



WETLANDS OF COLORADO

AN INVENTORY AND EVALUATION STUDY
OF WETLANDS FOR WATERFOWL HUNTING

STATE OF COLORADO — DEPARTMENT OF GAME, FISH AND PARKS

Wetlands of Colorado

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FOREWORD

MOST SPORTSMEN forget about waterfowl when they hang up their gun at the end of the hunting season. Little do they realize that perpetuation of their sport requires year-round effort. One of the most important components of a good program, and perhaps the least glamorous, is that part dealing with wetlands—those specific areas of greatest single significance to waterfowl.

Wetlands may be a meandering stream, a marsh complete with cattails or bulrushes, a farm pond, an irrigation ditch or a river-bottom. They may serve primarily for the production of ducks or geese; or they may offer a place for a man to hunt.

Wetlands are the basics in the management of waterfowl. Their preservation and improvement are the only answer to the perpetuation of the resource, and in turn, the sport. This report is Colorado's effort to inventory her wetland resources, particularly in those areas important to waterfowl harvest. As a result of this excellent study we have a firm basis for decision on the types of areas which should be acquired, and the general location where acquisition should be made. Both the waterfowl resource and the sportsmen of this state will benefit.

Jack R. Grieb

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Richard M. Hopper

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A primary and satisfying product of our wetlands—
quality hunting recreation. (Photo by Lee E. Yeager)

INTRODUCTION

Water, next to soil, is the most important natural resource, and is vital to many forms of wildlife. The need for water is particularly important to animals for which it constitutes the primary environmental element. Water environments, as known to wildlife managers, are collectively called "wetlands," a term used to designate areas where water permanently covers the land or saturates the soil sufficiently to encourage the growth of moist-soil vegetation. Wetlands include marshes, sloughs, swamps, bogs, wet meadows, potholes, ponds, lakes, reservoirs, streams, and overflow lands.

Many species of game and non-game animals — mammals, birds, fish, amphibians, and reptiles — inhabit wetlands and there find food, cover, and water. Among them waterfowl are considered the most important game birds, both because of the degree to which they use such lands and their national significance recreationally. Wetland losses affect waterfowl more than any other game group, and the welfare of continental waterfowl populations is directly related to the quality and quantity of wetland habitat available to them. Knowledge of wetlands, including extent, is basic to the continued success of state and national waterfowl management programs.

In 1960, the Colorado Game, Fish and Parks Department, through its Migratory Birds Research Project, initiated a wetlands inventory to obtain information on the extent of this resource in major waterfowl regions of the state. The inventory, continued through 1965, not only entailed an enumeration of water areas by counties, drainages, acres, and linear miles, but also involved plans for improving waterfowl hunting grounds, insuring maximum use by the public.

Specific objectives of the wetlands survey were determination of:

- (1) Number and amount of wetlands in the 4 major waterfowl migration, wintering, and harvest regions of Colorado.
- (2) Number and amount of wetlands leased for hunting, fishing, and other recreational purposes.
- (3) A method for rating wetlands in terms of value for acquisition as public hunting areas.
- (4) A priority list of areas suitable or potentially suitable as public hunting areas for Game, Fish and Parks Commission consideration.

Since this investigation is oriented from the standpoint of waterfowl hunting recreation enhancement, emphasizing improvement of hunting opportunity and development of harvest habitat, certain extensive Colorado wetlands were excluded from the survey. These wetlands, exemplified by North Park and South Park, and averaging about 9,000 feet elevation, are not important as hunting areas because of freezeup before opening of the regular waterfowl season. They are also relatively distant from population centers, resulting in little demand for further hunting opportunity. With the experience now attained in the inventory of important harvest wetlands, areas excluded from the initial coverage could quickly and easily be added to the state total should future circumstances warrant.

