DESERT BIGHORN COUNCIL. TRANSACTIONS

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Desert Bighorn Council

FIFTH ANNUAL MEETING

DESERT BIGHORN COUNCIL

APRIL 4–7, 1961

HERMOSILLA, SONORA, MEXICO

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Hermosillo, Sonora, Mexico

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DESERT BIGHORN COUNCIL

Mr. John B. Van den Akker, Chairman
U. S. Fish & Wildlife Service
P. O. Box 3737, Portland, Oregon

Mr. Ralph Welles, Secretary-Treasurer
,Death Valley National Monument
U. S. National Park Service
Death Valley, California

P R O G R A M

FIFTH ANNUAL MEETING
DESERT BIGHORN COUNCIL
April 4-7, 1961

Hermosillo, Sonora, Mexico

Arrangements Committee	Louis Macias Arellano, Chairman Jose Angel Davilla-C Ralph Welles
Program Committee	Bernardo Villa-R, Mexico, & Gale Monson, Arizona, Co-chairmen Richard A, Weaver, California Lowell Sumner, California

Meeting opens at 8:30 A, M., April 4, 1961

Welcome:	The Mayor of Hermosillo, the Rector of the University of Sonora, J. B. Van den Akker, and Luis Macias Arellano
Opening Remarks:	Mr. John B. Van den Akker, Chairman'
Introductions:	Attendants will stand and introduce themselves, A roster will be circulated for signatures and addresses.

POPULATIONS

Chairman:	Luis Macias Arellano, Director General of Hunting, Mexico, D.F.
9:30 to 9:40	Present and Past Populations of Desert Bighorn Sheep in New Mexico. Jack Gross, New Mexico Department of Game & Fish, Las Cruces, N. M.

9:40 to 9:55	Present and Past Populations in Arizona. Warren Kelly, Arizona Game & Fish Department, Wickenburg, Arizona,
9:55 to 10:10	**Break**
10:10 to 10:25	Present and Past Populations in **California.** Richard Weaver, California Department of Fish & **Game,** Riverside, California.
10:25 to 10:40	Present and Past Populations in **Nevada. Al Jonez,** Nevada Fish & Game Department, Las Vegas, **Nev.**
10:40 to 11:00	Mexican Populations, Bernardo Villa-R., Biological Institute, Mexico, D. F.
11:00 to 11:15	Present Status of Bighorn Sheep in Northern **Baja** California. Amin **Zarur Menex,** Department of Agriculture & Livestock, Mexico, **D.** F.
11:15 to 11:30	The Taxonomy of Desert Bighorn **Sheep.** E. **Lendell Cockrum,** The **University** of Arizona, **Tucson,** Arizona.
11:30 to 1:40	**Lunch**

POPULATION SURVEY METHODS

Chairman:	Cecil **A.** Kennedy, U. S. Fish & Wildlife Service, Las **Cruces,** New Mexico,
1:40 to 2:00	Significance of Bighorn Mortality Records. **Dr.** C. G. Hansen, U. S. Fish & Wildlife Service, **Las Vegas,** Nevada.
2:00 to 2:20	Waterhole Counts, **Blayne** D. Graves, U. S. Fish & Wildlife Service, Yuma, Arizona.
2:20 to 2:40	Censusing by Transects. **Newell** B. Morgan, U. S. Fish & Wildlife Service, Las Vegas, Nevada,
2:40 to 3:00	Counting Lambs and Yearlings. Warren Kelly, Arizona Game & Fish Department, Wickenburg, Arizona.

3:00 to 3:20	Break
3:20 to 5:00	Announcements; Annual Business Meeting, (If time is inadequate, Business Meeting may be completed after 7:00 P. M.); Reports of Committees presented by Jack Gross (Management) and Ralph Welles (Feral Burros),

Meeting opens at 8:30 A M., April 5, 1961

BIGHORN PREDATORS

Chairman:	Luther Goldman, U. S. Fish & Wildlife Service, Washington, D. C.
8:30 to 8:40	Bighorns and Coyotes, Richard A Weaver, California Department of Fish & Game, Riverside, California.
8:40 to 9:00	Bighorns and Bobcats, H. Nelson Elliott, U. S. Fish & Wildlife Service, Portland, Oregon, Presented by John Gatlin.
9:00 to 9:20	Bighorns and Cougars. James A. Blaisdell, National Park Service, Grand Canyon, Arizona,
9:20 to 9:40	Bighorns and Golden Eagles. Bob Jantzen, Arizona Game & Fish Department, Phoenix, Arizona.
9:40 to 10:00	Break
10:00 to 10:15	Predator Control Policies. John C. Gatlin, U. S. Fish & Wildlife Service, Albuquerque, New Mexico.

PROGRESS REPORTS

Chairman:	Fred A. Thompson, New Mexico Department of Game & Fish, Santa Fe, New Mexico.
10:15 to 10:30	Bighorn Management in Mexico, Luis Macias Arellano, Director General of Game, Mexico, D. F.
10:30 to 10:50	The Black Gap Bighorn Transplant, Tom Moore, Texas Game & Fish Commission, Alpine, Texas,

10:50 to 11:10	The Hart Mountain Bighorn Transplant. O. V. Deming, U. S. Fish & Wildlife Service, Lakeview, Oregon.
11:10 to 11:30	Vegetative Zones of the Territory of Baja California in Relation to Wildlife. Gaston Guzman Huerta, National Polytechnic Institute, Mexico, D. F.
11:30 to 11:50	Diseases and Parasites. Rex Allen, U. S. Agricultural Research Service, University Park, New Mexico. Presented by E. L. Fountain.
11:50 to 1:40	Lunch

BIGHORN HUNT SUMMARIES

Chairman:	George E. Barclay, U. S. Fish & Wildlife Service, Albuquerque, New Mexico.
1:40 to 1:55	Hunting Seasons in Mexico. Jose Angel Davila-C., Department of Wildlife Conservation, Mexico, D. F.
1:55 to 2:10	Hunting Results in Arizona. John Reed, Arizona Game & Fish Department, Nogales, Arizona.
2:10 to 2:30	Hunting Results in Nevada. Al Jonez, Nevada Fish & Game Department, Las Vegas, Nevada. Presented by Ray Breckbrill.
2:30 to 2:50	Legal Aspects of Bighorn Transportation. Lawrence J. Merovka, U. S. Fish & Wildlife Service, Albuquerque, New Mexico.
2:50 to 3:15	Break

MISCELLANEOUS

Chairman:	Gaston Guzman Huerta, National Poly-technic Institute, Mexico, D. F.
3:15 to 3:30	Fallout, Its Relation to Wildlife. Edmund L. Fountain, Mjr, VC, U.S. Army, asgnd. to USAEC, Las Vegas, Nev.

3:30 to 3:40	How Much Living Room Does the Desert Bighorn Need? Ralph Welles, U. S. National Park Service, Death Valley, California,
3:40 to 4:00	Bighorns of the Santa Rose Mountains of California, Lloyd Tevis, Jr., Rancho Mirage, California,
4:00 to 4:30	The Importance of Population Data, Gale Monson, U. S. Fish & Wildlife Service, Yuma, Arizona,
4:30 to 4:50	Summary of Work on Sheep in Santa Rosa Mountains, California. John D. Goodman, Assistant Professor of Biology, University of Redlands, Redlands, California.

FIELD TRIPS

April 6-7, 1961	Field trip arranged by Arrangements Committee, Entertainment in Sonora Fashion and Tradition for Council at Rancho Santos Cruz, Sonora, followed by overnight field trip to Bighorn Sheep Habitat at Kino Bay,

OPENING REMARKS BY CHAIRMAN

John B. Pan den Akker
U. S. Fish & Wildlife Service
Portland, Oregon

Amigos, it is my very great pleasure and privilege to open this Fifth Meeting of the Desert Bighorn Council. In accord with our usual custom, the meeting will proceed on an informal basis.

We will find some awkwardness with the two languages, and, through conversations with my compatriots, I perceive a third and more complex language creeping in, Host of us North Americans have been laboring diligently to gain a working knowledge of Spanish, but, from examples I have heard, it would seem wise to use our native tongues for the benefit of the interpreters,

We North Americans are humble before you Mexicans who generally are more proficient in English than we are in Spanish, Differences of language notwithstanding, we are very happy to meet our new friends and to enjoy again our earlier acquaintances,

It is gratifying that we meet with a common interest, and agreeably exchange knowledge and experience in the study and management of the Desert Bighorn, I know of no other group made up of such varying components which meets in more harmony and willingness to achieve common goals,

To each who has participated in making arrangements, we are grateful, The accommodations are excellent, and the courtesies extended are more than generous,

The program arranged is a credit to all who have worked on it and we are certain to benefit,

We are especially honored with the presence of the Major of Hermosillo and the Rector of the University, We will ask Dr. Villa to make the introductions. We would be most happy if he would speak for us.

Again, we are honored and please accept our appreciation for the hospitality of your great country,

PAST AND PRESENT STATUS OF THE DESERT BIGHORN SHEEP IN NEW MEXICO

Jack E. Gross, Biologist
Department of Game & Fish, New Mexico

Papers dealing with the status of the desert bighorn sheep in New Mexico have been prepared for Council proceedings by Gordon (1957), Ogren (1957), Kennedy (1957), Ogren (1958), and Cross (1960). These papers have enumerated much of the general information that is known concerning the desert bighorn sheep in New Mexico, and to repeat this information in detail would constitute unnecessary duplication. Thus, this paper summarizes the broad aspects of New Mexico desert bighorn population status.

Historic Status:

Records of desert bighorn sheep distribution prior to 1900 are for the most part sketchy and vague, but indicate the animal occupied nearly all of the major mountain groups in the southern one-third of the state, which included 12 to 15 more or less island ranges. Exact early distribution of desert bighorn in New Mexico is difficult to plot due to several large mountain chains containing bighorn habitat that grades from Rocky Mountain type on the north to desert type on the south. Bighorn were probably living throughout these arras, and the breaking point between the two possible subspecies can be established only arbritrarily. For instance, reliable records indicate that bighorn once existed in, or near, the lava fields near Grants, portions of the San Francisco River drainage, and White Mountain in the Sacramento Mountains, but skull series are inadequate to establish taxonomic status.

The desert bighorn is a native animal in New Mexico, and populations in all of the presently occupied mountain ranges are the holdovers from original stock. Prehistoric Indians in southwestern New Mexico knew of the bighorn as evidenced by bones of bighorn found in Basket Maker-Pueblo cave debris and by pictures painted on pottery of the Membres Culture. Numerous bighorn head artifacts carved from bone, stone, and shell have been excavated from ruins of El Paso, Chupidero, and Three-Rivers cultures in the San Andres and Sacramento Mountains in southcentral New Mexico. Petroglyphs depicting bighorn have been found in several mountain ranges in the southern part of the state. Considering the difficulties now encountered in bighorn inventory, any discussion concerning prehistoric population densities involves pure speculation,

Present Status:

Estimates of population numbers made 25 to 50 years ago may also be somewhat questionable, but there can be little doubt that New Mexico now supports fewer bighorn sheep than during the early or middle 1800's. The decline of bighorn populations in New Mexico since 1800 essentially follows the pattern typical of all the western states, An objective statement concerning desert bighorn sheep population numbers

can be made only within broad limits, and the maximum estimate is fully as applicable as the minimum estimate. Conservatively speaking, there are probably not less than 200 desert bighorn in the state. The maximum population could be reasonably estimated at 500 to 600 individuals. These bighorn range in the Guadalupe, San Andres, Organ, Big Hatchet, and possibly the Sacramento Mountains, with the bulk of the population centered in the San Andres and Organ Mountains,

Considering population conditions in individual areas, the Big Hatchet Mountain's herd sustained severe losses daring the early. 1950's, but is apparently starting to recover. Similarly, the San Andres Mountain's herd and possibly the Organ Mountain's herd suffered losses during the early 1950's, but bighorn are still scattered throughout the ranges and could possibly be as abundant as they were 25 to 50 years ago. The Guadalupe Mountains have been somewhat ignored in recent years, but evidence of occasional sightings indicates a remnant herd of desert bighorn still exists in that range,

Summary:

Prehistoric desert bighorn populations of undetermined numbers once occupied 12 to 15 desert mountain ranges in southern New Mexico. Present populations probably number between 200 and 600 individuals that inhabit four or five mountain ranges,

References and Literature Cited:

Gordon, Sidney Paul. 1957. The Status of Bighorn Sheep in New Mexico. Transactions, First Annual Meeting, Desert Bighorn Sheep Council.

Gross, Jack E. 1960. Progress of Mexican Bighorn Sheep Life History and Management Investigations in the Big Hatchet Mountains of New Mexico. Transactions, Fourth Annual Meeting, Desert Bighorn Council,

Gross, Sack E. 1960. History, ,Present, and Future Status of the Desert Bighorn Sheep (Ovis Canadensis Mexicana) in the Guadalupe Mountains of Southeastern New Mexico and Northwestern Texas. Transactions, Fourth Annual Meeting, Desert Bighorn Council.

Kennedy, Cecil A 1957. Status of Bighorn Sheep on the San Andres National Wildlife Refuge, Las Cruces, New Mexico. Transactions, First Annual Meeting, Desert Bighorn Sheep Council.

Ogren, Herman A, 1957. Additional Information on the Status of Bighorn Sheep in New Mexico. Transactions, First Annual Meeting, Desert Bighorn Sheep Council.

Ogren, Herman A, 1958. Sheep Hunting in New Mexico. Transactions, Second Annual Meeting, Desert Bighorn Sheep Council.

PRESENT AND PAST POPULATIONS OF DESERT BIGHORN SHEEP IN NEVADA

Al Jonez, District Supervisor
Charleston District -- Nevada Fish & Game Commission

Since the first report on the present and past populations of Desert Bighorn Sheep in Nevada in 1957, several new facts have cane to light. Instead of repeating some of the same information given before, I will limit my remarks to new information gained since 1957.

present Day Distribution:

Since 1957 other Districts in Nevada have held surveys on bighorn populatfons in an attempt to determine numbers and distribution. These areas in the State have been surveyed in recent years and bighorn sheep populations verified. The areas 'are: (See Map #1)

1. Silver Peak Range in Esmeralda County
2. Toiyabe Mountain Range in Nye County
3. Grant Range in Nye County

During the 1960 deer season a bighorn sheep ram was killed in the Willow Creek area of Elko County. This fourth area is by far the northernmost area of recent records on sheep distribution.

1. Silver Peak Range - Esmeralda County:

During the summer of 1960 Sierra District personnel held a waterhole count in this area. Five springs were watched for three days. No sheep were seen coming into water during the count. Ten rams were observed during the last day of the count about *two* miles fran Valcalda Spring. In addition, one ram was observed at Coyote Hole on the evening prior to the count. The day after the count two rams were observed on the ridge south of Valcalda Spring.

Ed Siri, Conservation Officer, reported seeing 20 ewes and lambs at Cow Camp Spring in the Silver Peak Range during the July chucker surveys,

2. Toiyabe Mountain Range - Nye County:

Reports from Conservation Officers in this area on bighorn sheep sightings led to a spring survey to determine numbers, composition and distribution.

In March, 1958, a total of 46 bighorn sheep were sighted, 24 from the air and 18 from the ground. Those flying the air survey reported a lot of difficulty in spotting animals. The survey crew was able to classify 33 sheep: 20 rams, 8 ewes, and 5 yearlings.

In March, 1959, a total of 28 sheep were sighted in the same general area as in 1958, The composition on part of this count is as follows: 4 rams, 7 ewes, and 5 yearlings.

In 1960 another survey was tried in this same general area. There was little snow in this area as compared to March of 1958 and 1959. Seven bighorn sheep were seen and classified during this count. The composition of the survey was five ewes and two yearlings. It was felt that the low count may have been attributable to the lack of snow. In the earlier years snow forced the animals down to the lower elevations.

3. Grant Range - Nye County:

Reports of bighorn sheep in this mountain range led to a survey in February of 1961.

During the survey a total of 66 sheep were observed. Broken down this amounted to 16 rams, 30 ewes, 17 yearlings, and three unclassified. Most of the sheep were seen around the 6,000-foot elevation on the west slopes of Troy Peak.

The most Sheep seen by Nevada Fish and Game personnel in this area.

4. Willow Creek - Elko County:

During the second week of October, 1960, Harry Elliott, Game Control Supervisor for Nevada, was deer hunting 10 to 12 miles south of Pallion, Nevada. He heard a shot and decided to see who was successful in deer hunting. While approaching the area he saw two men dressing a carcass. When he got to the spot where he saw the men start dragging it, he was surprised to see a bighorn sheep head freshly severed from the body. He examined further and found the offal from the animal. He then started after the pair with the carcass, but they had too much of a head start, and he could not catch them.

As far as it is known, this is the first report of sheep in the area for 39 years.

Identification:

In December, 1960, we received a letter from E. Raymond Bill, Museum of Natural History, University of Kansas, relative to the identification of three heads rent to him for subspecies identification. Two were from the Toiyabe Mountain area and the fresh head from the Willow Creek area of Elko County. However, the location of the heads was not sent with the heads, to eliminate any biased thinking in the identification.

Bill feels that all three heads were from Ovis canadensis nelsoni, the Desert Bighorn.

The information he used to determine his subspecies identification is as follows:

The characters are as follows: (1) The tips of the horns curve to a greater extent than in O. c. canadensis (as an

example of O.c. canadensis, see Plate II facing page 38 of 'Mammals of the Alpine Club Expedition to the Mount Robson Region' of British Columbia and Alberta by M. Hollister, Special Number of Canadian Alpine Journal, 1912); (2) the width across the zygomatic arches of the skull is less than 123 millimeters; and, (3) in the one skull that has the ventral parts intact enough to permit measuring the basilar length, the maxillary breadth of the skull amounts to 36 per cent (instead of less than 35 per cent) of the basilar length,"

Predators - Silver Peak Range, Esmeralda County:

Marshall Humphreys, Sierra District Big Game Technician, and Ray Corlett, Sierra District Supervisor, came upon an unexpected happening in the Cave Spring area of the Silver Peak Range on April 22, 1960.

As they came around a turn in the Canyon they saw a Bald Eagle take off. Another eagle was on the ground tearing at something and attempted to lift it in flight. Suddenly, aware of the spectators, it, too, took off,

Both men left their vehicle and checked to see what the eagle was eating. They found a bighorn sheep lamb with a hole tom in its side and the heart still palpitating. It, however, was dying. Both men suspected that the eagles killed the lamb, but neither saw the actual act,

The lamb was given to the Nevada State Museum for mounting. When the lamb was skinned out, it was found that the right shoulder joint was fused, (apparently the scapula fused to the humerus.) This, undoubtedly, restricted the movement of this lamb and may have been the reason it was susceptible to predation.

Literature Cited:

Nevada Fish & Game Commission Completion Reports and News Releases.

Hall, E. Raymond. 1960 Personnel Correspondence.

PRESENT CONDITIONS OF THE BIGHORN MOUNTAIN SHEEP IN THE STATE OF BAJA CALIFORNIA, MEXICO
(Translation)

Amin Zarur Menez, Biologist
General Hunting Administration
Department of Wildlife Conservation

Introduction:

The urgency of knowing the conditions under which the bighorn mountain sheep of our country find themselves brought on a trip to the Peninsula of Lower California during the months of November and December of 1960. Actually taking part were two Biologists of the General Hunting Board aided by guides familiar with the region and a professional hunter. As a precedent, we had the study made by Dr. Bernardo Villa R. in 1958-59,

Our work started d t h an aerial pass of the entire peninsula and a careful ground survey of the Wild Ram area of the Northern State of Baja California.

Current Distribution of the Bighorn Mountain Sheep in Lower California:

In general terms one could say that the bighorn mountain sheep (Ovis Canadensis Cremnobates and possibly other subspecies) are found distribute.&in the entire. length of the *mountain ranges* of the water shed.of the Gulf of California:.between 32.5 and 24.5 parallels north lattitude. Varying in concentration of population according to the definite area under study and obeying the ecological characteristics of the land, vegetation, and hydrological resources.

Geographical Description and Climatology:

The mountain ranges that border the State of Baja California are almost continuous, leaving from time to time small valleys.

The principal ranges of mountains that we encounter from north to south are the following: Sierra of the Cucapas parallel to the valley of Mexicali; Sierra of Juarez; La Sierrita (Sierra of San Pedro Martir, with maximum altitude of 3,300 meters, being the highest on the peninsula); Sierra *of* Santa *Rosa* situated to the south of San Pelipe; Sierra of San Migual; Sierra of Santa Isabel; Sierra of Calamajue; Sierra of La Asamblea, situated to the south of San Luis Gonzaga; Sierra of San Borja; Sierra of Las Animas; and Sierra of Calmalli, on the border of the southern territory.

Small valleys exist noticeably saline, usually along the coast, others at times on the edge of two ranges and less frequently within their own mountain nucleua. Some of them represent dried-up lakes, such as the one called Salt Lagoon situated between The Sierr of Juarex and the Sierra of The Cucapas, Chapala Lagoon, etc.

Permanent rivers and washes don't exist since the rainy season is so short and the precipitation so scarce, The little water that does fall rapidly drains to the sea due to the accentuated slope of the watershed, Permanent hydrological resources of the Mountain Sheep area are the small springs easily located in sane canyons by the presence of characteristic vegetation among which is the fan palm, and also the water holes formed by the gathering rain water. In our tour only in the lower zone of the Sierra of San Pedro Martir did we find some narrow valleys with real washes formed fa the upper part of the Sierra,

The climate is very extreme with very high temperatures in the summer and with sub-zero in the winter. On the temperature-chart taken by us, a maximum of 400 C. was registered on the 18th of November and a minimum of -3° C. on the 7th of December,

Some Ecological Considerations:

The Mountain Sheep zone of the State of Baja California belongs to the arid zone type, influenced in this by the nature of the sub-strata and the scarce rainfall. There are abundant species of Xerofita and Salofita plants among which we could easily find the "Palo Verde" (pithecollobium confine), the "mesquite" (prosopis juliflora) the "gobernadora" (larea tridentate), the "palo verde" (cercidium with various sub-species), the "torote" (bursera microphyllum), the "Chollas" (opuntia with various species), the "biznaga" (ferocactus with various species), the "Cardon" (pachycereus pringlei), the "Copal" (elephrium with various species), the fan palm (washingtonia filifera), the "pitaya agria" (mechaero cereus gummosus) the "Jojaba" (simodsia californica), the "magueyes" (agave with various species), the "detillillo" (yucca). The pastures and the dog grass have their pinnacle of power in the short rainy season,

Many of these plants enter into the alimentary diet of the Mountain Sheep, principally the palofierro, which the animals like because of its tender flowers and branches. The mesquite and the biznaga, the latter being the one from which, it appears that the Mountain Sheep obtains the greater part of the water required in its feeding.

The rugged rocky places are the ones preferred by the Mountain Sheep. On various occcasions we observed herds of these animals in the high parts of the mountains from which they could overlook a great deal of ground around them,

The low temperatures appear influential.in the Cimarrons in a definite manner causing an emigration from the higher parts (that generally have a lower temperature in the winter) to the lower parts, a phenomen that we could directly conclude being verified by the opinion of the people that live there.

In respect to the problem of predators, we know of the existence of the Puma (felis concolor), the wildcat (lynx rufus), the coyote (canis latrans), and the golden eagle (aquila chrysaetos), but

we don't know to what point they are a problem to the Mountain Sheep, This theme should be more extensively treated in later studies.

Apparently the problem of the competition of the Mountain Sheep with other wild animals in lower California does not exist, The Cimarron Burro, that in some parts of the United States competes heavily for forage with the Mountain Sheep today, is only found in small groups in this area and is not transcedental. We were informed that a few years ago a roundup was made of 10,000 Cimarron Burros, the meat being used for food. Other wild species are even less of a problem.

Working Methods::

The prime objective of our study was at the beginning a direct census of the Mountain Sheep, counting on the help of the airplane, However, due to the ruggedness of the mountains and taking into account the safety limits in which one should fly in that apparatus, it was not possible to carry out the intended census. Of course, the most effective method of carrying out such an experiment would be the direct count of the animals at the watering holes and springs as has been proven by the many trials made in the United States, However, it was also impossible to use this procedure because the time of the year was not appropriate,-the consumption of water in winter is much less, the Mountain Sheep being able to obtain it from other sources such as the biznagas. We chose then to carry out a direct sampling, including the major parts of the bighorn zones and in accordance with the total number of animals seen, relating these with the total area of distribution in order to reach the total number of Mountain Sheep that could exist in Baja California. In accordance to this information, the places where bighorn mountain sheep were seen and the number are listed below:

Arroyo Percebu	6
Arroyo de Matomi	5
Arroyo al North of San his Gonzaga.	4
Las Arrastras (Rinconada),	3
Los Paredones.	3
Total	21

If we take into account that our trip on foot was for 148 square kilometers and that the approximate area of distribution of the Mountain Sheep in the state is 2965 square kilometers in direct proportion, we reach a number of 420 Mountain Sheep; of course, we believe that this would be a number of theoretical estimation, that you couldn't take as definite. In the first place because the bighorn doesn't have the same intensity of distribution in the 'different zones while on the other hand we didn't see the quantity of bighorns we should have seen if a variable factor (the temperature, air pressure, ete.) had changed, Thus, while an exact census isn't carried out, this will remain as a data-base for our future considerations,

Other Observations:

The largest problem that the bighorn mountain sheep population has in lower California undoubtedly would be considered the hunters, whether for sport or not. In spite of the decree of total closed season that has existed for over 39 years, these animals have continually been hunted at times at an inmoderate rate as is shown by the skeletons that we have found from time to time. These represented real cemeteries by which you could note the slaughter *of* rams, ewes, and lambs. The lack of effective enforcement has been a prime factor adding *to* this the bad communication lines on the Peninsula and the numberous airfields scattered in different places from where the hunters can easily arrive. In other places as in the famous "Botica" boxed in on the Sierra of the Asamblea one can land by boat.

The constant visit of hunters to lower California, as many foreigners as Mexicans, has demonstrated the little sporting conscience and the little interest in conserving a valuable species, from the cinegetic point of view, as the bighorn mountain sheep. Adding to this those called "guides", while knowing what they are doing present themselves and rent out on "safaris" destroying a resource that they themselves will regret in the passing of time.

At this time the condition of the bighorn mountain sheep in lower California could be considered critical; however, recovery is feasible.

THE TAXONOMY OF DESERT BIGHORN SHEEP

E. Lendell Cockrum
Department of Zoology
University of Arizona
Tucson, Arizona

Since mammalogists no longer attempt to assign common names to subspecies, rather they use the common name to correspond to the species, the use of "Desert" Bighorn Sheep: is somewhat misleading. By convention among those interested in the management of Bighorn Sheep in the Southwestern United States and Northern Mexico, the term "Desert" Bighorn has been applied to the population in the more arid desert areas of Southern California, the Nevada Basin, Arizona, New Mexico, Texas and Northern Mexico,

The populations of Bighorn Sheep in this area show considerable variation, that, to some extent, can be correlated with geographic distribution, and seven names have been proposed to apply to various groupings of these populations. These names, the proposer's name and the type localities are as follows:

1897. Ovis nelsoni Merriam. Type from Grapevine Mountains, on the state line between Inyo County, California, and Esmeralda County, Nevada, just south of 37°N.

1901. Ovis mexicanus Merriam. Type from near Lake Santa Maria, Chihuahua, Mexico.

1903. Ovis cervina cremnobates Elliot. Type from Mattami, Sierra San Pedro Martir, Baja, California.

1907. Ovis canadensis gaillardi ~earns. Type from Gila Mountains between Tinajas Altas and the Mexican boundary; Yuma County, Arizona,

1912. Ovis canadensis texicanus Bailey. Type from Buadalupe Mountains, El Paso County, Texas.

1916. Ovis canadensis weemsi Goldman. Type from Cajon de Tecomaja, 2,000 ft., Sierra de la Giganta, about 30 mi. S Cerro de la Giganta, Baja, California,

It is obvious that the populations in the area under consideration do show variations, Since the basic purpose of applying subspecific names to populations is to recognize that the populations are genetically distinct but related to adjacent subspecies, the variation in the Bighorn must be analyzed to determine its origin. To adequately analyze population variations large samples are necessary. Herein lies much of the difficulty that taxonomists have met when they have concerned themselves with the subspecific taxonomy of Bighorn Sheep, For practical purposes taxonomists normally study only those parts of the variation that have been preserved in the usual museum specimen -- the

skin and skull. To determine whether genetic variations corresponding with geographic distribution exist in the materials studied, the taxonomist must first identify, quantify and eliminate variations due to such things as age and sexual differences and environmental effects. That these factors influence taxonomic studies of the Bighorn are easily demonstrable.

Wildlife biologists in general are becoming increasingly aware of the effects of diet on the morphology of individual animals. Many of the isolated desert mountain ranges, for example, are of volcanic origin and resultingly the soils are low in calcium, thus effecting the bone and antler size of the deer. Similar conditions may obtain in the Bighorn. In any case, the type of Ovis sheldoni Merriam is extremely small, either a dwarf caused by genetic, dietary or developmental characteristics.

To illustrate the extent of sexual and age variations in the Bighorn, I have compiled measurements available from Cowan (1940) and Dalquest and Hoffmeister (1948) on the mastoid width of various populations. This measurement, only one of several cranial measurements routinely taken in taxonomic studies, was chosen more or less at random to illustrate the degree of non-geographic variations.

Graph 1 shows the variations in mastoid width as the rams become older. This graph is based on measurements of 32 skulls now in the University of Kansas Museum of Natural History. All were taken from one population at Mount Chopaka, Washington, in 1889.

Graph 2 shows the average, standard deviation, and ranges of this measurement in various population samples of Bighorns from the Western United States and Northern Mexico. Sexual dimorphism is extremely evident. Of interest is the fact that the differences between the averages of various age groups of one population (Graph 1) are greater than the differences between the averages of population samples representing different subspecies: Obviously then in taxonomic studies only the comparisons between individuals of the same age and sex are reliable indications of geographic differences.

Finally, man's past and present activities are influencing the study through (1) the transplanting of individuals from one geographic area (and, thus, one genetic make-up) in areas presently or formerly occupied by individuals of a different genetic make-up and (2) the isolating of formerly continuous populations by fencing, extermination, and/or land use -- thus restricting or eliminating avenues of gene flow between adjacent populations.

