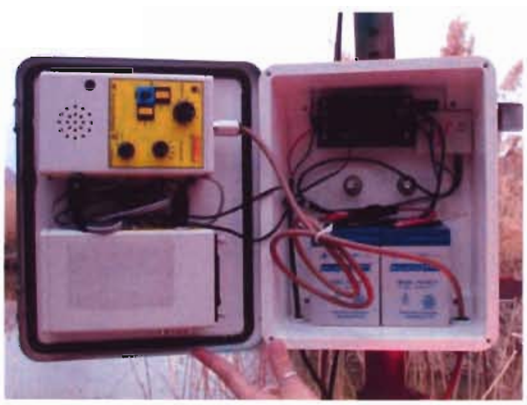
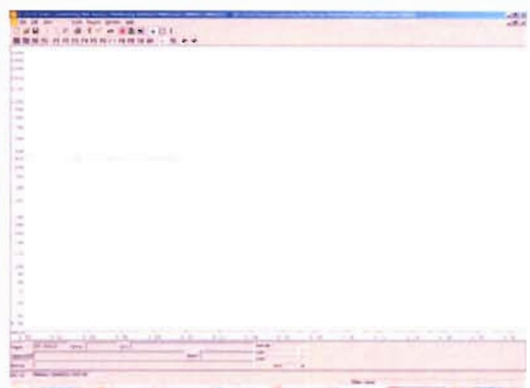
Las Vegas Wash Coordination Committee

Las Vegas Wash Bat Survey, 2004-2005





June 2006

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Las Vegas Wash Coordination Committee

Las Vegas Wash Bat Survey, 2004-2005

SOUTHERN NEVADA WATER AUTHORITY
Las Vegas Wash Project Coordination Team

Prepared For:
Las Vegas Wash Coordination Committee

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June 2006

ACKNOWLEDGEMENTS

We wish to thank the U.S. Bureau of Reclamation for providing funding to the Southern Nevada Water Authority under assistance agreement grant 03FG300027 for this study. The Southern Nevada Water Authority furnished the hardware to construct the three monitoring stations and provided personnel to service and maintain these units. Marissa Foster was invaluable for maintaining the monitoring stations and ensuring high quality data acquisition. Nick Rice contributed significantly with maintaining and configuring monitoring stations. Chris Corben has continued to provide advances in the analytic software allowing projects such as the present one to reach a successful conclusion. Chris Lowrey and Jason Williams provided invaluable help with statistics. We would like to thank the members of the Research and Environmental Study Team for reviewing this document and the Las Vegas Wash Coordination Committee for their continued support for this project and the implementation of the Las Vegas Wash Comprehensive Adaptive Management Plan.

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1.0 SUMMARY

Three continuous acoustic monitoring stations were established in the Las Vegas Wash (Wash) approximately 1.6 km apart in January 2004. Sites were intentially selected to sample the range of microhabitats available. The Downstream Station is located in a broad open portion of channel with sparse patches of common reed and quail bush. The Midstream Station is located in a backwater marsh habitat borderd by a dense stand of common reed and a patchy distribution of open water, unvegetated sandbars, and dense tamarisk. The Upstream Station is located along a narrow, incised portion of the Wash 4 m below the historical floodplain and is bordered by dense tamarisk.

A total of 17 species were documented for 2004 and 2005; eight are listed as Federal Species of Special Concern, four are State-listed Sensitive, and four are State-listed Protected. Fifty percent of all bat activity was recorded at the Upstream Station. The greatest species richness was found at the Downstream Station with 16 species and the least was found at the Midstream Station with 13 species. Four species (*Myotis yumanensis, My. californicus, Pipistrellus hesperus*, and *Tadarida brasiliensis*) comprised ≥ 90% of the activity at the Downstream Station both years and the Midstream Station in 2004 and *My. californicus* was replaced by *Lasiurus cinereus* in 2005. Three of the species (*My. californicus, M. yumanensis*, and *T. brasiliensis*) were core species at the Upstream Station but required *Lasiurus xanthinus*, and *Eptesicus fuscus* in 2004 and *L. xanthinus* and *P. hesperus* in 2005 to account for ≥ 90% of activity. Based on the amount of time spent at each monitoring station, habitat selection was determined for six species: *P hesperus* spent 49 and 54% of the time (2004 and 2005, respectively) at the Downstream Station; *Antrozous pallidus* (57 and 69%, 2004 and 2005, respectively) and *Corynorhinus townsendii* (62%) selected the Midstream Station; and, *T brasiliensis* (65 and 55%, 2004 and 2005, respectively), *L. xanthinus* (66 and 96%, 2004 and 2005, respectively), and *E. fuscus* (92 and 90%, 2004 and 2005, respectively) predominated at the Upstream Station. Some species showed crepuscular activity with the peak within the first hour after sunset, minor activity through the night, and a small but distinct peak within the hour prior to sunrise. Others showed a somewhat later peak and then prolonged moderate to high activity through most of the night. A few species demonstrated a later peak around 4-5 hours after sunset and then declining activity through the remainder of the night.

Of the 17 species documented along the Wash in 2004-2005, four were uncommon statewide (*Macrotus californicus, L. xanthinus, Nyctinomops macrotis*, and *Eumops perotis*) and five had never been found in Las Vegas Valley before (*Myotis ciliolabrum, M. thysanodes, M. yumanensis, Lasiurus blossevillii,* and *Idionycteris phyllotis*). The sensitive *C. townsendii* was found consistently within the Wash from spring through fall indicating the potential of a nearby maternity roost. Most species comprise a breeding community. Two of the migratory species (*L. cinereus* and *L. blossevillii*) were found in small numbers through the summer. These individuals probably composed of males and non-reproductive females. Although some species may roost long distances from the Wash, it is clearly used as an important foraging area. Four of the species are known to be particularly quiet and difficult to detect acoustically (*A. pallidus, C. townsendii, M. thysanodes*, and *Macrotus californicus*) indicating a more widespread use and quantity of activity within the Wash.

The present study provides an initial database of unprecedented detail of bat presence, activity, and habitat use within the Wash. The data demonstrate clearly that activity was variable from night to night and year to year. These variations are probably due to changes in weather patterns and other unknown abiotic and biotic factors. Only a long-term database will address these factors.

2.0 INTRODUCTION

Prior to 1954, all records of bat occurrence were based on shooting, finding dead animals, or locating a roost site (Hall, 1946). In 1954, mist nets were introduced to North American bat work (Dalquest, 1954), resulting in the ability to conduct focused surveys. Little was known about bat occurrence and distribution in southern Nevada until mist net studies were initiated by me in 1964. These studies were confined to small water holes that could be effectively netted. Thus the sites studied were confined to the fringes of the Las Vegas Valley and beyond.

Although mist nets provide an enhanced ability to study localized bat faunas, there is considerable bias inherent in their use (Kunz and Kurta, 1988). Technological advances over the past decade have produced acoustic equipment capable of recording and displaying the time-frequency structure of echolocation calls which then allows identification of the vocalizing species (O'Farrell, 1997; O'Farrell et al., 1999). Acoustic surveys have limitations, particularly for quiet species (O'Farrell and Gannon, 1999). However, significantly more species can be documented by acoustic means than standard capture methods (Kalko et al., 1996; O'Farrell and Gannon, 1999; Ochoa et al., 2000).

The purpose of the present study is to provide a baseline of knowledge on temporal changes in inventory and differential habitat use within the Wash. Because the baseline is being accrued during the initial phase of an extensive riparian restoration program in the Wash, the effects of the program can be documented on resident and transient bat populations. This is a final report of the initial phase of baseline collection from January 2004 through December 2005.

3.0 MATERIALS AND METHODS

Three acoustic monitoring stations were established at select sites within the Wash that reflect the range of habitat configurations present (Figure 1). The Downstream Station was located in a broad open portion of channel (25 m wide) with sparse tamarisk (*Tamarix ramosissima*), patches of common reed (*Phragmites australis)*, and quail bush (*Atriplex lentiformis var. lentiformis*) nearby. The unit sampled a volume over this open area. The Midstream Station was located in a backwater marsh habitat created behind one of the erosion control structures. The station sampled a volume above a dense stand of common reed and cattails (*Typha domingensis*) although a portion of the sampling volume includes a patchy distribution of open water, unvegetated sandbars, and dense tamarisk. The Upstream Station was located along a narrow portion of the Wash where the active channel has incised the historical floodplain by 4 m. The station sampled a 10 m wide portion of the stream, which was bordered on the north by dense tamarisk and the south by a moderately vegetated sandbar of tamarisk and common reed. All stations were deployed and activated on January 7, 2004. However, technical problems with the Midstream station prevented data collection until February 5, 2004.

