Supplement of J. Micropalaeontol., 38, 231–247, 2019
https://doi.org/10.5194/jm-38-231-2019-supplement


Journal of Micropalaeontology
Open Access

*Supplement of*

# Seasonal and interannual variability in population dynamics of planktic foraminifers off Puerto Rico (Caribbean Sea)

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**Table S1:** Census data of planktic and benthic foraminifers from plankton net hauls off Puerto Rico during autumn 2012.

| Date | 22.10. | 22.10. | 22.10. | 22.10. | 29.10. | 29.10. | 29.10. | 29.10. | 29.10. | 02.11. | 02.11. | 02.11. | 02.11. | 02.11. | 05.11. | 05.11. | 05.11. | 05.11. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 3 | 1 | 1 | 2 | 2 | 3 | 1 | 1 | 2 | 2 | 2 |
| Sampling depth (m) | 0-60 | 60-100 | 0-60 | 60-100 | 0-60 | 60-100 | 60-100 | 5 | 0-60 | 60-100 | 0-60 | 60-100 | 5 | 0-60 | 60-100 | 0-60 | 60-100 | 60-100 |
| Water volume ($m^{-3}$) | 2.56 | 1.71 | 2.56 | 1.71 | 2.56 | 1.71 | 1.71 | 52.35 | 2.56 | 1.71 | 2.56 | 1.71 | 52.35 | 2.56 | 1.71 | 2.56 | 1.71 | 1.71 |
| *Globigerinoides ruber* (white) | 8 | - | 7 | 1 | 2 | 2 | - | 3 | 13 | 1 | 14 | - | 2 | 4 | 3 | 2 | 1 | 1 |
| *Globigerinoides ruber* (pink) | 125 | 2 | 127 | 17 | 16 | 17 | 8 | 44 | 59 | 22 | 43 | 27 | 7 | 62 | 20 | 60 | 19 | 19 |
| *Trilobatus sacculifer* (without sac) | 137 | 6 | 112 | 15 | 18 | 12 | 7 | 27 | 105 | 31 | 40 | 48 | 1 | 56 | 23 | 38 | 28 | 28 |
| *Trilobatus sacculifer* (with sac) | 1 | - | - | - | 6 | - | - | - | 2 | 7 | 5 | 4 | - | 5 | 3 | 2 | - | - |
| *Hastigerina pelagica* | - | - | 1 | - | - | 1 | - | - | - | 1 | 2 | 3 | - | - | - | - | - | - |
| *Globigerina bulloides* | - | - | 1 | - | - | - | - | 1 | - | - | - | - | - | - | - | 1 | - | - |
| *Globigerinella calida* | 1 | 1 | 2 | 2 | 3 | - | 1 | 3 | - | 1 | 7 | - | 3 | - | 2 | 4 | 1 | 5 |
| *Globigerinella siphonifera* | - | - | 1 | 2 | - | 1 | - | 3 | - | - | 4 | 5 | 8 | - | - | 3 | 2 | 1 |
| *Globoturborotalita rubescens* | 19 | 3 | 11 | 3 | 2 | 1 | - | - | - | 4 | - | 2 | 1 | 1 | 1 | - | 2 | 1 |
| *Orbulina universa* | - | - | - | - | - | 2 | - | - | - | 3 | 1 | 2 | 4 | 1 | 1 | 5 | 1 | 2 |
| *Turborotalita quinqueloba* | - | 1 | - | - | - | - | 1 | - | 1 | - | - | - | - | 1 | - | - | 6 | - |
| *Globorotalia menardii* | 1 | - | 2 | 1 | - | 4 | - | 1 | 1 | 1 | 4 | - | 8 | - | 1 | 1 | 1 | 1 |
| *Neogloboquadrina dutertrei* | 10 | - | 2 | 3 | 3 | 2 | - | - | 1 | 4 | 2 | 3 | 8 | - | - | 2 | 4 | 4 |
| *Pulleniatina obliquiloculata* | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - |
| *Globigerinita glutinata* | 35 | - | 25 | 4 | 1 | 2 | 3 | 3 | - | 6 | - | 4 | 6 | - | 16 | 1 | 7 | 1 |
| *Candeina nitida* | - | - | 2 | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | 3 |
| unidentified planktic species | - | - | - | 2 | 2 | 2 | 5 | 6 | - | - | - | - | - | - | - | - | - | - |
| *Asterigerina carinata* | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - |
| *Bolivina minima* | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - |
| *Bolivina paula* | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - |
| *Bolivina striatula* | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - |
| *Bolivina variabilis* | - | - | 7 | 1 | 15 | 4 | 25 | 3 | 65 | - | 1 | 17 | 3 | 11 | - | - | 31 | 3 |
| *Cibicidoides pachyderma* | - | - | - | 1 | 1 | 1 | - | 2 | - | - | - | - | - | - | - | - | - | - |
| *Cornuspira involvens* | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - |
| *Tretomphalus bulloides* | - | - | 2 | 1 | - | - | - | - | - | - | - | 5 | - | 8 | - | - | 1 | 1 |
| *Trifarina bella* | - | - | 1 | 33 | 1 | 2 | - | 7 | - | - | 1 | - | - | - | - | - | 1 | - |
| unidentified benthic species | - | - | - | - | - | - | - | 1 | 1 | - | - | - | - | - | - | - | - | - |
| Total planktic species | 337 | 13 | 293 | 50 | 53 | 46 | 52 | 31 | 78 | 198 | 81 | 120 | 121 | 12 | 149 | 65 | 127 | 66 |
| Total benthic species | 0 | 0 | 10 | 36 | 17 | 8 | 26 | 14 | 68 | 0 | 2 | 22 | 3 | 19 | 0 | 0 | 33 | 4 |

