FINAL REPORT

**A COMPARISON OF LEVELS OF BAT FLIGHT AND FORAGING ACTIVITY AT
10 METERS AND 30 METERS ABOVE DRAINED CAROLINA BAYS AND
REFERENCE BAYS, PRIOR TO BAY RESTORATION**

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During summer 2000, we monitored levels of bat flight and foraging activity at 10 and 30 m above 6 drained and 6 reference (undrained) Carolina bays at the Savannah River Site (SRS), located near Aiken, South Carolina. To determine if the vegetational community type or structure of the forest community surrounding the bays affected bat activity levels, we monitored activity over 3 drained and 3 reference bays surrounded by pine/mixed hardwood communities and 3 drained and 3 reference bays surrounded by pine monocultures (see proposal for a detailed description of study design). We monitored bat activity using time expansion bat detectors. Calls were recorded to Sony Professional tape recorders (Sony WMD3). Detectors positioned at 10 m heights were linked directly to the tape recorders. We used time-expansion radiomicrophones to monitor activity at 30 m heights. The radiomicrophones were attached to 2-m diameter helium balloons and suspended approximately 30 m above the forest floor. Calls detected by the radiomicrophones were transmitted via a FM narrowband frequency to a scanner on the ground. Calls were recorded from the scanner.

We attempted to monitor bat activity over each of 12 bays for 4 nights. Because of inclement weather (e.g. high wind, thunderstorms) and equipment malfunction, we recorded analyzable data an average of 3 and 1 nights at 10 and 30 m, respectively for each bay sampled. We recorded a total of 467 calls and 33 feeding buzzes. Species recorded included eastern red/Seminole bats (*Lasiurus borealis*, *L. seminolus*; $n = 182$; grouped because of unreliability of distinguishing the calls of the 2 species), evening bats (*Nycticeius humeralis*, $n = 98$), big brown bats (*Eptesicus fuscus*, $n = 83$), hoary bats (*Lasiurus cinerius*, $n = 67$), eastern pipistrelles (*Pipistrellus subflavus*, $n = 33$), and southeastern myotis (*Myotis austroriparius*, $n = 3$). We recorded feeding buzzes of

eastern red/Seminole bats ($n = 13$), big brown bats ($n = 6$), hoary bats ($n = 6$), evening bats ($n = 4$), eastern pipistrelles ($n = 3$), and a southeastern myotis ($n = 1$).

When all data was pooled, irrespective of height or the vegetational community type surrounding the bays, a significantly greater number of calls of evening bats, big brown bats, and hoary bats were recorded over reference than drained bays (Table 1, Figure 1). The number of feeding buzzes recorded did not differ between drained and reference bays (Table 2, Figure 2). Our preliminary results suggest the surrounding vegetational community type strongly affected levels of bat activity over the bays. Bat activity levels were highest over reference bays surrounded by pine monocultures. In contrast, levels of bat activity over reference bays surrounded by pine/mixed hardwoods was the same as, or lower than, levels of activity over drained bays (Table 3, Figure 3). Levels of activity of eastern red/Seminole bats, evening bats, big brown bats, and hoary bats were significantly higher over reference bays surrounded by pines than drained bays or reference bays surrounded by pine/mixed hardwoods (Table 3, Figure 3). The number of feeding buzzes emitted by eastern red/Seminole bats also was significantly higher over reference bays surrounded by pines (Table 4, Figure 4). Levels of activity of eastern pipistrelles and southeastern myotids did not differ among the bays.

Interesting trends also emerged when the effect of monitoring height was considered. Although variance was high, comparison of figures 5 and 7 suggest that activity of big brown bats and hoary bats was greatest at 30-m heights, whereas activity of eastern red/Seminole bats was highest at 10 m. At 10 m, the activity of eastern red/Seminole bats, evening bats, and big brown bats differed significantly with the highest levels of activity recorded over reference bays surrounded by pines (Table 5,

Figure 5). Activity levels of hoary bats did not differ at 10 m. Although the same general trend was detected at 30 m for evening bats, activity levels of eastern red/Seminole bats and big brown bats did not differ among bays at 30 m. Although activity levels of hoary bats did not differ among bays at 10 m, at 30 m heights hoary bat activity was significantly higher above reference bays surrounded by pines than reference bays surrounded by pine/mixed hardwoods or drained bays (Table 7, Figure 7).

Foraging activity was low over all bays monitored. We did not detect any difference in levels of foraging activity over the bays at heights of 10 m (Table 6, Figure 6). Our inability to detect differences in levels of foraging activity over the bays may have resulted from our low samples sizes. However, at 30 m, levels of foraging activity by eastern red/Seminole bats were significantly higher over reference bays surrounded by pines than all other bays (Table 8, Figure 8).

