Supplementary Tables

Table S1. Phenotypic traits used for analysis, the trait suites to which they were assigned, the abbreviations used for them in the text, and a brief description of each trait. Traits indicated with an * were excluded from all multidimensional analyses.

Assigned Trait Suite / Group	Trait	Abbreviation	Description	Support for Trait Suite Assignment
Defense	Lateral Plate Count	LP	The number of lateral plates, if the number differed on R and L sides, mean number was used	Reimchen (2000), Bell et al. (2004), Stuart et al. (2017)
	Mean Lateral Plate Position	LP_M	Mean plate position, calculated from position of first and last plates on both sides	Reimchen (1983)
	Pelvic Spine Length	PS_L	Mean length of both pelvic spines from base to tip of spine. If one was broken, only intact spine was used	Reimchen (2000), Stuart et al. (2017), Marques et al. (2018)
	First Dorsal Spine Length	$DS1_L$	From base to tip of spine	Stuart et al. (2017), Marques et al. (2018)
	Second Dorsal Spine Length	$DS2_L$	From base to tip of spine	Stuart et al. (2017), Marques et al. (2018)
Swimming	Standard Length	SL	Length from tip of snout to base of posterior-most caudal fin ray	Walker (1997), Stuart et al. (2017)
	Body Depth	BD	Measured from base of DS1 to anterior of pelvis	Walker (1997), Stuart et al. (2017)
	Caudal Peduncle Width	CP	Top to bottom of caudal peduncle at narrowest point	Walker (1997), Stuart et al. (2017)
Trophic	Jaw Length	JL	Tip of snout to posterior tip of maxilla	Reimchen and Nosil (2006), Marques et al. (2018)
	Gape Width	GW	Maximum width between tips of maxillae	McGee and Wainwright (2013), Stuart et al. (2017)
	Pterotic Width	PW	Measured at widest portion of posterior process	Anker (1974)
	Buccal Cavity Length	BC	Measured from tip of snout to anterior extent of ectocoracoid	Caldecutt and Adams (1998), Stuart et al. (2017)
	Gill Raker Count	GR	Count of gill rakers on distal row of 1st right branchial arch	Hendry and Taylor (2004), Berner et al. (2009), Stuart et al. (2017)
	Snout Length	SN	Measured from tip of snout to anterior edge of eye	Reimchen et al. (2016), Caldecutt and Adams (1998)
	Head Length	HL	Measured from tip of snout to the posterior margin of operculum	Reimchen et al. (2016), Caldecutt and Adams (1998)
	Eye Diameter	ED	Measured from anterior to posterior edge of eye	Reimchen and Nosil (2006), Reimchen et al. (2016)
Shape	Landmark 1		Tip of snout	
	Landmark 2		Posterior tip of maxilla	
	Landmark 3		Anterior edge of eye	
	Landmark 4		Posterior edge of eye	
	Landmark 5		Dorsal insertion of pectoral fin	
	Landmark 6		Ventral insertion of pectoral fin	
	Landmark 7		Anterior insertion of anal fin	
	Landmark 8		Ventral edge at narrowest point of caudal peduncle	
	Landmark 9		Insertion of ventral-most caudal fin ray	
	Landmark 10		Insertion of dorsal-most caudal fin ray	
	Landmark 11		Dorsal edge at narrowest point of caudal peduncle	
	Landmark 12		Anterior insertion of dorsal fin	
	Landmark 13		Base of first dorsal spine	

	8 Semi-landmarks		Evenly spaced between Landmarks 1 and 13
Environment	Surface Area	Area	hectares
	Maximum Depth	MaxDepth	meters
	Chlorophyll-a	Chl-a	μgL^{-1}
	Total Nitrogen	TN	mgL^{-1}
	Total Phosphorus	TP	μgL^{-1}
	Dissolved Calcium	Ca	mgL^{-1}
	Conductivity	Cond	$\mu S.cm^{-2}$
	Dissolved Organic Carbon	DOC	mgL^{-1}
	pH	pH	
	% Littoral Area	Litt.	
	Daphnia Abundance	*Daph.*	individuals L^{-1}
	Gammarid Abundance	Gamm.	individuals $(m^2)^{-1}$

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Table S2. Sample sizes for each lake and trait before interpolation of missing values (n_I) and the number of individuals for which values were interpolated (n_+). Values for some traits, particularly meristic traits, were not interpolated: LP, LP_M, and GR. Shape and LDA columns show sample sizes for each lake.

