APPENDIX D

DETAILS OF MODELS OF RIPARIAN BIODIVERSITY AND COMMUNITY DIVERSITY

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Lentic Riparian Areas with High Biodiversity

Aquatic/Riparian Bird Species Richness

Manley and Schlesinger (in prep) detected 41 aquatic/riparian bird species. The best model predicting species richness of aquatic/riparian birds consisted of 9 variables ($F_{9,78} = 24.07$, $P < 0.0001$, adj. $R^2 = 0.70$) (Table D-1).

Table D-1—The best multiple linear regression model used to predict aquatic/riparian/meadow bird species richness around lentic systems in the Lake Tahoe basin. All variables were measured within 200 m of each site, except elevation, measured at the lake or meadow surface, and lentic area.

Variable	B	SE B	Beta	T	Sig T
Elevation (m)	-0.005	0.001	-0.506	-4.955	< 0.0001
Lentic area[a]	0.249	0.087	0.182	2.870	0.0053
Slope	-0.052	0.019	-0.209	-2.826	0.0060
Wooded riparian[b]	2.820	1.180	0.150	2.389	0.0193
Mixed conifer[a]	-1.257	1.257	-0.106	-1.000	0.3202
Meadow[b]	5.307	0.973	0.351	5.453	< 0.0001
Precipitation (cm)	-0.015	0.006	-0.187	-2.342	0.0217
Shrubs[b]	-2.031	0.744	-0.172	-2.731	0.0078
Canopy cover	-0.039	0.013	-0.252	-2.954	0.0041
Intercept	17.910	2.256		7.938	< 0.0001

Notes:
[a] ln (x) or ln (x + 1) transformation applied
[b] Square root transformation applied

The following equation was used to predict aquatic/riparian/meadow bird species richness:

$$ABR' = 17.910 + (-0.005 * \textit{elevation [m]}) + (0.249 * \ln[\textit{lentic area (ha)}]) + (-0.052 * \textit{slope}) + (2.820 * \sqrt{\textit{woodedriparian}}) + (-1.257 * \ln[\textit{mixed conifer}]) + (5.307 * \sqrt{\textit{meadow}}) + (-0.015 * \textit{precipitation [cm]}) + (-2.031 * \sqrt{\textit{shrubs}}) + (-0.039 * \textit{canopy cover}) - (1.282 * \sqrt{2.111})$$

where:

1) ABR' = predicted aquatic/riparian/meadow bird species richness
2) * = multiplied by
3) $\sqrt{\ }$ = square root
4) $\sqrt{2.111}$ = square root of the model's MSE
5) all variables except elevation and area were measured as proportions of land area within 200 m of each lentic unit

ABR' ranged from -4.49 to 10.08 ($\bar{x}$ = 0.55, s.e. = 0.105). The rescaled values ranged from 0 to 1 ($\bar{x}$ = 0.35, s.e. = 0.007) (Figure D-1).

