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**BENTHIC FORAMINIFERAL CENSUS DATA  
FROM GULF OF MEXICO CORES  
(TEXAS AND LOUISIANA CONTINENTAL  
SHELF)**

Lisa E. Osterman, Kate Pavich, and Jessica Caplan

U.S. Geological Survey, MS 926A, Reston VA 20192, USA

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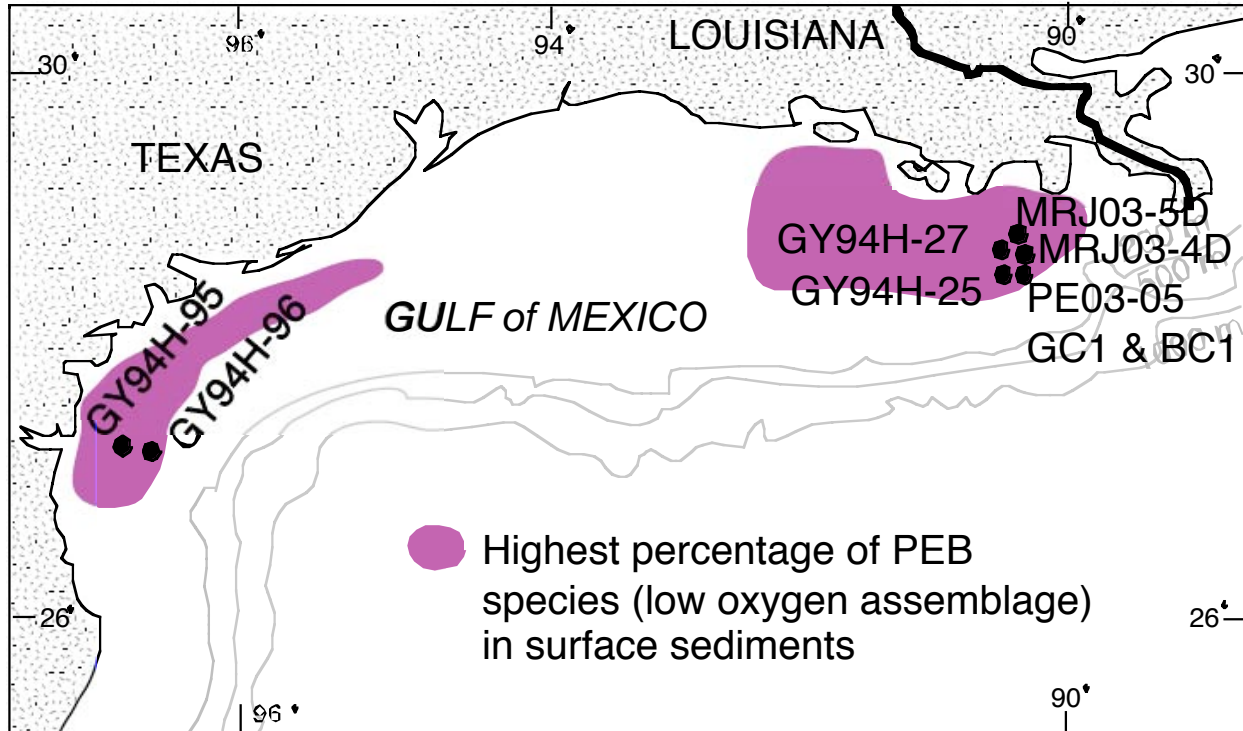
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**Introduction**

This paper presents the benthic foraminiferal data from eight sediment cores collected from the continental shelf of the Gulf of Mexico (Table 1), obtained as part of an initiative to investigate the geographic and temporal extent of hypoxia, low oxygen water, in the Gulf of Mexico. Two cores GY 94H-95 and 96 are located on the Texas continental shelf and the remainder of the cores are located on the Louisiana shelf.

Hypoxia (<1.4 ml/l or <2 ppm oxygen concentration) in the Gulf of Mexico waters can eventually lead to death of marine species (Malakoff, 1998). The development of hypoxia off the Mississippi Delta has increased steadily since measurements were begun in 1985, and has been linked to the use of fertilizer in the Mississippi Basin (Rabalais, 2002). Benthic foraminifers provide a method to track the development of hypoxia prior to 1985 (Blackwelder *et al.*, 1996; Sen Gupta *et al.*, 1996). Previous work (Osterman, 2003) has indicated that the relative occurrence of three low-oxygen tolerant species is highest in the hypoxia zone (Fig. 1). The cumulative percentage of these three species (*% Pseudonion atlanticum* + *% Epistominella vitrea*, + *% Buliminella morgani* = PEB index of hypoxia) provides a way to investigate fluctuation in paleohypoxia and will be discussed in future publications.

