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Appendix 1

Table A1. Definition of time periods used in analyses of timing of migration and plankton dynamics. a: 11ºC is the minimum temperature required for somatic growth in roach (van Dijk et al. 2002). b: both early outmigration and early return migration. The period accounted for 97.5% of out migrations and 43% of return migrations (Fig. A1). c: both late outmigration and late return migration. The period accounted for 2.5% of out migrations and 57% of return migrations (Fig. A1). d: chosen according to range of peak phytoplankton occurrence dates (20 March – 25 April). e: for proportion of fish being away from lake, however, 20 March – 30 April, since only very few fish returned after this date

Time period	Start date	End date	Start definition and rationale	End definition and rationale	Used for	Notes
Pre-migration growth period	27 March	31 August1	First date with observed temperatures above 11ºC	Potential start of migration	out migration dependency of temperature	a
Early migration	1 September	20 March	Earliest observed migration date	Earliest observed spring migrants	calculation of timing of migration	b
Late migration	21 March	6 May	Earliest observed spring migrants	Last observed return migration	calculation of timing of migration	c
Early winter	2 October	15 December	First date observed temperatures below 11ºC	Earliest average early return date	early return migration dependency of temperature	
Autumn	1 September	31 December	Earliest observed migration date	Arbitrary definition of season	Effect of season on zooplankton size and phytoplankton biomass	

Spring	1 January	6 May	Arbitrary definition of season	Last observed return migration	Effect of season on zooplankton size and phytoplankton biomass	
Phytoplankton spring	1 March	31 May	Avoidance of peaks not associated with spring plankton dynamics	Avoidance of summer peaks	Determination of day of maximum spring phytoplankton	
Zooplankton spring	1 April	30 June	Avoidance of peaks not associated with spring plankton dynamics	Avoidance of summer peaks	Determination of day of maximum spring zooplankton	
Pre-phytoplankton peak	1 March	30 April			For independent variables for explaining timing of phytoplankton peak	d
Pre-zooplankton peak	20 March	31 May			For independent variables for explaining timing of zooplankton peak	e

Table A2. Overview of analyses, dependent- and independent variables used in the study. a: we used first day of 10ºC rather than preceding average temperatures for this analysis, since Brönmark et al. (2008) suggests that timing of return migration is dependent on when water temperature reaches a threshold set by local predation risk/potential growth rate tradeoffs. Also the use of first day of 11ºC, and first day of 12ºC provided significant results in the analysis, but subsequent multiple regression analysis suggested that first day of 10ºC was the best explanatory variable. b: season were included as a factor in these analyses, to account for the fact that temperature development goes in opposite directions during autumn and spring and the subsequent possibility that size structure and biomass of the plankton community is affected differently by preceding periods, i.e. summer and winter.

Analysis	Dependent variable	Independent variables	Type of test	Notes
Proportion migrants	Proportion migrants	Temperature	Linear regression	
Timing of migration	Timing of early outmigration	Temperature	Linear regression	
	Timing early return migration	Temperature, average outmigration date	Multiple linear regression	
	Proportion of migrants returning early relative to late	Temperature, average outmigration date	Multiple linear regression	
	Timing late return migration	Temperature, average outmigration date	Multiple linear regression	a
Plankton community during migratory period	Zooplankton mean size	Temperature, proportion of migratory fish, season	ANCOVA	b
	Phytoplankton biomass	Temperature, proportion of migratory fish, season	ANCOVA	b
	Zooplankton biomass	Temperature, proportion of migratory fish, season	ANCOVA	b
Plankton spring phenology	Day of phytoplankton peak biomass	Temperature, proportion of migratory fish, zooplankton biomass	Multiple linear regression	
	Day of zooplankton	Temperature, proportion	Multiple linear	

	peak biomass	of migratory fish, phytoplankton biomass	regression	
	Time between phyto- and zooplankton peaks	Temperature, proportion of migratory fish, phytoplankton biomass	Multiple linear regression	

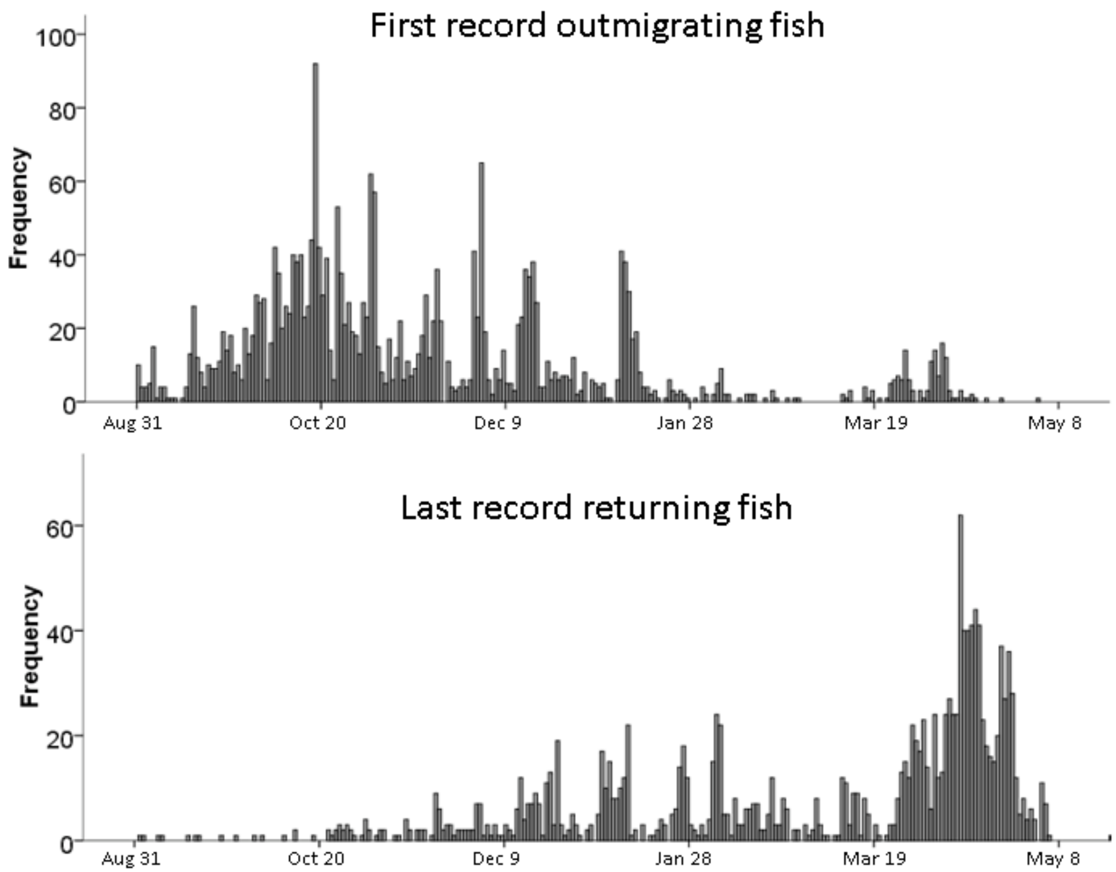

Figure A1. Frequency distributions of time of first record of fish migrating from lake to streams (upper panel) and of time of last record for fish returning to lake from winter stay in streams (lower panel). For outmigration, fish could be divided into individuals that left the lake during late autumn or early winter and individuals that left the lake in spring. For the return migration, fish could be divided into individuals that returned scattered throughout the winter and fish that returned during a relatively brief period during spring. On the basis of the figures the cut date between early and late migration for both outmigration and return migration was chosen as March 20.