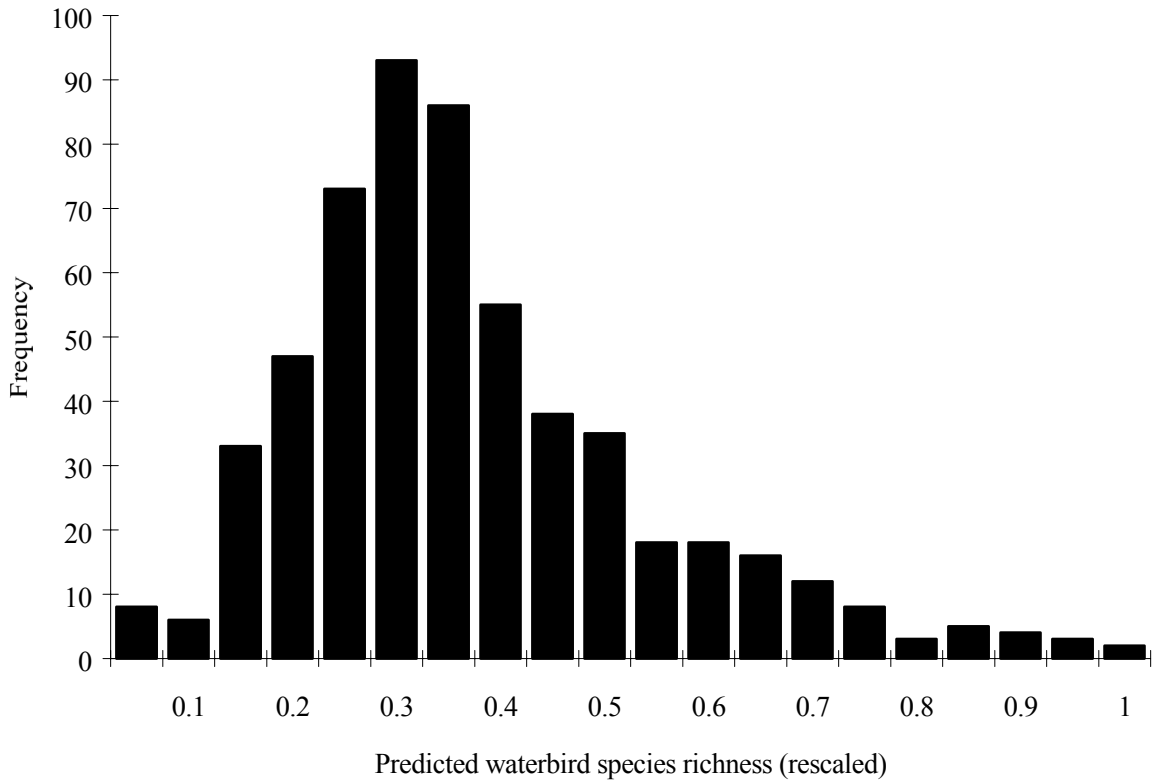

Figure D-1—Distribution of predicted waterbird species richness (rescaled from 0 to 1) around lakes and wet meadows in the Lake Tahoe basin.

Total Bird Species Richness

Manley and Schlesinger (in prep) detected 95 native bird species around lakes and wet meadows (Appendix H). The best model predicting total bird species richness consisted of 6 variables ($F_{6,81}$ = 14.26, P < 0.0001, adj. R^2 = 0.48) (Table D-2).

Table D-2—The best multiple linear regression model in predicting total bird species richness around lentic systems in the Lake Tahoe basin. All variables were measured within 200 m of each site, except elevation, measured at the lake or meadow surface, and lentic area.

Variable	B	SE B	Beta	T	Sig T
Elevation (m)	-0.004	0.002	-0.301	-2.599	0.0111
Lentic area (ha) [a]	0.229	0.159	0.121	1.445	0.1523
Slope	-0.059	0.033	-0.172	-1.795	0.0763
Wooded riparian[b]	6.613	2.083	0.254	3.175	0.0021
Mixed conifer[a]	3.698	1.820	0.225	2.032	0.0455
Meadow[b]	5.999	1.791	0.287	3.349	0.0012
Constant	18.929	3.985		4.750	< 0.0001

Notes:
[a] ln (x+1) transformation applied
[b] Square root transformation applied

The following equation was used to predict total bird species richness:

TBR' = 18.929 + (-0.004 * *elevation* [m]) + (0.229 * ln [*lentic area (ha)*]) + (-0.059 * *slope*) + (6.613 * $\sqrt{woodedriparian}$) + (3.698 * ln [*mixed conifer* + 1]) + (5.999 * $\sqrt{meadow}$) - (1.282 * [$\sqrt{7.158}$])

where:

1) TBR' = predicted total bird species richness
2) * = multiplied by
3) $\sqrt{\ }$ = square root
4) $\sqrt{7.158}$ = square root of the model's MSE
5) all variables except elevation and area were measured as proportions of land area within 200 m of each lentic unit

TBR' ranged from 0.28 to 14.59 ($\bar{x}$ = 7.31, s.e. = 0.126). The rescaled values ranged from 0 to 1 ($\bar{x}$ = 0.49, s.e. = 0.009) (Figure D-2).

