HUMAN AND ENVIRONMENTAL INFLUENCES ON ECOSYSTEM SERVICES AND WEST NILE VIRUS VECTOR INFECTION IN SUFFOLK COUNTY, NEW YORK (USA)

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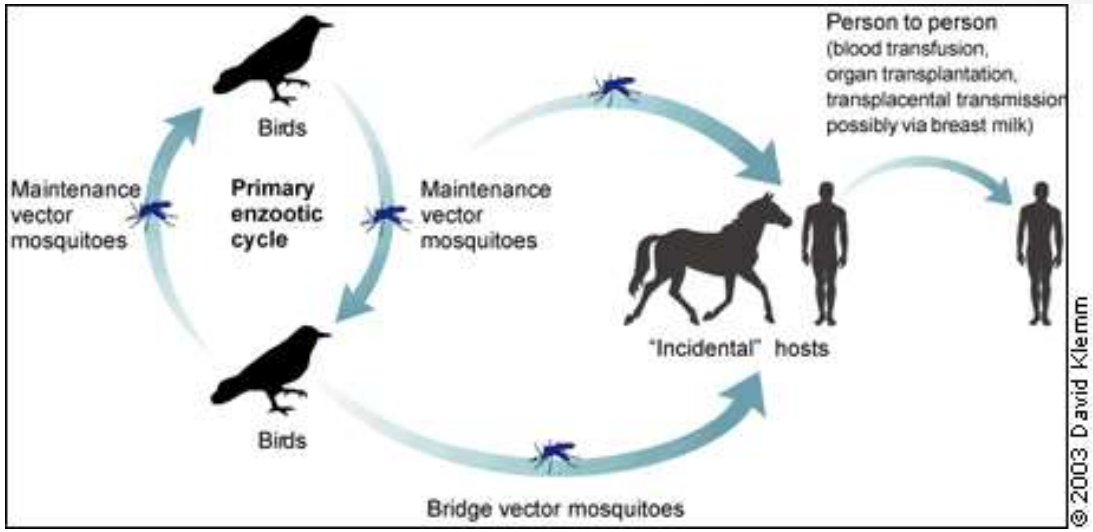
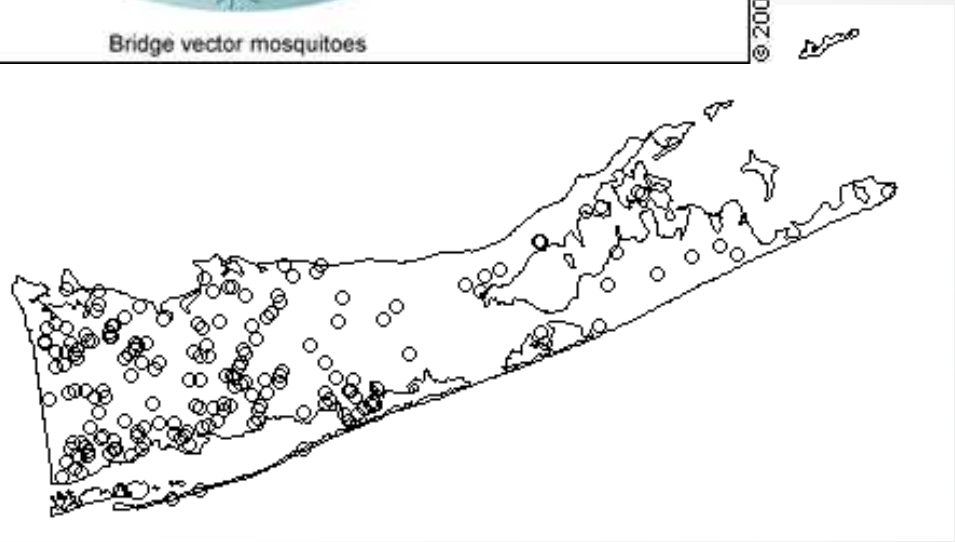
Study Context

- West Nile Virus is a mosquito-borne disease endemic in Suffolk County, NY.
- Surveillance programs sample mosquito populations across the county and test for the presence of West Nile.

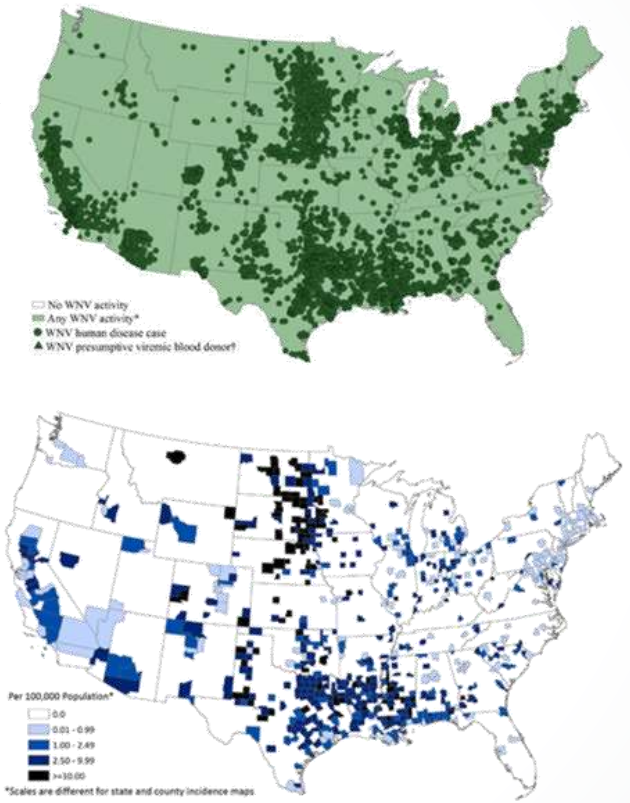




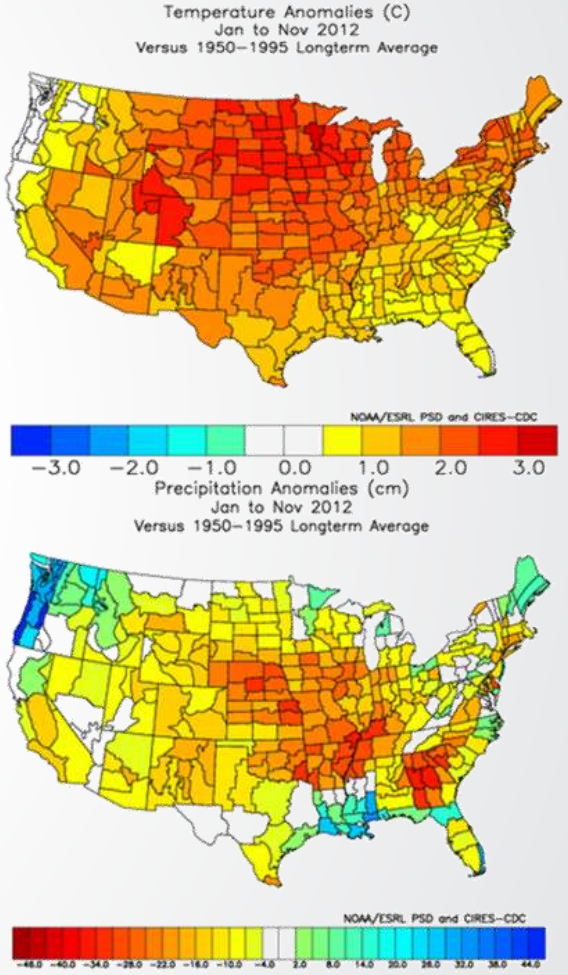
Circles represent mosquito trap sites.