Lake	Defense										Swimming						Trophic																Shape	LDAs				
	LP		$DS1_L$		$DS2_L$		PS_L		LP_M		SL		BD		CP		BC		GW		PW		GR		JL		SN		ED		HL			Def	Swi	Tro		Shape
	n_I	n_+	n_I	n_+	n_I	n_+	n_I	n_+	n_I	n_+	n_I	n_+	n_I	n_+	n_I	n_+	n_I	n_+	n_I	n_+	n_I	n_+	n_I	n_+	n_I	n_+	n_I	n_+	n_I	n_+	n_I	n_+	n_I	n_+				w/GR	no GR	
Corcoran	21	-	21	-	21	-	21	-	21	-	41	-	41	-	41	-	41	-	19	22	19	22	19	-	41	-	41	-	41	-	41	-	41	21	41	19	41	41
Echo	28	-	24	3	27	-	28	-	28	-	28	-	28	-	27	1	28	-	11	17	11	17	11	-	27	-	27	-	27	-	27	-	27	27	28	10	27	27
Engineer	41	-	35	6	41	-	40	1	41	-	60	-	60	-	60	-	60	-	15	45	15	45	10	-	60	-	60	-	60	-	60	-	55	41	60	10	60	55
Finger	42	-	38	4	42	-	42	-	42	-	60	-	60	-	59	1	60	-	20	40	20	40	20	-	59	1	59	1	59	1	59	1	0	42	60	20	60	-
G	67	-	66	1	67	-	67	-	67	-	100	-	100	-	100	-	100	-	32	68	32	68	27	-	100	-	100	-	100	-	100	-	92	67	100	27	100	92
Jean	37	-	36	1	37	-	37	-	37	-	60	-	60	-	60	-	60	-	20	40	20	40	20	-	60	-	60	-	60	-	60	-	59	37	60	20	60	59
Long	32	-	31	1	31	1	32	-	32	-	64	-	64	-	63	1	64	-	25	38	25	39	25	-	62	1	62	1	63	-	62	1	33	32	64	25	63	33
Ruth	61	-	58	3	59	2	61	-	61	-	99	-	99	-	99	-	99	-	20	79	20	79	20	-	99	-	99	-	99	-	99	-	96	61	99	20	99	96
South Rolly	23	-	22	1	23	-	23	-	23	-	23	-	23	-	23	-	23	-	15	8	15	8	15	-	23	-	23	-	23	-	23	-	22	23	23	15	23	22
Spirit	37	-	33	4	36	1	36	1	37	-	50	-	50	-	50	-	50	-	22	28	22	28	18	-	50	-	50	-	50	-	50	-	47	37	50	18	50	47
Tern	25	-	23	2	25	-	25	-	25	-	37	-	37	-	37	-	37	-	33	4	33	4	23	-	37	-	37	-	37	-	37	-	36	25	37	23	37	36
Walby	44	-	43	1	44	-	44	-	44	-	60	-	60	-	59	1	60	-	24	35	24	35	23	-	59	-	59	-	59	-	59	-	0	44	60	23	59	-
Watson	56	-	53	3	55	1	56	-	56	-	60	-	60	-	60	-	60	-	24	36	24	36	19	-	60	-	60	-	60	-	60	-	59	56	60	19	60	59
Wik	38	-	34	4	38	-	38	-	38	-	50	-	50	-	50	-	50	-	17	33	17	33	17	-	50	-	50	-	50	-	50	-	49	38	50	17	50	49

Table S3. Proportion of variance explained by first five linear discriminant axes for each trait suite and the first three trait suites combined. Also included are the sample size of each LDA (*N*), and the effective dimensionality of trait divergence (n_D).

Trait Suite	LD1	LD2	LD3	LD4	LD5	Sum LDs 1-5	N

Defense	0.921	0.049	0.017	0.009	0.005	1	551
Swimming	0.675	0.256	0.069	NA	NA	1	792
Trophic	0.445	0.255	0.132	0.073	0.035	0.940	266
Trophic no GR	0.429	0.292	0.122	0.082	0.044	0.970	789
Shape	0.352	0.170	0.119	0.103	0.073	0.818	616
Total	0.690	0.104	0.078	0.040	0.032	0.945	241
Total Excluding GR	0.714	0.092	0.075	0.034	0.027	0.941	549

Table S4. Trait loadings on the first 5 discriminant axis in combined Defensive, Swimming, and Trophic trait linear discriminant analysis.

Trait	LD1	LD2	LD3	LD4	LD5
LP	-0.226	0.038	-0.016	0.245	0.327
$DS1_L$	0.458	0.366	0.352	0.476	0.406
$DS2_L$	0.610	1.430	0.491	0.540	-0.432
PS_L	-4.215	-0.438	0.282	-0.085	-0.544
LP_M	0.005	0.254	-0.460	0.196	0.285
SL	1.010	-1.736	0.631	0.098	0.409
BD	-0.310	0.908	-0.730	-0.381	-0.251
CP	0.058	-0.673	-1.008	2.174	-0.86
BC	-0.356	0.443	0.236	-0.315	-0.064
GW	-0.012	0.543	0.178	-0.886	0.448
PW	-0.033	0.139	-1.279	-0.223	-0.593
GR	-0.012	-0.193	0.342	0.138	-0.304
JL	0.248	-0.472	-0.120	-0.211	0.636
SN	0.330	0.295	0.890	-0.408	-0.68
ED	-0.347	-0.098	0.057	1.025	1.785
HL	-0.338	-0.540	0.578	-0.758	-0.953
Cumulative proportion	**0.690**	**0.794**	**0.872**	**0.912**	**0.944**

Table S5. Trait loadings in Defensive trait linear discriminant analysis.

Trait	LD1	LD2	LD3	LD4	LD5
PS_L	-3.698	0.034	-0.461	-0.044	0.142
LP	-0.079	0.010	1.092	0.395	-0.179
LP_M	0.003	0.030	-0.222	0.897	0.524
$DS1_L$	0.304	0.768	0.448	-0.705	1.648
$DS2_L$	0.474	0.553	-0.369	0.635	-1.766
Cumulative proportion	**0.921**	**0.970**	**0.986**	**0.995**	**1**

Table S6. Trait loadings in Swimming trait linear discriminant analysis

Trait	LD1	LD2	LD3
SL	-1.973	1.203	1.073
BD	2.285	-0.118	0.697
CP	-0.478	-1.940	-0.865
Cumulative proportion	**0.675**	**0.931**	**1**

Table S7. Trait loadings in Trophic trait linear discriminant analysis

Trait	LD1	LD2	LD3	LD4	LD5	LD6	LD7	LD8
BC	0.008	0.310	-0.226	-0.566	-1.379	-1.428	-0.230	-1.614
GW	0.389	-0.268	0.805	0.601	0.227	1.027	1.021	-1.203
PW	1.275	1.479	-0.628	0.934	-0.848	-0.328	-0.800	1.859
GR	-0.529	-0.063	0.290	0.126	-0.612	0.008	0.701	0.483
JL	-0.043	-0.267	-1.418	0.977	0.763	-0.800	0.699	-0.134
SN	-1.108	0.310	1.905	1.765	0.307	0.239	-1.565	0.312
ED	0.069	-2.184	-0.077	0.079	-0.653	0.377	-0.680	0.517

HL	-1.137	0.821	-1.115	-3.162	1.425	1.330	1.191	0.015
Cumulative proportion	**0.445**	**0.700**	**0.832**	**0.904**	**0.940**	**0.964**	**0.983**	**1**

Table S8. Correlations between primary axes of divergence in trait suites across populations. Sample sizes represent the overlap in the number of individuals with complete data from both trait suites in the comparison.

