Bat Survey Along the Norris-Madison Junction Road Corridor, Yellowstone National Park, Wyoming, 1999

A Report to:

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ABSTRACT

An assessment of bat presence was conducted along the Norris-Madison Junction Road corridor in Yellowstone National Park, Wyoming during 20-25 September 1999. Twenty-three sites were monitored for bat activity, 21 sites were monitored overnight with electronic bat detectors, and two sites were mist-netted for 2.0-2.5 hr after sunset. Five bridges (including one just outside of the primary road corridor study area) were inspected for evidence of use by bats (droppings or roosting individuals), and one additional elevated wooden road structure spanning the outflow at a thermal feature was inspected for similar bat spoor. One undeveloped thermal area was checked for bat spoor around boulders because the area is a known maternity site by an unidentified bat species.

Bats were recorded at 17 of 21 sites monitored with bat detectors, equipment malfunction occurred at one site. Species tentatively identified included Western Long-eared Myotis (*Myotis evotis*) at 3 sites, Big Brown Bat (*Eptesicus fuscus*) at 3 sites, and Silver-haired Bat (*Lasionycteris noctivagans*) at 5 sites. Unknown bat species were recorded at 11 sites, unidentified Myotis at 10 sites, and indistinguishable Big Brown/Silver-haired bat at 11 sites. The amount of bat activity (number of recorded passes) was relatively low at the majority of sites where bats were detected, ranging from 1-40 passes. Twelve or fewer passes were recorded at 12 of 17 sites, 20 or more passes were recorded at the remaining 5 sites where bats were detected.

Two species of unidentified bats (one Myotis and one larger species) were observed foraging at crown level among lodgepole pines at the Norris Campground (B Loop and entrance area) between 19 40-21 15 MDT. A few bats were observed at the two mist-netting sites, but only one bat was captured, a male Little Brown Myotis (*M. lucifugus*) along the Gibbon River below the Tuff Cliffs picnic area. Bats observed at the second netting site (a small pond) were either Big Brown or Silver-haired bats.

Three of six bridges or bridge-like structures had evidence of bat use. Three of four bridges with steel beams and concrete or stone pilings had concentrations of bat droppings on their undersides. The wooden structure at Beryl Springs and the concrete bridge spanning the Gibbon River at Madison Junction are probably used little if at all as a roost site by bats.

ACKNOWLEDGMENTS

This project was conceived and promoted by Roy Renken (Yellowstone National Park) to supplement the scant information on bats in the park, especially along the highway corridors. Roy supported the current effort in all aspects, and his interest, foresight and enthusiasm are greatly appreciated. Thanks also to Roy Renken and Bob Proctor (Royal Society for the Protection of Birds; Nethybridge, Scotland) for participating in the most productive evening of mist-netting bats The study presented in this report was conducted under Research Authorization Permit Number 5024

INTRODUCTION

Little information is currently available on the bats inhabiting Yellowstone National Park (YNP) The most recent comprehensive account of the mammals of Wyoming (Clark and Stromberg 1987) provides records of only three bat species in the park Western Long-eared Myotis (*Myotis evotis*), Little Brown Myotis (*Myotis lucifugus*), and Townsend's Big-eared Bat (*Corynorhinus townsendii*) Six additional species were predicted to occur in YNP To date, at least one of these, the Silver-haired Bat (*Lasionycteris noctivagans*), has now been confirmed with specimen documentation (R Renken personal communication)

In the last five years at least two investigations of bats have occurred within limited areas of YNP Bogan and Geluso (1999) studied summer roosts (especially maternity roosts) of bats in human-made structures at several sites Little Brown Myotis was the only bat species they documented in YNP during their study An inventory of bat use of the Mammoth-Norris Grand Loop road corridor by Martinez (1999), using electronic bat detectors and mist-nets, reported six bat species including Fringed Myotis (*M. thysanodes*), Big Brown Bat (*Eptesicus fuscus*), and Hoary Bat (*Lasiurus cinereus*) With the exception of Townsend's Big-eared Bat, none of these species were captured or identified visually, so species identifications should be considered tentative (see Study Area and Methods for a discussion of using bat vocalizations for species identifications)

As part of a preliminary inventory and assessment of bat distribution in YNP the survey reported here compliments previous inventory efforts In the current survey the focus of the inventory was the section of highway and adjacent landscape between Norris and Madison Junction in the northwest portion of the park, a continuation to the south of the previous road corridor survey of Martinez (1999) Primary objectives were to identify areas of bat activity and provide species determinations where possible

