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A SURVEY OF THE BATS OF THE DEERLODGE NATIONAL FOREST MONTANA

1992

Final Report
September 1993

by

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for the

Deerlodge National Forest, U.S. Forest Service

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INTRODUCTION

The Endangered Species Act of 1973, Section 7 (a)(2) mandates that any federal agency assure that any of its actions "(are) not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of (its) habitat" (Finch 1992). In addition, the National Forest Management Act of 1976 and United States Forest Service (USFS) policy require that the Forest Service must maintain viable populations of native vertebrates in national forests (Sec. 219 (12)(g) and "where appropriate and to the extent practicable, ...preserve and enhance the diversity of plant and animal communities" (Finch 1992).

There are presently 14 species of bats in Montana (Thompson 1982)). Five species are listed by the Montana Natural Heritage Program as species of special concern. These are the Pallid bat (*Antrozous pallidus*), the Spotted bat (*Euderma maculatum*), Townsend's big-eared bat (*Plecotus townsendii*), the Fringed myotis (*Myotis thysanodes*), and the Northern long-eared bat (*Myotis septentrionalis*) (Genter 1993). The first three are listed as sensitive by the Northern Region (R 1) of the USFS (Mumma 1991). Sensitive species are "those plant and animal species identified by the Regional Forester for which population viability is a concern as evidenced by:

a) Significant current or predicted downward trends in population numbers and density;

2) Significant current or predicted downward trends in

habitat capability that would reduce a species' existing distribution" (Reel et al. 1989).

In 1991, the biologist for the Deerlodge National Forest contacted the director of the Montana Natural Heritage Program to discuss the possibility of developing baseline data on the occurrence, distribution, relative density, and habitat use of bats on the Forest. A study was initiated that year, and results were presented in "A Preliminary Survey of the Bats of the Deerlodge National Forest, Montana - 1991" (Butts 1993).

The study was continued in 1992. The findings of this work are presented here.

ACKNOWLEDGEMENTS

Field work for this study was performed by Tom Butts with the assistance of Michelle Brown and Jeremy Butts. Dave Genter of the Montana Natural Heritage Program provided direction, suggestions, editing of reports, field assistance, equipment, and bat identification. Jina Mariani, Deerlodge National Forest biologist, assisted with logistics and funding through the U.S. Forest Service's challenge cost share program, and made helpful editorial comments on the final report.

METHODS

Equipment

Mist nets: Braided nylon mist nets, in 18, 30, and 36 foot lengths, (50 dernier/2 ply; 1 1/2 inch mesh) were used to capture bats (Kunz and Kurta 1988). Mist nets were strung on sectional aluminum poles made from electrical conduit, cut to 5 foot lengths, each with a connector at one end, so a net pole could be fashioned to any desired height. Poles used for this study were two or three lengths high (10 to 15 feet). Poles were held in place with ropes tied to trees, rocks, or branches. Mist nets were deployed across forest trails, across the narrower stretches of slow moving streams and smaller pools, and adjacent to the shoreline of lakes and larger ponds (Kunz and Kurta 1988).

Harp Trap: A modified collapsible harp trap (Kunz and Kurta 1988, Tuttle 1974) was constructed using 3 inch PVC pipe for the frame and 10 pound monofilament fishing line strung between the vertical members of the trap. The double-frame trap was used at the mouths of caves and adits (Kunz and Kurta 1988).

Bat detectors: Tunable Broadband ultra-sonic bat detectors (QMC Mini-2) were used to detect night-time bat activity. If a single detector was being used it was tuned to 40 kHz when walking a transect. If two detectors were available, one was tuned to 38 kHz and the other to 25 kHz. When a bat was

detected, the dial of the detector could be manipulated to find the high and low range of the detected bat (if there was time, which there generally was not). With experience the activity of the bat (cruising, searching, or feeding) and the genus of the bat could be determined by the sound, duration, and intensity of the detected bat echolocations (Fenton 1988, Fenton and Bell 1981). Detections were recorded on field forms by time, frequency monitored, and species (if known or suspected)(See Appendix I for field forms).

Bat identification

Once captured in a mist net or harp trap, bats were carefully removed. Species of the bat, sex, age (juvenile or adult)(Anthony 1988), reproductive condition (females: lactating or non-lactating; males: scrotal or non-scrotal)(Racey 1988), and select measurements (forearm length, tibia length) and other identifying characteristics and measurements such as ear length, pelage coloration, etc., were recorded on field forms. Weight was taken using a Pesola spring scale (1/2 gram) and measurements were taken using a vernier caliper and recorded to the millimeter. Bats were identified using one of several dichotomous keys. The most useful were:

Bats of America Barbour and Davis 1969

The Mammals of Montana Hoffman and Pattie 1968

Handbook of Canadian Mammals van Zyll de Jong 1985

Most bats were released after data was recorded, though if there was a question of identification, or if the bat was considered unusual for that locality or habitat, the bat was collected to be verified later by a competent authority.

Site Selection

The following criteria were used in selecting sites to survey bat distribution and habitat use on the Deerlodge National Forest during the first year of study:

1) location and survey of caves and adits on the Forest was a top priority;
2) representative habitats on the Forest were to be surveyed;
3) surveys were to be made throughout the Forest, and;
4) surveys were to be completed within a timeframe dictated by bat behavior: at some time, presumably in September, bats would either hibernate or migrate out of the study area.

The Forest was divided into three broadly defined zones; the Phillipsburg and Anaconda area, the Boulder and Basin area, and the Butte area. Though habitats throughout the Forest were to be sampled, the highest priority was assigned the Phillipsburg/ Anaconda zone due to the higher number of caves and adits occurring within it, and the greater variety of habitats.

Caves and adits were located by consultation with Forest Service personnel, knowledgeable "cavers," "locals," and the available literature, particularly Campbell's (1978) Caves of Montana.

During the second year of study, the criteria of the first year were modified somewhat. Though the four criteria above were still operable, a priority was to be given to:

1) re-visiting those sites that had high bat densities in 1991;
2) locating new sites throughout the forest to sample in order to test the findings of 1991.

Once a general area was selected, the specific site was chosen that appeared to have potential roosting sites nearby, such as older trees, fractured rock, old buildings, or known caves or adits. If water was nearby, specific sites to set up mist nets were generally selected that crossed the slowest moving stretches of streams or pools.

Caves and Adits

When a cave or adit was located, it was searched for evidence of bat use (bats, droppings, characteristic odor) and the location, extent, potential for bat use, temperature, humidity, and other pertinent data were described on field forms.

