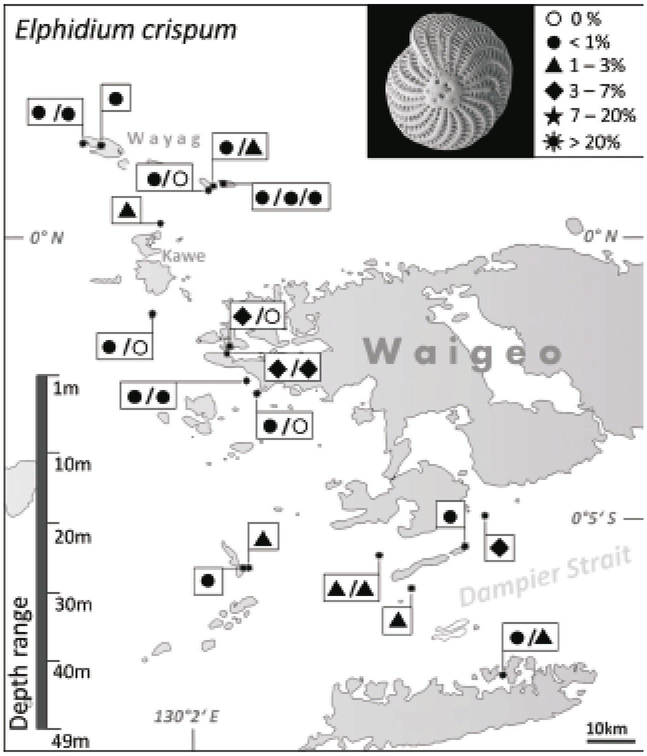
Occurrence: Gulf of Marseille and Sicily, Adriatic Sea (Schlumberger 1893, Cimerman and Langer 1991).

Quinqueloculina seminulum (Linnaeus 1758)
Plate 21, figures 1-9

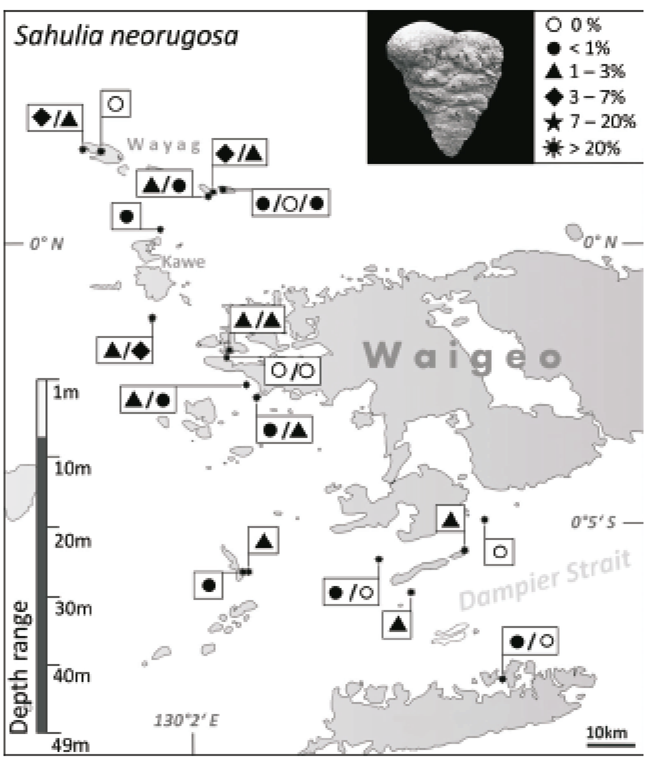
Serpula seminulum LINNAEUS 1758, p. 76, not figured, [Plancus 1739, op. cit. pl. 2, fig. 9; Gualtieri 1742, op. cit. pl. 19, fig. s.]
Quinqueloculina seminula Linnaeus – PARKER 2009, p. 251, figs. 180a-l, 181a-j, 182a-f.
Quinqueloculina seminula (no reference given) – PARKER and GISCHLER 2011, pl. 2, figs. 20-22.

Occurrence: Adriatic Sea (Linnaeus 1758), Ningaloo Reef (Parker 2009), Maldives (Parker and Gischler 2011).

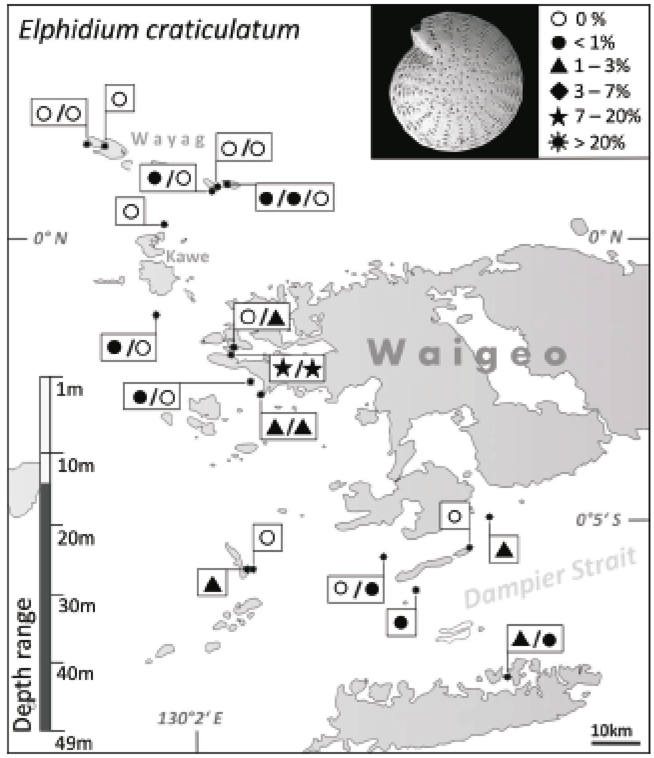
Quinqueloculina* cf. *Q. subgranulata (Cushman 1918)
Plate 24, figures 37-39



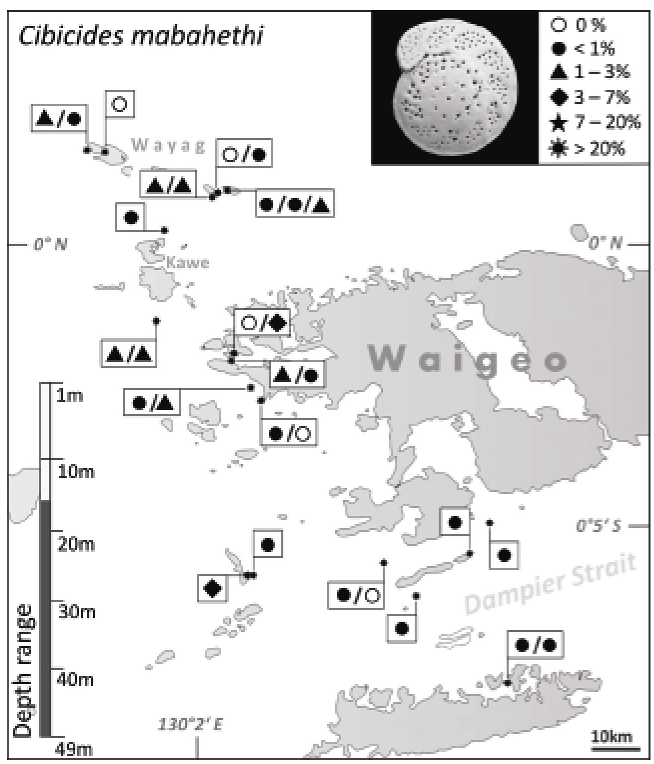
TEXT-FIGURE 28
Distribution and abundance of *Elphidium crispum*. Abundances vary between 0 and 6%. The depth range covers 1-49 m.



TEXT-FIGURE 29
Distribution and abundance of *Sahulia neorugosa*. Abundances vary between 0 and 3%. The depth range covers 8-49 m.



TEXT-FIGURE 30
Distribution and abundance of *Elphidium craticulatum*. Abundances vary between 0 and 10%. The depth range covers 14-49 m.



TEXT-FIGURE 31
Distribution and abundance of *Cibicides mabahethi*. Abundances vary between 0 and 4%. The depth range covers 16-49 m.

cf. *Triloculina subgranulata* CUSHMAN 1918, p. 290, pl. 96, fig. 4.

Remarks: Four chambers are visible from the exterior. This may represent a new species. See also discussion on *Quinqueloculina subgranulata* (Cushman) in Parker (2009, p. 259).

Occurrence: *Quinqueloculina subgranulata* was originally described from Murray Islands, Australia.

Quinqueloculina* cf. *Q. subparkeri McCulloch 1977
Plate 28, figures 22-24

cf. *Quinqueloculina subparkeri* McCulloch – PARKER 2009, p. 260, figs. 188a-f, 189a-h, 190a-j.

Remarks: *Quinqueloculina subparkeri* McCulloch depicted by Parker (2009) differs from the original description and illustrations by McCulloch (1977). The species resembles *Quinqueloculina* cf. *Q. kerimbatica* (Heron-Allen and Earland) *reticulostriata* Cushman (in McCulloch 1977, Philippines, p. 494, pl. 219, fig. 15a, b; not figs. 5, 7, 8, 10, 11, 16, 17). The reticulate ornamentation is similar in *Quinqueloculina philippinensis* Cushman.

Occurrence: Ningaloo Reef (Parker 2009).

Quinqueloculina tantabiddyensis Parker 2009
Plate 26, figures 4-6

Quinqueloculina tantabiddyensis PARKER 2009, p. 265, figs. 192a-j, 193a-h, 194a-I, 195a-f. – DEBENAY 2012, p. 127, 274.

Occurrence: Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

Quinqueloculina vandiemeniensis Loeblich and Tappan 1994
Plate 21, figures 16-18

Quinqueloculina vandiemeniensis LOEBLICH and TAPPAN 1994, p. 51, pl. 83, figs. 1-3. – PARKER 2009, p. 277, figs. 201a-h, 202a-k, 203a-j.

Occurrence: Sahul Shelf (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009).

Quinqueloculina zhengi Parker 2009
Plate 24, figures 13-15

Quinqueloculina zhengi PARKER 2009, p. 285, figs. 206a-l, 207a-g.

Occurrence: Ningaloo Reef (Parker 2009), new Caledonia (Debenay 2012).

***Quinqueloculina*? sp. 1**
Plate 24, figures 18-20

Description: Test porcelaneous, subcircular in outline, periphery rounded, with a somewhat planispiral appearance; five chambers visible from the exterior, chambers inflated; sutures depressed and distinct; surface smooth and unornamented; aperture terminal, an arch-shaped opening with a short tooth that is bifurcated at its tip.

Remarks: Further material is required for a definite species identification.

***Quinqueloculina* sp. 2**
Plate 21, figures 25-27

Quinqueloculina sp. C HAIG 1988, p. 234, pl. 9, figs. 7-10.

Quinqueloculina sp. 1 PARKER 2009, p. 288, fig. 209a-f (not figs. 208, 209g-i, 210, 211).

Remarks: For remarks on the morphology see discussion in Parker (2009).

Occurrence: Papuan Lagoon (Haig 1988), Ningaloo Reef (Parker 2009).

***Quinqueloculina* sp. 3**
Plate 21, figures 37-39

Description: Test porcelaneous, slightly elongate, ovate in lateral view, periphery rounded; surface smooth and unornamented; five chambers visible from the exterior, chambers broadest at the base, tapering towards the oral end; sutures distinct; aperture terminal, a high, subquadrangular opening without a rim, and provided with a simple, offset-placed, short and slender simple tooth.

***Quinqueloculina* sp. 4**
Plate 22, figures 29-31

Quinqueloculina sp. 24 PARKER 2009, p. 325, fig. 236a-j.

Remarks: For remarks on the morphology see discussion in Parker (2009).

Occurrence: Ningaloo Reef (Parker 2009).

***Quinqueloculina* sp. 5**
Plate 27, figures 16-18

Description: Test porcelaneous, slightly elongate, ovate in lateral view, periphery rounded with blunt angles; five chambers visible from the exterior, aboral end produced; surface entirely ornamented with longitudinally aligned, irregular, short striae; sutures depressed and incised; aperture terminal, a small subcircular opening with a small tooth that becomes thickened at its tip (note that the aperture is broken).

Remarks: This surface ornamentation of this species is similar in *Lachlanella barnardi* (Rasheed). However, it differs from the latter in having a small and rounded aperture with a small tooth, and in the rounded periphery.

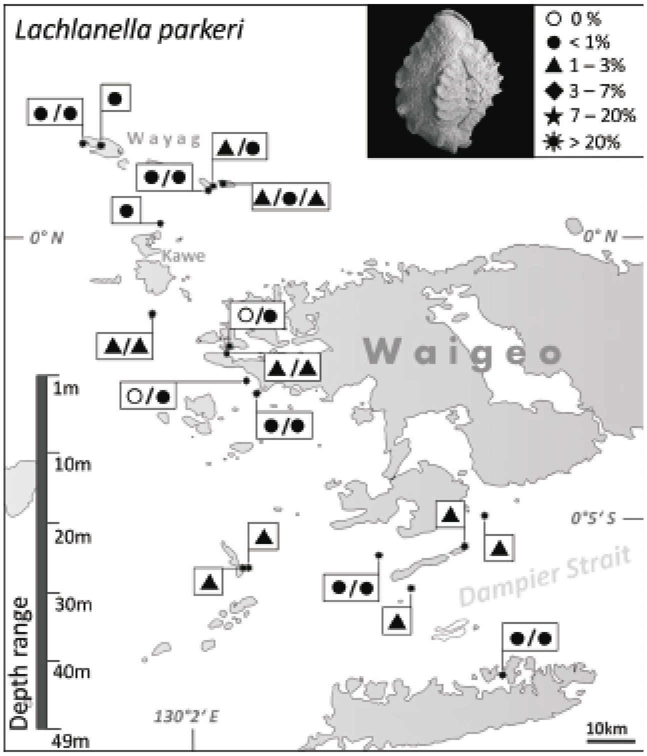
***Quinqueloculina* sp. 6**
Plate 21, figures 34-36

Description: Test porcelaneous, slightly elongate, periphery rounded; surface smooth and unornamented; five chambers visible from the exterior, chambers inflated, broadest at the base; sutures depressed, distinct; aperture terminal, a high, arch-shaped opening provided with a low T-shaped tooth.

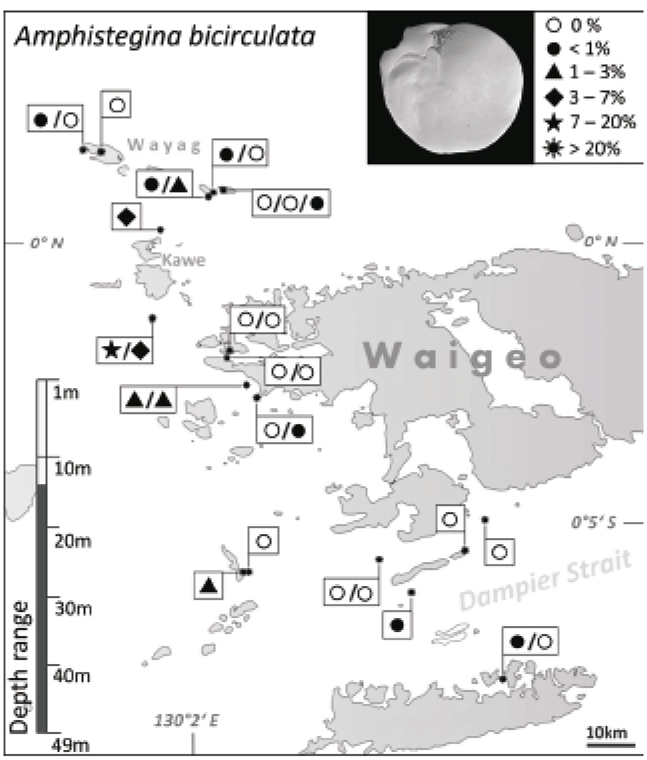
***Quinqueloculina* sp. 7**
Plate 25, figures 7-9

Description: Test porcelaneous, elongate, laterally strongly compressed, flattened, periphery carinate, carina partially becoming bicarinate; four chambers visible from the exterior; surface ornamented with very shallow, irregular, longitudinally oriented striae; aperture on a short neck terminal, an ovate opening with a peristomal rim and a short and simple tooth (note that the aperture is partially broken off).

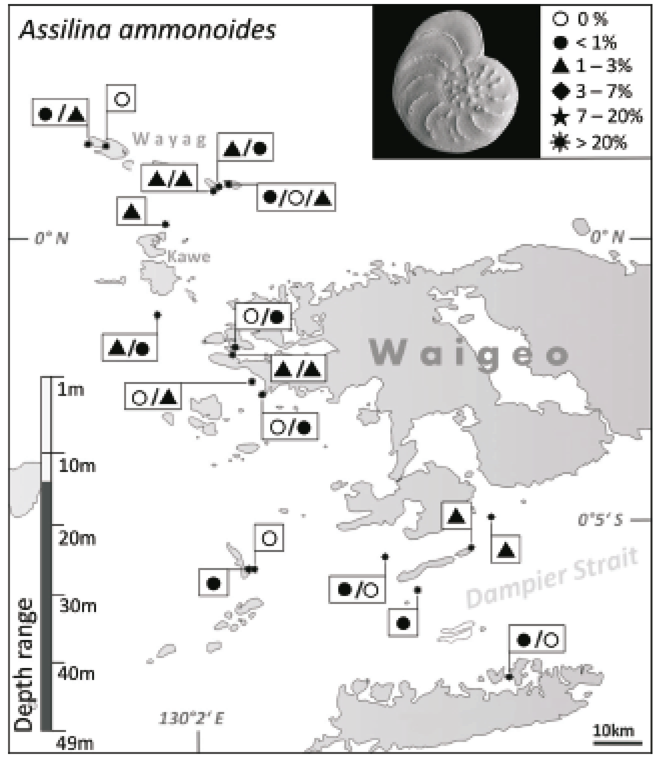
Remarks: This species resembles *Quinqueloculina planata* (Cushman 1932).



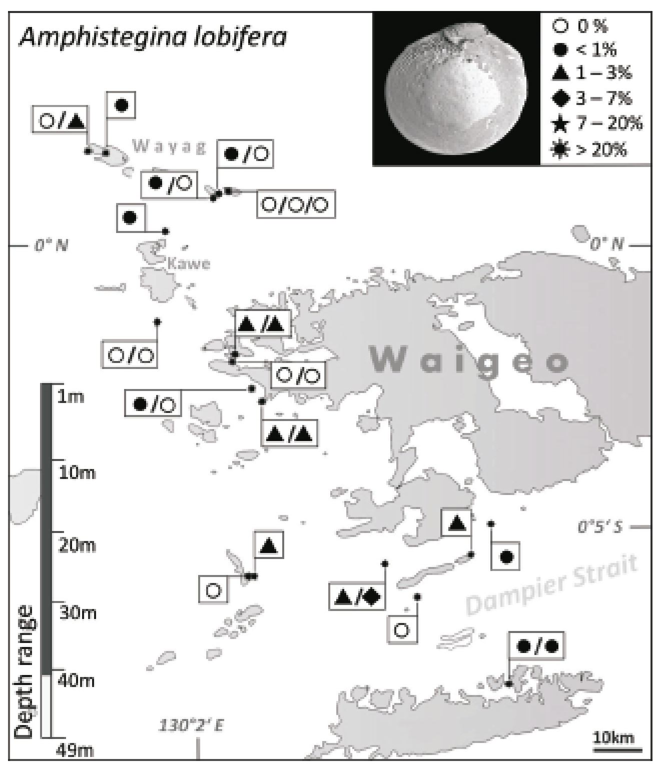
TEXT-FIGURE 32
Distribution and abundance of *Lachlanella parkeri*. Abundances vary between 0 and 2%. The depth range covers 1-49 m.



TEXT-FIGURE 33
Distribution and abundance of *Amphistegina bicirculata*. Abundances vary between 0 and 10%. The depth range covers 12-49 m.



TEXT-FIGURE 34
Distribution and abundance of *Assilina ammonoides*. Abundances vary between 0 and 3%. The depth range covers 12-49 m.



TEXT-FIGURE 35
Distribution and abundance of *Amphistegina lobifera*. Abundances vary between 0 and 5%. The depth range covers 1-41 m.

***Quinqueloculina*? sp. 8**
Plate 28, figures 25-27

Quinqueloculina subparkeri McCulloch – DEBENAY 2012, p. 127, 273.

Remarks: For details on the morphology see description in Debenay. It is uncertain whether the species from Raja Ampat belongs to *Quinqueloculina subparkeri* McCulloch. This species may belong to the genus *Siphonaperta* Vella because of the presence of agglutinated particles.

Occurrence: New Caledonia (Debenay 2012).

***Quinqueloculina* sp. 9**
Plate 21, figures 31-33

Description: Test porcelaneous, elongate, more than two times higher than broad, periphery broadly rounded; five chambers visible from the exterior, each chamber forming two deep lateral indentations on both sides of its aboral end; sutures depressed, distinct; surface smooth and unornamented; aboral and oral end produced; aperture terminal, a small circular opening without a rim and with a short, curved T-shaped tooth.

***Quinqueloculina*? sp. 10**
Plate 25, figures 22-24

Triloculina sp. A CUSHMAN, TODD and POST 1954, p. 340, pl. 85, fig. 20.
Quinqueloculina sp. 19 PARKER 2009, p. 319, fig. 230a-i.

Remarks: Three to four chambers are visible from the exterior. Sutures indistinct as described in Cushman, Todd and Post (1954). The Ningaloo Reef specimens depicted by Parker show five chambers and may represent more adult stages of this species.

Occurrence: Eniwetok Atoll (Cushman, Todd and Post 1954), Ningaloo Reef (Parker 2009).

***Quinqueloculina* sp. 11**
Plate 26, figures 7-12

Description: Test porcelaneous, slightly elongate, subelliptical in lateral view, subtriangular in top view, periphery subangular; five chambers visible from the exterior; sutures depressed, distinct, partially incised; surface smooth, occasionally ornamented with fine striae; aperture terminal, a circular opening with a short tooth that is bifurcated at its tip.

Remarks: This species resembles *Quinqueloculina* sp. D of Hottinger, Halicz and Reiss (1993; p. 61, pl. 58, figs. 1-4) but their specimens have an arch- to U-shaped aperture and the chambers are less inflated.

***Quinqueloculina* sp. 12**
Plate 26, figures 1-3

Description: Test porcelaneous, elongate, two and a half to three times higher than broad, periphery rounded; five chambers visible from the exterior, chambers slightly inflated; sutures slightly depressed, distinct, incised, parallel to test axis; surface smooth and unornamented; oral end produced, aperture terminal, an arch-shaped slightly elongated opening without a rim and provided with a slender tooth that is bifurcated at its tip.

***Quinqueloculina* sp. 13**
Plate 20, figures 27-29

Description: Test porcelaneous, slightly higher than broad, ovate in lateral view, subtriangular in top view, periphery rounded; five chambers visible from the exterior, chambers slightly inflated; sutures not depressed, distinct but weakly pronounced; surface smooth and unornamented; aperture terminal, an arch-shaped opening without a rim and provided with a short T-shaped tooth.

Remarks: A similar, not yet formally described species is present around southern Africa (Langer unpubl. data).

***Quinqueloculina* sp. 14**
Plate 20, figures 24-26

Description: Test porcelaneous, slightly higher than broad, ovate in lateral view, subtriangular in top view, periphery subangular; chambers slightly inflated; sutures not depressed, distinct but weakly pronounced; surface ornamented with weak costae at the outer margin of each chamber; aperture terminal, an arch-shaped opening with a well-developed rim (note that the aperture is broken).

Remarks: The specimen recovered from Raja Ampat is strongly abraded and resembles a similar, not yet officially described species from southern Africa (Langer unpubl. data).

***Quinqueloculina* sp. 15**
Plate 23, figures 7-9

Description: Test porcelaneous, slightly higher than broad, ovate in lateral view, subtriangular in top view, periphery rounded to subangular; five chambers visible from the exterior, chambers inflated; sutures distinct but weakly pronounced; surface with weakly developed costae at the outer margins of the chambers; aperture terminal, a small subcircular opening without a rim and provided with a T-shaped tooth.

Remarks: This species differs in the more rounded periphery, the less developed ornamentation and in the apertural features from *Quinqueloculina* sp. 16. A very similar species (not yet described) is present around southern Africa (Langer unpubl. data).

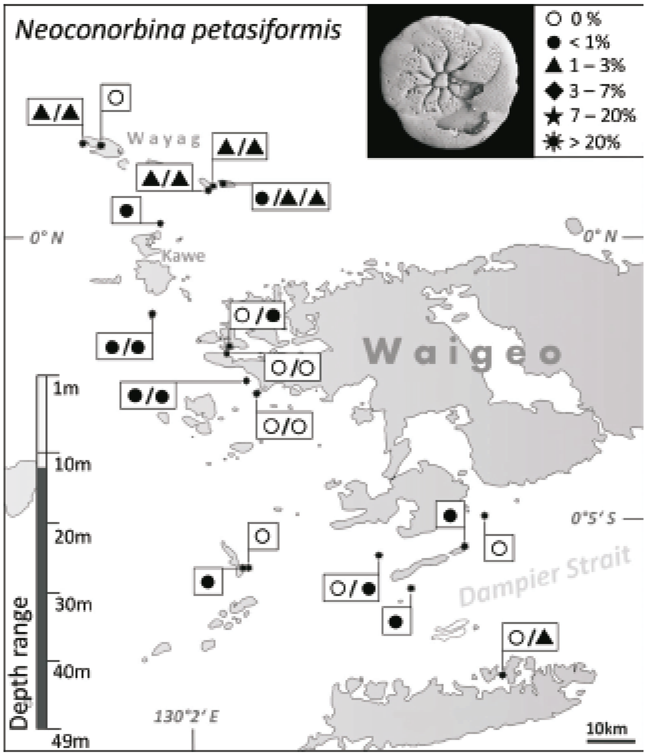
***Quinqueloculina* sp. 16**
Plate 22, figures 1-18

Description: Test porcelaneous, slightly higher than broad, ovate in lateral view, subtriangular in top view, periphery subangular; five chambers visible from the exterior; sutures distinct; surface ornamented with numerous weak costae that are more pronounced and at the outer margins of the chambers; aperture terminal, a subcircular opening with a T-shaped tooth.

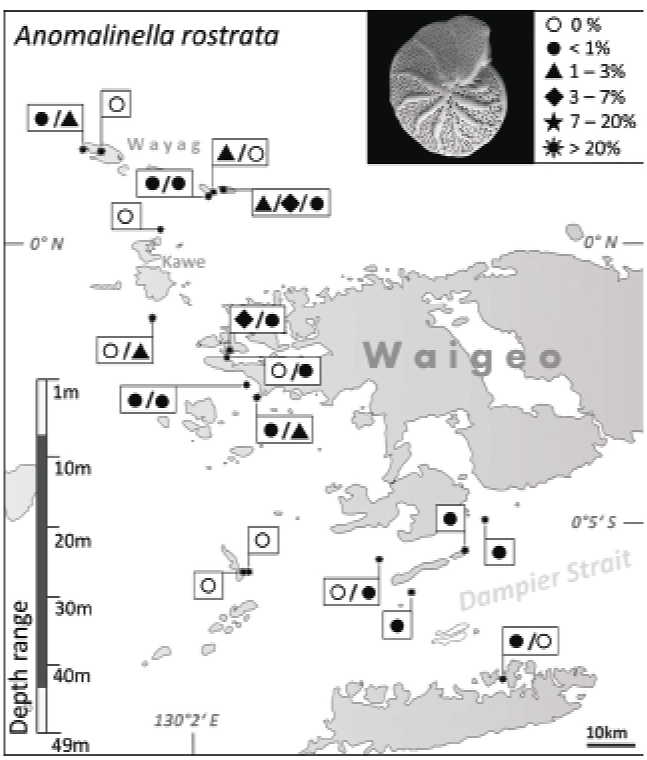
Remarks: This species exhibits a broad range of morphological variation. A very similar (not yet described) species is present around southern Africa (Langer unpubl. data).

***Quinqueloculina* sp. 17**
Plate 26, figures 28-30

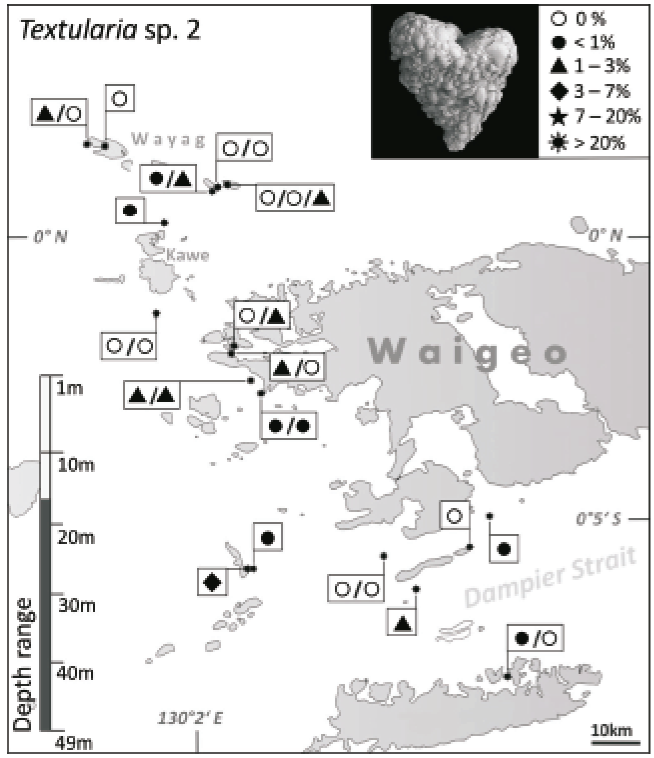
Description: Test porcelaneous, higher than broad, periphery with rounded angles; five chambers visible from the exterior, chambers slightly inflated and each provided with one to two blunt carinae; sutures depressed, indistinct, largely covered with agglutinated particles; surface uneven and roughly textured, incorporated agglutinated material visible; aperture terminal, a circular opening with a rim and a curved T-shaped tooth.



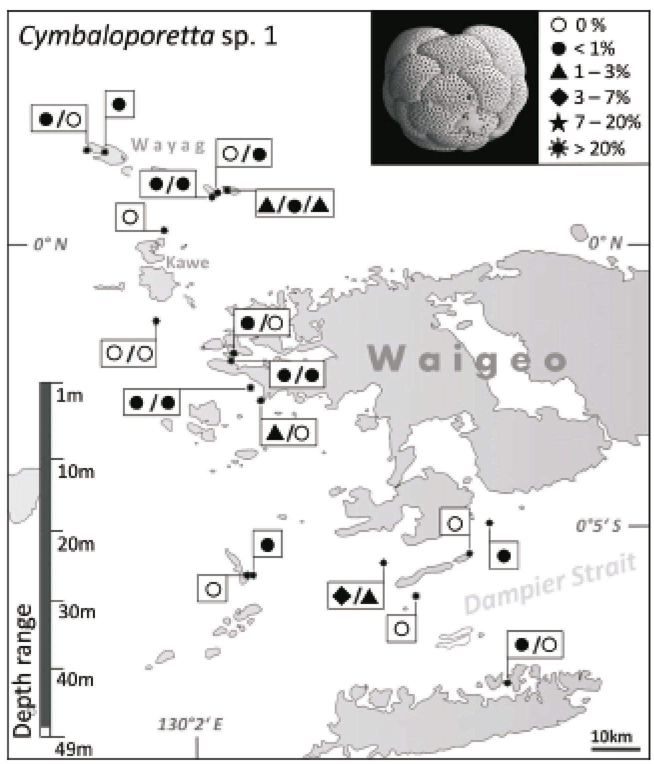
TEXT-FIGURE 36
Distribution and abundance of *Neoconorbina petasiformis*. Abundances vary between 0 and 3%. The depth range covers 12-49 m.



TEXT-FIGURE 37
Distribution and abundance of *Anomalinella rostrata*. Abundances vary between 0 and 4%. The depth range covers 8-45 m.



TEXT-FIGURE 38
Distribution and abundance of *Textularia* sp. 2. Abundances vary between 0 and 3%. The depth range covers 17-49 m.



TEXT-FIGURE 39
Distribution and abundance of *Cymbaloporetta* sp. 1. Abundances vary between 0 and 3%. The depth range covers 1-48 m.

Remarks: The wall texture of this species resembles that of *Quinqueloculina pittensis* Albani as illustrated in Parker (2009; p. 236, figs. 169a-h, 170a-h, 171a-j).

***Quinqueloculina* sp. 18**
Plate 20, figures 21-23

Description: Test porcelaneous, ovate in lateral view, periphery rounded, roughly triangular in top view; surface smooth and unornamented; five chambers visible from the exterior; sutures weakly depressed, distinct; aperture an arch-shaped opening, in terminal position, without a rim, and provided with a short tooth that is thickened at its tip.

***Quinqueloculina*? sp. 19**
Plate 28, figures 28-30

Description: Test porcelaneous, higher than broad, slightly inflated, slightly sigmioline in top view; four to five chambers visible from the exterior; surface roughly textured, test irregularly ornamented, discontinuous costae at the outer margins of the final chambers; aperture terminal, a small arch-shaped opening with small rounded tooth; the aperture appears to show the intial stage of a trematophore.

***Quinqueloculina* sp. 20**
Plate 25, figures 16-18

Remarks: This species resembles „*Quinqueloculina*" sp. A of Hottinger, Halicz and Reiss (1993; see also their discussion on p. 67) from the Red Sea and *Quinqueloculina oblonga* subsp. *segersi* of Baccaert (1987, pl. 45, fig. 5a,b) from the Great Barrier Reef.

Siphonaperta Vella 1957

Siphonaperta distorqueata (Cushman 1954)
Plate 27, figures 1-6

Quinqueloculina distorqueata Cushman in CUSHMAN, TODD and POST 1954, p. 333, pl. 83, fig. 27. – HAIG 1988, p. 233, pl. 5, figs. 26-28.

Occurrence: Bikini Atoll (Cushman, Todd and Post 1954), Papuan Lagoon (Haig 1988), Madang, Papua New Guinea (Langer unpubl. data).

Siphonaperta* cf. *S. distorqueata (Cushman 1954) **Type 1**
Plate 27, figures 7-12

cf. *Quinqueloculina distorqueata* Cushman in CUSHMAN, TODD and POST 1954, p. 333, pl. 83, fig. 27.

Remarks: The species resembles *Quinqueloculina semiplicata* McCulloch 1977.

Occurrence: *Siphonaperta distorqueata* was originally described from the Bikini Atoll.

Siphonaperta* cf. *S. distorqueata (Cushman 1954) **Type 2**
Plate 27, figures 13-15

cf. *Quinqueloculina distorqueata* Cushman in CUSHMAN, TODD and POST 1954, p. 333, pl. 83, fig. 27.

Remarks: The periphery is more rounded than in *Siphonaperta* cf. *S. subagglutinata* Type 1.

Occurrence: *Siphonaperta distorqueata* was originally described from the Bikini Atoll.

Siphonaperta hallocki Förderer and Langer 2016
Plate 26, figures 13-18

? *Quinqueloculina* sp. C HAIG 1988, p. 234, pl. 9, figs. 7-10.
? *Quinqueloculina* sp. 13 PARKER 2009, p. 311, figs. 224a-j, 225a-g.
Siphonaperta hallocki FÖRDERER and LANGER 2016, p. 13, fig. 6:A-F.

Occurrence: ? Papuan Lagoon (Haig 1988), ? Ningaloo Reef (Parker 2009).

Siphonaperta subagglutinata (Asano 1936)
Plate 28, figures 1-6

Miliolina undosa Karrer – BRADY 1884, p. 176, pl. 8, figs. 6, 7 (not fig. 8).
Quinqueloculina subagglutinata ASANO 1936, p. 620, pl. 32, figs. 1 a-c.
Quinqueloculina agglutinans (d'Orbigny) – GRAHAM and MILITANTE 1959, p. 41, pl. 4, figs. 10 a-c.
Dentostomina agglutinans (d'Orbigny) – BARKER 1960, pl. 8 figs. 6, 7.
Quinqueloculina agglutinans d'Orbigny – HAIG 1988, p. 233, pl. 4, figs. 12-14.
Siphonaperta subagglutinata (Asano) – MAKLED and LANGER 2011, p. 248, fig. 7, 10-15.

Occurrence: Admiralty Islands (Brady 1884, Barker 1960), Japan (Asano 1936), Philippines (Graham and Militante 1959), Papuan Lagoon (Haig 1988), Caroline Islands (Makled and Langer 2011), Madang, Papua New Guinea (Langer unpubl. data).

***Siphonaperta* sp.**
Plate 28, figures 7-9

Quinqueloculina sp. 2 PARKER 2009, p. 297, fig. 212a-g.

Remarks: For remarks on the morphology see the description in Parker (2009).

Occurrence: Ningaloo Reef (Parker 2009).

Subfamily MILIOLINELLINAE Vella 1957
Pseudolachlanella Langer 1992

Pseudolachlanella eburnea (d'Orbigny 1839)
Plate 22, figures 25-28

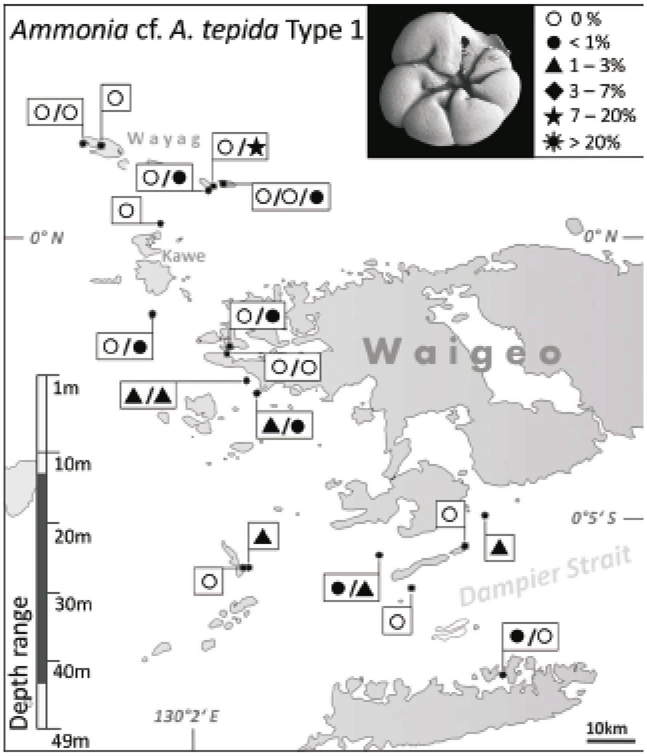
Triloculina eburnea D'ORBIGNY 1839, p. 180, pl. 10, figs. 21-23. – LE CALVEZ 1977, p. 104, pl. 20, figs. 1-4.
Quinqueloculina cf. *Q. incisura* (Todd) – HAIG 1988, p. 233, pl. 6, figs. 11-14.
"Quinqueloculina" eburnea (d'Orbigny) – HOTTINGER, HALICZ and REISS 1993, p. 59, pl. 53, figs. 9-11; pl. 54, figs. 3-5, not fig. 1.
Quinqueloculina eburnea (d'Orbigny) – PARKER 2009, p. 202, figs. 143-145. – FAJEMILA, LANGER and LIPPS 2015, fig. 2: 36.
Pseudolachlanella eburnea (d'Orbigny) – DEBENAY 2012, p. 115, 275.

Remarks: Molecular analysis is required to confirm that the specimens reported from the Indo-Pacific are the same as the specimens from the Caribbean.

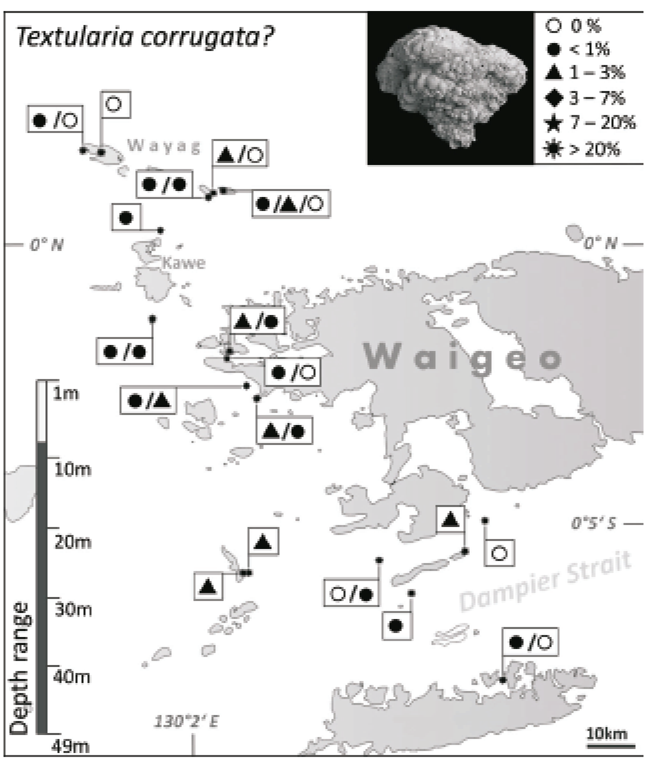
Occurrence: Cuba (d'Orbigny 1839, Le Calvez 1977), Papuan Lagoon (Haig 1988), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), Ningaloo Reef (Parker 2009), Moorea (Fajemila, Langer and Lipps 2015), New Caledonia (Debenay 2012).

Pseudolachlanella* cf. *P. eburnea (d'Orbigny 1839)
Plate 22, figures 32-34

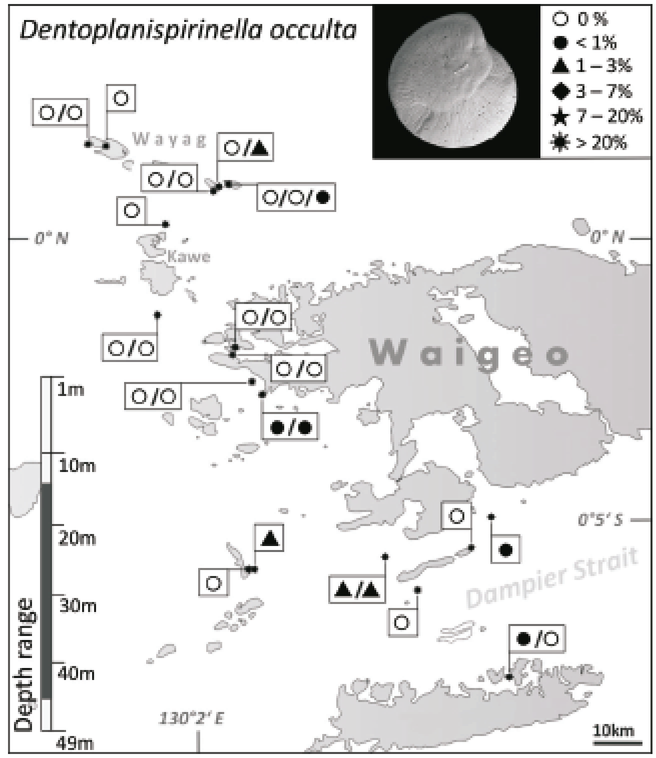
cf. *Triloculina eburnea* D'ORBIGNY 1839, p. 180, pl. 10, figs. 21-23.



TEXT-FIGURE 40
Distribution and abundance of *Ammonia* cf. *A. tepida* Type 1. Abundances vary between 0 and 9%. The depth range covers 14-45 m.



TEXT-FIGURE 41
Distribution and abundance of *Textularia corrugata*?. Abundances vary between 0 and 2%. The depth range covers 8-49 m.



TEXT-FIGURE 42
Distribution and abundance of *Dentoplanispirinella occulta*. Abundances vary between 0 and 2%. The depth range covers 14-45 m.

Remarks: The specimen may represent an aberrant or super-adult stage of *Pseudolachlanella eburnea* as indicated by its size.
Occurrence: Pseudolachlanella eburnea was orignally described from Cuba.

Pseudolachlanella* cf. *P. slitella Langer 1992
Plate 22, figures 22-24

cf. *Pseudolachlanella slitella* LANGER 1992, p. 90, pl. 2, figs.. 4-6.

Occurrence: *Pseudolachlanella slitella* was originally described from Madang, Papua New Guinea.

***Pseudolachlanella*? sp.**
Plate 22, figures 19-21

Description: Test small, porcelaneous, about three times higher than broad, periphery rounded; surface smooth, glossy; four chambers visible from the exterior; sutures weakly depressed; *Lachlanella*-like aperture terminal, without a rim and with a long and slender tooth that becomes thickened at the tip.

Remarks: The species strongly resembles *Quinqueloculina tantabiddyensis* Parker (2009; p. 265, figs. 192a-j, 193a-h, 194a-i, 195a-f), however, only four chambers are visible in the specimen from Raja Ampat. It also resembles *Pseudolachlanella slitella* Langer (1992) but differs in apertural features.

Miliolinella Wiesner 1931

Miliolinella* cf. *M. chiastocytis (Loeblich and Tappan 1994)
Plate 16, figures 29-31

cf. *Triloculinella chiastocytis* LOEBLICH and TAPPAN 1994, p. 57, pl. 97, figs. 7-9; pl. 98, figs. 4-6, 10-18.

Occurrence: *Miliolinella chiastocytis* was originally described from the Timor Sea.

Miliolinella circularis (Bornemann 1855)
Plate 17, figures 7-9

Triloculina circularis BORNEMANN 1855, p. 349, pl. 19, fig. 4.
Miliolinella circularis (Bornemann) – PARKER 2009, p. 120, fig. 85a-c. – DEBENAY 2012, p. 109, 275.

Occurrence: Oligocene, Germany (Bornemann 1855), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

Miliolinella moia Förderer and Langer 2016
Plate 17, figures 19-30

Miliolinella moia FÖRDERER and LANGER 2016, p. 7, fig. 3: A-L.

Miliolinella oceanica (Cushman 1932)
Plate 18, figures 19-24

Triloculina oceanica CUSHMAN 1932, p. 54, pl. 12, figs. 3a-c.
Quinqueloculina baragwanathi PARR 1945, p. 196, pl. 8, figs. 6a-c; pl. 12, fig. 3.
Miliolinella oceanica (Cushman) – CHENG and ZHENG 1978, p. 186, pl. 6, figs. 5, 6. – HAIG 1988, p. 224, pl. 2. Figs. 16-18. – PARKER 2009, p. 120, fig. 86a-h. – DEBENAY 2012, p. 110, 275.
Miliolinella baragwanathi (Parr) – BACCAERT 1987, p. 136, pl. 60, figs. 4, 5. – LANGER et al. 2013, fig. 5: 42.

Occurrence: Héréhérétué Atoll (Cushman 1932), Barwon River, Victoria (Parr 1945), Xisha Islands (Cheng and Zheng 1978), Papuan Lagoon (Haig 1988), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Great Barrier Reef (Baccaert 1987), Bazaruto (Langer et al. 2013).

Miliolinella* cf. *M. pilasensis McCulloch 1977
Plate 17, figures 16-18

cf. *Miliolinella pilasensis* MCCULLOCH 1977, p. 566, pl. 238, fig. 16.

Occurrence: *Miliolinella pilasensis* was originally described from the Philippines. A similar species is found in material from southern Africa (Langer unpubl. data).

Miliolinella* cf. *M. semicostata (Wiesner 1923)
Plate 18, figures 16-18

cf. *Quinqueloculina semicostata* WIESNER 1923, p. 72, pl. 14, figs. 177, 178.
Miliolinella cf. *M. semicostata* Wiesner – DEBENAY 2012, p. 110, 275.

Remarks: This species also resembles *Miliolinella flintiana* Cushman (1932; p. 55, pl 12, figs. 4a-c). However, to keep taxonomic consistency we concur with Debenay.

Occurrence: New Caledonia (Debenay 2012). *Miliolinella semicostata* was originally described from the Adriatic Sea.

Miliolinella subrotunda (Walker and Boys 1784)
Plate 19, figures 1-3

Serpula subrotunda dorso elevato WALKER and BOYS 1784, pl. 1, fig. 4.
Vermiculum subrotundum MONTAGU 1808, p. 521, pl. 1, fig. 4.
Miliolinella labiosa (d'Orbigny) – HAIG 1988, pl. 2, fig. 15
Miliolinella subrotunda (Walker and Boys) – CIMERMAN and LANGER 1991, p. 41, pl. 38, figs. 1-3. – PARKER 2009, p. 124, figs. 88a-j, 89a-g. – DEBENAY 2012, p. 110, 275.

Occurrence: British Isles (Walker and Boys 1784, Montagu 1808), Papuan Lagoon (Haig 1988), Mediterranean (Cimerman and Langer 1991), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Madang, Papua New Guinea (Langer unpubl. data).

Miliolinella undina Förderer and Langer 2016
Plate 18, figures 7-15

Miliolinella sp. B HAIG 1988, p. 224, pl. 2, figs. 23, 24.
Miliolinella sp. HATTA and UJIIÉ 1992, p. 72, pl. 10, fig. 6.
? *Miliolinella* cf. *M. semicostata* (Wiesner) – DEBENAY 2012, p. 110, 275.
Miliolinella undina FÖRDERER and LANGER 2016, p. 9, fig. 4:A-I.

Occurrence: Papuan Lagoon (Haig 1988), Ryukyu Islands (Hatta and Ujiié 1992), ? New Caledonia (Debenay 2012), Palawan, Philippines (Förderer unpubl. data).

Miliolinella webbiana (d'Orbigny 1839)
Plate 18, figures 1-6

Triloculina webbiana D'ORBIGNY 1839, p. 140, pl. 3, figs. 13-15.
Miliolinella webbiana (d'Orbigny) – LE CALVEZ 1974, p. 90-92, pl. 23, figs. 1-4, 13-15. – CHENG and ZHENG 1978, p. 186, pl. 6, fig. 4. – PARKER 2009, p. 124, fig. 90a-e. – DEBENAY 2012, p. 110, 275.
Miliolinella sp. HAIG 1988, p. 224, pl. 2, figs. 23, 24.
Miliolinella suborbicularis (d'Orbigny) – LOEBLICH and TAPPAN 1994, p. 52, pl. 89, figs. 1-9; pl. 96 figs. 14-16 (not figs. 11-13). – MAKLED and LANGER 2011, p. 238, fig. 5: 1-6.
Remarks: *Miliolinella webbiana* differs from *Miliolinella suborbicularis* in having a flap. See also remarks in Parker (2009; p. 124).

Occurrence: Canary Islands (d'Orbigny 1839, Le Calvez 1974), Xisha Islands (Cheng and Zheng 1978), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Papuan Lagoon (Haig 1988), Timor Sea (Loeblich and Tappan 1994), Caroline Islands (Makled and Langer 2011).

***Miliolinella*? sp. 1**
Plate 17, figures 1-6

Description: Test porcelaneous, circular in outline, somewhat compressed, periphery rounded; surface smooth and unornamented; three chambers visible from the exterior, chambers inflated, broadest at the base, giving them a sac-like appearance; sutures depressed and distinct; aperture a broad arch-shaped opening terminal, with a lip, and provided with a flap-like tooth.

***Miliolinella* sp. 2**
Plate 19, figures 19-21

Description: Test porcelaneous, slightly higher than broad, ovate in lateral view, slightly compressed, periphery rounded; surface smooth and unornamented; five chambers visible from the exterior; sutures slightly depressed; aperture a low arch-shaped opening terminal, provided with a broad but narrow flap-like tooth.

Remarks: This species resembles *Miliolinella* sp. 8.

***Miliolinella* sp. 3**
Plate 20, figures 1-3

Description: Test porcelaneous, circular in outline, strongly compressed, periphery rounded; surface smooth and unornamented; five chambers visible from the exterior; sutures slightly depressed, distinct; aperture an arch-shaped opening, terminal, with a well-developed lip, and provided with a broad flap-like tooth.

***Miliolinella* sp. 4**
Plate 19, figures 4-6

Description: Test large, porcelaneous, strongly irregular in outline, having a "crumpled"-like appearance; at least three chambers visible from the exterior, chambers irregularly formed; surface smooth and unornamented; aperture terminal, a broad irregular opening with a well developed everted lip and a flap-like tooth.

***Miliolinella*? sp. 5**
Plate 20, figures 14-17

Description: Test porcelaneous, broader than high, irregular in outline, periphery rounded; four to five chambers visible from the exterior, chambers inflated, irregularly formed; surface smooth and unornamented; sutures depressed, distinct; aperture terminal, a low and broad, curved opening without a true tooth or flap.

***Miliolinella*? sp. 6**
Plate 20, figures 4-6

Description: Test small, porcelaneous, ovate in lateral view, roughly triangular in top view, periphery with rounded angles; three chambers visible from the exterior; surface smooth and unornamented; sutures slightly depressed; aperture terminal, a low and broad arch-shaped opening with a flap-like tooth.

Remarks: This species resembles *Miliolinella* cf. *M. vigilax* Vella in Debenay (2012; p. 111).

***Miliolinella* sp. 7**
Plate 19, figures 7-12

Description: Test large, porcelaneous, irregular in outline, somewhat compressed, periphery rounded; four chambers visible from the exterior, chambers inflated, irregularly formed; surface smooth and unornamented; sutures depressed, distinct; aperture terminal, a broad arch-shaped opening provided with a lip and a flap-like tooth.

***Miliolinella* sp. 8**
Plate 19, figures 25-30

Description: Test porcelaneous, about two times higher than broad, periphery rounded; surface smooth and unornamented; five chambers visible from the exterior, chambers one half-coil in length, asymmetrical, broadest at the base and tapering towards the aperture, later chambers strongly overlapping the earlier ones; sutures slightly depressed; aperture a low arch-shaped opening terminal, situated in short distance below the end of the test, provided with a broad and narrow flap-like tooth.

Remarks: This species resembles *Kalosha aluta* Loeblich and Tappan (1994; p. 42, pl. 87, figs. 13, 14; pl. 97, figs. 13-15).

***Miliolinella* sp. 9**
Plate 17, figures 13-15

Description: Test porcelaneous, ovate in lateral view, strongly compressed, periphery with rounded angles; surface smooth and unornamented; four chambers visible from the exterior; sutures distinct; aperture a high triangular opening terminal, with a well-developed lip, and provided with a flap-like tooth.

***Miliolinella*? sp. 10**
Plate 20, figures 7-9

Description: Test porcelaneous, ovate in lateral view, roughly triangular in top view, periphery rounded; three chambers visible from the exterior, chambers inflated; surface rough, granular; sutures not depressed, oblique; aperture terminal, a narrow and low arch-shaped opening with a flap-like tooth.

***Miliolinella* sp. 11**
Plate 19, figures 22-24

Description: Test porcelaneous, slightly higher than broad, irregular in outline, slightly compressed, periphery rounded; surface smooth and unornamented; five chambers visible from the exterior, chambers irregularly formed and inflated, stronger inflated at the base; aperture a low arch-shaped opening terminal, provided with a broad and narrow flap-like tooth.

Remarks: This may represent an aberrant specimen of *Miliolinella* sp. 2.

***Miliolinella* sp. 12**
Plate 19, figures 13-18

Description: Test large, porcelaneous, broadly circular in outline; surface rough, granular; four to five chambers visible from the exterior, chambers strongly inflated; sutures strongly depressed; aperture a very broad arch-shaped opening terminal, provided with a well-developed lip and a very broad plate-like tooth.

***Miliolinella*? sp. 13**
Plate 17, figures 10-12

Description: Test porcelaneous, ovate in lateral view, somewhat compressed, periphery rounded; surface smooth and unornamented; three chambers visible from the exterior; sutures distinct; aperture a high arch-shaped opening terminal, with a well-developed lip, and provided with a low flap-like tooth.

Remarks: This species resembles *Miliolinella* cf. *M. pilasensis* McCulloch but appears to be more rounded and inflated.

***Miliolinella*? sp. 14**
Plate 20, figures 12, 13

Description: Test small, porcelaneous, ovate in lateral view, compressed, periphery angular; surface rough, ornamented with discontinuous, longitudinally aligned, aligned and somewhat irregular costae; five chambers visible from the exterior; sutures depressed; aperture with a *Miliolinella*-like, broad opening but appears to be broken.

Remarks: This species differs from *Miliolinella semicostata* (Wiesner) in the irregularity of the longitudinal costae.

***Miliolinella*? sp. 15**
Plate 20, figures 10, 11

Description: Test small, porcelaneous, subcircular in outline, compressed, periphery rounded; three chambers visible from the exterior; sutures weakly depressed, distinct; surface smooth, unornamented; aperture terminal, an arch-shaped opening without a rim or a tooth.

Remarks: The generic assignment is tentative as the tooth/flap appears to be broken off.

Pseudomassilina Lacroix 1938

Pseudomassilina reticulata (Heron-Allen and Earland 1915)
Plate 30, figures 4-6

Massilina secans var. *reticulata* HERON-ALLEN and EARLAND 1915, p. 582, pl. 45, figs. 1-4.
Pseudomassilina australis (Cushman) var. *reticulata* (Heron-Allen and Earland) – GRAHAM and MILITANTE 1959, p. 39, pl. 3, fig. 22.
Pseudomassilina reticulata (Heron-Allen and Earland) – HOTTINGER, HALICZ and REISS 1993, p. 54, pl. 42, figs. 5-8; pl. 43, figs. 1-8. – MAKLED and LANGER 2011, p. 248, fig. 5: 16-22.

Remarks: Our specimen differs from other reports of *Pseudomassilina reticulata* by having more inflated chambers with rounded angles. So far, only one, probably adult specimen was recovered from the sample material.

Occurrence: Quirimbas (Heron-Allen and Earland 1915), Philippines (Graham and Militante 1959), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), Caroline Islands (Makled and Langer 2011).

Pseudotriloculina Cherif 1970

Pseudotriloculina kerimbatica (Heron-Allen and Earland 1915)
Plate 16, figures 23-25

Miliolina kerimbatica HERON-ALLEN and EARLAND 1915, p. 574, pl. 43, figs. 13-23.
Pseudotriloculina sp. B MAKLED and LANGER 2011, p. 248, fig. 5: 33, 34.
Pseudotriloculina kerimbatica (Heron-Allen and Earland) – LANGER et al. 2013, p. 167, fig. 6: 14, 15.

Remarks: This species was shown to display a large morphological variability (Heron-Allen and Earland, 1915).

Occurrence: Quirimbas (Heron-Allen and Earland 1915), Caroline Islands (Makled and Langer 2011), Bazaruto (Langer et al. 2013).

***Pseudotriloculina* sp. 1**
Plate 16, figures 8-10

Description: Test porcelaneous, elongated, ovate in lateral view, compressed, periphery rounded with faint angles; surface smooth and unornamented; four chambers visible from the exterior; sutures slightly depressed; aperture an arch-shaped opening terminal, with a rim, and provided with a long, thick, and raised tooth.

Remarks: This recovered specimen is strongly abraded.

***Pseudotriloculina* sp. 2**
Plate 16, figures 20-22

Description: Test porcelaneous, ovate in lateral view, compressed with rounded periphery; surface smooth and unornamented; three chambers visible from the exterior; sutures depressed, distinct; aperture a *Lachlanella*-like opening, terminal, without a rim, and provided with a short slender tooth that is tapering at its tip.

Remarks: This species resembles *Miliolina seminulum* (Linnaeus) var. *angusteoralis* Wiesner. However, Wiesner's specimen is quinqueloculine.

***Pseudotriloculina* sp. 3**
Plate 16, figures 14-19

Description: Test porcelaneous, slightly elongate, ovate in lateral view, compressed, periphery rounded; surface smooth and unornamented; three chambers visible from the exterior; sutures weakly depressed; aperture a *Lachlanella*-like opening, terminal, without a rim and provided with a long slender tooth that is bifurcated at its tip.

Remarks: The larger specimen (figs. 17-19) is strongly abraded.

***Pseudotriloculina* sp. 4**
Plate 16, figures 5-7

Description: Test porcelaneous, elongate, about two and a half times higher than broad, laterally compressed, periphery acute, with a rounded carina; four chambers visible from the exterior, last two chambers with a rounded carina at the outer margin; sutures weakly depressed, distinct; surface ornamented with numerous irregular, longitudinally aligned, fine striae; aperture terminal, a *Lachlanella*-like opening on a short neck and with a well-developed peristomal rim.

Remarks: The specimen is abraded, the tooth morphology remains uncertain. The species illustrated resembles *Triloculina* sp. 1. However, the chamber arrangement is not triloculine and the specimens do not show the slightest indication of a keel. Further studies are required.

***Pseudotriloculina*? sp. 5**
Plate 16, figures 11-13

Quinqueloculina cf. *planciana* d'Orbigny – PARKER 2009, p. 237, fig. 172a-l.

Remarks: For details on the morphology see also remarks in Parker (2009).

Occurrence: Ningaloo Reef (Parker 2009).

Pyrgo Defrance 1824

Pyrgo denticulata (Brady 1884)
Plate 13, figures 4-6

Biloculina denticulata (Lamarck) var. *denticulata* BRADY 1884, p. 143, pl. 3, figs. 4, 5.
Pyrgo denticulata (Brady) – BACCAERT 1987, p. 113, pl. 51, figs. 5,6, pl. 52, fig. 1. – HAIG 1988, p. 233, pl. 3, figs. 28, 29. – HOTTINGER, HALICZ and REISS 1993, p. 56, pl. 49, figs. 8-12. – LOEBLICH and TAPPAN 1994, p. 54, pl. 92, figs. 1, 2. – PARKER 2009, p. 168, fig. 119a-h. – DEBENAY 2012, p. 117, 276. – LANGER et al. 2013, fig. 6: 26, 27.

Occurrence: Tonga (Brady 1884), Great Barrier Reef (Baccaert 1987), Papuan Lagoon (Haig 1988), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Bazaruto (Langer et al. 2013), Madang, Papua New Guinea (Langer unpubl. data).

Pyrgo* cf. *P. oblonga (d'Orbigny 1839)
Plate 12, figures 19-21

cf. *Biloculina oblonga* D'ORBIGNY 1839, p. 163, pl. 8, figs. 21-23.
Pyrgo oblonga (d'Orbigny) – HOTTINGER, HALICZ and REISS 1993, p. 57, pl. 50, figs. 1-6.

Occurrence: Gulf of Aqaba (Hottinger, Halicz and Reiss 1993). *Pyrgo oblonga* was originally described from Cuba.

Pyrgo rotaliara Loeblich and Tappan 1953
Plate 13, figures 7-9

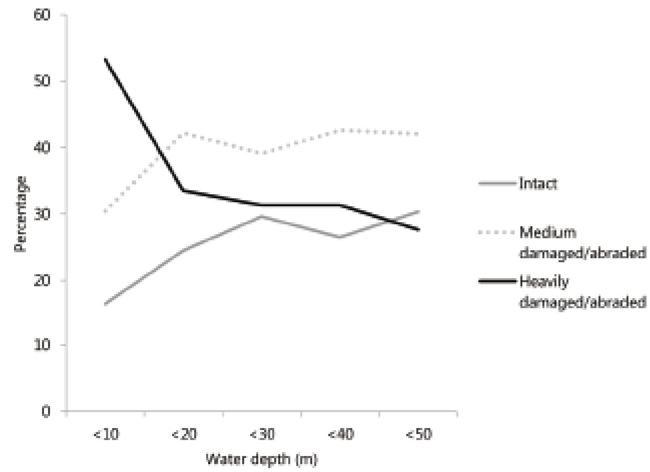
Pyrgo rotaliara LOEBLICH and TAPPAN 1953, p. 47, pl. 6, figs. 5, 6. – HOTTINGER, HALICZ and REISS 1993, p. 57, pl. 51, figs. 1-4. – DEBENAY 2012, p. 117, 277.
Pyrgo cf. *P. rotaliaris* Loeblich and Tappan – MCCULLOCH 1977, p. 532, pl. 241, figs. 1, 2; pl. 242, fig. 5.