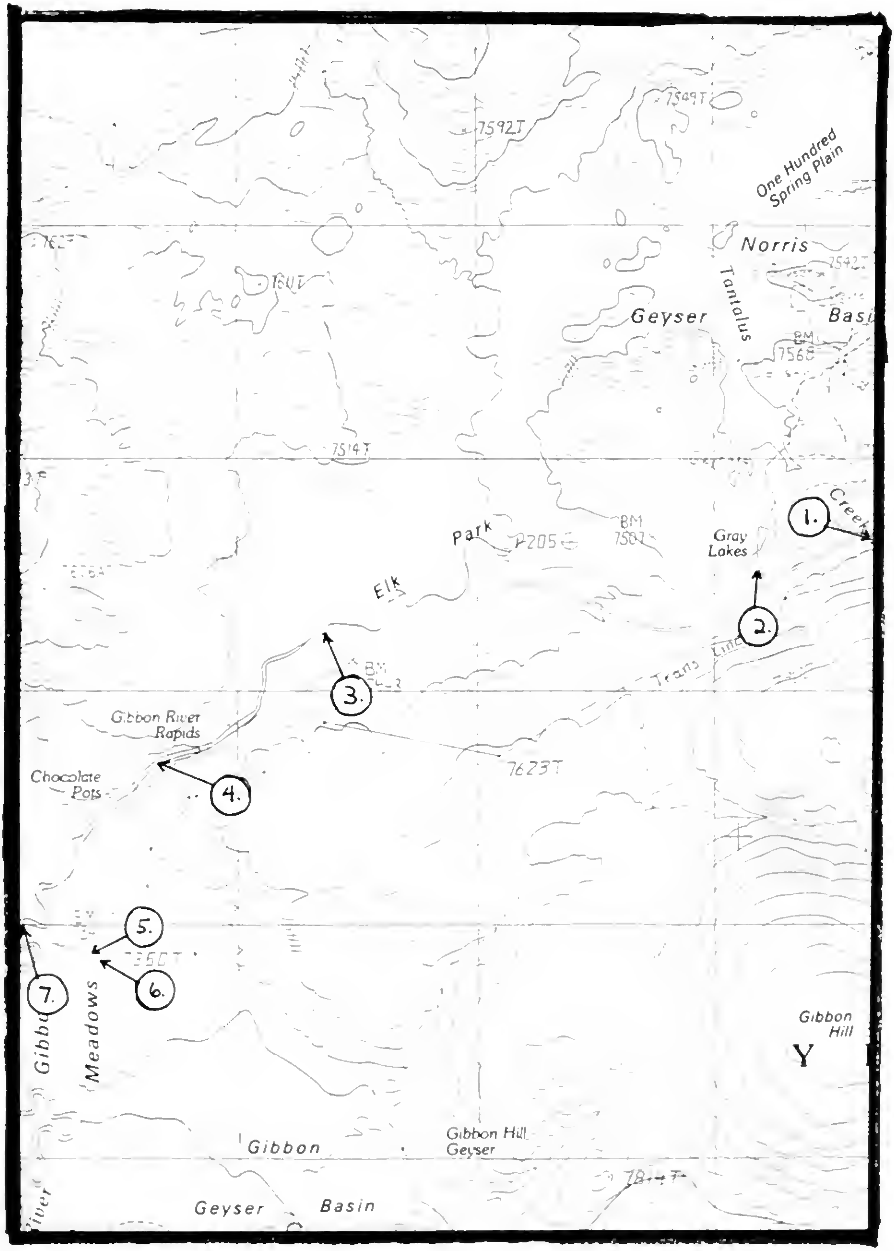
STUDY AREA AND METHODS

The portion of highway in YNP covered by the bat survey reported here (Norris to Madison Junction, see Fig 1-4) falls within the Yellowstone Volcanic Plateau of the Yellowstone Highlands Section (Nesser et al 1997), and is characterized by a cold continental climate with warm dry summers and cold dry winters There are a number of thermal features in the area, adding to the diversity of habitats dominated by extensive stands of conifers Sites surveyed during the inventory ranged in elevation from 6800-7600 ft (2073-2316 m) Most sites were in terrain dominated by lodgepole pine (*Pinus contorta*)

Fieldwork was conducted from 20-25 September 1999 Overnight low ambient temperatures were measured with a Taylor maximum-minimum thermometer Daily minimum temperatures ranged from 26°F on 21 and 22 September to 39°F on 24 September Daily temperature maxima were about 65-75°F

Bat detectors (ANABAT II, Titley Electronics, Ballina, Australia) or mist nets were deployed near water, cliffs or other outcrops, open corridors in forest, forest-meadow edges, and bridges where bats might be likely to forage Multiple survey techniques are recommended for more complete and accurate inventory (O'Farrell and Gannon 1999) Detector units (consisting of an ultrasound detector, timer tape-driver, and a voice-activated cassette tape recorder) were set

Figure 1. Sites 1-7 along the Norris-Madison Junction Road corridor, Yellowstone National Park, surveyed for bats in September 1999. Base Map from USGS 7.5' topographic quadrangle "Norris Junction, Wyoming" 1986 Provisional Edition.



