1977

WESTERN STATES ELK WORKSHOP

Estes Park, Colorado
January 31-February 2, 1977

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STATE OF COLORADO
Richard D. Lamm, Governor
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WILDLIFE
Jack R. Grieb, Director
6060 Broadway
Denver, Colorado 80216 (825-1192)

December 10, 1976

TO: Western States Elk Workshop Participants

FROM: Richard N. Denney, Chairman

SUBJECT: Biennial Meeting of Elk Workshop

Dear Participants:

Date: Due to a conflict in meeting dates, the Western States Elk Workshop date has been changed to Monday, January 31, through Wednesday morning, February 2, 1977. Attendants should plan to arrive on Sunday, January 30, and may depart on Wednesday afternoon, February 2.

Place: The workshop sessions and accommodations will be at the Holiday Inn Resort in Estes Park, Colorado. This is about 50 miles northwest of Denver, at the east entrance to Rocky Mountain National Park. If you plan to fly into Denver we will provide transportation to Estes Park on Sunday afternoon and evening only, and return to Denver on Wednesday afternoon. Rates at the motel run from $14 to $18 single, and $20 to $28 double occupancy.

Enclosed with this notice are brochures on the Holiday Inn Resort and the Estes Park area. Please make your own room reservations in advance, to Barbara Veile, Convention and Sales Manager, "Elk Workshop", Post Office Box 1468, Estes Park, Colorado 80517 (telephone (303) 586-2332).

Program: We plan sessions for Monday and Tuesday, with a banquet Tuesday evening, and a half-day field trip to local elk range Wednesday morning.

General session topics under consideration are: elk herd computer simulation, predation on elk (bear-elk relationships); competition (livestock-elk relationships), forest management-elk relationships, deer-elk relationships, elk seasons (stratified hunt, etc.), inter-agency relationships, etc.

State personnel, as well as federal, provincial and academic persons receiving this notice, or those who wish to participate or attend, should

advise me if you would like to present a paper at the workshop (subject or title, author(s) and abstract) by January 3, 1977, so that the program can be confirmed and printed.

Please advise me as soon as possible of the names, or at least the number, of people from your organization that plan to attend, and, if you will need transportation from the Denver airport to Estes Park include your airline, flight number and time of arrival.

See you there!

RND:am

Enclosures

PROGRAM

Sunday, January 30, 1977

Arrival and check-in

Monday, January 31, 1977 - Lower Level of Holidome

0800-0900 - Registration ($3.50) and Banquet Tickets ($6.50)

MEETING

Longs Peak Room

0900 Introductions, announcements - Dick Denney, Chairman, Colorado

0915 Welcome, Jack Grieb, Director, Colorado Division of Wildlife

0920 State elk status and management reports by State Representatives

Arizona - Tom Britt

Colorado - Dick Denney

1000 Coffee Break

Idaho - Jerry Thiessen

Oregon - Paul W. Ebert, Mailed in (late)

Montana - Terry Lonner

Utah - Rodney John

New Mexico - Jim Johnson

Washington - Zeke Parsons

Wyoming - Jim Petera

Non-member reports: Michigan - Bob Strong; South Dakota - Harvey Lancaster; Ontario - Bruce Ranta

1200 Lunch

1300 Elk herd simulation modeling by computer.
Tom Pojar, Colorado Division of Wildlife, Fort Collins

1400 A population model of the North Yellowstone elk.
Charles Fowler, Utah State University, Logan

1430 Coffee Break

1500 Black bear predation on elk.
Mike Schlegel, Idaho Fish and Game, Kamiah

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1800 Hospitality Hour

1900 Banquet, Guest Speaker, Dr. Martin Windsor, President
Wildlife Friends League, St. Louis, Missouri

Tuesday, February 1, 1977

0800 Elk calving behavior in west central Colorado.
John Seidel, Colorado Division of Wildlife, Carbondale

0830 Elk use and habitat type-cover type relationships on summer and fall range in southwestern Montana.
Terry Lonner, Montana Game and Fish, Bozeman

0915 Elk and timber harvest relationships.
Francis Petera, Wyoming Game and Fish, Cody

1000 Coffee Break

1015 Elk response to human disturbances as determined from heart rate.
Lorin Ward, Rocky Mtn. Forest and Range Experiment Station, Laramie

1045 New Mexico's stratified elk hunt.
Jim Johnson, New Mexico Game and Fish, Santa Fe

1115 Effectiveness of yearling bull breeding.
Mike Welch. Presented by Rodney John, Utah Division of Wildlife Resources, Salt Lake City

1145 Advances in thermal infra-red scanning of ungulates.
Marc Wride, Entera, Calgary, Alberta

1230 Lunch

1330 Investigation of the range and habitat requirements of wapiti in the north Georgian Bay region of Ontario.
Bruce Ranta, Carleton University, Ottawa

1350 Studies of recruitment and mortality among elk in the Pecos Wilderness, New Mexico.
Bob Lange. Presented by Jim Johnson, New Mexico Game and Fish, Santa Fe

1430 The Rocky Mountain National Park Cooperative Elk Study

(1) Elk and their winter forage resources.
Jim Ellis, Colo. State University Natural Resources Ecology Lab, Ft. Collins

(2) The mechanics of elk use studies field work.
Tom Hobbs, Colo. State University Natural Resources Ecology Lab, Ft. Collins

(3) The simulation modeling approach
Dave Swift, Colo. State University Natural Resources Ecology Lab, Ft. Collins

(4) General management implications.
Dan Baker, Colo. Division of Wildlife, Ft. Collins

Tuesday, February 1, 1977

(5) Elk management in Rocky Mountain National Park.
Dave Stevens, National Park Service, Estes Park

1600 Western States Elk Committee State Representatives

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1730 Hospitality Hour

1830 Supper on your own

2000 Slides and movies of interest volunteered by attendees.

Wednesday, February 2, 1977

0800-1200 - Field trip, Rocky Mountain National Park Beaver Meadows area, tame elk foraging, aspen enclosure.
Cooperative Elk Study personnel

WESTERN STATES ELK WORKSHOP

Jack R. Grieb, Director, Colorado Division of Wildlife

0900, 31 January 1977, Longs Peak Room,

Holiday Inn Resort, Estes Park, Colorado

Welcome to the 1977 elk workshop group:

Welcome to snowless Colorado! If any of you are skiers, some of the major ski areas still offer fair to good skiing conditions. Colorado's mountains have about one-fifth the normal snowpack for this time of year. This winter, following a relatively mild winter in 1975-76, should be of benefit to big game in Colorado, particularly for our deer, which are beginning to make a comeback. The impact of this winter, so far, on wildlife and other land uses won't really be known or evidenced until this spring and summer.

Colorado's elk herds are in good shape, in fact they are still in a generally increasing mode. We have larger herds, generally, in established herd areas, and we are finding elk in areas not previously in their normal range.

We view this condition with caution, however, and are looking for indices that may forwarn us prior to the decline experienced in mule deer in recent years.

For those of you new to the workshop, and to refresh the memories of the oldtimers, let me briefly review the bloodlines of the Western States Elk Workshop.

HISTORY

The initial idea for a periodic gathering of Western elk workers was conceived by Levi Mohler (Idaho) and Dick Denney (Colorado) after attending an impromptu meeting of Eastern deer workers during the 1958 North American Wildlife Conference in St. Louis. They were impressed with the accomplishments of that meeting and came away recognizing both a need for and the potential of a similar meeting among elk managers and researchers. They carried their idea to that summer's Western Association meeting at Sun Valley, and an informal Elk Committee was formed.

Between 1958 and 1961 meetings were short, informal and held in conjunction and competition with summer Western Association meetings. Since 1962, meetings have been more organized and structured, and have been held during winter. Through 1965, meetings were held annually; since 1967 they have been biennial. Attendance has ranged from only a handful at early meetings to 117 at the 1973 Workshop held in Montana, and 109 at the 1975 meeting in Idaho.

Between 1958 and 1962, meetings were an informal committee of Western elk workers, gathered together to exchange ideas and information. At its 1962 meeting in Seattle, the Western Association officially created by resolution a technical elk study committee known as the Western Elk Council. It included all of the present member states with the exception of Hawaii, and also included British Columbia. Over the years, the name has become the "Western

States Elk Workshop" and voting privileges at business meetings have been restricted to one representative from each Western Association member state.

Including the 1958 organizational meeting, there has been a total of 14 meetings and Workshops - 2 each in the states of Colorado, Idaho, Montana, New Mexico, Oregon and Utah, and 1 in Wyoming.

A. Objectives of the Elk Workshop Committee are:

1. To provide a close liaison among persons engaged in elk research and/or management.
2. To provide an opportunity for such persons to discuss current projects, methods and techniques; exchange new information; and develop new ideas.
3. To discuss long and short range research needs necessary to insure maintenance and proper management of the species.

The Elk Workshop Committee has no formal or adopted by-laws or operating procedure. Following are the unofficial policies by which the Committee operates:

1. The Western States Elk Workshop Committee consists of one representative from each of the Western Association member states. This group is responsible for transacting any necessary business, adopting resolutions or initiating changes in operating procedures.
2. The Elk Workshop is currently scheduled biennially.
3. The Chairman of a forthcoming workshop shall be a member of the host state's Fish and Game Department.
4. The format of workshop meetings is left to the discretion of the host state, to be directed in a manner consistent with the objectives of the Committee.

An attempt is made to standardize terms commonly used in elk research and management.

A field trip to an elk management area is a part of each Workshop. These trips have exposed elk researchers and managers to new situations, resulting in a broadened perspective and approach to elk management.

In-depth discussions of mutual problems and concerns are a part of each Workshop. Topics discussed include: identification of animals for movement and migration data; interpretation of pre and post season sex and age classifications; effects of various land use practices on elk populations; new techniques or concepts, etc.

Other topics concern game management in general, such as quality hunting, economics and the anti-hunting sentiment.

The Elk Workshop will help strengthen elk management programs in the Western Association member states. In short, workshops have helped researchers and managers better understand the problems confronting them, and allow them to do a better job.

In conclusion, gentlemen, I urge you to consider that each state and province has different problems as well as common problems, and different approaches to their solutions. Make the most of this opportunity to mutually benefit from this fine meeting.

The elk workshop has made significant contributions in the past. We in the west expect no less in the future.

Welcome to Colorado!

STATUS AND MANAGEMENT REPORT
BY MEMBER STATES AND PROVINCES

ARIZONA STATUS REPORT

T. L. Britt

Historical records indicate Merriam's elk (Cervus canadensis merriami) was the species native to Arizona prior to the turn of the century. Little is known of its distribution since it is believed the Merriam elk became extinct by the late 1890's. Cochrum (1960) documents the collection of three specimens in Arizona. One specimen was reported collected at the confluence of the Little Colorado and Colorado River on the eastern boundary of the Grand Canyon National Park. Another was reported collected from the Santa Catalina Mountains north of Tucson, and a third came from Hannagan Meadow in Greenlee County adjacent to the Arizona-New Mexico border. Davis (1973) reported elk north of the Colorado River on the Paria Plateau. The origin of these animals is unknown, but it is felt they were not Merriam's elk. This is the only instance of elk being reported north of the Colorado River in Arizona. Otherwise the major distribution of Merriam's elk was similar to the current distribution of the introduced Rocky Mountain elk (Cervus c. nelsoni).

Arizona's elk population is believed to be a result of intensive transplant efforts during the early 1900's. During this period Rocky Mountain elk were moved from Montana and Wyoming and released in Arizona. They were released primarily along the Mogollon Rim, which is thought to be the major habitat of the Merriam's elk.

Today elk are found primarily in the ponderosa pine (Pinus ponderosa) mixed conifer vegetative communities and the adjacent pinyon-juniper (Pinus sp.-Juniperus sp.) communities along the Mogollon Rim. Distribution extends from the Arizona-New Mexico border west, along the Mogollon Rim to a point east of Ash Fork. A northern extension of the distribution exists in the Flagstaff area and terminates on the south rim of the Grand Canyon. Three disjunct populations exist. One is found on the Hualapai Indian Reservation in Mojave County and a second is located in the Hualapai Mountains also in Mojave County. The third is located east of Globe in Gila County, Arizona.

The majority of Arizona's elk herds occur on lands which are under the jurisdiction of the United States Forest Service.

Habitat

Typically elk occupy a distinct summer and winter range in Arizona. Summer range is found at elevations ranging from 5,500 to 11,000 feet. Vegetation at these elevations ranges from ponderosa pine at lower elevations to fir and spruce (Abies sp. and Picea sp.) at the highest elevations. Winter range vegetative cover varies considerably, but is typically pinyon-juniper woodland. Winter range is generally found adjacent to summer range, often within drainages formed by canyons.

Migration to winter range occurs after the first major snowfall of the winter. In the southwest the first major winter storm might not occur until January. Elk generally remain on winter range until late April. Total distance of migration rarely exceeds several miles. Often it only involves moving from a north exposure to a south exposure.

Elk appear to be establishing themselves as year long residents on some of the more typical winter range. In one extreme instance a herd has established itself on a year long basis in a shrub-grass vegetative community east of Flagstaff, Arizona.

Management Problems

Timber Harvest. Timber practices in Arizona have been based primarily on a shelterwood, modified shelterwood, or strip cut harvest principle. The overall effect of timber harvest to date appears to have been beneficial to elk, however, the short term effects of logging and related constructions are not fully evident or understood. A recently concluded cooperative study by the Arizona Game and Fish Department and Coconino National Forest determined elk distribution was not influenced by vehicular travel but solely climatic conditions (Neff pers. comm.). These results were clouded because vehicular travel in the unrestricted areas was minimal except during hunting seasons.

Grazing. Elk range conditions are fair to good at present. Work is underway to improve these conditions. During the past 12 months three major livestock allotment reduction adjustments on elk range have been undertaken by the United States Forest Service. To date one adjustment is finalized and the remaining two should be completed within 12 months.

It became evident, early in 1975, that livestock and elk were abusing the winter range in several locations south of Flagstaff. As a result, antlerless elk permits were increased 100 percent in three game management units south of Flagstaff during 1976. It appears the increased harvest may have alleviated some of the range abuse.

Encroachment. During the past fifteen years several valuable meadow lands have been lost to summer home developments. Developments appear to have been impeded slightly by the state of the national economy. The Arizona Game and Fish Department purchased several critical habitat areas, which were destined to be lost to development. However, in the early seventies austere budgets terminated further purchases.

The U. S. Forest Service Land Exchange Program is currently active and is in the process of obtaining an important tract of elk summer range north of Flagstaff.

Illegal Taking. Illegal taking of elk appears on the upswing. In 1975 over 10 percent of the bulls harvested in one elk hunt area were taken illegally. The increase in illegally taken elk apparently is a result of improved vehicular capabilities and high intensity spot lights.

Predation. Predation does not appear to be an important factor in Arizona elk herds at this time.

Disease. Blindness in elk as a result of the blood parasite Elaeophora schneideri is currently a problem in Arizona elk herds.

(Neff, Don. Game Research Biologist, AZ Game & Fish Dept.)

Smith (1969) reported infection rates as high as 85 percent. Blind elk were recovered for laboratory examination and study and information was obtained from animals checked during operation of a hunter check station. Elk managers in eastern Arizona believe elk blindness may be the single most important limiting factor in several elk herds along the Mogollon rim (O'Neil pers. comm.).

Population Status

Elk herds in Arizona appear to be stable at present. Slight gains in total numbers appear to be occurring in the western range, but are being offset by losses in the eastern range. The state's population is estimated at about 12,000 animals.

