Supporting Information

Rogers *et al*. (2023) – Intermittent instability is widespread in plankton communities

Table S1. Metadata for time series from 17 lakes and 4 marine locations used in this study. Series names listed are only those used in the analysis that met data quality criteria (missing data, zeros). Aggregates were constructed using all available time series for that category (includes series not analyzed individually and thus not listed in this table). Number of data points (n data points) indicates the number of non-missing values (varies by time series, thus a range is presented). Units for plankton were individuals per volume (density) or biomass per volume (biomass), as indicated. Units for chla were micrograms per liter. Time series were standardized after aggregation, prior to analysis. Abbreviations: zoop. = zooplankton, herb. = herbivorous.

Site Name	Country	Type	Latitude	Longitude	Year range (n data points)	Units	Species-level series	Functional group-level series	Trophic-level series	Data Source
Loch Leven	Scotland	Lake	56.194	-3.375	1977-2007 (245-261)	density	*Cyclops abyssorum* *Eudiaptomus gracilis*	Copepods Cladocerans	Total herb. zoop. Chl-a	[1] [2]
Blelham Tarn	England	Lake	54.395	-2.979	1983-2010 (300-310)	density			Total crustacean zoop. Chl-a	[3] [4]
Windermere North	England	Lake	54.37	-2.935	1978-2010 (370-394)	density		Copepods Large cladocerans Small cladocerans	Total crustacean zoop. Chl-a	[3] [5]
Esthwaite Water	England	Lake	54.36	-2.985	1978-2010 (383-393)	density			Total crustacean zoop. Chl-a	[3] [6]
Lake Müggelsee	Germany	Lake	52.437	13.646	1979-2018 (318-462)	density	*Asplanchna priodonta* *Bosmina longirostris* *Brachionus angularis* *Brachionus calyciflorus* *Chydorus sphaericus* *Conochilus unicornis* *Cyclops vicinus* *Daphnia cucullata* *Daphnia galeata* *Dreissena polymorpha* larvae *Eubosmina coregoni* *Eubosmina longicornis berolinensis* *Eudiaptomus gracilis* *Eudiaptomus graciloides* *Kellicottia longispina* *Keratella cochlearis* *Keratella quadrata* *Leptodora kindtii*	Copepods Large cladocerans Small cladocerans Predatory zoop. Rotifers	Total herb. zoop. Chl-a	[7]

							Mesocyclops leuckarti *Polyarthra dolichoptera/ vulgaris* *Pompholyx sulcata* *Synchaeta oblonga,* *Synchaeta pectinata,* *Trichocerca similis*			
Lake Greifensee	Switzerland	Lake	47.35	8.68	1984-2016 (327-346)	density		Small herb. zoop. Medium herb. zoop. Large herb. zoop. Predatory zoop.	Total herb. zoop. Total phytoplankton	[8]
Lake Zurich	Switzerland	Lake	47.235	8.698	1987-2006 (138-219)	density	*Bosmina* sp. *Bythotrephes longimanus* *Cyclops abyssorum* *Cyclops bohater* *Cyclops vicinus* *Daphnia hyali* *Daphnia pulex* *Eudiaptomus gracilis* *Mesocyclops edax*	Copepods Large cladocerans Small cladocerans Predatory zoop.	Total herb. zoop. Chl-a	[9]
Lake Geneva	Switzerland /France	Lake	46.43	6.55	1959-2018 (272-639)	density	*Asplanchna priodonta* *Bythotrephes longimanus* *Conochilus* sp. *Cyclops prealpinus* *Cyclops vicinus* *Eubosmina longispina* *Eudiaptomus gracilis* *Kellicottia longispina* *Keratella cochlearis* *Keratella quadrata* *Leptodora kindtii* *Polyarthra* sp. *Synchaeta* sp.	Copepods Large cladocerans Small cladocerans Predatory zoop. Rotifers	Total herb. zoop. Chl-a	[10]
Lake Mendota	Wisconsin, United States	Lake	43.11	-89.43	1976-2018 (348-408)	density	*Acanthocyclops* sp. *Chydorus* sp. *Daphnia mendotae* *Daphnia pulicaria* *Diacyclops thomasi* *Diaptomid* spp. *Mesocyclops edax*	Copepods Large cladocerans Small cladocerans	Total herb. zoop.	[11] [12] [13] [14]

