ORGANIZATIONS STRONGLY OPPOSED TO THE DEVELOPMENT OF AN ASTROPHYSICAL COMPLEX ON EMERALD PEAK

Audubon Society:
National, Huachuca, Maricopa, Northern Arizona, Prescott, Tucson, Yuma
Rod and Gun Clubs:
Sierra Vista Club, Sportsman's Club, Tucson Club, Yuma Valley Club
Wildlife Federation:
Arizona Wildlife Federation and National Wildlife Federation
Trout Unlimited:
Zane Grey Chapter
Sierra Club:
Tucson Chapter, National Sierra Club, Sierra Club Legal Defense Fund
The Wildlife Society:
Arizona Chapter and National Wildlife Society
The Wilderness Society:
Arizona Chapter and National Wilderness Society
Defenders of Wildlife
National Parks and Conservation Association
Safari Club International
Scientists for the Preservation of Mt. Graham (national)
Earth First!
Animal Defense Council

Arizona Arms Association
Arizona Bear Society
Arizona Bowhunter's Association
Arizona Flycasters Association
Arizona Muzzleloaders Association
Arizona Native Plants Society
Arizona Wilderness Coalition
Cochise Conservation Council
Desert Whitetailers
Flagstaff Archers
The Great Bear Foundation
Grey Panthers' Partners
Mt. Graham Conservation Project
Southern Arizona Hiking Club
Sportsmen's Voice

The following organizations and agencies have no affiliation with the COALITION but opposed observatory construction:

Arizona Game and Fish Commission
Arizona Game and Fish Department
Nature Conservancy

BIOGEOGRAPHY OF THE HIGH PEAKS OF THE PINALENOS

Prepared by the Maricopa Audubon Society

Lithospheric Features

The astrophysical project is located in the Pinaleno Mountains, Graham County, Arizona. The Pinalenos, locally referred to as the Graham Mountains, are part of the Basin and Range province. The province generally extends from Southern Idaho to northern Mexico and is characterized by isolated, fault block mountain ranges separated from one another by broad, low-elevation alluvial plains. The Pinalenos sit on the border of the Basin and Range province. The next northern range, the Gila Mountains, belong to a transition province that separates the Basin and Range from the Colorado Plateau. The Gila River in Arizona, just north of the Pinalenos, is generally the northern boundary of the Basin and Range Province in this part of Arizona.

The Pinalenos are the highest mountains south of the Mogollon Rim (Table 3.1). They include Mt. Graham (10,720 feet) nearly 1,000 feet higher than the second highest peak in the Chiricahuas. Mt. Graham is the highest peak south of the Mogollon Rim as well as the highest in Arizona's Basin and Range province. The Pinalenos contain two square miles of land above 10,000 feet. No other southern mountain range has acreage above this elevation. The Pinalenos form long ridges making the definition of peaks somewhat arbitrary. Nevertheless, at least, eight promontories above 10,000 feet can be identified. Above 8,000 feet, the Pinalenos contain 32 square miles of land. Only the Chiricahuas (with 26.9 square miles) has an area of highland comparable to this. This high elevation ridge line is one feature that makes the mountain so attractive to astronomers, to the public for recreation and a habitat for the high peaks' unique biogeography.

The Pinalenos are surrounded by the Sulphur Springs-Aravaipa valleys on the south and west, the San Simon Valley on the east, and the broad Gila Valley on the north. The topographic relief between the top of Mt. Graham (10,720 feet) and the Gila River at Safford (2,900 feet) amounts to 7,820 feet, the greatest relief in Arizona. Northwest, the Pinalenos are separated by a low divide from the smaller Santa Teresa Mountains. On the south, Stockton Pass separates the main body of the Pinalenos from the Greasewood Range. The major structural features (the physical landscape and drainage patterns) were outlined before the end of the Tertiary with only minor faulting in Quaternary and recent times.

Because of its high elevation and very southern location (Latitude 32°42'N), the Pinalenos potentially contain valuable information on the presence of permanent ice or glaciers during the Pleistocene. Robert Scarborough has discovered remnant glacial features on the north and east side of High Peak and below Emerald Peak which are, along with minor features in the nearby Santa Catalina and Santa Rita Mountains, perhaps the southernmost location of such features in the United States (Figures 3.2 and 3.3). (Mexico has some minor glacial features south of Mexico City.)

Similarly, the north and east facing slopes contain three "cienegas" or alpine meadowlands unique to southern Arizona (Figure 3.3). These cienegas are unique because they produce perennial surface water at the headwaters; occur between 10,200 and 10,400 feet (as opposed to 8,500 feet on the south side of the Pinalenos); are completely snow-covered in winter; display low relief and broad depression in an otherwise mountainous area; have extensive soil development in an otherwise rocky terrain; have unique soils which alternately freeze then thaw, become seasonally anoxic-reducing, have high organic content and slow percolation rates; and nurture a unique bog-like vegetation that supports a richer variety of flora and fauna than the surrounding conifer forest (see below). They may also contain a valuable record of pollen in the stratified sediments of the bog. These pollen records can be used to reconstruct Pleistocene climatic change.

Bedrock

The Pinaleno Mountains are the easternmost of the metamorphic-core-complex mountain ranges in the southwest. The main part of the range is composed of Precambrian metamorphic and igneous rocks with a partially preserved sheath of gently dipping, lineated myolinitic rocks along its northern flank. The southern part of the range consists of Tertiary-age volcanic and plutonic rocks.

Rocks of the Pinalenos include two distinct terrains (Figure 3.4). The older terrain (on which the MGAA is located) includes gneisses (with volcanic and sedimentary protoliths), granitic plutons, meta-quartz latite dikes and diabase bodies, ranging in age from 1,100 to 1,700 million years. The younger terrain includes a mid-Tertiary (35 to 25 million years old) granitic stock and a complex eruptive center that includes flows, flow breccias, volcaniclastics, air-fall and ash-flow tuffs, and dike swarms. The younger terrain lies well to the south of the proposed astronomical area.

Three structural elements of the Pinalenos have regional as well as local geologic implications: the WNW-trending Stockton Pass fault zone; the Oak Draw fault and the mylonitic rocks along the northeast flank. These three structures will not be impacted by the proposed astronomical development, though the proposed powerline cuts across the Stockton fault zone, not known to be geologically active.

A fourth structure--a series of Quaternary faults along the piedmont of the eastern Pinalenos--has not been well studied. Depending on the recurrence interval of the fault zone, these faults could effect the proposed astronomical facilities by seismic shaking.

Telescopes are proposed for the topographic ridge that includes Peak 10,471 (Emerald Peak). The main rock type is porphyritic leucogranite. This rock tends to be deeply weathered (50 feet?) along the Emerald Spring Road. These rocks have not been tested for rock strength nor engineering properties--an area of concern for construction and earthwork impact. They have not been tested for groundwater movement--a water pollution concern, if septic tanks are built.

Soils

Soils result from relations between (the cycling of) climate, topography, plant life and bedrock weathering. As such, they are the interface between the physical and biological components of Mt. Graham. The low elevation soils, at the mountain-valley transition, are thermic semi-arid soils (3,600 feet). Mid-elevations contain mesic subhumid soils (from 3,000-5,000 to 7,000 feet). The crest area has frigid, subhumid soils (above 6,500 feet). With an increase in elevation, the soils have higher moisture equivalent and water holding capacity; higher total porosity; higher organic matter and C:N ratio; higher aggregation of small soil particles; decreased pH and total phosphate levels; larger populations of filamentous fungi (mold); and a decrease in aerobic cellulose-destroying bacteria and nitrifying bacteria. Both the low elevation soils (desert-like) and highest elevation (conifer-type) soils have low populations of bacteria and actinomyces. It is the acidity of the high elevation soils that reduces bacterial growth.

The frigid subhumid soils, the soils of the project area, can be found above 6,500 feet on the Colorado Plateau as well as a few other mountain ranges of the Basin and Range like the Pinalenos. They cover about 7% (5 million acres) of Arizona. They have a mean annual soil temperature below 47°F (8°C) and a mean annual precipitation of more than 16 inches (410 cm) with one-half falling during winter as snow, sleet or rain. These highland soils are shallow to deep, gravelly to very cobbly, sandy loams (i.e. moderately coarse textured soils) on hilly to steep slopes. Rock outcrops vary from zero to 20% of the terrain. Recent soil classification is the Mirabel-Baldy-Rock Outcrop Association but there is some controversy over soil types. Unique or rare soils may exist on Mt. Graham because of its southern latitude, relict spruce-fir forest and high elevations. The cienega soils are not well known.

Because the soils of the high peaks area are thin and well-anchored to moderate slopes, they have only slight to moderate erosion potential. The limitations to septic tank drainfield installation include depth to bedrock, lateral movement of polluted water, depth of soil freezing, low available water capacity and slopes. The soils appear to have good

permeability. As of October 1989, there have been no detailed studies of septic tank location, design and environmental impacts.

The surficial rock types within the proposed study area display virtually no signs of mineralization. The possible pre-emption of mining within the study area is therefore not an issue of concern.

