Seasonal Flux and Assemblage Composition of Planktic Foraminifera from the Northern Gulf of Mexico, 2008–2009

By Jessica W. Spear and Richard Z. Poore

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Abstract

The U.S. Geological Survey established a sediment trap in the northern Gulf of Mexico to collect time-series data on the flux and assemblage composition of live planktic foraminifers. This report provides an update of the 2008 time-series data to include results from 2009. Ten species, or varieties, of planktic foraminifers constitute >90 percent of the assemblage*: Globigerinoides ruber* (pink and white varieties), *Gs. sacculifer, Globigerina calida, Globigerinella aequilateralis, Globorotalia menardii group, Gt. truncatulinoides, Pulleniatina* spp., *Orbulina universa*, and *Neogloboquadrina dutertrei*. The mean daily flux is about 215 tests per square meter per day (m^{-2} day^{-1}), with maximum fluxes of >800 tests m^{-2} day^{-1} during early February and minimum fluxes of <20 tests m^{-2} day^{-1} during early October. *Globorotalia truncatulinoides* shows a clear preference for the winter and continues to provide the greatest number of tests for 2009, consistent with data from 2008. *Globigerinoides ruber* (white variety) flux increased more than 3 orders of magnitude from an average of 3 tests m^{-2} day^{-1} in 2008 to 11 tests m^{-2} day^{-1} in 2009. However, though *Gs. ruber* (white) abundance increased from 1.5 percent in 2008 to 4.9 percent in 2009, it continues to be a minor contributor to the total assemblage composition, in contrast to assemblage records from nearby sediments that indicate *Gs. ruber* (white) typically comprises approximately 20-30 percent of the assemblage.

Introduction

A sediment trap was moored in the northern Gulf of Mexico in January 2008 as part of a U.S. Geological Survey Mendenhall Postdoctoral Fellowship project. The sediment trap, equipped with an automated sampling system, has continuously collected material in the water column from January 2008 to the present and is currently deployed. Information on the trap, trap mooring, planktic foraminifers as climate proxies, and the results from the first year are detailed in Tedesco and others (2009). In this paper, we update results from the sediment-trap series to include material collected between January and December of 2009. The paper presents the data without interpretation.

Regional Setting

The Gulf of Mexico is a semi-enclosed basin surrounded by the Gulf Coast of the United States, Mexico, and Cuba (fig. 1). Sea-surface temperature (SST) at the trap site ranges from a winter low of around 21 °C to a high of 30 °C (World Ocean Atlas 2005 data cited in Locarnini and others, 2006). Sea-surface salinity (SSS) ranges from about 35 practical salinity units (psu) in the winter to 32 psu in the summer (World Ocean Atlas 2005 data cited in Antanov and others, 2006).

The Gulf of Mexico is connected to the Caribbean and tropical North Atlantic through the Loop Current. The Loop Current is a surface current that enters the Gulf of Mexico between Cuba and the Yucatan Peninsula and typically loops east and south before exiting through the Florida Straits.
The Gulf of Mexico, Caribbean Sea, and western tropical North Atlantic comprise the Atlantic Warm Pool, the Atlantic portion of the Western Hemisphere Warm Pool. The Atlantic Warm Pool is defined by the region covered by water warmer than 28.5 ºC and constitutes a large part of the tropical heat engine, supplying moisture to the atmosphere and latent heat to North America from early spring to early fall (Wang and Enfield, 2001; Wang and others, 2006). World Ocean Atlas 2005 climatology

indicates the trap site is part of the Atlantic Warm Pool during July, August, and September (summer) (Locarnini and others, 2006).

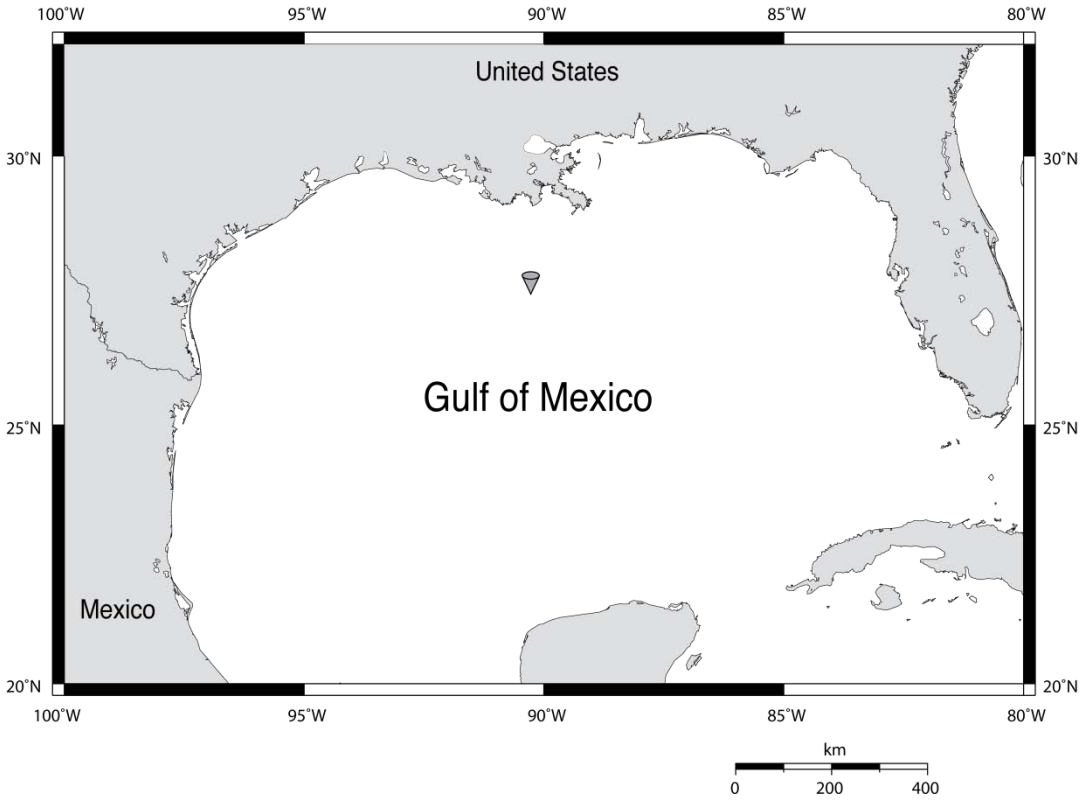

Figure 1. Location of the sediment trap mooring (inverted triangle) in the northern Gulf of Mexico at approximately 27.5°N. latitude and 90.3°W. longitude.

Materials and Methods

A McLane PARFLUX Mark 78 automated sediment trap was deployed in early January 2008 in approximately 1,150 m of water depth at approximately 27.5ºN. latitude and 90.3ºW. longitude. The trap is positioned at 700 m of water depth on the mooring to guarantee the collection of deeper dwelling species of planktic foraminifers (for example, *Globorotalia* spp.). The trap is equipped with 21 collection cups that are mounted on a rotating plate that is programmed to rotate every 7 to 14 days.

Each cup contains a 3.7-percent buffered (sodium borate) formalin solution to poison and preserve the samples. Each trap sample represents a 1- to 2-week collection period. The trap is recovered and redeployed every 3-6 months, depending on sampling frequency. A gap in our sampling occurred from late May to late September 2009 due to scheduling problems. Samples from the weeks of March 17, April 7, May 5, October 22, November 19, and December 10 of 2009 were not recovered due to loss of the cups during deployment. During visits to the trap site, conductivity-temperature-depth (CTD) measurements were collected using a Sea-Bird Electronics SBE9*plus* (fig. 2).

Sediment-trap samples were wet split into four aliquots using a precision rotary splitter at the University of South Carolina, stored in buffered deionized water, and then refrigerated. A quarter split was wet sieved over a 150-micrometer (μm) sieve and subsequently wet picked for all foraminifers. To supplement total test counts in intervals with less than 300 foraminifers, we sieved and picked an additional one-quarter split and summed the counts. All planktic foraminifers were identified to species. The species counts are reported as flux in tests per square meter per day. Flux was calculated by multiplying the individual species counts by number of splits, then dividing by sampling length, which was typically 7 or 14 days. Percent abundance is reported weekly and for each season. Seasonal flux is the total flux for each individual species. Seasons are defined as winter (January, February, and March), spring (April, May, and June), summer (July, August, and September), and fall (October, November, and December). Relative seasonal abundances were calculated by dividing the individual species total seasonal flux by the total seasonal flux for all planktic foraminifers.

