# Supplementary Material

## Supplementary Figures

**Figure S1.** The physical and chemical parameters along the transect from Pearl River estuary to northern South China Sea.

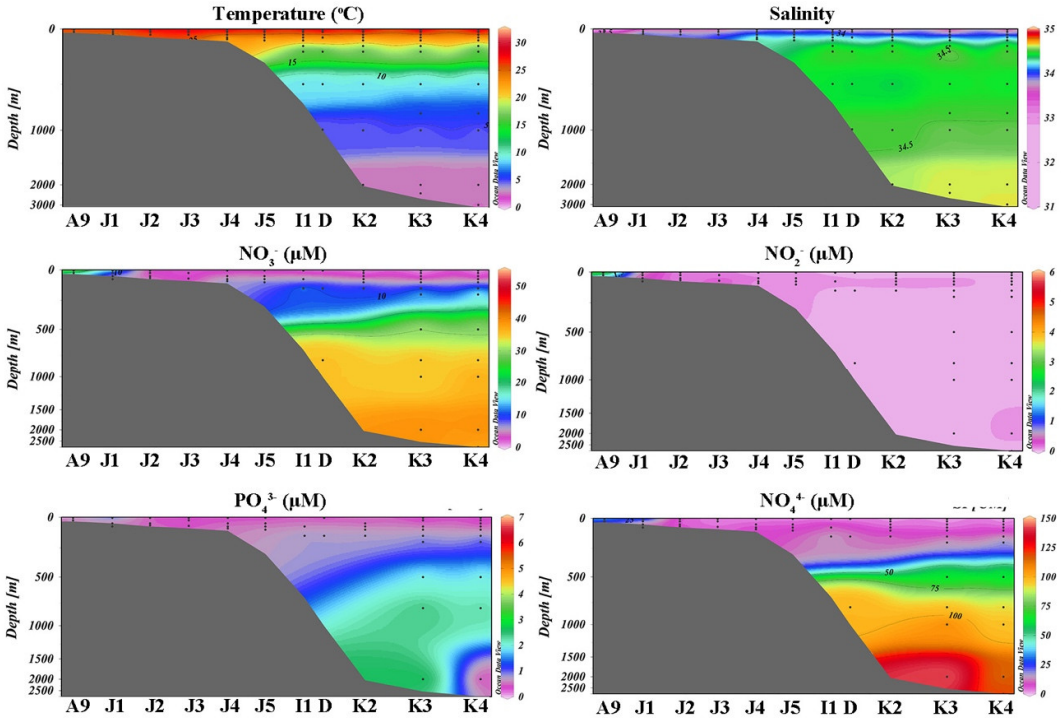


**Figure S2.** The biological parameters along the transect from Pearl River estuary to northern South China Sea.

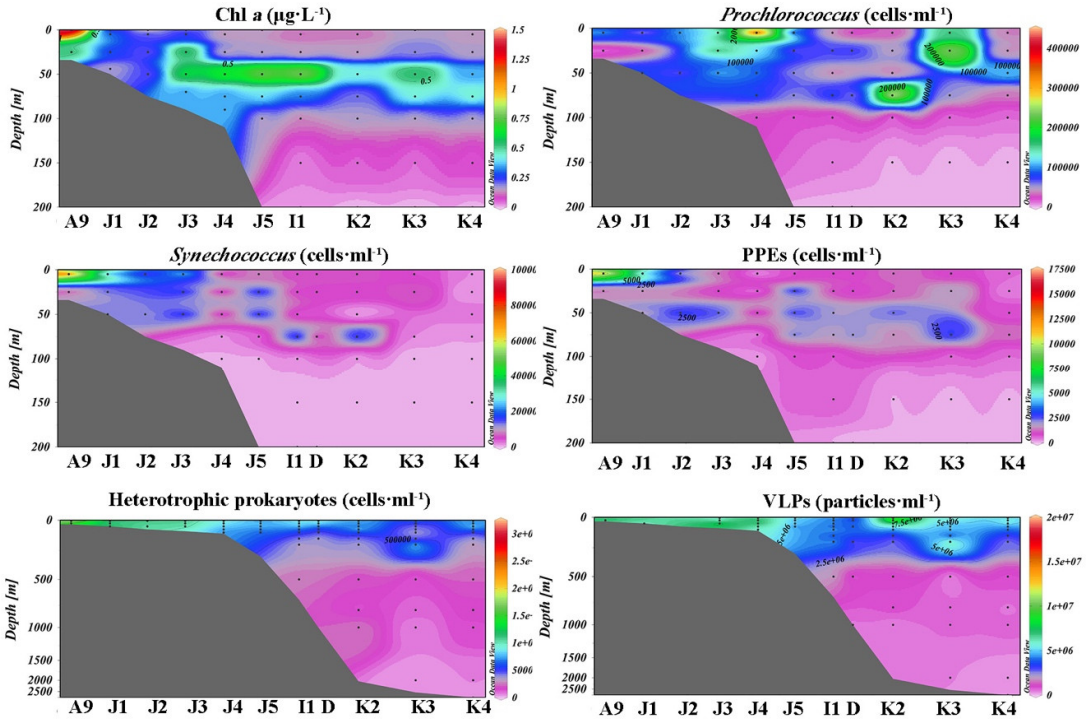