**Table S2:** Stable oxygen and carbon isotope values in calcite tests of *G. ruber* (pink) during sampling period in autumn 2012.

| Date | Station | Sampling depth (m) | Number of individuals/ sample | $\delta^{18}O_{CALCITE}$ (‰ VPDB) | $\delta^{13}C_{CALCITE}$ (‰ VPDB) |
|---|---|---|---|---|---|
| 22.10.12 | Station 1 | 0-60 | 10 | -2.59 | 0.62 |
| | Station 2 | 0-60 | 10 | -2.52 | 0.66 |
| | | 60-100 | 9 | -2.44 | 0.44 |
| 29.10.12 | Station 1 | 0-60 | 8 | -2.38 | 0.24 |
| | | 60-100 | 8 | -2.41 | 0.59 |
| | Station 2 | 0-60 | 7 | -2.63 | 0.29 |
| | | 60-100 | 4 | -2.33 | 0.49 |
| | Station 3 | 5 | 8 | -2.96 | -0.40 |
| 02.11.12 | Station 2 | 0-60 | 8 | -2.62 | 0.41 |
| | | 60-100 | 7 | -2.12 | 0.78 |
| 05.11.12 | Station 1 | 0-60 | 8 | -2.66 | 0.42 |
| | Station 2 | 0-60 | 7 | -2.60 | 0.80 |
| | | 60-100 | 6 | -2.70 | 0.96 |

**Table S3:** Stable oxygen isotopes of surface waters during the sampling period in autumn 2012.

| Date | Station | $\delta^{18}O_{SEAWATER}$ (‰VSMOW) |
|---|---|---|
| 22.10.12 | Station 1 | 0.76 |
| | Station 2 | 0.79 |
| 29.10.12 | Station 1 | 0.8 |
| | Station 2 | 0.78 |
| 02.11.12 | Station 1 | 0.8 |
| | Station 2 | 0.82 |
| | Station 3 | 0.8 |
| 05.11.12 | Station 1 | 0.91 |
| | Station 2 | 0.9 |

**Table S4:** Bray–Curtis similarity indices obtained from PAST (Hammer et al., 2001) on foraminiferal assemblages 2012.

| | 22.10.12 | 29.10.12 | 02.11.12 | 05.11.12 |
|---|---|---|---|---|
| 22.10.12 | 1.00 | 0.36 | 0.71 | 0.65 |
| 29.10.12 | 0.36 | 1.00 | 0.48 | 0.59 |
| 02.11.12 | 0.71 | 0.48 | 1.00 | 0.81 |
| 05.11.12 | 0.65 | 0.59 | 0.81 | 1.00 |

