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FALL AND WINTER BAT ACTIVITY AT A DESERT SPRING IN SOUTHERN NEVADA

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ABSTRACT. Bats were captured in a mist net at White Spot Spring, Desert Game Range, Clark County, Nevada during the months September through May for a total of 21 mist net nights. Time of capture, air temperature, and wind conditions are given for each species. Two species, *Pipistrellus hesperus* and *Myotis californicus* were active throughout the fall and winter. *Pipistrellus* was netted at air temperatures ranging from 1° to 31° C. *Myotis californicus* was netted at air temperatures of 2° to 27° C. Approximately 48% of the *Myotis* were taken at air temperatures between 2° and 6° C. and approximately 11% of the *Pipistrellus* were netted at air temperatures of 5° C. or below. A third species *Antrozous pallidus* was netted in low numbers at air temperatures as low as 2° C.

Studies of bat activity have usually been conducted during the spring, summer, and early fall months when bat activity is highest. Since bat activity is low or non-existent in temperate areas during the fall and winter, few data on activity are available for these seasons. The present study provides some indications of fall and winter activity for certain species found to be active at these seasons in southern Nevada.

DESCRIPTION OF THE STUDY AREA. White Spot Spring is located at 4460 feet elevation, on the north-facing slope of the Las Vegas Range, Desert Game Range, Clark County, Nevada. The spring flow is contained within a stone tank which is approximately 11.5 feet square by 2 feet deep. The tank was usually full of water. It is bordered on one side by *Tamarix spp.* and *Phragmites communis*. The surrounding area consisting or rolling hills is covered by various desert shrubs including *Coleogyne ramosissima*, *Larrea divaricata*, *Yucca schidigera*, and *Atriplex canescens*.

METHODS. A mist net was set at the tank by O'Farrell and Jones for a total of 15 nights between 5 September 1964 and 23 April 1965. Due to the abnormally severe winter it was not possible to reach the area for long periods from late December to late March. Each night one mist net was tended for a period of usually 5 to 7 hours. These records are

supplemented by six nights of mist netting by Bradley in 1962 during the months of February through May and November. The study is therefore based on a total of 21 mist net nights. The net was tended for a total of 172 hours for the entire study.

Wind conditions and air temperatures were recorded at approximately 30 minute intervals. These data are supplemented by thermograph records for the period March 1964 through April 1965. In addition, time of capture and air temperature were recorded when each bat was netted. Most of the bats taken in 1964 and 1965 were banded and released.

SEASONAL ACTIVITY. The number of bats of each species taken per mist net night is given in Table 1. Bats were taken in all months except December. When the study area was visited on 11 December 1964 the stone enclosure had been drained and although the mist net was maintained from 4 to 7 PM, no bats approached the net. One *Myotis* was seen at 5:10 pm. (air temperature of 2° C). Seven *Pipistrellus* were observed flying between 5:10 and 6 PM, during which time the air temperature varied between 2° and 1° C. An unidentified bat was seen at approxifately 7 PM at an air temperature of 1° C.

The two most abundant species, *P. hesperus* and *M. californicus*, were netted or observed throughout the fall and winter months indicating that both species are active throughout the fall and winter in southern Nevada. However, the numbers of both species netted per mist/net night were considerably lower for most of the fall and winter indicating that activity is reduced during these seasons.

Antrozous pallidus was netted at infrequent intervals during the fall and winter indicating perhaps a more infrequent activity during these seasons. *Eptesicus fuscus* and *Tadarida brasiliensis* were not taken in the fall or winter.

TABLE 1

Numbers of bats of each species taken per mist net night each month. The total mist net nights for each month is given in parenthesis under each month.

Species	Total taken	Sept. (4)	Oct. (3)	Nov. (3)	Dec. (1)	Feb. (2)	Mar. (5)	April (2)	May (1)
Pipistrellus hesperus	79	6.8	3.0	2.6		3.0	2.8	0.5	14.0
Myotis californicus	66	2.0	1.6	0.6		0.5	9.4	1.0	1.0
Antrozous pallidus	8		1.0	0.3		0.5			3.0
Eptesicus fuscus	2	0.3							1.0
Tadarida brasiliensis	1								1.0
Total	156	9.1	5.6	3.5		4.0	12.2	1.5	20.0

TABLE 2

The number of bats of each species taken at 30 minute intervals, from time of sunset. Time of sunset was taken from tables furnished by the United States Weather Bureau for Las Vegas, Nevada, which is at the approximate latitude of the study area.