<b>Table 1. Core locations</b>						
Core	Core Type	Shelf Location	Latitude	Longitude	Core length (cm)	Water depth (m)
GY94H-25	Box Core	LA	28.355877	90.507625	25	48
GY94H-27	Gravity Core	LA	28.529925	90.506670	36	35
GY94H-95	Gravity Core	TX	27.209198	96.938418	90	42
GY94H-96	Gravity Core	TX	27.186435	96.715390	81.5	70
PE03-05-GC1	Gravity Core	LA	28 23.796	90 27.701	164	47
PE03-05-BC1	Box Core	LA	28 24.108	90 26.484	31	47
MRJ03-4D	Box Core	LA	28 37.548	90 22.521	23	38
MRJ03-5D	Box Core	LA	28 55.508	90 22.538	40	24



## Methods and Materials

The cores were collected between 22 to 70 meters water depth (mwd) during three cruises. (Table 1) Gravity and box cores were collected along the Texas and Louisiana continental shelf and slope during the 94H (October, 1994) cruise of the RV *Gyre* as part of LATEX (Louisiana-Texas Shelf Physical Oceanography Program) and on the RV *Pelican* cruise PE-03-05 (July 2003). Box cores were collected on the RV *Longhorn* cruise MRJ 03 (July 2003). In all cases the box cores were subsampled with push cores on board ship. The cores were transported, sampled and processed in the USGS Foraminiferal Research Laboratory in Reston VA.

The samples for faunal analyses were soaked in a dilute calgon solution and agitated for 30 minutes to assist in disaggregation, then wet sieved at  $63\mu\text{m}$ . The washed residue was oven dried at  $\leq 50^\circ\text{C}$ , then dry sieved at  $125\mu\text{m}$ . In most cases the top 2-3 samples in each box core were additionally treated with Hydrogen peroxide to help to disaggregate organic material. The samples were not dried prior to the wet sieving process; the calculated dry weights were obtained by measuring the moisture content in a small subsample of each sample and are presented in Tables 2-9.

## **Faunal Analysis**

Samples contained abundant to few benthic foraminifera, when necessary a representative subsample of approximately 300 specimens was obtained for faunal analysis with a microsplitter (Table 2). Benthic foraminifers were hand picked from the >125 $\mu$ m faunal split and then placed on standard 60 square micropaleontological slides to be sorted by species. Identification of the benthic foraminifer species was made using standard literature, including the taxonomy of Loeblich and Tappan (1988, 1994), Phleger and Parker (1951), Parker (1954), Bandy (1954), Anderson (1961), Murray (1971, 2000), Bock et al. (1971), Poag (1981), and Morkhoven et al. (1986).

Tables 2-9 record the number of specimens that were counted in each sample. Note that the faunal counts of only the upper 60 cm of PE03-05 GC1 have been completed at this time. Most specimens were identified to the species level. However in Tables 2-9, rare species may be grouped with other foraminifers of the same taxonomic level; by family (eg., Nodosariidae spp.), or by genera (eg *Pyrgo* spp.). See the Appendix for more information about all identified species and the groups of rare species.

## **Acknowledgments**

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TABLE 3 BENTHIC FORAMINIFERS OF GY94H-27

GY94H-27	Sample depth (cm)	Calculated dry sample weight	% sample examined	<i>Ammotium salsum</i>	<i>Bigeneria irregularis</i>	<i>Lagenammia difflugiformis</i>	<i>Milliamina horrida</i>	<i>Textularia</i> spp.	<i>Textularia mayori</i>	<i>Ammonia parkinsoniana</i>	<i>Astronoion</i> sp.	<i>Bulimina marginata</i>	<i>Buliminella morgani</i>	<i>Cancris auriculus</i>	<i>Dentalina</i> spp.	<i>Elphidium discoideale</i>	<i>Elphidium excavatum</i>	<i>Epistominella vitrea</i>	<i>Fursenkoina pontoni</i>	<i>Hanzawai concentrica</i>	<i>Nodosariidae</i> spp.	<i>Nonionella opima</i>	Other calcareous	<i>Pseudononion atlanticum</i>	<i>Quinqueloculina bicarinata</i>	<i>Quinqueloculina dimidiata</i>	<i>Reussella spinulosa</i>	<i>Trifarina bella</i>	<i>Uvigerina peregrina</i>	Total Calcareous & Agglutinated	Total Agglutinated	Number of foraminifers/gm	PEB Index		
3.5	4.748	50	19	17	61		12	60																											
4.5	5.863	100	19	25	47	2	15	109	1	4	1	5	1	69		19	8	51		3	3	151	7	1	3	3	1	548	108	93	30.9				
5.5	6.314	100	1	14	13	2	4	138		2	1		1	109		14	1	8	2		1	36	29		1			377	34	60	13.4				
6.5	8.189	100	1	4	16		6	71	1		1		1	52		9	1	7			2	17	17			1	1	208	27	25	12.9				
7.5	7.324	100	2	2	11	1	3	27		1		1	1	11		6	4	4			1	17	4	1	2			95	19	13	23.7				
8.5	8.7	100	7	11	20		8	46				3			1	15	4	40		3	3	61	3	1		3	2	231	46	27	31.3				
9.5	8.353	100	2	12	12		4	15			2	1	2	15		10		7			2	31			3			118	30	14	35.5				
13.5	7.439	100	5	3	27		6	31				1	21					14			1	2	1	4	2			118	41	16	1.6				
14.5	9.163	100	14	16	58	7	32	81		1	2	6	1	69		1	3	36	1	5	27	7	3	3	3	1	374	127	41	7.8					
15.5	9.237	100	1	2	7	7	7	36				1	1	29		1	11						10	4	2			119	24	13	9.2				
16.5	8.142	100	2	1	5		1	35						17		1	5						6	1				74	9	9	9.5				
17.5	8.633	100	2	2			1	32						5				7					8	1				58	5	7	13.8				
18.5	8.521	100	5	10	24		11	52		1				28		10		21	1	3	31	1	1	3			202	50	24	19.8					
19.5	8.234	100	7	5	21		2	66			1	1	34		1	1	27						41	5	1			213	35	26	19.7				
20.5	9.456	100	5	6	5		5	22				2	16		2	3	15			2	25	2				1	111	21	12	23.9					
21.5	10.897	100		2	2		3	27						38		3	1	2		1	3	6						88	7	8	6.8				
22.5	10.048	100		6			1	6	76					42		4		1		1	2	12						151	13	15	4.0				
23.5	9.845	100					4	83						40		7							2	15	5			156	4	16	5.8				
24.5	9.227	100		6		1	5	82				1	99		5		1						6	26	2			234	12	25	4.7				
26.5	8.539	100						10						17										1					28	0	3	0.0			
28.5	11.047	100						16						1									3						20	0	2	15.0			
30.5	10.324	100	3	5	6		3	50				3	1	22		2		10					15	3	1			124	17	12	13.1				
33.5	6.295	100			7			3										6					3				1		20	7	3	15.0			
34.5	ND	100	5		21		1	8						2	5			9			1	3						55	27	ND	5.4				