LDA primary axes	Pearson's *r*	p	Spearman's ρ	p	N
Defense x Swimming	-0.47	<.001	-0.42	<.001	551
Defense x Trophic	-0.21	0.001	-0.10	0.109	241
Defense x Shape	-0.61	<.001	-0.59	<.001	432
Swimming x Trophic	0.63	<.001	0.65	<.001	266
Swimming x Shape	0.71	<.001	0.72	<.001	616
Trophic x Shape	0.65	<.001	0.65	<.001	199

Table S9. Distance matrix correlations of standardized trait values calculated using mantel tests. All linear measurements were adjusted for size before Z-transformation except for standard length. All mantel tests used 5000 permutations.

Trait Suites	Pearson's *r*	p	Spearman's ρ	p
Defense x Swimming	0.121	<2e-04	0.112	<2e-04
Defense x Trophic	0.078	0.0046	0.082	<2e-04
Defense x Shape	0.033	0.1104	0.037	0.055
Swimming x Trophic	0.789	<2e-04	0.705	<2e-04
Swimming x Shape	0.115	<2e-04	0.124	<2e-04
Trophic x Shape	0.092	<2e-04	0.101	<2e-04

Table S10. Statistical results of two-block PLS correlation tests between trait suites within each lake. P-values are FDR-adjusted for multiple comparisons. Tests with adjusted p-values ≤ 0.05 are bold and italicized. Negative Z-scores indicate that trait suites are less integrated than would be expected given random associations of traits.

Lake	Defense x Swimming			Defense x Trophic			Defense x Shape			Swimming x Trophic			Swimming x Shape			Trophic x Shape		
	r-PLS	p	Z	r-PLS	p	Z	r-PLS	p	Z	r-PLS	p	Z	r-PLS	p	Z	r-PLS	p	Z
Corcoran	**0.719**	**0.003**	**3.00**	**0.775**	**0.021**	**2.40**	0.584	0.689	0.08	**0.949**	**0.001**	**6.07**	**0.619**	**0.003**	**2.99**	0.682	0.056	1.72
Echo	**0.837**	**0.002**	**4.91**	**0.868**	**0.021**	**2.40**	**0.794**	**0.006**	**3.24**	**0.986**	**0.001**	**3.80**	**0.839**	**0.002**	**4.22**	**0.949**	**0.012**	**2.69**
Engineer	**0.612**	**0.004**	**3.12**	0.708	0.427	0.43	0.502	0.379	0.74	**0.855**	**0.011**	**2.36**	**0.662**	**0.002**	**4.70**	**0.927**	**0.041**	**1.76**
Finger	**0.768**	**0.002**	**6.22**	**0.887**	**0.007**	**4.13**	-	-	-	**0.972**	**0.001**	**5.71**	-	-	-	-	-	-
G	**0.462**	**0.003**	**3.82**	**0.582**	**0.034**	**2.44**	0.337	0.689	-0.18	**0.910**	**0.001**	**6.49**	**0.656**	**0.002**	**6.93**	**0.849**	**0.012**	**3.68**
Jean	0.385	0.129	1.22	0.570	0.429	0.25	0.552	0.226	1.32	**0.912**	**0.001**	**5.27**	**0.770**	**0.002**	**6.29**	**0.767**	**0.034**	**2.07**
Long	**0.871**	**0.002**	**6.06**	**0.872**	**0.007**	**4.68**	0.795	0.362	0.99	**0.954**	**0.001**	**6.83**	**0.681**	**0.008**	**2.71**	**0.926**	**0.024**	**2.10**
Ruth	**0.776**	**0.002**	**7.27**	**0.711**	**0.021**	**2.63**	0.552	0.08	2.16	**0.988**	**0.001**	**6.34**	**0.686**	**0.002**	**7.32**	**0.772**	**0.035**	**1.91**
South Rolly	**0.693**	**0.003**	**3.38**	0.751	0.054	1.93	0.487	0.95	-1.10	**0.920**	**0.001**	**4.32**	**0.740**	**0.014**	**2.14**	0.821	0.055	1.54
Spirit	**0.426**	**0.048**	**2.24**	0.443	0.672	-0.49	0.384	0.689	-0.28	**0.899**	**0.001**	**5.05**	**0.726**	**0.002**	**5.33**	**0.804**	**0.024**	**2.66**
Tern	**0.914**	**0.002**	**5.50**	**0.836**	**0.014**	**3.31**	**0.770**	**0.006**	**3.70**	**0.971**	**0.001**	**7.01**	**0.764**	**0.002**	**4.83**	**0.716**	**0.031**	**2.91**
Walby	**0.613**	**0.004**	**4.26**	0.533	0.427	0.38	-	-	-	**0.924**	**0.001**	**5.72**	-	-	-	-	-	-
Watson	**0.709**	**0.002**	**6.20**	0.702	0.078	1.78	0.511	0.171	1.64	**0.955**	**0.001**	**5.47**	**0.518**	**0.012**	**2.50**	0.670	0.168	0.97
Wik	0.434	0.080	1.52	0.632	0.120	1.50	0.333	0.962	-1.71	**0.963**	**0.001**	**5.41**	**0.688**	**0.002**	**4.60**	**0.776**	**0.034**	**2.02**

Table S11. Results of complete modularity test, including partitions between defense, swimming, and trophic traits. CR is the mean of covariance ratios between assigned modules. P-values are FDR-adjusted for multiple comparisons.

