Grizzly bear use of whitebark pine habitats in the Washburn Range
by Shannon Rhea Podruzny

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Fish and Wildlife Management
Montana State University

Abstract:
Whitebark pine (Pinus albicaulis) habitats are important to Yellowstone grizzly bears (Ursus arctos) as refuges and sources of food. In 1988, large-scale fires burned 28% of the whitebark pine in Yellowstone National Park. I examined grizzly bear use of whitebark pine habitats in the Washburn Bear Management Unit in north central Yellowstone National Park before (1978-87) and after (1989-97) the fires. Radiocollared grizzly bears were not located in habitat types in proportion to their availability, patterns of habitat selection were similar in both periods, and differences in habitat use and availability were more pronounced in years of good whitebark pine cone crops. Ground investigations revealed that sites used by grizzly bears for feeding on whitebark pine seeds were similar in both periods. I compared sites used by bears to randomly sampled sites within the whitebark pine zone in 1996. Bears selected sites that were generally higher in elevation, steeper, and more densely forested than random sites. White pine blister rust (Cronartium ribicold), a disease which threatens whitebark pine populations across the continent, was present in 9% of the whitebark pines on sampled plots. Grizzly bears obtain whitebark pine seeds mainly by raiding red squirrel (Tamiasciurus hudsonicus) cone caches, or middens. I repeated (1995-97) a study that examined the relationships between whitebark pine, red squirrels, and grizzly bears on Mt. Washburn proper (1984-86). Half of the study transects burned in 1988. Red squirrel midden density increased in unbumed areas, but decreased overall. Midden size's were 51% smaller post-fire, and bear use of middens decreased by 64% post-fire. Whereas the fires did not disrupt grizzly bear use patterns on a large scale, significant local effects were evident. I recommend (1) prevention of further large-scale losses of whitebark pine habitats until burned areas regenerate and (2) investigation of the effects of the fires on grizzly bear use of whitebark pine seeds on an ecosystem-wide scale.

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APPROVAL

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This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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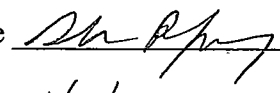
Signature 

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TABLE OF CONTENTS

Page

LIST OF TABLES vii

LIST OF FIGURES ix

ABSTRACT x

INTRODUCTION 1

STUDY AREA 4

METHODS 8

Habitat Use and Availability 1978-87 and 1989-97 8
Whitebark Pine Seed Feeding Sites 1978-87 and 1989-97 10
Random and Bear-Used Sites 1996 13
Sampling Design for Random Sites 13
Data Collection and Analyses 14
Red Squirrel Transects 1984-86 and 1995-97 15
Data Collection 15
Analyses 16
Red Squirrel Activity 16
Bear Use 17

RESULTS 19

Habitat Use and Availability 1978-87 and 1989-97 19
Whitebark Pine Seed Feeding Sites 1978-87 and 1989-97 23
Random and Bear-Used Sites 1996 24
Red Squirrel Transects 1984-86 and 1995-97 30
Red Squirrel Activity 30
Bear Use 35

TABLE OF CONTENTS–Continued

DISCUSSION 37

Habitat Use and Availability 1978-87 and 1989-97 37
Whitebark Pine Seed Feeding Sites 1978-87 and 1989-97 39
Random and Bear-Used Sites 1996 41
Red Squirrel Transects 1984-86 and 1995-97 42

CONCLUSIONS 45

Management Recommendations 46

LITERATURE CITED 48

APPENDIX A—STANDARD IGBST FORM FOR RECORDING DATA AT GRIZZLY BEAR ACTIVITY SITES 56

APPENDIX B—COLOR MAP OF HABITAT TYPES IN THE WASHBURN BEAR MANAGEMENT UNIT AND TRANSECTS USED TO RANDOMLY PLACE SAMPLE PLOTS, 1996 59

LIST OF TABLES

Table Page

1. Habitat types of the Washburn Bear Management Unit, Yellowstone National Park, 1978-87 and 1989-97 11

2. Number of aerial locations of grizzly bears by habitat type and percent availability of habitat types in the Washburn Bear Management Unit, Yellowstone National Park, during autumns of the pre- (1978-87) and post-fire (1989-97) periods 21

