STATUS AND MANAGEMENT OF MOOSE IN WYOMING

Patrick Hnilicka[1] and Mark Zornes[2]
[1]Wyoming Game and Fish Department, P.O. Box 163, Baggs, Wyoming, 82321; [2]Wyoming Game and Fish Department, 5400 Bishop Blvd., Cheyenne, Wyoming, 82006

ABSTRACT: The Shiras moose population in Wyoming is estimated at 12,000 and has significantly increased in size and distribution since the late 1800s. At present, the Wyoming Game and Fish Department operates within a planned management system involving inventory, objective and strategy setting, and monitoring. Wyoming's moose population is subdivided into discrete herd units, with each being managed toward a population objective. Objectives are set according to public input and biological considerations. Helicopter surveys, hunter harvest surveys, tooth aging, and population modeling are tools used to managed moose in Wyoming.

ALCES VOL. 30 (1994) pp.101-107

The Shiras moose is an exceptionally popular big game species among wildlife enthusiasts in Wyoming. The demand for licenses is very high, with nearly 16,300 hunters applying for 1,490 available licenses in 1993. In addition, moose are commonly viewed by thousands; they are especially popular among visitors to Yellowstone and Grand Teton Nationals Parks. Current management emphasis is directed toward attaining and/or maintaining herd unit populations at established objective levels, while secondarily providing maximum hunting opportunities (Wyoming Game and Fish Commission 1990).

HISTORICAL DISTRIBUTION AND DESCRIPTION OF WYOMING'S LAND FEATURES

The Shiras moose has increased in numbers and expanded its distribution within Wyoming over the last 100 years. References to moose are nearly absent from the diaries of early trappers and explorers. Osbourne Russell made no mention of moose during his travels between 1834-43 throughout the northwestern corner of the state (Haines 1955). By the late 1860s and early 1870s, moose were observed in Yellowstone National Park (Haines 1965, Houston 1968). Game and Fish Commission reports from 1905-15 indicated that moose were increasing rapidly in northwest Wyoming. In 1908, State Game Warden Nowlin stated that 10 years prior to the report's publication only a "handful" of moose were present statewide, but currently a "very respectable" number was distributed along the Tetons, along the Upper Yellowstone, and at the headwaters of the Green River (Wyoming Game and Fish Commission 1908).

The first official hunting season was established in 1916 (Wyoming Game and Fish Commission 1916). Prior to 1940, legal moose harvest was conservative, with less than 100 moose taken in any given year. During 1945-56, the estimated moose population (based on trend counts) was between 2,400 - 3,200. No population estimates were documented during 1956-74. Moose harvest steadily increased from 180 in 1947 to 1,460 in 1974. Since 1974, growth in the number of moose, number of hunters, and amount of harvest has continued. We speculate that the population and distribution expansion of moose since the turn of the century is a result of natural colonization into suitable habitat, enhanced by conservative annual harvests and a lack of natural predation by wolves. At the turn of the century, over 10,800 wolf bounties were paid during an 11 year period ending in 1908 (Long 1965). Prior to reintroduction efforts in Yellowstone National Park, viable wolf packs had been extirpated from Wyoming

since the 1940's (Clark and Stromberg 1987, Wyoming Game and Commission 1992).

Wyoming's 12 mountain ranges are separated by intermountain basins and plains and drained by 5 major rivers. Elevation ranges from 930 (extreme northeast) to 4,207 (west-central) m above sea level. Climate is highly variable. Mean precipitation ranges from 15 cm in the Great Divide Basin (south-central) to 152 cm in higher elevational reaches of the Absaroka, Gros Ventre, Teton, and Wind River ranges (north-west) and the Wyoming Range (extreme west-central). Mean low and high temperatures range from -21°C in Big Piney (west-central) to 32°C in Big Horn Basin (north-central) (Martner 1986). Vegetation can be subdivided into 7 ecoregions as defined by Bailey (1976). Great Plains Short Grass Prairie-Steppe dominates the eastern 1/3 of the state and is comprised of grama-needlegrass-wheatgrass, wheatgrass-needlegrass, and grama-buffalo grass types. Wyoming Basin-Steppe dominates the southwest and central portions of Wyoming and is typified by big sagebrush. Rocky Mountain Forest dominates the northwestern portion and is comprised of douglas fir and lodgepole pine-douglas fir types.

