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Memorandum

To: Regional Director, U.S. Fish and Wildlife Service, Albuquerque, New Mexico
(Attn: ARD-ES, D. Montano; M. Tuegel)

From: Field Supervisor

Subject: Final Intra-service Biological Opinion on the Implementation of a Captive Breeding Pilot Program and Issuance of a Section 10(a)(1)(A) Enhancement of Survival Permit for the Mt. Graham Red Squirrel

This memorandum includes our final intra-service biological opinion on the implementation of a captive breeding pilot program for the Mount (Mt.) Graham red squirrel in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act). The proposed action may affect, and is likely to adversely affect, the endangered Mt. Graham red squirrel (*Tamiasciurus hudsonicus grahamensis*), and may affect, but is not likely to adversely affect, the threatened Mexican spotted owl (*Strix occidentalis lucida*). Our concurrence on the Mexican spotted owl is provided in Appendix A of this document. Literature cited in this biological opinion is not a complete bibliography of all literature available on the species of concern and its effects, or on other subjects considered in this opinion. A complete administrative record of this consultation is on file in the Arizona Ecological Services Office, (AESO) Phoenix, Arizona.

Consultation History

- March 16, 2006: The Mt. Graham Red Squirrel Recovery Team discussed developing a captive breeding program. The Team endorsed establishing a pilot program with up to 16 squirrels to answer husbandry questions, should the need for a comprehensive propagation program develop.
- May 22, 2006: Dr. William Matter, Recovery Team Leader, sent a letter to Dr. Benjamin Tuggle, (Acting) Regional Director of the U.S. Fish and Wildlife Service (FWS), outlining the need to begin a small-scale pilot program of maintenance and breeding of captive animals (Appendix B).

- June 14, 2006: Dr. Tuggle responded to Dr. Matter's letter, concurring that it was time to investigate a captive propagation program for the Mt. Graham red squirrel (Appendix B).
- May 15, 2009: The FWS Arizona Ecological Services Office conducted pre-baiting activities in preparation for trapping Mt. Graham red squirrels for the proposed action (Consultation #22410-2009-I-0305).
- September 10, 2010: the draft environmental assessment was released for public comment. The comment period closed on October 12, 2010. Eight letters of comment were received from seven entities.
- June-July 2011: Four Mt. Graham red squirrels were captured and removed from the wild by the FWS in response to extreme fire hazard conditions in the Pinaleño Mountains. The two males and two females were taken to facilities at the Phoenix Zoo. The two females died the next July due to unknown causes; however, the two males remain alive and in good health.
- May 2013: FWS Regional Office and Field Office staff reviewed public comments and revised the environmental assessment, as needed.
- June 2013: Draft biological opinion coordinated with Regional Office staff.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The FWS, Region 2 proposes to issue a section 10(a)(1)(A) enhancement of survival permit to the Phoenix Zoo to authorize take of Mt. Graham red squirrels. The Miller Park Zoo in Bloomington, Illinois also has a section 10(a)(1)(A) permit for this purpose. The endangered Mt. Graham red squirrel (*Tamiasciurus hudsonicus grahamensis*) is a small arboreal rodent that lives only in the Pinaleño Mountains located in the Coronado National Forest in Graham County, Arizona. Because of its isolated range and low population numbers, it is important to establish a captive population of this subspecies to act as a buffer against the very real possibility of future catastrophic fire within its habitat. However, husbandry requirements for successfully rearing this subspecies in captivity and releasing individuals back into the wild are currently unknown. Therefore, the proposed action is to implement a captive breeding pilot program involving up to 16 Mt. Graham red squirrels taken from the wild. This number was suggested by the Mt. Graham Red Squirrel Recovery Team (Recovery Team) in a letter to Dr. Benjamin Tuggle (Acting Regional Director) dated May 22, 2006 (Appendix B). Dr. Tuggle provided written approval to investigate a captive propagation program in a letter to Dr. William Matter (Recovery Team Leader) dated June 14, 2006 (Appendix B).

We propose to capture and bring into captivity no more than 16 Mt. Graham red squirrels to establish the pilot program. Our preference is to acquire juvenile animals (those weighing less than 200 grams [gms] [seven ounces]); however, depending on the success in trapping this

cohort, up to eight adult Mt. Graham red squirrels (including no more than four females) may be captured and brought into captivity for this pilot program. Currently, two male Mt. Graham red squirrels are in captivity at the Phoenix Zoo. We propose to include those animals in the pilot program. Initially, trapping efforts in 2013 will attempt to obtain another male and three females and house two of the females at the Phoenix Zoo and the remaining male and female at the Miller Park Zoo in Bloomington, Illinois. Because the trapping effort is not age or sex selective, it may be necessary to trap and release more than 16 Mt. Graham red squirrels to meet these targets; however, no more than 10 percent of the population (based on the most recent mountain-wide census data, usually from the year before) will be trapped 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. Overall, no more than 16 Mt. Graham red squirrels that have been removed from the wild will be held in captivity. Should wild-caught Mt. Graham red squirrels die in captivity due to other than natural causes (see the Incidental Take Statement for possible causes of incidental mortality), the total number of wild Mt. Graham red squirrels held in captivity will be reduced by this number. Captive-born Mt. Graham red squirrels that die in captivity due to either natural or non-natural causes will not reduce the total number of wild-caught Mt. Graham red squirrels that may be held in captivity.

All Mt. Graham red squirrels brought into captivity would undergo a 30-day quarantine period (in accordance with Association of Zoos and Aquariums (AZA) guidelines and standards) (AZA 2013). There are two levels of quarantine to consider; on-site (meaning quarantining the animals in the structures built to house them) and off-site (in a separate quarantine facility away from the holding area). At this time, on-site quarantine is the preferred method as no disease issues have been raised by zoo veterinarians. If concerns about : a) prevention of the introduction of disease and parasites into the breeding facility or the wild populations, and/or b) or to have better control over climatic conditions (such as lighting and temperature) while in captivity to ensure the breeding cycle is not disrupted develop over time, more restrictive quarantine protocols would be implemented.

In either case, public information will 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. Annual reports on the progress of the pilot program will be provided to the FWS and the Recovery Team for review and discussion.

Successful breeding techniques for this subspecies are currently unknown. Therefore, once pairs of Mt. Graham red squirrels are in captivity, different techniques will be attempted based upon the best available information regarding their natural breeding behaviors, as well as similar species' breeding behaviors in captivity. Additionally, successful release techniques for this subspecies are also unknown. To maximize the potential for successful releases, we propose to use soft-release techniques for this project A soft-release enclosure measuring 4.7 meters (14 feet) wide by four meters (12 feet) deep by 2.3 meters (seven feet high) (Figure 1) will be installed on the mountain outside of Mt. Graham red squirrel critical habitat in a location agreed upon by the FWS (A), Mt. Graham Red Squirrel Population Management Plan (PMP) coordinator, U.S. Forest Service (Coronado National Forest, Safford Ranger District [USFS]), Arizona Game and Fish Department (AGFD), and the University of Arizona's Red Squirrel Monitoring Program (RSMP) (contacts can be found in Appendix C). The location of this enclosure will be selected to avoid conflicts with human activities and minimize impacts to the

wild squirrel population, while also providing captive squirrels the opportunity to experience their natural habitat. The site will also be convenient enough that captive squirrels can easily be cared for while housed in the soft-release facility. The enclosure itself 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. From this enclosure, squirrels will be recaptured and transported to release sites.