**Table S5:** Salinity and temperature measurements during the sampling period in autumn 2012.

| | | Salinity | | | Temperature (°C) | | |
|---|---|---|---|---|---|---|---|
| **Date** | **Water depth (m)** | **Station 1** | **Station 2** | **Station 3** | **Station 1** | **Station 2** | **Station 3** |
| 22.10.12 | 0 | 33.7 | 34.1 | - | 29.4 | 28.5 | - |
| | 10 | 33.8 | 34.2 | - | 29.4 | 28.4 | - |
| | 20 | 33.8 | 34.2 | - | 29.4 | 28.3 | - |
| | 25 | 33.8 | 34.2 | - | 29.4 | 28.3 | - |
| 29.10.12 | 0 | 33.7 | 33.7 | 33.7 | 29.1 | 29.2 | 29.5 |
| | 10 | 33.7 | 33.7 | 33.7 | 29.2 | 29.2 | 29.2 |
| | 20 | 33.8 | 33.8 | - | 29.2 | 29.2 | - |
| | 25 | 33.9 | 33.8 | - | 29.2 | 29.2 | - |
| 02.11.12 | 0 | 33.7 | 33.7 | 33.6 | 29.1 | 29.2 | 29.4 |
| | 10 | 33.7 | 33.7 | 33.7 | 29.1 | 29.4 | 29.5 |
| | 20 | 33.7 | 33.7 | - | 29.2 | 29.4 | - |
| | 25 | 33.8 | 33.8 | - | 29.2 | 29.4 | - |
| 05.11.12 | 0 | 33.7 | 33.7 | - | 29.3 | 29.2 | - |
| | 10 | 33.7 | 33.7 | - | 29.3 | 29.3 | - |
| | 20 | 33.8 | 33.7 | - | 29.4 | 29.2 | - |
| | 25 | 33.8 | 33.7 | - | 29.3 | 29.2 | - |

**Table S6:** Significance of lunar day (i.e. distance of sampling day from new moon), water depth at sampling location (150 m, 850 m), and sampled depth interval (0–60 m, 60–100 m) on the assemblage of planktic foraminifers off Puerto Rico in Autumn 1994 and Spring 1995 (Schmuker, 2000b) and Autumn 2012 (this study). The assemblage varied with depth in the 2012 stratified sampling (which could not be tested on the data by Schmuker (2000b), because there the whole depth interval was sampled in one single haul), but the water depth at the sampling location had no effect on the assemblage. While in autumn we see no significant assemblage change over time, the lunar day significantly correlates with the foraminiferal assemblage in spring 1995.

| | Autumn 1994 | Spring 1995 | Autumn 2012 |
|---|---|---|---|
| Lunar day | 0.414 | 0.007 | 0.161 |
| Water depth | 0.132 | 0.988 | 0.859 |
| Sampling depth interval | NA | NA | 0.027 |