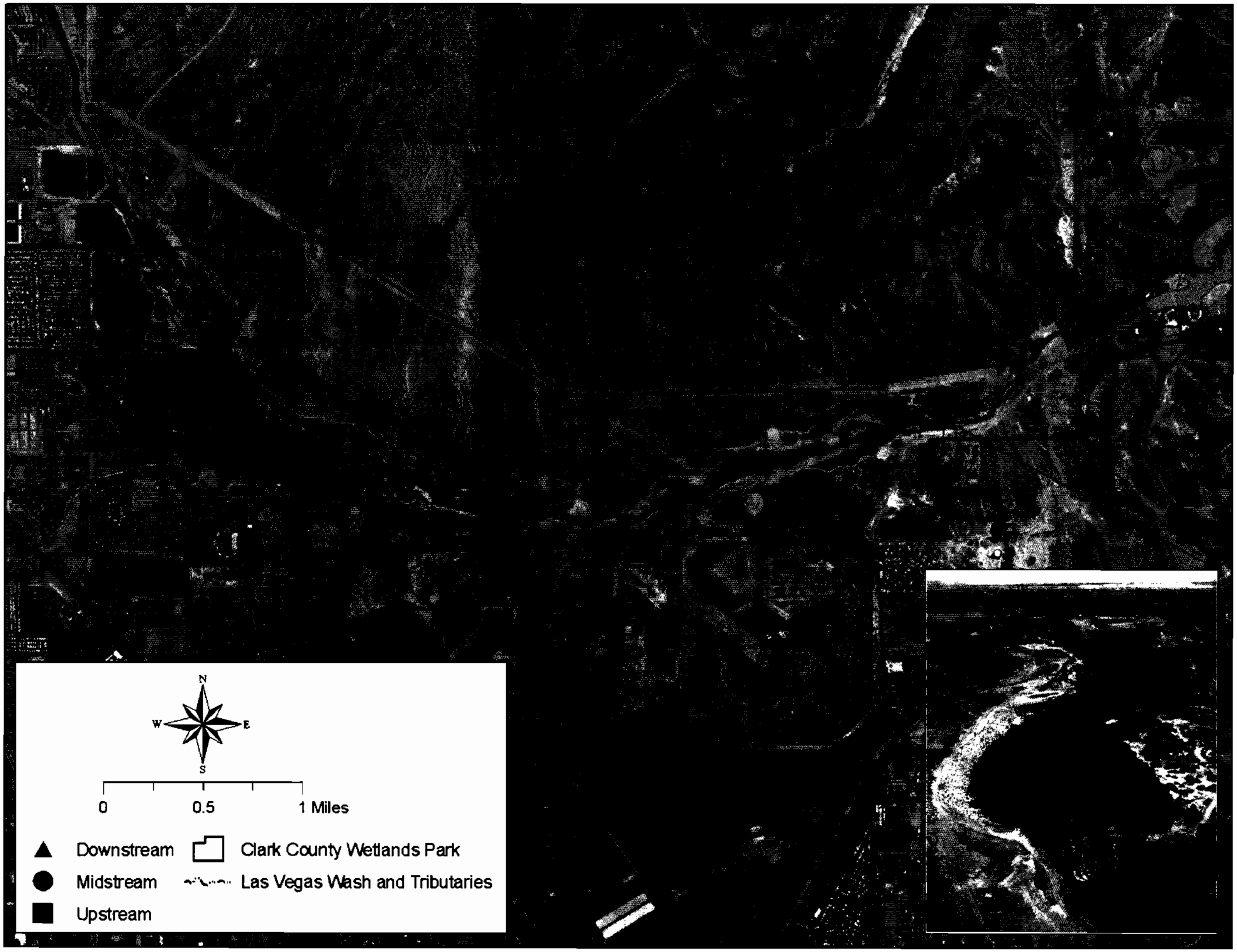

Figure 1: Locations of the three monitoring stations in Las Vegas Wash, Clark County, Nevada.

Likewise, during the first few months of data collection there were periodic gaps in data collection due to minor technical problems or extraneous noise, primarily from insects. Techniques were developed to orient the reflector to minimize general noise and judicious pruning of vegetation directly within the envelope of detection likewise minimized deleterious insect noise.

Each station contained an Anabat II bat detector with the microphone (i.e., transducer) encased in a protective shroud utilizing a reflector plate to collect bat vocalizations and mounted on a post approximately 3 m above ground level. The remaining equipment consisted of a Compact Flash Zero Crossings Analysis Interface Module (CF ZCAIM), a 5-watt solar panel, two rechargeable batteries, and a solar charge controller encased in a weatherproof NEMA case. The detector and CF ZCAIM were obtained from Titley Electronics, Ballina, New South Wales, Australia. In addition, a Hobo Pro Series temperature and humidity data logger (Onset Computer Corporation, Bourne, Massachusetts) were housed in a solar radiation shield and mounted on the microphone post.

Identification of species followed the methods of O'Farrell et al., 1999, based on frequency characteristics, call shape, and comparison with a comprehensive library of vocal signatures developed by O'Farrell and colleagues. Thus, species richness (# species verified as present) was obtained for each location. A key feature of the Anabat system is that each file saved to the computer is named with a time date code (e.g., B8012024.16#, where B = 2001, 8 = August, 01 = day of the month, 2024.16 = 8:24:16 PM). Thus, activity data was derived for each monitoring station. Relative abundance, or the magnitude of each species contribution to spatial use, was obtained using an Index of Activity (IA) modified from Miller (2001). The method is based upon the presence/absence of a species occurrence within 1-minute time increments. Thus, IA was the sum of increments with a species presence divided by the unit effort (IA = # minutes/nights of recording*100).

Statistical analyses were performed using SPSS (version 14.0). Standardized occurrence data (IA) were used to compare abundance/use of each species by habitat between years, which prompted use of a multiple analysis of variance (MANOVA) followed by Tukey-Kramer multiple comparisons (Zar, 1996). Statistical significance was determined using a $P < 0.05$ value for all tests.

4.0 RESULTS

A total of 17 species of bats have been recorded to date within the Wash (Table 1). Eight of the species are listed as Federal Species of Special Concern, four of them are State-listed Sensitive and four are State-listed Protected. Species richness varied among the sites and from year to year but no site demonstrated the entire inventory of species found within the Wash (Table 2). The trend was for species to be absent during 2005 although one species (*Lasionycteris noctivagans*) was added to the inventory at the Downstream Station. *Myotis thysanodes* was only found at the Downstream and Upstream stations and was absent at both in 2005. *Macrotus californicus* was only found at the Downstream Station and was absent in 2005.

The sampling effort generated differences among the three sites as well as from year to year at a specific site (Table 2; Appendix A-1). All measures of sampling effort (number of files, number of calls, and number of minutes) showed similar trends with a sharp drop in activity from 2004 to

Family Name	Species Name	Common Name
Phyllostomidae	Macrotus californicus	California Leaf-nosed Bat **,++
Vespertilionidae	Myotis californicus	California Myotis
Vespertilionidae	Myotis ciliolabrum	Western Small-footed Myotis ++
Vespertilionidae	Myotis thysanodes	Fringed Myotis ‡,++
Vespertilionidae	Myotis yumanensis	Yuma Myotis ++
Vespertilionidae	Lasionycteris noctivagans	Silver-haired Bat
Vespertilionidae	Lasiurus blossevillii	Western Red Bat **
Vespertilionidae	Lasiurus cinereus	Hoary Bat
Vespertilionidae	Lasiurus xanthinus	Western Yellow Bat
Vespertilionidae	Pipistrellus hesperus	Western Pipistrelle
Vespertilionidae	Eptesicus fuscus	Big Brown Bat
Vespertilionidae	Corynorhinus townsendii townsendii	Pacific Western Big-eared Bat **,++
Vespertilionidae	Idionycteris phyllotis	Allen's Big-eared Bat ‡,++
Vespertilionidae	Antrozous pallidus	Pallid Bat ‡
Molossidae	Tadarida brasiliensis	Brazilian Free-tailed Bat ‡
Molossidae	Nyctinomops macrotis	Big Free-tailed Bat ++
Molossidae	Eumops perotis californicus	Greater Western Mastiff Bat **,++

Table 1: Checklist of bats documented acoustically in Las Vegas Wash, 2004-2005 (Bradley et al., 2005).

** State-listed Sensitive

‡ State-listed Protected

++ Federal Species of Special Concern (formerly Category 2 for Federal Listing)

2005: a 25% decrease at the Downstream Station, a 57% decrease at the Midstream Station, and a 43% decrease at the Upstream Station.

The Downstream Station demonstrated the greatest species richness (16 species for both years combined), lacking only *Idionycteris phyllotis* (Tables 3 and 4; Appendices A-2 and A-3). Four to five species were active through the winter although seven species were recorded in February 2005. The winter was the least active in number of minutes present. Mid-to late summer through early fall had the greatest activity in both years. Spring was the second most active season in both years. In 2004, *Tadarida brasiliensis*, *Pipistrellus hesperus*, and *Myotis yumanensis* were the primary species with *My. californicus, Lasiurus xanthinus, L. cinereus*, and *Eptesicus fuscus* as secondary in contribution to activity levels. In 2005, *T. brasiliensis* was the primary species and *M. yumanensis, P. hesperus*, and *My. californicus* were secondary in contribution to activity levels. The primary migratory species (*Lasiurus* spp.) were minor components in 2005 although *Lasionycteris noctivagans* only occurred in mid-fall 2005. Consistent, low activity of *Corynorhinus townsendii* from March through October 2004 is noteworthy as is the reduction in 2005 to July through October. This was the only site with

	Downstream	Midstream	Upstream
Species Richness			
2004	15	13	14
2005	14	13	13
Number of Minutes			
2004	101,614	66,127	168,428
2005	76,134	28,594	95,305
Total	177,748	94,721	263,734

Table 2: Summary of Species Richness (number of species) and Index of Activity (number of minutes of activity/nights of recording*100) at the three monitoring stations in Las Vegas Wash, 2004-2005.

Macrotus californicus.

The Midstream Station demonstrated the smallest species richness (13 species for both years combined), lacking *Ma. californicus, M. thysanodes, L. noctivagans*, and *N. macrotis* (Tables 5 and 6; Appendices A-4 and A-5). Three to four species were active through the winter although January and March 2004 and December 2005 were lost due to equipment problems. The winter was the least active in number of minutes present although a large presence of *T. brasiliensis* occurred in February 2004. Mid- to late summer through early fall had the greatest activity in both years. Spring was the second most active season in both years. In 2004, *My. californicus*, *Pipistrellus hesperus*, and *M. yumanensis* were the primary species with *T. brasiliensis, Lasiurus xanthinus,* and *A. pallidus* as secondary in contribution to activity levels. In 2005, *L. cinereus* and *M. yumanensis* were the primary species with *T. brasiliensis, P. hesperus*, and *A. pallidus* were secondary in contribution to activity levels. The primary migratory species (*Lasiurus* spp.) were minor components in 2005 except for the significant presence of *L. cinereus* in 2005 and the increase in *L. blossevillii* by a factor of 10. Consistent, moderate activity of *C. townsendii* from May through October 2004 was three times greater than found at the other stations; the reduction in activity stretching from March through September 2005 remained three times greater than the other stations. This was the only site that demonstrated presence of *I. phyllotis.*

The Upstream Station was intermediate in species richness (14 species for both years combined), lacking *Ma. californicus, I. phyllotis,* and *L. noctivagans* (Tables 7 and 8; Appendices A-6 and A-7). Four to six species were active through the winter although seven species were recorded in February 2004. The winter was the least active in number of minutes present. Summer through mid-fall had the greatest activity in both years with the peak occurring in late summer. Spring was the second most active season in both years. In both years, *T. brasiliensis* was the overwhelming primary species with *My. californicus, M. yumanensis, L. xanthinus, E. fuscus*, and *P. hesperus* as secondary in contribution to activity levels. The primary migratory species (*Lasiurus* spp.) were reduced in activity in 2005 although *L. xanthinus* was secondary in importance for both years. Consistent, low activity of *C. townsendii* was restricted to summer months.

