# Elk Calf Survival Salmon River Mountains, Idaho: Summer 2004


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## Abstract

*The Rocky Mountain elk (Cervus elaphus nelsoni) populations in the Big Creek drainage and Cold Meadow area of the Salmon River Mountains have declined in recent years. Elk calf recruitment has been below management objectives of 24 calves per 100 cows in GMU 26 since 1995. Previous research has demonstrated that fecundity is high, but calf survival through the first year is low. Summer predation by gray wolves (Canis lupus), black bears (Ursus americanus), and cougars (Puma concolor) on the calves could be limiting population growth. At the same time density dependant factors such as age structure and herd composition ratios are acting on the population. Environmental changes related to recent fires are impacting available cover. Documenting when calves were born and died I analyzed the change in magnitude of calf:cow ratios from May 28 to August 10, 2004. 1,323 elk were documented in repeat observations with an observational estimate of calf:cow ratios 33:100 on August 10. ANOVA was used to denote the difference in proportions between the 3 study units. Predator scat analysis suggested bears were consuming young calves and wolves were consuming the most calves. Understanding elk calf summer survival can assist managing entities in land management practices, elk herd assessment and predator management policy.*

## Introduction

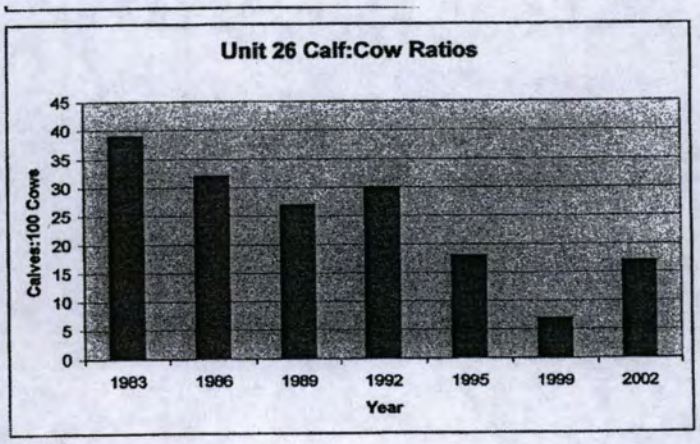
Recruitment of elk calves into elk populations has become a major source of concern for wildlife biologists in management agencies. During the summer of 2003 at the University of Idaho Taylor Ranch Field Station I became interested in the Rocky Mountain elk (*Cervus elaphus nelsoni*) populations located in the Big Creek drainage and Cold Meadow area. I observed that herd compositions appeared to show a low calf composition and recruitment into a declining population. Through changes in herd composition counts near the field station mortalities were suspected, but few remains were found and the causes generally unknown.

Akenson et al. (2002) large carnivore-ungulate research on Big Creek documented low calf:cow ratios, as well as low bull ratios in a declining elk population. These results were similar to the findings of helicopter aerial surveys conducted by Idaho Fish and Game (IDF&G) during the winters of 1999 to 2002. IDF&G aerial observations estimates showed calf:cow ratios to be low when compared to data from 1983 through

1992. Management objectives call for minimum of 24:100, but have been below this goal during March aerial survey flights since 1995 (Rohlman 2003). See Figure 1.

This problem of low calf recruitment has been identified elsewhere and investigated in many regions (Singer et. al 1997, Huff and Varley 1999, Mech et. al 2001, Zager et. al 2002). The Clearwater and Lochsa rivers have been studied extensively by Idaho Department of Fish and Game since 1973 to investigate the causes of low recruitment numbers. Over the course of many years of study they have found that 3 factors are affecting elk calf recruitment: 1.) Balance between elk density and habitat, 2.) Number and age structure of bulls, and 3.) Calf mortality (Zager et. al 2002).

Figure 1: Idaho Department of Fish and Game GMU 26 aerial survey elk ratio estimates




Interest in the decline of calf recruitment in the Salmon River Mountains caused further investigations into the potential causes. One hypothesis was that an old age structure of cows and low bull ratios were resulting in low reproductive rates for the population. Fecal hormone testing for progesterone levels in cows in the Big Creek drainage revealed that > 90% of cow elk tested in April were pregnant (Akenson et al.

