

A PROPOSAL FOR RESEARCH
ON
MODIFICATIONS OF SOCIAL BEHAVIOR
IN BIGHORN SHEEP

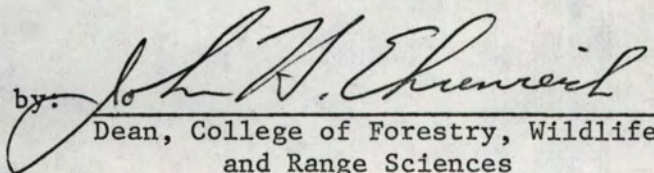
Project Leader: Ernest D. Ables
College of Forestry, Wildlife
and Range Sciences
University of Idaho

Cooperator: William Hickey
Research Biologist
Idaho Fish and Game Department

Proposed Starting Date: 1 July 1974

Proposed Duration: 6 years

Approved by:



Dean, College of Forestry, Wildlife
and Range Sciences

Feb. 7, 74
Date

Chairman, Research Council

Date

MODIFICATIONS OF SOCIAL BEHAVIOR
IN BIGHORN SHEEP

THE PROBLEM

The premise on which bighorn sheep (*Ovis canadensis*) hunting regulations are based is being challenged. Present game laws in most states or provinces allow any ram with horns of three-quarter curl or larger to be taken. The assumption has been that this age group contains older, less vigorous individuals who contribute less than their younger counterparts to the breeding potential of the herds.

Recently, the entire concept of trophy hunting for sheep has been questioned on philosophical and biological grounds. Morgan (1973) advanced four major reasons why he believes that present regulations are unsound. Firstly, he states that three-quarter-curl or larger rams include all of the prime breeding males; these rams contribute most to the breeding capability of the herd and their removal will result in a decline in productivity. Secondly, removal of the physically superior males will lead to genetic deterioration. Thirdly, home ranges and travel routes are traditional among sheep, knowledge of which is passed down from older to younger animals. Removal of older, knowledgeable males will break this chain and result in overcrowding and inoptimum habitat utilization. Fourthly, removal of the leaders will create social instability and jeopardize survival of both young and adults.

Whether or not one agrees with Morgan, his arguments are difficult to defend against and some are equally difficult to prove. He readily agrees that the required knowledge of sheep biology necessary for sound management is lacking. A moratorium on shooting trophy-classed rams has been called for and some persons have requested even more stringent measures. In the Daily Idahonian of 16 January 1974, an AP wire release datelined Washington, D.C., stated that the Fund For Animals has asked the Interior Department to classify the Rocky Mountain bighorn as an endangered species. Game management practices related to bighorns were described as "pseudoscientific" by Steph R. Seater, field director of Fund For Animals, and he reiterated some of the same objections raised

by Morgan. There is obviously a pressing need for additional research to clarify some of the above points.

PRESENT STATE OF KNOWLEDGE

Most studies of North American bighorn sheep have dealt with reasons for population declines or failure to increase and have concentrated on habitat. Buechner (1960) reviewed the status of the bighorn in the United States, and Smith (1954) presented the history, basic biology, and management of bighorns in Idaho. Similar studies have been conducted on bighorns in California (Jones 1950), in Wyoming (McCann 1956), in Colorado (Packard 1946, Bear and Jones 1973), and in Montana (Berwick 1968). These studies by no means represent an exhaustive search of the literature; excellent bibliographies of mountain sheep literature are included in the recent book by Geist (1971), in the annotated bibliography by Post (1971), and in earlier works (Smith 1954, Buechner 1960).

A few significant conclusions can be drawn from past studies of mountain sheep. They are ecologically sensitive and highly specific in topographic and vegetational characteristics of their habitat. Further, it is apparent that declines in sheep numbers from pristine levels are due to three major influences: (1) unrestricted and indiscriminate shooting, (2) habitat deterioration caused by overgrazing by domestic livestock, and (3) diseases introduced by domestic sheep. More recent studies have failed to identify diseases as causative agents in some declines. Hunting restrictions and even complete protection have not substantially increased sheep numbers over much of their range. Poor physical condition associated with inadequate nutritional levels that predispose sheep to pneumonia and other pathogens seems widespread. However, none of these factors, singly or in combination, has explained adequately why sheep have declined or else failed to increase under present-day conditions.