Occurrence: Arctic (Loeblich and Tappan 1953), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), New Caledonia (Debenay 2012), Guadaloupe and Bikini (McCulloch 1977).

Pyrgo sarsi (Schlumberger 1891)
Plate 13, figures 1-3

Biloculina ringens Lamarck – BRADY 1884, pl. 2, figs. 7a, b.
Biloculina sarsi SCHLUMBERGER 1891, p. 553, pl. 9, figs. 55-57, tfs. 10-12. – CUSHMAN 1921, p. 471, pl. 97, fig. 1, text-figs. 48-50.
Pyrgo sarsi (Schlumberger) – ZHENG 1988, p. 229, pl. 12, figs. 6-10, pl. 13, figs. 1,2, pl. 31, figs. 19-22, text-fig. 46. – LOEBLICH and TAPPAN 1994, p. 54, pl. 94, figs. 1-9. – PARKER 2009, p. 172, fig. 121a-f. – DEBENAY 2012, p. 117, 277.

Occurrence: West Indies (Brady 1884), North Atlantic (Schlumberger 1891), Philippines (Cushman 1921), East China Sea (Zheng 1988), Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).



TEXT-FIGURE 43
Test preservation state in relation to water depth. Percent abundances of intact, medium and heavily abraded/damaged tests. Note that the preservation of tests rises gradually with increasing water depth.

Pyrgo* aff. *P. sarsi (Schlumberger 1891)
Plate 13, figures 10-12

aff. *Biloculina sarsi* SCHLUMBERGER 1891, p. 553, pl. 9, figs. 55-57, tfs. 10-12.

Remarks: This species appears to be larger and more inflated than *Pyrgo sarsi* s. str.

Occurrence: *Pyrgo sarsi* was originally described from the northern Atlantic.

Pyrgo striolata (Brady 1884)
Plate 12, figures 13-18

Biloculina ringens (Lamarck) var. *striolata* BRADY 1884, p. 143, pl. 3, figs. 7, 8.
Biloculina denticulata (Brady) var. *striolata* Brady – CUSHMAN 1921, p. 477, pl. 98, figs. 2a-c.
Pyrgo denticulata (Brady) var. *striolata* (Brady) – GRAHAM and MILITANTE 1959, p. 40, pl. 4, figs. 4, 5.
Pyrgo striolata (Brady) – CHENG and ZHENG 1978, p. 180, pl. 13, figs. 7, 8. – HAIG 1988, p. 233, pl. 4, figs. 1-4. – HOTTINGER, HALICZ and REISS 1993, p. 57, pl. 51, figs. 5-11. – LOEBLICH and TAPPAN 1994, p. 54, pl. 92, figs. 9-15. – PARKER 2009, p. 172, fig. 122a-k. – DEBENAY 2012, p. 118, 277.
Pyrgo denticulata (Brady) subsp. *striolata* (Brady) – BACCAERT 1987, p. 114, pl. 52, figs. 2-5.

Remarks: This species shows a high variablity in the pronounciation of striae.

Occurrence: Torres Strait and off Papua (Brady 1884), Philippines (Cushman 1921, Graham and Militante 1959), Xisha Islands (Cheng and Zheng 1978), Papuan Lagoon (Haig 1988), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Great Barrier Reef (Baccaert 1987), Madang, Papua New Guinea (Langer unpubl. data).

***Pyrgo* sp.**
Plate 12, figures 22-24

Pyrgo sp. 3 DEBENAY 2012, p. 118, 277.

Description: Test porcelaneous, elongate, ovate in lateral view, subcircular in top view, tapering towards the apertural end, periphery rounded; surface smooth and unornamented; biloculine, two chambers visible from the exterior; sutures depressed; aperture somewhat elliptical, a wide opening, terminal, provided with a broad T-shaped tooth.

Occurrence: New Caledonia (Debenay 2012), Madang, Papua New Guinea (Langer unpubl. data).

Triloculina d'Orbigny 1826

Triloculina asymmetrica Said 1949
Plate 13, figures 13-15

Triloculina asymmetrica SAID 1949, p. 18, pl. 2, fig. 11. – HOTTINGER, HALICZ and REISS 1993, p. 64, pl. 66, figs. 4-9.

Remarks: Hottinger, Halicz and Reiss (1993) mentioned that the surface of this species is occasionally extremely faintly striated. However, the specimens from Raja Ampat are all finely but distinctly striate.

Occurrence: Red Sea (Said 1949, Hottinger, Halicz and Reiss 1993), southern Africa (Langer unpubl. data).

Triloculina bertheliniana (Brady 1884)
Plate 13, figures 16-18

Miliolina bertheliniana BRADY 1884, p. 166, pl. 114, fig. 2a, b. – HERON-ALLEN and EARLAND 1915, p. 563, pl. 41, figs. 32-35.
Triloculina bertheliniana (Brady) – CUSHMAN 1932, p. 60, pl. 13, fig. 5. – GRAHAM and MILITANTE 1959, p. 53, pl. 7, fig. 7. – MCCULLOCH 1977, p. 552, pl. 221, fig. 17. – CHENG and ZHENG 1978, p. 180, pl. 9, figs. 7, 8. – HATTA and UJIIÉ 1992, p. 73, pl. 11, figs. 7a, b. – LOEBLICH and TAPPAN 1994, p. 55, pl. 95, figs. 1-4. – PARKER 2009, p. 358, fig. 261a-j. – DEBENAY 2012, p. 136, 277. – LANGER et al. 2013, p. 167, fig. 6: 28, 29.
Triloculina trigonula (Lamarck) subsp. *bertheliniana* (Brady) – BACCAERT 1987, p. 133, pl. 59, figs. 4a, b.

Occurrence: Madagascar (Brady 1884), Quirimbas (Heron-Allen and Earland 1915), Paumotu Islands (Cushman 1932), Philippines (Graham and Militante 1959), Galapagos (McCulloch 1977), South China Sea (Cheng and Zheng 1978), Ryukyus (Hatta and Ujiié 1992), Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Bazaruto (Langer et al. 2013), Great Barrier Reef (Baccaert 1987), Madang, Papua New Guinea (Langer unpubl. data).

Triloculina* cf. *T. bertheliniana (Brady 1884)
Plate 13, figures 19-21

cf. *Miliolina bertheliniana* BRADY 1884, p. 166, pl. 114, fig. 2a, b.
Triloculina sp. 4 PARKER 2009, p. 376, fig. 272e-j.

Remarks: See discussion and description in Parker (2009) for *Triloculina* sp. 4.

Occurrence: Ningaloo Reef (Parker 2009). *Triloculina bertheliniana* was originally described from Madagascar.

Triloculina bicarinata d'Orbigny 1839
Plate 13, figures 22-24

Triloculina bicarinata D'ORBIGNY 1839, p. 158, pl. 10, figs. 18-20. – CHENG and ZHENG 1978, p. 181, pl. 9, figs. 9-12. – HATTA and UJIIÉ 1992, p. 73, pl. 11, figs. 8a, b. – DEBENAY 2012, p. 136, 278.

Occurrence: Cuba (d'Orbigny 1839), Xisha Islands (Cheng and Zheng 1978), Ryukyus (Hatta and Ujiié 1992), New Caledonia (Debenay 2012).

Triloculina? fichteliana d'Orbigny 1839
Plate 13, figures 25-30

Triloculina fichteliana D'ORBIGNY 1839, p. 171, pl. 9, figs. 8-10. – GRAHAM and MILITANTE 1959, p. 53, pl. 7, fig. 10. – HOTTINGER, HALICZ and REISS 1993, p. 65, pl. 66, figs. 10-15. – DEBENAY 2012, p. 137, 278.

Remarks: The specimens from Raja Ampat are tentatively placed in *Triloculina fichteliana*. However, it is uncertain whether the chamber arrangement is triloculine as some specimens appear to show a fourth chamber.

Occurrence: Cuba (d'Orbigny 1839), Philippines (Graham and Militante 1959), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), New Caledonia (Debenay 2012).

Triloculina* cf. *T. fichteliana d'Orbigny 1839
Plate 14, figures 1-3

cf. *Triloculina fichteliana* D'ORBIGNY 1839, p. 171, pl. 9, figs. 8-10.

Occurrence: *Triloculina fichteliana* was originally described from Cuba.

Triloculina kawea Förderer and Langer 2016
Plate 14, figures 7-14

Triloculina? sp. 2 PARKER 2009, p. 372, fig. 271f-j.
Triloculina kawea FÖRDERER and LANGER 2016, p. 11, fig. 5:A-H.

Occurrence: Ningaloo Reef (Parker 2009).

Triloculina latiformis McCulloch 1981
Plate 14, figures 4-6

Triloculina latiformis MCCULLOCH 1981, p. 64, pl. 21, figs. 1, 2. – DEBENAY 2012, p. 137, 278.

Occurrence: Trinidad (McCulloch 1981), New Caledonia (Debenay 2012).

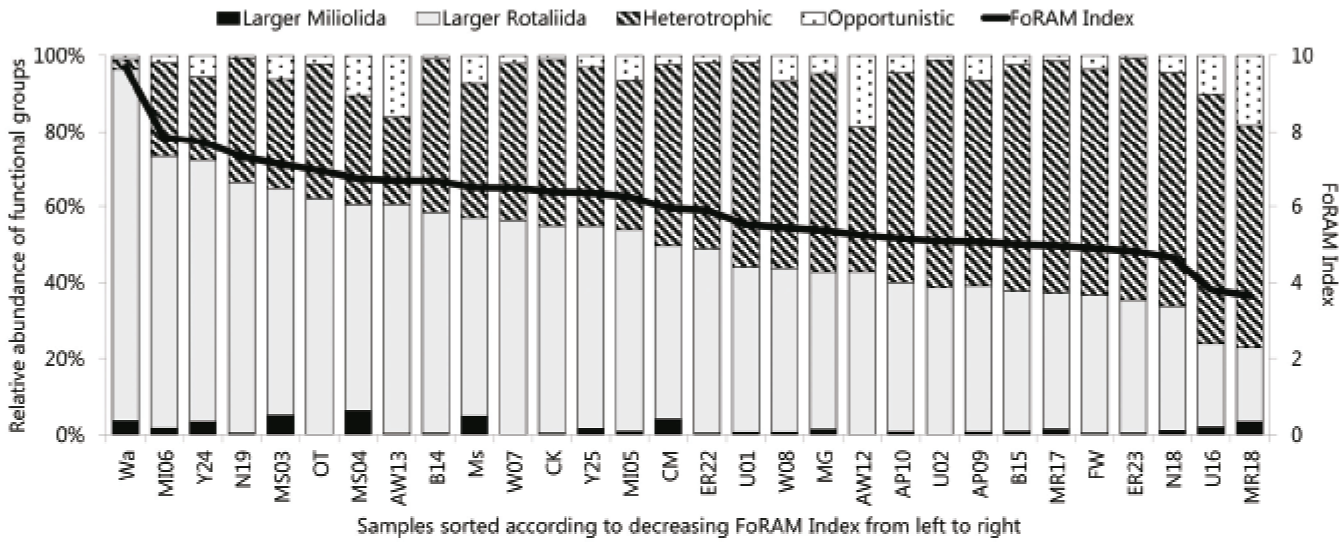
Triloculina serrulata McCulloch 1977
Plate 15, figures 25-30

Triloculina costifera Terquem – GRAHAM and MILITANTE 1959, p. 53, pl. 7, figs. 9a-c. – BACCAERT 1987, p. 125, pl. 56, fig. 3.
Triloculina serrulata MCCULLOCH 1977, p. 558, pl. 225, figs. 1, 2, 4. – HOTTINGER, HALICZ and REISS 1993, p. 65, pl. 67, figs. 1-9. – PARKER 2009, p. 364, fig. 264a-k. – PARKER and GISCHLER 2011, p. 43, pl. 3, figs. 10-12. – DEBENAY 2012, p. 137, 278. – LANGER et al. 2013, p. 167, fig. 6: 32.

Occurrence: Philippines (Graham and Militante 1959), Great Barrier Reef (Baccaert 1987), Red Sea (McCulloch 1977, Hottinger, Halicz and Reiss 1993), Ningaloo Reef (Parker 2009), Maldives (Parker and Gischler 2011), New Caledonia (Debenay 2012), Bazaruto (Langer et al. 2013).

Triloculina* cf. *T. sommeri Tinoco 1955
Plate 15, figures 7-9

cf. *Triloculina sommeri* TINOCO 1955, p.24, pl. 2, figs. 8, 9.



TEXT-FIGURE 44
FoRAM Index and relative abundances of functional groups. Diagram showing values of the FoRAM Index (FI) in relation to the relative abundance of functional groups of foraminifera. The samples (x-axis) are sorted by decreasing FI values (right-side y-axis) from left to right. The left-side y-axis indicates the relative abundance of the three functional groups (symbiont-bearing, heterotrophic, and opportunistic).

Triloculina sommeri Tinoco – LOEBLICH and TAPPAN 1994, p. 56, pl. 84, figs. 1-12.

Remarks: The specimens from Raja Ampat are more compressed than the specimens illustrated by Loeblich and Tappan (1994).

Occurrence: Timor Sea (Loeblich and Tappan 1994). *Triloculina sommeri* was originally described from Brazil.

Triloculina* cf. *T. terquemiana (Brady 1884) **Type 1**
Plate 14, figures 15-17

cf. *Miliolina terquemiana* BRADY 1884, p. 166, pl. 114, fig. 1.

Remarks: This very prominent and large species of *Triloculina* differs from the species described by Brady in having a more irregular ornamentation pattern, in the circular aperture that is *Lachlanella*-like in Brady's specimen, in the shape of the tooth that is T-shaped in the figures of Brady, in the more pronounced sutural depressions. The specimens from Raja Ampat further differ from specimens from southern Africa (Langer unpubl. data) in the surface ornamentation pattern.

Occurrence: *Triloculina terquemiana* was originally described from Madagascar.

Triloculina* cf. *T. terquemiana (Brady 1884) **Type 2**
Plate 14, figures 18-20

cf. *Miliolina terquemiana* BRADY 1884, p. 166, pl. 114, fig. 1.

Remarks: This species differs from the species described by Brady in the less pronounced ornamentation and the very slender *Lachlanella*-like aperture. It also differs from Type 1 in the more rectilinear and less pronounced surface ornamentation and the distinct *Lachlanella*-like aperture.

Occurrence: *Triloculina terquemiana* was originally described from Madagascar.

Triloculina tricarinata d'Orbigny 1826
Plate 15, figures 10-12

Triloculina tricarinata D'ORBIGNY 1826, p. 99 [nomen nudum]. – PARKER, JONES and BRADY 1865, pl. 1, fig. 8. – BRADY 1884, p. 165, pl. 3, figs. 17 a, b. – GRAHAM and MILITANTE 1959, p. 57, pl. 8, figs. 14 a,b. – RASHEED 1971, p. 33, pl. 10, fig. 1. – CHENG and ZHENG 1978, p. 185, pl. 12, figs. 12-14. – CIMERMAN and LANGER 1991, p. 46, pl. 44, figs. 3, 4. – VAN MARLE 1991, p. 278, pl. 4, figs. 1, 2. – HOTTINGER, HALICZ and REISS 1993, p. 65, pl. 68, figs. 7-12. – LOEBLICH and TAPPAN 1994, p. 56, pl. 96, figs. 1-7. – PARKER 2009, p. 366, figs. 266a-k; 267a-k. – DEBENAY 2012, p. 138, 278. – LANGER et al. 2013b, p. 167, fig. 6: 37, 38.
Miliolina (Triloculina) tricarinata d'Orbigny – EGGER 1893, p. 234, pl. 2, figs. 35-37.
Triloculina trigonula d'Orbigny – CUSHMAN 1932, p. 59, pl. 13, figs. 3 a, b.

Occurrence: Red Sea (d'Orbigny 1826, Parker, Jones and Brady 1865), Port Jackson, Australia (Brady 1884), Philippines (Graham and Militante 1959), Coral Sea, New Guinea (Rasheed 1971), Xisha Islands (Cheng and Zheng 1978), Mediterranean (Cimerman and Langer 1991), Eastern Indonesia (van Marle 1991), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Bazaruto (Langer et al. 2013), Raja Ampat (Egger 1893), Fiji (Cushman 1932), Madang, Papua New Guinea (Langer unpubl. data).

Triloculina trigonula (Lamarck 1804)
Plate 15, figures 13-15

Miliolites trigonula LAMARCK 1804, p. 351, pl. 17, figs. 4a-c. – BRADY 1884, p. 164, pl. 3, figs. 15, 16 (not fig. 14).
Triloculina trigonula (Lamarck) – CHENG and ZHENG 1978, p. 185, pl. 13, figs. 1-3. – CUSHMAN 1932, p. 56, pl. 13, figs. 1 a, b. –

HOTTINGER, HALICZ and REISS 1993, p. 66, pl. 69, figs. 1-10. – MAKLED and LANGER 2011, p. 249, fig. 7: 23-27. – DEBENAY 2012, p. 138, 278. – LANGER et al. 2013, p. 167, fig. 6: 39, 40.
Triloculina trigonula sensu stricto (Lamarck) – BACCAERT 1987, p. 131, pl. 58, figs. 4, 5 (not fig. 6).

Occurrence: fossil, Paris (Lamarck 1804), Ireland (Brady 1884), Xisha Islands (Cheng and Zheng 1978), Fiji (Cushman 1932), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), Caroline Islands (Makled and Langer 2011), New Caledonia (Debenay 2012), Bazaruto (Langer et al. 2013), Great Barrier Reef (Baccaert 1987), Madang, Papua New Guinea (Langer unpubl. data).

Triloculina triquetrella Loeblich and Tappan 1994
Plate 15, figures 16-18

Triloculina terquemiana (Brady) var. *papuaenis* RASHEED 1971, p. 37, pl. 10, fig. 4.
Triloculina triquetrella LOEBLICH and TAPPAN 1994, p. 56, pl. 96, figs. 8-10. – PARKER 2009, p. 369, figs. 268a-k; 269a-h.
Triloculina papuaensis Rasheed – HAIG 1997, p. 273, fig. 4, no. fig. 24.

Remarks: Some specimens depicted by Parker (2009) are ornamented with fine striae but all specimens from Raja Ampat have a smoothly polished and unornamented test surface.

Occurrence: Coral See, New Guinea (Rasheed 1971), Sahul Shelf (Loeblich and Tappan 1994), Western Australia (Haig 1997, Parker 2009).

Triloculina* cf. *T. vespertilio Zheng 1988 **Type 1**
Plate 14, figures 27-29

cf. *Triloculina vespertilio* ZHENG 1988, p. 247, 333, pl. 19, fig. 4; pl. 33, figs. 7-8; text-fig. 64.

Remarks: This species has strongly inflated chambers and deeply depressed sutures compared to *Triloculina* cf. *T. vespertilio* Type 2.

Occurrence: *Triloculina vespertilio* was originally described from the East China Sea.

Triloculina* cf. *T. vespertilio Zheng 1988 **Type 2**
Plate 14, figures 21-26

cf. *Triloculina vespertilio* ZHENG 1988, p. 247, 333, pl. 19, fig. 4; pl. 33, figs. 7-8; text-fig. 64.

Occurrence: *Triloculina vespertilio* was originally described from the East China Sea.

Triloculina* cf. *T. wiesneri Le Calvez and Le Calvez 1958
Plate 15, figures 1-3

cf. *Triloculina wiesneri* LE CALVEZ and LE CALVEZ 1958, p. 195, pl. 15, figs. 179-181. – DEBENAY 2012, p. 138, 278.

Remarks: The illustrated specimen is abraded.

Occurrence: New Caledonia (Debenay 2012). *Triloculina wiesneri* was originally described from the Mediterranean.

***Triloculina* sp. 1**
Plate 16, figures 1-4

Description: Test large, porcelaneous, elongate, about two and a half times higher than broad, laterally slightly compressed, periphery rounded; three chambers visible from the exterior, chambers slightly inflated; sutures slightly depressed, distinct; surface ornamented with numerous irregular, longitudinally aligned, fine striae; aperture terminal, a large *Lachlanella*-like opening on a short neck provided with a thick everted peristomal rim anda long tooth that is thickened and bifurcated at the tip.

Triloculina sp. 2
Plate 15, figures 19-24

Description: Test porcelaneous, slightly elongate, periphery rounded, subcircular to ovate in top view; three chambers visible from the exterior, chambers inflated; sutures depressed, distinct, wall smooth, ornamented with a few weakly developed longitudinal costae; aperture terminal, an elongated arch-shaped opening with a long and slender tooth that is bifurcated at its tip.

***Triloculina* sp. 3**
Plate 15, figures 4-6

Description: Test relatively small, porcelaneous, triloculine, triangular in top view with acute angles; surface ornamented with numerous discontinuous, irregular, longitudinally aligned striae; aperture terminal, a subcircular opening on a short neck with a well developed peristomal rim and a tooth (note tooth is broken, Pl. 15, fig. 4).

PLATE 1
Scale bar is 100 µm unless otherwise indicated.

1-3 *Paratrochammina globorotaliformis* (AW12).

4-6 *Haplophragmoides* sp. (W08).

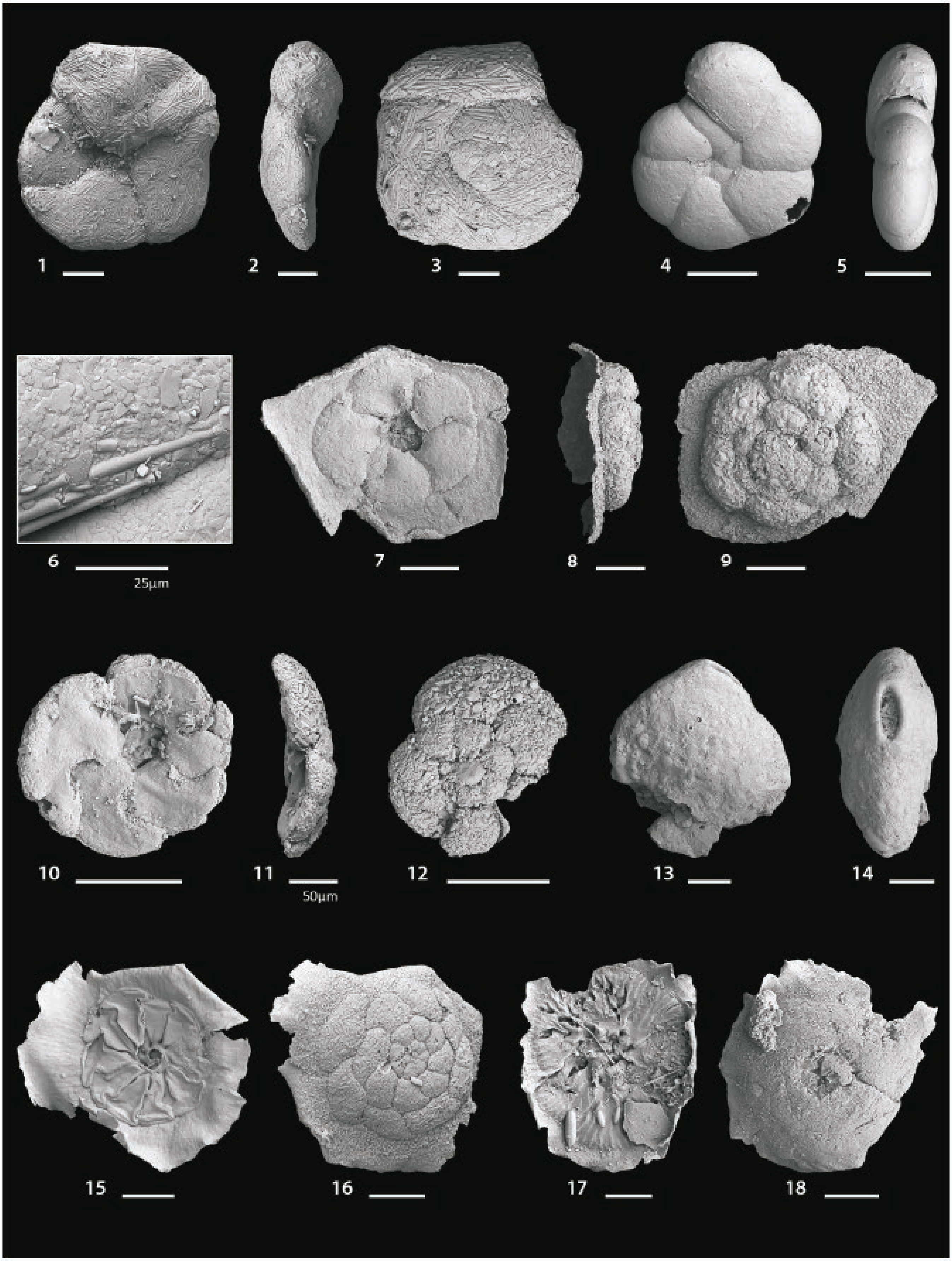
7-9 *Trochammina carinata* (CK*).

10-12 *Trochammina* sp. (W07).

13,14 *Nouria armata* (B15).

15,16 *Rotaliammina* sp. (15: OT; 16: Y24).

17,18 *Septotrochammina gonzalesi* (AW12).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Remarks: This species resembles *Triloculina* sp. 1 of Debenay (2012). It differs, however, in its more acute periphery, which resembles *Triloculina tricarinata* d'Orbigny that also occurs in our samples.

Triloculinella Riccio 1950

Triloculinella* cf. *T. pseudooblonga (Zheng 1980)
Plate 16, figures 26-28

cf. *Miliolinella pseudooblonga* ZHENG 1980, p. 158, 177, pl. 2, fig. 5.
pars *Triloculinella pseudooblonga* (Zheng) – LOEBLICH and TAPPAN 1994, p. 57, pl. 98, figs. 1-3 (not pl. 98, figs. 7-9, pl. 97, figs. 10-12 and pl. 88, figs. 7-18)

Remarks: The species of Zheng is slightly more elongated and has an aperture in the form of a broad arch with a flap-shaped tooth covering the largest part of the apertural opening. Zheng describes the aperture as crescent-shaped.

Occurrence: Timor Sea (Loeblich and Tappan 1994). *Triloculinella pseudooblonga* was originally described from the Xisha Islands, South China Sea.

Subfamily SIGMOILINITINAE Luczkowska 1974
Mesosigmoilina Zheng 1981

Mesosigmoilina minuta (Zheng 1979)
Plate 10, figures 10-14

Pseudosigmoilina minuta ZHENG 1979, p. 129, 208, text-fig. 6, pl. 7, figs. 2, 3.
Spirophthalmidium proxilum LOEBLICH and TAPPAN 1994, p. 41, pl. 64, figs. 6-8.
Mesosigmoilina minuta (Zheng) – PARKER 2009, p. 115, fig. 81a-d.

Occurrence: Xisha Islands (Zheng 1979), Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009).

Nummoloculina Steinmann 1881

Nummuloculina* cf. *N. contraria (d'Orbigny 1846)
Plate 9, figures 21-23

cf. *Biloculina contraria* D'ORBIGNY 1846, p. 266, pl. 16, figs. 4-6.
Nummuloculina contraria (d'Orbigny) – LOEBLICH and TAPPAN 1994, p. 57, pl. 99, figs. 18-21.

Occurrence: Timor Sea (Loeblich and Tappan 1994). *Nummuloculina contraria* was originally described from Austria (fossil).

Sigmamiliolinella Zheng 1988

Sigmamiliolinella australis (Parr 1932)
Plate 18, figures 25-30

Quinqueloculina australis PARR 1932, p. 7, pl. 1, fig. 8.
Miliolinella australis (Parr) – PONDER 1974, p. 127-133, pl. 1, figs. 1-5; pl. 2, figs. 1-5; pl. 3, figs. 1-12. – HAIG 1988, p. 224, pl. 2, fig. 14.
Sigmamiliolinella australis (Parr) – ZHENG 1988, p. 263, 334, pl. 20, figs. 5-7; pl. 33, figs. 16-19, text-fig. 76. – LOEBLICH and TAPPAN 1994, p. 58, pl. 100, figs. 1-3. – PARKER 2009, p. 330, figs. 238a-k, 239a-j, 240a-j, 241a-h. – DEBENAY 2012, p. 130, 279.

Remarks: This species was originally described by Parr (1932) as having a smooth test surface. However, in later publications, the surface is described as granular. The specimens from Raja Ampat have a test surface that is partially to completely covered with elongated calcite needles. See also discussion in Parker (2009, p. 330).

Occurrence: Victoria and South Australia (Parr 1932), Papuan Lagoon (Haig 1988), East China Sea (Zheng 1988), Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Madang, Papua New Guinea (Langer unpubl. data).

Sigmoihauerina Zheng 1979

Sigmoihauerina involuta (Cushman 1946)
Plate 29, figures 21, 22, 26-28

Hauerina ornatissima (Karrer) – BRADY 1884, p. 192, pl. 7, figs. 15-17.
Hauerina involuta CUSHMAN 1946, p. 13, pl. 2, figs. 25-28. – CHENG and ZHENG 1978, p. 188, pl. 8, figs. 11-13.
Pseudohauerina occidentalis involuta (Cushman) – PONDER 1972, p. 149, text-figs. 4, 7, 8, 9A, 11, 12A, 13A, 16. – BACCAERT 1987, p. 146, pl. 63, figs. 7 a,b; pl. 64, figs. 1, 2.
Pseudohauerina involuta (Cushman) – HAIG 1988, p. 228, pl. 3, figs. 16-18. – PARKER 2009, p. 158, fig. 112a-i. – DEBENAY 2012, p. 114, 280.
Sigmoihauerina involuta (Cushman) – LOEBLICH and TAPPAN 1994, p. 58, pl. 100, figs. 8-12. – HAIG 1997, p. 272. – MAKLED and LANGER 2011, p. 248, fig. 6: 38-42.

PLATE 2
Scale bar is 100 µm unless otherwise indicated.

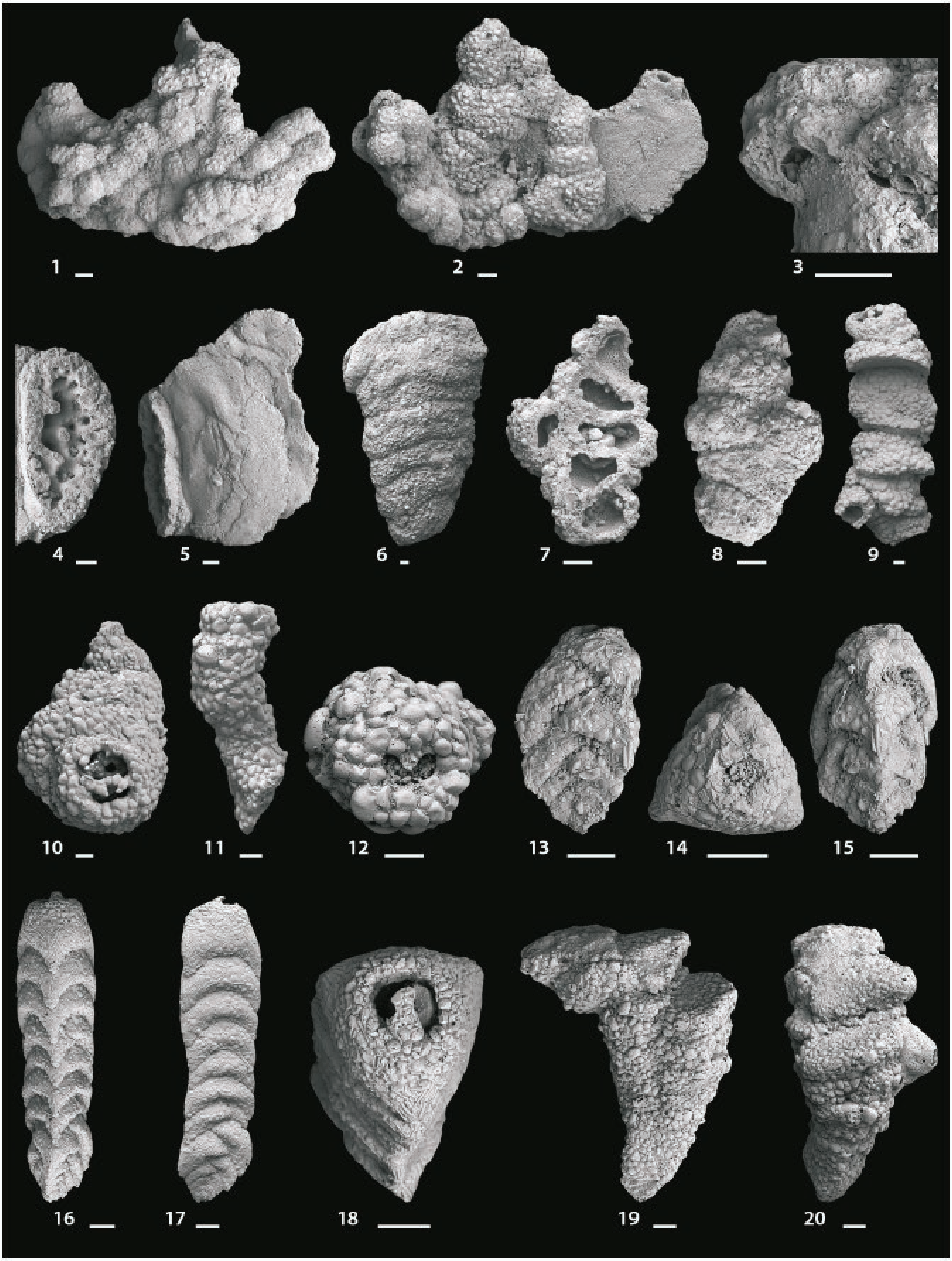
1-3 *Sorosphaera*? sp. (AW12).

4,5 *Bdelloidina aggregata* (CM).

6-12 *Haddonia torresiensis* (6: U01*; 7-10: CM; 11, 12: U02).

13-18 *Clavulina pacifica* (13-15: B14; 16-18: CM).

19,20 *Rudigaudryina minor* (Y24).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Occurrence: Admiralty Islands (Brady 1884), Marshall Islands (Cushman 1946), Xisha Islands (Cheng and Zheng 1978), Great Barrier Reef (Baccaert 1987), Papuan Lagoon (Haig 1988), Western Australia (Haig 1997, Parker 2009), New Caledonia (Debenay 2012), Timor Sea (Loeblich and Tappan 1994), Caroline Islands (Makled and Langer 2011), Madang, Papua New Guinea (Langer unpubl. data).

Sigmoilinella Zheng 1979

Sigmoilinella tortuosa Zheng 1979
Plate 24, figures 22-27

Sigmoilinella tortuosa ZHENG 1979, p. 130, 131, 208, 209, pl. 7, fig. 4, tf. 7. – HAIG 1997, p. 273, fig. 4: 20, 21. – PARKER 2009, p. 330, fig. 242a-j. – DEBENAY 2012, p. 131, 279.
Adelosina pascuaensis KOUTSOUKOS and FALCETTA 1987, p. 151, pl. 1, figs. 1-9, pl. 2, figs. 1-9.
Quinqueloculina cf. *Q. collumnosa* Cushman – HAIG 1988, p. 233, pl. 5, figs. 11-14.

Occurrence: Xisha Islands (Zheng 1979), Exmouth Gulf (Haig 1997), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Easter Island (Koutsoukos and Falcetta 1987).

Spirosigmoilina Parr 1942

Spirosigmoilina? parri Collins 1958
Plate 8, figures 28, 29

Spirosigmoilina parri COLLINS 1958, p. 365, pl. 3, figs. 3, 4. – LOEBLICH and TAPPAN 1994, p. 58, pl. 102, figs. 9-17, pl. 103 figs. 1-5.

Occurrence: Great Barrier Reef (Collins 1958), Timor Sea (Loeblich and Tappan 1994).

Subfamily SIPHONAPERTINAE Saidova 1975
Ammomassilina Cushman 1933a

Ammomassilina alveoliniformis (Millett 1898)
Plate 29, figures 3-10

Massilina alveoliniformis MILLETT 1898, p. 609, pl. 8, figs. 5-7.
Ammomassilina alveoliniformis (Millett) – HAIG 1988, p. 218, pl. 1, figs. 3-6. – HATTA and UJIIÉ 1992, p. 65, pl. 1, figs. 1 a, b. – HOTTINGER, HALICZ and REISS 1993, p. 45, pl. 5, figs. 1-5; pl. 69, figs. 1, 2. – MAKLED and LANGER 2011, p. 248, fig. 6: 30-32. – DEBENAY 2012, p. 103, 279.

Remarks: The specimens shown in figs. 3-5 are abraded and may represent early developmental stages.

Occurrence: Malay Archipelago (Millett 1898), Papuan Lagoon (Haig 1988), Ryukyus (Hatta and Ujiié), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), Caroline Islands (Makled and Langer 2011), New Caledonia (Debenay 2012).

Family TUBINELLIDAE Rhumbler 1906
Articulina d'Orbigny 1826

Articulina pacifica Cushman 1944
Plate 10, figures 1-4

Articulina pacifica CUSHMAN 1944, p. 17, pl. 14, figs. 14-18. – COLLINS 1958, p. 365. – GRAHAM and MILITANTE 1959, p. 34, pl. 3, figs. 5, 6. – CHENG and ZHENG 1978, p. 190, pl. 13, fig. 9. – BACCAERT 1987, p. 151, pl. 66, fig. 2. – HAIG 1988, p. 218, pl. 1, figs. 9, 10. – PARKER 2009, p. 90, fig. 64a-e. – MAKLED and LANGER 2011, p. 248, fig. 4: 7-14. – DEBENAY 2012, p. 104, 280.

Occurrence: Fiji (Cushman 1944), Great Barrier Reef (Collins 1958, Baccaert 1987), Philippines (Graham and Militante 1959), Xisha Islands (Cheng and Zheng 1978), Papuan Lagoon (Haig 1988), Ningaloo Reef (Parker 2009), Caroline Islands (Makled and Langer 2011), New Caledonia (Debenay 2012), Madang, Papua New Guinea (Langer unpubl. data).

Family MILIOLIDAE Ehrenberg 1839
Subfamily MIOLINAE Ehrenberg 1839
Miliola Lamarck 1804

Miliola sublineata (Brady 1884)
(no figure available; see remarks)

Miliolina circularis (Bornemann) var. *sublineata* BRADY 1884, p. 169, pl. 4, fig. 7a-c.

PLATE 3
Scale bar is 100 µm unless otherwise indicated.

1-3 *Gaudryina attenuata* (Y24).

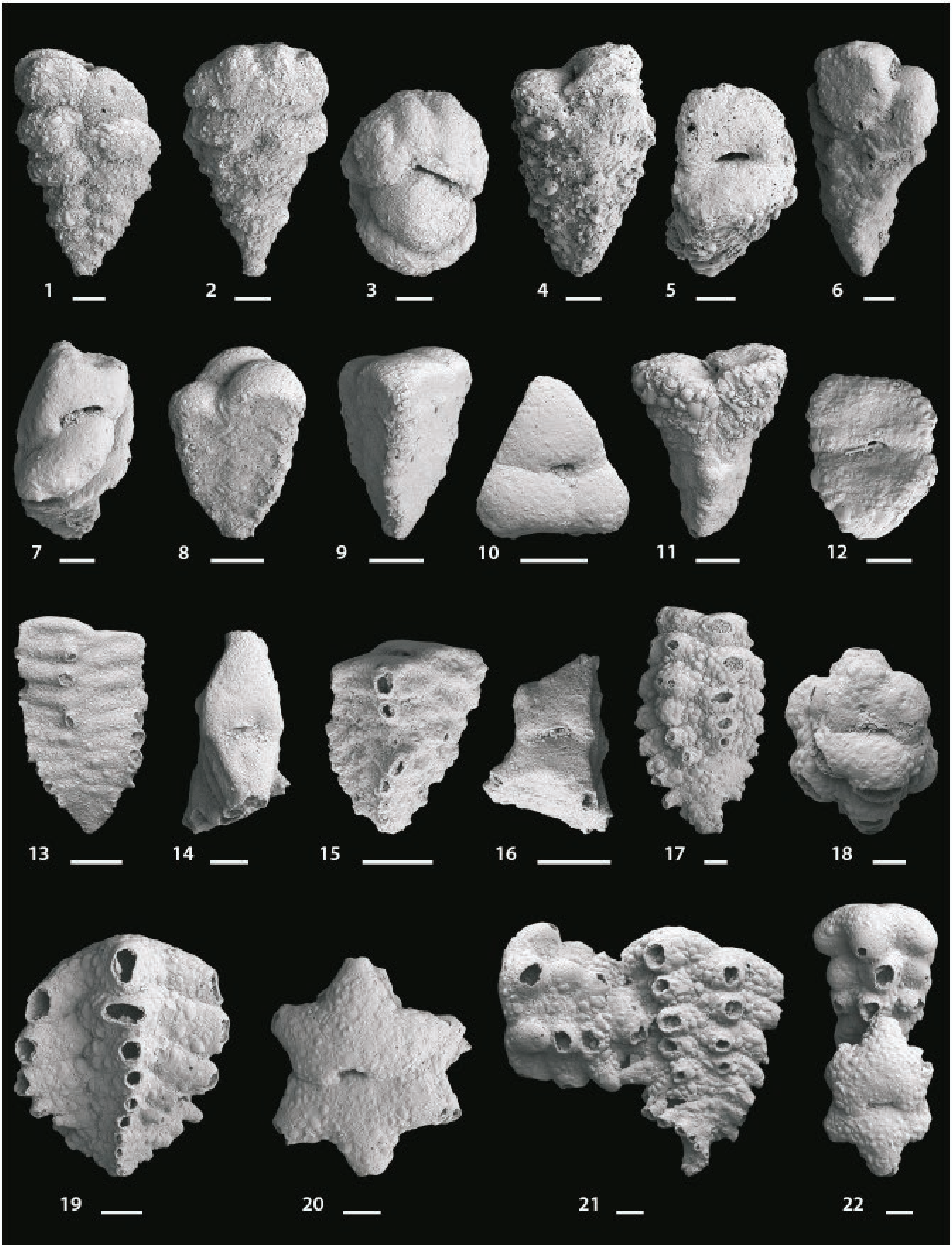
4,5 *Gaudryina quadrangularis* (Y25).

6-10 *Pseudogaudryina pacifica* (B15).

11, 12 *Pseudogaudryina* sp. (W08).

13-16 *Plotnikovina transversaria* (13, 14: U16; 15, 16: B14).

17-22 *Siphoniferoides siphoniferus* (17, 18: U01; 19, 20: MG; 21, 22: CM).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Miliolina circularis var. *sublineata* Brady – HERON-ALLEN and EARLAND 1915, pl. 41, figs. 9-11.
Miliola sublineata (Brady) – CHENG and ZHENG 1978, p. 187, pl. 6, fig. 7. – HAIG 1988, p. 220, pl. 2, figs. 10-11. – MAKLED and LANGER 2011, p. 248, fig. 5: 9-11.

Remarks: Only a single specimen was found of this species (lost and not illustrated).

Occurrence: Admiralty Islands (Brady 1884), Quirimbas (Heron-Allen and Earland 1915), Xisha Islands (Cheng and Zheng 1978), Papuan Lagoon (Haig 1988), Caroline Islands (Makled and Langer 2011), Madang, Papua New Guinea (Langer unpubl. data).

Superfamily AUSTROTRILLINOIDEA Loeblich and Tappan 1986
Family BREBINIDAE Mikhalevich 1988
Subfamily PSEUDOHAUERINIDAE Mikhalevich 1988
Pseudohauerina Ponder 1972

Pseudohauerina orientalis (Cushman 1946)
Plate 29, figures 23-25

Hauerina orientalis CUSHMAN 1946, p. 43, pl. 10, figs. 16, 17. – LOEBLICH and TAPPAN 1994, p. 60, pl. 76, figs. 12-14.
Pseudohauerina orientalis (Cushman) – HAIG 1988, p. 228, pl. 3, figs. 19, 20. – PARKER 2009, p. 162, figs. 113a-j, 114a-c. – MAKLED and LANGER 2011, p. 248, fig. 7: 1-4. – DEBENAY 2012, p. 114, 281.

Occurrence: Samoa (Cushman 1946), Timor Sea (Loeblich and Tappan 1994), Papuan Lagoon (Haig 1988), Ningaloo Reef (Parker 2009), Caroline Islands (Makled and Langer 2011), New Caledonia (Debenay 2012).

Pseudohauerinella McCulloch 1981

Pseudohauerinella dissidens? (McCulloch 1977)
Plate 27, figures 25-27

?*Pseudohauerina dissidens* MCCULLOCH 1977, p. 237, pl. 102, fig. 7. – HOTTINGER, HALICZ and REISS 1993, p. 67, pl. 74, figs. 1-8. – LANGER et al. 2013, fig. 7: 11,12.

Occurrence: ?Mexico, Pacific coast (McCulloch 1977), ?Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), Bazaruto (Langer et al. 2013).

Superfamily ALVEOLINOIDEA Ehrenberg 1839
Family ALVEOLINIDAE Ehrenberg 1839
Alveolinella Douvillé 1907

Alveolinella quoyi (d'Orbigny 1826)
Plate 31, figure 24

Alveolina quoii D'ORBIGNY 1826, p. 307, pl. 17, figs. 11-13. – GRAHAM and MILITANTE 1959, p. 65, pl. 10, fig. 12. – BACCAERT 1987, p. 153, pl. 66, figs. 6, 7. – LIPPS and SEVERIN 1986, figs. 1A-F, 2A-D. – LOEBLICH and TAPPAN 1987, p. 361, pl. 373, figs. 1-3. – HAIG 1988, p. 218, pl. 1, figs. 1, 2. – PARKER 2009, p. 83, fig. 59a-g. – DEBENAY 2012, p. 102, 281.

Remarks: This species is widely distributed in the Indo-Pacific. However, it is absent from the eastern coast of Africa and the coasts and islands of the eastern Pacific. It is at times confounded with the fossil Paleocene to Upper Eocene species *Alveolina boscii* (Defrance, in Bronn 1825).

Occurrence: Papua New Guinea (d'Orbigny 1826), Papuan Lagoon (Lipps and Severin 1986, Haig 1988), Philippines (Graham and Militante 1959), Great Barrier Reef (Baccaert 1987), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Madang, Papua New Guinea (Langer unpubl. data).

Borelis de Montfort 1808

Borelis pulchra (d'Orbigny 1839)
Plate 31, figures 22, 23

Alveolina pulchra D'ORBIGNY 1839, p. 70, pl. 8, figs. 19, 20.
Alveolina melo (Fichtel and Moll) – BRADY 1884, p. 221, pl. 17, figs. 13-15.
Borelis pulchra (d'Orbigny) – CUSHMAN 1930, p. 55, pl. 15, figs. 9, 10. – CHENG and ZHENG 1978, p. 202, pl. 18, fig. 1. – PARKER 2009, p. 92, fig. 66a-f. – PARKER and GISCHLER 2011, not figured.
Borelis schlumbergeri Reichel – FAJEMILA, LANGER and LIPPS 2015, fig. 2: 3.

Remarks: This species is at times confounded with the Miocene species *Borelis melo* (Fichtel and Moll). Parker (2009) notes that *B. pulchra* is distinguished from *B. melo* "by its shorter test, and its sub-globular barrel-like appearance".

PLATE 4
Scale bar is 100 µm unless otherwise indicated.

1-4 *Sahulia barkeri* (AW12; 4: note an unidentified specimen of *Trochammina* on wall surface).

5-8 *Sahulia conica* (5, 6: MG; 7, 8: Ms).

9, 10 *Sahulia* cf. *S. conica* (MI06).

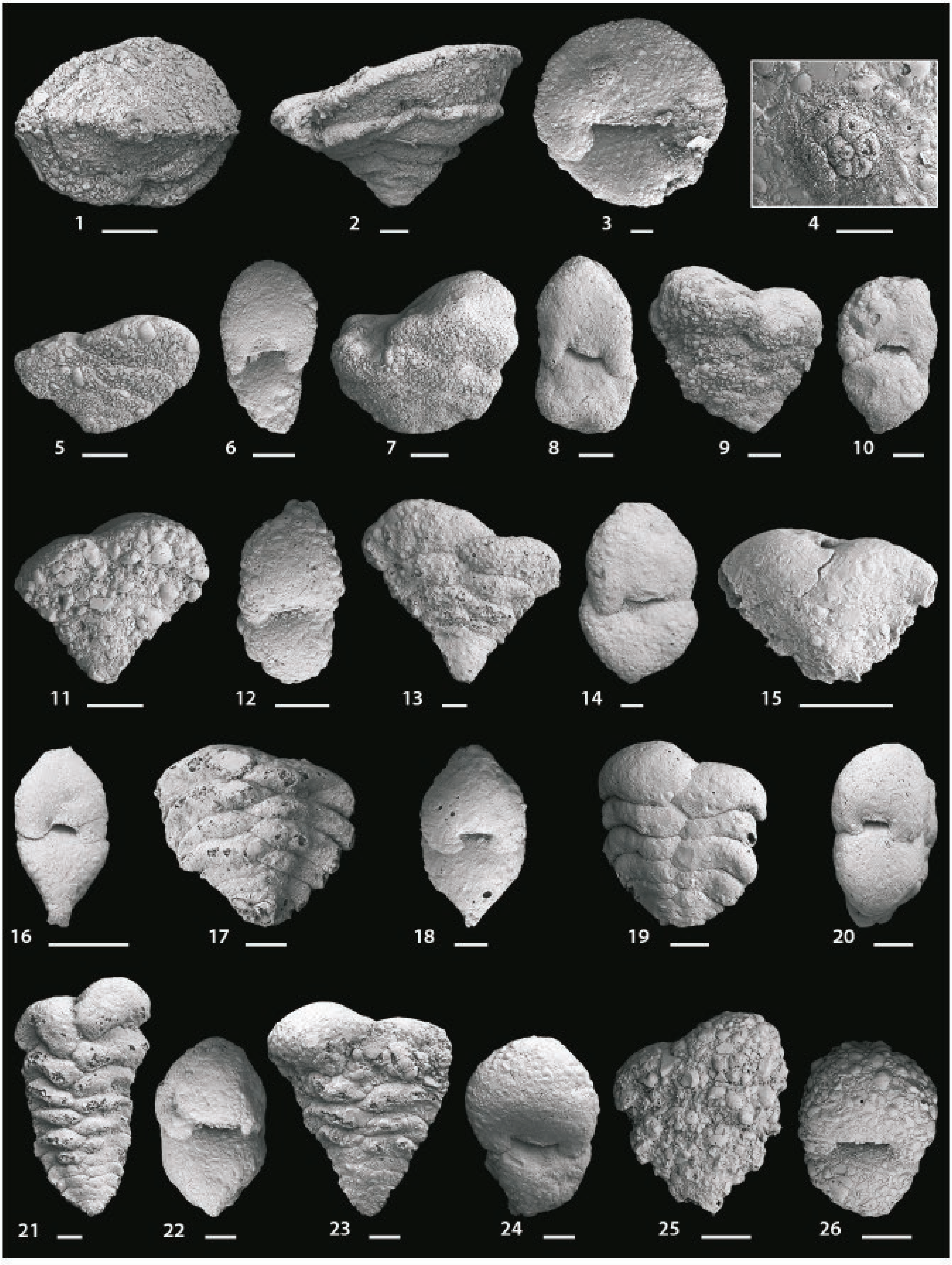
11, 12 *Sahulia* cf. *S. lutzei* (AP09).

13, 14 *Sahulia* sp. 2 (W07).

15-22 *Sahulia* cf. *S. kerimbaensis* (15, 16: B14; 17-20: Ms; 21, 22: FW).

23, 24 *Sahulia neorugosa* (MR17).

25, 26 *Sahulia*? sp. 1 (MR18).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Occurrence: Cuba (d'Orbigny 1839), Hawaii (Brady 1884), Bahamas (Cushman 1930), Xisha Islands (Cheng and Zheng 1978), Ningaloo Reef (Parker 2009), Maldives (Parker and Gischler 2011), Moorea (Fajemila, Langer and Lipps 2015).

Superfamily SORITOIDEA Ehrenberg 1839
Family PENEROPLIDAE Schultze 1854
Dendritina d'Orbigny 1826

Dendritina zhengae Ujiié in Hatta and Ujiié 1992
Plate 30, figures 13-15

Peneroplis sp. CUSHMAN, TODD and POST 1954, p. 348, pl. 87, fig. 3.
Peneroplis sp. GRAHAM and MILITANTE 1959, p. 63, pl. 10, figs. 5a-c, 6a, b.
Dendritina pacifica CHENG and ZHENG 1978, p. 194, 259, pl. 15, figs. 9-12 (not *Dendritina pacifica* McCulloch 1977).
Dendritina zhengae Ujiié, new name, in HATTA and UJIIÉ 1992, p. 78, pl. 15, figs. 2a-3b. – HOHENEGGER *et al.* 1999, p. 130, fig. 11.
Dendritina zhengae (no reference given) – HOHENEGGER 1999, fig. 2.
Monalysidium sp. A – MAKLED and LANGER 2011, p. 248, fig. 8: 6, 7.

Remarks: Originally this species has been described by Cheng and Zheng (1978) as *Dendritina pacifica* but was later renamed by Ujiié (in Hatta and Ujiié 1992).

Occurrence: Marshall Islands (Cushman, Todd and Post 1954), Philippines (Graham and Militante 1959), Xisha Islands (Cheng and Zheng 1978), Ryukyus (Hatta and Ujiié 1992, Hohenegger 1999, Hohenegger et al. 1999), Caroline Islands (Makled and Langer 2011).

Monalysidium Chapman 1900

Monalysidium acicularis (Batsch 1791)
Plate 30, figures 11, 12

Nautilus lituus GMELIN 1791, p. 373, pl. 1, fig. a; pl. 2, figs. d-e.
Nautilus (*Lituus*) *acicularis* BATSCH 1791, p. 3, 6, pl. 6, figs. 16a, b.
Spirolina (*Spirolinites*) *cylindracea* LAMARCK 1804, p. 245, No. 2.
Peneroplis pertusus (Forskål) *acicularis* (Batsch) – BACCAERT 1987, p. 59, pl. 18, figs. 2, 3; pl. 19, figs. 1, 2.
Monalysidium acicularis (Batsch) – HOTTINGER, HALICZ and REISS 1993, p. 70, pl. 78, figs. 1-14. – PARKER 2009, p. 138, figs. 98a-h, 99a-e. – DEBENAY 2012, p. 111, 281.
Monalysidium confusa McCulloch – FAJEMILA, LANGER and LIPPS 2015, fig. 2: 10.

Remarks: Only one broken specimen was found. The initial stage is missing. However, the ornamentation and chamber arrangement of the rectilinear stage is characteristic for *Monalysidium acicularis* (Batsch).

Occurrence: Red Sea (Gmelin 1791, Hottinger, Halicz and Reiss 1993), Mediterranean (Batsch 1791), Great Barrier Reef (Baccaert 1987), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Moorea (Fajemila, Langer and Lipps 2015).

Monalysidium okinawaensis (Ujiié and Hatta 1994)
Plate 30, figures 7-10

Spirolina okinawaensis UJIIÉ and HATTA 1994, p. 12, pl. 1, figs. 7, 8.
Monalysidium okinawaensis (Hatta and Ujiié) – PARKER 2009, p. 141, figs. 100a-k; 101a-g; 102a-k.

Remarks: The specimens recovered are abraded. See also remarks on the morphology in Parker (2009).

Occurrence: Ryukyus (Hatta and Ujiié 1992), Ningaloo Reef (Parker 2009).

Peneroplis de Montfort 1808

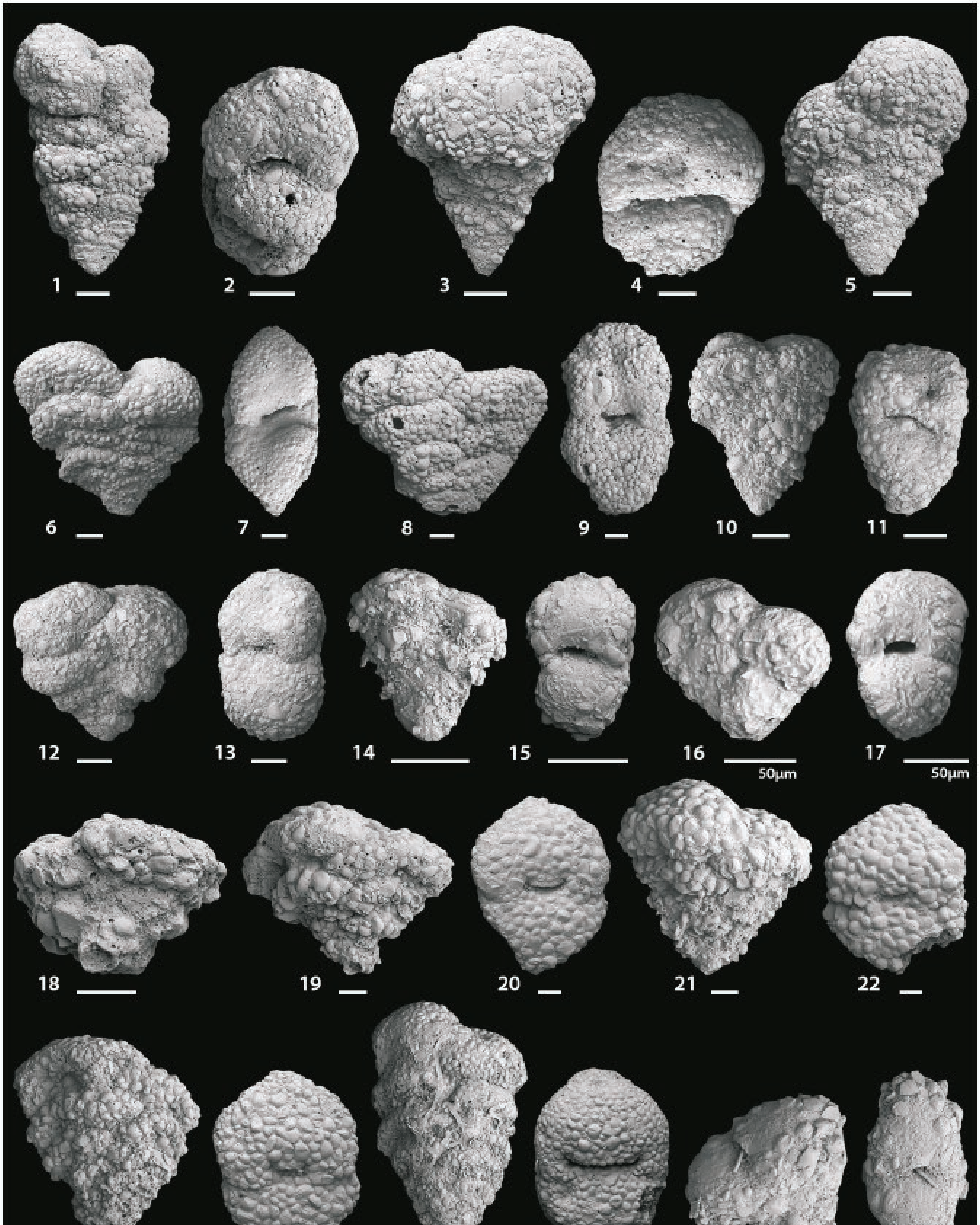
Peneroplis antillarum d'Orbigny 1839
Plate 30, figures 19-25

Peneroplis (*Dendritina*) *antillarum* D'ORBIGNY 1839, p. 58, pl. 7, figs. 3-6.
Peneroplis antillarum d'Orbigny – GUDMUNDSSON 1994, p. 111, text figs. 19, 20; pl. 3, fig. 4; pl. 4, fig. 4.
Peneroplis antillarum (no reference given) – NOBES and UTHICKE 2008, p. 11, fig. 15: a-f. – HOHENEGGER 2011, p. 43, figs. on p. 39, 44.

Remarks: *Peneroplis antillarum* has originally been described from the Atlantic Ocean and was reported to be rare by d'Orbigny. It is very often confounded with *P. planatus* (Fichtel

PLATE 5
Scale bar is 100 µm unless otherwise indicated.

1,2 *Textularia agglutinans* (B15).
3-5 *Textularia candeiana* (Y24).
6,7 *Textularia dupla* (Ms).
8,9 *Textularia truncata*? (MG).
10,11 *Textularia* sp. 4 (B15*).
12,13 *Textularia* sp. 8 (W07).
14-17 *Textularia* sp. 5 (14, 15: W08; 16, 17: MS04).
18-20 *Textularia corrugata*? (MI06).
12,22 *Textularia* sp. 1 (Ms*).
23-26 *Textularia* sp. 10 (CK).
27,28 *Textularia* sp. 7 (W07).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and Moll) and *P. pertusus* (Forskål). A detailed description and analysis of this species is given by Gudmundsson (1994).

Occurrence: Cuba (d'Orbigny 1839), British Solomon Isles and Japan (Gudmundsson 1994), Great Barrier Reef (Nobes and Uthicke 2008).

Peneroplis pertusus (Forskål 1775)
Plate 30, figures 26-32

Nautilus pertusus FORSKÅL 1775, p. 125, not figured.
Peneroplis pertusus, Forskål, var. b. BRADY 1884, p. 204, pl. 13, figs. 17, ?23 (not fig. 16).
Peneroplis pertusus (Forskål) – HALLOCK 1984, p. 251, fig. 1: 3. – GUDMUNDSSON 1994, p. 115, text figs. 23, 24; pl. 3, figs. 1, 3. – HOHENEGGER 2011, p. 27, 43, figs. on p. 43, 45.
Peneroplis pertusus (Foraskal) – NOBES and UTHICKE 2008, p. 12, fig. 15: j-o.

Remarks: *Peneroplis pertusus* is commonly confounded with *P. planatus* (Fichtel and Moll), *P.arietinus* (Batsch) and *Coscinospira hemprichii* Ehrenberg.

Occurrence: Suez, Egypt (Forskål 1775), Torres Strait (Brady 1884), Hawaii and Palau (Hallock 1984), Ryukyus (Gudmundsson 1994), Great Barrier Reef (Nobes and Uthicke 2008).

Peneroplis planatus (Fichtel and Moll 1798)
Plate 30, figures 16-18

Nautilus planatus var. α, β, γ FICHTEL and MOLL 1798, p. 91, pl. 16, figs. a-i.
Peneroplis planatus (Fichtel and Moll) – CIMERMAN and LANGER 1991, p. 50, pl. 50, figs. 1-6. – GUDMUNDSSON 1994, p. 117, text figs. 25, 26; pl. 4, figs. 1-3. – NOBES and UTHICKE 2008, p. 12, fig. 15: s-x.

Remarks: *Peneroplis planatus* (Fichtel and Moll) is commonly confounded with *P. pertusus* (Forskål) and *P. antillarum* d'Orbigny.

Occurrence: Tuscany, Italy (Fichtel and Moll 1798), Mediterranean (Cimerman and Langer 1991), Red Sea and Ryukyus (Gudmundsson 1994), Great Barrier Reef (Nobes and Uthicke 2008).

Laevipeneroplis Sulc 1936

Laevipeneroplis bradyi Cushman 1930
Plate 30, figures 1, 2

Laevipeneroplis bradyi CUSHMAN 1930, p. 40, pl. 14, figs. 8-10.
Sorites discoideus (Flint) – BACCAERT 1987, p. 63, pl. 21, figs. 2,3; pl. 22, figs. 1, 2; pl. 23, fig. 1; pl. 24, fig. 1.

Remarks: This species was originally described from the Caribbean and seems to be rare in the Indo-Pacific. Baccaert (1987) provides excellent illustrations of this species but assigns his specimens to *Sorites discoideus* (Flint). Bicchi, Debenay and Pagès (2002) also report "*Sorites discoideus*" from the Tuamotus Islands, but the specimen illustrated belongs to *Parasorites orbitolitoides* (Hofker), which they also report to be present in their material. As their specimens of "*Sorites discoideus*" were not figured, the identification requires further study. The taxonomic relationship between the two populations of *Laevipeneroplis bradyi* from the Atlantic and the Indo-Pacific requires additional molecular analysis.