2002). This would suggest high reproductive fecundity, but low survivorship of the elk calves. Therefore, mortality of the elk calves during their first year may be the cause of low calf recruitment rather than low birth rates. Several factors are hypothesized to be contributing to low survivorship.

Predation on elk calves by wolves (*Canis lupus*), black bears (*Ursus americanus*), cougars (*Puma concolor*), and other lesser predators can be a major mortality factor affecting population dynamics (Toweill and Thomas 2002). All 3 of these predators occur within the study area (Akenson and Akenson 2002). The Chamberlain Wolf Pack, introduced in 1995 had denned within study area near Cold Meadows in the last 6 years, and other packs formed adjacent boundaries. Elk are preferentially selected by wolves over other prey species and calves are killed disproportionate to their proportion in the population. Cougars were shown to also select calves, though not as strongly (Husseman et. al 2003). Previous research in this same region found that from the standpoint of determining ultimate numbers of elk and deer... it may be concluded that lion predation was inconsequential. While predation by mountain lions appears ineffective in limiting ungulate populations, the damping of oscillations of these populations can be important... The damping and protraction of fluctuations in ungulate populations can only have a beneficial effect on the environment (Hornocker 1970).

Black bears are opportunistic predators for whom predation is a learned behavior. Generally young bears are not effective predators. But older black bears can be an efficient predator. Under certain circumstances bears can constitute a significant mortality source for elk calves especially when elk populations are depressed (Toweill and Thomas 2002). Tracks of these predatory species were also seen in the meadows and along trails near streams where calving was observed which suggested that several species of predators were keying in on this calving area in search of elk calves during the early summer months. These observations suggested that predation in the Cold Meadow area may be a significant cause of calf mortality.

The factors of calf survival are variable among years and populations. While calf:cow ratios are used to estimate calf production and survival, they are not always indicative of population trends; instead they represent a combination of survival for calves and adults. The influence of predation is an integral and essential component of the elk ecology (Peek 2003). The effects and influence of such predation are considered of great significance in the maintenance of ecologic stability in a wilderness environment (Hornocker 1970). While predation is not the sole factor limiting recruitment of elk calves into the population, it is certainly one of interest that warranted investigation at this time in this unique region.

Habitat condition is probably the single largest factor in carrying capacity and it likely affects other factors as well. Habitat quality is likely the strongest influence on elk populations within a region (Toweill and Thomas 2002). The fires explained in the study area section have dramatically impacted the vegetation structure of this region and are certain to have an impact on elk populations by changing the feed availability and escape cover.

Many old cows with few new calves to replace them in an aging population will suffer from reduced fecundity and potentially collapse if low recruitment is not corrected to a stable level. The problem of continued low calf recruitment poses a considerable threat to the continued population retention for these elk. Calf recruitment into the population is essential for long term viability of this population.

The purpose of this study was to identify factors limiting the recruitment of elk calves during the summer season within the populations located in the study area. The objectives of this project were to:

1. Identify calving and nursery areas used by elk in the study area.
2. Identify the birth synchrony of elk in the study area.
3. Observe the magnitude of change in calf:cow ratios within the study area.
4. Document the timing when mortality occurs.
5. Identify and investigate the nature of the elk calf mortality.
6. Compare differences in calf:cow ratios affected in high and low elevation units.
7. Determine carnivores consuming calves through scat analysis.