Factors Influencing WNV Ecology

- Land cover and use
  - WNV mosquitoes are associated with developed land.
- Weather
  - Warm weather and low precipitation favor WNV transmission.
  - Cases occur in the summer.
- Anthropogenic influences
  - WNV mosquitoes breed in containers and ponds.
  - Water contaminated with nutrient and organic runoff favors WNV mosquitoes.



http://www.cdc.gov/ncidod/dvbid/westnile/surv&control.htm

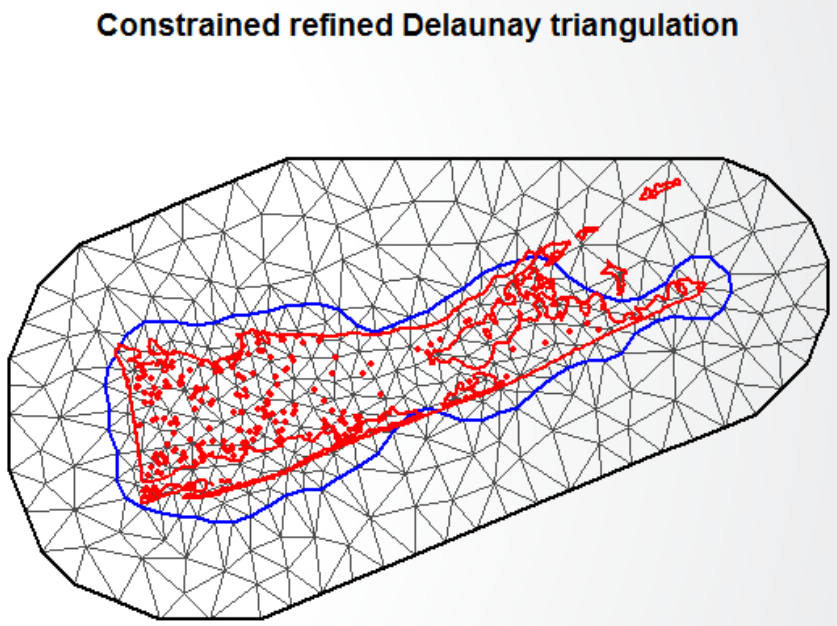


http://www.esrl.noaa.gov/psd/data/usclimdivs/

The INLA SPDE Method

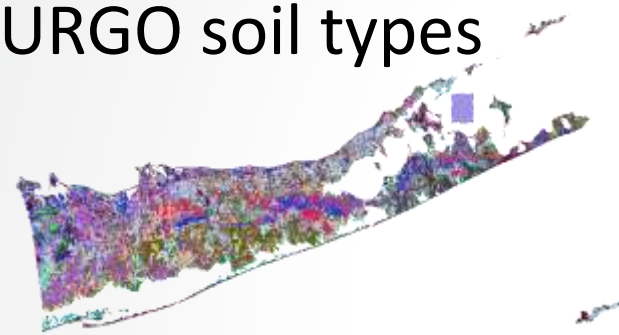
- Previous models of West Nile in mosquitoes struggled to incorporate spatial and temporal variability.

- The Integrated Nested Laplace Approximation – Stochastic Partial Differential Equation (INLA SPDE) allows a complex spatiotemporal model in common R statistical software.



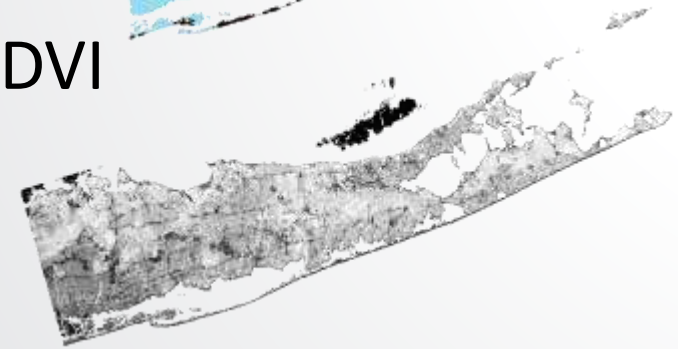
Variables Evaluated

21 SSURGO soil types

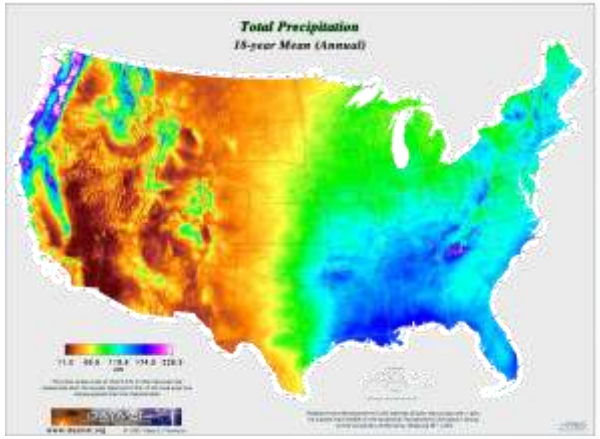


Septic systems

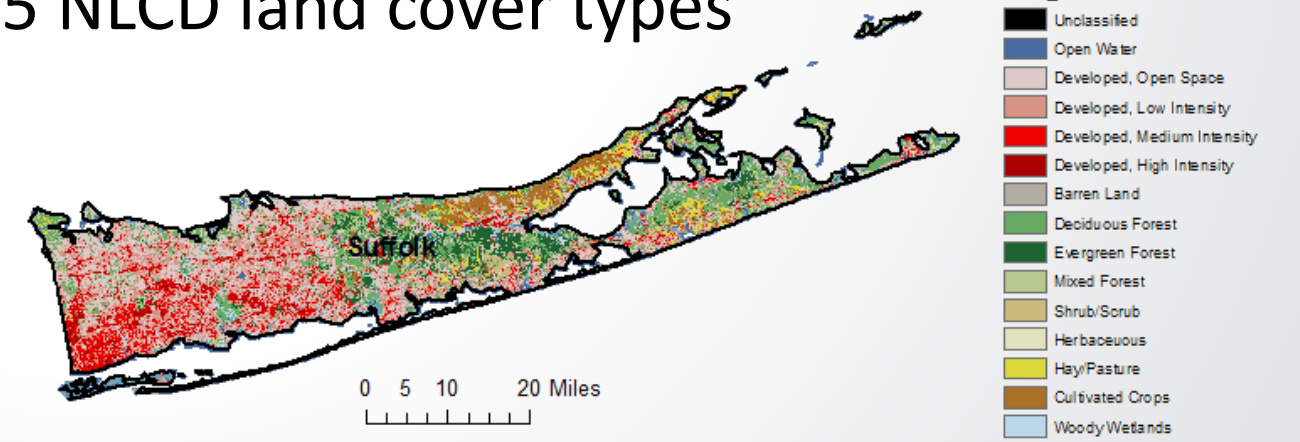
NDVI



6 DAYMET weather variables

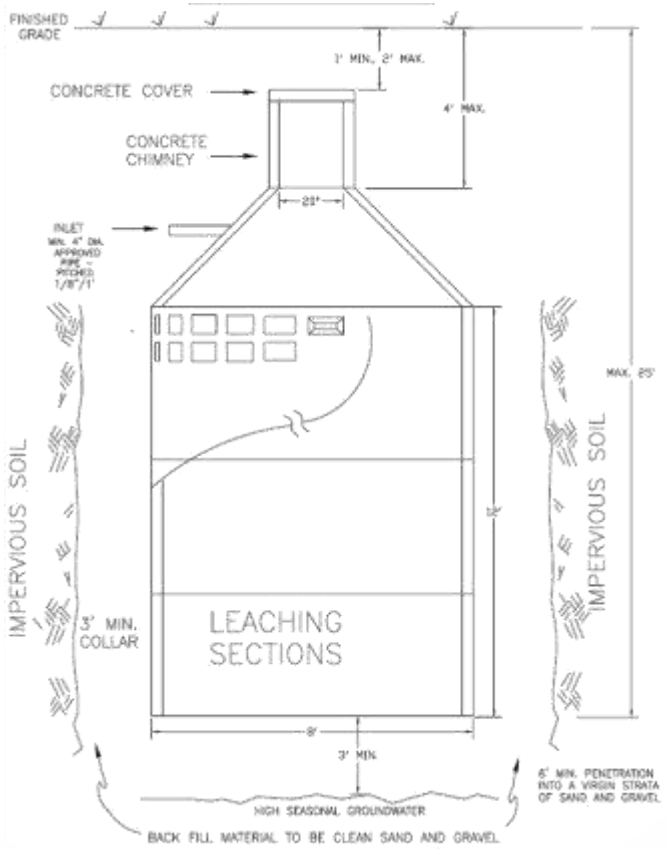


15 NLCD land cover types



Septic Systems on Long Island

- Population grew by 471% between 1940-1970, leading to a construction boom.
- 74% of residences are unsewered.
- Unusually high prevalence of old, unserviced cesspool systems.
- "Much of the nitrogen pollution in Suffolk County waters has been linked to unsewered, dense suburban sprawl" - *Suffolk County Comprehensive Water Resources Management Plan 2015.*