**Figure S3.** Rarefaction curves of the samples collected.

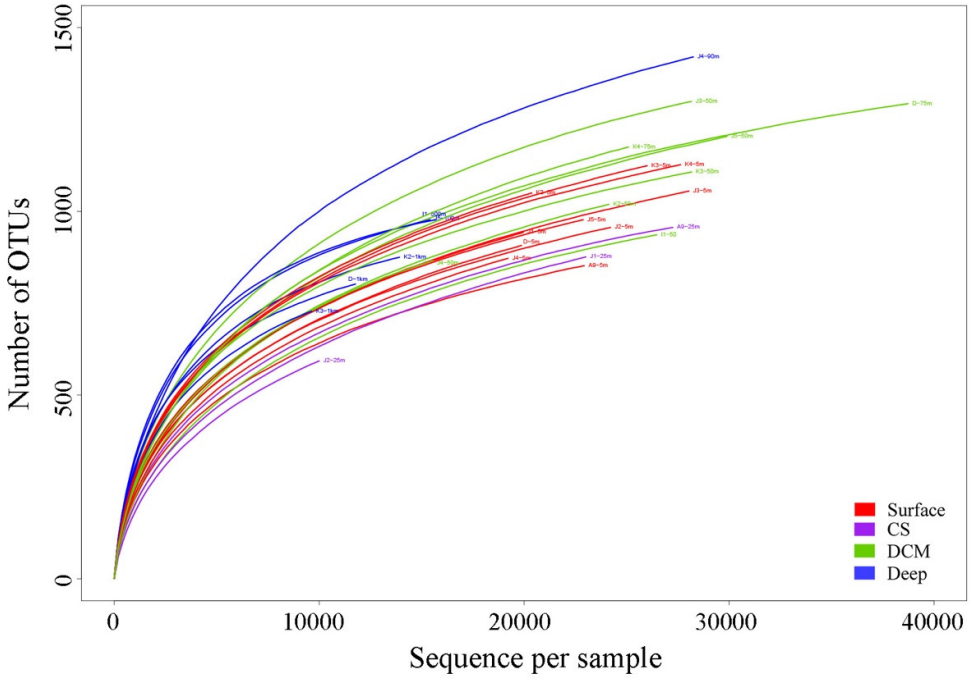


**Figure S4.** Relative abundances of sequences and OTUs of the eight supergroups. (A) Taxonomic Stramenopiles; (B) Aveolata; (C) Archaeplastida; (E) Rhizaria; (F) Excavata, Opisthokonta and Picozoa.

