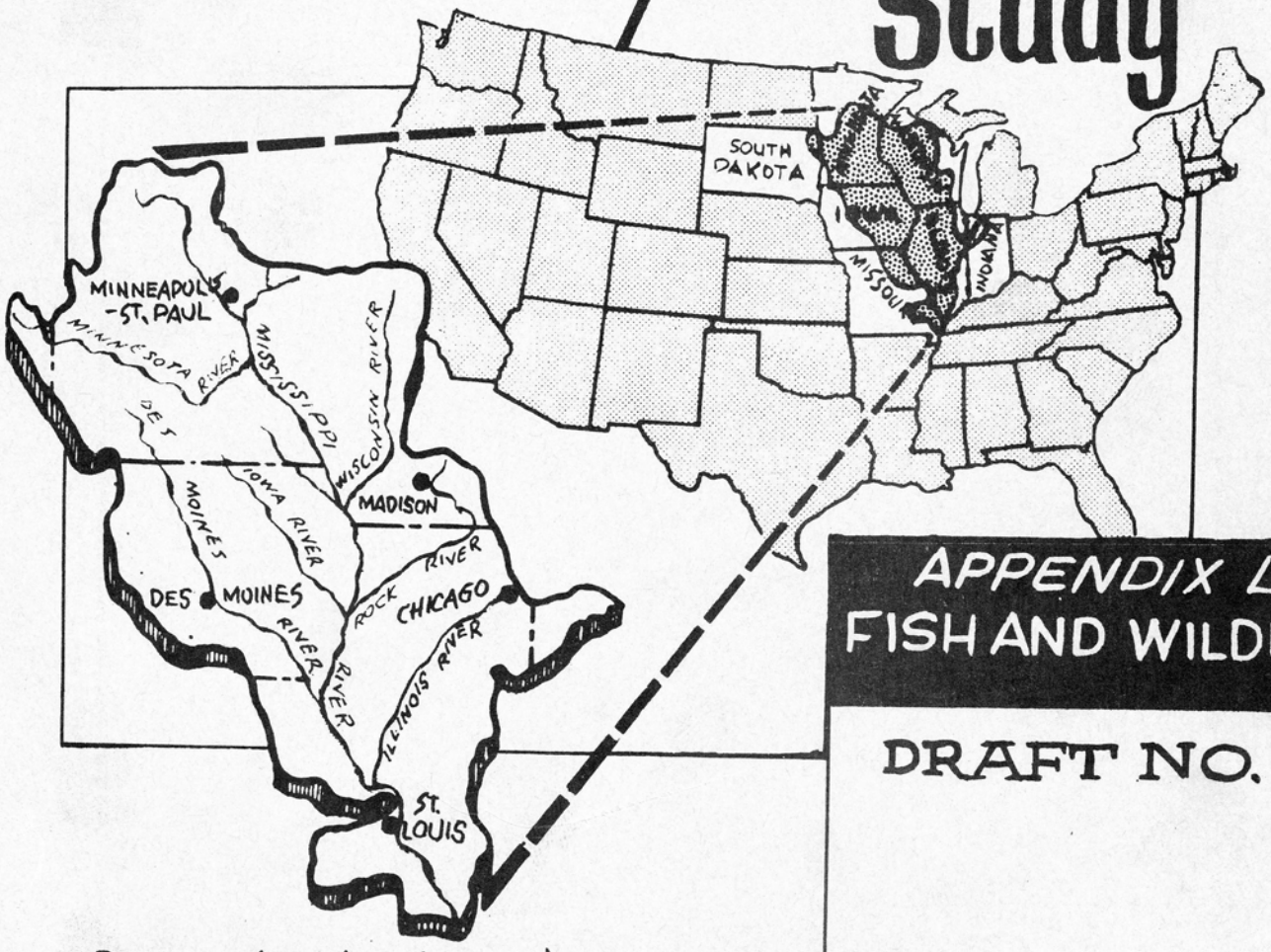
League of Women Voters of Minnesota Records

Copyright Notice:

Version 3
August 20, 2018

UPPER MISSISSIPPI RIVER... Comprehensive Basin Study



APPENDIX L
FISH AND WILDLIFE

DRAFT NO. 2

Prepared Under Supervision of
UMRB CO-ORDINATING COMMITTEE
—1969—

UPPER MISSISSIPPI RIVER
COMPREHENSIVE BASIN STUDY

APPENDIX L

FISH AND WILDLIFE RESOURCES

DRAFT NO. 2

Prepared by

U. S. Department of the Interior
Fish and Wildlife Service
Bureau of Sport Fisheries and Wildlife
Bureau of Commercial Fisheries

November, 1968

Coordinated by
UMRCBS Coordinating Committee

OUTLINE

UPPER MISSISSIPPI RIVER COMPREHENSIVE BASIN STUDY REPORT

Main Report

Appendix A: History of Investigation

Appendix B: Cultural and Aesthetic Values

Appendix C: Climate and Meterology

Appendix D: Surface Water Hydrology

Appendix E: Ground Water and Geology

Appendix F: Mineral Resources

Appendix G: Fluvial Sediment

Appendix H: Water Supply and Quality Control

Appendix I: Flood Control

Appendix J: Navigation

Appendix K: Recreation

Appendix L: Fish and Wildlife

Appendix M: Power

Appendix N: Agriculture

Appendix O: State and Federal Water Laws, Policies, and Programs

Appendix P: Economic Development

Appendix Q: FRAMEWORK FOR DEVELOPMENT

SYNOPSIS
SPORT FISH AND WILDLIFE RESOURCES

The fish and wildlife resource of the Upper Mississippi River Basin is one dominant feature of many outstanding basin assets. The Upper Mississippi River Basin has provided excellent hunting, fishing, and allied wildlife recreation opportunities to the Nation's sportsmen for many years. However, fish and wildlife populations are a function of the environment. The use, or misuse, of this irreplaceable surrounding automatically regulates fish and game populations, as well as man's existence.

In 1960, one of every four basin residents fished at least one time during the year; one of every 10 basin residents hunted. Countless thousands, who did not fish or hunt, enjoyed birds at their backyard feeder or observed wildlife while picnicking or hiking. When one considers that many individuals living in a Chicago ghetto, for example, had no opportunity and thus often no inclination to enjoy this form of outdoor recreation, the percentage of those participating in these activities is even more enlightening.

Attaching a dollar value to these pursuits may be pointless; it is certainly difficult. By conservative estimate, 412 million dollars were spent by basin fishermen and 150 million dollars were spent by basin hunters in 1960. But these figures do not include the "spin-off" effects on the basin's economy, nor do they measure the intrinsic value of having fish and wildlife present in an environment increasingly dominated by steel and concrete, and by social pressures of a burgeoning population.

In the face of the physical and social changes occurring in the Upper Mississippi River Basin, at least nine of the basin subareas are projected to have need for additional angler opportunities by 1980 and 12 are expected to have hunter opportunity needs by that date. Needs will increase through 2020. If opportunities are placed near urban areas, it is likely that many who are not now aware of fish or wildlife recreation activities will use these potential sites for their social betterment.

Plans for meeting both recognized and unrecognized needs for fish and wildlife opportunities fall under several broad categories. They must be geared in scope and number to the problems of the particular basin subarea. In general, planners, political authorities, and management experts should attempt to accomplish the following: (1) increase the utilization of existing resources through improved access, acquisition of public-use fish and wildlife facilities near metropolitan areas, greater emphasis on underutilized species, and creative enhancement techniques on available habitat; (2) firm and immediate correction of degrading pollution problems; (3) greater cooperation between Federal and State conservation agencies and between agencies with varying or conflicting interests on basin natural resources; (4) continuing accelerated research studies on pesticides, thermal pollution, and other expanding pollution problems; and (5) preservation of unique environmental systems which will be lost to future generations.

FOREWORD

The information presented in Appendix L, "Fish and Wildlife Resources" was initiated in 1963 and includes data collected through 1967.

Appendix L is the joint effort of numerous people working cooperatively through a Fish and Wildlife Advisory Committee. This is one of several working committees appointed and guided by the UMRCBS Coordinating Committee. The Bureau of Sport Fisheries and Wildlife, USDI, Minneapolis, Minnesota chaired this committee. The Bureau of Commercial Fisheries, USDI, Ann Arbor, Michigan supplied the Commercial Fishery Section of this appendix. Active cooperation has been received by personnel of the following agencies:

Illinois Department of Conservation

Indiana Department of Conservation

Iowa Conservation Commission

Minnesota Department of Conservation

Missouri Department of Conservation

South Dakota Department of Game, Fish and Parks

Wisconsin Department of Natural Resources, Division of Conservation

USDA: Forest Service, Soil Conservation Service and Economic Research Service

USDI: Bureau of Outdoor Recreation, Federal Water Pollution Control Administration, and Bureau of Commercial Fisheries.

U. S. Public Health Service, Department of Health, Education and Welfare, Chicago, Illinois

U. S. Army Corps of Engineers, North Central Division, Chicago, Illinois

TABLE OF CONTENTS

APPENDIX L

SPORT FISH AND WILDLIFE RESOURCES

LIST OF TABLES

APPENDIX L

SPORT FISH AND WILDLIFE RESOURCES

LIST OF FIGURES

APPENDIX L

SPORT FISH AND WILDLIFE RESOURCES

Section 1

INTRODUCTION

1.1 Purpose and Scope

1.1.1 Upper Mississippi River Basin Study

The Upper Mississippi River Comprehensive Basin Study (UMRCBS) is a Type 1 Coordinated Comprehensive Framework Survey. Type 1 studies will or have been made on 18 regions encompassing the Nation (except Alaska); they will furnish a general appraisal of overall water and related land resource development needs. The comprehensive plans developed from the UMRCBS provide projections of economic development, translation of such projections into demands for water and related land resource uses, hydrologic projections of water availability, both as to quantity and quality, and projections of related land resource availability. Through projections of availability, the planner can outline the characteristics of projected water and related land resource problems and the general approaches that appear appropriate for their solution. The framework plan for the Upper Mississippi River Basin is based on initial planning steps using general relationships, reasoned approximations, and available data. While potential alternatives have been identified, detailed project formulation studies have not been undertaken at this stage of framework planning.

This framework study provides general guides to future water resource development. Plans indicate which subareas have water or related land resource problems calling for prompt detailed planning efforts as well as those subareas where no such problems are current or looming. In addition, this study will provide a substantial contribution of facts and analyses to subsequent detailed plan formulation.

1.1.2 Fish and Wildlife Resources - Appendix L

The Upper Mississippi River Basin contains a rich and varied fish and wildlife resource. This resource has long been a vital element in the support, happiness, and prosperity of millions of people. Water and related land development projects have affected fish and wildlife in the past; developments are anticipated that will have an even more profound effect in the future. Therefore, the major objective of this appendix is to participate in comprehensive planning for future water and related land resource developments. Such planning is essential if preservation, development, and judicious use of fish and wildlife for future generations is to be assured.

Appendix L (Fish and Wildlife Resources) is one of several single-purpose appendices to accompany the Main Report. It expresses present use and future demands and needs for fish and wildlife (Table L-16) as well as alternative, broad-scale plans necessary to satisfy these demands.

Appendix L identifies (Table L-16) and evaluates the existing supply of fish and wildlife and attempts to define the complex relationship between supply and demand. Where possible, it delineates areas of conflict (past, present, and future) in the use of water and related lands, and the net effect of this competition on associated fish and wildlife resources.

Successful projection of any future demands, including those for fish and wildlife, depends upon accurately predicting socio-economic trends and their effect on human behavior. The accuracy of projections beyond 1980 is limited, but is adequate for planning within the scope of Type 1 comprehensive basin studies. A projection is a forecast based on a number of assumptions, and as such, projections should be revised as future conditions invalidate certain assumptions. Projected demands and needs for fishing

and hunting opportunities anticipate critical problem areas, and are guideposts for additional detailed study and more refined planning.

1.2 Study Objectives

The objectives of this appendix comply with stated purposes of a Type 1 comprehensive study. These objectives, broadly defined, are: (1) to provide a diversified recreational use of the resource for basin residents and others; (2) to provide quality in all fish and wildlife-related experiences in order to increase man's perception of his environment and his relationship to it; (3) to maintain the economic contribution derived from the resource; (4) to provide for scientific study and educational use of the existing natural resource; (5) to promote optimum development of fish and wildlife on all lands and waters, public and private; (6) to help promote effective and innovative resource management from new facts and ideas gained through research; and (7) to encourage continuance of public education programs which move the people to think and act responsibly in upgrading and conserving the resource.

1.3 Authority

Congressional authority for the Upper Mississippi River Basin Comprehensive Study is contained in a resolution adopted May 21, 1962 by the U. S. Senate Committee on Public Works. This resolution authorized formulation of a comprehensive set of plans for the timely, effective satisfaction of all demands for water and related land resources in all major drainage basins in the Nation. The Upper Mississippi River Basin, including that part of the drainage located above Cairo, Illinois, with the exception of the Missouri River Basin, was designated as a basin to be studied under this national program. Subsequently, the North Central Division of the U. S. Army Corps

of Engineers was assigned responsibilities for study sponsorship and coordination. The Division Engineer solicited full cooperation from Federal, State, and local agencies in their respective areas of interest.

Appendix L, covering fish and wildlife resources, has been conducted under the authority, and in accordance with the provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). This Act, in part, authorizes assistance to Federal, State, and other agencies in the development, protection, rearing, and stocking of fish and wildlife and controlling losses thereof; it authorizes surveys and reports by the Fish and Wildlife Service which recommend measures needed to prevent losses of fish and wildlife and to enhance hunting and fishing opportunities at water-use projects constructed or licensed by the Federal Government; and it authorizes land acquisition for fish and wildlife conservation purposes.

Several other legislative acts have been useful tools in the management of fish and wildlife resources in the basin. Some of those more important in relation to this study are as follows:

(1) Migratory Bird Conservation Act of 1929 authorized the acquisition of lands for migratory bird refuges.

(2) Federal Aid in Wildlife Restoration Act of 1937 provides for Federal grants to States for wildlife restoration projects. Funds from an excise tax in sporting arms and ammunition are provided to the States on a matching basis for research, land acquisition, development, maintenance, and management projects.

(3) Federal Water Pollution Control Act of 1948 provides for water pollution control activities. These include interstate cooperation, research, investigations, and Federal aid to the States for pollution abatement.

(4) Federal Aid in Sport Fish Restoration Act of 1950 provides, on a matching basis, Federal grants to the States for sport fish restoration projects.

(5) Watershed Protection and Flood Prevention Act of 1954 authorizes certain fish and wildlife improvement activities on small watershed projects. These improvements are financed on a cost sharing basis between the Department of Agriculture and local sponsors. The Fish and Wildlife features must be operated or managed for public enjoyment, including hunting, fishing, or general recreation.

(6) The Fish and Wildlife Recreation Act of 1962 establishes public recreation as an authorized use of conservation areas of the Department of the Interior. It authorizes acquisition of limited land areas for recreational development adjacent to existing or approved conservation areas.

(7) The Water Resources Research Act of 1964 authorizes Federal financial assistance to States in establishing water resources research and training programs. It also authorizes financial assistance to individuals and public agencies having competence in water research on specific projects.

(8) The Land and Water Conservation Fund Act of 1965 created a conservation fund from which Congress may appropriate funds to acquire lands and waters for any national area authorized to preserve endangered fish and wildlife species.

(9) The Wild Rivers Act of 1965 authorizes the preservation of selected rivers, or sections thereof, which possess unique water conservation, scenic, fish, wildlife, and outdoor recreation values.

(10) Food and Agriculture Act of 1965 authorizes the Secretary of Agriculture to transfer funds to any other Federal agency or to States or local government agencies for use in acquiring cropland for the development of wildlife or recreation facilities.

(11) The Water Resources Planning Act of 1965 provides for the Nation's natural resources through the coordinated planning of water and related land resources. It also provides financial assistance to the States to increase their participation in comprehensive planning.

(12) Endangered Species Act of 1966 provides for the conservation, protection, and propagation of native species of fish and wildlife threatened with extinction.

Section 2

GENERAL DESCRIPTION OF THE BASIN

2.1 Physical

2.1.1 Basin Boundaries

The Upper Mississippi River Basin, for purposes of this study, includes the drainage area of the Mississippi River above the mouth of the Ohio River at Cairo, Illinois, exclusive of the Missouri River Basin. This area includes portions of seven states and contains approximately 118 million acres of land and three million acres of water. The basin has been divided for study purposes into 17 planning subareas (Figure L-1), each of which conforms to the drainage of a major tributary (or group of tributaries) to the Mississippi River. Drainage boundaries were modified slightly to conform with county lines.

2.1.2 Topography

The topography of the basin ranges from hilly to flat with elevations varying from 400 to 1,900 feet above sea level. Gently rolling plains are dominant, with greater relief occurring in areas of glacial moraines, dissected stream borders, and the unglaciated areas centered in southwestern Wisconsin. Hilly terrain is predominant in the Ozarks of Missouri and the Shawnee Hills of southern Illinois.

2.1.3 Climate

Marked differences in climate exist within the boundaries of the study area. Mean annual temperatures (in degrees Fahrenheit) range from 38 in the north to 58 in the south. Extremes in temperature have ranged from a recorded minimum of minus 46 in Minnesota to a maximum of plus 116 in Missouri. A frost-free season of 120 days in the north to 200 days in the south, coupled with mean annual rainfalls of 22 and 45 inches, respectively,

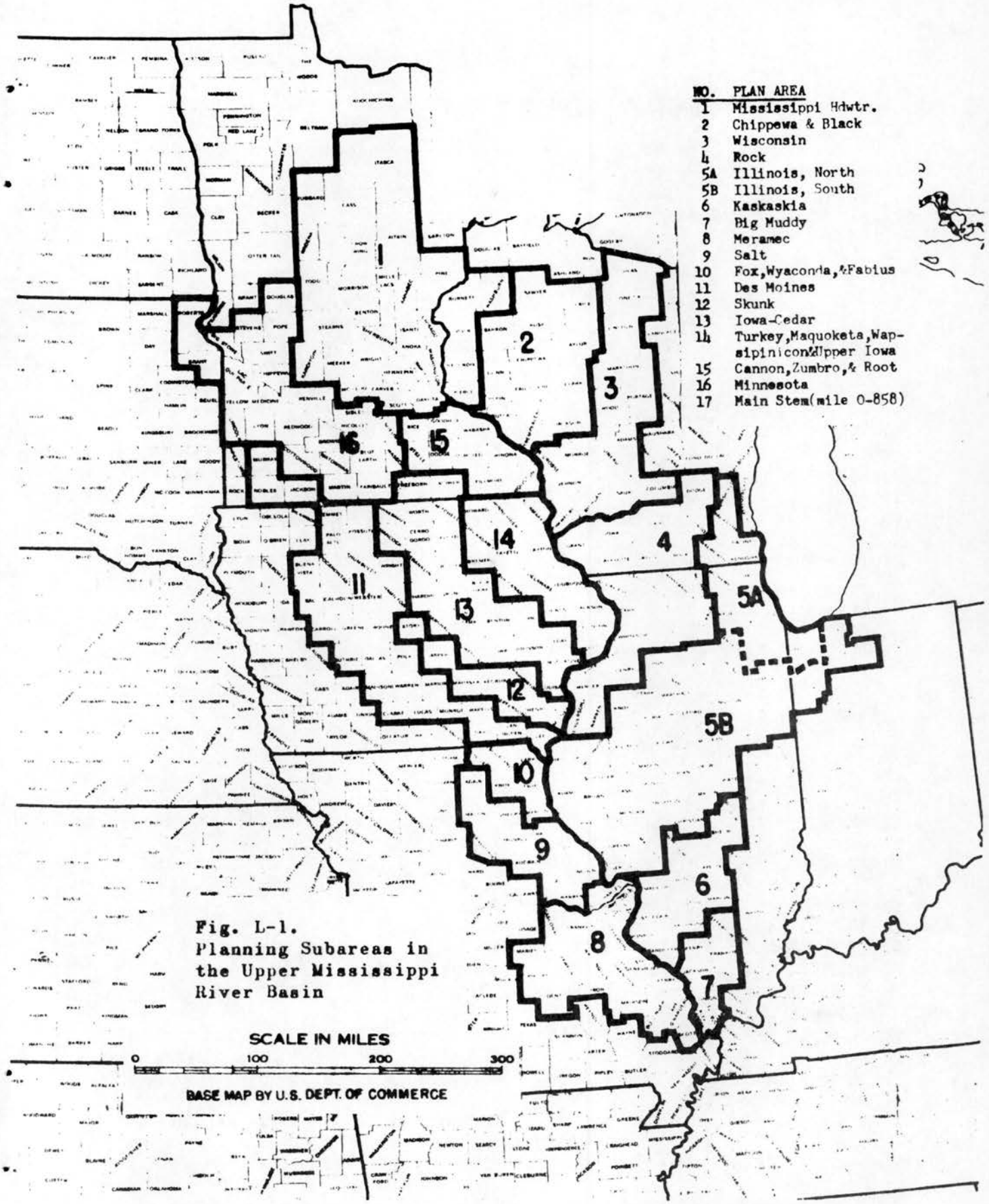


Fig. L-1.
Planning Subareas in the Upper Mississippi River Basin

is conducive to agriculture. The middle latitudes of the basin are subjected to contrasting air masses expelled from polar and tropical regions, causing frontal systems and cyclonic storms. These, and associated weather changes, sometimes cause extensive crop and property damage. Blizzards and cold waves during the winter months are especially dangerous to animal life, both domestic and wild.

2.1.4 Vegetation

Vegetation in the basin prior to settlement consisted primarily of forests in the north and south, prairies in the east and west, and their interspersion in the center of the basin. Most of the original natural vegetation has been replaced by cropland, pasture, cities, or devoted to other economic uses. Of the 118 million acres of land in the basin, about 71% is devoted to agriculture; 19% remains in forests; 5% is now urban or urban built-up areas; and 5% is of marginal agricultural value.

2.1.5 Soils

Basin soils are of seven principal groups; Chernozem, Prairie Podzolic, Red-Yellow Podzolic, Grey-Brown Podzolic, Wiesenboden, Planosol, and alluvial soils. These deposits are primarily of glacial origin and in depth from a few feet to several hundred feet. Most of these soils are rated from medium to high in natural productivity.

2.1.6 Water Resources

The basin contains almost three million surface acres of water. Ground water and surface water supplies are generally ample and of good quality in the northern states of Minnesota and Wisconsin. In the central and southern states of the basin, water supplies are more limited, and pollution has lowered the quality of much of the surface water.

The water resources of the basin are an invaluable asset. Beyond supplying the domestic needs of millions of people, they have a myriad of other uses. The Mississippi and Illinois Rivers provide major navigation routes where the annual volume of waterborne transportation is measured in billions of ton-miles. Expanding industries are using increasing quantities of water for such things as food processing, meat packing, pulp and paper production, cooling purposes, mining, and smelting. Water is being used to generate electricity to supply increasing power demands both domestic and industrial; and agricultural irrigation uses basin waters to augment natural precipitation. A water-oriented tourist industry has also become established in the basin, especially in the northern portion.

2.2 Socio-Economic

2.2.1 Population

In 1960 the basin population was 19.3 million people, (Table L-16, Column 1) or 10.8% of the total U. S. population; 74% of these people lived in urban areas and the remaining 26% resided in non-urban areas. The greatest population concentration in the basin is the metropolitan complex of Chicago, Illinois and northwestern Indiana. This area contained 6.8 million people in 1960. Two other metropolitan complexes had more than a million people in 1960: the St. Louis, Missouri and East St. Louis, Illinois area contained 2.1 million; and the Minneapolis and St. Paul, Minnesota greater metropolitan area contained 1.5 million.

2.2.2 Transportation

Few areas in the basin are without access by a major transportation facility. Those sections least accessible are located in northern Minnesota,

northern Wisconsin, and southeastern Missouri. Numerous rail, bus, and air facilities serve metropolitan areas, with connecting services from smaller cities. The Interstate Highway System has developed to that point where many more remote rural areas are now easily accessible.

2.2.3 Agriculture

Agriculture activities dominate the basin's economy in all but the industrial centers and the extensively forested regions. Soils are fertile, and Upper Mississippi River Basin farms produce a significant part of the Nation's total agricultural output. Wisconsin is the Nation's top dairy state; Iowa leads in corn production and is number two in soybean and oats production. Illinois ranks first in soybean production and second in corn; Minnesota leads the Nation in oats production, is fourth in dairy products and sixth in barley production. On the basis ofgross farm income, the basin accounts for one-fifth of the Nation's livestock and dairy products, one-eighth of the Nation's poultry products, and one-half of the Nation's corn, oats, and soybean production. Total value of all farm products marketed in the basin in 1959 was 5.2 billion dollars. Figure L-2 illustrates the basin's land resource areas in relation to agriculture.

2.2.4 Industry

Industrial output in the basin in 1958 approximated 20 billion dollars, accounting for 20 to 30 percent of the total United States production of machinery, processed food, primary metals, printing and publishing materials, and numerous other items. Timber production and the forest-products industry grossed an additional 2.5 billion dollars in 1958. Outdoor recreation and tourism have had a significant impact on the basin's economy, especially in northern Wisconsin and northern

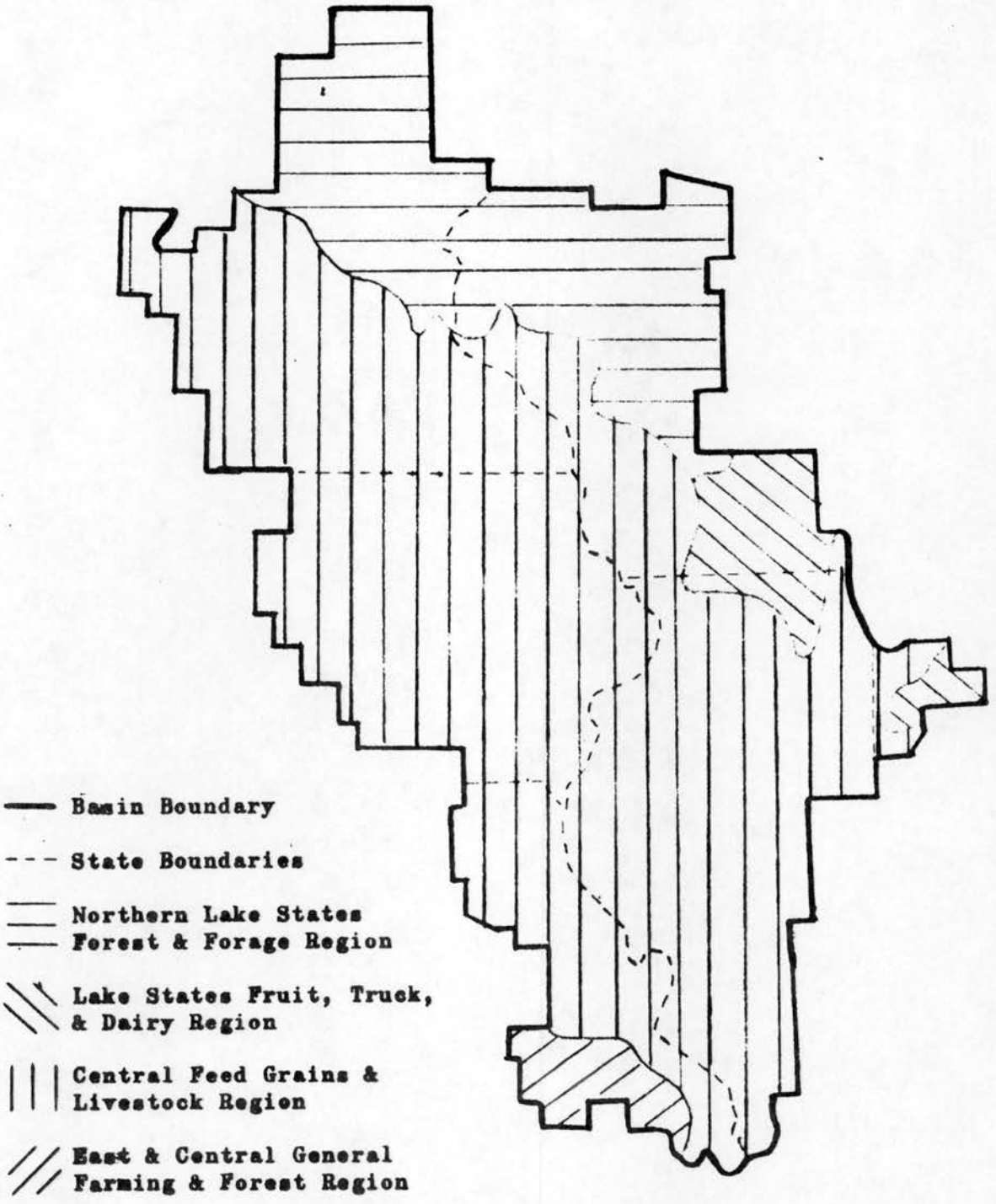


Fig. L-2. Land Resource Areas in Relation to Agriculture in the Upper Mississippi River Basin

Minnesota. Wisconsin's Outdoor Recreation Plan [13] indicated that in 1963 outdoor recreation, much of which was tourist oriented, contributed nearly one billion dollars to Wisconsin's economy.

Section 3

BASINWIDE SPORT FISH AND WILDLIFE RESOURCES

3.1 Historical Synopsis

Fish and wildlife resources have always been abundant in the Upper Mississippi River Basin. However, species composition, distribution, utilization, and attitudes governing the resources have been substantially altered.

3.1.1 History of Utilization

The use of fish and wildlife has evolved from a survival situation in the days of the Indian to a recreation-based activity today. Big game, upland game, fish, and waterfowl provided the Indian with a diversified food supply. Most of their clothing also was derived from these sources.

Following the white explorers and pioneer settlers, there was a brief period when the tribe's survival economy shifted to hunting and trapping for profit. The activities of profit hunting during this era generally were careless and unnecessarily destructive. Millions of animals were sacrificed to satisfy the whims of the expanding civilization. Buffalo were killed by the thousands merely for their tongues or hides. Elk and other big game animals were killed for the same purpose, plus for their teeth or antlers. Usually under pioneer conditions there were no rules; the useful forms of wildlife were overexploited, while many other species were considered to be varments and were drastically reduced.

Hunting and fishing for food and trophy have been important elements motivating the use of the resource. In recent years increasing importance

has been attached to the recreational use of the resource. Fish and game have ceased to be the basis of subsistence, yet fishing and hunting continue to be a major part of our recreational spectrum offering enjoyment to millions of people in the basin. The demands for other forms of outdoor recreation in the basin--past, present, and future--are presented in detail in Appendix K, UMRCBS.

3.1.2 Changes in the Environment

Fish and wildlife populations in a given area are a function of the environment. The use, or misuse, of this environment automatically regulates game and fish supplies.