Atmospheric Setting

Mountain Climate

Because of topography and the large energy flux caused by mountain barriers, the Pinalenos have large climatic contrasts. Its subtropical latitude places the Pinalenos in the arid mountain belt. Its high elevation causes a steep gradient from the desert to the mountain peaks; temperature descends (about 4°F every 1,000 feet); air density, water vapor, carbon dioxide and impurity levels decrease, and precipitation increases. Since water vapor is the chief heat-absorbing constituent of the atmosphere, the low water vapor near the peaks leads to rapid night cooling. The low air density leads to rapid radiant heating during the daytime. Low water vapor (vs. high precipitation) is a major advantage to astronomers concerned with infra-red telescopes and a major disadvantage to the red squirrel because radiant heating reduces the locations available for cone storage, and reduces conifer and fungi production. Any actions that reduce canopy cover by trimming branches or cutting whole trees increase the drying and heating of the forest floor. This is a central focus of habitat management for the red squirrel.

Mt. Graham squirrels receive 11% more solar radiation than populations in Denver; 22% more than Quebec; and 46% more than Fairbanks. High solar radiation eliminates the squirrel from some habitat types like ponderosa pine and increases the need for dense canopy closure (>60%).

The continentality of the Pinalenos means that, as a mountain range, it has more sunshine, less cloudiness, greater temperature extremes and less precipitation than equivalent mountain ranges along the coast. Continental mountain ranges tend to breed

clouds during the daytime and dissipate clouds at night (another advantage to astronomers who need clear skies). Finally, tall mountains like Mt. Graham can be very windy. The high winds can topple trees. Timber thinning or certain kinds of clearcuts can lead to greater forest losses because of windthrow. The increased opening of the canopy and loss of productive trees by extreme icestorms and windthrow has been controversial. The telescopes require cutting that will weaken forest stands. The USFWS Biological Opinion did not address these catastrophic events despite requests by experts. The damage to the forest and squirrel has been underestimated. Similarly, the large dishes for radio-astronomy may be inappropriate to some mountains because of wind conditions. The wind conditions of Mt. Graham are comparable to or lower than those of Mt. Hopkins and Kitt Peak.

Weather Systems

Two major weather systems have the greatest influence on atmospheric conditions of the Southwest and the Pinalenos: the Arctic-Pacific cyclonic storms of winter and the thunderstorms (monsoons) originating around the Gulf of Mexico or the Pacific coastal region of Mexico in summer.

Because of Arizona's and the Pinalenos' geographic position in North America, many of the winter storms pass to the north and many of the summer storms lose their moisture before arriving. The major characteristic of southeastern Arizona climate is its erratic, year-to-year behavior. This reduces the reliability of astronomical viewing (water vapor, clarity) and probably results in greater fluctuations in cone crops than found in more northern forests. Comparisons of population fluctuations of cone crops and red squirrels to more northern locations should be done skeptically.

The climatic gradient from desert to mountain top is not well known. Figure 3.5 gives approximate ranges of temperature and precipitation for the Pinalenos. From very partial records from some years, the mountaintop appears to receive about 30 inches of precipitation annually. Summer rainfall, occurring predominantly from July through August, has recently accounted for more than half the annual precipitation. These thunderstorms

result from orographic lifting of moisture. Winter precipitation, occurring from October through April as a result of cyclonic and frontal storm systems, falls primarily as snow but may also fall as sleet or rain. In between these two seasons of precipitation, drought occurs resulting in the typical rain/drought/rain/drought biseasonal weather pattern of the Sonoran desert. Usually, the driest months are May/June and November.

The snowfall on Mt. Graham results in drifts from four to fifteen feet deep. They present a major operating cost and limitation to the use of the mountain during winter. The environmental effects of snowplowing (including increased visitor use) are a concern that will not be addressed and reviewed by the public because the National Environmental Protection Act has been bypassed.

Summer storms are short and intense. These thunderstorms tend to build up towards evening and extend into the night. Lightning is a major cause of both forest fires and tree death. The increased nighttime cloudiness in summer decreases astronomical viewing time in July and August. These short, intense storms may cause erosional problems on cleared soils. The lightning also damages or destroys trees. Though only a few at a time, lightning strikes are most common in prime red squirrel habitat. Over the long-term, significant food trees and cover will be lost. This natural loss was not included in the total cumulative impacts on the red squirrel by either the Forest Service or the USFWS.

Air Quality

Air quality on Mt. Graham is the result of a combination of gases, aerosols and particulates. Natural additions to air include forest fires, decaying vegetation, turpenes from conifers, dust from wind action, spores, pollen and, from the astronomical point of view, light and insect swarms. Human-caused additions in the Pinaleno area include transportation (local and from Interstate I-10; mine smelters along the U.S.-Mexican border). Acid rain has become a concern in southeast Arizona. Dispersing agents in the Pinalenos include wind, vertical air movement up and down the mountain (mixing depth),

the height and tenacity of the inversion layer and topography. Increased mountain traffic, headlights and campfires near the proposed observatory impact air quality. The USFS and University of Arizona have forbidden public use of the high peaks area in order to reduce lights at night and avoid security problems. The impacts of terpenes and insects on astronomical viewing were never reviewed.

The inversion layer on Mt. Graham sinks during the nighttime as cooler air flows into the surrounding valleys. The inversion layer averages about 6,000-7,000 feet, trapping pollutants a few thousand feet below the summit. Human-caused air impurities from regional sources are not an issue of concern. Vertical air movement helps bring cooler air to red squirrels at lower elevations (enlarging their habitat) but also brings hot air up the slopes drying mushroom habitat and hurting "refrigeration" in storage middens.

Hydrospheric Features

The "forbidden zone" is the source of six streams that flow at least part way down the mountain to either the Gila River or the playa of Sulpher Springs Valley. Mt. Graham has an exceptional number of perennial streams or near perennial streams in part because of the heavy snow accumulation that feeds water to the streams late into the spring drought. The lowest flows occur in years of low snowfall, years with small summer rains or years of late summer drought. Figure 3.6 shows the watersheds of the Mt. Graham peak area: Marijilda, Deadman, Frye and Ash Creeks on the northeast slopes and Grant and Big Creeks and their tributaries on the southwest slopes. Many of these flows appear to originate in springs and seeps which may be controlled by local faults or relatively shallow joint sets but are commonly associated with a steepening of the gradient and/or basal contact of soil and alluvium with the underlying bedrock. The cienegas, are, perhaps an exception, in having deeper regolith fed by large accumulation of snow melt in bowl-shaped watersheds. Blasting impacts at Emerald Peak will have unknown effects on downstream water supply. Neither the University of Arizona nor the USFS have made any investigations.

The infiltration rates, percolation rates, groundwater basins, storm intensities and runoff patterns of the upper parts of Mt. Graham have not been studied.

Other nearby sources of permanent water are Riggs Flat Lake and a smaller impoundment at Snow Flat (Figure 3.1). Thermal springs occur in an "artesian belt" around the north and east sides of the mountain, and these feed a myriad of tanks and other artificial basins. Some larger bodies of water, i.e., Ropers' Lake ca. seven miles south of Safford, are maintained by pumpage from wells. Besides the Mt. Graham cienegas/springs, there are few marshy places.

Sustained records of streamflow have been kept by the U.S. Geological Survey for the period 1969-76 on Frye and Deadman Creeks, although the measurement locations are at lower elevations. No records of flow are available for mountaintop locations; however, estimates were made of the flow rate of springs and streams in or near the study area in October 1984. The University of Arizona is, at present, required to haul all water to the site.

Biological Features

Life-Zones

The steep relief of the Pinalenos with its graded climate has created the sharpest ascent from desert grassland to spruce-fir forest in Arizona. Figure 3.5 summarizes the life-zones: semi-arid grassland, chaparral, oak woodland, ponderosa pine, mixed conifer and spruce-fir. But this figure of the Pinalenos can be misleading. The mountain is rugged with long canyons running north-south, varied exposures to the sun (east-west slope variance) and pockets of special soils. For example, in Marijilda canyon, pockets of oaks are present below 3,500 feet. On the other hand, an "oak zone" on an almost vertical slope of the mountain extends to about 10,000 feet on xeric rockslides and shallow soils.

Biotic Affinities

The flora of the Pinaleno life-zones have been fed by two major floristic groups: the Nearctic or northern flora by way of the Colorado Plateau and the neotropical or southern flora by way of the Mexican Plateau. Near the crest, the spruce-fir forest is the southernmost pure stand in North America. This forest supports the Mt. Graham spruce

squirrel which is also at its southernmost point of distribution. Just below the spruce-fir, in the mixed conifer zone, the Chihuahuan Pine and the Mexican White Pine live at their northern extreme.

A summary of the mammals, birds and reptiles that dwell on the Chiricahuas vs. the Pinalenos vs. the White Mountains (Table 3.2) illustrates the mixture of northern and southern fauna within the region. Note that 10 of 16 species of obvious southern origin are from the adjacent Mexican plateau in the Chiricahuas. Only three of the ten range north to the Grahams. The White Mountains are completely northern. The northern relationship of the Grahams should not be over-emphasized. When flying mammals and birds are included, the Mexican "flavor" of the Pinalenos becomes more obvious (Table 3.2).

Table 3.3 illustrates a few of the floral extremes in the Pinalenos, notably the northern extreme of Teocoma and Macrosiphonia in lower Jacobson Canyon. The contrast between the Pinalenos, the Chiricahuas and the Whites--their northern vs. southern flora and fauna--is an important one to scientists and naturalists. It is part of a major biotic dividing line that crosses the southwest which can throw light on questions of past and future climate, especially glacial and inter-glacial periods.

