United States Department of the Interior

FISH AND WILDLIFE SERVICE
POST OFFICE BOX 1306
ALBUQUERQUE, N.M. 87103

2-21-86-F-75

In Reply Refer To:
Region 2, FWE/HC

July 14, 1988

Mr. Sotero Muniz
Regional Forester
U.S. Forest Service
517 Gold Avenue, S.W., Room 642B
Albuquerque, New Mexico 87102

Dear Mr. Muniz:

This responds to Mr. David F. Jolly, Deputy Regional Forester's February 10, 1988, request for formal consultation pursuant to Section 7 of the Endangered Species Act (Act) of 1973, as amended, on the Coronado National Forest Plan and the Mt. Graham Astrophysical Area Plan. These plans involve the Pinaleno Mountains on the Coronado National Forest, Graham County, Arizona. The species of concern is the endangered Mt. Graham red squirrel (Tamiasciurus hudsonicus grahamensis).

This biological opinion (opinion) is not a land use allocation analysis. The decision about the best use of the upper elevations of the Pinaleno Mountains involves issues beyond the Act and is ultimately your decision. In accordance with the Act, this opinion deals solely with the effect of the above proposed plans on endangered species.

A table of contents has been included (next page) because of the complexity and length of the supporting text.

TABLE OF CONTENTS

Page

CONSULTATION HISTORY 2

BIOLOGICAL OPINION 4

BACKGROUND INFORMATION 4

Project Description 4
Forest Plan 4
Astrophysical Area Plan 7

Mt. Graham Red Squirrel 9
Taxonomy 9
Habitat Requirements 9
Population Size 11
Current Status 13
Refugium 14
Vulnerability to Extinction 15

IMPACTS OF THE ACTION 17

Forest Plan 17
Land Management Prescriptions 17
Recreation 18
Special Management Area 20

Astrophysical Area Plan 20
Astrophysical Use Area 20
Physical Habitat Impacts 20
Human Use Impacts 21

Summary of Impacts 23

Conclusions 24

CORONADO NATIONAL FOREST PLAN 25

Incidental Take 25

Conservation Recommendations 25

MT. GRAHAM ASTROPHYSICAL AREA PLAN 26

Reasonable and Prudent Alternative 1 26
Features 27

Incidental Take 27

Conservation Recommendations 27

TABLE OF CONTENTS
(continued)

Reasonable and Prudent Alternative 2 27
Features 29

Incidental Take 30

Conservation Recommendations 31

Reasonable and Prudent Alternative 3 32
Features 34

Incidental Take 35

Conservation Recommendations 37

Literature Cited 38

Figures 40

Appendix Table 1 44

CONSULTATION HISTORY

This section briefly describes past activities relative to this formal Section 7 consultation.

An opinion on the Coronado National Forest Plan was issued by the Fish and Wildlife Service (Service) on December 6, 1985. That opinion dealt with Forest Service planning for the Pinaleno Mountains outside of a 3,500-acre area centered on the highest elevations of the mountains. This 3,500-acre area, referred to as the Mt. Graham Astrophysical Area, was under consideration for the placement of an astrophysical observatory (Figure 1). (Figures 1, 2 and 5 in this opinion, the only numbered figures included, are from USDA-FS 1988. Some information was added to Figure 5). The Forest Service decided to separate the planning for the Astrophysical Area from the Coronado National Forest Plan and address its management in conjunction with the astrophysical development proposal from the University of Arizona-Steward Observatory (University of Arizona).

The December 6, 1985, biological opinion predated the proposed and final rules for listing the Mt. Graham red squirrel (red squirrel) as endangered. An evaluation of the management policies, goals and objectives contained in the Forest Plan for their effect on the red squirrel was not made at that time.

This formal consultation will address all Forest Service management activities in the Pinaleno Mountains (Pinalenos), including management policies, goals, and objectives in both the Coronado National Forest Plan (Forest Plan) and Mt. Graham Astrophysical Area Plan (Astrophysical Area Plan).

A list of species was provided to the Forest Service for the Mt. Graham Astrophysical Area on April 1, 1986. Two listed species, the Arizona trout (Salmo apache) and peregrine falcon (Falco peregrinus), and three candidate category 2 species, the Pinaleno monkey grasshopper (Eurmorsea pinaleno), southern spotted owl (Strix occidentalis lucida) and the red squirrel, were on that list.

A proposal to list the Mt. Graham red squirrel as endangered with critical habitat was published in the Federal Register on May 21, 1986. We provided the Forest Service with this information informally in May. Our letter of September 22, 1986, updated the original species list.

On January 12, 1987, the Forest Service provided the Service with their assessment of impacts to the Arizona trout and peregrine falcon as a result of actions in the Astrophysical Area. The Service concurred with a finding of no effect to the peregrine falcon. However, owing to a lack of information on the potential for spill of toxic wastes generated by the astrophysical facility and the lack of a commitment to develop a management and spill contingency plan for these substances, we did not concur with the finding of no effect for the Arizona trout. The Forest Service was notified of our conclusions in a letter dated February 10, 1987. The Fore t Service responded to our concerns in a letter dated March 10, 1987, and as a result, we were able to concur with the finding of no effect to the Arizona trout in our letter dated March 30, 1987. This concurrence is contingent upon the development and implementation of a toxic waste management and spill contingency plan should an astrophysical facility be permitted in the Pinalenos.

The Forest Service requested an informal conference with the Fish and Wildlife Service on July 29, 1986, in regard to the proposed endangered red squirrel and proposed astrophysical facility. An August 26, 1986, meeting examined alternative development plans for the astrophysical facility to be included in the draft environmental impact statement, which was released October 7, 1986 (USDA-FS 1986B). Further discussions of the alternatives, potential conflicts with the red squirrel, and ways to analyze or minimize the conflicts were held December 8-9, 1986. The Forest Service prepared a draft biological assessment on their preferred alternative, which was reviewed by Arizona Game and Fish Department (AGFD), University of Arizona, and the Service at a March 25, 1987, meeting. The red squirrel was listed as endangered on June 3, 1987. Critical habitat remained proposed (Fig. 2). The revised biological assessment was transmitted to the Service along with a request for formal Section 7 consultation. The formal consultation period began on June 23, 1987.

The Service established a consultation team with representatives from the AGFD and the Forest Service. The astrophysical area applicant, University of Arizona, was involved in the consultation through the Forest Service. The team met on July 9, 1987, to prepare for a meeting with species and project experts that was held July 14-15, 1987. A representative of the Coalition to Preserve Mt. Graham also attended the meeting. The team met again on July 16, 1987. A meeting to discuss possible reasonable and prudent alternatives was held on July 29, 1987. The team met to consider the draft biological opinion on August 3-4, 1987.

Consultation on the Forest Service preferred alternative was halted on September 17, 1987, prior to the issuance of a final biological opinion. The Forest Service stated that consultation would be reinitiated on a proposed facility that the University of Arizona claimed would meet their minimum astrophysical development needs. The Forest Service further indicated that an expanded biological assessment would be prepared.

The Forest Service held a meeting on December 15, 1987 to discuss the basis for analysis that would be used in the expanded biological assessment (assessment). The assessment (USDA-FS 1988) was completed and transmitted to the Service on February 10, 1988 along with the request for reinitiation of formal Section 7 consultation. The 90-day consultation period began on February 17, 1988.

The consultation team was re-established with personnel from AGFD, the Forest Service, and the Service. A meeting with project and species experts was held March 15-16, 1988. Representatives from University of Arizona and the Coalition to Preserve Mt. Graham were in attendance. A meeting with species experts and the team was arranged on March 28, 1988, prior to the spring red squirrel midden census. The team met to discuss the draft biological opinion on April 8, 1988. The formal consultation period was extended first to June 15, 1988, then to July 15, 1988, to accommodate the evaluation of further information.

Officials from the Service, the Forest Service, and the University of Arizona met on June 3, 1988, to review the reasonable and prudent alternatives then under consideration. The Service and Forest service heard the views of the Gila Valley Economic Development Foundation also on June 3, 1988. Service, Forest Service, University of Arizona, and Arizona Game and Fish Department officials, and a representative of the Coalition for the Preservation of Mt. Graham met on June 15,

1988, to further discuss reasonable and prudent alternatives under consideration. On June 28, 1988, representatives of the Service, Forest Service, University of Arizona, Arizona Game and Fish Department, Coalition for the Preservation of Mt. Graham, and several law firms met to share any new information that may have become available.

This biological opinion is based on information contained in the Forest Service assessment, Coronado National Forest Plan, Mt. Graham Astrophysical Area Plan, status report for the red squirrel, the draft environmental impact statement, technical information from the University of Arizona, conversations and meetings with experts, published literature, and other sources of information.

BIOLOGICAL OPINION

It is my biological opinion that the implementation of the Coronado National Forest Plan as revised by letter dated June 22, 1988, is not likely to jeopardize the continued existence of the endangered Mt. Graham red squirrel because this plan does not significantly increase the existing jeopardy status of this red squirrel.

It is my biological opinion that the implementation of the Mt. Graham Astrophysical Area Plan that includes the establishment of the seven telescope Mt. Graham Observatory on Emerald and High Peaks is likely to jeopardize the continued existence of the endangered Mt. Graham red squirrel because this plan significantly increases the existing jeopardy status of this squirrel.

BACKGROUND INFORMATION: PROJECT DESCRIPTION

This section briefly describes the actions under this consultation.

Both the Forest Plan and Astrophysical Area Plan contain a series of management objectives that will form the basis for further planning to achieve the Forest Service's goal to provide for multiple use and sustained yield of goods and services from the Forest in a way that maximizes net public benefits in an environmentally sound manner. The objectives will be implemented through groups of management practices and activities called prescriptions. Each prescription has a set of standards and guidelines that set performance criteria for each activity. A more detailed explanation of forest planning can be found in the Forest Plan and the final Environmental Impact Statement for the Plan.

The proposed Astrophysical Area was evaluated under the same series of management objectives as contained in the Forest Plan. Once a final decision is made for the Astrophysical Area, the Astrophysical Area Plan will be incorporated into the Forest Plan as a supplement. The supplemented Forest Plan will be reviewed and evaluated on a 10-15 year cycle with revisions or amendments occurring as needed. The Forest Plan is reviewed periodically within the planning cycle which began in 1985.

Forest Plan

The Forest Plan contains a list of wildlife management prescriptions that are applicable to all forest areas and activities. Grazing, mineral development, timber harvest, recreation, and other objectives are all subject to the standards and

guidelines contained in the Forest Plan for wildlife. A number of these prescriptions specifically mention threatened and endangered species and state the Forest Service objectives for these species. A summary of these standards and guidelines is given below:

1. Maintain or improve occupied habitat of commonly hunted species, listed threatened or endangered species and management indicator species through mitigation of Forest activities with the cooperation of Arizona Game and Fish Department and the Fish and Wildlife Service.

2. With cooperation of Federal and Arizona wildlife agencies, develop overall direction for listed threatened and endangered species. Delist federally and state listed threatened and endangered species in accordance with species recovery plans. Reoccupy historic habitat Forest-wide with other identified species.

3. Reintroduce extirpated native species into historical habitats in accordance with cooperative interagency plans.

4. Consult with Arizona Game and Fish Department and the Fish and Wildlife Service during the environmental analysis process on projects significantly affecting wildlife and threatened and endangered plant habitats.

5. Determine presence of federally and state listed threatened and endangered plant and animal species in project areas through site inventory and consultation with existing data bases as part of environmental analysis completion. Recommendations for habitat needs will be made on a project by project basis.

6. In cooperation with Arizona Game and Fish Department and the Fish and Wildlife Service, develop a general activity plan for state and federally listed threatened and endangered species. This directional plan would guide habitat management on the Forest by:

   a. Determining critical habitat for threatened and endangered species and prescribing measures to prevent the destruction or adverse modifications of such habitat.

   b. Recommending appropriate conservation measures including the designation of special areas to meet the protection and management needs of such species.

   c. Setting priorities for completion of recovery plans in memoranda of understanding by species.

   d. Establishing a time frame for item c above.

   Habitat requirements, research needs and transplant goals with completion dates would be outlined for each species within the recovery plan.

7. Develop management plans for designated endangered species critical habitat on a site by site basis as species recovery plans are completed.

8. Within occupied habitat of threatened and endangered species, specific recommendations regarding mineral entry and oil and gas exploration will be made on a site by site basis to protect such species.

9. Tolerance levels for threatened and endangered species to recreation will be established on a project site by site basis.

10. In areas of threatened and endangered species habitat, fuelwood harvest standards and guidelines will be modified as necessary on a site by site basis.

11. Tolerance levels for threatened and endangered species for new construction and maintenance of roads will be established on a project by project basis.

12. Transplant listed threatened and endangered and other identified species into suitable habitat following guidelines of species recovery plans and memoranda of understanding.

13. Consider structural improvements and maintenance for threatened and endangered species' habitats as technology develops.

14. Timber management priorities are to enhance wildlife and recreation resources.

15. Utilize prescribed fire in wilderness to enhance wilderness values, including restoration and maintenance of threatened species habitat.

