



This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

- + *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.
- + *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.
- + *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.
- + *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at <http://books.google.com/>

Science
QL
737
.U53
R18
1989



153.2: B90 631

Nat.
Sci.
QL
737
.U53
R18
1989

Rangewide Plan for Managing Habitat of Desert Bighorn Sheep on Public Lands

UNIVERSITY OF MICHIGAN
LIBRARIES
MAY 09 1989
DEPOSITED BY
UNITED STATES OF AMERICA




U.S. Department of the Interior
Bureau of Land Management



Cover photo by
Bob McKeever/Tom Stack & Associates

Rangewide Plan for Managing Habitat of Desert Bighorn Sheep on Public Lands



**U.S. Department of the Interior
Bureau of Land Management, Washington, D.C.**

NAT

QL

737

.453

R16

1989

NAT. SCI
DEPOS. USA
7-14-89

Contents

Introduction	1
Acknowledgements	3
Background	5
The Plan	11
Section 1. Goal and Objectives	11
Section 2. Management Practices and Standards	17
Section 3. Information Needs and Standards	20
Future Activities, Plan Revisions, and Monitoring	23
Summary	25
Literature Cited	27
Appendix	29

Introduction

The Desert Bighorn Management Plan provides guidance and sets priorities for a program to manage desert bighorn sheep habitat on public lands administered by the Bureau of Land Management (BLM) in Arizona, California, Colorado, Nevada, New Mexico, and Utah. The goal of the program is to facilitate recovery of desert bighorn in the Southwest through a balanced program of inventory, on-the-ground projects, monitoring, and research. This program will be consistent with locally developed land-use plans. Numerous other wildlife species, many of which are threatened or endangered, will also benefit from this program.

This plan describes specific goals, objectives, and priorities of the program with regard to habitat areas, management practices, and information needs. More detailed information on actual projects, project costs, and locations are described in activity plans.

Resource Management Plans (RMPs) are developed by BLM with public participation to provide direction for management of Federal resources. RMPs are typically developed for Resource Areas, which may consist of several million acres. At this level, a management objective might be to manage habitat in a particular mountain range to maintain a viable population of desert bighorn sheep. On-the-

ground projects to achieve such objectives are specified in site-specific management plans, commonly termed "activity plans." These plans may target a specific land-use activity such as livestock grazing or several activities. Activity plans are usually developed for more local areas such as a mountain range of several thousand acres. Activity plans for wildlife are termed Habitat Management Plans (HMPs) in the BLM. At this planning level, an HMP might specify development of waters at three locations and prescribed burning for another area. These projects could support the overall RMP objective of maintaining a viable (self-sustaining) population of desert bighorn sheep.

This rangewide plan represents a third level of planning. It comprises a consolidation of desert bighorn sheep objectives in RMPs into rangewide objectives and priorities for the BLM. Thus, this rangewide plan has been developed from the ground up and is totally consistent with the more local RMPs. It is not a plan to override or supersede decisions made and objectives agreed upon through the normal land-use planning process. The rangewide plan thus provides for a coordinated and cost-effective program to facilitate recovery of desert bighorn on BLM lands in the southwestern United States.



*Nelson Bighorn
(Ovis canadensis
nelsoni)*

Bob McKeever/Tom Stack & Associates

Acknowledgments

Recovery of desert bighorn has been and will continue to be a cooperative effort between many individuals, private organizations, and State and Federal agencies. In the case of the desert bighorn, the private sector has been particularly important. The BLM wishes to acknowledge the Arizona Desert Bighorn Sheep Society, the Fraternity of the Desert Bighorn, Nevada Bighorns Unlimited, the Society for the Conservation of Desert Bighorn, and the Foundation for North American Wild Sheep for their continuing support of this program in contributed funds, labor, and other services. The Desert Bighorn Council has promoted sound scientific

management of desert bighorn and their habitat for many years, and the BLM appreciates their assistance and expertise in preparing and reviewing this plan. Finally the BLM wishes to express appreciation to the six State agencies, the Arizona Fish and Game Department, the California Fish and Game Department, the Colorado Division of Wildlife, the Nevada Department of Wildlife, the New Mexico Game and Fish Department, and the Utah Division of Wildlife Resources, for their assistance and expertise in preparing this plan and for their continued cooperation in the program.



Volunteers building water development for desert bighorn in California.

Background

Populations of desert bighorn sheep in the southwestern United States (*Ovis canadensis* subspecies *cremnobates*, *mexicana*, and *nelsoni*) have declined drastically since the early 1800s (Buechner 1960). Historic populations numbered in the hundreds of thousands. Today, desert bighorn numbers in the U.S. are approximately 16,000 (Weaver 1985; 1986). This decline has been attributed to several factors including exploitive hunting, disease, habitat destruction, competition from burros, and especially overgrazing by livestock. Legal hunting is no longer a cause of decline nor a factor preventing recovery (Kelly 1980), and some herds in areas where the habitat has recovered have begun to increase since around 1950 (Cooperrider 1985). Preservation and enhancement of habitat will thus be necessary for future recovery of desert bighorns (Cooperrider 1985; Wilson 1975).

About 80 percent of desert bighorn sheep habitat is on Federal land, the majority of which is administered by BLM (Figures 1 and 2). The BLM administers roughly 8,800,000 acres of desert bighorn habitat occupied by approximately 10,000 desert sheep. However, only 33 habitat areas on BLM lands support populations of at least 100 sheep and only 22 of these 33 herds consist of 125 animals or more. Populations of less than 125 are not considered viable by some biologists (Geist 1975:105). Therefore, the welfare of the desert bighorn is still precarious in the southwestern United States. However, BLM manages an additional 84 habitat areas that can support 100±20 sheep (Table 1). Through habitat management and working closely with State wildlife agencies and wild sheep organizations, BLM can play a key role in facilitating the recovery of desert bighorn populations in North America be-

Table 1. Habitat areas on BLM lands with potential for supporting viable populations of desert bighorn sheep.¹

	Category I				Category II				Category III				Total
	Habitat Areas with Existing Viable Populations ²				Habitat Areas with Remnant Herds ³				Unoccupied Habitat Areas Capable of Supporting Viable Populations ³				
	Peninsular	Mexican	Nelson	Subtotal	Peninsular	Mexican	Nelson	Subtotal	Peninsular	Mexican	Nelson	Subtotal	
Arizona	0	5	3	8	0	8	4	12	0	0	1	1	21
California	1	0	8	9	1	0	17	18	0	0	0	0	27
Colorado	0	0	0	0	0	1	3	4	0	0	2	2	6
Nevada	0	0	9	9	0	0	14	14	0	0	15	15	38
New Mexico	0	1	0	1	0	1	0	1	0	1	0	1	3
Utah	0	0	6	6	0	0	9	9	0	0	5	5	20
Total	1	6	26	33	1	10	47	58	0	1	23	24	115

¹ A criteria of 100±20 desert bighorn sheep is considered a viable population.

² A population must be estimated to have at least 100 sheep to be considered as an existing viable population.

³ A habitat area must be estimated to have the capability of supporting at least 80 desert bighorn sheep to be listed.