Lake	CR	95% CI Lower	95% CI Upper	p	Z
Corcoran	**1.072**	**0.931**	**1.229**	**0.022**	**-1.108**
Echo	**1.083**	**0.932**	**1.358**	**0.041**	**-1.341**
Engineer	1.093	0.948	1.766	0.076	-1.039
Finger	**1.101**	**0.978**	**1.191**	**0.022**	**-0.939**
G	**0.869**	**0.742**	**1.052**	**0.017**	**-1.002**
Jean	**0.839**	**0.768**	**1.114**	**0.017**	**-2.092**
Long	**1.112**	**1.026**	**1.172**	**0.017**	**-1.461**
Ruth	**1.062**	**0.843**	**1.197**	**0.024**	**-1.211**
South_Rolly	**1.019**	**0.790**	**1.181**	**0.017**	**-1.881**
Spirit	**0.659**	**0.647**	**1.047**	**0.017**	**-2.351**
Tern	**1.100**	**1.026**	**1.179**	**0.017**	**-1.522**
Walby	**0.867**	**0.702**	**1.129**	**0.017**	**-2.378**
Watson	**0.995**	**0.823**	**1.180**	**0.017**	**-2.137**
Wik	**0.837**	**0.689**	**1.166**	**0.017**	**-2.552**

Table S12. Results of focused modularity tests for defense, swimming, and trophic trait suites when a single partition is set between the trait suite of interest and all other traits. P-values are FDR-adjusted to account for multiple comparisons, and significant adjusted p-values are indicated in bold typeface.

	Defense					Swimming					Trophic				
Lake	CR	95% CI lower	95% CI upper	p	Z	CR	95% CI lower	95% CI upper	p	Z	CR	95% CI lower	95% CI upper	p	Z
Corcoran	**0.959**	**0.767**	**1.246**	**0.002**	**-4.353**	1.150	1.071	1.194	0.281	-0.427	**1.020**	**0.915**	**1.128**	**0.038**	**-3.73**
Echo	**0.984**	**0.757**	**1.371**	**0.005**	**-3.514**	1.171	1.130	1.229	0.281	-0.473	1.139	1.069	1.173	0.806	0.806
Engineer	**0.974**	**0.767**	**1.340**	**0.019**	**-2.166**	1.188	1.088	1.888	0.399	-0.32	1.024	0.869	1.22	0.124	-1.716
Finger	**1.029**	**0.872**	**1.142**	**0.003**	**-2.901**	1.127	1.082	1.161	0.243	-0.543	1.095	1.054	1.133	0.270	-0.668
G	**0.701**	**0.521**	**0.968**	**0.001**	**-7.636**	1.121	1.036	1.200	0.243	-0.302	**1.017**	**0.906**	**1.106**	**0.038**	**-3.030**
Jean	**0.700**	**0.591**	**1.085**	**0.001**	**-4.394**	1.072	0.927	1.190	0.281	-0.714	1.012	0.864	1.183	0.177	-1.234
Long	**1.046**	**0.906**	**1.135**	**0.001**	**-2.993**	1.131	1.102	1.159	0.243	-0.726	**1.056**	**0.997**	**1.092**	**0.038**	**-2.998**
Ruth	**0.927**	**0.606**	**1.120**	**0.001**	**-4.568**	1.179	1.167	1.207	0.302	-0.457	1.120	1.083	1.151	0.683	0.350
South_Rolly	**0.931**	**0.645**	**1.160**	**0.001**	**-4.319**	1.115	0.999	1.172	0.243	-0.815	1.079	0.980	1.133	0.177	-1.362
Spirit	**0.420**	**0.398**	**0.978**	**0.001**	**-8.984**	1.067	0.982	1.191	0.243	-0.657	**0.982**	**0.780**	**1.115**	**0.038**	**-3.042**
Tern	**1.014**	**0.913**	**1.115**	**0.002**	**-4.197**	1.156	1.127	1.179	0.281	-0.557	1.071	1.010	1.114	0.067	-2.690
Walby	**0.730**	**0.533**	**1.097**	**0.001**	**-5.574**	1.092	0.948	1.138	0.243	-0.691	1.058	0.932	1.124	0.219	-0.941
Watson	**0.870**	**0.656**	**1.111**	**0.001**	**-5.699**	1.144	1.066	1.206	0.281	-0.504	1.076	1.005	1.149	0.216	-0.985
Wik	**0.654**	**0.443**	**1.130**	**0.001**	**-8.787**	1.146	0.992	1.180	0.243	-0.621	1.112	0.956	1.153	0.177	-1.226

Table S13. Results of complete modularity test, including partitions between defense, swimming, trophic and shape traits. CR is the mean of covariance ratios between assigned modules. P-values are FDR-adjusted for multiple comparisons.

Lake	CR	95% CI lower	95% CI upper	p	Z
Corcoran	**0.842**	**0.820**	**1.063**	**0.006**	**-1.861**
Echo	0.982	0.900	1.193	0.053	-1.353
Engineer	1.010	0.934	1.535	0.084	-1.113
G	**0.791**	**0.727**	**0.963**	**0.002**	**-1.496**
Jean	**0.764**	**0.753**	**1.044**	**0.001**	**-2.268**
Long	**0.943**	**0.885**	**1.150**	**0.029**	**-1.663**
Ruth	**0.870**	**0.758**	**1.024**	**0.029**	**-1.395**
South_Rolly	**0.928**	**0.802**	**1.095**	**0.029**	**-1.468**
Spirit	**0.717**	**0.709**	**1.016**	**0.001**	**-2.731**
Tern	0.977	0.873	1.102	0.053	-1.393
Watson	**0.804**	**0.753**	**1.048**	**0.005**	**-1.709**
Wik	**0.783**	**0.709**	**1.053**	**0.002**	**-2.254**

Table S14**.** Results of focused modularity tests for Defense, Swimming, Trophic, and Shape traits when a single partition is set between the trait suite of interest and all other traits. P-values are FDR-adjusted to account for multiple comparisons, and significant adjusted p-values are indicated in bold typeface.