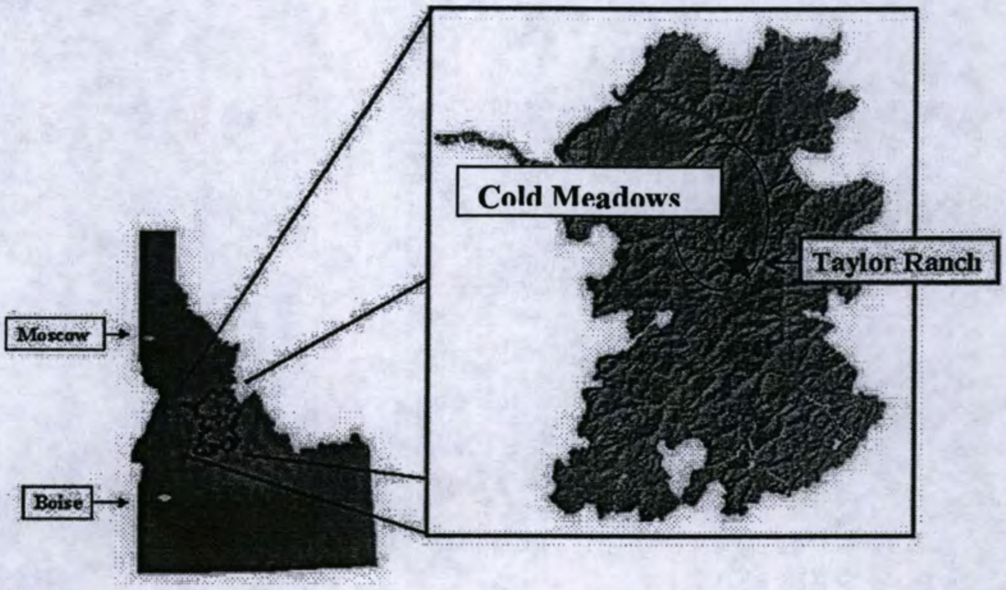
**Study Area**

Big Creek and Cold Meadow are located in the 2.35 million acre Frank Church River of No Return Wilderness in central Idaho. The Taylor Ranch field station is located on Big Creek, a main tributary to the Middle Fork of the Salmon River (Figure2). Observations took place at 3 study units. The first study unit was Big Creek complex that encompassed the middle to lower regions of the Big Creek drainage and tributaries. This low elevation study area extended along Big Creek from Acorn Creek to Goat Creek. The stream corridor elevation ranged 1158 m at Goat Basin to 1370 m at Acorn Creek. However, some of the peaks rising above the riparian corridor are > 2750 m. This complex was broken into two subunits, Mid-Big Creek and Lower-Big Creek. The dividing line between these two subunits was Brown's Basin; everything upstream was mid-Big Creek and downstream was in the Lower-Big Creek subunit. The Big Creek complex was at a much lower elevation by comparison to the Cold Meadows. This lower elevation complex was composed of Douglas fir (*Pseudotsuga menziesii*), mountain mahogany (*Carcocarpus ledifolius*), and bluebunch wheatgrass (*Agropyron spicatum*) plant communities. Bluebunch wheatgrass, Idaho fescue (*Festuca idahoensis*), cheatgrass (*Bromus tectorum*), and arrow leaf balsamroot (*Balsamorhiza sagitata*) are important species for elk foraging. The riparian zones and flood plains contained grassy meadows and riparian shrubs and trees. Most of this low elevation study area was burned during the Diamond Point Fire of 2000 changing the ecosystem dramatically.

The second complex was the Cold Meadow high elevation site. The elevation of this study area varied from 1701 m at Whimstick Creek to 2402 m on Runaway Ridge (Topozone 2004). The Cold Meadow surrounding area was dominated by coniferous forest vegetation with species composition varying in accordance with elevation and fire disturbance. Ponderosa pine (*Pinus ponderosa*), Douglas fir (*Pseudotsuga menziesii*), and Engelmann spruce (*Picea engelmanni*) composed the forest types. Large portions of the Douglas fir and Spruce zones were dominated by lodge pole pine (*Pinus contorta*) in seral stages following forest fires. The meadows were composed of moist to wet soils and support sedges, grasses, forbs, and shrubs (Wing 1969). Most of this high elevation study area was burned in the 1988 fire season.