Figure 1. *Historic range of desert bighorn sheep on BLM lands.*

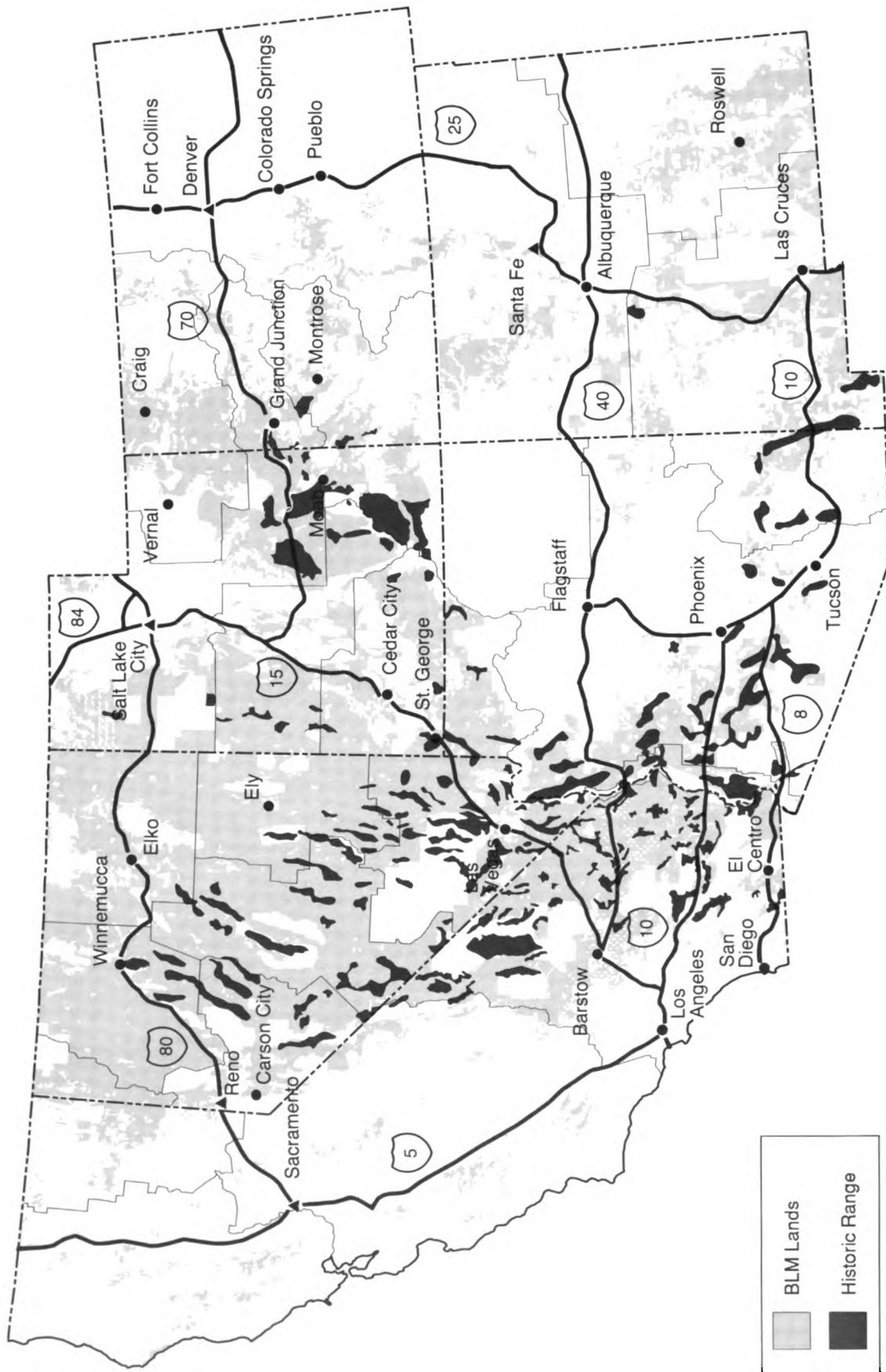
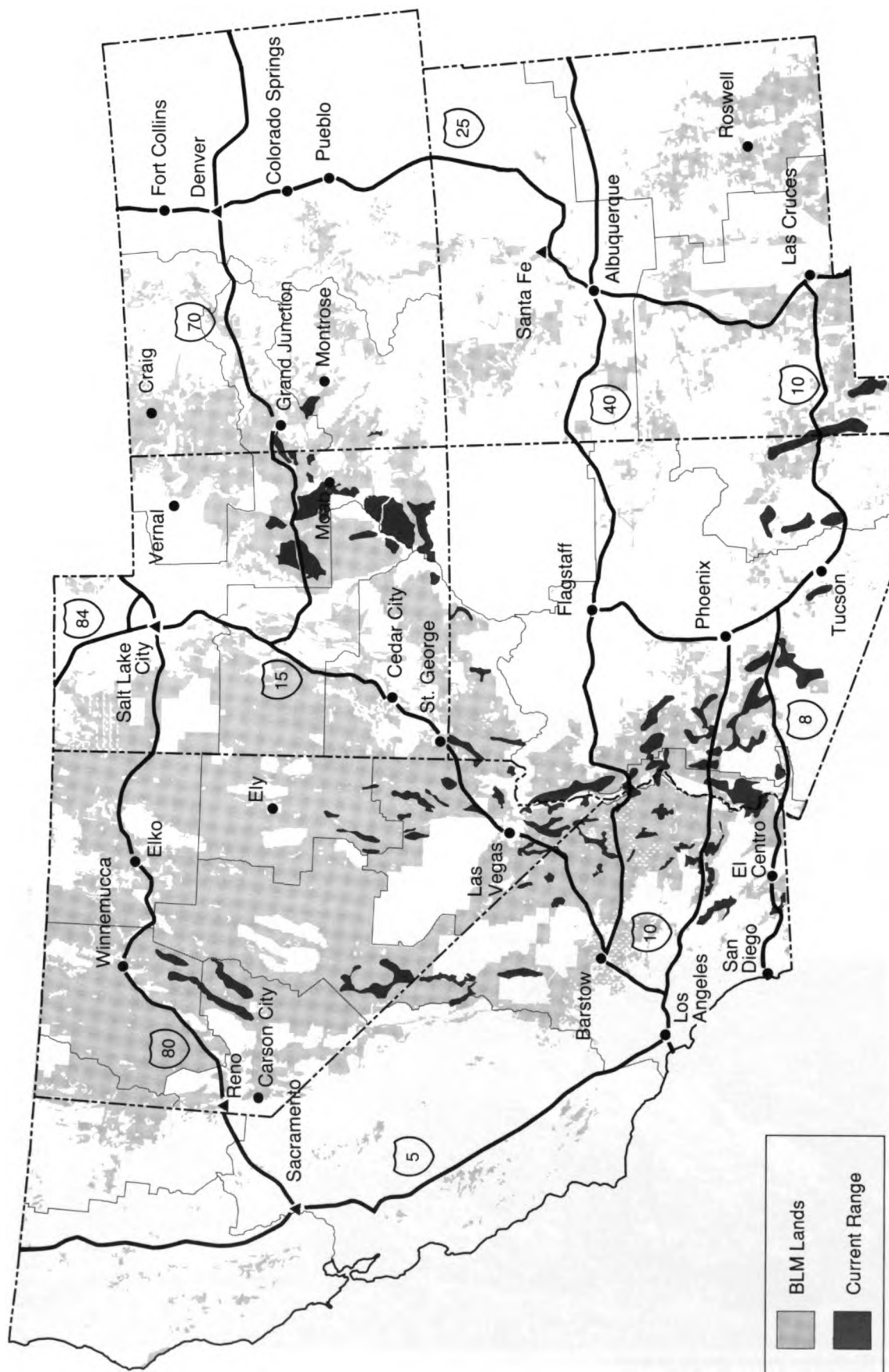


Figure 2. Current range of desert bighorn sheep on BLM lands.



cause of the amount of habitat it administers.

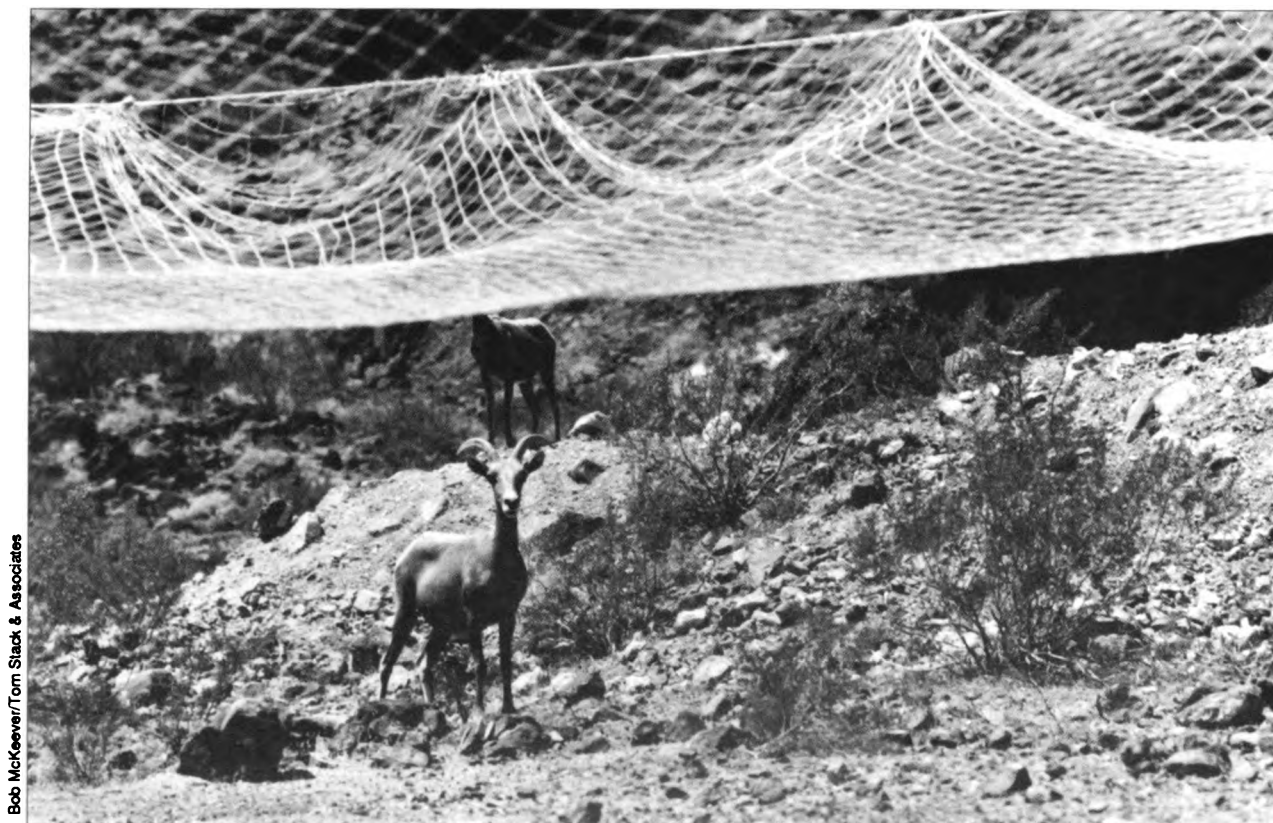
BLM biologists and managers have been working with State wildlife agencies, private individuals, and conservation groups to enhance bighorn sheep habitat for over 20 years. However, recent events and increasing awareness and concern for desert bighorns have provided the opportunity to increase and strengthen this effort. The history of BLM's involvement in bighorn habitat management through 1985 is summarized below and described in more detail in Cooperrider (1986).

The experience of the last two decades has demonstrated that bighorn sheep habitat on public lands administered by the BLM can be managed to allow recovery of desert bighorn populations. The earliest work focused on habitat management, primarily water development. In the past decade, BLM has cooperated with State wildlife agencies to reintroduce sheep into their historic ranges. In many cases, these efforts have been quite successful. However, they continue to be a piecemeal or "herd-by-herd" approach to management, with little rangewide perspective. For Fiscal Year 1985, Congress provided BLM with a challenge grant of

\$300,000 to initiate a program for recovery of desert bighorn sheep. This grant was to be matched by private contributions of money or in-kind services. In Fiscal Year 1985, BLM spent over \$900,000 on desert bighorn, including the grant, base funding, and contributed monies and services. Most of this money was spent on project work.

In Fiscal Years 1986 and 1987, this special appropriation was continued with the same conditions and approximately the same level of funding. These funds were used for the same types of efforts (water development, reintroductions, habitat inventory and monitoring, studies, and research). However, a plan was needed to identify priorities and give overall funding direction to BLM's desert bighorn recovery program. Thus, development of this rangewide plan was begun in Fiscal Year 1986.

In 1986, the BLM Service Center asked BLM State Directors in Arizona, California, Colorado, Nevada, New Mexico, and Utah for information on the status of their desert bighorn habitats and their priorities for desert bighorn sheep habitat management. A draft management plan was prepared based on this information. The draft plan was sent to the six



Bob McKeever/Tom Stack & Associates

Desert Bighorns enter dropnet trap.

State wildlife agencies for review and comment. Before preparing the final document, the authors of the plan met with representatives from each BLM State Office and each State wildlife agency to incorporate as many additional ideas or changes as possible. Following these revisions, the plan was sent to various organizations having particular interest in

desert bighorn such as the Foundation of North American Wild Sheep and the Desert Bighorn Council. The final plan was sent to the Directors of each State wildlife agency and presented to the BLM State Directors. Their comments and concerns have been incorporated into this printed draft.