CURRENT DISTRIBUTION

Moose are typically associated with mountain/foothill habitats and are distributed within 3 distinct areas of Wyoming: the western third of the state, the Bighorn Mountains, and the Snowy/Sierra Madre Mountains (Fig. 1). Expansion of populations from Colorado into the Snowy/Sierra Madre Mountains has warranted the designation of this herd unit. The herd unit will remain closed to hunting until additional information indicates this population can withstand harvest.

Management of big game species in Wyoming is founded upon the herd unit concept. Subdividing the statewide population into smaller, distinct herds facilitates and improves management. This "manageable" scale allows for greater precision and control in data collection, population estimation, and harvest distribution. Each herd unit contains a discrete population for which emigration and immigration between adjacent herds accounts for less than 10% of the herd unit's population. Hydrologic divides, major rivers, highways, and other natural and man-made barriers generally constitute a herd unit's boundaries. Additionally, radio telemetry and tagging studies have helped define herd unit boundaries. Herd units are further subdivided into hunt areas to provide additional management flexibility. Hunt areas are completely contained within their respective herd units.

MANAGEMENT PRACTICES

The Wyoming Game and Fish Department (WGFD) operates within a planned management system in which hunter harvest surveys, age and sex classifications, population modeling, and public input work in concert to answer 4 basic questions for each herd: Where are we (inventory)? Where do we want to go (objective)? How will we get there (strategy)? Did we make it (monitor)? (Crowe 1983). In relation to management of moose, these questions are applied as follows:

Inventory: Estimating moose population, distribution, and age and sex structure.

Populations are estimated using population model simulations and trend count data. WGFD conducts fixed-wing and helicopter surveys to classify herds by sex and age and to conduct trend counts (Wyoming Game and Fish Commission 1982). Aerial surveys for moose were begun in 1952 using a fixed-wing monoplane. Prior to this, moose were opportunistically recorded during aerial surveys for elk or were surveyed from the ground (Wyoming Game and Fish Commission 1952). Currently, helicopter surveys are flown annually or biennially during the winter months when moose are concentrated in willow complexes (Wyoming Game and Fish Commission 1994a, Wyoming Game and Fish Com-

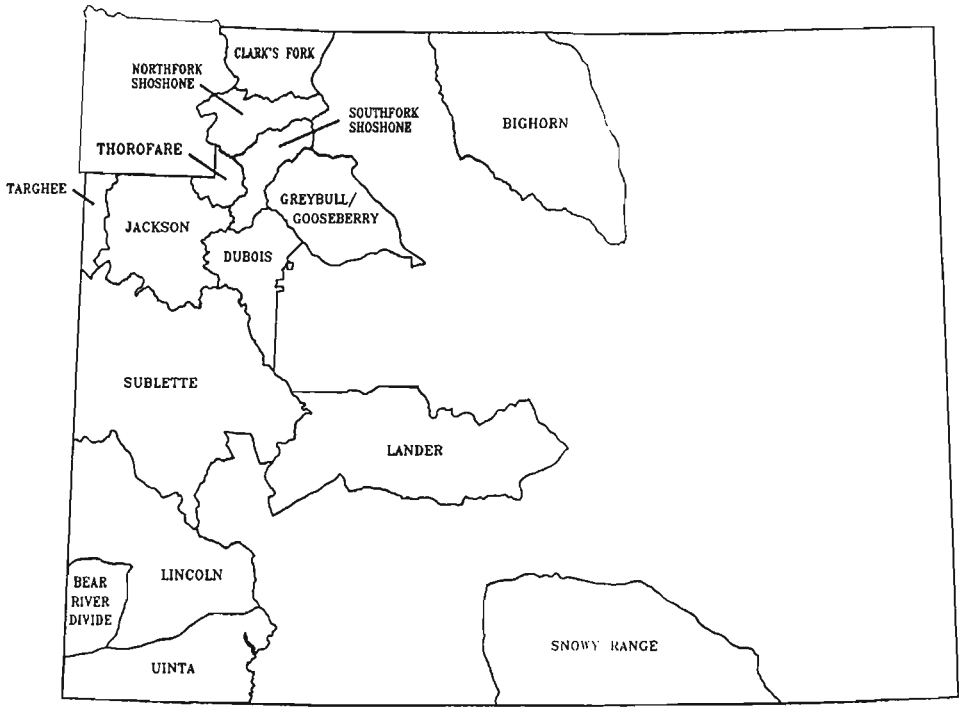

Fig. 1. Distribution of moose herd units in Wyoming, 1993. Herd unit boundaries indicate moose distribution.