The boundaries of the study area were large because the nursery bands of elk had a tendency to move throughout the summer in response to vegetation and predation. Winter range for this elk herd has been described by Akenson and Akenson (2002) as the lower elevations near the stream, generally preferring the south facing slopes. From ear tags placed on elk at the Cold Meadows study area it was determined that some of these animals winter on Big Creek and a smaller portion travel to the main Salmon River (Wing 1969).

Figure 2: Location of study area.




## Methods

### Data Collection

Observational records of animals were made using two observers for most of the project, usually at separate locations with radio contact. However this depended on the terrain and location of the animals. Two sets of 10x binoculars were used to locate animals. A 20-60x spotting scope was used to perform composition counts for cows, calves, bulls, and in some cases yearlings. Each count was performed for a minimum time period of 1 hour, unless the elk left the area and could not be observed. Counts were made independently by each observer and then compared afterwards. In most cases a count was made in the evening and then another in the morning of the same herd of animals to try to include all animals. Within each study unit a minimum of 15 independent samples were taken to provide a total sample size of no less than 45 independent observations for the whole project. A total of 67 observations were made, although not equally across all study units.

Four observational flights were made over the entire study area by two observers and a pilot in a fixed wing Cessna 185. Observational flights were performed during early morning while elk were still feeding in open terrain with a minimum of 2 observers in addition to the pilot. During these flights Global Positioning System (GPS) coordinates were taken on groups of elk observed and then transferred to MapSource topographical maps. The flights were performed in the manner outlined in "Estimation of wildlife population ratios incorporating survey design and visibility bias" (Samuel et al. 1992). GPS tracking mode was used to plot the flight times and patterns. Shown in Appendix 1. Locations of herds were recorded along with the total number of animals, composition of cows, calves, and bulls. Yearlings were not calculated from the air because it was felt they were not easily identifiable at the altitudes flown. Digital photographs were taken of groups for later analysis of vegetation and to verify count accuracy.

Two observers visited identified calving and nursery areas on foot to record the total number of animals, calf:cow ratios, and document neonatal mortality. Composition counts were compared between aerial and ground counts. This data was collected through direct observations of elk while hiking through the study areas or from stationary positions with binoculars and a spotting scope. We repeatedly surveyed designated routes through the study area spending more time at points where elk were seen during the flights.

Plant communities were classified by general categories. A general grouping of whether it was forested, burned, the dominant species, and an estimate of open, moderate, or closed canopy was recorded. Other classifications were mountain meadow, shrub-steppe or bunchgrass.

All mortalities that were identified were necropsied in the manner outlined in "Evaluation of Causes of Wildlife Mortality" (Roffe et al. 1996). Due to limited sampling by necropsy we documented all predator sign encountered and carnivore-ungulate interactions that occurred along the survey routes including track and scat surveys, vocalization, animal sightings, and carcasses by plotting GPS points. Initially fecal samples from carnivores and scavengers were examined at the point found and left in the field, but for the latter part of the study the samples were collected in Whirl-pak® bags and the locations found plotted on the GPS unit. The scat was then taken to the field station were they were washed over a series of three screens with wire mesh of 1", ½" and fine mesh respectively. Scats containing elk hair, hooves or other identifiable non-digested parts were noted. Other species consumed and identifiable were noted as well.

Figure 3: Scat analysis (Wolf scat containing elk calf hair and hooves).

**Data Analysis**

Proportions of cows with calves were calculated for each study unit across time. Day one began on May 28 and continued through day 74 on August 10, 2004. The results for each unit were combined and graphed across the entire study area through time. I used multiple comparisons of proportions to evaluate the significance in difference between the 3 independent study sites (Cold Meadow-Whimstick, Mid Big Creek, and Lower Big Creek). Univariate analyses were used to test for differences in means (t-test) and variances (F-test) between the 3 designated study areas. A Chi-squared analysis was done on the pooled variance of means squared between groups. From Zar (1984) I used the equation:

$$\chi 2 = \Sigma (X_i - n_i p)^2 / n_i pq$$
$$P = \Sigma (X_i / n_i)$$
$$Q = 1 - p$$
**where**
$$n_1 = 23, x_1 = 24.85$$
$$n_2 = 18, x_2 = 45.63$$
$$n_3 = 20, x_3 = 32.31$$
$$n_4 = 6, x_4 = 30.28$$

