DRAFT

ENVIRONMENTAL ASSESSMENT

Establishment of a Captive Breeding Pilot Program for the Endangered Mount Graham Red Squirrel

Prepared By: U.S. Fish and Wildlife Service
2321 West Royal Palm Road, Suite 103
Phoenix, Arizona 85021

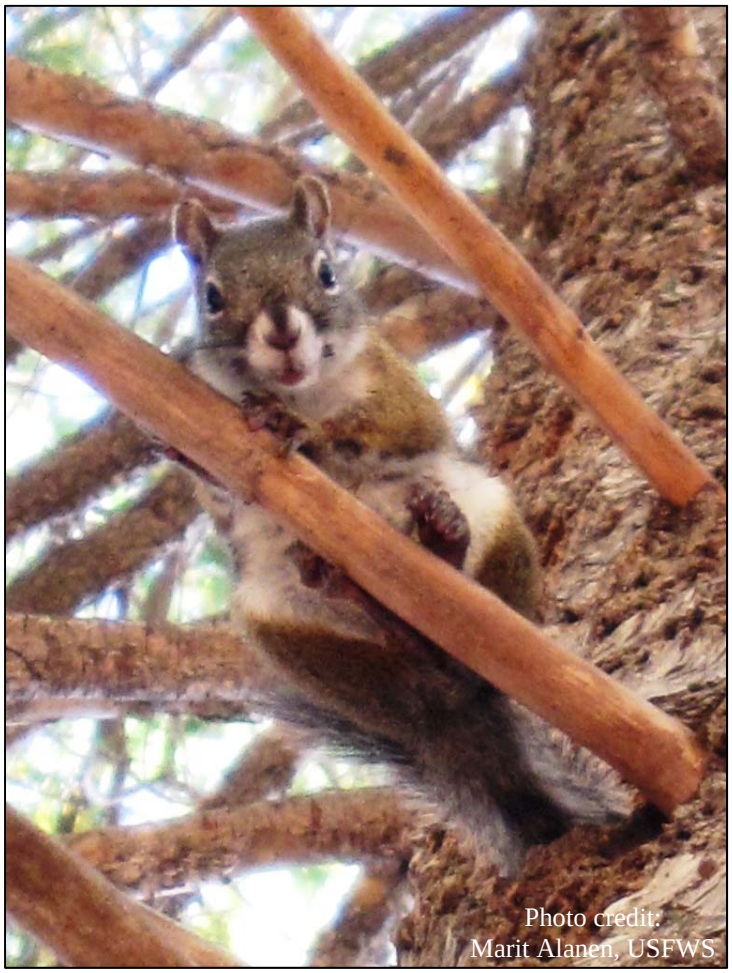

Photo credit:
Marit Alanen, USFWS

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Section I: PURPOSE AND NEED FOR ACTION

A. Introduction

The U.S. Fish and Wildlife Service (FWS) has prepared this draft Environmental Assessment (dEA) to analyze potential effects to physical, biological, social, and cultural resources that may result from establishing a captive breeding pilot program for the endangered Mount (Mt.) Graham red squirrel (*Tamiasciurus hudsonicus grahamensis*) (red squirrel or squirrel). The proposal stems from a FWS Federal action: removal of up to 16 Mt. Graham red squirrels from the wild to establish a captive breeding pilot program. The dEA was prepared in accordance with the National Environmental Policy Act (NEPA), Council on Environmental Quality regulations (40 CFR 1500-1508), and FWS NEPA Reference Handbook (January 1997).

This document is organized into six sections:

- ***Section 1 – Purpose and Need for Action****:* Presents information on the purpose of and need for the action and the FWS's proposal for achieving that purpose and need. This section also details how the FWS will inform and solicit comments from the public regarding the proposal.

- ***Section 2 – Description of Alternatives, including the Preferred Alternative****:* Provides a detailed description of the three alternatives evaluated in this dEA, including 1) the no action alternative, 2) the preferred alternative – establish a captive population(s) with up to 16 wild-caught Mt. Graham red squirrels, and 3) establish a captive population(s) with up to eight wild-caught Mt. Graham red squirrels.

- ***Section 3 – Affected Environment****:* Describes the environmental setting in which the proposed action would occur, including the site where the proposed action would be implemented.

- ***Section 4 – Environmental Consequences****:* Describes the environmental effects of implementing the three alternatives. The analysis is organized by resource topic (physical biological, social, and cultural environment). Effects are described for each of the three alternatives.

- ***Section 5 – Public Involvement****:* Describes the agencies and partners consulted during preparation of this dEA, as well as the public involvement period.

- ***References****:* Lists documents used in the preparation of this dEA.

- ***Appendices****:* The appendices provide more detailed information to support the analysis presented in this EA.

B. Purpose of the Proposed Action

The purpose of the proposed action is to 1) develop captive husbandry, rearing, and breeding techniques for the Mt. Graham red squirrel, as well as protocols for release of squirrels into the wild, and 2) establish a captive group of squirrels outside of Mt. Graham that could serve as a buffer in the event of future wildfire within the habitat in the Pinaleño Mountains or other causes of catastrophic decline of the wild Mt. Graham red squirrel population.

Developing captive techniques and release protocols for this subspecies would answer questions and provide data that can be used to inform the execution of a full captive breeding program in the future, should the Mt. Graham Red Squirrel Recovery Team (Recovery Team) determine such a program is necessary to recover the squirrel. Husbandry requirements for successfully rearing this subspecies in captivity and releasing individuals back into the wild are currently unknown.

C. Need for Taking the Proposed Action

The need for the proposed action stems from a May 22, 2006 letter from the Recovery Team to then FWS Acting Southwest Regional Director Dr. Benjamin Tuggle (now Regional Director) outlining a proposed captive pilot program and the reasons why such a program is necessary to recover the squirrel (see Appendix 1). The Regional Director concurred with this proposal in a letter to the Recovery Team Leader dated June 14, 2006 (see Appendix 1).

Development of captive husbandry techniques and release protocols, as well as establishing a captive population of squirrels outside of the Pinaleño Mountains is needed because:

- The Mt. Graham red squirrel remains a highly endangered subspecies that continues to be threatened by habitat loss, predation, and interspecific competition with the introduced Abert's squirrel.
- No individuals exist outside of the Pinaleño Mountains, making the entire population susceptible to catastrophic decline or extinction.
- Husbandry requirements for successfully breeding and rearing this subspecies in captivity and releasing individuals back into the wild are currently unknown.
- The information we learn about keeping and breeding this subspecies in captivity would contribute to recovery of the Mt. Graham red squirrel.

D. Decision to be made by the Responsible Official:

The proposed action would be undertaken by the Arizona Ecological Services Office of the FWS (AESO) in collaboration with the Arizona Game and Fish Department (AGFD), U.S. Forest Service (Coronado National Forest, Safford Ranger District) (USFS), Mt. Graham Red Squirrel Population Management Plan (PMP) coordinator, University of Arizona's Red Squirrel Monitoring Program (RSMP), and participating facilities (e.g., zoos). Facilities that have expressed interest in participating in this project currently include the Phoenix Zoo (Phoenix,

AZ) and Miller Park Zoo (Bloomington, IL). Our decision is whether we will, in cooperation with others, 1) take no action on removing Mt. Graham red squirrels from the wild, 2) establish a captive population(s) with up to 16 wild-caught Mt. Graham red squirrels, or 3) establish a captive population(s) with up to eight wild-caught Mt. Graham red squirrels. Our decision will occur after a 30-day public review of this dEA, and after consideration of all public comments received during the comment period. If the alternative selected would cause significant adverse impacts on the human or natural environment, an Environmental Impact Statement will be prepared before implementing that alternative. If no significant adverse impacts are anticipated, we will prepare a Finding of No Significant Impact and a final environmental assessment. These documents will be posted on our website (http://www.fws.gov/arizonaes/) and mailed to those who provided comments on this draft or who request copies.

Section II: ALTERNATIVES, INCLUDING THE PREFERRED ALTERNATIVE

1. Alternative A – No Action Alternative

Under the no action alternative, FWS would not capture any Mt. Graham red squirrels and would not implement a captive breeding pilot program. The no action alternative provides the baseline for comparison of environmental effects of the preferred alternative.

1.1 Points of concern

It is our expectation that the no action alternative would result in the following:

- The entire population of Mt. Graham red squirrels would remain at risk due to potential wildfires or other catastrophic events.
- The purpose and need for the proposed action would not be met under the No Action Alternative.

2. Alternative B – Establish a Captive Population(s) with up to 16 Wild-caught Red Squirrels from the Pinaleño Mountains (Preferred Alternative)

Under this alternative, FWS would, in cooperation with others, attempt to establish a captive population of up to 16 Mt. Graham red squirrels to implement a captive breeding pilot program. Evidence suggests that juvenile Mt. Graham red squirrels experience a high rate of mortality due to the extreme distances they must travel to establish a new territory (Munroe *et al*. 2009). For this reason, we would attempt to capture young-of-the-year squirrels (those weighing less than 7 ounces) around the time they begin to disperse from their natal area, as removing up to 16 individuals from this cohort should have less impact on the overall population than removing adults. However, depending on the success in trapping this cohort, up to eight adult squirrels (including no more than four females) could be captured and brought into captivity for this pilot program. No more than 10 percent of the population (based on the most recent mountain-wide census data) would be trapped in any one calendar year to populate this pilot program. This includes individuals trapped incidentally and released immediately (e.g., during an attempt to capture a female, a male is incidentally caught), as well as the 16 that would be brought into

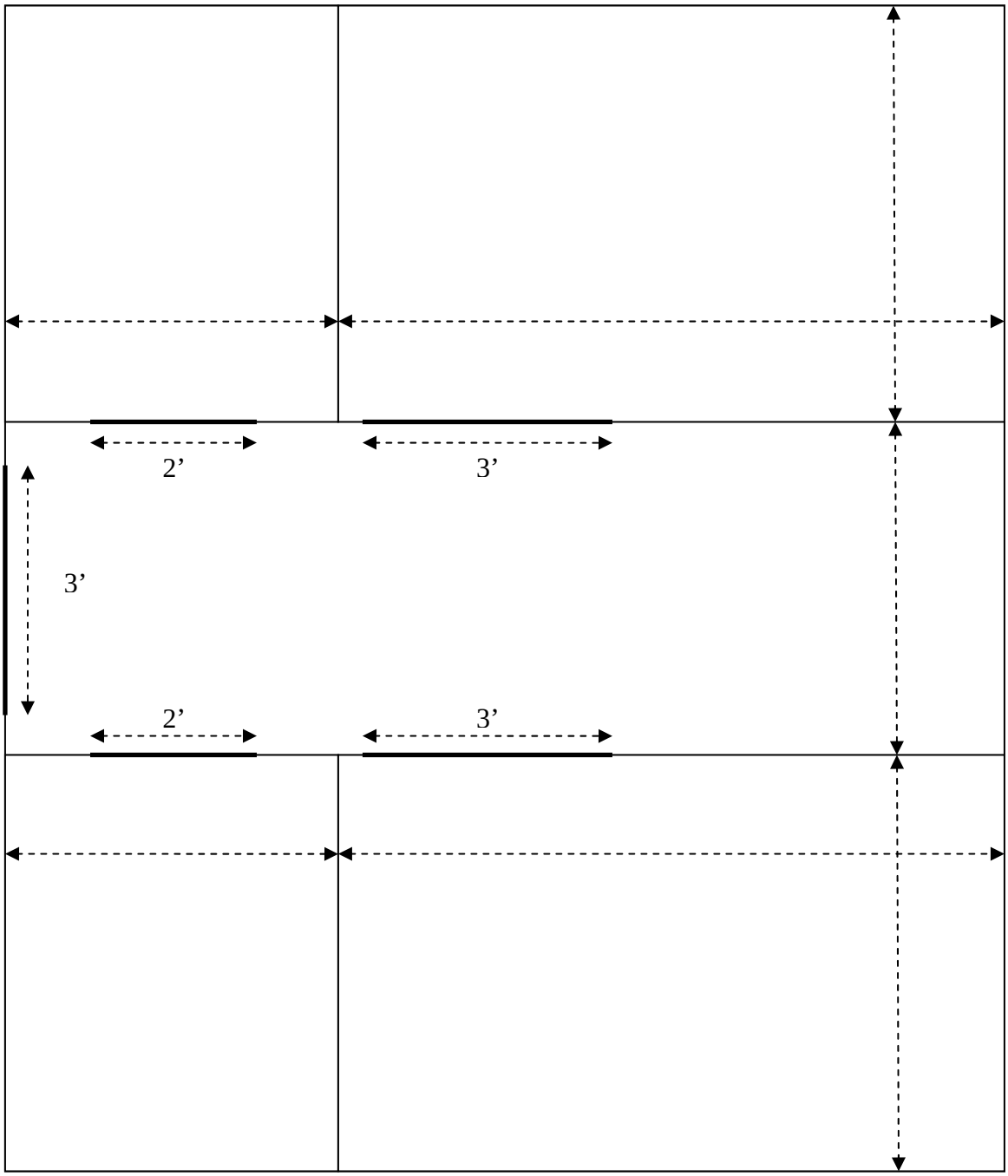
captivity. Should wild-caught squirrels die in captivity due to human-related causes (e.g., negligence during trapping, transport, or while in captivity), the total number of wild squirrels held in captivity would be reduced by this number. If a wild-caught squirrel should die in captivity due to natural causes (e.g., old age, disease, or breeding attempts), the individual would not be replaced by another wild-caught squirrel unless Mt. Graham red squirrels bred in captivity have been released back into the wild and have demonstrated they survive and reproduce at a level that meets or exceeds their natural level of survival and fecundity. Captive-born squirrels that die in captivity due to either human-related or natural causes would not reduce the total number of wild-caught squirrels that may be held in captivity.

