

APPENDIX

Table A1: Principal Component Analysis (PCA) results showing the eigenvalues (λ_i), percentage of total variance explained, and component loadings for seven morphological traits measured, by lake.

Lake and PC axis	λ_i	Variance (%)	BM	BL	LJL	BW	GRL1	GRL2	GRN
MacNair									
PC1	3.760	53.7	0.482	0.479	0.454	0.481	0.231	0.217	0.007
PC2	1.748	25.0	-0.214	-0.213	0.012	-0.198	0.651	0.665	0.054
PC3	0.998	14.3	0.004	0.010	0.001	0.007	-0.064	-0.012	0.998
First									
PC1	4.427	63.2	-0.447	-0.443	-0.445	-0.445	-0.318	-0.317	-0.072
PC2	1.376	19.7	0.229	0.249	0.078	0.246	-0.595	-0.602	0.319
PC3	0.939	13.4	-0.131	-0.118	-0.067	-0.093	0.188	0.169	0.944

BM: body mass; BL: body length; LJL: lower jaw length; BW: body width; GRL1 and GRL2: length of two largest gill rakers; GRN: gill raker number.

Table A2: Linear and quadratic selection gradients (β and 2γ) for body size (PC1), gill raker length (PC2) and number (PC3), by lake.

Lake and Trait	β	SE (β)	t	P	2γ	2SE (γ)	t	P
MacNair								
PC1	-0.032	0.035	-0.896	0.371	-0.035	0.034	-1.056	0.292
PC2	-0.073	0.036	-2.057	0.041	0.023	0.061	0.372	0.710
PC3	0.000	0.036	0.004	0.997	-0.052	0.055	-0.941	0.348
First								
PC1	-0.059	0.025	-2.374	0.018	-0.067	0.046	-1.470	0.142
PC2	-0.062	0.031	-1.982	0.048	-0.048	0.040	-1.196	0.232
PC3	0.016	0.069	0.638	0.524	0.046	0.031	1.489	0.137

Note: For each trait in each lake we provide the least squares slope estimate, its standard error, and statistical significance. Values in bold indicate regression terms that are significantly different from 0 at $\alpha = 0.05$. Linear and quadratic gradients were estimated from different analyses.

Table A3: Linear selection gradients (β) for a regression model including body size (PC1), gill raker length (PC2) and number (PC3), and $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ stable isotopes, in MacNair.

Trait	β	SE (β)	t	P
PC1	-0.031	0.039	-0.806	0.421
PC2	-0.029	0.042	-0.686	0.494
PC3	-0.042	0.038	-1.118	0.265
$\delta^{13}\text{C}$	0.006	0.044	0.124	0.901
$\delta^{15}\text{N}$	-0.097	0.040	-2.406	0.017

Note: For each trait we provide the least squares slope estimate, its standard error, and statistical significance. Values in bold indicate regression terms that are significantly different from 0 at $\alpha = 0.05$.

Table A4: Regression analyses of $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ stable isotopes onto body size (PC1), gill raker length (PC2) and number (PC3), by lake.

Lake, dependent variable and PC axis	Slope	SE	<i>t</i>	<i>P</i>	Overall model			
					<i>F</i>	df	<i>P</i>	<i>r</i> ²
MacNair, $\delta^{13}\text{C}^*$					20.79	4,239	<0.001	0.258
PC1	0.269	0.060	4.450	<0.001				
PC2	-0.404	0.118	-3.431	<0.001				
PC3	0.035	0.117	0.297	0.766				
MacNair, $\delta^{15}\text{N}$					4.705	3,240	0.003	0.056
PC1	-0.002	0.023	-0.074	0.941				
PC2	0.126	0.034	3.756	<0.001				
PC3	-0.003	0.045	-0.059	0.953				
First, $\delta^{13}\text{C}^*$					56.32	4,424	<0.001	0.347
PC1	-0.425	0.042	-10.041	<0.001				
PC2	0.571	0.096	5.962	<0.001				
PC3	-0.287	0.092	-3.127	0.002				
First, $\delta^{15}\text{N}$					17.08	3,425	<0.001	0.108
PC1	-0.076	0.011	-6.657	<0.001				

Lake, dependent variable and PC axis	Slope	SE	<i>t</i>	<i>P</i>	Overall model			
					<i>F</i>	df	<i>P</i>	<i>r</i> ²
PC2	0.000	0.021	0.007	0.994				
PC3	0.065	0.025	2.630	0.009				

Note: For each trait in each lake we provide the least squares slope estimate, its standard error, and statistical significance. We also provide the statistical significance and coefficient of determination for the overall models. Values in bold indicate significance at $\alpha = 0.05$. *Sex included as a factor.

Figure A1: First and second relative warps derived from 23 landmarks on the left side of the fish in (A) First Lake and (B) McNair Lake. $PC1_{rw}$ summarizes variation in the curvature of the body (downward versus upward) and $PC2_{rw}$ in the depth of the body (deep versus streamlined body). The outlined form in the grid-plots is meant to facilitate the location of landmarks and does not represent the true outline of the fish. The first axis ($RW_1 = PC1$) represents concave-up or concave-down body shape; such bending variation is often discarded as noise generated by preservation. However, here we find this trait correlated with diet and growth rate suggesting that the bending is biologically real.

