SMALL MAMMAL INVENTORY ON THE NORTH KAIBAB RANGER DISTRICT (COCONINO COUNTY, ARIZONA)

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INTRODUCTION

Little information is available on small mammal communities in ponderosa pine (*Pinus ponderosa*) forests of the Kaibab Plateau. The last comprehensive small mammal surveys were conducted in the 1930s (Rasmussen 1941). Hoffmeister and Durham (1971) reported results of mammal surveys on the Arizona Strip, which included ponderosa pine habitats similar to the Kaibab Plateau. Recent small mammal studies on the Kaibab Plateau have focused on single species (Kaibab squirrel, *Sciurus aberti kaibabensis*) (Hall 1981) or have reported captures incidental to other research (Berna 1990).

Southwestern ponderosa pine forests have changed dramatically since European settlement in the late 1800s. Prior to European settlement, Southwestern ponderosa pine forests underwent frequent (every 2-11 years) cool surface fires (Weaver 1951). Since the late 1800s, they have been subjected to aggressive fire suppression and livestock grazing (Cooper 1960, Harrington and Sackett 1992). These land management practices contributed to increased forest floor fuel accumulation and establishment of dense stands of small diameter ponderosa pine trees (ladder fuels). These conditions have led to intense, stand-replacing fires in ponderosa pine forests in the Southwest.

To reduce fire risk and address recently published management recommendations for the northern goshawk (*Accipiter gentilis*) (Reynolds et al. 1992), the U.S. Forest Service has implemented a prescribed burn program in ponderosa pine stands on the North Kaibab Ranger District (NKRD). Recommendations were designed to maintain and enhance habitat for the northern goshawk and 14 avian and small mammal prey species. These guidelines recommend desired amounts of woody debris and downed logs. Most ponderosa pine stands on the NKRD exceed recommended fuel loadings (D. Toelle, NKRD, pers. comm.) and can be reduced by prescribed fire. Prescribed burns remove woody debris and downed logs, important habitat components for small mammals (Goodwin and Hungerford 1979). Small mammals play an important role in the ponderosa pine ecosystem by feeding on various plants, dispersing seeds and providing food for predators. The effects of prescribed fire on small mammals in ponderosa pine forests are not well understood.

Given the lack of information on small mammal habitat relationships on the Kaibab Plateau and the need to develop management recommendations for prescribed burns in ponderosa pine habitats, the Arizona Game and Fish Department (AGFD), obtained IIPAM Heritage funds to conduct this study. The objectives of this study were to: 1) describe small mammal community composition and relative abundances in ponderosa pine forests on the Kaibab Plateau; 2) quantify small mammal community response (composition and relative abundance) to prescribed burns; and 3) develop

management recommendations to incorporate small mammal habitat requirements into future prescribed burns.

This report presents baseline small mammal data collected Spring 1996 on control and treatment areas prior to prescribed burns planned for Fall/Winter 1996. Post-treatment surveys on the same areas will be conducted Spring 1997 and again in 1998 if funding is secured.

STUDY AREA

The NKRD (Fig. 1) is located on the Kaibab Plateau in northcentral Arizona. The Plateau is a limestone formation with numerous shallow drainages and steeper canyons, rising from a shrubsteppe plain at approximately 5800 feet elevation to subalpine meadows at a maximum elevation of 9200 feet Ponderosa pine forests occur at mid-elevations between 6800-8200 feet (Rasmussen 1941, Brown 1994).