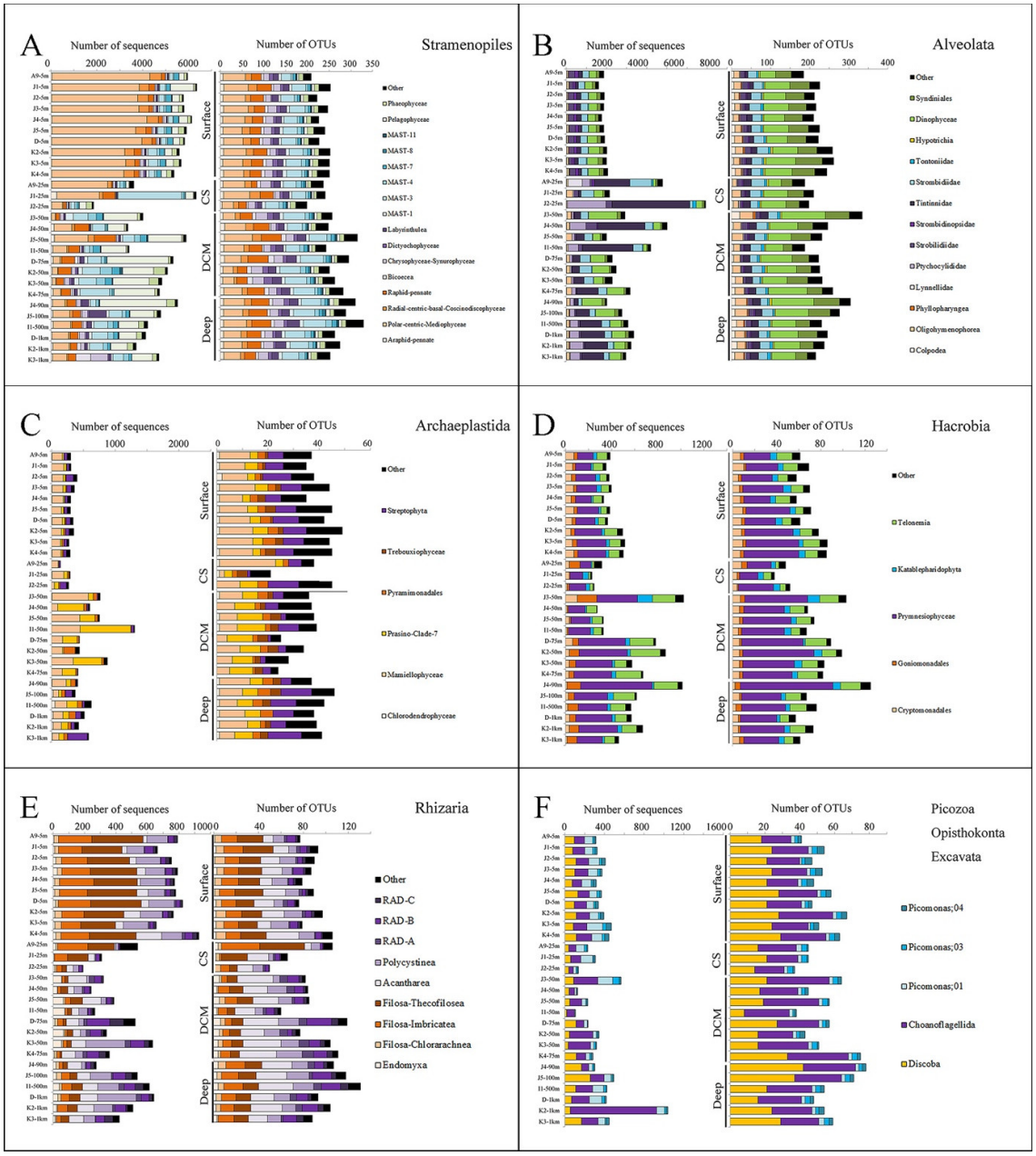


**Figure S5.** Alpha diversity estimates of OTU richness (A) and Shannon (B) the four groups (surface, CS, DCM, and Deep). ** $p < 0.01$, * $p < 0.05$.