Results and Discussion

More than 25 species of planktic foraminifers were identified in the sediment-trap material. Ten species, or varieties, of planktic foraminifers constitute >90 percent of the assemblage*: Globigerinoides ruber* (d'Orbigny) (pink and white varieties), *Gs. sacculifer* (Brady), *Globigerina calida* (Parker),

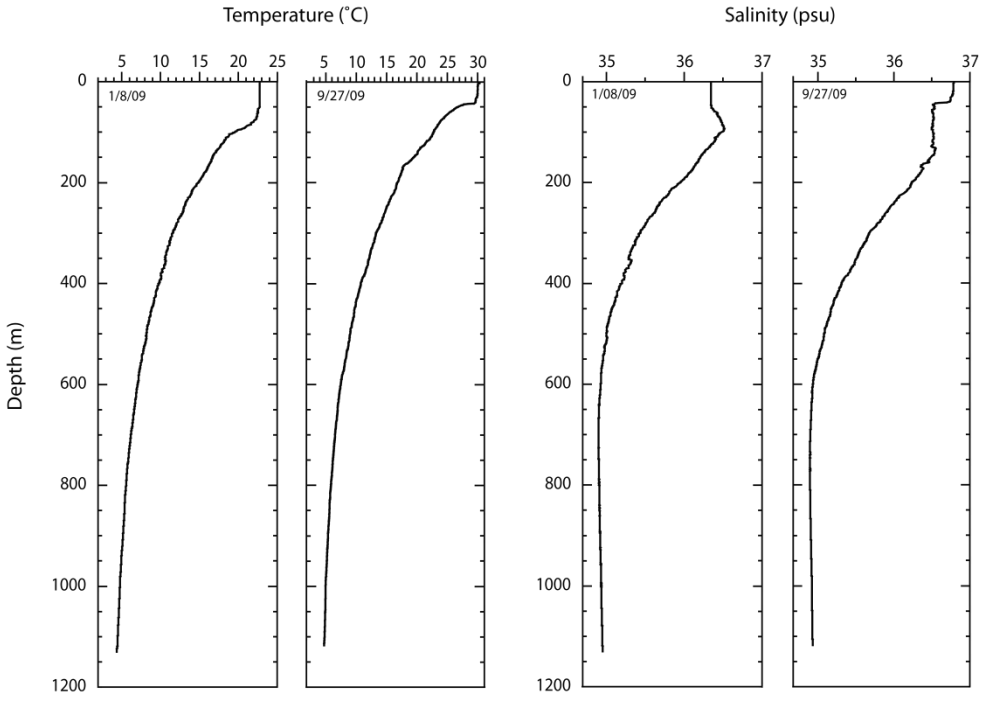

Figure 2. Temperature (panels on left) and salinity (panels on right) depth profiles from this study for the trap site during 2009. m, meters; psu, pratical salinity units.

Globigerinella aequilateralis (Brady), *Globorotalia menardii* group [The *Gt. menardii* group includes *Gt. menardii* (Parker, Jones, and Brady), *Gt. tumida* (Brady), and *Gt. ungulata* (Bermudez)], *Orbulina universa* (d'Orbigny), *Gt. truncatulinoides* (d'Orbigny), *Pulleniatina* spp., and *Neogloboquadrina dutertrei* (d'Orbigny) (table 1, figs. 3 and 4). We discuss further the seasonal and annual variability of two species: *Gt. truncatulinoides* and *Gs. ruber* (white and pink).

The mean daily flux of planktic foraminifers recovered from the sediment trap in 2009 was about 215 tests m^{-2} day^{-1} (table 1and fig. 3). The winter (January, February, and March) flux ranges from 84 to 865 tests m^{-2} day^{-1}, with a mean flux of 346 tests m^{-2} day^{-1}. Spring (April and May; June is missing) flux ranges from 36 to 208 tests m^{-2} day^{-1}, with a mean flux of 127 tests m^{-2} day^{-1}. The fall (October, November, and December) flux ranges from 16 to 384 tests m^{-2} day^{-1}, with a mean flux of 121 tests m^{-2} day^{-1}.

Table 1. Planktic foraminiferal flux (tests per square meter per day, $m^{-2} d^{-1}$) and percent contribution (in parentheses) to the total assemblage for the 14 most common species, northern Gulf of Mexico. Table is separated by season (that is, winter, spring, summer, and fall) and year. The first 10 species listed comprise about 90 percent of the total flux. Particularly low fluxes (that is, <50 tests $m^{-2} d^{-1}$) are denoted with an asterisk next to the mid-week collection date. [*Globigerinoides*= *Gs*., *Globorotalia*= *Gt*., *Globigerina*=*G*., *Globigerinella*=*Gl*., *Neogloboquadrina*=*N*, *Orbulina*=*O*.]

