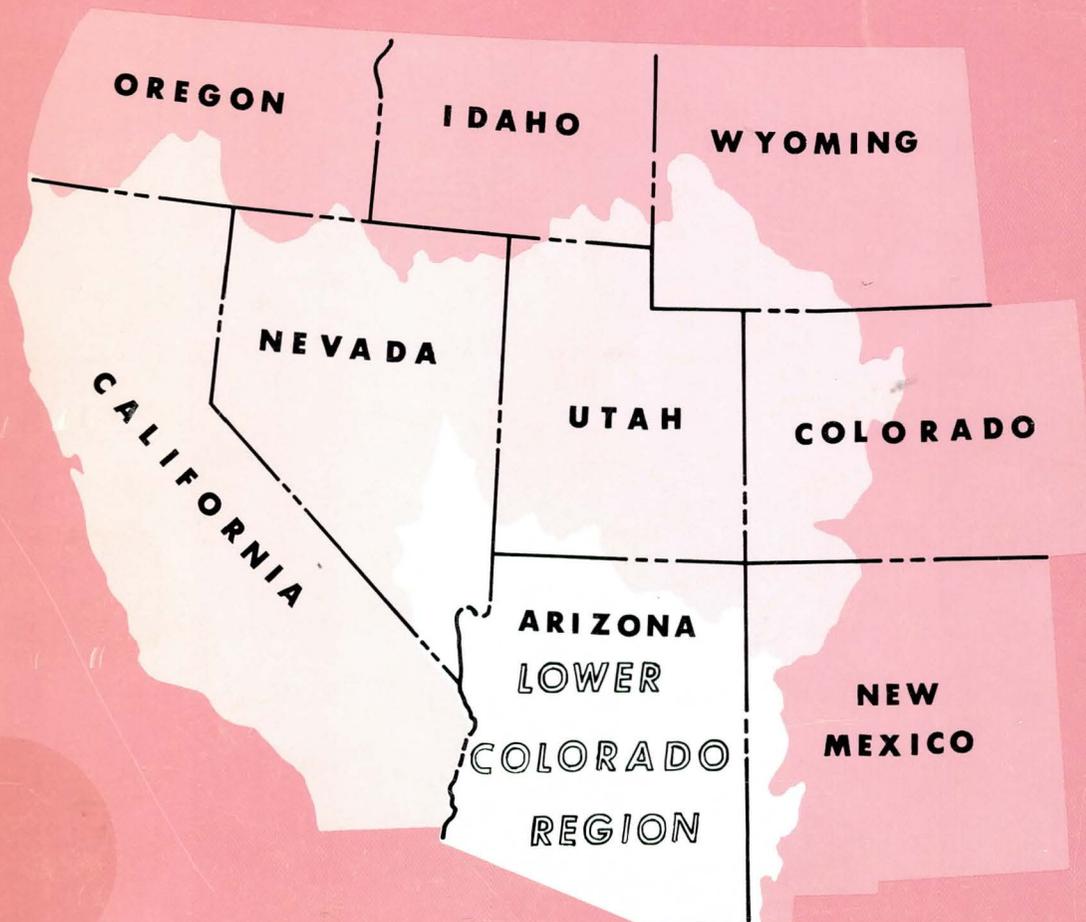


LOWER COLORADO REGION Comprehensive Framework Study

APPENDIX XIII
FISH AND WILDLIFE
JUNE 1971



PREPARED BY:

LOWER COLORADO REGION STATE - FEDERAL
INTERAGENCY GROUP FOR THE
PACIFIC SOUTHWEST INTERAGENCY COMMITTEE

FS-12

APPENDIXES TO THE MAIN REPORT

LOWER COLORADO REGION

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APPENDIX II - THE REGION

APPENDIX III - LEGAL AND INSTITUTIONAL ENVIRONMENT

APPENDIX IV - ECONOMIC BASE AND PROJECTIONS

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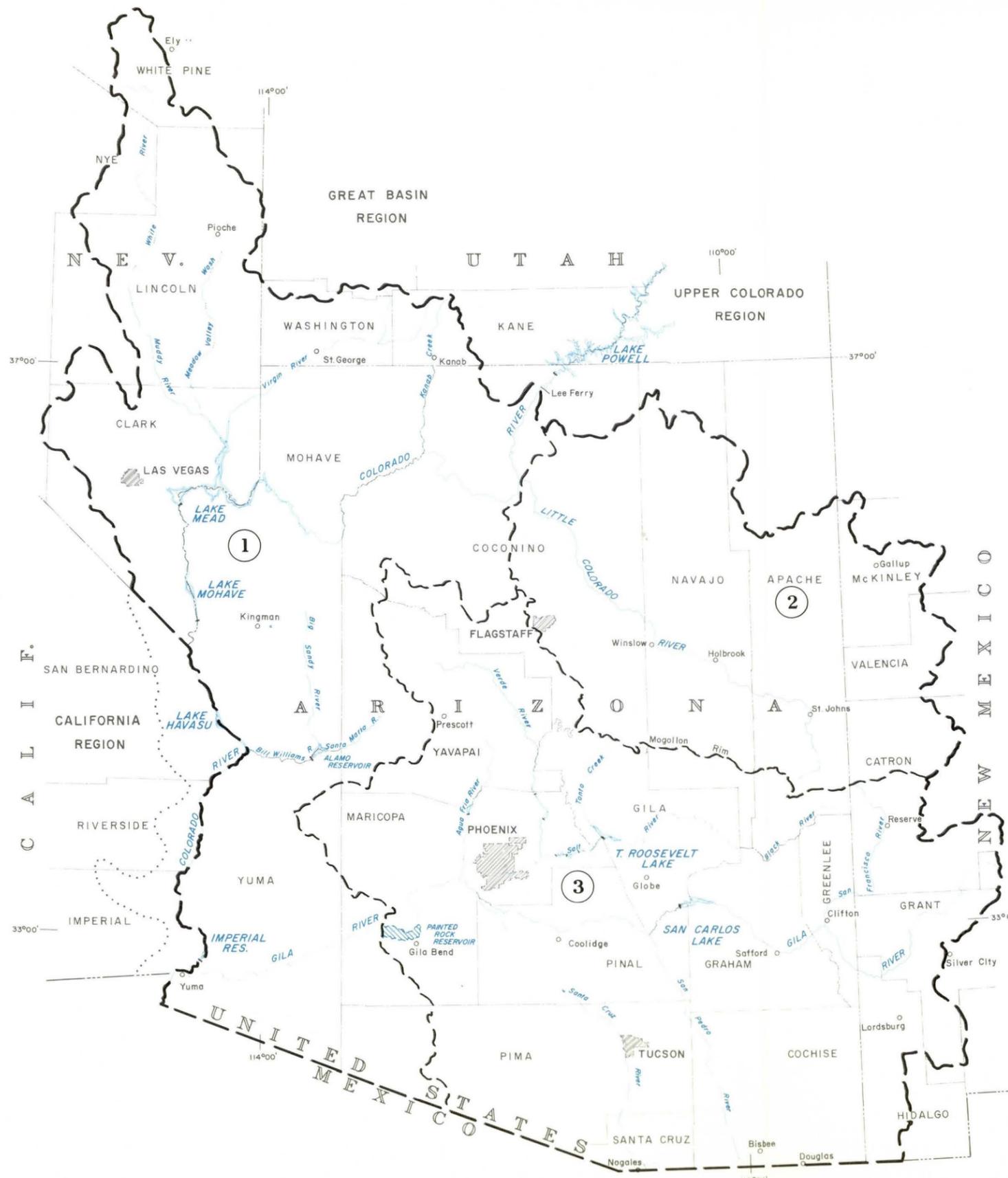
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LOWER COLORADO REGION
COMPREHENSIVE FRAMEWORK STUDY

APPENDIX XIII
FISH AND WILDLIFE

This report of the Lower Colorado Region Framework Study State-Federal Interagency Group was prepared at field-level and presents a framework program for the development and management of the water and related land resources of the Lower Colorado Region. This report is subject to review by the interested Federal agencies at the departmental level, by the Governors of the affected States, and by the Water Resources Council prior to its transmittal to the Congress for its consideration.

JUNE 1971



INDEX MAP

EXPLANATION

- Lower Colorado Region boundary
- - - Subregion boundary
- ① Lower Main Stem
- ② Little Colorado
- ③ Gila
- Lower Colorado Basin boundary
- Existing dam and reservoir
- Existing dam and intermittent lake



COMPREHENSIVE FRAMEWORK STUDY
 LOWER COLORADO REGION - HYDROLOGIC
GENERAL LOCATION MAP
 MAP NO. 1019-314-45
 SCALE OF MILES

This appendix prepared by the
FISH AND WILDLIFE WORK GROUP
of the
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The report narrative was prepared largely by the Bureau of Sport Fisheries and Wildlife, the lead agency in the Fish and Wildlife Work Group; however, it contains material from many sources and represents the thinking and judgment of numerous individuals from State and Federal agencies active in the fish and wildlife field.

SUMMARY OF FINDINGS

The Lower Colorado Hydrologic Region provides habitat for approximately 835 species of fish and wildlife. Of these, 65 are classified as game. In 1965, the game species provided about 5.5 million man-days of fishing and hunting for the human population of 1.8 million. With the population of 6.5 million predicted for the Region in 2020, the fish and wildlife resource will need to supply about 31 million man-days of fishing and hunting and an undeterminable amount of use resulting from other wildlife-oriented activities.

In 1965, approximately one of every seven residents participated actively in hunting and fishing. For every 100 resident sportsmen participating, there were 14 visiting sportsmen. Hunters and fishermen spent nearly 75 million dollars in connection with their sports. Expenditures for fishing were about twice that spent for hunting. A major portion of these expenditures were in the small communities near the hunting and fishing areas and represent an important segment of their economics. Also, it is estimated that the time and money spent on equipment, transportation, lodging, and related items for non-consumptive use of the fish and wildlife resources might equal that expended by the hunting fraternity.

The assurance of an adequate supply of fish and wildlife resources to meet future demands for hunting, fishing, other wildlife-oriented activities, and preservation of endangered species will require management of water and land to enhance these purposes. The measures proposed in the fish and wildlife program include the development and improvement of fish and wildlife habitat, associated public-use facilities, game management areas, fish hatcheries, improved management programs, and research. The measures proposed are designed to satisfy the total projected demands.

Nearly 47 million acres of the Region are in Federal ownership and support most of the fish and wildlife resources. These lands offer significant opportunities for further development. Most of the remaining 43 million acres of private, Indian, State, and other public areas provide wildlife resources and have the potential for satisfying a substantial part of the future fish and wildlife-oriented activities.

The fish and wildlife program proposes measures to maintain and improve the Region's available wildlife resource. Basically, the program proposes that the management and use of the wildlife resources be given consideration equal to that given to the other uses of the land. Recognition of the importance of wildlife production on the existing areas offers the potential of the Region being developed and managed beneficially for wildlife. Approximately 11.8 million acres within the overall ranges of some wildlife species should be designated and

managed primarily for fish and wildlife where development, management, and use of other resources would complement fish and wildlife purposes. This important aspect of preserving and adding to the quality and quantity of the resource is in part additional to that provided by wilderness, primitive, and wild and scenic river areas. There must be a re-assessment of priorities of beneficial use of lands and waters, and the development of these lands and waters must be based on other than the highest economic uses, to maintain the future environmental quality.

A considerable increase in the Region's supply of water providing fish and wildlife habitat is expected. By 1980, authorized multiple- and primary-purpose developments will enhance the resource supply existing in 1965 by 3 million man-days of fishing and hunting annually. Another one million man-days annually are expected from multiple-purpose projects expected to be developed during the 1981-2020 period.

In addition, this appendix includes proposals for water developments to improve the fish and wildlife resources which, when combined with the existing and expected resources, will satisfy the demands for fish- and wildlife-oriented activities through 2020. These proposals are for primary-purpose developments that total 2,000 acres during the 1966-1980 period; 10,500 acres during the 1981-2000 period; and 21,600 acres during the 2001-2020 period.

The annual consumptive water needs for the programmed facilities, when combined with the water consumed in 1965 at existing facilities, is estimated at 405,000 acre-feet by the year 2020. However, of this total, 110,000 represents existing water-rights at installations in 1965. Thus, the net increase in consumptive use of water for fish and wildlife purposes under the proposed program will amount to 32,000 acre-feet in 1980; 222,000 acre-feet in 2000; and 295,000 acre-feet in 2020.

The costs associated with the developments to satisfy demands for fish and wildlife during the 1966-1980, 1981-2000, and 2001-2020 study periods are \$50.5 million, \$113.8 million, and \$208.0 million respectively. However, of the total \$372 million by 2020, \$45 million are costs associated with authorized multiple- and primary-purpose projects expected by 1980 plus the multiple-purpose projects proposed during the 1981-2020 period. Thus the net costs for fish and wildlife developments to satisfy the remaining demands through 2020 are \$327 million.

The annual operation, maintenance, and replacement costs associated with the fish and wildlife developments for the last year of each period are \$3.8 million during the 1966-1980 period; \$9.6 million during the 1981-2000 period; and \$17.7 million during the 2001-2020 period. The total annual operation, maintenance, and replacements costs by 2020 are \$31.1 million.

Details of the fish and wildlife proposals are contained in the underlying report.

LOWER COLORADO REGION COMPREHENSIVE FRAMEWORK STUDY

APPENDIX XIII

FISH AND WILDLIFE

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INTRODUCTION

CHAPTER 1 - INTRODUCTION

PURPOSE, SCOPE, AND AUTHORITY

This appendix presents the findings of the Fish and Wildlife Work Group which is one of the committees assembled to prepare appendixes on designated elements of the Lower Colorado Region Comprehensive Study. The primary objectives of this study have been to determine for the Hydrologic Region as a whole and for each of three subregions: (1) the current status and extent of public use of fish and wildlife resources; (2) the future demand and need for fish and wildlife resources; and (3) opportunities for planning of development of these resources to meet future demands.

The Lower Colorado Region Comprehensive Study, one of four studies being conducted concurrently in the Pacific Southwest, was authorized by the Water Resources Planning Act approved July 22, 1965 (79 Stat. 244). It had its beginnings, however, in planning concepts embodied in Senate Document No. 97, 87th Congress, Second Session, and was subsequently initiated by a letter dated October 1966, from the Water Resources Council, requesting the Pacific Southwest Interagency Committee to assume direction of comprehensive studies in the Pacific Southwest.

RELATIONSHIP TO OTHER PARTS OF THE REPORT

This appendix relies primarily upon basic population data contained in the Economics Appendix IV, especially in relation to the fish and wildlife demand projections. It is also directly related to many of the functional appendixes.

Fish and wildlife are directly related to and are dependent upon other functions of water and related land resource development. Changes in land use through irrigation and drainage, for example, affect the environment either in a positive or negative sense, depending on the species inhabiting the area. Manipulations of water such as channelization of streams and lowering of groundwater tables affect fish and wildlife environments by altering habitat.

The relationships of fish and wildlife to other project functions of multipurpose resource development are covered in detail in this appendix as well as the Main Report and General Program and Alternatives Appendix XVIII. Data from this appendix are used in general plan studies as well as to provide a background for the fish and wildlife discussion in the Summary Analytical Report of the Pacific Southwest Region. Also, data from this appendix are used in other appendixes, including the Land

DESCRIPTION OF THE REGION

The Lower Colorado Hydrologic Region is comprised of 90,327,000 acres of land and water in Arizona, southern Nevada, western New Mexico, and southwestern Utah. It contains the drainage of the Colorado River from Lee Ferry, Arizona, to the Arizona-Mexico border, except that portion in California. Also, it includes several closed basins in Arizona, Nevada, and New Mexico. The Region's boundaries are Mexico on the south, the Continental Divide in New Mexico on the east, and California on the west, and it includes most of Arizona and parts of New Mexico, Nevada, and Utah.

A wide range of climatic conditions is a characteristic of the Lower Colorado Region due to wide differences in latitude and altitude. Temperatures of more than 100° F. are common during the summer in most of the Region, while some parts of the Region are subject to sustained winter temperatures below zero. Precipitation in the Region varies with location and altitude, from about 3 to over 30 inches annually.

In the Region, there are vast deserts; mountains that are barren, some that are sparsely forested, and others that are forested; fertile valleys; open foothills and those that are covered with chaparral; deep gorges of the Colorado River; and coldwater lakes, most of which are man-made. It is a region where precipitation for the most part is extremely low and yet contains sections where rain and snow are fairly heavy. With such extremes, there is a variety of plant life and habitats, and of fish and wildlife species.

The Lower Colorado Hydrologic Region in 1965 had a population of about 1,847,000, most of which was concentrated in the large metropolitan areas of Phoenix and Tucson, Arizona, and Las Vegas, Nevada. Principal industries in the Region include light manufacturing, tourism, lumber, mining, agriculture, and livestock.

HISTORY

The very early explorers, trappers, and mountain men lived off the land and had to depend on fish and game to survive. Competing with the Indians for food the early trappers, especially, spent considerable time in the Region and undoubtedly made every effort to scout out and secure game. The explorers, too, depended upon the land and logically had full-time hunters assigned to the larger groups. The smaller parties periodically detailed their members on food gathering expeditions.

Journals and historical reports indicate that by the mid-1800's, scratching out a wild meat meal was no picnic. Fish and rabbits were the main staples for many, both Indian and non-Indian. Bigger game was available, but becoming scarce as the reports show, when they mention extended hunting trips for bighorn sheep, deer, elk, antelope, sage hen, and waterfowl.

Realizing that the wildlife resources were being over-exploited, the early conservationists initiated conservation laws. The first provisions in the Region were made in 1851 for the control of predators in the area now known as Utah. Two years later, Utah initiated a law prohibiting the needless destruction of fish. Little can be found about early game laws in the territories of Arizona, Nevada, and New Mexico. It is known that the various territorial laws established during the 1860's and early 1870's were either inadequate or there was no enforcement.

In 1876, the Territory of Utah established seasons for the taking of game birds and big-game animals. The State of Nevada passed its first relatively comprehensive law in 1877 that set seasons for the taking of upland game and waterfowl and had a penalty attached for violators.

Arizona's earliest regulations mostly concerned fish until 1877 when the Territorial Fish Commission was given the added authority to regulate the taking of game. During this period, the Territory of New Mexico was establishing similar laws setting seasons and providing penalties for violators.

By 1890, the State of Nevada and the Territories of Utah, Arizona, and New Mexico had salaried administrators of fish and/or game. The early "commissioners" were prototypes of the early-day game wardens. They devoted most of their time to enforcing what few conservation laws were in existence and spent the rest of it trying to stock wildlife species.

The needs for game wardens, fish hatcheries, licenses for fishing and hunting, and numerous new laws were provided by the various governments in the Region at the turn of the century. Trapping and transplanting wildlife became a popular management practice. Utah passed a law preventing exportation of fish and game outside of the state. By 1910, State and Territorial bag limits were being established and seasons on selected animals were being closed.

Statehood brought the adoption of many fish and game laws established during the territorial days. For example, the first session of the New Mexico State Legislature in 1912 enacted 25 pages of laws for fish and game management.

Thus were the modest beginnings of fish and game administration in the Region. From those days until the 1930's, the fishing and hunting laws became more comprehensive and it was becoming apparent that if the wildlife resources were to receive any real management, some specialized group should have the authority to investigate and regulate the resource as needed. In 1929, Arizona established a Department of Conservation to enforce laws and do the countless other jobs which had evolved as a part of fish and game management. The Commissioners became an advisory, policy-making group. Subsequently, the conservation agencies of Utah, New Mexico, and Nevada have reorganized and now operate under a Commission-Department form of fish and game administration.

In 1937, federal monies became available to the various states for use on wildlife research and development projects. Similar appropriations were made in 1951 for fishery management and development programs. The beginning of the Commission-Department system and the available federal assistance paved the way for the scientific, biologically sound management practices applied today.

In summing up the Region's fish and wildlife past, the management policies of today are based on the early approaches. The early conservationists did the best job they knew and their procedures changed with time. Some changes have not been good, but overall, especially in the last 100 years, most changes must be listed as improvements. The success of past practices is verified by the fact that in general, wildlife is more numerous today than at the turn of the century. Fishing and hunting are better now and many game species which were nearly extinct in 1900 are now numerous enough to be hunted on a yearly basis.

RESOURCE UTILIZATION

Most of the Region provides habitat and is of value to both game and nongame species of fish and wildlife, although much of the habitat is not of high quality. Urban and transportation lands are considered valueless for most game species. Recreation lands and waters where heavy public use occurs are not usually important for fish and wildlife, but with improved management they would become more important, especially for nongame species. Many impoundments are without permanent pools and do not sustain a fishery. Such areas are important to wildlife if the water is available during the dry season or during the seasonal migration of waterfowl and if vegetation becomes established and provides wildlife cover. Generally, the more arid areas of the Region support only a few nongame species. Most are uniquely adapted to the conditions under which they exist.

It is estimated that 76,425,000 acres of the Region contribute materially as important habitat for fish and wildlife and most are available for fishing or hunting. Generally, game and nongame species are

compatible and commonly inhabit similar areas. Table 1 shows habitat types and acreages important to fish and wildlife.

Table 1
Important Fish and Wildlife Habitat

Broad Vegetal Cover Types ^{1/}	Regional Total		Fish and Wildlife Habitat	
	Acres (1,000's)	Percent	Acres (1,000's)	Percent of Regional Total
Conifer Forest	6,522.0	7.2	6,500.0	7.2
Woodland	19,903.0	22.0	19,500.0	21.6
Chaparral	3,466.0	3.8	3,400.0	3.7
Southern Desert Shrub	32,137.0	35.6	22,000.0	24.3
Northern Desert Shrub	8,547.0	9.5	7,600.0	8.4
Grassland	16,902.0	18.7	16,000.0	17.7
Riparian	106.0	0.1	97.0	0.1
Urban, Transportation	513.0	0.6	-0-	0.0
Cropland	1,816.0	2.0	1,000.0	1.1
Water	340.0	0.4	260.0	0.3
Barren and other	76.0	0.1	68.0	0.1
Regional Total	90,328.0	100.0	76,425.0	84.5

^{1/} Map of Cover Types in Land Resources and Use Appendix VI.

The State fish and game departments are responsible for the management of all game and nongame species of wildlife on lands within their respective boundaries, except for migratory birds whose welfare is a Federal-State responsibility. Presently, wildlife species on Indian lands are not managed by the respective States. The State fish and game departments and the Indian Tribes recognize that a controversy exists concerning the ownership and management of fish and wildlife on the reservations.

A substantial portion of the important wildlife habitat is on public lands and the management thereof is the responsibility of the land management agencies. This management is accomplished cooperatively with the appropriate State fish and game agency through agreements.

For the purpose of this study, the water and land area used by fish and wildlife is divided into three categories including fish and wildlife administered, multipurpose, and ancillary water and lands.

The water and land managed principally for fish and wildlife is administered by the several State fish and game agencies, the Bureau of Sport Fisheries and Wildlife, Indian interests, and other private land

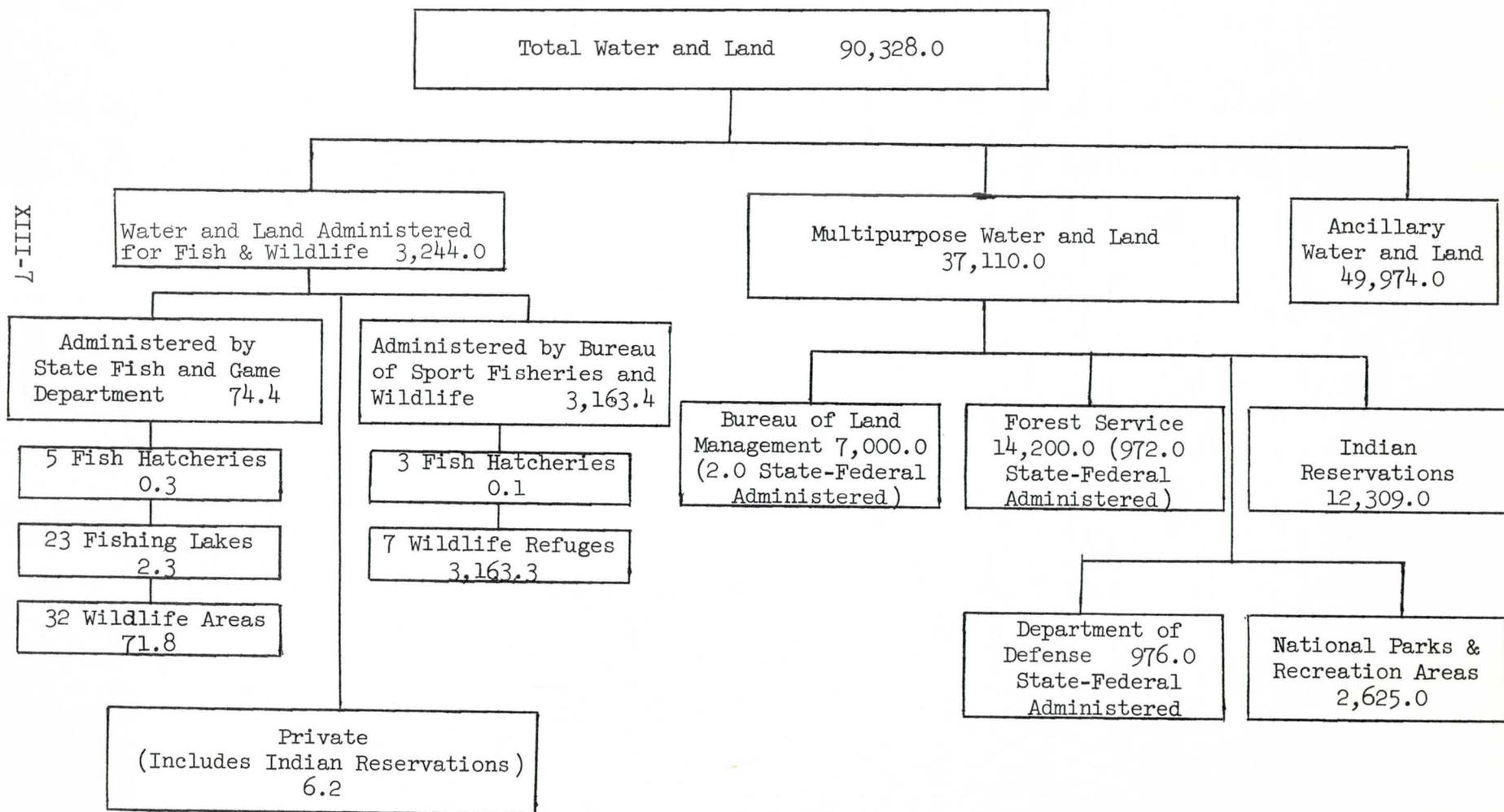
owners. These waters and lands are used, on a compatible basis, for other recreation purposes and occasionally for other uses. In the Lower Colorado Region, less than 4 percent (3.2 million acres) of the total area is managed principally for fish and wildlife.

Multipurpose refers to the water and land, both publicly and privately owned, that are administered under the principle of multiple use with fish and wildlife being managed as one of the more important resources. Of the 37.1 million acres in the Region included in the multipurpose category, nearly 2.0 million acres are being administered jointly by State fish and game agencies and Federal land management agencies.

Ancillary water and land areas in the Region are those important and productive in varying degrees to many game and nongame species, but because the management thereof is secondary to that of the other resources, some important wildlife populations are less than the potential. Most privately owned lands are ancillary. Included are those Indian Reservations where fish and wildlife are not truly considered an important resource at this time. Other ancillary lands are those administered by public agencies where wildlife species are not receiving the recognition required because of fund limitations, physical limitations, or political implications that prevent proper livestock management. Nearly 49.9 million acres are considered ancillary.

Figure 1 illustrates the fish and wildlife administered, multipurpose, and ancillary breakdown.

Figure 1
Fish and Wildlife Water and Land - 1965 (1,000 acres)



Water surface acres are included in the data shown in Figure 1. About 6.5 percent (21,400 acres) of the total wildlife-administered acreage is water area. The annual consumptive use of water on fish and wildlife administered croplands, marshes, impoundments, and fish hatcheries is estimated at about 108,500 acre-feet. See Table 2.