Behavioral studies of mountain sheep are few in number. The most important and pertinent to this discussion is the excellent book by Geist (1971). Ideas formulated by Geist seem to have been the basis for the major objections to sport hunting advanced by Morgan.

Genetic deterioration of sheep herds is difficult to prove; such studies do not lend themselves to short-term investigations. Logical reasoning suggests that selection against larger rams may be occurring as a result of sport hunting. A critical point is whether or not hunting removes such a large proportion of prime rams that females are bred by smaller and genetically inferior males. Geist has shown that in undisturbed habitats the largest males do most of the breeding, that these males are probably preferred as mates by estrous females, and that the largest-horned males are leaders in sheep society. However, absolute proof of a decline in horn size among wild bighorn populations would be made difficult to obtain because of nutritional complications associated with habitat conditions. This study does not propose to investigate the genetic implications of selection against large horns.

The other points raised by Morgan are more amenable to field investigation. The biological and behavioral bases from Geist are as follows. In sheep society the rams exist in social groupings with dominance hierarchies based on horn size. The largest-horned ram is the leader and is dominant over lesser rams; the second largest-horned ram is dominant over those smaller than himself, and so forth. Such a system is quite common among ungulates and lends order to their societies. During the rut it is these largest rams that participate in most breeding activities and are apparently preferred by females. It is also these same rams that pass on knowledge of winter and summer ranges as well as migratory routes to younger individuals. Such a knowledge is traditional in sheep and seems to be a major factor preventing range expansion.

Chronologically, a young ram attains sexual maturity at 1.5 to 2.5 years of age but does not reach full physical size until 6 to 7 years of age. Horns grow to three-quarters curl at approximately 4 to 5 years of age and reach their most massive configuration at 8 years. This last and oldest age group did most of the breeding in Geist's studies. Young rams have learned their home ranges and migratory routes at between 3 and 5 years of age. Thus, application of these findings would suggest that present hunting regulations permit rams to be harvested at the time of,

or possibly before, learning movement patterns, and that potential breeders can be removed before they have an opportunity to breed.

The question, then, is not whether sport hunting regulations allow prime rams to be taken, but rather what proportion is being taken and what effect this has on productivity, migratory patterns, social stability, and the ultimate survival of the herds. Smith (1954) believes that a ratio of one adult ram to three ewes would allow all ewes to be bred, and that too many rams breeding or attempting to breed a single female could result in psychological sterility of the female. Buechner (1960) believes that harvesting of old rams is beneficial to the herd. Neither of these authors had a detailed knowledge of the peculiarities of sheep behavior subsequently gathered by Geist. Both Smith and Buechner were perhaps biased in favor of sport hunting and their ideas of hunting large males were influenced by principles pertaining to the cervids. On the other hand, Morgan is writing at a time when the social climate is opposed to many of the traditional precepts of hunting, and he is publishing in an outlet where such ideas have a sympathetic and receptive audience. An unbiased investigation is of timely importance.

STUDY AREA

The base of operations will be the University of Idaho wilderness field station located at the Taylor ranch on Big Creek, a tributary of the Middle Fork of the Salmon River. This area of central Idaho is near the center of bighorn sheep distribution in the state as described by Smith (1954). The University owns the field station and 65 acres of land surrounding it. All adjacent lands are administered by the U.S. Forest Service, and are included in the present Idaho Primitive Area, currently being considered for designation as Wilderness. Access is only by air or horseback.

OBJECTIVES

Phase One-- To gather baseline behavioral information.