Source: U.S. EPA. (2005) A Homeowner's Guide to Septic Systems

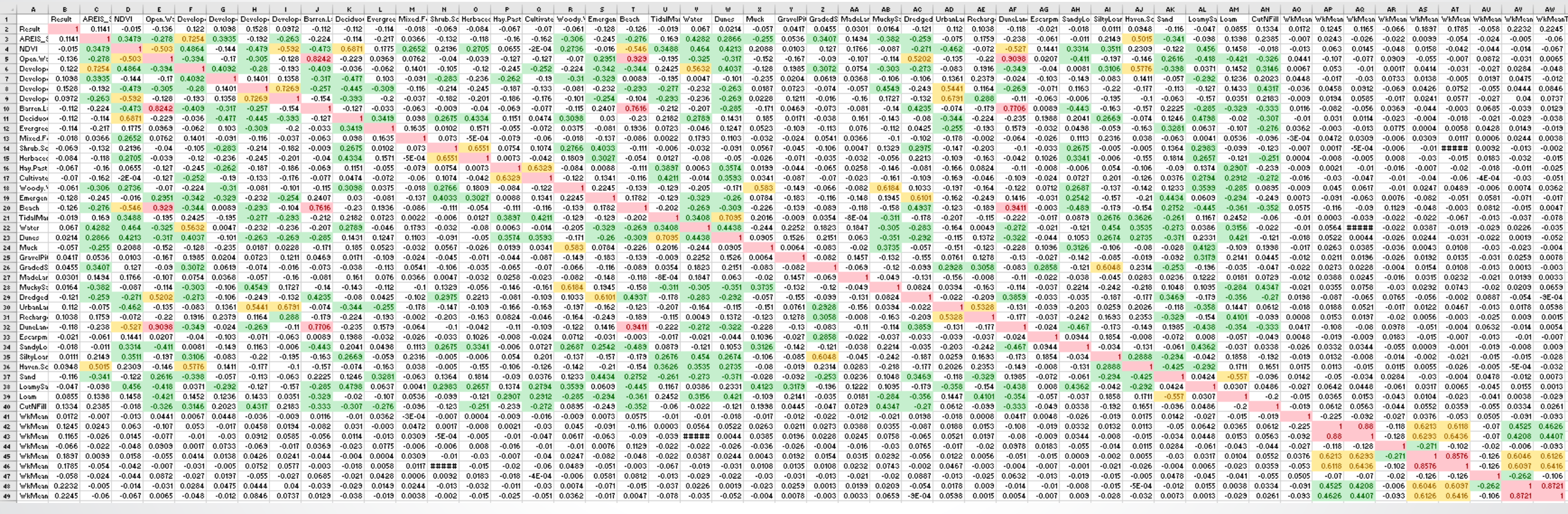
Source: riverheadlocal.com

Septic Systems as Mosquito Habitat

Source: Marin Sonoma Mosquito & Vector Control

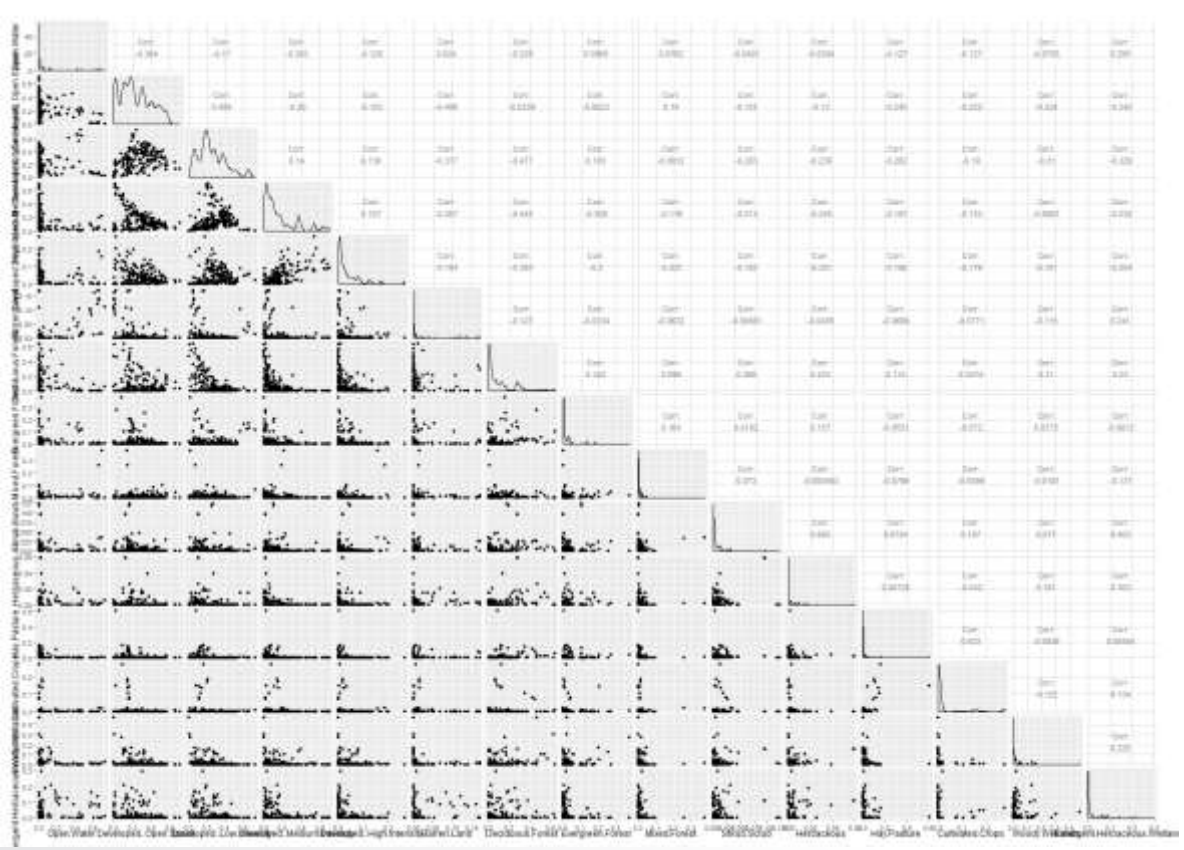
Source: affordableseptics.com

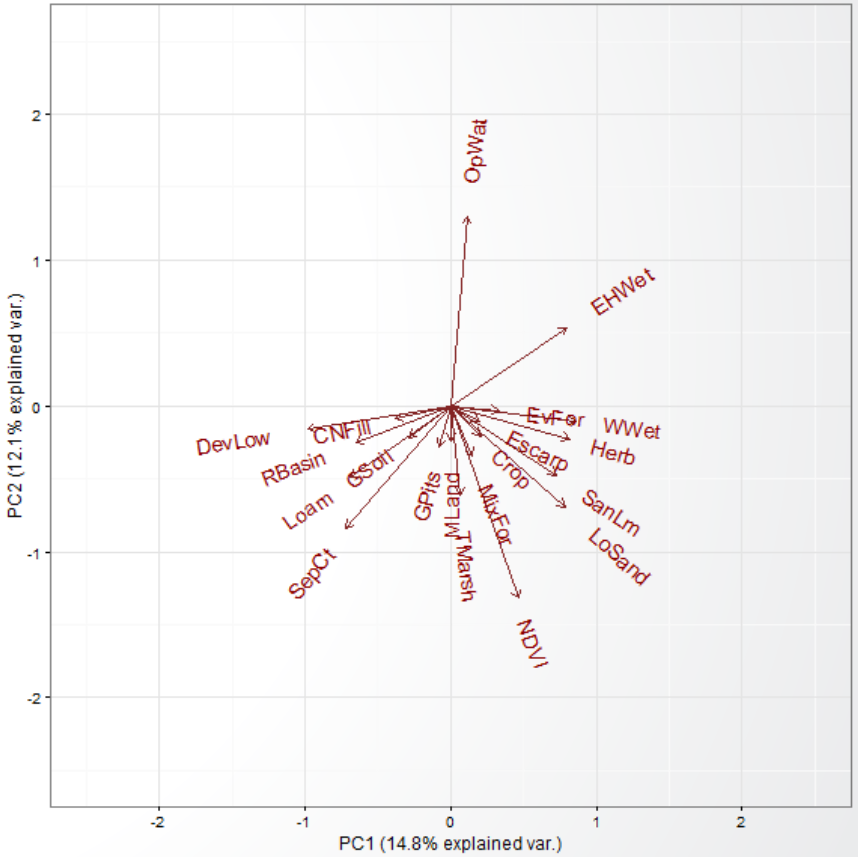
Variable Selection



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW
1		Result	AREIS_S	NDVI	Open.Ws	Develop	Develop	Develop	Develop	Barren.L	Deciduo	Evergree	Mixed.F	Shrub.Sc	Herbace	Hay.Past	Cultivate	Woody.V	Emergen	Beach	TidalMar	Water	Dunes	Muck	GravelPit	GradedS	MadeLar	MuckyS	Dredged	UrbanLa	Recharg	DuneLan	Escarpm	SandyLo	SiltyLoar	Haven.Sc	Sand	LoamySa	Loam	CutNFill	WkMean	WkMean	WkMean	WkMean	WkMean	WkMean	WkMean	WkMean	WkMean	WkMean
2	Result	1	0.1141	-0.015	-0.136	0.122	0.1038	0.1528	0.0372	-0.112	-0.112	-0.114	-0.018	-0.069	-0.084	-0.067	-0.07	-0.061	-0.128	-0.126	-0.013	0.067	0.0214	-0.057	0.0417	0.0455	0.0301	0.0164	-0.121	0.112	0.1038	-0.118	-0.021	-0.018	0.0111	0.0348	-0.116	-0.047	0.0855	0.1334	0.0172	0.1245	0.1165	-0.066	0.1837	0.1785	-0.058	0.2232	0.2245
3	AREIS_S	0.1141	1	0.3479	-0.278	0.7254	0.3935	-0.132	-0.263	-0.224	-0.114	-0.217	0.0366	-0.132	-0.118	-0.16	-0.162	-0.306	-0.245	-0.276	0.163	0.4282	0.2866	-0.255	0.0536	0.3407	0.1434	-0.382	-0.259	-0.075	0.1759	-0.238	-0.061	-0.011	0.2143	0.5015	-0.341	-0.098	0.1398	0.2385	-0.007	0.0243	-0.026	-0.022	0.0039	-0.054	-0.024	-0.005	-0.06
4	NDVI	-0.015	0.3479	1	-0.503	0.4864	-0.144	-0.479	-0.592	-0.473	0.6871	0.1775	0.2652	0.2196	0.2705	0.0655	-2E-04	0.2736	-0.016	-0.546	0.3488	0.464	0.4213	0.2088	0.0103	0.127	0.1766	-0.087	-0.271	-0.462	-0.072	-0.527	0.1441	0.3314	0.3511	0.2303	-0.122	0.456	0.1458	-0.018	-0.013	0.063	0.0145	-0.048	0.0158	-0.042	-0.044	-0.014	-0.067
5	Open.Ws	-0.136	-0.278	-0.503	1	-0.394	-0.17	-0.305	-0.128	0.8242	-0.229	0.0969	0.0762	-0.04	-0.039	-0.127	-0.127	-0.07	0.2951	0.323	-0.195	-0.325	-0.317	-0.152	-0.167	-0.09	-0.107	-0.114	0.5202	-0.135	-0.22	0.9038	0.0207	-0.411	-0.197	-0.146	0.2616	-0.418	-0.421	-0.326	0.0441	-0.107	-0.077	0.0909	-0.055	-0.007	0.0872	-0.031	0.0065
6	Develop	0.122	0.7254	0.4864	-0.394	1	0.4032	-0.28	-0.193	-0.409	-0.036	-0.062	0.1401	-0.105	-0.12	-0.245	-0.252	-0.224	-0.342	-0.344	0.2425	0.5632	0.4037	-0.128	0.1385	0.3072	0.0754	-0.303	-0.273	-0.083	0.1316	-0.349	-0.04	0.0081	0.3106	0.5776	-0.338	0.0371	0.1452	0.3146	0.0067	0.053	-0.01	0.0017	0.0414	-0.031	-0.027	0.0284	-0.048
7	Develop	0.1038	0.3935	-0.144	-0.17	0.4032	1	0.1401	0.1358	-0.317	-0.477	0.103	-0.091	-0.283	-0.236	-0.262	-0.19	-0.31	-0.328	0.0089	-0.195	0.0047	-0.101	-0.235	0.0204	0.0619	0.0368	-0.106	-0.106	0.1361	0.2379	-0.024	-0.103	-0.143	-0.083	0.1411	-0.057	-0.232	0.1236	0.2023	0.0448	-0.017	-0.03	0.0733	0.0138	-0.005	0.0197	0.0475	-0.012
8	Develop	0.1528	-0.132	-0.479	-0.305	-0.28	0.1401	1	0.7269	-0.257	-0.445	-0.309	-0.116	-0.214	-0.245	-0.187	-0.133	-0.081	-0.232	-0.293	-0.277	-0.232	-0.263	0.0187	0.0723	-0.074	-0.057	0.4543	-0.249	0.5441	0.1164	-0.269	-0.071	0.1163	-0.22	-0.177	-0.113	-0.127	0.1433	0.4317	-0.036	0.0458	0.0912	-0.069	0.0426	0.0752	-0.055	0.0444	0.0846
9	Develop	0.0972	-0.263	-0.592	-0.128	-0.193	0.1358	0.7269	1	-0.154	-0.393	-0.2	-0.037	-0.182	-0.201	-0.166	-0.176	-0.101	-0.254	-0.104	-0.293	-0.236	-0.269	0.0228	0.1211	-0.016	-0.16	0.1727	-0.132	0.6791	0.288	-0.11	-0.063	-0.006	-0.195	-0.1	-0.063	-0.157	0.0351	0.2183	-0.009	0.0194	0.0585	-0.017	0.0241	0.0577	-0.027	0.04	0.0737
10	Barren.L	-0.112	-0.224	-0.473	0.8242	-0.409	-0.317	-0.257	-0.154	1	-0.127	-0.033	-0.063	-0.009	-0.04	-0.063	-0.077	-0.115	0.2407	0.7616	-0.212	-0.207	-0.285	-0.171	0.0463	-0.073	-0.081	-0.14	0.4235	-0.074	-0.179	0.7706	0.0089	-0.443	-0.163	-0.157	0.2225	-0.285	-0.329	-0.333	0.0116	-0.082	-0.056	0.0369	-0.044	-0.003	0.0685	-0.033	0.0123
11	Deciduo	-0.112	-0.114	0.6871	-0.229	-0.036	-0.477	-0.445	-0.393	-0.127	1	0.3413	0.098	0.2675	0.4334	0.1151	0.0474	0.3098	0.03	-0.23	0.2182	0.2783	0.1431	0.185	0.0171	-0.038	0.161	-0.143	-0.08	-0.344	-0.224	-0.235	0.1368	0.2041	0.2663	-0.074	0.1246	0.4798	-0.02	-0.307	-0.01	0.031	0.0114	-0.023	-0.004	-0.018	-0.021	-0.029	-0.038