Sky-Island Endemics

The Pinalenos and, in particular, the high peaks area, are a semi-isolated mountain range restricting gene flow of smaller mammals, some birds, insects and mollusks as well as plants. Some biologists, emphasizing its isolation, like to call the Pinalenos a "sky-island" surrounded by desert. The genetically isolated flora and fauna are called "endemics" because of their uniqueness to a small geographical area and, at times, small populations. The Pinalenos have, at least, eight endemic plants of which two may be findable within the area impacted by the project (Table 3.3). Within the fir-spruce zone, three endemic subspecies of rodent can be found: the Mt. Graham spruce squirrel, the white-bellied vole and the Mt. Graham pocket gopher. There are two endemic species of snail and five to thirteen possible endemic or newly discovered species of insect (ten in the high peaks area). The preservation

of endemic plants and animals is a major goal of all regulatory agencies. Nevertheless, only six weeks have been spent collecting insects and no thorough survey of the astrophysical area (all seasons) has been made.

Vertical Richness

Looking at the mountain range only as a series of isolated life-zones stacked on top of each other or an isolated "sky-island" is to break apart the integrity of the Pinaleno ecosystem. The variety of vegetation condensed into one small mountain (five miles from top to bottom by airplane or some canyon bottoms) is among the richest in western North America. For instance, the Pinalenos support the densest population of bear in the southwest with the smallest home ranges due, in part, to steep terrain permitting easy movement to multiple food resources. Bear scat at 10,500 feet has been seen with prickly pear seeds probably harvested at 3,500 feet. Hummingbirds move up or down slope to take advantage of flowering; band-tailed pigeons to take advantage of mast and flycatchers to find insects. Raptors cruise all altitudes. Bear depend on cool-season grasses during the May-June drought and montane berries should the lower-elevation Gambel oak crop fail. An important question to managing wildlife and game populations in the Pinalenos is: how important is the fir-spruce zone to each species? The question becomes important in determining human influences on the whole environment of Mt. Graham, not just a single life-zone. The question remains unanswered for bear and mountain lion whose migratory paths include the project area. Similarly, despite evidence of goshawk use of the area, no investigation of its importance exists.

Habitats

Within each zone are smaller habitats modified by water, sun exposure, soils and human disturbance. In the high peaks area, these habitats include spruce-fir forest (679.2 acres); mixed conifer forest (2,168 acres); cienega bog/meadow (3.9 acres); non-cienega meadow (192.5 acres); stream riparian (5.2 miles); rock outcrops and talus (up to 20" of the forest or grassland habitats) figure 3.7). Figure 3.8 summarizes the habitats within the spruce-fir zone of the proposed project area.

Spruce-Fir Forest: Picea engelmanni (Engelmann spruce) and Abies lasiocarpa (subalpine fir) are the dominating trees. The spruce-fir forests (also known as Rocky Mountain subalpine conifer forest) occupy only 0.5% of Arizona and about 2% of New Mexico. The Mt. Graham spruce-fir community is (or was) 2% of all spruce-fir in Arizona. (The greatest development of spruce-fir in Arizona is on the Kaibab Plateau and the White Mountains.) The Catalina Mountains support small solitary stands of subalpine fir and and the Chiricahua Mountains support small stands of Engelmann spruce. But the high peaks forest of the Pinalenos is the southernmost development of a true subalpine conifer forest (fir and spruce) in North America.

The proposed project will impact the only location in the Pinalenos where pure fir-spruce stands occur. The vegetation type comprises Engelmann spruce and subalpine fir (or a variant called corkbark fir) growing in association or in stands where one or the other dominates. In the project area, the pure spruce-fir is found from 10,000 to 10,720 feet on level, northeast and southwest facing slopes. This Pleistocene relict forest has been reduced by 15% of its original 700 acres by logging and road clearing. The forest has been fragmented into three pieces, increasing micro-climate temperatures. The project further fragments and decreases the size of the relict forest in violation of OSFS guidelines and in critical squirrel habitat. The Sierra Club believes these actions to violate the National Forest Management Act and the ESA. The fragments increase risks of predation to migrating squirrels. Isolated stands also occur at lower elevations but not in a continuous (or formerly continuous) canopy.

Like all old growth forests, the spruce-fir forest has relatively few other plant species. But, for certain birds and the Mt. Graham spruce squirrel, the forest is a boreal oasis. The red crossbill and, to a lesser extent, the band-tailed pigeon depend directly on fir/spruce cones for food. About 25 species depend on the spruce/fir for insects by timber drilling, foliage or timber searching. About 40 species depend on spruce-fir for breeding as either hole or cup nesters. There are four ground nesters (understory or slash required) which prefer the ecozone between forest edge and open meadows or cienegas.

The actual spruce-fir forest (vs. the nearby cienegas and meadows) provides limited food at specific seasons (e.g., mushrooms for white-tailed deer; insect grubs, ants and cambium

resin for bears; mast for band-tailed pigeons). The importance of the actual forest (vs. meadows) to these species has not been studied.

Mixed Conifer: Although 7,200 acres of transition and mixed conifer exist on the Pinalenos, almost none will be directly impacted by the proposed development. Mixed conifer forests (also known as Rocky Mountain Montane Conifer) cover about 3% of Arizona and 4% of New Mexico. In southeastern Arizona, the Pinalenos provide the most extensive stand of mixed conifer as well as spruce-fir. The lower contact of spruce-fir with the mixed conifer is often indistinct and poorly differentiated. The spruce-fir merges into mixed conifer between 9,000 and 10,300 feet. Tree species in order of abundance are: Engelmann spruce, subalpine fir, Pseudotsuga menziesii (Douglas fir), Pinus flexilis (limber pine), Populus tremuloides (aspen), Abies concolor (white fir) and Pinus ponderosa (ponderose pine).

The transition zone also provides increased habitat for more mammals and birds because of aspen groves; the longer warm season; the open, park-like habitats of the ponderosa pine, and increased riparian areas. The introduced Abert's squirrel is dominant in mixed conifer and forms a competitive edge with the Mt. Graham spruce squirrel. Turkeys and spotted owls also appear in the transition zone just outside the proposed project area. While one species of hummingbird nests at the highest elevations, six hummingbird species have been seen at Shannon campground 1,500 feet below the summit. The altitude of nesting and feeding is probably opportunistic, depending on the year's snowfall and snowmelt.

Pockets of the mixed conifer are crucial to the red squirrel. When cone crops of the spruce-fir fail, only the lower elevation Doug Fir supports the remnant population. These pockets have not been mapped so their importance is unknown. It is hoped that perhaps 40 squirrels can survive in the Doug Fir mixed conifer. Any opening of the Doug Fir canopy appears to give the competitive advantage to the Abert's squirrel because the radiant heat prohibits red squirrel middens.

Logging of the mixed conifer has been intense. At least half of the suitable habitat for the red squirrel (probably more) has disappeared. Reforestation will not compensate for astro-project clearcutting. First, natural reforestation is much greater than proposed reforestation by the USFWS, USFS and the University of Arizona. Their "artificial" reforestation is a gesture of insignificant ecological importance. Second, the squirrel dilemna is the adequacy of short-term habitat. The natural and artificial forest growth will not significantly contribute to food and cover for 70 to 120 years. The University of Arizona and USFS have never admitted this. Nor have they surveyed existing forests to determine future productivity.

All that remains for the Mt. Graham red squirrel is 472 acres of excellent habitat and 1,565 acres of good quality. Because of its southern locale, "excellent" and "good" support much lower densities than more nothern habitats.

Non-Forest Habitats: The non-forested openings can be roughly divided into three habitats: cleared forest in the early seral meadow and shrub stage of succession; natural sub-alpine grasslands and bog-like cienegas. In the "refugium" of spruce fir forest, the greatest acreage of grassland/seral shrub has been created by the road and firebreak along FR 507 and FR 669. The firebreak tends to be colonized by fewer species, while natural meadows contain herbaceous species which have not colonized the firebreaks. The firebreak areas were a source of Christmas cuttings, now denied to the public, even as thinnings. The forest-grassland provides forage for deer; shelter for the endemic gopher; seasonal flowers for hummingbirds; feeding and nesting for yellow-eyed juncoes; berries for bears and humans, and hunting areas for raptors and carnivores. Humans have been forbidden to enter major berry picking areas.

In the cienegas, sedges and rushes dominate and herbs are common. The cienegas support a much denser population of birds because of the bog vegetation; provide grasses, sedges and wild onions to bears in the spring drought period; are the main habitat for the endemic white-bellied vole and pocket gopher; contain some of the more unique plants of the high mountain areas and provide watering areas for many animals. The proposed project is within the Emerald Spring cienega watershed.

The rocky outcrops and talus slopes can be found both within forest and grassland habitats. While small in acreage, rocky outcrops may support the most rare floral species. When combined with deep crevices and a southern exposure, the rocky habitats may provide hibernacula and feeding areas for the twin-spotted rattlesnake, the Arizona black rattlesnake and Yarrow's spiny lizard. The deeper talus slopes house snails endemic to the Pinalenos. The Emerald Peak has no detailed survey of the rock outcrops.

Species

Plants

The Pinalenos support a large number of genetically distinct species, whether listed as sensitive by legal protection agencies, or not. This is because the Pinalenos are isolated from similar gene pools in the Southern Rockies or the subtropics in Mexico. Many unique species are endemic, occurring only in the Pinalenos. Others are simply isolated small populations peripheral to larger gene pools where the represented lifezone is more widespread. Plants of specialized habitats in the Pinalenos such as seeps or springs may have wide distribution but exist on the mountains as only peripheral extensions. They reach the Pinalenos but no farther north or south. Endemics (Table 3.3) which illustrate the genetic uniqueness of these mountains include: Echinocereous ledingii, Graptopetalum rusby, Plummeria ambigens, Mammalaria viridiflora, Sophora arizonica, a variant of Perityle lemmonii, a variant of Rumex orthoneurus, Potentilla albiflora. (This list is not exhaustive.)