1. Population structure-- numbers, age ratios, sex ratios.

2. Social organization-- group numbers and composition, dominance hierarchies, stability of groups.
3. Reproductive behavior-- numbers of various age classes engaging in reproductive activities, breeding success of different-aged males, attitudes of females toward males of different ages.
4. Productivity of the herd-- number of lambs, survival of lambs.
5. Migratory patterns-- seasonal ranges, travel routes of males and females, fidelity of individuals to ranges and routes.
6. Daily activity patterns-- feeding resting, traveling, etc.

Phase Two-- To investigate the influence of selectively removing dominant males on the above parameters.

1. Effects on social organization and stability.
2. Effects on efficiency of breeding and physical conditions of both sexes during the rutting season.
3. Effects on production and survival of offspring.
4. Effects on home-ranging behavior and migratory behavior.

PROCEDURES

Phase One-- Collection of basic behavior information.

1. Population parameters-- Herds will be located and counted by aerial reconnaissance. Census flights will be conducted twice each year, once when sheep are on summer ranges and again when they are on winter ranges. Sex and age criteria of Geist will be used to assess population structure. Herds easily accessible from the Taylor Ranch will be studied more intensively than those in remote locations. Previous experience with these sheep indicates that they are approachable on foot and by horseback. There should be minimum difficulty in approaching sufficiently close to distinguish sex and age criteria.

2. Social organization-- As a preliminary to studies of social behavior, sheep of both sexes will be captured and marked by means of neck collars and colored ear tags. Drop nets can be set up over salt licks, the locations of which are known. Individually recognizable animals will permit social

rankings within sex and age groups to be identified. Particular attention will be devoted to agonistic interactions among males, hierarchies that develop, and the stability of these over time.

3. Reproductive behavior-- Quantification of tending, chasing, attempted mounts, and successful copulations by age classes of rams and by individual rams is a major objective. Reactions of estrous females toward different-aged rams will be noted. It is anticipated that the researchers will spend every possible day in the field during the rutting season.

4. Productivity-- Lamb:ewe and yearling:ewe ratios will be taken periodically throughout the year. Lambs will be counted as soon as possible after birth, in the fall and in spring in order to assess seasonal mortality rates.

5. Migratory patterns-- Summer ranges will be identified by aerial reconnaissance, and 2 to 3 males and females from each of the herds selected for intensive study will be equipped with radio transmitters. When the migrations to winter range commence, the migratory routes will be identified by monitoring radio-tagged animals. Activities and movements on winter ranges will be monitored throughout winter months as much as weather and snow conditions allow. Returns to summer ranges and activity on summer ranges will be studied in a similar manner. Aircraft will be used to locate radio-tagged animals but radio-tracking will be confined to the ground whenever possible.

6. Daily activity-- Activities will be categorized and individual animals chosen for observation. Each selected individual will be observed for 1-day periods and the time spent engaged in each activity recorded. The number of animals and the number of days observed will depend on time available from other studies.

Phase Two-- The influence of ram removal.

The above baseline studies will be done over a 2-year period. During this time, two female herds of convenient location and access will be chosen for experimental purposes. All physically adult rams (those 8 years of age or older) that associate with one herd of females will be

removed. From the second herd of females, most of the associated rams 4 to 5 years or older, or that have horns of three-quarter curl or larger, will be removed.

Since removal of three-quarter-curl or larger rams is potentially hazardous to survival of the herd involved, this portion of the experiment will be conducted with great caution. Some young rams that have made seasonal migratory journeys with older rams will be left. This more intensive ram removal will be done in two phases; if breeding success diminishes greatly after the first removal, no further removal will be made. Herds selected for the experimental removals will be small social units with only a few rams involved. Should the initial studies show a lack of distinctly associated ram and ewe herds, the above procedures will be modified.

Removal will be accomplished by either drug darting or drop-netting, and transporting the rams to release sites chosen by the Idaho Fish and Game Department. Some females will also be captured from selected locations and, along with the males, transplanted to potential ranges now vacant of bighorn sheep.

