RADIOTELEMETRY STUDY OF COLUMBIAN BLACK-TAILED DEER IN THE NORTHERN MENDOCINO NATIONAL FOREST

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ABSTRACT

Sixteen Columbian black-tailed does (_Odocoileus hemionus columbianus_) were radio-collared and five approximately 9-month old fawns were eartagged on 18 and 19 March 1986 and 5 May 1987. Three newborn fawns were eartagged during June 1986.

A total of 1553 locations of radio-collared does were recorded between 20 March 1986 and 4 April 1988. Three types of doe movements and home ranges were observed. The first "movement category" included those does (n=10) who remained on non-north-facing slopes year-round; during the winter, they either remained on their summer ranges (mean 372 ha, 919 acres) or migrated 2-8.5 km (1.3-5.3 miles) downhill. The second movement category was comprised of those does (n=3) whose winter ranges (mean 343 ha, 847 acres), were on relatively south-facing slopes, and whose summer ranges (mean 164 ha, 405 acres) were on more densely vegetated north-facing slopes 3-8 km (2-5 miles) from their winter ranges. The third group included does (n=3) whose winter ranges (mean 314 ha, 776 acres) were on relatively south-facing slopes, and whose summer ranges (mean 112 ha, 277 acres) were in more densely vegetated areas 16-27 km (10-17 miles) from their winter ranges.

Disturbance during the hunting season apparently caused the displacement of all four collared does whose home ranges during that time of year were less than about 200 m (range 10-200 m) from active roads. The displacements lasted from at least 1 day to as long as 3 weeks. These does were displaced 600 m to 2.5 km

(1.5 miles). The usual home ranges of the other collared does during that time of year were 300 m to 2.0 km (1.2 miles) from such roads; only one location of any of these does during the hunting season indicated displacement.

All timber strata groupings were utilized significantly less than their availability except the mixed hardwoods and grasslands, which were used significantly more than their relative availability. This apparent habitat preference was probably linked to the effects that fire suppression has exerted on shrub abundance and productivity. Does showed very significant individual differences in their utilization of willow and mixed hardwood habitats.

The peaks of the fawning periods were approximately a 2- to 3-week period centered on 21 June 1986 and a 2-week period centered on 19 June 1987. The peaks of the breeding season were about 8 December 1986 and 13 December 1987. The collared does showed a marked consistency in utilization of specific fawning areas year after year.

Five of 16 collared does died; three does were apparently consumed by coyotes (<u>Canis latrans</u>), one died from bluetongue infection, and one was shot during the 1987 buck-hunting season.

It is recommended that many smaller roads be closed and off-the-road vehicular travel be prohibited during the buck-hunting season in order to lessen doe mortalities, disturbances of deer family groups, and new roading. Heavy deer use of mixed hardwood areas and grasslands shows the importance of maintaining these areas for deer and indicates the need to improve the shrubland resource. Additional safeguards need to be implemented to ensure that cattle are not permitted onto the high country during the winter and to reduce cattle use of wet meadows and riparian areas.

INTRODUCTION

Justification

Detailed information on migratory deer herds of the west slope of California's coast range has not been collected. This information is needed to provide base data for decisions concerning herd management and habitat improvement. There have been numerous changes, and proposed changes, in harvest strategy and other management considerations by the California Department of Fish and Game (CDFG) and other agencies without the benefit of adequate deer herd information.

The Mendocino Deer Herd Management Plan (Booth et al. 1982) identified poor oak regeneration, poor habitat conditions on the summer range, and lack of age structure diversity in the brushlands on winter and intermediate ranges as major habitat problems relative to deer management. Computer modeling indicates that year-round adult deer mortalities and summer fawn mortalities are high when compared with adjacent areas of the county (J. W. Booth pers. comm.). In addition, the effects of human impacts such as livestock grazing, hunting, and off-the-road vehicle use need to be determined for this area.

Study area

Location

The study area is comprised of two smaller areas that include all of the locations of the radio-collared does. The locations of the 15 Etsel Ridge/Mendocino Pass does were included within subjective boundaries drawn along rivers, creeks, and ridgetops. The home range of the Sheep Ridge/Thomes Creek doe (Doe 325) comprised less than 2 percent of the overall study area, and was left separate from the major portion. The total study area is comprised of approximately 38,000 ha (93,860 acres) in Mendocino, Tehama, and Glenn counties in northeastern California (Figure 1). Elevations in this rugged area range from 2270 m (7448 ft) atop Black Butte to 366 m (1200 ft) along the Middle Fork of the Eel River. Properties are owned by the U.S. Forest Service (USFS) (Mendocino National Forest), U.S. Bureau of Land Management, and individuals.

Geology

The following description of the geology of the area is from J. P. Brooks (pers. comm., slightly edited).

> The area between Etsel Ridge and Black Butte Mountain is composed of a series of northwest-trending belts of different rock types of Franciscan rock units. Although the various formations were formed at the same approximate age, between the Jurassic and Cretaceous, they vary in degree of metamorphism from lightly metamorphosed rocks to more intensely metamorphosed schistose rocks. The degree of metamorphism and, in some cased the make-up of the formation, is a result of mountain-building forces that are responsible for the present configuration of the Coast Ranges.
>
> The Grindstone Creek Formation is a lightly metamorphosed graywacke sandstone which borders the Black Butte River. It is bounded on the east by the South Fork Mountain Schist and to the west by the Poison Rock Melange. West of the Poison Rock Melange, along the crest of Etsel Ridge, is the Bald Mountain Schist, which is a rock similar to the South Fork Mountain Schist.
>
> The present landform and, in some cases, the

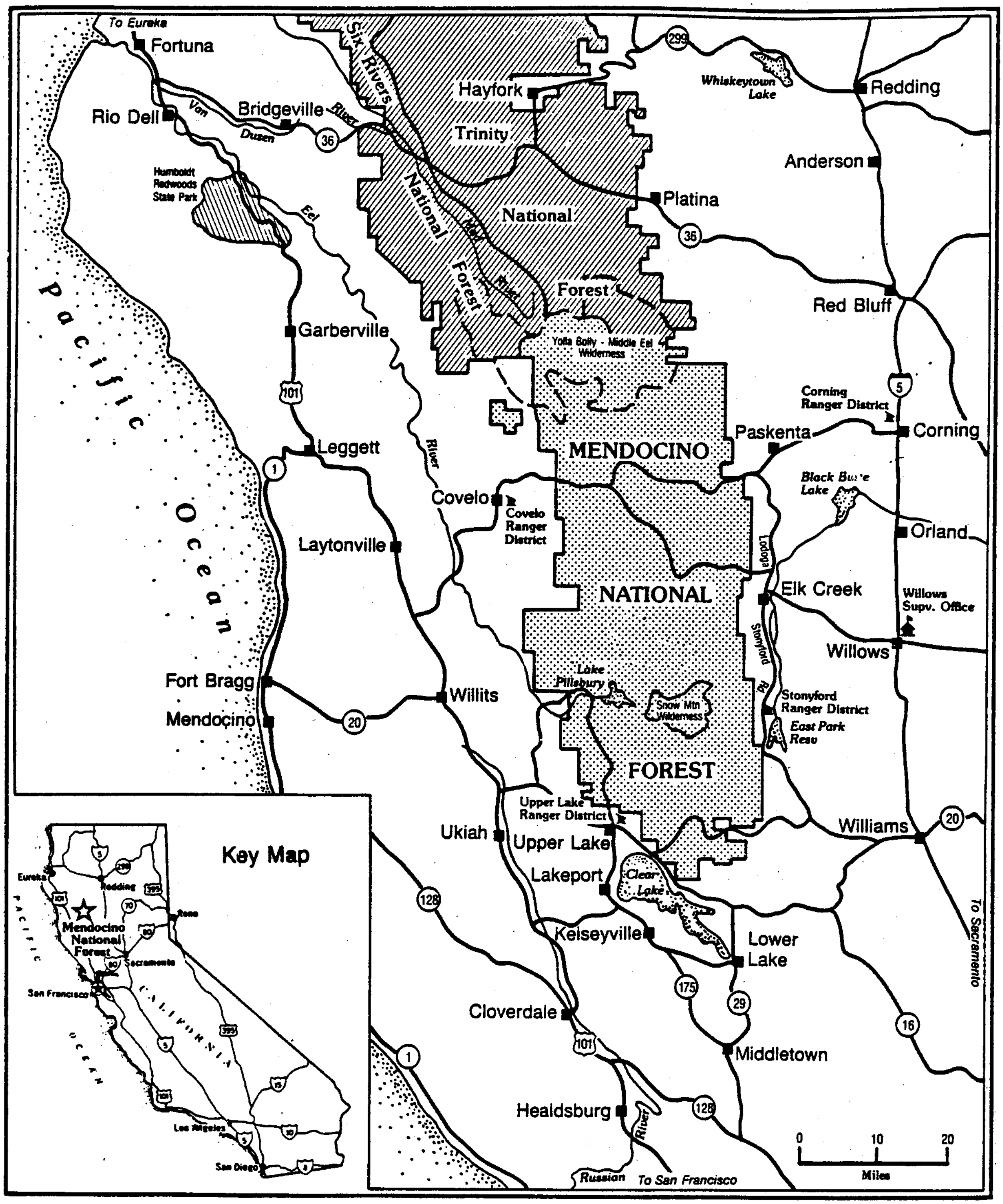

Figure 1. The study area (from USDA 1986)

vegetation, is a result of geologic factors ranging from composition and normal erosion to glaciation and landsliding. Within some formations, contrasting rock types significantly affect soil and vegetation. The Poison Rock Melange is by definition a mixture and has widely contrasting rock types such as serpentine, chert, and volcanic rock in a matrix of mudstone. Glaciation on the north of Black Butte Mountain has scoured a part of the mountain to bedrock; a large landslide on the south side has acted similarly. Much of the faulting trends to the northwest, and it is this faulting that has juxtaposed many of the formations. The faulting may impede or inhance the flow of water, or it may encourage the development of landslides.

The area between the Eel River and the eastern edge of the forest about the latitude of Hammerhorn Lake is an area of complex geology. It was originally mapped by John Suppe, who subdivided the area into several rock units: Hell Hole Graywacke, Williams Chaos Facies, and the Taliferro Metamorphic Complex. However, the area is being remapped by the U.S. Geologic Survey; this mapping is forcing a reevaluation of the geologic history of the area. New rock units are being designated such as Chicago Rock Melange and Laxyman Butte. All of these units are interbedded sandstones and shales with varying included blocks.

Between Hammerhorn Lake and Howard Lake are north-trending faults and thrust faults which separate a moderately metamorphosed and older rock unit--the Taliferro Metamorphic Complex (TMC)--from younger metasedimentary rocks. Along the eastern edge of the TMC is a zone of serpentine which has been carried to the surface through faulting. Is was along this serpentine zone that the Howard Lake (Espee) slide of 1979 originated. Landslides of hundreds, if not thousands, of acres are not uncommon, and it is these landslide areas that are the source of lakes, ponds and wetlands. Although some of the largest slides are classes as dormant, small movement on a large slide may go undetected and therefore some of the slides classed as dormant may actually be active. The evolution of the landslide is a dynamic process which is emphasized in this area.

Soils

A. L. James (pers. comm.) supplied the following information on the soils of the study area (slightly edited).

Most of the soils in the study area are shallow with weak fractured rock below it. Textures vary from gravelly loams to clay loam. High elevation areas with fir vegetation have the majority of organic materials on or above the surface of the soil. Glade areas are usually serpentine or shallow soils too droughty for conifer growth. Black oak-covered areas have organic materials well incorporated into the soil and have some clay development. Brush and grass types at lower elevations usually are very shallow with little organic materials. Organic material is an indication of biological activity with the richest soil found in the black oak areas. The second richest are the glade soils, and the high elevation areas are the third richest.

Temperature and precipitation

Summer temperatures normally range between 7 degrees C (45 F) at night and 35 degrees C (95 F) during the day. Winter temperatures below freezing are common. Annual rainfalls usually range from about 90 to 140 cm (35 to 55 inches). Snow levels are typically above about 1525 m (5000 ft) for several months during the winter. Approximately 90 percent of the precipitation falls between November and March.

Vegetation

The major vegetation types found in the study area are coniferous forest, chaparral, mixed hardwoods, oak-grassland savannah, and grassland. Riparian areas are laced along many ravine bottoms. Common species include Douglas-fir (*Pseudotsuga menziesii*), Ponderosa pine (*Pinus ponderosa*), Garry oak (*Quercus garryana*), blue oak (*Q. douglasii*), California black oak (*Q. kelloggii*), scrub oak (*Q. dumosa*), Pacific madrone (*Arbutus menziesii*), chamise (*Adenostoma fasciculatum*), manzanita (*Arctostaphylos patula*), and various *Ceonothus* and willows (*Salix* spp.). The timber strata present in the study area are presented below in "Results: Habitat Utilization."

Acknowledgements

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METHODS

Capture operations

Helicopter/drivenet captures are most effectively carried-out on open hillsides; trees allow the deer to avoid the helicopter by hiding, and trees "protect" deer by keeping the ship further away from the deer. Consequently, open hillsides in the study area were chosen for these captures. The helicopter/drivenet captures were piloted by Don Landells of Landells Aviation. Rectal temperatures were taken during handling; if a deer's temperature rose to above 106 degrees F, it was lightly watered-down. Only adult females were collared. All captured deer were eartagged and most deer were blood-sampled. Deer that sustained superficial cuts during chase or capture usually were excluded from blood-sampling.

Capturing young fawns was accomplished by holding hiding fawns and chasing-down fleeing fawns. A colored eartag was placed on one or both ears with Allflex pliers. Fawns were returned to their original locations. Fawn searches were done by vehicle and by foot. In addition to looking for young fawns, I searched for does that displayed the distinctive "reluctance to leave an area" behavior noted for other Columbian black-tails (Zwickel et al. 1953) and for Rocky Mountain elk (*Cervus elaphus canadensis*) (Livezey 1979). Such does allowed approach to within 10 m while they appeared to ignore the observer. Finding camoflaged, hiding fawns could be done best by carefully examining every square 0.5 m of ground; merely glancing around for a hiding fawn usually proved unsuccessful.

As stated above, the helicopter/drivenet system is most effectively used in open areas; these are, in this study area, almost exclusively situated on south-facing slopes. Other capture methods were carried-out in order to collar does in more densely vegetated areas.

Areas near and within Clover traps (Clover 1956) and additional sites without traps were prebaited with apples, grain mix, mistletoe, alfalfa pellets, alfalfa hay, alfalfa cubes, and salt blocks to encourage deer use of the trap sites and habituation to the traps. Actual setting of the specific traps would follow in sites showing adequate deer use. Detailed notes were kept concerning date, time, bait distributions, bait consumption, and animal species using the bait for each of these sites.

Attempts to capture does for radio-collaring were also carried-out using a Coda net gun.

Attempts were made to capture does with a a Cap-Chur dart gun using 2cc Cap-Chur darts and 2cc Pneu-darts. The Cap-Chur darts were accurate within about 40 m of the target, while the Pneu-darts were accurate within 60-70 m. Cap-Chur A115 was the tranquilizer used.

Equipment and equipment modifications

Aerial locations were made once or twice a month using a CDFG Cessna Skywagon 182 aircraft piloted by a CDFG Warden/Pilot.

Telonics TR-2 Scanning receivers and Telonics two-element hand-held Yagi antennas (Model RA-2AK) were used in aerial and ground-based locations. Telonics MOD-500 radiocollars with optional mortality mode sensors (Model S6A) were used. CDFG supplied the receivers, antennas, and the vehicles used in this study.

I fabricated an inexpensive, permanent enclosing frame of 1.3 cm and 1.9 cm (1/2 and 3/4 inch) polyvinyl chloride (PVC) tubing for the two-element hand-held Yagi antenna that protects the antenna from damage and prevents injury to the user from the ends of the elements (Livezey in press).

Some signals in especially rough terrain may be more effectively received when holding the elements of the Yagi antenna more perpendicular to the ground rather than parallel to it. This is due to the shift in signal polarization that occurs as the signals bounce over the terrain en route to the antenna (W. P. Burger pers. comm.).

Pulse rates vary from transmitter to transmitter; the pulse rates in this study varied from 1.0 to 1.4 pps.

The 22-power Bushnell spotting scope and 10-power Bushnell binoculars used in this study were duct-taped within 1.3-cm (1/2-inch) foam pipe insulation for protection.

Accuracy tests of antennas

Many studies have noted the errors associated with radiotelemetry locations (e.g. Cochran and Lord 1963, Storm 1965, Hawkins and Montgomery 1969, White and Garrott 1986). Some workers have tested the accuracy of two-element, hand-held Yagi antennas (Siperek 1983, Kufeld et. al in press), fabricated improvements on this system (Hallberg et al. 1974, Lee et al. 1985, Medina and Smith 1986, J. M. Siperek pers. comm.), and provided mathematical means to account for these errors (Springer 1979, Kufeld et. al in press).

I carried out tests of the directional accuracy of the two-element, hand-held Yagi antenna in order to calculate error polygons and to determine whether or not the PVC-enclosed Yagi antenna interfered with signal reception relative to the unframed Yagi antenna (for Livezey in press).

During these tests, transmitters were placed within the study area by helpers in locations unknown to me. The loudest signal method, considered to be the most accurate (Springer 1979), was used to determine signal directions. While receiving a signal, my eyes remained closed until the loudest signal was determined. Transmitters were 0.5-2.2 km (0.3-1.4 miles) from the receiver. A magnetic compass was used to take bearings from the receiver to the supposed locations of the transmitters. The true bearings were later figured using a 1:24,000 scale topographic map, and the differences (plus or minus) between the attempted and true bearings were determined. Ranges, means, standard deviations, 90 percent confidence limits, and 90 percent tolerance limits (Kufeld et. al in press) were calculated.

Consideration was given to using a boom antenna system mounted onto the bed of a pickup truck in which two, three-element antennas would be used (Kufeld et al. in press, J. M. Siperek pers. comm.). The accuracy of such a system is much better than a two-element hand-held Yagi (-1 to 1 degrees).

The receptive ability of the paddle hand-held antenna (Telonics Model RA-1A) relative to that of the two-element hand-held Yagi antenna was also tested.

The accuracy of aerially-received signals was tested by comparing signal locations of dead does with true locations determined later on the ground and by comparing signal locations of manually-placed transmitters with true locations. In addition, unquantifiable, more subjective "testing" was done by comparing locations recorded by pilots and by a substitute data-recorder with the "expected" locations of specific does.

Data sheets

Two types of prepared data sheets were used for on-the-ground and aerial data-recording: the cover page and the field maps. The cover page presented the observers' names, dates, times, areas censussed, climatic conditions, and the times, locations and bearings taken for each doe. The field maps were copied portions of 1:24,000 topographic maps. On these field maps were recorded aerial locations, triangulation data, hike routes and visual locations. Additional information, such as visual sighting accounts, were recorded on separate pages.

Radiotelemetry locations

Locations of collared deer were determined by on-the-ground triangulations and visuals, and aerial signal locations and visuals. Etsel Ridge and Mendocino Pass/Black Butte deer were located approximately once a week. Frequency of triangulations increased to as often as 9 times within 10 hours during times of migrations and fawning. Locations were taken from 05:00 until 02:00; however, most locations were taken from 08:00 until 17:00. Doe 325 (home range: Hammerhorn Lake area/lower Thomes Creek) was located almost exclusively by air (1 time per 2-6 weeks).

Ground triangulations

Partially obstructed signals received with the two-element, hand-held Yagi antenna are prone to significant directional errors (Kufeld et. al in press, J. M. Siperek pers. comm., pers. obs.). In addition, line-of-sight transmitters at distances as long as 21 km (13 miles) away can be received more strongly than partially obstructed signals as close as 1 km (0.6 mile) (pers. obs.). Consequently, only unobstructed, close readings were used. Typically, three to five bearings were taken for each radiocollared doe during triangulation. When a doe moved into a new area, five to 12 bearings were usually required while closing-in on her location. Usually no more than three bearings were mapped for any doe during one day; the other bearings were taken enroute to the closest, unobstructed, recorded bearings. Most recorded bearings were taken from roads within 0.5-1.5 km (0.3-1 mile) of collared does. From these bearings, lines were drawn on maps either in the field or, later, after using compass bearings recorded in the field.

Ground visuals

A visual observation of a collared doe necessitated identification of the individual doe. If the doe fled before I was able to see her, the occurrence was noted as a "visual attempt," rather than a "visual." Visual attempts were classified into one of three categories, in decreasing order of location accuracy: 1) the collared doe or other deer with her group were seen, but the collared doe was not identified, 2) the doe or other deer with her were heard but were not seen, or 3) deer were neither seen nor heard, but apparently were approached to within a few hundred meters. Visual attempts were considered to be ground triangulations in home range mapping.

In order to observe wary, collared does in steep, heavily timbered sections of the study area, planning, stealth, and timing were usually needed. Before beginning the hike toward a doe, it was important to take a sufficient number of radio-locations from roads to determine her location so that later readjustments in the approach did not jeopordize the attempt. It was necessary to approach from downwind or crosswind. Human scent is a positive identification to deer; however, the sight or sound of a slowly-moving person may not alert deer. If possible, I approached from a direction that would, if the doe fled, push her into open country where she could be observed. When within 0.5 km (0.3 mile) of the doe, I paused as often as once every minute to receive her signal. Such frequent signal reception helped in several ways. First, it allowed more efficient stalking of individual deer; slight deviations in my course often dictated success or failure of the attempt. Second, if more than one collared doe were in the area, it allowed correct ordering of deer to be stalked, depending upon cover, wind direction, distance, and effort. Third, such frequent signal reception kept me in tune with changes in signal strength and signal direction, which, when combined with changes in topography, communicated doe locations and probable movements. My walking speed typically began at a walk, then slowed to a walk-stalk, and slowed further to a stalk or crawl. When stalking, care was taken to walk as quietly as possible, by avoiding noisy substrates and taking advantage of quiet walking surfaces such as downed trees and rocks. Before descending into a deep ravine, it was necessary to determine the direction of the doe; once down in the ravine, signal bounce prohibited accurate direction-finding. The receiver was capable of receiving a signal without the aid of the antenna when the transmitter was within about 100-200 m of the receiver; consequently, removing the cord from the receiver for a few seconds helped to determine whether or not the deer was very close.

If deer were alerted in a densely vegetated area, it was usually unproductive to attempt further stalking. However, running after an alerted doe often proved successful if she moved (or could be directed) toward an untimbered area. In such cases, continual reception of the doe's signal during the 1-10 minute chase lessened the chance of my taking a wrong turn.

Following alerted, radio-collared does provided an opportunity to remain on the trail of an individual when one would otherwise have been left behind. Once alerted, deer typically ran directly away from the disturbance. If the source of the disturbance could not be determined, and they judged, usually by smell, that this source could be life-threatening, they usually continued to run directly away. However, if the source of the disturbance was determined, and gaining distance was still desired, they then chose the best avenue of escape. In open, hilly country, this often resulted in their running uphill. In mostly-open country laced with strips of vegetation, such as willow/maple riparian stringers, they often dashed to this cover and travelled more than 1 km (0.6 mile) concealed within it. In open areas interspersed with dense patches, such as partially logged-over areas, deer frequently dashed ahead of me and then "fishhooked"--turned off into some cover, stopped, and waited for me to go past. Unless such a deer were located before passing her, she usually quickly backtracked. Individual deer often used the same escape routes time after time.

The methods used to visually locate collared does and their fawns was influenced by the presence and age of fawns accompanying the does. Does with newborn fawns nearby occasionally displayed a reluctance to leave the area (Zwickel et al. 1953, Livezey 1975), allowing approach to within 10 m as they "nonchalantly" carried-out nonalerted activities. Does with newborn fawns further away than about 150 m from them usually quickly left the area. Approaching does with fawns less than about 1 month old often required greater stealth than during other times of the year, because such does were more alert than usual. Fawns typically accompanied does in flight after the fawns were 1-2 weeks old; determination of the presence of fawns younger than that often required backtracking the doe.

Identification of fawning areas

The degree to which each method used to determine the locations of fawning areas and document the presence of fawns varied from 1986 to 1987. In 1986, the fawning areas of collared does were determined mostly from triangulations. Few observations of them were attempted during the fawning season in order to minimize unnatural doe movements due to disturbance. These data were supplemented by surveying non-collared fawning does and by eartagging fawns throughout the study area. During 1987, methods were changed in the following ways: 1) the fawning areas of collared does were determined mostly by visual observations, 2) surveys for non-collared does' fawning areas were done only while enroute to collared does' fawning areas, and 3) photographing newborn fawns replaced eartagging. No eartagging was carried-out in 1987 due to: 1) apparent poor survival of fawns eartagged in 1987 (later data proved survival to be better than first believed), 2) significant mortalities of mule deer fawns (O. h. hemionus.) (Steigers and Flinders 1980) and tule elk calves (Cervus elaphus nannodes) (McCullough 1966) due to disturbances by researchers, and 3) the desire to identify fawning areas with the least amount of disturbance, again to minimize unnatural doe movements. I did not attempt visuals during the first 2 weeks of June 1987 to allow does to pick fawning areas without disturbance.

Laboratory examinations

Blood samples were processed and a dead doe was examined by personnel at the CDFG Wildlife Investigations Laboratory.

Time budget data

Time budget data can be very useful in determining the amount of time study animals spend in various activities and habitats. Scan sampling (Altmann 1974) of ten behaviors of all individuals within a group of deer were done exactly once a minute. The recorded behaviors were: grazing, browsing low, browsing medium-high, browsing high, browsing while standing up on rear legs, standing, walking, trotting, running, and lying down. If a deer passed out of view, the obstruction was noted. Record was kept of the vegetation type in which the deer were located and, when possible, the species that were browsed.

Identification of marked deer

Each radio-collared doe was referred to by the last three digits of its radio frequency number preceded by the word "Doe" (e.g. Doe 236 for transmitter 159.236 MHz). The non-collared deer tagged with orange, numbered CDFG eartags were referred to by their sex/age group and their plastic eartag number preceded by the word "Tag" (e.g. Buck Tag 258). Fawns eartagged with colored, non-numbered eartags were identified by their sex/age group and their eartag color(s) (right-left) (e.g. Female Fawn White-Red).

Analysis of habitat utilization vs. availability

The statistical technique used to calculate simultaneous confidence intervals for analyzing the utilization-availability data was from Neu et al. (1974), which was clarified in Byers et al. (1984). "Preference" for certain vegetation types could then be determined (Byers et al. 1984). Grouping of timber strata into timber strata groups was statistically acceptable, in that no group contained less than one expected observation, and no more than 20 percent of all groupings contained less than five expected observations (Cochran 1954).

Presentation of home range and habitat use data

To present locations of radio-collared does for this report, four symbols were used to differentiate between aerial signals, aerial visuals, ground triangulations and ground visuals. These symbols were placed onto 1:24,000 scale topographic maps. The home ranges were determined by connecting the outermost locations for each doe, excluding distant one-time locations, locations while enroute to summer or winter ranges, and outlying displacements due to hunting disturbances. The areas of the home ranges were calculated using a digital planimeter. If the home range of a doe extended onto more than one page, the location maps and habitat use maps were preceded in this report by a

1:63,360 scale map that showed the entire home range.

The habitat use data were presented by overlaying transparencies of vegetation groupings onto planimetric maps (simplified maps that show only important landmarks and roads), using 1:24,000 scale maps that included the same areas as the telemetric location maps. USFS timber strata were used as the vegetation classification in order to allow USFS personnel to easily use the results of this study and because the number of vegetation categories was considered manageable (Table 1). Western and southern Hayshed Basin, however, are not within the Mendocino National Forest, annd so are not mapped by the USFS. Consequently, the only alternative vegetation mapping of this area, done by the State of California (Dept. of Nat. Res., Div. of For., 1951) was used (Table 2). The State of California vegetation class data were placed into their corresponding USFS timber strata classifications for consistency; reclassifications were relatively simple by making comparisons with adjacent timber strata and due to the fact that more than 80 percent of these State data were grassland, chamise, or bare area. Acreage totals within timber strata polygons were obtained from USFS records.

Table 1. Descriptions of USFS timber strata symbols*

Type of vegetation	Label class of overstory	Symbol	Description	Specifications
Forest	Species	M	Mixed conifer	No coniferous species is >80% of the basal area (or number of stems in seeding and sampling stands)
		P	Ponderosa Pine	>80% Ponderosa Pine
		D	Douglas-fir	>80% Douglas-fir
		R	Red Fir	>80% Red Fir
		W	White Fir	>80% White Fir
		K	Knobcone Pine	>80% Knobcone Pine
		C	Conifer-hardwood	Hardwood densities = or > conifer densities
		HB	Black Oak	>80% Black Oak
		HM	Mixed hardwoods	Live oak, tanoak, madrone, etc. in uniform or mixed stands. Black Oak may appear in mixed hardwood stands.
		HS	Blue Oak-grassland savannah	Blue Oak may form a minimum of 5% of the area.
		PL	Plantation	
	Size (diameter) of tree crowns	1	<5 feet	
		2	6-12 feet	
		3	13-24 feet	
		4	25-40 feet	
		5	>40 feet	
		6	Variable	
	Density of crown closure	S	<20%	
		P	20-39%	
		N	40-69%	
		G	>70%	
Shrub		SA	Chaparral	Primarily manzanita
		SC	Chamise	
		SM	Misc. shrubs	
		SH	Shrub hardwoods	Primarily Brewer Oak
Non-woody		GX	Grass	
		GH	Herbs	
Non-vegetated		NB	Barren	
		NF	Recent fire	
		NT	Recent fuelbreak type conversion	

* Adapted from U.S. Forest Service information

Table 2. Definitions of State of California vegetation classes and their USFS timber strata equivalents

State of California vegetation classes	Description	U.S. Forest Service timber strata equilavents
Af	Chamise	SC
B	California black oak	HM4P
Ba	Bare or litter-covered area	NB
C	Canyon live oak	HM2P or HM4P
Cc	Wedgeleaf ceanothus	SC
G	Oregon white oak	HM4P
Gr	Grasses and other herbaceous plants	GX
M	Madrone	HM2P or HM4P
Qd	California scrub oak	HM2P or HM4P
Qw	Scrub interior live oak	HM2P or HM4P
W	Interior live oak	HM2P or HM4P
Y	Ponderosa pine	P3P

RESULTS AND DISCUSSION

Capture operations

Helicopter/drivenet

Fifteen does were radio-collared and eartagged and five approximately 9-month old fawns were eartagged on 18 and 19 March 1986 in five sites in the Etsel Ridge and Twin Rocks Ridge areas (Table 3). One male fawn's back was injured during capture; he was dispatched by a CDFG Warden. The fawn showed a partly-healed area of scab and puss about 12 cm (5 inches) in diameter on his right shoulder, which indicated injuries that may have increased his chances of being hurt during capture.

Seventeen hours of helicopter time were required to catch these 20 deer. About 60 deer were driven to the net sites, and about 35 deer actually hit nets. Some deer were able to hit the net, roll, and run away. Other deer driven to net sites were able to squeeze through nets having 20-cm (8-inch) mesh; 15-cm (6-inch) mesh proved able to hold these small deer better. Approximately 20 CDFG and U.S. Forest Service personnel worked on the capture operations.

Newborn fawn captures and observations

During 1986, three fawns were eartagged (Table 4). During 1987, eight newborn, hiding fawns were observed. Photographs were taken of five of these fawns; four of the five photographed fawns were fawns of radio-collared does (Does 336, 365, twins of

Table 3. Trapping information regarding fawns and radio-collared does captured during helicopter/drivenet and tranquilizer-darting operations

				Does eartagged and collared				Fawns eartagged				
				Eartags		Radiocollars			Eartags			
Date	Site no.	UTM coordinates	Location	Metal	Plastic	Number	Freq. (159. ___mH)	Sex	Metal	Plastic	Blood taken	Release time
18Mar86	1	4398.4N,495.3E	Hayshed Basin					F	8787	259(R)	Yes	07:00
								M	8786	262(R)	No	07:10
				8778	273(R)	24468	256				No	07:55
				8776	271(R)	24477	365				Yes	08:00
				8788	266(R)	24467	246				No	08:00
18Mar86	2	4395.2N,498.6E	Haynes Basin	8779		24466	236				No	11:10
				8777	270(R)	24482	415				Yes	12:00
								M	8792	269(R)	Yes	12:00
				8784	254(L)	24484	446				Yes	13:30
				8794	267(R)	24483	425				Yes	14:30
				8795	264(R)	24475	336				Yes	14:30
								M	8796	258(L)	Yes	14:45
				8780	251(R)	24469	276				Yes	16:00
				8785	253(R)	24478	375				Yes	16:15
19Mar86	3	4406.0N,502.3E	Twin Rocks	8798	261(R)	24470	285				Yes	08:00
				8799	260(L)	24481	405				Yes	08:15
19Mar86	4	4402.9N,504.3E	White Hawk	8793	257(R)	24472	306				No	13:20
								M	(injured, shot)		No	14:05
				8782	255(R)	24465	226				Yes	14:20
19Mar86	5	4402.5N,504.5E	White Hawk	8789	265(R)	24473	316				Yes	13:00
5May87	6	4423.0N,505.1E	Pony Ridge				325				No	21:00

Table 4. First observations, mortalities and minimal ages of fawns of radio-collared does and eartagged fawns of non-collared does, 1986-87

	Doe	No. of fawns	First fawn observation: Date	First fawn observation: Age of fawn	Last fawn observation: Date	Last fawn observation: Age of fawn	Fawn's age at death	First observ of doe without fawn	Date of doe's death (recovery date)
1986 fawns	226	1	26Jun86	2 weeks	20May87	11 months	--	--	--
	236	1	17Sep86	3 months	16Dec86	6 months	--	--	--
	246	1	10Dec86	6 months	--	--	--	--	20Feb87
	256	--	--	--	--	--	--	--	1Oct87
	276	1	30Oct86	4.5 months	17Mar87	9 months	--	--	--
	285	1	3Nov86	4.5 months	--	--	--	--	--
	306	1	13Aug87	2 months	26Nov86	5.5 months	--	--	--
	316	1	13Nov86	5 months	1Mar87	8.5 months	--	--	--
	336	1	31Oct86	4.5 months	20Mar87	9 months	--	--	--
	365	1	10Dec86	6 months	14Apr87	10 months	--	--	--
	375	1	25Oct86	4.5 months	16Dec86	6 months	--	--	--
	405	1	31Mar87	9 months	20May86	11 months	--	--	--
	415	2	25Oct86	4 months	9Mar87	9 months	--	--	--
			25Oct86	4 months	9Mar87	9 months	--	--	--
	425	1	17Nov86	5 months	9Mar87	9 months	--	--	--
	446	1	31Oct86	4.5 months	16Dec86	6 months	--	--	--
	Un-iden	2 (1 ear tagged Wh-Red)	21Jun86	4-6 days	15Jun87	1 year	--	--	--
			21Jun86	4-6 days	15Jun87	1 year	--	--	--
	Un-iden	2 (Red, Blue)	3Jul86	1-2 days	12Dec86	7 months	--	--	--
			3Jul86	1-2 days	--*	--	--	--	--

Table 4 (cont.). First observations, mortalities and minimal ages of fawns of radio-collared does and eartagged fawns of non-collared does, 1986-87

	Doe	No. of fawns	First fawn observation: Date	First fawn observation: Age of fawn	Last fawn observation: Date	Last fawn observation: Age of fawn	Fawn's age at death	First observ of doe without fawn	Date of doe's death (recovery date)
1987 fawns	226	--	--	--	--	--	--	--	--
	236	--	--	--	--	--	<1 months**	3Jul87	--
	276	1	29Jun87	1.5-2 wk	--	--	--	--	--
	285	--	--	--	--	--	<2 months**	31Jul87	--
	306	2	21Jul87	1 month	17Aug87	2 months	--	--	8Oct87
			21Jul87	1 month	17Aug87	2 months	--	--	
	316	--	--	--	--	--	--	--	18Jun87
	325	--	--	--	--	--	--	--	--
	336	2	22Jun87	1 week	14Dec87	6 months	--	--	--
			22Jun87	1 week	--	--	<2 months	18Aug87	--
	365	1	22Jun87	2-3 days	10Dec87	6 months	--	--	--
	375	1	16Jun87	2 days	3Mar88	8.5 months	--	--	--
	405	2	7Aug87	1.5 months	12Jan88	7 months	--	--	--
			7Aug87	1.5 months	12Jan88	7 months	--	--	--
	415	2	23Jun87	3-4 days	12Oct87	3.5 months	--	--	--
			23Jun87	3-4 days	12Oct87	3.5 months	--	--	--
	425	1	18Aug87	2 months	14Dec88	6 months	--	--	--
	446	--	--	--	--	--	<1 months**	29Jun87	--

* The fate of this fawn in unknown; there was only one partially obstructed sighting of this non-collared doe's family group after the eartagging.

** Fawns were never observed for these does, but the does were seen repeatedly without fawns

415).

Clover trap

Fifteen Clover traps were borrowed from the Hopland Field Station on 8 July 1986. Twelve of these traps were installed in six sites on Etsel Ridge between Grizzly Flat and Horse Pasture Ridge. These traps and two additional sites without traps were prebaited weekly from mid July to early September 1986.

Three of the eight Clover traps sites baited for deer were within wet meadow exclosures. These sites showed moderate deer use and heavy rodent and rabbit use. The other five trap sites were heavily utilized by cattle, moderately by rodents and rabbits, and minimally be deer. During the third week of August, one trap was slightly vandalized, and the doors of two traps were untied and lowered. Baiting of traps was terminated in late August due to poor deer use and heavy cattle use.

Mistletoe, hay, apples and salt blocks proved to be helpful in communicating the species of animal utilizing the bait. Teeth marks could be seen on the mistletoe branches, allowing distinction between: 1) deer, 2) rodents (Townsend Chipmunk (Eutamius townsendii), Golden-mantled Ground Squirrel (Citellus lateralis), California Ground Squirrel (Spermophilus beecheyi)) and Black-tailed Jackrabbbits (Lepus californicus) and 3) domestic cattle. Hay was moved very little and barely nibbled by rodents and rabbits, moved around and browsed more heavily by deer, and moved very much and completely consumed by cattle.

Teeth marks on apples showed rodent/rabbit use. The size of the licked-out cavity in salt blocks showed the type of animal that licked it. Use by Scrub Jays (*Aphelocoma coerulescens*), Steller's Jays (*Cyanocitta stelleri*), California Quail (*Callipepla californica*) and other birds were observed and could be noted after the fact by footprints.

Net gun

Attempts to capture does using a Coda net gun were carried-out during the evening of 19 September 1986 on Etsel, Doan, and O'Neil ridges. Only three does, three fawns, and two bucks were observed. An attempt to net one of the does was unsuccessful.

Attempts were made to tranquilize does in the Indian Dick/Hammerhorn Lake area north of the Middle Fork of the Eel River on 5-6 May and 26 May 1987. Two two-person teams were used on 5-6 May and three two-person teams and a dog were used on 26 May. One doe (Doe 325) was tranquilized and collared near Pony Ridge on 5 May (Table 3). Three does were shot-at but missed, and four more does were hit with darts but the does were not recovered. Time spent searching for darted does that were not recovered averaged 4.5 man-hours/doe. The dosage of the tranquilizer used immobilizes relatively unstressed deer in approximately 6 minutes. Alerted or stressed deer could take at least 10 minutes to succumb to the drug, or, possibly, may not succumb at all (W. E. Clark pers. comm.). A startled doe can travel more than 2 km (1.2 miles) within that time. The steep, heavily vegetated region and the distance a startled doe can travel before the drug takes affect contributed to the poor recovery of darted does. The dog proved to be a negative influence on the operations.

Accuracy tests of antennas

The directional accuracy tests of the two-element, hand-held Yagi antenna done during November 1987 yielded 90% tolerance limits on degrees of bias at 90% confidence intervals (Kufeld et al. in press) of -7.44 to 7.44 degrees for the PVC-enclosed antenna and -8.83 to 9.73 degrees for the unframed Yagi antenna (Table 5) (Livezey in press).

Error polygons of triangulations, using error arcs of -8 to 8 degrees, ranged from 0.25 to 8 ha (0.5 to 20 acres) for visual attempts and from 2 to 48 ha (4 to 120 acres) for triangulations. Error polygons of typical triangulations were 3.5 to 32 ha (9 to 80 acres).

I found the paddle hand-held antenna (Telonics Model RA-1A) to be of little or no help in locating radio-collared deer in this study area. Four collared does were situated within 0.5-2.0 km (0.3-1.2 miles) of me in Upper Haynes Basin during the tests. The direction of each of the four does could be determined within 10-15 seconds using the two-element antenna. Using the paddle antenna, however, even after knowing the direction of the does, I could make no sense out of the signals. Moisture, vegetation, and, most importantly, topography will severely interfere with signals received by the paddle antenna (W. P. Burger pers. comm.).

Table 5. Directional accuracy of telemetry signals received using a PVC-enclosed two-element Yagi antenna versus an unframed two-element Yagi antenna

Type of two-element hand-held Yagi antenna	Sample size	Range (degrees)	X	SD	90% conf.	90% tolerance limits on degrees of bias at 90% conf. interval*
PVC-enclosed	33	-9 to 10	0	3.72	-1.07 to 1.07	-7.44 to 7.44
Unframed	33	-11 to 10	0.45	4.64	-0.80 to 1.78	-8.83 to 9.73

* After Kufeld et al. (in press)

The two, three-element Yagi antenna system was not used in this study for several reasons. First, it is necessary to use beacon transmitters or landmarks in order to reorient the relative compass bearings determined by the compass rose mounted on the base of the antenna assembly. Many beacon transmitters and/or landmarks would be necessary in this study area, due to the heavily dissected topography. In many areas and during certain seasons and times of day, no landmarks are visible because timber, fog, or darkness obscure vision. Second, the time required to take down and set up the system many times a day was a consideration. Third, many of the triangulations carried-out in this study were done from close enough distances to the transmitters that the inaccuracies of the two-element hand-held antenna were not prohibitive. Fourth, frequent visuals and visual attempts increased the accuracy of many locations.

Results of the accuracy tests of aerially-received signals indicated that these locations were plus or minus about 0.4 km of the true locations. This estimate was determined by quantifiable tests (range 0.1-0.5 km, n=5) and scores of "unquantifiable tests" as described in Methods. Consequently, error circles associated with aerially-received signals were about 51 ha (125 acres).

Radiotelemetry locations

A total of 1553 locations of radio-collared does were recorded between 20 March 1986 and 4 April 1988 (Table 6). Etsel

Table 6. Number of locations of all radio-collared does by each type of location

	Type of location				
Doe	Aerial signal	Aerial visual	Ground triang.	Ground visual	Total
226	36	0	56	16	108
236	34	0	69	12	115
246	18	0	35	5	58
256	9	0	20	2	31
276	34	2	79	10	125
285	35	2	59	9	105
306	28	0	52	11	91
316	23	0	42	9	74
336	34	1	78	13	126
365	33	1	75	7	116
375	34	0	72	14	120
405	34	0	58	13	105
415	35	0	76	14	125
425	34	0	79	10	123
446	34	0	74	5	113
Subtotal for does captured near Etsel Ridge and Mendo Pass	455	6	924	150	1535
325	15	0	2	1	18
Total for all does	470	6	926	151	1553

Ridge and Mendocino Pass/Black Butte deer were located at least once a week from capture (18-19 March 1986) through mid February 1988. From 18 February through 4 April 1988, monitoring of collared does was limited to mortality checks and significant movements, due to the need to lessen recorded location data while this report was being written. Locations from mid April onward will be continued and will be included in a subsequent report. Location types, and the percent of total locations for each of these types, were: aerial signals (30.3%), aerial visuals (0.4%), ground triangulations (59.6%), and ground visuals (9.7%). The frequency of success I obtained visually locating the collared does differed between does (Table 7); this success frequency was dependent upon such factors as topography, vegetation, ground litter, doe behavior, and wind direction and velocity.

Movements, home ranges, and habitat utilization by radio-collared does

Movements

Movement categories-- The radio-collared does in this study can be placed within certain "movement categories," depending on their movements through the year (Table 8).