Occurrence: Caribbean (Cushman 1930), Great Barrier Reef (Baccaert 1987).

Laevipeneroplis malayensis (Hofker 1930)
Plate 30, figures 3, 4

Archaias discoideus (Flint) – HOFKER 1930, p. 147, pl. 56.
Puteolina malayensis HOFKER 1951, p. 456, fig. 43. – CHENG and ZHENG 1978, p. 196, pl. 16, figs. 3-7; pl. 33, fig. 1.
Peneroplis discoideus Flint – GRAHAM and MILITANTE 1959, p. 62, pl. 9, fig. 22.
Laevipeneroplis proteus (d'Orbigny) – RENEMA, HOEKSEMA and VAN HINTE 2001, tab. 2, fig. 7e, f.

Occurrence: Indonesia (Hofker 1930, 1951), Xisha Islands (Cheng and Zheng 1978), Philippines (Graham and Militante 1959), Spermonde shelf, Indonesia (Renema, Hoeksema and van Hinte 2001).

PLATE 6
Scale bar is 100 µm unless otherwise indicated.

1-8 *Septotextularia rugosa* (1, 2, 5, 6: CK; 3, 4: U01; 7, 8: W07).

9-11 *Textularia crenata* (9, 10: N18*; 11: B14).

12, 13 *Textularia stricta*? (Ms).

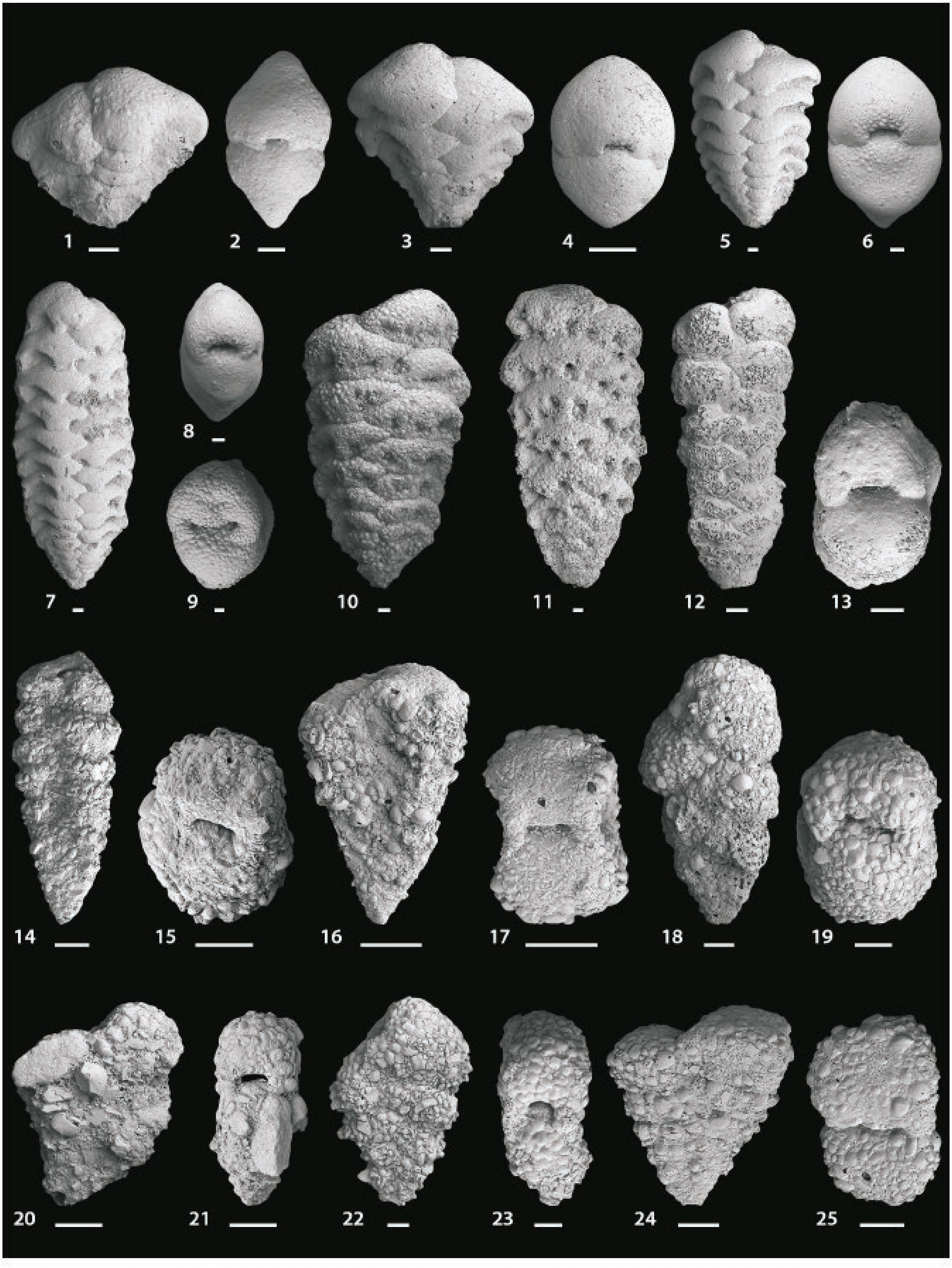
14-17 *Textularia cushmani* (14, 15: MR17; 16, 17: B14).

18, 19 *Textularia oceanica* (MI05).

20, 21 *Texularia occidentalis* (ER22).

22, 23 *Textularia foliacea* (W08).

24, 25 *Textularia* sp. 2 (Ms).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Family SORITIDAE Ehrenberg 1839
Subfamily ARCHAIASINAE Cushman 1927
Parasorites Seiglie, Grove and Rivera 1977

Parasorites orbitolitoides (Hofker 1930)
Plate 31, figures 5-11

Orbitolites marginalis (Lamarck) – BRADY 1884, p. 214, pl. 15, figs. 1-5.
Praesorites orbitolitoides HOFKER 1930, p. 149, pl. 55, figs. 8, 10; pl. 57, figs. 1-5; pl. 61, figs. 3-14.
Sorites orbitolitoides (Hofker) – LEHMANN 1961, p. 645, pl. 10, figs. 1-5.
Parasorites orbitolitoides (Hofker) – HAIG 1988, p. 228, pl. 3, figs. 8, 9. – HATTA and UJIIÉ 1992, p. 80, pl. 17, figs. 1a-2b. – DEBENAY 2012, p. 113, 282. – FAJEMILA, LANGER and LIPPS 2015, fig. 2: 8, 9.
Sorites marginalis (Lamarck) – LOEBLICH and TAPPAN 1994, p. 62, pl. 112, figs. 4, 5 (not figs. 1-3).
Sorites discoideus (Flint) – BICCHI, DEBENAY and PAGÈS 2002, fig. 4: 5.
Parasorites cf. *P. orbitolitoides* (Hofker) – PARKER 2009, p. 149, figs. 106a-k, 107a-h.
Sorites orbiculus (Forskål) – MAKLED and LANGER 2011, p. 248, fig. 8: 26, 27.
Sorites variabilis Lacroix – LANGER et al. 2013, fig. 7: 21.

Remarks: *Parasorites orbitolitoides* is most often confounded with *Sorites marginalis* (Lamarck), which is very similar, especially in the juvenile stage. Lehmann (1961) provides detailed information on differences between the two species. The taxonomic relationship to the similar *Sorites variabilis* Lacroix (Hottinger, Halicz and Reiss 1993, p. 73, pl. 84, figs. 1-15) needs to be clarified.

Occurrence: Hawaii and Fiji (Brady 1884), Flores Sea, Indonesia (Hofker 1930), Samoa (Lehmann 1961), Papuan Lagoon (Haig 1988), Ryukyus (Hatta and Ujiié 1992), New Caledonia (Debenay 2012), Moorea (Fajemila, Langer and Lipps 2015), Sahul Shelf (Loeblich and Tappan 1994), Tuamotus (Bicchi, Debenay and Pagès 2002), Ningaloo Reef (Parker 2009), Caroline Islands (Makled and Langer 2011), Bazaruto (Langer et al. 2013), Madang, Papua New Guinea (Langer unpubl. data).

Subfamily SORITINAE Ehrenberg 1839
Amphisorus Ehrenberg 1839

Amphisorus hemprichii Ehrenberg 1839
Plate 31, figures 19-21

Amphisorus hemprichii EHRENBERG 1839, p. 130, 145, pl. 3, fig. 3. – LEHMANN 1961, p. 649, pl. 10, figs. 6-9, pl. 11, figs. 1-5. – HOTTINGER 1977, p. 99, figs. 10, 22B, 31, 32C, 33A. – CHENG and ZHENG 1978, p. 199, pl. 17, figs. 10-17; pl. 31, figs. 4-6; pl. 32, figs. 2-4. – LOEBLICH and TAPPAN 1987, p. 380, pl. 417, figs. 1-8. – HOTTINGER, HALICZ and REISS 1993, p. 71, pl. 81, figs. 1-8; pl. 82, figs. 1-11. – GUDMUNDSSON 1994, p. 126, text-figs. 39-44. – LOEBLICH and TAPPAN 1994, p. 62, pl. 109, figs. 7-13; pl. 110, figs. 9, 10. – PARKER 2009, p. 85, figs. 60a-g, 61a-d. – DEBENAY 2012, p. 103, 282. – LANGER et al. 2013, fig. 7: 19.
Orbitolites duplex Carpenter – BRADY 1884, pl. 16, fig. 7.
Marginopora vertebralis Quoy and Gaimard – GRAHAM and MILITANTE 1959, p. 61, pl. 9, figs. 19, 20.

Remarks: *Amphisorus hemprichii* is often confounded with either *Sorites orbiculus* or *Marginopora vertebralis*. Lehmann (1961) provides a detailed comparison and analysis of the Soritidae.

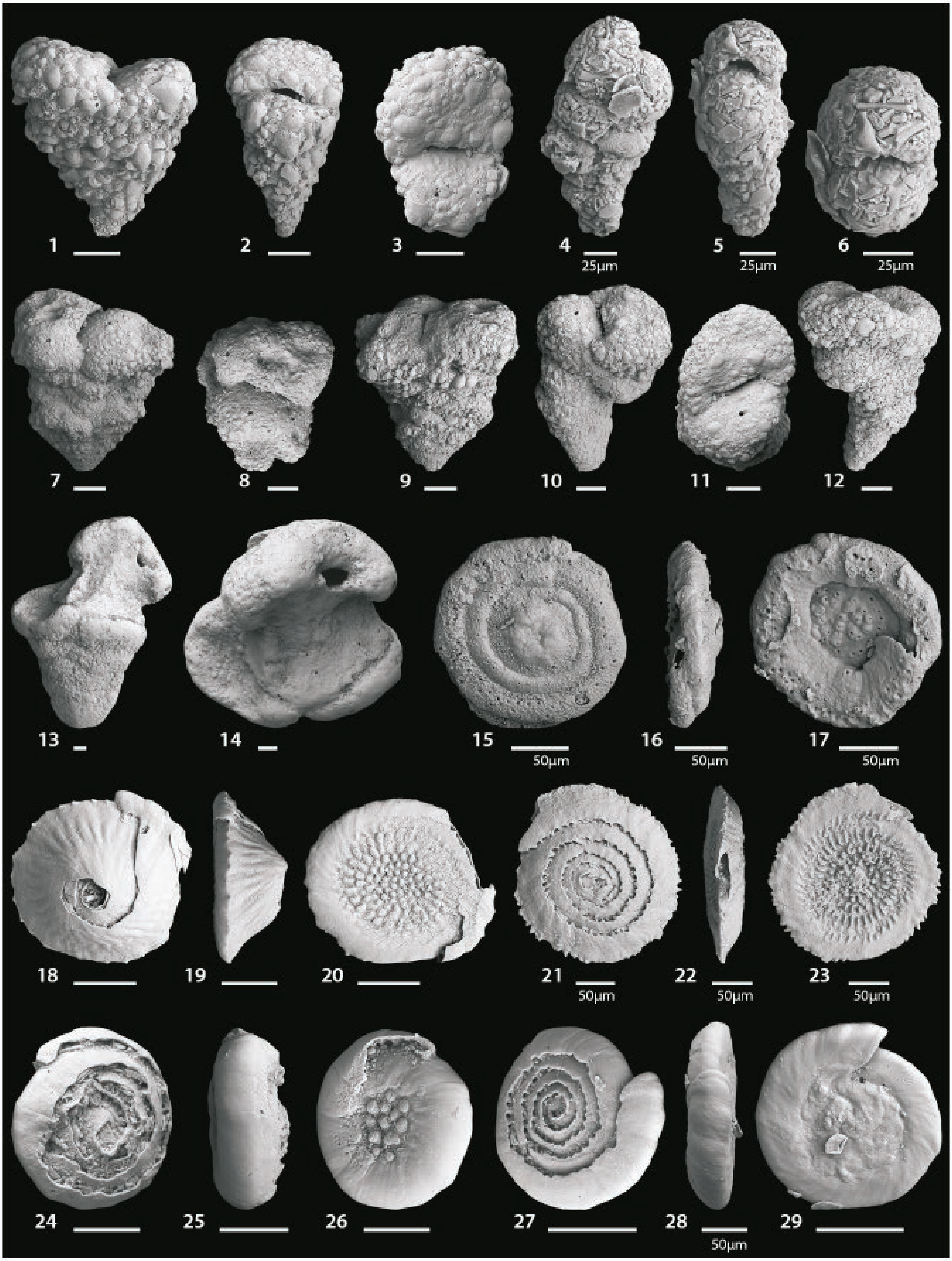
Occurrence: Mediterranean and Red Sea (Ehrenberg 1839, Hottinger 1977, Hottinger, Halicz and Reiss 1993, Gudmundsson 1994), Indonesia (Lehmann 1961), Xisha Islands (Cheng and Zheng 1978), Sahul Shelf (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Bazaruto (Langer et al. 2013), Fiji (Brady 1884), Philippines (Graham and Militante 1959), Madang, Papua New Guinea (Langer unpubl. data).

Marginopora Quoy and Gaimard 1830

Marginopora vertebralis Quoy and Gaimard 1830
Plate 31, figures 17, 18

PLATE 7
Scale bar is 100 µm unless otherwise indicated.

1-3 *Textularia* sp. 2 (B14).
4-6 *Textularia* sp. 3 (MR18).
7-9 *Textularia* sp. 9 (MS03).
10-12 *Textularia* sp. 6 (N19).
13, 14 *Spiroplectinella*? sp. (Wa).
15-17 *Spirillina*? sp. 2 (Y25).
18-20 *Conicospirillinoides semidecoratus*? (FW).
21-23 *Conicospirillinoides* cf. *C. elaboratus* (U01).
24-26 *Conicospirillinoides* sp. 1 (W08).
27-29 *Conicospirillinoides* sp. 2 (MR18).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Marginopora vertebralis Quoy and Gaimard, in BLAINVILLE 1830, vol. 6, p. 377. – LEHMANN 1961, p. 654, pl. 11 figs. 6-7, pl. 12, figs. 1-7. – BACCAERT 1987, p. 74, pl. 32, fig. 2; pl. 33, figs. 1, 2; pl. 34, figs. 1-3; pl. 35, figs. 1, 2; pl. 36, figs. 1-3. – HAIG 1988, p. 220, pl. 2, figs. 12, 13. – DEBENAY 2012, p. 109, 282.
Orbitolites complanata Lamarck var. *laciniata* BRADY 1884, p. 220, pl. 16, figs. 8-11.

Remarks: Only fragments and heavily abraded tests of this species were found in the sample material from Raja Ampat.

Occurrence: Indonesia (Lehmann 1961), Great Barrier Reef (Baccaert 1987), Papuan Lagoon (Haig 1988), New Caledonia (Debenay 2012), Fiji (Brady 1884), Madang, Papua New Guinea (Langer unpubl. data).

Sorites Ehrenberg 1839

Sorites orbiculus (Forskål 1775)
Plate 31, figures 12-16

Nautilus orbiculus FORSKÅL 1775, p. 125.
Sorites orbiculus (Forskål) – EHRENBERG 1840, pl. 3, figs. 2a-d. – CHENG and ZHENG 1978, p. 198, pl. 17, figs. 1-9; pl. 31, figs. 1-3; pl. 32, fig. 1. – HOTTINGER, HALICZ and REISS 1993, p. 72, pl. 83, figs. 1-13. – LOEBLICH and TAPPAN 1994, p. 63, pl. 112, figs. 6-8. – PARKER 2009, p. 336, figs. 244a-g; 245a-h. – DEBENAY 2012, p. 131, 282. – LANGER et al. 2013, fig. 7: 20. – FAJEMILA, LANGER and LIPPS 2015, fig. 2: 6, 7.
Sorites orbiculus Ehrenberg. LEHMANN 1961, p. 641, pl. 8, figs. 1-8, tf. 36. – HOTTINGER 1977, p. 94, figs. 9B, 30D, E, 32B.
Sorites variabilis Lacroix – MAKLED and LANGER 2011, p. 248, fig. 8: 23-25.

Remarks: *Sorites orbiculus* is often confused with *Sorites marginalis* (Lamarck) and *Amphisorus hemprichii* Ehrenberg. Lehmann (1961) provides a a detailed comparison and analysis of the Soritidae.

Occurrence: Mediterranean (Forskål 1775, Lehmann 1961), Red Sea (Forskål 1775, Ehrenberg 1840, Lehmann 1961, Hottinger 1977, Hottinger, Halicz and Reiss 1993), Indonesia (Lehmann 1961), Xisha Islands (Cheng and Zheng 1978), Sahul Shelf (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Caroline Islands (Makled and Langer 2011), Bazaruto (Langer et al. 2013), Moorea (Fajemila, Langer and Lipps 2015), Madang, Papua New Guinea (Langer unpubl. data).

Order SPIRILLINIDA Gorbachik and Mantsurova 1980
Suborder SPIRILLININA Hohenegger and Piller 1975
Family PLANISPIRILLINIDAE Piller 1978
Conicospirillinoides Cheng and Zheng 1978

Conicospirillinoides* cf. *C. elaboratus (McCulloch 1977)
Plate 7, figures 21-23

cf. *Spirillina elaborata* MCCULLOCH 1977, p. 138, pl. 48, fig. 9
Conicospirillinoides sp. 2 DEBENAY 2012, p. 192, 283.

Remarks: The ornamentation pattern illustrated in the specimens of McCulloch (1977, pl. 48, fig. 9b) differs slightly in our specimen.

Occurrence: New Caledonia (Debenay 2012). *Conicospirillinoides elaboratus* is originally described from Aruba, Caribbean.

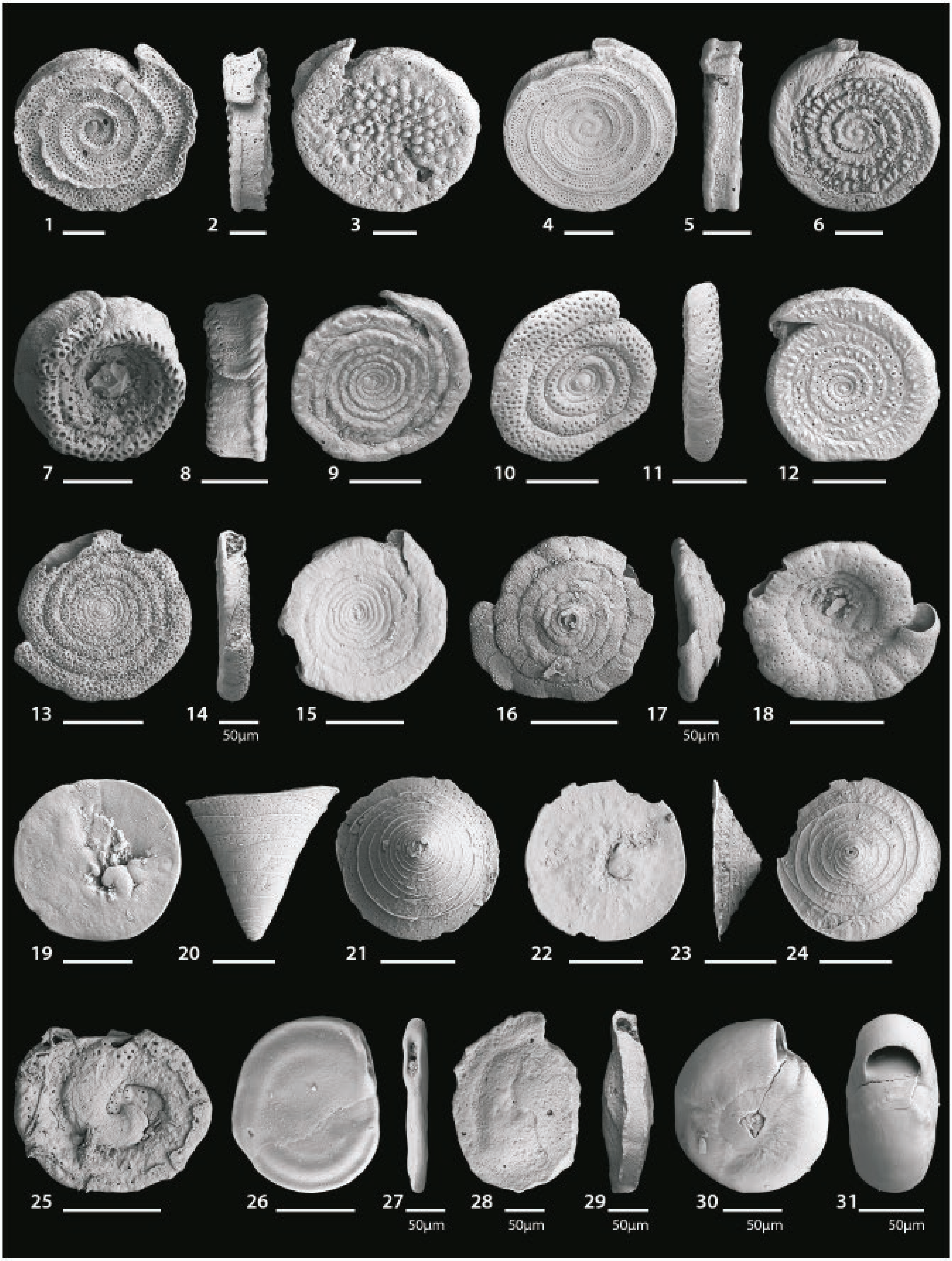
***Conicospirillinoides semidecoratus*?** (Heron-Allen and Earland 1915)
Plate 7, figures 18-20

? *Spirillina semidecorata* HERON-ALLEN and EARLAND 1915, p. 685, pl. 51, figs. 26-31.
Conicospirillinoides semidecoratus (Heron-Allen and Earland) – CHENG and ZHENG 1978, p. 218, pl. 30, figs. 14a-c, 15.
Conicospirillinoides sp. 2 PARKER 2009, p. 63, figs. 46h-k.

Occurrence: ? Quirimbas (Heron-Allen and Earland 1915), Xisha Islands (Cheng and Zheng 1978), Ningaloo Reef (Parker 2009).

PLATE 8
Scale bar is 100 µm unless otherwise indicated.

1-3 *Planispirillina tuberculatolimbata* (FW).
4-6 *Planispirillina* sp. 1 (N18).
7-9 *Planispirillina inaequalis* (N18).
10-12 *Spirillina grosseperforata* (Y24).
13-15 *Spirillina vivipara* (AP09).
16-18 *Spirillina* sp. 1 (B15).
19-21 *Patellina altiformis* (B15).
22-24 *Patellina* sp. 1 (B15).
25 *Patellina*? sp. 2 (U16).
26,27 *Planispirinella involuta* (N18).
28,29 *Spirosigmoilina*? *parri* (E22).
30,31 *Cornuspira planorbis* (Y24).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***Conicospirillinoides* sp. 1**
Plate 7, figures 24-26

Description: Test planoconvex, periphery rounded; proloculus followed by an undivided planispirally enrolled tubular chamber, whorls largely overlapping preceding whorls; chamber wall on the spiral side extending to a spiraling flange; central area of the flattened side covered with rounded knobs; aperture at the end of the tubular chamber on the flattened side.

Remarks: The aperture is broken. A similar species *Conicospirillinoides* sp. 1 is illustrated by Debenay (2012; p. 192, 283).

***Conicospirillinoides* sp. 2**
Plate 7, figures 27-29

Description: Test slightly planoconvex, periphery rounded; proloculus followed by an undivided planispirally enrolled tubular chamber; chamber wall on the spiral side extending to a spiraling flange with numerous radial indentations; surface smooth; central part of the flattened side with irregular accreted shell material; aperture at the end of the tubular chamber.

Planispirillina Bermúdez 1952

Planispirillina inaequalis (Brady 1879)
Plate 8, figures 7-9

Spirillina inaequalis BRADY 1879, p. 278, pl. 8, figs. 25a, b. – BRADY 1884, pl. 85, figs. 8-11.
Conicospirillinoides inaequalis (Brady) – LOEBLICH and TAPPAN 1994, p. 35, pl. 51, figs. 4-6.
Planispirillina? inaequalis (Brady) – PARKER 2009, p. 74, fig. 54a-h.
Planispirillina inaequalis (Brady) – DEBENAY 2012, p. 229, 283.

Remarks: The chamber width appears to remain constant in the specimen depicted by Brady. However, the figures in the following publications show an increased widening of the later chambers.

Occurrence: Hawaiian Islands, and Admiralty Islands (Brady 1884), Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

Planispirillina tuberculatolimbata (Chapman 1900)
Plate 8, figures 1-3

Spirillina tuberculato-limbata CHAPMAN 1900, p. 11, pl. 1, figs. 1a-c. – HATTA and UJIIÉ 1992, p. 163, pl. 20, figs. 1a-c.
Spirilina tuberculatolimbata Chapman – GRAHAM and MILITANTE 1959, p. 103, pl. 16, figs. 4, 5.
Planispirillina tuberculatolimbata (Chapman) – CHENG and ZHENG 1978, p. 218, pl. 30, figs. 9a-c, 10. – DEBENAY 2012, p. 229, 283.
Planispirillina spinigera (Chapman) – LOEBLICH and TAPPAN 1994, p. 35, pl. 51, figs. 7-9 (not figs. 8-12). – LANGER et al. 2013, p. 160, fig. 4: 17, 18.
Spirillina sp. A MAKLED and LANGER 2011, p. 248, fig. 8: 28.

Occurrence: Funafuti Atoll (Chapman 1900), Ryukyus (Hatta and Ujiié 1992), Philippines (Graham and Militante 1959), Xisha Islands (Cheng and Zheng 1978), New Caledonia (Debenay 2012), Timor Sea (Loeblich and Tappan 1994), Bazaruto (Langer et al. 2013), Caroline Islands (Makled and Langer 2011), Madang, Papua New Guinea (Langer unpubl. data).

***Planispirillina* sp.**
Plate 8, figures 4-6

Planispirillina cf. *P. tuberculatolimbata* (Chapman). PARKER 2009, p. 74, fig. 55a-i.

Remarks: Contrary to *Planispirillina tuberculatolimbata* (Chapman) the pustules on the umbilical side are oriented spirally. For details on the morphology see description in Parker (2009).

Occurrence: Ningaloo Reef (Parker 2009).

Family PATELLINIDAE Rhumbler 1906

Patellina Williamson 1858

Patellina altiformis Cushman 1933
Plate 8, figures 19-21

Patellina advena Cushman var. *altiformis* CUSHMAN 1933, p. 87, pl. 9, figs. 8a, b.
Patellina altiformis Cushman – DEBENAY 2012, p. 206, 283.

Occurrence: Tropical Pacific (Cushman 1933), New Caledonia (Debenay 2012).

***Patellina* sp. 1**
Plate 8, figures 4-6

PLATE 9
Scale bar is 100 µm unless otherwise indicated.

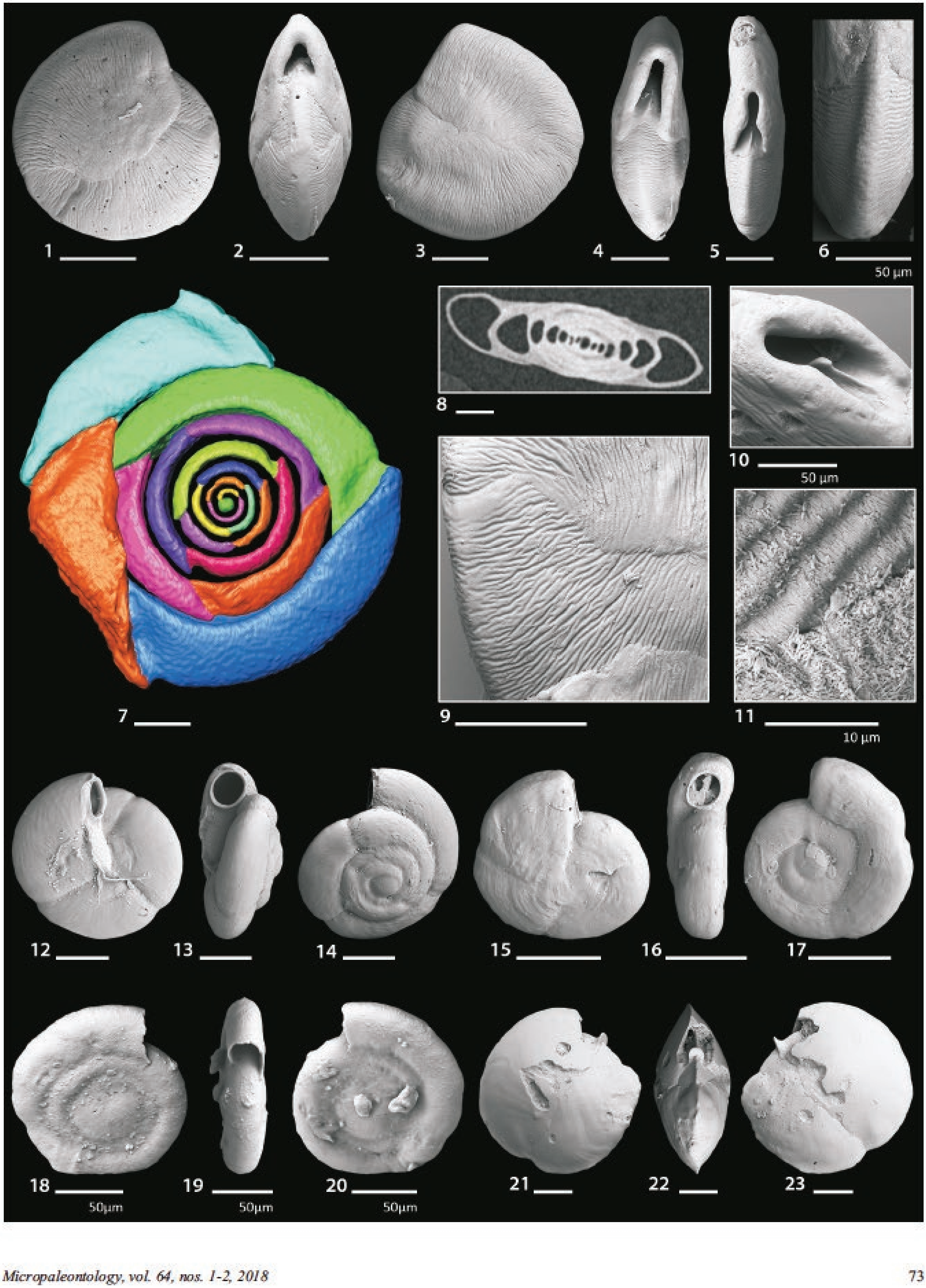
1-11 *Dentoplanispirinella occulta* (MS03).

12-14 *Fischerinella helix* (B14).

15-17 *Fischerinella diversa* (MI05).

18-20 *Fischerinella* sp. (MS04).

21-23 *Nummuloculina* cf. *N. contraria* (ER22).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Description: Test low conical, circular in top view, plano-convex, spiral side convex, umbilical side flat, periphery carinate; seven to eight whorls visible on the spiral side, small proloculus followed by low crescentric chambers, two chambers per whorl, all chambers visible on the spiral side, only the last two chambers are visible on the umbilical side; sutures raised; wall smooth at the outer margins of the chambers, somewhat granular at the inner margins; aperture a low opening towards the umbilicus, covered with a broad flap- to T-shaped apertural plate.

***Patellina*? sp. 2**
Plate 8, figures 25

Remarks: The specimen is incomplete and the taxon is tentatively assigned to *Patellina*.

Family SPIRILLINIDAE Reuss and Fritsch 1861
Spirillina Ehrenberg 1843

Spirillina grosseperforata Zheng 1979
Plate 8, figures 10-12

Spirillina grosseperforata ZHENG 1979, p. 174, 222, pl. 19, fig. 12a-c. – LOEBLICH and TAPPAN 1994, p. 36, pl. 53, figs. 1-8. – DEBENAY 2012, p. 232, 283. – THISSEN and LANGER 2017, p. 44, pl. 11, figs. 4-6.

Occurrence: Xisha Islands (Zheng 1979), Sahul Shelf (Loeblich and Tappan 1994), New Caledonia (Debenay 2012), Zanzibar (Thissen and Langer 2017).

Spirillina vivipara Ehrenberg 1843
Plate 8, figures 13-15

Spirillina vivipara EHRENBERG 1843, p. 323, 422, pl. 3, fig. 41. – BACCAERT 1987, p. 179, pl. 71, figs. 2, 3. – LOEBLICH and TAPPAN 1994, p. 36, pl. 54, figs. 5-10. – PARKER 2009, p. 81, figs. 58a-c. – DEBENAY 2012, p. 233, 283.

Occurrence: Mexico (Ehrenberg 1843), Great Barrier Reef (Baccaert 1987), Sahul Shelf (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

***Spirillina* sp. 1**
Plate 8, figures 16-18

Description: Test small, low conical, consisting of a proloculus and a low trochospirally enrolled tubular chamber that is slowly increasing in size with each whorl, all seven whorls visible on both sides of the test, periphery rounded; distinct, suture-like restrictions; tubular chamber more inflated on the more involute side, flattened on the more evolute side, somewhat constricted at irregular intervals; wall finely granular on the more evolute side, smooth and coarsely perforate on the more involute side; aperture a high arch-shaped opening formed at the open end of the tube.

***Spirillina*? sp. 2**
Plate 7, figures 15-17

Description: Test low conical, proloculus followed by an enrolled tubular chamber that gradually increases in size; all whorls visible on the spiral side, only the umbiculus and the final whorl visible on the umbilical side; spiral side finely granular, both sides perforated with irregular coarse pores, umbiliculus ornamented with knobs, coarsely perforate, umbilicus on the spiral side smooth and imperforate; aperture on the umbilical side at the end of the tubular chamber.

Remarks: The generic assigment is uncertain and needs further study.

Order LAGENIDA Lankester 1885
Superfamily NODOSARIOIDEA Ehrenberg 1838
Family VAGINULINIDAE Reuss 1860
Subfamily LENTICULININAE Chapman, Parr and Collins 1934
Lenticulina Lamarck 1804

Lenticulina platyrhinos Zheng 1980
Plate 45, figures 13, 14

Lenticulina platyrhinos ZHENG 1980, p. 178, pl. 3, fig. 2. – DEBENAY 2012, p. 224, 286.

PLATE 10
Scale bar is 100 µm unless otherwise indicated.

1-4 *Articulina pacifica* (1-3: N18; 4: U16).

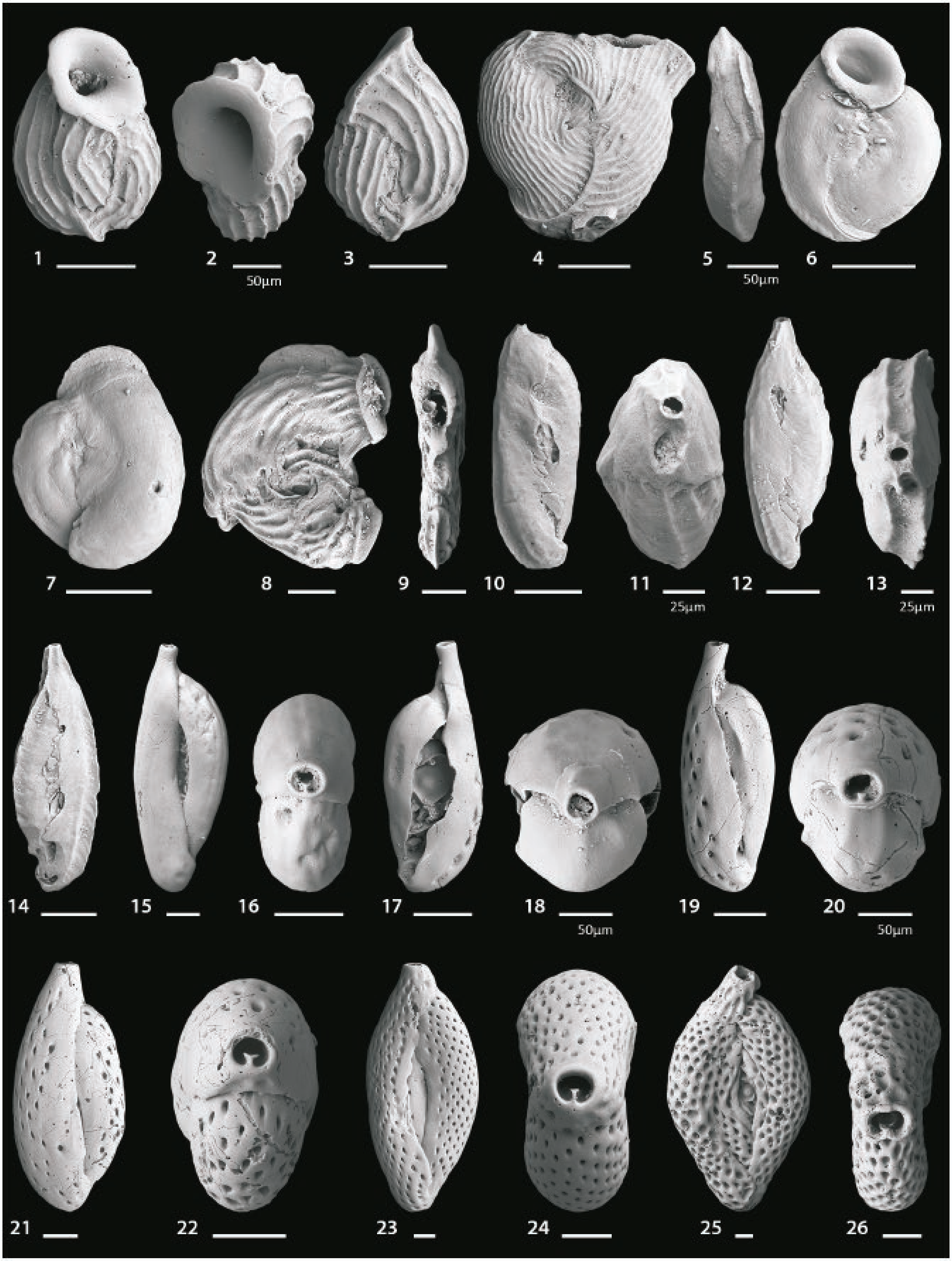
5-7 *Wiesnerella auriculata* (AW13).

8, 9 *Nodobaculariella convexiuscula* (N19).

10-14 *Mesosigmiolina minuta* (10, 11: U16; 12-13: W08).

15, 16 *Spiroloculina* sp. (OT).

17-26 *Spiroloculina foveolata* (17-20: B15; 21, 22: MG; 23, 24: U01; 25, 26: MS03).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Occurrence: South China Sea (Zheng 1980), New Caledonia (Debenay 2012).

Lenticulina suborbicularis Parr 1950
Plate 45, figures 9, 10

Lenticulina (Robulus) suborbicularis PARR 1950, p. 321, 322, pl. 11, figs. 5, 6.
Lenticulina suborbicularis Parr – LOEBLICH and TAPPAN 1994, p. 68, pl. 123, figs. 1-9.

Occurrence: Antarctic (Parr 1950), Timor Sea (Loeblich and Tappan 1994).

Lenticulina* cf. *L. suborbicularis Parr 1950
Plate 45, figures 11, 12

cf. *Lenticulina (Robulus) suborbicularis* PARR 1950, p. 321, 322, pl. 11, figs. 5, 6.
Lenticulina sp. A THISSEN and LANGER 2017, p. 44, pl. 11, figs. 14, 15.

Occurrence: Zanzibar (Thissen and Langer 2017). *Lenticulina suborbicularis* was originally described from the Antarctic.

***Lenticulina* sp.**
Plate 45, figures 7, 8

Description: Test planispiral, involute, biconvex, periphery acute with a thickened keel; sutures curved and limbate, raised; wall smooth; apertural face slightly depressed, aperture terminal, radiate.

Subfamily MARGINULININAE Wedekind 1937
Vaginulinopsis Silvestri 1904

***Vaginulinopsis*? sp.**
Plate 45, figures 25-27

Description: Test elongate, slightly curved, periphery rounded; early stage planispiral, later uncoiled; sutures slightly compressed in the adult stage, oblique, nearly straight and slightly curved backwards at the outer margin; surface smooth and unornamented; aperture terminal, radiate.

Superfamily POLYMORPHINOIDEA d'Orbigny 1839a
Family POLYMORPHINIDAE d'Orbigny 1839a
Subfamily POLYMORPHININAE d'Orbigny 1839a
Guttulina d'Orbigny 1839

Guttulina* cf. *G. succincta McCulloch 1977
Plate 45, figures 17, 18

cf. *Guttulina* (?) *succincta* MCCULLOCH 1977, p. 186, pl. 75, figs. 10, 12-20.

Remarks: The specimen resembles *Guttulina succincta* McCulloch as illustrated by Parker (2009; p. 406, fig. 293a-g) but is somewhat broader and not as elongate.

Occurrence: *Guttulina succincta* was originally described from the Gulf of California.

***Guttulina*? sp.**
Plate 45, figures 15, 16

Description: Test small, inflated, periphery rounded, subcircular in lateral view; wall finely perforate, smooth; aperture terminal, radiate.

Remarks: More specimens are required for a reliable generic assignment.

Krebsina McCulloch 1981

Krebsina* cf. *K. okinawaensis Hatta 1992
Plate 46, figures 1-3

cf. *Radiatobolivina okinawaensis* Hatta in HATTA and UJIIÉ 1992, p. 205, pl. 51, figs. 1-5.

Remarks: See remarks on conspecificity in Parker (2009; p. 451).

PLATE 11
Scale bar is 100 µm unless otherwise indicated.

1,2 *Spiroloculina antillarum* (B14).

3-5 *Spiroloculina angulata* (3, 4: W08; 5: Ms).

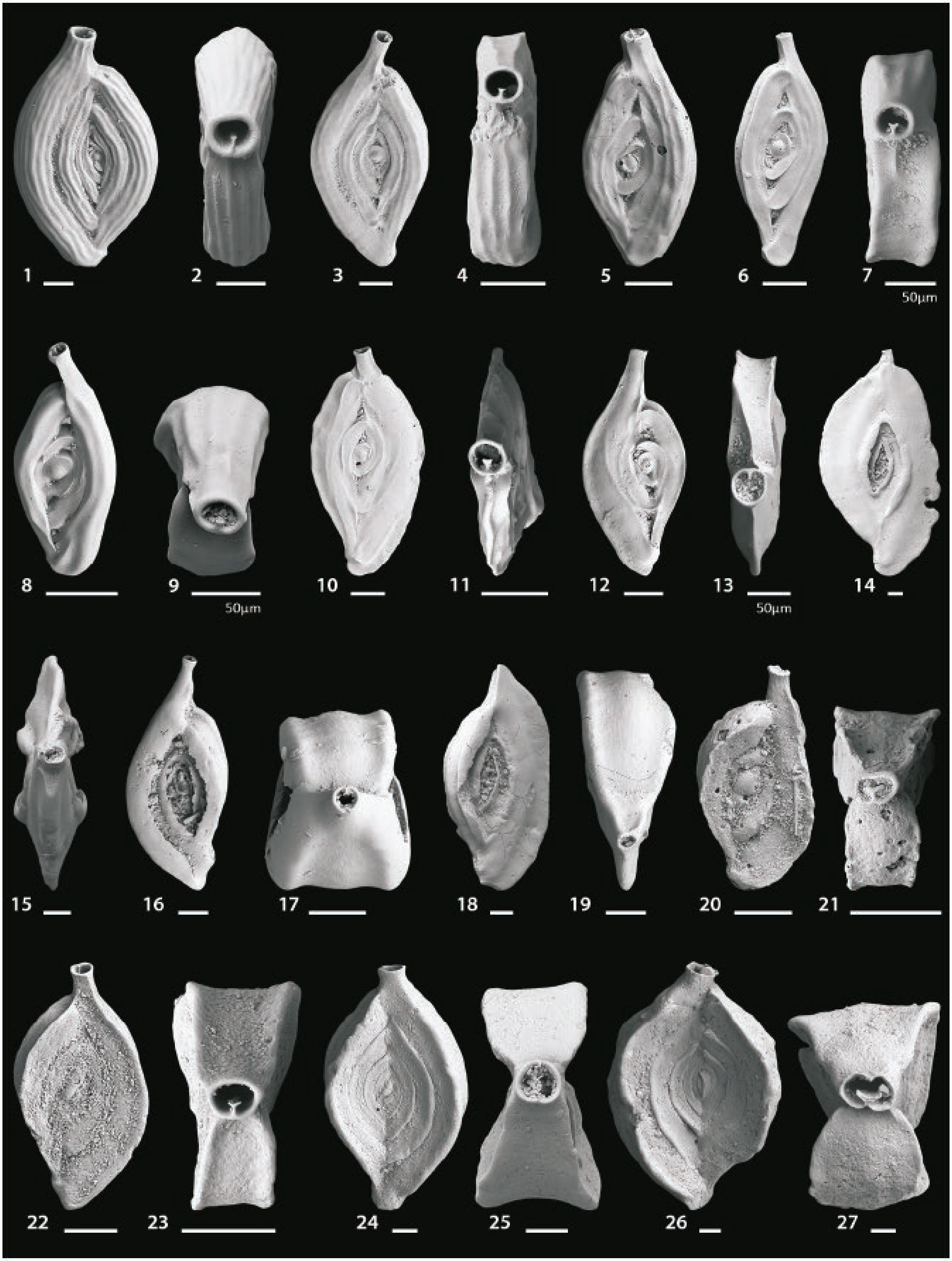
6-9 *Spiroloculina* cf. *S. angulata* (6, 7: W08; 8, 9: N18).

10-13 *Spiroloculina* cf. *S. caduca* (10, 11: B15; 12, 13: U16).

14,15 *Spiroloculina* cf. *S. venusta* (U02).

16-19 *Spiroloculina* cf. *S. mayori* (16, 17: B15; 18, 19: B14).

20-27 *Spiroloculina convexa* (20, 21: ER23*; 22, 23: Y25; 24, 25; FW; 26, 27: MG).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Occurrence: *Krebsina okinawaensis* was originally described from the Ryukyus.

Pseudopolymorphina Cushman and Ozawa 1928

Pseudopolymorphina ligua (Roemer 1838)
Plate 45, figures 23, 24

Polymorphina ligua ROEMER 1838, p. 385, pl. 3, fig. 25.
Pseudopolymorphina ligua (Roemer) – LOEBLICH and TAPPAN 1994, p. 83, pl. 146, figs. 8, 9. – DEBENAY 2012, p. 291, not figured.

Occurrence: Tertiary (Roemer 1838), Timor Sea (Loeblich and Tappan 1994), New Caledonia (Debenay 2012).

Sigmoidella Cushman and Ozawa 1928

Sigmoidella elegantissima (Parker and Jones 1865)
Plate 45, figures 19, 20

Polymorphina elegantissima PARKER and JONES 1865, p. 438., table 10. – PARKER, JONES and BRADY 1870, p. 231, pl. 40, figs. 15a-c. – CUSHMAN 1921, p. 267, pl. 54, figs. 1, 2.
Sigmoidella elegantissima (Parker and Jones) – CUSHMAN and OZAWA 1929, p. 76, pl. 16, figs. 10, 11. – CUSHMAN and OZAWA 1930, p. 140, pl. 39, fig. 1. – WHITTAKER and HODGKINSON 1979, p. 50, text fig. 46, pl. 8, fig. 7. – LOEBLICH and TAPPAN 1994, p. 83, pl. 148, figs. 4-12. – PARKER 2009, p. 422, fig. 305a-g. – DEBENAY 2012, p. 248, 291.

Occurrence: Victoria and Tasmania, Australia (Parker, Jones and Brady 1870), Philippines (Cushman 1921), Japan (Cushman and Ozawa 1929, 1930), Malaysia (Whittaker and Hodgkinson 1979), Sahul Shelf (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

Family ELLIPSOLAGENIDAE A. Silvestri 1923
Subfamily ELLIPSOLAGENINAE A. Silvestri 1923
Fissurina Reuss 1850

Fissurina lucida (Williamson 1848)
Plate 45, figures 21, 22

Entosolenia marginata (Montagu) var. *lucida* WILLIAMSON 1848, p. 17, pl. 2, fig. 7.
Fissurina lucida (Williamson) – LOEBLICH and TAPPAN 1994, p. 90, pl. 156, figs. 1-3. – DEBENAY 2012, p. 147, 292.

Occurrence: Sahul Shelf (Loeblich and Tappan 1994), New Caledonia (Debenay 2012).

Fissurina? trinalmarginata (Loeblich and Tappan 1994)
Plate 45, figures 3, 4

Duplella trinalmarginata LOEBLICH and TAPPAN 1994, p. 88, pl. 154, figs. 4-8.
Fissurina trinalmarginata (Loeblich and Tappan) – PARKER 2009, p. 402, fig. 289a-j.
Palliolatella fasciata carinata (Sidebottom) – DEBENAY 2012, p. 157, 293.

Remarks: Our specimen has a circular outline and differs slightly from the original illustration of Loeblich and Tappan (1994). The generic assignment is tentative, see discussion in Parker and description of Debenay (2012).

Occurrence: Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

Subfamily OOLININAE Loeblich and Tappan 1961
Buchnerina Jones 1984

Buchnerina lacunata (Burrows and Holland 1895)
Plate 45, figures 1, 2

Lagena lacunata Burrows and Holland in JONES 1895, p. 205, pl. 7, figs. 12a, b.
Fissurina lacunata (Burrows and Holland) – ALBANI 1968, p. 105, pl. 8, fig. 16.
Palliolatella lacunata (Burrows and Holland) – ALBANI and YASSINI 1989, p. 394, figs. 5g, h.
Cerebrina lacunata (Burrows and Holland) – LOEBLICH and TAPPAN 1994, p. 76, pl. 135, figs. 8-15. – PARKER 2009, p. 395, figs. 284a-l, 285a-i. – DEBENAY 2012, p. 142, 289.

Remarks: Our specimens and the specimens by Loeblich and Tappan (1994) show recessed grooves. The species is therefore tentatively placed in the genus *Buchnerina*.

PLATE 12
Scale bar is 100 µm unless otherwise indicated.

1-4 *Spiroloculina eximia* (1, 2: W08; 3, 4: Ms).

5,6 *Spiroloculina* cf. *S. subimpressa* (MI06*).

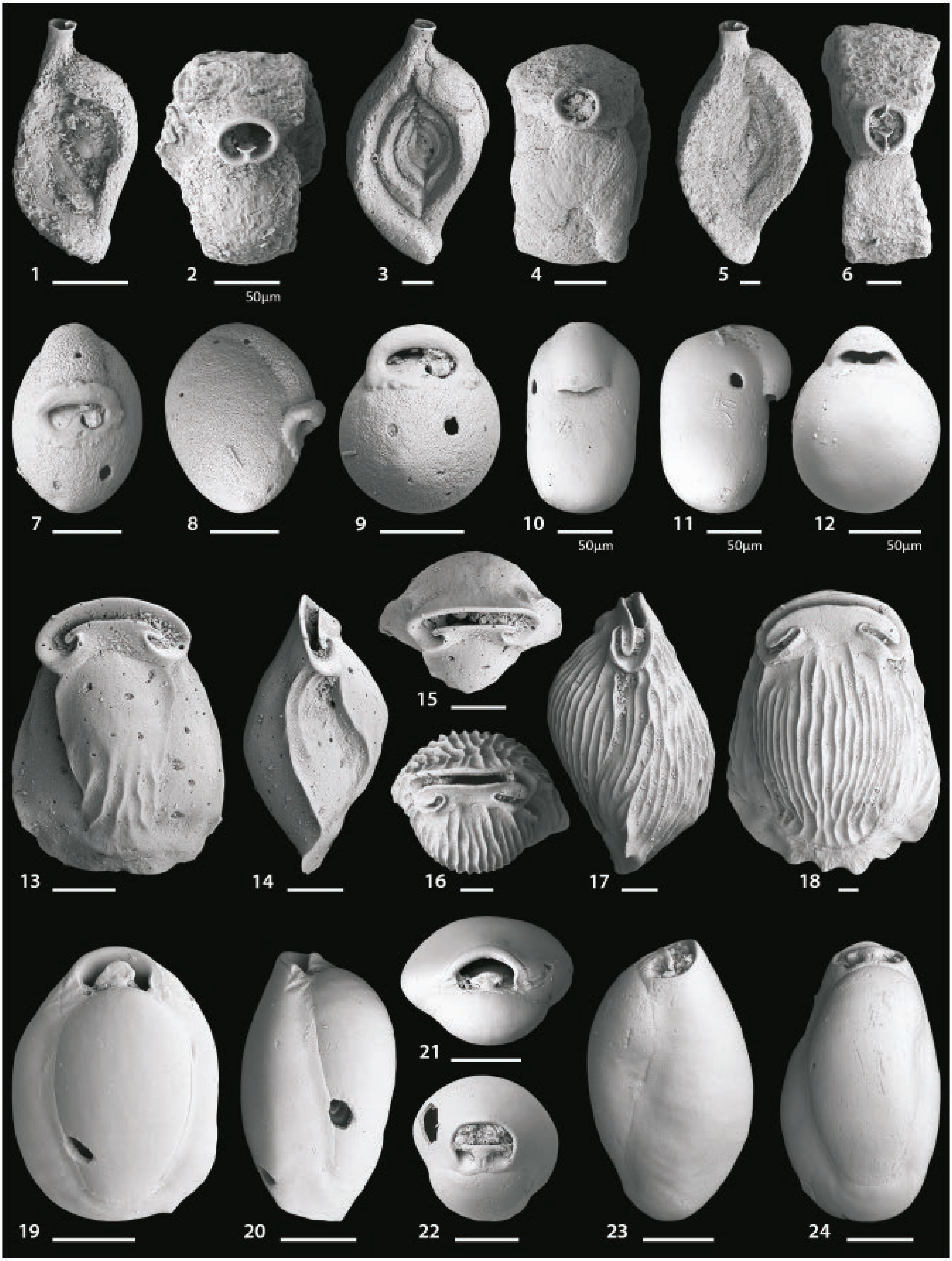
7-9 *Glomulina*? sp. 2 (N18).

10-12 *Glomulina*? sp. 1 (MI05).

13-18 *Pyrgo striolata* (13-15: B15; 16-18: N18*).

19-21 *Pyrgo* cf. *P. oblonga* (CK).

22-24 *Pyrgo* sp. (W08).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Occurrence: Pliocene, England (Burrows and Holland 1895), eastern Australia (Albani 1968, Albani and Yassini 1989), Sahul Shelf (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

Buchnerina milletti (Todd 1954)
Plate 45, figures 5, 6

Fissurina milletti Todd in CUSHMAN, TODD and POST 1954, p. 351, pl. 87, fig. 30.
Fissurina marginato-perforata (Seguenza) – HATTA and UJIIÉ 1992, p. 169, pl. 23, figs. 7a, b.
Cerebrina perforata (LeRoy) – LOEBLICH and TAPPAN 1994, p. 76, pl. 136, figs. 9, 10 (not figs. 5, 6).
Buchnerina milletti (Todd) – DEBENAY 2012, p. 140, 293.

Occurrence: Marshall Islands (Todd 1954), Ryukyus (Hatta and Ujiié 1992), Timor Sea (Loeblich and Tappan 1994), New Caledonia (Debenay 2012).

Order ROBERTINIDA Mikhalevich 1980
Superfamily ROBERTINOIDEA Reuss 1850
Family ROBERTINIDAE Reuss 1850
Geminospira Makiyama and Nakagawa 1941

Geminospira bradyi Bermúdez 1952
Plate 44, figures 28-30

Bulimina convoluta Williamson – BRADY 1884, p. 409, pl. 113, figs. 6a, b.
Geminospira bradyi BERM DEZ 1952, Brady's specimens, p. 80, pl. 13, fig. 7 (*fide* Belford 1966). – BELFORD 1966, p. 193-194, pl. 37, figs. 1-7, tf. 24, nos 5-8. – HATTA and UJIIÉ 1992, p. 170, pl. 24, figs. 5, 6a-c, 7. – JONES 1994, p. 111, pl. 113, figs. 6a, b (after Brady). – LOEBLICH and TAPPAN 1994, p. 99, pl. 177, figs. 1-14, pl. 178, figs. 1-9. – PARKER 2009, p. 385, fig. 310a-i.

Occurrence: Torres Strait (Brady 1884, Bermúdez 1952, Jones 1994), Miocene and Pliocene, New Guinea (Belford 1966), Ryukyus (Hatta and Ujiié 1992), Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009).

Order BULIMINIDA Fursenko 1958
Superfamily BOLIVINITOIDEA Cushman 1927
Family BOLIVINITIDAE Cushman 1927
Bolivina d'Orbigny 1839

***Bolivina doniezi*? ** Cushman and Wickenden 1929
Plate 47, figure 23

? *Bolivina doniezi* CUSHMAN and WICKENDEN 1929, p. 9, pl. 4, figs. 3a, b.
Bolivina doniezi Cushman and Wickenden – DEBENAY 2012, p. 171, 298.

Remarks: The final chamber of our specimen is broken and the specific assignment is tentative.

Occurrence: ? Chile (Cushman and Wickenden 1929), New Caledonia (Debenay 2012).

Bolivina variabilis (Williamson 1858)
Plate 47, figures 17, 18

Textularia variabilis WILLIAMSON 1858, p. 76, pl. 6, figs. 162, 163.
Bolivina variabilis (Williamson) – LOEBLICH and TAPPAN 1994, p. 111, pl. 216, figs. 7-15. – PARKER 2009, p. 434, fig. 315a-k. – DEBENAY 2012, p. 172, 298.

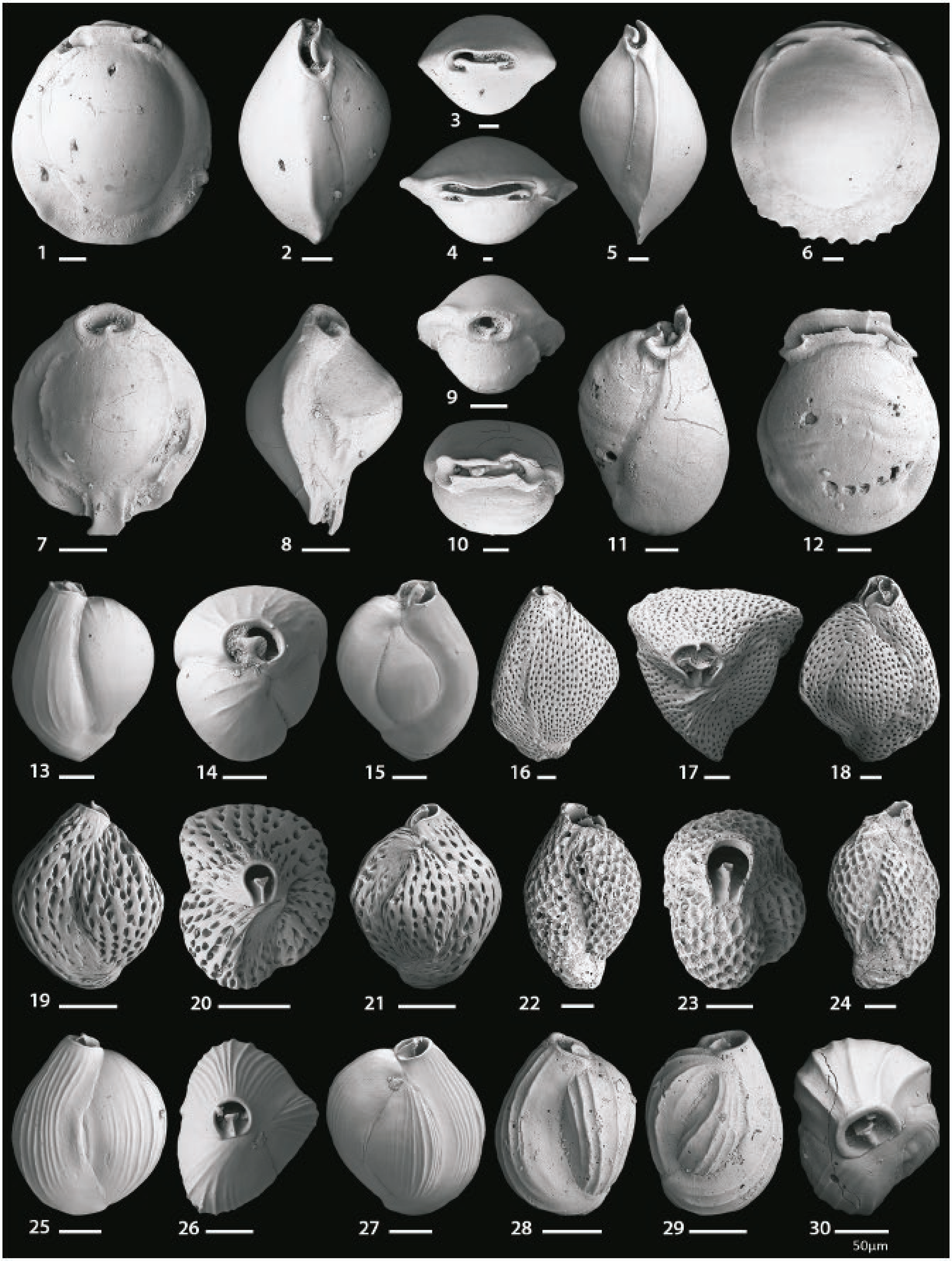
Occurrence: British Isles (Williamson 1858), Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

Bolivina sp. 1
Plate 47, figures 15, 16

Description: Test small, biserial, elongate, periphery rounded; chambers numerous, slowly increasing in size in the early portion, rapidly increasing in size in later portions; sutures depressed, obscured by ornamental features; wall unevenly pitted, pores surrounded by a polygonal pattern of ridges; aperture terminal and situated in a depression, an elongate loop bordered by a lip.

PLATE 13
Scale bar is 100 µm unless otherwise indicated.

1-3 *Pyrgo sarsi* (N19).
4-6 *Pyrgo denticulata* (N18*).
7-9 *Pyrgo rotaliara* (N18*).
10-12 *Pyrgo* aff. *P. sarsi* (Ms).
13-15 *Triloculina asymmetrica* (N18).
16-18 *Triloculina bertheliniana* (Y25).
19-21 *Triloculina* cf. *T. bertheliniana* (MG).
22-24 *Triloculina bicarinata* (Y25).
25-30 *Triloculina*? *fichteliana* (25-27: N18; 28-30: U16).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Remarks: This species differs from *Bolivina variabilis* (Williamson) by the pronounced ornamentation and its less inflated test.

***Bolivina*? sp. 2**
Plate 46, figures 29-32

Description: Test small, biserial, slightly elongate, laterally slightly compressed, periphery rounded; chambers gradually increasing in size; sutures depressed, indistinct; wall coarsely perforated, ornamented with scarce longitudinal costae at the base and the peripheral margins; aperture terminal, a loop-shaped opening encircled by a row of coarse pores and bisected by a toothplate.