Initially, trapping efforts would attempt to obtain a total of eight male and eight female squirrels; however, this ratio could change as the reproductive needs of the red squirrel are determined through this proposed action. Additionally, genetic testing could reveal that some individuals brought into captivity should be released back into the wild while others should be brought into captivity to increase genetic representation of those held in captivity. If it is determined that Mt. Graham red squirrels held in captivity should be exchanged for other wild-caught individuals for these reasons, as mentioned above, it must first be demonstrated that released individuals are able to survive and reproduce at a level that meets or exceeds the natural level of survival and fecundity for this subspecies. Ear-tagging and radio-telemetry equipment have been purchased to assist in monitoring released individuals.

All animals brought into captivity and released into the wild would undergo a 30-day quarantine period (in accordance with American Zoo and Aquarium Association (AZA) guidelines and standards). On-site quarantine (meaning quarantining the animals in the structures built to house them, rather than in a separate quarantine facility) of Mt. Graham red squirrels brought into captivity would be considered, and may eventually be required if it is determined this is necessary to: a) prevent the introduction of disease and parasites into the breeding facility or the wild populations, and/or b) have better control over climatic conditions (such as lighting and temperature) while in captivity to ensure the breeding cycle is not disrupted. Mt. Graham red squirrels could be kept either on- or off-exhibit at participating facilities. In either case, public information would be developed about the recovery program at zoological institutions, which may include (but not be limited to) informational kiosks, as well as providing photos and video of captive-rearing efforts to the press and management agencies for educational use.

Successful breeding techniques for this subspecies are currently unknown. Therefore, once pairs of squirrels are in captivity, different techniques would be attempted based upon the best available information regarding their natural breeding behaviors, as well as similar species' breeding behaviors in captivity. Successful release techniques for this subspecies are also unknown. Therefore, different release strategies would be studied (including hard- and soft-release techniques, described below) to determine which techniques would provide released squirrels with the greatest chance for survival. A soft-release enclosure measuring 14-feet wide by 12-feet deep by seven-feet high (Figure 1) would be installed within the USFS's Columbine administrative site on Mt. Graham. Installing the enclosure at this location would minimize conflicts with human activities and impacts to the wild squirrel population, while also providing captive squirrels the opportunity to experience the natural weather and elevational conditions

Figure 1. Mount Graham red squirrel soft-release enclosure design.



Panel Form Construction
4 Total Units
1 Hallway connecting them 4’ wide
2 Units 4’ w x 5’ d x 7’ high
2 Units 8’ w x 5’ d x 7’ high
Overall dimensions: 14’ wide x 12’ deep x 7’ high

Roof panels: Thermoclear solid roofing
1” sq. Anodized Aluminum Tubing
½” x 1” 16 gauge GAW wire mesh
Stainless Steel Hardware
2 doors - 24” x 72”
3 doors - 36” x 72”

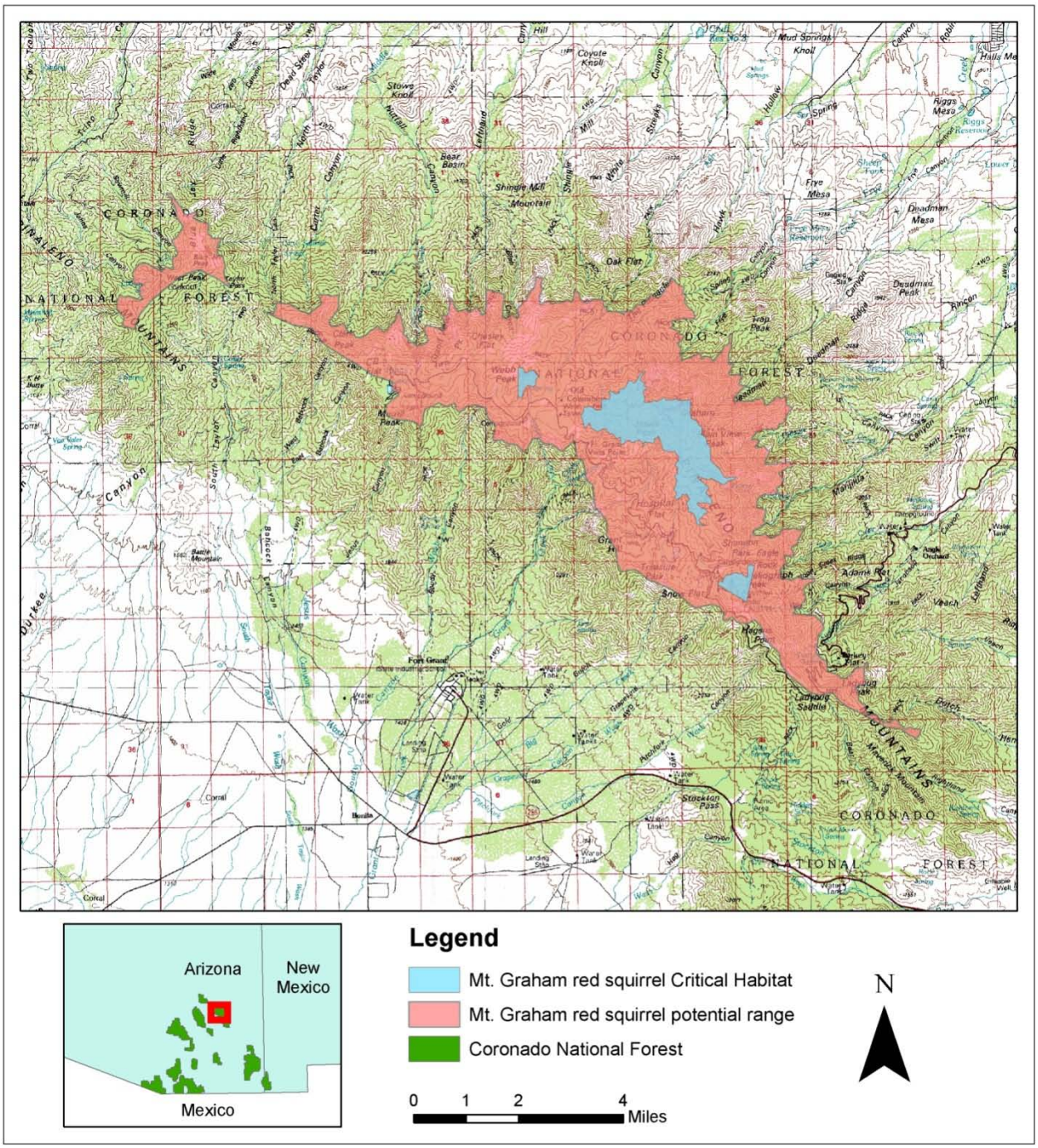
within their habitat prior to release. Locating the enclosure at Columbine also provides the convenience of running water and electricity (should it be needed) so that captive squirrels can easily be cared for while housed in the soft-release enclosure. From this enclosure, squirrels would be recaptured and transported to release sites.

The soft-release enclosure has been designed in paneled sections so that it can be assembled, disassembled, and moved if it is determined it should be relocated in the future as the captive breeding pilot program develops. It can be constructed using hand tools and small power tools (e.g. screwdrivers and drills) and would be attached to a floor made out of concrete blocks. Its exact location would be selected within the Columbine administrative site to avoid any new ground-disturbing activities. Should it become necessary to move the enclosure to a different location during the 10-year life of this pilot project, all necessary environmental compliance would be completed prior to relocating it.

One of the purposes of the pilot program is to determine the most effective release technique for increasing the likelihood that released captive Mt. Graham red squirrels have the best chance for survival. Currently we do not know what that successful strategy would be; however, two approaches to releasing captive-born animals into the wild would be applied during this pilot program. We would either apply a hard release, in which individuals would be transported directly to the release location and immediately released into the wild, or a soft release, in which individuals would spend approximately seven to 10 days in the soft-release enclosure described above to acclimate to local conditions prior to release. A person familiar with caring for captive squirrels (e.g., zoo personnel) would stay at the Columbine administrative site the entire time squirrels are in the enclosure to monitor their behavior and condition, as well as ensure they receive proper care. For both the hard- and soft-release techniques, candidates for release would be assessed as to whether they exhibit essential behavioral skills, including food recognition and acquisition, caching behavior, predator avoidance, and finding refugia. Each released Mt. Graham red squirrel would be individually tagged with color-coded ear tags, and radio-telemetry would be used to track their movements post-release. Ear tags and radio-telemetry equipment and techniques would follow the materials and methods outlined in Koprowski *et al*. (2008).

Areas of release would be coordinated with the contacts listed in Appendix 2. Release areas would be selected to avoid conflicts with human activities and to minimize impacts to the wild squirrel population. To avoid potential conflicts with human activities, sites would only be selected within the Mt. Graham red squirrel's range (Figure 2) and would not be located within 4,000 feet (ft) of existing structures, campgrounds, special use areas (e.g., summer homes, Bible and Boy Scout Camps), and the 150-acre (ac) Mount Graham International Observatory research area (for a description of these areas, see Environmental Setting below). This distance was chosen because it is greater than twice the mean dispersal distance recorded for this subspecies (1,916 ft); Kreighbaum and Van Pelt 1996, as reported in Munroe *et al*. 2009), and is also greater than the maximum distance a red squirrel has been found from its midden (3,028 ft) once it has an established territory (Koprowski *et al*. 2008). This should minimize the potential for released squirrels to disperse into and establish territories within areas that may impact human activities. In addition, sites would be selected so as to minimize impacts to the wild squirrel population.

Figure 2. Mount Graham red squirrel potential range and critical habitat, Pinaleño Mountains, Arizona (potential range boundary determined by Hatten 2009).



These could include gaps within the current distribution of red squirrels, currently unoccupied areas that appear to contain habitat, such as West Peak, and/or silviculturally treated areas (such as those that would be treated through the Pinaleño Ecosystem Restoration Project – see Environmental Setting below).

Concurrent with establishing the captive breeding pilot program, a Population Management Plan (PMP) and studbook would be developed for the Mt. Graham red squirrel. Information gathered during the pilot program would be incorporated into the PMP and studbook for this subspecies, which would serve as sources of reference on the biology, maintenance, housing, health, genetics, behavior, diet, breeding, restraint, transportation, and release of animals held in captivity.

Activities to implement the proposed action would include multiple visits to red squirrel territories to determine occupancy, sex, presence of young, and age of young; pre-baiting red squirrel territories to acclimatize squirrels to the taste of bait; trapping red squirrels; transporting red squirrels to participating facilities (e.g., zoos and museums); care within each facility (including genetic testing and individually marking animals); transporting individuals to Mt. Graham; and release of red squirrels to the wild.

Implementation of the field activities is expected to commence during the Fall of 2010. The pilot program would continue for a period of 10 years, at which point the Recovery Team would recommend either: a) developing a comprehensive captive breeding program involving more than 16 wild-caught Mt. Graham red squirrels, or b) discontinuing the pilot program because it is not meeting its goals. Mt. Graham red squirrels could be captured over a number of years until a total of 16 are held in captivity.

2.1 Mitigation Measures

The following mitigation measures would be implemented as part of the preferred alternative to minimize any potential effects to the environment:

1. Efforts would be made to capture juvenile individuals to populate this pilot program. If, however, trapping of juveniles proves unsuccessful, up to eight adult squirrels (including up to four females) may be captured and brought into captivity. No more than 16 squirrels that have been removed from the wild would be held in captivity at any time. Should wild-caught squirrels die in captivity due to human-related causes (e.g., negligence during trapping, transport, or while in captivity), the total number of wild squirrels held in captivity would be reduced by this number. If a wild-caught squirrel should die in captivity due to natural causes (e.g., old age, disease, or breeding attempts), the individual would not be replaced by another wild-caught squirrel unless Mt. Graham red squirrels bred in captivity have been released back into the wild and have demonstrated they survive and reproduce at a level that meets or exceeds their natural level of survival and fecundity. Captive-born squirrels that die in captivity due to either human-related or natural causes would not reduce the total number of wild-caught squirrels that may be held in captivity.