Several plant species are located on the Pinalenos which have either state or federal protection status (Table 3.3). In addition, three federally listed species, Allium goodingii, Erigeron pringlei, Polemonium pauciflorum var. hinckley, and Senecio huachucanus potentially occur on Mt. Graham because they occur on nearby mountains at similar elevations, but have not yet been collected on Mt. Graham.

Animals

Above the 9,000 feet elevation, there are probably 21 species of mammals (Table 3.4), 8 reptiles (Table 3.5), 50 birds (Table 3.6), and an unknown number of other invertebrates. The high peaks area is the headwater of six streams supporting species of fish. These species lists are partially hypothetical for fish, reptiles and birds because of incomplete surveys.

Of the 21 species of mammals, two have gone extinct in the Pinalenos: the Mexican gray wolf exists only in a captive-breeding population and the long-tailed weasel (seen but not captured by Hoffmeister in the Mt. Graham area) was not recorded in a later survey. Two species, beaver and Abert's squirrel, have been introduced.

Three species of mammal have been given special consideration because of their rarity. The Mt. Graham spruce squirrel is a unique, insular subspecies classified by the USFWS as endangered with jeopardy status--the most vulnerable classification possible--and by AGFD as endangered. No other mountain range of southern Arizona supports a species of Tamiasciurus. The White-Bellied Vole, another insular subspecies of Mt. Graham, is on the Arizona Natural Heritage Program's Special Element List and classified as Category 3C by the U.S. Department of the Interior, Fish and Wildlife Service, Endangered Species Program. A unique subspecies of the Western Pocket Gopher also occurs in the Pinalenos but has not been placed in any special category.

The Mt. Graham red squirrel is endangered because it has lost more than half its original habitat; because it has no immigration to replace population losses and because its juvenile wintering area is occupied by Abert's squirrels. It is sensitive to catastrophic events such as fire, lightning strikes, windblow, ice storms, tree diseases, prolonged drought and, possibly, rodent diseases. These catastrophic events in combination with "anticipated" cone crop failures are the major threat to its existence. The USFWS and USFS have not added the risks of catastrophic events into their "probability of extinction" estimates. Its population has decreased drastically in the last few years and now hovers around 100. This is below all reasonable estimates of "population viability" by all known experts for an isolated small mammal population. In addition, human stresses such as monitoring, handling and cars have begun to take their toll.

The herpetofauna is more diverse and probably more abundant in the Pinalenos than any other mountain range in southern Arizona. As such, it is a unique ecological resource found nowhere else in the west. None of the eight species found above 9,000 feet are considered endangered. The twin-spotted rattlesnake is considered a rare species in the United States. The bulk of the population is located south of the border in the Sierra Madre Occidental. The twin-spotted rattlesnake and the Sonoran mountain kingsnake are protected by the State of Arizona. Collectors prize these two species and they have suffered at the hands of poachers.

Of the fifty probable bird species inhabiting the high elevations of the Pinalenos, four are of official concern: the spotted owl, the wild turkey, the northern goshawk and the peregrine falcon. Because of their nesting and hunting habits, the peregrine is beyond the scope of this project. Spotted owls have been heard in the canyons of the mixed conifer within 1,000 feet elevation of the project area. No roosting, breeding or feeding areas have yet to be found, though only a preliminary search has been undertaken. The turkey population is considered small. It has been seen within 1,000 feet of High Peak (elevation). The thick-billed parrot makes occasional stops in the Pinalenos.

The Pinalenos lie within Unit 31 of the Arizona Game and Fish Commission. Huntable species include the white-tailed deer, javalena, bear, band-tailed pigeon, mountain lion, Abert's squirrel and other small game (bobcat, skunk, fox, coyote). The Pinalenos support the largest bear population and mountain lion population south of the Mogollon Rim. Species of major concern to wildlife management and hunters are bear, lion, and deer. The deer population has shown wide fluctuations in population size for unknown reasons. The bear population is perhaps the best managed in the southwest and has grown to 150 animals.

The fish fauna of the Pinalenos is depauperate. Seventeen species exist or existed in the Pinaleno Mountains and valleys surrounding them. Of the 17, only three native forms are known. On Mt. Graham, two of these three forms are probably extinct.

The Salt River form of the Apache trout has been introduced to Ash, Deadman, Gibson, Marijilda, Moonshine, Post, Crazy Horse and Grant Creeks as well as Hospital Flat, Soldiers and Riggs with some successful reproduction in the upstream reaches and less successful in lower reaches. In some creeks, the Apache has hybridized with rainbow trout. New surveys need to be done to confirm populations of pure Apache trout. It has threatened status (Federal; Group III, Arizona). The fish needs tiny, high-gradient brooks where summer temperatures rarely exceed 60° F. Winter conditions may include anchor ice. A closed forest canopy covering the stream appears to be crucial.

The speckled dace has been found in Grant Creek (1961 and 1965). It is now considered extinct, probably from ichthyotoxin treatment of the creek to kill off unwanted forms of trout. The Gila Mountain sucker was caught in Grant Creek in 1961. Minckley believes it may have been introduced by accident with trout. The status of this native fish is presently unknown. Two species of stocked trout (the brown trout and the brook trout) have established naturally-reproducing populations in upper and middle reaches of Marijilda Creek.

The Pinalenos are at the southern end of the boreal (Rocky Mountain) range of invertebrates. Many species (Table 3.2) reach their southernmost limit on Mt. Graham. Little is known of the invertebrate fauna derived from Neotropical origins or species which reach their northernmost limit in the Pinalenos.

The only invertebrate considered for threatened or endangered status by State or Federal government is the Pinaleno monkey grasshopper. (It does not have this status. It is listed for study.) The grasshopper has been collected only once near Stockton Pass. It may be rare or may appear rare because of improper collecting. The Pinaleno monkey grasshopper is endemic to Mt. Graham.

Two flightless beetles, Diplotaxis saylori, a scarab found mostly below 9,000 feet, and Scaphinotus petersi grahami Van Dyke, a carabid that has been collected as high as Heliograph Peak are two endemic beetles that have been found within the project area.

Another carabid, Trechus arizonae Casey, is also an endemic found within the cienegas (above 10,000 feet) within the projected area. The rarity, habitats and habits of these endemics are not known.

Ten species of insects found within the study area may be endemic to the high peaks (Table 3.8). These species have been found only in the high peaks area. No other specimens have been found in the University of Arizona entomology collection and no references to them appear in the literature on Arizona invertebrates. It is not known if these species exist in other areas (e.g., New Mexico or Mexico). Further fieldwork and taxonomic study may reveal more isolated populations and disjunct species. The importance of the project area to these species is completely unknown. Neither the University of Arizona nor the USFS has funded any surveys.

Two large snails and seven small mollusks (three determined only to generic level) can be found within the project area (Table 3.9). The two large snails are endemic to the Pinalenos. There are no mollusks endemic only to the project area. None of the mollusk populations are considered rare nor endangered within the proposed area. Sonorella favors steep, rock slides and talus slopes which will not be affected by the proposed project.

Summary

The biological importance of the high peaks, including the project area, derives from (1) its exceptional rich mixture of plant and animal species and subspecies with ties to northern and southern origins; (2) its relict Pleistocene spruce-fir forest, spruce squirrel population and glacial features which are at their southernmost point of distribution; (3) its isolation from other mountain ranges which has led to the evolution of endemic species and subspecies of plants, mammals, snails and insects unique to the mountain range; (4) its very condensed number of life-zones on one small, rugged mountain range creating a rich, multiple food source for birds and large game mammals that migrate altitudinally; (5) two small habitats--the cienegas and rock outcrops--that support unique floral and faunal micro-

communities because of Mt. Graham's altitude, isolation and biogeographic position in North America.

The spruce-fir forest, the rocky outcrops and the cienegas are the major biological zones of concern. Rare, unique, endemic or classified plants that may possibly be affected by the project are a major species concern. Of special faunal interest is the population of the Mt. Graham spruce squirrel, possible effects of the project on three game species (lion, bear and deer) and the mountain's Apache trout.

Historical Features

It is not clear how Mt. Graham got its name. Graham may have been Lt. William Emory's surveyor but the name "Graham" appears before the 1846 Emory expedition. While part of Mexico, the Pinalenos were called the "Sierra Bonita". "Pinalenos" probably comes from Apache--"pinal"--for deer.

The earliest finds of human activity occurred along the Gila River Valley. The Mogollon peoples disappeared from the Pinaleno area about 15,000 years ago. About 10,000 years ago, the Cochise and Hohokam peoples inhabited the foothills at the base of Mt. Graham. Shrines have been discovered on the Pinaleno peaks dating from about 1100 A.D. These have been claimed by the Zunis, believed descendants of the Mimbres culture who created the shrines.

In 1539, Fray Marcos deNiza went up the Sulpher Springs Valley alongside the Pinalenos. In 1540, Coronado followed his route. By the mid-1700s, the local Apache tribes had gone extinct or were so fractured by the Spanish invasion that their remnants joined other Apache bands. When Anglo historians began to record local history, the Western Apache and the Chiricahua Apache lived in the Pinaleno area.

