WILDLIFE SURVEY

CACHE CREEK AND LITTLE GRANITE CREEK

BRIDGER-TETON NATIONAL FOREST

OPEN-FILE REPORT 81-851

PUBLISHED BY: U.S. Geological Survey

CONDUCTED BY:

FRANZ J. CAMENZIND Ph.D.

INTRODUCTION

The results of the wildlife survey are drawn from 410 hours of field observations by the senior wildlife biologist and two biologist technicians, Terry Peterson and John Hoak. Additional observations were made by other project personnel, coincidental with other assigned duties, and by the senior biologist earlier in the season. An additional 23 hours were spent reviewing the available literature (17 hours) and talking with various individuals who have an intimate and respected knowledge of the study area (6 hours).

The Cache Creek area is an integral portion of the land mass often referred to as "The Greater Yellowstone Ecosystem". Although it is a part of the largest relatively intact wild land in the continental United States and harbors many unique species and significant portions of many species' total populations, very little biological research has originated directly from the study area. Consequently, the information reported in this study is drawn from 1), original survey work, 2) review of the literature pertaining to similar and/or adjacent habitat, and 3) discussions with knowledgeable individuals. Unfortunately, for too many species we had to rely on the latter two sources.

The assessment of our environment, or more specifically, the assessment of the natural resources indigenous to a particular area, is a monumental task. To be done properly, we should know everything about all things and understand their myriad interrelationships. Obviously we do not. As biologists we attempt to overcome these shortcomings by doing intensive and long-term research on the organism or area in question. Unfortunately, in this study we did not have the luxury of time. All the results came from one seasons's work - the transition from summer to winter.

We attempted to conduct an intensive study, but due to the nature of the season, many species were either absent, dispersed from key habitat, or already in hibernation.

As a biologist charged with a responsibility to the native fauna, many of the conclusions and recommendations are based upon the assumption that if conditions appear appropriate, the species is present and living a "normal" life

cycle. In some cases, this assumption may be overly protective, but until proven otherwise, my responsibility to the wildlife resources dictates that I follow this course.

METHODS

STUDY AREA

Because of the mobile nature of many wildlife species and the fact that wildlife must be managed at the population level, portions of this survey were conducted over a much larger area than that specifically proposed for development. The area was divided into three survey zones based on the degree of anticipated impact (Fig.1). The first and largest unit, referred to as the STUDY AREA, encompasses approximately 150 square miles and includes all of the proposed impact sites and their environs, plus a minimum two-mile perimeter with two exceptions. On the northwest corner, the study area limits are the Bridger-Teton Forest - Town of Jackson boundary, and on the southwest, the Hoback River.

The remainder of the study area boundaries are made up of the Bridger-Teton Forest boundary on the west (east of the Snake River), the Hoback River on the south, Granite Creek on the east and northeast and an east-west line transecting the headwaters of Flat, Sheep, Twin and South Twin Creeks paralleling the 10th Standard Parallel north.

The second zone, that which received more intense sampling, consisted of the NCRA and Getty LEASED UNITS outlined within the study area and totaling approximately 48 square miles (NCRA = 9 sq. mi.; Getty = 38 sq. mi.).

The third and most intensely surveyed zone encompasses all of the land one-half mile on all sides of the proposed access routes and drill pads located within the lease units. These areas are referred to as the IMPACT AREAS and total approximately 12 square miles, six square miles for each route and site.

DATA COLLECTION

Because of the large size and rugged nature of the study area, the wildlife survey was based on three major techniques; transects, aerial survey and foot survey of specific habitats.

First, ten one-half mile long permanent transects were established, five within each impact area, which were used for the small mammal trap lines, as well as the avian and herpitological census routes. The transects were plotted in such a way as to sample a majority (15 of 19) of the vegetation types present within the impact areas (Figs. 2 and 3). Vegetation types were identified and located from the Bridger-Teton Forest vegetation type map of the Cache Creek area. These types are referred to by number throughout this report and are listed in Appendix A.

Second, aerial surveys were conducted over the entire study area following major topographic features and drainages. All vertebrates sighted were recorded as to location, species, number and activity.

Third, specific drainages and habitats were walked in order to increase the sample size of specific habitat types.

Amphibians and Reptiles - Amphibians and reptiles were surveyed in three ways. First, all sightings made by all project personnel were recorded as to species, location and time. Second, the major habitat types present within the impact areas were sampled along the established transects. Third, specific riparian zones were walked. These included all of Cache Creek downstream from the proposed drill site to the edge of the study area, all of Horse and Game Creeks from the Cache Creek trail to the edge of the study area and all of the drainage downstream from the proposed Getty drill site to its junction with Little Granite Creek. Many decaying logs along these routes were overturned in a specific effort to locate rubber boas (a phylogenetic listing of scientific names is provided in Appendix B).

Two ponds were investigated for reptiles and amphibians. These included the pond between Jackson Peak and Nober Draw (S10, T40N, R115W) and the pond between Nober Draw and Cache Creek east-southeast of the Cache Creek drill site (S15, T40N, R115W). The later was dry when viewed on September 16th. The other showed evidence of night time freezing and no sign of reptile or amphibian activity.

Birds - For two days, all of the birds observed along each of the ten permanent transect lines were recorded as to

species, numbers and vegetation type-locations. This included all birds flushed from the line and all those identifiable with the unaided eye, usually less than 30 yards on either side of the line. In addition, all birds observed during the foot survey through the riparian areas were similarly recorded, as were all raptors observed during all field activities.

Mammals - The two predominate techniques used for collecting mammal data were live trapping and aerial big game surveys. The live trap lines were located astride the previously described transect lines within the impact areas. Off-survey sightings and indirect evidence of mammal presence were also recorded.

Live Trapping - Ten live trap lines were operated during September, 1980. Lines C 1-5 and G 1-5 were located in the Cache Creek and Little Granite Creek impact areas respectively (Figs. 2 and 3). Each line was composed of 100 Sherman live traps (9 in. x 3.5 in. x 3 in.) positioned approximately 10 yards apart, straddling the transect line. One line was operated in each of the impact areas simultaneously for three nights and then moved to the next location. The traps were opened and baited each day (usually mid-morning) with rolled oats and peanut butter. Four to six cotton balls were placed in each trap to provide the captured animals with nest material and insulation. Captured rodents were identified and individually color marked with either a red, yellow or blue felt-tip pen (Skillcraft brand).

Trapping data provided a species list, an indication of relative abundance and habitat affinities.

Aerial Survey- There is no accurate method of censusing big game over large areas that is totally acceptable. Most techniques are exceptionally costly and must be modified for each topographic condition. The most that management agencies can hope for is data consistently collected which will yield relative values for populations over long periods of time. Consequently, the big game survey of the Cache Creek area was modified to best meet the circumstances.

Survey flights were made with fixed-wing aircraft on 9/30, 10/11 and 10/22, for a total of 3.5 hours. Because of insufficient snow, the big game animals were not visible. Drainages and major topographic features were flown and yielded data pertaining to beaver distribution.

RESULTS

The results of the wildlife survey are drawn from 410 hours of field observations by the senior wildlife biologist and two biologist technicians, Terry Peterson and John Hoak. Additional observations were made by other project personnel, coincidental with other assigned duties, and by the senior biologist earlier in the season. An additional 23 hours were spent reviewing the available literature (17 hours) and talking with various individuals who have an intimate and respected knowledge of the study area (6 hours).

VEGETATION TYPES

Vegetation types for the study area are taken from the Bridger-Teton Forest vegetation type map. Acreage for each vegetation type sampled with the impact areas was determined with a planometer and is reported in Table 1. An IMPORTANCE CLASS is assigned to each, based on the relative amount of each vegetation type sampled within the impact area to the total amount of that type within the lease units. Acreage and importance classes were determined for eight types in the Cache Creek impact area, and nine within the Little Granite impact area.

An importance class value of "I" indicated that from 76 to 100 percent of that vegetation class occurs within the impact areas. A "II" value indicated that from 51 to 75 percent occurs within the impact area. A "III" represents 26 to 50 percent and a "IV" importance class value indicates that less than one-quarter of the total acreage for this type is found in the impact areas. Based on this evaluation, a vegetation type with an importance value of "I" has a very high management priority because a high percentage of it occurs only within the impact areas. Any modification or loss of an importance class "I" vegetation type would mean that the vast majority of that vegetation type within the entire lease unit would be lost or modified.

Similarly, an importance value "IV" vegetation type would warrant less management concern because a vast majority of this type exists outside of the impact area and is not subject to any immediate modification or loss.

The Cache Creek impact area contains three importance class "I" vegetation types (35, 63, and 72-74) and two "II" types (28 and 34) (Table 1). This represents a total of 414 acres, or 35% of the impact area, which should be managed with a "very high" or "high" concern. The drill site proper is in the midst of an importance class "III" vegetation type (61-62). In this case, the contiguous vegetation type of the drill site encompasses approximately 40 percent of this vegetation type found from within the entire lease unit. Development of this drilling site and access road would adversely affect almost one-half of this contiguous vegetation type, or about 20 percent of all of this type within the lease units.

Two of the three importance class "I" vegetation types (35 and 72-24) are immediately adjacent to or directly on the Cache Creek proposed access route. Type 35 is found exclusively within the impact area, while approximately 90 perent of type 72-24 lies within the impact area. Development of the Cache Creek access route would virtually eliminate all of 72-24 from the lease units and seriously affect the lower elevation portions of vegetation type 35.

Vegetation type 63 occurs exclusively within the Cache Creek impact area, but lies above and beyond the probable access route and would only be affected by its proximity to the disturbance along the route. The vegetation would probably not be directly altered, but wildlife use may be limited.

The Little Granite impact area has no importance class "I" vegetation type, but has two number "II" vegetation types (28 and 78) (Table 1). The drill site proper is located on an importance class "III" vegetation type, and the major access route would pass through an importance class "IV" vegetation type. The overall impact to unique vegetation types will be significantly less within the Little Granite impact area than within the Cache Creek impact area.

AMPHIBIANS AND REPTILES

Table 2 lists the 10 amphibian and reptile species potentially occurring or actually observed on the Cache Creek study area. The list is compiled from several sources. Carpenter (1953) identified nine species in the Jackson Hole area based on actual field surveys. The tenth species, the

wood frog, has not been observed on the Bridger-Teton Forest, but is listed as an "unknown" (Bridger-Teton Forest 1979).

Four species, the leopard frog, wood frog, bull snake and rubber boa are considered rare in Jackson Hole (Carpenter 1953 and Clark 1980). Of these, only the wood frog and rubber boa are listed as "sensitive" by the Bridger-Teton Forest (1979) and "rare" by the Wyoming Game and Fish Department (1977) and by Clark and Dorn (1979).

The wood frog prefers damp, shady woods, usually associated with clear streams and leafy ponds, as well as grassy areas bordered by willow and aspen at elevations from 7,500 to 10,000 (Bridger-Teton For. 1979 and Wyo. Game and Fish 1977).

The study area and, in particular, the impact areas appear to provide suitable habitat for the wood frog. This, plus its occurrence within the state as "...glacial relic populations" (Wyo. Game and Fish 1977) suggest that it may be found on the Forest.

The rubber boa may be more common in Jackson Hole than the literature indicates (R. Pace pers. comm). Carpenter (1963) reported one boa from Death Canyon in Grand Teton National Park. R. Pace has captured "numerous" specimens in the area from Alpine Junction, Wyoming to Swan Valley, Idaho (30 to 40 miles southwest of the study area). He does state, however, that the best time to find them is from May to June and, then, at night. The latest that he has observed boas in southeastern Idaho is mid-September, and he thinks that early September is the latest that any would be active in the Jackson Hole region.

The preferred habitat of the rubber boa includes the grasslands, woodlands and forests with moist soils and along rocky streams with sandy or loam banks, and numerous rotting and dead standing trees with loose bark. This habitat description fits a majority of the mature riparian zones found within the study area and, particularly, the impact areas of the Cache Creek drainage.

The tiger salamander, western toad, northern chorus frog, spotted frog and the two species of garter snake are considered common in Jackson Hole, while the leopard frog and bull snake are considered rare (Carpenter 1953 and Clark 1980).

The only species of reptile or amphibian observed during the study period was the western garter snake (8 individual on 6 days) (Table 2). All were seen in the riparian zones of Cache Creek and Game Creek, and in vegetation type 72-24 and its ecotone with 11.

Because of the timing of the study period, the herpetofauna of the Cache Creek area could not be adequately surveyed. Consequently, these results can not be considered reflective of the actual status of these species.

Before any specific development recommendations can be made, a concerted effort must be made to determine the status and distribution of the rare and sensitive amphibian and reptile species. This survey should be conducted from early May to late June and should include night-time lighted surveillance of trails and stream banks in the riparian zones and day time exploration of potential resting sites, i.e. dead and decaying logs. Ponds and wooded areas near ponds should be searched specifically for the wood frog.

BIRDS

Of the 271 bird species listed by Raynes et. al (1979) as occurring in the Jackson Hole area, 43 were observed on or near the study area by members of the biological survey crews. Of the 14 proposed "indicator" species potentially inhabiting the study area, nine were observed. Three species currently proposed as "sensitive" by the Bridger-Teton Forest, the trumpeter swan, osprey, and great gray owl, were observed on the periphery of the study area by the senior biologist during the summer of 1980 and are included here as species observed (Table 3).

Officially, no threatened or endangered species of birds are reported to occur on the study area (letter on file dated Aug. 6, 1980 #SE and Aug. 18, 1980 #2670; U.S. Fish and Wildlife Service to U.S. Forest Service Regional Office and U.S. Forest Service Regional Office to Supervisor, Bridger-Teton National Forest). However, three species, the American peregrine falcon, bald eagle and whooping crane, are included because of their known occurrence near, and recent sightings within the study area.

General Observations - Twenty-seven species of birds which have no special management status were seen on the study area (Table 3). Of these only the Say's phoebe is listed as rare for this area in the fall, as well as spring and summer (Raynes et. al. 1979). This sighting, of a single bird, was made on September 26 on trap line 5-C along the ecotone between vegetation type 72-24 and 11. Oakleaf et. al. (1979), lists sagebrush-grasslands and grasslands as the preferred nesting areas for the Say's phoebe but indicates that no nesting activity for this species has been documented for this portion of Wyoming. Its presence on the study area probably represents a fall movement through the area.

Seven additional species, the eastern kingbird, common crow, red-breasted nuthatch, brown creeper, Swainson's thrush, western meadowlark and western tanager are listed by Raynes et.al. (1979), as occurring occasionally in the area in the fall. Of these, the Swainson's thrush and western tanager are common summer residents, while the other few species are occasional summer residents. None of these have habitat requirements unique to the impact areas. The vegetation types in which all of the observed species occurred are listed in Table 3. The scant data available from the observations, plus the nature of the season of observations, make any definitive conclusions concerning habitat affinities impossible. For the species not observed, but probably occupants of the study area, only this can be said: Where suitable habitat occurs, corresponding species can be expected to appear in the appropriate season.

Indicator Species - There are 14 species of birds tentatively listed by the Bridger-Teton Forest as "indicator" species, which may occur on the study area (Table 3). Five of these were not observed on the study area (downy woodpecker, willow (Traill's) flycatcher, hermit thrush, ruby-crowned kinglet, and the water pipit). Raynes et.al. (1979) lists the water pipit and downy woodpecker as common fall species, while the hermit thrush and ruby-crowned kinglet are listed as occasional in the fall and common in summer. The willow flycatcher is listed as occurring occasionally in the spring-summer and fall. Of these, only the willow flycatcher is closely associated with the riparian zones prevalent, but not

exclusively found, within the impact areas. Other than the water pipit, which occurs in alpine situations, the remaining four species are found most commonly in aspen, mature and old growth forest. Alpine situations do not occur in the impact areas; and the other habitat types are found within, but not exclusively within, the impact areas.