Sample		Mid-week Date	*Gs. ruber* (pink)	*Gs. ruber* (white)	*Gs. sacculifer*	*Gt. menardii* group	*Pulleniatina* spp.	*N. dutertrei*	*Gl. aequilateralis*	*G. calida*	*O. universa*	*Gt. truncatulinoides*	Percent of seasonal flux	*Gt. crassaformis*	*Gg. glutinata*	*G. bulloides*	*G. falconensis*	Others	Total planktic flux	Percent of seasonal flux	Seasonal percent of annual flux
GMT-1	1	18-Jan-08	6.86 (2.99)	0.00 (0.00)	9.14 (3.99)	0.00 (0.00)	30.29 (13.22)	8.00 (3.49)	4.57 (2.00)	27.43 (11.97)	0.00 0.00	137.71 (60.10)		0.57 (0.25)	1.71 (0.75)	0.00 (0.00)	0.00 (0.00)	2.86 (1.25)	229.14		
GMT-1	2	25-Jan-08	7.43 (1.23)	0.57 (0.09)	18.29 (3.03)	7.43 (1.23)	33.71 (5.58)	28.00 (4.64)	13.71 (2.27)	23.43 (3.88)	1.71 (0.28)	452.57 (74.93)		7.43 (1.23)	6.86 (1.14)	0.00 (0.00)	0.00 (0.00)	2.86 (0.47)	604.00		
GMT-1	3	1-Feb-08	5.71 (1.31)	1.14 (0.26)	8.00 (1.83)	7.43 (1.70)	71.43 (16.32)	29.71 (6.79)	22.86 (5.22)	32.00 (7.31)	2.29 (0.52)	245.14 (56.01)		0.00 (0.00)	6.29 (1.44)	1.14 (0.26)	1.71 (0.39)	2.86 (0.65)	437.71		
GMT-1	4	8-Feb-08	8.00 (1.52)	1.14 (0.22)	4.57 (0.87)	1.71 (0.33)	38.86 (7.38)	31.43 (5.97)	18.86 (3.58)	64.00 (12.15)	0.57 (0.11)	346.29 (65.73)		1.14 (0.22)	5.71 (1.08)	1.71 (0.33)	0.57 (0.11)	2.29 (0.43)	526.86		
GMT-1	5	15-Feb-08	2.29 (1.29)	1.14 (0.65)	10.86 (6.13)	0.57 (0.32)	6.86 (3.87)	8.57 (4.84)	11.43 (6.45)	36.00 (20.32)	2.29 (1.29)	95.43 (53.87)		0.00 (0.00)	0.57 (0.32)	0.00 (0.00)	0.57 (0.32)	0.57 (0.32)	177.14		
GMT-1	6	22-Feb-08	18.29 (7.51)	1.14 (0.47)	16.57 (6.81)	2.29 (0.94)	8.00 (3.29)	18.29 (7.51)	11.43 (4.69)	40.00 (16.43)	2.29 (0.94)	110.86 (45.54)		1.71 (0.70)	5.71 (2.35)	1.71 (0.70)	0.00 (0.00)	5.14 (2.11)	243.43		
GMT-1	7	29-Feb-08	9.14 (6.15)	0.57 (0.38)	23.43 (15.77)	1.71 (1.15)	1.71 (1.15)	5.71 (3.85)	4.57 (3.08)	18.29 (12.31)	5.14 (3.46)	74.29 (50.00)		2.29 (1.54)	0.57 (0.38)	0.00 (0.00)	0.00 (0.00)	1.14 (0.77)	148.57		
GMT-1	8	7-Mar-08	32.57 (9.31)	4.57 (1.31)	127.43 (36.44)	0.57 (0.16)	1.71 (0.49)	28.57 (8.17)	47.43 (13.56)	9.14 (2.61)	21.14 (6.05)	57.71 (16.50)		2.29 (0.65)	10.29 (2.94)	0.00 (0.00)	0.00 (0.00)	6.29 (1.80)	349.71		
GMT-1	9	14-Mar-08	16.00 (8.16)	5.71 (2.92)	24.57 (12.54)	11.43 (5.83)	1.14 (0.58)	29.71 (15.16)	25.71 (13.12)	14.86 (7.58)	7.43 (3.79)	23.43 (11.95)		0.57 (0.29)	28.57 (14.58)	0.00 (0.00)	0.00 (0.00)	6.86 (3.50)	196.00		
GMT-1	10	21-Mar-08	31.43 (11.88)	3.43 (1.30)	49.71 (18.79)	62.86 (23.76)	3.43 (1.30)	32.57 (12.31)	26.86 (10.15)	6.29 (2.38)	18.86 (7.13)	4.57 (1.73)		2.29 (0.86)	16.00 (6.05)	0.00 (0.00)	0.00 (0.00)	6.29 (2.38)	264.57		
GMT-1	11	28-Mar-08	23.43 (10.54)	2.86 (1.29)	64.57 (29.05)	29.71 (13.37)	1.71 (0.77)	13.71 (6.17)	7.43 (3.34)	11.43 (5.14)	33.14 (14.91)	2.86 (1.29)		4.00 (1.80)	17.71 (7.97)	0.00 (0.00)	0.00 (0.00)	9.71 (4.37)	222.29		
winter		Total	161.14	22.29	357.14	125.71	198.86	234.29	194.86	282.86	94.86	1550.86		22.29	100.00	4.57	2.86	46.86	3399.43		
		(%)	(4.74)	(0.66)	(10.51)	(3.70)	(5.85)	(6.89)	(5.73)	(8.32)	(2.79)	(45.62)	(94.81)	(0.66)	(2.94)	(0.13)	(0.08)	(1.38)		(5.19)	(34.06)
GMT-1	12	4-Apr-08	12.00 (5.22)	0.57 (0.25)	86.29 (37.56)	9.14 (3.98)	0.57 (0.25)	9.14 (3.98)	49.71 (21.64)	8.57 (3.73)	40.00 (17.41)	0.57 (0.25)		1.71 (0.75)	4.57 (1.99)	0.00 (0.00)	0.00 (0.00)	6.86 (2.99)	229.71		
GMT-1	13	11-Apr-08	4.57 (7.41)	2.29 (3.70)	10.29 (16.67)	2.29 (3.70)	0.00 (0.00)	5.71 (9.26)	17.71 (28.70)	4.00 (6.48)	8.57 (13.89)	2.29 (3.70)		0.57 (0.93)	2.29 (3.70)	0.00 (0.00)	0.00 (0.00)	1.14 (1.85)	61.71		
GMT-1	14	18-Apr-08	25.33 (21.17)	2.00 (1.67)	9.33 (7.80)	5.67 (4.74)	1.00 (0.84)	3.00 (2.51)	9.67 (8.08)	7.67 (6.41)	12.67 (10.58)	4.00 (3.34)		30.00 (25.07)	4.67 (3.90)	0.00 (0.00)	0.00 (0.00)	4.67 (3.90)	119.67		
GMT-2	1	25-Apr-08	36.57 (12.61)	13.43 (4.63)	85.71 (29.56)	37.43 (12.91)	1.43 (0.49)	7.14 (2.46)	8.86 (3.05)	9.71 (3.35)	26.57 (9.16)	4.00 (1.38)		30.86 (10.64)	16.57 (5.71)	0.00 (0.00)	0.00 (0.00)	11.71 (4.04)	290.00		
GMT-2	2	2-May-08	15.43 (8.91)	2.86 (1.65)	57.14 (33.00)	1.14 (0.66)	0.00 (0.00)	2.29 (1.32)	26.29 (15.18)	13.14 (7.59)	31.43 (18.15)	5.71 (3.30)		9.14 (5.28)	2.29 (1.32)	0.00 (0.00)	0.00 (0.00)	6.29 (3.63)	173.14		
GMT-2	3	9-May-08	18.86 (23.57)	6.29 (7.86)	10.00 (12.50)	0.57 (0.71)	0.29 (0.36)	1.71 (2.14)	10.57 (13.21)	13.14 (16.43)	9.71 (12.14)	0.86 (1.07)		2.29 (2.86)	1.71 (2.14)	0.00 (0.00)	0.00 (0.00)	4.00 (5.00)	80.00		
GMT-2	4	16-May-08*	0.57 (2.63)	0.57 (2.63)	4.57 (21.05)	1.71 (7.89)	0.00 (0.00)	0.57 (2.63)	2.86 (13.16)	3.43 (15.79)	2.29 (10.53)	4.00 (18.42)		1.14 (5.26)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	21.71		
GMT-2	5	23-May-08	34.29 (20.13)	9.14 (5.37)	37.14 (21.81)	8.57 (5.03)	0.57 (0.34)	2.29 (1.34)	14.29 (8.39)	8.57 (5.03)	24.00 (14.09)	9.71 (5.70)		7.43 (4.36)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	14.29 (8.39)	170.29		
GMT-2	6	30-May-08	42.86 (43.99)	2.57 (2.64)	9.14 (9.38)	1.71 (1.76)	0.29 (0.29)	2.29 (2.35)	11.43 (11.73)	8.29 (8.50)	8.57 (8.80)	2.57 (2.64)		3.71 (3.81)	1.14 (1.17)	0.00 (0.00)	0.00 (0.00)	2.86 (2.93)	97.43		
GMT-2	7	6-Jun-08	24.57 (32.82)	9.71 (12.98)	3.43 (4.58)	0.57 (0.76)	0.57 (0.76)	1.14 (1.53)	10.86 (14.50)	9.14 (12.21)	4.00 (5.34)	1.71 (2.29)		1.71 (2.29)	1.14 (1.53)	0.00 (0.00)	0.00 (0.00)	6.29 (8.40)	74.86		
GMT-2	8	13-Jun-08	20.00 (26.12)	1.71 (2.24)	5.14 (6.72)	1.14 (1.49)	0.00 (0.00)	1.14 (1.49)	14.29 (18.66)	12.00 (15.67)	13.71 (17.91)	1.71 (2.24)		4.00 (5.22)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.71 (2.24)	76.57		
GMT-2	9	20-Jun-08	10.29 (27.27)	4.57 (12.12)	3.43 (9.09)	0.57 (1.52)	0.00 (0.00)	0.00 (0.00)	4.00 (10.61)	8.00 (21.21)	2.29 (6.06)	1.71 (4.55)		1.71 (4.55)	0.57 (1.52)	0.00 (0.00)	0.00 (0.00)	0.57 (1.52)	37.71		
GMT-2	10	27-Jun-08	6.86 (19.67)	3.43 (9.84)	5.71 (16.39)	0.57 (1.64)	0.57 (1.64)	0.57 (1.64)	1.14 (3.28)	4.57 (13.11)	2.29 (6.56)	1.71 (4.92)		6.29 (18.03)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.14 (3.28)	34.86		
spring		Total	252.19	59.14	327.33	71.10	5.29	37.00	181.67	110.24	186.10	40.57		100.57	34.95	0.00	0.00	61.52	1467.67		
		(%)	(17.18)	(4.03)	(22.30)	(4.84)	(0.36)	(2.52)	(12.38)	(7.51)	(12.68)	(2.76)	(86.57)	(6.85)	(2.38)	0.00	0.00	(4.19)		(13.43)	(14.71)
GMT-2	11	4-Jul-08	14.29 (38.46)	2.86 (7.69)	2.86 (7.69)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	3.43 (9.23)	5.14 (13.85)	2.29 (6.15)	0.00 (0.00)		3.43 (9.23)	1.14 (3.08)	0.00 (0.00)	0.00 (0.00)	1.71 (4.62)	37.14		
GMT-2	12	11-Jul-08	10.86 (43.18)	1.71 (6.82)	2.86 (11.36)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.29 (9.09)	4.00 (15.91)	0.00 (0.00)	0.57 (2.27)		0.57 (2.27)	0.57 (2.27)	0.00 (0.00)	0.00 (0.00)	1.71 (6.82)	25.14		
