**Table S1.** Species richness and total abundance (cells $L^{-1}$) of phytoplankton in the Eastern Tropical Pacific Ocean off Mexico (ETPOM )and Southern Gulf of California (SGC) during the strong El Niño of 2023/24.

| Species | Total abundance (cells $L^{-1}$) |
|---|---|
| **Diatoms** | |
| *Actinoptychus adriaticus* Grunow 1863 | 5780 |
| *Actinocyclus octonarius* Ehrenberg 1837 | 1550 |
| *Actinocyclus senarius* Ehrenberg 1838 | 590 |
| *Actinocyclus tenuissimus* Cleve 1878 | 20 |
| *Alveus marinus* (Grunow) Kaczmarska & Fryxell 1996 | 220 |
| *Amphora ovalis* (Kützing) Kützing 1844 | 40 |
| *Asterionellopsis glacialis* (Castracane) Round 1990 | 500 |
| *Asteromphalus arachne* (Brébisson) Ralfs 1861 | 240 |
| *Asteromphalus cleveanus* Grunow 1876 | 20 |
| *Asteromphalus elegans* Greville 1859 | 60 |
| *Asteromphalus flabellatus* (Brébisson) Greville 1859 | 20 |
| *Asteromphalus heptactis* (Brébisson) Ralfs 1861 | 20 |
| *Asteromphalus roperianus* (Greville) Ralfs 1861 | 40 |
| *Azpeitia nodulifera* (A.W.F.Schmidt) G.A.Fryxell & P.A.Sims 1986 | 2660 |
| *Bacteriastrum delicatulum* Cleve 1897 | 400 |
| *Bacteriastrum elongatum* Cleve 1897 | 60 |
| *Bacteriastrum furcatum* Shadbolt 1853 | 100 |
| *Bacteriastrum hyalinum* Lauder 1864 | 580 |
| *Bacteriastrum mediterraneum* Pavillard 1916 | 20 |
| *Bellerochea malleus* (Brightwell) Van Heurck 1885 | 80 |
| *Biddulphia alternans* (Bailey) Van Heurck 1885 | 20 |
| *Cerataulina dentata* Hasle 1980 | 20 |
| *Chaetoceros aequatorialis* Cleve 1901 | 440 |
| *Chaetoceros affinis* Lauder 1864 | 2500 |
| *Chaetoceros atlanticus* var. *skeleton* (F.Schütt) Hustedt 1930 | 40 |
| *Chaetoceros atlanticus* var. *neapolitanus* (Schroeder) Hustedt 1930 | 720 |
| *Chaetoceros aurivillii* Cleve 1901 | 80 |
| *Chaetoceros brevis* F.Schütt 1895 | 800 |
| *Chaetoceros coarctatus* Lauder 1864 | 20 |
| *Chaetoceros compressus* Lauder 1864 | 40 |
| *Chaetoceros constrictus* Gran 1897 | 40 |
| *Chaetoceros costatus* Pavillard 1911 | 20 |
| *Chaetoceros curvisetus* Cleve 1889 | 340 |
| *Chaetoceros danicus* Cleve 1889 | 140 |
| *Chaetoceros decipiens* Cleve 1873 | 2740 |
| *Chaetoceros densus* (Cleve) Cleve 1899 | 120 |
| *Chaetoceros denticulatus* H.S.Lauder 1864 | 340 |

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|---|---|
| *Chaetoceros dichaeta* Ehrenberg 1844 | 20 |
| *Chaetoceros diversus* Cleve 1873 | 2000 |
| *Chaetoceros didymus* Ehrenberg 1845 | 380 |
| *Chaetoceros mannaii* Y.Li, Boonprakob, Moestrup & Lundholm 2018 | 1380 |
| *Chaetoceros messanensis* Castracane 1875 | 800 |
| *Chaetoceros peruvianus* Brightwell 1856 | 480 |
| *Chaetoceros protuberans* Lauder 1864 | 140 |
| *Chaetoceros pseudocurvisetus* Mangin 1910 | 40 |