PROBLEMS ASSOCIATED WITH WETLANDS

MAJOR wetland problems of concern to federal and state conservation agencies having responsibility for maintaining waterfowl numbers are: (1) loss of wetlands, and (2) loss of public hunting on wetlands. These losses are of national significance because they affect the welfare of continental waterfowl populations, hunting, and aesthetic outdoor recreation in all parts of the country.

LOSS OF WETLANDS

Wetlands are subject to drainage, filling, and other types of destruction because they act as obstacles to bringing more land into agricultural production, industrial and residential expansion, and construction of highways and large impoundments. Wetlands have suffered from such projects because they have usually been regarded as waste areas of little value. As a result, wetlands in many parts of the United States have been, or are being, drained or otherwise altered at a faster rate than conservation agencies can establish new ones or restore old ones to waterfowl productivity (Fig. 1).

The Soil Conservation Service estimated the original natural wetlands of the United States at 127 million acres. At least 45 million acres, or over one-third of the total, had been lost by the mid-1950's through a combination of clearing, drainage, and flood control. This left only about 82 million acres on which drainage or flood-control operations had had little effect on their original wet condition (Shaw and Fredine, 1956).

Conflicting programs of wetland destruction and wetland preservation by federal agencies have compounded the problem of wetland loss. During the 20-year period prior to 1953, state and federal conservation agencies restored or improved 4.5 million acres of waterfowl habitat. In contrast, the U.S. Department of Agriculture drained more than 6 million acres in about 8 years of this period (Trippensee, 1953). Had the importance of some of the drained areas been known at the time, more effective effort could probably have been given to acquisition for waterfowl use.

The alarming loss of wetlands stimulated the Bureau of Sport Fisheries and Wildlife in the early 1950's to conduct a systematic inventory of the remaining aquatic habitats in the United States. Basic aims of the inventory were to determine: (1) location and extent of wetlands in each state, (2) wetland types in each area or group of areas, and (3) the relative usefulness of wetlands to wildlife, particularly waterfowl, in the states where found. Over 74 million acres of such lands were subsequently delineated, classified, and evaluated in both public and private ownership. An additional 5 to 7 million acres were overlooked (Shaw and Fredline, 1956). The total agrees with the 82 million acres previously mentioned.

The national inventory was adequate for the country as a whole, but was too general to meet the needs of individual states. Wetlands less than 40 acres in area were omitted from the inventory in the West. The survey also lacked sufficient quantitative data for detailed habitat analysis, prompting Colorado to initiate, in 1960, a wetlands inventory of its own. This does not infer that Colorado is losing significant amounts of wetlands, but it does indicate the need to accumulate wetland information as a necessary aid to better management of habitat for the future benefit of waterfowl and sportsmen.

LOSS OF PUBLIC HUNTING

Wildlife managers have become increasingly aware that more and more waterfowl habitat, particularly that suitable for hunting, is being leased or purchased by gun clubs or individuals for private recreational use. Included are wetlands on which landowners prohibit all hunting except by themselves and their personal friends. As a result, the average waterfowl hunter is finding it increasingly difficult to find a place to hunt. If wetlands continue



Figure 1—Water is removed from natural wetlands largely through construction of ditches and installation of drains. (Photo by Bureau of Sport Fisheries and Wildlife)

to be controlled, relatively few individuals will harvest the bulk of the waterfowl crop and reap most of the benefits from a public resource (Fig. 2).

Basic objectives of national waterfowl management programs are to: (1) increase continental waterfowl populations and maintain them at levels consistent with sound land and water use; and (2) obtain the greatest possible public use of the resource, including hunting, without endangering any of the various species. The latter objective cannot be realized if the more attractive wetland habitat becomes private hunting ground. In such event a large segment of the hunting public would pass out of the picture because most people cannot afford the expense of leasing or purchasing wetlands for recreation. The first objective would then be less necessary because fewer ducks and geese would be required to satisfy the needs of the comparatively few people who could afford waterfowl hunting under such a system.

The loss of public hunting on wetlands is a problem that faces many state conservation agencies. Colorado became concerned with this problem in the late 1950's, and a major portion of the wetlands survey reported here is aimed at its solution in this state.