Either four or five species accounted for $\geq 90\%$ of the minutes of activity at all sites in both years (Tables 3-8; Appendices A-2 to A-7). At the Downstream Station, *P. hesperus, T. brasiliensis, M.*

Species	Jan[a]	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Antrozous pallidus	12	0	16	27	23	37	61	61	43	19	3	0	**303**
Corynorhinus townsendii	0	0	19	10	3	17	10	10	23	3	0	0	**95**
Eptesicus fuscus	0	3	65	250	103	147	13	87	250	0	0	0	**918**
Eumops perotis	0	0	0	0	0	17	3	0	23	0	0	0	**43**
Lasiurus blossevillii	0	0	113	3	3	0	0	0	0	3	0	0	**123**
Lasiurus cinereus	0	0	55	597	113	0	6	245	30	13	10	0	**1069**
Lasiurus xanthinus	0	0	242	103	135	167	187	2519	3700	606	263	39	**7962**
Macrotus californicus	0	0	0	0	0	0	3	0	0	0	0	0	**3**
Myotis californicus	12	172	832	587	1381	2040	1561	2597	3340	1210	47	6	**13785**
Myotis ciliolabrum	0	0	0	0	6	0	3	3	3	0	0	0	**16**
Myotis thysanodes	0	0	0	0	0	0	3	0	0	0	0	0	**3**
Myotis yumanensis	32	17	552	223	258	797	2903	7868	7857	1487	73	10	**22077**
Nyctinomops macrotis	0	0	0	0	0	0	0	0	0	13	0	0	**13**
Pipistrellus hesperus	20	103	2397	637	1513	2847	5942	7068	6470	1184	123	29	**28332**
Tadarida brasiliensis	220	707	3648	4767	2810	2543	1826	4503	4153	819	730	145	**26872**
Total	**296**	**1003**	**7939**	**7203**	**6348**	**8610**	**12523**	**24961**	**25893**	**5358**	**1250**	**229**	**101614**

Table 3: Activity Index (number of minutes of activity/nights of recording*100) by month and species at the Downstream Site, Las Vegas Wash, 2004. The number of minutes of activity is given in Appendix A-2.

[a] No records for 1-6 January

Species	Jan	Feb	Mar	Apr	May	Jun	Jul[a]	Aug	Sep	Oct	Nov	Dec	Total
Antrozous pallidus	0	0	6	13	23	23	60	48	40	0	0	0	**214**
Corynorhinus townsendii	0	0	0	0	0	0	4	3	3	10	0	0	**20**
Eptesicus fuscus	0	32	55	27	10	13	24	32	90	55	7	0	**344**
Eumops perotis	0	0	3	0	0	3	36	6	10	10	0	0	**69**
Lasionycteris noctivagans	0	0	0	0	0	0	0	0	0	3	0	0	**3**
Lasiurus blossevillii	0	0	0	3	0	0	0	0	7	3	0	0	**13**
Lasiurus cinereus	0	4	13	77	77	3	0	26	93	3	0	0	**296**
Lasiurus xanthinus	0	0	16	10	26	87	56	45	87	42	10	3	**382**
Myotis californicus	6	14	248	383	558	990	1456	703	1827	1474	73	16	**7750**
Myotis ciliolabrum	0	4	0	0	0	0	0	0	7	0	0	0	**10**
Myotis yumanensis	3	39	148	207	819	1440	2728	3926	6587	2229	673	84	**18884**
Nyctinomops macrotis	0	0	0	3	0	3	0	6	20	0	0	0	**33**
Pipistrellus hesperus	29	50	226	420	1200	1780	4224	3916	2943	726	507	29	**16050**
Tadarida brasiliensis	368	832	2526	7147	4294	2973	2500	4210	3420	2503	893	400	**32065**
Total	**406**	**975**	**3242**	**8290**	**7006**	**7317**	**11088**	**12923**	**15133**	**7058**	**2163**	**532**	**76134**

Table 4: Activity Index (number of minutes of activity/nights of recording*100) by month and species at the Downstream Site, Las Vegas Wash, 2005. The number of minutes of activity is given in Appendix A-3.

[a] No records for 11-14 and 30-31 Jul

Species	Jan	Feb[a]	Mar	Apr[b]	May	Jun	Jul	Aug	Sep	Oct	Nov[c]	Dec[d]	Total
Antrozous pallidus	-	31	-	77	410	400	481	687	193	13	0	0	**2292**
Corynorhinus townsendii	-	0	-	0	16	27	106	52	7	39	0	0	**246**
Eptesicus fuscus	-	0	-	8	129	113	103	294	127	6	0	0	**780**
Eumops perotis	-	0	-	0	0	0	0	0	3	0	0	0	**3**
Idionycteris phyllotis	-	0	-	0	0	0	0	0	3	0	0	0	**3**
Lasiurus blossevillii	-	0	-	0	6	3	0	3	7	3	0	0	**23**
Lasiurus cinereus	-	0	-	0	0	3	0	0	10	0	0	0	**13**
Lasiurus xanthinus	-	0	-	65	174	163	384	761	1547	119	119	10	**3343**
Myotis californicus	-	13	-	319	781	1670	4503	6071	5963	2216	24	3	**21563**
Myotis ciliolabrum	-	0	-	0	3	13	3	19	13	3	0	0	**56**
Myotis yumanensis	-	0	-	15	235	637	1548	4477	7553	1542	71	7	**16087**
Pipistrellus hesperus	-	19	-	100	510	1290	5197	4400	3677	874	29	3	**16098**
Tadarida brasiliensis	-	1150	-	515	623	337	461	716	1210	442	152	13	**5620**
Total	**-**	**1213**	**-**	**1100**	**2887**	**4657**	**12787**	**17481**	**20313**	**5258**	**395**	**37**	**66127**

Table 5: Activity Index (number of minutes of activity/nights of recording*100) by month and species at the Midstream Site, Las Vegas Wash, 2004. The number of minutes of activity is given in Appendix A-4.

[a] No records for 1-4 and 21-29 February

[b] No records for 1-4 April

[c] No records for 22-30 November

[d] No records for 1 December

Species	Jan [a]	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov [b]	Dec	Total
Antrozous pallidus	0	0	0	23	252	683	232	103	50	0	0	-	**1344**
Corynorhinus townsendii	0	0	3	0	3	30	10	16	10	0	0	-	**72**
Eptesicus fuscus	0	0	13	0	6	47	58	48	33	0	0	-	**206**
Eumops perotis	0	0	0	0	0	0	3	6	0	0	0	-	**10**
Idionycteris phyllotis	0	0	0	10	13	0	3	3	0	0	0	-	**29**
Lasiurus blossevillii	0	0	16	3	23	33	103	61	0	0	0	-	**240**
Lasiurus cinereus	4	11	71	67	413	1493	2906	926	2403	1558	0	-	**9852**
Lasiurus xanthinus	0	0	0	0	10	0	6	0	0	0	0	-	**16**
Myotis californicus	0	0	0	0	10	0	0	3	3	3	0	-	**19**
Myotis ciliolabrum	0	0	0	0	0	0	0	0	0	6	0	-	**6**
Myotis yumanensis	0	4	32	77	271	523	1739	1823	3000	768	11	-	**8247**
Pipistrellus hesperus	21	4	26	77	365	660	1510	723	670	145	0	-	**4199**
Tadarida brasiliensis	96	96	532	780	448	580	458	316	170	242	633	-	**4353**
Total	**121**	**114**	**694**	**1037**	**1813**	**4050**	**7029**	**4029**	**6340**	**2723**	**644**	**-**	**28594**

Table 6: Activity Index (number of minutes of activity/nights of recording*100) by month and species at the Midstream Site, Las Vegas Wash, 2005. The number of minutes of activity is given in Appendix A-5.

[a] No records for 8-10 January

[b] No records for 5-16 and 22-30 November

Species	Jan[a]	Feb	Mar[b]	Apr[c]	May[d]	Jun[e]	Jul[f]	Aug	Sep[g]	Oct[h]	Nov	Dec[i]	Total
Antrozous pallidus	0	17	28	36	73	358	396	365	87	79	13	3	**1455**
Corynorhinus townsendii	0	0	0	7	0	8	54	6	0	0	0	0	**75**
Eptesicus fuscus	0	45	244	1143	445	2185	9979	4145	209	4	13	3	**18415**
Eumops perotis	0	0	0	0	0	0	0	0	0	4	0	0	**4**
Lasiurus blossevillii	0	0	0	0	0	8	4	13	4	29	0	0	**58**
Lasiurus cinereus	0	3	56	521	27	0	121	97	74	0	0	0	**900**
Lasiurus xanthinus	0	79	1164	279	882	1446	3332	8506	4883	1025	237	7	**21840**
Myotis californicus	4	31	348	657	664	2431	5568	6039	6070	2217	13	0	**24041**
Myotis ciliolabrum	0	0	0	0	0	0	29	6	4	17	0	0	**56**
Myotis thysanodes	0	0	0	7	0	0	0	0	0	0	0	0	**7**
Myotis yumanensis	4	7	104	143	227	354	2579	9358	11757	3021	60	10	**27623**
Nyctinomops macrotis	0	0	0	0	0	0	0	3	0	0	0	0	**3**
Pipistrellus hesperus	8	0	116	93	136	388	3804	4542	3774	288	17	7	**13172**
Tadarida brasiliensis	292	359	4484	3464	2327	3181	14164	19519	8504	3871	417	197	**60779**
Total	**308**	**541**	**6544**	**6350**	**4782**	**10358**	**40029**	**52600**	**35365**	**10554**	**770**	**228**	**168428**

Table 7: Activity Index (number of minutes of activity/nights of recording*100) by month and species at the Upstream Site, Las Vegas Wash, 2004. The number of minutes of activity is given in Appendix A-6.

[a] No records for 1-6 January
[b] No records for 26-31 March
[c] No records for 1-8 and 23-30 April
[d] No records for 1-20 May
[e] No records for 27-30 June
[f] No records for 1 and 14-15 July
[g] No records for 24-30 September
[h] No records for 1-7 October
[i] No records for 30-31 December

Species	Jan[a]	Feb	Mar	Apr	May[b]	Jun[c]	Jul[d]	Aug	Sep	Oct	Nov	Dec	Total
Antrozous pallidus	-	0	-	7	28	158	111	35	33	3	0	0	**375**
Corynorhinus townsendii	-	0	-	0	0	4	17	3	0	0	0	0	**24**
Eptesicus fuscus	-	0	-	30	97	2008	1667	219	817	110	10	29	**4986**
Eumops perotis	-	0	-	0	0	0	0	3	0	0	0	0	**3**
Lasiurus blossevillii	-	0	-	3	0	0	0	0	27	55	0	0	**85**
Lasiurus cinereus	-	0	-	43	55	4	0	23	127	6	0	0	**258**
Lasiurus xanthinus	-	5	-	23	493	1485	878	2945	2920	1035	7	0	**9791**
Myotis californicus	-	10	-	107	345	892	1856	629	1947	1832	3	3	**7623**
Myotis ciliolabrum	-	0	-	0	0	0	56	0	7	0	0	0	**62**
Myotis yumanensis	-	5	-	77	766	2477	4411	3697	5550	1842	87	6	**18917**
Nyctinomops macrotis	-	0	-	0	0	0	0	0	7	0	0	0	**7**
Pipistrellus hesperus	-	5	-	90	355	1023	3561	2371	1633	390	33	6	**9469**
Tadarida brasiliensis	-	90	-	4763	4328	6958	7922	6248	4083	7255	607	1452	**43706**
Total	**-**	**114**	**-**	**5143**	**6466**	**15008**	**20478**	**16174**	**17150**	**12529**	**747**	**1497**	**95305**

Table 8: Activity Index (number of minutes of activity/nights of recording*100) by month and species at the Upstream Site, Las Vegas Wash, 2005. The number of minutes of activity is given in Appendix 7.