mission 1994b, Wyoming Game and Fish Commission 1994c, Wyoming Game and Fish Commission 1994d, Wyoming Game and Fish Commission 1994e). Prior to surveying, target sample sizes are calculated for each herd unit to produce 90% confidence intervals ± 10% for sex and age classification ratios (Wyoming Game and Fish Commission 1977). Generally, sample sizes are met on only the larger herds. Rather than spending additional money on expensive helicopter flights, herd units with smaller populations are occasionally surveyed from the ground or from fixed-wing aircraft. Flights are structured to survey all documented winter range as completely as possible and to acquire a count of moose numbers. During winters with low snowfall, moose are more widely distributed into habitats located away from willow complexes. Consequently, the percent of the existing population that is counted differs between years (Wyoming Game and Fish Commission 1994d). Along with snowfall, differences in sightability may result from differences in light conditions, vegetation or topography. At present, data are not corrected for possible inconsistency between survey areas or between years. A sightability study is currently in progress and will improve population estimates and classification data (Lindzey and Anderson 1992).

In addition to aerial surveys, harvest data are also collected (Wyoming Game and Fish Commission 1994f). At the beginning of the hunting season, all moose hunters are sent a packet of information that includes a hunter survey card, a tooth collection box, and instructions for tooth removal. Tooth cementum annuli are analyzed by the WGFD Forensics Laboratory. Age structure of the harvest assists biologists in assessing the age structure of the population and the harvest pressure on each age cohort.

Once aerial classification, trend count, and harvest data have been collected, moose population sizes are estimated using POP-II,

a computer simulation model (Bartholow 1992). Modeling assumptions for POP-II include: 1) effects of emigration and immigration are negligible; 2) natural mortality rates effect all age cohorts in a predictable linear fashion; 3) estimates of sex and age classifications, harvest, natural mortality, and wounding loss mirror reality; 4) effects of density-dependent or other feed-back mechanisms are negligible (Bartholow 1992, Conroy 1993, Guenzel 1994). Models are validated using trend count data (Conroy 1993, Guenzel 1994). Population estimates prior to 1976 are based on trend counts only. Since 1976, WGFD has been modeling populations using POP-II and its precursors (Strickland 1979). In 1993, population estimates for 7 of 15 herd units were derived from model simulations. Herd units with small populations (< 300 moose) are difficult to model, thus population estimates are based on trend counts only.

Objectives: Establishing target population levels.

Population objectives for each herd unit are set according to biological, sociological, and political considerations. Public meetings involving landowners, hunters, and non-hunters help formulate population objectives acceptable to all. In addition, federal land management agencies are queried. Generally, population objectives are a compromise between a biological "carrying capacity" and a socio-political threshold. Population objectives are dynamic and can be readily altered if public pressures to do so are perceived.

Strategy: Directing population toward objective through harvest strategies and habitat manipulations.

Modeling, in conjunction with management expertise, is used to formulate harvest strategies that will direct a population closer to objective. An example of a harvest strategy implemented by WGFD is as follows. The estimated moose population of the Lincoln Herd Unit (n = 1,133) in 1993 was below the objective of 1,500. In 1993, 90 "antlered" (bulls only) and 20 "antlerless" (cows and calves only) permits were available in Hunt Area 26, while 5 "any" permits were available in Hunt Area 40. Limited harvests in 1992 (84 bulls, 25 cows) and 1993 (90 bulls, 17 cows) continued to direct this herd toward objective. A low calf to cow ratio (35 calves:100 cows) observed in 1993 prompted a decrease in the number of permits issued in 1994. Prior to implementation of the 1994 season, the wildlife manager used model simulations to create different scenarios of herd unit population changes in response to various harvest strategies.

No habitat management projects specifically designed to benefit moose are currently underway (G. Butler, WGFD, pers. comm.). However, grazing allotment plans are being revised to protect and enhance riparian areas throughout much of the state's occupied moose habitat.

Monitoring: Determining harvest and re-evaluating populations.