Family CHEILOCHANIDAE Loeblich and Tappan 1994
Cheilochanus Loeblich and Tappan 1994

Cheilochanus fimbriatus (Collins 1958)
Plate 46, figures 23-25

Bolivina alata Seguenza subsp. *fimbriata* COLLINS 1958, p. 394, pl. 5, figs. 1a, b.
Bolivina? fimbriata Collins – HATTA and UJIIÉ 1992, p. 171, pl. 25, figs. 5-7.
Lugdunum fimbriata (Collins) – HAIG 1993, p. 171, pl. 6, figs. 11, 12.
Cheilochanus fimbriata (Collins) – LOEBLICH and TAPPAN 1994, p. 112, pl. 218, figs. 3-14. – PARKER 2009, p. 443, fig. 319a-c.
Cheilochanus fimbriatus (Collins) – DEBENAY 2012, p. 173, 299.

Occurrence: Great Barrier Reef (Collins 1958), Ryukyus (Hatta and Ujiié 1992), Papuan Lagoon (Haig 1993), Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

Superfamily LOXOSTOMATOIDEA Loeblich and Tappan 1962
Family BOLIVINELLIDAE Hayward, in Hayward and Brazier 1980
Rugobolivinella Hayward 1990

Rugobolivinella elegans (Parr 1932)
Plate 47, figures 24-26

Textularia folium Parker and Jones – BRADY 1884 (not *Textularia agglutinans* d'Orbigny var. *folium* Parker and Jones, 1865), p. 357, pl. 42, figs. 3-5 (not figs. 1, 2).
Bolivinella elegans PARR 1932, p. 224. – GRAHAM and MILITANTE 1959, p. 78, pl. 12, figs. 8, 9. – VAN MARLE 1991, p. 112, pl. 9, figs. 1, 2. – HOTTINGER, HALICZ and REISS 1993, p. 93, pl. 113, figs. 1-6. – PARKER 2009, p. 436, fig. 316a-f. – FAJEMILA, LANGER and LIPPS 2015, fig. 2: 19.
Rugobolivinella elegans (Parr) – HAYWARD 1990, p. 69, pl. 8, figs. 5,6; pl. 17, figs. 5-21. – HATTA and UJIIÉ 1992, p. 173, pl. 26, fig. 4. – HAIG 1993, p. 171, pl. 6, fig. 13. – LOEBLICH and TAPPAN 1994, p. 113, pl. 220, figs. 1-6. – DEBENAY 2012, p. 177, 299.

Remarks: The ornamentation of the specimens depicted by Hottinger, Halicz and Reiss (1993) is more pronounced and includes beady pustules in between the sutural ribs. Molecular studies are required to confirm conspecificity.

Occurrence: Fiji (Brady 1884), Torres Strait (Brady 1884, Parr 1932), Philippines (Graham and Militante 1959), Eastern Indonesia (van Marle 1991), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), Ningaloo Reef (Parker 2009), Moorea (Fajemila, Langer and Lipps 2015), Indo-Pacific localities (Hayward 1990), Ryukyus (Hatta and Ujiié 1992), Papuan Lagoon (Haig 1988), Sahul Shelf (Loeblich and Tappan 1994), New Caledonia (Debenay 2012).

Superfamily CASSIDULINOIDEA d'Orbigny 1839a
Family CASSIDULINIDAE d'Orbigny 1839a
Subfamily CASSIDULININAE d'Orbigny 1839a
Cassidulina d'Orbigny 1826

Cassidulina hoodensis McCulloch 1977
Plate 46, figures 4-6

Cassidulina hoodensis MCCULLOCH 1977, p. 389, pl. 164, fig. 14.

Occurrence: Galapagos (McCulloch 1977).

Globocassidulina Voloshinova 1960

Globocassidulina decorata (Sidebottom 1910)
Plate 46, figures 14-16

Cassidulina decorata SIDEBOTTOM 1910, p. 107, pl. 4, fig. 2.

PLATE 14
Scale bar is 100 µm unless otherwise indicated.

1-3 *Triloculina* cf. *T. fichteliana* (U01).

4-6 *Triloculina latiformis* (MR18).

7-14 *Triloculina kawea* (FW).

15-17 *Triloculina* cf. *T. terquemiana* Type 1 (FW).

18-20 *Triloculina* cf. *T. terquemiana* Type 2 (Y25).

21-26 *Triloculina* cf. *T. vespertilio* Type 2 (21-23: ER 22; 24-26: ER23*).

27-29 *Triloculina* cf. *T. vespertilio* Type 1 (MG).


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Globocassidulina sp. HAIG 1993, p. 171, pl. 6, fig. 22.
Globocassidulina decorata (Sidebottom) – LOEBLICH and TAPPAN 1994, p. 115, pl. 222, figs. 14-19.

Occurrence: Southwest Pacific (Sidebottom 1910), Papuan Lagoon (Haig 1993), Timor Sea (Loeblich and Tappan 1994).

Globocassidulina subglobosa (Brady 1881)
Plate 46, figures 7, 8

Cassidulina subglobosa BRADY 1881, p. 60. – BRADY 1884, p. 430, pl. 54, figs. 17a-c.
Globocassidulina subglobosa (Brady) – BELFORD 1966, p. 149, pl. 25, figs. 11-16. – DEBENAY 2012, p. 239, 300.

Remarks: The specimens from Raja Ampat are more globulose than the ones depicted by Brady (1881). Belford (1966) noted the variability in sphericity, but inner structures remained consistent (see discussion in Belford).

Occurrence: Brazil (Brady 1884), Miocene, Papua New Guinea (Belford 1966), New Caledonia (Debenay 2012).

Globocassidulina* cf. *G. subglobosa (Brady 1881)
Plate 46, figures 9-12

cf. *Cassidulina subglobosa* BRADY 1881, p. 60.

Remarks: The specimens depicted by Brady are more inflated.

Globocassidulina* cf. *G. subtumida (Cushman 1933)
Plate 46, Figure 13

cf. *Cassidulina subtumida* CUSHMAN 1933, p. 93, pl. 10, fig. 5.

Occurrence: *Globocassidulina subtumida* was originally described from Paumotu.

Paracassidulina Nomura 1983

Paracassidulina* cf. *P. neocarinata (Thalmann 1950)
Plate 46, figures 17-19

cf. *Cassidulina neocarinata* THALMANN 1950, new name for *Cassidulina laevigata* var. *carinata* Cushman, p. 44.

Remarks: Similar specimens of *P. neocarinata* were illustrated by Debenay (2012; p. 245, 300) and Loeblich and Tappan (1994; p. 116, pl. 227, figs. 1-15). However, the specimens from Raja Ampat differ in the less pronounced carina and the more rounded and inflated test shape.

Occurrence: Paracassidulina neocarinata was originally described as a variety of *Cassidulina laevigata* d'Orbigny (1826) from the Caribbean (Cushman 1922).

Paracassidulina sulcata (Belford 1966)
Plate 46, figures 20-22

Cassidulina sulcata BELFORD 1966, p. 142, pl. 24, figs. 11-14; text-fig. 16: 7, 8.
Paracassidulina sulcata Belford – DEBENAY 2012, p. 245, 300.

Occurrence: Miocene, Papua New Guinea (Belford 1966), New Caledonia (Debenay 2012).

Superfamily TURRILINOIDEA Cushman 1927
Family STAINFORTHIIDAE Reiss 1963
Virgulopsis Finlay 1939

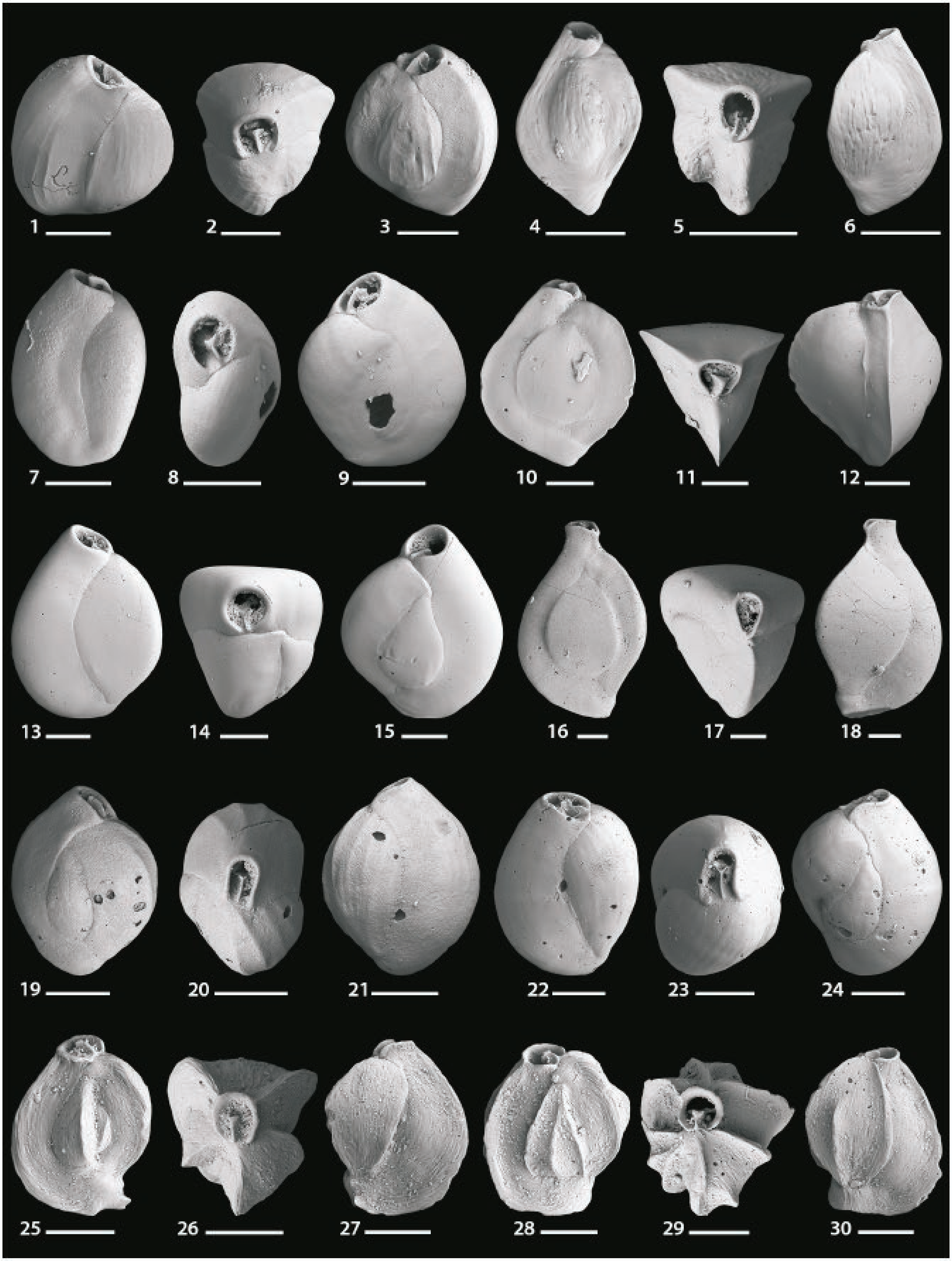
Virgulopsis spinea (Cushman 1936)
Plate 47, figures 19, 20

Bolivina spinea CUSHMAN 1936, p. 58, pl. 8, figs. 11a, b. – BACCAERT 1987, p. 181, pl. 73, figs. 5, 6.
Brizalina spinea (Cushman) – HATTA and UJIIÉ 1992, p. 172, pl. 26, figs. 1a, b.
Sagrina zanzibarica Cushman – LOEBLICH and TAPPAN 1994, p. 122, pl. 238, figs. 12-17.
Virgulopsis spinea (Cushman) – PARKER 2009, p. 472, fig. 340a-k. – DEBENAY 2012, p. 179, 301.

Occurrence: Fiji (Cushman 1936), Great Barrier Reef (Baccaert 1987), Ryukyus (Hatta and Ujiié 1992), Sahul Shelf (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

PLATE 15
Scale bar is 100 µm unless otherwise indicated.

1-3 *Triloculina* cf. *T. wiesneri* (B15).
4-6 *Triloculina* sp. 3 (MR18).
7-9 *Triloculina* cf. *T. sommeri* (AP10).
10-12 *Triloculina tricarinata* (U16).
13-15 *Triloculina trigonula* (Ms).
16-18 *Triloculina triquetrella* (N19).
19-24 *Triloculina* sp. 2 (19-21: MI06; 22-24: MS04).
25-30 *Triloculina serrulata* (25-27: FW; 28-30: MI06).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Superfamily BULIMINOIDEA Jones 1875
Family SIPHOGENERINOIDIDAE Saidova 1981
Subfamily SIPHOGENERINOIDINAE Saidova 1981
Loxostomina Sellier de Civrieux 1969

Loxostomina costulata (Cushman 1922)
Plate 47, figures 1-5

Bolivina limbata (Brady) var. *costulata* CUSHMAN 1922, p. 26, pl. 3, fig. 8.
Loxostoma limbatum (Brady) – CUSHMAN 1942, p. 35, pl. 10, figs. 1a, b, 2a, b, 3a, b.
Loxostomum limbatum costulatum (Cushman) – CHENG and ZHENG 1978, p. 241, pl. 18, figs. 8, 9.
Loxostomina costulata (Cushman) – LOEBLICH and TAPPAN 1994, p. 119, pl. 232, figs. 12-16. – DEBENAY 2012, p. 175, 302.
Loxostomina limbata (Brady) var. *costulata* (Cushman) – MAKLED and LANGER 2011, p. 248, fig. 8: 30-35.
Loxostomina limbata Brady – FAJEMILA, LANGER and LIPPS 2015, fig. 2: 26.
Loxostomina limbata (Brady) *costulata* (Cushman) – THISSEN and LANGER 2017, p. 48, pl. 13, figs. 19-21.

Occurrence: Tortugas (Cushman 1922), Guam and tropical Pacific (Cushman 1942), Xisha Islands (Cheng and Zheng 1978), Sahul Shelf (Loeblich and Tappan 1994), New Caledonia (Debenay 2012), Caroline Islands (Makled and Langer 2011), Moorea (Fajemila, Langer and Lipps 2015), Zanzibar (Thissen and Langer 2017), Madang, Papua New Guinea (Langer unpubl. data).

Subfamily TUBULOGENERININAE Saidova 1981
Siphogenerina Schlumberger, in Milne-Edwards 1882

Siphogenerina raphanus (Parker and Jones 1865)
Plate 47, figures 6-14

Uvigerina (Sagrina) raphanus PARKER and JONES 1865, p. 364, pl. 18, figs. 16, 17.
Sagrina raphanus (Parker and Jones) – BRADY 1884, p. 585, pl. 75, figs. 21-24.
Siphogenerina raphana (Parker and Jones) – SAID 1949, p. 34, pl. 3, fig. 26. – HATTA and UJIIÉ 1992, p. 174, pl. 26, figs. 11, 12. – HAIG 1993, p. 170, pl. 3, figs. 8-10. – LOEBLICH and TAPPAN 1994, p. 123, pl. 240, figs. 1-11. – HAIG 1997, p. 275. – PARKER 2009, p. 469, fig. 338a-j. – DEBENAY 2012, p. 169, 302. – LANGER et al. 2013, pl. 7: 27, 28.
Siphogenerina raphanus (Parker and Jones) – GRAHAM and MILITANTE 1959, p. 87, pl. 13, fig. 8.
Rectobolivina raphana (Parker and Jones) – CHENG and ZHENG 1978, p. 204, pl. 18, figs. 13-15. – BACCAERT 1987, p. 187, pl. 74, figs. 9-12.

Occurrence: West Indies, Panama, China and Australia (Parker and Jones 1865), Tropical Pacific (Brady 1884), Red Sea (Said 1949), Ryukyus (Hatta and Ujiié 1992), Papuan Lagoon (Haig 1993), Sahul Shelf (Loeblich and Tappan 1994), Western Australia (Haig 1997, Parker 2009), New Caledonia (Debenay 2012), Bazaruto (Langer et al. 2013), Philippines (Graham and Militante 1959), Xisha Islands (Cheng and Zheng 1978), Great Barrier Reef (Baccaert 1987), Madang, Papua New Guinea (Langer unpubl. data).

Family ORTHOPLECTIDAE Loeblich and Tappan 1984
Floresina Revets 1990

Floresina milletti (Cushman 1933)
Plate 48, figures 6, 7

Buliminella milletti CUSHMAN 1933, p. 78, pl. 8, figs. 5, 6. – CUSHMAN 1942, p. 7, pl. 3, figs. 1-4. – TODD 1957, p. 290, pl. 89, fig. 8.

Occurrence: Fiji (Cushman 1933, 1942), Mariana Islands (Todd 1957).

Orthoplecta Brady 1884

Orthoplecta clavata Brady 1884
Plate 48, figures 8, 9

Cassidulina (Orthoplecta) clavata BRADY 1884, p. 432, pl. 113, fig. 9.
Orthoplecta clavata Brady – DEBENAY 2012, p. 244, 303.

Occurrence: Admiralty Islands (Brady 1884), New Caledonia (Debenay 2012).

PLATE 16
Scale bar is 100 µm unless otherwise indicated.

1-4 *Triloculina* sp. 1 (B14).
5-7 *Pseudotriloculina* sp. 4 (ER22).
8-10 *Pseudotriloculina* sp. 1 (Wa).
11-13 *Pseudotriloculina*? sp. 5 (AP09).
14-19 *Pseudotriloculina* sp. 3 (14-16: B15; 17-19: N18).
20-22 *Pseudotriloculina* sp. 2 (N19).
23-25 *Pseudotriloculina kerimbatica* (MG).
26-28 *Triloculinella* cf. *T. pseudooblonga* (ER23*).
29-31 *Miliolinella* cf. *M. chiastocytis* (MS04).


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Family REUSSELLIDAE Cushman 1933
Fijiella Loeblich and Tappan 1962

Fijiella simplex (Cushman 1929)
Plate 47, figures 30-35

Trimosina simplex CUSHMAN 1929, p. 158, tf. 2.
Reussella simplex (Cushman) – CUSHMAN 1945, p. 40, pl. 7, figs. 5a, b. – SEIBOLD 1975, p. 187, pl. 4, figs. 6a-c. – VAN MARLE 1988, p. 148, pl. 1, fig. 7.
? *Reussella aculeata* Cushman – GRAHAM and MILITANTE 1959, p. 85, pl. 13, fig. 2.
Fijiella simplex (Cushman). – CHENG and ZHENG 1978, p. 206, pl. 18, fig. 10. – LOEBLICH and TAPPAN 1994, p. 129, pl. 252, figs. 5, 6. – MAKLED and LANGER 2011, p. 248, fig. 9: 1-4. – DEBENAY 2012, p. 180, 304.
Reussella cf. *R. insueta* Cushman. – LANGER et al. 2013, p. 167, fig. 7: 33, 34.

Occurrence: Fiji (Cushman 1929, 1945), India (Seibold 1975), Banda Sea (van Marle 1988), Philippines? (Graham and Militante 1959), Xisha Islands (Cheng and Zheng 1978), Sahul Shelf (Loeblich and Tappan 1994), Caroline Islands (Makled and Langer 2011), New Caledonia (Debenay 2012), Bazaruto (Langer et al. 2013), Madang, Papua New Guinea (Langer unpubl. data).

Reussella Galloway 1933

Reussella? spinulosa (Reuss 1850)
Plate 47, figures 27-29

Verneuilina spinulosa REUSS 1850, p. 374, pl. 47, fig. 12. – BRADY 1884, p. 384, pl. 47, figs. 1-3.
Reussella spinulosa (Reuss) – CUSHMAN 1942, p. 40, pl. 11, figs. 5-8. – DEBENAY 2012, p. 182, 305.

Remarks: The generic assignment requires further study as the specimens from Raja Ampat may have a toothplate and would belong to the genus *Fijiella* Loeblich and Tappan.

Occurrence: Admiralty Islands and Papua (Brady 1884), Fiji (Cushman 1942), New Caledonia (Debenay 2012).

Superfamily FURSENKOINOIDEA Loeblich and Tappan 1961
Family FURSENKOINIDAE Loeblich and Tappan 1961
Neocassidulina McCulloch 1977

Neocassidulina abbreviata (Heron-Allen and Earland 1924)
Plate 47, figures 21, 22

Bolivina limbata Brady var. *abbreviata* HERON-ALLEN and EARLAND 1924, p. 622, pl. 36, figs. 25-27.
Brizalina abbreviata (Heron-Allen and Earland) – CHENG and ZHENG 1978, p. 204, pl. 18, fig. 4a, b. – HATTA and UJIIÉ 1992, p. 172, pl. 25, figs. 8a, b.
Cassidelina abbreviata (Heron-Allen and Earland) – HAIG 1993, p. 170, pl. 1, figs. 1-3.
Neocassidulina abbreviata (Heron-Allen and Earland) – LOEBLICH and TAPPAN 1994, p. 131, pl. 258, figs. 1-7. – DEBENAY 2012, p. 175, 306.

Occurrence: Lord Howe Island, South Pacific (Heron-Allen and Earland 1924), Xisha Islands (Cheng and Zheng 1978), Ryukyus (Hatta and Ujiié 1992), Papuan Lagoon (Haig 1993), Timor Sea (Loeblich and Tappan 1994), New Caledonia (Debenay 2012).

Sigmavirgulina Loeblich and Tappan 1957

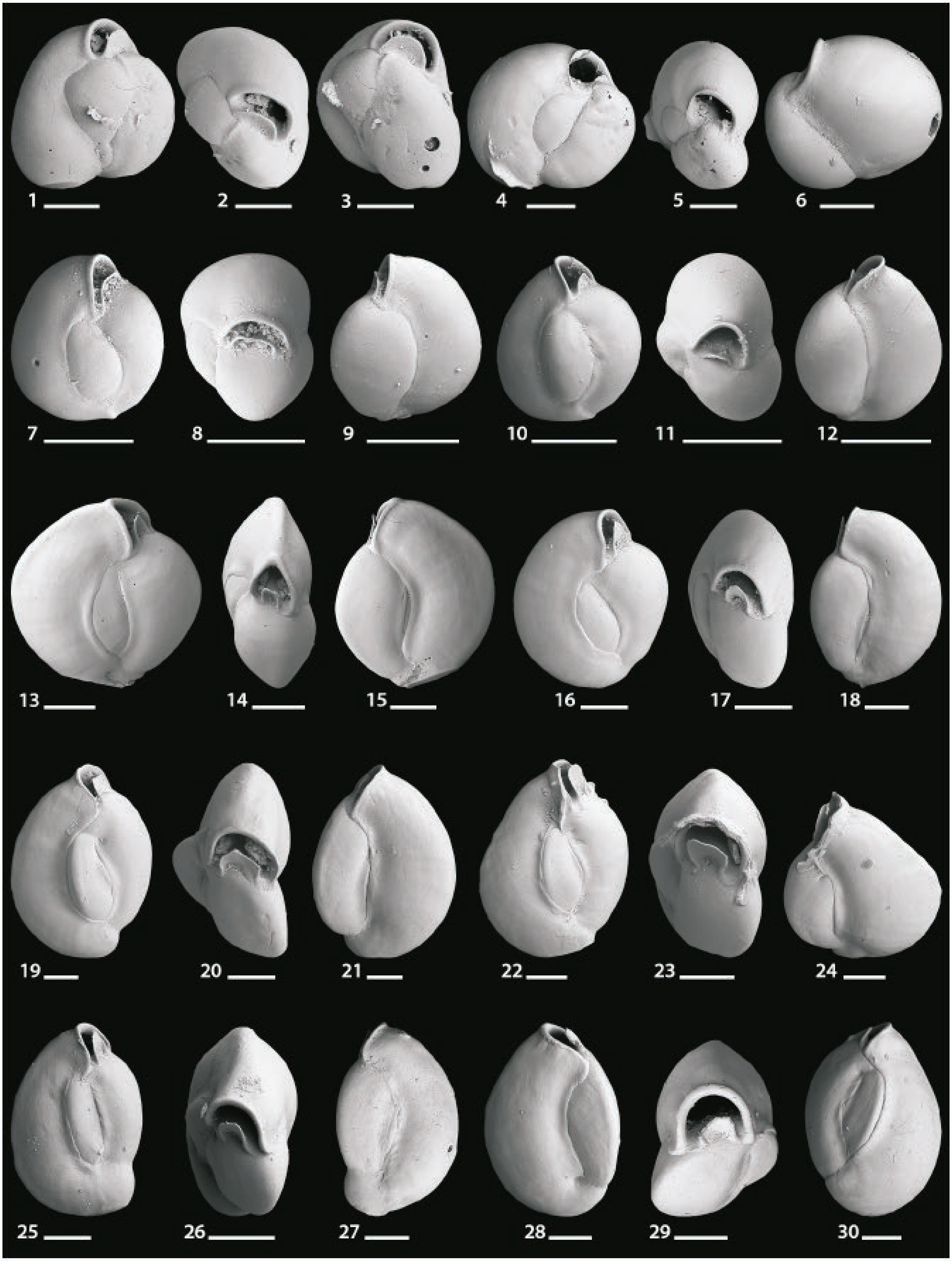
Sigmavirgulina tortuosa (Brady 1881)
Plate 46, figures 26-28

Bolivina tortuosa BRADY 1881, p. 57. – BRADY 1884, p. 56. – CUSHMAN 1924, p. 18, pl. 5, figs. 4, 5. – TODD 1957, pl. 89, fig. 19. – VAN MARLE 1991, p. 165, pl. 16, figs. 17-19.
Sigmavirgulina tortuosa (Brady) – LOEBLICH and TAPPAN 1957, p. 227, pl. 73, figs. 1, 2, text fig. 30. – GRAHAM and MILITANTE 1959, p. 87, pl. 13, figs. 6, 7. – CHENG and ZHENG 1978, p. 241, pl. 18, fig. 18a, b. – HATTA and UJIIÉ 1992, p. 177, pl. 28, figs. 3a, b. – HAIG 1993, p. 171, pl. 5, figs. 21, 22. – LOEBLICH and TAPPAN 1994, p. 132, pl. 132, pl. 261, figs. 1-10. – PARKER 2009, p. 466, fig. 337a-f. – DEBENAY 2012, p. 179, 306. – FAJEMILA, LANGER and LIPPS 2015, fig. 2: 29.

Occurrence: Admiralty Islands (Brady 1884), Samoa (Cushman 1924), Mariana Islands (Todd 1957), Eastern Indonesia (van Marle 1991), Philippines (Graham and Militante 1959), Xisha Islands (Cheng and Zheng 1978), Ryukyus (Hatta and Ujiié

PLATE 17
Scale bar is 100 µm unless otherwise indicated.

1-6 *Miliolinella*? sp. 1 (1-3: N19; 4-6: AP09).
7-9 *Miliolinella circularis* (N18).
10-12 *Miliolinella* sp. 13 (B15).
13-15 *Miliolinella* sp. 9 (N18).
16-18 *Miliolinella* cf. *M. pilasensis* (ER23*).
19-30 *Miliolinella moia* (19-24: B14, 25-20: ER23).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1992), Papuan Lagoon (Haig 1993), Sahul Shelf (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Moorea (Fajemila, Langer and Lipps 2015).

Order ROTALIIDA Lankester 1885
Superfamily DISCORBOIDEA Ehrenberg 1838
Family BAGGINIDAE Cushman 1927
Cancris de Montfort 1808

Cancris auriculus (Fichtel and Moll 1798)
Plate 39, figures 22-24

Nautilus auricula FICHTEL and MOLL 1798, p. 108, pl. 20.
Pulvinulina auricula (Fichtel and Moll) – CUSHMAN 1921, p. 329, pl. 69, figs. 6a-c.
Cancris auriculus (Fichtel and Moll) – GRAHAM and MILITANTE 1959, p. 91, pl. 23, figs. 18a, b. – LUTZE 1974, p. 29, pl. 6, figs. 108, 109. – WHITTAKER and HODGKINSON 1979, p. 62, pl. 5, fig. 10. – BACCAERT 1987, p. 197, pl. 78, figs. 1a-d. – HATTA and UJIIÉ 1992, p. 179, pl. 29, fig. 4a-c. – HOTTINGER, HALICZ and REISS 1993, p. 106, pl. 136, figs. 6-14. – LOEBLICH and TAPPAN 1994, p. 134, pl. 265, figs. 7-10. – DEBENAY 2012, p. 189, 307. – LANGER et al. 2013, p. 167, fig. 7: 40.

Occurrence: Tuscany, Italy (Fichtel and Moll 1798), Philippines (Cushman 1921, Graham and Militante 1959), Baltic Sea (Lutze 1974), Malaysia (Whittaker and Hodgkinson 1979), Great Barrier Reef (Baccaert 1987), Ryukyus (Hatta and Ujiié 1992), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), Sahul Shelf (Loeblich and Tappan 1994), New Caledonia (Debenay 2012), Bazaruto (Langer et al. 2013), Madang, Papua New Guinea (Langer unpubl. data).

Cancris bubnanensis (McCulloch 1977)
Plate 39, figures 28-30

Baggina indica (Cushman) – GRAHAM and MILITANTE (not *Pulvinulina indica* Cushman 1921) 1959, p. 91, pl. 13, fig. 17.
Baggina bubnanensis MCCULLOCH 1977, p. 342, pl. 137, fig. 5. – LOEBLICH and TAPPAN 1994, p. 134, pl. 264, figs. 5-10. – DEBENAY 2012, p. 187, 306.
Cancris bubnanensis (McCulloch) – PARKER 2009, p. 525, fig. 372a-d. – PARKER and GISCHLER 2011, pl. 4, figs. 1-3. – THISSEN and LANGER 2017, p. 50, pl. 14, figs. 4-6.

Occurrence: Philippines (Graham and Militante 1959, McCulloch 1977), Timor Sea (Loeblich and Tappan 1994), New Caledonia (Debenay 2012), Ningaloo Reef (Parker 2009), Maldives (Parker and Gischler 2011), Zanzibar (Thissen and Langer 2017).

Cancris oblongus (d'Orbigny 1839)
Plate 39, figures 25-27

Valvulina oblonga D'ORBIGNY 1839, p. 136, pl. 1, figs. 40-42.
Cancris oblongus (d'Orbigny) – LOEBLICH and TAPPAN 1994, p. 134, pl. 265, figs. 11-13. – DEBENAY 2012, p. 189, 307.

Occurrence: Canary Islands (d'Orbigny 1839), Timor Sea (Loeblich and Tappan 1994), New Caledonia (Debenay 2012).

Cribrobaggina McCulloch 1977

Cribrobaggina reniformis (Heron-Allen and Earland 1915)
Plate 39, figure 31

Discorbina valvulata var. *granulosa* HERON-ALLEN and EARLAND 1915, p. 696, pl. 52, figs. 1-6.
Cribrobaggina socorroensis MCCULLOCH 1977, p. 342, pl. 201, figs. 3-5. – HAIG 1997, p. 276, fig. 6: 13, 14.
Physalidia(?) duncanensis MCCULLOCH 1977, p. 348, pl. 154, figs. 7a-c.
Discorbina reniformis Heron-Allen and Earland – CHENG and ZHENG 1978, p. 209, pl. 19, figs. 4a-c, 5, 6a, b; pl. 32, fig. 11.
Cribrobaggina reniformis (Heron-Allen and Earland) – VÉNEC-PEYRÉ 1993, p. 72, pl. 3, figs. 1-7. – LOBEGEIER 2001, p. 303, pl. 18, figs. 1-9. – PARKER 2009, p. 546, fig. 388a-k. – DEBENAY 2012, p. 235, 307.

Occurrence: Quirimbas (Heron-Allen and Earland 1915), Socorro Island (McCulloch 1977), Western Australia (Haig 1997, Parker 2009), Ecuador (McCulloch 1977), Xisha Islands (Cheng and Zheng 1978), French Polynesia (Vénec-Peyré 1993), Great Barrier Reef (Lobegeier 2001), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

Rugidia Heron-Allen and Earland 1928

Rugidia? sp. 1
Plate 43, figures 27-29

Genus 3 sp. 1 (juvenile) PARKER 2009, p. 762, fig. 533a-h.

Remarks: For details on the morphology of this species see description and remarks in Parker (2009).

Occurrence: Ningaloo Reef (Parker 2009).

PLATE 18
Scale bar is 100 µm unless otherwise indicated.

1-6 *Miliolinella webbiana* (1-3: U16; 4-6: B14).

7-15 *Miliolinella undina* (7-9: MR18, 10-12: N18, 13-15: U16).

16-18 *Miliolinella* cf. *M. semicostata* (W07*).

19-24 *Miliolinella oceanica* (19-21: B14; 22-24: FW).

25-30 *Sigmamiliolinella australis* (25-27: MS03; 28-30: MR18).


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***Rugidia*? sp. 2**
Plate 43, figures 24-26

Description: Test small, globose, low trochospiral, periphery rounded; about seven to eight slightly inflated chambers; two whorls visible on the spiral side; sutures of the later chambers depressed and distinct, on the spiral side partially bridged by pillar-like projections; wall coarsely perforate on both sides; aperture a simple rounded opening on the umbilical side.

Remarks: The generic assignment remains uncertain and is in need of further study.

Valvulineria Cushman 1926

***Valvulineria*? sp.**
Plate 37, figures 16-18

Description: Test low-trochospiral, two to two and a half coils, periphery rounded, lobulate; chambers inflated, six chambers in the final coil, gradually increasing in size; sutures depressed, curved backwards; aperture umbilical, deep umbilicus covered with a large linguiform folium; wall finely perforated, including the early chambers.

Remarks: The specimens do not show the apertural features designated for the genus *Valvulineria* (see Loeblich and Tappan 1987, p. 547, pl. 593, figs. 12-17) and the generic assignment is uncertain. Our species resembles *Valvulineria* sp. 1 of Parker (2009; p. 754, fig. 530a-e) but differs in the apertural features and in having a finer and denser perforation that also covers the early chambers. It also resembles *Valvulineria candeiana* (d'Orbigny) of Debenay (2012; p. 214, 307) but differs in perforation, apertural features, and in having a more rounded periphery.

Family EPONIDIDAE Hofker 1951
Subfamily EPONIDINAE Hofker 1951
Eponides de Montfort 1808

Eponides repandus (Fichtel and Moll 1798)
Plate 40, figures 1-11

Nautilus repandus FICHTEL and MOLL 1798, p. 35, pl. 3, figs. a-d.
Eponides repandus (Fichtel and Moll) – MONTFORT 1808, p. 127, fig. 126. – HOTTINGER, HALICZ and REISS 1993, p. 106-107, pl. 137, figs. 1-10. – LOEBLICH and TAPPAN 1994, p. 136, pl. 268, figs. 10-13. – PARKER 2009, p. 603, fig. 429a-f. – DEBENAY 2012, p. 196, 307. – THISSEN and LANGER 2017, p. 50, pl. 14, figs. 19-23.
Eponides repandus Fitchel and Moll – FAJEMILA, LANGER and LIPPS 2015, fig. 2: 16.
Eponides repandus Fichtel and Moll – LANGER, MOUANGA and FAJEMILA 2016, p. 76, pl. 2: 14-16.

Remarks: The specimens in the material from Raja Ampat reveal some morphological variability.

Occurrence: Mediterranean (Fichtel and Moll 1798), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Moorea (Fajemila, Langer and Lipps 2015), Gabon (Langer, Mouanga and Fajemila 2016), Zanzibar (Thissen and Langer 2017), Madang, Papua New Guinea (Langer unpubl. data).

Poroeponides Cushman 1944

Poroeponides lateralis (Terquem 1878)
Plate 40, figures 12-14

Rosalina lateralis TERQUEM 1878, p. 25, pl. 2, figs. 11a-c.
Poroeponides lateralis (Terquem) – CUSHMAN 1944, p. 34, pl. 4, figs. 23a, b. – HOTTINGER, HALICZ and REISS 1991, p. 63, pl. 4, figs. 1-10, pl. 5, figs. 1-11. – MAKLED and LANGER 2011, p. 248, fig. 9: 5, 6. – DEBENAY 2012, p. 210, 308.

Occurrence: Rhodes, Greece (Terquem 1878), New England (Cushman 1944), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), Caroline Islands (Makled and Langer 2011), New Caledonia (Debenay 2012), Madang, Papua New Guinea (Langer unpubl. data).

Family PEGIDIIDAE Heron-Allen and Earland 1928
Pegidia Heron-Allen and Earland 1928

Pegidia dubia (d'Orbigny in Fornasini 1908)
Plate 44, figures 13-15

Rotalia dubia D'ORBIGNY 1826, p. 274. – FORNASINI 1908, p. 46, pl. 1, fig. 14.
Pegidia dubia d'Orbigny – TODD 1957, p. 290, pl. 93, fig. 11.
Pegidia lacunata – MCCULLOCH 1977, p. 347, pl. 154, figs. 2a-c. – HOTTINGER, HALICZ and REISS 1993, p. 108, pl. 139, figs. 7-9; pl.

PLATE 19
Scale bar is 100 µm unless otherwise indicated.

1-3 *Miliolinella subrotunda* (B15).

4-6 *Miliolinella* sp. 4 (W08).

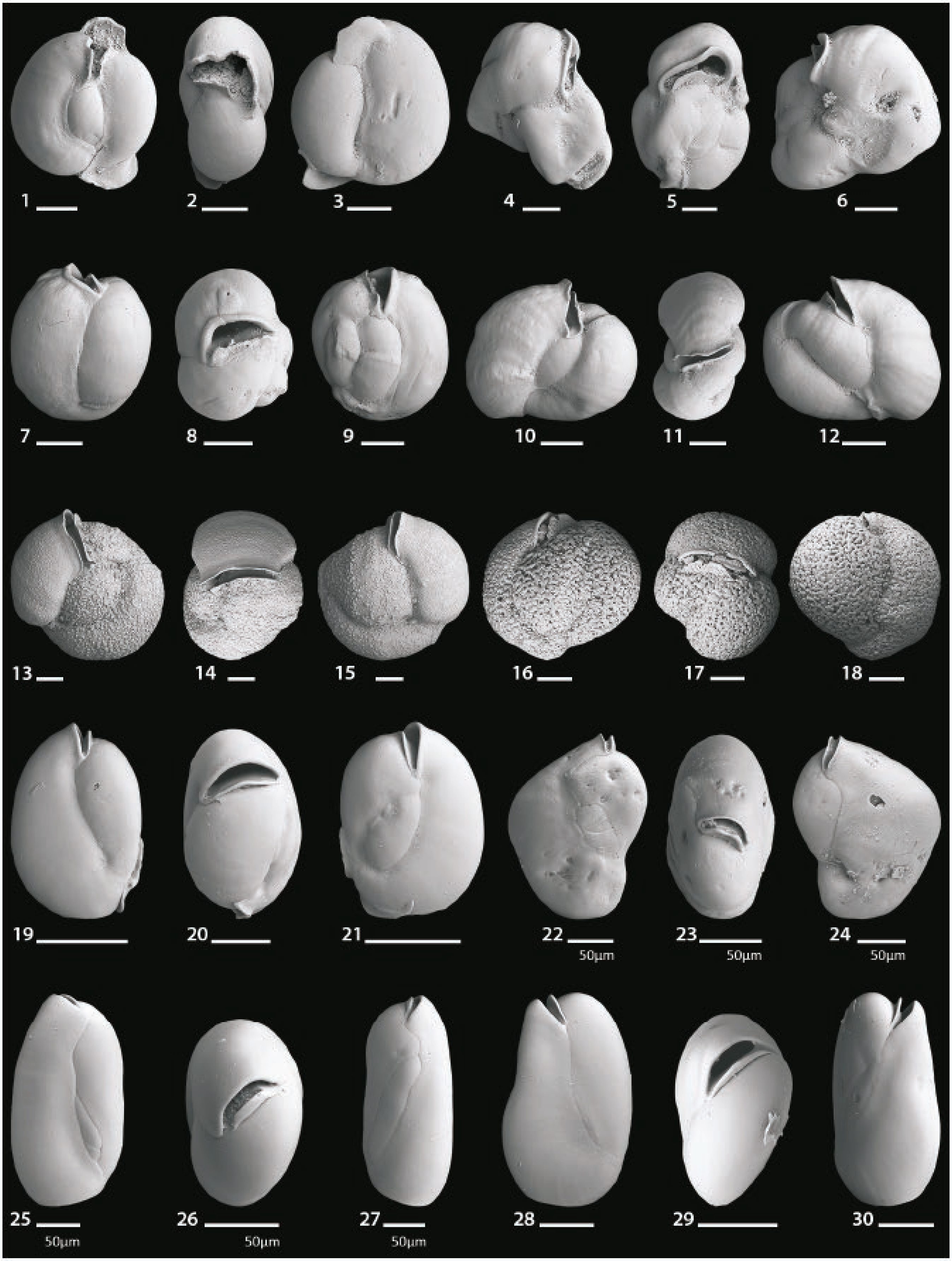
7-12 *Miliolinella* sp. 7 (ER23).

13-18 *Miliolinella* sp. 12. (13-15: U01; 16-18: AP10).

19-21 *Miliolinella* sp. 2 (MG).

22-24 *Miliolinella* sp. 11 (FW).

25-30 *Miliolinella* sp. 8 (25-27: CM; 28-30: U01).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140, figs. 1-5. – LOEBLICH and TAPPAN 1994, p. 137, pl. 274, figs. 10-12. – DEBENAY 2012, p. 245, 308.
Pegidia dubia (d'Orbigny) – CHENG and ZHENG 1979, p. 175, pl. 22, figs. 5a-c, 6a-c. – HATTA and UJIIÉ 1992, p. 181, pl. 31, fig. 2a-c (not fig. 3). – LOEBLICH and TAPPAN 1994, p. 137, pl. 275, figs. 1-6. – LANGER and LIPPS 2003, p. 152, fig. 7 D: d.

Occurrence: Mauritius (Fornasini 1908), Mariana Islands (Todd 1957), Philippines (McCulloch 1977), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), Timor Sea (Loeblich and Tappan 1994), New Caledonia (Debenay 2012), Xisha Islands (Cheng and Zheng 1979), Ryukyus (Hatta and Ujiié 1992), Madang, Papua New Guinea (Langer and Lipps 2003).

Sphaeridia Heron-Allen and Earland 1928

Sphaeridia papillata Heron-Allen and Earland 1928
Plate 44, figures 16-18

Sphaeridia papillata HERON-ALLEN and EARLAND 1928, p. 294, pl. 2, figs. 27-33; pl. 3, figs. 34-37. – TODD 1957, p. 290, pl. 93, fig. 12. – CHENG and ZHENG 1979, p. 176, pl. 23, fig. 1a-c. – HATTA and UJIIÉ 1992, p. 181, pl. 31, fig. 3, not figs. 2a-c. – HOTTINGER, HALICZ and REISS 1993, p. 108, pl. 140, figs. 6-10. – DEBENAY 2012, p. 161, 308.

Occurrence: Mariana Islands (Todd 1957), Xisha Islands (Cheng and Zheng 1979), Ryukyus (Hatta and Ujiié 1992), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), New Caledonia (Debenay 2012).

Family DISCORBIDAE Ehrenberg 1838
Orbitina Sellier de Civrieux 1977

Orbitina carinata Sellier de Civrieux 1977
Plate 37, figures 25-27

Orbitina carinata SELLIER DE CIVRIEUX 1977, p. 29, pl. 18, figs. 3-10. – LOEBLICH and TAPPAN 1994, p. 137, pl. 275, figs. 7-12. – DEBENAY 2012, p. 205, 309.
Orbitina cf. *O. parri* Collins – PARKER 2009, p. 678, figs. 477a-i, 478a-j.

Occurrence: Caribbean (Sellier de Civrieux 1977), Timor Sea (Loeblich and Tappan 1994), New Caledonia (Debenay 2012), Ningaloo Reef (Parker 2009).

Orbitina exquisita? (McCulloch 1977)
Plate 37, figures 28-30

? *Orbitina exquisita* (McCulloch) – LOEBLICH and TAPPAN 1994, p. 137, pl. 276, figs. 1-13.

Remarks: A very similar species occurs in southern Africa (Langer unpubl. data).

Occurrence: ? Timor Sea (Loeblich and Tappan 1994).

Orbitina taguscovensis (McCulloch 1977)
Plate 37, figures 22-24

Crouchina taguscovensis MCCULLOCH 1977, p. 296, pl. 121, figs. 13-15.
Orbitina taguscovensis (McCulloch) – LOEBLICH and TAPPAN 1988, p. 558, pl. 603, figs. 12-14 (not figs. 15-17).

Occurrence: Galapagos (McCulloch 1977).

Rotorbinella Bandy 1944

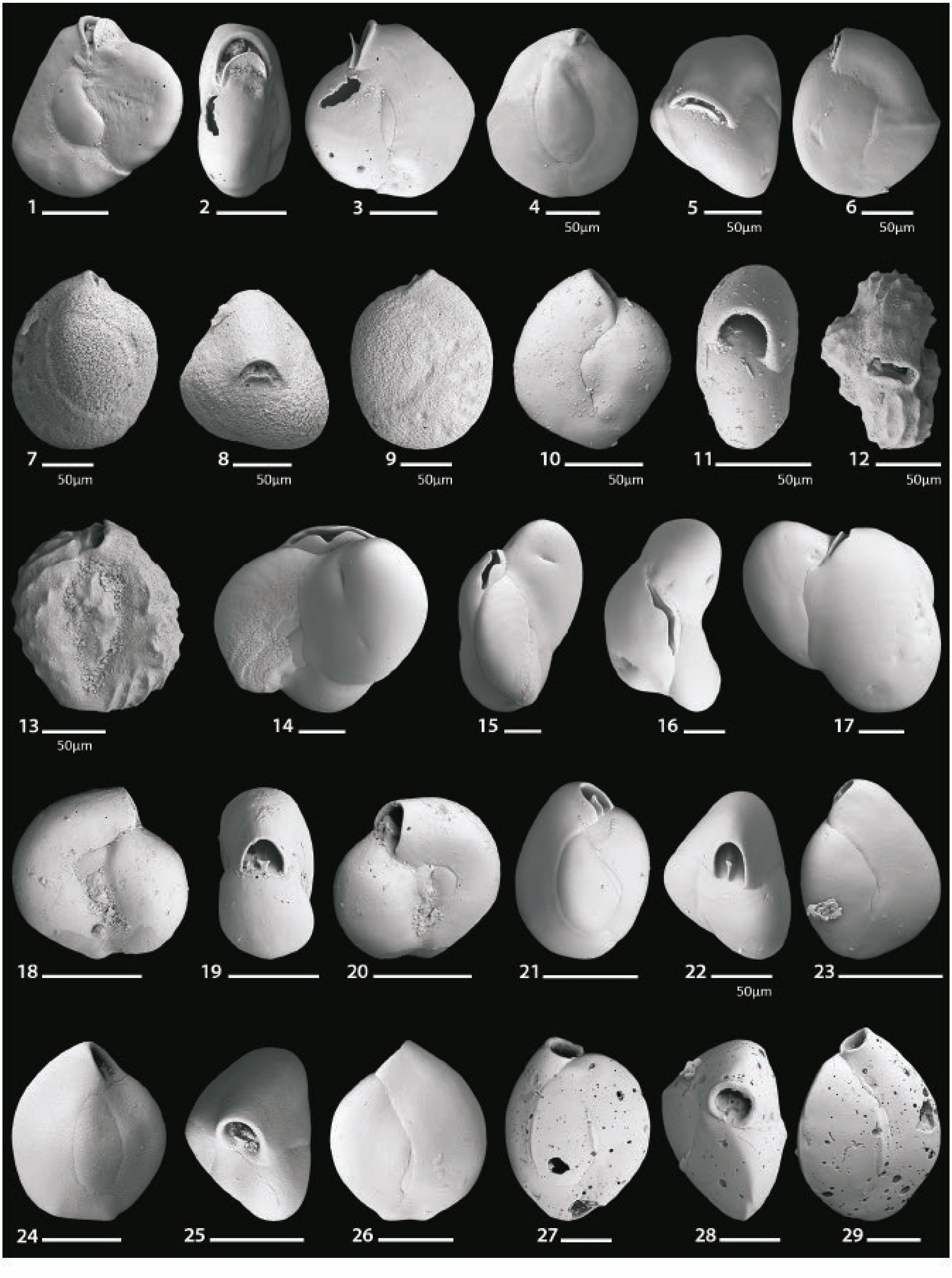
Rotorbinella lepida McCulloch 1977
Plate 44, figures 4-6

Rotorbinella lepida MCCULLOCH 1977, p. 360, pl. 116, fig. 4. – DEBENAY 2012, p. 212, 309.
Rotorbinella cf. *R. lepida* McCulloch – HOTTINGER, HALICZ and REISS 1993, p. 108, pl. 141, figs. 1-7.

Remarks: Parker (2009; p. 727, figs. 511a-h, 512a-j) depicts similar specimens but the perforations on their spiral side are more pronounced.

PLATE 20
Scale bar is 100 µm unless otherwise indicated.

1-3 *Miliolinella* sp. 3 (U16).
4-6 *Miliolinella*? sp. 6 (B14).
7-9 *Miliolinella*? sp. 10 (B15).
10, 11 *Miliolinella*? sp. 15 (U16).
12, 13 *Miliolinella*? sp. 14 (U16).
14-17 *Miliolinella*? sp. 5 (FW).
18-20 *Quinqueloculina*? sp. 1 (U16).
21-23 *Quinqueloculina* sp. 18 (AP10).
24-26 *Quinqueloculina* sp. 14 (ER23*).
27-29 *Quinqueloculina* sp. 13 (Ms).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Occurrence: Philippines (McCulloch 1977), New Caledonia (Debenay 2012), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993).

Rotorbis Sellier de Civrieux 1977

***Rotorbis*? sp.**
Plate 44, figures 7-12

Trochulina sp. A LANGER et al. 2013, p. 167, figs. 7: 41, 42.

Description: Test low trochospiral, spiral side convex, umbilical side flattened, periphery with a slightly rounded keel; chambers crescentic, gradually increasing in size; sutures slightly depressed on the spiral side, deeply depressed on the umbilical side, curved backwards; test smooth, wall coarsely perforate at the outer margins of the chambers on both sides; aperture an umbilical-extraumbilical narrow slit partially covered with a triangular flap-like wall extension of the final chamber.

Occurrence: Bazaruto (Langer et al. 2013).

Family ROSALINIDAE Reiss 1963
Neoconorbina Hofker 1951

Neoconorbina* cf. *N. albida McCulloch 1977
Plate 38, figures 21-23

cf. *Neoconorbina albida* MCCULLOCH 1977, p. 353, pl. 122, fig. 8.

Occurrence: *Neoconorbina albida* was originally described from the Philippines.

Neoconorbina crustata (Cushman 1933)
Plate 38, figures 12-14

Discorbis crustata CUSHMAN 1933, p. 88, pl. 9, fig. 4.
Neoconorbina crustata (Cushman) – TODD 1965, p. 15, pl. 2, figs. 2, 3.
Rosalina crustata (Cushman) – CHENG and ZHENG 1979, p. 164, pl. 17, fig. 5a-c.

Occurrence: Fiji (Cushman 1933, Todd 1965), Xisha Islands (Cheng and Zheng 1979).

Neoconorbina petasiformis (Cheng and Zheng 1978)
Plate 38, figures 1-3

Rosalina petasiformis CHENG and ZHENG 1978, p. 211, 260, pl. 19, figs. 9, 10; pl. 32, fig. 6. – HATTA and UJIIÉ 1992, p. 183, pl. 33, figs. 1,2.
Neoconorbina petasiformis (Cheng and Zheng) – LOEBLICH and TAPPAN 1994, p. 139, pl. 284, figs. 1-12.

Occurrence: Xisha Islands (Cheng and Zheng 1978), Ryukyus (Hatta and Ujiié 1992), Timor Sea (Loeblich and Tappan 1994).

Neoconorbina terquemi Rzehak 1888
Plate 38, figures 15-17

Discorbina terquemi RZEHAK 1888, p. 228.
Discorbis orbicularis (Terquem) – SAID 1949, p. 35, pl. 3, fig. 35.
Neoconorbina terquemi (Rzehak) – LOEBLICH and TAPPAN 1964, p. 582, figs. 457; 5a-c. – VAN MARLE 1989, p. 67, pl. 1, figs. 8, 9. – CIMERMAN and LANGER 1991, p. 66, pl. 70, figs. 5-7. – LOEBLICH and TAPPAN 1994, p. 139, pl. 284, figs. 1-12. – DEBENAY 2012, p. 310, not figured.
Rosalina terquemi (Rzehak) – CHENG and ZHENG 1979, p. 165, pl. 18, fig. 7a-c.

Occurrence: Red Sea (Said 1949), Xisha Islands (Cheng and Zheng 1979), Indonesia (van Marle 1989), Mediterranean (Cimerman and Langer 1991), Sahul Shelf (Loeblich and Tappan 1994), New Caledonia (Debenay 2012), Madang, Papua New Guinea (Langer unpubl. data).

PLATE 21
Scale bar is 100 µm unless otherwise indicated.

1-9 *Quinqueloculina seminulum* (1-6: MI05; 7-9: ER23*).

10-15 *Quinqueloculina* cf. *Q. patagonica* (10-12: Y24; 13-15: W08).

16-18 *Quinqueloculina vandiemeniensis* (N18).

19-24 *Quinqueloculina "lizardi"* (16-21: Ms; 22-24: MR18).

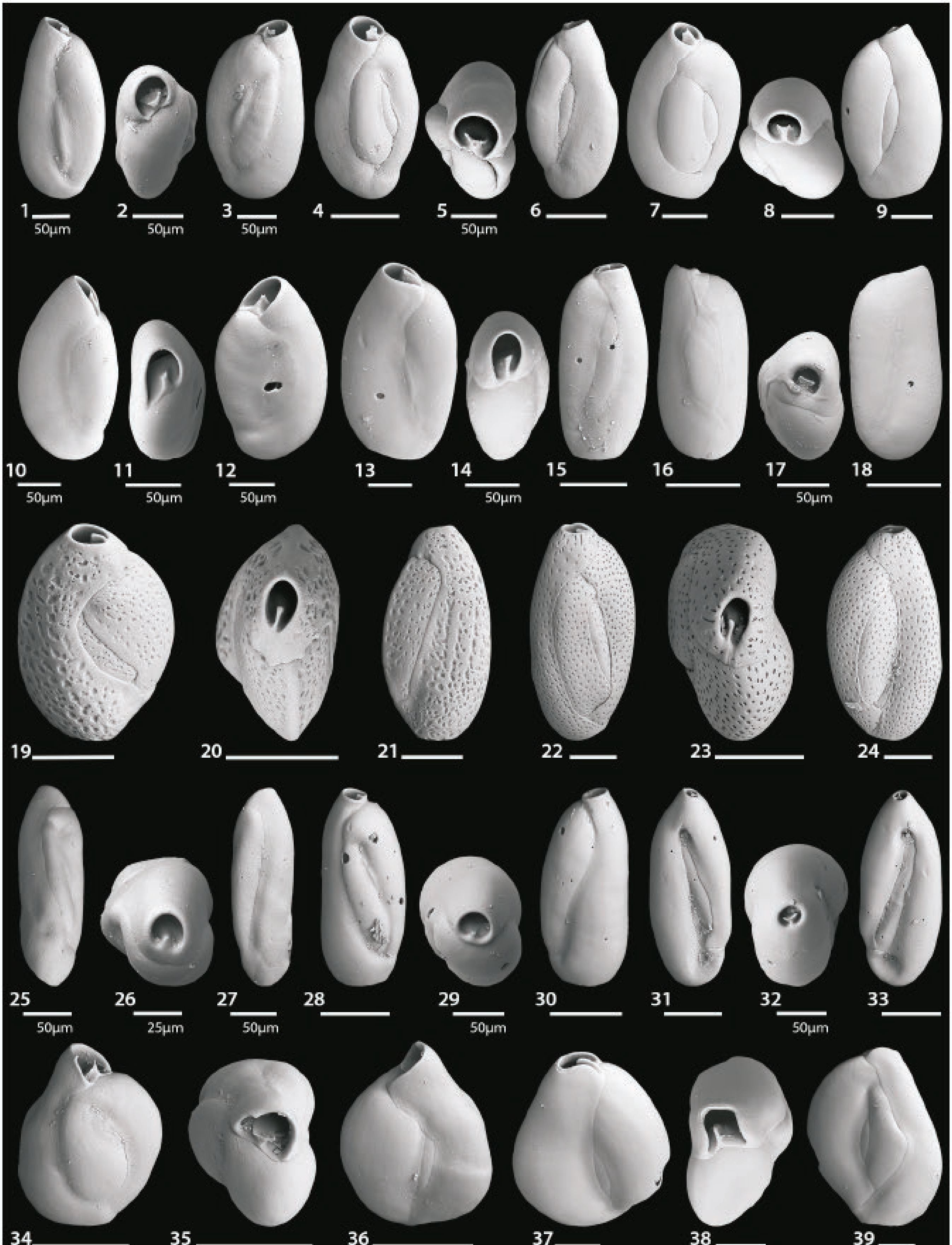
25-27 *Quinqueloculina* sp. 2 (U16).

28-30 *Quinqueloculina* cf. *Q. exsculpta* (U16).

31-33 *Quinqueloculina* sp. 9 (MR18).

34-36 *Quinqueloculina* sp. 6 (W07).

37-39 *Quinqueloculina* sp. 3 (MS03).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***Neoconorbina* sp. 1**
Plate 38, figures 18-20

Description: Test low trochospiral, conical, planoconvex, circular in outline, periphery rounded, lobulate; umbilical side flat to slightly concave with a depressed umbilicus; four chambers in the final whorl, last formed chamber covering about one third of the test on the umbilical side; sutures slightly depressed on the spiral side, depressed, distinct and slightly curved on the umbilical side; wall smooth, periphery of the chambers on the umbilical side ornamented with coarse pores; aperture a low opening at the basal edge of the final chamber, covered with an umbilical flap.

***Neoconorbina* sp. 2**
Plate 38, figures 6-11

Description: Test low trochospiral, concavoconvex, subcircular in outline, periphery acute, lobulate; umbilical side slightly concave with a deep open umbilicus; four chambers in the final whorl, chambers crescentic on the spiral side, gradually increasing in size; sutures depressed, distinct; wall covered with minute granules on the spiral side, smooth on the umbilical side, spiral side covered with coarse pores, umbilical side partially covered with coarse pores; aperture a low opening at the basal edge of the final chamber, covered with an umbilical flap.

***Neoconorbina*? sp. 3**
Plate 38, figures 4, 5

Description: Test trochospiral, conical, planoconvex, circular in outline, periphery rounded with an everted thick rim; umbilical side flat, spiral side convex, balloon-like appearance; number of chambers undeterminable from SEM pictures; sutures indistinct; wall smooth; aperture on the umbilical side, covered with a petasiform to "brain convolution"-like ornamentation that is encircled by patches of coarse pores.

Remarks: This species resembles *Neoconorbina petasiformis* (Cheng and Zheng) but differs in the very pronounced and unique ornamentation on the umbilical side.

***Neoconorbina*? sp. 4**
Plate 38, figures 24-26

Description: Test low trochospiral, low conical, planoconvex, circular in outline, periphery acute; spiral side convex, umbilical side flattened; number of chambers undeterminable from SEM pictures; sutures indistinct; surface on the spiral side covered with fine and scattered coarse pores; aperture an umbilical-extraumbilical slit.

Remarks: The specimen is poorly preserved. The generic assignment requires further study. The species may possibly belong in the genus *Orbitina* Sellier de Civrieux.

***Neoconorbina*? sp. 5**
Plate 38, figures 27-29

Description: Test trochospiral, conical, planoconvex, circular in outline, periphery acute; umbilical side flat to concave with a deep open umbilicus; spiral side convex, balloon-like appearance; chambers broad and crescentic on the spiral side, about two chambers per whorl; sutures thickened on the spiral side; wall smooth with coarse pores along the sutures on the spiral side; aperture umbilical, a low opening at the basal edge of the final chamber, covered with an umbilical flap.

***Neoconorbina*? sp. 6**
Plate 39, figures 1-3

Description: Test low trochospiral, conical, planoconvex, umbilical side slightly flattened, spiral side convex, subcircular in outline, peripheral margin acute, with a rounded carina; umbilicus closed; chambers crescentic; sutures of the later chambers slightly limbate on both sides of the test; wall with irregular surface on both sides, umbilical side ornamented with coarse pores in a petasiform arrangement in between the sutures; aperture an arch-shaped umbilical opening.

PLATE 22
Scale bar is 100 µm unless otherwise indicated.

1-18 *Quinqueloculina* sp. 16 (1-3: B15; 4-6: U16; 7-9: Y25; 10-12: AW13; 13-15: ER23*; 16-18: W07).

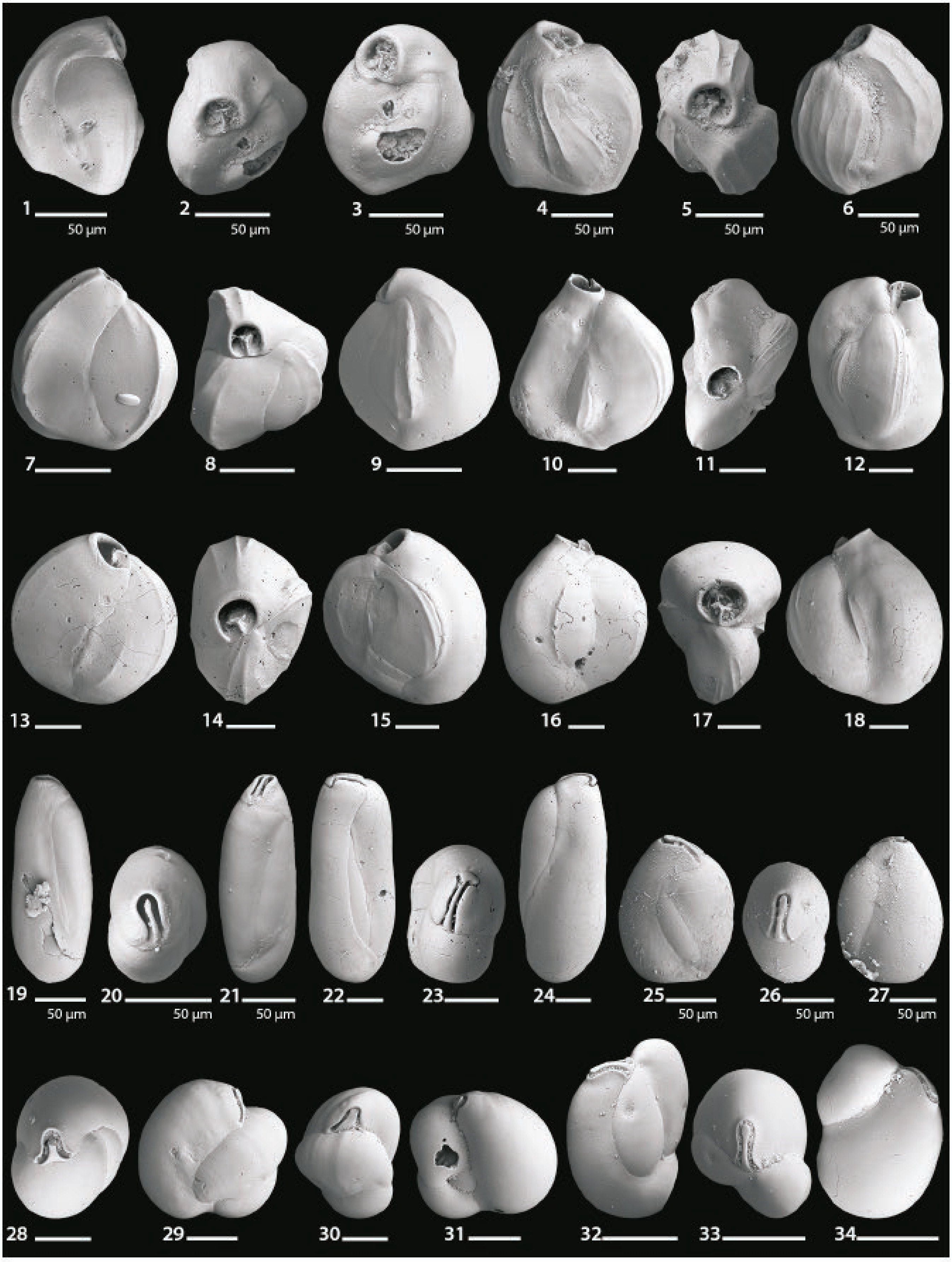
19-21 *Pseudolachlanella*? sp. (AW12).