During the past three years, statewide calf survival success has averaged 60 calves per 100 cows. During the same period bull:cow ratios have averaged 32 bulls per 100 cows.

Research Status

Two elk research projects are currently active in Arizona. One involves determining elk use on experimental watersheds in the ponderosa pine and pinyon-juniper types. This project is near completion. Data are currently being compiled. The second project involves marking and monitoring elk movements. The objective of this project is to determine discreteness of elk herds within specific game management units.

To date 119 elk have been trapped and marked on the summer range south of Winslow. The majority were trapped during the summer of 1976. Trapping was accomplished by the use of four corral traps (2 portable and 2 permanent) utilizing salt as bait. Winter trapping was started in January 1977, south of Flagstaff. Two permanent traps are in operation. Leafy alfalfa hay is being used as bait. Trapping success has been hampered by lack of snow.

Seasons and Harvest

Arizona's first elk season was held in 1934. Two hundred sixty-six hunters participated in the hunt.

All elk hunts held in Arizona are on a permit basis. Permits are obtained through a computerized drawing administered by the Arizona Game & Fish Department. Permits are available to both residents and nonresidents.

Several seasons are available for the sportsman to choose from. An early firearms season in late September, a late firearms season during the first week of December, and an archery season, sixteen days in length, held in early September provide a wide selection. Firearm seasons vary in length. The early season is six days in length while the late season is nine days.

As previously stated, all hunting is on a permit-only basis. Firearm hunters are eligible to apply every third year after obtaining a permit. Archery hunters are eligible to apply each year for archery permits; however, an archer must wait three years to apply for a firearms permit after obtaining an archery permit.

(O'Neil, John. Regional Game Specialist, AZ Game & Fish Dept.)

Firearms Hunt Statistics. During the period 1971-75 a mean of 6,190 firearm elk permits were issued annually. As a result a mean of 5,734 hunters hunted annually in Arizona. The above hunters harvested an annual mean of 1,255 animals (826 bulls, 333 cows, and 96 calves) during this period. The harvest resulted in a mean annual hunt success of 22 percent.

Archery Hunt Statistics. The archery elk season was begun in 1972. It is unique in that archery deer, bear, lion, turkey, squirrel and rabbit seasons run concurrently. No special permit is needed for the taking of the above species, but a tag is required for each of the big game species. Archery antelope season (permit only basis) is open during the same time period. This affords the archer maximum opportunity to take any of several species of wildlife. Archery elk permit numbers have increased since the first archery season in 1972. In 1972, 750 permits were issued, and in 1976, 2,201 permits were issued. Likewise, the harvest has also increased from 22 animals in 1972 to 120 animals in 1976. Hunt success increased from 3.2 percent to 5.5 percent in this period. During 1976 hunters took 79 bulls of which 60 percent had branched antlers and 37 percent were 5 x 5 or larger.

Literature Cited

Arizona Game and Fish Department. 1976. Arizona game survey and harvest data summary. Arizona Game and Fish Dept., Phoenix, Az. 84 pp.

Cockrum, E. L. 1960. The recent mammals of Arizona. Their taxonomy and distribution. Univ. of Ariz. Press, Tucson, Az. 276 pp.

Davis, G. P. 1973. Man and wildlife in Arizona. The presettlement era, 1823 - 1864. M. S. Theses. Univ. of Arizona. 251 pp.

Smith, R. H. 1969. Wildlife research in Arizona. Arizona Game and Fish Dept., Phoenix, Az. pp 97-99.

COLORADO STATUS REPORT

Richard N. Denney

Historical Background. Elk were present in portions of Colorado during the Basketmaker III era, as substantiated by unmistakable pictographs on the sandstone cliffs of western Colorado observed by this writer. From early chronicles of mountain men and trappers we find that they used elk hides, leather and meat extensively, as did the prospectors and miners of later years.

Warren (1942) disclosed that elk were most abundant in the mountainous parts of Colorado, but were also found in much of the plains area. By 1872, however, Governor McCook requested protective legislation for several wildlife species, including elk (Feltner, 1962).

In his historical back-glance, Feltner (1962) briefly summarized that the deer and elk season was for antlered animals from September 1 to November 30, 1888. During this general period live elk were sold - 90 head recorded from Routt County in one season. In 1893 Commissioner Callicotte lamented the illegal kill of elk just for their heads, and recommended a five-year closed season to restore them to former abundance. Swan then suggested an open elk season in 1898 to attract non-resident sportsmen looking for trophies. Of the estimated 7,000 elk in Colorado that year, 4,000 to 5,000 of them were calculated to be in Rio Blanco and Routt counties.

Because of almost-extermination, elk season was closed in 1903 and remained so until 1929. Nevertheless, the demand for elk teeth by a fraternal order fostered illegal kills and further wasting of the resource.

In 1908, Commissioner Farr estimated that Routt County had more elk than any area, and would increase satisfactorily if unmolested, but by 1910, Swift (1945) reported that there was good reason to suspect the extirpation of the Rocky Mountain elk in Colorado. Forest Service records indicate that there were 500 to 1,000 elk in Colorado in 1910, mostly surviving in wilderness areas, primarily the heads of the White and Gunnison Rivers. From 1910 to 1920 a large system of refuges was created, and together with animals introduced from Jackson Hole and Yellowstone from 1912 to 1928 in 14 plants totaling 350 animals, resulted in an estimated 24,000 elk by 1943.

Elk from Routt County were transplanted to Leadville (Twin Lakes) and Ouray. More details of dates, numbers and specific transplant sites in this restoration program are available in accounts by Warren, Swift and Feltner (op. cit.), but native remnant populations persisted and provided the bulk of the come-back in the Estes Park area; Saguache Creek; upper Rio Grande; Dolores River; San Juan headwaters; upper portions of the Gunnison River tributaries; Middle Park; the White River Plateau; and the Elk River (Routt).

Even though the Elks Lodge created a demand for elk teeth and indirectly contributed greatly to the near extermination of wapiti, they also fostered the movement which resulted in planting 62 elk in three groups during 1913-15 in the Frying Pan-Roaring Fork area near Aspen (Borden, 1932).

Therefore, it can be presumed that the combination of regulatory legislation, transplanting and an extensive refuge system allowed Colorado elk to increase from an estimated 1,000 to the point that a special season was declared in 1929 to relieve damage and scatter local herds.

Recent times, and within the memory of most of us, have seen possibly the greatest population to date, and because of habitat limitations, perhaps the largest elk herd that the State will ever know.

By 1940 many critical range areas became evident, and it was apparent that populations would have to be managed more in line with winter range limitations. Aerial counts were begun about this time, and have been continued, expanded and refined since then, to the extent that currently there are 51 aerial trend counts established, the majority of them conducted with helicopters.

Lack of satisfactory snow cover on some years precludes obtaining the counts, or, in some cases, storm, or lack of snow at lower elevations, makes only a partial count possible. Many people, including some in our Department have been highly critical of these aerial trend counts accusing us of counting shadows, rocks, stumps, etc. Because of varying conditions under which counts must be made, a set of qualifying condition descriptions has been set up, and in recent years is used to describe ground cover (snow), light and flight conditions for each trend count made. Although the trends are made under as nearly similar conditions each year as possible, one must accept that absolute comparisons are not probable due to the wide range of factors involved. Therefore, when the three conditions listed above are enumerated, they may qualify any obvious discrepancies for valid comparison.

Higher counts in the same trend area are possible with the helicopter as compared to the fixed-wing, and many of the newer areas are being flown with the helicopter. This, plus the fact that some feel the observer is getting much more efficient, is the argument that some use as the reason for apparent upward population trends. Probably the five-year comparison is the most valid, not being as reflective of yearly fluctuations due to other factors, but more sensitive to changes for management than the ten-year average.

Realistically though, I feel that the trends are becoming more efficient and meaningful, and reflect the condition of local herds better than any other enumeration method available. It is undoubtedly true that elk numbers in some very local areas may be down or decreasing, but all indications are that the general population trend is at least static, and gaining generally state-wide.

People who have observed elk grouped in herds of 500 and more as recently as 20 to 25 years ago feel that they are definitely down, seeing herds of less than 200 in the same areas nowadays. This tendency not to herd-up in large numbers is quite evident, but this generally is due not to a decrease in elk populations, but rather to a combination of several other factors, not the least of which is the relatively heavy hunting pressure exerted upon elk during the past 25 years. One tremendously important factor contributing to this situation has been the Englemann spruce beetle epidemic which killed one quarter million acres of timber in the heart of some of our best elk country. The death of this timber, some 5.4 billion board feet, and the subsequent needle dropping, caused the opening of the canopy of the overstory so that many plants were able

to invade range once denied them by competition and lack of tolerance. The presence of much more feed in the timber undoubtedly was the major cause of many of the larger groups of elk dispersing into smaller herds and becoming interspersed over a wider area and new range. This assumption is substantiated by the Lost Solar Park elk exclosure and similar studies which revealed a lack of concentrating in the large parks by elk after invasion of the timber stands by many forage species. Now, after 25 to 30 years, there are areas where reproduction has become established by Englemann spruce and Alpine fir, the stands are beginning to close up.

It is conceivable that in the not too distant future we may again have spring and summer range damage by elk in some areas where the plant succession has denied them the forage supply now available in beetle-killed stands. This, of course, will not be a blanket effect, nor will it happen suddenly, but the changes may be so slow and imperceptible as to progress unnoticed until a problem has developed.

This situation may force us to liberalize local seasons, revise our herd management objectives, and be reconciled with a smaller herd. In addition to this, other factors may make it imperative to hold herds at present levels or lower. Two such factors are the increasing demand for available ranges by domestic livestock, and even for intensive agricultural development in some areas, and the unfortunate fact that many ranges are steadily deteriorating and will not support even present numbers under existing range management practices by land-use agencies.

Therefore, it appears that we are very possibly in the heyday of elk numbers now, and can only expect to manage more intensively with lower numbers in years to come.

It is apparent that the greatest number of elk are to be found over broader areas in the southwestern part of the State than elsewhere; with more localized, high densities in northwestern Colorado.

How many elk we actually have in Colorado at present is not absolutely known, and is a matter primarily of conjecture. Estimates in 1961 have been made of a State total of 56,000 elk on national forests by the Forest Service (1961), while unofficial Department guesstimates run around 50,000 head. We currently (1977) estimate around 125,000 elk in Colorado.

Past Elk Harvest. In the mid-1800's people were still killing elk and other game animals just for the hind quarters, heads or teeth. By the late 1800's restrictive legislation protected elk during some portion of the year, and generally allowed only the harvest of antlered animals. Elk season was closed from 1903 until 1929 when a special season was declared in four counties to alleviate damage to fields. In these three days of season, 300 head were killed, and crop damage curtailed, but violations, wounding losses and lack of sportsmanship were high.

A five-day special season was first held in November, 1931, in Eagle, Garfield, Gilpin, Grand, Hinsdale, Jefferson, La Plata, Larimer, Pitkin, Routt and Summit counties for male elk with forked-antlers or better, and an average of 400 elk were killed annually for several years.

Elk seasons became more liberal and from 1940 through 1944 cow licenses were permitted, averaging 2,246 cow licenses per year, with the kill averaging 4,069 total elk per season.

In 1945 hunter's choice elk seasons were begun, and ran generally until 1952, when validations or either sex licenses as we now know them were initiated. According to an earlier report (Denney, 1961), approximately 70 per cent, or about 30,000 square miles, of the State open to elk hunting was open to validations, and approximately 97 per cent of all elk harvested were from validation areas.

Since the inception of validations in 1953 on an intensive scale, and during the period 1953 through 1967, the number ranged from 2,525 to 9,330, with a ten-year average of 7,163 validations, and with an average success ratio of 47 per cent. While the per cent of validation holders taking bulls varied from year to year, it averaged five per cent. During this 10-year period, the elk kill averaged 24 per cent higher (8,737) than it averaged the eight years from 1945-1952 (7,029). The mean for the period was 7,978 elk.

By this time the validations for cow elk evolved into either sex licenses limited in number by game management unit. After two years of preparation of the landowners involved and the general public through local meetings and published material, an experimental season was held in 1966 on the White River (Units 23 and 24), wherein the total number of bull hunters was limited, as the cow hunters had been since 1953. The basis for this new type of management, called a specified season, was the very high and increasing numbers of bull hunters, the decreased number of large or trophy bulls, the increasingly lowered bull to cow sex ratios each year, and a decreasing calf to cow ratio. At the same time the general herd population trend was increasing, so in an attempt to correct several faults, increased pressure and harvest were oriented toward the producing part of the herd, the cows.

The success of this type of season is reflected in the fact that it has been expanded to up to 15 areas in the state which meet the necessary criteria, and 1977 marks the twelfth year of its implementation.

During the nine seasons beginning in 1968 and running through 1976, the mean elk harvest has been 19,260 total animals, compared to a mean total kill of 8,269 for the period 1940 through 1967.

Figure 1 depicts a graphical presentation of elk license sales and harvest data from 1940 through 1976. Table 1 lists these and other data for the same period.

Future Management. The goals set in Colorado's strategic plan for elk are relatively conservative, and should be comparatively easy to attain with proper, progressive management. The population goal of 118,500 elk set for 1983 has probably already been reached, and the predicted annual harvest of 27,000 elk by 1983 may be attained prior to that year.

There is a far greater challenge, however, than meeting the theoretical objectives of a strategic plan. This is to manage the elk population in such a manner as to optimize hunter opportunity while maintaining an optimum herd

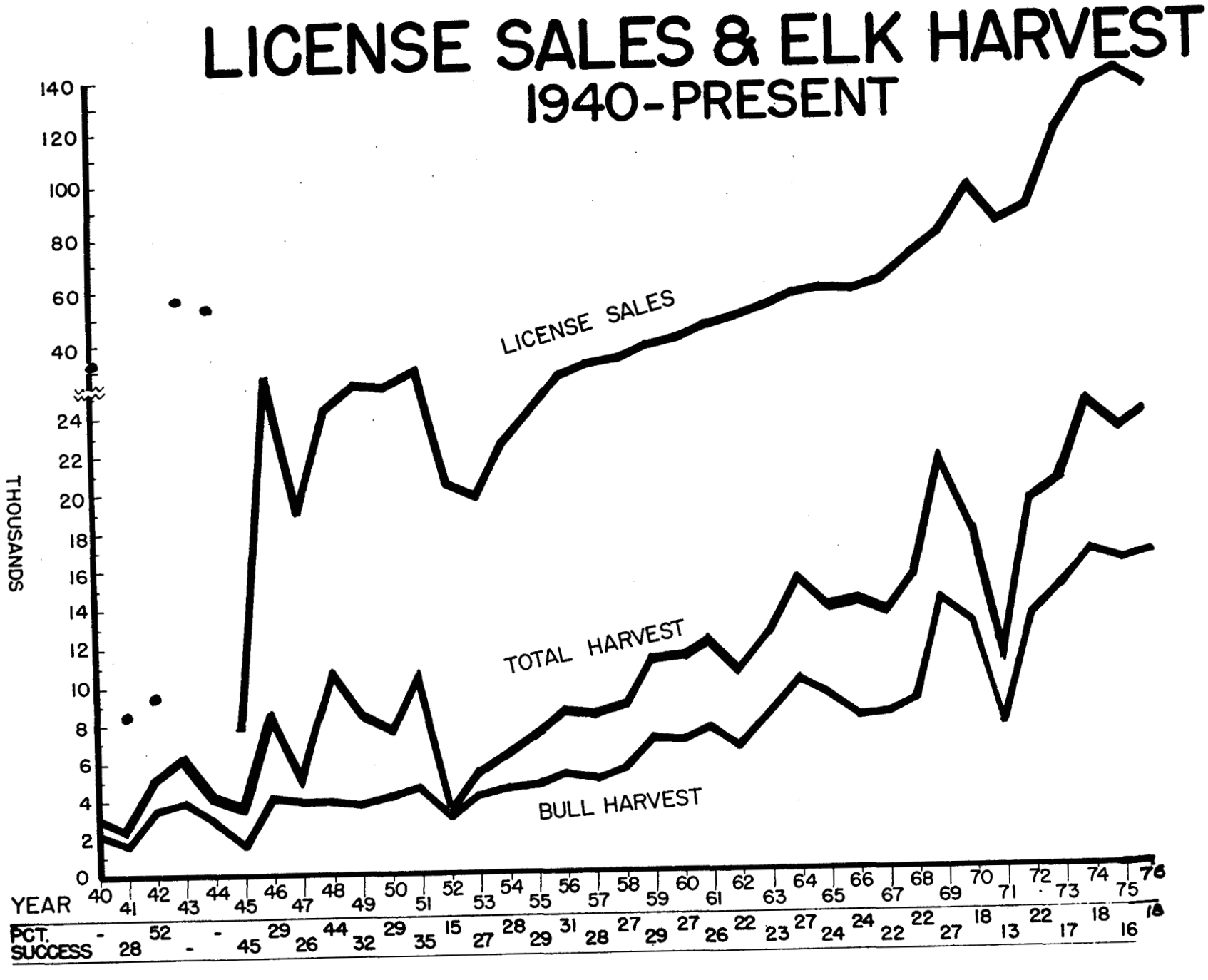

Figure 1. Elk hunting season data, 1940 through 1976, Colorado.