3. Test statistics for hypotheses of no difference between proportions of used and available habitats in the Washburn Bear Management Unit, Yellowstone National Park, during autumn 1978-87 and 1989-97 22

4. Number of sites used by grizzly bears for feeding on whitebark pine seeds, by habitat type and study period, found in the Washburn Bear Management Unit, Yellowstone National Park, 1978-87 and 1989-97 23

5. Values of continuous variables recorded at 78 whitebark-pine feeding sites in the Washburn Bear Management Unit, Yellowstone National Park, 1978-87 and 1989-97 26

6. Number of random sites and sites used by grizzly bears, by habitat type, Washburn Bear Management Unit, Yellowstone National Park, 1996 27

7. Values of continuous variables recorded at 22 grizzly-bear used sites and 46 random sites in the Washburn Bear Management Unit, Yellowstone National Park, 1996 28

8. Mean linear densities (No./km) of red squirrel middens by habitat type on 57 transects, Mt. Washburn, Yellowstone National Park, averaged among years, by period, 1984-86 and 1995-97 33

LIST OF TABLES–Continued

Table Page

9. Counts of red squirrel middens and chi-square tests of homogeneity for proportions of active middens pre-fire and post-fire, by habitat type along red squirrel transects on Mt. Washburn, Yellowstone National Park, 1984-86 and 1995-97 34

10. Mean area (m2) of active red squirrel middens by habitat type on transects on Mt. Washburn, Yellowstone National Park, 1984-86 and 1995-97 35

11. Yearly counts of bear-excavated red-squirrel middens on transects on Mt. Washburn, Yellowstone National Park, 1984-86 and 1995-97, and linear densities of excavations associated with abundant whitebark pine cone crops in 1985 and 1996 36

LIST OF FIGURES

Figure Page

1. The study area, delineated by the boundaries of the Washburn Bear Management Unit in northcentral Yellowstone National Park 5

2. Red squirrel transects, Mt. Washburn, Yellowstone National Park, 1984-86 and 1995-97 7

3. Average cones per whitebark pine tree on a monitoring transect, Mt. Washburn, Yellowstone National Park (IGBST data) 9

4. Percent coverage by habitat type in the Washburn Bear Management Unit, Yellowstone National Park, before and after the 1988 fires 20

5. Circular plots of aspects observed at whitebark pine feeding sites during the (A) pre- and (B) post-fire study periods in the Washburn Bear Management Unit, Yellowstone National Park, 1978-87 and 1989-97 25

6. Circular plots of aspects observed at (A) random and (B) bear-used pine feeding sites in the Washburn Bear Management Unit, Yellowstone National Park, 1996 31

7. Total length (km) of each habitat type along red squirrel transects on Mt. Washburn, Yellowstone National Park, 1984-86 and 1995-97 32

ABSTRACT

Whitebark pine (*Pinus albicaulis*) habitats are important to Yellowstone grizzly bears (*Ursus arctos*) as refuges and sources of food. In 1988, large-scale fires burned 28% of the whitebark pine in Yellowstone National Park. I examined grizzly bear use of whitebark pine habitats in the Washburn Bear Management Unit in north central Yellowstone National Park before (1978-87) and after (1989-97) the fires. Radiocollared grizzly bears were not located in habitat types in proportion to their availability, patterns of habitat selection were similar in both periods, and differences in habitat use and availability were more pronounced in years of good whitebark pine cone crops. Ground investigations revealed that sites used by grizzly bears for feeding on whitebark pine seeds were similar in both periods. I compared sites used by bears to randomly sampled sites within the whitebark pine zone in 1996. Bears selected sites that were generally higher in elevation, steeper, and more densely forested than random sites. White pine blister rust (*Cronartium ribicola*), a disease which threatens whitebark pine populations across the continent, was present in 9% of the whitebark pines on sampled plots. Grizzly bears obtain whitebark pine seeds mainly by raiding red squirrel (*Tamiasciurus hudsonicus*) cone caches, or middens. I repeated (1995-97) a study that examined the relationships between whitebark pine, red squirrels, and grizzly bears on Mt. Washburn proper (1984-86). Half of the study transects burned in 1988. Red squirrel midden density increased in unburned areas, but decreased overall. Midden sizes were 51% smaller post-fire, and bear use of middens decreased by 64% post-fire. Whereas the fires did not disrupt grizzly bear use patterns on a large scale, significant local effects were evident. I recommend (1) prevention of further large-scale losses of whitebark pine habitats until burned areas regenerate and (2) investigation of the effects of the fires on grizzly bear use of whitebark pine seeds on an ecosystem-wide scale.