When the treaty of Guadalupe (1848) was signed, the Pinalenos remained in Mexican territory. It was purchased by the United States as part of the Gadsden Purchase (1848). In 1871, the Pinalenos, including the project area, formed the southern boundary of the Apache Reservation. But Anglo-European settlers complained to Washington and in 1873

the boundary was moved north of the Gila. During this period the mountains were used mostly by trappers and hunters. By the 1880s, the grizzly and wolf population were extinct. The Apache Tribal Council has claimed that the astronomical project is a violation of the Native American Religious Freedom Act.

In 1872, the first Anglo (Lt. George Wheeler) ascended the peak. In 1881 Graham County was formed from Apache/Pima counties. About this time, the first major phase of lumbering occurred in the lower drainages. Lumber from these areas built Ft. Grant (1872) and Tucson schools (1875) and Camp Arcadia (1879) and provided shingles, house logs and rough timber for the surrounding communities. This horse and wagon timber harvest, mostly on the north and east slopes, continued until the 1920s when lower elevation timber ran out. The Gila Valley, Globe and Northern railroad which went through Safford helped boost timber sales.

In 1886, General Nelson Miles set up a heliograph station on the Pinalenos to capture the last 36 Apaches (20 men) in southeast Arizona.

In 1902, the Mt. Graham Forest Reserve was organized by the Forest Service. In 1908, the Forest Service began fighting forest fires. In 1910, fire towers were installed on Webb, Heliograph, Lady Bug and Mt. Graham.

The next significant entry into the Pinalenos occurred between 1923 (when a $500,000 bond was posted to build Swift Trail) and 1933 when the road to Columbine was completed. By this time, grazing had become as much a part of the Pinalenos as timber harvest. In 1923, Mrs. Welch brought 22 dairy cows to Columbine and summer houses were built at Turkey Flat. By the 1950s, overgrazing on the slopes of the Pinalenos had become so severe that the first policies limiting cattle were enforced by the Forest Service. This had led to a gradual restoration of many of the high elevation grasslands and wildlife habitat.

The new road opened timber harvest into mid-elevations. Between 1890 and 1946, 23 MM board feet of timber had been taken from the Pinalenos. The most recent period of

Pinaleno history began in 1961 with initial entry into the highest elevation virgin stands of mixed conifer near and up to the peak (FR 507). Western Pine Sales of Cutter, Arizona removed 27 MM boardfeet of lumber between 1963 and 1972.

Competition with other users became a major concern of the Forest Service by the mid-1960s. In 1964, Congress passed the Wilderness Bill and, in 1971, the National Environmental Protection Act. When Swift Trail was widened and partially paved in 1977, its construction required the first public review of Forest Service policy and development on the mountain. By this time, summer houses, regulated hunting, recreational fishing, hiking, and winter time snow play had become a normal part of the Pinalenos. Timber harvest was diminishing--replaced by timber salvage and firewood gathering. In 1988, because of the impacts on the red squirrel, timber harvesting ceased.

In 1982, during discussions of the boundary for the roadless area and proposed wilderness area on the Pinalenos, the Smithsonian Institution asked for boundary re-adjustments to accommodate an astronomical observatory. This began the struggle to save Mt. Graham.

TABLE 3.1

MT. RANGES BELOW MOGOLLON RIM

Range	Higher Elevation Area (sq miles) (above 8,000 ft)	Highest Peak
Pinaleno	32.0 (2.0 above 10,000)	10,720
Chiricahuas	26.9	9,795
Huachuca	7.2	9,466
St. Catalina	5.9	9,157
St. Rita	1.8	9,453
Animas (N. Mex)	1.0	8,532
Big Hatchet (N. Mex)	0.3	8,441
Big Barro (N. Mex)	-	8,035
Baboquivari	-	7,740
Galiuro	-	7,660
Dragoon	-	7,519
Peloncillo	-	6,922

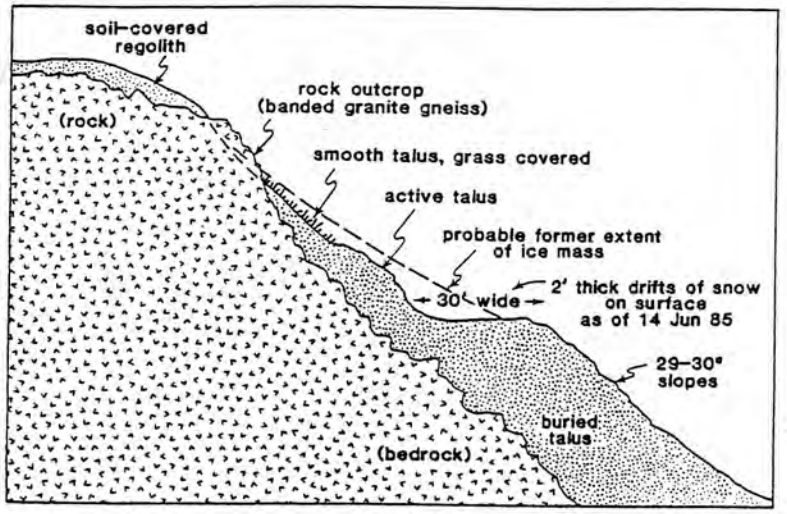


Figure 3.2 Remnant Glacial Features of High Peak

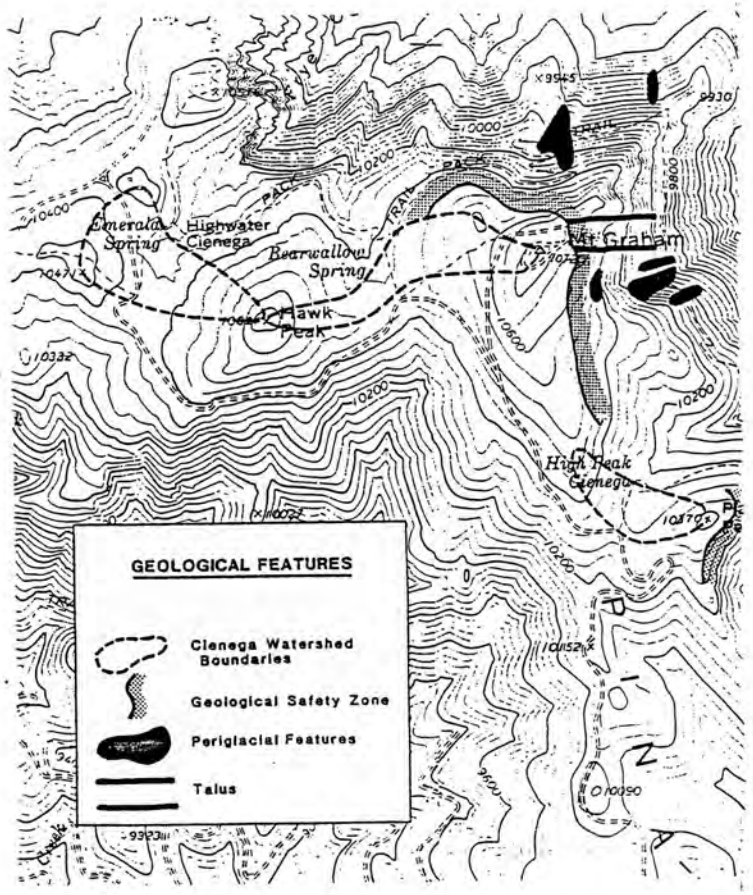


Figure 3.3 Cienega Watershed Boundaries
(glacial features near Emerald Peak are not shown)