Table 1. Total Elk Harvest, Percent Yearling, License Sales and Percent Success by Year, 1940-1976.

Year	Bulls	Cows	Calves	Harvest	Percent Yearlings[1/]	Total Licenses	Percent Success[2/]
1940	2,375	612[3/]		2,987	--	33,540-D/E	
1941	1,680	707[3/]		2,387	--	8,436	28
1942	3,558	1,335[3/]		4,893	--	9,376	52
1943	3,932	2,216[3/]		6,148	--	55,458-D/E	
1944	2,827	1,104[3/]		3,931	--	53,729-D/E	
1945	1,481	1,452	428	3,361	32.0	7,517	45
1946	4,114	3,185	1,129	8,428	34.3	28,945	29
1947	3,849	700	244	4,793	39.2	18,708	26
1948	3,831	5,154	1,643	10,628	32.5	24,278	44
1949	3,641	3,481	1,126	8,248	28.0	25,379	32
1950	4,061	2,519	866	7,446	30.2	25,266	29
1951	4,581	4,240	1,509	10,330	34.2	29,302	35
1952	2,977	26	3	3,006	33.9	20,317	15
1953	4,158	934	207	5,299	31.6	19,400	27
1954	4,512	1,361	283	6,156	38.7	22,302	28
1955	4,640	2,052	345	7,037	38.9	24,006	29
1956	5,137	2,725	510	8,372	36.3	27,261	31
1957	4,869	2,748	538	8,155	34.3	29,639	28
1958	5,290	2,776	532	8,598	31.0	31,589	27
1959	6,823	3,306	691	10,820	33.4	37,223	29
1960	6,806	3,358	675	10,839	33.5	39,495	27
1961	7,413	3,820	510	11,743	34.8	44,406	26
1962	6,343	3,307	703	10,353	36.6	46,919	22
1963	8,114	3,377	629	12,120	35.1	51,672	23
1964	9,734	4,492	749	14,975	40.4	55,002	27
1965	8,972	3,943	680	13,595	40.3	56,902	24
1966	7,812	4,752	1,158	13,722	36.5	56,751	24
1967	7,913	4,484	791	13,188	41.9	59,939	22
1968	8,676	5,324	1,088	15,088	44.3	69,008	22
1969	13,851	5,989	1,100	20,940	34.4	78,970	27
1970	12,660	3,944	632	17,236	40.9	94,788	18
1971	7,275	2,945	573	10,693	21.3	82,015	13
1972	13,017	5,082	935	19,034	38.6	86,208	22
1973	14,548	4,611	771	19,930	46.8	116,338	17
1974	16,208	6,501	1,237	23,946	41.2	133,352	18
1975	15,745	5,500	1,387	22,632	48.6	143,319[4/]	16
1976	16,055	6,225	1,559	23,839	40.2	130,291[4/]	18

1/ Based on check station data.
2/ Based on total elk license sales.
3/ Cow, calf breakdown not available for the years 1940-44.
4/ License sales estimates based on returns as of February 15, 1977.
D/E Deer or elk.

in balance with the carrying capacities of their seasonal ranges, landowner tolerance and damage problems, and other land use practices.

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IDAHO STATUS REPORT

Jerry Thiessen

Rocky Mountain elk populations in Idaho have declined steadily between 1960 and 1975. Harvests have fluctuated, but also show a basic decline while success rates have decreased steadily. Widespread adverse changes in reductions in suitable habitat have led to compounding adverse effects from harvest, predation, and other nonhunting mortalities. Major adjustments in harvest programs were made in 1976 to more nearly reconcile harvest with reduced population levels and to compensate for increased nonhunting mortalities. The 1976 harvest was 4,135 compared to 16,545 in 1960. Long range management plans are currently being drafted to systematically deal with the reduction. As a result of these plans an increase in population numbers is expected through at least 1985.

MICHIGAN STATUS REPORT

Bob Strong

Elk were found in Michigan prior to 1870. Homesteading and timber harvesting of most of the lower peninsula resulted in loss of elk.

They were introduced in several locations in 1915-18 period. A small herd of 18 elk from Yellowstone and several private zoos were released in Cheyboygan County near Lance Lane.

This herd spread over a range of cut-over aspen, northern hardwoods, jack pine plains covering 300-400 square miles and reached an estimated population of 1,500 elk by the late 1950's.

Competition with white-tailed deer and damage to agricultural crops led to Michigan legislators approving a 2 year hunt in 1964 and 1965. Thirty-three thousand hunters applied for 300 permits and they harvested 269 elk in 1964. The 1965 hunt was similar with 190 elk harvested by 300 hunters. No seasons have been held since 1965.

Development in the form of land sales, subdivisions, cattle grazing, utility and gas pipelines tended to move elk into the state-owned Pigeon River Forest and satellite hunting clubs in the 1960's.

Oil development in early 1970 created a new threat to elk range. Several wells were drilled in the southern part of the forest and were successful. Further development has been delayed to date by court action resulting from the State of Michigan claiming damage to resources. A compromise plan of development has been approved by the Natural Resources Commission and oil representatives but further court action is expected from environmental groups.

A helicopter and ground search in the spring of 1975 counted 159 elk with an estimated population of 180-200 elk. A drop in the population from 1966-1975 has been due to: (1) loss of habitat, (2) human disturbance, (3) illegal kill, and (4) brain worm (Parelaphostrongulus tenuis). Hydrocarbon development threatens to open the area to more people because of roads, pipelines and increasing traffic.

Present population has stayed around 200 with illegal kills reduced the last two years due to increased law enforcement, violator rewards and higher penalities. Range development is tied to the white-tailed deer habitat program. A comprehensive plan of a 600 square mile unit which includes the elk range is underway by a multi-discipline task force.

It is hoped that a compromise plan best suiting all of the resources and uses can be developed and further serve as a model for similar comprehensive planning of all state lands.

MONTANA STATUS REPORT

Terry Lonner

Elk occur on 36,400 sq. miles, or 28 percent of the state (excluding National Parks and Indian lands). They are distributed primarily in the forested areas of western and central Montana, but also occur in the rough terrain of the Missouri Breaks in northeastern Montana. Land ownership status where elk occur is 73 percent public, 2 percent state school land and 25 percent private. Slightly over 80 percent of the elk harvest is estimated to come from public land.

The state has been divided into 7 administrative regions and all but one of these regions (southeastern Montana) has elk hunting. In 1976 the six regions with elk hunting were divided into 104 management units ranging from 3-30 per region.

The total hunting season length ranges from about the first week in September to the end of November with possibly one or two late hunts extending into February. The general rifle season usually occurs from around October 20 to the end of November. A special archery season occurs from the first week in September to October 10 or so in all but 1 of the units. Last season there were 3 units open for rifle hunting on September 15. Two of these were for either sex elk. One was open until October 23 and the other until October 31, after which antlered bull only hunting was allowed for the remainder of the season in both units. The other unit open on September 15 was for antlered bulls only until the end of the general season. Permit only hunting sometimes is allowed in 3 units from late December through late January and possibly into February; depending on weather conditions and migration of elk out of Yellowstone Park.

During the general (October 20-November 28) 1976 hunting seasons Montana had 5 basic types of elk hunting regulations. They were as follows:

1. General license valid for the choice of a cow, calf, or bull in 4 units, but the season abbreviated to one week or shorter in 3 of these units.

2. General license was valid for hunting cow, calf, or bull during the first portion of the season (varied from only a few days to when quota was met on cows and calves, which could last the entire season) with antlered bull hunting open all season. This occurred in 37 units.

3. General license valid for hunting antlered bulls only. Special permit required for choice of cow, calf, or bull in 39 units.

4. General license valid for hunting antlered bulls only in 12 units.

5. All elk hunting by special permit only in 12 units.

The season recommendations are primarily based on 4 criteria; results from hunter questionnaire surveys; winter and early summer classification and count flights; winter range forage evaluations; and public sentiment.

The resident elk hunter has to pay $8.00 for an elk tag and an additional $1.00 for a conservation license. Another $6.00 must be paid to hunt elk with a long bow and arrow during the pre-gun archery season. The nonresident elk hunter must pay $225.00 plus $1.00 for a conservation license. The nonresident license must be purchased from the Fish and Game offices at the State Capitol in Helena and has a quota of 17,000 (first come, first serve). This license includes 1 deer tag, an elk tag, black bear, and authorizes hunting for game birds and fishing. It also gives them the privilege to buy some special tags (grizzly bear, lion, archery stamp) and apply for others (either sex elk, sheep, goat, moose, and antelope). Application for special licenses must be made by July 1 for both resident and nonresident. Incidentally last year was the first with the 17,000 quota and we fell short by 4,400.

Since 1950, estimated annual elk harvests have usually been sustained between 10,000 and 17,000. Elk management, including acquisition of important winter ranges, has received a high degree of Department emphasis and has been relatively successful. Most of the State's elk herds have stable or increasing populations. A total of about 160,000 acres in 16 different areas has been purchased at a cost of approximately $4,993,000 through 1976. In addition we have another 66,300 acres leased for elk winter range, in combination with the deeded acreage on these 16 units. The Department pays about $11,500 annually for leasing this land.

Hunting demand for elk is continually increasing; the number of elk hunters reported afield statewide increased from 70,300 in 1971 to 90,700 in 1975, or 7 percent per year. From 1971 to 1975 the average hunting effort was 50 hunting days to kill an elk. Our 6-year objective (1977-1982) is to provide by 1980 an average of 831,000 days of elk hunting annually at a hunting success rate of 15 percent and an average hunting effort of 50 days/elk harvested.

Problems

- Access and landowner conflicts (i.e. haystack depredation)
- Land use conflicts
    - logging
    - domestic grazing
    - other wildlife management conflicts (mule deer, especially)
    - recreational developments
- Hunter ethics and public support

NEW MEXICO STATUS REPORT

Jim Johnson

In the 1960's New Mexico initiated a general bull elk hunt where the number of hunters was unlimited and sportsmen could hold a license every year. This hunt provided opportunity and it was estimated that hunter success would be in the neighborhood of 10%. This continued until harvest leveled off at about 500 bull elk per year but the number of licenses sold continued to raise to 7,434. In 1974 the number of licenses was restricted to 5,000 and the requirement was put into effect that hunters could only have a general bull license every other year. This method of hunting continued until 1976 when a stratified elk season was recommended to the commission, and was accepted by the commission.

The stratified elk hunt had three seasons or hunt periods in October 1976 and three more hunt periods which followed the deer season in late November and to mid-December. I will discuss this type of season in more detail tomorrow.

New Mexico elk hunters from 1974 to 1976 numbered at about 7,500 and harvest was between 1,500 and 2,000 elk annually. In 1976 with the stratified season, the number of elk licenses sold went to over 13,000 and the elk harvested remained at just under 2,000 head.

The population trend appears to be on a very slight increase and some problem areas, such as the Pecos elk herd, appear to be making a satisfactory recovery.

There is no special season to hunt elk with a muzzle-loading rifle although this weapon is legal if a regular elk hunter chooses to use it. The first archery hunt for elk was held in 1975 and in 1976, where 300 permits were available, only 202 licenses were sold and only 180 hunters participated in the hunt to harvest two elk.

On-going research in New Mexico consists of an elk study in the Pecos Wilderness which was initiated to determine causes of a population decline and radio telemetry is being used to assist in the findings. Another study is a cooperative study with Dr. Grant Kinzer, New Mexico State University, that will continue studies on the vectors or flies which are involved in transmitting the parasite Elaeophora schneideri.

Under New Mexico's Habitat Protection Act, and in cooperation with the U.S. Forest Service, certain roads in the Tres Piedras area have been closed to vehicular travel during the big game seasons. This has generally been accepted by the public and appears to have increased the elk harvest within this area.

There is a bill to be introduced into legislature to increase license fees. This will be our first general increase in fees since 1964. There also is legislation to increase fines imposed for game law violations. The latter of course will not increase revenue to our Department but hopefully will be somewhat more of a deterrent to game violations than the present fines.

OREGON STATUS REPORT

Paul W. Ebert

Rocky Mountain elk hunt numbers reached a record high in 1975 in most management units of northeastern Oregon. Aerial counts made in February, March and April of 1976 averaged 11.3 elk per mile compared to 10.3 per mile the previous year and a ten-year average of 8.2 elk per mile. Calf:cow ratios gathered in February and March of 1976 averaged 47 calves per 100 cows, a production and survival rate equal to the average of the last ten years. Calf: cow ratios have not been a problem in the Rocky Mountain elk herds except recently in the Snake River drainage. Reasons for low calf survival in the Snake River Canyon are unknown at present, but management personnel suspect weather, predation and low bull ratios as possible contributing factors.

Bull:cow ratios reached a low of 3 bulls per 100 cows after the 1975 hunting season, which has caused concern in the state. These are minimal ratios, since the terrain and habitat in some management units make it impossible to sample bull numbers at a representative rate. In six of the major management units of northeastern Oregon, bull:cow ratios have dropped down to one bull per 100 cows or less. Although this is far below desirable carry-over levels, there has not been a correlation between low bull ratios and low calf ratios. Because of the Commission and public concern over these low ratios the Division has been directed to consider alternatives to improve these ratios, but there is disagreement between levels of ratios that may be practical.

The 1975 harvest of Rocky Mountain elk was the second highest recorded and totaled 10,869 elk, of which 68% were bulls and 32% antlerless elk. Rocky Mountain elk hunters also reached a peak in 1975 and reports from the annual Hunter Questionnaire indicate 73,280 hunters participated in Rocky Mountain elk hunting and averaged 15% success. Concern over too many hunters in the more popular hunting areas of eastern Oregon prompted the following steps: (1) the hunting season was reduced by three days to provide greater bull escapement, (2) applicants successful in drawing a controlled hunt permit were not allowed to hunt during the general bull season, (3) hunters were required to select between hunting with a bow or a rifle when purchasing a tag and were restricted to that type of weapon during the entire season, (4) legislature allowed an increase in the price of the elk tag from $10 to $15, (5) a computerized drawing system, obtained from Idaho, was established and the priority system is being phased out and a three year waiting period established in lieu of the priority system.