| *Chaetoceros pseudodichaeta* Ikari 1926 | 20 |
| *Chaetoceros radicans* F.Schütt 1895 | 1060 |
| *Chaetoceros rectus* Hernández-Becerril 1992 | 20 |
| *Chaetoceros salsugineus* Takano 1983 | 40 |
| *Chaetoceros socialis* H.S.Lauder 1864 | 1040 |
| *Chaetoceros teres* Cleve 1896 | 840 |
| *Chaetoceros willei* Gran 1897 | 2420 |
| *Cylindrotheca closterium* (Ehrenberg) Reimann & J.C.Lewin 1964 | 10,950 |
| *Climacodium frauenfeldianum* Grunow 1868 | 40 |
| *Corethron hystrix* Hensen 1887 | 220 |
| *Corethron pennatum* (Grunow) Ostenfeld 1902 | 140 |
| *Coscinodiscus asteromphalus* Ehrenberg 1844 | 360 |
| *Coscinodiscus centralis* Ehrenberg 1839 | 100 |
| *Coscinodiscus granii* L.F.Gough 1905 | 1140 |
| *Coscinodiscus radiatus* Ehrenberg 1840 | 20 |
| *Coscinodiscus wailesii* Gran & Angst 1931 | 360 |
| *Cyclotella stylorum* Brightwell 1860 | 680 |
| *Cyclotella choctawhatcheeana* Prasad 1990 | 300 |
| *Cyclotella litoralis* Lange & Syvertsen 1989 | 3060 |
| *Dactyliosolen fragilissimus* (Bergon) Hasle 1996 | 160 |
| *Dactyliosolen mediterraneus* (H.Peragallo) H.Peragallo 1892 | 1220 |
| *Dactyliosolen phuketensis* (B.G.Sundström) G.R.Hasle 1996 | 680 |
| *Detonula moseleyana* (Castracane) H.H.Gran 1900 | 1140 |
| *Detonula pumila* (Castracane) Gran 1900 | 640 |
| *Ditylum brightwellii* (T.West) Grunow 1885 | 200 |
| *Eucampia cornuta* (Cleve) Grunow 1883 | 9580 |
| *Eucampia zodiacus* Ehrenberg 1839 | 180 |
| *Eupyxidicula palmeriana* (Greville) S.Blanco & C.E. Wetzel 2016 | 20 |
| *Eupyxidicula turris* (Greville) S.Blanco & C.E.Wetzel 2016 | 180 |
| *Fragilariopsis doliolus* (Wallich) Medlin & P.A.Sims 1993 | 1720 |
| *Fragilariopsis pseudonana* (Hasle) Hasle 1993 | 20 |
| *Grammatophora marina* (Lyngbye) Kützing 1844 | 40 |
| *Guinardia cylindrus* (Cleve) Hasle 1996 | 40 |
| *Guinardia flaccida* (Castracane) H.Peragallo 1892 | 840 |
| *Guinardia striata* (Stolterfoth) Hasle 1996 | 5020 |
| *Gyrosigma spenceri* (Bailey ex Quekett) Griffith & Henfrey 1856 | 40 |
| *Hobaniella longicruris* (Greville) P.A.Sims & D.M.Williams 2018 | 180 |

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|---|---|
| *Haslea trompii* (Cleve) Simonsen 1974 | 720 |
| *Hemiaulus hauckii* Grunow ex Van Heurck 1882 | 660 |
| *Hemiaulus membranaceus* Cleve 1873 | 480 |
| *Hemiaulus sinensis* Greville 1865 | 20 |
| *Lauderia annulata* Cleve 1873 | 100 |
| *Leptocylindrus danicus* Cleve 1889 | 1320 |
| *Leptocylindrus minimus* Gran 1915 | 140 |
| *Licmophora flabellata* (Greville) C.Agardh 1831 | 7460 |
| *Lioloma pacificum* (Cupp) Hasle 1996 | 2000 |
| *Mastogloia cribosa* Grunow 1860 | 20 |
| *Melosira varians* C.Agardh 1827 | 20 |
| *Meuniera membranacea* (Cleve) P.C.Silva 1996 | 600 |