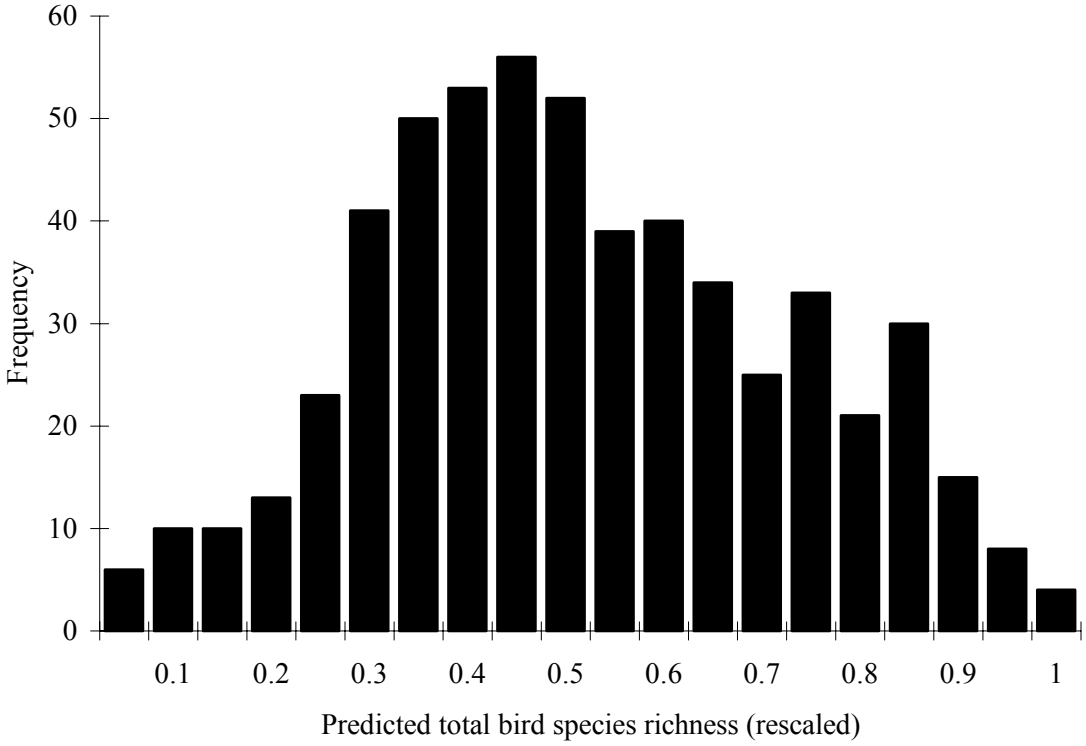

Figure D-2—Distribution of rescaled predicted total bird species richness around lakes and wet meadows in the Lake Tahoe basin.

Lotic Riparian Areas with High Biodiversity

Aquatic/Riparian Bird Species Richness

Manley and Schlesinger (in preparation) detected 39 aquatic/riparian bird species in surveys of lotic riparian areas. The best model predicted total bird species richness consisted of six variables ($F_{6,73}$ = 15.21, P < 0.0001, adj. R^2 = 0.52) (Table D-3).

Table D-3—Multiple linear regression model used to predict bird species richness within lotic corridors (within 300 meters of each side of streams) in the Lake Tahoe basin.

Variables	B	SE B	Beta	T	Sig T
Subalpine conifer	-2.744	2.510	-0.113	-1.093	0.278
Elevation[a]	-10.430	6.189	-0.215	-1.685	0.096
Precipitation[a]	-2.029	1.356	-0.158	-1.497	0.139
Wooded riparian[b]	8.014	3.130	0.227	2.560	0.013
Meadow[b]	12.468	1.944	0.529	6.415	< 0.000
Shrubs[b]	1.861	1.513	0.111	1.230	0.223
Constant	92.516	44.674		2.071	0.042