The nine tentative indicator species observed and the associated habitat are listed in Table 3. All but the white-crowned sparrow (uncommon fall and abundant summer) are listed as common fall species. As with the other indicator species, none of these have habitat requirements unique to the impact areas or even the study area.

Two of the observed "indicator" species, the blue grouse and ruffed grouse, are also game species as defined by the Wyoming Game and Fish Department. All 17 blue grouse observations were made in the Little Granite impact area, while ruffed grouse were seen in both impact areas and in Horse Creek. Blue grouse occurred in six vegetation types, while the ruffed grouse were seen in three types. Seven of the 17 blue grouse sightings occurred in sub-alpine fir types, one in aspen and the remainder were in tall forb types. Ten of the ruffed grouse sightings occurred in sub-alpine fir types, while the remainder were tall forb types (Table 3).

Three of the observed indicator species, the goshawk, bald eagle and osprey, will be discussed in a section on raptors.

That such a high proportion of the tentative indicator species was observed during such a short and inappropriate census period suggests strongly that this area and, in particular the impact areas, provides a diverse and healthy array of bird habitats.

Sensitive Species - Three species currently listed or proposed as sensitive species by the Bridger-Teton Forest, the trumpeter swan, osprey and great gray owl, were observed on the periphery of the study area by the author during the summer and fall of 1980. Only the trumpeter swan will be discussed here. The remaining two species will be discussed in the section on raptors.

The trumpeter swan is a year-round resident of Jackson Hole and can frequently be seen in the National Elk Refuge

northwest of the study area and occasionally on the Snake River west of the study area. Its preferred habitat includes expanses of calm water, such as beaver ponds. It has not been obvserved on the study area.

Threatened and Endangered Species - Although, offically, no threatened or endangered species of birds are reported to occur on the study area (op. cit.), the status of three species, the whooping crane, bald eagle and American peregrine falcon, will be considered. The whooping crane will be discussed here, while the other two species will be considered within the raptor section.

On April 24, 25 and 26 of 1980 an immature whooping crane was observed in the upper region of Cache Creek about 8,800 feet elevation (pers. comm. B. Raynes). It was in the company of two adult sandhill cranes and had a band on its left leg. This was probably one of the re-introduced cranes from the Grays' Lake foster parent program and represents transient birds.

Two adult sandhill cranes were observed circling over the upper end of transect line 2-C on the 15th of September. D. MacLeod (pers. comm.) has seen sandhill cranes nesting in the upper reaches of Open Door peak on the east side of the study area, and I have seen them in the Granite Creek area from late spring through the summer. That sandhill cranes use the higher meadows found throughout the study area seems certain. However, the likelihood of whooping cranes using these meadows for anything other than feeding areas during movements seem low. Similarly, the importance that the study area holds for the success of the whooping crane reintroduction effort, or, even in the overall perpetuation of the species, would appear minimal. However, that these birds do use the area indicates that it must fulfill some of their requirements.

Raptors - Currently, all hawks, eagles, falcons, and owls are protected in Wyoming by either state or federal law. Wyoming's Falconery Law, enacted in 1969, protects all falcons and hawks. In 1972 all hawks, eagles, falcons, and owls were placed under federal protection when the United States Government passed an amendment to the Migratory Bird Treaty Act.

Situated at the head of the food chain, raptors may be the most impact-sensitive species found on the study area. Many biologists consider the well-being of an area's raptor population to be indicative of the condition of the entire area. Similarly, diversity at the top of the food chain can only occur if the food chain itself is diverse. In the Cache Creek study area 11 species of raptors were observed, and only seven are listed as being common by Raynes et.al. (1979).

Seventeen species of raptors are considered in this report. This list is derived from actual observations (11 species) and a review of the literature (6 species). Twelve of the 17 species have no unique management status. Seven of these were observed. Four probably occur, and one may occur (Table 3).

With the exception of the rough-legged hawk (fall and winter resident), all of the observed species can be expected to nest in or near the study area. Two other buteos, the red-tailed hawk and Swainson's hawk, are common nesting species in the study area. No Swainson's hawks were observed during the field work. Their activity in the Jackson Hole area is limited to the summer months, arriving in April, nesting in mid-May and leaving the area again in early September (Table 4).

Red-tailed hawks may be the most common large raptor in the study area. Six were observed on the study area (four in the Cache Creek impact area and two in the Little Granite impact area). Their activity period in the Jackson Hole region starts two to three weeks earlier than that of the Swainson's hawk, and late season sightings may extend into late October (Table 4).

Golden eagles and prairie falcons are known to have nested successfully in 1980, less than four miles to the north of the study areas. Two adults and one immature golden eagle were observed on September 14 and 15, flying over the higher portions (south end) of transect line 3-C (vegetation type 26). R. Perkins (pers. comm.) reported to me that a pair of golden eagles fledged two young in 1973 and another in either 1975 or 1976 from a nest north of the Spotted Horse Ranch (Sec 30, T319N, R115W) in the Hoback Canyon. D. MacLeod

(pers. comm.) reported that golden eagles commonly nested on Open Door peak along the east edge of the study area. He has not seen them in the area for nearly 10 years.

Three active golden eagle nests were located in the study area in 1978 by Oakleaf (1978). All contained incubating birds when observed on 4-27-1978. One was located on the North Fork of Horse Creek (T40N, R115W, Sec. 34) in the northern portion of the Little Granite Creek lease unit. Another was located on the cliffs overlooking Stinking Springs on the south boundary of the study area (T38N, R115W, Sec. 3) and the third was south of the lease unit on Bear Creek (T39N, R115W, Sec. 36). Their current status is unknown. Development of either proposed drill site should have no adverse impact on these nesting eagles.

Prairie falcons are not abundant in Jackson Hole (Raynes et.al. 1979). Their preferred nesting habitat includes rock cliffs overlooking sage-grasslands and meadows. These areas exist in limited amounts within the study area. Oakleaf (1978) reported a suspected nesting pair of falcons in the area overlooking the Horse Creek elk winter feed grounds (T39N, R116W, Sec. 12) and observed incubating birds (3 eggs) on Battle Mountain, located on the southeast boundary of the study area (T38N, R116W, Sec. 3). The current status of these nest sites is unknown.

The American kestrel, although not observed during the study period, is known to nest around the periphery of the study area and certainly nests within the study area. The kestrel may be the most abundant raptor in the study area, but no determination can be made until a nesting survey is completed.

Three of the four accipiter species which might occur in the study area were observed. Only the northern harrier was absent. It is known to nest in Jackson Hole, but, until a nesting season survey can be conducted, its status can only be guessed. Its major nesting requirements are wetlands, riparian meadows, sage-grasslands and grasslands (Oakleaf et. al. 1979). None of these are common, although all occur in small amounts within the major drainages of the study area.

Of the accipiters, the goshawk is the only year-round resident of the area. While it is generally more abundant

than the Cooper's or sharp-shinned hawk, none are abundant anywhere within their range. All three species could nest in any of the major forest types present within the study area. None require any habitat types unique to the impact areas or the study area in general.

Three Cooper's hawks and two sharp-shinned hawks were sighted during the study period. The Cooper's hawks were seen in the Cache Creek drainage in vegetation types 61-2 and 26, the first between trap sites 30-35 on transect 1-C and the second at the mouth of Cache Creek. The third was seen over the mouth of Curtis Canyon, north of the study area.

One sharp-shinned hawk was seen at the mouth of the creek, which flows below (south) the proposed NCRA drill site on the ecotone between vegetation types 6-62 and 26. The other sightings occurred on transect 2-G in vegetation type 71-73.

The goshawk will be discussed with the indicator species.

Three of the four owl species listed were observed on or near the study area. Only the long-eared owl was absent and its status is questionable, although it has nested sporadically within Jackson Hole. Its nesting requirements include douglas fir and spruce-fir forests, aspen stands, sage-grasslands and riparian deciduous forests, all of which are common within the study area.

The great-horned owl, a year-round resident of the area, is one of the most common owl species in North America, and its presence on the study area was expected. Its nesting requirements encompass virtually all of the forest types present in the study area, none of which are unique to the impact areas.

The pygmy owl, considered to be rare in Jackson Hole (Raynes et al. 1979) was observed on September 22 on transect 5-G in vegetation type 26. Oakleaf et.al. (1979) indicates that there is circumstantial evidence of the pygmy owl nesting in this region and lists lodgepole, douglas fir, spruce-fir, aspen and riparian deciduous forests as important nesting habitat types.

Sensitive Species - The great gray owl is proposed as being a sensitive species by the Bridger-Teton Forest, and

the osprey is already listed as such. The osprey will be discussed with the indicator species.

One immature great gray owl was seen on July 25, 1980 by the senior biologist along the Hoback River and U.S. Highway 187-189 near the Hoback Campground (Sec. 1, T38N, R115W). A. Franklin (pers. comm.), who is conducting a survey of the great gray owl population/distribution in northwestern Wyoming and eastern Idaho, states that great gray owls prefer to nest in either abandoned raptor or raven nests near the tops of dead trees or actually on the snag-ends of large broken off trees, usually douglas firs. These nest sites are usually bordered by, or are in close proximity to, open meadows which are apparently used for hunting. Such conditions appear to be quite common in the study area and suggest that this species may be more common than the results of this study indicate.

Indicator Species - All three of the tentative indicator species (goshawk, osprey and bald eagle) were observed on or near the study area. One adult goshawk, previously mentioned, was seen on September 9 over the Noker Mine (Sec. 9, T41N, R115W) in vegetation type 26.

Osprey, also listed as sensitive by the Bridger-Teton Forest, were sighted several times fishing over the upper portion of Granite Creek (near Granite Creek Ranch) in July, and also over Flat Creek in the town of Jackson (along the northwest boundary of study area) throughout the summer months. S. Moore (pers. comm.) has seen two osprey repeatedly for the past few summers on the divide between west Shoal Creek and Granite Creek Campground (Sec. 20-29, T38N. R113W). This would suggest that osprey nest in that area. No other nesting areas are suspected in or near the study area. Their primary range exists on the periphery of the study area, sympatric with the larger open water courses (Richardson 1980).

Endangered Species - Two species are considered here, the bald eagle and the American peregrine falcon. The bald eagle is listed both as a tentative indicator species and as an endangered species.

Bald eagles nest along the Snake River to the south and west of the study area and occur in moderate numbers on the

elk carrion in the fall in Grand Teton National Park and the National Elk Refuge north of the study area. No bald eagles were seen on the study area, but S. Moore (pers. comm.) has seen an adult bald eagle along Granite Creek upstream from its confluence with Little Granite Creek several times in October of 1980. D. MacLeod (pers. comm.) states that 15 to 20 years ago bald eagles were commonly seen feeding on elk "gut piles" during the fall hunting season in the Little Granite Creek area. He recalls no consistent sightings of adult bald eagles during the summer months in the study area.

The other species listed as endangered and included in this report is the American peregrine falcon. In 1980 a peregrine falcon reintroduction program was initiated in Grand Teton National Park. The goals of the project are to reestablish a nesting population of peregrines into northwestern Wyoming. The program does not call for any birds to be released in or near the study area. However, portions of the study area, particularly the periphery, appear to provide potential nesting habitat for peregrines; and, if the reintroduction program succeeds, peregrines may eventually appear in the study area.

Nesting dates and seasonal activity for raptors are outlined in Table 4. These dates represent the earliest and latest dates and not averages (Craighead and Craighead 1969). Disturbance from one to two weeks before nesting and through nesting will frequently cause raptors to either not nest or abandon nests with eggs. Seldom will nests be abandoned once hatching has occurred, although it may influence their return to the site the following year.

The Cache Creek study area is very rich in bird species, particularly raptors. This group represents the top of many food chains and clearly indicates that many aspects of the area's basic native plant and animal communities are diverse, complete and functioning naturally.

An accurate status report of the birds in the study area can only be prepared from year-long investigations, emphasizing nesting activity, its chronology, site selection and productivity. If management decisions must be made without benefit of such an investigation, then for the sake of the species, those decisions should be made as though all

probable species are present. No one species will, in all probability, be eliminated from the study area if development of the two sites occurs, but there would certainly be a reduction in total numbers because of the loss of habitat through direct destruction and the disturbance brought on by the drilling activity.

MAMMALS

The mammals of the Cache Creek study area represent a diverse group of species, in form, ecological role and economic importance. Of the 49 species which could reasonably be expected to occur, 26 were actually observed or identified by recent "sign". Four additional species will be considered 1) because of their known historic presence on the area and 2) because ecological and management conditions favorable to their return either do exist or could be reasonably implemented (Table 5). This list is drawn from a variety of sources, including Long 1965, Negus and Findley 1969, Clark 1980, Clark and Dorn 1979 and Bridger-Teton Forest 1979 and undated tentative "Indicator Species" list, as well as the results of this survey.

Small Mammal Transects - The transect sampling procedure for small mammals yielded data significant only to species occurrence, relative abundance and habitat affinities. As described in the METHODS section, 10 trap lines of 100 traps each were operated for three consecutive days each (3,000 total trap nights). The results are summarized in Table 6.

Sixteen identified species of small mammals were captured from the 15 vegetation types sampled. Thirteen species were captured in no more than four vegetation types and five in only one vegetation type (Sorex palustris, Microtus richardsoni, Mustela frenata, Citellus lateralis and Thamomys talpoides). Of these, only the first two are expected to occur in limited vegetation types. The limited occurrence of the other three species is probably a result of either inappropriate capture techniques (Mustela frenata and Thamomys talpoides), or lateness of trapping season (Citellus lateralis) and should not be construed to be representative of their relative abundance.

The three identified species which were captured in the most vegetation types were Eutamias minimus (N=8), Peromyscus

maniculatus (N=15) and Clethrionomys gapperi (N=12). Peromyscus maniculatus was the most abundant species in 10 of the 15 vegetation types sampled (11, 28, 35, 63, 71, 78 61-62, 71-73,71-74 and 72-24), while Clethrionomys gapperi was the most abundant species in four vegetation types (22, 23, 26 and 77). Euktamias minimus and Clethrionomys gapperi were equally abundant in one vegetation type (34). No other species was the most abundant in any of the vegetation types sampled.

Two vegetation types (26 and 61-62) provided the greatest number of species (8 and 10 identified species respectively), while two types (71-74 and 72-23) yielded only one species. This may be a result of trapping effort and not representative of species diversity because vegetation type 26 was the most heavily sampled, while 71-74 and 72-24 were sampled the least. Not surprisingly, there appears to be a strong relationship between trapping effort and numbers of species captured (Fig 4). Therefore, a comparison of species richness between vegetation types would be inappropriate.

Of the 16 identified species, six are tentatively listed as indicator species by the Bridger-Teton Forest. All of the indicator species which are expected to occur in the study area and could be trapped with the techniques used were captured.

The three shrew species (Sorex cinereus, S. vagrans and S. palustris) all occurred in their expected habitats. However, Clark (1973) found that S. cinereus occurred over the widest range of community types followd by S. vagrans and then S. palustris in Grand Teton National Park. In this study, Sorex vagrans occurred in three vegetation types (12 captures), followed by S. cinereus from two types (2 captures) and one S. palustris. All three species were captured in vegetation type 26, and both S. cinereus and S. vagrans were captured in type 61-62. One Sorex vagrans was captured in vegetation type 11 and 28 each.