Colorado's interest in wetlands lies largely in the necessity of wetlands to provide waterfowl migration, wintering, and harvest habitat. Colorado is not, and probably never will be, a major waterfowl production state, particularly when about 75 percent of all ducks produced in the United States, excluding Alaska, come from North Dakota, South Dakota, Minnesota, and Montana. But, from September 1 through May 1, Colorado booms with migrating and wintering ducks and geese. During this period nearly one million birds may reside in the state at any one time, occupying all kinds and sizes of wetland areas. Waterfowl then become a highly valuable resource within state boundaries.

Sportsmen in Colorado, therefore, enjoy some of the finest waterfowl hunting in the nation as a result of the presence of large numbers of ducks and geese in season. Mallard shooting is unsurpassed along the riverbottoms and on the ponds and sloughs of the South Platte, Arkansas, and San Luis valleys. Canada goose hunting is excellent around large reservoirs and in



Figure 2—Signs of this nature indicate the growing trend in public hunting restrictions on privately owned wetlands. (Photo by Richard M. Hopper)

grain fields of the Arkansas Valley. And there is good waterfowl hunting locally throughout the state.

Despite this wealth of recreational opportunity, the welfare of waterfowl hunters, particularly duck hunters, is threatened. As stated, some of the best harvest habitat has already been removed from public use through purchase or lease of wetlands by private hunting groups or clubs. This process is continuing. Because of its inherent obligation to provide sportsmen of the state with all possible opportunity to hunt, the Colorado Game, Fish and Parks Department does not wish the wetlands shortage to progress to the point of no return. The Department cannot, of course, guarantee hunters access on private lands, now or in the future; its recourse, for waterfowl hunters, is acquisition of wetlands through purchase or lease for management as public hunting grounds.

It may be argued that the Department cannot acquire enough hunting grounds to accommodate more than a small percentage of waterfowl hunters. Examples of the fallacy in such thinking are demonstrated by public hunting areas at Two Buttes Reservoir and Monte Vista National Wildlife Refuge. During the 1965-1966 goose hunting season, 2,596 hunters used the firing-line at the Two Buttes Goose Management Area for 5,264 man-days of recreation, bagging 941 geese during the season. Grieb and Hunter (1966) estimated the total number of goose hunters, 1965-1966, in the entire 9-county region of southeastern Colorado at 6,313, for 34,911 man-days of recreation. The harvest totaled 9,613 geese. It was determined that 41 percent of all goose hunters in southeastern Colorado utilized the public hunting facilities at Two Buttes Reservoir at least once. Further, the reservoir supplied 15 percent of the total days of recreation. Even though grainfield hunting accounted for most of the goose harvest, nearly 10 percent of the total occurred on the firing-line of this 3,260-acre public hunting ground.

The San Luis Valley provides another example of what public shooting grounds can contribute to waterfowl hunting in a given locality. About 2,700 individuals hunted ducks in the San Luis Valley during the 1965 experimental season, held the first 18 days of October, providing an estimated 7,280 man-days of recreation. Monte Vista National Wildlife Refuge, with approximately 5,300 acres open to public hunting, attracted 867 individuals, or 32 percent of the total number of hunters in the Valley (Geis et al., 1966). This comparatively small area provided 1,604 man-days of hunting, or 22 percent of all duck hunting derived from the early season. Hunting success on the refuge was only slightly less than that for the Valley as a whole.

These two examples demonstrate the extent to which public shooting areas may supply a very substantial percentage of the waterfowl hunting in a locality, and should argue well in justifying enlarged and improved public waterfowl hunting grounds in Colorado.

Before undertaking an extensive acquisition program there are certain procedures that should be followed in order to increase the success of such operations. Essential to effectiveness is a means for rating the value of wetlands for waterfowl and hunting use. Characteristics that produce good hunting and encourage optimum waterfowl use must, therefore, be determined. Areas of no value in attracting and holding waterfowl will not serve the waterfowl hunter or enhance hunting recreation. Also, each area's value for other types of hunting and recreation should be considered, since use for other than waterfowl hunting will further justify acquisition.