2. No more than 10 percent of the wild population (based on the most recent mountain-wide census data) would be trapped as a part of this proposed action in any one calendar year, including individuals trapped incidentally and released immediately (e.g., during an attempt to capture a female, a male is incidentally caught) and those brought into captivity.

3. Trapping and handling of Mt. Graham red squirrels would be conducted by AESO staff and/or individuals holding Federal and State permits (including trapping as a permitted activity) for this subspecies. Trapping and handling techniques would follow those outlined in Koprowski *et al*. (2008) and Koprowski (2002). Briefly, collapsible, single door live traps (Tomahawk Live Trap, Tomahawk WI: Model # 201) would be used, and bait would consist of peanuts and/or peanut butter or an acceptable substitute (e.g., almonds and/or almond butter). Traps would be checked every two hours and closed to capture each night. Handling of red squirrels would be kept to a minimum; however, if handling is required (e.g., to determine the weight of the squirrel), a cloth handling cone (Koprowski 2002) would be used. Additionally, while traps are open, pieces of wood and bark would be laid across and against the sides of the traps to provide shade within the trap, and if the weather becomes inclement, the traps would be checked immediately and closed to capture until the weather event has passed.

4. Mt. Graham red squirrels would be transported to a participating facility or suitable holding location within 24 hours of capture. Transportation would follow International Air Transport Association (IATA) airport code regulations for flight and AZA standards for overland transport. They would be transported in species-appropriate enclosures (e.g. Sky Kennel, small size), and provided adequate water and food, if necessary. Climate would be controlled through heating or air conditioning within the vehicle (car, truck, and/or cargo plane) during transportation so that the squirrels do not experience heat or cold related stress during transport.

5. Squirrels would only be released into the wild when the snow has melted, food resources are available, and sufficient time is available for the released squirrels to cache cones and fungi for the winter (May through August). To the greatest extent possible within this timeframe, release events would be timed to coincide with natural juvenile dispersal during that year.

6. Release sites would be coordinated with the AESO, the PMP coordinator, USFS, AGFD, and RSMP (contacts listed in Appendix 2), and would be selected to avoid conflicts with human activities and minimize impacts to the wild squirrel population, while also providing captive squirrels the greatest opportunity for survival. A soft-release enclosure would be installed within the Columbine administrative site to minimize conflicts with human activities and impacts to the wild squirrel population, while also providing captive squirrels the opportunity to experience their natural habitat.

7. Ear tagging and radio-telemetry equipment and techniques would follow the materials and methods outlined in Koprowski *et al*. (2008). Briefly, released Mt. Graham red

squirrels would be fitted with uniquely numbered ear tags (Monel 1005-1, National Band and Tag) with colored ear disks (1 cm Model 1842, National Band and Tag) for individual identification. Radiocollars (SOM 2190, Wildlife Materials International) weighing <5 percent of body mass would be fitted and replaced as needed (approximate life = 1 yr).

8. Facilities that participate in this program would be members of the AZA or would be able to demonstrate they can meet or exceed the accepted standards developed by the AZA. Available at: http://www.aza.org/uploadedFiles/Accreditation/Microsoft%20Word%20-%202010%20Accred%20Standards.pdf.

9. Implementation of the proposed project would follow the FWS's Policy Regarding Controlled Propagation of Species Listed under the Endangered Species Act (65 FR 56916). Available at: http://frwebgate5.access.gpo.gov/cgi-bin/PDFgate.cgi?WAISdocID=592669416585+1+2+0&WAISaction=retrieve.

10. The Technical Subgroup of the Mt. Graham Red Squirrel Recovery Team would review the pilot program annually to ensure that the program is meeting its objectives. Based on their review, they could recommend that FWS: a) develop a full captive-breeding program, which may involve holding more than 16 wild-caught squirrels in captivity at one time, or b) discontinue the pilot program because it is clearly not benefitting the subspecies. Expansion of the program to more than 16 wild-caught squirrels would undergo additional review under NEPA.

2.2 Continued Coordination

All aspects of the captive breeding pilot program would be coordinated among AESO, AGFD, USFS, the Mt. Graham Red Squirrel PMP coordinator, RSMP, and participating facilities; these entities would provide input during key decision-making times throughout the life of the project (e.g., where to capture squirrels, where to release squirrels, etc.). Additionally, the Technical Subgroup of the Mt. Graham Red Squirrel Recovery Team would review the pilot program annually to ensure the program is meeting its objectives. Especially important would be input from these cooperators regarding the success of breeding efforts and release techniques, including recommendations for adaptive management. Adaptive management would be employed within the constraints of the project described herein to improve the likelihood of success of the project and to reduce any potential adverse effects on resources or affected parties. Should the Technical Subgroup feel that a full captive-breeding program is necessary to recover the Mt. Graham red squirrel (possibly involving more than 16 captive squirrels), a meeting of both the Technical and Stakeholder Subgroups of the Recovery Team would be convened to discuss this option.

2.3 Points of concern

It is our expectation that the proposed action alternative would result in the following:

- An unknown number of individuals would be harassed during reconnaissance and pre-baiting activities.

- The non-lethal removal of up to 16 Mt. Graham red squirrels from the wild potentially could affect the overall population.
- Squirrels potentially could be injured or harmed during trapping, transport, and/or release activities, or while in captivity.
- Release of captive-bred squirrels could detrimentally affect wild squirrels.

3. Alternative C – Establish a Captive Population(s) with up to Eight Wild-caught Red Squirrels from the Pinaleño Mountains

This alternative is identical to Alternative B, above, except rather than removing 16 Mt. Graham red squirrels from the Pinaleño Mountains, this alternative would remove eight. Like Alternative B, we would attempt to capture young-of-the-year squirrels (those weighing less than 7 ounces) around the time they begin to disperse from their natal area, but may capture up to eight adult squirrels (including no more than four adult females) if trapping this cohort proves unsuccessful. No more than eight squirrels would be removed from the wild under this alternative, unless Mt. Graham red squirrels bred in captivity have been released back into the wild and have demonstrated they survive and reproduce at a level that meets or exceeds the natural level of survivorship and fecundity for this subspecies. The mitigation measures and continued coordination as described under Alternative B would be identical for this alternative, with the exception that in measure #1, no more than eight Mt. Graham red squirrels would be removed from the wild.

3.1 Points of concern

It is our expectation that this alternative would result in the following:

- An unknown number of individuals would be harassed during reconnaissance and pre-baiting activities.
- The non-lethal removal of up to eight Mt. Graham red squirrels from the wild potentially could affect the overall population.
- Squirrels potentially could be injured or harmed during trapping, transport, and/or release activities, or while in captivity.
- Release of captive-bred squirrels could detrimentally affect wild squirrels.
- A total of eight wild squirrels may limit our ability to meet the purpose and need of the captive breeding pilot program.

4. Other Alternatives Considered

Two other alternatives, Alternatives D and E, were considered but ultimately rejected because they did not meet the proposed action's purpose and need. Alternative D involved establishing a captive breeding pilot program using up to 16 Mogollon red squirrels from the White Mountains, Arizona, instead of Mt. Graham red squirrels. The White Mountains support the nearest population of red squirrels to the Pinaleño Mountains. These squirrels share similar life-history traits with the Mt. Graham red squirrel, and therefore could act as a surrogate for the Mt. Graham subspecies in developing captive husbandry, rearing, breeding, and release techniques. However, bringing these squirrels into captivity rather than Mt. Graham red squirrels would not

meet the purpose and need to establish a group of Mt. Graham red squirrels outside of the Pinaleño Mountains that could serve as a buffer against catastrophes; therefore, this alternative was eliminated from further consideration.

Alternative E involved translocating up to 16 Mt. Graham red squirrels to appropriate habitat in another mountain range in Arizona. This alternative possibly could have met the purpose and need to establish a group of Mt. Graham red squirrels outside of Pinaleño Mountains that could serve as a buffer against catastrophes. However, it did not meet the purpose and need to develop captive husbandry, rearing, breeding, and release techniques; therefore, this alternative was eliminated from further consideration.

The No Action Alternative (Alternative A) also fails to satisfy the purpose and need of the proposed action, but is retained as the baseline for comparing environmental effects.

Section III: AFFECTED ENVIRONMENT

Environmental Setting

The Pinaleño Mountains are located in southeastern Arizona and are within the Safford Ranger District of the Coronado National Forest, which means all ongoing and future actions are either led by or coordinated with the USFS. Mt. Graham red squirrels inhabit an approximately 19,768-ac area in the high-elevation forests of this mountain range (Figure 2, p. 10). Their habitat supports primarily Engelmann spruce (*Picea engelmanii*) and corkbark fir (*Abies lasiocarpa* var. *arizonica*) at the highest elevations, and is dominated by Douglas fir (*Pseudotsuga menziesii*) in the lower, mixed-conifer association, with white fir (*Abies concolor*) and Mexican white pine (*Pinus strobiformis*) as sub-dominants.

Catastrophic wildfire currently poses the greatest threat to the human and biological environment in the Pinaleño Mountains, including all remaining habitat for the Mt. Graham red squirrel. The cumulative effects due to past practices of fire suppression, livestock grazing, and logging have resulted in a shift in the fire regime from short-interval, low-intensity fires to infrequent but larger, high-intensity fires (U.S. Forest Service 2000a). Two such fires have occurred in the recent past, the Clark Peak Fire in 1996 and the Nuttall Complex Fire in 2004, which together affected approximately 35,000 acres of forested area. Fire size is currently limited by wildfire-suppression activities and fuel-reduction projects (such as the Pinaleño Ecosystem Management demonstration project and Pinaleño Ecosystem Restoration Project, described below). Engelmann spruce and corkbark fir, both fire-intolerant species, now grow in much greater density and probably at lower elevations than in the past, as evidenced by the number of these trees less than 110 years old in areas where the dominant, older trees are almost exclusively fire-resistant Douglas-fir, ponderosa pine, and southwestern white pine. In addition to accumulation of fire-intolerant species, the mixed conifer forest has become dense with continuous horizontal (canopy cover) and vertical (ladder) fuels, meaning these forests no longer provide a fire buffer to the spruce-fir forest, resulting in increased fire intensity (hotter fires) and an increased risk of

crown fire (severity), both of which are more likely to alter and destroy resources on the mountain.

One silvicultural project designed to address the heavy fuel loads in the Pinaleño Mountains has been completed in the mixed-conifer area, the Pinaleño Ecosystem Management (PEM) demonstration project, which was implemented from 2000 through 2008. The PEM project involved thinning, piling, burning, and sometimes broadcast burning in an area occupied by the Mt. Graham red squirrel, northern goshawk, Mexican spotted owl, and other USFS Sensitive species. Another, larger, fuel reduction and forest restoration project proposed by the Coronado National Forest is the Pinaleño Ecosystem Restoration Project. This project is designed to help reduce the threat of catastrophic wildfire (described above) in much of the remaining mixed conifer zone, and will begin to set the forest on a trajectory towards conditions that will allow a return to low-intensity fire cycles without risk of catastrophic fire damage. The mixed conifer forest currently has the largest block of remaining Mt. Graham red squirrel habitat, and monitoring of impacts to the red squirrel and its habitat are incorporated into the project's design. This project will take a decade or more to complete.

Compounding the threat of wildfire are the added pressures of insect and disease outbreaks and climate change. At the highest elevations, Engelmann spruce and corkbark fir populations in the Pinaleño Mountains were severely depleted by recent catastrophic outbreaks of *Nepytia janetae*, spruce beetle, western balsam bark beetle (U.S. Forest Service 1999, 2000b), and spruce aphid (Lynch 2004). Additionally, armillaria root disease, and associated blowdown, was observed in Engelmann spruce and corkbark fir in the mixed-conifer forest type in 2008. Armillaria root disease activity may be increasing due to the increase in food substrate that became available from spruce and fir mortality, and it appears that armillaria is infecting Engelmann spruce and other species weakened by drought and defoliators, and may be spreading to relatively healthy trees, although further study is warranted (A. Lynch and M.L. Fairweather, USFS, pers. comm. 2008). As the spruce-fir forest is lost due to insects, disease, and other sources of mortality, it is unclear what forest type may replace it.