Caves or adits that were potentially used by bats were surveyed by setting up one or more mist nets at or near the opening, or a harp trap within the entrance, shortly before dark, and monitoring the nets throughout the night. Mist nets were collapsed shortly before dawn. An observer also used one or more "bat detectors" at the entrance, beginning at dusk and staying at least an hour, and then until there was no bat activity for more than 30 minutes.

Habitat Use Surveys

Once a site was selected, from two to six mist nets were set up in the evening across trails, next to lakeshores, and across streams or ponds. Nets were not raised into final position until about one-half hour after sunset to avoid catching birds. Depending on the site, the height of the bottom of the net above ground or water varied from less than a foot to 6 feet. Nets were checked at least every hour until after mid-night, then again between one hour, and one-half hour before sunrise. Nets were taken down one-half hour before sunrise to avoid catching birds.

One or two walking transects were conducted at each site, depending upon available personnel. Beginning approximately one-half hour after sunset, and lasting for one hour, a transect was walked through habitat representative of the area, using a bat detector. All bats heard were recorded as "cruising, searching,

or feeding," depending on activity, by species if identifiable, and by time period.

As information collected in 1991 suggested that little bat activity occurred after midnight, walking transects were run no later than that time.

Habitats sampled for bat activity were broken into several habitat components for analysis. These were :

COMPONENT	CODE
Dense lodgepole pine forest	Lpp
Mixed hardwoods	Mh
Mature Douglas fir forest	DF
Sub-alpine fir/limber pine	SF
Clearcuts nearby	CC
Lake nearby	La
Rock outcrops nearby	Ro
Cave/Adit nearby	Ca
Riparian (willow, alder, aspen)	Ri
Beaver ponds nearby	Be
Old buildings nearby	BL
Open areas (meadows, fields)	Op

Sites were assigned codes determined by habitat components at or near that site, and bat occurrence and relative density (measured by bat passes recorded per hour of walking transect) using

various habitats was determined.

Mixed hardwoods were primarily cottonwoods and/or aspen stands. Mature Douglas fir stands consisted of trees generally 18 inches diameter at breast height (DBH). "Nearby" habitat components were within 1/4 miles (440 m) of the survey sites.

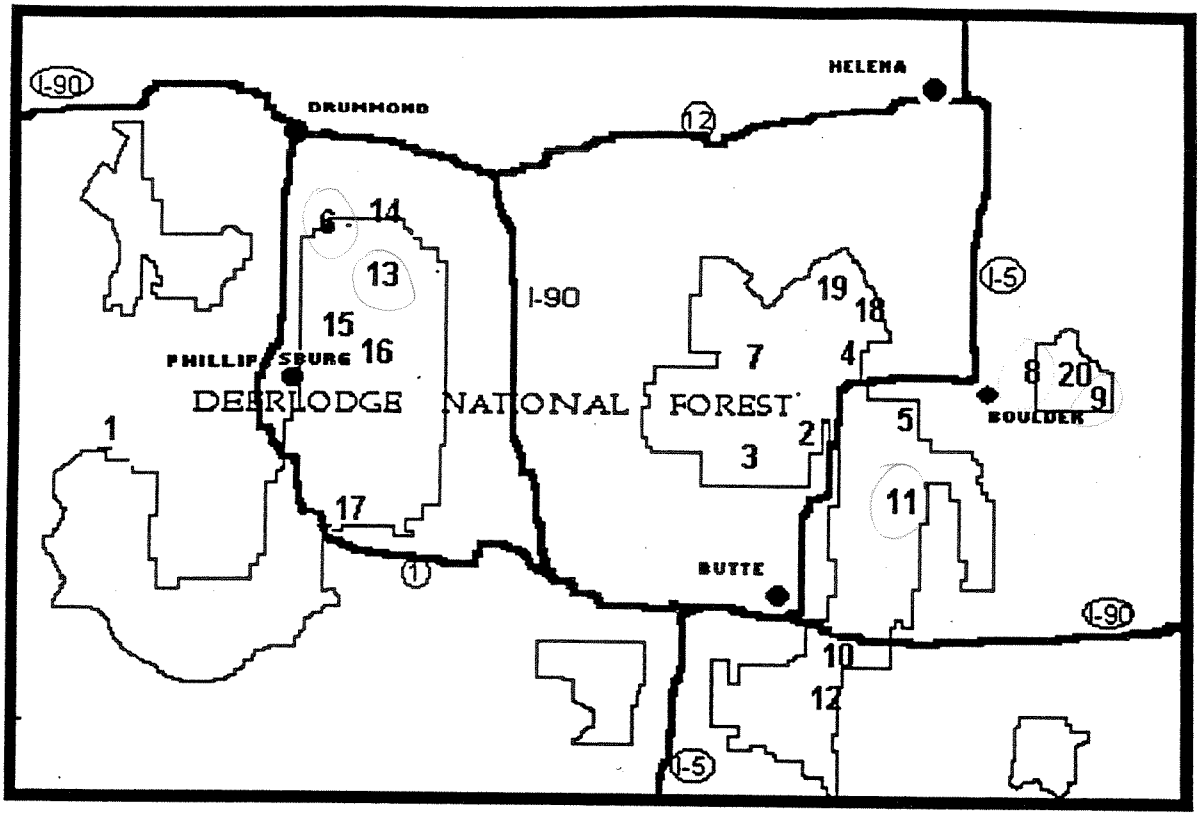
RESULTS

Habitat Use Surveys

A total of 20 sites were surveyed for bats on the Deerlodge National Forest between June 3 and September 7, 1992 (Figure 1). Four of these sites were visited twice each. An attempt was made to cover as many of the forested habitats in the forest as possible, and to visit sites not surveyed in 1991, as well as to re-visit sites that had high bat activity in 1991.

A minimum of one hour was spent on a walking transect, using a bat detector, at each site surveyed. At several sites, two or three hours of transect were run (Table 1). Two or more mist nets were set up at all sites except one. Twenty-two trap nights were expended at 19 sites (Table 1).