12	Evergree	-0.114	-0.217	0.1775	0.0369	-0.062	0.103	-0.309	-0.2	-0.033	0.3413	1	0.1635	0.0102	0.1571	-0.055	-0.072	0.0375	-0.081	0.1936	0.0723	-0.046	0.1247	0.0523	-0.109	-0.113	0.076	-0.112	0.0425	-0.255	-0.193	0.1579	-0.032	0.0498	-0.059	-0.163	0.3281	0.0637	-0.107	-0.276	0.0362	-0.003	-0.013	0.0775	0.0004	0.0058	0.0428	0.0143	-0.019
13	Mixed.F	-0.018	0.0366	0.2652	0.0762	0.1401	-0.091	-0.116	-0.037	-0.063	0.098	0.1635	1	0.073	-5E-04	-0.079	-0.06	-0.018	-0.137	-0.086	0.0022	0.1793	0.1103	-0.032	-0.024	0.0541	0.0366	-0.1	-0.102	-0.178	-0.002	-0.064	-0.026	0.1113	0.2316	0.038	-0.063	0.0041	0.0536	-0.096	-3E-04	0.0472	0.0309	-0.006	0.0309	0.0117	0.0006	0.0244	0.0038
14	Shrub.Sc	-0.063	-0.132	0.2196	-0.04	-0.105	-0.283	-0.214	-0.182	-0.009	0.2675	0.0102	0.073	1	0.6551	0.0754	0.1074	0.2766	0.4033	-0.111	-0.006	-0.032	-0.091	0.0567	-0.045	-0.106	0.0047	0.1329	0.2375	-0.147	-0.203	-0.1	-0.033	0.2675	-0.005	-0.005	0.1364	0.2383	-0.099	-0.123	-0.007	0.0017	-5E-04	-0.006	-0.01	#####	0.0092	-0.013	-0.002
15	Herbace	-0.084	-0.118	0.2705	-0.033	-0.12	-0.236	-0.245	-0.201	-0.04	0.4334	0.1571	-5E-04	0.6551	1	0.0073	-0.042	0.1803	0.3027	-0.054	0.0127	-0.08	-0.05	-0.026	-0.071	-0.035	-0.032	-0.056	0.2213	-0.109	-0.163	-0.042	0.1026	0.3341	-0.006	-0.155	0.1814	0.2657	-0.121	-0.251	0.0004	-0.008	-0.005	0.008	-0.03	-0.015	0.0183	-0.032	-0.015
16	Hay.Past	-0.067	-0.16	0.0655	-0.127	-0.245	-0.262	-0.187	-0.186	-0.063	0.1151	-0.055	-0.079	0.0754	0.0073	1	0.6323	-0.084	0.0088	-0.111	0.3897	0.0063	0.3574	0.0199	-0.044	-0.065	0.0258	-0.146	-0.081	-0.166	0.0824	-0.11	-0.008	-0.006	0.054	-0.106	-0.03	0.1374	0.2307	-0.239	-0.009	0.0021	-0.01	-0.016	-0.007	-0.02	-0.018	-0.011	-0.025
17	Cultivate	-0.07	-0.162	-2E-04	-0.127	-0.252	-0.19	-0.133	-0.176	-0.077	0.0474	-0.072	-0.06	0.1074	-0.042	0.6323	1	-0.122	0.1341	-0.116	0.4211	-0.014	0.3533	0.0341	-0.087	-0.07	-0.023	-0.161	-0.103	-0.163	-0.046	-0.109	-0.024	0.0727	0.201	-0.126	0.0376	0.2794	0.2312	-0.272	-0.016	-0.03	-0.047	-0.01	-0.04	-0.06	-4E-04	-0.03	-0.051
18	Woody.V	-0.061	-0.306	0.2736	-0.07	-0.224	-0.31	-0.081	-0.101	-0.115	0.3098	0.0375	-0.018	0.2766	0.1809	-0.084	-0.122	1	0.2245	-0.139	-0.123	-0.205	-0.171	0.583	-0.149	-0.066	-0.082	0.6184	0.1033	-0.197	-0.164	-0.122	0.0712	0.2687	-0.137	-0.142	0.1233	0.3593	-0.285	0.0895	-0.009	0.045	0.0617	-0.01	0.0247	0.0489	-0.006	0.0074	0.0362
19	Emergen	-0.128	-0.245	-0.016	0.2951	-0.342	-0.329	-0.232	-0.254	0.2407	0.03	-0.081	-0.137	0.4033	0.3027	0.0088	0.1341	0.2245	1	0.1782	-0.129	-0.329	-0.26	0.0784	-0.183	-0.116	-0.148	0.1945	0.6101	-0.162	-0.249	0.1416	-0.031	0.2542	-0.157	-0.21	0.4434	0.0609	-0.294	-0.249	0.0073	-0.091	-0.063	0.0076	-0.082	-0.051	0.0581	-0.071	-0.017
20	Beach	-0.126	-0.276	-0.546	0.323	-0.344	0.0083	-0.293	-0.104	0.7616	-0.23	0.1936	-0.086	-0.111	-0.054	-0.111	-0.116	-0.139	0.1782	1	-0.202	-0.269	-0.309	-0.226	-0.139	-0.089	-0.118	-0.158	0.4937	-0.123	-0.189	0.9411	-0.003	-0.483	-0.179	-0.154	0.2752	-0.445	-0.361	-0.352	0.0575	-0.116	-0.09	0.1129	-0.048	-0.003	0.0812	-0.015	0.0047
21	TidalMar	-0.013	0.169	0.3488	-0.195	0.2425	-0.195	-0.277	-0.293	-0.212	0.2182	0.0723	0.0022	-0.006	0.0127	0.3897	0.4211	-0.129	-0.129	-0.202	1	0.3408	0.7095	0.2016	-0.009	0.0354	-8E-04	-0.311	-0.178	-0.207	-0.115	-0.222	-0.017	0.0879	0.2676	0.3626	-0.261	0.1167	0.2452	-0.06	-0.01	0.0003	-0.039	-0.022	-0.022	-0.067	-0.013	-0.037	-0.078
22	Water	0.067	0.4282	0.464	-0.325	0.5632	0.0047	-0.232	-0.236	-0.207	0.2783	-0.046	0.1793	-0.032	-0.08	0.0063	-0.014	-0.205	-0.329	-0.269	0.3408	1	0.4438	-0.244	0.2252	0.1823	0.1847	-0.305	-0.283	-0.164	0.0043	-0.272	-0.021	-0.121	0.454	0.3535	-0.273	0.0386	0.3156	-0.022	-0.01	0.0564	#####	-0.022	0.0387	-0.019	-0.029	0.0226	-0.035
23	Dunes	0.0214	0.2866	0.4213	-0.317	0.4037	-0.101	-0.263	-0.269	-0.285	0.1431	0.1247	0.1103	-0.091	-0.05	0.3574	0.3593	-0.171	-0.26	-0.309	0.7095	0.4438	1	0.0305	0.1526	0.2151	0.063	-0.351	-0.292	-0.115	0.1372	-0.322	-0.044	0.1053	0.2674	0.2735	-0.371	0.2331	0.421	-0.121	-0.018	0.0522	0.0044	-0.026	0.0244	-0.031	-0.022	0.0019	-0.052
24	Muck	-0.057	-0.255	0.2088	-0.152	-0.128	-0.235	0.0187	0.0228	-0.171	0.185	0.0523	-0.032	0.0567	-0.026	0.0199	0.0341	0.583	0.0784	-0.226	0.2016	-0.244	0.0905	1	0.0064	-0.083	-0.02	0.3735	-0.057	-0.151	-0.123	-0.228	0.1096	0.3126	-0.106	-0.08	-0.028	0.4123	-0.109	0.1398	-0.017	0.0263	0.0385	-0.036	0.0043	0.0108	-0.03	-0.023	-0.004
