

Microplankton Assemblages in the Gulf of Aqaba, Red Sea, during the De-stratification Period

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The samples from two cruises, during October and December 1989, were analyzed for species composition and chlorophyll concentration at the surface layer, near 100 m and just below the thermocline, at our Reference Station A at the northern end of the Gulf of Aqaba. The two cruises covered the end of the eight-month stratification period and the incipient annual winter overturn, respectively. The taxonomic groups studied, collected by the FTF (Filter Transfer Freeze) technique [1] included the cyanobacteria, monads and silicoflagellates of the pico and nanoplankton and the diatoms and dinoflagellates of the larger phytoplankton. (Tables 1-2).

During the October cruise (Fig. 1), a pronounced chlorophyll maximum was observed at the surface. A second chlorophyll maximum was observed between 60-100 m, followed by a steep decline at greater depths. This state was typical of the whole stratification period. During the second cruise (Fig. 2), the chlorophyll values remained similar down to 200 m, following again by a steep decline. These differences between the two cruises correspond to the hydrographic data, which indicate a strong stratification in October and no stratification down to 200 m in December (B. Lazar, pers. comm.).

The samples collected during the two cruises differed both in general taxonomic representation of the microplankton components and in the distribution of species composition assemblages with depth. Thus, for example, the dinoflagellates, tintinnids and acantharia were far better represented in October than in December. As to the depth distribution, in October different species assemblages were recorded at each depth, while in December such a comparison showed a substantial overlap. As with chlorophyll concentration, these temporal and depth related differences in species assemblages can be correlated to the hydrographic conditions existing at the time. Qualitatively similar relationships had been observed off the Mediterranean coast of Israel [2].

The overall autotrophic biomass (data not shown) showed three maxima (0, 60 and 110 m) in October, but was stable with depth down to 200 m in December. Cyanobacterial biomass was significant in all depths over the thermocline, averaging 20-30% of the total microplankton biomass. The heterotrophic biomass was significant and increased rather steadily with depth down to 100 m in October, while it was low and varied with depth in December. The fraction of heterotrophs in the microplankton biomass was much higher in October (25%) than in December (12%). This feature can be related to the level of nutrient recycling, which is considered to be more important in the photic zone of highly oligotrophic and stratified waters [3].

TABLE 1. SPECIES COMPOSITION, STATION A, OCTOBER 1989. See Table 1 for further details.

DEPTH (m):	SYNCHROCYCLES	MONADS (90 to 2 µ)	DIATOMS	DINOFLAGELLATES (autotrophic)	DINOFLAGELLATES (heterotrophic)	TINTINNIDS	ACANTHARIA
0	(13,94/925)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
10	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
20	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
30	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
40	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
50	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
60	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
70	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
80	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
90	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
100	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
110	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
120	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
130	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
140	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
150	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
160	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
170	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
180	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
190	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
200	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
210	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
220	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
230	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
240	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
250	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
260	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
270	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
280	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
290	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
300	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
310	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
320	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
330	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
340	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
350	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
360	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
370	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
380	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
390	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
400	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
410	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
420	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
430	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
440	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
450	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
460	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
470	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
480	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
490	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
500	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
510	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
520	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
530	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
540	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
550	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
560	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
570	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
580	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
590	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
600	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
610	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
620	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
630	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
640	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
650	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
660	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
670	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
680	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
690	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
700	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
710	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
720	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
730	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
740	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
750	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
760	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
770	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
780	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
790	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
800	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
810	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
820	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
830	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)	611-Lauderi (1830)	613-Prorocentrum (40)	612-Nitzabka (1400)
840	(104,46/8)	(104,46/8)	610-Nitzabka (1230)	614-Rhizosolenia (50)			