	Defense					Swimming					Trophic					Shape				
Lake	CR	95% CI lower	95% CI upper	p	Z	CR	95% CI lower	95% CI upper	p	Z	CR	95% CI lower	95% CI upper	p	Z	CR	95% CI lower	95% CI upper	p	Z
Corcoran	0.905	0.790	1.408	0.091	-1.564	0.779	0.664	1.001	0.055	-1.411	**0.696**	**0.619**	**0.930**	**0.001**	**-4.798**	**0.587**	**0.559**	**0.917**	**< 0.001**	**-10.25**
Echo	0.982	0.840	1.352	0.154	-1.069	1.025	0.901	1.158	0.218	-0.779	0.945	0.848	1.052	0.051	-1.848	**0.838**	**0.746**	**1.023**	**< 0.001**	**-5.719**
Engineer	1.004	0.859	1.355	0.226	-0.851	1.061	0.899	1.929	0.268	-0.64	**0.851**	**0.771**	**1.101**	**0.006**	**-2.924**	**0.863**	**0.836**	**1.039**	**0.001**	**-4.054**
G	**0.702**	**0.608**	**0.997**	**0.002**	**-3.228**	0.896	0.761	1.026	0.13	-0.733	**0.846**	**0.763**	**0.954**	**0.008**	**-3.065**	**0.797**	**0.720**	**0.931**	**< 0.001**	**-6.082**
Jean	0.879	0.771	1.272	0.067	-1.764	**0.709**	**0.643**	**0.965**	**0.034**	**-1.619**	**0.772**	**0.716**	**0.992**	**0.002**	**-3.945**	**0.762**	**0.725**	**0.966**	**< 0.001**	**-6.563**
Long	0.952	0.838	1.175	0.111	-1.406	0.931	0.778	1.111	0.130	-1.159	**0.899**	**0.799**	**1.072**	**0.016**	**-2.563**	**0.772**	**0.707**	**1.032**	**< 0.001**	**-7.124**
Ruth	0.983	0.803	1.144	0.259	-0.708	1.084	0.936	1.135	0.349	-0.497	0.827	0.686	0.954	0.064	-1.944	**0.580**	**0.519**	**0.790**	**< 0.001**	**-8.420**
South_Rolly	0.908	0.765	1.194	0.083	-1.642	0.936	0.797	1.061	0.131	-0.971	**0.863**	**0.776**	**0.995**	**0.010**	**-2.836**	**0.798**	**0.732**	**0.955**	**< 0.001**	**-5.967**

Spirit	**0.638**	**0.570**	**1.126**	**0.002**	**-4.009**	0.795	0.675	1.071	0.055	-1.478	**0.803**	**0.726**	**0.976**	**0.002**	**-3.847**	**0.757**	**0.712**	**0.946**	**< 0.001**	**-7.230**
Tern	1.057	0.968	1.135	0.251	-0.586	1.076	0.953	1.123	0.268	-0.608	**0.863**	**0.712**	**1.010**	**0.017**	**-2.832**	**0.761**	**0.591**	**0.977**	**< 0.001**	**-8.224**
Watson	**0.801**	**0.733**	**1.229**	**0.033**	**-1.94**	0.797	0.672	1.016	0.056	-1.145	**0.619**	**0.562**	**0.871**	**0.001**	**-4.732**	**0.541**	**0.527**	**0.858**	**< 0.001**	**-9.314**
Wik	**0.679**	**0.561**	**1.145**	**0.002**	**-3.294**	0.989	0.776	1.093	0.218	-0.823	**0.817**	**0.674**	**0.983**	**0.006**	**-3.343**	**0.741**	**0.643**	**0.939**	**< 0.001**	**-7.398**

Table S15. Eigenvalues, singular values, lake values of principal components, and PC loadings for an environmental PCA including only physico-chemical environmental variables.

	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9
Eigenvalues	4.528	1.57	1.373	0.754	0.306	0.257	0.131	0.073	0.007
Proportion Explained	0.503	0.174	0.153	0.084	0.034	0.029	0.015	0.008	0.001
Corcoran	-0.419	-0.093	0.28	-0.447	0.197	0.018	0.024	-0.091	0.202
Engineer	-0.052	0.296	0.419	0.59	-0.017	-0.304	-0.264	-0.359	0.08
Finger	-0.365	0.511	-0.161	0.121	0.295	0.12	0.519	0.126	-0.197
G	0.414	-0.308	0.178	0.112	0.39	-0.207	0.389	0.274	0.313
Jean	-0.256	-0.07	-0.571	-0.072	0.202	-0.368	-0.457	0.089	0.266
Long	0.115	-0.233	0.044	-0.188	-0.203	-0.011	0.219	-0.465	0.203
South_Rolly	0.324	0.171	0.103	-0.187	-0.175	-0.377	-0.14	0.464	-0.379
Spirit	0.265	0.45	-0.098	-0.107	-0.372	0.414	-0.086	0.147	0.506
Tern	-0.192	-0.466	-0.241	0.524	-0.325	0.244	0.092	0.217	-0.061
Walby	-0.223	-0.1	0.097	-0.242	-0.49	-0.201	0.162	-0.062	-0.293
Watson	-0.031	-0.174	0.343	-0.052	0.274	0.531	-0.436	0.149	-0.25
Wik	0.42	0.017	-0.395	-0.052	0.225	0.141	-0.022	-0.488	-0.39
Area	0.001	0.673	-0.262	0.436	-0.072	0.42	0.151	-0.116	0.265
Max Depth	0.231	0.347	-0.584	-0.273	0.166	-0.176	-0.403	0.281	-0.332
DOC	0.056	0.516	0.575	-0.201	-0.459	-0.209	-0.08	0.314	-0.021
TP	-0.369	0.107	0.392	0.148	0.474	0.353	-0.517	0.046	-0.24
TN	-0.34	-0.125	-0.166	0.66	-0.374	-0.375	-0.178	0.133	-0.276
Chl-a	-0.38	0.328	0.02	-0.059	0.437	-0.639	0.188	-0.27	0.191
Cond.	-0.441	0.058	-0.1	-0.198	0.026	0.22	0.611	0.35	-0.456
pH	-0.404	0.057	-0.162	-0.401	-0.442	0.147	-0.237	-0.599	-0.124
Ca	-0.435	-0.139	-0.205	-0.187	-0.079	0.073	-0.209	0.485	0.651

Table S16. Eigenvalues, singular values, lake values of principal components, and PC loadings for an environmental PCA including physico-chemical and foraging-associated environmental variables.