25	GravelPit	0.0417	0.0536	0.0103	-0.167	0.1385	0.0204	0.0723	0.1211	0.0469	0.0171	-0.109	-0.024	-0.045	-0.071	-0.044	-0.087	-0.143	-0.183	-0.133	-0.003	0.2252	0.1526	0.0064	1	-0.082	0.1457	-0.132	-0.155	0.0761	0.1278	-0.13	-0.027	-0.142	-0.085	-0.019	-0.092	0.3173	0.2141	0.0445	-0.012	0.0211	0.0196	-0.026	0.0192	0.0135	-0.031	0.0259	0.0078
26	GradedS	0.0455	0.3407	0.127	-0.09	0.3072	0.0619	-0.074	-0.016	-0.073	-0.038	-0.113	0.0541	-0.106	-0.035	-0.065	-0.07	-0.066	-0.116	-0.089	0.0354	0.1823	0.2151	-0.083	-0.082	1	-0.069	-0.12	-0.099	0.2328	0.3058	-0.083	0.2858	-0.121	0.6048	0.2314	-0.253	-0.136	-0.035	-0.047	-0.022	0.0273	0.0228	-0.004	0.0154	0.0108	-0.013	0.0013	-0.003
27	MadeLar	0.0301	0.1494	0.1766	-0.107	0.0754	0.0368	-0.057	-0.16	-0.081	0.161	0.076	0.0366	0.0047	-0.032	0.0258	-0.023	-0.082	-0.148	-0.118	-8E-04	0.1847	0.063	-0.02	0.1457	-0.069	1	-0.049	-0.131	-0.156	-0.008	-0.11	-0.022	-0.038	-0.045	0.0283	0.0236	0.1222	0.0181	0.0729	-0.012	0.0388	0.0245	-0.016	0.0315	0.0232	-0.021	0.0199	0.0033
28	MuckyS	0.0164	-0.382	-0.087	-0.114	-0.303	-0.106	0.4543	0.1727	-0.14	-0.143	-0.112	-0.1	0.1329	-0.056	-0.146	-0.161	0.6184	0.1945	-0.158	-0.311	-0.305	-0.351	0.3735	-0.132	-0.12	-0.043	1	0.0824	0.0334	-0.163	-0.114	-0.037	0.2214	-0.242	-0.218	0.1048	0.1095	-0.284	0.4347	-0.021	0.0355	0.0758	-0.03	0.0292	0.0743	-0.02	0.0209	0.0659
29	Dredged	-0.121	-0.259	-0.271	0.5202	-0.273	-0.106	-0.243	-0.132	0.4235	-0.08	0.0425	-0.102	0.2975	0.2213	-0.081	-0.103	0.1033	0.6101	0.4937	-0.178	-0.283	-0.232	-0.057	-0.155	-0.039	-0.131	0.0824	1	-0.022	-0.209	0.3859	-0.033	-0.035	-0.187	-0.177	0.3469	-0.179	-0.356	-0.27	0.0198	-0.087	-0.065	0.0765	-0.056	-0.002	0.0887	-0.054	-3E-04
30	UrbanLa	0.112	-0.075	-0.462	-0.135	-0.083	0.1361	0.5441	0.6731	-0.074	-0.344	-0.255	-0.178	-0.147	-0.109	-0.166	-0.163	-0.197	-0.162	-0.123	-0.207	-0.164	-0.115	-0.151	0.0761	0.2928	-0.156	0.0394	-0.022	1	0.5328	-0.131	-0.033	-0.203	0.0259	0.2026	-0.118	-0.358	0.1447	0.0612	-0.018	0.0188	0.0521	-0.017	0.0122	0.0467	-0.013	0.0178	0.0598
31	Recharg	0.1038	0.1759	-0.072	-0.22	0.1316	0.2379	0.1164	0.288	-0.179	-0.224	-0.193	-0.002	-0.203	-0.163	0.0824	-0.046	-0.164	-0.249	-0.189	-0.115	0.0049	0.1372	-0.123	0.1278	0.3058	-0.008	-0.163	-0.209	0.5328	1	-0.177	-0.037	-0.242	0.1633	0.2353	-0.329	-0.154	0.4101	-0.093	0.0008	0.0153	0.0197	-0.02	0.0056	-0.003	-0.025	0.009	0.0015
32	DuneLan	-0.118	-0.238	-0.527	0.9038	-0.349	-0.024	-0.269	-0.11	0.7706	-0.235	0.1579	-0.064	-0.1	-0.042	-0.11	-0.103	-0.122	0.1416	0.9411	-0.222	-0.272	-0.322	-0.228	-0.13	-0.083	-0.11	-0.114	0.3859	-0.131	-0.177	1	-0.024	-0.467	-0.173	-0.143	0.1385	-0.438	-0.354	-0.333	0.0417	-0.108	-0.08	0.0378	-0.051	-0.004	0.0632	-0.014	0.0054
33	Escarpm	-0.021	-0.061	0.1441	0.0207	-0.04	-0.103	-0.071	-0.063	0.0089	0.1988	-0.032	-0.026	-0.033	0.1026	-0.008	-0.024	0.0712	-0.031	-0.003	-0.017	-0.021	-0.044	0.1096	-0.027	0.2858	-0.022	-0.037	-0.033	-0.033	-0.037	-0.024	1	0.0944	0.1854	-0.008	-0.072	0.008	-0.057	-0.043	0.0048	-0.019	-0.009	0.0183	-0.015	-0.007	-0.013	-0.01	-0.007
34	SandyLo	-0.018	-0.011	0.3314	-0.411	0.0081	-0.143	0.1163	-0.006	-0.443	0.2041	0.0498	0.1113	0.2675	0.3341	-0.006	0.0727	0.2687	0.2542	-0.489	0.0873	-0.121	0.1053	0.3126	-0.142	-0.121	-0.038	0.2214	-0.035	-0.203	-0.242	-0.467	0.0944	1	-0.034	-0.131	-0.061	0.4362	-0.037	0.0338	-0.026	0.0332	0.0344	-0.055	0.0009	-0.001	-0.019	-0.008	0.009
35	SiltyLoar	0.0111	0.2143	0.3511	-0.197	0.3106	-0.083	-0.22	-0.195	-0.163	0.2663	-0.059	0.2316	-0.005	-0.006	0.054	0.201	-0.137	-0.157	-0.179	0.2676	0.454	0.2674	-0.106	-0.085	0.6048	-0.045	-0.242	-0.187	0.0259	0.1693	-0.173	0.1854	-0.034	1	0.2888	-0.294	-0.042	0.1858	-0.192	-0.019	0.0132	-0.008	-0.014	-0.002	-0.021	-0.015	-0.015	-0.028
36	Haven.Sc	0.0948	0.5015	0.2309	-0.146	0.5776	0.1411	-0.177	-0.1	-0.157	-0.074	-0.163	0.038	-0.005	-0.155	-0.106	-0.126	-0.142	-0.21	-0.154	0.3626	0.3535	0.2735	-0.08	-0.019	0.2314	0.0283	-0.218	-0.177	0.2026	0.2353	-0.149	-0.008	-0.131	0.2888	1	-0.425	-0.232	0.1711	0.1651	0.0175	0.0113	-0.015	0.0115	0.0055	-0.026	-0.005	-5E-04	-0.032