GMT-2	13	18-Jul-08	102.00 (54.75)	9.71 (5.21)	18.29 (9.82)	1.43 (0.77)	0.00 (0.00)	5.14 (2.76)	11.71 (6.29)	6.86 (3.68)	16.00 (8.59)	0.29 (0.15)		7.71 (4.14)	1.71 (0.92)	0.00 (0.00)	0.00 (0.00)	5.43 (2.91)	186.29		
GMT-2	14	25-Jul-08	80.57 (53.61)	2.86 (1.90)	17.43 (11.60)	1.43 (0.95)	0.29 (0.19)	4.57 (3.04)	5.71 (3.80)	5.43 (3.61)	16.29 (10.84)	0.86 (0.57)		5.43 (3.61)	4.00 (2.66)	0.00 (0.00)	0.00 (0.00)	5.43 (3.61)	150.29		
GMT-3	1	4-Aug-08	83.43 (40.22)	2.29 (1.10)	59.43 (28.65)	0.57 (0.28)	0.00 (0.00)	20.00 (9.64)	18.86 (9.09)	1.71 (0.83)	7.43 (3.58)	0.57 (0.28)		7.43 (3.58)	5.71 (2.75)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	207.43		
GMT-3	2	11-Aug-08	31.43 (32.74)	2.86 (2.98)	14.29 (14.88)	0.29 (0.30)	0.00 (0.00)	5.14 (5.36)	11.43 (11.90)	5.14 (5.36)	16.57 (17.26)	0.29 (0.30)		3.43 (3.57)	0.29 (0.30)	0.00 (0.00)	0.00 (0.00)	4.86 (5.06)	96.00		
GMT-3	3	18-Aug-08	19.71 (36.51)	0.86 (1.59)	7.43 (13.76)	0.86 (1.59)	0.00 (0.00)	3.71 (6.88)	4.86 (8.99)	4.57 (8.47)	7.71 (14.29)	0.00 (0.00)		1.71 (3.17)	2.29 (4.23)	0.00 (0.00)	0.29 (0.53)	0.00 (0.00)	54.00		
GMT-3	4	25-Aug-08	22.86 (45.20)	2.29 (4.52)	4.00 (7.91)	0.57 (1.13)	0.00 (0.00)	1.71 (3.39)	5.71 (11.30)	4.57 (9.04)	2.00 (3.95)	0.29 (0.56)		2.86 (5.65)	1.71 (3.39)	0.00 (0.00)	0.00 (0.00)	2.00 (3.95)	50.57		
GMT-3	5	1-Sep-08	14.57 (21.89)	2.29 (3.43)	4.86 (7.30)	0.00 (0.00)	0.00 (0.00)	1.43 (2.15)	15.43 (23.18)	16.29 (24.46)	0.57 (0.86)	0.00 (0.00)		5.14 (7.73)	0.86 (1.29)	0.00 (0.00)	0.00 (0.00)	5.14 (7.73)	66.57		
GMT-3	6	8-Sep-08	26.86 (40.17)	5.43 (8.12)	6.00 (8.97)	0.00 (0.00)	0.00 (0.00)	2.00 (2.99)	6.57 (9.83)	8.57 (12.82)	1.71 (2.56)	0.00 (0.00)		6.57 (9.83)	0.57 (0.85)	0.00 (0.00)	0.00 (0.00)	2.57 (3.85)	66.86		
GMT-3	7	15-Sep-08	30.57 (40.38)	1.43 (1.89)	15.71 (20.75)	0.29 (0.38)	0.29 (0.38)	2.29 (3.02)	7.43 (9.81)	6.57 (8.68)	5.71 (7.55)	0.29 (0.38)		3.43 (4.53)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.71 (2.26)	75.71		
GMT-3	8	22-Sep-08	12.00 (13.91)	3.14 (3.64)	10.86 (12.58)	5.14 (5.96)	6.00 (6.95)	25.14 (29.14)	3.43 (3.97)	3.14 (3.64)	2.57 (2.98)	0.29 (0.33)		3.71 (4.30)	4.29 (4.97)	0.29 (0.33)	0.00 (0.00)	6.29 (7.28)	86.29		
GMT-3	9	29-Sep-08	15.14 (12.96)	0.86 (0.73)	9.14 (7.82)	0.29 (0.24)	14.29 (12.22)	22.86 (19.56)	31.14 (26.65)	9.43 (8.07)	5.43 (4.65)	0.29 (0.24)		1.71 (1.47)	2.29 (1.96)	0.86 (0.73)	0.00 (0.00)	3.14 (2.69)	116.86		
summer		Total	464.29	38.57	173.14	10.86	20.86	94.00	128.00	81.43	84.29	3.71		53.14	25.43	1.14	0.29	40.00	1219.14		
		(%)	(38.08)	(3.16)	(14.20)	(0.89)	(1.71)	(7.71)	(10.50)	(6.68)	(6.91)	(0.30)	(90.16)	(4.36)	(2.09)	(0.09)	(0.02)	(3.28)		(9.84)	(12.22)
GMT-3	10	6-Oct-08	39.14 (32.16)	1.43 (1.17)	8.00 (6.57)	1.14 (0.94)	9.71 (7.98)	20.00 (16.43)	16.57 (13.62)	9.43 (7.75)	8.86 (7.28)	0.00 (0.00)		1.43 (1.17)	4.29 (3.52)	0.29 (0.23)	0.00 (0.00)	1.43 (1.17)	121.71		
GMT-3	11	13-Oct-08	5.14 (5.57)	2.29 (2.48)	24.86 (26.93)	6.00 (6.50)	7.14 (7.74)	11.71 (12.69)	11.43 (12.38)	11.43 (12.38)	5.43 (5.88)	0.00 (0.00)		1.14 (1.24)	2.57 (2.79)	0.00 (0.00)	0.29 (0.31)	2.86 (3.10)	92.29		
GMT-3	12	20-Oct-08	6.00 (9.95)	1.14 (1.90)	9.14 (15.17)	7.14 (11.85)	5.43 (9.00)	4.00 (6.64)	5.43 (9.00)	5.71 (9.48)	5.43 (9.00)	0.00 (0.00)		0.00 (0.00)	2.86 (4.74)	0.00 (0.00)	0.00 (0.00)	8.00 (13.27)	60.29		
GMT-4	1	30-Oct-08	12.57 (7.80)	0.57 (0.35)	27.14 (16.84)	6.00 (3.72)	20.00 (12.41)	22.00 (13.65)	45.43 (28.19)	7.14 (4.43)	2.57 (1.60)	0.00 (0.00)		10.00 (6.21)	3.43 (2.13)	0.29 (0.18)	0.00 (0.00)	4.00 (2.48)	161.14		
GMT-4	2	5-Nov-08	4.00 (2.36)	1.71 (1.01)	16.00 (9.46)	5.14 (3.04)	68.57 (40.54)	30.29 (17.91)	14.86 (8.78)	8.00 (4.73)	2.29 (1.35)	0.00 (0.00)		8.57 (5.07)	9.14 (5.41)	0.00 (0.00)	0.00 (0.00)	0.57 (0.34)	169.14		
GMT-4	3	12-Nov-08	11.43 (2.86)	5.14 (1.29)	38.29 (9.57)	44.00 (11.00)	177.71 (44.43)	36.00 (9.00)	45.14 (11.29)	14.29 (3.57)	18.29 (4.57)	0.00 (0.00)		1.14 (0.29)	6.86 (1.71)	0.57 (0.14)	0.00 (0.00)	1.14 (0.29)	400.00		
GMT-4	4	19-Nov-08	11.43 (3.39)	2.86 (0.85)	33.71 (10.00)	34.86 (10.34)	125.14 (37.12)	72.00 (21.36)	19.43 (5.76)	18.29 (5.42)	6.29 (1.86)	0.00 (0.00)		0.00 (0.00)	5.14 (1.53)	0.57 (0.17)	0.57 (0.17)	6.86 (2.03)	337.14		
GMT-4	5	26-Nov-08	8.00 (1.51)	1.14 (0.22)	42.86 (8.10)	9.71 (1.84)	305.14 (57.67)	49.14 (9.29)	84.00 (15.87)	15.43 (2.92)	2.86 (0.54)	0.00 (0.00)		1.14 (0.22)	3.43 (0.65)	5.14 (0.97)	0.00 (0.00)	1.14 (0.22)	529.14		
GMT-4	6	3-Dec-08	16.00 (2.43)	2.86 (0.43)	54.86 (8.32)	12.57 (1.91)	322.86 (48.96)	99.43 (15.08)	33.14 (5.03)	41.71 (6.33)	2.86 (0.43)	0.00 (0.00)		1.14 (0.17)	6.29 (0.95)	47.43 (7.19)	16.57 (2.51)	1.71 (0.26)	659.43		
GMT-4	7	10-Dec-08	2.86 (1.23)	0.57 (0.25)	28.57 (12.29)	4.00 (1.72)	76.00 (32.68)	64.57 (27.76)	16.57 (7.13)	19.43 (8.35)	1.71 (0.74)	0.00 (0.00)		1.14 (0.49)	0.57 (0.25)	9.14 (3.93)	4.57 (1.97)	2.86 (1.23)	232.57		
GMT-4	8	17-Dec-08	2.86 (0.91)	3.43 (1.09)	18.86 (6.01)	3.43 (1.09)	120.00 (38.25)	72.57 (23.13)	12.00 (3.83)	37.71 (12.02)	1.14 (0.36)	4.00 (1.28)		1.14 (0.36)	12.00 (3.83)	12.57 (4.01)	10.29 (3.28)	1.71 (0.55)	313.71		
GMT-4	9	24-Dec-08	14.29 (2.93)	6.29 (1.29)	27.43 (5.63)	1.71 (0.35)	97.14 (19.95)	67.43 (13.85)	39.43 (8.10)	108.00 (22.18)	1.71 (0.35)	24.00 (4.93)		0.57 (0.12)	2.29 (0.47)	24.00 (4.93)	68.57 (14.08)	4.00 (0.82)	486.86		
GMT-4	10	31-Dec-08	4.57 (1.38)	0.57 (0.17)	9.14 (2.76)	0.57 (0.17)	53.71 (16.23)	42.29 (12.78)	22.86 (6.91)	89.14 (26.94)	1.71 (0.52)	85.14 (25.73)		0.57 (0.17)	3.43 (1.04)	6.86 (2.07)	6.86 (2.07)	3.43 (1.04)	330.86		
fall		Total	138.29	30.00	338.86	136.29	1388.57	591.43	366.29	385.71	61.14	113.14		28.00	62.29	106.86	107.71	39.71	3894.29		
		(%)	(3.55)	(0.77)	(8.70)	(3.50)	(35.66)	(15.19)	(9.41)	(9.90)	(1.57)	(2.91)	(91.15)	(0.72)	(1.60)	(2.74)	(2.77)	(1.02)		(8.85)	(39.02)
Annual		Total	1015.90	150.00	1196.48	343.95	1613.57	956.71	870.81	860.24	426.38	1708.29		204.00	222.67	112.57	110.86	188.10	9980.52		
		(%)	(10.18)	(1.50)	(11.99)	(3.45)	(16.17)	(9.59)	(8.73)	(8.62)	(4.27)	(17.12)	(91.60)	(2.04)	(2.23)	(1.13)	(1.11)	(1.88)		(8.40)	
GMT-4	11	7-Jan-09	1.00 (0.52)	0.00 (0.00)	4.00 (2.09)	2.00 (1.05)	8.00 (4.19)	10.00 (5.24)	7.00 (3.66)	40.00 (20.94)	0.00 (0.00)	107.00 (56.02)		0.00 (0.00)	3.00 (1.57)	3.00 (1.57)	3.00 (1.57)	3.00 (1.57)	191.00		
GMT-5	1	13-Jan-09	8.86 (3.92)	2.57 (1.14)	32.86 (14.56)	1.43 (0.63)	3.71 (1.65)	10.00 (4.43)	3.43 (1.52)	19.71 (8.73)	1.71 (0.76)	138.86 (61.52)		1.14 (0.51)	0.00 (0.00)	0.29 (0.13)	0.00 (0.00)	1.14 (0.51)	225.71		
GMT-5	2	20-Jan-09	48.00 (10.49)	18.29 (4.00)	42.86 (9.36)	5.71 (1.25)	8.00 (1.75)	25.14 (5.49)	12.00 (2.62)	30.86 (6.74)	2.29 (0.50)	257.71 (56.30)		0.00 (0.00)	4.00 (0.87)	0.00 (0.00)	0.00 (0.00)	2.86 (0.62)	457.71		