The Forest Plan contains other prescriptions which pertain to wildlife values that would also concern threatened and endangered species management. For information on those prescriptions, please refer to the Forest Plan (USDA-FS 1986A). On June 22, 1988, the Forest Service submitted to the Service an amendment to the Forest Plan to be considered under the consultation. The amendment contained the following management directives:

1. The proposed Snow-Flat Treasure Park Campground would be deferred until the next planning period which will allow time for development of the recovery plan and additional research on this species. Riggs Ridge Campground development would be allowed this planning period although actual construction would likely not occur for at least several years, also allowing time for more species research and recovery planning.

2. Vehicle access onto Forest Roads 507 and 669 would be closed at mile post 1.8. This closure is "elo[illegible] the wall" near the bo[illegible] of the proposed critical habitat.

3. Measures for pet (dog) control within the "Refugium" will be developed and will involve total prohibition or leash restrictions.

4. Dispersed recreation would be allowed in management area 2A. If research and/or monitoring indicates that conflicts are present or have the potential to develop, then steps will be taken to modify the dispersed recreation guidelines to minimize or avoid these conflicts. Closure alone of Forest Road (FR) 507 and 669 to vehicle access is predicted to reduce recreational visitor use to one-third of current levels.

5. Compliance with regulations, monitoring of use, and education of the Forest users would take place through the use of a recreation technician or other personnel working in the area.

Within the area covered by the Forest Plan, consumptive uses such as grazing, mineral development, oil and gas exploration, timber and fuelwood harvest and recreation uses, will be subject to both their own prescriptions as well as the wildlife prescriptions discussed previously. There have been changes made to the Forest Plan for these uses in the Pinalenos to protect the red squirrel. No fuelwood gathering will be permitted within suitable habitat for the red squirrel to preserve the downed log component of the habitat. There is no timber harvest within red squirrel habitat. Grazing is not and has not been permitted in red squirrel suitable habitat. There will also be no expansion of the two organizational camps located within the red squirrel habitat.

Total recreation use in the Pinaleno Mountains is estimated in the vicinity of 220,000 visitor use days per year (USDA-FS 1986B). This is approximately half of the projected capacity of 470,000 visitor use days per year. Access for 96 percent of the visitors is along Swift Trail (SR 366) where most developed public and private recreation sites are located (figure 1). Estimates place recreation growth at 2 to 5 percent per year. At a rate of 5 percent, recreation use would be in the vicinity of 432,000 visitor use days in the year 2000.

The increased visitor use includes both a campground and dispersed recreation component. There are 47 established dispersed campsites above 7,000 feet elevation in the Pinalenos accessible via Swift Trail. The High Peak area is a popular destination for dispersed campers, hikers, and picnickers. Present use is estimated to be 6,000 Recreation Visitor Days (RVD's), increasing to 7,300 RVD's by the year 2000 without any road closures. With the restrictions on vehicle access to FR 507 and 669, RVD's are expected to drop to 1,900 and only increase to 2,400 by the year 2000 (USDA-FS 1986B). Combined recreational and camping use of established campsites would retard or prevent reforestation of heavily used areas due to trampling, parking, and camp area maintenance. Much of the impact would be in existing recreational use areas and would not involve new habitat losses. In addition, there is no irretrievable commitment in these areas that would prevent their restoration as squirrel habitat if data show such a need.

The Forest Plan contains a large area that would be recommended for Congressional designation · wilderness. Cyclical review of the Forest Plan would not affect management of designated wilderness.

Astrophysical Area Plan

The Astrophysical Area Plan contains the same specific standards and guidelines as the Forest Plan with some additions designed to emphasize management for the red squirrel. These additions are summarized below:

1. Designate a 470-acre Research Natural Area for the purpose of maintaining the acreage in a natural climax vegetative state.

2. Designate an additional 743 acres as wilderness.

3. Assess needs for and design of studies for both red and tassel-eared (Sciurus aberti) squirrels in the management area.

4. Reforest, either by encouraging natural regeneration or by artificial means, existing fuelbreaks and clearcuts to increase habitat for closed canopy old growth forest-dependent species, including the red squirrel.

5. Monitor red squirrel populations and habitats annually through intensive inventory and analysis.

6. Any timber harvest activities with appropriate stand examinations will be done only to benefit specific wildlife or recreation values after consultation with appropriate parties (Fish and Wildlife Service, Forest biologist and Arizona Game and Fish Department).

7. Recommend withdrawal from mineral entry and mineral leasing on all 3500 acres to protect essential habitat for Federal and State listed threatened and endangered species, recreational opportunities and recreational/astrophysical site investments.

Grazing, commercial timber harvest and fuelwood harvest would be prohibited within the Astrophysical Area and some recreation uses would be curtailed. Daytime motorized access would be allowed on FR 507 and FR 669; however, nighttime access would not be allowed above "the wall" on FR 507 (approximately 3.6 miles above the junction with State Route 366). Public motorized access would be prohibited on FR 507 and FR 669 from approximately November 15 to April 15 due to snow conditions. A gate would be located at the base of FR 507 to enforce the closure. Other roads would be closed and reforested.

Camping and hiking would be allowed in the Astrophysical Area except for certain restrictions in the Astrophysical Use Area to protect the instruments. The High Peak Cienega trailhead would be relocated to below "the wall" to line up with a new parking area at that location.

Approximately 24 acres would be allocated under a special use authorization for the proposed Mt. Graham Astrophysical Observatory (Observatory) by University of Arizona (Fig. 1). A restricted public use area would protect the Observatory from human activities, such as campfires, gunfire and radio transmissions, that could affect the proper operation of the telescopes. Otherwise, all prescriptions described for the Astrophysical Area apply.

The proposed Observatory includes three major components: the access roads (FR 507 and 669), Emerald Peak facilities, and the High Peak facilities. The development plan provides for seven telescopes, logistics buildings, support facilities, a buried powerline, sewage leach fields, utility boxes, as well as public parking and picnic areas.

Some widening and realignment of FR 507 and 669 would be required to provide year round access to the Observatory. Unlike the existing conditions, these roads would be kept cleared of snow but with restricted access during the winter. Some new roads would be constructed at Emerald Peak to serve the telescopes.

Four of the seven telescopes, the 11.3 optical/infrared (IR) binocular, two 8M optical/IR and the submillimeter interferometer array would be located on Emerald Peak. The remaining three, an 8M optical/IR, a 5M, and 10M submillimeter telescopes, would be sited on High Peak.

The site development plan also contains measures to minimize tree cutting and clearing, and reduce windthrow and other physical degradation of existing red squirrel habitat. These measures will be addressed more fully under Impacts of the Action.

BACKGROUND INFORMATION - MT. GRAHAM RED SQUIRREL

This section briefly examines the biology of the red squirrel.

The Forest Service expanded biological assessment (USDA-FS 1988) provides detailed information on what is known about the Mt. Graham red squirrel, including its habitat, current population, and predicted vulnerability to extinction. Refer to that document for information not contained in this summary. Much more information needs to be gathered on this squirrel.

Taxonomy

The Mt. Graham red squirrel was first described in 1894 from three specimens taken on August 17-19, 1894, in the Pinaleno Mountains by W.W. Price and B.C. Condit. The collection records show the three were taken from the fir forest on the summit of Mt. Graham. The species was officially described by J.A. Allen in 1894 in the Bulletin of the American Museum of Natural History (Arizona Game and Fish Department 1985). The subspecies was recognized on the basis of difference in color and later differences in size and various morphometric characteristics. There may also be differences in behavioral characteristics that separate the Mt. Graham subspecies from other red squirrels.

Habitat Requirements

The Mt. Graham red squirrel is found in conifer forest, especially old growth spruce-fir, Douglas fir and mixed conifer types in the upper elevations of the Pinalenos. Engelmann spruce (Picea engelmanii), corkbark fir (Abies lasiocarpa) and Douglas-fir (Pseudotsuga menziesii) seeds are the primary food of the red squirrel, though Engelmann spruce is the most important source of food. The cones containing these seeds are cached by the red squirrel in storage areas or middens. Other foods include mushrooms and rusts, bones and carrion, spruce and

fir cambium, pollen and spruce/fir buds, and perhaps berries and seeds of broad-leaf trees and shrubs. Each of these foods has a seasonal importance. The stored cache of closed conifer cones in each squirrel's midden provides food through the winter.

C. Halvorson (1988A) judges the existing excellent rated Mt. Graham red squirrel habitat as not being well provisioned with either red squirrel food or shelter components as compared with what are considered excellent coniferous red squirrel habitats in the northern Rocky Mountains. There may be differences in the most critical habitat components between these two areas due to ecological and climatic conditions within the habitat that result in differences in red squirrel population densities or responses to habitat or climatic changes.

Closed conifer cones provide most of the food base in the Pinalenos. Unlike other red squirrel habitats, there is a marked paucity of grasses, herbaceous material, and berry producing shrubs that contribute significantly to the food base of other populations. The Mt. Graham red squirrel has only buds, cambium, and mushrooms as supplementary foods and none are available enough to sustain the red squirrel on a long term basis.

Middens may be constructed inside a standing hollow tree, in association with downed logs, or at the base of a large live tree. Middens are usually located near good cone crop producing trees within the territory of a squirrel. It is not known how long it takes to establish a midden that can hold enough cones to sustain a squirrel through a winter.

The microclimate necessary to support a midden is critical to the continued existence of the squirrel. Areas that are dark, cool and moist aid in keeping the cones from drying, opening and losing the seeds to other seed eaters and decay organisms. In the Pinalenos, the red squirrel and the spruce-fir forest upon which it depends reach the southern most extension of their range. At the latitude of the Pinalenos, solar radiation is as much as 46 percent higher than at the northern end of the red squirrel's range. This increase in solar radiation results in a drier and warmer microclimate for middens. Compounding this situation is the low water vapor found in the desert air. Red squirrels in the Pinalenos must be more selective about midden sites than the northern subspecies because of the dryness-solar radiation condition at this latitude. Sites that possess the necessary microclimate are not abundant. Younger age stands of trees or areas that have been opened up by logging, windthrow or other causes do not provide good midden sites as they tend to be warmer and drier. Data from areas outside the Pinalenos for different red squirrel subspecies indicate substantial differences in red squirrels per unit area in logged versus unlogged areas. There are significant decreases in midden densities in logged areas when compared to unlogged areas. Opening the canopy enables wind and sunlight to degrade midden habitat. Loss of midden habitat renders areas largely unsuitable for squirrels despite the continued presence of cone producing trees.

In addition to good cone producing trees and midden sites, red squirrels generally require trees for nesting. Nests are typically near middens. Young of the year squirrels may not be able to establish a midden their first year; thus, overwintering areas may be especially critical for juvenile survival. Such areas may be in

lower elevation habitats now occupied by the tassel-eared squirrel and may no longer be fully available to juvenile red squirrels.

Population Size

Using data on tree stand type and quality, survey transects, vegetation plots and other data, the forest habitats in the Pinaleno Mountains were evaluated for their current relative quality as squirrel habitat. A total of 22,436 acres were evaluated. Of this acreage, 11,733 acres were considered to contain habitat ranging from excellent to very poor and 10,703 acres were judged to have no potential for squirrels. A breakdown by habitat quality is given below:

Habitat Quality	Acres	% of Total	% of Suitable
Excellent	472	2.10	4.02
Good	1,564	6.97	13.33
Fair	1,182	5.27	10.07
Poor	2,747	12.24	23.41
Very Poor	5,768	25.71	49.16
Not Suitable	10,703	47.71	-0-
TOTAL	22,436	100.00	99.99

Areas within the suitable habitat were intensively surveyed for red squirrel middens in May 1986 and October 1987. Using numbers of observed active middens and acreages of habitat quality, an estimate of total population was made for spring of 1986 (328 ± 55), the fall of 1987 (246 ± 40) and spring of 1988 (215). Active middens per habitat quality and density figures are given below:

Habitat Quality	Acres	1986 Active Middens	Density Active Middens Per Acre	1987 Active Middens	Density Active Middens Per Acre
Excellent	472	71	.15	53	.11
Good	1,564	128	.08	96	.06
Fair	1,182	46	.04	35	.03
Poor	2,747	41	^2	30	^1
Very Poor	5,768	42	.01	32	.005
TOTAL		328		246	

Converting active midden counts to the actual population of red squirrels is not entirely accurate. Although assumptions were made concerning midden activity areas (containing one or more middens) in calculating the potential population, we do not know enough about activity areas in the Pinalenos to be confident of the assumptions. The actual number of midden activity areas may be higher or lower than hypothesized for a particular year. The number and density of active midden activity areas were also used to determine density for acres of red squirrel habitat not included in the surveys. If areas surveyed had higher or lower densities than areas not surveyed, extrapolated density figures would be in error, leading to errors in the population estimates. Further complicating matters is the fact that habitat acreages of equal quality were clumped together to create the estimate, thus approximating a contiguous habitat instead of a fragmented one as exists in the Pinalenos. Given these factors, the population estimates may be somewhat optimistic, but are the best available.

The figures given reflect only that portion of the population that possesses a midden activity area. Juveniles may not be accounted for depending on when the survey was made and transient adults would not be included in any survey. Mortality may be significantly higher for these non-midden related animals, decreasing their contribution to recruitment.

The population estimates we have represent three points on a curve of the red squirrel population cycle. Two are at approximately the same time of year (May 1986, March 1988) and one is not (October 1987). We do not have any data that show whether the red squirrel is near a high, low, or mid-point of its population cycle and what the changes from 1986 to 1988 tell us. We do know that the estimated population size has declined 33 percent in 2 years (328 to 215) and we cannot be sure we have reached the low point on the population curve in 1988.