[a] No records for 1-3 and 25-28 February

[b] No records for 30-31 May

[c] No records for 27-30 June

[d] No records for 1-5 and 9-14 and 30-31 July

yumanensis, and *My.californicus* comprised 90 and 98% for 2004 and 2005, respectively. The same species assemblage accounted for 90% of the activity at the Midstream Station in 2004 but in 2005, *My. californicus* was a minor component and was replaced by *L. cinereus* thus accounting for 97% of the activity in 2005. At the Upstream Station, *T. brasiliensis, M. yumanensis*, *L. xanthinus* and *My.californicus* comprised the core species but required *E. fuscus* in 2004 to account for 91% and *P. hesperus* in 2005 to account for 94% of the activity.

An examination of bat occurrence and abundance among the three habitat types and between years showed significant differences (MANOVA for habitat $F = 2.479$, $d.f. = 34$, $P < 0.0001$; and year $F = 2.389$, $d.f. = 17$, $P < 0.05$). A comparison of mean differences between sites revealed three species selected Upstream more than either Midstream or Downstream habitats: *E. fuscus* ($P < 0.05$); *L. xanthinus* ($P < 0.05$ and $P < 0.01$, respectively); and, *T. brasiliensis* ($P < 0.05$ and $P < 0.001$, respectively). One species selected Downstream more than either Midstream or Upstream: E. perotis ($P < 0.05$). Two species selected Midstream more than Downstream or both Upstream and Downstream: *A. pallidus* ($P < 0.01$); and, *N. macrotis* ($P < 0.01$), respectively). Remaining species showed no preference among the three habitats however, several species were represented by insufficient sample size to adequately assess selection (*I. phyllotis, L. noctivagans*, and *Ma. californicus*).

The patterns and magnitude of activity through the night is variable among species as well as among sampling locations. *Pipistrellus hesperus* was crepuscular in activity patterns with a major peak of activity within the first 1-1.5 hr after sunset, low and declining activity through the night, and a small distinct peak within the hour before sunrise (Figures 2-4). *Myotis californicus* and *M. yumanensis* demonstrated a similar initial crepuscular peak but a more prolonged period of moderate to high activity through much of the night. The clear patterns shown for summer of both years (Figures 2-4) was similar in other seasons; the general trend was for spring number of minutes to be very low, whereas fall number of minutes to be near or slightly lower than summer values. The reduction in number of minutes of use from 2004 and 2005 was constant among these species and sites.

Antrozous pallidus and *L. xanthinus* generally showed a crepuscular pattern of activity although for *L. xanthinus* a more prolonged period of activity was found at the Upstream Station (Figures 5-7). However, *A. pallidus* demonstrated relatively constant activity through the night in summer 2004 (Figure 10). *Eptesicus fuscus* tended to show a peak of activity at 2.5-3 hrs after sunset with declining activity through the remainder of the night. *Tadarida brasiliensis* demonstrated moderate to high activity through much of the night with relatively consistent peak in activity after midnight. The clear patterns shown for summer of both years (Figures 2-4) was similar in other seasons; the general trend was for spring number of minutes to be very low, whereas fall number of minutes to be lower than summer values except for *T. brasiliensis* and *L. xanthinus* for fall 2004 at the Midstream Station. The reduction in number of minutes of use from 2004 and 2005 was constant among these species and sites.

Lasiurus cinereus and *L. blossevillii* showed erratic bouts of activity throughout the night for most seasons and most sites (Figures 8-10). Both species showed an early peak of activity between 2-4 hrs after sunset with declining activity through the remainder of the night in spring 2004 at the Downstream Station. The Midstream Station was the only site with sufficient

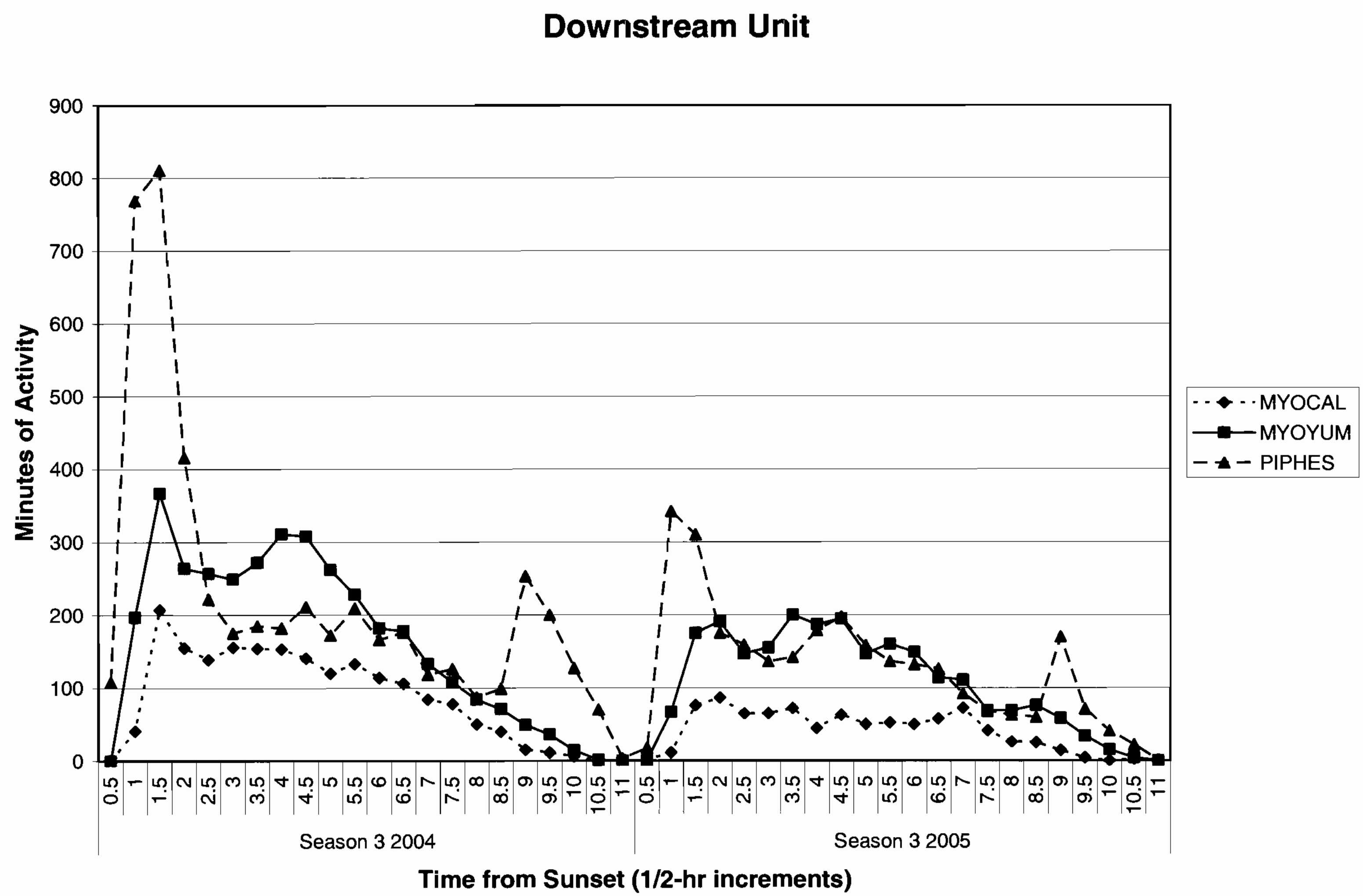

Figure 2: Nightly activity by season for *Myotis californicus, M. yumanensis*, and *Pipistrellus hesperus* at the Downstream Unit. Season 3 = Summer.