TABLE 8 BENTHIC FORAMINIFERS OF MRJ03 4D

MRJ03 4D	Sample depth (cm)	Calculated dry sample weight	% sample examined	<i>Ammotium salsum</i>	<i>Bigeneria irregularis</i>	<i>Lagenammia difflugiformis</i>	<i>Milliamina horrida</i>	Other agglutinated	<i>Textularia</i> spp.	<i>Textularia mayori</i>	<i>Ammonia parkinsoniana</i>	<i>Bolivina subspiniensis</i>	<i>Brizalina striatula</i>	<i>Brizalina translucens</i>	<i>Brizalina</i> spp.	<i>Bulimina marginata</i>	<i>Buliminella morgani</i>	<i>Cancris auriculus</i>	<i>Dentalina</i> spp.	<i>Elphidium crispium</i>	<i>Elphidium discoidale</i>	<i>Epistominella vitrea</i>	<i>Eponides antillarum</i>	<i>Fursenkoina pontoni</i>	<i>Fursenkonia</i> spp.	<i>Glandulina laevigata</i>	<i>Hanzawai concentrica</i>	<i>Lenticulina</i> spp.	<i>Nodosariidae</i> spp.	<i>Nonion depressulum</i>	Other calcareous	Other milioids	<i>Pseudononion atlanticum</i>	<i>Quinqueloculina bicarinata</i>	<i>Quinqueloculina compta</i>	<i>Rectobolivina advena</i>	<i>Reussella spinulosa</i>	<i>Siphonina pulchra</i>	<i>Trifarina bella</i>	<i>Uvigerina pergerina</i>	Total calcareous & agglutinated	Total agglutinated	Number of foraminifers/gm	Number of Ostracods in split	PEB Index	
0.5	14.7	3.13	22	14	24		10	1	12	12			3		1	3	3				38	6	1	3	2		59	1	2					93	4	5			3	2	324	83	707	4	31.5	
1.5	25.6	9.38	34	21	30		1		7	15					1	1	8		1	1	58	2	3				70	1	2				48	1	3	2		1	1	303	93	126	6	16.5		
2.5	17.8	6.25	27	28	22		5		8	28						1	1	8		2	53	8	3	8			72	2	2		3	4	172	5	2	2		5	2	475	90	427	11	38.1		
3.5	18.4	6.25	22	21	19				11	27			2		2	4	6	1		1	82	24	4	7		1	55	2	3		1	1	124	3	3			5	3	389	73	339	5	35.5		
4.5	27.5	6.25	43	38	31				17	47			1	3	1	5				1	82	24	4	7			117	1	1	1	1	2	305	8	5	3		9	7	764	129	444	10	43.2		
5.5	21.9	12.5	26	13	17		3		17	29			1	1	3	7	4				50	8	5	4			47		5		1		139	5	3	1		4		393	76	144	3	39.2		
6.5	23.8	12.5	23	19	18	1	4		13	24		2	7		1	6	3	1			42	26	2				45	1	2	3	1		131	6	1	4	1	4		391	78	131	9	41.7		
7.5	26.2	9.38	30	15	16	1	2	2	5	19		1	5	2		1	4	2			42	30	2	7			68	3	4			1	133	16	2	2		3	2	420	71	171	13	39.8		
8.5	38.5	12.5	41	21	16		1		3	29	1	3	2			19	3				55	30		7	1		54	2	3	1			171	1	2	6	1		8	1	482	82	100	8	45.6	
9.5	35.1	6.25	30	23	25				9	28	1	2		1	3	21				2	37	26	4	4	1		56	1	2	1	3	2	215	10		1	1		7	4	520	87	237	6	50.4	
10.5	32.9	6.25	29	22	17				7	16		5			5	24	2			2	52	36	6	5	1	1	74	2		1	2	1	246	3	1		1	4	2	567	75	276	6	54.0		
11.5	30.0	6.25	41	22	13				11	29	2	2			6	21	6				46	53	1				75	2	6	2	1	1	362	1	3	1		8	3	718	87	383	4	60.7		
12.5	41.6	6.25	14	22	11		1	3	16				2	1	8	3	1			1	26	20	4				33	1			2	1	145	1	1	2		3	1	323	51	124	4	53.6		
13.5	26.2	100	16	2	5				4	15		3			1	10					25	16	1	1			34	2	1				106	2	2	1		1	2	250	27	10	3	52.8		
14.5	26.4	100	13	13	10				4	7						1	5				27	5	2	2	1		42	2	1		2	1	96	10	1					245	40	9	4	41.6		
15.5	27.9	100	12	3	11				6	9					3	1	3			1	65	4					13	1					49	3	1	1		1	1	188	32	7	1	28.7		
16.5	25.4	100	2	2	4				1	2								1			50			1			2						6							71	9	3		8.5		
17.5	27.8	100	2	1					1	1											30							5						5							45	4	2	1	11.1	
18.5	33.1	100	2		4				2	3											15													5							31	8	1		16.1	
19.5	39.6	100								2											51																					53	0	1		0.0
20.5	29.8	100								4											83														1							88	0	3		0.0
21.5	22.1	100	1							3											34														1							39	1	2		2.6
22.5	21.9	100	8	2	19					20	1						1	4	1		1	77	3	3			10	3				1		14			3	7		4		182	29	8		9.9