GMT-5	3	27-Jan-09	25.14 (17.64)	10.29 (7.21)	11.43 (8.02)	4.00 (2.81)	4.29 (3.01)	7.14 (5.01)	10.00 (7.01)	6.29 (4.41)	5.71 (4.01)	53.43 (37.47)		0.57 (0.40)	1.71 (1.20)	0.29 (0.20)	0.29 (0.20)	2.00 (1.40)	142.57		
GMT-5	4	3-Feb-09	68.00 (7.86)	8.57 (0.99)	40.57 (4.69)	14.86 (1.72)	35.43 (4.10)	30.86 (3.57)	40.00 (4.62)	54.29 (6.27)	19.43 (2.25)	546.86 (63.21)		1.71 (0.20)	2.86 (0.33)	0.00 (0.00)	0.00 (0.00)	1.71 (0.20)	865.14		
GMT-5	5	10-Feb-09	36.57 (6.89)	17.71 (3.34)	13.14 (2.48)	41.71 (7.86)	42.86 (8.07)	37.71 (7.10)	22.86 (4.31)	32.57 (6.14)	20.00 (3.77)	254.29 (47.90)		4.00 (0.75)	4.57 (0.86)	0.00 (0.00)	0.57 (0.11)	2.29 (0.43)	530.86		
GMT-5	6	17-Feb-09	103.43 (17.80)	37.71 (6.49)	30.29 (5.21)	48.00 (8.26)	118.86 (20.45)	101.14 (17.40)	8.00 (1.38)	22.86 (3.93)	5.71 (0.98)	62.86 (10.82)		0.57 (0.10)	32.57 (5.60)	7.43 (1.28)	0.00 (0.00)	1.71 (0.29)	581.14		
GMT-5	7	24-Feb-09	35.14 (13.25)	6.57 (2.48)	13.14 (4.96)	4.86 (1.83)	12.00 (4.53)	24.00 (9.05)	84.29 (31.79)	13.71 (5.17)	3.71 (1.40)	60.29 (22.74)		4.00 (1.51)	2.57 (0.97)	0.00 (0.00)	0.00 (0.00)	0.86 (0.32)	265.14		
GMT-5	8	3-Mar-09	65.71 (21.44)	29.71 (9.69)	23.71 (7.74)	6.57 (2.14)	9.43 (3.08)	25.43 (8.29)	19.71 (6.43)	58.57 (19.11)	8.57 (2.80)	35.43 (11.56)		0.29 (0.09)	8.29 (2.70)	11.14 (3.63)	0.00 (0.00)	4.00 (1.30)	306.57		
GMT-5	9	10-Mar-09	106.57 (29.23)	54.57 (14.97)	48.86 (13.40)	28.29 (7.76)	8.29 (2.27)	26.00 (7.13)	27.71 (7.60)	22.57 (6.19)	13.14 (3.61)	15.43 (4.23)		0.00 (0.00)	2.86 (0.78)	1.43 (0.39)	0.00 (0.00)	8.86 (2.43)	364.57		
GMT-5	11	24-Mar-09	17.43 (12.53)	6.86 (4.93)	10.86 (7.80)	7.43 (5.34)	0.57 (0.41)	3.71 (2.67)	20.29 (14.58)	35.43 (25.46)	4.57 (3.29)	27.14 (19.51)		1.43 (1.03)	0.86 (0.62)	0.57 (0.41)	0.00 (0.00)	2.00 (1.44)	139.14		
GMT-5	12	31-Mar-09	25.71 (30.30)	17.71 (20.88)	7.14 (8.42)	2.57 (3.03)	1.14 (1.35)	3.14 (3.70)	7.71 (9.09)	9.14 (10.77)	3.14 (3.70)	4.86 (5.72)		0.00 (0.00)	0.29 (0.34)	0.00 (0.00)	0.00 (0.00)	2.29 (2.69)	84.86		
winter		Total	541.57	210.57	278.86	167.43	252.57	304.29	263.00	346.00	88.00	1564.14		13.71	63.57	24.14	3.86	32.71	4154.43		
		(%)	(13.04)	(5.07)	(6.71)	(4.03)	(6.08)	(7.32)	(6.33)	(8.33)	(2.12)	(37.65)	(96.68)	(0.33)	(1.53)	(0.58)	(0.09)	(0.79)		(3.32)	(66.44)
GMT-5	14	14-Apr-09	33.71 (17.99)	8.29 (4.42)	64.29 (34.30)	21.14 (11.28)	8.29 (4.42)	8.57 (4.57)	10.86 (5.79)	11.14 (5.95)	6.00 (3.20)	10.29 (5.49)		0.86 (0.46)	0.00 (0.00)	0.57 (0.30)	0.00 (0.00)	3.43 (1.83)	187.43		
GMT-5	15	21-Apr-09	28.29 (13.58)	6.57 (3.16)	39.71 (19.07)	7.14 (3.43)	7.71 (3.70)	9.14 (4.39)	42.57 (20.44)	36.00 (17.28)	8.29 (3.98)	14.57 (7.00)		4.86 (2.33)	0.29 (0.14)	0.29 (0.14)	0.00 (0.00)	2.86 (1.37)	208.29		
GMT-5	16	28-Apr-09*	6.57 (17.83)	1.71 (4.65)	4.00 (10.85)	0.57 (1.55)	1.14 (3.10)	1.71 (4.65)	7.71 (20.93)	6.00 (16.28)	1.14 (3.10)	4.00 (10.85)		0.86 (2.33)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.43 (3.88)	36.86		
GMT-5	18	12-May-09	53.71 (33.27)	9.14 (5.66)	26.57 (16.46)	5.43 (3.36)	6.29 (3.89)	3.71 (2.30)	22.00 (13.63)	12.86 (7.96)	12.00 (7.43)	5.43 (3.36)		1.14 (0.71)	0.57 (0.35)	0.00 (0.00)	0.00 (0.00)	2.57 (1.59)	161.43		
GMT-5	19	19-May-09	22.86 (24.17)	4.86 (5.14)	17.14 (18.13)	2.86 (3.02)	2.57 (2.72)	2.57 (2.72)	11.71 (12.39)	12.86 (13.60)	6.00 (6.34)	6.00 (6.34)		1.14 (1.21)	1.14 (1.21)	0.29 (0.30)	0.00 (0.00)	2.57 (2.72)	94.57		
GMT-5	20	24-May-09	28.80 (38.50)	3.20 (4.28)	8.00 (10.70)	0.40 (0.53)	1.20 (1.60)	1.20 (1.60)	14.00 (18.72)	6.80 (9.09)	2.80 (3.74)	5.20 (6.95)		1.60 (2.14)	0.80 (1.07)	0.00 (0.00)	0.00 (0.00)	0.80 (1.07)	74.80		
spring		Total	173.94	33.77	159.71	37.54	27.20	26.91	108.86	85.66	36.23	45.49		10.46	2.80	1.14	0.00	13.66	763.37		
		(%)	(22.79)	(4.42)	(20.92)	(4.92)	(3.56)	(3.53)	(14.26)	(11.22)	(4.75)	(5.96)	(96.32)	(1.37)	(0.37)	(0.15)	(0.00)	(1.79)		(3.68)	(12.21)
GMT-6	1	1-Oct-09*	4.00 (23.73)	0.29 (1.69)	2.57 (15.25)	1.43 (8.47)	0.00 (0.00)	0.57 (3.39)	0.57 (3.39)	1.43 (8.47)	3.71 (22.03)	0.00 (0.00)		1.71 (10.17)	0.29 (1.69)	0.29 (1.69)	0.00 (0.00)	0.00 (0.00)	16.86		
GMT-6	2	8-Oct-09	15.71 (22.73)	9.43 (13.64)	2.57 (3.72)	17.71 (25.62)	0.29 (0.41)	1.14 (1.65)	1.14 (1.65)	13.14 (19.01)	1.43 (2.07)	0.57 (0.83)		5.43 (7.85)	0.57 (0.83)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	69.14		
GMT-6	3	15-Oct-09	30.00 (34.77)	14.57 (16.89)	7.43 (8.61)	12.57 (14.57)	0.00 (0.00)	3.14 (3.64)	7.14 (8.28)	6.86 (7.95)	0.29 (0.33)	0.00 (0.00)		2.00 (2.32)	0.57 (0.66)	0.00 (0.00)	0.86 (0.99)	0.86 (0.99)	86.29		
GMT-6	5	29-Oct-09	10.29 (14.34)	21.71 (30.28)	5.71 (7.97)	4.86 (6.77)	0.29 (0.40)	4.86 (6.77)	3.43 (4.78)	16.29 (22.71)	0.00 (0.00)	0.29 (0.40)		0.57 (0.80)	2.29 (3.19)	0.00 (0.00)	0.00 (0.00)	1.14 (1.59)	71.71		
GMT-6	6	5-Nov-09	6.86 (12.50)	3.71 (6.77)	6.57 (11.98)	6.29 (11.46)	1.71 (3.13)	12.00 (21.88)	3.71 (6.77)	9.43 (17.19)	0.86 (1.56)	0.29 (0.52)		0.57 (1.04)	2.29 (4.17)	0.00 (0.00)	0.00 (0.00)	0.57 (1.04)	54.86		
GMT-6	7	12-Nov-09*	1.14 (3.33)	1.14 (3.33)	3.14 (9.17)	5.14 (15.00)	2.57 (7.50)	7.14 (20.83)	3.14 (9.17)	4.00 (11.67)	1.14 (3.33)	0.00 (0.00)		0.86 (2.50)	3.43 (10.00)	0.00 (0.00)	0.00 (0.00)	1.43 (4.17)	34.29		
GMT-6	9	26-Nov-09	2.57 (1.62)	2.86 (1.80)	2.29 (1.44)	13.71 (8.62)	69.14 (43.45)	42.86 (26.93)	8.57 (5.39)	10.00 (6.28)	3.14 (1.97)	0.00 (0.00)		1.43 (0.90)	0.29 (0.18)	0.86 (0.54)	0.29 (0.18)	1.14 (0.72)	159.14		
GMT-6	10	3-Dec-09	2.29 (1.30)	0.57 (0.32)	3.43 (1.94)	30.86 (17.50)	50.86 (28.85)	69.14 (39.22)	6.00 (3.40)	8.00 (4.54)	0.29 (0.16)	0.29 (0.16)		2.29 (1.30)	0.00 (0.00)	0.29 (0.16)	0.57 (0.32)	1.43 (0.81)	176.29		
GMT-6	12	17-Dec-09	1.14 (0.62)	3.43 (1.86)	1.71 (0.93)	1.14 (0.62)	38.29 (20.74)	76.00 (41.18)	12.00 (6.50)	26.29 (14.24)	1.14 (0.62)	0.00 (0.00)		0.57 (0.31)	1.14 (0.62)	3.43 (1.86)	17.71 (9.60)	0.57 (0.31)	184.57		
GMT-6	13	24-Dec-09	0.00 (0.00)	0.57 (0.58)	1.14 (1.17)	0.86 (0.88)	7.71 (7.89)	28.57 (29.24)	7.71 (7.89)	39.43 (40.35)	0.00 (0.00)	3.14 (3.22)		1.43 (1.46)	0.00 (0.00)	2.86 (2.92)	3.71 (3.80)	0.57 (0.58)	97.71		
GMT-6	14	31-Dec-09	2.29 (0.59)	3.43 (0.89)	1.14 (0.30)	5.14 (1.34)	46.29 (12.04)	57.71 (15.01)	4.57 (1.19)	187.43 (48.74)	0.00 (0.00)	22.86 (5.94)		2.86 (0.74)	2.29 (0.59)	28.00 (7.28)	20.57 (5.35)	0.00 (0.00)	384.57		
fall		Total	76.29	61.71	37.71	99.71	217.14	303.14	58.00	322.29	12.00	27.43		19.71	13.14	35.71	43.71	7.71	1335.43		
		(%)	(5.71)	(4.62)	(2.82)	(7.47)	(16.26)	(22.70)	(4.34)	(24.13)	(0.90)	(2.05)	(91.01)	(1.48)	(0.98)	(2.68)	(3.28)	(0.58)		(8.99)	(21.36)
Annual		Total	791.80	306.06	476.29	304.69	496.91	634.34	429.86	753.94	136.23	1637.06		43.89	79.51	61.00	47.57	54.09	6253.23		
		(%)	(12.66)	(4.89)	(7.62)	(4.87)	(7.95)	(10.14)	(6.87)	(12.06)	(2.18)	(26.18)	(95.43)	(0.70)	(1.27)	(0.98)	(0.76)	(0.86)		(4.57)	