Threats due to insects in the mixed-conifer forest currently include bark beetles in Douglas-fir and southwestern white pine, and defoliators in Douglas-fir and spruce. These agents are generally not exclusive but interact with each other and other stressors such as drought, root disease, and dwarf mistletoes to cause tree mortality. Increasing levels of drought due to climate change (see below) likely will work in combination with increasing levels of insect outbreaks and wildfires, which will likely directly impact the environment and resources in the Pinaleño Mountains.

Currently, Arizona is experiencing a severe, multiple-year drought (refer to http://www.azwater.gov/azdwr/StatewidePlanning/Drought/DroughtStatus.htm and http://www.climas.arizona.edu/outlooks/swco), and current models suggest that a 10 to 20 year (or longer) drought is anticipated (Swetnam and Betancourt 1998, Woodhouse and Overpeck 1998, McCabe *et al.* 2004, Seager *et al*. 2007). While this drought is apparently within natural historical variation (Swetnam and Betancourt 1998), mean annual temperatures are forecasted to rise 8.1-11.0 ^{0}F in the 21st century (Intergovernmental Panel on Climate Change 2007), which in

turn are predicted to be accompanied by a more arid climate (Seager *et al.* 2007), increasing insect outbreaks in Southwestern forests, and increasing wildfires (Betancourt 2004).

Human activities in the Pinaleño Mountains and within Mt. Graham red squirrel habitat include transportation, recreational use, scientific study, and forest administration and management. The 35.2-mile Swift Trail (Arizona Route 366) is the main road providing access to the mountain. The lower 21.85 miles of the road are paved, while the upper 13.35 miles are graded dirt. The entire road is open to vehicular use from April 15 to November 14 (snow permitting), with seasonal closure occurring at the beginning of the dirt portion of the road. Non-motorized recreation is allowed beyond the road closure during the winter months. Improvements to Swift Trail may occur in the future, which could include paving the remaining portion of graded dirt road to Riggs Flat Lake (located near the end of Swift Trail).

Recreational opportunities within the range of the Mt. Graham red squirrel include eight developed campgrounds, as well as a number of hiking and mountain biking trails. Riggs Flat Lake, located near the end of Swift Trail, is an 11-acre impoundment providing fishing opportunities for rainbow, brown, and brook trout. There are two areas permitted for special use of summer homes on the mountain, the Columbine and Turkey Flat cabin areas, containing 14 and 74 summer homes, respectively. Other developments within the red squirrels' range include a Bible Camp and a Boy Scout Camp.

The Mount Graham International Observatory (MGIO) is accessed off of Swift Trail and includes an access road and three telescopes on eight acres on and around Emerald Peak. These telescopes were authorized under the Arizona-Idaho Conservation Act (1988), which also established a 1,750-ac Mt. Graham red squirrel Refugium surrounding the Hawk Peak-High Peak areas, as well as a 150-ac research area (including the footprint of the telescopes) to monitor the effects of the MGIO on the Mt. Graham red squirrel. Activities within the research area and use of the telescopes are ongoing. There is the potential that up to four more telescopes could be constructed on an additional eight acres within the research area in the future.

Within the proposed action area, USFS Administrative Sites are established at Heliograph Peak, Columbine Work Center, and Webb Peak Lookout. There are also fire lookout towers on Clark, West, Webb, and Heliograph peaks. Other than treatments that will occur through the Pinaleño Ecosystem Restoration Project (described above), there are no planned activities near these locations that would require additional section 7 consultation.

Biology and Status of the Mt. Graham Red Squirrel

Mt. Graham red squirrels are small, grayish-brown arboreal rodents with a rusty to yellowish tinge along the back (Spicer *et al.* 1985). They are highly territorial (Smith 1968), creating and defending middens within their territories. Middens are areas that consist of piles of cone scales in which squirrels cache additional live, unopened cones as an over-wintering food source. Placement of these middens tends to be in areas with high canopy closure near food sources (e.g. Douglas-fir, corkbark fir, and Engelmann spruce). This type of placement allows specific

moisture levels to be maintained within the midden, thereby creating prime storage conditions for cones and other food items, such as mushrooms, acorns, and bones. They also seem to prefer areas with large snags or downed logs that provide cover and safe travel routes, especially in winter, when open travel across snow exposes them to increased predation.

Female Mt. Graham red squirrels give birth to fewer young (reported means=2.35 and 2.15) compared to other red squirrels (reported means=3.69 and 3.72) (Rushton *et al*. 2006 and Munroe *et al*. 2009, respectively). Nests can be in a tree hollow, a hollow snag, a downed log, or among understory branches of a sheltered canopy. Nests may be built in natural hollows or abandoned cavities made by other animals, such as woodpeckers, and enlarged by squirrels (U.S. Fish and Wildlife Service 1992). Froehlich (1990) found that Mt. Graham red squirrels built 60 percent of their nests in snags, 18 percent in hollows or cavities in live trees, and 18 percent in logs or underground. Only four percent of nests were bolus grasses built among branches of trees (also called dreys). Slightly different proportions were found by Morrell *et al*. (2009), who noted 67 percent of the Mt. Graham red squirrel nests within their study area were located in tree cavities, 27 percent were bolus nests, and seven percent were ground nests. Leonard and Koprowski (2009) found that Mt. Graham red squirrels appear to favor cavity nests over bolus nests, whereas the nearest population of red squirrels in the White Mountains, the Mogollon red squirrel, used predominantly dreys. They speculate that localized processes such as slightly elevated temperatures and isolation may be responsible for the disparity between these two subspecies. In the Pinaleño Mountains, snags are important for cone storage as well as nest location. Both nests and stored cones have been found in the same log or snag.

Maximum longevity for the red squirrel in the wild is reported to be 10 years (Walton 1903) and nine years in captivity (Klugh 1927), although 3-5 years is more typical (Munroe *et al*. 2009). Annual adult mortality of Mt. Graham red squirrels appears to be higher than for red squirrels throughout North America (47 percent vs. 34.73 percent) (Rushton *et al*. 2006). Annual juvenile mortality has not been studied directly, but Munroe *et al*. (2009) suggest it could be higher than other populations of red squirrels due to the extreme natal dispersal distance required to establish a new territory. Studies of radio-collared animals suggest predation accounts for a large majority of mortality in red squirrels (Kemp and Keith 1970, Rusch and Reeder 1978, Stuart-Smith and Boutin 1995a&b, Kreighbaum and Van Pelt 1996, Wirsing *et al.* 2002); however, the availability of alternative prey for predators (Stuart-Smith and Boutin 1995a), availability of food for red squirrels (Halvorson and Engeman 1983, Wirsing *et al.* 2002), and variation in vigilance and use of open areas by individual squirrels (Stuart-Smith and Boutin 1995b) have been suggested to predispose some animals to higher susceptibility to predation. Indications are that 75 to 80 percent of the mortality experienced by Mt. Graham red squirrels is due to predation, most of which is caused by raptors (Koprowski, March 16, 2006 Recovery Team Meeting Minutes).

Rangewide, multi-agency red squirrel surveys, based on a sample of middens throughout the range of the Mt. Graham red squirrel, have been conducted since 1986. Midden surveys showed increasing numbers of Mt. Graham red squirrels into 1998-2000, with peaks over 500, after which the population declined. Population estimates dropped in 2001 to less than 250; since that time, population estimates have remained fairly stable, varying from approximately 200 to 350.

Koprowski *et al.* (2005) characterized the decline of the Mt. Graham red squirrel in their study area as catastrophic. They noted that in areas of high tree mortality in Alaska and Colorado, red squirrels did not completely disappear but rather persisted in residual stands of trees where conditions remained suitable. The ability of the Mt. Graham red squirrel to survive declines is unknown; however, it apparently survived a similar situation in the late 1600s. Grissino-Mayer *et al.* (1995) sampled fire-scarred trees in four areas of the Pinaleño Mountains from Peter's Flat east to Mt. Graham. The oldest trees in the spruce-fir forest were about 300 years old. They found evidence for a widespread, stand-replacing fire in 1685 that probably eliminated much of the forest atop the Pinaleño Mountains. Although the Mt. Graham red squirrel population persisted through that event, small populations can exhibit genetic or demographic problems that further compromise the ability of the subspecies to survive. Recent genetic analysis (Fitak and Culver 2009) indicates the average relatedness among Mt. Graham red squirrel individuals is over 90 percent, which is near the value of human identical twins and indicates potential impacts from inbreeding depression. Low genetic variability in small populations is a concern because deleterious alleles are expressed more frequently, disease resistance might be compromised, and there is little capacity for evolutionary change in response to environmental change. Koprowski *et al.* (2005) recommended management actions to increase available habitat and population size in the near and distant future. A captive breeding program was also recommended, the concept of which has been endorsed by the MGRS Recovery Team and is the subject of this dEA.

Threats facing the Mt. Graham red squirrel include loss of habitat due to native and exotic insect infestations (Koprowski *et al.* 2005), direct mortality and loss of habitat and middens due to large-scale wildfires (Koprowski *et al.* 2006), loss of habitat due to human factors (e.g., disturbance, conversion to roads, trails, and/or recreation sites, permitted special uses, etc.; U. S. Fish and Wildlife Service 1992), and loss or reduction of food sources due to drought, predation, and apparent dietary and territory competition with Abert's squirrel, which was introduced in the 1940s by the Arizona Game and Fish Department (Edelman *et al.* 2005). Current management of the Mt. Graham red squirrel includes an annual mountain-wide survey of a random selection of middens to determine population size and trends, as well as research and monitoring activities performed by RSMP and University of Arizona graduate students (under the guidance of Dr. John Koprowski) to continue refining our understanding of the subspecies and its habitat.

Section IV: ENVIRONMENTAL CONSEQUENCES

Effects of the three alternatives, including the no action and preferred alternatives, are summarized in the "Summary Table of Environmental Consequences".

The no action alternative would have no direct effect on biological, cultural, economic, or water resources because no activities related to the proposed action would be conducted. However, the no action alternative would result in a continuation of current conditions under which the entire population of Mt. Graham red squirrels is at risk due to ongoing threats to its habitat and competition with introduced Abert's squirrels.

Possible concerns and issues regarding environmental consequences if Alternative B (the preferred alternative) or Alternative C were to be implemented are discussed below, including:

1) What are the economic impacts of developing a Mt. Graham red squirrel captive breeding pilot program?
2) How would releasing captive-bred Mt. Graham red squirrels impact land use and human activities in the Pinaleño Mountains?
3) What are the impacts to the wild population of Mt. Graham red squirrels when individuals are released back into the wild?
4) How would removal of either eight or 16 Mt. Graham red squirrels from the wild affect threatened and endangered species and their habitats?
5) How would cumulative effects on all resources be affected by the proposed alternatives?

With implementation of Alternatives B or C, no ground-disturbing activities would occur, no vegetation would be removed, driving would occur only on designated roads, and reconnaissance, pre-baiting, and trapping activities would not preclude or displace recreational activities or other human uses of the forest. Therefore, we expect no effects to water quantity, water quality, air quality, cultural and historical resources, visual resources, soils, or geology.

Economics

Alternative A – No Action Alternative
Under the no action alternative, the FWS would take no action to establish a captive breeding pilot program for the Mt. Graham red squirrel; thus no Federal funds would be expended beyond those already obligated in this and other planning processes, and no economic impacts would occur to achieve the purposes of the proposed action.

Alternative B – Establish a Captive Population(s) with Up to 16 Wild-caught Red Squirrels from the Pinaleño Mountains (Preferred Alternative)
In 2009 the AESO was awarded a small grant of approximately $15,000 to begin establishing a captive breeding pilot program for the Mt. Graham red squirrel. These funds were spent on purchasing equipment (e.g., traps, travel crates, soft-release enclosure, radio telemetry equipment, etc.) and future transportation of squirrels. Costs for this project would be expected to increase as 16 wild squirrels eventually are brought into captivity and successful husbandry and breeding techniques are learned. Currently, these additional costs would be absorbed by the facilities (e.g., zoos and museums) that have volunteered to participate in this pilot program. These institutions plan to absorb the care and husbandry of these squirrels into the general duties of their zoo keepers. Once the pilot program is fully populated with 16 wild squirrels, costs should be similar from year to year as captive squirrels are consistently housed, bred, transported, and released to the wild. Funding would continue to be pursued to alleviate some of the costs incurred by facilities participating in this program.

Alternative C – Establish a Captive Population(s) with up to Eight Wild-caught Red Squirrels from the Pinaleño Mountains
The economic costs involved with this alternative would initially be less than those detailed in Alternative B, because fewer or smaller captive facilities for Mt. Graham red squirrels would be built and maintained, at least initially. Over time, the costs of this alternative could equal Alternative B, as captive-bred squirrels produced could be maintained for breeding purposes rather than released into the wild.

