

PLANKTONIC FORAMINIFERA COLLECTED BY THE R/V MELVILLE (1972) IN THE SOUTHWEST ATLANTIC

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ABSTRACT: *The planktonic foraminiferal fauna was studied from 186 samples collected by the R/V Melville in the Southwest Atlantic Ocean during 1972. The samples were collected in the surface layer (horizontal tows) and throughout the water column from 500-0 m. (vertical tows). Twenty species were recognized (some with various formae). These species can be divided according to their temperature requirements into cold-temperate, warm-temperate, warm and cosmopolitan species. Based on the distribution of these species, 4 types of surface water were determined.*

THE objectives of this work were: a) to study qualitatively and quantitatively the distribution of the planktonic foraminiferal fauna collected by the R/V Melville (October-November 1972) in the Southwest Atlantic Ocean, and b) to attempt to separate different water masses on the basis of the distribution of planktonic foraminifera.

MATERIAL—The material studied consisted of 186 planktonic samples (Fig. 1): 21 were collected through the water column from 500-0 m (vertical samples) and 165 were horizontal samples taken from the surface water layer using of the pump-filter method.

Planktonic foraminifera were found in only 9 of the vertical and in 30 of the horizontal samples. This was probably because most of the samples were collected over the continental shelf which does not favor the occurrence of planktonic foraminifera (Boltovskoy, 1970).

SURFACE HYDROLOGY OF THE SOUTHWEST ATLANTIC—The hydrology of the southwest Atlantic was described in detail by Boltovskoy in 1970 and 1978.

In the South Atlantic, the warm subtropical waters of the Brazilian Current converge with the cold subantarctic waters of the West Wind Drift and its western branch, the Falkland Current. The contact between these water masses is known as the Subtropical/Subantarctic Convergence (Fig. 1). This is a wide zone of belts, tongues and patches, of different mixtures of subtropical and subantarctic waters. The northern limit of the zone of convergence is located in summer at 29°S latitude and in winter at 34°S. The southern limit has less seasonal changes in summer; it is at 47-48°S and in winter at 47°S (Boltovskoy, 1970).

SYSTEMATICS—Most of the species determined in the surface samples were represented by a few, small specimens, while in the vertical samples numerous, large specimens were found.

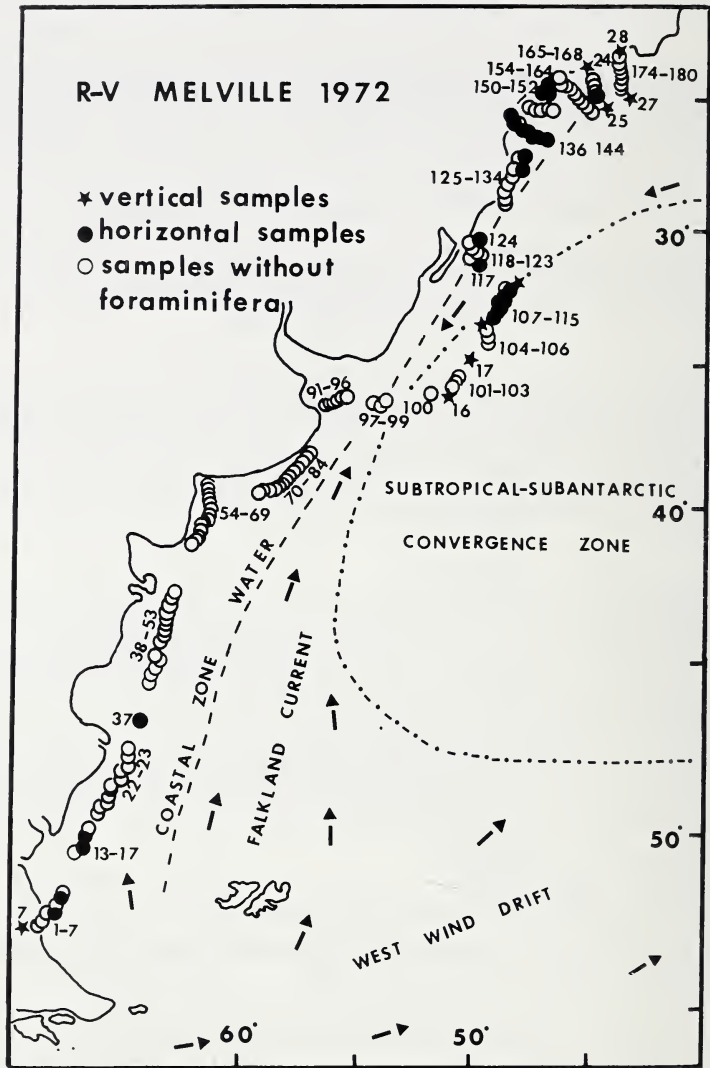


Fig. 1. R/V Melville (1972) sample locations. Hydrologic scheme after Boltovskoy, 1970.