In resume then, it is evident that the populations of "Desert Bighorn Sheep" actually represent more than one subspecies. The unifying factor appears to be the many ecological and management problems that exist in common throughout the area rather than any genetic or taxonomic unity,

As to which taxon a given population of Bighorn should be assigned, it appears that, for practical purposes at present, the

pattern shown by Hall and Kelson (1959) might well be followed. However, before too much more time has elapsed someone should attempt to assemble measurements and specimens of large numbers of individuals of known age and sex from native (not introduced) populations and attempt a more complete analysis of the known geographic variations, especially among the populations now known as Ovis canadensis mexicana Merriam.

Literature Cited:

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Dalquest, Walter W. and Hoffmeister, Donald F. 1948. Mountain Sheep from the State of Washington in the Collection of the University of Kansas. Trans. Kansas Acad. Science, 51:224-234.

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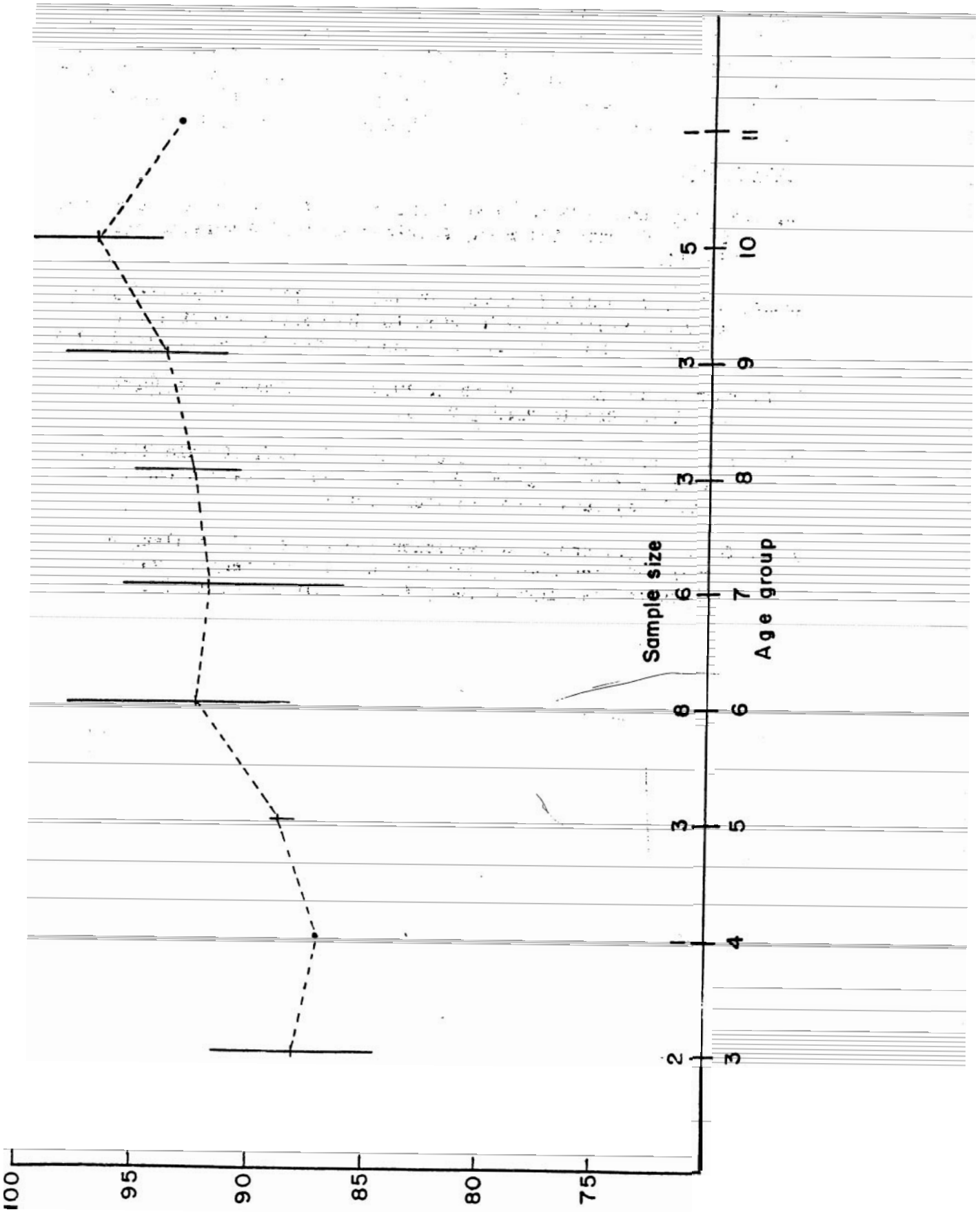
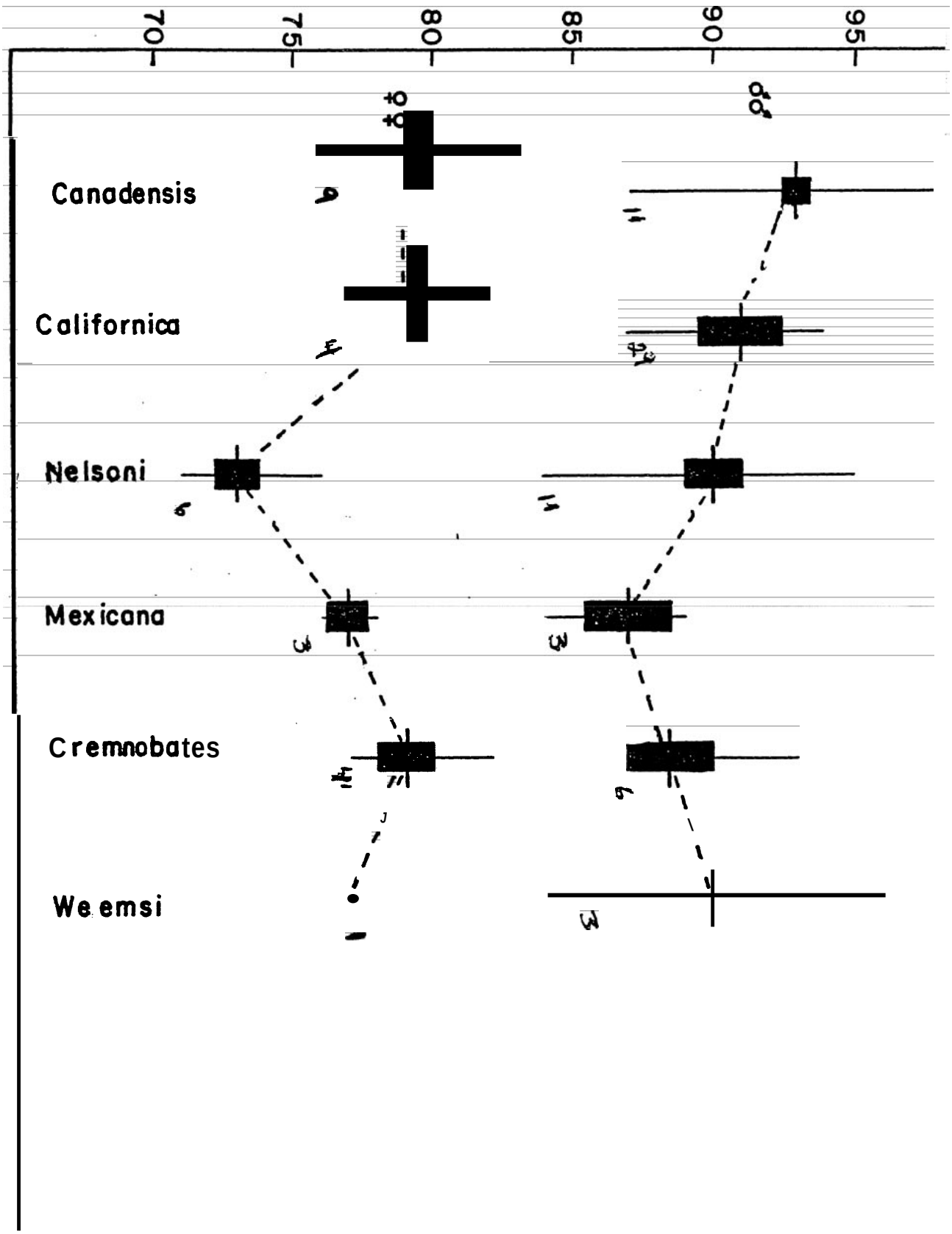
Graph 1. The average and ranges of the mastoid width of male Bighorn Sheep of various ages taken Mount Chopak, Washington (Data from Dalquest and Hoffmeister, 1948).

Graph 2. The average, standard deviation and ranges of population samples (males above, females below) representing various subspecies of Bighorn Sheep (Data from Cowan, 1940).


Sample size
Age group
I
II
5
10
3
9
3
8
6
7
8
6
3
5
1
4
2
3
100
95
90
85
80
75
Millimeters


Millimeters
70
75
80
85
90
95
Canadensis
Californica
Nelsoni
Mexicana
Cremnobates
Weemsi

SIGNIFICANCE OF BIGHORN MORTALITY RECORDS

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Desert Game Range, Bureau of Sport Fisheries and Wildlife

Mortality is a natural function of all species of animals. Keeping records of the causes and rates of mortality of game animals is an important part of a game manager's program. Some of these records are known directly as hunter kill or number of animals trapped and indirectly as fawn or lamb success and calf or kid survival.

The remains of animals that die from natural causes are usually difficult to find. Consequently records that are made of natural mortality are frequently only incidental to a management program except in cases where some unusual incident occurs and large numbers of animals are killed by disease or extreme climatic conditions.

On the Desert Game Range there is a fair concentration of Bighorn sheep, and the environment lends itself to preserving the remains of these animals at least for a few years. There are in the refuge files enough incidental records of natural sheep mortality to warrant a consolidation of this type of information. However, at this time many of the records are incomplete and therefore definite conclusions cannot be drawn from much of these data.

Since 1955 all sheep carcasses that have been found have been either tagged or collected. A numbered metal tag was wired to the skull of those remains that were found in situations where it was considered impractical for them to be collected. Notes on each mortality were made, and the following information was recorded when possible:

1. The date found and the location of the carcass.
2. The sex and age of the animal.
3. How long the animal had been dead.
4. The cause of death.
5. General remarks on condition and situation of the remains,

In addition certain measurements were taken from the ram horns when they were found with the carcass. The same measurements were also made on the horns of the rams killed by hunters during the regular sheep hunting season.

As of March, 1961, there are records of 242 carcasses. These records are not complete since it is often impossible to tell definitely much more than the sex of the animal. The age of some of these animals was recorded only as a lamb or adult. Those recorded as adults were often classified as young, mature, prime or old. However, since the ram horns have a distinct ring which develops annually throughout the

lifetime of the animal, the ageing of 102 ram carcasses was considered accurate enough to use in illustrating possible patterns of mortality rates. The length of time that the animal had been dead is difficult to determine. However, a check on tagged carcasses was made after several years had passed, and this showed that if the remains of an adult sheep were from one to four years old when found the observers were quite accurate in estimating the time that had elapsed. Beyond four years the recorded estimates became increasingly more questionable.

The determination of the cause of death was very difficult and about 90% were recorded as dying from unknown causes. Frequent notes were made on the condition of the teeth, and many of the old age animals had very poor teeth.

Some information from these mortality records is complete enough to show the significance of making an increased effort to gather as much information as possible pertaining to natural mortality on the Desert Game Range.

The locations of these mortalities were plotted on a map. They were designated by sex and by age, that is, male or female, and lamb, yearling or adult. This map showed a definite concentration of rams in some areas and ewes and lambs in others. There was an overlap in some places, but this is to be expected. It was evident that large numbers of lamb and ewe carcasses were found in ram wintering areas. This suggests that on the Desert Game Range the ewe mortality is highest during the winter months. However, more work along this line is needed before definite conclusions may be made.

In respect to the sex and age ratio of the animals found it is interesting that 135 were rams, 66 were ewes, five were yearlings and 36 were lambs. The reason for these odd proportions in a population that is supposed to have an equal sex ratio is not known. Several possibilities for the disproportionate sex and age composition are suggested below.

1. Ram horns, being heavy, are not dragged and scattered by predators or scavengers.

2. Ram horns, being heavy and to a certain extent curled, have a tendency to roll or slide into washes where they are more easily found.

3. Ewe, yearling and especially lamb bones, being lighter and more fragile than ram bones, are subject to more rapid decomposition and scattering by predators and scavengers.

4. Ewes, yearling and lambs die in rough, rocky terrain for one reason or another and, therefore, are not as likely to be encountered as those that die in or near the dry washes.

In order to establish the age of an animal at the time of its death it was necessary to determine the sequence in which the annular

rings on the horns are laid down. On rams these rings appear to form during the rutting season when horn growth stops and a deep depression forms at the base of the horn. In the spring and early summer growth is resumed, and this new portion below the last ring appears quite bluish in contrast to the buff color of the older portion of the horn. The bluish area changes to buff or brown within about a year in adult sheep. On the horns of the young penned rams at the Corn Creek field station of the Desert Game Range the first ring did not form until the second rutting season after the sheep were born. Since the rutting season and consequently the lambing season for wild sheep occurs over a period of at least six months, there is no way of knowing at what time of the year the animal is born. Therefore, the first ring or impression from the tip of the horn was arbitrarily designated as the second year ring and should correspond to their second rutting season of life. The maturity of the wild sheep at the time of their second rutting season probably determines the depth and/or character of the first ring. The amount of growth between rings was measured on 29 sets of horns, and it was found that after seven to ten years of age the horn grew less than one quarter of an inch a year. This leaves the last inch or two at the base of the horn quite dark in color and encircled by very slight rings which are difficult to distinguish. Therefore, ageing rams after they were about ten years of age required very close inspection.

The horns of 135 ram carcasses were examined and their age at the time of death was estimated by using these observations. The estimated ages of only 102 of these rams were considered accurate enough to be used in the following table.

TABLE #1

Estimated ages of male bighorn sheep at the time of death taken from 102 carcasses found on the Desert Game Range.

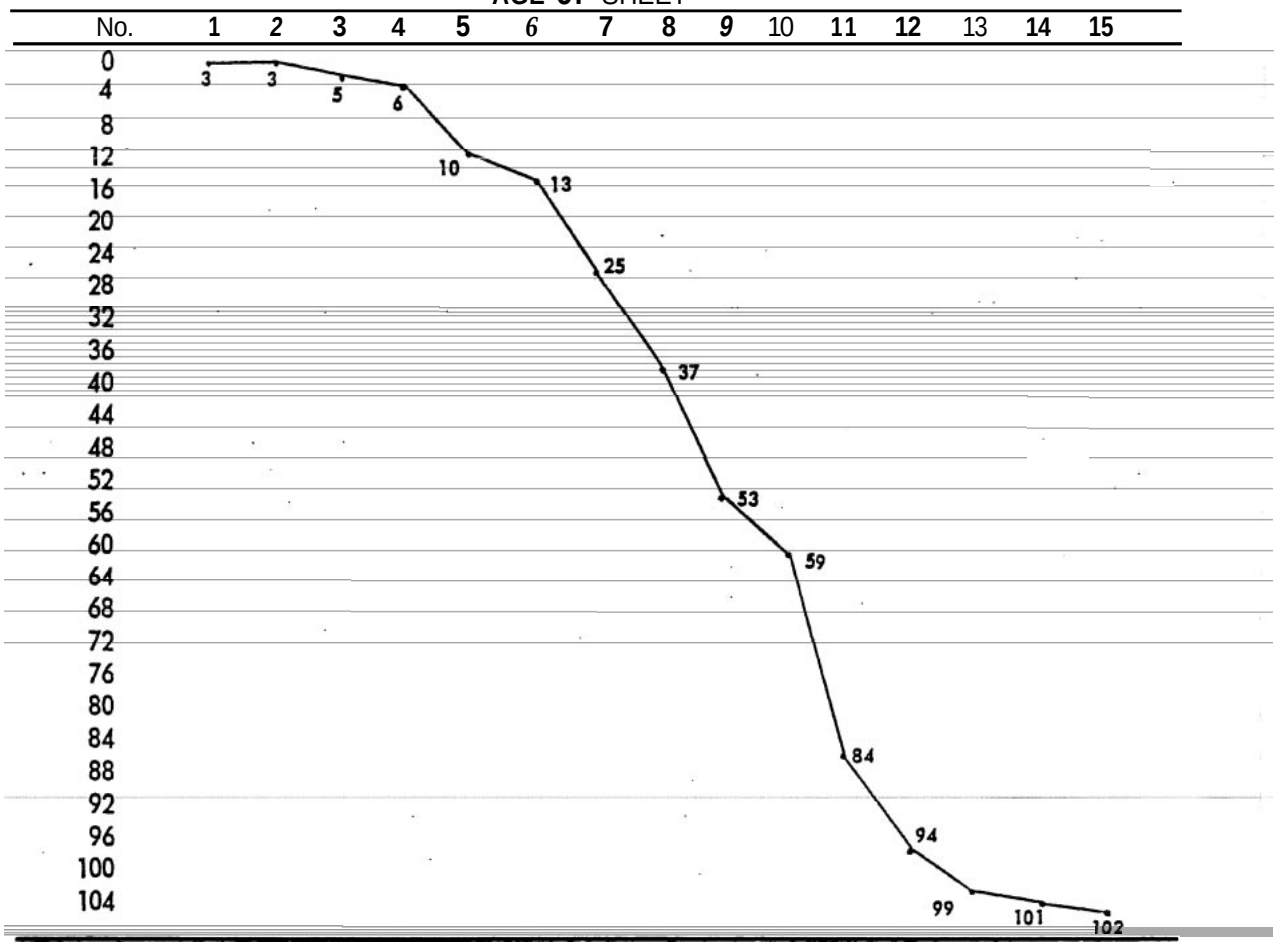
Age in Years	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Number of Carcasses	3	0	2	1	4	3	12	12	16	6	25	10	5	2	1

It should be noted that in Table #1 the number of rams in the 10-year age class is low and that the number in the 11-year age class is high because several of the estimated ages were recorded as 10 plus years of age, thus putting them in the 11-year age class.

A curve was plotted using the figures in Table #1 in order to illustrate graphically the mortality rate of these 102 rams.

FIGURE 1

Natural mortality rate curve plotted from the **estimated ages at** the time **of death of 102 male bighorn sheep found on the Desert Game** Range.



The ageing of ewe horns was **found** to be very difficult since no comparative material was available. However, the estimated **ages** recorded from ewe mortalities when plotted on a graph such as **Figure** 1 followed quite closely the curve for **rams.** This is to be expected since Desert Bighorn Sheep theoretically have an equal sex ratio and the mortality rates for both **sexes** should be approximately equal. **However,** if ewes could be aged with a certain degree of accuracy, **it may** be found that these is a differential **in** longevity between rams and ewes which would cause a greater number of one sex than the other in certain age classes.

A curve such **as** the **one** shown in Figure **l** if based on sufficiently accurate data could be used **as** a basis for a life **table** for certain populations of Bighorn sheep. This curve is in essence a survival curve in reverse. For example, **it** could represent the mortality rate of 102 animals. That is out of 102 yearlings present in 1960 three die leaving 99 alive to be two-year olds in 1961, zero of these two-year olds die leaving 99 alive to be three-year olds in 1962, two of these three-year olds die leaving 97 alive to be four-year olds in 1963 and **so** forth, until the last yearling **from** the 1960 herd dies at the age of 15 in 1974. Table **#2** illustrated this mortality rate in the form of a life table.

TABLE #2

Theoretical life table of 102 yearling Bighorn sheep present in 1960 on the Desert Game Range

	YEAR														
	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Age in Years															
1	102														
2		99													
3			99												
4				97											
5					96										
6						92									
7							89								
8								77							
9									65						
10										49					
11											43				
12												18			
13													8		
14														3	
15															1

There are many ramifications connected with a life table such as shown in Table #2. It would be necessary to conduct continuous field investigations in order to correct the mortality rate each year as a result of unexpected losses due to hunting or adverse environmental conditions. It would also be necessary to obtain an accurate estimate of the annual increment in order to establish the number of yearlings present in the population each year. After a life table such as appears in Table #2 is filled in for each year and age class, then the estimated total population figures can be obtained for any one year by adding together the numbers in the vertical columns.

A tentative life table was made using the available data in the files of the Desert Game Range that were compiled from 1936 through 1960. This life table was found to correspond quite closely with total population estimates based on other types of surveys. It also pointed out that because of the large lamb crops and the excellent survival rates of these lambs in the years 1943 through 1948 a large natural die-off of mature sheep was to be expected in about ten years. The mortality records that were made from actual field notes reveal that a large number of mature sheep did die during the years 1953 through 1958 with the peak numbers around 1955. Therefore, instead of these animals dying of disease or adverse climatic conditions as was suspected when so many carcasses were found, their death was probably a result of the normal mortality rate that is to be expected in any natural population of animals.

In closing it is important to point out again that only those data pertaining to the geographic location of the carcasses and the sex of the adult sheep were accurate enough to use in drawing conclusions concerning the sheep on the Desert Game Range. The inaccuracies found in the other types of information are due to the lack of knowledge pertaining to the effect of the environment on sheep carcasses, the physical development of the bones and horns of the animals themselves and the many factors which contribute to their death. The principles presented in this paper demonstrate the significance of mortality records and how they can be used in the over-all management program of the Desert Bighorn Sheep.

WATERHOLE OBSERVATIONS OF BIGHORN SHEEP

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This paper deals with observations made on the Kofa and Cabeza Prieta Game Ranges in Southwestern Arizona. These two refuges contain 660,000 and 880,000 acres, respectively, and consist of very rugged mountains (3,500' - 4,600') separated by broad valleys. These refuges were established for the preservation of the Bighornsheep and are administered by the United States Fish & Wildlife Service.

The purpose of the counts is to collect information for management purposes. Although many species of wildlife are observed, the Bighorn sheep is the primary interest throughout the counts. The counts are conducted in the summer when available water is at a minimum and the Bighorn must depend on a few scattered waters. These waters may be grouped into three classes; there are tanks (both natural and man-made), springs and wells. The tanks are entirely dependent upon rain water for replenishment, The Counts consist of watching each water from dawn to dusk for three consecutive days, The theory behind the count is that if a Bighorn drinks at least once every three days, and if each Bighorn is individually distinguishable, and if all waters are observed, then we can determine the total population, sex ration, ewe-lamb ration, etc. Things, however, are not that simple.

Before proceeding further, two points should be emphasized. First, the waterhole counts are in the beginning stages and all the following remarks should be accepted with that qualification in mind. Second, some of the information presented has not been proven to be definite fact.

It is believed that "Bighorn sheep do not become dependent on water until daytime temperatures regularly exceed 100 degrees Fahrenheit and a minimum of green food is available." Logically these counts should not be held until these conditions are met. In Southwestern Arizona, this means after July 1. A count made prior to this time has limited merit because some, or many, of the Bighorn may not be visiting the waters yet. Also, a count made after this time is simplified in that many of the smaller waters have dried up. A factor that complicates the counts is that summer rains may occur as early as July 10, or even earlier, so that a satisfactory count may not be made every year. The result of the summer rains is that water is available to the Bighorn in many small pockets and the smaller tanks so that it would be impossible to watch all the waters, Then, too, desert vegetation responds very quickly to these rains and the Bighorn may have green food available, in which case he may not need free water, even though the weather remains hot.

It would do well to elaborate on the watering frequency of the Desert Bighorns, Observations on the two refuges lead us to believe that under maximum temperatures and minimum green food conditions,

most Bighorns will water every three to five days, We have some instances of Bighorns watering once every third day and other cases where animals do not water more often than every fifth day. As yet the data is insufficient to allow any conclusions to be drawn, We hope the future will shed a considerable light on this area of our knowledge,

Throughout the last six years, we have learned that it is usually not difficult to distinguish individual animals, Rams are often quite easily recognized by differences in horn spread, size, curl or other features, such as chips or breaks in the horn. Ewes also may often be separated on horn characteristics, Other features, such as scars, color patches, or differences in shedding of winter coats, may aid the observer, At times, a ewe may be identified by the lamb with her, which may be of different age or sex. With a little experience, the observer can single out animals and describe them carefully in his notes so that if the animal should turn up at another water, the duplication may be recognized. We feel that the number of animals that defy identification is small,

The watering behavior of the Bighorn sheep varies greatly and no generalizations may be made, Some approach the waters warily, while others come in to drink without any hesitation. Older rams, especially, will fall in the latter group. Some Bighorn may drink for several minutes, taking as many as 100 swallows, while other drink briefly. Some animals display a marked thirst, while others show little inclination to drink, Some Bighorns leave the water immediately after drinking, while others linger in the area for some time. The animals may leave by the same route as they approached the water or by a different one, provided a different route is available.

We believe that some definite remarks *may* be made in regard to the time of watering. This is generally between sunrise and 8 or 9 a.m., and again between 4 and 6 p.m. There is little watering between 11 a.m. and 3 p.m. or at sunset, It is believed that watering during the hours of darkness rarely occurs,

The count observations indicate that a reliable ewe-lamb ratio cannot be obtained during these counts, Although we believe that the lamb normally accompanies the ewe, there has been an observation of a ewe caching her lamb before going to water a mile away. There is a possibility that this caching may occur more frequently than we think, In many instances, it may be possible to judge by the condition of the udder whether or not the ewe has a lamb, If the udder appears to be distended, we can reasonably believe that she does have a lamb. We have several instances of such "wet" ewes coming to water without their lambs,

A certain amount of information may be collected on the food habits and rutting behavior, The rutting season begins in July, and we hope that we can obtain some important information concerning breeding activities during these counts,

The following photographs (slides) will show some of the tanks on the game ranges and will illustrate some aspects of Bighorn

behavior: (1) Yaqui Tanks, a good example of an unimproved natural tank; (2) Cereus Tank, a man-made tank blasted out of rock; (3) Four Peaks Dam, the only good day-type water hole on the refuges; (4) Adams Well, the water is piped to a trough which sets down wash of the well; (5) Bighorn ram with deformed horns at Tunnel Springs; (6) A normal ram at Halfway Tank; (7) A ram lying down at Agua Dulce Spring; (8) A ram drinking at Agua Dulce Spring; (9) A group of Bighorns at Tunnel Springs; (10) A lamb and two ewes at Tunnel Springs; (11) A ewe drinking at High Tank 2, a trough with a good supply of water sets about 100 yards downhill from the spring.

In conclusion, I would like to remind you that these counts are still in their infancy. We have high hopes that the water hole counts will prove a valuable means of collecting information for the management of the Bighorn sheep.

CENSUSING BY TRANSECT

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To refresh your minds on what the books say on censusing by transect there are four main types of transects as follows:

1. The belt transect is a sample plot that is longer than it is broad.

2. The line transect has a specified length but no width,

3. The stratum transect cuts vertically across the strata.

4. The random transect is random samplings of an area.

There are probably many others that I have not listed. Many factors enter into censusing by this method. Range surveys are necessary, center lines must be laid out, representative habitat chosen, acreage determined, etc. Many of the authorities do not favor the transect censuses for big game.

In view of the many requirements the 11 transects ridden every month for two years on the Desert Game Range would be called observation strips. The project was undertaken to test the feasibility of using the transect as a method of censusing Bighorn sheep. Four oval and seven line observation strips were used in this experiment.

All of you who are acquainted with Bighorn sheep habitat can appreciate the difficulties encountered in trying to lay out a census transect. This is particularly true of the Desert Game Range. Our sheep range in elevations from 2,000 to 9,000 feet and through several vegetation zones, where the sheep are well scattered and there are large areas of little or no use. Our 11 observation strips totaled 138 miles in length. In the two years of censusing by this method approximately 3,300 miles were ridden and 250 man-days expended to see 415 sheep. The needed personnel was not always available, and at one time or another anyone available was pressed into service. Observers included managers, biologists, maintenance men, student assistants and sometimes innocent bystanders.

A large amount of information was gathered and a report of the results is being compiled. In spite of many inconsistencies in information gathered we believe that we did gain the knowledge to set up a belt transect that would reduce the sampling errors to a point where this type of censusing could be used for Bighorn sheep.

Some of the weaknesses involved the observation abilities of the various observers. An example is the number of unidentified sheep reported - 16 out of 415 sheep seen. There could be some doubt here as more than 50% of the observations were made of sheep running and some

at a distance in excess of 300 yards. Another weakness is that the strips were not laid out to represent a portion of the total area. Habitat types should be sampled in the same proportion as they occur in the total area. And perhaps the strips should not have been ridden in the same direction each time. From the records of the actions of the sheep seen it would appear that the sheep became aware of the frequency of the observers. These may seem minor items but they can affect the accuracy of the final work.

From the experience gained we suggest the following for setting up an ideal Bighorn sheep censusing belt transect:

1. A range survey is a must to determine the areas for censusing.

2. Obtain a minimum of 100 samples.

3. Census should be made over a short period of time and twice a year if possible. June and October would probably be the ideal times.

4. Census each type of habitat in proportion to the total area so that all members of the population would have an equal chance to be counted.

There are some sticky wickets in these suggestions. One would be securing 100 samples. In the operation of our 11 observation strips an estimated 84,000 acres produced an average of 67 observations or samples. To get the required 100 samples 127.000 acres would have to be covered. Another would be covering all of the vegetation zones. This would require a total of 382 belt transects on the Desert Game Range. The biggest sticker of all would be manpower. To census the 382 transects 26 riders would have to spend three weeks riding five days a week.

In summing up this report I believe that if it were possible to set up a belt transect census and ride it twice a year it would supply accurate information on survival within the year and serve as a check on the total population figures, but it would be an expensive operation. In contrast during our 1960 waterhole count, 33 man-days were expended to observe 268 sheep. Consequently, it appears that a waterhole count, using a comparable number of man-days, would produce a more accurate census at a much smaller cost in manpower and equipment

We have found that observation strips are a worthwhile project. They can be set up easily and ridden two, three, or more times a year as time permits to observe trends in population, range conditions and the locations of mortalities.

LAMB AND YEARLING COUNTS

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I believe we will all agree that the Desert Bighorn is undoubtedly one of the most difficult animals to census of any on the North American Continent, During the time I have spent working with desert sheep, several different types of: survey methods have been tried, and much thought and. effort has gone toward devising a survey method that would be both economical and feasible. I know that all of us working in.this field are always striving for better'methods of gathering pertinent data for better management of the species. This paper will deal with some of the methods tried in the past and the accepted survey procedures in use today.

But first let us take a look at the animal with which we are working. Young lambs have been observed in almost every month of the year, but. the normal drop occurs from January to June with the peak in February, At this time, the ewes are usually found on so-called lambing grounds in extremely rugged terrain.