Changes in the wildlife environment began with the pioneers. To help support the rapid influx of settlers, timber was cut and native grasses were plowed under or heavily grazed. These activities, coupled with urban-industrial development, gradually eliminated much of the basin's original wildlife habitat. The less adaptable animal species rapidly declined or disappeared as their environment was altered.

Big game animals which suffered serious population setbacks or elimination from the area included the bear, buffalo, antelope, cougar, woodland caribou, elk and timber wolf. Limited numbers of wolves, moose, and bear are still present in the northern extremes of the basin.

Prairie chickens, wild turkeys, and sharp-tailed grouse once flourished in the basin. Now, the grouse range is generally reduced and the prairie chickens almost eliminated. Wild turkeys, which disappeared from the basin, have been reintroduced and appear to be making a fine comeback in the southern portions of the drainage.

The loss of food and cover has seriously reduced waterfowl populations. Natural wetlands have all but disappeared following extensive drainage

activities in portions of Iowa, Minnesota, Illinois, and Wisconsin. Waterfowl numbers have declined dramatically in these drained areas.

Fish populations have also been affected through a change in their habitat. Water quality has been reduced by pollution. Intensive cultivation, overpasturing, and other damaging land use practices have resulted in serious sedimentation problems. Excess nitrogen and phosphate compounds from farm fertilizers, and from livestock and human wastes, have produced problems of over-enrichment in many of the basin's lakes and streams. Toxic chemicals from strip mining, pulp mills, and other industrial activities have also resulted in major water quality degradation.

As a result, fish species needing relatively pure, cool, unpolluted waters have been eliminated from many areas. Some of the waters where pike, bass, trout, and certain panfish once flourished are now occupied by such fish species as freshwater drum, buffalo, carp and gar--all of which are more biologically tolerant of poor water quality.

The present fish and wildlife resource is the result of adaptation to past and/or presently changing habitat conditions. For some species, however, our present land practices have had a net beneficial influence. When the coniferous and deciduous forests were removed by lumbering operations and replaced by agricultural crops, second growth timber, or brush, white-tailed deer quickly populated this new environment. Since the 1920's, deer have extended their original basin range considerably where the proper combination of forest, brush and cropland is present.

Pheasants, jackrabbits, cottontails, fox squirrels, quail, Hungarian partridge and mourning doves are also examples of wildlife species which

have been compatible with man's activities. Pheasants and Hungarian partridge were introduced from abroad and are now well established. The bobwhite quail and cottontail have been favored by cropland-brush fringe habitat, which is plentiful in the southern portion of the basin.

Water development practices have resulted in a net improvement of the sport fishery resource. This has been accomplished through the creation of new fish habitat and improvement of existing fishing waters. One example was the 9-foot channel project for the Upper Mississippi River, authorized in the early 1930's. This project has improved the river's attractiveness for boating, fishing, swimming, camping, picnicking, and hunting, by providing fairly stable water levels and year-round slack water pools. Single-purpose reservoirs for flood control, irrigation, and power, have seldom been used only for their original purpose. Fishing opportunity has often been an additional benefactor from these "single-purpose" projects.

Trends toward intensified land and water use will continue or accelerate as the needs of urbanization, agriculture, transportation systems, and industry expand. These changes will have their accompanying affects upon air and water.

3.1.3 Resource Management

Overharvesting and loss of habitat led to declining game and fish populations. Management of the resource followed. The evolution of management began with the enactment of laws. These game and fish laws were essentially a device for dividing up a dwindling resource which nature had produced. By 1880, all basin states had laws which included license requirements to hunt or fish, bag limit restrictions, and prohibitions on methods of procuring and selling the resource. The first daily bag limit (25 prairie chickens per hunter) was established in Iowa in 1878.

Conservation, as it applies to management practices, did not materialize until about 1910. Conservation put into practice the concept that wildlife, forests, soils, and water are renewable resources if managed or harvested judiciously.

The true application of conservation to the management of fish and game is relatively new. Artificial production of the resource and control of the environment represent two important initial efforts in this science, where new techniques have been successfully applied.

Originally, artificial production of game animals was not usually motivated by shortages of native species, but more often because of a longing for fish or wildlife species from "the old country" or perhaps from the desire to possess something new or exotic. The carp and the pheasant are prime examples of these attitudes which have greatly influenced the fish and game populations of today.

One of the best modern day examples of artificial propagation has been in the fishery field. State and Federal fish hatcheries are strategically located throughout the basin. Hatcheries have contributed to maintaining sport and commercial fisheries or in establishing new populations. Public support and understanding of stocking programs have become widespread. These programs are being administered to avoid the artificial conditions of a "put-and-take" fishery. Some areas would be severely deficient of desired species were it not for the fish hatchery program.

Environmental preservation in the form of parks, reservations, or refuges was initiated in this basin late in the 19th century. The refuge was not used as a management technique until about 1910; many ideas associated with the term "refuge" were practiced much earlier. For

example, the modern concept of refuge conditions (including a designated boundary, provision of food and cover within the refuge, and regulated shooting hours) was practiced on Weber's Pond in Horicon Marsh, Wisconsin, around 1891. Since this beginning, many refuges have been established throughout the basin by State and Federal agencies. Refuges provide essential nesting, feeding, and resting habitat for waterfowl and other indigenous forms of fish and wildlife. They also are important sanctuaries for rare and endangered species. Beyond being beneficial to fish and game, the refuges provide opportunities for fishing, hunting, birdwatching, photography, sightseeing, etc., when such uses do not conflict with the production and protection of wildlife.

Refuges, hatcheries, and other fish and wildlife areas existing in the basin are geographically located in Figures L-3 and L-4.

The fish and wildlife resources of the Upper Mississippi Basin constitute an extremely valuable asset both to the region and to the Nation. In 1956, Congress recognized the importance of the resource and issued a declaration of national policy in the Fish and Wildlife Act:

> "The Congress hereby declares that the fish, shellfish, and wildlife resources of the Nation make a material contribution to our national economy and food supply, as well as a material contribution to the health, recreation, and well-being of our citizens; that such resources are a living, renewable form of national wealth that is capable of being maintained and greatly increased with proper management, but equally capable of destruction if neglected or unwisely exploited, . . ."

Today, State and Federal fish and wildlife agencies administer the resource. These activities include cooperation with each other, with landowners, and with other administrating agencies, to study, protect, regulate, and enhance the resource.

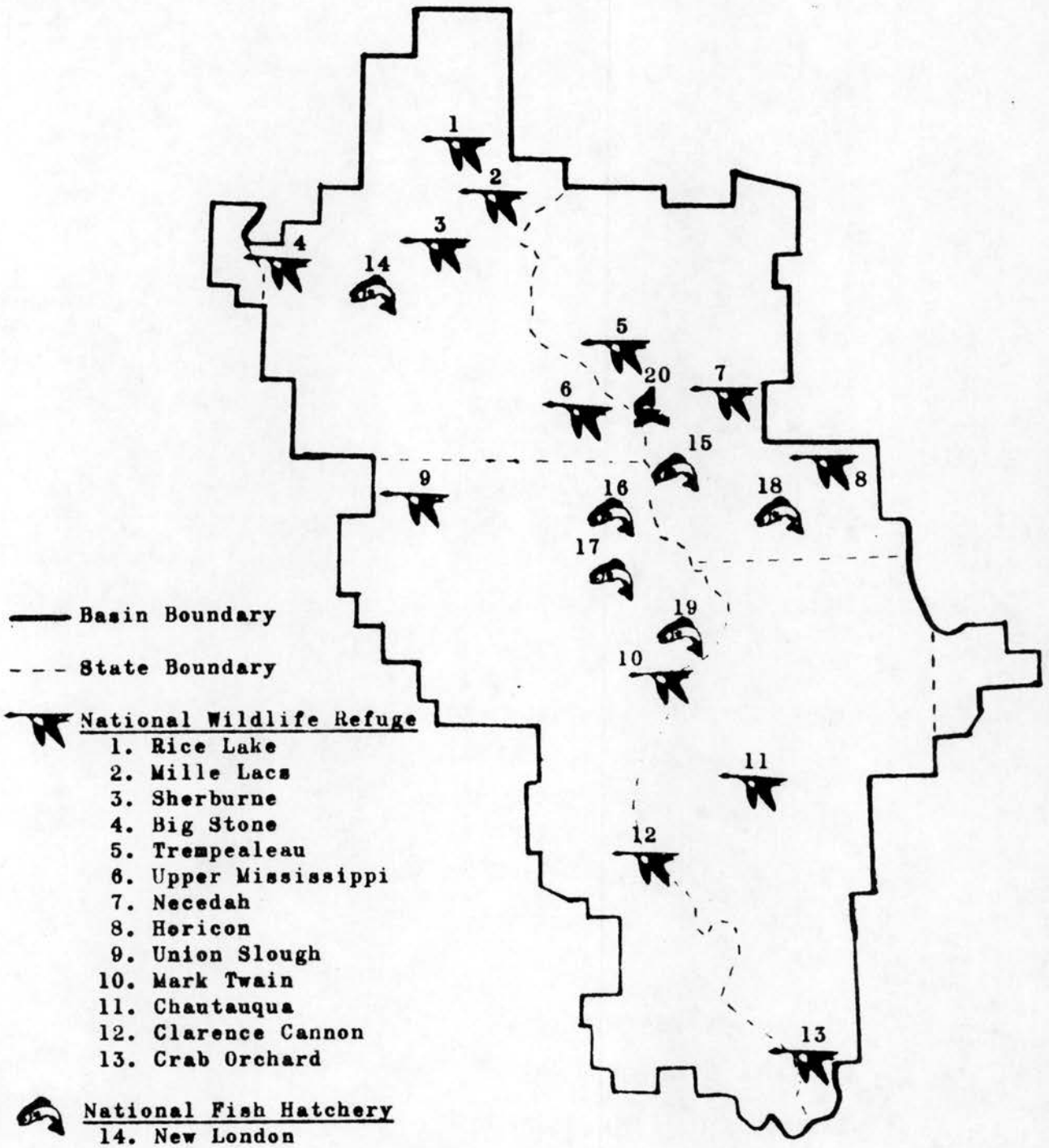


Fig. L-3. Fish and Wildlife Facilities Operated by the Bureau of Sport Fisheries and Wildlife in the Upper Mississippi River Basin.

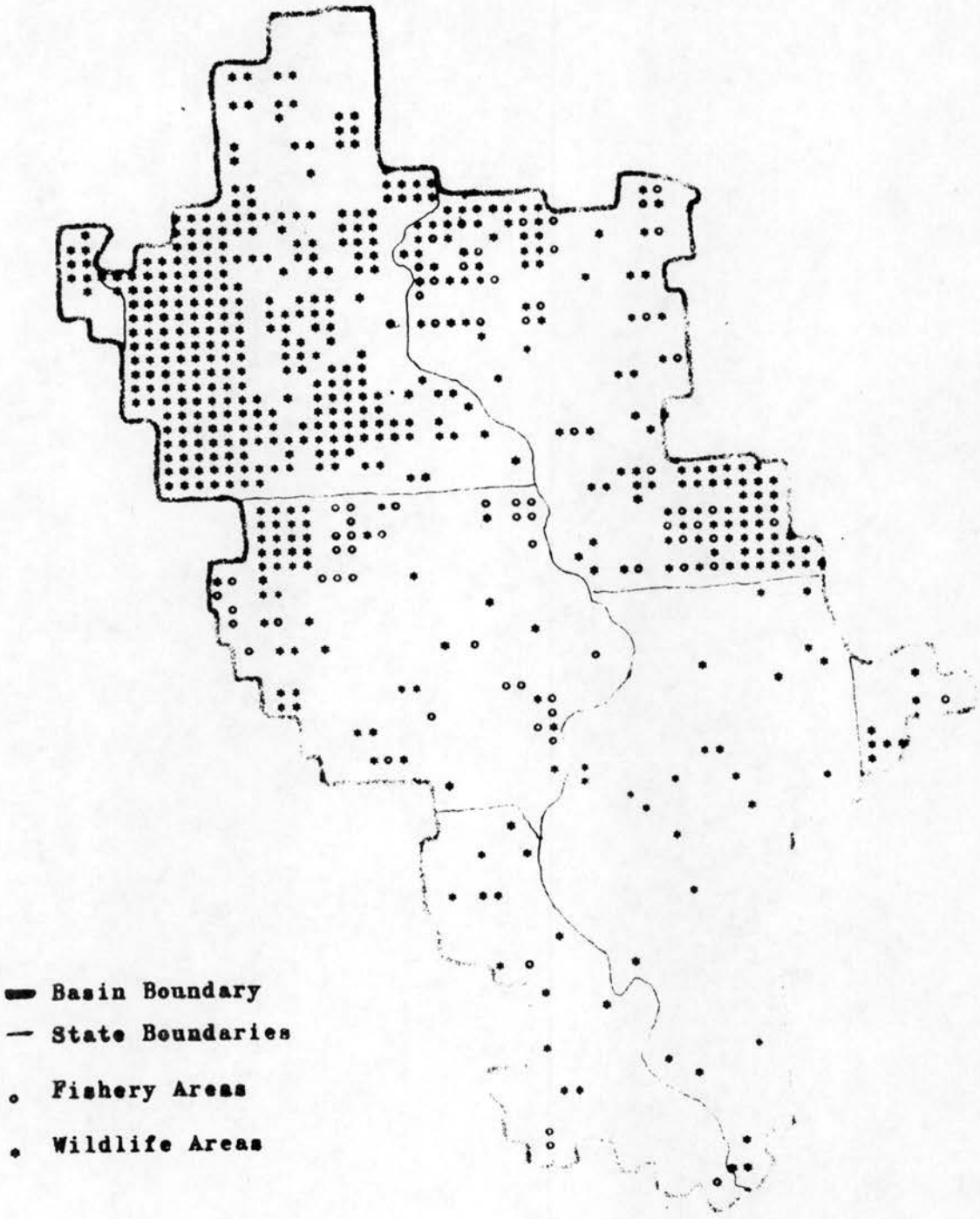


Fig. L-4. State Areas Devoted Primarily to Fishery & Wildlife Management & Research in the Upper Mississippi River Basin.

3.2 Sport Fish and Wildlife Populations, 1960

Fish and wildlife resources in the Upper Mississippi River Basin are diversified. Basin waters support both cold water and warm water fish. Fishery habitat includes natural lakes, rivers, streams and ponds. In addition, there are numerous artificial impoundments (larger reservoirs and farm ponds) built during the past 20 years and presently supporting fish life. Basin lands which support a myriad of animals include bog and marsh areas, large tracts of coniferous and deciduous forest, cutover brushland, prairie grassland, and millions of acres of cultivated or pastured agricultural land.

3.2.1 Fish Species

The principal game fish in the basin (Table L-1) are trout, pike, perch, bass, crappies, sunfish, bullheads, and catfish. These species have qualities or relative abundance that establish them as the most popular fishes in a given area. The general distributions of fishes most frequently utilized are shown in Figure L-5.

Natural populations of brook, brown, lake, and rainbow trout are restricted to colder waters within the basin. However, many marginal lakes and streams are successfully stocked or otherwise managed to increase trout fishing opportunities.

Several species of bass provide good fishing opportunities. The largemouth bass is sought throughout most of the basin, while the smallmouth is generally more prevalent in northern lakes and streams.

The catfish-bullhead group is especially important in southern Minnesota, Iowa, Illinois, and Missouri. The channel catfish is a preferred species, because of its outstanding sporting qualities and excellent table values. Several species of bullhead provide much opportunity because of their wide distribution and catchability characteristics.

Table L-1 - Game Fish Found in the Upper Mississippi River Basin, 1960**

Shovelnose Sturgeon	Scaphirhynchus platorynchus
Paddlefish	Polyodon spathula
Bowfin	Amia calva
Gar	Lepisosteus spp.
Gizzard Shad	Dorosoma cepedianum
River Herring	Alosa chrysochloris
Brown Trout*	Salmo trutta
Rainbow Trout	Salmo gairdneri
Brook Trout	Salvelinus fontinalis
Lake Trout	Salvelinus namaycush
Cisco (Lake Herring)	Coregonus artedii
Lake Whitefish	Coregonus clupeaformis
Grass Pickerel	Esox americanus vermiculatus
Northern Pike*	Esox lucius
Muskellunge*	Esox masquinongy
Blue Sucker*	Cycleptus elongatus
Buffalo	Ictiobus spp.
Carpsucker	Carpiodes spp.
Spotted Sucker	Minytrema melanox
Chubsucker	Erimyzon spp.
Hog Sucker	Hypentelium nigricans
Harelip Sucker	Lagochila lacera
Redhorse	Moxostoma spp.

Table L-1 (cont'd). Game Fish Found in the Upper Mississippi River Basin, 1960**

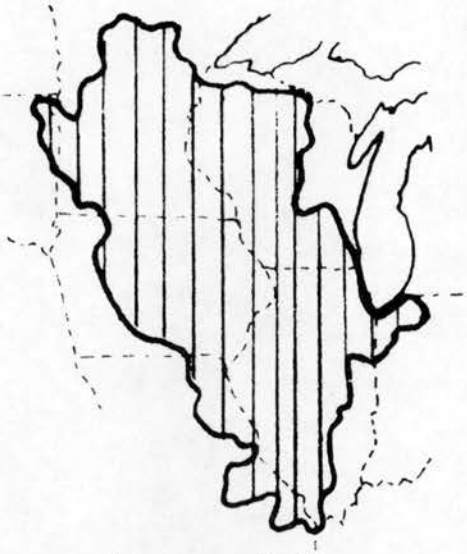
White Sucker	Catostomus commersoni
Longnose Sucker	Catostomus catostomus
Carp*	Cyprinus carpio
Blue Catfish*	Ictalurus furcatus
Channel Catfish	Ictalurus punctatus
Yellow Bullhead	Ictalurus natalis
Brown Bullhead	Ictalurus nebulosus
Black Bullhead	Ictalurus melas
Flathead Catfish	Pylodictus olivaris
Stonecat	Noturus flavus
Madtom	Noturus spp.
Burbot	Lota lota
White Bass	Roccus chrysops
Yellow Bass	Roccus mississippiensis
Largemouth Bass*	Micropterus salmoides
Smallmouth Bass*	Micropterus dolomieui
Spotted Bass	Micropterus punctulatus
Black Crappie	Pomoxis nigromaculatus
White Crappie	Pomoxis annularis
Warmouth	Chaenobryttus gulosus
Rockbass	Ambloplites rupestris
Sunfish*	Lepomis spp.
Bluegill*	Lepomis macrochirus
Pumpkinseed	Lepomis gibbosus

Table L-1 (cont'd). Game Fish Found in the Upper Mississippi River Basin, 1960**

Yellow Perch*	Perca flavescens
Walleye*	Stizostedion vitreum
Sauger	Stizostedion canadense
Freshwater Drum*	Aplodinotus grunniens

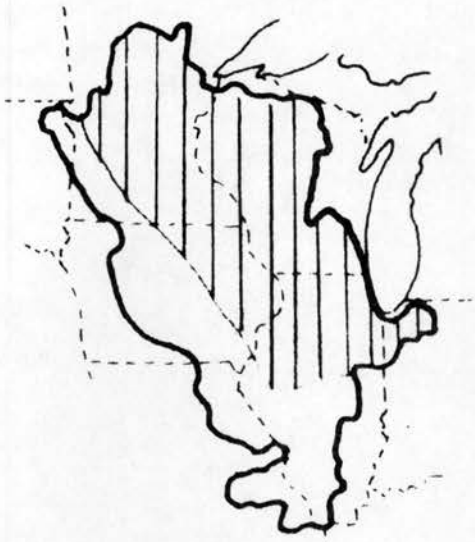
* Species or species group distribution located on range maps.

** Scientific names are taken from the American Fisheries Society's 1960 List of Common and Scientific Names of Fishes from the United States and Canada. 6



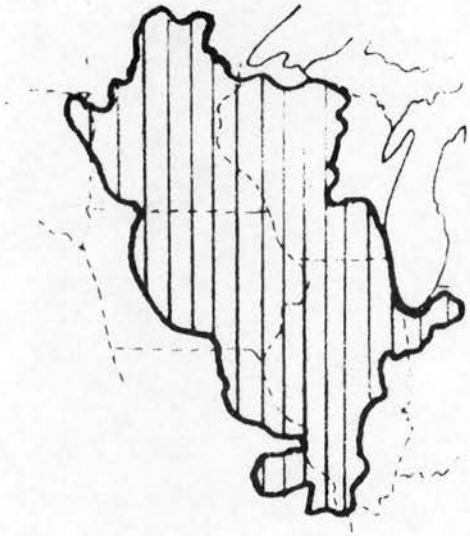
Largemouth Bass

Micropterus salmoides



Smallmouth Bass

Micropterus dolomieui



Bluegill & Sunfish

Lepomis spp.

Trout

Salvelinus spp.
Salmo spp.

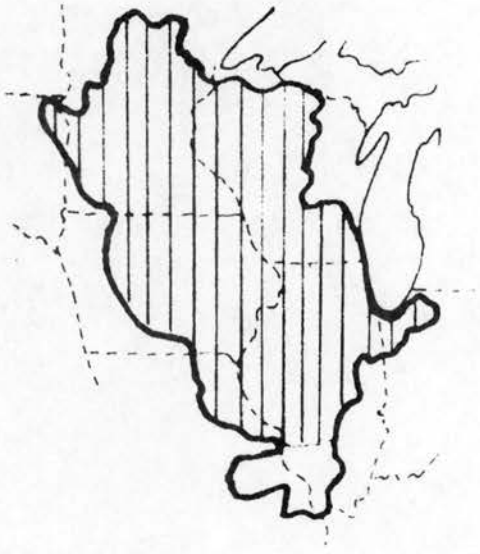
Fig. L-5. Distribution of Various Species of Fish in the Upper Mississippi River Basin

Walleye

Stizostedion vitreum

Yellow Perch

Perca flavescens



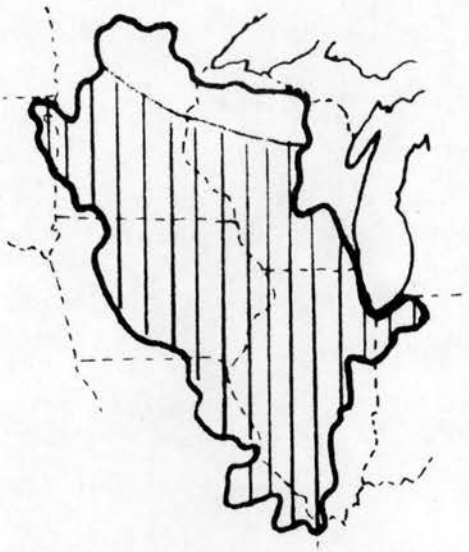
Northern Pike

Esox lucius

Muskellunge

Esox masquinongy

Fig. L-5 (cont'd). Distribution of Various Species of Fish in the Upper Mississippi River Basin



Carp

Cyprinus carpio

Catfish & Bullheads

Ictalurus spp.
Noturus spp.

Suckers

Nine Genera

Freshwater Drum

Aplodinotus grunniens

Fig. L-5 (cont'd). Distribution of Various Species of Fish in the Upper Mississippi River Basin

In Minnesota and Wisconsin, walleyes, muskellunge, and northern pike constitute an especially important part of the sportsman's creel. Panfish, including crappies and sunfishes, receive considerable fishing pressure throughout the basin. Panfish, along with yellow perch, walleye, and whitefish comprise the more popular winter fishery species.

Some species formerly considered as rough fish are gaining rapidly in popularity and frequency of catch. Bullheads, as previously discussed, are examples of fish species now readily accepted by many fishermen. Carp and suckers receive similar acceptance in some sections of the basin. The frequency of various sport fish in an angler's creel reflects availability, and probably to a lesser degree, popularity.

Standing crop represents the poundage of a given species or complex of fish species present in a body of water at a given time. The standing crop of a given body of water is governed by: (1) the fertility of the surrounding and underlying soil, (2) the rainfall-runoff ratio as it affects the accumulation of nutrients, (3) the morphometry of the body of water (smaller and/or shallower waters generally have higher productivity), (4) the geographical location as it relates to mean temperature and rainfall, (5) the distribution of fish species in relation to ecological conditions, and (6) the competition among fish species. The Upper Mississippi River Basin, having some of the more fertile soils in the Nation, has many waters with above average standing crops.[3] Since approximately one-third of the standing crop may be harvested annually, there is a large reservoir of potentially harvestable fish.

Total fishing water in the basin, by subarea, is tabulated in Table L-2. Categories of basin water habitat fished most often in 1960 were natural

lakes, 48.5%; rivers and streams, 26.5%; and large and small artificial impoundments, 25.5%.[15] Fish production from these waters (angler harvest) depended upon access, fishing pressure, and that portion of the standing crop consisting of desirable species.

Table L-2. Distribution of Fishing Waters, by Subarea, in the Upper Mississippi River Basin, 1960

Subarea	Water Area (1,000 Acres)			
	Less than 40 Acres	40 to 6,000 Acres	Greater than 6,000 Acres	Total
1	126	476	569	1,171
2	67	72	64	203
3	91	145	95	331
4	29	75	58	162
5	57	192	0	249
6	19	28	0	47
7	22	28	7	57
8	14	38	0	52
9	12	16	0	28
10	8	9	0	17
11	10	47	0	57
12	4	9	0	13
13	8	8	25	41
14	6	57	0	63
15	8	41	0	49
16	65	128	56	249
Total	546	1,369	874	2,789

Source: UMRCBS, Appendix N, Draft No. 2, Table III-7.

3.2.2 Wildlife Species

The principal game animals, furbearers, and game birds in the basin are listed in Tables L-3 and 4. Wildlife species which provide hunting or trapping, or which have a reasonable potential to do so, are white-tailed deer, black bear, moose, antelope, wild turkey, squirrels, rabbits, grouse, pheasant, quail, woodcock, dove, foxes, raccoon, beaver, mink, muskrat, and many species of waterfowl. The general distributions of animals most frequently harvested are shown in Figure L-6.

The white-tailed deer is the most popular big game animal in the basin. It ranges throughout most of the Mississippi Drainage and is extensively hunted in all basin States. The other big game animals generally are not widely distributed nor hunted. Moose and black bear are restricted to the northern portions of the basin, while limited numbers of antelope extend their Missouri River Basin range into South Dakota basin counties and rarely into western Minnesota. Wild turkeys, classified as big game in some areas, have been re-established and are hunted in southeastern Missouri.

Squirrels and rabbits inhabit the majority of the basin and are the most utilized of small game mammals. Foxes and raccoon are also distributed basinwide and generally provide huntable populations.

Popular upland game birds include grouse, pheasant, quail, and woodcock. All receive heavy hunting pressure where they are locally abundant.

Waterfowl provide the basin sportsman with an excellent hunting experience. A variety of ducks and geese are available during fall

migrations. The distribution of favorable waterfowl habitat results in major migration corridors across the Upper Mississippi Basin (Figures L-7, 8, 9 and 10). The existing wetlands, in addition to attracting Canadian produced birds, constitute some of the most productive breeding and nesting grounds in the United States (Figure L-11). Many of the waterfowl harvested in the Nation have been raised on local basin wetlands. Other waterfowl available for hunting are snipe, rails, gallinules, and coots.

The mourning dove, a migratory bird, is hunted by many sportsmen in South Dakota, Missouri, and Illinois. These birds are very abundant in all areas of the basin. Their hunting potential is not utilized in Minnesota, Wisconsin, Iowa, and Indiana because of legal restrictions.

Harvestable furbearers, that are generally abundant throughout the basin, are mink, muskrat, beaver, raccoon, and fox. Recent trends show furbearers decreasing in economic importance, due to a declining demand for fur products. Therefore, these animals (especially the fox and raccoon) are presently utilized more as a recreational form of hunting, than as an economic trapping activity.

Harvest of specific wildlife species is dependent upon the availability and abundance of the species, access to hunting lands, ability of the hunter, and hunter acceptance of available species. Harvest estimates of major huntable species for 1960 (Table L-5) were compiled from State and Federal sources and tabulated for five states within the basin.

Table L-3. Game Animals and Furbearers Found in the Upper Mississippi River Basin, 1960**

Moose*	Alces alces
White-tailed Deer*	Odocoileus virginianus
Antelope*	Antilocapra americana
Black Bear*	Ursus americanus
Snowshoe Hare*	Lepus americanus
Whitetail Jackrabbit*	Lepus townsendi
Swamp Rabbit*	Sylvilagus aquaticus
E. Cottontail Rabbit*	Sylvilagus floridanus
E. Fox Squirrel*	Sciurus niger
E. Gray Squirrel*	Sciurus carolinensis
Red Fox*	Vulpes fulva
Grey Fox*	Urocyon cinereoargenteus
Raccoon*	Procyon lotor
Opossum*	Didelphis marsupialis
Mink	Mustela vison
River Otter	Lutra canadensis
Least Weasel	Mustela rixosa
Shorttail Weasel	Mustela eminea
Longtail Weasel	Mustela frenata
Striped Skunk	Mephitis mephitis
Spotted Skunk	Spilogale putorius
Beaver*	Castor canadensis
Muskrat*	Ondatra zibethica

*Species distribution on range map.
**Scientific names are taken from W. H. Burt and R. P. Grossenheider, A Field Guide to the Mammals.[2]

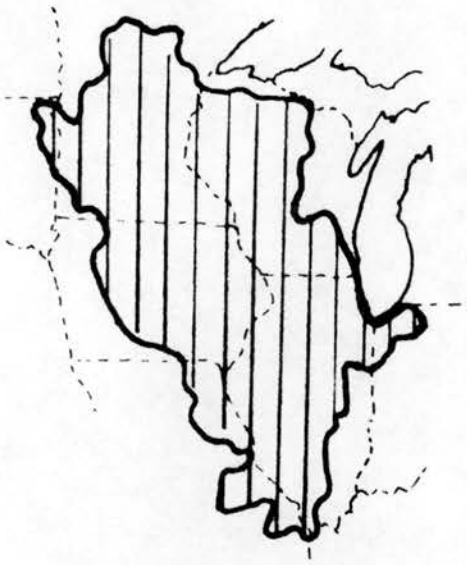
Table L-4. Game Birds Found in the Upper Mississippi River Basin, 1960**

Ruffed Grouse*	Bonasa umbellus
Sharp-tailed Grouse*	Pediocetes phasianellus
Bobwhite Quail*	Colinus virginianus
Hungarian Partridge*	Perdix perdix
Ring-necked Pheasant*	Phasianus colchicus
Wild Turkey*	Meleagris gallopavo
Mourning Dove*	Zenaidura macroura
Rock Dove	Columba livia
Woodcock*	Philohela minor
Wilson's Snipe*	Capella gallinago
King Rail*	Rallus elegans
Virginia Rail*	Rallus limicola
Sora Rail*	Porzana carolina
Canada Goose	Branta canadensis
Snow Goose	Chen hyperborea
Blue Goose	Chen caerulescens
Mallard	Anas platyrhynchus
Black Duck	Anas rubripes
Gadwall	Anas strepera
Pintail	Anas acuta
Green-winged Teal	Anas carolinensis
Blue-winged Teal	Anas discors
American Widgeon	Marcea americana
Shoveller	Spatula clypeata

Table L-4 (cont'd). Game Birds Found in the Upper Mississippi River Basin, 1960**

Wood Duck	*Aix sponsa*
Redhead	*Aythya americana*
Canvasback	*Aythya valisneria*
Lesser Scaup	*Aythya affinis*
Ring-necked Duck	*Aythya collaris*
Bufflehead	*Bucephala albeola*
Ruddy Duck	*Oxyura jamaicensis*
Common Merganser	*Mergus merganser*
Red-breasted Merganser	*Mergus serrator*
Hooded Merganser	*Lophodytes cucullatus*
Coot	*Fulica americana*
Florida Gallinule	*Gallinula chloropus*

* Species distribution on range maps.
** Scientific names[4] are taken from the 1957 A.O.U. Checklist of North American Birds.