Lake Kasumigaura (avg. of stations 3, 9)	Japan	Lake	36.03	140.4	1980-2018 (425-450)	density	*Asplanchna* spp. *Bosmina* spp. *Brachionus calyciflorus* *Diaphanosoma brachyurum* *Filinia* spp. *Keratella cochlearis* *Polyarthra* spp. *Trichocerca* spp.	Copepods Large cladocerans Small cladocerans Rotifers	Total herb. zoop. Chl-a	[15]
Yale Lake	Florida, United States	Lake	28.912	-81.735	1999-2016 (145-152)	biomass		Copepods Cladocerans	Total herb. zoop. Chl-a	[16]
Lake Griffin	Florida, United States	Lake	28.883	-81.85	1999-2016 (187-192)	biomass		Copepods Cladocerans	Total herb. zoop. Chl-a	[16]
Lake Eustis	Florida, United States	Lake	28.847	-81.73	1999-2016 (165-187)	biomass		Copepods Cladocerans	Total herb. zoop. Chl-a	[16]
Lake Dora	Florida, United States	Lake	28.788	-81.7	1999-2016 (179-192)	biomass		Copepods Cladocerans	Total herb. zoop. Chl-a	[16]
Lake Harris	Florida, United States	Lake	28.778	-81.81	1999-2016 (178-188)	biomass		Copepods Cladocerans	Total herb. zoop. Chl-a	[16]
Lake Beauclair	Florida, United States	Lake	28.773	-81.660	1999-2016 (184-202)	biomass		Copepods Cladocerans	Total herb. zoop. Chl-a	[16]
Lake Apopka	Florida, United States	Lake	28.626	-81.63	1999-2016 (192-206)	biomass		Copepods Cladocerans	Total herb. zoop. Chl-a	[16]
North Sea		Marine	56.3	3.4	1958-2013 (251-672)	density	*Paralia sulcata* *Skeletonema costatum* *Thalassiosira* spp. *Rhizosolenia styliformis* *Rhizosolenia hebetata semispina* *Chaetoceros Hyalochaete* spp. *Chaetoceros Phaeoceros* spp. *Odontella sinensis* *Thalassionema nitzschioides* *Proboscia.alata* *Pseudo nitzschia delicatissima*	Herb. zoop. Predatory zoop.	Total zoop. Total phytoplankton	[17] [18]

complex
Pseudo nitzschia seriata
complex
Rhizosolenia imbricata
Coccolithaceae Total
Silicoflagellates
Ceratium fusus
Ceratium furca
Ceratium lineatum
Ceratium tripos
Ceratium macroceros
Ceratium horridum
Ceratium longipes
Dinophysis spp. Total
Protoperidinium spp.
Scrippsiella spp.
Tintinnida Total
Oithona spp.
Pseudocalanus spp.
Adult Atlantic
Para Pseudocalanus spp.
Temora longicornis
Centropages typicus
Centropages hamatus
Calanus finmarchicus
Calanus helgolandicus
Metridia lucens
Candacia armata
Podon spp.
Evadne spp.
Cyphonautes
Echinoderm larvae
Gammaridea Hyperiidea Total
Decapoda larvae Total
Cirripede larvae Total
Appendicularia
Bivalvia larvae
Thecosomata North.Atlantic
Fish larvae