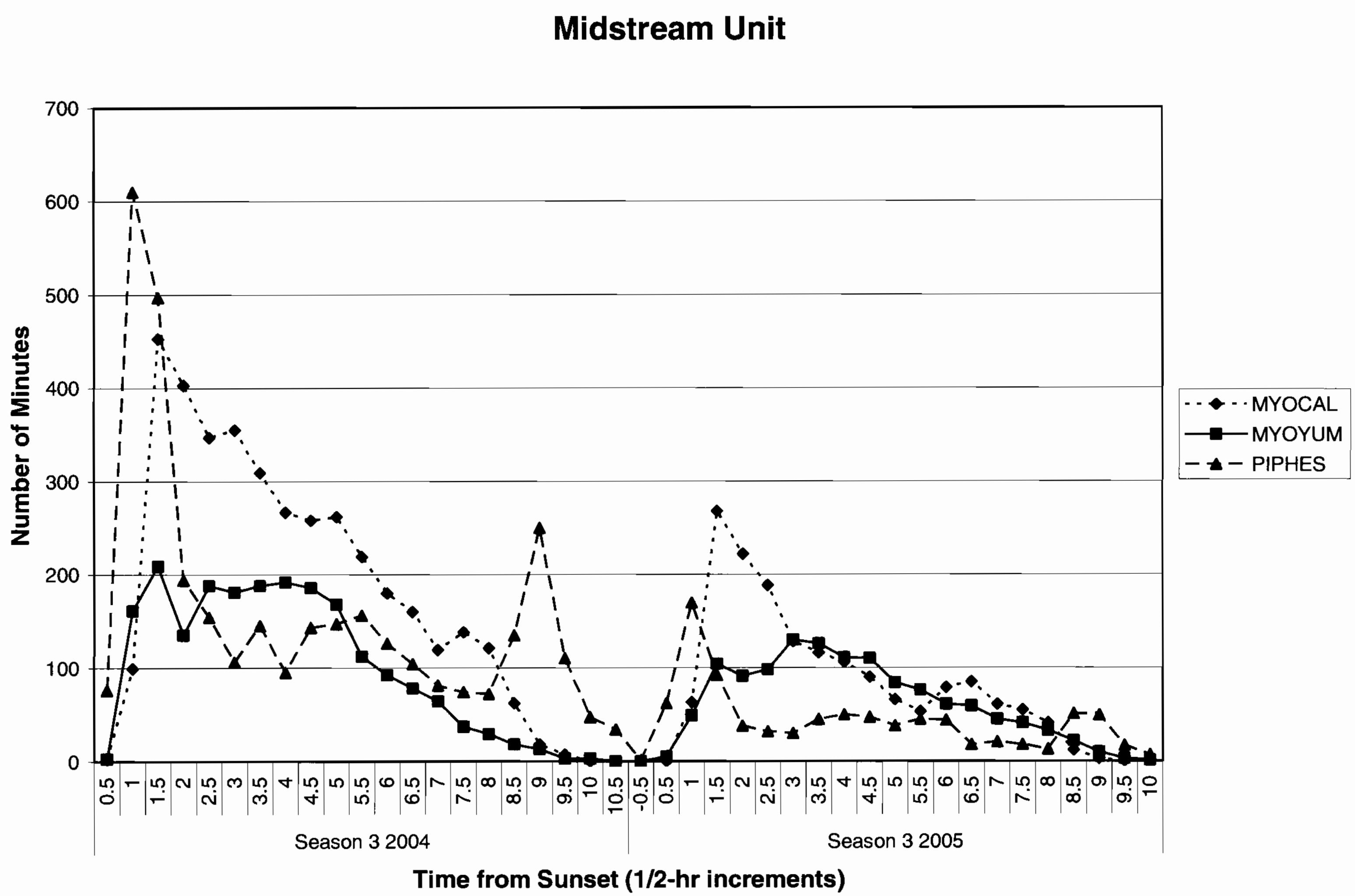

Figure 3: Nightly activity by season for *Myotis californicus, M. yumanensis*, and *Pipistrellus hesperus* at the Midstream Unit. Season 3 = Summer.

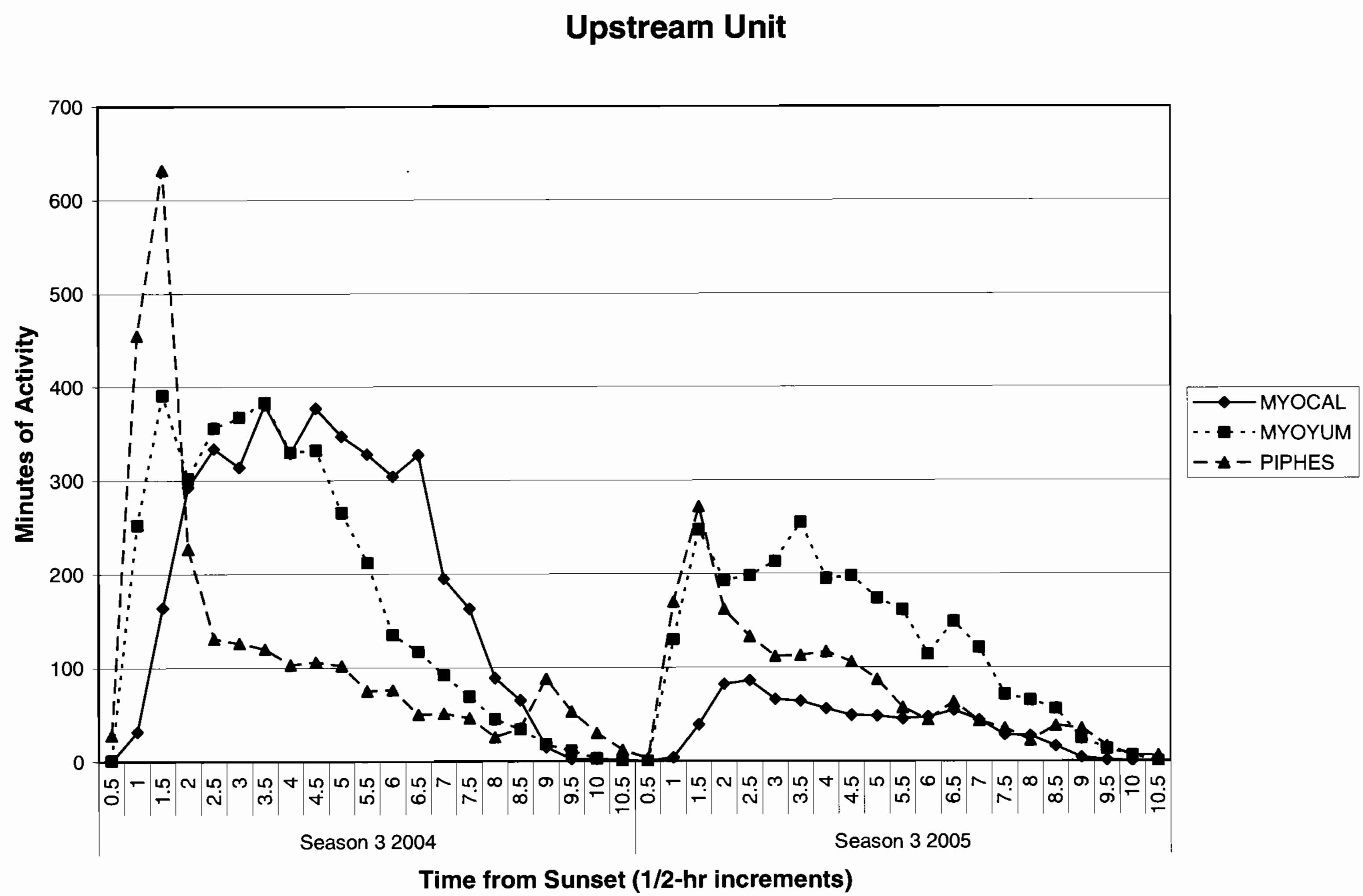

Figure 4: Nightly activity by season for *Myotis californicus, M. yumanensis*, and *Pipistrellus hesperus* at the Upstream Unit. Season 3 = Summer.

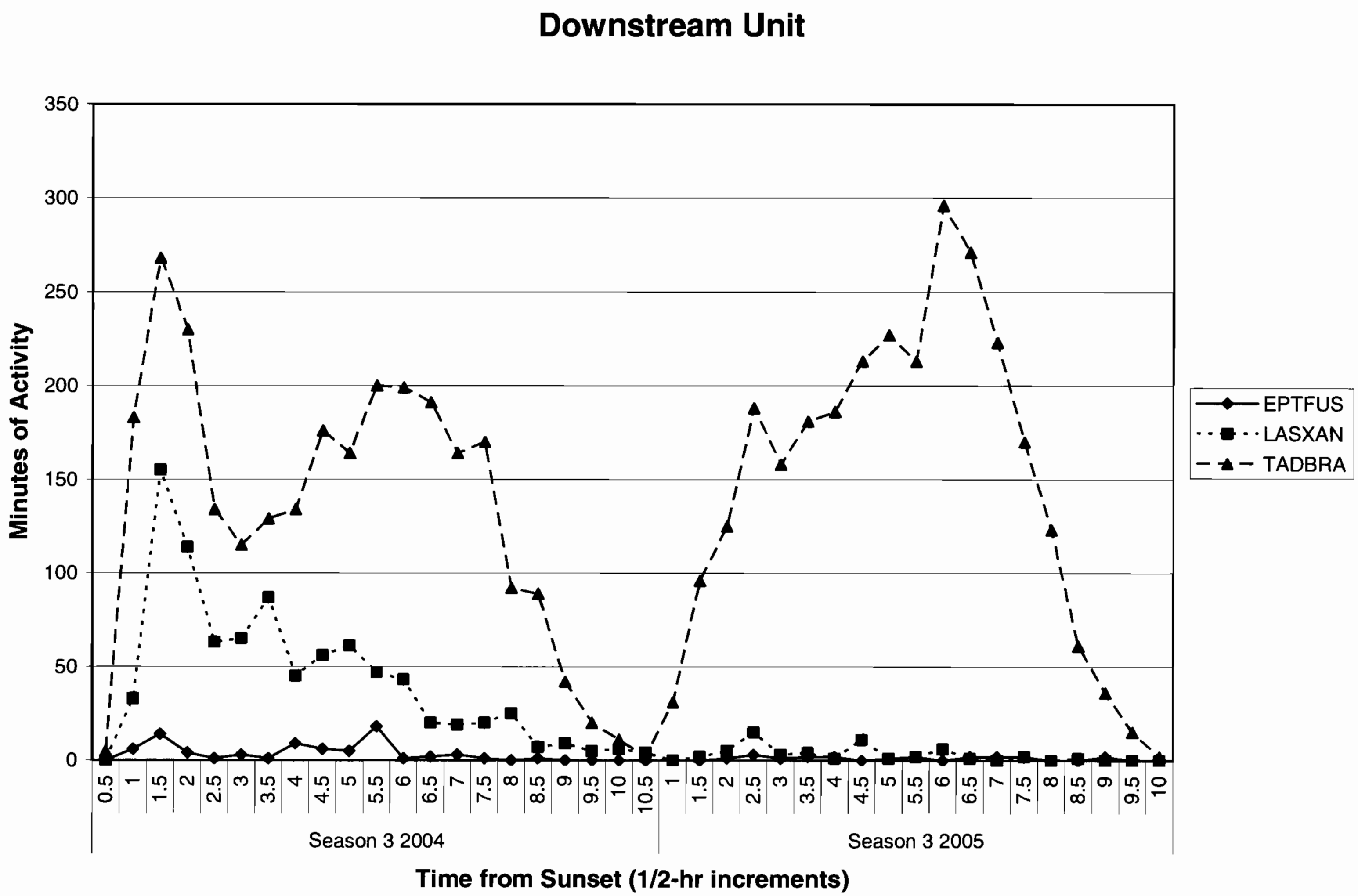

Figure 5: Nightly activity by season for *Eptesicus fuscus, Lasiurus xanthinus*, and *Tadarida brasiliensis* at the Downstream Unit. Season 3 = Summer.

