Seasonal Observations of Bat Species at Mercer Slough Nature Park in Bellevue, Washington

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Introduction

Washington state is home to 15 species of bats, and 10 of these occur west of the Cascade Mountains. Much basic information about bat habitat uses and seasonal occurrence remains unknown (Hayes and Wiles 2013). To determine what bat species are present at different times of year at a large suburban nature park near Seattle, Bats Northwest[2], a Seattle-based nonprofit educational and advocacy organization, conducted 23 acoustic surveys over four years at Mercer Slough Nature Park in Bellevue, WA. This report summarizes the species present, based on analysis of the acoustic records, and their apparent seasonality in the park. We also include some additional information about preferred prey and roost preferences of these species, from the Washington State Bat Conservation Plan (Hayes and Wiles 2013).

Materials and Methods

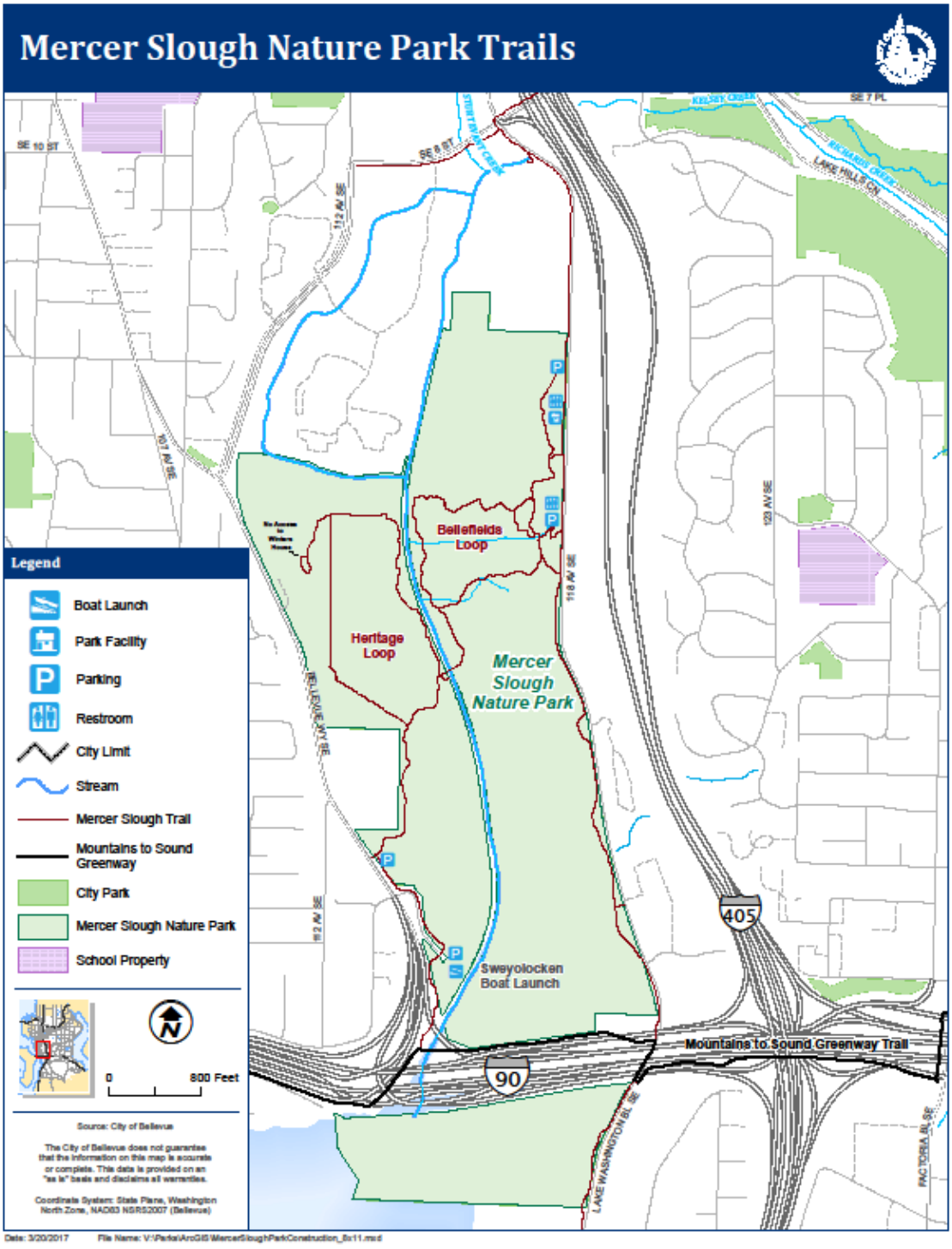
Mercer Slough Nature Park, in Bellevue, WA, is a 320-acre park with four main habitat types: a commercial blueberry farm in the northwest quadrant ("Heritage Loop", Figure 1); a narrow swath of native Douglas Fir-western red cedar forest on a steep slope on the east side of the park; a central creek and wetlands that drain SSW to Lake Washington; and, between the creek and the eastside slope, a scrubby riparian mix of willow, alder and birch with a few open meadow areas ("Bellefields Loop" in Figure 1). Most of these habitats are accessible by a system of walking trails.

The park is bounded by urban infrastructure. The City of Bellevue's downtown core with high-rise offices, apartments, condominiums and commercial areas is less than two miles north. Highways or freeway form the western, southern and eastern borders of the park, generating considerable noise and light pollution. Beginning in January 2018, tree removal and construction activity dominated the western border as construction of light rail from Seattle began.