PERSONNEL AND TIME SCHEDULE

Ernest D. Ables, Professor of Wildlife Management, will be the project leader. His vitae are included at the end of this proposal. Three Ph.D. graduate research assistants with expertise or deep interest in ethology will be recruited. The anticipated beginning date of Phase One is during summer, 1974. A research assistant will be selected to begin the 2-year basic study at this time. Two additional researchers will be chosen to conduct the experimental phase, each one for 2 years of field studies for a total of 6 years for the entire project.

SUPPORT BY THE COLLEGE OF FORESTRY, WILDLIFE AND RANGE SCIENCES, UNIVERSITY OF IDAHO

Most important will be the University of Idaho Wilderness Research field station located at the Taylor Ranch on Big Creek. Available here are housing for the researchers, laboratory space, workshop and tools, a

horse and saddle, 2-way radios for communication, a landing strip, and a caretaker. All of this support will be furnished at no cost to the project. Salary of the project leader will be paid by the University and in addition some air travel and one assistantship will be supplied, depending on availability of funds.

EXPLANATION OF BUDGET

The most expensive single category is salaries for graduate assistantships. For a Ph.D. candidate, a minimum of 4 years of financial support is required, 2 years for field studies and 2 years minimum for course work and writing. A project of this nature, conducted in remote inaccessible areas and depending for its success on aerial radio-tracking, requires considerable air time. The amounts requested are based on actual figures obtained by Dr. Maurice Hornocker (personal communication) during research on cougars conducted from the Taylor Ranch field station.

LITERATURE CITED

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- Berwick, S. H. 1968. Observations on the decline of the Rock Creek Montana, population of bighorn sheep. M.S. Thesis, Univ. Montana, Missoula.
- Buechner, H. K. 1960. The bighorn sheep in the United States, its past, present, and future. Wildl. Monogr. No. 4. 174 pp.
- Geist, V. 1971. Mountain sheep - A study in behavior and evolution. The Univ. Chicago Press, Chicago and London. 383 pp.
- Jones, F. L. 1950. A survey of the Sierra Nevada bighorn. Sierra Club Bull. pp. 29-76.
- McCann, L. J. 1956. Ecology of the mountain sheep. Am. Midl. Nat. 56(2): 297-324.
- Morgan, J. K. 1973. Last stand for the bighorn. Nat. Geog. 144(3):382-399.
- Packard, F. M. 1946. An ecologic study of the bighorn sheep in Rocky Mountain National Park, Colorado. J. Mammal. 27:3-28.
- Post, G. (ed.). 1971. An annotated bibliography of the wild sheep of North America. Rachelwood Wildlife Research Preserve Publ. No. 1. 86 pp.
- Smith, D. R. 1954. The bighorn sheep in Idaho: Its status, life history and management. Idaho Dept. Fish and Game Wildl. Bull. No. 1. 154 pp.

