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October 5, 2017

Memo to: Mike Armstrong, Andrew King and Robyn Niver

From: Mark Ford *Mark*

Subject: Kaleidoscope 4.5 and 4.3 Test on Expanded Data

Below are the returned MLE  $p$ -values on the estimates of presence or absence of bat community composition datasets (also with runs of northern long-eared bats *Myotis septentrionalis* removed or Indiana bats *Myotis sodalis* removed) for the 0 and -1 sensitivity settings over ten independent and randomly generated test libraries as well as associated producer's and user's accuracy (Tables 1-12). Both versions at both settings would fail for the Indiana bat, however, all would pass for the northern long-eared bat; false positives continue to be an issue for Indiana bats in the "removed" dataset. Expanding beyond the two bats in question, these software versions continue to have difficulty identifying Southeastern myotis (*Myotis austroriparius*) presence. While all four versions "found" Southeastern myotis, it appears that echolocation passes attributable to that species in all cases were other bat species, and hence numerous other bats were misclassified as Southeastern myotis.

cc: A. Silvis

**Table 1. Summary MLE results for version 4.5 at the 0 setting. *Myotis septentrionalis* and *Myotis sodalis* in green are correct. Those in red fail and those in orange indicate failure to meet MLE < 0.05 to signify presence but indicate program identification of individual calls of those species.**

USFWS 4.5.0 S/A: 0		EPTFUS	LASBOR	LASCIN	LASNOC	MYOAUS	MYOGRI	MYOLEI	MYOLUC	MYOSEP	MYOSOD	NYCHUM	PERSUB
test 1	all	0	0	0	0.805122	0.04507	0	0.000787	0	0.0009813	0	NA	0
	no MYOSEP	0	0	0	0.834664	0.2073613	0	0.0007198	0	1	0	NA	0
	no MYOSOD	0	0	0	0.806134	0.1807296	0	0.0003613	0	0.0000891	0	NA	0
test 2	all	0.0000771	0	0	0.12661	0.0173123	0	1	0	0.0374275	0	NA	0
	no MYOSEP	0.0000701	0	0	0.12784	0.1193945	0	1	0	1	0	NA	0
	no MYOSOD	0.0000787	0	0	0.126643	0.0176264	0	1	0	0.0100126	0.0000044	NA	0
test 3	all	0.0000001	0	0	0.236992	0.0924382	0	0.0487432	0	0.0002445	0.0000292	NA	0
	no MYOSEP	0.0000001	0	0	0.229489	0.3898074	0	0.0473724	0	0.7748281	0.0000051	NA	0
	no MYOSOD	0.0000004	0	0	0.233399	0.0910219	0	0.0283133	0	0.0000104	0.1613928	NA	0
test 4	all	0.0000004	0	0	0.089053	0.0176045	0	0.057026	0	0.0000005	0	NA	0
	no MYOSEP	0.0000003	0	0	0.083287	0.0985545	0	0.0568956	0	1	0	NA	0
	no MYOSOD	0.0000003	0	0	0.087093	0.0157264	0	0.0382789	0	0	0.1170208	NA	0
test 5	all	0	0	0	0.302584	0.0171451	0	0.0484305	0	0.0000146	0	NA	0
	no MYOSEP	0	0	0	0.322695	0.093666	0	0.048505	0	1	0	NA	0
	no MYOSOD	0	0	0	0.301534	0.0919244	0	0.0373554	0	0.0000009	0.0000011	NA	0
test 6	all	0.0000001	0	0	0.677776	0.017005	0	0.0474703	0	0.0140614	0	NA	0
	no MYOSEP	0.0000003	0	0	0.723789	0.1030543	0	0.046918	0	1	0	NA	0
	no MYOSOD	0.0000001	0	0	0.679498	0.0154264	0	0.0311928	0	0.0020228	0	NA	0
test 7	all	0.0000046	0	0	0.154018	0.0003947	0	0.0457864	0	0.0000727	0	NA	0
	no MYOSEP	0.0000037	0	0	0.149011	0.0165609	0	0.0446466	0	0.4036296	0	NA	0
	no MYOSOD	0.0000046	0	0	0.152707	0.0024398	0	0.029295	0	0.0000038	0.0000003	NA	0
test 8	all	0	0	0	0.953006	0.008091	0	0.0008836	0	0.0000435	0	NA	0
	no MYOSEP	0	0	0	0.961849	0.0480552	0	0.0008431	0	1	0	NA	0
	no MYOSOD	0	0	0	0.953244	0.0077108	0	0.0004883	0	0.0000004	0.0000042	NA	0
test 9	all	0	0	0	1	0.0023133	0	1	0	0.0001682	0	NA	0
	no MYOSEP	0	0	0	1	0.0172256	0	1	0	1	0	NA	0
	no MYOSOD	0	0	0	1	0.0168928	0	1	0	0.0000144	0.0097114	NA	0
test 10	all	0.0000004	0	0	0.183642	0.6268378	0	0.0009396	0	0.000026	0	NA	0
	no MYOSEP	0.0000003	0	0	0.185948	0.6245363	0	0.0008687	0	0.8994246	0	NA	0
	no MYOSOD	0.0000007	0	0	0.185676	0.607046	0	0.0004219	0	0.0000009	0.0106749	NA	0