In 2015 and 2016, surveys were conducted in summer months only (June, July and August). In 2017 and 2018 we attempted to conduct surveys every month year-round; however, inclement weather and availability of volunteers limited us to eight surveys in 2017 and seven in 2018. The weather requirement for all surveys was no precipitation for the duration of the survey. Winter surveys were conducted only on evenings with air temperature at least 50^{o}F at sunset, i.e. at the start of the survey. Survey dates are listed in Appendix Tables 1-3.

[2] See also www.batsnorthwest.org

Figure 1. Mercer Slough Nature Park, Bellevue, WA



Walking surveys were conducted for 3.5 hours beginning at sunset, usually employing four or five detectors, with a few exceptions (see Appendix Tables 1-3). The 3.5-hour survey duration was standard procedure for a prior USFS Bat Grid project (protocol described in P.C. Ormsbee, unpublished manuscript, as cited in Rodhouse et al. 2012). Bats Northwest volunteers adopted the 3.5-hour survey duration for walking surveys in the Lower Snoqualmie Valley and continued it for this study. This protocol collects sufficient data to analyze but does not "overwork" the volunteers doing the work. Surveys were conducted with Pettersson D240X detectors and bat passes were recorded with iRiver digital recorders. Calls were analyzed with Sonobat[3] 3.2.0 (Northwest Suite) using the Western Washington analysis package.

A bat call is a set of ultrasonic pulses emitted by a bat. Calls are generally species-specific, particularly in the Pacific Northwest. This specificity allows identification of each of the 10 species found in Western Washington from the search phase calls produced.
The SonoBat software assigns species designations to a sequence of bat calls (i.e., a bat pass) with a neural net classifier which was developed from a library of search phase calls collected from bats of known species in free flight. Known call characteristics are provided on SonoBat web site. Identification of the species in the database has been determined by physical examination of bats after capture in a mist net; bats are then marked with a "glow stick" tag and released, and search phase calls recorded while bats are still in area of release. Quality control criteria are incorporated in the SonoBat Classifier to ensure species classifications meet a minimal level of certainty.

In general, a data file contains several bat calls (ultrasonic pulses) with the exact number being directly proportional to the rate of calling by the animal and inversely proportional to the length (duration) of each call.

A bat pass is defined as the period of time during which a flying bat approaches an acoustic detector, reaches a point of closest approach, and then flies away from the detector. During this time period, the animal emits repeated ultrasonic pulses in the direction of travel. Each recorded interaction with a bat (i.e., each data file) contains a 1.7-second portion of the bat pass; the particular portion of the bat pass which is recorded is determined by when the operator (i.e., a volunteer) activates the recorder.

In this study (Mercer Slough) a species ID was accepted as valid in the following cases:

1. Bat passes were assigned a DEFINITE SPECIES ID by the Sonobat Classifier; these data were used in the analysis with only minimal checking. All such bat passes were visually examined by the researcher to ensure that the classifier made a reasonable identification.
2. Bat passes were assigned a PROBABLE or POSSIBLE SPECIES ID by the Classifier; these bat passes were further examined by the researcher to determine if:

[3] Sonobat.com. Bat Call Analysis Software

a. There were calls within the pass which were assigned a definite species ID from a single species and only one species, and
b. There were at least two (2) of these identified calls in the sequence.

If these criteria were met, then the bat pass was included in the data as an occurrence of the species determined for the minimum two calls.

Results

Based on Sonobat analysis of the iRiver recordings, eight bat species were present during one or more of the 23 surveys (Table 1). In order of highest activity to lowest, based on numbers of identified calls, these were: California Myotis (*Myotis californicus*); Little Brown Myotis (*Myotis lucifugus*); Silver-haired Bat (*Lasionycteris noctivagans*); Long-legged Myotis (*Myotis volans*); Big Brown Bat (*Eptesicus fuscus*); Yuma Myotis (*Myotis yumanensis*); Hoary Bat (*Lasiurus cinereus*); and Western Long-eared Myotis (*Myotis evotis*).

The most commonly recorded bat was California Myotis *(Myotis californicus).* On one survey (January 2018) it represented 100 percent of the identified calls. This species was predominant both in the high percentage (fraction of total) bat calls on a given night and in its appearance on every survey conducted (Figure 2), including those in winter.

The seven other species recorded did not match the abundance of calls by California Myotis, and several appeared to exhibit marked seasonality. The second and third most-frequently observed species were Little Brown Myotis (*Myotis lucifugus*) and Silver-haired Bat (*Lasionycteris noctivagans*) (Figure 3), present in 17 and 18 surveys, respectively. These two species occasionally comprised relatively higher percentages of the total calls; i.e., Little Brown Myotis's identified calls were more than 20 percent of the total calls in eight surveys, whereas the Silver-haired Bat's identified calls were more than 20 percent of total calls in only two surveys. Little Brown Myotis could be considered a "spring-summer" bat, based on its presence limited to April through September. In contrast, Silver-haired Bats were present for much of the year; i.e., they were recorded in all months surveyed except January.

Long-legged Myotis (*Myotis volans*) were recorded in 15 of the 23 surveys and appeared to exhibit seasonality, i.e., they were present only in surveys from April through September (Table 1). This species' "best showing" (i.e., the month with highest percentage of the total identified calls) was August 2018, at 7.9 percent (Appendix Table 3).