Areas of release will be coordinated with the contacts found in Appendix C. Release areas will 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 will only be selected within the Mt. Graham red squirrel's range (Figure 2) and will not be located within at least 4,000 feet (ft) of existing structures, campgrounds, special use areas (e.g., summer homes, Bible and Boy Scout Camps), and the 60.7 hectare (ha) (150-acre [ac]) Mount Graham International Observatory research area. This distance was chosen because it is greater than twice the mean dispersal distance recorded for this subspecies (584 m [1,916 ft]; Kreighbaum and Van Pelt 1996, and is also greater than the maximum distance a Mt. Graham red squirrel has been found from its midden (923 m [3,028 ft]) once it has an established territory (Koprowski *et al.* 2008). This should avoid the potential for released Mt. Graham red squirrels to disperse into and establish territories within areas that may impact human activities. In addition, sites will be selected so as to minimize impacts to the wild squirrel population. These could include gaps within the current distribution of Mt. Graham 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 – see Factors Affecting the Species and its Critical Habitat within the Action Area below).

Concurrent with establishing the captive breeding pilot program, a PMP and studbook will be developed for the Mt. Graham red squirrel. Information gathered during the pilot program will be incorporated into the PMP and studbook for this subspecies, which will 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 shall include multiple visits to Mt. Graham red squirrel territories to determine occupancy, sex, presence of young, and age of young; pre-baiting Mt. Graham red squirrel territories to acclimatize Mt. Graham red squirrels to the taste of bait; trapping Mt. Graham red squirrels; transporting Mt. Graham red squirrels to participating facilities (e.g., zoos); care within each facility (including genetic testing and individually marking animals); transporting individuals to Mt. Graham; caring for Mt. Graham red squirrels while housed in the soft-release facility; and release of Mt. Graham red squirrels to augment the wild population.

As part of the proposed action, the FWS will issue section 10(a)(1)(A) enhancement of survival permits to the Phoenix Zoo and Miller Park Zoo and other cooperators as they are ready to join the project, which will authorize take of Mt. Graham red squirrels. The permit length is five years and renewable in five-year increments. Implementation of the field activities is expected to commence during the summer and fall of 2013. The pilot program will continue for a period of up to 10 years until the Recovery Team recommends 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

may be captured over a number of years until a total of up to 16 have been removed from the wild and are held in captivity.

Conservation Measures

The following conservation measures are included in the proposed action and act to reduce or offset adverse effects of establishing the captive breeding pilot program for the Mt. Graham red squirrel:

1. Efforts will 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 Mt. Graham red squirrels that have been removed from the wild will be held in captivity.
2. No more than 10 percent of the population (based on the most recent mountain-wide census data) will 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 will be conducted by FWS staff and/or individuals holding Federal and State permits (including trapping as a permitted activity) for this subspecies. Trapping and handling techniques will follow those outlined in Koprowski *et al.* (2008) (Appendix D) and Koprowski (2002) (Appendix E). Briefly, collapsible, single door live traps (Tomahawk Live Trap, Tomahawk WI: Model # 201 or equivalent) will be used and bait will consist of peanuts and/or peanut butter or an acceptable substitute (e.g., almonds and/or almond butter). Traps will be checked every two hours and closed to capture each night. Handling of Mt. Graham red squirrels will 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) will be used. Additionally, while traps are open, pieces of wood and bark will be laid across and against the sides of the traps to provide shade within the trap, and if the weather becomes inclement, the traps will be checked immediately and closed to capture until the weather event has passed.
4. Mt. Graham red squirrels will be transported to a participating facility or suitable holding location within 24 hours of capture. Transportation will follow International Air Transport Association (IATA) airport code regulations for flight and AZA standards for overland transport. They will be transported in species appropriate enclosures (e.g. Sky Kennel, small size), and provided adequate water and food, if necessary. Ambient temperatures will 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. Mt. Graham red squirrels released back into the population, whether for increasing genetic representation in the captive population or augmenting the wild population, will only be released when the snow has melted, food resources are available, and sufficient time is available for the released Mt. Graham red squirrels to cache cones and fungi for the winter (May through August). To the greatest extent possible within this timeframe, release events will be timed to coincide with natural juvenile dispersal during that year.

Release sites will be coordinated with the AESO, Mt. Graham Red Squirrel PMP coordinator, USFS, AGFD, University of Arizona's RSMP, and participating facilities (contacts listed in Appendix C).

6. Breeding facilities that participate in this program will be members of the AZA or will be able to demonstrate they can meet or exceed the accepted standards developed by the AZA (AZA 2013).
7. Implementation of the proposed project will follow the FWS 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&WAIAction=retrieve>.
8. The Technical Subgroup of the Mt. Graham Red Squirrel Recovery Team will review the pilot program annually to ensure the program is meeting its objectives. Based on their annual review, they may choose to recommend: a) continue implementing the pilot program, b) develop a full captive-breeding program, which may involve removing more than 16 Mt. Graham red squirrels from the wild; or c) discontinue the pilot program because it is clearly not benefitting the subspecies.

STATUS OF THE SPECIES

In 1987, we listed the Mt. Graham red squirrel as endangered (52 FR 20994, June 3, 1987) (USFWS 1987). The final rule concluded that the Mt. Graham red squirrel was endangered because its range and habitat were reduced, and its habitat was threatened by a number of factors, including the (then) proposed construction of an astrophysical observatory, occurrences of catastrophic wildfires, proposed road construction and improvements, and recreational developments at high elevations on the mountain. The rule noted that Mt. Graham red squirrels might also suffer due to resource competition with the introduced Abert's (tassel-eared) squirrel (*Sciurus aberti*). In 1990, we designated critical habitat for the Mt. Graham red squirrel (55 FR 425, January 5, 1990) (USFWS 1990). We finalized the first Mt. Graham Red Squirrel Recovery Plan in 1993 (USFWS 1993); it is currently undergoing revision with a draft provided for public review in 2011 (USFWS 2011).

A complete description of the Mt. Graham red squirrel can be found in Allen (1894), Spicer *et al.* (1985), Hoffmeister (1986), and Gurnell (1987). The taxonomy of the Mt. Graham red squirrel is described in Hall (1981), Hoffmeister (1986), Riddle *et al.* (1992), Sullivan and Yates (1995), and Fitak and Culver (2009).

Mt. Graham red squirrels inhabit a narrow selection of habitats in the high-elevation areas that support primarily Engelmann spruce (*Picea engelmannii*) and corkbark fir (*Abies lasiocarpa* var. *arizonica*); in the mixed-conifer stands dominated by Douglas fir (*Pseudotsuga menziesii*), with white fir (*Abies concolor*) and Mexican white pine (*Pinus strobiformis*) sub-dominants; and in the ecotone life zone between these community types. The squirrels apparently do not inhabit pure stands of ponderosa pine (*Pinus ponderosa*) (USFWS 1993). In recent years, these forests have experienced significant ecological changes, many of which are dramatic and detrimental to the survival of the Mt. Graham red squirrel. Large, high-severity fires in 1996 and 2004 affected approximately 35,000 acres of forested area. Extended drought has created severe physiological stress on trees, especially in the higher elevation forest types. Tree diseases are present on the

mountain and appear to be increasing in scale and intensity. Outbreaks of forest insects, including defoliators, bark beetles, and phloem feeders, have contributed to substantial additional tree mortality. In 2005, trees near all 1,251 documented Mt. Graham red squirrel territories showed signs of insect damage. With the loss of most of the higher-elevation habitat in the spruce-fir due to wildfire and insect damage, Mt. Graham red squirrels now occur primarily in the mixed-conifer forest on the mountain but also in remaining patches of spruce-fir. The potential for large-scale fires to occur in the remaining habitat of the Mt. Graham red squirrel remains very high.

Other threats facing 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.; USFWS 1993), 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 (Edelman *et al.* 2005).