INTRODUCTION

Whitebark pine (*Pinus albicaulis*) seeds are an important food of Yellowstone grizzly bears (*Ursus arctos*) (Blanchard 1980, Kendall 1983, Mattson and Jonkel 1990, Mattson et al. 1991). The lipid-rich seeds provide a high-calorie food source of particular value when bears are building fat deposits during hyperphagia (Mealey 1980, Mattson and Reinhart 1994). Annual cone crops vary greatly, with little or no cone production occurring between irregular intervals of large crop yields (Arno and Hoff 1989). Yellowstone grizzlies consume whitebark pine seeds almost exclusively when the seeds are available in sufficient quantities (Blanchard 1990, Mattson et al. 1992). Extensive use of pine seeds occurs when cone crops are large, averaging >13-23 cones per tree on monitored transects (Blanchard 1990, Mattson and Reinhart 1994). In years of low cone crops, bears forage closer to human facilities and roads, increasing the number of management actions and bear mortalities (Mattson et al. 1992).

Red squirrels (*Tamiasciurus hudsonicus*) are important intermediaries for grizzly bears foraging on pine seeds. Red squirrels harvest the indehiscent cones after they mature in late summer and fall (Kendall 1983) and cache them in middens within their territories (Smith 1970). Middens are food storage areas identified by the accumulation of cone debris (Finley 1969). A midden may be used by successive generations of red squirrels, and is a central feature of each individual's territory (Finley 1969, Rusch and Reeder 1978). Yellowstone grizzlies obtain whitebark pine seeds mainly by raiding middens and taking cones (Kendall 1983, Reinhart and Mattson 1990, Mattson and

Reinhart 1994). Therefore, consideration of red squirrel populations may be important to effective management of grizzly bear habitat within the whitebark pine zone.

The Interagency Grizzly Bear Study Team (IGBST) studied the relationships among grizzly bears, red squirrels, and whitebark pine on the Mt. Washburn massif from 1984-87 (Reinhart and Mattson 1990, Mattson and Reinhart 1990, 1996, 1997). Vocalizations, sightings, and middens recorded on line transects served as indices of red squirrel abundance. Use of pine seeds by bears was documented with counts of excavated middens along the same transects (Reinhart and Mattson 1990).

More than a quarter of Yellowstone's whitebark pine zone burned in 1988 (Renkin and Despain 1992), including approximately 30% subalpine forests of the Washburn Range and half of the red squirrel study transects. Stand-replacing fires may benefit whitebark pine populations by creating open sites where regeneration is most successful (Morgan et al. 1994). However, as cone production remains relatively low until stands are more than 100 years old (Weaver et al. 1990), a considerable amount of effective whitebark pine habitat for grizzly bears has been removed for much of the next century.

Whitebark pine populations across the northern Rocky Mountains are declining or at risk from the effects of white pine blister rust (*Cronartium ribicola*), mountain pine beetles (*Dendroctonus ponderosae*), and advancing succession due to fire suppression (Keane and Morgan 1994, Kendall and Arno 1990, Kendall 1994). White pine blister rust, a fungus introduced into this continent from Europe in 1910, is considered to be the most damaging factor across the range of whitebark pine (Arno and Hoff 1989, Keane

and Morgan 1994, Hoff and Hagle 1990). Whitebark pine mortality rates from blister rust in northwest Montana have been as high as 90%, and mortality rates are increasing southward along the Continental Divide towards Yellowstone (Keane and Morgan 1994). Mortality rates in Yellowstone's colder, drier climate are currently low, about 4% (Kendall, in press).

