

Supplementary tables and figures

Shifted dynamics of plankton communities in a restored lake: exploring the effects of climate change on phenology through four decades

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Table S1. Results of Mann-Kendall (MK) tests for environmental variables.

A positive vs. negative test statistic (tau) indicates an increasing vs. decreasing trend. The yearly aggregated values and slopes (in cases with significant MK tests) are shown in Figure S1 - Figure S4.

(a)

Variable	Average value		Maximum value		Timing of central value		Timing of maximum value	
	p	tau	p	tau	p	tau	p	tau
Lake temperature	0.004	0.323	0.005	0.314	0.012	0.282	0.724	0.044
Schmidt stability	<0.001	0.533	<0.001	0.456	0.025	0.263	0.302	0.132
Secchi	0.002	0.339	0.092	0.19	0.161	0.158	0.027	-0.283
Total P	<0.001	-0.509	<0.001	-0.519	<0.001	0.439	0.161	0.167
Total N	0.217	0.139	0.133	0.17	0.077	0.198	0.791	0.034
NO ₃	0.002	0.347	<0.001	0.62	0.14	0.166	0.182	-0.174
SiO ₂	<0.001	0.683	<0.001	0.7	0.023	0.255	0.105	0.195
Phytoplankton	<0.001	-0.49	<0.001	-0.433	0.086	0.193	0.013	0.293
PTI	<0.001	-0.466	0.003	-0.328	<0.001	0.4	0.818	-0.029
Zooplankton	0.828	0.026	<0.001	-0.417	0.042	-0.228	0.148	-0.172

(b)

Variable	Start date		End date	
	p	tau	p	tau
Stratification	0.045	-0.233	0.0024	0.354
Ice cover	0.51	-0.071	0.012	-0.264

Table S2. Results of Mann-Kendall tests for phytoplankton classes.

The yearly aggregated values and slopes (in cases with significant MK tests) are shown in Figure S5, Figure S6, Figure S9 and Figure S10. For more explanation, see Table S1.

Taxon name	Average biomass		Peak biomass		Timing of central biomass		Timing of peak biomass	
	p	tau	p	tau	p	tau	p	tau
Bacillariophyceae								
Chlorophyceae	<0.001	-0.449	<0.001	-0.398	0.037	0.233	0.01	0.305
Choanoflagellata	0.002	-0.344	0.047	-0.223	0.866	-0.02	0.066	-0.214
Chrysophyceae	<0.001	0.476	0.07	0.204	0.002	0.351	0.191	-0.161
Cryptophyceae	<0.001	-0.474	<0.001	-0.393	0.578	0.063	0.437	-0.095
Cyanophyceae	0.011	-0.285	0.029	-0.246	0.497	-0.078	0.472	-0.085
Dinophyceae	0.023	0.255	0.358	0.104	0.005	0.317	0.021	0.271
Prymnesiophyceae	<0.001	-0.486	0.001	-0.381	0.804	-0.03	0.639	0.057
Synurophyceae	<0.001	-0.433	<0.001	-0.501	0.024	0.252	0.055	0.225
Trebouxiophyceae	<0.001	-0.603	<0.001	-0.4	0.79	-0.031	0.971	-0.006

Table S3. Results of Mann-Kendall tests for zooplankton species.

The yearly aggregated values and slopes (in cases with significant MK tests) are shown in Figure S7, Figure S8, Figure S11 and Figure S12. For more explanation, see Table S1

Taxon name	Taxon code	Average biomass		Peak biomass		Timing of central biomass		Timing of peak biomass	
		p	tau	p	tau	p	tau	p	tau
<i>Eudiaptomus gracilis</i>	Eudiapto	0.123	-0.187	0.155	-0.173	0.594	0.066	0.621	0.064
<i>Limnocalanus macrurus</i>	Limnocal	0.374	-0.109	0.678	-0.052	0.085	-0.209	0.003	-0.386
<i>Bosmina longispina</i>	Bospina	0.002	-0.365	0	-0.426	0.075	-0.216	0.114	-0.207
<i>Daphnia galeata</i>	Daphgal	0.678	-0.052	0.155	-0.173	0.767	0.037	0.825	0.032
<i>Thermocyclops oithonoides/ Mesocyclops leuckarti</i>	Ther_Mes	0.614	0.062	0.678	-0.052	0.657	0.055	0.878	0.022
<i>Leptodora kindtii</i>	Leptodora	0.041	-0.248	0.035	-0.255	0.273	0.134	0.925	-0.015
<i>Cyclops lacustris</i>	Cyclacust	0.224	0.148	0.358	0.112	0.146	-0.176	0.424	-0.102
<i>Daphnia cristata</i>	Daphcris	0.028	-0.266	0.018	-0.285	0.882	-0.02	0.448	0.099
<i>Heterocope appendiculata</i>	Heterapp	0.155	-0.173	0.514	-0.08	0.013	-0.301	0.005	-0.374
<i>Holopedium gibberum</i>	Holoped	0	0.517	0	0.524	0.025	-0.286	0.013	-0.343
<i>Polyphemus pediculus</i>	Polyphem	0.635	-0.059	0.965	-0.007	0.836	0.027	0.367	-0.119
<i>Bythotrephes longimanus</i>	Bythotrep	0.049	0.242	0.029	0.271	0.754	0.046	0.983	-0.006
<i>Bosmina longirostris</i>	Bostris	0.288	-0.133	0.197	-0.162	0.726	0.053	0.868	-0.029
<i>Acanthocyclops spp./ Megacyclops spp.</i>	Acant_Mega	0.934	-0.013	0.815	-0.033	0.08	0.363	0.017	0.503
<i>Cyclops</i> indetermined	Cyclubest	0.033	0.278	0.028	0.287	0.787	-0.059	0.522	-0.131
<i>Cyclops scutifer</i>	Cycscutif	0.816	-0.034	0.858	-0.027	0.696	-0.11	0.874	-0.057
Chydoridae	Chydorida	0.266	-0.144	0.168	-0.181	0.718	0.066	0.816	-0.046
<i>Diaphanosoma brachyurum</i>	Diaphano	0.56	-0.084	0.56	-0.084	0.085	0.69	0.027	0.894
<i>Ceriodaphnia</i> spp.	Ceriodaph	0.888	0.022	0.857	0.028	0.454	-0.255	0.258	-0.371
<i>Daphnia cucullata</i> + <i>D. longispina</i>	Dacuc_long	0.541	0.096	0.541	0.096	1	1	1	1