From the time of birth, both sexes develop horns and the growth rate is approximately one inch per month until the animal reaches six months of age. The the horn growth in the female becomes negligent, but the rams continue to grow at about the same rate until the animal is two to three years old. We have measured rams in Arizona with horns 21 to 24 inches .in length that were only two years old (the ages of the rams were determined by using Deming's Table of Tooth Development and by annual rings on the horns).

During the period of six to 12 months of age, it is difficult for the inexperienced observer and sometimes the experienced observer to determine the sex unless they have ample time to observe the animals through high-powered binoculars or a spotting scope. During this period of. growth, the principal distinguishing characteristics are the shape of the horns and the presence of the. genitals. The horns of the male are thicker at the base and are turned out in preparation of developing into the magnificent curl of the trophy ram. The tip-to-tip spread is greater in the male than the female, and, toward the end of the first year, the horns of the male are longer than the female. Even experienced observers shouldn't use the horn method of sexing at this age, but should look for the presence or absence of the male genitals to make certain of a positive identification,

Census Methods:

During the time spent working in Nevada, several different methods were tried, One consisted of several routes in two mountain ranges by four different modes of travel: truck, horse, boat, helicopter. No foot routes were established because of the relative short distance a person could travel in the summer months, These routes were

traveled once each month to establish a trend which we hoped would give an indication of population. Routes were established in the Muddy Mountains, the Eldorado Mountains, the north shore of Lake Mead, and the west shore of Lake Mohave.

At this time, arrangements were made with the Air Force to make a monthly flight over the Muddy Mountains. This proved to be an unworkable relationship because of the need for the helicopter for standby duty in the event of an air crash.

There were three horseback routes, two boat routes and one truck route. Sheep were seen on all six of these routes, but the number of sheep seen averaged out to almost nothing when the totals of several months were added together. We realized we were surveying low population density ranges, but were in hopes of sighting more animals. Since this was a management study, it was felt that too much time was being expended for the results that were being obtained, At about this time, additional duties in the form of small work were added to the project and a cut in the big game portion of the work activities was necessary.

Out of all this effort, we did learn that we would have to go to some other form of survey,

During this same period of time, we were carrying out a migration distribution study with trapped animals. There was some thought given to using Lincoln's Index to determine a population figure if enough animals could be tagged and released.

Although this proved to be a most interesting project, it also proved to be time-consuming and produced very little results. We were trapping along the Colorado River and baiting the traps with hay. This worked in one area where the animals were used to eating hay but not at all in other areas.

Still another survey method is being used on the Kofa Game Range and was primarily devised as a method to count lambs. This is a variation of the route system tried in Nevada but works much better. Each person is assigned a portion of a mountain and this is surveyed by foot, or in some areas by horseback, with considerable time spent in "glassing" the surrounding country. The first year the survey was tried (February 1958), feed conditions were exceptional, and ewes and lambs were difficult to find. Only two lambs were seen out of a total of 75 sheep. (See Table I.)

TABLE I

Year	Rams	Ewes	Lambs	Uncl.	Total	Lambs/100 Ewes	
1958	56	15	2	4	77	13.3	Winter
1958	28	46	14	3	91	30.3	Summer

As you can see, there is a great difference in herd composition figures resulting from the two surveys. The 1959 winter survey produced a

great difference in herd cpmposition figures from the preceding year. (See Table II.)

TABLE II - WINTER LAMB SURVEY

Year	Rams	Ewes	Lambs	Uncl.	Total	Lambs/100 Ewes
1959	10	29	7	9	55	24.1

The two winters varied greatly in amounts of precipitation, which had a direct relation on the distribution of the sheep. During the 1958 survey, the majority of the sheep were seen from horseback, but the 1959 survey produced not one animal by this method.

This survey, although it gives us much information, would be costly and Xime-consuming if it were applied to all of the Bighorn ranges in Arizona that are being hunted,

Aircraft surveys have been tried and are continually being tried, but the results are negligible. Observers on the Desert Game Range found that sheep could be seen from fixed wing-type of aircraft if a prior knowledge of the exact location of the sheep was known. They found that it was almost impossible to fly just any mountain range that has sheep and locate the animals.. I have had similar experiences both here and in Nevada. Some sheep will be seen, but the few that are seen would give no indication of total population. Helicopters are much better for finding sheep and are very good for locating water, but the cost of operation is so great that Government agencies can't afford to hire this type of aircraft, The military air bases have been most generous in furnishing us transportation in military helicopters, but it has been most difficult to correlate our needs with their activities where there isn't too great a conflict or imposition,

We had used Luke Field helicopters four times during a period of about a year when the Director received a letter from the Commanding Officer stating that any further use of their helicopters would be at the rate of $300 per hour. This completed the program we had initiated to re-evaluate our primary Bighorn Sheep ranges by helicopter,

The best type of survey we have at present is the water hole count. Many of you have participated in this type of survey and have sat at a waterhole for three consecutive days classifying and recording the animals that appeared at the waterhole, This type of survey will give the game biologist the best possible data for the lowest cost per manhour.

Although the waterhole counts do not indicate the percentage of the lamb drop, they do give the lamb survival, Lambs that come into water that are three to five months old have an excellent chance of survival and growing to adulthood. The survival rate is what the biologist is interested in because these are the animals that he will base his hunting seasons on in future years.

In my experiences watching a waterhole, I have never tried to

second-guess a ewe as to whether she has a lamb. I do not believe a person can tell from the condition of the udder whether that ewe's lamb is alive or, in many cases, whether she is wet or dry. There are too many changes that the ewe could look wet when she isn't or the lamb could have died prior to the ewe being seen by the observer. If this is felt to be a problem that distorts the lamb-ewe ratio, the observation. point could be relocated to such an advantage that the majority of the sheep that use the waterhole can be seen before they arrive at the waterhole. The ewes could then be seen hiding their lambs out before they come in to drink. This has never presented a problem on any of our waterhole counts in Arizona.'

A factor that must be considered before any type of lamb survey is made is the amount of moisture that the range has received that winter and the amount of annual growth, I think we will all agree that lamb production and survival are high during years when there is an abundance of feed. In other words, if the range gets moisture, there will be lambs to count, but if there is little or no moisture, the production will be so small that it will have little effect on the total population.

Although several types of surveys have been tried, and these ate by no means all of them, the best and most economical is the waterhole count. The data obtained from this type of survey is adequate to indicate lamb survival, ram-ewe ratios, and ewe-yearling ratios. The waterhole count is far from being the perfect census method. Future years may produce more life history information that will make the survey more accurate.

THE FERAL BURRO IN DEATH VALLEY
(Summary of a Report)

Ralph and Florence Welles

Since 1954 the National Park Service has sponsored what has become known as the Death Valley Bighorn Research Project. While this program has been aimed primarily at the life history of the Nelson Bighorn population in the Death Valley region, considerable data on the feral burro of the area has accumulated, some of it indicating significant gaps in the generally accepted concept of burro-Bighorn interrelationships.

In an effort to fill in these gaps as much as possible it was decided to temporarily shift the emphasis of the project from Bighorn to burros. From February 21 to June 30, 1960, this was done. Here is a summary of the results of that work:

There are probably less than half the number of burros originally believed to inhabit the Monument area.

Of the estimated maximum population of 900 we observed 154. With the exception of three lactating jennies, two jennies suffering from the effects of observed over-breeding, and three jacks suffering from past battles and old age, all the animals were in good physical condition.

The feeding habits and behavior of the burro are not as directly competitive with Bighorn as has been believed.

In its preferred habitat the burro is not in significant conflict with Bighorn.

Forage competition is lessened by the differential in preferred forage plants. Forage is at least adequate at the present time.

Burros and Bighorn have been observed feeding in the same area, but with significant topographical barriers of relative ruggedness separating their respective sections of the foraging area.

Increasing pressure of a rising population density results in a gradual depression of preferred vegetation along the trails to water, increasing in intensity as the trails merge at the hub of the spring area.

The burro does not always totally destroy the cover for other species in spring areas.

The watering habits and behavior of the burro are not as directly competitive or destructive as has been believed. Thriving Bighorn populations have been watering at the same springs with thriving burro populations since before 1937. They are still doing it as witness the record number of 28 Bighorn watering with 6 burros at Quartz Spring on June 1, 1960.

The burro does not always destroy installations at water sources: Far from always fouling water sources so that no other species can use them, the burro apparently seldom, if ever does.

The nocturnal watering habit of the burro lessens the direct competition between it and the diurnal Bighorn,

Without controls the burro population would logically be expected to exceed the carrying capacity of the range within a very short time. At this point a drought would turn a critical condition into an emergency, and under emergency circumstances the burro becomes a desperate competitor with other wildlife species, This would result in direct competition for water, fighting other animals away from it and under stress of battle probably fouling what is left. Depletion of vegetation would follow, with spring area vegetation, normally ignored by burros, beginning to be browsed by them and eventually the "carry over" food supplies so necessary to Bighorn and other species being depleted, and cover for all species destroyed. Finally, eventual destruction of ground cover plants such as creosote bush (Larrea) would take place, with denudation of water sheds and in the end destruction of water sources.

There are two important large animals in Death Valley National Monument, the Bighorn and the burro, The Bighorn, if it had been left alone, would have "managed" itself, but people and the burro have arrived and with them the necessity for the apportionment among the species of places to feed, drink, hide, rest, sleep, play, and to raise their young,

BIGHORN AND COYOTES

Richard A. Weaver
California Department of Fish & Game
Riverside, California

First, I'd like to qualify myself on giving this paper. I'm no expert on the subject in any sense. In all of the years that I have been privileged to hike around in Bighorn habitat, I have never seen Bighorn and coyotes at the same time. I have seen them a few minutes apart at waterholes, but not at the same time.

If that isn't enough, let me further state that I'm admittedly biased, It seems to me that there are two schools of thought in regard to coyotes, Either you are for them or you are against them. I'm "fer 'em." If that isn't enough, I'm loyal to the organization 1 work for, which is not making any predator control effort except to make some limited funds available to the U. S. Fish & Wildlife Service that is engaged in this work, Furthermore, I believe in our policies.

In view of all of this, I wandered just what I might be able to contribute on this subject. I thought that perhaps with the small amount of time that I could devote to it and the limited material available to me, I might try to make a search of literature. I realized fully that it could not be complete, but I hoped I could compile some significant facts from the written material. By the time I had made several pages of notes, I discovered that this was a duplication of effort and had already been done by Helmut K. Buechner in his monograph "The Bighorn Sheep in the United States." So, I recommend to anyone interested in pursuing this subject of Bighorn and coyotes to refer to this monograph. It was somewhat gratifying to me when I found he and I had gleaned from the literature the same material as being significant, even though I'm sure he had more time and greater source of information and probably assistance.

One thing seems pretty certain in this Bighorn-coyote relationship, and I can personally attest to this, and that is the coyote is the most common predator occupying Bighorn ranges, and you can find signs in some very inacessible places indicating that they get pretty much all over the Bighorn ranges.

It is pretty much agreed that coyotes are capable of killing Bighorn, at least on occasion; however, I did not find anything in print where anybody had actually witnessed such an act.

One of the most conclusive accounts that I could find a record of is this short note from the files of the Bureau of Sport Fisheries & Wildlife Office at Yuma, Arizona:

SHEEP DEPREDATION

Huyson J. Johnson

"On the morning of Friday, August 12, 1949, while on

routine patrol, I visited Dripping Spring in the Gila Mountains, In this area I discovered the remains of seven Arizona Bighorn Sheep, three lambs, two ewes, one yearling ewe, and one 4-year old ram, apparently killed by predators as there was sign of no other activity in the area.

"Five of these had been killed in the past 60 days, and one, the yearling ewe, had been killed the morning of the 12th, for the blood was still moist and fresh on the rocks. The carcass of this animal had been absolutely devoured, with only the head and a few fleshless bones remaining. The fresh blood, pliability of a few scraps of the hide remaining attached to the skull, and the freshness of the bones all point to the fact that this animal had been killed and devoured in a very short time,

"Five coyotes were observed in the vicinity, and one was shot and wounded by me as it made its escape.

"The local State Game Ranger was notified, and he and I made a later trip at which time pictures were taken and the stomach contents of one of the dead sheep secured for analysis,:

Warren Kelly reported at our first council meeting, and it is printed in the proceedings, definite evidence of predation. He said, "One band of coyotes ganged up on a ram on the Kofa and proceeded to polish him off."

You will note that these incidents where the evidence was considered as conclusive were packs or bands of coyotes.

I found three recorded incidents where people had witnessed single coyotes stalking sheep. One was in Buechner's 1960 monograph, one in Dwight Smith's "Bighorn Sheep in Idaho (1954)," and an incident related by Al Jonez at our first Council meeting. All these attempts were unsuccessful, including the attempt on a lone, very young lamb. Sheep use precipitous escape cover very effectively.

It is assumed, and I have seen this in print too, that Desert Bighorn Sheep are most vulnerable to predation at waterholes; and it is true we can often find carcasses near water, Yet I have had incidents related to me where people had observed both sheep and coyotes in the immediate vicinity of water with no apparent fear or concern shown by the sheep,

In a Wyoming Bighorn Sheep Study by Horness and Frost, 1942, it is stated, "The survey party members have on many occasions seen coyotes hunting less than 50 yards of sheep that were near the rim rocks,-with no outward evidence that either the coyote or sheep condescended to notice the other. On the other hand, the survey has found

direct proof that sheep fear coyotes when they are any distance from natural protective cover,"

On the other end of the scale is the incident related by Frank Groves at our first meeting where it was believed that a ewe killed a coyote that was seen stalking sheep at the site. I, for one, believe the incident could be true because I have seen a ewe butt and rout a large dog,

In an effort to evaluate the effect of predation on Bighorn, the unglamourous job of collecting scat for examination has been done in a number of areas. Sane of this dung data is of interest.

Smith reports :("Bighorn Sheep in Idaho") that a collection and analyses of 687 droppings indicate that Bighorn Sheep are relatively unimportant in the diet of coyote and were in only 19, or 2.8%, of the droppings, How much of the ingested material was carrion and how much from kill was not known, It was known that carcasses of sheep known to have died of other causes contributed to the samples from three localities,

John Russo, in his "Desert Bighorn Sheep in Arizona" (1956), reports that analysis of scat was inconclusive because the sample was too small, but, more important, the scat containing sheep or deer did not prove the coyote killed the animal, Approximately 3% contained sheep or deer. Also, there was no significant difference at any season of the year, including lambing, or when sheep concentrated at water.

Dalton E. Merkle, California State Park Naturalist, reported to us at our 1959 meeting in Death Valley that analyses of 636 scat samples gathered on the Anza-Borrego Desert State Park, only three contained the remains of Bighorn. These were collected in September.

Doctors Murie and Sperry examined 584 droppings in Wyoming during 1938-40, This study shows coyotes were eating Bighorn through most of the year, Observations showed a one-month lay in the time of highest lamb mortality. The coyotes disposed of carcasses so quickly that it was difficult to ascertain cause of death,

As a part of this study, a coyote removal program was begun to determine if lamb losses would continue, or to find enough carcasses if the loss continued to determine the responsible agent, The coyote population was reduced by 75%. Evidence gathered indicated they occasionally kill Bighorn Sheep. The estimated kill amounted to between 3 - 7% of the herd,

Russo justified predator control because of an apparent response in Bighorn reproduction to predator control on the Kofa Game Range, as reported by Barkley (1947) and Holloran (1949), and to minimize one possible limiting factor,

A 1080 poison program was carried on for three winters in seven counties, Coyotes were effectively reduced; however, there was no concurrent or subsequent increase in lamb survival which may have

been due to other undetermined factors.

There is a lot of information in Adlolph Murie's Ecology of Coyote in Yellowstone, but it can be summed up simply. The data obtained from Coyote droppings, from observations of the coyote on Bighorn ranges, and from lamb counts at various times indicate that the coyote predation is at the most an unimportant mortality factor, this in spite of large populations of coyotes on Bighorn range.

Fred Jones (1950) said, "Coyotes are not considered to have any measurable effect on numbers of Sierra sheep under normal circumstances." In that word "normal" is the out if you believe that coyote reduction can be a tool in managing Bighorn as it might be in abnormal circumstances, such as transplanted sheep or extremely small remnant populations.

BOBCATS AND BIGHORN SHEEP

H. Nelson Elliott
U. S. Fish & Wildlife Service
Portland, Oregon

Although the role of bobcats as predators on Desert Bighorn Sheep has not been clearly established by study on this specific subject, there is little question, however, that bobcats are capable of destroying them.

To be sure laboratory food habit studies and competent field observations throughout the country clearly point out the bobcats ability to kill deer. Seasonally, in certain localities where rabbits and other small prey are scarce and deer plentiful, the latter may well be a principal item in the bobcat's diet.

In Charles C. Sperry's laboratory, examination of 3,538 bobcat stomachs collected from 30 states deer contributed an annual average of 5 per cent of the bobcat's food. The subject of feeding habits has been very well summarized by Stanely P. Young in "The Bobcat of North America."

Competent observations of bobcats killing antelope have also been recorded.

Competent observations of bobcats killing Bighorn sheep are also not lacking. For example, Vernon Bailey on July 23, 1928, recorded the capture of a bobcat that had previously killed a full-grown mountain sheep at the north end of the Kaibab Plateau near a spring east of Kanab.

P. C. Coats, foreman for the Figure 2 ranch in Culberson County, Texas, reported several years ago that he had found a fresh Bighorn sheep kill, placed a trap there and caught a bobcat the first night, We have no basis on which to question this report.

Some 20 years ago it was my pleasure to spend considerable time hunting mountain lions in the Bighorn sheep range of Culberson County. During this period the lions regularly killed Bighorn sheep along with deer and livestock. Field analysis of bobcat and coyote feces also revealed that these animals fed on the Bighorn,

Rather than bore you with additional evidence that bobcats do prey on the Bighorn, which most of you have perhaps already read or heard, attention is drawn to your discussion on predation during your first annual meeting in Las Vegas, Nevada. Evidence presented there certainly indicated bobcat predation on the Desert Bighorn in Nevada and Arizona,

Like the mountain lion, the bobcat is a silent prowler, obtaining most of its prey by stalking. When within striking distance it generally grasps its victim by the head and neck. On obtaining a

secure hold it quickly bites deeply into the victim's skull or neck just back of the skull.

Characteristic of mountain lions, following feeding, the bobcat also usually conceals the remains of its victim by covering it or moving it into natural cover,

An interesting example where rather severe predation to domestic sheep by both a mountain lion and bobcats occurred at the same time during early stages of range lambing without detection, although an attendant was daily riding the pasture containing the sheep, is recalled. In February of 1940 a call was received from the W. B. Mitchell, Escondido Ranch in Presidio County, Texas, reporting the loss of an unusual number of sheep. On riding with the ranch attendant, some 25 dead ewes were conspicuous on the two bed-grounds located above the rim rock which framed the southern boundary of the pasture, On . . examining,' each dead ewe had been bitten through the head by a mountain lion but the attendant had been unable to determine the cause of death. This man had simply assumed that the ewes had died from unknown causes on the' bed-grounds. On further investigation, seven lambs killed by bobcats were located in an oak-covered rock pile at the southwest corner of the pasture. Two days later a young female lion was taken with dogs under the rim just below one of the bed-grounds and the following week a pair of bobcats were trapped in the oak-covered rocks. This example is cited to point up the possibility of bobcats preying on Bighorn sheep on their lambing ranges without being detected, Their ability to conceal their victims without detection, even by experienced predatory animal control workers, contributes significantly—to the importance of the bobcats role as a predator,

It is generally accepted that predator populations are governed by the abundance of available food, It is also known that populations of rabbits and various field rodents, which compose the principal items in the diet of bobcats, rise and fall because of environmental factors. Observations have conclusively revealed that when normal food is lacking the larger carnivores, including bobcats, depend on other available forms, including both livestock and big game, In such instances the abundance of predators is not always an important factor as an individual is quite capable of severe predation in a given locality, whether it be livestock or big game needing protection.

Over 20 years ago. Joseph C. Allen, describing the ecology and management of Nelson's Bighorn on the Nevada mountain ranges, stated: "The pitifully small bands of Nelson's Bighorn sheep found in some of 'the Nevada ranges are the remnants of a once flourishing population of this form." This report also states: "Coyotes, bobcats and mountain lions occur in the Nevada sheep ranges and in some instances constitute a problem in sheep-range management. The greatest destruction by predators is in the devouring of new-born lambs and this may sometimes .account for a readily noticeable herd reduction, This problem is egsily taken care of in most instances by efficient predator control in and around the lambing grounds just before and during the lambing period."

Records of predator control activities of Nevada Bighorn sheep ranges before 1946 were not readily available. However, from July, 1946, through February of this year, 477 bobcats and 355 coyotes are known to have been removed from, and immediately adjacent to, the Desert Game Range by mammal control agents employed under the cooperative control program in Nevada. No predator control was conducted during fiscal years 1953 and 1958.

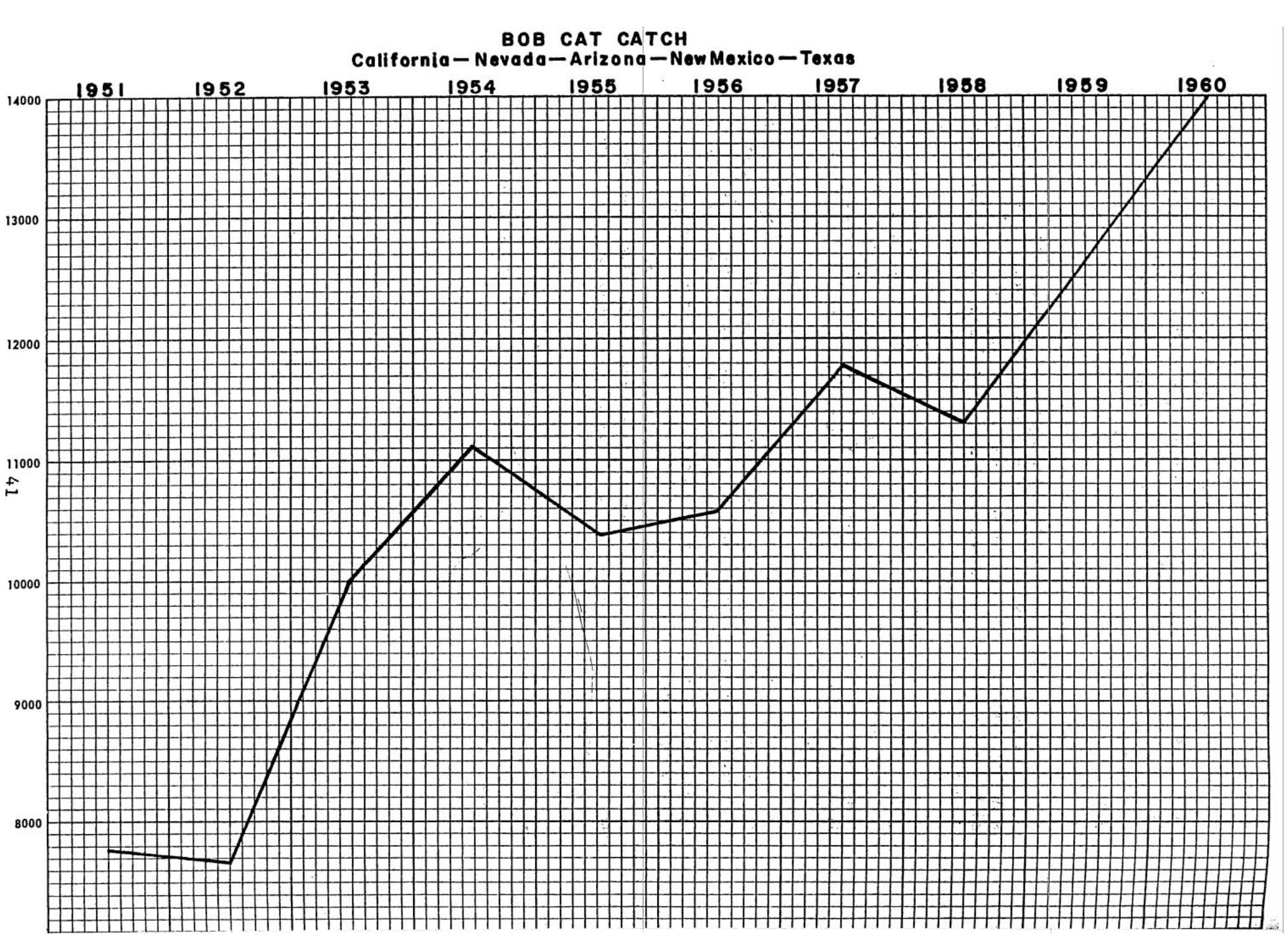
As a side line of possible interest to this discussion, we have prepared in graph form the catch of bobcats by Bureau of Sport Fisheries and Wildlife supervised mammal control agents in the states of California, Nevada, Arizona, New Mexico, and Texas during the past decade.

If we can accept these data as an indication of the population trend, there will be little question that the numbers of bobcats overall have increased significantly. There has been no significant change in efforts directed toward the removal of bobcats during this period. Of the five states, only in Arizona has the catch remained fairly constant annually.

Since Allen's Nevada work, the impression has been made that Bighorn sheep numbers on the Desert Game Range have increased to an estimated 1,500 animals, representing what is recognized as the largest single group of these animals in existence in our country today. In recent years it has been possible to harvest regulated numbers of trophy rams from the Game Range herd.

On the basis of the Desert Game Range, it becomes apparent that the control of bobcats has been one of the elements of management which has contributed to the welfare of the Bighorns.

When conducting a program to protect scarce species such as the Desert Bighorn, the elimination of all sources of loss should be given due consideration. This would, of course, include systematic predator control in certain areas.


BOB CAT CATCH
California — Nevada — Arizona — New Mexico — Texas
1951
1952
1953
1954
1955
1956
1957
1958
1959
1960
14000
13000
12000
11000
10000
9000
8000

BIGHORN - COUGAR RELATIONSHIPS

James A. Blaisdell
Grand Canyon, Arizona

Having never observed the actual predation on Desert Bighorn by cougars, and having found no persons who have, it has been necessary for me to search as much of the written material as was possible for me to find. You all realize, I am sure, that to locate writings concerning the cougar is not too difficult, but the Desert Bighorn articles are still not abundant, as Dr. Wood knows from compiling his most useful bibliography, and written items mentioning Bighorns and cougars in the same paragraph are even more rare. Consequenlty, in order to obtain any information at all for presentation at this time, it was necessary that all Bighorn sheep species be included in this paper.

This report is simply a collection of quotes. The method of presentation will be to begin with the earliest writing, and I admit there must be earlier data than that with which I will begin, and perhaps we can get some idea of how the thoughts of writers have changed through the years. When I have finished, I hope that we can discuss this subject, and perhaps some of those present who have observed actual predation will speak up.

Aldo Leopold quoted in his book Game Management back in 1933 an earlier discussion with Burnham, "Burnham says of the Salada Desert- We-did-see-ev-idence-that the mountain sheep.-.-.occasionally come to the tenahas for water. The country, however, is so infested with mountain lions...that I think the sheep at times go for days without going to water. At each tenaha we found remains of sheep killed by mountain lions (but) never of antelope or deer, which would have equally fallen, a prey to lions, had they been in the habit of watering.". Then Leopold himself added, "Lions catch mountain sheep by lying in ambush on high rocks which command the trail to water holes. Old-timers say that certain 'look-out points' near water holes in the Catalina Mountains of Arizona were formerly littered with the bones of mountain sheep which had been ambushed by mountain lions. If this country had been better watered, the lions could not have operated so successfully."

The following quote is from a 1939 publication by Davis and Taylor and relates one extreme of cougar-Bighorn relationships. "Most people are prone to blame the mountain lion for the reduction of Bighorns in Texas, This can hardly be true because the past and present predator control activities by state and federal forces have kept the mountain lion population in the trans-Pecos at a very low ebb-indeed. During the past 10 years, with expert predator control men in the field, only 39 mountain lions have been reported killed in the entire trans-Pecos region, and only 28 in the counties in which Bighorns are known to occur. If mountain lions are a check on Bighorns, the sheep should increase as the lions decrease, But they do not."

Cahalane, although in his writing he suggests danger to Bighorns by cougars, says, "-but because the immense horns of the ram are

prized trophies, the high-powered rifle with telescopic sights is a far more potent enemy than the cougar and golden eagle."

Gabrielson (1944) continues along the same line when he stated, "With the exception of the coyote, large predators are so few in number that under present conditions any possible effect that they may have on the total numbers of most big game species is more theoretical than real, There are few places in the United States where mountain lions or wolves are now abundant enough to affect in any way the stocks of deer, elk, antelope, and other species of big game."

Now comes a statement from Gale Monson, and I quote from a personal letter to me from him, "We have only one record of any mountain lion staying on either of our game ranges for any length of time, and that was of an old male taken in the Kofa Mountains February 17, 1944. I quote from the Kofa Game Range Narrative Report for the period January - April, 1944: 'The skin and skull of the mountain lion taken were sent to the Carnegie Museum. Hunter Casto found the partly buried carcasses of six mountain sheep in the vicinity of Squaw Peak Tank. Four of them were rams and two of them ewes and he believes that they had been killed in late August or early September as they were, most of them, cached out in small washes and were partly covered up and had they been placed there prior to the first of &gust, the heavy flash rains that we had in early August would have uncovered and washed them down. The altitude is wer 4,000 feet near Squaw Peak Tank which would be a fairly cool location during the hot part of the summer and Hunter Casto believes that lions must have taken advantage of this condition as they-evident-ly hunted in-other-sections-of the country after the fall.rains and there were no winter kills found. PI Monson goes on to say about this report, "With respect to this quotation, I think it is fairly well established that this lion was not accompanied by others, and was strictly a solitary individual. I also think there is a good chance the Bighorns were killed later than in August or September. Besides the Bighorn kills, I understand a number of deer kills were also found."

As an enemy of mountain sheep Grinnell wrote of the cougar, "While, of course, it cannot overtake sheep in a fair chase, the puma lies in wait for them among the rocks, killing many, because the sheep range is on ground suitable for the lions to stalk them on; that is to say, among the rocks on steep mountain sides or the edge of canons, According to Mr. Hofer, pumas appear to choose favorite lurking spots on mountain sides, where they lie ready to pounce on passing sheep. At such points as many as 18 sheep skulls have been found,"

Packard, in his 1946 paper An Ecological Study of the Bighorn Sheep in Rocky Mountain National Park, Colorado, dealt with our subject at greater length than most of the authors quoted when he wrote, "Many local ranchers attribute the decrease of Bighorns principally or entirely to predation. They blame cougars, coyotes, and eagles especially; rarely, they speak of the former effect of wolves. This point of view cannot be entirely discounted as prejudice for many people have watched game in the park for many years and have reasonable basis for their assertions However, the few predators seer. near

or feeding on carcasses have invariably been accused of killing the sheep, which may or may not have been the case. "Years ago," he goes on, "when Bighorns were plentiful, predators also were numerous and it is reasonable to suppose that predation on the former by the latter did occur with some frequency....Whatever part predation played as an historical factor, its influence today is equally obscure. It is believed, on rather inadequate evidence, that about 12 cougars remain in the park (1946). The deaths of three Bighorns have been attributed to mountain lions during the past 10 years, but without any valid proof to support these assertions. In 1919 or 1920 a party including Mr. Fred G. Bonfils, a co-owner of the Denver Post, saw a cougar run into a band of Bighorns on Specimen Mountain and kill one or more sheep. More recent reports are questionable."