I compared the means of each calf:cow ratio for each herd in the study area. This was done using ANOVA performing F-test statistics. The assumptions for the F test are that "the samples are independent random samples; the distribution of the response variable is a normal curve within each population, the different populations may have different means, and all populations have the same standard deviation" (Utts and Heckard 2004). An analysis of variance was used to compare the differences in calf:cow ratios affected by habitat type.

## Results

A sample size of 1,323 elk was documented over the course of the summer. 1107 cows, 199 calves, and 17 bulls. Spikes were included in yearling count, not bull composition. This is not a population estimate, but repeat observations of the same cows-calf groups through time. When comparing the total number of cows observed to the number of calves observed across the entire study area for the summer months the observed mean across time was 15 calves per 100 cows. When counting of cows did not begin until the presence of calves with them the value changed to 35.6 cows with calves. However, an end of the summer mean between the study areas observed proportion of 33.1% is a more accurate estimate that represents summer survival of elk calves. The size of each herd remained fairly constant suggesting little exchange between groups during the summer months.

Cold Meadows had a total calf:cow ratio= 16:100, Mid-Big Creek=46:100, and lower Big Creek=34:100. Figure 4 shows the trend across time.

Figure 4: Proportion of cows with calves across time through the entire study area.

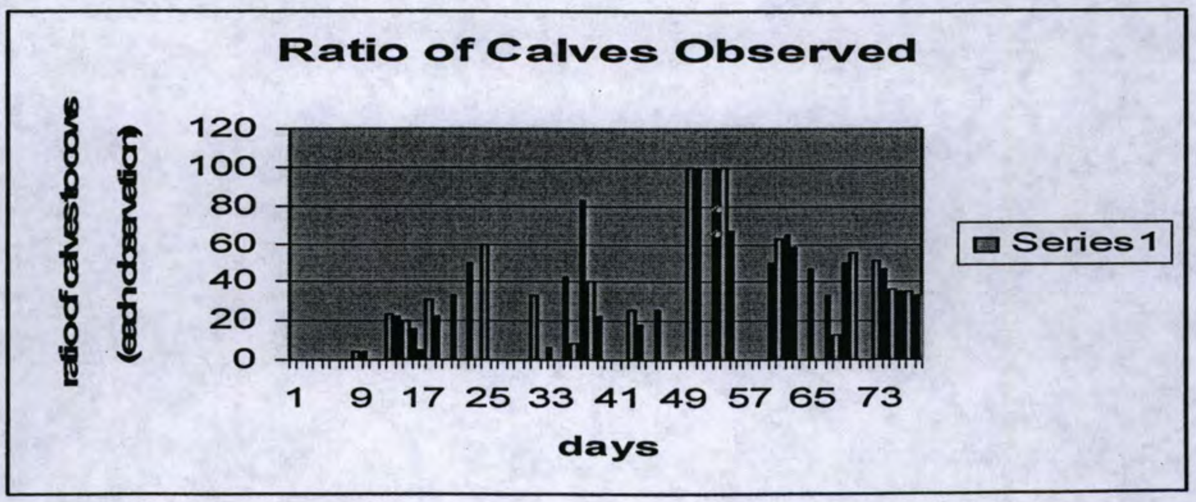
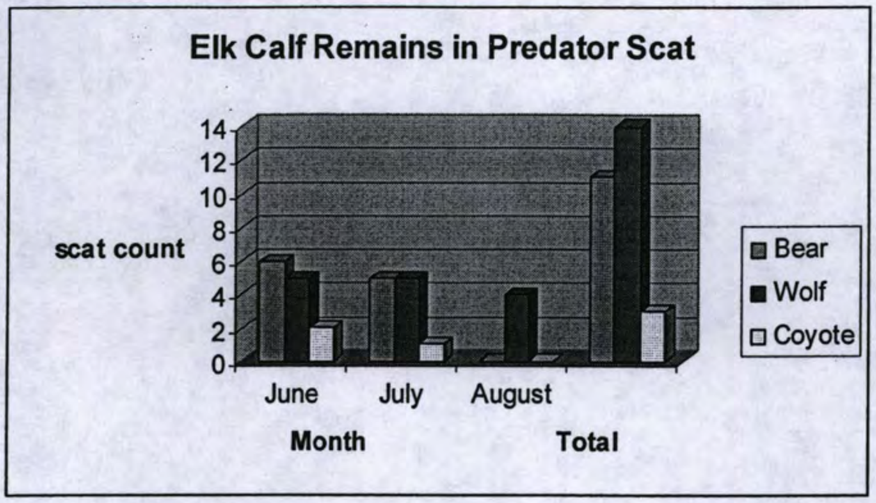