Land Use and Human Activities

Alternative A – No Action Alternative
There would be no impact associated with releasing Mt. Graham red squirrels into the wild on land use and human activities, as no squirrels would be released.

Alternative B – Establish a Captive Population(s) with up to 16 Wild-caught Red Squirrels from the Pinaleño Mountains (Preferred Alternative)
Mitigation measure #6 is designed to avoid conflicts between released squirrels and human activities and land use. Release sites would only occur within the Mt. Graham red squirrel's range (Figure 2, p. 10) and would not be located within 4,000 ft of existing structures, campgrounds, special use areas (e.g., summer homes, Bible and Boy Scout Camps), and the 150-ac MGIO research area. This distance was chosen because it is greater than twice the mean dispersal distance recorded for this subspecies (1,916 ft; Kreighbaum and Van Pelt 1996, as reported in Munroe *et al*. 2009), and is also greater than the maximum distance a red squirrel was found from its midden (3,028 ft) once it has an established territory (Koprowski *et al*. 2008). This should avoid the potential for released squirrels to disperse into and establish territories within areas that may conflict with human activities. Release sites would be coordinated with the AESO, Mt. Graham Red Squirrel PMP coordinator, USFS, AGFD, and RSMP, and would be detailed in an annual report to the Technical Team each year for their input.

A 14-ft wide by 12-ft deep by seven-ft high soft-release enclosure (Figure 1, p. 8) would be installed within the Columbine administrative site to provide captive squirrels the opportunity to experience their natural habitat prior to release. From this enclosure, squirrels would be recaptured and released at sites meeting the requirements discussed above. The enclosure has been designed in paneled sections so that it can be assembled using hand tools and small power tools. It would be built on a concrete block floor and would not require any ground-disturbing activities. Therefore, the soft-release enclosure should have no impact to land use and human activities.

Future projects proposed by the USFS potentially could be impacted by releasing Mt. Graham red squirrels into currently unoccupied areas. For example, areas treated through PERP may be considered as potential release sites for captive red squirrels to determine if these areas can or will provide habitat; however, releasing squirrels into PERP-treated areas would not affect implementation of PERP, as releases would not occur in these areas until after treatment is completed. Additionally, because all release sites would be coordinated with the contacts listed

in Appendix 2 (including the USFS), sites can be selected to minimize the potential for released squirrels to affect future USFS activities. In practice, the USFS currently consults with the FWS on activities above 7,000-feet elevation that may impact Mt. Graham red squirrel habitat, as well as areas of known midden locations and red squirrel sightings (A. Casey, USFS, pers. comm. 2010). Therefore, releasing squirrels into areas agreed upon by the USFS would minimize any effects this pilot program has on future activities. Release of squirrels into the wild through the proposed action also would not affect the USFS ability to fight or control fires in the future, as firefighting techniques within the range of the Mt. Graham red squirrel will remain the same (A. Casey, USFS, pers. comm. 2010).

Alternative C – Establish a Captive Population(s) with up to Eight Wild-caught Red Squirrels from the Pinaleño Mountains

Impacts to land use and human activities due to released squirrels eventually would be identical to those described under Alternative B, although there would likely be fewer effects initially because fewer squirrels would be available for release.

Threatened and Endangered Species – Effects to the Mt. Graham Red Squirrel

Alternative A – No Action Alternative

Under the no action alternative, the FWS would take no action to establish a captive breeding pilot program for the Mt. Graham red squirrel. Continuing and increasing threats to Mt. Graham red squirrels and their habitat, as well as other threatened, endangered, and sensitive species and their habitats in the Pinaleño Mountains, would continue to affect the population.

Alternative B – Establish a Captive Population(s) with up to 16 Wild-caught Red Squirrels from the Pinaleño Mountains (Preferred Alternative)

Aspects of the preferred alternative could result in some short-term adverse effects to individual squirrels, but should promote recovery of the squirrel in the longer term. Effects to red squirrels could result from the following activities: a) reconnaissance and pre-baiting; b) trapping and transport; c) captivity and care (including collecting samples for genetic testing, individually marking each squirrel, monitoring the health of individuals, etc.); and d) releases back to the wild.

<u>Effects of reconnaissance and pre-baiting activities</u>

An unknown number of individuals would be harassed during reconnaissance and pre-baiting activities. We could find no information relating to deleterious effects of human presence (such as would occur during reconnaissance) on the behavior of red squirrels in their natural environment. Mt. Graham red squirrels have been noted to react to the presence of people within their territory (M. Alanen, FWS, personal observation), but human presence does not appear to influence survivorship, as the same red squirrel will occupy a territory even after multiple visits and multiple capture events (e.g., as noted in Koprowski 2005 and Koprowski *et al*. 2008).

In terms of the effects of supplementing food resources (e.g., during pre-baiting), Layne (1954) reported that once red squirrels are trapped and the food source is learned, the animals will return regularly and be recaptured. Linduska (1950) noted that yearly fluctuations in the trapability of red squirrels correlated with a shortage of natural foods. Sullivan (1990) found that with supplemental feeding, red squirrel populations were three to four times higher than control populations, and that food resources were likely the driving force behind population fluctuations. Additionally, he found that once food was withdrawn, population densities gradually approached those of the control. It appears that red squirrels are not trap-shy, and will instead take advantage of, and even benefit from, additional food resources when available. Therefore, the effects of pre-baiting could likely be slightly beneficial in the short term to the Mt. Graham red squirrel population.

Effects of trapping and transport activities

The proposed action includes the non-lethal take of up to 10 percent of the total population in any calendar year through intentional capture, including individuals trapped incidentally (those trapped and released immediately) or removed through purposeful trapping (those brought into the pilot captive program). According to the most recent mountain-wide census data (conservative Fall 2009 estimate = 250), up to 25 squirrels could be trapped in 2010, with 16 of them (six percent, including no more than eight females) removed from the wild to become a part of the pilot project. The number of squirrels trapped as a part of this proposed action would fluctuate depending upon the most recent population information, never exceeding 10 percent of the total population in any one calendar year. No more than 16 Mt. Graham red squirrels would be removed from the wild, unless Mt. Graham red squirrels bred in captivity have been released back into the wild and survive and reproduce at a level that meets or exceeds their natural level of survivorship and fecundity. Should wild-caught squirrels die in captivity due to human-related causes (e.g., negligence during trapping, transport, or while in captivity), the total number of wild squirrels held in captivity would be reduced by that number.

Red squirrels appear to be less susceptible to handling "shock" than other species of squirrels (e.g., fox squirrels and gray squirrels; Layne 1954, Yahner and Mahan 1992). Yahner and Mahan (1992) suggest that nutritional stress may correlate with instances of handling shock, including two Mt. Graham red squirrels that died during handling in 1988, a year with a poor autumn cone crop. However, use of a cloth handling cone to restrain squirrels during handling has proven effective for individuals of seven tree squirrel species, including 47 Douglas squirrels, eight red squirrels, 13 Abert's squirrels, 65 western gray squirrels, 43 Mexican fox squirrels, and 857 fox squirrels (Koprowski 2002). Of 2,458 eastern gray squirrels captured and handled, only three died or were injured during use of the handling cone, two of which appeared to have been from nutritional stress and exhaustion (the third was a result of suffocation when the animal's front paw lodged in its throat while the animal was in the cone) (Koprowski 2002). Additionally, over a seven-year period of trapping and handling Mt. Graham red squirrels (August 2001 through November 2008), only one squirrel in 1,877 capture events died as a result of handling shock; the protocol has since been revised to allow animals that begin to escape during handling be allowed to do so (Koprowski 2008).

In terms of trap shock (i.e., squirrels found dead in a trap prior to handling), less information is available. Layne (1954) documented one of 149 live-trapped red squirrels dying in a trap. Hamilton (1939) states "the red squirrel has such a nervous temperament that if left long in a trap it will injure or fret itself to death," and recommends checking traps frequently and removing trapped squirrels immediately. No trap deaths or injuries have occurred with Mt. Graham red squirrels during the 1,877 capture events conducted by Koprowski, which is likely due to Koprowsi *et al*. (2008)'s protocol of checking traps every two hours and closing them to capture each night. The proposed action would follow this protocol, in addition to placing pieces of wood and bark across and against the sides of the traps to provide shade and protection within the trap, and if the weather becomes inclement, the traps would be checked immediately and closed to capture until the weather event has passed.

The effect of trapping and immediately releasing Mt. Graham red squirrels (as would happen if the wrong age or sex of squirrel were accidentally captured during trapping activities) is likely to have minimal impact on the captured individuals. From September 1 through December 31, 2006, Dr. Koprowski captured 34 individual Mt. Graham red squirrels (Koprowski 2007). From this time period through November 30, 2009, 15 of these individuals were captured two to five times, five were captured six to nine times, and nine were captured 10 times or more, with the greatest number of re-captures of an individual during this time period totaling 16 (Koprowski 2008 and 2009). All of these animals were successfully released after each capture event, and, while the ultimate fate of each squirrel is unknown, the fact that many were trapped multiple times over this time period appears to indicate that Mt. Graham red squirrels will tolerate being trapped and released multiple times with minimal negative effects.

We were unsuccessful in finding information related to mortality of red squirrels during transport. The limited information we have comes from three Mt. Graham red squirrels that were captured on Mt. Graham and delivered to a State and Federally permitted wildlife rehabilitator in Tucson, Arizona. Two of these individuals were a young-of-the-year sibling pair captured at 3:30 pm on May 23, 2004 by the Red Squirrel Monitoring Program, who cared for them until a FWS employee picked them up by vehicle the next day at 8:30 pm. They were carried in a secure transport box along with formula and feeding supplies and delivered safely to the wildlife rehabilitator, who cared for them until October 28, 2004, when they were then delivered to the Arizona-Sonora Desert Museum, an AZA member and State and Federally permitted facility. The Museum cared for them until their deaths approximately 3.5 and 4.5 years later (see Effects of captivity and care). The other individual (approximately five days old) was found after dark at the base of a nest tree on May 25, 2010. He was nursed back to health by the Red Squirrel Monitoring Program, who then delivered him to the same wildlife rehabilitator on May 28, 2010. The wildlife rehabilitator cared for the young squirrel until he succumbed to pneumonia on Jun 30, 2010.

Of the anticipated effects of the proposed action, removal of up to 16 Mt. Graham red squirrels from the wild would be expected to have the greatest negative effects. Attempts would be made to capture dispersing juvenile squirrels, which, according to Munroe *et al*. (2009), likely suffer a high rate of mortality due to the extreme distances they must travel to locate a new territory. Therefore, capturing these individuals just prior to or during dispersal should lessen the impact

on the overall population, as keeping these individuals in captivity could extend their life expectancy while at the same time provide individuals for future release. Should capturing dispersing juveniles prove unsuccessful, up to eight adults (including up to four females) could be captured. Currently, eight adults represent six percent of the overall population. While a short-term negative effect on the overall population may be caused by removing these individuals from the wild, it is likely that in the long-term these individuals would be replaced by recruitment, including animals produced in captivity. Mt. Graham red squirrels were known to have been lost during the Nuttall Complex Wildfire in 2004, including at least four adult males and three adult females (Koprowski *et al*. 2006). We suspect that these losses were reflected in the decreased population numbers during the year following this fire. However, since that time the population has increased to a size similar to pre-fire numbers, and continues to fluctuate annually between approximately 200 and 350 squirrels. We expect the removal of up to four adult males and four adult females would affect the overall population to a lesser extent than the Nuttall Complex Wildfire, as no habitat would be lost due to the proposed action, and individuals produced in captivity would be available to replace those removed from the wild.

Effects of captivity and care

The maximum longevity for red squirrels in captivity is reported to be nine years, with signs of aging becoming apparent around age five or six (Klugh 1927). Layne (1954) captured 22 red squirrels and kept them in captivity for periods ranging from two days to 10 months. Two Mt. Graham red squirrels have been kept in captivity in the past, a young-of-the-year male and female sibling pair that were collected on May 23, 2004 and housed primarily at the Arizona-Sonora Desert Museum in Tucson, Arizona. The male red squirrel died in captivity on December 13, 2007 (approximate age of 3.5 years), possibly as a result of excessive feeding that may have contributed to the development of a tumor of fatty tissues in the thorax and subsequent hypoxia due to severe lung compression. The female died on December 11, 2008 (approximate age of 4.5 years) due to a bacterial infection. Additionally, one very young red squirrel (approximately five days old when found) was kept in captivity at a wildlife rehabilitation facility in Tucson, Arizona, until it succumbed to pneumonia on June 30, 2010, at approximately six weeks of age. Pneumonia is a common cause of death in young red squirrels (J. Koprowski, UA, pers. comm. 2010). None of the squirrels were bred, as other unrelated Mt. Graham red squirrels were not available in captivity at that time. However, Prescott and Ferron (1978) were able to successfully breed red squirrels three times in outdoor enclosures, even though female red squirrels are in estrus for less than one day each year. Eight pups were produced from these three breeding events. They state that adult red squirrels are easily kept in captivity, and despite their territoriality, can tolerate the presence of conspecifics in the same enclosure, provided that the amount of food is always slightly more than their needs. It is unknown if this could be a successful strategy with Mt. Graham red squirrels, as the two that were held in captivity at the Desert Museum were housed in separate cages.