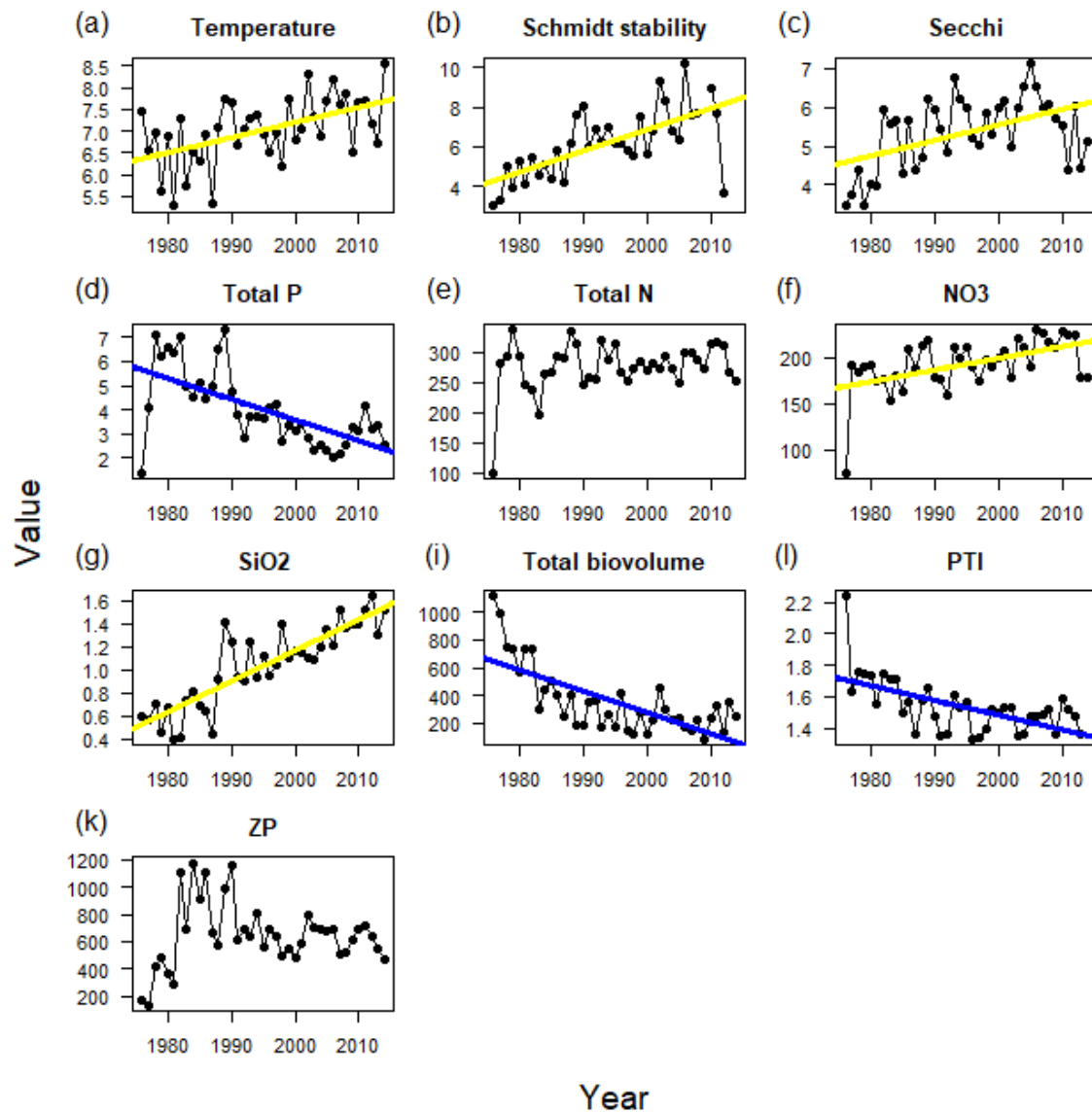


Figure S1. Trends in environmental data: yearly average values.

Explanation to headers: P = phosphorus, N = nitrogen, NO₃ = nitrate, SiO₂ = silicate, Total biovolume = phytoplankton biovolume, PTI = phytoplankton trophic index, ZP = zooplankton biomass. For units, see Table 1 or Figure 2.

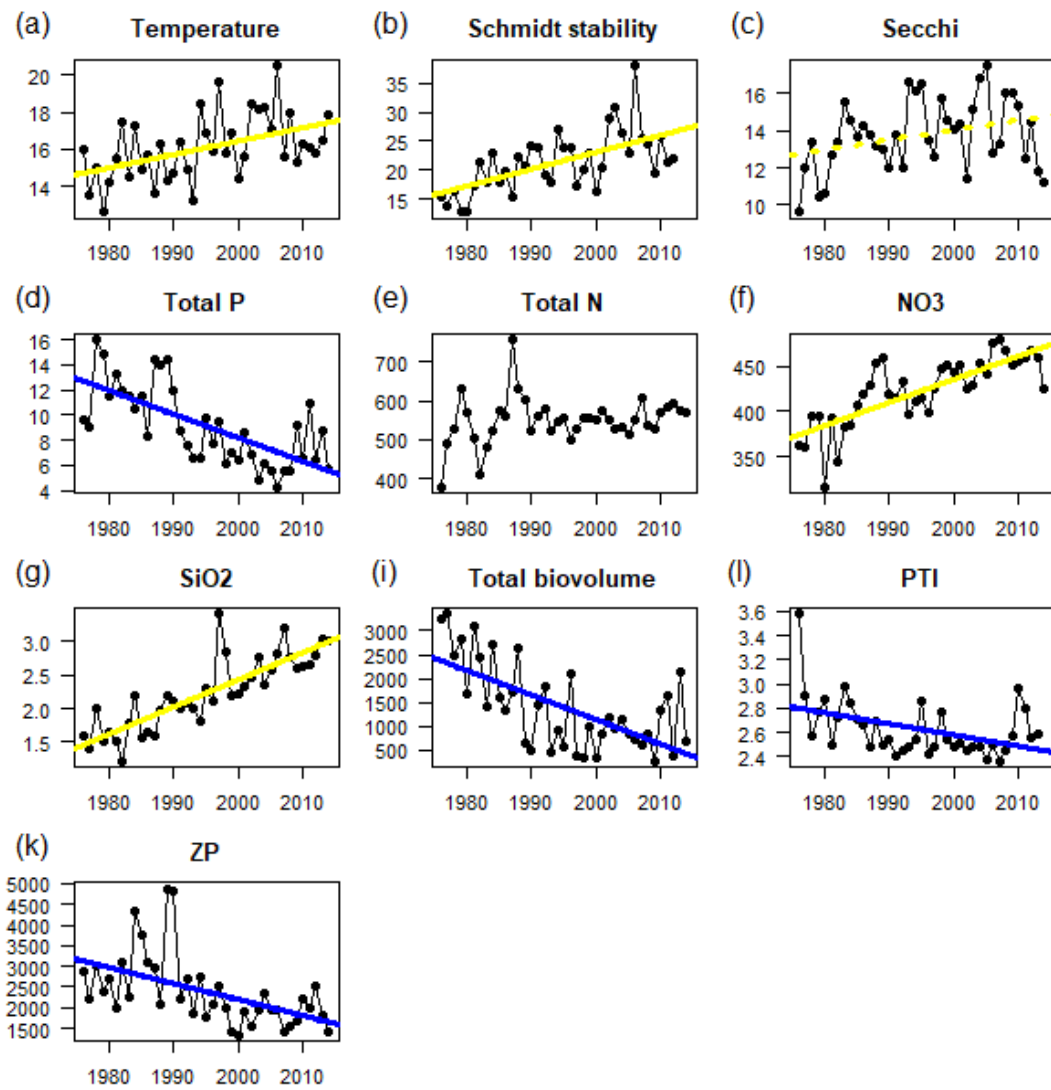


Figure S2. Trends in environmental data: yearly maximum values. For more explanation, see Figure S1.