In 1947, Cahalane wrote, "Among the cliffs, the cougar and possibly the wolverine may wait in ambush," but he continued his 1943 defence of the cougar by saying, "If the predators had been such important enemies that they controlled the numbers of Bighorns, we might expect that the Bighorns would have increased when predators were in turn reduced: However, the extermination of the wolf, cougar, and wolverine in several Bighorn areas seems to have had no beneficial effect on the Bighorn population."

Cronemiller, in 1948, wrote the following: "Evidence of the predation on Desert Bighorn (Ovis canadensis nelsoni) by a mountain lion (Felis concolor) was found on the San Bernardino National Forest in Southern California in March 1947. Forest Officer Elwood M. Stone found portions of a recently killed Bighorn, including the complete head. Tracks in the immediate vicinity identified the attacker as a mountain lion and showed that a struggle had taken place before the Bighorn succumbed."

A talk on the subject of Desert Bighorn Management was presented by Halloran at the Fourteenth North American Wildlife Conference in 1949. A part of his speech concerned predation and had a rather interesting "twist" to it. He stated, "A study of refuge records in 1945 indicated that but one yearling sheep had been observed for every six lambs seen on the range. Expressed more concisely, our lamb-yearling ratio was 1 to .16. This ratio indicated that sheep were not surviving their first year." According to Halloran, range conditions were normal, water had been developed, no sick lambs had been observed, winters were mild at Kofa, and it was unlikely that poachers would take lambs because of their preference for mature ram heads; therefore, it was determined that predation was an important factor. Halloran continued, "However, near water, we were finding the remains of young sheep, apparently killed by predators. An experienced lion hunter of the (Fish and Wildlife) Service had found several sheep kills that he attributed to a lion. Analysis of lion scats from both the Kofa and the San Andres indicated that lions ate sheep," Halloran attributed much of the killing to other predators such as the bobcat and coyote, He also felt that their predator program, during which 300 to 400 animals were accounted for, had something to do with the increase of the lamb-yearling ratio of from 1 to .16 in 1945 to 1 to .71 in 1948, or three years later. Only one of these animals taken was a lion,

however, unless some died as the result of poisoning and the carcasses not found, Now, whether or not it was the one lion out of 300 - 400 other predators taken that made the difference in the lamb-yearling ratio was not stated,

In his 1950 publication, A Survey of the Sierra Nevada Bighorn, Jones reported that "Mountain lions occur in this region (Sierra Nevada Range) in small numbers, I saw tracks of one at a high altitude in Symmes Creek and during the field work heard reports of three others occurring along the sheep range; no doubt there are more, In a letter to Joseph Grinnell, M. Hall McAllister told of a sheep killed by a mountain lion that was found in Independence Creek (the sheep, the speaker assumes) in 1930 by Clyde. The few individuals that are present on the Sierra Nevada Bighorn ranges are not believed to prey on sheep other than by chance. Any such losses are necessarily small."

About this subject in Idaho, Dwight Smith wrote, "Considered as an individual, the cougar is an important predator on Bighorn sheep in Idaho. His agility and size, combined with his habit of seeking prey in rough terrain, are characteristics that cause him to be potentially dangerous to Bighorn populations. Mr. Willard Rood, Jr., a rancher and former state trapper, reports an incident which occurred several years ago when he trailed a cougar to the freshly uncovered carcasses of six Bighorn sheep that were previously cached, A few cougar-killed Bighorn were reported in Banff National Park by Green (1949). Mr. Green, reporting an 11 year study of the Bighorn, cites three instances of observations of a cougar stalking or pursuing a group of ewes and lambs, The sheep successfully eluded the big cat on each occasion." Mr, Smith then wrote of the lack of predator hunters these days because of the good wages elsewhere, and went on to say, "From the standpoint of abundance of large prey - particularly deer - and the general difficulty in keeping total game numbers within range capacities, a moderate cougar population appears desirable, It must be considered, too, that a number of people hunt this animal primarily for sport; however, there should be no hesitation to destroy individual cougars whenever there are reliable reports of specific predation upon Bighorn herds."

John Russo made this statement in his 1956 writing; "Mountain lion predaciousness upon the Desert Bighorns is unknown. Only a few isolated animals reside in regions north of the Bill Williams - Santa Maria Rivers (Arizona). Occasionally, reports are received of lion sign or sight records in the southwest sheep ranges. Investigations of these by predator trappers invariably prove the animal to be a large bobcat."

We now come to the latest writing I was able to locate on this subject, and this is a statement from Buechner's 1960 Bighorn paper, He, like I, depended upon past writings and personal contacts for much of his information, His statement reads, "The only native predators likely to have real depressant effects on populations of Bighorn sheep are wolves and cougars, The former is gone from all of the Bighorn sheep ranges within the United States with the exception of Glacier National Park." I suspect this is not true of some of the

Desert Bighorn ranges near the Mexican border. Buechner continues, "The latter (cougars) remains in significant numbers on some ranges.,. One cannot be as positive about the effect of cougar predation on population levels of Bighorn sheep as with coyotes and golden eagles. However, it is known specifically that excellent populations of Bighorn sheep existed together with numerous cougars in the Guadalupe Mountains on New Mexico and Texas (Snow and Zemmerman, 1939), and it is generally evident from the journals of early travelers that Bighorn sheep were present in large numbers where they must have co-existed with cougars. By resorting to protective cliffs and extremely rocky habitat, Bighorn sheep seemed to have developed a pattern through which populations effectively avoided excess predation by cougars and wolves."

To sum up, and to present you with a few subjects for discussion, it is evident from the written work quoted that:

1. either there is little cougar predation on Bighorns, or few people who write know about it;

2. there may be "bad" cougars just as there *ate* "bad" bears, and killing the right one is a problem;

3. a good spread of water, which is not usually possible in our arid Desert Bighorn country, would be a benefit to Bighorns in more ways than one;

4. several writers stated that where predator control was established, Bighorn survival increased, while others noted no difference. I'm sure we can get a discussion going on that;

5. one thing is agreed upon by all persons quoted: lions will kill Bighorns; it seems to me that it is the *degree* to which they kill, and the influence the predation has on the total population which should concern us. Perhaps much more is known about the subject than has been written. I surely hope so!

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BIGHORNS AND GOLDEN EAGLES

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Predator-prey relationships are, at best, difficult to determine quantitatively or qualitatively and, as a matter of nature, differ with each new combination of environmental factors, Often premises, or statements taking a side of this facet of life history studies, are refuted or their effect nullified by equally factual or vociferous claims from the opponents; many times the statements are based on first hand accounts of predations, years of field experience, painstaking laboratory analyses all by people dedicated to the correct interpretation of nature's way.

One would expect that claim and counter-claim would bring, wer a period of time and catalogued information, an indictment or no bill against the predator (who is always the sinner). Often this is not the case, even after years of study. Economical aspects of predator activities may demand that more information, more time, be spent before facts can be sifted with conclusive results,

Perhaps one of the most spectacular and interesting predator-prey studies is that of the Golden Eagle, (Aquila chrysaëtos), and, to a lesser extent, the Bald Eagle, (Halieaetus leucocephalus), with the species which support them. The Bighorn has been relegated to its place on the eagles' dinner table more than once.

Does the Bighorn make provender for the golden eagle? Without doubt it does. Both animals share an overlapping habitat, and there are first-hand accounts of eagles attacking Bighorn young, Russo (1956) mentions an eyewitness account reported to him of eagles taking a lamb and cites references of predation among them. Kennedy (1948) reported on a golden eagle taking a Bighorn lamb. Jones (1950) cites references which showed that eagles take young and, in some instances, yearling Bighorns. Smith (1954) cites six occasions where eagles were seen swooping over or diving at Bighorns in Idaho during his study, but none of these attempts, if they could be called that, was successful. Mr. Groves, in a personal communication, stated that he, Dr. Cottam, and two others watched an apparently unsuccessful attempt by a pair of golden eagles to take a yearling Bighorn in the Pintwater Range of Clark County, Nevada, in the early 1950's. In the same letter he tells of a recent field report on April 22, 1960, of two bald eagles flushed from a freshly killed lamb in the Silver Peak Range, Nevada. The lamb's heart was still palpitating, and it was assumed the eagles had killed it.

Mr. Gale Monson, in another personal communication, cited a field report from a USF&WS employee dated March 3, 1959, wherein the remains of a lamb were found in Four Palms Canyon of the Kofa Game Range. "The remains were on top of a large rock and...showed much evidence of having been tom by a beak rather than chewed upon by teeth."

He went on to say, however, that there was no evidence to indicate the lamb had been killed by an eagle.

The Bighorn's cousin, the mountain *goat,* is subjected to eagle predation also, Brandborg (1955) tells an account of a bald eagle successfully taking and gliding away with *a* kid which he estimated WAS only a few days old and weighed less than seven pounds,

Undoubtedly, when one witnesses such attempts, it makes an indelible impression. In the early stages of amassing natural history data, the eyewitness accounts of eagle predation and the circumstantial evidence of feeding habits may have given more importance to this relationship as a depressing effect on Bighorn populations than later and more complete information would support.

Eagles are known to eat carrion or freshly dead animals which they themselves did not kill. In *fact,* one method of trapping eagles is to ring an animal carcass with steel coyote traps. This effective method is used in Northern Arizona in the winter when migrant golden eagles are present. 'Coyotes, killed with a cyanide gun and dead several days, make good bait. The traps are usually set around the carcass after the eagle has been seen feeding on it.

Inspection of golden eagle nests on Anderson Mesa, in the heart of Arizona's summer antelope habitat, has shown some evidence of antelope fawn ingestion; skeletal remains of young antelope were found at some of the nests, but in no case was a complete or near complete skeleton found, and in three consecutive summers of work no attempts on antelope by eagles were observed. Fawn carcass inspections and coyote predation seemed to indicate eagles were gleaning antelope remains but were not directly responsible for fawn losses. Possibly this carrion eating habit of the big birds helped label them important depressants of Bighorn in the minds of some of the early workers.

How does the eagle stack up now? Is he considered a serious limiting factor of Bighorn sheep populations? Most authors who have intensively investigated the status of the Bighorn sheep say not. Smith (op. cit.), speaking of declining Bighorn populations, states that "the bulk of the evidence indicates that a program of eliminating eagles would not be a panacea for our problems."

Jones (op. cit.) felt that high lamb and yearling survival in 1947 and 1948 in the Sierra Nevada Range suggested eagle predation on young was not regularly severe, even though eagles were regularly present in Bighorn habitat. Honess and Frost (1942) concluded on the basis of evidence gathered during their study that eagles could be exonerated of any serious blame for the Crystal Creek, Wyoming, sheep herd decline.

Murie (1944) examined 632 pellets collected from perches and nests in Dall sheep lambing areas and found a very low incidence of lamb remains in them. He stated, "In any event, whatever eagle predation exists, it is apparent that it would have no appreciable effect on the mountain sheep populations."

Personal communications with Janssen (1961) in California, Gross (1961), Ogren (1961), Laug (1961) in New Mexico, Groves (op. cit.) in Nevada, and Monson (op. cit.) in Arizona are consistent in that evidence of direct predation by eagles on Bighorn is lacking.

Dr. Buechner (1960), in his excellent monograph on the Bighorn sheep in the United States, reviewed eagle-Bighorn predation and summarized, "No matter how attractive depression of Bighorn sheep populations by eagle depredation may seem, the only conclusion from the available evidence is that such predation is incidental and does not control population levels."

Eagle predation on Bighorn, spectacular and emotionally appealing as it may be, is quite probably opportunistic and seasonal. Most substantiated accounts of attempts by eagles on Bighorn involve the young of the year. Sometimes yearlings or adults are attacked, but usually the lamb is found dead or seen struck down, which follows a basic concept of predation - that the young are more susceptible than the older, stronger, and wiser.

Latham (1951) discusses the fallacies of demonstrating seasonal food habits of predators as indicative of a year-long condition. This must surely be considered when speaking of the eagle-Bighorn relationship, taking into account the relatively short lambing period which occurs once a year.

The declining populations of sheep which instigated detailed investigations seem to have been caused by many different factors, some in combination, others directly. Some of the more outstanding, as listed by Buechner, are man's encroachment on habitat, deteriorating range, interspecific competition for forage (with wild and domestic species), lungworm infestation, and non-verminous acute pneumonia. In all these situations, the role of eagles and other predators has not been fully assessed and may never be. Dynamic, ever changing environmental structures offer little promise for "black versus white" statements concerning them. To be complacent about any predator-prey relationship is to make a mistake. Eagle predation at this time does not appear to be a serious limiting factor on Bighorn sheep populations. Still, as Russo (op. cit.) suggests, in isolated, low density, prey populations such as the Desert Bighorn exhibit, there is that possibility that eagle predation could seriously affect survival thresholds.

Eagle predation, even though it appears to be a minor limiting factor on Bighorn sheep at this time, should not be ignored. Continuous evaluation and re-evaluation of predation effects is a necessary job of the biologist if the same high standards of objective investigation which have yielded so much in the past are to be maintained.

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BIGHORN MANAGEMENT IN MEXICO

Luis Macias Arellano
(Translation)

On addressing you, I should refer to the prevailing conditions of wild life in Mexico, but treating on a special theme at this meeting I shall refer only to the Bighorn Mountain Sheep, mentioning the aspects that in my opinion give an idea of the situation of this species, what causes started it and the corrective measures that should be put into practice,

The administration of matters corresponding to the Bighorn Mountain Sheep has not been firmly inaugurated. I can say that the organization responsible to implement it, the General Hunting Administration, has been established only two years and although this does not justify the lack of adequate action, it is a calculation to be taken into account, Considering, nevertheless, the importance of protecting this species, that, at least in Mexico is in eminent danger of extinction', studies have been initiated to make known its actual condition in order to be in a position to recommend the pertinent corrective measures.

The investigations made by Dr. Bernardo Villa certainly suggest a discouraging situation. As he expressed it yesterday, in Coahuilia and Chihuahua the Bighorn can be considered extinct for all practical purposes, unless further investigations reveal some small groups in these areas. In Northwest Sonora, again referring to statements by Dr. Villa, the existence is known of small populations distributed the length of the Sierras of Pincate, Antimonia, El Viejo, Pozo Coyote and Johnson Peak. Unfortunately, these populations are very small,

On the peninsula of Baja California the work carried out by the biofogists Davilla and Zarur indicates that in the northern part, in that zone which is the actual state of Baja California, populations were also located in reduced numbers. Together they are estimated to be about five hundred (500) animals, Perhaps we should mention here that this number is probably lower than the actual numbers present and should be larger.

In the south of Baja California, territory of the same name, the lack of time last year impeded the investigation of Bighorn habitat, but the existence is known of some groups of animals, especially in the Sierra of La Ciganta.

This general panorama reveals to us a critical situation for the Bighorn and demonstrates the urgency of establishing vigorous corrective measures that would positively protect the present populations, The profit incentive suggests the opening of a short hunting season, limited to a reduced number of animals in a well controlled zone.

Analyzing the conditions which have caused the present

situation, one arrives at the conclusion that the critical condition of the Bighorn can be attributed in a definite manner to the action of the uncontrolled hunters, as a limiting factor, They have, in spite of a closed season in existence for a period of almost thirty years, continued to harvest the population, It is not strange here to mention the hunter since the General Hunting Administration attributes to the hunter the most energetic action and is considered the first factor that must be controlled. I do not believe that this assumption is wrong since the actual and former Bighorn populations have always lived in the same rocky mountains, with very little water and scant vegetation. This species is able to live there only because of its extraordinary resistance to its environment and its tolerance of dryness. In other words they live in an appropriate habitat which assuredly has a capacity of sustenance for a much larger quantity of Bighorn.

In this respect, therefore, the tendency of the administration will be to maintain unalterably the habitat for the Bighorn. Happily, apart from fires, there is no other danger that could modify the environment as commonly occurs in other regions where man exercises his actions to obtain other products that interest him, Agriculture and ranching are not possible here. This area is best suited for the production of animals for hunting, especially the Desert Bighorn and for this I believe preventing modification or destruction of the habitat will not constitute a grave problem,

While the problem of competition with domestic animals does not exist, predators could be a problem. There are no precise reports since the studies carried out can not be considered complete. It is easy--to suppose-that-there-might be-predators,-but I--do--not-venture to confirm it at this time. Without using a definite scientific basis, it is probable that this relation remains: predators are found in a naturally balanced environment unless later studies prove the contrary,

Definitely the practice of the administration will have to concern itself primarily in the precise knowledge of what is the actual distribution of the Bighorn populations that already exist and secondly, what number represents the actual population and how it is distributed. The first steps have already been taken, and as I said at the beginning, the studies of Villa, Davila and Zarur indicate that Bighorns now exist only in Sonora and Baja California, We also know in approximate form how the populations are distributed and approximately what number they represent, Based on this work, the project is already started of dictating dispositions that would modify the actual conditions in order to expedite a small number of licenses in places which can be controlled and under conditions yet to be determined.

This project also includes the implementation of a warden service that would allow control of the authorized hunters and prevent them from entering zones where the closed season shall persist, and also prohibit the furtive, illegal hunting that causes the major harm.

When this project is implemented, I am sure that a step forward will have been taken to conserve the Bighorn, this conservation, each day becoming more urgent,

Hermosillo, Sonora - April 5, 1961

THE TEXAS BIGHORN SHEEP TRANSPLANT

Tom D. Moore, Biologist
Texas Game and Fish Commission

Introduction:

No trapping was done for Bighorn broodstock on the Kofa Game Range in 1960 for it was assumed that the nine sheep (four rams and five ewes) on the Black Gap Area would produce sufficient numbers of lambs to get a nucleus herd started. From this herd the Texas Game and Fish Commission could begin to attain its original objective which is to restore the Bighorn sheep to some of its historical range in the state. The following is a brief account of what has happened to the Texas transplant since our last meeting in Las Cruces.

Survival and Lambing:

In early May of 1960 three lambs were born to two of the ewes. The twin lambs were, of course, a surprise. Our total population increased to 12. Meanwhile, three other ewes were observed several times each week but they had no young. Usually they stayed together, whereas the ewes having lambs isolated themselves as best they could in the 500 acre enclosure. The estimated ages of the lambs when first observed was about three days. Horn growth a few months later disclosed that two were males and one was a female. From then until now the lambs have done well, At this time they are almost the size of the adult ewes.

Our good luck was not to last long for on June 5 two adults, an old ewe and a 3-year old ram, suddenly died, having been located by circling vultures. The cause of death could not be determined for they were practically destroyed when found. Their deaths appeared related since they died about the same time and were only 300 yards apart. Previous observations of these sheep ruled out death from screw worms and there was no evidence of predator sign, At this time an intensive search was made for another dry ewe which had not been seen for several weeks. She was found dead, and except for scant remains, was destroyed by vultures,

In the opinion of Mr. Tom Allen, a poisonous plant expert of the Marfa Experiment Station, the sheep probably died from a mineral or a vitamin deficiency. A search of the enclosure revealed several species which could have caused death if eaten exclusively or in large quantities. But such plants are usually not eaten by choice, and with more than ample good forage available it appeared unlikely toxic vegetation would be taken.

Several weeks prior to their death the pasture was very dry and little green forage was available. A shortage of vitamin A could have caused death or perhaps a shortage of phospherous, or maybe trace minerals. Fortunately, good rains 'fell and green forage became available shortly thereafter. According to Allen, animals dying of

poisoning show signs of struggling before death but this was not found. Bone samples could not be thoroughly annlysed for mineral deficiencies without samples from healthy individuals. And since none were on hand the comparison could not be made. Rib and leg bones appeared normal to the casual observor.

Since the sheep had been eating small amounts from mineral salt blocks a diet deficiency was not suspected. The salt blocks were replaced with two 33-pound blocks of concentrate containing all the essential minerals plus vitamin A, Terramycin, and a salt content of 14 per cent. Within a week the sheep began to eat the concentrate and after six weeks the nine sheep had consumed both blocks. The recommended consumption is about 1/4 pound per day for a sheep which is about what they ate - or 66 pounds in 42 days.

With this particular feed there is a tendancy to overeat with harmful effects (Enterotoxemia); therefore, the blocks were weighed twice per week. The block used was named Moor Mann's, and its manufacturer at Quincy, Illinois, states that it is not a complete feed but a concentrate, and must be fed with pasture and/or roughage.

No more losses have occurred whether because of the green feed or the addition of the concentrate.

At the beginning of the spring lambing season this year there were three adult rams, three adult ewes, and three lambs or yearlings. On March 23 two more lambs were born to the two ewes which had lambs last year. We think the other ewe has, or will have, a lamb soon. Observations of the sheep can usually be made without going into the pasture by using binoculars.

Continuous predator control by a full time trapper has netted one mountain lion, 19 coyotes, four bobcats, and 42 gray fox in the past 12 months. Several mountain lion roamed through the Black Gap Area but were not caught. Twelve of the big cats were caught by Fish and Wildlife Service trappers within forty miles of the area. Frequent inspection of the seven-foot net fence is made and fresh batteries installed for the electric fence every two weeks. This hot wire is attached to the top of the regular fence. No predators have ever killed any of the brood sheep nor has any sign been found in the enclosure. In this respect we have indeed been fortunate.

In summary, we now have produced five lambs and have a total of 11 sheep. We now know that sheep will reproduce in our enclosure and that raising them is a much more satisfying experience than trapping them.

BLACKGAP AREA

BIGHORN SHEEP PASTURE

Poisonous Plants:

Conyza canadensis
Conyza coulteri
Solanum eleaguifolium
Baileya multiraidata
Agave lechaguilla
Psilostrophe tagentina
Gutierrezia microcephala
Nicotina trigonophylla
Notholaena sinuata var. cochensis
Centaurium calcosum

Grasses:

Cynodon dactylon
Tridens albescens
Tridens pulchellus
Tridens pilosua
Tridens mutica
Sorghum halapense
Trichachne californica
Pappophrum bicolor
Setaria leucopila
Sporobolus cryptandrus
Bouteloua ramosa
Bouteloua curtipendula
Panicum hallii
Heteropogon contortus
Muhlenbergia porterii

Forbs:

Dichondra argentea
Iresine heterophylla
Sida physocalyx
Aplopappus spinulosus
Dyssodia pentachaeta
Euphorbia albomarginata
Euphorbia antisyphilitica
Melapodium leucanthum
Penstemon harvardi
Houstonia angustifolia
Hymenoxys scaposa var. linearis

Forbs: (Cont'd)

Siphonoglossa pilosella
Castilleja integra
Chrysactina mexicana
Hoffmanseggia jamesii
Simsia calva
Linum aristatum
Lesquerella fendleria
Nama hispidum
Paronchia sessilflora
Evolvulus alsinoides
Croton fruiticulosus
Cassia bauhinioides

Woody:

Berberis trifoliolata
Aloysia ligustrina
Prosopic juliflora
Parthenium incanum
Acacia constricta
Acacia greggii
Zizyphus obtusifolia
Porlieria angustifolia
Selloa glutinosa
Leucophyllum minus
Dasylirion leuophyllum
Leucaena retusa
Larrea Tridentata
Jatropha spathulata
Viguiera stenoloba
Fallugia parodora
Fouquiera splendens
Ephedra triturca
Kameria grayii
Tecoma stans
Diospyros texana
Opuntia leptocaulis
Echinocactus horizonthalionas
Echinocactus scheerii
Echinocactus triglochidiatus
Buddleia marrubiifolia

(Compiled by Tom Allen, Marfa Experiment Station, Marfa, Texas)

BIGHORN SHEEP TRANSPLANTS AT THE HART MOUNTAIN NATIONAL ANTELOPE REFUGE

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Introduction:

Since the native California Bighorn Sheep (Ovis canadensis californiana) were exterminated on Hart Mountain, in Southeastern Oregon, around the turn of the century, two transplants have been made in attempts: to re-establish the Bighorn sheep in that area. The purpose of this paper is to briefly cover the historical aspects of Bighorn sheep in the area, to briefly discuss the two transplants, and to still more briefly review and summarize the entire Bighorn picture in Southern Oregon,

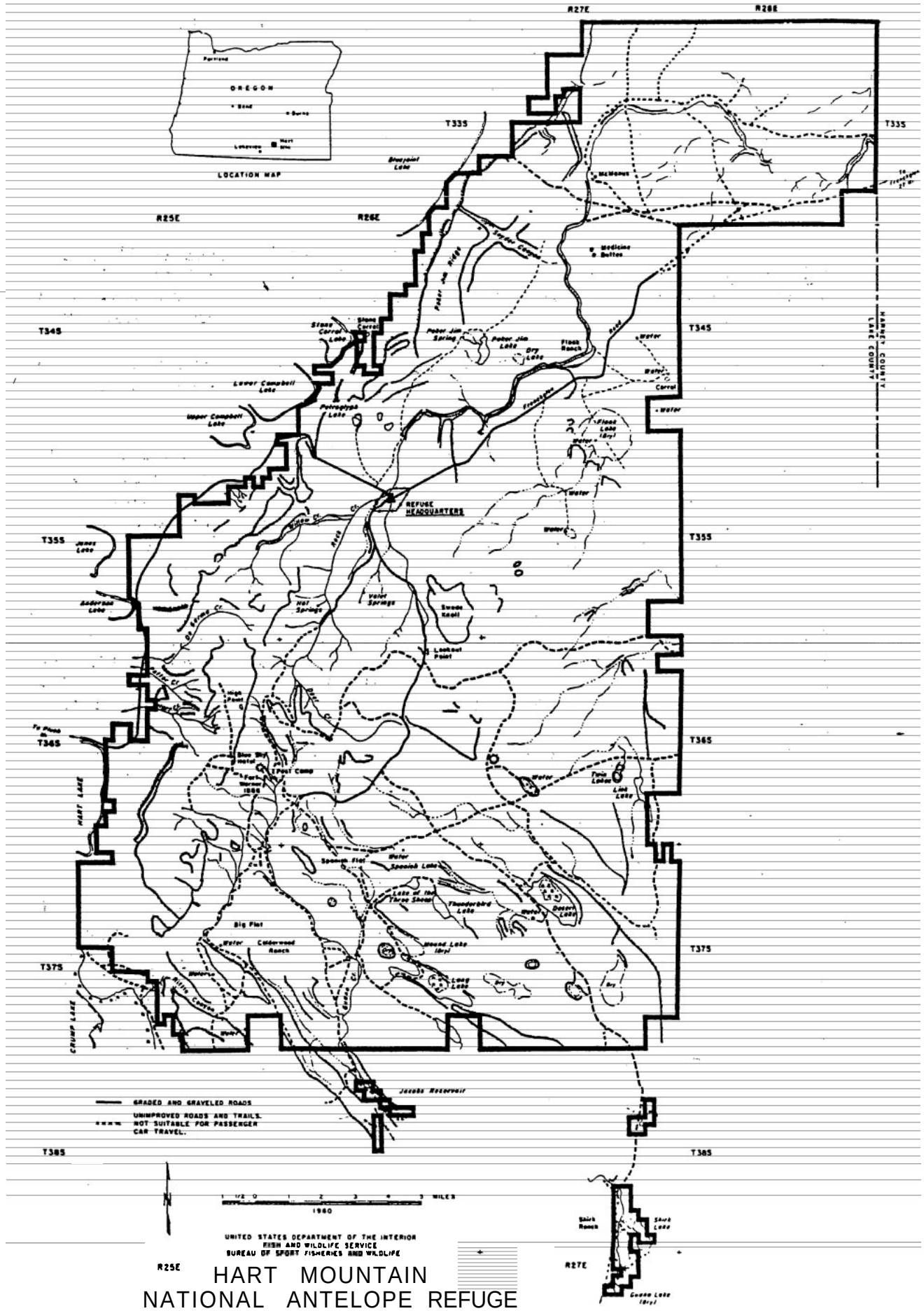
The material used in this paper came largely fran the files of the Hart Mountain National Antelope Refuge and the Oregon Game Commission. The data in Figure 1 was furnished by Mr. Frank Grogan, District Agent, Oregon Game Commission. The wholehearted cooperation of the Oregon Game Commission and the Refuge, which made this paper possible, is greatly and deeply appreciated.

My own part in the transplants has been a minor one in that I did not participate until the Oregon Game Commission transplant of 1954, when I made a report on the ecological aspects of the proposed Bighorn pasture site for the Bureau of Sports Fisheries & Wildlife. Since then my activity has been that of keeping a weather eye on the Bighorn to prevent harrassment by a curious public and to cooperate with the Oregon Game Commission on any phase of Bighorn study or management where my help was needed or desired. This relationship has been a friendly and interesting one, making it possible for me to retain my title of "Government Sheepherder."

Description of Area:

The Hart Mountain National Antelope Refuge was established in 1936 to provide protection to the fast-dwindling herds of antelope that many biologist, naturalists, and interested individuals at that time felt were faced with extinction, The 240,000 acres within the refuge were withdrawn from public lands or purchased from private owners. This refuge and the Charles Sheldon National Antelope Refuge and Range in nearby Nevada contain a portion of the winter and summer ranges of the antelope, and provide a suitable area for study and management.

Hart Mountain, which borders the west boundary of the Hart Mountain Refuge, is a massive volcanic block fault mountain rising from the surrounding valleys and plains to an altitude of 8,020 feet above sea level. The west side of the mountain is precipitous, ascending abruptly from the floor of Warner Valley in a series of rugged cliffs, steep slopes and knife-like ridges. The face of the canyon is cut by



HART MOUNTAIN
NATIONAL ANTELOPE REFUGE

LAKE COUNTY, OREGON

several steep, rugged canyons. The east side of the mountain, as is typical of block fault mountains, rises gently from the level plain west of Catlow Valley and Guano Valley,

The mountain proper is well watered with many springs, and the life zones extend from the hot semi-desert of the Upper Sonoran to the cool Canadian Zone in its sheltered canyons. Precipitation at the Refuge Headquarters has averaged 10.5 inches for a 13-year period, with most of the precipitation coming as snow during the winter. The headquarters, however, is in a rain shadow, and greater precipitation is found south of that point and also on the higher portions of the mountain that is Bighorn habitat.

