Ecography

ECOG-01871
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Supplementary material

Figure A2. Spatial distribution of the reference sites for the period 1980-1991.

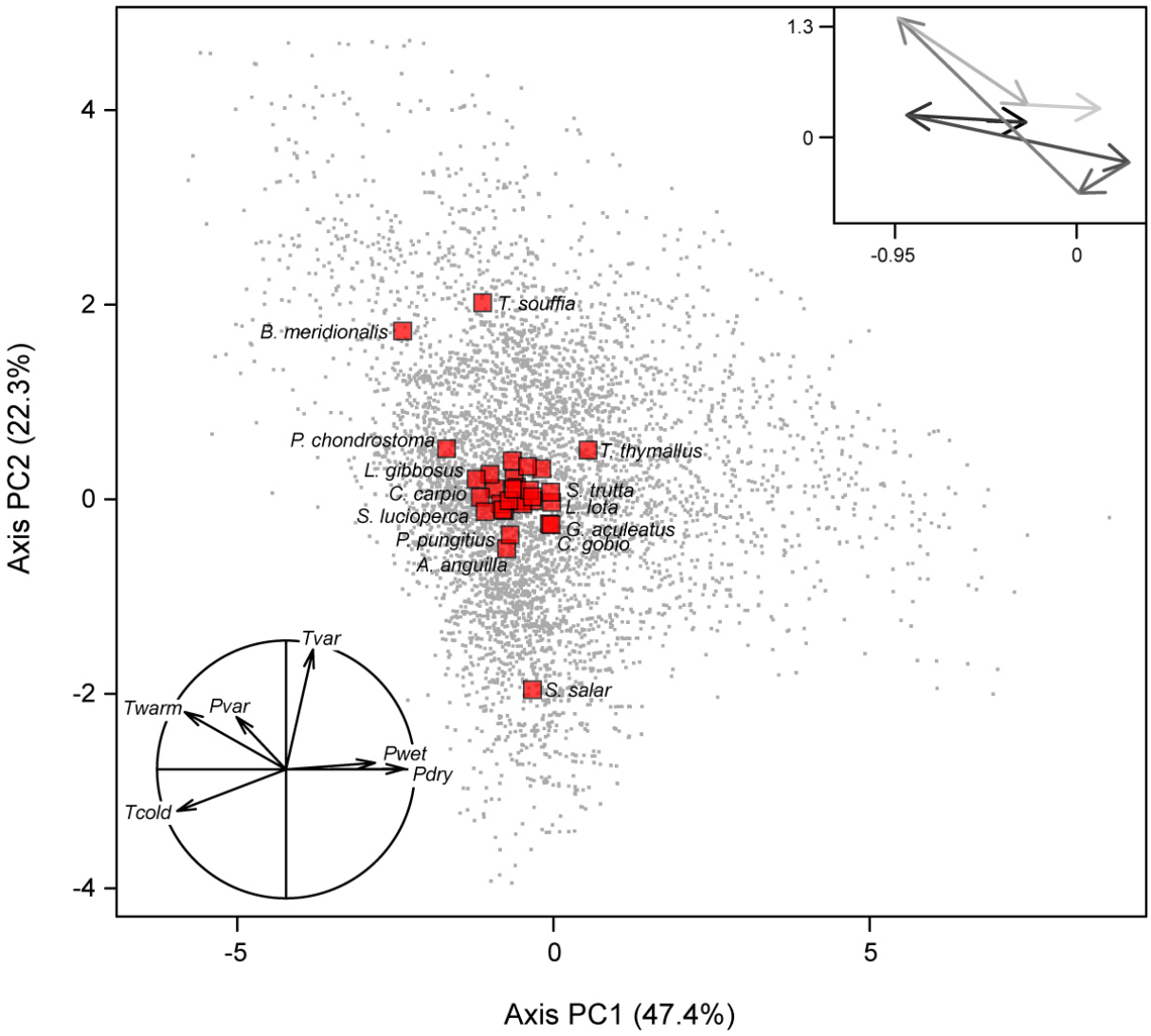

Figure A3. Climatic space depicting the conditions of the sampling sites (black dots) across the eight consecutive periods, here shown in two-dimensions. PC1 represents a gradient from warmer and drier areas (negative values) to cooler and wetter areas (positive values). PC2 represents a gradient from stable climatic conditions (negative values) to more variable climatic conditions (positive values). Red dots indicate species climatic niche centroids. The inset illustrates the mean climatic trends in the climatic space across the eight periods: each arrow represents the average trajectory of the climatic conditions between two consecutive periods with the colour scale varying from dark for the first transition (from 1992-1995 to 1996-1997) to light grey for the more recent one (from 2006-2008 to 2009-2011).