Table 2
Water and Land Administered
for Fish and Wildlife - 1965

Hydrologic Subregion	Land	Water		
	Acres (1,000)	Acres (1,000)	Non-Consumptive ^{1/} (1,000 Ac-ft.)	Consumptive ^{2/} (1,000 Ac-ft.)
Lower Main Stem	3,188.4	15.3	140.0	90.0
Little Colorado	16.0	2.5	6.0	7.5
Gila	19.0	3.6	50.0	11.0
Regional Total	3,223.4	21.4	196.0	108.5

^{1/} Water diverted

^{2/} Water consumed based on established water rights

Consumptive use of water for fish and wildlife purposes included in the multipurpose use category has not been included herein. The multipurpose areas primarily serve other purposes, such as irrigation, municipal and industrial water, flood control, power, and general recreation, and the annual water loss would not be measurably reduced if the fish and wildlife purposes were eliminated.

Nearly 47 million acres of the Region are in Federal ownership. Federal lands support most of the Region's fish and wildlife resources and offer significant opportunities for further development. Next most important is the private and Indian lands. Over 32 million of these acres provide wildlife resources and have the potential for satisfying a substantial part of the future fishing and hunting demand.

A substantial portion of the area within National, county, and city parks and recreation areas is known to be of great importance to fish and wildlife. Hunting and fishing man-day data are not available to classify these waters and lands on the same basis as other areas. However, an important non-consumptive use of the fish and wildlife resources is that by people of all ages who are simply observers. Included in this category are the amateur and professional photographers. It

is estimated that the time and money spent on equipment, transportation, lodging, and related items for non-consumptive use of the fish and wildlife resources might approach that expended by the hunting fraternity.

Another non-consumptive use of the fish and wildlife resources, particularly in the National Parks and Recreation Areas, that will continue to gain in importance is that of scientific investigations. State fish and game departments as well as universities are increasing their requests because of the relatively little disturbances and the control afforded approved projects.

Fish and wildlife resources of the Lower Colorado Region are important to the Nation. In the Region in 1965, approximately one out of every seven residents participated actively in hunting and fishing. For every 100 resident sportsmen participating, there were 14 visiting sportsmen. Hunters and fishermen spent an estimated \$2,445,000 for license, stamp, and tag requirements. Nearly 75 million dollars was spent in 1965 by hunters and fishermen for various products and services, including license fees, transportation, food, lodging, supplies, boats, vehicles, equipment, clothing, etc. Expenditures in the Region for fishing were about twice as large as those spent for hunting.

The national average per capita rates of hunting and fishing computed by dividing the total number of man-days 1/ fishing and hunting by the total human population were 2.68 for fishing and 0.95 for hunting in the United States in 1965. The Regional man-day per capita rates of 2.3 for fishing and 0.73 for hunting are below the national average. Variables such as increasing leisure time, greater mobility, increased life expectancy, and earlier retirements will cause an increase in per capita participation, particularly for fishing.

Also, trends indicate that the non-resident demand for fishing will continue increasing at a much greater rate in such areas as the Colorado River and western New Mexico than in other areas of the Region. This demand will cause the per capita for fishing rate to increase.

Observations by the fish and game departments indicate that people of the Region generally do not consider the presently available supply as offering adequate fishing and hunting opportunities within reasonable traveling distance. On this basis, it is reasonable to assume that there is an unexpressed demand.

In light of the above, it has been concluded that the projected man-days per capita rates within the Region will average 3.3 for fishing and 0.74 for hunting for the periods, 1965, 1980, 2000, and 2020. This report is premised on the average rates of fishing and hunting, projected to meet the demands of the population levels provided by the

1/ A man-day is a day, any part of which was spent fishing or hunting.

Office of Business Economics, Economic Research Service, and by preferential figures supplied by each state.

Included in this report are discussions of the differences of fishing and hunting demands, between the original OBE-ERS population levels and those which have been modified by the states.

STATUS OF FISH
AND WILDLIFE RESOURCES

FISH

Supply (Sport Fish)

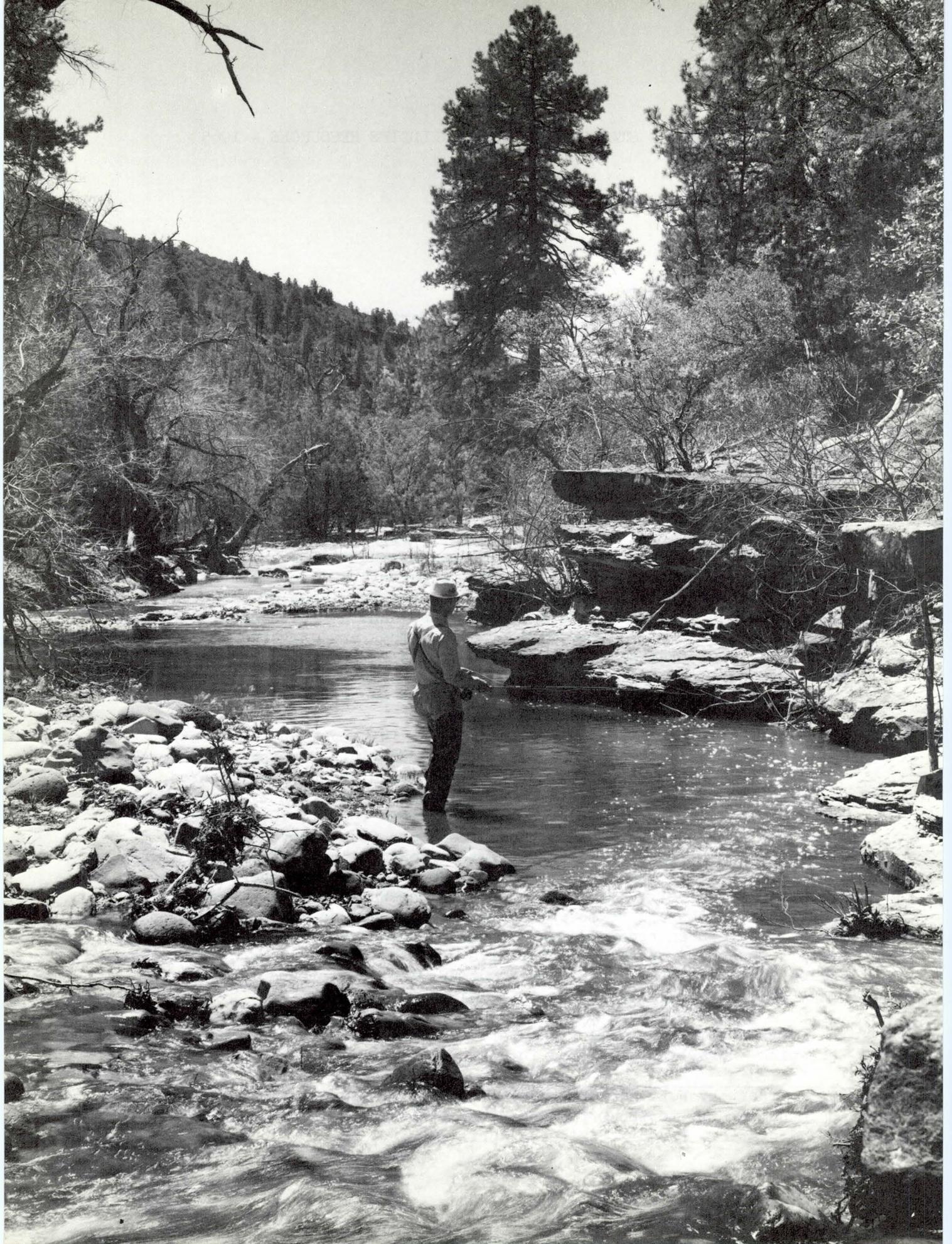
According to the list of fishes in "Partial Check-List of Fishes of the Lower Colorado River Basin," ^{1/} there are about 85 species of fish in the Region. Approximately 25 species provide sport fishing. The others are of value as forage fishes, as pollution indicators, for scientific investigations, and a source for a possible commercial fishery.

Fifty-six species of fish have been introduced into the Lower Colorado Region. The notable introductions of game fishes include all the common warmwater sport and commercial fishes and all trout, except the endangered Gila and Apache trouts. Other game fishes introduced are the coldwater species of walleye, grayling, and northern pike. The introduced warmwater species include striped bass, white bass, channel catfish, flathead catfish, yellow perch, and tilapia. The threadfin shad has been introduced into reservoirs below 4,500 feet elevation as forage for game fish. Fishes introduced into the lakes on the Colorado River include white sturgeon in Lake Havasu and kokanee and silver salmon in Lake Mohave and Lake Mead. These fishes are expected to add to the variety of fish species available to the fisherman in the Lower Colorado Region. Native species have not provided any important sport or commercial fishing in the Region for many decades.

Coldwater habitat, most of which is in the Mogollon Rim country of east-central Arizona and in New Mexico, provides fishing for several species of trout. Rainbow trout, most of which are hatchery reared, comprise the major part of the catch. Rainbow and brown trout are found commonly in the streams and impoundments from 5,500 to 10,000 feet elevation. Native cutthroat and brook trout are found above 8,500 feet elevation. The endangered Gila trout is found only in Diamond, McKenna, and Spruce Creeks in the Gila National Forest. The endangered Apache trout is principally found in streams of the White Mountain Apache Reservation. Some streams on the Kaibab, Apache, and Coronado National Forests have been renovated and stocked with Apache trout. In the cold waters impounded on the Colorado River and the cool reaches of the river below the dams, stocked rainbow trout provide year-around fishing. On Lake Mead, they provide a supplemental fishery.

Other coldwater game fishes are the arctic grayling and the northern pike. Grayling are found in central Arizona in Bear Canyon, Lee

^{1/} Report by W.L. Minckley, Department of Zoology, Arizona State University to the Office of River Basins, U.S. Department of Interior, Phoenix, Arizona, April 1969.



Valley, and Chevelon Canyon Lakes. Northern pike have been stocked in Mormon, Mary, and Long Lakes in central Arizona.

For the most part, introduced spiny-rayed warmwater fishes predominate in the waters of the Lower Colorado Region. Largemouth bass is one of the major game fishes in the Region and is found in most lakes in the drainages of the Colorado, Gila, Salt, and Verde Rivers. Smallmouth bass are found in the Salt and Verde Rivers. Spotted bass are restricted in range to West Clear Creek in Arizona.

Other sunfishes are abundant in many of the warmwater lakes and streams. Bluegill and green sunfish are widespread throughout the Region. The warmouth and redear sunfish are found in the lakes of the Lower Colorado River and in the lakes along the Salt River in Arizona. Crappie are most common in the larger reservoirs throughout the Region. Some crappies are in smaller lakes up to 7,000 feet elevation. Rockbass are caught occasionally in lower Oak Creek in the Verde River drainage.

Two species of the perch family are found in the Region. Yellow perch seem established in a few of Arizona's lakes at relatively high elevations and contribute to ice-fishing. Walleye or pike perch are found in the waters of the lower Salt River and could be an important fish in colder, deeper lakes in the future.

White bass are found in Lake Carl Pleasant in the Gila River basin and have been introduced in the Colorado River below Lake Havasu. Yellow bass are found in the Salt River reservoirs below Roosevelt Lake. Striped bass are found in the Colorado River from near Blythe, California, north to Lake Mohave and just recently planted in Lake Mead.

Catfishes are found throughout the Region. Channel catfish are the most prized catfish and are found in most of the large reservoirs and the Colorado River. Irrigation canals and many stock ponds throughout the Region, notably those on the Indian Reservations, have been stocked with channel catfish. Flathead catfish are found in the San Carlos Reservoir on the Gila River and in the Colorado River from Laguna Dam north to Headgate Dam. Black bullhead are found in small, muddy streams, lakes, and canals at lower elevations. Yellow bullhead are found in some of the small, relatively clear, rocky streams. Tilapia are found in the warmer irrigation canals near Gila Bend and Buckeye, Arizona; in the Colorado River below Imperial Reservoir; and in the irrigation drains around Yuma, Arizona, to the south.

Supply (Commercial Fish)

The Region contains a variety of introduced fishes of potential commercial value. Populations of food-fishes from wild resources such as carp, buffalo-fishes, and various suckers are found in the larger reservoirs. Important species of bait fishes such as the redshiner,

fathead minnow, speckled dace, redbside shiner, and threadfin shad are found regionwide in most streams and lakes.

Habitat

Fishing waters in the Lower Colorado Region include streams and man-made impoundments. There are no natural lakes of importance to fishing. The fishery is classified into two major categories: the coldwater trout fishery of headwaters and impoundments generally above 5,500 feet elevation; and the warmwater "spiny-rayed" fishery in the streams and impoundments of elevations below 6,000 feet elevation. The waters of the Colorado River and other streams in the Region that are stocked and provide trout fishing only during the cooler months of the year are classed as warmwater fisheries.

In 1965, there were approximately 2,500 miles of stream habitat for fishes in the Lower Colorado Region comprising approximately 10,200 surface acres of which about 2,000 acres and 8,200 acres were cold- and warmwater, respectively. Impoundments provided nearly 241,000 surface acres of fishing habitat of which 7,000 acres were coldwater and 234,000 acres were warmwater. Table 3 shows cold- and warmwater habitat available by subregion.

Use

In 1965, there were 4,217,000 fisherman-days expended in the Lower Colorado Region. Based on the hydrologic Region's human population of approximately 1,847,000, the pressure on the fishery resources was 2.3 man-days per capita.

Over 52 percent of the total fishing in the Region occurs in the Lower Main Stem Subregion. About 30 percent of the Region's coldwater fishing occurs in the reservoirs and the cool tailwaters found in the Lower Main Stem Subregion. About 60 percent of the Region's warmwater fishing is realized in this subregion, mainly in the Colorado River and Lakes Mead, Mohave, and Havasu.

The second most-fished subregion is the Gila in which 40 percent of the total fishing occurs. Very popular to fishermen are the coldwater impoundments and free-flowing streams within the mountainous and forested areas. Almost 50 percent of the Region's coldwater fishing occurs here. The lower elevation lakes in the Gila Subregion provide 36 percent of the Region's warmwater fishing.

The Little Colorado Subregion provides eight percent of the total fishing in the Region. The available coldwater habitat provides 20 percent of the Region's coldwater fishing. Very little warmwater habitat exists in the Little Colorado Subregion and only 4 percent of the Region's warmwater fishing occurs here.

Table 3
 Fish Habitat: Cold- and Warmwater ^{1/} - 1965 (Acres)

Hydrologic Subregion	Streams		Impoundments ^{2/}		Subtotal		Total
	Coldwater	Warmwater	Coldwater	Warmwater	Coldwater	Warmwater	
Lower Main Stem ^{3/}	294	6,215	1,753	212,487	2,047	218,702	220,749
Little Colorado	188	11	2,401	2,162	2,589	2,173	4,762
Gila	1,483	2,007	3,013	19,060	4,496	21,067	25,563
Regional Total	1,965	8,233	7,167	233,709	9,132	241,942	251,074

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- ^{1/} Habitat includes all waters in the Region supporting fish populations. Coldwater: Waters generally above 5,500 feet elevation that provide year-around trout fishing. Warmwater: Waters generally below 6,000 feet elevation that provide year-around fishing for such species as largemouth bass, bluegill, catfish, and winter-only fishing for trout.
- ^{2/} The relative small acreages of farm and ranch ponds are included.
- ^{3/} Acreages include the Colorado River and impoundments measured to the west shoreline, including all backwaters open to the river from Davis Dam downstream to the International border.

Sixty-seven percent of the fishing in the Region is in impoundments. Impoundments are generally easier to fish, provide more open water, and are more accessible than most streams. Warmwater impoundments being more numerous and located nearer the population centers, support 49 percent of the total fishing as compared to 18 percent from coldwater impoundments.

Streams accounted for the remaining 33 percent of the total fishing. Again, easier access accounts for warmwater streams providing 23 percent of the total fishing as compared to only 10 percent from coldwater streams.

Table 4 shows man-days of fishing expended annually for the Region. The fisherman-days expended in 1965 are estimated to be nearly 75 percent of the Region's capacity. Capacity, as used here, is an estimate of fishing that could be realized if all habitat were used at a high level and provided an acceptable degree of satisfaction to a majority of the fishermen. The estimated total Region capacity of 5,723,000 man-days is the sum of estimated individual capabilities for the coldwater and warmwater habitats comprising the fishery resource. The available warmwater habitat is being fished to 67 percent of its potential and provides most of the excess capacity. Only an insignificant amount of coldwater habitat is not being used to its natural capacity.

Although the overall supply of sport fishing in the Region presently appears adequate, many factors tend to discourage use or limit realization of the available capacity. Poor distribution of the supply relative to demand is the most important factor limiting full use of the capacity. Sheer magnitude of the demands generated by the population centers causes severe localized demand-supply problems. Demand varies directly with human population, and good quality fishing opportunities vary inversely with the population. A large share of the demands of the metropolitan areas of Phoenix and Tucson is satisfied in the Mogollon Rim and White Mountain areas of the Gila and Little Colorado Subregions. A large share of Las Vegas area demand is satisfied in southern Utah and parts of California and Nevada outside the Lower Colorado Region.

The total demand of fishermen on the entire resource base does not necessarily reflect the demand on any one segment of the resource. For example, in the Mogollon Rim area, coldwater fishing demands placed on the more accessible streams and smaller reservoirs were greater than their capacity despite the fact that there was a regionwide surplus of fishing area in 1965. This surplus was created by less accessible streams and larger reservoirs where demands technically were somewhat less than capacity. Such waters were being used to the limit of their accessibility rather than the limit of their productive capacity.

Table 4
Sport Fishing: Cold- and Warmwater (1,000 man-days) - 1965

Hydrologic Subregion	Streams		Impoundments		Subtotal		Total
	Coldwater	Warmwater	Coldwater	Warmwater	Coldwater	Warmwater	
Lower Main Stem ^{1/}	189.9	640.8	204.9	1,189.0	394.8	1,829.9	2,224.6 ^{2/}
Little Colorado	27.3	1.6	213.4	103.7	240.7	105.3	346.0
Gila	219.1	315.1	349.1	763.1	568.2	1,078.2	1,646.4
Regional Total	436.3	957.5	767.4	2,055.8	1,203.7	3,013.4	4,217.0

XIII-11

^{1/} Approximately 75 percent of the coldwater fishing man-days was expended in "Warmwater" habitat. (Table 3).

^{2/} An additional 6.0 man-days of coldwater fishing and 604.0 man-days of warmwater fishing are expended on the California side of the Colorado River from Davis Dam downstream to the International border.

Fishery Developments and Facilities

Fishery installations existing in the Region in 1965 consisted of 97 fishing lakes and 8 fish hatcheries.

The fishing lakes provided about 6,400 acres of water for fishing. These lakes were constructed and managed primarily for fishing and use of the water surface is restricted. Nineteen of the lakes, totaling about 1,400 acres, are administered by State fish and game agencies. Four lakes, providing 850 acres, are administered jointly by State-Federal agencies. Two private lakes of 140 acres were open to the public and managed by the Arizona Game and Fish Department.

Indian Tribes administered 72 fishing lakes providing about 4,000 acres of water. Sixty-nine lakes are in Arizona, of which 28 are on the San Carlos Reservation and 26 are on the Fort Apache Reservation. The remaining 15 lakes in Arizona are on the Colorado River, Hopi, and Truxton Reservations. There are three lakes on the Navajo Reservation in New Mexico.

In 1965, five State hatcheries and three Federal hatcheries produced approximately 6,700,000 fish, all of which were trout except for 150,000 channel catfish. The Region's production was about 80 percent of the total fish stocked. The remaining 20 percent of the fish stocked were imported from outside the Region. It is estimated that approximately 30 percent of the man-days fishing were expended in pursuit of stocked fish. Over 90 percent of the trout caught in the Region were stocked fish. Table 5 shows the total fish stocked in the Region.

The fish developments and facilities are listed on Table 21 and located on Map 1.

Table 5
Fish Stocking: Cold- and Warmwater - 1965 (1,000)

Hydrologic Subregion	Federal Hatcheries		State Hatcheries		Subtotal		Total Number
	Coldwater Number	Warmwater Number	Coldwater Number	Warmwater Number	Coldwater Number	Warmwater Number	
Lower Main Stem	2,333.6	-0-	337.9	10.7	2,671.5	10.7	2,682.2
Little Colorado	1,039.5	129.0	1,361.4	193.0	2,400.9	322.0	2,722.9
Gila	1,018.3	34.3	1,626.6	292.1	2,644.9	326.4	2,971.3
Regional Total	4,391.4	163.3	3,325.9	495.8	7,717.3	659.1	8,376.4

Water Supply Requirements

Consumptive use of water by hatcheries and impoundments designed for fish generally is minor. Fish hatcheries need firm supplies of water of the right quantity, quality, and temperature, but the amounts needed while important are relatively small in quantity and largely non-consumptive. As for the aggregate amount of water currently used on fishing lakes administered by fish and wildlife agencies, the total is low and does not reflect the role and importance of fish resources on the economy of the Lower Colorado Region. In 1965, approximately 10,315 acre-feet of water were consumptively used. In addition to the 6,400 surface acres of water, approximately 500 acres of land were utilized for hatchery facilities and fisherman access. Table 6 shows land and water needed in 1965 to maintain fish facilities in each subregion.

Table 6
Land and Water Requirements for
Fishery Facilities 1/ - 1965

Hydrologic Subregion	Land Acres	Water		
		Acres	Non-Consumptive (Acre-feet)	Consumptive (Acre-feet)
Lower Main Stem	5	300	30,000	15
Little Colorado	45	2,500	6,000	4,300
Gila	375	3,600	50,000	6,000
Regional Total	425	6,400	86,000	10,315

1/ Fish hatcheries and fishing lakes administered by fish and wildlife agencies.

Economic Importance

Sport fishery resources in the Lower Colorado Region enticed fishermen to expend an estimated 50 million dollars for goods and services, including licenses. Most of this amount was spent in the Region, particularly since 90 percent of the total outlay was expended by residents. Nonresidents spent the remaining 10 percent. Most of this amount was spent locally for food, lodging, and transportation.

About 60 percent of the total dollars expended was for coldwater fishing. The remaining 40 percent was expended for warmwater fishing. Residents of the Region paid out about 90 percent of all coldwater fishing costs compared with 95 percent of warmwater fishing costs.

In addition to the above expenditures, many resident fishermen went on salt-water fishing trips to Mexico and the West Coast, spending money inside the Region. Surveys show that over 2 million dollars were spent in the Region for transportation, food, tackle, and gear.

Deep-sea fishermen from adjacent states flow through the Region toward salt waters, but expenditures in the Region by these people have not been surveyed. If this information were available, it would undoubtedly have expanded the total by a substantial amount.

Commercial fishing is of minor importance and has never been an overly successful occupation in the Region. Although commercial fishing has been conducted on a sporadic basis for a number of years, there are few records of commercial catches prior to 1964. Since then, approximately six enterprises, providing only part-time employment, have been involved in commercial fishing for wild resources. Since 1960, the Region's total catch of commercial food-fishes has been taken from Roosevelt and Apache Lakes on the Salt River in central Arizona. Annual harvest from these lakes in the period 1963-1968 ranged between 17,640 and 33,075 pounds. Buffalofishes comprised over 95 percent of the catch. The commercial fishermen sold most of their catch to Phoenix wholesalers at the rate of \$0.18 to \$0.22 per pound. The wholesale and retail price was approximately \$0.30 and \$0.40, respectively. ^{1/}

The only recorded fishing for bait fishes from wild sources is from the Utah portion of the Region, and the catch in 1965 was nearly 250 pounds. The value of the catch, which was sold to fishermen, was approximately \$1,200.

Approximately seven enterprises rear bait- and food-fishes from private ponds. In 1965, 2,500 pounds of bait-fish valued at \$13,000 retail and 57,500 pounds of rainbow with an estimated market value of \$50,000 were recorded. The trout were raised for food and for stocking fee-fishing ponds.

Commercial bait shops are increasing annually the number of water dogs (salamanders) imported from states outside the Region. In 1968, nearly 2.0 million water dogs were sold in the Lake Mead area. The sale of water dogs outnumbered the sale of minnows by about one-third. The large imports of water dogs is causing concern because of the possibility of introduction of undesirable fish with the shipments.

^{1/} Data from "Investigations of Commercial Fisheries Potentials in Reservoirs." August 1969, Department of Zoology, Arizona State University.



WILDLIFE

Supply

Wildlife species in the Lower Colorado Region are as many and varied as the climate, terrain, and vegetative types. More than 750 species and subspecies of birds and animals occur in the Region. Over 40 of these species of wildlife provide hunting ranging from highly-prized big-game hunting to sport hunting of nongame species. Many other species, mostly small mammals and birds, provide enjoyment for the non-hunting outdoorsman for nature study and photography. For the purpose of this study, the wild game species have been classified as big game, small game, and waterfowl.

Big-game species in the Region are distributed throughout approximately 72 million acres of widely diverse habitat types. Deer are the most abundant and widespread of the big-game species, with the desert mule deer occupying a greater part of the desert shrub and most of the forested habitat of the three subregions. White-tailed deer occupy habitat ranging from southern desert shrub to the ponderosa pine forests, mostly in the Little Colorado and Gila Subregions. Approximately 69.5 million acres within the Region are occupied by the two species of deer.

Somewhat more limited in range than deer, but still an important big-game species, elk occupy over 6 million acres of habitat in the higher mountain forest and meadow areas primarily in the Little Colorado and Gila Subregions. They occupy the higher country during the summer months, moving down into the woodland and open grass country in the more severe winter months.

The pronghorn antelope are more numerous than the elk. Antelope occupy nearly 10 million acres of the rolling grassland, occurring both north and south of the Mogollon Rim in Arizona, and in similar areas of Nevada, New Mexico, and Utah.

Desert bighorn sheep occur in several of the low desert mountain ranges in southern Nevada and in the southern and western portions of Arizona, primarily in the Lower Main Stem and Gila Subregions. Bighorns travel in small bands through nearly 40 million acres of this arid country. Although its numbers are low, it is one of the most prized big-game trophies of the Region.

The black bear ranges throughout much of the Region's coniferous forests and pinyon-juniper and oak woodland country along the Mogollon Rim. This species is relatively abundant throughout its range of more than 9 million acres in the three subregions.

The wild turkey inhabits approximately the same area as the black bear and is considered as big game in most of the Region. The turkey ranges throughout nearly 12 million acres of pine forests, pinyon-juniper, and oak habitat.

The javelina, or collared peccary, is found at a somewhat lower elevation than that of the bear and turkey. Javelina range from the lower pinyon-juniper into the southern desert shrub and chaparral areas. Although population densities are usually relatively low, the javelina range is about 36 million acres. While this species occurs primarily in the Gila Subregion, it has been found in the other two subregions.

The American bison, or buffalo, now extinct throughout most of its former range, is found only in two special areas of the Region set aside especially for its preservation. Approximately 61,000 acres are being managed for buffalo in Arizona. They are House Rock Valley in the Lower Main Stem Subregion and Raymond Ranch in the Little Colorado Subregion.

Small-game species vary widely in the extent of their range, some extending nearly throughout the Region while others are quite localized in distribution. Examples of these wide variations of distribution include the mourning dove and cottontail rabbit with a regionwide distribution of nearly 90 million acres.

The white-winged dove is more restricted in distribution, occurring on almost 21 million acres in the lower desert regions of western Arizona and southern Nevada primarily in the Lower Main Stem and Gila Subregions. The bandtail pigeon occupies over 14 million acres of high, mountainous range in the central and southeastern portion of the Region but is found in all three subregions. Even more limited in distribution are the blue grouse, chukar, and sage grouse with a range of 1.3 million, 68,000, and 17,000 acres, respectively. The blue grouse occurs in the Lower Main Stem and Gila Subregions, and the chukar in the Gila and Little Colorado Subregions, while the sage grouse occurs in Utah and around Ely, Nevada, in the Lower Main Stem Subregion.

Three species of quail--Gambel's, Mearn's, and scaled--occur in the Region. The Gambel's quail occupies an area of approximately 13 million acres primarily in the desert and lower mountain elevations of the three subregions. Mearn's and scaled quail normally occur in the grasslands at higher elevations than Gambel's quail, and occupy ranges of approximately 12 million acres in the Gila and Little Colorado Subregions.