22-24 *Pseudolachlanella* cf. *P. slitella* (MR17).

25-28 *Pseudolachlanella eburnea* (25-27: B14; 28: U16).

29-31 *Quinqueloculina* sp. 4 (N18).

32-34 *Pseudolachlanella* cf. *P. eburnea* (W08).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Remarks: This species is represented by a single specimen and was picked from the same sample (MS04) as the solitary specimen of *Eoeponidella pulchella* (Parker). The umbilical side shows features that also resemble *Eoeponidella* Wickenden. The generic assignment requires further study (see also remarks in Parker 2009; p. 668 for *Neoconorbina* sp. 1).

Rosalina d'Orbigny 1826

Rosalina globularis d'Orbigny 1826
Plate 36, figures 28-30

Rosalina globularis D'ORBIGNY 1826, p. 271, pl. 13, figs. 1-4. – LOEBLICH and TAPPAN 1994, p. 140, pl. 286, figs. 10-12 (not figs. 7-9, 13-18). – PARKER 2009, p. 718, fig. 504a-l. – DEBENAY 2012, p. 211, 310.

Occurrence: Bay of Biscay (d'Orbigny 1826), Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

***Rosalina orientalis*? ** (Cushman 1925)
Plate 36, figures 19-24

Rosalina globularis (d'Orbigny) toothed variety HERON-ALLEN and EARLAND 1915, p. 694, pl. 51, figs. 36, 37 (not 38, 39).
? *Discorbis orientalis* CUSHMAN 1925, p. 130, not figured.
Rosalina orientalis (Cushman) – BACCAERT 1987, p. 201, pl. 79, figs. 5, 6. – HOTTINGER, HALICZ and REISS 1993, p. 111, p. 143, figs. 1-3; pl. 144, figs. 1, 2.

Remarks: This species has particularly thickened and unornamented sutures. For a reliable specific assignment, the examination of the material of Cushman is required.

Occurrence: Quirimbas (Heron-Allen and Earland 1915), ? central Pacific Ocean (Cushman 1925), Great Barrier Reef (Baccaert 1987), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), Madang, Papua New Guinea (Langer unpubl. data).

Rosalina* aff. *R. orientalis (Cushman 1925)
Plate 36, figures 25-27

aff. *Discorbis orientalis* CUSHMAN 1925, p. 130, not figured.
aff. *Rosalina orientalis* (Cushman) – HOTTINGER, HALICZ and REISS 1993, p. 111, p. 143, figs. 1-3; pl. 144, figs. 1, 2.

Remarks: This species mainly differs from *Rosalina orientalis* reported by Hottinger, Halicz and Reiss 1993 from the Gulf of Aqaba in its more compressed test shape, the finer perforations, and the more thickened sutures.

Occurrence: *Rosalina orientalis* was originally described from the central Pacific Ocean.

***Rosalina*? sp. 1**
Plate 37, figures 1-3

Description: Test compressed, umbilical side slightly convex, spiral side slightly flattened, outline lobulate, periphery acute, with a rounded carina; two whorls visible on the spiral side; chambers increasing in size as added, about six in the final whorl; sutures curved and depressed on the spiral side, depressed and slightly curved on the umbilical side; wall smooth, finely perforate on both sides, the earliest chambers remain imperforate on the spiral side; aperture covered with folia.

***Rosalina* sp. 2**
Plate 37, figures 4-6

Rosalina cf. *R. orientalis* (Cushman) – PARKER 2009, p. 719, fig. 506a-k.

Remarks: For details on the morphology see description in Parker (2009).

Occurrence: Ningaloo Reef (Parker 2009), Madang, Papua New Guinea (Langer unpubl. data).

***Rosalina* sp. 3**
Plate 37, figures 7-9

Description: Test compressed, concavo-convex, outline slightly lobulate, periphery rounded; two whorls visible on the spiral side; chambers inflated, increasing gradually in size as added, about seven in the final whorl; sutures nearly radial, slightly curved and depressed on the spiral side, deeply depressed on the umbilical side; wall smooth, coarsely perforate on both sides,

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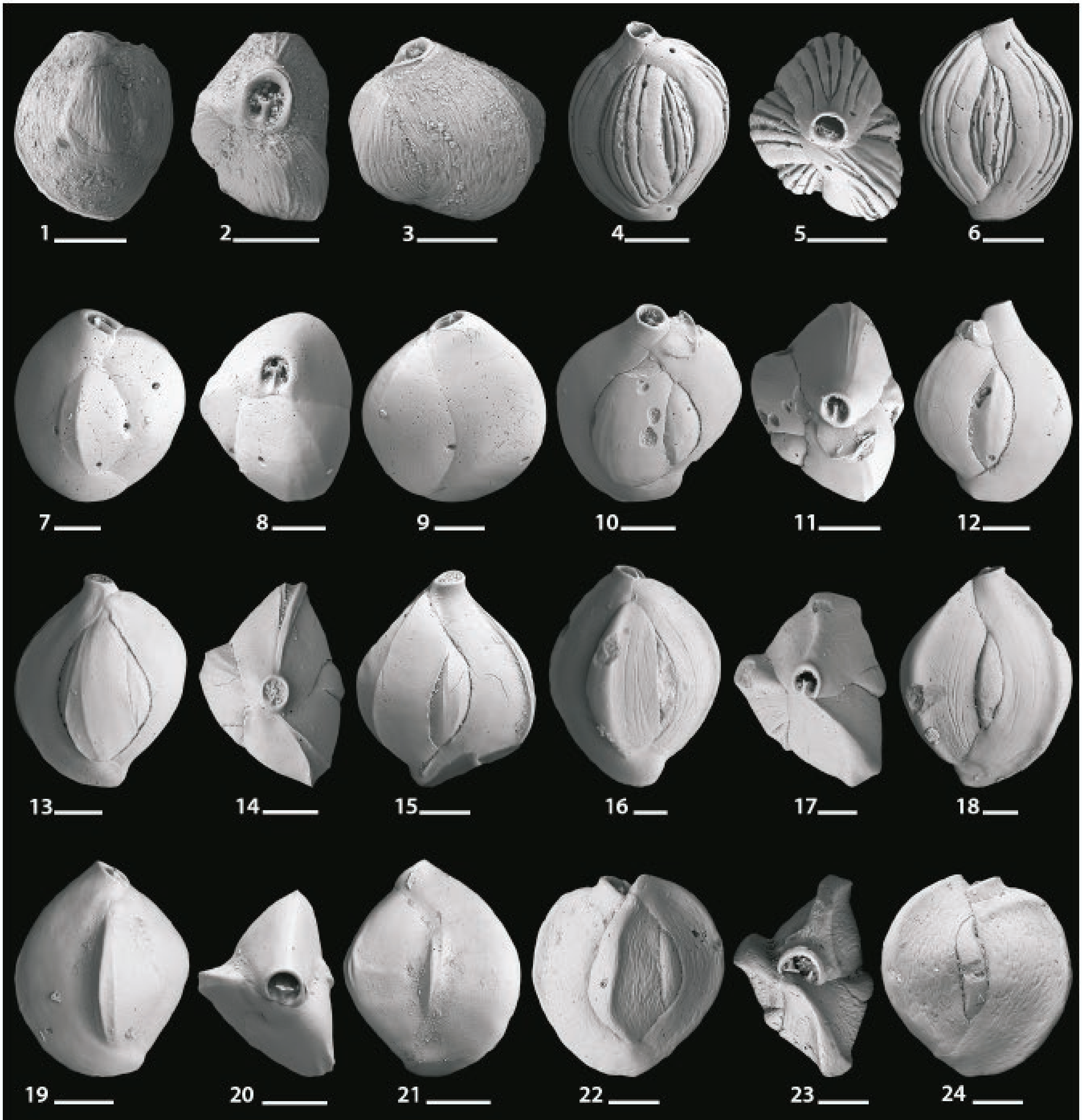
PLATE 23

1-3 *Quinqueloculina cuvieriana* (W08).
4-6 *Quinqueloculina crassa* (MG).
7-9 *Quinqueloculina* sp. 15 (MR17).
10-15 *Quinqueloculina* cf. *Q. bicarinata* (B14).
16-18 *Quinqueloculina* cf. *Q. cuvieriana* Type 1 (N19).
19-21 *Quinqueloculina bicarinata* (AP10).
22-24 *Quinqueloculina* cf. *Q. cuveriana* Type 2 (N18).
25-27 *Lachlanella barnardi* (N18).
28-30 *Quinqueloculina* cf. *Q. multimarginata* (B14).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the earlier chambers remain imperforate on the spiral side, test on the spiral side ornamented with scattered granules that are more pronounced on the later chambers; aperture partially covered by folia.

Remarks: The precise apertural features of the depicted specimen remain indeterminable as they are covered by shell fragments.

***Rosalina*? sp. 4**
Plate 37, figures 10-12

Description: Test compressed, umbilical side convex and involute, spiral side flattened and partially involute, outline lobulate, periphery acute, with a rounded carina; two whorls visible on the spiral side; chambers become inflated and increase in size as added, about six in the final whorl; sutures curved and depressed on the spiral side, curved and deeply depressed on the umbilical side; wall smooth, perforate on both sides; the earlier chambers and inner parts of the later chambers remain imperforate on the spiral side; aperture interiomarginal-extraumbilical bordered by a thin lip on the upper margin.

Remarks: The specimen is broken. This species strongly resembles *Rosalina*? sp. 3 of Parker (2009, Ningaloo Reef, p. 723, fig. 508a-e) but is less porous on the spiral side.

***Rosalina*? sp. 5**
Plate 37, figures 13-15

Description: Test strongly concavo-convex, outline slightly lobulate, periphery subacute; two whorls visible on the spiral side; chambers inflated, increasing rapidly in size as added, five to six in the final whorl; sutures strongly curved, depressed; wall smooth, coarsely perforate on both sides, the earlier chambers remain imperforate on the spiral side; aperture interiomarginal-extraumbilical.

Tretomphaloides Banner, Pereira and Desai 1985

***Tretomphaloides clarus*?** (Cushman 1934)
Plate 44, figures 1-3

? *Tretomphalus clarus* CUSHMAN 1934, p. 99, pl. 11, figs. 6a-c, pl. 12, figs. 16, 17.
? *Tretomphaloides clara* (Cushman) – HOTTINGER, HALICZ and REISS 1993, p. 112, pl. 145, figs. 6-11.

Remarks: The preservation of the specimen is poor and precludes a definitive species indentification.

Occurrence: ?Gulf of Aqaba (Hottinger, Halicz and Reiss 1993).

Superfamily GLABRATELLOIDEA Loeblich and Tappan 1964
Family GLABRATELLIDAE Loeblich and Tappan 1964
Angulodiscorbis Uchio 1953

Angulodiscorbis tobagoensis McCulloch 1981
Plate 48, figures 33, 34

Angulodiscorbis (?) *tobagoensis* MCCULLOCH 1981, Tobago, p. 145, pl. 49, figs. 19, 20.
Angulodiscorbis tobagoensis McCulloch – DEBENAY 2012, New Caledonia, p. 186, 311.

Occurrence: Tobago (McCulloch 1981), New Caledonia (Debenay 2012).

Glabratella Dorreen 1948

Glabratella socorroensis (McCulloch 1977)
Plate 48, figures 24-26

Earltheeia socorroensis MCCULLOCH 1977, p. 302, pl. 114, figs. 17a-c.
Glabratella socorroensis (McCulloch) – PARKER 2009, p. 612, fig. 434b, 435a-f.

Occurrence: Socorro Island (McCulloch 1977), Ningaloo Reef (Parker 2009).

PLATE 24
Scale bar is 100 µm unless otherwise indicated.

1-3 *Quinqueloculina* cf. *Q. carinatastriata* (B15).

4-6 *Quinqueloculina carinatastriata* (MS04).

7-9 *Quinqueloculina* cf. *Q. chathamensis* (MS04).

10-12 *Adelosina litoralis* (U16).

13-15 *Quinqueloculina zhengi* (B15).

16-18 *Quinqueloculina* cf. *Q. bradyana* (Y24).

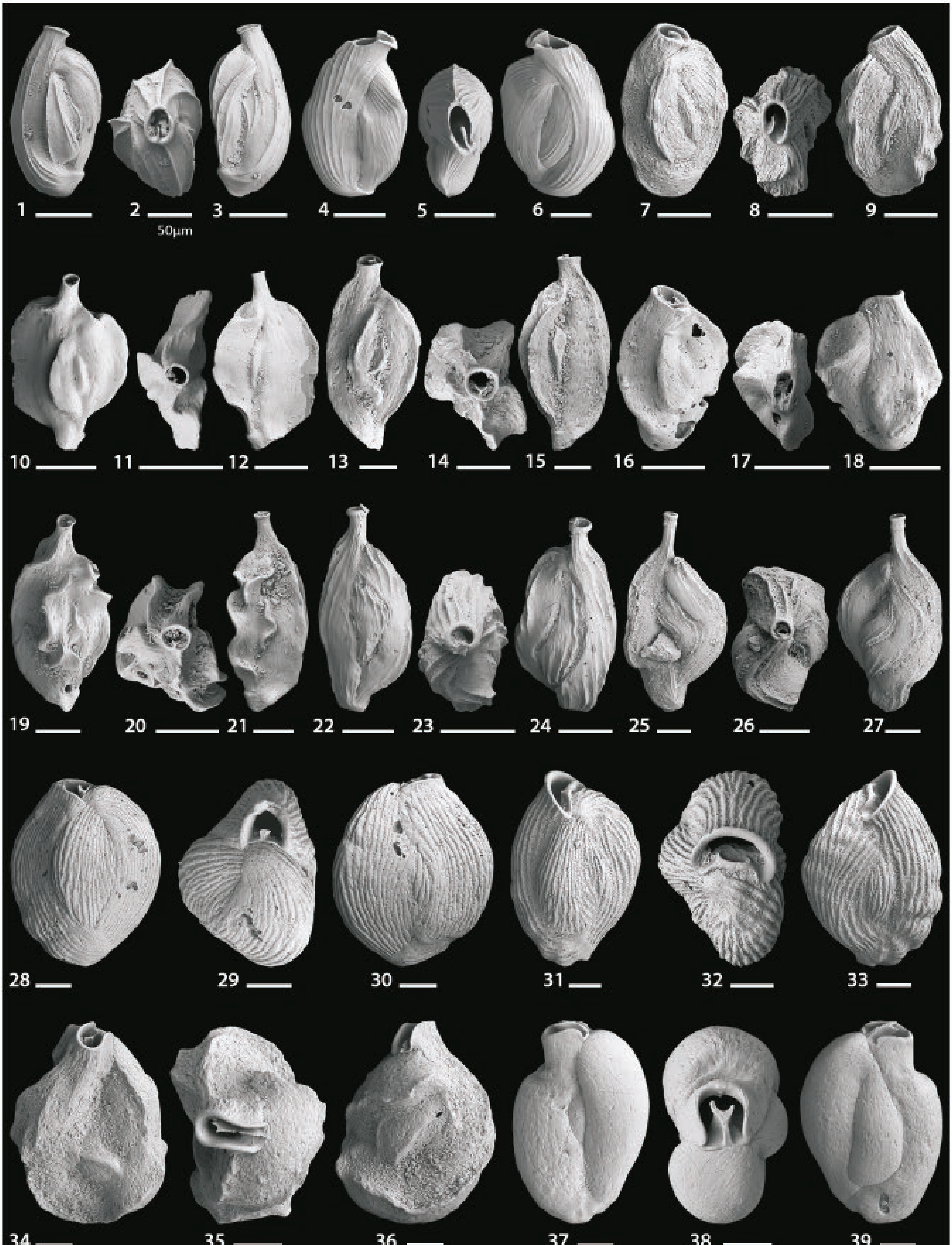
19-21 *Cycloforina* sp. (N18)

22-27 *Sigmoilinella tortuosa* (22-24: MR18; 25-27: U16).

28-33 *Quinqueloculina neostriatula* (28-30: Ms; 31-33: MR17).

34-36 *Lachlanella* cf. *L. spiralis* (ER23*).

37-39 *Quinqueloculina* cf. *Q. subgranulata* (MI06)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***Glabratella* sp.**
Plate 48, figures 21-23

Description: Test small, consisting of two whorls, concavo-convex, spiral side slightly convex, umbilical side concave; periphery lobulate, rounded; six chambers in the final whorl, inflated, gradually increasing in size; sutures depressed, distinct; wall smooth, evenly and finely perforate on both sides; aperture umbilical.

Remarks: The apertural part is broken.

Glabratellina Seiglie and Bermúdez 1965

Glabratellina tabernacularis (Brady 1881)
Plate 48, figures 15, 16

Discorbina tabernacularis BRADY 1881, p. 65. – BRADY 1884, p. 648, pl. 89, figs. 5-7.
Discorbis tabernacularis (Brady) – CUSHMAN 1915, p. 18, text fig. 20; pl. 5, fig. 4.

Occurrence: Papua and Admiralty Islands (Brady 1884), North Pacific (Cushman 1915).

***Glabratellina* sp.**
Plate 48, figures 17, 18

Glabratellina tabernacularis (Brady) – DEBENAY 2012, p. 197, 312.

Remarks: For details on the morphology see description in Debenay (2012).

Occurrence: New Caledonia (Debenay 2012).

Pileolina Bermúdez 1952

***Pileolina minogasiformis*?** Ujiié 1992
Plate 48, figures 19, 20

Discorbinoides minogasiformis Ujiié in HATTA and UJIIÉ 1992, p. 185, pl. 24, figs. 2, 3.
Discorbinoides? *minogasiformis* (Ujiié) – PARKER 2009, p. 562, fig. 398a-k.
Pileolina minogasiformis Ujiié – DEBENAY 2012, p. 207, 312.

Occurrence: Ryukyu Islands (Ujiié 1992), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

Pileolina patelliformis (Brady 1884)
Plate 48, figures 10-14

Discorbina patelliformis BRADY 1884, p. 647, pl. 88, figs. 3a-c, pl 89, figs. 1a-c.
Discorbis patelliformis (Brady) – CUSHMAN 1915, p. 17, pl. 5, figs. 5a-c.
Angulodiscorbis patelliformis (Brady) – PEREIRA 1979, pl. 33, figs. N-Q, pl. 34, figs. A-D.
Glabratella (?) *patelliformis* (Brady) – BACCAERT 1987, p. 206, pl. 81, figs. 4-7, pl. 82, fig. 1.
Pileolina patelliformis (Brady) – DEBENAY 2012, p. 208, 312.

Remarks: The convolutions on the spiral side appear to be less pronounced in the specimens from Raja Ampat (compare illustrations by Brady).

Occurrence: Admiralty Islands (Brady 1884), Great Barrier Reef (Baccaert 1987), New Caledonia (Debenay 2012), Madang, Papua New Guinea (Langer unpubl. data).

Planoglabratella Seiglie and Bermúdez 1965

Planoglabratella opercularis (d'Orbigny 1826)
Plate 48, figures 30-32

Rosalina opercularis D'ORBIGNY 1826, p. 271, no. 7.
Discorbis opercularis (d'Orbigny) – CUSHMAN 1915, p. 18, text fig. 21; pl. 11, fig. 3.
Planoglabratella opercularis (d'Orbigny) – HATTA and UJIIÉ 1994, p. 15, pl. 4, figs. 2, 3. – DEBENAY 2012, p. 208, 312.

Occurrence: New Zealand (Cushman 1915), Ryukyus (Hatta and Ujiié 1992), New Caledonia (Debenay 2012).

PLATE 25

Scale bar is 100 µm unless otherwise indicated.

1-3 *Quinqueloculina schlumbergeri* (W07*).

4-6 *Quinqueloculina quinquecarinata* (MR18).

7-9 *Quinqueloculina* sp. 7 (W07).

10-12 *Lachlanella* sp. (U02).

13-15 *Quinqueloculina planata* (N19).

16-18 *Quinqueloculina* sp. 20 (Y24).

19-21 *Massilinoides baccaerti* (N18).

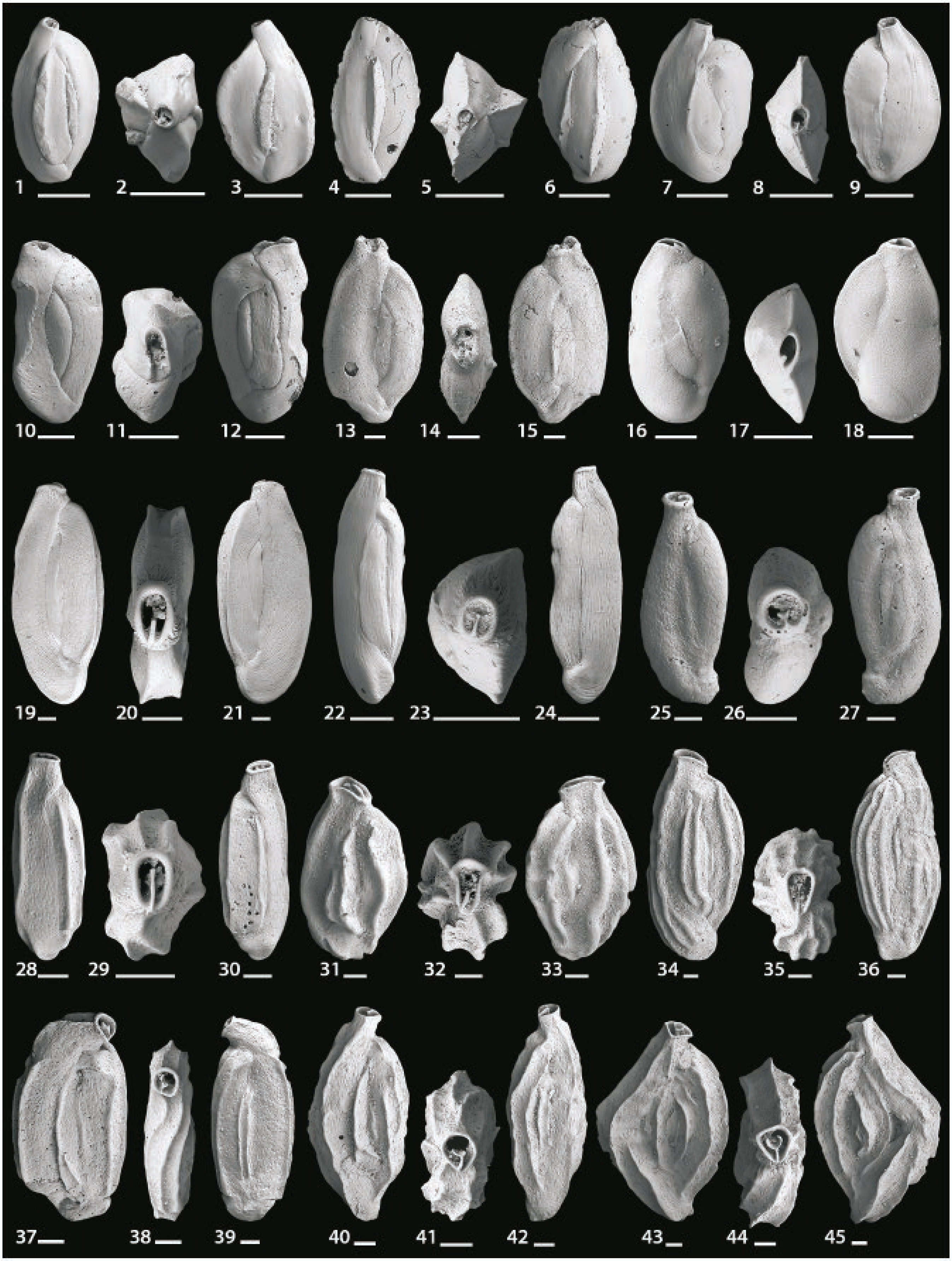
22-24 *Quinqueloculina*? sp. 10 (N18).

25-27 *Cycloforina tropicalis* (N18).

28-33 *Lachlanella subpolygona* (28-30: Ms; 31-33: MR17.

34-36 *Lachlanella rebeccae* (Y24).

37-45 *Cycloforina granulocostata* (37-39: CK; 40-42: W07*; 43-45: FW).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Family HERONALLENIIDAE Loeblich and Tappan 1986
Heronallenia Chapman and Parr 1931

Heronallenia polita Parr 1950
Plate 44, figures 27-29

Heronallenia polita PARR 1950, p. 358, pl. 14, fig. 9. – LOEBLICH and TAPPAN 1994, p. 143, pl. 296, figs. 13-18. – DEBENAY 2012, p. 198, 312.

Occurrence: Australasian Antarctic Expedition (Parr 1950), Timor Sea (Loeblich and Tappan 1994), New Caledonia (Debenay 2012).

Family BULIMINOIDIDAE Seiglie 1970
Buliminoides Cushman 1911

Buliminoides williamsonianus (Brady 1881)
Plate 48, figures 1, 2

Bulimina williamsoniana BRADY 1881, p. 56. – BRADY 1884, p. 408, pl. 51, figs. 16, 17. – MILLETT 1900, p. 279, pl. 2, fig. 8.
Buliminoides williamsoniana (Brady) – GRAHAM and MILITANTE 1959, p. 82, pl. 12, fig. 23. – SEIGLIE 1970, p. 113, text figs. 1, 2.
Buliminoides williamsonianus (Brady) – CHENG and ZHENG 1978, p. 203, pl. 18, fig. 7. – BACCAERT 1987, p. 177, pl. 72, figs. 6a, b. – HAIG 1993, p. 170, pl. 3, figs. 24, 25. – LOEBLICH and TAPPAN 1994, p. 143, pl. 297, figs. 1-9. – HAIG 1997, p. 274, not figured. – PARKER 2009, p. 440, fig. 317a-c. – DEBENAY 2012, p. 188, 312.

Occurrence: Admiralty Islands and Torres Strait (Brady 1884), Malaysian Archipelago (Millett 1900), Philippines (Graham and Militante 1959), Xisha Islands (Cheng and Zheng 1978), Great Barrier Reef (Baccaert 1987), Papuan Lagoon (Haig 1993), Timor Sea (Loeblich and Tappan 1994), Western Australia (Haig 1997, Parker 2009), New Caledonia (Debenay 2012), Madang, Papua New Guinea (Langer unpubl. data).

Elongobula Finlay 1939

Elongobula parallela (Cushman and Parker 1931)
Plate 48, figures 3-5

Buliminella parallela CUSHMAN and PARKER 1931, p. 13, pl. 3, figs. 15a-c.
Elongobula parallela (Cushman and Parker) – PARKER 2009, p. 446, fig. 322a-l. – DEBENAY 2012, p. 194, 313.

Occurrence: Rio de Janeiro, Brazil (Cushman and Parker 1931), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

Superfamily SIPHONINOIDEA Cushman 1927
Family SIPHONINIDAE Cushman 1927
Subfamily SIPHONININAE Cushman 1927
Siphonina Reuss 1850

Siphonina tubulosa Cushman 1924
Plate 43, figures 18-20

Siphonina tubulosa CUSHMAN 1924, p. 40, pl. 13, figs. 1, 2. – COLLINS 1958, p. 413. – BACCAERT 1987, p. 211, pl. 83, figs. 2-4. – HATTA and UJIIÉ 1992, p. 186, pl. 35, figs. 1, 2. – LOEBLICH and TAPPAN 1994, p. 144, pl. 299, figs. 1-10. – PARKER 2009, p. 731, fig. 515a-i. – DEBENAY 2012, p. 213, 313. – THISSEN and LANGER 2017, p. 4, pl. 16, figs. 4-6.
Siphonina reticulata (Brady) – HOFKER 1951, p. 369, fig. 251.

Remarks: Hofker (1951) erroneously assigns this species to Brady, as he refers to Czjek as the author in the remarks. According to Hofker, the Miocene *Siphonina reticulata* is identical with the three recent forms *S. tubulosa*, *S. philippinensis* and *S. bradyana* erected by Cushman.

Occurrence: Samoa (Cushman 1924), Raja Ampat (Hofker 1951), Great Barrier Reef (Collins 1958, Baccaert 1987), Ryukyus (Hatta and Ujiié 1992), Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Zanzibar (Thissen and Langer 2017), Madang, Papua New Guinea (Langer unpubl. data).

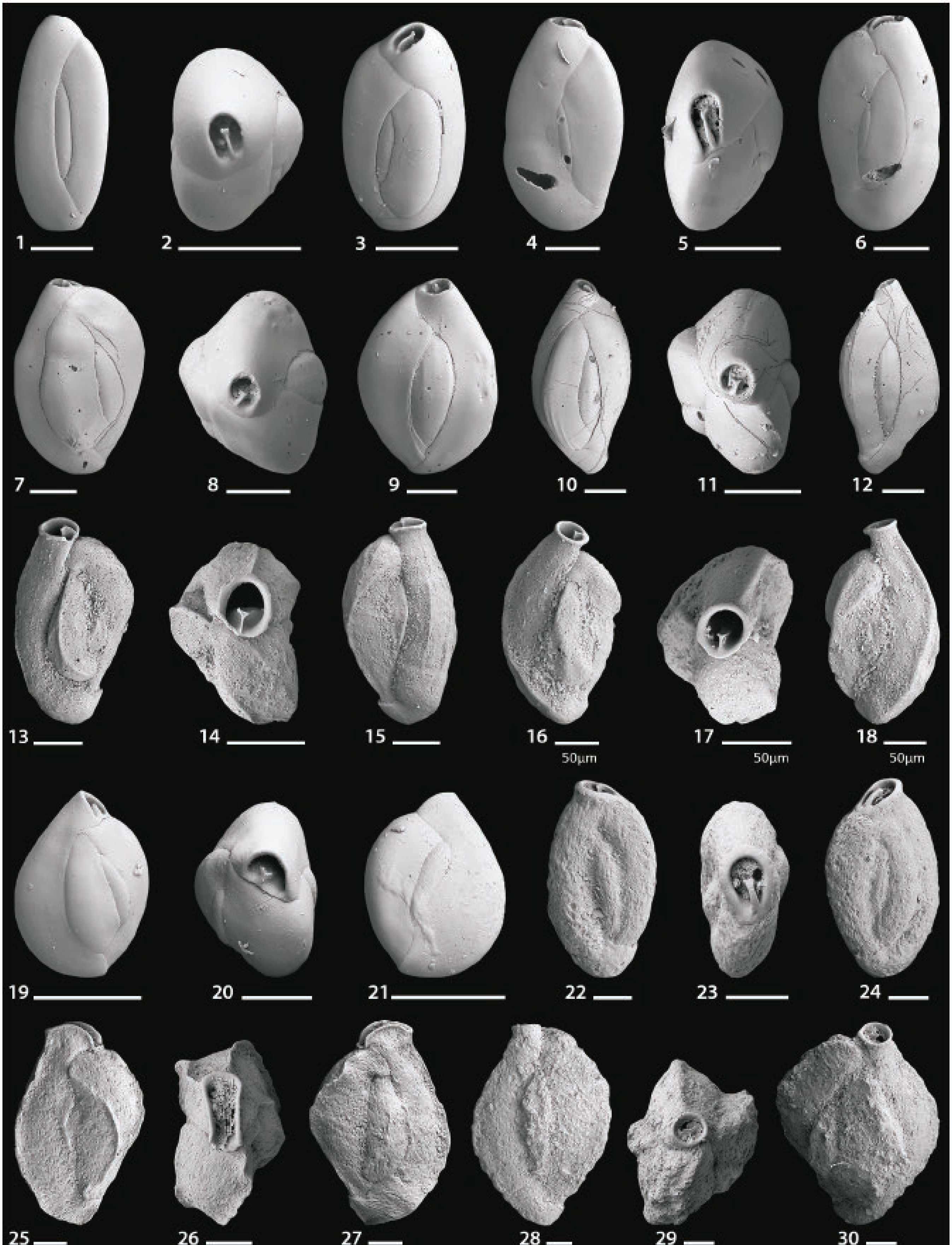
Siphoninoides Cushman 1927a

Siphoninoides diphes Loeblich and Tappan 1994
Plate 43, figures 13, 14

Siphoninoides diphes LOEBLICH and TAPPAN 1994, p. 144, pl. 300, figs. 5, 6.

PLATE 26
Scale bar is 100 µm unless otherwise indicated.

1-3 *Quinqueloculina* sp. 12 (MR18).
4-6 *Quinqueloculina tantabiddyensis* (MR18).
7-12 *Quinqueloculina* sp. 11 (W08).
13-18 *Siphonaperta hallocki* (13-15: MS03; 16-18: N18).
19-21 *Quinqueloculina* cf. *Q. incisa* (ER23).
22-24 *Quinqueloculina debenayi* (W08).
25-27 *Affinetrina bassensis* (B14).
28-30 *Quinqueloculina* sp. 17 (U16).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Occurrence: Timor Sea (Loeblich and Tappan 1994).

Siphoninoides echinata (Brady 1879)
Plate 43, figure 15

Planorbulina echinata BRADY 1879, p. 283, pl. 8, figs. 31a-c.
Truncatulina echinata (Brady) – BRADY 1884, pl. 96, figs. 9-14.
Siphoninoides echinatus (Brady) – CHENG and ZHENG 1978, p. 215, pl. 20, figs. 7-9. – LOEBLICH and TAPPAN 1994, p. 144, pl. 300, figs. 7-13. – PARKER 2009, p. 735, fig. 516a-l. – DEBENAY 2012, p. 248, 313. – THISSEN and LANGER 2017, p. 54, pl. 16, figs. 7, 8.
Siphoninoides laevigatus (Howchin) – LOEBLICH and TAPPAN 1994, p. 144, pl. 300, figs. 1-4.

Occurrence: Torres Strait, Hawaii and Admiralty Islands (Brady 1879, 1884), Xisha Islands (Cheng and Zheng 1978), Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Zanzibar (Thissen and Langer 2017).

Siphoninoides* cf. *S. laevigata (Howchin 1889)
Plate 43, figures 16, 17

cf. *Truncatulina echinata* (Brady) var. *laevigata* HOWCHIN 1889, p. 13, pl. 1, fig. 8.

Occurrence: *Siphoninoides laevigata* was originally described from the Tertiary of Australia.

Superfamily DISCORBINELLOIDEA Sigal in Piveteau 1952
Family PARRELLOIDIDAE Hofker 1956
Discorbia Sellier de Civrieux 1977

Discorbia candeiana (d'Orbigny 1839)
Plate 39, figures 7-9

Rosalina candeiana D'ORBIGNY 1839, p. 97, pl. 4, figs. 2-4.
Truncatulina candeiana (d'Orbigny) – CUSHMAN 1922, p. 47, pl. 6, figs. 7-9.
Discorbis candeiana (d'Orbigny) – GRAHAM and MILITANTE 1959, p. 93, pl. 13, fig. 22.
Discorbia candeiana (d'Orbigny) – SELLIER DE CIVRIEUX 1977, p. 18, pl. 4, figs. 1-8; pl. 5, figs. 1-8; pl. 6, figs. 1-9; pl. 14, figs. 6-8. – LOEBLICH and TAPPAN 1994, p. 150, pl. 320, figs. 1-10.

Occurrence: Tortugas (Cushman 1922), Philippines (Graham and Militante 1959), Caribean (Sellier de Civrieux 1977), Timor Sea (Loeblich and Tappan 1994).

***Discorbia*? sp.**
Plate 39, figures 10-12

Description: Test trochospiral, irregularly formed, periphery rounded; ten to eleven chambers visible on the umbilical side; chambers inflated, increasing rapidly in size as added; sutures depressed, distinct; wall coarsely perforate on both sides of the test, ornamented with scattered, minute pustules; aperture covered with porous flap-like projections of the later chambers towards the umbilicus.

Remarks: Our specimen may represent an aberrant variety of *Discorbia candeiana* (d'Orbigny). However, the characters listed below differ from *D. candeiana*, and we therefore consider our specimens a separate species: 1. size of the pores, 2. perforated folium, and 3. oblique aperture that allows no comparison.

Superfamily DISCORBINELLOIDEA Sigal in Piveteau 1952
Family PSEUDOPARRELLIDAE Voloshinova 1952
Subfamily PSEUDOPARRELLINAE Voloshinova 1952
Epistominella Husezima and Marushi 1944

***Epistominella* sp.**
Plate 43, figures 10-12

Description: Test low trochospiral, biconvex, subcircular in outline, periphery rounded to subacute, slightly lobulate; test consisting of three whorls, seven chambers in the final whorl, chambers are slowly increasing in size as added; sutures slightly depressed on the umbilical side; wall ornamented with coarse pores on both sides of the test, more pronounced at the periphery on the spiral side; aperture a horizontally aligned elongate opening on the umbilical side near the peripheral margin.

Occurrence: Madang, Papua New Guinea (Langer unpubl. data).

PLATE 27
Scale bar is 100 µm unless otherwise indicated.

1-6 *Siphonaperta distorqueata* (1-3: B14; 4-6: ER23).

7-12 *Siphonaperta* cf. *S. distorqueata* Type 1 (7-9: FW; 10-12: CK).

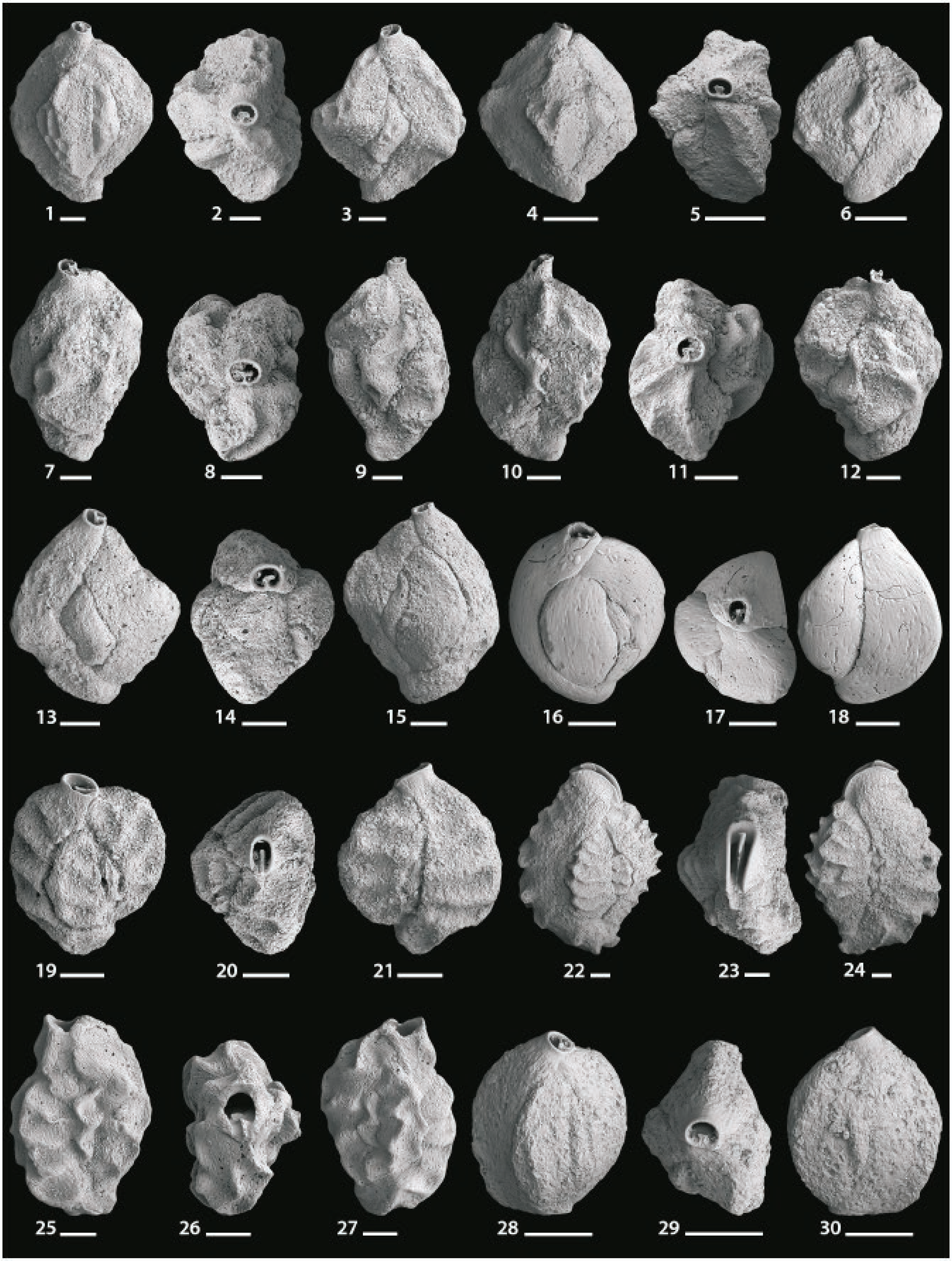
13-15 *Siphonaperta* cf. *S. distorqueata* Type 2 (Ms).

16-18 *Quinqueloculina* sp. 5 (Ms).

19-24 *Lachlanella parkeri* (19-21: N18; 22-24: ER23).

25-27 *Pseudohauerinella dissidens*? (Ms).

28-30 *Quinqueloculina pittensis* (U16).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Rhaptohelenina Clark 1993

***Rhaptohelenina* sp. 1**
Plate 44, figures 21-24

Description: Test trochospiral, biconvex, periphery slightly lobulate, rounded; eight chambers in the final whorl; chambers inflated, slowly increasing in size as added; sutures depressed; wall smooth, with scattered large pores on both sides of the test; primary aperture a low arch-shaped opening on the umbilical side, secondary apertures consist of large sutural openings on both sides of the test.

Remarks: This species mainly differs from *R.* sp. 2 in the more globose test shape and the in the ornamentation with large pores on both sides.

***Rhaptohelenina* sp. 2**
Plate 44, figures 25-27

Description: Test trochospiral, biconvex, flattened, periphery slightly lobulate, rounded to subacute; seven to eight chambers in the final whorl, chambers slightly inflated, slowly increasing in size as added; sutures depressed; wall smooth, spiral side ornamented with scattered large pores; primary aperture a low arch-shaped opening on the umbilical side, secondary apertures consist of large sutural openings on the spiral side of the test.

Remarks: This species mainly differs from *Rhaptohelenina* sp. 1 in having a more compressed test shape and in lacking the ornamentation on the umbilical side.

Family PLANULINOIDIDAE Saidova 1981
Planulinoides Parr 1941

Planulinoides* cf. *P. planoconcavus (Chapman, Parr and Collins 1932)
Plate 43, figures 4-6

cf. *Planulina biconcava* (Parker and Jones) var. *planoconcava* CHAPMAN, PARR and COLLINS (*fide* Ellis and Messina, 1940 *et seq.*) 1932, p. 232, pl. 12, figs. 34a-c.

Remarks: The species is represented by one specimen and resembles the specimen depicted by Hatta and Ujiié (1992, pl. 36, figs. 3a-5c). As the original figure of Chapman, Parr and Collins does not show a distinctly perforated spiral side, it may be a new species.

Occurrence: *Planulinoides planoconcavus* was originally described from southern Australia.

Family DISCORBINELLIDAE Sigal in Piveteau 1952
Subfamily DISCORBINELLINAE Sigal in Piveteau 1952
Discorbinella Cushman and Martin 1935

Discorbinella bertheloti (d'Orbigny 1839)
Plate 39, figures 13-15

Rosalina bertheloti D'ORBIGNY 1839, p. 135, pl. 1 figs. 28-30.
Discorbina bertheloti (d'Orbigny) – BRADY 1884, p. 650, pl. 89, figs. 10-12. – LOEBLICH and TAPPAN 1994, p. 147, pl. 309, figs. 13-15. – DEBENAY 2012, p. 194, 314.

Occurrence: Canary Islands (d'Orbigny 1839), Philippines and Ireland (Brady 1884), Timor Sea (Loeblich and Tappan 1994), New Caledonia (Debenay 2012).

***Discorbinella*? sp.**
Plate 39, figures 16-18

Discorbinella? sp. 1 PARKER 2009, p. 556, figs. 395a-n, 396a-h.

Remarks: For details on the morphology see description and remarks in Parker (2009).

Occurrence: Ningaloo Reef (Parker 2009).

Torresina Parr 1947

***Torresina* sp.**
Plate 36, Figure 18

Remarks: The specimen is partially broken. A similar species has been reported by Loeblich and Tappan (1994; *Torresina haddoni* Parr, p. 148; pl. 312, figs. 6-8); however, the periphery of the species from the Timor Sea is less rounded.

PLATE 28
Scale bar is 100 µm unless otherwise indicated.

1-6 *Siphonaperta subagglutinata* (1-3: CM; 4-6: ER22).

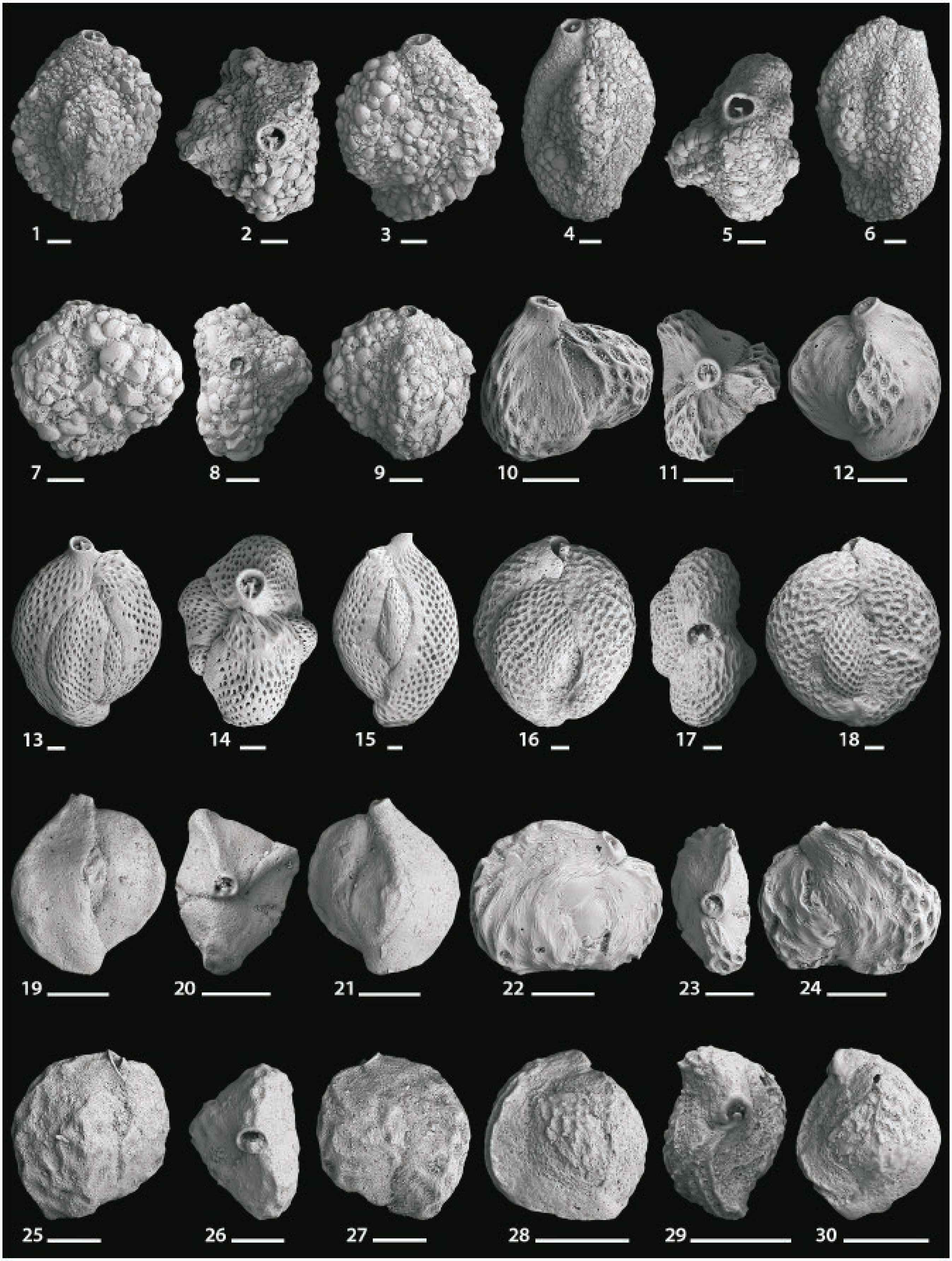
7-9 *Siphonaperta* sp. (MI05).

10-21 *Quinqueloculina philippinensis* (10-12: N18; 13-15: Ms; 16-18: AP10; 19-21: U01*).

22-24 *Quinqueloculina* cf. *Q. subparkeri* (FW).

25-27 *Quinqueloculina*? sp. 8 (AP10).

28-30 *Quinqueloculina*? sp. 19 (U16).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Family CIBICIDIDAE Cushman 1927
Subfamily CIBICIDINAE Cushman 1927
Cibicides de Montfort 1808

Cibicides mabahethi Said 1949
Plate 36, figures 1-6

Cibicides mabaheti SAID 1949, p. 42, pl. 4, fig. 20. – HOTTINGER, HALICZ and REISS 1993, p. 115, pl. 151, figs. 6-12. – DEBENAY 2012, p. 190, 315.

Remarks: The specimens from Raja Ampat are high to low biconvex. Parker (2009) and Haig (1988) have reported a similar species: *Cibicides basilanensis* McCulloch.

Occurrence: Red Sea (Said 1949, Hottinger, Halicz and Reiss 1993), New Caledonia (Debenay 2012).

Cibicides? mayori (Cushman 1924)
Plate 35, figures 24-26

Truncatulina mayori CUSHMAN 1924, p. 39, pl. 12, figs. 3, 4.
Cibicides mayori (Cushman) – TODD 1965, p. 53, pl. 22, fig. 7. – CHENG and ZHENG 1978, p. 233, pl. 21, fig. 5a-c.
Cibicides (?) *mayori* (Cushman) – HOTTINGER, HALICZ and REISS 1993, p. 116, pl. 152, figs. 1-6.
Lobatula mayori (Cushman) – DEBENAY 2012, p. 201, 315.

Remarks: The specimens from Raja Ampat are particularly flat compared to those figured by Hottinger, Halicz and Reiss (1993; for generic assignment see also discussion on p. 116).

Occurrence: ?Samoa (Cushman 1924), Guam (Todd 1965), Xisha Islands (Cheng and Zheng 1978), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), New Caledonia (Debenay 2012).

Cibicides* cf. *C. phillipensis Collins 1974
Plate 36, figures 7-9

cf. *Cibicides phillipensis* COLLINS 1974, p. 49, pl. 4, figs. 41a-c.

Remarks: Parker (2009) illustrates similar specimens of *Cibicides phillipensis* Collins (Parker, 2009, p. 532, fig. 377a-i).

Occurrence: *Cibicides phillipensis* was originally described from Victoria (Australia).

Cibicides? sp. 1
Plate 36, figures 10, 11

Description: Test trochospiral, planoconvex, spiral side flattened, umbilical side slightly convex, peripheral margin subacute; twelve chambers in the final whorl; sutures slightly curved and thickened on the spiral side, sutures of the later chambers depressed on the umbilical side; wall coarsely perforate on the spiral side, not porous but roughly textured on the umbilical side; aperture interiomarginal.

Remarks: The final chamber of our specimen is broken.

Cibicides? sp. 2
Plate 36, figures 27-29

Description: Test trochospiral, planoconvex, spiral side flattened, umbilical side convex, peripheral margin acute; seven to eight chambers in the final whorl; sutures curved on both sides, slightly depressed on the spiral side, more deeply depressed on the umbilical side; wall coarsely perforate on the spiral side, not porous on the umbilical side; aperture interiomarginal.

Lobatula Fleming 1828

Lobatula lobatula (Walker and Jacob 1798)
Plate 35, figures 9-17

Nautilus lobatulus Walker and Jacob in KANMACHER 1798, p. 642, pl. 14, fig. 36.
Truncatulina lobatula d'Orbigny – EGGER 1893, p. 396, pl. 16, figs. 1-2, 10-12.
Cibicides lobatulus (Walker and Jacob) – GRAHAM and MILITANTE 1959, p. 116, pl. 19, figs. 12 a-c. – BARKER 1960, pl. 92, fig. 10; pl. 93, figs. 1, 4, 5; pl. 95, figs. 4, 5. – V. DANIELS 1970, p. 89, pl. 8, fig. 3. – COLOM 1974, p. 147, figs. 29 a-g, i, fig. 30. – REISS and HOTTINGER 1984, fig. G. 29d. – PARKER 2009, p. 532, fig. 376a-i.
Lobatula lobatula (Walker and Jacob) – LOEBLICH and TAPPAN 1987, p. 583, pl. 637, figs. 10-13. – LOEBLICH and TAPPAN 1994, p. 150, pl. 316, figs. 8-11; pl. 319, figs. 1-7. – DEBENAY 2012, p. 201, 315. – LANGER et al. 2013, p.167, fig. 7: 51, 52.

Occurrence: British Isles (Walker and Jacob 1798), Raja Ampat (Egger 1893), Philippines (Graham and Militante 1959), Atlantic and Pacific (Barker 1960), Adriatic Sea and Mediterranean (v. Daniels 1970, Colom 1974), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), Sahul Shelf (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay

PLATE 29
Scale bar is 100 µm unless otherwise indicated.

1,2 *Nubeculina advena* (U16).

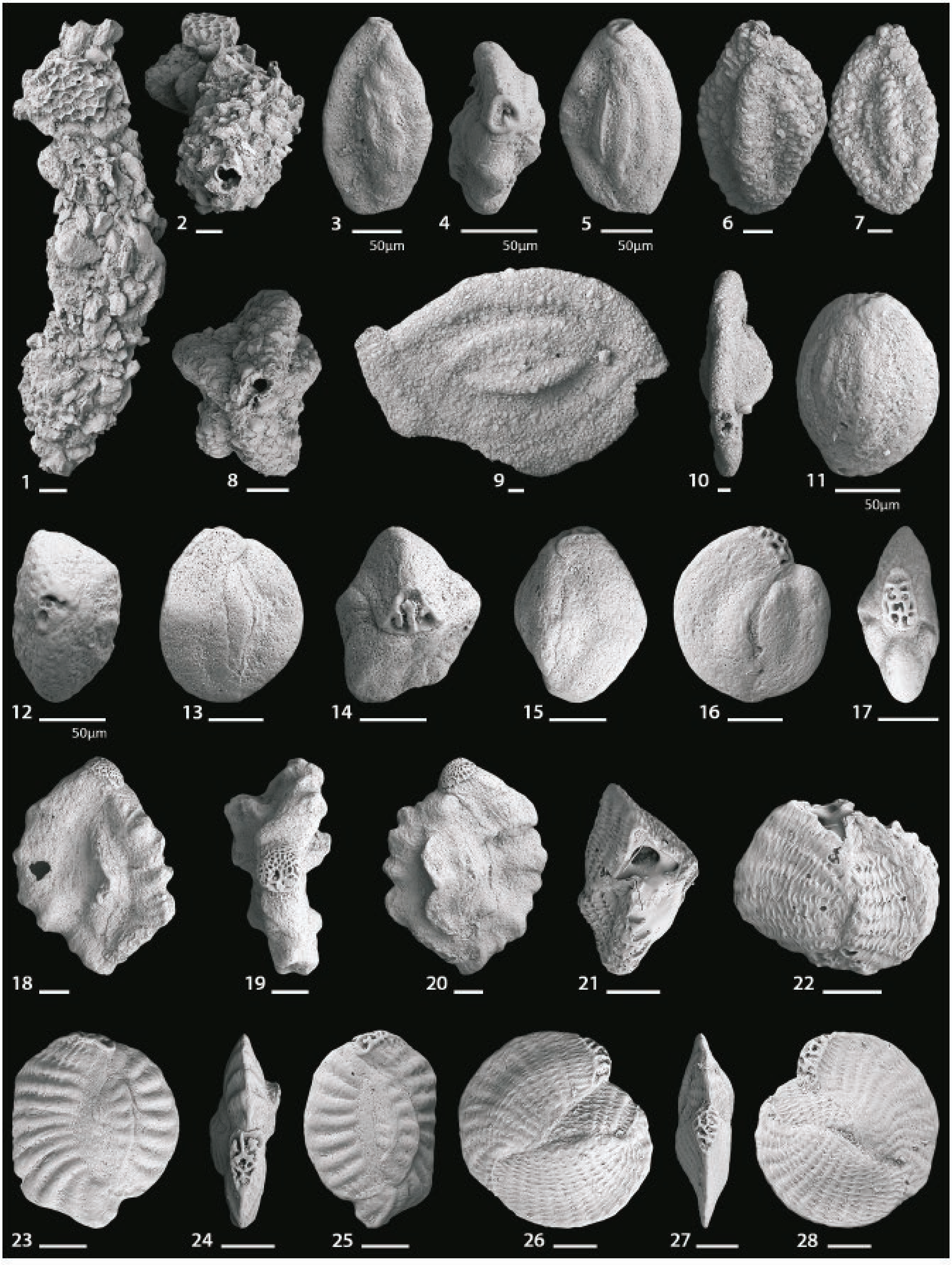
3-10 *Ammomassilina alveoliniformis* (U16).

11-17 *Hauerina pacifica* (11-12, 16, 17: MR18; 13-15: N19).

18-20 *Hauerina rugosa* (W07).

21,22, 26-28 *Sigmoihauerina involuta* (21, 22: W08; 26-28: B15).

23-25 *Pseudohauerina orientalis* (MG).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2012), Bazaruto (Langer et al. 2013), Madang, Papua New Guinea (Langer unpubl. data).

Paracibicides Perelis and Reiss 1975

Paracibicides edomica Perelis and Reiss 1975
Plate 35, figures 18-20

Paracibicides edomica PERELIS and REISS 1975, p. 94, pl. 9, figs. 5, 6. – HOTTINGER, HALICZ and REISS 1993, p. 117, pl. 155, figs. 1-8.
Paracibicides edomicus (Perelis and Reiss) – DEBENAY 2012, p. 206, 315.

Occurrence: Gulf of Elat (Perelis and Reiss 1975), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), New Caledonia (Debenay 2012).

***Paracibicides* sp.**
Plate 35, figures 21-23

Description: Test trochospiral, planoconvex, spiral side evolute, umbilical side involute, peripheral margin subacute; nine chambers in the final whorl; sutures slightly curved on the spiral side, radial and curved backwards near the margin on the umbilical side; wall coarsely perforate on the spiral side, no pores visible on the umbilical side; aperture interiomarginal bordered by a lip, supplementary apertures on the spiral side, remaining open in the last chambers.

Subfamily ANNULOCIBICIDINAE Saidova 1981
Planorbulinoides Cushman 1928

Planorbulinoides* cf. *P. retinaculatus Parker and Jones 1862
Plate 34, figures 9-11

cf. *Planorbulinoides retinaculata* Parker and Jones in CARPENTER, PARKER and JONES 1862, p. 209.

Remarks: The specimen from Raja Ampat strongly resembles *Planorbulinoides retinaculatus* Parker and Jones depicted by Debenay (2012, p. 246).

***Planorbulinoides*? sp.**
Plate 34, figures 9-11

Description: Test planoconvex, spiral side attached, flattened, umbilical side slightly inflated, periphery rounded; early stage trochospiral, cibicid-like, later chambers irregularly added in a single plane; wall coarsely perforate on both sides, scarcely ornamented with granular pustules on the umbilical side; small sutural apertures on both side of the test.

Subfamily STICHOCIBICIDINAE Saidova 1981
Dyocibicides Cushman and Valentine 1930

Dyocibicides* cf. *D. biserialis Cushman and Valentine 1930
Plate 33, figures 11-19

cf. *Dyocibicides biserialis* CUSHMAN and VALENTINE 1930, p. 30.

Remarks: The initial chamber arrangement of this species is trochospiral and shows a tendency to biserial coiling in later stages. Brady (1884; pl. 93, figs. 6, 7) figures a specimen of *Dyocibicides biserialis* (*Truncatulina variabilis* d'Orbigny) from New Zealand that is similar to the our material from Raja Ampat.

Occurrence: *Dyocibicides biserialis* was originally described from the Holocene of California.

Family PLANORBULINIDAE Schwager 1877
Subfamily CARIBEANELLINAE Saidova 1981
Caribeanella Bermúdez 1952

***Caribeanella* sp. 1**
Plate 33, figures 25-29

Description: Test trochospiral, consisting of two whorls, planoconvex, spiral side flattened, umbilical side convex and more involute; test subcircular in top view, periphery subacute, with a weak, rounded carina; nine to ten chambers visible in the final whorl, gradually increasing in size as added; sutures depressed on the umbilical side, thickened on the spiral side; wall

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PLATE 30
Scale bar is 100 µm unless otherwise indicated.

1-3 *Hauerina earlandi* (MR18).

4-6 *Pseudomassilina reticulata* (MI05).

7-10 *Monalysidium okinawaensis* (7, 8: MR18*; 9, 10: Ms).

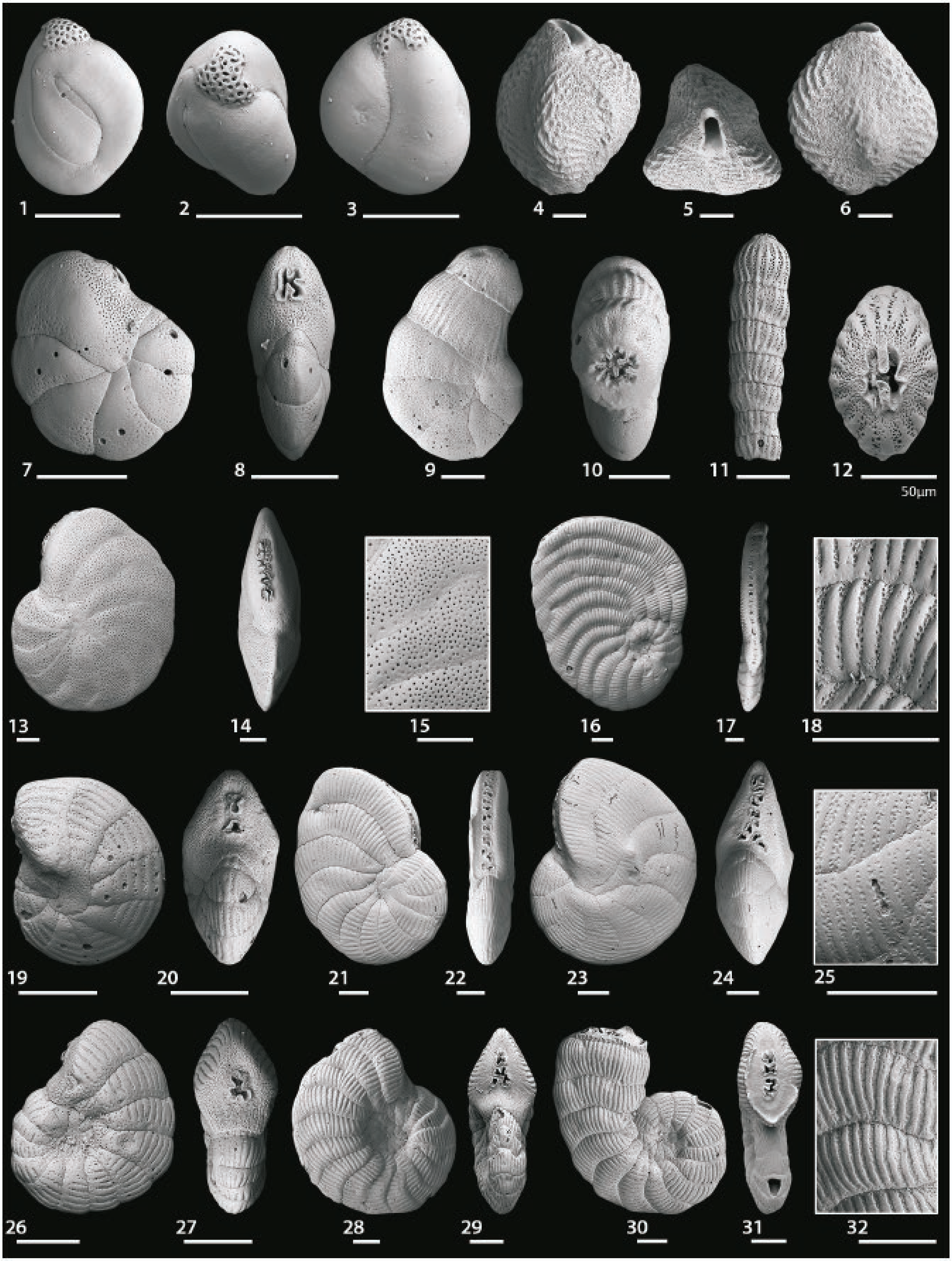
11, 12 *Monalysidium acicularis* (MR18).