A mail survey of all hunters is conducted annually. From the survey, we can determine the number of hunters, the number of moose harvested, sex and age of the harvest, and the days of effort required to harvest a moose. Return rates for hunter survey cards are quite high and generally approach 85%. Classification surveys and trend counts are then flown again, and the cycle begins anew.

In years past, WGFD set objectives for harvest success rates, recreation days, and hunter effort. However, managing for these objectives has been deemphasized since the population objective ultimately influences the outcomes of the others.

POPULATION STATUS

In 1993, 16 herd units, comprised of 41 hunt areas, ranged in size from 873 to 9,880 km^2 and averaged 2,515 km^2. Within these

herd units, moose occupied 40,236 km^2 of this, 22,616 km^2 and 38,362 km^2 were designated as winter and summer range, respectively. Though moose are commonly found in Yellowstone National Park, seasonal ranges found there are not included in the occupied range totals since management of wildlife within the park is beyond the jurisdiction of WGFD. Crucial winter range, defined as range that determines whether a population maintains and reproduces at or above the population objective over the long term, accounted for 10.1% of the total occupied moose habitat and was identified in 9 of 15 herd units. During 1993, the statewide moose population was estimated at 11,719, resulting in a density of 0.29 moose/km^2 of occupied habitat. Herd unit subpopulations ranged from 65 to 5,112 and averaged 732 moose, resulting in densities of 0.04 to 0.52 moose/km^2. Herd composition post-hunting season was 48 bulls:100 cows:42 calves from 1990-93 and was nearly identical for each year during that period. Tooth analysis indicated that the mean age of harvested moose in 1993 was 4.07 and 4.63 years for males and females, respectively (n males = 502, n females = 317). Mean age at time of harvest has been nearly identical for each year since 1990. Age and herd composition data were not analyzed prior to 1990 for this report.

Since 1975, the documented statewide population increased from 6,300 to a high of 13,645 in 1991, surpassing the statewide population objective for 1993 of 12,225 moose (Fig. 2). The observed increase in moose numbers may simply be an artifact of improved classification data and improved modeling techniques. However, we believe the population has probably increased since 1975. During this period, an average of 1,566 hunters harvested 1,353 for a success rate of 86.4 %. Hunter effort was negatively correlated with success (r^2 = -0.69) and averaged 5.4 days/moose harvested.

Moose fatalities as a result of collisions with vehicles were available from 1979-93 (Wyoming Game and Fish Commission, Wildlife Observation Computer System, Cheyenne). During this period, 206 moose fatalities were documented. Little correlation (r^2 = 0.26) exists between the statewide estimated annual moose populations and the annual number of fatalities. Weak correlation exists between estimated moose density and the number of documented fatalities within

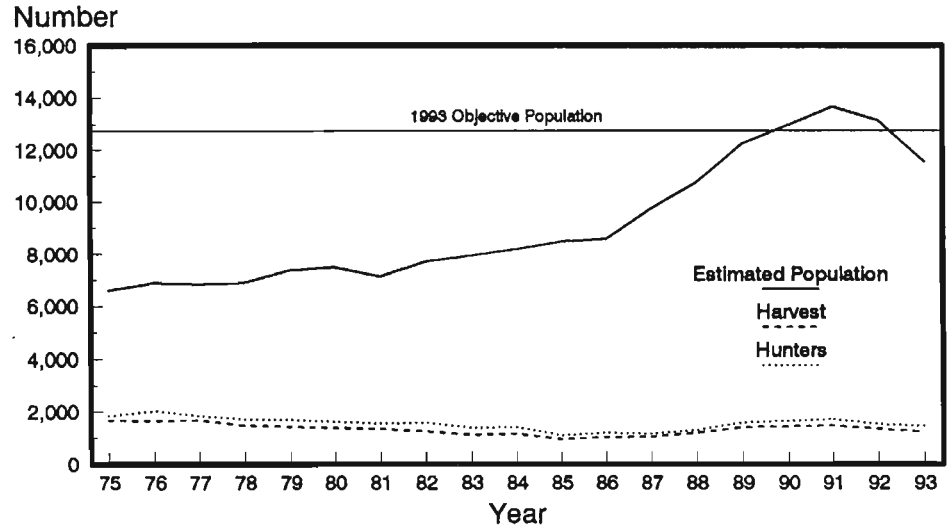

Fig. 2. Estimated moose harvest, moose hunters, and moose population (based on aerial surveys and computer modeling) in Wyoming, 1975-93.

each herd unit ($r^2 = .54$). The greatest number of documented fatalities (n = 67) has occurred in the Jackson Herd Unit. Speculated causes for this are an extreme volume of vehicle traffic in association with a high moose density.