Mt. Graham red squirrels create middens, which are areas that consist of piles of cone scales in which squirrels cache 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.

The red squirrel is highly territorial (Smith 1968), and the concept of one squirrel per midden is widely accepted and used for Mt. Graham red squirrel management (Vahle 1978). Occasionally, conditions arise where more than one squirrel occupies a midden or a Mt. Graham red squirrel uses more than one midden (Froehlich 1990, Koprowski *et al.* 2003, 2004), but these are likely exceptional cases and usually seem to occur when food is either extremely abundant or rare. Home range sizes and juvenile dispersal distances of Mt. Graham red squirrels are significantly larger than other populations of red squirrels, suggesting forests in the Pinaleño Mountains are sub-optimal in comparison to other North American red squirrel habitat (Munroe *et al.* 2009). Juvenile survivorship has not been measured directly, but the extreme natal dispersal distances they must travel to find available habitat may translate to decreased juvenile survival and recruitment (Munroe *et al.* 2009).

Observations indicate that Mt. Graham red squirrels eat: (1) conifer seeds from closed cones, (2) above-ground and below-ground macro-fungi and rusts, (3) pollen (pistillate) cones and cone buds, (4) cambium of conifer twigs, (5) bones, and (6) berries and seeds from broadleaf trees and shrubs. Each food is used seasonally; pollen and buds in the spring, bones by females during lactation, fungi in the spring and late summer, and closed cones low in lipids in the early summer. Closed, live-cut cones high in lipids are stored for winter-time use (Smith 1968).

Mt. Graham red squirrels eat seeds and store live cones from Englemann spruce, white fir, Douglas-fir, corkbark fir, and white pine. Midden surveys indicate that Engelmann spruce and Douglas-fir are the most common tree species supplying food to the squirrel. Douglas-fir, generally a consistent cone producer (Finley 1969), is important in the Pinaleño Mountains,

especially in areas where it co-exists with Engelmann spruce, which is more prone to cone crop failure. Use of ponderosa pine seeds or caching ponderosa pine cones by Mt. Graham red squirrels is extremely limited, probably due to microclimate considerations. Cone caching and consumption of cone seeds by red squirrels have been reported in more northerly latitudes (Hatt 1943, Finley 1969, Ferner 1974). Miller (1991) found that nutritional values of seeds from several conifer species in the Pinaleno Mountains vary seasonally and by tree species.

Additionally, Miller (1991) analyzed the nutritional content of the three above-ground species of mushrooms eaten by Mt. Graham red squirrels. Percent crude protein and percent digestible protein were higher than all conifer seeds except Engelmann spruce in summer (Miller 1991). Truffle protein content also was as high as some conifer seeds per unit weight (Smith 1968). Mushrooms and truffles may take less effort to eat than extracting seeds from cones. Combined with information on nutritional values, this may explain in part the relative importance of fungi in the diet.

Depending on climatic conditions and growing seasons, red squirrels throughout North America generally breed from February through July (Koprowski 2005a). 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 Mt. Graham red squirrels (USFWS 1993). 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. 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 (also called dreys), 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 Pinaleno 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 9 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 as previously mentioned, 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).

Mammalian predators of Mt. Graham red squirrels include mountain lion, black bear, bobcat, coyote, and gray fox (Hoffmeister 1956, USFS 1988). On Mt. Graham, a bobcat was observed stalking a Mt. Graham red squirrel (Schauffert *et al.* 2002) and a gray fox captured an adult female squirrel (24 Feb 2003, Koprowski, unpubl. data). Avian predators of Mt. Graham red squirrels likely include goshawks, red-tailed hawks, Mexican spotted owls, great horned owls, and Cooper's hawks (USFS 1988, Schauffert *et al.* 2002). On Mt. Graham, Kreighbaum and Van Pelt (1996) reported that four juvenile Mt. Graham red squirrels were killed by raptors during natal dispersal. Additionally, a Mexican spotted owl was documented killing one juvenile Mt. Graham red squirrel near the natal nest (Schauffert *et al.* 2002).

Rangewide, multi-agency Mt. Graham red squirrel surveys, based on a sample of middens throughout the range of the Mt. Graham red squirrel, have been conducted since 1986 (Appendix F). In 1998, the surveys were expanded from a single survey per year to two surveys per year, one in fall and one in spring, but beginning in 2009, it was determined a single survey in the fall would be adequate. The numbers are derived by simple formulas that use the percent of active middens in each vegetation type found in the random sample and the number of known middens in each vegetation type. The estimate uses only those middens where activity is certain. Midden surveys show increasing numbers of Mt. Graham red squirrels into 1998-2000, with peaks over 500, after which the population declined. Population estimates dropped 42 percent in 2001 as compared to 1998-2000; since that time, population estimates have remained fairly stable, varying from 199 to 346 (Appendix F). The last survey (Fall 2012) resulted in an estimate of 214 Mt. Graham red squirrels.

The Red Squirrel Monitoring Program at the University of Arizona (UA) was established by the Arizona Idaho Conservation Act (AICA 1988 – see Factors Affecting the Species and its Critical Habitat within the Action Area) to monitor effects of the Mount Graham International Observatory (MGIO) on the Mt. Graham red squirrel. As part of that program, Koprowski *et al.* (2005) monitored all middens in 250 ha (624 ac) surrounding the MGIO from 1989-2002. Middens were visited monthly from 1989-1996 and quarterly thereafter. From 1994-2002, the mixed conifer forest within their study area supported 54-83 middens, while the spruce-fir forest contained 120-224 middens. The population trend in the mixed conifer forest was found to be relatively stable from 1994-2001; however, by 2002, only two occupied middens were found in the spruce-fir forest. Population declines in the spruce-fir forest corresponded with a period of insect damage and wildfires that began in 1996 and had devastated that forest type by 2002. Census data collected by the RSMP indicate a more dramatic decline than do the data of the multi-agency surveys (which have shown fairly stable populations since Fall 2001 after a steep decline from 1998-2000). The differences in the results are likely due to differences of scale. The RSMP has focused on a subset of the mountain in which impacts of fire and insect damage have been pronounced in the spruce-fir forest, whereas the multi-agency surveys sample the population range wide.

Koprowski *et al.* (2005) characterized the decline of the Mt. Graham red squirrel in their study area as catastrophic. They note 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 the current catastrophic decline 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 Pinaleno 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 Pinalenos. Although the Mt. Graham red squirrel population persisted through that event and may persist through the current catastrophic 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 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 biological opinion (see Appendix B).

Mt. Graham Red Squirrel Critical Habitat

On January 5, 1990, we designated approximately 1,900 acres as Mt. Graham red squirrel Critical Habitat (55 FR 425-429) (USFWS 1990). Critical Habitat includes three areas (Figure 2):

- 1) The area above 10,000 feet in elevation surrounding Hawk and Plain View peaks and a portion of the area above 9,800 feet;
- 2) the north-facing slopes of Heliograph Peak above 9,200 feet; and
- 3) the east-facing slope of Webb Peak above 9,700 feet.

The main attribute of these areas at that time was the existing dense stands of mature (about 300 years old) spruce-fir forest. The Mt. Graham red squirrel Refugium established by the AICA has the same boundary as the designated Critical Habitat boundary surrounding Hawk and Plain View peaks (about 680 ha [1,700 acres]), but does not include Critical Habitat on Heliograph or Webb Peaks. Unfortunately, most of the habitat in the Refugium and in Critical Habitat has been devastated by wildfire and insect damage. There remains a small, unknown amount of habitat in the Refugium (A. Casey, pers. comm. 2008).

ENVIRONMENTAL BASELINE

The environmental baseline includes past and present impacts of all Federal, State, or private actions in the action area, the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early section 7 consultation, and the impact of State and private actions that are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation.