Two species, Big Brown Bat (*Eptesicus fuscus*) and Yuma Myotis (*Myotis yumanensis*) were recorded in 10 of the 23 surveys (Table 1). However, their apparent seasonality differed, with Big Brown Bat appearing only in April through August, and Yuma Myotis appearing most months of the year, but not in October or November. The Big Browns' identified calls were 9 percent of total calls in August 2018, and Yuma Myotis calls were 6.5 percent of the March 2018 identified calls (Appendix Table 3).

Table 1. Bat species identified in 23 acoustic surveys from June 2015 through September 2018.

Summary of Observations for 2015 - 2018 (Total no. of surveys = 23)																		
Species	**No. of surveys in which species was observed**	**No. of surveys in which this species was present, by month**											**Highest percent of all species' calls in a single survey, by this species**		**No. of surveys in which species was >20% of identified calls**		
		J	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**					
		2*	0**	2*	2*	2*	4*	3*	4*	2*	1*	1*	0**	**Percent**	**MoYear**			
MYCA	23	2		2	2	2	4	3	4	2	1	1		100	Jan2018	23		
MYLU	17				2	2	4	3	4	2				50.6	Aug2018	8		
LANO	18			2	2	2	3	2	4	1	1	1		27.2	Apr2018	2		
MYVO	15				2	2	4	3	3	1				7.9	Aug2018	0		
EPFU	10				1	2	2	1	4					9.0	Aug2018	0		
MYYU	10	1		2	1	2	1	1	1	1				6.5	Mar2018	0		
LACI	7						2	2	2	1				9.4	Aug2015	0		
MYEV	3						1	2						0.5	Jun2017	0		

* Number of surveys in this month, over the 4 years.

** No surveys were conducted in February or December.

MYCA = Myotis californicus; MYLU = Myotis lucifugus; LANO = Lasionycteris noctivagans; MYVO = Myotis volans; EPFU = Eptesicus fuscus; MYYU = Myotis yumanensis; LACI = Lasiurus cinereus; MYEV = Myotis evotis.

Figure 2. Occurrence of California Myotis (fraction of bat passes) in 23 surveys 2015-2018

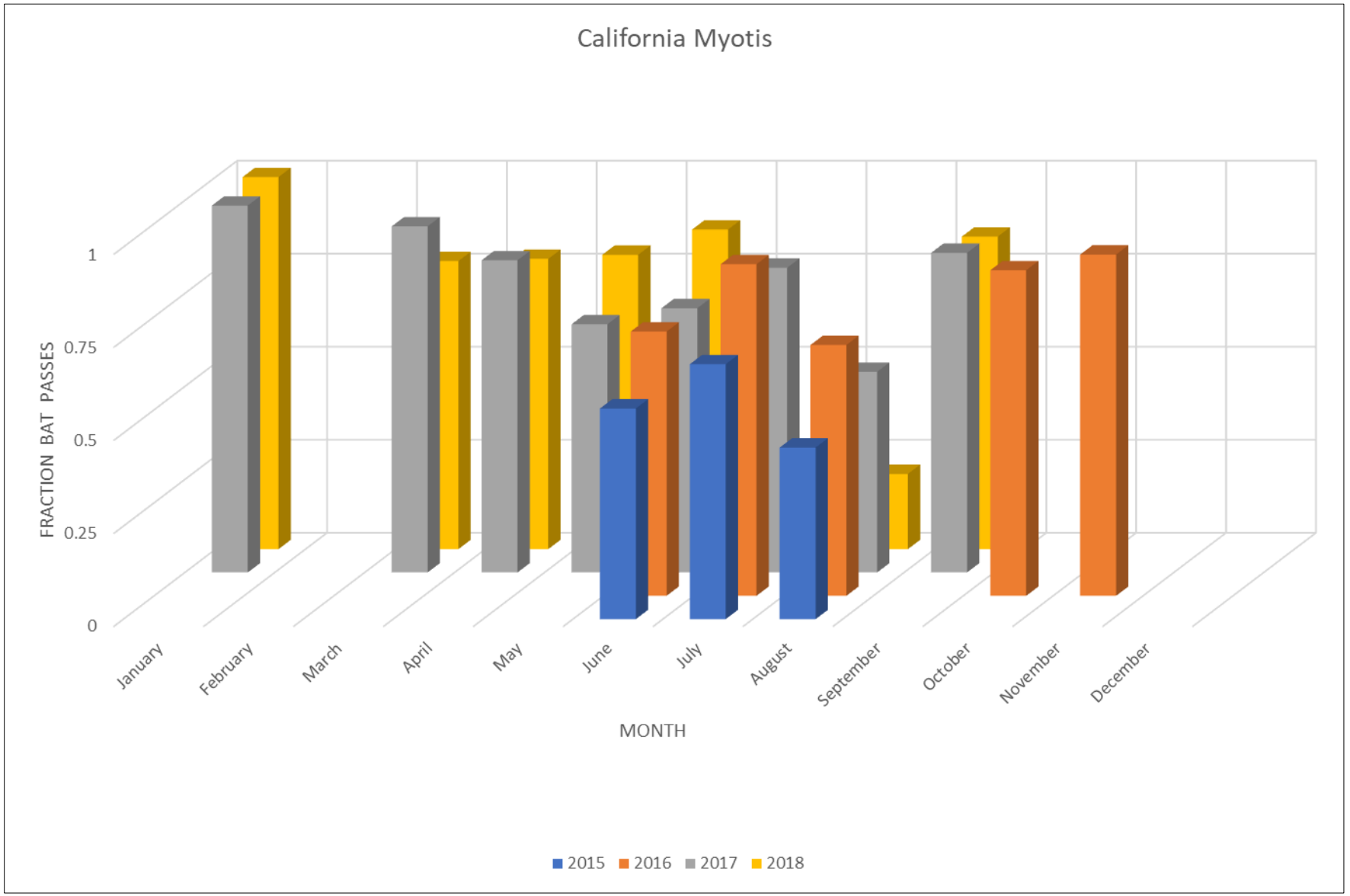


Figure 3. Number of identified calls of California Myotis, Little Brown Myotis, and Silver-haired Bat. Each column represents a different survey year (l to r, 2015, 2016, 2017, 2018).