Whitetail Deer

Odocoileus virginianus

Moose

Alces alces

Black Bear

Ursus americanus

Antelope

Antilocapra americana

Fig. L-6. Distribution of Various Species of Wildlife in the Upper Mississippi River Basin

Snowshoe Hare

Lepus americanus

Whitetail Jackrabbit

Lepus townsendi

Swamp Rabbit

Sylvilagus aquaticus

E. Cottontail Rabbit

Sylvilagus floridanus

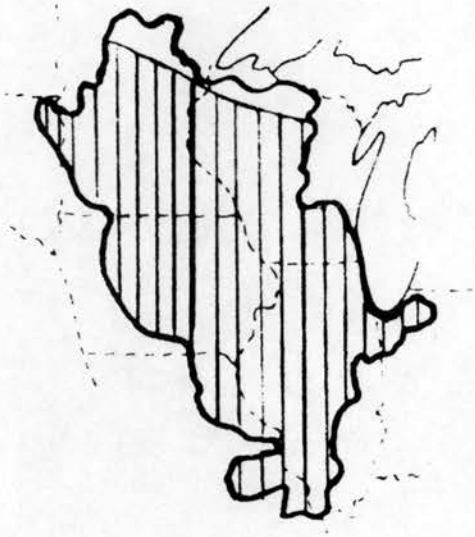
Fig. L-6 (cont'd). Distribution of Various Species of Wildlife in the Upper Mississippi River Basin

Red Fox

Vulpes fulva

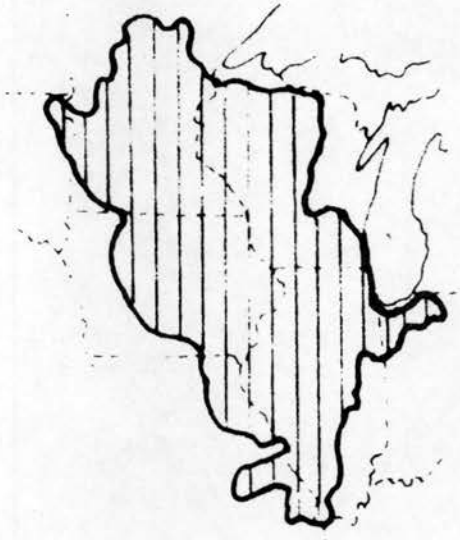
Gray Fox

Urocyon cinereoargenteus



E. Fox Squirrel

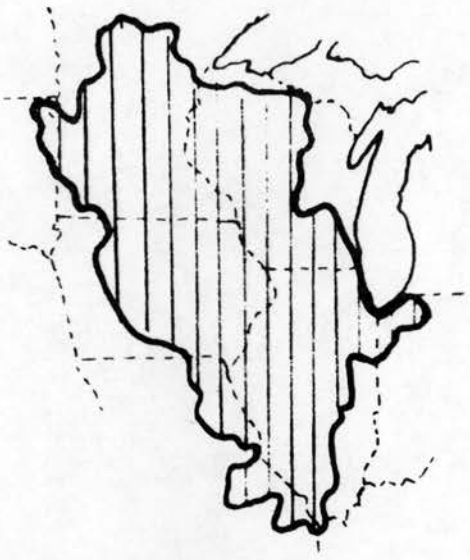
Sciurus niger



E. Gray Squirrel

Sciurus carolinensis

Fig. L-6 (cont'd). Distribution of Various Species of Wildlife in the Upper Mississippi River Basin



Raccoon

Procyon lotor

Opossum

Didelphis marsupialis

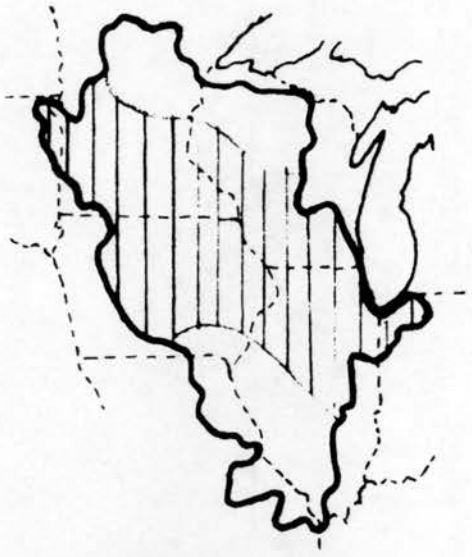
Beaver

Castor canadensis

Muskrat

Ondatra zibethica

Fig. L-6 (cont'd). Distribution of Various Species of Wildlife in the Upper Mississippi River Basin

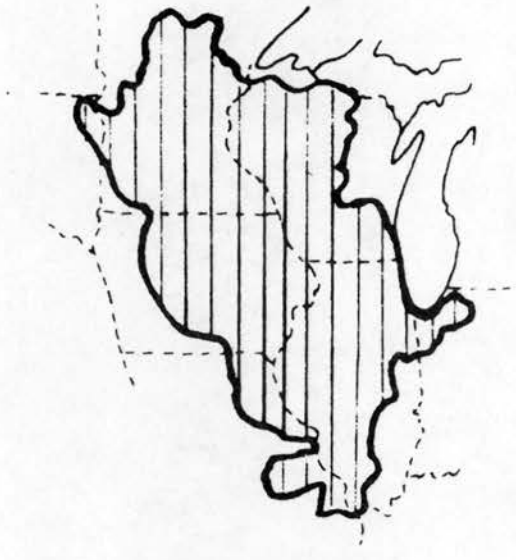


Ring-necked Pheasant

Phasianus colchicus

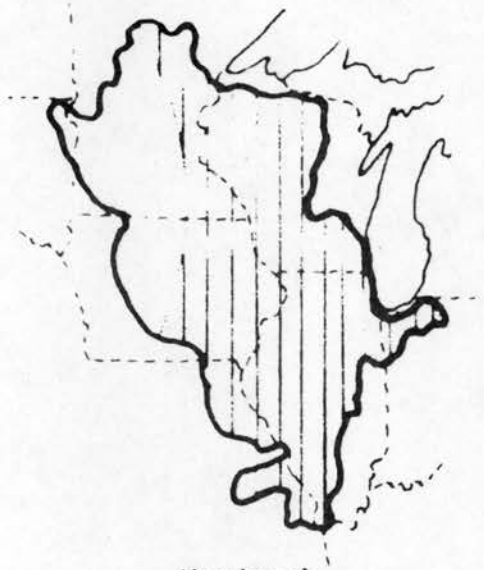
Wild Turkey

Meleagris gallopavo



Mourning Dove

Zenaidura macroura



Woodcock

Philohela minor

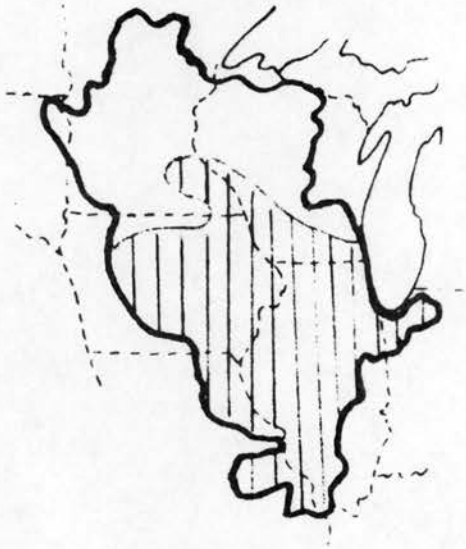
Fig. L-6 (cont'd). Distribution of Various Species of Wildlife in the Upper Mississippi River Basin

Ruffed Grouse

Bonasa umbellus

Sharp-tailed Grouse

Pediocetes phasianellus



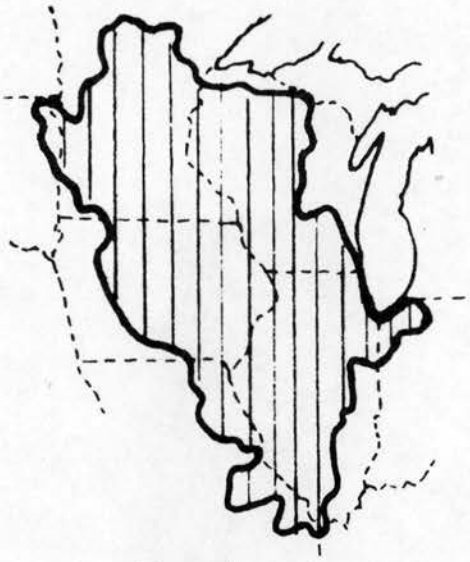
Bobwhite Quail

Colinus virginianus

Hungarian Partridge

Perdix perdix

Fig. L-6 (cont'd). Distribution of Various Species of Wildlife in the Upper Mississippi River Basin



Wilson's Snipe

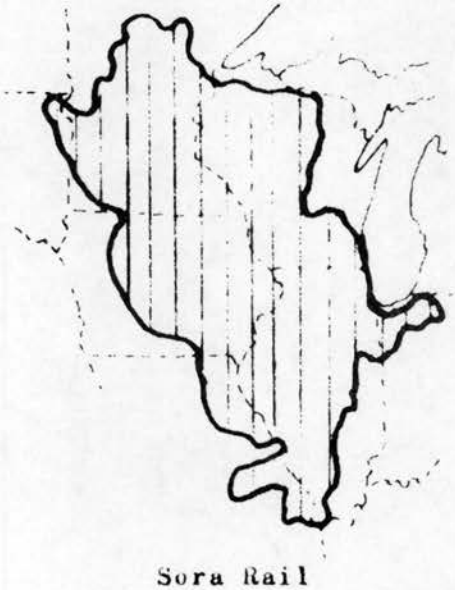
Capella gallinago

King Rail

Rallus elegans

Virginia Rail

Rallus limicola



Sora Rail

Porzana carolina

Fig. L-6 (cont'd). Distribution of Various Species of Wildlife in the Upper Mississippi River Basin

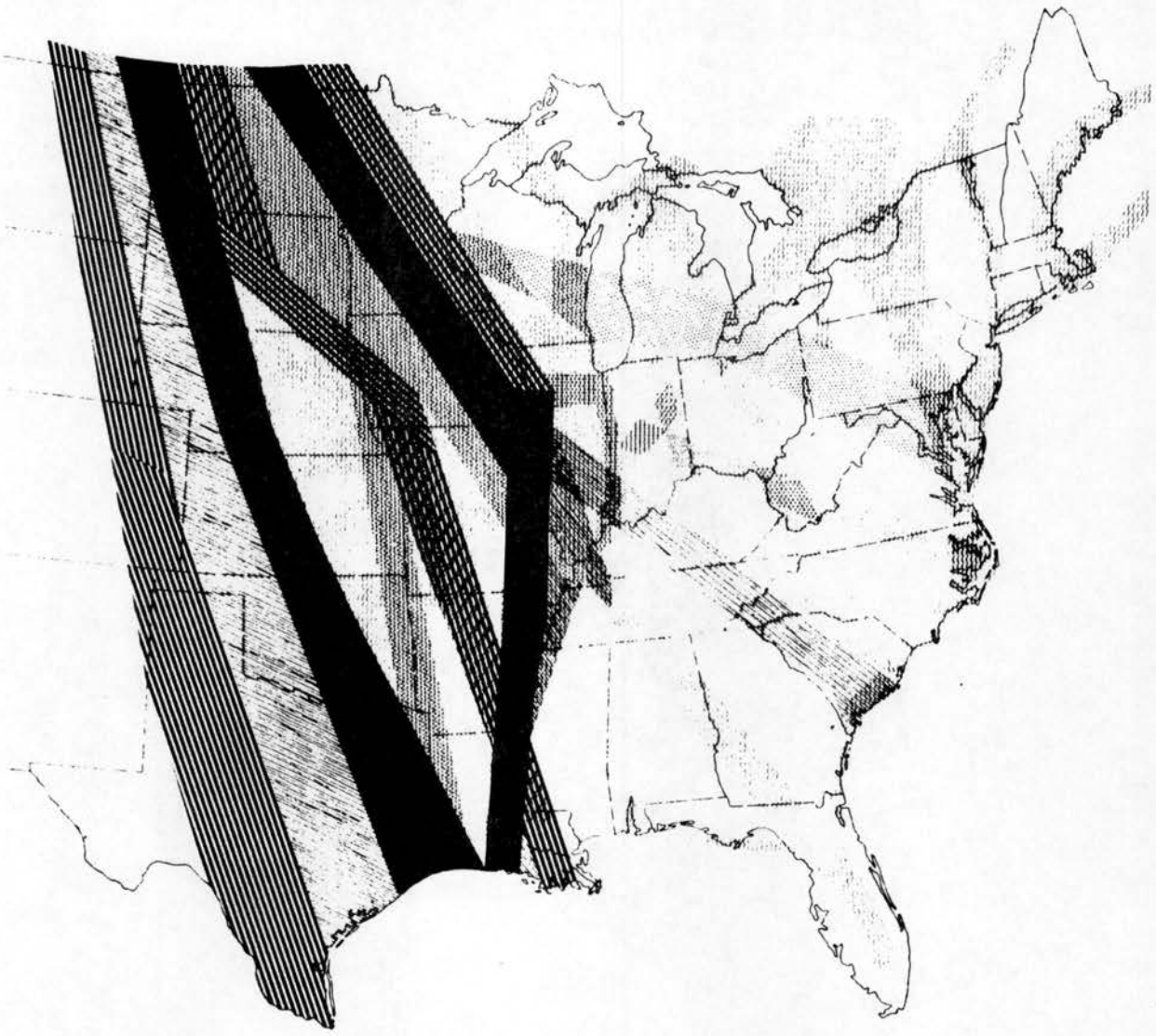


Fig. L-7. Migration Corridors - East of the Rocky Mountains - Used by Dabbling Ducks During Their Fall Migration (adapted from: Frank C. Bellrose, Waterfowl Migration Corridors, Illinois Natural History Survey Biological Notes, No. 61. June, 1968).[1]

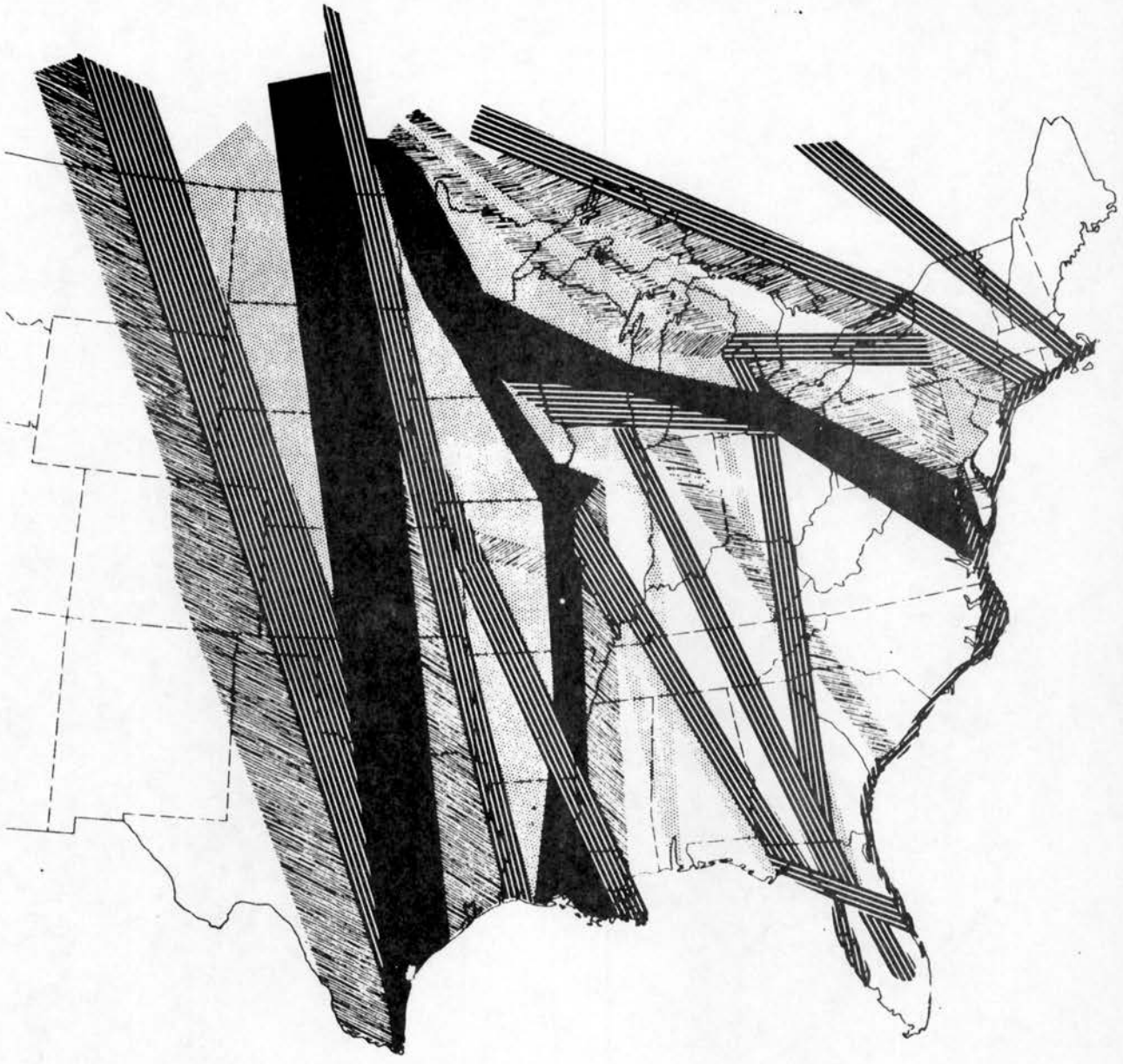


Fig. L-8. Migration Corridors - East of the Rocky Mountains - Used by Diving Ducks During Their Fall Migration (adapted from: Frank C. Bellrose, Waterfowl Migration Corridors, Illinois Natural History Survey Biological Notes, No. 61. June, 1968).[1]

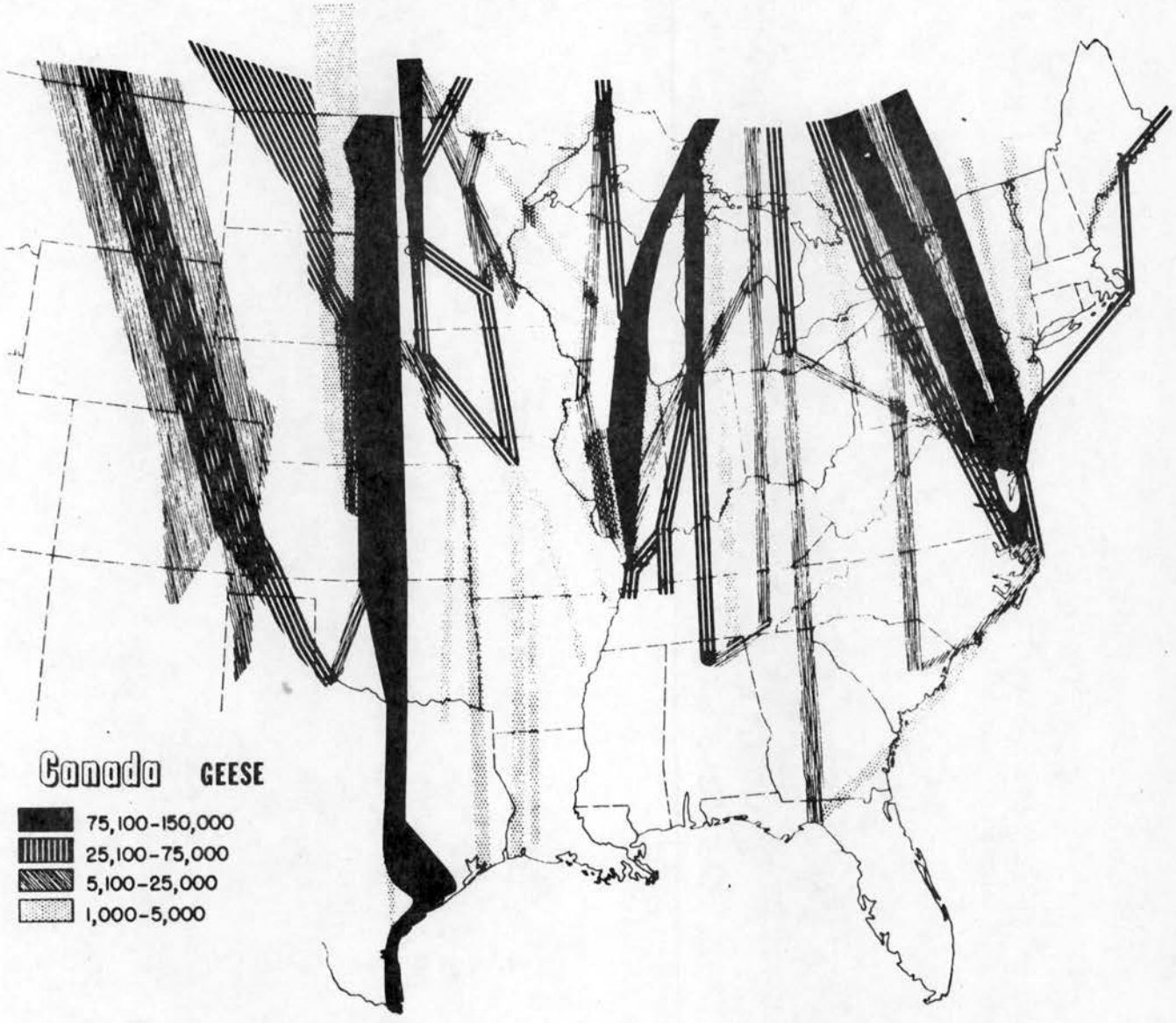


Fig. L-9. Migration Corridors - East of the Rocky Mountains - Used by Canada Geese During Their Fall Migration (adapted from: Frank C. Bellrose, Waterfowl Migration Corridors, Illinois Natural History Survey Biological Notes, No. 61. June, 1968).[1]

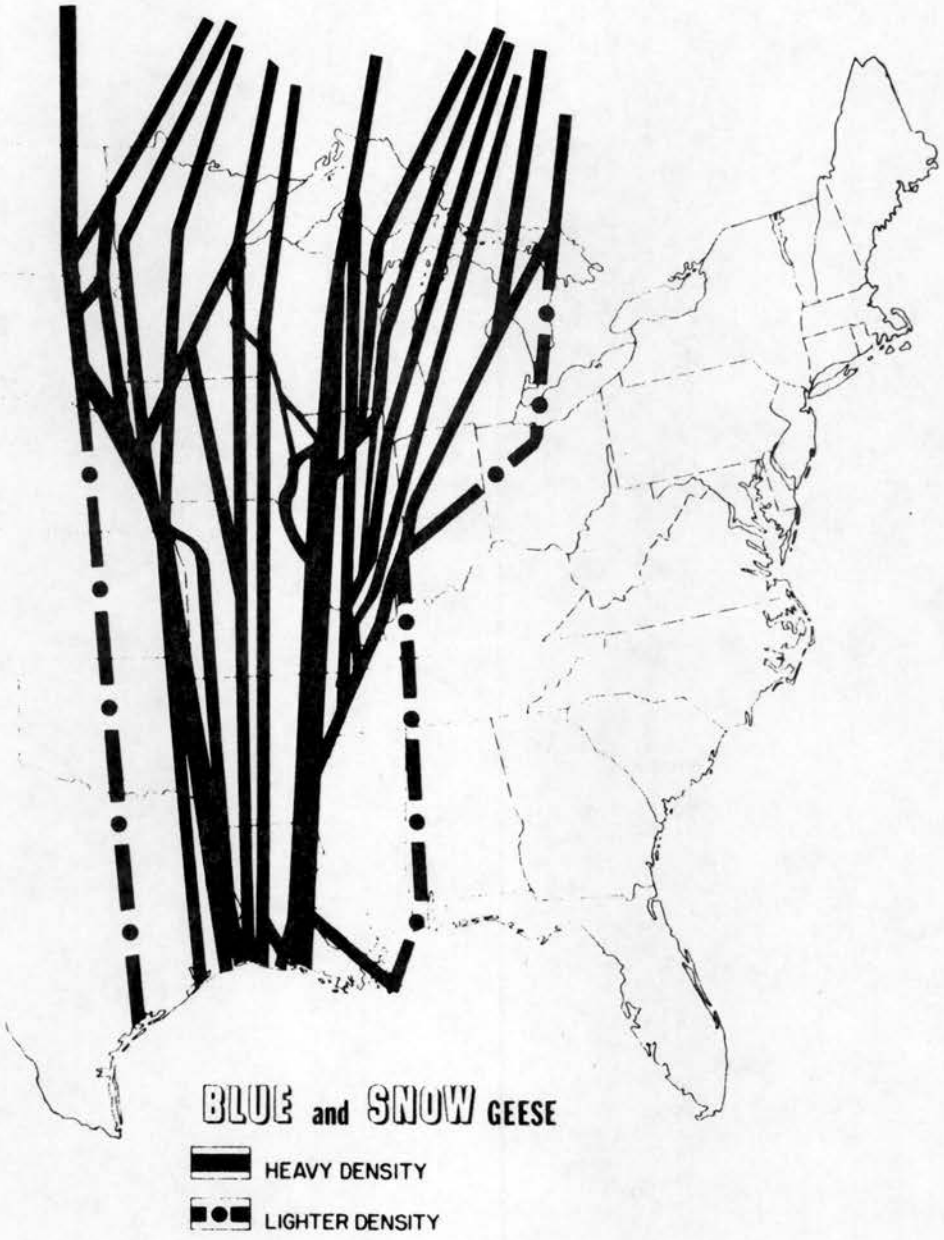


Fig. L-10. Migration Corridors - East of the Rocky Mountains - Used by Blue and Snow Geese During Their Fall Migration (adapted from: Frank C. Bellrose, Waterfowl Migration Corridors, Illinois Natural History Survey Biological Notes, No. 61. June, 1968).[1]

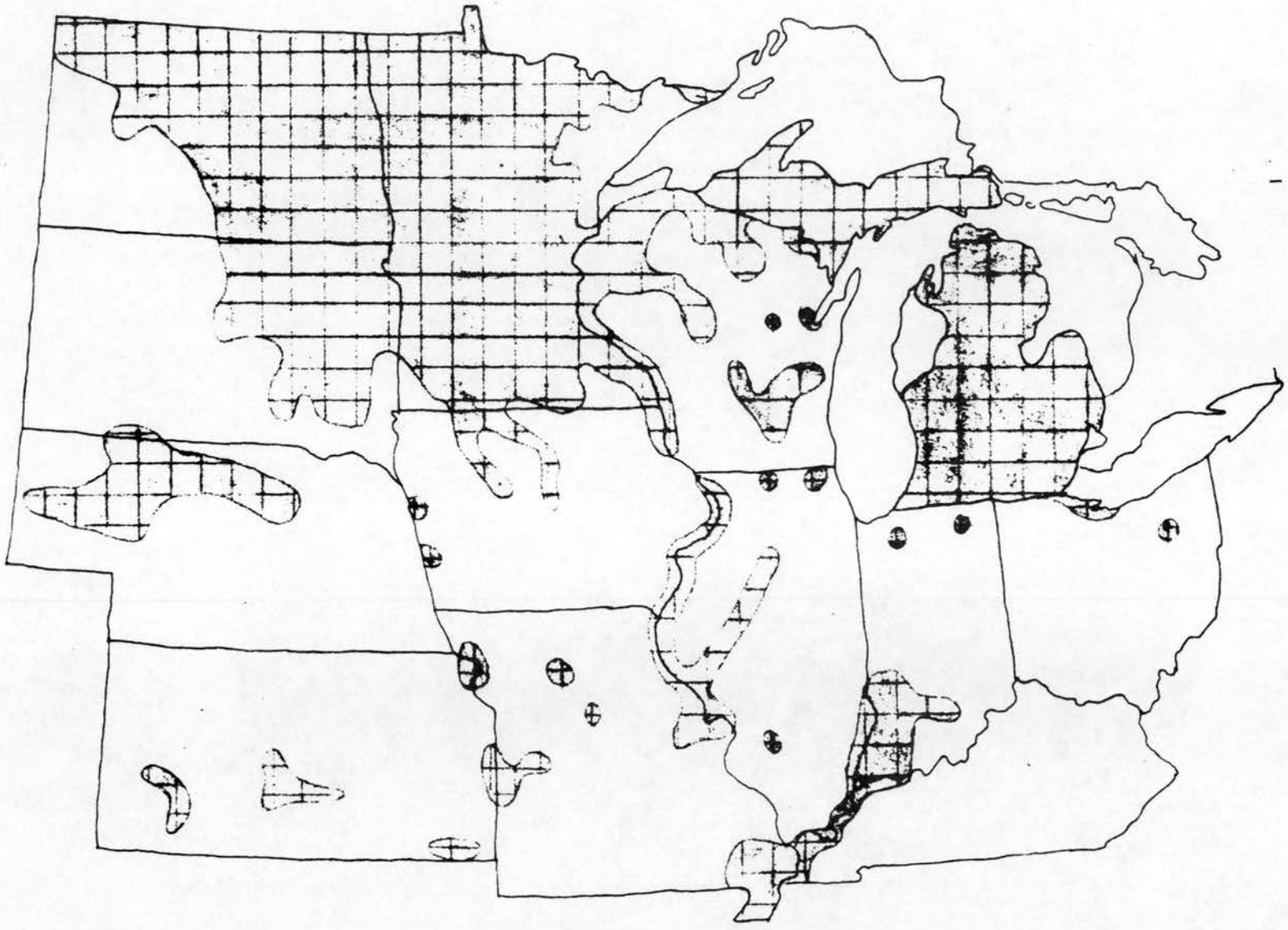


Fig. L-11. Location of Wetlands of Primary Importance to Waterfowl in the North-Central United States.