The Plan

The plan is presented in three sections. In Section 1, the overall goal and general objectives of the plan are described. Achievement of the goal and objectives will be the measure of the success of the program. In Section 2, general management practices and standards are described. Management practices are the means by which habitat can be maintained or enhanced to support viable populations of desert bighorn sheep. This section provides a synopsis of the known practices that the BLM will adhere to, when supporting a viable population of bighorn sheep is a management objective. In Section 3, information needs are described. This section describes practices (inventory, monitoring, studies, research) and standards that must be followed to obtain the information necessary to enhance desert bighorn recovery.

Section 1. Goal and Objectives

The goal of the program is to facilitate the recovery of desert bighorn sheep in 115 identified habitat areas so that they can support viable populations of bighorn sheep. This goal will be achieved

through the attainment of the following three objectives:

- Maintain or enhance the habitat of 33 habitat areas (Table 2) currently supporting viable populations of desert bighorn sheep (Category I areas),
- Enhance habitat on 58 habitat areas (Table 3) with remnant herds that are capable of supporting viable populations (Category II areas),
- Maintain and enhance historic habitat in 24 habitat areas (Table 4) to allow reintroduction and reestablishment of viable populations (Category III areas).

These 115 habitat areas do not represent all areas that historically or currently had desert bighorn, but only those that meet certain criteria discussed below. The other areas will continue to be managed in accordance with BLM policies and regulations but will not receive priority for funding or management efforts under the procedures described in this plan.

These habitat areas, listed in Tables 2 through 4,



*Peninsular Bighorn
(Ovis canadensis
cremnobates).*

Table 2. Habitat areas on BLM lands supporting viable populations of desert bighorn sheep (Category I Areas).

State	Habitat Area	Subspecies	Current Population Estimate	Potential Population Estimate	Percent BLM
Arizona					
	Aravaipa Canyon	Mexican	160	300	90
	Bill Williams Mountains/Aubrey Hills/Castenada Peak/Aubrey Peak	Nelson	100	160	85
	Black Mountains	Nelson	1200	1500	84
	Eagletail/Little Horn/New Water/Paloma Mountains/Ridge/Tank Mountains/Gila Bend Mountain Cemetary	Mexican	290	400	98
	Plomosa	Mexican	194	250	98
	Sand Tanks/Tabletop/Sauceda/Betamote/Coffee Pot Mountains	Mexican	160	350	99
	Trigo/Trigo Mountains/Chocolate/Dome Rock Mountains	Mexican	200	240	50
	Virgin Mountains	Nelson	100	150	99
California					
	Clark Mountain	Nelson	150	150	97
	Kelso Mountains/Old Dad Peak	Nelson	250	250	95
	Kingston Mountains	Nelson	150	180	97
	Last Chance Range/Dry Mountain	Nelson	100	150	85
	Marble Mountains	Nelson	180	200	55
	New York/Providence/Woods Mountain/Hackberry Mountains	Nelson	165	165	80
	Picacho Peaks	Nelson	110	150	55
	Santa Rosa Mountains	Peninsular	350	500	35
	Turtle Mountains	Nelson	110	150	96
Nevada					
	Arrow Canyon	Nelson	117	396	99
	Eldorado Mountains	Nelson	424	742	50
	Lone Mountain/Silver Peak/Monte Crisco	Nelson	394	394	unk
	Meadow Valley Mountains	Nelson	175	510	100
	Mormon Mountains	Nelson	362	362	100
	Muddy Mountains	Nelson	265	505	88
	Newberry	Nelson	105	169	30
	River Mountains	Nelson	207	207	30
	Stillwater Mtns.	Nelson	102	350	99
New Mexico					
	Big Hatchet/Alamo Hueco/Little Hatchet	Mexican	100	400	63
Utah					
	Kaparowitz Plateau	Nelson	100	150	70
	North San Juan	Nelson	556	556	50
	North San Rafael Desert	Nelson	225	225	89
	Potash	Nelson	222	222	88
	South San Juan	Nelson	834	834	60
	South San Rafael Desert	Nelson	120	150	90

Table 3. Habitat areas on BLM land with remnant herds that are capable of supporting viable populations (Category II Areas).

State	Habitat Area	Subspecies	Current Population Estimate	Potential Population Estimate	Percent BLM
Arizona					
	Buckskin Mountains	Mexican	31-105	110	95
	Black Mountain/Ives Peak/Poachie Range/Burro Creek	Nelson	10-20	125	65
	Grand Wash Cliffs	Nelson	60	200	100
	Harquahala/Little Harquahala Mountains/Granite Wash/Bighorn Mountains	Mexican	90	145	97
	Kanab Creek	Nelson	50	130	95
	Maricopa Mountain	Mexican	20	200	100
	Mescal Mountains	Mexican	transient	100	75
	Muggins Mountains	Mexican	10	80	36
	Needles Peaks/Mojave Mountains	Mexican	25	120	73
	Paria Canyon/Vermillion Cliffs	Nelson	70	175	100
	Redfield/Muleshoe/Sombrero Butte	Mexican	50	150	60
	Silverbell Mountains	Mexican	30	80	80
California					
	Argus Range	Nelson	25	100	55
	Avawatz Mountains	Nelson	35	100	55
	Cady Mountains	Nelson	50	90	70
	Castle Mountains/Hart Peak/Piute Range	Nelson	25	80	95
	Chuckwalla Mountains	Nelson	10	100	95
	Coxcomb Mountains	Nelson	15	80	60
	Eagle Mountains	Nelson	45	80	75
	Granite Mountains	Nelson	15	100	95
	Inyo Mountains/Nelson Range	Nelson	40	140	95
	Jacumba/In-Ko-Pah Mountains	Peninsular	30	100	35
	Newberry Mountains/Rodman Mountains	Nelson	15	200	70
	Nopah Range	Nelson	80	100	95
	Old Woman/Iron/Ship/Piute	Nelson	70	200	75
	Orocopia	Nelson	80	150	55
	Sacramento/Chemehuevi	Nelson	80	125	70
	Sheep Hole Mountains	Nelson	50	85	95
	Whipple Mtns.	Nelson	80	130	95
California/ Nevada					
	New York/Castle Mountains	Nelson	25	140	99
Colorado					
	Devils-Mee Canyon	(Nelson X Mexican)	60-70	300	90
	Upper Dolores River	Nelson	35	200	60
	West Gunnison	Nelson	45-50	450	95
Colorado/ Utah					
	Westwater	Nelson	30	125	96

Table 3 (continued). *Habitat areas on BLM land with remnant herds that are capable of supporting viable populations (Category II Areas).*

State	Habitat Area	Subspecies	Current Population Estimate	Potential Population Estimate	Percent BLM
Nevada					
	Clan Alpine	Nelson	30	125	99
	Could Butte	Nelson	20	671	99
	Delmar Mountains	Nelson	50	759	99
	East Range	Nelson	50	unk	68
	Far South Egan Range	Nelson	19	unk	99
	Golden Gate Range	Nelson	transient	unk	99
	Highland	Nelson	41	134	100
	McCullough Mountains	Nelson	80	734	99
	Pahranagats	Nelson	unk	574	99
	South Pahroc	Nelson	33	165	100
	South Spring/Bird Spring Mountains	Nelson	50	708	97
	Tobin Range	Nelson	44	339	97
	Virgin Mountains	Nelson	69	484	99
	Worthington Mountains	Nelson	25	unk	95
New Mexico					
	Peloncillo Mountains	Mexican	30	400	50
Utah					
	Beckwith Plateau	Nelson	39	200	90
	Colorado River/Professor Valley	Nelson	10	125	96
	Dirty Devil	Nelson	25-50	unk	unk
	Dolores River	Nelson	unk	250	96
	Horseshoe Canyon/Bowknot Bend	Nelson	25	200	98
	Kane Springs-Lockhart	Nelson	50	unk	96
	Little Rockies	Nelson	unk	unk	96
	San Juan River	Nelson	72	unk	85
	Westwater Canyon	Nelson	30	125	96

were given priority in the program based on data and feedback from BLM field biologists. These biologists recommend that the BLM give priority for funding and management to . . .

- areas capable of supporting viable populations of desert bighorn sheep;
- areas where BLM, or BLM with other agencies or organizations, has both substantial management responsibility and also substantial control over activities on the land; and
- areas where conflicting land-uses will not prevent achievement of desert bighorn sheep objectives.

All 115 areas listed in Tables 2 through 4 meet these criteria.

In addition, the biologists identified two criteria for ranking priorities among these areas:

- Areas with the rarer subspecies (Peninsular bighorn, *O.c. cremnobates* and Mexican bighorn *O.c. mexicana*) should receive priority over the more common Nelson bighorn (*O.c. nelsoni*), and
- State wildlife agency priorities for habitat enhancement should receive a high priority.

These latter criteria will be used to determine annual funding priorities among the 115 habitat areas listed in Tables 2 through 4.

Table 4. Historic desert bighorn habitat areas on BLM lands capable of supporting viable populations (Category III Areas).

State	Habitat Area	Subspecies	Current Population Estimate	Potential Population Estimate	Percent BLM
Arizona					
	Gila Box	Nelson	0	200	82
Colorado					
	Lower Dolores River	Nelson	0	400	99
	Palisades	Nelson	0	100	100
Nevada					
	Bare Mountain	Nelson	0	169	50
	Clover Mountains	Nelson	0	unk	99
	Groom Range	Nelson	0	360	99
	Hiko Mountains	Nelson	0	117	100
	Humboldt	Nelson	0	359	76
	Johnie (Last Chance) Range	Nelson	0	unk	99
	North Hiko	Nelson	0	unk	99
	North Pahrangat Range	Nelson	0	unk	95
	North Pahroes	Nelson	0	218	99
	Pancake Range	Nelson	0	110	100
	Seaman Range/Timber Mountain	Nelson	0	240	90
	Sonoma	Nelson	0	285	52
	Spector Range	Nelson	0	unk	unk
	Wassuk Range	Nelson	0	125	95
Nevada/ Utah					
	Pilot Range	Nelson	0	140	50
New Mexico					
	Ladron Mountains	Mexican	0	130	56
Utah					
	Wah Wah Mountains	Nelson	0	unk	94
	Newfoundland Mountains	Nelson	0	500	84
	Confusion Mountains	Nelson	0	unk	92
	House Range Mountains	Nelson	0	unk	89
	Red Mountain	Nelson	0	100	95

The interim measures identified for judging if areas have met these standards are described below.