The effects of captivity and care would include the non-lethal harassment of up to 16 wild-caught individuals and an unknown number of captive progeny annually while in captivity due to genetic testing, health screenings, individually marking each squirrel, etc. Harassment of squirrels while in captivity due to health care activities and genetic testing is unlikely to result in mortality, as indicated by the normal life-spans of the Mt. Graham red squirrels kept at the

Arizona-Sonora Desert Museum (3.5-4.5 years). Harassment activities at the Museum included routine veterinarian examinations (including anesthetization and microchip implantation) and general care (cage cleaning, feeding, enrichment, etc.). Additionally, the RSMP has individually marked nearly every Mt. Graham red squirrel within their study area with color-coded ear tags (more than 100 individuals), as well as outfitted many with radio-telemetry collars to track their movements. These individuals do not appear to have been negatively affected by these markers, as indicated by the number of times they were subsequently seen and captured (e.g., as noted in Koprowski 2005 and Koprowski *et al*. 2008). However, captive breeding events have not been attempted with this subspecies, so there could be potential for some injury or mortality of captive squirrels to occur while husbandry requirements are being determined, particularly in the first few years of the program.

Effects of release to the wild

Several infectious agents have been reported for red squirrels including tularemia (Burroughs *et al.* 1945), *Haplosporangium* (Dowding 1947), Adiaspiromycosis (Dvorak *et al.* 1965), Silverwater virus (Hoff *et al.* 1971), California encephalitis (Masterson *et al.* 1971), and Powassan virus (McLean 1963, McLean *et al.* 1968). A diversity of parasites has been reported from red squirrels in various parts of their range (reviewed by Flyger and Gates 1982). All animals coming into captivity and prior to release into the wild would undergo a 30-day quarantine period (per AZA guidelines and standards), which requires a complete physical examination, infectious disease testing, and all relevant vaccinations, making it unlikely that captive animals released into the wild would transmit diseases or parasites to the wild population. Additionally, parasite and disease infestations are not known to significantly contribute to the mortality of Mt. Graham red squirrels (J. Koprowski, UA, pers. comm. 2008).

Currently we do not know the most successful strategy to release captive-raised Mt. Graham red squirrels into the wild. One of the purposes of the pilot program would be to determine the best release techniques to ensure captive Mt. Graham red squirrels have the best chance at survival once released. We would either apply a hard release, in which individuals would be transported directly to the release location and immediately released into the wild, or a soft release, in which individuals would spend approximately seven to 10 days in the soft-release enclosure to acclimate to local conditions prior to release. A person familiar with caring for captive squirrels (e.g., zoo personnel) would stay at the Columbine administrative site the entire time squirrels are in the enclosure to monitor their behavior and condition, ensure they receive proper care, and provide a human presence to prevent captive squirrels from being harmed by other wildlife (e.g., bears) or people. In both the hard- and soft-release techniques, candidates for release would be assessed as to whether they exhibit essential behavioral skills, including food recognition and acquisition, caching behavior, predator avoidance, and finding refugia. Each released Mt. Graham red squirrel would be individually tagged with color-coded ear tags, and radio-telemetry would be used to track their movements post-release.

The effects of building a soft-release enclosure are expected to be minimal. An enclosure measuring 14 feet wide by 12 feet deep by seven feet high (Figure 1, p. 8) would be installed within the USFS's Columbine administrative site on Mt. Graham. Installing the enclosure at this location would minimize conflicts with human activities and impacts to the wild squirrel

population, while also providing captive squirrels the opportunity to experience the natural weather and elevational conditions within their habitat prior to release. Locating the enclosure at Columbine also provides the convenience of running water and electricity (should it be needed) so that captive squirrels can easily be cared for while housed in the soft-release enclosure. The soft-release enclosure has been designed in paneled sections so that it can be assembled using hand tools and small power tools (e.g. screwdrivers and drills) and would be attached to a floor made out of concrete blocks. Its exact location would be selected within the Columbine administrative site to avoid any new ground disturbing activities. From this enclosure, squirrels would be recaptured and transported to release sites.

Interactions between released squirrels and wild squirrels would be expected to occur, but should be minimized by Mitigation Measure #6. Red squirrels are territorial, and therefore wild squirrels would defend their midden from intruders, including released squirrels. There could be the potential that wild squirrels could be harmed by released squirrels during these encounters, including being displaced, although it is more likely that the wild squirrels would have an advantage over released squirrels (most often they would be older and already familiar with the area), and therefore would be able to drive them away. Locations for release of captive squirrels would be chosen to minimize potential encounters between squirrels while still allowing released squirrels the opportunity to establish their own territories. Release sites would only occur within the Mt. Graham red squirrel's range (Figure 2, p. 10), and locations could include gaps within the current distribution of red squirrels, currently unoccupied areas that appear to contain habitat, such as West Peak, and/or silviculturally treated areas (such as those that would be treated through the Pinaleño Ecosystem Restoration Project). Future projects proposed by the USFS potentially could be impacted by releasing Mt. Graham red squirrels into currently unoccupied areas. However, because all release sites would be coordinated with the contacts listed in Appendix 2 (including the USFS), sites could be selected to minimize this impact. In practice, the USFS currently consults with the FWS on activities above 7,000-feet elevation that may impact Mt. Graham red squirrel habitat, as well as areas of known middens and red squirrel sightings (A. Casey, USFS, pers. comm. 2010). Therefore, releasing squirrels into areas agreed upon by the USFS would minimize any effects this pilot program would have on future activities. All areas of release would be detailed in an annual report to the Technical Team each year for their input.

Effects of Mitigation Measures

The proposed mitigation measures would aid in offsetting the effects of the proposed action on the Mt. Graham red squirrel population through the following:

1. ***Efforts would be made to capture juvenile individuals to populate this pilot program. If, however, trapping of juveniles proves unsuccessful, up to eight adult squirrels (including up to four females) may be captured and brought into captivity. No more than 16 squirrels that have been removed from the wild would be held in captivity at any time. Should wild-caught squirrels die in captivity due to human-related causes (e.g., negligence during trapping, transport, or while in captivity), the total number of wild squirrels held in captivity would be reduced by that number. If a wild-caught squirrel should die in captivity due to natural causes (e.g., old age, disease, or breeding***

attempts), the individual would not be replaced by another wild-caught squirrel unless Mt. Graham red squirrels bred in captivity have been released back into the wild and have demonstrated they survive and reproduce at a level that meets or exceeds their natural level of survival and fecundity. Captive-born squirrels that die in captivity due to either human-related or natural causes would not reduce the total number of wild-caught squirrels that may be held in captivity. Attempting to remove only dispersing juveniles from the wild population should minimize the effect on the overall population, as it is likely that the mortality rate of dispersing juveniles in the wild is high due to the extreme distance they must travel from their natal area to establish a new territory (Munroe *et al*. 2009). Keeping juvenile red squirrels in captivity would likely extend their lifespan to that characteristic of other populations of red squirrels (3-5 years), as indicated by the two that were housed at the Arizona-Sonora Desert Museum for 3.5-4.5 years. If trapping of juveniles proves unsuccessful, removing up to eight adult squirrels (including up to four females) would temporarily affect the overall population, but likely would not have long-term effects, because if captive breeding is successful, offspring would be produced and released to augment the wild population and replace those removed from the wild. Additionally, keeping animals off-site (out of the Pinaleño Mountains) and determining successful breeding techniques for this subspecies would assist in its long-term conservation, should it be decided that a full captive-breeding program is warranted.

2. ***No more than 10 percent of the population (based on the most recent mountain-wide census data) would be trapped as a part of this proposed action in any one calendar year, including individuals trapped incidentally and released immediately (e.g., during an attempt to capture a female, a male is incidentally caught) and those brought into captivity.*** This ensures that potential effects are limited to a small percentage of the population in any one year.

3. ***Trapping and handling of Mt. Graham red squirrels would be conducted by AESO staff and/or individuals holding Federal and State permits (including trapping as a permitted activity) for this subspecies. Trapping and handling techniques would follow those outlined in Koprowski et al. (2008) and Koprowski (2002). Briefly, collapsible, single door live traps (Tomahawk Live Trap, Tomahawk WI: Model # 201) would be used, and bait would consist of peanuts and/or peanut butter or an acceptable substitute (e.g., almonds and/or almond butter). Traps would be checked every two hours and closed to capture each night. Handling of red squirrels would be kept to a minimum; however, if handling is required (e.g., to determine the weight of the squirrel), a cloth handling cone (Koprowski 2002) would be used. Additionally, while traps are open, pieces of wood and bark would be laid across and against the sides of the traps to provide shade within the trap, and if the weather becomes inclement, the traps would be checked immediately and closed to capture until the weather event has passed.*** Using these techniques, Dr. John Koprowski and his crew experienced only one squirrel death in 1,877 captures over a seven-year period. Following these techniques would ensure trapping and handling of red squirrels would be done in such a way as to

reduce stress to the animal, thereby avoiding trap- and handling-related mortality to the greatest extent practicable.

4. ***Mt. Graham red squirrels would be transported to a participating facility or suitable holding location within 24 hours of capture. Transportation would follow International Air Transport Association (IATA) airport code regulations for flight and American Zoo and Aquarium Association (AZA) standards for overland transport. They would be transported in species appropriate enclosures (e.g. Sky Kennel, small size), and provided adequate water and food, if necessary. Climate would be controlled through heating or air conditioning within the vehicle (car, truck, and/or cargo plane) during transportation so that the squirrels do not experience heat or cold related stress during transport.*** Transporting red squirrels to participating facilities or suitable holding locations within 24 hours of capture would ensure proper care is initiated as quickly as possible. Providing a quiet, dark environment with sufficient food and water during transport would further reduce stress to the animal.

5. ***Squirrels released back into the wild would only be released when the snow has melted, food resources are available, and sufficient time is available for the released squirrels to cache cones and fungi for the winter (May through August). To the greatest extent possible within this timeframe, release events would be timed to coincide with natural juvenile dispersal during that year.*** Releasing red squirrels to the wild at this time, especially in coordination with the natural dispersal period, would give released individuals the opportunity to locate an appropriate territory and begin caching food for the winter during a time when food resources are available and red squirrels are naturally establishing new territories in the wild.

6. ***Release sites would be coordinated with the AESO, the PMP coordinator, USFS, AGFD, and RSMP (contacts listed in Appendix 2), and would be selected to avoid conflicts with human activities and minimize impacts to the wild squirrel population, while also providing captive squirrels the greatest opportunity for survival. A soft-release enclosure would be installed within the Columbine administrative site to minimize conflicts with human activities and impacts to the wild squirrel population, while also providing captive squirrels the opportunity to experience their natural habitat.*** Release sites would be coordinated with the AESO, Mt. Graham Red Squirrel PMP coordinator, USFS, AGFD, and RSMP, thereby ensuring that all agencies and experts can provide input on the best locations for release. Release sites would only occur within the Mt. Graham red squirrel's range (Figure 2, p. 10), and locations could include gaps within the current distribution of red squirrels, currently unoccupied areas that appear to contain habitat, West Peak, and/or silviculturally treated areas that do not currently provide habitat (such as those that would be treated through the Pinaleño Ecosystem Restoration Project). This should minimize effects to both released and wild squirrels.

7. ***Ear tagging and radio-telemetry equipment and techniques would follow the materials and methods outlined in Koprowski et al. (2008). Briefly, released Mt. Graham red squirrels would be fitted with uniquely numbered ear tags (Monel 1005-1, National Band and Tag) with colored ear disks (1 cm Model 1842, National Band and Tag) for individual identification. Radiocollars (SOM 2190, Wildlife Materials International) weighing <5 percent of body mass would be fitted and replaced as needed (approximate life = 1 yr).*** Using these materials and methods, Dr. John Koprowski and his crew have not experienced any squirrel deaths attributable to ear tagging or radio collars during eight years of research. Following these techniques would ensure tagging and collaring of red squirrels would be done in such a way as to avoid marking-related mortality to the greatest extent practicable.

8. ***Facilities that participate in this program would be members of the AZA or would be able to demonstrate they can meet or exceed the accepted standards developed by the AZA.*** Facilities that participate in this program would be members of the AZA, or would be able to demonstrate they can meet or exceed the accepted standards developed by the AZA, ensuring the latest guidance and standards for animal care would be followed at each facility.