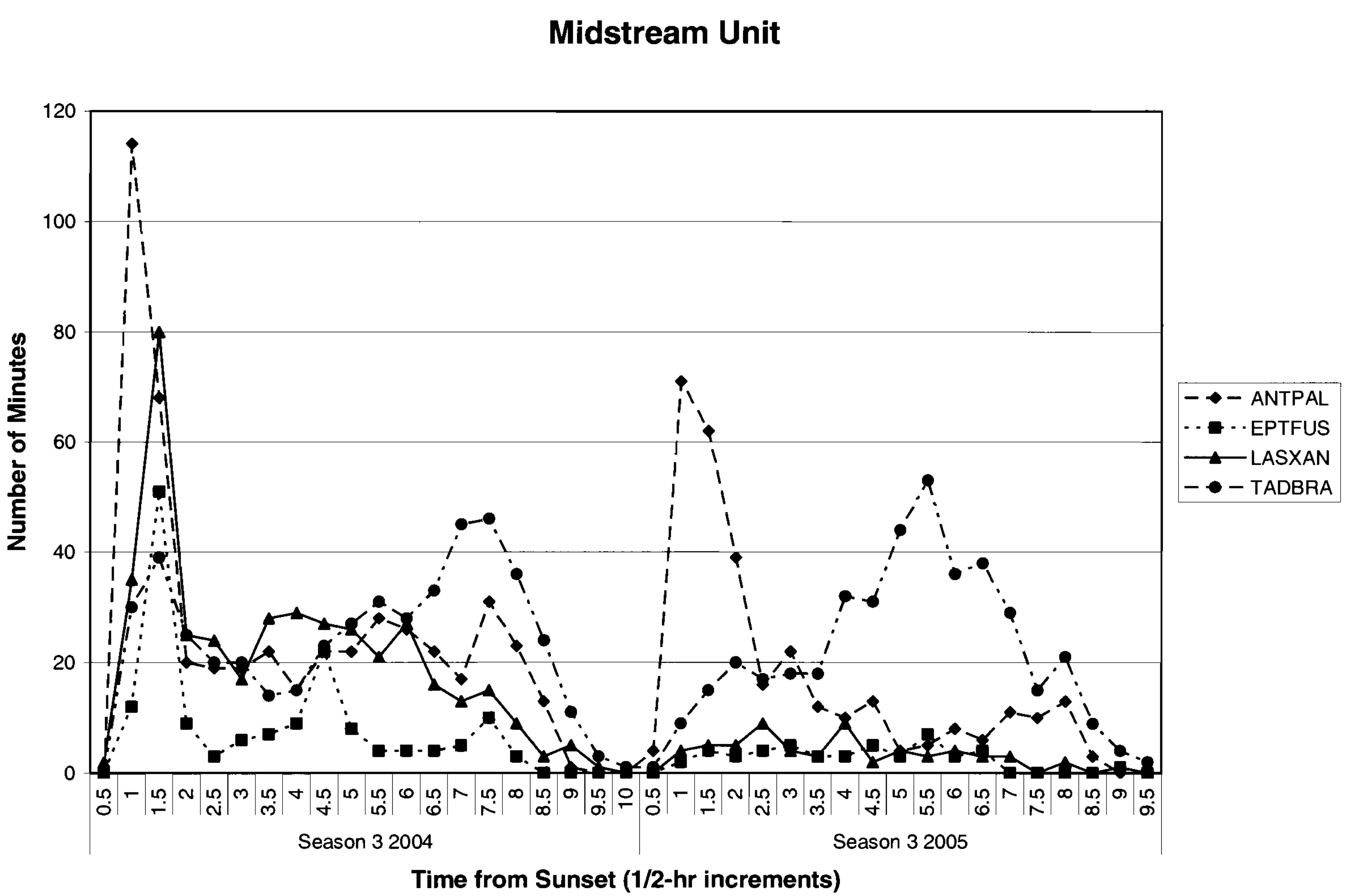

Figure 6: Nightly activity by season for *Antrozous pallidus, Eptesicus fuscus, Lasiurus xanthinus*, and *Tadarida brasiliensis* at the Midstream Unit. Season 3 = Summer.

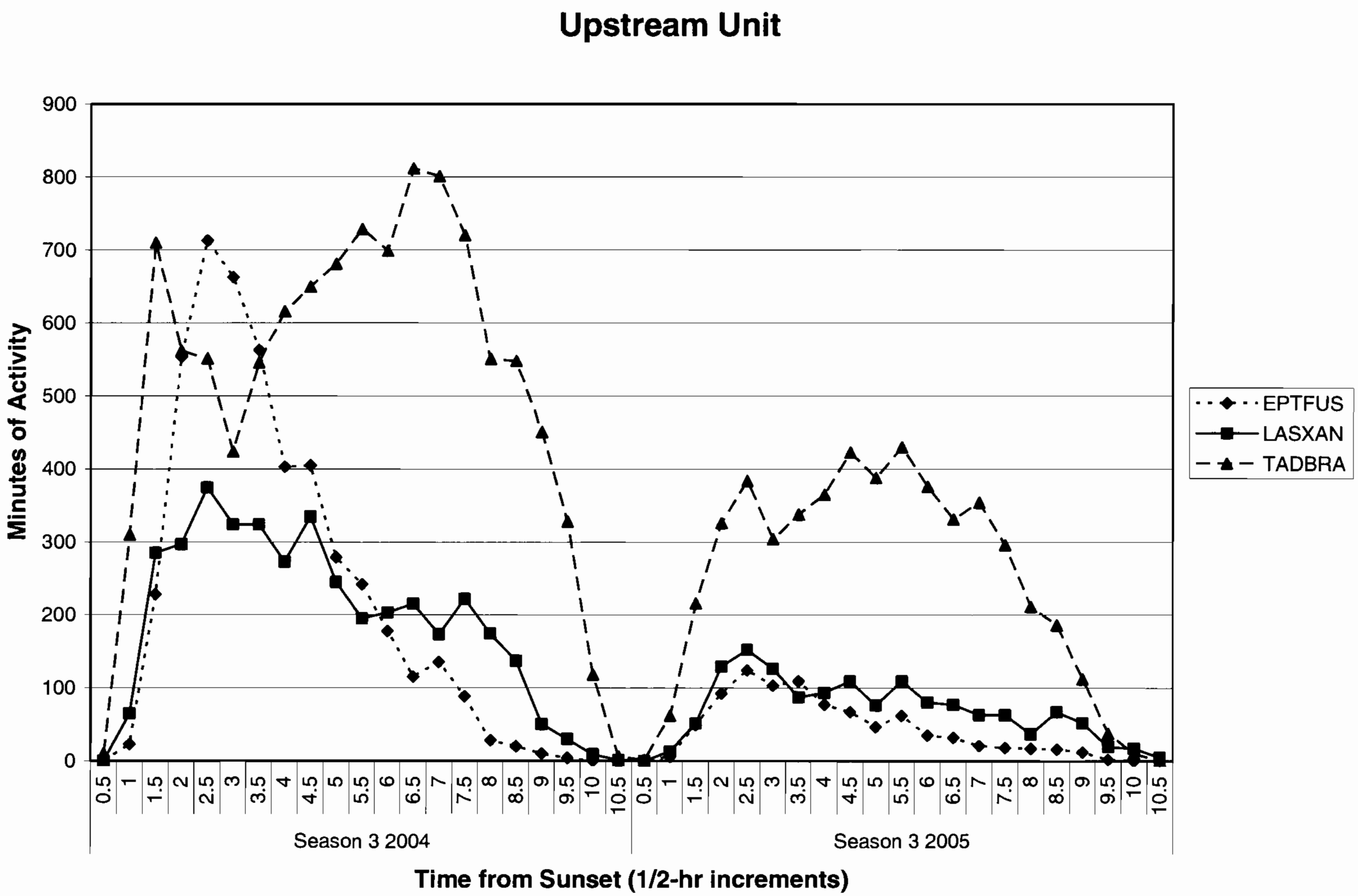

Figure 7: Nightly activity by season for *Eptesicus fuscus, Lasiurus xanthinus*, and *Tadarida brasiliensis* at the Upstream Unit. Season 3 = Summer.

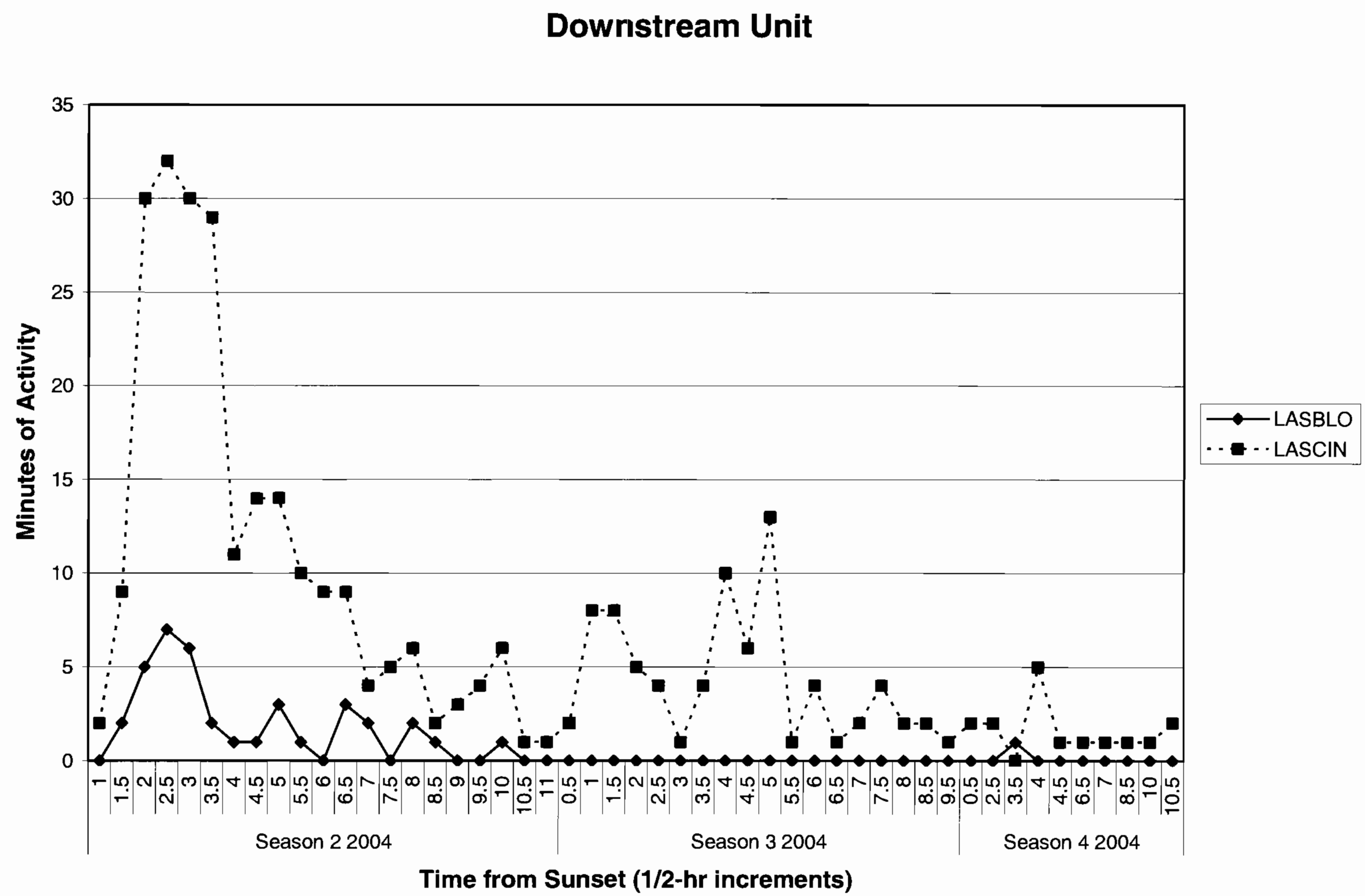

Figure 8: Nightly activity by season for *Lasiurus blossevillii* and *L. cinereus* at the Downstream Unit. Season 2 = Spring; Season 3 = Summer; Season 4 = Fall.