A viable population has been defined as "one that is self-sustaining with minimal demographic or genetic intervention over the long term" (Wilcox 1986). The following types of information provide evidence that a given habitat area is capable of supporting a viable population:

- historic presence of viable populations (where the cause of the decline to non-viable levels was either non-habitat-related or, if habitat related, has been remedied);
- current presence of viable populations;

- large areas of suitable habitat; or

- carrying-capacity calculations that indicate the habitat would support a viable population (based on forage supply within suitable habitat or on an accepted habitat evaluation procedure).

To use such evidence quantitatively, however, one must estimate a number to represent a viable population of desert bighorn.

For this plan, a bighorn herd of approximately 100 sheep (100±20%) with normal sex and age structure will be considered a viable population. This number is consistent with opinions of bighorn sheep biologists (Geist 1975; Weaver 1986) and is



Mexican bighorn (Ovis canadensis mexicana).

supported by current evidence from conservation biology (Brussard 1986; Marcot et al. 1986). Thus, evidence that the habitat is capable of supporting a population of at least 100 sheep will be the general measure. Where acreage of suitable habitat is the only data available, 32,000 acres of bighorn habitat will be considered the smallest habitat size (based on two sheep per section [one sheep per 320 acres] on marginal bighorn range).

These guidelines do not disregard the potential importance of small semi-isolated populations. Rather the approach recognizes that small semi-isolated populations need to be managed as part of an entire system or "metapopulation," as advocated by Krausman and Leopold (1985) and Schwartz et al. (1986). Where such situations exist, the criteria of 100 ± 20 animals is applied to the metapopulation.

This number is only a guideline to be used in identifying priorities for BLM funding and management. It is not intended to be used inflexibly, nor does the BLM claim that it represents a scientifically derived number or an absolute management criteria. The concept here is to concentrate funding and management effort where it will do the most long-

term good. Biological and economic common sense demand that the BLM focus funding on habitats that can support self-sustaining populations. If future studies or research provide evidence that the BLM should be using a lower or higher number, this guideline will be adjusted accordingly.

Habitat areas that consist of at least 50 percent BLM lands are considered to be areas in which BLM has both substantial management responsibility and substantial control over other land-use activities. However, such a criteria has not and will not be used inflexibly, since local situations often are more important than arbitrary numbers. In particular, where other government agencies or private institutions together with BLM comprise over 50 percent of the habitat area, BLM may have substantial responsibility and control, particularly if the other organizations are committed to managing habitat for desert bighorn. Habitat areas comprising less than 30 percent BLM lands are not considered to be areas over which BLM has substantial control or responsibility. Although BLM might cooperate with another agency on desert bighorn habitat management on such areas, BLM would not normally have lead

responsibility, and such areas are not considered priority areas for BLM's desert bighorn sheep program. The BLM should concentrate funding and management effort where other potentially detrimental activities can be controlled.

Habitat areas free of conflicting land-use activities are identified through the BLM's land-use planning process. As explained earlier, habitat areas to be managed for the purpose of supporting viable populations of desert bighorn sheep are identified in RMPs as are the general actions and allocations necessary to resolve conflicting land-use activities. The specific actions necessary to accomplish such objectives are identified in HMPs or other activity plans. The desert bighorn habitat areas identified in Tables 2 through 4 as priority areas are either (1) areas already identified in land-use plans to be managed for viable populations of desert bighorn sheep; or (2) areas tentatively identified as likely to be managed for such objectives following the next round of land-use planning. If the objectives for an area are changed during future land-use planning, the area will be added or deleted from the list of priority areas, as appropriate.

Subsequent research, studies, habitat inventories, monitoring and/or land-use planning may identify new areas that meet the three critical criteria (capability of supporting viable population; substantial BLM control; no land-use conflicts). These areas will be added to the list of priority areas. Similarly, future information and land-use decisions may identify areas for which managing to support viable populations of desert bighorn is no longer feasible or desirable. These areas will be dropped from the plan.

Section 2. Management Practices and Standards

Maintenance and restoration of desert bighorn habitat require appropriate land-use management in addition to project work, such as water developments. The following practices and standards represent the best available knowledge on managing habitat to sustain viable populations of desert bighorn sheep.



Dick George/Tom Stack & Associates

Lambing areas are crucial for desert bighorn survival.

1. Crucial areas, such as lambing grounds, migration routes, mineral licks, and areas within 1 mile of permanent water sources, will receive maximum habitat protection.
2. Carrying-capacity determinations and forage allocations for desert bighorn sheep, where necessary, will be based on a requirement of 4 pounds (air dry weight) of good quality bighorn forage per day.
3. To the extent possible, and with close coor-

dination with State game departments, mule deer populations and habitat will be managed to minimize competition for food, water, cover, and space with desert bighorns.

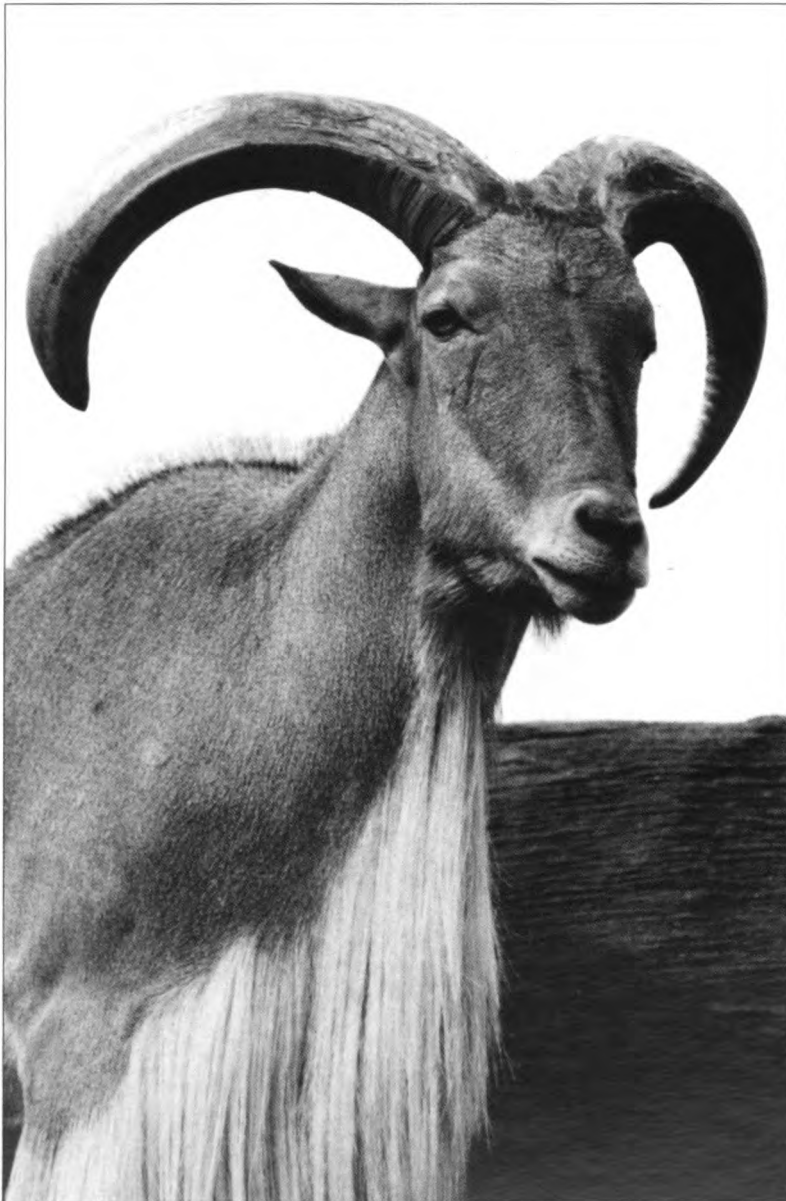
4. Livestock grazing on desert bighorn habitats will be managed via land-use or activity plans to mitigate impacts to desert bighorn and their habitats and to ensure objectives for desert bighorn are being achieved.

5. Spread of junipers (*Juniperus spp.*), tamarix (*Tamarix spp.*), or other similar trees and shrubs into "open" habitats through plant succession, regression, or exotic plant introduction will be controlled to preserve open habitats.

6. Only 3-strand fences with the bottom wire smooth and the wires spaced 20, 35, and 39 inches from the ground will be constructed in desert bighorn habitat areas. Fencing of bighorn waters will be avoided except where necessary to reserve water for bighorn. All fencing will be according to BLM standards (U.S. Dep. Interior, Bureau of Land Management 1985).

7. If an exotic ungulate population occurs in a desert bighorn habitat, where the exotic species is capable of surviving and competing with desert bighorn, the population will be controlled at the lowest numbers possible. No new release of exotic ungulates will be permitted within desert bighorn habitats.

8. Wild horses and burros will be controlled at the lowest num-



Gary Randall/Tom Stack & Associates

Barbary sheep, an introduced exotic, compete with desert bighorn for food and water.



Feral Burros compete with desert bighorn for forage and other resources.

- bers possible or as identified in land-use plans to mitigate impacts to desert bighorn and desert bighorn habitat.
- 9. Excessive use by recreationists will be regulated on major desert bighorn use areas.
- 10. To the extent possible, the BLM will not authorize activities that result in permanent human occupation or dwellings within desert bighorn habitat.
- 11. Off-road vehicles in desert bighorn habitats will be limited to existing roads and trails.
- 12. Impacts to desert bighorn or their habitats will be mitigated to the extent possible on all mineral or fossil fuel exploration and development proposals.
- 13. New road construction will be minimized in desert bighorn habitats and, where feasible, roads no longer serving a definite purpose will be "put to bed."
- 14. In carrying out BLM's responsibilities regarding reintroducing desert bighorn into historic habitats, BLM will be guided by established procedures as recommended by the Desert Bighorn Council (Wilson and Douglas 1982) and by newly accepted practices as they are developed.
- 15. For additional guidance on management of desert bighorn habitat, BLM will use established guidance as recommended by the Desert Bighorn Council (Wilson et al. 1980) or subsequent updates.