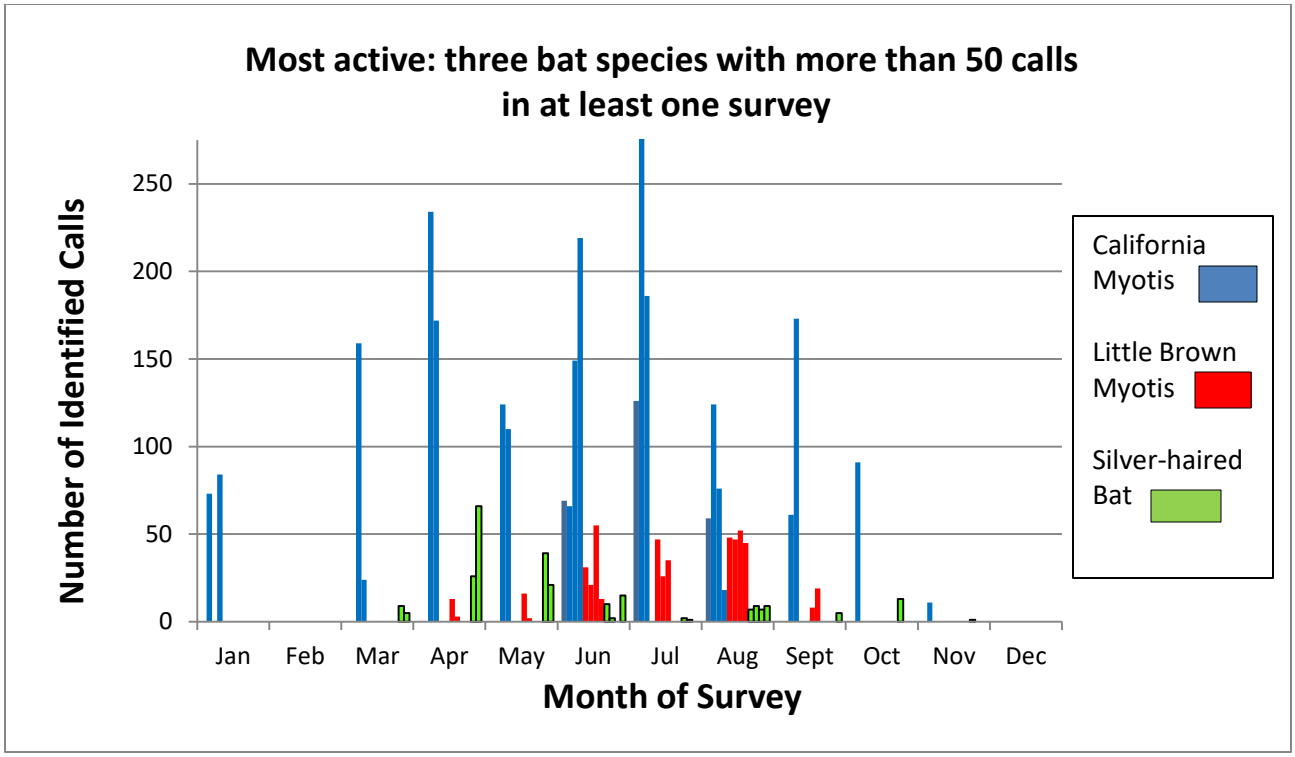


Figure 4. Number of identified calls of Long-legged Myotis, Big Brown Bat, and Yuma Myotis.