The Forest Service attempted to estimate potential carrying capacity for red squirrels in the Pinalenos. The Habitat Capability Model (HCM) was used to develop one of the carrying capacity estimates. Using values for food and cover characteristics of different age and stand quality of spruce-fir and mixed conifer types and a pre-set red squirrel density figure, the HCM generated a predicted maximum of 502 carrying capacity units. This number was based on a density in excellent habitat in the best population years of 0.23 red squirrels/acre. This number may be somewhat over estimated due to the consolidation of small habitat areas. In non-peak years the population will not approach carrying capacity.

Another carrying capacity estimate may be made using the total number of active and inactive middens as an index. A red squirrel activity area contains a primary midden and any number of secondary or satellite middens that may or may not be actively used in a particular year. In a peak population year, all potential activity areas will be occupied. Some secondary middens may be used by juvenile squirrels if the adult tolerates them. Distances in an activity area between middens will vary due to habitat quality, local features, and red squirrel energy costs to maintain the area. Therefore the number of potential activity areas is some factor less than the total number of middens found except in peak years where it may equal or exceed the number of middens found (C. Halvorson 1988B). Using the two survey periods, a total of 444 active and inactive middens is estimated.

With the estimated maximums of 502 and 444, remembering that these numbers represent an optimistic level of carrying capacity, we can grossly estimate the population cycle of the red squirrel. Rodent populations undergo periodic population fluctuations (Elton 1939). If we assume a mean population of 222 to 251 based on estimated maximums, we see that the 1988 population of 215 is approximately one-half of a potential maximum.

Red squirrel populations, like all rodent populations, undergo very wide population fluctuation. Records from other populations indicate a 60-80 percent loss in population in one year is possible (Wolff and Zasada 1975). Other data indicate that populations may vary as much as four times around their balance point (C. Halvorson 1988B). Given the red squirrel population levels and maximum potentials, the low point of the population may drop below 100 animals.

Density surveys in 1986 of red squirrels in the Pinalenos averaged 15 squirrels per 100 acres in excellent habitat. This figure is unusually low in comparison to other densities for the species in North America. Densities of other red squirrel subspecies of 35 to 277 per 100 acres in Alberta, Canada (Rusch and Reeder 1978) and 51 to 101 per 100 acres elsewhere in Arizona have been reported. Only a logged area in Arizona, at 16 middens per 100 acres, approached the maximum densities seen in the Pinalenos (Vahle 1978).

There is considerable evidence that the red squirrel was once more widespread in the Pinalenos. Surveys in 1914 reported capturing red squirrels at between 6,685 and 9,906 feet elevation and were reported as being common above 8,417 feet elevation in spruce-fir forests (Hoffmeister 1986). By the 1950's red squirrels were not observed in historic locations and researchers in the 1960's failed to find any at all (Minckley 1968). The species was again recorded in 1971 and surveys completed for the species status report in 1984 found 31 individuals (Spicer et al. 1985). Further surveys in 1985 and 1986 located 177 red squirrel middens. The population estimates contained in the assessment were based on the 1986 and 1987 midden survey data.

Current Status

The Mt. Graham red squirrel was listed as endangered on June 3, 1987. In the final rule that determined the subspecies to be endangered, modifications to or loss of habitat and interactions with the tassel-eared squirrel were listed as the primary factors in determining the species' status.

The loss of habitat to the red squirrel parallels the logging of the Pinalenos from 1880 to 1973. Logging began in the lower elevation ponderosa pine and oak areas and may have resulted in physical changes to these areas that made them less usable by red squirrels. Logging operations reached the mixed conifer types in the 1946-1958 period and the spruce-fir types on the summits in 1963. It was in the period of the 1950's and 1960's that researchers noted the disappearance of the red squirrel (Minckley 1968).

In addition to timber harvest, roads destroyed forest habitat directly and also indirectly through opening edges and windthrow that opened forest canopies, drying soils and middens. The 1956 Nuttall Fire burned 29,000 acres of shrub and forest

habitats, further removing red squirrel habitat. Construction of campgrounds for the increasing number of recreationists also removed some potential habitat areas.

In the 1940's, the Arizona Game and Fish Department introduced the tassel-eared squirrel to the Pinalenos. This species has expanded into the ponderosa pine and mixed conifer forests and may be competing with the red squirrel in those areas. The tassel-eared squirrel has also been reported in the spruce-fir habitat. Much of the present tassel-eared squirrel habitat would not support middens but may have been important over-wintering sites for red squirrel young of the year.

Another factor in the current status of the red squirrel is the impact of human presence. The red squirrel elsewhere in its range has adapted to the presence of people and their facilities within suitable habitat. We do not have information, however, as to the reductions in habitat use that result from human disturbance. In areas with abundant habitat and large red squirrel populations, impacts from human presence may not be readily apparent. The effect of people on Mt. Graham red squirrels is unclear.

The past logging, road construction, campgrounds, forest fires, and perhaps introduction of the tassel-eared squirrel in the Pinalenos have resulted in fragmentation and reduction of red squirrel habitat. Maps of known midden sites indicate that most of the middens are concentrated above 9000 feet near the summits of the Pinalenos (figure 5). These areas are the most essential to the survival of the red squirrel as a subspecies, both in the long and short term, of all habitats on the mountain. Of the 11,733 acres of suitable habitat remaining, only 2,036 acres are good to excellent habitat. This small area represents 17 percent of all suitable habitat and currently supports 60 percent of the remaining red squirrels. This habitat is essential for the survival of this species.

During the consultation, efforts were made to estimate the past population or carrying capacity for red squirrels in the Pinalenos. The Forest Service, using HCM, had projected a carrying capacity of 725 units at 200 years in the future. The increase over present carrying capacity (502) was due to growth and development over a 200-year period of red squirrel habitats in the mixed conifer forest. Only four units were gained in the spruce-fir areas that contain most of the currently rated excellent or good habitats, indicating low potential for further increase in these habitats.

The 725 units can also be projected back in time to approximate the condition of the mountain prior to significant human impacts (pre-1880). Because the 725 figure does not include areas that would remain as habitat already disturbed by humans (i.e., State Route 366, campgrounds, etc.), it is actually a low estimate of historic carrying capacity. It also assigns no value to lower elevation habitats disturbed by logging, fires and other incidents and currently occupied by the tassel-eared squirrel. These habitats may have provided some value to red squirrels in the past. Taking into account these factors and information concerning persistence in size of small populations, a speculative estimate of 1000 units in the 1880's was made. This estimate, even though speculative, can serve as an indication of trend. If the present maximum carrying capacity, 502, is compared to the possible past carrying capacity, a loss of 50 percent of 1880's capacity is estimated. The spring 1988 optimistic population estimate of 215 is only about 20 percent of the speculative 1880's potential maximum of 1000.

Refugium

An examination of maps with plots of known middens shows a definite concentration of middens in the Emerald-Hawk-High Peaks area. In the assessment, the 882 acres above 10,200 feet contain 136 middens (figure 5). If the boundary is adjusted to conform to the proposed critical habitat area around High Peak (Mt. Graham on maps), an additional 10-15 middens are added. This represents approximately 27 to 30% of the present carrying capacity of 502. Because this area contains the longest contiguous stand of good to excellent habitat and the densest concentration of red squirrel middens, we consider it to be the core or refugium of the population. For the sake of convenience, the critical habitat boundary proposed in the Federal Register Vol. 51, No. 98, May 21, 1986, for the Hawk Peak-Mt. Graham area will be used to define the refugium.

This area, in all likelihood, provides the best existing habitat components for the survival of this species, more so than any other area in the Pinaleno Mountains. Refugia are extremely important because they provide for the core population of the species and are most able to survive a catastrophe (e.g., prolonged drought, major fire or disease outbreak). This population is also the main source of individuals to re-colonize other areas hit by catastrophes. The refugium must be of sufficient size and quality to ensure enough individuals of the population survive the catastrophe to maintain the integrity of the species. There are other clusters of middens found in areas of good to excellent habitat, but none are large enough to serve as refugia for the red squirrel. Over time, as the forest regenerates, we would expect that the area around Webb Peak and Ash Creek drainage would become more important red squirrel habitat and connect with the Emerald Peak portion of the refugium.

Vulnerability to Extinction

The Mt. Graham red squirrel is, for several reasons, extremely vulnerable to extinction. As an isolated subspecies with only one population, it is inherently vulnerable, especially to environmental catastrophes that effect significant portions of the habitat (Halvorson 1988A and Soule 1988). The red squirrel has survived such natural catastrophes over its 10,000 year isolation. The effects of human activities since the 1880's, however, have severely compromised the ability of the red squirrel to survive subsequent similar events in the near future.

The red squirrel has both a low population and a low population density. There is also a limit on current carrying capacity that effectively prevents expansion of the population to substantially safer levels. There has been considerable effort in recent years to define a "safe" population level that would ensure the survival of a species over a set period of time. Estimates of 500 individuals have been proposed in the literature; however, this figure varies with the type of animal or plant involved, the time period, genetic heterozygosity in the population, and other factors.

Two estimates of threshold level population size have been developed for the red squirrel in the Pinalenos. Dr. C.C. Smith (USDA-FS 1987) estimated that 150 individuals in the spring would be the lower limit able to sustain the population. C. Halvorson (1988A) suggested that a median spring population of 300 adults and

yearlings would be a safe minimum with numbers as low as 200 to 250 acceptable on a short term, if the population in both estimates is on the verge of increasing through recruitment during the summer.

The estimated spring red squirrel population based on midden counts was 326 in 1986 and 215 in 1988. We do not know if these estimates represent the low range of a vigorous population or the high of a non-vigorous population. We are inclined to believe the population reflects the latter. This is the belief, in part, because of the 246 midden count of October 1987, which was recorded when the population should have been close to its seasonal maximum. Low populations are also critical when normal population level fluctuations occur. The low population and carrying capacity increase the natural vulnerability of the red squirrel to catastrophe.

Both the red squirrel and the spruce-fir habitat upon which it depends are at the extreme southern edge of their range and are subject to stress of temperature, isolation, and dryness that strongly influence their survival. The extremely low density of red squirrels in the Pinalenos may be an indication of the population's response to a habitat under stress. As stated previously, the Mt. Graham red squirrel is dependent upon cone crops for the major portion of its food source.

Dependence on cone crops alone is hazardous. Conifers do not produce large cone crops every year and there is the additional variance involved in seed viability. The tree species the red squirrel depends on are at the southern limit of their range and may, therefore, produce fewer good cone crops and have lower seed viabilities than in other portions of their range. Douglas fir produces good crops every 2 to 11 years, Engelmann spruce every two to five years and corkbark fir is intermediate between them in other areas of their range. We do not know how often conifers in the Pinalenos produce good cone crops; however, an estimate of two good, two bad and six intermediate cone years per 10 year cycle has been made. We have no data on seed viability, a factor as important as cone numbers, because it is viable seeds that provide food for the red squirrel. Red squirrel numbers are more likely to fluctuate sharply in response to cone crops than if there was a substantial natural alternative food base. The lower elevation oak and pine habitats that may have provided an additional food resource for red squirrels in the past may no longer be fully exploitable by red squirrels due to possible competition with the introduced tassel-eared squirrel.

In the event of extensive and consecutive cone crop failures, no significant alternative food source exists for the Mt. Graham red squirrel and high mortality may result. Because the habitat is so constrained, environmental conditions that eliminate the cone crop are likely to affect all or most of the available habitat, and thereby all or most of the red squirrel population.

The vulnerability of the red squirrel is increased because of the limited knowledge of its life history, as well as limited information on the quality of its environment. We have insufficient data on the reaction of this squirrel to recreation and land uses, and on breeding habits, fecundity, and survivorship. We have extremely limited data on location of this squirrel in relation to its population cycle. We do not understand red squirrel activity areas or dispersal patterns, cone crop production cycles, or seed viability. The limited information base requires a cautious approach before proceeding with additional habitat disrupting activities. This approach ensures that those actions would not further jeopardize the continued

existence of the red squirrel. Development related losses to the red squirrel, that would be imposed on natural population cycles, could cause the squirrel to fall below minimum populations necessary for survival in the event of a catastrophe. Even in a non-catastrophic situation, a small additional squirrel loss, as a result of human activities, could be sufficient to reduce the red squirrel population levels below the extinction threshold during low points in the population cycle.

The influence of the tassel-eared squirrel on the red squirrel is also a significant question. The nature and extent of their interaction must be identified prior to any program to control tassel-eared squirrels. The habitat quality of the area where red squirrels and tassel-eared squirrels overlap should also be evaluated. The unknowns surrounding these interactions add a potential additional threat to the continued existence of the red squirrel.

The long term survival and recovery of the red squirrel depends upon increasing the quality and quantity of habitat, and concurrently eliminating or reducing man-caused mortality and interference with red squirrel reproduction. Elimination of the fragmentation within existing habitat and restoration of other contiguous potential habitat areas will be especially important. This will increase the amount of contiguous habitats and reduce wind and solar effects in adjoining habitats. It can be achieved by reforesting existing timber harvest areas, fuelbreaks, and roads and blowdowns, but may take nearly 200 years. Restoration of degraded areas within the good to excellent habitats, especially in the refugium and areas adjacent to it, would help to maintain this essential area. Restoration of areas that are potentially good to excellent habitat are also very important. The Forest Service has predicted, using HCM, that few new squirrel equivalents are attainable at the higher elevations. More units would be attained at lower elevations where the mixed conifer forest occurs. However, maximum benefits are 200 years away. The Forest Service has estimated it will take that long to develop the old growth habitat needed by the red squirrel. The larger and better the core or refugium area, the higher the probability of survival of the species until habitat recovery can occur. It will take decades, at least, to eliminate or substantially reduce further increases to the red squirrel's vulnerability to extinction caused by past human activities.