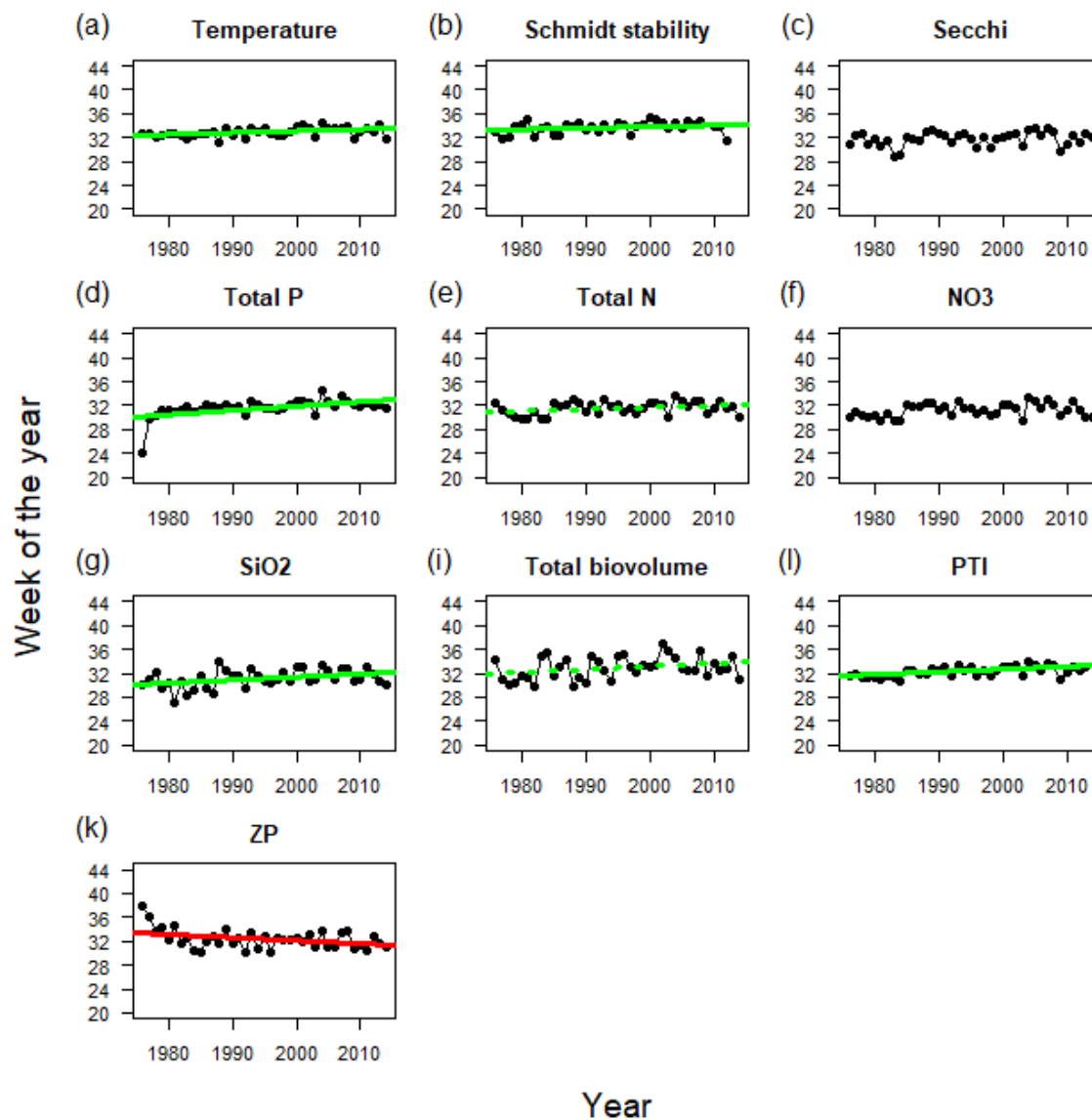


Figure S3. Trends in environmental data: timing of yearly central values. For more explanation, see Figure S1.