Time from Sunset (0)	Pipistrellus hesperus	Myotis californicus	Antrozous pallidus	Eptesicus fuscus	Tadarida brasiliensis
0 + 30 min.	9	12			
31 min. — 1 hr.	7	10			
1 hr. + 30 min.	12	17			
31 min. — 2 hr.	18	4	1		
2 hr. + 30 min.	12	8	1		
31 min. — 3 hr.	5	5	2	1	1
3 hr. + 30 min.	4	3	1	1	
31 min. — 4 hr.	4	2	1		
4 hr. + 30 min.	3	1	1		
31 min. — 5 hr.			1		
5 hr. + 30 min.					
31 min. — 6 hr.					
6 hr. + 30 min.					
31 min. — 7 hr.					
7 hr. + 30 min.					
31 min. — 8 hr.					
8 hr. + 30 min.					
31 min. — 9 hr.		1			
9 hr. + 30 min.					
31 min. — 10 hr.					
10 hr. + 30 min.					
31 min. — 11 hr.					
11 hr. + 30 min.	2	1			
31 min. — 12 hr.	3	2			
Total	79	66	8	2	1

TIME OF ACTIVITY. The time of capture for each species in relation to sunset is given in 30 minute intervals in Table 2. Approximately 75% of the *Pipistrellus* and *Myotis* were taken in the first 2½ hours after sunset. The peak of activity for *Myotis* occurred between 1 and 1½ hours after sunset followed by a peak of activity for *Pipistrellus* 1½ to 2 hours after sunset. Both species were first taken at sunset although both, particularly *Pipistrellus*, were seen flying during the half hour interval before sunset. Activity of both species as determined by captures and observations, ceased at approximately 8¾ hours after sunset and both species exhibited slight activity later in the night just before sunrise.

Our limited data for *Antrozous* does not indicate an activity peak but

individuals being regularly taken from approximately 1½ to 5 hours after sunset.

ACTIVITY IN RELATION TO AIR TEMPERATURE. The number of *Myotis* and *Pipistrellus* taken at different ranges of air temperature is given in Table 3. These temperatures do not indicate a temperature preference or temperatures at which activity is highest since many of the mist net nights occurred in the fall and winter months when all temperatures were in the lower ranges. They do however indicate that some activity occurs over a wide temperature range, including the lower temperature intervals. We estimated the number of hours of mist netting at different temperature ranges when bats were taken and the number of *Myotis* and *Pipistrellus* taken per mist net hour. There is a clear indication in Figure 1 that *P. hesperus* activity is greatly influenced by air temperatures as the number taken per mist net hour increases greatly at the higher temperatures. Our data do not indicate any appreciable difference in activity in relation to air temperature for *M. californicus*.

Pipistrellus hesperus was most active at air temperatures of approximately 31° C and was taken over a wide range of air temperatures from 1° to 31° C. However approximately 11% were netted at temperatures of 5° C or below, indicating considerable activity under reduced air temperatures. *Myotis californicus* was netted over a range of air temperature of 2° to 27° C. Approximately 48% of the captures occurred at air temperatures between 2° and 6° C showing appreciable activity in this species at lowered temperatures.

We have netted *Antrozous pallidus* on numerous occasions at elevations below 5000 feet in southern Nevada during the summer months

TABLE 3

The number of Pipistrellus hesperus *and* Myotis californicus *netted at different temperature intervals.*

Temperature interval in degrees C.	Number of bats netted	
	Pipistrellus hesperus	*Myotis californicus*
1– 5	9	18
6–10	14	29
11–15	4	6
16–20	25	9
21–25	9	3
26–30	12	1
31–35	6	0
Total	79	66