Table L-5. 1960 Game Harvest Figures for Illinois, Iowa, Minnesota, Missouri, and Wisconsin

	Illinois	Iowa	Minnesota	Missouri	Wisconsin
Deer					
Harvest	2,555	3,465	95,753	17,781	62,771
Harvest/DL	0.14	0.40	0.39	0.20	0.18
Pheasants					
Harvest	711,900	1,150,000	1,163,905	00	274,300
Harvest/SL	1.49	3.60	3.31		0.80
Hungarian Partridge					
Harvest	00	8,000	13,773	00	19,500
Harvest/SL		0.03	0.04		0.06
Ruffed Grouse					
Harvest	00	00	404,725	00	215,400
Harvest/SL			1.15		0.63
Sharp-tailed Grouse					
Harvest	00	00	41,592	00	6,800
Harvest/SL			0.12		0.02
Bobwhite Quail					
Harvest	1,480,000	150,000	00	620,702	7,400
Harvest/SL	3.11	0.47		1.88	0.02
Mourning Doves					
Harvest	1,362,000	00	00	386,629	00
Harvest/SL	2.86			1.18	
Rabbits					
Harvest	3,475,000	1,105,200	385,600	1,309,993	555,700
Harvest/SL	7.29	3.46	1.10	3.97	1.62
Squirrels					
Harvest	2,741,000	1,500,000	441,000	1,481,610	1,301,800
Harvest/SL	5.75	4.70	1.25	4.50	3.79
Ducks					
Harvest	298,900	210,600	995,900	217,500	551,300
Harvest/DS	3.80	4.24	7.16	4.43	5.02
Geese					
Harvest	41,100	17,500	29,700	30,400	26,900
Harvest/DS	0.65	0.43	0.35	0.78	0.30
Deer Licenses	18,259	8,772	245,562	90,399	342,147
Small Game Licenses	476,461	319,203	351,801	329,539	343,705
Duck Stamps	78,722	49,657	139,065	49,103	109,875

Harvest/DL: Harvest per Deer License.
Harvest/SL: Harvest per Small Game License.
Harvest/DS: Harvest per Duck Stamp.
00: Harvest negligible or no open season.
Goose harvest and harvest per duck stamp are for 1961.

Private and public hunting lands, by subarea, are presented in Table L-6. These data represent land quantity which is inhabited by huntable animals and potentially available to the sportsman. They do not, however, identify or evaluate specific opportunities or high value lands which are vitally important in determining wildlife populations and hunter utilization. Quality environmental systems in the basin are visually and quantitatively expressed in Appendix B, Aesthetic and Cultural Values - Regional Design for Human Impact. Appendix B delineates existing basin features (topography, land use and cover, water resources, etc.) having outstanding or better-than-average quality. These features, expressed as "corridors", act as a lifeline to present fish and game populations. Reduction of waterfowl from wetland drainage and loss of fish species from pollution emphasizes the value of these corridors. These environmental resource inventory maps should be used when planning new developments and in conservation-preservation planning.

Table L-6.1 Distribution of Hunting Land in the Upper Mississippi River Basin, 1960

Subarea	Hunting Land Area (1,000 Acres)				
	Cropland	Pasture	Forest	Other	Total
1	6,449	919	7,170	1,459	15,997
2	3,229	500	3,873	398	8,000
3	3,443	513	3,154	505	7,615
4	6,871	957	708	469	9,005
5	13,914	920	1,418	1,073	17,325
6	3,168	285	617	262	4,332
7	1,112	77	520	144	1,853
8	1,788	212	2,314	136	4,450
9	1,732	456	588	117	2,893
10	1,195	398	271	82	1,946
11	7,598	875	295	305	9,073
12	2,251	315	219	72	2,857
13	6,817	461	280	272	7,830
14	4,213	453	643	161	5,470
15	2,583	300	544	128	3,555
16	8,522	780	325	617	10,244
Total	74,885	8,421	22,939	6,200	112,445

Source: UMRCBS, Appendix N, Draft No. 2, Table III-7.

3.2.3 Nongame Species

Fish and wildlife species discussed in the previous two subsections are hunted, trapped, or fished. These species are also used extensively for nature study, photography, and other wildlife-associated activities. Resource management for hunting and fishing indirectly provides for wildlife-associated demands. Generally, if fish and game populations are sufficient to provide fishing and hunting opportunities, non-consumptive users will also be satisfied.

A large number of additional animals are not consumptively used by the public, but have enough intrinsic worth to be included in comprehensive studies. Nongame animals (rare and endangered species, songbirds, etc.) are either legally withheld from sportsmen, or their consumptive use is not socially accepted. These animals, in conjunction with animals taken by sportsmen, broaden the aesthetic and cultural appreciation of existing flora and fauna.

Rare and endangered animals are one category of nongame species. These animals have not been able to adjust to and endure environmental changes. They are now only present in limited numbers. Basin species considered rare and endangered are the American peregrine falcon, timber wolf, greater sandhill crane, northern greater prairie chicken, Indiana bat, and lake sturgeon. Special emphasis has been placed on identifying and preserving these species for future generations to enjoy. The distribution of rare and endangered species is illustrated in Figure L-12.

Several animal species in the basin could support far greater consumptive pressures. This animal category does not universally receive game status throughout the country or basin. They include the coot, crow, blackbird, dove, raccoon, and species of rough fish like the carp and sucker.

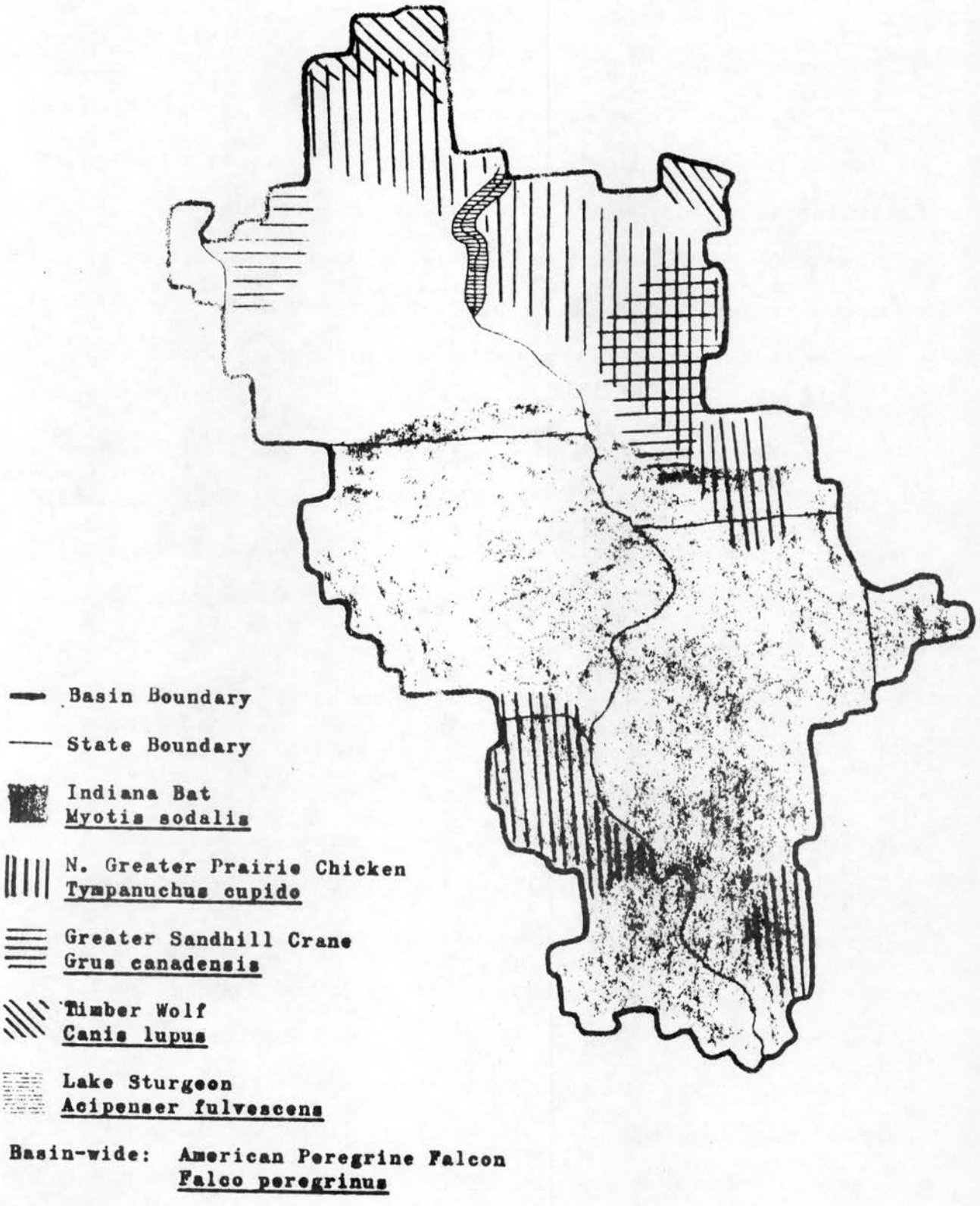


Fig. L-12. The Distribution of Rare & Endangered Species of Fish & Wildlife in the Upper Mississippi River Basin.

When the stigma attached to the harvest of these animals is overcome through more favorable public knowledge of these species, they will be accepted and provide new types of sport fishing and hunting.

Within any ecological community the animals and plants are dependent upon each other for food and cover. Every plant and animal contributes in some way to the balance of that community. Since plants and animals are so inter-related, all forms must be wisely managed to avoid a negative alteration of the community.

3.3 Resource Utilization, 1960

3.3.1 Types of Utilization

The desire to utilize fish and wildlife resources is termed demand. For purposes of this report, demand is separated into three categories: consumptive, non-consumptive, and latent.

Consumptive demand is the most obvious; it is expressed by those people who gain personal possession of a portion of the resource through hunting and fishing. Consumptive demand is also the most easily measured of the demand categories because most users are required to buy hunting or fishing licenses. In some states, however, certain people are not obligated to buy licenses, i.e., (1) those under a specified age; (2) those over a specified age; (3) the disabled; (4) active servicemen; (5) property owners; (6) American Indians; and (7) indigents. The present and future demand estimates expressed within Appendix L apply only to consumptive demand.

Non-consumptive demand refers to visual or scientific use of the resource. With this category of demand the resource generally is not

physically utilized. Birdwatching, wildlife photography, general nature study, sightseeing, and camping are some examples of non-consumptive demand. The enjoyment of observing wildlife and fish provides a considerable stimulus to most forms of outdoor recreation. Therefore, demands for nature-related outdoor recreation (Appendix K, Outdoor Recreation, UMRCBS) are closely integrated with non-consumptive demands for fish and wildlife. As previously stated, it is assumed that where resources are sufficient to support consumptive demand, non-consumptive users will also be satisfied.

Latent demand to hunt, fish, study, or otherwise utilize fish and wildlife resources is inherent in much of the total population, but is not fulfilled because of restrictions. These restrictions may be real or imaginary. They include lack of fish and game, lack of facilities; limited leisure time; lack of money, equipment, or ability; ill health, old age, or family ties; and other potential factors. Existing studies of latent demand are subjective and therefore questionable; they have failed to separate the truly restricted sportsman from the individual who expresses a pseudo-desire to hunt and fish. Latent demand is also regionally variable; generally it is of greater magnitude in urban areas where opportunities to hunt and fish are more limited.

Latent demand appears in two ways. The individual may not participate as many days per year as he desires, or he may not be able to participate in his specific activity at all. In either situation, he is exhibiting a form of latent demand.

Because of problems inherent in assessing latent demand on a regional basis, this factor was not considered in this report. It appears

that latent demand could be more easily and accurately measured where individual projects are being considered. The people within the project's area of influence are more homogeneous economically and socially, allowing the planner to have greater confidence in determining the latent demand of the immediate population.

3.3.2 Factors Affecting Consumptive Utilization

Demand for any hunting or fishing experience is a function of participants and participation. Participants, by definition, are those people in a given population who hunt or fish when provided with an opportunity to do so. Participation is the number of times an individual annually hunts or fishes. An understanding of the demand functions and the significant factors presently affecting them is necessary before probable future resource demands and responsive plans can be determined.

Hunting and fishing license sales are an index of the number of participants. License sales reflect actual use, are accurately tabulated, readily available, and are indicative of many factors that determine use. Fishing license sale data (Table L-7) and hunting license sale data (Table L-8) show that basin states experienced a rapid increase in sales from 1940 to the late 1950's. State sales following this period were somewhat variable; some states continued the previous trend, while others remained consistent with previous sales or began to decline.

Figure L-13 illustrates 1940, 1950, and 1960 license sales for five basin states in terms of total sales and sales as a percent of the total population. A portrayal of total license sales reflects the discussion in the previous paragraph. From 1940 to 1950, the percent of the population

Table L-7. Fishing License Sale Data for Fiscal Years 1942-1967, Upper Mississippi River Basin States

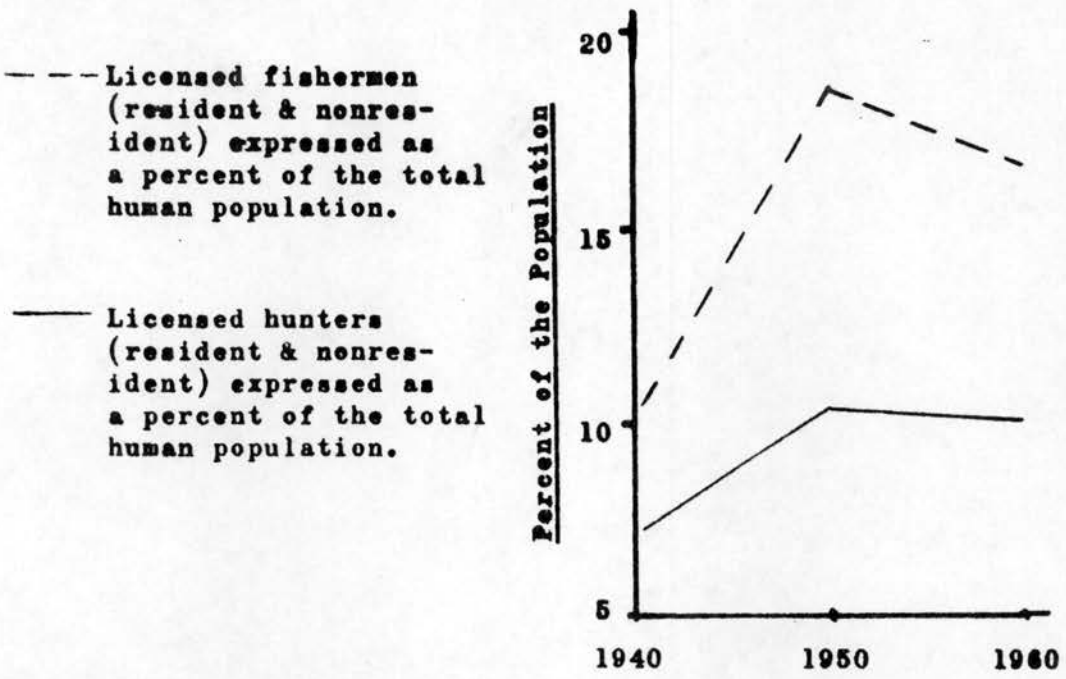
F.Y.	Ill.	Ind.	Iowa	Minn.	Mo.	S. Dak.	Wisc.
				License Sales (1,000's)*			
1942	447	520	233	581	350	55	412
1943	491	495	216	495	335	60	378
1944	452	461	202	419	337	61	352
1945	412	564	228	498	358	65	393
1946	560	534	322	628	527	81	518
1947	537	522	304	765	527	99	653
1948	682	575	334	843	571	120	844
1949	783	610	420	863	599	134	1,022
1950	693	579	352	915	595	139	971
1951	762	633	451	955	642	129	1,029
1952	751	546	393	931	654	134	1,039
1953	829	550	351	923	630	124	1,012
1954	789	618	404	1,337	565	128	1,082
				License Holders (1,000's)**			
1955	882	624	415	1,375	593	139	1,085
1956	740	844	381	1,233	565	141	1,012
1957	826	847	382	1,243	578	124	1,143
1958	814	835	398	1,410	669	127	1,112
1959	699	742	400	1,238	666	139	1,032
1960	685	770	385	1,404	662	143	1,031
1961	713	709	409	1,356	657	146	1,080
1962	701	754	414	1,288	691	148	1,060
1963	701	726	391	1,345	654	155	1,049
1964	690	748	415	1,362	701	184	1,107
1965	682	727	419	1,311	665	190	1,097
1966	695	689	404	1,312	704	195	1,052
1967	760	617	415	1,378	763	198	1,128

* Number of resident plus nonresident fishing licenses.
** Number of resident plus nonresident licensed fishermen.
Source: Division of Federal Aid, BSF&W.

Table L-8. Hunting License Sale Data for Fiscal Years 1942-1967, Upper Mississippi River Basin States

F.Y.	Ill.	Ind.	Iowa	Minn.	Mo.	S.Dak.	Wisc.
			License Sales (1,000's)*				
1942	343	401	232	296	215	109	328
1943	324	377	220	371	209	111	257
1944	268	342	190	332	201	93	292
1945	300	399	226	328	229	138	298
1946	326	381	300	356	315	204	306
1947	426	369	295	495	332	211	379
1948	418	392	269	346	303	149	381
1949	471	408	349	506	333	195	421
1950	503	393	339	480	336	173	460
1951	497	432	330	331	345	115	483
1952	501	390	346	515	349	151	636
1953	499	414	335	527	333	161	589
1954	525	430	352	481	287	164	594
			License Holders (1,000's)**				
1955	516	451	350	493	321	172	586
1956	529	680	374	525	362	169	616
1957	556	674	387	553	380	163	652
1958	513	664	351	509	402	154	625
1959	508	596	361	493	354	196	553
1960	497	621	325	430	373	179	536
1961	477	574	320	458	311	172	524
1962	469	608	308	473	333	209	442
1963	480	593	294	428	339	208	456
1964	490	609	315	461	368	229	482
1965	482	586	311	425	390	163	499
1966	459	490	283	394	356	140	576
1967	478	439	303	465	425	118	571

* Number of resident plus nonresident hunting licenses.
** Number of resident plus nonresident licensed hunters.
Source: Division of Federal Aid, BSF&W.



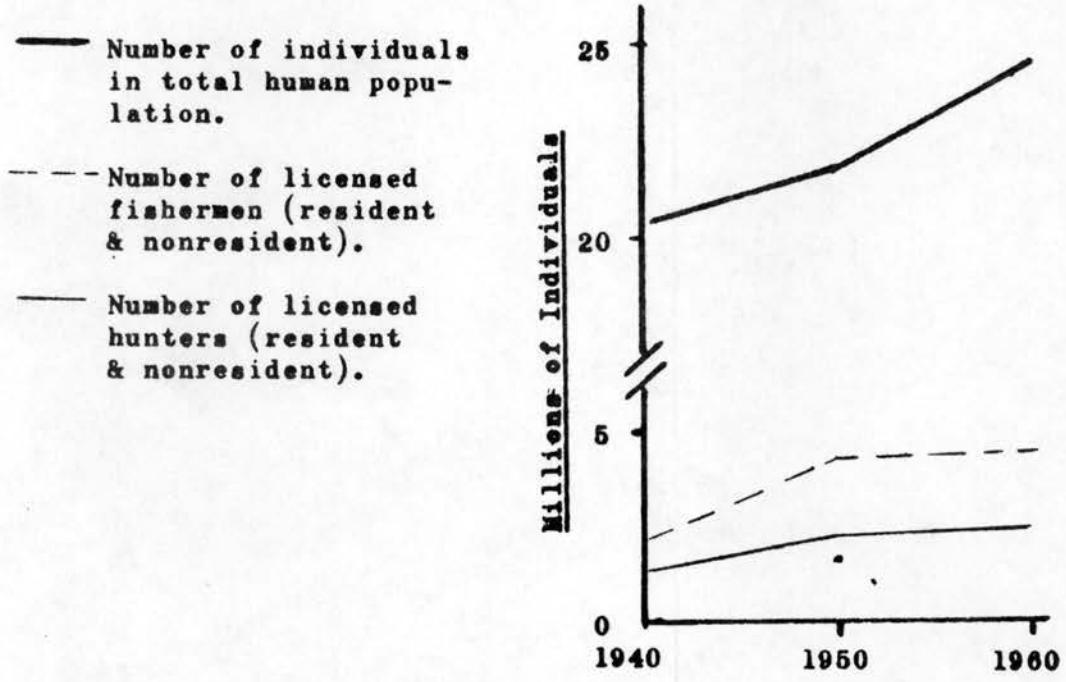


Fig. L-13. Trend in Hunting and Fishing License Sales in a Group of Five States (Minnesota, Wisconsin, Iowa, Illinois, and Missouri) from 1940 through 1960.

purchasing fishing licenses increased from 10.2 to 18.8% and those buying hunting licenses increased from 7.3 to 10.6%. This growth was not sustained from 1950 to 1960; fishing license sales as a percent of total population decreased from 18.8 to 16.9% and hunting license sales did not quite keep pace with population growth as they decreased from 10.6 to 10.2%. The decrease in percent of the population buying licenses began in about 1956 and has accelerated since the mid 50's.

The causes of license sale fluctuations are not easily identified. Yearly sales can be affected by weather conditions, legal restrictions, and by opportunity forecasts. For example, a percentage of northern deer hunters do not buy licenses when there is warm weather and a resultant lack of snow for tracking deer. Hunters are discouraged because of low success expectancy and potential meat spoilage.

Explanations for long-term fluctuation in license sales are exceedingly more complex. Illinois explained a decrease in their fishing license sales as follows:

> "The chief factor is a social change in recreation habits caused by rapid urbanization of the State's population. Urbanization has brought with it reduced access to fishing waters, recreational water-use conflicts, and poor water quality for fish habitat. These factors, coupled with the lack of an adequate promotional or educational program for fishing, have caused a substantial drop in license sales."[12]

Minnesota defined current and future problems affecting the hunter:

> "As our human population has increased and can be expected to continue to increase along with such associated human developments as homes, schools, highways, airports, and intensified farming, the amount of available habitat for certain species will continue to decrease and will result in a reduction of animal numbers. Certain species of wildlife, particularly waterfowl, have been exhibiting declines due to loss of potential habitat. Reduced bag limits and crowded hunting areas have served to reduce the number of hunters who engage in this recreational activity."[7]

These two explanations reflect factors which affect demand, and cause long-term fluctuations in license sales. Sales appear to be a result of resource attractiveness and the socio-economic profile of the population. Resource attractiveness includes availability of acceptable use facilities, diversity of species choice and quality, and the degree of success expectancy within the legal framework of bag and season limits. The socio-economic profile of the population, as it affects sales, includes an individual's health, age, expendable income, education, sex, leisure time, and distance from and acceptance of existing opportunity. An individual's demand for particular recreational activities is also strongly influenced by the desires of his peers.

Variations in resource attractiveness or in the population profile within the basin have a significant impact on participants and participation in hunting and fishing. For example, use facilities of the resource normally exist only where significant fish and wildlife occur; they are not necessarily located near human population centers. Those people of the metropolitan areas who want to hunt or fish, and will accept the product being offered at the facility, must have the money to cover license costs, specialized equipment, and associated goods or services connected with using the facility and obtaining the product. They must also have a mode of transportation and the time necessary to reach, enjoy and return from the facility. The utilization of the fish and wildlife resource by a segment of the population ultimately depends upon the strength of the consumers' desire to fish and hunt in relation to time and money necessary to participate. Normally, high-quality fish and wildlife experiences are high-priced, particularly to the urban dweller.

Public fish and wildlife agencies often try to maintain a resource variety at various geographic locations in order to meet many different demands. Many users of the resource are satisfied to have ordinary quality at a low price; as the price increases, however, a portion of users will shift to other recreational activities causing a decline in license sales. If price is held constant, but quality increases, license sales per capita are likely to increase. When both price and quality fluctuate at the same rate, increasing or decreasing together, the number of license sales will tend to level-off but the identity of the users may change. Those no longer buying licenses are replaced by other individuals who are willing and able to accept existing standards.

3.3.3 Consumptive Resource Use, 1960

Estimates of present hunting (Table L-16, Column 38) and fishing (Table L-16, Column 13) use were determined on 16 subbasin units. Subbasin 17, the Mississippi River Main Stem, has been incorporated into the subareas adjoining the River. Pressure applied to the existing Upper Mississippi River opportunities are generated from human populations adjoining the river; therefore, a demand-supply relationship is not present in subbasin 17.

In most cases, collection of resource data by subbasin counties was relatively uncomplicated. Some statistics not available on a county basis were extrapolated from more generalized data. Estimates of unlicensed participants and rates of participation were drawn from regional or national sources.

Participation by basin fishermen and hunters was based on data presented in several ORRRC reports,[8, 15] and the 1960 National Survey of Fishing and Hunting.[10] The 1960 angler participation rates were

determined by applying annual rates of 18 user days for the non-urban fishing population and 10 days for the urban population. Rates of 13 days and 9 days were used for non-urban and urban hunting populations, respectively, in estimating 1960 hunting participation rates. Urban and non-urban population separation was provided in Appendix P, Economic Base Study and Projections, UMRCBS.

The use of the resource by legally non-licensed individuals is a significant portion of total hunting and fishing demand. Because sub-basin variation in numbers of unlicensed hunters and fishermen was not available, an estimate of non-licensed sportsmen was derived from the 1965 National Survey of Fishing and Hunting.[11] To include the unlicensed sportsman, the licensed participants were increased by 50% for unlicensed anglers and 23% for unlicensed hunting. Total basin anglers and hunters in 1960 are presented by subarea in Table L-16, Columns 5 and 26.

3.3.4 Consumptive Resource Need, 1960

An inventory of 1960 opportunity and use serves two purposes in this report: (1) it reveals presently existing areas of insufficient hunting and fishing opportunity which could be benefited by immediate remedial management action; and (2) the inventory provides a base for projections of future needs.

The word "opportunity", as used in this report, is best defined as availability of lands or waters upon which hunting or fishing could be performed. Generally, opportunity also implies: (1) availability of fish and game stocks; and (2) the seasons and limits governing take. These latter implications are equally important to the full development of the resources. However, the hunter and fisherman benefits little

if he is denied access to lands and waters abounding in game and fish. Access is, therefore, also a direct function of opportunity.

Although methods used to determine sub-basin hunting and fishing pressure per acre of habitat were not totally consistent, comparative data analysis does provide an index of 1960 sub-basin need. License sales per capita and acres of habitat (opportunity) per capita also provide secondary indices of need in 1960. These indices are listed by subarea in Table L-9. The medians of these subarea indices were used as an intra-basin comparison of 1960 needs. A median index is often more indicative of actual conditions than the mean; means often overemphasize atypical sub-area conditions.

Where use per acre is above the median, and percentage license sales and habitat acres per capita are below the median, one may assume that needs for fishing and hunting were present in 1960. This condition existed in Subareas 5, 6, 8, 12, and 14 for sport fishing and in Subareas 4, 5, 6 and 8 for hunting. These areas were often those showing greatest needs in 1980 and thereafter. The methodology employed for post-1960 years permitted a more complete detailing of needs and their comparative magnitudes for the years 1980, 2000, and 2020.

3.3.5 Economic Importance of Consumptive Use, 1960

Several approaches for deriving monetary estimates of fish and wildlife recreational values are available which have a degree of practical application and probable reliability.

Expenditures by fishermen and hunters for goods and services used in connection with fishing and hunting activities have frequently been used as a basis for assigning monetary values to fish and wildlife. Such

expenditures have been used as a basis for attaching a value to fish and game yield or as a measure of the value of each visit or user-day.

Expenditures normally used in this approach consist of the amount of money spent for goods and services (special equipment, food, lodging, and transportation) that may be directly attributed to fishing and hunting activities. Adjustments are usually made to reflect only the increased costs of fishing and hunting; for example, allowances are made for the cost of food that would have been consumed at home had the fishing or hunting trip not been taken.

Data on expenditures by fishermen and hunters have been assembled for many years by the Bureau of Sport Fisheries and Wildlife and the various State fish and game departments in the basin. The National Survey of Fishing and Hunting, conducted by the Bureau of Sport Fisheries in 1955,[9] 1960, [10] and 1965, [11] is a source of consolidated information. National expenditures of freshwater fishermen and of persons who hunted in 1960 [3] are presented in Table L-10. In 1960, freshwater fishermen in the United States spent an average of $95.25 for fishing expenditures while hunters spent an average of $79.34 annually for their recreational activity.

By applying the 1960 National Survey [10] expenditure figures to the basin's 1960 hunting and fishing population, estimates of basin expenditures were derived (Table L-11). The 1960 totals were 412 million dollars for fishing and 150 million dollars for hunting. About 41% of total fishing expenditures and 28% of all hunting expenditures were generated from sub-basins 1, 2, and 3 in northern Minnesota and Wisconsin. Hunting and fishing coupled with associated recreational activities in these three sub-basins are responsible for a tourist industry which is the backbone of local economies.

Table L-9. Indices of 1960 Hunting and Fishing Needs, Upper Mississippi River Basin

Fishing				Hunting			
Sub-area	Use per Acre	% License Sales per Capita	Habitat Acres per Capita	Sub-area	Use per Acre	% License Sales per Capita	Habitat Acres per Capita
1	9.7	38.8	0.56	1*	0.19	12.7	7.7
2	9.2	43.3	0.65	2	0.11	22.4	25.6
3	9.2	46.8	0.66	3*	0.16	20.0	15.2
4*	17.8	14.3	0.12	4**	0.15	8.6	6.9
5**	36.1	6.7	0.03	5**	0.26	4.4	1.9
6**	23.7	10.4	0.07	6**	0.16	8.6	6.1
7*	8.8	14.3	0.26	7*	0.16	11.9	8.3
8**	45.2	8.3	0.03	8**	0.26	5.6	2.4
9	18.5	17.7	0.17	9	0.09	12.9	17.7
10*	8.2	11.9	0.25	10*	0.04	9.7	28.9
11*	40.8	16.2	0.07	11*	0.13	11.7	10.7
12**	44.4	14.9	0.06	12	0.11	11.8	12.9
13*	50.8	15.7	0.05	13*	0.14	11.6	10.1
14**	19.5	14.8	0.13	14	0.12	11.8	11.6
15*	27.1	28.4	0.18	15	0.12	12.8	13.0
16	12.1	40.2	0.56	16	0.08	14.2	23.2
Basin Median	19.0	15.3	0.15		0.14	11.8	11.2

* Average Needs in 1960.
** Above Average Needs in 1960.