TABLE 9 BENTHIC FORAMINIFERS OF MRJ-03 5D

MRJ03 5D Sample depth (cm)	Calculated Wet Sample wt.	% sample examined	<i>Ammotium salsum</i>	<i>Bigeneria irregularis</i>	<i>Lagenammima difflugiformis</i>	<i>Milliamina horrida</i>	Other agglutinated	<i>Reophanus scorpiurus</i>	<i>Textularia</i> spp.	<i>Textularia mayori</i>	<i>Ammonia parkinsoniana</i>	<i>Ammonia beccarii</i>	<i>Ammonia</i> sp.	<i>Boilvina subspinsensis</i>	<i>Brizalina striatula</i>	<i>Brizalina translucens</i>	<i>Bucella hanni</i>	<i>Bulimina marginata</i>	<i>Buliminella morgani</i>	<i>Cancris auriculus</i>	<i>Dentalina</i> spp.	<i>Elphidium discoidale</i>	<i>Elphidium excavatum</i>	<i>Elphidium gunterii</i>	<i>Elphidium poeyanum</i>	<i>Elphidium</i> spp.	<i>Epistominella vitrea</i>	<i>Eponides antillarum</i>	<i>Fursenkoina pontoni</i>	<i>Glandulina laevigata</i>	<i>Globocassidulina subglobosa</i>	<i>Hanzawai concentrica</i>	<i>Lenticulina</i> spp.	<i>Nodosariidae</i> spp.	<i>Nonion depressulum</i>	Other calcareous	<i>Pseudononion atlanticum</i>	<i>Quinqueloculina</i> spp.	<i>Quinqueloculina bicarinata</i>	<i>Quinqueloculina compta</i>	<i>Quinqueloculina dimidiata</i>	<i>Rectobolivina advena</i>	<i>Siphonina pulchra</i>	Total calcareous & agglutinated	Total agglutinated	Number of foraminifers/gm	Number of ostracods in split	PEB Index					
0.5	56.83	3	25	2			1		4	31	20				3		1	19				30								9	1	6	31										183	32	103	2	27.32						
1.5	46.33	6	35	10			3		1	50	26							4				32	2	1	3		3			29	1		17											217	49	75	0	11.06					
2.5	33.54	6	30	18					3	47	11							1				37	1	1			3			15		2	12		2								183	51	98	0	8.74						
3.5	31.20	6	27	13			2		6	112	26	1						2				61	3	1	16				14		11	46		6									347	48	178	13	13.83						
4.5	32.98	25	16	14	1		2		1	66	43		1				2					36	5	38				21		6	10		1										263	34	32	3	3.80						
5.5	33.22	25	27	8	1		2	2	2	92	91	4	1				1			1		62	5	56			2		21		15	42		4									437	40	53	9	10.07						
6.5	35.42	25	2	2					1	52	52									1		45		46					7		26	10												244	5	28	26	4.10					
7.5	30.42	25	9	10						42	42	3						4				72	2	46			2	2		10		3	19		1	1								268	19	35	15	9.33					
8.5	27.17	50	7	5					5	40	86	4										70		43		2	3	3		26		5	2											298	17	22	0	1.68					
9.5	26.23	13	3	16			2		1	86	25	5				1		2				50	3	2	52		3		8		28	41											331	22	101	28	13.90						
10.5	30.47	25	10	7					3	55	40											31	6	24			1		10		43	5		1										236	20	31	34	2.12					
11.5	21.28	25	19	13	1	2			1	51	42	2							2			46	1	22				28	1	19	15		1											267	36	50	20	5.62					
12.5	31.19	25	17	17				2		106	90	2										77		23					27		24	15												401	36	51	46	3.74					
13.5	31.03	13	28	28		1			9	84	70	3			1		1	1	2			78		19				1		49		20	21		1			1						418	66	108	15	5.26					
14.5	34.81	25	4	3						101	184				1				1			79	11	30		1			4		59	9													487	7	56	76	2.05				
15.5	28.71	25	8	7				2		85	96	3										66		1	19			1	13		49	16													366	17	51	31	4.37				
16.5	31.45	25	11	9		1			1	116	127		2				2	1				78	4	27			2		15		37	18											1	452	22	57	50	4.87					