The other three indicator species, Microtus montanus, M. longicaudus and M. richardsonii were captured in six different vegetation types. All three were captured in only one type (61-62), while the rest were captured exclusively in separate types. Microtus montanus occurred in types 11, 71,

61-62, and M. richardsonii was captured only in type 61-62 near its ecotone with type 26 at an elevation of 7,900 feet. Negus and Findley (1959) found this species at 9,000 feet on Togwotee Pass and at 7,000 feet near Grassy Lake in the northern portion of Jackson Hole. They are usually associated with low gradient streams with overhanging banks and near spruce-fir stands. The two individuals trapped were found on either side of Noker Creek on transect line 1-C, trap stations 64 and 65.

Clark (1973) states that Microtus longicaudus is the most restricted of the four species he investigated (Clethrionomys gapperi, Microtus pennsylvanicus, M. montanus and M. longicadus). This distinction could not be detected from the results of this study.

The abundance and distribution of Phenacomys intermedius corresponds with Negus and Findley (1959). It is found in limited numbers in a variety of habitats reaching from 6,000 to 10,000 feet elevation.

Microtus pennsylvanicus occurred in four types, while Clethrionomys gapperi was captured from 12 types, and Peromyscus maniculatus was the most ubiquitous, occurrng in all 15 types sampled. The latter two species accounted for 82 percent of all captures (252 and 250 of 611, respectively. The high proportion and wide habitat utilization is not surprising for Peromyscus maniculatus, but is unexpected for Clethrionomys gapperi. One can only believe that the Cache Creek study area is currently experiencing a "high" in the C. gapperi cycle. This should be considered if further monitoring is conducted in the area.

The presence of Tamiasciurus hudsonicus and Eutamias minimus and other unidentified Eutamias in the limited numbers probably represents inadequate trapping procedures. Many red squirrels and chipmunks were seen while conducting the field work. The capture of three flying squirrels, Claucomys cabrinus in vegetation types 28 and 35, corresponds to what Negus and Findley (1959) found.

Pikas were observed, but not captured, in the rock slides above and to the south of transect 2-C. They were common in appropriate habitat (type 710), which occurs on only the fringes of the Little Granite Creek impact area but more commonly through the study area.

Several other small mammals undoubtedly occur on the study area, but were not captured. These include the Uintah ground squirrel, yellow pine chipmunk, Wyoming chipmunk, and Rocky Mountain jumping mouse. The Uintah ground squirrel, an abundant mammal in this portion of Wyoming, was already hibernating before the study began. The two chipmunks may have been trapped (5 unidentified Eutamias) but because they can be idenfied only from skulls and pelage, their presence could not be documented.

The Rocky Mountain jumping mouse is active above ground for about 2.5 months extending from late May to mid-August (Clark 1971). Their preferred habitat includes lowland aspen stands, as well as shrub and sedge-grasslands with moist soils, usually within 50 yards of water. These conditions appear to be common within the study area; and, consequenty, it must be assumed that this species is present but could not be censused.

Small Mammals Not Observed - None of the four bat species listed as possibly residing in the area could be censused because of 1) lateness of sample period and 2) time involved to perform an accurate census. These species may occur on the study area; but before their status can be determined, specific census techniques must be carried out.

Five other species, the yellow-bellied marmot, bushy-tailed woodrat, porcupine, white-tailed jackrabbit and snowshoe hare were not observed, but probably occur on the study area. The marmot, porcupine and snowshoe hare are common throughout this area.

The snowshoe hare is a tentative indicator species, dependent on early successional forest stages as well as mature and old growth timber types both of which are common through the study area. The Wyoming Game and Fish Department lists the hare as a game species but its economic importance is low with only an estimated 60 being harvested in all of Teton County in 1979 from an estimated 205 hunter days (Wyoming Game and Fish 1980a).

The presence of the woodrat and white-tailed jackrabbit may be questionable. The woodrat occurs in the rocky cliffs along the east portion of the National Elk Refuge and may occupy similar habitat throughout the lower portions of the

study area. White-tailed jackrabbits also occur on the Elk Refuge in limited numbers and may occupy the lower elevation sagebrush-grasslands along the southeastern portions of the study area. None of these species require specific management plans and would be minimally affected by development of the two drill sites and access roads.

Large Mammals - Because most large mammals wander over very large home ranges during their normal life cycle, their habitat affinities are not as definable as those for small mammals. Consequently, the emphasis of the large mammal assessment was not oriented to particular vegetation types but instead to overall numbers, distributions and movements as relating to particular geographic locations.

Predators/Furbearers - Thirteen species are listed by the state as being either a predator or furbearer. The designations have little to do with phylogenetic classification (Table 5). Only those species scientifically classified as carnivores are considered in this discussion of large predators and furbearers. Fifteen species are either known to occur, or thought to occur, on the Cache Creek study area. Eleven occupy terrestrial habitats, while the remaining four occur in aquatic environments.

The coyote is perhaps the most ubiquitous of the terrestrial predators. They range over virtually every habitat type, adapt to modified habitats with ease and utilize an extremely wide variety of food items (Weaver 1977 and Camenzind 1978). Their presence in the study area was noted from scats along the trails. The first day that the Little Granite trail was walked, 19 coyote scats were counted. Four coyote scats were counted on the first day that the Cache Creek trail was walked. This may represent an actual difference in abundance between the two areas because of the difference in proximity to major population centers and amount of human use. The Cache Creek trail receives a great deal of human use whereas the Little Granite trail is much more remote, less frequently traveled.

No estimate of the number of coyotes harvested is available, but a figure of 15 to 25 annually would appear reasonable.

Red fox have been reported infrequently from the Jackson Hole area, and no recent sightings have appeared on the study area. Clark (1980) lists both the red fox and striped skunk as uncommon within the Jackson Hole area. Neither was observed during the study period, and both would be expected to occur only in the lower elevations around the periphery of the study area.

The badger, although common in the valley portions of Jackson Hole, is not expected to be common within the study area. They are usually associated with the lower sagebrush-grasslands in and near ground squirrel populations.

Although none of the three felid species are common on the area, all have been reported. A cougar was sighted but unverified on the eastern margin of the National Elk Refuge in June of 1980; and a positive sighting occurred on October 21, 1980, south of Goodwin Lake (Sec. 11, T40N, R115W), on the northern boundary of the study area. An adult male cougar was found dead in the Little Granite drainage in the fall of 1977, and two cougars were reported from the Hoback Junction area in the winter of 1976-77 (Wyo. Game and Fish Department Files; Jackson Off.). C. Wheeldon (pers. comm.) has seen three cougars in the Horse Creek drainage in the past 10-15 years. Cougars are listed as game species by the state.

In order to survive, cougars require large, rugged (i.e., not easily accessible to man) areas with substantial year-round ungulate populations (Seidensticker et. al. 1973). Russell (1978 summarizes cougar density data and indicated that female cougars utilize from 15 to 30 square miles, while males occupy from 25 to 35 square miles of territory. Assuming territories of twice the reported size, the Cache Creek area (150 square miles) could and apparently does, support a cougar population of from two to four individuals.

Bobcats have been either seen or trapped almost every year from the study area and immediate surroundings. They appear to overlap their range with the lynx in this region although both are considered rare (Clark 1980). The lynx is protected by state law and the bobcat is listed as a predator.

Marten are common in Jackson Hole (Clark 1980 and Cambell 1979). Seven marten scats were observed on the first hike up the Little Granite drainage on September 8, 1980. Marten prefer mature old growth timber, which is prevalent within the study area. Their food preferences range from small rodents (Clethrionomys gapperi and Microtus sp.) to limber pine nuts. They are adversely affected by habitat clearing but adjust to human presence moderately well, if their habitat remains intact (Cambell 1979).

Development of the two proposed drill sites would affect the terrestrial predators/furbearers differently. The coyote would not suffer from the habitat loss, but it would be exposed to more shooting pressure with the added roads and human traffic. The smaller predators, such as the badger, striped skunk and red fox, are already scarce within the area and would not be adversely affected by the development. The marten would experience some limited negative impact from the reduction of habitat and, perhaps, from increased trapping pressure brought on by the improved access.

Of the three cat species, the cougar will experience the greatest negative impact from the development of the two sites. The roads and accompanying activity will nearly dissect the area. This will reduce the value of the area as cougar habitat.

The lynx and bobcat will likely experience less adverse impact from the proposed intrusion than will the cougar, although all will be subject to greater shooting and trapping pressure and a reduction in habitat. The extent of the impact can not be determined.

Four species of predators/furbearers are associated with aquatic habitats; the mink, river otter, muskrat and beaver. The first two are uncommon throughout the Jackson Hole area, and probably only the mink exists in limited numbers along the major drainages surrounding the study area. The muskrat is moderately common in Jackson Hole (Negus and Findley 1959), but was not observed in the study area. It would be confined to large streams or areas inundated by beaver activity.

Three species, the gray wolf, wolverine and grizzly bear, will be considered because of their historic presence within the study area.

The wolverine is listed as a sensitive and rare species by the Bridger-Teton Forest and Wyoming Game and Fish Department respectively. Its status in western Wyoming has been summarized by Hoak et. al. (1979). Since the 1960's, six sightings have occurred along the eastern edge of the study area, extending from the Hoback Basin Road (LS33, T38N, R113W) northward to the headwaters of the Gros Ventre River. Wolverine tracks were found in January of 1974 near the junction of Little Granite and Boulder Creeks east of the Getty lease unit.

Numerous sightings have been reported from the Wind River Range, Teton Wilderness, northern Grand Teton National Park and from Yellowstone National Park. It is not known if wolverine presently occur within the study area.

The northern Rocky Mountain wolf was placed on the endangered species list in 1973. Officially, none now occur on the study area (letters on file; op. cit.). However, since 1973 "...one or two large canids were observed on the Gros Ventre District (of the Bridger-Teton Forest)" (Bridger-Teton forest 1979, p. 88). This area is considered to be "biologically suitable" habitat for wolves and lies from six to 15 miles to the east and northeast of the study area. [But most important, the terrain between the "suitable habitat" and the study area is mountainous, remote, completely road and development-free and is currently proposed for wilderness designation. These two areas are, in fact, contiguous ecological units; and when dealing with a species as mobile as the wolf, all of this area can be potential wolf range.]

The grizzly bear is listed as both a threatened and tentative indicator species and although not reported from the study area in recent years, it occupies habitat immediately to the north. The grizzly bear management guidelines published in 1979 put the study area in a zone 5 classification, which means that maintenance of grizzly habitat "...is an option and major activities and programs on the area probably will not affect grizzly conservation and recovery."

In dealing with a species as mobile as the grizzly bear and knowing that they exist, albeit in limited numbers, on the area contiguous to the northern portion of the study area, it would not be unexpected to have them appear occas-

ionally within, if not actually extend their range into, the study area. However, if the development of the proposed oil and gas leases occur, the subsequent activity will limit the study area for future grizzly bear use (Mealy 1979, p. 111).

Game species - Six species listed as game animals by the Wyoming Game and Fish Department occur on or near the Cache Creek study area. These are the black bear, pronghorn antelope, mule deer, moose, bighorn sheep and elk. The last four are tentatively listed as indicator species by the Bridger-Teton Forest and are the most abundant of the group.

Virtually all of the information presented in this discussion is derived from Wyoming Game and Fish records, management unit reports on file at the District Office in Jackson and Harvest Records and Annual Reports from the state Office in Cheyenne. The study area is considered to be good to excellent big game range (letter from G. Roby to D. Strickland, T. Toman, J. Straley, D. Crawford and R. Hudelson; Wyo. Game and Fish).

Black bear sign was observed on transect 2-G on September 15 and 23. Two bears are known to have been harvested on Little Granite during the survey period. Fresh bear scat was observed on transect 4-C on the 22nd of September in vegetation type 34. Black bears are widely distributed, but prefer mature old-growth timber types as well as both wet and dry forb meadows.

Wyoming Game and Fish records report that an average of five bears are harvested annually from the management unit which encompass the study area. It is estimated that two-thirds of these, or about three, come from the Cache Creek study area (Table 7).

Pronghorn antelope are sporadic residents of the Jackson Hole area (Negus and Findley 1959). They occur in restricted habitats along the fringes of the study area, particularly within the sagebrush-forb meadows bordering the lower reaches of Granite Creek. Six to 10 antelope were observed in that area in the summer of 1980, but were never seen further into the study area. Other than the fringe areas, the study area does not provide any habitat for this species.

Mule deer occur throughout the study area in the summer months and in the winter in only a few locations. The major

critical winter area extends eastward from the Snake River along the Hoback drainage, primarily on the east and north sides of the rivers (Fig. 5). No portion of this winter range extends into the lease units or impact areas. Smaller groups of deer also winter on the south and west facing slopes along the western boundary of the study area from the town of Jackson south to the Hoback River. Precise migration routes are not plotted, but movements can be expected to occur along the drainages flowing out of the study area to the winter grounds.

Additional winter grounds exist north of the study area, astride the Bridger-Teton Forest/National Elk Refuge boundary.

Harvest records for the Lower Hoback deer unit (#152) area are given in Table 7. This unit includes the area south of the Hoback River. G. Roby (pers. comm.) estimates that approximately two-thirds of the total harvest comes from the Cache Creek study area. In 1978 an estimated 286 deer were harvested from the study area. The Wyoming Game and Fish Department estimated that each deer hunter spent an average of $64.40 per deer hunting day and that it took an average of five days to harvest one deer. This amounts to an expenditure of $320.52 for each deer harvested. Consequently, the deer harvested from the Cache Creek study area in 1978 provided $91,668.72 to the economy (Table 8).

It is difficult to predict the exact amount of impact that the development of the proposed oil and gas sites will have on the deer population. Certainly, deer distribution and movements will be altered by development activities. The impacted areas reaching from the drill sites to the edge of the study area (12 sq. miles) will be of less value to the deer. The same areas will become obstacles to their movements and will expose them to increased harassment and hunting pressure, all of which may weaken and reduce the deer herd.

The broad mountains and remote terrain provide excellent habitat for bighorn sheep. In the winter of 1978-79 the Wyoming Game and Fish Department transplanted 13 sheep into the winter range in an effort to increase both the numbers and genetic variation of the Cache Creek herd. Following the re-

lease, 51 sheep were counted on the two major wintering areas (Fig. 5). As with the deer, approximately two-thirds of the sheep from the entire management unit (#7) actually summer on the study area, but virtually all of the critical winter range lies on the study area. Additional critical winter range exists along the eastern margin of the Elk Refuge. Several sheep have wintered on the hills overlooking lower Porcupine Creek; and, at various times, sheep have wintered on the northern ridges at the mouth of Cache Creek.

No sheep were observed during the study period, but S. Moore (pers. comm.) saw several sheep on the ridges immediately northeast of the proposed Getty drill site in the summer of 1980. Seven sheep were seen in the southern meadows of the National Elk Refuge in June of 1980. Others are known to summer on the ridges and peaks lying along the northeastern margin of the lease units (from Pinnacle Peak northwestward to Cache Peak inside the NCRA lease unit) and on the peaks southeast of the Getty lease units in the Cream Puff Peak area (G. Roby pers. comm.).

In 1978, 12 bighorn rams were harvested from the management unit, of which seven are thought to have come from the study area. The 1979 Wyoming Game and Fish Annual Report estimates that, state wide, each harvested animal resulted in a total expenditure of $1,427.39. This would mean that the sheep harvested from the Cache Creek area generated approximately $9,991.73 to the economy (Table 8).

It has been well documented that the initiation of logging activities, the construction of recreation facilities, and any persistent human intrusion into bighorn sheep range increases stress in the sheep, lowers their physical condition and causes sheep to abandon prime range and move into marginal habitat, all of which have the cumulative affect of lowering sheep numbers (DeForge 1972 and 1976; Dixon 1936; Dunaway 1971; Horejsi 1976; Hansen 1971; Light 1971 and Woodward et. al. 1974). Because sheep rely on memory while using migration routes, lambing grounds, and summer and winter range, displacement from these areas often results in the sheep not re-using the locations even years after the disturbance has been removed (Geist 1971).