13-15 *Dendritina zhengae* (MR18*).

16-18 *Peneroplis planatus* (MR18)*.

19-25 *Peneroplis antillarum* (19, 20: MR18*; 21, 22: Ms*; 23-25: MS04*).

26-32 *Peneroplis pertusus* (26, 27: MR18*; 28, 29: U01; 30-32: CM).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coarsely perforate on both sides, perforation less pronounced on the umbilical side; primary aperture a low interiomarginal arch bordered with a lip, supplementary apertures at the inner margin and at the periphery of the chambers, open in the last formed chambers.

Remarks: The last formed chambers of the specimen are broken off.

***Caribeanella*? sp. 2**
Plate 35, figures 6-8

Description: Test trochospiral, concavo-convex, spiral side concave, umbilical side convex, periphery acute, carinate; about six to seven chambers in the final whorl; sutures curved, slightly depressed on the spiral side, depressed on the umbilical side; wall coarsely perforate on both sides, ornamented with rounded granules on the umbilical side; primary aperture a low interiomarginal arch bordered with a lip, supplementary apertures at the inner margins and at the periphery of the chambers, open in the last formed chambers.

Subfamily PLANORBULININAE Schwager 1877
Cibicidella Cushman 1927

***Cibicidella*? sp.**
Plate 33, figures 20-24

Cibicidella? sp. 1 PARKER 2009, p. 527, fig. 374a-i.

Remarks: This species is morphological highly variable. The attribution to the genus *Cibicidella* Cushman is uncertain, as the specimens also show features of *Caribeanella* Bermúdez. For details on the morphology see description and remarks in Parker (2009).

Occurrence: Ningaloo Reef (Parker 2009).

Planorbulina d'Orbigny 1826

***Planorbulina* sp.**
Plate 34, figures 12-17

Planorbulina sp. 1 PARKER 2009, p. 702, figs. 494a-j, 495a-I, 496a-n.

Remarks: The test wall on the umbilical side is finely granular. For further details on the morphology see description in Parker (2009).

Occurrence: Ningaloo Reef (Parker 2009).
Planorbulinella Cushman 1927

Planorbulinella larvata Parker and Jones 1865
Plate 34, figures 18-29

Planorbulina larvata PARKER and JONES 1865, p. 379, pl. 19, figs. 3 a, b. – BRADY 1884, p. 658, pl. 92, figs. 5, 6. – GRAHAM and MILITANTE 1959, p. 118, pl. 19, figs. 17 a, b.
Planorbulinella larvata (Parker and Jones) – CHENG and ZHENG 1978, p. 235, pl. 22, fig. 2; pl. 32, fig. 5. – BACCAERT 1987, p. 222, pl. 88, figs. 4, 5. – HOTTINGER, HALICZ and REISS 1993, p. 118, pl. 158, figs. 1-12. – LOEBLICH and TAPPAN 1994, p. 152, pl. 327, figs. 1-7. – PARKER 2009, p. 709, fig. 498a-j. – DEBENAY 2012, p. 246, 316. – LANGER et al. 2013, p. 167, fig. 8: 5-6. – THISSEN and LANGER 2017, p. 56, pl. 17, figs. 9-11.

Occurrence: "Indian Sea" (Parker and Jones 1865), Tonga (Brady 1884), Philippines (Graham and Militante 1959), Xisha Islands (Cheng and Zheng 1978), Great Barrier Reef (Baccaert 1987), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Bazaruto (Langer et al. 2013), Zanzibar (Thissen and Langer 2017), Madang, Papua New Guinea (Langer unpubl. data).

Planorbulinella*? *sublarvata Hatta 1992
Plate 35, figures 1-5

Planorbulinella? *sublarvata* Hatta in HATTA and UJIIÉ 1992, p. 189, pl. 38, figs. 4a-c; pl. 39, figs. 1a-c.
Planorbulinella sublarvata Hatta – LOEBLICH and TAPPAN 1994, p. 152, pl. 324, figs. 10-13.
Miniacina? *sublarvata* (Hatta and Ujiié) – PARKER 2009, p. 641, figs. 455a-h, 456a-j.
Miniacina sublarvata (Hatta) – DEBENAY 2012, p. 244, 318.

Remarks: The generic assignment requires further study (see also remarks in Parker 2009). The specimens from Raja Ampat

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PLATE 31
Scale bar is 100 µm unless otherwise indicated.

1,2 *Laevipeneroplis bradyi* (MS03).

3,4 *Laevipeneroplis malayensis* (U16).

5-11 *Parasorites orbitolitoides* (6, 7: MR18; 7, 8: U16; 9, 10: MS03*; 11: MR18*).

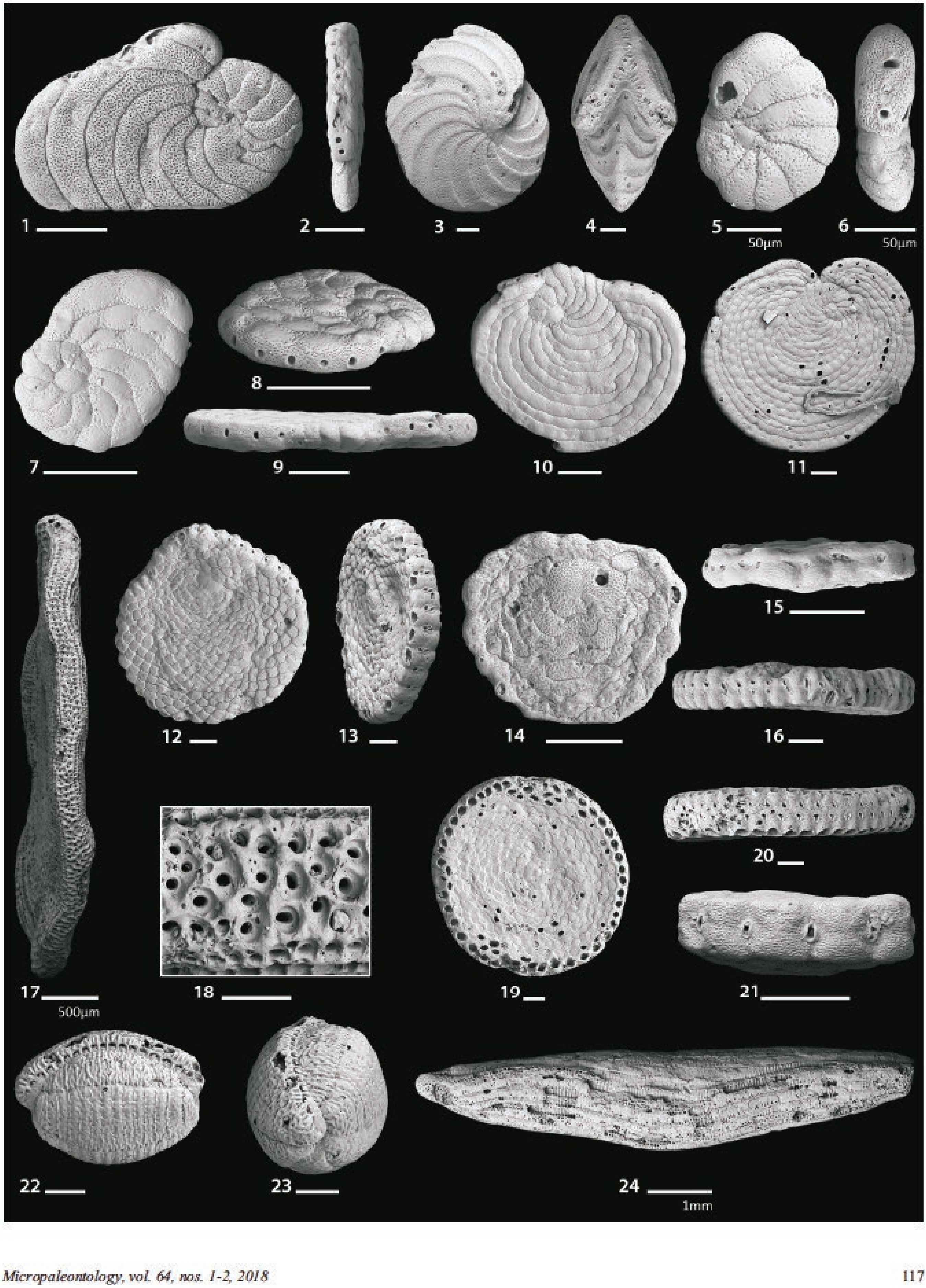
12-16 *Sorites orbiculus* (12, 13: Y24; 14, 16: MS03; 15: W08).

17,18 *Marginopora vertebralis* (MS04*).

19-21 *Amphisorus hemprichii* (19, 20: MS03; 21: MR18*).

22,23 *Borelis pulchra* (U01*).

24 *Alveolinella quoyi* (MS04*).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are of whitish color. Figures 1-3 probably represent an adult specimen.

Occurrence: Ryukyus (Hatta 1992), Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

Family CYMBALOPORIDAE Cushman 1927
Subfamily CYMBALOPORINAE Cushman 1927
Cymbaloporetta Cushman 1928

Cymbaloporetta bradyi (Cushman 1915)
Plate 32, figures 12-14

Cymbalopora poeyi sp. BRADY 1884, p. 637, pl. 102, figs. 14a-d.
Cymbalopora poeyi (d'Orbigny) var. *bradyi* CUSHMAN 1915, p. 25, pl. 10, fig. 2; pl. 14, fig. 2.
Cymbaloporetta bradyi (Cushman) – CHENG and ZHENG 1978, p. 238, pl. 23, figs. 1-3. – LOEBLICH and TAPPAN 1994, p. 152, pl. 327, figs. 8-10; pl. 328, figs. 1-3. – PARKER 2009, p. 552, fig. 391a-o. – DEBENAY 2012, p. 236, 316.

Occurrence: Torres Strait and Papua (Brady 1884), Hawaii (Cushman 1915), Xisha Islands (Cheng and Zheng 1978), Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

Cymbaloporetta*? aff. *C. bradyi Cushman 1915
Plate 32, figures 15-17

aff. *Cymbalopora poeyi* (d'Orbigny) var. BRADY 1884, p. 637, pl. 102, figs. 14a-d.
aff. *Cymbalopora poeyi* (d'Orbigny) var. *bradyi* CUSHMAN 1915, p. 25, pl. 10, fig. 2; pl. 14, fig. 2

Remarks: This species is tentatively placed in *Cymbaloporetta*. The large number of apertures, possibly indicates an assignment to the genus *Cymbaloporella* Cushman.

Occurrence: *Cymbaloporetta bradyi* was originally reported and described from Torres Strait and Papua (Brady 1884) and Hawaii (Cushman 1915).

Cymbaloporetta squammosa d'Orbigny 1839
Plate 32, figures 18-20

Rosalina squammosa D'ORBIGNY 1839, p. 91, pl. 3, figs. 12-14.
Cymbalopora poeyi (d'Orbigny) – BRADY 1884, p. 636, pl. 102, figs. 13a-c.
Cymbaloporetta squammosa (d'Orbigny) – GRAHAM and MILITANTE 1959, p. 108, pl. 18, figs. 3a-c. – CHENG and ZHENG 1978, p. 238, pl. 23, figs. 4a-c, 5. – BACCAERT 1987, p. 227, pl. 92, figs. 2-4.) – HATTA and UJIIÉ 1992, p. 190, pl. 40, figs. 3a-c. – LOEBLICH and TAPPAN 1994, p. 152, pl. 328, figs. 4-8. – DEBENAY 2012, p. 236, 316.

Occurrence: Cuba (d'Orbigny 1839), Admiralty Islands (Brady 1884), Philippines (Graham and Militante 1959), Xisha Islands (Cheng and Zheng 1978), Great Barrier Reef (Baccaert 1987), Ryukyus (Hatta and Ujiié 1992), Timor Sea (Loeblich and Tappan 1994), New Caledonia (Debenay 2012), Madang, Papua New Guinea (Langer unpubl. data).

***Cymbaloporetta* sp. 1**
Plate 32, figures 1-10

Cymbaloporetta sp. 1 PARKER 2009, p. 552, figs. 392a-k, 393a-e.

Remarks: For details on the morphology see description and remarks in Parker (2009).

Occurrence: Ningaloo Reef (Parker 2009).

***Cymbaloporetta*? sp. 2**
Plate 32, figure 11

Description: Test low trochospiral, spiral side slightly convex, periphery rounded; chambers inflated, gradually increasing in size; sutures depressed, slightly curved on the spiral side, nearly radial on the umbilical side; wall coarsely perforate on both sides; aperture interiomarginal.

Remarks: Our specimen is possibly a juvenile individual of *Cymbaloporetta* but the final chambers of the specimen are broken.

Millettiana Banner, Pereira and Desai 1985

Millettiana milletti (Heron-Allen and Earland 1915)
Plate 32, figures 23-27

Cymbalopora milletti HERON-ALLEN and EARLAND 1915, p. 689, pl. 51, figs. 32-35.

PLATE 32
Scale bar is 100 µm unless otherwise indicated.

1-10 *Cymbaloporetta* sp. 1 (1-3: MR18; 4-9: MS03; 10: MG).

11 *Cymbaloporetta*? sp. 2 (B15).

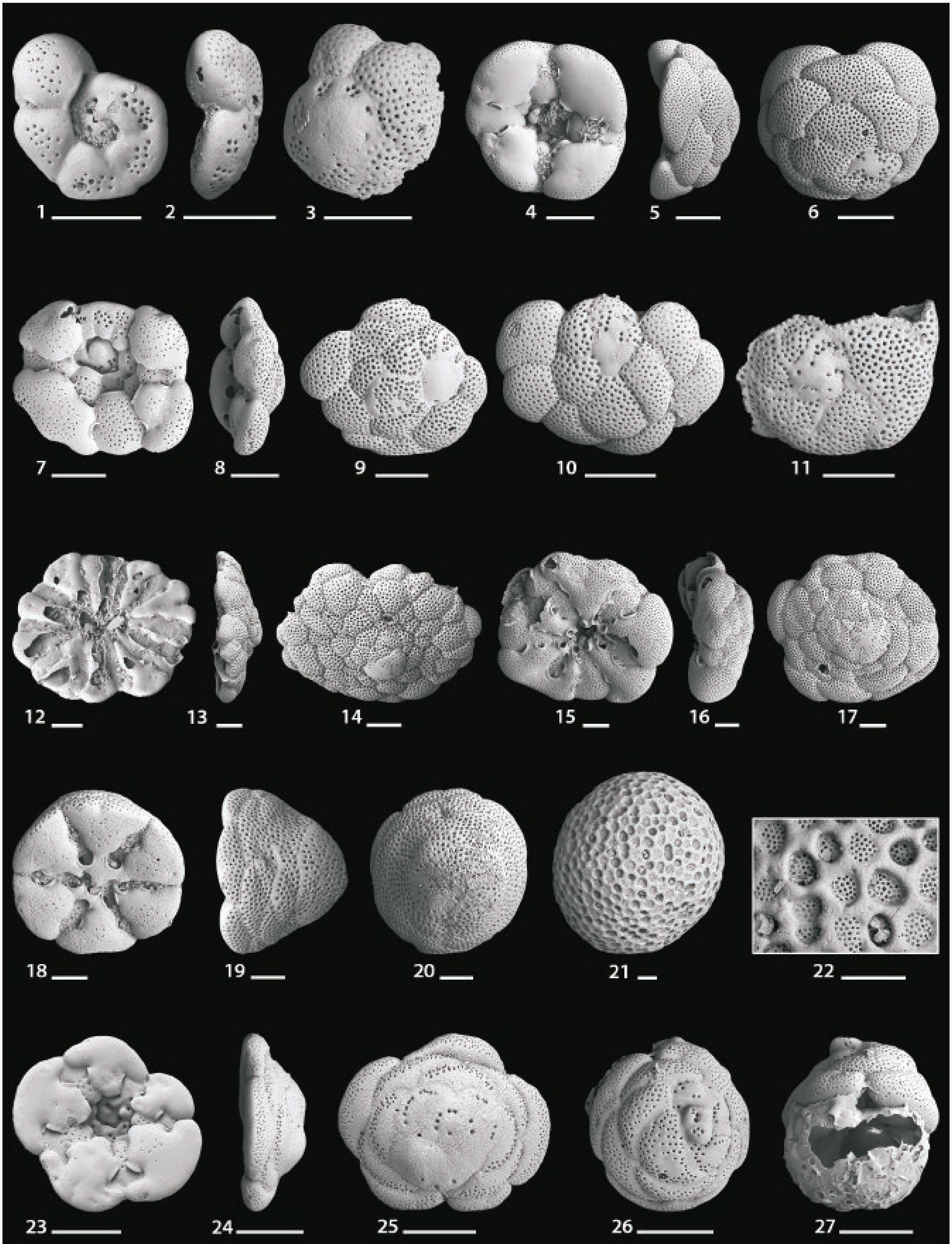
12-14 *Cymbaloporetta bradyi* (N19).

15-17 *Cymbaloporetta*? aff. *C. bradyi* (B14).

18-20 *Cymbaloporetta squammosa* (B14).

21,22 *Sphaerogypsina globulus* (U02).

23-27 *Millettiana milletti* (23-25: FW; 26, 27: U16).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Millettiana milletti (Heron-Allen and Earland) – BANNER, PEREIRA and DESAI 1985, p. 170, pl. 4, figs. 1-10. – HATTA and UJIIÉ 1992, p. 191, pl. 40, figs. 4, 7. – HOTTINGER, HALICZ and REISS 1993, p. 120, pl. 160, figs. 9-13. – LOEBLICH and TAPPAN 1994, p. 153, pl. 329, figs. 1-12. – PARKER 2009, p. 640, figs. 452a-k, 453a-g. – DEBENAY 2012, p. 244, 316. – THISSEN and LANGER 2017, p. 58, pl. 18, figs. 5-7.

Occurrence: Quirimbas (Heron-Allen and Earland 1915), Kenya (Banner, Pereira and Desai 1985), Ryukyus (Hatta and Ujiié 1992), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Zanzibar (Thissen and Langer 2017).

Family VICTORIELLIDAE Chapman and Crespin 1930
Subfamily CARPENTERIINAE Saidova 1981
Carpenteria Gray 1858

Carpenteria utricularis (Carter 1876)
Plate 44, figures 19, 20

Polytrema utriculare CARTER 1876, p. 210, pl. 13, figs. 11-16.
Carpenteria utricularis (Carter) – BRADY 1884, p. 678, pl. 99, figs. 6, 7; pl. 100, figs. 1-4. – HOTTINGER, HALICZ and REISS 1993, p. 121, pl. 162, figs 1-9; pl. 163, figs. 1-6. – LOEBLICH and TAPPAN 1994, p. 153, pl. 330, figs. 4-12.

Occurrence: Admiralty Islands (Brady 1884), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), Timor Sea (Loeblich and Tappan 1994).

Superfamily ACERVULINOIDEA Schultze 1854
Family ACERVULINIDAE Schultze 1854
Acervulina Schultze 1854

Acervulina mabahethi (Said 1949)
Plate 33, figures 1-10

Planorbulina mabahethi SAID 1949, p. 44, pl. 4, fig. 26. – LOEBLICH and TAPPAN 1994, p.152, pl. 323, figs. 11-13.
Acervulina mabahethi (Said) – HOTTINGER, HALICZ and REISS 1993, p. 122, pl. 165, figs. 1-7; pl. 166, figs. 1-8. – PARKER 2009, p. 475, figs. 341a-i, 342a-j, 343a-i. – MAKLED and LANGER 2011, p. 248, fig. 9: 20. – DEBENAY 2012, p. 234, 317. – LANGER et al. 2013, p. 167, fig. 8: 10, 11. – THISSEN and LANGER 2017, p. 8, pl. 18, figs. 8-13.

Occurrence: Red Sea (Said 1949, Hottinger, Halicz and Reiss 1993), Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), Caroline Islands (Makled and Langer 2011), New Caledonia (Debenay 2012), Bazaruto (Langer et al. 2013), Zanzibar (Thissen and Langer 2017).

Planogypsina Bermúdez 1952

Planogypsina acervalis (Brady 1884)
Plate 34, figures 1-4

Planorbulina acervalis BRADY 1884, p. 657, pl. 92, fig. 4. – BACCAERT 1987, p. 220. Plate 88, figs. 1-3.
Planogypsina acervalis (Brady) – HOTTINGER, HALICZ and REISS 1993, p. 125, pl. 169, figs. 1-9; pl. 170, figs. 1-8. – PARKER 2009, p. 697, figs. 490a-e, 491a-i. – DEBENAY 2012, p. 246, 317.

Occurrence: Booby Island, Pacific (Brady 1884), Great Barrier Reef (Baccaert 1987), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

***Planogypsina*? sp.**
Plate 34, Figure 5

Remarks: The specimen illustrated here is partially broken. The test wall of the attached side is less porous than in *Planogypsina acervalis* and more specimens are required for both generic and specific identification.

Sphaerogypsina Galloway 1933

Sphaerogypsina globulus (Reuss 1847)
Plate 32, figures 21, 22

Ceriopora globulus REUSS 1847, p. 33, pl. 5, fig. 7
Gypsina globulus (Reuss) – BRADY 1884, p. 717, pl. 101, fig. 8. – SAID 1949, p. 44, pl. 4, fig. 24. – GRAHAM and MILITANTE 1959, p. 117, pl. 19, fig. 15
Gypsina vesicularis (Parker and Jones) – BRADY 1884, pl. 101, figs. 9-12.
Gypsina (*globula*) (Reuss) – CHENG and ZHENG 1978, p. 236, pl. 22, fig. 8a, b; pl. 33, fig. 4; text-fig. 12.
Gypsina globula (Reuss) – BACCAERT 1987, p. 223, pl. 89, figs. 1-4
Sphaerogypsina globula (Reuss) – CIMERMAN and LANGER 1991, p. 72, pl. 80, figs. 6-9. – LOEBLICH and TAPPAN 1994, p. 154, pl. 333, figs. 1-9; pl. 334, figs. 1-3. – HAIG 1997, p. 278. – PARKER 2009, p. 736, fig. 517a-j. – MAKLED and LANGER 2011, p. 248, fig. 9: 21, 22. – DEBENAY 2012, p. 249, 317.

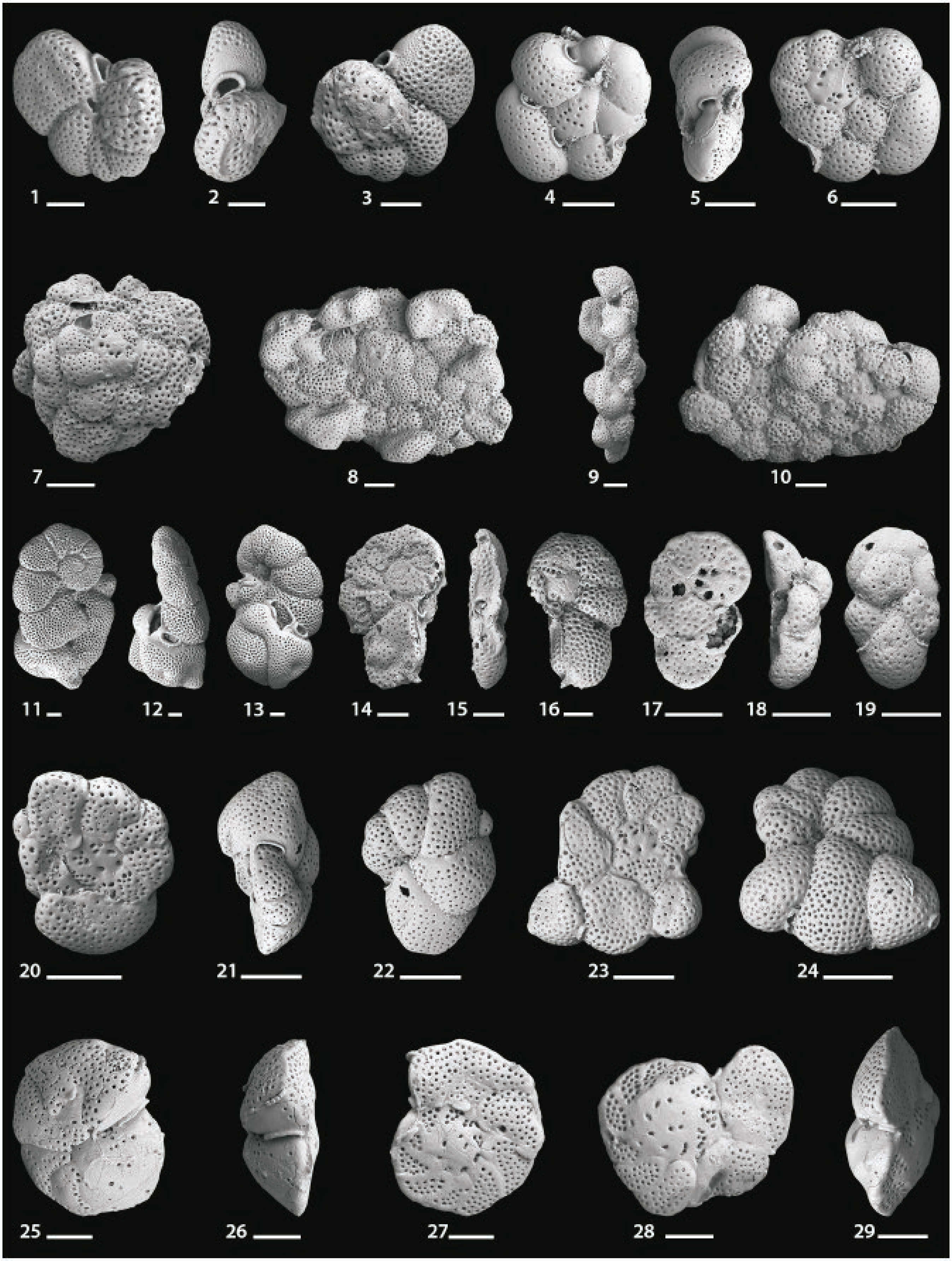
PLATE 33
Scale bar is 100 µm unless otherwise indicated.

1-10 *Acervulina mabahethi* (1-3: AW12; 4-6: W07*; 7: AP09; 8-10: ER22).

11-19 *Dyocibicides* cf. *D. biserialis* (11-13: MR17; 14-16: AW12; 17-19: U16).

20-24 *Cibicidella* sp. (20-22: B14; 23, 24: U16).

25-29 *Caribeanella* sp. 1 (25-27: Ms; 28, 29: U01).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Sphaerogypsina globulus (Reuss) – THISSEN and LANGER 2017, p. 58, pl. 18, figs. 15, 16.

Occurrence: Miocene, Vienna Basin (Reuss 1847), Honolulu, Tonga (Brady 1884), Red Sea (Said 1949), Philippines (Graham and Militante 1959), Xisha Islands (Cheng and Zheng 1978), Great Barrier Reef (Baccaert 1987), Mediterranean (Cimerman and Langer 1991), Timor Sea (Loeblich and Tappan 1994), Western Australia (Haig 1997, Parker 2009), Caroline Islands (Makled and Langer 2011), New Caledonia (Debenay 2012), Zanzibar (Thissen and Langer 2017), Madang, Papua New Guinea (Langer unpubl. data).

Family HOMOTREMATIDAE Cushman 1927
Homotrema Hickson 1911

***Homotrema*? sp.**
Plate 43, figures 21-23

Remarks: This probably represents a species of *Homotrema*. However, the state of preservation is extremely poor and does not allow a reliable assignment or description.

Superfamily ASTERIGERINOIDEA d'Orbigny 1839
Family EPISTOMARIIDAE Hofker 1954
Subfamily EPISTOMARIINAE Hofker 1954
Asanonella Huang 1965

Asanonella tubulifera (Heron-Allen and Earland 1915)
Plate 43, figures 7-9

Truncatulina tubulifera HERON-ALLEN and EARLAND 1915, p. 710, pl. 52, figs. 37-40.
Epistominella tubulifera (Heron-Allen and Earland) – GRAHAM and MILITANTE 1959, p. 110, pl. 18, figs. 8a, b.
Alabamina tubulifera (Heron-Allen and Earland) – BELFORD 1966, p. 160, 161, pl. 27, figs. 1-6, tf. 22, no. 6.
Asanonella tubulifera (Heron-Allen and Earland) – LOEBLICH and TAPPAN 1987, p. 600, pl. 666, figs. 1-7. – HATTA and UJIIÉ 1992, p. 193, 194, pl. 42, figs. 1a-c. – LOEBLICH and TAPPAN 1994, p. 155, pl. 337, figs. 1-10. – LANGER and LIPPS 2003, p. 152, fig. 7 D: h. – PARKER 2009, p. 514, figs. 365a-k, 366a-f. – DEBENAY 2012, p. 187, 318. – THISSEN and LANGER 2017, p. 58, pl. 18, figs. 17-20.

Occurrence: Indonesia (Heron-Allen and Earland 1915), Philippines (Graham and Militante 1959, Late Cenozoic, Papua New Guinea (Belford 1966), Timor Sea (Loeblich and Tappan 1987, 1994), Ryukyus (Hatta and Ujiié 1992), Madang, Papua New Guinea (Langer and Lipps 2003), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Zanzibar (Thissen and Langer 2017).
Monspeliensina Glacon and Lys 1968

***Monspeliensina*? sp.**
Plate 37, figures 19-21

Monspeliensina? sp. 3 PARKER 2009, p. 652, fig. 463a-e.

Remarks: The generic assignment requires further study. For details on the morphology see description and remarks in Parker (2009).

Occurrence: Ningaloo Reef (Parker 2009).

Family ALFREDINIDAE Singh and Kalia 1972
Epistomaroides Uchio 1952

***Epistomaroides* sp.**
Plate 40, figures 21-25

Epistomaroides polystomelloides (Parker and Jones) – HATTA and UJIIÉ 1992, p. 194, pl. 42, fig. 2a-c.

Description: Test low trochospiral, biconvex, laterally flattened, periphery rounded, slightly lobulate; about ten chambers in the adult; sutures deeply incised; wall coarsely perforate.

Remarks: The specimens are heavily abraded, the final chambers are broken. The apertural features require further study.

Occurrence: Ryukyus (Hatta and Ujiié 1992).

Family ASTERIGERINATIDAE Reiss 1963
Eoeponidella Wickenden 1949

Eoeponidella pulchella (Parker 1952)
Plate 39, figures 4-6

Pnineaella? pulchella PARKER 1952, p. 420, pl. 6, figs. 18-20.
Eoeponidella pulchella (Parker) – LOEBLICH and TAPPAN 1987, p. 607, pl. 675, figs. 8-11. – DEBENAY 2012, p. 195, 318.

PLATE 34
Scale bar is 100 µm unless otherwise indicated.

1-4 *Planogypsina acervalis* (N18).

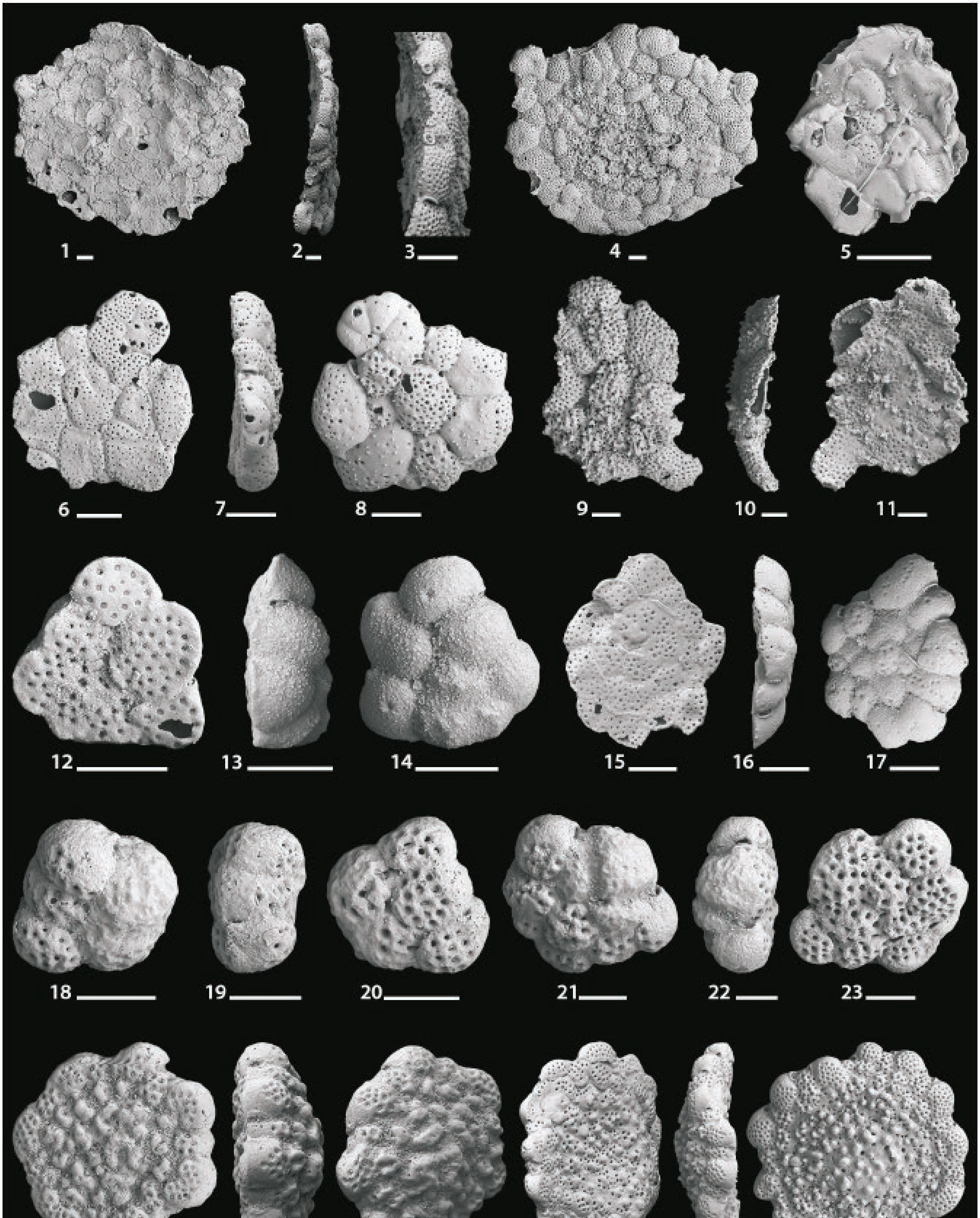
5 *Planogypsina*? sp. (W08).

6-8 *Planorbulinoides*? sp. (ER23).

9-11 *Planorbulinoides* cf. *P. retinaculatus* (AW13).

12-17 *Planorbulina* sp. (U16).

18-29 *Planorbulinella larvata* (24-26: U01; 27-29: W08).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Occurrence: off New Hampshire, Atlantic (Parker 1952), New Caledonia (Debenay 2012).

Family AMPHISTEGINIDAE Cushman 1927a
Amphistegina d'Orbigny 1826

Amphistegina bicirculata Larsen 1976
Plate 50, figures 17-19

Amphistegina bicirculata LARSEN 1976, p. 10, pl. 2, figs. 1-5; p. 16, text figs. 9.2, 10.2. – HOTTINGER, HALICZ and REISS 1993, p. 132, pl. 182, figs. 1-11; pl. 183, figs. 1-7. – DEBENAY 2012, p. 215, 318.

Occurrence: Gulf of Aqaba (Larsen 1976, Hottinger, Halicz and Reiss 1993), New Caledonia (Debenay 2012).

Amphistegina lessonii d'Orbigny 1826
Plate 51, figures 4-6

Amphistegina lessonii D'ORBIGNY 1826, p. 304. – VAN MARLE 1991, p. 80, pl. 21, figs. 7, 8. – HOTTINGER, HALICZ and REISS 1993, p. 132, pl. 184, figs. 1-11; pl. 185, figs. 1-7. – PARKER 2009, p. 498, fig. 355a-d. – MAKLED and LANGER 2011, p. 248, fig. 9: 30, 31. – DEBENAY 2012, p. 215, 318. – FAJEMILA, LANGER and LIPPS 2015, fig. 2: 12. – LANGER, MOUANGA and FAJEMILA 2016, p. 76, pl. 2, figs. 28-31.

Occurrence: Mauritius (d'Orbigny 1826), eastern Indonesia (van Marle 1991), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), Ningaloo Reef (Parker 2009), Caroline Islands (Makled and Langer 2011), New Caledonia (Debenay 2012), Moorea (Fajemila, Langer and Lipps 2015), Gabon (Langer, Mouanga and Fajemila 2016).

Amphistegina lobifera Larsen 1976
Plate 50, figures 23-28

Amphistegina lobifera LARSEN 1976, p. 4-6, pl. 3, figs. 1-5; pl. 7, fig. 3; pl. 8, fig. 3. – HOTTINGER, HALICZ and REISS 1993, p. 133, pl. 186, figs. 1-10; pl. 187, figs. 1-7; pl. 188, figs. 1-6. – RENEMA 2003, p. 344, figs. 9a, b. – PARKER 2009, p. 498, fig. 355e-o. – DEBENAY 2012, p. 216, 319.
Amphistegina (not specified) – CARILLI and WALSH 2012, p. 91, not figured (material examined).

Occurrence: Gulf of Aqaba (Larsen 1976, Hottinger, Halicz and Reiss 1993), Indonesia (Renema 2003), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Kiritimati (Carilli and Walsh 2012).

Amphistegina madagascariensis d'Orbigny 1826
Plate 51, figures 7-11

Amphistegina madagascariensis D'ORBIGNY 1826, p. 305. – TODD 1965, p. 34, pl. 12, figs. 1, 2 (not pl. 11, fig. 3).
Amphistegina lessonii d'Orbigny var. *madagascariensis* d'Orbigny – CUSHMAN 1921, p. 372, not figured.
Amphistegina cf. *madagascariensis* d'Orbigny – MCCULLOCH 1977, p. 410, pl. 154, figs. 8, 9.

Remarks: *Amphistegina madagascariensis* is considered to be a variety of *Amphistegina lessonii* d'Orbigny by some authors. However, very characteristic specimens from sample material from Palawan (Philippines, Förderer unpubl. data) indicate that *A. madagascariensis* may indeed represent a distinct species (see also remarks on the morphology in Cushman 1921, Todd 1965, and McCulloch 1977). The inside of the tests is of an orange-brownish color, a feature also noted by Todd. The original record of d'Orbigny is from Madagascar (precise location not given).

Occurrence: Madagascar (d'Orbigny 1826), Fiji (Todd 1965), Philippines (Cushman 1921, McCulloch 1977), Hawaii (McCulloch 1977).

Amphistegina papillosa Said 1949
Plate 50, figures 20-22

Amphistegina radiata (Fichtel and Moll) var. *papillosa* SAID 1949, p. 39, pl. 4, fig. 12.
Amphistegina papillosa Said – HOTTINGER, HALICZ and REISS 1993, p. 134, pl. 189, figs. 1-10; pl. 190, figs. 1-7. – PARKER 2009, p. 499, not figured. – DEBENAY 2012, p. 216, 319.

PLATE 35
Scale bar is 100 µm unless otherwise indicated.

1-5 *Planorbulinella*? *sublarvata* (1-3: Y24; 4, 5: U01*).

6-8 *Caribeanella*? sp. 2 (U16).

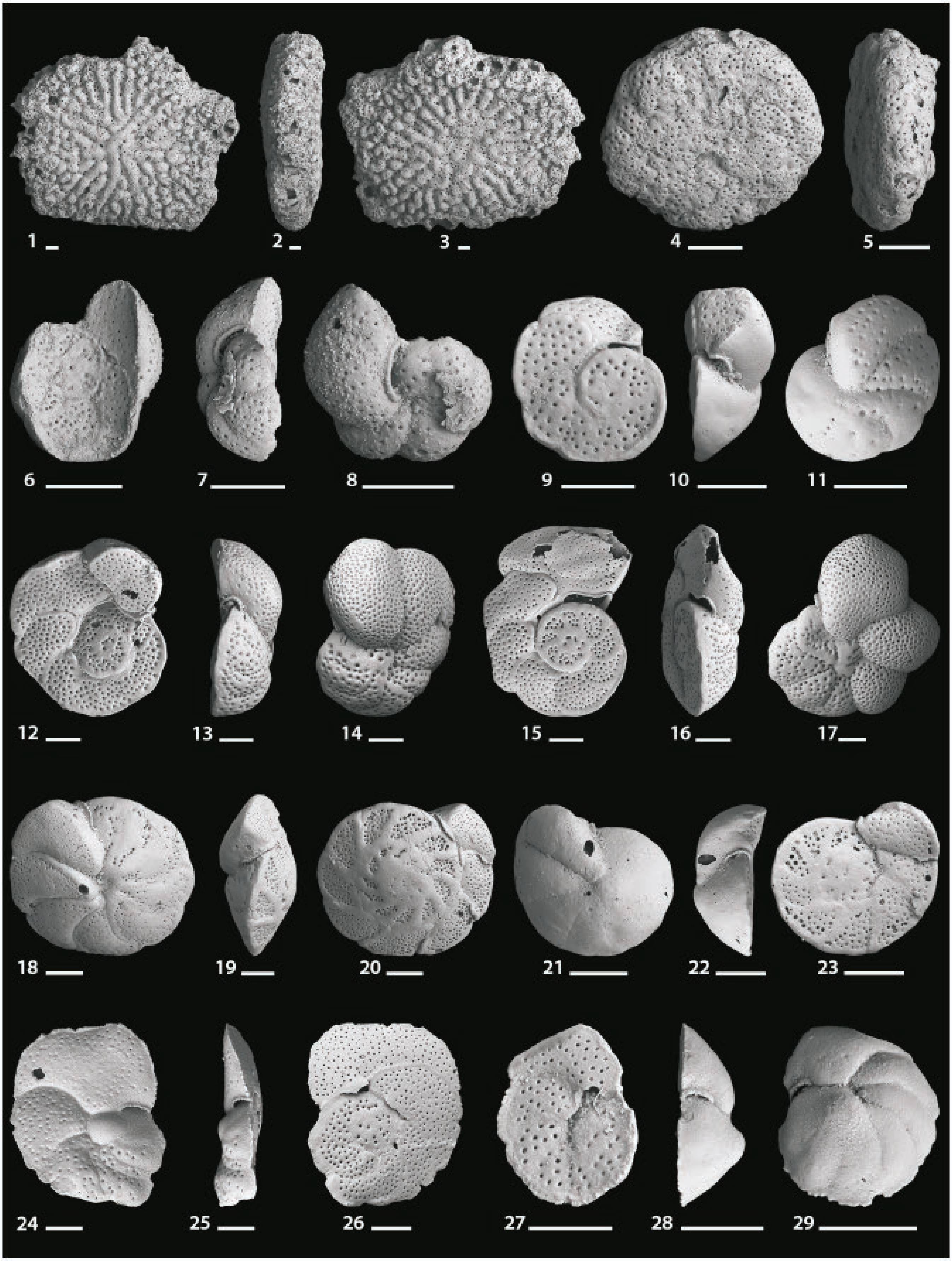
9-17 *Lobatula lobatula* (9-11: W07; 12-14: AW12; 15-17: ER23*).

18-20 *Paracibicides edomica* (U01).

21-23 *Paracibicides* sp. (ER23).

24-26 *Cibicides*? *mayori* (ER23*).

27-29 *Cibicides*? sp. 2 (W08).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Occurrence: Red Sea (Said 1949, Hottinger, Halicz and Reiss 1993), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

Amphistegina radiata (Fichtel and Moll 1798)
Plate 51, figures 1-3

Nautilus radiatus FICHTEL and MOLL 1798, p. 58, pl. 8, figs. a-d.
Amphistegina radiata Fichtel and Moll – HOFKER 1927, p. 76, pl. 29; pl. 30, figs. 2-4, 6, 7.
Amphistegina radiata (Fichtel and Moll) – MAKLED and LANGER 2011, p. 248, fig. 10: 1, 2. – PARKER 2009, p. 499, fig. 356a-j. – DEBENAY 2012, p. 216, 319.

Occurrence: Red Sea (Fichtel and Moll 1798), Raja Ampat (Hofker 1927), Caroline Islands (Makled and Langer 2011), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

***Amphistegina* sp.**
Plate 51, figures 12-16

? *Amphistegina* sp. 1 PARKER and GISCHLER 2011, pl. 5, figs. 15-17.
? *Amphistegina quoii* d'Orbigny – DEBENAY 2012, p. 216, 319.

Remarks: This species resembles juvenile forms of *Amphistegina radiata*. It differs from the latter in the smaller and more flattened shape and by oblique sutures.

Occurrence: ? Maldives (Parker and Gischler 2011), ? New Caledonia (Debenay 2012).

Superfamily NONIONOIDEA Schultze 1854
Family NONIONIDAE Schultze 1854
Subfamily ASTRONONOININAE Saidova 1981
Astrononion Cushman and Edwards 1937

Astrononion stelligerum (d'Orbigny 1839)
Plate 42, figures 4, 5

Nonionina stelligera D'ORBIGNY 1839, p. 128, pl. 3, figs. 1, 2.
Astrononion stelligerum (d'Orbigny) – CUSHMAN 1939, p. 36, pl. 10, fig. 1. – LOEBLICH and TAPPAN 1994, p. 158, pl. 344, figs. 11-14.

Occurrence: Canary Islands (d'Orbigny 1839), Timor Sea (Loeblich and Tappan 1994).

Subfamily NONIONINAE Schultze 1854
Nonionella Cushman 1926

Nonionella auris (d'Orbigny 1839)
Plate 42, figures 6-8

Valvulina auris D'ORBIGNY 1839, p. 47, pl. 2, figs. 15-17.
Nonionides auris (d'Orbigny) – LOEBLICH and TAPPAN 1994, p. 158, pl. 345, figs. 5-16.

Occurrence: Chile (d'Orbigny 1839), Timor Sea (Loeblich and Tappan 1994).

Nonionella? sp.
Plate 41, figures 31-33

Description: Test small, low trochospiral, laterally slightly compressed, periphery rounded; spiral side more evolute, umbilical side more involute; chambers numerous, gradually increasing in size as added, small, flap-like projections of the chambers partially cover the umbilicus on the umbilical side; sutures slightly compressed and curved, indistinct in the early stage; wall smooth, finely perforate; apertural face ornamented with a few low pustules or spines; aperture an interiomarginal arch extending to the umbilical side.

Nonionoides Saidova 1975

Nonionoides grateloupi (d'Orbigny 1826)
Plate 42, figures 1-3

Nonionina grateloupi D'ORBIGNY 1826, p. 294.
Nonionoides grateloupi (d'Orbigny) – LOEBLICH and TAPPAN 1987p. 618, pl. 692, figs. 7-14. – PARKER 2009, p. 675, fig. 475a-h. –

PLATE 36
Scale bar is 100 µm unless otherwise indicated.

1-6 *Cibicides mabahethi* (1-3: FW; 4-6: B14).

7-9 *Cibicides* cf. *C. phillipensis* (W07).

10, 11 *Cibicides*? sp. 1 (U16).

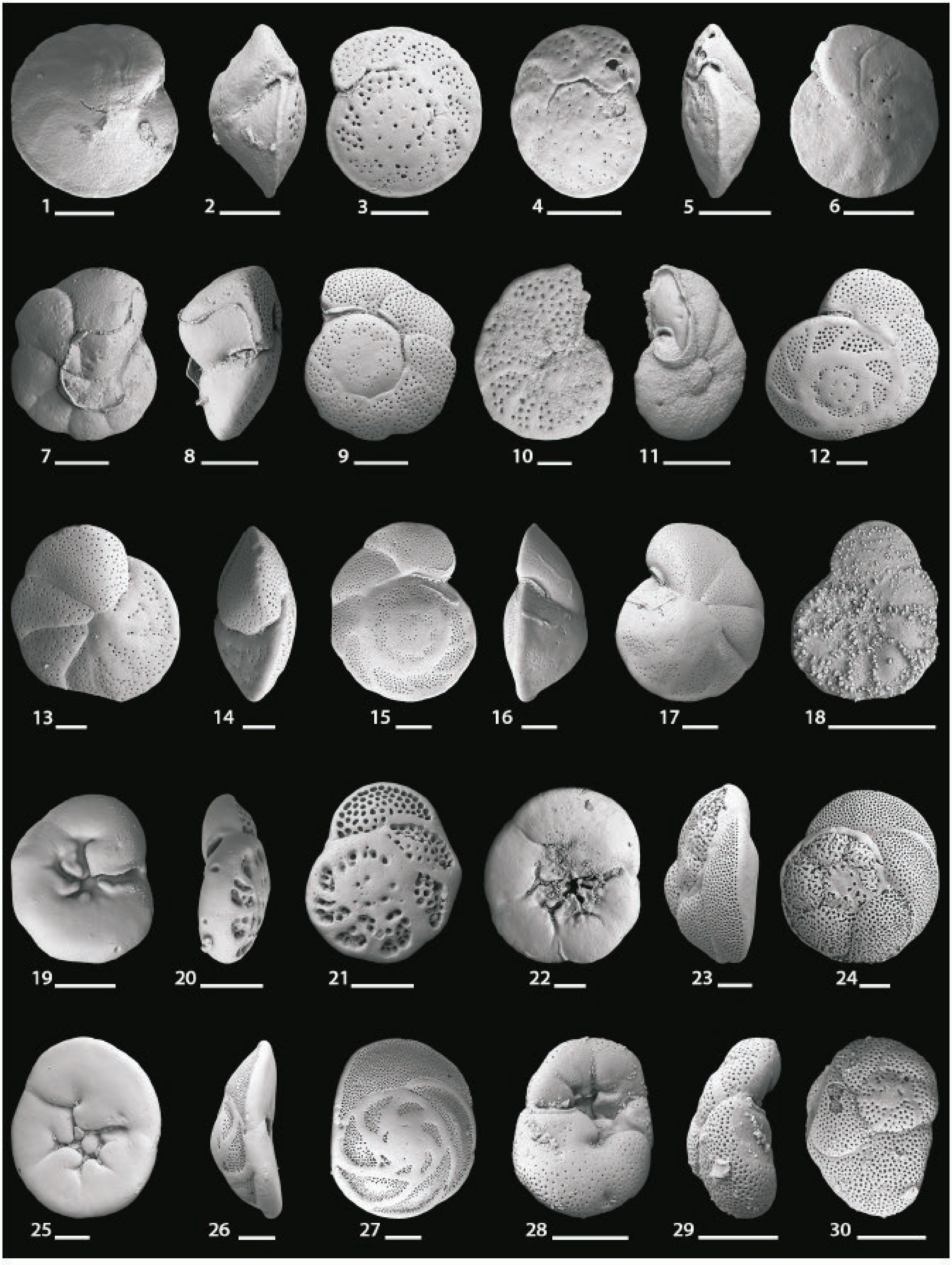
12-17 *Heterolepa subhaidingeri* (12-14: B14; 15-17: MR17).

18 *Torresina* sp. (B15).

19-24 *Rosalina orientalis*? (19-21: W08; 22-24: CM).

25-27 *Rosalina* aff. *R. orientalis* (MI05).

28-30 *Rosalina globularis* (B14).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DEBENAY 2012, p. 227, 320. – THISSEN and LANGER 2017, p. 60, pl. 19, figs. 21-23.
Nonionella amplilabrata Belford – BACCAERT 1987, p. 268, pl. 107, figs. 2a-c (not fig. 3a-d).
Nonionides grateloupi d'Orbigny – FAJEMILA, LANGER and LIPPS 2015, fig. 2: 27.

Occurrence: Cuba (d'Orbigny 1826), Timor Sea (Loeblich and Tappan 1987), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Zanzibar (Thissen and Langer 2017), Great Barrier Reef (Baccaert 1987), Moorea (Fajemila, Langer and Lipps 2015), Madang, Papua New Guinea (Langer unpubl. data).

Subfamily PULLENIINAE Schwager 1877
Melonis de Montfort 1808

***Melonis* sp.**
Plate 42, figures 12-14

Melonis sp. 1 PARKER 2009, p. 638, fig. 451a-e.

Remarks: For details on the morphology see description and remarks in Parker (2009).

Occurrence: Ningaloo Reef (Parker 2009).

Family ALMAENIDAE Myatlyuk in Rauzer-Chernousova and Fursenko 1959
Subfamily ANOMALINELLINAE Saidova 1981
Anomalinella Cushman 1927

***Anomalinella rostrata* (Brady 1881)**
Plate 43, figures 1-3

Truncatulina rostrata BRADY 1881, p. 65. – BRADY 1884, p. 668, pl. 94, figs. 6 a-c. – CUSHMAN 1924, p. 38, pl. 11, figs. 6, 7.
Anomalinella rostrata (Brady) – GRAHAM and MILITANTE 1959, p. 115, pl. 19, figs. 9 a, b. – CHENG and ZHENG 1978, p. 243, pl. 21, fig. 9a, b. – BACCAERT 1987, p. 269, pl. 109, figs. 1a, b. – HATTA and UJIIÉ 1992, p. 197, pl. 43, fig. 3. – LOEBLICH and TAPPAN 1994, p. 160, pl. 349, figs. 1-8. – LANGER and LIPPS 2003, p. 152, fig. 7 B: e. – PARKER and GISCHLER 2011, pl. 4, figs. 16, 17. – MAKLED and LANGER 2011, p.248, fig. 8: 8, 9. – DEBENAY 2012, p. 217, 320. – THISSEN and LANGER 2017, p. 60, pl. 19, figs. 24-26.
Anomalinella rostrata Brady – FAJEMILA, LANGER and LIPPS 2015, fig. 2: 15.

Occurrence: Papua New Guinea (Brady 1881), Admiralty Islands (Brady 1884), Samoa (Cushman 1924), Philippines (Graham and Militante 1959), Xisha Islands (Cheng and Zheng 1978), Great Barrier Reef (Baccaert 1987), Ryukyus (Hatta and Ujiié 1992), Timor Sea (Loeblich and Tappan 1994), Madang, Papua New Guinea (Langer and Lipps 2003), Maldives (Parker and Gischler 2011), Caroline Islands (Makled and Langer 2011), New Caledonia (Debenay 2012), Zanzibar (Thissen and Langer 2017), Moorea (Fajemila, Langer and Lipps 2015).

Superfamily CHILOSTOMELLOIDEA Brady 1881
Family ALABAMINIDAE Hofker 1951
Oridorsalis Andersen 1961

***Oridorsalis*? sp.**
Plate 40, figures 15-17

Description: Test lenticular, subcircular in lateral view, spiral side flattened, umbilical side convex, outline subcircular, lobulate, with a weak carina; number of chambers indeterminate; wall finely perforate, smooth; aperture a low interiomarginal slit, secondary openings indeterminate.

Remarks: This species is represented by a single specimen only. The apertural features do not allow a reliable generic assignment. Loeblich and Tappan (1994; pl. 270, figs. 1-10) depicted a similar specimen of *Eponides pusillus* Parr.

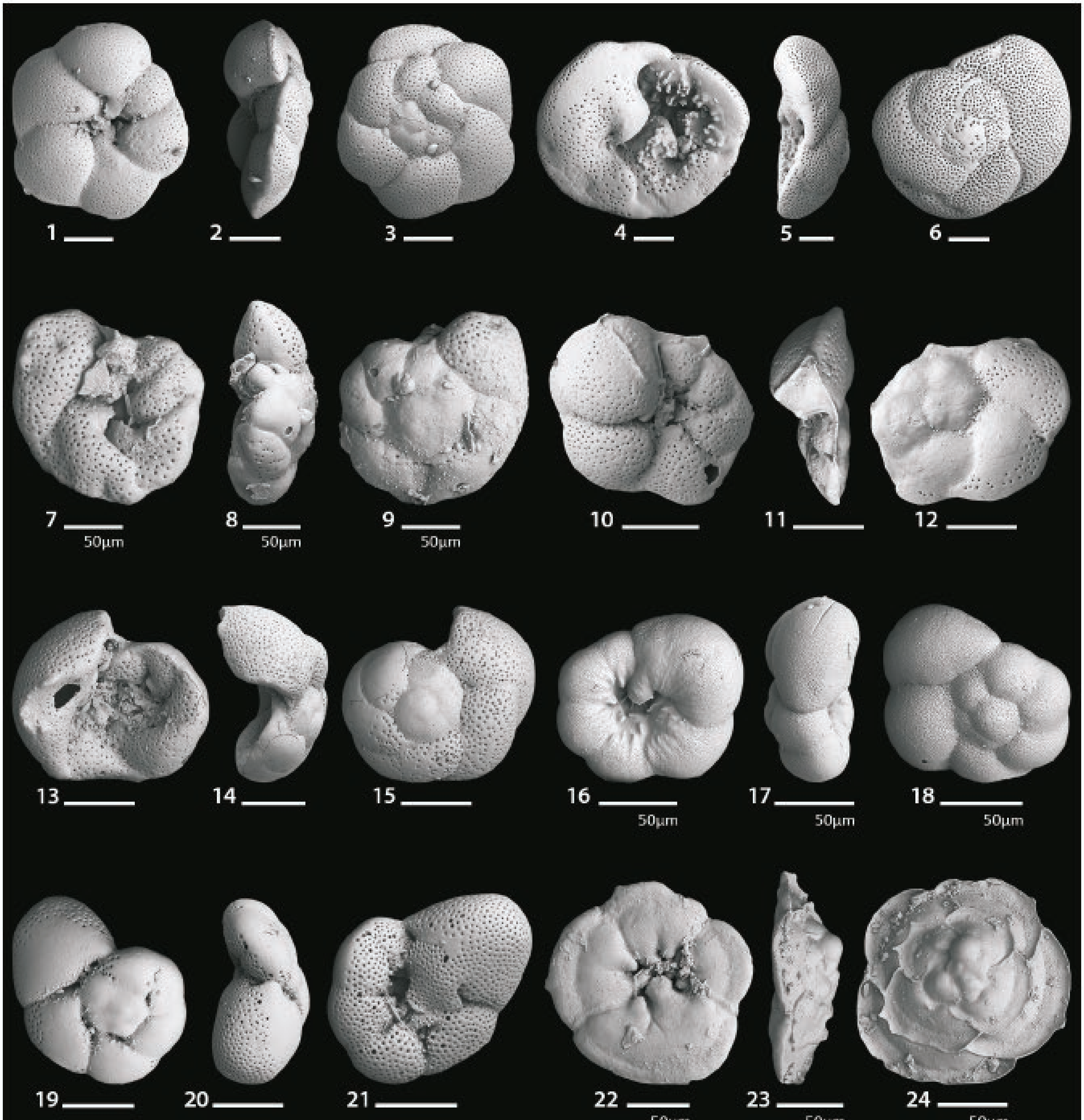
Family HETEROLEPIDAE Gonzáles-Donoso 1969
Anomalinoides Brotzen 1942

***Anomalinoides* cf. *A. cavus* Belford 1966**
Plate 42, figures 15-17

cf. *Anomalinoides cavus* BELFORD 1966, Miocene, Papua New Guinea, p. 180, pl. 33, figs. 1-8.

PLATE 37
Scale bar is 100 µm unless otherwise indicated.

1-3 *Rosalina*? sp. 1 (AW12).
4-6 *Rosalina* sp. 2 (MI05).
7-9 *Rosalina* sp. 3 (Y24).
10-12 *Rosalina*? sp. 4 (W08).
13-15 *Rosalina*? sp. 5 (U16).
16-18 *Valvulineria*? sp. (MS04).
19-21 *Monspeliensina*? sp. (W08).
22-24 *Orbitina taguscovensis* (Y25).
25-27 *Orbitina carinata* (N18).
28-30 *Orbitina exquisita*? (N18).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Remarks: The figures by Belford (1966) show a specimen with slightly less inflated chambers.

Occurrence: *Anomalinoides cavus* was originally described from the Miocene of Papua New Guinea.

Anomalinoides globulosus (Chapman and Parr 1937)
Plate 42, figures 18-20

Anomalina globulosa CHAPMAN and PARR 1937, p. 117, pl. 9, fig. 27.
Anomalinoides globulosus (Chapman and Parr) – VAN MARLE 1991, p. 130, pl. 13, figs. 3-5. – HATTA and UJIIÉ 1992, p. 197, pl. 43, fig. 4. – LOEBLICH and TAPPAN 1994, p. 162, pl. 354, figs. 11-13; pl. 355, figs. 4-13. – DEBENAY 2012, p. 186, 321.

Occurrence: Banda Arc region (van Marle 1991), Ryukyus (Hatta and Ujiié 1992), Timor Sea (Loeblich and Tappan 1994), New Caledonia (Debenay 2012).

Heteroplepa Franzenau 1884

Heterolepa subhaidingeri (Parr 1950)
Plate 36, figures 12-17

Truncatulina haidingerii d'Orbigny – BRADY 1884, p. 663, pl. 95, fig. 7.
Truncatulina haidingerii (d'Orbigny) – CUSHMAN 1921, p. 315, pl. 64, fig. 3.
Cibicides subhaidingeri PARR 1950, p. 364, pl. 15, fig. 7. – CHENG and ZHENG 1978, p. 233, pl. 21, fig. 7a-c.
Heterolepa subhaidingeri (Parr) – LOEBLICH and TAPPAN 1994, p. 163, pl. 359, figs. 1-13. – DEBENAY 2012, p. 199, 321.

Remarks: The entire group of *Cibicides* and *Heterolepa* requires further study (see also remarks in Parker, 2009; p. 529).

Occurrence: Torres Strait (Brady 1884), Philippines (Cushman 1921), Antartica (Parr 1950), Xisha Islands (Cheng and Zheng 1978), Sahul Shelf (Loeblich and Tappan 1994), New Caledonia (Debenay 2012).

Family GAVELINELLINAE Hofker 1956
Subfamily GAVELINELLINAE Hofker 1956
Anomalinulla Saidova 1975

Anomalinulla glabrata (Cushman 1924)
Plate 42, figures 9-11

Anomalina glabrata CUSHMAN 1924, p. 39, pl. 12, figs. 5-7. – GRAHAM and MILITANTE 1959, p. 115, pl. 19, figs. 8a-c. – HOTTINGER, HALICZ and REISS 1993, p. 139, pl. 197, figs. 6-11. – PARKER 2009, p. 508, fig. 361a-l. – DEBENAY 2012, p. 187, 321. – THISSEN and LANGER 2017, p. 62, pl. 20, figs. 1-3.

Occurrence: Samoa (Cushman 1924), Philippines (Graham and Militante 1959), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Zanzibar (Thissen and Langer 2017).

***Anomalinulla* sp.**
Plate 42, figures 21-32

Anomalinulla sp. 2 PARKER 2009, p. 512, fig. 364a-e.

Remarks: For details on the morphology see description and remarks in Parker (2009).