The action area is defined as the area within which effects to the listed species and its critical habitat are likely to occur and is not limited to the actual footprint of the proposed action. We define the action area to be the entire potential range of the Mt. Graham red squirrel (Figure 2).

A. Status of the Species and Critical Habitat within the Action Area

As the action area includes the entire potential range and all Critical Habitat of the Mt. Graham red squirrel, this section is identical to the Status of the Species section above.

B. Factors Affecting the Species and its Critical Habitat within the Action Area

Our biological opinion (BO) pursuant to section 7 of the Act for the proposed astrophysical development on Mt. Graham and Forest Management Plan was completed on July 14, 1988 (USFWS 1988). The Forest Management Plan was found not to jeopardize the continued existence of the Mt. Graham red squirrel, but the proposed seven-telescope astrophysical development was found to jeopardize the continued existence of the squirrel. Three reasonable and prudent alternatives were described, but before the USFS agreed to any, the AICA was passed by Congress. It mandated the third reasonable and prudent alternative with some modifications. It authorized the construction of three telescopes on Emerald Peak, necessary support facilities, and an access road to the site. The law further required the UA, with the concurrence of the Secretary of the Interior, to develop a management plan for the Mt. Graham red squirrel. Construction of additional telescopes will require a new section 7 consultation. The 1988 BO established the Mt. Graham Red Squirrel Refugium, which also comprises the largest of three areas of Mt. Graham Red Squirrel Critical Habitat (see Mt. Graham Red Squirrel Critical Habitat).

In 2003, the Coronado National Forest began developing the Pinaleño Ecosystem Restoration Project (PERP). This project was designed to restore the higher elevation, mixed-conifer forest of the Pinaleño Mountains to conditions prior to the Federal policy of suppressing all fires; further the needs of native species of plants and wildlife (including threatened and endangered species); and reduce the risk of catastrophic wildfire and its devastating effects on the heavily fuel-loaded mountain range. The project will reduce the density of trees and amount of fuel (e.g., dead wood, both standing and on the ground) and promote the more open and healthy conditions that existed before widespread, long-term (50 years or more) fire-suppression actions lead to unnatural and unhealthy forest conditions. The PERP is designed in such a way as to be sensitive to the needs of the Mt. Graham red squirrel. When implemented, it is anticipated to reduce the risk of catastrophic wildfire affecting the Forest and the Mt. Graham red squirrel population. The Final Environmental Impact Statement for the Pinaleño Ecosystem Restoration Project was issued in 2010 (USFS 2010).

The Mt. Graham red squirrel and its critical habitat have been the subject of numerous section 7 consultations since its listing in 1987. The July 14, 1988, BO on the astrophysical development and Coronado's Forest Management Plan, described above, is the only jeopardy opinion issued for the species (USFWS 1988). Effects of the third reasonable and prudent alternative in that BO included anticipated incidental take of six Mt. Graham red squirrels per year. In a June 9, 1999, BO we anticipated 15 Mt. Graham red squirrels were incidentally taken due to fire suppression activities during the Clark Peak fire emergency suppression and rehabilitation (USFWS 1999). On May 5, 2007, we completed informal consultation with the Coronado on a project to plant conifer seedlings within high severity burn areas of the Nuttall-Gibson Complex wildfire areas

within the Mt. Graham red squirrel Refugium. This project is ongoing. In a June 8, 2007, BO, we anticipated that incidental take of one Mt. Graham red squirrel occurred during suppression activities in the Nuttall-Gibson Complex wildfires (USFWS 2007). Additionally, in an August 18, 2008, BO to renew the Mt. Graham Summer home Special Use Permits, we anticipated incidental take of up to two Mt. Graham red squirrels (USFWS 2008). Ongoing research and monitoring provides critical information but may also impact the species including work by Dr. John L. Koprowski who is permitted to capture up to 100 adult male and 100 adult female Mt. Graham red squirrels each year and for ear-tag placement or be fitted with a radio collar.

EFFECTS OF THE ACTION

Aspects of the proposed action that may result in effects to Mt. Graham red squirrels include a) reconnaissance and pre-baiting activities; b) trapping and transport activities; c) captivity and care (including collecting samples for genetic testing, individually marking each Mt. Graham red squirrel, monitoring the health of individuals, etc.); and d) releases back to the wild.

Effects of reconnaissance and pre-baiting activities:

An unknown number of individuals will 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 (personal observation), but human presence does not appear to influence survivorship, as the same Mt. Graham red squirrel will occupy a territory even after multiple visits and multiple capture events (e.g., as observed in Koprowski 2005b and Koprowski *et al.* 2008).

Pre-baiting with peanuts and/or peanut butter (or almonds and/or almond butter as an acceptable substitute) is done on the middens of lactating females to allow them to eat the bait and pass taste into her milk. Once the young are weaned, they recognize the bait as food. Traps are then baited to lure the animals into the trap. 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 are likely to be slightly beneficial 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 (based on the most recent mountain-wide census data) of the total population in any calendar year through intentional capture, including individuals trapped incidentally (those trapped and later released) or removed through purposeful trapping (those brought into the pilot captive program). According to the most recent mountain-wide census data (conservative Fall 2012 estimate = 214, see Appendix F),

up to 21 Mt. Graham red squirrels could be trapped in 2013, and we anticipate removal of four individuals from the wild to become a part of the pilot project. The number of Mt. Graham red squirrels trapped as a part of this proposed action will fluctuate depending upon the most recent population information, never exceeding 10 percent (based on the most recent mountain-wide census data) of the total population in any one calendar year.

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 seven species of tree squirrel, 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 Mt. Graham red 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 do so (Koprowski *et al.*, 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 red 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 Koprowski *et al.* (2008)’s protocol of checking traps every two hours and closing them to capture each night. The proposed action will 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 will 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 Annual Permit Report). 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 Annual Permit Reports). Based on this information, it does not appear that Mt. Graham red squirrels will be negatively affected by being trapped and immediately released.

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 wildlife rehabilitator in Tucson, Arizona and the four Mt. Graham red squirrels brought to the Phoenix Zoo in 2011. Two of these individuals

were 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 an individual, who cared for them until October 28, 2004, when they were then delivered to the Arizona-Sonora Desert Museum. The four individuals from 2001 were safely transported to the Phoenix Zoo by FWS staff.

Of the anticipated effects of the proposed action, removal of up to 16 Mt. Graham red squirrels from the wild is expected to have the greatest negative effects. Attempts will be made to capture dispersing juvenile Mt. Graham red 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 (since many of these juveniles would die in the wild), as keeping these individuals in captivity may extend their life expectancy while at the same time providing individuals for future release. Should capturing dispersing juveniles prove unsuccessful, up to eight adults (including up to four females) may be captured. Currently, eight adults represent 3.7 percent of the overall population in the 2012 Census (Appendix F). Since we will not be removing eight adults in any one year, the effect to the adult population in any year is reduced. 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 will 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 (Appendix F). 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 Mt. Graham red squirrels. We expect the removal of up to four adult males and four adult females will affect the overall population to a lesser extent than the Nuttall Complex Wildfire, as no habitat will be lost due to the proposed action, and individuals produced in captivity will 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). The two females captured in 2011 died in 2012 of unknown causes. None of Mt. Graham red squirrels were bred, as other unrelated Mt. Graham red squirrels were not available in captivity at that time or, in the case of the four 2011 captured individuals,

breeding was not allowed under the section 10(a)(1)(A) permit held by the Phoenix Zoo. 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 (a circannual reproductive cycle entrained by photoperiod; Becker 1993). Eight red squirrel 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 as were the four held at the Phoenix Zoo.