Despite technical difficulties encountered in 2000, analysis of our pretreatment data indicates significant differences in levels of flight and foraging activity over the drained and reference bays prior to the treatment. In addition, analyses indicated that surrounding vegetational community type strongly impacted the levels of bat foraging activity above the bays. Although larger sample sizes may have permitted us to detect differences in levels of foraging activity among treatments, the pretreatment data we collected will be sufficient to allow us to quantify the effect of the treatments, post-treatment, on bat activity patterns.

Table 1. A comparison (Wilcoxon Test) of the mean number of calls collected per night over reference and restoration bays during 2000 (pretreatment).

Variable	Reference		Treatment		Chi Square	P
	Mean	SE	Mean	SE		
LABOSE	3.793	1.2160	3.130	0.7935	0.000	1.000
PISU	0.828	0.4154	0.391	0.2154	0.368	0.544
NYHU	2.621	0.6685	0.957	0.3413	3.685	0.055
EPFU	2.517	1.2364	0.435	0.1971	6.030	0.014
LACI	2.138	1.2113	0.217	0.2174	7.414	0.007
MYAU	0.103	0.0576	0.000	0.0000	2.476	0.116
NOID	0.000	0.0000	0.043	0.0435	1.261	0.262

Table 2. A comparison (Wilcoxon Test) of the mean number of feeding buzzes collected per night over reference and restoration bays during 2000 (pretreatment).

Variable	Reference		Treatment		Chi Square	P
	Mean	SE	Mean	SE		
LABOSE	0.310	0.1005	0.174	0.0808	0.821	0.364
PISU	0.103	0.0576	0.000	0.0000	2.476	0.116
NYHU	0.069	0.0479	0.087	0.0601	0.057	0.811
EPFU	0.207	0.2069	0.000	0.0000	0.793	0.373
LACI	0.172	0.1410	0.043	0.0435	0.168	0.681
MYAU	0.034	0.0345	0.000	0.0000	0.793	0.373
NOID	0.000	0.0000	0.000	0.0000	0.000	1.000

Table 3. A comparison of the mean number of calls recorded per night over reference and treatment bays surrounded by mixed pine hardwoods and by pines, pretreatment. Because the data was non-normally distributed, ANOVA was performed on ranked values. Means followed by the same letter are not significantly different (Duncan's MMC).

Variable	Pine hardwood reference		Pine hardwood treatment		Pine reference		Pine treatment		F	P
	Mean	SE	Mean	SE	Mean	SE	Mean	SE		
LABOSE	0.800 c	0.175	2.818 bc	0.971	7.000 a	2.243	3.417 b	1.270	6.78	0.0007
PISU	0.800	0.480	0.727	0.428	0.857	0.710	0.083	0.083	0.63	0.6000
NYHU	0.600 bc	0.235	0.273 c	0.195	4.786 a	1.110	1.583 b	0.583	10.96	0.0001
EPFU	0.667 b	0.252	0.273 b	0.195	4.500 a	2.482	0.583 b	0.336	4.44	0.0078
LACI	0.533 b	0.350	0.455 b	0.455	3.857 a	2.442	0.000 b	0.000	5.46	0.0026
MYAU	0.067	0.067	0.000	0.000	0.143	0.097	0.000	0.000	1.08	0.3650
NOID	0.000	0.000	0.091	0.091	0.000	0.000	0.000	0.000	1.26	0.2981

Table 4. A comparison of the mean number of feeding buzzes recorded per night over reference and treatment bays surrounded by mixed pine hardwoods and by pines, pretreatment. Because the data was non-normally distributed, ANOVA was performed on ranked values. Means followed by the same letter are not significantly different (Duncan's MMC).

[illegible]

Table 5. A comparison of the mean number of calls recorded per night at 10 m over reference and treatment bays surrounded by mixed pine hardwoods and by pines, pretreatment. Because the data was non-normally distributed, ANOVA was performed on ranked values. Means followed by the same letter are not significantly different (Duncan's MMC).

[illegible]

Table 6. A comparison of the mean number of feeding buzzes recorded per night at 10 m over reference and treatment bays surrounded by mixed pine hardwoods and by pines, pretreatment. Because the data was non-normally distributed, ANOVA was performed on ranked values. Means followed by the same letter are not significantly different (Duncan's MMC).