9. ***Implementation of the proposed project would follow the FWS's Policy Regarding Controlled Propagation of Species Listed under the Endangered Species Act (65 FR 56916)***. Facilities that participate in this program agree to follow the FWS's Policy Regarding Controlled Propagation of Species Listed under the Endangered Species Act, ensuring compliance with the FWS's guidelines and policies.

10. ***The Technical Subgroup of the Mt. Graham Red Squirrel Recovery Team would review the pilot program annually to ensure the program is meeting its objectives. Based on their review, they may recommend that FWS: a) develop a full captive-breeding program, which may involve holding more than 16 wild-caught squirrels in captivity, or b) discontinue the pilot program because it is clearly not benefitting the subspecies.*** By annually reviewing the pilot program, the Technical Subgroup of the Mt. Graham Red Squirrel Recovery Team would be able to provide a recommendation for the future of the captive breeding program based on the best available information.

These mitigation measures would reduce the impact of the proposed action on the Mt. Graham red squirrel population, reduce stress on individuals, and provide information on the husbandry and breeding needs of the squirrel, while also contributing to the long-term conservation of the squirrel through off-site (out of the Pinaleño Mountains) captive maintenance of individuals and subsequent population augmentation with progeny from the captive animals. We expect the long-term benefits of the proposed action would outweigh the short-term effect of trapping up to 10 percent of the wild population (including the removal and captive holding of up to 16 wild individuals) and the additional harassment of an unknown number of squirrels during reconnaissance, pre-baiting, and release activities.

Alternative C – Establish a Captive Population(s) with up to Eight Wild-caught Red Squirrels from the Pinaleño Mountains

Impacts to Mt. Graham red squirrels due to this alternative are expected to be identical to those described under Alternative B, with the exception that eight red squirrels would be removed from the wild instead of 16. This represents three percent of the current population rather than six percent (Fall 2009 conservative estimate = 250). While the impact to the wild population potentially would be less than that expected by implementing Alternative B, it is possible that this alternative would not provide the flexibility required to develop a viable captive breeding pilot program, as the founder population of squirrels would be based on eight individuals rather than 16.

Additional Endangered, Threatened, and Sensitive Species Potentially Affected

Alternative A – No Action Alternative

Under the no action alternative, the FWS would take no action to establish a captive breeding pilot program for the Mt. Graham red squirrel. Therefore, there would be no effects to other threatened, endangered, and sensitive species and their habitats in the Pinaleño Mountains.

Alternative B – Establish a Captive Population(s) with up to 16 Wild-caught Red Squirrels from the Pinaleño Mountains (Preferred Alternative)

Mexican spotted owl (*Strix occidentalis lucida*), bald eagle (*Haliaeetus leucocephalus*), northern goshawk (*Accipiter gentilis*), Apache trout (*Oncorhyncus apache*), and Gila trout (*Oncorhyncus gilae*) have been documented within the range of the Mt. Graham red squirrel. No effects on either fish species are expected, as no work would be conducted in the streams they inhabit, and no removal of vegetation (which could increase sedimentation in these streams) would occur due to this alternative.

Effects to the raptor species are expected to be minimal. The presence of a small number of people in forested areas while implementing the preferred alternative is not likely to adversely affect these species. The soft-release enclosure would be located within the Columbine administrative site, which is an area that does not provide habitat for these raptors. The presence of traps, peanuts, and peanut butter (or their equivalent as bait) within a midden has the potential to affect the prey base of the owl (squirrels and other small mammals may be drawn to this food resource), but the effects of traps and bait on the prey base are expected to be extremely small, as each area that would be baited and trapped is approximately 0.05 acre. Therefore, we expect Alternative B to have little to no effect on the Mexican spotted owl, bald eagle, and northern goshawk.

Alternative C – Establish a Captive Population(s) with up to Eight Wild-caught Red Squirrels from the Pinaleño Mountains

Impacts to other threatened, endangered, and sensitive species and their habitats due to this alternative eventually would be identical to those described under Alternative B, although likely

would have fewer effects initially because fewer squirrels would be trapped and fewer would be available for release in the early part of the pilot program.

We would conduct an intra-service formal consultation, in accordance with section 7 of the Endangered Species Act of 1973, as amended, to describe in more detail the effects of the chosen alternative on the Mt. Graham red squirrel and other listed species. The consultation would conclude prior to deciding on how to proceed with this project. The conclusions of formal consultation would be used in the decision-making process and would be summarized in any future NEPA documents on this project.

Cumulative Effects

The Council on Environmental Quality defines cumulative effects as "the impacts on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-federal) or person undertakes such other actions." Cumulative impacts can be concisely defined as the total effects of the multiple land uses and development, including their interrelationships, on the environment.

Alternative A – No Action Alternative
Under the no action alternative, the FWS would take no action to establish a captive breeding pilot program for the Mt. Graham red squirrel. Therefore, there would be no cumulative effects on the environment.

Alternative B – Establish a Captive Population(s) with up to 16 Wild-caught Red Squirrels from the Pinaleño Mountains (Preferred Alternative)
Most of the current land uses and human activities in the focus area of this proposal were described in the "Affected Environment" herein. The primary uses of the area include transportation, recreational use, scientific study, and forest administration and management. Of these primary uses, the proposed project is most likely to add to the impacts that occur and would continue to occur through scientific study. Current and ongoing research projects include annual or semi-annual mountain-wide censuses of randomly selected middens within the range of the Mt. Graham red squirrel, which have effects similar to those described above during reconnaissance. Additionally, Dr. John L. Koprowski is permitted to capture up to 100 adult male and 100 adult female Mt. Graham red squirrels each year and ear-tag them, of which 60 of each sex may also be fitted with a radio collar. These individuals may be captured multiple times throughout the year and over multiple years to monitor residency, survivorship, and reproductive performance. The radio-collared individuals are also tracked throughout the year and over multiple years to determine habitat use throughout the day as well as during different seasons. Dr. Koprowski was also recently permitted to capture up to 40 juvenile male and 40 juvenile female Mt. Graham red squirrels each year and ear-tag them, of which up to 25 of each sex may also be fitted with a radio collar to monitor habitat use, territory size, space use, and movements. The effects of Dr. Koprowski's research are similar to those described above during reconnaissance, pre-baiting, trapping, and handling activities.

Cumulative effects of reconnaissance and pre-baiting

The proposed project would add to the impacts that are currently occurring to the Mt. Graham red squirrel population due to human presence and supplementing food resources (e.g., during pre-baiting). Currently, an annual mountain-wide census of randomly selected Mt. Graham red squirrel middens is conducted each fall, and Dr. John Koprowski and the RSMP continue to study the Mt. Graham red squirrel population year-round. This project would add the presence of one to four more people within the range of the Mt. Graham red squirrel during the activities of reconnaissance and pre-baiting. As discussed above, human presence near Mt. Graham red squirrels and their middens does not appear to negatively impact Mt. Graham red squirrels. While Mt. Graham red squirrels may react to the presence of people within their territory (M. Alanen, FWS, personal observation), human presence does not appear to influence survivorship, as the same red squirrel would occupy a territory even after multiple visits and multiple capture events (e.g., as observed in Koprowski 2005 and Koprowski *et al*. 2008). Therefore, the cumulative effects of human presence would not be expected to detrimentally affect the Mt. Graham red squirrel.

As discussed above, food resources are likely the driving force behind red squirrel population fluctuations (Linduska 1950, Sullivan 1990). Therefore, the cumulative effects of pre-baiting Mt. Graham red squirrel middens due to the proposed project, in addition to pre-baiting activities performed by Dr. Koprowski and the RSMP, would likely be slightly beneficial to the Mt. Graham red squirrel population.

Cumulative effects of trapping

As mentioned above, Dr. Koprowski is permitted to capture up to 100 adult male and 100 adult female Mt. Graham red squirrels each year and ear-tag them, of which 60 of each sex may also be fitted with a radio collar. He is also permitted to capture up to 40 juvenile male and 40 juvenile female Mt. Graham red squirrels each year and ear-tag them, of which up to 25 of each sex may also be fitted with a radio collar. All individuals may be captured and monitored multiple times throughout the year and over multiple years to assess habitat use, territory size, movements, survivorship, and reproductive performance. A summary of captures based on the last three Annual Reports for Dr. Koprowski's permit can be found in Table 1. The proposed project could add the presence of one to four more people during trapping activities and additional capture events equaling up to 10 percent of the total population (based on the previous mountain-wide census). For calendar year 2010, this would mean an additional 25 capture events could occur (conservative Fall 2009 estimate = 250).

As discussed previously, the Mt. Graham red squirrel appears to tolerate multiple capture and handling events, with only one handling death having occurred during 1,877 capture events (Koprowski 2008). Of the 34 individuals Dr. Koprowski captured from September 1 through

Table 1. Demographic summary of Mt. Graham red squirrels captured by Dr. John Koprowski from September 1, 2006 through November 30, 2009. Note that the same individuals may be captured multiple times within one year, as well as over a number of years.

Report year		Age at first capture in reporting period			Total individuals captured	Total capture events in reporting period
		Juvenile	Sub-Adult	Adult		
2007	Male	18	Not reported	38	56	
	Female	27	Not reported	32	59	
	Total	45	Not reported	70	115	262
2008	Male	5	1	27	33	
	Female	10	1	30	41	
	Total	15	2	57	74	194
2009	Male	1	0	15	16	
	Female	2	0	15	17	
	Total	3	0	30	33	107

December 31, 2006, 85 percent (29 of 34) were captured at least twice over the next three years, while 50 percent (17 of 34) were captured at least five times over the same period. None of these squirrels died or were injured during capture or handling, and the multiple captures is evidence of survival between captures. Therefore, it does not seem likely that the cumulative impact of capturing an additional number of squirrels equaling up to 10 percent of the population would negatively impact the Mt. Graham red squirrel population. Additionally, as discussed previously, the presence of one to four more people during trapping activities is unlikely to detrimentally affect the Mt. Graham red squirrel.

All activities related to this project would be coordinated with the contacts listed in Appendix 2, including trapping and release locations of Mt. Graham red squirrels. No habitat modifications would occur as a result of this project. Therefore, this project would not affect past, current, and ongoing research activities related to the Mt. Graham red squirrel and its habitat.

Alternative C – Establish a Captive Population(s) with up to Eight Wild-caught Red Squirrels from the Pinaleño Mountains

Cumulative effects due to this alternative are expected to be less than those described under Alternative B, as fewer squirrels would be trapped and removed from the wild as a part of the captive breeding pilot program.

Summary Table of Environmental Consequences

Resources	Alternative A – No Action Alternative	Alternative B – Establish a Captive Population(s) With Up to 16 Wild-caught Red Squirrels from the Pinaleño Mountains (Preferred Alternative)	Alternative C – Establish a Captive Population(s) With Up to Eight Wild-caught Red Squirrels from the Pinaleño Mountains
Economics	No effects.	Costs of establishing a captive breeding pilot program for the Mt. Graham red squirrel would be relatively low at the beginning, but would be expected to increase as 16 wild squirrels are brought into captivity and successful husbandry and breeding techniques are learned. Once established, costs would be similar from year to year as captive squirrels are consistently housed, bred, transported, and released to the wild.	Costs of establishing a captive breeding pilot program for the Mt. Graham red squirrel would be relatively low at the beginning, but would be expected to increase as eight wild squirrels are brought into captivity and successful husbandry and breeding techniques are learned. Costs associated with this alternative initially would be less than Alternative B, but over time could be similar, if captive-bred squirrels are kept in captivity for breeding purposes.
Land Use and Human Activities	No effects.	Minimal effects, as trapping-related activities would not preclude recreational or other human activities, and squirrels would be released at least 4,000 ft away from existing structures, campgrounds, special use areas (e.g., summer homes, Bible and Boy Scout Camps), and the 150-ac MGIO research area.	Minimal effects, as trapping-related activities would not preclude recreational or other human activities, and red squirrels would be released at least 4,000 ft away from existing structures, campgrounds, special use areas (e.g., summer homes, Bible and Boy Scout Camps), and the 150-ac MGIO research area.
Threatened, Endangered, and Sensitive Species	No effects initially, but continuing and increasing threats to Mt. Graham red squirrels due to habitat loss, predation, and competition with introduced Abert's squirrels would result in the increasing likelihood of losing this subspecies in the wild due stochastic events and/or catastrophic decline. No impacts to other threatened, endangered, and sensitive species within	Some short-term negative effects initially due to the removal of up to 16 Mt. Graham red squirrels from the wild and the potential incidental loss of some individuals during the establishment of the pilot program. Long-term effects likely would be beneficial because some individuals would be maintained off-site (out of the Pinaleño Mountains) and augmenting the wild population with captive-produced progeny would help to recover the subspecies. Minimal to no impacts to other threatened, endangered, and sensitive	Some short-term negative effects initially due to the removal of up to eight Mt. Graham red squirrels from the wild and the potential incidental loss of some individuals during the establishment of the pilot program. Long-term effects likely would be beneficial because some individuals would be maintained off-site (out of the Pinaleño Mountains) and augmenting the wild population with captive-produced progeny would help to recover the subspecies. Minimal to no impacts to other threatened, endangered, and sensitive

	the focus area.	species within the focus area.	species within the focus area.
Soils and Geology	No effects.	No effects.	No effects.
Cultural and Historical Resources	No effects.	No effects.	No effects.
Air Quality	No effects.	No effects.	No effects.
Water Quantity	No effects.	No effects.	No effects.
Water Quality	No effects.	No effects.	No effects.
Visual	No effects.	No effects.	No effects.
Cumulative Effects	No effects.	Minimal effects, as Mt. Graham red squirrels appear to tolerate multiple capture and handling events. Additionally, all project-related activities would be coordinated between the AESO in collaboration with AGFD, USFS, the PMP coordinator, and the RSMP.	Minimal effects, as Mt. Graham red squirrels appear to tolerate multiple capture and handling events. Additionally, all project-related activities would be coordinated between the AESO in collaboration with AGFD, USFS, the PMP coordinator, and the RSMP.