BUDGET

Y E A R

	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>TOTAL</u>
I. Salaries							
A. Ph.D. level Grad. Res. Assts. (3)							
1. First	3,717	3,906	4,095	4,095	--	--	15,813
2. Second	--	3,717	3,906	4,095	4,095	--	15,813
3. Third	--	--	3,717	3,906	4,095	4,095	15,813
B. Fringe benefits (7% of salaries)	260	534	820	847	573	287	3,321
SALARY SUBTOTALS	3,977	8,157	12,538	12,943	8,763	4,382	50,760
II. Capital Outlay							
A. Tape recorders, 2	110	--	110	--	--	--	220
B. Binoculars, 2 pair	120	--	120	--	--	--	240
C. Spotting scopes, 2	100	--	100	--	--	--	200
D. Pocket electronic calculator	100	--	--	--	--	--	100
E. Radio receivers, 2 @750	1,500	--	--	--	--	--	1,500
F. Drop net and equipment	1,800	--	--	--	--	--	1,800
CAPITAL OUTLAY SUBTOTALS	3,730	0	330	0	0	0	4,060
III. Other Expenses							
A. Supplies and Materials							
1. Components for radio transmitters, 6/yr @60	360	360	360	360	360	360	2,160
2. Drugs and darts	200	100	100	100	100	100	700
3. Marking materials	100	50	50	50	50	50	350
SUPPLIES AND MATERIALS SUBTOTALS	660	510	510	510	510	510	3,210
B. Travel							
1. Air Travel							
6 round trips, Moscow-Big Creek @130	780	780	780	780	780	780	4,680
6 round trips, Big Creek-McCall @50	300	300	300	300	300	300	1,800
Flying time for census and radio-tracking	2,500	2,500	2,500	2,500	2,500	2,500	15,000
Air freight for food & supplies	600	600	600	600	600	600	3,600
2. Per diem and auto travel	400	400	400	400	400	400	2,400
TRAVEL SUBTOTALS	4,580	4,580	4,580	4,580	4,580	4,580	27,480
OTHER EXPENSES SUBTOTALS	5,240	5,090	5,090	5,090	5,090	5,090	30,690
PROJECT TOTALS	12,947	13,247	17,958	18,033	13,853	9,472	85,510

BIOGRAPHICAL DATA

Ables, Ernest D.

January 1974

Professor, Wildlife Management

Age: 40

Citizenship: U.S.

S.S. #445-34-8990

Birthplace: Hugo, Oklahoma

Marital Status: Married

Number of Children: One (Christopher David)

EDUCATION:

B.S., Zoology (Wildlife), 1961, Oklahoma State University

M.S., Wildlife Management, 1964, University of Wisconsin

Ph.D., Zoology-Wildlife Ecology, 1968, University of Wisconsin

EXPERIENCE AND EMPLOYMENT:

Summer 1959 - Biologist aid, Oklahoma Conservation Department

May 1966 - May 1967 -- Radio-tracking studies of impala antelope in Kenya, East Africa; a special project financed by the Rockefeller Foundation and the Wisconsin Alumni Research Foundation.

September 1968 - Assistant Professor, Department of Wildlife Science, Texas A&M University.

September 1971 - Associate Professor, Department of Wildlife Science, Texas A&M University.

August 1973 - Professor; College of Forestry, Wildlife and Range Sciences, University of Idaho.

PREVIOUS AND CURRENT RESEARCH:

Home-range, movement, and activity studies of red foxes.

Radio-tracking studies of impala antelope in Africa.

Population ecology of Thomson's gazelles in the Serengeti plains of Tanzania.

Radio-tracking studies of nilgai antelope on King Ranch, Texas.

Behaviour, population ecology, and food habits of axis deer and blackbuck antelope in Texas.

Relationship of weather variables to productivity of wild turkeys and bobwhite quail in South Texas.

Predator-prey relationships and competition studies of the Carmen Mountains white-tailed deer, Big Bend National Park.

E. D. Ables, Publications:

- Schemnitz, S. D., and E. Ables, 1962. Notes on the food habits of the great horned owl in Western Oklahoma. Condor 64(4): 328-329.
- Ables, E. D. 1964. Arboretum foxes. Arboretum News 13(1):3pp.
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- Storm, G. L., and E. D. Ables. 1966. Notes on newborn and full-term wild red foxes. J. Mammal. 47(1):116-118.
- Ables, E. D. 1968. Exotic game, its problems and potentials. Proceedings Wildl. and Fish. Spec. Session, Texas Ag. Ex. Serv., College Station, Texas, Aug. 27, 1968. 8pp.
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- _____. 1969. Field immobilization of free-ranging impala in Northern Kenya. E. Af. Wildl. J. 6:61-66.
- _____. 1971. Radio-tracking studies of a Kenya hartebeest. E. Af. Wildl. J. 9:145-146.
- Sheffield, W. J., Jr., E. D. Ables, and B. A. Fall. 1971. Geographic and ecologic distribution of nilgai antelope in Texas. J. of Wildl. Mgmt. 35:250-257.
- Ables, E. D. 1973. Ecology of the red fox in North America in Ecology and Behavior of Canids (edited by M. E. Fox). Von NOSTRAND Reinhold Co. In press.
- Ables, E. D. and C. W. Ramsey, 1973. Indian mammals on Texas rangelands. J. Bombay Nat. Hist. Soc. In press (accepted).
- Ables, E. D., Z. L. Carpenter, Lynn Quarrier, and W. A. Sheffield. 1973. Carcass and meat characteristics of nilgai antelope. Texas Ag. Exp. Misc. Pub. 3-1130. 8 pp.
- Research projects under my direction during the period, 1968-72 (M.S. and Ph.D.)
1. Population ecology and reproduction in the axis deer (M.S. project)
 2. Behavior in the axis deer (M.S.)