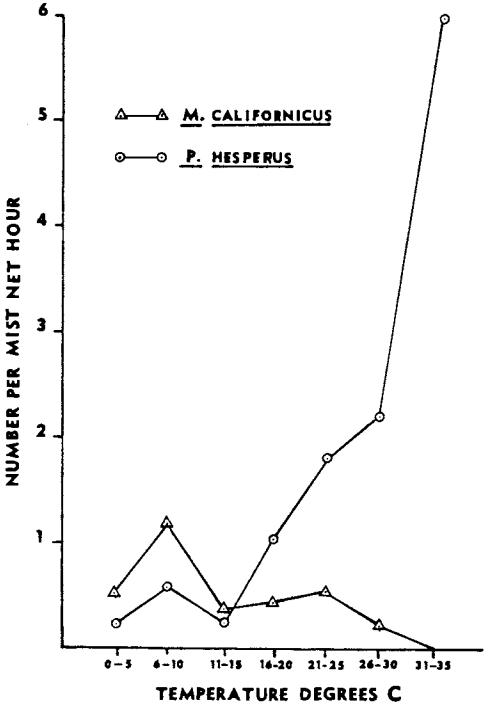

Fig. 1. The number of *Pipistrellus hesperus* and *Myotis californicus* taken per mist net hour at different temperature ranges.

and consider it a common and characteristic species of this area. Four were netted at low air temperatures. On 23 October 1964 two males were taken at 7:35 PM (air temperature 10° C). One male was taken on 27 November 1964 at 6 PM (air temperature 2° C) and another on 1 February 1965 at 8:30 PM (air temperature 3° C). These records are an indication of erratic and infrequent activity at low air temperatures for this species.

The number of *P. hesperus* and *M. californicus* of either sex netted at the lower air temperatures is indicated in Figure 2. In *Pipistrellus* both sexes exhibited activity throughout much of the lower air temperature range. However, females were not netted at approximately the lower three degrees of air temperature at which males were netted. Both sexes of *Myotis* were netted throughout the lower air temperature range.

ACTIVITY IN RELATION TO WIND. Wind speed was estimated and checked at 30 minute intervals by means of a Dwyer Wind Meter. The number of bats per mist net hour of each species netted at dif-

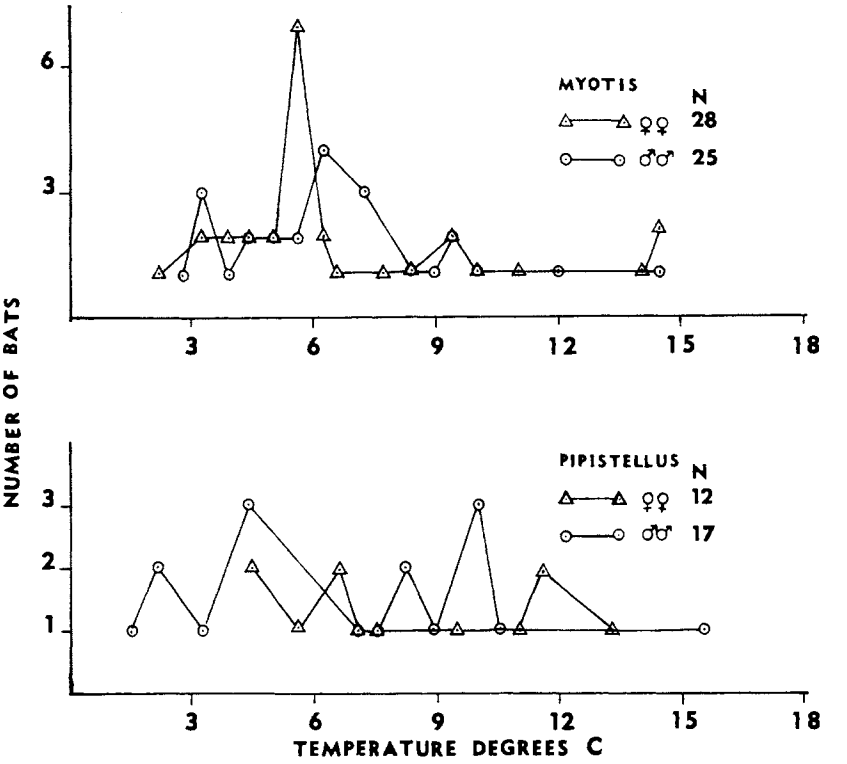

Fig. 2. The number of *Pipistrellus hesperus* and *Myotis californicus* of either sex taken at lower air temperatures.

ferent wind speeds is given in Table 4. None were netted at wind speeds in excess of 9 miles per hour. During windy intervals there was a definite indication of reduced activity based on observations of bats flying in the vicinity, and no bats were observed flying when winds

TABLE 4

The number of bats of each species taken per mist net hour at different wind speeds.