Bat activity was recorded as bat passes per hour of transect. If more than one transect was run at a site, the transect recording the most activity was used for the following analysis. Activity



1) STONEY CREEK C.G.
2) BISON CREEK
3) LOWLAND C.G.
4) BASIN CREEK
5) ELDER CREEK C.G.
6) DOUGLAS CREEK MINES
7) BOULDER RIVER
8) BROWN'S GULCH
9) QUEEN'S GULCH
10) OLD HIGHWAY 10
11) BEAVER CREEK.
12) PIGEON CREEK
13) PIKES PEAK CREEK
14) FRENCH GULCH
15) BOULDER CREEK
16) MOUNTAIN LION MINE
17) FOSTER CREEK
18) EVA MAE MINE, BASIN
19) NORTHEAST OF BASIN
20) ELKHORN

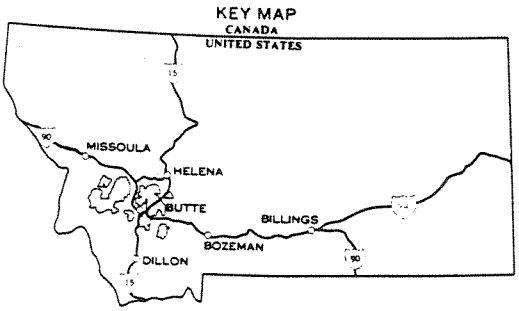


Figure 1: Map of Deerlodge National Forest and Survey Sites, 1992.

Site	Hours	Trap Nights	Habitat components	Bat passes per hour	Bats captured	Species
Stoney Creek C.G.	1	1	Ri,Mh,DF,Op	8	0	
Bison Creek	2	2	Ri,Mh,Lpp,Be	22,34	0	
Lowland C.G.	1	1	Ri,Op,Lpp,Be	3	0	
Basin Creek	1	1	Ri, Lpp, DF	3	0	
Elder Creek C.G.	2	1	Ri, Mh, DF, Ro	5,6	0	
Douglas Creek Mine	3	1	Ri, BL, Ca, DF, Ro	9,3,8	8	Big brown, Small-footed myotis, Northern long-eared myotis
Boulder River	2	1	Ri, OP, Lpp, DF. Mh	3,3	0	
Brown's Gulch	2	1	Ri, Mh, OP, Ro, Pond	20+,0	2	Little brown
Queen's Gulch	3	1	Ri, Ro, DF	1,5,6	1	Fringed myotis saw Big browns
Old Highway 10	1	1	Ri, Lpp, Be	3	0	
Beaver Creek	1	1	Ri, Lpp, Be	17	1	Fringed myotis
Pigeon Creek	1	1	Ri, Ro, DF	23	0	
Pikes Peak Creek	3	3	Ri, Ro, Ca, Lpp, DF, CC	27	2	Little brown Northern long-eared myotis
French Gulch	1	1	Ri, DF, Lpp	6	0	
Boulder Creek	2	1	Ri, Mh, DF. Be	56,13	0	
Mountain Lion Mine	1	1	Ca, DF	9	0	saw Big browns
Foster Creek	1	1	Ri, Mh, Ro, Lpp	0	0	
Eva Mae Mine	1	1	BL, Lpp, Ri	5	0	saw Big browns
NE of Basin	1	0	Lpp	1	0	
Elkhorn	1	1	BL, Lpp	0	0	

Table 1. Survey sites and bat survey data,1992.

was arbitrarily assigned to three categories: low= 0-4 bat passes per hour; moderate= 5-9 bat passes per hour; and high= 10 plus bat passes per hour.

No bat activity was recorded at only two sites surveyed (Foster Creek and Elkhorn). The evening that Foster Creek was surveyed had thunderstorms with wind and occasional heavy rain.

Light bat activity (one to four bat passes per hour) was recorded at five sites (25%). These sites included Lowland Campground, Basin Creek, the Boulder River, Old Highway 10 east of Butte, and the unidentified mine site several miles northeast of Basin (Table 1).

Moderate activity (five to nine passes per hour) was recorded at Stoney Creek Campground, Elder Creek Campground, the Douglas Creek Mines, Queen's Gulch, French Gulch, the Mountain Lion Mine, and the Eva May Mine (35% of the sites visited)(Table 1).

Sites with high activity (10 or more bat passes per hour) were Bison Creek, Brown's Gulch, Beaver Creek, Pigeon Creek, Pikes Peak Creek, and Boulder Creek (30% of the sites)(Table 1).

The number of sites surveyed that contained a given habitat component, and the number and percentage of these sites that had high, moderate, or low activity, is shown in Table 2. For

Habitat component	# of sites surveyed	# with high activity	% with high activity	# with moderate activity	% with moderate activity
Rock outcrops	7	3	43	3	43
Caves/adits	3	1	33	2	67
Riparian	16	6	38	5	31
Beaver ponds	6	4	67	0	0
Douglas fir	11	3	27	6	55
Clearcuts	1	1	100	0	0
Lodgepole pine	11	3	27	1	9
Mature hardwoods	7	3	43	2	29
Old buildings	3	0	0	2	67

Table 2: Number and percentage of sites with high and moderate bat activity for a given habitat component.

* * *

instance, seven of the sites had rock outcrops nearby. Of these sites, 43% had high bat activity, 43% had moderate activity, and 14% had low activity. Habitat features in which one-third or more of the sites with that component had high bat activity were rock outcrops, caves/adits (33%), riparian (38%), beaver ponds (67%), mature hardwoods (43%), and clearcuts (100%).

Moderate bat activity was associated with the following components at least one-third of the time when that component was available: rock outcrops (43%), caves/adits (67%), Douglas fir forest (55%), and old buildings (67%) (Table 2).

One-third of the sites with old buildings had low bat activity,

while 67% of the sites with lodgepole pine had low activity (Table 2).

Table 3 shows the percentage of high, moderate, and low activity sites containing a given habitat component. For instance, half of the sites with high bat activity had rock outcrops, mature hardwoods, lodgepole pine forest, or Douglas fir components nearby (note: some sites may have had all of these components, some only one, or any combination). All of the sites with high activity were in riparian areas. Only 17% of the high activity sites had caves or adits nearby, and the same percentage were near clearcuts.

Sites that had moderate bat activity were associated with Douglas fir stands 86% of the time and riparian areas 71% of the time, while no sites with moderate activity were associated with beaver ponds or clearcuts (Table 3).

All sites with low bat activity had lodgepole pine as a component of the habitat; 71% of these sites were in riparian area while none were near clearcuts and only 14% had old buildings or rock outcrops nearby (Table 3).

Bat species captured

Bats were captured at five of the 19 sites where mist nets were set on the Deerlodge National Forest in 1992. These were at the

Relative Bat Activity	Rock outcrops	Caves/adits	Riparian	Beaver ponds	Douglas fir	Clearcuts	Lodgepole pine	Mature hardwoods	Old buildings
High	50	17	100	67	50	17	50	50	0
Medium	43	29	71	0	86	0	14	29	29
Low	14	0	71	29	29	0	100	29	14

Table 3. Percentage of sites with high, moderate, and low bat activity featuring a given habitat component (i.e 50% of sites with high bat activity were near rock outcrops).