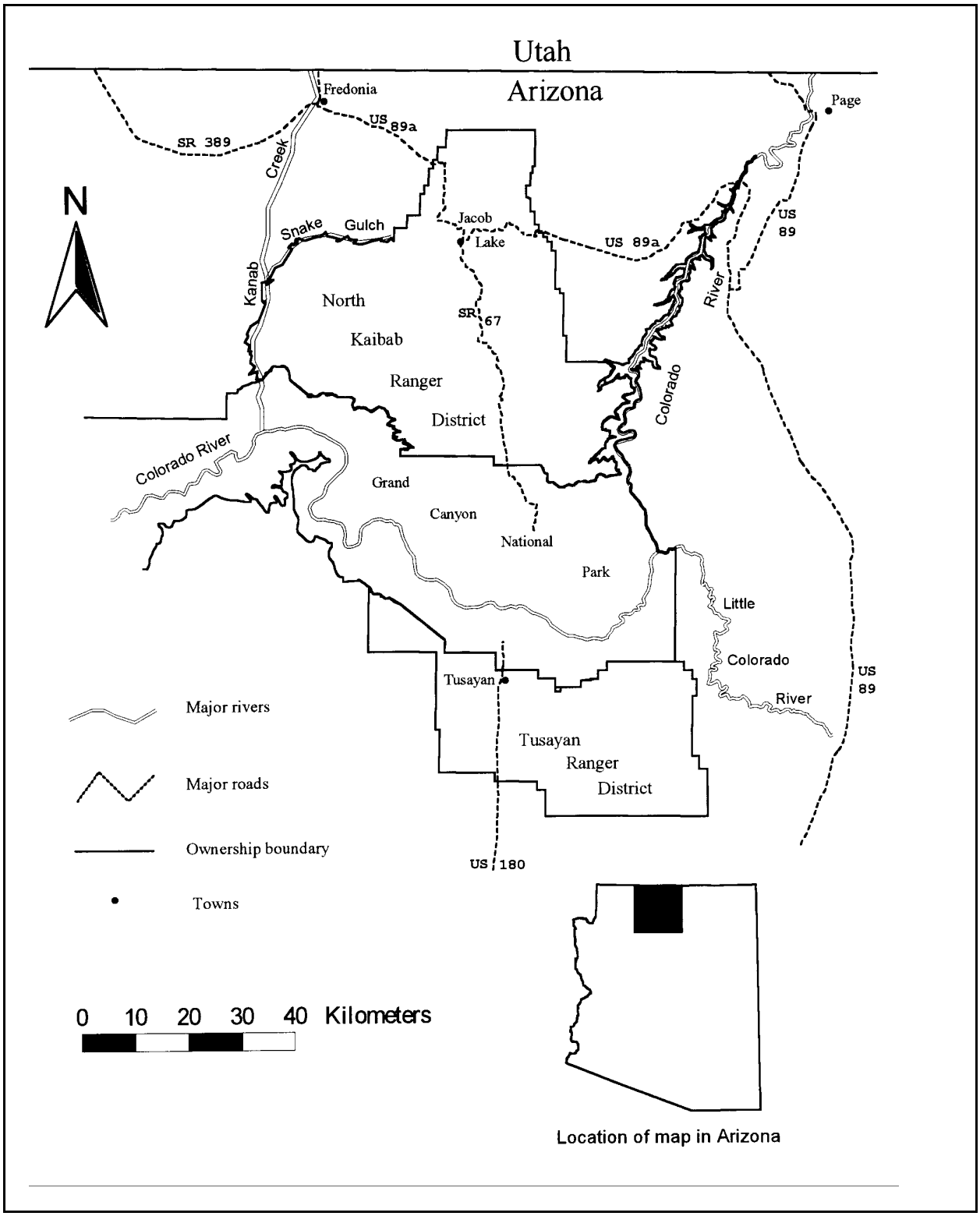
This study was conducted at two sites (7700-7900 feet) in ponderosa pine forest habitats in the vicinity of Jacob Lake (Fig. 1). The Jacob Lake site was immediately north of Jacob Lake; the Big Ridge site was approximately one mile to the east. These sites were chosen by the following criteria: 1) dead and down woody debris exceeded fuel loading management recommendations (5-7 tons/ac); 2) the sites were scheduled for prescribed burning; and, 3) habitat structure and forest floor fuel loading were representative of ponderosa pine habitats across the NKRD.

The Jacob Lake study site was dominated by larger, older ponderosa pines and had a fuel loading of approximately 10 to 12 tons per acre. Dead and down material consisted primarily of larger fuels, 12 to 20 inches in diameter. The Big Ridge site had smaller, younger ponderosa pines with an approximate fuel loading of 12 to 15 tons per acre. Dead and down material consisted primarily of finer fuels, 3 to 5 inches in diameter.