Wadden Sea		Marine	55.03	8.46	1999-2008 (114-115)	density	*Acartia* sp. Balanidae nauplii Bivalvia larvae *Centropages hamatus* Gastropod larvae Harpacticoida Membranipora larvae *Noctiluca scintillans* *Oikopleura dioica* *Oithona* sp. *Pseudocalanus elongatus* *Paracalanus parvus* *Paracalanus* sp. *Rathkea oktopunctata* Rotatoria *Spionida* nektochaeta *Temora longicornis* Turbellaria	Herb. zoop. Predatory zoop.	Total zoop. Total phytoplankton	[19] [20] [21]
Port Erin Bay	Isle of Man	Marine	54.088	-4.768	1907-1920 (134-168)	density	*Chaetoceras decipiens* *Chaetoceras debile* *Chaetoceras teres* *Rhizosolenia semispina* *Rhizosolenia shrubsolei* *Rhizosolenia stolterfothii* *Coscinodiscus concinnus* *Coscinodiscus radiatus* *Coscinodiscus grani* *Biddulphia mobiliensis* *Biddulphia sinensis* *Guinardia flaccida* *Lauderia borealis* *Ceratium tripos* *Noctiluca miliaris* *Paracalanus parvus* *Pseudocalanus elongatus* *Oithona similis* *Acartia clausi* *Calanus finmarchicus* *Centropages hamatus* *Temora longicornis* Echinoderm plutei Polychaete larvae Lamellibranch larvae	Herb. zoop. Predatory zoop.	Total zoop. Total phytoplankton	[22] [18]

							Gastropod larvae *Sagitta bipunctata* Medusoid gonophores			
Narragansett Bay	Rhode Island, United States	Marine	41.567	-71.384	1972-1997 (168-287)	biomass	*Acartia hudsonica* *Acartia tonsa*		Total zooplankton Chl-a	[23]

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Table S2. Analysis of variance (ANOVA) tables for cross-site analysis. *p<0.05

Response variable	Taxonomic resolution	Source	df	F	p
LE	Species	Mean temperature	1	0.03	0.87
		Temperature range	1	4.00	0.085
		Residuals	7		
	Functional group	Mean temperature	1	11.30	0.0043*
		Temperature range	1	0.26	0.62
		Residuals	15		
	Trophic level	Mean temperature	1	3.27	0.087
		Temperature range	1	6.74	0.018*
		Residuals	18		
Seasonality of local eigenvalues	Species	Mean temperature	1	0.36	0.57
		Temperature range	1	0.0041	0.95
		Residuals	7		
	Functional group	Mean temperature	1	0.11	0.73
		Temperature range	1	0.11	0.74
		Residuals	15		
	Trophic level	Mean temperature	1	0.19	0.66
		Temperature range	1	0.053	0.82
		Residuals	18		
Relative seasonality of local eigenvalues	Species	Mean temperature	1	1.36	0.28
		Temperature range	1	0.17	0.69
		Residuals	7		
	Functional group	Mean temp.	1	4.34	0.054
		Temp. range	1	0.82	0.38
		Residuals	15		
	Trophic level	Mean temperature	1	8.96	0.0078*
		Temperature range	1	3.61	0.073
		Residuals	18		
Proportion positive local eigenvalues	Species	Mean temperature	1	0.13	0.73
		Temperature range	1	0.34	0.58
		Residuals	7		
	Functional group	Mean temperature	1	0.28	0.60
		Temperature range	1	0.0087	0.92
		Residuals	15		
	Trophic level	Mean temperature	1	1.058	0.317
		Temperature range	1	3.56	0.075
		Residuals	18		