	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8
Eigenvalues	5.545	2.506	1.805	0.948	0.558	0.371	0.213	0.054
Proportion Explained	0.462	0.209	0.15	0.079	0.046	0.031	0.018	0.004
Finger	0.324	-0.674	0.129	0.023	0.319	0.1	0.443	0.067
Jean	0.291	-0.245	-0.518	-0.221	-0.494	0.206	-0.372	0.046
Long	-0.045	0.296	-0.074	0.311	-0.193	-0.096	0.285	0.755
South_Rolly	-0.362	0.054	-0.247	0.583	0.169	0.457	-0.036	-0.34
Spirit	-0.396	-0.259	0.115	-0.076	0.343	-0.365	-0.584	0.234
Tern	0.386	0.535	-0.232	-0.293	0.552	-0.025	-0.014	-0.093
Walby	0.323	0.083	0.258	0.382	-0.293	-0.551	-0.058	-0.415
Watson	-0.003	0.186	0.705	-0.243	-0.191	0.494	-0.135	0.014
Wik	-0.517	0.025	-0.135	-0.466	-0.211	-0.219	0.47	-0.268
Area	-0.075	-0.493	-0.033	-0.265	0.685	-0.26	0.052	0.218
Max Depth	-0.266	-0.344	-0.37	-0.152	-0.187	-0.018	-0.196	-0.507
DOC	-0.17	-0.199	0.33	0.699	0.249	-0.037	-0.451	-0.237
TP	0.279	-0.138	0.433	-0.15	0.059	0.648	-0.116	0.087
TN	0.384	0.076	-0.225	-0.169	0.238	-0.014	-0.122	-0.51
Chl-a	0.271	-0.452	-0.065	0.152	-0.192	0.155	0.308	-0.173
Cond.	0.382	-0.249	0.09	0.009	0.147	-0.091	0.191	0.01
pH	0.359	-0.17	0.014	0.066	-0.362	-0.535	-0.324	0.358
Ca	0.404	-0.075	-0.073	-0.13	-0.132	0.079	-0.449	-0.046
Daph.	-0.267	-0.018	0.387	-0.56	-0.073	-0.073	-0.376	-0.062
Gamm.	0.197	0.418	-0.36	0.068	0.394	0.094	-0.296	0.129
% littoral area	0.219	0.313	0.467	-0.061	0.082	-0.414	0.246	-0.438

Table S17. Results of two-block PLS tests of phenotypic trait groups against environmental variables. Adjusted p-values are adjusted for multiple comparisons using the FDR method. Because diet-related environmental variables were available for only eight lakes, statistics are shown from PLS tests including all environmental variables on the left, and those including physico-chemical environmental variables only on the right.

	All Env. Variables				Physico-chemical Env. Variables			
	r_{PLS}	p	Z	adj. p	r_{PLS}	p	Z	adj. p
Defense	0.852	0.096	1.259	0.144	0.821	0.044	1.632	0.066
Swimming	0.904	0.049	1.463	0.144	0.822	0.031	1.922	0.066
Trophic	0.787	0.298	0.639	0.298	0.544	0.698	-0.523	0.698
All traits	0.893	0.066	1.412	NA	0.799	0.096	1.337	NA

Table S18. Singular values, eigenvalues, and vector loadings of environmental variables and stickleback traits in Two-Block PLS correlations between environmental and trait suite data. PLS correlation is calculated using singular value decomposition rather than eigen decomposition of matrices, but because singular values are square roots of eigenvalues, eigenvalues are provided for comparison with LDA and RDA results for which eigenvalues are provided.

	Dim1	Dim2	Dim3	Dim4	Dim5	Dim1	Dim2	Dim3	Dim1	Dim2	Dim3	Dim4	Dim5	Dim6	Dim7	Dim8
Singular Values	2.258	1.023	0.531	0.363	0.022	1.464	0.821	0.092	2.357	0.778	0.302	0.276	0.211	0.111	0.072	0.016
SV^2	5.098	1.046	0.282	0.132	0	2.143	0.674	0.008	5.554	0.605	0.091	0.076	0.044	0.012	0.005	0
Area	-0.321	0.602	0.394	0.276	-0.237	-0.056	0.149	-0.038	-0.179	0.322	0.14	0.629	-0.285	0.401	0.376	0.258
Max_Depth	-0.434	0.452	-0.084	-0.039	0.509	0.22	0.31	-0.092	0.296	0.115	-0.443	0.443	-0.299	-0.552	-0.006	-0.228
DOC	-0.105	-0.052	0.499	-0.578	-0.477	0.08	0.176	-0.19	0.06	0.406	0.007	0.365	0.776	-0.041	-0.299	-0.005
TP	0.347	-0.102	0.69	0.439	0.273	-0.415	-0.173	-0.3	-0.472	-0.231	0.369	0.141	0.245	-0.489	0.46	-0.217
TN	0.381	0.241	-0.22	0.118	-0.224	-0.357	-0.544	-0.297	-0.307	-0.469	0.107	0.41	-0.147	0.199	-0.61	-0.267
ChlA	0.304	0.001	0.199	-0.383	0.521	-0.289	-0.363	0.604	-0.055	-0.494	-0.659	0.137	0.34	0.246	0.328	0.113
Cond.	0.366	0.287	-0.106	-0.084	-0.049	-0.479	0.411	0.494	-0.504	0.301	-0.28	-0.236	0.024	0.125	-0.096	0.011
pH	0.224	0.417	0.037	-0.451	0.123	-0.335	0.408	-0.082	-0.313	0.327	-0.274	-0.115	-0.098	0.122	0.084	-0.646
Ca	0.395	0.326	-0.109	0.157	-0.209	-0.466	0.239	-0.401	-0.452	0.059	-0.221	-0.011	-0.137	-0.404	-0.250	0.578
LP	0.411	0.485	-0.769	0.041	-0.056											
$DS1_L$	0.413	-0.533	-0.174	-0.138	0.704											
$DS2_L$	0.497	-0.496	-0.003	-0.149	-0.697											
PS_L	0.519	0.483	0.552	-0.424	0.115											
LP_M	0.379	0.043	0.273	0.882	0.050											
SL						0.672	-0.413	0.615								
BD						-0.539	-0.842	0.022								
CP						0.508	-0.346	-0.789								
BC									0.378	-0.216	0.421	-0.506	0.499	-0.239	0.19	0.188
GW									-0.037	-0.632	-0.662	-0.096	0.043	-0.036	0.384	0.024
PW									0.111	-0.622	0.364	0.124	-0.234	0.532	-0.29	0.175
GR									0.444	0.352	-0.305	-0.248	0.14	0.705	0.086	-0.033
JL									0.46	0.084	0.083	0.652	-0.071	-0.094	0.468	0.34
SN									0.464	0.037	-0.278	-0.25	-0.477	-0.356	-0.437	0.314
ED									0.235	-0.122	-0.234	0.412	0.606	-0.104	-0.546	-0.17
HL									0.406	-0.139	0.141	0.007	-0.274	-0.123	0.128	-0.83