Reduction of mast crops due to mortality of mature trees and lower productivity of infected trees may hinder the recovery of grizzly bear populations (Kendall and Arno 1990). To assess current grizzly bear use of whitebark pine habitats and the effects of the 1988 fires, I examined data collected by myself and the IGBST in northcentral Yellowstone National Park. The specific study objectives were to:

1. Compare use and availability of whitebark pine habitats in both the pre- and post-fire periods on a coarse scale using radiolocation data and digital vegetation maps;

2. Compare specific physical and vegetative characteristics of sites used by bears before the fires with sites used after the fires;

3. Examine random sites within whitebark pine habitats for specific characteristics (e.g., whitebark pine crown diameter, levels of pathogens) for comparison with whitebark pine sites used in the same year; and

4. More specifically quantify the effects of the fires on red squirrels and bear use of whitebark pine seeds by repeating the original Mt. Washburn transect study.

STUDY AREA

The Washburn Bear Management Unit served as the study area (Figure 1). The 831 km^2 area encompassed the Washburn Range in northcentral Yellowstone National Park. Elevations ranged from 1600 m at the north entrance of the park to 3150 m at Mt. Washburn in the southeast portion of the study area. The climate of the area was characterized by long, cold winters and cool summers (Dirks and Martner 1982). Average temperature for January, the coldest month, was –10.6° C at the Tower Falls climate station (Dirks and Martner 1982). Average maximum temperature for July, the warmest month, was 26.3° C (Dirks and Martner 1982).

The study area contained a wide variety of plant communities. Big sagebrush (*Artemesia tridentata*)/Idaho fescue (*Festuca idahoensis*) communities and Douglas fir (*Pseudotsuga menziesii*) or lodgepole pine (*Pinus contorta*) forests were typical of the northern portion of the study area (Despain 1990). Lodgepole pine forests, mostly in the subalpine fir (*Abies lasiocarpa*)/grouse whortleberry (*Vaccinium scoparium*) climax habitat type, blanketed the rhyolite flows of the Central Plateau in much of the study area (Despain 1990). The Washburn Range, remnants of 40 million-year-old Abasaroka volcanoes (Keefer 1971), remained as islands above the more recent lava flows in the central and eastern portion of the study area. Those mountains supported a wide variety of forested habitat types, including subalpine fir/western meadowrue (*Thalictrum occidentale*) and subalpine fir/grouse whortleberry-whitebark pine climax types, interspersed with smaller patches of non-forested areas (Despain 1990).