Expenditures of Fresh-Water Fishermen in 1960

The total number of fresh-water fishermen (12 and over) in the United States was 21,677,000.

Expenditure item	Number of spenders	Percent of all fresh-water fishermen	Total spent	Average spent per fisherman
	Thousands		*Thousands*	
United States total	20,756	95.8	$2,064,680	$95.25
Food and lodging:				
Food	11,560	53.3	152,025	7.01
Lodging	2,288	10.6	49,378	2.28
Transportation:				
Automobile	18,350	84.7	301,470	13.91
Bus, rail, air, and water	107	.5	1,345	.06
Auxiliary equipment:				
Boats and boat motors	1,942	9.0	584,550	26.97
General	4,201	19.4	216,635	9.99
Fishing equipment	13,380	61.7	234,380	10.81
Licenses, tags, and permits	13,404	61.8	49,170	2.27
Privilege fees and other:				
Annual lease and privilege fees	555	2.6	8,341	.39
Daily entrance and privilege fees	2,247	10.4	31,166	1.44
Bait, guide fees, and other trip expenses	13,518	62.4	390,470	18.01
Boat launching fees	784	3.6	9,723	.45
Other	3,227	14.9	36,033	1.66

Expenditures of Persons Who Hunted in 1960

The total number of hunters (12 and over) in the United States was 14,637,000.

Expenditure item	Number of spenders	Percent of all hunters	Total spent	Average spent per hunter
	Thousands		*Thousands*	
United States total	14,294	97.7	$1,161,242	$79.34
Food and lodging:				
Food	6,461	44.1	78,252	5.35
Lodging	918	6.3	27,391	1.87
Transportation:				
Automobile	12,501	85.4	159,987	10.93
Bus, rail, air, and water	54	.4	8,379	.57
Auxiliary equipment:				
Boats and boat motors	159	1.1	121,423	8.30
General	3,875	26.5	95,631	6.53
Hunting equipment	11,450	78.2	355,464	24.29
Licenses, tags, and permits:				
Licenses, tags, and permits	10,606	72.5	58,098	3.97
Duck stamps	1,526	10.4	4,575	.31
Privilege fees and other:				
Annual lease and privilege fees	387	2.6	10,500	.72
Daily entrance and privilege fees I[1]	191	1.3	7,067	.48
Daily entrance and privilege fees II[2]	382	2.6	8,058	.55
Bait, guide fees, and other trip expenses	986	6.7	37,091	2.53
Dogs	2,298	15.7	158,908	10.86
Other	2,044	14.0	30,418	2.08

[1] Daily fees for hunting on commercially operated preserves.
[2] Daily fees for hunting on wild lands.

L-48

Table L-10. **Expenditures of Hunters and Fresh-water Fishermen in the United States for 1960 (adapted from the 1960 National Survey of Fishing and Hunting, U.S.D.I.).**[10]

Table L-11. Expenditures by Hunters and Fishermen in the Upper Mississippi River Basin, 1960 [1/]

Subarea	Total Fishermen [2/] (1,000's)	Total Expenditures (1,000's $)	Total Hunters [3/] (1,000's)	Total Expenditures (1,000's $)
1	1,207.5	115,014	323.4	25,659
2	202.5	19,288	86.0	6,823
3	351.0	33,433	122.8	9,743
4	280.5	26,718	138.5	10,989
5	909.0	86,582	490.3	38,900
6	111.0	10,573	75.4	5,982
7	48.0	4,572	32.7	2,594
8	231.0	22,003	128.2	10,171
9	43.5	4,143	26.0	2,063
10	12.0	1,143	8.0	635
11	205.5	19,574	121.8	9,664
12	49.5	4,715	32.0	2,539
13	181.5	17,288	110.7	8,783
14	105.0	10,001	68.6	5,443
15	117.0	11,144	43.0	3,412
16	267.0	25,432	77.1	6,117
Total	4,321.5	411,623	1,884.5	149,517

1/ In 1960, the nationwide average annual expenditure was $95.25 per freshwater fisherman and $79.34 per hunter according to the 1960 National Survey of Fishing and Hunting, U.S.D.I. [10]

2/ Includes resident, nonresident, licensed and unlicensed fishermen.

3/ Includes resident, nonresident, licensed and unlicensed hunters.

Expenditures, in most instances, represent only a partial picture of the actual values of fish and wildlife. Some costs, such as expenditures of the sportsman's free time, energy, and pre-season preparation, cannot be measured in dollars. Secondary contributions to local economies through jobs and monies accrued by sales and services to sportsmen, supplement expenditures previously considered.

The monetary values derived under the expenditure approach do not supply adequate data on the relationship of total expenditures to the value of specific hunting and fishing opportunities. For goods and services such as hunting and fishing that are provided as a public service, evaluation of the product (species quality and acceptability) and existing facilities (access and environmental attractiveness) are essential if a dollar value is to be equated with existing economic market prices. Demand or economic impact studies have questionable value when not tied to the pricing system.

Admittance fees and user charges are payments made for the privilege of using recreational opportunities. These payments at recreational areas are evidence that there is a demand for the recreational opportunities or services provided, and that the users are willing to pay a price for such services. Such fees or charges at privately and publicly operated facilities are equated to market prices and have therefore become a feasible monetary measure in evaluating economic importance of recreation.

Fees have been established to cover both the use of the basic resource as well as varying amounts of services. These services may be limited, including only picnic tables, water, and sanitary facilities, or they may be extensive and include meals, lodging, equipment, guides, and a

guaranteed quantity of fish or game. Privately-operated areas are designed for owner profit, while such charges at public areas provide revenues to help meet operation and maintenance costs.

Wide ranges in prices charged, because of varying types of services provided, have presented difficulties in establishing net recreational values from unrefined fee or user charge data. Although this approach has future potential for supplying reliable data, procedural refinements are necessary before it can be used as a reliable monetary estimate of fish and wildlife values.

The existing monetary evaluation of fish and wildlife by the Federal Government is based on an interim schedule of values supplied in Supplement No. 1 to Senate Document No. 97, 87th Congress. These user-day unit values (Table L-12) are based on available sources of applicable information, experience, and judgment. Use of the price schedule is required by Federal agencies until improved data become available.

The need for monetary estimates covering fish and wildlife resulted with the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). Section 2 (f) of this Act requires that reports submitted to the Congress recommending water use projects or units for authorization include an estimation of the fish and wildlife benefits and losses and the part of the cost of joint-use facilities allocated to fish and wildlife.

Table L-12. Interim Schedule of Dollar Values Used by the Federal Government in Determining Hunting and Fishing Benefits on Water Development Projects

Form of Recreation	
Fishing	
Reservoir	0.50 to 1.50
Stream or Lake	
Warm Water	0.50 to 1.50
Cold Water	1.00 to 3.00
Hunting	
Small Game	
Mammals	0.50 to 1.50
Birds	1.50 to 4.50
Waterfowl	1.50 to 4.50
Big Game	
Deer and Antelope	1.50 to 4.50
Other	2.00 to 6.00

Fish and wildlife benefits (or losses) due to project development are estimated in terms of user-days gained (or lost). Gains are multiplied by the unit value assigned to quality or quantity of fish and wildlife present prior to the project as compared to the volume of sport fishing and hunting anticipated with the project. When a project is constructed in an area already rich in fish and wildlife, the project may not benefit the resource; inundation of a particularly desirable and heavily-used stream fishery by a project may be harmful. Conversely, if a project is constructed in an area which has sparse resources, fish and wildlife, and the sportsman, are frequently benefited by project construction.

Selection of values within the price range depends on specific developments and takes into consideration: (1) extent of fishing and hunting pressure in the general area of the project; (2) availability and quality of alternative fishing and hunting opportunities in the area; (3) volume of use anticipated as related to optimum capacity and conflicting purposes of the project; and (4) attractiveness of the environment surrounding the project.

The attachment of dollar values to fish and wildlife and the environment they inhabit is a relatively new science. Greater coordinated efforts between economists and conservationists are necessary to insure proper economic evaluation of this important and irreplaceable resource. If dollar values should continue to be the primary planning index, the resource's actual worth must be correctly evaluated in competitive economic terms.

Section 4

FUTURE DEMANDS FOR FISH AND WILDLIFE

Traditionally, resource planning has developed on a three-phased approach: (1) an inventory of physical and biological resources; (2) an estimation of future demands on these resources; and (3) a plan of development to satisfy the demand. The rationale of the approach and methods of providing the needed information have varied from study to study, but these elements are usually present. These three basic elements may be found in Sections 3, 4, and 5, respectively, of this report.

In this study the "user-day" was chosen as the index of the comparative need. The plan simply weighs user-days provided by the existing conditions, and those supplemented by acquisition or construction of proposed fish and wildlife facilities, against the number of user-days required. These plans are based on several premises; a major assumption is that the necessary lands and waters acquired and made available to the public will be managed to provide the stock of fish and game required to sustain the increased demands for hunting and fishing.

In the development of a model which would accurately project future demands for hunting and fishing, the approach was limited to those factors which were judged "significant determinants" and were quantified in some available reference. Of those factors which were numerically represented, many were not comparable from state to state or within states. As a result, this study could not consider all pertinent factors which might influence the future demands for fishing and hunting experiences (see 3.3.2, Factors Affecting Consumptive Utilization). Also, it became

evident that the integrity of our projective methodology depended to a great extent on the assumption that current relationships between significant variables would remain constant throughout the years covered by the projections. Because this assumption is obviously subject to error, projections further into the future should be viewed with the knowledge of this inherent problem. However, since a projection is a forecast based on a number of basic assumptions, data presented should be revised as future conditions invalidate certain assumptions.

To take full advantage of the flexible quality of projections, the reader should have knowledge of the basic assumptions and their effect upon the developed methodology. A sample subarea has been taken through the appropriate calculation procedures (Supplement 1) to facilitate an understanding of the methodology discussed in this Section.

4.1 Population

The projection of the need for fish and wildlife must be based on some estimate of future demands for fish and wildlife. These demands are, obviously, in a very fundamental sense, a function of the size and distribution of the basin's future population. Estimates of population growth were determined in the Economic Base Study, Appendix P, UMRCBS, and appear in this report in Table L-16, Columns 2, 3, and 4. The basin population is projected to increase 150 percent (19.3 million to 48.2 million) from 1960 to 2020.

The geographic distribution of the population will also affect demand. Projections of future population distribution in Appendix P reveal an increasing trend toward urbanization. The typical rural or farm population will continue to decrease in the future. In 1960, 10% of the total basin

population was considered farm population, while in 2020 the farm population is expected to drop to two percent of the total (Table L-13).

This knowledge of the relative urban-rural population relationships is vital for estimating future demands for hunting and fishing. Fishing, and particularly hunting, have historically been basic recreation to rural-oriented populations. For example, all adults (18 years of age and older) who live in standard metropolitan Statistical Areas with population over one million, hunt an average of 0.25 trips per year; but adults living in rural or farm areas hunt 4.43 trips per year [5], a ratio, rural to urban, of about 18 to 1.

There are fundamental sociological problems associated with using the Bureau of Census' definition of an urban population (incorporated places of 2,500 or more) as reflecting normal urban character. For example, a town of 4,500 located in a comparatively uninhabited area has few urban characteristics which would moderate the inhabitant's traditional desire to hunt or fish. Conversely, residents of unincorporated villages of less than 2,500 on the fringe of a large metropolis, will likely be urban oriented. Population densities, expressed as population per square mile, remove these potential misinterpretations and provide a greater degree of comparability between socially homogeneous areas. Therefore, population densities (people per square mile) were used in this study as a basic factor in projecting future demands for hunting and fishing. Population densities were projected to increase from a mean basin figure of 102 people per square mile in 1960, to 138 in 1980, 187 in 2000, and ultimately 255 people per square mile throughout the basin in 2020.

evident that the integrity of our projective methodology depended to a great extent on the assumption that current relationships between significant variables would remain constant throughout the years covered by the projections. Because this assumption is obviously subject to error, projections further into the future should be viewed with the knowledge of this inherent problem. However, since a projection is a forecast based on a number of basic assumptions, data presented should be revised as future conditions invalidate certain assumptions.

To take full advantage of the flexible quality of projections, the reader should have knowledge of the basic assumptions and their effect upon the developed methodology. A sample subarea has been taken through the appropriate calculation procedures (Supplement 1) to facilitate an understanding of the methodology discussed in this Section.

4.1 Population

The projection of the need for fish and wildlife must be based on some estimate of future demands for fish and wildlife. These demands are, obviously, in a very fundamental sense, a function of the size and distribution of the basin's future population. Estimates of population growth were determined in the Economic Base Study, Appendix P, UMRCBS, and appear in this report in Table L-16, Columns 2, 3, and 4. The basin population is projected to increase 150 percent (19.3 million to 48.2 million) from 1960 to 2020.

The geographic distribution of the population will also affect demand. Projections of future population distribution in Appendix P reveal an increasing trend toward urbanization. The typical rural or farm population will continue to decrease in the future. In 1960, 10% of the total basin

population was considered farm population, while in 2020 the farm population is expected to drop to two percent of the total (Table L-13).

This knowledge of the relative urban-rural population relationships is vital for estimating future demands for hunting and fishing. Fishing, and particularly hunting, have historically been basic recreation to rural-oriented populations. For example, all adults (18 years of age and older) who live in standard metropolitan Statistical Areas with population over one million, hunt an average of 0.25 trips per year; but adults living in rural or farm areas hunt 4.43 trips per year [5], a ratio, rural to urban, of about 18 to 1.

There are fundamental sociological problems associated with using the Bureau of Census' definition of an urban population (incorporated places of 2,500 or more) as reflecting normal urban character. For example, a town of 4,500 located in a comparatively uninhabited area has few urban characteristics which would moderate the inhabitant's traditional desire to hunt or fish. Conversely, residents of unincorporated villages of less than 2,500 on the fringe of a large metropolis, will likely be urban oriented. Population densities, expressed as population per square mile, remove these potential misinterpretations and provide a greater degree of comparability between socially homogeneous areas. Therefore, population densities (people per square mile) were used in this study as a basic factor in projecting future demands for hunting and fishing. Population densities were projected to increase from a mean basin figure of 102 people per square mile in 1960, to 138 in 1980, 187 in 2000, and ultimately 255 people per square mile throughout the basin in 2020.

Table L-13. Farm and Non-farm Populations in the Upper Mississippi River Basin for 1960 and 2020*

	1960	2020
Farm Population (1,000's)	1,984	965
Percent of Total	10%	2%
Non-farm Population (1,000's)	17,333	47,265
Percent of Total	90%	98%
Total Population (1,000's)	19,317	48,230

*Adapted from UMRCBS, Appendix P, Draft No. 2, Part I, Table 5. The "farm population" was derived from data on farm employment developed by the Economic Research Service.

The general change from a rural-agricultural to an urban-industrial society will bring about new attitudes affecting recreational demand for hunting and fishing.

4.2 Demand

Annual demand by hunters and fishermen is a function of the numbers of participants in that particular year and their annual rate of participation. Forecasting of demand involves projecting both the number of participants and their rate of participation as defined by projected values of correlated factors. The result of these two factors is termed demand and is expressed in man-days of use.

4.2.1 Participants

The number of hunters and fishermen projected to use the resource in the basin is a composite of licensed and unlicensed sportsmen.

Licensed participants include both resident and non-resident individuals. Resident license sales, by county, for the base year were totaled and adjusted for each planning subarea. Adjustments were necessary to avoid duplication of a licensee who may have bought more than one type of license (big game, small game, trapping, etc.) during the season. Non-resident license sales were also available on a county basis. The methodology assumes that the ratio of non-resident license sales in a particular subarea will remain reasonably constant to the resident sales of that subarea over the projective interim.

Many individuals in the basin do not need a license to hunt or fish. Those who are legally exempted from buying licenses were discussed in Section 3.3.1 of this report. Methods for estimating the number of unlicensed sportsmen were discussed in Section 3.3.3.

License sales are indicative of the sum of many factors that determine demand. By identifying these factors, ascertaining which ones are represented by quantitatively available data, and then relating the data to projected populations, estimates of future license sales can be determined.

Quantitative data available for the basin reflected an inter-relationship between sub-basin license sales, the amount of hunting or fishing space (acres per capita) available in a sub-basin, and sub-basin population densities. The correlation coefficients (r) were significant at the 95% level of probability for the relationship between fishing license sales per capita and population per square mile, and significant at the 99% level for fishing license sales per capita and acres of fishing water per capita. Hunting license sales per capita were significant at the 99% levels or probability for both population per square mile and potential acres of hunting lands per capita. The two independent variables, sub-basin population density and acres of habitat per capita, accounted for nearly 88% of the variation in fishing license sales per capita and approximately 53% of the variation in hunting license sales per capita in 1960.

Other factors likely to affect hunting and fishing (social or economic status of the users and availability, convenience, and diversity of special opportunities) were not tested to ascertain their affect on license sales. These factors were not numerically represented, comparable within the basin, or specific to the basin; or they did not show evidence of strong correlative potential with license sales. Among these factors was the necessary information to determine much of the remaining un-accounted for variability. Therefore, a discussion of some of the potential variables affecting hunting and fishing demand follows.

Personal income of basin residents is expected to increase from an average of $2,431 in 1960 to $10,192 in 2020. Substantial ranges in basin per capita income will depend upon ranges of education, age, and occupation. Mueller and Gurin [8] stated that fishing and hunting participation showed no clear increase with rising income. This was particularly interesting, because these two activities require more expense than do hiking, picnicking, and nature and bird walks, which entail minimal expense, but increase in participation frequency with income. Education generally showed a strong relationship with general outdoor activity; those having more years of education participated less than those who were high school graduates, indicating that an upper threshold was established at approximately 12 years of schooling. With changing education patterns expected during the projection years, and education being reflected in part by age and income differences, this study could not justifiably use this factor as an accurate indicator of future hunting and fishing demands.

Participation by the potential outdoor recreationist (all outdoor activities) appeared to be greater for those in higher status occupations, but this was due in a large part to three related factors--income, education, and length of paid vacation.[8] The magnitude of expected increased leisure time was projected by the Department of Labor in 1961.[14] Their 1960, 1976, and 2000 estimates for average weekly hours worked were 38.5, 35.4, and 30.7 respectively; and average annual holidays were 6.3, 8.5, and 10.1, respectively. It can be expected, however, that many people, especially urban dwellers who are given additional leisure time without increased fish and wildlife opportunities, will increase their

participation in their present favorite recreational activities and not branch out into hunting and fishing activities.

After consideration of factors shown to be related to participation in various outdoor recreational pursuits, the inter-relationship between license sales, areas of locally available opportunity, and population densities appeared to provide the best available method for determining future license sales as a function of projected population. An estimate of the number of future licensed fishermen and hunters, by subarea, was determined by applying per capita subarea license sale factors to subarea population densities. Multiple regression equations relating 1960 subarea opportunity and subarea population densities to license sales were developed. Each computed 1960 subarea license sales per capita factor was adjusted as it deviated from the known 1960 per capita license sale, to partially account for various unknown determinants specific to each particular subarea. We assumed that these random elements will remain constant and that their effect on "Y" will remain nearly the same over the projection years. Adjustment factors were not large, but were thought to provide increased accuracy when applied to 1980, 2000, and 2020 determinations.

The regression formulas are:

FISHING:

$$Y = 10.25 - 0.0156x_1 + 51.66x_2 \qquad (1)$$

HUNTING:

$$Y = 12.39 - 0.029x_1 + 0.148x_2 \qquad (2)$$

WHERE:

Y = licensees as a percent of subarea population
X_1 = population per square mile
X_2 = acres of habitat per capita

The projected licensed participants were increased by factors representing non-licensed individuals; 50% for fishing and 23% for hunting. Total (licensed and unlicensed) anglers and hunters for the projection years appear in Table L-16, Columns 6, 7, 8, 27, 28, and 29. These figures do not include a total assessment of latent demand because of the difficulty of accurately determining this nebulous factor. However, when considering particular projects within the basin in future years, the demand generated by a particular development will be considered and accounted for. Origin and destination data between the Upper Mississippi River Basin and other basins, and within Upper Mississippi River Basin subareas, were not available unless the sportsman crossed a State-line and was required to purchase a non-resident license. Those participants crossing subarea lines within a particular state could not be identified from summarized license data. In this situation, ingress-egress travel patterns between these hydrologic boundaries were considered equal.

4.2.2 Participation Rate

Derivation of average annual hunter and fisherman participation rates, by subarea, was discussed in Section 3.3.3 (Consumptive Resource Use, 1960) of this report. These data were formulated on the basis of the urban-rural characteristics of the population (Table L-14). Future participation rates expressed in the table show a declining trend for both hunters and fishermen because of the expected continued urbanization of all subareas.

Table L-14. Average Annual Participation, 1960-2020

Year	User-Days per Year			
	Urban Fishermen	Non-urban Fishermen	Urban Hunters	Non-urban Hunters
1960	10.0	18.0	9.0	13.0
1980	9.3	16.7	8.1	11.7
2000	8.6	15.5	7.3	10.3
2020	8.0	14.4	6.6	9.6

To determine projected demand for the target years 1980, 2000, and 2020, the projected 1980 hunter and sport fisherman participation rates for each subarea were assessed against each subarea's projected 1980, 2000, and 2020 participants. Subarea demands and the total basin demand are expressed as angler and hunter days (Table L-16, Columns 14, 15, 16, 39, 40, 41) and as water and land acreages (Table L-16, Columns 17, 18, 19, 42, 43, 44).

Demand for fishing in the Upper Mississippi River Basin is expected to increase from 43.4 million angler days in 1960 to 47.9 in 1980 (10%); 52.1 in 2000 (20%); and by 2020, demand is estimated to be 57.4 million angler days or a 32% increase when compared to 1960 angler demand (Figure L-14).

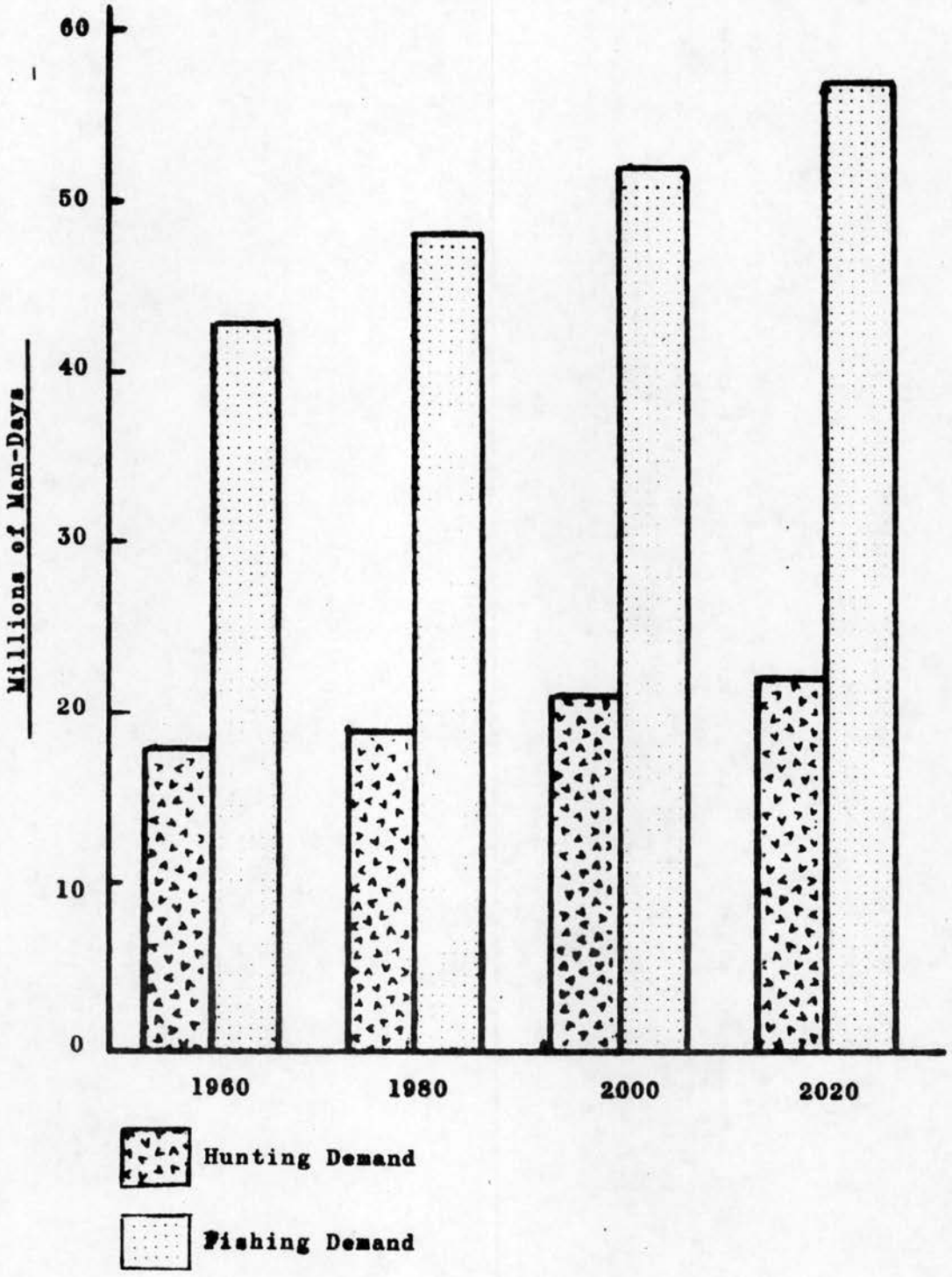


Fig. L-14. Total Demand for Hunting and Fishing (Millions of Man-Days) in the Upper Mississippi River Basin.

Basin hunting demand was estimated to be 18.0 million hunter-days use in 1960. Demand is expected to increase to 19.5 million days-use by 1980 (8%); 20.9 by 2000 (16%); and ultimately to 22.2 million hunter-days by 2020, an increase of 23% when compared with 1960 gross hunter demand (Figure L-14).

4.3 Need

Net needs are projected when estimated demand exceeds projected supply, and are most accurately expressed in user-days.

A prerequisite to estimating future need is the determination of future supply. Construction and management plans of resource-oriented agencies were drawn from their planning documents. Definite water development plans were seldom available for post-1980 years. Those developments constructed or presently authorized are listed in Table L-15 and have been included in the 1980 fishing water acreage estimates, Table L-16, Column 10. Estimates of water developments beyond 1980 were not established. Information on projected land use changes were provided by the Economics Research Service of the U. S. Department of Agriculture. These projections determined potential lands available for future game populations by indicating shifts or reduction in land use categories. Those decreases of potential hunting acres represented in Table L-16, Columns 31, 32, and 33 are a result of the conversion of agricultural acreages to urban usage.

Thus, the angler is normally provided with ever increasing acreages of impounded water through construction programs. Impoundments, however, are usually gained at the expense of fishable stream habitat and inundated

wildlife habitat. Greater acreages of lands supporting wildlife are consumed by urban sprawl, highways, more intensive agricultural practices, and other practices of a burgeoning population.

Near future (1980) needs for hunting and sport fishing were determined by subtracting the 1960 use from the projected 1980 demand. Hunting opportunity foregone through land use changes during the interim 1960-1980 was added to the difference; fishing opportunity gained through water developments was subtracted from the difference. Hunting and sport fishing needs for 2000 and 2020 were determined using nearly the same method as was used for 1980. Thus, 2000 and 2020 needs were a function of the demand changes in the interim years (1980-2000 and 2000-2020) plus the needs existing from the previous target year (if any), and in considering hunting needs, the effects of land use changes on opportunity and use.

It is estimated that the sport fishing needs for various subareas (Table L-16, Columns 20, 21 and 22) will be of greater intensity near urban population centers by the target years (Figures L-15, 16, and 17). Estimates of additional acres required to satisfy subarea fishing needs are presented in Table L-16, Columns 23, 24 and 25.

Subarea hunting needs are also generally located near urban centers (Figures 18, 19, and 20). Needs are presented in user-days (Columns 45, 46, and 47) and acres (Columns 48, 49, and 50) in the Compendium Table L-16.

Table L-15. Preliminary Angler Use Estimates for Developments Constructed or Authorized during the Interim 1960-1968

Subarea	Number of Impoundments	Total Acres of Water	Preliminary Angler-Day Estimates
1	4	576	15,275
2	10	1,701	40,495
3	15	3,562	66,525
4	9	1,567	78,985
5	12	12,516	239,245
6	8	62,069	474,380
7	2	2,770	46,090
8	19	18,458	322,260
9	9	17,700	203,990
10	5	823	40,295
11	8	25,693	294,920
12	3	2,200	47,400
13	9	10,045	168,150
14	6	1,500	56,500
15	0	0	0
16	1	1,900	16,720

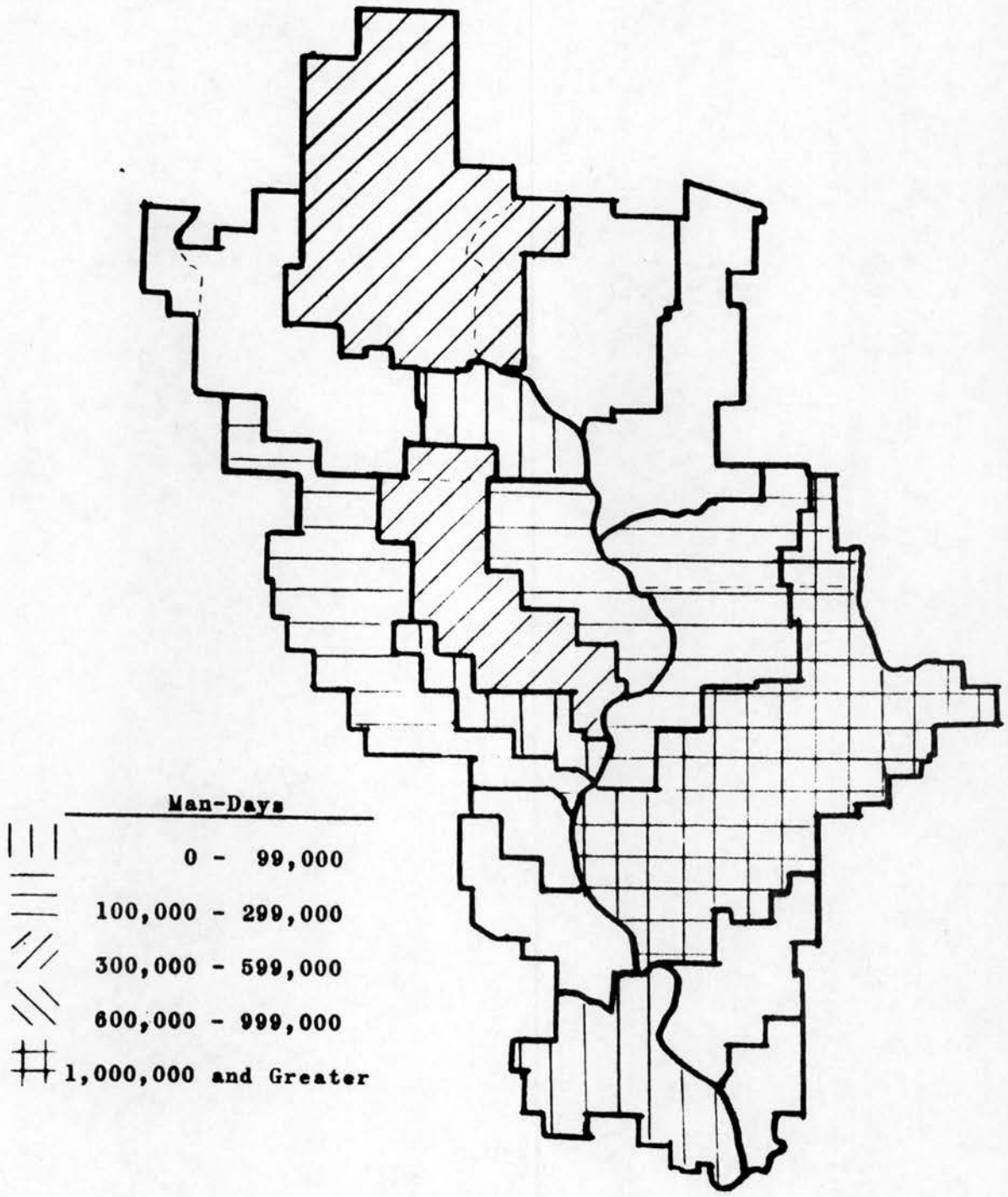


Fig. L-15. Net Man-Day Needs for Fishing by 1980 in the Upper Mississippi River Basin.