Movement Category I included those does who remained on south-, west-, or east-facing slopes year-round; during the winter, they either remained on their summer ranges or migrated 2-8.5 km (1.3-5.3 miles) downhill. One doe's summer range included two adjacent drainages. This movement category is

Table 7. Percent of total attempts in which radio-collared does were visually located (visual success frequency)

Doe	Ground visuals	Ground visual attempts	Visuals plus attempts	Visual success freq.(%)
226	16	6	22	73
236	12	10	22	54
246	5	0	5	100
256	2	1	3	67
276	10	6	16	62
285	9	9	18	50
306	11	10	21	52
316	9	3	12	75
325	1	2	3	33
336	13	3	16	81
365	7	5	12	58
375	14	3	17	82
405	13	10	23	56
415	14	2	16	88
425	10	5	15	67
446	5	2	7	71

Table 8. Movements of radio-collared does, March 1986 through April 1988

Movement category[1] / Doe	Type of range[2]	Dates[3]	Location	Elevation	Aspect
I / 226	Year-long	19Mar86-10Apr88	White Hawk Creek Valley	675-1400m (2200-4600ft)	S,E,W
I / 246	Spring/summer/fall	18Mar86-2Jan87	Upper Hayshed Basin	1150-1450m (3800-4800ft)	W,SW
	Intermediate	3-5Jan87	Mid Hayshed Basin	750m (2500ft)	S
	Intermediate	9-22Jan87	Upper Hayshed Basin	1150-1450m (3800-4800ft)	W,SW
	Winter	29Jan-6Feb87	Lower Hayshed/Thatcher creeks	550-675m (1800-2200ft)	W
	Spring	11-20Feb87 (dead)	Upper Hayshed Basin	1150-1450m (3800-4800ft)	W,SW
I / 256	Spring/summer/fall (year-long?)	18Mar-10ct86 (dead)	Upper Hayshed Basin	950-1450m (3100-4800ft)	W
I / 276	Spring/summer/fall	18Mar-21Dec86	Upper Skunk Lake Creek Valley	1275-1600m (4200-5200ft)	SW,S
	Winter	2Jan-16Jan87	Lower Skunk Lake Creek Valley	1025-1275m (3400-4200ft)	SW,S
	Spring/summer/fall	22Jan-16Sep87	Upper Skunk Lake Creek Valley	1275-1600m (4200-5200ft)	SW,S
	Fall/winter	23Sep-12Dec87	Lower Skunk Lake Creek Valley	1025-1275m (3400-4200ft)	SW,S
	Winter/spring	19Dec87-10Apr88	Upper Skunk Lake Creek Valley	1275-1600m (4200-5200ft)	SW,S
I / 336	Year-long	18Mar86-10Apr88	Upper and Mid Haynes Creek Valley	1025-1600m (3400-5200ft)	SW,S

Table 8 (cont.). Movements of radio-collared does, March 1986 through April 1988

Movement category[1]/ Doe	Type of range[2]	Dates[3]	Location	Elevation	Aspect
I / 365	Spring/summer/fall	18Mar-16Dec86	Upper Hayshed Basin	900-1450m (3000-4800ft)	W,S
	Intermediate	21Dec86	Mid Thatcher Ridge	1150m (3800ft)	W
	Intermediate	2-3Jan87	Upper Hayshed Basin	1275-1350m (4200-4400ft)	W
	Intermediate	5Jan87	Mid Thatcher Ridge	No specific location	?
	Intermediate	9-22Jan87	Upper Hayshed Basin	950-1450m (3100-4800ft)	W
	Winter	29Jan-19Mar87	Across Middle Fork Eel River	425-550m (1400-1800ft)	SE
	Spring/summer/fall	20Mar-23Dec87	Upper Hayshed Basin	975-1450m (3200-4800ft)	W,S
	Winter	10Jan-11Mar88	Across Middle Fork Eel River	425-550m (1400-1800ft)	SE
	Spring	17Mar-10Apr88	Upper Hayshed Basin	975-1450m (3200-4800ft)	W,S
I / 375	Year-long	18Mar86-10Apr88	Upper and Mid Haynes Creek Valley	1100-1600m (3600-5200ft)	SW,S
I / 415	Year-long	18Mar86-26Mar88 (dead) (excl. 11Feb87)	Upper and Mid Haynes Creek Valley	1050-1600m (3500-5200ft)	SW,S
	Winter	11Feb87	Mouth Haynes Creek	700m (2300ft)	S
I / 425	Year-long	18Mar86-10Apr88	Upper and Mid Haynes Creek Valley	1100-1625m (3600-5300ft)	SW,S
I / 446	Spring/summer/fall	18Mar-12Nov86	Red Rock Ridge, mouth Skunk L. Cr., Upper Haynes Cr. V.	850-1500m (2800-4900ft)	S,SW
	Winter	17Nov-4Dec86	Jack Hollow/Haydon Rock	1450-1525m (4800-5000ft)	NW
	Spring	10Dec87-10Apr88	Red Rock Ridge, Lower Haynes Cr. V., Upper Haynes Cr. V.	575-1500m (1900-4900ft)	S,SW

Table 8 (cont.). Movements of radio-collared does, March 1986 through April 1988

Movement category[1]/ Doe	Type of range[2]	Dates[3]	Location	Elevation	Aspect
II / 306	Spring	19Mar-10Apr86	White Hawk Creek Valley, Upper Blue Slide Creek	1000-1450m (3300-4800ft)	S,SW
	Intermediate	22+30Apr86	Seven Troughs	1525-1600m (5000-5200ft)	SW
	Intermediate	7-16May86	White Hawk Creek Valley	1200m (4000ft)	SW
	Summer/fall	26May-12Sep86	Recer Ridge	1400-1675m (4600-5500ft)	N
	Fall/winter/spring	22Sep86-30Apr87	White Hawk Creek Valley, Upper Blue Slide Creek	1000-1450m (3300-4800ft)	S,SW
	Intermediate	7May87	Seven Troughs	1525-1600m (5000-5200ft)	SW
	Summer/fall	14May-8Oct87 (dead)	Recer Ridge	1400-1675m (4600-5500ft)	N
II / 316	Spring	19Mar-14May86	White Hawk Creek Valley, Seven Troughs	800-1650m (2600-5400ft)	SW,S
	Summer	16May-14Jun86	Ridge W of Lake Ridge	1225-1650m (4000-5400ft)	N
	Intermediate	20-26Jun86	Seven Troughs	1525-1650m (5000-5400ft)	SW
	Summer/fall	3Jul-9Oct86	Ridge W of Lake Ridge	1225-1650m (4000-5400ft)	N
	Fall/winter/spring	13Oct86-22Apr87	White Hawk Creek Valley, Seven Troughs	800-1650m (2600-5400ft)	SW,S
	Summer	30Apr-7May87	Ridge W of Lake Ridge	1225-1650m (4000-5400ft)	N
	Intermediate	14May87	Seven Troughs	1525-1650m (5000-5400ft)	SW
	Summer	20May-18Jun87 (dead)	Ridge W of Lake Ridge	1225-1650m (4000-5400ft)	N

Table 8 (cont.). Movements of radio-collared does, March 1986 through April 1988

Movement category[1]/ Doe	Type of range[2]	Dates[3]	Location	Elevation	Aspect
II / 405	Spring	19Mar-10Apr86	White Hawk Creek Valley	1100-1375m (3600-4500ft)	S,SE,SW
	Spring/summer/fall	22Apr-9Oct86	1.5-3.0km up Recer Cr.	1100-1450m (3600-4800ft)	NE
	Winter	13Oct86-13Apr87	White Hawk Creek Valley	1100-1375m (3600-4500ft)	S,SE,SW
	Intermediate	22Apr87	0.8 km NW of Mendo. Pass	1525m (5000ft)	S
	Intermediate	30Apr87	0.5km W of Lake Ridge	1225m (4000ft)	N
	Summer/fall	7May-25Oct87	1.5-3.0km up Recer Cr.	1100-1450m (3600-4800ft)	NE
	Fall/winter/spring	29Oct87-10Apr88	White Hawk Creek Valley	1100-1375m (3600-4500ft)	S,SE,SW
III / 236	Spring	18Mar-14May86	Upper Haynes Cr. Valley	1300-1600m (4300-5300ft)	SW,S
	Intermediate	21May86	Upper Doan Ridge	1450m (4800ft)	NE
	Summer/fawning	30May-13Aug86	3-3.5km above mouth Cold Creek	1100-1500m (3600-4900ft)	NW
	Summer	25Aug-17Sep86	Upper Doan Ridge	1350-1575m (4400-5200ft)	NE
	Intermediate	22Sep86	Lower Blue Slide Creek	850m (2800ft)	S
	Intermediate	1-21Oct86	Upper Haynes Cr. Valley	1300-1600m (4300-5300ft)	SW,S
	Intermediate	22Oct86	Lower Newhouse Ridge	800m (2600ft)	NE
	Fall	25-31Oct86	Upper Haynes Cr. Valley	1300-1600m (4300-5300ft)	SW,S
	Fall	4Nov86	Upper Doan Ridge	1575m (5200ft)	NE
	Fall/winter/spring	10Nov86-14May87	Upper Haynes Cr. Valley	1300-1600m (4300-5300ft)	SW,S
	Summer	19May-20Jun87	3-3.5km above mouth Cold Creek	1100-1500m (3600-4900ft)	NW
	Summer	26Jun-1Sep87	Upper Doan Ridge	1350-1575m (4400-5200ft)	NE
	Summer	7-22Sep87	0.2-3.5km above mouth Cold Creek	850-1500m (2750-4900ft)	S,N,NE

Table 8 (cont.). Movements of radio-collared does, March 1986 through April 1988

Movement category[1]/ Doe	Type of range[2]	Dates[3]	Location	Elevation	Aspect
III / 236 (cont.)	Intermediate	3-4Oct87	Lower Plaskett Ridge	1025-1150m (3400-3800ft)	W
	Intermediate	6-30Oct87	Upper Doan Ridge	1350-1575m (4400-5200ft)	NE
	Winter	5Nov87-13Feb88	Upper Haynes Cr. Valley	1300-1600m (4300-5300ft)	SW,S
	Winter	26Feb88	Upper Doan Ridge	1575m (5200ft)	NE
	Winter/spring	3-10Apr88	Upper Haynes Cr. Valley	1300-1600m (4300-5300ft)	SW,S
III / 285	Spring	19Mar-16May86	White Hawk Creek Valley	925-1450m (3000-4700ft)	SW,S
	Summer	30May-7Aug86	Cold Creek Valley, 0.5-2.7km E of Brushy Mt.	1600-1900m (5300-6200ft)	N,S,E,W
	Fall/winter/spring	13Aug86-30Apr87	White Hawk Creek Valley	925-1450m (3000-4700ft)	SW,S
	Enroute	7May87	Plaskett Creek	No specific location	?
	Summer/fall	14May-10Sep87	Cold Creek Valley, 0.5-2.7km E of Brushy Mt.	1600-1900m (5300-6200ft)	N,S,E,W
	Enroute	14-15Sep87	Harvey Spring, Recer, Lake ridges, 7 Troughs, Blue Slide and White Hawk creeks	1300-1925m (4300-6300ft)	N,W,S
	Fall/winter/spring	15Sep87-10Apr88	White Hawk Creek Valley	925-1450m (3000-4700ft)	SW,S
III / 325	Summer/fawning	5May-10Sep87	Pony Ridge	1600-1775m (5300-5800ft)	S
	Fall/winter/spring	8Oct87-18Feb88	Slate Creek	725-1150m (1800-2800ft)	S
	Summer/fawning	4Apr88-?	Pony Ridge	1650m (5400ft)	S

1 Descriptions of the three Movement Categories can be found in "Results: Movement Categories."

2 Summer ranges include fawning areas

3 18Mar86, 19Mar86, and 5May87 were the days of radiocollaring. 10Apr88 is the last day of data collection used for this report.

comprised of Doe 226 (of White Hawk Creek), Does 245, 256, and 365 (of Hayshed Basin), Doe 276 (of Skunk Lake Creek Valley), and Does 336, 375, 415, 425, and 446 of Haynes Creek Valley).

1) Doe 226 (Figures 2-4) remained year-round in the White Hawk Creek drainage, although once she was situated across the Black Butte River 0.3 km (0.2 mile) from the mouth of White Hawk Creek. Subtle movements throughout the year included her living along the east-central side of White Hawk Creek from 20 March through 1 October 1986, moving to the west side of central and lower White Hawk Creek from 9 October through 11 December 1986, living along either side of central White Hawk Creek from 18 December 1986 through 30 January 1987, moving back up to the east-central side of the creek from 8-21 February 1987, and then remaining in the area including the east-central side of the creek and either side of the creek from 1 March 1987 through March 1988.

2) The home ranges of Does 246, 256 and 365 (Figures 14-18, 19-20, 52-56, resp.) included Hayshed Basin. Doe 246 lived for most of the year in upper Hayshed Basin. From 3 to 5 January 1987, Doe 246 moved about 1 km (0.6 mile) downhill, and then travelled back up to upper Hayshed Basin. She migrated as far as 8.5 km (5.3 miles) downhill to 1 km (0.6 mile) south of the mouth of Thatcher Creek from 29 January to 6 February 1987. She then moved back up to upper Hayshed Basin and was found dead on 20 February. Doe 256 lived in upper Hayshed Basin, but she died before her year-round home range could be determined (1 October 1986). Doe 365 wintered across the Middle Fork of the Eel River

Figure 2. Legend for radio-collared doe location maps

Map symbol	Location type
○	Aerial signal
⬡	Aerial visual
□	Ground triangulation
△	Ground visual

[2]	Numbers within symbols present the number of locations of that type at that specific spot
[E]	Enroute location between winter and summer ranges
[H]	Hunting season displacement out of usual home range

See "Results: Accuracy tests of antennas" for ranges of location errors associated with aerial signals and ground triangulations during both winters. Her winter range was 7 km (4.2 miles) southwest of her summer range. Doe 365 took two short-term trips at least one-half way down to her winter range during the winter of 1986-87 (on 21 December 1986 and 5 January 1987) prior to her wintering across the Middle Fork. These journeys of Does 246 and 365 may have been "test trips" (Bertram and Rempel 1977); Doe 365 was not observed taking such trips the following winter.

3) Doe 276 lived year-round in Skunk Lake Creek Valley (Figures 21-22). She remained almost exclusively within 1 sq km in upper Skunk Lake Creek Valley from 20 March to 9 September 1986, 17 November to 21 December 1986, and 22 January to 16 September 1987. Sixty-one percent (76 of 125) of her locations were from this small area.

4) Five does lived year-round in the Haynes Creek Valley area of Etsel Ridge. Does 336 (Figures 50-51), 375 (Figures 57-58), 415 (Figures 64-65), and 425 (Figures 66-67) lived in the upper basin (between Red Rock and Rose Rock). Doe 446 (Figures 68-69) roamed more widely than the other four does. Her home range extended downhill to the mouth of Haynes Creek and southeastward from the upper basin 5 km (3 miles) to Haydon Rock near Jack Hollow Creek, where she wintered from 17 November to 4 December 1986. Doe 446 travelled 1.5-4.0 km (1-2.5 miles) back and forth from the Red Rock Ridge area to the area near the mouth of Red Rock Creek at least twice between 10 September and 22 October 1986 and at least five times between 25 July and 1 December 1987. Water was readily available in both the uphill

and the downhill locations. Like Doe 446, five does in the Loft et al. (1984) Columbian black-tailed deer study "summered at elevations that were 30-150 m lower than their winter ranges."

Movement Category II was comprised of those does whose winter ranges were on south-, west-, or east-facing slopes, and whose summer ranges were on more densely vegetated north-facing slopes 3-8 km (2-5 miles) from their winter ranges. Does 306 (Figures 32-36), 316 (Figures 37-41), and 405 (Figures 59-63) wintered in the White Hawk Creek area and fawned in the Lake/Recer ridges area to the northeast. Doe 316 travelled back and forth from north-facing to south-facing slopes more than any other collared doe. Between 20 March 1986 and 20 May 1987, she made at least seven trips over the Mendocino Pass area.

Movement Category III includes Does 236, 285, and 325, whose winter ranges were on relatively south-facing slopes, and whose summer ranges were in more densely vegetated areas 16-27 km (10-17 miles) from their winter ranges. At least one of these does had several intermediate ranges (holding areas).

1) The yearly movements of Doe 236 (Figures 5-13) included the widest variety of aspects and habitats of any collared doe, and she travelled farther than any doe other than Doe 325. Doe 236 remained in her fawning area, which was 11 km (6.5 miles) from her wintering area, for 2-1/2 months during 1986 before she and her fawn returned to Doan Ridge. During 1987, however, she left her fawning area for Doan Ridge, without a fawn, after only 1 month. About 2-1/2 months later, she returned to her fawning

area for about 2 weeks.

2) Doe 285 summered near Cold Creek east of Brushy Mountain and spent the rest of the year at White Hawk Creek 16 km (10 miles) to the northwest (Figures 23-31). Like Doe 236, she successfully raised a fawn in 1986 and lost her 1987 fawn within 2 months of birth. Unlike Doe 236, Doe 285 did not leave her fawning area shortly after losing her fawn, but she stayed at her fawning area longer in 1987 than in 1986. I followed the travels of Doe 285 as she covered aproximately one-half of the distance between her fawning area and her winter range from 16:30 until 02:00 on 14-15 September 1987. Nine triangulations traced her path as she moved along upper Harvey Spring, Recer, and Lake ridges, "over the top" about 0.5 km (0.3 mile) below Seven Troughs Spring, across upper Blue Slide Creek, and 0.7 km (0.4 mile) below Bredehof Place. This night was moonless, clear, and star-filled. By 09:00, she had moved 1 more km (0.6 mile), placing her at upper White Hawk Creek.

3) Doe 325 stayed in her fawning area between Pony and Sheep ridges, northeast of Hammerhorn Lake (Figures 42-49), from the date of her collaring (5 May 1987) until at least 10 September. She was nowhere in the area on 4 October, and was located near Slate Creek on 8 October. Slate Creek flows into Thomes Creek within 1.5 km (0.9 mile) of where Thomes Creek enters the western edge of the Sacramento Valley. Her winter range was located 24-27 km (15-17 miles) southeast of her summer range. She returned to her summer range/fawning area by 4 April 1988.

Publications dealing with Columbian black-tailed does' home ranges/fawning areas make no mention of such migratory behavior (Miller 1970, Bertram and Rempel 1977, Kie et. al 1982, Siperek 1983, Loft et. al 1984, Welker 1984). In neighboring Lake County, Taber and Dasmann (1957) found that the deer were "nonmigratory and ... most of them occupy home ranges with diameters of about one-half mile (does) to three-quarters of a mile (bucks)." Neither D. R. McCullough (pers. comm.) nor D. W. Kitchen (pers. comm.) know of any documentation of this behavior for black-tailed deer. However, J. M. Siperek (pers. comm.) radio-tracked a black-tailed doe in the Thomes Creek area whose migratory pattern was similar to the patterns of these 3 does, although the distance this doe travelled was shorter. This Thomes Creek doe moved 8-10 km (5-6 miles) to her fawning area during 1981 and 1982.

Movements on winter range due to weather-- Snow levels infrequently influenced collared doe movements when the deer were on their winter ranges on Etsel Ridge and White Hawk Creek. On 6 occasions (5 January 1987; 14, 17, 19 20, 25 March 1987; 10 December 1987), collared does apparently were pushed downhill 1-2 km (0.6-1.2 miles) to avoid undrifted snow levels of 10-40 cm (4-16 inches). Collared and non-collared deer typically moved down to areas in which less than 50 percent of the ground was snow-covered.

Cold, strong winds (up to 80 km/hr, 50 mph) also apparently displaced deer and may have motivated their choice of location more markedly, for short periods, than snow levels. Since Haynes

Basin and White Hawk Creek Basin are situated in a north-south orientation, winds from the north and south sweep through these areas very effectively. During 3 days (15, 16 January 1987, 10 December 1987) of strong winds, collared does on Etsel Ridge situated themselves in small, protected ravines 1-2 km (0.6-1.2 miles) below the ridgetop. The five collared does of upper Haynes Basin were situated at least 1 km (0.6 mile) above the snow line during only one day of data-collection. On this day (24 January 1987), a strong wind from the south pushed rain and snow up the valley. The deer were more protected from the wind where they were located than they would have been down the valley below the snow line. Temporarily avoiding strong, cold winds on this day may have been more important to these does than moving out of snow up to 40 cm (16 inches) deep.

Movements due to hunting-- The traffic on the larger dirt roads of the study area (Etsel Ridge Road, Forest Highway 7) during the non-hunting season is approximately 0-40 vehicles/day, most of which is due to logging activities and USFS personnel (pers. obs.). Smaller roads (eg. up Recer Ridge, down White Hawk Creek) support much less traffic. During the hunting season, however, vehicle numbers increase to approximately 50-200 per day on the larger roads, and about 10-40 per day on the smaller roads (pers. obs.). "Road-hunting" is common throughout the study area during hunting seasons. Driving on off-road areas such as ridgetops during hunting seasons continually increases the roading of the area and permits more widespread and frequent disturbances to deer.

Human disturbances during the 1987 hunting season (19 September-25 October) apparently caused the displacement of all four collared does whose usual locations during that time of year were within 10-200 m of an actively used dirt road. These four does (Does 226, 276, 306, 405) moved 0.6-2.5 km away from their usual areas. The initial habitats of these does were conifer-hardwoods (Doe 226), grasslands and mixed hardwoods (Doe 276), mixed conifers (Doe 306), and mixed conifers and conifer hardwoods (Doe 405). Doe (226) was situated 1 km downhill of her usual location, in deeper cover, on 22 September. Doe 276 was located 1 km, 1 km, and 1.5 km (1 mile) downhill, in denser cover, on 23 September, 6 and 12 October, respectively. Doe 306 was 2.5 km (1.6 miles) and 200 m from her usual areea, in denser cover, on 22 September and 2 October. She returned to her usual fawning area by 4 October. On 8 October, she was found dead from gunshot woulds 30 m from a road. She had apparently run across the road, been shot, and took several leaps downhill before she died. Doe 405 was 400 m, 500 m, and 600 m from her usual area on 3, 4, and 6 October, respectively, in cover that was equal to or denser than her usual areas. All of these movements were directed away from roads.

All other collared does were typically situated 300 m to 2.0 km (1.2 miles) from such roads; only one location of any of these does during the hunting season indicated displacement (Doe 425, 24 October).

Five dead does were found on the Monday after opening weekend near Brushy Mountain; two does were near Cottonwood Glade and three does were near Ocean View (A. Burt, A. Frazier, T. Tovalis, S. Cushman pers. comm.).

Home range sizes

The mean year-round home ranges of Movement Category I radio-collared does was 372 ha (919 acres; range 291-477 ha, 719-1178 acres; including the summer range for Doe 365) (Table 9). Mean winter and summer home ranges of Movement Category II does were 343 ha (847 acres; range 196-422 ha, 484-1042 acres) and 164 ha (405 acres; range 76-246 ha, 188-608 acres), respectively. Movement Category III does had winter and summer home ranges of 314 ha (776 acres; range 265-362 ha, 655-894 acres) and 112 ha (277 acres; range 45-193 ha, 111-477 acres), respectively (excluding the approximate winter home range data for Doe 325).

The summer ranges of the Columbian black-tails in the study by Loft et al. (1984) averaged 138 ha (341 acres; range 33-375 ha, 81-926 acres) for does that summered between 910 and 1520 m (2985 and 4987 ft) and 185 ha (257 acres; range 137-234 ha, 339-578 acres) for does that summered above 2070 m (6792 ft).

Habitat utilization

Analysis of the timber strata utilized by all collared does (Tables 10-11) and by each collared doe (Tables 12-26) show different uses of the habitats in the study area. A very significant difference existed between the utilization of timber

Table 9. Home range areas and lengths of migration of radio-collared does

Movement category[1] / Doe	Year-round home range in hectares (acres)	Winter home range in hectares (acres)	Summer home range in hectares (acres)	Length of migration in km (mi) between winter and summer ranges	Length of migration in km (mi) during other movements
I / 226	339 (838)				
I / 246	384 (949)	? (1 1987 location)		8.5 (5.3)	
I / 256	347 (857)				
I / 276	316 (782)				
I / 336	477 (1178)				
I / 365		5 (11)	390 (963)	7 (4)	
I / 375	291 (719)				
I / 415	359 (887)				3 (2)
I / 425	349 (862)				
I / 446	467 (1155)	36 (90) (3 1986 locations)		5 (3)	
II / 306		422 (1042)	76 (187)[2]	4.5 (2)	
II / 316		410 (1012)	246 (608)	1 (0.6)	
II / 405		196 (484)	172 (426)	4 (2.5)	2 (1)
III / 236		362 (895)[3]	98 (243)	11 (6.5)	9 (5.5)
III / 285		265 (654)	193 (478)	16 (10)	
III / 325		608 (1503)	45 (112)	26 (16)	

1 Descriptions of the 3 Movement Categories can be found in "Results: Movement Categories"

2 Excludes movements due to hunting disturbance

3 Includes intermediate area used throughout the year

Table 10. Areas of the timber strata within the study area

Timber strata	Timber strata area: Hectares	Acres	Percent of total study area
M1P	40	98	0.108
M2S	49	122	0.135
M2P	106	262	0.29
M2G	22	55	0.061
M3S	552	1365	1.511
M3P	1302	3217	3.561
M3G	957	2365	2.618
M4G	2438	6025	6.669
M4S	498	1231	1.362
M4P	2040	5042	5.581
M6G	1237	3056	3.382
Mixed conifers	9241	22838	25.278
P1P	395	975	1.079
P2P	78	193	0.214
P3P	624	1541	1.706
P4P	1709	4223	4.674
Ponderosa pines	2806	6932	7.673
D2P	53	131	0.145
D2G	69	171	0.182
D3S	769	19	0.021
D3P	13	32	0.035
D3G	129	319	0.353
D4S	12	30	0.033
D4P	74	182	0.201
D4G	396	979	1.084
D6G	450	1111	1.23
Douglas firs	1965	2974	3.284

Table 10 (cont). Areas of the timber strata within the study area

Timber strata	Timber strata area: Hectares	Timber strata area: Acres	Percent of total study area
R2P	813	2009	2.224
R2G	163	402	0.445
R4P	461	1139	1.261
R4G	364	900	0.996
Red firs	1801	4450	4.926
W1P	13	32	0.035
W2P	4	11	0.012
W2G	38	94	0.104
W3S	191	471	0.521
W3P	424	1047	1.159
W3G	1095	2705	2.994
W4S	26	64	0.071
W4P	64	159	0.176
W4G	46	114	0.126
White firs	1901	4697	5.198
K2P	8	20	0.022
K2N	37	92	0.102
Knobcone pines	45	112	0.124
C2P	2505	6189	6.85
C4P	3037	7505	8.307
Conifer-hardwoods	5542	13694	15.157
HB2P	183	453	0.501
HB2G	378	934	1.034
HB4P	442	1092	1.209
HB4G	102	253	0.28
Black oaks	1105	2732	3.024

Table 10 (cont). Areas of the timber strata within the study area

Timber strata	Timber strata area: Hectares	Acres	Percent of total study area
HM2P	99	244	0.27
HM2G	382	943	1.044
HM4P	1887	4662	5.16
HM4G	1435	3547	3.926
Mixed hardwoods	3803	9396	10.4
HS2P	37	91	0.101
HS2G	125	308	0.341
HS4P	73	181	0.2
Blue oak-savannah	235	580	0.642
PL	62	154	0.17
Plantation	62	154	0.17
SA	197	486	0.538
SC	2186	5401	5.978
SM	663	1638	1.813
SH	2236	5526	6.116
Shrubs	5282	13051	14.445
GX	3136	7748	8.576
GH	108	266	0.294
Grass-herbs	3244	8014	8.87

Table 10 (cont). Areas of the timber strata within the study area

Timber strata	Timber strata area		Percent of total study area
	Hectares	Acres	
NB	188	464	0.514
NF	64	157	0.174
NT	41	101	0.111
Non-veg	293	722	0.799
Total	37325	90346	99.99

Table 11. Number of locations of all radio-collared does within each timber stratum

Timber type	Aerial signal	Aerial visual	Ground triang.	Ground visual	Total
	Type of location				
M1P	4	--	1	3	8
M2S	--	--	--	--	0
M2P	--	--	--	--	0
M2G	--	--	--	--	0
M3S	1	--	5	1	7
M3P	7	--	8	4	19
M3G	3	--	8	--	11
M4G	11	--	22	--	33
M4S	3	--	2	--	5
M4P	15	1	24	6	46
M6G	9	--	8	1	18
Mixed conifers	53	1	78	15	147
P1P	4	--	4	--	8
P2P	1	--	--	--	1
P3P	7	--	4	4	15
P4P	3	--	17	1	21
Ponderosa pines	15	0	25	5	45
D2P	1	--	--	--	1
D2G	--	--	--	--	0
D3S	--	--	--	--	0
D3P	--	--	--	--	0
D3G	1	--	--	--	1
D4S	--	--	--	--	0
D4P	--	--	--	--	0
D4G	3	--	7	1	11
D6G	--	--	--	--	0
Douglas firs	5	0	7	1	13

Table 11 (cont). Number of locations of all radio-collared does within each timber stratum

Timber type	Aerial signal	Aerial visual	Ground triang.	Ground visual	Total
	Type of location				
R2P	--	--	--	--	0
R2G	--	--	--	--	0
R4P	--	--	--	--	0
R4G	--	--	--	--	0
Red firs	0	0	0	0	0
W1P	--	--	--	--	0
W2P	--	--	--	--	0
W2G	--	--	--	--	0
W3S	--	--	2	--	2
W3P	1	--	1	--	2
W3G	2	--	4	--	6
W4S	--	--	--	--	0
W4P	--	--	--	--	0
W4G	--	--	1	--	1
White firs	3	0	8	0	11
K2P	--	--	--	--	0
K2N	--	--	--	--	0
Knobcone pines	0	0	0	0	0
C2P	9	--	32	--	41
C4P	31	--	62	8	101
Conifer-hardwoods	40	0	94	8	142
HB2P	--	--	--	--	0
HB2G	--	--	--	--	0
HB4P	2	--	1	2	5
HB4G	4	--	8	1	13
Black oaks	6	0	9	3	18

Table 11 (cont). Number of locations of all radio-collared does within each timber stratum

Timber type	Aerial signal	Aerial visual	Ground triang.	Ground visual	Total
	Type of location				
HM2P	--	--	1	--	1
HM2G	--	--	--	--	0
HM4P	95	--	209	29	333
HM4G	63	--	86	13	162
Mixed hardwoods	158	0	296	42	496
HS2P	1	--	--	1	2
HS2G	1	--	--	--	1
HS4P	--	--	--	--	0
Blue oak-savannah	2	0	0	1	3
PL	--	--	--	--	0
Plantation	0	0	0	0	0
SA	--	--	2	--	2
SC	2	--	2	--	4
SM	1	--	1	--	2
SH	7	--	11	1	19
Shrubs	10	0	16	1	27
GX	163	5	390	74	632
GH	--	--	--	--	0
Grass-herbs	163	5	390	74	632

Table 11 (cont). Number of locations of all radio-collared does within each timber stratum

Timber type	Aerial signal	Aerial visual	Ground triang.	Ground visual	Total
	Type of location				
NB	--	--	--	--	0
NF	--	--	1	--	1
NT	--	--	--	--	0
Non-veg	0	0	1	0	1
Total	455	6	924	150	1535

Timber strata locations for Doe 325 are presented separately.

Table 12. Number of locations of Doe 226 within each timber stratum and location type

	Type of location				
Timber strata	Aerial signal	Aerial visual	Ground triang.	Ground visual	Total
P2P	1	--	--	--	1
P3P	3	--	1	1	5
P4P	--	--	1	--	1
D2P	1	--	--	--	1
C4P	12	--	25	7	44
HM4P	5	--	10	1	16
HM4G	7	--	9	--	16
SC	1	--	--	--	1
GX	6	--	10	7	23
Total	36	0	56	16	108

Table 13. Number of locations of Doe 236 within each timber stratum and location type

Timber strata	Type of location: Aerial signal	Aerial visual	Ground triang.	Ground visual	Total
M3S	1	--	--	--	1
M4P	2	--	3	1	6
M6G	7	--	5	--	12
P3P	--	--	1	--	1
P4P	2	--	10	1	13
D3G	1	--	--	--	1
C2P	1	--	6	--	7
C4P	1	--	4	--	5
HM4P	9	--	15	4	28
HM4G	3	--	10	--	13
HS2G	1	--	--	--	1
SH	--	--	1	--	1
GX	6	--	14	6	26
Total	34	0	69	12	115

Table 14. Number of locations of Doe 246 within each timber stratum and location type

	Type of location				
Timber strata	Aerial signal	Aerial visual	Ground triang.	Ground visual	Total
C4P	--	--	1	--	1
HM4P	2	--	5	3	10
HM4G	12	--	10	--	22
SC	--	--	2	--	2
SH	--	--	1	1	2
GX	4	--	16	1	21
Total	18	0	35	5	58

Table 15. Number of locations of Doe 256 within each timber stratum and location type

Timber strata	Type of location: Aerial signal	Aerial visual	Ground triang.	Ground visual	Total
C4P	1	--	1	--	2
HM4P	--	--	2	--	2
HM4G	6	--	3	1	10
SH	--	--	2	--	2
GX	2	--	12	1	15
Total	9	0	20	2	31

Table 16. Number of locations of Doe 276 within each timber stratum and location type

Timber strata	Type of location: Aerial signal	Aerial visual	Ground triang.	Ground visual	Total
M4P	--	1	1	1	3
D4G	1	--	3	1	5
C4P	6	--	12	--	18
HM4P	14	--	27	3	44
HM4G	3	--	7	1	11
GX	10	1	29	4	44
Total	34	2	79	10	125

Table 17. Number of locations of Doe 285 within each timber stratum and type of location

Timber strata	Type of location: Aerial signal	Aerial visual	Ground triang.	Ground visual	Total
M1P	--	--	1	--	1
M3P	3	--	--	1	4
M3G	--	--	1	--	1
M4S	3	--	2	--	5
M4P	4	--	1	1	6
M4G	1	--	3	--	4
M6G	1	--	2	--	3
P3P	1	--	--	--	1
P4P	--	--	4	--	4
W3S	--	--	2	--	2
W3P	1	--	1	--	2
W3G	--	--	2	--	2
W4G	--	--	1	--	1
C2P	--	--	1	--	1
C4P	2	--	10	--	12
HM4P	11	--	15	2	28
HM4G	--	--	1	--	1
SH	3	--	1	--	4
GX	5	2	11	5	23
Total	35	2	59	9	105

Table 18. Number of locations of Doe 306 within each timber stratum and location type

Timber strata	Type of location: Aerial signal	Aerial visual	Ground triang.	Ground visual	Total
M3S	--	--	4	1	5
M3P	1	--	4	2	7
M3G	3	--	3	--	6
M4P	6	--	6	1	13
M4G	--	--	2	--	2
M6G	--	--	1	1	2
P1P	4	--	4	--	8
P3P	3	--	2	2	7
P4P	1	--	2	--	3
W3G	--	--	1	--	1
C2P	--	--	3	--	3
C4P	2	--	4	--	6
HB4P	1	--	--	1	2
HB4G	--	--	2	--	2
HM4P	2	--	5	--	7
SH	1	--	--	--	1
GX	4	--	9	3	16
Total	28	0	52	11	91

Table 19. Number of locations of Doe 316 within each timber stratum and location type

Timber strata	Type of location: Aerial signal	Aerial visual	Ground triang.	Ground visual	Total
M1P	1	--	--	--	1
M3S	--	--	1	--	1
M3P	3	--	4	1	8
M4P	--	--	4	--	4
M4G	4	--	4	--	8
D4G	--	--	1	--	1
W3G	2	--	1	--	3
C2P	1	--	2	--	3
C4P	--	--	2	--	2
HB4P	1	--	1	1	3
HM4P	2	--	3	1	6
HM4G	1	--	3	1	5
HS2P	1	--	--	1	2
SA	--	--	2	--	2
SH	1	--	4	--	5
GX	6	--	10	4	20
Total	23	0	42	9	74

Table 20. Number of locations of Doe 336 within each timber stratum and location type

Timber strata	Type of location: Aerial signal	Aerial visual	Ground triang.	Ground visual	Total
M3G	--	--	1	--	1
D4G	1	--	--	--	1
C4P	1	--	--	--	1
HM4P	10	--	15	--	25
HM4G	5	--	3	1	9
SH	1	--	1	--	2
GX	16	1	58	12	87
Total	34	1	78	13	126

Table 21. Number of locations of Doe 365 within each timber stratum and location type

Timber strata	Type of location: Aerial signal	Aerial visual	Ground triang.	Ground visual	Total
C4P	--	--	1	--	1
HB4G	4	--	6	1	11
HM2P	--	--	1	--	1
HM4P	6	--	16	1	23
HM4G	8	--	16	2	26
GX	15	1	35	3	54
Total	33	1	75	7	116

Table 22. Number of locations of Doe 375 within each timber stratum and location type

Timber strata	Type of location: Aerial signal	Aerial visual	Ground triang.	Ground visual	Total
M3G	--	--	1	--	1
HM4P	8	--	14	2	24
HM4G	2	--	2	2	6
GX	24	--	55	10	89
Total	34	0	72	14	120

Table 23. Number of locations of Doe 405 within each timber stratum and location type

Timber strata	Type of location: Aerial signal	Aerial visual	Ground triang.	Ground visual	Total
M1P	3	--	--	3	6
M4P	2	--	4	1	7
M4G	6	--	13	--	19
M6G	1	--	--	--	1
P3P	--	--	--	1	1
C2P	7	--	20	--	27
C4P	4	--	--	--	4
HM4P	3	--	11	3	17
HM4G	1	--	5	2	8
SH	1	--	1	--	2
GX	6	--	4	3	13
Total	34	0	58	13	105

Table 24. Number of locations of Doe 415 within each timber stratum and location type

Timber strata	Type of location: Aerial signal	Aerial visual	Ground triang.	Ground visual	Total
C4P	1	--	--	--	1
HM4P	1	--	19	3	23
HM4G	5	--	7	1	13
SC	1	--	--	--	1
GX	27	--	50	10	87
Total	35	0	76	14	125

Table 25. Number of locations of Doe 425 within each timber stratum and location type

	Type of location				
Timber strata	Aerial signal	Aerial visual	Ground triang.	Ground visual	Total
M3G	--	--	2	--	2
D4G	1	--	--	--	1
C4P	--	--	1	--	1
HM4P	10	--	35	5	50
HM4G	9	--	10	2	21
GX	14	--	31	3	48
Total	34	0	79	10	123

Table 26. Number of locations of Doe 446 within each timber stratum and location type

Timber strata	Type of location: Aerial signal	Aerial visual	Ground triang.	Ground visual	Total
M4P	1	--	5	1	7
D4G	--	--	3	--	3
C4P	1	--	1	1	3
HM4P	12	--	17	1	30
HM4G	1	--	--	--	1
SM	1	--	1	--	2
GX	18	--	46	2	66
NF	--	--	1	--	1
Total	34	0	74	5	113

strata groupings by Etsel Ridge/Mendocino Pass does (distant Doe 325 was excluded from this analysis) and the area covered by these timber strata groupings (X^2=3113, df=13, P<<0.0001). Each timber strata group was used significantly less than its availability except the mixed hardwoods (HM4P, HM4G) and grasslands (GX); these two groupings were used significantly more than their relative availability (Table 27). In this analysis, "where the expected proportion of usage... does not lie within the interval, we conclude the expected and actual utilization are significantly different" (Byers et al. 1984). When the expected usage is greater than the interval, then utilization is less than availability, and vice versa (Byers et al. 1984). The probable reason for this apparent habitat preference is presented below in "Habitat Conditions."

It could be argued that the capture method (helicopter/ drivenet), which was done in open grassland areas, biased the habitat use data toward those does that frequented grassland areas. However, at least 95 percent of the deer in this study area typically are located in these relatively open, south-facing slopes during the third week of March (the time of capture) (F. Barney, Z. Bauer, J. W. Booth, pers. comm., pers. obs.). Consequently, the sample of radio-collared does obtained for this study is considered to be a representative sample in regard to habitat use.

Willow "stringers" were common along many ravine bottoms, especially in the grassland areas. These riparian areas were heavily used by deer for fawning areas, hiding cover, thermal

Table 27. Simultaneous confidence intervals using the Bonferroni approach for utilization of timber strata groupings

Timber strata groupings	Expected proportion of usage	Actual proportion of usage	Bonferroni intervals for Pi	Apparent selection behavior ($\alpha<0.05$)
Mixed conifers	0.25278	0.09576	$0.07398 < P_1 < 0.11754$	Avoidance
Ponderosa pines	0.07672	0.02932	$0.01683 < P_2 < 0.04181$	Avoidance
Douglas firs	0.03284	0.00847	$0.00169 < P_3 < 0.01525$	Avoidance
Red firs	0.04926	0	$0 < P_4 < 0$	Avoidance
White firs	0.05198	0.00717	$0.00092 < P_5 < 0.01342$	Avoidance
Knobcone pines	0.00124	0	$0 < P_6 < 0$	Avoidance
Conifer-hardwoods	0.15157	0.0925	$0.07105 < P_7 < 0.11395$	Avoidance
Black oaks	0.03024	0	$0 < P_8 < 0$	Avoidance
Mixed hardwoods	0.10400	0.32313	$0.28851 < P_9 < 0.35775$	Preference
Blue oak-savannah	0.00642	0.00195	$-0.00131 < P_{10} < 0.00522$	Avoidance
Plantation	0.00170	0	$0 < P_{11} < 0$	Avoidance
Shrubs	0.14445	0.01759	$0.00786 < P_{12} < 0.02732$	Avoidance
Grass-herbs	0.08870	0.41173	$0.37530 < P_{13} < 0.44816$	Preference
Non-veg	0.00799	0.00065	$-0.0012 < P_{14} < 0.00254$	Avoidance
Total	0.99989	0.98827	------	------

cover, and as a source of food (Loft et al. 1984, pers. obs.). Doe 375 and her 1987 fawn were situated within willow stringers during the day during all four visuals or close triangulations (within 100 m) of them during the first 1-1/2 weeks of the fawn's life, and Doe 415 apparently fawned within a willow stringer in 1987. The USFS timber strata maps do not delineate riparian areas. The distribution of these areas could be approximated for grassland areas from aerial photos, but mapping the riparian stringers present under forest canopies would require hiking down each ravine in the study area.

The four collared does that remained year-round in Upper Haynes Creek Valley showed very significant individual differences in their use of willow and mixed hardwood habitats (X^2=12.57, df=3, $0.010 < P < 0.005$) (Table 28). From visual observations of undisturbed does, Does 375 and 415 used willows more than mixed hardwoods, Doe 336 used mixed hardwoods more than willows, and Doe 425 apparently showed no preference for either habitat.

The habitat utilizations and movements relative to elevation (Table 8) of all three Movement Category II does and two of the three Movement Category III does were similar to those of Columbian black-tailed does studied by Loft et al. (1984): "Little change in elevation was observed as the does moved from dry south slope, annual-type winter range areas to fawning habitats in meadow-riparian types [like Doe 306] and in dense timber stands [like Does 236, 285, 316, and 405]." Only three

Table 28. A comparison of individual deer use of willows along ravine bottoms and mixed hardwoods by the four year-round collared does of Upper Haynes Creek[1]

	Number of observations				
Vegetation	Doe 336	Doe 375	Doe 415	Doe 425	Total
Willows[2]	1	9	6	5	21
HM4P, HM4G	9	2	2	4	17
Total	10	11	8	9	38

[1] Based upon observations of undisturbed does

[2] Included within GX timber stratum

does (285, 306 and 325) fawned in areas that were at least 150 m (range 150-450 m, 500-1500 ft) higher in elevation than the upper levels of their ranges during the rest of the year.

The habitat uses of Doe 325 (Table 29) are tabulated separately from those of the other collared does because this doe's summer and winter ranges are at least 17.5 and 22.5 km (10.9 and 14 miles), respectively, from home ranges of any of the other does. During the infrequent locations of her, she was situated in mixed conifer timber strata on Pony Ridge (her fawning area) and chaparral on Lower Thomes Creek (her winter range). More than 83 percent (15 of 18) of the locations of Doe 325 were aerial signal locations, so the habitat utilization of this doe is known somewhat approximately (White and Garrott 1986).

Fawning behavior and fawning habitat of radiocollared does

Initiation and peak of fawning

The fawning periods in the study area during 1986 and 1987 began on about 8 June and 13 June, respectively. The peaks of the fawning periods during these 2 years, based on scores of fawn sightings, were approximately a 2- to 3-week period centered on 21 June 1986 and a 2-week period centered on 19 June 1987. These peaks of the fawning periods are similar to the 3-week period centered on 22 June reported for California mule deer (*O. h. californicus*) of the North Kings River in Fresno County (Salwasser and Holl 1979) and the 4-week period centered on 30

Table 29. Number of locations of Doe 325 within each timber stratum and location type

Timber strata	Type of location: Aerial signal	Aerial visual	Ground triang.	Ground visual	Total
Summer range (accurate data)					
M3S	2	--	1	1	4
M3P	3	--	1	--	4
M3G	2	--	--	--	2
M4S	1	--	--	--	1
W3G	1	--	--	--	1
Enroute to winter range (approximate datum)					
P4P	1	--	--	--	1
Winter range (approximate data)					
C4P	1	--	--	--	1
SA	2	--	--	--	2
SM	2	--	--	--	2
Total	15	0	2	1	18

June (Loft et al. 1984) for Columbian black-tails in Trinity County.

Assuming a 203-day gestation period (Anderson 1981), these dates would estimate the peak of the rutting season to be centered on 8 and 13 December. These estimates are similar to the 9 December rutting season reported for two herds of Columbian black-tails in Trinity County (Kie et al. 1984).