37	Sand	-0.116	-0.341	-0.122	0.2616	-0.398	-0.057	-0.113	-0.063	0.2225	0.1246	0.3281	-0.063	0.1364	0.1814	-0.09	0.0376	0.1233	0.4434	0.2752	-0.261	-0.273	-0.371	-0.028	-0.092	-0.253	0.0236	0.1048	0.3463	-0.118	-0.329	0.1985	-0.072	-0.061	-0.294	-0.425	1	0.0424	-0.557	-0.096	0.0142	-0.05	-0.034	0.0284	-0.03	-0.004	0.0478	-0.012	0.0073
38	LoamySa	-0.047	-0.098	0.456	-0.418	0.0371	-0.232	-0.127	-0.157	-0.285	0.4798	0.0637	0.0041	0.2983	0.2657	0.1374	0.2734	0.3599	0.0609	-0.445	0.1167	0.0386	0.2331	0.4123	0.3173	-0.136	0.1222	0.1095	-0.179	-0.358	-0.154	-0.438	0.008	0.4362	-0.042	-0.232	0.0424	1	0.0307	0.0486	-0.027	0.0642	0.0448	-0.061	0.0317	0.0065	-0.045	0.0155	0.0013
39	Loam	0.0855	0.1398	0.1458	-0.421	0.1452	0.1236	0.1433	0.0351	-0.329	-0.02	-0.107	0.0536	-0.093	-0.121	0.2307	0.2912	-0.285	-0.294	-0.361	0.2452	0.3156	0.421	-0.103	0.2141	-0.035	0.0181	-0.284	-0.356	0.1447	0.4101	-0.354	-0.057	-0.037	0.1858	0.1711	-0.557	0.0307	1	-0.2	-0.015	0.0365	0.0153	-0.043	0.0104	-0.023	-0.041	0.0038	-0.029
40	CutNFill	0.1334	0.2385	-0.018	-0.326	0.3146	0.2023	0.4317	0.2183	-0.333	-0.307	-0.276	-0.036	-0.123	-0.251	-0.239	-0.272	0.0895	-0.249	-0.352	-0.06	-0.022	-0.121	0.1998	0.0445	-0.047	0.0729	0.4347	-0.27	0.0612	-0.093	-0.333	-0.049	0.0338	-0.192	0.1651	-0.096	0.0486	-0.2	1	-0.019	0.0612	0.0563	-0.044	0.0552	0.0359	-0.055	0.0334	0.0261
41	WkMean	0.0172	-0.007	-0.013	0.0441	0.0067	0.0448	-0.036	-0.009	0.0116	-0.01	0.0362	-3E-04	-0.007	0.0004	-0.003	-0.016	-0.003	0.0073	0.0575	-0.01	-0.01	-0.018	-0.017	-0.012	-0.022	-0.012	-0.021	0.0198	-0.018	0.0008	0.0417	0.0048	-0.026	-0.019	0.0175	0.0142	-0.027	-0.015	-0.019	1	-0.225	-0.092	-0.027	0.0376	-0.053	0.0505	-0.031	-0.093
42	WkMean	0.1245	0.0243	0.063	-0.107	0.053	-0.017	0.0458	0.0194	-0.082	0.031	-0.003	0.0472	0.0017	-0.008	0.0021	-0.03	0.045	-0.031	-0.116	0.0003	0.0564	0.0522	0.0263	0.0211	0.0273	0.0388	0.0355	-0.087	0.0188	0.0153	-0.108	-0.019	0.0332	0.0132	0.0113	-0.05	0.0642	0.0365	0.0612	-0.225	1	0.88	-0.118	0.6213	0.6118	-0.07	0.4525	0.4626
43	WkMean	0.1165	-0.026	0.0145	-0.077	-0.01	-0.03	0.0912	0.0585	-0.056	0.0114	-0.013	0.0309	-5E-04	-0.005	-0.01	-0.047	0.0617	-0.063	-0.09	-0.033	#####	0.0044	0.0385	0.0196	0.0228	0.0245	0.0758	-0.065	0.0521	0.0197	-0.08	-0.009	0.0344	-0.008	-0.015	-0.034	0.0448	0.0153	0.0563	-0.092	0.88	1	-0.128	0.6233	0.6436	-0.07	0.4208	0.4407
44	WkMean	-0.066	-0.022	-0.048	0.0309	0.0017	0.0733	-0.063	-0.017	0.0363	-0.023	0.0775	-0.006	-0.006	0.008	-0.016	-0.01	-0.01	0.0076	0.1129	-0.022	-0.022	-0.026	-0.036	-0.026	-0.004	-0.016	-0.03	0.0765	-0.017	-0.02	0.0978	0.0183	-0.055	-0.014	0.0115	0.0284	-0.061	-0.043	-0.044	-0.027	-0.118	-0.128	1	-0.271	-0.102	-0.02	-0.006	-0.093
45	WkMean	0.1837	0.0039	0.0158	-0.055	0.0414	0.0138	0.0426	0.0241	-0.044	-0.004	0.0004	0.0309	-0.01	-0.03	-0.007	-0.04	0.0247	-0.082	-0.048	-0.022	0.0387	0.0244	0.0043	0.0192	0.0154	0.0315	0.0292	-0.056	0.0122	0.0056	-0.051	-0.015	0.0009	-0.002	0.0055	-0.03	0.0317	0.0104	0.0552	0.0376	0.6213	0.6293	-0.271	1	0.8576	-0.126	0.6046	0.6126
46	WkMean	0.1785	-0.054	-0.042	-0.007	-0.031	-0.005	0.0752	0.0577	-0.003	-0.018	0.0058	0.0117	#####	-0.015	-0.02	-0.06	0.0469	-0.051	-0.003	-0.067	-0.019	-0.031	0.0108	0.0135	0.0108	0.0232	0.0743	-0.002	0.0467	-0.003	-0.004	-0.007	-0.001	-0.021	-0.026	-0.004	0.0065	-0.023	0.0359	-0.053	0.6118	0.6436	-0.102	0.8576	1	-0.126	0.6037	0.6416
47	WkMean	-0.058	-0.024	-0.044	0.0872	-0.027	0.0197	-0.055	-0.027	0.0685	-0.021	0.0428	0.0006	0.0092	0.0183	-0.018	-4E-04	-0.006	0.0581	0.0812	-0.013	-0.029	-0.022	-0.03	-0.031	-0.013	-0.021	-0.02	0.0887	-0.013	-0.025	0.0632	-0.013	-0.019	-0.015	-0.005	0.0478	-0.045	-0.041	-0.055	0.0505	-0.07	-0.07	-0.02	-0.126	-0.126	1	-0.262	-0.106
48	WkMean	0.2232	-0.005	-0.014	-0.031	0.0284	0.0475	0.0444	0.04	-0.033	-0.029	0.0143	0.0244	-0.013	-0.032	-0.011	-0.03	0.0074	-0.071	-0.015	-0.037	0.0226	0.0019	-0.023	0.0259	0.0013	0.0199	0.0209	-0.054	0.0178	0.009	-0.014	-0.01	-0.008	-0.015	-5E-04	-0.012	0.0155	0.0038	0.0334	-0.031	0.4525	0.4208	-0.006	0.6046	0.6037	-0.262	1	0.8721
49	WkMean	0.2245	-0.06	-0.067	0.0065	-0.048	-0.012	0.0846	0.0737	0.0129	-0.038	-0.019	0.0038	-0.002	-0.015	-0.025	-0.051	0.0362	-0.017	0.0047	-0.078	-0.035	-0.052	-0.004	0.0078	-0.003	0.0033	0.0653	-9E-04	0.0586	0.0015	0.0054	-0.007	0.009	-0.028	-0.032	0.0073	0.0013	-0.029	0.0261	-0.093	0.4626	0.4407	-0.093	0.6126	0.6416	-0.106	0.8721	1