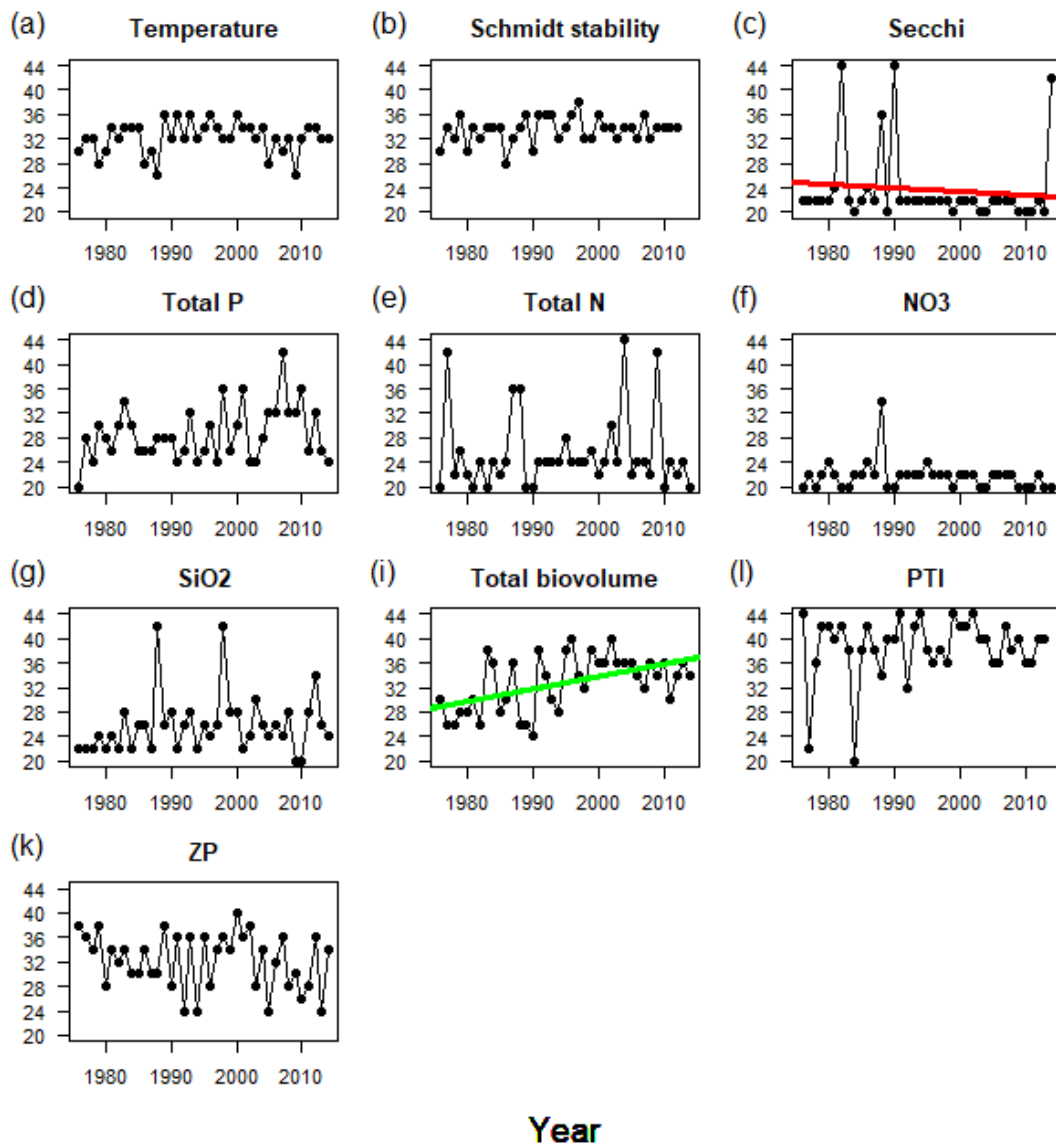


Figure S4. Trends in environmental data: timing of yearly maximum values. For more explanation, see Figure S1.

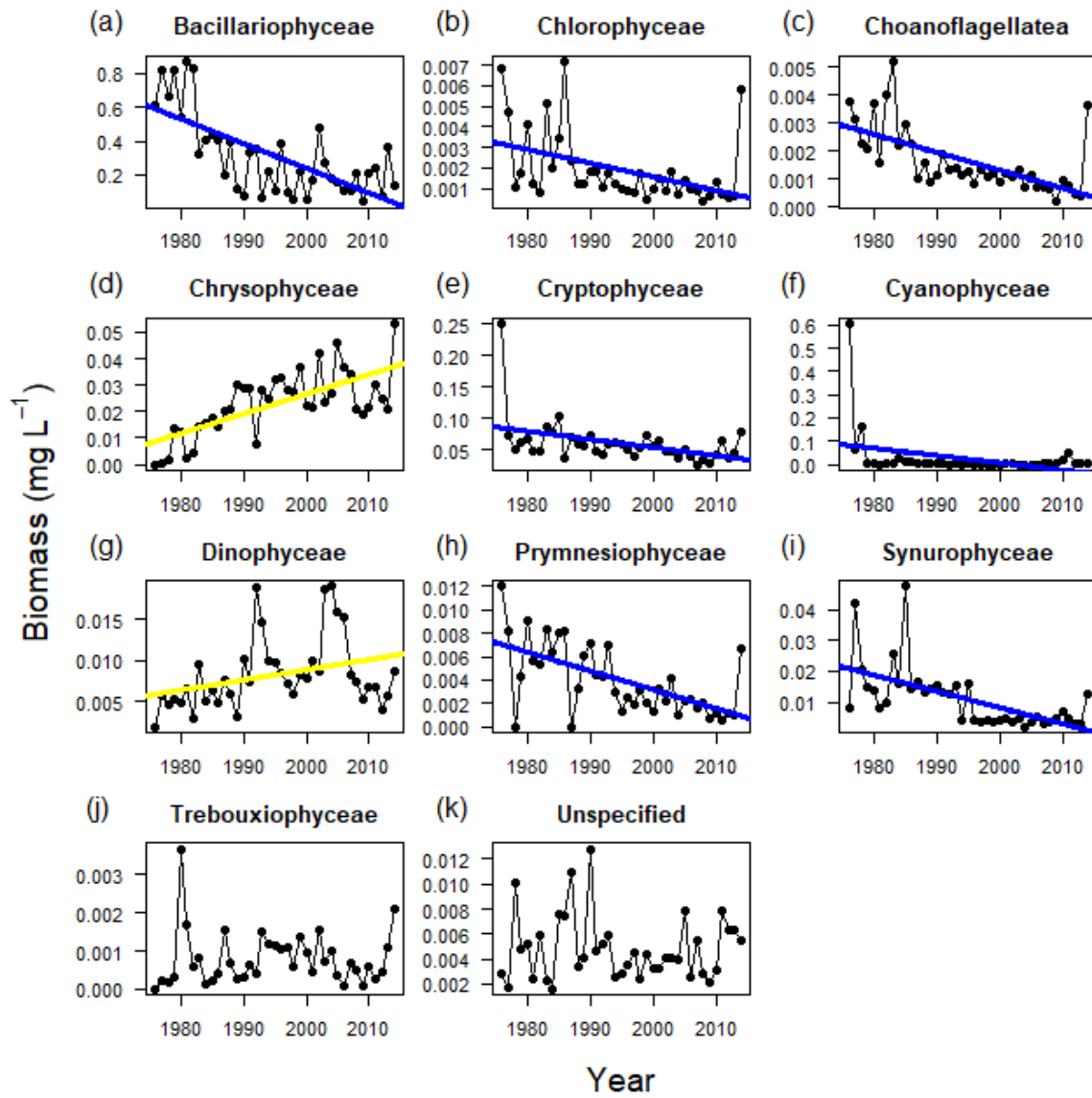


Figure S5. Trends in phytoplankton abundance: yearly average biomass of classes.