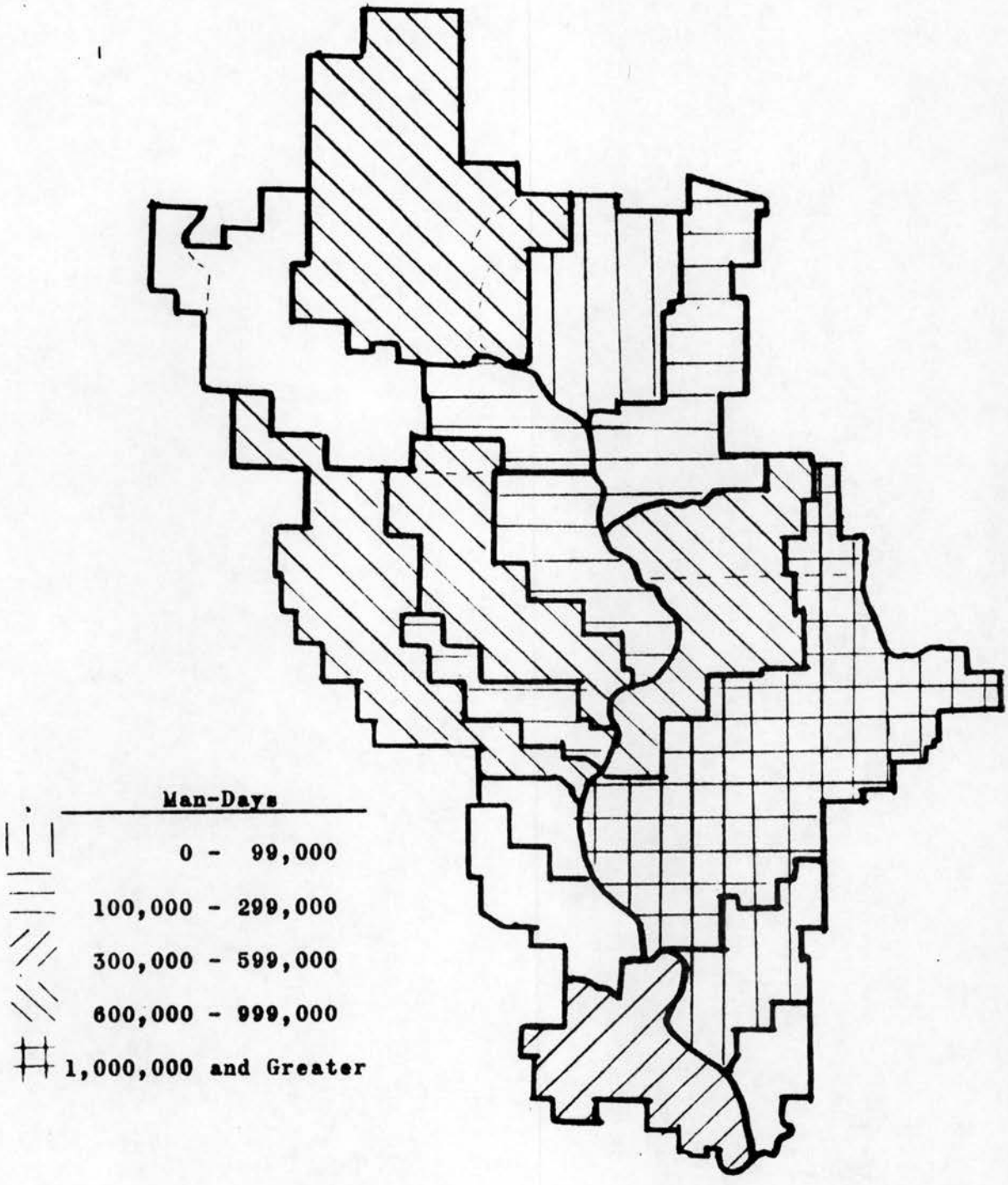


Fig. L-16. Net Man-Day Needs for Fishing by 2000 in the Upper Mississippi River Basin.

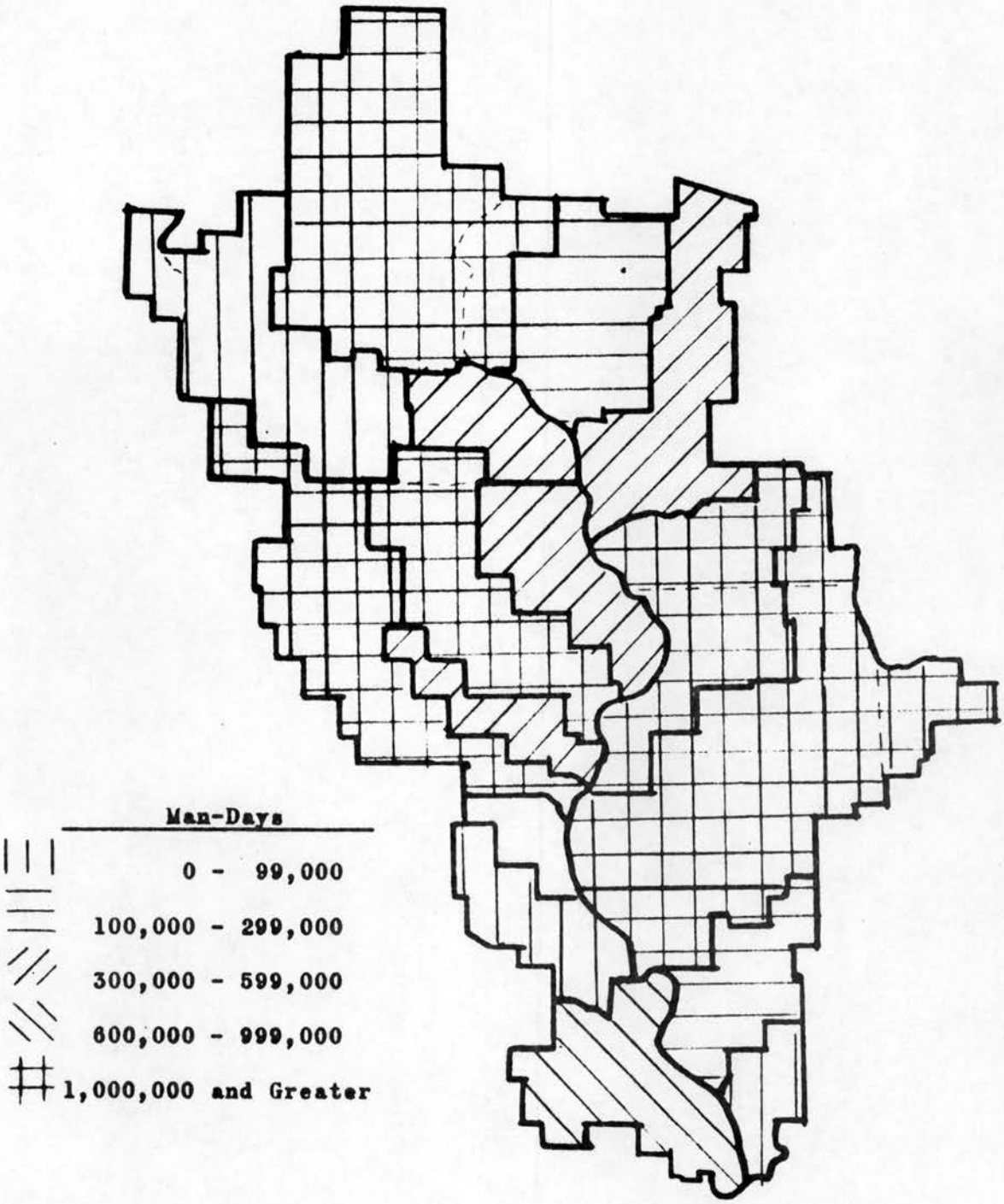


Fig. L-17. Net Man-Day Needs for Fishing by 2020 in the Upper Mississippi River Basin.

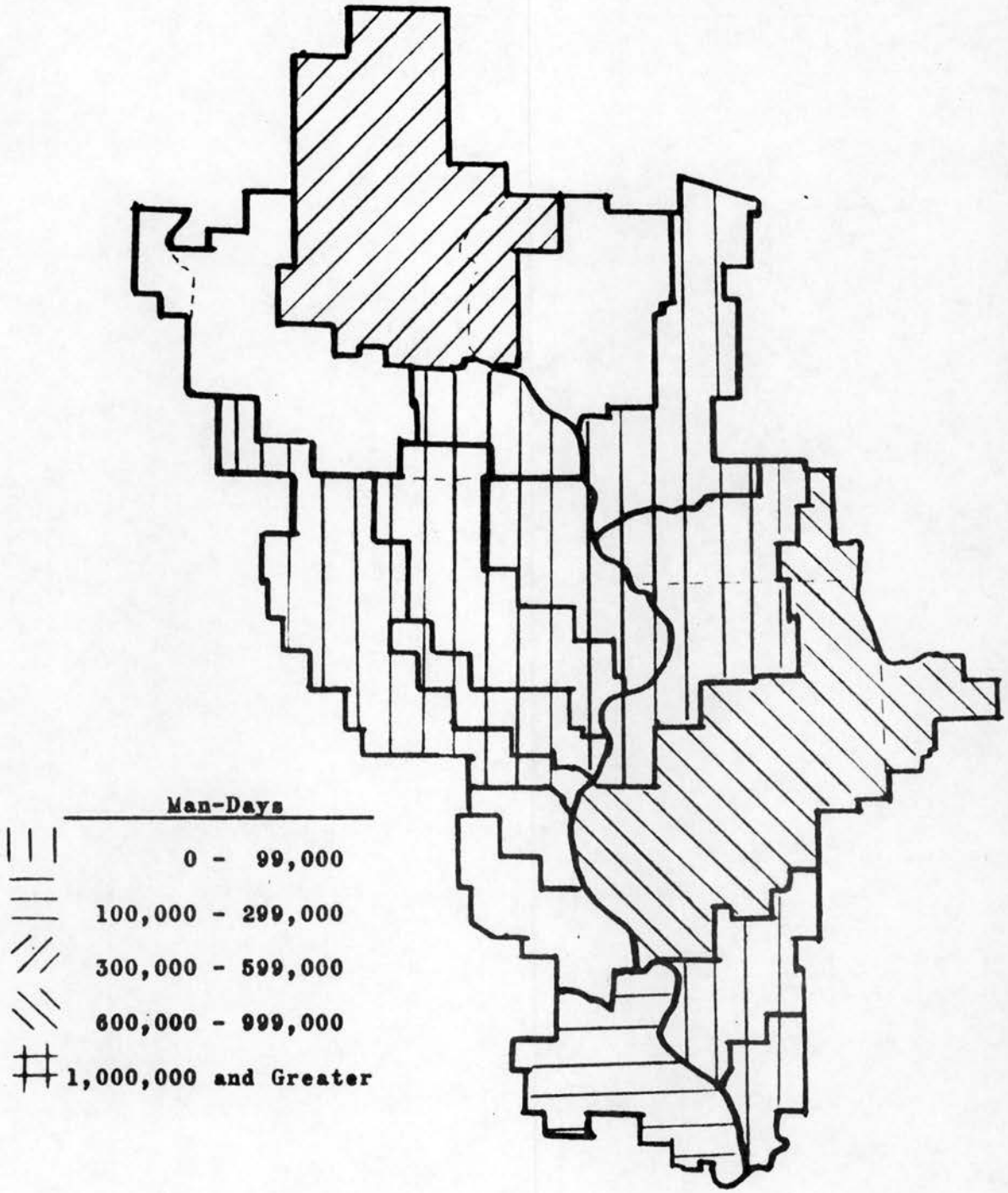


Fig. L-18. Net Man-Day Needs for Hunting by 1980 in the Upper Mississippi River Basin.

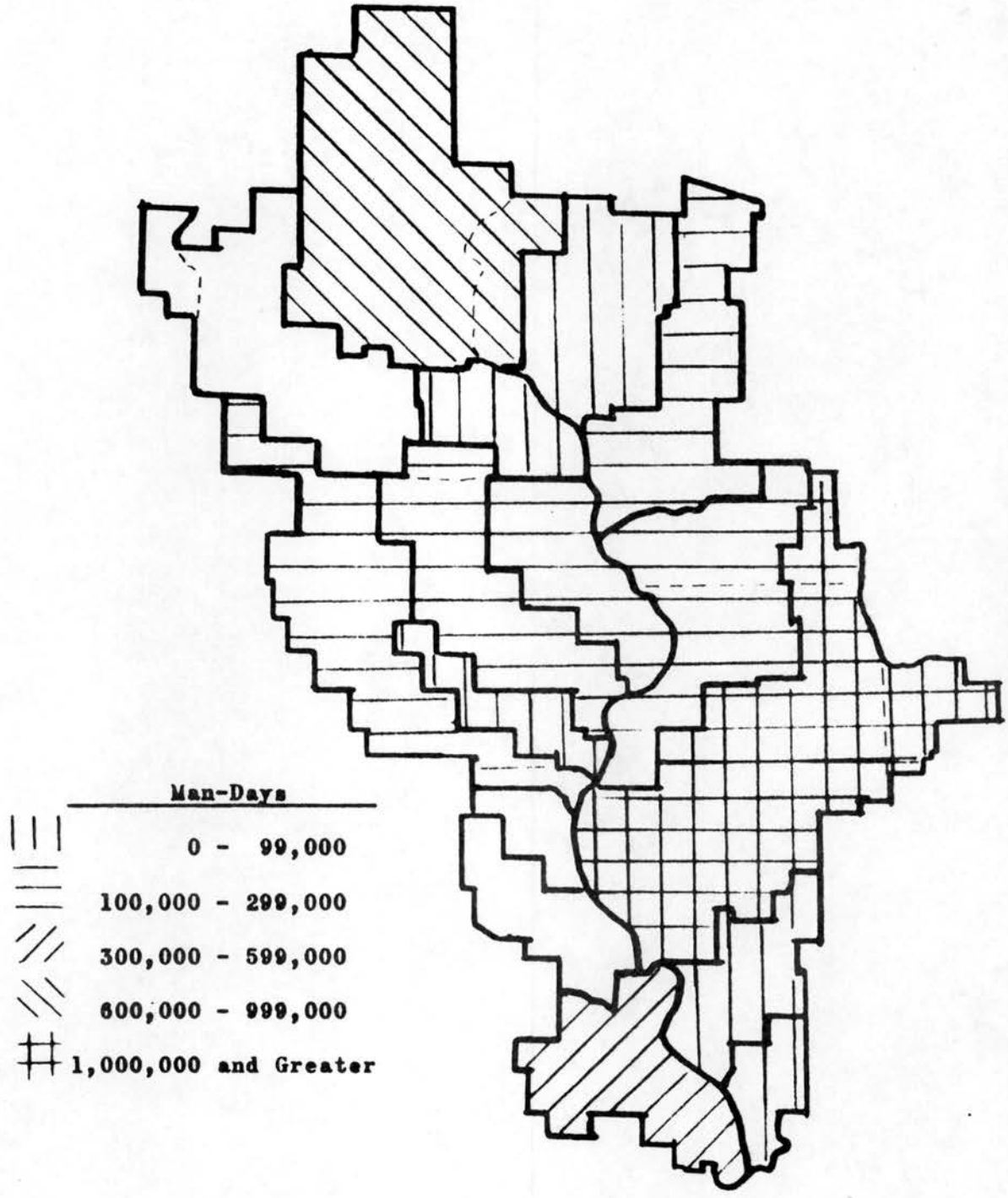


Fig. L-19. Net Man-Day Needs for Hunting by 2000 in the Upper Mississippi River Basin.

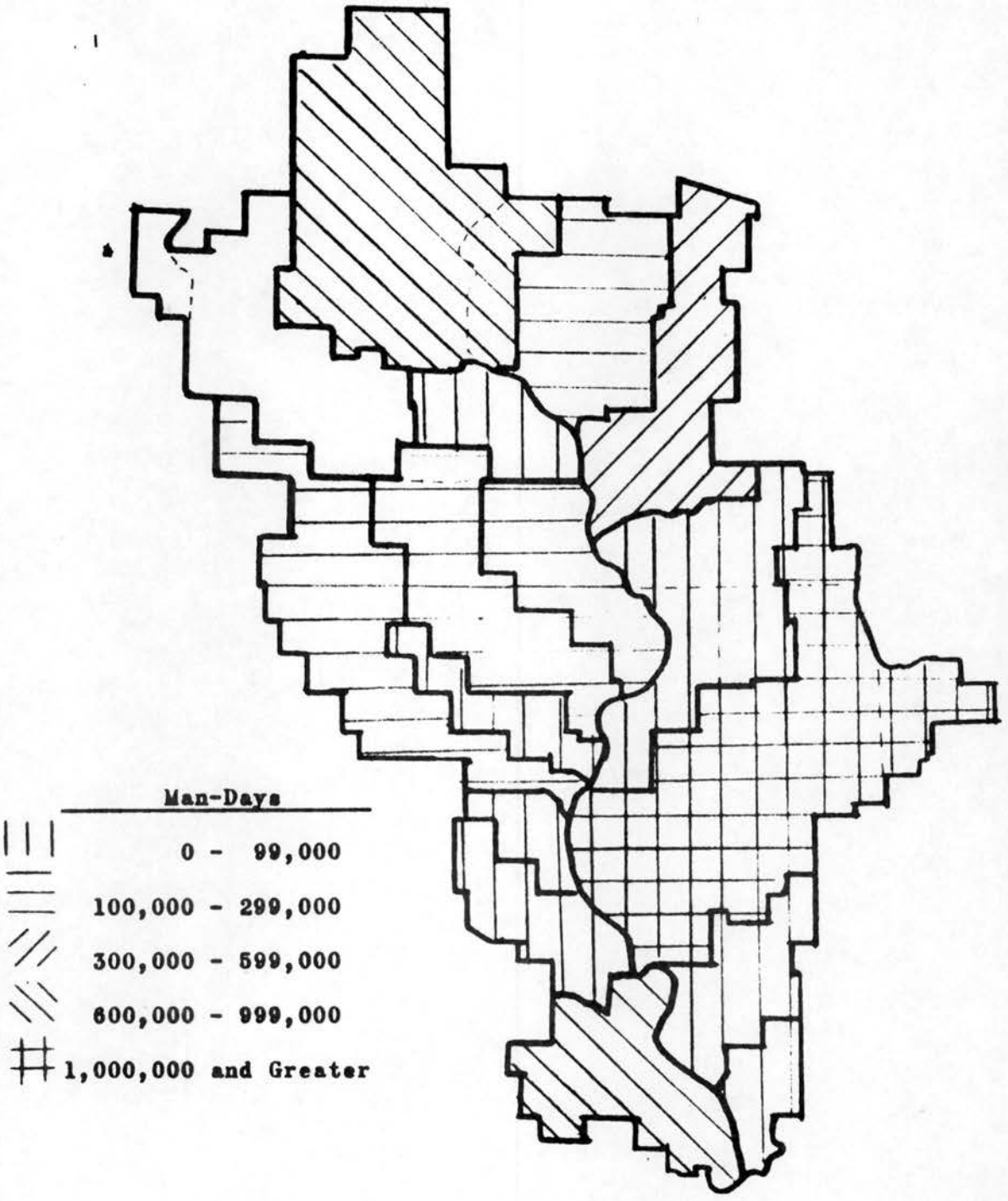


Fig. L-20. Net Man-Day Needs for Hunting by 2020 in the Upper Mississippi River Basin.

Section 5

FUTURE PROGRAMS FOR SPORT FISH AND WILDLIFE

Frameowrk studies are designed to: (1) provide broad-scale analysis of water and related land resource problems; and (2) furnish general appraisals of the nature, extent, and timing of measures for their solution. Existing resource problems, their causes, and a brief discussion of corrective programs have been treated previously in this report. The problems of the future, as they pertain to deficiencies between supply and demand for fishing and hunting opportunity, are displayed in Table L-16.

Broad-scale planning procedures for the Upper Mississippi River Basin have been divided into five categories. They include general considerations applicable to all subareas. Although the number of planning concepts could be expanded, it is believed that those presented represent the key elements necessary to satisfy projected needs, further expand and strengthen the fish and wildlife resource, and guide its proper utilization. Priorities for solving water and related land resource problems are best determined by an inter-subarea comparison of target year needs as given in Table L-16, Columns 20-25 and 45-50.

5.1 Increased Utilization of Existing Resources

Many additional user-days of hunting and fishing could be realized by increasing the utilization of the existing resources, whether these resources be land or water, or the wildlife and fish adaptable to the available habitat.

5.1.1 Underutilized Habitat

In some basin subareas the fish and wildlife habitat available to the public could not support all future fishing and hunting needs even if optimum use of these lands and waters could be realized. Adjoining subareas, having underutilized acreages of fish and wildlife habitat, provide alternative opportunities. However, there are two inter-related factors precluding hunting and fishing in these underutilized areas: (1) lack of high-speed highways connecting urban areas to the rural areas and (2) lack of sufficient time to utilize the existing highways. These two factors apparently are partially responsible for existing travel patterns of basin sportsmen.

Studies in midwestern states have indicated that warmwater stream fishing is primarily a local pursuit. Approximately 75 percent of stream anglers come from less than 25 miles to fish. Reservoir and natural lake fishing presents a similar picture, with 85-90 percent of the anglers coming from less than 50 miles away. Surveys in Illinois and Indiana indicate that hunting usually is done close to home. Over 50 percent of the hunters do all their hunting in their home county. The balance seldom hunt away from their home county more than once or twice during a season. Information from the eastern portions of the basin indicate that public hunting grounds draw from a larger area than public fishing waters. Upland game units, without bird releases, primarily attract local hunters. Approximately 50 percent of the hunters using these areas come from less than 25 miles away. With pheasant releases, over 80 percent of the hunters come from more than 25 miles away. Therefore, attractive management procedures in

conjunction with suitable land transportation systems should be useful for transferring unsatisfied needs from one subarea to an adjacent subarea capable of meeting these needs.

The provision of public access to suitable habitat represents another problem. Those states which have relied heavily on an outdoor recreation economy have shown the importance of having sufficient, well-marked, access sites. However, the provision for future access will require careful planning to provide a reasonable balance between the resource and the people who will use it.

Where capacity potential will permit increased use, new access points should be developed. Provision for future access will include acquisition of sites by purchase or easements by State and Federal conservation agencies; improvement of existing access facilities; cooperative programs with other agencies in locating, acquiring, and developing access; and cooperation with private individuals to encourage access to private property or to provide access through private property to public-use areas.

Overuse of certain hunting and fishing areas can also be a serious problem that should not be ignored by the planner. When overcrowding occurs, access should be restricted. This can be done by limiting access points, by prohibiting activities which may cause conflicts, by legislation regulating types of equipment that can be used at a facility, and by imposing entrance fees. Access must be designed to fully utilize the resource for the purposes intended, and to provide a high level of enjoyment to those who participate.

State and Federal conservation agencies have purchased lands having high wildlife potential to insure their use by future generations. Generally, these areas have been acquired where: (1) the land in the project area was either too poor for general farming or its withdrawal from agriculture would not seriously reduce the economy of the area; (2) each area was large enough to form an economical, manageable land unit; (3) the area had good potential for game restoration; (4) land prices were reasonable compared to surrounding lands; and (5) the area was close enough to population centers to assure substantial public use.

A problem faced by all agencies interested in land acquisition is the rapid escalation of land prices. The national farm real estate index increased nearly $15 per acre from 1960 to 1965. In several central "cornbelt" states, the per acre cost index has recently increased eight percent annually. In Indiana, this index rose 12 percent in a four-month period from November 1965 to March 1966. The estimated cost per acre of recreational lands associated with water is $1,460 in several "lake" states. All of these figures point out the necessity of obtaining land now. One of the greatest problems is failing to acquire needed lands promptly following authorization. As an alternative to fee-purchase, easements or leases of private land can achieve some of the same results as acquisition but at less cost and with less disruption of the local tax base.

5.1.2 Underutilized Species

Ideally, fish and wildlife management would allow a maximum sustained yield of fish and game. However, certain species are not

readily accepted by the public, or season and bag limits are too restrictive.

In past years antlerless deer seasons have been established in most of the United States. This program has curbed certain deer management problems while at the same time provided needed additional opportunity for the hunter. The mourning dove represents another wildlife species that could provide additional opportunity without additional cost or hunting acreages, merely by adding it to the game-bird list. Iowa, Indiana, Minnesota and Wisconsin could provide thousands of additional annual hunter-days use by allowing hunting of mourning doves.

The fox, raccoon, most of the furbearers, coot, carp, and sucker could also withstand considerably more hunting and fishing pressure than is currently applied. Programs can be designed to influence the potential user's choice of recreational activities by informing him of fish and game surpluses, by defining the attributes of the species involved, and by identifying facilities where hunting and fishing of these species is permissible. Increases in bag limits and lengthening of seasons may also promote acceptability of some under-utilized species.

5.1.3 Wildlife Enhancement Possibilities

Future losses of game producing habitat will reduce hunting opportunities as well as wildlife populations. These losses of habitat will be the result of urban expansion, intensified agricultural practices, and increased pollution of the air, soil, and water. To offset

these losses and provide for the future hunter, many programs of game management will be required.

There never will be the large amounts of publicly owned land in this drainage as in the country's western river basins. Therefore, substantial future demands for hunting must be met on private lands. The private landowner should be encouraged to maintain habitat which will support wildlife populations. State and Federal programs are presently available to supply the private landowners with technical, financial, and material assistance for improving their land for wildlife. If these programs are to be effective, the private landowner must realize a suitable return on his investment. To accomplish this, future programs of cost sharing and planning assistance will have to be accelerated. Additional techniques in this area could include expanded information programs to inform landowners of assistance available for beneficial wildlife projects, reduced tax rates on private property set aside and improved for wildlife, and encouragement and support of private fee hunting areas.

Native wildlife populations could be bolstered by introduction of exotic species more compatible with existing land-use patterns or by re-introduction of former native species. Turkeys thriving in portions of the basin may also be potential game birds in additional subareas.

Continued efforts should be made to repeal bounty laws existing in the basin. This antiquated system has little biological basis and is an unnecessary budget drain.

5.1.4 Fishery Enhancement Possibilities

The basic goal of State and Federal fishery departments has been to provide better fishing opportunities. Specific basin programs have

been designed to provide fulfillment of this goal, but future programs will require further acceleration and expansion if they are to satisfy future angler needs.

Fishery management programs in future years must provide improved production of existing waters. The chemical eradication of problem fish populations, with a subsequent restocking with desirable fish, has been an expanding program. Partial treatments have been used for thinning overabundant panfish populations to encourage growth and thereby produce more catchable fish. Corrective stocking, based on biological practicability, should also be accelerated.

Experimental stocking would provide knowledge of new species suited to basin waters. The coho salmon introductions in the Great Lakes appear encouraging. No doubt there are similar opportunities for developing underutilized habitat niches in the Upper Mississippi River Basin. The possible introduction of the striped bass into newly created impoundments offers an example of an important potential quality fishery.

5.2 Correction of Pollution Problems

A great deal of the basin's water habitat is degraded through the effects of industrial, municipal, and agricultural pollution. Some waters are already completely devoid of fish life, other waters can support only the more tolerant aquatic forms; and thousands of acres of additional water receive periodic fish kills. Water pollution has caused measurable changes in vascular water plants, crustaceans, aquatic insects, and other dietary staples of animals. Deaths of

fish and/or wildlife have resulted from various forms of pollution; some of the kills have resulted from excessive silt loads, water low in oxygen content, insecticides, and other toxic materials. Some kills have occurred which cannot be explained, even after detailed analysis. Such kills may be the result of synergetic effects of several unrelated toxic materials recombining to form even more toxic pollutants.

The increase in human population will cause an additional pollution burden. New sources of pollution will affect species quality and will generally degrade hunting and fishing experiences. Some sources, which are not considered a serious threat today, may be extremely threatening in the future. These sources include greater use of more toxic chemicals and pesticides; a build-up of nitrogen and phosphorus compounds, detergents, and radioactive materials; and excessive heating of the aquatic environment from thermoelectric power plants.

Pollution must be controlled not only to insure environmental conditions favorable to fish and wildlife, but also to insure the health of humans. Progressive action has resulted in all basin states drafting water quality criteria to meet the requirements of the Federal Water Pollution Control Act, as amended.

Water quality criteria must be established that will meet the requirements of a diversified aquatic community encompassing all life history stages. In setting standards for aquatic life, it is important that the most sensitive species, the intolerant developmental stages, the synergistic effects of combined stresses, the long-term effects of sustained low-level toxicity, and many other factors be considered.

If specific waters are classified below their capabilities for supporting aquatic life, many existing and potential sources of fishing opportunity will be lost or severely impaired. When these criteria have been finalized and approved by the Secretary of the Interior, and properly enforced by policing agencies, they should prove useful in protecting our water resources. Recommendations of the National Technical Advisory Committee to the Secretary of the Interior should be followed in the Upper Mississippi River Basin whenever particular circumstances are not adequately covered in accepted state water quality standards.