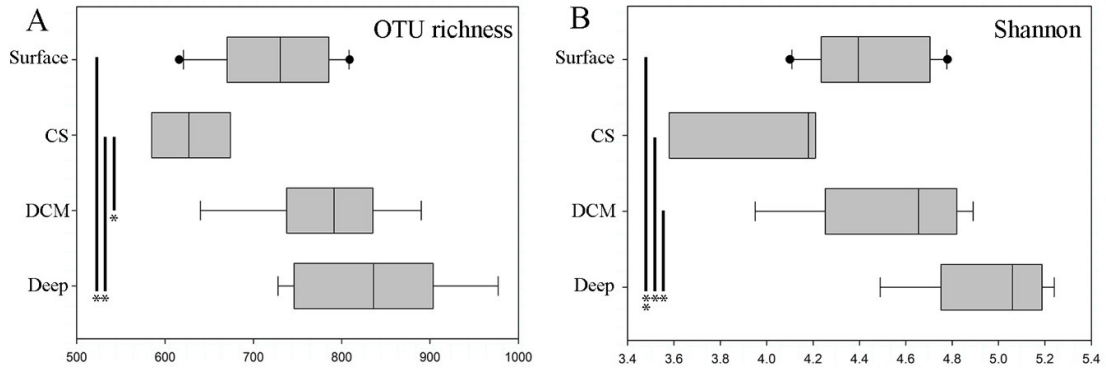


**Figure S6.** Sequences abundance of the abundant (A) and OTU richness of the rare (B) groups at the supergroup taxonomic level.

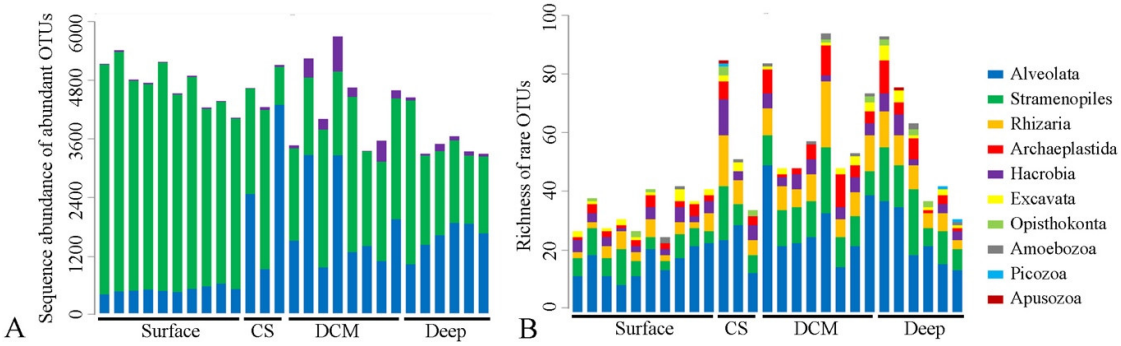
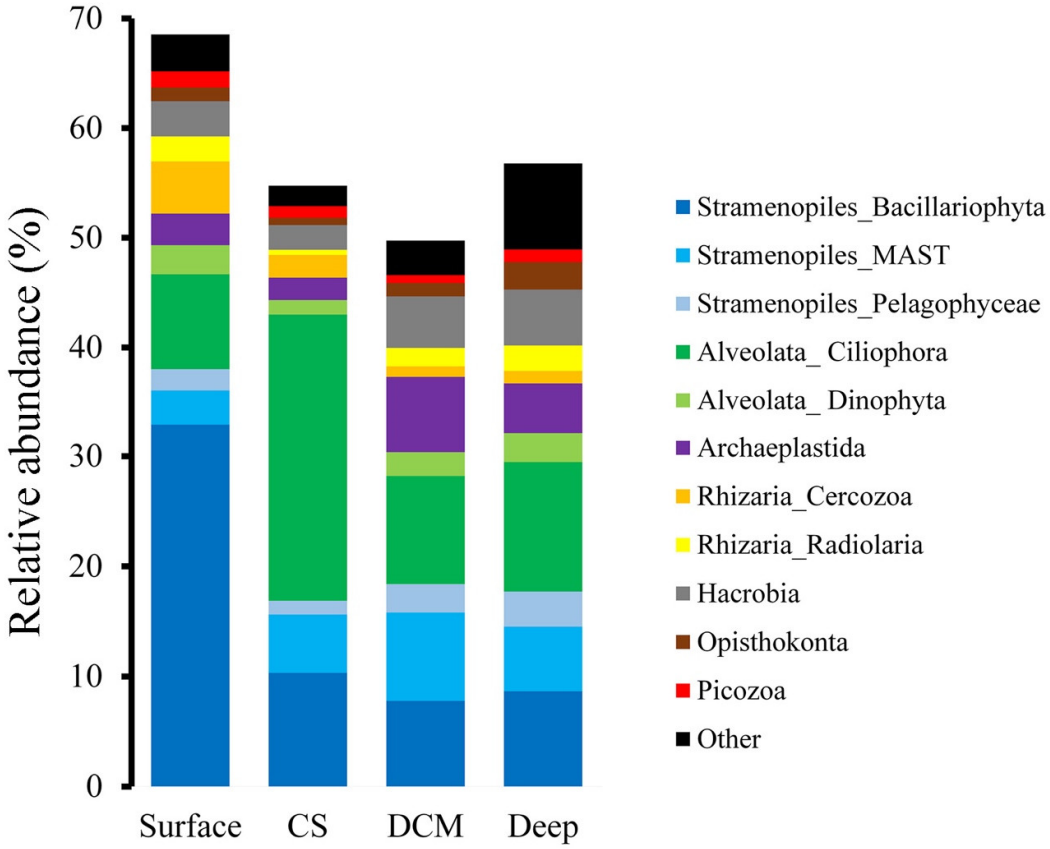