| *Navicula directa* (W.Smith) Brébisson 1854 | 20 |
| *Navicula distans* (W.Smith) Brébisson 1854 | 20 |
| *Neodelphineis pelagica* H.Takano, nom. inval. 1983 | 560 |
| *Nitzschia bicapitata* Cleve 1901 | 1260 |
| *Nitzschia ikeanae* Fryxell & H.Y.Lee 1996 | 100 |
| *Nitzschia interruptestriata* Simonsen 1974 | 160 |
| *Nitzschia leehyi* G.Fryxell 2000 | 20 |
| *Nitzschia longissima* (Brébisson ex Kützing) Grunow 1862 | 1920 |
| *Nitzschia sicula* (Castracane) Hustedt 1958 | 40 |
| *Pachyneis gerlachii* Simonsen 1974 | 120 |
| *Planktoniella muriformis* (Loeblich III, W.W.Wight & W.M.Darley) Round 1972 | 1840 |
| *Planktoniella sol* (G.C.Wallich) Schütt 1892 | 2440 |
| *Pleurosigma decorum* W.Smith 1853 | 320 |
| *Pleurosigma nicobaricum* Grunow 1880 | 40 |
| *Pleurosigma normanii* Ralfs 1861 | 260 |
| *Pleurosigma salinarum* (Grunow) Grunow 1880 | 20 |
| *Proboscia alata* (Brightwell) Sundström 1986 | 1120 |
| *Proboscia indica* (H.Peragallo) Hernández-Becerril 1995 | 20 |
| *Pseudoguinardia recta* von Stosch 1986 | 180 |
| *Pseudo-nitzschia americana* (Hasle) Fryxell 1993 | 60 |
| *Pseudo-nitzschia brasiliana* Lundholm, Hasle & G.A.Fryxell 2002 | 120 |
| *Pseudo-nitzschia multistriata* (H.Takano) H.Takano 1995 | 20,710 |
| *Pseudo-nitzschia pseudodelicatissima* (Hasle) Hasle 1993 | 57,000 |
| *Pseudo-nitzschia pungens* (Grunow ex Cleve) Hasle 1993 | 35,460 |
| *Pseudo-nitzschia roundii* D.U.Hernández-Becerril 2006 | 3500 |
| *Pseudo-nitzschia sabit* S.T.Teng, H.C.Lim, P.T.Lim & C.P.Leaw 2015 | 100 |
| *Pseudo-nitzschia subfraudulenta* (Hasle) Hasle 1993 | 680 |
| *Pseudo-nitzschia subpacifica* (Hasle) Hasle 1993 | 260 |
| *Ralfsiella smithii* (Ralfs) P.A.Sims, D.M.Williams & Ashworth 2018 | 20 |
| *Rhizosolenia acuminata* (H.Peragallo) H.Peragallo 1907 | 80 |
| *Rhizosolenia bergonii* H.Peragallo 1892 | 480 |
| *Rhizosolenia clevei* Ostenfeld 1902 | 40 |
| *Rhizosolenia fallax* B.G.Sundström 1986 | 60 |

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|---|---|
| *Rhizosolenia imbricata* Brightwell 1858 | 20 |
| *Rhizosolenia ostenfeldii* B.G.Sundström 1986 | 20 |
| *Rhizosolenia pungens* A.Cleve 1937 | 400 |
| *Rhizosolenia temperei* H.Peragallo 1888 | 20 |
| *Roperia tesselata* (Roper) Grunow ex Pelletan 1889 | 230 |
| *Shionodiscus oestrupii* (Ostenfeld) A.J.Alverson, S.-H.Kang & E.C.Theriot 2006 | 20 |
| *Skeletonema pseudocostatum* Medlin 1991 | 640 |
| *Skeletonema tropicum* Cleve 1900 | 1920 |
| *Stigmaphora lanceolata* Wallich 1860 | 70 |
| *Stigmaphora rostrata* Wallich 1860 | 40 |
| *Surirella fastuosa* (Ehrenberg) Ehrenberg 1843 | 160 |
| *Tetramphora decussata* (Grunow) Stepanek & Kociolek 2016 | 60 |
| *Thalassionema frauenfeldii* (Grunow) Tempère & Peragallo 1910 | 880 |