Aggresiveness by parturient does

Parturient does fight-off both their young of previous years and other does as an intraspecific defense of their fawning territories (Taber and Dasmann 1958, Ozoga et al. 1982). I observed apparently pregnant does behave very aggressively toward year-old fawns on three occasions. These does were not acting in "usual" aggressive behavior as would be expected in day-to-day living, where aggressive acts seem to be in response to specific circumstances (Livezey 1979). These were "overly" aggressive acts, where each doe went out of her way to aggress toward the fawns.

In the first instance (on 21 June 1986), a doe chased the yearling accompanying her for at least 20 m into a stand of white oaks. A second doe (on 26 June 1986) displayed a "head low" and a "double forefoot kick" (Livezey 1979) to top of the withers of a female yearling. The third doe (on 6 July 1986), while travelling with another doe and two female yearlings, chased a yearling while displaying a "head low" five times; one chase included a forefoot kick without contact.

Analysis of specific fawning areas

A presentation of some physical and vegetative characteristics concerning specific fawning areas will be given in the subsequent report to be done during Fall 1988. A fawning area is defined as "the home range, including the drop site, of a fawn during the first 2 months of life" (Siperek 1983). Welker (1984) found no difference between random occurrence and observed occurrences of slope, aspect, shrub species, and percent of canopy cover, litter, bare ground, or rock in fawning areas or locations in which young fawns were located.

Consistency of use of fawning areas year after year

The 12 collared does that lived through the 1986 and 1987 fawning seasons showed a marked consistency in utilization of specific fawning area year after year. As mentioned in "Methods," more detailed observations of collared does' fawning areas were done in 1987 than in 1986. All five does whose fawning areas were known within 150 m in both years (Does 226, 236, 276, 306, 405) spent their 1987 fawning seasons 100-300 m from their 1986 areas. One of these (Doe 306) was located several times during both fawning seasons within an area about 30 m in diameter. The distance between the 1986 and 1987 fawning areas of all seven of the other does was probably less than 400 m, judging from an examination of the more general nature of these 1986 triangulations and the more specific locations of 1987 fawning areas. More exact observations of 1986 fawning areas would probably have shown much more consistent use of fawning areas between years for these seven does.

The 1988 fawning locations of the radio-collared does will be determined by a CDFG Seasonal Aide. The results of his work will be presented in a supplementary report.

Consistency of use of fawning areas throughout the year

All Movement Category I does used their specific fawning areas throughout much of 1987. During the late summer and fall, I visually located Does 276, 336, 365, 375, and 415 5-20 m from the specific locations where I had observed their young, usually hiding fawns months earlier. Does 226, 425, and 446 were observed later in the season within the specific locations in which I suspected they fawned in 1987. Such continual use of a small area is probably a function of the small home ranges of these does.

Post-fawning movements

Five does (Does 276, 336, 365, 375, 425) fawned in relatively open country in the Etsel Ridge area in 1987. All of these does moved to areas of more dense vegetation about 0.5-1.0 km (0.3-0.6 mile) from their fawning areas when their fawns were 3-4 weeks old. Three of these does returned to their fawning areas after about 2 weeks.

There are several possible motivations for these movements. The does may have been seeking cover from the sun; however, maximum daytime temperatures during this time ranged only in the high 70's (F), and most of the does returned to their fawning areas about 2 weeks later when temperatures reached the high 80's. Water was available throughout these fawning areas, so these movements did not appear to be water-related. Hiding cover obviously would be greater in these areas; such hiding cover could lessen disturbances and danger by predators and people. Possibly, fawning areas in these areas bordered one another, and it was to each doe's benefit to find the best place to fawn within her territory. Neighboring does that occupied more desirable areas may have limited movement of other does into their areas during their own times of fawning (Riley and Dood 1984). The does from less desirable areas would be more able to travel with their fawns after the fawns reached 3 weeks of age. The increased competition between does during the 2 weeks the transients were in their neighbor's fawning areas may have been more than compensated for, as far as the transients were concerned, by the greater hiding cover. The does may have moved back to their fawning areas when their fawns were 5-6 weeks old because the fawns were then better able to avoid predators and people, and the greater hiding cover was then not so crucial to their survival.

Fawn production

The reproductive rate of does in this study's sample, considering only eartagged fawns and observations of fawns of radiocollared does, was 1.29 (31 fawns/24 doe-fawn groups) (Table 4). This estimated reproductive rate is probably much lower than the true rate, since the rate was determined merely by fawn observations, rather than examination of uteri.

Kie et al. (1984) stated:

> Reproductive rates for Trinity County deer [1.39 for Weaverville, 1.5 for Hayfork] are similar to those for other black-tailed deer herds in northern California. Fetal rates for mature black-tailed does from Glenn, Tehama, and Siskiyou counties in California ranged from 1.54 to 1.73 embryos per doe (Bischoff 1958). In Lake County, 1.45 fawns per mature doe were produced in good quality, mixed-shrubland habitat, but only 0.71 fawns per mature doe were produced in dense, chamise chaparral habitat (Taber and Dasmann 1958). The lower mean fetal rates among Weaverville deer in this study may indicate poorer range condition.

Siperek (1983) found an embryo rate of 1.81 for black-tailed does in Thomes Creek.

Fawn mortality

The known mortality of eartagged fawns and known fawns of radio-collared does less than 2 months old was only 3% (1 of 31) (Table 4). The only fawn assumed to have died before 2 months old was one of Doe 336's 1987 twin fawns, who was not with its doe from at least 18 August onward. The fates of two other fawns (Female Fawn Blue and 276's 1987 fawn) were not determined. Female Fawn Blue probably died within 7 months of birth, but no more accurate determination of death age could be made. Observations of Doe 276's fawn after 29 June 1987 were obscured by other does being present in the group. Twenty-eight of these 31 fawns lived at least 2 months to 1 year (mean = 7 mo). It could not be determined exactly how much longer these fawns lived. Positive identification of a radio-collared doe's untagged fawn necessitated that the doe was unaccompanied by another doe, or that the doe and fawn behaved in a manner strongly indicating their relationship. Identifications were obscured by the tendency of deer to group together during fall and winter.

A higher rate of fawn mortality is probable after examining two other considerations. First, only 80% (24 of 30) of the does in the sample are known to have fawned. However, 94% of the Thomes Creek sample of black-tailed does were carrying embryos (Siperek 1983), and 93-100% of the North Kings River mule deer herd were pregnant (Salwasser et al. 1978). Fawns of six does (1986: Doe 256; 1987: Does 226, 236, 285, 316, 446) were never located; many of these does probably lost their young fawns. Three of these does (Does 236, 285, 446) were without fawns within 2 months of regular fawning times. It is not known whether or not Doe 316 had fawned before she died by 18 June 1987; if she had fawned, it is probable that her offspring was (were) also consumed with her.

The second consideration that indicates a higher rate of fawn mortality is that only 29% (7 of 24) of identified doe-fawn groups were comprised of a doe with twins. Rate of mutiple births is dependent on the health of the mother (Taber and Dasmann 1958) and is not known for this study area, although twinning could occur as frequently as 80-90% of the time (J. W. Booth pers comm.). Consequently, other fawns, the second members of a twin group, probably died before I saw them.

An estimated 13 other fawns (5 more singletons plus 8 more second members of twin groups) may have been born within this sample group and died shortly after birth. Consequently, the estimated mortality of eartagged fawns and fawns of radio-collared does during their first 2 months of life was 32% (14 of 44 eartagged fawns plus known fawns of collared does plus estimated fawns of collared does).

Habitat conditions

Fire suppression impacts

It is well documented that the effects of fire suppression policies during the past 75 years have been deleterious to deer habitat. Siperek (1983) stated:

> Fire history is important in the way in which it has (or has not) shaped the vegetative component of habitat. Traditionally, most of the range naturally burned at fairly short intervals, probably a light ground fire every 10-12 years in the timber and an interse crown fire in the mid-elevation chaparral every 20-35 years. Most of the brush species of this area regenerates primarily by sprouting, indicating an evolutionary adaption to periodic fires. Suppression of all fires began about 1910 and has continued as Federal and State policy.

Wallmo et al. (1981) wrote: "Many of the shrub species are vigorous root-sprouters, and others produce seeds that are responsive to heat scarification and the zone's unique weather conditions for germination and survival." A list of the principal foods of the Tehama, Jawbone, and Lake County deer herds can be found in Urness (1981).

There are several ways in which fire suppression has shown its negative effects on deer browse species within the study area

(M. P. VanDame and B. Smith pers. comm., pers. obs.). First, many stands of Brewer Oak (*Quercus garryana breweri*) and Bitter Cherry (*Prunus emarginata*) have grown so tall that they are largely unavailable to deer; deer merely "highline" the vegetation as high as they can reach. Second, Mountain Whitethorn (*Ceanothus cordulatus*) often grows in clumps so large and thick that most of these shrubs are unavailable. Third, many conifers outcompete these shrubs when fire is excluded. Fourth, it has been shown in other areas (see below) that the nutritive value of these shrubs and, consequently, the deer use of the shrubs decrease within a few years after a fire.

Similar effects of fire suppresssion have been observed throughout much of California's deer habitats. Concerning Columbian black-tails in Thomes Creek, Siperek (1983) wrote:

> Excluding fire from the intermediate range has led to inaccessible stands of decadent chaparral that provide little or no forage value. ...It has probably caused an increase in browsing in conifers... [and] in oak-grassland has favored weedy grasses such as red brome, foxtail and medusa and may have encouraged the spread of noxious weeds such as star thistle.

In neighboring Trinity County, Kie et al. (1982) found:

> Successional stage vegetation created by earlier wildfires is decreasing in value as deer habitat. Browse species present have matured and become decadent, providing less nutritive forage for deer. ...Loss of early successional stage foraging habitat for deer has resulted in deer declines since 1966.

Salwasser et al. (1978), in their study of the North Kings River California mule deer herd, attributed "a maturing trend in plant communities on spring migration and early summer habitats as the ultimate cause of the herd's decline." Holl et al. (1979) found that "a diet dominated by mature browse during the spring migration led to a decline in the energy reserves of the does during the last trimester of gestation" in their study of North Kings River deer.

Booth et al. (1982), in the Mendocino Deer Herd Management Plan, stated:

> Summer range at higher elevations is in poor habitat condition with low productivity... [the] winter and intermediate range brushlands lack age-structure diversity... [and] oak regeneration is lacking and mast crops are sporadic.

The disproportionate use of grassland and mixed hardwoods by radio-collared does in this study may have been due to the condition of the shrubs in the area due to fire exclusion, bringing about the unavailability of the shrubs to deer, the inability of shrubs to compete with conifers, and the nutritional decadence of the shrubs. The deer then depend upon the grasses and forbs of the open areas and the oak leaves, acorns, and mistletoe (Ashcraft 1981) of the mixed hardwoods. The traditional winter range of many of the black-tailed deer in lower Thomes Creek shifted from the chaparral to lower oak-savannah areas during the 1930's in apparent response to this fire suppression scenerio (Siperek 1983, J. M. Siperek pers. comm.).

Nutritive forages may be at least as important to deer health as nutritive shrubs during certain times of the year. Kie et al. (1984), in their report on the food habits of Columbian black-tails in Trinity County, stated:

> We believe that the relatively poor physical condition in Weaverville deer reported by Kie, Burton, and Menke (1984) was correlated with diet. Consumption of large amounts of wedgeleaf ceanothus and small amounts of grasses by Weaverville deer in early winter suggests that they should have been in better condition than Hayfork deer. Most ceanothus species are taken readily by deer in California (Dixon 1934, Leach and Hiehle 1958). Mature grasses, low in digestible nutrients, are not readily used by deer (Nagy, Hakonson, and Knox 1969). However, the concept that deer are browsers rather than grazers by choice has been questioned (Wilson 1969, Gill 1976) and Evans (1976) has suggested that high consumption of wedgeleaf ceanothus by deer may be related to lack of more palatable forages. Furthermore, the volume of vigorously growing, green grasses in the diets of black-tailed deer in the spring has been estimated to be as high as 55% in Tehama County (Leach and Hiehle 1958:171) and 90% in Mendocino County, California (Longhurst et al. 1979:221).
>
> It appeared that Weaverville deer collected on winter ranges were in poorer condition than Hayfork deer (Kie, Burton, and Menke 1984). We found that over one-third of the early winter diet of Hayfork deer consisted on grasses and forbs.

Consequently, increasing shrub health and growth would be expected to increase deer density in areas with vigorous shrub growth, but may not lessen deer use of grassland and mixed hardwoods (T. M. Bertram pers. comm.).

Grazing impacts

A comprehensive summary of current research concerning competition between cattle and mule deer can be found in Bowyer and Bleich (1984):

> Many authors have contended that only slight competition occurred (Stoddart and Rasmussen 1945, Julander 1955, Swank 1958, Skovlin, Edgerton, and Harris 1968), whereas others reported considerable overlap in the diet of these herbivores (Dixon 1934, Martinsen 1960, Tueller and Monroe 1975). Overlap in

forage preference may be unimportant on lightly-stocked cattle ranges (Leopold et al. 1951, Mackie 1970, Dusek 1975), but heavy cattle grazing has the potential to adversely affect deer populations (Longhurst, Leopold, and Dasman 1952, Mackie 1981).

In their study of southern mule deer (_Odocoileus_ _hemionus_ _fuliginatus_), Bowyer and Bleich (1984) found:

> Deer pellet groups were found significantly more often on ranges without cattle than on ranges with them. Vegetative sampling indicated that total cover of plants was significantly greater in meadows where cattle were absent. The diet of cattle substantially overlapped that of deer.

Loft et al. (1986) investigated the interactions of radio-collared cattle and California mule deer on Sierra summer ranges. They wrote that "meadow-riparian and aspen habitats are heavily used by cattle. Deer also prefer to use these habitats and do so until the vegetation becomes severely degraded." Cattle often displace deer from desired bedsites (Riley and Dood 1984).

Barrett (1982) studied the relative habitat preferences of feral hogs (_Sus_ _scrofa_), Columbian black-tails, and cattle in 17 habitat types. He found: "An association analysis indicated the greatest potential for interspecific competition would be between cattle and deer on foothill ridgetops and between cattle and hogs on irrigated pastures."

There are different degrees of grazing pressure throughout the study area. Cattle are grazed throughout the privately-owned sections of White Hawk Creek Valley. Grazing is insignificant in the areas north of Mendocino Pass (summer ranges of Does 306, 316, and 405), on Cold Creek (summer ranges of Does 236 and 285) and near Sheep Ridge (summer range of Doe 325). Much of the Etsel Ridge portion of the study area is grazed by a permittee (Zola Bauer). The grazing schedule for this North Unit allows grazing for two years and then is "rested" for two years. The two years of this study took place during two grazing years. The 450 head of cattle are usually permitted onto the area during mid May and are taken off by late October. The present system of grazing and resting the area was initiated in 1982 in order to mitigate the negative effects of previous grazing pressures.

> Overgrazing of ridgetops and meadows has been a problem on the [Etsel Ridge] Complex for many years. This overgrazing has continued for two reasons, despite reductions in numbers of permitted livestock. First, ridgetops and meadows are "key forage areas," meaning that the cattle graze them prior to, and heavier than the rest of the allotment. Second, these areas provide only a small percentage of the total grazing capacity, so the cattle are able to over utilize them early in the grazing season, and keep them over utilized throughout the remainder of the season.
>
> The overgrazing has resulted in several adverse impacts on the environment. There is insufficient litter and vegetative ground cover to protect the soil from erosion. Desirable forage species have declined in number and vigor, causing a decrease in forage production. Less rainfall is able to infiltrate into the soil, and so it becomes surface runoff. This runoff results in sheet and gully erosion, decreasing the productivity of the soils, and polluting streams with sediment [USDA 1981].

About 75 percent of the boundary between the North Unit and the Middle Unit to the south is fenced; cattle movement through the rest of the boundary is minimal due to steep topography and dense vegetation. The eastern edge of the North Unit is unfenced; cattle tend to drift eastward out of the unit toward the Black Butte River, rather than into the unit from the east (M. P. VanDame pers. comm.). Due to these incompletely fenced boundaries, the possibility of fence sections being in disrepair, and the tendency of Z. Bauer to occasionally leave gates open (M. P. VanDame pers. comm.), the cattle may drift into the unit at any time of the year. Cattle were not permitted in the North Unit between late October 1986 and mid May 1987. However, cattle were virtually always present in northeastern Hayshed Basin, upper Skunk Lake Creek Valley and/or upper Haynes Creek Valley throughout winter 1986 and spring 1987 (e.g. 21 cows on 10 Dec 1986; 39 cows on 22 Jan 1987; 21 cows on 6 Feb 1987; 31 cows on 11 Feb 1987; 21 cows on 17 Mar 1987).

I walked 4 km (2.4 miles) of the western fenceline from southeast mid Haynes Creek to Skunk Rock on 8 April 1987, and found no breaks in the fenceline large enough to permit cattle movement. During fence construction, allowance was made for deer in four places.

The utilization of grasses in the key areas in the North Unit was calculated to be 60-70% by the end of both seasons, and there was an estimated 1000+ pounds per acre of mulch during the fall of 1986 (M. P. VanDame pers. comm.). A recommended amount of mulch to enhance range condition and soil stability in northern California is 700 pounds per acre (McDougald 1981).

According to T. M. Bertram, USFS Wildlife Biologist for the Mendocino National Forest (pers. comm.), the grazing in the study area, "especially in the wet meadows, is too early, too long, and too intense." During many years, "cattle move up faster than the vegetation can produce what it needs for long-term survival. The grasses are eaten when they are attempting to develop root reserves and before the seed heads mature and drop."

Radio-collared does heavily used grassland areas in Haynes Creek and Skunk Lake Creek valleys (see Habitat Utilization); cattle were in direct competition with these does in these areas.

Cattle commonly displaced deer in willows and wet meadows during the summer in upper Haynes Creek Valley (pers. obs.) and displaced deer from newly growing grass in the winter (B. Smith pers. comm.).

Water availability during late summer and fall

Water was available through late summer and fall, often in small quantities, within all of the home ranges of the radio-collared does.

Mortality and disease

Blood samples

Results of the blood sample analysis are presented in Table 30. A description of the significance of these results, by Dr. David Jessup of the CDFG Wildlife Investigations Laboratory, follows:

> Of the 15 deer sampled, none had evidence of infection with brucellosis, leptospirosis, bluetongue or EHD. Twenty percent had low titers to IBR, 53% had low titers to BVD, 60% had low titers to PI-3, and 47% had low titers to BRSV, all of which are common viruses of domestic cattle. The mean whole blood selenium level was 122 ppm and appears to be quite adequate.

Table 30. Results of blood samples taken from collared and eartagged deer, March 1986

Deer #	Bovine respiratory syncitial virus	Epizootic hermorhagic disease	Blue tongue virus	Leptospirosis	Brucelosis	Tarainfluenza 3	Selenium	Infect. bovine rhinotraceitus	Bovine viral diarrhea
Doe 226*							0.138		
Doe 276	16	--	--	--	--	16	0.153	--	8
Doe 285	8	--	--	--	--	16	0.094	2	16
Doe 316	8	--	--	--	--	8	0.093	--	16
Doe 336	--	--	--	--	--	16	0.134	--	--
Doe 365	--	--	--	--	--	--	0.079	2	--
Doe 375	16	--	--	--	--	8	0.087	2	32
Doe 405	--	--	--	--	--	16	0.130	--	8
Doe 415	8	--	--	--	--	8	0.149	--	8
Doe 425	8	--	--	--	--	16	0.125	--	8
Doe 446	8	--	--	--	--	8	0.143	--	8
M Tag 258							0.148		
F Tag 259							0.134		
M Tag 269							0.110		

* Selenium levels only were determined for Doe 226, Male Tags 258 and 269, and Female Tag 259

In summary, of the infectious diseases for which we test, the most pathogenic do not appear to be important to the Covelo deer herd. Several livestock viruses which may or may not affect deer are quite prevalent. Is there close contact with cattle? We are not able to evaluate parasite levels or nutritional state with the samples submitted.

Radio-collared does

Five radio-collared does died during the course of this study (Table 31). Three does were apparently consumed by coyotes, one probably died from bluetongue infection (D. A. Jessup pers. comm.), and one was shot during the 1987 buck-hunting season. The remains of coyote-killed does consisted of only a few bones, some hair, the radio-collar and, in one case, the eartag. Coyote tracks and droppings indicated the predators' presence.

Eartagged fawns and fawns of collared does

Mortality of eartagged fawns and known fawns of radio-collared does is presented in "Fawn mortality" above.

Eartagged bucks

Two of the three yearling bucks eartagged as 9-month old fawns were shot during the 1987 buck-hunting season (Table 31).

Time budget data

I collected a total of 3,886 bits of time budget data on study area deer during six days between 11 April and 14 May 1986. These data were gathered on male and female fawns, male and female yearlings, two bucks, and many does. Four collared does

Table 31. Mortalities of radio-collared does and eartagged deer

Doe	Fawns eartagged on 18Mar86		Date found	Probable date of death	Location	Cause of death
	Sex	Metal no.				
256			1Oct87	29-30Sep87	NE Hayshed Basin	Bluetongue virus
246			20Feb87	13-16Feb87	NE Hayshed Basin	Consumed by coyotes
316			18Jun87	14-16Jun87	East of Lake Ridge	Consumed by coyotes
306			8Oct87	7Oct87	Recer Ridge	Illegal kill
415			26Mar88	22-24Mar88	Mid Haynes Valley	Consumed by coyotes
	M	8792	late Sept87	late Sept87	Poison Rock	Legal kill
	M	8786	3Oct87	3Oct87	Skunk Rock	Legal kill

(Does 236, 246, 256, 365) and two eartagged male fawns (Tags 258, 269) were included.

Collection of further time budget data was suspended because other facets of the study took priority. The sample taken is not large enough to overcome the biases inherent is such data-gathering (Livezey 1979, Jacobsen and Wiggins 1982), and so the results will not be presented here.

MANAGEMENT IMPLICATIONS

Antenna modifications and accuracy tests

Enclosing the two-element, hand-held Yagi antenna within PVC tubing (Livezey in press) lessens equipment costs and down times due to damaged antennas and minimizes the chance of injury caused by the ends of the elements.

Movements

An analysis of the range of movements by radio-collared does in this study would be beneficial in determination of CDFG hunting zone boundaries and in coordination between USFS districts.

It is recommended that many smaller roads be closed and off-the-road travel be prohibited during the hunting season to lessen doe mortalities, disturbance of deer family groups, and "construction" of new roads by use.

Habitat management

The heavy use of mixed hardwood areas and grasslands by radio-collared does shows the importance of maintaining these areas for deer use and also indicates the need to improve the shrubland resource.

Wallmo et al. (1981) outlined the methods used to maintain favorable deer habitat in chaparral:

> Methods used purposefully to achieve this state have been reviewed by Cable (1975). Primarily, they

> include prescribed burning, mechanical destruction of brush (by cabling, chaining, railing, flailing, mowing, root-plowing, or bulldozing), and chemical control with foliar or soil-applied herbicides. ...Initial treatment commonly is followed by seeding with nonnative grasses and legumes to increase forage supplies and enhance watershed stabilization.

A detailed description of recommendations for prescribed burning methodologies designed to benefit deer habitat can be found in Siperek (1983); topics addressed include habitat diversity, size of burns, site selection, vegetation selection, seasonal timing of burns, and rotation periods. Scrivner et al. (1988) stated, in their analysis of mineral concentrations of Columbian black-tailed deer diets in chaparral: "To improve forage quality in mixed-age chaparral managers can implement range improvement practices, such as prescribed burning and chemical and mechanical brush control."

Other procedures that are effective in enhancing deer habitat include top-cutting Brewer Oaks (M. P. VanDame pers. comm.) and top-cutting or removing conifers such as White Fir that competete with the shrubs (J. W. Booth pers. comm.).

During April and May 1986, USFS and CDFG employees broadcast-burned and planted approximately 120 ha (300 acres) on lower White Hawk Ridge with Harding grass, rose clover, sub clover, and perennial ryegrass. The growth of these grasses by April 1988 is considered to be "fair to good" (W. M. Garland pers. comm.). Additional type conversions would further benefit deer habitat.

It is recommended that additional safeguards be implemented to ensure that cattle are not permitted onto the high country during the winter. In addition, cattle utilization of wet meadows and riparian stringers must be reduced. If further fencing and exclosures are financially prohibitive, consideration should be given by CDFG to buy the grazing lease in order to keep cattle out of the area completely (J. W. Booth pers. comm.).

Timing of fawning

Knowledge of the timing of fawning is necessary to ensure that activities such as logging and road maintenance do not disturb fawning does.

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APPENDIX

(Figures 3-69)

Figure 2. Legend for radio-collared doe location maps

Map symbol	Location type
○	Aerial signal
⬡	Aerial visual
□	Ground triang-ulation
△	Ground visual

[2] Numbers within symbols present the number of locations of that type at that specific spot

[E] Enroute location between winter and summer ranges

[H] Hunting season displacement out of usual home range

See "Results: Accuracy tests of antennas" for ranges of location errors associated with aerial signals and ground triangulations

Figure 3. Locations of Doe 226

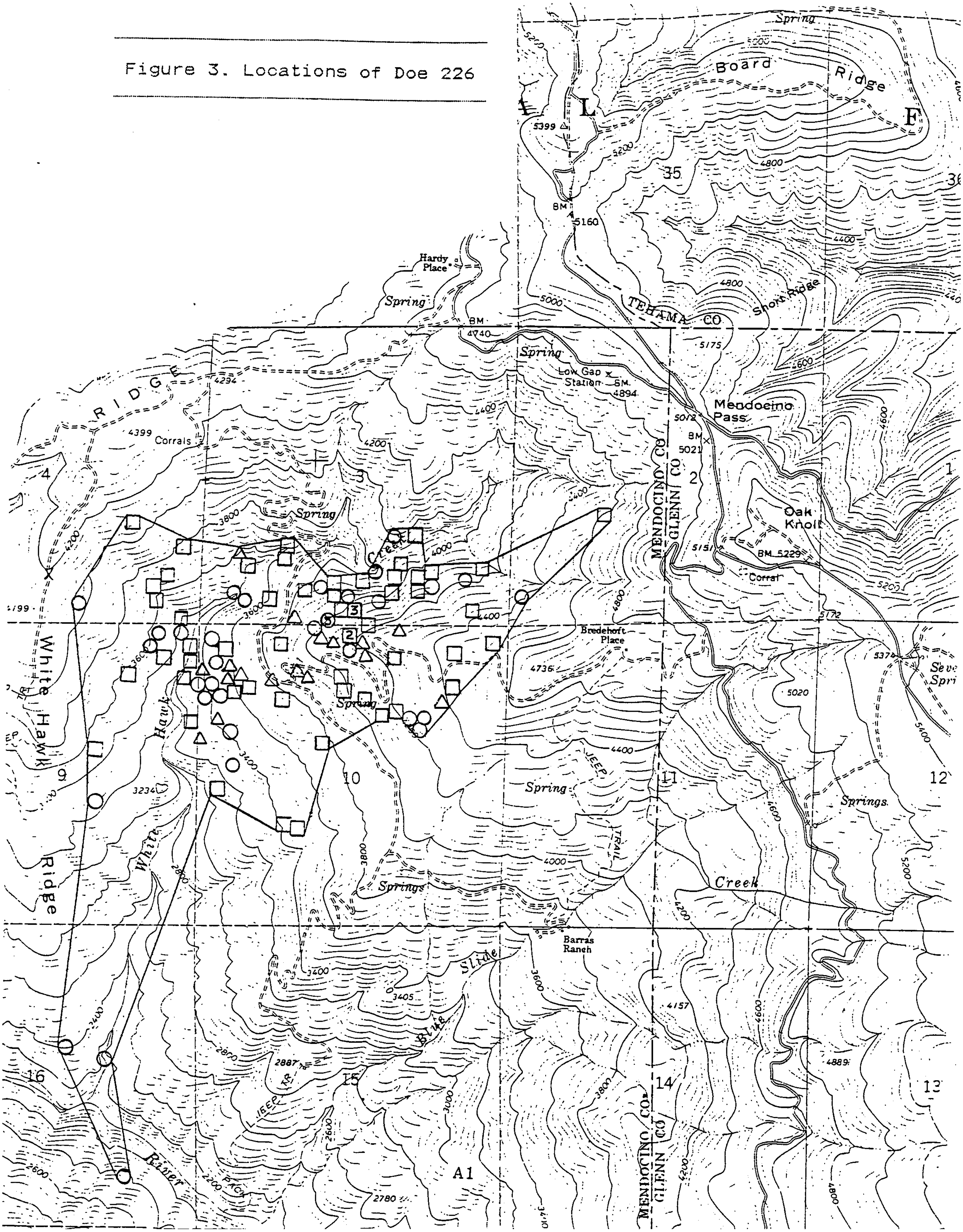


Figure 4. Timber strata use by Doe 226

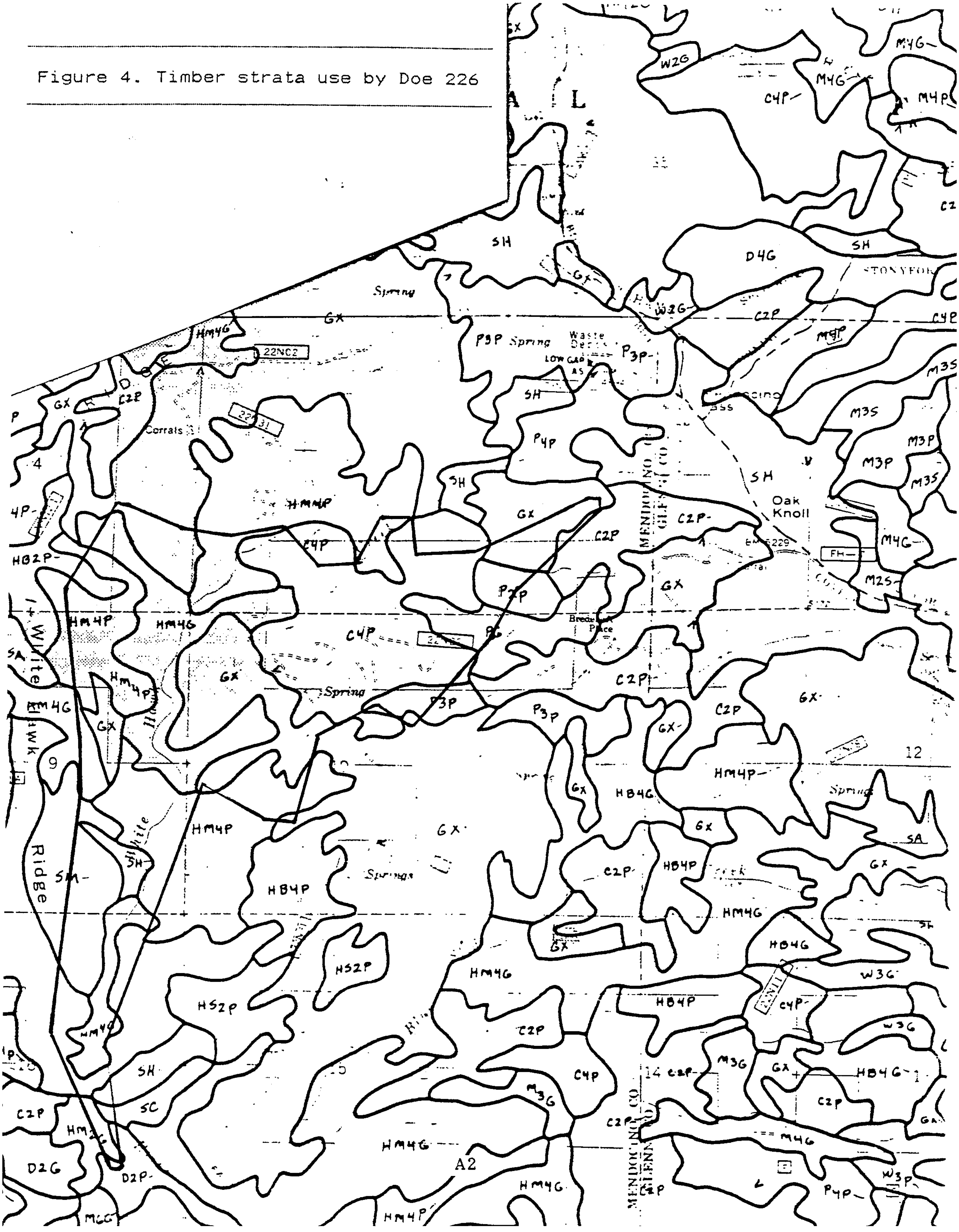


Figure 5. Home range of Doe 236

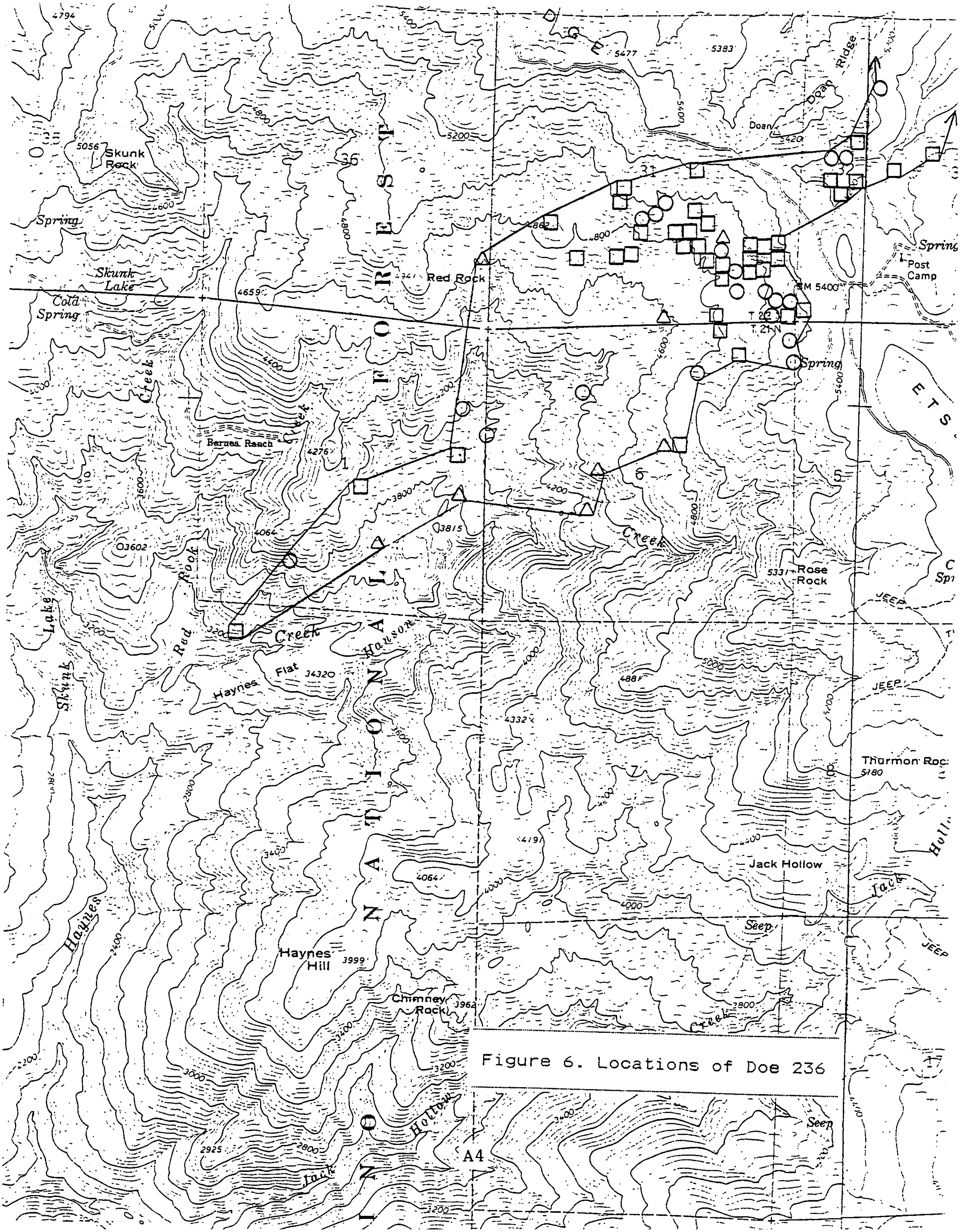


Figure 6. Locations of Doe 236

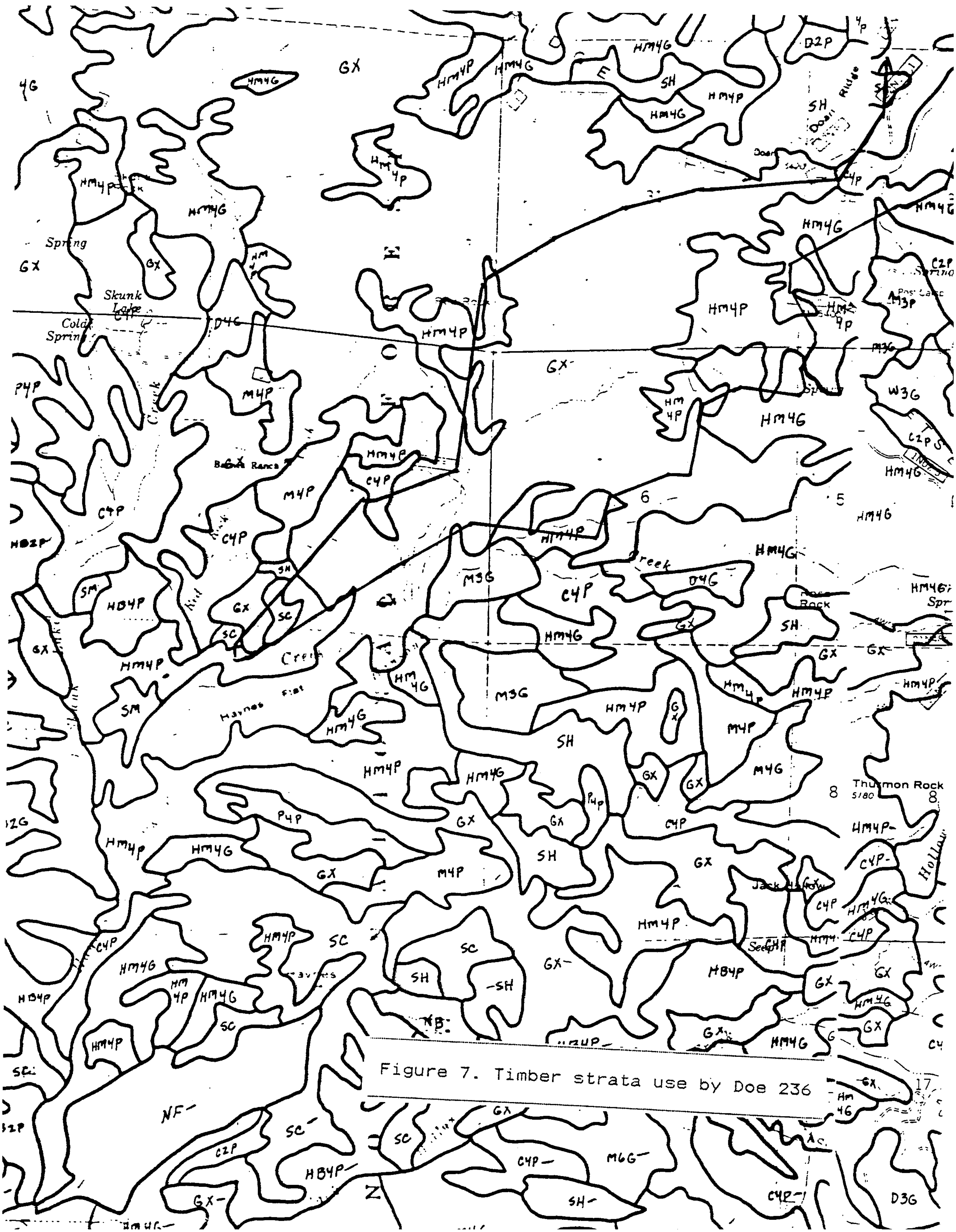


Figure 7. Timber strata use by Doe 236

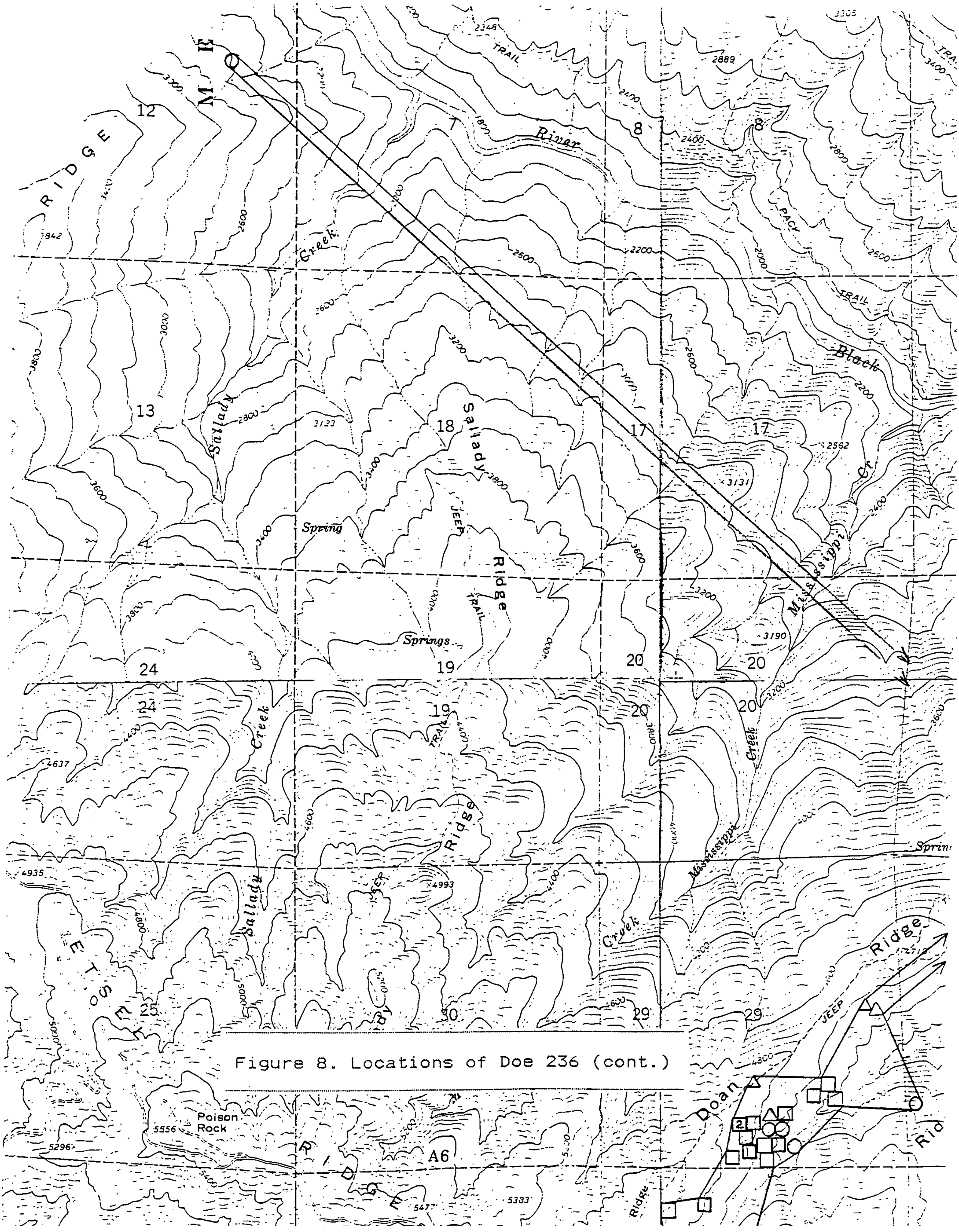


Figure 8. Locations of Doe 236 (cont.)