**Figure S7.** Compositions of the rare taxa that can shift to abundant taxa in the four groups.



## Supplementary Tables

**Table S1.** Name, coordinates, and environmental parameters of the samples. HP: Heterotrophic prokaryotes; PPEs, pigmented pico-sized eukaryotes; VLPs, viral like particles; ND: Not detected; BDL: Below detection limit.

| Sample | Latitude | Longitude | Depth | Depth of sea bottom | Temperature | Salinity | Concentrate | | | | | Abundance | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Chl *a* | $NO_3^-$ | $NO_2^-$ | $PO_4^{3-}$ | $SiO_4^{4-}$ | *Prochlorococcus* | *Synechococcus* | PPEs | HP | VLPs |
| | (N) | (E) | (m) | (m) | (°C) | (PSU) | (μg·L$^{-1}$) | (μM) | (μM) | (μM) | (μM) | (cells·ml$^{-1}$) | (cells·ml$^{-1}$) | (cells·ml$^{-1}$) | (cells·ml$^{-1}$) | (particles·ml$^{-1}$) |
| A9-5m | 22 | 114 | 5 | 28 | 28.16 | 31.13 | 1.488 | 53.608 | 5.677 | 0.4 | 56.242 | 1.25E+05 | 1.00E+05 | 1.51E+04 | 3.16E+06 | ND |
| A9-25m | 22 | 114 | 25 | 28 | 23.2 | 34.35 | 0.526 | 3.848 | 0.928 | 0.428 | 9.467 | 4.33E+03 | 2.20E+03 | 1.15E+03 | 1.52E+06 | 7.59E+06 |
| J1-5m | 21.66 | 114.17 | 5 | 46 | 28.66 | 33.2 | 0.296 | 30.29 | 0.012 | 2.138 | 69.389 | 1.44E+04 | 4.80E+03 | 2.75E+03 | 6.71E+05 | ND |
| J1-25m | 21.66 | 114.17 | 25 | 46 | 24.28 | 34.18 | 0.255 | 2.171 | 0.252 | ND | 4.593 | 2.24E+04 | 1.59E+04 | 1.58E+03 | 5.97E+05 | ND |
| J2-5m | 21.33 | 114.33 | 5 | 71 | 29.65 | 33.04 | 0.237 | 0.07 | 0.015 | 0.183 | 0.63 | 1.11E+05 | 7.60E+03 | 8.46E+02 | 1.11E+06 | ND |
| J2-25m | 21.33 | 114.33 | 25 | 71 | 27.53 | 33.86 | 0.21 | 0.068 | 0.014 | ND | 0.85 | ND | ND | ND | ND | ND |
| J3-5m | 21 | 114.5 | 5 | 76 | 29.64 | 33.08 | 0.267 | ND | ND | 0.191 | 0.795 | 1.05E+05 | 2.88E+04 | 1.16E+03 | 1.26E+06 | 6.19E+06 |
| J3-50m | 21 | 114.5 | 50 | 76 | 24.87 | 34.2 | 0.615 | ND | ND | ND | ND | 1.16E+05 | 2.04E+04 | 2.70E+03 | 1.22E+06 | 1.29E+07 |
| J4-5m | 20.66 | 114.67 | 5 | 106 | 30.02 | 33.69 | 0.153 | 0.08 | 0.013 | 0.173 | 0.254 | 7.14E+04 | 1.76E+04 | 9.83E+02 | 1.04E+06 | 5.72E+06 |
| J4-50m | 20.66 | 114.67 | 50 | 106 | 24.86 | 34.21 | 0.817 | 3.212 | 0.159 | 0.415 | 3.962 | 1.05E+05 | 8.12E+03 | 2.55E+03 | 8.40E+05 | 9.93E+06 |