The Little Granite impact area lies much closer to major bighorn sheep range than does the Cache Creek impact area. Development of the Little Granite Creek site will reduce, if not entirely eliminate, bighorn sheep daily and seasonal use of nearly one square mile of high medowland immediatley surrounding the site (veg. type 71-73, 28 and 26).

Since the site is nearly on the divide between Little horse Creek and Little Granite creek and in an open area, its presence may well cause the sheep to alter their migration route between the winter range (along the Hoback River and on Cream Puff Peak) and their summer range on the ridges and peaks to the north and northeast of the site.

The amount of extra energy required to complete a longer migration has not been determined specifically for bighorn sheep; but Geist (1971) did estimate similar data for caribou and emphasizes that any cost, whatever size, is borne directly by the foetus growing in the female. He also emphasizes the disadvantages that may arise from diversions, particularly in delayed arrival at their objective, be it winter range or lambing grounds, or the complete displacement to less favorable areas, particularly lambing grounds, all jeopardizing the physical condition and ultimate survival of the offspring.

All of these factors will have a cumulative, negative impact on the individuals, the herd and the population. An exact estimate of how many sheep would be lost from the herd is difficult to make, but development of just the Cache Creek site would have less effect than the development of the Little Granite site and much less than if both were developed.

Development of both sites with the possible development of the entire field would in all probability reduce the herd to below a harvestable limit, if not eliminate it completely.

The Cache Creek area supports a substantial moose population. Ten were observed during the study; two adult cows in Cache Creek (transect 1-C, vegetation type 61-62 and transect 5-C vegetation type 35) and the remainder in the Little Granite impact area (4 cows, 3 calves and 1 bull). Numerous fresh "signs" were observed in all of the drainages investigated.

Moose are restricted during the winter months to the lower elevation riparian zones (Fig. 6). For the remainder of the year, they range throughout most of the vegetation types below the open ridges and peaks of the highest elevations.

Critical winter range extends throughout the Cache Creek drainage from the Jackson town limit upstream to slightly beyond the southeast limit of the impact area. It also extends along the western and southern boundary of the study area, with major extensions approximately five miles up the Game Creek and Little Granite Creek drainages. Therefore, all of the Cache Creek and Little Granite Creek moose winter ranges would be subject to heavy impact if the access routes to the respective sites were developed within the drainages. What portion of the moose population would be affected is unknown, but these two drainages represent approximately 20 percent of the entire moose critical winter range. If these areas support a similar proportion of the total population, then 20 percent of the study area's moose population will be affected.

The type of impact will include 1) actual destruction of habitat due to road development, 2) increased hunting pressure due to improved access, and 3) increased disturbance due to increased human presence, primarily on the winter range and secondarily on the summer range.

The tolerance shown by moose toward human disturbance has been well documented (Denniston 1956) but has always been based on their fleeing reaction. New biotelemetry techniques developed to monitor heart rates of wildlife exposed to various disturbances has lead biologists to realize that fleeing is not the only parameter expressing wildlife reaction to humans (Ward 1977 and Geist 1975). Consequently, virtually all kinds of human presence, once noted by the species in question, will have some negative impact, even if fleeing behavior is not initiated. And when this occurs during the winter months, the cumulative impact can be quite severe, affecting the condition of the animal and in the case of adult females, the condition of the foetus (Geist 1975).

The exact number of moose within the study area is unknown, but based on the standard 20 percent harvest objective

and an average harvest of 48 animals over the past nine yaers, the population can be estimated at 225 to 250 animals (Wyoming Game and Fish Big Game Harvest Report, 1979). If two-thirds of the management unit's (#21) population occurs in the study area, then the Cache Creek moose population would be between 150 and 165 animals (Table 7).

In 1978, 48 moose were harvested from the unit and approximately 32 of these came from the study area. The Wyoming Game and Fish Department's Annual Report (1979) estimates that statewide, $347.11 was spent for each moose harvested. This results in a total expenditure of $11,107.52 for the moose harvested from the Cache Creek study area (Table 8).

A loss of 20 percent of these animals would amount of 30 to 32 fewer moose, six fewer harvested animals and a loss to the economy, based on 1978 values, of $2,082.66.

The proposed development may adversely affect the moose population during the summer months, particularly in the riparian zones leading to both sides, but will adversely affect at least 20 percent of the wintering moose population because of the human intrusions into critical winter range.

Elk are undoubtedly the most important big game species within the Cache Creek study area. They represent the largest population of any species, largest harvest figures, greatest management emphasis, and greatest economic contribution. The study area contains all of the elements necessary for the elk's year-round survival. The population figures and distribution data come from Game and Fish records on file in the Jackson office and from conversations with G. Roby.

An estimated 820 elk summer within the study area. Summer concentrations occur in two areas; along the slopes southeast of the upper reaches of Flat Creek (northeast edge of study area) and throughout the eastern one-half of the Getty lease unit and sympatric with the Little Granite impact area. About 300 head of elk summer in the immediate vicinity of the Little Granite impact area and an additional 750 summer at the head of the Big and Little Horse Creek drainages. Virtually all of the summer range for these 1250 elk (69 percent of the herd) lies within the two lease units (Fig. 7). The remaining 600 elk are distributed through the area.

Two calving areas have been identified by the Wyoming Game and Fish Department. The first is located on approximately six square miles of land between Camp Creek on the south and Big Horse Creek on the north and along the southwest boundary of the Getty lease unit. The second calving area is located entirely within the NCRA lease unit and overlaps all of the enclosed impact area and the proposed drill site. It is estimated that 75 to 100 cows calve on the NCRA grounds and 150 on the Horse Creek grounds. Calving takes place from late May to mid June.

Key winter elk range occurs along the Hoback River to the south of the study area and westward to the Snake River and northward to the town of Jackson. Additional winter range exists north of the study area on the National Elk Refuge and along the lower portions of Cache Creek, from the town of Jackson nearly to the boundary of the NCRA lease unit.

Four operated feed grounds support portions of the Cache Creek elk herd. The Elk Refuge supports the northern Cache Creek elk, while the State operated South Park feed grounds winter approximately 300 of the Cache Creek elk. Two additional state operated feed grounds along the southwest margin of the study area, Horse Creek and Camp Creek, support approximately 950 and 300 of the Cache Creek area elk, respectively.

Migration routes between the summer and winter ranges follow major drainage patterns and topographic features. One major route crosses the proposed route and impact area leading to the Getty drill site.

Harvest figures indicate that an average of 365 elk are taken from the Cache Creek study area annually. In 1978, an estimated 265 elk were taken, and the Wyoming Game and Fish 1979 Annual Report states that each elk harvested state wide accounted for a hunter expenditure of $1,106.95. Therefore, the Cache Creek elk harvest in 1978 contributed an estimated $293,341.75 to the economy. In 1979, 335 elk were harvested. Adding 10 percent to the 1978 expenditure figure, the 1979 harvest represents a $407,909.40 benefit to the economy (Table 8).

Anticipated impact to the elk herd will occur during the calving season, while on their summer range, and during the migration. Current plans for drilling activities in the two areas should have no direct effect on the elk on their winter range.

All of the 75 to 100 elk calving in the NCRA lease unit will be affected; some will be displaced (approximately one-half) and all will be subjected to development activities as they move from their winter range, on the National Elk Refuge to the NCRA site. The elk will probably be displaced to either the northeast, toward the head of Flat Creek, or to the south, toward the head of Game and Porcupine Creeks. The result will be added stress due to 1) actual encounters with development, 2) increased migration distance, 3) calving in unfamiliar and/or marginal habitat, 4) competing with other resident elk and 5), arriving later on the calving grounds. All factors may work together to have a cumulative negative impact on the condition and survival of the new-born calves because of the increased energy demands placed on the cow elk (Geist 1975).

Several studies have indicated that elk adjust their use of the habitat when confronted with disturbances as obvious as hunting or as subtle as the mere presence of humans within their range (Morgantini et.al. 1979). In Wyoming, this displacement is generally one-half mile from the source of the disturbance (Ward 1973).

Approximately one-third to one-half of the estimated 300 elk which summer in the Little Granite Creek impact area will be subjected to the disturbance associated with the development of that site. Based on work by Ward (1973), it is anticipated that they will move at least one-half mile from the site. This will place added demands on the habitat that they enter and are forced to share with the resident elk, and will probably result in an increased drain on the energy budget of each, resident and newcomer, resulting in decreased productivity of the herd (Geist 1975).

Fall migrations of the elk from the vicinity of the Little Granite impact area to the winter range to the southwest will be affected by the proposed development. One-third to one-half of the 300 elk will be forced to move around the

disturbed area and will be subjected to increased stress and added travel, both of which will undoubtedly consume energy which would otherwise help the elk survive the winter (Geist 1975). These stresses will have the greatest impact during the harshest winters.

Similarly, if the test wells prove productive, then the subsequent development of the total lease units would adversely affect the vast majority of the 1,800 elk residing in the study area.

A summary of the economic impact of the four major game species is presented in Table 10. These figures are compiled from 1978 Wyoming Game and Fish Department data. Expenditure values from 1979 are estimated to be 10 percent higher than for 1978. Total economic benefit from these four species is $406,109.72 and $491,000.52, for 1978 and 1979, respectively (Table 8). This does not take into account the economic benefit generated from black bear hunting, fur-bearer harvests, small game or upland game hunting. It does not take into account money generated by wildlife watchers or photographers.

SUMMARY

The Cache Creek study area is an integral part of the Greater Yellowstone Ecosystem, the largest remaining, relatively contiguous, wild country in the continental United States. The rugged and isolated terrain has for centuries provided wildlife with an undisturbed habitat, which today has become and island of universally unique species. Most of the elements of this island are still intact, interacting as they have for millennia. Intact, but no longer secure; for, with each new development, the integrity of this island diminishes. Each intrusion into this island eliminates some habitat, alters normal wildlife interactions and reduces species survival potentials.

Some developments often create smaller islands which at first glance appear to contain all of the elements of the once large whole. But for some species, an island can become too small. Some species simply require larger undisturbed areas within which to roam, others require diverse and contiguous habitats within which to carry out their full life

cycle. All require genetic mixing - a large diverse gene pool from which to realize their full genetic potentials, potentials required to survive the rigors of natural selection. For whatever reason, islands can become too small, no longer equalling the sum of the whole.

With the request to develop the Cache Creek oil and gas leases, we are proposing to isolate 150 square miles of the Greater Yellowstone Ecosystem, to create a smaller island.

Two-thirds of the periphery of the Cache Creek study area is bound by highways, developments and towns. The remaining one-third directly links the area to the rest of the Yellowstone Ecosystem. The development of the proposed oil and gas sites in Cache Creek and Little Granite Creek would create an intrusion extending more than 50 percent of the way across the link to the remainder of the ecological system. This would begin the isolating process of nearly 150 square miles of prime wildlife range.

To assess the wildlife resources over such a large area and in such a short time span, the study area was divied into three zones based upon the degree of anticipated impact. The largest zone, the study area (150 sq. mi.), encompasses the two lease units (NCRA and Getty; 51 sq. mi.), and the drill sites. The drill sites and the proposed access routes were outlined by a one-half mile corridor on all sides, totalling approximately three square miles for each site. The impact areas were intensively sampled, while the lease units and the study area were surveyed to a lesser degree. In reality, the impact area extends beyond the edge of the lease units, all the way down the access drainages to the existing roadways.

VEGETATION TYPES

Bridger-Teton vegetation type maps of the lease units were used to assess the habitat. Within the NCRA lease unit 35% of the plant cover is very unique to the impact area and should receive special management attention to prevent its being severely reduced within the lease units. The overall impact to unique vegetation types will be considerably less in the Little Granite area than in the Cache Creek area.

AMPHIBIANS AND REPTILES

Ten species of amphibians and reptiles potentially inhabit the study area. Special management status species in-

clude the rubber boa and wood frog, both listed rare by the Wyoming Game and Fish Department and sensitive by the B-T forest. Neither species could be properly assessed, due to the lateness of the study period. Their preferred habitats are not unique to the impact areas, but do include riparian zones which dominate the access routes to the drill sites. Of the two, the rubber boa has the greatest chance of occurring on the study area.

BIRDS

Of the 271 species of birds potentially inhabiting the study area, 43 were observed on or near the study area. Nine of the tentative 14 indicator species and two of the three sensitive species were observed on the study area. Officially, no threatened or endangered species occur on the study area; however, a whooping crane was observed in June on the NCRA lease unit in company of two sandhill cranes. Its use of the area is probably limited to a transient situation linked with its sandhill crane foster parents.

Both of the sensitive species are raptors; the osprey and the great gray owl (proposed for sensitive status). The primary habitat of the osprey occurs on the periphery of the study area, while that of the great gray owl occurs throughout. The preferred habitat of all the special management status species is not unique to the impact areas, although the riparian zone is an important element of many species' total habitat requirements.

Eleven of 17 raptor species, potentially occurring on the study area, were actually observed. This diversity of raptor species suggests that the plant and animal communities of the study area are intact, diverse and functioning normally. No data was obtained pertaining to nesting seasons, success or habitat requirements. Such data can only be derived from a nesting survey study (mid May to early August).

Raptors are most sensitive to disturbance during their nesting season, which on the study area, extends from mid March to early August. Nesting activity may be reduced within one-half mile of the drill site and affected within the same distance along the access routes.

MAMMALS

Twenty-six of the 49 mammalian species potentially residing on the study area were actually observed. Sixteen species of small mammals were captured on the 10 trap line transects (3,000 trap nights). Peromyscus maniculatus and Clethrionomys gapperi accounted for 82% of all captures and occurred in 15 and 12 of the 15 vegetation types sampled respectively.

All six of the tentative indicator species expected to occur on the study area and which could be trapped with the techniques used, were captured.

No species whose habitat requirements are unique to the impact areas were observed, although, the riparian zones play an important role in the species diversity of the area and dominate the impact areas.

Twelve species of predators and furbearers are either known to occur or thought to occur on the Cache Creek study area. Eight occupy terrestrial habitat, and four are associated with aquatic habitat.

All of these species would suffer from development of the two sites, by direct habitat loss, increased disturbance brought on by the development activities and increased hunting and trapping pressure because of improved access. The widest ranging species, i.e., the cougar will also be influenced by the development because of the island affect the intrusion will have on its extensive range requirements. This could perhaps eliminate and certainly would reduce the value of the area as potential cougar range.

Three species, the wolverine, gray wolf and grizzly bear are discussed because of their historic occurrence on the area and possible presence within the Yellowstone ecosystem. The potential for them to reoccupy their former range will be reduced, if not eliminted if the sites are developed, and as long as activity remains in the area.

The most significant large mammals on the study area are the big game species. Six species are considered; pronghorn antelope (uncommon on the periphery of the study area), black bear, mule deer, bighorn sheep, moose and elk. The latter four are discussed in regards to their distribution, harvest levels, density and economic importance.

Black bears are common on the area, and each year about three animals are harvested from the study area. Development would not greatly affect their numbers but would influence their distribution and exposure to hunting, due to the improved access.

Mule deer would suffer primarily from an overall reduction in summer range, increased hunting pressure and disturbed migration. Its 1978 contribution to the economy via harvested animals, was estimated at $91,668.72.

The bighorn sheep would suffer from significant summer range loss, critical migration route disturbance (Getty lease unit), and increased year-round disturbance. The estimated economic benefit from the harvested bighorn sheep in 1978 was $9,991.73.