The effects of captivity and care will include the non-lethal harassment of up to 16 individuals annually while in captivity due to genetic testing, health screenings, individually marking each Mt. Graham red squirrel, etc. Harassment of Mt. Graham red squirrels while in captivity due to health care activities and genetic testing is unlikely to result in a fatality, 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 Desert Museum included routine veterinarian examinations (including anesthetization and microchip implantation) and general care (cage cleaning, feeding, enrichment, etc.). Similar actions are taken with the two males at the Phoenix Zoo.

Additionally, the Red Squirrel Monitoring Program has individually marked Mt. Graham red squirrels 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 observed in Koprowski 2005b and Koprowski *et al.* 2008). However, captive breeding events have not been attempted with this subspecies, so there is the 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 will 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 will 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 is to determine the best release techniques to ensure captive Mt. Graham red squirrels have the best chance at survival once released. We have decided to use soft-release techniques to release captive-born individuals. Reintroduction candidates will be trained in essential behavioral skills (e.g., food recognition,

food-finding, caching food, predator avoidance, and shelter-seeking) and will be exposed to environmental conditions that will foster necessary physiological adaptations (such as coat growth for thermoregulation). Individuals will spend time in a soft-release enclosure (usually 10-14 days or until they exhibit all essential behavioral skills) located within Mt. Graham red squirrel habitat prior to release into the wild. Each released Mt. Graham red squirrel will be individually tagged with color-coded ear tags, and they will be monitored post-release. Radio-telemetry equipment has been purchased to assist in this monitoring effort.

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 2) will be installed on the mountain outside of Mt. Graham red squirrel critical habitat in a location agreed upon by the AESO, Mt. Graham Red Squirrel PMP coordinator, USFS, AGFD, and the University of Arizona's RSMP (contacts can be found in Appendix C). The location of this enclosure will be selected to avoid conflicts with human activities and minimize impacts to the wild squirrel population, while also providing captive squirrels the opportunity to experience their natural habitat. The site will also be convenient enough that captive squirrels can easily be cared for while housed in the soft-release facility. The enclosure itself 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. From this enclosure, squirrels will be recaptured and transported to release sites.

Interactions between released Mt. Graham red squirrels and wild Mt. Graham red squirrels are expected to occur. Red squirrels are territorial, and therefore wild Mt. Graham red squirrels will defend their midden from intruders, including released Mt. Graham red squirrels. There is the potential that wild Mt. Graham red squirrels could be harmed by released Mt. Graham red squirrels during these encounters, including being displaced, although it is more likely that the wild Mt. Graham red squirrels will have an advantage over released Mt. Graham red squirrels (most often they will be older and already familiar with the area), and therefore will be able to drive them away. Locations for release of captive Mt. Graham red squirrels will be chosen to minimize potential encounters between Mt. Graham red squirrels while still allowing released Mt. Graham red squirrels the opportunity to establish their own territories. Release locations will be coordinated by the contacts listed in Appendix C.

Effects of Conservation Measures

The proposed conservation measures that are part of the proposed action will aid in reducing the effects of the proposed action offsetting the effects of the proposed action on the Mt. Graham red squirrel population through the following:

1. Removing and maintaining up to 16 dispersing juveniles from the wild population at one time in captivity should minimize the effect on the overall population, as it is likely that the mortality rate of dispersing juveniles is high due to the extreme distance they must travel from their natal area to establish a new territory (Munroe *et al.* 2009). Since many of the dispersing juveniles die before becoming adults, the actual effect of removal of juveniles to the overall population is reduced. Keeping juvenile Mt. Graham red squirrels in captivity will likely extend their lifespan to that characteristic of other populations of red squirrels (3-5 years), as indicated by the two housed at the Arizona-Sonora Desert Museum for 3.5-4.5 years. If trapping of juveniles proves unsuccessful, removing up to eight adult Mt. Graham red squirrels (including up to four females) will temporarily

affect the overall population, but likely will not have long-term effects, because if captive breeding is successful, offspring will be produced and released to augment the wild population and replace those removed from the wild. Additionally, keeping animals off-site (out of the Pinaleno Mountains) and determining successful breeding techniques for this subspecies will assist in its long-term conservation, should the FWS decide 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) will 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 will be conducted by Fish and Wildlife Service staff and/or individuals holding Federal and State permits (including trapping as a permitted activity) for this subspecies, and will follow the techniques developed by Koprowski *et al.* (2008) (Appendix D) and Koprowski (2002) (Appendix E). 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 will ensure trapping and handling of Mt. Graham red squirrels will 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. Transporting Mt. Graham red squirrels to participating facilities or suitable holding locations within 24 hours of capture will ensure proper care is initiated as quickly as possible. Providing a quiet, dark environment with sufficient food and water during transport will further reduce stress to the animal.
5. Young produced in captivity will be used to augment the wild population, unless for genetic or health reasons it is determined they are not to be released. Red squirrels released back into the population will only be released when the snow has melted, food resources are available, and sufficient time is available for the released Mt. Graham red squirrels to cache cones and fungi for the winter (May through August). This will assist in the long-term conservation of this subspecies by augmenting the wild population and ensuring the released Mt. Graham red squirrels have the greatest chance of survival in the wild. Release sites will be coordinated with the AESO, Mt. Graham Red Squirrel PMP coordinator, USFS, AGFD, University of Arizona's RSMP, and participating facilities, thereby ensuring that all agencies and experts can provide input on the best locations for release, minimizing effects to both released and wild Mt. Graham red squirrels.
6. Facilities that participate in this program will be members of the AZA, or will 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 will be followed at each facility (AZA 2013).
7. Implementation of the proposed project will follow the U.S. Fish and Wildlife Service's Policy Regarding Controlled Propagation of Species Listed under the Endangered Species Act.

8. The Technical Subgroup of the Mt. Graham Red Squirrel Recovery Team will review the pilot program annually to ensure the program is meeting its objectives. Based on their review, they may recommend discontinuing the pilot program if it is clearly not benefitting the subspecies.

These conservation measures will 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 Mt. Graham red squirrel, while also contributing to the long-term conservation of the Mt. Graham red squirrel through off-site (out of the Pinaleño Mountains) captive maintenance of individuals and subsequent population augmentation with progeny from the captive animals. The long-term benefits of the proposed action outweigh the short-term effect of trapping up to 10 percent (based on the most recent mountain-wide census data) 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 Mt. Graham red squirrels during reconnaissance, pre-baiting, and release activities.

Effects of Permit Issuance

Issuance of an enhancement of survival permits by the FWS would authorize the captive program including multiple visits to Mt. Graham red squirrel territories to determine occupancy, sex, presence of young, and age of young; pre-baiting Mt. Graham red squirrel territories to acclimatize squirrels to the taste of bait; trapping Mt. Graham red squirrels; transporting Mt. Graham red squirrels to and from participating facilities and the Pinaleño Mountains; care within each facility; genetic testing of each Mt. Graham red squirrel in captivity; individually marking each Mt. Graham red squirrel; and release of Mt. Graham red squirrels to augment the wild population. The effects of these activities are described above. Purposeful take anticipated to occur as a result of these activities will be authorized via section 10(a)(1)(A) of the Act and incidental take is authorized by the Incidental Take Statement included in this BO.

Effects to Critical Habitat

No vegetation (including dense stands of spruce-fir forest, the main characteristic that describes Mt. Graham red squirrel Critical Habitat) will be altered or affected by the proposed action. Therefore, no adverse effects to critical habitat are anticipated to result from the proposed action.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the action area considered in this BO. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

The Forest manages lands (except private) in the Pinaleño Mountains and administers projects and permits on those lands; thus, almost all activities that could potentially affect Mt. Graham red squirrels in the action area are Federal activities and subject to additional section 7 consultation under the Act.