| *Thalassionema nitzschioides* (Grunow) Mereschkowsky 1902 | 1160 |
| *Thalassiosira angustelineata* (A.W.F.Schmidt) G.Fryxell & Hasle 1977 | 100 |
| *Thalassiosira diporocyclus* Hasle 1972 | 20 |
| *Thalassiosira eccentrica* (Ehrenberg) Cleve 1904 | 840 |
| *Thalassiosira echinata* H.J.Semina 1994 | 20 |
| *Thalassiosira leptopus* (Grunow) Hasle & G.Fryxell 1977 | 100 |
| *Thalassiosira punctifera* (Grunow) Fryxell, Simonsen & Hasle 1974 | 20 |
| *Thalassiosira tealata* H.Takano 1980 | 1180 |
| *Thalassiosira tenera* Proshkina-Lavrenko 1961 | 3240 |
| *Trieres mobiliensis* (Bailey) Ashworth & E.C.Theriot 2013 | 20 |
| **Dinoflagellates** | |
| *Achradina pulchra* Lohmann 1903 | 100 |
| *Akashiwo sanguinea* (K.Hirasaka) Gert Hansen & Moestrup 2000 | 40 |
| *Alexandrium minutum* Halim 1960 | 100 |
| *Alexandrium tamiyavanichii* Balech 1994 | 20 |
| *Amphisolenia bidentata* B.Schröder 1900 | 20 |
| *Azadinium caudatum* (Halldal) Nézan & Chomérat 2012 | 180 |
| *Azadinium poporum* Tillmann & Elbrächter 2011 | 540 |
| *Azadinium spinosum* Elbrächter & Tillmann 2009 | 160 |
| *Blepharocysta denticulata* D.-S.Nie 1939 | 3320 |
| *Blepharocysta paulsenii* Schiller 1937 | 240 |
| *Blepharocysta splendor-maris* (Ehrenberg) Ehrenberg 1873 | 240 |
| *Boreadinium breve* (T.H.Abé) Sournia 1984 | 20 |
| *Ceratoperidinium falcatum* (Kofoid & Swezy) Reñé & Salas 2013 | 20 |
| *Corythodinium biconicum* (Kofoid) F.J.R.Taylor 1976 | 40 |
| *Corythodinium reticulatum* (Stein) F.J.R.Taylor 1976 | 40 |
| *Corythodinium tesselatum* (F.Stein) Loeblich Jr. & Loeblich III 1966 | 120 |
| *Cucumeridinium coeruleum* (Dogiel) F.Gomez, P.López-García, H,Takayama & D.Moreira 2015 | 4400 |
| *Cucumeridinium lira* (Kofoid & Swezy) F.Gómez, P. López-García, H.Takayama & D.Moreira 2015 | 80 |
| *Dinophysis caudata* Kent 1881 | 60 |

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|---|---|
| *Diplopelta asymmetrica* (Mangin) M.Lebour ex Balech 1988 | 400 |
| *Diplopelta globula* (T.H.Abé) Balech 1979 | 80 |
| *Diplopsalopsis orbicularis* (Paulsen) Meunier 1910 | 40 |
| *Fragilidium mexicanum* Balech 1988 | 120 |
| *Gonyaulax areolata* Kofoid & J.R.Michener 1911 | 40 |
| *Gonyaulax diegensis* Kofoid 1911 | 20 |
| *Gonyaulax fragilis* (Schütt) Kofoid 1911 | 20 |
| *Gonyaulax fusiformis* H.W.Graham 1942 | 40 |
| *Gonyaulax polygramma* F.Stein 1883 | 20 |
| *Grammatodinium tongyeonginum* Z.Li & H.H.Shin 2017 | 40 |
| *Gymnodinium catenatum* H.W.Graham 1943 | 1140 |
| *Gymnodinium impudicum* (S.Fraga & I.Bravo) Gert Hansen & Moestrup 2000 | 40 |
| *Gyrodinium fusiforme* Kofoid & Swezy 1921 | 16,100 |
| *Gyrodinium pepo* (F.Schütt) Kofoid & Swezy 1921 | 20 |
| *Gyrodinium rubrum* (Kofoid & Swezy) Y.Takano & T.Horiguichi 2004 | 120 |