As a result of the above steps, it appears that tag sales declined by approximately 10,000, about 7,000 controlled hunt hunters were eliminated from the bull hunting ranks, and approximately 3,000 bowhunters were restricted to bowhunting only. Regardless of these conditions, six of the major Rocky Mountain elk units in northeastern Oregon had extremely high hunter numbers during the opening weekend of the 1976 general bull season, which far exceeds desirable levels when considering hunting quality. Separation of the cow hunter provided quality experience in these controlled hunts, but many hunters appeared to be lonesome hunting without the normal crowds they have experienced

in past years. Unusually mild conditions during both the general bull season and the controlled antlerless hunts produced a lower take of elk, although the exact take will not be known until results of the annual Hunter Questionnaire are available.

Elk damage to agricultural lands and haystacks was low during the past year because of the extremely mild conditions. Trapping and transplanting of problem herds of elk has been a valuable tool in northeastern Oregon and 335 elk have been transplanted during the last three years from problem areas.

Habitat quantity and quality maintenance has been a major problem in Rocky Mountain elk management. Important escape cover has been reduced through logging operations to salvage the tussock moth infected trees and the new mountain pine beetle kills. Construction of logging roads and the resulting public use further compounds the reduction of escape cover. Logging guidelines have been prepared by a multi-agency committee but the application of these guidelines varies by forest and district. Oregon's cooperative road closure program was expanded to include 27 elk hunting areas which encompassed 1,066,000 acres. Hunters continue to seek out these areas, which has substantiated public acceptance of the program and need for further expansion. The bulk of the expenses of this program has been carried by the Department of Fish and Wildlife and further expansion of the program is limited by available funds and manpower. Program cooperation and funding also varies considerably by forest and ranger district.

Hunter management and habitat retention are the major problems currently facing the wildlife manager. Alternatives are being considered for the 1977 season to reduce elk hunters' participation and to spread out the available opportunities. Quality hunting is a strong consideration at present and branch antlered regulations are being proposed by the Commission as alternatives. Regardless of the alternatives considered for the 1977 hunting seasons, it appears imminent that a quota system by unit will be the end result before or by 1980.

ROCKY MOUNTAIN ELK HERD COMPOSITION

Units by Region	Management District	Elk Classified				Bulls per 100 Cows			Calves per 100 Cows		
		Bulls	Cows	Calves	Total	1976	1975	10-Year Average	1976	1975	10-Year Average
Baker		11	210	91	312	5	10	12	43	49	58
Catherine Cr.		6	85	38	129	7	6	6	45	53	49
Chesnimnus		4	426	170	600	1	1	2	40	29	46
Desolation		1	84	51	136	1	13	8	61	47	38
Heppner		12	271	146	429	4	11	8	54	49	48
Imnaha		6	164	83	253	4	4	6	51	37	44
	Union	7	97	45							
	Wallowa	39	235	115							
Minam		46	332	160	538	14	14	15	48	45	42
Pine Creek		0	52	20	72	0	0	4	38	50	44
Sled Springs		2	231	129	362	1	2	3	56	51	46
Snake River		3	276	95	374	1	6	7	34	37	44
	Baker	1	46	21							
	Union	6	345	155							
Starkey		7	391	176	574	2	4	6	45	48	52
Ukiah		3	429	210	642	1	11	7	49	34	45
	Union	0	29	10							
	Umatilla	5	329	156							
Umatilla		5	358	166	529	1	4	3	46	45	49
Walla Walla		4	282	146	432	2	4	3	47	50	48
Wenaha		9	291	127	427	3	4	6	44	37	46
TOTALS AND AVERAGES		119	3,882	1,808	5,809	3	6	6	47	42	47

ROCKY MOUNTAIN ELK POPULATION TRENDS
(Aerial Census)

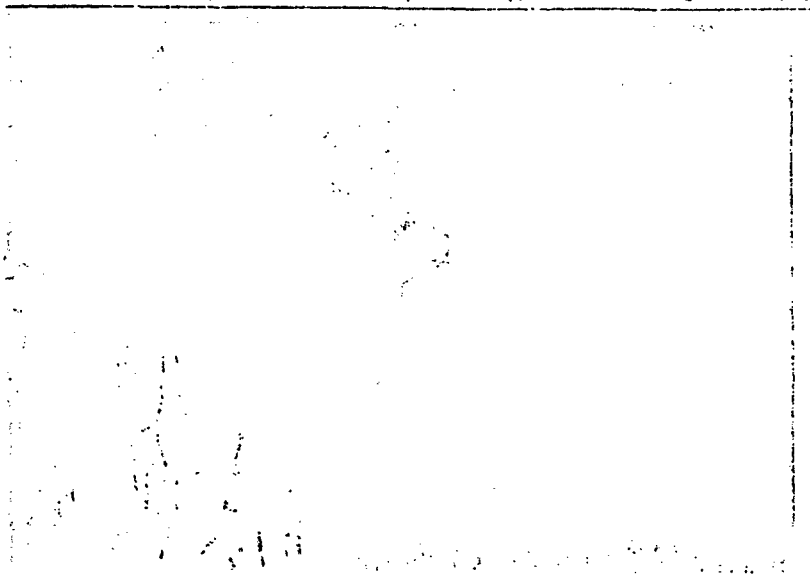
Units by Region	Wildlife Management District	Miles Traveled	Elk Observed	Elk per Mile		
				1976	1975	10-Year Average
Baker	Baker	115	368	3.2	2.2	2.0
Catherine Cr.	Union	125	389	3.1	4.3	3.3
Chesnimnus	Wallowa	302	3,426	11.3	9.4	7.5
Desolation	Grant	94	605	6.4	8.7	5.7
Heppner	Heppner	67	849	12.7	11.9	7.3
Imnaha	Wallowa	200	539	2.7	3.3	2.5
Keating	Baker	75	79	1.1	1.8	1.2
Minam	Wallowa	200	1,712	8.6	8.3	6.3
Murderer's Cr.	Grant	55	23	0.4	2.2	1.3
Northside	Grant	68	102	1.5	1.2	0.7
Pine Creek	Baker	90	209	2.3	2.6	2.2
Sled Springs	Wallowa	130	1,958	15.0	12.6	11.0
Snake River	Wallowa	200	1,787	8.9	9.2	8.6
Starkey	Union	106	2,062	19.5	16.4	13.5
Ukiah	Umatilla	69	3,348	48.5	45.8	25.8
Umatilla	Umatilla	93	3,123	33.6	26.4	19.6
Walla Walla	Umatilla	55	1,094	19.9	16.1	18.7
Wenaha	Wallowa	159	3,221	17.0	18.2	14.8
NORTHEAST REGION		2,203	24,894	11.3	10.3	8.2

ROCKY MOUNTAIN ELK TRANSPLANT RECORDS
Northeastern Oregon

Year	Number Elk Caught	Trapping Site		Release Site		Hauling Losses
		Landowner	Location	Number Elk	Location	
1973 - 1974	64	L. Westenskow	Harris Mt. (Union Co.)	23	Bridge Cr. WMA	
				41	Upper Grande Ronde	
	28	Rainbow Ranch Inc.	Hunt Mt. (Baker Co.)	28	Elkhorn WMA (Auburn)	
Total	92					
1974 - 1975	48	Armond Arnoldus	Pumpkin Ridge (Union Co.)	48	Upper Grande Ronde	
	69	L. Creger	Hunt Mt. (Baker Co.)	67	Elkhonr WMA (Auburn)	2
	53	Carl Loening	Muddy Creek (Baker Co.)	42	Hells Canyon	
				11	Elkhorn WMA (N. Powder)	
Total	170					
1975 - 1976	50	Cross J. Ranch	Elk Creek (Baker Co.)	46	State of Idaho	
				4	Elkhorn WMA (N. Powder)	
	23	Gerald Brown	Alder Slope (Wallowa Co.)	23	Pete King Creek (State of Idaho)	
Total	73					
Grand Total	335					

DEER HUNTING TRENDS 1952-1975

	STATE TOTALS			MULE DEER						BLACK-TAILED DEER				
Year	Hunters	Deer Harvested	Percent Hunter Success	General Season Hunters	Number Harvested	Percent Hunter Success	Percent of Total	Antlerless Harvest	Percent Antlerless	General Season Hunters	Number Harvested	Percent Hunter Success	Percent of Total	Antlerless Harvest	Percent Antlerless
1952	188,250	77,897	41	126,719	53,030	61	68	20,570	39	61,531	24,867	40	32	5,210	21
1953	204,808	105,275	51	121,356	64,607	53	61	24,652	38	83,552	40,668	49	39	13,045	32
1954	215,047	112,622	52	134,617	76,877	57	68	22,410	29	80,430	35,745	44	32	8,043	22
1955	230,585	133,834	58	148,566	90,126	61	67	37,752	42	81,919	43,708	53	33	13,146	31
1956	233,842	146,568	54	146,568	85,394	58	68	37,978	44	87,274	40,277	45	32	13,340	33
1957	221,960	116,409	52	140,627	81,373	58	70	26,363	33	81,333	34,626	43	30	8,877	26
1958	233,885	116,251	50	139,183	71,250	51	61	19,308	27	94,702	45,001	47	39	15,251	34
1959	248,701	146,003	59	138,856	88,261	64	61	23,685	27	104,750	56,670	54	39	20,108	35
1960	259,739	157,504	61	141,102	96,122	68	61	28,254	29	110,725	61,382	55	39	20,133	33
1961	265,326	163,939	62	147,597	97,951	66	60	30,538	31	101,971	65,988	65	40	24,529	37
1962	263,838	139,712	53	143,580	76,776	53	55	24,977	32	108,343	62,936	58	45	21,932	35
1963	258,375	117,619	45	136,676	64,678	47	55	15,403	24	105,603	52,941	50	45	16,754	32
1964	249,080	143,023	57	148,215	84,665	57	59	19,931	23	110,555	58,358	53	41	18,807	32
1965	267,840	119,369	45	143,618	71,637	50	60	19,242	27	103,281	47,732	44	40	13,348	27
1966	270,770	147,975	55	147,975	88,516	56	60	22,821	26	110,384	59,459	52	40	14,687	25
1967	272,150	142,000	52	153,950	87,180	57	61	22,518	34	109,250	54,820	50	39	15,039	27
1968	284,600	151,380	53	163,260	89,020	55	59	23,374	26	111,940	62,360	56	41	16,586	27
1969	264,900	101,500	38	166,350	68,860	41	68	14,265	21	88,850	32,640	37	32	5,757	18
1970	282,000	101,600	36	180,150	72,200	40	71	14,453	20	92,050	29,400	32	29	4,347	15
1971	279,220	87,800	31	162,180	47,240	29	54	7,840	17	109,120	40,560	37	46	7,990	20
1972	245,770	73,400	30	110,700	29,380	27	40	95	0	127,200	44,020	35	60	7,970	18
1973	296,290	103,470	35	124,040	41,340	33	40	62	1	153,360	62,130	41	60	19,099	31
1974	286,560	76,400	27	118,980	30,960	26	41	1,018	3	155,420	45,440	29	59	10,511	23
1975	251,930	54,980	22	112,430	23,620	21	43	390	2	151,430	31,360	21	57	2,230	7



ELK HUNTING TRENDS 1933-1975

	STATE TOTAL					ROCKY MOUNTAIN ELK					ROOSEVELT ELK				
Year	Hunters	Bulls	Antlerless	Total Harvest	Percent Hunter Success	Hunters	Bulls	Antlerless	Number Harvested	Percent Hunter Success	Hunters	Bulls	Antlerless	Number Harvested	Percent Hunter Success
1933.....	2,440	579	0	579	24	2,440	579	0	579	24			No Open Season		
1940.....	6,152	1,350	1,179	2,529	41	4,809	1,152	1,179	2,331	48	1,343	198	0	198	15
1945.....	8,597	2,398	67	2,465	29	7,270	2,176	67	2,243	31	1,327	222	0	222	17
1950.....	22,802	3,157	2,234	5,391	24	16,726	2,210	1,234	3,444	21	6,076	947	1,000	1,947	32
1955.....	27,709	4,228	1,855	6,083	22	21,504	3,361	1,749	5,110	24	6,205	867	106	973	16
1961.....	51,349	9,707	2,384	12,091	24	36,514	7,098	1,863	8,961	25	14,835	2,609	521	3,130	21
1962.....	52,991	7,998	2,178	10,176	19	39,432	6,460	1,925	8,385	21	13,559	1,538	253	1,791	13
1963.....	54,724	10,082	3,606	13,688	25	41,216	6,959	3,606	10,565	26	13,508	3,125	0	3,123	23
1964.....	62,898	11,846	5,311	17,157	27	41,010	7,576	4,879	12,455	30	21,898	4,270	432	4,702	21
1965.....	67,387	8,066	4,200	12,266	18	47,651	5,768	3,524	9,362	20	19,736	2,298	606	2,904	15
1966.....	68,178	8,030	3,372	11,402	17	49,504	5,529	3,189	8,718	18	18,674	2,501	183	2,684	14
1967.....	64,200	7,660	2,870	10,530	16	46,100	5,220	2,690	7,910	17	18,100	2,440	180	2,620	14
1968.....	65,900	7,160	2,250	9,410	14	45,800	4,170	1,980	6,150	13	20,500	2,990	270	3,260	16
1969.....	66,000	7,900	2,118	9,918	15	46,300	5,800	2,080	7,880	17	19,700	2,090	38	2,038	10
1970.....	73,560	10,150	2,530	12,680	17	52,190	6,920	2,470	9,390	18	21,370	3,230	110	3,340	16
1971.....	74,550	7,830	2,440	10,270	14	51,640	5,330	2,260	7,590	15	22,910	2,500	160	2,660	12
1972.....	79,100	8,075	2,235	10,310	13	53,700	5,742	2,188	7,930	15	25,400	2,333	47	2,380	9
1973.....	98,300	11,087	2,913	14,001	14	65,190	7,626	2,735	10,361	16	33,200	3,461	178	3,640	11
1974.....	106,200	9,527	4,543	14,070	13	69,160	6,628	4,035	10,664	15	37,600	2,899	507	3,406	9
1975.....	110,830	11,481	3,870	15,351	14	73,260	7,893	3,476	10,869	15	37,570	4,087	395	4,482	12

MAY 1976

UTAH STATUS REPORT

Rodney John

Prior to 1967 all elk hunting in the state of Utah was controlled by a limited permit system. During the ten years previous to that, the number of permits and hunters had averaged about 2,400 to 2,500, and the average annual harvest for the previous 20 years was about 1,100 elk. Elk populations appeared to be static. Aerial trend counts had remained at about 3,000 for several years, and there appeared to be little or no expansion of elk into new areas.

In 1967 a significant change in elk management was made. An unrestricted number of permits for hunting bulls was authorized for most of the major elk units of the state. Within the following two years all major elk units were managed under this system. Game Managers, of course, knew that hunter success would drop to a low level. The Division printed an affidavit stating that the open bull hunt was designed as a recreational hunt and success could go below 10 percent. Hunters were required to sign this affidavit before purchasing a permit. Success held at about 20 percent for the first four or five years, but as the number of participants has increased in recent years, success has declined. This affidavit has helped greatly, it is believed, in minimizing opposition to this hunt.