Moose would suffer significantly from critical winter range loss (Cache Creek area) and to a lesser degree from overall disturbance. The economic benefit derived from the harvested moose in 1978 was estimated to be $11,107.52.

Elk represent the most common big game species on the study area (1979 estimate, 1820). They would suffer the loss of one large, critical calving area (NCRA site), severe disturbance to one large summer herd concentration (Getty lease unit), impeded fall migration (Getty lease unit), increased exposure to year-round disturbance and increased hunting pressure from improved access.

Total economic benefit derived form the harvest of elk in 1978 is estimated at $293,341.75 and for 1979, $407,909.40.

Total economic benefit derived from the harvest of all four big game species in 1978 is estimated at $491,000.52. This does not take into account the furbearer harvest, upland game hunting and small game hunting. It does not consider the value of wildife to hikers, campers, photographers and wildlife watchers.

MANAGEMENT RECOMMENDATIONS TO MITIGATE THE IMPACT OF DEVELOPMENT ON WILDLIFE

I. The first recommendation is that neither site be developed, that access and drilling permits be denied, that the area be managed as is, that the wilderness status

currently proposed for portions of the study area be purused with the greatest haste, and that the mineral leases be purchaed from the current owners.

Realistically, the companies holding the leases can have only one objective, that is to conduct exploratory drilling with the intent of developing the field if oil or gas is located. And as the administrative agency, the Bridger-Teton Forest, can not expect the lease holders to conduct exploratory drilling and then be denied the permit to develop the leases if oil or gas is found. Therefore, the ultimate question to be considered is what will the impact be on the wildlife resources if the leases are completely developed. The justification is summarized below.

1. There is not enough current information available regarding many potential and actual inhabitants of the study area. For example, no accurate survey has been conducted to assess the status of the rubber boa and the wood frog. The bird survey has not taken into account nesting status or even the occurrence of many of the tentative indicator species. And many small mammals, particularly the bats, remain unsurveyed. Before any development permit can be considered, these concerns need to be addressed.
2. With development of the two proposed sites, the isolating mechanism will begin, which for some species will effectively remove approximately 150 square miles of habitat from the Greater Yellowstone Ecosystem. This will result in various levels of negative impact to many species. No native species is expected to benefit from the development.

3. Genetic Isolation - Many of the sedentary species, particularly the small mammals, will become isolated, if not completely, then by a fraction, which will have a negative effect on the populations by reducing the size of their

gene pools, their potential for variability and their ability to survive their changing environment.

Bighorn sheep will experience severe negative impact because so much of their movements and habitat utilization is dependent upon memory. Any development which will inhibit their normal movements and diminish their chances of contacting other populations of sheep will enhance the isolating mechanism.

4. Abandoment of Habitat - With the development of the two sites and the development of the entire lease, the undisturbed range may become too small to support a viable population of wide-ranging species such as the cougar and wolverine. These species may abandon the range. Other species, although now not present, may find this habitat unsuitable for future expansion. These include the gray wolf and grizzly bear.

5. Reduction in Numbers - Many species will experience various levels of reduced numbers because of destroyed habitat and habitat made unavailable because of disturbance. Virtually 100 percent of the bighorn sheep herd will be affected by the development of the leases. They will face disturbance on their migration routes and summer range. The herd may be reduced to below a harvestable limit, may survive only as a remnant population and may be completely eliminated over a period of many years as a consequence of the cumulative effect of the genetic isolation and constant disturbance.

Up to 70 percent of the elk herd will be effected by disturbance on their summer range, calving grounds and migration routes. The cumulative effect will reduce the vitality of the herd and eventually the herd itself.

Twenty percent of the moose herd will be immediately affected by the access route through their winter range. With the development of the complete lease unit, a majority of the herd will face disturbance on their summer range. The cumulative effect will reduce the vitality of the herd and may eventually reduce the herd itself.

II. The first alternative recommendation includes all of the following:

GENERAL

1. Road and site access shall be limited to authorized project personnel and access/service roads shall be closed to the public at all times.
2. All off-road/site vehicle use shall be disallowed at all times.
3. No firearms shall be allowed on the sites at any time.
4. No on-site occupancy shall be allowed at any time.
5. All road surfaces shall be watered when necessary to minimize dusting.
6. Road surfaces shall not exceed ten feet in width and cut and fill operations shall not occur closer than five yards to any natural water course.
7. No silt or chemical run-off caused by, or originating from, construction activity shall be allowed to enter drainage systems.
8. Any and all snow removal operations on roadways shall be done by snow blower, directing the snow so as not to cover winter range, i.e., not to blow snow into the riparian zone covering willow or any-naturally flowing water course.
9. All snow removal operations on access roads shall include the construction of escape exits at least every 200 yards to allow wildlife a means of leaving the roadway.
10. When a drill site proves unproductive, or when the-site is pulled out of production, it, along with the access roads, shall be reclaimed to their original contour with reasonable replacement of soil

profiles and they shall be re-seeded with native plants to a reasonable seral stage.

11. No vehicle traffic shall be allowed on any roads or trails after reclamation has been completed.

VEGETATION

1. Minimize pad size and access road development at NCRA site to avoid excessive destruction of vegetation type 61-62.
2. No new road construction in riparian zone, particularly vegetation types 72-24 and 35.
3. Excess fill and top soil shall be stockpiled in an ecologically sound manner.

AMPHIBIANS AND REPTILES

1. Recommendations pertaining to riparian zones shall have effect when considering the amphibians and reptiles.
2. Initiate a thorough survey, from early May to late June, to determine the status of the rubber boa and the wood frog. If it is determined that neither species is present, or present only in specific locations, the locations without populations of either species can be developed in accordance with the accompanying recommendations.

BIRDS

1. A nesting survey shall be conducted (mid March to early August) to determine the species occurrence and distribution, within the impact areas.
2. In order to monitor the effect of development activity, a flushing census shall be conducted following the 10 transect lines for two consecutive days, 20 to 30 days apart, from May 1 to August 31 and for two consecutive days in October, December and February.

MAMMALS

1. In order to determine changes in species composition, relative abundance and distribution, maintain small mammal transect lines and conduct live trapping for three consecutive days on each of the lines in May, July and September.

2. To minimize disturbance during elk calving, no development shall be allowed in the NCRA site from May 15 to July 15.
3. To minimize disturbance to elk, bighorn sheep and mule deer movements, no development activities shall be allowed at the Getty site from September 1 to December 15.
4. To minimize the disturbance to wintering big game, access to and activity at the NCRA site shall be restricted to essential personnel from November 1 to May 1.

NCRA SITE

1. No alternative access route shall be allowed because none will have less impact on the wildlife and habitat resources than the proposed Cache Creek route.
2. No loop road shall be allowed via Game Creek to the drill site with connections to Cache Creek.

GETTY SITE

1. No surface access shall be allowed to the Getty site. Access shall be by helicopter only and then with strictly enforced flight lanes and with a minimum altitude of 500 feet.

LITERATURE CITED

Bridger-Teton National Forest. 1979. Habitat Management Programs: Threatened and Endangered Plant and Animals. Jackson, Wyo. 111pp.

Cambell, T.M. 1979. Short-term Effects of Timber Harvests on Pine Marten Ecology. M.S. Thesis. Colorado State University. Fort Collins. 71pp.

Camenzind, F.J. 1978. Behavior Ecology of Coyotes on the National Elk Refuge, Jackson, Wyoming. In: Coyotes: Biology, Behavior, and Management. Ed. Marc Bekoff. Academic Press, New York, 384pp.

Carpenter, C.C. 1953. An ecological survey of the herpetofauna of the Grand Teton - Jackson Hole Area of Wyoming. Copeia. 3:170-174.

Clark, T.W. 1980. Ecology of Jackson Hole, Wyoming. In Press. Univ. of Nebraska Press.

Clark, T.W. 1973. Distribution and reproduction of shrews in Grand Teton National Park, Wyoming. Great Basin Naturalist. 33(4):205-217.

Clark, T.W. 1971. Ecology of the Western Jumping Mouse in Grand Teton National Park, Wyoming. Northwest Science. 45(4):229-238.

Clark, T.W. and R. Dorn (Eds.). 1979. Rare and Endangered Plants and Vertebrates of Wyoming. Private Publication. 78pp.

Craighead, J.J. and F.C. Craighead. 1969. Hawks, Owls and Wildlife. Dover Publications, Inc. New York. 443pp.

DeForge, J.R. 1972. Man's invasion into the bighorn's habitat. Trans. Desert Bighorn Counc. 16:112-116. Abstract In: Ream, C.H. 1980.

DeForge, J.R. 1976. Stress: Is it limiting Bighorn? Trans. Desert Bighorn Counc. 20:30-31. Abstract In: Ream, C.H.

Denniston, R.H. 1956. Ecology, behavior and population dynamics of the Wyoming or Rocky Mountain moose. Zoologica. 41:105-118.

Dixon, J.S. 1936. The status of the Sierra bighorn sheep. Proc. First North Am. Wildl. Conf. p. 641-643. Abstract In: Ream, C.H.

Dunaway, D.J. 1971. Bighorn sheep habitat management on the Inyo National Forest, a new approach. Trans. Desert Bighorn Counc. 15:18-23. Abstract In: Ream, C.H.

Geist, V. 1975. Harassment of large mammals and birds - with a critique of research submitted by Arctic Gas Limited on this subject. Report to Berger Commission. Mackenzie Valley Pipeline Inquiry. 62pp.

Geist, V. 1971. Mountain Sheep. Univ. Chicago Press. 383pp.

Hansen, C.G. 1971. Overpopulation as a factor in reducing desert bighorn populations. Trans Desert Bighorn Counc. 15:46-52 Abstract In: Ream, C.H.

Hoak, J.H., J.L. Weaver and T.W. Clark. 1979. Wolverines in Western Wyoming. Unpub. paper. 11pp.

Horejsi, B. 1976. Some thoughts and observations on harassment and bighorn sheep. In North. Wild Sheep Counc. Proc. p. 149-155. Jackson, Wyoming. Abstract In: Ream, C.H.

Light, J.T.R. 1971. An ecological view of bighorn habitat on Mount San Antonio. Trans. North Am. Wild Sheep conf. 1:150-157. Abstract In: Ream, C.H.

Long, C.A. 1965. The Mammals of Wyoming. Univ. Kansas Press, Lawrence. 265pp.

Mealy, S.P. 1979. method for determining Grizzly Bear habitat quality and estimating consequences of impacts on Grizzly habitat quality. In: Guidelines for Management Involving Grizzly Bears in the Greater Yellowstone Area. 136pp.

Morgantini, L.E. and R.J. Hudson. 1979. Human disturbance and habitat selection in elk. In: North American Elk: Ecology, Behvior and Management. Ed. Boyce, M. and L.D. Hayden-Wing. Univ. Wyo. Press, Laramie. 294pp.

Negus, N.C. and J.S. Findley. 1959. Mammals of Jackson Hole, Wyoming. Jour. Mamm. 40(3):371-381.

Oakleaf, B. 1978. Inventories of the Peregrine Falcon and other diurnal raptors in the Jackson-Pinedale area and a summary of the state-wide status of Peregrines in Wyoming. Wyo. Game and Fish Dept.

Oakleaf, B., H. Downing, B. and M. Raynes, and O. Scott (Eds.). 1979. Working Draft of Wyoming Avian Atlas. Wyo. Game and Fish Dept. Cheyenne, 68pp.

Raynes, B. and M. Raynes. 1979. Birds of Jackson Hole, Checklist.

Ream, C.H. 1980. Impact of backcountry recreationists on wildlife: an annotated bibliography. USDA For. Serv. Gen. Tech. Rep. INT-84, 62pp. Intermt. For. and Range Exp. Stn., Ogden, Utah.

Richardson, L. 1980. Ospreys in the Bridger-Teton National Forest, Wyoming. Bridger-Teton Forest, Jackson. 60pp.

Russell, K.P. 1978. Mountain Lion. In: Big Game of North America. (Eds.) J.L. Schmidt and D.L. Gilbert. Stackpole Books. Harrisburg, Pa. 494pp.

Seidensticker, J.C. M.G. Hornocker, W.V. Wiles and J.P. Messick. 1973. Mountain Lion Social Organization in the Idaho Primitive Area. Wildlife Monographs. No. 35. The Wildlife Society. 60pp.

Ward, A.L. 1977. The effects of highway operation practices and facilities on elk, mule deer and pronghorn antelope. Project no. 942-41-42-13-0088-33F2-6-2580.

53pp. Annu. Rep. Fed. Highway Admin., Office of Research and Development, Washington, D.C. Abstract In: Ream, C.H. 1980.

Ward, A.L. 1973. Elk behavior in relation to multiple uses on the Medicine Bow National Forest. Proc., 53rd Conf. West. Assoc. of State Game and Fish Commissioners. p. 125-139. Abstract In: Ream, C.H. 1980.

Weaver, J.L. 1977. Coyote-food Base Relationships in Jackson Hole, Wyoming. M.S. Thesis. Utah State Univ. Logan, Utah. 88pp.

Wyoming Game and Fish Dept. 1980a. Annual Report of Upland Game and Furbearer Harvest, 1979. Cheyenne. 62pp.

Wyoming Game and Fish Dept. 1980b. Annual Report of Big Game Harvest, 1979. Cheyenne, 172pp.

Wyoming Game and Fish Dept. 1979. 1979 Annual Report. Cheyenne. 95pp.

Wyoming Game and Fish Dept. 1977. Current Status and Inventory of Wildlife in Wyoming. Cheyenne. 133pp.

Appendix A. Vegetation Types of the Cache Creek Study Area.