| *Gyrodinium spirale* (Bergh) Kofoid & Swezy 1921 | 1120 |
| *Heterocapsa niei* (A.R.Loeblich) L.C.Morrill & A.R.Loeblich 1981 | 280 |
| *Heterocapsa orientalis* Iwataki, Botes & Fukuyo 2003 | 3640 |
| *Kapelodinium vestifici* (Schütt) Boutrup, Moestrup & Daugbjerg 2016 | 10,840 |
| *Karenia bicuneiformis* Botes, Sym & Pitcher 2003 | 960 |
| *Karenia brevisulcata* (F.H.Chang) Gert Hansen & Moestrup 2000 | 6640 |
| *Karenia mikimotoi* (Miyake & Kominami ex Oda) Gert Hansen & Moestrup 2000 | 100 |
| *Karenia selliformis* A.J.Haywood, K.A.Steidinger & L.MacKenzie 2004 | 560 |
| *Levanderina fissa* (Levander) Moestrup, Hakanen, Gert Hansen, Daugbjerg & M.Ellegaard 2014 | 20 |
| *Lingulodinium polyedra* (F.Stein) J.D.Dodge 1989 | 760 |
| *Margalefidinium fulvescens* (M.Iwataki, H.Kawami & Matsuoka) F.Gómez, Richlen & D.M.Anderson 2017 | 20 |
| *Margalefidinium polykrikoides* (Margalef) F.Gómez, Richlen & D.M.Anderson 2017 | 20 |
| *Nematodinium armatum* (Dogiel) Kofoid & Swezy 1921 | 680 |
| *Noctiluca scintillans* (Macartney) Kofoid & Swezy 1921 | 20 |
| *Ornithocercus magnificus* F.Stein 1883 | 20 |
| *Oxyphysis oxytoxoides* Kofoid 1926 | 20 |
| *Oxytoxum curvatum* (Kofoid) Kofoid & J.R.Michener 1911 | 60 |
| *Oxytoxum mediterraneum* Schiller 1937 | 1060 |
| *Oxytoxum sceptrum* (F.Stein) Schröder 1900 | 1960 |
| *Oxytoxum scolopax* F.Stein 1883 | 360 |
| *Oxytoxum variabile* J.Schiller 1937 | 1440 |
| *Phalacroma cuneus* F.Schütt 1895 | 20 |
| *Phalacroma parvulum* (Schütt) Jørgensen 1923 | 40 |
| *Phalacroma rotundatum* (Claparéde & Lachmann) Kofoid & J.R.Michener 1911 | 60 |
| *Podolampas bipes* F.Stein 1883 | 40 |
| *Podolampas palmipes* F.Stein 1883 | 60 |
| *Podolampas spinifera* Okamura 1912 | 100 |
| *Preperidinium meunieri* (Pavillard) Elbrächter 1993 | 240 |

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|---|---|
| *Pronoctiluca spinifera* (Lohmann) Schiller 1932 | 1040 |
| *Prorocentrum compressum* (Bailey) T.H.Abé ex J.D.Dodge 1975 | 4920 |
| *Prorocentrum gracile* F.Schütt 1895 | 1380 |
| *Prorocentrum koreanum* M.-S.Han, S.Y.Cho & P.Wang 2016 | 100 |
| *Prorocentrum lenticulatum* (Matzenauer) F.J.R.Taylor 1976 | 1500 |
| *Prorocentrum mexicanum* Osorio-Tafall 1942 | 280 |
| *Prorocentrum obtusidens* J.Schiller 1928 | 3620 |
| *Prorocentrum robustum* Osorio-Tafall 1942 | 360 |
| *Prorocentrum rostratum* F.Stein 1883 | 40 |
| *Prorocentrum sigmoides* Böhm 1933 | 80 |
| *Protoperidinium bispinum* (J.Schiller) Balech 1974 | 300 |
| *Protoperidinium brochii* (Kofoid & Swezy) Balech 1974 | 20 |
| *Protoperidinium cassum* (Balech) Balech 1974 | 100 |
| *Protoperidinium cepa* (Balech) Balech 1974 | 20 |
