**Supplementary material**


**Figure S1.** Distribution of temperature (a), salinity (b), DIN (c), DIP (e), DSi (f) and Chl *a* (g) in the summer in the Northwest Pacific Ocean.

 **Figure S2.** Rarefaction curve index for each sample (a), alpha-diversity estimates including OTU Richness (b), Shannon indexes (c) by metabarcoding method in the summer in the Northwest Pacific Ocean.

 **Figure S3.** Wilcoxon test were analyzed to test the relative phytoplankton abundance differences between southern and northern regions based on the results of CHEMTAX (a) and metabarcoding (b) analysis.

 **Figure S4.** Distribution of the relative abundance of harmful algae: *Heterocapsa rotundata* (a), *Karlodinium veneficum* (b)and *Aureococcus anophagefferens* (c) based on the results of metabarcoding analysis.

**Figure S5.** Pairwise comparison of CHEMTAX and metabarcoding in determining phytoplankton taxonomic composition: diatoms (a), prymnesiophytes (b), pelagophytes (c), chorophytes (d).

**Table S1.** Physiochemical characteristics for each sampling sites.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| station | date | Latitude (N) | Longitude (E) | Temperature (°C) | salinity | DIN (μmol/L) | DIP (μmol/L) | DSi (μmol/L) | Chl *a* (μg/L) |
| M1 | 0523 | 40.42 | 163.4 | 9.598  | 34.50  | 3.457  | 0.294  | 16.931  | 0.732  |
| M2 | 0525 | 41.45 | 166.43 | 8.872  | 34.22  | 3.825  | 0.439  | 20.530  | 0.560  |
| M3 | 0529 | 42.04 | 166.58 | 11.227  | 33.61  | 2.838  | 0.186  | 11.621  | 1.044  |
| M4 | 0602 | 42.05 | 166.51 | 10.086  | 34.26  | 3.409  | 0.256  | 13.448  | 0.364  |
| M5 | 0607 | 42.14 | 166.54 | 9.462  | 34.05  | 3.339  | 0.299  | 15.738  | 0.545  |
| M6 | 0612 | 42.59 | 168.49 | 11.796  | 34.38  | 1.636  | 0.100  | 7.518  | 0.864  |
| M7 | 0615 | 43 | 168.38 | 11.301  | 34.88  | 2.239  | 0.181  | 11.685  | 0.579  |
| M8 | 0617 | 43 | 167.06 | 8.853  | 33.22  | 6.548  | 0.643  | 26.351  | 0.323 |
| M9 | 0624 | 43.33 | 168.24 | 6.970  | 33.95  | 5.250  | 0.570  | 26.976  | 0.232  |
| M10 | 0701 | 43.51 | 168.21 | 12.410  | 34.03  | 5.441  | 0.509  | 19.833  | 0.111 |
| M11 | 0627 | 44.07 | 168.39 | 9.890  | 34.02  | 5.905  | 0.649  | 27.970  | 0.084 |
| M12 | 0702 | 44.22 | 169.14 | 13.710  | 34.92  | 5.473  | 0.584  | 24.222  | 0.041  |
| M13 | 0628 | 44.4 | 168.53 | 7.032  | 33.52  | 6.120  | 0.695  | 31.823  | 0.133  |
| M14 | 0630 | 44.53 | 169.03 | 12.154  | 33.65  | 6.405  | 0.713  | 35.724  | 0.158  |
| M15 | 0703 | 44.57 | 169.44 | 11.010  | 34.06  | 5.430  | 0.593  | 25.260  | 0.378  |
| M16 | 0704 | 45.09 | 169.33 | 9.890  | 33.49  | 6.275  | 0.679  | 32.391  | 0.161  |
| M17 | 0705 | 45.13 | 170.52 | 7.818  | 33.69  | 6.788  | 0.703  | 33.565  | 0.172  |
| M18 | 0706 | 45.14 | 171.44 | 7.816  | 33.63  | 6.161  | 0.677  | 31.087  | 0.164  |
| M19 | 0707 | 46.04 | 171.12 | 7.708  | 33.61  | 7.384  | 0.749  | 39.020  | 0.157  |
| M20 | 0712 | 47.19 | 167.56 | 8.718  | 33.72  | 6.552  | 0.676  | 32.859  | 0.666  |
| M21 | 0713 | 47.33 | 168.36 | 8.817  | 33.66  | 6.471  | 0.697  | 32.792  | 0.201  |
| M22 | 0715 | 47.42 | 167.47 | 7.852  | 33.71  | 5.545  | 0.622  | 30.607  | 0.789  |
| M23 | 0709 | 47.44 | 165.48 | 7.961  | 33.81  | 5.986  | 0.651  | 30.659  | 0.215  |
| M24 | 0717 | 48.08 | 168.52 | 8.186  | 33.52  | 5.664  | 0.618  | 30.451  | 0.147  |

**Table S2.** Comparison of phytoplankton community composition in the Northwest Pacific Ocean.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Summer, 1999 (n=3)a(Liu et al, 2004)b | September- October 2005 (n=3)(Fujiki et al, 2009) | October 2010(Fujiki et al, 2014) c | June-July 2021 (n=28)(this study) |
| Diatoms | 14.5 ± 4.3 | 8.2 ± 2.4 | 0.2 | 13 |
| Prymnesiophytes | 12.6 ± 2.4 | 29.2 ± 5.6 | 26.6 | 16 |
| Pelagophytes | 6.6 ± 0.5 | 19.2 ± 1.5 | 18.3 | 17 |
| Chlorophytes | 6.4 ± 3.3 | 2.4 ± 1.2 | 35.7 | 13 |
| Prasinophytes | 30.9 ± 2.3 | 9.3 ± 1.2 | 7.5 | 5 |
| Cryptophytes | 14.0 ± 1.8 | 8.0 ± 1.4 | 8.1 | 25 |
| Dinoflagellates | 4.1 ± 2.2 | 5.0 ± 1.0 | 3.1 | 5 |
| Cyanobacteria | 10.9 ± 4.2 | 18.8 ± 3.9 | 0.7 | 6 |

a n is the number of sampling stations

.b The data are from Suzuki et al. (2002), which are recalculated by Liu et al. (2004).

c The data are from Table 2. of Suzuki et al. (2002), which are the average of phytoplankton group composition on 26 and 29 October, 2010. SE was not given due to lack of sampling stations.