Most of the species were easy to identify except for a few juveniles that showed intermediate characteristics between *Globoquadrina pachyderma* and *G. dutertrei*. We consider these as *G. pachyderma/G. dutertrei*. The strong morphological similarities and the gradual and nearly continuous gradation between these 2 species were noted by Kennett (1976). *Globorotalia menardii, forma typica* and *G. menardii, forma tumida* were also difficult to separate because they are connected by a series of transition specimens. We consider these as *G. menardii (sensu lato)*.

The following species were represented in more than 1 form.

Globigerinoides ruber has 3 forms; 2 on the basis of the wall color (*forma alba* and *forma rosea*) and 1 on the basis of test morphology (*forma elongata*). The first 2 forms tolerate different ecological changes. In the warm open sea, *forma rosea* (pink wall colored) is more abundant. In unfavorable changes (e.g., low salinity, low temperature, proximity of the coast), *forma alba* (white wall colored) is more frequent (Boltovskoy, 1968). *Globigerinoides trilobus* was represented by 2 forms: *forma typica* and *forma sacculifera*. *Forma sacculifera* is less tolerant to low temperature than the other one. *Globoquadrina dutertrei* was represented by 2 forms: *forma typica* and *forma eggeri*.

The most abundant species and also the one that showed the widest distribution was *Globigerinoides ruber* (*sensu lato*), followed by *Globorotalia menardii* (*sensu lato*), *G. inflata*, *Globigerinoides trilobus* (*sensu lato*), *Globigerinella aequilateralis*, *Hasterigerina pelagica*, *Globigerinita glutinata*, *Globorotalia hirsuta*, *G. scitula* and *G. truncatulinoides*. The other species were represented by a few scattered specimens (Tables 1 and 2).

All species determined, arranged in alphabetical order, are as follows:

- Candeina nitida* Orbigny, 1839, *In: de la Sagra Hist. Phys. Pol. Nat. Cuba, "Foraminifères"*, p. 108, pl. 2, figs. 27-28.
- Globigerina bulloides* Orbigny, *forma trilocularis* Orbigny = *Globigerina trilocularis* Orbigny, 1826, *Ann. Sci. Nat.*, v. 7, p. 277, no. 2.
- Globigerina calida* Parker, 1962, *Micropaleontology*, v. 8, p. 221, pl. 1, figs. 9-13, 15.
- Globigerina hexagona* Natland, 1938, *Scripps Inst. Ocean., Techn. Ser.*, v. 4, no. 5, p. 149, pl. 7, fig. 1.
- Globigerina rubescens* Hofker, 1956, *Copenhagen Univ., Zool. Mus., Spolia*, v. 15, p. 234, pl. 35, figs. 18-21.
- Globigerinita aequilateralis* (Brady), *forma involuta* Cushman, 1917, *U.S. Nat. Mus., Proc.*, v. 15, no. 2172, p. 662.
- Globigerinita glutinata* (Egger) = *Globigerina glutinata* Egger, 1893, *Abh. K. Bayer, Akad. Wiss. München, Cl. II*, v. 18, p. 371, pl. 13, figs. 19-21.
- Globigerinoides conglobatus* (Brady) = *Globigerina conglobata* Brady, 1879, *Quart. J. Micr. Sci. n.s.*, v. 19, p. 286; 1884, *Rept. Voy. "Challenger"*, *Zool.*, v. 9, pl. 80, figs. 1-5; pl. 82, fig. 5.
- Globigerinoides ruber* (Orbigny) = *Globigerina ruber* Orbigny, 1839, *In: de la Sagra, Hist. Phys. Pol. Nat. Cuba, "Foraminifères"*, p. 82, pl. 4, fig. 12-14.
- Globigerinoides ruber* (Orbigny), *forma typica* (Orbigny), *ut supra*.
- Globigerinoides ruber* (Orbigny), *forma alba* Boltovskoy, 1968, *Rev. Micropaleontologie*, v. 11, no. 2, p. 89.
- Globigerinoides ruber* (Orbigny), *forma elongata* (Orbigny) = *Globigerina elongata* Orbigny, 1826, *Tabl. Méth. Ann. Sci. Nat. Paris, Sér. 1*, v. 7, p. 277.
- Globigerinoides ruber* (Orbigny), *forma rosea* Boltovskoy, 1968, *Rev. Micropaleontologie*, v. 11, no. 2, p. 89.
- Globigerinoides trilobus* (Reuss) = *Globigerina triloba* Reuss, 1850, *K. Akad. Wiss. Wien. Denkschr.*, v. 1, p. 374, pl. 47, fig. 11.
- Globigerinoides trilobus* (Reuss), *forma typica* (Reuss), *ut supra*.
- Globigerinoides trilobus* (Reuss), *forma sacculifera* (Brady) =
- Globigerina sacculifera* Brady, 1877, *Geol. Mag., n.s.*, v. 4, no. 12, p. 535; 1884, *Rept. Voy. "Challenger"*, *Zool.*, v. 9, p. 604, pl. 80, figs. 11-17; pl. 82, fig. 4.
- Globoquadrina dutertrei* (Orbigny) = *Globigerina dutertrei* Orbigny, 1839, *In: de la Sagra, Hist. Phys. Pol. Nat. Cuba, "Foraminifères"*, p. 84, pl. 4, fig. 19-21.
- Globoquadrina dutertrei* (Orbigny), *forma typica* (Orbigny), *ut supra*.
- Globoquadrina dutertrei* (Orbigny), *forma eggeri* Rhumbler, 1901, *In: Brandt, Nordisch Plankton, Lief. 1*, no. 14, p. 19, fig. 20.