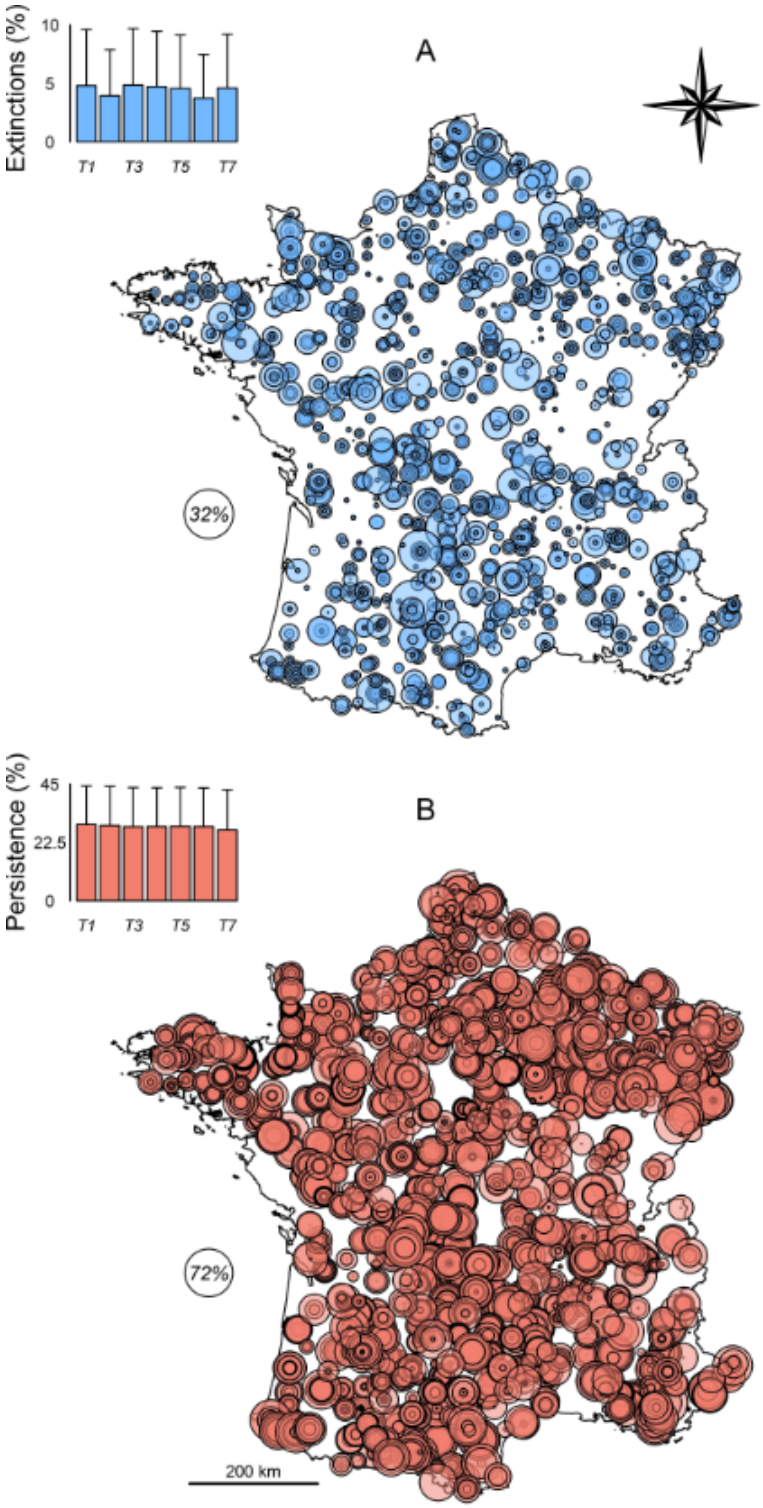

Figure A4. Percentages of (A) extirpation and (B) persistence events at each sampling site and between each consecutive periods with regards to the overall number of events for this given transition (i.e. extirpation, persistence, colonization and absence). The size of the circle is proportional to the percentage of events calculated for the 32 species. The barplots represent the average percentage of extirpation/persistence events between consecutive time periods (± SD). A linear-mixed model with the initial time period as a continuous fixed effect and the site ID nested within the hydrographic basin as a random factor demonstrated that there was no temporal trend in the overall percentage of extirpation per site ($P = 0.36$).

Table A1. Full list of models ran for the extirpation dynamics.

Model	Code
Null	
$logit(y) = \beta_0$	M1
Anthropogenic-only	
$logit(y) = \beta_0 + \beta_4.pop$	M2
$logit(y) = \beta_0 + \beta_5.frag$	M3
$logit(y) = \beta_0 + \beta_4.pop + \beta_5.frag$	M4
Exposure	
$logit(y) = \beta_0 + \beta_3.Exp$	M5
$logit(y) = \beta_0 + \beta_3.Exp + \beta_4.pop + \beta_{10}.(Exp \times pop)$	M6
$logit(y) = \beta_0 + \beta_3.Exp + \beta_4.pop$	M7
$logit(y) = \beta_0 + \beta_2.Exp + \beta_5.frag + \beta_{11}.(Exp \times frag)$	M8
$logit(y) = \beta_0 + \beta_3.Exp + \beta_5.frag$	M9
$logit(y) = \beta_0 + \beta_3.Exp + \beta_4.pop + \beta_5.frag + \beta_{10}.(Exp \times pop) + \beta_{11}.(Exp \times frag)$	M10
$logit(y) = \beta_0 + \beta_3.Exp + \beta_4.pop + \beta_5.frag + \beta_{10}.(Exp \times pop)$	M11
$logit(y) = \beta_0 + \beta_3.Exp + \beta_5.frag + \beta_4.pop + \beta_{11}.(Exp \times frag)$	M12