Notes:
[a] Log-normal transformed
[b] Square-root transformed

The following equation was used to predict aquatic/riparian bird species richness:

$$ABR' = (-2.744 * \textit{subalpine conifer}) + (-10.430 * \ln[\textit{elevation (m)}]) + (-2.029 * \ln[\textit{precipitation (cm)}]) + (8.014 * \sqrt{\textit{woodedriparian}}) + (12.468 * \sqrt{\textit{meadow}}) + (1.861 * \sqrt{\textit{shrubs}}) + 92.516 - (1.282 * \sqrt{7.001})$$

where:

1) ABR' = predicted species richness of aquatic/riparian birds
2) * = multiplied by
3) $\sqrt{\ }$ = square root
4) $\sqrt{7.001}$ = square root of the model's MSE
5) all variables were summarized within 300 m of each stream

ABR' ranged from –4.89 to 16.78 ($\bar{x}$ = 4.03, s.e. = 0.08). The rescaled values ranged from 0 to 1 ($\bar{x}$ = 0.41, s.e. = 0.004; Figure D-3).

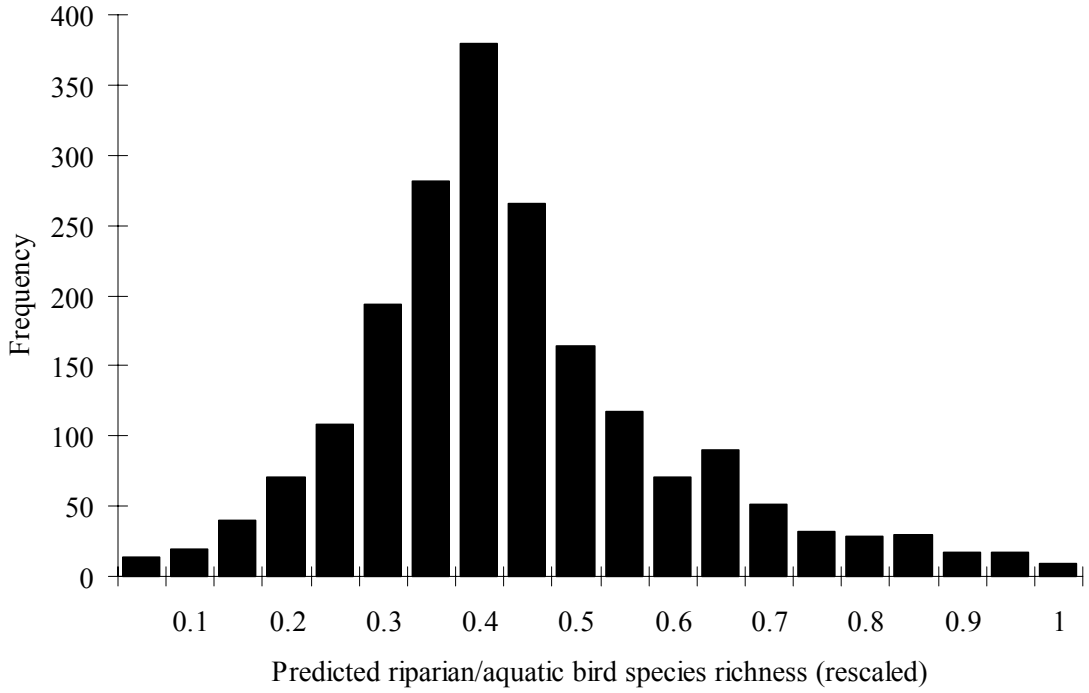

Figure D-3—Distribution of rescaled predicted species richness of riparian/aquatic birds in lotic riparian areas in the Lake Tahoe Basin.

Total Bird Species Richness

Manley and Schlesinger (in prep) detected 101 bird species in surveys of lotic riparian areas (Appendix G). The best model predicting total bird species richness consisted of 5 variables ($F_{5,74} = 6.52$, $P < 0.0001$, adj. $R^2 = 0.26$) (Table D-4).

Table D-4—Multiple linear regression model used to predict total bird species richness within lotic corridors (within 300 meters of each side of streams) in the Lake Tahoe basin.