No.	Abbreviation	Scientific Name	Common Name
11	Pifl/Heki	Pinus flexilis/Hesperochloa kingii	Limber Pine/Spike Fescue
22	Abla/Osch	Abies lasiocarpa/Osmorhiza chilensis	Subalpine fir/Mt. Sweet-root
23	Abla/Arla	Abies lasiocarpa/Arnica latifolia	Subalpine fir/Mt. Arnica
24	Abla/Acru	Abies lasiocarpa/Actaca rubra	Subalpine fir/Baneberry
26	Abla/Acgl	Abies lasiocarpa/Acer glabrum	Subalpine fir/Mt. Maple
28	Abla/Vagl-Vasc	Abies lasiocarpa/Vaccinium globulare-V. scoparium	Subalpine fir/Tall Huckleberry-Grouse Whortleberry
71	Lifi-Deoc-Ruoc	Ligusticum filicinum-Delphinium occidentale-Rudbeckia occidentalis	Loveroot-Larkspur-Coneflower
72	Hela-Meci	Heracleum lanatum-Mertensia ciliata	Cow Parsnip-Bluebells
73	Heun-Agur-Basa	Helianthella uniflora-Agastache urticifolia-Balsamorhiza sagittata	Mt. Sunflower-Giant Hyssop Mint-Balsamroot
74	Aral-Aqca	Arnica lutifolia-Aquiligia caerulea	Arnica-Columbine
77	Leki-Agsp-Feid	Leucopoa kingii-Agropyron spicatum-Festuca idahoensis	Western grass-Bluebunch Wheatgrass-Idaho fescue
78	Arsp-Syor	Artemisia Sp.-Symphoricarpos oreophilus	Sagebrush-Snowberry
710	Rock-talus		
34	Psme/Caru	Pseudotsuga menziesii/Calamagrostis rubescens	Douglas fir/Pinegrass
35	Psme/Spbe	Pseudostuga menziesii/Spiraea betulifolia	Douglas fir/White spiraea
61	Potr/Lifi	Populus tremuloides/Ligusticum filicinum	Aspen/Loveroot
62	Potr/Hela	Populus tremuloides/Heracleum lanatum	Aspen/Cow Parsnip
63	Potr/Caru	Populus tremuloides/Calamagrostis rubescens	Aspen/Pinegrass

APPENDIX "B" - SCIENTIFIC NAMES OF VERTEBRATES MENTIONED IN TEXT

AMPHIBIANS	
Tiger Salamander	Ambystoma tigrinum
Boreal Toad	Bufo boreas
Boreal Chorus Frog	Pseudacris triserata
Leopard Frog	Rana pipiens
Spotted frog	Rana pretiosa
Wood frog	Rana sylvatica
REPTILES	
Rocky Mountain Rubber Boa	Charina bottae
Bullsnake	Pituophis melanoleneas
Western Garter Snake	Thammophis elegans
Common Garter Snake	Thammophis sirtalis
BIRDS	
Trumpeter Swan	Olar buccinator
Goshawk	Accipiter gentilis
Sharp-shinned Hawk	Accipiter striatus
Cooper's Hawk	Accipiter cooperii
Red-tailed Hawk	Buteo jamaicensis
Swainson's Hawk	Buteo swainsoni
Rough-legged Hawk	Bueto lagopus
Golden Eagle	Aquila chrysaetos
Bald Eagle	Haliaetus lencocephalus
Northern Harrier	Circus cyaneus
Osprey	Pandion haliaetus
Prairie Falcon	Falco mexicanus
Peregrine Falcon	Falco peregrinus
American Kestrel	Falco sparverius
Blue Grouse	Dendragopus obscuras
Ruffed Grouse	Bonasa umbellus
Whooping Crane	Grus americana
Sandhill Crane	Grus canadensis
Great Horned Owl	Bubo virginianus
Pygmy Owl	Glaucidium gnoma
Great Gray Owl	Strix mebulosa

Long-eared Owl	Asio otus
Belted Kingfisher	Megaceryle alcyon
Common Flicker	Colaptes cafer
Yellow-bellied Sapsucker	Sphyrapicus varius
Harry Woodpecker	Dendrocopos villosus
Downy Woodpecker	Dendrocopos pubescens
Eastern Kingbird	Tyrannus tyrannus
Say's Phoebe	Sauornis saya
Willow Flycatcher	Empidonax traillii
Gray Jay	Perisoreus canadensis
Steller's Jay	Cyanocitta stelleri
Black-billed Magpie	Pica pica
Common Raven	Corvus corax
Common Crow	Corvus brachyrhynchos
Clark's Nutcracker	Nucifraga columbiana
Black-capped Chickadee	Parus atricapillus
Mountain Chickadee	Parus gambeli
Red-breasted Nuthatch	Sitta canadensis
Brown Creeper	Certhia familiaris
North American Dipper	Cinclus mexicanas
American Robin	Turidis migratorius
Hermit Thrush	Hylocichla guttata
Swainson's Thrush	Hylocichla ustulata
Mountain Bluebird	Sialia currucoides
Ruby-crowned Kinglet	Regulus calendula
Water Pipit	Motacilla flava
Yellow Warbler	Dendroica petechia
Wilson's Warbler	Wilsonia pusilla
Western Meadowlark	Sturnella neglecta
Brewer's Blackbird	Euphagus cyanocephalus
Brown-headed Cowbird	Molothrus ater
Western Tanager	Piranga ludoviciana
Oregon Junco	Junco hyemalis
Brewer's Sparrow	Spizella breweri
White-crowned Sparrow	Zonotrichia leucophrys

MAMMALS

Cinereos shrew	Sorex cinereus
Dwarf shrew	Sorex nanus
Wandering Shrew	Sorex vagrans
Water Shrew	Sorex palustris

Little Brown Bat	Myotis lucifugus
Hairy-winged bat	Myotis valans
Long-eared bat	Myotis evotis
Hoary bat	Lasiurus cinereas
Grizzly Bear	Ursus arctos
Black Bear	Ursus americanus
Pine marten	Martes americana
Ermine	Mustela erminea
Long-tailed weasel	Mustela frenata
Mink	Mustela vison
Otter	Lutra canadensis
Striped Skunk	Mephitis mephitis
Badger	Taxidea taxus
Wolverine	Gulo gulo
Red Fox	Vulpes Fulva
Coyote	Canis latrans
Gray Wolf	Canis lupus
Puma	Felis concolor
Lynx	Lynx canadensis
Bobcat	Lynx rufus
Yellow-bellied Marmot	Marnota flaviventris
Uinta grand squirrel	Citellai armatus
Golden-manteled ground squirrel	Citellus lateralis
Least chipmunk	Eutamius mininus
Yellow pine chipmunk	Eutamius amoenus
Wyoming chipmunk	Eutamius umbrimus
Red Squirrel	Tamiasciurus hudsonicus
Northern flying squirrel	Glaucomys sabrinus
Northern pocket gopher	Thomomys talpoider
Beaver	Gastor canadensis
Deer mouse	Peromyscus maniculatus
Bushy-tailed woodrat	Neotoma cinerea
Rocky Mountain lenning vole	Phonacomys internedius
Red-backed vole	Clethrionomys gapperi
Meadow vole	Microtus pennsylvanicus
Mountain vole	Microtus longicanders
Water vole	Microtus richardsoni

Muskrat	Ondatra zibethica
Rocky Mountain Jumping Mouse	Zapus princeps
Porcupine	Erethizon dorsatum
Pika	Ochotona princeps
White-tailed jackrabbit	Lepus townsendi
Varying hare	Lepus americanus
Elk	Cervus canadensis
Mule deer	Odocoileus homionus
Moose	Alces alces
Pronghorn	Antilocapra americana
Bighorn sheep	Ovis canadensis

END APPENDIX "B"

TYPE #	Acreage in Impact Area CACHE CREEK	I.C.*	LITTLE GRANITE	I.C.*
22	90.1	III	18	III
23			126.2	IV
26	486.7	IV	1262.0	IV
28	36.0	II	90.0	II
34	99.2	II		
35	108.2	I		
63	27.1	I		
71			18.0	IV
77			18.0	III
78			45.0	II
61-62	198.2	III		
71-73			306.5	III
71-74			18	III
72-74	72.1	I		
TOTAL	1189.5		1901.2	

* IMPORTANCE CLASS: Classifacation based on the relative amount of each vegetation type sampled within the IMPACT AREAS to the total amount of that type within the LEASE UNITS.

I Greater than 75% of the vegetation type occurs within the IMPACT AREA - VERY HIGH MANAGEMENT CONCERN.

II From 50 to 74% of the vegetation type occurs within the IMPACT AREA - HIGH MANAGEMET CONCERN.

III From 25 to 49% of the vegetation type occurs within the IMPACT AREA - MODERATE MANAGEMENT CONCERN.

IV Less than 25% of the vegetation type occurs within the IMPACT AREA - LOW MANAGEMENT CONCERN.

Table 1. Vegetation types surveyed within the Impact Areas with Importance Class values.

Table 2. Status of Amphibians and Reptiles Potentially Inhabiting the Cache Creek Study Area

	Observed During Study	Forest[1]	Status State[2]	Other
Tiger Salamander				
Boreal Toad				
Boreal Chorus Frog				
Leopard Frog				
Spotted Frog				
Wood Frog		S	R	R[3]
Rocky Mt. Rubber Boa		S	R	R[3]
Bullsnake				
Western Garter Snake	x			
Common Garter Snake				

1 Bridger-Teton Nat. Forest 1979
2 Wyo. Game and Fish Dept. 1979
3 Clark, T.W. and D. Dorn (eds) 1979.

R=Rare
S=Sensitive

TABLE 3. LIST OF BIRDS OBSERVED OR DISCUSSED FROM CACHE CREEK STUDY AREA

		SEASONAL OCCURRENCE S S F W	FOREST	STATUS STATE	FED.	VEG. TYPE IN WHICH OBSERVED
Trumpeter Swan		C C C C	I S	G C		
Goshawk	x	C C C C	I	U P	P	26
Sharp-shinned Hawk	x	O O O		U P	P	71-73 61-62 26
Cooper's Hawk	x	O O O		U P	P	26;
Red-tailed Hawk	x	C C C R		C P	P	23,26 72-24 61-62
Swainson's Hawk		C C C		U P	P	
Rough-legged Hawk	x	R R C C		C P	P	71-73
Golden Eagle	x	O O O O		C P	P	26
Bald Eagle	x	C C C C	I	P R	P E	
Northern Harrier		O O O R		U P	P	
Osprey	x	C C C O	I S	R P	P	
Prairie Falcon		O O O		U P		
Peregrine Falcon		R R R		P R	P E	
American Kestrel		C C C R		P U	P	
Blue Grouse	x	C C C C	I	G C		71-73 71 22,23, 74,61
Ruffed Grouse	x	C C C C	I	G C		22, 72-24, 26
Whooping Crane		X X		P R	E	

Sandhill Crane	x	C	O	C			I		G	C		26 (flying)
Great Horned Owl	x	O	O	O	O				C		P	34
Pygmy Owl	x	R	R	R	R				U		P	26
Great Gray Owl	x	O	O	O	O		P	S	R		P	
Long-eared Owl			O	O					U		P	
Belted Kingfisher	x	O	C	C	O				C			72-24
Commong Flicker	x	C	C	C	O				C			22,34 72-24
Yellow-bellied Sapsucker	x	C	C	C			I		C			
Hairy Woodpecker	x	C	C	C	C				U			28,72, 11,35
Downy Woodpecker		C	C	C	C		I		C			
Eastern Kingbird	x	O	O	O					C			61-62
Say's Phoebe	x	R	R	R					C			11,72-24
Willow Flycatcher		O	O	O			I		U			
Gray Jay	x	C	C	C	C				C			71-73, 77,71, 34,11, 35,26
Steller's Jay	x	C	C	C	C				C			71-73, 26,71, 72-24, 11,35

Black-bellied Magpie	x	C C C C		C	22,71-73
Common Raven	x	C C C C		C	71-73, 22,23, 74,61, 26,77, 34
Common Crow	x	O O O O		C	71-73
Clark's Nutcracker	x	C C C C		C	22,23 34,35, 11
Black-capped Chickadee	x	C C C C		C	63,22, 26
Mountain Chickadee	x	C C C C		C	22,71-73,29, 11,23, 78,26, 35
Red-breasted Nuthatch	x	O O O O		C	22
Brown Creeper	x	O O O O		C	28,26
North American Dipper	x	C C C C		C	72-24
American Robin	x	a a a R		C	11,35
Hermit Thrush		C C O	I	U	
Swainson's Thrush	x	C C O	I	C	35
Mountain Bluebird	x	C C C		U	61,61-62
Ruby-crowned					

Kinglet		C	C	O	R	I	C	
Water Pipit		C	C	C	R	I	C	
Yellow Warbler	x	a	a	c			U	72-24
Wilson's Warbler	x	c	c	c			C	72-24
Western Meadowlark	x	O	O	O			C	22,35
Brewer's Blackbird	x	C	C	a	R		C	28
Brown-headed Cowbird	x	C	C	C			C	72-24
Western Tanager	x	C	C	O			C	71-73
Oregon Junco	x	a	a	C	O		C	22,71-73,28,23,74,78,26,77,72-24,34

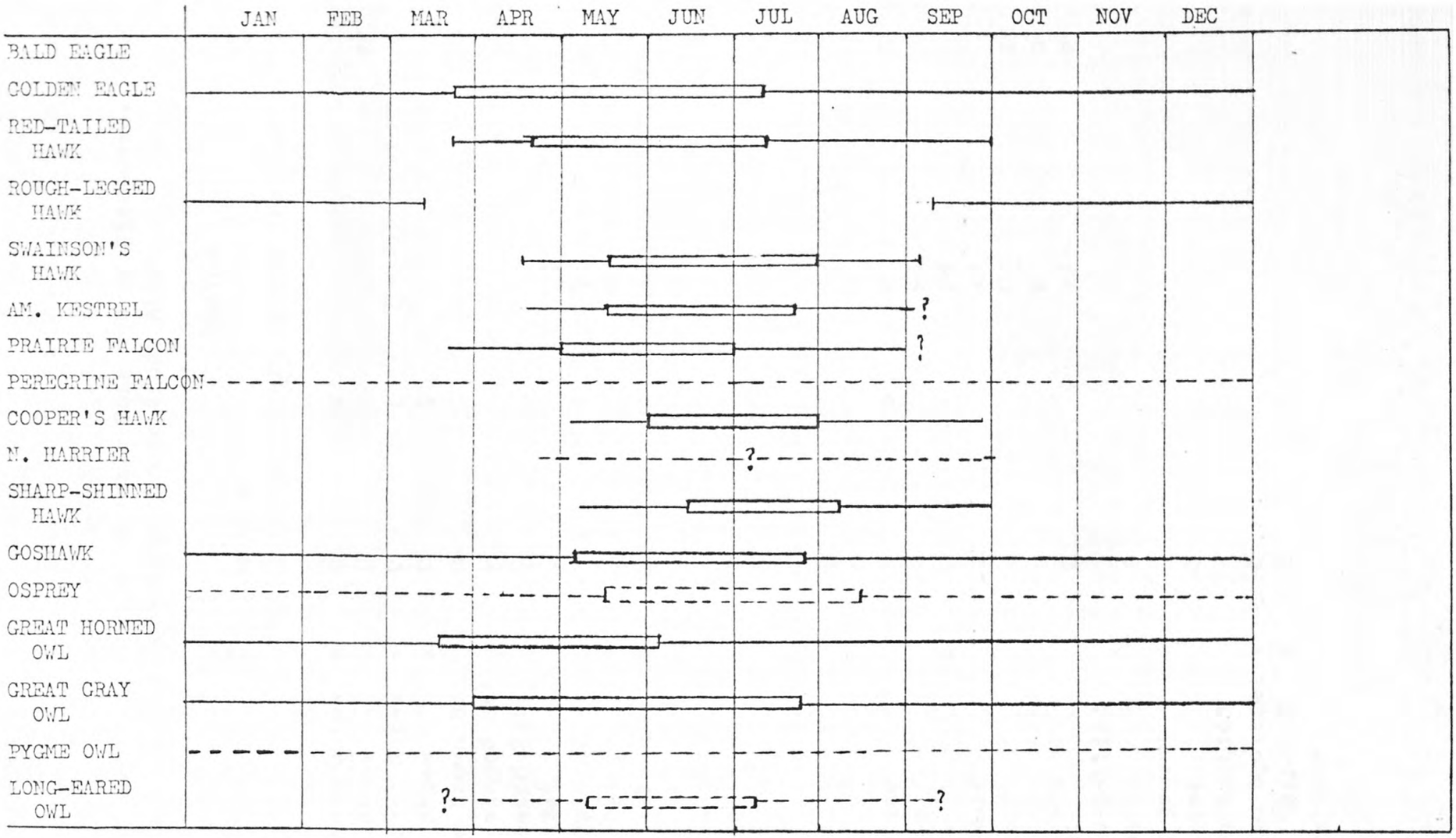


Table 4. Seasonal activity cycle of raptors in the Cache Creek area.