$logit(y) = \beta_0 + \beta_3.Exp + \beta_4.pop + \beta_5.frag$	M13
Dynamic	
$logit(y) = \beta_0 + \beta_2.(d_{t+1}-d_t)$	M14
$logit(y) = \beta_0 + \beta_2.(d_{t+1}-d_t) + \beta_4.pop + \beta_8.((d_{t+1}-d_t) \times pop)$	M15
$logit(y) = \beta_0 + \beta_2.(d_{t+1}-d_t) + \beta_4.pop$	M16
$logit(y) = \beta_0 + \beta_2.(d_{t+1}-d_t) + \beta_5.frag + \beta_9.((d_{t+1}-d_t) \times frag)$	M17
$logit(y) = \beta_0 + \beta_2.(d_{t+1}-d_t) + \beta_5.frag$	M18
$logit(y) = \beta_0 + \beta_2.(d_{t+1}-d_t) + \beta_4.pop + \beta_2.(d_{t+1}-d_t) + \beta_5.frag + \beta_8.((d_{t+1}-d_t) \times pop) + \beta_9.((d_{t+1}-d_t) \times frag)$	M19
$logit(y) = \beta_0 + \beta_2.(d_{t+1}-d_t) + \beta_4.pop + \beta_5.frag + \beta_8.((d_{t+1}-d_t) \times pop)$	M20
$logit(y) = \beta_0 + \beta_2.(d_{t+1}-d_t) + \beta_5.frag + \beta_4.pop + \beta_9.((d_{t+1}-d_t) \times frag)$	M21
$logit(y) = \beta_0 + \beta_2.(d_{t+1}-d_t) + \beta_4.pop + \beta_5.frag$	M22
Static	
$logit(y) = \beta_0 + \beta_1.d_t$	M23
$logit(y) = \beta_0 + \beta_1.d_t + \beta_4.pop + \beta_6.(d_t \times pop)$	M24
$logit(y) = \beta_0 + \beta_1.d_t + \beta_4.pop$	M25
$logit(y) = \beta_0 + \beta_2.d_t \times \beta_5.frag + \beta_7.(d_t \times frag)$	M26
$logit(y) = \beta_0 + \beta_1.d_t + \beta_5.frag$	M27
$logit(y) = \beta_0 + \beta_1.d_t + \beta_4.pop + \beta_2.d_t + \beta_5.frag + \beta_6.(d_t \times pop) + \beta_7.(d_t \times frag)$	M28
$logit(y) = \beta_0 + \beta_1.d_t + \beta_4.pop + \beta_5.frag + \beta_6.(d_t \times pop)$	M29
$logit(y) = \beta_0 + \beta_1.d_t + \beta_5.frag + \beta_4.pop + \beta_7.(d_t \times frag)$	M30
$logit(y) = \beta_0 + \beta_1.d_t + \beta_4.pop + \beta_5.frag$	M31