The Afghan white-winged pheasant recently has been stocked in agricultural areas in the desert mostly within the Gila Subregion, and presently occupies approximately 292,000 acres of suitable habitat. The ring-necked pheasant is found primarily in the Yuma, Arizona, locality of the Lower Main Stem Subregion.



Pine forests are the preferred habitat for the Abert's squirrel, which occupies approximately 6 million acres of habitat in the three subregions.

Several species of fur animals including beaver, muskrat, grey fox, and kit fox occur in the Region. While some species, such as the kit fox, are relatively limited, primarily to the desert areas of the Lower Main Stem and Gila Subregions, other species, including the beaver, are widely distributed throughout the three subregions. The fur animals normally do not reach prime fur condition which is attained in the cooler climates, and the interest in trapping for furs solely for profit is very low. Fur animal species such as foxes are also considered varmints, and as such are relatively heavily hunted. A small number of furs are collected by varmint hunters as a secondary benefit from hunting.

Several species of predatory animals and nongame animals, as well as the previously mentioned fur animals, are hunted in this Region. Most of these species are well distributed throughout the three subregions and include coyotes, bobcats, mountain lions, jackrabbits, prairie dogs, various ground squirrels, and ravens. Sport hunting for the above species is considered as small-game hunting throughout this report.

Waterfowl are present in greatest concentrations in the Region during fall and winter migration periods. A number of waterfowl winter in the desert wetlands of the Lower Main Stem and Gila Subregions. There is also a small number that nest in the mountainous marshlands in the summer primarily in the Gila and Little Colorado Subregions. Suitable habitat for waterfowl consists of 42,000 acres of wetlands and marsh associated with permanent streams and man-made lakes.

All wildlife species are of interest to the people of the Region as well as many from outside the Region. The great variety of habitat types of this area support an equally great variety of bird and animal varieties ranging from the great southern bald eagle to the smallest long-billed marsh wren and the black-chinned hummingbird. Bird lovers from all over the nation come to this area to view and photograph wildlife. While the wildlife interests are active throughout the Region, the Gila Subregion is probably the focal point for this non-consumptive use of the wildlife resources.

Use

In 1965, there were 1,343,500 man-days of hunting expended in the Lower Colorado Region. Small-game hunting was the most popular in the Region, accounting for 56 percent of all hunting. Big-game hunting accounted for 39 percent and waterfowl accounted for the remaining 5 percent of the hunting in the Region.

Information concerning the use rates associated with birdwatching, photography, and other non-consumptive uses of the wildlife resources is limited. Some wildlife specialists have estimated this use rate might approach the hunter-use rate.

The widest variety and largest expanses of the better habitat types are in the Gila Subregion and are easily accessible to approximately 75 percent of the Region's human population. Approximately 70 percent of the Region's total hunting occurs in this subregion. Of the Region's total, approximately 61 percent of the big-game hunting, 77 percent of the small-game hunting, and 58 percent of the waterfowl hunting occurs in the Gila Subregion.

The Lower Main Stem Subregion also has a wide variety of habitat and is the second most hunted subregion. The best bighorn sheep habitat occurs in this subregion, as well as much of the white-winged dove and waterfowl habitat. This subregion, however, does not have the human population concentrations of the Gila Subregion. The Lower Main Stem Subregion supports 20 percent of the Regional hunting pressure. Occurring in the Lower Main Stem Subregion is 25 percent of the big-game hunting, 15 percent of the small-game hunting, and 32 percent of the waterfowl hunting of the Lower Colorado Region.

The Little Colorado Subregion has some of the Region's better pronghorn antelope habitat, as well as good elk and mourning dove habitat. The hunting pressures are not as great as in the more populous subregions. This subregion accounts for 11 percent of the total Regional hunting. It accounts for 14 percent of the big-game, 8 percent of the small-game, and 10 percent of the waterfowl hunting of the Region.

Nonresident hunting within the Region is relatively low. Permits for some big-game species are made available to nonresidents, but the number issued is a small percentage of the total permits. White-winged dove hunting attracts hunters from across the nation, but nonresident hunting is still a very small part of the total Regional hunting.

Table 7 shows the distribution of sport hunting in the Lower Colorado Region.

Table 7
Sport Hunting - 1965 (1,000 Man-days)

Subregion	Big-Game	Small-Game	Waterfowl	Total
Lower Main Stem	129.6	112.6	23.6	265.8
Little Colorado	76.1	61.5	7.4	145.0
Gila	316.3	574.0	42.4	932.7
Regional Total	522.0	748.1	73.4	1,343.5

Hunter use of the wildlife resource in 1965 is estimated to be approximately 53 percent of total resource capacity. The total capacity as used here is a consideration of maximum wildlife populations which are likely to occur on existing habitat under existing conditions, and maximum hunter use which could occur without significantly detracting from the quality of the wildlife resource.

The total wildlife resource creates the appearance of being sufficient to supply the needs; however, the abundance occurs only with certain species. There are also other factors which limit the use of the resource. The distribution of some types of wildlife in relation to human populations has a great influence on their use. Certain big-game species are not greatly affected by these factors, since hunters will travel great distances for such an attraction. A large share of the demands of the metropolitan areas of Phoenix and Tucson for big-game hunting are satisfied in the Mogollon Rim area of the Gila and Little Colorado Subregions and the North Kaibab strip area of the Lower Main Stem Subregion. A large share of the demands from the Las Vegas area is satisfied outside the Region in California and parts of Nevada.

Small-game resources are heavily hunted in some areas while other areas remain relatively untouched by the hunter. Demands on one species, therefore, do not reflect the total demands on all species of the Region.

The rugged terrain of the Region, while creating a natural refuge for wildlife in many areas, is a limiting factor in the hunting of game. A lack of access limits utilization of a sizable portion of the total wildlife resource. Although lack of easy access to rough country is more typical of remote areas, it is not limited to these areas. The

Sierra Estrella, within 30 minutes' travel-time from downtown Phoenix, are so inaccessible that until recently it was not known that a hunt-able population of desert bighorn sheep existed there.

Illegal posting of public lands by ranchers holding grazing permits is a factor limiting utilization of wildlife resources in some locations. Efforts of sportsmen and ranchers in attempting to maintain a harmonious relationship is a continuing program. Efforts by State and Federal agencies are being made to eliminate illegal posting.

In other situations, a private landowner may own land which blocks access to tracts of public land, or he himself may have large holdings of prime wildlife habitat. In either case, he may limit the hunting or wildlife resources over a large area. The rancher's actions are due largely to increasing vandalism. The greater the vandalism, the greater the threat to public access on and over private land.

Wildlife Developments and Facilities

Designated wildlife developments and facilities managed intensively for wildlife production and in existence in 1965 included 49 multiple- and primary-use management areas, 568 habitat improvement facilities, and 20 access roads, comprising a total of approximately 4,190,000 acres. The habitat improvements include water catchments, plot enclosures, and other local developments. Twenty access roads were developed within the Region primarily for the development and utilization of wildlife resources.

Nine of the wildlife management areas totaling approximately 3,185,000 acres were administered by the Federal Government; 32, totaling approximately 72,000 acres, were administered by State governments; and eight, totaling over 930,000 acres, were administered jointly by State and Federal interests.

Nineteen of the wildlife areas in the Region, totaling 3,955,000 acres, were developed primarily for big-game populations; seven areas, totaling 7,300 acres, were developed for small-game; 17, totaling 197,000 acres, were set aside for the protection of waterfowl; and three, totaling 29,000 acres, for wildlife in general. In addition, one recreation area of 40 acres and one public shooting range of 1,542 acres are administered by fish and wildlife interests and are considered management areas.

Many management areas for big game within the Region are located in the more arid southern desert shrub country where the lack of water makes it difficult to secure a high level of productivity. Although some desert shrub areas may not produce the highest densities of game, the species produced may be of importance. Bighorn sheep for one would be an example. Areas at higher elevations are managed for the production of mule deer, elk, antelope, turkey, and other wildlife utilizing the area.

The wildlife management areas and refuges are listed on Table 20 and located on Map 1.

Water developments, including stock ponds, windmills, and spring developments for livestock use on both public and private lands, are also used by wildlife. Some modification to these developments could enhance their value to wildlife considerably.

Water Supply Requirements

The management of lands for big game and small game does not require significant amounts of water. Water catchments developed for these species are small and are normally constructed in such a manner as to reduce evaporation. A total of approximately 1,000 acre-feet of water is consumed at the existing water catchments.

There are, however, an estimated 34,300 surface acres of water which have been developed in conjunction with waterfowl management in the Region. These waterfowl areas require impounded water for lake and marsh development and maintenance. Water also is required to irrigate and flood crops for waterfowl use. In 1965, nearly 100,000 acre-feet of water were consumptively used on wildlife management areas mostly in the Lower Main Stem Subregion. Water consumption for wildlife management areas in the Gila and Little Colorado Subregions was insignificant in 1965. Table 8 shows the land and water usages of wildlife developments and facilities which were in existence in 1965.

Table 8
Land and Water Requirements ^{1/}
for Wildlife Facilities - 1965

Subregion	Land	Water	
	(Acres)	Diversion (Acre-feet)	Consumptive Use (Acre-feet)
Lower Main Stem	4,037,000	110,000	100,000
Little Colorado	16,000	<u>2/</u>	<u>2/</u>
Gila	137,000	<u>2/</u>	<u>2/</u>
Regional Total	4,190,000	110,000	100,000

^{1/} Water rights for diversion and consumptive use.
^{2/} Less than 100.



Economic Importance

Sport hunters in the Region expended approximately 25 million dollars in pursuit of game in 1965. This expenditure included goods and services as well as license and permit fees. Residents of the Region spent slightly over 90 percent of the total amount while nonresident spending was just under 10 percent. Most of the total expenditure was for guns, gun accessories, and transportation.

About 60 percent of the total hunting expenditure was for big-game hunting. Nearly 35 percent of the total was spent in pursuit of small game and 5 percent for waterfowl.

Commercial fur trapping is insignificant in the Lower Colorado Region. The furs produced in this generally hot climate do not attain the prime condition of northern fur animals, and therefore, do not reach a commercial value which would warrant their taking.

Some furs are taken, however, by sport hunters. These consist primarily of the predatory fur animal species such as coyote, bobcat, fox, and mountain lion. Thus, fur marketing is a secondary factor or a by-product from the sport hunting of these species, and is not sufficient to support full-time hunters or trappers. The recorded fur-animal take in 1965 was approximately 5,000 pelts valued at \$12,000.

RARE AND ENDANGERED SPECIES

On October 15, 1966, Congress passed Public Law 89-669, the "Endangered Species Preservation Act." This legislation gives recognition to the fact that growth and development of the United States adversely affects some native species of fish and wildlife and therefore provides for a program to inventory, conserve, protect, restore, and propagate those species which are threatened.

In 1969, the U.S. Department of Interior published "The Right to Exist--A Report on Our Endangered Species." The report indicated that of all the continents, North America has witnessed the most drastic changes in abundance of wildlife and the greatest number of extinctions in historic times. Twenty-one species of fish and wildlife in the United States have become extinct mainly because of its sudden transition from primitive to highly civilized conditions. There may be others that have passed out of existence, with so little known about them that their passing went unrecorded.

The Bureau of Sport Fisheries and Wildlife Resources Publication No. 34, "Rare and Endangered Fish and Wildlife of the United States" (Red Book), lists the Merriam elk as the only species to become extinct

in the Lower Colorado Region. The masked bobwhite quail, suspected to be extinct in the Region, is classified as "endangered."

Endangered species are those so few in numbers or so threatened by present circumstances as to be in danger of extinction. The "Red Book" lists twelve endangered species in the Region. The endangered species, their present distribution, habitat and reasons for decline are listed below.

Known Endangered Species - Lower Colorado Region

Mammals

1. Sonoran Pronghorn Antilocapra americana sonoriensis

Present distribution: Lower Main Stem Subregion--desert plains of Cabeza Prieta Game Range and the Organ Pipe National Monument, and into the State of Sonora, Mexico.

Habitat: Southern desert shrub.

Reasons for decline: Competition from domestic livestock and predation on the limited populations.

Birds

2. Mexican Duck Anas diazi

Present distribution: Gila Subregion--San Simon Valley in Arizona and New Mexico south into Mexico.

Habitat: Small, shallow marshy (cienega) areas.

Reason for decline: Drainage of marshes.

3. American Peregrine Falcon Falco peregrinus anatum

Present distribution: Regionwide.

Habitat: Mainly open country.

Reasons for decline: Pesticide poisons.

4. Masked Bobwhite Colinus virginianus ridgwayi

Present distribution: Gila Subregion--no native populations known to exist. Being re-introduced north of Nogales, Arizona, with releases of captured





birds from wild stock in Mexico and from stock raised at the Bureau of Sport Fisheries and Wildlife Patuxent Wildlife Research Center near Laurel, Maryland.

Habitat: Tall grass--mesquite plains with smaller shrubs and cactus.

Reason for decline: Overgrazing.

5. Yuma Clapper Rail Rallus longirostris yumanensis

Present distribution: Lower Main Stem Subregion--Colorado River from Topock Marsh (Needles, California) south into Mexico.

Habitat: Fresh and brackish waters with cattail and bull-rush thickets.

Reasons for decline: Drainage of marshes by channelization and filling programs, and flooding of marshes by reservoirs.

6. Southern Bald Eagle Haliaeetus leucocephalus leucocephalus

Present distribution: Regionwide.

Habitat: Cliffs and tall trees in mountain areas.

Reasons for decline: Increase in human population in primary nesting areas. Disturbance of nesting birds, illegal shooting, loss of nest trees, and reduced reproduction as a result of pesticides ingested with food.

Fishes

7. Gila Trout Salmo gilae

Present distribution: Gila Subregion--Diamond, and possibly McKenna and Spruce Creeks in the Black Range Primitive Area of the headwaters of the Gila River, Gila National Forest, New Mexico.

Habitat: Stable headwater streams.

Reasons for decline: Competition and hybridization with introduced species of trout; suspected modification of habitat.

8. Arizona (Apache) Trout Salmo sp.
Present distribution: Gila Subregion--Fort Apache Indian Reservation, Apache National Forest; Coronado National Forest. Lower Main Stem Subregion--Kaibab National Forest.
Habitat: Stable headwater streams.
Reasons for decline: Competition and hybridization with introduced species of trout; suspected modification of habitat resulting from conflicting land use.
9. Humpback Chub Gila cypha
Present distribution: Lower Main Stem Subregion--Colorado River from Grand Canyon north into Upper Colorado Region.
Habitat: Large, turbid rivers.
Reasons for decline: Lack of turbid water resulting from impounding.
10. Moapa Dace Moapa coriacea
Present distribution: Lower Main Stem Subregion--near source of Moapa (Muddy) River, Clark County, Nevada.
Habitat: Warm springs.
Reason for decline: Modification of springs for commercial-domestic uses.
11. Colorado River Squawfish Ptychocheilus lucius
Present distribution: Lower Main Stem Subregion--main channel of Colorado River.
Habitat: Large, free-flowing rivers.
Reason for decline: Modification of habitat resulting from construction of large reservoirs.
12. Gila Topminnow Poeciliopsis occidentalis
Present distribution: Gila Subregion--near Safford, Arizona, and north side of Gila River near Bylas, Arizona.

Habitat: Isolated springs.

Reason for decline: Introduction of competitive species.

Classified in the "Red Book" as "rare" forms found in the Lower Colorado Region are the spotted bat, Kaibab squirrel, Little Colorado spinedace, and Vegas Valley leopard frog. More recent investigations have the Virgin River spinedace and the wound fin classified as rare species and are threatened to become extinct by the construction of proposed dams. Rare animals are those whose numbers are few throughout their range. So long as conditions remain stable and favorable, such species may continue to survive in limited numbers. The spotted bat probably has always been rare, but the others have declined in numbers mainly from modification of habitat as a result of human activities. The rare species, their present distribution, and habitat are listed below.

Known Rare Species - Lower Colorado Region

Mammals

1. Spotted Bat Euderma maculatum

Present distribution: Regionwide, rare migrant recorded at least once in each State.

Habitat: Yellow pine and pinyon pine areas.

2. Kaibab Squirrel Sciurus kaibabensis

Present distribution: Lower Main Stem Subregion--Kaibab Plateau on north side of Grand Canyon.

Habitat: Yellow pine forest.

Fishes

3. Little Colorado Spinedace Lepidomeda vittata

Present distribution: Little Colorado Subregion--East Clear Creek, Coconino National Forest, Arizona.

Habitat: Mountain stream headwaters.

4. Virgin River Spinedace Lepidomeda mollispinos mollispinos

Present distribution: Lower Main Stem Subregion--Virgin River drainage, Utah, Arizona, and Nevada.

Habitat: Muddy, shallow streams.

5. Wound Fin Plagopterus argentissimus

Present distribution: Lower Main Stem Subregion--Virgin River drainage, Utah, Arizona, and Nevada.

Habitat: Muddy, shallow streams.

Amphibians

6. Vegas Valley Leopard Frog Rana pipiens fisheri

Present distribution: Lower Main Stem Subregion--unknown, Clark County, Nevada.

Habitat: Restricted to springs and seepage areas.

In addition, the "Red Book" lists 23 peripheral species and 13 species whose status is undetermined in the Lower Colorado Region. Peripheral species are forms whose occurrence in the Region is at the edge of their natural range. Such animals may be found in satisfactory numbers outside the Region, but their retention in our fauna may call for special attention, especially those near the Mexican border. The "status undetermined" species need to be studied and their status determined. This classification includes many animals suspected of being extinct, especially nongame fishes. More detailed information is available in the Bureau of Sport Fisheries and Wildlife "Red Book."

In addition to the above list, fishery biologists from the Arizona Game and Fish Department and taxonomists from the University of Arizona and Arizona State University list the following fish species as endangered: Spikedace, Meda fulgida; Loach Minnow, Tiaroga cobitis; and two distinct groups of the Desert Pupfish, Cyprinodon macularius. Listed as rare is the Bonytail Chub, Gila elegans. The peripheral species listed include the Mexican Stoneroller, Campostoma ornatum; Yaqui Chub, Gila purpurea; Yaqui Sucker, Catostomus bernardini; and Yaqui Shiner, Notropis mearnsi. The latter three peripheral species are thought to have become extinct since 1967.

FUTURE SUPPLY, DEMAND,
AND UNMET DEMANDS

CHAPTER 3 - FUTURE SUPPLY, DEMAND, AND
UNMET DEMANDS - 1980, 2000, 2020

FISH

Supply: 1965-1980

A considerable increase in the Region's supply of sport fish habitat is expected by the year 1980. Authorized projects in the Region will add approximately 17,000 acres of permanent water capable of providing 3,182,000 man-days of fishing. Approximately one-half of the increase in water will be attributable to the proposed multipurpose reservoirs constructed for operation of the authorized Central Arizona Project. Smaller reservoirs will be constructed primarily for fishing in areas of high demand, by State and Federal agencies and by the Indian Tribes. Most of the fishing lakes will be developed on public lands in conjunction with the multi-use concept designed for lands administered by the U.S. Forest Service and the Bureau of Land Management. It is also expected that lakes will be built on private lands to provide fishing in connection with the development of these lands for residential and summer home use and for resort, other recreation, and industrial uses.

The Central Arizona Project will contribute to the Region approximately 462,000 man-days of incidental fishing benefits annually accruing from impoundments necessary for project operation. If the impoundments are operated and managed to accommodate fishery needs, an additional 600,000 man-days of fishing annually would be provided. Fishery needs include adequate fisherman access to the reservoirs, zoning for undisturbed angling, nongame fish eradication, and fishery management investigations.

In the Lower Main Stem Subregion, Osborne Wash Reservoir is a potential part of the Central Arizona Project and would be located northeast of Parker, Arizona. This reservoir with fishery accommodations would provide approximately 90,000 man-days of fishing annually in the Lower Main Stem Subregion. Other multiple-purpose projects in the subregion include the authorized Dixie Project that is expected to provide 70,000 man-days annually of fishing in the St. George area of Utah and Alamo Reservoir that will provide 50,000 man-days annually of fishing.

Also, in the Lower Main Stem Subregion many backwaters of the Colorado River are being developed for fishery purposes from Davis Dam south to the International border. By 1980, the improved habitat will add 200,000 man-days annually of fishing to the supply of the Lower Main Stem Subregion.



In the Little Colorado Subregion, the Arizona Game and Fish Department and Federal land management agencies where appropriate, have proposed development of approximately 700 acres of fishing impoundments capable of providing about 210,000 man-days of fishing annually. In New Mexico, a 130-acre impoundment will be developed on Largo Creek by the New Mexico Department of Fish and Game that will provide approximately 40,000 man-days of fishing annually.

In the Gila Subregion, facilities of the Central Arizona Project have the potential to provide 972,000 man-days of fishing annually. Orme Reservoir, to be located near Phoenix and within an hour's drive of nearly 40 percent of the people in the Region, will have the potential to provide an estimated 670,000 man-days of fishing annually. Charleston Reservoir will provide about 170,000 man-days of fishing annually in the Tucson-Douglas area. Buttes Reservoir will provide about 40,000 man-days annually in the Florence area. Hooker Reservoir in New Mexico will provide about 92,000 man-days annually to the Silver City area and the Arizona areas of Safford and Clifton.

Also in the Gila Subregion, habitat will be developed through stream and lake improvement and construction of impoundments by the fish and game departments of Arizona and New Mexico, Federal land management agencies where appropriate, and the Fort Apache Indian Tribe that will add **1.3 million man-days of coldwater fishing annually to the Mogollon Rim area.** Also, new fishing lakes to be developed by 1980 in the Tucson-Douglas area will add 250,000 man-days of warmwater fishing annually to the supply.

Supply: 1981-2020

Multiple-purpose developments contained in the framework program for the period 1981-2020 have the potential to provide 1.0 million man-days of fishing annually in the Little Colorado and Gila Subregions of which about 60 percent would be expended within 75 miles of the major urban centers. The program contains no multiple-purpose reservoirs for the Lower Main Stem Subregion during this period. Future plans for fishing lake construction by the State fish and game departments, the Federal land management agencies, and the Indian Tribes have not been projected for the 1981-2020 period.

In the Little Colorado Subregion, the framework program includes development of multiple-purpose reservoirs on Clear Creek and on Silver Creek during the 1981-2000 period. With the other habitat expected to be available in the subregion, it is expected that the demand would be satisfied through 2000. The potential 90,000 man-days of fishing annually that would be expected from the Clear and Silver Creek reservoirs would be of importance in satisfying the demand after the year 2001.

Multiple-purpose developments included in the framework program for the Gila Subregion during the 1981-2020 period include reservoirs on the Gila and San Francisco Rivers. Regulating reservoirs for water import into the Subregion would be provided within 75 miles of the large urban areas and the exchange water principle would provide for upstream development.

The above programs are expected to add habitat capable of providing 930,000 man-days of fishing annually, of which 150,000 man-days will satisfy a portion of the annual demand in Arizona by year 2001 and the remaining 780,000 man-days will satisfy a portion of the annual demand, most occurring in New Mexico, during the 2001-2020 period.

The increase in supply expressed in man-days of fishing and expected from the above water developments have been determined for each study period and are shown in the "Incremental Increase" columns of Table 9. The "Cumulative Total" columns of Table 9 show the total supply expected to be available at the end of the designated study period.

Table 9
Sport Fishing Supply (1,000 Man-days)

Hydrologic Subregion	1965	1966-1980		1981-2000		2001-2020	
	Total	Incremental Increase	Cumulative Total	Incremental Increase	Cumulative Total	Incremental Increase	Cumulative Total
<u>Lower Main Stem</u>							
Coldwater	395.0	70.0	465.0	-0-	465.0	-0-	465.0
Warmwater	<u>2,745.0</u>	<u>340.0</u>	<u>3,085.0</u>	<u>-0-</u>	<u>3,085.0</u>	<u>-0-</u>	<u>3,085.0</u>
Subtotal	3,140.0	410.0	3,550.0	-0-	3,550.0	-0-	3,550.0
<u>Little Colorado</u>							
Coldwater	241.0	250.0	491.0	-0-	491.0	90.0	581.0
Warmwater	<u>157.0</u>	<u>-0-</u>	<u>157.0</u>	<u>-0-</u>	<u>157.0</u>	<u>-0-</u>	<u>157.0</u>
Subtotal	398.0	250.0	648.0	-0-	648.0	90.0	738.0
<u>Gila</u>							
Coldwater	568.0	1,200.0	1,768.0	-0-	1,768.0	580.0	2,348.0
Warmwater	<u>1,617.0</u>	<u>1,322.0</u>	<u>2,939.0</u>	<u>150.0</u>	<u>3,089.0</u>	<u>200.0</u>	<u>3,289.0</u>
Subtotal	2,185.0	2,522.0	4,707.0	150.0	4,857.0	780.0	5,637.0
<u>Regional Total</u>							
Coldwater	1,204.0	1,520.0	2,724.0	-0-	2,724.0	670.0	3,394.0
Warmwater	<u>4,519.0</u>	<u>1,662.0</u>	<u>6,181.0</u>	<u>150.0</u>	<u>6,331.0</u>	<u>200.0</u>	<u>6,531.0</u>
Total	5,723.0	3,182.0	8,905.0	150.0	9,055.0	870.0	9,925.0

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The State and Federal fish and game agencies have plans for additional propagation of fish to supplement natural reproduction in the available waters of the Region through 1980.

The Arizona Game and Fish Department is constructing a coldwater hatchery on Canyon Creek near Young, Arizona. The hatchery is expected to be in operation in 1972 and will produce 1,000,000-1,250,000 fish annually for stocking State waters.

Lake Mead has been determined through research as a "two-story" reservoir capable of supporting both cold- and warmwater species. To supply coldwater species, the Nevada Department of Fish and Game is planning for the construction by 1973 of a hatchery in the Saddle Island area of Lake Mead. Approximately 2 million fish will be produced annually and planted primarily in Lake Mead. Some fish will also be stocked in Lake Mohave.

In addition, the Nevada Department is programming for a striped bass-warmwater fish rearing and research facility below Davis Dam in the "Big Bend" area. Nevada's planned facilities will meet in part the demands of the angling public of the Las Vegas area.

All State fish and game departments plan to gradually increase production capability at their fish hatcheries over the years. However, the rate of increase must be expanded if the anticipated requirements are to be met. This is particularly true for trout and other coldwater species. Bureau of Sport Fisheries and Wildlife trout hatcheries can increase production by only 10 percent with existing facilities. This will be sufficient to meet anticipated demands only on the Region's Indian Reservations through 1980.

Future fish requirements for the Region, from Federal, State, and commercial sources, depend upon the fishing demand and the available habitat. The development of new waters will increase the requirements for hatchery fish beyond the planned production capability. Lake-building plans by the Indian Tribes in the Region will be capable of consuming the entire production capacity of the Federal hatcheries in the Region prior to 1980. Also, nearly 90 percent of the warmwater fishes stocked in the Region presently come from hatcheries outside the Region. These hatcheries cannot continue to supply the predicted needs for fish within the Lower Colorado Region in the face of expanding requirements in their own areas.

Changes are occurring which will be detrimental to fish and wildlife habitat within the Lower Colorado Region. The quality of water may be threatened in various areas from pollution through industrial, agricultural, residential, or recreation development. It is possible that some of these influences on the habitat can be modified before losses become extreme. For example, the Navajo Power Plant proposed for

construction on the south shore of Lake Powell in the Upper Colorado Region and the completed Mohave Power Plant located west of Bullhead City near the Colorado River have provisions that prohibit the return of effluent to the river. However, wastes discarded on adjacent lands and subsequent fall-out from atmospheric pollution from these plants and future plants poses a threat to the water quality downstream. Future plans call for the construction of the Warm Creek Power Plant on the north shore of Lake Powell. This plant will be twice as large as the Navajo Power Plant and will burn coal of a lower quality; consequently, substantially more pollutants will be produced.

In addition, over-development of public-use facilities has prevented efficient use of many waters in the past and will continue to do so in the future. The result is a dissatisfied public and what appears to be universal infringement upon the natural environment. Many of the smaller, high mountain trout lakes and streams in the Mogollon Rim and White Mountain areas are in this category.