These recommended practices and standards are based on substantial literature and represent a consensus of biologists on the requirements to maintain viable populations of desert bighorn sheep. They will be used as guidelines in developing RMPs, HMPs, and other activity plans where BLM's objective is to maintain or restore habitat to support a viable desert bighorn sheep population. These guidelines will not be used to override management decisions already made through the land-use planning

process. Where management objectives and practices are not consistent with these guidelines, funding will be redirected to areas where such conflicts do not exist until RMPs can be amended or management practices modified. BLM's commitment to following these practices and standards on areas where the objective is to maintain or restore habitat for viable populations will ensure efficient use of funds expended in the program.

Section 3.

Information Needs and Standards

A successful program for recovery of desert bighorn sheep requires good information. Standards and practices for obtaining information through inventory, monitoring, special studies, or research and development are described in this section.

Inventories of desert bighorn habitat and populations are needed to determine how to manage habitat for viable populations of desert bighorn. These inventories must be completed, documented, and used to develop desert bighorn management objectives in HMPs or other activity plans. Activity plans with desert bighorn objectives will be completed and approved according to BLM standards (U.S. Dep. Interior, Bureau of Land Management 1981).

Monitoring of desert bighorn populations and habitats is essential to determine if management objectives of activity plans are being achieved. Monitoring will be conducted on all areas being enhanced to support viable populations to see if objectives are being achieved.

Special studies are often necessary to obtain specific information such as bighorn seasonal movements or competition with other ungulates. Such studies will be conducted or contracted as information is needed for effective management and as funding is available.

Research and development is needed to solve habitat management problems and facilitate management. Research often takes many years to produce results that can be used by management. Thus, research and development represents an investment in the future and a long-term commitment. BLM will conduct or fund such efforts through a program of well-planned, adequately funded, goal-oriented research.

Specific research and development areas and topics have been identified and ranked by a task force of BLM biologists (U.S. Department of the Interior 1982). These topics fall into the following five general areas:

- a. **Disease and Genetics.** Information is needed on the cause of both catastrophic and chronic mortality from disease, particularly lamb mortality, and the habitat factors that contribute to such mortality.
- b. **Nutritional Requirements.** A method is needed to quantify carrying capacity of desert bighorn ranges based on seasonal production and nutritional properties of forage in relation to nutritional requirements of the animal.
- c. **Impacts of Domestic Livestock and Feral Animals.** The impact of varying densities of livestock or feral animals on desert bighorn and their habitat through competition for forage, space, and water and through transmission of disease needs to be understood.
- d. **Habitat Evaluation Techniques.** An improved, standardized, and computer-compatible procedure for habitat evaluation is needed. This system would provide a standardized rating system for habitats presently occupied by bighorn as well as for those being considered for introductions.
- e. **Methodology for Mitigation and Habitat Improvement.** A set of specific, practical, and uniform guidelines for mitigating impacts to desert bighorn habitat or for habitat improvement is needed.

More specific discussion of these topics and proposed strategies for pursuing such information needs are found in the task force report (U.S. Department of the Interior 1982). This effort will be guided by this report and coordinated through the BLM Service Center. In order to achieve continuity in the research program, BLM will commit approximately 10 to 15 percent of the program funding to research and development annually.

However, so that such efforts do not encroach upon ongoing management, the research and development effort will never exceed 15 percent of the total program for a given year.

Future Activities, Plan Revisions, and Monitoring

Long-range plans incorporating vast areas must be dynamic if they are to continue to be useful as management guidelines. Therefore, the previously stated goal, objectives, and procedures will be revised as necessary. Similarly, the management practices and information needs will be modified or amended as new information becomes available.

Information from inventory, monitoring, and research will provide the basis for formally updating the plan every 5 years. The number of habitat areas that are supporting viable populations, as reported by the field offices, will ultimately measure the success of the program.

Summary

The BLM's desert bighorn program will be continued under the direction of this management plan. Adherence to the plan should facilitate maintenance of 33 desert bighorn viable populations, recovery of an additional 58 populations to viable

population size, and reintroduction of populations into 24 historic habitat areas. All of these objectives can be met within the next 10 years with adequate funding.

Literature Cited

BRUSSARD, P.F. 1986. The Perils of Small Populations II: Genetic Threats to Persistence. Chapter 4, pp. 33-40 in Wilcox, B.A., P.F. Brussard, and B.G. Marcot (Eds.) *The Management of Viable Populations—Theory, Applications and Case Studies*. Center for Conservation Biology, Stanford University, 188 pp.

BUECHNER, H.K. 1960. The bighorn sheep in the United States, its past, present, and future. *Wildl. Monogr.* No. 4, 174 pp.

COOPERRIDER, A.Y. 1985. The desert bighorn. Pages 472-485 in R.L. Di Silvestro, ed. *Audubon Wildlife Report 1985*, The National Audubon Society, New York, N.Y. 671 pp.

———. 1986. BLM's desert bighorn sheep program. *Trans. N. Amer. Wildlife and Natural Resources Conference* 51:45-51.

GEIST, V. 1975. On the management of mountain sheep: theoretical considerations. Pages 77-105 in J.B. Trefethen, ed. *The wild sheep in modern North America*. Proc. of the Workshop on the Management Biology of North American Wild Sheep. Boone and Crockett Club, New York, N.Y. 302 pp.

KELLY, W.E. 1980. Hunting. Pages 336-342 in G. Monson and L. Sumner, eds. *The desert bighorn—its life history, ecology, and management*. Univ. Arizona Press, Tucson, 370 pp.

KRAUSMAN, P.R. and B.D. LEOPOLD. 1986. The importance of small populations of desert bighorn sheep. *Trans. N. Amer. Wildl. and Nat. Res. Conf.* 51:52-61.

MARCOT, B.G., R.S. Holthausen, and H. Salwasser. 1986. Viable population planning. Chapter 6, pp. 49-62 in Wilcox, B.A., P.F. Brussard, and B.G. Marcot (Eds.) *The Management of Viable Populations—Theory, Applications and Case Studies*. Center for Conservation Biology, Stanford University, 188 pp.

SCHWARTZ, O.A., V.C. Bleich, and S.A. Holl. 1986. Genetics and conservation of mountain sheep *Ovis canadensis nelsoni*. *Biol. Conserv.* 37:179-190.

U.S. DEPARTMENT OF THE INTERIOR, BUREAU OF LAND MANAGEMENT. 1981. Manual 6780 - Habitat Management Plans. Unnumbered.

U.S. DEPARTMENT OF THE INTERIOR, BUREAU OF LAND MANAGEMENT. 1982. Research needs for desert bighorn sheep habitat. Unpub. Report, 16 pp.

U.S. DEPARTMENT OF THE INTERIOR, BUREAU OF LAND MANAGEMENT. 1985. Manual Handbook H-1741-1 - Fencing. Unnumbered

WEAVER, R.A. 1985. The status of the desert bighorn in the United States. pp. 82-85 in M. Hoefs (ed.) *Wild Sheep—Distribution, abundance, management and conservation of the sheep of the world and closely related mountain ungulates*. Northern Wild Sheep and Goat Council, Special Report, 218 pp.

WEAVER, R. 1986. Personal communication. Mr. Weaver indicated that all the desert bighorn ranges in the California Desert that were originally estimated to have less than 80 animals, no longer supported bighorn populations. The original estimates were made in late 1950s and early 1960s.

WILCOX, B.A. 1986. Introduction. Chapter 1, pp. 1-6 in Wilcox, B.A., P.F. Brussard, and B.G. Marcot (Eds.) *The Management of Viable Populations—Theory, Applications and Case Studies*. Center for Conservation Biology, Stanford University, 188 pp.

WILSON, L.O. 1975. Report and recommendations of the desert and Mexican bighorn sheep workshop group. Pages 110-143 in J.B. Trefethen, ed. *The Wild Sheep in Modern North America*. Proc. of

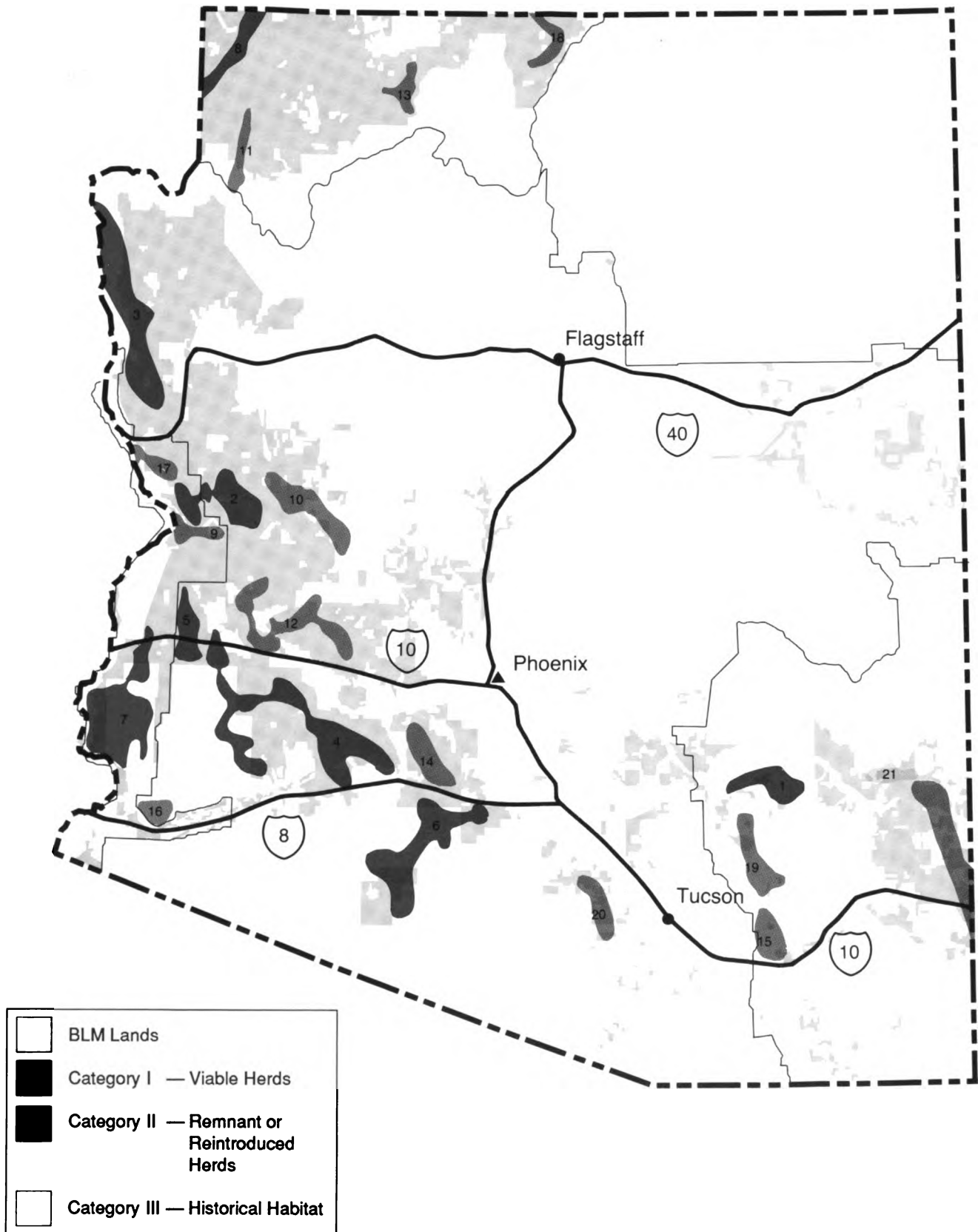
the Workshop on the Management Biology of North American Wild Sheep. Boone and Crockett Club, New York. 302 pp.