* * *

Douglas Creek Mines (8 bats), Brown's Gulch (2 bats), Queen's Gulch (1 bat), Pikes Peak Creek (2 bats) and Beaver Creek (1 bat) (see Table 1 and Table 4).

A total of fourteen bats were captured, representing five species and two genera (Table 4). These included Big brown bats (*Eptesicus fuscus*), Little brown bats (*Myotis lucifugus*), Long-eared myotis (*Myotis evotis*), Small-footed myotis (*Myotis ciliolabrum*), and the Fringed myotis (*Myotis thysanodes*).

Location	Species	Sex	Wt.(gr.)	Forearm (mm)	Reprod. cond.	Age
Douglas Creek Mines	Big brown bat	M	15.5	44.5	NS	AD
"	"	M	14.5	45.5	NS	AD
"	"	M	14.5	45.8	NS	AD
"	"	M	15.5	47.2	NS	AD
"	"	M	15.0	45.3	NS	AD
"	Long-eared myotis	M	7.4	8.0	NS	AD
"	Small-footed myotis	M	4.0	30.5	NS	AD
Brown's Gulch	Little brown bat	M	6.5	36.0	NS	JV
"	"	M	7.0	37.0	NS	AD
Queen's Gulch	Fringed myotis	F	7.0	39.0	NL	AD
Beaver Creek	"	F	6.6	39.0	L	AD
Pike's Peak Creek	Little brown bat	M	6.2	37.0	NS	AD
"	Long-eared myotis	M	6.5	35.0	NS	AD

M=Male; S=Scrotal; NS=Nonscrotal
F=Female; L=Lactating; NL= Non-lactating
AD=Adult; JV=Juvenile

Table 4. Bats captured on the Deerlodge National Forest, 1992.

* * *

Biological data of these bats, including species, sex, age, weight, and forearm length, and reproductive condition is given

in Table 4.

Other bat species

Surveys during 1991 on the Deerlodge National Forest resulted in the capture of the Yuma bat (*Myotis yumanensis*), the Hoary bat (*Lasiurus cinerius*), and the Silver-haired bat (*Lasionycteris noctivagans*) as well as several of the species captured again in 1992. Thus, eight species representing four genera were documented on the Forest during this study. One of these, the Fringed myotis is listed as species of special concern by the Montana Natural Heritage Program (Genter 1993).

Though not documented by capture, several Townsend's big-eared bats (*Plecotus townsendii*), another MNHP species of special concern, and a species listed by USFS Region 1 as sensitive, were possibly observed flying above a road at dusk on two consecutive evenings near Pikes Peak Creek and the Crater. Unfortunately, none were captured for positive identification.

Bat Species by Habitat and Distribution

Little brown bats (*Myotis lucifugus*) were captured at Pikes Peak Creek south of Gold Creek in riparian habitat, amid mature Douglas fir, and extensive lodgepole pine forests, with known caves and limestone rock outcrops, and clearcuts in the vicinity. They were also captured on the Deerlodge N.F. at Brown's Creek east of Boulder near the Elkhorn Mountains, over a small pond

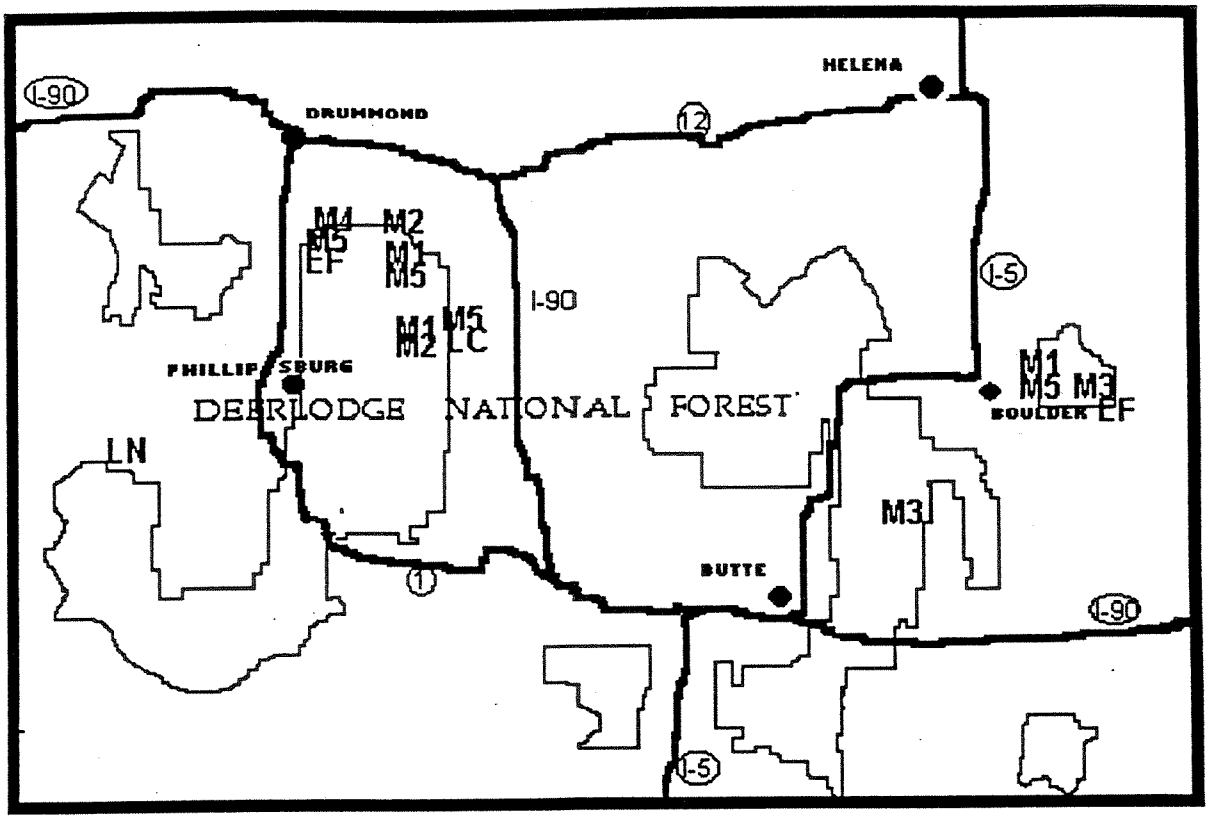
surrounded by cottonwoods situated in a sagebrush dominated valley (Figure 2). Myotis species were heard on the bat detector at most sites surveyed on the Deerlodge National Forest in 1992. Myotis were almost always the most abundant bats present (they were not heard at one site where other bat species were; the Eva Mae Mine northeast of Basin).