Efficient use of fishery resources is also limited by legal access difficulties. Access tends to be most restricted around reservoirs and along rivers bordered by some private lands. Fishing on lands held in trust for the Indians by the United States requires special fishing permits.

Large reservoirs such as Lake Mead, although providing most of the warmwater fishing in the Region, present inherent restrictions to fisherman use. Big impoundments require large personal investments in boats, motors, and camping equipment and often present unsafe fishing and boating conditions. Aesthetic qualities are frequently low, especially where extensive reservoir drawdowns are common. Unrestricted speedboating curtails fishing on most impoundments and this serious problem is rapidly growing.

Another, though somewhat more obscure, limitation is the preference of today's fishermen for a certain type of fishery. Demand for coldwater fishing tends to reach capacity more quickly than the demand for warmwater activities. Tradition and climate create this situation. During the long hot summer, the recreation period, most anglers seek fishing at the cool, higher elevations. As demands increase and the coldwater fishing opportunities become less available or degraded and less attractive, people will make more use of the warmwater fishing opportunities. Despite this adjustment, the peak summer demand for coldwater fishing in the mountains will continue to climb.

Changes in some of these repressing factors may some day provide profound benefits. On the other hand, gradual degradation of existing habitat through water quality deterioration and reservoir obsolescence will tend to offset many of the gains. A basis for quantifying these factors may be even more obscure than for projecting expected increases.



Benefits that may accrue from improved fishery management are even more intangible. Techniques are presently available to significantly increase fish productivity and efficiency of use of many waters, but conditions caused by limitations imposed by the socio-political climate, plus a lack of funds and shortage of qualified technical personnel, must be corrected to assure proper management and efficient use of the resource.

Demand (Sport Fish)

The demand for sport fishing is expected to grow because of increasing human population, leisure time, mobility, and affluence. There will be an unexpressed demand where the existing supply does not provide adequate fishing opportunity within and adjacent to the population centers of the Region.

Regionwide, the existing supply plus the additional supply expected from future water developments would appear to satisfy a substantial part of the demand through 2020. However, many of the future developments will be located well beyond the reach of most of the fishermen who are seeking a one-day or less fishing experience. The bulk of the demand will come from the metropolitan areas of Las Vegas, Gallup, Phoenix, Tucson, and Yuma. Other areas of high demand and inadequate supply are the Colorado River south of Davis Dam, the Mogollon Rim area from Flagstaff east into New Mexico, and the Gila and San Francisco River areas in New Mexico.

The fishing potential of the Colorado River and its many impoundments have the potential to satisfy a portion of the projected demand for fishing originating from within and outside the Region. However, this potential will not be reached because of high demand for the available water surface for other uses incompatible with fishing. Speedboating and anticipated shoreline development will reduce fishing quality and quantity.

At least 80 percent of the fishermen on the Colorado River south of Davis Dam are nonresidents and most of these are from the Los Angeles area. The large number of nonresident fishermen and a sparse resident population results in a high per-capita use rate. The ratio of resident to nonresident fishermen and the per-capita use rate is expected to continue increasing through the year 2020. Additional habitat will be needed in the Lower Main Stem Subregion by the year 1980 to meet the exceptionally high demands and to maintain a quality fishery.

Fish habitat in the forested, mountain areas of the Mogollon Rim in central Arizona is not adequate to meet the demand expected by 1980. The Fort Apache Indian Reservation offers nearly half of the Region's coldwater fishing habitat and the 1965 demand on the Reservation is expected to double by 1980. Demand on the remaining coldwater habitat

in the Mogollon Rim area of the Gila and Little Colorado Subregion is expected to increase at a similar rate.

In the New Mexico portion of the Gila Subregion the demand will be mostly from persons living outside the Region. Increasing human population east of the Continental Divide will soon overcrowd the existing fishery and fishermen will be forced to travel to the next nearest area which is the New Mexico segment of the Gila Subregion. The demand in this area is expected to double by year 2000, and again by 2020.

The 1965 level of angler use (Table 4) provided by the State fish and game departments has been projected taking into account the factors influencing future demands. The demands projected to 1980, 2000, and 2020 are shown on Table 10. Projected needs for sport fishing were determined by comparing projected demand with supply (Table 9) and are expressed in terms of unmet demand on Table 10.

Table 10

Sport Fishing: Demand and Unmet Demand ^{1/}
 (1,000 Man-days) ^{2/}

Hydrologic Subregion	1980		2000		2020	
	Demand	Unmet Demand	Demand	Unmet Demand	Demand	Unmet Demand
<u>Lower Main Stem</u>						
Coldwater	754.0	289.0	1,566.0	1,101.0	2,783.0	2,318.0
Warmwater	3,506.0	421.0	6,214.0	3,129.0	9,274.0	6,189.0
Subtotal	4,260.0	710.0	7,780.0	4,230.0	12,057.0	8,507.0
<u>Little Colorado</u>						
Coldwater	515.0	24.0	600.0	109.0	1,021.0	440.0
Warmwater	162.0	5.0	186.0	29.0	223.0	66.0
Subtotal	677.0	29.0	786.0	138.0	1,244.0	506.0
<u>Gila</u>						
Coldwater	1,784.0	16.0	2,004.0	236.0	3,954.0	1,606.0
Warmwater	2,941.0	2.0	4,529.0	1,440.0	8,749.0	5,460.0
Subtotal	4,725.0	18.0	6,533.0	1,676.0	12,703.0	7,066.0
<u>Regional Total</u>						
Coldwater	3,053.0	329.0	4,170.0	1,446.0	7,758.0	4,364.0
Warmwater	6,609.0	428.0	10,929.0	4,598.0	18,246.0	11,715.0
Total	9,662.0	757.0	15,099.0	6,044.0	26,004.0	16,079.0

^{1/} Unmet Demand: The demand at end of each study period not satisfied by the total supply (Table 9).

^{2/} Figures are cumulative.

Demand (Commercial Fish)

The Region contains a potential commercial fishery. The States in the Region are actively studying their waters and species to learn more about the commercial fisheries potential with the view of developing a sustained harvest at some feasible level and compatible with the

sport fishery. Nevada is studying the market demand, most suitable species, and methods of artificial rearing on a commercial basis of certain indigenous bait fishes. Utah is studying rainbow trout used in commercial trout raising with the hope of developing better strains for market purposes. Arizona and New Mexico are presently studying life histories, harvestability, and population dynamics of certain species found in their reservoirs.

Results of investigations performed in the Salt River drainage basin and reported (1969) by the Arizona State University indicate that a substantial resource exists, and the populations of buffalofishes at least, are comparable to those of other areas. Furthermore, the long growing season in the Region, and the apparently high productivity of desert reservoirs, indicate that production of commercial fishes could be at least comparable to that in other regions.

In the Region there are eleven large reservoirs with about 184,000 acres having a potential commercial fishery (Table 11). It is estimated that these impoundments could sustain an annual catch of nearly 30 pounds per acre without adversely affecting the sport fisheries. Total potential catch is about 5,500,000 pounds annually valued at \$1,000,000 based on 1965 prices.

Table 11
Waters 1/ with Commercial Fishery Potential

Source (Lakes)	Average Surface Acres
<u>Lower Main Stem Subregion</u>	
Havasu	20,000
Mead	115,000
Mohave	26,500
<u>Little Colorado Subregion</u>	
(none)	-0-
<u>Gila Subregion</u>	
Apache	2,500
Bartlett	1,100
Roosevelt	10,000
Saguaro	1,000
San Carlos	1,000
Lake Pleasant	1,500
Orme* <u>2/</u>	2,300
Charleston* <u>2/</u>	3,000
<hr/>	
Regional Total	183,900

1/ Defined as an impoundment of 1,000 or more surface acres. All such impoundments in the Region are included on the assumption that they are biologically capable of sustaining a commercial fishery. However, some are managed or operated for purposes which may preclude realization of any commercial potential.

2/ *Authorized for construction.

Based on national trends, the commercial demand for freshwater fishery food products within the Lower Colorado Region is expected to increase (Table 12). Nationally, the demands for fish products for human food and for industrial purposes are a reflection of increasing population and of increasing per capita consumption of fishery products. The estimated demands do not necessarily reflect demands for fishery products produced within the basin; rather, they reflect demands to be filled by a combination of in-basin products and imports.

Table 12
 Estimated Demand for Freshwater Fishery
 Food Products (1,000 Pounds)

Hydrologic Subregion	Year			
	1965	1980	2000	2020
Lower Main Stem	132.9	302.9	631.1	1,330.6
Little Colorado	64.3	130.9	180.6	264.0
Gila	587.9	1,127.5	2,020.4	3,796.0
Regional Total	785.1	1,561.3	2,832.1	5,390.6

The demand in the Lower Colorado Region for fish for human consumption has never been satisfied by local fishing efforts. In fact, most of the wholesalers and retail dealers in the Region maintain their supplies of carp and buffalofishes wholly by importation. Most fishes caught locally are sold to small, individual grocers. It is estimated that the commercial catch in the Region satisfies less than five percent of the demand for food fishes.

Although the present potential catch of 5,500,000 pounds could satisfy the demand in 2020 (Table 12), there are indications that the quality of fishes caught must improve before they would be accepted by the consumer. Often present catches include strong-tasting fish in poor condition and possessing a high content of oils and fatty tissues. Unless measures are taken to improve the quality of the commercial fishes, it is expected that the bulk of food fish and fish products must come from outside sources.

Nationally, there is a large demand for industrial fishery products, primarily fishmeal, for use in animal-food industries. This demand is currently large enough to absorb a significant portion of the Region's virtually untapped supply potential in contrast to current food fish demand. To bring this about, however, will require greater knowledge on how to manage reservoir fish populations as well as development of economically feasible harvesting and processing techniques specifically adapted to Region conditions.

A rather new development is the rearing of channel catfish and other fishes in cages placed in irrigation storage reservoirs. Private interests are investigating the feasibility of this method to produce fishes for commercial purposes. As demands increase more economical

production methods will be devised. Existing information about fishes propagated for food, bait, and sport fee-fishing industries in the Region does not permit quantifying present and future demands. It is expected these endeavors will grow significantly, corresponding to the rate of increase in sport fishing as a whole.

WILDLIFE

Supply: 1965-2020

Unlike reservoir fish habitat, wildlife habitat generally cannot be constructed wherever needed. Habitat can be managed, however, to provide a greater resource on existing lands. All animals have the same basic requirements--cover, food, and water--and any one of these requirements can be limiting. Determining and providing the necessary habitat requirement for each wildlife species at every feasible opportunity, could provide an increase in the wildlife resource.

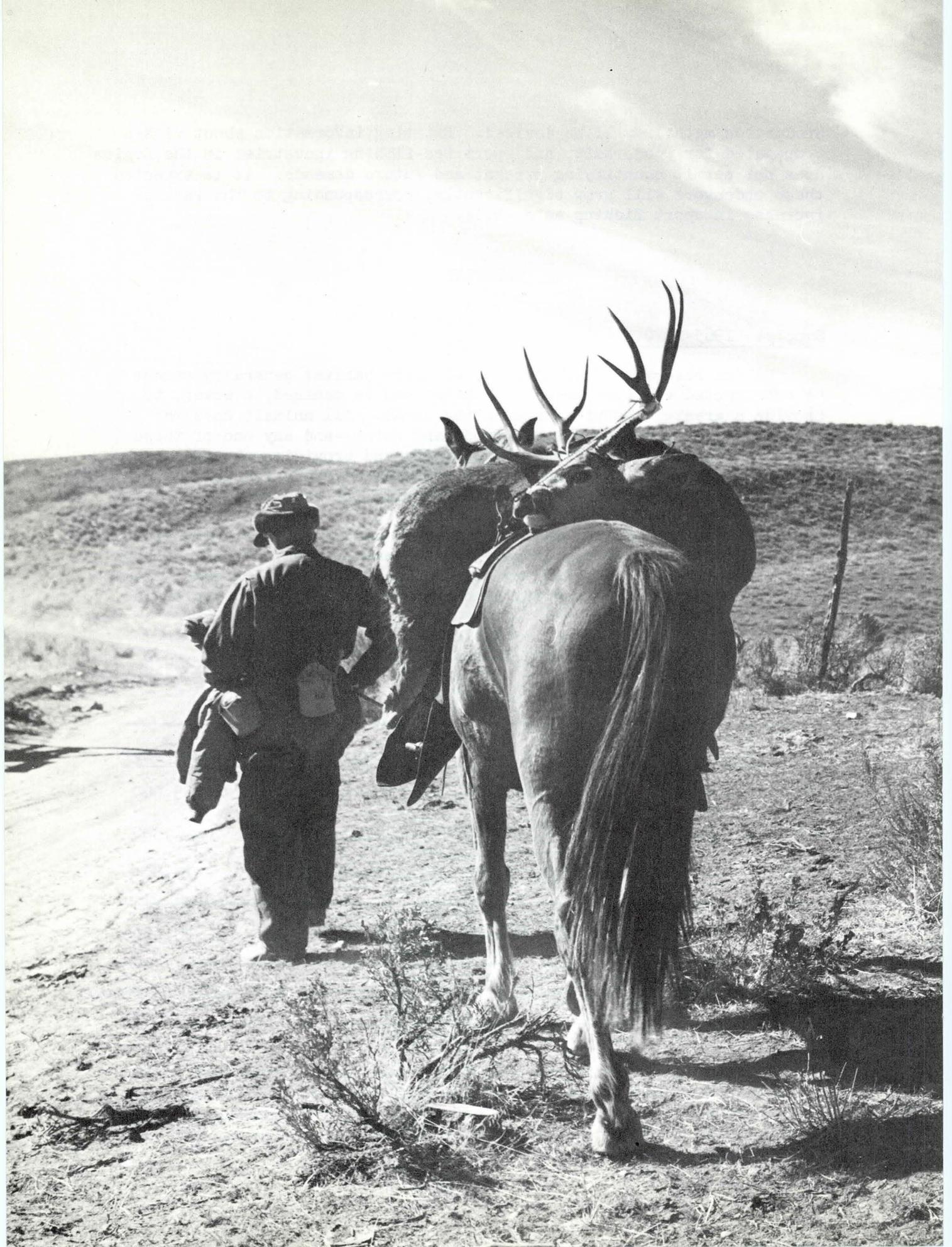
The existing habitat must be preserved and managed in a manner to assure a continuous supply of game and nongame species. Table 13 shows the acres of habitat existing in the Region in 1965 for big game, small game, and waterfowl. A variety of nongame species is found Regionwide.

Table 13
Total Wildlife Habitat - 1965 Base Year ^{1/}
(Acres)

Hydrologic Subregion	Big Game	Small Game	Waterfowl
Lower Main Stem	30,160,000	35,945,000	33,000
Little Colorado	5,550,000	17,252,000	1,300
Gila	36,375,000	36,425,000	7,800
Regional Total	72,085,000	89,622,000	42,100

^{1/} Tabulated from data provided by the appropriate State game departments

The supply of hunting used in this report is an estimate of the optimum hunter use of game populations that could occur without reducing the breeding population. The estimated supply of hunting in man-days is shown on Table 14. The supply estimates as shown may indicate



a confusing situation. For example, interpretation of the following Table 14 and Table 15, entitled "Sport Hunting: Demand and Unmet Demand," could indicate that an unlimited supply of small-game hunting exists in the Little Colorado Subregion beyond the year 2000. In actuality, this supply is composed mostly of cottontail rabbits, a species of extremely low hunter demand. Small game such as quail are in high demand by the hunter but are present only in limited numbers in this subregion.

The sport hunting supply is projected as unchanged for the years 1965, 2000, and 2020 since a minimal amount of wildlife habitat is expected to be developed by 1980. Thereafter, data concerning development for wildlife is extremely sketchy.

Table 14
Sport Hunting Supply 1965-2020 (1,000 Man-days)

Hydrologic Subregion	Big Game	Small Game	Waterfowl
Lower Main Stem	377.0	214.7	49.2
Little Colorado	98.0	110.4	11.0
Gila	446.3	1,138.6	85.4
Regional Total	921.3	1,463.7	145.6

Demand

Hunter demand in 1965 was approximately 56 percent of the total supply. This overall demand, however, had relatively little bearing on the localized demands or on the demand for a specific type of hunting activity. For example, big game generally could be considered to have been hunted at capacity in 1965 if only elk, antelope, javelina, and bighorns were to be considered. However, the demand for deer hunting was sufficiently under capacity so that the unmet demand for other species of big game could be met by deer hunting until after 1980 in areas which were accessible to the hunter. This principle is true not only for big game, but for small game and waterfowl. Hunters have preferences in the species which they seek. The quality and quantity of the available resource is reflected directly in the demand.

As the population of the Region increases, the demand for sport hunting also will increase, and long before the year 2000, the demand for hunting will have exceeded the supply throughout the Region except for the Little Colorado Subregion. This subregion probably will have

an adequate supply of small-game hunting until about 2005. Thus, soon after the year 2000, hunter demand will have exceeded all segments of the supply throughout the Region.

The current limitations on nonresident hunting of some species of big game can be expected on all species of big game. This trend also can be expected to extend to small game and waterfowl as the surpluses of hunting diminish. Thus the future nonresident consumptive use of the Regional wildlife resource is expected to be negligible.

Several proposed and authorized Federal water development projects will be in operation by 1980, including the Colorado River Basin Project and the Colorado River Front Work and Levee System, which provide for the Cibola National Wildlife Refuge. The Nevada Department of Fish and Game is expanding the Overton Wildlife Management Area to approximately 12,000 acres. Additions to the wildlife resource provided by these projects will be limited primarily to waterfowl and, even with this additional hunting, demands for waterfowl hunting will have exceeded the supply by the year 2000.

The level of hunter use provided for 1965 (Table 7) by the State fish and game departments has been projected taking into account the factors influencing future demands. The demands projected to 1980, 2000, and 2020 are shown on Table 15. Projected needs for sport hunting were determined by comparing projected demand with supply (Table 13) and are expressed in terms of unmet demand on Table 15.

Table 15
 Sport Hunting: Demand and Unmet Demand ^{1/}
 (1,000 Man-days) ^{2/}

Hydrologic Subregion	1980		2000		2020	
	Demand	Unmet Demand	Demand	Unmet Demand	Demand	Unmet Demand
<u>Big Game</u>						
Lower Main Stem	315.8	-0-	592.2	215.2	776.7	399.7
Little Colorado	112.4	14.4	147.1	49.1	195.5	97.5
Gila	<u>403.7</u>	<u>-0-</u>	<u>687.0</u>	<u>240.7</u>	<u>1,056.3</u>	<u>610.0</u>
Total	831.9	14.4	1,426.3	505.0	2,028.5	1,107.2
<u>Small Game</u> ^{3/}						
Lower Main Stem	274.4	59.7	514.5	299.8	674.9	460.2
Little Colorado	90.9	-0-	119.0	8.6	158.1	47.7
Gila	<u>780.4</u>	<u>-0-</u>	<u>1,245.0</u>	<u>106.4</u>	<u>1,914.3</u>	<u>775.7</u>
Total	1,145.7	59.7	1,878.5	414.8	2,747.3	1,283.6
<u>Waterfowl</u>						
Lower Main Stem	57.2	8.0	107.2	58.0	140.6	91.4
Little Colorado	11.2	.2	14.7	3.7	19.5	8.5
Gila	<u>58.3</u>	<u>-0-</u>	<u>93.0</u>	<u>7.6</u>	<u>143.0</u>	<u>57.6</u>
Total	126.7	8.2	214.9	69.3	303.1	157.5
Regional Total	2,104.3	82.3	3,519.7	989.1	5,078.9	2,548.3

^{1/} Unmet Demand: The demand at end of each study period not satisfied by the total Supply (Table 14).

^{2/} Figures are cumulative.

^{3/} Includes hunting for nongame species of wildlife.

Potential Loss: Habitat

Many Federal and State agencies, as well as private organizations within the Region, are striving diligently to maintain or improve habitat and increase the wildlife resource. There are, however, many more activities which tend to degrade or displace habitat, thereby reducing the available wildlife resource supply.

General land-use trends currently in practice, if continued and expanded, will tend to reduce wildlife populations. Present urban areas will continue to grow. The encroachment of these areas onto undeveloped land immediately reduces wildlife habitat, while the effect of movement into agricultural lands is felt secondarily.

Normally, in the irrigated agricultural areas of the Region, food and water are relatively plentiful, and in such areas it is the third habitat requirement, cover, which is limiting. With the invasion of urbanization into agricultural areas, the secondary result is the movement of agriculture into native habitat. The end result is the destruction of native woody and brushy cover, thus reducing wildlife populations. The possible exception to this movement is the role of citrus orchards in agriculture. Citrus is used to some degree by some species of upland-game birds for nesting and roosting cover.

Modern farming and ranching methods themselves tend to limit wildlife habitat and populations. Clean farming, or eliminating all except harvestable vegetation from an overall operation, has caused a decrease in wildlife cover. Under these farming techniques, irrigation ditches have been lined to reduce water losses through seepage. This procedure curtails the growth of brushy vegetation and annual plants which provide food and cover. With clean farming techniques, many brushy fencerows and woodlots have been cleared, and about 1.5 million acres of grazing land, both Government and private, have been cleared of woody vegetation to stimulate higher grazing production. This may decrease the availability of wildlife habitat unless properly planned and carried out. Agricultural interests should receive additional encouragement to consider the retention of valuable wildlife habitat and the development of additional habitat in conjunction with their farming practices. These developments could be used as commercial hunting areas to supplement the income from farming.

Livestock grazing is one of the principal uses of public land that can and does significantly influence all surface resource values. Properly managed livestock operations can be compatible with other multiple-use values on public domain. Many areas of public lands, however, are excessively utilized and livestock management has not been accomplished. Where these conditions exist, vegetative species deteriorate, soil movement occurs, and downstream values are affected. The aesthetics associated with open space are damaged and sometimes lost where livestock use is excessive.

Wildlife values have been depreciated in many areas where livestock numbers are too great for the forage available and where management and proper distribution or reduction of livestock has not been attained. Severely utilized browse species provide no assurance of vegetative regeneration and the existing plants are of limited value to game populations. The potential of many areas is virtually unknown, particularly where historic and current use prevents development of the wildlife potential. Areas properly managed can provide suitable habitat for livestock and wildlife without detriment to the vegetative or soil resource.

Legislative changes are required that will place more administrative authority in the hands of public officials charged with the management responsibility of public domain and state lands. The manager must be responsible for public trust of the public domain and have the prerogative to establish limits of use that are not detrimental to the environment and the public interest.

Chemical pesticides are used in nearly every phase of human existence, including industry, in urban areas, and in ranching and farming operations. Some of these chemicals are hazardous or potentially hazardous to wildlife. Contamination of the environment by pesticides is becoming a greater problem because of the increased use of these chemicals. Some of these compounds which are known to be highly destructive to most life forms have been restricted in use, while others are developed to take their place. Thus it is important that adequate research efforts and continuous monitoring programs be carried out to keep the undesirable effects of these pesticides to a minimum. Continuing research by Federal, State, and private entities is expected to result in more rigid controls on pesticide use.

Water development projects take their toll of wildlife cover. Reservoir projects flood all of the habitat within the normal pool area, and usually destroy that which is within the flood, irrigation, or power pool areas. These reservoir projects do provide resting areas for migrating waterfowl, and often, through natural succession, lakeside vegetation will become established which can be of value to other wildlife. Generally, there is a time lag of five to ten years when there is a conspicuous absence of habitat vegetation.

Municipal, industrial, and irrigation demands for increased water supplies have caused several public and private agencies to initiate a practice of vegetation manipulation to produce a greater water yield. This practice consists primarily of the conversion of woody and brushy areas to grasslands and the removal of riparian vegetation. The overall result may be a net loss of roosting, nesting, and escape cover for many species of wildlife. Although these acreages are not generally great, many times they occur in the better habitat areas.

Vegetative manipulation or control can be planned to maintain or improve wildlife habitat in many cases through the creation of edge

effect. An increase in edge effect from vegetative manipulation is but one of the benefits that may be realized. In portions of the Region a dense, competing overstory of woody vegetation threatens the continued survival of important wildlife food plants. For example, juniper control on a design basis has released cliffrose and other plant species to allow for their improved vigor and subsequent regeneration.

Transfer of water use and increased water run-off practices on many areas extend into the control and complete removal of phreatophytic or riparian vegetation. In many cases the desirability of these watershed treatment practices have been questioned on the basis that the benefits derived from aesthetic and wildlife values exceed the benefits from increased water yield and forage production. Riparian vegetation in many areas of the Region makes up the greater part of the wildlife habitat. Several wildlife species are dependent upon this riparian growth. On selected areas, strip clearing would provide a beneficial edge effect.

Flood control channelization is also highly detrimental to the riparian vegetation wildlife habitat type. This is primarily because flood channels are usually designed to follow the main stream channel. The natural stream channel usually provides a riparian oasis in this typically arid desert Region. Destruction of this oasis can have far-reaching effects on wildlife populations. Alternate locations and properly designed new channels could preserve existing habitat.

Important wildlife habitat areas frequently are associated with a rugged topography of mountainous ranges throughout the southwest region. These areas are also usually subject to mining entry under the mining law of 1872. A few areas where public values were considered to be of such importance that surface destruction by mining activity cannot be permitted have been withdrawn from mineral entry. Most of the Federally administered lands are subject to entry for mining and prospecting. Indiscriminate and speculative mining interests have substantially damaged wildlife habitat and the land surface in many areas of the West. Surface destruction has been uncontrolled and aesthetic values as well as basic wildlife values have been lost. Antiquated State and Federal laws have resulted in assessment work without true purpose.

Existing legislation provides no assurance that mountain ranges or other areas important for a variety of wildlife will be protected from the location of spurious mining claims. A revision of the mining laws could provide for the controls necessary to prevent indiscriminate surface disturbance and destruction of public values. Areas holding significant surface resource values, including wildlife, can be withdrawn from mineral entry where required. Exclusion of mining cannot be accomplished, however, without the expectation of confrontation with the mining industry because in many areas exploratory work has not been completed to the extent necessary to prove or disprove the existence of valuable mineral deposits. Each proposed withdrawal must be approached

with the knowledge that important mineral reserves are imperative to the Nation's economic survival. The values to be protected by the withdrawal, if measured to be substantial, can justify this action.

Construction of roads and rights-of-way over public domain land for electric and gas transmission purposes often causes destruction of habitat and permits access into remote wildlife areas. Most of the public domain not reserved for other public purposes is subject to entry for road construction by states and counties. The right to construct highways on public domain where the lands have not been reserved for another purpose is granted in perpetuity without restriction. Roads can be built by any design and over any route without consideration of the potential damage to wildlife habitat or populations. Wildlife habitat on National Forest lands is one of the prime considerations in any impact study or survey for highways, transmission lines, and other public utilities.

Rights-of-way over public domain may be appropriated by Federal agencies, if the holding agency consents. The location of rights-of-way is frequently determined on the basis of economics and political and social influences. Wildlife resource values and aesthetics usually have little or no bearing on the route applied for. It is anticipated that the Environmental Policy Act of 1969 will lead to more comprehensive analysis of problems such as unrestricted road and powerline construction.

Substantial areas of wildlife habitat are being lost to construction of rights-of-way for electric, natural gas, and other utility transmission purposes, and roads and highways. Authorizations are not granted for powerline and gas line rights-of-way under existing procedure without careful review for all of the aesthetics and public values involved. Additional planning and emphasis must go into the control of this land use if important wildlife areas are to be protected.

The impact of right-of-way development causes substantial losses of food and cover habitat. However, the greatest effect is often erosion induced by removal of vegetative cover and vehicular soil disturbance. Wind erosion is persistent and widespread. Soil is removed from level land as well as slopes and is distributed over wide areas. Water erosion on the hillsides releases vast quantities of material much of which eventually finds its way into streams, even though distant, causing deterioration of the aquatic environment. Unless properly planned and programmed, these rights-of-way will continue to result in losses to environmental values and to fish and wildlife habitat.