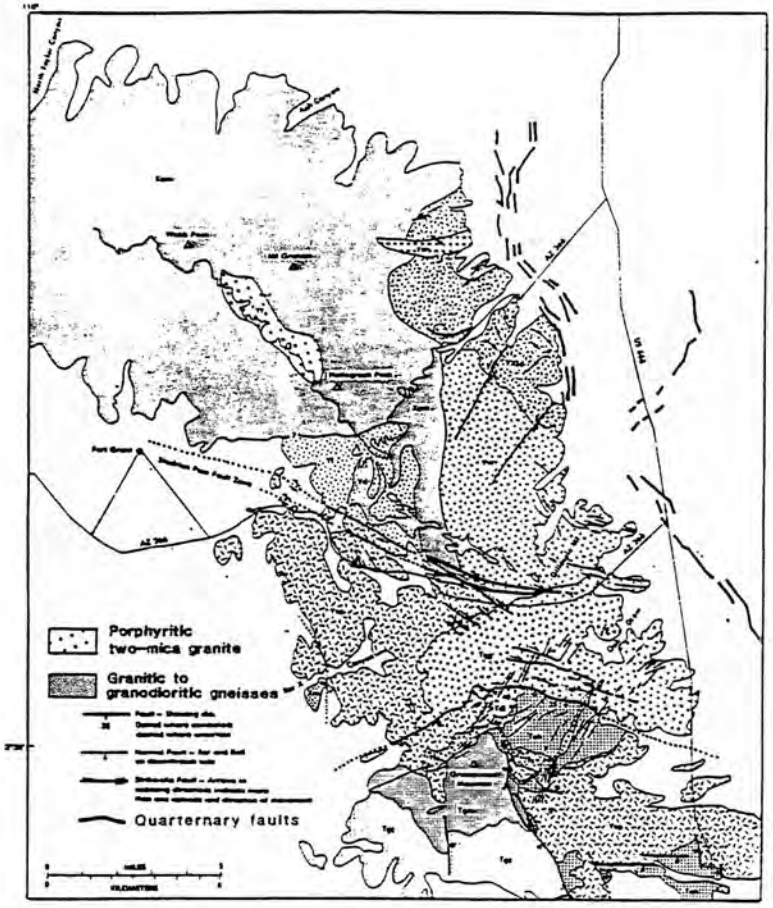


Figure 3.4 Geology Map of the Pinaleno Mountains

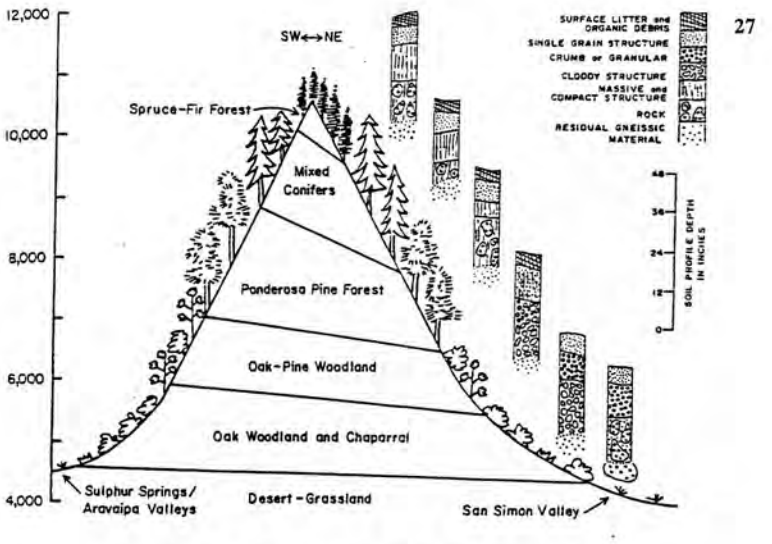


Figure 3.5 Life Zone of Mt. Graham

Spruce-Fir Forest (aka Rocky Mountain or Petran Subalpine Conifer Forest)

Because of its southern latitude, spruce-fir begins about 9,000 ft and extends to summit (10,720). Pure stands occur above 10,000 ft. Found on moderately sloping to moderately steep slopes. Boreal climate: growing season less than 75 days; heavy winter snow; summer thunderstorm; 30-45 inches precipitation. Mean temperatures: January (35-40° F); July (60-65° F); Engelmann spruce and corkbark fir with scattered white and Douglas fir.

Montane Conifer Forest (aka Mixed Conifer; Rocky Mt. or Petran and Madrean Montane Conifer)

At higher elevations, white fir and Douglas fir (area 9,000-9,800 ft). Slopes range from moderate to very steep (15-80%) with the steeper slopes predominant at lower elevations. Precipitation falls as winter snow and summer thunderstorms with some wintertime sleet and rain: ranges from 28-32". Mean temperatures: January (35-45° F); July (65-70° F). Evapotranspiration exceeds available moisture in growing season. Forest mixes with white fir, limber pine and aspen higher) and pinyon-juniper, chaparral and oak woodland (lower).

Interior Chaparral

Nearing southeastern limit in Pinalenos. On moderately sloping to moderately steep slopes between 4,300 and 5,500 ft. Humid subtropical climate: gentle rains in winter; thunderstorms in summer. Precipitation: 16-21". Mean temperatures: January (45-50° F); July (80-80° F). Dominant plants include mountain mahogany, desert ceanothens, manzanita. Emory, silver leaf and Arizona white oaks. Scattered Chihuahua pinyon and Ponderosa pines.

Semi-Desert Grassland

Pinalenos are degraded grasslands non-invaded by shrubs and trees from nearby plant associations. Found in level to moderate by sloping alluvial fans, valley and predominant plains, tableland and interspersed hills (elevation 5,000 to 5,500 ft as low as 4,000). Climate varies from humid subtropical to semi-desert. Precipitation falls as gentle winter rains and summer thunderstorms. Total varies: 11" to 18". Mean temperature: January (45-50° F); July (80-85° F). Grasses include gama, bush mohly, needle and thread grass, sacaton with pockets of sotol, beargrass, yucca, mesquite, acacia and others.

Madrean Evergreen Woodland (aka Oak-Pine and Oak-Chaparral)

Found on nearly level to very steep slopes (1-30%) with steepness predominant at higher altitudes. Higher elevations (7,000-9,000') includes Ponderosa pine, gambel oak, alligator juniper and some madrone. Mid-elevations (6,500-7,700 ft) include Manzanita, Arizona white oak, silver leaf oak, alligator juniper, pinyon pine, Chihuahua pine and some Ponderosa. Lower elevations (5,000-3,000 ft) include small associations of pinyon-juniper with Arizona and Emory oaks. Climatic regime changes from temperate continental to humid subtropical Mostly snow at higher elevations: mostly rain at lower. Precipitation ranges from 22-26" (higher) to 17-22" (lowest). Temperature ranges from 40-50° F (January) to 70-80° F (July). Soils change from completely to incompletely leached.

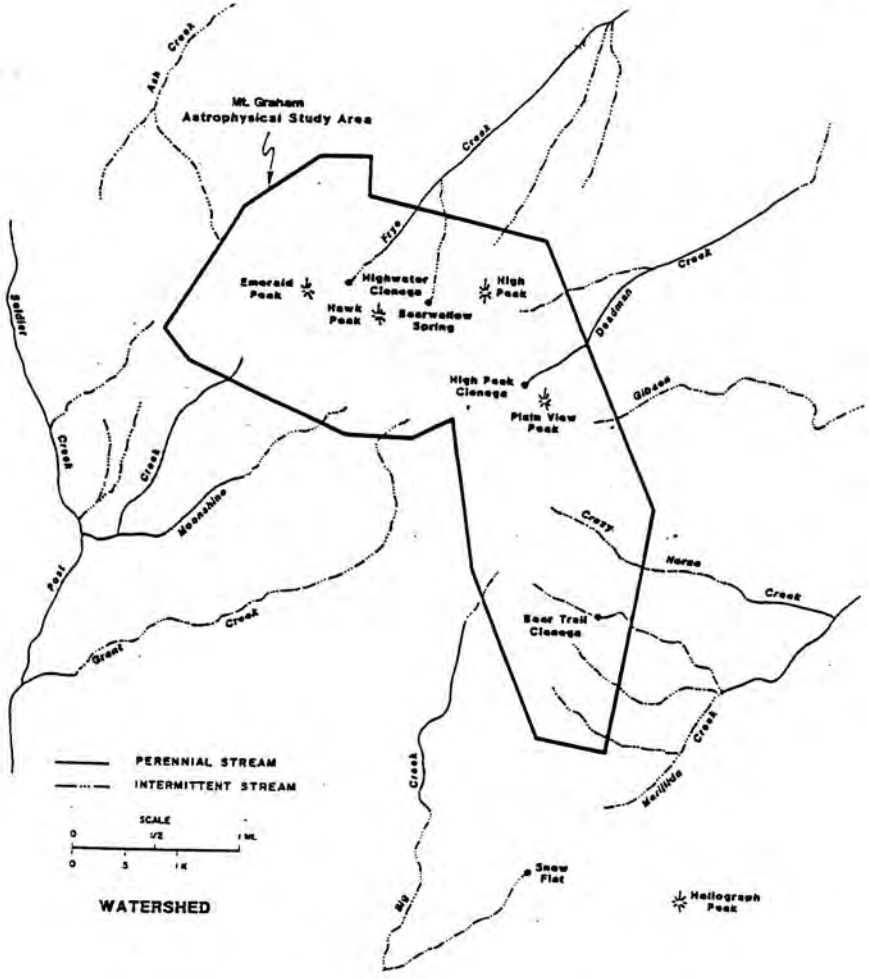


Figure 3.6 Watersheds of the Mt. Graham Astrophysical Area

TABLE 3.2
THE PINALENOS AS A TRANSITIONAL MIXTURE OF SPECIES MEXICAN AND COLORADO PLATEAU[1]

Species	Mountain Range: Whites	Pinalenos	Chiricahuas	Probable Origin
Butterflies				
Nymphalis milberti (Godart)	P	P**	A	
Speveria atlantis (Edwards)	P	P**	A	
Oeneis alberta daura (Strecker)	P	P**	A	
Habrodais grunus (Boisduval)	P	P**	A	
Erynnia icelus (Scudder & Burgess)	P	P**	A	
Piruna pirus (Edwards)	P	P**	A	
Thorybes mexicana (Herrich-Schaeffer)	P	P**	A	
Yarrow's Spiny Lizzard	A	P	P	Southern
Sagebrush Lizard	P	A	A	Northern
Bunch Grass Lizard	A	A	P	Southern
Striped Plateau Lizard	A	A	P	Southern
Mountain Skink	A	A	P*	Southern
Mock Rattlesnake	A	A	P	Southern
Twin-Spotted Rattlesnake	A	P*	P	Southern
Mexican Long-Tongued Bat	A	P*	P	
Tree Squirrel	P	P**	A	Northern
Apache Squirrel	A	A	P*	Southern
Long-Tail Weasel	P	P**	A	Northern
Coati	A	P	P	Southern
Blue Grouse	P**	A	A	Northern
Whiskered Owl	A	A (?)	P	Southern
Violet-Crowned Hummingbird	A	A	P	Southern
Rivoli's Hummingbird	A+	P	P	Southern
Yellow-Bellied Sapsucker	P	A	A	Northern
Northern Three-Toed Woodpecker	P	A	A	
Earred Trogon	A	A	P*	Southern
Elegant Trogon	A	A	P	Southern
Downy Woodpecker	P**	A	A	Northern
Williamson's Sapsucker	P	A	A	Northern
Arizona Woodpecker	A	P	P	Southern (?)
Sulphur-Bellied Flycatcher	A	P*	P	Southern
Olivaceows Flycatcher	A+	P*	P	Southern (?)
Gray Flycatcher	P	A	A	Southern (?)
Dusky Flycatcher	P	A	A	Southern (?)
Clark's Nutcracker	P	A	A	Northern
Gray Jay	P	A	A	Northern
Pinon Jay	P	A	A	Northern
Mexican Chickadee	A	A	P*	Northern
Mountain Chickadee	P	P**	A	Northern
Ouzel	P	P**	A	Northern
Mountain Bluebird	P	A	A	Northern
Eastern Bluebird	A	A	P	Northern
Townsend Solitaire	P	A(?)	A	Northern
Orange-Crowned Warbler	P	P	A	Southern (?)
Pine Grosbeak	P	A	P	Northern
Green-Tailed Towlee	P	A	A	Northern
Dark-Eyed Junco	A	P	P	Northern
Yellow-Eyed Junco	A	P	P	Northern