Long-eared myotis (*Myotis evotis*) were captured at two sites in 1992 on the Deerlodge N.F.; near the Douglas Creek mines and on Pikes Peak Creek. Both sites are riparian, have caves or adits nearby, and have mature Douglas fir in the vicinity (Figure 2).

A Small-footed myotis (*Myotis ciliolabrum*) was captured near the adits, and observed exiting from them, at the Douglas Creek mines (Figure 2).

Fringed myotis (*Myotis thysanodes*) were captured at Queen's Gulch and Beaver Creek in 1992 (Figure 2). Both of these sites were near streams and riparian vegetation in mature Douglas fir forests. There are rock outcrops nearby in Queen's Gulch, and beaver ponds and extensive willow stands on Beaver Creek.

Big brown bats (*Eptesicus fuscus*) were captured in mist nets at the Douglas Creek mines in 1992, and at Queen's Gulch in the Elkhorn Mountains east of Boulder in 1991. They were also observed, and heard on bat detectors, at the Mountain Lion Mine



M1= Little brown bat (*Myotis lucifugus*)
M2= Yuma bat (*M. yumanensis*)
M3= Fringed myotis (*M. thysanodes*)
M4= Small-footed myotis (*M. ciliolabrum*)
M5= Long-eared myotis (*M. evotis*)

EF= Big brown bat (*Eptesicus fuscus*)
LN= Silver-haired bat (*Lasionycteris noctivagans*)
LC= Hoary bat (*Lasiurus cinereus*)

Figure 2: Bat species captured, by location; 1991-1992.

east of Princeton, at the Eva May Mine northeast of Basin, and at Queen's Gulch in 1992 (Figure 2). There were old mine buildings at most of these sites. All of these sites are also in or near riparian areas, and most have mature Douglas fir or mature hardwoods nearby.

This species was heard on the bat detector at numerous sites during surveys in 1992. These sites were Bison Creek, Queen's Gulch and Brown's Gulch in the Elkhorns, Pike's Peak Creek, Pigeon Creek, Beaver Creek, Boulder Creek, and along Old Highway 10 southeast of Butte. They were also heard at the Mountain Lion Mine and the Douglas Creek Mines southeast of Drummond, and the Eva Mae Mine northeast of Basin. All sites except the Mountain Lion Mine were in riparian areas, and all had mature Douglas fir or mature hardwoods in the area. Extensive rock or rock outcrops were components of six of the 11 sites. Old mine buildings were at two of the sites.

The Hoary bat (*Lasiurus cinereus*) was captured in 1991 above Rock Creek Lake northwest of Deerlodge. It was flying low over a slow-moving stream amid dense willows, in a Douglas fir forest. No other Hoary bats were captured on the Deerlodge N.F. during 1991 and 1992, though one was captured in similar habitat over Indian Creek on the Helena N.F. on the east flank of the Elkhorn Mountains in 1992. Hoary bats were heard on the bat detector at Stoney Creek Campground near Rock Creek during surveys in 1992.

The habitat is riparian with open meadows, old Douglas fir, mature hardwoods, and nearby old buildings and rock outcrops.

The Silver-haired bat (*Lasionycterus noctivagans*) caught in 1991 was flying over a slow moving side-channel of Rock Creek west of Phillipsburg. It was in willow habitat amid cottonwoods and aspens, with dense Douglas fir forests and rock outcrops nearby. This species was heard on the bat detector on Bison Creek during surveys in 1992, and near Rock Creek during 1991 surveys. Both sites are riparian with moving water, beaver ponds, mature Douglas fir, mature cottonwoods, and aspens in the vicinity. There are extensive rock outcrops and cliffs near the Rock Creek site, and dense lodgepole forests near the Bison Creek site.

A bat tentatively identified as Yuma myotis (*Myotis yumanensis*) was captured as it left a limestone cave next to the Crater on Pike's Peak Creek late in the summer of 1991. The habitat is riparian with mature Douglas fir, dense stands of lodgepole, and clearcuts nearby.

The possible sightings of Townsend's big-eared bats (*Plecotus townsendii*) occurred near Pikes Peak Creek southeast of Drummond. The habitat is riparian, with mature Douglas fir, dense stands of lodgepole pine, and nearby clearcuts. A limestone outcrop in the vicinity has some caves that have been explored for bat activity. It seems possible that there may be undocumented caves in the

area.

Cave and Adit Surveys

One cave and several mines were located and surveyed for evidence of bat use on the Deerlodge National Forest in 1992. These were:

The Crater NW 1/4 Sec 10 T8N R11W

This cave was visited twice in 1991. No evidence of bat use was found at that time, though a Silver-haired bat was captured in a mist net leaving the cave in September 1991. The cave was once again searched for evidence of use in 1992. None was found. The harp trap was again placed in the entrance. No bats were captured.

No other caves were located or surveyed on the Deerlodge National Forest in 1992.

The Mountain Lion Mine

This mine adit, located east of Princeton, has been gated to allow passage of bats. Mist nets were placed near the entrance on the evening of August 19, and a bat detector was used to listen for activity, but none was heard leaving the mine, though Big brown bats were heard in the vicinity. No bats were captured.

Douglas Creek Mines

Two nights were spent at this site on Douglas Creek. There are two gated adits, both apparently fairly extensive as cold air was blowing out of both. Mist nets were placed near the entrances, and the bat detector was used to listen for activity. There are also old mine buildings in the vicinity and these were searched for evidence of bat use. Bat activity was moderate at the site, including at the mouths of the adits and around the buildings. Six Big brown bats, one Small-footed myotis, and one Northern long-eared bat were captured in mist nets. Bats entering and leaving the adits appeared to be primarily Small-footed myotis. One of the old mine buildings, a small shed 1/4 mile (440m) east of the adits, apparently was being used by Big brown bats as a day roost.

Eva May Mine 5 miles NE of Basin

One night (August 21) was spent using mist nets and listening for bat activity, near the old buildings at this site. No bats were captured. A moderate amount of activity by Big brown bats was recorded.

Mine site near Rocker Peak 6 miles NE of Basin

One evening was spent listening for bat activity at a minesite one mile north of the Eva May Mine northeast of Basin. No bat activity was recorded.

Elkhorn

One night was spent listening for bats around old mine buildings 1/2 mile north of the townsite of Elkhorn in the Elkhorn Mountains. No evidence of bat activity was recorded.

An attempt was made to locate some reported mine sites west of the mouth of Foster Creek west of Anaconda, but these could not be located. No other mine sites were surveyed on the Deerlodge National Forest in 1992.