Occurrence: Ningaloo Reef (Parker 2009).

Hanzawaia Asano 1944

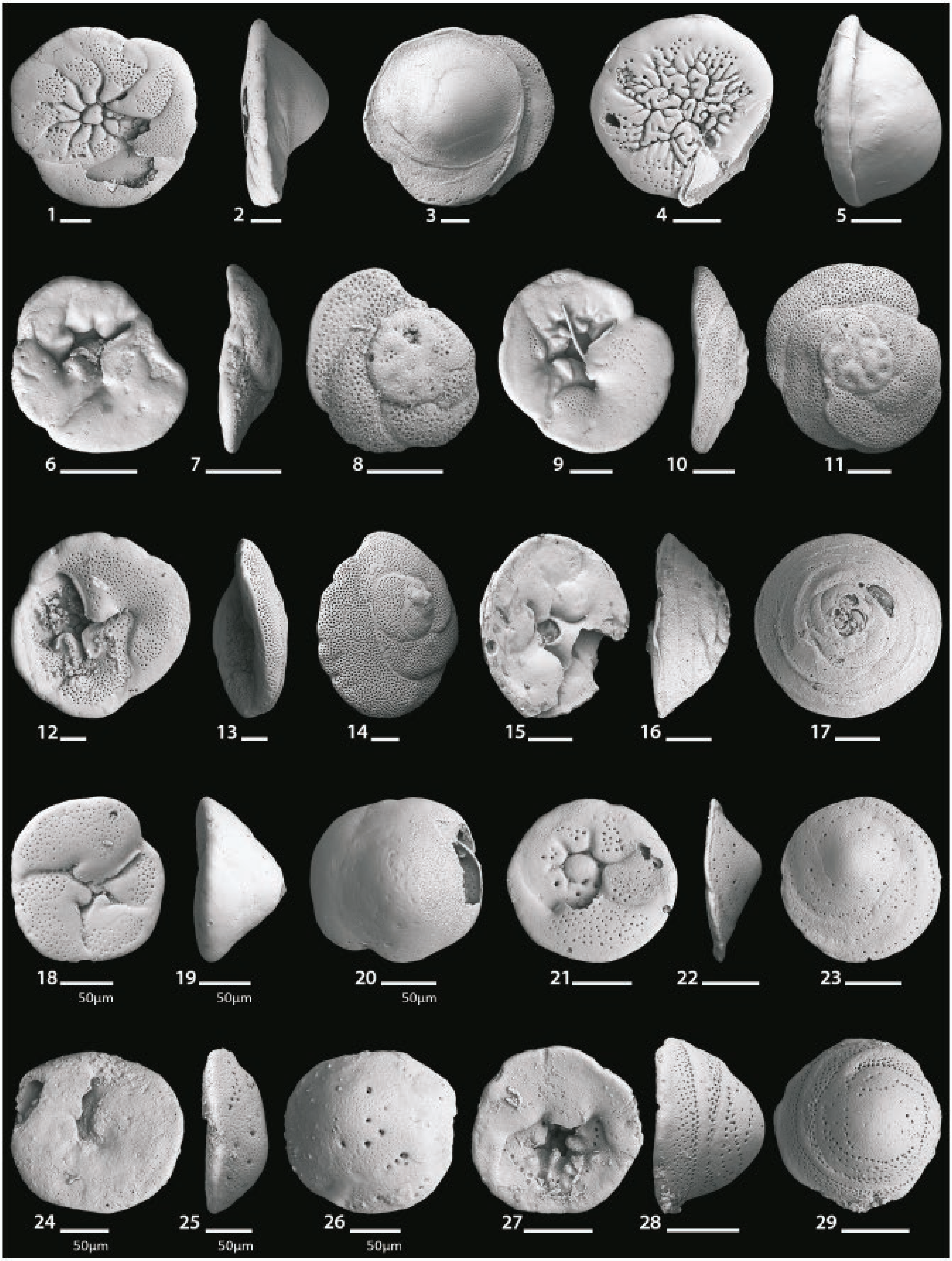
Hanzawaia* cf. *H. nipponica Asano 1944
Plate 39, figures 19-21

cf. *Hanzawaia nipponica* ASANO 1944, p. 98, 99, pl. 4, figs. 1, 2.
Hanzawaia cf. *H. nipponica* Asano – PARKER 2009, p. 623, fig. 442a-h.

Occurrence: Ningaloo Reef (Parker 2009). *Hanzawaia nipponica* was originally described from the Pliocene of Japan.

PLATE 38
Scale bar is 100 µm unless otherwise indicated.

1-3 *Neoconorbina petasiformis* (B14).
4,5 *Neoconorbina*? sp. 3 (CK).
6-11 *Neoconorbina* sp. 2 (6-8: OT; 9-11: CK*).
12-14 *Neoconorbina crustata* (B14).
15-17 *Neoconorbina terquemi* (U01).
18-20 *Neoconorbina* sp. 1 (N18).
21-23 *Neoconorbina* cf. *N. albida* (ER22).
24-26 *Neoconorbina*? sp. 4 (OT).
27-29 *Neoconorbina*? sp. 5 (U01).



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Superfamily ROTALIOIDEA Ehrenberg 1839 (ROTALIACEA according to Hottinger 2014)
Family ROTALIIDAE Ehrenberg 1839
Subfamily PARAROTALIINAE Reiss 1963
Ammonia Brünnich 1772

Ammonia* cf. *A. tepida (Cushman 1926) **Type 1**
Plate 49, figures 1-3

cf. *Rotalia beccarii* (Linnaeus) var. *tepida* CUSHMAN 1926, p. 79, pl. 1.

Remarks: This variety has a flat umbilical side and a more lobulate periphery compared to *Ammonia* cf. *A. tepida* Type 2.

Occurrence: *Ammonia tepida* was originally described from Puerto Rico.

Ammonia* cf. *A. tepida (Cushman 1926) **Type 2**
Plate 49, figures 4-6

cf. *Rotalia beccarii* (Linnaeus) var. *tepida* CUSHMAN 1926, p. 79, pl. 1.

Remarks: This variety is more strongly biconvex than *Ammonia* cf. *A. tepida* Type 1.

Occurrence: *Ammonia tepida* was originally described from Puerto Rico.

Neorotalia Bermúdez 1952

Neorotalia calcar (d'Orbigny 1826)
Plate 49, figures 7-11

Calcarina calcar D'ORBIGNY 1826, p. 276, modèle no. 34. – d'Orbigny 1839, p. 81, pl. 5, figs. 22-24. – LE CALVEZ 1977, p. 15, pl. 2, figs. 1-5. – HOTTINGER and LEUTENEGGER 1980, p. 123-124, pl. 1, figs. 1-17.
Rotalia defrancei (d'Orbigny) – MÖBIUS 1880, p. 104-105, pl. 14, figs. 1-7.
Rotalia calcar (d'Orbigny) – BRADY 1884, p. 709, pl. 108, fig. 3. – HOFKER 1927, p. 37, pl. 17, figs. 1-13.
Pararotalia calcar (d'Orbigny) – CHENG and ZHENG 1978, p. 221, pl. 25, figs. 2-7.
Neorotalia calcar (d'Orbigny) – HOTTINGER, HALICZ and REISS 1991, p. 23, figs. 4.1-4.6, 5.1-5.4, 6.1-6.6, 7.1-7.2. – HOTTINGER, HALICZ and REISS 1993, p. 140, pl. 199, figs. 1-10. – LANGER and LIPPS 2003, p. 152, fig. D: f. – RENEMA 2003, p. 347, 348, figs. 13a, b. – PARKER 2009, p. 668, figs. 472a-f, 473a-i. – DEBENAY 2012, p. 204, 205, 323. – LANGER et al. 2013, fig. 8: 27.

Occurrence: Caribbean, Mauritius and Madagascar (d'Orbigny 1826), Cuba (d'Orbigny 1839), Mauritius (Möbius 1880), Miocene, Malta (Brady 1884), Raja Ampat (Hofker 1927), Xisha Islands (Cheng and Zheng 1978), Gulf of Aqaba (Hottinger, Halicz and Reiss 1991, 1993), Madang, Papua New Guinea (Langer and Lipps 2003), Indonesia (Renema 2003), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012), Bazaruto (Langer et al. 2013).

Family CALCARINIDAE Schwager 1876
Baculogypsina Sacco 1893

Baculogypsina sphaerulata (Parker and Jones 1860)
Plate 49, figures 20-23

Orbitolina concava var. *sphaerulata* PARKER and JONES 1860, p. 34, 38.
Baculogypsina sphaerulata (Parker and Jones) – GRAHAM and MILITANTE 1959, p. 105, pl. 17, fig. 1. – HOTTINGER and LEUTENEGGER 1980, p. 125, pl. 9, figs. 1-11. – BACCAERT 1987, p. 242, pl. 99, figs. 2, 3. – HATTA and UJIIÉ 1992, p. 199, pl. 44, figs. 3-5. – LANGER and LIPPS 2003, p. 152, fig. D: f. – MAKLED and LANGER 2011, p. 248, fig. 10: 8, 9.) – HOHENEGGER 2011, p. 35, 61. – DEBENAY 2012, p. 234, 323.

Occurrence: Philippines (Graham and Militante 1959), Indonesia (Hottinger and Leutenegger 1980), Great Barrier Reef

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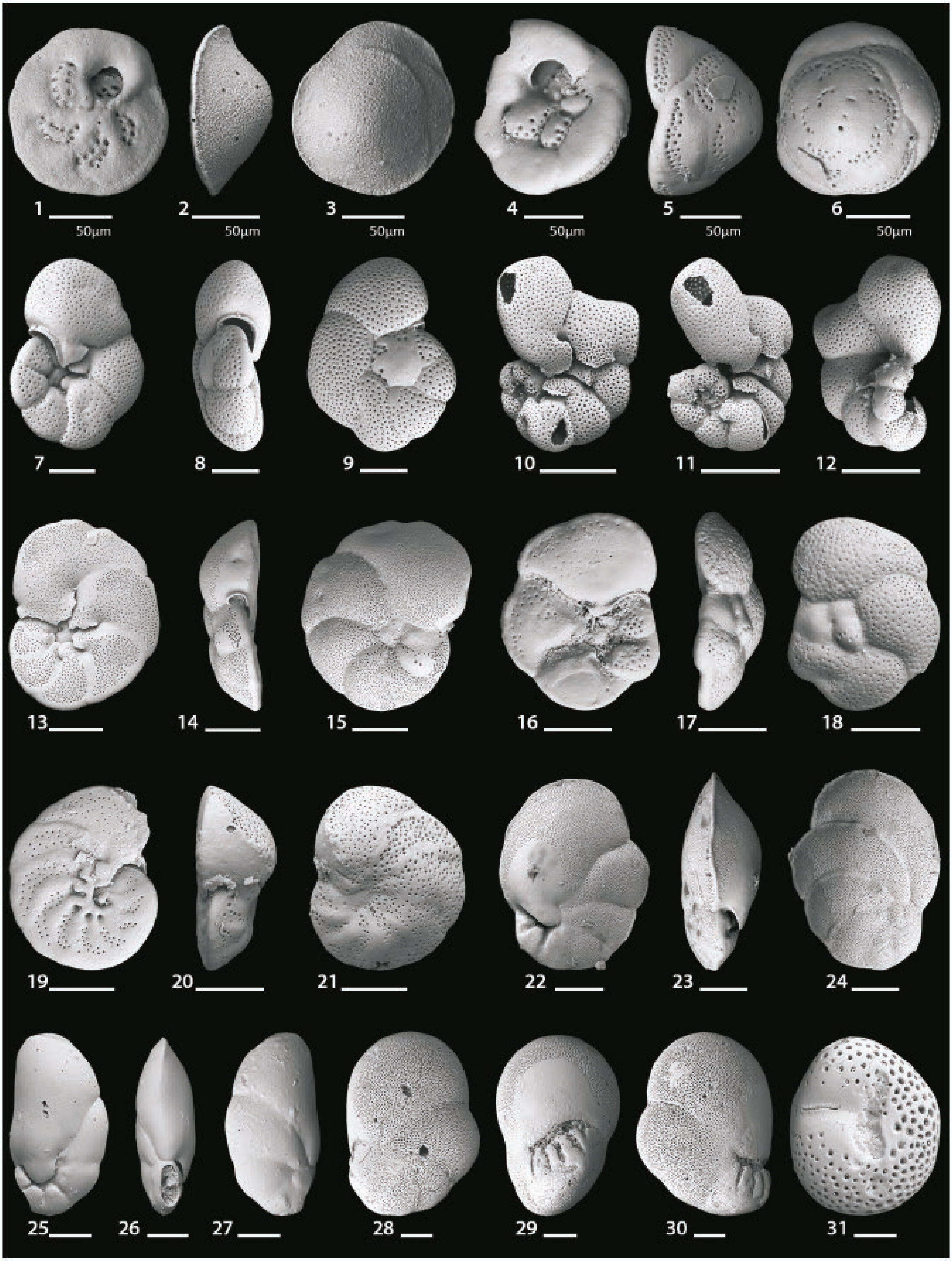
PLATE 39
Scale bar is 100 µm unless otherwise indicated.

1-3 *Neoconorbina*? sp. 6 (MS04).
4-6 *Eoeponidella pulchella* (MS04).
7-9 *Discorbia candeiana* (MS03).
10-12 *Discorbia*? sp. (CM)
13-15 *Discorbinella bertheloti* (W07*).
16-18 *Discorbinella*? sp. (B15).
19-21 *Hanzawaia* cf. *H. nipponica* (19: ER23*; 20, 21: ER22).
22-24 *Cancris auriculus* (W08).
25-27 *Cancris oblongus* (B15).
28-30 *Cancris bubnanensis* (U01).
31 *Cribrobaggina reniformis* (Ms).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(Baccaert 1987), Ryukyu Islands (Hatta and Ujiié 1992), Madang, Papua New Guinea (Langer and Lipps 2003), Caroline Islands (Makled and Langer 2011), New Caledonia (Debenay 2012).

Baculogypsinoides Yabe and Hanzawa 1930

Baculogypsinoides spinosus Yabe and Hanzawa 1930
Plate 49, figure 16

Baculogypsina tetraedra (Gümbel) – HOFKER 1927, p. 48, pl. 23, figs. 1-3, 5 (not fig. 4; pl. 24, figs. 1-7, 9.
Baculogypsinoides spinosus – YABE and HANZAWA 1930, p. 45, pl. 2, fig. 7; pl. 9, fig. 13 – GRAHAM and MILITANTE 1959, p. 106, pl. 17, figs. 2-4. – ZHENG 1980, p. 169, pl. 6, figs. 1-5; pl. 7, figs. 1-6; pl. 8, figs. 1-6. – HATTA and UJIIÉ 1992, p. 199, pl. 44, figs. 6-8. – LOEBLICH and TAPPAN 1994, p. 166, pl. 373, figs. 8-11; pl. 374, figs. 1-9. – HOHENEGGER et al. 1999, p. 152, fig. 26. – RENEMA 2003, p. 351, figs. 21, 22.

Occurrence: Raja Ampat (Hofker 1927), Taiwan, fossil (Yabe and Hanzawa 1930), South China Sea (Zheng 1980), Philippines (Graham and Militante 1959), Timor Sea (Loeblich and Tappan 1994), Ryukyus (Hatta and Ujiié 1992, Hohenegger et al. 1999), Bali (Renema 2003).

Calcarina d'Orbigny 1826

Calcarina defrancei d'Orbigny 1826
Plate 49, figures 17-19

Calcarina defrancei D'ORBIGNY 1826, p. 276, pl. 13, figs. 5-7.
Calcarina defrancii d'Orbigny – BRADY 1884, p. 714, pl. 108, fig. 6. – HOTTINGER and LEUTENEGGER 1980, p. 124, pls 2, 3, 7: 4-6. – HATTA and UJIIÉ 1992, p. 200, pl. 45, fig. 6. – HOHENEGGER 2011, p. 55, figs. on p. 56.

Occurrence: Papua New Guinea (Brady 1884), Indonesia (Hottinger and Leutenegger 1980), Ryukyu Islands (Hatta and Ujiié 1992).

Calcarina gaudichaudii d'Orbigny in Ehrenberg 1826
Plate 49, figures 24-26

Calcarina gaudichaudii D'ORBIGNY 1826, p. 276 [nomen nudum].
Calcarina gaudichaudii D'ORBIGNY in EHRENBERG 1840, p. 131. – HOTTINGER and LEUTENEGGER 1980, p. 124, pls 4, 5. – HATTA and UJIIÉ 1992, p. 201, pl. 47, figs. 1-6. – RENEMA and HOHENEGGER 2005, p. 18, pl. 2, figs. 10-19. – HOHENEGGER 2011, p. 55, figs. on p. 57.
Calcarina spengleri (Gmelin). – GRAHAM and MILITANTE 1959, p. 107, pl. 17, figs. 9-12 (not fig. 13).

Occurrence: Indonesia (Hottinger and Leutenegger 1980), Ryukyu Islands (Hatta and Ujiié 1992), Philippines (Graham and Militante 1959, Renema and Hohenegger 2005).

Calcarina hispida Brady 1876
Plate 50, figures 14-16

Calcarina hispida BRADY 1876, p. 589. – BRADY 1884, p. 713, pl. 108, figs. 8, 9. – MCCULLOCH 1977, p. 432, pl. 155, figs. 7a-c. – CHENG and ZHENG 1978, p. 222, pl. 27, figs. 1-10; pl. 33, fig. 8. – RENEMA and HOHENEGGER 2005, p. 18, pl. 1, figs. 1-13 (not figs. 14-19). – DEBENAY 2012, p. 189, 323.
Calcarina hispida (no reference given) – HOHENEGGER 2011, p. 56, figs. on p. 58, 59.

Occurrence: Ryukyu Islands (Brady 1876), Pacific (Brady 1884), Murray Island, Australia (McCulloch 1977), Xisha Islands (Cheng and Zheng 1978), Philippines (Renema and Hohenegger 2005), New Caledonia (Debenay 2012).

Calcarina* cf. *C. hispida (Brady 1876)
Plate 49, figures 12-15

cf. *Calcarina hispida* BRADY 1876, p. 589.

Remarks: This spinose calcarinid species differs from *Calcarina hispida* in the more flattened shape and in having more numerous spines. It differs from *Neorotalia calcar* in having more robust spines and in the spinose ornamentation.

Calcarina mayori Cushman 1924
Plate 50, figures 12, 13

Calcarina spengleri Linné – BRADY 1884, p. 712, pl. 108, fig. 7 (not fig. 5).
Calcarina mayori CUSHMAN 1924, p. 44, pl. 14, figs. 4-7. – LOEBLICH and TAPPAN 1994, p. 167, pl. 375, figs. 1, 2; pl. 376, figs.

PLATE 40
Scale bar is 100 µm unless otherwise indicated.

1-11 *Eponides repandus* (1-3, 10, 11: Ms; 4-6: B14; 7-9: Ms*).

12-14 *Poroeponides lateralis* (W07).

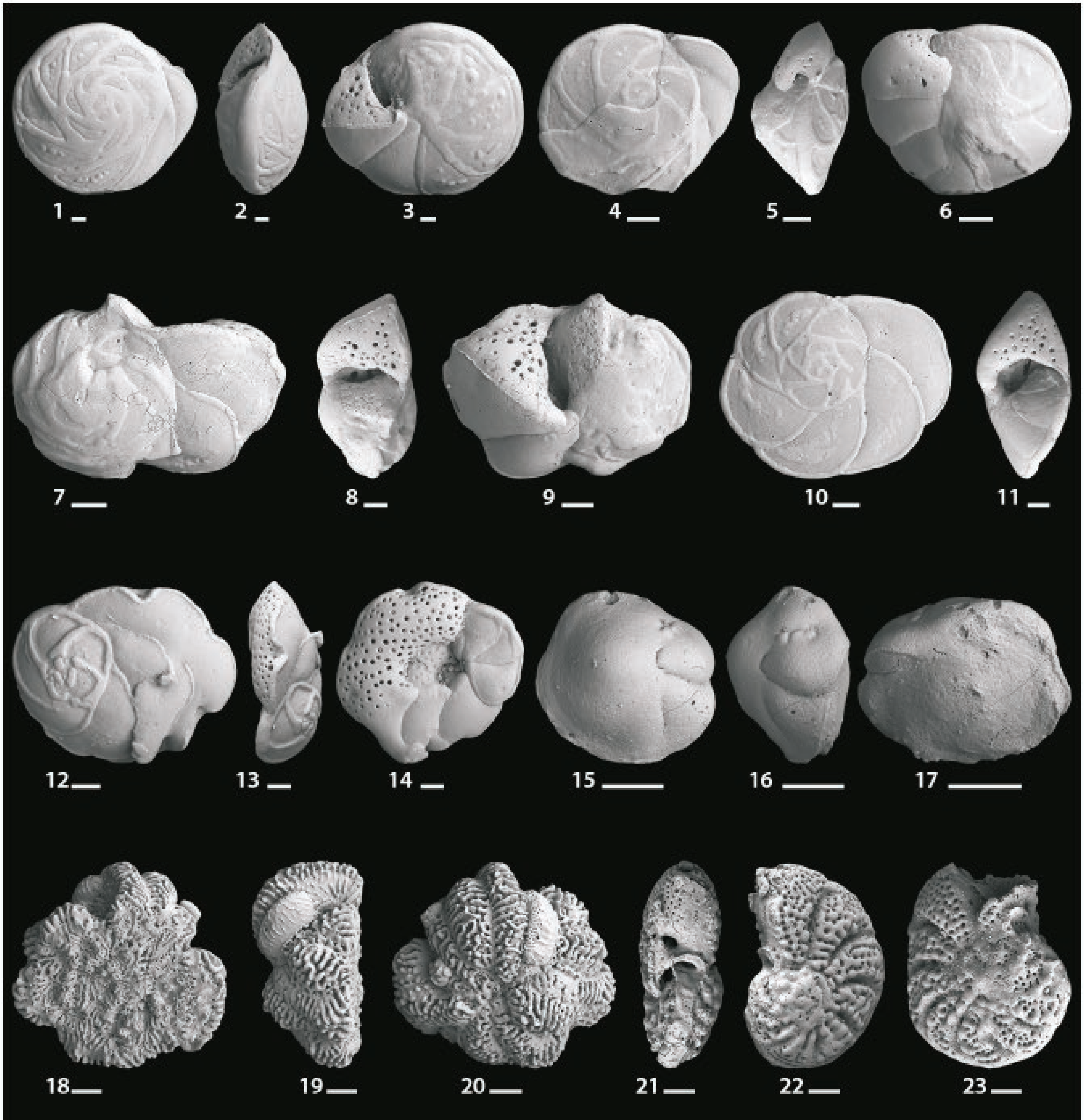
15-17 *Oridorsalis*? sp. (U16).

18-20 *Cristatavultus pacificus* (B14).

21-25 *Epistomaroides* sp. (21, 22: MS04; 23-25: AW13).

26,27 *Elphidium*? *hispidulum* (W07*).

28,29 *Elphidium* cf. *E. milletti* (AP10).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1-5. – RENEMA and HOHENEGGER 2005, p. 16, fig. 2, pl. 1, figs. 14-21 (not figs. 22-24).
Calcarina mayori (no reference given) – HOHENEGGER 2011, p. 56, figs. on p. 59.

Occurrence: Indonesia (Brady 1884), Samoa (Cushman 1924), Timor Sea (Loeblich and Tappan 1994), Indonesia and Philippines (Renema and Hohenegger 2005).

Calcarina spengleri (Gmelin 1791)
Plate 50, figures 1-11

"Ammonshorn" SPENGLER 1781, p. 379, pl. 2, figs. 9a-c.
Nautilus spengleri GMELIN 1791, p. 3371.
Calcarina spengleri Linné – BRADY 1884, p. 712, pl. 108, fig. 5 (not fig. 7).
Calcarina spengleri (Gmelin) – GRAHAM and MILITANTE 1959, p. 107, pl. 17, fig. 9 (not figs. 8, 10-13). – RENEMA and HOHENEGGER 2005, p. 16, fig. 1, pl. 2, figs. 1-10 (not pl. 1, figs. 1-10).
Calcarina hispida Brady – GRAHAM and MILITANTE 1959, p. 106, pl. 17, fig. 5 (not figs. 6, 7).

Occurrence: Indonesia (Gmelin 1791, Brady 1884, Renema and Hohenegger 2005), Philippines (Graham and Militante 1959, Renema and Hohenegger 2005).

Family ELPHIDIIDAE Galloway 1933
Subfamily ELPHIDIINAE Galloway 1933
Elphidium Galloway 1933

Elphidium* cf. *E. alvarezianum d'Orbigny 1839
Plate 40, figures 9, 10

cf. *Polystomella alvareziana* D'ORBIGNY 1839, p. 31, pl. 3, figs. 11, 12.

Occurrence: *Elphidium alvarezianum* was originally described from Patagonia, Argentina and the Falkland Islands.

Elphidium botaniense Albani 1981
Plate 40, figures 23-24

Elphidium botaniense ALBANI 1981, p. 155, figs. 4j, n. – PARKER 2009, p. 572, fig. 404a-h. – DEBENAY 2012, p. 218, 324.

Occurrence: New South Wales, Australia (Albani 1981), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

Elphidium craticulatum (Fichtel and Moll 1798)
Plate 40, figures 1-4

Nautilus craticulatus FICHTEL and MOLL 1798, p. 51, pl. 5, figs. h-k.
Polystomella craticulata Fichtel and Moll – HOFKER 1927, p. 56, pl. 27, figs. 1-4.
Elphidium craticulatum (Fichtel and Moll) – HANSEN and LYKKE-ANDERSEN 1976, p. 7, pl. 2, figs. 3-9. – BACCAERT 1987, p. 252, pl. 102, fig. 8; pl. 103, figs. 1a, b. – LANGER and LIPPS 2003, p. 152, fig. 7 B: h. – PARKER 2009, p. 575, fig. 405a-e. – MAKLED and LANGER 2011, p. 248, fig. 10: 10, 11. – DEBENAY 2012, p. 219, 324.
Cellanthus craticulatum (Fichtel and Moll) – CHENG and ZHENG 1978, p. 227, pl. 28, fig. 1a, b; pl. 29, figs. 1, 2. – LOEBLICH and TAPPAN 1994, p. 167, pl. 380, figs. 1-10.

Occurrence: Indian Ocean (Fichtel and Moll 1798), Raja Ampat (Hofker 1927), Banda Sea (Hanse and Lykke-Andersen 1976), Great Barrier Reef (Baccaert 1987), Madang, Papua New Guinea (Langer and Lipps 2003), Ningaloo Reef (Parker 2009), Caroline Islands (Makled and Langer 2011), New Caledonia (Debenay 2012), Xisha Islands (Cheng and Zheng 1978), Timor Sea (Loeblich and Tappan 1994).

Elphidium crispum (Linnaeus 1758)
Plate 40, figures 7, 8

Nautilus crispus LINNAEUS 1758, p. 709 [figured in Plancus 1739, p. cit., pl. 1, figs. 2d-f; pl. 19, figs. a, d.]
Elphidium crispum (Linné) – LOEBLICH and TAPPAN 1994, p. 168, pl. 378, figs. 4-6. – PARKER 2009, p. 576, fig. 406a-h. – DEBENAY 2012, p. 219, 324.

PLATE 41
Scale bar is 100 µm unless otherwise indicated.

1-4 *Elphidium craticulatum* (1, 2: MI05; 3, 4: MS04).

5,6 *Elphidium fichtelianum* (AW13).

7,8 *Elphidium crispum* (Ms).

9,10 *Elphidium* cf. *E. alvarezianum* (U16).

11,12 *Elphidium maorium* (MS03).

13-16 *Elphidium* sp. 2 (13, 14: AP09; 15, 16: AW12).

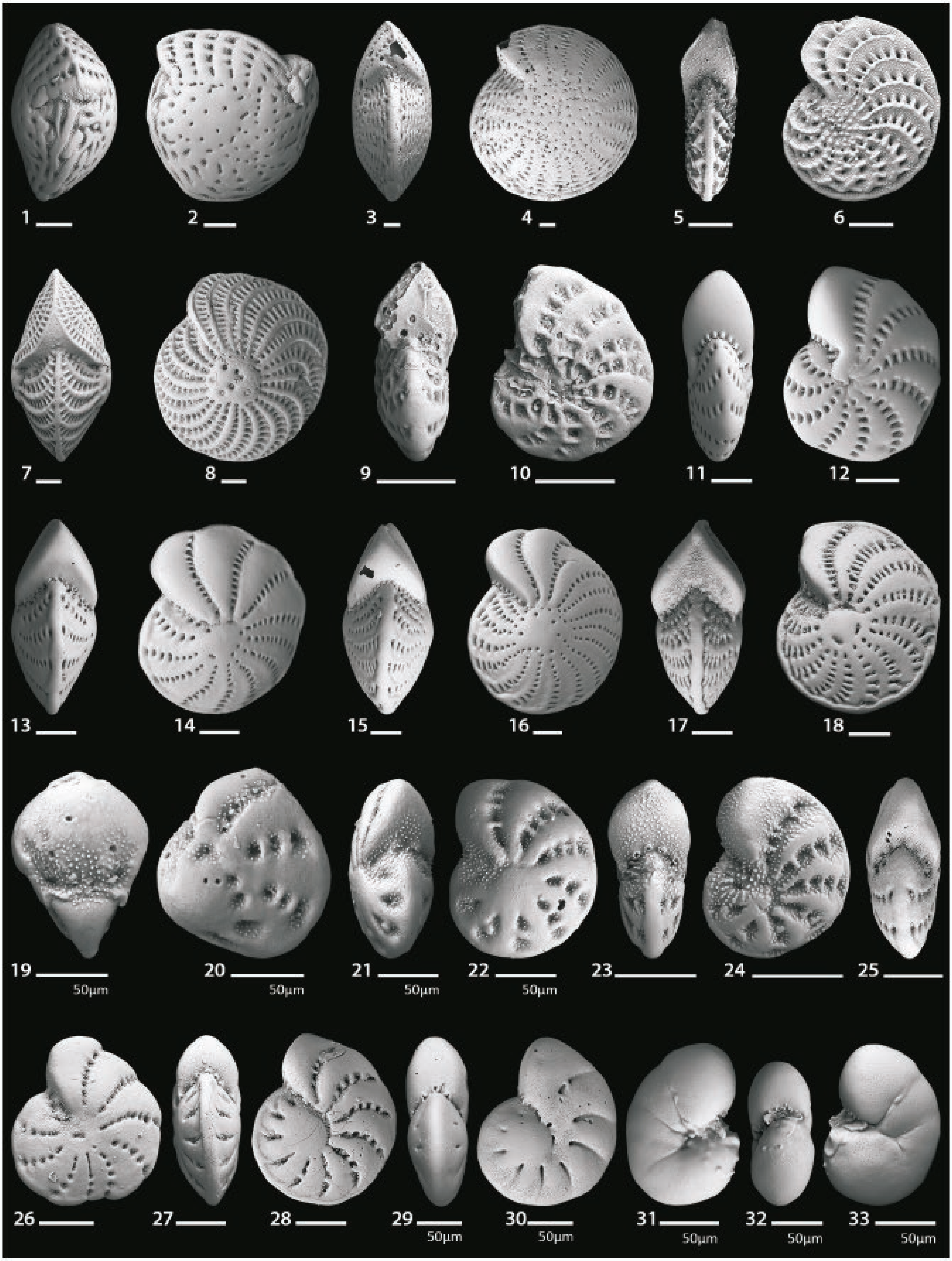
17,18 *Elphidium* sp. 1 (MR18).

19-22, 25-28 *Elphidium tongaense* (19, 20: U16; 21, 22: MS04; 25, 26: ER23*; 27, 28: B14).

23,24 *Elphidium botaniense* (MS04)

29,30 *Elphidium lene* (MS04).

31-33 *Nonionella*? sp. (MR18).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Occurrence: Mediterranean (Linnaeus 1758), Timor Sea (Loeblich and Tappan 1994), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

Elphidium fichtelianum (d'Orbigny 1846)
Plate 40, figures 5, 6

Polystomella fichtelianum D'ORBIGNY 1846, p. 125, pl. 6, figs. 7, 8.
Elphidium jenseni Cushman – HOTTINGER, HALICZ and REISS 1993, p. 148, pl. 211, figs. 8-14. – THISSEN and LANGER 2017, p. 64, pl. 21, figs. 1-3.
Elphidium fichtelianum (d'Orbigny) – DEBENAY 2012, p. 219, 324.
Elphidium jenseni (Cushman) – LANGER et al. 2013, p. 167, fig. 8: 28, 29.

Occurrence: Austria (d'Orbigny 1846), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), Zanzibar (Thissen and Langer 2017), New Caledonia (Debenay 2012), Bazaruto (Langer et al. 2013).

Elphidium? hispidulum (Cushman 1936)
Plate 40, figures 26, 27

Elphidium hispidulum CUSHMAN 1936, p. 83, pl. 14, fig. 3.
Parellina hispidula (Cushman) – LOEBLICH and TAPPAN 1994, p. 170, pl. 384, figs. 5-7; pl. 387, figs. 1-3. – LANGER and LIPPS 2003, p. 152, fig. 7 A: d. – PARKER 2009, p. 683, figs. 482a-f, 483a-e. – DEBENAY 2012, p. 229, 325.

Remarks: The depicted specimen may represent an early stage of development. The generic assignment is questionable. See also remarks in Parker (2009).

Occurrence: Queensland, Australia (Cushman 1936), Timor Sea (Loeblich and Tappan 1994), Madang, Papua New Guinea (Langer and Lipps 2003), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

Elphidium lene Cushman and McCulloch 1940
Plate 41, figures 29, 30

Elphidium incertum (Williamson) var. *lene* CUSHMAN and MCCULLOCH 1940, p. 170, pl. 19, figs. 2, 4.
Elphidium lene Cushman and McCulloch – PARKER 2009, p. 579, figs. 408a-h, 409a-i. – DEBENAY 2012, p. 220, 324.

Occurrence: California (Cushman and McCulloch 1940), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

Elphidium maorium Hayward 1997
Plate 41, figures 11, 12

Elphidium sp. A CHENG and ZHENG 1978, p. 226, pl. 28, fig. 5.
Elphidium advenum maorium HAYWARD 1997, p. 69, pl. 4, figs. 11-14 (not figs. 15, 16; not pl. 5, figs. 1-5).
Elphidium maorium Hayward – DEBENAY 2012, p. 220, 324.

Occurrence: Xisha Islands (Cheng and Zheng 1978), South-West Pacific (Hayward 1997), New Caledonia (Debenay 2012).

Elphidium* cf. *E. milletti (Heron-Allen and Earland 1915)
Plate 40, figures 28, 29

cf. *Polystomella milletti* HERON-ALLEN and EARLAND 1915, p. 735, pl. 53, figs. 38-42.
Elphidium sp. 6 PARKER 2009, p. 600, figs. 426a-h, 427a-h.

Remarks: See also remarks in Parker (2009; p. 600)

Occurrence: Ningaloo Reef (Parker 2009). *Elphidium milletti* was originally described from the Quirimbas.

Elphidium tongaense (Cushman 1931)
Plate 41, figures 19-22, 25-28

Ozawaia tongaensis CUSHMAN 1931, p. 80, pl. 10, figs. 7- 10.
Elphidium tongaense (Cushman) – DEBENAY 2012, p. 221, 325. – THISSEN and LANGER 2017, p. 64, pl. 21, figs. 20-22.

Occurrence: South Pacific (Cushman 1931), New Caledonia (Debenay 2012), Zanzibar (Thissen and Langer 2017).

***Elphidium* sp. 1**
Plate 41, figures 17, 18

Description: Test planispiral, biconvex, subcircular in lateral view, periphery acute with a rounded keel; about 15 chambers in the last whorl; sutures curved backwards, with thin sutural bridges; test ornamented with minute pustules within the fossettes and at the apertural face; aperture a row of multiple openings at the base of the final chamber.

Remarks: A similar species also occurs in southern Africa (Langer unpubl. data).

PLATE 42
Scale bar is 100 µm unless otherwise indicated.

1-3 *Nonionoides grateloupi* (MR18).

4,5 *Astrononion stelligerum* (ER22).

6-8 *Nonionella auris* (N18).

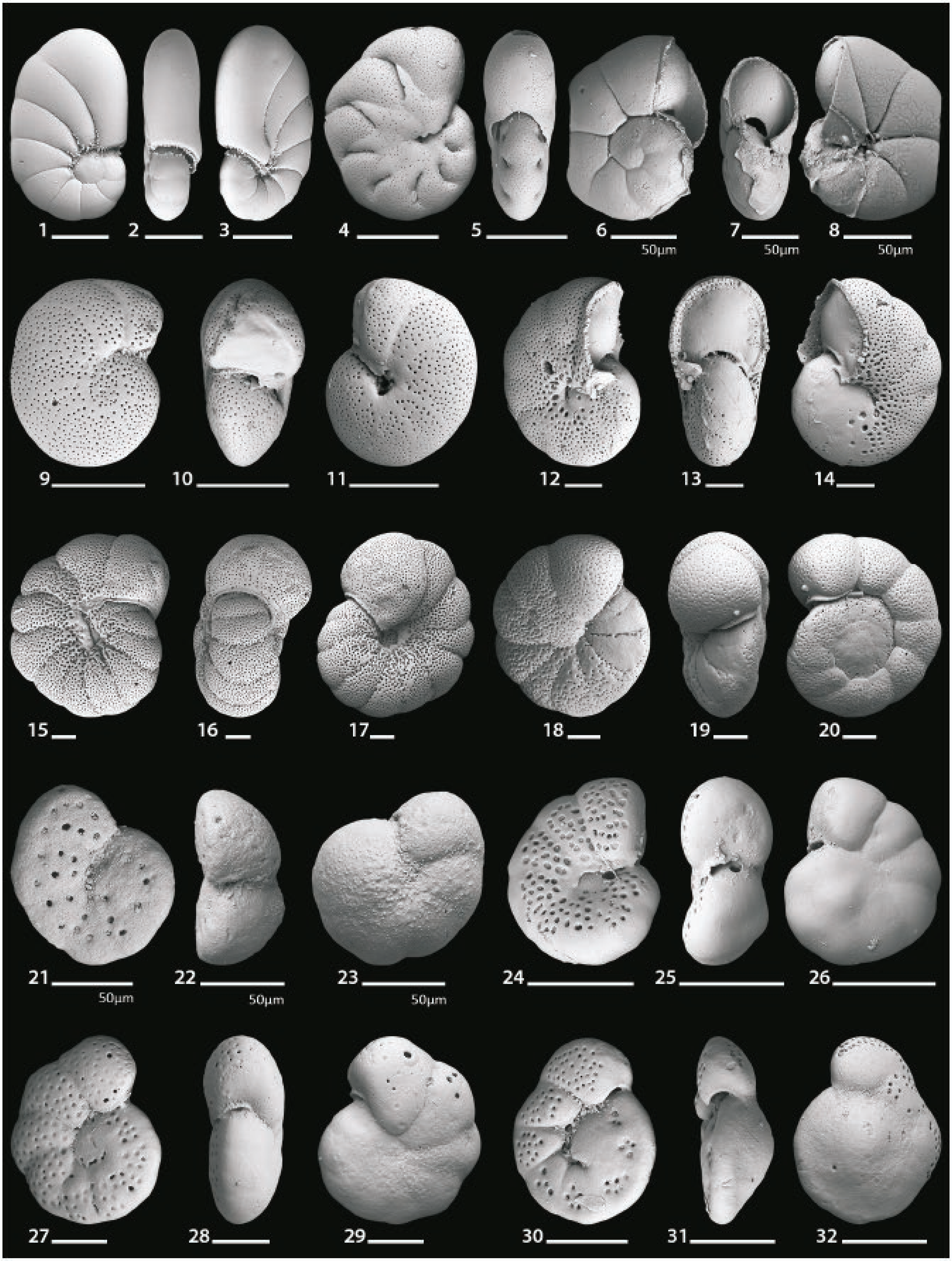
9-11 *Anomalinulla glabrata* (B14).

12-14 *Melonis* sp. (Ms).

15-17 *Anomalinoides* cf. *A. cavus* (Ms*).

18-20 *Anomalinoides globulosus* (MR17).

21-32 *Anomalinulla* sp. (21-23: B15; 24-26, 30-32: N18*; 27-29: ER23).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***Elphidium* sp. 2**
Plate 41, figures 13-16

Description: Test planispiral, biconvex, subcircular in lateral view, periphery acute with a rounded keel; about 17 chambers in the last whorl; sutures slightly curved backwards, with short sutural bridges; test ornamented with minute pustules within the fossettes and at the apertural face; aperture a row of multiple openings at the base of the final chamber.

Remarks: This species differs from *Elphidium* sp. 1 by having shorter sutural bridges and in less pronounced ornamentation features (pustules).

Occurrence: cold-water habitats around southern Africa (Langer unpubl. data).

Subfamily NOTOROTALIINAE Hornibrook 1961
Cristatavultus Loeblich and Tappan 1994

Cristatavultus pacificus (Collins 1958)
Plate 40, figures 18-20

Polystomella milletti Heron-Allen and Earland – CUSHMAN 1924, p. 48, pl. 16, figs. 7, 8.
Elphidium milletti (Heron-Allen and Earland) – CUSHMAN 1933, p. 49, pl. 11, figs. 8 a, b.
Elphidium pacificum COLLINS 1958, p. 421, pl. 5, fig. 13.
Parrellina pacifica (Collins) – BACCAERT 1987, Great Barrier Reef, p. 244, pl. 100, figs. 2, 3. – HATTA and UJIIÉ 1992, p. 204, pl. 49, figs. 8a, b; pl. 50, figs. 1a-c.
Cristatavultus pacificus (Collins) – LOEBLICH and TAPPAN 1994, p. 168, pl. 377, figs. 7, 8;pl. 378, figs. 1-3. – DEBENAY 2012, p. 218, 325.

Occurrence: Samoa (Cushman 1924), Fiji (Cushman 1933), Great Barrier Reef (Baccaert 1987), Ryukyus (Hatta and Ujiié 1992), Timor Sea (Loeblich and Tappan 1994), New Caledonia (Debenay 2012), Madang, Papua New Guinea (Langer unpubl. data).

Superfamily NUMMULITOIDEA de Blainville 1827
Family NUMMULITIDAE de Blainville 1827
Assilina d'Orbigny 1839

Assilina ammonoides (Gronovius 1781)
Plate 51, figures 19-22

Nautilus ammonoides GRONOVIUS 1781, p. 282, pl. 19, figs. 5, 6.
Assilina ammonoides (Gronovius) – HOTTINGER, HALICZ and REISS 1993, p. 154, pl. 222, figs. 1-8; pl. 223, figs. 1-14; pl. 224, figs. 1-8; pl. 225, figs. 1-9.
Operculina ammonoides (Gronovius) – HOHENEGGER, YORDANOVA and HATTA 2000, p. 18, pl. 2, figs. 7-12; pl. 5, figs. 7-12.
Assilina ammonoides (Schröter) – PARKER 2009, p. 515, fig. 367a-j.
Operculina ammonoides (Gronovius) – DEBENAY 2012, p. 228, 326.

Remarks: Detailed information on the ongoing controversy regarding the generic assignment is given by Parker (2009).

Occurrence: Holocene, type locality not given (Gronovius 1781), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), West Pacific (Hohenegger, Yordanova and Hatta 2000), Ningaloo Reef (Parker 2009), New Caledonia (Debenay 2012).

***Assilina complanata*?** (Defrance in Blainville 1822)
(no figure available; see remarks)

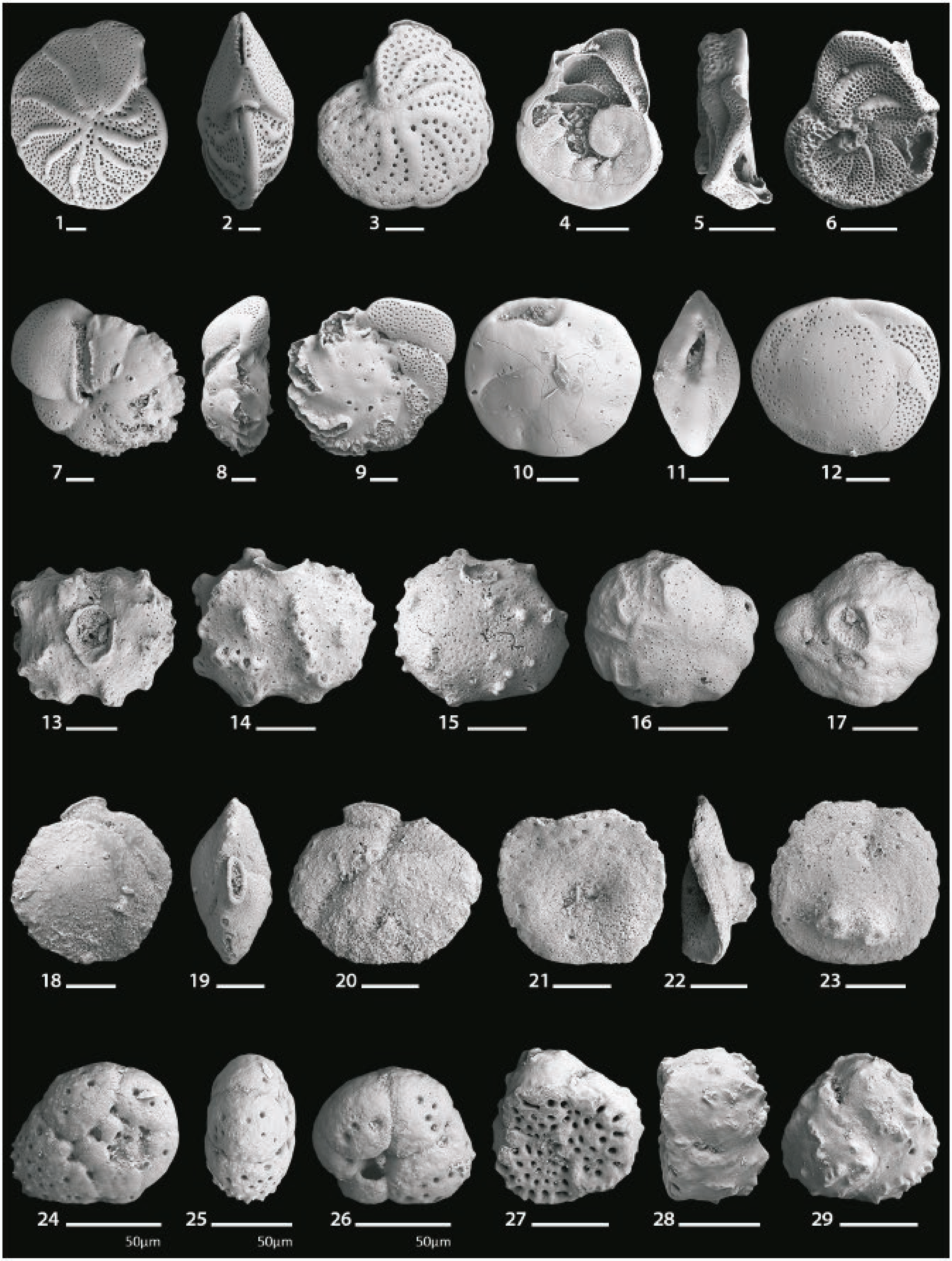
?*Lenticulites complanata* Defrance in DE BLAINVILLE 1822, p. 453, not figured.
?*Operculina complanata* Defrance – BRADY 1884, p. 743, pl. 112, figs. 3-5, 8.
?*Operculina* cf. *O. complanata* (Defrance) – HOHENEGGER, YORDANOVA and HATTA 2000, p. 20, pl. 2, figs. 13-18.

Remarks: There is an ongoing debate if this is a valid species or may be a variety of the highly variable *Assilina ammonoides* (see also discussion in Jones 1994, p. 230). A single heavily abraded specimen was recovered from our material. The test is very large, flat, and has numerous irregular chambers. The poor preservation precluded SEM imaging.

Occurrence: ? France and Italy (Defrance 1822), ? West Pacific (Hohenegger, Yordanova and Hatta 2000).

PLATE 43
Scale bar is 100 µm unless otherwise indicated.

1-3 *Anomalinella rostrata* (1, 2: Ms; 3: B14).
4-6 *Planulinoides* cf. *P. planoconcavus* (MR17).
7-9 *Asanonella tubulifera* (N18).
10-12 *Epistominella* sp. (B14).
12, 14 *Siphoninoides diphes* (W08).
15 *Siphoninoides echinata* (MS03).
16, 17 *Siphoninoides* cf. *S. laevigata* (U16).
18-20 *Siphonina tubulosa* (FW).
21-23 *Homotrema*? sp. (MR18).
24-26 *Rugidia*? sp. 2 (W08).
27-29 *Rugidia*? sp. 1. (Y24).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Assilina discoidalis (d'Orbigny 1826)
Plate 51, figures 23, 24

Nummuline (Assiline) discoidalis D'ORBIGNY 1826, p. 296, modèle no. 88.
Operculina discoidalis (d'Orbigny) – HOHENEGGER, YORDANOVA and HATTA 2000, p. 21, pl. 2, figs. 1-6; pl. 5, figs. 1-6. – DEBENAY 2012, p. 228, 326.
Assilina discoidalis (d'Orbigny) – PARKER 2009, p. 519, fig. 368a-e.

Remarks: Detailed information on the ongoing controversy regarding the generic assignment is given by Parker (2009).

Occurrence: West Pacific (Hohenegger, Yordanova and Hatta 2000), New Caledonia (Debenay 2012), Ningaloo Reef (Parker 2009).

Heterostegina d'Orbigny 1826

Heterostegina depressa d'Orbigny 1826
Plate 51, figures 25-28

Heterostegina depressa D'ORBIGNY 1826, p. 305, pl. 17, figs. 5-7.
Heterostegina suborbicularis d'Orbigny – HOFKER 1927, p. 70, pl. 35; pl. 36, figs. 3, 6-12. – MAKLED and LANGER 2011p. 248, fig. 10: 15
Heterostegina depressa d'Orbigny – BACCAERT 1987, p. 261, pl. 105, figs. 7, 8. – HOTTINGER, HALICZ and REISS 1993, p. 157, pl. 228, figs. 1-11; pl. 229, figs. 1-8; pl. 230, fig. 9. – LOEBLICH and TAPPAN 1994, p. 171, pl. 389, figs. 1-6; pl. 390, figs. 1-3. – RENEMA 2003, p. 355, figs. 30a, b. – PARKER 2009, p. 625, fig. 443a-j. – PARKER and GISCHLER 2011, pl. 5, figs.. 27, 28. – MAKLED and LANGER 2011, p. 248, fig. 10: 14. – DEBENAY 2012, p. 222, 325. – LANGER et al. 2013b, fig. 8: 40, 41. – FAJEMILA, LANGER and LIPPS 2015, fig. 2: 13. – THISSEN and LANGER 2017, p. 66, pl. 22, figs. 9-15.

Remarks: *Heterostegina depressa* is the most widespread nummulitid foraminifer. Originally described from the Atlantic Ocean, it is globally distributed in tropical and subtropical marine waters. As most authors nowadays recognize the genus *Heterostegina* as monospecific and represented by the species *Heterostegina depressa* (e.g. Hohenegger, Yordanova and Hatta 2000, Langer and Hottinger 2000), *Heterostegina curva* Möbius and *Heterostegina suborbicularis* d'Orbigny are regarded herein as synonyms. However, specimens assigned to H. curva by McCulloch (1977, p. 228, pl. 99, figs. 5-8, 10) have beeen found recently in material from Moorea and Zanzibar. Further study is required to clarify the taxonomic status of individual nummulitid species.

Occurrence: Saint Helene Island, Atlantic(d'Orbigny 1826), Raja Ampat (Hofker 1927), Carolines (Makled and Langer 2011), Great Barrier Reef (Baccaert 1987), Gulf of Aqaba (Hottinger, Halicz and Reiss 1993), Timor Sea (Loeblich and Tappan 1994), Indonesia (Renema 2003), Ningaloo Reef (Parker 2009), Maldives (Parker and Gischler 2011), New Caledonia (Debenay 2012), Bazaruto (Langer et al. 2013), Moorea (Fajemila, Langer and Lipps 2015), Zanzibar (Thissen and Langer 2017).

Nummulites Lamarck 1801

Nummulites venosus (Fichtel and Moll 1798)
Plate 51, figures 17, 18

Nautilus venosus FICHTEL and MOLL 1798, p. 59, pl. 8, figs. e-h.
Nummulites venosus (Fichtel and Moll) – HOHENEGGER, YORDANOVA and HATTA 2000, p. 11, pl. 1, figs. 1-10; pl. 4, fig. 10. – DEBENAY 2012, p. 228, 326.

Remarks: This species is commonly confounded with *Nummulites cummingii* (Carpenter). The two species are often regarded as synonymous (see comments by Hohenegger, Yordanova and Hatta (2000).

Occurrence: Red Sea (Fichtel and Moll 1798), West Pacific (Hohenegger, Yordanova and Hatta 2000), New Caledonia (Debenay 2012).

PLATES

A total of 419 species are illustrated on 51 plates in this catalogue of benthic foraminifera from Raja Ampat. Two species could not be figured because of their poor preservational status (see remarks on *Miliola sublineata* and *Assilina complanata*? in the Systematics and Taxonomy section). Sample locatlities are provided in the figure captions. Specimens marked with an asterisk were recovered through selective picking. The scale bar for all specimens is 100µm, unless otherwise indicated.

PLATE 44
Scale bar is 100 µm unless otherwise indicated.

1-3 *Tretomphaloides clarus*? (Y24).

4-6 *Rotorbinella lepida* (N18).

7-12 *Rotorbis*? sp. (7-9: AP09; 10-12: B15).

13-15 *Pegidia dubia* (B14).

16-18 *Sphaeridia papillata* (B14).

19,20 *Carpenteria utricularis* (B15).

21-24 *Rhaptohelenina* sp. 1 (N18*).

25-27 *Rhaptohelenina* sp. 2 (B15).

28-30 *Geminospira bradyi* (CK).

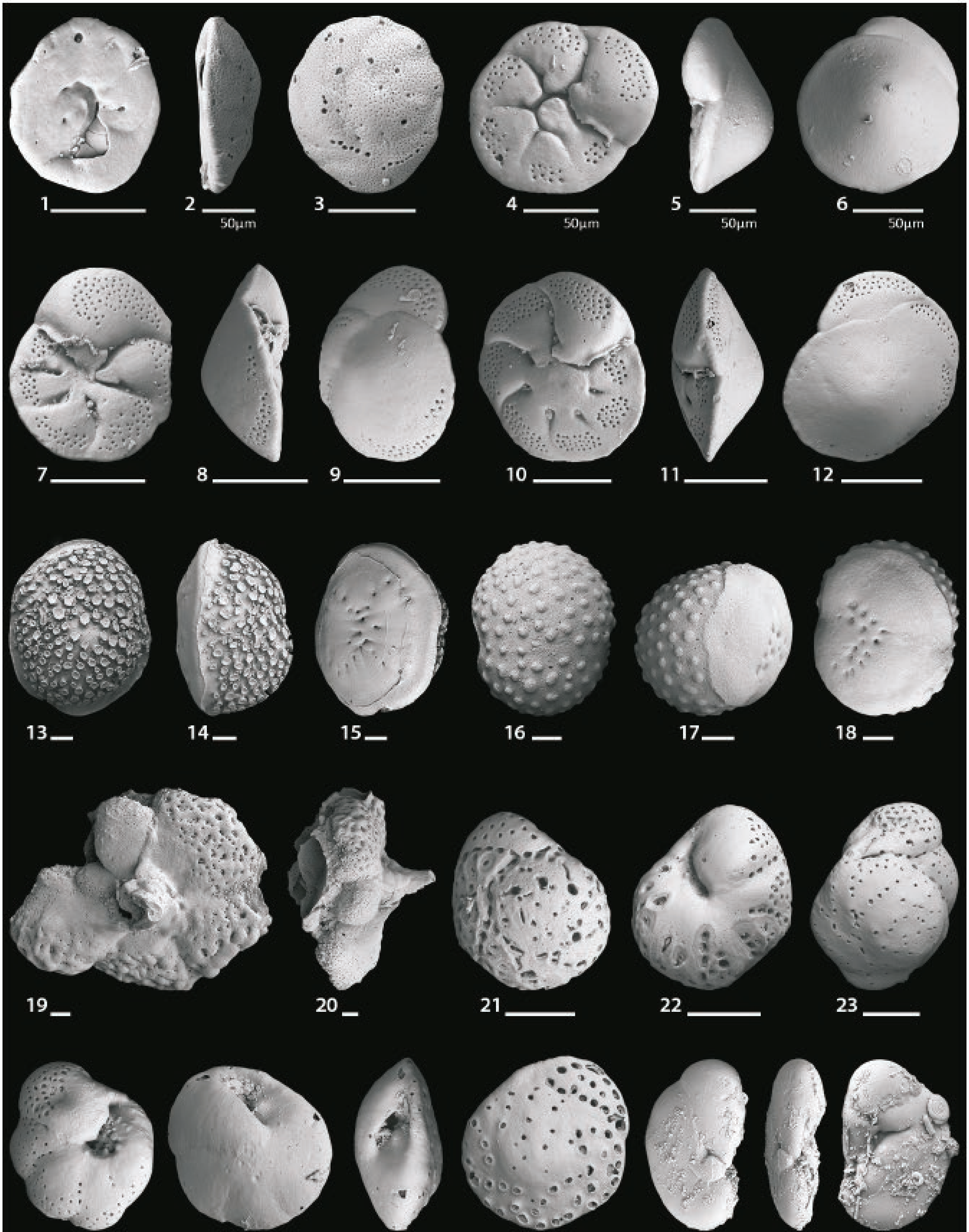

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PLATE 45
Scale bar is 100 µm unless otherwise indicated.

1,2 *Buchnerina lacunata* (U16).

3,4 *Fissurina? trinalmarginata* (N18*).

5,6 *Buchnerina milletti* (N18).

7,8 *Lenticulina* sp. (CK).

9,10 *Lenticulina suborbicularis* (CK).

11,12 *Lenticulina* cf. *L. suborbicularis* (U02).

13,14 *Lenticulina platyrhinos* (U01).

15,16 *Guttulina*? sp. (N18).

17,18 *Guttulina* cf. *G. succincta* (N18).

19,20 *Sigmoidella elegantissima* (U01).

21,22 *Fissurina lucida* (U16).

23,24 *Pseudopolymorphina ligua* (B14).

25-27 *Vaginulinopsis*? sp. (ER23*).

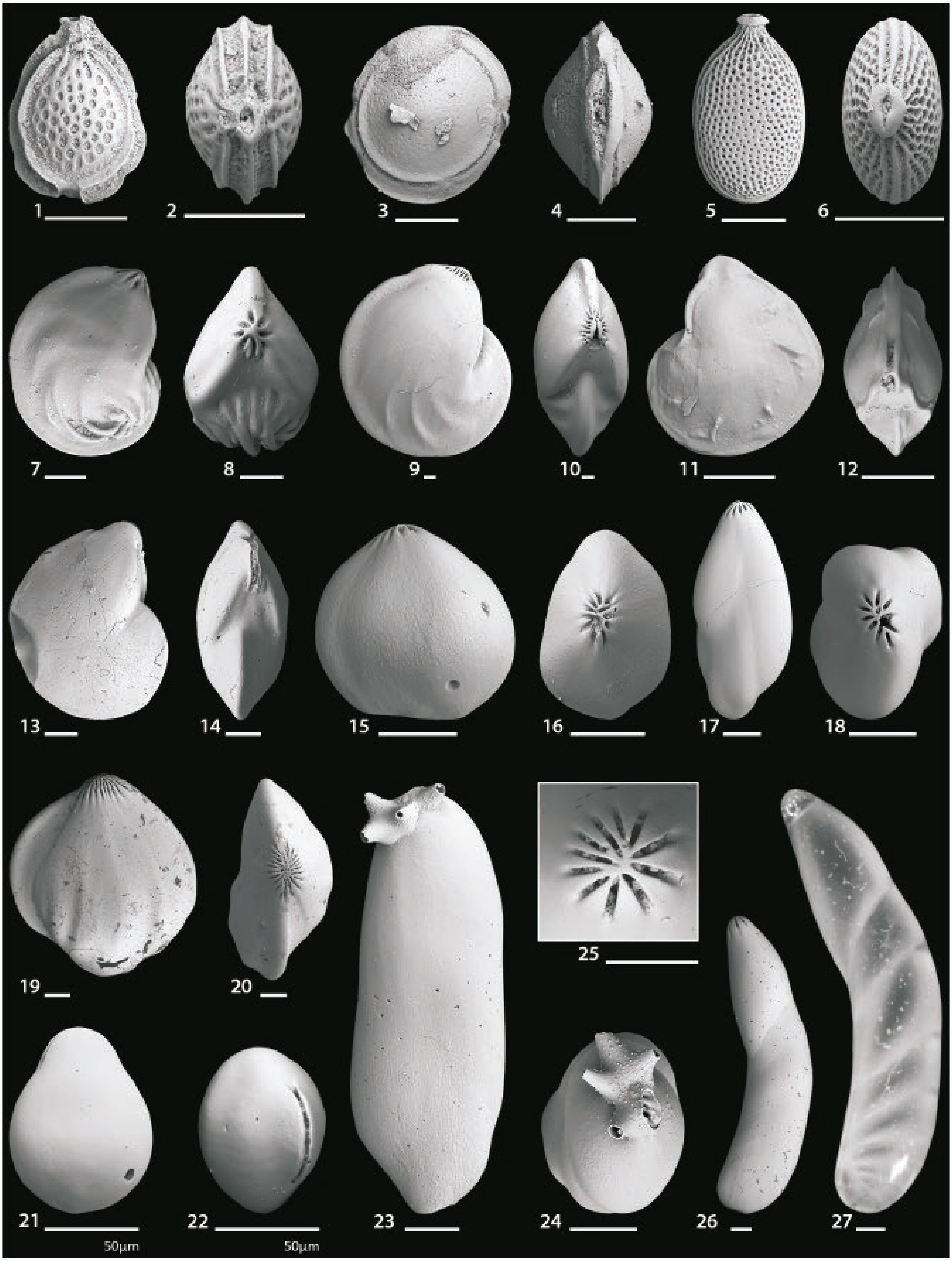
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PLATE 46

Scale bar is 100 µm unless otherwise indicated.

1-3 *Krebsina* cf. *K. okinawaensis* (N18).

4-6 *Cassidulina hoodensis* (MR17).

7,8 *Globocassidulina subglobosa* (B14).

9-12 *Globocassidulina* cf. *G. subglobosa* (9, 10: MS04; 11, 12: B15).

13 *Globocassidulina* cf. *G. subtumida* (N18).

14-16 *Globocassidulina decorata* (B14).

17-19 *Paracassidulina* cf. *P. neocarinata* (N18*).

20-22 *Paracassidulina sulcata* (B14).

23-25 *Cheilochanus fimbriatus* (N18*).

26-28 *Sigmavirgulina tortuosa* (B14).

29-32 *Bolivina*? sp. 2 (29, 30: N18; 31, 32: AP09).