Table A2. Average percentage of extirpation (versus persistence) events across the eight time periods for each species (± SD) with *Nsites* indicating the total number of sites where either persistence or extirpation events have occurred for each species.

	Extirpations	*Nsites*
Abramis brama	28.06 ± 7.02	297
Alburnoides bipunctatus	11.99 ± 4.12	201
Alburnus alburnus	9.27 ± 3.04	381
Ameiurus melas	33.76 ± 17.06	163
Anguilla anguilla	8.04 ± 1.18	484
Barbatula barbatula	5.45 ± 1.7	579
Barbus barbus	7.84 ± 3.02	336
Barbus meridionalis	11.03 ± 12.23	43
Blicca bjoerkna	26.51 ± 11.25	244
Chondrostoma nasus	14.81 ± 6.37	197
Cottus gobio	5.87 ± 2.40	480
Cyprinus carpio	45.28 ± 15.59	289
Esox lucius	21.53 ± 7.36	366
Gasterosteus aculeatus	30.45 ± 14.02	191
Gobio gobio	4.47 ± 1.26	593
Gymnocephalus cernua	24.74 ± 8.45	224
Lepomis gibbosus	18.18 ± 7.07	354
Leuciscus leuciscus	16.38 ± 7.71	410
Lota lota	27.11 ± 6.88	69
Parachondrostoma toxostoma	29.32 ± 17.95	84
Perca fluviatilis	14.27 ± 4.17	468
Phoxinus phoxinus	6.38 ± 1.56	547
Pungitius pungitius	25.07 ± 9.84	146
Rutilus rutilus	7.08 ± 2.79	536
Salmo salar	14.45 ± 6.34	92
Salmo trutta	8.67 ± 2.39	590
Sander lucioperca	39.95 ± 10.38	180
Scardinius erythrophthalmus	36.05 ± 10.86	363
Squalius cephalus	3.43 ± 1.90	559
Telestes souffia	12.61 ± 7.92	77
Thymallus thymallus	28.75 ± 19.89	69
Tinca tinca	28.64 ± 10.01	358

Table A3. AIC weights of evidence for the species-specific models of extirpation dynamics. Asterisks indicate models for which the cumulative weights are ≥ 0.95 (N_{w95} = number of models) and bold the model with the highest support.