Water quality or low-flow augmentation should be considered only when sources of pollution cannot be eliminated or satisfactorily reduced by available technical knowledge. Every effort should be made to supply tertiary treatment to potential pollutants at major basin population centers as soon as feasible.

5.3 Planning and Development Coordination

Federal and State fish and wildlife agencies are the primary organized administrators of the basin's fish and wildlife resources. Private land owners and public and private water resource construction and land management concerns, however, often have greater potential for affecting the ultimate survival and destiny of fish and wildlife.

Some programs designed for the betterment of the people are beset with inconsistencies. Too often, individuals and agencies representing single-purpose interests deal in emotionalism instead of fact.

Developmental projects capable of meeting multiple-purpose needs are not achieved because of lack of coordination. For example, wetlands which have conserved waters and protected past generations from flood damages are drained to allow greater production of food and fiber, even though crop surpluses continue, farm prices drop, and crop production is curtailed on existing agricultural lands. Also, large impoundments are constructed for water supply near existing rivers carrying water too polluted for human consumption.

Comprehensive planning for the Upper Mississippi River Basin must include a full understanding and recognition by all participants of the need for an objective program--a program which recognizes the needs of all interests for land and water and provides alternatives which are mutually compatible. This study must also provide the opportunity for private sectors of the basin to share in present planning and future cooperative programs.

A necessary precept to be followed in wildlife planning of all types is the preservation, renewal, or improvement of habitat wherever publicly sponsored developments occur. Where habitat must be inundated or otherwise made unavailable to wildlife, similar habitat must be provided equal to the magnitude of the loss. Without complete adherence to this precept, the future wildlife population cannot possibly stem present downward trends.

5.4 Suggested Applied Research

Application of knowledge gained through research has advanced technological ability to its present status. In the future, research

must provide new insights into the problems of today and tomorrow. The need for additional facts to guide fish and wildlife management in the Upper Mississippi River Basin is imperative. Those problems discussed below and requiring special emphasis should be investigated as soon as possible.

Research is needed for a better understanding of the motivation behind consumptive demands. A reliable census of demand should determine the sportsman's desire for quality and quantity experiences, his ability and willingness to pay for the experiences, and those elements of the experience which make it rewarding. The key questions are: how important are individual species; what is the magnitude of latent demand; and how can it be satisfied; how important is success expectancy; do season lengths and bag limits restrict use; do other forms of recreation significantly affect hunting and fishing; how much influence does environmental quality have on hunting and fishing; how much open space does the sportsman need to actively participate; and how restrictive are elements of time, money, energy, comfort, and skill when related to hunting and fishing.

Another pressing problem is the financing of future fish and wildlife programs. The present funding system, primarily dependent upon the sale of hunting and fishing licenses, needs re-examining. Fish and wildlife have always been considered "free" by-products of land and water. This concept may not extend into the future. The cost of providing fish and wildlife in the future should be borne by

all of those who use and enjoy the resource. Research into the following basin alternatives should be undertaken: (1) use of general funds as supplemental monies for conservation programs; (2) collection of entrance fees and user charges to utilize available opportunity; and/or (3) licenses priced commensurate with the quality and quantity of days-use experienced.

Certain multiple-use programs should be re-evaluated. Multiple use for certain experiences results in overcrowding and the consequent reduction in quality of the experiences of the users. Single-purpose areas should be provided for certain uses, e.g., natural areas for scientific studies and refuges for rare or endangered species. Future multiple-use projects, including fish and wildlife as a purpose, may require more detailed planning and coordination between economists, biologists, and recreation planners.

Additional projects are considered important to basin fish and wildlife populations. Fishery studies, including those concerned with mortality and disease, cold and warmwater population dynamics, general creel censuses, age and growth analyses, limnology of lakes and streams, fish toxicants, and aquatic plant control, all are expected to provide answers that will create increased future use of existing habitat, with increased efficiency. Studies designed to aid in the management of future wildlife populations include those on the effects of pesticides and herbicides on wildlife, tracking wildlife movement through radio-telemetry, evaluation of hunter success resulting from game management measures, analysis of inventory and population estimation methods,

studies of farmland deer herds, and surveillance of diseases such as rabies, lead poisoning, and botulism.

The results of future research studies and their application to management will largely determine the future welfare of fish and wildlife and the people who utilize the resource.

5.5 Preservation of Natural Environmental Systems

Environmental resource inventories are presented in Appendix B, Aesthetics and Cultural Values. Appendix B identifies natural environmental systems by mapping topography, vegetation, and water areas within the study area. Map symbols locate such natural features as wildlife, vegetation, land forms, water resources, and historic and archaeological resources having above average quality.

The mapping information presented in Appendix B should be utilized to its fullest extent in both developmental and conservation planning. Future industrial, urban, recreational, and other intensive land and water use developments should be designed to provide a minimum of environmental disturbance. Conservation agencies should identify special features, i.e. scenic waterways (Figure L-21), wetlands providing waterfowl nesting potential (Figure L-11), ranges of rare and endangered species (Figure L-12), significant fish spawning areas, wilderness and natural areas, and open space near urban concentrations. Action should be taken to protect these features through acquisition, easement, or proper zoning.

Present efforts in many fields have generally been geared toward quantity production of man's needs; in the future, quality must be

stressed. Comprehensive planners should be prepared to exercise the skill and foresight necessary to provide an adequate array of natural resources for future generations. These decisions may not always be popular or necessarily expedient to all. However, the passage of time should justify actions taken that allowed an animal species or a particular unique area to survive.

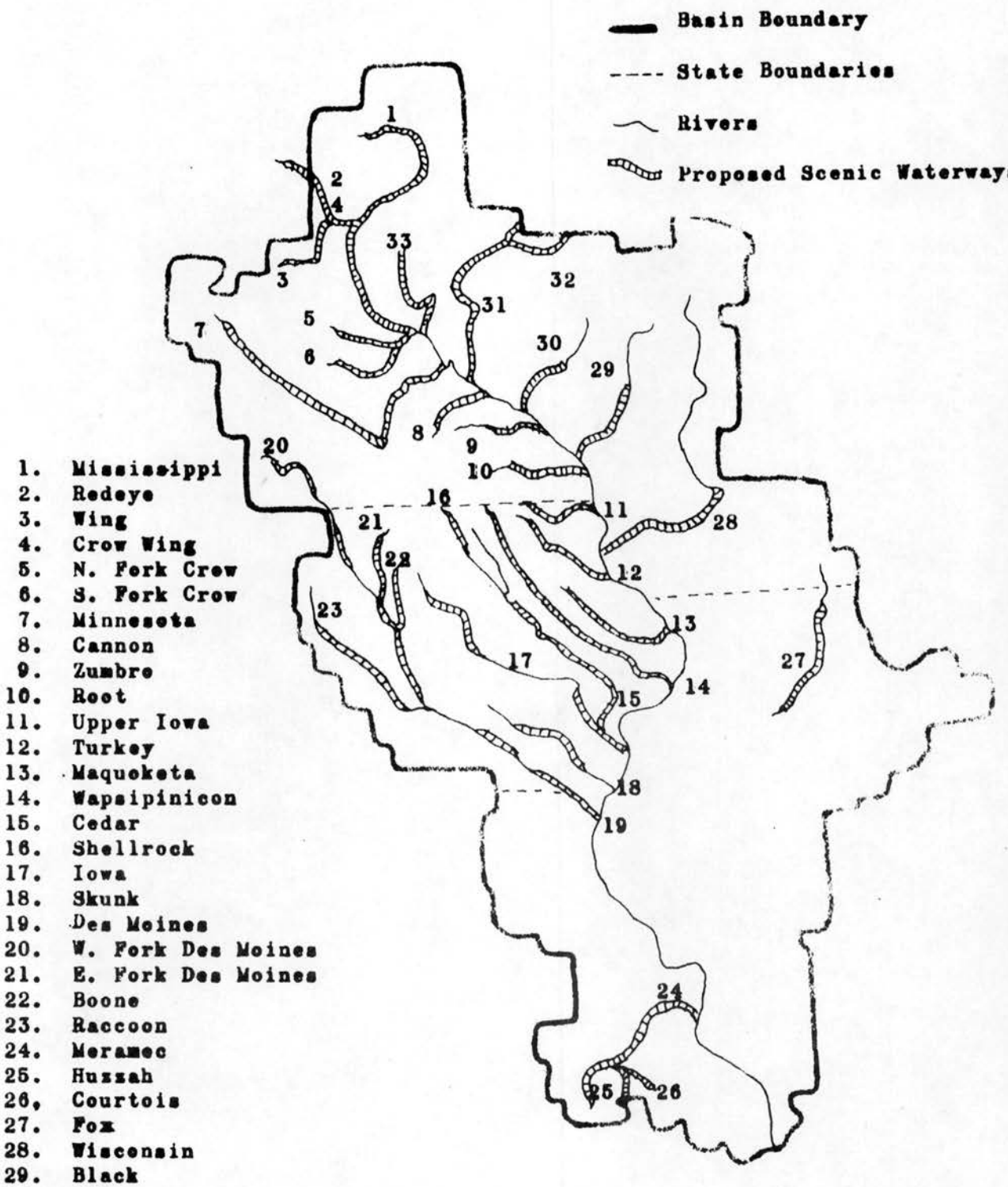


Fig. L-21. Proposed Scenic Waterways in the Upper Mississippi River Basin.

Section 6

SUMMARY

6.1 General

Congressional authority for the Upper Mississippi River Basin Comprehensive Study is contained in a resolution adopted May 21, 1962 by the United States Senate Committee on Public Works. The sport fish and wildlife resources study of the UMRCBS has been conducted under the authority, and in accordance with the provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). This Act, in part, authorizes assistance to Federal, State, and other agencies in the development, protection, rearing, and stocking of fish and wildlife and controlling losses thereof; it authorizes surveys and reports by the Fish and Wildlife Service which recommend measures needed to prevent losses of fish and wildlife and to enhance hunting and fishing opportunities at water-use projects constructed or licensed by the Federal Government; and it authorizes land acquisition for fish and wildlife conservation purposes.

The Upper Mississippi River Basin, for purposes of this study, includes the drainage area of the Mississippi River above the mouth of the Ohio River at Cairo, Illinois, exclusive of the Missouri River. This area includes portions of seven states and contains approximately 118 million acres of land and three million acres of water.

In 1960 the basin population was 19.3 million people, or 10.8% of the total U. S. population; 74% of these people lived in urban areas and the remaining 26% resided in non-urban areas. The greatest

population concentration in the basin is the metropolitan complex of Chicago, Illinois and northwestern Indiana. This area contained 6.8 million people in 1960. Two other metropolitan complexes had more than a million people in 1960: the St. Louis, Missouri and East St. Louis, Illinois area contained 2.1 million; and the Minneapolis and St. Paul, Minnesota greater metropolitan area contained 1.5 million.

Traditionally, resource planning has developed on a three-phased approach; (1) an inventory of physical and biological resources; (2) an estimation of future demands on these resources; and (3) a plan of development to satisfy the demand. The rationale of the approach and methods of providing the needed information have varied from study to study, but these elements are usually present.

6.2 Basinwide Sport Fish and Wildlife Resources

Fish and wildlife populations in the basin are a function of the environment. The use, or misuse, of this environment automatically regulates game and fish supplies. Changes in the wildlife environment began with the pioneers. To help support the rapid influx of settlers, timber was cut and native grasses were plowed under or heavily grazed. These activities, coupled with urban-industrial development, gradually eliminated much of the basin's original wildlife habitat. The less adaptable animal species rapidly declined or disappeared as their environment was altered. Trends toward intensified land and water use will continue or accelerate as the needs or urbanization, agriculture, transportation systems, and industry expand. These changes will have their accompanying effects upon air and water.

The present fish and wildlife resources is the result of adaptation to past and/or presently changing habitat conditions. For some species our present land practices have had a net beneficial influence. When the coniferous and deciduous forests were removed by lumbering operations and replaced by agricultural crops, second growth timber, or brush, white-tailed deer quickly populated this new environment. Since the 1920's, deer have extended their original basin range considerably where the proper combination of forest, brush, and cropland is present.

Pheasants, jackrabbits, cottontails, fox squirrels, quail, Hungarian partridge, and mourning doves are also examples of wildlife species which have been compatible with man's activities. Pheasants and Hungarian partridge were introduced from abroad and are now well established. The bobwhite quail and cottontail have been favored by cropland-brush fringe habitat, which is plentiful in the southern portion of the basin.

Water development practices have resulted in a net improvement of the sport fishery resource. This has been accomplished through the creation of new fish habitat and improvement of existing fishing waters. Single-purpose reservoirs for flood control, irrigation, navigation,and power have seldom been used only for their original purpose. Fishing opportunity has often been an additional benefactor from these "single-purpose" projects.

The principal game fish in the basin are trout, pike, perch, bass, crappies, sunfish, bullheads and catfish. These species have qualities or relative abundance that establish them as the mostpopular fishes in a given area.

Natural populations of brook, brown, lake, and rainbow trout are restricted to colder waters within the basin. However, many marginal lakes and streams are successfully stocked or otherwise managed to increase trout fishing opportunities.

Several species of bass provide good fishing opportunities. The largemouth bass is sought throughout most of the basin, while the smallmouth is generally more prevalent in northern lakes and streams.

The catfish-bullhead group is especially important in southern Minnesota, Iowa, Illinois, and Missouri. The channel catfish is a preferred species, because of its outstanding sporting qualities and excellent table values. Several species of bullhead provide much opportunity because of their wide distribution and catchability characteristics.

In Minnesota and Wisconsin, walleyes, muskellunge, and northern pike constitute an especially important part of the sportsman's creel. Panfish, including crappies and sunfishes, receive considerable fishing pressure throughout the basin. Panfish, along with yellow perch, walleye, and whitefish comprise the more popular winter fishery species.

Some species formerly considered as rough fish are gaining rapidly in popularity and frequency of catch. Carp and suckers are examples of fish species now readily accepted by many fishermen.

Categories of basin water habitat fished most often in 1960 were natural lakes, 48.5%; rivers and streams, 26.5%; and large and small artificial impoundments, 25.0%. Fish harvest from these waters depended upon access, fishing pressure, and that portion of the standing crop consisting of desirable species.

Wildlife species which provide hunting or trapping, or which have a reasonable potential to do so, are white-tailed deer, black bear, moose, antelope, wild turkey, squirrels, rabbits, grouse, pheasant, quail, woodcock, dove, foxes, raccoon, beaver, mink, muskrat, and many species of waterfowl.

The white-tailed deer is the most popular big game animal in the basin. It ranges throughout most of the Mississippi Drainage and is extensively hunted in all basin States. The other big game animals generally are not widely distributed nor hunted. Moose and black bear are restricted to the northern portions of the basin, while limited numbers of antelope extend their Missouri River Basin range into South Dakota basin counties and rarely into western Minnesota. Wild turkeys, classified as big game in some areas, have been re-established and are hunted in southeastern Missouri.

Squirrels and rabbits inhabit the majority of the basin and are the most utilized of small game mammals. Foxes and raccoon are also distributed basinwide and generally provide huntable populations.

Popular upland game birds include grouse, pheasant, quail, and woodcock. All receive heavy hunting pressure where they are locally abundant.

Waterfowl provide the basin sportsman with an excellent hunting experience. A variety of ducks and geese are available during fall migrations. The distribution of favorable waterfowl habitat results in major migration corridors across the Upper Mississippi Basin. The existing wetlands, in addition to attracting Canadian produced birds, constitute some of the most productive breeding and nesting grounds in

the United States. Many of the waterfowl harvested in the Nation have been raised on local basin wetlands. Other waterfowl available for hunting are snipe, rails, gallinules, and coots.

The mourning dove, a migratory bird, is hunted by many sportsmen in South Dakota, Missouri, and Illinois. These birds are very abundant in all areas of the basin. Their hunting potential is not utilized in Minnesota, Wisconsin, Iowa, and Indiana because of legal restrictions.

Harvestable furbearers, that are generally abundant throughout the basin, are mink, muskrat, beaver, raccoon, and fox. Recent trends show furbearers decreasing in economic importance, due to a declining demand for fur products. Therefore, these animals (especially the fox and raccoon) are presently utilized more as a recreational form of hunting, than as an economic trapping activity.

Harvest of specific wildlife species is dependent upon the availability and abundance of the species, access to hunting lands, ability of the hunter, and hunter acceptance of available species.

A large number of additional animals is not consumptively used by the public, but has intrinsic worth and should be considered in comprehensive studies. Nongame animals (rare and endangered species, songbirds, etc.) are either legally withheld from sportsmen, or their consumptive use is not socially accepted. These animals, in conjunction with animals taken by sportsmen, broaden the aesthetic and cultural appreciation of existing flora and fauna.

Rare and endangered animals are one category of nongame species. These animals have not been able to adjust to and endure environmental

changes. They are now present only in limited numbers. Basin species considered rare and endangered are the American peregrine falcon, timber wolf, greater sandhill crane, northern greater prairie chicken, Indiana bat, and lake sturgeon. Special emphasis should continue to be placed on identifying and preserving these species for future generations to enjoy.

Several animal species in the basin could support far greater consumptive pressures. This animal category does not universally receive game status throughout the country or basin. They include the coot, crow, blackbird, dove, raccoon, and species of rough fish like the carp and sucker. When the stigma attached to the harvest of these animals is overcome through more favorable public knowledge of these species, they will be accepted and provide new types of sport fishing and hunting.

Within any ecological community the animals and plants are dependent upon each other for food and cover. Every plant and animal contributes in some way to the balance of that community. Since plants and animals are so inter-related, all forms must be wisely managed to avoid a negative alteration of the community.

The desire to utilize fish and wildlife resources is termed demand. Demand may be separated into three categories: consumptive, non-consumptive, and latent. Consumptive demand is expressed by those people who gain personal possession of a portion of the resource through hunting and fishing. Non-consumptive demand refers to visual or scientific use of the resource. Latent demand to hunt, fish, study, or otherwise utilize fish and wildlife resources is inherent in much of

the total population, but is not fulfilled because of restrictions. The present and future demand estimates expressed within Appendix L apply only to consumptive demand.

Demand for any hunting or fishing experience is a function of participants and participation. Participants, by definition, are those people in a given population who hunt or fish when provided with an opportunity to do so. Participation is the number of times an individual annually hunts or fishes.

Hunting and fishing license sales are an index of the number of participants. License sales reflect actual use, are accurately tabulated, readily available, and are indicative of many factors that determine use. Fishing and hunting license sales show that basin states experienced a rapid increase in sales from 1940 to the late 1950's. State sales following this period were somewhat variable; some states continued the previous trend, while others remained consistent with previous sales or began to decline. From 1940 to 1950, the percent of the population purchasing fishing licenses increased from 10.2 to 18.8% and those buying hunting licenses increased from 7.3 to 10.6%. This growth was not sustained from 1950 to 1960; fishing license sales as a percent of total population decreased from 18.8 to 16.9% and hunting license sales did not quite keep pace with population growth as they decreased from 10.6 to 10.2%. The decrease in percent of the population buying licenses began in about 1956 and has accelerated since the mid 50's.

The causes of license sale fluctuations are not easily identified. Yearly sales can be affected by weather conditions, legal restrictions,

and by opportunity forecasts. Explanations for long-term fluctuation in license sales are exceedingly more complex. Sales appear to be a result of resource attractiveness and the socio-economic profile of the population. Resource attractiveness includes availability of acceptable use facilities, diversity of species choice and quality, and the degree of success expectancy within the legal framework of bag and season limits. The socio-economic profile of the population, as it affects sales, includes an individual's health, age, expendable income, education, sex, leisure time, and distance from and acceptance of existing opportunity. An individual's demand for particular recreational activities is also strongly influenced by the desires of his peers.

Licensed and unlicensed basin anglers totaled 4,325,000 individuals in 1960. Total basin hunters consisted of 1,885,000 people in 1960. The 1960 angler participation rates for resident sportsmen were determined by applying annual rates of 18 user days for the non-urban fishing population and 10 days for the urban population. Rates of 13 days and 9 days were used for non-urban and urban hunting populations, respectively, in estimating 1960 hunting participation rates. Urban and non-urban subarea population data provided subarea participation rates to apply against total basin anglers and hunters. The total use within the basin in 1960 was 43,377,000 angler-days and 17,968,000 hunter-days.

Where subarea use per acre is above the basin median, and percentage subarea license sales and habitat acres per capita are below the basin median, one may assume that subarea needs for fishing and

hunting were present in 1960. This condition existed in Subareas 5, 6, 8, 12, and 14 for sport fishing and in Subareas 4, 5, 6, and 8 for hunting. These areas were often those showing greatest needs in 1980 and thereafter. The methodology employed for post-1960 years permitted a more complete detailing of needs and their comparative magnitudes for the years 1980, 2000, and 2020.

In 1960, freshwater fishermen in the United States spent an average of $95.25 for fishing expenditures, while hunters spent an average of $79.34 annually for their recreational activity. By applying these expenditure figures to the basin's 1960 hunting and fishing population, estimates of basin expenditures were derived. The 1960 totals were 412 million dollars for fishing and 150 million dollars for hunting. About 41% of total fishing expenditures and 28% of all hunting expenditures were generated from sub-basins 1, 2, and 3 in northern Minnesota and Wisconsin. Hunting and fishing coupled with associated recreational activities in these three sub-basins are responsible for a tourist industry which is the backbone of local economies.

Expenditures, in most instances, represent only a partial picture of the actual values of fish and wildlife. Some costs, such as expenditures of the sportsman's free time, energy, and pre-season preparation, cannot be measured in dollars. Secondary contributions to local economies, through jobs and monies secured by sales and services to sportsmen, supplement the above expenditures.

6.3 Future Demands for Sport Fish and Wildlife

The projection of the need for fish and wildlife must be based on some estimate of future demands for fish and wildlife. These demands are obviously, in a very fundamental sense, a function of the size and distribution of the basin's future population. The basin population

is projected to increase 150 percent (19.3 million to 48.2 million) from 1960 to 2020. The geographic distribution and the density of the population will also have a strong effect upon demand. Fishing, and particularly hunting, have been basic recreation to rural-oriented populations in years past. Population densities, projected to increase from a mean basin figure of 102 people per square mile in 1960, to 138 in 1980, to 187 in 2000, and ultimately to 255 people per square mile throughout the basin in 2020, will bring about new attitudes affecting recreational demand for hunting and fishing.

Forecasting of demand involves projecting both the number of participants and their rate of participation as defined by projected values of correlated factors. The result of these two factors is termed demand and is expressed in man-days of use.

After consideration of factors shown to be related to participants in various outdoor recreational pursuits, the inter-relationship between license sales, areas of locally available opportunity, and population densities appeared to provide the best available method for determining future license sales as a function of projected population. An estimate of the number of future licensed fishermen and hunters, by subarea, was determined by applying per capita subarea license sale factors to subarea population densities. Multiple regression equations relating 1960 subarea opportunity and subarea population densities to license sales were developed. The projected licensed participants were increased by factors representing non-licensed individuals; 50% for fishing and 23% for hunting. Total (licensed and unlicensed) participants for 1980, 2000,

and 2020 were 5,018,000; 5,688,000; and 6,473,000 (fishing); and 2,338,000; 2,828,000; and 3,322,000 (hunting), respectively. These figures do not include a total assessment of latent demand because of the difficulty of accurately determining this nebulous factor. However, when considering particular projects within the basin in future years, the demand generated by a particular development will be considered and accounted for. Origin and destination data between the Upper Mississippi River Basin and other basins, and within Upper Mississippi River Basin subareas, were not available unless the sportsman crossed a State line and was required to purchase a non-resident license. Those participants crossing subarea lines within a particular state could not be identified from summarized license data. In this situation ingress-egress travel patterns between these hydrologic boundaries were considered equal.

To determine projected demand for the target years 1980, 2000, and 2020, the projected 1980 hunter and sport fisherman participation rates for each subarea were assessed against each subarea's projected 1980, 2000, and 2020 participants. Demand for fishing in the Upper Mississippi River Basin is expected to increase from 43.4 million angler days in 1960 to 47.9 in 1980 (10%); 52.1 in 2000 (20%); and by 2020, demand is estimated to be 57.4 million angler days or a 32% increase when compared to 1960 angler demand. Basin hunting demand was estimated to be 18.0 million hunter-days use(1960). Demand is expected to increase to 19.5 million days-use by 1980 (8%); 20.9 by 2000 (16%); and ultimately to 22.2 million hunter-days by 2020, an increase of 23% when compared with 1960 gross hunter demand.

Net needs are projected when estimated demand exceeds projected supply. The angler is normally provided with ever increasing acreages of impounded water through construction programs. Impoundments, however, are usually gained at the expense of fishable stream habitat and inundated wildlife habitat. Greater acreages of lands supporting wildlife are consumed by urban sprawl, highways, more intensive agricultural practices, and other practices of a burgeoning population.

An estimated 167,000 acres of additional water will be available to basin anglers by 1980 that were not present in 1960. This acreage should provide approximately 2.1 million additional annual angler-days opportunity by 1980. However, 9 of the 16 subareas are expected to have angler needs by 1980. In 2000 there are 12 subareas projected to have need for additional opportunity; by 2020, all but one subarea shows angler-day needs.

Land lost to urban sprawl will approximate 1.8 million acres from 1960-1980, 1.4 million acres from 1980-2000, and 1.4 million acres in the interim 2000-2020. Total hunter-days foregone on these lands are approximately 1.2 million annual days-use. Hunter needs are projected in 12 subareas by 1980, 13 by 2000, and 13 by 2020. No doubt the transfer of use into presently underutilized subareas will also severely tax those resources.

6.4 Future Programs for Sport Fish and Wildlife

Broad-scale planning procedures for the Upper Mississippi River Basin were divided into five categories. They include general considerations applicable to all subareas. Although the number of planning concepts could be expanded, it was believed that those presented

represented the key elements necessary to satisfy projected needs, further expand and strengthen the fish and wildlife resource, and guide its proper utilization. Priorities for solving water and related land resource problems are best determined by an inter-subarea comparison of target year needs.

Many additional user days of hunting and fishing could be realized by increasing the utilization of the existing resources. Underutilized habitat of a particular subarea could provide opportunities to adjoining subarea residents if suitable land-transportation systems were available and if management procedures were adopted to provide a quality hunting or fishing experience. Where capacity potential of particular areas will permit increased use, new access points should be provided through acquisition of sites by purchase or easement; improvement of existing access facilities; cooperative programs to locate, acquire, and develop access; and encouragement of access to private property or across private property to public-use areas.

Certain species, such as the mourning dove, could provide additional opportunity without additional cost or hunting acreages, merely by adding them to the game-bird list in Indiana, Iowa, Minnesota and Wisconsin. Programs can be designed to influence the potential user's choice of recreational activities by informing him of fish and game surpluses, by defining the attributes of the species involved, and by identifying facilities where hunting and fishing of these species is permissible. Increasing bag limits and lengthening of seasons may also promote acceptability of some underutilized species.

To partially offset the inevitable loss of wildlife habitat, private landowners should be encouraged to increase wildlife production through accelerated programs of cost sharing and planning assistance, by insuring a more equitable return on his wildlife investment, and by reduced tax rates on private property conserved and improved for wildlife. Native wildlife populations could also be supported by re-introduction of former native species and by new introductions of suitable exotic species more compatible with existing land-use patterns. Continued efforts should also be made to repeal existing bounty laws that drain limited budgets of conservation agencies.

Present fishery management techniques must provide improved production on existing waters; more inventive and farsighted facilities must be planned for newly created waters. Supplemental and experimental fish stocking must be closely tied with biological fact to utilize presently unfilled habitat niches.

Degraded waters suffering fish kills, supporting only pollution tolerant species, or completely devoid of fish life must be corrected. Excessive silt loads, low oxygen content or high temperatures of water and foreign toxic materials causing these problems can and must be eliminated. Progressive action programs which are properly enforced are necessary to provide a water habitat suitable for a diversified aquatic community encompassing all life history stages.

Private landowners and public and private water resource construction and land management concerns have great potential for affecting the ultimate survival and destiny of fish and wildlife. This study must provide the vehicle for private sectors of the basin to share

in present planning and future cooperative programs. This coordinated plan must recognize the needs of all interests for land and water and provide alternatives which are mutually compatible.

The need for additional facts to guide fish and wildlife management in the Upper Mississippi River Basin is imperative. Research is needed for a better understanding of the many factors which motivate consumptive demand. Means of adequately financing future fish and wildlife programs are essential. The present system depends too heavily on the hunter and fisherman and is not adequately borne by all users.

While multiple-purpose projects are often the best use of existing lands, this concept needs re-evaluation; certain experiences are compatible with very few other uses or the quality of the experience suffers tremendously through multiple-use practices.

Future industrial, urban, recreational, and other intensive water and related land use developments should be designed to provide a minimum of environmental disturbance. Mapping information which locates scenic waterways, wetlands providing waterfowl potential, ranges of rare and endangered species, significant fish spawning areas, wilderness and natural areas, and open space near urban concentrations should be provided to the planner, and used by him to the fullest extent in both developmental and conservation planning.

Table L-16. Compendium of Data Relative to Present and Future Fishing and Hunting Demand in the Upper Mississippi River Basin, 1960-2020

Planning Subarea	1 1960 Pop. (1,000's)	2 1980 Pop. (1,000's)	3 2000 Pop. (1,000's)	4 2020 Pop. (1,000's)
1 Miss. Hdwtr.	2,074	3,098	4,126	5,671
2 Chip. & Black	312	383	495	635
3 Wisconsin	500	669	894	1,184
4 Rock	1,311	1,752	2,455	3,583
5 Illinois	9,058	12,346	16,808	23,014
6 Kaskaskia	714	893	1,123	1,460
7 Big Muddy	223	268	327	425
8 Meramec	1,864	2,568	3,584	4,841
9 Salt	164	178	227	294
10 Fox, Wya. Fabius	67	75	95	124
11 Des Moines	845	1,112	1,472	1,946
12 Skunk	222	286	392	545
13 Iowa-Cedar	772	1,048	1,407	1,958
14 Turk., Maq., Waps. & Upper Iowa	474	619	856	1,190
15 Cannon, Zumbro, and Root	274	357	455	600
16 Minnesota	443	502	593	760
Total	19,317	26,154	35,309	48,230
Median				

Table L-16 (con't). Compendium of Data Relative to Present and Future Fishing and Hunting Demand in the Upper Mississippi River Basin, 1960-2020

Planning Subarea	5 1960 Tot. Anglers (1,000's) 1/	6 1980 Tot. Est. Ang. (1,000's) 1/	7 2000 Est. Ang. (1,000's)	8 2020 Est. Ang. (1,000's)	9 1960 Fishing Water Acres (1,000's)	10 1980 Est. Fishing Water Acres (1,000's) 2/
1	1,208	1,335	1,435	1,558	1,171	1,172
2	203	217	232	251	203	205
3	351	379	412	449	331	336
4	281	326	394	462	162	164
5	909	1,080	1,268	1,484	249	262
6	111	164	184	204	47	109
7	48	51	56	63	57	60
8	231	278	335	386	52	70
9	44	59	66	74	28	46
10	12	13	15	17	17	18
11	206	276	324	386	57	83
12	50	60	77	97	13	15
13	182	240	294	364	41	51
14	105	127	151	184	63	65
15	117	134	152	177	49	49
16	267	279	293	317	249	251
Total	4,325	5,018	5,688	6,473	2,789	2,956
Median						

1/ Includes resident, nonresident, licensed, and unlicensed participants.