17.5	34.03	25	4	9	1	1	1	1	1	115	108	1							1			73	14	21			2		11		28	17												408	17	48	30	4.66					
18.5	27.32	25	1	1						132	80											67	8	27						44		1		1												362	2	53	35	0.28			
19.5	32.78	19	8	2						109	104	1										81	2	25			1		2		24	2	2													363	10	59	19	0.83			
20.5	29.01	25	3							137	105											106	6	26						33																416	3	57	51	0.00			
21.5	26.73	25	4							90	106						1					70	5	19					4		23	6														328	4	49	35	2.13			
22.5	32.82	25	7	5	1					69	57	1					1					70	7	27					6	1	27	10														289	13	35	55	3.46			
23.5	34.97	25	7	3						106	117								2			117	9	29					4		18	8														420	10	48	70	1.90			
24.5	28.13	13	8	3					1	30	24						1					30	1	8					2		27	6														141	12	40	17	4.96			
25.5	29.95	25	2							90	53											61	4	24					1		35	1															273	2	36	31	0.37		
26.5	34.96	25	6	1						66	51											62		19					2		14	1	5														227	7	26	20	2.20		
27.5	24.56	50	1	1						83	58											95	2	3	18		1	1		1	25	2														291	2	24	27	1.03			
28.5	29.89	25	1							77	44											111	5	11						17	1																267	1	36	28	0.37		
29.5	36.19	25	2							61	58											83	2	1	20		1		1	1	24	2															256	2	28	45	1.17		
30.5	22.80	50	16	5					2	66	66	2										88	3	13					8		13	1	34														317	23	28	21	10.73		
31.5	30.55	13								85	44											104		14						23																		270	0	71	23	0.00	
32.5	28.99	13	2							90	47	1										94		15			1		3		7	1	15															276	2	76	28	5.80	
33.5	25.82	25	11	2		1				211	70						5					163	3	15					4	1	15	8																509	14	79	34	2.55	
34.5	33.61	13	2	1						114	71											91	1	12							4	2																298	3	71	63	0.67	
35.5	35.25	25	1							112	55											62	3	4	16					16																		269	1	31	75	0.00	
36.5	29.29	50	4	1					1	67	32						1	2				75	1	22			1		1		14	12		1														236	6	16	31	6.36	
37.5	24.34	50	2	4						106	46						4					145		40			2			1	2																		421	6	35	63	11.64

## APPENDIX 1 GULF OF MEXICO FORAMINIFERS

### AGGLUTINATED SPECIES

*Ammotium salsum* Cushman and Brönniman, 1948, Cush. Found. Foram. Res., Contr., v. 24, pt. 2, p. 39, pl. 7, fig. 9.

*Bigeneria irregularis* Phlegar and Parker, 1951, Geol. Soc. Amer. Mem 46, pt. II, p. 4, pl. 1, fig. 16-21.

*Gaudryina minuta* Earland, 1929, Discovery Repts. v. 10, p. 121, pl. 5, fig. 45-46. Note: small-sized, medium-grained triserial cone.

*Haplophragmoides bradyi* (Robertson) = *Trochammina bradyi* Robertson, 1897, Ann. Mag. Nat. His., ser. 6, v. 7, p. 388. fine grained troccamidid

*Lagenammina difflugiformis* (Brady) = *Reophax difflugiformis* Brady, 1879, Notes on some of the Reticularian Rhizopoda of the *Challenger* Expedition: Quarterly J. of Micro. Sci., new series, v. 19, p. 51, pl. 4, figs. 3a,b.

*Milliamina horrida* (Cushman) = *Quinqueloculina horrida* Cushman, 1947, Contr. Cushman Lab. Foram. Res., v. 23, pt. 88, Pl. 19, fig. 1.