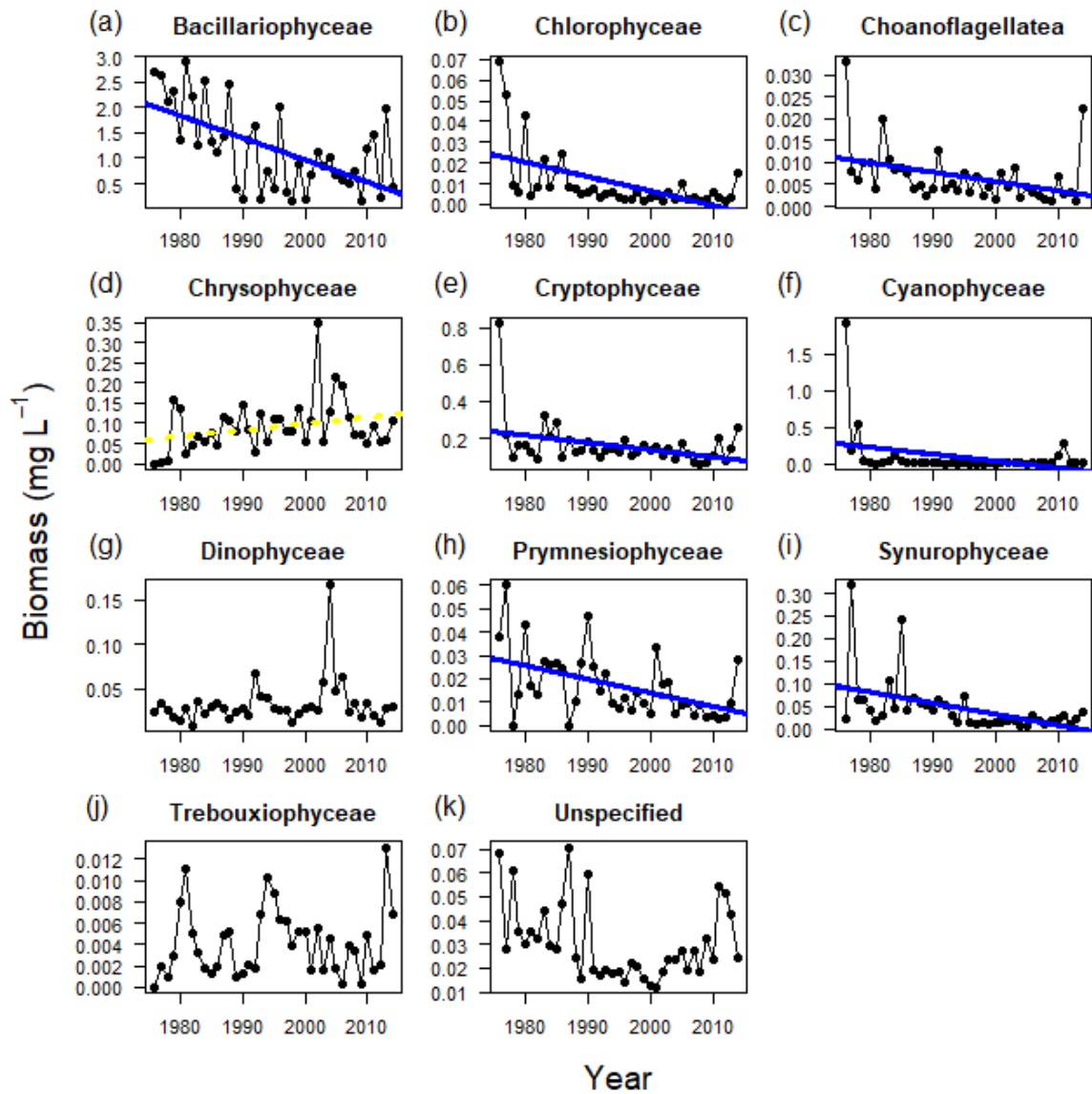


Figure S6. Trends in phytoplankton abundance: yearly maximum biomass of classes.

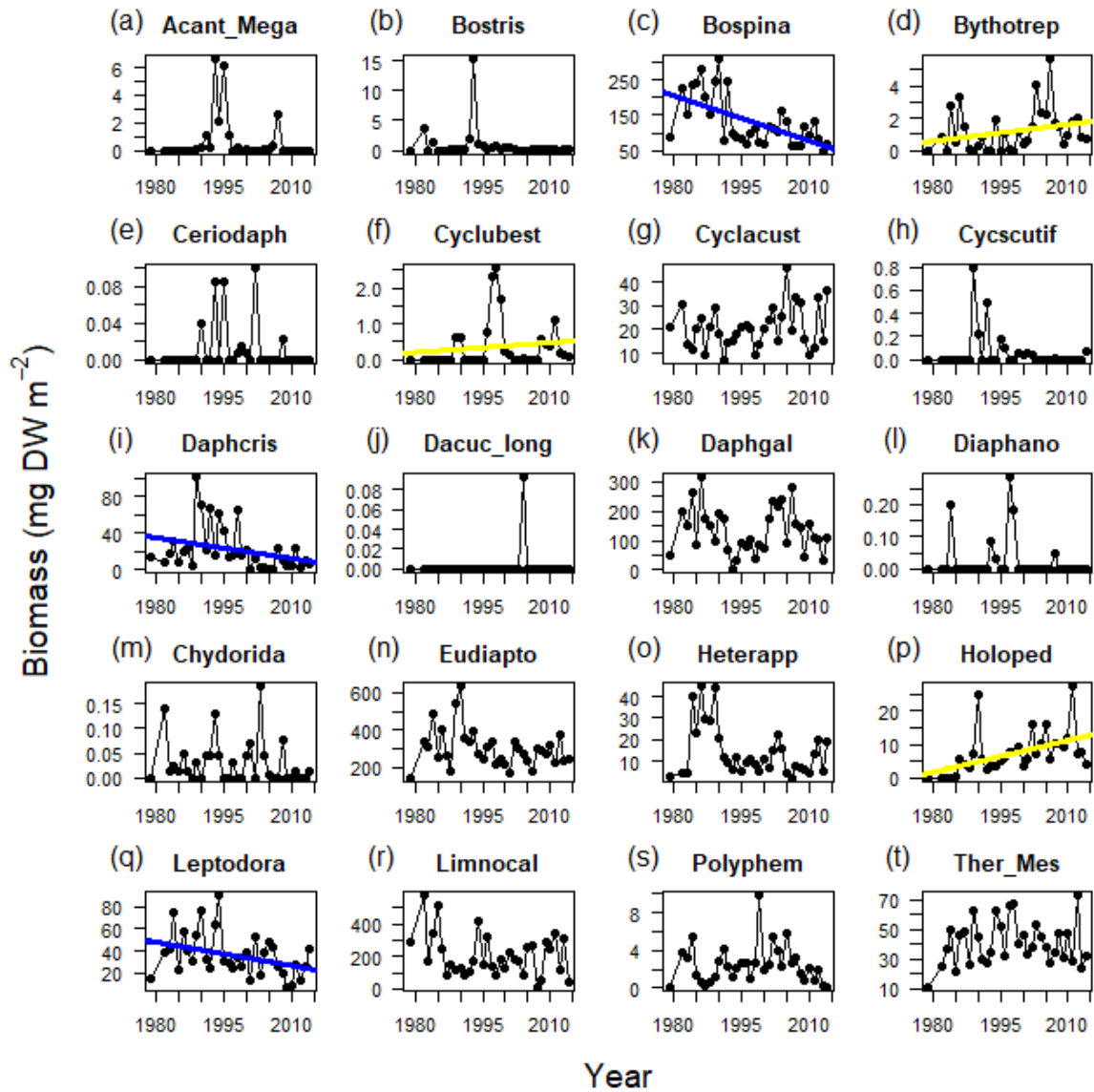


Figure S7. Trends in zooplankton abundance: yearly average biomass of species. For full species names, see Table S3.