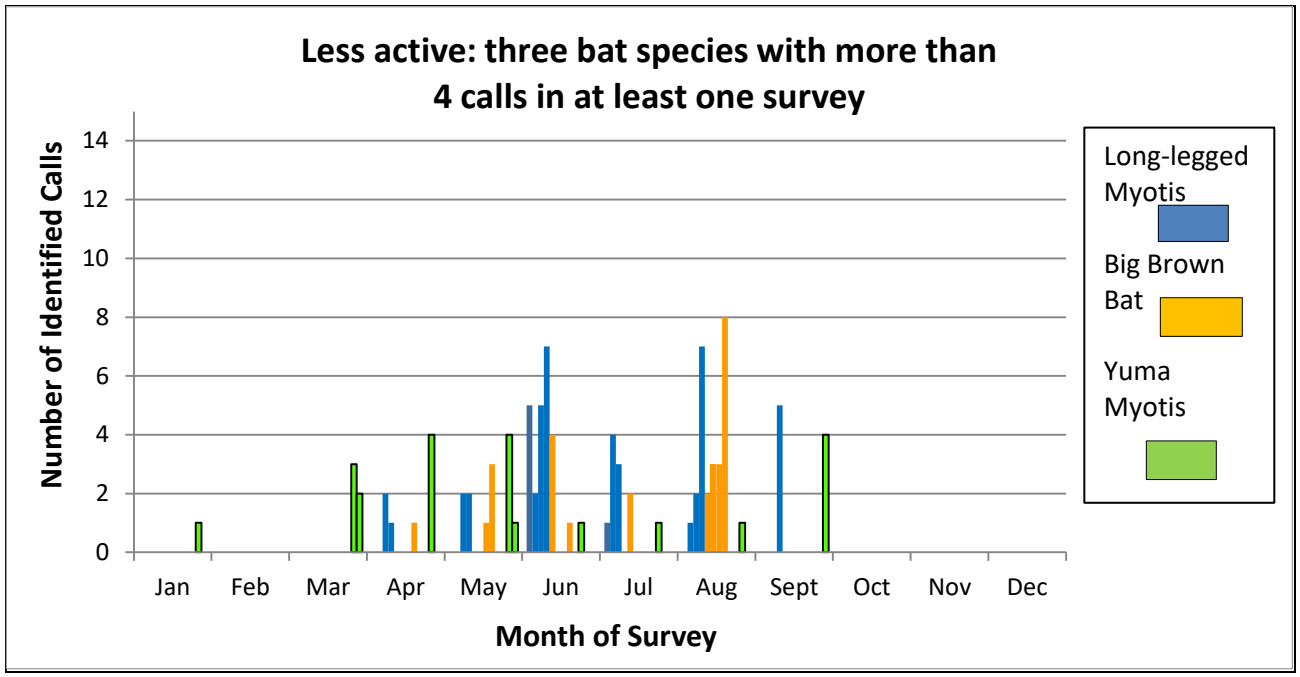
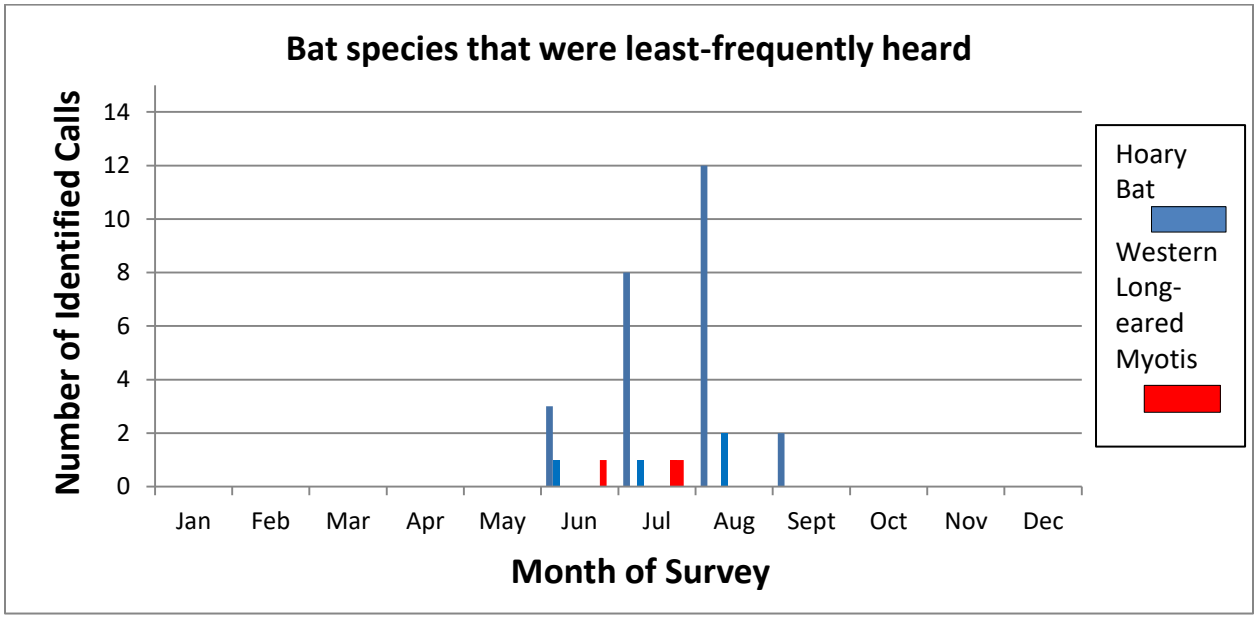


Figure 5. Number of identified calls of Hoary Bat and Western Long-eared Myotis.



The two species least frequently heard in our surveys were Hoary Bat (*Lasiurus cinereus*) which was detected in seven surveys, and Western Long-Eared Myotis (*Myotis evotis*) in only three surveys (Table 1). These two species could be considered "summer bats," based on recordings only in June through September.

Two bat species known to occur in Western Washington but not recorded in our surveys are Townsend's Big-eared Bat (*Corynorhynus townsendii*) and Fringed Myotis (Myotis thysanodes). Bats Northwest has recorded Townsend's Big-Eared Bat in acoustic surveys in the Snoqualmie River valley, a rural area about 20 miles east of Bellevue. It is probable that this species' sensitivity to human disturbance (Nagerson and Brigham 1993, and Pierson et al. 1999; both cited in Hayes and Wiles 2013) makes it less likely to occur in suburban Bellevue. Another factor may be this species' quiet echolocation calls (WBWG 2005 as reported in Hayes and Wiles, 2013).

Because numbers of echolocation calls do not correlate with numbers of bats, the call data presented in Figures 3, 4 and 5 are considered differences in activity levels of the bat species recorded rather than differences in numbers of bats (see Discussion).

Discussion

The data from four years of Mercer Slough acoustic surveys are evidence of the presence and absence of eight local bat species and provide an indication of the seasonality of each species. In order of most- to least-frequently observed, these were: California Myotis, Little Brown

Myotis, Silver-haired Bat, Long-legged Myotis, Big Brown Bat, Yuma Myotis, Hoary Bat, and Western Long-eared Bat.