**Other Agglutinated** = Other unidentified and rare species

*Pseudoclavulina mexicana* (Cushman) = *Clavulina humilis* Brady var. *mexicana* Cushman, 1922, Bull. 104, U.S. National Museum, pt. 3, p. 83, pl. 16, figs. 1-3. Note: initial part triserial with latter chambers uniserial, often fine grained

*Reophanus oviculus* (Brady) = *Reophax ovicula* Brady, 1879, Quart. J. Micro. Sci., n. ser., 19, p. 20-62.

*Reophanus scorpiurus* (Montfort) = *Reophax scorpiurus* in Brady 1884, Rept. Voy. *Challenger*, Zool., v. 9, p. 62, pl. 30, fig. 12, 14-17. Note coarse to medium grained multichambered

*Textularia candeina* d'Orbigny, 1839, in Ramone de la Sagra, Hist. Fis. Pol. Nat. Cuba

"Foraminiferes", p. 143, pl. 1, figs. 25-27. Note round form with typical textularia aperture

*Textularia mayori* Cushman, 1922, Publ. 311 Carnegie Instit. Washington, v. 17, p. 23, pl. 2, fig. 3. Note: Spikey form found in shallow water

*Textularia* spp. = other unidentified, rare forms

*Trochammina globulosa* Cushman, 1920, Bull. U.S. National Museum, v. 104, pt. 2, p. 77, pl. 16, figs. 3,4.

*Trochammina inflata* (Montagu) = *Nautilus inflatus* Montague, 1808, Testacea Britannica, Supplement, p. 81, pl. 18, fig. 3.

*Trochammina* spp. other unnamed species

### CALCAREOUS SPECIES

*Ammonia beccarii* (Linne) = *Nautilus beccarii* Linne, 1758, Systemae Naturae, 10<sup>th</sup> ed. P. 710.

*Ammonia parkinsoniana* (d'Orbigny) = *Rosalina parkinsoniana* d'Orbigny, 1939, in Ramone de la Sagra, Hist. Fis. Pol. Nat. Cuba "Foraminiferes", p. 99, pl. 4, fig. 25-27.

*Ammonia* sp. unidentified species possibly reworked

*Astrononion* spp. unidentified forms

*Bolivina subspinensis* Cushman, 1922, Bull. 104, U.S. Nat. Museum, pt 3, p. 48, pl. 7, fig. 5.

*Brizalina fragilis* (Phleger and Parker) = *Bolivina fragilis* Phleger and Parker, 1951, GSA Mem. 46, pt II, p. 13, pl. 6, figs. 14, 23, 24a, b...

*Brizalina striatula* Cushman var. *spinata* Cushman = *Bolivina striatula* Cushman var. *spinata* Cushman, 1936, Spec. pub. n. 6, Cushman Lab. For am. Res., p. 59, pl.8, figs. 9a, b.

*Brizalina subaenariensis* Cushman var. *mexicana* Cushman = *Bolivina subaenariensis* Cushman var. *mexicana* Cushman, 1922 Bull. Nat. Mus., pt. 3, pt. 47, pl. 8. fig. 1

**Brizalina spp.** rare unidentified forms

*Brizalina transluscens* (Phleger and Parker) = *Bolivina transluscens* Phleger and Parker, 1951, GSA Mem. 46, pt II, p. 15, pl. 7, figs. 13, 14a,b.

*Buccella hanni* (Phleger and Parker) = *Eponides hanni* Phleger and Parker, 1951, GSA Mem. 46, pt. 2, p.21, pl. 11, figs. 1a, b, 2a, b.

*Bulimina marginata* d'Orbigny, 1826, Ann. Sci. Nat., v. 7, p. 269, no.4, pl. 12 figs 10-12.

*Bulimina tenuis* Phleger and Parker, 1951, GSA Mem. 46, pt. 2, p.16, pl. 7, figs. 33 a, b, 34a, b.

*Buliminella morgani* Anderson, 1961, LA Geol. Bull n. 35, pt II, p. 87, pl. 19, fig. 10.

*Cancris auriculus* (Fichtel and Moll) = *Nautilus auricula* var. □ Fichtel and Moll, 1798, p. 108, pl. 20, fig. a-c. NOTE: this is the *Cancris sagra* (d'Orbigny) of Anderson, 1961.

*Cassidulina curvata* Phleger and Parker, 1951, GSA Mem. 46, pt II, p. 26, pl. 14, figs 5a, b.

*Cassidulina reniforme* (Nørvang) = *Cassidulina crassa* d'Orbigny var. *reiniforme* Nørvang, 1945, The zoology of Iceland. *Foraminifera* 2(2): 1-79.

*Chilostomella oolina* Schwager, 1878, Bol. Com. Geol, Ital., v. 9, p. 527, pl. 1, fig. 16. NOTE: included in other calcareous species

**Cibicides spp.** other unnamed *Cibicides*

*Cibicides mundulus* (Brady, Parker and Jones)=*Truncatulina mundula*, Brady Parker and Jones, 1888, Zool. Soc. London, Trans. 12 (pt. 7, n1) p. 228, pl. 45 fig. 25a-c.