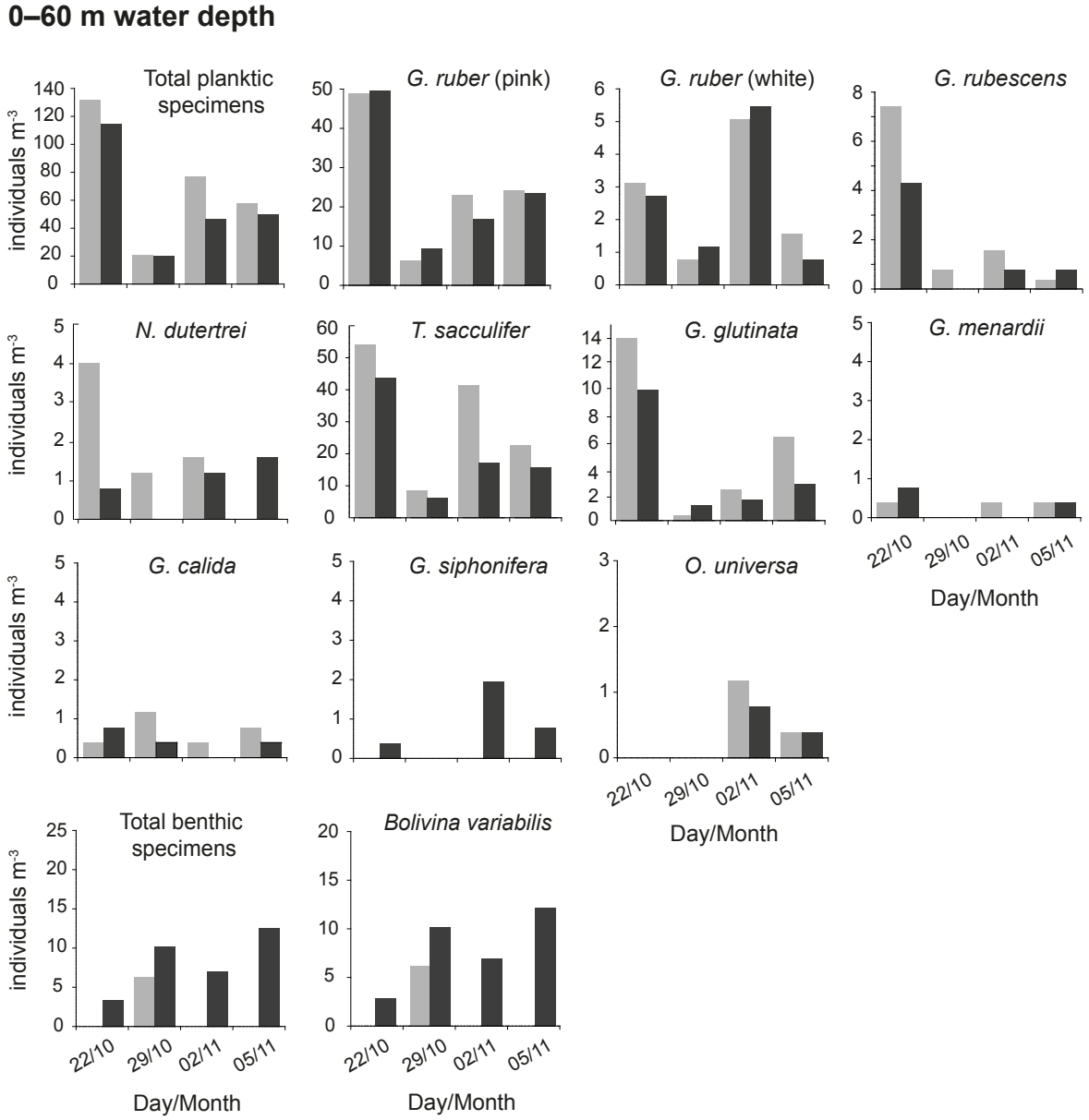


**Figure S1:** Abundance of planktic and benthic species at stations 1 and 2 of the upper sampling interval (0–60 m) in 2012. The number is given in individual $m^{-3}$ for each sampling day and depth interval. Living planktic species >1% of the total assemblage are depticted. Light grey bars: Station 1; Dark grey bars: Station 2.