DISCUSSION

Survey methods

A study designed to determine absolute and quantitative abundance of a species is a census. Several methods, such as mark-recapture and visual counts (Thomas and LaVal 1988), have been used by researchers to estimate absolute bat numbers, but these have generally been in enclosed areas such as caves, or at specific roosting or maternity sites. Determining quantitative measures of bat densities in a given habitat or foraging within a given area is not considered possible with current technology (Findley 1993, Thomas and West 1989).

A survey is designed to provide relative and qualitative

information, in short to "respon(d) to such questions as, Does habitat A have more bats of a given species than habitat B does? or Is species X more abundant before or after modification of habitat Y?" (Thomas and West 1989). Findley (1993) concluded that the best that can be done by a community ecologist studying bats is to assess the relative abundance of different species and to compare regions and habitats with respect to the numbers of bats obtained for given amounts of effort applied.

Summer roost counts, visual counts of foraging bats, ultrasonic detectors, vampire bites, and mist-netting and trapping were methods listed by Thomas and LaVal (1988) to estimate bat abundance in habitats or other geographic areas. The use of ultrasonic detectors and mist-netting were selected as methods for this study as no summer roost sites were known in the study area prior to the study, there are no vampire bats, and visual counts are limited to a short time after dusk, prior to the time many species in Montana emerge from day roosts.

Species occurrence

One of the objectives of this study was to document the occurrence of bat species on the Deerlodge National Forest. There are 14 species of bats in Montana (Thompson 1982). Several of these are not expected to be on or near the Forest due to limited distribution in the state, such as the Spotted bat (*Euderma maculatum*) and the Pallid bat (*Antrozous pallidus*), both

apparently restricted in Montana to the vicinity of the Pryor Mountains south of Billings (Worthington and Ross 1990). Most of the species known to inhabit the state, however, could potentially be found on the Forest. Documentation of both general species diversity, as well as the occurrence of species suspected of being relatively uncommon, such as Townsend's big-eared bat (*Plecotus townsendii*), is necessary for Forest planning and management, considering the mandates of federal legislation to manage for species diversity, and to maintain viable populations.

Though an experienced observer can identify many bat species visually by size, shape, and flight characteristics, when light conditions allow, documentation was not considered positive for this study unless specimens were captured.

Capturing bats with mist nets incorporates several biases. In this study, nets were never more than 15 feet above the ground, and therefore selected against the capture of high flying foragers. Other bats, such as the Townsend's big-eared bat are slow, maneuverable flyers that can usually detect and avoid a mist net or a harp trap, and thus are difficult to document by capture with these techniques. All insectivorous bats are probably capable of detecting and avoiding mist nets using echo-location. Few bats are thus captured while foraging. Most bats captured are probably "commuting" along habitually used pathways

on the way to or from foraging or watering areas (Thomas and West 1989). There is therefore an inherent site bias that cannot provide unequivocal information on the distribution of bats among sites or habitats using mist-nets as a survey method (Thomas and West 1989). Mist nets were used in this study to document species occurrence, while realizing that there are inherent biases in the method that select against the documentation of some species.

A potential problem with capture methods such as mist-netting is mis-identification of bat species. Most species in Montana can be identified easily using one of several available dichotomous keys, such as van Zyll de Jong (1985). When there was any question of identification during this study, the bat in question was collected and taken to an expert for positive identification. Bats most easily confused on the Deerlodge National Forest are the Fringed myotis (*Myotis thysanodes*) with the Northern long-eared bat (*Myotis evotis*), and the Little brown bat complex: Yuma bat (*Myotis yumanensis*), California myotis (*Myotis californicus*), and Little brown bat (*Myotis lucifugus*).

Relative density

Relative density between sites and between habitats by different bat species can be determined using ultra-sonic bat detectors. Discussions of the various types of ultrasonic detectors, along with their inherent strengths and weaknesses, can be found

elsewhere (see Fenton 1988, and Thomas and West 1989). One or two tunable heterodyne detectors were used during this study. These detectors can be tuned to a number of frequencies, but can only scan a narrow band at one time. Detectors were normally set at 40 kHz during surveys, as most bats in Montana can be detected at that frequency. If a bat was heard long enough, an attempt was made to determine its lowest detectable frequency, as several species, or groups of species, can be identified using this characteristic. When two detectors were used on one survey, one was set at 40 kHz and one at 28 kHz. The lowest frequencies emitted by *Myotis* species (except *M. volans*, down to 32 kHz) are around 36 to 38 kHz, thus when a bat was heard on both detectors, it was presumed that it was not a *Myotis*. If it was only heard on the 40 Khz detector, it probably was a *Myotis*.

The intensity of the echolocation call differs between species, as well as the frequency range of the call. This characteristic biases relative density information. Bats with intense vocalizations, such as Hoary bats or Big brown bats , are much more likely to be detected than those with weaker vocalizations, such as Townsend's big-eared bat. *Myotis* species fall between these extremes in intensity of their vocalizations. In effect, the area sampled by the detector is much larger for the strong emitters than for the moderate or weak emitters. Thus, direct comparisons of relative density between species based solely on bat detector results is unwise.

Some effort was made to determine species heard with bat detectors. Because of the biases discussed above, a quantitative comparison of relative densities of species will not be made. However, *Myotis* species were by far the most commonly heard bats at all sites except one (the Eva May Mine 5 miles northeast of Basin had only Big brown bats).

Habitat use

To analyze the use of various habitats, and the importance of various components of these habitats within the Deerlodge National Forest, bat use was determined from the results of surveys conducted with ultrasonic bat detectors. Bat use was defined as "bat passes per hour," as heard on a bat detector. An observer cannot generally differentiate between one bat passing several times, and several bats passing once, so the measurement is quite relative. For the habitat analysis, no attempt was made to differentiate species; all bat echolocation calls detected were recorded and used as a measure of relative density. Bat activity was arbitrarily assigned to categories of high (more than 10 passes per hour), moderate (5 to 9 passes per hour), and low (less than 5 passes per hour). This classification is completely arbitrary, and is based on results that occurred across the Deerlodge National Forest during 1991 and 1992. Of 31 hours of transects run during 1992, only 13% recorded more than 21 bats per hour, and about 65% had less than 10 bats per hour. In other localities 10 or even 60 bat passes per hour may be

considered low activity, but these categories will serve for the analysis of relative habitat use on the Deerlodge.