*Cibicoides pachyderma* (Rzehak) = *Truncatulina pachyderma* Rzehak, 1886, Naturf. Ver. Brünn, Verh., Brünn, Bd. 24 (1885), p. 87, pl. 1, fig. 5 a-c. (see Morkoven, et al., 1986, p. 68-71). NOTE: *Planulina floridana* (Cushman) = *Truncatulina floridana* Cushman, 1919. U.S. Geological Survey Bull. 676, p. 62, pl.19, fig.2. (see Loeblich and Tappan 1994, p. 149, pl. 312, fig. 9-14)/ *Planulina floridana* (sublittoral) Poag 1981/ *Cibicides pseudoungerianus* (Cushman)/ *Cibicides cicatricosus* (Schwager) in Bock. *Cibicides umbonatus* (Phleger and Parker, 1951. Plate 17, fig 7a, b, 8a, b.)

*Cornuspira planorbis* Schultze, 1854, Organismus Polythal., p. 40, pl.2, fig. 21.

*Dentalina communis* d'Orbigny in Brady 1884, Rept. Voy. *Challenger*, Zool., v. 9, p. 130, pl 62, fig. 21, 22, Note: most common species included in *Dentalina* spp.

*Elphidium discoidale* (d'Orbigny) = *Polystomella discoidalis* d'Orbigny, 1839, in Ramone de la Sagra, Hist. Fis. Pol. Nat. Cuba "Foraminiferes", p. 56, pl. 6, figs. 23, 24.

*Elphidium excavatum* (Terquem) = *Polystomella excavata* Terquem, 1876, Societé Dunquerqueoise, Memoires, v. 19 (1874-75) p. 429.

*Elphidium poeyanum* (d'Orbigny) = *Polystomella poeyana* d'Orbigny, 1839, in Ramone de la Sagra, Hist. Fis. Pol. Nat. Cuba "Foraminiferes", p. 55, pl. 6, figs. 25, 26 NOTE: Characteristic semicircular openings along sutures.

*Epistominella vitrea* Parker, in Parker, Phleger, and Peirson, 1953, Cushman Foundation Sp. Pub n. 2, p. 9, pl. 4, fig. 34-36, 40, 41.

*Eponides antillarum* ( d'Orbigny) = *Rotalina antillarum* d'Orbigny, 1839, in Ramone de la Sagra, Hist. Fis. Pol. Nat. Cuba "Foraminiferes", p. 75, pl. 5, figs. 4-6. NOTE: round

*Fursenkoina pontoni* (Cushman) = *Virgulina pontoni* Cushman, 1932, Contr. Cushman Lab. Foram. Res., v. 8, pt. 1, p. 17, pl. 3, fig. 7.

**Fursenkoina spp.** other unidentified *Fursenkoina*

*Gavelinopsis translucens* (Phleger and Parker) = “*Rotalia*” *translucens* Phleger and Parker 1951, GSA Mem. 46, pt. 2, p.24, pl. 12, figs. 11a, b, 12a, b

*Glandulina laevigata* (d'Orbigny) = *Nodosaria laevigata* d' Orbigny 1826, Ann. Sci. Nat., ser. 1, vol. 7, p. 252, pl. 10, figs. 1-3.

*Globocassidulina subglobosa* (Brady) = *Cassidulina subglobosa* Brady, 1881, Quart. Journ. Micr. Sci., v.21, p. 30 (p. 60)

*Hanzawaia concentrica* (Cushman) = *Truncatulina concentrica* Cushman, 1918, U.S.G.S. Bull. 676, p. 64, pl. 21, fig. 3.

*Lenticulina calcur* (Linné) = *Nautilus calcur* Linné, 1767, Syst. Nat. 12<sup>th</sup> ed., p. 1162, n. 272  
Note: most common species included in *Lenticulina* spp.

*Marginulina marginulinoides* (Göes) = *Cristellaria aculeata* var. *marginulinoides* Göes, 1896, Bull. Mus. Comp. Zool., v. 29, p. 56, pl. 5, figs. 15, 16. Note: most common form, included in *Marginulopsis* spp.

*Miliolinella subrotunda* (Montague) = *Vermiculum subrotundum* Montague 1803. Note: Type species concept was revised with the establishment of neotype for *M. subrotunda* in 1974. Includes *Pateoris hauerinoides* (Rhumbler)-Loeblich and Tappan 1953, pl.7, fig. 8-12.

*Neocorbina terquem* (Rzhak) see Loeblich and Tappan, 1988 pl. 609 fig 8-10.

*Neolenticulina peregrina* (Schwager) = *Cristellaria peregrina* Schwager, 1866, *Novara*. Expedition, Geol. Thiel, v.2, p. 245. Pl. 7, fig. 89. Note: More commonly referred to as *Lenticulina perigrina*

*Nodosaria albatrossi* Cushman = *Nodosaria vertabralis* (Batsch), var. *albatrossi* Cushman, 1923, Bull. 104, U.S. Nat. Mus., pt. 4, p. 87, pl. 15, fig. 1. Note: included in *Nodosaria* spp.

*Nodosaria pyrula* d'Orbigny, 1826, Ann. Sci. Nat., v. 7, p. 253, no. 13. Note: included in *Nodosaria* spp.