Variable Selection



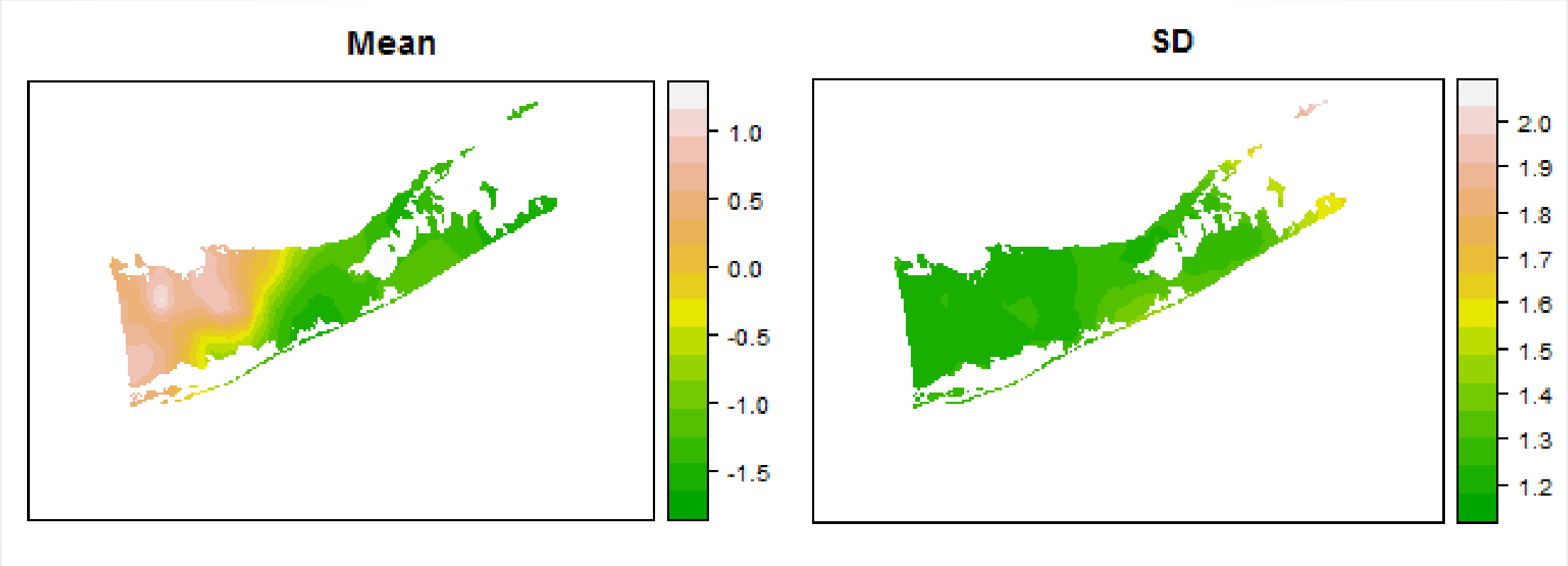


Regression Results

Magnitude of Effect

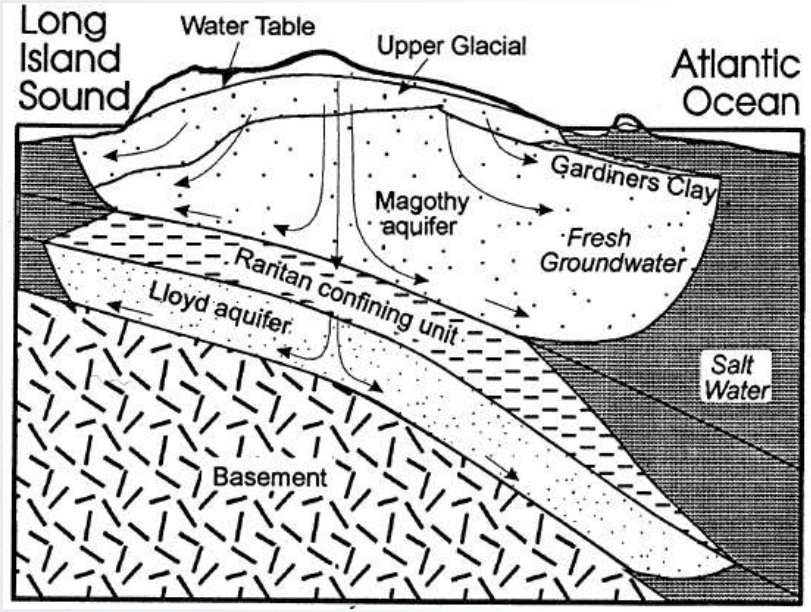
Variable name	Coefficient (95% CI)
Open Water	**-0.92(-1.29:-0.57)**
Average Temperature	**0.29 (0.15:0.42)**
Septic Count	**0.23 (0.09:0.40)**
Woody Wetlands	**-0.14 (-0.29:-0.01)**
Precipitation	**-0.11 (-0.20:-0.02)**
NDVI	-0.14 (-0.34:0.07)
Developed, Low Intensity	-0.08 (-0.29:0.11)
Emergent Herbaceous Wetlands	-0.02 (-0.19:0.16)
σ_s^2 (spatial variance)	1.29 (0.40:3.36)
r (spatial range)	82 (32:191)
φ (AR1 coefficient)	0.98 (0.94:0.99)