Assuming that the degree of bat activity associated with a site correlates with the preference by bats for some component of the habitat of that site, analysis of bat activity by habitat component should indicate which components bats appear to be selecting for, or against. For instance, 67 percent of the sites surveyed in which beaver ponds were a component of the habitat had high bat activity, while another none had moderate activity (Table 2). Of sites with mature Douglas fir, 27% had high activity and 55% moderate activity.

The habitat components at which a third or more of the sites featuring that component had high bat activity were: beaver ponds (67%), rock outcrops (43%), mature hardwoods (43%), riparian areas (38%), caves and adits (33%), and clearcuts (100%). There was only one site surveyed in 1992 with a clearcut nearby, and that site had high activity; it also had a riparian area, mature Douglas fir and mature hardwoods, a limestone cave, and rock outcrops in the vicinity. Features at which a third or more of the sites with that component had moderate activity were: old buildings (67%), caves and adits (67%), mature Douglas fir stands (55%), and rock outcrops (43%) (Table 2).

Of those sites that had high bat activity, 100% had riparian

areas nearby, and 67% had beaver ponds in the vicinity (Table 3). Components that were part of the habitat at half or more of the sites with high bat activity, in addition to those mentioned, were mature Douglas fir (50%), and mature hardwoods (50%), rock outcrops (50%), and lodgepole pine forest (50%). No sites with high bat activity had old buildings in the area (Table 3).

These results are similar to those reported during the 1991 study (Butts 1993). During 1991 and 1992, high and moderate bat activity was associated with sites that had rock outcrops, beaver ponds, mature hardwoods, or mature Douglas fir as components of the habitat.

All bat species, with the exception of Silver-haired bats (*Lasionycteris noctivagans*) in Washington, were detected at dramatically higher rates in old-growth stands than in young or mature stands of Douglas fir in studies done in Oregon and Washington (Thomas and West 1991). Bats were between 2.5 and 9.8 times more abundant in old-growth than in young or mature stands in both regions. Thomas and West (1991) speculated that the activity of the *Myotis* species, the Big brown bats, and the Silver-haired bats in Oregon were more abundant in old-growth because that habitat provided an increased variety and abundance of day roosts. Perkins and Cross (1988) reported that all of the Hoary bats and most of the Silver-haired bats in their study roosted in old-growth Douglas fir. They speculate that Hoary

bats prefer these older trees because they roost in foliage, and older trees provide a combination of shelter, open space to gain flight when leaving the roost, and immediate accessibility upon return. Silver-haired bats appear to prefer older Douglas fir trees because the bark tends to pull away from the bole providing crevices for shelter. Older trees are also may provide roosting crevices or cavities created by wind and lightning damage, shed limb holes, excavations by cavity nesting birds, cracks in the wood, and so on (Perkins and Cross 1988).

Old-growth ponderosa pine provided some roosting sites, but was not selected as often by bats as old-growth Douglas fir because bark ridges are not as deep and bark exfoliation is not as common in ponderosa pine (Perkins and Cross 1988).

Bats may roost in numerous sites within a forest exclusive of old-growth timber. Old buildings, including recreational cabins and buildings associated with abandoned mines, provide favored sites for many species, including the Little brown bat and the Big brown bat (Fenton 1992), but these are often unavailable in much of the forested west. Caves and adits may provide roosting sites for many species of bats (Fenton 1992). Many of the *Myotis* species, including the Fringed myotis, the California myotis, and the Small-footed bat, have been found roosting in fissures and under rock slabs (Thomas and West 1986).

Foraging sites are found where there is an abundance of insects. Thomas and West (1991) reported that, although old-growth stands of timber had dramatically higher activity than other forest stands, Myotis species did not appear to forage there. In some cases, they reported, feeding rates were dramatically greater over water. Though insect density was similar in forested and lacustrine habitat, Lunde and Harestad (1986) found bat activity 75 times greater in the lacustrine habitat. They reported no bat activity in cutover forest though insects were abundant in that habitat.

Cave and adit surveys

One cave and several mine sites were surveyed for evidence of bat use in 1992. The cave, near the Crater on Pikes Peak Creek, was also searched in 1991. No evidence of bat use was found in the cave, though one silver-haired bat was captured at the mouth of the cave in 1991. This cave has not been searched in the fall for evidence of swarming, or in the winter for evidence of use as a hibernaculum. As it is a rather small cave it is not a likely hibernaculum, especially for bats such as Myotis species that need cold, stable temperatures and high humidity.

The Douglas Creek mines, on private property adjacent to the Deerlodge National Forest southeast of Drummond presently gated so that bats can easily enter and exit. They are apparently deep, cool adits that may be used as hibernacula. They were not

entered during surveys, but there was high bat activity in the area. They are probably being used as a summer roosting site for male Big brown bats and Small-footed myotis.

SUMMARY

During 1991 and 1992, eight species of bats, representing four genera, were documented by capture during this phase of the study. These were the Big brown bat (*Eptesicus fuscus*), the Little brown bat (*Myotis lucifugus*), the Yuma bat (*Myotis yumanensis*), the Northern long-eared myotis (*Myotis evotis*), the Small-footed myotis (*Myotis ciliolabrum*), the Fringed myotis (*Myotis thysanodes*), the Hoary bat (*Lasiurus cinereus*), and the Silver-haired bat (*Lasionycteris noctivagans*). The Fringed myotis is on the Montana Natural Heritage Program's list of species of special concern (Genter 1993).

Another species of special concern that was possibly observed on the Deerlodge National Forest, but was not positively identified, was the Townsend's big-eared bat (*Plecotus townsendii*). Several were possibly observed in the vicinity of the Crater on Pike's Peak Creek late in the summer of 1992.

Relative bat densities varied between habitats. Those with rock-outcrops, beaver ponds, mature hardwoods, mature Douglas fir, or riparian areas nearby had the greatest bat activity during both years of the study.

Findley (1993) stated that an increase in species richness accompanies increased availability of roosts. "Forested regions lacking cliffs, caverns, and caves support fewer species, and those that do occur are known to use trees as daytime roosts in summer. Mountainous, broken topography with opportunities for roosting in crevices, cliff faces, caverns, and caves support richer communities" (Findley 1993).

Management activities that encourage undisturbed stands of old-growth forest, especially old stands of Douglas fir and mature hardwoods, the maintenance of healthy riparian areas, including snags and old individual aspens and cottonwoods, and the preservation of caves and access to abandoned mine adits will provide roosting and foraging habitat for a diversity and abundance of bats. Management activities that encourage large monocultures of relatively young trees, and even-aged management of forest stands will be detrimental to the diversity and abundance of bats using the forest.