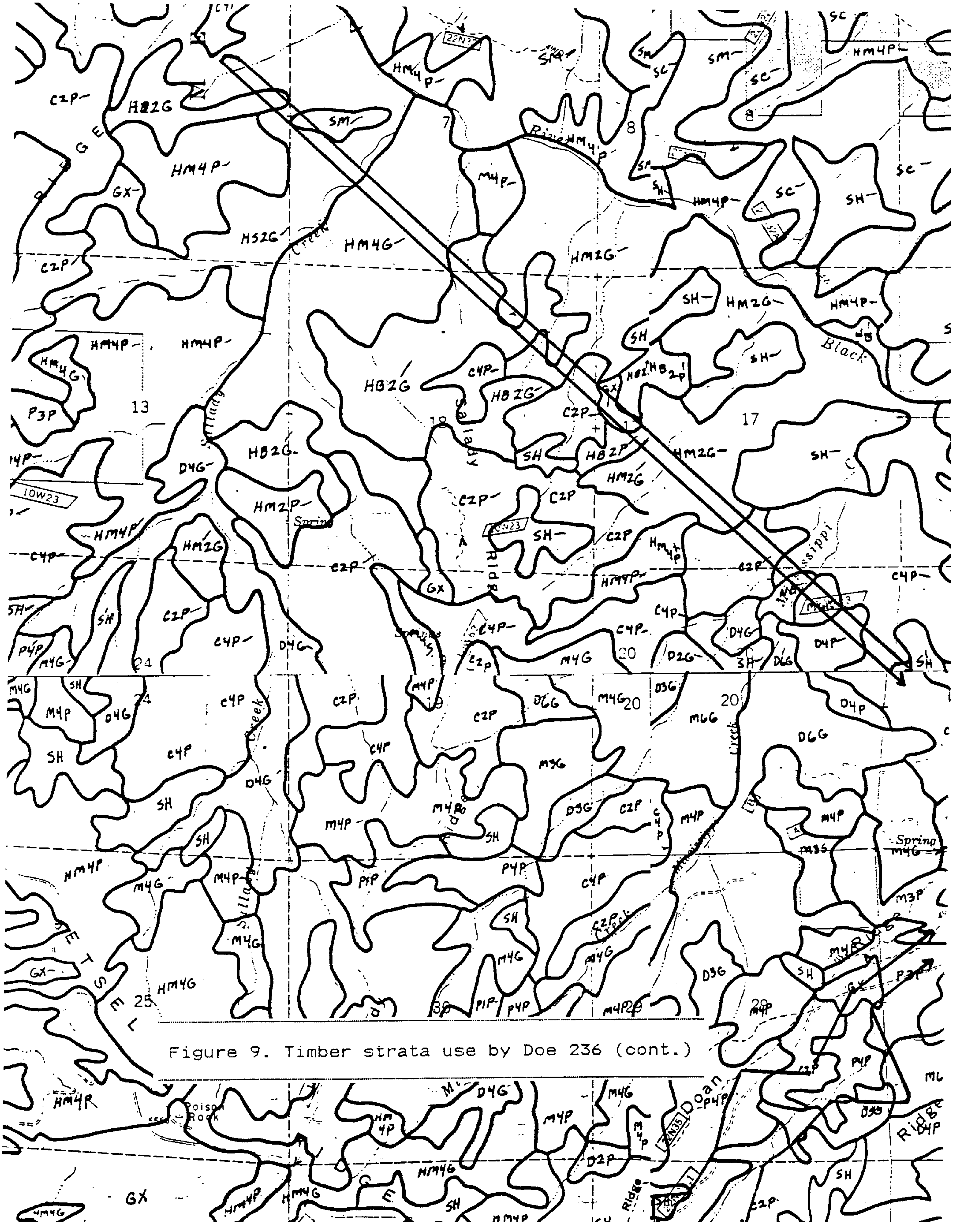


Figure 9. Timber strata use by Doe 236 (cont.)

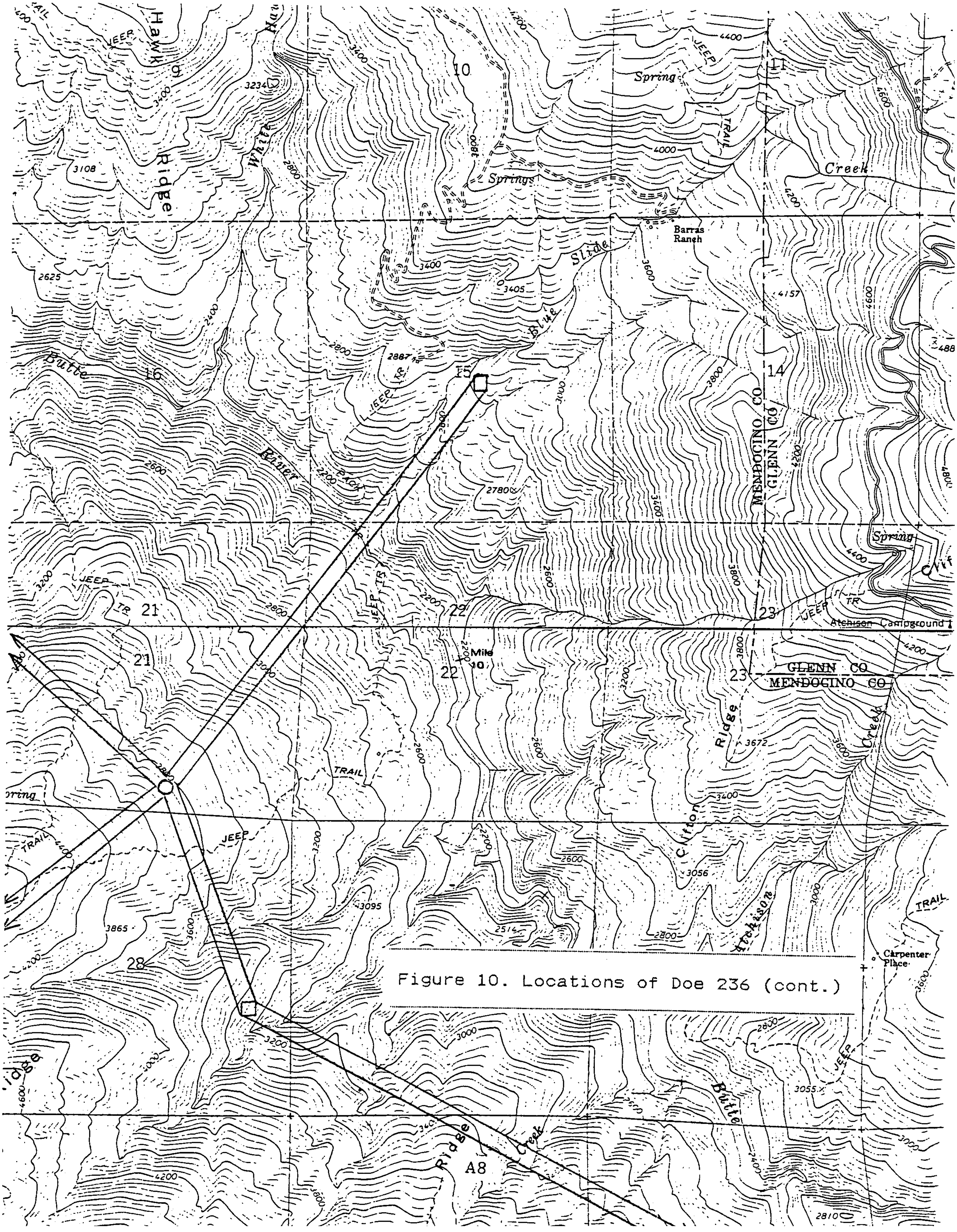


Figure 10. Locations of Doe 236 (cont.)

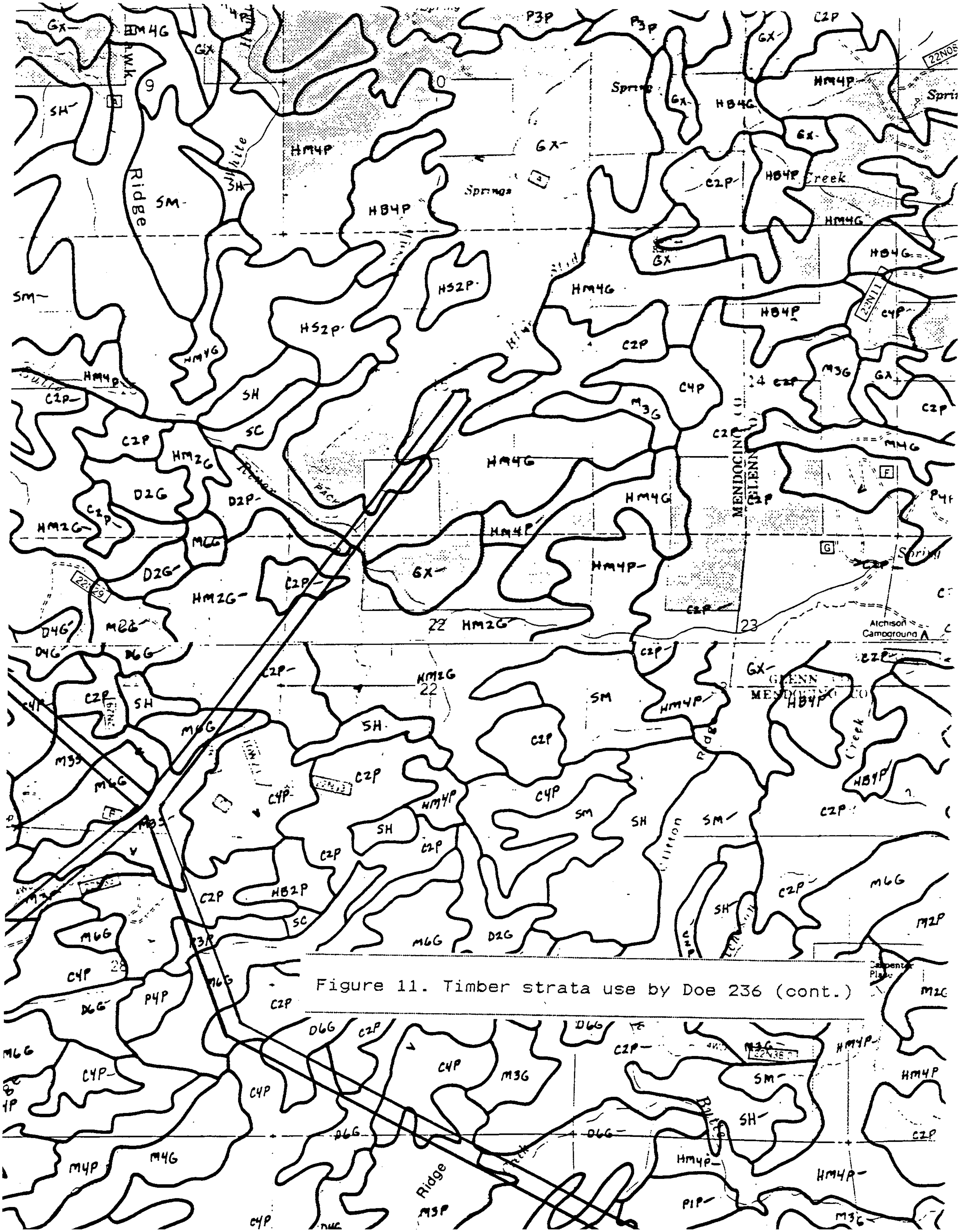


Figure 11. Timber strata use by Doe 236 (cont.)

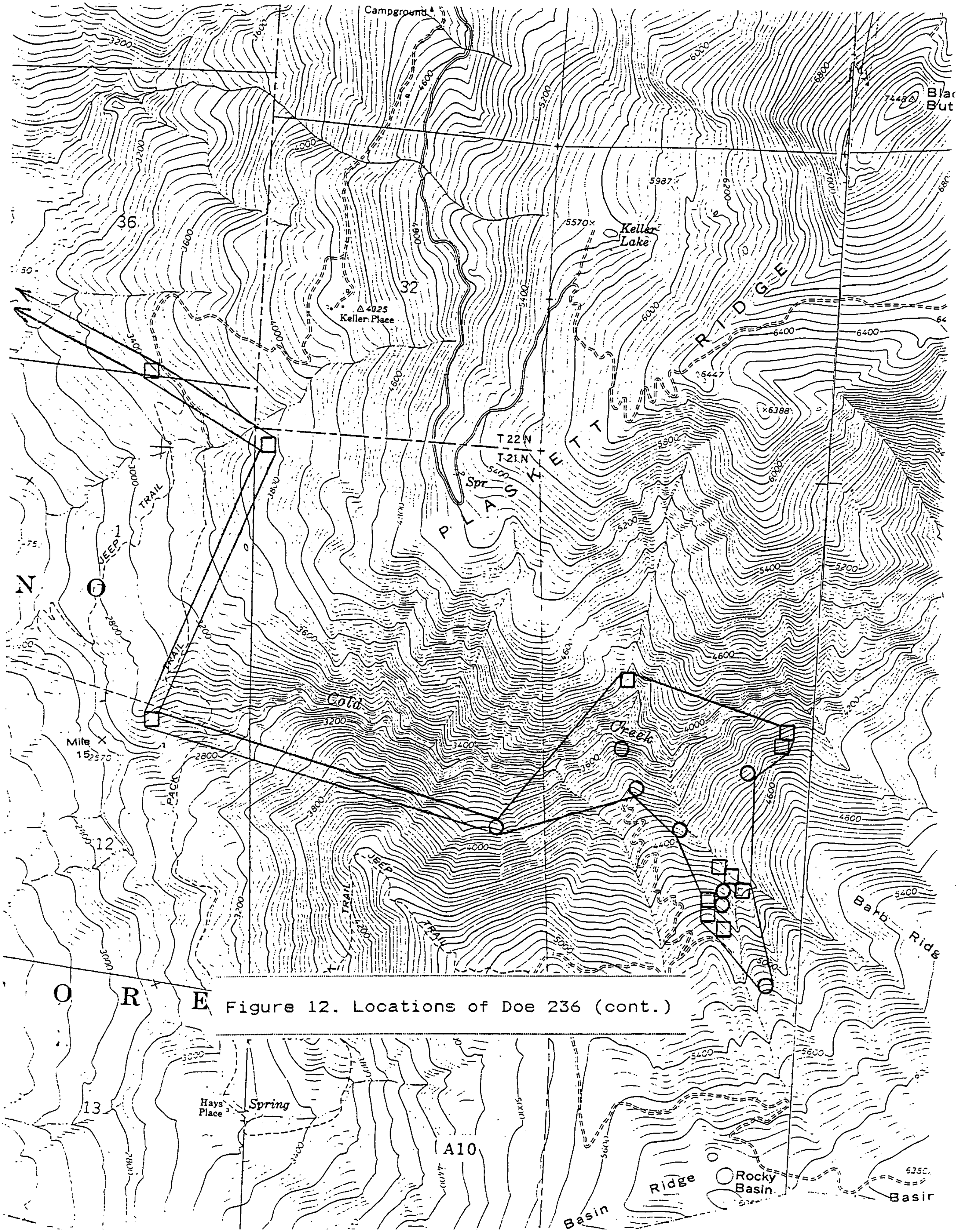


Figure 12. Locations of Doe 236 (cont.)

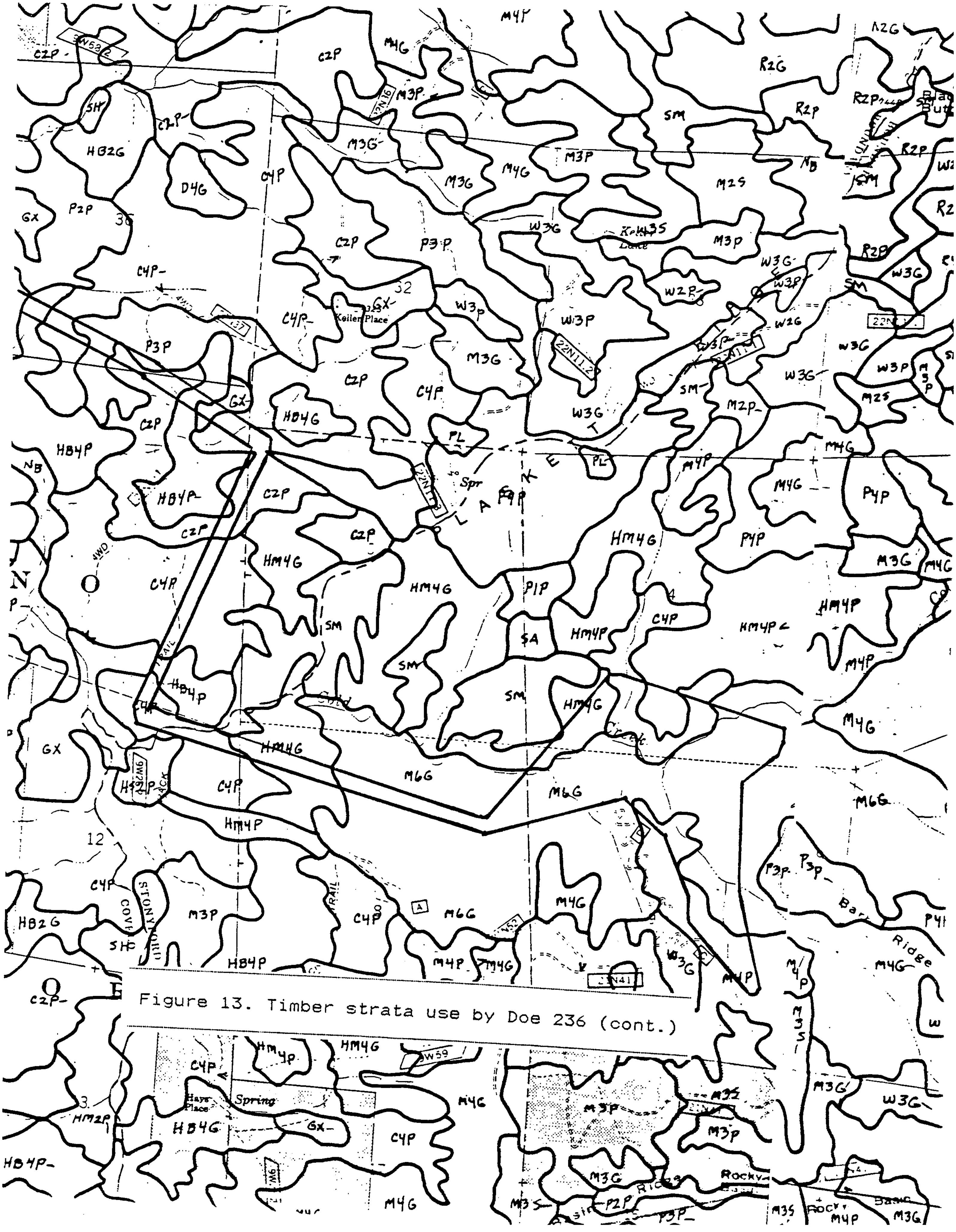
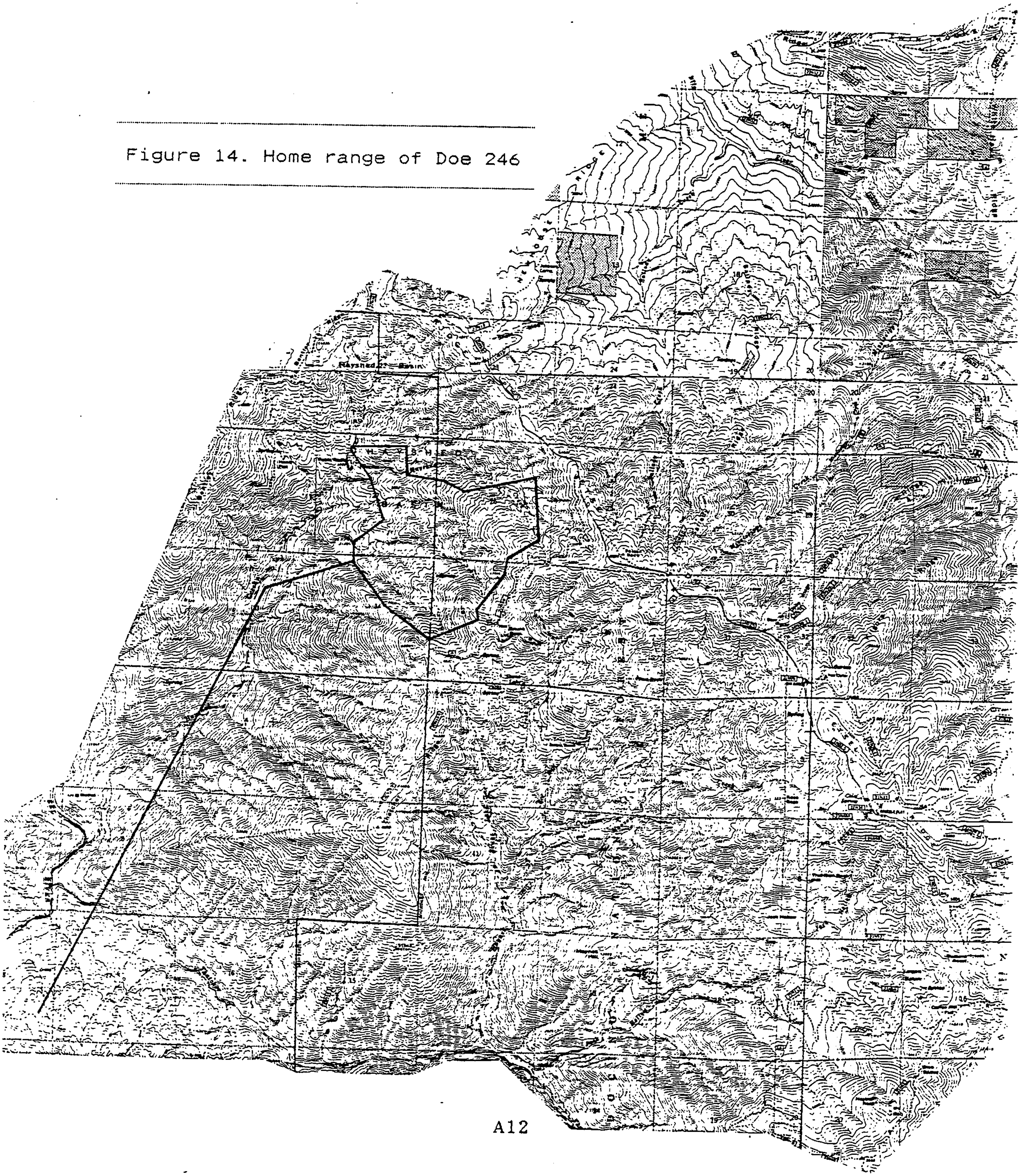


Figure 13. Timber strata use by Doe 236 (cont.)

Figure 14. Home range of Doe 246



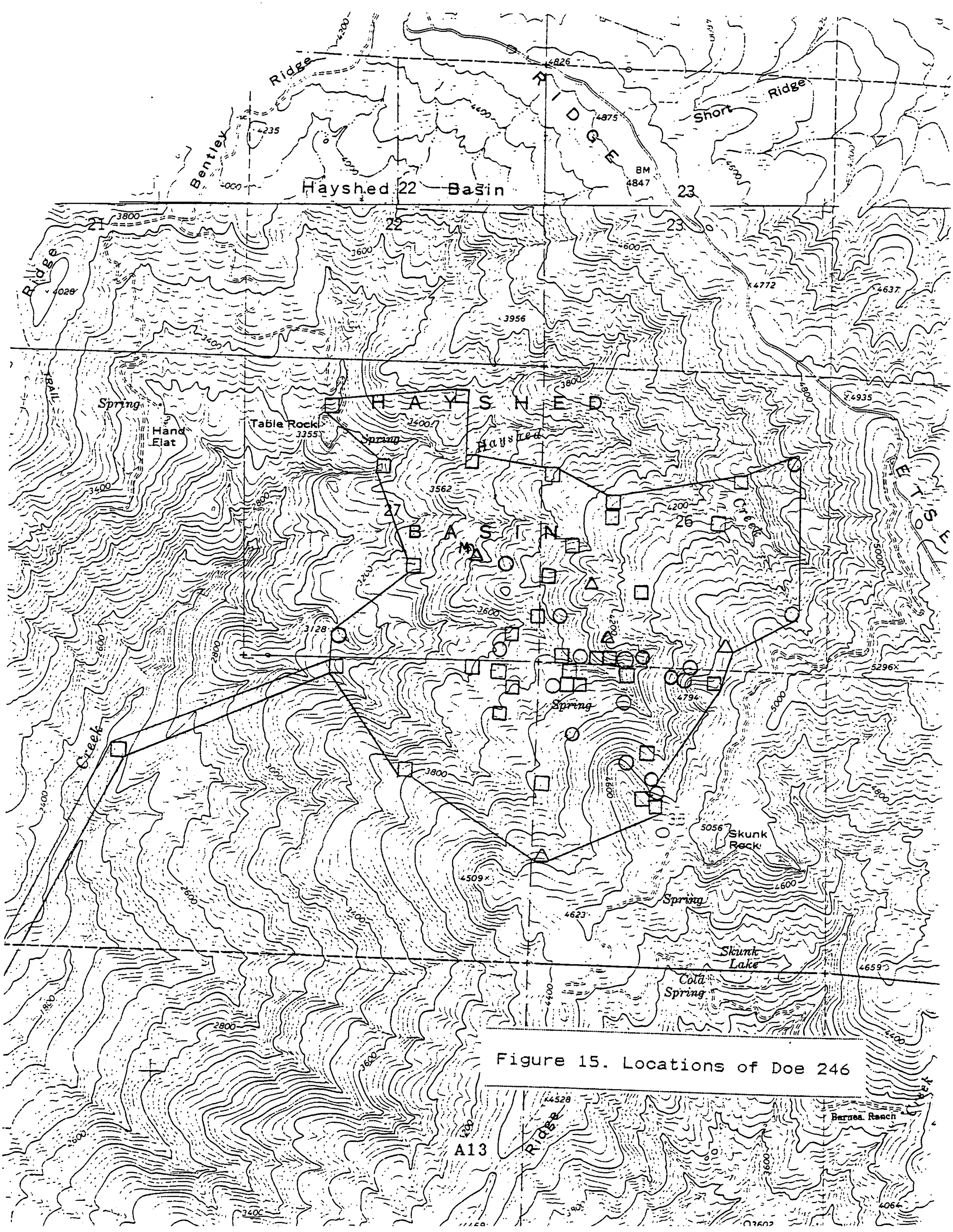


Figure 15. Locations of Doe 246

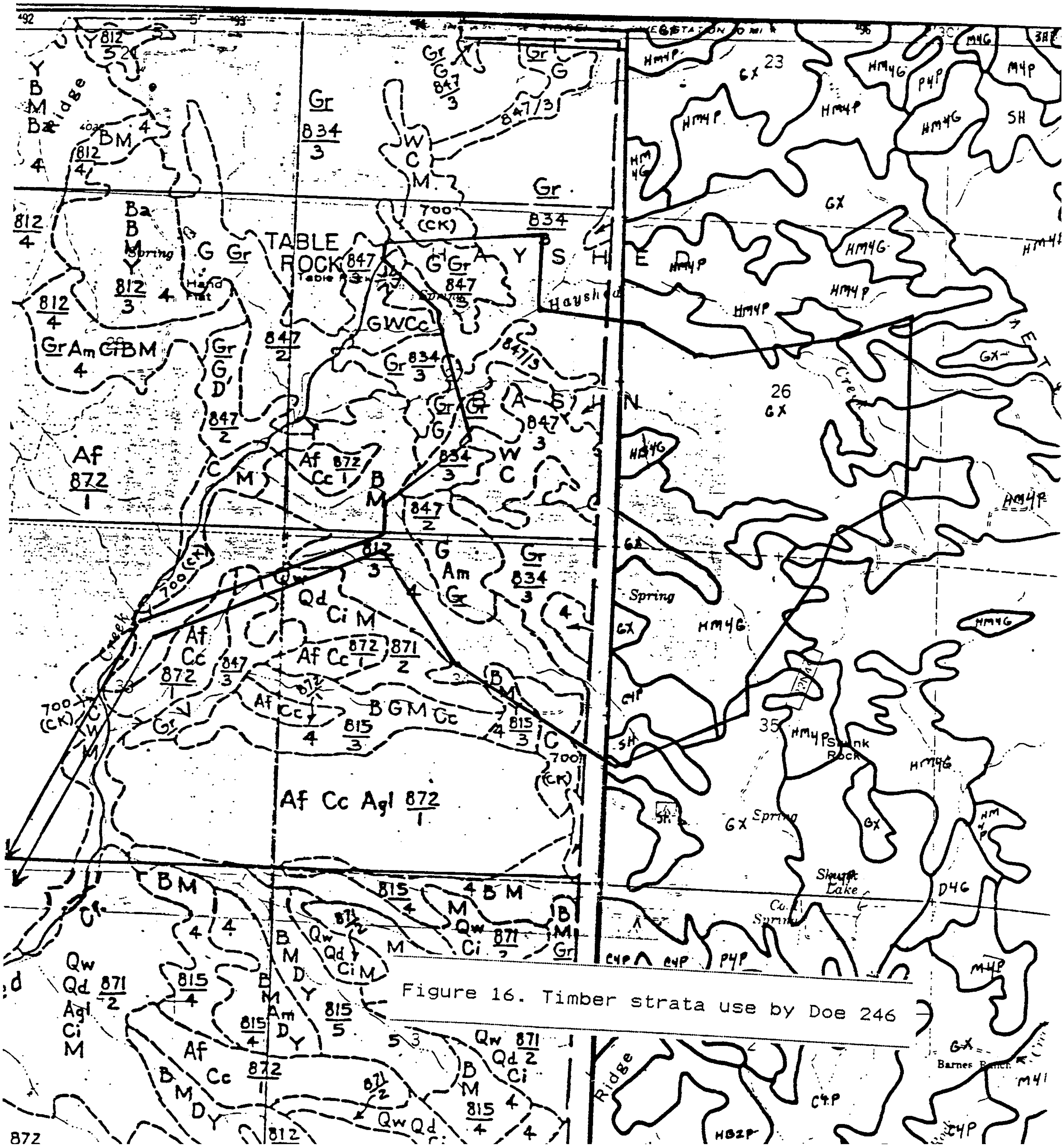


Figure 16. Timber strata use by Doe 246

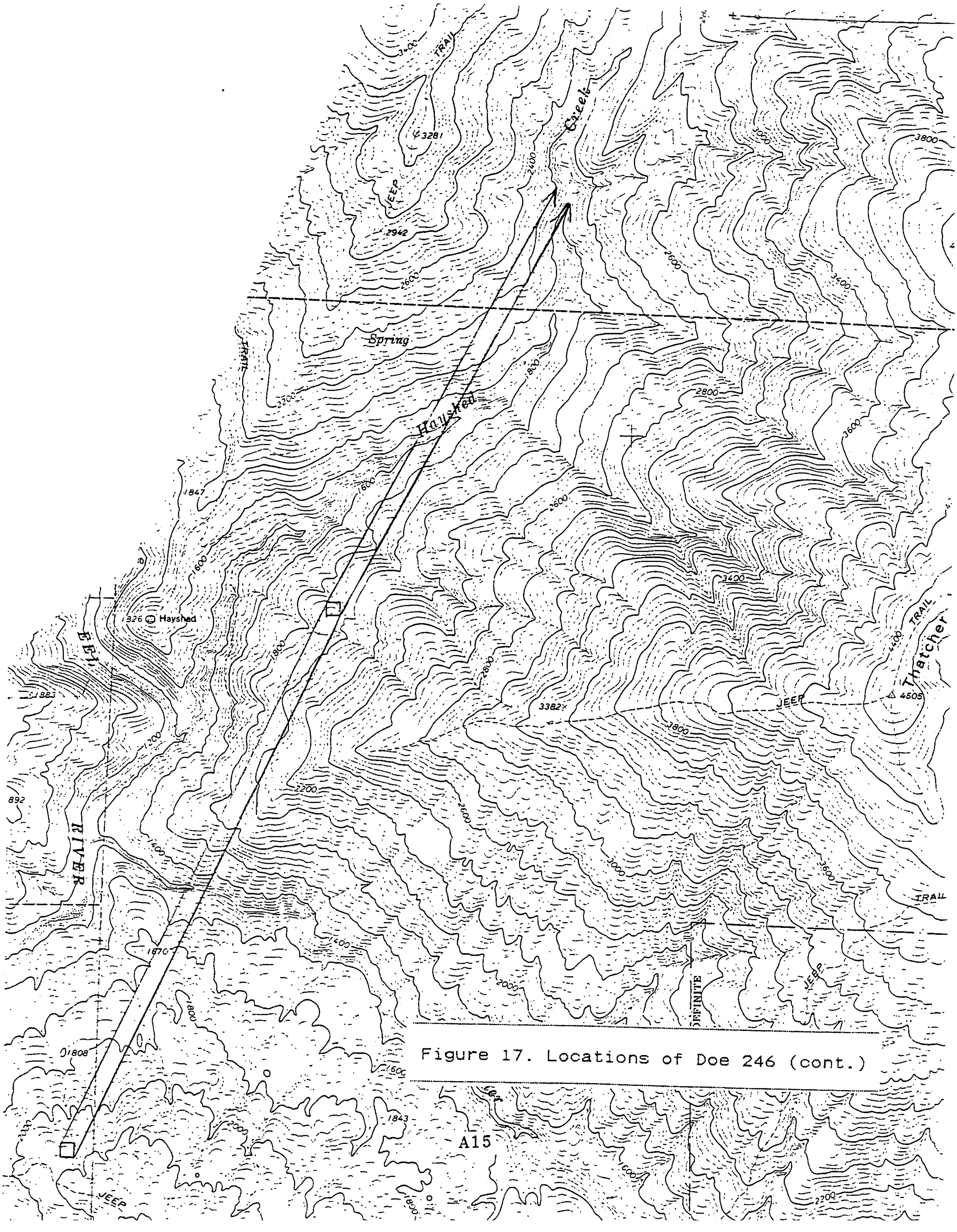


Figure 17. Locations of Doe 246 (cont.)

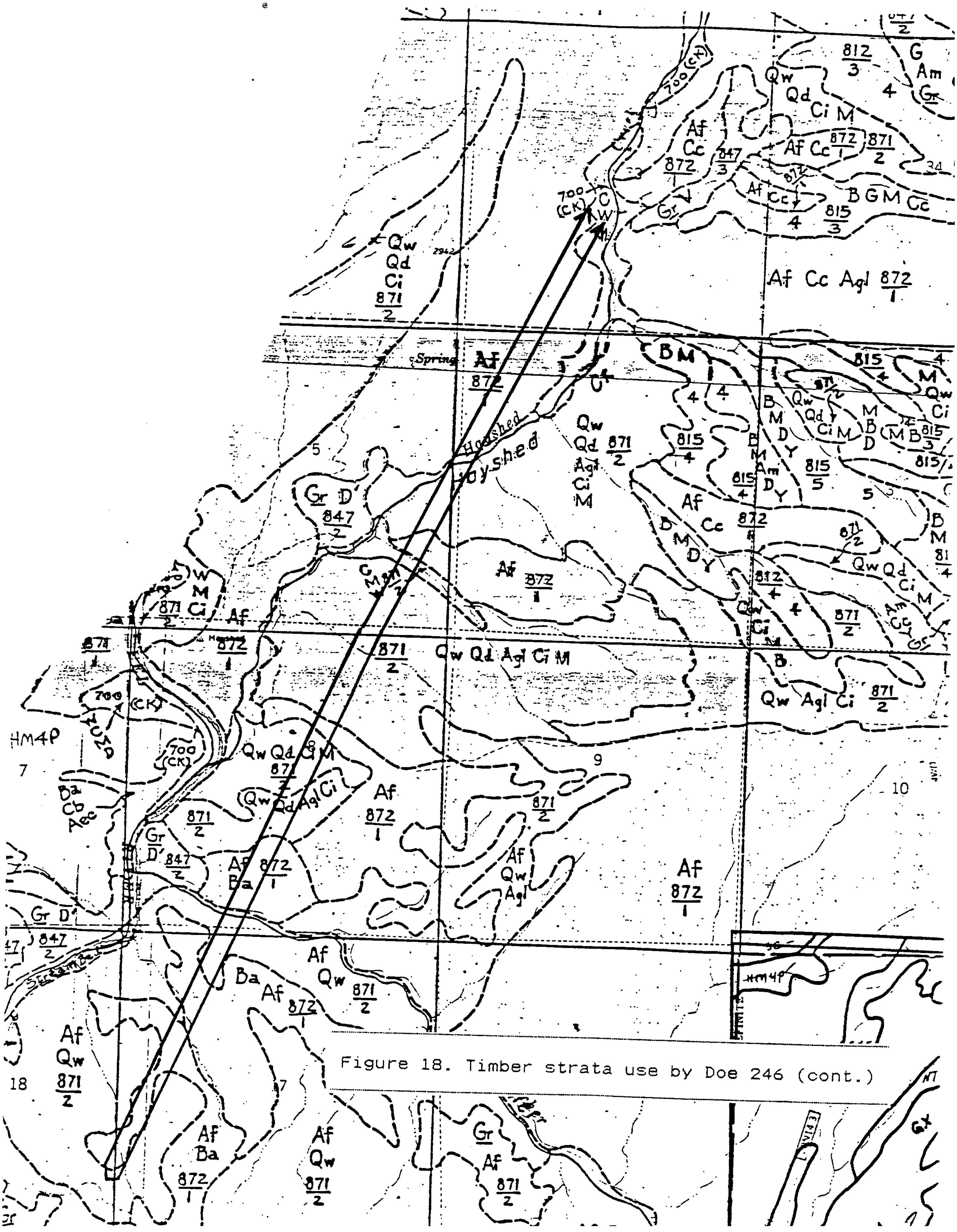


Figure 18. Timber strata use by Doe 246 (cont.)