Variables	B	SE B	Beta	T	Sig T
Precipitation[a]	-7.305	2.902	-0.302	-2.518	0.0140
Wooded riparian[b]	12.408	6.974	0.186	1.779	0.0793
Meadow[b]	12.952	4.988	0.292	2.596	0.0114
Mixed conifer	9.237	4.744	0.322	1.947	0.0553
Canopy cover	-0.128	0.069	0.270	-1.846	0.0689
Constant	62.346	13.795		4.519	< 0.0001

Notes:
[a] Log-normal transformed
[b] Square-root transformed

The following equation was used to predict bird species richness:

$$BR' = (-7.305 * \ln[\textit{precipitation (cm)}]) + (12.408 * \sqrt{\textit{woodedriparian}}) + (12.952 * \sqrt{\textit{meadow}}) + (9.237 * \textit{mixed conifer}) + (-0.128 * \textit{canopy cover}) + 62.346 - (1.282 * \sqrt{38.257})$$

where:

1) BR' = predicted bird species richness
2) * = multiplied by
3) $\sqrt{\ }$ = square root
4) $\sqrt{38.257}$ = square root of the model's MSE
5) all variables were summarized within 300 m of each stream

BR' ranged from 12.13 – 42.66 ($\bar{x}$ = 26.68, s.e. = 0.11). The rescaled values ranged from 0 to 1 ($\bar{x}$ = 0.48, s.e. = 0.004; Figure D-4).

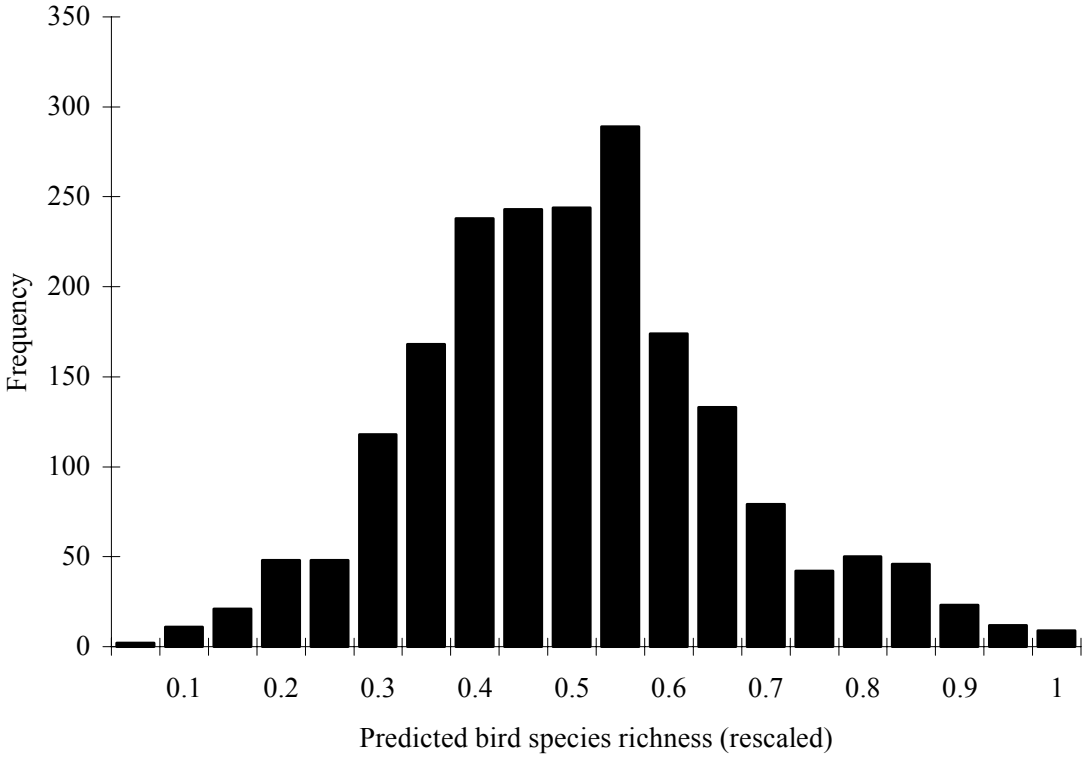

Figure D-4—Frequency distribution of predicted bird species richness (rescaled from 0-1) within 300 m of lotic systems in the Lake Tahoe basin.