The number of hunters afield during this ten year period has averaged a little over 12,000, but exceeded 24,000 in 1973. In 1976 there were 17,500 hunters afield, and there are some indications the pressure may stabilize at about this level. The harvest has increased from the 1,100 average prior to open bull hunting to about 2,300 in recent years. It too has remained somewhat static at 2,200-2,400 over the past few years. Population levels have increased over the ten year period. From aerial counts of 3,000 elk in the 1960's, the trend has gone to a count of 8,100 in 1975. Distribution has also been affected. Elk are now found in significant numbers in several more areas of the state. Four new herd units have been opened to hunting and several units have been expanded.

Division biologists knew, of course, that the average age of bulls in the herd would decline. As an example, on the Cache unit, one of the state's most heavily hunted units, there were 0.72 yearlings per adult bull in the 1966 harvest. In 1975 this ratio had increased to 3.0 yearlings per adult bull. Bull: cow ratios have remained somewhat stable at about 35 bulls per 100 cows preseason through the present time. Production has been monitored closely to detect any change due to the change in management practices. Since the late 1940's the calf:cow ratio has not deviated substantially from 50 calves per 100 cows preseason.

Although natural expansion of the state's elk herds is taking place, a more rapid expansion into suitable range is desired by the Division of Wildlife Resources. The accomplishment of this objective has been somewhat difficult, however. Twenty seven years were required before the first breakthrough came in the form of an agreement with the Forest Service to transplant elk. Three transplants have now been fully or partially accomplished, and more will be sought in the future. A priority list has been drawn up and the Division will continue to work with the land management agencies in moving elk to these new areas.

One discordant note concerning the open bull type hunting has been the complaint of "too many hunters during the opening weekend." Hunters don't seem to mind almost 200,000 other deer hunters out there with them on the opening of deer season, but they do complain about less than 20,000 elk hunters during the opening of the elk season. Also, different livestock and sportsmen factions have not been able to agree on an opening date. Generally the sportsmen were for a September opening that would allow a longer season, and the stockmen favored an opener later in October after livestock were off the ranges. Following the lead of Washington State, a committee established by the Board of Big Game Control, the big game policy making board, studied the problem and recommended an opening date on the Wednesday nearest October 1. This was adopted by the Board for a five year period, and during the two years it has been in effect it has had little opposition. It has reduced the opening day's pressure while not decreasing overall participation in the hunt.

In summary, Utah's elk populations are in a healthy condition, and the Division anticipates no new changes in management direction over that of the last few years.

WASHINGTON STATUS REPORT

Zeke Parsons

Population: 65,000. Westside of Cascade Mountains, we have 40,700 native Roosevelt Elk in five population areas: (1) Olympic - 15,000 plus 5,000 on Olympic National Park; (2) Willapa - 9,000 on timber company land; (3) St. Helens - 7,000; (4) Rainier - 4,000 including 2,000 on Mt. Rainier National Park; (5) Nooksack - 700.

Eastside of Cascades we have 24,300 Rocky Mountain elk originally introduced from Gardner, Montana, between 1913 and 1930: (6) Wenaichee Mountains - 5,000 including "Colockum herd"; (7) Yakima - 12,000 which are artificially fed on our land on most winters; (8) Blue Mountains - 7,000 mostly on the Umatilla National Forest; (9) Pend Oreille - 300 on our land.

Trends. Westside: because of extensive logging, slowly increasing. We harvest at a rate of 40 cows/calves per 100 bulls, to allow slow increase and some range expansion.

Eastside: stable by necessity of land on which they can range. We harvest at a rate of 90 cows/calves per 100 bulls to prevent increase.

Seasons. Statewide two week bull season which starts on Monday (since 1971). About 6,000 either-sex permits are issued, mostly on the eastside.

Harvest. Average 11,000 elk yearly in recent years, about equally divided between east and westsides. More bulls taken on westside; more cows/calves eastside. Bull harvest about 7,000. Twelve thousand were taken in 1975; Ten thousand in 1976.

Problems. Yakima herd had no winter range when planted and extensive orchard damage forced us to purchase a great deal of land; build elk drift fences; and artificially feed to compensate for lack of winter range.

In the Wenatchee Mountains, the Colockum herd has taken to crossing slack water behind Wanapum Dam on the Columbia River into irrigated farm land in the Columbia Basin. After several years of herding back across the river, this year we trapped 130 head and moved them behind drift fence at Oak Creek. We will raise permit levels there in 1977 to crop additionally that amount.

Westside rain forests make harvest difficult so city hunters prefer the eastside. Westside success and elk population are higher but westsiders do not like to hunt sala thickets.

Equalizing hunter distribution among major herd areas is a problem without resorting to drawings.

Hunter resistance to either-sex harvest on westside makes cropping difficult. Since everything is green there, they do not recognize a carrying capacity. Since elk are difficult to see in heavy timber, many are not convinced as to their abundance.

Majority of hunters prefer the eastside, causing pressure problems there.

Hunter Distribution. By residence, 25% live on eastside, 75% on westside.

By hunting area: 55% hunt eastside, 36% westside, 9% both sides.

To equalize pressure, considering several split elk tag options: (1) eastside and westside tags, hunters choice; (2) stratification of (a) bull only early, and (b) late bull and possiblity of either-sex permit. Only the latter tag could apply for a controlled either-sex hunt permit.

Licenses: Residents may purchase a $14.00 combination fishing-hunting license or a $7.50 hunting license plus an $11.00 elk tag. Non-residents must purchase a $60.00 license and a $42.00 elk tag, no limit. We only have about 2,000 non-resident hunters who purchase about 1,000 elk tags. Archery and/or muzzle loader seasons require a $6.00 permit in addition to license and tag. However, they may hunt general seasons without this additional permit.

Research. We have none presently, although we have had a few minor projets in past years.

WYOMING STATUS REPORT

Jim Petera

Generally speaking, Wyoming elk herds are at a very high level in comparison with past years, due to the unusually mild fall of 1976 and the resultant lack of hunter success. This is especially true of the larger areas in the north and west portions of the state.

Some of the smaller, more isolated herds which are hunted on permit only basis, had an adequate harvest.

Future management will follow the Department's five year plan as closely as possible.

The population increase in Wyoming due to the energy development now taking place, will put additional demands on the resource, and more permit type hunts will be prevalent than in the past. Shorter elk seasons are also seen as a distinct possibility in the not too distant future.

Elk range conditions are generally favorable, but we do have some problems yet at isolated areas with both summer and winter range.

Future management of the elk, along with cooperation from the Federal Land Management Agencies on grazing of livestock, point towards resolving these conflicts in coming years.

ELK HERD SIMULATION MODELING BY COMPUTER

Thomas M. Pojar
Fort Collins, Colorado

Abstract

The Colorado Division of Wildlife began the big game population modeling project in 1973. The elk range in the State was divided into Data Analysis Units (DAU's) and a population simulation was established for each DAU. Two examples were discussed relating to the use of simulations to explore various management goals and potential means of attaining these goals. Population simulations provide three main benefits in big game management. It forces consistent and biologically feasible rationale about a population; current management and planning can be based on the best available information which is organized in a standardized fashion by the model; and the most critical management data needs are readily identified.

Population modeling was entered into due to increased pressure on the resources which made it necessary to come up with a better census system to help make realistic 5-year goals and to have a more efficient use of the resource.

Modeling is basically an abstract of the real world system. We are dealing with mathematical systems for population models. We started with an initial population size separated by age class. The first impact on the population is a hunting season, the harvest is then deducted from the initial population. The next impact on the population is the winter loss. After a one year reproduction and loss cycle, by simple addition and subtraction by age class, you can easily determine the population size.

Criteria is set up by DAU concept which is similar to a herd concept. The area must encompass the year around range of the animal. Data collected are characteristic of the population inhabiting that DAU, and the boundaries should follow game management units making it easier to collect harvest information.

The initial data gathering began with core information from known data; bull:cow ratios, cow:calf ratios and trend counts. In areas that did not have that information we borrowed from areas that did and modified them by intuition to apply to the area. The next step was to take this information to the regional biologists, and then out to the field people for an even more realistic population. The end product of this initial simulation was to simulate the population and have it mimic the real world population size. From this point on we assume the attributes stay constant and we can project into the future using the assumed population. The further away you get from the end point of the real data in the future, of course, the more shakey the simulation becomes.

From here we go to a couple of examples of how we use the population model in Colorado on two of our herds. We use them to set herd goals in planning and to design management strategies to attain those goals, and a direction on how to get there. For example, an elk population right now in 1976 with a projected harvest based on numbers of permits given out, and historic hunter success in these areas, project a post season population size and bull:cow ratio. The goal then is to maintain that population size. The calculated estimated amount of harvest is then given to carry out that population size and ratio from 1977 through 1980. If we desire to increase or decrease the population size that simulation would be placed in the modeling simulator to calculate the harvest strategy necessary to attain that goal for the next 5 years.

In conclusion, there are three benefits of this modeling program, it forces us to consider biologically feasible rationale of one population and to look at all aspects of the population. It also provides us with the best hypothesis of the status of the population on which to base current information and planning, and it organizes all information in a standardized fashion.

A POPULATION MODEL OF THE NORTH YELLOWSTONE ELK

Charles W. Fowler
Logan, Utah

Elk which spend their winters on an area of about 385 square miles in Yellowstone National Park and Montana (along the Yellowstone and Lamar Rivers) comprise what is often called the northern Yellowstone elk herd. This herd has been the subject of much controversy and many studies. As a result of many of these studies, especially those since 1935, a considerable quantity of data has been collected. The biologists involved in these studies have been quite successful in obtaining the type of data which, when combined to produce a dynamic model, make possible an analysis of the population which was previously impossible.

An initial estimate of the survival for the various age classes of the females in this herd has been possible based on several types of samples. Similarly, the birth rate for adult females has been estimated. These characteristics of the population were not shown to vary significantly as the populations changed over time and, for this study, were assumed to be constant.

Several aspects of the population, however, did change. First, as a result of manipulation, the population has changed over time. Correlated with this change were changes in calving rates and survival of the younger age classes. Equations representing the relationships between these variables and the size of the winter population of this herd were incorporated into a population model.

Analysis of this model gave rise to several representations of the dynamic properties of this population as examples of the ways this type of model (a variable projection matrix) may be useful in the study of the population dynamics of large mammals. An estimate of the equilibrium population under existing conditions, as one application of the model, was demonstrated. An analysis of the potential impact of additional calf mortality (such as that which might result from additional predation) was examined. An example of how this type of model can be used to evaluate various harvest regimens was shown.

The type of data needed for the construction of a variable projection matrix is:

1. Estimates of herd size over a range larger than normal year-to-year changes induced by the physical environment.

2. Age specific survival information (for at least major age groups).

3. Age specific birth rates (again, for at least major age groups)

4. Information showing that at least one of the age specific survival rates, of the age specific birth rates, (or both) is correlated with population size.

Having such information, it is a straightforward process to construct a variable projection matrix model. Through analysis and simulation a number of very useful types of information may be produced.

(Details concerning the elk model are described in: Fowler, C. W. and W. J. Barmore, (in press) A Population Model of the Northern Yellowstone Elk Herd.)

FACTORS AFFECTING CALF ELK SURVIVAL ON COOLWATER RIDGE IN NORTH CENTRAL IDAHO

Michael W. Schlegel
Kawiah, Idaho

At the last Western States Elk Workshop in 1975 I gave a progress report on a study we initiated in 1973 to determine the factors affecting calf elk survival. The areas experiencing calf elk survival problems are in the north central portions of the state which were burned out in 1910, 1919 and 1934. As a result we have large brush fields which are now converting back to a coniferous stage.

Most of the logging associated with our elk populations in the north central part of the state are at summer range elevations, with increased access and multiple use. Strip mining operations that are being considered for southeast Idaho are also becoming a concern to us. In 1964, the department initiated an elk ecology study to determine the best method of reverting the land to reproductive forage. The area studied accounts for over one-half the elk harvest in the state, all the winter range in the area was created by wildfires. The initial theory was, even though the cows were conceiving and producing calves, they were born too weak to survive which was due to the quality and quantity of the range. However, after a 5-year evaluation of the range conditions we were getting only 25 per cent utilization and at the same time the population decreased from 457 to between 60 and 80 elk. Snow conditions in north central Idaho are heavy and do not wind whip so the elk have a difficult time plowing through and are dependent upon the portions of the plants that are above snow level. In 1969, Dr. Knight at the Coop Unit initiated a population dynamics study to complement the range work. Since 1969 we have collected crop data and the calf/cow ratio has been 25:100, the average bull/cow ratio has been 31:100 post season.

Seventy per cent of the calves were captured during calving the last few days of May and the first week in June. In order to assess the physical condition of each calf captured a set of criteria was used, how it looked standing, whether or not the hair was wet, downy or matted, tooth eruption through the gum line, condition of the hooves, and how well it maintained its body weight. Dr. Thorn's (Wyoming Fish and Game Department) "Feed Lot Studies" determined that any calf weighing 35 pounds at birth had a 90 per cent chance of surviving. The average weight of our captured calves ran 37 pounds. We also got some idea of the weight gain, in most cases they gained about 2 pounds per day. Leg measurements were also taken to correlate with weight to try to come up with a way to determine physical condition. Whenever possible we'd take a blood sample, and send it to a pathologist in Lewiston for a print-out on serum parameters. One of the problems with wild populations is there is nothing to compare to, referring to domestic calves and sheep doesn't appear to bear any physiological deficiencies. We also had samples screened for disease and had no positive reactors.

The second objective was to find out what was happening to the calves, which we did through the use of telemetry. It was determined the cow/calf ratio was basically the same in September as in the winter, so we knew the mortality was occurring some time before September, therefore a collar was designed to come off in six to eight months.

When we ordered the transmitter we specified the antenna had to go up and back into the same side so we didn't have anything closing the collar. In order to maintain the same size and shape of the antenna which left one opening of 22 inches and the neck on the calves is 9-11 inches. This was solved by using a piece of elastic around the inside of the collar opposite the antenna. The collar material bunched up on 2 pieces of elastic so it would expand with the calf growth. Judging from the few ear tagged calves that survived going into the winter we did see a few calves that dropped their collars.

The mortality unit on the transmitter was based on motion and it was determined that any calf that didn't move for 4 hours was sick or dead. If the calf was actively moving around the transmitter emitted a broken signal, if it didn't move in a 4-hour period the signal changed to a continuous buzzing sound. During the first week a calf was marked, we monitored it twice a day, then once a day thereafter through June, then once a week until the radio went out.

Totally we have captured 67 calves, nine of which lost their collars. Thirty-four calves were killed by predators, twenty-five by black bear, five by mountain lion and one unknown. Five calves were rejected, one calf died of bacterial infection, one calf was killed during hunting season, and seventeen were alive when the transmitters quit.

As mentioned above, we had five rejections. We knew this was going to present a problem, but did not know how great it would be. It didn't seem to be related to the age of the calf in any way, for example we had one calf that weighed 67 pounds when we caught it and in four days it was dead. It seemed to be four days after the calves were handled that they would die. The pattern was the same, severe weight loss and no milk curds in the rumen.

One major mortality factor was predation, primarily black bear. Predator losses on the study area were fairly consistent with the capture sites, 80 per cent of the predation occurred within a 2-week period, the 30th of May to the 14th of June. When looking at these kills, we tried to determine what type of animal killed it. On the bear kills we found basically two situations, one in which only a portion of the carcass was eaten, we speculated from the way the area was torn up in almost all cases the cow was within 50 yards of the calf when we went in to retrieve the collar. Even though she had not prevented the bear from killing the calf, she harassed it after the bear started feeding on it. Almost all of the predation, whether it was bear or lion, occurred at night. One of the questions that has come up was, how do you know the calf wasn't rejected and the bear stumbled on it and started feeding on it? In checking the hair on the calf you can tell this trauma was inflicted on the calf when it was still alive. Another thing we try to check whenever possible was whether there were milk curds in the rumen, which would indicate whether the calf had been rejected or not.