| J4-90m | 20.66 | 114.67 | 90 | 106 | 19.2 | 34.51 | 0.243 | 9.889 | 0.043 | 0.815 | 11.388 | 1.69E+04 | 2.95E+02 | 1.07E+03 | 6.53E+05 | 4.77E+06 |
| J5-5m | 20.33 | 114.82 | 5 | 141 | 29.69 | 33.49 | 0.143 | 0.096 | 0.015 | 0.179 | 0.248 | 5.52E+04 | 8.87E+03 | 8.46E+02 | 4.52E+05 | 6.33E+06 |
| J5-50m | 20.33 | 114.82 | 50 | 141 | 24.91 | 34.15 | 0.753 | 1.387 | 0.162 | 0.349 | 2.334 | 5.06E+04 | 1.89E+04 | 2.94E+03 | 8.96E+05 | 5.67E+06 |
| J5-100m | 20.33 | 114.82 | 100 | 141 | 18.56 | 34.54 | 0.139 | 10.461 | 0.035 | 0.822 | 10.936 | 1.15E+04 | 1.94E+02 | 6.76E+02 | 4.76E+05 | ND |
| I1-50m | 20 | 115 | 50 | 737 | 24.21 | 33.54 | 0.768 | ND | ND | ND | ND | 3.51E+04 | 2.34E+03 | 1.80E+03 | 1.21E+06 | 5.67E+06 |
| I1-500m | 20 | 115 | 500 | 737 | 8.51 | 34.43 | ND | ND | ND | ND | ND | ND | ND | ND | 2.33E+05 | 2.20E+06 |
| D-5m | 19.88 | 115.15 | 5 | 1231 | 29.9 | 33.5 | ND | 0.074 | 0.013 | 0.16 | 0.956 | 1.98E+04 | 6.50E+03 | 8.19E+02 | 1.12E+06 | 2.97E+06 |
| D-75m | 19.88 | 115.15 | 75 | 1231 | 21.35 | 34.37 | ND | ND | ND | ND | ND | 4.65E+04 | 9.85E+02 | 2.17E+03 | 2.88E+05 | 2.98E+06 |
| D-1km | 19.88 | 115.15 | 1000 | 1231 | 4.51 | 34.49 | ND | ND | ND | ND | ND | ND | ND | ND | ND | 4.99E+05 |
| K2-5m | 19.5 | 115.25 | 5 | 2176 | 29.77 | 33.44 | 0.12 | 0.074 | 0.005 | ND | 1.065 | 2.78E+04 | 5.68E+03 | 1.27E+03 | 8.36E+05 | 7.17E+06 |
| K2-50m | 19.5 | 115.25 | 50 | 2176 | 24.89 | 34.04 | 0.419 | 0.082 | BDL | 0.188 | 1.165 | 3.44E+04 | 7.81E+02 | 2.26E+03 | 5.09E+05 | 5.37E+06 |
| K2-1km | 19.5 | 115.25 | 1000 | 2176 | 4.59 | 34.49 | ND | ND | ND | ND | ND | ND | ND | ND | 2.63E+05 | 2.55E+05 |
| K3-5m | 19 | 115.5 | 5 | 2671 | 29.78 | 33.37 | 0.161 | 0.074 | BDL | 0.19 | 1.288 | 1.53E+05 | 4.47E+03 | 8.57E+02 | 9.58E+05 | 5.17E+06 |
| K3-50m | 19 | 115.5 | 50 | 2671 | 24.32 | 33.98 | 0.537 | 0.07 | BDL | ND | 1.588 | ND | ND | ND | 2.54E+05 | 2.72E+05 |
| K3-1km | 19 | 115.5 | 1000 | 2671 | 4.36 | 34.53 | ND | 34.472 | BDL | ND | 108.358 | ND | ND | ND | 4.37E+04 | 5.52E+05 |
| K4-5m | 18.5 | 115.75 | 5 | 3754 | 29.95 | 33.4 | 0.142 | 0.168 | BDL | 0.247 | 0.947 | 3.59E+04 | 1.78E+03 | 4.71E+02 | 8.04E+05 | 4.01E+06 |
| K4-75m | 18.5 | 115.75 | 75 | 3754 | 21.95 | 34.32 | 0.456 | 1.862 | 0.088 | 0.389 | 3.277 | 3.44E+04 | 1.17E+03 | 1.30E+03 | 7.98E+05 | 3.06E+06 |