Table S19. Singular values, eigenvalues, and vector loadings of environmental variables and the traits in defensive, swimming, and trophic trait suites in Two-Block PLS correlations between environmental and trait data.

	Dim1	Dim2	Dim3	Dim4	Dim5	Dim6	Dim7	Dim8	Dim9
Singular Values	3.434	1.55	0.813	0.735	0.51	0.285	0.162	0.1	0.04
SV^2	11.793	2.401	0.661	0.54	0.26	0.081	0.026	0.01	0.002
Area	-0.026	0.654	0.509	-0.299	-0.047	0.147	-0.354	0.031	-0.272
Max_Depth	-0.34	0.385	0.286	0.392	-0.161	-0.415	0.395	0.118	0.365
DOC	-0.089	0.149	-0.299	-0.238	-0.649	0.446	0.35	0.285	0.001
TP	0.431	-0.06	0.153	-0.647	-0.145	-0.436	0.239	-0.158	0.274
TN	0.369	-0.202	0.569	0.199	0.113	0.55	0.259	0.06	0.272
ChlA	0.206	-0.332	0.26	0.304	-0.666	-0.245	-0.375	0.093	-0.185
Cond.	0.465	0.305	-0.315	0.139	0.1	-0.043	-0.355	0.503	0.426
pH	0.299	0.346	-0.228	0.291	-0.212	0.139	-0.019	-0.76	0.108
Ca	0.454	0.186	-0.069	0.211	0.135	-0.184	0.452	0.19	-0.646
LP	0.277	0.01	0.069	0.752	0.451	0.28	0.12	0.091	-0.005
$DS1_L$	0.202	-0.497	-0.394	-0.015	0.058	0.02	-0.026	0.052	0.19
$DS2_L$	0.261	-0.501	-0.4	-0.072	-0.052	0.083	0.04	0.05	-0.087
PS_L	0.368	0.046	0.025	0.193	-0.636	0.162	0.164	-0.49	-0.045
LP_M	0.253	-0.14	0.11	-0.207	0.225	-0.382	0.265	0.074	-0.539
SL	-0.278	-0.241	0.135	-0.141	0.128	0.336	-0.265	0.066	0.117
BD	0.237	-0.307	0.543	-0.07	-0.166	0.265	-0.262	0.133	-0.116
CP	-0.208	-0.184	0.143	-0.159	0.15	0.348	0.377	-0.243	-0.382
BC	-0.237	-0.286	-0.088	0.001	-0.012	-0.131	0.089	-0.221	0.175
GW	0.059	-0.232	0.284	0.25	-0.157	-0.564	-0.276	0.089	-0.041
PW	-0.051	-0.283	0.374	0.02	0.137	-0.017	-0.06	-0.239	0.147
GR	-0.303	-0.032	-0.279	0.249	-0.197	0.153	-0.503	0.02	-0.518
JL	-0.315	-0.079	0.098	0.104	-0.226	0.038	0.302	0.126	-0.177
SN	-0.305	-0.139	-0.081	0.351	0.027	-0.234	0.112	-0.099	-0.182

ED	-0.147	-0.129	0.073	0.122	-0.368	0.071	0.385	0.638	0.174
HL	-0.265	-0.188	0.073	0.155	0.016	-0.134	0.116	-0.336	0.272

Table S20. Singular values, eigenvalues, and vector loadings of environmental variables and stickleback traits in Two-Block PLS correlations between environmental and trait suite data. PLS correlation is calculated using singular value decomposition rather than eigen decomposition of matrices, but because singular values are square roots of eigenvalues, eigenvalues are provided for comparison with LDA and RDA results for which eigenvalues are provided.