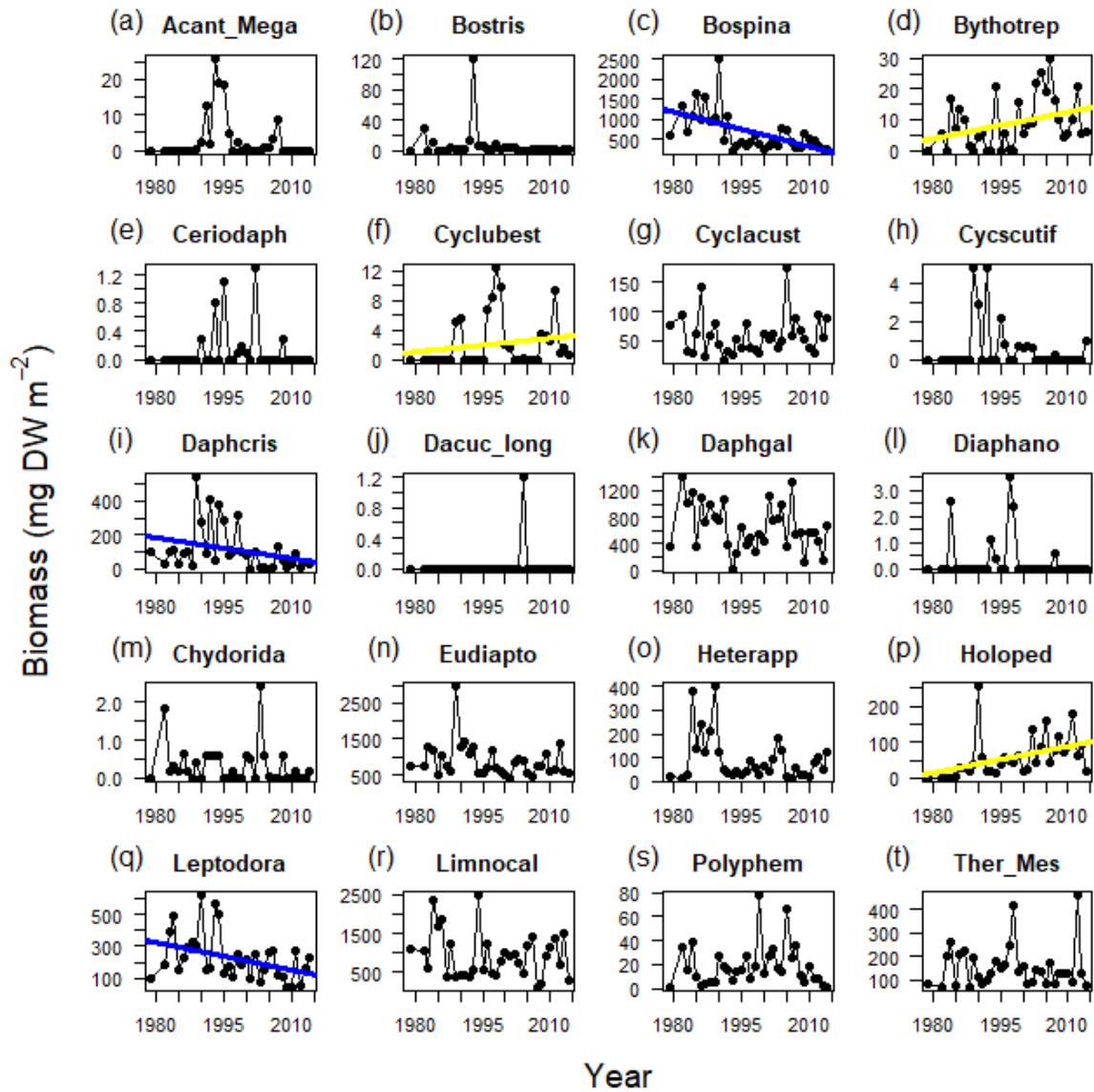


Figure S8. Trends in zooplankton abundance: yearly maximum biomass of species. For full species names, see Table S3.