**Table 2. Producers's accuracy for version 4.5 at the 0 setting.**

	Found	SD	Mis-ID
EPTFUS	0.82	0.7	NOID
LASBOR	0.9	0.83	NOID
LASCIN	0.8	0.72	NOID
LASNOC	0.46	0.16	NOID
MYOAUS	0	0	MYOLUC
MYOGRI	0.44	0.38	NOID
MYOLEI	0.08	0.19	MYOAUS
MYOLUC	0.44	0.39	MYOSOD
MYOSEP	0.3	0.28	NOID
MYOSOD	0.3	0.26	MYOLUC
NYCHUM	NA	NA	NA
PERSUB	0.83	0.69	MOID

**Table 3. Uses's accuracy for version 4.5 at the 0 setting.**

	Found	SD	Mis-ID
EPTFUS	0.61	0.67	LASNOC
LASBOR	0.45	0.44	NYCHUM
LASCIN	0.09	0.15	NOID
LASNOC	0.58	0.44	NOID
MYOAUS	0	0	NOID
MYOGRI	0.48	0.44	PERSUB
MYOLEI	1	1	CORRECT
MYOLUC	0.54	0.49	MYOSOD
MYOSEP	0.97	0.87	MYOLUC
MYOSOD	0.53	0.34	MYOLUC
NYCHUM	NA	NA	NA
PERSUB	0.74	0.69	NOID

**Table 4. Summary MLE results for version 4.5 at the -1 setting. *Myotis septentrionalis* and *Myotis sodalis* in green are correct. Those in red fail and those in orange indicate failure to meet MLE < 0.05 to signify presence but indicate program identification of individual calls of those species.**