IMPACTS OF THE ACTION: FOREST PLAN

This section describes the impacts of the Forest Plan on the red squirrel.

Land Management Prescriptions

Overall, implementation of the land management prescriptions and associated standards and guidelines contained in the Forest Plan and Astrophysical Project Plan are an improvement over the status quo for the red squirrel. The emphasis on management to maintain and enhance habitat is of special importance in this determination. The commitments to reforest the fuelbreaks and degraded areas will begin the reforestation process vital to the long term survival of the red squirrel. Controls and prohibitions on timber and fuelwood harvest, expansion of existing human use facilities, and recreation use preserve existing red squirrel habitat and protect individual red squirrels from excessive disturbance. The prescriptions concerning the commitments to develop and implement recovery plans, monitoring, and other protective features are also necessary to secure the future of the squirrel.

As standards and guidelines contained in the wildlife protection prescription are adhered to and guided by red squirrel needs, adverse effects to the red squirrel from consumptive uses such as commercial timber harvest and fuelwood cutting will be minimized or eliminated. Areas are present in the Pinalenos where these activities may take place without affecting the red squirrel. In addition, proper reforestation will require timber stand management to enhance old growth development, prevent disease outbreaks, and suppress the likelihood of fire.

Recreation

Increases in recreation use of the Pinalenos would adversely affect the red squirrel in several ways. Direct mortality is the most obvious adverse affect. With the increase in traffic on both FR 507 and FR 669 and the Swift Trail, road kills of red squirrels will likely increase. In 1987, one kill was documented on Swift Trail and another two or three were reported but not confirmed. Road kill deaths may be highest during juvenile dispersal; however, any animal whose midden activity area is near a road is at risk. Other forms of direct mortality may include poaching, accidental shooting and capture by pets.

Equally important is the loss of habitat and habitat components due to recreational activities. Fuelwood gathering for campfires, mushroom and berry picking that removes scarce supplemental food resources, trampling of tree seedlings at campsites and other areas, all have some effect on red squirrels. The construction of a new campground at Riggs Ridge would remove 23.3 acres of currently rated very poor habitat. Over the long term, this habitat would continue to rate as 23.3 acres of very poor habitat because it is too low in elevation to support either mixed conifer or spruce fir.

The third type of impact to red squirrels from recreationists is the least understood. Red squirrels are not notoriously shy animals. In many places throughout their range, they are found in close proximity to human developments and adapt to human presence quite readily. However, there are indications that the type of human activity involved may affect the degree of red squirrel adaptation, and that the Mt. Graham red squirrel may be more vulnerable to human use impacts than other red squirrels.

Recreationists are an uncontrolled impact. They are not concentrated in one place and can thereby reach any area of red squirrel habitat, although those midden activity areas nearest developed or established campsites, roads, or trails, would be most affected. Red squirrels are attractive small mammals that have a high level of acceptability with the public. If one is seen, people would attempt to get closer for a better look and perhaps take pictures. The red squirrel remains within its midden area and does not flee very far away if it feels threatened. Presence of people on the midden interrupts normal activities to some extent (some red squirrels in the Pinalenos are less shy than others) but may also lead to attempts to abuse the animal (throwing items in an attempt to hit it or attempt to capture it), lure it with unnatural foods (pecans, crackers, etc.) or vandalism of the midden. Because the Mt. Graham red squirrel seems less wary than other subspecies, it is more vulnerable to these types of physical abuse, or of capture by dogs (C. Halvorson 1988C). The approachability of the red squirrel in the Pinalenos has been noted by both Forest Service and Service personnel.

We do not infer that recreationists are intentionally disruptive. What may seem to be undamaging wildlife observation may be affecting the red squirrel in subtle ways. Watching intruders instead of gathering and storing cones has an effect on winter survival and if intruders enter into the immediate midden area, storage activities are disrupted. The red squirrel may also be less aware of other potential dangers (i.e., predators such as goshawks) if engaged in observing humans in the vicinity of the midden. Data from other areas (C. Halvorson 1988D) indicate that portions of an activity area or part of a midden may be abandoned if human presence becomes too intrusive. An animal disturbed by capture or harassment on the midden may not utilize the area where the action occurred. Red squirrels avoid areas of dense camping and would likely abandon a midden activity area that contained a well used camp site within 25 feet of the main storage area (C. Halvorson 1988D). Red squirrels with young in the nest are the most sensitive to nearby uses or intrusions into the midden activity area.

Preliminary information suggests that intermittent exposure to an impact is more deleterious than a continuous exposure (C. Halvorson 1988D). Red squirrels apparently adapt better to a continuous human presence than one that appears at irregular intervals and irregular levels. The constant exposure allows the animal to study the intrusion over time and adapt to its presence. This assumes that the intrusion is of a low enough level that red squirrels do not immediately leave the area and not return. A low level intermittent intrusion would be less disruptive than either a larger intermittent or a larger continuous intrusion. For example, an occasional hiker passing through a midden activity area without stopping is far less intrusive than a well used picnic or camping area in the same area or a permanently manned station. The station would likely have a zone of abandonment around it, the extent of which would be related to the difficulty the red squirrel has in adjusting to its presence.

In sum, recreationists are involved in direct mortality through road kills and harassment deaths from dogs, rocks, or poaching, and in habitat losses for recreational facilities. In addition, through harassment impacts that we do not clearly understand, recreationists also adversely affect the ability of the red squirrel to behave normally. Recreation impacts are mostly intermittent, with levels of use varying seasonally and weekly, as well as by location. It is our conclusion that the effects of recreation on the red squirrel may be significant and that increases in use levels within the best habitat for the red squirrel is not without some risk. More study is needed to define the problem.

The number of recreationists in the Pinalenos is going to increase during the planning cycle. Commitments by the Forest Service to curtail recreation use within the refugium would protect that area from the effects of increasing recreational use and enable monitoring to determine the extent of this concern. Allowing for recreation to continue as presumably envisioned within the remainder of the Pinalenos will provide us with the opportunity to study human/red squirrel interactions to determine proper management.

With the two-thirds decrease in recreation use within the refugium and the commitment to evaluate and correct any problems regarding the concerns raised in this document regarding recreation, the projected increases in recreation do not significantly increase the level of jeopardy to the red squirrel.

Special Management Area

The establishment of the proposed Research Natural Area and Wilderness in the Pinalenos would protect those areas from future development. This protection benefits the red squirrel by protecting the integrity of its habitat. It should be noted that management restrictions inherent in such designations may limit some types of silvicultural actions that could benefit the red squirrel within the boundaries of these areas. The degree of this limitation cannot be established at this time. Depending upon the administrative design of the Research Natural Area, recreation impacts within it could be controlled.

IMPACTS OF THE ACTION: ASTROPHYSICAL AREA PLAN

This section describes the impacts of the Astrophysical Area Plan on the red squirrel.

Astrophysical Use Area

The establishment of the restricted use area would, of itself, have very limited effects on the red squirrel. The protective Forest Service prescriptions would apply to this area and the restrictions to public use inherent in this area may provide a slight benefit to the species. This benefit would be countered by the increased disturbance and intrusion at the Observatory development areas.

The following discussion of effects resulting from the Observatory comes in part from the expanded biological assessment.

Physical Habitat Impacts

The Mt. Graham Observatory would be located on Emerald and High Peaks. Immediate fire suppression and mineral withdrawal would likely protect red squirrel habitats in the vicinity of the project.

A site plan for the Mt. Graham Observatory was included in the biological assessment. This assessment also contained measures that would be followed to reduce the acres disturbed by construction and operation of the facility. The measures to reduce impacts on the spruce-fir forest included restrictions on forest clearing with trimming and topping preferred over clear-cutting. Raising of telescope pedestals is also planned to minimize trimming. Clearings will be designed to minimize windthrow. Revegetation of degraded areas is also included.

The Observatory would require clearing of .90 acres of trees on High Peak, 2.34 acres on Emerald Peak and 1.3 acres for road widening along FR 507 and 669 plus new spur roads. An additional 18.82 acres previously cleared of trees (cleared but in some locations beginning to naturally revegetate) would be used for buildings and roads to serve the new Observatory. A total of 23.36 acres would be committed to the Observatory for astrophysical development and the associated road system (Appendix Table 1).

The High Peak habitat is currently degraded, open canopy spruce-fir as a result of past management actions (road construction and logging). No red squirrel middens are in the area where the telescopes would be sited; however, two squirrel middens

are located within approximately 350 feet of the perimeter road. The probable food gathering territories of these two squirrels would be directly impacted by the line of sight tree cutting for the 5M and 10M submillimeter telescopes. In addition, the proximity of these two middens to each other requires that significant portions of each foraging territory may include the area on top of High Peak where the three telescopes and related facilities would be constructed. The construction of the facility would remove significant amounts of this habitat. Unless there is sufficient alternate foraging habitat available, these two middens may no longer be viable for red squirrels. In a worst case scenario, the two middens could be lost.

Emerald Peak contains a large fuelbreak and an area of windthrow, but excellent closed canopy habitat is found there. Eight middens are located in the triangle formed by the existing road and new spur roads. Another midden is located adjacent to the large 11.3M binocular scope site. The other eight middens are already affected by wind and solar degradation because of the existing roads; however, due to road widening and extension, these effects are likely to become more acute and may significantly affect the viability of some or all of these middens. Data are insufficient to determine if these eight middens would be abandoned because of project activities. The other (ninth midden) would probably be lost due to the construction of the 11.3M binocular scope facility in close proximity to this midden.

In addition to the 4.54 acres directly cleared at Emerald and High Peaks and along the roads, the new clearing would result in additional degraded edge and windthrow totaling 4.0 to 7.6 acres in the short term. Three squirrel middens are located in the fragment of habitat between FR 507 and 669 on the north that may be adversely affected by improvements to the roads, increases in traffic and subsequent increases in wind and solar degradation. Data are insufficient to determine the degree of effect to these three middens.

Over the life of the project, the Forest Service intends to reforest, either naturally or with human assistance, the fuelbreaks and road edges along FR 507 and 669. Without the Observatory, the roads could be closed and removed so that revegetation could occur over the entire area. The need to maintain the roads to serve the Observatory prevents the regeneration in the road bed and results in a zone of degradation in the new forest growing in the cleared areas because the road provides the edge effect for wind and sunlight. The assessment states that 64.7 to 105.3 acres will not become midden habitat owing to the siting of the Observatory. An additional 23.36 acres is permanently lost due to roads and buildings for the Observatory.

Human Use Impacts

Three types of human use would occur with the construction and operation of the proposed Observatory. Only one, recreation, currently exists in the Emerald-High Peak area. The additional two are construction and astrophysical workers.

Public use would include camping, hiking, picnicking, nature study, and visitation of the Observatory. From 1.1 to 1.5 acres of land is estimated to be removed from active reforestation due to trampling, 1 acre for the 8 campsites along FR 507 and 0.1 to 0.5 acres due to illegal parking along FR 507. These figures were

developed during consultation and do not appear in the assessment. These 2.2 to 3.0 acres would be located largely within the degraded edge along FR 507 and FR 669 so they do not add acres to the physical habitat lost. However, the 1 acre for campsites described in the assessment would not be allowed to reforest at all, thus adding 1 acre to the Observatory commitments, a new total of 24.36 for the proposal (Appendix Table 1).

Recreation impacts would be of the same types as previously discussed under the Forest Plan with one exception. The construction of the Observatory will draw another type of recreationist, the "astro-tourist." This individual's primary experience would be touring the telescopes and they may or may not be interested in the natural resources of the Pinalenos. The University of Arizona estimates there would be 10,000 astro-tourists at project buildout in 30 years (approximately 2020). During the early years of the facility, there would be a much lower number of visitors.

Astro-tourists would arrive at the site via the Observatory shuttle bus from Safford or by private car. The Observatory shuttle could potentially transport 8,000 astro-tourists. Shuttle bus tourists would have a guided tour of the telescopes, other astro-tourists and general recreationists would be free to wander about. Some hikers may use the shuttle for transport to the mountain top, then hike down. These hikers have the same effect on red squirrels as do other hikers.

Uncontrolled astro-tourists that enter the forested areas would have some effect on red squirrels as general recreationists, i.e., harassment, trampling of seedlings, berry or mushroom picking, and midden disturbance. By the year 2000, at least two of the major telescopes, the 10M SMT and 11.3M binocular would be built and attracting visitors. These would be the largest telescopes in Arizona and may attract at least 2,000-3,000 people a year, increasing the visitor load on High Peak from 28,500 to over 30,000. By the time the Observatory is completed in 2020, the maximum sustainable visitor use days in the Pinalenos likely would have been exceeded and some management actions on people numbers would have been taken.

The construction of the facility would require heavy equipment and work crews to be on-site during the snow-free period. Estimates of 10 or 12 workers to 22 workers per day have been made by the University of Arizona and the Office of Arid Lands Studies.