	Dim1	Dim2	Dim3	Dim4	Dim5	Dim1	Dim2	Dim3	Dim1	Dim2	Dim3	Dim4	Dim5	Dim6	Dim7	Dim8
Singular Values	3.119	1.004	0.717	0.172	0.043	1.676	1.209	0.192	3.468	1.247	0.508	0.41	0.32	0.096	0.061	0.003
SV^2	9.725	1.008	0.514	0.03	0.002	2.809	1.461	0.037	12.024	1.554	0.259	0.168	0.103	0.009	0.004	0
Area	-0.306	0.491	-0.232	-0.499	-0.11	-0.012	-0.198	0.009	-0.131	0.077	0.035	-0.302	0.732	0.39	0.305	0.123
Max_Depth	-0.366	0.131	-0.232	0.003	0.052	0.287	0.227	0.122	0.424	-0.176	-0.257	-0.097	0.332	-0.283	-0.12	-0.455
DOC	-0.13	-0.34	0.094	-0.721	0.04	0.135	-0.474	0.008	-0.04	0.587	0.534	-0.181	0.208	-0.274	-0.396	-0.217
TP	0.198	0.187	0.56	-0.037	-0.613	-0.405	-0.238	0.146	-0.474	-0.074	0.102	-0.301	-0.135	-0.551	0.322	0.172
TN	0.365	0.457	-0.191	-0.022	0.099	-0.417	0.26	0.202	-0.251	-0.472	0.042	-0.224	0.068	0.076	-0.15	-0.495
ChlA	0.209	-0.162	0.104	-0.188	-0.154	-0.279	0.098	-0.459	-0.029	-0.235	0.21	0.393	0.234	-0.321	0.248	-0.139
Litt_Area	0.215	0.057	0.309	0.065	0.606	-0.318	-0.439	-0.154	-0.54	0.239	-0.151	0.27	-0.169	0.295	-0.049	-0.501
Cond.	0.26	0.116	0.096	-0.28	0.042	-0.401	-0.071	-0.201	-0.316	-0.135	0.16	0.217	0.263	0.06	0.092	0.037
pH	0.135	0.009	0.093	-0.259	0.402	-0.204	-0.02	0.121	-0.117	-0.055	-0.058	0.385	0.24	0.061	-0.494	0.368
Ca	0.287	0.283	0.14	-0.168	0.08	-0.398	0.129	0.389	-0.24	-0.342	-0.035	0.003	0.13	-0.223	-0.458	0.185
Daph.	-0.469	0.456	0.449	0.126	0.149	0.109	-0.437	0.596	-0.226	0.238	-0.677	-0.294	0.113	-0.178	-0.142	0.078
Gamm.	0.323	0.226	-0.434	0.031	-0.127	-0.098	0.382	0.357	0	-0.288	0.282	-0.465	-0.22	0.322	-0.253	0.093
LP	0.503	0.21	-0.834	0.02	0.084											
$DS1_L$	0.527	-0.295	0.197	0.502	-0.586											
$DS2_L$	0.565	-0.178	0.368	-0.006	0.717											
PS_L	0.343	-0.034	0.142	-0.855	-0.359											
LP_M	0.178	0.914	0.332	0.125	-0.082											
SL						0.59	0.498	-0.635								
BD						-0.652	0.758	-0.011								
CP						0.476	0.421	0.772								
BC									0.339	0.036	-0.182	0.067	-0.608	-0.05	0.247	-0.643
GW									0.163	-0.701	0.081	0.231	0.423	-0.183	0.422	-0.175
PW									0.144	-0.556	-0.22	0.065	-0.238	0.608	-0.416	0.131
GR									0.367	0.385	0.279	0.607	0.185	0.463	0.144	0.044
JL									0.501	0.165	-0.296	-0.6	0.443	0.241	0.079	-0.112
SN									0.413	0.036	-0.116	0.274	0.178	-0.5	-0.668	-0.105
ED									0.369	-0.146	0.796	-0.358	-0.232	-0.072	-0.091	0.114
HL									0.38	-0.006	-0.315	0.072	-0.28	-0.257	0.326	0.707

Table S21. Singular values, eigenvalues, and vector loadings of environmental variables and the traits in defensive, swimming, and trophic trait suites in Two-Block PLS correlations between environmental and trait data. Seven dimensions with singular values <0.0001 are excluded from this table.

	Dim1	Dim2	Dim3	Dim4	Dim5	Dim6	Dim7	Dim8
Singular Values	4.37	2.788	1.409	0.645	0.53	0.347	0.176	0.07
SV^2	19.092	7.773	1.986	0.417	0.281	0.12	0.031	0.005
Area	0.045	-0.36	0.409	0.379	0.563	-0.154	-0.264	-0.245
Max_Depth	0.431	0.08	0.372	-0.194	0.182	0.074	0.167	0.513
DOC	0.064	-0.276	-0.52	0.337	0.408	0.351	0.399	0.271
TP	-0.421	-0.224	0.054	-0.153	-0.083	0.678	-0.247	-0.067
TN	-0.367	0.208	0.39	0.204	0.046	-0.01	0.056	0.489
ChlA	-0.146	0.194	-0.054	-0.437	0.419	0.071	-0.199	0.143
Litt_Area	-0.442	-0.325	-0.219	0.05	-0.168	-0.498	-0.05	0.427
Cond.	-0.35	-0.013	0.031	-0.085	0.335	-0.126	-0.082	-0.085
pH	-0.154	0.024	-0.017	-0.213	0.185	-0.277	0.548	-0.358
Ca	-0.324	0.11	0.246	-0.151	0.062	0.145	0.501	-0.099
Daph	0.072	-0.644	0.366	-0.124	-0.299	0.065	0.248	0.005
Gama	-0.15	0.352	0.152	0.597	-0.177	0.128	0.134	-0.11
LP	-0.249	0.435	0.061	0.633	0.124	-0.463	0.014	0.296
$DS1_L$	-0.293	0.337	-0.365	-0.163	-0.257	0.115	-0.158	-0.041
$DS2_L$	-0.34	0.313	-0.336	-0.189	-0.182	0.1	0.202	0.056
PS_L	-0.211	0.186	-0.162	0.012	0.149	0.158	0.269	-0.168
LP_M	-0.193	-0.023	0.486	0.119	-0.202	0.104	0.287	-0.027
SL	0.238	0.172	-0.001	0.173	-0.29	-0.158	-0.532	-0.299
BD	-0.211	0.343	0.348	-0.202	0.204	0.047	-0.039	-0.366
CP	0.191	0.125	0.101	0.242	-0.424	0.075	0.365	-0.536
BC	0.244	0.18	-0.072	-0.111	-0.341	-0.028	-0.078	0.244
GW	0.051	0.306	0.362	-0.343	0.313	0	-0.214	0.008
PW	0.053	0.248	0.305	-0.226	-0.208	-0.16	-0.034	0.08
GR	0.285	0.113	-0.341	-0.051	0.354	-0.404	0.099	-0.43
JL	0.391	0.167	0.049	0.165	0.059	0.177	0.249	0.171
SN	0.299	0.206	-0.048	-0.225	0.128	-0.124	0.445	0.184
ED	0.231	0.305	-0.074	0.304	0.25	0.673	-0.197	0.044
HL	0.276	0.194	0.002	-0.198	-0.228	-0.068	0.016	0.228