Mammal Species Richness

Manley and Schlesinger (in prep) detected 35 mammal species in lotic riparian areas (Appendix G). The best model predicting mammal species richness consisted of seven variables ($F_{7,72}$ = 3.04, P = 0.0075, adj. R^2 = 0.15) (Table D-5).

Table D-5—Multiple linear regression model used to predict mammal species richness in lotic riparian areas (within 100 meters of each side of streams) in the Lake Tahoe basin.

Variables	B	SE B	Beta	T	Sig T
Elevation[a]	0.925	0.225	0.622	4.117	0.0001
Slope[a]	-0.339	0.312	-0.147	-1.086	0.2811
Wooded riparian[a]	3.723	2.407	0.222	1.547	0.1263
Decid/conif riparian[a]	4.200	1.905	0.286	2.205	0.0307
Shrubs[a]	2.732	1.532	0.260	1.784	0.0787
Mixed conifer[b]	4.259	1.749	0.492	2.435	0.0174
Meadow	5.172	2.937	0.326	1.761	0.0825
Constant	-39.473	11.804		-3.344	0.0013

Notes:
[a] Square-root transformed
[b] Arcsine of square-root transformed

The following equation was used to predict mammal species richness within lotic corridors:

$$MR' = (0.925 * \sqrt{elevation}) + (-0.339 * \sqrt{slope}) + (3.723 * \sqrt{woodedriparian}) + (4.200 * \sqrt{dcriparian}) + (2.732 * \sqrt{shrubs}) + (4.259 * \text{arcsine}[\sqrt{mixedconifer}]) + (5.172 * meadow) - 39.473 - (1.282 * \sqrt{6.241})$$

where:

1) MR' = predicted species richness of mammals
2) * = multiplied by
3) $\sqrt{\ }$ = square root
4) $\sqrt{6.241}$ = square root of the model's MSE
5) all variables were summarized within 100 m of each stream

MR' ranged from –2.72 to 10.29 ($\bar{x}$ = 5.24, s.e. = 0.04). The rescaled values ranged from 0 to 1 ($\bar{x}$ = 0.61, s.e. = 0.003) (Figure D-5).