METHODS

We used standard live-trapping techniques to capture small mammals (Davis 1982, Schemnitz 1994) from 22 May to 6 June 1996. We established six trapping grids at each study site (3 treatments and 3 controls) for a total of 12 grids. The treatment grids are scheduled by the NKRD for prescribed burning Fall/Winter 1996. We used the following guidelines (J. Ward, Rocky Mtn. For. and Range Exper. Sta., Fort Collins, pers. comm.) to establish grid locations: 1) grids should be at least 1650 feet apart, and 2) all grids should be at least 330 feet from edges or major roads.

Grids were 200 x 200 foot squares. Each grid received 49 Sherman traps (H.B. Sherman Inc., dimensions = 12.0 x 3.0 x 3.5 in and 15.0 x 4.0 x 4.5 in), 24 tomahawk traps (Tomahawk Live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Major rivers
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Ownership boundary
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0 10 20 30 40 Kilometers
Location of map in Arizona

Figure 1. Small mammal survey study area, North Kaibab Ranger District, Arizona, May-June 1996.

Trap Co., #202) and two pitfall trap arrays with drift fences (4 pitfall traps/array = 8 pitfalls) for a total of 81 traps per grid. Pitfalls consisted of three gallon polyethylene buckets. Sherman traps were 33 feet apart; tomahawks 66 feet apart. Pitfall arrays were located in the southeast and northwest corners of each grid. Within an array, pitfalls were 10 feet apart. Six inch tall lawn-edging was used for the pitfall drift fences.

We trapped four grids during each of three trapping periods, one control and one treatment grid at each study site. We sampled control and treatment grids from each site simultaneously to minimize potential effects from weather changes, moon phase and reproductive activity.

Sherman and tomahawk traps were baited with a mixture of rolled oats and peanut butter. Shermans were also supplied with small carrot chunks and raw wool bedding. Traps were set for three consecutive days and nights and were checked three times per day: early morning, noon and evening. During each grid check the following data were collected: observer(s), time of visit, date and general weather. For each capture the following data were collected: station number, species, trap type, and whether the mammal was a new capture or a recapture. When possible, sex, age and reproductive condition (i.e. pregnant, lactating, or descended testes) were also recorded. These data were collected primarily for deer mice (*Peromyscus maniculatus*).

Small mammals were marked with permanent, non-toxic felt-tipped markers that lasted the length of the trapping session. The color marking scheme allowed us to identify recaptures and to detect movement between adjacent grids.

Abundance was estimated by counting the number of new (unmarked) individuals captured on each grid. On several occasions animals were accidentally released prior to marking, which hindered our ability to correctly identify recaptures. In such cases, information collected at original captures was used to determine whether an unmarked animal was a recapture. If this was not sufficient, a potential new capture was considered a recapture.

Precautions were taken when handling traps and small mammals to minimize exposure to *Hantavirus* (Mills et al. 1995; Craig Levy, Arizona Health Department, Phoenix, pers. comm.; J. Ward, Rocky Mtn. For. and Range Exper. Sta., Fort Collins, pers. comm.). These included using rubber gloves and plastic bags to handle mammals, and a 10% Clorox® solution to disinfect potentially contaminated surfaces.

RESULTS

A total of 2916 trap nights yielded 143 individuals representing six species on the Jacob Lake and Big Ridge control and treatment grid study sites (Table 1 and Table 2). Sherman traps captured 131 individuals representing four species in 1764 trap nights. Tomahawks captured eight individuals representing three species in 864 trap nights. Pitfall traps captured four individuals representing two species in 288 trap nights.

Table 1. Small mammals trapped during May-June 1996 on the Jacob Lake and Big Ridge control grid study sites, North Kaibab Ranger District, Arizona.