ENVIRONMENTAL QUALITY

It should be recognized that an emphasis on the technological aspects of regional study can become a barrier to truly comprehensive planning. More specifically, the inclination to think in terms of a rapid population growth and maximum feasible utilization of resources as ends in themselves can lead to inadequate recognition of potential losses of environmental quality.

Increased human population in the Lower Colorado Region and the attendant demand which these people will place upon the fragile desert environment, which comprises much of the Region, could lead to severe limitations and even destruction of much of the fish and wildlife habitat. Thus, as the human population grows, the opportunities to meet public demands for high quality hunting and fishing will become more limited.

Environmental quality as it applies to fishing and hunting means more than catching fish and shooting game. It also involves a need for clean water, clean air, natural landscape, and an opportunity for a certain degree of isolation or retreat for the individual. With provision of sufficient money and a relatively small water supply, cultural methods conceivably could provide almost unlimited sport fishing and an increased supply of some types of hunting on an intensive use basis near urban areas. However, the mere availability of fish and game, although an essential ingredient, is not enough in itself to impart quality to hunting, fishing, and wildlife-oriented recreation. Essentially, fish and wildlife production when designed merely to provide for intensive public use does not fully meet the need which so many people have for release from their everyday crowded environment. This important aspect of demand can be met only through provision of adequate natural fish and wildlife habitat on rather extensive land and water areas in addition to that provided by wilderness, primitive, and wild and scenic river areas.

In essence, preservation of the environmental quality of fish and wildlife habitat for public benefit might be considered to present a paradox. Planning for the efficient use of the resources in terms of securing the maximum number of man-days per dollar invested may impair or destroy the quality of the environment and reduce the value of each man-day of use. Conversely, planning for efficient use in terms of protection of quality necessitates inherent restrictions on the amount of public use and may increase governmental investment cost per fisherman-hunter-day.

Within the constraints of practicability, it is the objective of this report to come as close as possible to meeting the extensive public demands for hunting and fishing and wildlife-oriented recreation



without undue sacrifice in quality. The attempt has been to achieve this objective through planning of diverse programs, some to meet the needs for intensive public use and others designed to provide the qualitative characteristic associated with more limited use.

It is recognized that the Lower Colorado Region appears to be approaching a point in time when the average person or family group no longer will be able to spend a day hunting or fishing without meeting another human. The growth of the human population dictates this consequence. However, it is believed that through proper planning the Region can preserve sufficient natural environment so that the average man can go afield with some assurance of an opportunity to escape his everyday crowded existence. This objective can best be accomplished when intensive wildlife management on public lands becomes a reality.

WILDERNESS AREAS

A landmark achievement toward preserving the natural environment was the passing of the Wilderness Act of September 3, 1964. This act assured that within the next 10 years nearly 2 percent of the lands of the United States will be protected and managed so as to preserve its natural conditions. These lands will offer outstanding opportunities for solitude or primitive and unconformed type of recreation. Generally, these lands will be open to most forms of outdoor recreation, to hunting and fishing, to grazing of livestock where established prior to the effective date of the Wilderness Act, and scenic, scientific, educational, conservation, and historic uses, so long as the wilderness character of the area is preserved.

In the Lower Colorado Region, nearly 3,200,000 acres of undeveloped federally administered lands are classified or being studied for suitability of wilderness classification. All but about 45,500 acres of lands expected to be included in the Wilderness System and administered by the National Park Service will provide hunting. Wilderness lands will provide opportunities for fishing and for photography, bird-watching, and other non-consumptive uses of the fish and wildlife resources.

From the wildlife standpoint, one of the principal benefits to be derived from the wilderness system is the preservation of large tracts of undisturbed wildlife habitat. The wilderness areas offer a type of environment essential to those animals requiring a minimum of human disturbance and may be the salvation of some species that are unable to compete with the changes wrought by civilization. Some examples of these species are desert bighorn sheep, Sonoran antelope, kit fox, black bear, and southern bald eagle. Such species may be preserved in the designated wilderness tracts.

An additional benefit of the wilderness areas, and one that will become increasingly vital in the future, is the refuge available to wildlife which becomes exposed to disturbance from off-road vehicular use. Snowmobiles, trail bikes, and 4-wheel-drive vehicles are invading the roadless back-country in ever-growing numbers with resultant disturbance and sometimes harassment of wildlife. Since use of motorized vehicles in wilderness areas is prohibited, these areas will provide local relief from this form of molestation.

In the Gila Subregion there are six established wilderness areas totaling nearly 900,000 acres, all administered by the Forest Service. Seven other units totaling about 600,000 acres of lands administered by the Forest Service, Bureau of Land Management, and the National Park Service are being studied for wilderness classification. Two units totaling nearly 58,000 acres in the Little Colorado Subregion are being studied by the National Park Service and the Forest Service for suitability of wilderness classification. The established wilderness areas and others proposed by the Forest Service, Bureau of Land Management, and National Park Service are shown in Appendix VI, Land Resources and Use.

The Bureau of Sport Fisheries and Wildlife is studying eight units totaling over 1,654,000 acres of National Refuge lands in the Lower Main Stem Subregion for suitability of wilderness classification. Considerations are being given to preserve the refuges for the purposes intended, to retain maximum wilderness characteristics, to provide adequate access to the users, and to assure ease for enforcing user regulations. An additional 835,000 acres of land administered jointly by the Bureau of Sport Fisheries and Wildlife and the Department of Defense will be considered for wilderness classification if and when the area is no longer needed for military operations.

WILD AND SCENIC RIVERS

The Wild and Scenic Rivers Act of 1968 (Public Law 90-542) instituted a national wild and scenic rivers system to preserve rivers or portions of rivers "in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations." The Act designated eight rivers as original components of the system. Twenty-seven other rivers were designated for potential addition to the system. None of the rivers designated in the Act are in the Lower Colorado Region.

The Act provided for additional components to be added to the system from time to time. Subsequently, a number of rivers in the Region have been suggested for study to determine the feasibility of adding to those listed in the Act. These include:

1. Colorado River, Lower Main Stem Subregion, Arizona, Nevada, and California: Lee Ferry to Mexican border--a distance of 512 miles.
2. Little Colorado River, Little Colorado and Lower Main Stem Subregion, Arizona: Grand Falls to confluence with Colorado River--a distance of 100 miles.
3. Chevelon Creek, Little Colorado Subregion, Arizona: Headwaters to confluence with Little Colorado River--a distance of 86 miles.
4. Gila River, Gila Subregion, Arizona, New Mexico: Headwaters to town of Florence--a distance of 412 miles.
5. Oak Creek, Gila Subregion, Arizona: Headwaters to Verde River --a distance of 40 miles.
6. Salt River and tributaries including Black River, White River, Cherry Creek, Canyon Creek, and Tonto Creek, Gila Subregion, Arizona: Headwaters to Roosevelt Lake--a distance of 308 miles.
7. Verde River and tributaries including Wet Beaver Creek and West Clear Creek, Gila Subregion, Arizona: Headwaters to Salt River--a distance of 160 miles.
8. East Verde River, Gila Subregion, Arizona: Headwaters to confluence with Verde River--a distance of 52 miles.

A more detailed discussion of the Wild and Scenic Rivers program for the Lower Colorado Region may be found in Appendix XII, Recreation.

MEANS TO SATISFY
DEMANDS

CHAPTER 4 - MEANS TO SATISFY DEMANDS

The Lower Colorado Region has the potential and it is inherent that resource planners are obligated to develop a resource base of productive land and water for future fish and wildlife-oriented activities. The development of the resource base is the responsibility of the Federal, State, and local governmental agencies. The resource should be developed to provide quality fishing and hunting and to maintain a resource supply whereby the demands for non-consumptive fish-and-wildlife-oriented activities such as bird watching, nature observation, and photography are satisfied. Although under no obligation, private concerns will develop some fish and wildlife resources as business ventures, and additional areas will be developed or maintained by conservation groups and by enthusiastic wildlife conservationists for the sake of protecting and encouraging the enjoyment of the wildlife resources of the Region.

The degree of maintenance and future development for fish and wildlife is dependent upon the public demand, potential private profit, and the capacity of the available resource. Fish and wildlife values are being recognized by the public and all land management agencies as becoming more important and requiring a more important place in the overall comprehensive management of all lands and water. Means of implementing planned developments will vary, depending on the item or agency involved. Existing Congressional Acts that provide assistance in this area are listed in Appendix III, Legal and Institutional Environment, Lower Colorado Region.

The development of a resource base capable of satisfying the expected demand for fish and wildlife is dependent upon an adequate water supply. The consumptive water needs for fish and wildlife purposes must have a priority comparable to other water uses within the Region, or there will not be adequate opportunity for satisfying future unmet demands (Table 9). Satisfying the unmet demands is dependent upon equal consideration of fish and wildlife water needs and adequate appropriations to meet those needs.

It is critical that all water quality degradation trends be reversed, especially those associated with industrial, municipal, and agricultural pollution. Water quality requirements for protection of aquatic and wildlife resources cover a broad range of environmental factors, which are variable, dependent upon individual species to be protected. The following levels ^{1/} of water quality are indicators of criteria which will adequately support the general freshwater aquatic and wildlife environment throughout the Region. Additional criteria can be found

^{1/} "Water Quality Standards for Surface Waters in Arizona," July 18, 1968, Arizona State Department of Health.

in Appendix XV, Water Quality, Pollution Control, and Health Factors.

1. Dissolved oxygen content about 5 milligrams per liter
2. pH between 6.5 and 8.6
3. Free carbon dioxide content below 3 cubic centimeters per liter
4. Ammonia not over 1.5 milligrams per liter
5. Suspended solids such that the millionth intensity of light penetration will not be less than 5 meters
6. Essentially complete absence of toxic substances. These substances tend to accumulate in concentrations along the food chain.

Aquatic life is very sensitive to concentrations of copper and zinc, and the limits for concentrations of these metals in waters are governed by the need to preserve the aquatic life.

Criteria similar to the above have been adopted by the States in the Region, and if enforced, pollution will not be a major opponent to the protection and propagation of aquatic and wildlife resources.

FISH

Resource Base (Minimum Water Requirements)

It is realistic to assume that increased opportunity for fishing will be provided for within the Region. Additional water for lakes is expected by most conservationists to be available from allocations provided for in the Colorado River Basin Project Act of September 30, 1968. In time, it is reasonable to recognize that additional water will be imported to the Southwest.

The States in the Lower Colorado Region will be hard-pressed to satisfy the fishing demands through management of the waters expected to be existing in 1980, 2000, and 2020. In addition to regulating all water-based recreation (boating, skiing, swimming, etc.) in a manner consistent with increased angler usage, the remaining demand will have to be fulfilled by the construction of new impoundments, both primary-purpose and multipurpose reservoirs.

Satisfying the fishing demands in the Region is mainly dependent upon developing an adequate resource base within day-use distance of urban centers. One possibility is the use of adequately treated sewage effluent as a water source.



For the purpose of this study, the projected requirements for fishing waters are based on optimum conditions generally found at primary-purpose fishing impoundments. Generally, impoundments of 50 to 200 acres have the greatest potential and most economically serve the needs for public fishing although larger and smaller are also important. Such lakes designed primarily for fishing can be easily managed for maximum production, fishing quality, and public use. The following program is designed to satisfy the total demand for sport fishing in each time frame of the study period. In addition, the program provides for the preservation of endangered species and for non-consumptive fishery-oriented activities.

Fishing use on readily accessible primary-purpose coldwater lakes in the less populated areas will provide an average of 300 man-days fishing per acre. Warmwater lakes managed primarily for fishing and readily available to the majority of the population will provide an average of 500 man-days fishing per acre. These average figures are not to be interpreted to mean that all cold- and warmwater habitat is capable of such a fishing pressure. The environment and quality of fishing on some coldwater fishing streams is adversely affected when fishing pressure exceeds 25-50 man-days per acre. Elsewhere, quality has been replaced by quantity and fishing pressures of 800-1,000 man-days per acre have been observed.

The acres of habitat and water consumption requirements to satisfy Regional fishing demands are shown on Table 16. The Resource Base for 1980 includes the 1965 water requirements (Table 6) and 18,500 acre-feet of water determined to be necessary for filling and maintaining the authorized primary-purpose fishing lakes discussed previously in this report (pages 34 and 35).

Consumptive use of water for fish purposes included in the multipurpose use category has not been included herein. The multipurpose waters primarily serve other purposes, such as irrigation, municipal and industrial water, flood control, power, water quality, and general recreation, and the annual water loss would not be measurably reduced if the fish and wildlife purposes were eliminated. Also, the additional water requirements to satisfy the 1980, 2000, and 2020 unmet demands (Table 10) are shown on Table 16. The additional requirements are minimal estimates based in part on expected improvements in management techniques and in part on the development of primary-purpose fishing lakes of 200 acres or less, mostly within day-use distance of the urban centers.

The water requirements shown on Table 16 for the Las Vegas, Yuma, and Colorado River areas of the Lower Main Stem Subregion and for the Phoenix Metropolitan and Tucson-Douglas areas of the Gila Subregion are mainly for warmwater impoundments. The remaining water requirements shown are mostly for coldwater impoundments.

Table 16
Minimum Water Requirements to Satisfy Unmet Demand ^{1/} for Fishing

Hydrologic Subregion (Area of Demand)	Resource Base ^{2/}	1980 ^{3/}			2000 ^{3/}			2020 ^{3/}		
	1980 Consump- tion (Ac-ft)	Habitat (Acres)	Storage (Ac-ft)	Consump- tion (Ac-ft)	Habitat (Acres)	Storage (Ac-ft)	Consump- tion (Ac-ft)	Habitat (Acres)	Storage (Ac-ft)	Consump- tion (Ac-ft)
<u>Lower Main Stem</u>										
Nevada		1,400	21,000	8,400	5,900	88,000	35,400	9,200	138,000	55,300
Yuma		-0-	-0-	-0-	200	3,000	1,200	400	6,000	2,400
Colorado River south of Davis Dam		<u>400</u>	<u>6,000</u>	<u>2,200</u>	<u>2,500</u>	<u>37,000</u>	<u>13,800</u>	<u>4,600</u>	<u>69,000</u>	<u>25,400</u>
Subtotal	500	1,800	27,000	10,600	8,600	128,000	50,400	14,200	213,000	83,100
<u>Little Colorado</u>										
Gallup		90	900	450	400	4,000	2,000	1,100	11,000	5,500
Flagstaff- Springerville		<u>10</u>	<u>100</u>	<u>50</u>	<u>100</u>	<u>1,000</u>	<u>500</u>	<u>1,000</u>	<u>10,000</u>	<u>5,000</u>
Subtotal	8,300	100	1,000	500	500	5,000	2,500	2,100	21,000	10,500
<u>Gila</u>										
Flagstaff- Prescott		50	500	250	300	3,000	1,500	600	6,000	3,000
Phoenix (Metropolitan)		-0-	-0-	-0-	2,700	43,500	15,000	8,600	129,000	47,000
Tucson-Douglas		-0-	-0-	-0-	200	4,000	1,100	2,300	35,000	13,000
Mogolon Rim		-0-	-0-	-0-	250	3,800	1,400	6,000	90,000	33,000
New Mexico		<u>10</u>	<u>100</u>	<u>50</u>	<u>250</u>	<u>2,000</u>	<u>1,300</u>	<u>600</u>	<u>6,000</u>	<u>3,000</u>
Subtotal	20,000	60	600	300	3,700	56,300	20,300	18,100	266,000	99,000
Regional Totals	28,800	1,960	28,600	11,400	12,800	189,300	73,200	34,400	500,000	192,600

(For footnotes see following page)

- 1/ Unmet Demand: The demand at end of each study period not satisfied by the total supply (Tables 9 and 10).
- 2/ Resource Base: Includes 1965 water requirements (Table 6) and 18,500 acre-feet of water required for the authorized primary-purpose fishing lakes (pages 34 and 35).
- 3/ Figures are cumulative, excluding the 1980 Resource Base requirement.

The needs of the population centers are twofold. Fishing water is needed within and adjacent to the cities to provide fishing for the less adventuresome, to the fisherman with limited time, and for the young, the old, and others incapable of traveling longer distances. Approximately one-fourth of the habitat shown in Table 16 for Las Vegas, Gallup, Phoenix, and Tucson-Douglas is needed within the city proper. The remaining three-fourths of the habitat is needed within 75 miles of the designated cities. These facilities would satisfy the fisherman seeking a better quality fishing experience within a one-day or less trip. All of the habitat shown for Yuma should be within and adjacent to the city limits. The habitat shown for the Colorado River will provide additional facilities.

To a lesser degree, fishing lakes are needed within and adjacent to the city limits of communities far removed from fishing waters and the towns of Flagstaff and Prescott. Most of the habitat requirements shown for the areas of Flagstaff-Springerville, Flagstaff-Prescott, the Mogollon Rim, and New Mexico are for the remote, mountainous areas. These lakes would assure preservation and wise use of local high quality resources, provide more fishing and sustain a coldwater fishery, and better distribute the Region's fishermen. The opportunity for such developments exists mainly in the forest-covered mountain areas. The majority of these lakes would be constructed on public lands.

In selecting sites for lake development, careful consideration must be given to assure preservation of other fish and wildlife resources such as trout streams and elk meadows. Aesthetics and riparian vegetation associated with permanent streams can be modified or lost with lake development. In some areas, with proper planning, aesthetic values may be enhanced.

Most of the habitat required to satisfy fishing demands through 1980 on the Colorado River south of Davis Dam is presently available; however, unrestricted use of the water surface is adversely affecting fisherman-use. Small-lake development, zoning, and adequate enforcement will assure the public optimum recreation experiences on the Colorado River through the year 2020. Highspeed boating in the river should be restricted in the main channel and confined largely to the deeper waters of the impoundments.

To assure efficient use in terms of protection of quality fishing and to preserve the natural environment, approximately 10 percent of the surface acres required to satisfy the demands for each time period shown on Table 16 must have inherent restrictions on the amount of public use. Selected waters throughout the Region and especially in the high mountain areas should be developed to assure maximum use not to exceed 100 man-days fishing per acre on coldwater habitat and 200 man-days fishing per acre on warmwater habitat. Planning and development of these areas must begin by 1980, because as the human population grows, the opportunities to preserve the environment and still satisfy demands for high quality fishing will become more limited.

Use of water for fishery purposes does not alter significantly the quality of the water for other uses. The consumptive needs for fishery purposes are relatively minor and consist of the initial filling and the evaporation losses from water surfaces assigned to fish and wildlife. The consumptive use of water for the required primary-purpose fishing waters is shown on Table 16. Releases and seepage from fish and wildlife impoundments will pass downstream or recharge ground water supplies and thus are available to other users. In circumstances where intended use of water for the fishing facilities might be in conflict with established water rights, exchanges or purchases of water could be effected. Water exchanges would assure development of fishing habitat in areas presently devoid of adequate fishing opportunities.

Most multiple-purpose reservoirs are larger than 200 acres and are designed primarily for uses other than fishing. These reservoirs usually result in increases in net fishing supply and most offer substantial opportunity to increase the benefits. However, the man-days fishing per surface acre on multipurpose reservoirs is almost invariably less than that on smaller reservoirs designed primarily for fishery purposes. Only specific studies of a particular project proposal can determine the fishing benefits. The operation and type of other recreation uses planned for each impoundment would influence fishing. Severe water fluctuations and unrestricted speedboating seriously detract from the fishery benefits. Measures must be taken to reserve water, both in depth and on the surface, for fishery purposes, and speedboating must be adequately controlled. Planning of such impoundments must be fully coordinated among concerned agencies to insure that fishery enhancement features are adequately considered in project formulation.

Municipal, industrial, agricultural, and reclaimed waste water supplies available within and adjacent to the cities should be used for fishery purposes to assure wise and multiple-use of the available supply. Multipurpose storage reservoirs and aqueduct systems designed to accommodate fishery needs would provide a resource base capable of satisfying much of the expected demand.

A substantial increase in fishing opportunity may become available in canals and canalside impoundments associated with the Central Arizona Project. Much of this water will be reasonably available to urbanized populations. Early evaluations of the project have identified that modifications can be provided for in or near the aqueduct which will result in improved fish habitat.

Only the multiple-purpose developments included in the discussion on pages 34-36 of this report have been evaluated as to their potential in meeting a portion of the fishing demand. When planning for other multiple-purpose projects becomes a reality, they will be evaluated and the project requirements (Table 16) will be reduced accordingly. Fishery developments associated with multiple-purpose projects must be provided according to the needs of the area.



Resource Base (Facilities)

To assure that the projected resource base will satisfy the fishing demand, complementary actions must be taken. These include providing access facilities, supplying fish for stocking purposes, and controlling nongame species.

The degree of development for the lakes and streams of the Region will depend upon the area involved. Future development must limit access to what a specific site can accommodate. Selected lakes and reaches of streams will require facilities for intensive use, while other areas will require that use on adjacent lands be limited to preserve natural environmental conditions. Buffer strips should separate the shorelines of lakes and streams from the campground and access roads. Access roads, gravel parking and boat-launching areas, and minimum sanitary facilities will be needed at selected sites.

All of the Region's free-flowing streams and impounded lakes are in jeopardy from being over-developed. In the Mogollon Rim and mountainous areas, the quality and aesthetic values of many trout streams are being destroyed by what appears to be overdevelopment of recreation facilities and streamside access. The demand for streamside camping and picnicking seems to be accelerated by each improvement and expansion of the facilities. Continued additions of facilities thus seem to create a self-perpetuating demand which in turn leads to a diminishing natural streamside environment and reduction in the qualitative aspects of fishing. Often, unimproved access will limit the use of an area to its fishing capacity; if so, maintenance is the only activity that should be allowed. Some agencies are revising their development programs to protect streamside and lakeside environment.

To satisfactorily stock the habitat available and meet fishing demands in the Region, the equivalent of one coldwater and two warmwater hatcheries will be needed by 1980. Thereafter, to meet the demands, the equivalent of one coldwater hatchery every 8-10 years and one warmwater hatchery every 6-8 years will need to be developed. This can be accomplished by constructing new hatcheries or by expanding those in existence. In some cases the latter may be more feasible due to a shortage of hatchery sites.

The equivalent of each hatchery would require approximately 50 acres of land including 3-5 surface acres of water. The annual consumptive use would be about 20 acre-feet for each facility. The initial construction costs, based on 1965 prices, for each hatchery or an equivalent one would be \$1 million. Annual operation, maintenance, and replacement costs for each hatchery would be about \$175,000. Land and water costs cannot be adequately determined without knowledge of site location, but probably would not exceed \$100,000 for any one site.



Fishery management practices are used to maintain a ratio between game and nongame fish which yields the most productive sport fishing. The most effective practice is chemical applications to reservoirs and streams. Between 1965 and 1980 rehabilitation is planned for approximately 3,000 acres of water. After 1980, the program will need to be expanded to include new reservoirs which come into existence. More frequent treatments also will be needed at available waters as fishing pressure increases.

Costs: Fishery Developments

Based on 1965 prices, the estimated costs for construction, development, and maintenance of facilities to satisfy fishing demands through year 2020 are shown on Table 17. The costs developed in this appendix are to satisfy unmet demands and do not include ongoing and anticipated agency programs.

WILDLIFE

Resource Base (Land)

The demand for hunting can be satisfied through the year 2020 with adequate planning and sufficient funds, and a shift in hunter preference. Unfortunately, the projected human population growth for the Region and the associated demands on the natural resources, as well as the related increase in hunting and wildlife-oriented recreation will result in an overall reduction in the quality of the resource.

Land-use trends at the present time tend toward the engulfment of undisturbed lands by agricultural and urban interests. Much of this development occurs along riverbottom lands, thus destroying prime wildlife habitat. This problem is more severe near the major metropolitan agricultural areas. Riverbottom lands under private or state ownership in or near metropolitan areas frequently have been committed through inadequate zoning practices to developments incompatible with wildlife. Not uncommonly these riverbottom areas are also subject to the threat of flood. Flood control projects generally are designed to protect the developed lands along the river bottom where investment values are considered by some to justify the expenditure of flood control. Riverbottom lands more distant from metropolitan areas frequently comprise an important segment of wildlife habitat throughout much of the Lower Colorado Region. Channelization and phreatophyte control for the purpose of flood control and increased water will have substantially reduced the wildlife productivity of many river channels.

Table 17
Fishery Development Costs Required to Satisfy Demands
(Million Dollars)

Hydrologic Subregion	1980			2000		2020	
	Authorized ^{1/}	Programed ^{2/}	Total ^{3/}	Incre- mental Increase	Cumu- lative Total	Incre- mental Increase	Cumu- lative Total
<u>Lower Main Stem</u>							
Primary-purpose							
Habitat Development	4.6	5.4	10.0	20.6	30.6	16.7	47.3
Hatcheries	1.0	-0-	1.0	1.0	2.0	1.0	3.0
Public-use Facilities	0.3	0.2	0.5	1.0	1.5	0.8	2.3
Subtotal	5.9	5.6	11.5	22.6	34.1	18.5	52.6
Multiple-purpose ^{4/}	1.0	None	1.0	-0-	1.0	-0-	1.0
<u>Little Colorado</u>							
Primary-purpose							
Habitat Development	2.0	0.3	2.3	1.2	3.5	4.8	8.3
Hatcheries	-0-	-0-	-0-	1.0	1.0	1.0	2.0
Public-use Facilities	0.1	*	0.1	0.1	0.2	0.2	0.4
Subtotal	2.1	0.3	2.4	2.3	4.7	6.0	10.7
Multiple-purpose ^{4/}	-0-	None	-0-	0.9	0.9	-0-	0.9
<u>Gila</u>							
Primary-purpose							
Habitat Development	5.0	0.2	5.2	10.9	16.1	43.2	59.3
Hatcheries	1.0	3.0	4.0	3.0	7.0	3.0	10.0
Public-use Facilities	0.5	*	0.5	0.5	1.0	2.3	3.3
Subtotal	6.5	3.2	9.7	14.4	24.1	48.5	72.6
Multiple-purpose ^{4/}	14.4	None	14.4	6.9	21.3	1.2	22.5

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Table 17 (Continued)
Fishery Development Costs Required to Satisfy Demands
(Million Dollars)

Hydrologic Subregion	1980			2000		2020	
	Authorized ^{1/}	Programed ^{2/}	Total ^{3/}	Incre- mental Increase	Cumu- lative Total	Incre- mental Increase	Cumu- lative Total
<u>Regional Totals</u>							
Primary-purpose							
Habitat Development	11.6	5.9	17.5	32.7	50.2	64.7	114.9
Hatcheries	2.0	3.0	5.0	5.0	10.0	5.0	15.0
Public-use Facilities	0.9	0.2	1.1	1.6	2.7	3.3	6.0
Subtotal	<u>14.5</u>	<u>9.1</u>	<u>23.6</u>	<u>39.3</u>	<u>62.9</u>	<u>73.0</u>	<u>135.9</u>
Multiple-purpose	15.4	None	15.4	7.8	23.2	1.2	24.4
<u>Annual Operation, Maintenance, and Replacement Costs</u>							
Lower Main Stem	0.8	0.3	1.1	1.3	2.3	1.0	3.3
Little Colorado	0.1	*	0.1	0.3	0.4	0.4	0.9
Gila	<u>0.8</u>	<u>0.5</u>	<u>1.3</u>	<u>1.4</u>	<u>2.8</u>	<u>2.9</u>	<u>5.6</u>
Regional Total	1.7	0.8	2.5	3.0	5.5	4.3	9.8

^{1/} Multiple-purpose and primary-purpose projects expected to be constructed during the 1966-1980 study period (pages 34-35).

^{2/} Developments to meet demands (Table 10) not satisfied by the authorized projects (see footnote ^{1/}) and those existing in 1965.

(Footnotes continued on following page)

Footnotes--Table 17 (Continued)

3/ Authorized and programmed developments to meet demands not satisfied by the developments existing in 1965.

4/ Figures are least-cost alternative estimates for the development of primary-purpose facilities designed to provide fish resources equal to that of the multiple-purpose projects expected to be constructed through the year 2020 (pages 34-36).

* Less than 0.1 million dollars.