[1] Many races and subspecies could be added to emphasize transitional position of the Pinalenos (e.g., pygmy owl, brown creeper, evening grosbeak). The list is incomplete and is to illustrate importance to North American biogeography. Birds are for breeding species only. "P" means "breeding". "A" means "non-breeding" or "absent". * means species is at northernmost point of distribution. ** means southernmost point of distribution. + means fluctuating presence as breeder.

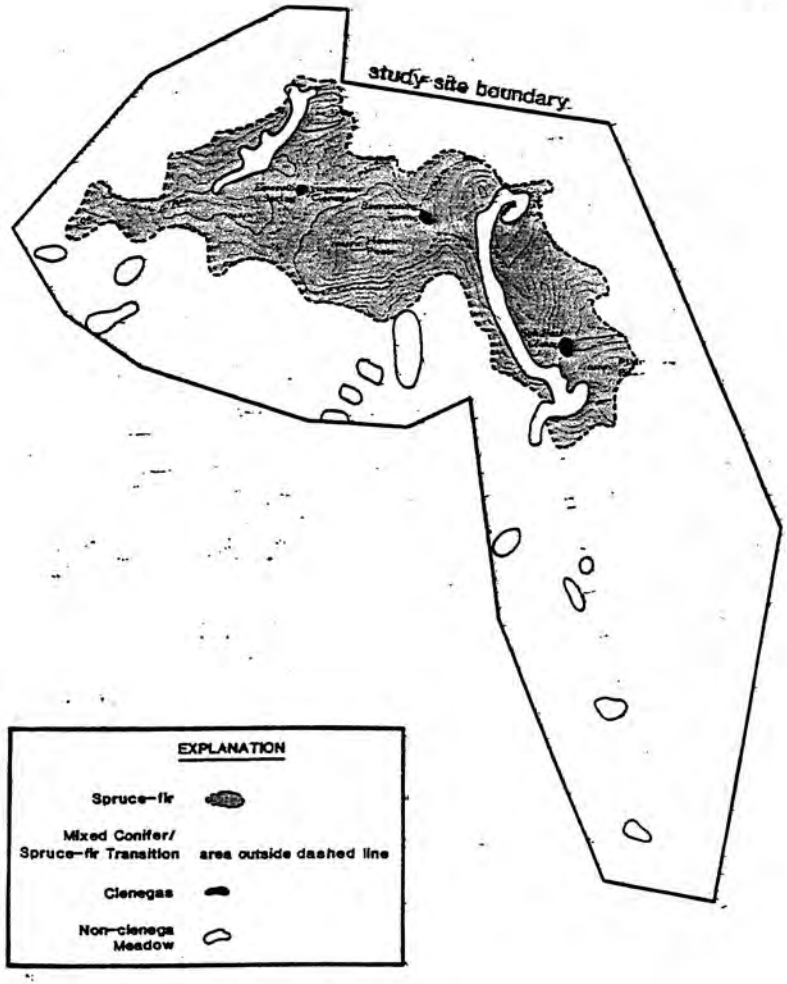


Figure 3.7 Vegetation of the Proposed Mt. Graham Astrophysical Study Area
(Further habitat destruction occurs along FR669,
access road to Emerald Peak and on Emrald Peak itself.)

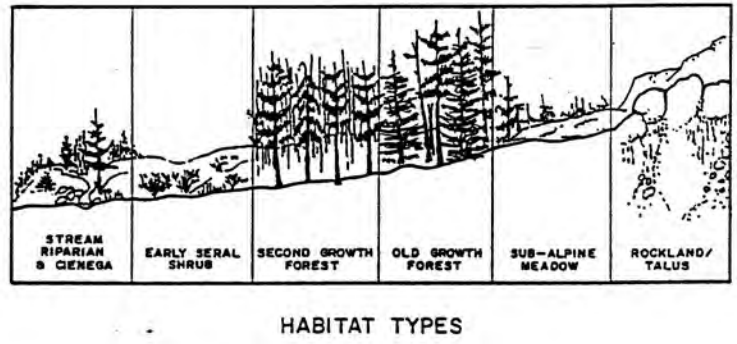


Figure 3.8 Habitat Types of the Proposed Mt. Graham Astrophysical Study Area

TABLE 3.3
PLANTS OF SPECIAL INTEREST IN THE PROPOSED
MT. GRAHAM ASTROPHYSICAL STUDY AREA

Species	Status
1. Protected Species	
Erigeron pringlei	USF&W category C-2
Dodecatheon ellisae	Az. Ag. and Hort. Comm. protected species
Corralorhiza maculata	
Habenaria hyperborea	
Primula rusbyi	
Veratrum lanatum	
2. Endemics within Study Area	
Potentilla albiflora	Mt. Graham Endemic
Erysimum capitatum (wheeleri)	
3. Other Mt. Graham Endemics	
Echinocereus ledingii	Southern Arizona Endemic
Graptopetalum rusbyi	
Plummera ambigens	
Mammillaria viridiflora	
Sophora arizonica	
Perityle lemmoni (var)	
4. Species at Distributional Limits	
Abies lasiocarpa	Southern edge of distribution
Physocarpus monogynus	Southern edge of distribution
Tecoma	Northern edge of distribution
Macrosiphonia	Northern edge of distribution
Pinus lelophylla var. arizonia	Northern edge of distribution

TABLE 3.4

CONFIRMED AND PROBABLE SPECIES OF MAMMALS
OCCURRING ABOVE 9,000 FEET IN THE PINALENO MOUNTAINS

Myotis volans interior	Hairy Winged Myotis Bat
Eptisecus fuscus pallidus	Big Brown Bat
Canis lupus baileyi**	Mexican Grey Wolf
Felis rufus baileyi*	Bobcat
Felis concolor azteca*	Mountain Lion, Puma
Ursus americanus amblyceps*	Black Bear
Conepatus mesoleucus venaticus	Hog-Nosed Skunk
Mephitus mephitus estor	Striped Skunk
Castor canadensis	Beaver
Odocoileus virginianus couesi	Coues's White-Tailed Deer
Mustela frenata neomexicana**	Long-Tailed Weasel
Sciurus aberti aberti*	Abert's Squirrel
Tamiasciurus hudsonicus grahamensis*	Mt. Graham Spruce Squirrel
Spermophilus variegatus grahamensis	Rock Squirrel
Eutamias dorsalis dorsalis*	Cliff Chipmunk
Neotoma mexicana mexicana*	Mexican Wood Rat
Peromyscus maniculatus rufinus*	Deer Mouse
Microtus longicaudus leucophaeus*	Long-Tailed Vole
Reithrodontomys megalotis megalotis*	Western Harvest Mouse
Sorex vagrans monticola*	Vagrant Shrew
Thomomys bottae grahamensis*	Western Pocket Gopher

* Seen by EIS team or other observers.
** Extinct in Pinalenos.

TABLE 3.5

CONFIRMED AND PROBABLE SPECIES OF REPTILES FOUND ON OR NEAR PROPOSED OBSERVATORY SITES IN THE PINALENO MOUNTAINS, GRAHAM COUNTY, ARIZONA

Crotalus viridus cerberus	Arizona Black Rattlesnake
Crotalus pricei pricei	Twin-Spotted Rattlensake
Crotalus molosus molosus	Black-Tailed Rattlesnake
Pituophis melanoleucus affinis	Gopher Snake
Thamnophis cyrtopsis cyrtopsis	Western Garter Snake
Lampropeltis pyrelomena pyrelomena	Sonora Mountain Kingsnake
Sceloporus jarrovi jarrovi	Yarrow's Spiny Lizard
Phrynosoma douglassi hernandesi	Mountain Short-Horned Lizard