7592T
7549T
One Hundred Spring Plain
Norris
Geyser
Basin
Tantalus
7542T
BM 7568
7514T
Creek
Gray Lakes
Park
7205
BM 7507
Elk
Trans Line
Gibbon River Rapids
Chocolate Pots
7623T
Meadows
Gibbon Hill
Y
Gibbon
Gibbon Hill Geyser
Geyser
Basin
River
1.
2.
3.
4.
5.
6.
7.

Figure 2. Sites 8-12 along the Norris-Madison Junction Road corridor, Yellowstone National Park, surveyed for bats in September 1999. B1-B3 are bridges inspected for bat sign. The "X" is the site in the Geyser Springs Group of the Gibbon Geyser Basin where bat sign was found. Base Map from USGS 7.5' topographic quadrangle "Norris Junction, Wyoming" 1986 Provisional Edition.

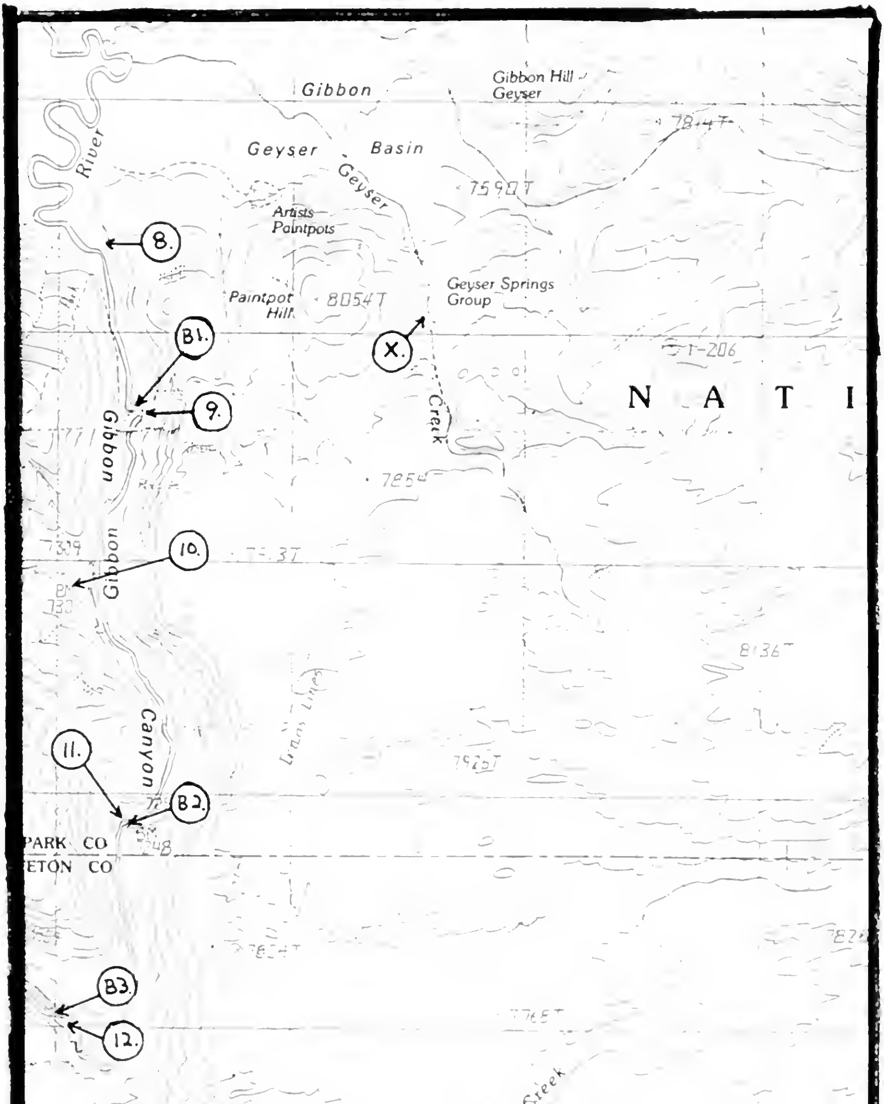
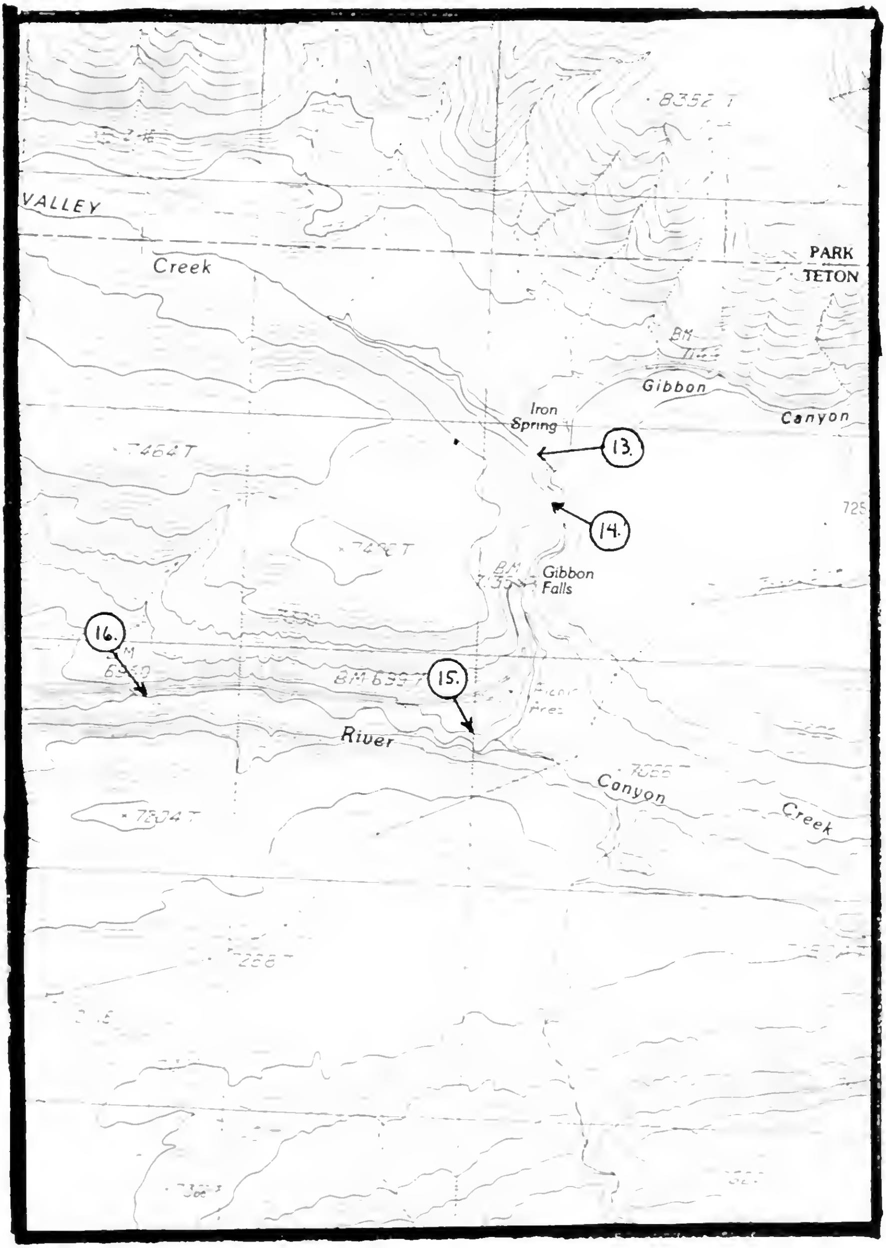
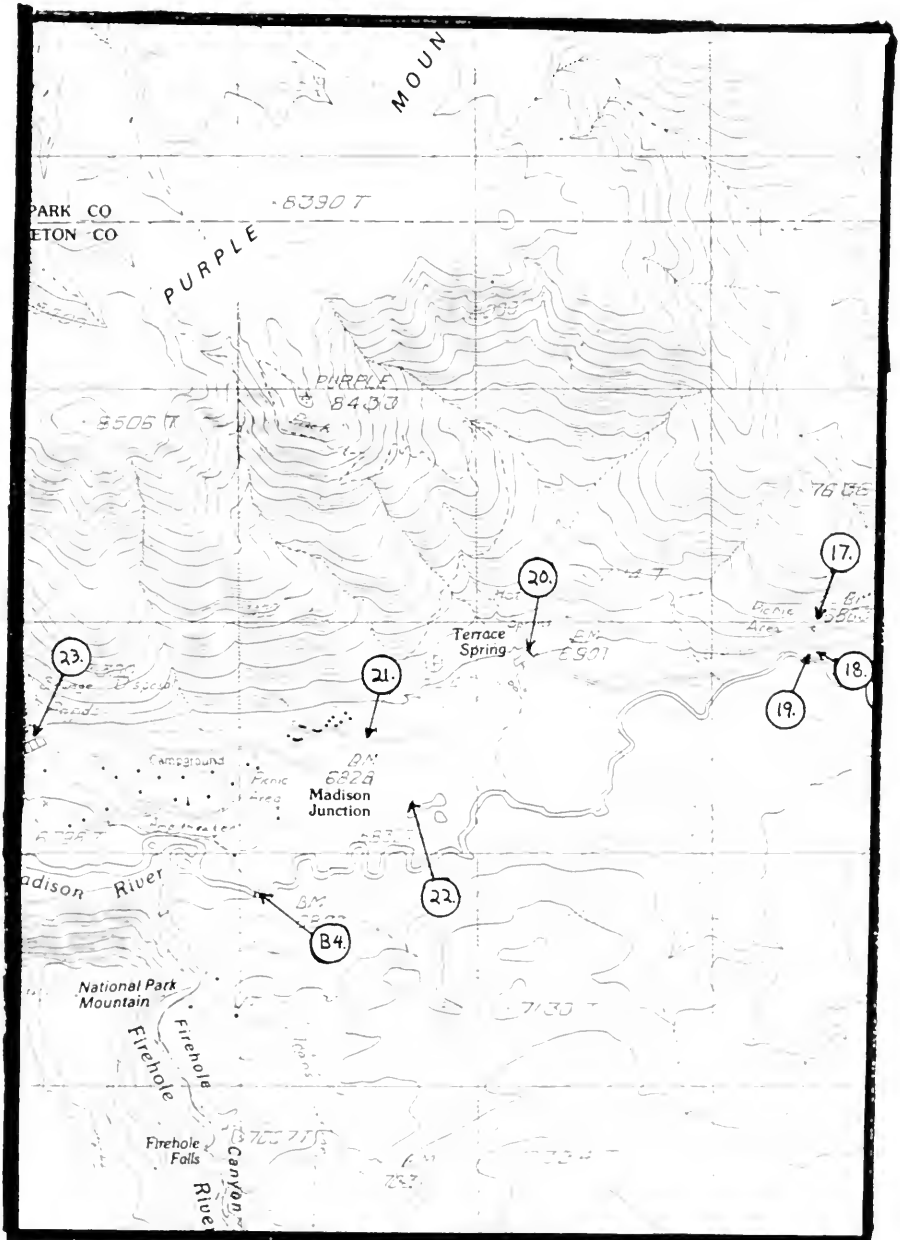