The Bighorn habitat on the mountain contains numerous springs, seeps and streams, and the vegetation is quite similar to typical Great Basin flora and is abundant due to the terrain that has restricted livestock use.

Historical:

Information gathered from journals of explorers, fur trappers, personal interviews, and other sources by Vernon Bailey and recorded in his publication, "Mammals and Life Zones of Oregon," covers most of the material known of the historical background of the Bighorn sheep in Southeastern Oregon.

The California Bighorn Sheep, also known as the rimrock sheep or lava beds--Bighorn--appears once been a common resident of most of the canyons, buttes, small mountains and lava beds east of the Cascade Range in Oregon, with the exception of the high mountain area in the northeast corner of the state, where the Rocky Mountain Bighorn Sheep (Ovis canadensis canadensis) was once a common resident.

The California Bighorn Sheep held up in large numbers over its vast range in Oregon until about 1885, when the great decline set in. The last stronghold of the sub-species appears to have been the Steens Mountains and Hart Mountain, about 65 airline miles to the west of the Steens. On the old maps of the area, Hart Mountain is called the Warner Mountains. Bailey records statements of old timers in the Hart Mountain area that indicate the Bighorn were once as abundant as the antelope, and that in 1890 a party of surveyors on Hart Mountain used Bighorn for camp meat. The last record of Bighorn sheep on Hart Mountain was about 1912, and 1911 was the last record for the Steens Mountains,

Of interest are the stories told by the early Indians of hunting Bighorn on horseback when they were in the sagebrush valleys crossing from one mountain to another. Early Pahutes Indians claimed the Bighorn in the Steens Mountains migrated in winter west to Warner Valley and Summer Lake, and east of the Steens to the great Alvord Playa. From old horn fragments picked up in recent years, we have also been able to deduct a movement from the Steens South into the connecting Pueblo Mountains, then west into McGee Mountain, Big Spring Table and the Hell Creek breaks in Nevada, which are now on the Sheldon Antelope Refuge and Range.

It borders on the ironical that the state from which came the type species collected and named by Douglas in 1826 should be one of the first areas in which the animal became extinct.

Causes of Decline:

Hunting, denuded ranges, disease and winter kill have been advanced by the old timers as reasons for the decline and extermination of the California Bighorn Sheep in Oregon. Vernon Bailey is rather emphatic in placing the blame on scabies that the wild sheep contracted from their domestic brethren. Bailey also stated that on good range the wild ewes will often raise twins, so he may be as amiss in his first statement as he is in his last one.

Regardless of cause or causes, we can assume, without too much fear of contradiction, that the coming of the white man marked the beginning of the end for the two types of Bighorn sheep in Oregon. Either directly or indirectly he destroyed that great natural resource in Oregon just as he destroyed the heath hen, the passenger pigeon, the buffalo, and other species of wildlife on his march from the Atlantic to the Pacific.

Restoration: The 1939 Transplant.

It was a quarter of a century after the last Bighorn was reported in the Hart Mountain country that man began to foster the idea of replacing them in their former habitat. Early in 1936 W. O. Harriman, the Supervisor of the Fremont National Forest with headquarters at Lakeview, Oregon, sold his idea of Bighorn restoration on Hart Mountain to a group of sportsmen in Lakeview. Burt K. Snyder, president of the group, appointed Mr. Harriman as chairman of a committee to investigate the possibility of obtaining Bighorn sheep for release on Hart Mountain.

Harriman soon aroused the interests of Stanley G. Jewett, biologist with the old Biological Survey in Portland, and Dr. Ira N. Gabrielson, the Chief. The only available Bighorn available from Federal sources at that time was a herd at the National Bison Range in Montana, where frequent poaching and other causes had necessitated placing them in an 800-acre pasture near the center of the Bison Range. This herd of Rocky Mountain Bighorn were not thriving well and had a heavy incident of pasturella pneumonia among the animals, so the decision was made to move them to the Hart Mountain Antelope Refuge where ecological conditions appeared to be more ideal, and it was hoped that the Bighorn would show improvement in health and numbers.

On September 26, 1939, 23 Rocky Mountain Bighorn sheep were released at the mouth of Hart Canyon on the west side of Hart Mountain. The sheep had been brought from the National Bison Range in a flat-bottom truck covered with a tarp. Partitions had been made so that the sheep were divided into small groups to avoid trampling and piling up. They survived the trip in good condition.

The history of the 1939 transplant is one of disappointments.

In poor flesh and poor health, five of the Bighorn died soon after being released. Not long afterward a ram died in a pothole of water in Warner Valley. The sheep were prone to wander into the valley bottom and to roam over extended areas so that keeping accurate watch and records of their numbers and activities became an acute problem. Reproduction appeared low. One record of a golden eagle killing a lamb was made. The sheep were observed to continue coughing after their release, so pasturella pneumonia may have continued to take a toll as it had in Montana.

As the sheep decreased in numbers they became separated from each other and wandered over larger areas. One old ewe spent two vinters with domestic cattle in Warner Valley. A ram and a ewe were reported in the vicinity of Poison Creek, below Abert Rim, about 20 miles to the west of Hart Mountain.

In 1943 efforts were made to get two additional rams and two ewes to add new life and numbers to the dwindling herd. Again in 1945 efforts were made to obtain additional animals from the Desert Game Range in Southern Nevada, but World War II curtailed this attempt. The last written report of this transplant is of a lone Bighorn ram on Poison Creek in 1947, It is assumed that the herd officially ceased to exist soon after that.

Nothing remains of this transplant but an occasional Bighorn skull found on Hart Mountain and the material in the refuge files gathered during the project. These files are of interest to anyone concerned with Bighorn sheep, recording factual data on food habits, breeding, lambing, predation, disease, and other factors. Unfortunately the material is too bulky to include in this paper.

The failure of this transplant should not be layed to planning or management. Qualified veterinarians and other observers of the sheep were of the opinion that the majority of them would have died from poor health even if they had remained in Montana. We may be prone to criticize the transplanting of unhealthy animals, but as they appeared doomed in their Montana environment, there was a possibility, however remote, that in a more favorable habitat they may have survived and increased. Unfortunately they did not.

Planning: The 1954 Transplant.

In 1950 the Oregon Game Commission entered negotiations with Dr. James Hatter of the British Columbia Game Department regarding the possibility of obtaining California Bighorn sheep for transplanting to Southern Oregon. Correspondence was carried on regarding details until 1953.

In 1952 interested-individuals also began action to restore Bighorn sheep to the Hart Mountain rimrocks, In April of that year, Francis Lambert of Portland, Oregon wrote the Secretary of the Interior regarding the obtaining of Nelson Bighorn sheep (Ovis canadensis nelsoni) from the Desert Game Range in Nevada for transplanting on Hart Mountain. He was assured by the Secretary that if he could obtain the

cooperation of the Oregon Game Commission and the Nevada Fish and Game Commission, the Department of Interior would cooperate fully on such a project.

In July 1952, Mr. Lambert addressed 370 members of the Order of the Antelope at their annual meeting on Hart Mountain and obtained many offers to assist on a Bighorn transplant to the mountain. This received considerable attention in the newspapers of the state, who were probably unaware of the preliminary negotiations then underway with British Columbia by the Oregon Game Commission. As the plans of the Game Commission assumed more definite possibilities of fulfillment, it appears that the plans of Mr. Lambert were abandoned,

The Oregon Game Commission plans passed the letter writing stage in September, 1953. At that time three sites were considered for a Bighorn transplant. They were the Owyee Reservoir perimeter, the Steens Mountains, and the Hart Mountain Antelope Refuge. The Refuge was selected on the basis of a favorable site for a holding pasture, harrassment from deer hunters would be limited, and access to the area is somewhat controlled. The Department of Interior favored the project, and a memorandum of understanding was drawn up between the two agencies. The Bart Mountain Refuge Bighorn pasture was to be primarily a reservoir of breeding stock, with surplus animals being used to re-stock other Bighorn habitat.

In November 1953, personnel of the Oregon Game Commission made a trip to the Jack Moon Ranch, 26 miles west of Williams Lake in British Columbia. A trap site was located and construction details were discussed. In December of the same year, Commissioner Frank Butler of British Columbia sent an official letter to the Oregon Game Commission, offering to furnish 25 California Bighorn Sheep, with trapping and transportation costs to be paid for by the Oregon Game Commission.

The project was moving rapidly now. In January 1954, Pittman-Robertson Project No. W - 44 - D - 1 was prepared that would make Federal money available under the Federal Aid to Wildlife Restoration Act. Robert U. Mace was to be the project leader and A, V. Meyers the coordinator. This project was approved by Director Phil Schneider on March 3, 1954. Under this project the Federal Aid Branch of the Bureau of Sports Fisheries and Wildlife was to furnish $17,359.44 of Pittman-Robertson money and the Oregon Game Commission was to furnish $5,786.48 to complete the estimated $23,145.92 needed to bufld the holding pasture for the Bighorn at Hart Mountain Refuge. It is my understanding that the wages of Norman Minnick, Asst. Project Leader, and the cost of trapping and transporting the Bighorn were also paid by the Game Commission.

In February 1954, I was detailed from the Desert Game Range in Nevada to the Hart Mountain Refuge by the Bureau of Sports Fisheries and Wildlife to examine the Juniper Canyon site that had been selected by the Oregon Game Commission as the place for the Bighorn pasture. This pasture was to embrace slightly over 600 acres of rough, broken terrain on the west side of the mountain. My report on the ecology of

this area was favorable in respect to factors necessary to insure adequate, suitable habitat for Bighorn sheep. Soon afterward a temporary holding pasture of approximately 34 acres was started in Juniper Canyon by Mr. Minnick. This was completed in July.

In the meantime the Oregon Game Commission was busy clearing the way for bringing Bighorn sheep from Canada into the United States. Clearance with customs were necessary to allow the Bighorn to enter duty free, Arrangements were made for a veterinarian to examine the animals in Canada to ascertain that they were healthy. A certificate from the U. S. Council in Canada was needed, and other details of this part of the project kept cropping up until the Bighorn were over the border.

Trapping and Transportation:

By October 1954, the trap at the Jack Moon Ranch was completed and being baited with salt, hay, dairy feed, sheep pellets, cabbage, and other enticements. By November most green feed on the range was dry, and the Bighorn began to show more interest in the lures within the trap. The raw cabbage appeared to be a favorite of the animals.

The tripping mechanisms on the two gates were fixed to drop when a blasting machine set off dynamite caps that severed a small rope holding the gates open at both ends of the trap. Both gates were devised to drop simultaneously, The blasting machine was located 600 yards from the trap. Snow fence wings were also installed to guide the sheep into the trap.

Approximately 100 Bighorn sheep were ranging in the vicinity of the trap, and on November 4 British Columbia game biologist Lawson Sugden dropped the gates on 28 Bighorn sheep. The Oregon Game Commission was notified the same day, and personnel left that evening with a one-ton GMC flatbed truck with a double deck rack. The double deck rack allowed 40 inches of headroom on each level and proved to be adequate for the purpose,

At 11 a.m. on November 6, personnel of the two game departments commenced loading the Bighorn, A number were loaded by driving them into a V-shaped wing along the inside of the fence and handling them to the truck, about 50 feet away, where they were loaded and ear tagged, Rams refused to enter the wing and were roped. In the process of loading, three Bighorn broke their necks in the trap fence or died of exhaustion and probably shock, Of the 25 Bighorn loaded five died before the truck returned to Williams Lake, 26 miles from the trap site.

The loss of eight animals casts no reflection on the personnel involved, as trapping and transporting Bighorn sheep was largely a new experience to all of them, Trapping losses have accompanied most of our transplanting efforts in many areas with species of big game, so is not new or unknown. We are aware in this audience that Bighorn sheep are prone to this type of loss from exhaustion and shock.

In evaluating the experience, personnel of the Oregon Game Commission were of the opinion that future losses could be reduced or eliminated by building a small board corral along the fence inside the trap and herding the animals into it before attempting to load, They felt this would reduce injury and exhaustion, In 1950 and 1961 they did use this method of capturing Bighorn within the Hart Mountain pasture and transported 11 to the Steens Mountains without trapping or transportation loss. They also recommended that the rams be handled first, as they were the most nervous and excited the other animals, Speed in handling and loading was considered very essential, My experimental trapping and transporting of Bighorn at Desert Game Range almost a decade ago prompted me to make similar conclusions at that time. Recommendations on transportation given by the Oregon Game Commission included adequate ventilation, with two-inch spaces between the boards on the truck, and keeping the animals on their feet until their respiration rate returned to normal.

The truck left Williams Lake at 6 p.m. on November 6 and arrived,. with very few stops. enroute, at Hart Mountain Refuge at 1:30 p.m. on November 8, . The sheep survived the 36-hour trip from the trap site to Hart Mountain in very good condition, standing when the truck was on rough roads and down when the road was smooth, They were docile enroute, but rapidly became wild and unapproachable when released, The animals released were classified as one 6-year-old ram, three 6-year-old ewes, three 5-year-old ewes, four 4-year-old ewes, two 3-year-old ewes, five ewe lambs, and two ram lambs,

Fence Construction:

The construction of a 34-acre temporary holding pasture for the Bighorn at Hart Mountain has been mentioned. Construction details of this fence are similar to those of the larger fence, so will not be discussed. The purpose of the small pasture was to hold the Bighorn until the larger pasture could be constructed,

Construction of the large pasture fence was started in March 1955, and completed in July, A total of 4.65 miles of Hart Mountain, enclosing approximately 626 acres, The work was contracted, costing $14,676.32. Materials and incidental costs amounted to $8,396.99 for a total of $23,073.31. The large fence was located so that the smaller enclosure would be inside along the west fenceline and could be used in connection with future trapping activities within the large pasture.

Specifications on the large pasture fence called for 11-foot treated cedar or juniper posts to be set one rod apart with rock jacks as needed. Postholes were to be approximately 3-feet deep, Two widths of woven wire were specified, with the bottom width 47 inclies high and the top width 32 inches high. One strand of barbwire was required at the bottom end two strands at the top, giving a total height of 8 feet. Wire used was typical heavy gauge hog wire.

Life History Notes - Supplemental Feeding:

From the time the Bighorn were placed in the 34-acre temporary

holding pasture until they were released into the 626-acre pasture on July 26, 1955, they were given supplemental rations of sheep cubes, good grade alfalfa, hay, and salt. The sheep cubes and hay were fed daily, and took pressure off the natural forage within the holding pasture. The sheep thrived on this type of supplemental food and were in very good flesh when released into the larger pasture. No damage was done to the natural ground cover within the holding pasture that averaged less than two acres per sheep for the approximate eight months they were in there.

Lambing:

Host or all of the mature ewes brought to Hart Mountain were bred before leaving British Columbia. On April 10, 1955, the first lamb was observed in the small holding pasture. Lambing continued over a three-week period, and eight lambs were born to the 12 ewes classified as mature: The following year the lambs began to appear about two weeks later than in 1955, and the lambing pattern has been fairly regular since then.

The ability of animals to adjust the oestrual cycle and the subsequent parturition season when moved to environments different than that they were raised in and established an oestrual cycle in has been demonstrated many times. This is probably Nature's way of assuring that the offspring are born at a period favorable to survival.

Domestic ewes bred in England and shipped to Australia, where the seasons are reversed, lambed in winter the first year, but from then on gave birth to lambs in the Australian spring, Similar changes have been noted with North American wild sheep at the San Diego Zoo and other areas.

Mortality:

During the period 1954 - 1961 there were known losses of four lambs, four ewes, and three rams for a total of 11 Bighorn. Probable causes of these mortalities have been established in six instances. One lamb died of an inverted intestine and another lamb died of a steptococcus infection of the navel cord. One ewe died of a broken neck when she rammed the fence, and another carcass of a ewe was found with a lamb fetus inside. She might have died during parturition, One ram was found caught by the horns in the large pasture fence as he was apparently attempting to return inside from the outside. One ram skull was examined that showed deterioration of the bone covering one part of the brain. This could be attributed to a tumor or Gid bladder worm (Coenurus cerebralia).

Parasites:

Examination of fecal samples while the Bighorn were in the small holding pasture showed evidence of intestinal round worm ova. Efforts were made to treat the sheep with phenothiazine capsules, but due to the wildness of the animals it was abandoned after treating one yearling.

Shock:

All of us who have handled Bighorn sheep know how susceptible they arc to shock. Rams appear to be especially so, with young lambs the least affected, During the trapping operations at the Hart Mountain pasture in November 1960, one ram got caught in the fence, fought the fence, fought the trappers, fought the truck, fought a lamb placed in with it, fought sticks poked in the truck, and remained in an angry belligerent mood until released an hour or so after capture. As this waa the breeding season, that may have had something to do with this individual's apparent immunity to shock of any sort, We might look for this in our work to ascertain if the breeding urge has any effect on lessening the shock tendency,

Movements After Releases:

Releases of Bighorn sheep have been made from the Hart Mountain pasture to Hart Mountain and to the Steens Mountains, 65 airline miles east of Hart Mountain. Movement records obtained by Mr. Grogan on the Hart Mountain releases are as follows:

3 rams - 30 miles south of Hart Mountain pasture,
1 ram - 30 miles east of the Hart Mountain pasture at Beatty Butte,
2 ewes - 40 miles south of pasture in Long Valley, Nevada.
2 rams - 50 miles south of pasture at Dismal Swamp, Warner Mountains.
6 rams - 60 miles south of pasture in Ft. Bidwell area, Warner–Mountains:

Of the four Bighorn sheep released in the Steens Mountains in November, two ewes and a lamb were seen near the Alvord Ranch, below the release point,

Regarding the Hart Mountain releases, the rams seem to be doing most of the extracurricular traveling; however, they have not been seen far afield during the breeding season and probably returned to Hart Mountain at that time, Our own experiences have shown that it is not uncommon for rams to move over considerable distances on the desert, even from mountain range to mountain range, during' portions of the year.

Resume Of The Protect:

It is my opinion that the Oregon Game Commission is to be commended for a well-planned and well-executed program of Bighorn restoration that has the appearance of an unqualified success. The data in Table 1 indicates that the Bighorn from British Columbia have made a satisfactory adjustment at Hart Mountain and have made a satisfactory increase in numbers with limited losses during the 1954 - 1961 period, The increase has been sufficient to allow establishment of the Bighorn outside the pasture on Hart Mountain and the beginning of transplanting operations to another former favored Bighorn habitat, the Steens Mountains, This has taken place during a period of slightly more than six years.

YEAR	HART MTN. BIGHORN PASTURE							HART MTN. RELEASE							STEENS MTNS. RELEASE				GRAND TOTAL
	E	R	L	UNCL.	SUB-TOTAL	LOSS	TOTAL	E	R	L	UNCL.	SUB-TOTAL	LOSS	TOTAL	E	R	L	TOTAL	
November 1954	12	1	7		20	0	20												20
1955	16	4	8		28	1 E 2 L	25												25
1956	17	8	11		36		36												36
1957	23	13	14		50	18 Re 11 Es	21				29	29	1 L	28					48
1958	13	8	6		27	1 E.	26							28+					54+
1959			6	26	32	1 R 5 Es	26				28 5	33+	1 R	32+					58+
1960	13	13	6		32	1 L 1 R 4 Re	26	15	7	10	4	36+	2 E	34+	2	1	1	4	64+
March 1961				32	32	7 Re	25							34 +	5	5	1	11	70 +

E. – Ewe
R. – Ram
L. – Lamb
Re. – Released
Es. – Escaped

TABLE 1 – SUMMARY OF HART MTN. BIGHORN SHEEP PLANT 1954–1961
(Compiled by Frank Grogan, Dist. Agent, Ore. Game Comm.)

FIGURES DO NOT REPRESENT ABSOLUTE TOTAL NUMBERS.

The grand total of numbers for March 1961 is 70-plus Bighorn. This figure accounts only for known animals recorded during infrequent intervals and does not take into consideration normal increases for 1958 and 1959 outside the Bighorn pasture at Hart Mountain, I have discussed population increases with Mr. Grogan, who has had the closest contact with the Bighorn, and it is our opinion that an estimated increase from 20 to 90 Bighorn sheep is not out of line.

More complete information could have been acquired had someone been detailed full time to the Bighorn from the time of their release inside the pasture in 1954. It is doubtful, however, if the additional information obtained would outweigh the added expense, from a management standpoint; Game Commission and Refuge personnel all have a personal interest in this Bighorn project and have devoted enough time to it to detect fence line breaks, count Bighorn, note forage conditions inside the pasture, find mortalities, check lambing, and other factors necessary to an understanding of the progress of the project,

When we examine the age classes of the animals released into the Bighorn pasture in 1954, we can assume that there will soon be a loss of aged animals in greater proportions than in the past. The 4, 5 and 6-year-old age classes in 1954 will now be past their prime and starting into old age. This is a normal loss to be expected, and after they axe gone there should be a period of less loss due to age until the new generation of animals reared at Hart Mountain enter the same advanced age class,

If additional information is desired beyond what I have given on the 1939 and 1954 transplants, it can be acquired by writing the Refuge Manager, Sheldon-Hart Mountain Refuges, Lakeview, Oregon, or the Oregon Game Commission, Portland, Oregon,

VEGETATION ZONES OF THE TERRITORY OF BAJA CALIFORNIA IN RELATION TO WILD LIFE
(Translation)

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In the months of January and February of 1958, the author had the opportunity of studying the biological conditions of lower **Baja** California. He participated in the Geographical & Biological exploration that **was** organized by The **Mexican** Society of Geograph and Statistics under the direction of the Geographer, Angel **Bassols Batalla.** The results of that exploration were published at the end of the same year. (2) That which is presented here is a concrete study of the distribution of twenty-four species of mammals in the vegetation zones, analyzing the ecological conditions.

Thanks is given to the Biologists Jose Angela **Davila Cardenas** and **Ticul Alvarez** for their assistance in identifying the wildlife material under consideration.

Biotic Zones:

Because of its great length, narrowness, orography, and orientation, the peninsula of **Baja** California presents special biological conditions which help to distinguish it. The endemic study truly reflects these conditions. Orographically, Baja California is transected by a mountain range that divides it into two watersheds; the Pacific Ocean and the California Gulf, both slopes having different ecological conditions. The former gradually slopes to the sea with wide plains; the latter in contrast, is abrupt because of the nearness of the sea to the mountain range, The extreme south of the peninsula, because of its location, presents tropical shading (neotropical zone) that contrasts it with the dryness of the rest of the territory (neo artic zone). Finally the regions of more than 1,500 meters above sea level over the mountains is characterized by a moderate, wooded, humid climate.

In conclusion, one can say that the territory of **Baja** California has the following five biotic zones:

1. **Arrid** zone of the Pacific
2. **Arrid** zone of the California Gulf
3. Arrid zone of the Mountain Range
4. Tropical zone of the extreme south
5. Moderate humid wooded zone of the regions of more than 1,500 meters above sea level.

Based on the study of the flora, we have been able to form sub-zones that correspond exactly with the above named vegetation zones being much better ecologically characterized. The distribution of wildlife, especially the mammals, agrees with the sub-zones.

Vegetation Zones:

There has been considered seven vegetation zones. They are: (1) 'Viscaino Desert (2) Magdalena Desert (3) Gulf Desert (4) Central Desert (5) Tropical deciduous forest (6) Evergreen Oak forest (7) Pine-oak forest. The first two correspond to the "Arrid zone of the Pacific," the third to the Arrid zone of the Gulf, the fourth to the "Arrid zone of the Mountain Range," the fifth to the "Tropical zone of the extreme South," and the last two to the "Moderate humid wooded zone,"

The study of the flora is based in great part on the work carter (3,4), Goldman (5), Johnston (6), Shreeve (10), and the observations and collections of the author (2). In Table No. 1 the.distribution of the sixty flower maps studied has been placed after the seven vegetation zones.

Viscaino and Magdalena deserts are characterized by sandy plains and mists; the latter caused by humid winds combing the Pacific Ocean, thus favoring the development of numerous epiphytes, such as lichens (Ramalina Reticulata on the Viscaino Desert and Rocella Tictorea on the Magdalena) and bromeliaceae (Tillandisia Recurvata).

The Central and Gulf Deserts present uneven orography. The first is characterized by the rocky areas of volcanic origin and it is typical of the western part of the mountain range. The second is formed by the short eastern water shed. Both lack the mist and for that reason they don't have epiphytes. The dry conditions are more marked in the Central Desert than in the Gulf.

The tropical deciduous forest is confined to the extreme south territory (Cape Region) and extends toward the north behind the mountain range to parallel 27. Its vegetation is very similar to that which exists on the coasts of Sinaloa, Nayarit and Jalisco.

The evergreen oak forest and the pine-oak forests are confined to the high parts of the mountain range, especially to the Sierras of La Laguna and the Giganta, at an altitude of 1,500 Meters above sea level. It is notable that the pine-oak forest exists only in the Sierra of La Laguna.

Mammal Species Considered - Ecology and Distribution:

Of all the fauna of Baja California only twenty-four species of mammals have been considered. All of them were observed in the field and some were collected. The taxonomical and ecological studies are based on the work of Alvarez (1), Leopold (8), and Martin and associates (9).

The twenty-four species studied belong to the genera; Ovis, antilocapra, Odocoileua, Lynx, Felis, Canis, Vulpes, Urocyon, Bassariscus, Spilogale, Taxidea, Dasypus, Silvilagus, Lepus, Perognathus, Dipodomys, Peromyscus, and Neotoma. In Table No. 2 they are noted according to the distribution that follows the seven vegetation zones, specifying the abundance or scarcity of the same,

The first nine genera are, from the cinegetic point of view, the most important. Of these, the first six are becoming extinct due to man, but this isn't true of the Canis, Vulpes, and Urocyon that seem favored by the anthropogenetic conditions. According to ecology there can be formed four types of habitats which are: (1) Plains (Viscaino and Magdalena Deserts); (2) Rocky Mountain areas (Central and Gulf Deserts); (3) Wooded Tropical areas (Tropical deciduous forest) and (4) Moderate wooded areas (Evergreen oak and Pine-oak forests). In the plains, species of the following genera are common: Antilocapra, Canis, Vulpes, Urocyon, Bassariscus, Dasypus, Spilogale, Silvilagus, Lepus, Perognathus, Dipodomys, and Peromyscus. In the Rocky Mountain areas you find Ovis, Felis, Spilogale, Lepus and Neotoma. In the Tropical Forests Odocoileus, Felis, Bassariscus, Dasypus, Taxidea and Peromyscus. Finally in the Temperate Forests you find Ovis, Felis, Bassariscus, Perognathus, and Neotoma.

From the point of view of numbers of species and of individual animals (qualitative appreciation), the arrid zones and the tropical zones are the best (see table No. 2 and the map of the vegetation zones). The number of species now existing in each vegetation zones are noted on the map, having the following relation; Biscaino Desert, 15 species; Magdalena Desert, 17 species; Gulf Desert, 13 species; Central Desert, 15 species; Tropical Deciduous Forest, 13 species; Evergreen Oak Forest, 5 species; and Pine-Oak Forest, 3 species.

Summary:

The distribution of 24 species of mammals in the vegetation zones of Lower California is discussed. First the biotic zones are analysed and related to the seven vegetation zones proposed and distribution of 60 species of flowering plants in the zones are written down (Table No. 1).

The 24 species of mammals are studied briefly in relation with the flora, their ecology and distribution (Table No. 2)-(they belong to the following genera: Ovis, Antilocapra, Odocoileus, Lynx, Felis, Canis, Vulpes, Urocyon, Bassariscus, Spilogale, Taxidea, Dasypus, Silvilagus, Lepus, Perognathus, Dipodomys, Peromyscus, and Neotoma.

A map with the vegetation zones with the number of the species of mallals studied is enclosed. The number obtained were: Vizcaino Desert, 15 species; Magdalena Desert, 17 species; Desert of the Gulf, 13 species; Central Desert, 15 species; Tropical deciduous forest, 13 species; Oak Forest, 5 species and Pine-oak Forest, 3 species.

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TABLE NO. 1

DISTRIBUCION DE LAS FANEROGAMAS EN LAS ZONAS VEGETALES DEL TERRITORIO DE BAJA CALIFORNIA.