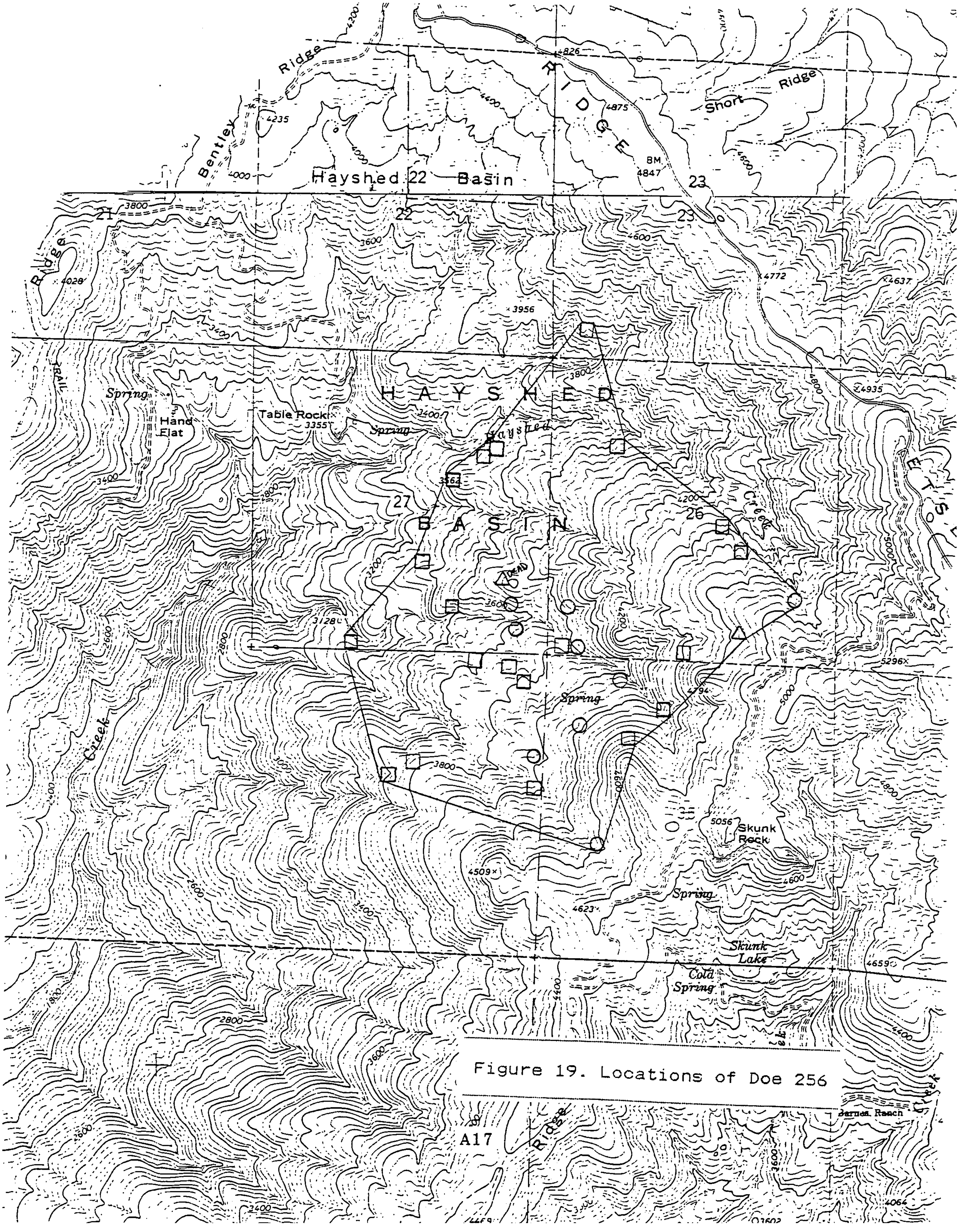


Figure 19. Locations of Doe 256

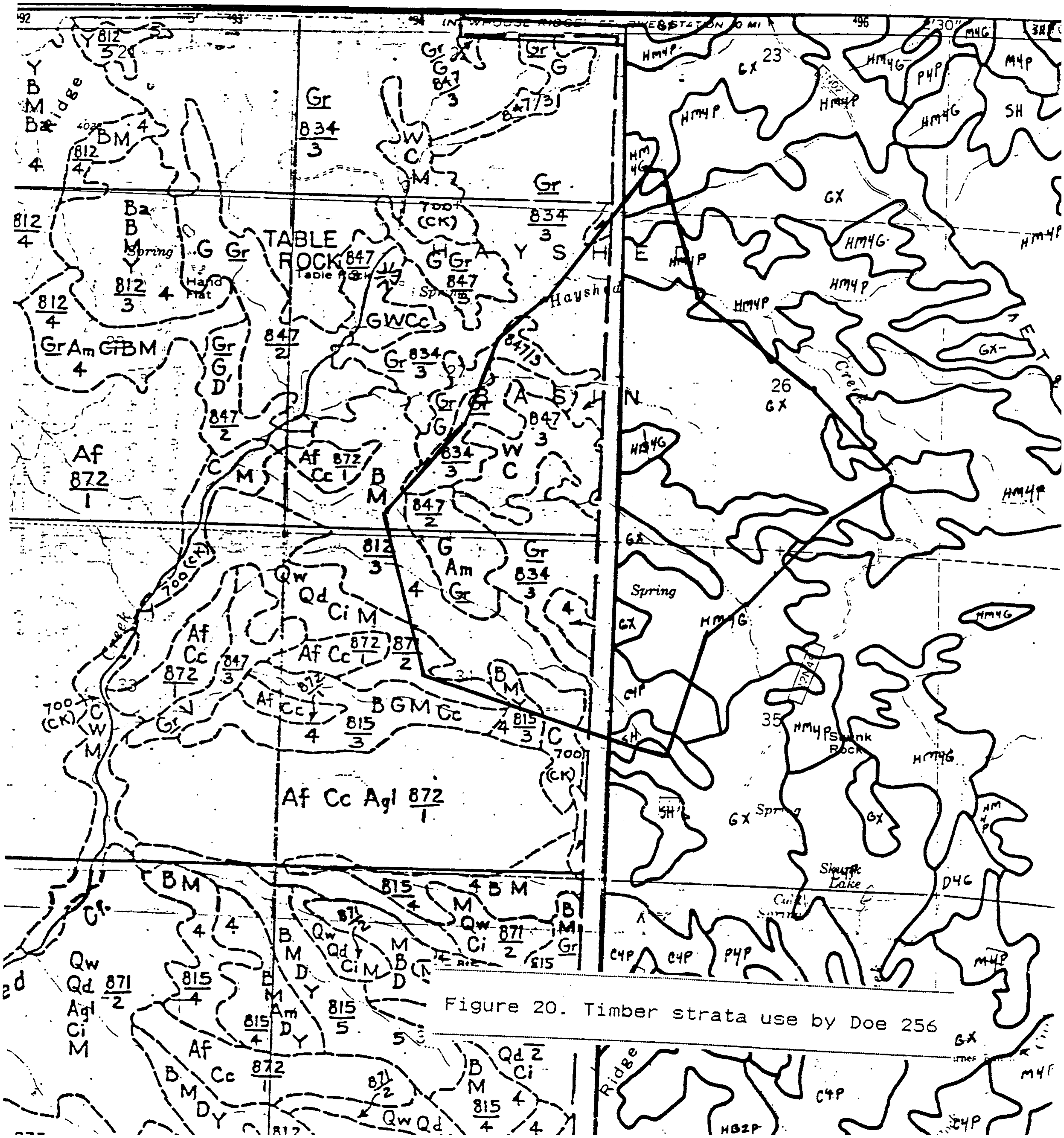


Figure 20. Timber strata use by Doe 256

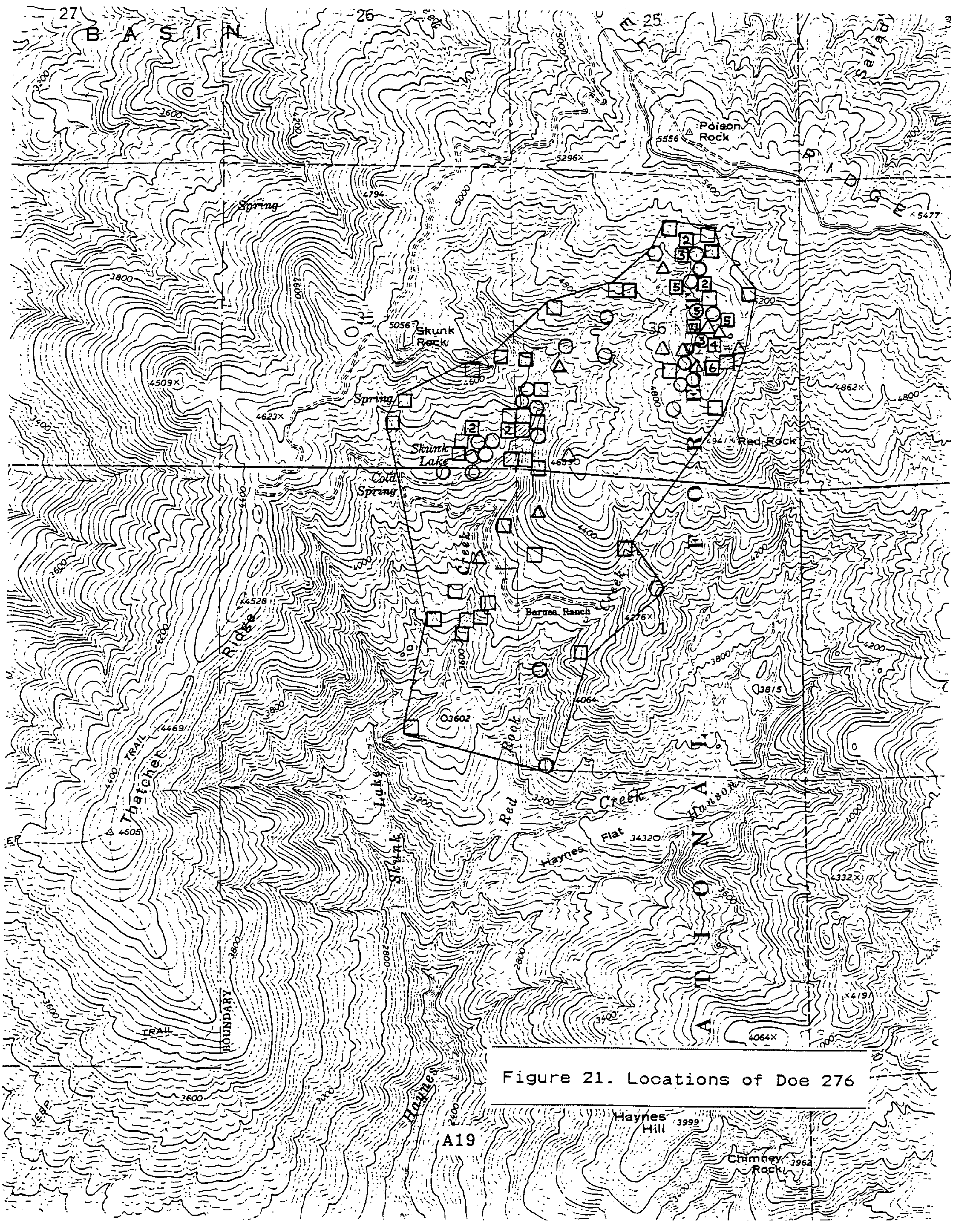


Figure 21. Locations of Doe 276

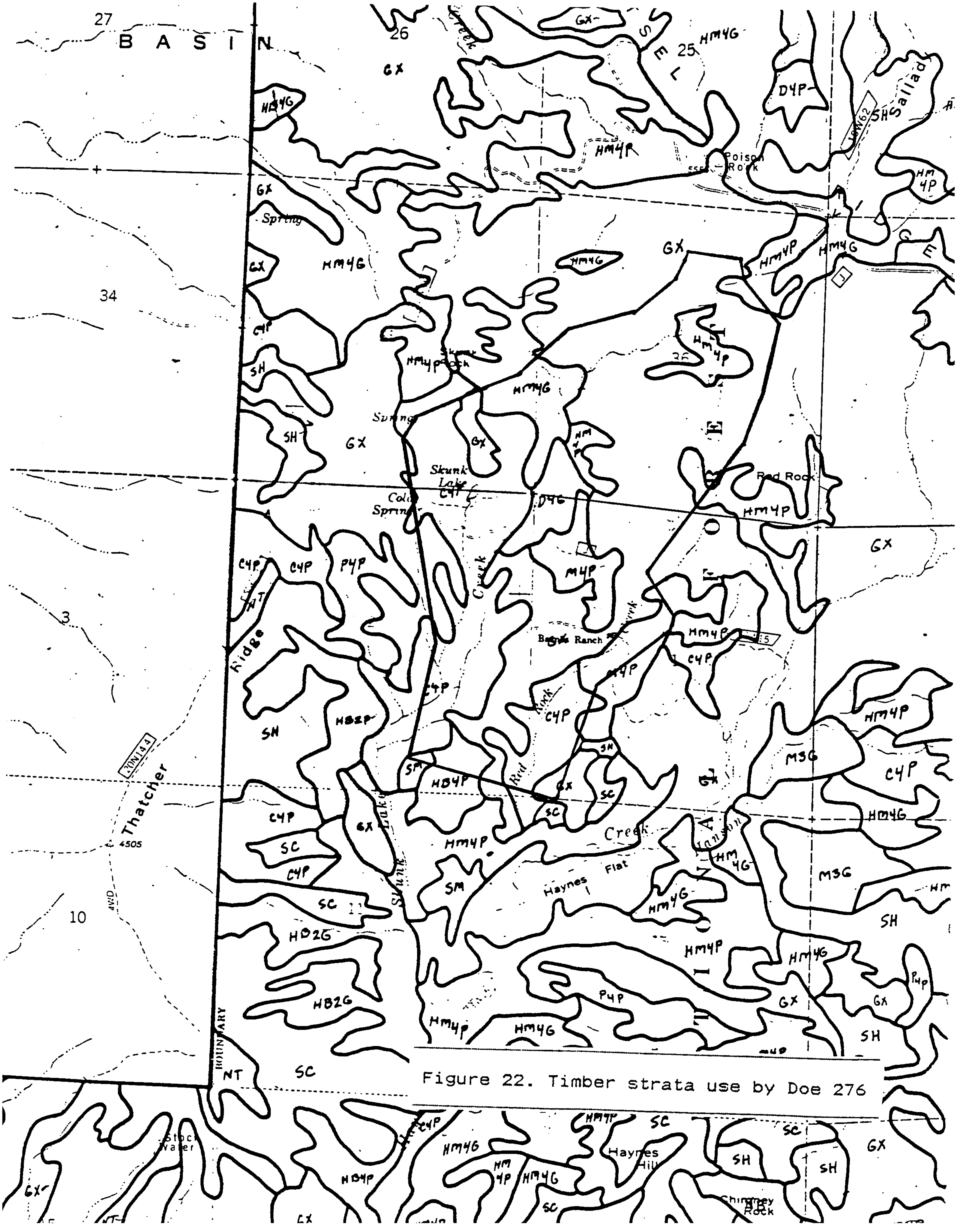


Figure 22. Timber strata use by Doe 276

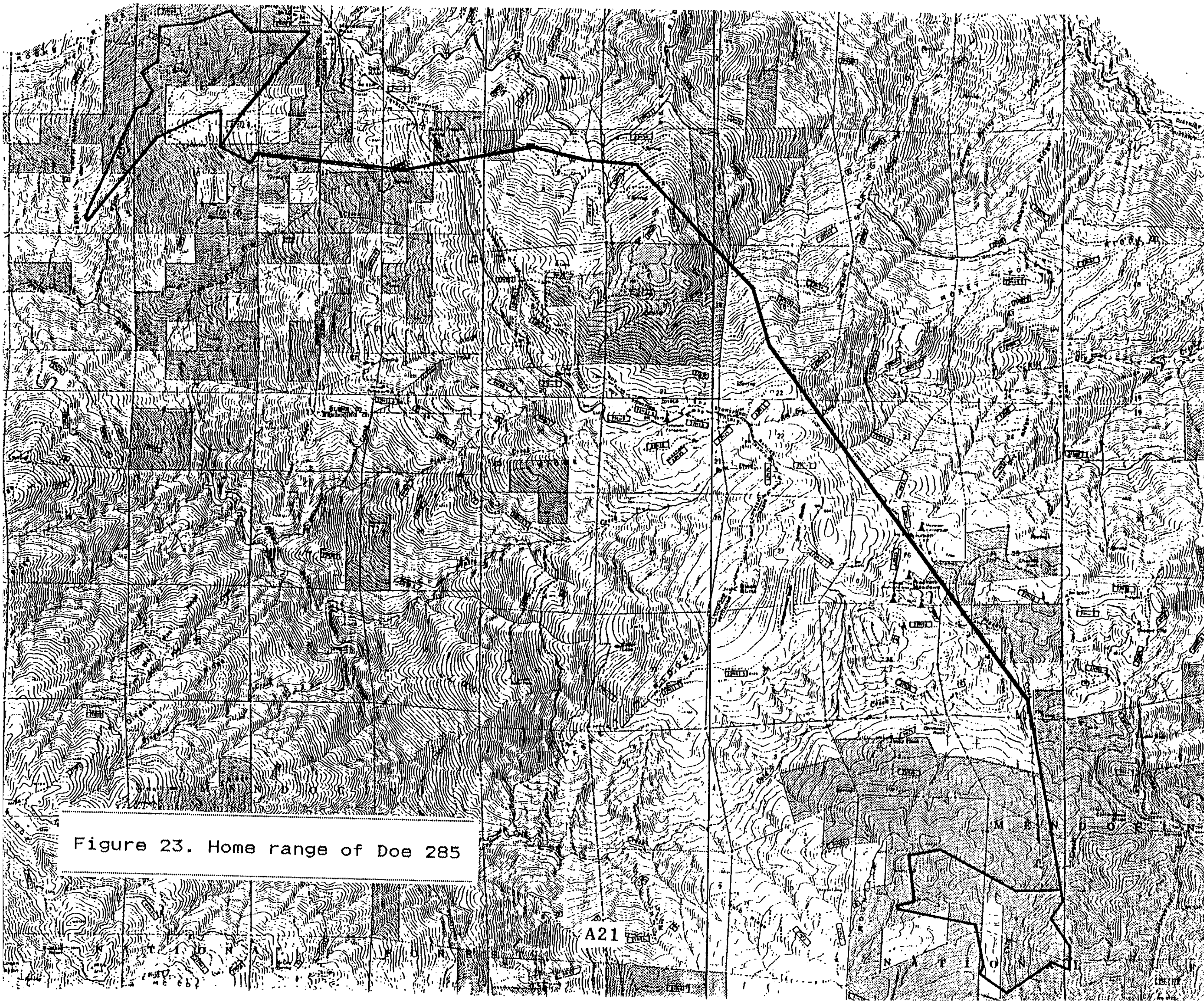


Figure 23. Home range of Doe 285

A21

Figure 24. Locations of Doe 285

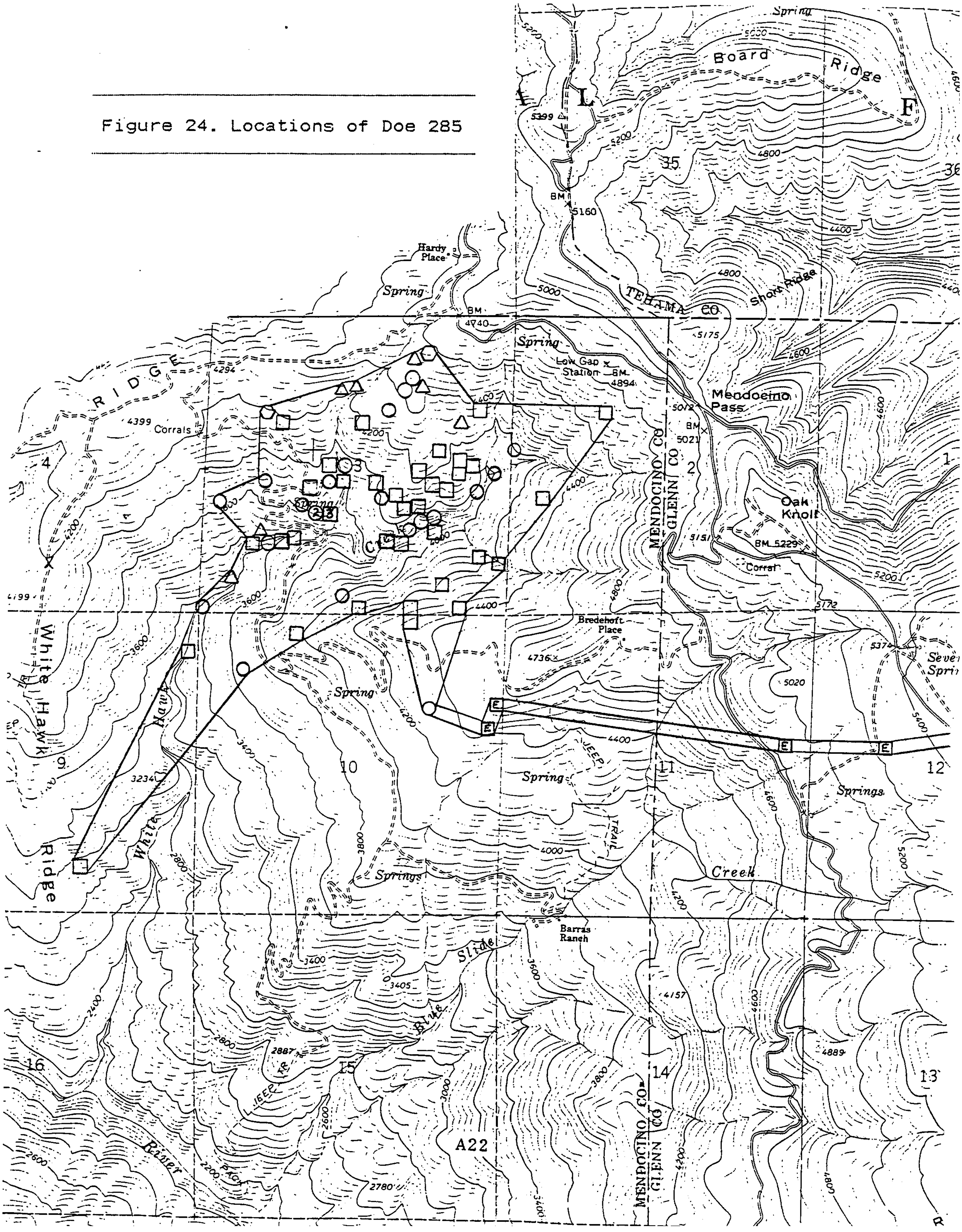
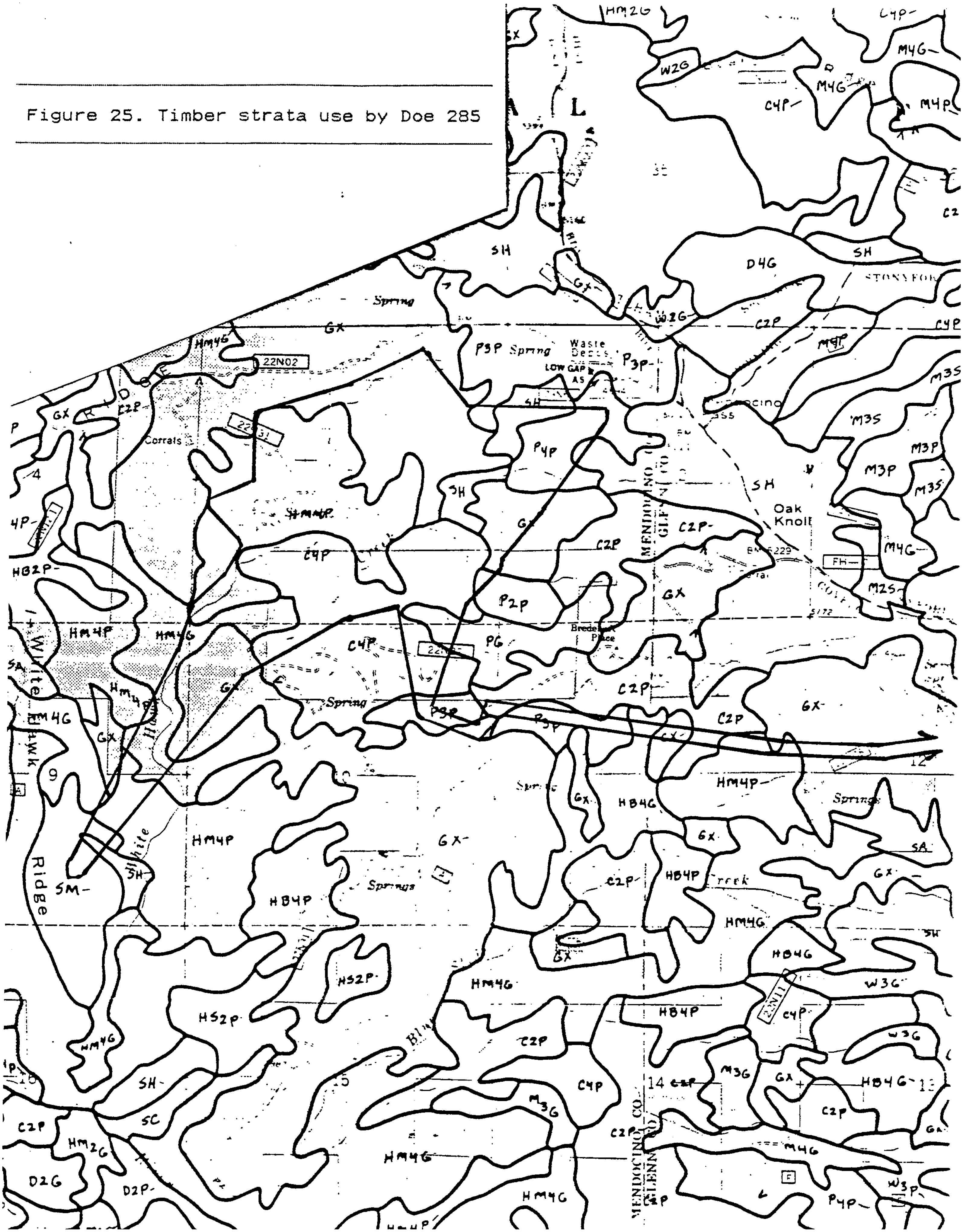


Figure 25. Timber strata use by Doe 285



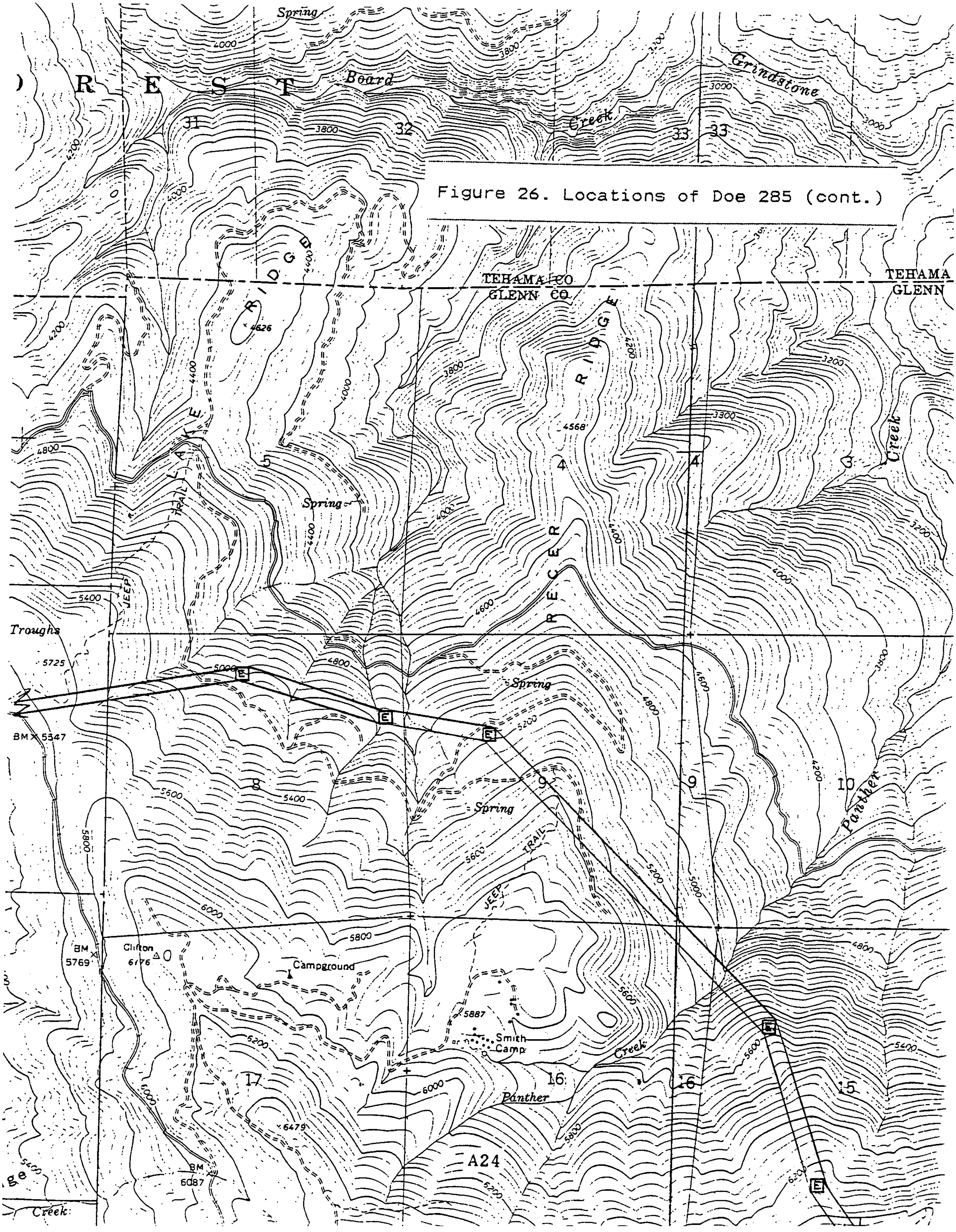


Figure 26. Locations of Doe 285 (cont.)

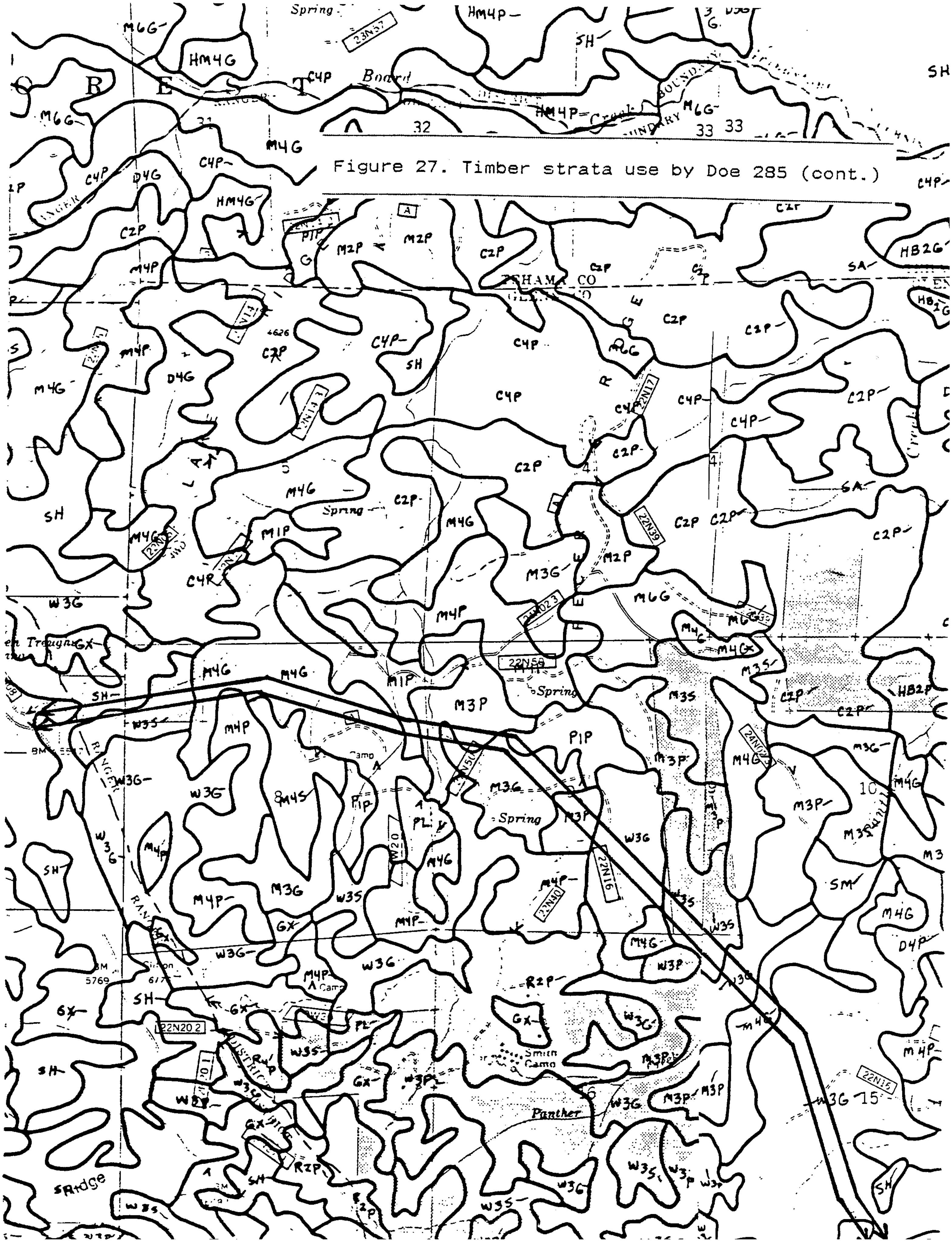


Figure 27. Timber strata use by Doe 285 (cont.)

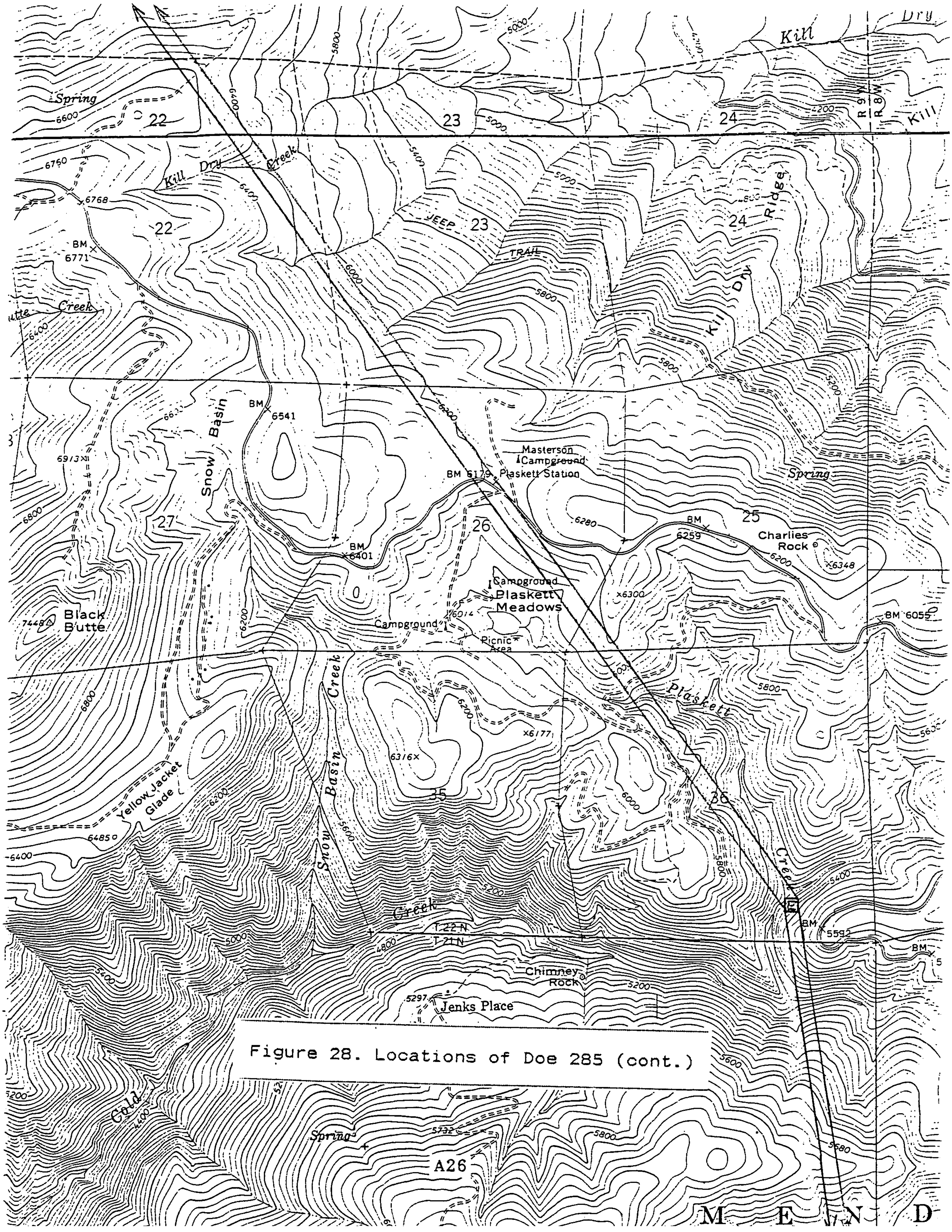


Figure 28. Locations of Doe 285 (cont.)

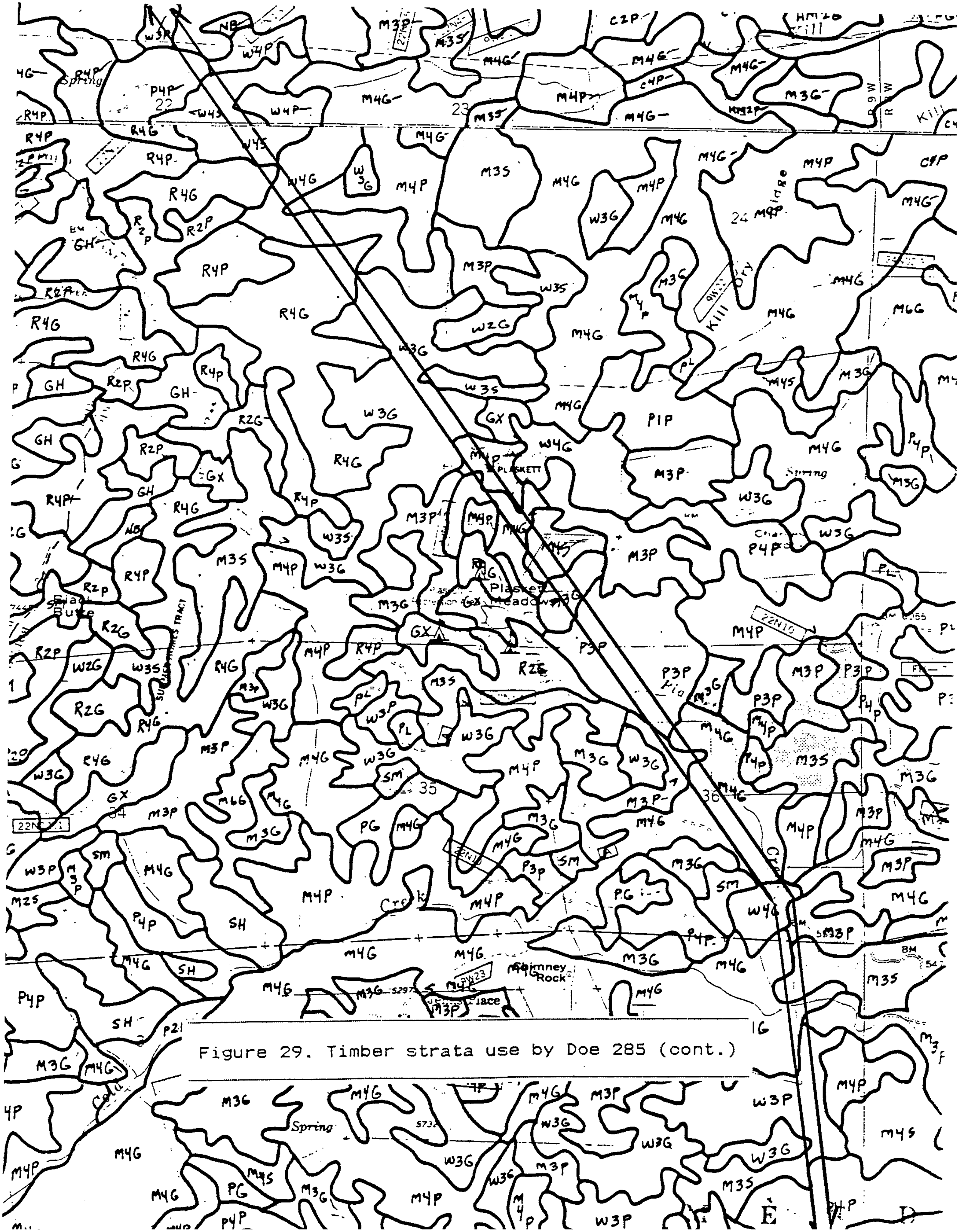


Figure 29. Timber strata use by Doe 285 (cont.)

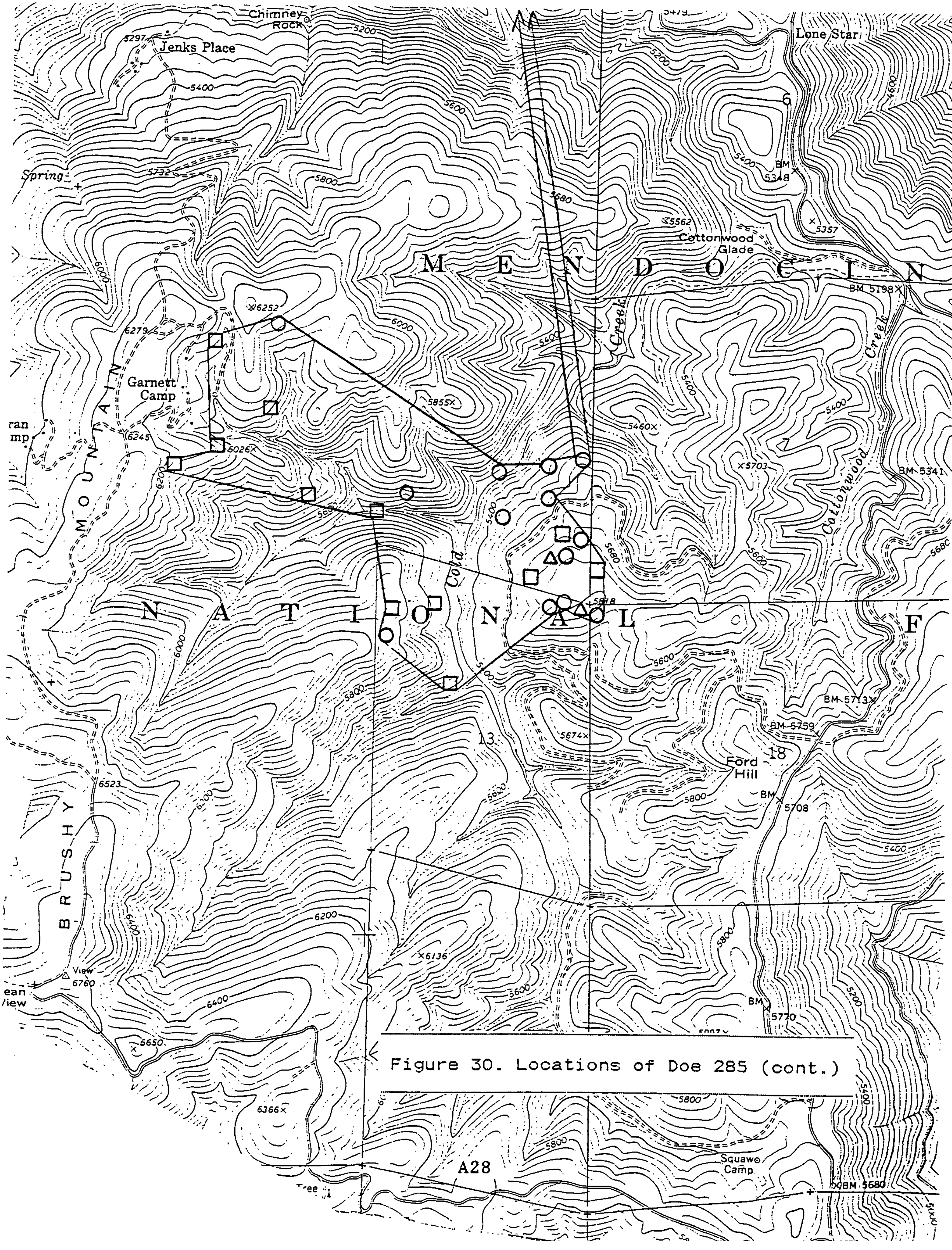


Figure 30. Locations of Doe 285 (cont.)

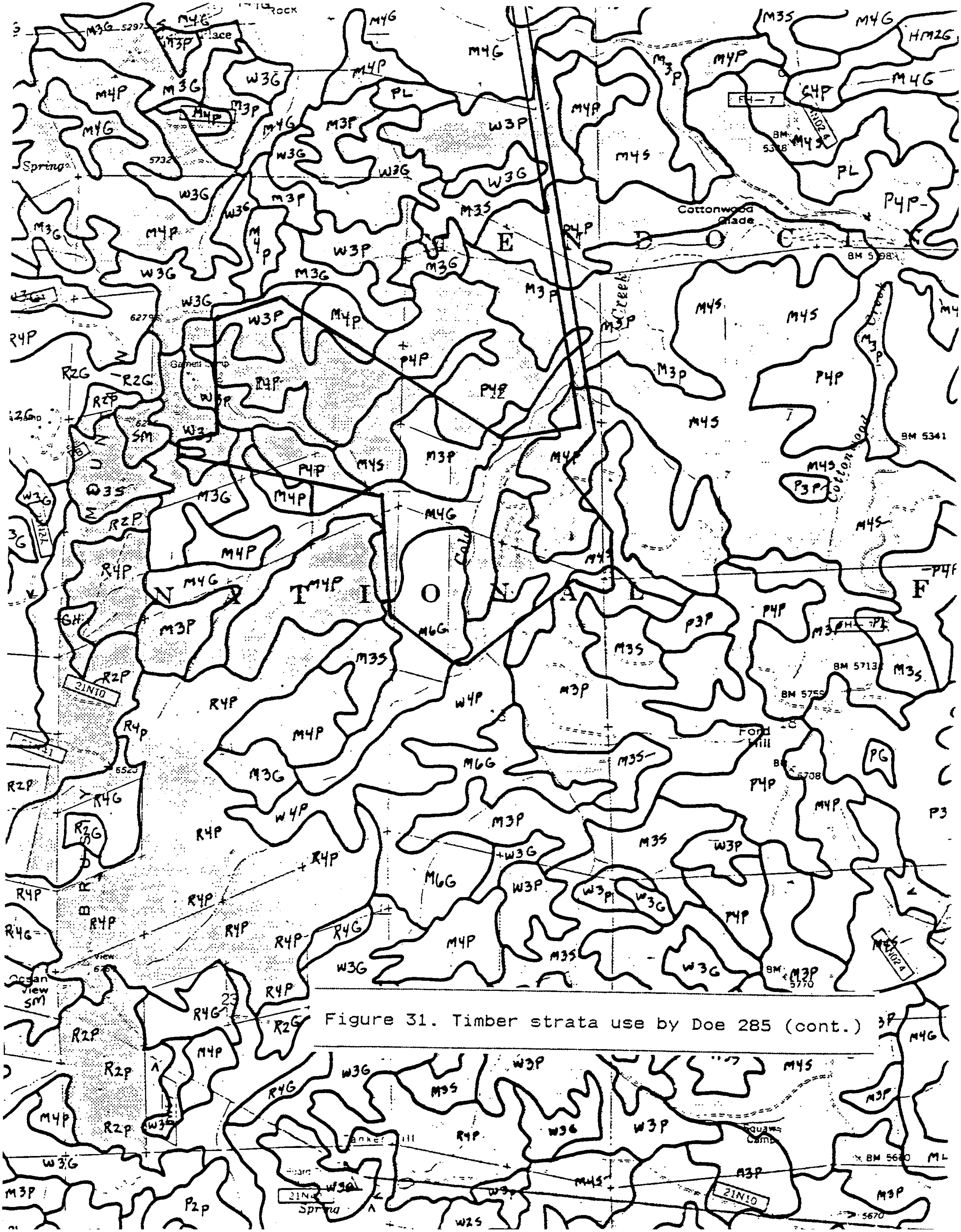


Figure 31. Timber strata use by Doe 285 (cont.)