Figure 5: scat samples containing calf remains during study period.




Observed calving occurred mostly along the riparian corridors within 100 m of a water source. A total of 7 newborn calves were found that were believed to less than 1 week old based on physiology.

## Discussion

The information presented in this paper needs to be regarded with long term population trends of elk in this study area. This elk population is in a decline after reaching a historical high in the early 1990's. It is likely that this elk population was near the ecological carrying capacity. The high mortality of the calves may be a compensatory mortality in response to density dependant environmental conditions rather than a limiting additive mortality (Singer et al 1997). Figure 1 demonstrates that the elk population for this area was declining before the reintroduction of wolves in 1995. But the cause for concern is the change in the rate of decline after the wolf packs became established. Elk herds are being reduced, but not in danger of severe declines in this region based on summer calf recruitment. Elk recruitment should adapt to the new predation impact by wolves and elk calf recruitment and calf:cow ratios should recover and stabilize with time.

Between the study areas a significant difference was found in the proportion of cows with calves. The total numbers estimate proportion is skewed because it included early summer observations with pregnant cow groups who had not calved yet, and had a zero proportion of calves present or calves were hidden from observer view. Sample sizes within each study group may be too small for accurate proportional comparisons. When looking at individual units it appears that some have high survival and others are lower, but when graphed together the entire study area seems to show expected results within the normal range of variation for the species.

Observer bias in sampling methods may influence the results found. An assumption of accuracy when herds were located is reasonable high, but the issue of not documenting groups of animals could influence the ratios. The irregularity in locating herds and being limited in the area covered could place additional bias in actual versus observed population ratios. During the middle of the study the emphasis was observing small nursery groups with each cow having a calf, thus causing a 100% proportion during that time period. This was not indicative of the entire study population. In the predator scat sampling the wolves were likely a higher proportion of collections because of their behavior to mark trails with excrement, whereas cougars were absent from the sample because of their secretive behaviors in excretion. Other predators likely were somewhere between those two extremes. It should not be assumed that because an animal consumed an elk calf that it was responsible for killing that animal.

Although not addressed in this paper, because of a lack of time specific data and statistical analysis, the timing of calving appears to be an issue that is impacting the recruitment of calves into the elk population in the study area. I observed a prolonged calving period. There is an apparent rightward shift in the highest observed calf ratios later in the season, which would not be expected in normal population trends. This information may have the most important management implications for this population. The calving synchrony could be related to the low bull ratio and the age structure of the bulls present (White 2001). The recent fires have caused a reduction in the amount of available cover to be used during calving. With limited cover and a calving period that spans over a month in length the elk calves are a readily available and easy prey for carnivores. Predators seem to be concentrating in areas with dense cover where the young calves are hidden by cows. Under these circumstances normal predator swamping is lost and is instead turned into a population sink that provides a "buffet table" for predators that learn where to look for calves throughout the summer and repeatedly kill young calves in the same locations that have the limited cover on the landscape. This leads to a higher summer predation rate and reduced survival of calves. Predator control policies may be a short term fix, but it appears the deeper problems are related to habitat change and the sex ratios of adults in this elk population.