	ZONAS VEGETALES						
	1	2	3	4	5	6	7
Acacia farnesiana	X	X	X	X	X		
A.brandegeana			X	X			
Agave nelsoni	X	X					
A.shawii	X						
A.margaritae		X					
Atriplex spp.	X	X	X				
Albizzia occidentalis					X		
Arbutus peninsularis						X	X
Bursera microphylla			X	X	X		
Castela peninsularis					X		
Calliandra californica				X	X	X	
Cercidium spp.	X	X	X	X	X		
Cyrtocarpa edulis			X		X		
Dodonaea viscosa			X		X	X	
Encelia farinosa			X	X			
Erythrina flabelliformis					X		
Ficus palmeri					X		
Fouquieria peninsularis	X	X	X	X	X		
Gossypium spp.			X	X			
Idria columnaris	X						
Ibervillea sonorae			X				
Jatropha angustidens					X		
J.cinerea	X	X	X	X	X		
J.spathulata			X	X			
Karwinskia humboldtiana			X	X			
Larrea tridentata	X	X	X	X			
Lemairocereus thurberi	X	X	X		X		
Lycium spp.	X	X	X	X			
Lysiloma candida		X	X		X		

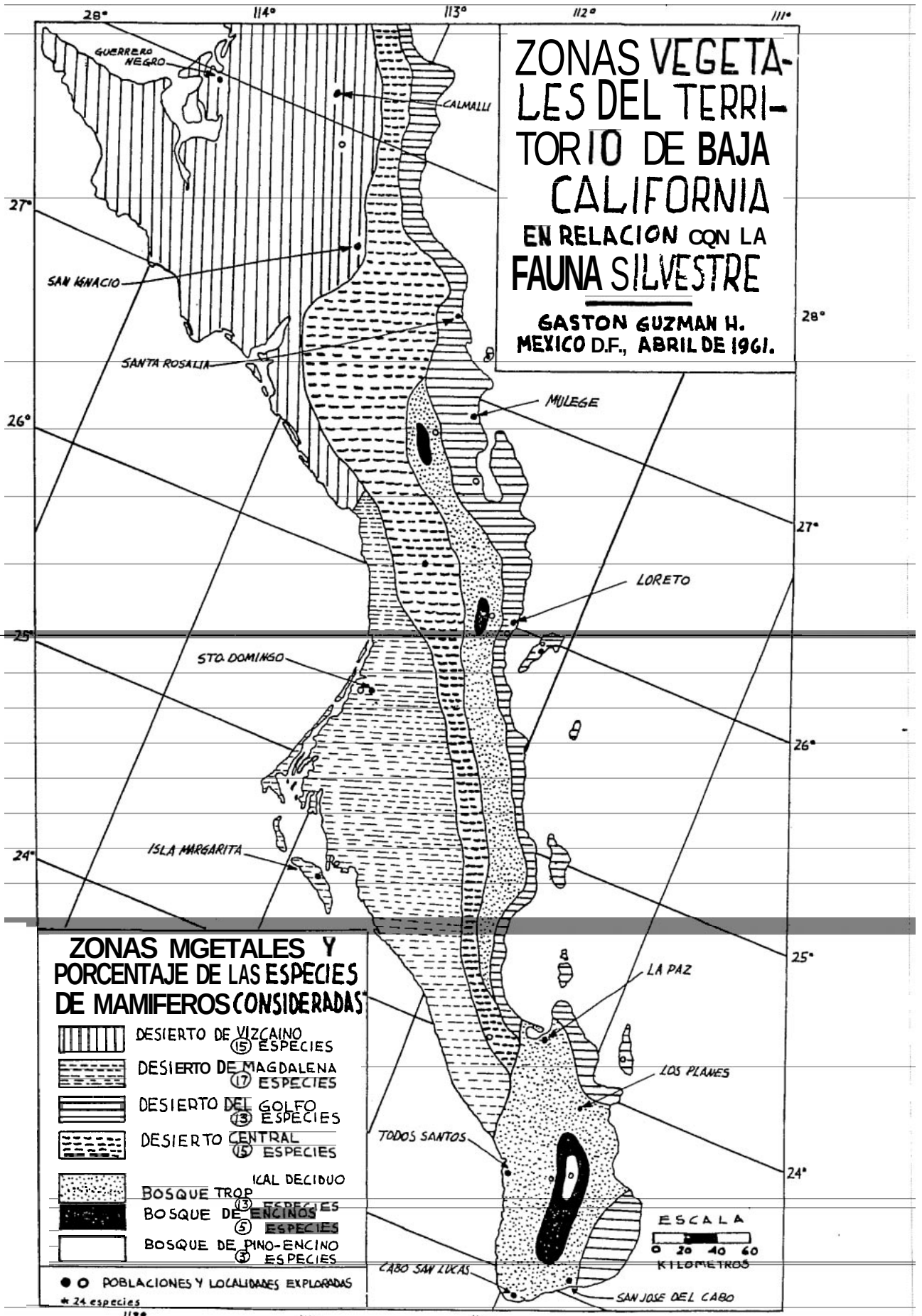
	ZONAS VEGETALES						
	1	2	3	4	5	6	7
Machaerocereus eruca		X					
M.gummosus	X	X	X	X	X		
Neolina beldingi						X	X
Notholaena aura						X	X
Opuntia cholla	X	X	X	X	X		
O.clavellina			X	X			
O.bigelovi			X	X			
Olneya tesota	X	X	X	X			
Pachycereus pringlei	X	X	X	X			
P.pecten-aborigenum					X		
Pachycornus discolor	X						
Pedilanthus macrocarpus	X	X	X	X	X		
Pinus cembroides							X
Plumeria acutifolia					X		
Pithecollobium dulce			X		X		
P.mexicanum			X		X		
Prosopis juliflora	X	X	X				
Populus monticola					X		
Quercus devia							X
Q.tuberculata						X	X
Q.reticulata						X	
Q.oblongifolia						X	
Sebastiana bilocularis	X	X	X				
Salix bonplandiana	X	X	X	X	X		
Simmondsia californica					X		
Tecoma stans			X	X	X		
Turnera diffusa					X		
Viscainoa geniculata	X	X	X				
Yucca valida	X						

DISTRIBUCION DE LAS ESYECIES DE MAMIFEROS CONSIDERADAS, EN LAS ZONAS VEGETALES DEL TERHITORIQ DE HAJA CALIFORNIA.

	ZONAS VEGETALES						
	1	2	3	4	5	6	7
1. Ovis canadensis, "borego silvestre"	X	-	XX	XX	X	XX	XX
2. Antilocapra americana, "berrendo"	XX	-	-	-	-	-	-
3. Odocoileus hemionus, "venado bura"		-	-	XX	-	-	-
4. Lynx rufus, "gato montés"	-	-	-	-	XX	-	-
5. Felis concolor, "león"	-	-	X	X	XX	XX	X
6. Felis onca, "tigrillo"	-	-	-	-	XX	-	-
7. Canis latrans, "coyote"	XX	XX	X	X	X	-	-
8. Vulpes macrotis, "zorra"	XX	XX	-	-	-	-	-
9. Urocyon cinereoargenteus, "zorra gris"	XX	XX	XX	X	X	-	-
10. Bassariscus astutus, "cacomixtle"	X	X	X	XX	XX	X	X
11. Spilogale gracilis, "Zorrillo"	XX	YY	XX	XX	X	-	-
12. Taxidea taxus, "tlalcoyote"	-	X	X	X	XX	-	-
13. Dasypus novemcinctus, "armadillo"	XX	XX	X	-	XX	-	-
14. Silvilagus auduboni, "conejo"	XX	XX	XX	XX	-	-	-
15. Lepus californicus, "liebre"	XX	XX	XX	XX	X	-	-
16. Perognathus bailegi extimus, "ratón de abazones"	X	XX	-	X	-	-	-
17. Perognathus arenarius ambiguus, "ratón de abazones"	XX	X	-	-	-	-	-
18. Perognathus arenarius albus, "ratbn de abazones"	-	XX	-	-	-	-	-
19. Perognathus spinatus peninsulae, "ratón espinoso"	XX	XX	XX	XX	X	-	-
20. Dipodomgs merriami brunnsis, "rata canguro"	X	X	XX	X	-	-	-
21. Peromyscus eremicus eva, "ratón de campo"	X	XX	XX	X	X	X	-
22. Yeromyscus maniculatus margaritae, "ratón de campo"	-	XX	-	-	-	-	-
23. Neotoma lepida ravida, "rata de campo"	-	-	-	XX	-	X	-
24. Neotoma lepida pretiosa, "rata de campo"	-	XX	-	XX	-	-	-

1. DESIERTO DE VIZCAINO
2. DESIERTO DE MAGDALENA
3. DESIEHTO DEL GOLFO
4. DESIERTO CENTRAL
5. BOSQUE TROPICAL DECIDUO
6. BOSQUE DE ENCINOS
7. BOSQUE DE PINO-ENCINO

XX abundantes
X escasos


ZONAS VEGETALES DEL TERRITORIO DE BAJA CALIFORNIA
EN RELACION CON LA FAUNA SILVESTRE
GASTON GUZMAN H.
MEXICO D.F., ABRIL DE 1961.
GUERRERO NEGRO
CALMALLI
SAN IGNACIO
SANTA ROSALIA
MULEGE
LORETO
STO. DOMINGO
ISLA MARGARITA
LA PAZ
LOS PLANES
TODOS SANTOS
CABO SAN LUCAS
SAN JOSE DEL CABO
28°
27°
26°
25°
24°
114°
113°
112°
111°
110°
ZONAS MGETALES Y PORCENTAJE DE LAS ESPECIES DE MAMIFEROS CONSIDERADAS
DESIERTO DE VIZCAINO (15) ESPECIES
DESIERTO DE MAGDALENA (17) ESPECIES
DESIERTO DEL GOLFO (13) ESPECIES
DESIERTO CENTRAL (15) ESPECIES
ICAL DECIDUO
BOSQUE TROP (13) ESPECIES
BOSQUE DE ENCINOS (5) ESPECIES
BOSQUE DE PINO-ENCINO (3) ESPECIES
POBLACIONES Y LOCALIDADES EXPLORADAS
* 24 especies
ESCALA
0 20 40 60
KILOMETROS

METHODS OF EXAMINING BIGHORN SHEEP FOR PARASITES

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Buechner (1960) and Honess and Winter (1956) listed 34 species of parasites as having been recorded from Bighorn sheep. These parasites are listed in the accompanying table, which shows their scientific and common names and their locations on or in the host animal. Seven of these parasites are arthropods, which are found on the skin or in the nasal cavity. The remaining 27 species are internal parasites. Thirteen of these are roundworms, five are tapeworms, eight are protozoa, and one is of uncertain classification, Although this information is valuable, we still have a long way to go before we know everything we need to know about the parasites of this host. We still need more information about geographical distribution of the various species of parasites, their incidence in different herds of Bighorn sheep, the conditions under which they are able to maintafn themselves in this host, and the extent to which they cause parasitic disease,

Significant additions to our present knowledge can be made by increasing the amount of collecting that is done for diagnostic purposes in the field. The purpose of this paper is to outline methods that may be helpful to those who are interested in this endeavor. There are essentially two major phases of this procedure: (1) The observation and collection of specimens in the field, and (2) the examination of the specimens and diagnosis of the condition and the identification of the parasites in the laboratory. The first phase can be carried out by any layman having a bit of curiosity and with only a very small amount of equipment and a general knowledge of the gross appearance of the organs of a normal healthy animal, The second phase requires special training and equipment usually not available to the average field worker.

Sane information about parasitic infections in these animals can be obtained from examining fecal specimens, Gross examinations of the fresh feces may sometimes reveal characteristic segments of adult tapeworms, Microscopic examinations of fecal pellets in the laboratory provide information about the kinds and numbers of worm eggs and coccidial oocysts being gassed by the donor animal. The information so obtained is useful only in revealing the presence of mature parasites that produced the reproductive elements found in the feces. It does not tell us anything about the number of immature parasites or about those not living in the digestive or respfratory systems of the host. To obtain the best results from such an examination, the fecal specimens should be collected when freshly passed, If they cannot be examined immediately they should be kept on ice or in a refrigerator until they can be prepared for laboratory examination, This is done by mixing the feces with various solutions for the purpose of separating the eggs from the fecal material so that they can be seen, identified, and

counted. The prepared specimens are then examined with the microscope. Although it is necessary to examine fresh feces for eggs of the parasites present in the gastrointestinal tract, living lungworm larvae have been recovered from fecal specimens that were subjected to drying for many months.

We can get our most reliable information about parasitic conditions by examining a freshly killed animal, and by properly preserving the blood samples, parasites, and affected tissues that are removed from it. Precise diagnosis of the condition and of the parasites encountered in the animal can only be made if the collected specimens have not been allowed to deteriorate, The order in which the various examinations should be made is as follows: Blood smears should be taken promptly after the animal dies so that the blood cells do not lose the characteristics they had in the living animal. Only clean slides should be used. One of the greatest difficulties in making satisfactory blood smears is to make the film thin enough, The tendency is to try to put too much blood on the slide, A drop of blood no more than two or three millimeters in diameter will be sufficient if spread on the slide, Blood smears are examined at high magnification for the presence of parasites and the smear must be thin enough so that the substage lighting of the microscope will penetrate through the film of blood. It is sometimes helpful to have smears of peripheral blood as distinct from heart blood, and also smears of tissues other than blood, such as bone marrow, spleen, kidney, and liver, Such smears should be allowed to dry thoroughly in the shortest possible time, The slides, if at all possible, should then be immersed in absolute methyl alcohol for a few minutes, and again thoroughly dried,

A sample of blood may then be collected in a small vial and saved for serological tests such as that used to diagnose brucellosis, The cells are not important in these tests because only the serum is used, but the blood should not be allowed to deteriorate to any great degree, Small vials of blood may be preserved by putting them in an ice chest or refrigerator. If this is not feasible, one or two drops of chloroform added to each vial of blood will help retard decomposition,

Although arterial worms (filariids) have not been reported from Bighorn sheep, these parasites should be looked for if at all possible. According to Kemper (1957), the sites of predilection for the adult arterial worms in domestic sheep are the carotid, iliac, and mesenteric arteries; they may also be found in the heart, The specimens measure from 6 to 12 centimeters in length. One of the most effective and practical ways of examining for these parasites is to cut the animal's throat and to strain the escaping blood through hardware cloth or ordinary window screen, The worms are separated from the blood in this manner and may be found on the screen, The ends of the carotid arteries are exposed when the head of an animal is severed, Starting at these ends, the arteries should be slit in both directions and examined for worms, Domestic sheep that harbor arterial worms often show extensive skin lesions on the head, but a similar condition has not been observed in deer that harbor these parasites,

The next step is to scerch for external parasites. The entire

surface of the body should be examined carefully for ticks, mites, and lice. Mites, lice, and young stages sf ticks may be hard to find because of their small size, but sometimes they produce lesions or scabs which will identify their presence, By moving the palm of the hand and the fingers gently over the surface of the skfn, one can often detect ticks and/or lesions that are hidden under the hair coat. Examine the inside of the ear for ear ticks; these may occur at such a depth in the the ear canal that they can be discovered only by severing the ear at its base and examining the areas exposed by this procedure.

External parasites may be preserved in 70 per cent ethyl alcohol or 10 per cent formalin. Ticks may be preserved in the dry state, but mites, lice, and head grubs are best placed in a liquid preservative. The surfaces of the eye and under the eye lids should be examined for roundworms of the genus Thelazia. Look for enlarged joints, skin lesions, and other pathological conditions which might occur on the outside of the animal. If these are present, collect and preserve samples of the affected parts, If feasible open the head with a saw, heavy knife, or hand axe in such a way as to expose the nasal cavities and any head grubs which might be present,

The animal is now ready to be eviscerated. This is best accomplished by placing the animal on its back and making an incision extending all the way from the anterior end of the neck to the anus. The sternum should be split or sawed in such a way that the body cavity can be made to stand open, Starting with the anterior ends of the trachea and the esophagus, incisions should be made which will enable one to remove all of the viscera including the rectum, After evisceration, the walls of the pleural and peritoneal cavities should be examined for adhesions and other evidence of pathologic conditions. Large roundworms known as abdominal worms may be present in the body cavities and can be seen easily with the naked eye, Bladderworms may also be found free in the body cavity, but they as well as abdominal worms frequently adhere to the viscera,

A convenient first step in the examination of the viscera is to open the heart and look for arterial worms in the chambers and for tapeworm larvae, which might be encysted in the wall of the organ. The latter may be no larger than a grain of wheat. These same stages may occur in the diaphragm and in the skeletal muscles so that it is well to make several incisions in these organs to rule out their presence.

The lungs may be examined next, The surfaces should be carefully examined for slightly raised, circumscribed areas which may contain adults and larvae of lungworms. These areas are usually somewhat lighter in color than normal lung tissue, Other species of lungworms may occur only in the bronchial tubes; therefore, these structures should be slit open and examined, Lungs should be examined for abscesses and other abnormalities. The liver is frequently the site of abnormalities and parasites, The superficial bile ducts should be opened and examined for tapeworms and lives flukes. The latter are leaf-shaped and dark brown in color. The two species of tapeworms that occur in the bile ducts also may be found in the duodenum adjacent to the point where the common bile duct empties into the small intestine.

The esophagus should be opened and the wall examined for gullet worms; these are closely associated with the lining of the esophagus but are easily seen with the unaided eye. The rumen, reticulum, and omasum may be examined but sheep usually do not harbor parasites in these organs.

Several species of roundworms may be found in the abomasum and in the small and large intestines. Since many of those are microscopic in size, it is best to examine these organs where laboratory facilities are available. In practice the contents of the organs are emptied out, diluted with water, and screened in such a way that the parasites are recovered. Small parasites are searched for with the aid of a microscope. Usually a sample of known volume in relation to the total quantity is taken for microscopic examination. In this manner an estimate of the total number or parasites present can be made. The walls of the abomasum and intestine also must be examined carefully and any worms present included in the count.

All worm parasites may be preserved in the alcohol or formalin solutions used for external parasites, but their identifications will be expedited if the solutions are heated almost to the boiling point before being added to the worms. Blocks of tissues for histological studies are best preserved in Bouin's solution or in 10 per cent formalin. It is highly desirable to limit the size of each block to a maximum of one-half centimeter; this limitation promotes rapid penetration of the tissues by the preservative. Also, it is helpful to renew the preservative at intervals during the first day or so. Ordinary powdered borax also is satisfactory as a preservative if used in sufficient quantity. It has the advantage of being convenient to carry in the field. Whole sets of viscera, or parts thereof, may be preserved for parasitological examination by freezing or by adding 10 per cent formalin. The latter method should be used only as a last resort because formalin makes the material extremely hard to handle.

The final step is the identification of the various species of worms present. This must be done by a person trained in parasitology, especially in helminthology.

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A LIST OF PARASITES RECORDED FROM BIGHORN SHEEP

Scientific Name	Common Name	Location
Oestrus ovis	Head grub	Nasal cavity
Dermacentor albipictus	Winter tick	Body surface
Dermacentor hunteri		Body surface
Dermacentor venustus	Rocky Mountain Wood Tick	Body surface
Otobius megnini	~ ~ h o eae tick	Ear
Psoroptes equi	Psoroptic mite	Body surface
Sarcoptes ovis	Sarcoptic mite	Body surface
Haemonchus contortus	Large stomach worm	Abomasum
Ostertagia circumcincta	Medium stomach worm	Abomasum
Ostertagia occidentalis	Medium stomach worm	Abomasum
Ostertagia marshalli	Medium stomach worm	Abomasum
Pseudostertagia bullosa		Abomasum
Nematodirus abnormalis	Thread-necked wonn	Small intestine
Nematodirus spathiger	Thread-necked worm	Small intestine
Cooperia oncophora	Cooperia	Small intestine
Oesophagostomum sp.	Nodular worm	Large intestine
Trichuris discolor	Whipworm	Large intestine
Skrjabinema ovis	Pinworm	Large intestine
Protostrongylus stilesi	Lungworm	Bronchial tubes
Protostrongylus rushi	Lungworm	Lung parenchyma
Cysticercus tenuicollis	Bladderworm	Body cavity
Moniezia benedeni	Broad tapeworm	Small intestine
Moniezia expansa	Broad tapeworm	Small intestine
Thysanosoma actinioides	Fringed tapeworm	Bile ducts and duodenum
Wyominia tetoni		Bile ducts and duodenum
Eimeria ah-sa-ta	Coccidium	Small intestine
Eimeria arloingi	Coccidium	Small intestine
Eimeria crandallis	Coccidium	Small intestine
Eimeria faurei	Coccidium	Small intestine
Eimeria granulosa	Coccidium	Small intestine
Eimeria intricata	Coccidium	Small intestine
Eimeria nina-l ehl-yakimovi	Coccidium	Small intestine
Eimeria parva	Coccidium	Small intestine
Sarcocystis tenella	Sarcosporidium	Muscles

HUNTING SEASONS IN MEXICO
(Translation)

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1. Analysis of the results of a total and permanent closed season on the Bighorn Mountain Sheep and Berrendo in Mexico.

The reasons for establishing the permanent closed season on Bighorn Mountain Sheep and the Berrendo in Mexico are principally the excessive manner in which they were being hunted and their eminent danger of extinction. The punishments that should be imposed on the violaters of the law are established in the same declaration.

Without question the ordinance was prudent and would have produced the desired results, that is to say the increase of the species in a few years, if it had been carried out with appropriate enforcemen .

It is conservatively calculated that nearly one-hundred Bighorn sheep and Berrendo are killed anually on the Peninsula of Baha California and in the State of Sonora, which results in approximately 4,000 animals killed in the last 40 years.

The law was violated and the undeniable proof of this is seen in the expensive trophies and col ions of the many hunters in Mexico and other countries, and in the almost total extinction of the Berrendo in the State of Baja California.

I had the pleasure of attending the fourth meeting of the Council in Las Cruces, New Mexico, U.S.A. in April of last year and found that since 1959 the authorities, being in their third year of presiding, have granted only one permit for the collection of scientific specimens for the Museum of Natural History in Guadalajara, Jalisco.

Due, among other things, to the rickety budget under which the Director General of hunting operates, it has been impossible to make wildlife surveys that would permit the appropriate administration of hunting as a renewable natural resource. Thanks to the negotiations made by the acting Under-Secretary of the Branch, it was possible last year to make the first study of the Bighorn Mountain Sheep population in Lower California, counting also on the economic help of the Governor of that state.

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While the Director General of Hunting is not making technical surveys in the rest of the states, the closed season on these two species must continue. It is not so with the Mountain Sheep in the State of Baja California which I judge are much too susceptible to excessive and uncontrollable hunting due to the absolute lack of enforcement. This consequently causes the loss of receipts not collected by the treasury, that without doubt would have paid enough for a rational administration and the realization of wildlife studies.

The Mountain Sheep area on the Peninsula extends to the mountains, washes and canyons more or less near the coast of the Sea of Cortez or Gulf of California approximately between parallels 24.5° and 32.5° north lattitude.

Based on the study taken in Lower California, I am able to make the following recommendations:

1. Abolishment of the permanent closed season established for the Mountain Sheep of Cimarron in the State of Baja California, but not so with the rest of the country where the closed season should continue until technical studies are made that might justify their elimination. This measure should remain conditioned on and guaranteed by a body of well prepared and salaried game wardens, and with ample facilities to be able to enforce the ordance. The closed season should also remain in effect for the Berrendo.

2. A temporary closed hunting season on Mountain Sheep in the area between Mexacali and San Felipe.

Due to, among other reasons, the accessibility of the area, the illegal slaughter of sheep takes place at all seasons of the year. This presents a critical condition for the species, and if immediate action is not taken, they could be classified in danger of extinction. This is due principally to the impact of man. The conditions are favorable for the re-establishment of a sheep population. With the assurance that the temporary closed season is properly observed, the area could be opened to hunting again in a few years.

3. The opening of a hunting season for Mountain Sheep in the area called Arroya de Matoni and Cerro Canelo, state of Baja California.

Due to the rugged and extensive territory that comprises this zone, its unequaled feeding conditions as habitat for the sheep, and the direct and indirect surveys already made of its existence, I have thought that this area might support a hunting season, This would be conditioned upon the issuance of a limited number of permits for mature male animals, on a set date, and with the guarantee of enforcement and absolute control of guides and Big Game Hunters.

4. Establishment of refuges for Mountain Sheep in the zones known as "La Botica," "Sierra de Las Animas," and "Paredones," State of Baja California and "Puerto Escondido," South Territory.

a. The "Botica" zone is comprised of the area bounded by the unncessible peaks of the Sierra de Calamajue. The extensive dry lagoons and the Sea of Cortez. It remains practically isolated and the only access to it is by way of the sea, which is made at the Bay of San Luis Gonzaga and the Bay of Los Angeles. The enforcement could be carried out with limited personnel that live in the area itself, or by control of the major points of departure.

b. Sierra de Las Animas and Paredones-Extensive zones that include a series of Mountain ranges divided by wide sandy plains. The enforcement could be established at the bay of Los Angeles or with two permanent posts at the foot of the Sierra de Las Animas and another in the place called Paredones.

c. Puerto Escondido-Combines exceptional conditions for a natural refuge. The western limits consist of an important mountainous boundary. The only access is through the canyons of Tecomaja and Tabor in the lower regions and higher up by way of the ranches called "El Peloteado," "La Higuera," and "El Parral." The eastern limits are small ranges of hills and on the north, the coast. To the south are found narrow private entrances and exits. Two Game Wardens would suffice to guarantee the vigilance and conservation of such an interesting area.

Recommendation for the Branch of Enforcement for the Mountain Sheep Zone of Sonora and the Peninsula of Baja California.

a. An extensive publicity campaign carried out to give the people an understanding of the value of the wildlife as a renewable natural resource and particularly the species such as the Bighorn Mountain Sheep that stand-in-danger-ofdi appearing because of the misuse by the people themselves. The misuse such as the hunting of the females and the lambs, the use of small arms that only wound the animal, the commercializing of the meat, etc. At the same time explain catagorically the crime committed by the violators and the punishments imposed by the Federal Hunting Laws.

b. Soliciting the collaboration of all of the authorities, civilian, military and federal to the end that they might assist the General Hunting Board in their programs of administration and conservation of wildlife.

c. Repeating the final orders to the authorities, civilian and military, state laws as well as federal, that they cease from dispatching hunting licenses. Such authority should be exclusively under the General Hunting Administration by way of its corresponding offices.

d. Considering that the Mountain Sheep zone in the state of Sonora consists approximately of the mountains situated to the north of Bahia Kino, from "Pico Johnson" to "Tinajas Altas" in the southernmost extreme of the state and considering that the normal base of

departure for hunters, resident aad foreign, is generally the cities of Hermosillo, Bahia Kino, or from Sonoita and Nogales to Caborca, it is recommended that permanent enforcement be established in Bahia Kino, Caborca, Puerto Libertad, and a mobile enforcement group that periodically patrols the area.

The means of departure that the hunters, both resident and foreign use, in this grandiose and extensive territory are most varied. Large areas are accessible by land travel such as the area between Mexicali and San Felipe that have excellent asphalt highways and local roads or dry wash beds that run into it. Other areas are only accessible by sea as in the area called "La Botica" leaving from chartered embarcations in the Bays of San Louis Ganzaga and Los Angeles. As occurs with the "Mechudo" and neighboring mountains, in the South Territory in which the hunter generally departs from La Paz. Air travel is utilized in other cases. Numerous towns such as Santa-Rosalia, Loreto, Muleje, etc. have very good airports and even guide service, well versed in the terrain.

Permanent Ranger Stations are recommended for the Port of San Felipe, Bay of San Louis Gonzaga and the Bay of Los Angeles and a mobile patrol that patrols periodically and aids the fixed posts. Thus, in relation to the State and Territory, the major points of enforcement would be in La Paz, Loreto, and Santa Rosalia.

ARIZONA BIGHORN SHEEP HUNT HIGHLIGHTS

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Arizona's ninth consecutive and third increased permit hunt was held from December 2-11. Eighty permits were issued this season, an increase of 15 over the year before, Two areas were opened for the first time, these being Arizona Game Management Units 39 and 40, with 15 permits, and a portion of the Kofa Game Range, with five permits. (See Map.) Units 15 and 16 were combined for this hunt as they were in 1958 and the total number of permits decreased from 20 to 15. All other areas and permit numbers remained the same as for the 1959 hunt.

Because of the increase in areas and number of permits, the number of checking stations was increased from two to four. The new stations were in Gila Bend and Yuma, fairly close to the newly-opened areas. The other *two* stations were in Salome and Kingman, as they had been in past hunts, These checking stations are used to gather hunt results, biological information, and, where the operator is familiar with the area, help the hunter get into sheep country.

This year, for the first time, a restriction was placed on nun-resident sheep hunters as to the number who could participate each year. This was to be not more than 102 of the total number of permits issued.

All 80 hunters were in the field and 24 of them took trophies for a hunter success of 30%. This was .6% below the hunter success of last year and 10.8% below the nine-year average of 40.8%.

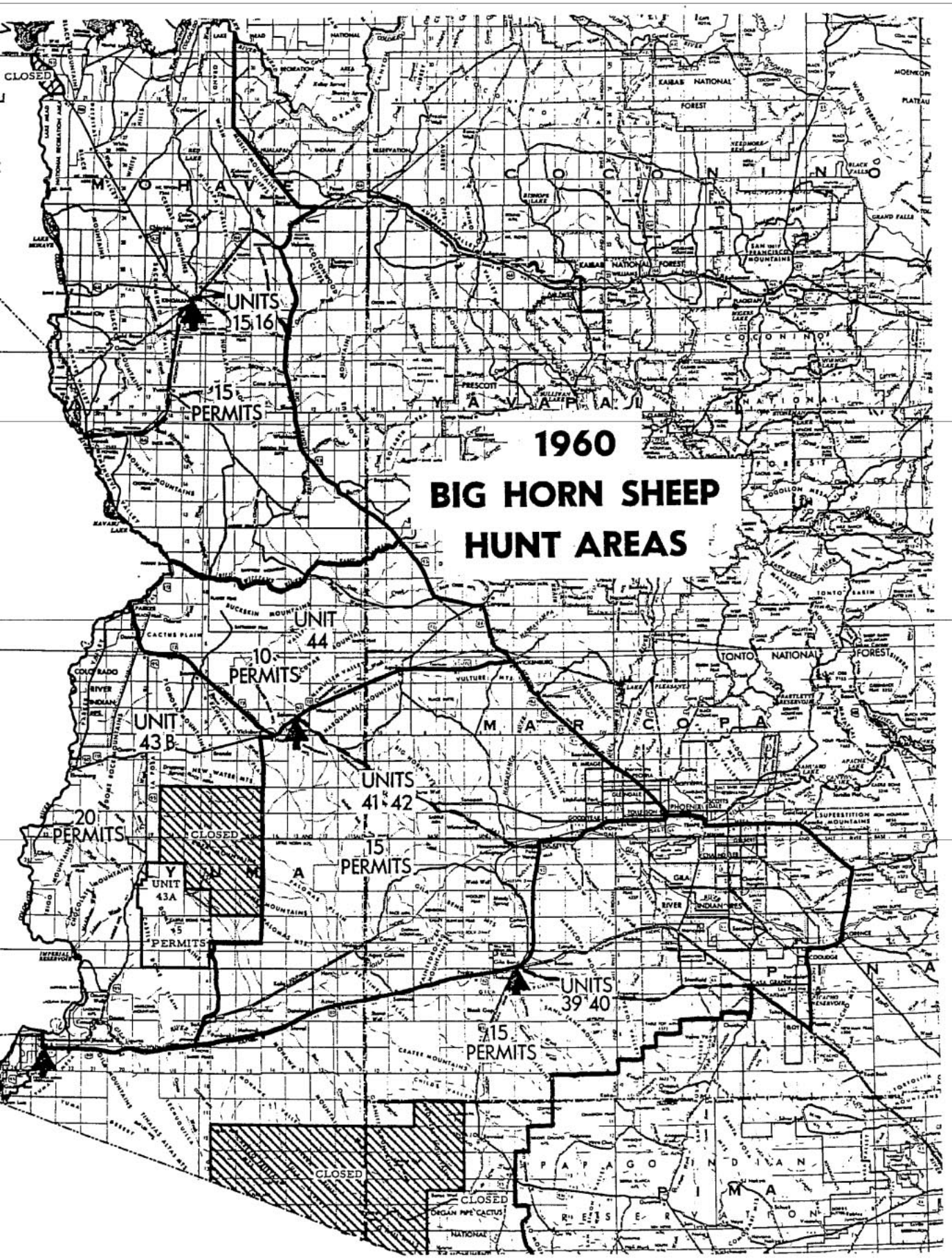
Hunter success by area varied from zero, for the five hunters who hunted the open portion of the Kofa Game Range, to 53%, for Unit 39-40. A11 of the hunters in the latter area hunted in Unit 39. No hunter went into Unit 40, which is an Air Force and Marine Aerial Gunnery Range usually accessible only on weekends.