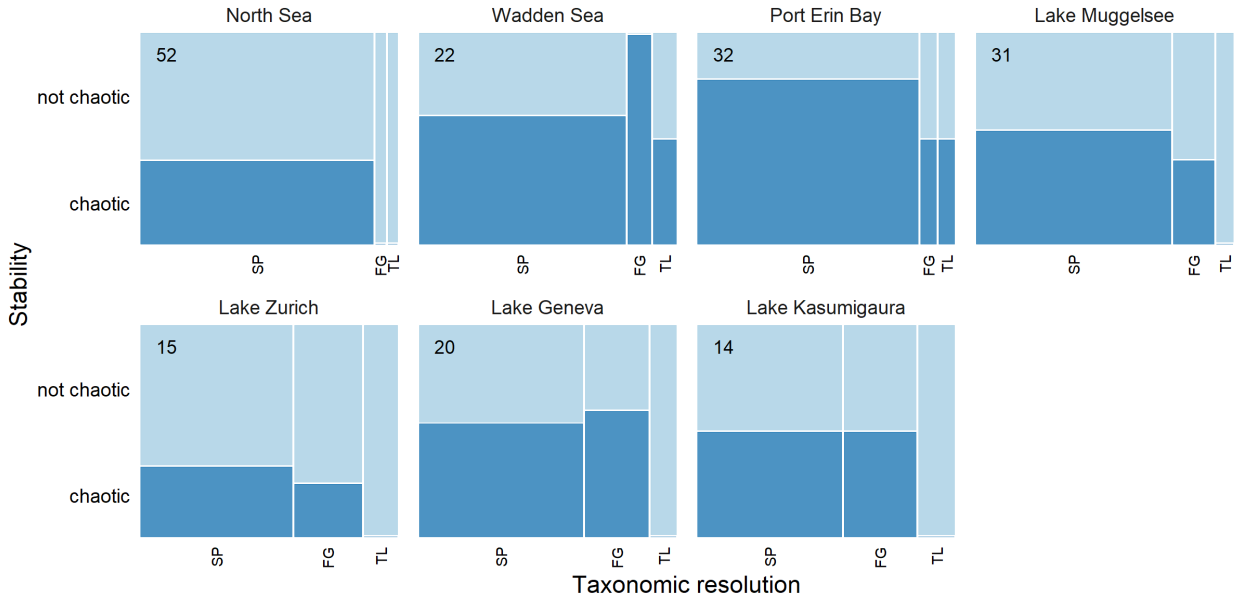

Fig S1. Mosaic plot indicating stability classification of time series at three levels of taxonomic resolution for sites which have all levels represented and at least 6 species-level time series. Axes show the relative frequency of each category. Numbers in top left are the total number of series for that site (total panel area). SP = species, FG = functional group, TL = trophic level.