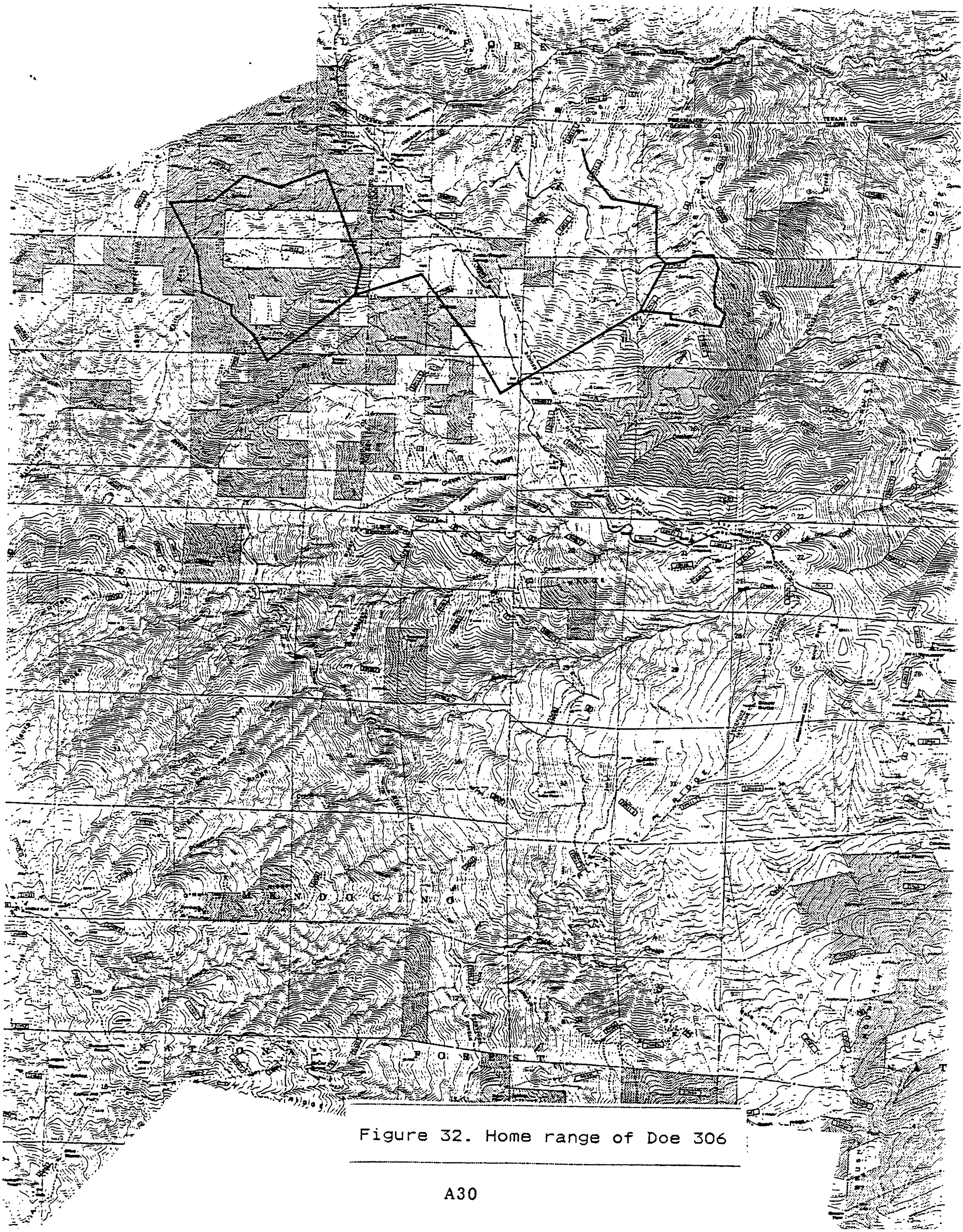


Figure 32. Home range of Doe 306

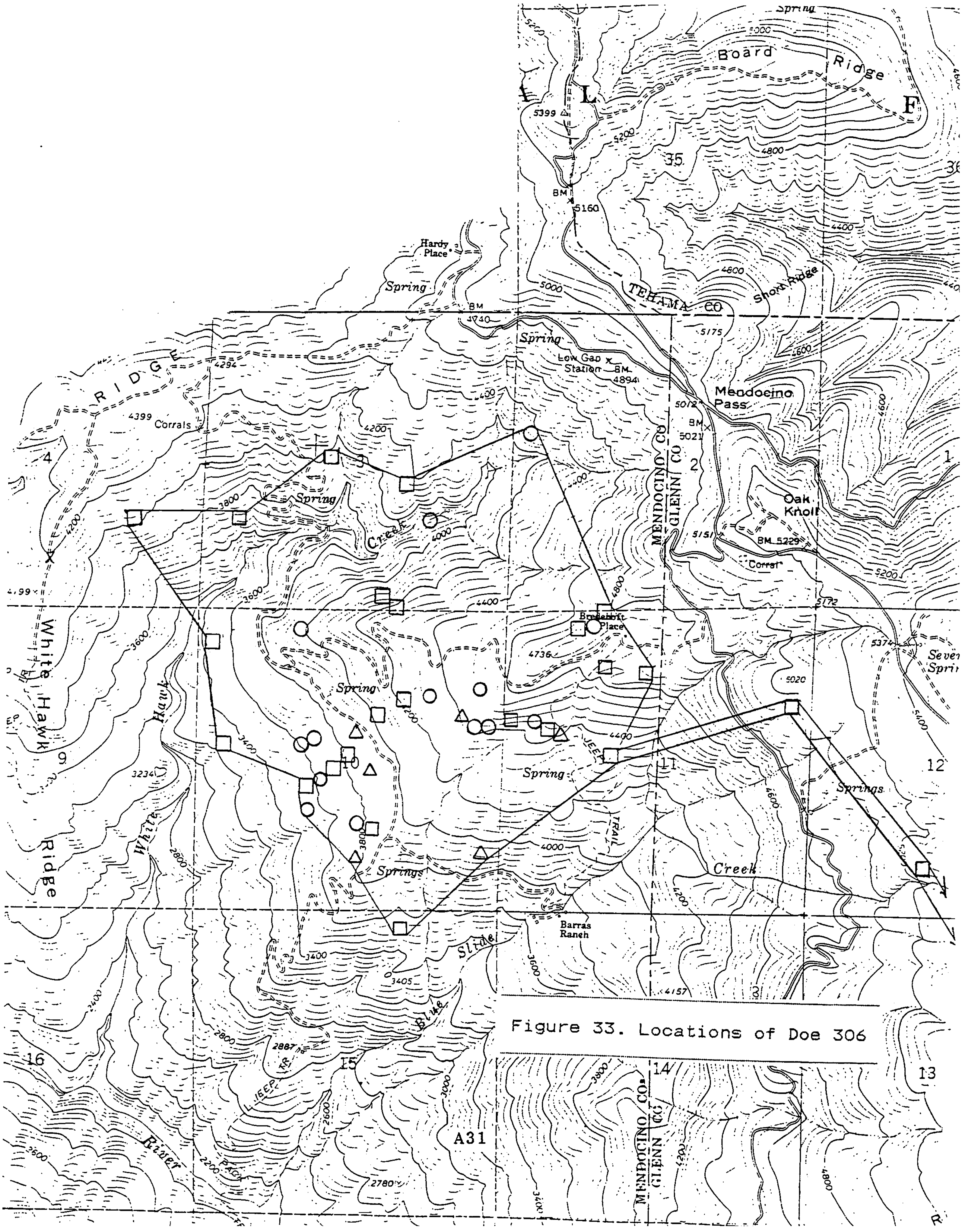


Figure 33. Locations of Doe 306

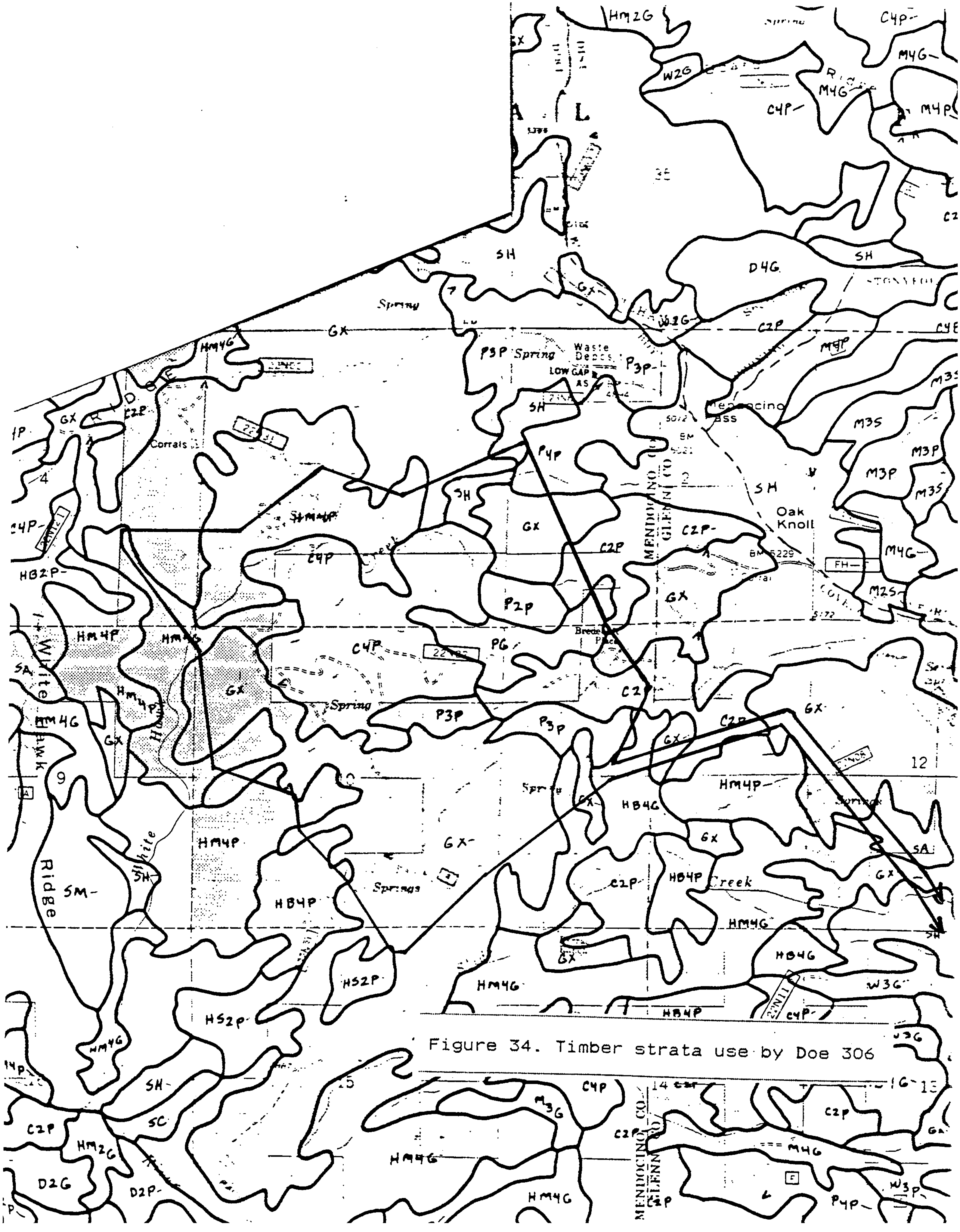


Figure 34. Timber strata use by Doe 306

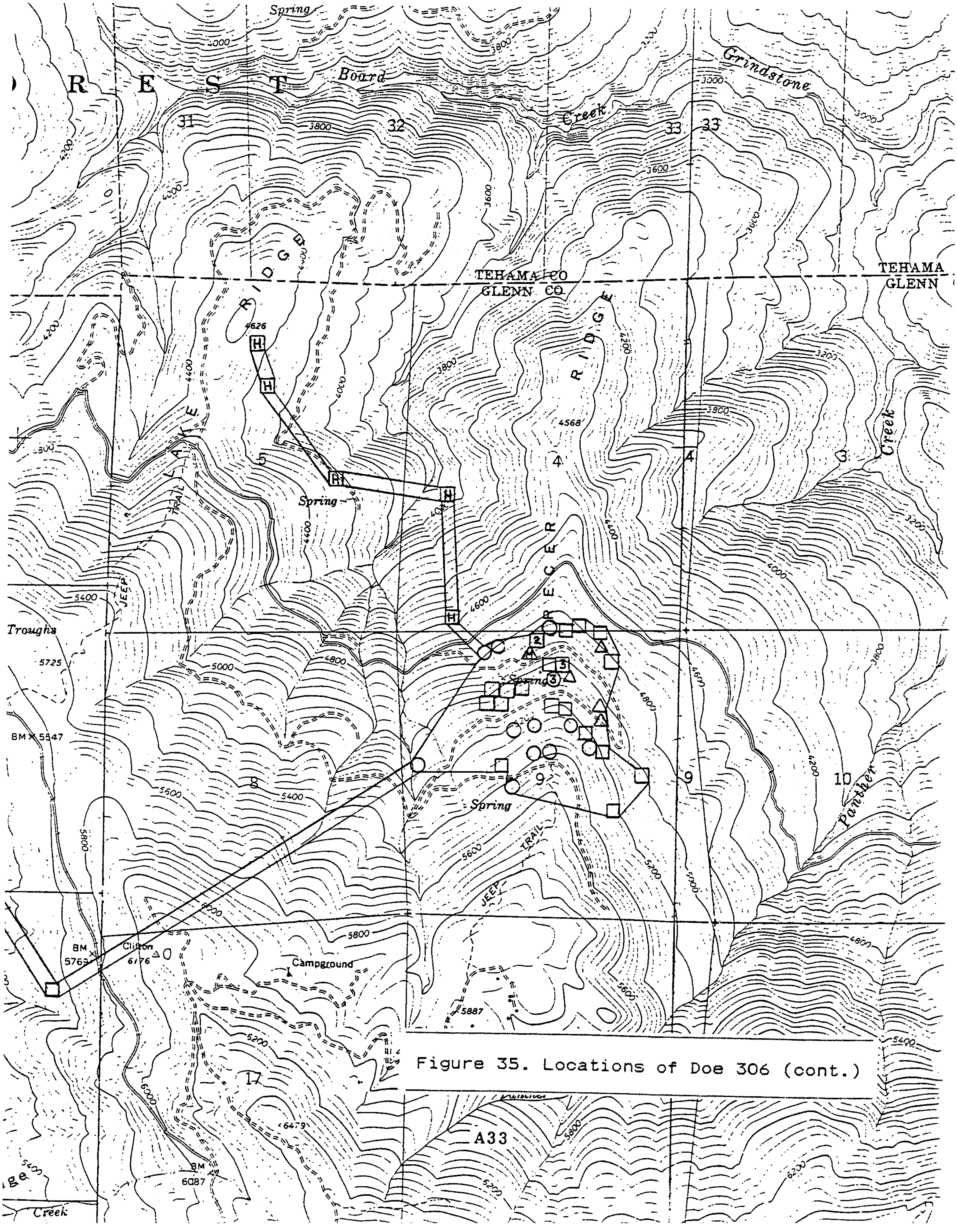


Figure 35. Locations of Doe 306 (cont.)

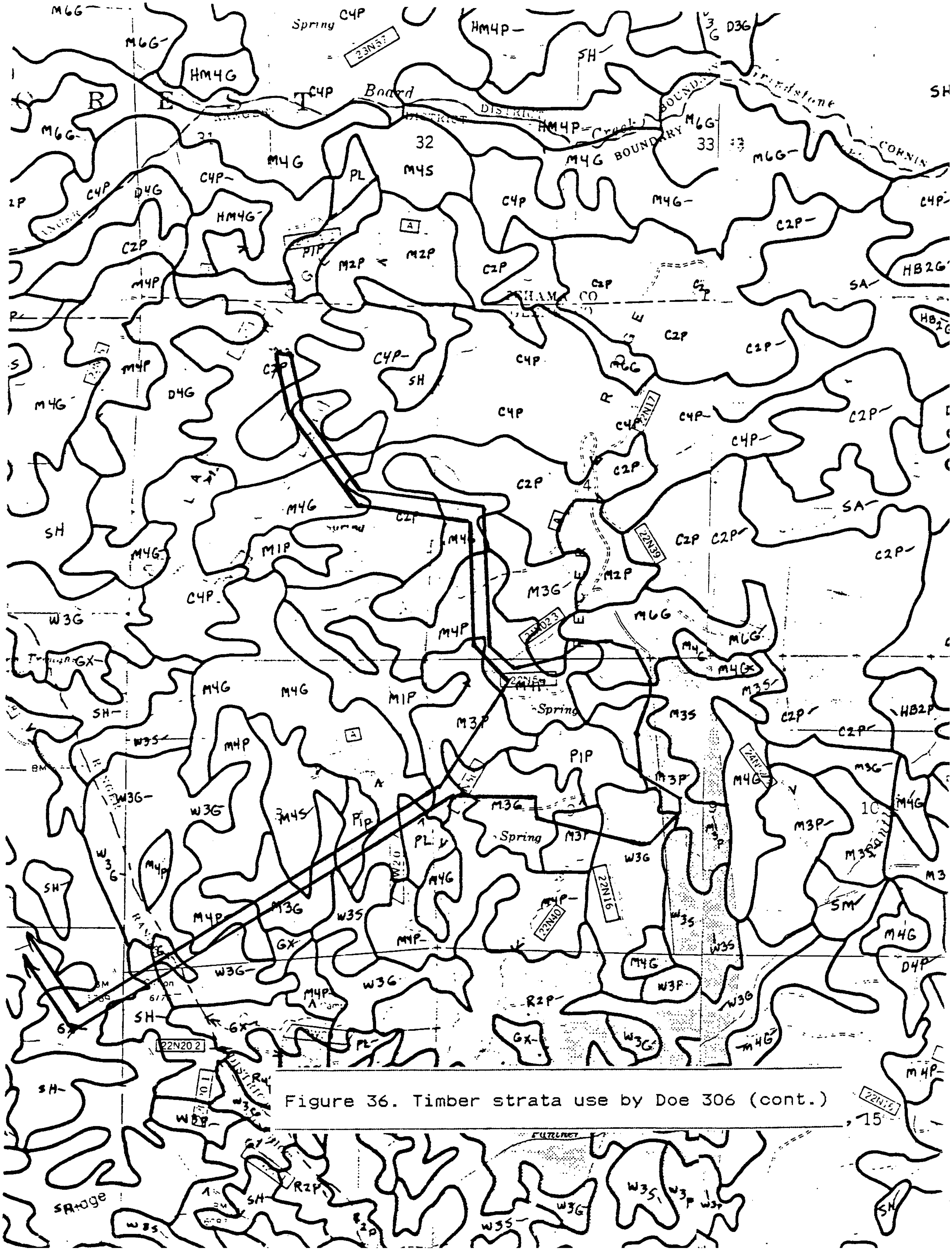


Figure 36. Timber strata use by Doe 306 (cont.)

Figure 37. Home range of Doe 316

Figure 38. Locations of Doe 316

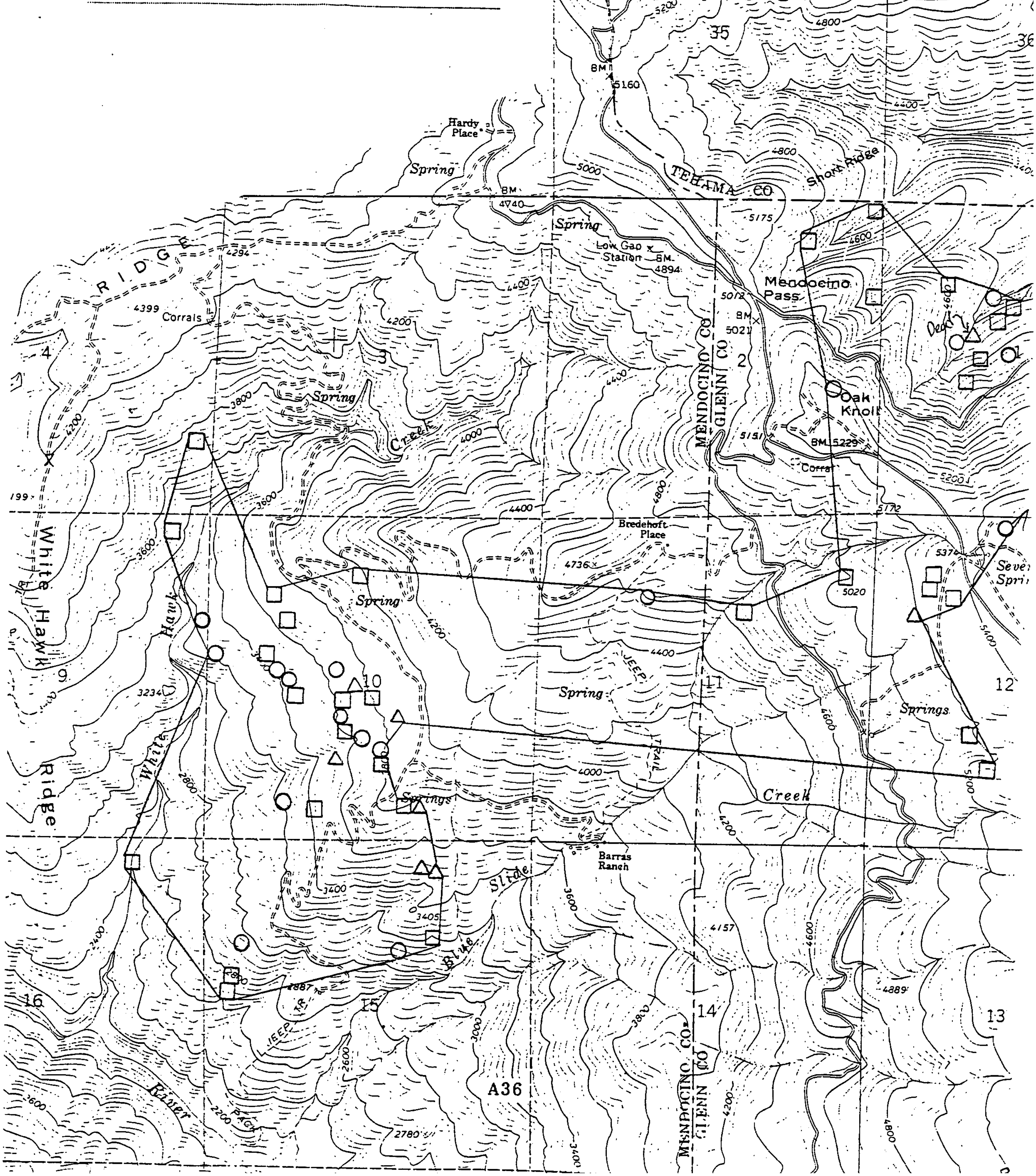
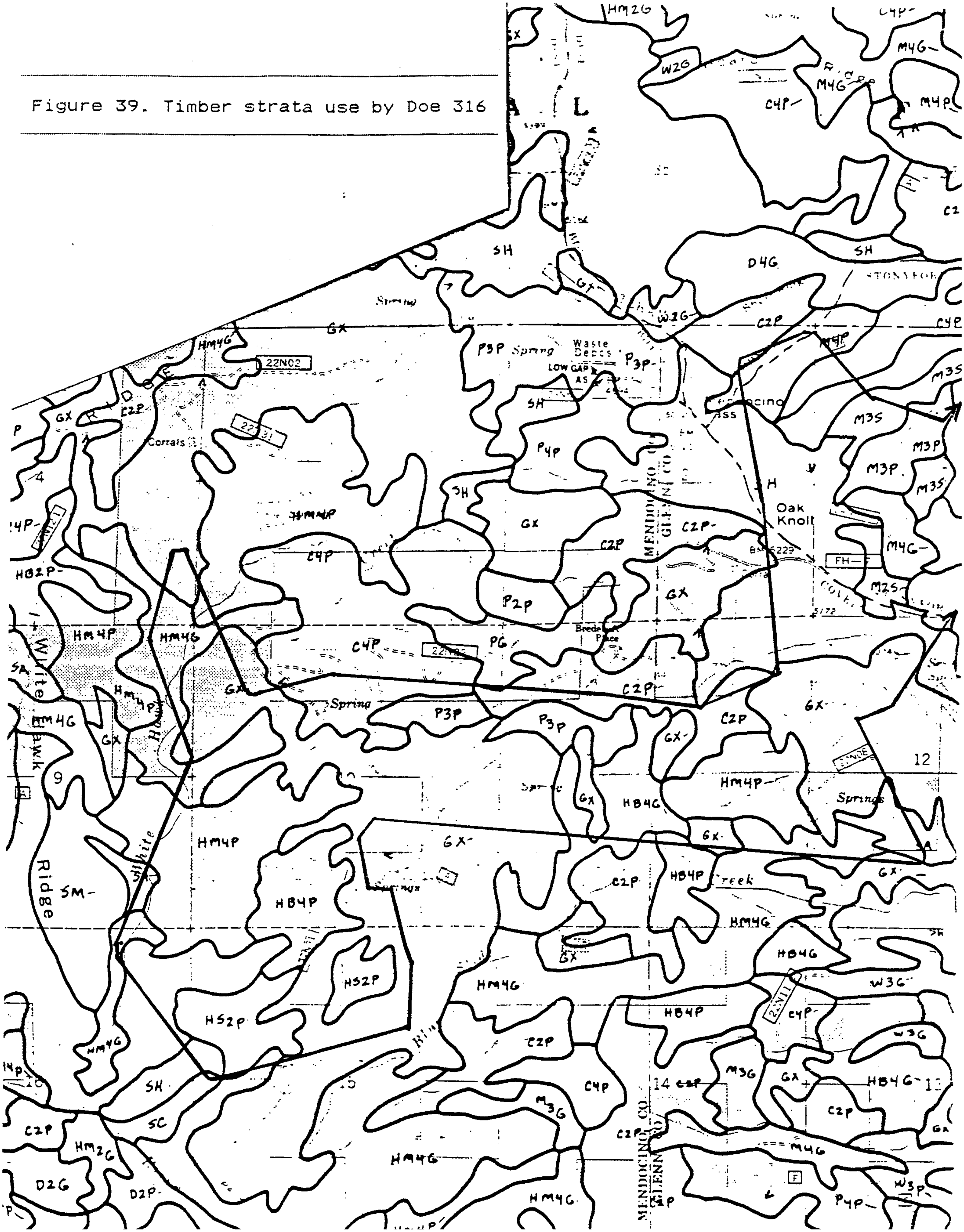


Figure 39. Timber strata use by Doe 316



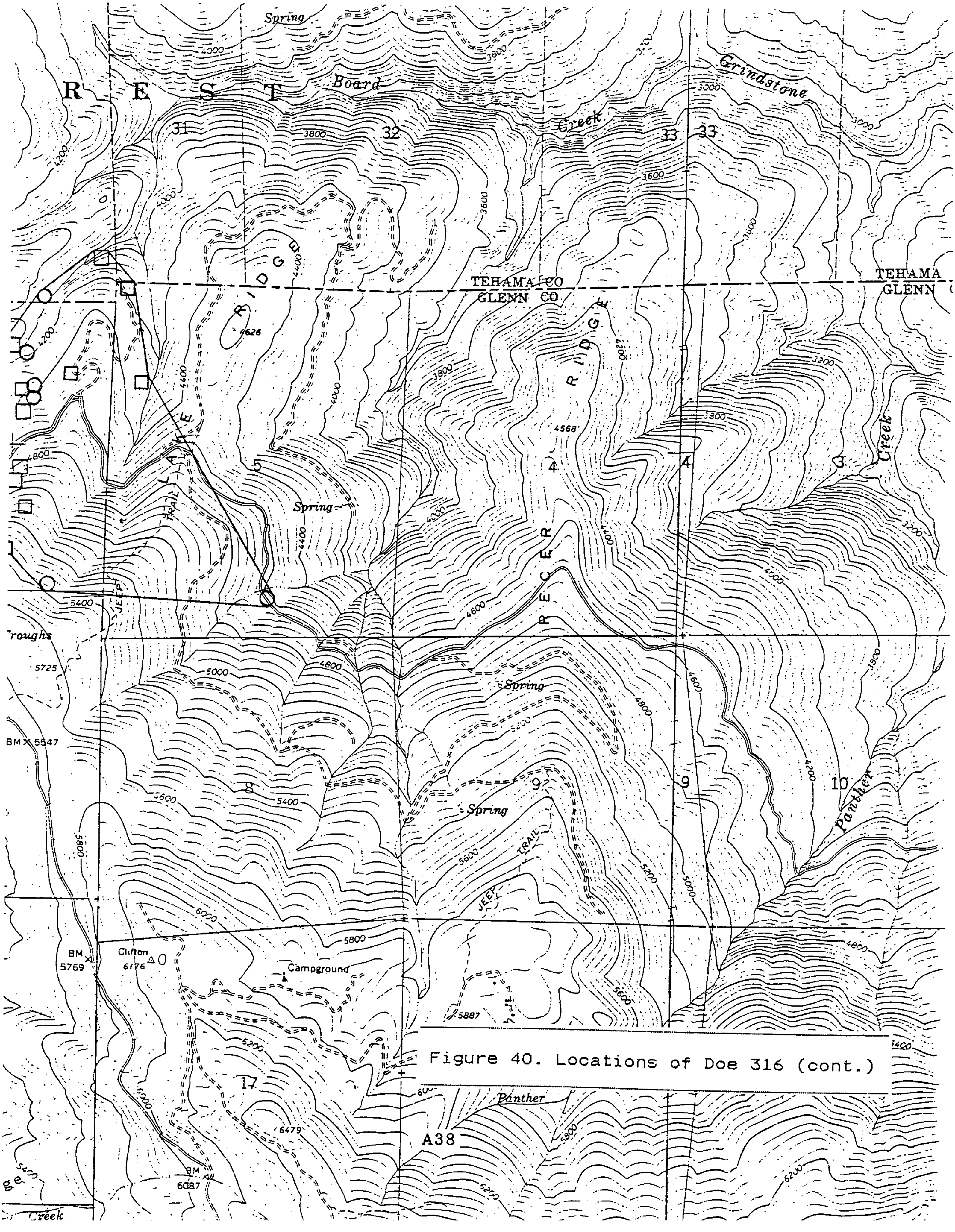


Figure 40. Locations of Doe 316 (cont.)

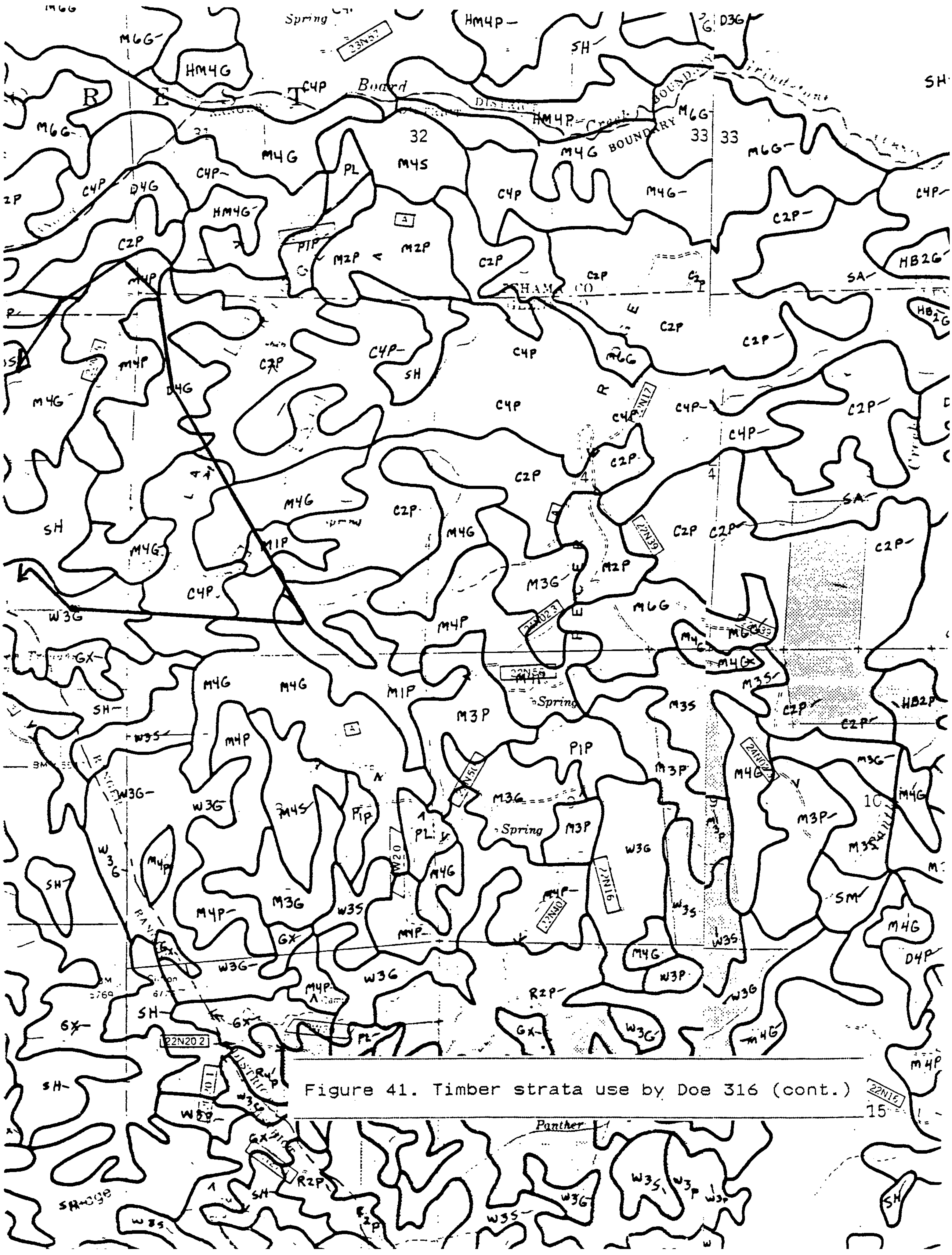


Figure 41. Timber strata use by Doe 316 (cont.)

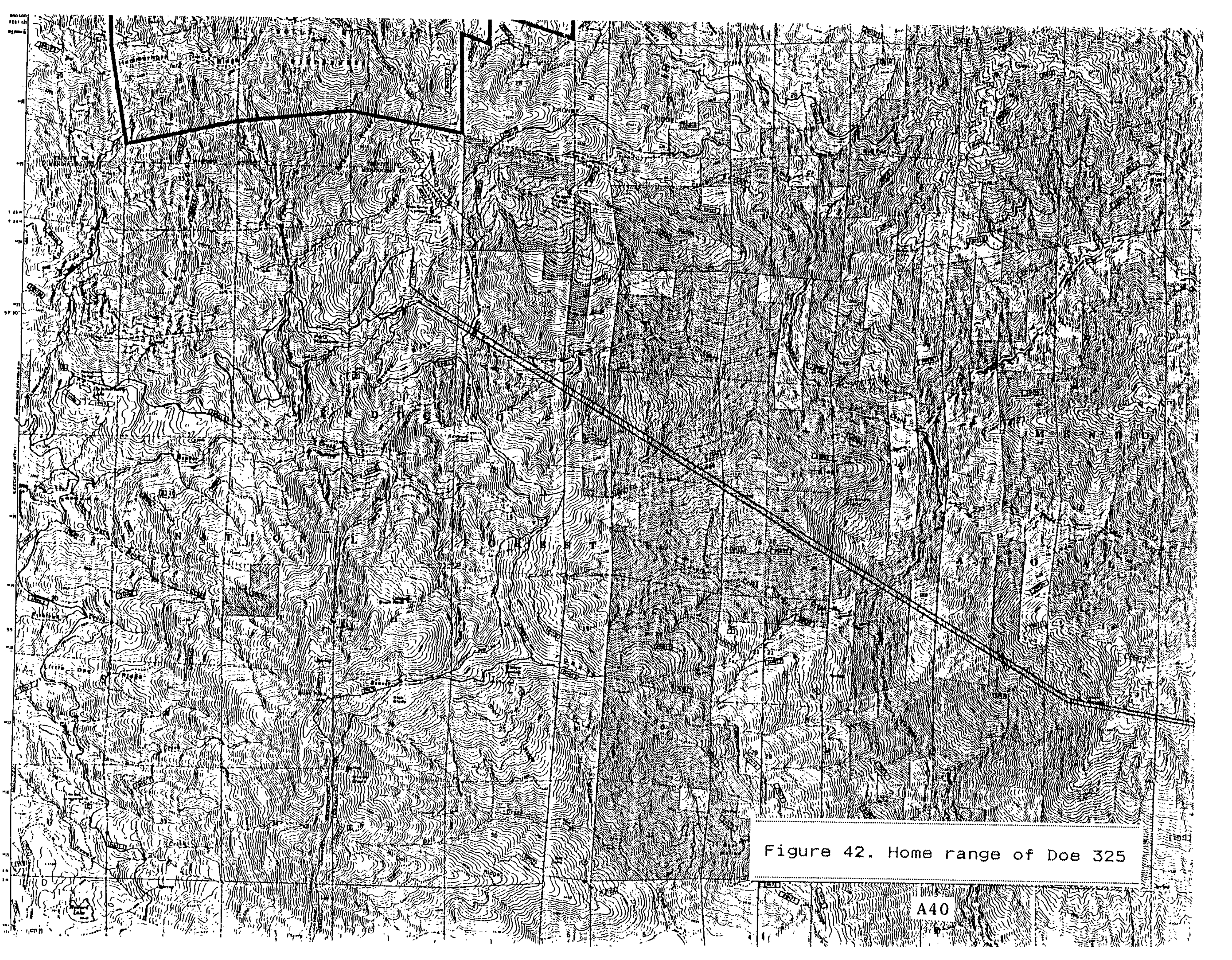
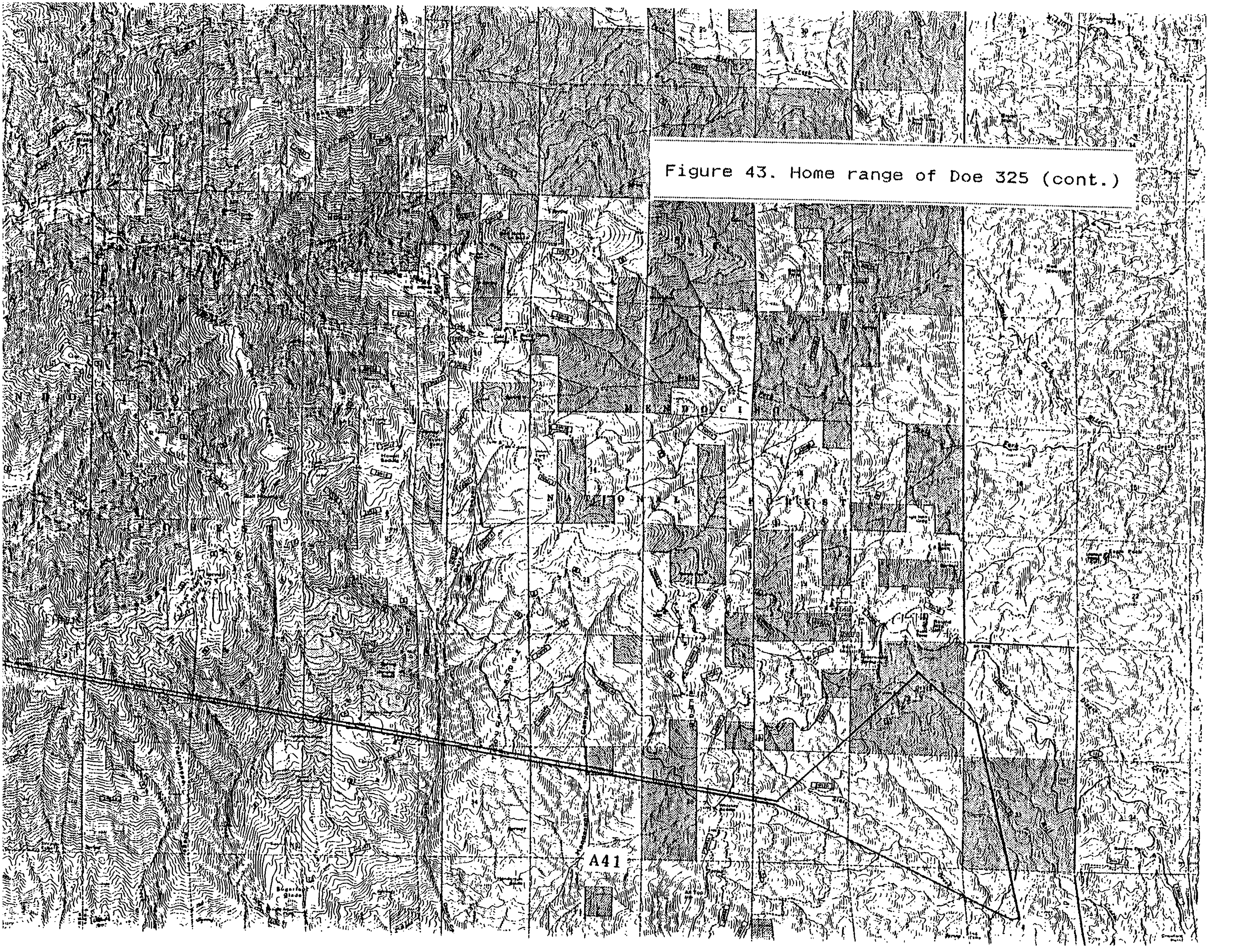


Figure 42. Home range of Doe 325

Figure 43. Home range of Doe 325 (cont.)



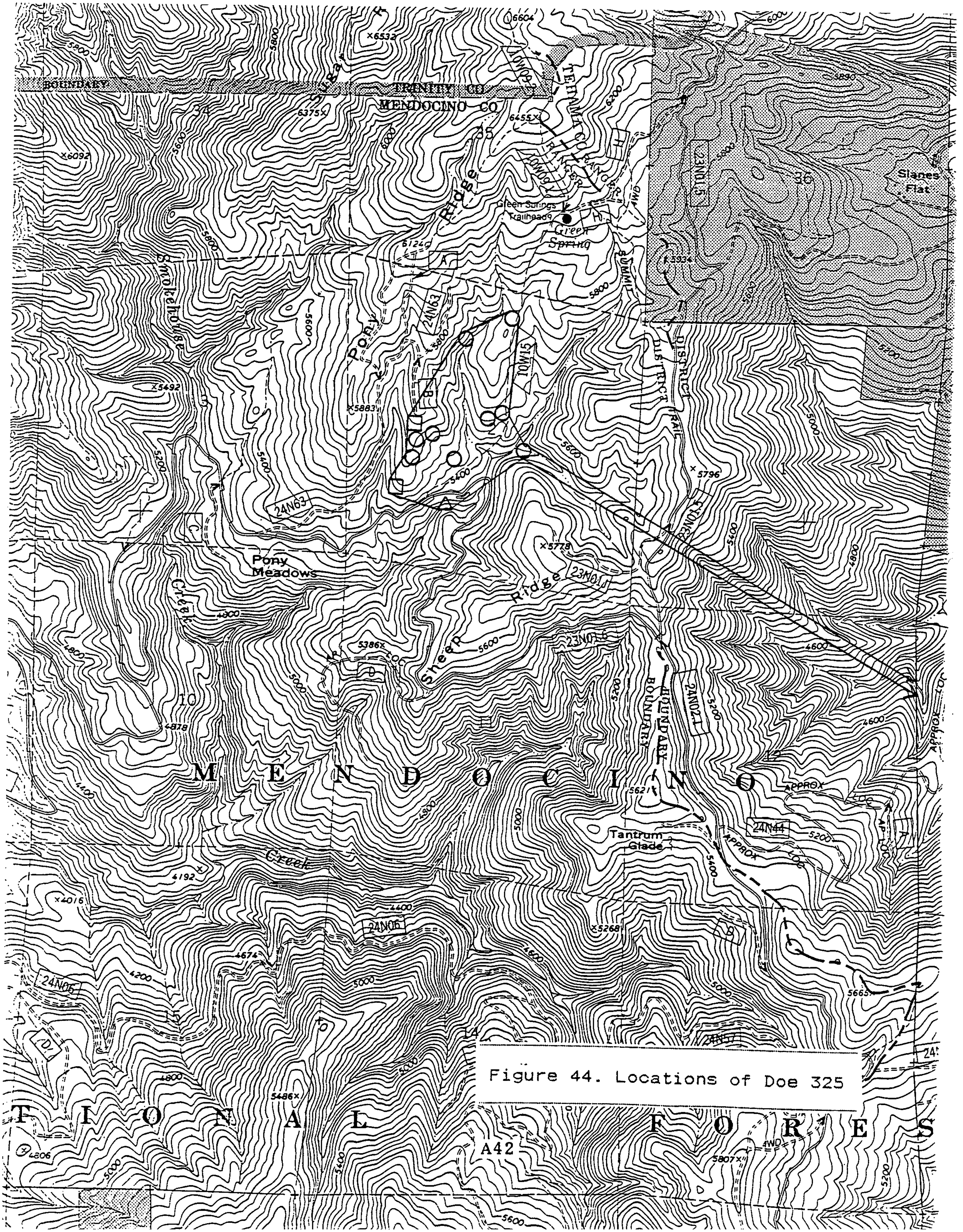


Figure 44. Locations of Doe 325

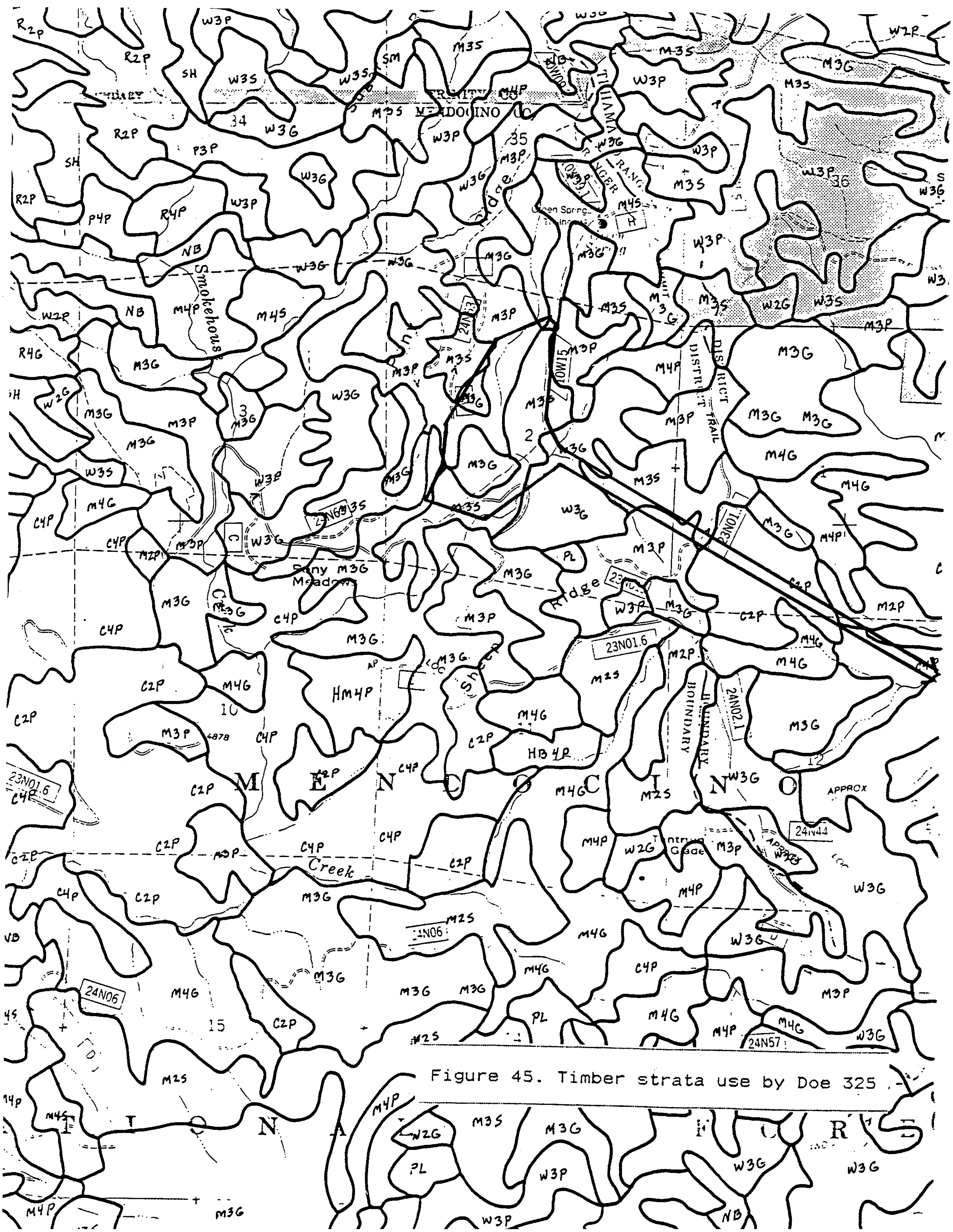


Figure 45. Timber strata use by Doe 325

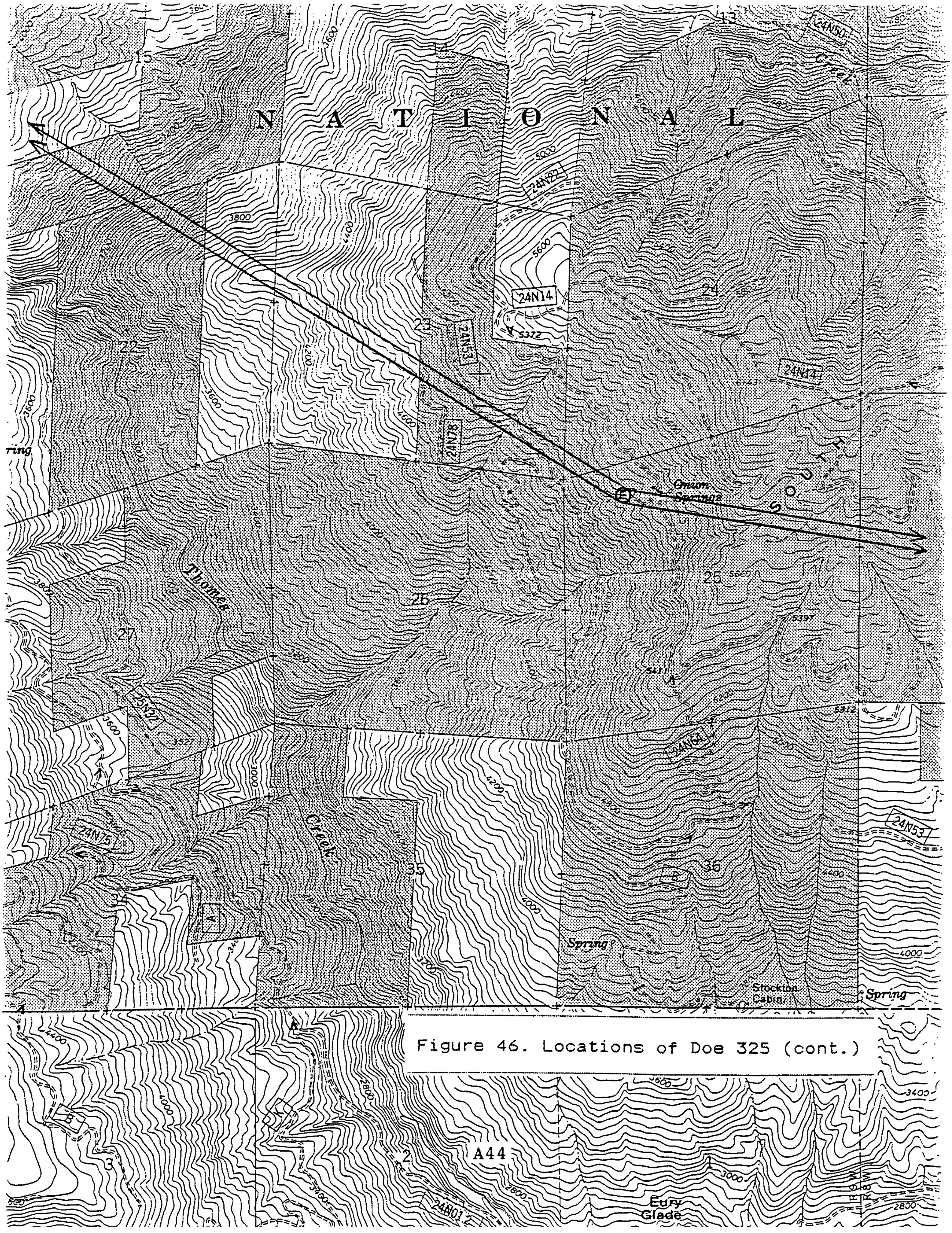


Figure 46. Locations of Doe 325 (cont.)