TABLE 1. Planktonic Foraminifera found in surface horizontal samples (R/V Melville, 1972). Specimens number: R (rare) < 5, C (common) = 6-24, A (abundant) = 25-49, P (predominant) > 50.

Horizontal Sample Number	4	6	14	37	107	109	110	111	112	114	115	117	124	127	131	132	133	134	135	136	138	139	140	141	142	143	144	151	152	153	165		
GLOBOQUADRINA PACHYDERMA (f. superficialia)	R	R																															
GLOBIGERINA BULLOIDES (f. trilocularis)			R	R																													
GLOBOROTALIA INFLATA	R		R		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		
GLOBIGERINOIDES RUBER (f. alba)					R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		
GLOBIGERINOIDES RUBER (f. rosea)					R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		
GLOBIGERINOIDES TRILOBUS (f. typica)					R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		
GLOBIGERINELLA AEQUILATERALIS (f. involuta)																																	
GLOBOQUADRINA PACHYDERMA/G. DUTERTREI																																	
ORBULINA UNIVERSA																																	
HASTERIGERINA PELAGICA																																	
GLOBOROTALIA CRASSAFORMIS																																	
GLOBOROTALIA MENARDII (s.l.)																																	
WATER ZONES	COASTAL WATER OF ARGENTINA																MIXED WATER						COASTAL WATER OF SOUTH BRAZIL										

TABLE 2. Planktonic Foraminifera found in vertical samples (R/V Melville, 1972). Specimens number: R (rare) < 5, C (common) = 6-24, A (abundant) = 25-49, P (predominant) > 50.

Vertical Sample Number	716	17	18	19	25	27	26	28
GLOBOQUADRINA PACHYDERMA (f. superficialia)	RR	R						
GLOBIGERINA BULLOIDES (f. trilocularis)	R	R	R	R				
GLOBOROTALIA INFLATA	R	P	P	C				
GLOBOROTALIA TRUNCATULINOIDES		C	C	C	C			
GLOBOROTALIA SCITULA		C	C	C			R	
GLOBOROTALIA HIRSUTA		C	C	C			R	
GLOBOROTALIA CRASSAFORMIS							R	R
GLOBIGERINOIDES RUBER (f. alba)	C	A	A	A	A	C		
GLOBIGERINOIDES RUBER (f. rosea)	A	A	P	P	C			
GLOBIGERINOIDES RUBER (f. elongata)	C	R	C					
HASTERIGERINA PELAGICA	R	R	R	A	A			
GLOBIGERINELLA AEQUILATERALIS (f. involuta)	R	R	R	C	C			
GLOBIGERINOIDES TRILOBUS (f. typica)	A	C	P					
GLOBIGERINOIDES TRILOBUS (f. sacculifera)	C			A	R			
GLOBIGERINOIDES CONGLOBATUS	R							
GLOBIGERINA RUBESCENS	R	R	C	R				
GLOBOQUADRINA DUTERTREI (f. eggeri)			R					
GLOBOQUADRINA DUTERTREI (f. typica)		R		R	R			
GLOBOQUADRINA PACHYDERMA/G. DUTERTREI	C							
GLOBIGERINA HEXAGONA	R			R				
GLOBIGERINA CALIDA	R			R				
GLOBOROTALIA MENARDII (s.l.)	C	R	C	P	C	R	R	R
CANDEINA NITIDA				R				
GLOBIGERINITA GLUTINATA	C	R	R	A	C			
WATER ZONES								
	COASTAL WATER OF ARGENTINA		MIXED WATER		SUBTROPICAL WATER		COASTAL WATER OF BRAZIL	

Globoquadrina pachyderma (Ehrenberg), forma *superficialia* Boltovskoy, 1971, In: Funnell and Riedel, The Micropaleontology of Oceans, p. 281.