REFERENCES

BAILEY, R. G. 1976. Ecoregions of the United States. U. S. Dept. Inter. For. Serv. Ogden, UT.

BARTHOLOW, J. 1992. POP-II system documentation. Fossil Creek Software. Fort Collins, CO. 50 pp.

CLARK, T. W., and M. R. STROMBERG. 1987. Mammals in Wyoming. Univ. Kansas Press. Lawrence, KS. 314 pp.

CONROY, M. J. 1993. The use of models in natural resource management: prediction, not prescription. Trans. No. Am. Wildl. and Natur. Resour. Conf. 58:509-519.

CROWE, D.M. 1983. What is planning? Pages 5-16 63rd Annual Conf. Western Assoc. of Fish and Wildl. Agencies. Teton Village, WY. 282 pp.

GUENZEL, R. J. 1994. Adapting new techniques to population management: Wyoming's pronghorn experience. Trans. No. Am. Wildl. and Natur. Resour. Conf. 59:189-200.

HAINES, A.L. 1955. Osbourne Russell's journal of a trapper. Univ. Nebraska Press. Lincoln, NE. 191pp.

_____. 1965. The valley of the Upper Yellowstone; an exploration of the headwaters of the Yellowstone River in the year 1869 as recorded by Charles W. Cook, David E. Folsom and William Peterson. Univ. Oklahoma Press. Norman, OK. 79pp.

HOUSTON, D.B. 1968. The Shiras moose in Jackson Hole, Wyoming. Grand Teton Natural History Assoc. Tech, Bull. No. 1. Grand Teton National Park. 110pp.

LINDZEY, F.G. and C.R. ANDERSON JR. 1992. Aerial moose sightability in western Wyoming. Pages 357-360 District I Annual Big Game Herd Unit Reports. Wyoming Game and Fish Commission. Cheyenne, WY 430pp.

LONG. C. A. 1965. The mammals of Wyoming. Univ. Kansas Publ. Mus. Nat. Hist. 14:493-758.

MARTNER, B.E. 1986. Wyoming climate atlas. Univ. Nebraska Press.

STRICKLAND, J. 1979. ONEPOP - Implementation and use in Wyoming. Pages 7-10. Workshop on the status and application of big game population. T. M. Pojar and D. Strickland, eds. Colorado Div. Wildl., Fort Collins. 53 pp. as cited in Guenzel, R. J. 1994. Adapting new techniques to population management: Wyoming's pronghorn experience. Trans. No. Am. Wildl. and Natur. Resour. Conf. 59:189-200.

WYOMING GAME and FISH COMMISSION. 1908. Annual report. Cheyenne, WY. 35pp.

_____. 1916. Annual report. Cheyenne, WY. No page numbers.

_____. 1952. Big game surveys. Cheyenne, WY. No page numbers.

_____. 1977. Sample sizes and confidence intervals for wildlife population ratios. Planning report 6-A. Cheyenne, WY. 14pp.

_____. 1982. Handbook of biological techniques. Cheyenne, WY. 442 pp.

_____. 1990. A strategic plan for the comprehensive management of wildlife in Wyoming 1990-1995. Cheyenne, WY. 60pp.

_____. 1992. Wyoming bird and mammal atlas. Cheyenne, WY. 170 pp.

_____. 1994a. District I annual big game herd unit report 1993. Cheyenne, WY. 471 pp.

_____. 1994b. District II annual big game herd unit report 1993. Cheyenne, WY. 462 pp.

_____. 1994c. District III annual big game

herd unit report 1993. Cheyenne, WY. 461 pp.

_____. 1994d. District IV annual big game herd unit report 1993. Cheyenne, WY. 423 pp.

_____. 1994e. District VI annual big game herd unit report 1993. Cheyenne, WY. 476 pp.

_____. 1994f. Annual report of big game harvest 1993. Cheyenne, WY. 476 pp.