The AGFD manages sportfish and wildlife resources in the Pinaleño Mountains. Some of these

actions have Federal funding through the Sportfish and Wildlife Restoration Programs of the FWS and are subject to section 7 consultation. Other activities to remove introduced Apache trout and replace them with Gila trout in several streams also has a Federal nexus and section 7 consultation is required for these actions. No additional cumulative effects are anticipated for this action. However drought and other climate conditions may continue to compromise the full success of this pilot program if released Mt. Graham red squirrels are unable to find suitable midden sites with adequate food resources.

CONCLUSION

After reviewing the current status of the Mt. Graham red squirrel, the environmental baseline for the action area, the effects of the proposed establishment of a captive breeding pilot program for the Mt. Graham red squirrel, including permit issuance to authorize the program, and the cumulative effects, it is our biological opinion that the action, as described, is neither likely to jeopardize the continued existence of Mt. Graham red squirrel, nor result in destruction or adverse modification of critical habitat.

Our findings are based on the following:

- Efforts will be made to collect young-of-the-year individuals for the captive breeding pilot program to reduce the impact to the overall population to the greatest extent possible. If young-of-the-year cannot be collected, up to eight adults (including four females) may be captured for the pilot program.
- Long-term benefits are anticipated through maintaining Mt. Graham red squirrels off-site (out of the Pinaleño Mountains), and captive individuals will probably live as long or longer in captivity than in the wild, while also augmenting the wild population with captive-produced progeny. The information we learn about keeping and breeding this subspecies in captivity will contribute to recovery of the Mt. Graham red squirrel.
- All effort will be made, including use of tested protocols where available, to reduce the level of stress on each animal during capture, restraint, transport, and release.
- All participating facilities will be members of the AZA, or will be able to demonstrate they can meet or exceed the accepted standards developed by the AZA.
- Information on husbandry, breeding, and release techniques will be incorporated into the Mt. Graham Red Squirrel PMP, ensuring each facility is using the most up-to-date information and assisting in the success of the pilot program.
- No vegetation (including dense stands of spruce-fir forest, the main characteristic that describes Mt. Graham red squirrel Critical Habitat) will be altered or affected by the proposed action.

This biological opinion does not rely on the regulatory definition of “destruction or adverse modification” of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the Act to complete the above analysis with respect to critical habitat. In particular, herein we considered how the proposed action would affect those physical or biological features

that are essential to the conservation and recovery of the species, and whether such effects rise to the threshold of destruction or adverse modification. If a proposed action would severely compromise or preclude our ability to recover a species, then that threshold has been exceeded.

In conclusion, we believe the Mt. Graham red squirrel is critically endangered, and recent habitat loss caused by insect outbreaks, drought, and catastrophic wildfires has been the major factor that, over time, has pushed this species nearer to extinction. We believe the establishment of a captive breeding pilot program for the Mt. Graham red squirrel does not jeopardize the continued existence of Mt. Graham red squirrel or result in adverse modification or destruction of critical habitat, and, over the long-term, will benefit this subspecies by maintaining breeding individuals off-site and safe from habitat loss, while also providing individuals for augmentation of the wild population. We conclude that the establishment of a captive breeding pilot program will contribute to the likelihood of the survival and recovery of the Mt. Graham red squirrel throughout its range in the wild.

The conclusions of this biological opinion are based on full implementation of the project as described in the Description of the Proposed Action section of this document, including any Conservation Measures that were incorporated into the project design.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. “Take” is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. “Harm” is defined (50 CFR 17.3) to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. “Harass” is defined (50 CFR 17.3) as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. “Incidental take” is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act, provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary and must be undertaken by the U.S. Fish and Wildlife Service so that they become binding conditions of any grant or permit issued, as appropriate, for the exemption in section 7(o)(2) to apply. The U.S. Fish and Wildlife Service has a continuing duty to regulate the activity covered by this incidental take statement. If the U.S. Fish and Wildlife Service (1) fails to assume and implement the terms and conditions or (2) fails to require adherence to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the U.S. Fish and Wildlife Service must report the progress of the action and its impact on the species as specified in the incidental take statement. [50 CFR §402.14(i)(3)].

AMOUNT OR EXTENT OF TAKE

The capture of and removal from the wild of up to 16 wild-born Mt. Graham red squirrels for the pilot project is purposeful, not incidental take. Purposeful take for recovery purposes is allowed under section 10(a)(1)(A) enhancement of survival permits issued to FWS staff and cooperators. Subsequent to capture and removal from the wild, husbandry and breeding of Mt. Graham red squirrels held in captivity and the transport and release actions are also covered under the permit. Wild-born and captive born Mt. Graham red squirrels are subject to this purposeful take. This incidental take statement does not provide coverage for purposeful take; however, the analysis done in the biological opinion includes the potential effects on the Mt. Graham red squirrel wild population from this purposeful take to inform the issuance of enhancement of survival permits for actions undertaken in the pilot project.

As described above, incidental take is that take not intended as part of the proposed action. All trapped Mt. Graham red squirrels (trapped and released or taken into captivity) and any Mt. Graham red squirrels born into captivity are anticipated to be harassed during capture, transport, handling, and captive maintenance as described in the Effects of the Proposed Action. Up to 10 percent (based on the most recent mountain-wide census data) of the population may be trapped in any one calendar year, and up to 16 wild Mt. Graham red squirrels may be held in captivity.. Should wild-caught Mt. Graham red squirrels die in captivity due to other than natural causes (see below for possible causes of incidental mortality), the total number of wild Mt. Graham red squirrels held in captivity will be reduced by this number. Mortality of wild-caught Mt. Graham red squirrels due to natural causes will not reduce the total number of wild-caught Mt. Graham red squirrels that may be held in captivity. Captive-born Mt. Graham red squirrels that die in captivity due to either natural or non-natural causes will not reduce the total number of wild-caught Mt. Graham red squirrels that may be held in captivity.

In 1,877 capture events, Koprowski experienced one Mt. Graham red squirrel death due to handling activities while following the guidelines detailed in Koprowski *et al.* (2008) and Koprowski (2002). While we do not anticipate 1,877 captures will be needed to obtain the 16 squirrels needed for the captive breeding pilot program, it is possible that a death may occur at some point during trapping, handling, or transport-related activities. Therefore, we anticipate that one Mt. Graham red squirrel could be incidentally taken through injury or fatality during these activities. If this incidental take is of a wild-caught squirrel, the number of wild-caught individuals available to be held in captivity will be reduced by one.

In terms of incidental mortality during captive management activities, the best information we have available is for the two Mt. Graham red squirrels that were housed at the Arizona-Sonora Desert Museum for approximately 3.5 to 4.5 years and the four brought to the Phoenix Zoo in June-July 2011. The two at the Desert Museum survived to an age similar to that noted in other red squirrel populations (Munroe *et al.* 2009) and died due to natural causes. The two females at the Phoenix Zoo died within a year of capture of unknown causes; the two males are still alive as of June 2013 and seem to be in good health. There is, therefore, a risk that one or more Mt. Graham red squirrels could be harmed or killed inadvertently while in captivity for reasons other than natural causes, particularly because cooperating institutions will need to gain experience with holding Mt. Graham red squirrels and captive breeding has not been attempted before with this subspecies. Harmed or killed individuals could be wild-or captive-bred. Greater occurrence of mortality and injury is likely to occur early in the program, as husbandry methods are being developed. We therefore anticipate that up to six Mt. Graham red squirrels could be incidentally taken (from other than natural causes) through injury or mortality within the first three years of the pilot program, with this number decreasing to four individuals over the next seven years of

the pilot program for a total of 10 individuals. If one or more wild-caught individuals should be incidentally taken in this manner, the number of wild-caught individuals held in captivity will be reduced by this number.