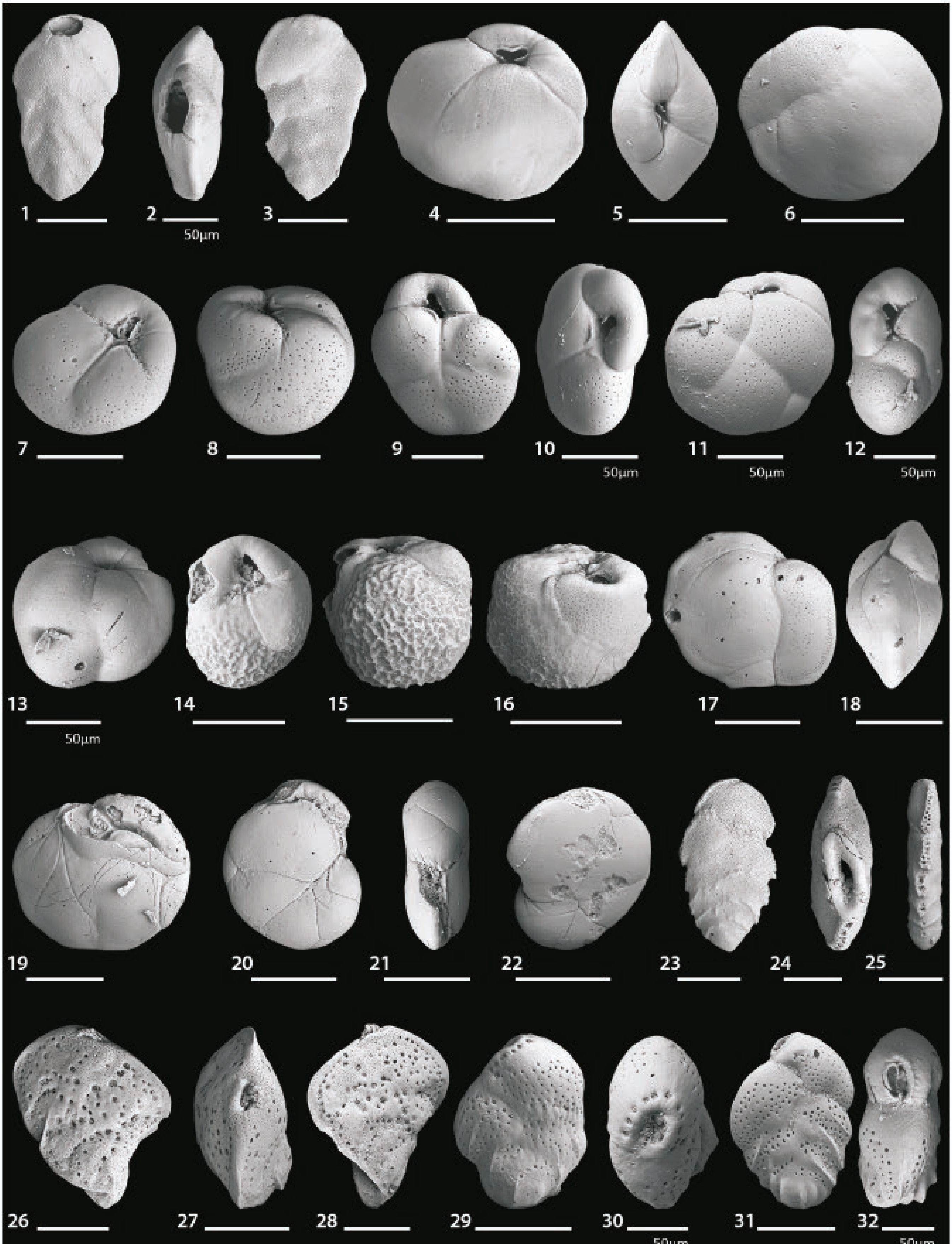
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PLATE 47
Scale bar is 100 µm unless otherwise indicated.

- 1-5 *Loxostomina costulata* (1-3: B14; 4, 5: Ms).
- 6-14 *Siphogenerina raphanus* (6-8, 13, 14: U16; 9, 10: B15; 11, 12: MI05).
- 15,16 *Bolivina* sp. 1 (B15).
- 17,18 *Bolivina variabilis* (W07*).
- 19,20 *Virgulopsis spinea* (Ms).
- 21,22 *Neocassidulina abbreviata* (B15).
- 23 *Bolivina doniezi*? (MR18).
- 24-26 *Rugobolivinella elegans* (U16).
- 27-29 *Reussella*? *spinulosa* (W08).
- 30-35 *Fijiella simplex* (30-32: B15; 33.35: ER23*).

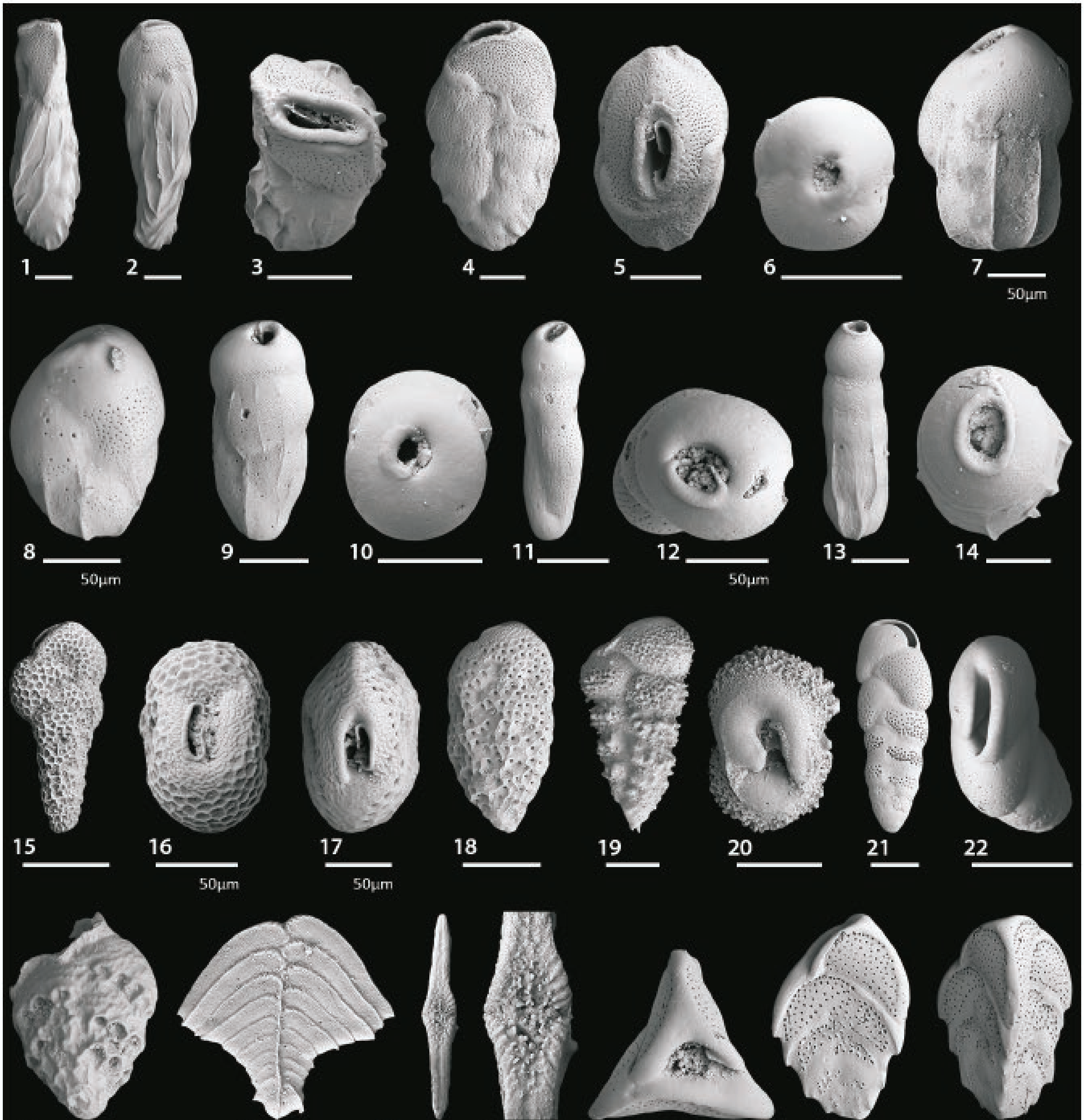
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PLATE 48
Scale bar is 100 µm unless otherwise indicated.

1,2 *Buliminoides williamsonianus* (Ms).

3-5 *Elongobula parallela* (MG).

6,7 *Floresina milletti* (U16).

8,9 *Orthoplecta clavata* (N18).

10-14 *Pileolina patelliformis* (10, 11: N18*; 12-14: N18).

15,16 *Glabratellina tabernacularis* (U16).

17,18 *Glabratellina* sp. (U16).

19,20 *Pileolina minogasiformis*? (MR18).

21-23 *Glabratella* sp. (MS03).

24-26 *Glabratella socorroensis* (U02).

27-29 *Heronallenia polita* (CM).

30-32 *Planoglabratella opercularis* (U16).

33,34 *Angulodiscorbis tobagoensis* (U16).

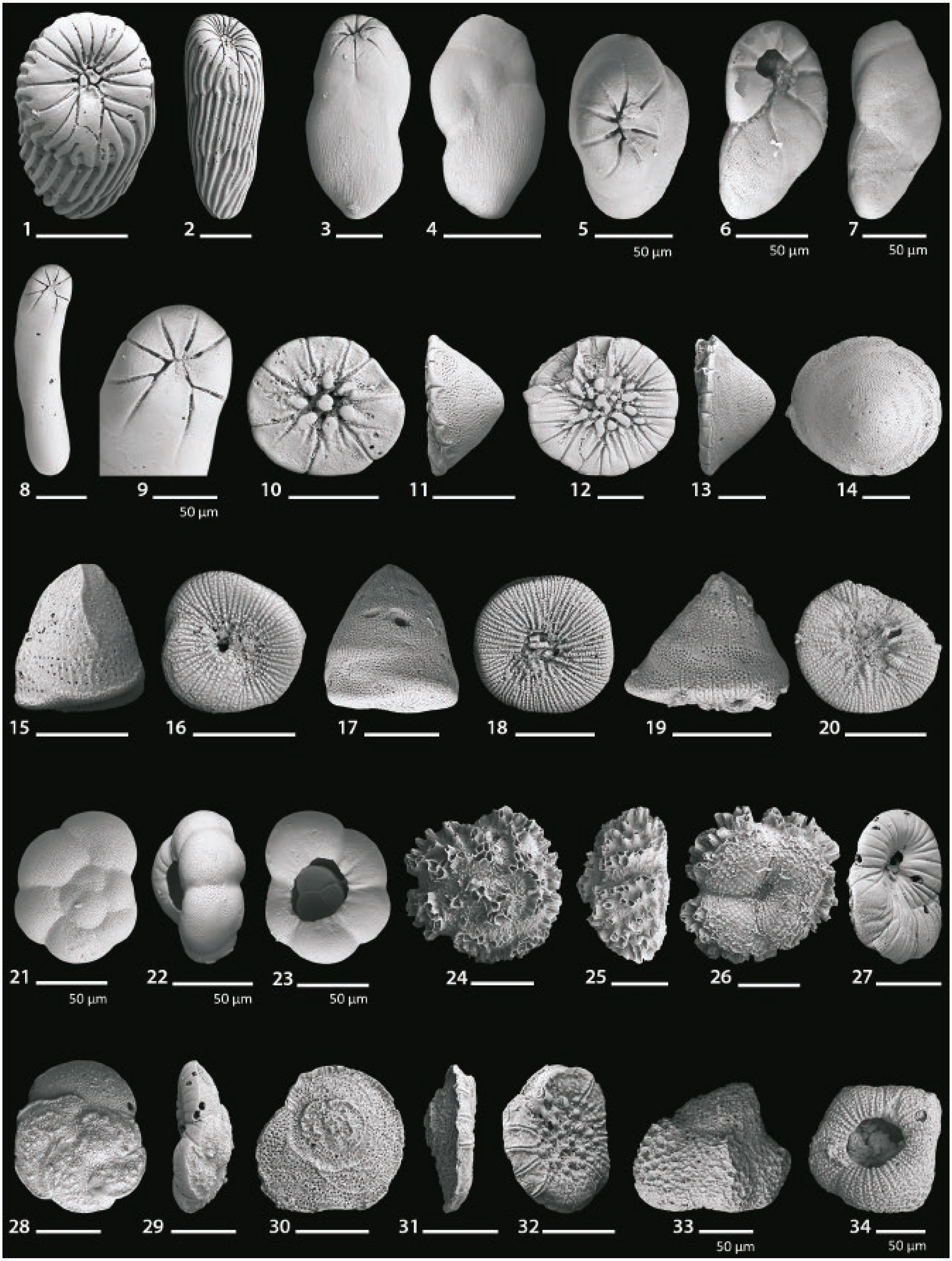
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PLATE 49

Scale bar is 100 µm unless otherwise indicated.

1-3 *Ammonia* cf. *A. tepida* Type 1 (1: MS03; 2, 3: MR18).

4-6 *Ammonia* cf. *A. tepida* Type 2 (Y24).

7-11 *Neorotalia calcar* (7-9: Y24; 10, 11: U16).

12-15 *Calcarina* cf. *C. hispida* (12-14: W07; 15: MS04).

16 *Baculogypsinoides spinosus* (Ms).

17-19 *Calcarina defrancei* (AP09).

20-23 *Baculogypsina sphaerulata* (B14).

24-26 *Calcarina gaudichaudii* (MS03).

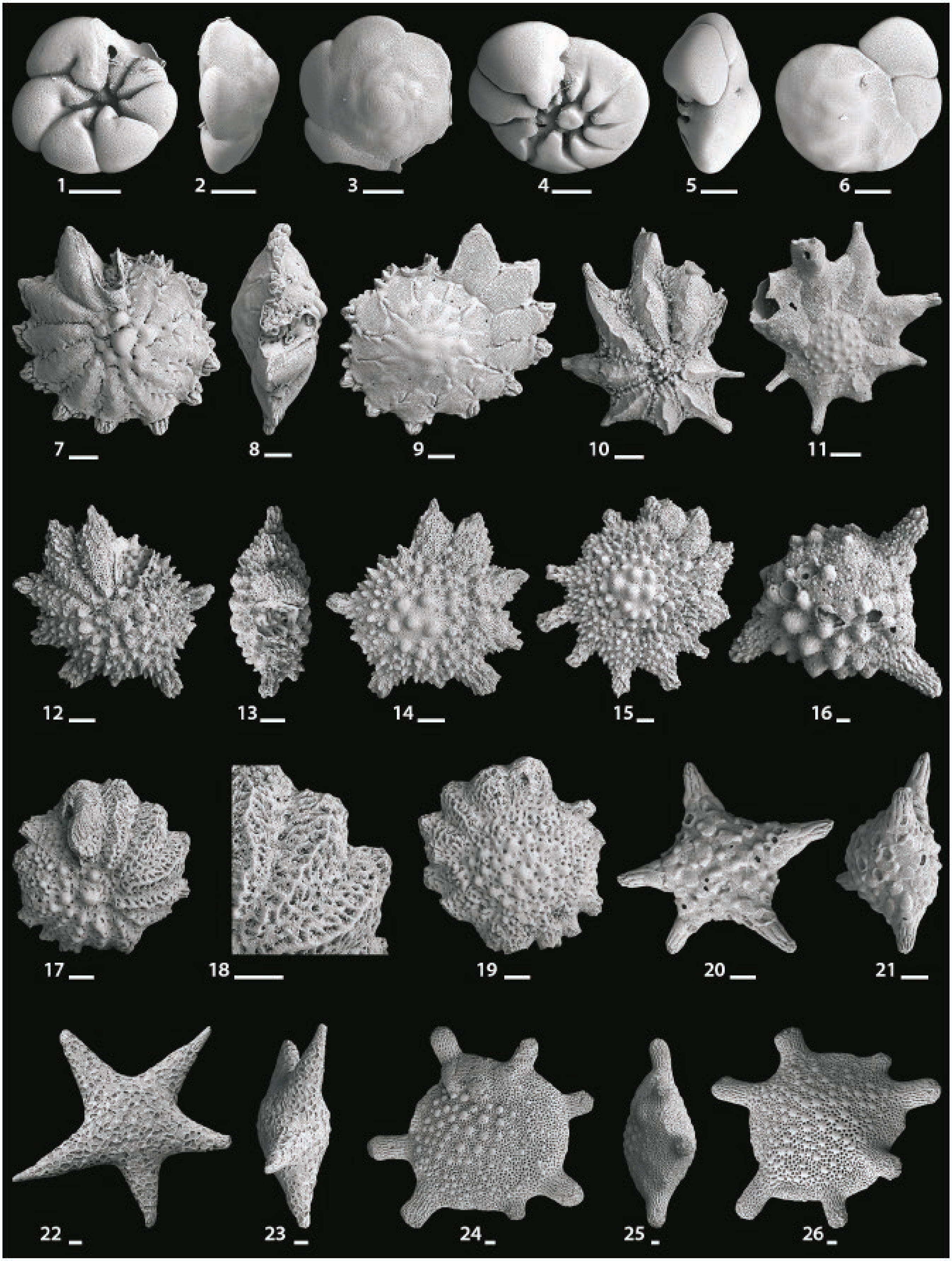
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PLATE 50

Scale bar is 100 µm unless otherwise indicated.

1-11 *Calcarina spengleri* (1-3: MS04; 4-6: U02; 17, 18: B15; 9-11: N18*).

12, 13 *Calcarina mayori* (Ms).

14-16 *Calcarina hispida* (U16*).

17-19 *Amphistegina bicirculata* (B14).

20-22 *Amphistegina papillosa* (U01).

23-28 *Amphistegina lobifera* (23-25: MS04; 26-28: Ms).

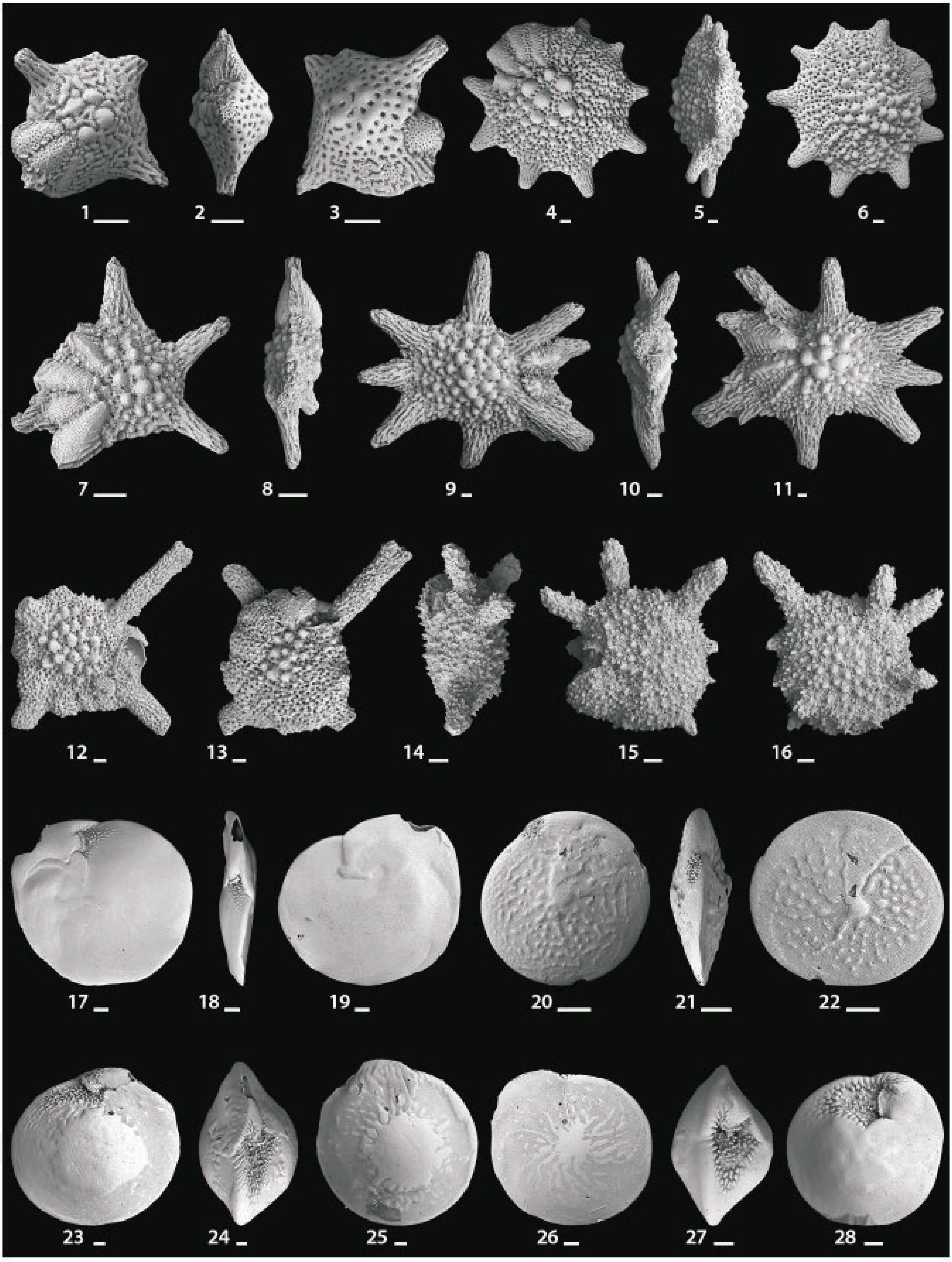
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PLATE 51

Scale bar is 100 µm unless otherwise indicated.

1-3 *Amphistegina radiata* (Ms).

4-6 *Amphistegina lessonii* (MI05).

7-11 *Amphistegina madagascariensis* (MI05).

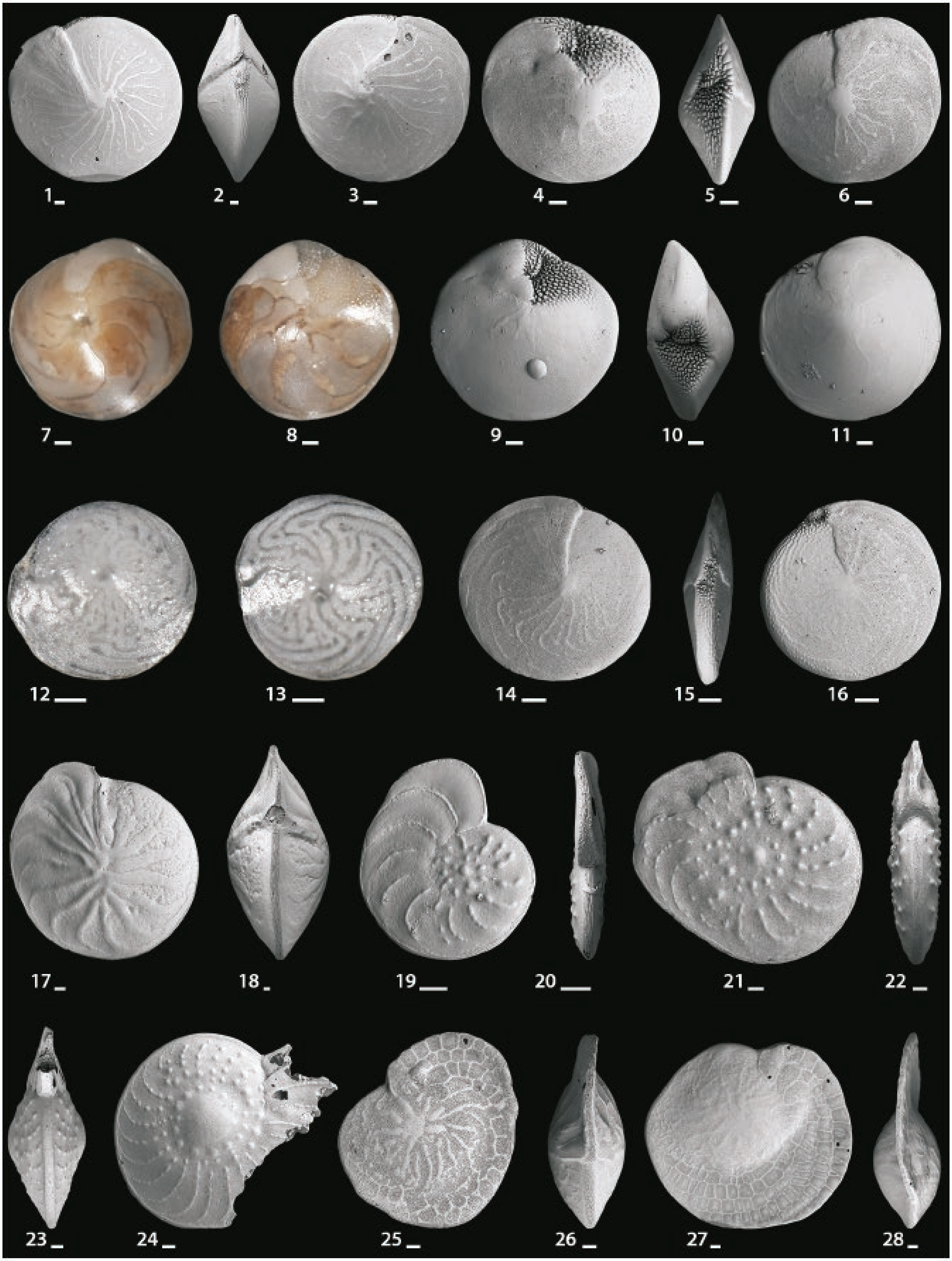
12-16 *Amphistegina* sp. (MI05).

17,18 *Nummulites venosus* (CK).

19-22 *Assilina ammonoides* (19, 20: ER22; 21, 22: MS04*).

23,24 *Assilina discoidalis* (U16).

25-28 *Heterostegina depressa* (25, 26: N19; 27, 28: Y24).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APPENDIX 1

Counting data. All species are listed alphabetically with their total number of specimens (N), their relative abundance (RA) and frequency of occurrence (FO). Comparatively high RA and FO values are boldfaced. Occurrences marked with an "x" were recorded through selective picking after counting was completed.

	AW12	AW13	AP09	AP10	B14	B15	CK	CM	ER22	ER23	FW	MR17	MR18	MI05	MI06	MS03	MS04	MG	Ms	N18	N19	OT	U01	U02	U16	Wa	W07	W08	Y24	Y25	N	RA (%)	FO (%)
Acervulina mabahethi	2		4	3	3	6		2	1	4			2	2					1		1				4		2	2		1	40	0.349	**83.3**
Adelosina litoralis																									1						1	0.009	3.3
Affinetrina bassensis			2	1	2	1			1	2	3		2	2			3			4		1						1	1	1	27	0.236	**50.0**
Alveolinella quoyi																x	x																
Ammomassilina alveoliniformis																									3						3	0.026	3.3
Ammonia cf. *A. tepida* Type 1				1		3			1				26	8	1	1	5	3	4						1			4	5		61	**0.532**	43.3
Ammonia cf. *A. tepida* Type 2	2		1										1			1				1						1			5		10	0.087	23.3
Amphisorus hemprichii							1	1								2	2	1								4			1		12	0.105	23.3
Amphistegina bicirculata					2	5		2	27	10	7	2			1					1		17			4		4	4	1		87	**0.759**	**46.7**
Amphistegina lessonii	31	37	39	53	115	64	53	55	3	7	31	54	36	175	134	52	41	66	81	81	76	52	54	47	26	4	70	38	60	39	1664	**14.519**	**100.0**
Amphistegina lobifera			4	5	1		7					2		9	6	9	15	3	3		4	2				2	1		4	1	78	**0.681**	**86.7**
Amphistegina madagascariensis														5				1													6	0.052	6.7
Amphistegina papillosa	1				1	1	1		4		1		1					2	1			4	14	1				1	5		38	0.332	**46.7**
Amphistegina radiata	50	61	25	23	59	40	29	7	58	33	14	23	2	53	26	1	3	25	40	46	69	72	39	38	12		33	24	33	22	960	**8.376**	**96.7**
Amphistegina sp.	4				2	2		2			5			7	11			1	4	10		15			7		5	32	4	7	118	**1.030**	**53.3**
Angulodiscorbis tobagoensis																									1						1	0.009	3.3
Anomalinella rostrata		1	9	2	6	1	1	1		4		5		3	3		1		3	4	5		4	13	1		1	1	5		72	**0.628**	**70.0**
Anomalinoides cf. *A. cavus*			1						1																		1				3	0.026	10.0
Anomalinoides globulosus	1					1				2	1	2							1	1											9	0.079	23.3
Anomalinella glabrata				2	2					1	1		1						1	1			1				1		1		12	0.105	33.3
Anomalinella sp.	1					3		1	2	1				2						1	1							1	2	2	17	0.148	36.7
Articulina pacifica													1			1				2					1						5	0.044	13.3
Asanonella tubulifera	2	1	10	12	18	16	2		10	31	7	9	1	2	2			2		14	6	7	1	1	4		1	4	2	2	147	**1.283**	**83.3**
Assilina ammonoides	8	8		1	8	5	6	2	5	1	1	4	2		1	2			4	3	8	4	1		6			3	1		84	**0.733**	**73.3**
Assilina complanata?																	x																
Assilina discoidalis																									2						2	0.017	3.3
Astrononion stelligerum									1																			1			2	0.017	6.7
Baculogypsina sphaerulata			6	1	46	1	5	5											1						3	127			78		273	**2.382**	33.3
Baculogypsinoides spinosus					1							1							2					1						1	6	0.052	16.7
Bdelloidina aggregata			3		7			2		1								1				1							2		17	0.148	23.3
Bolivina doniezi?													1																		1	0.009	3.3
Bolivina variabilis	1																														1	0.009	3.3
Bolivina sp. 1						1																									1	0.009	3.3
Bolivina? sp. 2			1			1														2					2						6	0.052	13.3
Borelis pulchra																													4		4	0.035	3.3
Buchnerina lacunata						1														1					1						3	0.026	10.0
Buchnerina milletti	1																			1					1						3	0.026	10.0
Buliminoides williamsonianus																			1	2					3						6	0.052	10.0
Calcarina defrancei	1		1											1											2						5	0.044	13.3
Calcarina gaudichaudii				2	16	1	22	21						6		80	50		3							145			4		350	**3.054**	36.7
Calcarina hispida																									x								
Calcarina cf. *C. hispida*			2				1	7		3			3			38	49		11			1			10	65	7	1	82	12	292	**2.548**	**80.0**
Calcarina mayori																			2	5			2	2	4		7		1	1	24	0.209	26.7
Calcarina spengleri	12	67	8		186	31	6	11	4	6	1	3	1	44	25	13	5	7		16	18	3	5	17	2	4	16	6	8	5	530	**4.624**	**93.3**
Cancris auriculus																				1								1			2	0.017	6.7
Cancris bubnanensis			1																				1					1			3	0.026	10.0
Cancris oblongus						1																									1	0.009	3.3
Caribeanella sp. 1																	1		1				1								3	0.026	10.0
Caribeanella ? sp. 2																									1						1	0.009	3.3
Carpenteria utricularis						1																									1	0.009	3.3
Cassidulina hadleyi				1								1	2																		4	0.035	10.0
Cheilochanus fimbriatus																				x													

APPENDIX 1
Continued.

	AW12	AW13	AI09	AI10	B14	B15	CK	CM	ER22	ER23	FW	MR17	MR18	MI05	MI06	MS03	MS04	MG	Ms	NI8	NI9	OF	U01	U02	U16	Wa	W07	W08	V24	V25	N	RA (%)	FO (%)
Cibicidella? sp.					1																										1	0.009	3.3
Cibicides cf. C. phillipensis	1					2		1		1			4	2	1					1							1				14	0.122	30.0
Cibicides mabahethi	4	3		12	12	9	2	2	4	3	8		1	2		2		1	2	11	2	1	1	1	13		1	4	1	1	103	0.899	83.3
Cibicides ? mayori											1				1									1			2	1			6	0.052	16.7
Cibicides ? sp. 1																									1						1	0.009	3.3
Cibicides ? sp. 2				1	2	1							2	1		1			1	2					1			1		1	14	0.122	36.7
Clavulina pacifica				1	1	1	1	2		2		1		2	1			1		6		1	1	3	1				1		26	0.227	53.3
Conicospirillinoides cf. C. elaborata																							1								1	0.009	3.3
Conicospirillinoides semidecoratus ?		2	1								1	1		1																	6	0.052	16.7
Conicospirillinoides sp. 1									2																			1			3	0.026	6.7
Conicospirillinoides sp. 2													1																		1	0.009	3.3
Cornuspira planorbis																													1		1	0.009	3.3
Cribrobaggina reniformis															1				1												2	0.017	6.7
Crisatarolina pacifica					1																										1	0.009	3.3
Cycloforina granulocostata					1	1	1			1			2	1					2		1										10	0.087	26.7
Cycloforina tropicalis																				1											1	0.009	3.3
Cycloforina sp.										1										1											2	0.017	6.7
Cymbaloporetta bradyi								1												2			1								4	0.035	10.0
Cymbaloporetta ? aff. C. bradyi					x																												
Cymbaloporetta squammosa					1		1	1				1		1		4	1			1							1			1	13	0.113	33.3
Cymbaloporetta sp. 1	1	1	1		1	2							1	7		10	7	2	1	3			7	2	7	1	1	2	5		62	0.541	63.3
Cymbaloporetta ? sp. 2						1											5	1	1					1	1						10	0.087	20.0
Dendritina zhengae													x																				
Dentoplanispirinella occulta													3	4	2	6	5	4	2						1				1		28	0.244	30.0
Discorbis candeiana			1							1	1					1	2		2				6	5				1			20	0.175	30.0
Discorbis ? sp.								1												1											2	0.017	6.7
Discorbinella bertheloti																											x						
Discorbinella ? sp.			1			1											1											1			4	0.035	13.3
Dyocibicides cf. D. biserialis	1		1	1								1													1						5	0.044	16.7
Elongobula parallela																		1					1								2	0.017	6.7
Elphidium cf. E. alvarezianum				1																					1						2	0.017	6.7
Elphidium botaniense													1				1			3					2						7	0.061	13.3
Elphidium craticulatum	23	34		4	1			2	2		4			14	3		1		5				2	1			1		10	1	108	0.942	53.3
Elphidium crispum	18	17	10		1		2	3	1		2	2	4	1		6	8	4	10	2	1	6	2	1	3	3	1	1	6	3	118	1.030	86.7
Elphidium fichtellianum		1	2		1	1							4	1						5					7						22	0.192	26.7
Elphidium? hispidulum														1		1			1						2					1	6	0.052	16.7
Elphidium lene														1			2														3	0.026	6.7
Elphidium maorium			1										1	3		1	2		1										4		13	0.113	23.3
Elphidium cf. E. milletti				1																											1	0.009	3.3
Elphidium tongaense			3		1					2				4	1	9	5	5		1					2		2				35	0.305	36.7
Elphidium sp. 1		1											1				2														4	0.035	10.0
Elphidium sp. 2	8	2	1	4					1		3		5	2						2								13		1	42	0.366	36.7
Eoeponidella pulchella																	1														1	0.009	3.3
Epistomaroides sp.		1															1								1		1				4	0.035	13.3
Epistominella sp.			1	2	5	2				4									1	1		2						1			19	0.166	30.0
Eponides repandus	6	4	11	9	47	30	12	10	18	10	14	33	2	18	7	2	3	18	13	19	8	17	31	49	6	1	8	14	12	12	444	3.874	100.0
Fijiella simplex	1					1						1					2		1	2					1			1			10	0.087	26.7
Fischerinella diversa																									9						9	0.079	3.3
Fischerinella helix					1					1										1											3	0.026	10.0
Fischerinella sp.	1		1											1			2								4		1			1	11	0.096	23.3
Fissurina lucida																									1						1	0.009	3.3
Fissurina ? trimarginata													1															1			2	0.017	6.7
Floresina milletti																	1								1						2	0.017	6.7

APPENDIX 1
Continued.

	AW12	AW13	AP09	AP10	B14	B15	CK	CM	ER22	ER23	FW	MR17	MR18	MH05	MH06	MS03	MS04	MG	Ma	N18	N19	OT	U04	U02	U16	Wa	W07	W08	V24	V25	N	RA (%)	FO (%)
Gaudryina attenuata	1		4				1											1							1			1			9	0.079	20.0
Gaudryina quadrangularis																								1						1	2	0.017	6.7
Geminospira bradyi							1																								1	0.009	3.3
Glabratella zocarroensis																				1				1	1						3	0.026	10.0
Glabratella sp.																1				1					1						3	0.026	10.0
Glabratellina tabernacularis						1											1		1	1					12						16	0.140	16.7
Glabratellina sp.				1					1				1												4						7	0.061	13.3
Globocassidulina decorata					1	4			1				8							11					2						27	0.236	20.0
Globocassidulina subglobosa	2		2	1	1				2				1				1			5	1	1									17	0.148	33.3
Globocassidulina cf. *G. subglobosa*	1					1											1			1					2						6	0.052	16.7
Globocassidulina cf. *G. subtumida*																				1											1	0.009	3.3
Glomulina? sp. 1														1																	1	0.009	3.3
Glomulina? sp. 2																				1											1	0.009	3.3
Guttulina cf. *G. succincta*	1																			1											2	0.017	6.7
Guttulina? sp.																				1											1	0.009	3.3
Haddonia torresiensis	1	1		2	11	1		8	1	3	3	1		2	1			4		1			1	1			1		7	1	51	0.445	63.3
Hanzawaia cf. *H. nipponica*	2			2					2				1								1							1	1	1	11	0.096	26.7
Haplophragmoides sp.																												1			1	0.009	3.3
Hauerina earlandi													1																		1	0.009	3.3
Hauerina pacifica		1				3							10			1	2			3					2						22	0.192	23.3
Hauerina rugosa																											x						
Heronallenia polita								1																	1						2	0.017	6.7
Heterolepa subhaidingeri	2	3	6	4	14	7	1	5	6	4	8	7	4	17	2		1	5	7	3	1	6	3	7	7	1	6	16	2	7	162	1.413	96.7
Heterostegina depressa	22	25	17	23	31	14	17	16	27	24	38	9	10	18	24	4		15	17	20	15	25	25	16	11	2	22	26	20	19	552	4.816	96.7
Homotrema ? sp.													1																		1	0.009	3.3
Krebsina cf. *K. okinawaensis*																				1											1	0.009	3.3
Lachlanella bernardi	2	1		3	3				1	4	1	10						4		2			6						4	3	44	0.384	43.3
Lachlanella parkeri	7	8		2	5	3	4	3	3	4	6	4	2	5	1	1	3	3	6	4	1	1	4	2	6	1		1	5	1	96	0.838	93.3
Lachlanella rebeccae						1																		1							2	0.017	6.7
Lachlanella cf. *L. spiralis*										x																							
Lachlanella subpolygona	3	1		1	2			1	4	1	6	5	2	1					1				2	1	1			2	1		35	0.305	86.7
Lachlanella sp.																								1							1	0.009	3.3
Laevipeneroplis bradyi																1															1	0.009	3.3
Laevipeneroplis malayensis																			3						2	4					9	0.079	10.0
Lenticulina platyrhinus																							x										
Lenticulina suborbicularis			2			2	1		1		1	3										2	3	2							16	0.140	30.0
Lenticulina cf. *L. suborbicularis*									1				1											1							3	0.026	10.0
Lenticulina sp.							1																								1	0.009	3.3
Lobatula lobatula	2	3		3	1	2	1						2	3	2	1				1			1		2		6	4			34	0.297	50.0
Loxostomina costulata	1			1	2	1		2			1	1		2			2		1	1				1	11		1	1			29	0.253	50.0
Marginopora vertebralis								1					1													1			1		4	0.035	13.3
Massilinoides boscoarri			1							1										1										1	4	0.035	13.3
Melonis sp.				1																											1	0.009	3.3
Mesosigmoilina minuta																									1			1			2	0.017	6.7
Miliola sublineata																			1												1	0.009	3.3
Miliolinella cf. *M. chiastocytis*																	1														1	0.009	3.3
Miliolinella circularis			1		2	1				2			2	1			1			2								3	2	1	18	0.157	36.7
Miliolinella moia					2	1				3		1								1					1						9	0.079	20.0
Miliolinella oceanica	1			2	3			1	1	1	1	3	2	2					1	1					5		2		1		27	0.236	50.0
Miliolinella cf. *M. pilasensis*							1						1			2				1					3				1		9	0.079	20.0
Miliolinella cf. *M. semicostata*																									1						1	0.009	3.3
Miliolinella subrotunda			1		2	1	1					1								1											7	0.061	20.0
Miliolinella undina													1							1					1						3	0.026	10.0
Miliolinella webbiana			2		1			1	1													1		1	1						8	0.070	23.3

APPENDIX 1
Continued.

	AW12	AW13	AP09	AP10	B14	B15	CK	CM	ER22	ER23	PW	MR17	MR18	M105	M106	M503	M504	MG	Ms	N18	N19	OT	U01	U02	U16	Wa	W07	W08	Y24	Y25	N	RA (%)	FO (%)
Miliolinella? sp. 1			2								1									1					1						5	0.044	13.3
Miliolinella sp. 2	1					3				1	1			1			3	1							8						19	0.166	26.7
Miliolinella sp. 3						2						1		1											1						5	0.044	13.3
Miliolinella sp. 4																				1							1	1			3	0.026	10.0
Miliolinella? sp. 5											1																				1	0.009	3.3
Miliolinella? sp. 6					1					1																					2	0.017	6.7
Miliolinella sp. 7						2				2													1		3						8	0.070	13.3
Miliolinella sp. 8								1						2	1	1							1		1						7	0.061	20.0
Miliolinella sp. 9																				1											1	0.009	3.3
Miliolinella? sp. 10						1																									1	0.009	3.3
Miliolinella sp. 11											1																				1	0.009	3.3
Miliolinella sp. 12				1									1					1		1			1								5	0.044	16.7
Miliolinella? sp. 13						x																											
Miliolinella? sp. 14																									1						1	0.009	3.3
Miliolinella? sp. 15						1																			1						2	0.017	6.7
Millettiana milletti											1			1				1		1		1			1						6	0.052	20.0
Monalysidium acicularis													1																		1	0.009	3.3
Monalysidium okinawaensis								1											1							1					3	0.026	10.0
Monspeliensina ? sp.																											1	2			3	0.026	6.7
Neocassidulina abbreviata					1	2							4	1	1		2			3	1		2		10			1	8	2	38	0.332	43.3
Neoconorbina cf. *N. albida*	1								2				1							1		1	2						2		8	0.070	23.3
Neoconorbina crustata					1	8							1		3	1			3			1						1		1	15	0.131	30.0
Neoconorbina patelliformis				1	12	12	2	2	1	1	2	8	7				2			7	4	1	1	3	5		2	2		3	78	0.681	66.7
Neoconorbina terquemi									1				1	1				2		1		2	1								9	0.079	23.3
Neoconorbina sp. 1																				1											1	0.009	3.3
Neoconorbina sp. 2				1		1							1									1		1				1			6	0.052	20.0
Neoconorbina ? sp. 3							1																								1	0.009	3.3
Neoconorbina ? sp. 4																						1							1		2	0.017	6.7
Neoconorbina ? sp. 5																							2								2	0.017	3.3
Neoconorbina ? sp. 6																	1														1	0.009	3.3
Neorotalia calcar			8	2	9	2	4	4				1							1	1		1			8	2	1		135	27	206	1.797	60.0
Nodobaculariella convexiuscula																				1											1	0.009	3.3
Nonionella auris													1							1											2	0.017	6.7
Nonionella? sp.													1																		1	0.009	3.3
Nonionoides grateloupi							1						1			1	1														4	0.035	13.3
Nouria armata ?						1																									1	0.009	3.3
Nubeculina advena																									1						1	0.009	3.3
Nummoloculina cf. *N. contraria*									1																						1	0.009	3.3
Nummulites venosus	3	7	2				3			1			1				1	1	2	3					4		1		3		32	0.279	43.3
Orbitina carinata																				1			1						1		3	0.026	10.0
Orbitina exquisita ?																				1					1						2	0.017	6.7
Orbitina ingaseensis																														1	1	0.009	3.3
Oridorsalis ? sp.																									2						2	0.017	3.3
Orthoplecta clavata																				1											1	0.009	3.3
Paracassidulina cf. *P. neocarinata*						1							1												1						3	0.026	10.0
Paracassidulina sulcata					1															1											2	0.017	6.7
Paracibicides edomica						5	2	3	4		2	1								3			3				2				25	0.218	30.0
Paracibicides sp.						3				1										2					1						7	0.061	13.3
Parasorites orbitolitoides													1												2						3	0.026	6.7
Paratrochammina globorotaliformis	4													1																	5	0.044	6.7
Patellina altiformis						1							1			1	1														4	0.035	13.3
Patellina sp. 1						1			1																1						3	0.026	10.0
Patellina? sp. 2																									2						2	0.017	3.3
Pegidia dubia					1					3										1											5	0.044	10.0

APPENDIX 1
Continued.

	AW12	AW13	AP09	AP10	B14	B15	CK	CM	ER22	ER23	FW	MR17	MR18	MH05	MH06	MS03	MS04	MG	Ma	N18	N19	OT	U04	U02	U16	Wa	W07	W08	Y24	Y25	N	RA (%)	FO (%)
Peneroplis antillarum			1			1							2			2	9		3				1		2	2			7	1	31	0.270	36.7
Peneroplis pertusus		1		1	3	1		4		1		1		3	1	3			2	1			1						5	2	30	0.262	60.0
Peneroplis planatus								4					1	1	3	6	8		4						3	2					32	0.279	30.0
Pileolina zonogeriformis ?				1									2																		3	0.026	6.7
Pileolina patelliformis													3			1				1											5	0.044	10.0
Planispirillina inaequalis																				1					1						2	0.017	6.7
Planispirillina tuberculatolimbata											1			1									1		2						5	0.044	13.3
Planispirillina sp.																				1											1	0.009	3.3
Planispirinella involuta																				1					1			1			3	0.026	10.0
Planoglabratella opercularis																									2						2	0.017	3.3
Planogypsina acervalis					1	1			1					1						6			1							1	12	0.105	23.3
Planogypsina? sp.																												x					
Planorbulina sp.				2	3	1		1							1								1		2		2		1		14	0.122	30.0
Planorbulinella larvata	6	8	4	2	10	5	1	11	3	4	6	3		10	7			8	3	2	4	12	5	6	1		13	4	6	1	145	1.265	86.7
Planorbulinella? sublarvata																												1			1	0.009	3.3
Planorbulinoides cf. *P. retinaculatus*		1									3																				4	0.035	6.7
Planorbulinoides? sp.										1																					1	0.009	3.3
Planulinoides cf. *P. planoconcavus*												1																			1	0.009	3.3
Plotnikovina transversaria		1			3	2		3	3	2	1	2								2					1		1				21	0.183	36.7
Poroeponides lateralis			1											2									1				1				5	0.044	13.3
Pseudogaudryina pacifica		1	2		1	3		2	2			3		2						1		2	2							1	24	0.209	40.0
Pseudogaudryina sp.											1									4							4	2			11	0.096	13.3
Pseudohauerina orientalis	1	1											2				1				1							1			7	0.061	20.0
Pseudohauerinella dilucida		1						2			1								1	1											6	0.052	16.7
Pseudolachlanella eburnea					1	1		3					1				1			4					27					2	40	0.349	26.7
Pseudolachlanella cf. *P. eburnea*																				1								1		1	3	0.026	10.0
Pseudolachlanella cf. *P. slitella*					1	2						1		1					1	2					1			1			10	0.087	26.7
Pseudolachlanella? sp.	1																														1	0.009	3.3
Pseudomassilina reticulata														1																	1	0.009	3.3
Pseudopolymorphina ligua					1																										1	0.009	3.3
Pseudotriloculina kerimbatica																		1													1	0.009	3.3
Pseudotriloculina sp. 1																										1					1	0.009	3.3
Pseudotriloculina sp. 2													1							1											2	0.017	6.7
Pseudotriloculina sp. 3						1													1	1						1					4	0.035	13.3
Pseudotriloculina sp. 4									1																				1		2	0.017	6.7
Pseudotriloculina? sp. 5			1																												1	0.009	3.3
Pyrgo cf. *P. oblonga*							3				1				1					1										1	7	0.061	16.7
Pyrgo denticulata		1		2	1	4	2					1			1					1		1	1	2							17	0.148	36.7
Pyrgo rotalaria																		1		1											2	0.017	6.7
Pyrgo sarsi			2				1							1						6	3		2	4					1	1	21	0.183	30.0
Pyrgo aff. *P. sarsi*																			x														
Pyrgo striolata						1	1			1								1											1		5	0.044	16.7
Pyrgo sp.																												1			1	0.009	3.3
Quinqueloculina bicarinata				1																		1							1		3	0.026	10.0
Quinqueloculina cf. *Q. bicarinata*	1				4		2	1			2		3						3	6	1									4	27	0.236	33.3
Quinqueloculina cf. *Q. bradyana*													1				1	1									1		1		5	0.044	16.7
Quinqueloculina carinatastriata													1	2			1			2											6	0.052	13.3
Quinqueloculina cf. *Q. carinatastriata*																									1						1	0.009	3.3
Quinqueloculina cf. *Q. chathamensis*																	1														1	0.009	3.3
Quinqueloculina crassa			2	2	3	1	2		2	1		3				1		1	3	1									1		23	0.201	43.3
Quinqueloculina cuvieriana																												1			1	0.009	3.3
Quinqueloculina cf. *Q. cuvieriana* Type 1	1	1	2	2	3			1		2		3	1		1	1	1			2	6	3		2	2			2			36	0.314	60.0
Quinqueloculina cf. *Q. cuvieriana* Type 2																				1											1	0.009	3.3
Quinqueloculina debenayi			2																									2	1		5	0.044	10.0

APPENDIX 1
Continued.

	AW12	AW13	AP09	AP10	B14	B15	CK	CM	ER22	ER23	FW	MR17	MR18	MI05	MI06	MS03	MS04	MG	Ms	N18	N19	DT	U01	U02	U16	Wa	W07	W08	Y24	Y25	N	RA (%)	FO (%)
Quinqueloculina cf. *Q. exsculpta*																									1						1	0.009	3.3
Quinqueloculina cf. *Q. incisa*										1										2		1									4	0.035	10.0
Quinqueloculina "lecardi"													1						1												2	0.017	6.7
Quinqueloculina cf. *Q. multimarginata*			3	1	2	1		1	1	2										2									1		14	0.122	30.0
Quinqueloculina neostriatula											1	1	4			2		1	3						2		1				15	0.131	26.7
Quinqueloculina cf. *Q. patagonica*					1	2			1					1				1		1								1	1		9	0.079	26.7
Quinqueloculina philippinensis	1	1	2	5	5	1		1		3	2			2	1				3	2		2		4	1						36	0.314	**53.3**
Quinqueloculina pittensis																									1						1	0.009	3.3
Quinqueloculina planata																				3											3	0.026	3.3
Quinqueloculina quinquecarinata						1							2												12						15	0.131	10.0
Quinqueloculina schlumbergeri													1																		1	0.009	3.3
Quinqueloculina seminulum														4						2									2		8	0.070	10.0
Quinqueloculina cf. *Q. subgranulata*															1																1	0.009	3.3
Quinqueloculina cf. *Q. subparkeri*											1														1						1	0.009	3.3
Quinqueloculina tantabiddyensis													1																		1	0.009	3.3
Quinqueloculina vandiemeniensis	2					1							1	1						2					2						9	0.079	20.0
Quinqueloculina zhengi						1							1												2						4	0.035	10.0
Quinqueloculina? sp. 1																									1						1	0.009	3.3
Quinqueloculina sp. 2													2												2						4	0.035	6.7
Quinqueloculina sp. 3																1															1	0.009	3.3
Quinqueloculina sp. 4																				2											2	0.017	3.3
Quinqueloculina sp. 5																			2												2	0.017	3.3
Quinqueloculina sp. 6																											1		1		2	0.017	6.7
Quinqueloculina sp. 7																	1								2		1				4	0.035	10.0
Quinqueloculina? sp. 8			1	1																											2	0.017	6.7
Quinqueloculina sp. 9													1																		1	0.009	3.3
Quinqueloculina? sp. 10																				1									1		2	0.017	6.7
Quinqueloculina sp. 11																												2			2	0.017	3.3
Quinqueloculina sp. 12													1												1						2	0.017	6.7
Quinqueloculina sp. 13							1									5			1									1			8	0.070	13.3
Quinqueloculina sp. 14					2					2												2			1						7	0.061	13.3
Quinqueloculina sp. 15				1					1	1		2							1	2											8	0.070	20.0
Quinqueloculina sp. 16		1	3	1		1		2			2		2			1			2	2					1		1		1	2	22	0.192	**46.7**
Quinqueloculina sp. 17																									1						1	0.009	3.3
Quinqueloculina sp. 18				1																		1						1			3	0.026	10.0
Quinqueloculina? sp. 19																									1						1	0.009	3.3
Quinqueloculina sp. 20													1				2												1		4	0.035	10.0
Reussella? *spinulosa*	1					1						1				4				2	2				3			1		1	16	0.140	30.0
Rhaptohelenina sp. 1						2														2					1						5	0.044	10.0
Rhaptohelenina sp. 2						1																			2						3	0.026	6.7
Rosalina globularis			2	2	1	1	1					3	3	4			3		4	1					7		1	3	1		37	0.323	**80.0**
Rosalina orientalis?		1		1	3	4		3	2	1	3		2	6		4	1	3	2	2			1		2		3	7	4	1	56	**0.489**	**70.0**
Rosalina aff. *R. orientalis*														1		1	1	1		1						1			1		7	0.061	23.3
Rosalina? sp. 1	1																														1	0.009	3.3
Rosalina sp. 2					1								1	2							1										5	0.044	13.3
Rosalina sp. 3					1									1														1	1	1	5	0.044	16.7
Rosalina? sp. 4																												1	3	1	5	0.044	10.0
Rosalina? sp. 5														2											1						3	0.026	6.7
Rotaliammina sp.												1						2	1			1		1	1			1	2		10	0.087	26.7
Rotorbinella lepida	4				1	1							3	1				1		1	1				1						14	0.122	30.0
Rotorbis? sp.			5		1	2	1		1											1											11	0.096	20.0
Rudigaudryina minor	1							2		1								1				1							1		7	0.061	20.0
Rugidia? sp. 1																													1		1	0.009	3.3
Rugidia? sp. 2																												1			1	0.009	3.3

APPENDIX 1
Continued.

	AW12	AW13	AP09	AP10	B14	B15	CK	CM	ER22	ER23	FW	MR17	MR18	MH05	MH06	MS03	MS04	MG	Ma	N18	N19	DT	U01	U02	U16	Wa	W07	W08	Y24	Y25	N	RA (%)	FO (%)
Rugobolivinella elegans																				1					3						4	0.035	6.7
Sahulia barkeri	3	2					1	1		2								1	3	1			3	3			1	1		1	23	0.201	43.3
Sahulia conica	3		2	2					1				4	13	1	10	2	4	1		1		3	3				1	2	4	57	0.497	56.7
Sahulia cf. *S. conica*			1											5	2			2	1	1	2						3			3	20	0.175	30.0
Sahulia cf. *S. kerteharensis*	10	5	6	25	23	16	18	14	15	8	17	14		16	11	5	2	13	10	19	7	3		7	1	1	6	5	12	11	300	2.618	93.3
Sahulia cf. *S. lutsi*			1		1	1					2			1																	6	0.052	16.7
Sahulia neoregusa			3	8	14	2	5	4	4	8	1	10	5	4	5	1		7		17	3	3	3		1		4	2	1		115	1.003	76.7
Sahulia? sp. 1					1								1			3															5	0.044	10.0
Sahulia sp. 2						2									1			1			2				1		5	4			16	0.140	23.3
Septotextularia rugosa			4	1	1		2	2		2				4	3					2		2	6	11			1	1	1	1	44	0.384	53.3
Septotrochammina gonzalezi	1															1															2	0.017	6.7
Sigmamiliolinella australis	1		2	1	1	3			1		1	1	10		1	2		2		3		3			1					1	34	0.297	53.3
Sigmavirgulina tortuosa					1	2							1							4					5						13	0.113	16.7
Sigmoidella elegantissima												1										2	1	1							5	0.044	13.3
Sigmoihauerina involuta						1				1	1		1					1		2					1						8	0.070	23.3
Sigmoilinella zorracca													1												2						3	0.026	6.7
Siphogenerina raphanus	2		2		4	2						2		4			1		2	3				1	6					2	31	0.270	40.0
Siphonaperta distorqueata		2	3		3		2	2	1	2			1			1			1		6		1	2	1				2		30	0.262	50.0
Siphonaperta cf. *S. distorqueata* Type 1								1	1		1							1	1		2										7	0.061	20.0
Siphonaperta cf. *S. distorqueata* Type 2					3													1	1						1						6	0.052	13.3
Siphonaperta kallocta																1				2							1				4	0.035	10.0
Siphonaperta sp.														2																	2	0.017	3.3
Siphonaperta subagglutinata	2	1	3		1		8	1	3		3			7		1		8	1	5		3	1	1			1	2		3	55	0.480	63.3
Siphoniferoides siphoniferus	2	2	1	3	10	6	15	11	1	6	5	4		2	2	1		4		7	3	9	22	19	1		6		5		149	1.300	80.0
Siphonina tubulosa			1								1									1					1						4	0.035	13.3
Siphoninoides cf. *S. laevigata*																									1						1	0.009	3.3
Siphoninoides diplex														1														1			2	0.017	6.7
Siphoninoides echinata																1															1	0.009	3.3
Sorites orbiculus			1	1		2		1	1		1	3	4	1	1	3		3	3	5	1							2		1	34	0.297	56.7
Sorosphaera ? sp.	1																														1	0.009	3.3
Sphaeridia papillata					1	1																									2	0.017	6.7
Sphaerogypsina globulus			1		1													1			1	1		2			1				8	0.070	23.3
Spirillina grossoperforata						1								1											4						6	0.052	10.0
Spirillina vivipara			2	1		1							1							1					1						7	0.061	20.0
Spirillina sp. 1						1																			1						2	0.017	6.7
Spirillina? sp. 2																														1	1	0.009	3.3
Spiroloculina angulata					4	1								1					1	1	1				1		1	1			12	0.105	30.0
Spiroloculina antillarum					4			1		1	1	1	2	1	1					1			1				1	1			16	0.140	40.0
Spiroloculina cf. *S. angulata*																												1			1	0.009	3.3
Spiroloculina cf. *S. caduca*						2							1												1						4	0.035	10.0
Spiroloculina communis	5	3					1		1		3		1		1			2		3		1			1			1		1	24	0.209	43.3
Spiroloculina eximia	2		1		1	1												1	1	2							1	1		1	12	0.105	33.3
Spiroloculina foveolata					2	3										1		2					1							2	11	0.096	20.0
Spiroloculina cf. *S. mayori*					2	1														1											4	0.035	10.0
Spiroloculina cf. *S. subimpressa*															x																		
Spiroloculina cf. *S. venusta*						1																		1	1						3	0.026	10.0
Spiroloculina sp.																						2									2	0.017	3.3
Spiroplectinella ? sp.															1											1					2	0.017	6.7
Spirosigmoilina ? *parri*									1																						1	0.009	3.3
Textularia agglutinans	1	3	3	3	1	2	3	4		1	2			2			1	1	1	2	2	1	3	2	2				1		41	0.358	70.0
Textularia candeiana	1	1			2	1	1	1									1				1								1		10	0.087	30.0
Textularia corrugata ?	1		3	1	2	2	5	2	1	1	3	5		7	2		1	7		1		2	2	5			1	3	1		58	0.506	73.3
Textularia crenata				1	4			4											1	1											11	0.096	16.7
Textularia cushmani		1	7	1	1	1			3			1		9				1		4	2							3		1	35	0.305	43.3

APPENDIX 1
Continued.

	AW12	AW13	AB09	AB10	B14	B15	CK	CM	ER22	ER23	FW	MR17	MR18	M105	M106	MS03	MS04	MG	Ms	N18	N19	DT	U01	U02	U16	Wa	W07	W08	Y24	Y25	N	RA (%)	FO (%)
Textularia dupla	5	3	1	2			2									1		1	1						1		1				18	0.157	33.3
Textularia foliosa	1		1		1	1			1	1	1			2					1	6			1		1			1	1		20	0.175	46.7
Textularia occidentalis									1																						1	0.009	3.3
Textularia conomica													1	1																	2	0.017	6.7
Textularia stricta ?																			1												1	0.009	3.3
Textularia truncata ?													3					1			1	1									6	0.052	13.3
Textularia sp. 1			1	1	2	1		1		2		1		3		1		2	1	2	3	2	4	3			5	1	9	1	46	0.401	66.7
Textularia sp. 2	5			3	6	3		4			8			1	1			2	1	8		1			9		3	9	1		67	0.586	53.3
Textularia? sp. 3													1																		1	0.009	3.3
Textularia sp. 4						1																							1		2	0.017	6.7
Textularia sp. 5		1	1	3	1	1	2		1		2			1			4			3							1			1	22	0.190	43.3
Textularia sp. 6		2	2			1	1				3	1				2				1										1	14	0.122	30.0
Textularia sp. 7																											2				2	0.017	3.3
Textularia sp. 8																											1				1	0.009	3.3
Textularia sp. 9							2			2				1		1		1											1	1	9	0.078	23.3
Textularia sp. 10	3	2	2				2		1	3	3			2					1		3	2	14	10			2	1	1		52	0.454	53.3
Torresina sp.						1																									1	0.009	3.3
Tretomphaloides clarus ?																													1		1	0.009	3.3
Triloculina asymmetrica					1	2	1	1		10		2								2	1		2		1						23	0.201	33.3
Triloculina bertheliniana	1																1										2		4	2	10	0.087	16.7
Triloculina cf. *T. bertheliniana*																		1													1	0.009	3.3
Triloculina bicarinata							1	1																				1		1	4	0.035	13.3
Triloculina? *fichteliana*								1										1		1					1	1					5	0.044	16.7
Triloculina cf. *T. fichteliana*																								1	2			1			4	0.035	10.0
Triloculina kerana						5					3			1			1			1					1					2	14	0.122	23.3
Triloculina laiformis													2							1											3	0.026	6.7
Triloculina serrulata	1					1					1				1																4	0.035	13.3
Triloculina cf. *T. sommeri*				1																					1						2	0.017	6.7
Triloculina cf. *T. terquemiana* Type 1						1					1			2				5											4	2	15	0.131	20.0
Triloculina cf. *T. terquemiana* Type 2																														1	1	0.009	3.3
Triloculina tricarinata		1	1			4				1	1	4	7	8	1	2		3		4	3				4					1	45	0.398	60.0
Triloculina trigonula		1	1		6	2	1						2			2	1		1	1			1								19	0.166	36.7
Triloculina trigonella					1											4				1					1		1				8	0.070	16.7
Triloculina cf. *T. vespertilio* Type 1					1													1							1						3	0.026	10.0
Triloculina cf. *T. vespertilio* Type 2					2				1											2											5	0.044	10.0
Triloculina cf. *T. wiesneri*						1																									1	0.009	3.3
Triloculina sp. 1			1		1									1																	3	0.026	10.0
Triloculina sp. 2				1									1		1		1														4	0.035	13.3
Triloculina sp. 3													1																		1	0.009	3.3
Triloculinella cf. *T. pseudooblonga*																									1						1	0.009	3.3
Trochammina carinata							x																										
Trochammina sp.				1																							1				2	0.017	6.7
Vaginulinopsis? sp										x																							
Valvulineria? sp.																	2														2	0.017	3.3
Virgulopsis spinea													1				1		1	1											4	0.035	13.3
Wiesnerella auriculata		1											1				2								1						5	0.044	13.3
Number of benthic specimens	309	341	291	280	822	461	283	290	264	243	270	277	288	600	305	334	303	293	330	570	288	316	322	315	460	379	297	313	635	252	10,721		
Globorotalia menardii	2	1		2	3	6	1		3	1	2	1	3					1		4		1					1	1			33		
Other planktonics	9	3	21	15	66	136	22	13	32	48	36	12	19	24	7	1	0	27	7	73	9	9	11	2	51	0	20	43	3	23	740		
Total number of foraminiferal specimens	320	345	312	295	891	593	306	303	299	292	308	290	310	624	312	335	303	321	337	647	297	326	333	317	511	379	318	357	638	275	11494		

ALPHABETICAL INDEX OF SPECIES

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