2/ Includes reservoirs constructed or authorized for construction from 1960-1968.

Table L-16 (con't). Compendium of Data Relative to Present and Future Fishing and Hunting Demand in the Upper Mississippi River Basin, 1960-2020

Planning Subarea	11 1960 Acres/Cap.	12 1960 Acres/Cap.	13 1960 Ang. Days Use (1,000's)	14 1980 Ang. Days Demand (1,000's) 3/	15 2000 Ang. Days Demand (1,000's) 3/	16 2020 Ang. Days Demand (1,000's) 3/
1	0.56	0.38	11,414	11,993	12,410	13,053
2	0.65	0.54	1,876	1,884	1,921	2,018
3	0.66	0.50	3,054	3,112	3,259	3,457
4	0.12	0.09	2,878	3,178	3,653	4,131
5	0.03	0.02	8,994	10,251	11,581	13,127
6	0.07	0.12	1,115	1,563	1,683	1,813
7	0.26	0.22	501	511	535	574
8	0.03	0.03	2,350	2,709	3,138	3,503
9	0.17	0.26	517	661	692	747
10	0.25	0.24	139	142	150	165
11	0.07	0.08	2,324	2,913	3,257	3,741
12	0.06	0.05	578	653	792	961
13	0.05	0.05	2,081	2,574	2,990	3,560
14	0.13	0.11	1,227	1,387	1,565	1,827
15	0.18	0.14	1,326	1,422	1,529	1,714
16	0.56	0.50	3,003	2,932	2,922	3,036
Total			43,377	47,885	52,077	57,427
Median	0.15	0.13				

3/ Disregards latent demand.

Table L-16 (con't). Compendium of Data Relative to Present and Future Fishing and Hunting Demand in the Upper Mississippi River Basin, 1960-2020

Planning Subarea	17 1980 Gross Water Ac. Demand (1,000's) 4/	18 2000 Gross Water Ac. Demand (1,000's) 4/	19 2020 Gross Water Ac. Demand (1,000's) 4/	20 1980 Net Ang. Days Need (1,000's) 3/	21 2000 Net Ang. Days Need (1,000's) 3/	22 2020 Net Ang. Days Need (1,000's) 3/
1	1,227	1,265	1,320	563	980	1,624
2	205	206	215	0	5	101
3	336	350	369	0	139	336
4	175	196	214	221	696	1,174
5	288	323	363	1,018	2,348	3,894
6	107	115	123	0	94	224
7	58	59	63	0	0	26
8	71	82	91	37	466	830
9	42	44	48	0	0	26
10	17	17	18	0	0	0
11	91	100	110	294	638	1,112
12	16	18	21	28	167	336
13	57	64	72	325	740	1,310
14	70	77	86	104	282	544
15	52	56	61	96	203	388
16	244	243	252	0	0	17
Total	3,056	3,215	3,426			
Median						

3/ Disregards latent demand.

4/ Acreage requirements based on 1960 use of extensively managed areas.

Table L-16 (con't). Compendium of Data Relative to Present and Future Fishing and Hunting Demand in the Upper Mississippi River Basin, 1960-2020

Plan. Sub-area	23 1980 Net Water Ac. Need (1,000's) 4/	24 2000 Net Water Ac. Need (1,000's) 4/	25 2020 Net Water Ac. Need (1,000's) 4/	26 1960 Total Hunters (1,000's) 1/	27 1980 Estimated Hunters (1,000's) 1/	28 2000 Estimated Hunters (1,000's) 1/	29 2020 Estimated Hunters (1,000's 1/
1	55	93	148	323	421	490	538
2	0	1	10	86	99	120	154
3	0	14	33	123	153	190	230
4	11	32	50	139	166	195	202
5	26	61	101	490	624	782	954
6	0	6	14	75	86	96	103
7	0	0	3	33	37	42	49
8	1	12	21	128	169	212	255
9	0	0	2	26	28	33	40
10	0	0	0	8	9	10	12
11	8	17	27	122	149	180	211
12	1	3	6	32	39	49	60
13	6	13	21	111	138	167	198
14	5	12	21	69	84	105	127
15	3	7	12	43	52	62	74
16	0	0	1	77	84	95	115
Total				1,885	2,338	2,828	3,322
Median							

1/ Includes resident, nonresident, licensed, and unlicensed participants.

4/ Acreage requirements based on 1960 use of extensively managed areas.

Table L-16 (con't). Compendium of Data Relative to Present and Future Fishing and Hunting Demand in the Upper Mississippi River Basin, 1960-2020

Plan. Sub-area	30 1960 Potential Hunting Ac. (1,000's) 5/	31 1980 Potential Hunting Ac. (1,000's) 5/	32 2000 Potential Hunting Ac. (1,000's) 5/	33 2020 Potential Hunting Ac. (1,000's) 5/	34 1960 Acres per Cap.	35 1980 Acres per Cap.	36 2000 Acres per Cap.	37 2020 Acres per Cap.
1	15,997	15,783	15,589	15,394	7.71	5.09	3.78	2.71
2	8,000	7,992	7,987	7,982	25.65	20.88	16.13	12.57
3	7,615	7,601	7,586	7,570	15.23	11.36	8.48	6.39
4	9,005	8,884	8,776	8,668	6.87	5.07	3.58	2.42
5	17,325	16,331	15,567	14,803	1.91	1.32	0.93	0.64
6	4,332	4,281	4,252	4,223	6.07	4.79	3.79	2.89
7	1,853	1,850	1,849	1,848	8.30	6.91	5.66	4.35
8	4,450	4,352	4,214	4,075	2.39	1.69	1.18	0.84
9	2,893	2,886	2,879	2,872	17.66	16.19	12.66	9.76
10	1,946	1,945	1,943	1,942	28.92	25.97	20.43	15.61
11	9,073	9,040	9,024	9,009	10.74	8.13	6.13	4.63
12	2,857	2,851	2,850	2,849	12.89	9.97	7.27	5.23
13	7,830	7,782	7,734	7,687	10.14	7.47	5.50	3.93
14	5,470	5,454	5,443	5,432	11.55	8.82	6.36	4.56
15	3,555	3,477	3,460	3,444	12.96	9.74	7.61	5.74
16	10,244	10,168	10,158	10,148	23.15	20.26	17.14	13.36
Total	112,445	110,677	109,311	107,946				
Median					11.14	8.48	6.24	4.60

5/ Includes all land acres except "urban and built-up".

Table L-16 (con't). Compendium of Data Relative to Present and Future Fishing and Hunting Demand in the Upper Mississippi River Basin, 1960-2020

Plan. Sub-area	38 1960 Hunter Days Use (1,000's)	39 1980 Hunter Days Demand (1,000's) 3/	40 2000 Hunter Days Demand (1,000's) 3/	41 2020 Hunter Days Demand (1,000's) 3/	42 1980 Gross Ac. Demand (1,000's) 4/	43 2000 Gross Ac. Demand (1,000's) 4/	44 2020 Gross Ac. Demand (1,000's) 4/
1	3,042	3,474	3,614	3,573	17,938	18,441	18,264
2	885	869	912	1,048	7,900	8,251	9,251
3	1,211	1,296	1,416	1,549	8,113	8,691	9,295
4	1,318	1,386	1,440	1,339	9,422	9,751	9,155
5	4,475	5,081	5,717	6,296	19,121	20,264	20,847
6	704	710	708	687	4,363	4,352	4,229
7	306	308	313	326	1,868	1,896	1,970
8	1,168	1,340	1,545	1,684	4,987	5,419	5,626
9	264	243	255	274	2,667	2,793	2,982
10	80	75	78	84	1,825	1,946	2,067
11	1,197	1,261	1,341	1,417	9,533	10,031	10,440
12	317	329	362	399	2,959	3,204	3,442
13	1,085	1,170	1,241	1,324	8,395	8,803	9,222
14	679	719	785	852	5,777	6,229	6,545
15	431	451	469	504	3,708	3,817	4,024
16	806	757	744	799	9,619	9,442	10,148
Total	17,968	19,469	20,940	22,155	118,195	124,330	127,507
Median							

3/ Disregards latent demand.

4/ Acreage requirements based on 1960 use of extensively managed areas.

Table L-16 (cont'd). Compendium of Data Relative to Present and Future Fishing and Hunting Demand in the Upper Mississippi River Basin, 1960-2020

Planning Subarea	45 1980 Net Hunter Days Need (1,000's) 3/	46 2000 Net Hunter Days Need (1,000's) 3/	47 2020 Net Hunter Days Need (1,000's) 3/	48 1980 Net Hunter Ac. Need (1,000's) 4/	49 2000 Net Hunter Ac. Need (1,000's) 4/	50 2020 Net Hunter Ac. Need (1,000's) 4/
1	474	656	660	2,155	2,852	2,870
2	0	29	165	0	264	1,269
3	87	210	345	512	1,105	1,725
4	86	156	73	538	975	487
5	865	1,738	2,599	2,790	4,697	6,044
6	14	17	1	82	100	6
7	3	8	22	18	47	122
8	197	446	636	635	1,205	1,551
9	0	0	11	0	0	110
10	0	0	5	0	0	125
11	69	151	229	493	1,007	1,431
12	13	46	83	108	354	593
13	92	171	261	613	1,069	1,535
14	42	110	178	323	786	1,113
15	30	50	87	231	357	580
16	0	0	0	0	0	0
Total						
Median						

3/ Disregards latent demand.

4/ Acreage requirements based on 1960 use of extensively managed areas.

SUPPLEMENT 1

An example of calculation procedures for converting population projections into hunting demands and needs.

Des Moines River (#11) Subarea

Given:

1980 Subarea Population	1,112,000
2000 Subarea Population	1,472,000
2020 Subarea Population	1,946,000
1960 Subarea Population Per Square Mile (X_1)	56.9
1980 Projected Subarea Population Per Sq. Mile (X_1)	74.9
2000 Projected Subarea Population Per Sq. Mile (X_1)	99.1
2020 Projected Subarea Population Per Sq. Mile (X_1)	131.0
1960 Subarea Total Licensed Hunters	99,000
1960 Subarea Total Licensed Hunters Per Capita	11.71
1960 Subarea Estimated Unlicensed Hunters	22,800
1960 Acres of Potential Hunting Land in Subarea	9,073,000
1960 Acres of Potential Hunting Land Per Capita (X_2)	10.74
1960 Subarea Resident Hunter Participation Rate	9.91
1960-1980 Man-Days on Potential Huntable Acres Lost	4,300
1980 Acres of Potential Hunting Land in Subarea	9,040,000
1980 Acres of Potential Hunting Land Per Capita (X_2)	8.13
1980 Subarea Resident Hunter Participation Rate	8.56
1980-2000 Man-Days on Potential Huntable Acres Lost	2,200
2000 Acres of Potential Hunting Land in Subarea	9,024,000
2000 Acres of Potential Hunting Land Per Capita (X_2)	6.13
2000 Subarea Resident Hunter Participation Rate	7.52
2000-2020 Man-Days on Potential Huntable Acres Lost	2,200
2020 Acres of Potential Hunting Land in Subarea	9,009,000
2020 Acres of Potential Hunting Land Per Capita (X_2)	4.63
2020 Subarea Resident Hunter Participation Rate	6.75
1960-2020 Non-Resident Hunter Participation Rate	4.5
1960-2020 Percent of Total Hunters Who Are Residents	98.4
1960-2020 Percent of Total Hunters Who Are Non-Residents	1.6
1960-2020 Percent of Total Hunters Who Are Unlicensed	23
1960 Hunter-Days Use	1,196,800

Licensed hunters by 1980, 2000, and 2020 were determined from the following regression formula:

$$Y = (12.39 - 0.029X_1 + 0.148X_2)\ (\text{Adjustment Factor})$$

$$\text{Adjustment Factor} = \frac{\text{Actual 1960 Subarea Hunting License Sales Per Capita}}{\text{Calculated 1960 Subarea Hunting License Sales Per Capita}}$$

$$= \frac{11.71}{12.39 - 0.029\ (56.9) + 0.148\ (10.74)} = 0.95$$

1980

$$[12.39 - 0.029\ (74.9) + 0.148(8.13)]\ [0.95] = 10.85$$

(1,112,000) (.1085) = 120,700 Total Subarea Licensed Hunters

2000

$$[12.39 - 0.029\ (99.1) + 0.148\ (6.13)]\ [0.95] = 9.91$$

(1,472,000) (.0991) = 145,900 Total Subarea Licensed Hunters

2020

$$[12.39 - 0.029\ (131.0) + 0.148\ (4.63)]\ [0.95] = 8.82$$

(1,946,000) (.0882) = 171,600 Total Subarea Licensed Hunters

Unlicensed subarea hunters for 1980, 2000, and 2020:

1980

(120,700) (.23) = 27,800

2000

(145,900) (.23) = 33,600

2020

(171,600) (.23) = 39,500

Total subarea hunters for 1980, 2000, and 2020:

1980

120,700 + 27,800 = 148,500

2000

145,900 + 33,600 = 179,500

2020

171,600 + 39,500 = 211,100

Subarea hunter demand for 1980, 2000, and 2020:

1980

(148,500) (.984) = 146,100 Resident Hunters

(146,100) (8.56) = 1,250,600 Resident Hunter Demand (Man-Days)

(148,500 - 146,100) (4.5) = 10,800 Non-Resident Hunter Demand (Man-Days)

1,250,600 + 10,800 = 1,261,400 Total Man-Days Demand

2000

(179,500) (.984) = 176,600 Resident Hunters

(176,600) (7.52) = 1,328,000 Resident Hunter Demand (Man-Days)

(179,500 - 176,600) (4.5) = 13,000 Non-Resident Hunter Demand (Man-Days)

1,328,000 + 13,000 = 1,341,000 Total Man-Days Demand

2020

(211,100) (.984) = 207,700 Resident Hunters

(207,700) (6.75) = 1,402,000 Resident Hunter Demand (Man-Days)

(211,100 - 207,700) (4.5) = 15,300 Non-Resident Hunter Demand (Man-Days)

1,402,000 + 15,300 = 1,417,300 Total Man-Days Demand

Subarea hunter needs for 1980, 2000, and 2020:

1980

1980 Need = 1980 Demand - 1960 Use + 1960 to 1980 M-D Lost

1,261,400 - 1,196,800 + 4,300 = 68,900 Hunter-Days Need

2000

2000 Need = 2000 Demand - 1980 Demand + 1980 Need + 1980 to 2000 M-D Lost

1,341,000 - 1,261,400 + 68,900 + 2,200 = 150,700 Hunter-Days Need

2020

2020 Need = 2020 Demand - 2000 Demand + 2000 Need + 2000 to 2020 M-D Lost

1,417,300 - 1,341,000 + 150,700 + 2,200 = 229,200 Hunter-Days Need

GLOSSARY

Angler-Day - any portion of a given 24-hour day devoted to sport fishing.

Angling - See Fishing.

Base Year - 1960.

Catch - the annual harvest of fish or game from any particular area.

Correlation - the degree of interdependence of two or more variables.

Demand - an expressed desire for use of fish and wildlife resources.

Environmental Corridor - an undeveloped strip of land with scenic value and the potential for development as an outdoor recreation area.

Fisherman-Day - see Angler-Day.

Fishing Water - includes all surface water as described in Table III-7, Appendix N (Draft No. 2), UMRCBS.

Flow Augmentation - increasing the flow (in cubic feet per second) of a stream or river by releasing water from an impoundment upstream from where the flow is to be increased.

Habitat - the land and/or water necessary to sustain fish or wildlife.

Harvest - see Catch.

Hunter-Day - any portion of a given 24-hour day devoted to hunting.

Hunting - the sport of taking wild birds and mammals with a gun or bow and arrow.

Hunting Land - includes all land area except "Urban and Built-Up" as described in Table III-7, Appendix N (Draft No. 2), UMRCBS.

Latent Demand - that desire to hunt or to fish which is not fulfilled because of lack of facilities, leisure time, or other pertinent factors.

Linear Regression - the degree in which one dependent variable changes with the change of an independent variable, resulting in an association which does not differ significantly from a straight line when plotted.

Man-Day - see User-Day.

Mean - an average; the sum of a given set of values divided by the number of values.

Median - in a given set of values, that value below and above which there is an equal number of values.

Multiple Linear Regression - the degree to which one dependent variable changes with the changes of two independent variables, resulting in an association which does not differ significantly from a plane when plotted.

Needs - unsatisfied demand.

Non-Resident - a person who hunts or fishes in a state of which he is not a legal resident.

Opportunity - land or water to which some individual may gain access to, and upon which he can expect to realize a hunting or fishing experience.

Participant - an individual who hunts or fishes.

Participation - the number of days an individual annually participates in a hunting or fishing experience.

Pressure - the number of user-days a particular hunting or fishing area receives over a particular length of time.

Production - the amount of fish or wildlife produced on a given area of land or water.

Productivity - the rate at which a given amount of fish or wildlife is produced on a given area of land or water.

Projection - a forecast based on certain assumptions.

Resident - a person who hunts or fishes in that state of which he is a legal resident.

Significant - this term, in a statistical sense, is used for stating results of an appropriate statistical test. When the probability of the occurrence of a particular event is 19 in 20 or more ($P = 0.95$), the probability is termed "significant". When the probability is 99 in 100 or more ($P = 0.99$), it is termed "highly significant".

Sport Fishing - the sport of taking fish with a hook and line, bow and arrow, or spear.

Supply - see Opportunity.

Sustained Yield - the maximum amount of fish or wildlife that can be annually harvested from a given area without depleting the resource over a period of time.

Target Years - 1980, 2000, and 2020.

Use - see Pressure.

User-Day - any portion of a given 24-hour day devoted to either hunting or sport fishing.

Utilization - see Pressure.

LIST OF SYMBOLS

 - denotes location of refuges within the basin.

 - denotes location of fishery facilities (hatcheries, etc.) within the basin.

 - denotes location of special research facilities within the basin.

LIST OF REFERENCES

1. Bellrose, Frank C., "Waterfowl Migration Corridors," Biological Notes No. 61, Illinois Natural History Survey, Urbana, 1968.

2. Burt, W. H. and Grossheider, R. P., A Field Guide to the Mammals, Houghton Mifflin Co., Boston, 1964.

3. Carlander, K. D., Handbook of Freshwater Fishery Biology, W. C. Brown Co., Dubuque, Iowa, 1953.

4. "Check-list of North American Birds," 5th edition, American Ornithologists' Union, Lord Baltimore Press, Baltimore, 1957

5. Ferris, A. L., National Recreation Survey, Study Report 19, Washington, D. C., Government Printing Office, 1962.

6. "A List of Common and Scientific Names of Fishes from the United States and Canada," 2nd Edition, Special Publication No. 2, American Fisheries Society, Ann Arbor, Michigan, 1960.

7. "Minnesota Outdoor Recreation Preliminary Plan," St. Paul, Minnesota, 1965.

8. Mueller, E. and Gurin G., Participation in Outdoor Recreation: Factors Affecting Demand Among American Adults, Study Report 20, Washington, D. C., Government Printing Office, 1961.

9. "National Survey of Fishing and Hunting - 1955," Circular 44, U. S. Department of Interior, Fish and Wildlife Service, Washington, D. C.,1956.

10. "National Survey of Fishing and Hunting - 1960," Circular 120, U. S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Washington, D. C., 1961.

11. "National Survey of Fishing and Hunting - 1965," Resource Publication 27, U. S. Department of Interior, Bureau of Sport Fisheries and Wildlife Washington, D. C., 1966.

12. "Outdoor Recreation in Illinois," Illinois Department of Business and Economic Development, Springfield, 1965.

13. "The Outdoor Recreation Plan," Wisconsin Department of Resource Development, Madison, 1966.

14. Projections to the Years 1976 and 2000: Economic Growth, Population, Labor Force and Leisure, and Transportation, Study Report 23, Washington, D. C., Government Printing Office, 1962

15. "Sport Fishing - Today and Tomorrow," Study Report 7, Washington, D. C., Government Printing Office, 1962.

SELECTED BIBLIOGRAPHY

Aldrich, J. W. and A. J. Dewall 1955. "Distribution of American Gallinaceous Game Birds", U. S. Fish and Wildlife Service, Circular 34.

Allen, J. M. 1954. "Gray and Fox Squirrel Management in Indiana - A Research and Management Study," Indiana Department of Conservation PR Bulletin No. 1

Anonymous, 1941. "Climate and Man - Yearbook of Agriculture," U. S. Department of Agriculture.

Anonymous, 1942. "Areas of United States: 1940"; U. S. Department of Commerce, Bureau of the Census.

Anonymous, 1950-1965. Proceedings, Sixth through Twenty First Annual Meeting; Upper Mississippi Conservation Committee.

Anonymous, 1955. "National Survey of Fishing and Hunting" - U. S. Department of the Interior, Fish and Wildlife Service, Circular 44.

Anonymous, 1956. "Iowa Supplement, 1955 National Survey of Fishing and Hunting" - Crosley S-D Survey.

Anonymous, 1956. "The Natural Resources of Wisconsin"; The Natural Resources Committee of State Agencies.

Anonymous, 1957. "Policy and Procedure for Development of National Inventory of Soil and Water Conservation Needs" - U. S. Department of Agriculture, Washington, D. C

Anonymous, 1958. "A Guide to Mississippi Flyway Waterfowl Management," Mississippi Flyway Council.

Anonymous, 1958 "Fox Lake Fisheries Investigation 1952 - 1955" - Ill. Dept. of Cons., Abstract from Final Report, Illinois Project F-2-R.

Anonymous, 1960. "Soils of the North Central Region of the United States" - University of Wisconsin, Ag. Exp. Station, North Central Regional Publication No. 76.

Anonymous, 1960. "Water Resources Activities in the United States - Fish and Wildlife and Water Resources" - Select Committee on National Water Resources, U. S. Senate; Committee Report No. 18.

Anonymous, 1961. "Wisconsin Conservation Department Summary of Commercial Fishing Questionnaire" - Wisconsin Conservation Department, LaCrosse, lp., mineo.

Anonymous, 1961. "North Dakota Soil and Water Conservation Needs Inventory," - North Dakota Conservation Needs Committee.

Anonymous, 1961. "United States Census of Population, 1960", U. S. Dept. of Commerce, Bureau of the Census, PC (1) 1A-US.

Anonymous, 1962. "Annual Report 1961-1962" - Missouri Conservation Commission.

Anonymous, 1962. "Hunting in the United States -- Its Present and Future Role," - University of Michigan, School of Natural Resources, ORRRC Study Report No. 6.

Anonymous, 1962. "Illinois Soil and Water Conservation Needs Inventory," Illinois Conservation Needs Committee.

Anonymous, 1962. "Indiana Soil and Water Conservation Needs Inventory," Indiana Conservation Needs Committee.

Anonymous, 1962. "Minnesota Soil and Water Conservation Needs Inventory," - Minnesota Conservation Needs Committee.

Anonymous, 1962. "Missouri Soil and Water Conservation Needs Inventory," - Missouri Conservation Needs Committee.

Anonymous, 1962. "Policies, Standards, and Procedures in the Formulation, Evaluation, and Review of Plans for Use and Development of Water and Related Land Resources," The President's Water Resources Council, Senate Document No. 97.

Bushong, C. 1961. "Evaluation of Farm-Game Habitat Restoration Efforts in Indiana," - Indiana Department of Conservation, Bulletin No. 5.

Anonymous, 1962. "South Dakota Soil and Water Conservation Needs Inventory"- South Dakota Conservation Needs Committee.

Anonymous, 1963. "National Economic Growth Projections - 1980, 2000, 2020," - Economic Task Group of the Ad Hoc Water Resources Council Staff.

Anonymous, 1963. "A Long Range Report of the Bureau of Commercial Fisheries," U. S. Department of Interior, Circular No. 149.

Anonymous, 1963. "Waterfowl Status Report" - U. S. Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, Special Scientific Report #75.

Anonymous, 1964. "Illinois Surface Water Inventory," - Illinois Department of Conservation, Special Fisheries Report No. 1

Anonymous, 1964. "Organization and Methodology for River Basin Planning" - U. S. Study Commission - Southeast River Basins, pp. 278-290.

Anonymous, 1964. "Senate Document No. 97" - Supplement No. 1, Ad Hoc Water Resources Council.

Anonymous, 1964. "The Agricultural Economy of the Upper Mississippi River Basin", U. S. Department of Agriculture, Economic Research Service.

Anonymous, 1964. "U. S. Department of Health, Education and Welfare, Conference in the Matter of Pollution of the Interstate Waters of the Upper Mississippi River" - St. Paul, Minnesota, Volume IV, February 8, 1964, pp. 1155-1157, 1168-1169.

Anonymous, 1964. "Upper Mississippi River Comprehensive Basin Study Coordination Committee Interpretation of Guidelines for Framework Studies", 11-20-64 - Upper Mississippi River Comprehensive Basin Study, Coordination Committee.

Anonymous, 1965. "Guidelines for Framework Studies, 6-10-65" - Inter-departmental Staff Committee, Ad Hoc Water Resources Council.

Bailey, R. M. and M. O. Allium, 1962. "Fishes of South Dakota" - Museum of Zoology, University of Michigan, Ann Arbor.

Barnickol, Paul G. and William C. Starrett, 1951. "Commercial and Sport Fishes of the Mississippi River between Caruthersville, Missouri, and Dubuque, Iowa" - Illinois Natural History Survey Bulletin, Vol. 25, Art. 5, Sept. 1951, pp. 267-350.

Barnes, W. B. 1965. "Use and Harvest on Public Hunting Areas in Indiana" - Indiana Department of Con., Personal communication.

Barnickol, P. G. and W. C. Starrett, 1951. "Commercial and Sport Fishes of the Mississippi River" - Illinois Natural History Survey, Vol. 25, Art. 5.

Bellrose, F. C. and C. T. Rollings, 1949. "Wildlife and Fishery Values of Bottomland Lakes in Illinois" - Illinois Natural History Survey, Biol. Notes No. 21.

Bennett, G. W. - 1945. "Overfishing in a Small Artificial Lake" - Illinois Natural History Survey, Vol. 23, Article 3.

Bennett, G. W. - 1962. "Management of Artificial Lakes and Ponds" - Reinhold Publishing Corp.

Carlander, H. B. - 1954. A History of Fish and Fishing in the Upper Mississippi River. Issued by the Upper Mississippi River Conservation Committee.

Carlaudu, R. D. and R. B. Morman, 1956. "Standing Crops of Fish in Iowa Ponds", - The Iowa Academy of Science, Vol. 63.

Eddy S. and L. Surber, 1947. "Northern Fishes", University of Minnesota Press.

Erickson, A. B., 1961. "The White-tailed Deer of Minnesota" - Minnesota Department of Conservation Technical Bulletin No. 5.

Fernholz, Willis, 1965. "Mississippi River Commercial Fishing Statistics 1965" - Wisconsin Conservation Department, Fish Management Division, Madison, 1965, 32 pp.

Gerking, S. D., 1945. Distribution of the Fishes of Indiana" - Indiana Department of Conservation, Investigation of Indiana Lakes and Streams, Vol. III (1): 1-137.

Hall, R. E. and H. R. Kelson, 1959. "The Mammals of North America" - Vol. I and II. The Ronald Press Co., New York.

Hansen, H. A. and M. R. Hudgins, 1965. "Waterfowl Status Report 1965" - SSR No. 9, BSF&W, U. S. Fish and Wildlife Service.

Kiel, W. H. Jr., 1959. "Mourning Dove Management Units - A Progress Report", SSR - Wildlife No. 42, U. S. Fish and Wildlife Service.

Landis, K. K. and R. C. Hussey, 1948. "Geology and Man", Prentice-Hall Incorporated.

Lee, F. B., 1964. "Waterfowl in Minnesota" - Minnesota Department of Conservation Tech. Bull. No. 7.

Leopold, A. 1933 - "Game Management" - Charles Scribner's Sons.

Odum, E. P., 1959. Fundamentals of Ecology. W. B. Saunders' Company, Philadelphia.

Shaw, S. P. and C. G. Fredine, 1956. "Wetlands of the United States - Their Extent and Their Value to Waterfowl and Other Wildlife", U. S. Dept. Interior, Fish and Wildlife Service, Circular 39.

Stokes, J. D., Delisle, G. E. and McCormick, J. B., 1968. Fish and Wildlife Resource Planning Guide, Department of Fish and Game, State of California.


BUREAU OF OUTDOOR RECREATION
ECONOMIC RESEARCH SERVICE
U.S. DEPARTMENT OF COMMERCE
OFFICE OF BUSINESS ECONOMICS
NATIONAL INCOME
BALANCE OF PAYMENTS
SURVEY OF CURRENT BUSINESS
DEPARTMENT OF HEALTH, EDUCATION & WELFARE
U.S.A.
DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA
STATE OF SOUTH DAKOTA
GREAT SEAL
1889
NATIONAL PARK SERVICE
Department of the Interior
WOOD · WATER · FORAGE
WILDLIFE · RECREATION
FOREST SERVICE
US
DEPARTMENT OF AGRICULTURE
GREAT SEAL OF THE STATE OF WISCONSIN
BUREAU OF INDIAN AFFAIRS
DEPARTMENT OF COMMERCE
UNITED STATES OF AMERICA
UNITED STATES GEOLOGICAL SURVEY
UNITED STATES DEPARTMENT OF AGRICULTURE
THE GREAT SEAL OF THE STATE OF IOWA
SEAL OF THE STATE OF INDIANA
1816
UNITED STATES WEATHER BUREAU
1870
AREA REDEVELOPMENT ADMINISTRATION
U.S. PUBLIC HEALTH SERVICE
1798
FEDERAL POWER COMMISSION
OFFICE OF WATER AND POWER DEVELOPMENT
U.S. DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF COMMERCIAL FISHERIES
U.S. DEPARTMENT OF THE INTERIOR
MARCH 3, 1849
U.S. DEPARTMENT OF COMMERCE
BUREAU OF THE CENSUS
OUR SOIL ★ OUR STRENGTH