	Null	**Anthropogenic-only**			**Exposition**									**Dynamic**		
Species	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16
Abramis brama	0.120*	0.045*	0.045*	0.017*	0.126*	0.018*	0.047*	0.018*	0.047*	0.003	0.007	0.007	0.017*	0.044*	0.011*	0.016*
Alburnoides bipunctatus	**0.179***	0.081*	0.078*	0.030*	0.090*	0.014*	0.035*	0.024*	0.033*	0.004	0.005	0.009	0.013*	0.092*	0.013*	0.035*
Alburnus alburnus	0.015*	0.124*	**0.133***	0.049*	0.131*	0.018*	0.048*	0.019*	0.052*	0.003	0.007	0.007	0.019*	0.006	0.020*	0.047*
Ameiurus melas	0.045*	0.021*	0.026*	0.013*	**0.241***	0.040*	0.102*	0.061*	0.164*	0.011*	0.030*	0.028*	0.076*	0.017*	0.003	0.008
Anguilla anguilla	0.003	0.017*	0.025*	0.001	0.001	0.026*	0.007	0	0.011*	0.009	0.017*	0.003	0.005	0.001	**0.289***	0.006
Barbatula barbatula	0.010*	0.010*	0.025*	0.023*	0.110*	0.125*	**0.178***	0.029*	0.069*	0.021*	0.048*	0.028*	0.068*	0.004	0.025*	0.026*
Barbus barbus	**0.095***	0.069*	0.029*	0.023*	0.089*	0.065*	0.075*	0.017*	0.037*	0.012*	0.026*	0.013*	0.029*	0.064*	0.025*	0.045*
Barbus meridionalis	0.027*	0.088*	0.010	0.033*	**0.183***	0.042*	0.131*	0.109*	0.076*	0.021*	0.001	0.060*	0	0.010*	0.002	0.059*
Blicca bjoerkna	0.077*	0.071*	0.029*	0.026*	0.036*	0.052*	0.032*	0.005	0.014*	0.007	0.019*	0.004	0.012*	0.031*	0.012*	0.028*
Chondrostoma nasus	**0.153***	0.056*	0.098*	0.036*	0.062*	0.009*	0.023*	0.043*	0.040*	0.006	0.006	0.016*	0.015*	0.084*	0.012*	0.031*
Cottus gobio	0.032*	0.097*	0.013*	0.037*	0.044*	**0.173***	0.128*	0.018*	0.018*	0.078*	0.066*	0.049*	0.048*	0.015*	0.015*	0.038*
Cyprinus carpio	0.002	0.002	0.091*	**0.154***	0.001	0	0.001	0.013	0.033*	0.018*	0.047*	0.021*	0.057*	0.002	0.001	0.001
Esox lucius	0.042*	0.016*	0.023*	0.009*	0.022*	0.007	0.009*	0.005	0.012*	0.001	0.004	0.002	0.005	0.037*	0.012*	0.014*
Gasterosteus aculeatus	0.035*	0.049*	0.105*	**0.138***	0.013*	0.007	0.019*	0.023*	0.040*	0.011	0.020*	0.030*	0.053*	0.014*	0.008	0.019*
Gobio gobio	0.094*	0.043*	0.035*	0.015*	0.038*	0.014*	0.017*	0.005	0.014*	0.002	0.005	0.002	0.007	0.042*	0.010*	0.019*