Present in area ——————

Nesting activity ═══════

Uncertain - - - - -?- - -

Table 5. List of Mammals Observed or Discussed, From Cache Creek Study Area

	OBSERVED	ABUNDANCE (State-Wide)	STATUS Forest	State	Federal	Other
Cinereous Shrew	x	U	I			
Dwarf Shrew		U				R[3]
Wandering Shrew	x	U	I			
Water Shrew	x	U	I			
Little Brown Bat		U				
Hairy-winged Bat		U				
Long-eared Bat		U				
Hoary Bat		U				
Grizzly Bear		U	I	G	T	
Black Bear	x[1]	C		G		
Pine Marten	x[1]	U	I	F		
Ermine		C		Pd		
Long-tailed Weasel	x	C		Pd		
Mink		C		F		
Otter		U		P		
Striped Skunk		C		Pd		
Badger		C		F		
Wolverine		R	S	P		R[3]
Red Fox		C		Pd		
Coyote	x[1]	C		Pd		
Gray Wolf		U		Pd	E	
Cougar		C		G		R[3]
Lynx		U		P		R[3]
Bobcat		U		Pd		R[3]
Yellow-bellied Marmot		C				
Uinta ground Squirrel		C				
Golden-mantled Ground Squirrel	x	C				
Least Chipmunk	x	C				
Yellow-pine						

Chipmunk				
Wyoming Chipmunk		C		
Red Squirrel	x	C		G
Northern Flying Squirrel	x	U		
Northern Pocket Gopher	x	C		
Beaver	x[1]	C	I	F
Deer Mouse	x	C		
Bushy-tailed Woodrat		C		
Rocky Mountain Lemming Vole	x	C		
Red-backed Vole	x	C		
Meadow Vole	x	C		
Mountain Vole	x	C	I	
Long-tailed Vole	x	C	I	
Water Vole	x	C	I	
Muskrat		U		F
Rocky Mountain Jumping Mouse		U		
Porcupine	x	C		
Pika	x	C		
White-tailed Jackrabbit		C		Pd
Varying Hare		C	I	G
Elk	x	C	I	G
Moose	x	C	I	G
Pronghorn		C		G
Bignorn Sheep	x	C	I	G

1 "observed" from fresh "sign"
2 abundance determined from: Wyo. Game and Fish Dept. 1977
3 Clark T.W. and R. Dorn (eds) 1979

C	Common	P	Protected
U	Uncommon	Pd	Predator
I	Indicator Species	F	Furbearer

Table 6. Small mammal trap record. Upper figure is actual number captured and lower number is computed captures/1000 trap nights.

SPECIES | VEG.TYPE	11	22	23	26	28	34	35	63	71	77	78	61 62	71 73	71 74	72 24	TOTAL	in which species was captures
Sorex cinerius				1 1								1 5				2	2
Sorex vagrans	1 5			4 6	1 3							6 31				12	4
Sorex palustris				1 1												1	1
Mustela frenata							1 8									1	1
Citellus lateralis					1 3											1	1
Eutamias minimus		1 4	1 4	6 9	3 10	7 34	2 16				1 7		8 18			29	8
Eutamias sp.				2 3								3 16				5	2
Tamiasciurus hudsonicus		1 4					1 8									2	2
Glaucomys sabrinus					1 3		2 16									3	2
Thomonys talpoides												1 5				1	1
Peromyscus maniculatus	32 175	29 124	13 56	54 88	15 50	1 5	19 154	8 178	3 33	1 16	10 68	23 120	29 65	1 42	12 444	250	15
Phenacomys intermedius			1 4	1 1								1 5	3 7			6	4
Clethrionomys gapperi	5 27	30 128	14 61	172 248	6 20	5 25	1 8		2 22	2 32	2 14	11 57	2 5			252	12
Microtus pennsylvanicus						2 10				1 16		3 16	7 16			13	4
Microtus montanus	1 5								1 11			3 16	1 2			6	4
Microtus longicaudus				1 1				1 22				2 10				4	3
Microtus richardsoni												2 10				2	1
Microtus sp.	2 11	1 4	2 9	3 4	2 7	3 15						8 42				21	7
TOTAL TRAPPED	41	62	31	245	29	18	26	9	6	4	13	64	50	1	12	611	

	Herd Unit No.	1971	1972	1973	1974	1975	1976	1977	1978	1979	Av.
BLACK BEAR	84	2	3	5	2	1	2	13	10	6	4.9
study area*		1	2	3.3	1	0	1	8.6	6.6	4	3
MULE DEER	152	820	549	266	245	305	308	416	433	275	401
study area*		541	362	175	161	201	203	275	286	182	265
MOOSE	21	41	53	44	48	53	52	47	48	44	48
study area*		27	35	29	32	35	34	31	32	29	32
BIGHORN SHEEP	7					6	6	13	12	9	8
study area*						4	4	8	8	6	6
ELK	84	724	428	1018	368	546	344	636	401	508	553
study area*		478	282	672	243	360	227	420	265	335	365

* Harvest from study area estimated to be two-thirds of unit harvest(G. Roby pers. comm.)

Table 7. Big game harvest averages for Cache Creek study aree. From: Wyo. Game and Fish Annual Harvest Reports.

		Hunter expenditure per harvested animal	Total number harvested from Cache Creek study area	Total expenditures from harvested animals	
				1978	1979
ELK	1978	$1,106.95	265	$293,341.75	
	1979	1,217.64*	335		$407,909.40
DEER	1978	320.52	286	91,668.72	
	1979	352.57*	182		64,167.74
MOOSE	1978	347.11	32	11,107.52	
	1979	381.82*	29		11,072.78
BIGHORN SHEEP	1978	1,427.39	7	9,991.73	
	1979	1,570.12*	5		7,850.60
			TOTAL	$406,109.72	$491,000.52

Table 8. Economic benefit of 4 big game species harvested on Cache Creek study area in 1978 and 1979.

* 1979 expenditure values are 1978 values plus 10%

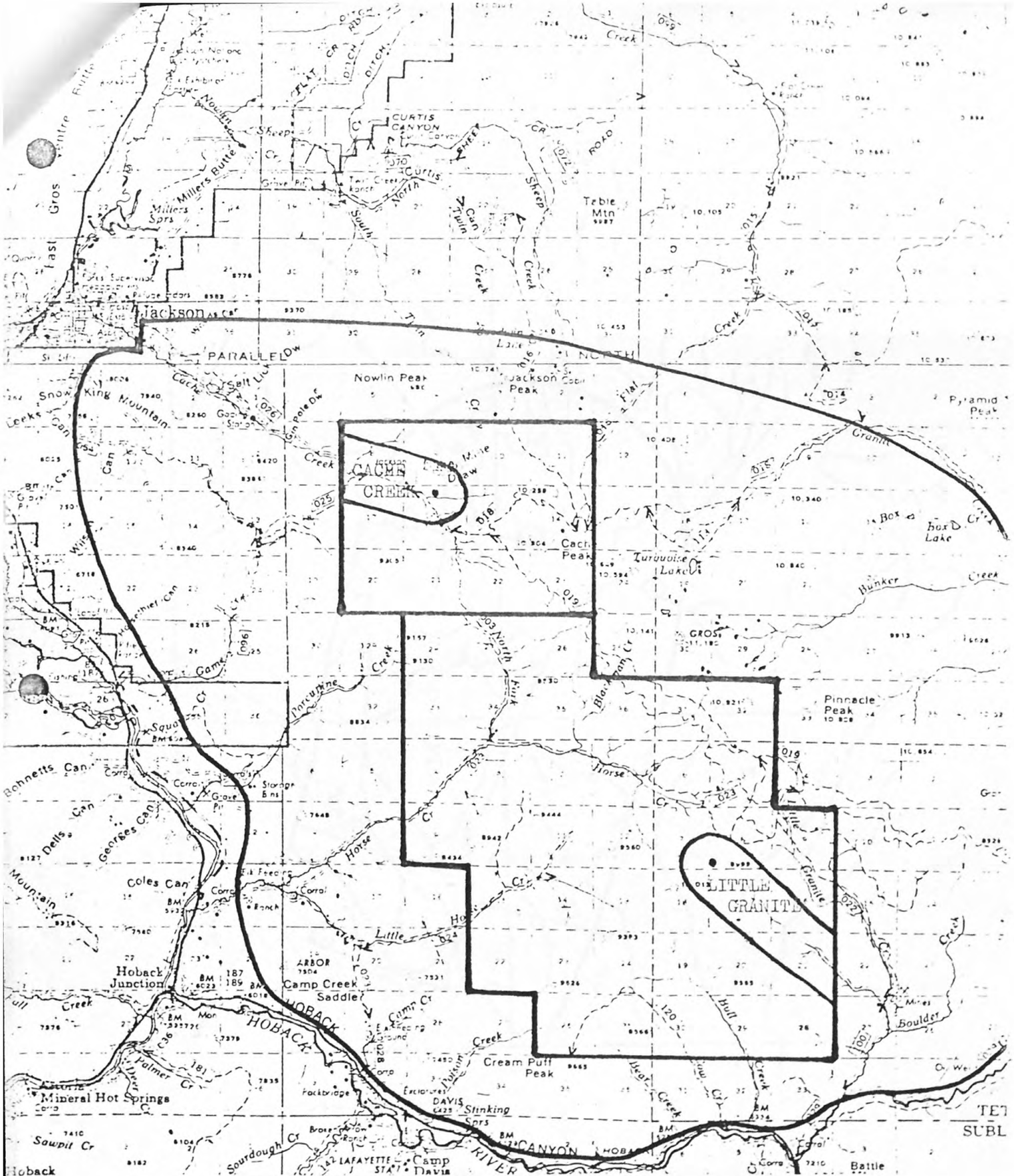


Fig. 1 CACHE CREEK

STUDY AREA
LEASE UNITS
IMPACT AREA

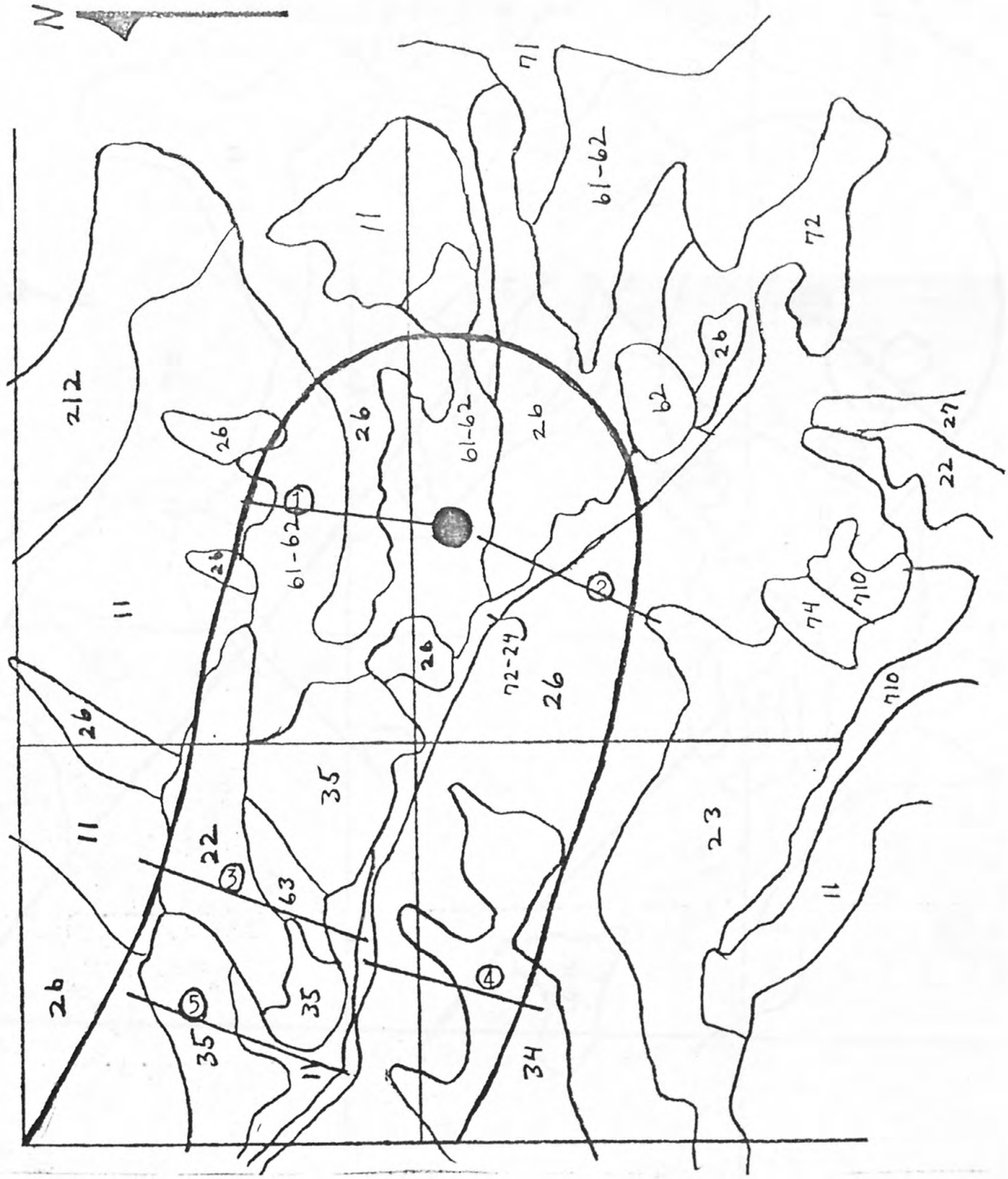


Fig. 2 Map of NCRA site (Cache Creek) with vegetation type numbers, sample transect 1-C to 5-C and one mile wide IMPACT AREA.