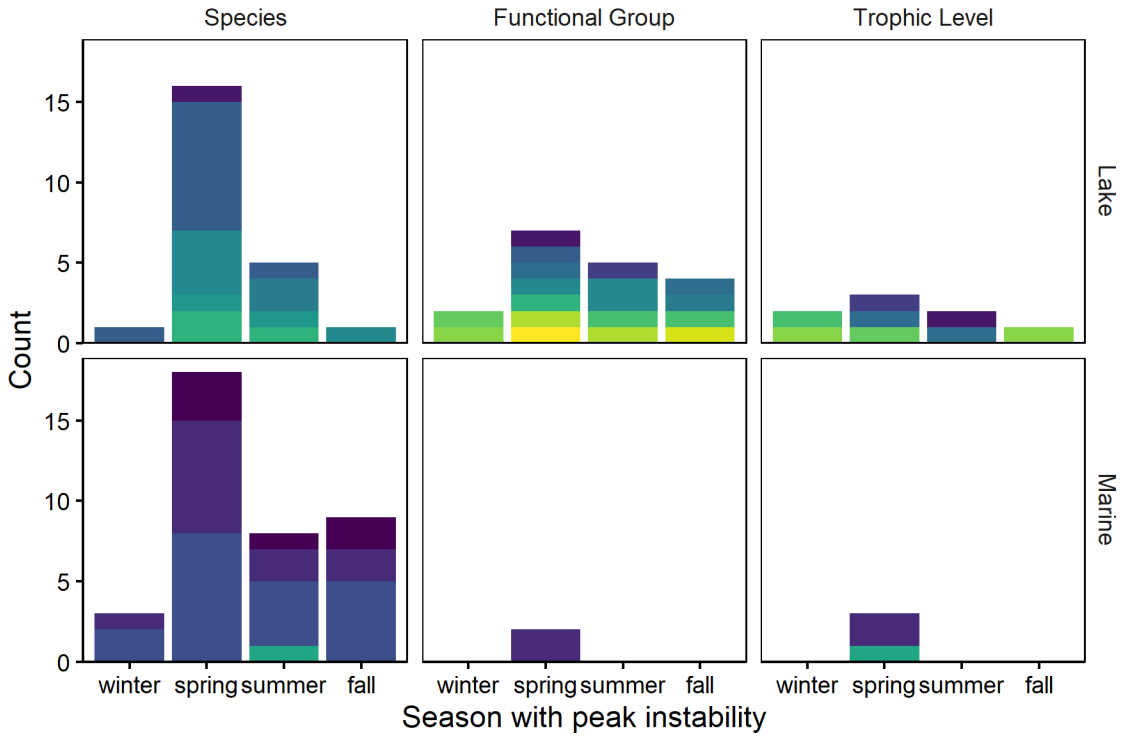

Fig. S2. Timing of peak local instability. The horizontal axis indicates the season in which the monthly mean local eigenvalue reached its maximum for each level of taxonomic resolution, dividing lakes and marine sites. Bar height indicates the number of time series. Only results from series with proportion positive local eigenvalues >0 and local eigenvalue seasonality (difference between min and max monthly medians) >0.25 are shown. Colors indicate different sites. Winter months: 12,1,2; spring months: 3,4,5; summer months: 6,7,8; fall months: 9,10,11.

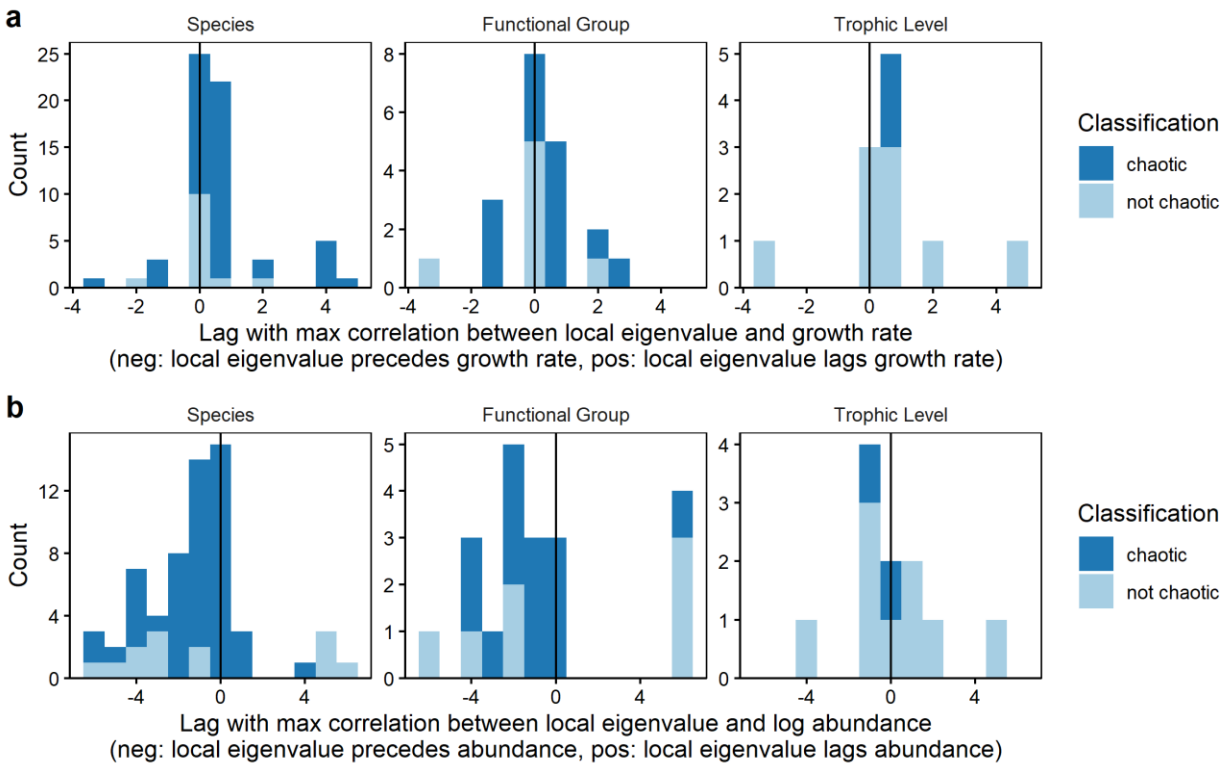

Fig. S3. Lag with maximum cross-correlation between (a) local eigenvalue and population growth rate, and (b) local eigenvalue and log population abundance for each level of taxonomic resolution. Only results from series with proportion positive local eigenvalues >0 and local eigenvalue seasonality (difference between min and max monthly medians) >0.25 are shown.