Globorotalia crassaformis (Galloway and Wissler) = *Globigerina crassaformis* Galloway and Wissler, 1927, J. Paleont., v. 1, p. 41, pl. 7, fig. 12.

Globorotalia hirsuta (Orbigny) = *Rotalia hirsuta* Orbigny, 1839, In: Barker-Webb et Berthelot, Hist. Nat. Iles Canaries, "Foraminifères", v. 2, pt. 2 Zool., p. 131, pl. 1, figs. 37-39.

Globorotalia inflata (Orbigny) = *Globigerina inflata* Orbigny, *Ibidem*, p. 134, pl. 2, figs. 7-9.

Globorotalia menardii (Orbigny) = *Rotalia menardii* Orbigny, 1826, Ann. Sci. Nat., Sér. 1, v. 7, p. 273, no. 26, Mod. 10.

H Globorotalia menardii (Orbigny), forma *typica* (Orbigny), *ut supra*.

H Globorotalia menardii (Orbigny), forma *tumida* (Brady) = *Pulvinulina tumida* Brady, 1884, Rept. Voy. "Challenger", Zool, v. 9, p. 692, pl. 103, figs. 4-6.

Globorotalia scitula (Brady) = *Pulvinulina scitula* Brady, 1882, Roy. Proc., v. 11 (1880-1882), no. 111, p. 716.

Globorotalia truncatulinoides (Orbigny) = *Rotalia truncatulinoides* Orbigny, 1839, In: Barker-Webb et Berthelot, Hist. Nat. Iles Canaries, "Foraminifères", v. 2, pt. 2, p. 132, pl. 2, figs. 25-27.

Hasterigerina pelagica (Orbigny) = *Nonionina pelagica* Orbigny, 1839, Voy. Amér. Mérid., v. 5, pt. 5, "Foraminifères", p. 27, pl. 3, figs. 13-14.

Orbulina universa Orbigny, 1839, In: de la Sagra, Hist. Phys. Pol. Nat. Cuba, "Foraminifères", p. 3, pl. 1, fig. 1.

PLANKTONIC FORAMINIFERAL ASSEMBLAGE—The distribution of the planktonic foraminiferal species is shown in Tables 1 and 2. They are arranged according to their tolerance of high temperatures or their penetration to the north (Boltovskoy, 1969; 1978; Bé and Tolderlund, 1971; and Lena and Watanabe, in press). In the samples analyzed, 4 groups of species were distinguished:

1) Cold-temperate water species: *Globoquadrina pachyderma* (forma *superficiaria*), *Globigerina bulloides*, *Globorotalia truncatulinoides*, *G. scitula* and *G. inflata*.

2) Warm-temperate water species: *Globorotalia hirsuta* and *G. crassaformis*.

3) Warm water species: *Globigerinoides ruber*, *Hasterigerina pelagica*, *Globigerinella aequilateralis*, *Globigerinoides trilobus*, *G. conglobatus*, *Globoquadrina dutertei*, *Globigerina hexagona*, *G. calida*, *Globorotalia menardii* and *Candeina nitida*.

4) Cosmopolitan species: *Globigerinita glutinata*.

WATER ZONES—The following water zones were recognized based on the distribution of the planktonic foraminifera collected (Fig. 2): a) Coastal Water Zone of Argentina (Subantarctic water modified by its proximity to the coast). In this type of water the foraminiferal fauna consisted of cold-temperate species in a low frequency (generally 1 specimen/sample); b) Mixed Water of the Subtropical/Subantarctic Convergence Zone. The planktonic foraminiferal fauna consisted mostly of warm and warm-temperate species mixed with some cold-temperate species; c) Subtropical Water Zone. This zone is characterized by warm and warm-temperate species. The presence of *Globorotalia scitula* and *G. truncatulinoides* in vertical samples, number 25 and 27 is an exception and can be explained as the result of subantarctic water upwelling (E. Boltovskoy, 1970); d) Coastal Water Zone of South Brazil (Subtropical water mixed with water coming from the south and modified by its proximity to the coast). Only a few warm water species were found in this area.