**Nodosariidae spp.** includes assorted species of the genera *Lagena*, *Fissurina* and *Oolina*

*Nonion depressulum* (Walker and Jacob) var. *matagordanum* Kornfeld, 1931, Stanford Univ., Dept., Geol., Contr., v. 1, n. 3, p. 87, pl. 13, fig. 2a,b.

*Nonionella opima* Cushman, 1947, Cont. Cushman Lab. Foram Res., v. 23, pt. 4, p. 90, pl. 20, figs 1-3.

*Oridorsalis umbonatus* (Reuss) = *Rotalina umbonatus* Reuss, 1851, Zeitschrift der Deutschen Geologischen Gesellschaft, Berlin, vol. 3, p. 75, pl. 5, figs. 35 a-c. Note: *O. umbonatus* includes individuals identified as *Eponides tener* by other authors.

*Osangularia cultur* (Parker and Jones) = *Panorbulina cultur* Parker and Jones, 1865, Phil. Trans., p. 421, pl. 19, fig 1,

**Other calcareous** other unidentified and rare species

**Other miliolids** other unidentified and rare species

*Planulina foveolata* (Brady) = *Anomolina foveolata* Brady 1884, Rept. Voy. *Challenger*, Zool., v. 9, p. 676, pl. 94, figs. 1 a-c..

*Pseudononion atlanticum* (Cushman) = *Nonionella atlantica* Cushman, 1947, Cont. Cush. Lab. Foram. Res., v. 23, pt. 4, p. 11, pl. 5, figs. 21-23.

*Pseudonosaria comatula* (Cushman) = *Nodosaria comatula* Cushman, 1923, Bull. 104, U.S. Nat. Mus., pt. 4, p. 83, pl. 14, fig. 5.

*Pyrgo nasutus* Cushman, 1935, Smithsonian Misc. Coll., v. 91, n. 21, p. 7, pl. 3, figs. 1-4.

**Pyrgo spp.** Includes other unidentified *Pyrgo* spp.

***Quinqueloculina bicarinata*** d'Orbigny, 1826, Ann. Sci. Nat. v.7, p. 302. NOTE: this is the triangular shaped form with no striations

***Quinqueloculina compta*** Cushman, 1947, Contr. Cushman Lab. Foram. Res., v. 23, pt. 4, p. 87, pl. 19, fig. 2. Note: elongated form

***Quinqueloculina dimidiata*** Terquem, 1876, Essai sur le classement des animaux que vivent sur la plage et dans le environs le Dunkerque, p. 81, pl. 4-, figs. 5 a-c.

***Quinqueloculina* spp.** assorted other species of the genera

***Rectobolivina advena*** Cushman = *Siphogenerina advena* Cushman, 1922, Carnegie Inst., Washington, Pub. 311, p. 35, pl. 5, fig. 2.

***Reussella spinulosa*** (Reuss) = *Verneuilina spinulosa* Reuss, 1850, Denkschriften Kaiser. Akad. Der Wissensch. Math. - Natur. Classe. 1, 374. NOTE checked *Reussella spinulose* (Reuss) var. *atlantica* Cushman, 1947 Cont. Cush. Lab. Foram. Res., v. 23, pt. 4, p. 91, pl. 20, figs. 6-7, but I believe it to be the same.

***Robertinoides charlottensis*** (Cushman,) = *Cassidulina charlottensis* Cushman, 1925, Contr. Cushman Lab. Foram. Res., vol. 1, pt. 2, p. 41, pl. 6, figs. 6, 7.

***Rosalina suezensis*** = ***Rosalina bahamensis*** Todd and Low, 1971, U.S.G.S., Prof. Paper 683-C, p. C14, pl. 3 fig. 2.

***Saracenaria* spp.** assorted species of this genera

***Siphonina pulchra*** Cushman, 1919, Publ. 291, Carnegie Instit. Washington, p. 42, pl. 14, fig. 7 a-c.

***Spirolaccamina* spp** assorted species of the genera.

***Trifarina bella*** (Phleger and Parker) = *Angulogerina bella* Phleger and Parker, 1951, GSA Mem. 46, pt II, p. 12, pl. 6, figs. 7, 8.

***Triloculinella tegminis*** (Loeblich and Tappan) = *Scutuloris tegminus* Loeblich and Tappan, 1953, Studies of Arctic Foraminifera, Smithsonian Miscellaneous Collections, v. 121, no. 7, p. 41, pl. 6, fig. 10; includes *Miliolinella chukchiensis* (Loeblich and Tappan) 1953, pl. 7, fig. 7

***Quinqueloculina subrotunda*** (Montague) Todd and Low, 1967; and *Quinqueloculina subrotunda* (Montague?) Cushman, 1948

***Uvigerina peregrina*** Cushman 1923, Bull. 104, U.S. Nat. Mus., pt. 4, p. 166, pl. 42, figs. 7-10.

***Valvulina laevigata*** Phleger and Parker, 1951, GSA Mem. 46, pt. 2, p.25, pl. 13, figs. 11a, b, 12a, b.