LITERATURE CITED

Anthony, E.L.P. 1988. Age determination in bats. *In* Ecological and behavioral methods for the study of bats. T.H. Kunz *Ed*. Smithsonian Institution Press, Washington, D.C. 533 pp.

Barbour, R.W. and W.H. Davis. 1969. Bats of America. Univ. Press of Kentucky, Lexington. 286 pp.

Butts, T.W. 1993. A preliminary survey of the bats of the Deerlodge National Forest, Montana, 1991. U.S.D.A. Forest Service, Deerlodge National Forest, Butte.

Campbell, N.P. 1978. Caves of Montana. Bulletin 105, State of Montana Bureau of Mines and Geology, Butte. 169 pp.

Fenton, M.B. 1988. Detecting, recording, and analyzing vocalizations of bats. *In* Ecological and behavioral methods for the study of bats. T.H. Kunz *Ed*. Smithsonian Institution Press, Washington, D.C. 533 pp.

Fenton, M.B. 1992. Bats. Facts on File. New York, NY. 207 pp.

Fenton, M.B. and G.P. Bell. 1981. Recognition of species of insectivorous bats by their echolocation calls. J. Mammal., 62:233-243.

Finch, D.M. 1992. Threatened, endangered, and vulnerable species of terrestrial vertebrates in the Rocky Mountain Region. Gen. tech. rpt. RM-215. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins. 38 pp.

Findley, J.S. 1993. Bats: a community perspective. Cambridge Univ. Press, Cambridge.

Genter, D.L. 1993. Animal species of special concern. Montana Natural Heritage Program, Helena. 11 pp.

Hill, J.E. and J.D. Smith. 1984. Bats: a natural history. Univ. Texas Press, Austin. 243 pp.

Hoffman, R.S. and D.L. Pattie. 1968. A guide to Montana mammals: identification, habitat, distribution, and abundance. Univ. Montana, Missoula.

Kunz, T.H. and A. Kurta. 1988. Capture methods and holding devices. *In* Ecological and behavioral methods for the study of bats. T.H. Kunz *Ed*. Smithsonian Institution Press, Washington, D.C. 533 pp.

Lunde, R.E. and A.S. Harestad. 1986. Activity of little brown bats in coastal forests. Northwest Science 60: 206-209.

Mumma, J. 1991. Updated Northern Region sensitive species list. Unpubl. memo. Northern Region, USDA Forest Service, Missoula.

Racey, P.A. 1988. Reproductive assessment in bats. *In* Ecological and behavioral methods for the study of bats. T.H. Kunz *Ed*. Smithsonian Institution Press, Washington, D.C. 533 pp.

Reel, S., L. Schassberger, and W. Ruediger. 1989. Caring for our natural community: Region 1 threatened, endangered, and sensitive species program. USDA Forest Service, Northern Region. Missoula.

Thomas, D.W. and R.K. LaVal. 1988. Survey and census methods. *In* Ecological and behavioral methods for the study of bats. T.H. Kunz *Ed*. Smithsonian Institution Press, Washington, D.C. 533 pp.

Thomas, D.W. and S.D. West. 1986. Forest age associations of bats in the southern Washington Cascades and Oregon Coast Range. Final rep. PNW-84-234. Forest Sciences Laboratory, Univ. Wash., Seattle.

Thomas, D.W. and S.D. West. 1989. Sampling methods for bats. Gen. tech. rep. PNW-GTR-243. Pacific Northwest Res. Sta., USDA Forest Service, Portland.

Thomas, D.W. and S.D. West. 1991. Forest age associations of bats in the southern Washington Cascades and Oregon Coast ranges. *In* Wildlife and vegetation of unmanaged Douglas-fir forests. Pacific Northwest Res. Sta., USDA Forest Service, Portland.

Thompson, L.S. 1982. Distribution of Montana amphibians, reptiles,and mammals. MT Audubon Council, Helena.

Tuttle, M.D. 1974. An improved trap for bats. J. Mammal.,55:475-477.

van Zyll de Jong, C.G. 1985. Handbook of Canadian mammals:bats. National Museum of Canada, Ottawa. 21 pp.

Worthington, D.J. and H.N. Ross. 1990. Abundance and distribution of bats in the Pryor Mountains of south central Montana. MT Natural Heritage Program, Helena.

APPENDIX I.

MTNHP 92/2-1

BAT SURVEY FIELD FORM

DATE: _____ LOCATION: _____

LEGAL DESCRIPTION: _____

WEATHER:	(start/time)	(finish/time)
TEMPERATURE	_____	_____
WIND	_____	_____
CLOUD COVER	_____	_____
HUMIDITY	_____	_____

SITE CHARACTERISTICS:

VEGETATION (tree and shrub species, canopy coverage, size, density, distribution) -

WATER (stream width, depth, speed, bank cover; pond or lake size, emergent vegetation) -

LOCAL GEOLOGY (rock type, extent of outcrops or cliffs) -

CAVES OR ADITS (in vicinity?, status: surveyed?)
Note: if bat survey is at a specific cave or adit, describe here and complete a cave inventory form)

MIST NET (OR TUTTLE TRAP) RESULTS:

Number and sizes of mist nets set: ____ 18' ____ 30' ____ 42' ____ 60' ____ other ( )

How/where set (trail, stream, canopy, pond, meadow, cave entrance, etc - record number and setting):

Tuttle trap used? Y / N Where set: _____

APPENDIX I (cont.).

MTNHP 92/2-2

Bats captured Y/N (Species, sex and number): _____

_____

_____

_____

_____

For each bat captured, record:

SPECIMEN NUMBER: ____ DATE: _____ LOCATION: _____

TIME of CAPTURE: _____ _____ County, MT

1) Species: _____

2) Sex: M F Un 3) Age: Ad Juv Un

4) Reprod status: F: Lac / Non Lac, Grav / Postpartum, Unkn None; M: Scrotal / Nonscrot

5) Weight: ___.___ grams. Forearm lenght: _____ mm. Other specific characteristics: _____

6) Comments (net type and height, condition of bat and markings/scars, collected or released):

* * * * *

For each bat captured, record:

SPECIMEN NUMBER: ____ DATE: _____ LOCATION: _____

TIME of CAPTURE: _____ _____ County, MT

1) Species: _____

2) Sex: M F Un 3) Age: Ad Juv Un

4) Reprod status: F: Lac / Non Lac, Grav / Postpartum, Unkn None; M: Scrotal / Nonscrot

5) Weight: ___.___ grams. Forearm lenght: _____ mm. Other specific characteristics: _____

6) Comments (net type and height, condition of bat and markings/scars, collected or released):

* * * * *