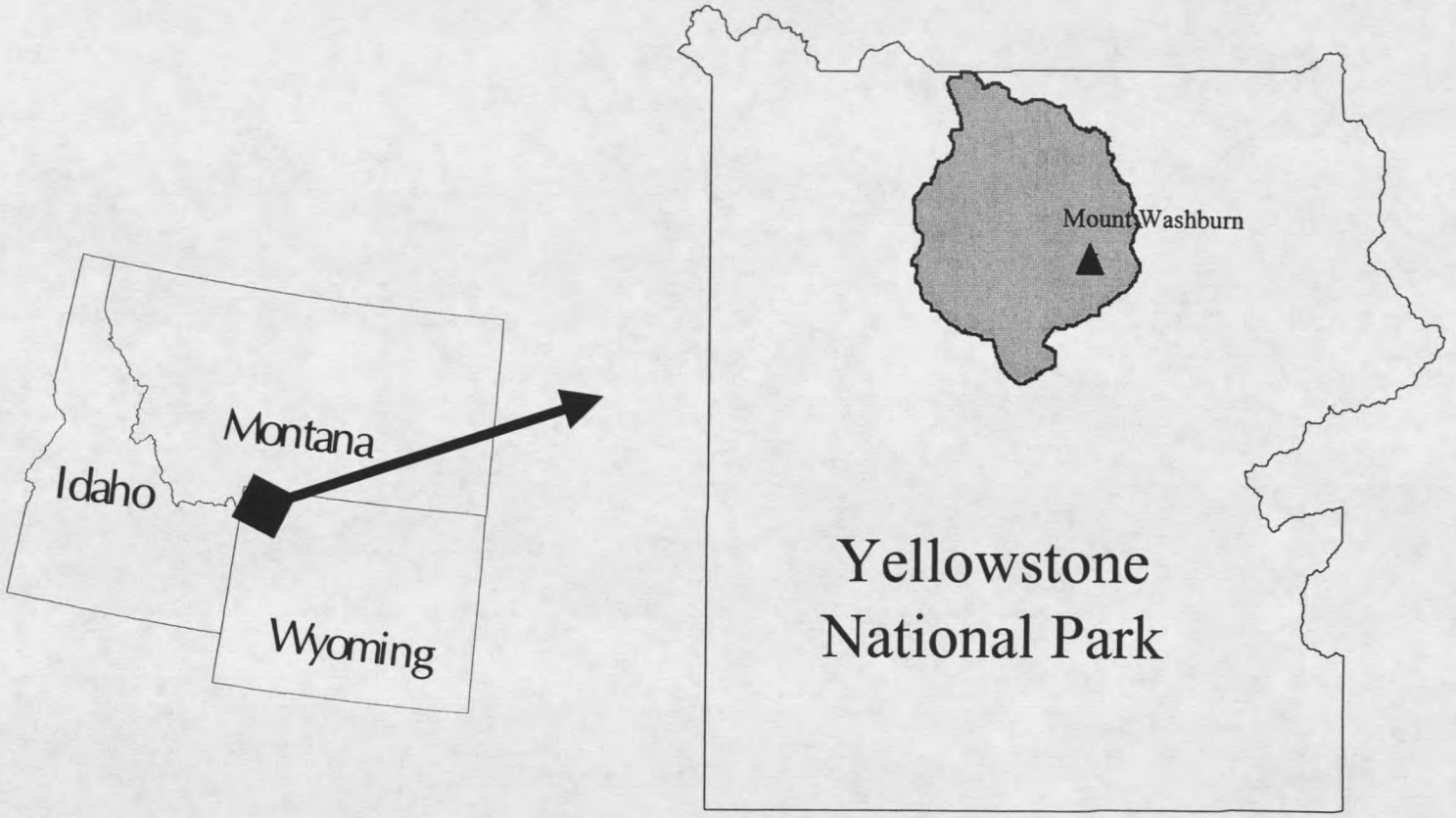

Figure 1. The study area, as delineated by the boundaries of the Washburn Bear Management Unit in northcentral Yellowstone National Park.

Other large carnivores inhabited the study area, including gray wolves (*Canis lupus*), coyotes (*Canis latrans*), bobcats (*Felis rufus*), mountain lions (*Felis concolor*), and black bears (*Ursus americanus*). The area also supported bighorn sheep (*Ovis canadensis*), mule deer (*Odocoileus hemionus*), Shiras moose (*Alces alces*), and abundant elk (*Cervus elaphus*) populations. Other species in the study area were known to use whitebark pine seeds, including Clark's nutcrackers (*Nucifraga columbiana*), Stellar's jays (*Cyanocitta stelleri*), ravens (*Corvus corax*), pine grosbeaks (*Pinicola enucleator*), mountain chickadees (*Parus gambeli*), red-breasted nuthatches (*Sitta canadensis*), red squirrels, and chipmunks (*Eutamias* spp.) (Hutchins 1990).

The red squirrel transect study area (Figure 2) was located on the northwest portion of Mt. Washburn, and was described in detail by Reinhart and Mattson (1990) and Mattson and Reinhart (1996, 1997). This 9.5 km^2 study area ranged in elevation from 2,360 m to 2,870 m. Topography was moderately steep and mainly north- and west-facing. Forest cover in the area was typical of Yellowstone's whitebark pine zone and, aside from burned areas, consisted mostly of mature stands of whitebark pine, lodgepole pine, subalpine fir, and Englemann spruce (*Picea engelmannii*).