Construction workers tend to stay in the area they are working in with only minor wandering. Noise, strange smells, vibrations, and intrusion of large equipment into the habitat are the major effects to red squirrels. The severity of the intrusion depends upon the distance from the midden or nest, screening afforded by trees and landforms, and the continuity of the action. Distances of 100 feet or less may be most critical, especially for females with young (Halvorson 1988D). Construction would take place during the nesting season and would occur over the 30-year period of development. Anywhere from 1900 to 4180 construction worker-use days would occur in any given year on the site (assuming 190 days of work). As different telescopes would be constructed, location of the disturbance would change. Some years may have no construction, while others may have work on more than one telescope. The more continuous the disturbance (i.e., same types of noises or actions over time), the less disruptive to the red squirrel. If construction only occurs during the week, with quiet weekends, the intermittence, and thus potential

for disruption, increases. Because construction workers are not likely to wander far, harassment of red squirrels at the midden may be lessened, even more so because recreationists would avoid construction areas.

The third type of human use would begin once the first telescope was built--the astrophysical worker. The number of daily workers would increase to an estimated 40 at completion of the project. In addition, observers and visiting scientists would be using the facilities. This group probably has the lowest impact on the red squirrel because their main focus is on their work and they would not spend the day wandering the forest. Their activities are continuous, making adaption to them easier for nearby animals. Noise may not be a significant factor, except possibly for the interferometer which will require heavy equipment to move the dishes from station to station. There may be a zone around the buildings that the red squirrels will move out of permanently as part of the adaption process, but the size or amount of abandonment cannot be calculated at this time.

Red squirrel experts do not feel that the change in season of human use from summer only to year round would be significant due to the type of activity that would occur in the winter with only astrophysical workers on site.

Astrophysical workers may utilize forest areas more than construction workers as they take "short cuts" from telescope to telescope. This may be of special importance to the eight red squirrels in the triangle of affected habitats on Emerald Peak. Human passage through that area would act as recreationist harassment and would further stress those animals. A "short cut" from High Peak to Emerald would pass by middens around Bear Wallow Cienega.

In addition to short cuts, astrophysical workers on site every day may be motivated by the scenic qualities of the spruce-fir forest to use part of their time off during the day to enjoy the aesthetic qualities of the area. University of Arizona personnel have repeatedly stated that astronomers are conservationists, as well as physical scientists, and have an appreciation for natural resources. As such, they have impacts to red squirrels more in line with recreationists.

All human uses in the astrophysical use area involve vehicles. Private vehicles would still be able to drive up to High Peak and out to Emerald Peak during daylight hours, which is very similar to the current conditions. Improvements to both FR 507 and 669 will make access even easier. In addition to this traffic, heavy construction and vehicles delivering materials would operate on FR 507 and 669 as well as Swift Trail up to the FR 507 turnoff. Observatory vehicles, including the 36 passenger shuttle bus, would run from High Peak to Emerald, as well as up and down Swift Trail. The increase in traffic both increases the potential for road kills of red squirrels, and requires a higher level of road maintenance to prevent erosion and maintain a driveable surface. Changes in downslope drainage, compaction of soil on tree roots, and deepening of road cuts may affect red squirrel habitat, including middens. One red squirrel midden was lost between May 1986 and October 1987 due to erosion from FR 669.

SUMMARY OF IMPACTS

The implementation of the Coronado National Forest Plan with the protective prescriptions contained in it should benefit the red squirrel, because it includes

protection and restoration of red squirrel habitat. There are some adverse effects to the red squirrel from traffic mortality and increased human use for recreation over the life of the Forest Plan. The closure of the refugium to vehicles will significantly reduce human use in this important red squirrel habitat as a counter to increasing use in other areas of the Pinalenos. The opportunity to study and monitor red squirrel/human interactions will enable the Forest Service to determine the extent and type of problems existing now and to be able to plan for them in the next Forest Plan.

The siting of the Observatory within the currently rated good to excellent habitat of what we consider the refugium is significant. A total of 8.54 to 12.14 acres of habitat will be lost in the near term due to clearing, new edge degradation and windthrow. Further, 88.06 to 128.66 acres will never provide midden habitat because of the physical placement of buildings and degraded edge effects. Of this, 59.77 to 83.10 acres are in the refugium area. At least 14 midden activity areas are in proximity to facilities or are in fragmented areas that are adjacent to or surrounded by Observatory facilities. The presence of the facility magnifies the problem of human use impacts with additional visitor use days for tourists, construction workers, and astrophysical workers resulting from the Observatory.

Although the impact from habitat loss may be estimated, the question of human impact is a complex one that is inadequately understood. Red squirrels are adaptable, but conditions of distance, type of human use, and constancy of use all determine the degree to which the red squirrel will adjust to people. The red squirrel in the Pinalenos is already a very approachable animal. Its lack of fear renders it all the more vulnerable to abuse and harassment, and to the development of unnatural habits by individual squirrels.

CONCLUSIONS

The Mt. Graham red squirrel is presently in jeopardy. The past actions of man have removed or altered a major portion of its habitat, reducing the possible carrying capacity of its range by 50 percent or more. The introduction of the tassel-eared squirrel in the 1940's by the Arizona Game and Fish Department may also have had a significant effect on red squirrel use of non-prime habitats.

Models and other numerical representations of the acreage losses, numbers of squirrels, and squirrel habitat equivalents effects have been developed by the Forest Service in their assessment and by informed individuals during the consultation. These models examined the potential for increase in risk of extinction due to physical changes in the habitats owing to the proposed actions. In any of the models, the hypothetical increases were small. The potential impacts due to human presence were not evaluated in any of the models.

It is important to consider the data that went into those figures and the questions that at present cannot be answered concerning the red squirrel and its habitat. We do not have enough information on the red squirrel's population dynamics, genetics, habitat quality, habitat use or interactions with other species to dismiss any hypothesized increase in extinction probability as trivial because of its present status.

The commitments made in the amended Forest Plan prevent the continuing adverse impacts allowed by the plan to become a significant increase in the level of jeopardy. The same cannot be said for the Observatory, where increased habitat loss and degradation and changes to human use patterns do cause significant impacts.

It is our contention that the losses to habitat and the impact of increased human presence due to the Observatory within the habitat of the red squirrel increases the level of jeopardy that exists under current conditions.

CORONADO NATIONAL FOREST PLAN: INCIDENTAL TAKE

Section 9 of the Endangered Species Act, as amended, prohibits any taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct) of listed species without a special exemption. 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 taking within the bounds of the Act provided that such taking is in compliance with the incidental take statement.

The Service anticipates five red squirrels could be taken in the form of harassment, harm, wounding, and/or killing per year as a result of the Forest Plan. At present levels, vehicle traffic takes an estimated two red squirrels per year. The projected increase in traffic going up Swift Trail through the planning cycle increases this risk. In addition, we anticipate one midden will be abandoned because of increased recreation. Reasonable and prudent measures that will reduce incidental take are:

1. The Forest Service shall take steps to reduce the risk of road kills along all roads within red squirrel habitat in the Pinalenos under their jurisdiction (e.g., speed bumps, appropriate signs, etc.).

The following terms and conditions must be complied with in order to implement the above measures:

1. All red squirrels killed, wounded, or harmed by vehicles or other human related causes shall be immediately reported to the Service's Phoenix Ecological Services Office. The handling and deposition of all carcasses will follow Service procedures.

If, during the course of the action, the amount or extent of the incidental take is exceeded, the Forest Service must reinitiate formal consultation with the Service. The Forest Service should provide an explanation of the causes of the taking.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. The term "conservation recommendations" has been defined as suggestions of the Service regarding discretionary

measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information.

1. Forest roads 507 and 669 be abandoned and reforested.

2. The Forest Service shall determine if the removal of existing human use areas (i.e., campgrounds, summer homes, radio sites) from red squirrel habitat would significantly benefit the species and, if so, consider their removal.

3. The Forest Service should take the lead in developing and funding long-term studies on the life history and habitat of the red squirrel. A list of specific research needs for the red squirrel would be developed jointly between the Forest Service, Arizona Game and Fish Department, and the Service.

4. Reforestation efforts should proceed as quickly as possible.

MT. GRAHAM ASTROPHYSICAL AREA PLAN REASONABLE AND PRUDENT ALTERNATIVES

The Section 7 regulations have defined reasonable and prudent alternatives as alternate actions identified during formal consultation that can be implemented in a manner consistent with the intended purpose of the action, that can be implemented consistent with the scope of the Federal agency's legal authority and jurisdiction, that is economically and technologically feasible, and that the Service believes would avoid the likelihood of jeopardizing the continued existence of listed species or result in the destruction or adverse modification of critical habitat.

We have developed three reasonable and prudent alternatives to eliminate the increase in level of jeopardy due to construction and operation of the Observatory. The increase in level of jeopardy would be due to habitat losses in the short and long-term and increases in human use in the refugium.

A comparison of the acreages and numbers of middens affected by the Astrophysical Area Plan and each of the reasonable and prudent alternatives described below is shown in Appendix Table 1.

REASONABLE AND PRUDENT ALTERNATIVE 1

This alternative would eliminate the increase in jeopardy due to the Observatory by requiring the telescopes to be sited at other existing or potential astrophysical sites elsewhere in the world, not in the Pinalenos. Of the telescopes in the proposed action, four have been specifically identified in the biological assessment and only the 11.3M binocular telescope has requirements for a continental United States location. The consortium that is developing the telescope wants it conveniently and more cheaply located on this continent rather than in Hawaii or Chile. Possible continental sites would be in New Mexico or South Baldy Peak (Cibola National Forest) or Sacramento Peak (Lincoln National Forest). All candidate sites in the United States would be subject to Section 7 of the Endangered Species Act if any threatened or endangered wildlife or plants might be affected by the proposed action. The other three could be located at existing or potential sites anywhere in the world. Without the Observatory, the refugium could be

closed to access and FR 507 and 669 removed and reforested. No habitat would be lost and human impacts would not change from Forest Plan conditions (Appendix Table 1).

Features

1. No land allocation or special use permit for an astrophysical observatory in the Pinalenos would be made.

2. All commitments included under the Coronado National Forest Plan as amended would be in effect for the entire 3500 acre Astrophysical Plan Area.

3. All testing permits held by University of Arizona would be revoked immediately and all test equipment and facilities would be removed and all site damages repaired.

4. New requests for testing or special use permits would not be accepted during this planning period.

INCIDENTAL TAKE

Same as for the Forest Plan (see page 50).

CONSERVATION RECOMMENDATIONS

Same as for the Forest Plan (see page 51).

REASONABLE AND PRUDENT ALTERNATIVE 2

This alternative allows for the development of the Observatory in the Pinalenos. The applicant would be allowed to develop telescopes at High Peak only. This alternative commits 14.15 acres to the Observatory, of which 1.0 acre would be new clearing. An additional 1 to 2 acres (estimated) would be degraded because of the clearing in the short term. Over the long term, a total of approximately 53 to 78 acres of committed and degraded acreage would be maintained. Two middens would be affected indirectly by construction on High Peak.

A 10-year study of the red squirrel's biology and population dynamics, habitat, and microclimatic factors would be funded by the Forest Service or the applicant. Information on construction impacts and techniques would be gathered during development of High Peak and the responses of red squirrels would be monitored. Preliminary work on human/red squirrel interactions would also be accomplished. If an application to also develop telescopes on Emerald Peak is subsequently filed, information from these studies could be used in issuance of the ensuing biological opinion. No obliteration of FR 669 would be called for until a decision is made regarding the siting of facilities on Emerald Peak, however, restoration and revegetation of areas identified as not needed for a facility there would be undertaken as soon as feasible.

Any request by the Forest Service to reinitiate Section 7 consultation on the effects of additional development on the species prior to the completion of the

10-year studies would be accommodated. Analyses would be based on all information available at that time. If available information does not show that astrophysical development could be accommodated on Emerald Peak without jeopardizing the continued existence of the red squirrel, FR 669 would be permanently closed and all areas revegetated within 3 years of the decision.

The construction of telescopes on High Peak will provide the opportunity to evaluate construction methods and determine if acreage impacts due to construction as presented by the University of Arizona are accurate. The two telescopes that would be ready for construction first, the Max Planck 10M SMT and the Vatican 1.8M optical/IR were both scheduled for High Peak in the site plan. The SMT is ready to be built at any time and the Vatican mirror has been cast. The construction of the third scheduled telescope, the 11.3M binocular in 1992, may have to be postponed unless relocated to High Peak. No starting date is available for the interferometer or the remaining three optical/IR telescopes.

Impacts due to human presence are also minimized to the extent possible under this alternative. The development and operation of the Observatory will require construction and astrophysical workers to be on-site. In addition to these people, astro-tourists and other recreationists would also be utilizing the refugium in increasing numbers. The goal is to maintain human use levels at or below pre-Observatory levels and in accord with guidelines established in the Forest Plan.

Astrophysical and construction workers would be required to remain within the designated boundary of the Observatory or on FR 507. The same constraints apply to astro-tourists and general recreationists. All other areas of the refugium are closed to all but authorized entry. Walk-in access for recreationists is provided to the High Peak overlook via FR 507. The Emerald Peak portion of the refugium would be protected from most human disturbance for the 10-year study period. Further restrictions on use of motorized vehicles have been prescribed in order to reduce the frequency and intensity of human/squirrel interactions and minimize disturbance levels.