Gymnocephalus cernua	0.110*	0.051*	**0.119***	0.052*	0.063*	0.011*	0.029*	0.041*	0.068*	0.007	0.011*	0.018*	0.030*	0.043*	0.008	0.020*
Lepomis gibbosus	0.044*	0.029*	0.016*	0.011*	0.038*	0.032*	0.025*	0.005	0.014*	0.005	0.012*	0.003	0.009*	0.017*	0.004	0.012*
Leuciscus leuciscus	0.023*	0.009*	0.008*	0.003	0.009*	0.002	0.003	0.003	0.003	0.001	0.001	0.001	0.001	0.009*	**0.339***	0.003
Lota lota	0.009*	0.012*	0.004	0.005	0.004	0.002	0.005*	0.001	0.002	0	0.001	0.001	0.002	0.004	0.004	0.005*
Parachondrostoma toxostoma	0.003	0.093*	0.001	0.035*	0.005	0.117*	**0.169***	0.001	0.002	0.016*	0.043*	0.023*	0.062*	0.001	0.015*	0.041*
Perca fluviatilis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phoxinus phoxinus	**0.154***	0.076*	0.057*	0.028*	0.096*	0.021*	0.056*	0.024*	0.036*	0.005	0.008	0.014*	0.021*	0.061*	0.036*	0.035*
Pungitius pungitius	0.003	0.001	0.002	0.001	0.007	0.001	0.003	0.002	0.004	0	0.001	0.001	0.002	0.002	0.001	0.001
Rutilus rutilus	**0.114***	0.065*	0.043*	0.025*	0.074*	0.026*	0.042*	0.014*	0.028*	0	0.010	0.008	0.016*	0.101*	0.024*	0.063*
Salmo salar	0.089*	0.100*	0.044*	0.045*	0.033*	0.015*	0.037*	0.007	0.016*	0.003	0.007	0.007	0.017*	0.035*	0.023*	0.039*
Salmo trutta	0.003	0.027*	0.017*	0.010	0.018*	0.039*	0.103*	0.006	0.007	0.014*	0.015*	0.037*	0.040*	0.017*	**0.175***	0.100*
Sander lucioperca	0.061*	0.041*	0.030*	0.018*	0.022*	0.006	0.015*	0.004	0.011*	0.001	0.003	0.002	0.007	0.023*	0.013*	0.015*
Scardinius erythrophthalmus	0.003	0.050*	0.006	0.071*	0.001	0.097*	0.020*	0.001	0.002	0.085*	**0.147***	0.014*	0.028*	0.001	0.057*	0.024*
Squalius cephalus	0.010	0.102*	0.090*	0.04*	0.004	0.025*	0.042*	0.018*	0.002	0.004	0.010*	0	0.017*	0.083*	0.001	0.038*
Telestes souffia	**0.167***	0.068*	0.062*	0.026*	0.066*	0.077*	0.027*	0.011*	0.025*	0.014*	0.029*	0.004	0.010	0.075*	0.016*	0.031*
Thymallus thymallus	0.079*	0.051*	**0.096***	0.065*	0.047*	0.013*	0.035*	0.032*	0.060*	0.008	0.017*	0.023*	0.047*	0.031*	0.008	0.019*
Tinca tinca	0.020*	0.104*	0.011*	0.046*	0.022*	0.054*	**0.129***	0.007	0.011*	0.014*	0.024*	0.034*	0.057*	0.008	0.052*	0.038*