The wetlands rating system described later in this report will permit establishment of a priority list for acquiring high-quality wetlands for public shooting. Wetlands having the highest priority can then be considered for purchase or lease by the Game, Fish and Parks Commission.

SURVEY METHODS

STUDY AREAS AND SECTIONS

Because of the importance of fall and winter waterfowl populations, the survey was limited to Colorado's 4 major migration, wintering, and harvest regions. These are the irrigated portions of the South Platte Valley, Arkansas Valley, San Luis Valley, and the Western Slope (Uncompahgre-Gunnison-Colorado River complex). These 4 regions hold at least 90 percent of the state's wintering waterfowl, and support an equal percentage of its harvest and hunting recreation.

Dryland farming regions were excluded from the survey, since only a very small percentage of the state's wetlands occur in these localities. Drylands lack irrigation reservoirs, seepage, and ponded water from irrigation and river overflows, which account for nearly all of the wetlands in irrigated valleys and adjacent lands.

The inventory was conducted on a county-by-county basis in which the irrigated portion of each county constituted a study area. All counties in a region were completed before beginning the survey of the next region.

It was not feasible to survey wetlands in all sections of an area because of the limited duration of the study. Therefore, a method of sampling was applied to each area to obtain the desired information. Two sections were selected from a table of random numbers for intensive study in each township, giving a sampling intensity of 5.5 percent. This sample permitted projection of the data and thus compilation of information by counties, by major regions, and the state as a whole. Sections selected for study were marked on county highway maps, enabling the observer to locate them with ease.

MAPPING OF STUDY SECTIONS

Some orientation concerning the location of wetlands on each section was desirable before visiting the site. This was accomplished by mapping obvious aquatic types with the aid of aerial photographs. Aerial photographs (8 inches to 1 mile) were made available through the district offices of the Soil Conservation Service.

Wetland acreages and miles of running water were also determined by using aerial photographs. A planimeter was employed to calculate acres of

wetlands, and a cyclometer, or map measurer, for determining miles of ditches, streams, and canals.

Maps indicating land ownership were also available at Soil Conservation Service offices, and were useful in ascertaining names of individuals holding various properties.

VISITATION OF STUDY SECTIONS

Study sections were visited after completing the initial map of an area. A detailed field evaluation was made of each wetland present. Sections were visited successively, resulting in the location and evaluation of all wetlands in one section before moving to another.

WETLAND CATEGORIES AND TYPES

Wetlands encountered were classified into the following categories: (1) lakes and reservoirs, (2) ponds and marshes over 5 acres in size, (3) ponds and marshes less than 5 acres in size, (4) streams, and (5) ditches and canals. The size that distinguished ponds from lakes and reservoirs was set at 20 acres.

Each wetland of 5 acres or more was also classified as one of the 20 types described by the Fish and Wildlife Service (Martin et al., 1953, and Fish and Wildlife Service, 1955). Stream channels and their associated marginal land were considered 2 different types in the classification. Thus, the total number of water areas classified as to type is greater than the total number classified in the wetland categories listed in the previous paragraph. Wetland types encountered in this survey are listed and described in Appendix B.

Only streams with permanent water flow were included. Similarly, only ditches and canals carrying water during most of the year were considered of sufficient value to waterfowl for inclusion in the survey.

WETLANDS EVALUATION

A "Wetlands Habitat Evaluation" form, used to record data required in developing a method for rating wetlands, was completed for each area except ditches and canals and ponds and marshes of less than 5 acres. These forms were executed, so far as possible, in on-the-spot examination of each wetland in question. The form used in the field survey is illustrated in Appendix B.