Table 1. Planktic foraminiferal flux (tests per square meter per day, m^{-2} d^{-1}) and percent contribution (in parentheses) to the total assemblage for the 14 most common species, northern Gulf of Mexico. Table is separated by season (that is, winter, spring, summer, and fall) and year. The first 10 species listed comprise about 90 percent of the total flux. Particularly low fluxes (that is, <50 tests m^{-2} d^{-1}) are denoted with an asterisk next to the mid-week collection date.

Globorotalia truncatulinoides is the most abundant species in the early winter season, comprising >50 percent of the assemblage during January to mid-February (fig. 4). The spinose species *Gs. ruber* (pink), *Gs. ruber* (white), *Gl. aequilateralis*, and *G. calida* become important contributors for the remaining 6 weeks of the winter season. The spring assemblage is dominated by *Gs. ruber* (pink) and *Gs. sacculifer*, which combined make up >40 percent of the total assemblage. *Globigerinella aequilateralis* and *G. calida* contribute about 25 perecent. The summer season was not sampled in 2009. Assemblage composition for the first half of fall is composed mostly of spinose species, *Gs. ruber* (pink), *Gs. ruber* (white), and *G. calida*. The non-spinose species *Gt. menardii* group, *N. dutertrei*, and *Pulleniatina* spp. dominate the latter half of the fall assemblage.