Table A3. (continued)

	Dynamic						Static									
Species	M17	M18	M19	M20	M21	M22	M23	M24	M25	M26	M27	M28	M29	M30	M31	N_{w95}
Abramis brama	0.006	0.016*	0.001	0.004	0.002	0.006	**0.158***	0.031*	0.060*	0.022*	0.058*	0.004	0.011*	0.008	0.022*	21
Alburnoides bipunctatus	0.016*	0.034*	0.003	0.005	0.002	0.013*	0.081*	0.014*	0.028*	0.013*	0.030*	0.002	0.005	0.005	0.011*	22
Alburnus alburnus	0.037*	0.050*	0.006	0.008*	0.014*	0.019*	0.006	0.027*	0.046*	0.001	0.049*	0.004	0.011*	0.007	0.018*	22
Ameiurus melas	0.004	0.010*	0.001	0.002	0.002	0.005	0.027*	0.005	0.012*	0.012*	0.015*	0.003	0.003	0.006	0.007	19
Anguilla anguilla	0.005	0.009*	0.101*	0.197*	0.002	0.004	0.043*	0.020*	0.023*	0.029*	0.031*	0.04*	0.044*	0.015*	0.016*	18
Barbatula barbatula	0.004	0.011*	0.001	0.010	0.004	0.010*	0.010*	0.026*	0.062*	0.010	0.026*	0.004	0.010*	0.009	0.004	22
Barbus barbus	0.010*	0.020*	0.004	0.010	0.007	0.018*	0.051*	0.054*	0.037*	0.007	0.018*	0.008	0.022*	0.006	0.015*	25
Barbus meridionalis	0.001	0.014*	0	0.008	0.004	0.002	0.036*	0.002	0.033*	0.013*	0.023*	0	0.005	0.005	0.002	17
Blicca bjoerkna	0.004	0.012*	0.002	0.004	0.004	0.011	0.112*	**0.129***	0.092*	0.016*	0.043*	0.018*	0.048*	0.013*	0.035*	23
Chondrostoma nasus	0.020*	0.053*	0.003	0.008	0.007	0.019*	0.067*	0.009*	0.025*	0.023*	0.043*	0.003	0.006	0.009	0.016*	23
Cottus gobio	0.002	0.005	0.002	0.006	0.006	0.014*	0.012*	0.015*	0.037*	0.003	0.006	0.002	0.006	0.006	0.012*	21
Cyprinus carpio	0.027*	0.068*	0.034*	0.079*	0.043*	0.108*	0.001	0	0.001	0.021*	0.042*	0.012	0.025*	0.033*	0.064*	18
Esox lucius	0.007	0.020*	0.002	0.007	0.003	0.008*	**0.232***	0.038*	0.094*	0.092*	0.138*	0.016*	0.024*	0.039*	0.059*	21
Gasterosteus aculeatus	0.017*	0.045*	0.008	0.023*	0.022*	0.059*	0.013	0.018*	0.018*	0.015*	0.039*	0.020*	0.049*	0.020*	0.051*	26
Gobio gobio	0.007	0.015*	0.002	0.004	0.003	0.007	**0.225***	0.039*	0.097*	0.066*	0.083*	0.012*	0.015*	0.028*	0.036*	21
Gymnocephalus cernua	0.019*	0.047*	0.003	0.008	0.008	0.021*	0.049*	0.009	0.022*	0.024*	0.058*	0.004	0.010*	0.010*	0.025*	24
Lepomis gibbosus	0.002	0.006	0.001	0.002	0.002	0.004	0.049*	**0.360***	0.039*	0.008	0.018*	0.071*	0.139*	0.007	0.015*	19
Leuciscus leuciscus	0.006	0.003	0.201*	0.128*	0.002	0.001	0.078*	0.038*	0.030*	0.021*	0.029*	0.010*	0.014*	0.008	0.011*	16
Lota lota	0.001	0.001	0.001	0.001	0.001	0.002	0.003	0.003	0.005	0.345*	0.001	0.156*	0.001	**0.419***	0.002	7
Parachondrostoma toxostoma	0.001	0	0.006	0.006	0.016*	0.015*	0.002	0.093*	0.120*	0	0.001	0.014	0.034*	0.020*	0.045*	17
Perca fluviatilis	0	0	0	0	0	0	0	0.138*	**0.376***	0	0	0.036	0.094*	0.099*	0.256*	5
Phoxinus phoxinus	0.011*	0.023*	0.006	0.013*	0.006	0.014*	0.058*	0.037*	0.034*	0.009	0.022*	0.006	0.013*	0.006	0.013*	24
Pungitius pungitius	0.001	0.002	0	0	0	0.001	**0.253***	0.097*	0.115*	0.104*	0.177*	0.034*	0.059*	0.044*	0.080*	9
Rutilus rutilus	0.015*	0.042*	0	0.009	0.008	0.024*	0.082*	0.019*	0.052*	0.023*	0.031*	0.006	0.007	0.011*	0.020*	23
Salmo salar	0.007	0.018*	0.004	0.010*	0.007	0.018*	0.123*	**0.038***	0.102*	0.021*	0.054*	0.006	0.016*	0.017*	0.043*	23
Salmo trutta	0.002	0.006	0.026*	0.069*	0.014*	0.039*	0.001	0.016*	0.100*	0	0	0.023*	0.056*	0.015*	0.004	21
Sander lucioperca	0.006	0.011*	0.003	0.006	0.004	0.007	0.207*	**0.081***	0.152*	0.034*	0.090*	0.013*	0.032*	0.023*	0.061*	20
Scardinius erythrophthalmus	0.001	0.003	0.030*	0.081*	0.012*	0.032*	0.003	0.022*	0.060*	0.002	0.006	0.010	0.027*	0.028*	0.074*	19
Squalius cephalus	0.001	0.002	0.003	0.007	0.006	0.015*	0.042*	0.073*	0.019*	0.062*	**0.167***	0.011*	0.029*	0.003	0.075*	19
Telestes souffia	0.016*	0.028*	0.003	0.006	0.007	0.012*	0.070*	0.025*	0.029*	0.023*	0.026*	0.017*	0.009	0.009	0.011*	24
Thymallus thymallus	0.027*	0.036*	0.009	0.010	0.019*	0.024*	0.034*	0.026*	0.022*	0.017*	0.042*	0.018*	0.043*	0.011	0.030*	26
Tinca tinca	0.002	0.004	0.013*	0.023*	0.008	0.017*	0.019*	0.046*	0.124*	0.004	0.009	0.008	0.019*	0.021*	0.053*	23