TABLE 3.6

CONFIRMED AND PROBABLE BIRDS OF THE MT. GRAHAM ASTROPHYSICAL STUDY AREA*

Species	Species	Foraging Method[a]	Nest Type[b]
Cathartes aura	Turkey Vulture		
Buteo jamaicensis	Red-Tailed Hawk	P	C
Buteo albonotatus	Zone-Tailed Hawk		
Falco sparverius	American Kestrel	P	H
Accipiter gentilis	Goshawk	P	C
Accipiter cooperii	Cooper's Hawk		
Aquila chrysaetos	Golden Eagle	P	C
Falco peregrinus	Peregrine	P	C
Columba fasciata	Band-Tailed Pigeon	C,TFS	C
Zenaida macroura	Mourning Dove		
Otus flammeolus	Flammulated Owl	P	H
Bubo virginianus	Great Horned Owl	P	C
Glaucidium gnoma	Pygmy Owl	P	H
Strix occidentalis	Spotted Owl**	P	C
Aegolius acadicus	Saw-Whet Owl*	P	H
Selasphorus platycercus	Broad-Tailed Hummingbird	N	C
Lampornis Clemenciae	Blue-Throated Hummingbird	N	C
Colaptes aurctus	Common Flicker	GS	H
Picoides villosus	Hairy Woodpecker	TD	H
Picoides pubescens	Downy Woodpecker	TD	H
Empidonax difficilis	Western Flycatcher	F	C
Contopus pertinax	Coues' Flycatcher	F	C
Tachycineta thalassina	Violet-Green Swallow	A	H
Progne subis	Purple Martin*	A	H
Cyanocitta stelleri	Steller's Jay	TFS	C
Corvus corax	Common Raven	P	C
Parus gambeli	Mountain Chickadee	TFS	H
Sitta carolinensis	White-Breasted Nuthatch	TG	H
Sitta canadensis	Red-Breasted Nuthatch	TG	H
Sitta pygmaea	Pigmy Nuthatch	TG	H
Certhia familiaris	Brown Creeper	TG	H
Troglodytes aedon	House Wren	GS	H
Turdus migratorius	American Robin	GS	C
Catharus guttatus	Hermit Thrush	GS	C
Sialia mexicana	Western Bluebird*	F	H
Sialia currucoides	Mountain Bluebird	F	H
Myadestes townsendi	Townsend's Solitaire*	GS	G

TABLE 3.6 (CONT'D)

CONFIRMED AND PROBABLE BIRDS OF THE MT. GRAHAM ASTROPHYSICAL STUDY AREA*

Species	Species	Foraging Method[a]	Nest Type[b]
Regulus satrapa	Golden-Crowned Kinglet	TFS	C
Regulus calendula	Ruby-Crowned Kinglet	TFS	C
Vireo gilvus	Warbling Vireo	FTS	C
Vermivora celata	Orange-Crowned Warbler	TFS	G
Meleagris gallapavo merriama	Turkey	GS	G
Vermivora virginiae	Virginia's Warbler	TFS	G
Peucedramus rwnirua	Olive Warbler		
Dendroica coronata	Yellow-Rumped Warbler	TFS	C
Dendroica graciae	Grace's Warbler	TFS	C
Cardellina rubrifrons	Red-Faced Warbler	TFS	G
Septophaga picta*	Painted Redstart	TFS	C
Piranga iudoviciana	Western Tanager	TFS	C
Pheucticus melanocephalus	Black-Headed Grosbeak	TFS	C
Carduelis pinus	Pine Siskin	TFS	C
Loxia curvirostra	Red Crossbill	C	C
Pipilo chlorurus	Green-Tailed Towhee	GS	C
Junco phaenotus	Yellow-Eyed Junco	GS	G
Spizella passerina	Chipping Sparrow	GS	C

[a] Foraging Method:
A = aerial forager, F = flycatcher, GS = ground or slash forager, N = nectar feeder, P = predator on vertebrates, C = cone forager, TD = timber driller, TFS = timber-foliage searcher, TG = timber gleaner

[b] Nest Type:
H = Hole, C = cup (non-ground), G = ground

* Probable but no confirmed sightings.

** Heard adjacent to study area. Not known to nest in study area.

+ Transients not well studied. Not included.

References: field notes, 1984-85, Peter Warshall; Phillips, et al, 1964; Monson and Phillips, A.R., 1981.

TABLE 3.8

UNIQUE INSECTS FOUND IN THE PROPOSED MT. GRAHAM ASTROPHYSICAL STUDY AREA

Coleoptera
- Byrrhidae
  - Byrrhus sp.[1]
- Carabidae
  - Trechus arizonae Casey[2]
- Salpingidae
  - Priognathus sp.[1]
- Scarabaeidae
  - Diplotaxis saylori Cazier[2]
  - Scaphinotus petersi grahami Van Dyke[2]

Diptera
- Rhagionidae
  - Symphoromyia fulvipes Group[1]

Hemiptera
- Anthocoridae
  - Tetraphleps sp.[1]
- Miridae
  - Deraeocoris sp.[1]
  - Dichrooseytus sp.[1]

Orthoptera
- Eumastacidae
  - Eumorsea pinaleno Rehn and Grant[2]

[1] Possible endemic species.

[2] These insects, located so far only on Mt. Graham, are unique to Arizona. No specimens from other areas could be found in University of Arizona collection. They are not mentioned in reviewed literature on Arizona. It cannot be said, at this time, if the species can be found in other states.

TABLE 3.9

MOLLUSKS FOUND WITHIN THE PROPOSED
MT. GRAHAM ASTROPHYSICAL STUDY AREA

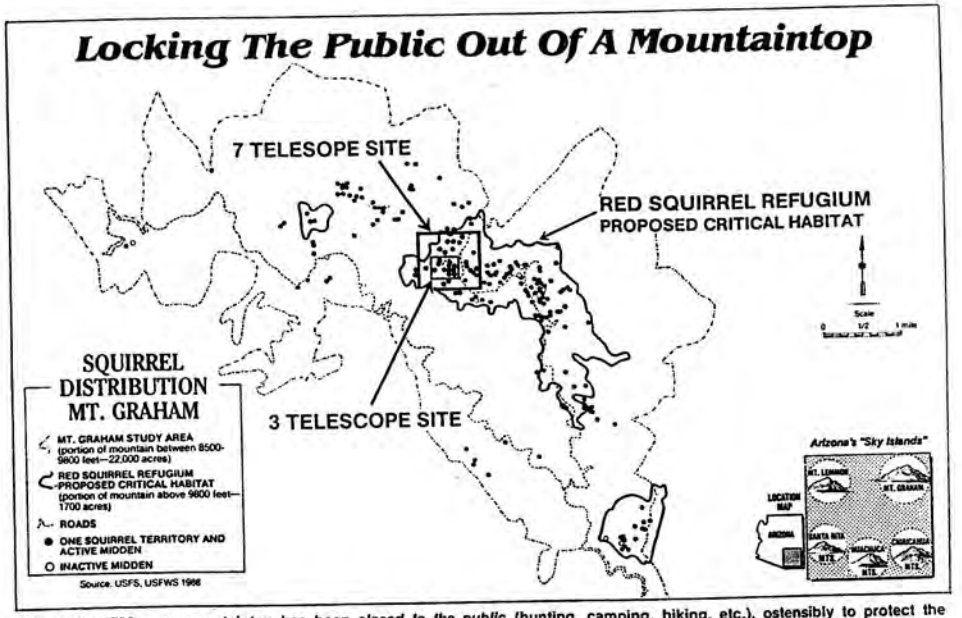
1. Large mollusks (above 1 cm in diameter):

   Sonorella imitator Gregg & Miller*
   Oreohelix grahamensis Gregg & Miller*

2. Small mollusks (1mm to 10mm):

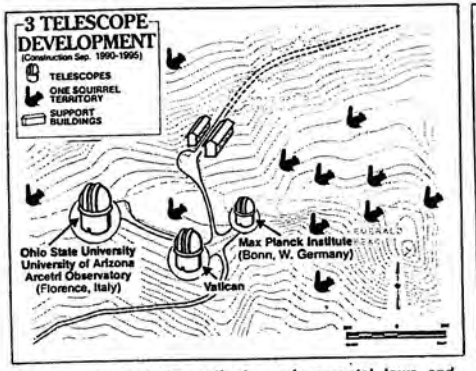
   Discus Cronkhitei (Newcomb)
   Punctum Californicum (Bland)
   Vallonia perspectiva Sterki
   Microphysula ingersolli (Bland)
   Gastrocopta spp.
   Pupilla spp.
   Vertigo spp.

*Endemic to the Pinaleno Mountains.

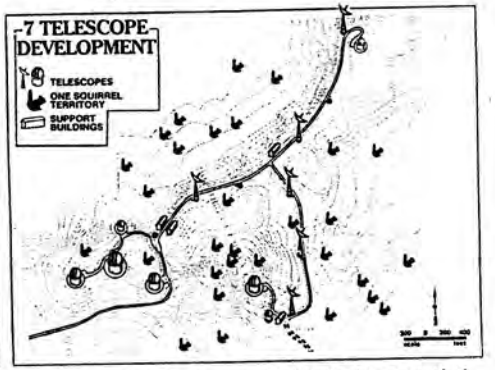


The entire 1700 acre mountaintop has been *closed to the public* (hunting, camping, hiking, etc.), ostensibly to protect the squirrel, but in reality to *lock out the public* from a private, security-tight U. of Arizona telescope fiefdom—free of campfires, headlights, etc.

All of the consortium's (the Vatican, West Germany's Max Planck Institute, Ohio State University, the Smithsonian Institute, and Italy's Arcetri Observatory) telescopes could be built at sites elsewhere which would not result in species and ecosystem destruction. The University of Arizona wanted Mt. Graham because it was close, handy, and under their control, rather than, for example, the University of Hawaii or New Mexico (where sites exist).



Congress trashed the nation's environmental laws and decreed 3 telescopes in the heartland of the *endangered* Mt. Graham Red Squirrel's best old-growth spruce-fir habitat.



Congress legislated enlargement of the 3 telescope project to 7 telescopes, actually 12 telescopes and 15 telescope pads, subject to NEPA review.