The hydrological results of our paper are similar to those previously obtained from foraminiferal data (Boltovskoy, 1959, 1966, 1970, 1978; Lena, 1975 and Lena and Watanabe, in press).

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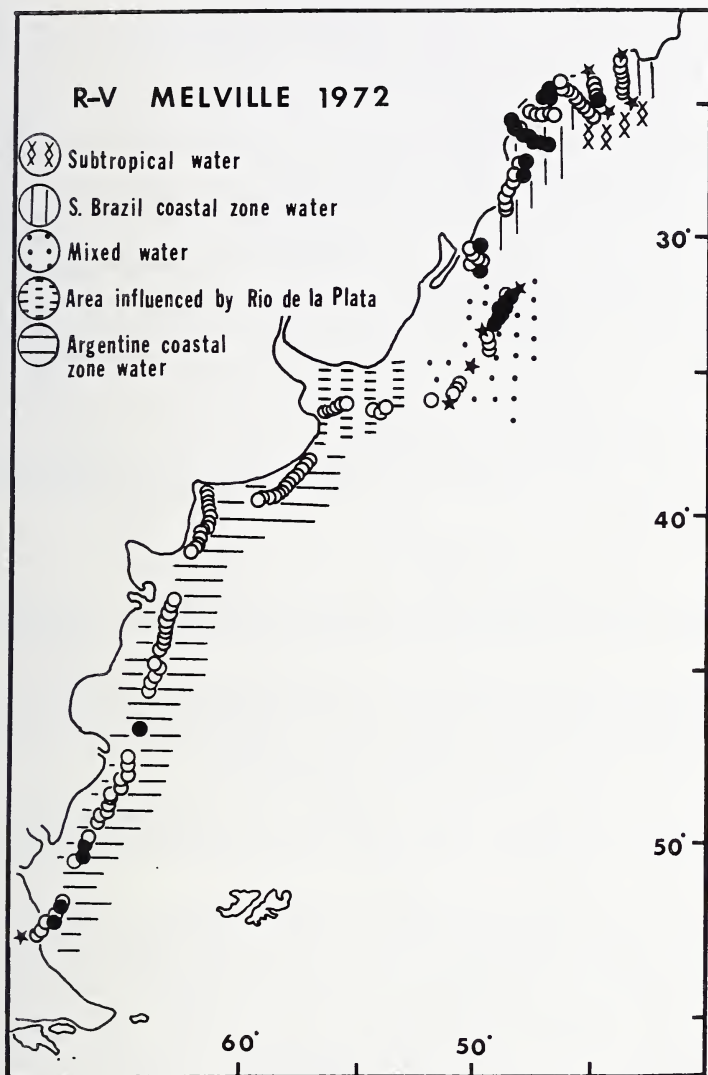


Fig. 2. Surface water zones determined on the basis of planktonic foraminiferal data during R/V Melville (1972) cruise in the southwest Atlantic.

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PROBABLE ESTABLISHMENT AND RANGE EXTENSION OF THE SPOTTED TILAPIA, *TILAPIA MARIAE* BOULENGER (PISCES: CICHLIDAE) IN EAST CENTRAL FLORIDA—M. R. Clark, Harbor Branch Foundation, Inc., RR 1, Box 196, Fort Pierce, Florida 33450.¹

ABSTRACT: *Juvenile Tilapia mariae* were collected in southeastern Brevard County, Florida. A description of the area, probable methods of introduction, and reasons for probable establishment, are given.

THE introduction of the spotted tilapia, (*Tilapia mariae*) in Dade County, Florida was reported by Hogg (1974). Later, Hogg (1976) reported the establishment of this species in canals and ponds of Dade County. Courtenay and Hensley (1979) recently reported the range expansion of spotted tilapia to Broward and Collier counties, Florida (Fig. 1).

Tilapia mariae was recently collected at spillway S-157 in the Fellsmere Canal, Brevard County, Florida on 17 September 1979. (Fig. 1). This spillway is the last in the Fellsmere Canal before it enters the north fork of Sebastian Creek. Seventy specimens were collected above the spillway; 1 specimen was collected below the spillway (see Table 1), approximately 150 m west of the confluence with C-54 Canal and north fork of Sebastian Creek. Specimen ranged from 11-37 mm standard length (\bar{x} = 24.1 mm SL). Subsequent collections in October, November, and December yielded additional specimens in salinities up to 4 ‰, determined with use of American optical refractometer (see Table 1). All collections were made with a 3 m seine

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