Section V. Public Involvement

Agency Involvement

- The development of this draft environmental assessment was coordinated with the AGFD Region V (Tucson, Arizona), USFS (Coronado National Forest, Safford Ranger District, Safford, Arizona), the Red Squirrel Monitoring Program, University of Arizona, School of Natural Resources and the Environment, Tucson; and the Phoenix Zoo.

Public Review

This document will be made available for public review for 30 days (through October 12, 2010). It will be mailed to interested and potentially affected parties and agencies, and posted on the AESO website (http://www.fws.gov/arizonaes/).

List of preparers and partners consulted during preparation of dEA

- U.S. Fish and Wildlife Service Ecological Services, Tucson
  Marit Alanen
  Jim Rorabaugh

- Arizona Game and Fish Department (AGFD), Region V, Tucson
- US Forest Service (USFS), Safford Ranger District, Safford
- Red Squirrel Monitoring Program, University of Arizona, School of Natural Resources and the Environment, Tucson
- The Phoenix Zoo, Phoenix

List of Acronyms

AESO = Arizona Ecological Services Office of the U.S. Fish and Wildlife Service
AGFD = Arizona Game and Fish Department
dEA = draft Environmental Assessment
FWS = U.S. Fish and Wildlife Service
NEPA = National Environmental Policy Act
PMP = Population Management Plan
RSMP = Red Squirrel Monitoring Program, University of Arizona, School of Natural Resources and the Environment
USFS = U.S. Forest Service

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Appendix 1: Letters between the Mt. Graham Red Squirrel Recovery Team and Dr. Benjamin Tuggle

United States Department of the Interior

FISH AND WILDLIFE SERVICE

P.O. Box 1306
Albuquerque, New Mexico 87103
http://ifw2es.fws.gov

In Reply Refer To:
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JUN 1 4 2006

William J. Matter, Ph.D.
Team Leader
Mt. Graham Red Squirrel Recovery Team
325 Bio Sciences East Building
Tucson, Arizona 85721

Dear Dr. Matter:

Thank you for your letter of May 22, 2006, requesting concurrence on the Mount Graham Red Squirrel Recovery Team's (recovery team) recommendation to initiate captive propagation planning and implementation for the Mount Graham red squirrel (squirrel). Given the squirrel's current population size and the substantial decline in habitat quality and quantity on Mount Graham in the face of continuing threats, I concur that it is time to investigate a captive propagation program for the squirrel.

As I understand your letter, the recovery team will guide the development of a pilot captive propagation plan; should the team determine that implementation of the pilot program may aid in the recovery of the squirrel, implementation of the pilot program will be used to answer a variety of questions pertaining to removal of squirrels from the wild, breeding and rearing techniques, long-term population maintenance, and release protocols. Answers to these questions will be critical in determining whether a larger captive propagation effort for the squirrel may be an effective recovery tool to improve the species' status.

Please keep me apprised of the recovery team's progress on this project. In particular, please notify me when the recovery team has reached decision points regarding implementation of the pilot or full captive propagation programs. I commend the recovery team's proactive approach in considering the need for captive propagation of the Mount Graham red squirrel. Please feel free to coordinate with Paul Barrett of my staff, at 520-670-5160 (ext. 228). I look forward to our progress on this important recovery project.

Sincerely,

ACTING Regional Director

cc: Supervisor, Ecological Services Field Office, Phoenix, AZ
Assistant Field Supervisor, Ecological Services Sub-office, Tucson, AZ
Recovery Coordinator, Region 2, Albuquerque, NM

College of Agriculture and Life Sciences
School of Natural Resources

THE UNIVERSITY OF
ARIZONA®
TUCSON ARIZONA

325 Biological Sciences East Building
P.O. Box 210043
Tucson, AZ 85721-0043
(520) 621-7255
FAX: (520) 621-8801

May 22, 2006

Benjamin N. Tuggle, Ph.D.
Acting Regional Director
Southwest Region 2, USFWS
P.O. Box 1306
Albuquerque, New Mexico 87103

Dear Dr. Tuggle:

At the May 8, 2006 meeting of the Mount Graham Red Squirrel Recovery Team, members in attendance voted to submit a request to you for approval to plan and, if deemed appropriate by the Recovery Team, initiate emergency removal from the wild of a limited number of endangered Mount Graham red squirrels, *Tamiasciurus hudsonicus grahamensis* (MGRS) to: 1) establish at least one captive population; 2) begin a small-scale pilot program of maintenance and breeding of captive animals; 3) plan and initiate studies of the efficacy of release of captive-bred animals to augment the existing population in the wild; and 4) eventually develop and initiate a larger-scale captive breeding and supplemental release program for the species. Below, I briefly outline the rationale for this request, offer details on the process to accomplish the proposed tasks, and note challenges to implementation.

Need to Establish a Captive Population of Mount Graham Red Squirrels (MGRS)

The species was listed as endangered in 1987 because its range and habitable area had been greatly reduced, and remaining habitat was threatened by a number of factors. The estimated (conservative estimate, AZ Game & Fish Department) population size has gone from a low of 99 (± 53) animals in 1989 to a high of 562 (± 12) in 1999. Estimated population size declined after 1999 and has changed relatively little over the past 4-5 years; the latest estimate in fall 2005 was 276 (±12) animals.

More importantly, the already limited area of habitat was severely reduced by the 1996 Clark Peak Fire (6,700 acre/2,710 ha within the burn perimeter) and the 2004 Nuttall Complex Fire (over 29,000 acre/11,700 ha within the burn perimeter). Danger of catastrophic fire remains high due to continuing drought, heavy fuel loads, and increasing numbers of dead trees due to insect infestation and tree disease. Living trees stressed by recent fires and drought are particularly susceptible to insects and disease. Ongoing efforts for fuel reduction and forest thinning will have long-term benefits for MGRS, but may have negative impacts on survival and habitable area for MGRS in the short-term.

Recent research directed by Dr. John Koprowski of the University of Arizona indicates that, although red squirrels can live to 15-20 years, few MGRS now live beyond 2 years due to high predation and other forces of mortality. Also, MGRS occur in unusually low density, have much larger home ranges, and show low productivity compared to closely related red squirrels in the

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White Mountains of Arizona. Dr. Koprowski's preliminary evaluation of newly acquired satellite imagery shows extensive loss of habitable conditions within areas known to have formerly supported MGRS, especially within the high-elevation refuge area (also designated as critical habitat) for MGRS. A post-fire survey of 1,251 known middens found that only 455 still exist (almost a 64% loss). The pattern of habitat loss has resulted in greater isolation of inhabited patches from each other. Also, introduced Abert's squirrels, much larger than MGRS, may be excluding red squirrels from some habitable areas; definitive data are not available.

In combination, these conditions are an extraordinary threat to persistence of MGRS and represent a reasonable trigger for our request to plan and eventually implement the proposed emergency removal and creation of a captive population.

Process for Captive Population(s), Pilot Breeding, and Supplemental Release Program

Little information is available on holding and rearing captive red squirrels. We will collect information on maintenance and breeding and identify personnel with expertise. We will canvas zoos and museums to identify facilities with interest and capability of holding a captive population of red squirrels. The Arizona-Sonora Desert Museum in Tucson currently holds two young MGRS siblings removed in 2005 after death of their mother. We propose to start with capture and removal of up to 16 individuals from Mount Graham, but the age and sex of individuals and sites of capture must be determined so as to minimize the impact of removal on the wild population. Eventually more than one captive population should be established to guard against loss of all captive animals in a single catastrophic event. Participating zoos will determine conditions appropriate for maintenance and successful breeding of captive MGRS. Some young produced will be released to augment the wild population and help ensure full colonization of remaining habitat fragments. Different release protocols (age of animals, timing of release, site of release) will be studied to help identify effective practices. Parallel efforts to study holding and rearing of non-endangered red squirrels in other regions will be considered. Proposals for funding must be developed to meet costs of rearing and studies of rearing and release protocols. Young squirrels produced that are not used in a release program will be added to the captive population or eventually used to establish an additional captive population. There are few data on the genetic makeup of MGRS, and this information is critical to long-term decisions on removal of individuals, captive breeding, and supplemental release. We will seek funding for genetic analysis (pedigree and genetic variation), including analysis of animals captured or released during the proposed pilot program. Facilities and expertise for analysis are available at the University of Arizona and Arizona State University.

Challenges and Information Needs

Identification of the most appropriate number, age and sex of MGRS to remove from the wild, and identification of the best sites for removal to minimize risk to the wild population and risk of genetic loss must occur. Effective protocols for holding, breeding, and rearing of MGRS must be identified, as well as effective protocols for successful release of captive-reared MGRS. Information is needed on risks of release of captive-bred squirrels to the genetic composition and incidence of disease for the wild population of MGRS. If much of existing habitat for MGRS is

lost to fire, insect damage, or other threats, captive-reared animals may not be able to be released for many decades when appropriate forest conditions return. Needs for such long-term population maintenance are unknown.

Thank you for your consideration of our request to proceed with development of a plan for creating a captive population and for eventual implementation if deemed appropriate by the Recovery Team. Should you require additional information, members of the Recovery Team and I will be available to discuss this issue with you in person or by phone. My phone number is 520/621-7280. We would appreciate your expeditious response to this request, as we anticipate that conditions on Mt. Graham may decline precipitously this summer due to drought conditions and the forecasted intense wildfire season.

Sincerely,

W. J. Matter

William J. Matter, Ph.D.
Team Leader
Mt. Graham Red Squirrel Recovery Team
c/o 325 Bio Sciences East Bldg.
School of Natural Resources
University of Arizona
Tucson, AZ 85721
Email: wmatter@ag.arizona.edu

Email CC: Sherry_Barrett@fws.gov, Paul_Barrett@fws.gov, Marit_Alanen@fws.gov, Jim_Rorabaugh@fws.gov, Thetis_Gamberg@fws.gov

Appendix 2: Mt. Graham Red Squirrel Captive Breeding Pilot Program Contacts

Ms. Marit Alanen, Mount Graham Red Squirrel Lead Biologist
U.S. Fish and Wildlife Service
201 N. Bonita Ave., Suite 141
Tucson, AZ 85745
(520) 670-6150 x 234
Marit_Alanen@fws.gov

Mr. Stuart Wells, Director of Conservation and Science, Mount Graham Red Squirrel Population Management Plan and Stud Book Coordinator
The Phoenix Zoo
455 N. Galvin Parkway
Phoenix, AZ 85008
(602) 914-4317
swells@thephxzoo.com

Ms. Anne Casey, District Biologist and Recreation Staff
Safford Ranger District, Coronado National Forest
711 14th Ave., Suite D
Safford, AZ 85546
(928) 348-1962
(520) 780-8091 cell
acasey@fs.fed.us

Mr. Tim Snow, Region V Nongame Biologist
Arizona Game and Fish Department
555 N. Greasewood Road
Tucson, AZ 85745
(520) 388-4449
TSnow@azgfd.gov

Dr. John Koprowski, Professor, Director of the Red Squirrel Monitoring Program
Wildlife and Fisheries Science
School of Natural Resources and the Environment
214 Biological Sciences East
University of Arizona
Tucson, AZ 85721
(520) 626-5895
squirrel@ag.arizona.edu