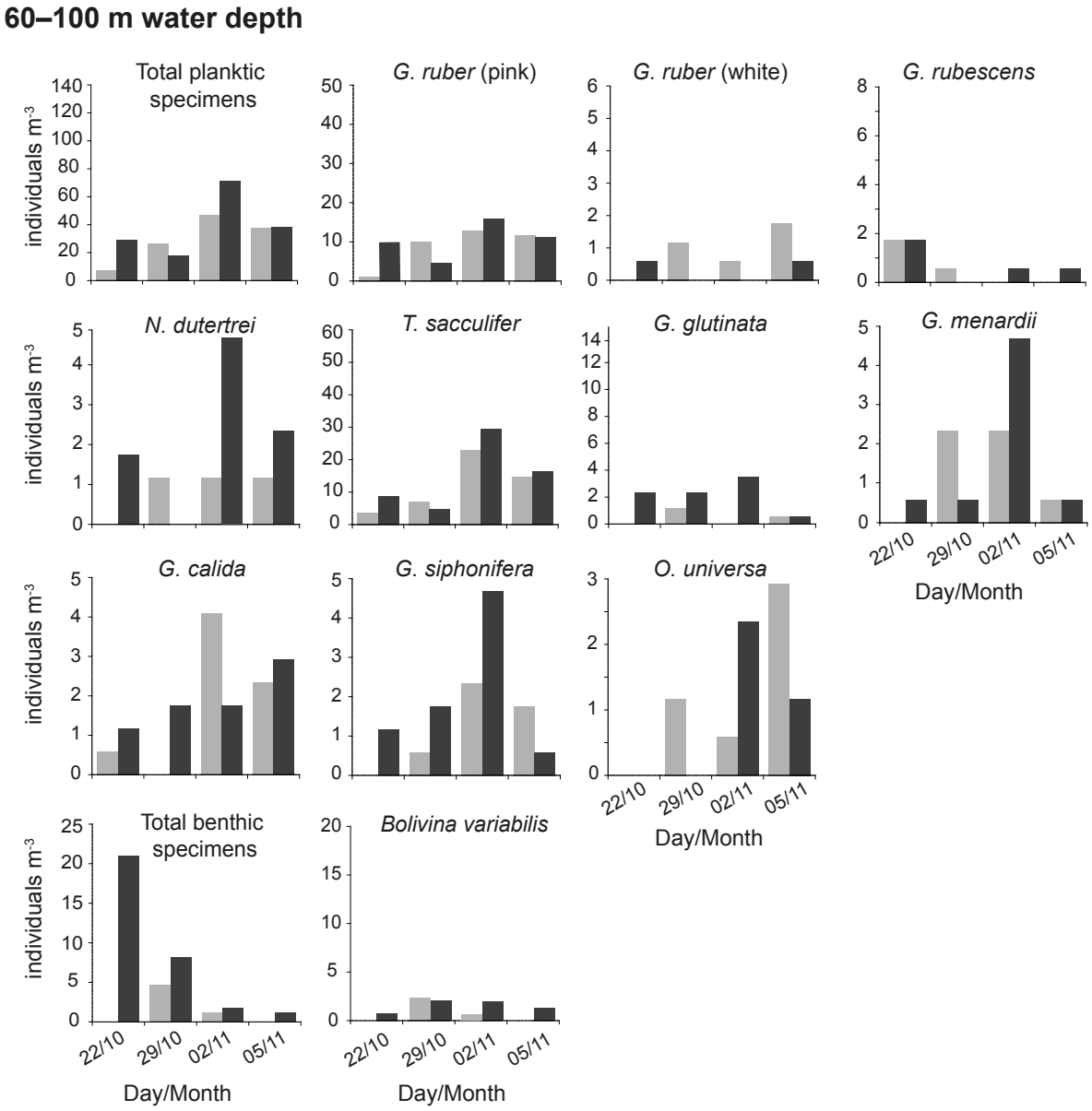


**Figure S2:** Abundance of planktic and benthic species at stations 1 and 2 of the deeper sampling interval (60–100 m) in 2012. The number is given in individual $m^{-3}$ for each sampling day and depth interval. Living planktic species >1% of the total assemblage are depticted. Light grey bars: Station 1; Dark grey bars: Station 2.

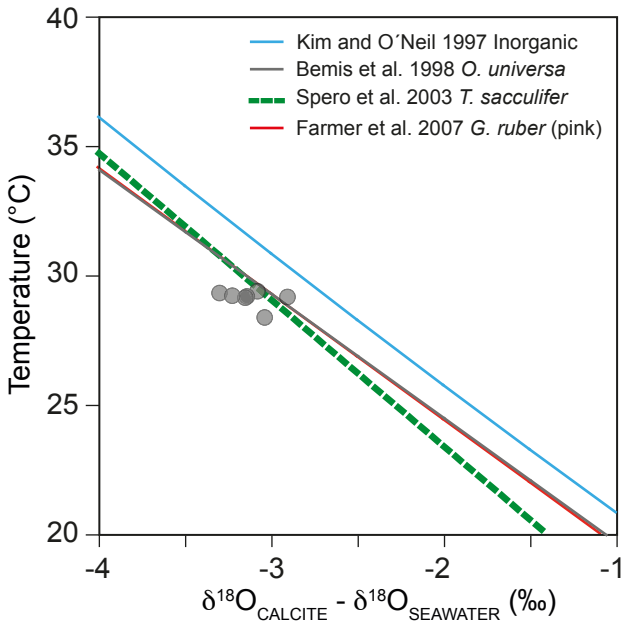


**Figure S3:** $\delta^{18}O$-temperature relationship. Grey dots: Difference of $\delta^{18}O_{CALCITE}$ values of living *G. ruber* (pink) and in situ $\delta^{18}O_{SEAWATER}$ values collected in the upper water column (0–60 m) vs. in situ measured temperature. Different $\delta^{18}O$-temperature equations are depicted as blue line (Kim and O´Neil, 1997), grey line (Bemis et al., 1998), green dashed line (Spero et al., 2003) and red line (Farmer et al., 2007).

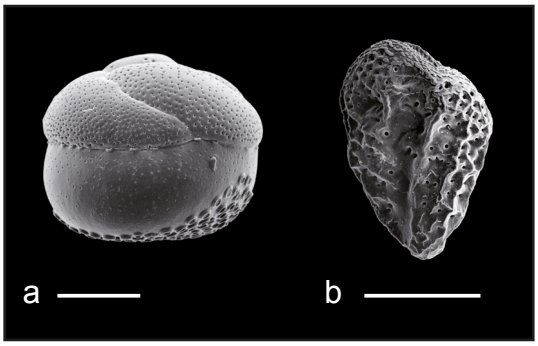


**Figure S4:** SEM pictures of benthic species collected in 2012 off Puerto Rico.

a: *Tretomphalus bulloides* (with floating chamber), from Station 3 (5 m water depth)

b: *Bolivina variabilis*, from Station 2 (0–60 m water depth)

Scale bar: 100 µm

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