The surveys don't provide information about population sizes of the bats, because numbers of echolocation calls associated with a given species do not correlate with numbers of bats present. This was demonstrated in a study by Miller (2001): for example, during one of Miller's 5-minute acoustic monitoring segment, the activity of four species was recorded as 28 passes; 11 passes; 10 passes and seven passes, respectively. Direct observation showed that only one individual of each species was responsible for all the recorded passes. Because numbers of calls do not correlate with numbers of bats, the echolocation call data presented in Figures 3, 4 and 5 should be viewed as representing differences in activity levels of the bat species rather than differences in numbers of bats.

Species identification and verification

More rigorous species identifications for the Mercer Slough recorded bat calls could theoretically be achieved through capture and examination of individuals using mist nets. However, netting bats does not guarantee that all species in an area will be captured; some species are not active in the circumstances appropriate for mist netting and thereby evade capture. Currently capture is discouraged by Washington Department of Fish & Wildlife, because of critical concerns about the spread of White-nose Syndrome (https://wdfw.wa.gov/species-habitats/diseases/bat-white-nose).

Seasonality of the Mercer Slough bats – comparison with other studies

Our data set has fewer surveys conducted in fall, winter and spring compared with summer surveys. As a result, the suggested patterns of seasonality are not definitive. Nevertheless, we can look for consistency between the Mercer Slough surveys and other studies of seasonality of bats in the Pacific Northwest. For example, we recorded California Myotis in both summer and winter surveys, similar to Burles (2014) who documented that California Myotis were periodically active in all winter months except December in the Haida Gwaii, British Columbia, Canada. Also, Falxa (2007) observed winter foraging by Silver-haired Bat and California Myotis at locations near Olympia, Washington.

A recent study (Barnett and Collins 2019) documenting presence and seasonality of 16 bat species at six National Wildlife Refuges [4]across three geographic areas in the northwestern U.S. can also be compared with our survey results. In this study, passive acoustic monitoring provided much more continuous records of bat echolocation calls – capturing data both all night long and over many days and weeks at a time. Mercer Slough in Bellevue is less than 100

[4] Two refuges were in the Northern Rockies (Kootenai in Idaho and Little Pend Oreille in Washington). Three were in the Columbia Basin in Washington (Columbia, McNary, and Toppenish). The sixth was in the northern Great Basin (Sheldon, in Nevada).

ft ASL and is within the moist climatic zone of the greater Puget Sound region. In contrast, the six refuges of the Barnett and Collins study are located considerably further inland at locations with elevations ranging from 300 ft to 6800 ft ASL. These locations would be expected to have colder winter temperatures and warmer summer temperatures than Mercer Slough, as well as other differences in roost and prey availability. In particular, the researchers located the passive detectors near water sources and rock cliffs that provide the crevices used for roosting by some species. (Mercer Slough does not have any nearby cliffs with rock crevices.) Still, as in the Mercer Slough data, Barnett and Collins observed California Myotis to be present year-round at five of the six refuges.

In the Mercer Slough data, Little Brown Myotis activity was recorded in April through September. This is not inconsistent with a reported hibernation period of September or October until March or April in interior British Columbia (Nagorsen and Brigham 1993 as cited in Hayes and Wiles 2013). Barnett and Collins (2019) reported similar seasonality for this species, except for the Great Basin (northern Nevada) refuge which had a few of this species year-round.

We recorded Silver-haired Bat in Mercer Slough surveys in March through November. Hayes and Wiles (2013) report that Washington's population of this species is comprised of both year-round and migratory individuals, and that both museum records and acoustic detections suggest that large numbers occur year-round in western Washington. (Also pertinent is Falxa's report in 2007 of winter foraging by Silver-haired Bat near Olympia, WA, noted above.) Barnett and Collins (2019) similarly report this species exhibited some overwintering activity at two (Little Pend Oreille and Great Basin) of the six northwestern US refuges. At the remaining four refuges, both seasonal and year-round activity was evident.

We recorded Long-legged Myotis in April through September in Mercer Slough. This can be compared with the reported hibernation period in Washington from early November to late March (Senger et al. 1974 as cited in Hayes and Wiles 2013). Barnett and Collins (2019) reported only incidental activity of this species at the six refuges.

We recorded Big Brown Bats only in the April through August period, which is not inconsistent with a report from interior British Columbia that this species hibernates from November to April (Nagorsen and Brigham 1993 as cited in Hayes and Wiles 2013). Our result differs from Barnett and Collins (2019) who observed Big Brown Bats year-round at all six refuges.

Yuma Myotis was present in all Mercer Slough surveys except for October and November. Our recording of Yuma Myotis in one of our two January surveys is a bit surprising given that this species has been found hibernating in caves in coastal Washington (Nagorsen and Brigham 1993), in lava tubes in Skamania County (Senger et al. 1974), and in an underground storage structure at Hanford (Lucas 2011) (all these citations are from Hayes and Wiles 2013). Hibernation is reported from late October or early November to March in eastern Washington (Lucas 2011 as cited in Hayes and Wiles 2013). Barnett and Collins (2019) also report that this

species is present only seasonally at the six refuges, except for some winter activity detected at the most southern (but also highest elevation) Great Basin, NV, refuge.

We recorded Hoary Bat in summer (June through September). This seasonality appears to be consistent with reported migratory behavior by this species. Spring migration is reported to occur from April to June (several citations in Hayes and Wiles 2013) and fall migration between early August and October (several citations in Hayes and Wiles 2013). Wintering areas are known in California and Mexico; however details of migration are poorly known. In contrast, G. Falxa (Falxa, pers. comm. cited in Hayes and Wiles 2013) has recorded acoustic activity of this species in winter in Thurston County, Washington. Barnett and Collins (2019) report similar seasonality at five of the six National Wildlife Refuges, with some winter activity reported only at Great Basin National Wildlife Refuge in Nevada.