It is conceivable that improved planning between respective agencies could result in preservation of the remaining productive river channels. Extensive acreages of these lands are under Federal ownership. Projects between various agencies, if properly coordinated, could reduce the threat of flood through improved zoning by modification of upstream flood control programs. The need for downstream channelization could be substantially reduced if upper watershed areas could be modified for runoff storage to allow for minimum release of flood waters downstream. It is conceivable that flood control projects above metropolitan areas, properly engineered, will prevent the need for downstream channelization in areas of important wildlife habitat. Economic benefits might also be realized from the procedure. The potential for preservation of wildlife habitat in river channels is unknown unless the responsible construction agencies properly coordinate with intent of purpose consistent with preservation. No agency, State, Federal, or private, should have the prerogative to impose measures destructive to wildlife habitat areas unless the public, fully knowledgeable of the consequences, accepts that the destruction must occur. Current wildlife programs cannot cope with habitat loss problems.

Many methods are available to wildlife managers which could be used to satisfy future demands. Since Federal lands support most of the Region's fish and wildlife, the following methods are suggested mainly for use on public lands. These methods largely involve dispersal of hunters and wildlife-oriented recreationists through provision of a large number of habitat improvement facilities over a large area. This methodology, while basically an attempt to meet the rapidly increasing demand for wildlife-oriented recreation, also attempts to retain the quality of the natural experience associated with quietude and serenity. Hunter dispersal will also reduce the safety problems associated with crowded hunting conditions.

The prime concern of responsible land managers must be the preservation and development of existing important habitat areas. In some cases, consideration should be given to restoration of once-prime habitat which has been destroyed or degraded.

Just as important is the improvement of habitat to fulfill the needs of the ever-increasing number of nonhunting, wildlife-oriented activities. Much of the habitat in the Region, while not highly productive of wildlife populations in its existing condition, is marginal or unsuitable for many other uses. Some of these areas which are important to the preservation of wildlife would be more beneficially utilized and would be more highly productive if managed primarily for wildlife.

There are tracts of habitat within the Region which, while they are of value for other uses, are extremely important for the preservation of wildlife populations. These high-value wildlife lands include those essential for the preservation of rare or endangered species and areas of extremely important key wildlife habitat which, if preserved,

would assure the perpetuation of existing wildlife and other associated activities.

Considerations for the endangered and rare species must be made in comprehensive planning. Land acquisition to preserve essential habitat will be necessary. Comprehensive planning must be accomplished through a joint effort of all agencies holding responsibility to the values recognized important to a wildlife species.

Acquisition should not be considered as the sole prerogative of private conservation groups or State game and fish departments. Acquisition can be accomplished by Federal land management agencies. Federal land agencies frequently have prerogatives and authorities to complete land exchanges that could be beneficial in blocking and maintaining important wildlife habitat areas. The burden of purchase of land areas by private or State entities can be prohibitive and unrealistic. Public agencies are all charged with responsibility of public interest. The Environmental Quality Act and Coordination Act require every consideration of the environment. Where these responsibilities are fully met and public review occurs, land management programs can be effected with a promise that the resource will be conserved.

Preservation of habitat involves more than acquisition of land. The quality of the total environment must be protected from pollution, fire, human disturbance, loss of food and cover, reduction in stream flow, siltation, changes in water temperatures, lowering of water tables, clearing of vegetation, or other factors that can reduce or destroy its value as productive lands or waters. Since only about 18 percent of the Region is in private ownership, the responsibility to maintain habitat for all species of wildlife lies primarily with Federal land management agencies and the appropriate State land and conservation departments.

Unwarranted loss of habitat through purely economic project objectives throughout the Region will reflect a judgment that, after the fact, may well be objectionable to the public. The federal agencies can dictate the future potential productivity of wildlife habitat on Federal lands. The land holdings of Federal land agencies are so vast as to have an overriding implication on benefits or losses to be expected in the future.

Already under the jurisdiction of Federal agencies are 47 million acres of public lands. Some of these areas now serve as habitat for endangered animals and should be so preserved. Other acreages can, through management and development, contribute to a program of preserving endangered species of fish and wildlife. Surveys are currently being made by Federal and State conservation agencies, colleges, private organizations, and individuals, of existing public lands that might provide habitat needed to guard against further loss of native fauna.

The overall range suitable for important wildlife species can be quite extensive, especially for big game. Most of the higher mountain forests and meadows along the length of the Mogollon Rim in Arizona and New Mexico are suitable for elk. The pine forests, pinyon-juniper, and oak woodland are suitable for turkey, and the higher elevation grasslands provide habitat for antelope. Most of these lands are publicly owned. The overall management of the important wildlife ranges by Federal and State agencies should give primary consideration to the preservation and wise use of wildlife and associated habitat. Management of these areas should also limit other activities to those compatible with the preservation and wise use of wildlife.

Most of the valuable wildlife habitat is on public lands and administered under the principle of multiple-use with fish and wildlife being managed as one of the important resources. The density may be less for some species on public lands, but that does not make the so-stated multiple-purpose lands of less significance to the overall production of wildlife. The importance of multiple-purpose lands to the wildlife resource is presently twofold. The extremely large acreages of these lands contribute greatly to the resource. Adding to the quality and quantity of the resource on these many thousands of acres, are the large numbers of developments which contribute to the well-being of wildlife.

Multiple-purpose lands may be as productive of wildlife as the habitat will allow. Improvement of the habitat for fish and wildlife purposes is needed to increase wildlife production and aid in achieving optimum multiple-use of public lands. Satisfying a part of the future demands for fish and wildlife resources is dependent upon accelerated fish and wildlife development on public lands.

Also, satisfying future demands for fish and wildlife resources will require that selected acreages be managed more intensively for fish and wildlife purposes. In addition to those lands currently managed primarily for wildlife and others expected to be identified in future studies, this report identifies 52 areas totalling 11.8 million acres as needing more intensive management to yield maximum fish and wildlife values. The areas would be managed with emphasis directed to the production of fish and wildlife, with appropriate consideration of compatible and/or complementary uses. The basis for selecting areas is dependent upon the species and production capabilities of the area, the area's present or threatened status of remoteness and public access, and the area's value for providing a reasonably natural wildlife area close to metropolitan areas.

The large increase in fish and wildlife lands is necessary in the Lower Colorado Region because of the high quality but fragile nature of the arid environment, where the lack of rainfall requires a long recovery period for damaged environment. The rapid increase in human populations and the resultant fish and wildlife demand also requires a large acreage of fish and wildlife land to sustain needs.

Anderson Mesa, southeast of Flagstaff, Arizona, is an example of an area which has historically produced high numbers of antelope. This area is also, as yet, relatively undisturbed by man. An area of as much as 250,000 acres should be designated on Anderson Mesa, to be preserved in a reasonable natural condition primarily for the production of antelope.

South of Anderson Mesa in the vicinity of Mormon Lake is an area highly productive of elk and turkey. As much as 100,000 acres in an area of this type could be designated and managed primarily for these wildlife species.

There are other areas in the Region, both publicly and privately owned, that may or may not be in a reasonably natural condition. However, the areas support populations of important wildlife species and are also within reasonable use distance of the Region's population centers. An example of such an area would be the slopes of the Sierra Anchas, along Tonto Creek, upstream from Roosevelt Lake. This area supports important populations of wild turkey in the upper elevations and javelina in the lower elevations. The area is also reasonably accessible to the Phoenix metropolitan area. The designation of approximately 100,000 acres could prove to be a substantial asset to the wildlife resources of the Region.

There are areas of specific habitat types which are limited in area, or diminishing in size, that should become designated wildlife areas.

The Gila River, downstream from Texas Hill is an example of an area having riparian vegetation that is extremely valuable for small game. This area contains approximately 10,000 acres of valuable wildlife habitat for quail, doves, waterfowl, and a variety of nongame species. Much of this area currently supports a variety of phreatophytic vegetation, which if allowed to mature, would provide excellent wildlife habitat. A similar area of 60,000 acres has been established on public domain lands west of Phoenix on the Gila River to preserve dove habitat.

Many areas throughout the Region are suitable and worthy of being designated specifically for wildlife. The 11.8 million acres (52 areas) which were identified for this report are listed on Table 22 and shown on Map 2. For the purpose of this report, delineation of these areas is very general. Any specific acreage determination, location, or boundary delineation for wildlife areas should be established cooperatively with the appropriate State game department.

Administrative policies of the Federal land management agencies provide for the maintenance, preservation, and enhancement of wildlife habitat. The priority given to wildlife on multipurpose lands must be increased in order that those interests which may bring a higher primary

financial return do not dominate. To maintain the wildlife resource on multiple-purpose lands, the management and use of the resources must be given consideration equal to that given to the other uses of the lands. Recognition of each area on its importance for wildlife production and subsequent emphasis on each respective wildlife species offers the potential of several million acres of public lands being managed beneficially for wildlife. The management of wildlife or its habitat is a monumental task requiring the utmost cooperation between all concerned State and Federal agencies. Proper application of the policies would provide substantial aid to the appropriate State fish and game program with a minimum investment required on their behalf.

Plans directly related to wildlife habitat improvement and management are carried out by most land management agencies. Many of these plans are original, others were developed by cooperators and game and fish agencies, and still others have been taken from the literature. Most of these plans have wide application and nearly all are undergoing continued refinement.

Wildlife benefits often accrue from several land management programs administered on multiple-use lands by the administering agencies. Most land management programs, when properly planned and carried out, can be beneficial to wildlife. These include livestock water developments, proper timber harvest, erosion control, manipulation of vegetation, and many others. Lands managed by public land administration agencies that are of primary significance for wildlife can be managed with that emphasis and no basic conflict with other resource uses need result.

Public lands generally are open to grazing by permit or lease. Where forage is sufficient and management of livestock is a reality, competition with wildlife is of little or no consequence. In those areas where management is inadequate or lacking, livestock frequently competes severely with wildlife. In these situations the forage resource is depleted and not infrequently the area becomes of low value to wildlife. In those ranges where browse species predominate, severe utilization by livestock can jeopardize the productivity of the area from a wildlife production standpoint for many years in the future. Improved livestock management may require a reduction in livestock numbers. The procedures required to effect reductions are difficult to apply and require extensive field investigations. Public land agencies must have increased budgets in order to substantially improve vegetative conditions where livestock numbers are excessive. In time, public land managers may have the opportunity to be more effective and responsible for management of the surface resources, providing legislative changes occur. The wildlife productive potential must be recognized at all times and given additional emphasis when competition is extreme.

Federal land management agencies have a program of classifying Federal lands, some of which are classified for disposal. While the

classification program is essentially complete, land disposals continue to occur, especially where previous commitments require land transactions. Most lands more suitable for urbanization, industrial development, or private ownership have been disposed of or identified for disposal.

The land disposal program can result in a loss of wildlife habitat. To keep the losses at a minimum, the resources should be evaluated by fish and wildlife agencies and if deemed important, the lands in question should be identified and responsible land management agencies notified of their value. Identification of important areas must occur before land classifications proceed to the point where disposal becomes a reality. Coordinated planning has been accomplished to a substantial degree in recent years to prevent undue loss of high value wildlife lands. Where the importance of land areas for wildlife habitat is recognized, there should generally be no need to dispose of the land to State game departments unless the land agency cannot meet the commitment of the management decision. The judgment can only be made following careful objective review by the affected responsible State and Federal agencies.

In other situations, important wildlife habitat can be preserved under the existing authorities of most public land agencies. State laws frequently are not as well developed to provide for proper management on State land. It would not be necessary for the State game and fish department to become primary land holder. It would be appropriate that the Federal Government cooperate with State game departments in the management, development, and preservation of important wildlife habitat. Agreements are in effect between land management agencies and State agencies to assure the perpetuation of wildlife species.

Ancillary lands, while being managed primarily for other uses, may continue to contribute in varying degrees to the wildlife resource. All agencies have some lands which fall into this category and which contribute little to the resource. These include administration sites, transportation rights-of-way, etc.

Some ancillary lands can be relatively important to wildlife, while others are relatively unimportant. Agricultural lands in certain crops, such as small grains, can be an extremely important food source for many species of wildlife, providing the other life requirements are close at hand. Other lands, such as those in active mining production, are relatively unimportant to wildlife, although advance planning for habitat rehabilitation will result in long-range wildlife benefits.

The amount of ancillary land falling under an agency's administration depends upon the activities of that organization. Public lands administered by land and resource management agencies, such as the Bureau of Land Management and the U.S. Forest Service, have a proportionately small amount of these lands. Lands administered by private organizations and by the military have an extremely high proportion of ancillary lands.

There are, in the Region, several million acres of lands which are not open to public hunting. Over 18 percent of the Region consists of lands held in trust for the Indian people. Some Indian lands have been developed for wildlife, and hunting by non-Indians is allowed on a permit basis. Many reservations are not open to public hunting for big game. On many areas, wildlife has been virtually eliminated and not allowed to repopulate. Some Indian trust lands contain rolling grasslands which would be suitable for pronghorn antelope. Many of the desert mountain areas, such as occur on the Papago Reservation, are suitable for the bighorn sheep.

The development of these areas for increased wildlife production and the stocking of suitable wildlife species could provide additional sanctuaries and a great deal of valuable hunting. In addition to stocking of appropriate wildlife species on Indian trust lands, the development of facilities such as catchment and oasis-type watering stations and cover stations, as previously described, would provide a significant increase in hunting.

Extensive research would be necessary to select suitable habitat for each species and to determine the feasibility of introducing new species into an area. The costs associated with the necessary research and with the stocking program would probably not exceed 140,000 dollars per study period.

The Department of Defense has set aside over 4 million acres of public land within the Region. Only a small portion of these lands is open to public hunting. Much of this area, prior to military withdrawal, was developed to some degree by fish and wildlife interests for the enhancement of wildlife populations. Many wildlife-watering developments were built on the Cabeza Prieta Game Range and on areas of the Yuma Proving Grounds prior to military withdrawal. The construction of these watering devices benefited the desert mule deer, desert bighorn sheep, and the endangered Sonoran antelope and other species of wildlife.

Military testing activities reduce the natural vegetation and expose desert areas to wind and water erosion. Some wildlife developments have been destroyed also. The reconstruction of wildlife developments, the replacement of destroyed habitat, and the return of these lands to public hunting would provide an extremely important addition to the wildlife resource. If these areas were to be retained by the military, wildlife habitat should be maintained by the military, and the areas should be open to public hunting during seasons. The opening of smaller military areas, including Fort Huachuca and the Navajo Ordnance Depot, to public hunting rather than restricted hunting for military personnel and government employees of the area, would help satisfy a portion of the local hunting demand.

White-winged and mourning doves probably provide the most impressive small-game hunting within the Region. Under the current situation, white-winged doves are exposed to hunting pressures for only a short period because of the early migration of this species. These birds migrate to Mexico on or around the first day of September, which is the normal opening day of the season. Opening the season one week earlier, on approximately August 25, would extend the hunting considerably. Such a program would require close management and hunter education to prevent the shooting of mourning doves, which are protected under the guidelines set forth by the Convention between the United States and Great Britain for the Protection of Migratory Game Birds.

The acquisition of irrigated lands within the prime white-winged dove areas and managing them properly would prove a valuable asset. Plots of these lands should be scattered around the metropolitan areas of Phoenix, Tucson, Yuma, and others within the southwest desert range of the whitewing. The general locations of these areas are shown on Map 2. These areas should be managed to provide grain sorghums maturing between August 1 to September 15. These plots could be sharecropped by a neighboring farming operation with little or no farming costs borne by wildlife interests. This cropping procedure would tend to hold white-wings in the area longer, would provide more high-quality hunting areas, and would disburse hunters over a wider area, reducing crowded hunting conditions. They would also provide feeding areas where feed for doves is now in short supply. Under current conditions, most crops suitable for use by doves for food are harvested and plowed under by September 1, or are not sufficiently mature to be attractive to doves.

White-winged dove populations are highly dependent upon sufficient cover for roosting and nesting. This habitat is ideally provided by mesquite and salt cedar thickets which occur primarily in riverbottom areas. This habitat is rapidly being destroyed by water-salvage and flood control projects. Habitat of this type which still remains at this time must be preserved, managed, and possibly restored within some prime areas. These areas are also shown on Map 2.

Selection of additional wildlife areas depends upon the habitat available for nongame and endangered species as well as small game. Those of primary concern are lands consisting primarily of riparian vegetation and natural marshes. These include the 1,000-acre Picacho Reservoir site which, as a result of rapid loss of riparian vegetation in the Region, may soon become the primary remaining nesting habitat for white-winged doves. This area is also highly productive of mourning dove, Gambel's quail, cottontails, many important nongame species, and is heavily used by waterfowl.

Waterfowl, being migratory birds, present an entirely different management situation. Waterfowl management consists of a different type of habitat manipulation than is required for small game and big

game. Habitat management for waterfowl consists of construction and maintenance of marshes and ponds for open water plus provisions of feeding areas within the marshes, or if necessary, the planting of crops adjacent to water areas.

It is possible that sufficient numbers of waterfowl to satisfy hunting demands could migrate into the Region if resting and wintering habitat were made available. However, the level at which the national waterfowl population can be maintained outside of the Region is the primary factor determining the migratory waterfowl population in the Region.

Waterfowl hunting could be enhanced by providing for management areas on selected existing or proposed reservoirs. These management areas should be zoned to reduce conflicting activities. Each management area should contain a minimum of 250 acres of primary-purpose land suitable for irrigation, which could be sharecropped by adjacent farming operations to provide waterfowl food. Four of these management areas, strategically located around the Phoenix, Tucson, and Las Vegas metropolitan areas as shown on Map 2, would not only provide waterfowl hunting areas, but would attract heavier concentrations of birds into adjacent areas, and would tend to hold migrating birds in the area longer.

Land for waterfowl areas should be provided in conjunction with proposals for water development projects. Water to provide irrigation for 1,000 acres of irrigated land would be purchased for approximately \$600,000 per year; the costs would be paid in part by the farming of these lands. Expenditures for the development of farming facilities and hunter facilities through 2020 would be approximately \$900,000.

There are areas within the Region which are currently used by waterfowl for nesting. This nesting habitat should be expanded, and additional lands developed to accommodate waterfowl nesting. This practice would essentially develop a local huntable population of waterfowl. This habitat would also be extremely valuable to shorebirds and other nongame species for which suitable habitat is now quite limited. About 1,000 acres of identified marsh areas at the higher elevations and additional areas that are suitable for development into marsh areas should be managed to provide suitable habitat for waterfowl and shorebird nesting. Marsh areas suitable for waterfowl and shorebird nesting that are now in private ownership should be considered for acquisition by public agencies, either State or Federal, where this is necessary to assure protection of this type of wildlife habitat.

The San Simon drainage is an area where past abuse has resulted in severe erosion, loss of soil, and substantial loss of waterfowl habitat. Rehabilitation of over approximately 60 miles of drainage could result in the construction of a number of detention structures. Modification should be effected in each structure to provide for impoundment

of water. Existing developments have been modified to provide for impoundment in an effort to create waterfowl habitat. These efforts have proven to be successful. On a large scale the cost may far exceed benefits based on normal economic analysis. If the public values can be identified to be of substantial importance, economic or otherwise, feasibility need not be questioned nor the potential doubted. Each structure required in rehabilitation of the San Simon could, in addition to waterfowl, provide for fishing use.

Resource Base (Facilities)

Wildlife watering stations in water-short areas of the desert where other habitat requirements are met would be of significant value to game and nongame species alike. These watering stations could be of the catchment type which would catch and store runoff water in protected areas to reduce evaporation. Water catchments of this type are nearly maintenance-free and are designed to provide a ready supply of water except during extreme periods of drouth. Provisions could be made to haul water by truck to these catchments during these extended dry periods. Each of these water catchments when constructed in a selected location would provide approximately 130 man-days of hunting annually.

Wildlife watering stations of the drip or oasis type could be constructed in areas where a water supply is available. This water supply could be provided through a small-gauge, short-length pipeline to these stations from the many existing and projected cross-desert irrigation canals or from private stock-watering or domestic water facilities. This type of watering facility could be constructed on the desert floor where the construction of a catchment-type facility would be less satisfactory. The construction of these facilities in water-short areas would provide approximately 130 man-days of hunting annually per station.

In areas of the desert where food and/or cover are in short supply, the provision of watering stations alone will not increase wildlife populations appreciably. In these areas it would be possible to provide food and cover through the construction of water-spreading dikes along the natural drainages. The construction of a spreader dike along a shallow wash within a broad floodplain would provide a natural irrigation effect. Water use in this type of facility would consist of temporary detention of minor runoff waters, and water consumption, basically a result of evapotranspiration, would be minimal. This could supply sufficient water to support a stand of native desert annuals for wildlife food. Desert brushy and woody species would eventually become established and provide needed cover. These natural processes, however, would take many years. This time-lag could be shortened considerably by the planting of annuals, and the planting or transplanting of woody vegetation such as mesquite, ironwood, palo verde, catclaw, et cetera. This type of cover station, ranging from 25 to 100 acres in size, constructed in cover-short areas and retained specifically for wildlife usages,



could provide 115 man-days of hunting annually when mature.

In addition, the use of spreader dikes as a water-collecting device for a wildlife watering facility would provide an additional 75 man-days of hunting annually at each of these facilities.

The three types of facilities discussed above could be of great value to the hunter as well as the wildlife. To be of the greatest value, these devices should be constructed in areas which have a high potential value for game. The facilities, when distributed properly throughout the drier parts of the country, would each provide hunting areas for a small group of hunters. The construction of sufficient numbers of these stations would tend to distribute hunters over a larger area, reducing crowded hunting conditions. This practice would tend to maintain the high quality, uncrowded condition which hunters prefer and is most beneficial to preserving adequate populations of wildlife.

There would tend to be some retention of runoff water at the catchments and spreader dikes. The actual water consumption in these devices, however, would be only slightly more than drinking water for wildlife, and consumptive use would be negligible. The water requirement for each oasis-type station would be approximately one acre-foot per year.

Fencing of high-value wildlife areas would prevent damage to these areas by livestock. It is estimated that a minimum of 150 miles of fence would be needed during each study period to enclose the areas of highest value to wildlife. A more exact need for fencing and the benefits derived therefrom could be evaluated only through a more detailed study.

The construction of roads and trails into the more remote areas would improve access for big-game hunting. Approximately 135 miles of roads would be needed by 1980, 270 miles by 2000, and 350 miles by the year 2020. Construction of roads for wildlife purposes would be essential to the development of wildlife areas and with proper coordination these roads could be designed to be of benefit for fire control, range management, and other purposes. The rights-of-way should be carefully selected with attention given to maintenance of environmental quality in the fragile desert ecology and the availability of game populations. Many of these wildlife developments when properly planned would be of equal value in any habitat type in the Region.

Resource Base (Minimum Water Requirements)

The water required for the development of land and operation of the facilities discussed previously in this report is shown on Table 18. The projected water consumption shown is required to satisfy Regional hunting demands through 2020.

Table 18
Minimum Water Requirements to Satisfy
Unmet Demand 1/ for Hunting

Hydrologic Subregion	Resource Base <u>2/</u>	1980		2000		2020	
	1965 Consumption (Ac-ft)	Storage (Ac-ft)	Consump- tive Use (Ac-ft)	Storage (Ac-ft)	Consump- tive Use (Ac-ft)	Storage (Ac-ft)	Consump- tive Use (Ac-ft)
Lower Main Stem	100,000	-0-	1,500	400	15,900	600	27,700
Little Colorado	<u>4/</u>	-0-	700	-0-	2,700	100	5,400
Gila	<u>4/</u>	-0-	-0-	-0-	12,000	400	50,600
Regional Total	100,000	-0-	2,200	400	30,600	1,100	83,700

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- 1/ Unmet Demand: The demand at end of each study period not satisfied by the total supply (Tables 14 and 15).
- 2/ Resource Base: Total water rights for fish and wildlife purposes (Table 8).
- 3/ Figures are cumulative, excluding the 1965 Resource Base requirements.
- 4/ Less than 100 acre-feet.

Costs: Wildlife Developments

Table 19 shows a breakdown of the total costs associated with the development of wildlife habitat facilities which in association with other wildlife features of this plan will satisfy most of the projected demand in each time frame of the study period for hunting and other wildlife-oriented activities. The structures would be constructed on both primary-purpose and multiple-purpose public lands, with the type of structure selected as most suitable for any specific location.

The land acquisition costs shown on Table 19 are for the purchase of small plots of private lands and costs associated with the transfer of administration and ownership of public lands. The necessity for acquisition of public lands by states is dependent primarily upon the direction followed by Federal land management agencies. Existing laws, including the Coordination Act, Environment Quality Policy Act, Classification and Multiple Use Act, and others give promise that Federal agencies will do their part.

The "Authorized 1980" costs shown on Table 19 are those attributable to mitigation measures expected to be developed by 1980 to replace wildlife lost as a result of the construction of multiple-purpose projects. The mitigation measures include the development of Cibola National Wildlife Refuge and the Mittry Lake State Wildlife Management Area on the Colorado River. Other wildlife measures such as investigations, habitat rehabilitation, and minor facilities are included in the development of the Central Arizona Project. None of the above measures are expected to add to the wildlife resource base. The costs shown in this appendix were designed to satisfy the demands generated by the framework program and do not include ongoing and anticipated agency programs.

Table 19
Wildlife Development Costs Required to Satisfy Demands
Generated by the Framework Program
(Million Dollars)

Hydrologic Subregion	1980			2000		2020	
	Authorized ^{1/}	Programed ^{2/}	Total ^{3/}	Incre- mental Increase	Cumu- lative Total	Incre- mental Increase	Cumu- lative Total
<u>Lower Main Stem</u>							
Habitat Development	1.0	2.1	3.1	28.0	31.1	25.8	56.9
Land Acquisition	3.0	*	3.0	0.1	3.1	0.1	3.2
Access	*	0.1	0.1	0.2	0.3	0.1	0.4
Research	*	*	*	0.1	0.1	*	0.1
Subtotal	<u>4.0</u>	<u>2.2</u>	<u>6.2</u>	<u>28.4</u>	<u>34.6</u>	<u>26.0</u>	<u>60.6</u>
<u>Little Colorado</u>							
Habitat Development	-0-	2.5	2.5	4.0	6.5	6.7	13.2
Land Acquisition	-0-	*	*	*	*	*	*
Access	-0-	0.2	0.2	0.1	0.3	0.1	0.4
Research	*	0.3	0.3	*	0.3	*	0.3
Subtotal	<u>*</u>	<u>3.0</u>	<u>3.0</u>	<u>4.1</u>	<u>7.1</u>	<u>6.8</u>	<u>13.9</u>
<u>Gila</u>							
Habitat Development	0.6	-0-	0.6	33.1	33.7	100.1	133.8
Land Acquisition	1.0	-0-	1.0	0.1	1.1	0.3	1.4
Access	*	0.7	0.7	1.0	1.7	0.4	2.1
Research	*	*	*	0.1	0.1	0.2	0.3
Subtotal	<u>1.6</u>	<u>0.7</u>	<u>2.3</u>	<u>34.3</u>	<u>36.6</u>	<u>101.0</u>	<u>137.6</u>

(Footnotes on following page)

Table 19 (Continued)
Wildlife Development Costs Required to Satisfy Demands
Generated by the Framework Program
(Million Dollars)

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Hydrologic Subregion	1980			2000		2020	
	Authorized ^{1/}	Programed ^{2/}	Total ^{3/}	Incre- mental Increase	Cumu- lative Total	Incre- mental Increase	Cumu- lative Total
<u>Regional Totals</u>							
Habitat Development	1.6	4.6	6.2	65.1	71.3	132.6	203.9
Land Acquisition	4.0	*	4.0	0.2	4.2	0.4	4.6
Access	*	1.0	1.0	1.3	2.3	0.6	2.9
Research	*	<u>0.3</u>	<u>0.3</u>	<u>0.2</u>	<u>0.5</u>	<u>0.2</u>	<u>0.7</u>
Total	5.6	5.9	11.5	66.8	78.3	133.8	212.1
<u>Annual Operation, Maintenance and Replacement Costs</u>							
Lower Main Stem	0.4	0.2	0.6	2.8	3.4	2.6	6.0
Little Colorado	*	0.3	0.3	0.5	0.8	0.7	1.5
Gila	<u>0.2</u>	<u>0.1</u>	<u>0.3</u>	<u>3.4</u>	<u>3.7</u>	<u>10.1</u>	<u>13.8</u>
Regional Total	0.6	0.6	1.2	6.7	7.9	13.4	21.3

^{1/} Wildlife developments expected to be constructed during the 1966-1980 study periods.