| *Protoperidinium claudicans* (Paulsen) Balech 1974 | 40 |
| *Protoperidinium corniculum* (Kofoid & J.R.Michener) F.J.R.Taylor & Balech 1988 | 20 |
| *Protoperidinium depressum* (Bailey) Balech 1974 | 20 |
| *Protoperidinium furcatum* (T.H.Abé) Balech 1994 | 60 |
| *Protoperidinium marukawae* (T.H.Abé) Balech 1974 | 140 |
| *Protoperidinium mastophorum* (Balech) Balech 1974 | 40 |
| *Protoperidinium mite* (Pavillard) Balech 1974 | 20 |
| *Protoperidinium obtusum* (Karsten) Parke & J.D.Dodge 1976 | 220 |
| *Protoperidinium oceanicum* (Vanhöffen) Balech 1974 | 20 |
| *Protoperidinium ovum* (J.Schiller) Balech 1974 | 120 |
| *Protoperidinium punctulatum* (Paulsen) Balech 1974 | 11,320 |
| *Protoperidinium robustum* (Meunier) Hernández-Becerril 1991 | 6300 |
| *Protoperidinium steinii* (Jørgensen) Balech 1974 | 140 |
| *Protoperidinium tuba* (J.Schiller) Balech 1974 | 320 |
| *Pyrocystis fusiformis* C.W.Thomson 1876 | 60 |
| *Pyrocystis lunula* (F.Schütt) F.Schütt 1896 | 40 |
| *Pyrocystis pseudonoctiluca* Wyville-Thompson 1876 | 40 |
| *Pyrophacus steinii* (Schiller) Wall & Dale 1971 | 940 |
| *Scrippsiella acuminata* (Ehrenberg) Kretschmann, Elbrächter, Zinssmeister, S.Soehner, Kirsch, Kusber & Gottschling 2015 | 3820 |
| *Scrippsiella spinifera* G.Honsell & M.Cabrini 1991 | 260 |
| *Spiraulax kofoidii* H.W.Graham, nom. illeg. 1942 | 20 |
| *Thoracosphaera heimii* (Lohmann) Kamptner 1944 | 940 |
| *Torquentidium convolutum* (Kofoid & Swezy) H.H.Shin, Z,Li, K.W.Lee & K.Matsuoka 2019 | 40 |
| *Torquentidium helix* (Lemmermann) H.H.Shin, Z.Li, K.W.Lee & K.Matsuoka 2019 | 620 |
| *Triadinium polyedricum* (Pouchet) J.D.Dodge 1981 | 5320 |
| *Tripos brevis* (Ostenfeld & Johannes Schmidt) F.Gómez 2021 | 20 |
| *Tripos falcatus* (Kofoid) F.Gómez, nom. inval. 2013 | 20 |
| *Tripos furca* (Ehrenberg) F.Gómez 2013 | 280 |
| *Tripos fusus* (Ehrenberg) F.Gómez 2013 | 80 |

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|---|---|
| *Tripos humilis* (Jørgensen) F.Gómez 2013 | 60 |
| *Tripos kofoidii* (Jørgensen) F.Gómez 2013 | 80 |
| *Tripos lineatus* (Ehrenberg) F.Gómez 2021 | 100 |
| *Tripos macroceros* (Ehrenberg) Hallegraeff & Huisman 2020 | 60 |
| *Tripos muelleri* Bory 1826 | 20 |
| *Tripos teres* (Kofoid) F.Gómez 2013 | 20 |
| *Tripos trichoceros* (Ehrenberg) Gómez 2013 | 20 |
| **Silicoflagellates** | |
| *Octactis octonaria* (Ehrenberg) Hovasse 1946 | 760 |
| *Dictyocha calida* Poelchau 1976 | 180 |
| *Dictyocha californica* Schrader & Murray 1985 | 80 |
| *Dictyocha fibula* Ehrenberg 1839 | 460 |
| *Dictyocha fibula* var. *robusta* Schrader & Murray | 20 |
| **Ciliates** | |
| *Mesodinium rubrum* Lohmann 1908 | 20,980 |
| **Cynobacteria** | |
| *Trichodesmium hildebrandtii* Gomont 1892 | 1760 |