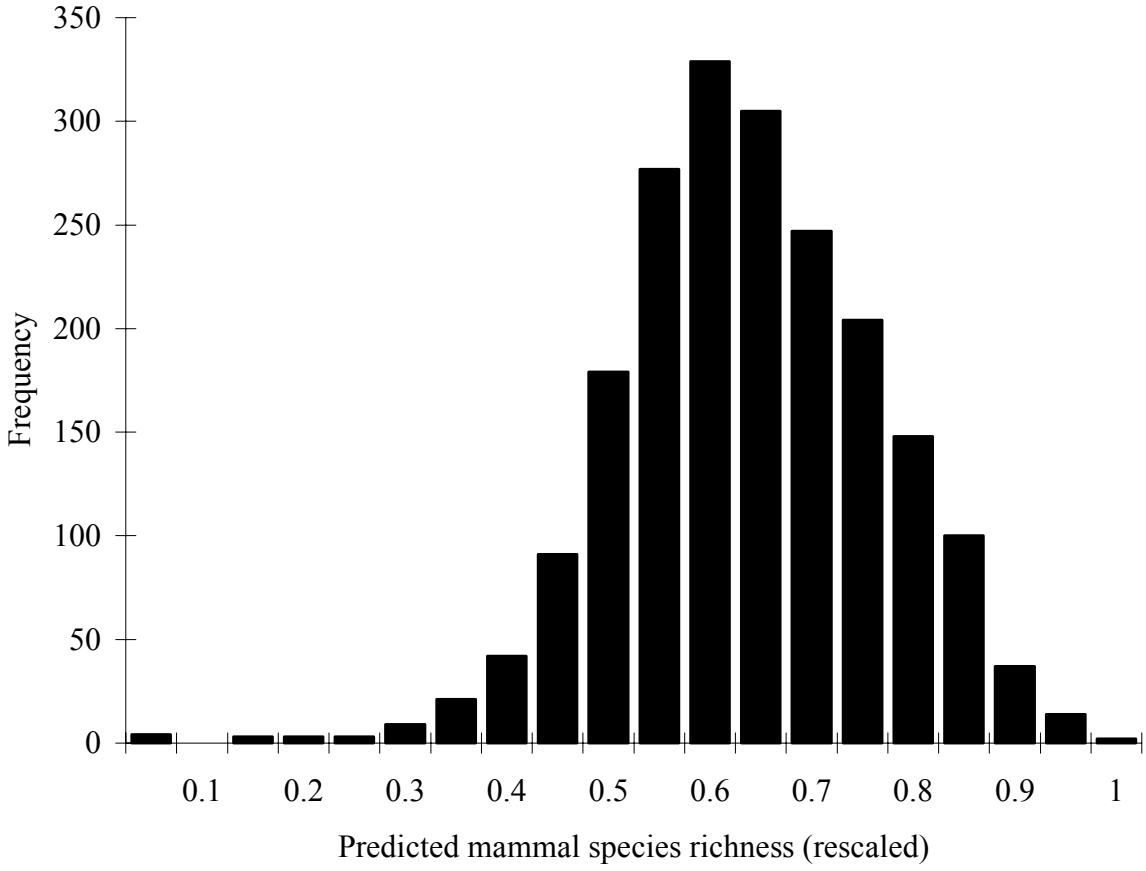

Figure D-5—Frequency distribution of predicted mammal species richness (rescaled from 0-1) within 100 m of lotic systems in the Lake Tahoe basin.

Vascular Plant Species Richness

Manley and Schlesinger (in prep) detected 471 vascular plant species in surveys of lotic riparian areas (see Appendix E). The best model predicting total bird species richness consisted of 10 variables ($F_{10,69} = 7.18$, $P < 0.0001$, adj. $R^2 = 0.44$) (Table D-6). Other variables might also be good predictors of vascular plant species richness, but were not available at the time of this analysis.

Table D-6—Multiple linear regression model used to predict vascular plant species richness within lotic corridors (within 30 m of each side of streams) in the Lake Tahoe basin.

Variables	B	SE B	Beta	T	Sig T
Wooded riparian	42.269	11.156	0.554	3.789	0.0003
Precipitation[a]	27.148	5.821	0.439	4.664	< 0.0001
Decid/conif riparian[b]	33.801	9.768	0.529	3.460	0.0009
Meadow[b]	25.259	12.901	0.348	1.958	0.0543
Shrubs[b]	20.984	9.804	0.246	2.140	0.0359
Mixed conifer[c]	23.799	9.339	0.413	2.548	0.0131
Gravelly alluvial land	14.145	7.190	0.171	1.967	0.0532
Inville soils	-41.395	13.887	-0.257	-2.981	0.0040
Meiss soils	-20.874	9.205	-0.200	-2.268	0.0265
Umpa soils	-9.880	6.134	-0.139	-1.611	0.1118
Constant	-93.255	30.554		-3.052	0.0032

Notes:
[a] log-normal transformed
[b] square-root transformed
[c] arcsine of square-root transformed

The following equation was used to predict vascular plant species richness:

VPR' = (42.269 * wooded riparian) + (27.148 * ln[*precipitation*]) + (33.801 * $\sqrt{dcriparian}$) + (25.259 * $\sqrt{meadow}$) + (20.984 * $\sqrt{shrubs}$) + (23.799 * arcsine [$\sqrt{mixedconifer}$]) + (14.145 * *gravelly alluvial land*) + (-41.395 * *Inville soils*) + (-20.874 * *Meiss soils*) + (–9.880 * *Umpa soils*) – 93.225 – (1.282 * $\sqrt{190.617}$)

where:

1) VPR' = predicted vascular plant richness
2) * = multiplied by
3) $\sqrt{\ }$ = square root
4) $\sqrt{190.617}$ = square root of the model's MSE
5) all variables were summarized within 300 m of each stream

VPR' ranged from –18.22 to 92.69 ($\bar{x}$ = 49.42, s.e. = 0.351). The rescaled values ranged from 0 – 1 ($\bar{x}$ = 0.61, s.e. = 0.003) (Figure D-6).