Landowners were contacted before visiting wetlands to be studied and evaluated. Valuable information necessary to completing the evaluation form was often obtained during these contacts, along with permission to enter the property. Explanation of survey objectives to landowners increased cooperation in most cases. In evaluating reservoirs, it was usually necessary to contact the irrigation company concerned. Information regarding recreational activities on wetlands owned or leased by sportsmen's clubs could often be obtained by contacting one of the members.

Evaluation forms were completed by walking around wetlands and observing conditions governing the habitat factors considered. In some instances a portion of the wetland was outside the study section. Then it was necessary to complete a form for the portion inside the section and one for the area as a whole. Only the portion in the section in the sample was included in inventory data; the other form provided information on the entire area, the state's primary interest. For streams, this procedure was not followed because of the difficulty in obtaining information for the entire length of this wetland category.

EVALUATION OF MAJOR WATERFOWL REGIONS

Location of Colorado's 4 major waterfowl migration, wintering, and harvest regions are shown in Figure 3. The South Platte and Arkansas valleys occur on the plains east of the Continental Divide, while the San Luis Valley and Uncompahgre-Gunnison-Colorado River complex are situated in the mountains of central and western Colorado. Only the latter region occurs west of the Continental Divide and in the Pacific Flyway. The other 3 regions are in the Central Flyway. Brief physical and economic descriptions of these regions are presented below, along with information on breeding and wintering waterfowl populations, hunting, and harvest.

SOUTH PLATTE VALLEY

General Description and Economy

The South Platte River drainage encompasses a large portion of north-central and northeastern Colorado. For purposes of this study, it includes all irrigated lands along the South Platte River from Denver to Julesburg and the large expanse of irrigated lands between Denver and Fort Collins. The latter comprises the smaller valleys of the Saint Vrain, Thompson, and Cache la Poudre rivers east of the Front Range (Fig. 3), tributaries of the South Platte.

Fenneman (1931) described the land form of the South Platte Valley of Colorado as the "Colorado Piedmont" section of the Great Plains province. This section is characterized by extensive erosion caused by water flow down the South Platte River and its tributaries. The main stream and large tributaries produced broad terraces and left them covered with gravel and loam as the streams cut to lower levels. Remnants of these terraces are found over 10 miles from the main stream. The older and higher ones are mostly gravelly because the surface loam has since been removed by water and wind. The lower terraces are still loam-covered and form the extensive irrigated lands of the South Platte Valley.

Elevation of the Valley ranges from about 5,500 feet at the western edge to 3,400 feet at the Colorado-Nebraska boundary. Climatic features of the Valley, as well as of the Colorado plains as a whole, include low relative humidity, abundant sunshine, light precipitation, moderately high winds, and large daily and seasonal temperature ranges. Climate is more uniform