One of the purposes of this pilot program is to determine the most effective way to release captive Mt. Graham red squirrels back into the wild. During use of soft-release techniques, captive Mt. Graham red squirrels may be injured or harmed. Released Mt. Graham red squirrels may also interact with wild Mt. Graham red squirrels, with detrimental effects to the released animal or wild animals. Therefore, we anticipate that up to and not to exceed 50 percent of all captive Mt. Graham red squirrels that are released into the wild could be incidentally taken through injury or mortality while these release techniques are being developed and honed. While we will attempt to avoid releasing captive-bred Mt. Graham red squirrels into areas immediately adjacent to occupied middens, we also anticipate that up to three wild Mt. Graham red squirrels per each five year period starting from the date of this opinion could be harassed or harmed due to interactions with released captive Mt. Graham red squirrels. As we gain experience with and refine release protocols, the percentage of released captive Mt. Graham red squirrels injured or dead, and numbers of wild Mt. Graham red squirrels harassed or harmed, will decline.

EFFECT OF THE TAKE

In this biological opinion, the FWS determines that this level of anticipated take is not likely to result in jeopardy to the species.

REASONABLE AND PRUDENT MEASURES AND TERMS AND CONDITIONS

Reasonable and Prudent Measures necessary to minimize Incidental Take, and the necessary Reporting requirements, are already part of the proposed action or as Conservation Measures. Therefore, in this incidental take statement we prescribe no additional Reasonable and Prudent Measures and Terms and Conditions for the proposed action.

Disposition of Dead or Injured Listed Species

Upon locating a dead, injured, or sick listed species, initial notification must be made to the FWS's Office of Law Enforcement (Resident Agent in Charge), 4901 Paseo del Norte NE, Suite D, Albuquerque, New Mexico 87113, telephone: 505/248-7889 within three working days of its finding. Written notification must be made within five calendar days and include the date, time, and location of the animal, a photograph if possible, and any other pertinent information. The notification shall be sent to the Law Enforcement Office with a copy to this office. Care must be taken in handling sick or injured animals to ensure effective treatment and care and in handling dead specimens to preserve the biological material in the best possible state.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

We have no further conservation recommendations beyond those proposed as Conservation Measures. We will continue to coordinate this project with the AGFD and other cooperators.

REINITIATION NOTICE

This concludes formal consultation on the implementation of a captive breeding pilot program for the Mt. Graham red squirrel. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

For further information, please contact Marit Alanen at (520) 670-6150 (x234) or Lesley Fitzpatrick (602) 242-0210 (x236) of my staff. Please refer to consultation number 02EAAZ00-2009-F-0305 in future correspondence concerning this project.

/s/ _____
Field Supervisor

Date 7/19/2013

Concurrence

/s/ _____
Deputy Regional Director

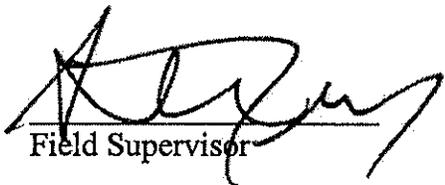
Date 8/6/2013

cc: Assistant Field Supervisor, Fish and Wildlife Service, Tucson, AZ
Regional Supervisor, Arizona Game and Fish Department, Tucson, AZ (Attn: Tim Snow)
Recovery Team Leader, Mt. Graham Red Squirrel Recovery Team, Tucson, AZ
Stuart Wells, The Phoenix Zoo, Phoenix AZ
Jay Tetzloff, Miller Park Zoo, Bloomington, IL

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Field Supervisor

7/19/13
Date

Concurrence


Deputy Regional Director

8/6/13
Date

cc: Assistant Field Supervisor, Fish and Wildlife Service, Tucson, AZ
Regional Supervisor, Arizona Game and Fish Department, Tucson, AZ (Attn: Tim Snow)
Recovery Team Leader, Mt. Graham Red Squirrel Recovery Team, Tucson, AZ
Stuart Wells, The Phoenix Zoo, Phoenix AZ
Jay Tetzloff, Miller Park Zoo, Bloomington, IL