Gibbon
Gibbon Hill
Geyser
Geyser
Basin
Geyser
River
7590T
Artists
Paintpots
8.
Geyser Springs
Group
Paintpot
Hill
8054T
B1.
X.
T-206
9.
Creek
N A T I
Gibbon
7854
Gibbon
10.
8136
Canyon
11.
B2.
PARK CO
ETON CO
B3.
12.
Creek

Figure 3. Sites 13-16 along the Norris-Madison Junction Road corridor, Yellowstone National Park, surveyed for bats in September 1999. Base Map from USGS 7.5' topographic quadrangle "Madison Junction, Wyoming" 1986 Provisional Edition.



8352 T
VALLEY
Creek
PARK
TETON
BM
Gibbon
Canyon
Iron
Spring
13.
7464 T
14.
725
Gibbon
Falls
16.
BM
BM 6997
15.
River
Canyon
Creek
7204 T

Figure 4. Sites 17-23 along the Norris-Madison Junction Road corridor, Yellowstone National Park, surveyed for bats in September 1999. B4 is a bridge inspected for bat sign. Base Map from USGS 7.5' topographic quadrangle "Madison Junction, Wyoming" 1986 Provisional Edition



MOUN
PARK CO
ETON CO
8390 T
PURPLE
PURPLE
8433
8506 T
7666
17.
20.
Hot
Terrace
Spring
BM
6901
Picnic
Area
18.
19.
23.
21.
22.
B4.
Campground
Picnic
Area
BM
6828
Madison
Junction
adison River
BM
National Park
Mountain
Firehole
Firehole
Firehole
Falls
Canyon
River
7130

before dusk facing over water bodies or meadows, out over cliff faces, under or near bridges, or down forest corridors and left in place overnight. An attempt was made to set out four or five detector units each night. Recorded calls were analyzed on an IBM compatible PC using ANABAT II zero-crossings analysis interface module (ZCAIM) and software.