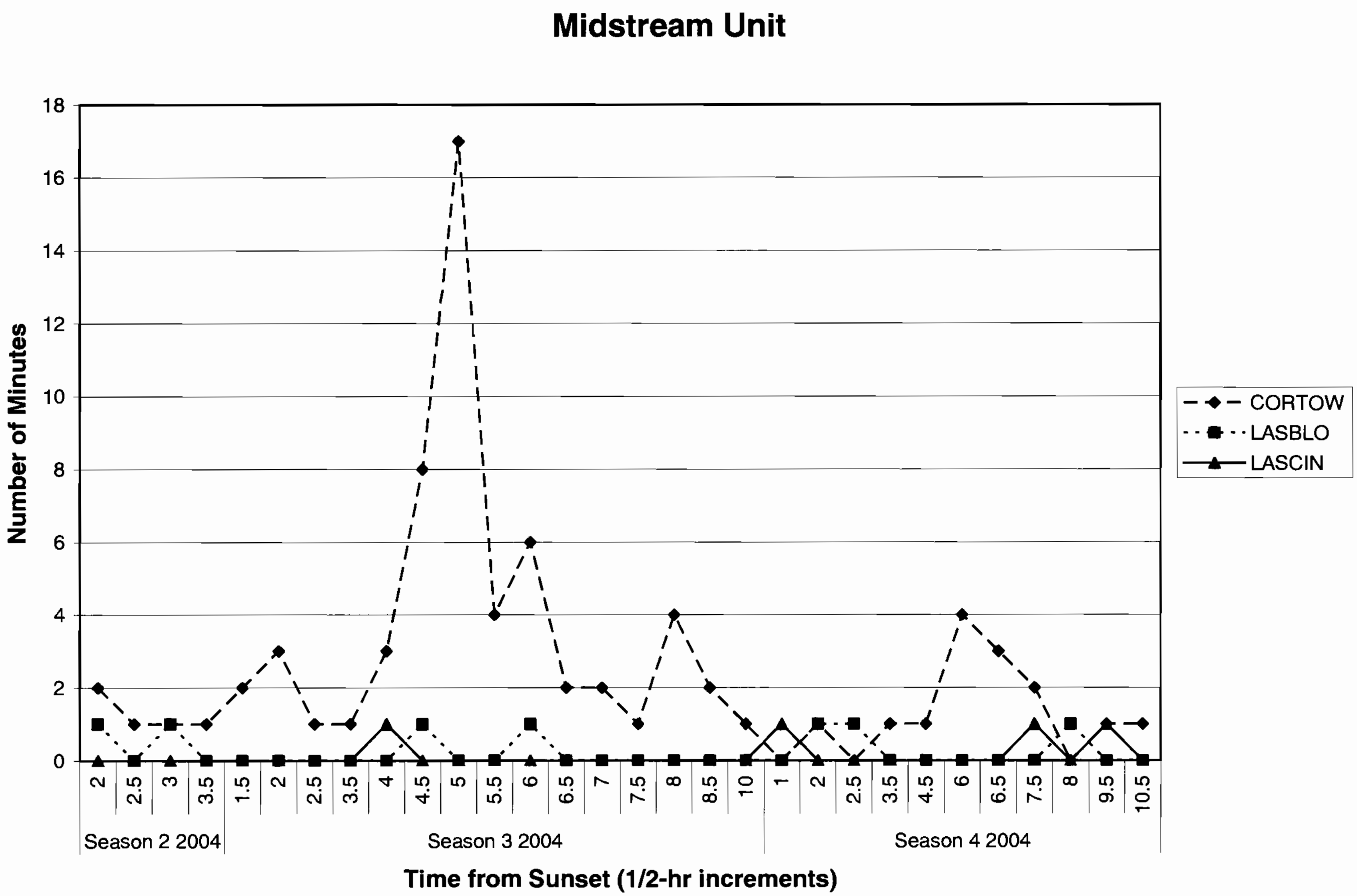

Figure 9: Nightly activity by season for *Corynorhinus townsendii, Lasiurus blossevillii* and *L. cinereus* at the Downstream Unit. Season 2 = Spring; Season 3 = Summer; Season 4 = Fall.

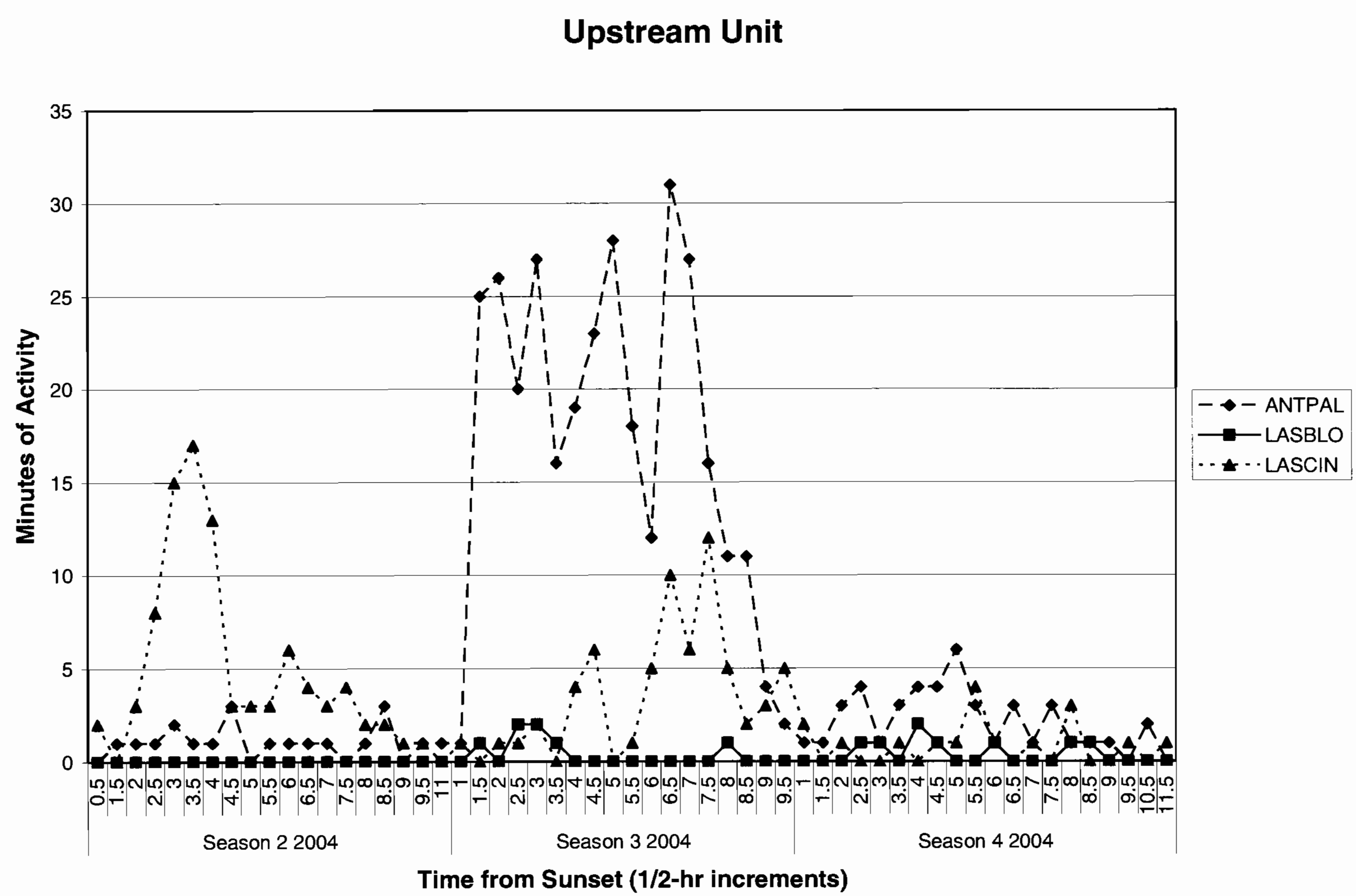

Figure 10: Nightly activity by season for *Antrozous pallidus, Lasiurus blossevillii* and *L. cinereus* at the Upstream Unit. Season 2 = Spring; Season 3 = Summer; Season 4 = Fall.

activity to examine temporal use by *C. townsendii* (Figure 9). The peak in activity was at 5 and 6 hours after sunset, summer and fall respectively. Where numbers permitted, the patterns in 2005 tended to show a reduction in number of minutes in all seasons except for an increase in number of minutes for *L. blossevillii* at the Upstream Station in fall 2005.