USFWS 4.5.0 S/A:-1		EPTFUS	LASBOR	LASCIN	LASNOC	MYOAUS	MYOGRI	MYOLEI	MYOLUC	MYOSEP	MYOSOD	NYCHUM	PERSUB
test 1	all	0.000007	0	0	0.984883	0.6193253	0.0000001	0.0000097	0	0.0000231	0.0000138	NA	0.0000358
	no MYOSEP	0.000005	0	0	0.982069	0.2546236	0.0000001	0.0001198	0	1	0.0000027	NA	0.0000346
	no MYOSOD	0.000007	0	0	0.985095	0.6631532	0.0000001	0.0002977	0	0.0000005	0.0002763	NA	0.0000358
test 2	all	0.0013026	0	0	0.375361	0.3258967	0	0.0001127	0	0.0526728	0	NA	0
	no MYOSEP	0.0012532	0	0	0.404468	0.2545022	0	0.0019079	0	1	0	NA	0
	no MYOSOD	0.0013889	0	0	0.375599	0.3133329	0	0.0000298	0	0.0057409	0.0000465	NA	0
test 3	all	0.0000052	0	0	0.814979	0.0002982	0.0000019	0.0000028	0	0.008606	0.0038579	NA	0.0000081
	no MYOSEP	0.0000042	0	0	0.859153	0.016933	0.000001	0.0000365	0	1	0.0010759	NA	0.0000083
	no MYOSOD	0.0000056	0	0	0.816395	0.0000848	0.0000009	0.0000784	0	0.0001418	0.0307984	NA	0.0000081
test 4	all	0.0000428	0	0	0.48177	0.7864981	0.0000006	0.0000032	0	0.0000841	0.001984	NA	0.0000568
	no MYOSEP	0.0000333	0	0	0.432553	0.900766	0.0000003	0.0000019	0	1	0.0001151	NA	0.0000364
	no MYOSOD	0.0000458	0	0	0.477473	0.6600876	0.0000015	0.0000745	0	0.0000011	0.58822	NA	0.0000627
test 5	all	0.0000047	0	0	0.757729	0.3756496	0.0000022	0.0000016	0	0.0000473	0.0000002	NA	0.0001278
	no MYOSEP	0.0000032	0	0	0.755758	0.7498012	0.0000013	0.000018	0	1	0	NA	0.0000663
	no MYOSOD	0.0000048	0	0	0.760162	0.3853779	0.0000022	0.0000301	0	0.0000084	0.002986	NA	0.0001302
test 6	all	0.0002123	0	0	0.923156	0.0005437	0	0.0000505	0	0.008481	0	NA	0.0000121
	no MYOSEP	0.0001853	0	0	0.943798	0.0164774	0	0.0001461	0	1	0	NA	0.000013
	no MYOSOD	0.0002253	0	0	0.923846	0.0002015	0	0.0001946	0	0.000832	0.0002391	NA	0.000012
test 7	all	0.0000919	0	0	0.757016	0.0488062	0.0000044	0.0000217	0	0.0065532	0.000002	NA	0.0000284
	no MYOSEP	0.0000809	0	0	0.811708	0.0388436	0.0000029	0.0000709	0	1	0.0000005	NA	0.0000383
	no MYOSOD	0.0000981	0	0	0.759211	0.0509168	0.0000032	0.002312	0	0.0002035	0.0013458	NA	0.0000308
test 8	all	0.0000021	0	0	0.892024	0.0172282	0.0000437	0.0000018	0	0.0068454	0.0000293	NA	0
	no MYOSEP	0.0000017	0	0	0.91915	0.101274	0.0000341	0.0000002	0	1	0.0000023	NA	0
	no MYOSOD	0.0000022	0	0	0.892743	0.0045039	0.0000303	0.0039863	0	0.000326	0.011207	NA	0
test 9	all	0	0	0	1	0.1279494	0.0000007	0.0006051	0	0.0053469	0.0006392	NA	0.0000411
	no MYOSEP	0	0	0	1	0.2502383	0.0000004	0.0004645	0	1	0.0000369	NA	0.0000424
	no MYOSOD	0	0	0	1	0.1715259	0.0000002	0.0006579	0	0.0003424	0.1475798	NA	0.0000422
test 10	all	0.0000592	0	0	0.849103	0.2533131	0	0.0001355	0	0.0044449	0.0002411	NA	0.000138
	no MYOSEP	0.0000409	0	0	0.836723	0.7618582	0	0.0021177	0	1	0.0000098	NA	0.0000642
	no MYOSOD	0.0000636	0	0	0.850192	0.1806139	0	0.0009115	0	0.0001114	0.0142074	NA	0.0001413

**Table 5. Producers's accuracy for version 4.5 at the -1 setting.**

	Found	SD	Mis-ID
EPTFUS	0.53	0.57	LASNOC
LASBOR	0.4	0.39	NYCHUM
LASCIN	0.04	0.12	NOID
LASNOC	0.54	0.47	NOID
MYOAUS	0	0	MYOSEP
MYOGRI	0.33	0.42	MYOAUS
MYOLEI	0.6	0.39	MYOSOD
MYOLUC	0.49	0.45	MYOSOD
MYOSEP	0.81	0.66	MYOLUC
MYOSOD	0.38	0.21	MYOLUC
NYCHUM	NA	NA	NA
PERSUB	0.69	0.64	NOID