Assignment of vocalizations to a particular species of bat was achieved by matching time-frequency structure of field recordings with a reference set of calls obtained from captured individuals and published descriptions of vocalizations (e.g., Fenton et al. 1983, O'Farrell 1997). However, bat species can show significant variation in call structure (Betts 1998, Barclay 1999), and we did not actively track and record flying bats (O'Farrell et al. 1999) to maximize quality and quantity of diagnostic sequences. Furthermore, some units recorded bats flying near potential roosts, such as cliffs or bridge structures. Roost-exit calls and calls in high environmental clutter tend to be fragmentary, lacking diagnostic features necessary for species identification (O'Farrell 1999). Therefore, all species-level identifications based on recorded vocalizations are considered tentative where made in this study.

Myotis designations (as a group) were assigned to recordings with vocalizations of short duration (< 3 msec) with a relatively linear, perpendicular call pattern. Where call sequences were assigned to *M. evotis* the sweep pattern ranged from a maximum 75 kHz to a minimum of 30 kHz. Otherwise all were classified *Myotis* species. Calls with a bilinear (extreme curvilinear) pattern were tentatively assigned to a non-*Myotis* species or classified as unknown bat. Passes with call fragments were also designated unknown bat if no associated calls allowed finer resolution. Bilinear call sequences were assigned to *Eptesicus fuscus* if a continuous frequency tail fell within the range of 33-28 kHz with duration of the narrow band component of 1-3 msec, and the maximum frequency extended to 45-50 kHz. This could result in confusion with *Lasionycteris noctivagans* (Betts 1998) because of significant overlap in call structure. Maximum frequency of the latter species is about 40 kHz with a narrow band component lasting 3-5 msec, and calls with these characteristics were assigned to this species. However, in the majority of cases these two species were not distinguished by the recorded calls.

Number of "passes" (defined here as a distinct vocalization with at least a 1 sec gap between prior and following vocalizations) was recorded as a measure of relative activity at each site. At one site equipment malfunctioned prematurely, and at another site with recorded activity the recorder malfunctioned during the night. Therefore, relative activity as presented here is useful primarily as an index with variable degrees of error.

Capture of bats was attempted using 50-denier mist nets of various lengths (most often 2.8 and 6 m) and set in a variety of arrays across and along water bodies at two sites. Nets typically were operated for 2.0-2.5 hours (dusk until 21:30). Captured bats were identified with aid of keys in van Zyll de Jong (1985) or Nagorsen and Brigham (1993). Individuals were sexed, aged, measured (forearm, weight), reproductive status noted, then released.

The undersides of all bridges spanning the Gibbon River (n = 5, including one just outside the primary study area) and a section of elevated road on a wooden structure at a thermal site were inspected for evidence of use by bats. Areas most likely to provide roosting sites included steel I-beam girders near any cross structure, and the spaces between longitudinal spans and pilings. Bat sign most often included accumulated droppings (easily distinguishable from rodent droppings) and sometimes staining of surfaces above potential roosting sites.

A visit was made to one thermal area off of the highway to inspect the undersides of boulders for roosting bats or evidence of roosting activity (presence of bat droppings). This thermal area (the Geyser Springs Group of the Gibbon Geyser Basin) has been a maternity site for an unidentified species of *Myotis* in previous years (S Martinez personal communication)

RESULTS

Twenty-three sites (Figs 1-4, Table 1) were surveyed for bats using bat detectors (n = 21) or mist-nets (n = 2) In addition, five bridges (one near Norris Campground outside the study area) crossing the Gibbon River and one elevated wooded road structure crossing a thermal feature were inspected for bat use, and one thermal area was checked for sign of roosting bats (see Figs. 2 and 4)

Bat detector Survey Sites Bats were recorded at 17 (81%) of 21 sites where bat detectors were deployed (Table 1). Of the four sites with no detected activity, equipment failed at one At the sites where bats were detected, the majority (12 of 17) recorded low levels of activity (12 or fewer passes) Activity at the remaining five sites ranged from 20-40 passes The vast majority (> 90%) of recorded passes occurred between 19.30-22.30 MDT at all sites