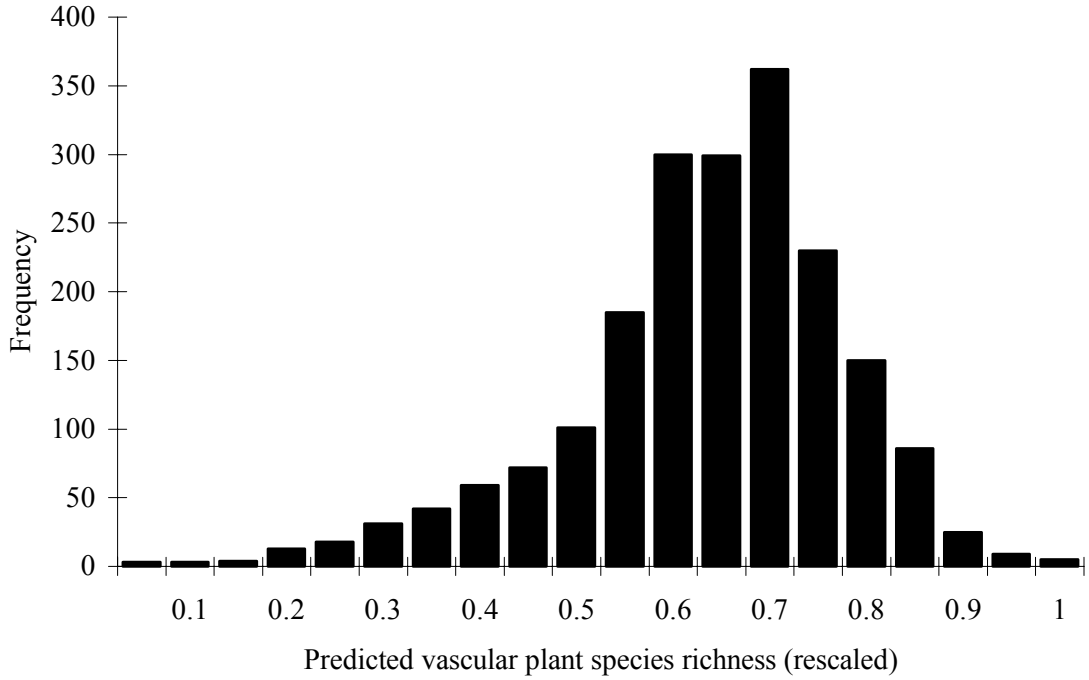

Figure D-6—Frequency distribution of predicted vascular plant species richness (rescaled from 0-1) within 30 m of lotic systems in the Lake Tahoe basin.

Community Diversity

The best regression model describing community diversity consisted of five variables (elevation, precipitation, slope, distance to stream, and distance to lake ($F_{5,129933} = 9938.36$, $P < 0.0001$, adj. $R^2 = 0.28$) (Table D-7).

Table D-7—The best regression model describing plant community diversity in the Lake Tahoe Basin.

Variables	B	SE B	Beta	T	Sig T
Precipitation	0.0137	0.000309	0.177081	44.287	< 0.0001
Elevation	0.0004	0.000015	0.120597	27.136	< 0.0001
Distance to stream	-0.0001	0.000001	-0.280046	-94.085	< 0.0001
Distance to lake	-0.0001	0.000003	-0.066567	-21.367	< 0.0001
Percent slope	0.0537	0.001744	0.100100	30.766	< 0.0001
Constant	0.5799	0.025862		22.423	< 0.0001

Notes:
[a] log-normal transformed
[b] square-root transformed
[c] arcsine of square-root transformed