Unit 15-16, where per cent of success has been above average during the three seasons it has been open, was 4.2% above the long-term average this year for a 472 success.

In Unit 41-42, 13% of the 15 hunters took two sheep. This was *one* sheep less than last year, when the success was 20%.

In Unit 44, success was down to 40% from 30% the year before, although four sheep were taken each year, the difference being made by two more hunters who participated this year.

Unit 43b has been open for all nine seasons and for the first six was the only area open. Twenty permits have been available each year. In 1958 when the permits were also good in Units 41 and 42, 15 of the hunters hunted in 43b. Per cent of success in six of the nine


1960
BIG HORN SHEEP
HUNT AREAS
UNITS 15, 16
15 PERMITS
UNIT 44
10 PERMITS
UNIT 43 B
20 PERMITS
CLOSED
UNIT 43A
15 PERMITS
UNITS 41 & 42
15 PERMITS
UNITS 39 & 40
15 PERMITS
CLOSED
CLOSED
ORGAN PIPE CACTUS
NATIONAL
MOHAVE
COCONINO
NATIONAL FOREST
YAVAPAI
MARICOPA
PINAL
PAPAGO INDIAN RESERVATION
PIMA
TONTO NATIONAL FOREST
KAIBAB NATIONAL FOREST
PRESCOTT
PHOENIX
COLORADO RIVER INDIAN RES.
GILA RIVER INDIAN RES.
SAN CARLOS INDIAN RES.
SUPERSTITION MOUNTAINS
CASA GRANDE
FLORENCE
DOUGLAS
GRAND CANYON
PLATEAU
MOENKOPI
WARD TERRACE
BLACK VALLEY
SAN FRANCISCO MOUNTAINS
MOGOLLON MESA
MESA VERDE
TONTO BASIN
CLOSED

hunts has been below average. This year the success was 15%, which was 10% above last year's 5% success. Observation of sheep by hunters was considerably greater this year with 84 sheep sightings by hunters. Twenty-one of these were legal rams and 14 of them had a full curl (Table 1). While there are so many variables to figure on these sightings that they cannot be used for management purposes, they can be compared as to number seen and hunter success from season to season (Table II).

After nine seasons, the sheep population in the area has remained relatively stable, according to information gathered on surveys.

The largest trophy head this year measured 100-2/8 and the smallest 68-2/8, with an average of 90-3/8. Four sheep had horns with a basal circumference greater than 15 inches and an outside of 34 inches or greater. One of these had a spread of 23 inches.

Weights of 14 field-dressed sheep ranged from 80 to 140 pounds, with an average of 117.2 pounds. This average weight was heavier by 3.2 pounds over last year. Only 14 of 20 sheep could be weighted this year while last year 16 out of 19 sheep taken were weighed and would present a more accurate average weight of all sheep taken.

With expanded hunts and more personnel involved, hunter- and supervisory-wise, less accurate detailed information is obtained. Arizona hunts have progressed beyond the research stage, but we still don't know all that we should about management and the role that hunting plays in it. Arizona hunts have probably been on the conservative side so far and over-all success has been good. Units, 15, 16 and 44 have had a good harvest for three seasons, and it will be interesting to find out in the next two to three years whether this remains so or follows the pattern of Unit 43b and drops to some extent.

There is still room for expansion in area and number of permits but I don't think a chance to gain useful information should be sacrificed to increase hunts and cut operating costs.

TABLE I

BIGHORN SHEEP OBSERVED BY ALL HUNTERS, 1960 SEASON

UNIT	TOTAL BIGHORN	TOTAL LEGAL RAMS	TOTAL WITH FULL CURL	TOTAL ILLEGAL
15–16	148	15	4	17
39–40	71	17	11	15
41–42	41	9	8	
43A	3	1	1	1
43B	84	21	14	17
44	94	26	12	11

TABLE II

UNIT 43B, 9 –YEAR SUMMARY

HUNT	YEAR AND DATES	NO. OF HUNTERS	SHEEP. TAKEN	% OF SUCCESS	SHEEP OBSERVED
1	Jan. 9–18, 1953	20	10	50	161
2	Dec. 4–13, 1953	17	10	59	95
3	Dec. 10–19, 1955	20	12	62	36
4	Dec. 2–11, 1955	20	5	25	57
5	Dec. 2–16, 1956	19	6	32	56
6	Dec. 6–15, 1957	20	6	30	45
7	Nov. 21–30, 1958	15	5	33.3	
8	Dec. 1–14, 1959	20	1	5	
9	Dec. 2–11, 1960	20	3	15	84
Total		171	58		

HUNTING RESULTS IN NEVADA 1960

Al Jonez, District Supervisor
Charleston District
Nevada Fish & Game Commission

Nevada's eighth Bighorn sheep hunt was held in the fall months of 1960 during the period of November 26th to December 19th. This year's hunt was comparable to those of the last two years. The season length was the same, as was the number of tags, and the area hunted.

This year all hunters were required to check in and out of the hunt, and verbal assistance was given when the hunters checked in.

Samples were collected in all areas during the hunt by giving the hunters prepared kits to carry with them on the hunt.

Samples collected during the hunt were:

Stomach	25
Kidney	23
Testis	24

These samples were requested by Herman Ogren, New Mexico Department of Game & Fish, and were sent to him after the hunt.

The average weight of 23 field dressed Bighorn sheep was 110 pounds.

The average Boone & Crockett score was 153 points, the same as for the two years past. The largest head measured was 178-1/2" and the smallest was 112-5/8", both animals having been killed on the Desert Game Range, Area B-2.

As in the past years, the hunt was a cooperative one, with the Desert Game Range personnel handling Areas B-1 and B-2, and the Nevada Fish and Game personnel handling Area B-3.

Records and samples for Area B-1 and B-2 were supplied by the Desert Game Range personnel.

In 1960 there were 225 applications for the 80 tags available, as against 174 applications for 80 tags in 1959.

As was stated last year, a fall hunt will result in approximately a 30% to 40% hunter success. As can be seen from the accompanying table, the success was 35%.

Literature Cited:

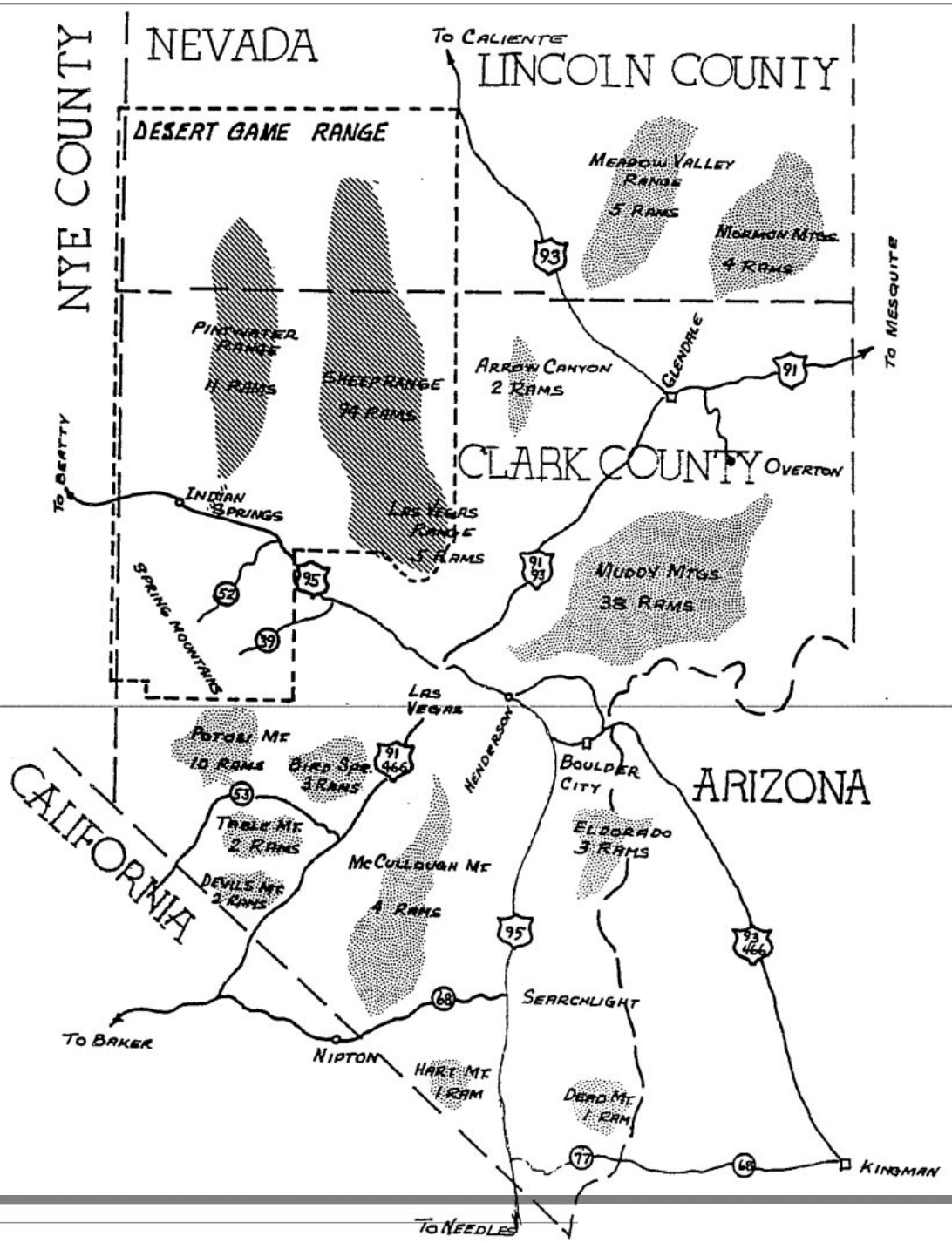
Nevada Fish & Game Commission Completion Reports on Bighorn Sheep Records on Bighorn Sheep Hunts, U. S. Fish and Wildlife Service, Desert Game Range.

DESERT BIGHORN SHEEP – SUMMARY OF ALL HUNTS

YEAR	SEASON (DAYS)	TAGS AVAILABLE (NUMBER THAT ACTUALLY HUNTED)			TOTAL TAGS (NO. ACTUALLY HUNTED)	NUMBER SUCCESSFUL (% SUCCESSFUL)			ALL HUNTS	
		Pint – waters	Sheep Range	County		Pint – waters	Sheep Range	County	TOTAL NUMBER SUCC. HUNTERS	% TOTAL HUNTER SUCC.*
1952	Spring (18)			50 (48)	50 (48)			15 (31.2)	15	31.2
1953	Spring (25)			60 (53)	60 (53)			15 (28.3)	15	28.3
1954	Spring (15)		12 (12)	48 (48)	60 (60)		5 (41.6)	6 (12.5)	11	18.3
1955		NO	HUNT	HELD		NO	HUNT	HELD		
1956	Fall (22)		25 (25)	15 (12)	40 (37)		25 (100.0)	1 (8.3)	26	70.2
1957	Fall (16)	10 (7)	30 (30)	20 (20)	60 (57)	2 (28.5)	19 (63.3)	4 (20.0)	25	43.9
1958	Fall (24)	10 (9)	35 (34)	35 (34)	80 (77)	3 (33.3)	16 (47.1)	11 (32.3)	30	39.0
1959	Fall (24)	10 (8)	35 (33)	35 (35)	80 (76)	4 (50.0)	20 (60.1)	12 (34.3)	36	47.4
1960	Fall (24)	10 (9)	35 (35)	35 (33)	80 (77)	2 (22.2)	14 (40.0)	11 (33.3)	27	35.0
Total	(168)	40 (33)	172 (169)	298 (283)	510 (485	11 (33.3)	99 (58.5)	75 (26.5)	185	38.1

**Success figures are based on the number of hunters that actually hunted.*

1962 – 53 were guided hunts
1954 – 56 were supervised hunts.
1957 – 60 were unsupervised hunts.


NEVADA
NYE COUNTY
LINCOLN COUNTY
CLARK COUNTY
ARIZONA
CALIFORNIA
DESERT GAME RANGE
To Caliente
To Mesquite
To Beatty
To Baker
To Needles
Meadow Valley Range
5 Rams
Mormon Mtns.
4 Rams
Pinkwater Range
11 Rams
Sheep Range
34 Rams
Arrow Canyon
2 Rams
Las Vegas Range
3 Rams
Muddy Mtns.
38 Rams
Glendale
Overton
Indian Springs
Spring Mountains
Las Vegas
Potosi Mt.
10 Rams
Bird Spr.
3 Rams
Table Mt.
2 Rams
Devils Mt.
2 Rams
McCullough Mt.
4 Rams
Henderson
Boulder City
Eldorado
3 Rams
Searchlight
Nipton
Hart Mt.
1 Ram
Dead Mt.
1 Ram
Kingman
93
91
95
52
39
53
68
77
466

MAP NO. 1

LEGAL ASPECTS OF BIGHORN SHEEP TRANSPORTATION

L. J. Merovka
Regional Supervisor of Management and Enforcement
U. S. Bureau of Sport Fisheries and Wildlife

As a prelude to discussion of the subject that has been assigned to me, I should like to touch briefly on some aspects of Bighorn sheep hunting, There are several species of North American big game mammals which are commonly sought as trophies, but perhaps none so assiduously as the Alaskan brown bear and the several kinds of bighorn sheep, The ultimate of achievement in sheep hunting for trophy purposes is to collect good heads of dall, stone, Rocky Mountain, and desert Bighorns. Not many trophy hunters have achieved this goal. A man with enough time and money can get good dall, stone, and Rocky Mountain sheep heads without too much difficulty other than the expenditure of a great deal of physical energy. These animals can be lawfully hunted in a number of places; good guide services are usually available, and hunting permits are not too difficult to obtain. Horses are used extensively in connection with sheep hunting in the north, and this is most helpful to the hunter; but desert sheep hunting is quite another thing. In most circumstances it is an extremely rigorous undertaking. Jack O'Connor, a former resident of Southern Arizona who I think presently lives in Idaho, is one of the most noted and experienced big game hunters in the United States. He had an article on desert sheep hunting in the May 1960 issue of Outdoor Life magazine, in which he stated that "the toughest hunting I have ever done has been for desert Bighorn sheep, In hunting other types of sheep in North America, horses can be used much of the time to take the hunter right into ram country. On a Wyoming hunt for Rocky Mountain bighorns, a companion and I actually camped on a plateau at 11,000 feet and grazed our hobbled horses higher than the head of the canyon where I later shot a ram, In the Yukon I once tied my horse, took my rifle out of the scabbard, and walked a couple of hundred yards to the point from which I shot a fine trophy. But in Sonora, Mexico, where I have done my desert sheep hunting, it is all foot work. Most of the sheep mountafns are so rough and rocky that a horse couldn't get 50 feet up the first slope, Many of the mountains are vast piles of solid rock, full of deep canyons, knife sharp ridges, and precipitous drops. The mountains do not go very high, but they rise sharply fran low country. Among the toughest ranges I have ever hunted are the Cubabi Mountains south and somewhat east of Sonoyta, Sonora, The peak is only 4,480 feet above sea level, but it rises sharply from a plain about 1,200 feet in elevation, and when anyone climbs to the top and back in one day, he knows he's been somewhere.

The Cubabis are solid granite, much of it is worn as smooth as glass by rain and weather. The Pinfcates, below the Arizona line in Northwestern Sonora, are a series of lava fields, volcanac craters, and cinder cones. The highest of these, Pinicate Peak, is about 4,500 feet high. Cerro del Viejo, or the Mountain of the Old Man, is weathered limestone so sharp that a few days on it will tear the soles off the strongest shoes. To me the toughest mountains of all are those of decomposed granite, so steep and unstable that every chunk of rock is

ready to roll. A sheep hunter makes three steps upward and slides down two."

Despite such tremendous obstacles and the fact that desert Bighorn sheep hunting has been prohibited in Mexico for a good many years, we still have American citizens who defy the laws of our good neighbor and face up to the rugged toil of hunting these mountains in order to draw a bead on a nice Bighorn ram. Why do they do it? Well I guess it's partly because some people have a strong urge to demonstrate their ability to achieve success in the face of formidable obstacles and partly because desert sheep are so highly prized as trophy animals.

This brings me to the subject that has been assigned to me for discussion, namely laws which govern the international and interstate transportation of Bighorn sheep. It is quite generally known that there is a treaty between the United States and Mexico for the protection of migratory birds, but comparatively few people are aware of the fact that this same treaty contains provisions whereby the two contracting parties agreed not to permit the transportation over the American-Mexican border of game mammals, dead or alive, which live in their respective countries, or parts or products of such animals, without a permit of authorization provided for that purpose by the government of each country. There is a further provision that in case such game mammals or parts or products are transported from one country to the other without the required official authorization, they will be considered as contraband and treated accordingly, Current applicable regulations of the United States government under provisions of the Migratory Bird Treaty Act, are as follows:

5.1 Definition of game mammals. The species of game mammals under the terms of the convention between the United States and the United Mexican States for the protection of migratory birds and game mammals, concluded February 7, 1936 (49 Stat. 1311), include antelope, mountain sheep, deer, bear, peccary, squirrel, rabbit, and hare.

5.2 Transportation of game mammals to and fran Mexico - (a) To Mexico. Game mammals, or parts or products thereof, taken in and transported from a State, Territory, or the District of Columbia, may be transported to Mexico, if the importation thereof is not prohibited by law or regulation of that country, upon presentation to the collector of customs at the port of exit of the certificate of an official, warden, or other officer of the game department of such State, Territory, or District, that such game mammals, or parts or products thereof which must be listed in the certificate, were taken or acquired and are being transported in compliance with the laws or regulations of such State, Territory, or District.

(b) From Mexico. Game mammals, dead or alive, their parts or products, may be transported from Mexico into the United States if accompanied by a Mexican export permit, and if alive by such permit as may be required under regulations of the Secretary of the Treasury (19 CFR 12.26) relating to the transportation of wild birds and other animals under humane and healthful conditions: Provided, that their

possession in any State or Territory or the District of Columbia, shall be subject to the laws of such State, Territory, or District.

Another law applicable to the transportation of Bighorn sheep is the old and well-known United States Government statute usually referred to as the Lacey Act. It has been amended several times, most recently under date of September 2, 1960. Provisions thereof which are most pertinent to the purposes of my discussion are as follows:

43. Transportation of wildlife taken in violation of State, National, or foreign laws; receipt; making false records

"Whoever delivers, carries, transports, ships, by any means whatever, or knowingly receives for shipment, to or from any State, territory, the District of Columbia, the Commonwealth of Puerto Rico, any possession of the United States, or any foreign country, any wild mammal or bird of any kind, or the dead body or parts thereof, or the offspring or eggs therefrom, as the case may be, which was captured, killed, taken, purchased, sold, or otherwise possessed or transported in any manner contrary to any Act of Congress or regulation issued pursuant thereto or contrary to the laws or regulations of any State, territory, the District of Columbia, the Commonwealth of Puerto Rico, possession of the United States, or foreign country; or

"Whoever receives, acquires, or purchases, knowingly, any such wild mammal or bird of any kind or the dead body or parts thereof, or the offspring or eggs therefrom, which was so transported, delivered, carried, or shipped by any means whatsoever, as aforesaid; or

"Whoever, having acquired any of the foregoing properties which was so transported, delivered, carried, or shipped by any means whatever, as aforesaid, makes any false record, account, label or identification thereof; or

"Whoever imports from or exports to Mexico any game mammal, dead or alive, or parts or products thereof, except under permit or authorization of the Secretary of the Interior, in accordance with regulations issued by him and approved by the President--

"Shall be fined not more than $500 or imprisoned not more than six months, or both; and the wild animals or birds, or the dead bodies or parts thereof, or the eggs of such birds, shall be forfeited!'

(June 25, 1948, ch. 645, 62 Stat. 687.)

Well now how do these laws work out under the test of practical application? Let's consider the case of illegal sheep hunting here in the State of Sonora, Mexico, by United States citizens. Despite the rigors of sheep hunting down here that I have already mentioned, a goodly number of non-residents succeed in making kills. They are then faced with the problem of getting the prized heads and capes out of the country. Since these are contraband and Mexican export permits, therefore, cannot be obtained, there is only one way to get them out and that is by smuggling. There are people who are willing to do this for a price, and I regret to say that they are all too often successful in their efforts. In recent years only one has been caught in the act. But after a head and cape has been successfully smuggled into the United States, the owner still has the problem of dodging the law because he invariably wants his prize trophy mounted, and by some taxidermist he can trust to do a real good job. Here is where the outlaw

sheep hunter is presently most vulnerable to the long arm of the law. There are comparatively few taxidermists in the United States to whom discriminating sheep hunters will entrust the job of mounting their trophies. We know who these taxidermists are, and you will recall that there is a provision in the Lacey Act which makes it unlawful to make any false record, account, label, or identification in respect to any wild bird or mammal received by a consignee, Few taxidermists will take a chance on getting in trouble through falsification of their records.

Here is a rundown on a specific case that was handled through our Regional Office at Albuquerque, New Mexico several years ago. I noticed an ad in one of our national hunting and fishing magazines which offered guide and outfitting services for hunting in Mexico. It had been placed by a resident of Southern Arizona and represented in part that Mexican permits were available for sheep hunting. I had a copy of the current Mexican game regulations, and they stated that the hunting of "borrego silvestre" or Bighorn sheep was permanently prohibited in that country. I had not heard of any change in these regulations, but I had to be sure and so I had our Central Office make inquiry of the Mexican game officials in regard thereto. Back came a reply stating that the prohibition against sheep hunting in Mexico was still in effect. We then launched into an extensive investigation of the activities of the Arizona guide. The head and cape of a desert Bighorn killed by one of his clients about 43 miles north of Kino Bay, Sonora, Mexico was seized by the U. S. Customs Service after being flown into Arizona in a plane that had smuggled the specimen out of Hermosillo, Mexico. Then we made a thorough check of the records of prominent taxidermists covering a period of three years, which then was the statutory limitation for initiation of Federal prosecutive action in most criminal cases, but which has since been increased to five pears. As a result of this activity we obtained information that eventually led to the location of 11 desert sheep heads that came from animals illegally killed in Sonora, Mexico. Only three of them had been killed by clients of the aforementioned guide, He was prosecuted and convicted in Federal court at Tucson, Arizona, and he then gave up guiding and outfitting for hunting in Mexico. The three men he helped to get sheep down there all claimed that they paid him $500 apiece for guide and outfitting services and $100 each for sheep hunting permits, but no such permits were ever in evidence. The hunters all stoutly contended that they had acted in good faith and had been duped by the guide, but this was disproved in two of the cases and so two heads were seized. In some of the other cases, the statutory time for initiation of legal proceedings had already expired and in the others the only evidence we were able to obtain was of a self-incriminating nature, and this is insufficient for purposes of prosecutive action in the Federal courts. Nevertheless there is evidence that the investigation had a good effect because since then we have had but few reports of illegal sheep hunting in Mexico by U. S. citizens. By and large, people who hunt sheep as trophies are a pretty close-knit clan and word gets around when any of them get in trouble, The people who killed the aforementioned eleven desert sheep were residents of Alaska, Michigan, New Mexico, New York, Ohio, Texas, and Washington State. An interesting disclosure was that eight of the sheep were killed in February,

one in May, and one in October. My records do not show when the other one was killed.

Of the eight states under the administrative jurisdiction of our Regional Office in Albuquerque, New Mexico, we have desert-type sheep in three of them, namely Arizona, New Mexico, and Texas. In recent years we have had very little trouble with cases involving the illegal taking and subsequent illegal interstate transportation of such sheep, but there have been some instances of iocai poaching. I am unaware of what the situation is in California and Nevada, which are under administration of our Regional Office at Portland, Oregon.

A recent development that holds good promise for more effective action against U. S. citizens who kill sheep and other game illegally in Mexico and then smuggle it back home is the assignment by the Mexican Game Department to the border area of an official who will have responsibility for working closely with United States law enforcement personnel toward the suppression of such activities. I highly commend this action.

FALLOUT, ITS RELATION TO WILDLIFE

E. L. Fountain, Major, VC, U. S. Army

It's a pleasure to be here in Hermosillo, Mexico to attend the Fifth Annual Meeting of the Bighorn Sheep Council. Last year Dr. Gary Farmer attended as the representative of the Atomic Energy Commission. He has since been transferred to Fort Leavenworth, Kansas. He is attending the Army's Command and General Staff College.

As you all know, the Veterinary Officers assigned by the Army to the Las Vegas Area Office of the Atomic Energy Commission have always taken an active interest in the Desert Bighorn Council. I would like to continue this association during my assignment in Las Vegas.

My paper is entitled "Fallout - Its Relation to Wildlife." I would like to review with you:

What fallout is,

The means by which it enters the atmosphere.

How it is then redistributed on the surface of the earth.

Where we can expect maximum deposits, and the methods by which it is picked up and deposited in the biological specimen.

I don't intend to discuss effects of radioactive isotopes at this time, since it appears that neither now nor in the foreseeable future will we be able to observe any gross or miscroscopic changes in either man or animals resulting from low level fallout. With the cessation of aboveground testing in October of 1958, additional radioactive material has not been incorporated in our present biosphere.

Fallout - first, what is it? When we talk of fallout, we must consider that it is formed from the products produced when the nucleus of a large atom (such as Uranium^{235} or ^{238} or Plutonium^{239}) is split by bombardment with neutrons. There are various methods of neutron bombardment used to produce this splitting or fissioning of the atom, but we are mainly concerned with the products of the nuclear reaction that takes place when a super-critical mass of fissionable material is brought together - and an uncontrolled nuclear event takes place. This is essentially what happens in our so-called "Atomic Bomb" or "Nuclear Device." I say "uncontrolled event" since the same reaction takes place in a controlled state when we operate a nuclear reactor, such as we have in our atomic submarines and our nuclear power plants. This chain reaction that results from the apposition of supercritical masses of nuclear fuel produces heat - energy, fission fragments and isotopes of various elements, Some of these isotopes are radioactive - others aren't. We are mainly concerned with the long-lived radioactive isotopes that might be absorbed into the physiological systems of plants, animal and man.

At the present time my main interest is in three isotopes - I^{131}, Sr^{90}, Cs^{137}. From a graph that Major Farmer has previously shown you we can see that the greatest amounts of fission products are produced at the isotopic numbers - 90 and 137, with 131 close to the 137 peak. These three elements are of great concern since they are readily absorbed into the physiological systems of plants and animals.

Sr^{90} is in the same periodic table as calcium and chemically behaves like calcium. Cs^{137} is in the periodic table with potassium and is absorbed by the plants and animals like potassium. Iodine is a volatile gas and is readily absorbed by plants and animals. Calcium is essential to proper skeletal development. Potassium is essential to muscular development, and iodine is necessary for proper functioning of the thyroid gland. Iodine has a half-life of eight days and is quickly eliminated from the body. So we will not consider it as a serious fallout contaminate. Sr^{90} and Cs^{137} have half-lives of 28 years, so should be considered as serious contaminates of fallout. So we see fallout is actually radioactive isotopes produced by the detonation of nuclear devices in an uncontrolled state,

How is it distributed - When a device is detonated, we see the familiar mushroom-shaped cloud. This cloud contains radioactive substances - dust and debris. A low-yield weapon essentially contaminates areas adjacent to ground zero for varying periods of time. We are not concerned with smaller yield detonations in considering worldwide fallout since these devices contaminate small areas in a controlled access area, such as the Nevada Test Site. The atmosphere is usually contaminated to a very slight degree and actually does not constitute a threat to the general population. We become concerned when the larger tests, such as we conducted in the Pacific and the Russians in Siberia, contaminate the atmosphere and stratosphere.

Surrounding the earth, we have atmosphere to varying altitudes: then troposphere; an inversion layer called the tropopause; then stratosphere. The tropopause tends to be an effective barrier between the atmosphere and the stratosphere. Since the equatorial tropopause is at a higher elevation than the'polar tropopause, there tends to be a break in this barrier at about 350 to 450 latitude, north and south. This is where our stratospheric fallout enters the atmosphere. Because of this, there is an increased density of fallout in a band around the earth at about 400 N & S latitudes. The band is heavier in the Northern Hemisphere because most tests have taken place in the Northern Hemisphere. As this stratospheric fallout drifts through the break in the tropopause, it attaches itself to dust particles - these, in turn, act as the nucleus for raindrops and we find the fallout is a function of rainfall to a great extent, As this fallout comes down with the 'rain, it is deposited on the surface of plants and on the soil. That which is deposited on the surface of plants is immediately available to the animal upon consumption of the contaminated plant life. The portion on the soil must be picked up by the plant as an element necessary for plant life and then enter the food chain. Much of this deposited on the soil becomes bound into insoluble chemical compounds and thus is unavailable for absorption. Thus, a great deal of the fallout material produced is never available to plant or animal life.

Last year during the hunts on the Nevada Game Range, Kofa Game Range, Sandia Mountain (New Mexico), Rocky Mountain Bighorn Hunt and the controlled access deer hunt on the San Andres Refuge, we received a total of 33 hock joints for analysis for Sr^{90}. I also received joints from the Nevada Fish & Game Commission, but haven't received the laboratory results on Nevada Fish and Game animals yet. The Sr^{90} incorporated into the skeletal systems of these animals is as follows:

San Andres	1.96 ± 0.2 uus Sr^{90}/gm Ash
Sandia Mts.	7.3 ± 0.4
D.G.R.	4.3 ± 0.4
Kofa G.R.	3.0 ± 0.3

I would like to mention the San Andres samples are deer - consequently shouldn't be compared with DGR and KGR results. Also, the Sandia Mountain samples are from Rocky Mountain Bighorn and the possible sub-species'difference between the Rocky Mountain Bighorn and the Desert Bighorn should be taken into consideration.

We don't have enough figures to draw conclusions, but I believe we can make some observations.

First, there is a difference in uptake where rainfall varies to any great degree.

DGR and KGR - perhaps 7" annual rainfall compared to Sandia Mountains with perhaps 18" AR.

A difference in uptake in ddfferent species probably resulting from different vegetation utilization, as illustrated in results from RMBH from Sandia Mountains and deer from San Andres. Although we also must take into account a much lower rainfall in San Andres Refuge (8-10) as compared to Sandia Mountains, 17-18".

How do these figures compare with a year ago - about the same. Dr. Farmer reported an average of:

8.4 uuc Sr^{90}/gm Ca in 1959.

4.7 uuc Sr^{90}/gm Ca.