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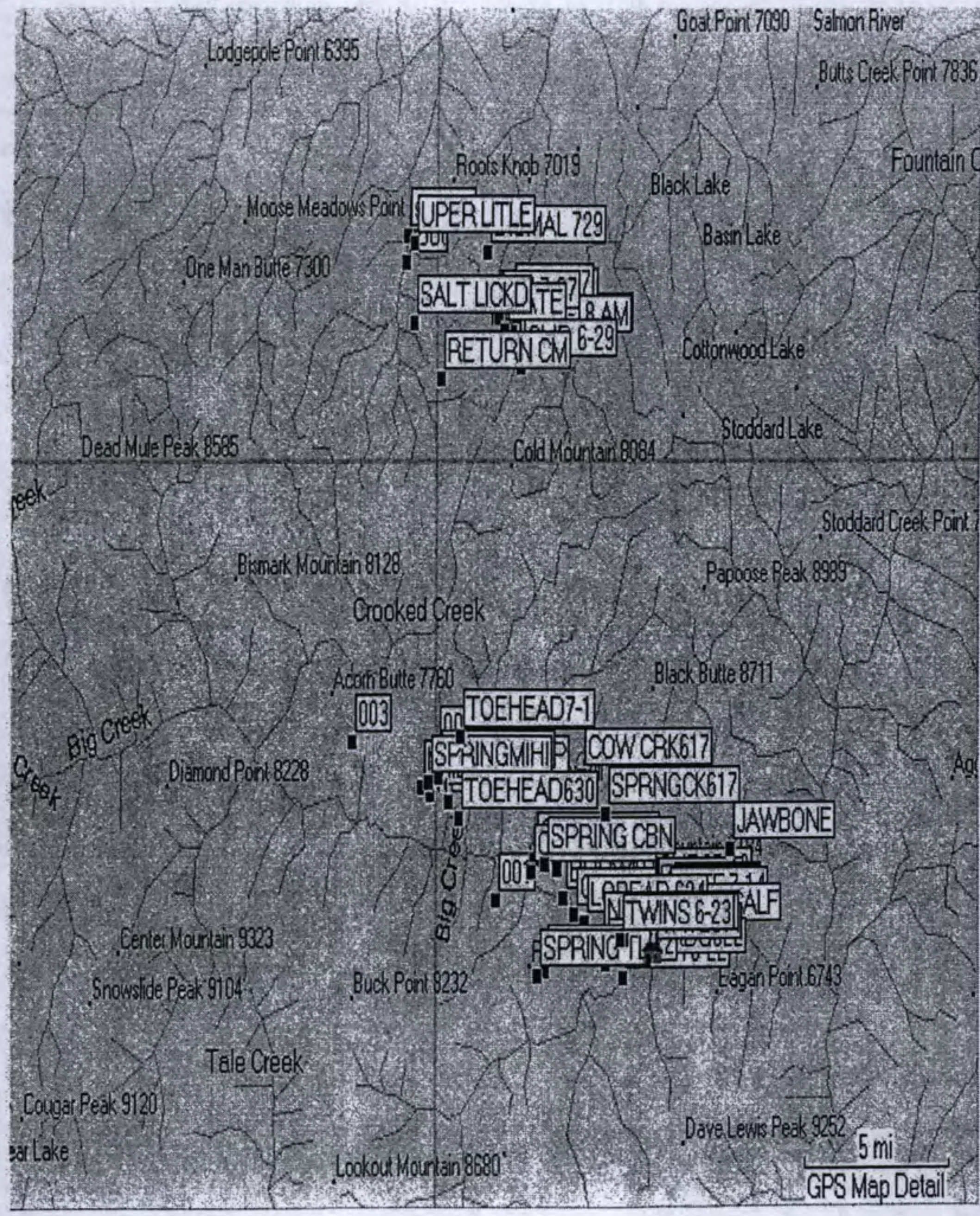