Species	Estimated wind speed in miles per hour				
	0	1–3	4–6	7–9	10+
Pipistrellus hesperus	0.98	0.27	0.07	0.50	0
Myotis californicus	0.25	0.70	0.15	0.50	0
Antrozous pallidus	0.06	0.06	0	0	0
Eptesicus fuscus	0.01	0	0	0.50	0
Tadarida brasiliensis	0.01	0	0	0	0
Total	1.31	1.03	0.22	1.50	0

were in excess of 12 miles per hour. For example, on 25 September 1964, no bats were observed flying when the air temperature varied from 14° to 28° C and the wind speed varied from 12 to 20 miles per hour. These data strongly suggest that activity may be greatly reduced during strong winds although other conditions such as air temperature and time of night are favorable for bat activity.

BANDING. In 1964 and 1965, 44 *Pipistrellus*, 16 *Myotis*, and 3 *Antrozous* were banded and released. None were recovered at the spring. Due to the small number of bats banded no conclusions can be drawn concerning the possibility of continued use of the spring by individual bats.

DISCUSSION. Comparison with other studies is difficult since data on fall and winter activity are largely nonexistent. Although *T. brasiliensis* commonly migrates from the Southwest into Mexico during the winter, Grinnell (1918) reported this species as active at various times throughout the winter in California. Reeder and Cowles (1951) reported *Macrotus californicus* as active throughout the winter in California and Cross (1965) indicated that *P. hesperus* was active during cold periods in southern Arizona. Intercave movements between winter hibernacula have been reported by Mumford (1958), Beer (1955), Twente (1955), and others.

Jones (1965) netted bats in New Mexico during April through October and found them least abundant in August and October. He attributed their lower abundance in August as due to increased availability of water and therefore wider dispersion of bats. Differences in seasonal availability of water was not a factor in the present study and it is probable that reduced activity was due to a combination of lowered temperatures and a reduction in food supply.

The pronounced activity peak in *P. hesperus* occurring in the hour after sunset is well known and has been thoroughly documented (Cockrum and Cross, 1964; Mumford et al., 1964; Jones, op. cit.). Our activity peak is similar but our data indicate continued activity for about four hours which is about one hour longer than indicated by any of the above studies. Activity occurred at dawn which is not indicated by the other studies in which nets were not tended all night. Cross (1965) in a study of the roosting habits of *P. hesperus* indicated that flying is restricted to the evening hours during the winter months. We also found no indication of morning activity during the fall and winter months.

Myotis californicus was active for approximately the same time periods as *P. hesperus* which indicates a more prolonged period of

activity than that given for this species of either Mumford et al. (op. cit.) or Jones (op. cit.). Our data also indicate some activity after midnight and in the early morning hours. In the fall and winter months activity may not only be lower but more erratic and prolonged because different individuals may become active at different times of the night in these seasons resulting in a more extended activity period.

Our data for *A. pallidus* suggest a slightly longer activity period but does not differ significantly from that presented by Cockrum and Cross (op. cit.) Mumford et. al. (op. cit.) and Jones (op. cit.).

Jones (op. cit.) collected *P. hesperus* in April through August and gives a temperature range of approximately 14° to 29° C and a mean air temperature of approximately 22° C. Cross (op cit.) indicates that very few *P. hesperus* flew when the air temperature was below 19° C and further suggests that only males are active during the winter periods. In contrast, we netted 34 at air temperatures below 10° C and found both sexes active during the winter.

Jones (op. cit.) collected *M. californicus* in May through September and indicates an air temperature range of approximately 9° to 24° C and a mean of approximately 16° C for this species as compared with numerous captures below 9° C in the present study. Our data also indicate activity in *A. pallidus* at air temperatures approximately 6° C lower than that given by Jones (op. cit.).

These temperature differences for the three species, may indicate physiological differences between populations of the same species but more probably represent lower temperatures not encountered during the months of the other study.

Jones (op. cit.) also considers wind an unimportant factor in influencing bat activity. He states that wind does influence the effectiveness of the net resulting in fewer captures but not the number of bats observed. Our observations, limited to a single spring, would suggest that wind speeds approaching or in excess of 10 miles per hour is a factor in reducing activity.

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