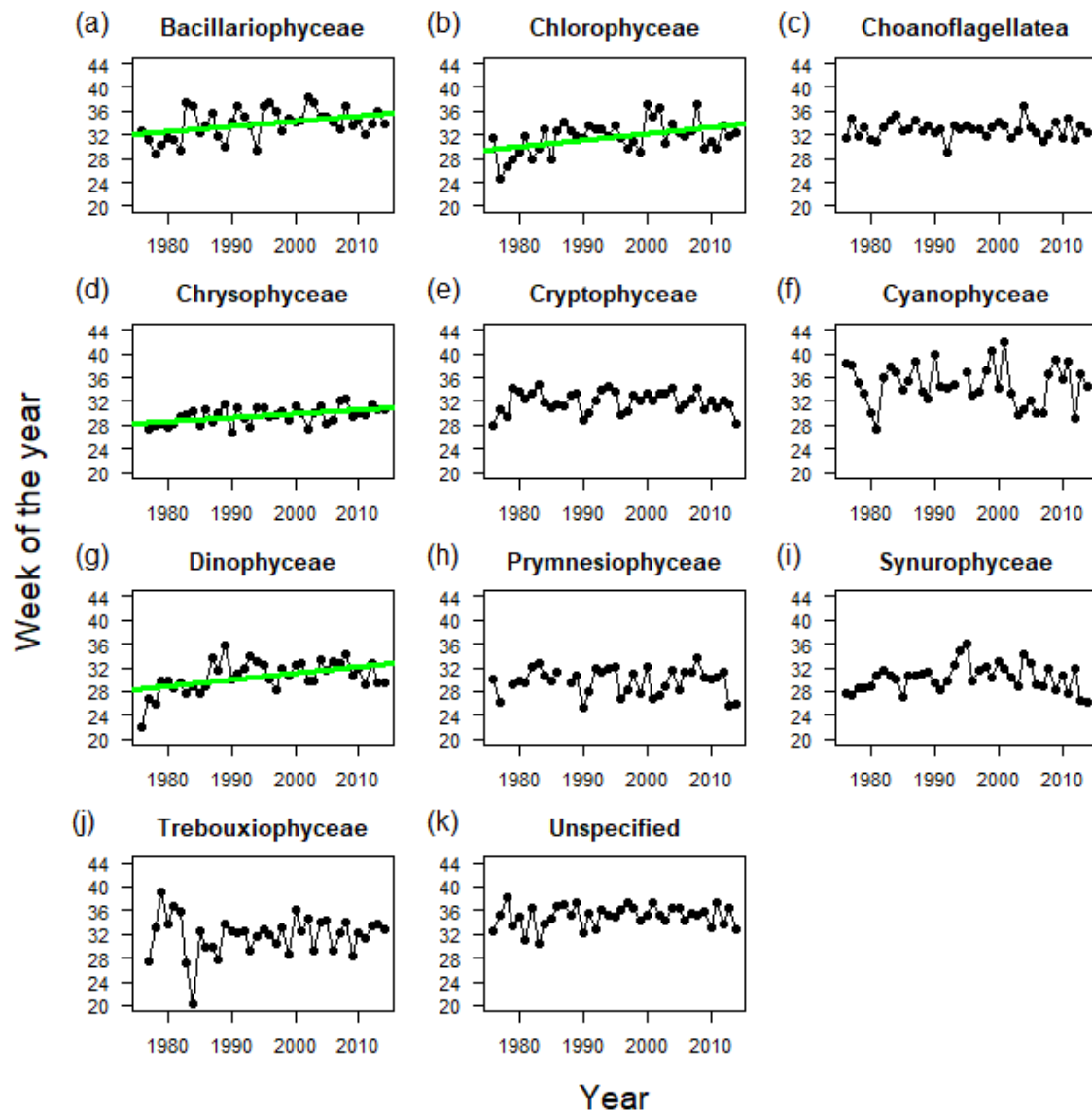


Figure S9. Trends in phytoplankton phenology: timing of yearly central biomass of classes. For full species names, see Table S3.

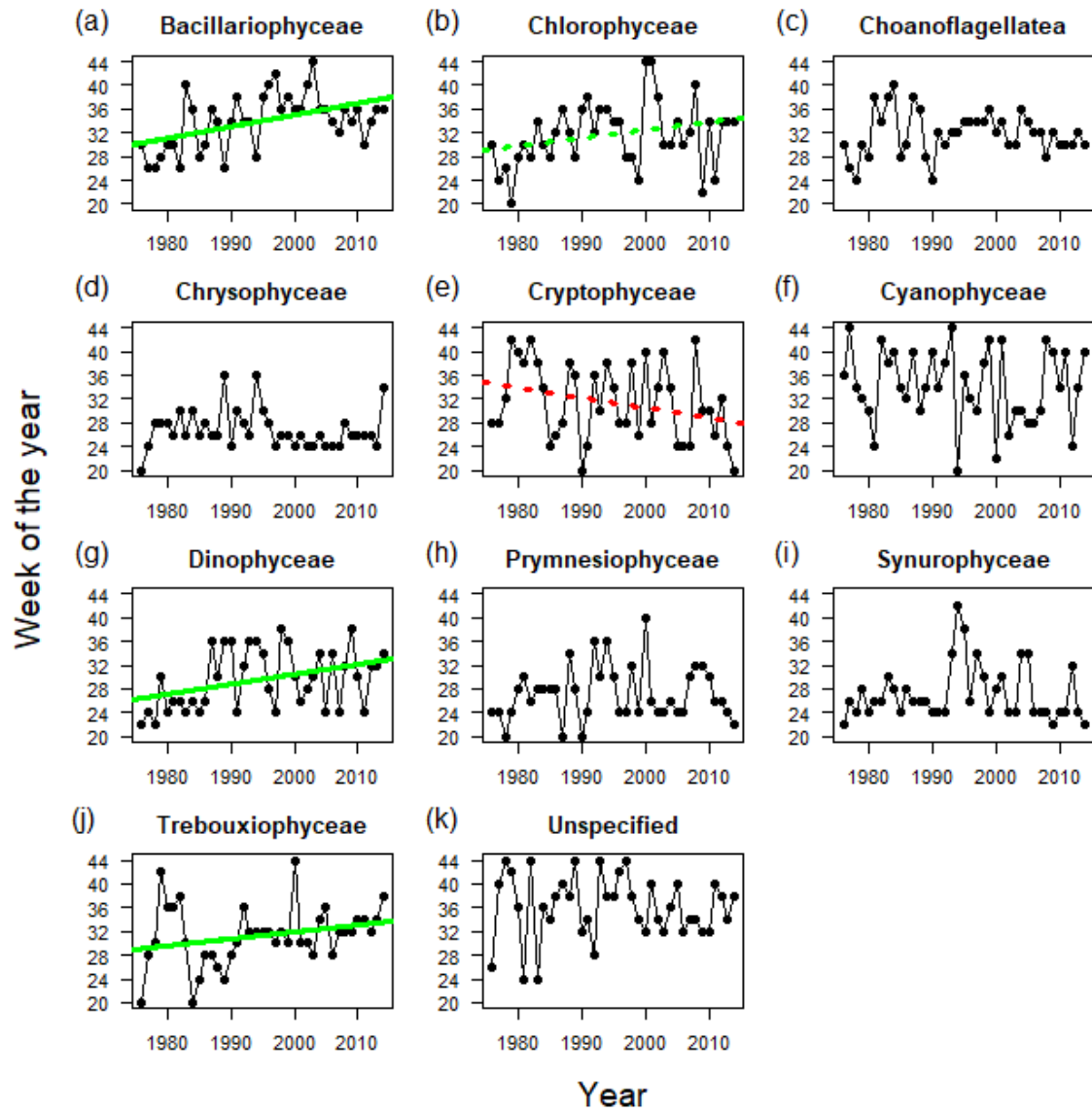


Figure S10. Trends in phytoplankton phenology: timing of yearly maximum biomass of classes. For full species names, see Table S3.