This alternative also attempts to deal with the loss of habitat due to the Observatory. Short term losses have been minimized to the extent possible by the design of the facility and the delayed decision for siting telescopes on Emerald Peak. Long term losses, both direct and indirect, are more difficult to reduce. As a replacement for some of these long term losses, restoration of a habitat area with the potential to provide good to excellent habitat, or protection of such an area from degradation was considered.

The summer homes at Columbine and the Arizona Bible Camp are along a forest road that leads into the Ash Creek drainage, an area that has considerable potential for red squirrels. Removal of the Bible Camp and summer homes would enable those acreages (2.5 and 14.5 respectively) to be incorporated into forest restoration plans for the area. The summer homes area was projected to recover to good to excellent habitat, the Bible Camp to fair.

These two areas are not in the spruce-fir vegetation type considered to be the best available for the red squirrel, but are rather in the mixed conifer. Because this is the habitat type where the Forest Service predicts the greater gains in red squirrel equivalents over time (USDA-FS 1988), any augmentation to this area,

especially in the Ash Creek drainage, is worthwhile. Removal of the Bible Camp and summer homes and subsequent reforestation represents the best opportunity to regain previously lost habitat outside the refugium.

In sum, this alternative attempts to reduce human impacts and habitat loss over the short and long term by its features. The unanswered questions about the red squirrel, its biology, and the quality of its habitat, will be addressed so that an informed decision can be made on the appropriateness of siting the Observatory on Emerald Peak if such an application is filed at a later date. In the interim, the Emerald Peak portion of the refugium is protected from development and human use.

Features

1. Steward Observatory's testing permit for Emerald Peak will be revoked immediately and all testing equipment removed.

2. All construction workers and eventual astrophysical workers will be shuttled to the High Peak site. No private cars will be allowed and only limited numbers of Observatory vehicles will be permitted at the Observatory.

3. All visitors to High Peak (recreationists, construction workers, astrophysical workers) will remain on FR 507 or in the telescope facility area itself. The remainder of the refugium area is closed to all access except by authorized personnel. The closure is in effect for recreationists as well as Observatory personnel.

4. A management plan to govern the construction and operation of the astrophysical complex and the associated road systems in ways least likely to adversely affect the squirrel would be developed. This plan should set standards and guidelines for human activities on the site and adjacent areas. Some examples of the type of human activities to consider for inclusion in the plan include use of the restricted use areas, use of paths and trails, storage of materials on-site, and trash disposal.

5. Forest Service will develop construction inspection methods and monitoring that will ensure compliance with the management plan and will provide a mechanism for immediate control of on-site activities.

6. A construction fence delineating the areas of allowed ground disturbance impact will be placed around each development site prior to the start of construction. Violation of the perimeter will not be tolerated.

7. Small trees, that would be destroyed by construction, shall be salvaged for use in reforestation.

8. If a siting decision is ever made for the telescopes not sited on High Peak, a new management plan will be developed to govern the entire Observatory.

9. Methods to minimize windthrow or blowdown will be employed.

10. Studies to define the life history and ecology of the red squirrel and the spruce-fir and mixed conifer forests will be conducted for a 10-year period. Specific studies to be done will be determined by a committee comprised of representatives from the Forest Service, Arizona Game and Fish Department, University of Arizona, and the Service with outside experts called in as appropriate. The Service, with due sensitivity for funding considerations, will have final approval authority for any study plan developed. The funding agency, while complying with requirements of the study plan, will retain fiscal approval for the study plan.

11. Adequate funding for monitoring of red squirrels adjacent to astrophysical development and the associated road systems is required for the life of the astrophysical complex and this monitoring will be considered in development of the management plan.

12. Reforestation efforts within red squirrel habitat will be initiated immediately and completed in 5 years.

13. Forest Road 669 will be gated closed to all but official vehicles. No human access to this area except for authorized personnel.

14. Between November 15 and April 15 each year, Swift Trail (FR 366), beginning at its intersection with FR 507 to its terminus, would be closed to all motorized vehicles except those officially authorized.

15. All access roads leading off Swift Trail above FR 507 (including but not limited to the roads to Grant Hill and Webb Peak) and the access road from Swift Trail to Heliograph Peak, would be closed year-round to all motorized vehicles except those officially authorized.

16. The refugium will be closed to all dispersed recreation use. All hiking trails through the area are closed. Walk-in use to High Peak only along FR 507 is allowed.

17. Permits for the 14 summer homes at Columbine and the Arizona Bible Camp will not be renewed in 1992. These areas and the access road will be actively reforested to manage for red squirrel habitat once the facilities are removed.

18. As findings are developed from the studies, modifications to the management plan and Forest Plan will be made as appropriate.

INCIDENTAL TAKE

The Service anti'ipates six red squirrels could be taken per year, in the form of harassment, harm, wound and/or kill, as a result of the Forest P' .. and allowing astrophysical development on High Peak. At present levels, vehicle traffic takes an estimated two red squirrels per year. The projected increase in traffic going up Swift Trail through the planning cycle increases this risk. In addition, we anticipate two middens will be abandoned because of increased recreational use and

astrophysical development and operation. Reasonable and prudent measures that will reduce incidental take are:

1. All construction workers and eventual astrophysical workers will be shuttled to the High Peak site. No private cars will be allowed and only limited numbers of Observatory vehicles will be permitted at the Observatory.

2. Forest Road 669 will be gated closed to all but official vehicles. No human access to this area except for authorized personnel.

3. Between November 15 and April 15 each year, Swift Trail (FR 366), beginning at its intersection with FR 507 to its terminus, would be closed to all motorized vehicles except those officially authorized.

4. All access roads leading off Swift Trail above FR 507 (including but not limited to the roads to Grant Hill and Webb Peak) and the access road from Swift Trail to Heliograph Peak, would be closed year-round to all motorized vehicles except those officially authorized.

5. The refugium will be closed to all dispersed recreation use. All hiking trails through the area are closed. Walk-in use to High Peak only along FR 507 is allowed.

6. The Forest Service shall take steps to reduce the risk of road kill along all roads within red squirrel habitat in the Pinalenos under their jurisdiction (e.g., speed bumps, appropriate signs, etc.).

The following terms and conditions must be complied with in order to implement the above measures:

1. All red squirrels killed, wounded or harmed by vehicles or other human related causes shall be immediately reported to the Service's Phoenix Ecological Services Office. The handling and disposition of all carcasses will follow Service procedures.

2. Red squirrels near High Peak should be monitored for their response to construction and operation of the Observatory, and this monitoring should be reported semi-annually to the Service's Phoenix Ecological Services Office.

If during the course of the action, the amount or extent of the incidental take is exceeded, the Forest Service must reinitiate formal consultation with the Service. The Forest Service should provide an explanation of the causes of the taking.

CONSERVATION RECOMMENDATIONS

1. Snow blowing along FR 507 should avoid adverse impacts to middens.

2. If maintenance of FR 507 is excessive and downslope erosion or water diversion becomes an issue, consider hard surfacing those portions where erosion effects are significant.

REASONABLE AND PRUDENT ALTERNATIVE 3

This alternative allows for the development of the Observatory in the Pinalenos. The applicant would be allowed to develop three telescopes on Emerald Peak only. A new access road approximately 2 miles in length would be constructed from Swift Trail below the Columbine Work Center to Emerald Peak. An alternate routing of an access road to Emerald Peak has been identified by the Arizona Game and Fish Department. Timing precludes a full and fair analysis of their suggested route prior to the scheduled issuance of this biological opinion. If this, or any other route, however, is found after evaluation and consultation to be more compatible with the needs of the squirrel, it will replace the route shown in Fig. 5 and be incorporated into the provision for implementation of the Emerald Peak alternative.

The three telescopes (11.8M binocular, Max Planck 10M SMT and Vatican 1.8M) and support facilities would be clustered off the west end of the existing fuelbreak on FR 669 (Fig. A). A total of 8.6 acres would be committed to the Observatory with approximately 6.28 acres of that to be new clearing. An additional 0.5 acres along the new access road would be subject to windthrow. This clearing creates an additional 16.68 to 26.62 acres of degraded habitat, with a long term total of 23.63 to 37.75 acres. Two middens could be directly or indirectly affected.

The creation of a new and shorter access road allows for the closure of FR 507 and 669, thus providing long term protection and enhancement for the eastern portion of the refugium. Under this alternative, FR 507 from 1.8 miles above Swift Trail to High Peak would be obliterated and reforested. Similarly, FR 669 would be obliterated and reforested from its junction with FR 507 to the point at which the first proposed interferometer pedestal was located on the University of Arizona's plan for Emerald Peak.

A 10-year study of the red squirrel's biology and population dynamics, habitat, and microclimatic factors would be funded by the Forest Service or the applicant. Information on construction impacts and techniques would be gathered during the development of the minimum facility and the responses of red squirrels would be monitored. Interactions between humans and red squirrels would also be studied. If an application to develop additional telescopes on Emerald Peak is subsequently filed, information from these studies could be used in issuance of the ensuing biological opinion. The remainder of FR 669 and the fuelbreak would be closed to access during this period and natural reforestation would be encouraged.

Any requests by the Forest Service to reinitiate Section 7 consultation on the effects of additional development on the species prior to the completion of the 10-year studies would be accommodated. Analyses would be based on all information available at that time. If available information does not show that expansion of facilities on Emerald Peak could be accommodated without jeopardizing the continued existence of the red squirrel, the remainder of FR 669 and the fuelbreak would be completely reforested within 3 years of the decision. In this alternative there is no potential to expand to High Peak.

The construction of a minimal facility on Emerald Peak will provide the opportunity to evaluate construction methods and determine if acreage impacts due to construction as presented by the University of Arizona are accurate.

Impacts due to human presence are also minimized to the extent possible under this alternative. The development and operation of the Observatory will require construction and astrophysical workers to be on-site. In addition to these people, astro-tourists and other recreationists would also be utilizing the refugia in increasing numbers. The goal is to maintain human use levels at or below pre-Observatory levels and in accord with guidelines established in the Forest Plan.

Astrophysical and construction workers would be required to remain within the designated boundary of the Observatory or on the new access road. The same constraints apply to astro-tourists and general recreationists. All other areas of the refugium are closed to all but authorized entry. There is no access for recreationists to High Peak under this alternative. Further restrictions on use of motorized vehicles have been prescribed in order to reduce the frequency and intensity of human/squirrel interactions and minimize disturbance levels.

This alternative attempts to deal with the long-term losses of habitat resulting from maintaining FR 507 and 669 open. Existing roads 507 and 669 would, without modification, remain available to the applicant to do site engineering, test drilling, and site preparation (of a reversible nature) only until the new access road is opened for use or no later than one year following issuance of a permit for the astrophysical facility development by the Forest Service. All construction traffic would be confined to the new access road only. By constructing a new access road, the long term improvement of the refugium can be enhanced. The new road and telescope locations are located on the western end of the refugium and thus enables better management of the area as a whole. The additional clearing of forest in this alternative will not enhance the status of the squirrel in the short term, but the immediate curtailment of human activity over a large portion of the refugium and in other locations will. This alternative results in the fewest total acres permanently unsuitable for midden habitat among the astrophysical development options in the Pinaleno Mountains (Appendix Table 1).

Because of the increased short-term risk resulting from this alternative, it becomes even more imperative that habitat restoration via reforestation be accelerated. Acreages not presently considered for restoration must be included. The summer homes at Columbine and the Arizona Bible Camp are along a forest road that leads into the Ash Creek drainage, an area that has considerable potential for red squirrels. Removal of the Bible Camp and summer homes would enable those acreages (2.5 and 14.5 respectively) to be incorporated into forest restoration plans for the area. The summer home area was projected to recover to good to excellent habitat, the Bible Camp to fair.

These two areas are not in the spruce-fir vegetation type considered to be the best available for the red squirrel, but are rather in the mixed conifer. Because this is the habitat type where the Forest Service predicts the greater gains in red squirrel equivalents over time (USDA-FS 1988), any augmentation to this area, especially in the Ash Creek drainage, is worthwhile. Removal of the Bible Camp and summer homes and subsequent reforestation represents the best opportunity to regain previously lost habitat outside the refugium.

In sum, this alternative attempts to reduce human impacts and habitat loss over the long term by its features. The unanswered questions about the red squirrel, its biology, and the quality of its habitat, will be addressed so that an informed decision can be made on the appropriateness of expanding the Observatory on Emerald Peak. The High Peak portion of the refugium is protected from development and human use, and is not an expansion site for the Observatory.

Features

1. Steward Observatory's testing permit for High Peak will be revoked immediately and all testing equipment removed.

2. All construction workers and eventual astrophysical workers will be shuttled to the Emerald Peak site. No private cars will be allowed and only limited numbers of Observatory vehicles will be permitted at the Observatory.

3. All visitors to Emerald Peak (recreationists, construction workers, astrophysical workers) will remain on the access road or in the telescope facility area itself. The remainder of the refugium area is closed to all access except authorized personnel. The closure is in effect for recreationists as well as Observatory personnel.

4. A management plan to govern the construction and operation of the astrophysical complex and the associated road systems in ways least likely to adversely affect the squirrel would be developed. This plan should set down standards and guidelines for human activities on the site and adjacent areas. Some examples of the type of human activities to consider for inclusion in the plan include use of the restricted use areas, use of paths and trails, storage of materials on-site, and trash disposal.