The Western Long-eared Myotis was present in only three of our surveys, in June and July. This species is reported to have quiet echolocation which could affect a solely-acoustic survey (Falxa, 2008a, as cited in Hayes and Wiles 2013). The species is reported to begin hibernation from about late September to late October (Nagorsen and Brigham 1993; and Maser 1998, as cited in Hayes and Wiles 2013). Barnett and Collins (2019) report this species as incidental at three of the six refuges; both year-round and seasonal activity only at the Great Basin (NV) refuge; and no occurrences at Columbia or Toppenish refuges.

Because of milder winters in Western Washington, some local bat species appear to be able to use a “snack and snooze” strategy for surviving winter. In other words, while some species such as Hoary Bat are believed to migrate, researchers have suggested that other species are able to utilize a shallow level of torpor, and rouse themselves for feeding on evenings of days with warmer daytime temperatures (Johnson et al., 2012). Barnett and Collins (2019) cite Lausen and Barclay (2006): “All hibernating bats periodically arouse and some individuals leave the hibernaculum, but it is believed that they do not fly long distances.” They state that detection of echolocation calls in winter suggests that bats hibernate nearby, and note there is limited information on hibernacula for many western bat species. It may be that the Yuma Myotis activity recorded in Mercer Slough in January 2017 is an example of this type of short term arousal in winter.

Questions for future research

During the field work in Mercer Slough, it was tempting to speculate about affinities of particular species with specific habitats of the park. Some correlation of species and habitats might have been possible if each volunteer stayed only in one habitat during each survey. However, usually volunteers needed to pass through two or more habitat areas during a survey. The iRiver recording devices do not have a time stamp on them, so we were not able to make any correlations between subsets of an evening’s recordings and time spent in specific habitats.

So our conjectures represent areas of inquiry that we might want to pursue through future investigations:

- Do *Myotis californicus* mainly use the forested areas of the park? If so, what and where are their roosts?
- When does *Myotis lucifugus* leave the vicinity for the winter, and where does it go?
- When does *Lasiurus cinereus* leave for its annual migration to California or other parts of the southwest?
- Are *Myotis lucifugus* and *M. yumanensis* the bat species we saw (and recorded) catching insects just above the water surface at Sweylocken Boat Launch?

We provide in Appendix Table 4 a summary (based on information in Hayes and Wiles, 2013) of what is generally known about the eight species recorded in Mercer Slough – preferred prey, summer and winter roost preferences, and what is known about migration. Overwintering strategies are particularly poorly known – which species migrate and to what area? Which stay local and what sorts of built structures or natural spaces do they occupy? These questions offer opportunity for future investigations.

Acknowledgements

Bats Northwest is very grateful to the City of Bellevue Department of Parks and Community Services for permitting use of Mercer Slough Nature Park for surveys after hours. The Parks Department staff were also helpful in alerting local police to the unusual presence of individuals wearing headlamps and wandering through the park after hours.

The surveys could not have been accomplished without Bats Northwest's amazing volunteers: John Bassett (who analyzed the iRiver acoustic records as well as directed much of the survey effort), Bernice Tannenbaum (who did the survey scheduling), Michelle Noe, Sally Lawrence, Christina Teresa, Veda DePaepe, Albert Meerscheidt, Curt Black, Erika Price, Julio Lafleur, Anne del Campo, Anne Dettelbach, Heidi Richter, Heather Kolowinski, and Art Eash.

Photographs

Survey volunteers in 2015, from left: Michelle Noe, Bernice Tannenbaum, John Bassett, Veda DePaepe, Erika Price, Curt Black (photo Sally Lawrence)

Volunteer with bat detector (photo Sally Lawrence)

Mercer Slough bat (photo Albert Meerscheidt)

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Appendix Table 1. Mercer Slough Bat Acoustic Data for 2015 and 2016

Survey Date	Numbers in table are numbers of identified calls for each species								
Year	2015				2016				
Day	15	23	18		16	19	16	25	14
Month	June	July	August		June	July	August	October	November
		Summer				Summer			
Species									
EPFU	4	2	2				3		
LACI	3	8	12		1				
LANO	10		7		2	2	9	13	1
MYCA	69	126	59		66	277	124	91	11
MYEV						1			
MYLU	31	47	48		21	26	47		
MYVO	5	1			2	4	1		
MYYU					1	1			
Total	1.001	0.999	1.001		1.002	1.000	0.999	1.000	1.000
Number of Passes Recorded	221	291	199		154	465	261	158	15
Number of Passes Identified	122	184	128		93	311	184	104	12
Fraction of Passes Identified	0.552	0.632	0.643		0.604	0.669	0.705	0.658	0.800
Number of Detectors Used	5	4	5		4	4	4	2	4

MYCA = Myotis californicus; MYLU = Myotis lucifugus; LANO = Lasionycteris noctivagans; MYVO = Myotis volans; EPFU = Eptesicus fuscus; MYYU = Myotis yumanensis; LACI = Lasiurus cinereus; MYEV = Myotis evotis.