3. Food habits of the axis deer. (M.S.)
4. Natural History Survey of the sambar deer. (M.S.)
5. Characteristics of Rio Grande turkey roosts. (M.S.)
6. Food habits and habitat of sandhill cranes in southern Texas. (M.S.)
7. Radio-tracking studies of nilgai antelope on King Ranch. (M.S.)
8. Reproduction and productivity of the blackbuck antelope in Texas. (M.S.)
9. Population parameters of the Carmen Mountains white-tailed deer (M.S.)
10. Population ecology of the Thomson's gazelle in the Serengeti Plains (Ph.D.)
11. Numbers, distribution, habitat, predator-prey relations and competition of Carmen Mountains white-tailed deer. (Ph.D.)
12. Ecology of feral swine in Texas (Ph.D.)
13. Habits and population parameters of baboons in the Laikipia District of Kenya (M.S.)
14. Graduate committees on which I served as a member during 1968-72:
 - A. Wildlife and Fisheries Sciences - 14
 - B. Range Science - 7
 - C. Entomology - 7

Foreign Research activities during 1968-72:

1. March-April 1970 - 6 weeks in Kenya, Tanzania, and South Africa directing and assisting in research on baboons, mountain reedbuck, and Thomson's gazelle.
2. May-December 1972 - Conducted studies of productivity of impala and Thomson's gazelle following commercial cropping operations in Kenya. My wife and I camped for 6 months on location in order to follow the fate of these populations on an intensive basis.

Misc. personal research projects:

1. Carcass and meat characteristics of nilgai antelope.
2. Palatability of axis deer venison.
3. Use of infra-red sensing as a potential technique for censusing herbivores on Texas range lands.

Professional and Scientific Societies:

The Wildlife Society, member of position statement committee, 1972
American Society of Mammalogists
AIBS
Ecological Society of America
Texas Academy of Sciences
East African Wildlife Society
The Wilderness Society
Sigma Xi
Texas Chapter, The Wildlife Society, President 1971-72

Courses taught at Texas A&M University:

- a. WFS-201 Wildlife Conservation and Management
- b. WFS-301 Wildlife and the Changing Environment
- c. WFS-403 Animal Ecology
- d. WFS-416 Animal Population Dynamics
- e. WFS-603 Vertebrate Ecology
- f. WFS-609 Research Methods

Courses taught at University of Idaho:

- a. FWR-448 Fish and Wildlife Ecology
- b. FWR-314 Population Ecology
- c. FWR-541 Advanced Population Biology

Additional Experience and Duties:

- a. Acting Chairman of Caesar Kleberg Research Program in Wildlife Ecology for 6 months.
- b. Acting Department Head in absence of Head on a continual basis.
- c. Chairman, Departmental Self-study Committee, Fall 1971.
- d. Member, Terrestrial Committee, Navasota Environmental Study, Texas A&M and Corps of Engineers.
- e. Member, Departmental Curriculum Committee.
- f. Advisor for undergraduate degree programs.
- g. Chairman, committee for development of new ecology course in School of Natural Biosciences.
- h. Worked as a consultant for LTV to develop a wildlife management plan for Camp Eagle Ranch.