^{2/} Developments to meet demands (Table 15) not satisfied by facilities existing in 1965, on going and expected agency programs, or authorized projects (See footnote ^{1/}).

^{3/} Authorized and programed developments to meet demands not satisfied by the developments existing in 1965.

* Less than 0.1 Million Dollars.



Development Response: Big Game

Standard management procedures as outlined in the previous section would provide additional big-game hunting consisting primarily of deer hunting. The construction of approximately 26,000 wildlife watering facilities with appropriate fencing and hunter access on public lands would increase the wildlife resources sufficiently to support about 570,000 man-days of additional big-game hunting annually. Costs associated with the developments would be approximately 109 million dollars by 2020. Operation, maintenance, and replacement costs for the areas would be approximately 11 million dollars annually.

The development of additional wildlife facilities on other public lands, including approximately 17,000 watering facilities, appropriate fencing, development and access, and other associated facilities, would provide approximately 370,000 man-days of big-game hunting annually. Costs of development of these facilities would be approximately 70.5 million dollars. Operation, maintenance, and replacement costs would be approximately 7.1 million dollars annually.

The programs of development and stocking of Indian lands not now available to public hunting could provide a substantial income to the Indian people where none exists now, and provide an estimated 120,000 man-days of big-game hunting annually toward satisfaction of the 2020 needs.

Costs associated with the development of facilities sufficient to maintain this additional hunting on Indian lands would be approximately 15 million dollars. The annual operation and maintenance costs of these facilities would be approximately \$1,500,000 annually. These costs would be associated primarily with the development of about 3,550 watering facilities.

The military areas could provide an estimated 50,000 man-days of big-game hunting annually to the Region if they were opened to public hunting. Approximately 1,700 habitat facilities would need to be restored or developed and maintained. Costs for restoration and maintenance of these lands is estimated to be seven million dollars and should be provided by the military.

In summarization, the total demand for big-game hunting in the year 2020 can be met by adopting the proposed program. The big-game supply, however, will be mainly deer, and many hunters who would prefer to hunt other species must shift to deer hunting.

Development Response: Small Game

Like big-game, the small-game resource can be improved through management. Furthermore, small-game species require less area and a lower cost of habitat development per man-day of hunting provided.

Water and habitat preservation and development in the way of water catchments, oasis-type watering stations, and cover stations, along with access development and fence construction on multiple-purpose and primary-purpose lands, as discussed for big game, also will provide benefits to the small-game hunting resource. The construction of sufficient numbers of these stations would tend to distribute hunters over a large area, reducing crowded hunting conditions and maintaining the high quality condition which hunters prefer. The previously discussed big-game developments will benefit Gambel's quail, mourning doves, and other game species as well as associated nongame species and provide approximately 800,000 man-days of small-game hunting annually to the Region.

Opening the season the third week of August, developing of feeding areas for small game at an acquisition cost of about \$600,000, and maintaining or increasing nesting habitat for white-winged doves would provide in excess of 200,000 man-days additional small-game hunting annually. This addition to the small-game resource alone would provide approximately 17 percent of the unmet demand for small game in 2020.

The introduction of exotic species of small game could prove to be extremely valuable in maintaining high quality small-game hunting with the rapidly expanding human populations. The introduction of the ring-necked pheasant into the United States from the Far East is a good example of how important these introductions can be. Extensive research is necessary to select exotics and to prove the benefits to be derived, or the possible dangers, before an introduction can be made.

As with big game, the opening to public hunting of military lands on which hunting is now restricted could provide greater opportunity for use of small-game resources. The reestablishment of habitat and reconstruction of wildlife facilities on military lands under restricted usage, and allowing small-game hunting, could provide as much as 100,000 man-days of additional small-game hunting annually.

Indian trust lands are now generally open to non-Indian hunting of small game by permit. Therefore, only through more intensive management could this segment of the resource be increased.

The development of wildlife habitat facilities, as described previously, for big game on Indian trust lands, also would benefit small game. These developments could provide up to 400,000 man-days of small-game hunting if properly placed and constructed.

With implementation of the plan as outlined in this report, the small-game hunting demand through 2020 will be met. In addition, a sufficient number of man-days of small-game hunting will be provided to supply this demand which will be generated for other types of hunting. A large portion of the demand for small-game hunting beyond the year 2000 will remain unmet if adequate planning and development are not undertaken. As previously pointed out, the demand for small game could



be met through management and habitat manipulation, providing sufficient land, water, and development funds are made available to land management agencies and fish and wildlife interests.

Development Response: Waterfowl

The benefits of the combined effects of providing waterfowl and shorebird habitat for concentrating and holding birds and providing hunting and nesting areas would amount to about 150,000 man-days of waterfowl hunting annually. Waterfowl hunting will be available only to the extent that habitat is provided and the population of waterfowl is sufficient. Hunting undoubtedly will be limited to a permit system on public shooting areas plus some leasing of hunting rights on private areas. The remaining demand for waterfowl hunting must be satisfied by other wildlife-oriented activities as with the demand for big game. It is possible, with a continued decline in the national waterfowl population, that this objective will not be reached.

Development Response: Other Wildlife-oriented Activities

The demand for other wildlife-oriented activities by the year 2020 will approach 1.5 million man-days annually in the Region. These activities, including bird and animal watching and nature photography, have a somewhat different effect on wildlife populations. While these activities are non-consumptive, as such, of wild animals and birds, human disturbance and destruction have a limiting effect on wildlife populations. The program discussed previously including all existing and proposed wildlife areas would accommodate the demand for non-consumptive wildlife-oriented activities as well as the fishing and hunting demand through the year 2020.

When it is no longer possible to provide a hunting experience of the quality existing at the present time, then an experience of lesser quality must be accepted. When the demand for hunting a certain species exceeds the supply, then that hunting must be put on a permit basis, as many species are now, such as elk and antelope. When this occurs, demands can be satisfied by the hunter's shifting to small-game species. At the point when the demand for small-game hunting exceeds the supply, the methods of meeting the demand for quality hunting will rest upon the development of private hunting preserves, available only to those hunters who can afford the high costs of the hunting experience.

All field investigators recognize that the wildlife resource is limited. The land area and available wildlife habitat are restricted. Productivity levels can be increased to a higher level than now in evidence. Ultimately, however, under the best of conditions, the resource will be unable to satisfy increasing demand. A projection based on a premise to provide for a continually increasing demand is not realistic. Other controls are required. Limited water reserves within the Region

must be realistically appraised to prevent unrealistic promotion that invites a human population influx that in turn is incompatible with existing or projected resources.

Past trends concerning wildlife management and preservation generally reveal a decreasing supply in the face of an increasing demand. Unfortunately, concern seems to arise only when a situation becomes critical, or when a species of wildlife becomes endangered or extinct.

Attitudes toward wildlife have undergone their own evolutionary changes in the recent past. Research by Federal and State agencies, universities, and private organizations is expected to continue contributing to the development of wildlife management techniques. However, funds are generally not sufficient to put into practice the improved techniques except on a local and short-term basis. Knowledge, concern, and some improvement on a local basis has become greater, but the concern outside of the wildlife agencies for wildlife requirements on a state-, region-, and country-wide basis has not increased appreciably.

The ability of this Region to satisfy future hunting demand will not only depend upon the interest which can be stimulated in this field, but upon the time element as well. Setting aside habitat in existence at this time is the most economical method of preserving the natural environment and associated species. It is very expensive and difficult to reestablish a habitat type and reintroduce the appropriate species, a process that involves many years to accomplish. Once a species is near extinction, it is most difficult to reestablish.

The wildlife plan as set forth in this report in the time frame indicated, could meet the future demands for wildlife-oriented activities. Any action of a lesser degree will in turn cause associated demands to be unmet.

However, it must be recognized that a human population increase from 1,847,000 to 6,876,800 will necessitate greatly the intensity of use of land and water areas, thereby militating against preservation of the quality of hunting. Thus, even though demands for hunting are shown as being met by the plan presented in this report, the qualitative aspects can be maintained only to a limited extent in selected areas.

COMPARISON OF OBE-ERS
AND MODIFIED OBE-ERS

CHAPTER 5 - COMPARISON OF OBE-ERS AND MODIFIED OBE-ERS PROJECTIONS

Based on the human populations provided by the Office of Business Economics, Economic Research Service, the Regional demand for fish and wildlife resources would be somewhat less than for the projections shown in the main body of this report. The differences stem from the lower human population projected by OBE-ERS for the metropolitan areas of Nevada, New Mexico, and Utah. Population projections for Arizona were the same for both the OBE-ERS and the Modified projections.

The overall result is relatively minor, with the Regionwide projected demand for fish and wildlife resources being approximately 12 percent less than the Modified projections. The local demand differences are greater. For example, during the 1966-1980 study period, the OBE-ERS-based demands for hunting in the Lower Main Stem Subregion would be satisfied by the existing resource base; however, for the Modified projections, there is a need for additional wildlife facilities and associated water requirements.

The OBE-ERS projected land needs for fish and wildlife would not vary significantly from those projected in this report. The water and associated facility requirements, however, are less than those projected to satisfy the fish and wildlife needs based on the Modified projections. Table 20 shows the comparison of consumptive-use water needs for fish and wildlife by time frame and subregion.

Table 20
 Comparison of Water Needs: 1/ MOD-OBE-ERS:OBE-ERS
 Primary-Purpose Fish and Wildlife

	Consumptive-Use (Acre-feet)		
	1980	2000	2020
<u>Lower Main Stem Subregion</u>			
MOD-OBE-ERS	12,585	66,755	111,320
OBE-ERS	8,764	47,776	99,155
<u>Little Colorado Subregion</u>			
MOD-OBE-ERS	5,190	9,155	19,900
OBE-ERS	5,069	8,093	15,797
<u>Gila Subregion</u>			
MOD-OBE-ERS	14,300	46,300	163,580
OBE-ERS	14,174	45,605	162,093
<u>Regional Total</u>			
MOD-OBE-ERS	32,075	122,210	294,800
OBE-ERS	28,007	101,474	277,045

1/ Needs are in addition to the water used in 1965 (Table 2) and that required for the operation of the developments planned for construction (pages 34, 35, 36).

PROGRAM EVALUATION

CHAPTER 6 - PROGRAM EVALUATION

The fish and wildlife program for the Lower Colorado Region has been described in this appendix and summarized in Appendix XVIII, General Program and Alternatives. The fish and wildlife program is based on the fish and wildlife resource existing in 1965.

The plans and projections being made by other interests of the comprehensive framework plan are expected to have a significant effect on the fish and wildlife program. The other studies include features which will both benefit and detract from the basic fish and wildlife resource. They may result in a species composition change or a use type change, such as a reservoir producing a fishery at the cost of wildlife production. Although an overall increase in use may occur, it is not normally considered a benefit to the total fish and wildlife resource. The ultimate effect of each plan generally results in a net loss to the wildlife resource. The final result is a need for an expanded plan for fish and wildlife resources, especially wildlife, to meet future demands.

The discrepancies between the various appendixes reveal the lack of coordination between various agencies or disciplines. None of the projections can be considered as realistic where direct conflicts will occur between the programs proposed. Fish and wildlife values will be severely jeopardized if many of the projections identified in the other appendixes are realized.

Appendix XVIII, General Program and Alternatives, presents a framework program to supply the Region's water needs for all interests including fish and wildlife. In providing for these needs in the early action program, the water resources development program includes vegetative manipulation along the Colorado and Gila Rivers to increase water available to higher economic uses by 30,000 acre-feet annually. This process does not truly constitute increased water yield, but a transfer of water from one use to another. The ultimate result will be reduction in the wildlife resource base. The proposal also includes land treatment for increased water yield on 350,000 acres during the early action program, and 1.2 million acres during the continuing program. With proper planning this vegetation manipulation can create edge effect, benefiting wildlife in the larger, more dense areas. Throughout most of the Region, however, the brushy and woody vegetation is not sufficiently dense over a large enough area to merit clearing to create this edge; thus wildlife is not benefited significantly.

The transfer of water use does not assure downstream flows adequate to sustain a stream fishery. The downstream storage of this increased runoff water may provide additional reservoir benefits. However, the

net result is an overall reduction of the wildlife resource.

Appendix VI, Land Resources and Use, presents a framework program for land treatment including vegetation manipulation and structural measures, under several programs. The total acreage, including multiple treatments of some lands, totals 64 million acres. About 1.3 million acres of the proposed land treatment consists of vegetative manipulation to increase water yield or livestock forage production. Often these programs, even when properly planned, are not beneficial to wildlife.

Appendix IX, Flood Control, framework program proposes a number of various methods by which flood damage can be reduced. Flood channel improvement, a widely used flood control practice, is proposed extensively in this appendix. An early action program calls for 580 miles of channel improvement, with an additional 535 miles in a continuing program. Channel improvement is often combined with the construction of levees for additional protection. The early action program provides for 275 miles of levees, with an additional 165 miles included in the continuing program.

These structures are normally constructed through the prime river-bottom vegetation and are highly destructive of wildlife habitat. In recent years, some effort has been made by construction agencies to retain or allow regrowth of a small portion of this habitat; however, the overall result is a loss of nearly 75 percent of what is normally the best wildlife cover of the desert.

Flood control impoundments are also widely used for damage prevention. The early action program calls for 3.1 million acre-feet of flood control storage while the continuing program includes 1.2 million acre-feet of storage.

Some destruction of habitat normally occurs during construction of these structures, and some habitat is lost due to flooding. However, some of these losses are offset by the growth of new habitat within the flood pools due to the irrigation effect of floodwater detention, and some wildlife water is provided. With proper planning, these structures can be quite beneficial to wildlife. With the inclusion of a permanent storage pool, these structures can provide a productive fishery. Storage facilities can also reduce the necessity of extensive channelization. Alternatives to flood control channelization have not been adequately explored. Each possible alternative should be objectively analyzed. The method of flood damage reduction which would be least destructive to wildlife is flood zoning. This procedure could prevent development along the primary floodplains of major streams and in other areas subject to extreme flood damage. This procedure would preserve the better wildlife habitat for the benefit of all people and reduce the need for extremely expensive flood control projects which normally protect the interests of small groups.

Appendix X, Irrigation and Drainage, provides a framework program for irrigation and development of 200,000 acres of new croplands in an early action program and 300,000 acres in the continuing program. Part of this land to be put into crops would replace lands lost to other interests, and part of it would represent an increase in total crop acreage. This acreage must be taken from unbroken land, thereby reducing the native habitat available to wildlife.

The Irrigation and Drainage Appendix also indicates the need for drainage on 68,000 acres. While most of this drainage is designed for irrigation drainage, any draining of existing marsh areas would destroy a type of habitat which is in extremely short supply in the Region.

Appendix XII, Recreation, shows an estimated increase in recreational demand from 138 million man-days in 1965 to 918 million in 2020. This increase will result in competition for open space, not only between the recreationist and hunter or fisherman, but between recreationists and the wildlife itself. Excessive human activity in the open space will actually destroy wildlife. Of major concern is the operation of off-road vehicles which often destroy habitat and lead to severe wind and water erosion problems.

Water-based recreation such as speedboating and water skiing tend to increase water turbidity through wake-caused wave action and pollute the water with oil and fuel. Such pollution destroys fish habitat. These factors tend to reduce both the quality and the quantity of fish and wildlife resources and associated activities.

Appendix XIV, Electric Power, estimates that by 1980 the Region will require 8.3 gigawatts of electric power. By the year 2020, this demand will increase to 108 gigawatts. To supply this power need, additional power supplies will be developed, and importation of power from outside the Region will be required.

Development of power supply plants present possible pollution threats in the way of thermal pollution of water and solid pollutants to the air. The possibility of nuclear pollution of both water and air occur with nuclear plants.

Power transmission facilities require rights-of-way along which most brushy and woody vegetation is cleared. In a few areas where large expanses of dense woody vegetation occur, this could be of some benefit to wildlife. In most areas, however, this right-of-way clearing results in a reduction of the availability of woody habitat and can lead to severe erosion problems not aesthetically desirable. The physical presence of overhead powerlines and undue soil disturbance or vegetation removal reduces environmental quality. The natural and scenic environment in areas of the Region having wild and primitive values is damaged where transmission facilities are allowed. Long-range comprehensive

planning is not in evidence in projected future right-of-way routes. Each right-of-way is authorized without sufficient knowledge of future requirements for additional transmission facilities.

The evaluation of the total effect of the other comprehensive plans on fish and wildlife would require extremely detailed information concerning the environmental conditions of the areas to be developed. A superficial examination of these plans, however, indicates an even greater need for implementing a positive comprehensive development plan for the preservation of fish and wildlife.

CONCLUSIONS AND
RECOMMENDATIONS

CHAPTER 7 - CONCLUSIONS AND RECOMMENDATIONS

The Fish and Wildlife Appendix provides the best information available concerning the fish and wildlife resources and associated 1965 conditions, and those expected through the year 2020. The plan presented is designed to satisfy the fish and wildlife demands expected from the projected population levels provided for the Comprehensive Framework Study. Inherent restrictions placed on this study by established guidelines, inadequate funding, and personnel ceilings have prevented the fish and wildlife work group from developing alternate plans based on preserving the environment of the Region. The development and utilization of the resources of the Region in a manner to promote the attainment of a rising standard of living for all residents is dependent upon maintaining a desirable human population size with proper distribution densities throughout the Region. Such considerations would provide an enriched natural and cultural resources heritage for the future generations of residents.

One of the most significant problems that faced fish and wildlife in the past was found in the basic philosophy of most resource planners and land developers. Land and water development planners gave major emphasis to accepted project purposes but little or no consideration to fish and wildlife resources. Repeated following of this approach conditioned planning to the effect that the environment supporting fish and wildlife received very little attention and was sacrificed in the interest of other project purposes with greater monetary benefit. In more recent years, increased public interest in resource management, continued efforts by public and private conservation agencies, and legislative changes have combined to effect a general change of land and water development philosophy. Considerations now given to fish and wildlife include provisions for minimum pools in reservoirs, maintenance of minimum flows in streams, provisions for fish and wildlife facilities, maintaining reservoir levels conducive to spawning of fish and nesting of birds, and enhancement of wildlife habitat where appropriate. It seems obvious that if the fish and wildlife resources are to be properly conserved and utilized in future years, continued effort must be made to further elevate these considerations in the public and private development planning.

Quantifying the true value of fish and wildlife to man is another problem. In addition to providing hunting and fishing recreation, these resources are valuable to the birdwatcher, photographer, vacationer and sightseer, scientist, historian, armchair reader, student, and those who simply love the out-of-doors and the wildlife that live there. To date, no adequate system has been devised to measure the worth of the fish and wildlife resources in terms which can be compared with other human values.

Major fishery problems of the Region through 2020 are the following: 1) shortages of fishing waters near metropolitan areas; 2) shortages of quality fishing areas in the less-populated areas; 3) pollution of fishing waters and difficulties involved in adequately improving and protecting water quality; 4) channelization and dewatering of streams with resultant loss of habitat and fishability; 5) overdevelopment of facilities and access on adjacent lands and unrestricted use of streams and other fishing waters; 6) undeveloped commercial fishery; and 7) lack of equal consideration of fish and wildlife as a "beneficial user" of water.

Among the more significant wildlife problems on some lands are the following: 1) poor land-use practices such as overgrazing and indiscriminate clearing; 2) inadequate review and controls of land conversions, rights-of-way locations, and mining activities; 3) channelization of streams and drainage of wetlands; 4) inundation of wildlife habitat through construction of reservoirs; 5) overdevelopment of access to high-value wildlife areas; 6) indiscriminate use of pesticides for agricultural and watershed management purposes; 7) lack of consideration for wildlife resources on some private, Indian, and military lands; and 8) unused and under-utilized game populations resulting from hunter preferences.

In view of the many problems as well as opportunities for fish and wildlife preservation and development which have become evident during the course of this framework study, the following concepts are recommended as a guide to future actions:

DEVELOPMENT AND MANAGEMENT OF HABITAT

Fish

In localized areas throughout the Region, a need exists for reservoir fishing waters. This is particularly true in the vicinity of the metropolitan areas. Fishing can be provided by constructing primary-purpose lakes particularly adapted to intensive pond-fish management and by multiple-purpose impoundments.

A minimum of 1,560 acres by 1980, 13,100 acres by 2000, and 37,800 acres by 2020 will need to be impounded and managed primarily for fishery purposes to satisfy the projected fishing demand and maintain the quality type of fishing that existed in 1965. These are in addition to the 268,700 acres of fish habitat expected to be existing in 1980. To assure efficient use in terms of protection of quality fishing and to preserve the natural environment, approximately 10 percent of the additional water must have inherent restrictions on the amount of public use. The minimum requirements and areas of need are presented in Table 14.



Larger multiple-purpose reservoirs would add variety to lake fishing opportunities and provide an opportunity to enhance stream fisheries by controlling the quality and quantity of the waters discharged downstream. Multiple-purpose reservoirs to be built entirely or in part with Federal or State financing should be designed and operated to:

1. Include a permanent minimum pool adequate to sustain a reservoir fishery.
2. Maintain an uninterrupted bypass in sufficient volume to preserve or improve the downstream fishery.
3. Provide for public use of the reservoir and tailwater fisheries.

Present and future canals for the delivery of water throughout the metropolitan areas should be developed for fishery purposes. Additional fishing could be provided by acquiring water rights to provide minimum pools in the existing reservoirs.

All fish habitat in the Region that sustains fish life must be preserved in its present capacity or improved. All natural free-flowing streams in the Region provide fishery resources and aesthetic values of high quality that enhance the outdoor experience. Future flood control programs and water salvage projects on fishable streams should utilize alternatives to stream channelization and clearing of riparian vegetation such as watershed improvement, detention structures, bypass channels, or non-structural floodplain management measures or any combination of these. Efforts should be initiated to utilize properly treated sewage effluents as a source of water for fishing lakes in and near metropolitan areas.

Other waters that are irreplaceable are those sustaining populations of rare and endangered fishes. These waters are discussed in the "Rare and Endangered Species" section of this report.

Wildlife

The number of acres of the Region which are not used to some degree by wildlife are few; however, the importance of these lands to wildlife is highly variable. With an expanding demand for wildlife-oriented recreation, there will be a need to improve the wildlife resource itself. Since it is not possible to increase the acreage of the Region, the only alternative is to improve wildlife production on existing lands. This can be partially provided by establishing primary-purpose wildlife lands and applying intensive wildlife management practices. On all other lands suitable for wildlife, it is equally important that the resource be managed to preserve and improve existing habitat.

A minimum of 330,000 acres by 1980, 3,956,000 acres by 2000, and 11,806,000 acres by 2020 of specific habitat types should be designated and managed intensively for wildlife purposes to preserve areas of high wildlife production. Establishing priorities for designating the wildlife areas is equally important. The most fragile habitat types and those in the most danger of immediate destruction should be of the highest priority and should be designated prior to 1980. These include the wetland and marsh areas, and riparian-vegetation-covered areas.

Possibly of a lesser priority but equally as important, are the less fragile small-game and big-game habitat types. These should, however, be set aside as early as practicable. In addition, it is essential that areas be designated to preserve the rare and endangered wildlife species of the Region and the Nation.

The large blocks of Federal lands of the Region offer an exceptional opportunity to develop wildlife habitat, improve game populations, and provide increased opportunities for public hunting.

Wildlife-oriented public agencies should be allowed to review and assist in establishing grazing practices on public lands. Grazing should be controlled to prevent deterioration of wildlife cover and food species. On overgrazed lands, allotments should be cancelled or not renewed until desirable vegetation has been reestablished by artificial and natural means.

Brush control and other range rehabilitation programs on Federal and State land should include provisions for the maintenance or improvement of food and cover required by the wildlife of the area. Brush control practices should not include the use of herbicides.

Pesticides are a hazard to fish and wildlife resources. No pesticide should be used when there is "basis for belief" that water quality would be degraded and hazards exist that would unnecessarily threaten fish and wildlife, their food chain, or other components of the natural environment.

Mining activities, both present and future, should incorporate such measures as are necessary to control the emission of pollutants, of water, land, and air, to such acceptable levels as to not adversely affect fish and wildlife. In addition, in the case of surface mining, all excavated areas should be restored to natural conditions, insofar as possible, immediately upon cessation of mining activities.

Drainage practices involving Federal participation should include preservation or mitigation measures where wetlands of value to fish and wildlife are involved. Other practices, such as water salvage or flood control which would result in the drainage of wetlands on Federal land, should use alternate plans in an attempt to preserve the wetlands involved.

Wildlife habitat including vegetation and marsh areas should be preserved on private lands. Financial and technical assistance designed to benefit wildlife are available to landowners through State fish and wildlife agencies and through agencies of the Federal Government. Most financial assistance is provided through federally sponsored programs of the Department of Agriculture.

When public funds are involved in agricultural developments that affect fish and wildlife resources, public fishing and hunting access should be assured. These developments should also be required to provide for habitat preservation and enhancement. These provisions should be a condition to funding.

Many agricultural programs have the potential to benefit wildlife, but in application, they usually are not utilized at the field level. Often, habitat is destroyed by brush and timber clearing, drainage, burning, use of herbicides, and the use of non-seed-producing ground covers. Much of this activity is cost-shared to increase or improve agricultural lands, unfortunately at the direct expense of wildlife.

Preserving wildlife on private lands could result from increased profit incentives for landowners through expanded Agricultural Stabilization and Conservation Program (ACP), the Cropland Adjustment Program (CAP), other similar programs, tax incentive, and related measures. Research designed to develop agricultural methods and techniques that also benefit wildlife offers promise. A constant reevaluation of current land management practices, in light of long-range needs, is also indicated.

Steps should be taken by the State and Federal agencies to open more private land to hunting. The need for hunting areas, especially in the vicinity of population centers, is becoming critical. Acquisition of land in fee title for public hunting may be prohibitive, but the acquisition of public hunting easements may be one of the possible available alternatives.

A most urgent need is to preserve the remaining riparian habitat found along the river bottoms. On federally administered lands, provisions can be made to preserve the habitat. On private lands, fee acquisition may be the only effective means of assuring that this critical habitat will be preserved. For broad application this may be impractical and incentives should be provided the private owners to preserve habitat, such as tax relief or cost-sharing assistance in preserving and enhancing wildlife resources under various Department of Agriculture programs. The acquisition of lands and development rights along floodplains, for the preservation of habitat could prove to be an economical alternative to structural measures for flood damage reduction.

The public might well accept a cost share of flood insurance in order to protect valued habitat. Flood insurance may be less expensive than structural measures and no loss of wildlife habitat be required. Each alternative must be considered and every effort be made to reduce the environmental impact of flood control projects.

ACCESS AND FACILITIES: FISH AND WILDLIFE

Optimum public utilization of the projected fish and wildlife resource base deemed necessary to satisfy the Region's demand for wildlife-oriented activities is dependent upon adequate access and facilities.

Public lands should be posted by the administering agencies so that hunters, fishermen, and other wildlife-oriented recreationists may know which lands are open for their use. A wider distribution of printed materials designating access to public lands and the available facilities is needed.

Where private lands block public access to public lands, effort should be directed to obtain public access easements where needed. Public access should be acquired through easement purchase or land exchange where existing restrictions on public access are of significance and the action justified.

The degree of development for the lakes and streams of the Region should depend upon what the area can accommodate. Selected areas near the population centers will require facilities for intensive use, while other areas would require limited access and facilities to preserve the natural environment. For primary-purpose fishing impoundments, gravel access roads, parking, and boat-launching areas and minimum sanitary facilities would be necessary.

To provide fish for the existing and projected resource base and meet the fishing demands in the Region, one coldwater hatchery and two warmwater hatcheries would be needed by 1980. Thereafter, the equivalent of one coldwater hatchery every 8-10 years and one warmwater hatchery every 6-8 years will be needed. This can be accomplished by constructing new hatcheries or by expanding those in existence.