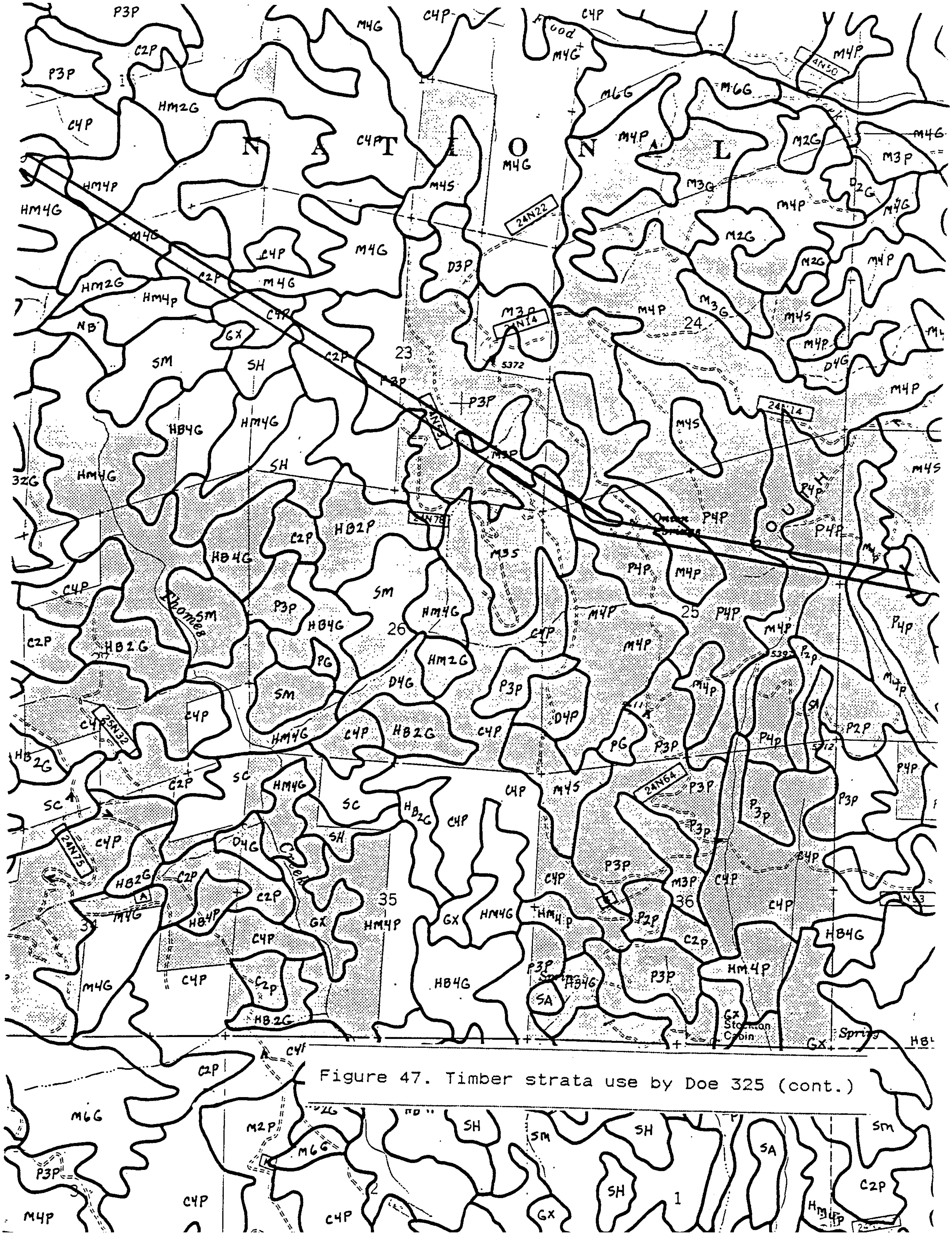


Figure 47. Timber strata use by Doe 325 (cont.)

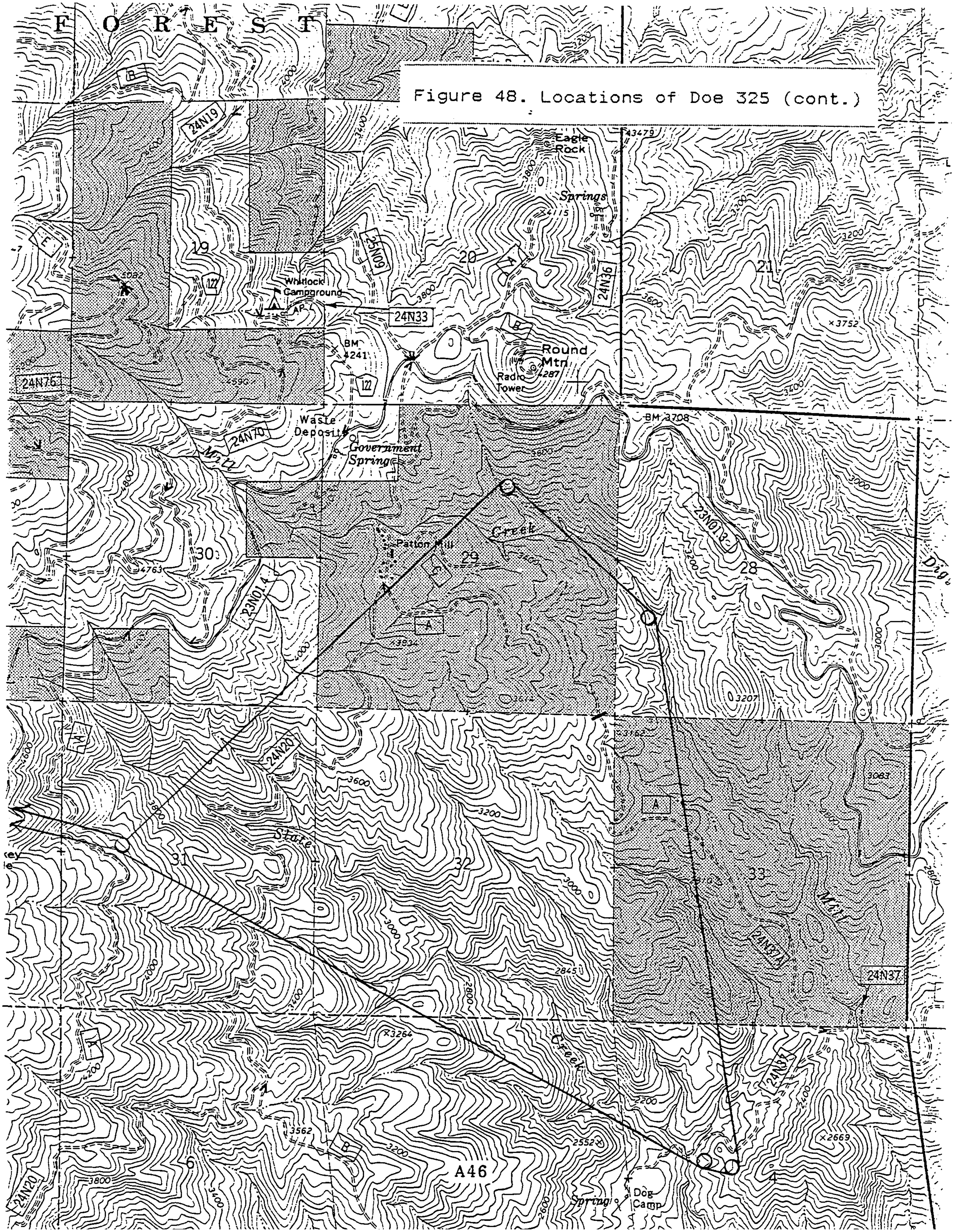


Figure 48. Locations of Doe 325 (cont.)

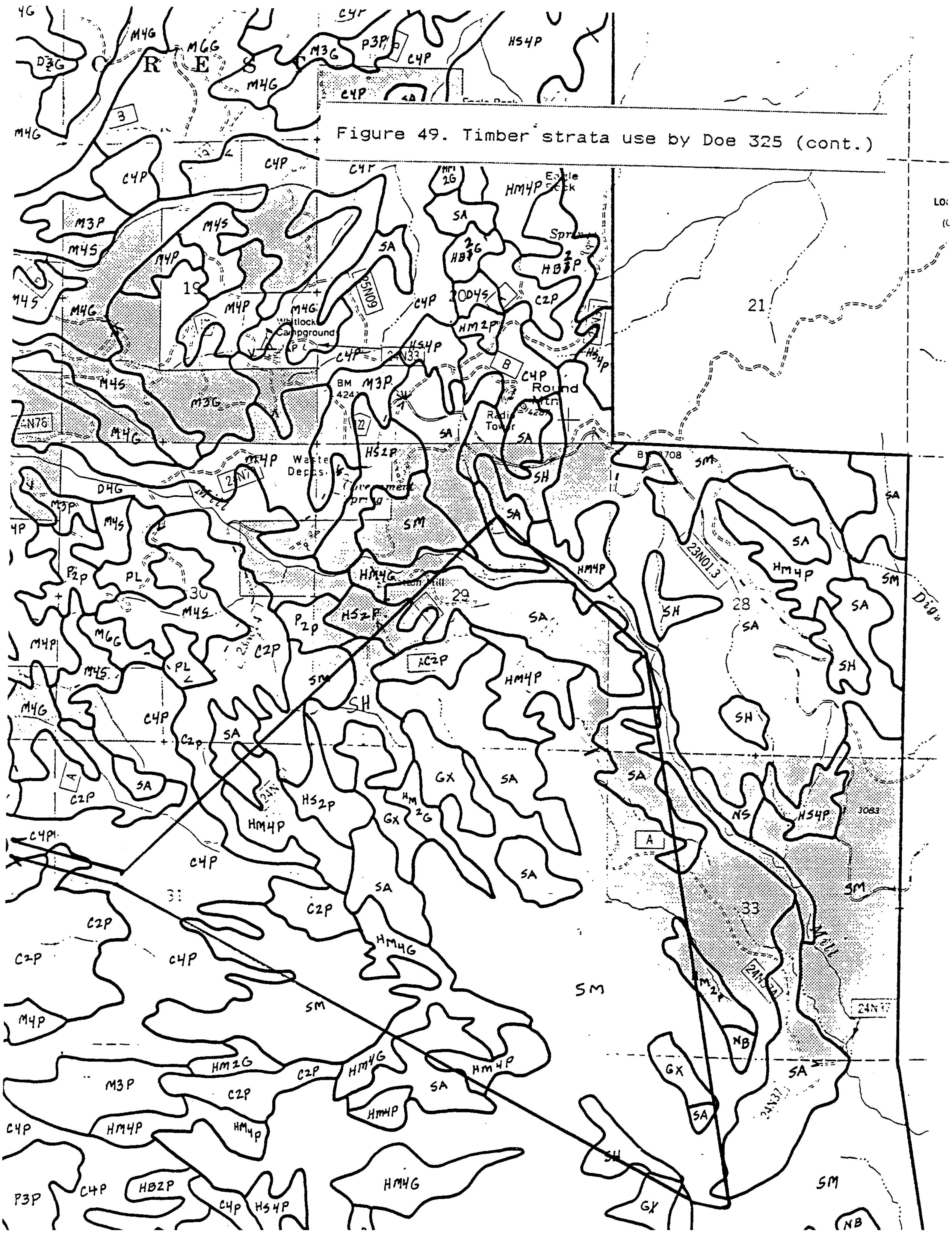


Figure 49. Timber strata use by Doe 325 (cont.)

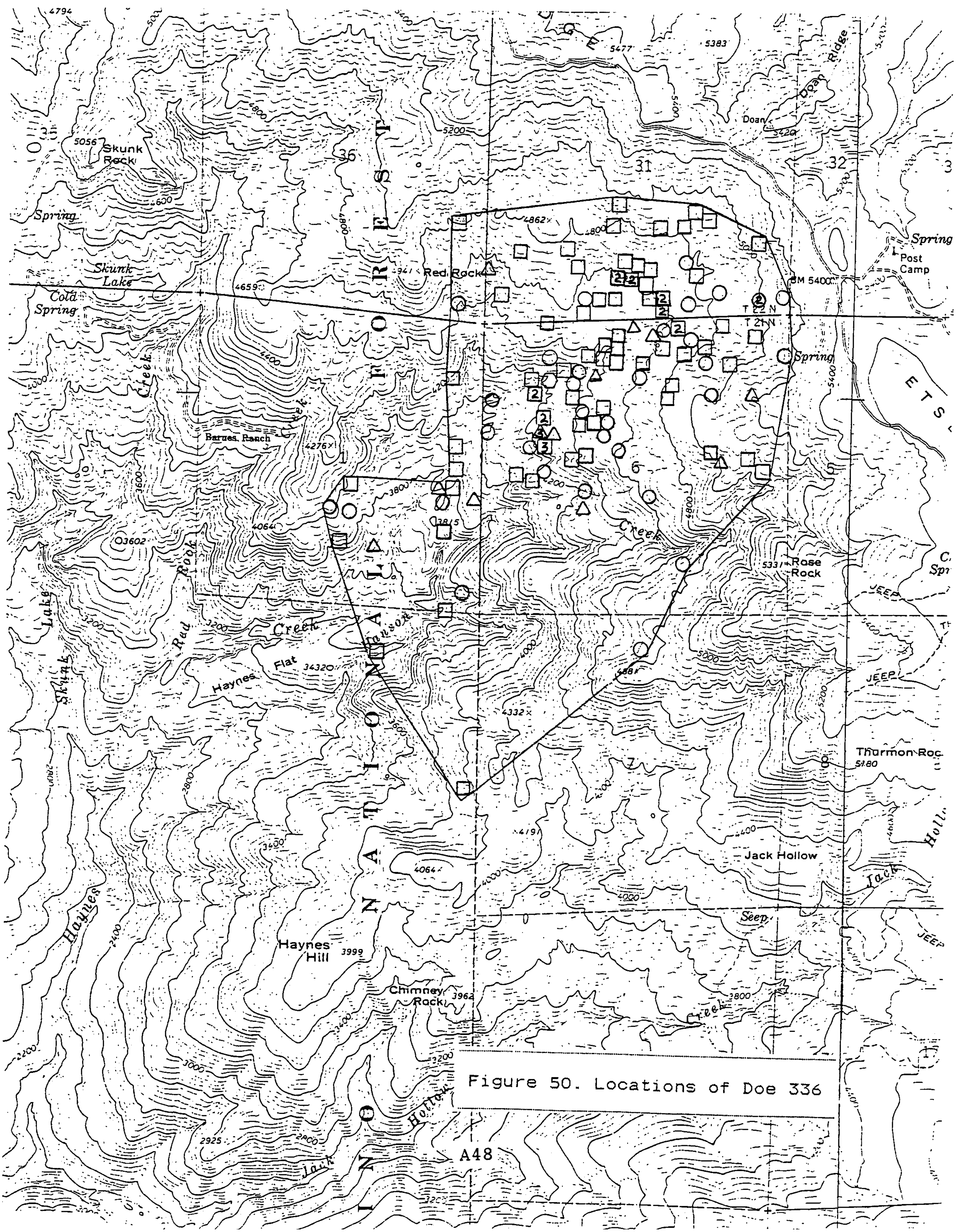


Figure 50. Locations of Doe 336

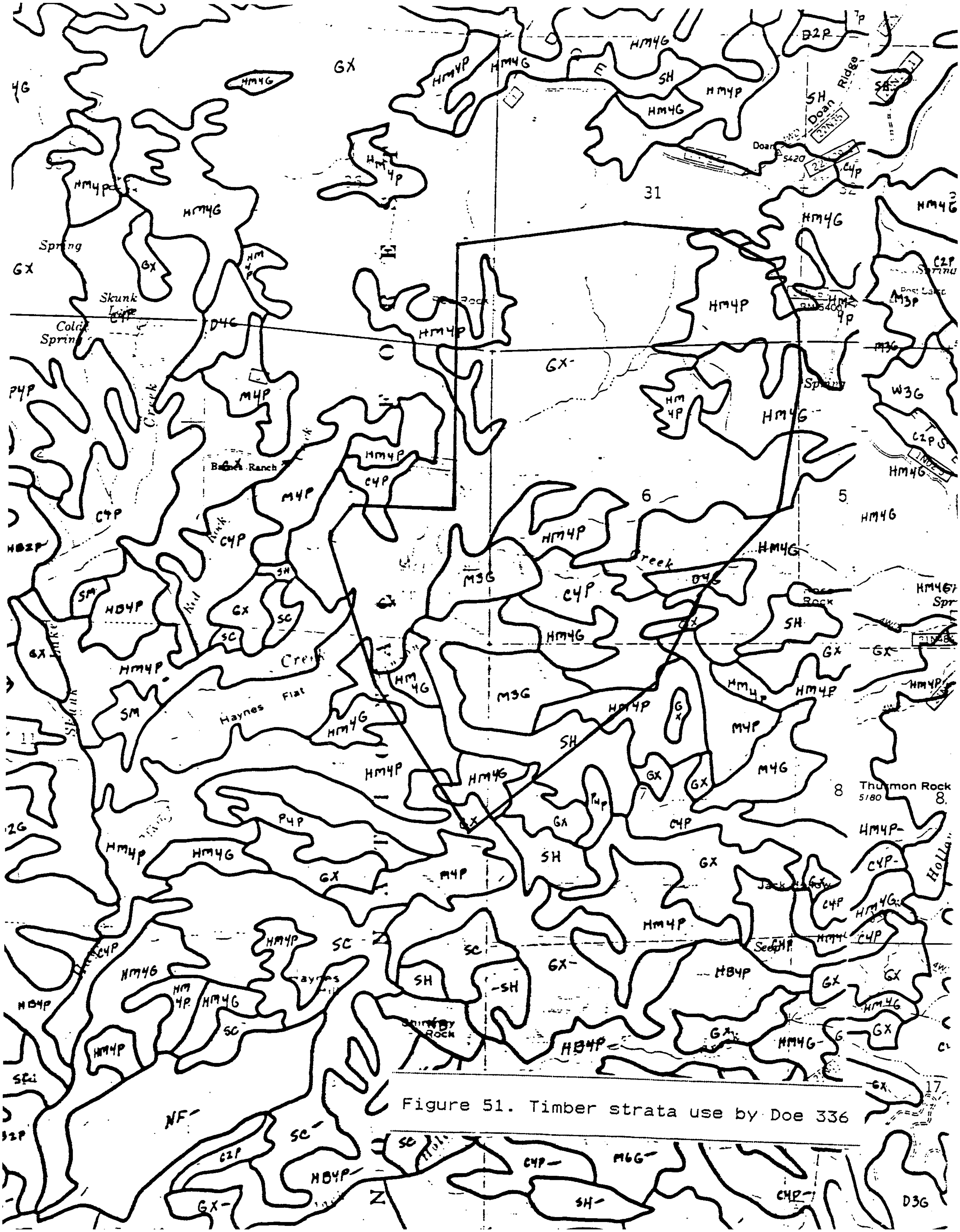
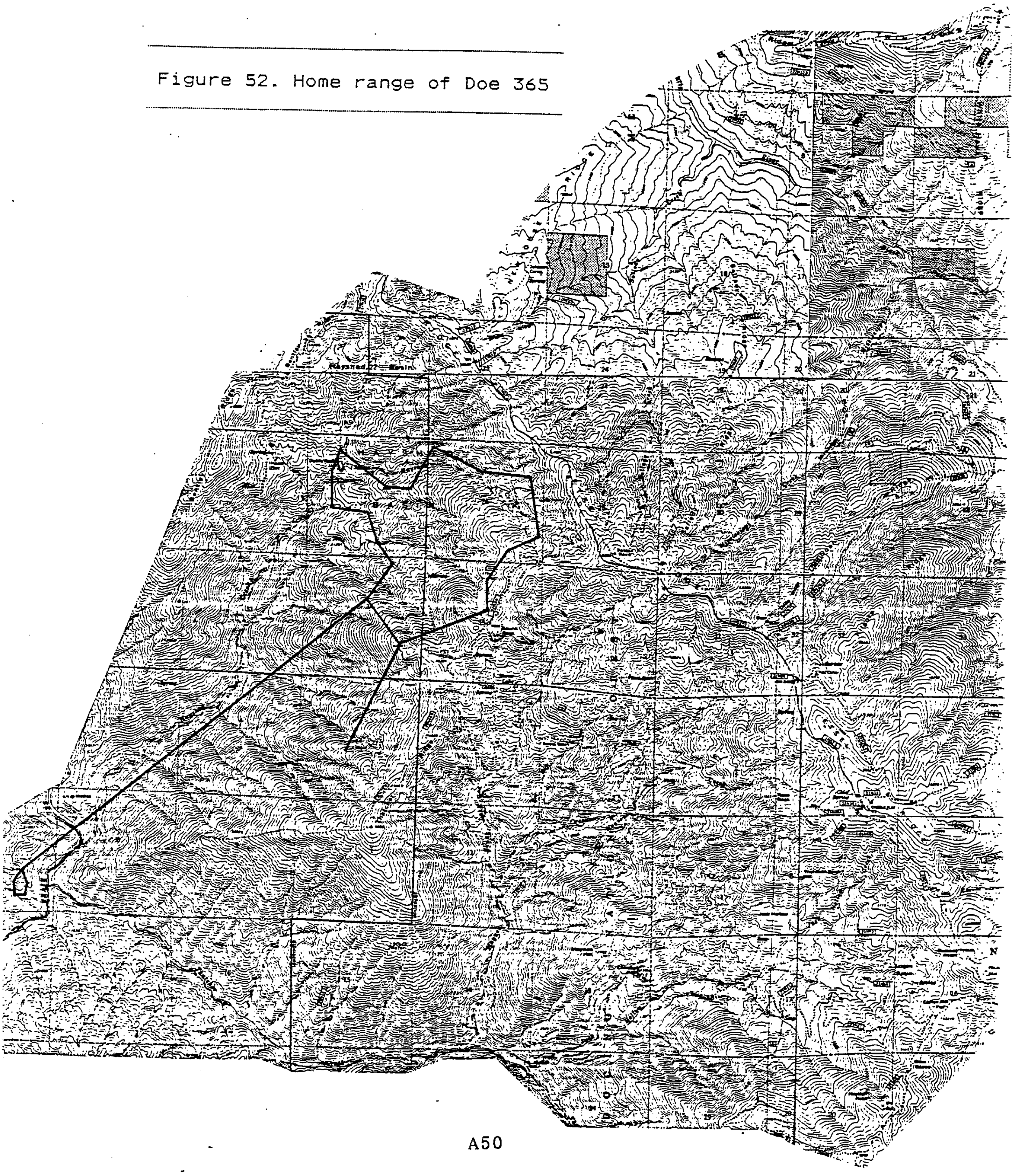


Figure 51. Timber strata use by Doe 336

Figure 52. Home range of Doe 365



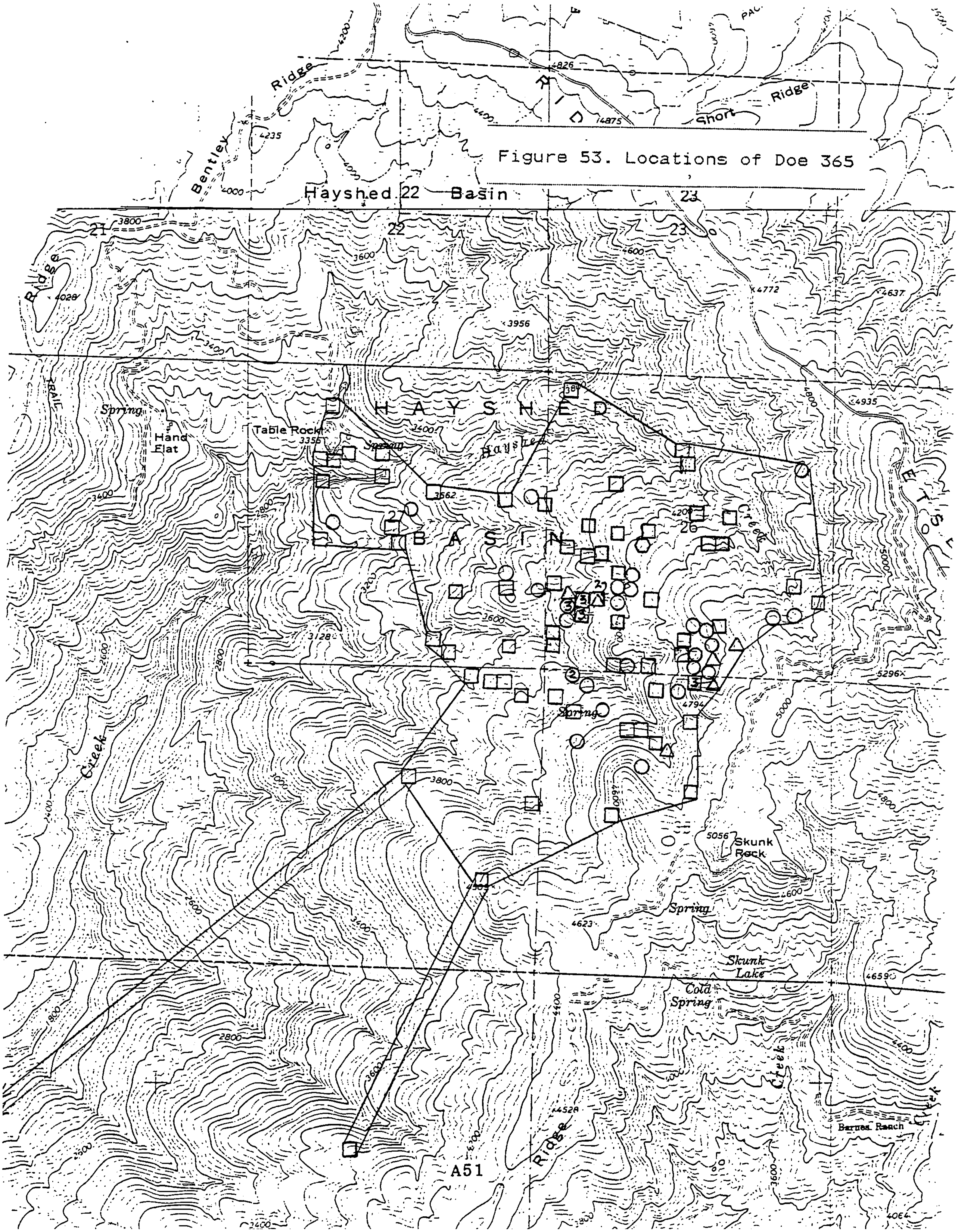
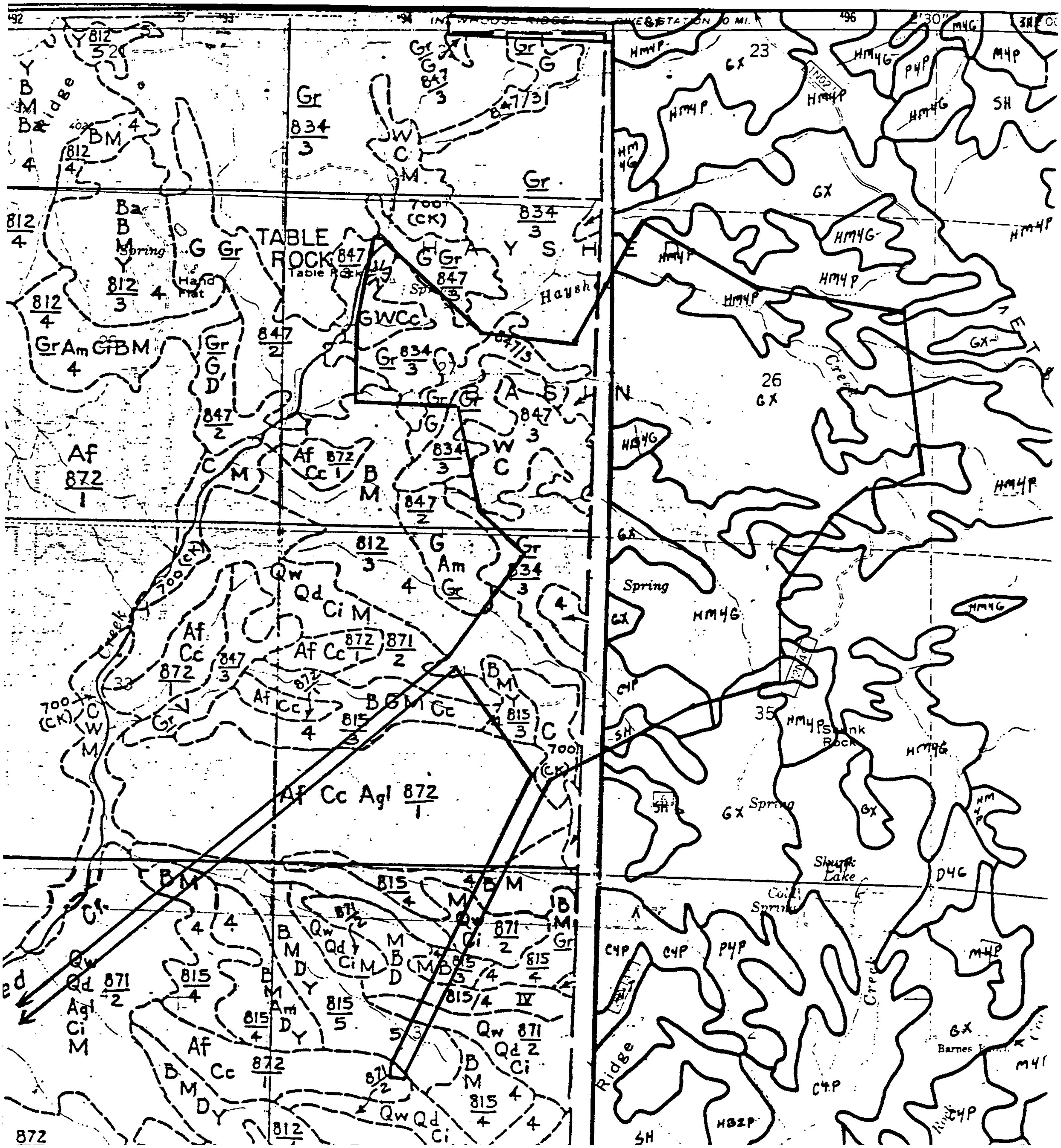


Figure 53. Locations of Doe 365

Figure 54. Timber strata use by Doe 365



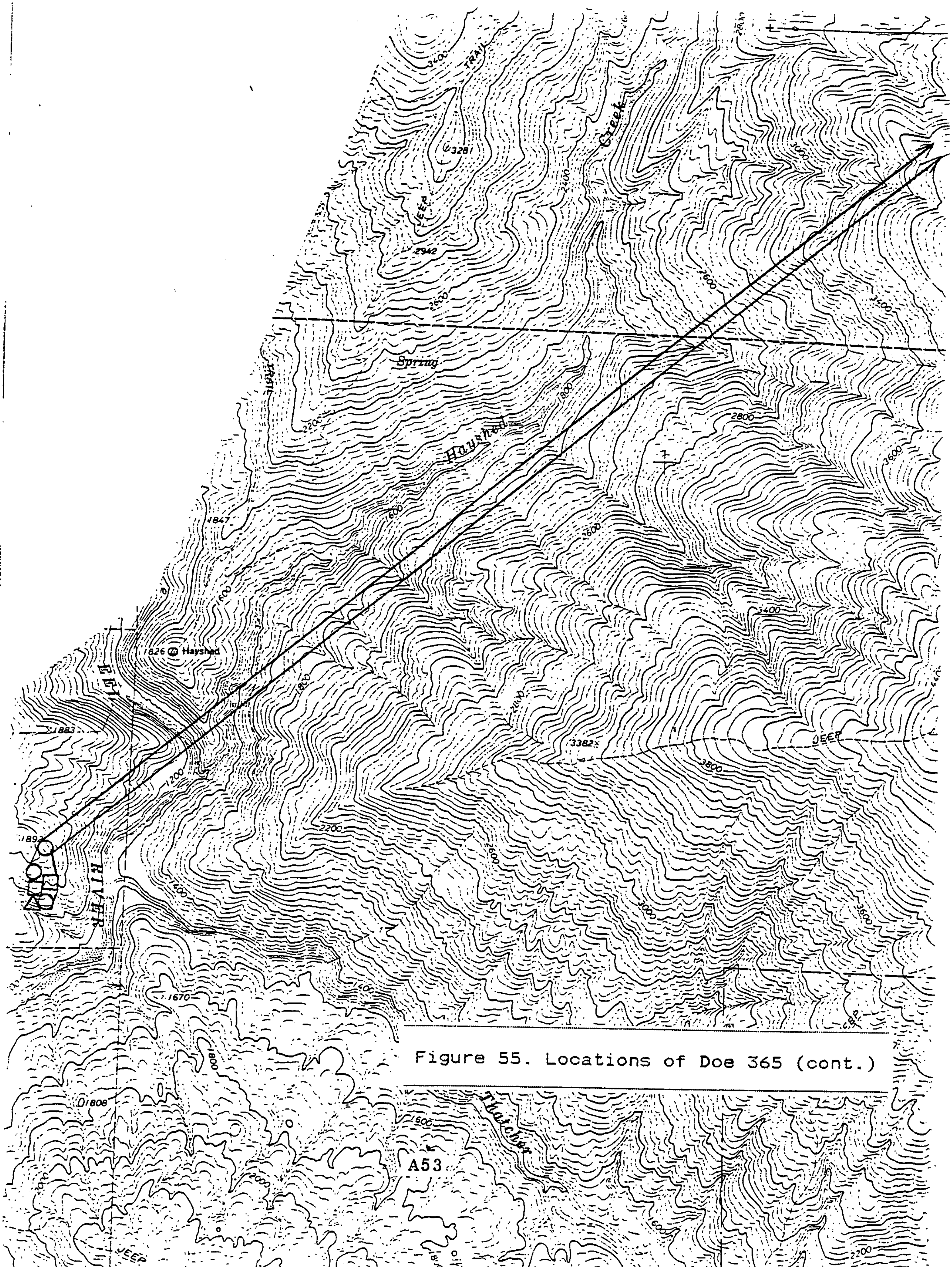


Figure 55. Locations of Doe 365 (cont.)

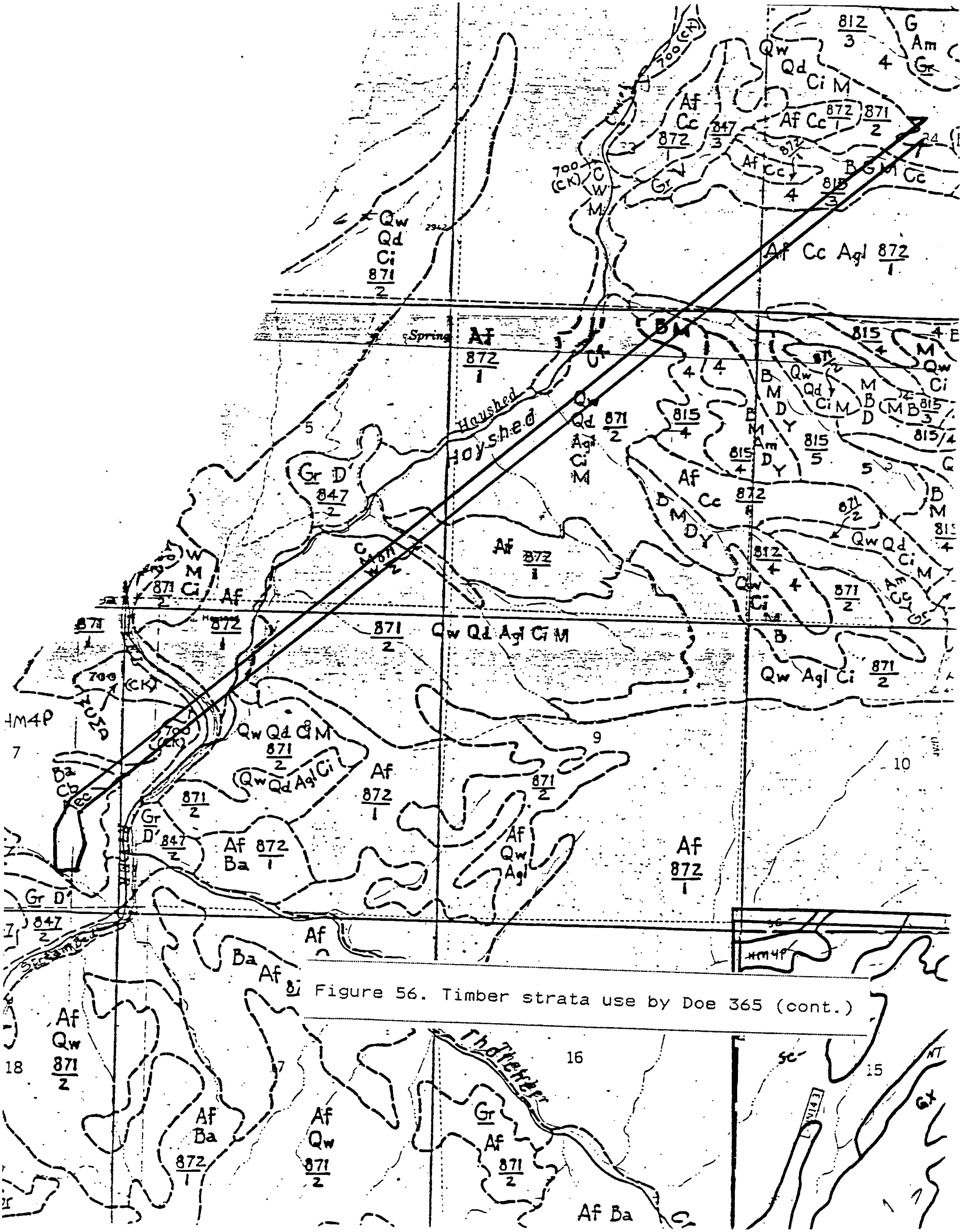


Figure 56. Timber strata use by Doe 365 (cont.)