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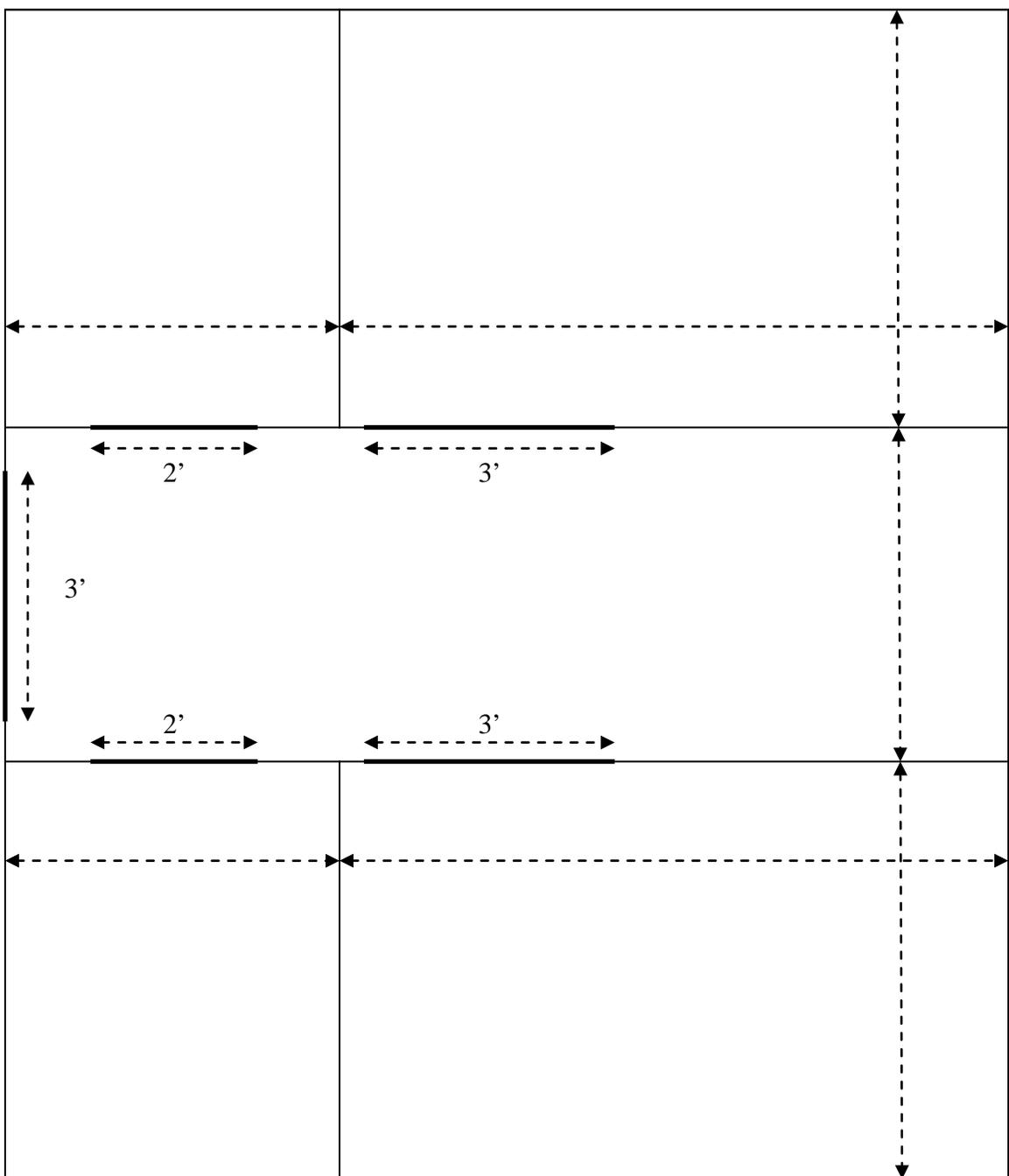
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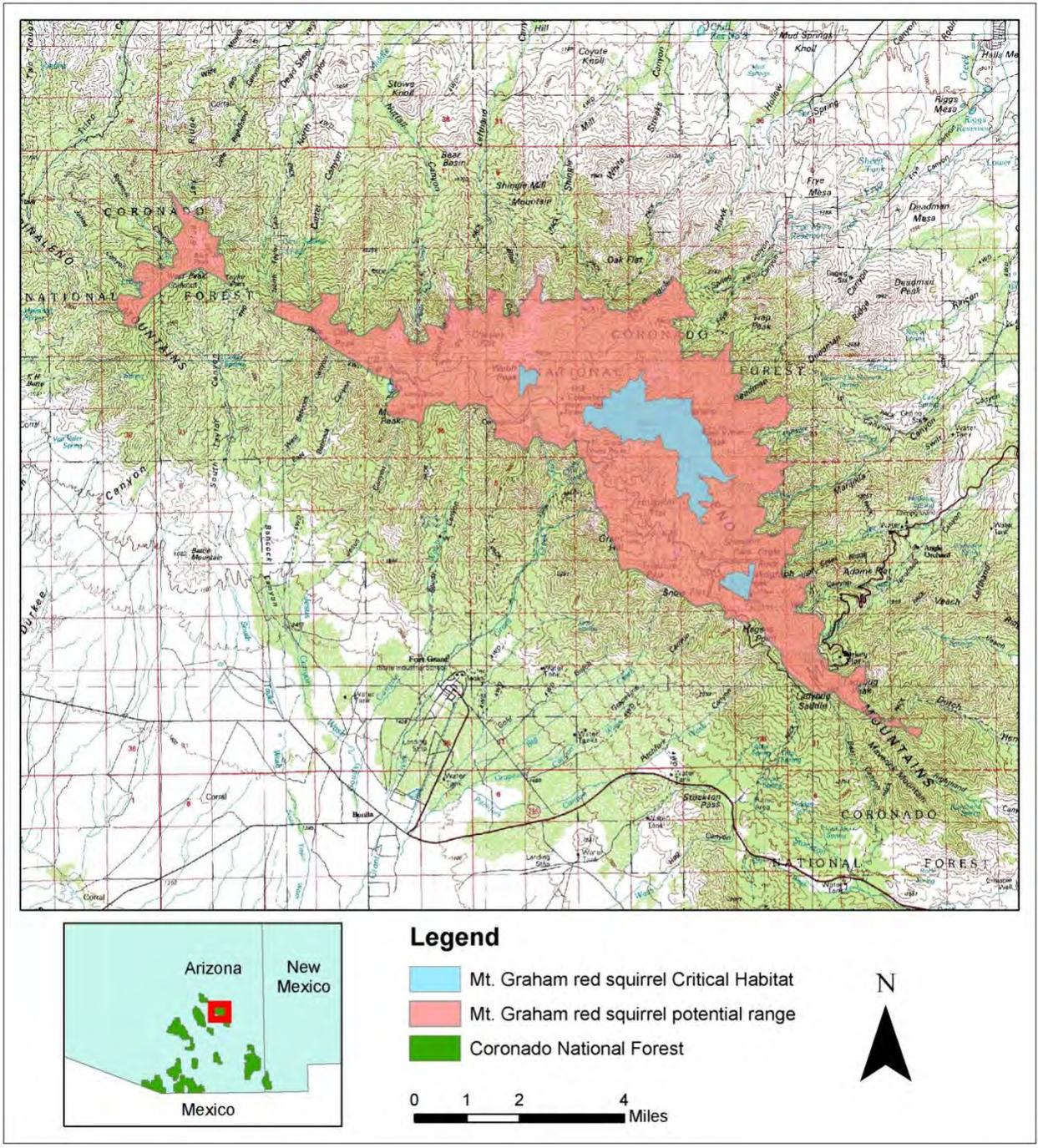
Figure 1. Mount Graham red squirrel soft-release enclosure design.



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
1/2" x 1" 16 gauge GAW wire mesh
Stainless Steel Hardware
2 doors - 24" x 72"
3 door - 36" x 72"

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



APPENDIX A CONCURRENCE

Mexican spotted owl

We concur with your determination that this project may affect, but is not likely to adversely affect, the Mexican spotted owl for the following reasons:

- The presence of a small number of people walking through Protected Activity Centers (PACs) while implementing the proposed action is not likely to adversely affect this subspecies. Therefore, potential effects to the owl due to reconnaissance are discountable.
- No taped owl calls or loud noises will occur as part of this project, so harassment of the owl due to call playback or increased noise levels will not occur.
- The presence of peanuts and peanut butter 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 the bait on the prey base cannot be meaningfully measured, as each area that will be baited is approximately 0.05 acre, while a PAC is 600 acres total. Therefore, these effects are insignificant because they will have a very small effect on the Mexican spotted owl.
- The presence of traps has the potential to affect the prey base of the owl (squirrels and other small mammals are anticipated to be trapped incidentally, and while in the trap they will be unavailable as prey for owls), but because trapping activities will only occur during the daytime, trapping activities will not affect the owl.
- This project will not affect Mexican spotted owl critical habitat.

APPENDIX B

**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:
R2/ES-TE
CL 6-15

JUN 14 2006

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

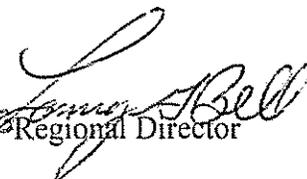
Dear Dr. Matter:

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,


ACTIVE 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

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 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.

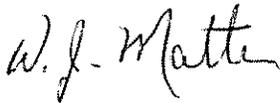
Challenges and Information Needs

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,



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APPENDIX C
MT. GRAHAM RED SQUIRREL CAPTIVE BREEDING PILOT PROGRAM
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APPENDIX D
Koprowski et al. 2008

APPENDIX E
Koprowski 2002

AGFD Mt. Graham Red Squirrel Population Monitoring Reports 2000-2012

AGFD organizes the annual midden surveys that are used to estimate the number of Mt. Graham red squirrels extant in that year. The population estimate is based on the percentage of active middens in each vegetation type found in the random sample of middens visited and the known number of middens in each vegetation type. A conservative and an optimistic estimate of population size are made. In 2009, the spring surveys were abandoned leaving only data for the fall survey available after 2008. Data from fall surveys beginning in 2000 are presented in the table below.

Year	Conservative	Optimistic	Average
2000	474 (+/- 11)	493 (+/- 11)	484
2001	247 (+/- 12)	292 (+/- 12)	270
2002	269 (+/- 8)	315 (+/- 8)	292
2003	274 (+/- 13)	311 (+/- 13)	293
2004	264 (+/- 12)	288 (+/- 12)	276
2005	276 (+/- 12)	301 (+/- 12)	289
2006	276 (+/- 12)	293 (+/- 11)	285
2007	299 (+/- 11)	310 (+/- 11)	305
2008	263 (+/- 11)	282 (+/- 10)	273
2009	250 (+/- 11)	268 (+/- 11)	259
2010	214 (+/- 12)	217 (+/- 12)	216
2011	240 (+/- 12)	248 (+/- 12)	244
2012	214 (+/- 11)	222 (+/- 11)	215