In addition to finding calves to mark, we found six that had been killed that were not handled. One had a coyote feeding on the carcass and the only damage we could find were two puncture wounds. The body temperature indicated it had only been dead for about two hours.

Some people think the bear in the study area have a unique ability of finding the calves. My theory is that the bear and elk are overlapping on the spring range basically for the same purpose - the spring green-up and they are both following the snow line up and overlapping because of forage conditions.

When it was indicated that bear were predominantly preying on calves we started collecting as much data as we could on the bear population. In 1975 we decided to look at the sex and age structure of the bear population, and remove some of the bear from the area. As many bear as possible were marked during five field seasons, 12 bear were captured from the helicopter and 33 in foot snares. Eighty per cent were adults and 20 per cent were subadults. In 1974 we had 124 observations and only saw 11 cubs, in 1975 we had 144 observations and only saw 13 cubs. When we went into the area in March of 1975, out of 14 adult females only one was lactating which substantiated what we were observing from the helicopter.

Telemetry work was tried to determine association of bear movements with the elk movements. Boars were basically selected to monitor as it was felt they were the ones primarily involved in the predation. Seven boars and one female were collared, and after two weeks the female was the only one left with a collar on. In 1976 a request was made to the Commission to remove bear from the area. Permission was granted, however, they had to be transplanted. That year we removed 75 bear from the study area. Of the 75 bear removed, 16 were marked, 25 were adult females, 25 adult males and 25 cubs. Of the 25 adult females only four were active, one had twin yearlings, two had triplet cubs of the year and one had a single cub of the year, the rest were not lactating.

In 1977 field work will resume on the calves again, and at the same time bear removal efforts will continue to determine if the structure of the bear population has changed.

Even though it looks like over harvest has occurred in the past few years and predation has been causing low survival rates, a cut back on the season (bull only) may get some positive results.

ELK CALVING BEHAVIOR IN WEST CENTRAL COLORADO

John W. Seidel
Colorado Division of Wildlife

Introduction

It has been estimated that cow elk utilized specific habitat and topographic types for calving areas. Furthermore, it has been suggested that the same areas are used each year except when disturbed by increasing pressure from various forms of human-related activities. Identification of areas and study of activity and habitat relationships could determine effect of pressures on the species population.

Habitat Description

Five study areas have been evaluated. They are Lilly Lake, west of Marble; Haystack Mountain, northwest of Aspen; South Thompson Creek, southwest of Carbondale; Beaver Creek, west of Vail; and Salt Creek, south of Eagle. All areas are located in the White River National Forest with some private lands at Beaver Creek, Lilly Lake, and Salt Creek. The general description of these areas are aspen (Populus tremuloides) benches containing a dense understory of snowberry (Symphoricarpos) and chokecherry (Prunus virginiana). The areas of calving activity were found between 8,000 and 9,000 feet (2,438 and 2,743 meters) in elevation. They were located within .75 mile (1.2 km) of their winter range generally along a spring migration route. Each area contained approximately 1,500 acres of suitable habitat.

Methods

Each area was first flown in a fixed wing aircraft one or two days prior to initial ground investigations. This enabled the observer to locate cows and likely habitat. Cows were observed in small groups of 5 to 15 animals consisting of cows and yearlings. Ground searches were made utilizing a team of five to nine men on horseback. The teams searched the area riding at spaced intervals observing all signs of elk activity. Teams stayed in each study area for three to four days. All elk activity was recorded and locations marked on maps. The location and descriptions of birth beds were documented with measurements and photographs. Measurements were taken with a standard tape measure and consist of width and length. Each area was revisited the following years by the same personnel.

Results

Elk calve in the upper Eagle, Roaring Fork and Crystal River drainages between May 15 and June 15. These dates are similar to those found in the literature and as reported by Murie (1951); Haran (1960); Johnson (1955); Altman (1952); and Caine (1975). Calving study areas were free of snow and had some degree of understory growth despite varying winter snow depths. Similar conditions of vegetation, topography and snow cover were recorded by Caine (1975) and Altman (1952).

For all five areas elk calving occurred in specific habitat types and on prepared beds that are reused each year. Beds were prepared by the cow with complete removal of all vegetation and ground litter down to bare dirt. Birth beds were found to contain broken hair ground into the dirt and caught on exposed roots. Some beds were found to emit a slight ammonia odor. The general dimensions of the prepared bed were 34" x 56". The beds were found generally on south or east facing slopes of rolling hillock aspen benches with a dense understory of snowberry or chokecherry. Three to fifteen beds occurred in groups at a density of approximately 10 beds/sq. mile. Beds were located in close proximity to each other, some less than three feet distance. Beds were generally found on a slight rise or hillock that afforded a downhill observation. All beds were located within 200 yards of water.

Calving areas and birth beds were found to utilize the "edge" effect as referred to by Johnson (1955). One newborn calf was found on a birth bed, but it is believed that the calves are moved from the actual birth site within a matter of minutes (Altman 1952). The documented birth beds were re-examined each succeeding year and beds were found to be reused each year. The continuation of the study did not disturb the elk from returning to their selected areas on either a daily or annual basis. The degree or type of disturbance that will cause elk to abandon calving areas is unknown.

Discussion

This project was undertaken to collect data for impact statements on pending ski area development. It was felt that if the elk selected specific sites out of thousands of acres of seemingly suitable habitat then those areas became extremely important to the management of that species. The theory that elk prepare a definite birth bed and reuse that bed several years in succession was investigated in some of the study areas for four years. It is my conclusion that such is the case. Birth beds differing considerably from day beds were located in each of the study areas. It is thought that the key criteria for the calving area consisted of a location free of snow proximal to winter range, spring migration routes, and available water. Calves located during the study were not handled or tagged. Calf locations were documented and photographed only. Only one calf was observed on a birth bed although several were observed in the study areas near beds.

The identification and documentation of elk calving habitat through the location of birth beds can be used in assessing potential man-related impacts. Protection of calving habitat is vital to the management of this species.

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ELK USE-HABITAT TYPE-COVER TYPE RELATIONSHIPS ON SUMMER AND FALL RANGE IN SOUTHWESTERN MONTANA

Terry N. Lonner
Montana Department of Fish and Game

Summary

Elk use within and between several habitat types has been recorded and measured every summer and fall since 1972 in a scattered forest type in southwestern Montana. During the summer months (June-August) elk had a strong affinity for wet sedge parks and broken parks that were interspersed with and/or immediately bordered by the Alpine fir (Calamagrostis canadensis) forest habitat type (Pfister, et al. 1975). A dramatic shift of elk use from wet sedge parks and broken parks during the summer to the timber general cover type and dry parks during the rut (September-mid-October) was very apparent and occurred all 5 years. Elk use of habitat and cover types during the fall (October-November) was similar to elk use during the rut, except there were some minor shifts in sub-types within the dry park general cover type. A substantial difference of elk use between successional stages within 5 forest habitat types was quite evident between seasons. Regeneration density of conifers (trees < 4" dbh and < 20' tall) was used as the indicator of successional advancement and/or hiding cover quality. The more dense the regeneration the more advanced the succession (only for those stands 50 years old and older).

During the summer months findings show very little selection for any particular density class for all habitat types. Conversely, during the rut and the entire fall elk use tended to increase as regeneration density increased or sight distance decreased. These findings point out that while habitat type notations often give a reasonable description of plant community composition and ecological potential, the structural characteristics (cover types) of plant communities at a given time and general location can vary within habitat types and phases. Also, seral stages in different habitat types may be structurally similar. Elk use of these cover types within and between forest habitat types is often specific on summer and fall range. This can change in both space and time, i.e. moist sites within various habitat types may be highly preferred by elk from June through August with lower use during the fall months; relatively mature dense stands of timber may not be as important to elk during June through August as in the fall months.

Awareness and knowledge of spatial and temporal differences of elk use within and between habitat types and cover types is of utmost importance before the full value of these types to the elk and timber manager can be realized. Interspersion and juxtaposition of the various types is also of utmost importance, especially when associated with various road densities and varying human uses of these roads. Preliminary aerial photograph surveys have shown the area to be 68 percent timber and 32 percent open. The interspersion of timber, to open or "non-foraging" sites to "foraging sites," is roughly 80 foraging sites averaging 2.4 acres in size (range + .1 to 70 acres) per square mile.

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ELK AND TIMBER HARVEST RELATIONSHIP
Gros Ventre Cooperative Elk-logging Study in the Jackson Hole Area of Wyoming

Francis Petera
Wyoming Game and Fish, Cody

In 1974, the Wyoming Game and Fish Department and the Bridger-Teton National Forest signed a cooperative agreement that provided for the study of elk-timber harvest relationships.

Sixteen million board feet of timber is to be harvested by selective cutting and clear cutting methods. Clear cut blocks will range in size from 4 to 34 acres. Timber is to be removed by a main access road with a network of spur roads into the cutting units.

Study methods include radio-telemetry equipment installed in collars attached to individual elk, and observation of unmarked elk. Emphasis will be placed on locating collared elk. Most of the elk collared were trapped at the nearest feed ground in the area, operated by the Wyoming Game and Fish Department. Elk were also collared in the field using a powdered form of the drug succinylcholine chloride.

Relocations of collared elk were accomplished by aircraft, foot, and horseback. Distances of elk to cutting blocks and logging activity are being recorded, as are distances to nearest roads and jeep trails.

Time lapse cameras are being used to record elk, human, and livestock activity, with photographs being taken at three minute intervals during daylight hours. Pellet transects are also being run in the area of the camera locations to further ascertain the elk use pattern. Pre-logging harvest data will be compared to post harvest data.

Elevations vary from 7,400 feet to 10,700 feet. Elevation locations are being recorded when elk sightings are made. The Forest Service has agreed to confine vehicle access in the area to the main logging road, and affect an area closure on the rest of the jeep and logging trails.

Seventeen elk have been collared with radios during the three years of the project; 11 of these radios are still operating. Relocation of collared animals has been highly successful, with the majority of the elk collared found in the pre-timbering study area.

Due to the comparative nature of the study, no conclusive results will be determined until the completion of the study and all facts are present for evaluating.

ELK RESPONSE TO HUMAN DISTURBANCES AS DETERMINED FROM HEART RATE

A. Lorin Ward
Rocky Mountain Forest and Range Experiment Station
Laramie, Wyoming

Abstract

A small transmitter implanted beneath the elk's hide relays electrical impulses from the heart to a collar transceiver for rebroadcast to a remote monitor station. It is possible to measure changes in heart beat rate and the animal's position (resulting from changing signal strengths caused by movement of the collar transmitter antenna), and movement. Two cow elk and one spike bull elk have been monitored under field conditions during the last two years on Pole Mountain near Laramie, Wyoming. All elk showed concern for audible gunshots and sonic booms. Heart rates increased when people approached to within 100 to 300 meters and the elk moved away in most instances. Moving traffic, either automobiles or trail bikes, had little effect on elk when the vehicles were over 200 meters away. When a vehicle visible to the elk stopped within 500 meters, heart rates increased. Airplanes, even at low altitudes, were ignored when the elk were in forested cover.

In our efforts to determine animal response to different multiple uses we began with visual observation and then telemetry. After two years we began working on remote monitoring systems, whereby electronic signals of animal movement data were recorded on a chart. With this system, however, we were not able to pick up all of the animal's reactions. We then began to think about what parameter within the animal would get us an immediate response, i.e. heart rate. Due to the activity of the animals, a system on the outside of the animal would be ineffective and short lived. Implants were determined to be the best system.

An implant was made under the skin similar to the pacemaker humans use to make their heart beat, except we take the electrical impulse off the heart and make the transmitter beat. The transmitter inside the animal emits a signal to a transceiver on the outside of the animal, and then broadcasts the signal to a monitor within a five mile perimeter. This system has been used in three elk in the wild under natural conditions. It is a very small sample, but does give an indication of what the system can accomplish.

The data are received and recorded on a chart which shows heart rate, signal strength and activity. The system monitors 24 hours a day and the daily pattern of the animal can be determined. The heart rate definitely changes in relation to activity. During extremely cold weather (-18°, wind 30 mph), the heart rate slowed to 31-33 beats per minute. Relationship to livestock within 100 yards was monitored and showed no significant disturbance to the elk.

Deer entering the area before the elk could see them caused an immediate response, however, when the deer were visible the heart rate slowed. This indicates that activity in the natural environment can also put stress on elk.

We found that steady traffic noise did not cause a reaction in the elk, however, when a car door slammed the signal strength changed and it took about 45 minutes to return to normal. Motor bike disturbances were tested and during the testing it was determined that the elk definitely could see the motor bike which caused an increase in heart rate as the bike came into view, however, the elk were not disturbed enough to leave the area.

Dogs were used to test the reactions of the elk. A dog was placed in an area where the elk could see the dog and the elk had an immediate reaction, but settled down immediately. When the dog was accompanied by a person it caused an extreme reaction and the elk ran off.

Another experiment was conducted during the hunting season. The elk was approached from a half-mile away with only a small reaction. However, when a gun was discharged it caused an extreme stimulation in the elk.

In summary, it was determined that the greatest stress on elk is noises related to man,i.e. walking, gunshots, sonic booms, etc. Less stress occurred from noise of automobiles, motor bikes, etc.

NEW MEXICO'S FIRST STRATIFIED ELK HUNT

Jim Johnson
New Mexico Game and Fish, Santa Fe

Abstract

New Mexico's 1976 elk season consisted of six different hunt periods. Three of the hunt periods were in October when the majority of the state was open. The last three hunt periods were in late November and to mid-December, with the open area consisting of two-thirds of the north half of the state.

Anyone wishing to hunt elk could apply for, and receive, an elk license if they had not held such during the previous year. There were a number of validations available for harvesting antlerless elk during the last three hunt periods and these were obtained through a public drawing on public hunt areas. In private land areas hunters could pick up a validation, or, in some cases, could obtain a validation when they presented a letter authorizing permission from the landowner.

The stratified elk hunt resulted in 5,436 more elk hunters than reported for the previous year. Violations pertaining to the stratified hunt were small and the following table gives pertinent information on this hunt.

1976 Stratified Elk Hunt Season Dates, Licenses and Harvest

Hunt Period	Date	Hunt Days Available	Licenses Sold	Elk Harvest	Percent Hunter Success
G-1-A	Oct. 8-10	3	4,001	428	11
G-1-B	Oct. 12-17	6	3,349	410	13
G-1-C	Oct. 19-24	6	1,209	211	19
G-1-D	Nov. 27-Dec. 3	7	2,114	391	21
G-1-E	Dec. 4-10	7	996	180	19
G-1-F	Dec. 11-17	7	1,476	282	22
Total			13,145	1,969	15

EFFECTIVENESS OF SPIKE BULL BREEDING

Mike Welch
Utah Division of Wildlife Resource, Salt Lake City

Summary

This study was conducted at the Hardware Ranch Game Management Unit in Cache County, Utah, to determine the effects of increased hunting pressure on elk (Cervus canadensis nelsoni) and develop possible methods of increasing overall elk production. The objectives were: (1) to compare the reproductive effectiveness of yearling and adult bulls, (2) to determine the induction of twinning in elk, and (3) to validate procedures for predicting preseason calf: cow ratios. Data were collected from May, 1972, through August, 1974, from two elk harems consisting of a yearling bull harem composed of 15 to 21 adult cows and 3 yearling bulls, and an adult bull harem composed of 14 to 21 adult cows and 2 to 3 adult bulls. Each harem was confined to an 8 hectare (20 acre) meadow enclosure.