**Table S2** List of the twelve abundant OTUs with the relative abundance of sequences, taxonomic identification, GenBank accession number and the identification of the nearest named neighbor (NNN), similarity (%-S) with the NNN, and GenBank accession number of the nearest neighbor (NN) and similarity (%-S) with NN.

| OTU ID | Relative abundance | Group | Name of NNNs and GenBank accession no. | %-S (NNN) | GenBank accession no. | %-S (NN) |
|---|---|---|---|---|---|---|
| OTU1676 | 8.58% | Stramenopiles; Bacillariophyta; Thalassiosirales | *Skeletonema costatum* (AB948141) | 100.00 | DQ396523 | 100.00 |
| OTU885 | 8.54% | Stramenopiles; Pelagophyceae; Pelagomonadales | *Pelagomonas calceolata* (EF455763) | 100.00 | KP404872 | 100.00 |
| OTU896 | 6.12% | Stramenopiles; Bacillariophyta; Thalassiosirales | *Thalassiosira eccentrica* (JQ217343) | 99.23 | KX253953 | 99.23 |
| OTU1697 | 5.18% | Alveolata; Ciliophora; Tintinnida | *Tintinnopsis radix* (KU715774) | 100.00 | KX158726 | 100.00 |
| OTU6290 | 3.11% | Alveolata; Dinophyceae; Prorocentrales/ Peridiniales/ Gonyaulacales/ Gymnodiniales | *Parvodinium cf. umbonatum* (MG255428) | 100.00 | KP404853 | 100.00 |
| OTU3058 | 2.77% | Alveolata; Ciliophora; Strombidiidae/ Cyrtostrombidiidae | *Apostrombidium orientale* (MH688480) | 98.39 | KF129744 | 100.00 |
| OTU5639 | 2.59% | Alveolata; Ciliophora; Tintinnida | *Favella panamensis* (KU715760) | 100.00 | KU715760 | 100.00 |
| OTU6542 | 2.21% | Stramenopiles; Solenicola | *Solenicola setigera* (HM163291) | 92.97 | JQ782081 | 100.00 |
| OTU6547 | 1.44% | Stramenopiles; Labyrinthulomycetes | *Oblongichytrium sp.* (KY980037) | 96.03 | JQ781995 | 100.00 |
| OTU3063 | 1.19% | Stramenopiles; Bacillariophyta; Rhizosoleniales | *Rhizosolenia setigera* (KY980291) | 100.00 | GU823605 | 100.00 |
| OTU6546 | 1.12% | Viridiplantae; Chlorophyta; Trebouxiophyceae | *Coccomyxa viridis* (HG973007) | 90.15 | JX188279 | 100.00 |
| OTU3056 | 1.04% | Stramenopiles; Bacillariophyta; Rhizosoleniales | *Eucampia sp.* (KX253956) | 90.15 | KX253956 | 99.23 |