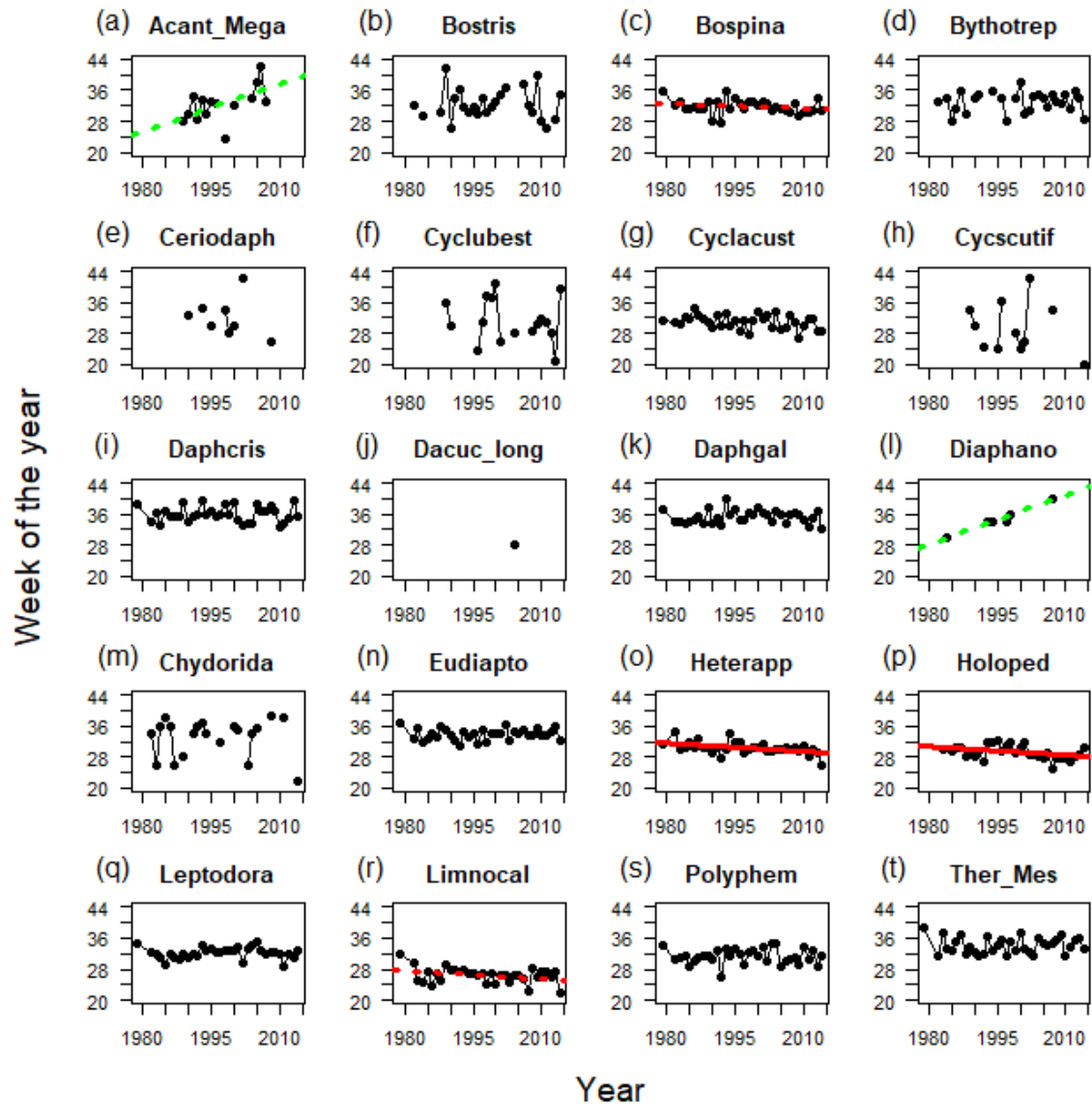


Figure S11. Trends in zooplankton phenology: timing of yearly central biomass of species. For full species names, see Table S3.

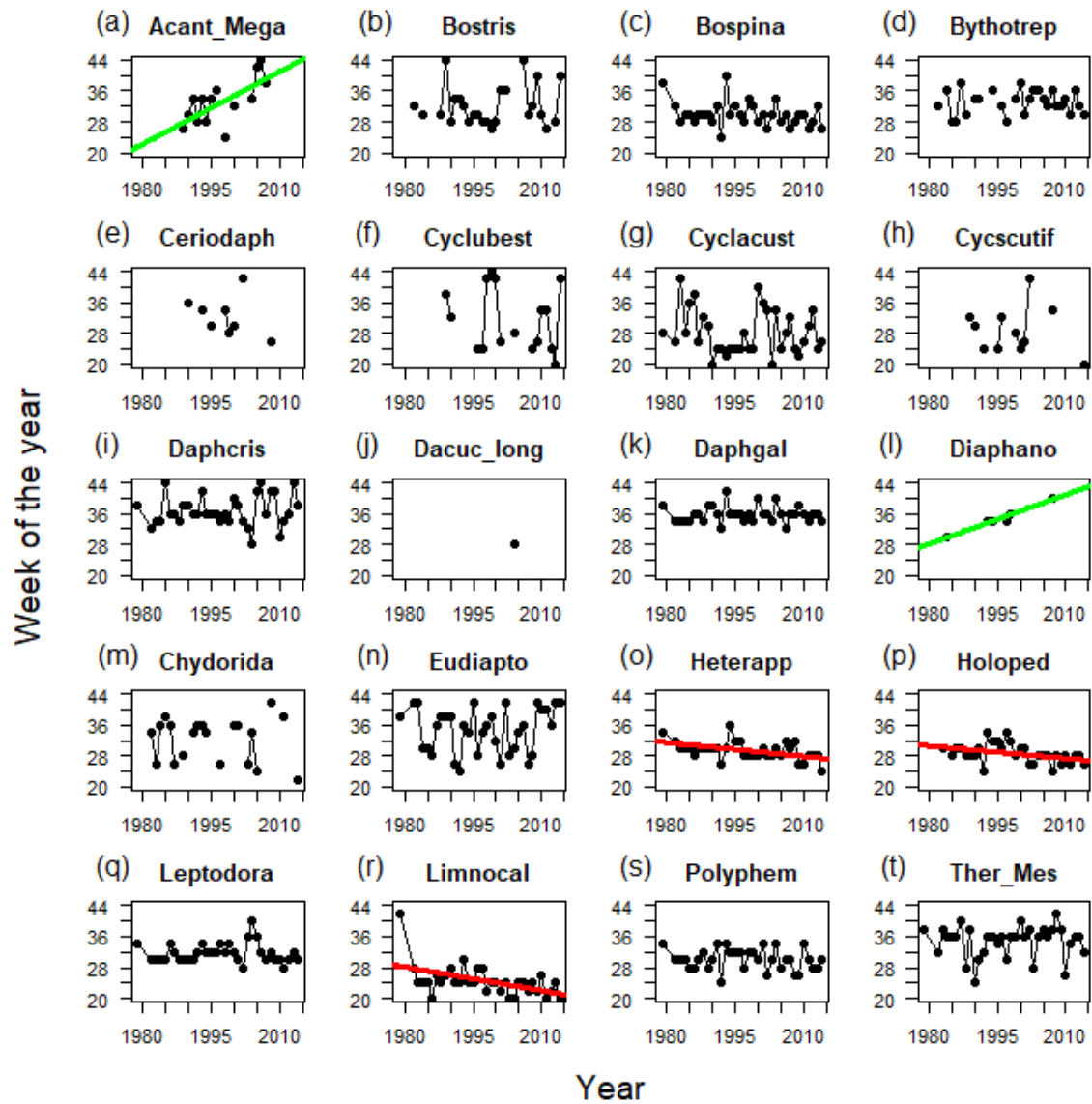


Figure S12. Trends in zooplankton phenology: timing of yearly maximum biomass of species. For full species names, see Table S3.