Spatial Regression Results



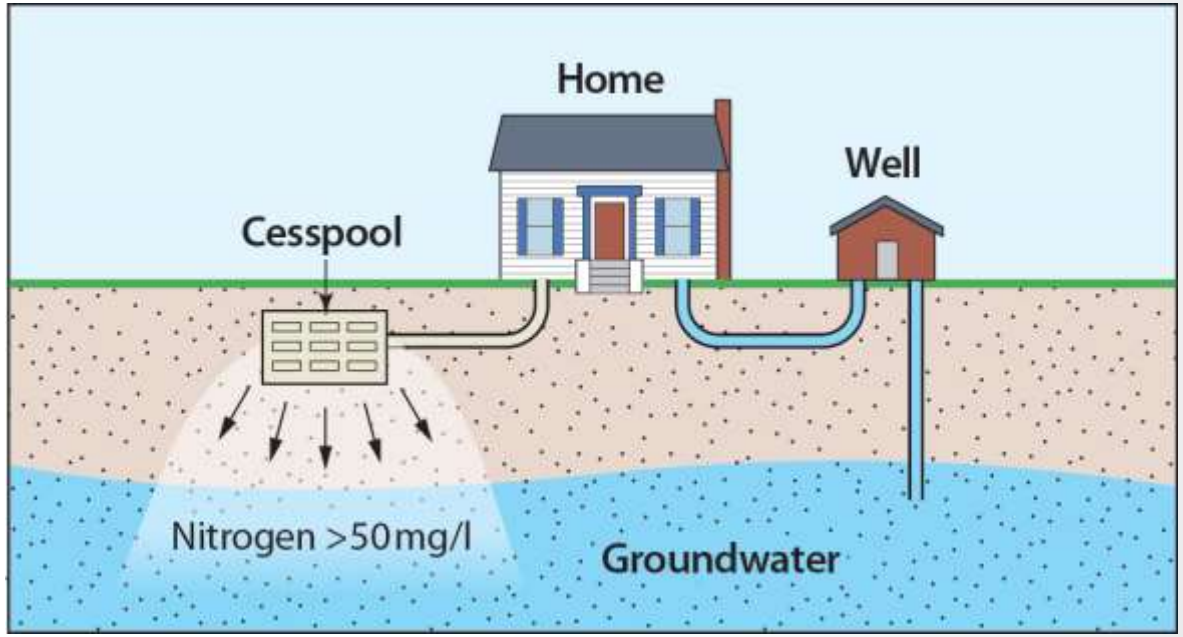
Units are log-odds of a mosquito pool testing positive for WNV

Septic Systems as Nitrogen Polluters



Source: SUNY-Stony Brook

Long Island has a high water table, and groundwater is the only freshwater source.



Source: SUNY-Stony Brook

Nitrogen Pollution and West Nile Virus

Source: geograph.org.uk

Culex restuans (Diptera: Culicidae) Oviposition Behavior Determined by Larval Habitat Quality and Quantity in Southeastern Michigan

Michael H. Reiskind, Mark L. Wilson

Linking environmental nutrient enrichment and disease emergence in humans and wildlife

Pieter T. J. Johnson,[1,*] Alan R. Townsend,[1,2] Cory C. Cleveland,[3] Patricia M. Glibert,[4] Robert W. Howarth,[5] Valerie J. McKenzie,[1] Eliska Rejmankova,[6] and Mary H. Ward[7]

Source: lawestvector.org

Healthy Wetlands Reduce Vector-Borne Disease

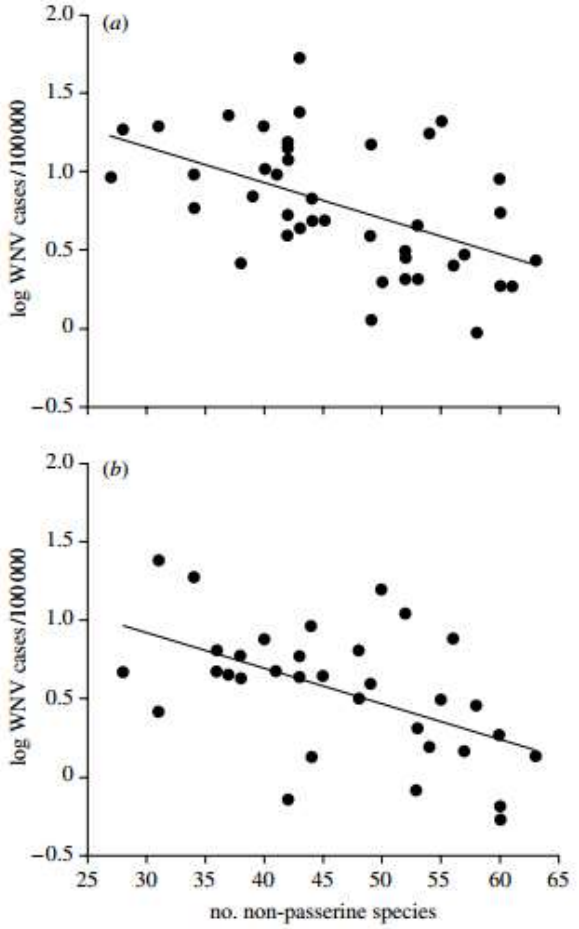
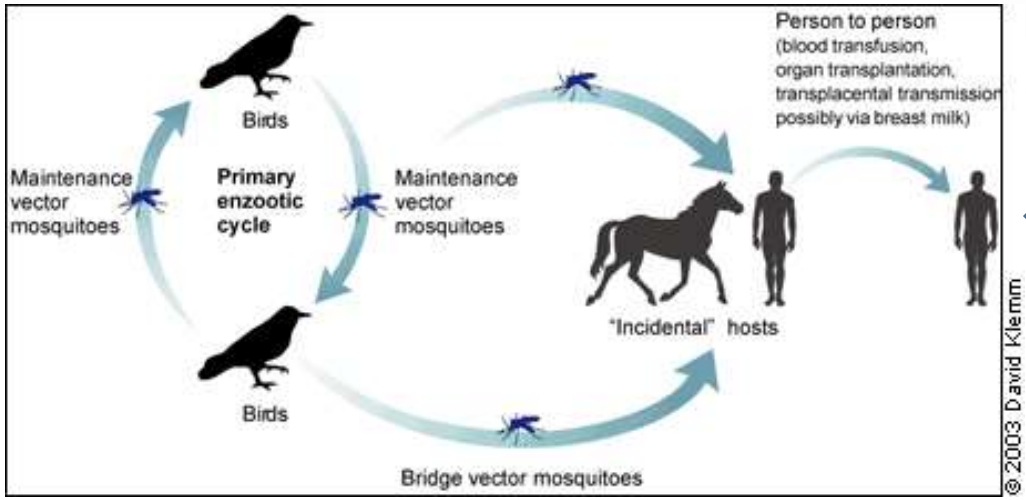


Figure 3. Relationship between human WNV disease incidence by county and non-passerine species richness in (*a*) 2002 and (*b*) 2003. In minimum adequate multiple regression models, non-passerine species richness was the sole predictor of disease incidence in 2002 ($r = -0.52$, $t = -3.79$, $p < 0.001$), and one of two predictors of disease incidence in 2003 ($r = -0.34$, $t = -2.49$, $p < 0.05$).



Year-round wetland availability discourages clustering of birds and bridge vectors.

Avian biodiversity "dilutes" community composition away from WNV reservoirs.

Source: myweb.rollins.edu

Conclusions

- Septic systems are correlated with an increase in WNV incidence.
- Woody wetlands are correlated with a reduction in WNV incidence.
- Nitrogen pollution from septic systems is known to degrade wetlands.
  - A modest negative correlation was found between septic count and woody wetland cover, r= -.306
  - Dynamics of the relationship as it relates to WNV are unknown.

Implications for Ecosystem Valuation

- Prevention of disease is valuable, especially for life-threatening diseases spread by mosquitoes.
  - Existing treatment and prevention efforts are expensive and time-consuming.

- The relationship between healthy wetland function and vector-borne disease prevention merits further research to determine whether prevention represents an overlooked wetland service.