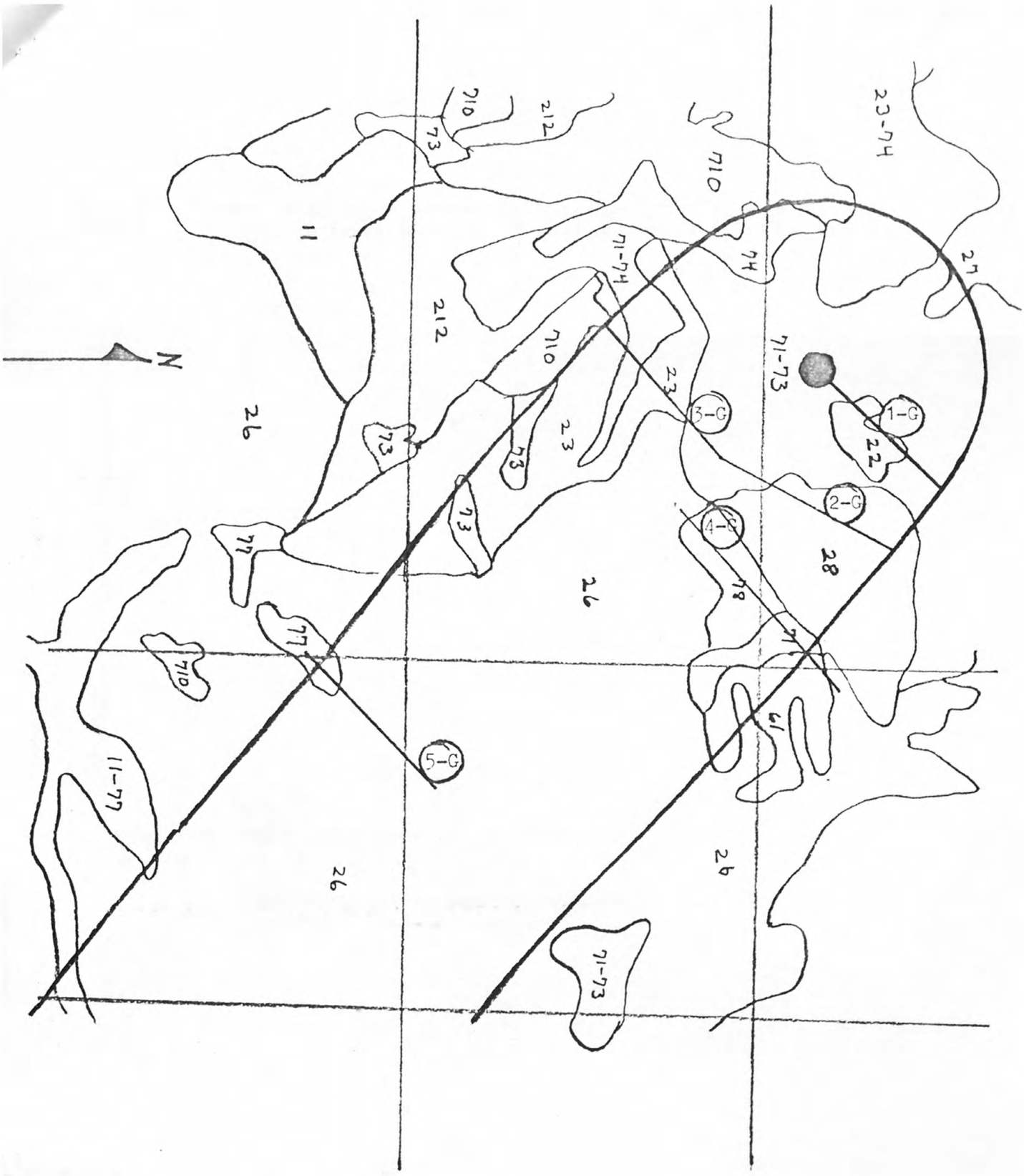
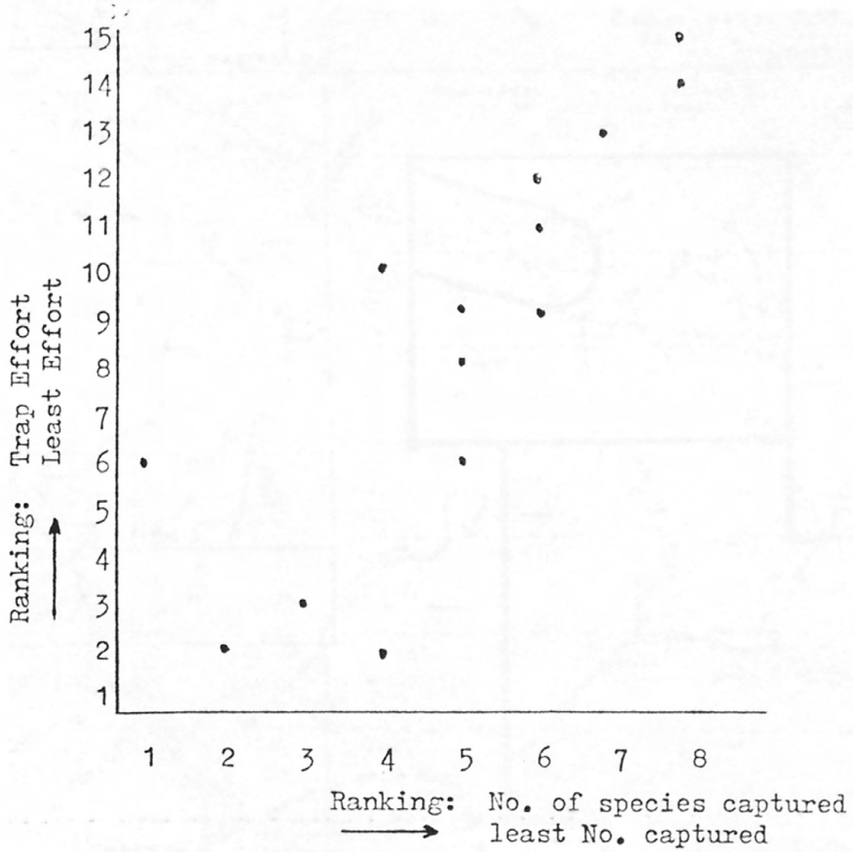


Fig. 3. Map of GETTY site with vegetation type numbers, sample transects 1-G to 5-G and one mile wide IMPACT AREA.

Fig. 4 Number of species captured in each vegetation type in relation to trapping effort (Rankings: highest to lowest)



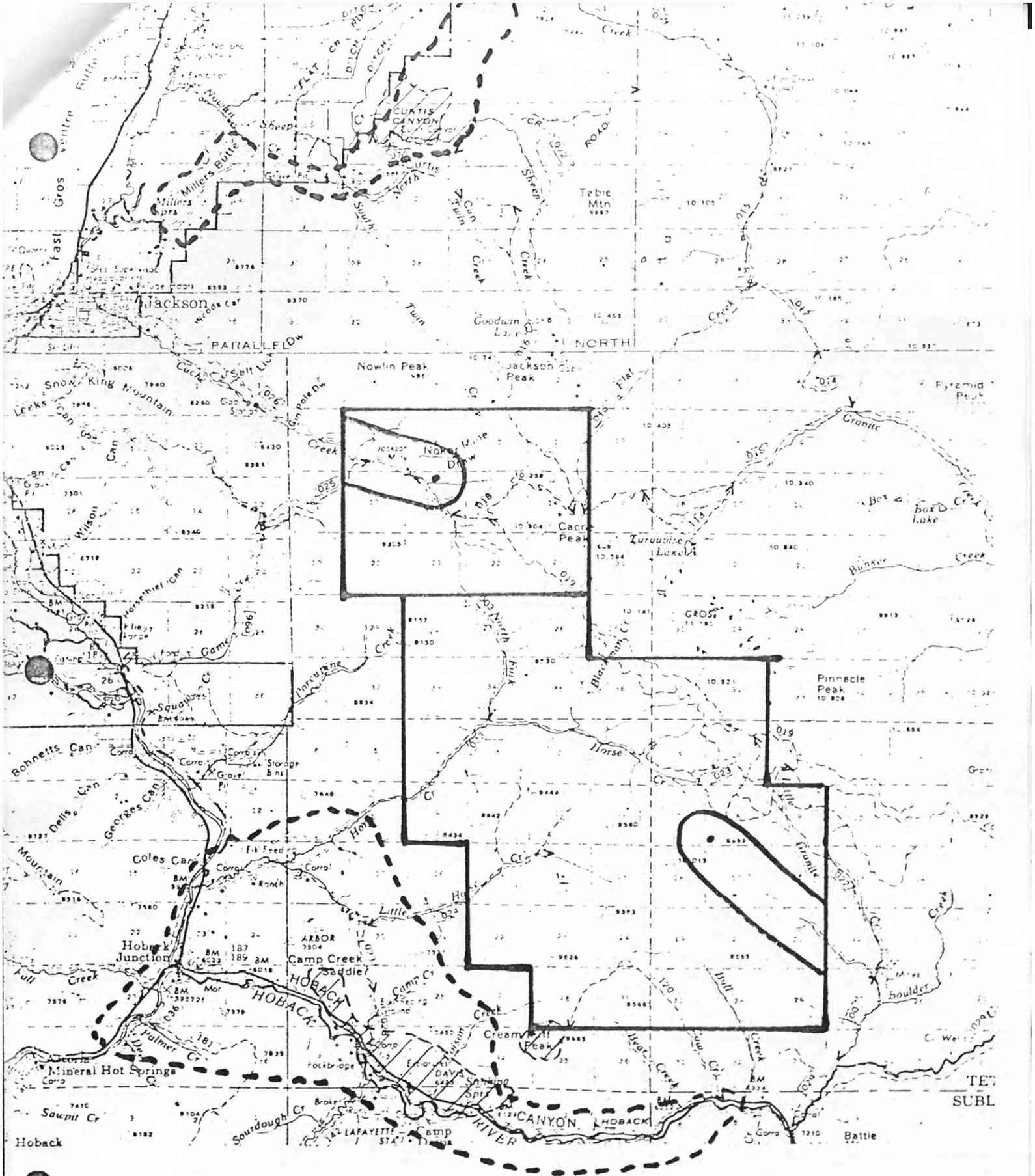


Fig. 5

CACHE CREEK
MTN. SHEEP & DEER
RANGE

CRITICAL DEER WINTER RANGE

CRITICAL MTN. SHEEP WINTER RANGE

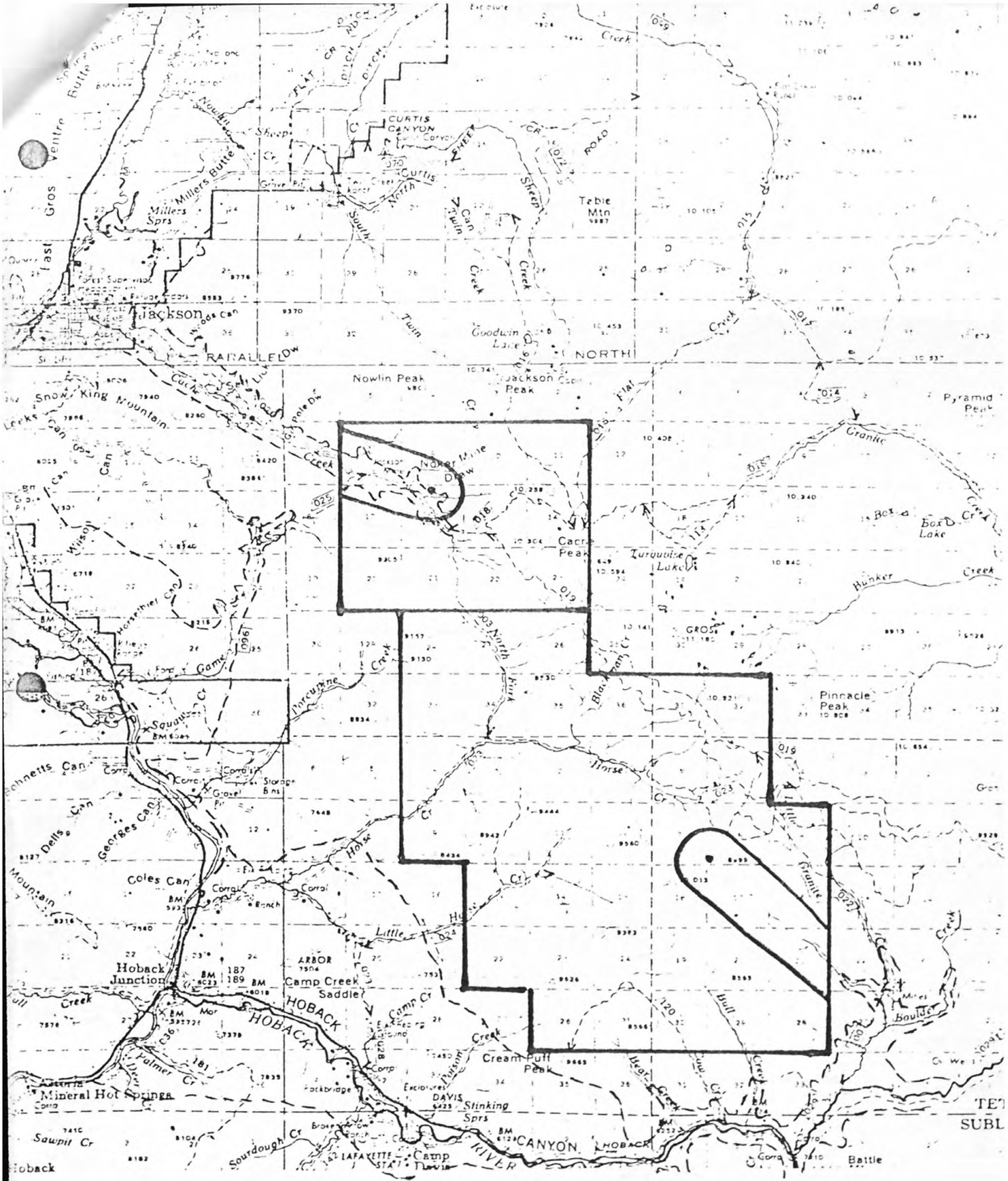


Fig. 6

CACHE CREEK
MOOSE RANGE

CRITICAL MOOSE WINTER RANGE

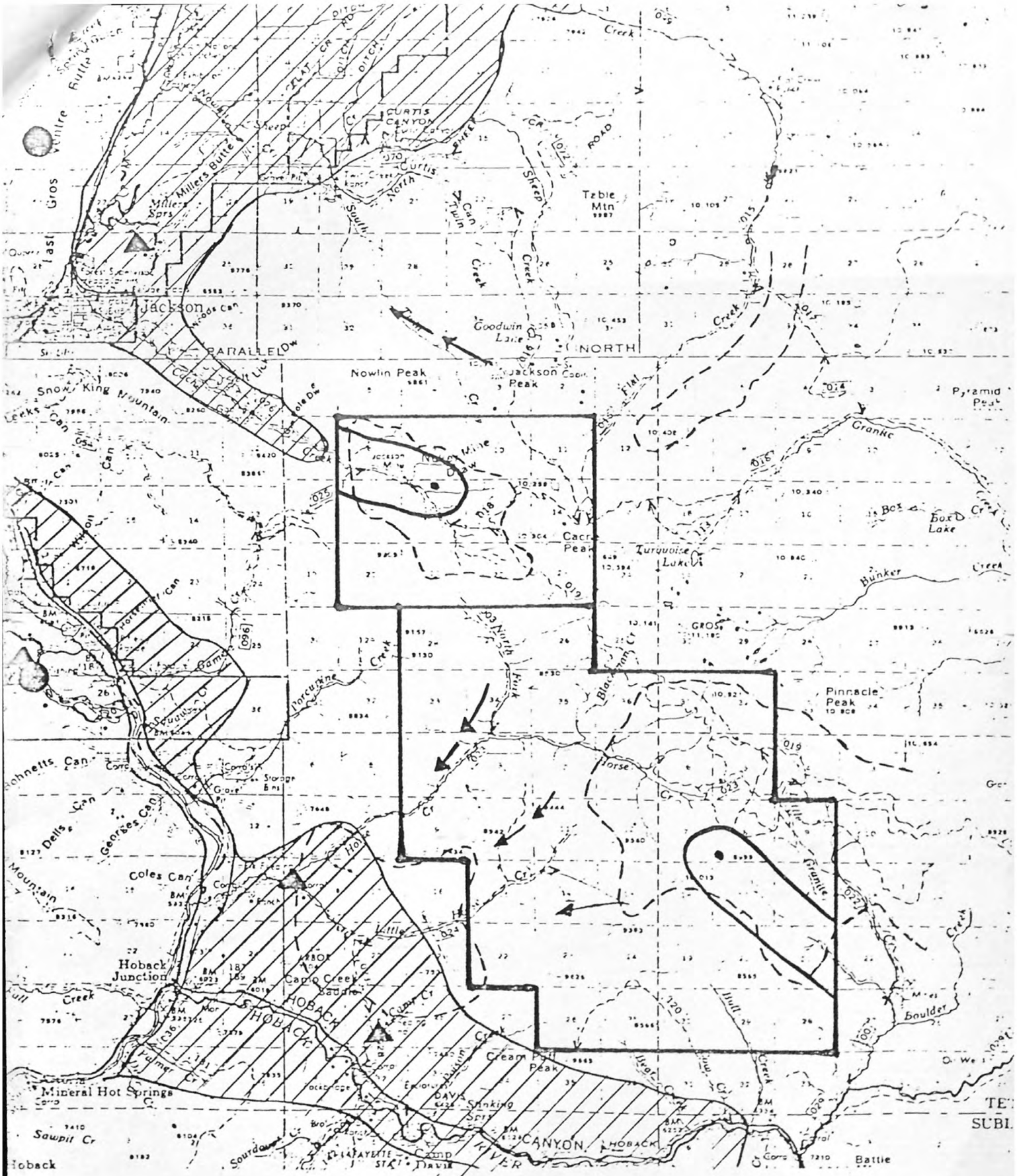


Fig. 7

CACHE CREEK
ELK RANGE

CRITICAL WINTER RANGE
SUMMER CONCENTRATIONS
CALVING AREAS
WINTER FEED GROUNDS
FALL MIGRATION ROUTES