*PPE α-diversity*

Clone sequence data of the 16S rDNA from all the transects studied here (except the BEAGLE and Indian Ocean transects) representing 31 clone libraries allowed us to calculate species richness values (α-diversity) using the Margalef index (Dmg) (Table 2). A relatively high variation in this index was seen between sites (Table 2) with, on average, samples taken from the Gulf of Naples, Mediterranean Sea, showing the highest diversity (Dmg = 7.3). This high richness was positively correlated with temperature ($r = 0.84$, $P < 0.05$) and low nutrient concentrations ($r = 0.71$, $P < 0.05$), that is, oligotrophic stations over the time series. Conversely, the lowest richness was observed along the Arabian Sea and Atlantic Ocean transects (average Dmg = 0.97 and 1.97, respectively) and seems to coincide with low PPE abundances. On the BIOSOPE transect (the only cruise where different depths were analysed for α-diversity), PPE species richness decreased with depth. Similar conclusions were made by Schnetzer *et al.* (2011), but for total microbial eukaryote diversity (again using environmental gene libraries), with depth negatively influencing species richness in the eastern North Pacific.

*PPE β-diversity*

*Global PPE class distributions.* Plastid 16S rRNA oligonucleotide probes used for dot blot hybridisation analysis revealed specific global distribution patterns for each PPE class detected (Figure 3). The classes Prymnesiophyceae and Chrysophyceae were globally important across the range of ocean environments analysed (Figures 3 and 4). These classes were detected in every sample analysed and on average comprise 78% of the total relative hybridisation values obtained with the 10 PPE class-specific probes used over all 7 transects. Interestingly, these two classes have complementary distribution patterns across several transects (AMT, BIOSOPE, ARCTIC and AMBITION). The high Prymnesiophyceae signal detected across all ocean basins (Supplementary Table 3) supports the observation that 19′-hexanoyloxyfucoxanthin, a prymnesiophyte-specific pigment (though also present in a few other Heterokont algae, see Andersen, 2004), often dominates oceanic pigment analyses (Not *et al.*, 2008; Liu *et al.*, 2009). Recent fluorescent *in situ* hybridisation studies confirm the high abundance of these pico-prymnesiophytes in the

**Table 2** Photosynthetic picoeukaryote (PPE) α-diversity calculated using the Margalef index (DMg)

| Cruises | Clone libraries | Depth (m) | Latitude | Longitude | Margalef index (DMg) | DMg mean |
|---|---|---|---|---|---|---|
| AMT 15 | 1B | 10 | 48.74 | -7.85 | 3.57 | |
| | 15B | 10 | 17.83 | -20.89 | 0.82 | |
| | 27B | 30 | -23.56 | -17.49 | 0.27 | |
| | 33B | 5 | -37.83 | 1.23 | 3.21 | 1.97 |
| ELLETT LINE | IB4 | 32 | 58.5 | -16 | 3.57 | |
| | EG3 | 10 | 60.25 | -9.01 | 4.43 | 4.00 |
| BIOSOPE | MAR1 | 15 | -8.38 | -141.23 | 5.76 | |
| | STB1 | 25 | -11.74 | -134.10 | 3.05 | |
| | STB6 | 55 | -20.44 | -122.91 | 3.30 | |
| | STB6 | 180 | -20.44 | -122.91 | 1.48 | |
| | STB7 | 40 | -22.04 | -120.35 | 4.07 | |
| | STB7 | 175 | -22.04 | -120.35 | 2.40 | |
| | STB11 | 0 | -27.76 | -107.27 | 3.00 | |
| | STB11 | 5 | -27.76 | -107.27 | 4.42 | |
| | STB11 | 200 | -27.76 | -107.27 | 2.80 | |
| | STB14 | 5 | -30.03 | -98.39 | 4.50 | |
| | STB14 | 150 | -30.03 | -98.39 | 2.35 | |
| | STB17 | 20 | -32.39 | -86.78 | 4.04 | |
| | STB17 | 30 | -32.39 | -86.78 | 1.64 | |
| | STB17 | 70 | -32.39 | -86.78 | 1.39 | |
| | UPW1 | 5 | -33.96 | -73.37 | 4.20 | |
| | UPW1 | 35 | -33.96 | -73.37 | 3.00 | 2.94 |
| Mediterranean Sea | MC597 | surface | 40.81 | 14.31 | 6.35 | |
| | MC601 | surface | 40.81 | 14.31 | 2.34 | |
| | MAMA64 | surface | 40.81 | 14.31 | 4.67 | |
| | 250304 | surface | 40.81 | 14.31 | 11.83 | |
| | MC615 | surface | 40.81 | 14.31 | 9.69 | |
| | MC622 | surface | 40.81 | 14.31 | 8.98 | 7.31 |
| Ambition | AS2 | 50 | -0.001 | 66.99 | 1.30 | |
| | AS10 | 50 | 24.33 | 58.16 | 0.65 | 0.97 |
| Arctic | A 50 | 60 | 76.5 | 3 | 2.30 | 2.3 |

Coloured symbols illustrate the temperature and trophic status of the samples from which clone libraries were constructed. Circle, oligotrophic (Phosphate concentration $<10\,mg\,m^{-3}$); square, mesotrophic (Phosphate concentration 10–20 $mg\,m^{-3}$); star, eutrophic (Phosphate concentration $>20\,mg\,m^{-3}$); blue, very low temperature (<10 °C); green, low temperature (10–14.99 °C); yellow, medium temperature (15–19.99 °C); orange, high temperature (20–24.99 °C); red, very high temperature (≥25 °C).