Appendix Table 2. Mercer Slough Bat Acoustic Data for 2017

Survey Date	Numbers in table are numbers of identified calls for each species							
Year	2017							
Day	28	25	24	22	30	23	27	23
Month	January	March	April	May	June	July	August	September
						Summer		
Species								
EPFU				1			3	
LACI						1		2
LANO		9	26	39		1	7	
MYCA	73	159	234	124	149	186	6	61
MYEV					1	1		
MYLU			13	16	55	35	52	8
MYVO			2	2	5	3	2	
MYYU	1	3	4	4			1	
Total	1.000	1.001	1.000	1.001	1.001	0.998	1.000	1.000
Number of Passes Recorded	117	287	406	352	357	317	280	130
Number of Passes Identified	74	171	279	186	210	227	141	71
Fraction of Passes Identified	0.632	0.596	0.687	0.528	0.588	0.716	0.504	0.546
Number of Detectors Used	4	4	4	4	5	5	5	5

MYCA = Myotis californicus; MYLU = Myotis lucifugus; LANO = Lasionycteris noctivagans; MYVO = Myotis volans; EPFU = Eptesicus fuscus; MYYU = Myotis yumanensis; LACI = Lasiurus cinereus; MYEV = Myotis evotis.

Appendix Table 3. Mercer Slough Bat Acoustic Data for 2018

Survey Date	Numbers in table are numbers of identified calls for each species						
Year	2018						
Day	14	11	26	27	27	27	23
Month	January	March	April	May	June	August	September
					Summer		
Species							
EPFU			1	3	1	8	
LACI						2	
LANO		5	66	21	15	9	5
MYCA	84	24	172	110	219	18	173
MYEV							
MYLU			3	2	13	45	19
MYVO			1	2	7	7	5
MYYU		2		1			4
Total	1.000	1.000	1.000	0.999	1.000	1.000	0.999
Number of Passes Recorded	146	49	431	258	366	179	306
Number of Passes Identified	84	31	243	139	255	89	206
Fraction of Passes Identified	0.575	0.633	0.564	0.539	0.697	0.497	0.673
Number of Detectors Used	5	1	5	4	4	5	3

MYCA = Myotis californicus; MYLU = Myotis lucifugus; LANO = Lasionycteris noctivagans; MYVO = Myotis volans; EPFU = Eptesicus fuscus; MYYU = Myotis yumanensis; LACI = Lasiurus cinereus; MYEV = Myotis evotis.

Appendix Table 4. Prey and habitat preferences of bat species recorded at Mercer Slough (information from Hayes and Wiles 2013)

Species	Apparent Seasonality (at Mercer Slough)	Prey	Summer Roost Types	Winter Roost Types	Migratory?
Big Brown Bat (*Eptesicus fuscus*)	M, J, J, A	Hard-bodied insects such as beetles Also caddisflies, termites, bees, ants, termites, moths	Buildings, trees, snags, caves, mines, crevices in cliffs and bridges	Buildings, caves, mines, rock crevices	Likely remain close to summer range
California Myotis (*Myotis californicus*)	Year-round	Caddisflies, beetles, moths, neuropterans, termites, bees	Crevices under tree bark, rocks, tree cavities, caves, mines, bridges, shrubs, on ground	Buildings, caves, mines (in small groups)	Likely very limited
Hoary Bat (*Lasiurus cinereus*)	J, J, A, S	Considered moth specialist but also beetles, grasshoppers, dragonflies, wasps, termites, midges, other flies	Foliage of coniferous and deciduous trees 3 – 16 m above ground. Roost trees commonly at edge of clearings	Not well known. Individuals found on tree trunks and in tree cavities, squirrel nests, clumps of moss	Yes Long-distance
Little Brown Myotis (*Myotis lucifugus*)	Apr, M, J, J, A, S	Emerging aquatic insects, e.g midges, also moths, beetles, non-aquatic flies, spiders	Buildings, tree cavities, under bark, in rock crevices, caves & mines	Poorly known. Caves, abandoned mines, lava tubes. Singly or in small clusters in PNW (unlike other parts U.S.)	In eastern US, long migrations. Not known for PNW.
Long-legged Myotis (*Myotis volans*)	Apr, M, J, J, A	Moths most. Also termites, flies, beetles, lacewings, wasps, leafhoppers, true bugs, spiders, other	Snags, live trees with loose bark; rock crevices; streambanks, buildings, bridges, caves, mines.	Caves and mines, lava tubes. Hibernate from early November to late March in WA.	No information
Silver-haired Bat (*Lasionycteris noctivagans*)	Spring-summer-fall (Mar, Apr, M, J, J, A, O, N)	Moths, flies, beetles, leafhoppers, true bugs, neuropterans, caddisflies	Snags and live trees, both coniferous & deciduous; buildings, bat houses, wood piles,	Trees, buildings, abandoned mines, even bat houses. Caves not much used. Hibernate or go into daily torpor.	Yes Long-distance
Western Long-eared Myotis (*Myotis evotis*)	J, J	Moths, beetles, flies, spiders, true bugs, caddisflies, termites	Under tree bark, snags, stumps, downed logs, buildings, crevices in ground-level rocks and cliffs, tree cavities, caves, mines.	Caves, mines and possibly buildings. Use of trees unknown. Hibernation usually starts late Sept to late October	Migration likely betw. summer roosts & winter hibernacula. WA migration unknown
Yuma Myotis (*Myotis yumanensis*)	Nearly year-round (Jan, Mar, Apr, M, J, J, A)	Aquatic insects, moths, beetles, neuropterans, leafhoppers, termites, spiders	Buildings, bridges, cliff crevices, caves, mines, and trees	Poorly known in WA, but some found in caves & lava tubes. From late Oct/early Nov to March in E. Washington.	No information available.