5. Forest Service will develop construction inspection methods and monitoring that will ensure compliance with the management plan and will provide a mechanism for immediate control of on-site activities.

6. A construction fence delineating the areas of allowed ground disturbance impact will be placed around each development site prior to the start of construction. Violation of the perimeter will not be tolerated.

7. The new access road will be located to avoid degrading existing midden habitat. A minimum buffer of 220-250 feet is required between the road and any midden.

8. Small trees, that would be destroyed by construction, shall be salvaged for use in reforestation.

9. If additional facilities are authorized after the 10-year study period, a new management plan will be developed to govern the entire Observatory.

10. Methods to minimize windthrow or blowdown will be employed.

11. Studies to define the life history and ecology of the red squirrel and the spruce-fir and mixed conifer forests will be conducted for a 10-year period. Specific studies to be done will be determined by a committee comprised of representatives from the Forest Service, Arizona Game and Fish Department, University of Arizona, and the Service with outside experts called in as appropriate. The Service, with due sensitivity for funding considerations, will have final approval authority for any study plan developed. The funding agency, while complying with requirements of the study plan, will retain fiscal approval for the study plan.

12. Adequate funding for monitoring of red squirrels adjacent to astrophysical development and the associated road systems is required for the life of the astrophysical complex and this monitoring will be considered in development of the management plan.

13. Reforestation efforts within red squirrel habitat will be initiated immediately and completed within 5 years.

14. FR 507 from 1.8 miles above Swift Trail and FR 669 to the first interferometer site will be obliterated and reforested within 5 years of the completion of construction of the new road to Emerald Peak.

15. Forest Road 669 will be gated closed to all but official vehicles beyond the Observatory boundary.

16. Between November 15 and April 15 each year, Swift Trail (FR 366), beginning at its intersection with FR 507 to its terminus, would be closed to all motorized vehicles except those officially authorized.

17. All access roads leading off Swift Trail above FR 507 (including but not limited to the roads to Grant Hill and Webb Peak) and the access road from Swift Trail to Heliograph Peak, would be closed year-round to all motorized vehicles except those officially authorized.

18. The refugium will be closed to all dispersed recreation use. All hiking trails through the area are closed. Walk-in use to the Observatory on Emerald Peak only along the access road is allowed.

19. Permits for the 14 summer homes at Columbine and the Arizona Bible Camp will not be renewed in 1992. These areas and the access road will be actively reforested to manage for red squirrel habitat once the facilities are removed.

20. As findings are developed from the studies, modifications to the management plan and Forest Plan will be made as appropriate.

INCIDENTAL TAKE

The Service anticipates six red squirrels could be taken per year, in the form of harassment, harm, wound and/or kill, as a result of the Forest Plan and allowing

astrophysical development on Emerald Peak. At present levels, vehicle traffic takes an estimated two red squirrels per year. The projected increase in traffic going up Swift Trail through the planning cycle increases this risk. In addition, we anticipate two middens will be abandoned because of increased recreational use and astrophysical development and operation. Reasonable and prudent measures that will reduce incidental take are:

1. All construction workers and eventual astrophysical workers will be shuttled to the Emerald Peak site. No private cars will be allowed and only limited numbers of Observatory vehicles will be permitted at the Observatory.

2. Forest Road 569 will be gated closed to all but official vehicles beyond the Observatory boundary.

3. Between November 15 and April 15 each year, Swift Trail (FR 366), beginning at its intersection with FR 507 to its terminus, would be closed to all motorized vehicles except those officially authorized.

4. All access roads leading off Swift Trail above FR 507 (including but not limited to the roads to Grant Hill and Webb Peak) and the access road from Swift Trail to Heliograph Peak, would be closed year-round to all motorized vehicles except those officially authorized.

5. The refugium will be closed to all dispersed recreation use. All hiking trails through the area are closed. Walk-in use to the Observatory on Emerald Peak only along the access road is allowed.

6. The Forest Service shall take steps to reduce the risk of road kills along all roads within red squirrel habitat in the Pinalenos under their jurisdiction (e.g., speed bumps, appropriate signs, etc.).

The following terms and conditions must be complied with in order to implement the above measures:

1. All red squirrels killed, wounded or harmed by vehicles or other human related causes shall be immediately reported to the Service's Phoenix Ecological Services Office. The handling and disposition of all carcasses will follow Service procedures.

2. Red squirrels near Emerald Peak should be monitored for their response to construction and operation of the Observatory, and this monitoring should be reported semi-annually to the Service's Phoenix Ecological Services Office.

If during the course of the action, the amount or extent of the incidental take is exceeded, the Forest Service must reinitiate formal consultation with the Service. The Forest Service should provide an explanation of the causes of the taking.

CONSERVATION RECOMMENDATIONS

1. Snow blowing along the access road should avoid adverse impacts to middens.

2. If maintenance of the access road is excessive and downslope erosion or water diversion becomes an issue, consider hard surfacing those portions where erosion effects are significant.

We appreciate the Forest Service's level of participation in this consultation. The Forest Service's commitment to facilitate the use of the best available scientific and commercial information is acknowledged.

Because this is a jeopardy biological opinion, the Forest Service is required to notify the Fish and Wildlife Service of its final decision on the reasonable and prudent alternatives.

In order for the Fish and Wildlife Service to be kept informed of actions that either minimize or decrease adverse effects or which benefit listed endangered and threatened species or their habitat, we request you inform us if any of the conservation recommendations in this biological opinion will be implemented.

This concludes formal consultation on this action. Reinitiation of formal consultation is required if the amount or extent of incidental take is exceeded, if new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion, if the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion, and/or if a new species is listed or critical habitat designated that may be affected by the action.

Sincerely,

Regional Director

cc:
Director, Arizona Game and Fish Department, Phoenix, Arizona
Director, Fish and Wildlife Service, Washington, D.C. (EHC)
Field Supervisor, Ecological Services, Fish and Wildlife Service, Phoenix, Arizona

LITERATURE CITED

Arizona Game and Fish Department. 1985. Status of the Mt. Graham Red Squirrel, Tamiasciurus hudsonicus grahamensis (Allen), of Southeastern Arizona. Report to Fish and Wildlife Service. 48 pp. Phoenix, Arizona.

Elton, C. 1939. Animal Ecology. McMillian Co., New York, New York. 209 pp.

Halvorson, C.H. 1988A. Personal communication to Lesley Fitzpatrick, USFWS, Phoenix, Arizona. 3/30/88.

_____. 1988B. Personal communication to Lesley Fitzpatrick, USFWS, Phoenix, Arizona. 3/28/88.

_____. 1988C. Personal communication to Gary Halvorson, USFWS, Albuquerque, New Mexico. 5/24/88.

_____. 1988D. Personal communication to Lesley Fitzpatrick, USFWS, Phoenix, Arizona. 5/9/88.

Hoffmeister, D.F. 1986. Mammals of Arizona. University of Arizona Press, Tucson, Arizona.

Minckley, W.L. 1968. Possible Extinction of the Spruce Squirrel from the Pinaleno (Graham) Mountains, Southcentral Arizona. J. Arizona Academy of Science 5:110. Tempe, Arizona.

Rusch, D.A. and W.G. Reeder. 1978. Population Ecology of Alberta Red Squirrels. Ecology 59(2):400-420. Tempe, Arizona.

Soule, M. 1988. Letter to Lesley A. Fitzpatrick, USFWS, Phoenix, Arizona. 3/19/88.

U.S. Department of Agriculture, Forest Service. 1986A. Coronado National Forest Plan. USDA-FS, Tucson, Arizona 130 pp.

_____. 1986B. Draft Environmental Impact Statement, Proposed Mt. Graham Astrophysical Area, Pinaleno Mountains, Coronado National Forest. USDA-FS, Tucson, Arizona. 217pp.

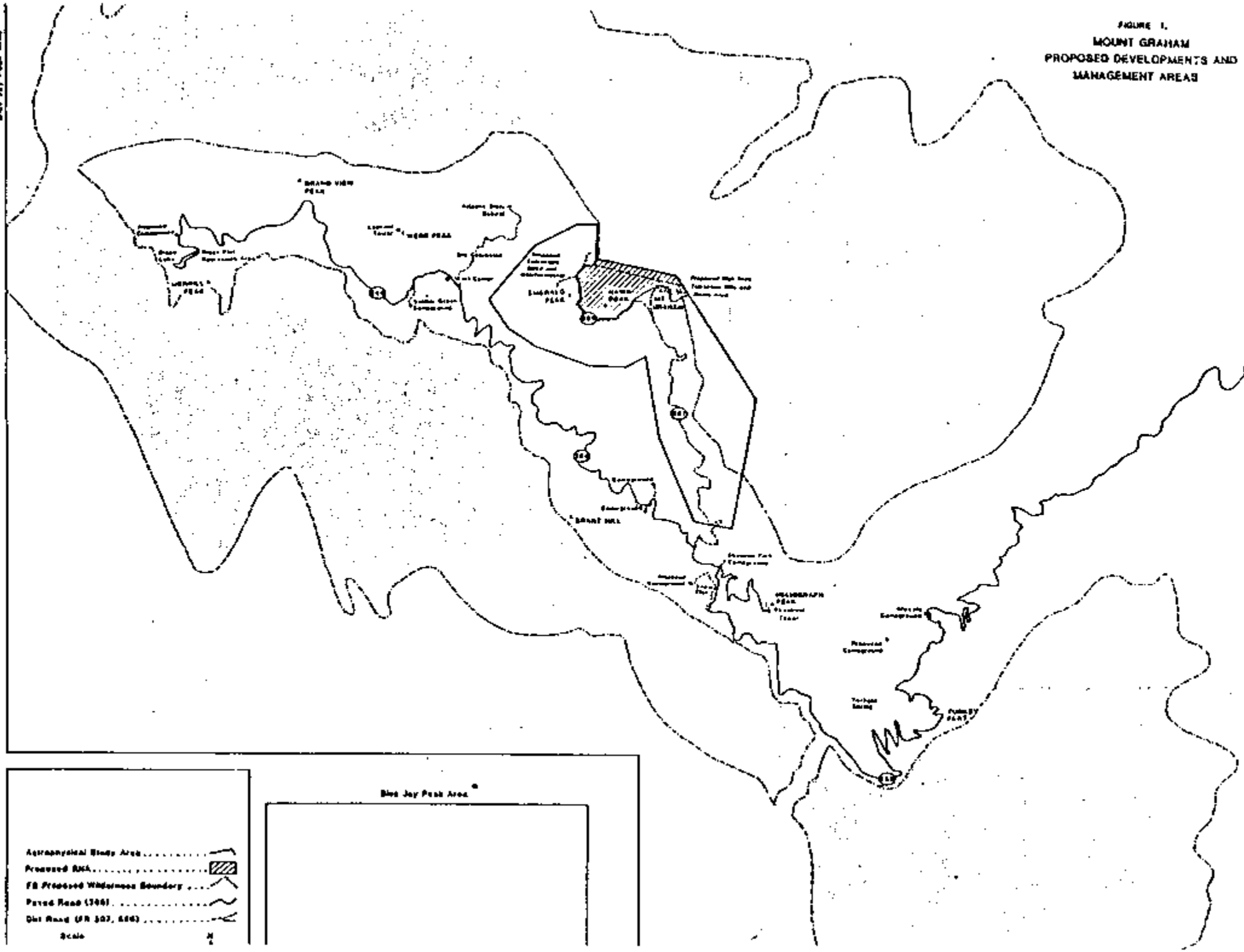
_____. 1987. Mount Graham Red Squirrel. A Biological Assessment of Impacts, Proposed Mt. Graham Astrophysical Project, Coronado National Forest, Tucson, Arizona 92 pp.