Globorotalia truncatulinoides (d'Orbigny) is a non-spinose species that is common in the tropics and subtropics (Tolderlund and Bé, 1971). *Globorotalia truncatulinoides* is the most abundant species found in the trap, comprising >25 percent of the annual assemblage composition and providing more than twice as many tests as the next most abundant species. Six years of sediment-trap data from the Sargasso Sea indicate that *Gt. truncatulinoides* is the largest source of foraminiferal calcite to the seafloor (Deuser, 1986). Its restriction to the winter season may be related to reproduction. A number of studies have suggested this species relies on vertical mixing, which is greatest in winter, to help advect juveniles to the euphotic zone (Bé and Ericson, 1963; Hemleben and others, 1985; Lohmann and Schweitzer, 1990).

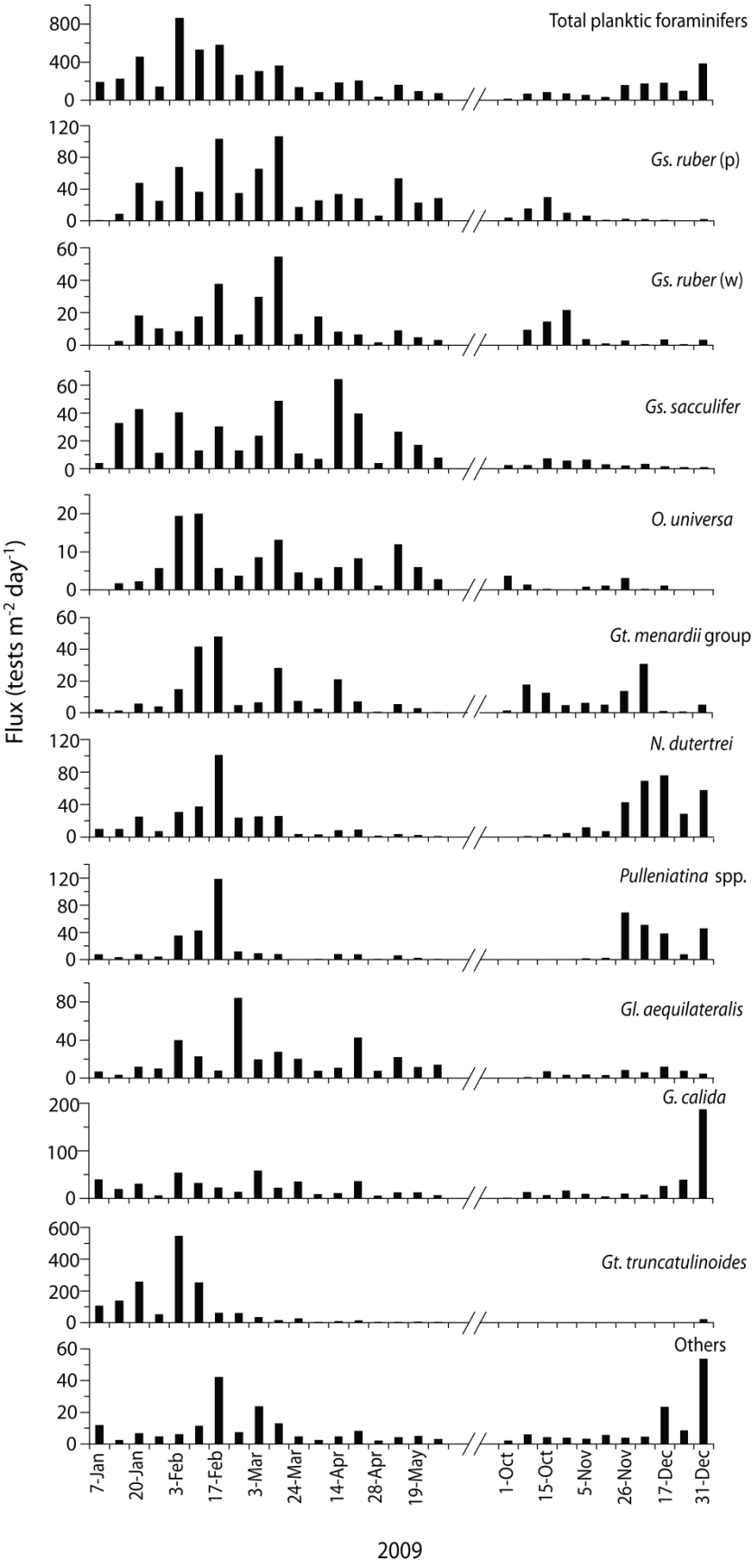
Total planktic foraminifers
Gs. ruber (p)
Gs. ruber (w)
Gs. sacculifer
O. universa
Gt. menardii group
N. dutertrei
Pulleniatina spp.
Gl. aequilateralis
G. calida
Gt. truncatulinoides
Others
Flux (tests m-2 day-1)
7-Jan
20-Jan
3-Feb
17-Feb
3-Mar
24-Mar
14-Apr
28-Apr
19-May
1-Oct
15-Oct
5-Nov
26-Nov
17-Dec
31-Dec
2009

Figure 3. Average daily flux (tests per meter square per day, m^{-2} day^{-1}) of 7- to 14-day long sampling intervals of all planktic foraminifers and the 10 most abundant species/groups during 2009. Note the scale change in the y-axes. The break in the x-axis represents a gap in sampling from late May to late September.

Globigerinoides ruber is a spinose, symbiont-bearing species that occurs in two forms, pink and white, distinguished by the presence of pink pigmentation that ranges in coverage from the proloculus to the entire test. This species is an important proxy for past low- to mid-latitude climate reconstructions, and, therefore, its seasonal range has implications for interpreting the records embedded in their calcite.

The sediment record shows *Gs. ruber* (white) is a major component (~20-30 percent) of late Holocene planktic foraminifer assemblages (Kennett and others, 1985; LoDico and others, 2006; Poore and others, in press). In contrast, flux and percent-abundance data from the northern Gulf of Mexico in 2008 and 2009 indicate *Gs. ruber* (white) is a minor component of the annual assemblage, comprising only 1-5 percent of the total assemblage. Furthermore, the pink variety of *Gs. ruber*, typically comprising 8-10 percent of the assemblage, occurs in greater abundance than the white variety. Both varieties of *Gs. ruber* showed considerable increase in winter flux and percent abundance between 2008 and 2009 (fig. 5). *Globigerinoides ruber* (white) flux increased to 55 tests m^{-2} day^{-1} by the beginning of March, an increase of 4 orders of magnitude compared to peak fluxes of 2008. Percent abundance for the white variety was highest in early October, at 30 percent. *Globigerinoides ruber* (pink) winter flux peaks at >100 tests m^{-2} day^{-1}, which, in total, exceeds the 2008 interval of highest flux for this species (that is, summer). Percent abundance for the pink variety was highest in late May, at 39 percent. Both varieties comprise the bulk (~60 percent) of the total planktic foraminifer population in October.