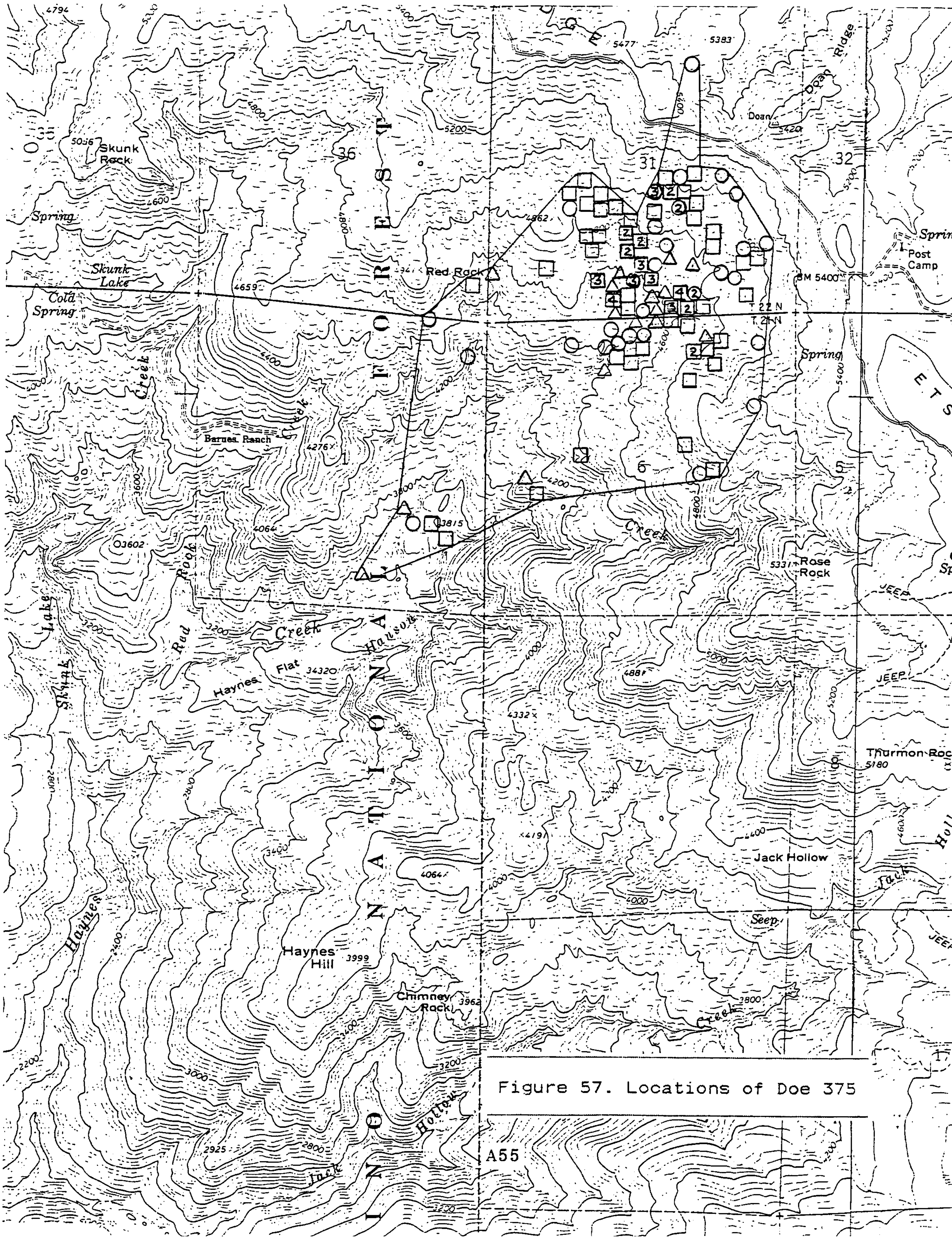


Figure 57. Locations of Doe 375

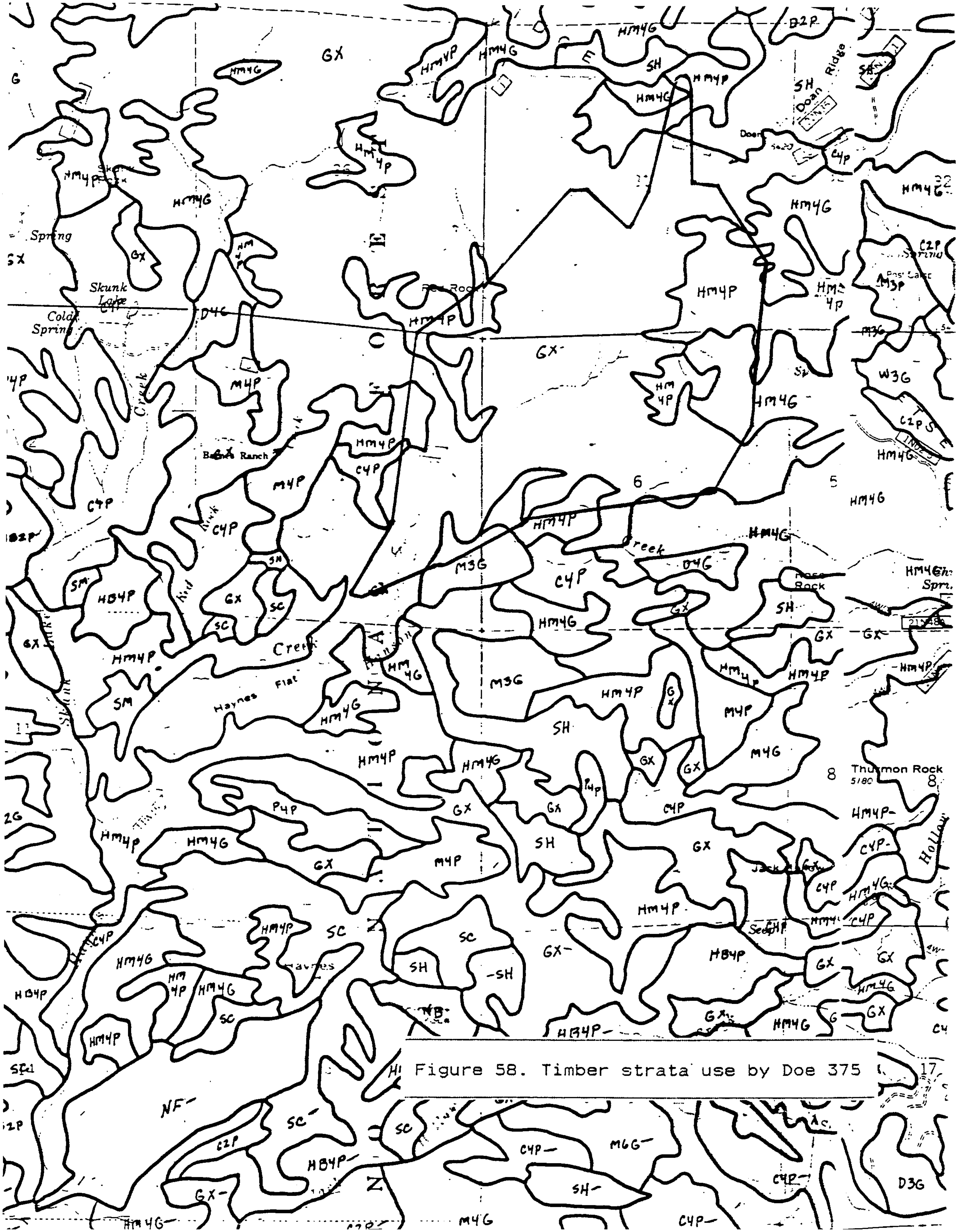


Figure 58. Timber strata use by Doe 375

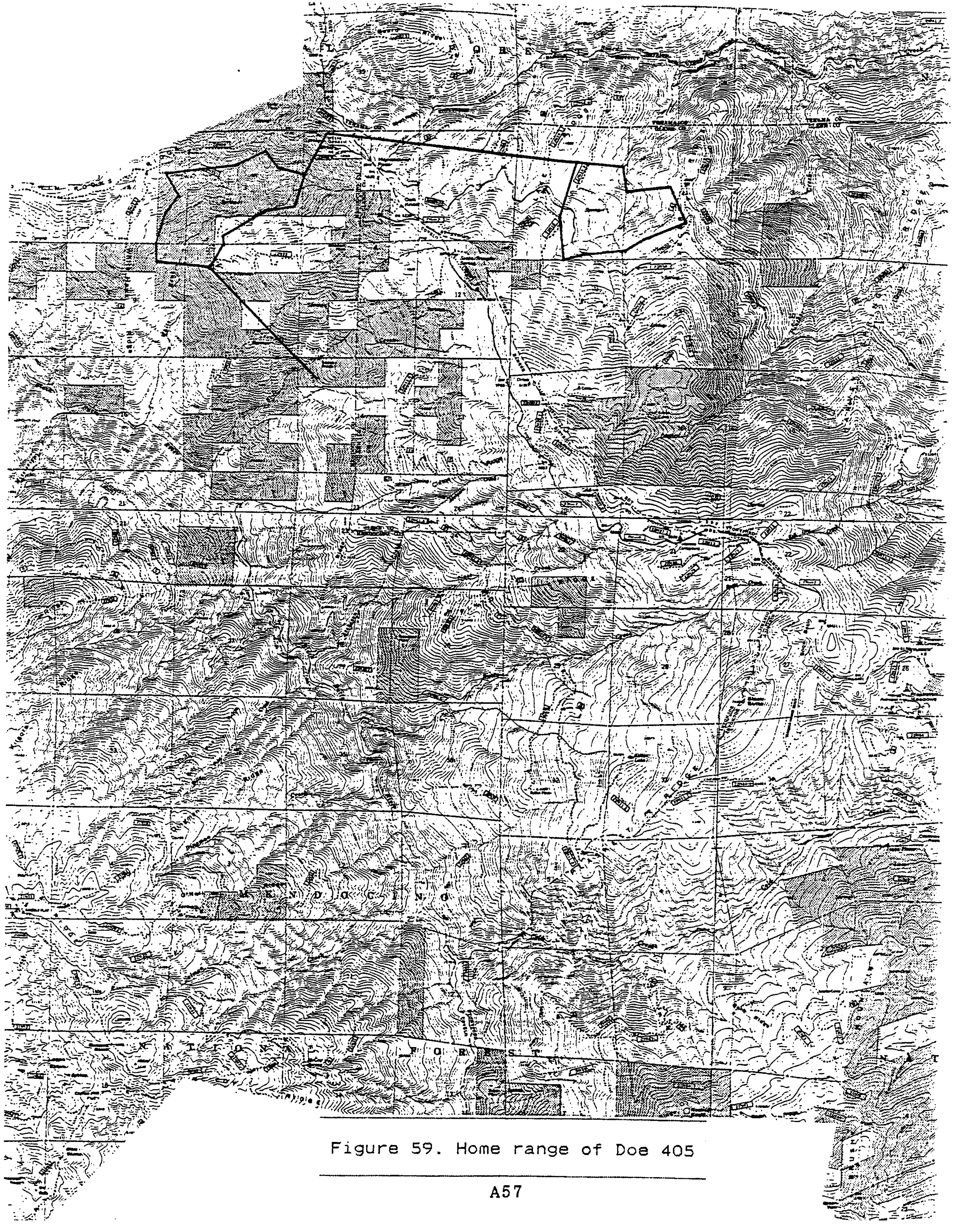


Figure 59. Home range of Doe 405

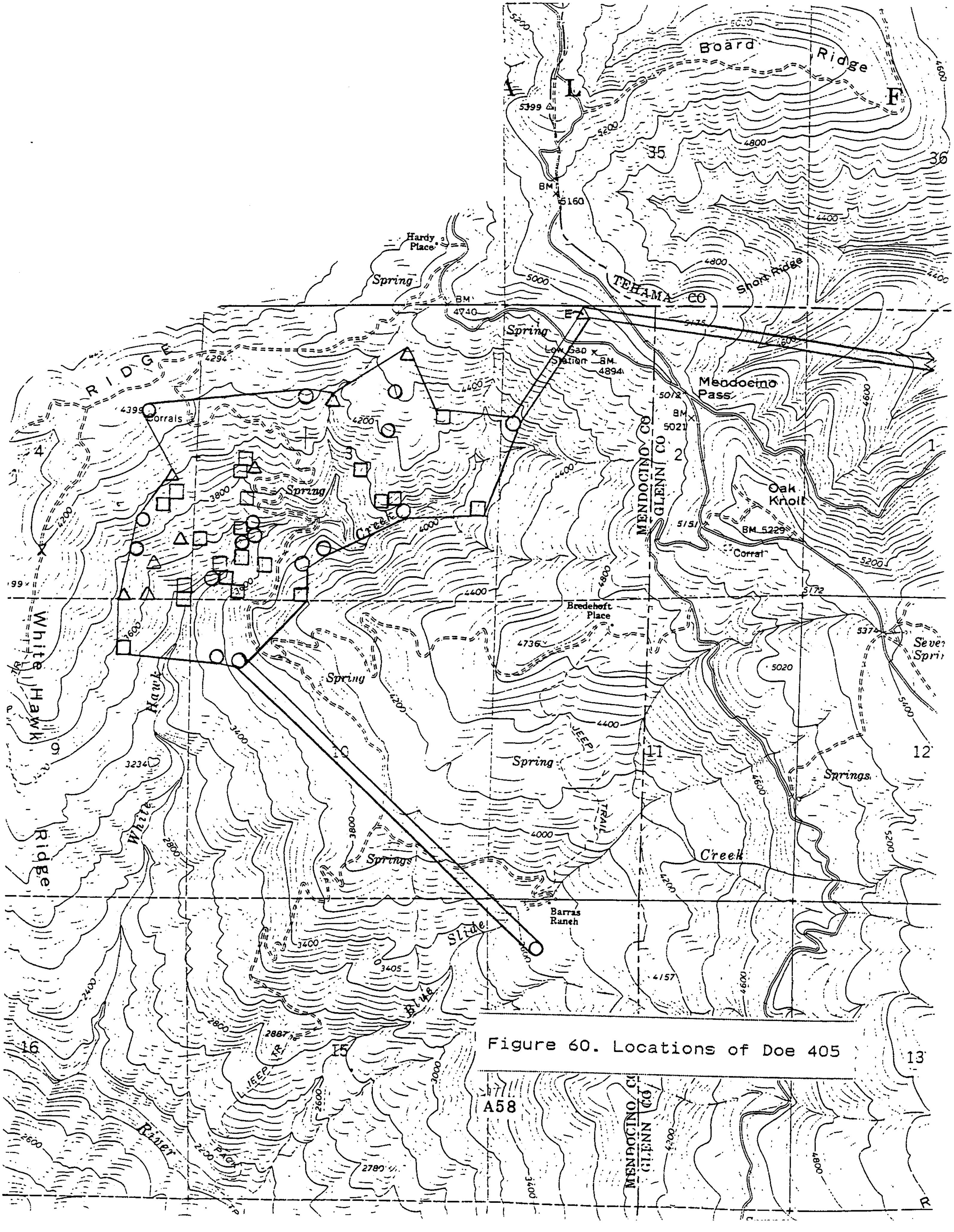


Figure 60. Locations of Doe 405

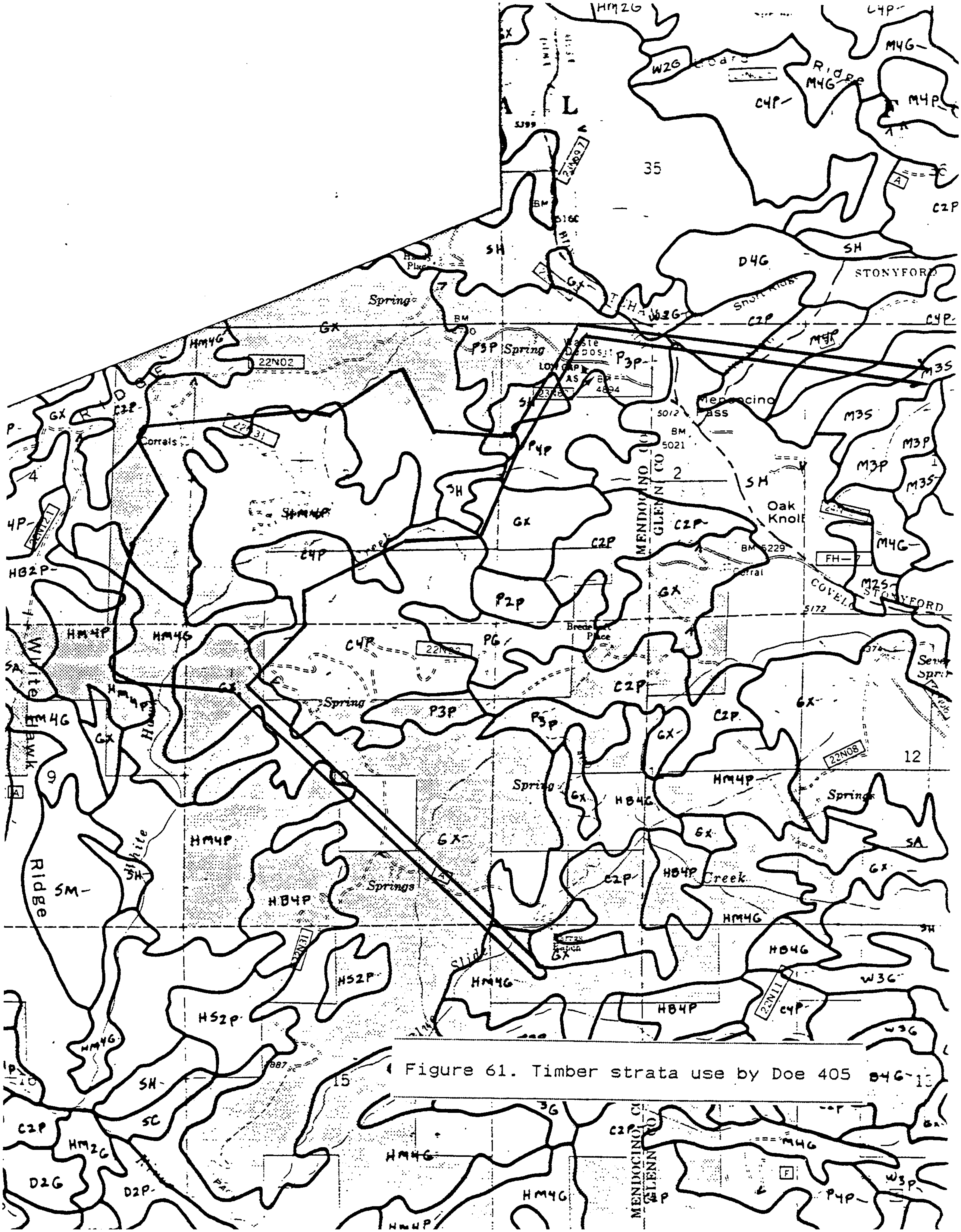


Figure 61. Timber strata use by Doe 405

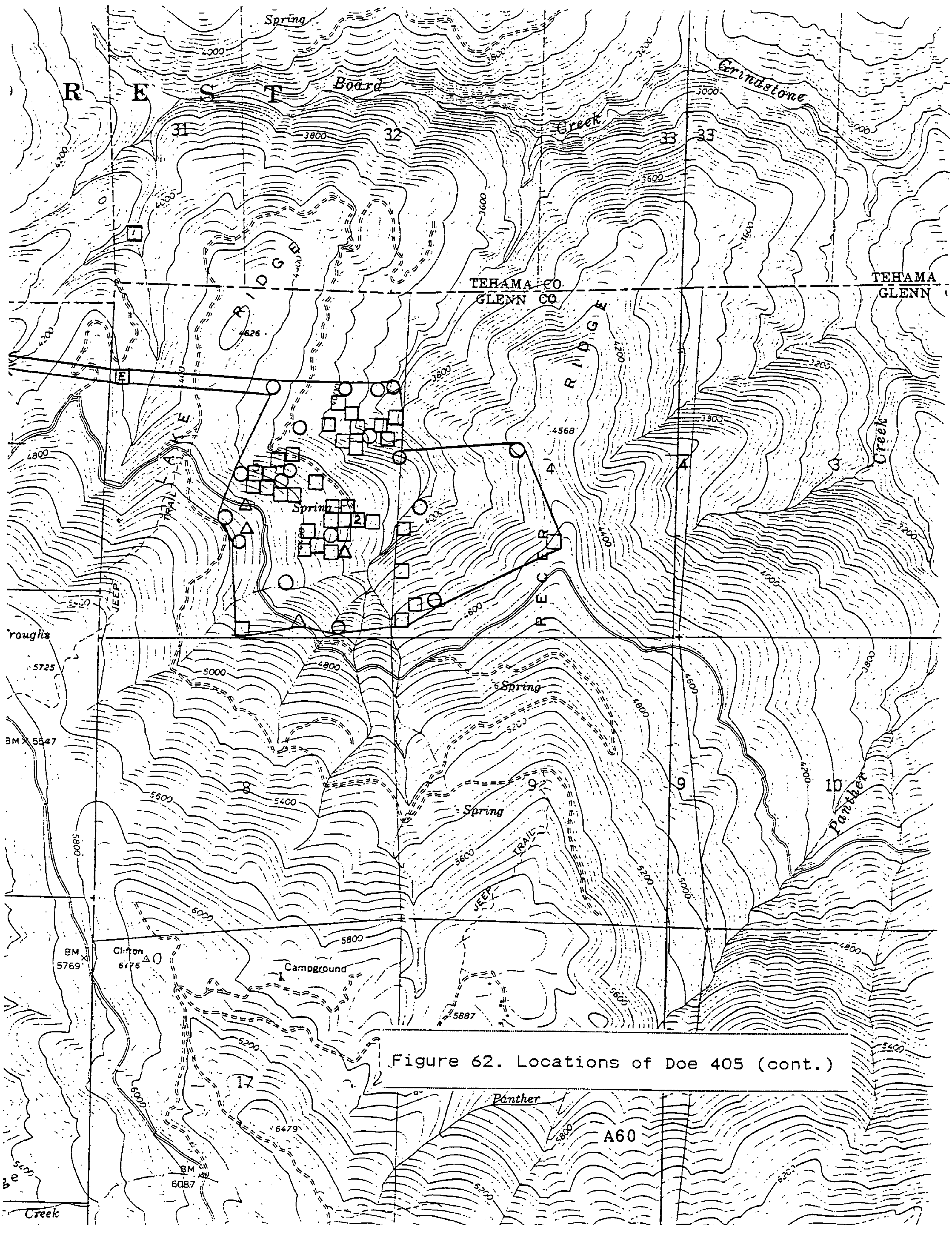


Figure 62. Locations of Doe 405 (cont.)

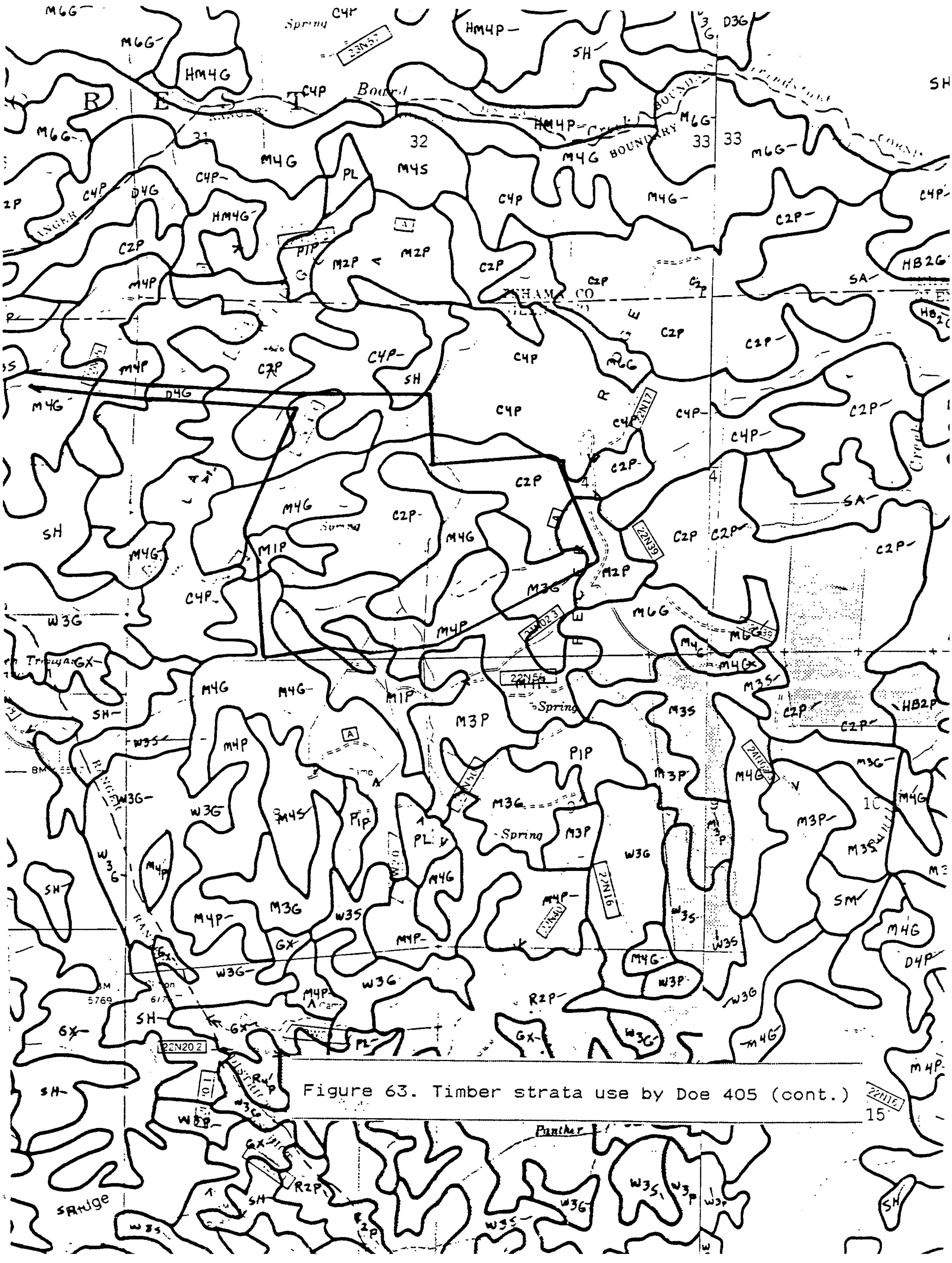


Figure 63. Timber strata use by Doe 405 (cont.)

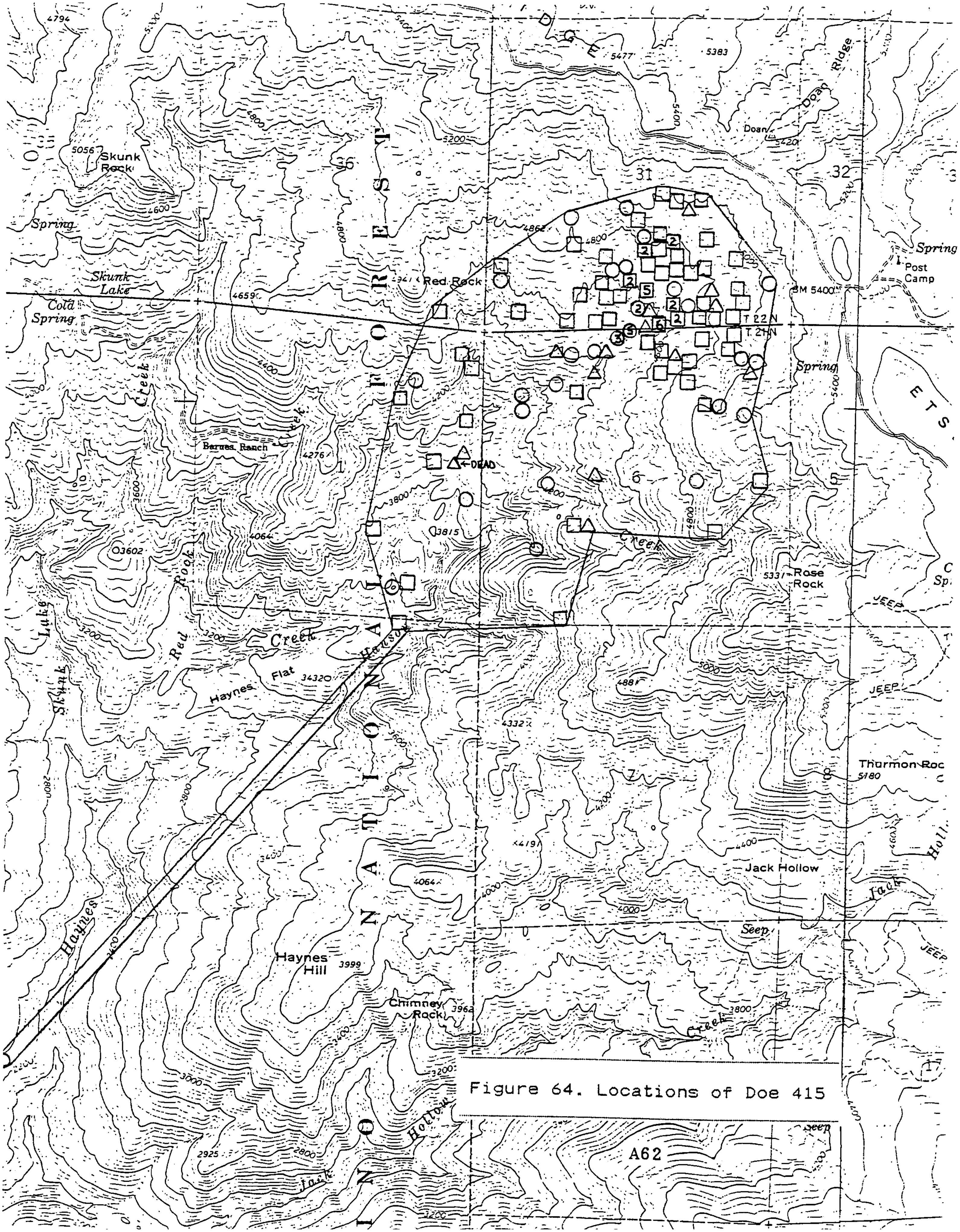


Figure 64. Locations of Doe 415

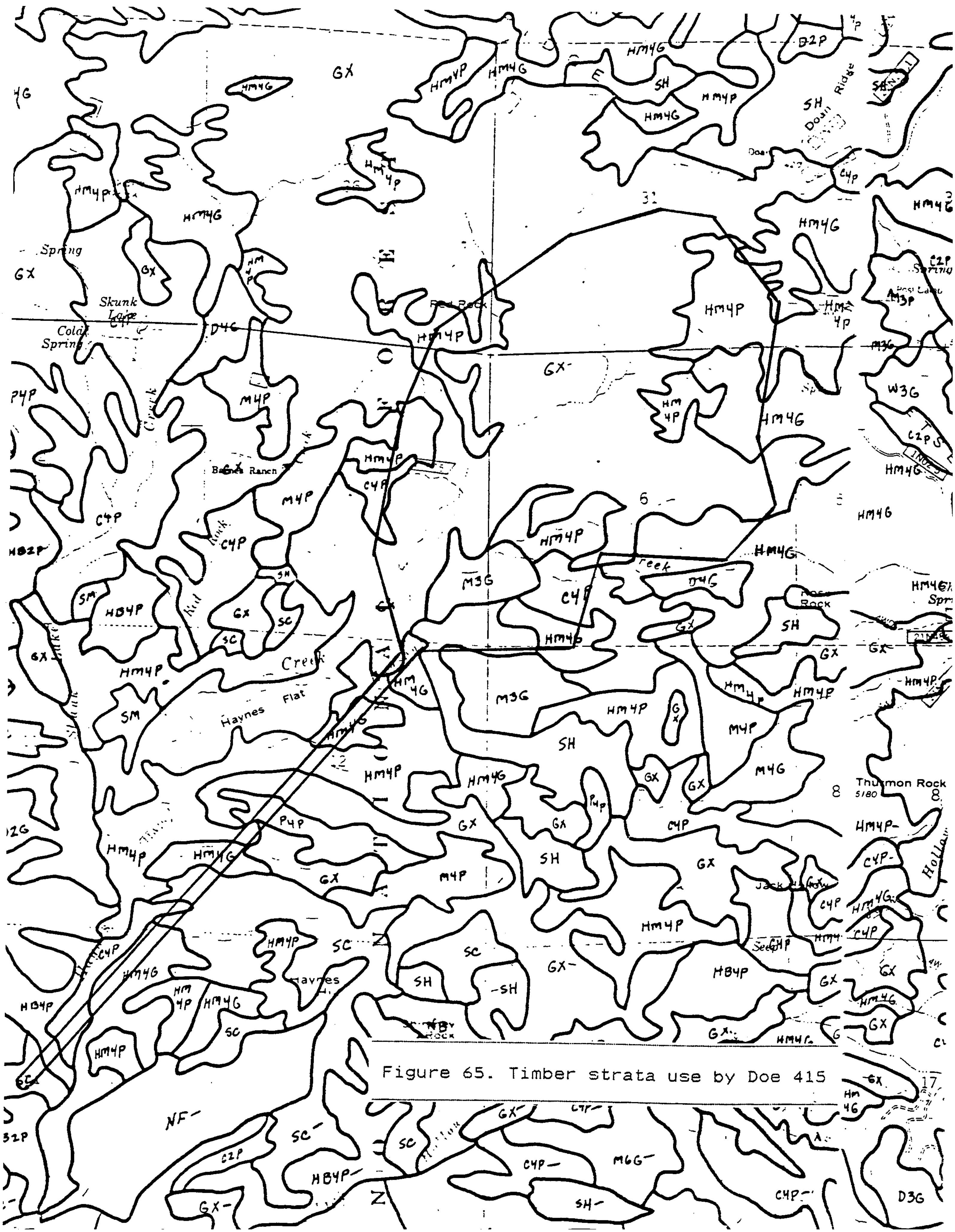


Figure 65. Timber strata use by Doe 415

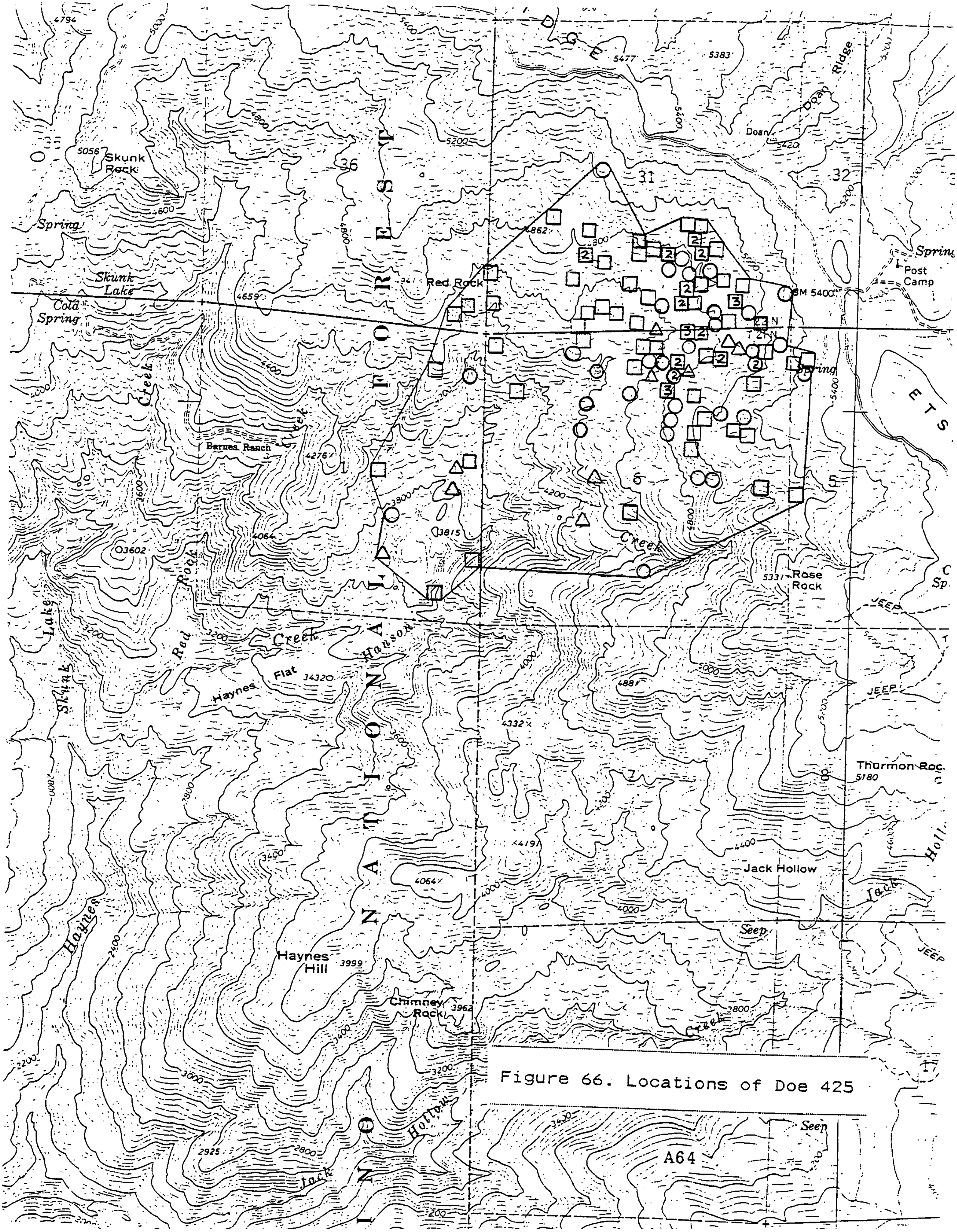


Figure 66. Locations of Doe 425

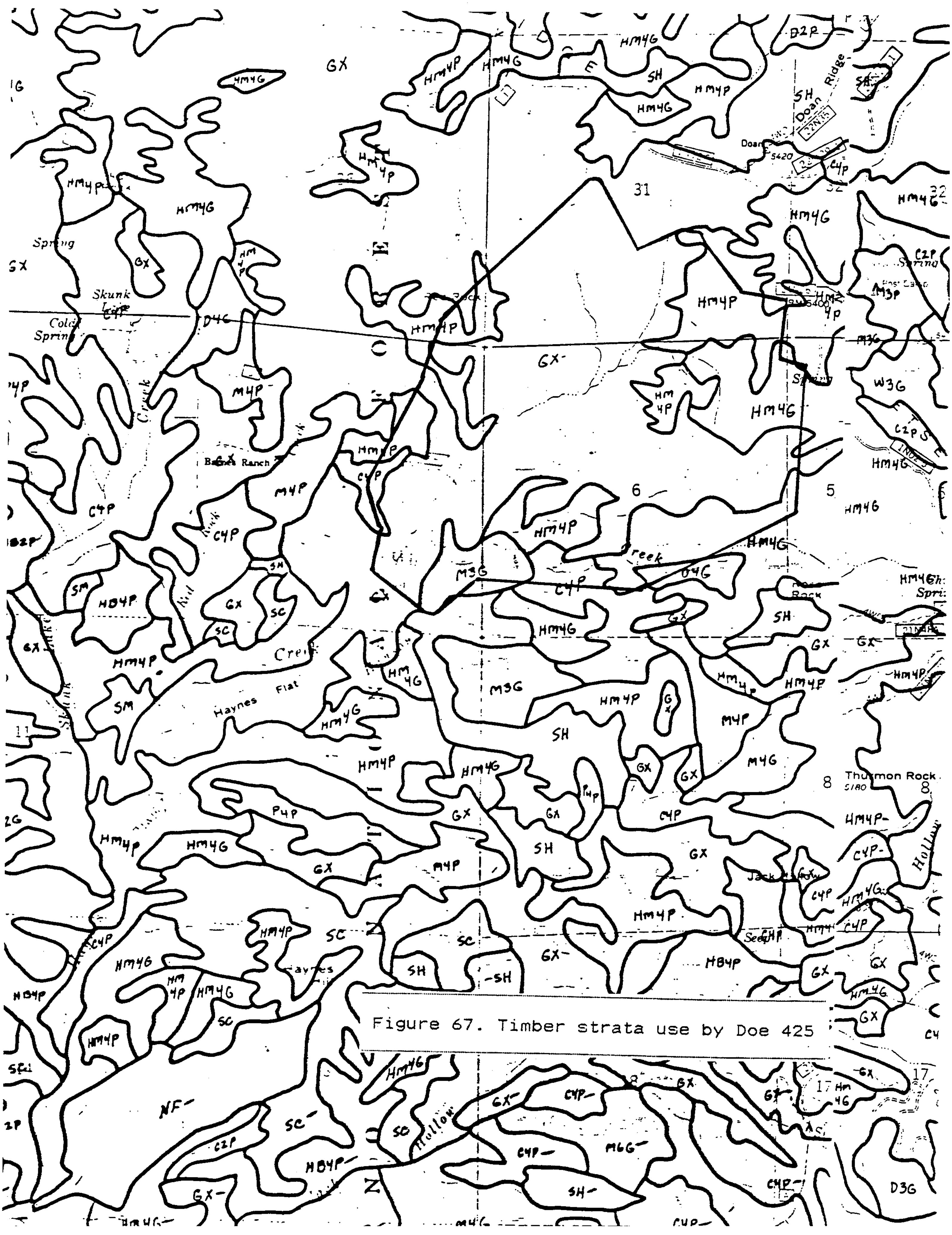


Figure 67. Timber strata use by Doe 425

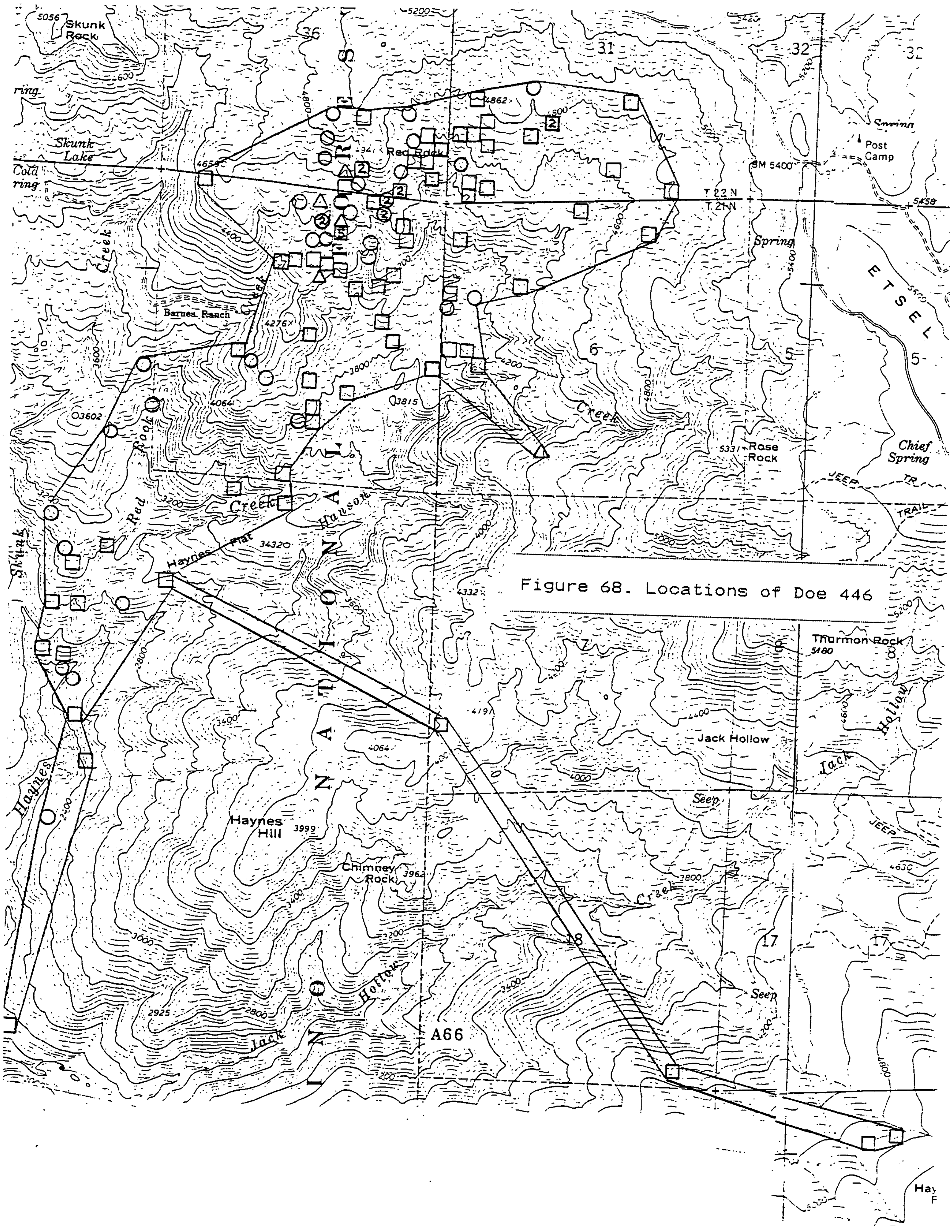


Figure 68. Locations of Doe 446

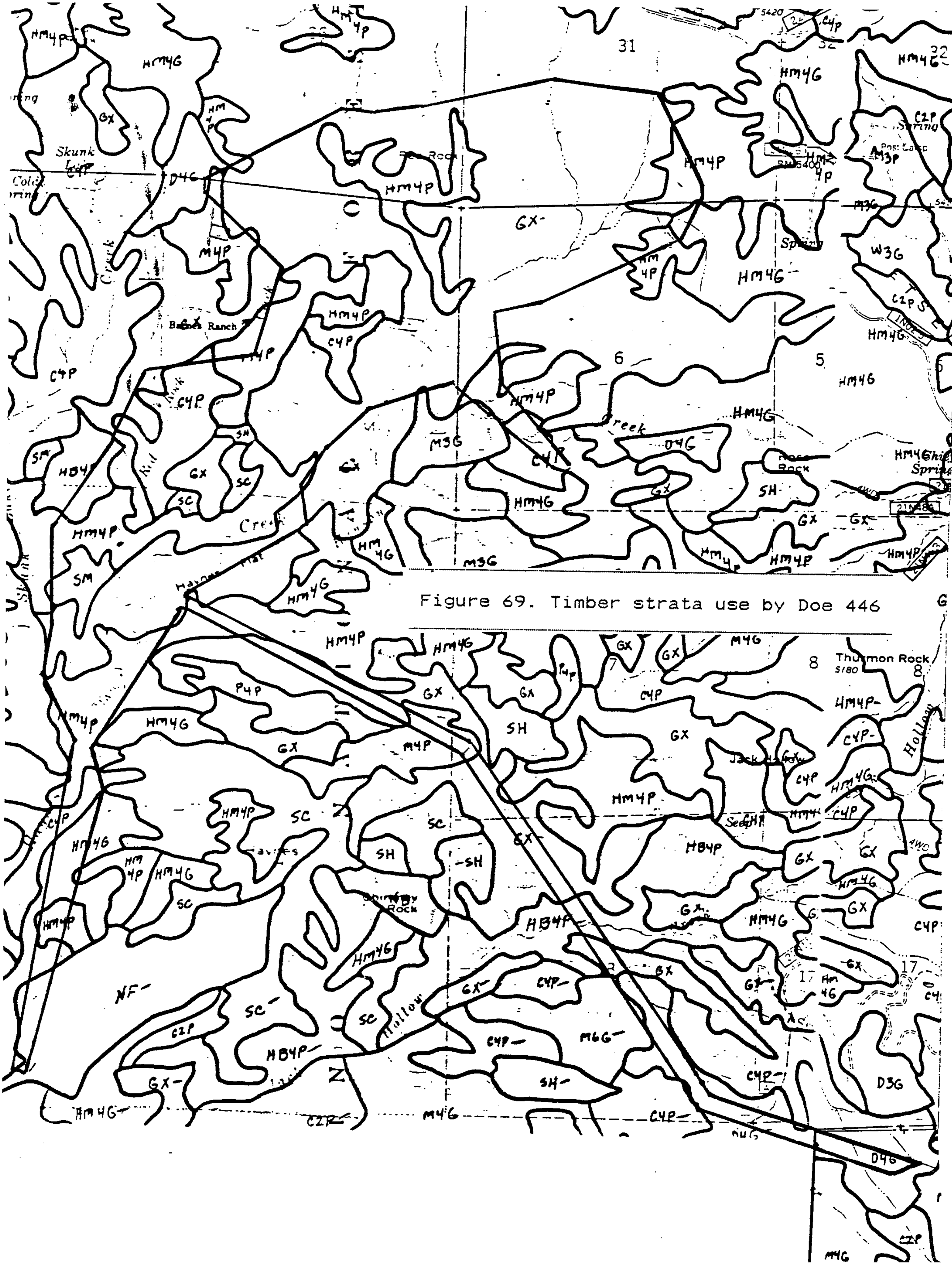


Figure 69. Timber strata use by Doe 446