In summary, I believe we can say:

1. In fallout constituents, we are concerned with the long half-lived ones that are easily assimilated into the biosphere, such as Sr^{90} - CS^{137}.

2. This is being distributed from the stratosphere with about a 3-4 year half-life; hence, we have about reached optimum concentration since cessation of tests in October 1958.

3. At the present time or in the foreseeable future, it is impossible to detect any deleterious effects on plant-animal or human life from radioactive fallout.

4. Apparently a peak concentration of Sr^{90} in the skeletal systems of Bighorn Sheep has been reached at this time.

HOW MUCH ROOM DOES A BIGHORN NEED

Ralph Welles

How much room does a Bighorn need? This sounds like a simple question with a simple answer like, how many acres of buffalo grass does it take to feed a cow? Or a domestic sheep? All you have to know to answer that is a few simple things like the nature of the supply and the nature of the demand; the nutritional value of buffalo grass for various purposes, such as development of beef on a steer on the one hand or milk in a dairy cow or wool on a sheep on the other; how good, how dense, how over-grazed is the buffalo grass, how long has the drought lasted; what kind of cattle are you raising, Herefords, Black Angus, or Brahma hybrids? And, of course, a thing like trace element deficiencies can show up, but all of these questions are simple if you know where to find the answers, and a great many men are equipped for this and are doing it every day -- asking the questions and finding the answers.

In range lands, pasture lands and feeding lots both quantity and quality of both stock and food supply can be analyzed, measured and regulated; controlled experiments can be made to produce applicable formulas for the development of profitable animal husbandry. They can say with confidence that given this factor and this and this, you will get this -- but leave out the third factor, you don't get the fourth, you get a fifth. With domestic stock it's controllable, Depending on what we want to raise and why we want to raise it, we can, with vaccinations, mineral additives and processed foods crows more and more animals into smaller and smaller spaces. We breed this quality, this ability to survive and thrive to the day of slaughter with a minimum of space and freedom, into our domestic stock and call it good.

In many ways we have found that what we have learned from a study of domestic animals has been helpful in our study of the wild. When we look at a domestic sheep, for example, and compare it to a desert Bighorn it is hard to imagine them both descended from a common ancestor, but we must keep this in mind -- for one is the product of natural selection and the survival of the fittest and the other, you might say, an example of game management in its ultimate form, where all its living processes are subject to at least limited controls.

So in looking at the short, squat, wooly, hornless domestic sheep we get a partial answer to our question of how much living room a Bighorn needs -- because this suggests that the question could be asked another way: How much control will he stand? And still another -- and probably the most pertinent way to ask the question would be this: What kind of sheep do you want to have in Death Valley, the Desert Game Range, on the Kofa, or in Sonora?

Let's look more closely at the picture -- and let's remember it has more than one side to it.

On the measurable side the picture is complicated by the

great diversity of habitat, It is relatively easy to measure and to determine the carrying capacity of the flat upland range -- for domestic sheep -- or for burros. The cover is relatively easy to assess and rainfall comparatively stable. And if nothing disturbs a burro he could be happy here all his life.

But how useful is this type of range to the desert Bighorn? Some say none -- and until recently we would have agreed. But in 1959 we found the Death Valley Nevares popuiatfon spreading to two and three miles from the mountain base across the mesa in daily search of emergency rations. This occurred only once in over eleven years of study, but that once might have spelled the difference between extinction and survival for that particular herd. And, since that is true we must evaluate the entire habitat not just the prefered part of it, the traditional, inaccessible mountain fastness where even the most avid hunter brings himself to bay at the foot of that final rampart. How do we measure this terrain: How much of this type of room does a Bighorn need?

The answer, by natural law, is simple -- all of it. The populations of desert Bighorn we now have need all the room now at their disposal, since any substantial reduction of their range will -- eventually -- mean a reduction of the population. For sooner or later they will utilize all of their forage reserves as droughts drain their normal or preferred ranges dry. Bighorn have utilized the accumulated storeroom of Badwater Bay only twice in 11 years -- six years apart.

In the Death Valley biota we have about three million acres of land -- and an estimated minimum of 600 Bighorn -- so it is easy to see that from the point of view of carrying capacity alone we need abut 5,000 acres to carry one Bighorn through the twelve years of his life.

On this point we can learn something from geology, and botany too. A recent six-year geological survey (C. B. Hunt, ms. in preparation) discloses the existence in Death Valley of several thousand acres of land with an average of only one plant to the acre. Other hundreds of acres have no plants whatever.

A recent botanical research project came up with a core from a bristlecone pine on Telescope Peak which indicates a prehistoric drought of 40 years duration and of such intensity that even trees in the coolest, wettest section of the region grew scarcely at all. If this appeared in Death Valley it most certainly happened throughout the Southwest. Springs would have dried up by the hundred and only the most prolific could have continued to flow. A glance at the map of Death Valley will show us three areas only which could have survived such a catastrophe -- one in the north at Scotty's castle, one near the center at Park Village and the other a few miles south at Furnace Creek.

Judging by the present diminished summer flow of the rest of the free water sources in the Amargosa Range we can safely assume that all but the three mentioned would fall an early casualty to the recurrence of such a drought -- and these three, the one time last stand

of the Amargosa herd, are now almost completely diverted to human use! It is easy to see what would happen then -- the Bighorn would stand for awhile abbve the dried up water holes and a few would make it across the Valley to Cottonwood Creek or Hanaupah.

In Death Valley we have become aware that in a very specific way the survival of the Bighorn depends on the nature and shape of the crust of the earth -- on this he depends for his water in the rain shadows which are his natural storage areas of food, his escape to security- his ephemeral water supplies to survive the drought.

The Death Valley Bighorn ran into a drought of a different kind in the thirties when the depression put a prospector at every accessible water source in the region. A few they couldn't reach and those few brought a nucleus herd through the crisis until the springs were freed again, And here is the crux of the matter: Is it just living room the Bighorn needs, or is it room of a certain type, or is it room all to himself that we must consider? Some say yes, the Bighorn moves out when a competitor moves in. For years it has been contended by some that when the burro moves in the Bighorn leaves, that the Bighorn is a. shy, elusive and exclusive creature which would rather die than be made captive, and in some cases this is true, The records show it. Tom Moore can tell you how many animals captured on the Kofa failed to reach Texas, If I understand him correctly, Dr. Charles Hansen says that he has recently found some indication that some sheep captured and marked at one spring on the Desert Game Range will subsequently seek another source for watering; in Death Valley we have long noted that sheep frequent that part of their habitat accessible to human beings only as long as foraging and watering conditions make it necessary for them to do so.

There is another side of this picture, too, and one of growing proportions and vividness of color, We have found that Bighorn will and do live in the same habitat with burros, By natural selection leadership takes over which accepts the inevitable.

In 1955 an old ewe came down from Pyramid Peak and we made friends with her and she made friends with everybody to the extent that her band became a traffic hazard on Highway 190, She was there for over a year, and people joked about the "wild mountain sheep" and claimed they fed them from their hands. The continued presence of the band in the area for 18 months depended entirely on her -- when she eluded them and left to have her lamb the band itself became as spooky as ever and fled within 24 hours, At Stubbe Spring in Joshua Tree National Monument photographers have "trained" the sheep to come to water within a few feet of their clicking cameras; Anselmo Lewis and his friends have for several years lunched regularly with his "Beverly Wilshire herd" on Mt. Baldy; several generations have survived in the San Diego Zoo -- they were successfully having lambs there in 1947; and of course, there is the Desert Game Range,

They began an experiment at the Desert Game Range in 1947. In 1948 they brought in two lambs destined for the history books, which we have known as the Old Lady and the Old Man. In two years they began

having lambs, but the lambs died. We were there in 1953 when Ock Deming went out on St. Patrick's Day in the morning and found one had been born that was to live -- and a new generation of Bighorn had been established which had found captive conditions acceptable as a way of life. The Old Lady died when she was six years old but she left behind her another matriarch to carry on in her stead. The Old Man was thirteen years old this spring and has played a big part in demonstrating that under certain circumstances Bighorn need very little living room indeed.

It would appear that once Bighorn leadership has been established which accepts-control others will be more likely to accept it also. Not always. A yearling ewe was caught and brought in to Corn Creek in 1953 who scarcely stopped running until she died two years later. On the other hand, Little Pokey was found and brought in on April 18, 1957. From the beginning he couldn't make up his mind whether he was a dog or a human, but he was certain he was not a sheep. When they tried to make him realize his destiny at three years of age, he died of a "broken heart" because of his rejection by what he seemed to think was his own kind.

Now looking at both sides of the picture at once we see an animal which seems to prefer solitude in the wilderness but which seems capable also of making some adjustments to an increasing encroachment, with its concomitant of controls. Introduction of a competing species of animal like the burro is in effect a control because it places a new limit on available forage; diversion of a spring for any purpose is a control for the same reason; limited hunting of a predetermined age, class and sex of an animal is in effect a selective breeding control. All of these things and more we have already done -- a successful, controlled population seems to be on its way -- if that is what we want! It would appear that we must decide what kind of Bighorn we want, then, before we decide on how much living room they are going to need. The wild sheep, the shy, elusfve magnificent Bighorn we like to think about needs room and freedom enough to be wild in -- freedom from interference of all kinds -- for any interference will change him a little from what he has been for the last eleven or twelve thousand years.

Yet on the other hand, given the right kind of leadership on both sides of the fence -- the right Old Lady and Old Man, who won't hand down fear to their progeny, and the right kind of people on the outside, who won't develop fear in them and who know, for instance, that when the Old Man knocks you over the fence he is not being nasty but simply communicating with you in his own language -- you can have a race of Bighorn who seem to need no more living room than the compound has to offer.

It may be wise to aim at having as many as we can of both, so that we can learn from one how to preserve the other. Larger populations than we have now in larger pastures, compounds, fenced, measurable and controllable, where a Bighorn band can live out its natural life under completely recordable conditions. This to gather data applicable to populations outside -- and possibly, eventually to insure the survival of at least our control populations.

BATTLE TO SAVE THE BIGHORN RANGE IN SANTA ROSA MOUNTAINS OF CALIFORNIA

Lloyd Tevis, Jr.

Two years ago when I reported to the Death Valley meeting of this Council regarding man's effect on Bighorns in the Santa Rosa Mountains of California I could say that the Bighorns had been little disturbed by human encroachment. But I predicted that because of the proximity of their range -- the best wild sheep habitat in California -- to the booming desert resort area of Palm Springs and La Quinta, they would be driven out soon by real estate developers.

Since then, spurred on by the vision of a continuous Southern California megametropolis stretching from the Salton Sea to the Pacific and from Santa Barbara to the Mexican line, there has been a wild scramble by all sorts of people and organizations for land in the Santa Rosa Mountains.

Competition is intense. On one side are the subdividers -- the despoilers of the natural scene. They are out to grab all possible acreage, no matter how rugged the terrain, in order to cut it up into building sites. These people are united and ruthless. Their only concern is to buy land cheap and sell it dear.

On the other side are the conservationists, who, although alerted to the danger confronting the Bighorns, often disagree among themselves as to what can or should be done to perpetuate the wildlife of the Santa Rosas, They comprise many diverse groups, such as the Desert Protective Council, Nature Conservancy, California Department of Fish and Game, United States Bureau of Land Management, United States Forest Service, Palms to Pines Wildlife Committee, Idyllwild Chapter of Izaak Walton League, Riverside County Parks Department, and University of California,

The battle between the despoilers and the conservationists has been joined; the issue of whether or not the Bighorns can be saved is still to be decided, There have been some encouraging developments, but also I shall have to report major setbacks,

The most disastrous event in the last two years has been discovery of water in bedrock of the mountains, Heretofore it had been assumed that subdivisions on the arid slopes of the Santa Rosas would be limited by having to truck-in water. Then a drilling company, employing percussion on a tungsten-carbide bit, reached water-bearing fissures below the level of alluvial deposits.

This water from bedrock has been a boon to the land speculators, and they have been quick to take advantage of it. On private holdings they are drilling wells and drawing plans for subdivisions. On government land they are staking out claims with applications to Washington.

One hugh tract has already been opened in the pinyon-junipers.

Two years ago this site was wild and peaceful. Today the road is lined with flag-bedecked tables from which real estate brokers, like hawkers at a bazaar, sell lots to Sunday throngs.

Among the conservationists one of the first organizations to realize that the Bighorns needed help was the Desert Protective Council. A few years ago it proposed that most of the Santa Rosa and San Jacinto mountains be set aside as a Nature Reserve. All indigenous species of plants and animals were *to* be protected, predator and prey alike, and no hunting was to be allowed.

This proposal was supported enthusiastically by many groups, such as camera clubs, bird societies, and the Palms to Pines Wildlife Committee, but criticized by others. Because of the prohibition against hunting it was vigorously opposed by the United States Forest Service, the California Department of Fish and Game, the Idyllwild Chapter of the Izaak Walton League, and sportsmen. Thereby a schism developed between groups which should have been working together in a common cause.

The weakness of the Desert Protective council's proposal for a Nature Reserve is that while attempting to protect wildlife through a ban on hunting it does not offer a positive program for saving habitat from subdividers.

Another organization which concerned itself with Bighorns at an early date was the California Department of Fish and Game. Its approach was to improve water holes, Under the guidance of Mr. Richard Weaver it has done an outstanding job from which the sheep have benefited tremendously. But what good is water hole development if speculators ultimately get the land -- as happened in one instance last summer when a subdivider purchased an improved water hole on Carrizo Creek.

From the long term viewpoint it seems that the Department of Fish and Game's program of water hole development in the Santa Rosas is as futile as the Desert Protective Council's proposed ban on hunting. Land acquisition in the name of conservation has to come first.

Many of us would like to see the Anza-Borrego State Park extend its boundaries to the north. To date the Park authorities have not been interested. The United States Forest Service, on the other hand, has been trying to eliminate private inholdings within the upper border of the Bighorn range by land trades -- only to have negotiations bog down from lack of funds with which to make a survey.

The newly established Riverside County Parks Department also has jumped into the fray. It has filed on many government sections in order to try to keep individuals or other organizations from possessing potential park sites before a master plan for recreation can be devised.

Essentially, all these groups, working together or in competition with each other, have made no real progress towards protecting the Santa Rosa Bighorns in the only way that will count: save the range from subdividers.

The first step in that direction was taken by the University of California at Riverside when it established the Deep Canyon Desert Research Station. Here, in the very heart of the Bighorn habitat, facilities for research are being erected, and every encouragement will be given persons who wish to study mountain sheep.

The argument impressed Mr. Philip Boyd, who had donated the original property, and he responded generously by giving funds for the purchase of three adjoining sections from the government. His action was none too soon, for subdividers had already filed upon two-thirds of the land.

Realizing that the battle was now just beginning, Dr. Mayhew enlisted the help of Nature Conservancy.

Through its Western Representative, Mr. William Drake, Nature Conservancy organized the Santa Rosa Bighorn Sheep Committee. The objective of this Committee was to save the wild sheep of the Santa Rosas by beating the subdividers to the land. If successful it could look forward to the day when its efforts would be applauded not only by aficionados of Bighorn watching but also by all inhabitants of Southern California's horrendous megametropolis of the future, who will desperately appreciate whatever wildland remains in their midst.

With Mayhew as chairman, the Committee's first decision was to order a strategic retreat. All of the Santa Rosas from Palm Canyon south to the Palms to Pines Highway (California 74) was abandoned, the reason being that land prices there had skyrocketed to impossible figures. Regrettably, this surrendered territory contains some of the finest Bighorn habitat and is the center for herd studies which Dr. John Goodman of the University of Redlands has been conducting since 1954.

The Committee decided to fight instead for the remaining ninety-one sections of steep rangeland extending from Deep Canyon to the Anza-Borrego Park.

First priority in acquisition was given to land surrounding the Deep Canyon Station, second priority to the best water hole country, and third and fourth to intermediate and peripheral sections of the range.

Complicating this order of priorities was the fact that the pattern of land ownership over the entire area is like a checkerboard, in which private sections alternate with sections of public domain. Therefore, the Committee had to approach individuals as well as the government.

The principle individual land owner said he was interested in Bighorns. In order to help their cause he indicated a willingness to sell his seven sections of high priority land for a little less than a million dollars - an offer which later he reduced to $175,000. But where is Nature Conservancy to get even that amount of money for seven of the ninety-one required sections?

Such is the enormity of the problem faced by the Committee. In an attempt to solve it, an application for funds has been made to various Foundations.

In the meantime the Committee had approached Mr. Nolan Keil of the United States Bureau of Land Management. Mr. Keil was quick to understand the gravity of the situation. He made a personal reconnaissance of the area.

Shortly thereafter the Bureau of Land Management announced that all government land within the area of first priority, as defined by the Bighorn Committee, was withdrawn from public sale. Furthermore, Mr. Virgil Bottini of the Bureau invited the University of California to enter into a cooperative agreement for management of this land.

Such an agreement was drawn up at a conference between Bottini and Keil of the Bureau and Mayhew and Dr, Lars Carpelan of the University of California.. Currently it is being processed.

The speed with which the Bureau acted, once it had been appraised of the precarious predicament of the Santa Rose Bighorns is most encouraging and will go down in history as a milestone for conservation.

Now, if government land in the area of second priority can be classified for recreation under Section 7 of the Taylor Grazing Act, then the California Department of Fish and Game can enter into a cooperative agreement with the Bureau for preservation and management of the sheep and other wild animals.

By then,. with private sections surrounded, the problem they create may be less difficult of solution. Land trades, if not actual purchases, might be feasible.

In any event, through the efforts of Dr. Wilbur Mayhew, Mr. Philip Boyd, Mr. Nolan Keil, and Mr. Virgil Bottini, much has been accomplished since I last reported to the Desert Bighorn Council. At the present time it looks as though the battle to save a large portion of the Bighorn range in the Santa Rosa Mountains can be won, that the subdividers can be defeated.

* * *

In this report I have spoken somewhat unfairly of the subdivider as though he were the disease, the cancer eroding the sheep range. Actually, he is only a symptom of a pathological condition which, unless it is recognized as such and dealt with accordingly, is destined to nullify all of today's efforts to save and manage wildlife.

In the not-too-distant future, when most of Southern California is one vast malignant megametropolis, the need to acquire more and yet more living space for mankind will be so irresistible that all public lands, whether set aside for hunters, Bighorns, or trees, gradually will have to be turned over to the subdivider. In short, wildlife

management today, to make any sense for tomorrow, can not ignore the question of what to do about uncontrolled reproduction of the human species.

THE IMPORTANCE OF POPULATION DATA

Gale Monson

The implications of the subject of this paper are perhaps so obvious as to hardly warrant discussion, However, I would like to develop the subject somewhat with the purpose of clarifying in my own mind, if no one else's, just how we ,intend to use the population data we are accumulating, and may accumulate in the future.

The primary, reason we want population data,. of course, is to help us do a better job of perpetuating the desert Bighorn sheep. I think that's what we are mainly interested in - keeping as many Bighorn sheep in as much area as we can.

Satisfactory population data, maintained on an annual basis, will provide us an answer to the question that continually crops up,. "How are the sheep doing?" To answer that question on a sound basis, as the result of improved censusing techniques, we should know how the desert Bighorn is faring, not only on any given desert mountain, but throughout its entire international range. If as a result of using such techniques it appears anywhere throughout the Bighorn's range that numbers are changing, special studies can be initiated in an attempt to find the cause for the change, if indeed there is one. These studies will furnish information that will aid in diagnosing subsequent population changes, and perhaps furnish clues that will enable us to take measures to halt any decline in numbers. This would apply especially in the case of disease or harmful parasitism.

Although we are quite certain that human disturbance of one sort or other has a profound effect on the numbers and distribution of desert Bighorn, we often are not sure just what the nature of the effect may be, nor do we know what sort of human disturbance is more harmful than another. Here good population data will assist us in understanding just how much of various types of human disturbance Bighorn can tolerate. I am speaking now mainly of encroachment on habitat - just plain human presence with its buildings, roads, fences, usurpation of water supplies, etc.

We notice, from time to time, what appear to be drastic changes in Bighorn numbers in certain areas. From all appearances it seems the Bighorns have disappeared, perhaps wiped out by some calamity, Then we later find that the animals in question have only moved to another area with perhaps better food, or even with no apparent more attractive attributes. Good population data will quickly tell us when these changes occur, how often they occur, and perhaps even why they occur. More or less normal changes might eventually be separated from those changes that may have a ,really serious origin.

The possibility has been suggested that the desert Bighorn is an animal on the downgrade, evolutionally speaking, and that it will gradually disappear relatively soon in spite of what we may do. A mass of population data will help determine whether or not this is so.

Although such evidence would hardly be important except academically or sentimentally, it would furnish a complete record of the species' demise and could be of value in helping avoid the extinction of other species.

Another aspect of Bighorn ecology that will be understood only by having good population data is the matter of Bighorn versus climate. Do Bighorn populations fluctuate with the climate, and to what extent? Are these fluctuations long-term, or do they occur relatively frequently, or are there recognizable fluctuations or cycles within cycles? Such information would be taken into account in almost any phase of desert Bighorn culture, or management, or perpetuation, or whatever you may wish to call it.

The most obvious uses to which population data can be put are, of course, in setting up hunting seasons, bag limits, and hunt areas, which restrictions would properly be in direct ration to Bighorn numbers. The same would hold true of any restocking programs that might be planned.

When I speak of good population data, I do not mean only a simple enumeration of animals by the most satisfactory counting techniques, but a breakdown of the enumeration into sex and age classes in as great and accurate detail as possible. These must be complemented by pertinent data, such as date or even time of day, exact location, and weather. The object in all this is to accomplish, as nearly completely as can be done, an inventory of the entire desert Bighorn sheep society. This, of course, cannot be done without a lot of manpower and without a lot of cooperation, but I think it can be done and should be done. Hay I close with a suggestion that such a program be commenced as soon as possible.

SUPPLEMENT TO THE BIBLIOGRAPHY OF THE BIGHORN SHEEP

John E. Wood
New Mexico State University

At the annual meeting of the Desert Bighorn Council last year, I presented a bibliography of the Bighorn. Since that presentation, it has been suggested that the reference list be added to and brought to a more complete form.

Since the bibliography presented at last year's meeting was based on an extensive review of the literature, I have little to add, but further inquiry and search have revealed certain omissions and a limited number of references published since the 1960 meeting.

The following reference list dealing with Bighorn sheep is a supplement to the reference list published in the 1960 proceedings of the Desert Bighorn Council. With this supplement, I feel that the bibliography of the Bighorn is fairly complete.

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SUMMARY - POPULATION SURVEY METHODS

This section brought out rather conclusively that waterhole counts are the most popular and probably the most accurate -- certainly the most productive.

Mortality records are inconclusive for several obvious reasons. Favorable lambing one year will have, or leave, a predictable effect on records some 10 years later. Dr. Hansen's talk pointed up many interesting features illustrated by graphs and charts, and any effort here to summarize his observations would be wasted -- one needs to get the entire story as he presented it,

Mr. Graves described methods of waterhole counts as practiced in Southwest Arizona. Although such counts are made after summer temperatures have passed 100°, range cured, and watering places watched for three full days, it is admitted that the accuracy of waterhole counts leaves something to be desired.

Mr. Morgan discussed the transect method and expressed the belief that it is valuable as a check on survival within the year if done properly. To do the job properly by transects is extremely expensive in comparison with waterhole counts, and he concludes that man for man and dollar for dollar the water hole count provides a more accurate population figure,

Mr. Kelly, in discussing lamb and yearling counts, stated the job is tough at best and not conclusive. He cited the example of a ration of 13 lambs per 100 ewes as found by a winter lamb count whereas a waterhole count developed a 33 per 100 ratio. One of the major values of waterhole counts is the data observed such as animal condition, habits, etc., in addition to number of animals. He observed that airplanes are not good census tools, but helicopters in the right circumstances are excellent but too expensive for most agencies to afford.

Tom Williams

SUMMARY - BIGHORN PREDATORS

Coyote: The coyote is the most common predator in Desert Bighorn Sheep habitat and is quite capable of killing sheep. Sufficient evidence is on hand to prove that on occasion coyotes do kill mountain sheep. However, Adolph Murie, through scat studies, and other workers feel that the predation on Bighorn Sheep is insignificant.

Bobcats: Bobcats do prey upon mountain sheep. A number of witnessed instances bear this out. The loss of newborn lambs to bobcats has a definite retarding effect on herd growth in places. A claim was made that the control of bobcat numbers is one of the important reasons for the increase of sheep numbers on the Desert Game Range.

Mountain Lion: Evidence at waterholes appears to be conclusive that kills of sheep are made by mountain lions. Authentic records have been made to support the puma as a definite predator. Yet the removal of the lions from a particular sheep range had no appreciable effect on the existing sheep population. Also, that lions can and do coexist with sheep and yet sheep survival is good.

Golden Eagle: Definite sight records have been made of golden eagles preying upon mountain sheep. Adolph Murie found little evidence from an extensive study of golden eagle pellets that this bird has appreciable effect on sheep numbers.

From the above we can say that coyotes, bobcats, mountain lions and golden eagles each and all upon occasion will prey upon mountain sheep and occasional control measures are justified. However, it is the degree of killing that is the important thing -- not that they sometimes do kill a sheep.

Other predatory losses include those by man the hunter and man the researcher while satisfying the need for specimens.

Luther C. Goldman

SUMMARY - POPULATIONS

1. Present and Past Populations of Desert Bighorn Sheep in New Mexico - presented by Jack Gross

Records of Desert Bighorn Sheep prior to 1900 are vague. However, the fact that the Desert Bighorn is a native is indicated by Indian petroglyphs, skulls, etc. Prehistoric populations are purely conjecture. Even estimates of population as late as 50 years ago are unreliable.

At present there are not less than 200 animals with a possible maximum population of 500 to 600 probably. The bulk of this population is located in the San Andreas and Organ Mountains.

2. Present and Past Populations in Arizona - presented by Warren Kelly.

Bighorns are found in the area known as the "Arizona Strip," the Grand Canyon, along the Colorado River to the Mexican Border and eastward through Southern Arizona as far as Phoenix and Tucson. There is one transplant group in Southeastern Arizona.

John Russo has estimated that there are at present approximately 2,500 animals in the state.

3. Present and Past Populations in California - presented by Dick Weaver.

No additional data has been made available since 1957. It is estimated that there are now 2,000 to 2,500 animals in the state. Some current estimates include:

Sierra Nevada Range	- 390
Santa Rosa Mountains	- 350
San Gabriel Mountains	- 120 to 160
Joshua Tree National Monument	- 100 to 200
Death Valley National Monument	- possible 1,200 to 1,500 (300 counted)

4. Present and Past Populations in Nevada - paper prepared by Al Jonez and presented by Ray Brechbill.

Four new areas surveyed since 1957. All of these are north of accepted Desert Bighorn range. No new population figures have been developed.

5. Present and Past Populations in Mexico.

Desert Bighorns have practically disappeared from the states of Chihuahua and Coahuila. Approximately 200 animals have been counted in surveyed areas in Northern Sonora. There are approximately 1,000 animals in Baja California.

6. Present status of Bighorn Sheep in Northern Baja California.

Two government biologists made a study of this area during November and December of 1960. Animals were found all through the mountain chains of Northern Baja California, These surveys were made by airplane to determine:

1. Population
2. Habitat
3. Competition
4. Predation

It appears that the main threat is hunting.

Monte E. Fitch

SUMMARIES OF BIGHORN HUNT SUMMARIES

Barclay - The Desert Game Range and other refuges are preparing master plans that are approved in the region and in Washington. Objectives are stated. There must be a balance between strong protectionist and liberal management. More must be produced to meet increased demands.

Jose Angel Davila C. - Important Bighorn populations for hunting are in Baja California between Mexicali and San Felipe. New refuges are being established. Permits are to be issued to hunt a few Bighorns. Game wardens are being appointed.

John Reed - Maybe spread into new areas. However, the kill remains about the same. Will have new hunt sauthwest of Tucson. Heads may be larger than in the past but age remains the same.

Al Jonez - (presented by Ray Brechbill) - Nevada held its eighth hunt. All hunters had to check in at stations except one who took a ram without passing the station. Thirty permits were issued with 35% success. Boone and Crockett Club score about same as past year.

Larry Merouka - OUTDOOR LIFE was quoted as saying that the Desert Bighorn is the most difficult animal to hunt. A review of the Migratory Bird Treaty Act was given. Lacey Act was also given. Primary point was illegal transportation of certain animals across the Mexican border. Promised continued aid to Mexico in control of illegal hunting. Related actual case history of the taking of a Bighorn.

ATTENDEES AT FIFTH ANNUAL DESERT BIGHORN COUNCIL MEETING

1. O. V. Deming, U. S. Bureau of Sport Fisheries and Wildlife, Lakeview, Oregon,
2. Dr. Edmund L. Fountain, Las Vegas Area Office, AEC, Las Vegas, Nevada.
3. Ray Brechbill, Nevada Fish and Game Commission, Alamo, Nevada.
4. Blayne D. Graves, U. S. Fish and Wildlife Service, Kofa Game Range, Yuma, Arizona.
5. Newell B. Morgan, U. S. Fish and Wildlife Service, Desert Game Range, Las Vegas, Nevada,
6. Charles G. Hansen, U. S. Fish and Wildlife Service, Desert Game Range, Las Vegas, Nevada.
7. Gale Monson, U. S. Fish and Wildlife Service, Desert Game Range, P. O. Box 1032, Yuma, Arizona.
8. John J. Reed. Arizona Game & Fish Department, Bird Rill Trailer Park, Nogales, Arizona,
9. George E. Barclay, U. S. F. W. S., Box 1306, Albuquerque, New Mexico.
10. Fred D. Thompson, New Mexico Dept. of Game & Fish, Santa Fe, New Mexico,
11. Larry Merouka, U. S. Bur. of Sport Fisheries & Wildlife, Albuquerque, New Mexico,
12. Luther C. Goldman, U. S. Bureau of Sport Fisheries & Wildlife, Washington, D. C.
13. Cecil A. Kennedy, U. S. Bureau of Sport Fisheries & Wildlife, Las Cruces, New Mexico.
14. Jack E. Gross, New Mexico Dept. of Game & Fish, Las Cruces, New Mexico.
15. Coleman Newman, National Park Service, Washington, D. C.
16. Tom Williams, National Park Service, Santa Fe, New Mexico.
17. Richard G. Prasil, National Park Service, San Francisco, California.
18. Monte E. Pitch, National Park Service, Organ Pipe Cactus National Monument, Arizona.
19. William L. Mathews, Bureau of Land Management, Washington, D. C.

20. Warren J. Gray, Bureau of Land Management, Phoenix, Arizona.

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