**Table 6. User's accuracy for version 4.5 at the -1 setting.**

	Found	SD	Mis-ID
EPTFUS	0.85	0.8	MYOSOD
LASBOR	0.9	0.8	MYOLUC
LASCIN	1	1	CORRECT
LASNOC	0.74	0.82	EPTFUS
MYOAUS	0	0	MYOSEP
MYOGRI	1	1	CORRECT
MYOLEI	0.52	0.42	MYOAUS
MYOLUC	0.59	0.5	MYOSOD
MYOSEP	0.64	0.56	MYOAUS
MYOSOD	0.35	0.21	MYOLUC
NYCHUM	NA	NA	NA
PERSUB	0.95	0.84	MYOGRI

**Table 7. Summary MLE results for version 4.3 at the 0 setting. Myotis septentrionalis and Myotis sodalis in green are correct. Those in red fail and those in orange indicate failure to meet MLE < 0.05 to signify presence but indicate program identification of individual calls of those species.**

		EPTFUS	LASBOR	LASCIN	LASNOC	MYOAUS	MYOGRI	MYOLEI	MYOLUC	MYOSEP	MYOSOD	NYCHUM	PERSUB	
4.3.0 S/A: 0	test 1	all	0.000007	0	0	0.958072	0.000046	0	0	0	0.0108645	0	0.129382	0
		no MYOSEP	0.000011	0	0	0.963849	0.000007	0	0	0	1	0	0.225355	0
		no MYOSOD	0.000008	0	0	0.958195	0.0000321	0	0	0	0.0009768	0.0000001	0.136718	0
	test 2	all	0.0000341	0	0	0.066001	0.2498957	0	0	0	0.0585913	0	0.229468	0
		no MYOSEP	0.0000609	0	0	0.074446	0.1317492	0	0	0	1	0	0.245534	0
		no MYOSOD	0.0000332	0	0	0.066423	0.2402451	0	0	0	0.0121022	0.0000001	0.235958	0
	test 3	all	0.0000015	0	0	0.08385	0.0010532	0	0	0	0.0319201	0.0000001	0.012569	0
		no MYOSEP	0.0000017	0	0	0.093014	0.0000789	0	0	0	1	0	0.020523	0
		no MYOSOD	0.0000017	0	0	0.083553	0.0007761	0	0	0	0.0051539	0.0000376	0.016497	0
	test 4	all	0.0000578	0	0	0.076682	0.0279497	0	0	0	0.0013641	0	0.230135	0
		no MYOSEP	0.0000762	0	0	0.077112	0.1261939	0	0	0	1	0	0.234993	0
		no MYOSOD	0.0000597	0	0	0.076171	0.0258049	0	0	0	0.0001182	0.0020223	0.237345	0
	test 5	all	0	0	0	0.690497	0.3260003	0	0	0	0.000575	0	0.265617	0
		no MYOSEP	0	0	0	0.695112	0.1316785	0	0	0	1	0	0.280956	0
		no MYOSOD	0	0	0	0.691999	0.3061794	0	0	0	0.0000147	0.0000921	0.276603	0
	test 6	all	0.0000076	0	0	0.042917	0.0000153	0	0	0	0.3311094	0	0.696457	0
		no MYOSEP	0.0000155	0	0	0.057252	0.0000981	0	0	0	1	0	0.785193	0
		no MYOSOD	0.0000093	0	0	0.042646	0.000011	0	0	0	0.1294772	0.0000064	0.7058	0
	test 7	all	0.0000091	0	0	0.375418	0.0012607	0	0	0	0.0077913	0	0.049536	0
		no MYOSEP	0.0000086	0	0	0.357277	0.0001535	0	0	0	0.9323383	0	0.030477	0
		no MYOSOD	0.0000104	0	0	0.376615	0.0009912	0	0	0	0.0004219	0.0000639	0.054275	0
	test 8	all	0.0000001	0	0	0.523807	0	0	0	0	0.1476766	0	0.078956	0
		no MYOSEP	0.0000001	0	0	0.559846	0	0	0	0	1	0	0.150229	0
		no MYOSOD	0.0000001	0	0	0.525486	0	0	0	0	0.0434729	0.0000731	0.082642	0
	test 9	all	0	0	0	1	0.001086	0	0	0	0.0441434	0	0.974578	0
		no MYOSEP	0	0	0	1	0.0047401	0	0	0	1	0	0.988041	0
		no MYOSOD	0	0	0	1	0.0008505	0	0	0	0.0062788	0.0003323	0.976997	0
	test 10	all	0.0000432	0	0	0.234388	0.0245503	0	0	0	0.0116747	0	0.544046	0
		no MYOSEP	0.000019	0	0	0.208964	0.151026	0	0	0	0.9648618	0	0.547552	0
		no MYOSOD	0.0000417	0	0	0.235043	0.021969	0	0	0	0.0014789	0.0001386	0.555562	0