Bats of unknown identity were detected at 11 sites and undifferentiated *Myotis* were detected at 10 sites These two categories represented 151 (72 6%) of 208 total passes recorded The remaining 57 passes were identified as Western Long-eared Myotis (*M. evotis*) 8 passes at three sites, Big Brown Bat (*Eptesicus fuscus*) 11 passes at three sites, Silver-haired Bat (*Lasionycteris noctivagans*) 13 passes at five sites, undifferentiated Big Brown/Silver-haired bat 25 passes at 11 sites Four of five sites with the most activity (20 or more passes) were down river from Gibbon Falls, bat activity in the Norris area was relatively widespread but at low intensity. Not surprisingly, greatest activity was at water sources

Mist-net Survey Sites Bat activity at the two sites where mist-nets were deployed was low No bats were captured at the first site (#6, see Table 1), a small pond near a service road at Gibbon Meadows However, a bat was observed flying along the road corridor nearby at crown height, first at 19 45 with the last of ten passes at 20.35 (the nets were folded at 21.30) This species was either a Big Brown or Silver-haired bat, based on size and the sound of the converted vocalizations

At the second netting site (#19, bank of Gibbon River with a small backwater of calm water below Tuff Cliffs), bats were first detected at 19.52 and continued activity at very low levels nearby until nets were folded (21 30) Thirteen total passes were noted in two hours of netting One Little Brown Myotis (*M. lucifugus*) was captured at 20 05 when it came down to drink from the pocket of calm water It was a mature scrotal male (right forearm length = 38 2 mm, weight = 8 5 g)

Bridges Four bridges spanning the Gibbon River in the Norris-Madison Junction road corridor were checked for sign of bat use The first three bridges are built with steel I-beams across stone or concrete pilings, the bridge at Madison Junction is solid concrete A fifth bridge, near Norris Campground, was essentially constructed like bridges B1-B3 An elevated section of road on wooden ties and pilings at Beryl Springs was also inspected

No bat droppings were noted under the span of the first bridge (B1) south of Norris, although this bridge appears to offer some suitable roosting sites Scattered bat droppings were noted on stone/concrete pilings and the steel beams of bridges B2 and B3 at the upstream ends Two sizes of droppings were found at bridge B3, indicating that more than one bat species has roosted under this span The concrete span (B4) at Madison Junction offers no roost sites for

TABLE 1. Sites surveyed for bat activity, 20-25 September 1999 along the Norris-Madison Junction Road corridor in Yellowstone National Park, Wyoming. Primary survey methods used at these sites were bat detectors (D) or mist-nets (N).

Site #	Site Name	Date	Method	Bats Detected[1] (# passes)
1	Tantalus Creek (S of highway)	24 Sept.	D	None
2	Slope above Gray Lakes	24 Sept.	D	MYSP (1)
3	SW end of Elk Park	24 Sept.	D	EPFU/LANO (1)
4	Gibbon River Rapids	24 Sept.	D	None
5	Gibbon Meadows service road	20 Sept.	D	EPFU/LANO (1)
6	Gibbon Meadows service road pond	21 Sept.	N	EPFU/LANO (10 distant passes; no captures)
7	Gibbon Meadows, N end on river	20 Sept.	D	UNKN (2), MYSP (10)
8	Gibbon Meadows, S end cliffs	20 Sept.	D	MYSP (2), LANO (1), EPFU/LANO (3)
9	Near Bridge B1 (Gibbon Canyon)	21 Sept.	D	MYSP (1), EPFU/LANO (1)
10	Beryl Springs	24 Sept.	D	None (equipment malfunction)
11	Near Bridge B2 (Gibbon Canyon)	21 Sept.	D	UNKN (1), MYSP (2), EPFU/LANO (1)
12	Near Bridge B3 (Gibbon Canyon)	21 Sept.	D	UNKN (14), MYSP (4), EPFU (4), LANO (1)
13	Secret Valley Creek, near mouth	21 Sept.	D	UNKN (1)
14	N of Gibbon Falls, W side cliff	22 Sept.	D	LANO (9)
15	Gibbon Falls picnic area (W end)	22 Sept.	D	UNKN (4)
16	Gibbon River bottom , at stone wall	23 Sept.	D	UNKN (5), MYSP (29), EPFU/LANO (2)
17	Base of Tuff Cliffs	23 Sept.	D	UNKN (2), MYSP (5), MYEV (1), EPFU/LANO (1)
18	Gibbon River at Tuff Cliffs	22 Sept.	D	UNKN (15), MYSP (14), MYEV (6), EPFU (2), LANO (1), EPFU/LANO (2)
19	Gibbon River at Tuff Cliffs	24 Sept	N	MYLU (1 male); 12 passes by at least 2 species
20	Terrace Spring	23 Sept.	D	None
21	Purple Mountain trailhead	22 Sept.	D	UNKN (2), MYEV (1), EPFU/LANO (2)
22	Madison Junction marshes/ponds	23 Sept.	D	UNKN (2), MYSP (4), EPFU (5), LANO (1), EPFU/LANO (8)
23	Madison Junction sewage ponds	23 Sept	D	UNKN (31), EPFU/LANO (3); equip. problems