	Pine hardwood reference	Pine hardwood treatment	F	P
Variable	Mean	SE	Mean	SE
LABOSE	0.091	0.091	0.286	0.184
PISU	0.091	0.091	0.000	0.000
NYHU	0.091	0.091	0.143	0.143
EPFU	0.000	0.000	0.000	0.000
LACI	0.091	0.091	0.000	0.000
MAYAU	0.091	0.091	0.000	0.000
NOID	0.000	0.000	0.000	0.000

Table 7. A comparison of the mean number of calls recorded per night at 30 m over reference and treatment bays surrounded by mixed pine hardwoods and by pines, pretreatment. Because the data was non-normally distributed, ANOVA was performed on ranked values. Means followed by the same letter are not significantly different (Duncan's MMC).

Variable	Pine hardwood reference			Pine hardwood treatment			Pine reference		Pine treatment		
	Mean	SE		Mean	SE		Mean	SE	Mean	SE	P
LABOSE	1.000	0.408		4.000	2.646		2.667	0.667	4.200	2.939	0.52 0.6778
PISU	0.500	0.500		0.333	0.333		0.000	0.000	0.000	0.000	0.79 0.5263
NYHU	0.250 b	0.250		0.667 b	0.667		3.333 a	0.882	2.200 ab	1.068	3.34 0.0595
EPFU	0.250	0.250		0.333	0.333		12.667	11.681	1.400	0.678	1.00 0.4270
LACI	0.000 b	0.000		0.000 b	0.000		12.000 a	11.015	0.000 b	0.000	5.71 0.0132
MYAU	0.000	0.000		0.000	0.000		0.333	0.333	0.000	0.000	1.47 0.2771
NOID	0.000	0.000		0.333	0.333		0.000	0.000	0.000	0.000	1.47 0.2771

Table 8. A comparison of the mean number of feeding buzzes recorded per night at 30 m over reference and treatment bays surrounded by mixed pine hardwoods and by pines, pretreatment. Because the data was non-normally distributed, ANOVA was performed on ranked values. Means followed by the same letter are not significantly different (Duncan's MMC).

Variable	Pine hardwood reference			Pine hardwood treatment			Pine reference		Pine treatment		
	Mean	SE		Mean	SE		Mean	SE	Mean	SE	P
LABOSE	0.000 b	0.000		0.000 b	0.000		0.667 a	0.333	0.000 b	0.000	5.87 0.0121
PISU	0.250	0.250		0.000	0.000		0.000	0.000	0.000	0.000	0.90 0.4737
NYHU	0.000	0.000		0.333	0.333		0.000	0.000	0.000	0.000	1.47 0.2771
EPFU	0.000	0.000		0.000	0.000		2.000	2.000	0.000	0.000	1.47 0.2771
LACI	0.000	0.000		0.000	0.000		1.333	1.333	0.000	0.000	1.47 0.2771
MYAU	0.000	0.000		0.000	0.000		0.000	0.000	0.000	0.000	0.00 1.0000
NOID	0.000	0.000		0.000	0.000		0.000	0.000	0.000	0.000	0.00 1.0000

Fig. 1. A comparison of the number of calls collected over drained and reference bays, irrespective of height or surrounding treatment, pretreatment, at the Savannah River Site, Summer 2000.

Fig. 2. A comparison of the number of feeding buzzes collected over drained and reference bays, irrespective of height or surrounding treatment, pretreatment, at the Savannah River Site, Summer 2000.

Fig. 3. A comparison of the number of calls collected over drained (treat) and reference (ref) bays surround by mixed pine hardwood (ph) forests and pine monocultures (p), pretreatment, at the Savannah River Site, Summer 2000.

Fig. 4. A comparison of the number of feeding buzzes collected over drained (treat) and reference (ref) bays surround by mixed pine hardwood (ph) forests and pine monocultures (p), pretreatment, at the Savannah River Site, Summer 2000.

Fig. 5. A comparison of the number of calls collected over drained (treat) and reference (ref) bays surround by mixed pine hardwood (ph) forests and pine monocultures (p) at a height of 10 m, pretreatment, at the SRS, Summer 2000.

Fig. 6. A comparison of the number of feeding buzzes collected over drained (treat) and reference (ref) bays surround by mixed pine hardwood (ph) forests and pine monocultures (p) at a height of 10 m, pretreatment, at the SRS, Summer 2000.

Fig. 7. A comparison of the number of calls collected over drained (treat) and reference (ref) bays surround by mixed pine hardwood (ph) forests and pine monocultures (p) at a height of 30 m, pretreatment, at the SRS, Summer 2000.

Fig. 8. A comparison of the number of feeding buzzes collected over drained (treat) and reference (ref) bays surround by mixed pine hardwood (ph) forests and pine monocultures (p) at a height of 30 m, pretreatment, at the SRS, Summer 2000.