5.0 DISCUSSION

There were four species of uncommon (for the state of Nevada) bats documented within the Wash; three of these have designated sensitive status (Bradley et al., 2005; Table 1): *Macrotus californicus, Lasiurus xanthinus, Nyctinomops macrotis*, and *Eumops perotis*. *Macrotus californicus* was known from an historic roost in Frenchman's mine at the southern end of Frenchman's Mountain near the Wash but that was permanently closed by 1960 (O'Farrell, 1970). *Lasiurus xanthinus* is a bat recently new to the State and was only found as a transient in the Wash in May 2002 (O'Farrell et al., 2004). *Nyctinomops macrotis* was known in Nevada from a single animal found in Henderson (Bradley et al., 1965). Recent acoustic surveys have documented autumn occurrence in the Upper Moapa Valley (Williams, 2001) and Kyle and Lee canyons (O'Farrell, 2002; 2006). *Eumops perotis* was known in Nevada from a single animal found in southeast Las Vegas (Bradley and O'Farrell, 1967). Recent acoustic surveys have documented summer occurrences in Kyle Canyon (O'Farrell, 2003). The occurrence of *Ma. californicus* in the present study indicates at least a summer roost in the general vicinity of the Wash. Solitary presence at the Downstream Station further suggests a roost in the Rainbow Gardens area immediately to the north. The population of *L. xanthinus* within the Wash appears to have evolved from transient migratory use to that of year round use similar to that established in the Upper Moapa Valley (O'Farrell et al., 2004). The large molossids (*N. macrotis* and *E. perotis*) tend to fly at high altitudes and forage frequently in association with large reservoirs. They tend to roost in fissures on high cliff faces, which would suggest that these species are commuting from outside the Wash proper. Nearby Lake Las Vegas and the large open volume above the Wash would provide ample foraging space.

Five species have never been recorded in Las Vegas Valley; all have been accorded sensitive status (Bradley et al., 2005; Table 1): *Myotis ciliolabrum, M. thysanodes, M. yumanensis, Lasiurus blossevillii,* and *Idionycteris phyllotis*. *Myotis ciliolabrum* is a relatively common species of mid- to high elevations but appears to periodically use the Wash, probably as a transient. *Myotis thysanodes* was known only from a single location in Nevada near the historic town of St. Thomas which was inundated with the formation of Lake Mead (Hall, 1946). More recently, it has been documented in the Upper Moapa Valley (Williams, 2001). All further observations have been associated with mid- to high elevations within the Spring Mountain Range (O'Farrell, 2002a and b; 2006). Sparse occurrence in the Wash suggests only transient use. *Myotis yumanensis* is common along the Colorado River and associated lakes. It forages low over water. Occurrence within the valley is probably associated with the recent formation of Lake Las Vegas and construction of several weirs within the Wash. *Lasiurus blossevillii* was known in Nevada from one animal each at Overton and Fallon (Hall, 1946). Since then, several individuals have been captured near Fallon in 1958 (J. R. Alcorn collection, Nevada State Museum of Natural History). Recently, observations verified a year round presence in the Upper Moapa Valley (Williams, 2001; O'Farrell et al., 2003) and seasonal occurrence in the Spring Mountain Range (O'Farrell, 2002a and b; 2006). Prolonged use of the species in the Wash suggests that the Wash is being used as a stepping stone during seasonal migration but harbors small numbers of individual through the summer. These individuals are probably males and/or non-reproductive females. *Idionycteris phyllotis* has a patchy distribution in Nevada since it was initially discovered in Red Rock Canyon (O'Farrell and Bradley, 1969). A single capture occurred near Gold Butte (Bradley et al., 2005). The majority of locations center in the southern Spring Mountain Range at Red Rock Canyon, Lovell Canyon, and Mt. Potosi (O'Farrell, 2002b) and more recently in lower Kyle Canyon (O'Farrell, 2006). This species was found only at the Midstream Station but occurred through the spring and summer months. The purpose of such usage is not clear at this time.

The consistent presence of *C. townsendii* with the Wash was somewhat surprising. It is known to occur around the fringe of the valley and is primarily associated with abandoned mines and old buildings (Bradley et al., 2005). There may be roosts in abandoned mines found in the Rainbow Gardens area immediately to the north of the Wash. No known probable roosts occur within the Wash proper. The species may travel long distances to reach foraging grounds so there may be no close roosts. Regardless, it is clear that the Wash is used as a consistent foraging area.

Based upon the data collected in 2004 and 2005, general seasonal and behavioral characteristics can be formulated for the inventory generated in the present study (Table 1). Six species are year round residents of the Wash: *Myotis californicus, M. yumanensis, L. xanthinus, P. hesperus, A. pallidus*, and *T. brasiliensis*. Eight species were found in the spring, summer, and fall: *M. ciliolabrum, L. blossevillii, L. cinereus, E. fuscus, C. townsendii, I. phyllotis, N. macrotis,* and *E. perotis*. Two species were detected only during the summer (*Macrotus californicus* and *M. thysanodes*) and a single species occurred only during the fall (*L. noctivagans*). All year round species are known to breed in the area. Most of the species found either during the summer, including those detected in spring and summer also breed in the area. Possible exceptions are known migratory species (*Lasiurus* spp.) with known breeding grounds elsewhere. Individuals of these species collected in the Upper Moapa Valley during the summer were found to be males or non-reproductive females (Williams, 2001). *Lasionycteris noctivagans* apparently use the Wash solely as a stepping stone during migration. The remaining species found in small numbers presumably breed within the local geographic region but pass only periodically through the wash, probably as a minor feeding ground.

Occurrence of migrating species in southern Nevada has been poorly known (Bradley et al., 2005), particularly prior to 2001 because data were solely from capture methods. *Lasiurus cinereus* was known from a handful of specimens either as individuals found dead (Bradley et al., 1965) or isolated captures, generally in May. Intense acoustic work since 2000 has documented a prolonged spring period of movement from February through early June and shorter period in the fall from late August through October (Williams, 2001; O'Farrell, 2002a and b; O'Farrell, 2006; O'Farrell et al., 2003). In the present study, the IA increased from 13 in 2004 to 9852 (Tables 5 and 6) which was mirrored by an IA of 11,963 documented simultaneously in lower Kyle Canyon in 2005 (O'Farrell, 2006). Unfortunately, the latter study did not start until November 2004. Unlike a declining trend in activity for other species (see below), the large increase for *L. cinereus* in 2005 appeared to be an unusual phenomenon in southern Nevada.

A similar, but far less dramatic, increase in activity was found for *L. blossevillii*. However, the quantity of data generated for this species from recent acoustic studies has been significant. Prior to 2001, this species was known from southern Nevada from a single specimen found in a mesquite near Overton in the 1940's (Hall, 1946). Acoustic studies documented prolonged presence in the Upper Moapa Valley (Williams, 2001; O'Farrell et al., 2003). A few isolated occurrences have been documented in the Spring Mountain Range (O'Farrell, 2002a and b). The level of activity in 2005 was similar at the Midstream Station (IA = 240; Table 6) and lower Kyle Canyon (IA = 284; O'Farrell, 2006).

Large-eared bats tend to forage in closed, cluttered microhabitats and tend to have simple short duration calls of low intensity and therefore difficult to detect acoustically (O'Farrell and Gannon, 1999). The documentation of presence of large-eared quiet species (*A. pallidus, C. townsendii, M. thysanodes,* and *Macrotus californicus*) demonstrates significant presence of these species. The large quantity of minutes of activity recorded for *C. townsendii* was unexpected because it is a very quiet bat and only can be detected at distances of less than 10 m. *Macrotus* is a whispering bat and usually cannot be recorded at distances more than 1 or 2 m. It is reasonable to assume that there is more widespread use and quantity of activity for these species within the Wash.

MANOVA analysis determined significant differences in abundance and use among the three habitats and between years. Multiple comparisons showed that Midstream was selected more than Downstream by *A. pallidus* and more than both the other habitats by *N. macrotis*. Midstream habitat differed from the other two habitats by representing a large open section of wash that was dominated by sedges and reeds with a mosaic of stream channels and other small open water. Midstream also had the largest amount of activity of *C. townsendii* but sample size was small and statistical significance was not reached ($P < 0.08$). *N. macrotis* is a high altitude, fast flying species and may prefer the large expanse of sedges and reeds for presence of adequate insects in an open setting. Downstream was selected by *E. perotis* more that either of the other two habitats. This may be a reflection of the close proximity of Downstream to Lake Las Vegas; *E. perotis* appears to prefer foraging near large reservoirs. Three species selected Upstream more than the other two habitats: *E. fuscus, L. xanthinus*, and *T. brasiliensis*, which differed from the other habitats by representing a narrow, deeply incised segment of wash bordered by dense, robust tamarisk woodland. *E. fuscus* and *L. xanthinus* are known to roost and forage in various woodland habitats. However, *T. brasiliensis* is a high altitude species that apparently is finding greater quantities of insects above the narrow, heavily wooded channel. This is borne out by activity patterns (Figure 5-7). Activity away from Upstream tended to be unimodal or bimodal, but at Upstream activity remained high throughout the majority of the night. Remaining species did not show a preference for any of the habitat types and were relatively evenly distributed throughout the Wash.

The significant difference between years is visually apparent with the sharp decline in the quantity of activity from 2004 to 2005 (Tables 3-8). The only exceptions were *N. macrotis* and *T. brasiliensis* at the Downstream Station and *L. cinereus* at the Midstream Station. The proximal cause for the disparity between years is not clear. Records from the National Weather Service at McCarran Airport indicate that the winter of 2004-2005 was the fourth wettest on record. The associated storm fronts accounted for greatly reduced bat activity in winter and early spring, but does not account for the magnitude of activity decline documented for 2005. In contrast, winter of 2005-2006 was unusually warm and dry promoting prolonged and greater bat activity. It was predicted that activity would increase in summer of 2005 because of the high levels of winter-spring rains and the expected increase in vegetation growth and associated insect availability. This obviously did not happen. It is equally obvious that two years do not provide a sufficient database to understand annual variations in occurrence and levels of activity, as well as potential changes in habitat preference due to prey availability in the different habitat types.

It is clear from the present study that continuous acoustic sampling has allowed an unprecedented look at bat presence, activity, and habitat use within the Wash. The operation of the monitoring stations for two years provides ample evidence of seasonal variation in occurrence and magnitude of spatial use. However, causes of these annual fluctuations and resulting magnitude of such changes remain unknown. Further, operation of other monitoring stations throughout the region will allow meaningful comparison of the simultaneous dynamics with the bat community. Not only will a greater understanding of community dynamics be determined, but also critical changes at the individual population level can be identified. Thus, deleterious events potentially can be determined and remediated in a timely manner. With respect to the Wash, a long-term database will provide an understanding of the basic dynamics of the bat community and enable the assessment of future progress in riparian restoration. The current study is part of the first step in achieving the recommendation of the Nevada Bat Conservation Plan to create a network of acoustic monitoring stations throughout the state in order to follow regional patterns in bat community dynamics (Bradley et al., 2005). Implementation of such a plan will provide invaluable knowledge in order to conserve a valuable natural resource.

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