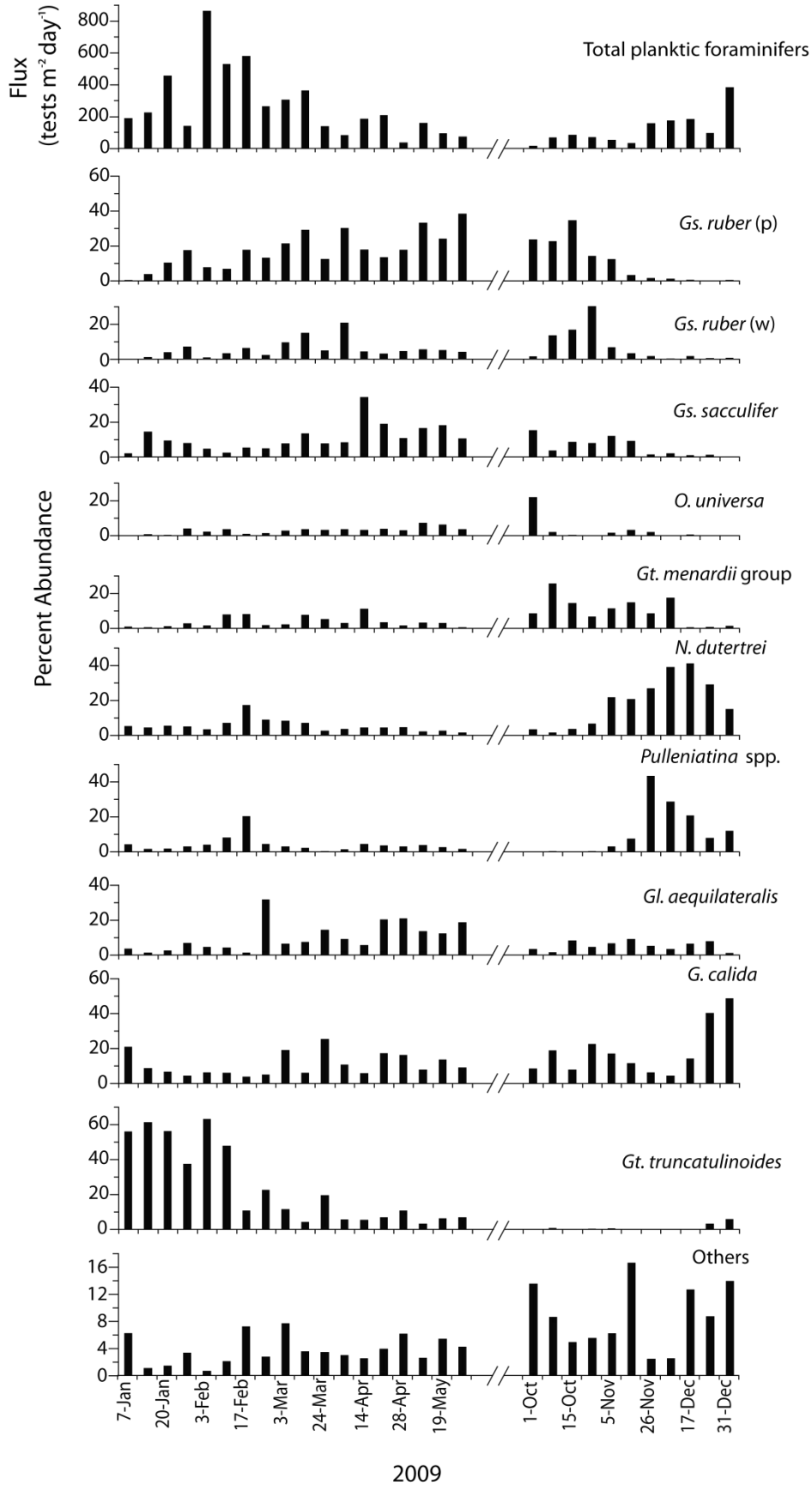
Flux
(tests m-2 day-1)
Total planktic foraminifers
Gs. ruber (p)
Gs. ruber (w)
Gs. sacculifer
O. universa
Gt. menardii group
N. dutertrei
Pulleniatina spp.
Gl. aequilateralis
G. calida
Gt. truncatulinoides
Others
Percent Abundance
7-Jan
20-Jan
3-Feb
17-Feb
3-Mar
24-Mar
14-Apr
28-Apr
19-May
1-Oct
15-Oct
5-Nov
26-Nov
17-Dec
31-Dec
2009

Figure 4. Average daily flux for all planktic foraminifers (tests m^{-2} day^{-1}) (top panel) and weekly percent abundance of the 10 most common species/groups of planktic foraminifers during 2009. Note scale change in the y-axes. The break in the x-axis represents a gap in sampling from late May to late September.

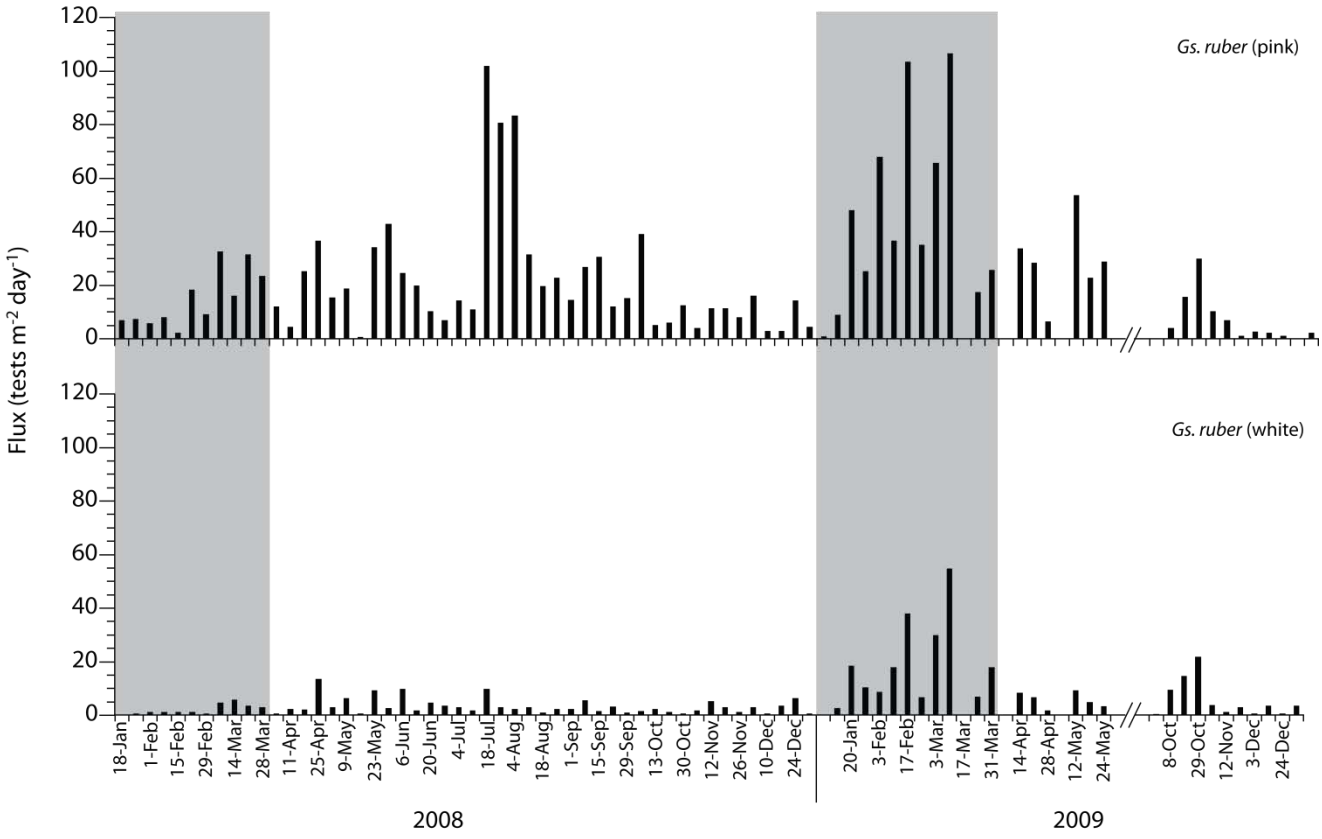

Figure 5. Average daily flux (tests per meter square per day, m^{-2} day^{-1}) of 7- to 14-day long sampling intervals of *Globigerinoides* (*Gs.*) *ruber* (pink) (top panel) and *Gs. ruber* (white) (bottom panel) during 2008 and 2009. The break in the x-axis in 2009 represents a gap in sampling from late May to late September 2009. Flux of *Gs. ruber* (white) was substantially higher in 2009 than 2008. A comparison of pink and white *Gs. ruber* flux during winter 2008 and 2009 (gray shading) shows both species increased in abundance by several orders of magnitude.

Conclusions

Sediment-trap material from January to December of 2009 shows more than 25 species of planktic foraminifers were present in our sediment-trap samples. Of that, 10 species/groups comprise >90 percent of the total flux. A gap in sampling from late May to late September makes a comparison of 2008 and 2009 difficult. Nonetheless, *Gt. truncatulinoides* data continue to indicate that this species supplies the greatest number of tests, almost exlusively in winter (particularly January and February). Winter fluxes for *Gs. ruber* (white) and *Gs. ruber* (pink) were approximately 3 and 5 orders of magnitude greater, respectively. Percent abundance of *Gs. ruber* (white), although approximately 3 orders of magnitude higher in 2009 than 2008, remains anomalously low compared to assemblage records from nearby sediments.

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