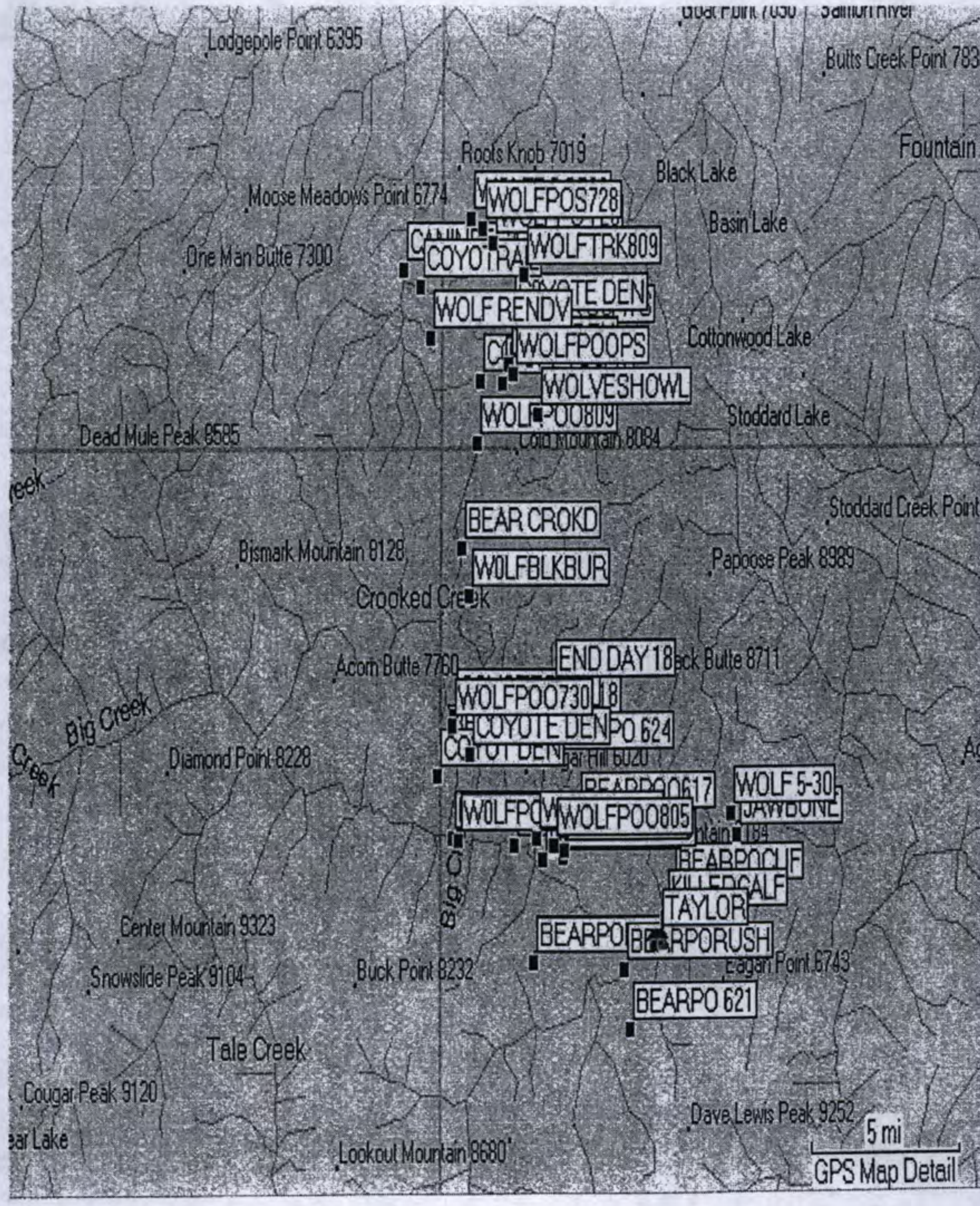
# Calf Locations May 30- August 10, 2004



# Predator Presence Detected



# Flight Pattern