**Table 8. Producers's accuracy for version 4.3 at the 0 setting.**

	Found	SD	Mis-ID
EPTFUS	0.72	0.59	NOID
LASBOR	0.61	0.59	NOID
LASCIN	0.90	0.86	NOID
LASNOC	0.43	0.37	NOID
MYOAUS	0.00	0.00	NYCHUM
MYOGRI	0.52	0.56	NOID
MYOLEI	0.25	0.21	MYOAUS
MYOLUC	0.44	0.39	NOID
MYOSEP	0.27	0.24	NOID
MYOSOD	0.22	0.28	MYOLUC
NYCHUM	0.62	0.05	LASBOR
PERSUB	0.80	0.62	NOID

**Table 9. User's accuracy for version 4.3 at the 0 setting.**

	Found	SD	Mis-ID
EPTFUS	0.63	0.66	LASNOC
LASBOR	0.68	0.63	NYCHUM
LASCIN	0.07	0.13	NOID
LASNOC	0.53	0.41	NOID
MYOAUS	0.00	0.00	NOID
MYOGRI	0.38	0.49	NOID
MYOLEI	1.00	1.00	CORRECT
MYOLUC	0.45	0.43	MYOSOD
MYOSEP	1.00	1.00	CORRECT
MYOSOD	0.43	0.39	MYOLUC
NYCHUM	0.54	0.35	LASBOR
PERSUB	0.69	0.68	NOID

Table 10 . Summary MLE results for version 4.3 at the -1 setting. *Myotis septentrionalis* and *Myotis sodalis* in green are correct. Those in red fail and those in orange indicate failure to meet MLE < 0.05 to signify presence but indicate program identification of individual calls of those species.