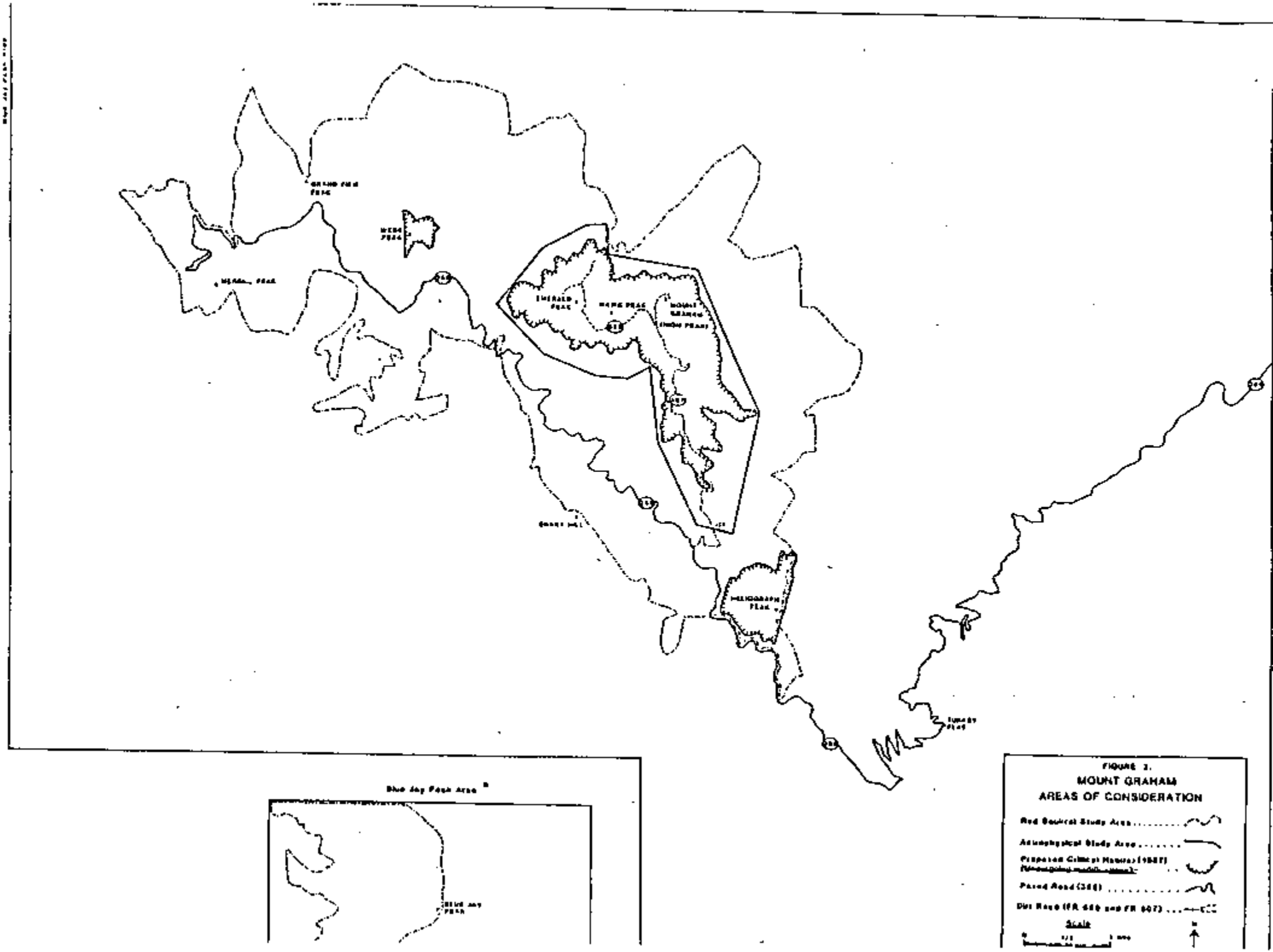
_____. 1988. Mount Graham Red Squirrel. An Expanded Biological Assessment of Impacts.Coronado National Forest Land Management Plan and University of Arizona Proposal for Mt. Graham Astrophysical Development. Coronado National Forest. Tucson, Arizona. 130 pp.

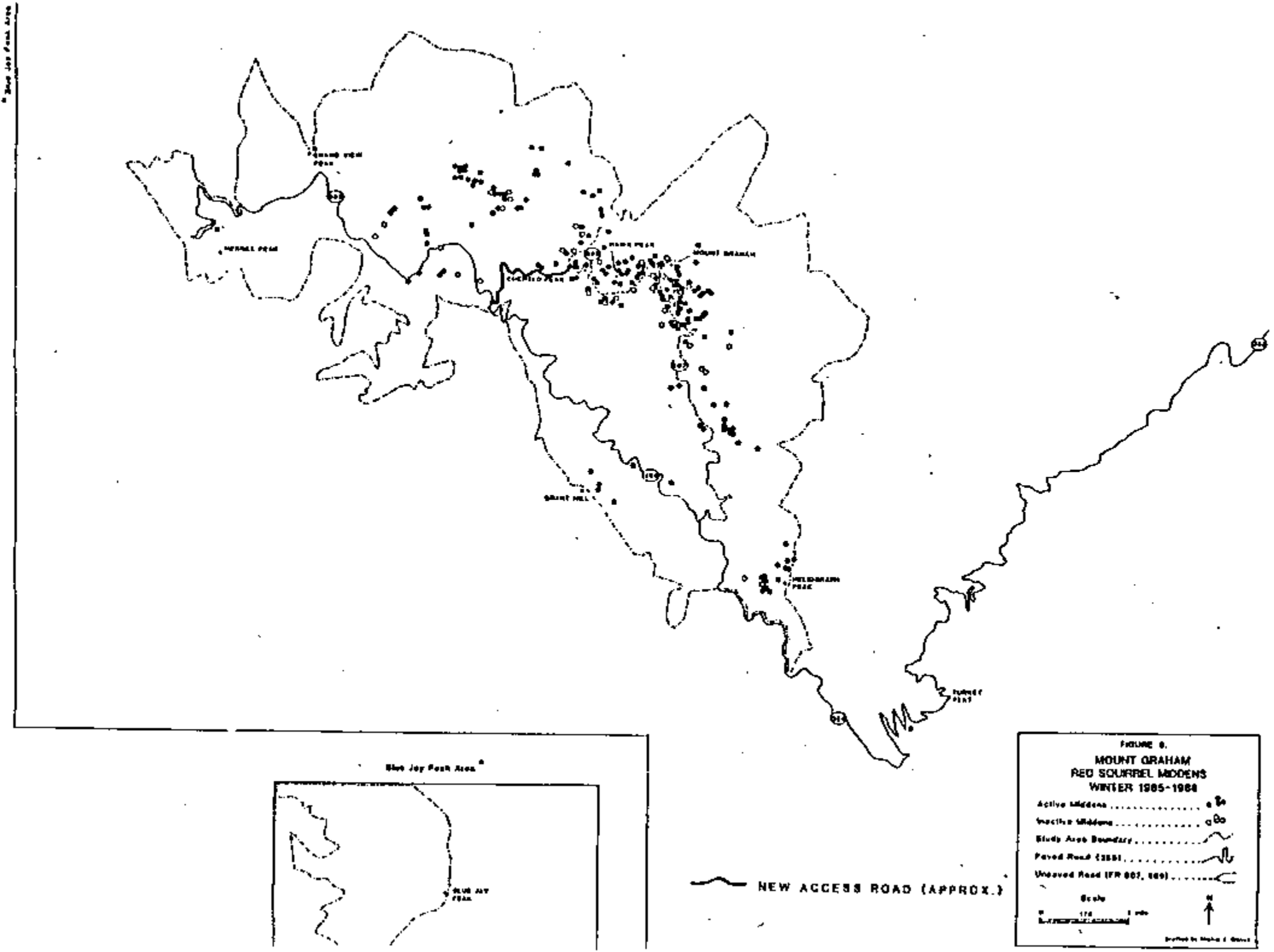
Vahle, J.R. 1978. Red Squirrel Use of Southwestern Mixed Coniferous Habitat. M.S. Thesis, Arizona State University, Tempe, Arizona.

Wolff, J.R. and J.C. Zasada. 1975. Red Squirrel Response to Clearcut and Shelterwood Systems in Interior Alaska. USDA, Forest Service, Pacific Northwest Forest and Range Experimental Station. Research Note. Portland, Oregon.

FIGURE 1.
MOUNT GRAHAM
PROPOSED DEVELOPMENTS AND
MANAGEMENT AREAS




Blue Jay Peak Area
FIGURE 2.
MOUNT GRAHAM
AREAS OF CONSIDERATION
Scale


Blue Jay Peak Area
NEW ACCESS ROAD (APPROX.)
FIGURE 8.
MOUNT GRAHAM
RED SQUIRREL MIDDENS
WINTER 1985-1986
Active Middens
Inactive Middens
Study Area Boundary
Paved Road
Unpaved Road
Scale
N

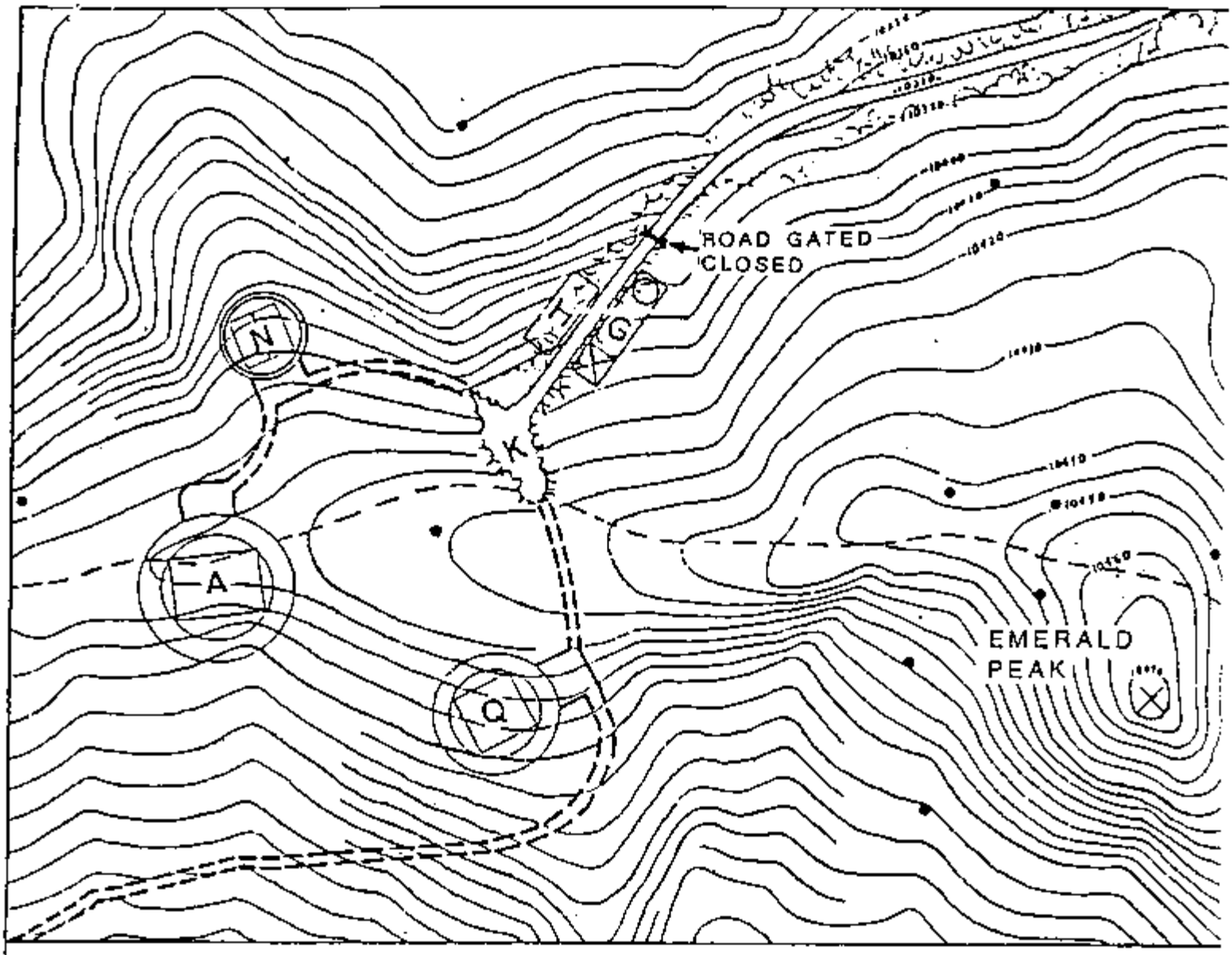


FIGURE A: REASONABLE AND PRUDENT ALTERNATIVE 3.

THREE EMERALD PEAK TELESCOPES

•	MIDDEN
A	11.3 METER BINOCULAR TELESCOPE
N	10 METER SUBMM TELESCOPE
Q	1.8 METER VATICAN TELESCOPE
K	PARKING AND TURNING AREA
G	EQUIPNENT, WATER STORAGE, HELICOPTER PAD, RESIDENCE, COMMUNICATIONS BUILDING
H	LOGISTICS, SHOP, RESIDENCE, UTILITIES
═══	GENERAL LOCATION OF EMERALD PEAK TELESCOPE ACCESS ROAD

COMPARISON OF MT. GRAHAM ASTROPHYSICAL AREA PLAN (AREA PLAN)
AND REASONABLE AND PRUDENT ALTERNATIVES (R&P) TO THE AREA PLAN[1]

Proposal	Committed Acres[2]	New Clearing Areas[3]	New Degraded Acres[4]	Long-term Degraded Acres[5]	Total Acres Permanently Unsuitable for Midden Habitat	Number of Squirrel Middens[6]
Area Plan	24	5	4 - 8	65 - 105	88 - 129	14
R&P No. 1 (no astrophysical development in Pinaleno Mtns.)	No changes from existing surface conditions would be caused by astrophysical development					
R&P No. 2 (4 High Peak scopes w/study)	14	1	1 - 2	39 - 64	53 - 78[7]	2
R&P No. 3 (3 Emerald Peak scopes w/study)	9	6	17 - 27	24 - 38	33 - 47[7]	2

---

[1] All acreage figures have been rounded to the nearest whole number.

[2] Acres to be occupied by buildings, roads, parking areas, and other astrophysical development requirements.

[3] Acres of trees that will be cleared to accommodate the astrophysical development.

[4] The acres of degraded forest edge resulting from the new clearing required by the astrophysical development.

[5] The acres of degraded forest edge that will be maintained over the life of the astrophysical project.

[6] The number of squirrel middens in vicinity of the astrophysical project that will or may be affected by the proposal.

[7] These negative acreages would be offset by the restored habitat at the summer home and Bible Camp sites (17 acres).