The preservation of habitat will preserve the wildlife resource, but development of these lands is necessary to increase the resource. A minimum of 980 wildlife combined water and feed facilities by 1980, 16,800 by 2000, and 48,500 by 2020 will be needed to provide a resource sufficient to satisfy the needs by those time periods. These include oasis- and catchment-type watering stations, cover stations, and food plots.

In addition to these developments, access roads will be needed for the construction of these watering devices and for the efficient use of the increased resource. Some of the developments must also be fenced to reduce damage by livestock and other activities.

The development and use of primary-purpose lands is extremely important toward the satisfaction of wildlife-oriented recreational needs through 2020. Probably equally as important, however, is the development and use of multiple-purpose lands. These lands, composed of state and federally administered lands, and Indian and private lands, make up the bulk of the lands of the Region.

The development of facilities and the use of the wildlife resource on public lands should be given equal consideration with the other uses of these lands.

WATER QUALITY: FISH AND WILDLIFE

It is critical that water quality degradation trends be reversed, especially those associated with industrial, municipal, and agricultural pollution. Water quality requirements for protection of aquatic and wildlife resources cover a broad range of environmental factors, which are variable dependent upon individual species to be protected. The list of water quality indicators and criteria presented on page 58 will adequately support the general freshwater aquatic and wildlife environment.

Siltation of streams caused by erosion attributable to deterioration of range vegetation should be controlled through reduction in grazing and, as necessary, revegetation of the watershed.

SURVEYS AND RESEARCH: FISH AND WILDLIFE

The development and implementation of a sound management program for all major fish and wildlife resources in the Region will require continuing inquiry into the fields of basic and applied biology. Research efforts and findings of the various resource agencies should be well coordinated and applied universally to help meet the demands of a growing population. To supplement this program, periodic surveys should be made to sample public desires for additional services, facilities, and recreational opportunities. These surveys should be given appropriate consideration in the development of management and development programs.

Recurrent inventories should be made of major Region fish and wildlife resources and the environmental factors that affect their abundance and distribution. Such work should be standardized to meet the needs of the managing agencies and furnish trends and long-term comparisons that would permit evaluation of management practices.

Research should be undertaken to fill gaps in life histories, population dynamics, and ecology of important species. Investigations should seek to determine the effects of streamflow regulations, land-use changes, pesticides, parasites, and diseases on fish and wildlife populations. The introduction of exotic or specialized species of fish and wildlife should be evaluated in terms of biological feasibility and the impact on recreational and commercial utilization of the resources.

Special research and management programs should be activated by 1980 to control nongame fish within existing reservoirs. As new reservoirs are impounded, they would be brought under this program.

INTERPRETATION AND EXTENSION SERVICES

The public generally is not aware of the fish- and wildlife-oriented recreational opportunities currently available and lacks the knowledge to take full advantage of these opportunities. Likewise, it is unaware of the many varied responsibilities for preservation and wise use of these resources. Without specific corrective action, this situation can only worsen under conditions that will occur with future population growth.

A full-scale public education program should be implemented to inform the public on the ecological relationships of man and nature, to stimulate appreciation for conservation, and point out fish and wildlife recreational opportunities. All forms of public contact media should be utilized to provide information on when, where, and how to enjoy these resources. Attention should be given to the variety and seasonal aspects of wildlife-oriented outdoor activities available to the public, and the type and location of access and facilities.

Educational programs should be provided to teach the skills of hunting, fishing, bird watching, nature observation, and photography. In addition, there is a need and opportunity for community and individual projects to improve habitat for fish and wildlife in the Region. Programs of this kind would afford recreation associated with both the development of such projects and enjoyment of the resources. These interpretative and educational services could be headquartered at several "Nature Centers" located at appropriate natural areas, public institutions, and facilities such as wildlife refuges and parks.

Extension programs should be made available to sport fishing and hunting guides, marina and shooting preserve operators, owners of agricultural and timber lands, and similar private enterprise to assure optimum public use and enjoyment of fish and wildlife resources. Services should include advice and training in techniques of improving fishing and hunting, the development and operation of private enterprise projects, and the raising and handling of fish bait and game species. Similar programs also would be beneficial to the commercial fishing industry as an aid in providing better products, developing markets, and promoting cooperation between sport and commercial fishermen. The objectives of the extension services would be to encourage the private sector to complement fish and wildlife programs provided by public agencies.

LEGISLATION AND ADMINISTRATION

State programs that benefit the general public and include the preservation of wildlife resources for all people must have a broader base for financing than the sportsman's dollar. Other programs that benefit the general public and need general funds are those not directly related to fishing and hunting, such as conservation education, management and research for nongame species, and participation in programs for endangered species.

Federal legislative and administrative changes should provide Federal agencies with adequate funds to accelerate programs and develop facilities to meet public demands for the use of the fish and wildlife resources. Suggested legislative and administrative changes at both the State and Federal levels are as follows:

- (1) Determine by State legislative study, the need and appropriate means of providing funds to help support fish and wildlife programs which clearly benefit the general public.
- (2) Legislative action is needed at the State level to establish procedures, responsibilities, and funding to coordinate State water resources planning and management with the planning and management for fish and wildlife and other natural resources.
- (3) Legislative action is needed to provide funds and authority to the Directors of the respective State fish and game departments to control and promote commercial fisheries through regulation of seasons, species, size, gear, and licensing.
- (4) There is a need for State lands with recognized fish and wildlife values and associated uses to be administered accordingly and any transfer of such lands should be based

on the fish and wildlife values rather than maximum dollar returns.

- (5) Legislative action should provide for the updating of State and Federal mining laws for the protection of the environment, and the fish and wildlife resources.
- (6) There is a need at both the State and Federal levels to determine environmental standards and appropriate human population numbers and distribution and to reassess accordingly the priorities of beneficial uses of land and water. Also, there is an associated need to provide for more comprehensive and complementing land use plans, including land use zoning authorities.
- (7) There is a need at State and Federal levels for review and removal of policy restraints which preclude full recognition of fish and wildlife values and the importance of public access in the administration of public lands.
- (8) State and Federal land administering agencies which lack the restriction and enforcement powers relating to off-road vehicular use should seek the appropriate authorities.
- (9) State and Federal public land administrators should recognize the need for accelerated fish and wildlife development on public lands and for intensified primary purpose management on selected lands to produce maximum fish and wildlife returns.
- (10) Administrative and legislative considerations of alternatives deserve more emphasis on water development projects in the interest of preservation and enhancement of fish and wildlife and environmental values. There is a particular need for Federal planning agencies to seek such authority as may be necessary to implement non-structural methods of flood damage reduction, including the purchase of lands and development rights along floodplains for the preservation of fish and wildlife habitat, as an alternative to the construction of structural measures.
- (11) Legislative action should be initiated which would amend the Wilderness Act and the Land and Water Conservation Act to allow participation by the Bureau of Land Management.
- (12) Legislation should be provided to reestablish an organic act for the Bureau of Land Management to assure continuance of existing multiple-use policies, including provisions for fish and wildlife as established under the Classification and Multiple Use Act of 1964 that expired December 1970.

FOLLOW-UP STUDIES

Framework or Type I comprehensive studies are, by definition, preliminary or reconnaissance investigations intended to provide broad-scaled analyses of water and related land resource problems and furnish general appraisals of the probable nature, extent, and timing of measures for their solutions. Logically, studies of such generalized nature should be followed by Type 2 studies which are intended to carry the planning process forward to a degree of refinement or detail adequate for program authorization or implementation.

MAP LEGENDS
AND MAPS

Table 2J
Map 1 Legend: Fish and Wildlife Installations
Administered by Federal and State Fish & Game
Agencies Existing in 1965

Arizona

1. Pinetop State Fish Hatchery
2. Fools Hollow Lake
3. Show Low Lake
4. Scotts Reservoir Lake
5. Ashurst Lake
6. Coconino Lake
7. Woods Canyon Lake
8. Kinnikinick Lake
9. Lee Valley Lake
10. Knoll Lake
11. Black Canyon Lake
12. Bear Canyon Lake
13. Chevelon Lake
14. Nelson Lake
15. Blue Ridge Reservoir
16. Indian Reservation Fishing Lakes
17. Alchesay National Fish Hatchery
18. Williams Creek National Fish Hatchery
19. Page Spring State Fish Hatchery
20. Sterling Spring State Fish Hatchery
21. Tonto State Fish Hatchery
22. Luna Lake
23. Big Lake
24. Riggs Flat Lake
25. Pena Blanca Lake
26. Rose Canyon Lake
27. Lynx Lake
28. Parker Canyon Lake
29. Rucker Canyon Lake
30. Willow Beach National Fish Hatchery
31. Raymond Ranch Wildlife Management Area
32. Viet Ranch Wildlife Management Area
33. Hancock Tracts Wildlife Management Area
34. Lee Valley Lands Wildlife Management Area
35. Chevelon Canyon Wildlife Management Area
36. Chevelon Creek Waterfowl Management Area
37. Nelson Land Wildlife Management Area
38. Woods Canyon Wildlife Management Area
39. Kinnikinick Wildlife Management Area
40. Fool Hollow Land Wildlife Management Area
41. May Memorial Refuge Wildlife Management Area
42. Cluff Ranch Wildlife Management Area
43. Manhattan Claims Wildlife Management Area

44. Gila River Waterfowl Management Area
45. Cunningham Tract Wildlife Management Area
46. Black Canyon Shooting Range Recreation Area
47. Green Belt Dove Nesting Wildlife Management Area
48. Paradise Valley Recreation Area
49. Three Bar Wildlife Management Area
50. Luna Lake Waterfowl Management Area
51. Painted Rock Wildlife Management Area
52. B&M Ponds Waterfowl Management Area
53. Parks Lake Waterfowl Management Area
54. Big Lake Waterfowl Management Area
55. Pena Blanca Waterfowl Management Area
56. Parker Canyon Waterfowl Management Area
57. Wellton-Mohawk Wildlife Management Area
58. House Rock Valley Wildlife Management Area
59. Ryan Station Wildlife Management Area
60. Cibola Waterfowl Management Area
61. Topock Tract Waterfowl Management Area
62. Mittry Lake Waterfowl Management Area
63. Imperial National Wildlife Refuge
64. Cabeza Prieta National Wildlife Refuge
65. Kofa National Wildlife Refuge
66. Havasu Lake National Wildlife Refuge
67. Roosevelt Lake Waterfowl Management Area
68. North Kaibab Deer Reserve Wildlife Management Area

New Mexico

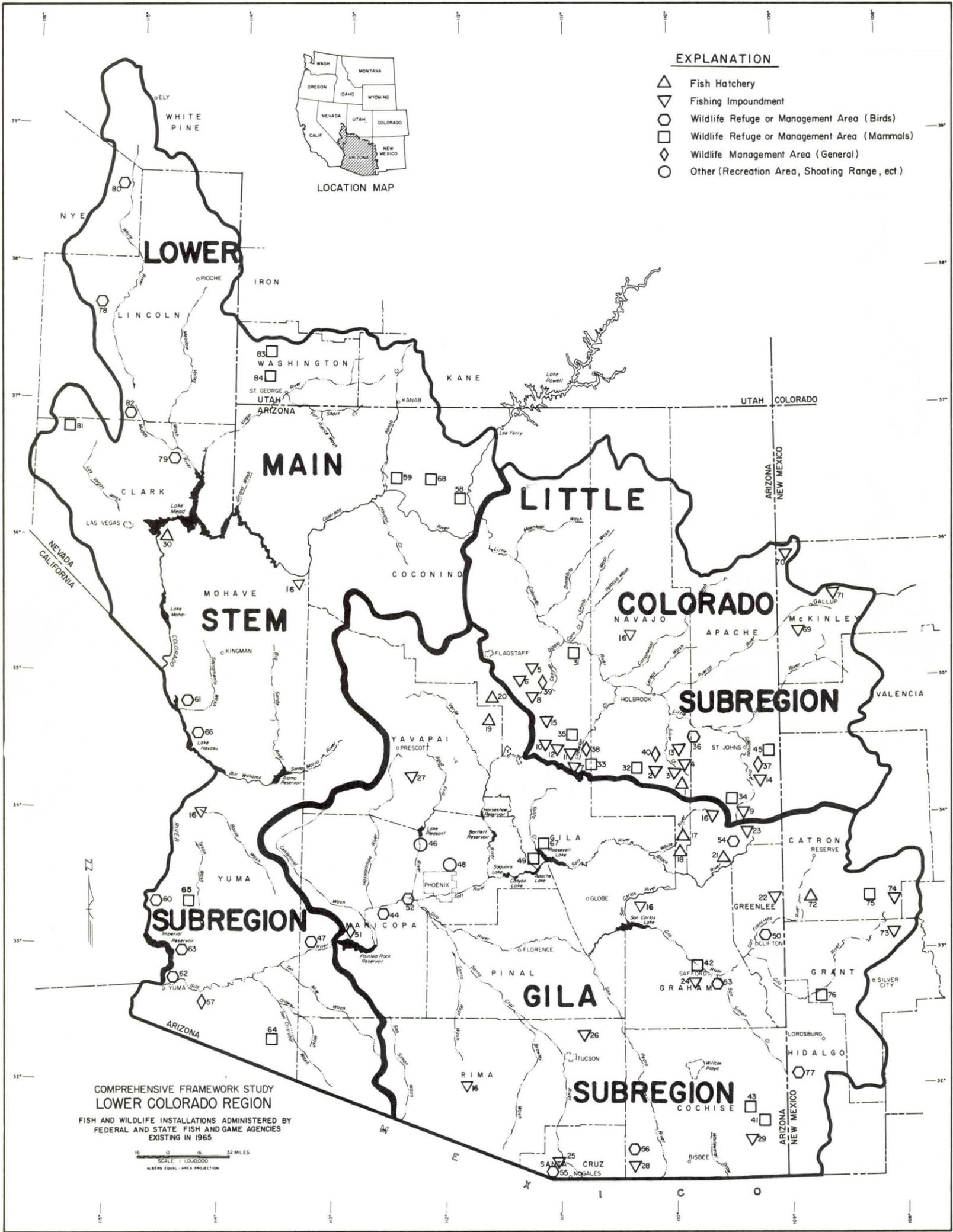
69. McGaffey Lake
70. Asaayi Lake
71. Mariano Lake
72. Glenwood State Fish Hatchery
73. Lake Roberts
74. Wall Lake
75. Heart Bar Wildlife Management Area
76. Red Rock Wildlife Management Area
77. San Simon Waterfowl Management Area

Nevada

78. Key Pittman Wildlife Management Area
79. Overton Wildlife Management Area
80. Kirch Wildlife Management Area (includes Adams McGill, Dacey,
and Haymeadow Reservoirs)
81. Desert National Wildlife Refuge
82. Pahranaagat National Wildlife Refuge

Utah

83. Tobin Rench Wildlife Management Area
84. Jackson Springs Wildlife Management Area



MAP I

Table 22
Map 2 Legend: Designated Wildlife Areas

Code	Vegetal Type <u>1/</u> <u>2/</u>	Primary Species <u>3/</u>	Area (Acres)	Primary Value <u>4/</u> <u>5/</u>	Area Designation	Land Administration 1965 <u>6/</u>
<u>Lower Main Stem</u>						
<u>Subregion</u>						
XIII-108 1	NDS	BS,GQ	100,000	H	Delmar Mountains	BLM
2	SDS	BS,GQ	100,000	H	Mormon Range	BLM
3	SDS	SG,NG	50,000	H	Moapa Valley	BLM
4	SDS,R,F	SG,W	50,000	H	Virgin Valley	BLM
5	SDS	BS,De	100,000	H	Virgin Mountains	BLM-NPS
6	SDS,We	W	250	H	Mead	DOD-BLM
7	SDS	BS,GQ	300,000	H	McCulloch-Bird Springs-Spring	BLM-NPS-PR
8	SDS	BS,GQ	100,000	H	Newberry-El Dorado	BLM-NPS
9	SDS	BS	2,500,000	H	Mohave	PR-BLM-BR
10	Wo	De	750,000	H	Music Mountains	BLM-BR-NPS-I
11	NDS,Wo	BS,W,De	1,500,000	H	Shivwits-Virgin	NPS-BLM-ST
12	NDS,Co,Wo	De,KS,T,B,A	1,500,000	H,P	Kaibab	FS-BSFW-NPS-BLM-ST
13	SDS,Cr	WWDo	150	H	Buckskin	BLM
14	SDS	BS	750,000	H	Plomosa	ST-PR-BLM
15	SDS	BS	1,000,000	H	Chocolate-Trigo-Dome	BSFW-BLM-I-DOD
16	SDS,Cr	WWDo	150	H	Yuma	PR-ST-DOD
17	SDS	SP,BS	150,000	H,P	Growler Mountains	DOD
18	R	SG,NG	350,000	H	Gila	BLM-ST-PR
19	R	Do,NG,W,YCR	75,000	H,P	Bill Williams	BLM
20	R	Do,NG	75,000	H	Santa Maria	ST-BLM
21	R	Do,NG	50,000	H	Big Sandy	BR-BLM
<u>Little Colorado</u>						
<u>Subregion</u>						
22	Wo,We	W,E,T	100,000	H	Mormon Lake	FS
23	G	B,A	250,000	H	Anderson Mesa	FS-PR-ST-BLM
24	G	A	10,000	H	Winslow Flats	ST-PR

(Footnotes on last page of Table)

Table 22 - Map 2 Legend (Continued)

Code	Vegetal Type <u>1/</u> <u>2/</u>	Primary Species <u>3/</u>	(Acres)	Value <u>4/</u> <u>5/</u>	Area Designation	Land Administration 1965 <u>6/</u>
25	Wo,We	W	5,000	H,N	Show Low	FS-PR
26	Wo,G	A,De	100,000	H	Red Hill-Quemado	PR-ST-FS-BLM
<u>Gila Subregion</u>						
27	Wo,Co,Ch	De,J	100,000	H	Tonto	FS
28	SDS,We	W	500	H	Salt	I-PR
29	SDS,Cr	WWDo	200	H	Peoria	PR-ST
30	SDS	De,Q	150,000	H	White Tanks	BLM-PR
31	SDS,Cr	WWDo	150	H	Centennial	BLM-ST-PR
32	SDS	SG	250,000	H	Gila and Salt Rivers	BLM-PR
33	SDS	BS,De,Q	150,000	H	Sierra Estrella	BLM-ST-PR
34	SDS,Cr	WWDo	150	H	Maricopa	PR
35	SDS	SG,NG	1,000	H	Picacho	PR
36	SDS,Cr	WWDo	200	H	Saguaro	PR
37	Co,Wo,We	W	250	H	Tucson	PS-PR-NPS
38	O,G	MQ,MB	50,000	H,P	Altar	ST-FS-PR
39	O,G	MQ,MB	50,000	H,P	Sonoita	PR-ST-DOD
40	R	SG	300,000	H	San Pedro	BLM-ST-PR
41	R	SG	200,000	H	Graham	BLM-ST-PR
42	R	SG	75,000	H	San Jose	BLM-ST-PR
43	R	SG,MD	200,000	H,P	San Simon	ST-BLM
44	We	W,NG	100,000	H	Willcox	PR-ST-DOD
45	Co,We	W,NG	500	H	Carrizo	I
46	Co	E,De	5,000	H	Luna	FS-PR
47	Co,Wo,G	A	2,500	H	Sand Flat	FS
48	SDS,R,We	De,P,Q,W	50,000	H	Red Rock	BLM-ST-PR
49	SDS	De,J,Q	10,000	H	Stines Pass	BLM-ST
50	We,Wo,G,SDS,R	De,J,Q,MD	100,000	H,P	Rodeo	BLM-ST-PR
51	R	SG,NG	50,000	H	East Verde	FS
52	SDS,R,Wo,O,G	J,SG,WWDo,Do	15,000	P	Guadalupe Canyon	BLM-ST-PR
Regional Total			11,826,000	<u>7/</u>		

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(Footnotes on following page)

Table 22 - Footnotes

1/ Vegetal types as used by Land Resources and Use and Watershed Management Work Group.

Key to Symbols

2/ Vegetal Type:

NDS = Northern Desert Shrub
SDS = Southern Desert Shrub
R = Riparian
F = Farming
We = Wetlands
Wo = Woodland
Co = Conifer
Cr = Cropland
Ch = Chaparral
O = Oak
G = Grassland

6/ Land Administration - 1965:

BLM = Bureau of Land Management
BR = Bureau of Reclamation
BSFW = Bureau of Sport Fisheries & Wildlife
NPS = National Park Service
FS = Forest Service
DOD = Department of Defense
ST = State
PR = Private
I = Indian Trust

3/ Primary Species:

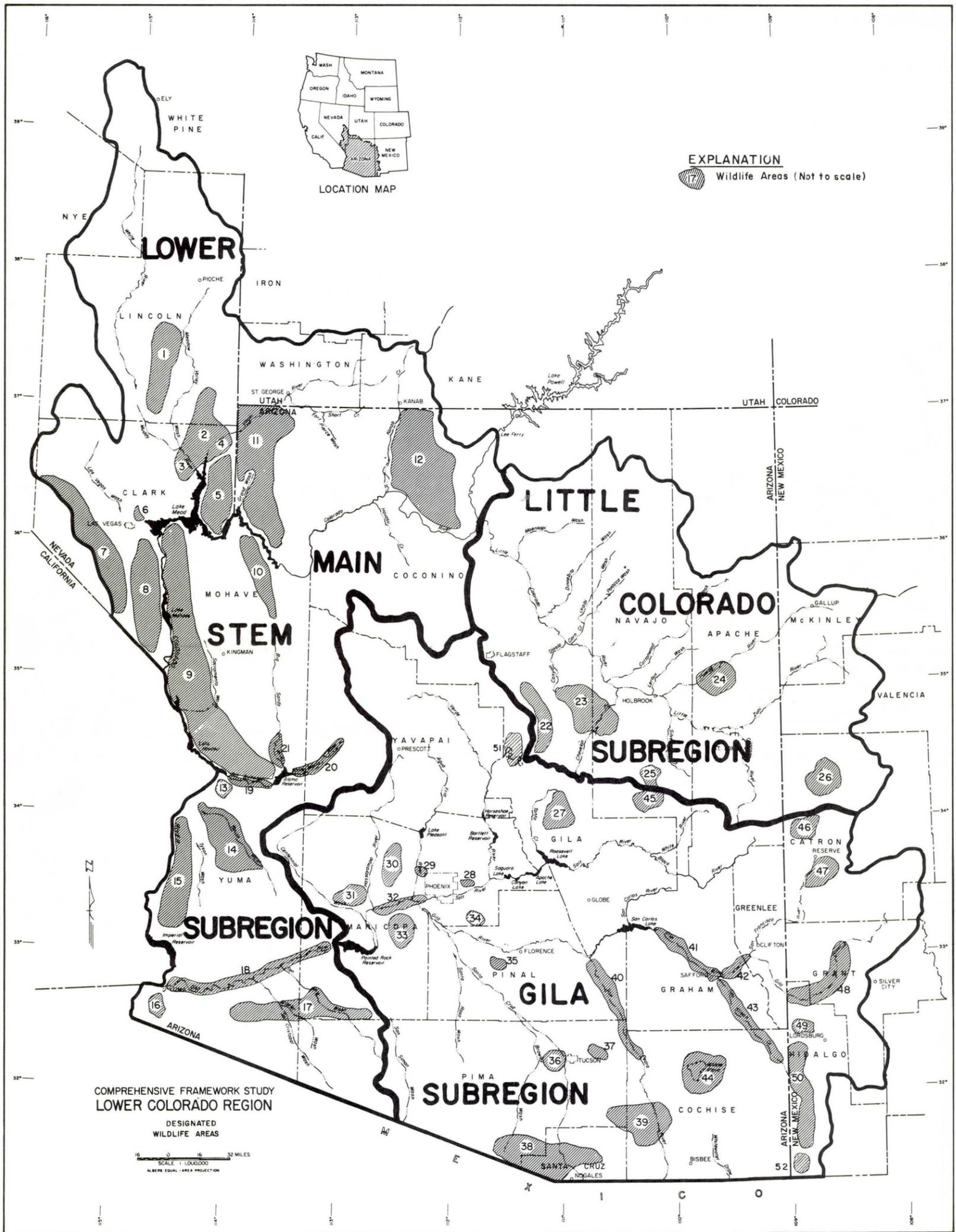
BS = Bighorn Sheep	GQ = Gambel's Quail
SG = Small Game	NG = Nongame
W = Waterfowl	De = Deer
KS = Kaibab Squirrel	T = Turkey
B = Buffalo	A = Antelope
WWD0 = White-winged Dove	SP = Sonoran Pronghorn
Do = Dove	YCR = Yuma Clapper Rail
E = Elk	J = Javelina
MQ = Mearn's Quail	MB = Masked Bobwhite
MD = Mexican Duck	P = Pheasant

7/ This should not be considered to be the total acreage suitable, but that known acreage which was designated for the purpose of this report.

4/ Primary Value:

H = Hunting
N = Nesting
P = Preservation

5/ There are also secondary values, including bird-watching, nature photography, etc.



MAP 2

SUPPLEMENTAL DATA

Water Needs 1965-2020 (Acre-feet)
 Fish and Wildlife
 (Totals Cumulative)
 OBE-ERS

	1965		1980		2000		2020	
	Withdrawal	Depletion	Withdrawal	Depletion	Withdrawal	Depletion	Withdrawal	Depletion
Lower Main Stem								
Arizona	107,000	70,015	108,536	72,780	126,524	86,670	161,703	100,420
Nevada	33,000	30,000	39,215	35,972	70,082	60,965	115,150	98,544
Utah	--	--	32	27	190	156	249	206
Subtotal	140,000	100,015	147,783	108,779	196,796	147,791	277,102	199,170
Little Colorado								
Arizona	5,500	4,000	9,706	8,088	11,926	9,938	19,212	16,010
New Mexico	500	300	1,552	1,281	2,992	2,455	5,841	4,087
Subtotal	6,000	4,300	11,258	9,369	14,918	12,393	25,053	20,097
Gila								
Arizona	47,000	5,625	47,300	18,875	84,746	49,530	215,839	164,699
New Mexico	3,000	375	3,053	1,299	4,203	2,075	12,951	3,394
Subtotal	50,000	6,000	50,353	20,174	88,949	51,605	228,790	168,093
Regional Totals								
Arizona	159,500	79,640	165,542	99,743	223,196	146,138	396,754	281,129
New Mexico	3,500	675	4,605	2,580	7,195	4,530	18,792	7,481
Nevada	33,000	30,000	39,215	35,972	70,082	60,965	115,150	98,544
Utah	--	--	32	27	190	156	249	206
Total	196,000	110,315	209,394	138,322	300,663	211,789	530,945	387,360

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Water Needs 1965-2020 (Acre-feet)
 Fish and Wildlife
 (Totals Cumulative)
 MOD-OBE-ERS

	1965		1980		2000		2020	
	Withdrawal	Depletion	Withdrawal	Depletion	Withdrawal	Depletion	Withdrawal	Depletion
Lower Main Stem								
Arizona	107,000	70,015	108,536	72,780	126,524	86,670	161,703	100,420
Nevada	33,000	30,000	43,188	39,790	92,810	79,944	129,647	110,640
Utah	--	--	36	30	190	156	332	275
Subtotal	140,000	100,015	151,760	112,600	219,524	166,770	291,682	211,335
Little Colorado								
Arizona	5,500	4,000	9,706	8,088	11,926	9,938	19,212	16,010
New Mexico	500	300	1,682	1,402	4,220	3,517	11,628	8,190
Subtotal	6,000	4,300	11,388	9,490	16,146	13,455	30,840	24,200
Gila								
Arizona	47,000	5,625	47,300	18,875	84,746	49,530	215,839	164,699
New Mexico	3,000	375	3,060	1,425	4,694	2,770	17,857	4,881
Subtotal	50,000	6,000	50,360	20,300	89,440	52,300	233,696	169,580
Regional Totals								
Arizona	159,500	79,640	165,542	99,743	223,196	146,138	396,754	281,129
New Mexico	3,500	675	4,742	2,827	8,914	6,287	29,485	13,071
Nevada	33,000	30,000	43,188	39,790	92,810	79,944	129,647	110,640
Utah	--	--	36	30	190	156	332	275
Total	196,000	110,315	213,508	142,390	325,110	232,525	556,218	405,115