4.3.0 S/A:-1		EPTFUS	LASBOR	LASCIN	LASNOC	MYOAUS	MYOGRI	MYOLEI	MYOLUC	MYOSEP	MYOSOD	NYCHUM	PERSUB
test 1	all	0.000065	0	0	0.508384	0.1773317	0	0	0	0.0001844	0	1	0.0000161
	no MYOSEP	0.0000733	0	0	0.51393	0.1100775	0	0.0000011	0	0.9086276	0	1	0.0000189
	no MYOSOD	0.0000591	0	0	0.502157	0.1732206	0	0.0000001	0	0.0000003	0.0000019	1	0.0000122
test 2	all	0.0049288	0	0	0.034482	0.1375628	0	0.0000029	0	0.0145055	0	1	0
	no MYOSEP	0.0039437	0	0	0.0244	0.0735796	0	0.000021	0	1	0	1	0
	no MYOSOD	0.0048333	0	0	0.033879	0.1489101	0	0.0000205	0	0.0011871	0	1	0
test 3	all	0.0002865	0	0	0.050193	0.0255847	0	0.0000325	0	0.0001326	0.0000001	1	0.0000005
	no MYOSEP	0.0003362	0	0	0.047708	0.187632	0	0.0000094	0	0.9020625	0	1	0.0000008
	no MYOSOD	0.0003051	0	0	0.051227	0.0298799	0	0.0003145	0	0.0000009	0.0001149	1	0.0000004
test 4	all	0.0080125	0	0	0.007231	0.2091849	0	0.0008651	0	0.0000025	0	1	0.0000811
	no MYOSEP	0.0101427	0	0	0.008271	0.2898844	0	0.0005315	0	0.9375007	0	1	0.0001522
	no MYOSOD	0.0087054	0	0	0.00781	0.206671	0	0.00713	0	0	0.0063454	1	0.0000837
test 5	all	0.0000346	0	0	0.223044	0.7263853	0	0.0000001	0	0.0000902	0	1	0.0004046
	no MYOSEP	0.0000017	0	0	0.086268	1	0	0	0	1	0	1	0.0005381
	no MYOSOD	0.000033	0	0	0.216116	0.6350078	0	0.0000002	0	0.0000037	0.0001504	1	0.0003592
test 6	all	0.002479	0	0	0.052605	0.0000187	0	0	0	0.0939348	0	1	0.0000045
	no MYOSEP	0.0024842	0	0	0.052634	0.0074285	0	0.0000062	0	1	0	1	0.0000041
	no MYOSOD	0.0024986	0	0	0.052712	0.0000267	0	0.0000002	0	0.0099099	0.0002842	1	0.0000039
test 7	all	0.0071349	0	0	0.154204	0.0061833	0	0.0000376	0	0.0144478	0	1	0.0000011
	no MYOSEP	0.0066103	0	0	0.146182	0.0066504	0	0.000077	0	1	0	1	0.0000009
	no MYOSOD	0.0071858	0	0	0.152848	0.0052904	0	0.0000058	0	0.0013801	0.0002575	1	0.0000008
test 8	all	0.0000166	0	0	0.252016	0.0161443	0	0.0000654	0	0.0023371	0	1	0
	no MYOSEP	0.0000169	0	0	0.212728	0.0184875	0	0.0001445	0	1	0	1	0
	no MYOSOD	0.0000174	0	0	0.23903	0.0152956	0	0.0004645	0	0.0002193	0.0016121	1	0
test 9	all	0.0000002	0	0	0.74879	0.0023234	0	0.0000221	0	0.1211494	0	1	0.0000041
	no MYOSEP	0.0000003	0	0	0.760768	0.06698	0	0.0000386	0	1	0	1	0.0000051
	no MYOSOD	0.0000002	0	0	0.752002	0.0019958	0	0.0000027	0	0.0273574	0.0000187	1	0.0000034
test 10	all	0.0009942	0	0	0.148313	0.1311717	0	0.0001044	0	0.0003653	0	1	0.000082
	no MYOSEP	0.001082	0	0	0.1554	0.6280788	0	0.0038261	0	0.4163965	0	1	0.0001553
	no MYOSOD	0.0009694	0	0	0.14621	0.1110616	0	0.0010017	0	0.0000246	0.0000039	1	0.0000685

Table 11. Producers's accuracy for version 4.3 at the -1 setting.

	Found	SD	Mis-ID
EPTFUS	0.60	0.60	LASNOC
LASBOR	0.58	0.52	NYCHUM
LASCIN	0.05	0.14	NOID
LASNOC	0.51	0.41	NOID
MYOAUS	0.00	0.00	MYOSEP
MYOGRI	0.35	0.45	MYOLEI
MYOLEI	0.65	0.38	MYOSOD
MYOLUC	0.47	0.42	MYOSOD
MYOSEP	0.69	0.48	MYOLUC
MYOSOD	0.39	0.25	MYOLUC
NYCHUM	0.43	0.33	LASBOR
PERSUB	0.67	0.63	MYOAUS

Table 12. User's accuracy for version 4.3 at the -1 setting.

	Found	SD	Mis-ID
EPTFUS	0.82	0.75	MYOLUC
LASBOR	0.64	0.64	NYCHUM
LASCIN	1.00	1.00	CORRECT
LASNOC	0.71	0.61	EPTFUS
MYOAUS	0.00	0.00	NYCHUM
MYOGRI	1.00	1.00	CORRECT
MYOLEI	0.55	0.38	MYOAUS
MYOLUC	0.60	0.52	MYOSOD
MYOSEP	0.53	0.41	MYOLUC
MYOSOD	0.36	0.29	MYOLUC
NYCHUM	0.71	0.71	LASBOR
PERSUB	0.94	0.81	MYOGRI