Yearling bulls produced 8 calves from 15 cows in 1973 and no calves from 21 cows in 1974, while adult bulls produced 11 calves from 14 cows in 1973, and 6 calves from 21 cows in 1974. Analysis of data indicated no significant differences in the effectiveness of yearling versus adult bulls except in calf production in 1974. This difference was due to the absence of a visual barrier between the harems which allowed intimidation of yearling bulls by adult bulls. Yearling bulls are as physiologically as capable as adults for breeding, but adult bulls can psychologically prevent yearling bulls from breeding. Median calving dates for captive yearling bull-bred cows were 3 July in 1972, and 1 July in 1973, while the median calving dates for captive adult bull-bred cows were 28 June in 1972, 18 June in 1973, and 19 June in 1974. Calving dates for wild bull-bred cows were determined by placing pregnant wild bull-bred cows in captivity. Median calving dates for wild bull-bred cows were 17 June in 1972, 1 June in 1973, and 31 May in 1974.

Calves born to captive bull-bred cows were born later than calves sired by wild bulls, but there was no difference in calving dates for captive yearling or adult bull-sired calves. Seventy-one calves weighed within 36 hours of birth averaged 16.5 kilograms (36 pounds) and ranged in weight from 10.0 to 21.5 kilograms (22 to 47 pounds).

Testosterone levels in bulls ranged from a low in April, the time of antler drop, of 1 nanagram per milliliter to a high in August and September, the time of antler hardening, of 2.5 to 19 nanagrams per milliliter, depending on the age of the bull. Sperm concentrations were lowest in the April-May period, 0 to 3 x 10^6 cells per milliliter of semen, and highest in the November-February period, 15 to 25 x 10^6 cells per milliliter of semen. Sperm were found throughout the year in semen samples of yearling and older bulls.

Multiple ovulation experiments conducted to induce multiple births in elk used Pregnant Mare's Serum (PMS) in conjunction with progesterone. The four cows treated in the fall of 1972 produced only single calves in 1973. These cows calved 314, 253, 258, and 296 days after injection of PMS, indicating that the

cows which calved 253 and 258 days after injection should have conceived in the estrus period in which multiple ovulation occurred. If multiple conceptions did occur, all fetuses except one were resorbed in these two cows.

Ninety-eight wild cows rectally palpated in January through March 1973, showed that 4 of 23 (17 percent) yearling cows and 64 of 72 (89 percent) adult cows were pregnant. One of 25 (4 percent) yearling cows and 61 of 65 (94 percent) adult cows were pregnant in 1974. Postseason calf:cow ratios were 41 and 58 calves per 100 cows in 1973 and 1974, respectively. These data were used to predict preseason calf:cow ratios. The 1973 predicted preseason calf:cow ratio was 58 calves per 100 yearling and older cows as compared to an observed ratio of 55 calves per 100 cows. The predicted and observed ratios in 1974 were 53 and 48 calves per 100 cows, respectively.

The question about yearling bull elk breeding effectiveness and predicting preseason calf:cow ratios have been answered. However, more information is needed about the reproductive biology of female elk to insure the success of artificial induction of twins.

ADVANCES IN THERMAL INFRARED SCANNING OF UNGULATES

Marc C. Wride
Intera Environmental Consultants

and

Keith Baker
Parks Canada, Western Range

A Daedalus thermal linescanner mounted in a light single engine aircraft was used to image the entire 270 square kilometers within the fenced perimeter of Elk Island Park, Alberta, Canada. The data were collected during winter, 1976, in morning and midday (overcast conditions), processed and analyzed to obtain a number for total ungulates. Five different ungulate species were present during the survey, including bison (Bison bison); elk (Cervus canadensis); moose (Alces alces); white-tail (Odocoileus virginianus) and mule deer (O. hemionus).

Ungulates easily observed during the analysis of linescanner imagery and the total number of ungulates was established at 2175. This compared to figures of 1010 and 1231 for visual method aerial survey results of the same area that year. It was concluded that the scanner was much more accurate and precise for census of ungulates than visual techniques. Advantages over visual survey methods include: no technician effect; no observed fatigue; operation at night, early morning and without snow cover; detection of camouflaged or neutral colored animals; accurate repeatable results; and habitat permanently recorded. Disadvantages include: restricted in severe terrain, sex of animal is not recorded, species separation is limited, and cost is equal to or higher than visual methods. Applications of the thermal scanner include total counts of ungulate concentrations or high densities and sampling programs or animal habitat relationships (both habitat and animal are represented on imagery). Cost is not excessive for the above applications.

INVESTIGATION OF THE RANGE AND HABITAT REQUIREMENTS OF WAPITI IN THE NORTH GEORGIAN BAY REGION OF ONTARIO

Bruce Ranta
Carleton University, Ottawa

Research has been initiated on the range and seasonal habitat requirements of elk in the North Georgian Bay region of Ontario. Animals are the descendents of a stocked population on historical elk range in 1933. The last native elk was recorded in 1893.

Elk and bison were released into a penned enclosure on Burwash Industrial Farm. Elk increased to 300-400 animals, bison to about half that by the mid-1940's. Elk and bison were then slaughtered because it was believed they could spread Fascioloides magna, the giant liver fluke, to native white-tailed deer and to domestic livestock. Some elk and bison had escaped the penned enclosure during previous years and form the basis for the existing herd.

Present range of elk is approximately 400 square miles. Bison numbers are very low, but an estimated 50-200 elk survive. Habitat types vary from cleared agricultural land, mixed deciduous forest, heavy coniferous cover, oak ridges, and sedge meadows.

Use of habitat types by elk may be seasonal based upon recorded sightings. Research objectives are to quantify habitat types within the range and identify similar habitats close by but presently unoccupied by elk. The importance of the dry meadows at Burwash during spring "green-up" will be investigated by visual observation and the use of a photographic record. This will be done with a camera on a platform suspended by a helium filled balloon. Coverage will be one to four square miles dependent upon the height of the balloon (1000-3000 feet). Food habits during winter months will be related to snow cover, available browse, aspect, and habitat types. Browse surveys have been modified to suit low population densities by being dependent upon the location of fresh tracks.

Present mortality is due to drowning and hunting. Predator relationships are unknown, although black bears, timber wolves and coyotes are present. Elk are classified with white-tailed deer for hunting purposes, and an estimated 25 elk were shot during the 1976 open season. Season length varies from 6 days in the northern part of the range to 13 on the southern portion.

In recent years elk sightings outside the considered range have increased. Research hopes to indicate habitat condition and offer suggestions for future management. Increasing human pressure for recreational and industrial land are immediate threats to the future of the Burwash-French River elk.

STUDIES OF RECRUITMENT AND MORTALITY AMONG ELK IN THE PECOS WILDERNESS, NEW MEXICO

Bob Lange
New Mexico Game and Fish, Santa Fe

Abstract

In the early 1970's elk harvest and hunter success in the Pecos Wilderness area declined sharply. The numbers of elk counted on winter aerial surveys also declined during this period.

In reaction to this problem, a study was started in the winter of 1974-75 to determine recruitment and mortality patterns. Since that time it has been determined that 100 per cent of the cows two years old or older are pregnant and that 33 per cent of the yearling females had been bred. This information was determined by trapping elk on winter concentration areas using Clover-type traps and pregnancy testing by rectal palpation.

Mature female elk were fitted with radio collars, and transmitters located in the vagina between the cervex and the vulva. The purpose of the latter was to monitor progress of pregnancy. The vaginal transmitters were expelled during the second week of May, but it was determined that abortions had not taken place. Following parturition, radio collars were placed on as many elk calves as possible. The results to date indicate that fetuses successfully reached term, at least in 1976, are healthy, and that predation, disease, or other causes had an insignificant effect on the 1976 elk calf crop.

Ten 1976 calves will be radio-collared in February 1977 and followed for the next year or better. Also, ten 1977 calves will be radio-collared to again check on possible mortality factors.

ELK AND THEIR WINTER FORAGE RESOURCES

James E. Ellis
Colorado State University Natural Resources Ecology Laboratory
Fort Collins

The elk herd in Rocky Mountain National Park has apparently reached such a size that its feeding activities are beginning to have noticeable effects on forage resources. Consequently the quantity and quality of available forage may affect the elk population.

Elk impacts on forage resources are evident in the valleys which sustain heavy winter use. In some of these areas aspen reproduction has been halted and mature aspen trees show signs of severe barking. Losses of aspen stands could simply reflect natural successional trends resulting from the prolonged absence of wildfire. Alternatively, because aspen degradation is taking place only on major elk wintering grounds, it may be the result of selective browsing by the elk. Whatever the cause, the elimination of aspen from the winter range is a cause for concern. In the first place, aspens are attractive to park visitors, an asset to the park, and a natural part of the ecosystem. Additionally, since aspens are selected by elk, they may comprise an important food resource. It has been suggested that intermediate successional stages, such as aspen communities, are essential parts of elk winter range.

In recent years it has been observed that some young elk are dying in early spring. This may indicate a state of poor nutrition or some form of nutritional stress which is evident only in this age class. If so, these infrequent deaths may portend more serious problems in the future. If the elk herd is approaching the carrying capacity of the winter range, then the loss of aspens may be a preliminary sign of more serious difficulties for both winter range vegetation and the park elk herd in the future.

The causes of this potential problem are clear. Rocky Mountain National Park encompasses a large area of summer range but a much smaller wintering area, due largely to the encroachments of the town of Estes Park. Thus the Park can support many more animals in the summer than in the winter. Further, there are no effective predators on this population, nor is it hunted (except outside the boundaries of the park). Thus it is possible that the herd could approach or exceed the carrying capacity of this constricted winter range.

The purpose of the cooperative elk study is to investigate, through simulation modeling and data collection and analysis, the foods eaten by wintering park elk, the quality, chemical content, abundance, and availability of these elk foods, and the energy and nutrient requirements of the elk herd. The results of the data collection and simulation studies will provide information as to the current carrying capacity of the winter range, the probably nutritional state of the wintering elk herd, and how changes in either forage resources or elk numbers might influence the interaction between elk and the ecosystem. This information will be useful in the consideration of alternative strategies for managing the park ecosystem.

THE MECHANICS OF ELK USE STUDIES FIELD WORK

N. T. Hobbs
Colorado State University Natural Resources Ecology Laboratory
Fort Collins

During fall and winter 1976-77, studies were conducted on the feeding ecology of elk in Rocky Mountain National Park. Objectives of the study included: (1) to identify the plant species which are consistently eaten by elk, (2) to quantify the relative importance of those forages in elk diet, (3) to estimate the biomass of elk food available at the beginning of winter, and (4) to determine the nutritional quality of the principal elk forages. Methods used to address these questions are discussed.

Winter range in Rocky Mountain National Park is confined to upper-Montane valleys following the major river drainages between 7600 and 9000 ft. in elevation on the east slope of the Continental Divide. Fifteen thousand acres within the park boundary are used by deer and elk during winter. Westerly winds remove snowcover and exposed areas consequently tend to be free of snow year round.

Elk food habits were investigated by counting forage bites taken by tame calves. Calves were obtained from the Wyoming Game and Fish Department and the Denver Zoological Gardens. Each animal was removed from its dam within 48 hours of birth and bottle raised at the Colorado Division of Wildlife research headquarters in Fort Collins, Colorado. Animals were trained to load and travel in a modified horse trailer, to follow on halter and rope, and to come to a handler when he blows a whistle. During August a pilot grazing experiment was conducted to accustom animals to close observation and to finalize sampling procedures.

The sampling design followed during winter studies involved repeated observations on five calves. Each month from November through March a 10-day grazing trial was conducted. For the first two days of each trial, animals were habituated to the study area. During the following eight days each animal was released daily in a randomly selected plant community and allowed to graze and wander freely for 1.25 hours. One observer recorded each bite of each plant species taken, while another simultaneously collected plant material for estimation of bite weights and chemical analysis.

Studies of forage quality and quantity were conducted to complement food habits experiments. During September and October biomass sampling was conducted in the major plant communities used by elk for feeding. These vegetation types include willow, sagebrush, aspen, willow/alder savanna, ponderosa pine savanna, wet meadow, mesic meadow, and grassland. In each type four representative stands were selected and 30 1/4-square meter plots in each stand were randomly placed and ground-level clipped. Eighteen plant species were individually separated, sacked, dried, and weighed.

Analysis of forage quality is currently in progress. Nutritional value of elk food is being assessed by determination of crude protein, gross energy, cell wall constituents, dry matter, and <u>in vitro</u> digestibility.

Data on forage quality and quantity and on elk diet mix will be integrated in a simulation model (see abstracts by Ellis, Swift, and Baker in this volume) developed to investigate nutritional status of elk during winter.

THE SIMULATION MODELING APPROACH

Dave Swift
Colorado State University Natural Resources Ecology Laboratory
Fort Collins

Our present research is directed toward determining the carrying capacity of the elk winter range in Rocky Mountain National Park. We are studying elk/range relationships on the winter range and assessing the quantity and quality of forage there. Our objectives are to estimate forage use under varying elk densities and estimate animal condition under various range conditions so that the park management can make an informed decision on carrying capacity of the winter range.

To achieve these objectives we have designed a research program which combines field and laboratory studies with simulation modeling. The model being used was developed by me under the US/IBP Grassland Biome Study.

Table 1 shows the information necessary to meet our objectives and shows which of the information items will be measured and which will be estimated via simulation.

Table 1. Information Required

To Measure	To Simulate
Dietary mix	Energy requirements
Forage quality	Protein requirements
Forage quantity	Voluntary intake
Elk numbers	Energy partitioning
	Changes in lean body and fat

The decision to measure or to simulate was based on technical feasibility and cost effectiveness. For instance, diet selection is not being simulated because the mechanisms controlling diet selection are not well understood and thus cannot be stated as a model with a high level of confidence. Instead, we are measuring diet selection by observing the feeding habits of tame elk. Total forage intake is much more difficult to determine in the field but we feel we can simulate it accurately based on a knowledge of rumen function and forage quality.

Our model serves a wide range of purposes other than estimating parameters which we cannot measure.

(i) The model acts as an integrator of information from field, laboratory, and literature; it provides us with a clear conceptual framework within which to work.

(ii) The model provides us with a gaming capability. For instance we would like to investigate the question, "How will elk condition change if aspen were to disappear from the winter range?" We cannot readily study this in the field but can address this question with the model.

(iii) The model can provide a dynamic solution to questions that are usually posed and answered in a static context. As an example, we feel it is unsatisfactory to cite a single figure as representing forage protein requirements for wintering elk. Any such figure will surely be different for different sex and age classes and, for any one class, will vary within and between winters as a function of weather. It will also change as a function of the level of protein depravation deemed acceptable by the herd manager. The model will demonstrate the effects of varying levels of dietary protein and varying degrees of protein requirements.

(iv) The model can guide further research. The construction and exercise of the model pinpoints processes that are either poorly represented or poorly understood and thus require further study.

The model currently being used in this study is a generalized model of ruminant energy and nitrogen balance. The model simulates energy and nitrogen requirements, voluntary intake of forage, the release of nitrogenous and non-nitrogenous compounds via digestion, and the joint metabolism of the energy and nitrogen thus released. The result is a dynamic determination of energy and nitrogen balance and concomitant changes in the mass of lean body tissue and depot fat reserves; and indices of animal condition and possible future performance.

The data which we are collecting in the field and in the laboratory will serve as necessary input or driving information for the model. This combination of data and nutritional theory permits a more comprehensive study than could be realized by either approach alone.