[1] UNKN (unknown bat species), MYSP (*Myotis* species), MYEV (*Myotis evotis*), MYLU (*Myotis lucifugus*), EPFU (*Eptesicus fuscus*), LANO (*Lasionycteris noctivagans*), EPFU/LANO (either *E. fuscus* or *L. noctivagans*).

bats, and no sign of bat use was found. The largest quantity of bat guano was found under the downstream end of the bridge near Norris Campground. No sign was found on or under the wooden road structure at Beryl Springs, a thermal area that passes under the road span.

Undeveloped thermal areas. The Geyser Springs Group of the Norris Geyser Basin is a known maternity site for an undetermined species of *Myotis* (S. Martinez personal communication). This site was visited to search for roosting bats or signs of use under the boulders in the thermal area (where the roost is located). Numerous boulders or exposed rocks imbedded in the area were checked for bats and bat sign. Scattered droppings were found beneath 2-3 boulders near the site marked "X" in Fig. 2.

Norris Campground. Bat activity in the campground (B Loop and entrance area) was observed during the evening of 23 September. The first pass by a bat was noted at 19:40. At least three individuals of two species were observed foraging near treetop and lower crown height (10-13 m): a species of *Myotis* and the larger Big-Brown or Silver-haired bat. Foraging rate was about 3 passes/min from 20:10-20:43, about 1 pass/min from 20:45-21:00, and about 0.5 pass/min from 21:00-21:15, when observations terminated.

DISCUSSION

At least four species of bats were recorded during the survey in the Norris-Madison Junction area: Western Long-eared Myotis, Little Brown Myotis, Big Brown Bat, Silver-haired bat. Activity levels were relatively low at all sites, but this could be partly a result of the late date of the surveys. Activity in the Norris and Gibbon Meadows area was lower than that recorded at the lower-elevation area below Gibbon Falls to Madison Junction. This did not seem to be related entirely to differences in over-night temperatures.

Foraging activity by bats at and over thermal features was low, as Martinez (1999) also noted. Perhaps thermal areas are not as attractive to the variety and abundance of aerial insects that are fed upon by bats as are some non-thermal sites. Nevertheless, maternity colonies of at least two bat species (Townsend's Big-eared Bat, and a species of *Myotis*) have been documented in thermal areas in YNP (Martinez 1999, personal communication). Similar maternity sites have been reported elsewhere in western North America (e.g. Nagorsen and Brigham 1993, West and Swain 1999). The thermal areas of YNP could support maternity colonies of several bat species and merit closer survey effort by qualified biologists and park personnel.

Bats use a number of man-made structures in YNP for maternity roosts (Bogan and Geluso 1999). Bridges may also be used for this purpose, but are more likely to be used as night roosts. Bridges throughout YNP deserve closer monitoring to determine when they are being used, by how many individuals and species, and for what purposes. Bridges could provide important roosting habitat to some species in areas receiving considerable human impact. As bridges are repaired or replaced, they could be designed to be "bat friendly" by providing the undersides with tight or secure spaces for roosting, usually on exposed steel I-beams or where these are secured close to the pilings supporting the bridge. The bridge design at Madison Junction is distinctly unsuitable for bats, and the elevated road span at Beryl Springs is perhaps too low and accessible to predator attack to be very attractive to bats.

As is already obvious, more inventory effort is needed in YNP to determine which species of bats are present and when, what habitat features are especially attractive to them, and what human activities within the park are most likely to have the greatest impact on the bat populations present. Sites in most need of identification are maternity roosts and hibernacula, as these are very sensitive to human disturbance. Future systematic inventories should make use of multiple survey techniques (see Thomas and West 1989, O'Farrell and Gannon 1999) to assure the most complete assessment of the bat fauna.

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