WILSON, L.O. and C.L. DOUGLAS (Eds.). 1982. Revised procedures for capturing and re-establishing desert bighorn. Trans. Desert Bighorn Council 26:1-7.

WILSON, L.O., J. Blaisdell, G. Welsh, R. Weaver, R. Brisham, W. Kelly, J. Yoakum, M. Hinks, J. Turner, and J. DeForge. 1980. Desert bighorn habitat requirements and management recommendations. Trans. Desert Bighorn Council 24:1-7.

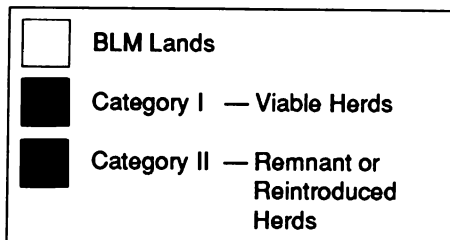
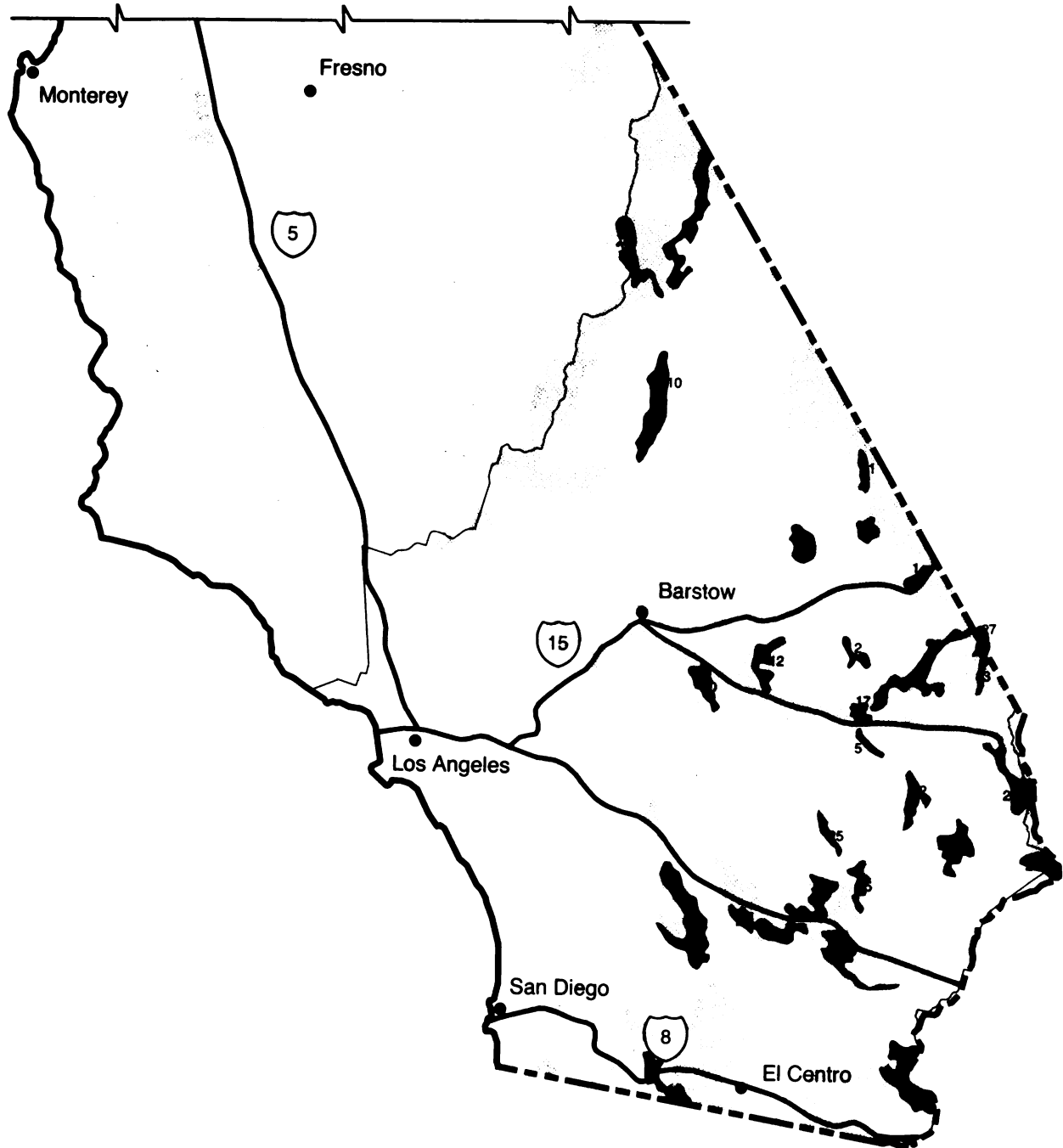
Appendix

ARIZONA



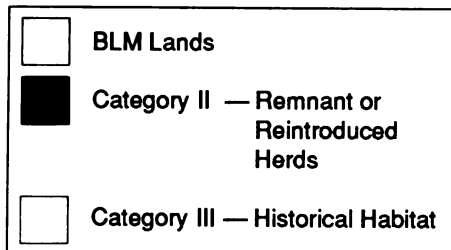
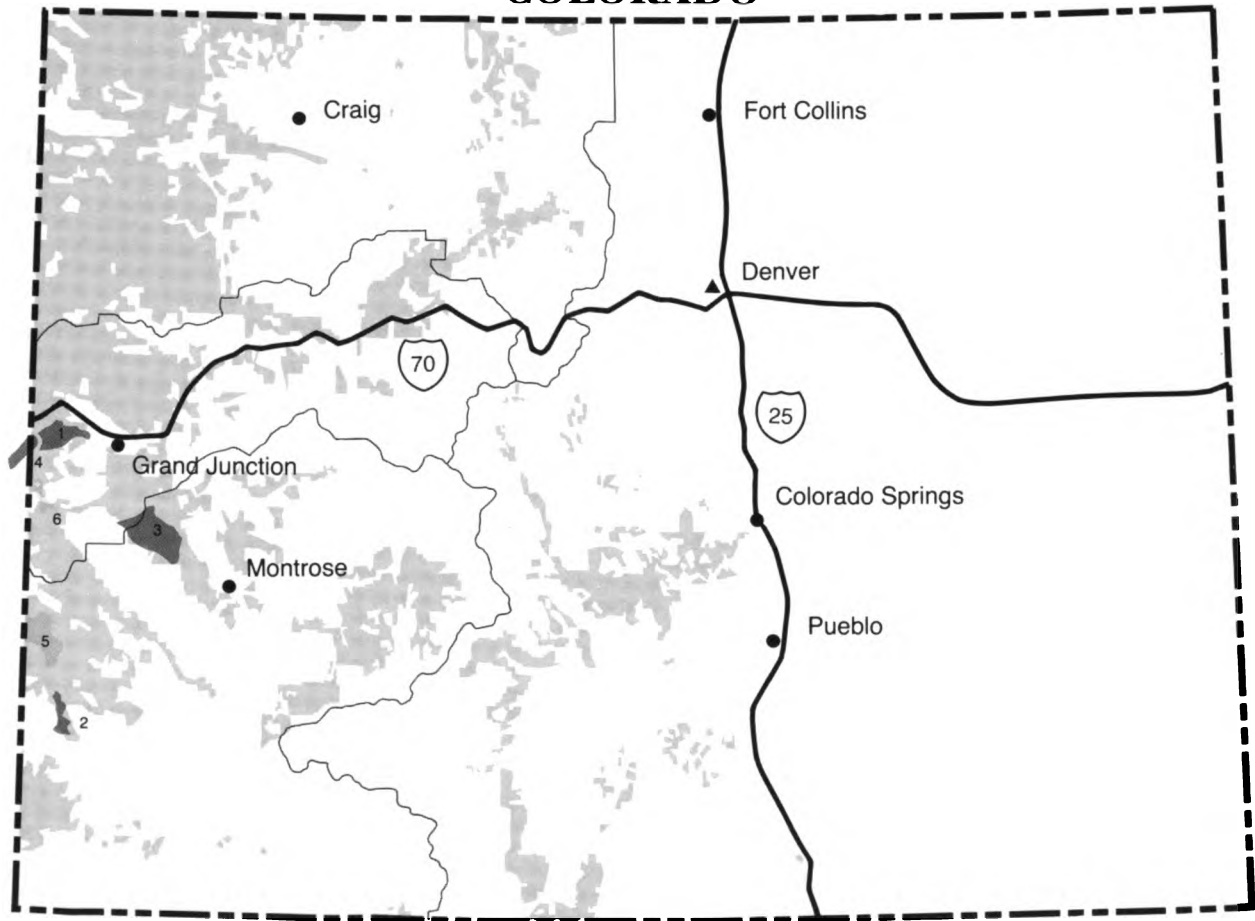
Arizona Habitat Area	Subspecies	Current Population Estimate	Potential Population Estimate	Percent BLM
Category I				
1. Aravaipa Canyon	Mexican	160	300	90
2. Bill Williams Mountains/Aubrey Hills/ Castenada Peak/Aubrey Peak	Nelson	100	160	85
3. Black Mountains	Nelson	1200	1500	84
4. Eagletail/Little Horn/New Water/ Paloma Mountains/Cemetary Ridge/ Tank Mountains/Gila Bend Mountain	Mexican	290	400	98
5. Plomosa	Mexican	194	250	98
6. Sand Tanks/Tabletop/Sauceda Betamote/Coffee Pot Mountains	Mexican	160	350	99
7. Trigo/Trigo Mountains/Chocolate/ Dome Rock Mountains	Mexican	200	240	50
8. Virgin Mountains	Nelson	100	150	99
Category II				
9. Buckskin Mountains	Mexican	31-105	110	95
10. Black Mountain/Ives Peak/ Poachie Range/Burro Creek	Nelson	10-20	125	65
11. Grand Wash Cliffs	Nelson	60	200	100
12. Harquahala/Little Harquahala Mountains/ Granite Wash/Bighorn Mountains	Mexican	90	145	97
13. Kanab Creek	Nelson	50	130	95
14. Maricopa Mountain	Mexican	20	200	100
15. Mescal Mountains	Mexican	transient	100	75
16. Muggins Mountains	Mexican	10	80	36
17. Needles Peaks/Mojave Mountains	Mexican	25	120	73
18. Paria Canyon/Vermillion Cliffs	Nelson	70	175	100
19. Redfield/Muleshoe/Sombrero Butte	Mexican	50	150	60
20. Silverbell Mountains	Mexican	30	80	80
Category III				
21. Gila Box	Nelson	0	200	82