SPECIES	CONTROL NO. INDIVIDUALS								
	JACOB LAKE				BIG RIDGE				TOTAL
	1A	1B	1C	SUB TOTAL	4A	4B	4C	SUB TOTAL	
PEMA	7	2	3	12	12	7	2	21	33
EUUM	2	3	12	17	0	5	10	15	32
SPLA	0	3	1	4	0	0	4	4	8
SCAB	0	1	0	1	0	1	0	1	2
TAHU	0	0	0	0	0	0	0	0	0
SONA	0	0	1	1	0	0	0	0	1
TOTAL (#indiv/#spp)	9/2	9/4	17/4	35/5	12/1	13/3	16/3	41/4	76/5

Table 2. Small mammals trapped during May-June 1996 on the Jacob Lake and Big Ridge treatment grid study sites, prior to prescribed burning on the North Kaibab Ranger District, Arizona.

SPECIES	TREATMENT NO. INDIVIDUALS								
	JACOB LAKE				BIG RIDGE				TOTAL
	2A	2B	2C	SUB TOTAL	3A	3B	3C	SUB TOTAL	
PEMA	3	9	6	18	11	2	7	20	38
EUUM	1	2	11	14	6	3	4	13	27
SPLA	0	0	0	0	0	0	0	0	0
SCAB	0	0	0	0	0	0	0	0	0
TAHU	1	0	1	2	0	0	0	0	2
SONA	0	0	0	0	0	0	0	0	0
TOTAL (#indiv/#spp)	5/3	11/2	18/3	34/3	17/2	5/2	11/2	33/2	67/3

The most commonly trapped species was the deer mouse (PEMA). Other species captured were Uinta chipmunk (*Eutamias umbrinus*) (EUUM), golden-mantled ground squirrel (*Spermophilus lateralis*) (SPLA), Kaibab squirrel (SCAB), red squirrel (*Tamiasciurus hudsonicus*) (TAHU) and dwarf shrew (*Sorex nanus*) (SONA). The dwarf shrew has been identified based on size only. Dentition must yet be checked to positively identify the species.

Small mammal species richness was higher on the Jacob Lake site (6 vs. 4 spp.) and on control grids (x=2.8 vs. 2.3 spp.). The Jacob Lake site captured the only shrew and the two red squirrels. Relative abundances of species captured on both sites across control and treatment grids were similar.

Six trap mortalities (4% of captures) occurred on two grids: three chipmunks, two ground squirrels and one shrew. All occurred during the last trapping session. Twelve animals (8%) from six grids were accidentally released prior to marking. No movement between adjacent grids was

detected. Two non-target species were captured, a dark-eyed junco (*Junco hyemalis*) and a northern flicker (*Colaptes auratus*).

DISCUSSION

During 1996, we documented six species of small mammals in ponderosa pine forest habitats on the Kaibab Plateau. All but one have been documented in this area before and were expected (Hoffmeister 1986). Pending positive identification, the dwarf shrew capture represents a new locality record.

Only two shrew species have been documented on the Kaibab Plateau, Merriam's shrew (*Sorex merriami*) and dwarf shrew. The only record of a Merriam's shrew was from a grassy meadow surrounded by spruce-fir forest on the North Rim of Grand Canyon National Park (Hoffmeister 1986). The dwarf shrew has been documented from four locations on the Kaibab Plateau, with the closest location approximately seven miles south of our study area (Berna 1990).

In 1988-89, Berna (1990) captured 23 dwarf shrews at Fracas Lake, which extended the known range of this species in Arizona northward by 15 miles. The Fracas Lake captures also represented a new habitat type for the dwarf shrew in Arizona. Prior to Berna's (1990) captures, dwarf shrews on the Kaibab Plateau had only been reported in higher elevation mixed-conifer and grassy meadow habitats. Fracas Lake, like our study area, is dominated by ponderosa pine. However, it is a more mesic site at a higher elevation than our study area. Shrews captured at Fracas Lake were within 26 feet of water. The shrew captured on our study area was at least 0.5 miles from the closest water.

This report is a compilation of the data collected during our 1996 small mammal surveys in ponderosa pine habitats on the NKRD. The 1996 surveys established baseline small mammal population data. Prescribed burns are scheduled for Fall/Winter 1997 on the treatment grids. Spring 1997, we will repeat these surveys using the same methods on the same sites. Results of the 1997 surveys will be used to measure the response of small mammal communities to prescribed burning. Funding will be sought for a third year of surveys to examine longer-term response to the prescribed burn.

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