SIMULATION OF THE CARRYING CAPACITY OF THE ROCKY MOUNTAIN NATIONAL PARK ELK WINTER RANGE MANAGEMENT IMPLICATIONS

Dan L. Baker
Colorado Division of Wildlife, Fort Collins

Abstract

Empirical evidence gathered from Rocky Mountain National Park (RMNP) suggest that the elk herd in this ecosystem has reached sufficient size that its foraging activities may be adversely affecting its food resources and as a result the elk may be reaching a poor state of nutritional condition. A co-operative project was initiated by the National Park Service to decide if in fact the elk population has increased in size beyond the capacity of the range to support a healthy herd. If this question can be answered before the herd has reached a critical population density then an attempt could be made to instigate management procedures to prevent, rather than alleviate, environmental degradation resulting from over-grazing.

Data from this study will be gathered principally from RMNP to provide answers pertinent to a specific question. However, the problems confronting RMNP are not unique. Natural resource managers of ungulate populations in other ecosystems face the same problem of attempting to keep big game populations and their habitat in balance. Therefore, a basic goal of this study is to not only test a specific hypothesis and assimilate information relative to a specific ecosystem, but also to provide tools and methods that can have broader application for evaluating other ungulate populations and habitats.

Range evaluation methods have been used as a tool for many years by the resource manager in evaluating attempts to keep big game populations in balance with their habitat. None of these procedures have been shown to provide a demonstrable relationship between measured attributes of habitat and its carrying capacity (Wallmo et al. 1976).

Assuming food to be the major limiting factor of an animal population, Moen (1973) and Robbins (1973) outlined a concept for the estimation of carrying capacity based upon the nutritional requirements of wild ungulates and the nutritional supply of their range forage. This concept is inherent in the approach employed by the RMNP Cooperative Elk Project. One goal of this study is to develop a quantitative system of basic biological information which will allow the resource manager to predict the number of animals a given habitat will support based upon selected measured parameters of vegetation.

What vegetative measurements are required in this type of carrying capacity model? Since all vegetation does not represent elk forage, knowledge of elk food habits by vegetation type will be important in any system which estimates carrying capacity. Next, the nutritional composition of this forage species is essential to enable the manager to convert biomass estimates into quantities of physiologically usable nutrients (Gill, unpublished).

Equally fundamental to this approach to determining carrying capacity is an understanding of the nutritional requirements of the animal for survival, growth and reproduction as well as an estimate of their digestive efficiency for the conversion of food into metabolically useful products.

It is obvious that carrying capacity is a complex, dynamic ecological relationship due to the constantly changing interaction between the animals' nutrient condition and requirements and the range supply of those nutrients. The complexity of these interactions necessitates the use of a computer simulation model which represents the biology of this animal-range interaction.

Once the components of this model are quantified the resource manager can begin to use this tool to assess the adequacy of habitat to support wildlife. With a growing loss of wildland habitat and increasing pressure and controversy over land use it is critical that the professional resource manager have a thorough understanding of the biological system. Only with this foundation can he hope to make rational management decisions (Moen 1973).

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ELK MANAGEMENT IN ROCKY MOUNTAIN NATIONAL PARK

Dave Stevens
Rocky Mountain National Park, Estes Park

It is the policy of Rocky Mountain National Park to perpetuate native animal life for their essential role in the natural ecosystems. Management strives to maintain the natural abundance, behavior, diversity, and ecological integrity of native animals. In so doing, it will as far as possible, eliminate or minimize the impact of modern man on the environment.

In the case of elk, a portion of the ecologically complete habitat which was available to the animals in historic times in located outside the boundaries of the Park. These areas have drastically been influenced by man's activities and are slowly being eliminated as elk habitat through land development. The major predators have been extirpated. Migratory patterns have been lost by the reintroduced elk population.

In 1943, it was decided that natural regulations no longer limited the population. Periodic population reduction was initiated in order that other parts of the Park ecosystem would not be irreversibly damaged by over populations of elk.

The elk, however, is considered a major ecological influence on its habitat and the ecosystem of which it is a member. The levels at which the elk population will ultimately be maintained will be determined primarily by the reaction of climax vegetation to the grazing influence. The condition and trend of the habitat is being closely monitored. When changes in the vegetation become greater than expected, population management will be initiated. Presently, changes are noted on several successional species, primarily willow and aspen.

In 1962 it was agreed by the three agencies concerned, The Colorado Division of Wildlife, the Forest Service and the Park Service, that if possible, elk determined to be in excess to natural conditions in the Park should be made available for public hunting outside the park. After cooperative scientific studies showed that elk were outside the Park at certain times, special hunting seasons were initiated to allow harvest of these animals by Colorado sportsmen.

In 1968, the last direct reduction within the Park boundaries was made by trapping. The Division of Wildlife now attempts to set seasons which will harvest elk outside the Park as they move out in response to weather conditions. Some years the conditions are favorable, but many years they are not. This program is dependent on the elk winter range in the vicinity of Estes Park being accessible to hunters at the time the elk leave the Park.

Another alternative would be the reintroduction of the gray wolf. The wolf is probably the only effective predator on elk. If reestablished, it could perform several important functions necessary to the elk and its ecosystem.

WESTERN STATES ELK WORKSHOP

Committee Meeting

Representatives from Arizona, British Columbia, Colorado, Idaho, Michigan, Montana, New Mexico, Utah, Washington and Wyoming met for a business meeting on February 1, 1977.

Next Workshop Location

The main subject of the meeting was the selection of the site for the Western States Elk Workshop in 1979. British Columbia extended an invitation, as did Arizona. It was voted to hold the 1979 Workshop in British Columbia, in mid- to late February, 1979, at a site in the southeastern portion of the province with good access, possibly Cranbrook.

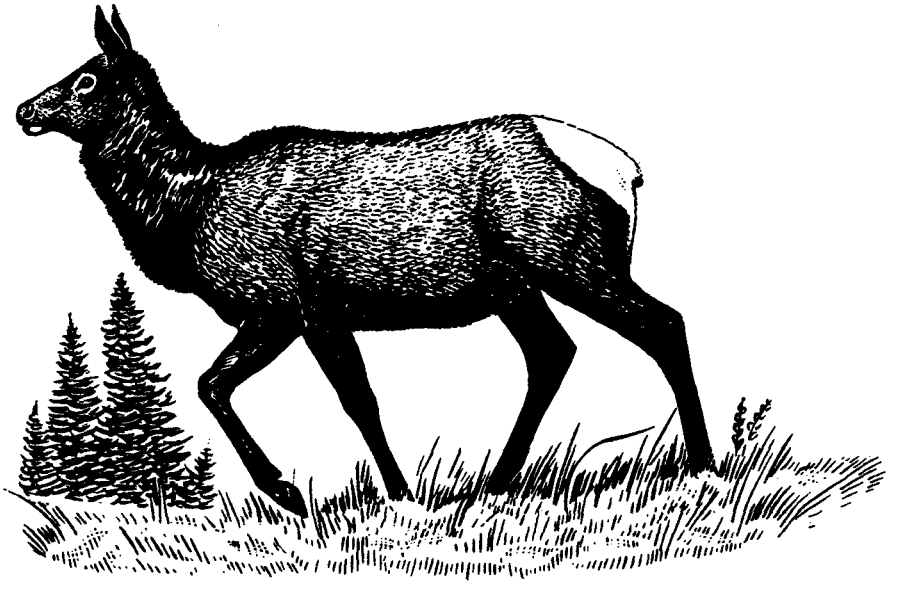
It was voted to accept Arizona's invitation for the site of the 1981 Western States Elk Workshop.

Transactions

A motion was made, and it was voted in favor, that proceedings of each workshop be published, consisting of state elk status reports, the abstracts of papers presented, and possibly some of the pertinent discussions on the papers.

Other Discussion

It was also suggested that the Workshop study the guidelines developed by the Bighorn Sheep Council and the Antelope Workshop, and possibly develop something similar for the Western States Elk Workshop.



PERSONS ATTENDING THE 1977 WESTERN STATES ELK WORKSHOP

Name	Agency	Address
Iola Baker	Colo. Division of Wildlife	6060 Broadway, Denver, CO 80216
Roger Bumstead	U. S. Forest Service	R. O. R-1, Missoula, MT 59801
George Bear	Colo. Division of Wildlife	Ft. Collins, CO 80521
Lyle Bennett	Colo. Division of Wildlife	Norwood, CO
Tom Britt	Arizona Game & Fish Dept.	310 Lake Mary Road Flagstaff, AZ 86001
Gene Byrne	Colo. Division of Wildlife	0303 - 265 Road Rifle, CO 81650
Gene Carr	Carr Associates	3150 Iris - 302 Boulder, CO 80301
Bob Caskey	Colo. Division of Wildlife	Box 24-A, Trappers Lake Rt. Meeker, CO 81641
Charles Cesar	Bureau of Land Management	Post Office Box 68 Kremmling, CO 80459
Jim Chadwick	Dames and Moore	605 Parfet Street Denver, CO 80215
Dave Clippinger	Colo. Division of Wildlife	Post Office Box 92 Hot Sulphur Springs, CO 80451
David Cook	San Juan Nat'l. Forest	Post Office Box 341 Durango, CO 81301
Jim Cruse	Roosevelt Nat'l. Forest	Ft. Collins, CO 80521
Alex Cringen	Colo. State University Dept. of Fisheries and Wildlife Biology	Ft. Collins, CO 80521
Dick Denney	Colo. Division of Wildlife	6060 Broadway, Denver, CO 80216
Nick Dudiak	Dames and Moore	1550 N. W. Hwy. Park Ridge, IL 60068
John Ellenberger	Colo. Division of Wildlife	Grand Junction, CO
Bob Evans	Colo. Division of Wildlife	6060 Broadway, Denver, CO 80216
Richard Fentzlaff	Colo. Division of Wildlife	P. O. Box 365, Ignacio, CO 81137
Charles Fowler	Dept. of Wildlife Science	Utah State University Logan, Utah 84322

Phil Garrett	Bureau of Land Management	824 Nieman Rawlins, WY 82301
Bruce Goforth	Colo. Division of Wildlife	Post Office Box 86 Blanca, CO 81123
Jim Graban	Boise Cascade Corporation	One Jefferson Square Boise, Idaho 83728
Van Graham	Colo. Division of Wildlife	Post Office Box 2037 Steamboat Springs, CO 80477
Chuck Grand Pre	Colo. Division of Wildlife	6060 Broadway, Denver, CO 80216
Pete Greene	U. S. Forest Service	Regional Office, Denver, CO
Tom Henry	Colo. Division of Wildlife	Grand Junction, CO
Jim Hicks	Colo. Division of Wildlife	Post Office Box 1879 Steamboat Springs, CO 80477
Dave Hoart	Colo. Division of Wildlife	Post Office Box 82 Gypsum, CO 81637
Tom Hobbs	Natural Resources Ecology Laboratory	Colo. State University Ft. Collins, CO 80521
Jim Houston	Colo. Division of Wildlife	Post Office Box 868 Gunnison, CO 81230
Bill Heicher	Colo. Division of Wildlife	Box 401, Eagle, CO 81631
Rodney John	Division of Wildlife Resources	Salt Lake City Utah 84116
Jim Johnson	New Mexico Dept. of Game and Fish	Santa Fe, New Mexico
Craig Kling	Ecology Consultants, Inc.	Post Office Box 2105 Ft. Collins, CO 80522
Matt Kniesel	Bureau of Land Management	Post Office Box 670 Rawlins, Wyoming 82301
Dick Knowles	Corps of Engineers	Ahsahka, Idaho 83544
Skip Kowalski	U. S. Forest Service	Post Office Box 948 Glenwood Springs, CO 81601
Harvey Lancaster	Custer State Park	Custer, South Dakota 57730
Harold Lanning	Colo. Division of Wildlife	Post Office Box 438 Collbran, CO 81624

Carl Leonard	Colo. Division of Wildlife	1430 Meeker Drive Longmont, CO 80501
Terry Lonner	Dept. of Fish & Game Montana State University	Post Office Box 85 Bozeman, MT 59715
John McKern	Corps of Engineers	City & County Airport Bldg. 602 Walla Walla, WA 99362
Mike McLain	Colo. Division of Wildlife	Post Office Box 525 Dove Creek, CO 81324
Francis Marcoux	Colo. Division of Wildlife	Post Office Box 159 Drake, CO 80515
Lynn Martin	Ecology Consultants	5600 E. 6 Rd. 50 Ft. Collins, CO
Lowell D. Parsons	Washington Game Department	600 N. Capitol Way Olympia, WA 98504
Francis Petera	Wyoming Game and Fish	Cody, Wyoming
Tom Pojar	Colo. Division of Wildlife	Ft. Collins, CO 80521
Merritt Pulkrabek	S. Dakota Game, Fish and Parks	R. R. 2 Hermosa, South Dakota 57744
Don Redfearn	Fish & Wildlife Service	Post Office Box C Jackson, Wyoming 83001
Harlan Riffel	Colo. Division of Wildlife	6060 Broadway, Denver, CO 80216
Russell Robbins	Fish & Wildlife Service	Post Office Box C Jackson, Wyoming 83001
Lee Rottman	Colo. Division of Wildlife	15577 E. Brown Place Aurora, CO 80015
Bruce Ranta	Carleton University Biology Dept.	Colonel By Drive Ottawa, Ontario, Canada
Bob Root	Dames and Moore	1550 N. W. Hwy. Park Ridge, IL 60068
John Ross	U. S. Forest Service	Shoshone Nat'l. Forest Cody, Wyoming 82414
John Russo	Arizona Game & Fish Dept.	Phoenix, Arizona
Wayne W. Sandfort	Colo. Division of Wildlife	6060 Broadway, Denver, CO 80216

Rick Sandquist	Colorado State University (Student)	Ft. Collins, CO 80521
Mike Schlegel	Idaho Dept. Fish & Game	Post Office Box 626 Kawiah, Idaho 83536
W. C. Shuster	Forest Service	301 W. Howes Ft. Collins, CO
John Siedel	Colo. Division of Wildlife	Post Office Box 218 Carbondale, CO 81623
Don Sommers	Forest Service	Meeker, CO 81641
Homer Stapley	Division of Wildlife Resources	Salt Lake City, UT 84116
Dave Stevens	National Park Service	Rocky Mtn. National Park Estes Park, CO 80517
Bob Strong	Michigan Dept. Natural Resources	Post Office Box 576 Gaylord, Michigan 49735
Ken Sumanik	Fish & Wildlife Branch	British Columbia Dept. of Recreation and Conservation 310 Ward St. Victoria, British Columbia Canada
Dave Swift	Colorado State University	Natural Ecology Laboratory Ft. Collins, CO 80521
Jerold Thiessen	Idaho Fish and Game	Boise, Idaho 83707
Bob Tully	Colo. Division of Wildlife	Denver, CO 80216
Harold Swope	Colo. Division of Wildlife	Ft. Collins, CO 80215
Joe Vogt	Michigan Wildlife Division	St. Mason Bldg. Lansing, Michigan
Lorin Ward	Rocky Mtn. Forest and Range Experiment Station	Laramie, Wyoming 82071
Jim Webb	Routt National Forest	Steamboat Springs, CO
Fred Wild	Grand Mesa, Uncompahgre and Gunnison National Forests	Delta, CO 81416
Gary Wolfe	Vermejo Park Corp.	Post Office Drawer E Raton, New Mexico 87740
Marc C. Wride	Environmental Consultants Ltd.	1200-603 - 7th Ave., S.W. Calgary, Alberta, Canada T2P2T5