CALIFORNIA



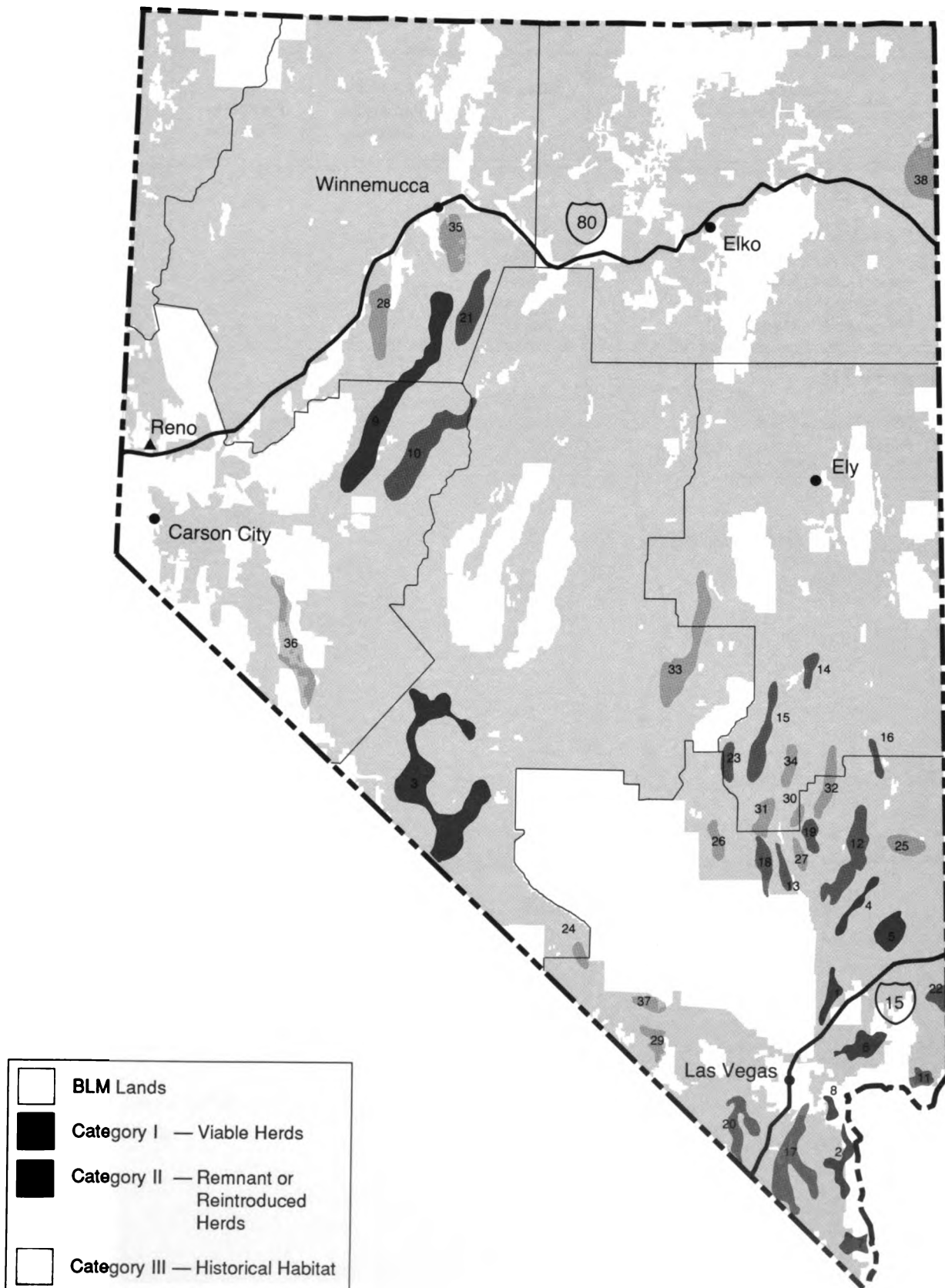
California Habitat Area	Subspecies	Current Population Estimate	Potential Population Estimate	Percent BLM
Category I				
1. Clark Mountain	Nelson	150	150	97
2. Kelso Mountains/Old Dad Peak	Nelson	250	250	95
3. Kingston Mountains	Nelson	150	180	97
4. Last Chance Range/Dry Mountain	Nelson	100	150	85
5. Marble Mountains	Nelson	180	200	55
6. New York/Providence/Woods Mountain/ Hackberry Mountains	Nelson	165	165	80
7. Picacho Peaks	Nelson	110	150	55
8. Santa Rosa Mountains	Peninsular	350	500	35
9. Turtle Mountains	Nelson	110	150	96
Category II				
10. Argus Range	Nelson	25	100	55
11. Avawatz Mountains	Nelson	35	100	55
12. Cady Mountains	Nelson	50	90	70
13. Castle Mountains/Hart Peak/Piute Range	Nelson	25	80	95
14. Chuckwalla Mountains	Nelson	10	100	95
15. Coxcomb Mountains	Nelson	15	80	60
16. Eagle Mountains	Nelson	45	80	75
17. Granite Mountains	Nelson	15	100	95
18. Inyo Mountains/Nelson Range	Nelson	40	140	95
19. Jacumba/In-Ko-Pah Mountains	Peninsular	30	100	35
20. Newberry Mountains/Rodman Mountains	Nelson	15	200	70
21. Nopah Range	Nelson	80	100	95
22. Old Woman Mountains	Nelson	70	200	75
23. Orocopia Mountains/Mecca Hills	Nelson	80	150	55
24. Sacramento Mountains/ Chemehuevi Mountains	Nelson	80	125	70
25. Sheep Hole Mountains	Nelson	50	85	95
26. Whipple Mountains	Nelson	80	130	95
27. New York/Castle Mountains (California/Nevada)	Nelson	25	140	99

COLORADO



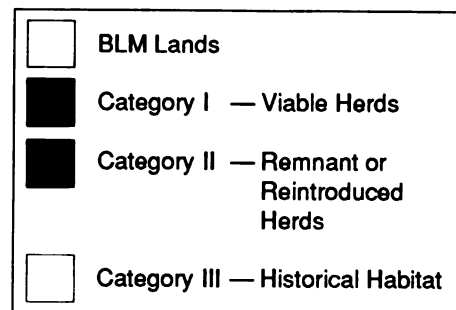
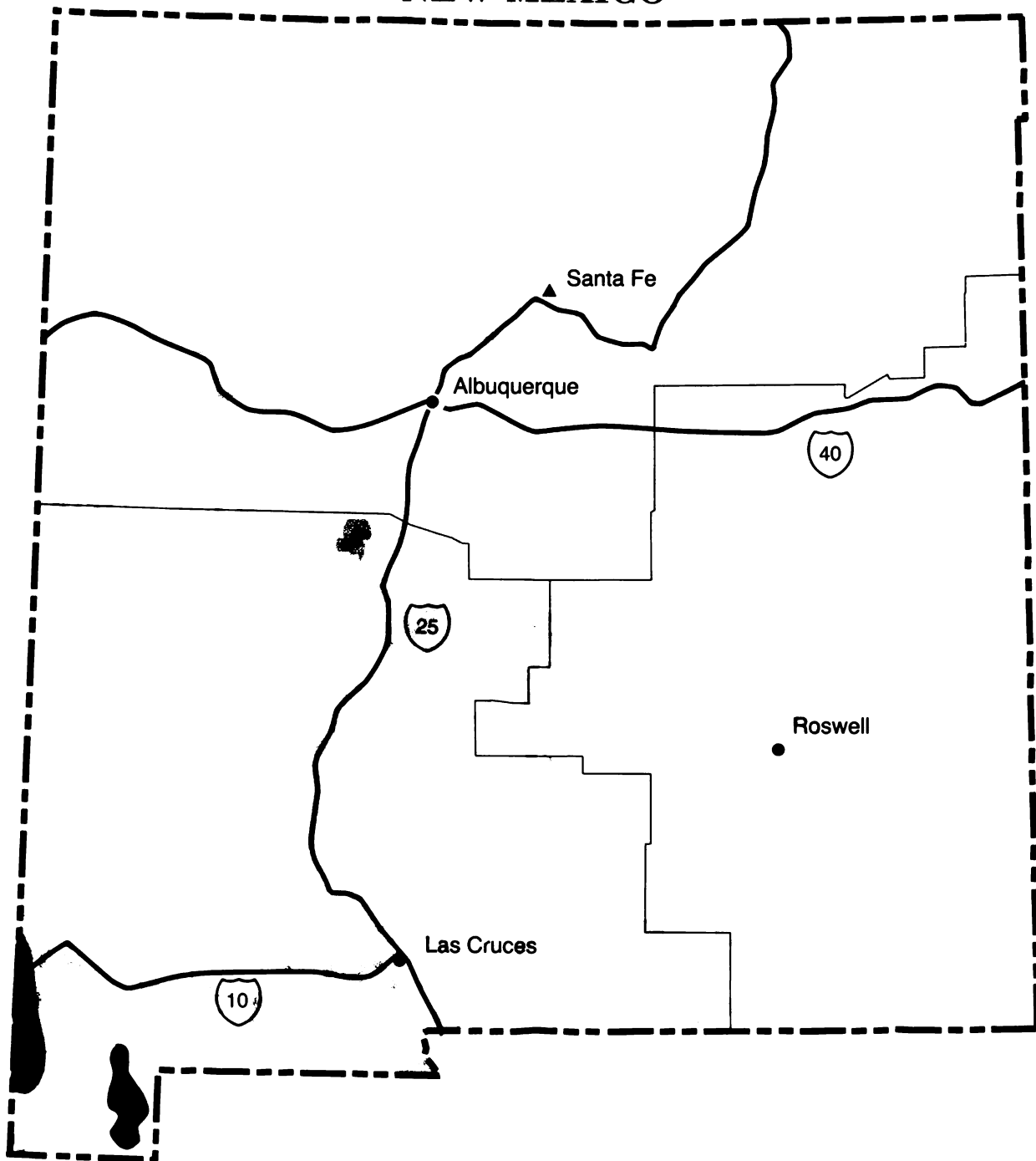
Colorado Habitat Area	Subspecies	Current Population Estimate	Potential Population Estimate	Percent BLM
Category II				
1. Devils-Mee Canyon	(Nelson X Mexican)	60-70	300	90
2. Upper Dolores River	Nelson	35	200	60
3. West Gunnison	Nelson	45-50	450	95
4. Westwater (Colorado/Utah)	Nelson	30	125	96
Category III				
5. Lower Dolores River	Nelson	0	400	99
6. Palisades	Nelson	0	100	100

NEVADA



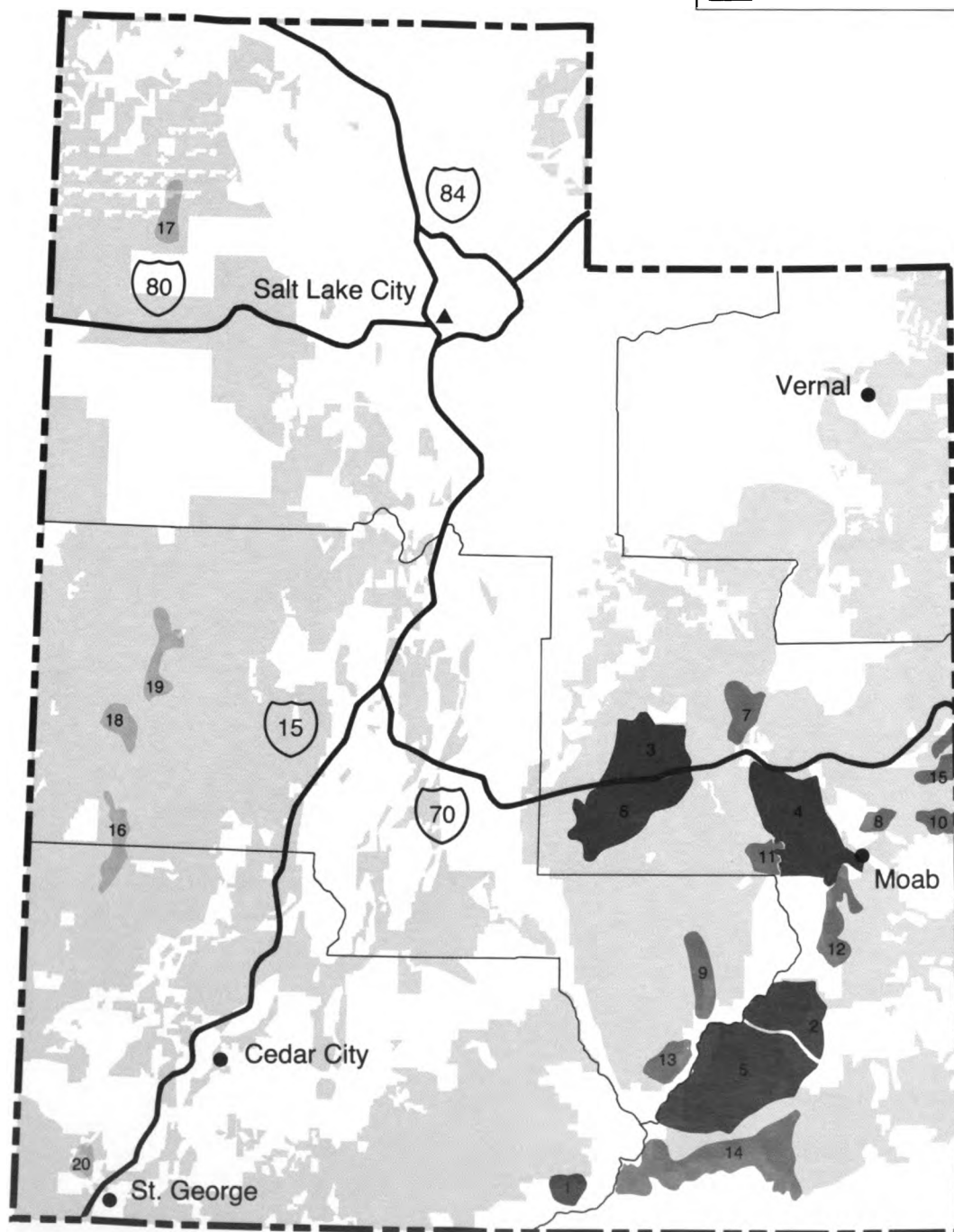
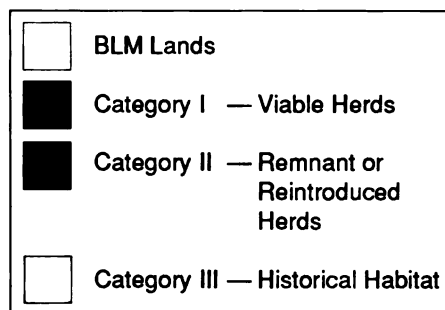
Nevada Habitat Area	Subspecies	Current Population Estimate	Potential Population Estimate	Percent BLM
Category I				
1. Arrow Canyon	Nelson	117	396	99
2. Eldorado Mountains	Nelson	424	742	50
3. Lone Mountain/Silver Peak/ Monte Crisco	Nelson	394	394	unk
4. Meadow Valley Mountains	Nelson	175	510	100
5. Mormon Mountains	Nelson	362	362	100
6. Muddy Mountains	Nelson	265	505	88
7. Newberry	Nelson	105	169	30
8. River Mountains	Nelson	207	207	30
9. Stillwater Mountains	Nelson	102	350	99
Category II				
10. Clan Alpine	Nelson	30	125	99
11. Gold Butte	Nelson	20	671	99
12. Delmar Mountains	Nelson	50	759	99
13. East Pahrnagat Range	Nelson	50	unk	68
14. Far South Egan Range	Nelson	19	unk	99
15. Golden Gate Range	Nelson	transient	unk	99
16. Highland Range	Nelson	41	134	100
17. McCullough Mountains	Nelson	80	734	99
18. South Pahrnagat Range	Nelson	unk	574	99
19. South Pahroc	Nelson	33	165	100
20. South Spring/Bird Spring Mountains	Nelson	50	708	97
21. Tobin Range	Nelson	44	339	97
22. Virgin Mountains	Nelson	69	484	99
23. Worthington Mountains	Nelson	25	unk	95
Category III				
24. Bare Mountain	Nelson	0	169	50
25. Clover Mountains	Nelson	0	unk	99
26. Groom Range	Nelson	0	360	99
27. Hiko Mountains	Nelson	0	117	100
28. Humboldt	Nelson	0	359	76
29. Johnie (Last Chance) Range	Nelson	0	unk	99
30. North Hiko	Nelson	0	unk	99
31. North Pahrnagat Range	Nelson	0	unk	95
32. North Pahroes	Nelson	0	218	99
33. Pancake Range	Nelson	0	110	100
34. Seaman Range/Timber Mountain	Nelson	0	240	90
35. Sonoma	Nelson	0	285	52
36. Wassuk Range	Nelson	0	125	95
37. Spector Range	Nelson	0	unk	99
38. Pilot Range (Nevada/Utah)	Nelson	0	140	50

NEW MEXICO



New Mexico Habitat Area	Subspecies	Current Population Estimate	Potential Population Estimate	Percent BLM
Category I				
1. Big Hatchet/Alamo Hueco/Little Hatchet	Mexican	100	400	63
Category II				
2. Peloncillo Mountains	Mexican	30	400	50
Category III				
3. Ladron Mountains	Mexican	0	130	56

UTAH



Utah Habitat Area	Subspecies	Current Population Estimate	Potential Population Estimate	Percent BLM
Category I				
1. Kaparowitz Plateau	Nelson	100	150	70
2. North San Juan	Nelson	556	556	50
3. North San Rafael Desert	Nelson	225	225	89
4. Potash	Nelson	222	222	88
5. South San Juan	Nelson	834	834	60
6. South San Rafael Desert	Nelson	120	150	90
Category II				
7. Beckwith Plateau	Nelson	39	200	90
8. Colorado River/Professor Valley	Nelson	10	125	96
9. Dirty Devil		25-50	unk	unk
10. Dolores River	Nelson	unk	250	96
11. Horseshoe Canyon/Bowknot Bend	Nelson	25	200	98
12. Kane Springs-Lockhart	Nelson	50	unk	96
13. Little Rockies	Nelson	unk	unk	96
14. San Juan River	Nelson	72	unk	85
15. Westwater Canyon	Nelson	30	125	96
Category III				
16. Wah Wah Mountains	Nelson	0	unk	94
17. Newfoundland Mountains	Nelson	0	500	84
18. Confusion Mountains	Nelson	0	unk	92
19. House Range Mountains	Nelson	0	unk	89
20. Red Mountain	Nelson	0	100	95

THE UNIVERSITY OF MICHIGAN

DATE DUE