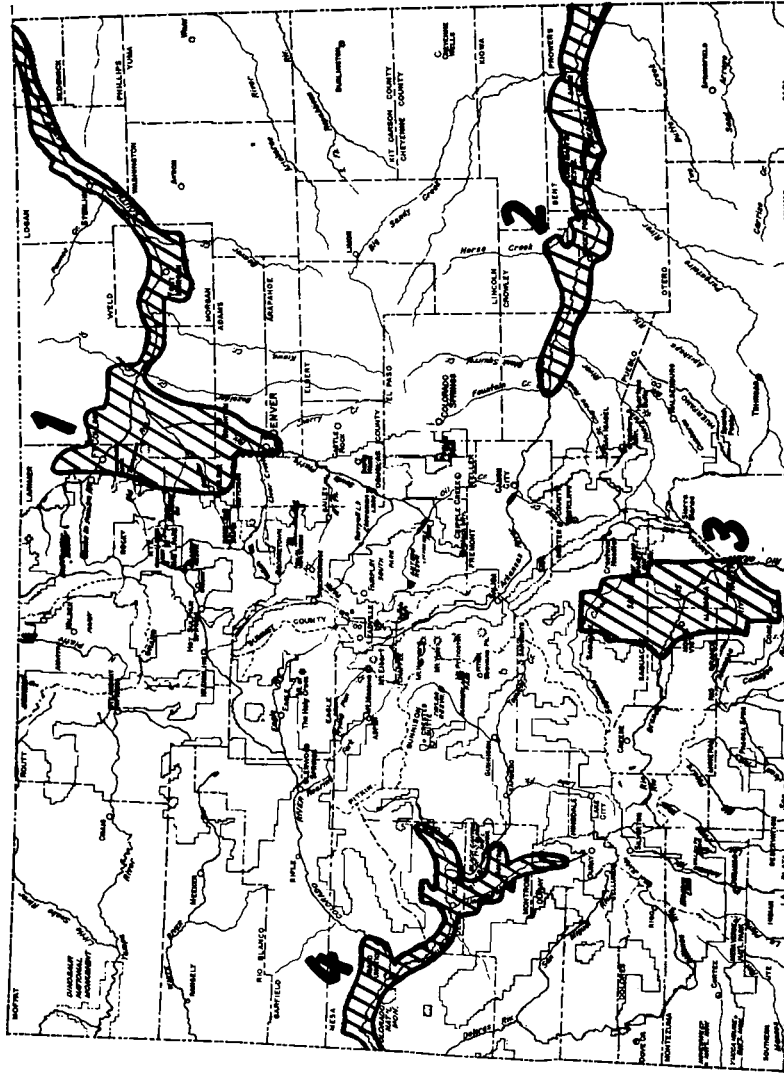


Figure 3—Colorado's four major waterfowl migration, wintering and harvest regions: (1) South Platte Valley, (2) Arkansas Valley, (3) San Luis Valley, and (4) Uncompahgre-Gunnison-Colorado River complex. (Map by Richard M. Hopper)



Figure 4—A scarcity of natural nesting sites in the Denver, Boulder, and Fort Collins areas has made artificial nesting structures a necessary device for increasing the resident flock of Canada geese. (Photo by Jack R. Grieb)

from place to place than in mountain areas. High temperatures often reach 95 degrees F or more, while low temperatures range from 0 to about 15 degrees F below zero. Precipitation ranges from slightly over 11 inches to about 18.5 inches annually. The heaviest precipitation occurs at both the western and eastern edges of the Valley. The Greeley and Fort Morgan

areas, situated in the central part of the Valley, receive the lightest precipitation (Colorado State Planning Division, 1964).

Economy of the South Platte Valley is based primarily on crop and livestock production. Major crops include corn, small grains, sugar beets, dry beans, hay, and commercial vegetables. Cattle are the principal livestock. Supplemental water from the western slope, provided by the Colorado-Big Thompson Water Diversion Project, has greatly increased the agricultural economy of the Valley (Colorado State Planning Division, 1964).

Waterfowl Resource

Breeding Populations—The duck breeding population of the South Platte Valley has increased in recent years to an estimated 22,310 birds in 1965, making it the third most important breeding ground in Colorado (Rutherford, 1966). Mallards (*Anas platyrhynchos*)^a and blue-winged teals (*A. discors*) normally constitute over 90 percent of the total.

Canada geese of the Great Basin subspecies (*Branta canadensis moffitti*) presently breed in substantial numbers in the Valley as a result of introductions. This population is estimated at about 2,000 birds, the greatest number occurring along the Front Range in the Denver, Boulder, and Fort Collins areas. The success of this breeding population of geese has largely been attributed to the erection of artificial nesting structures and controlled hunting (Fig. 4).

The Valley offers several important types of waterfowl breeding and nesting habitat. Both ducks and geese utilize ponds, marshes, and river-bottom seeps and sloughs.

Wintering Populations—The South Platte Valley is the major duck wintering area in Colorado, with concentrations of over 400,000 in some years. Wintering ducks find an abundant food supply in the form of corn on irrigated and dryland farms. Resting sites are on numerous lakes and reservoirs and on many miles of riverbottom. Mallards comprise at least 95 percent of the duck population, with green-winged teals (*A. carolinensis*), pintails (*A. acuta*), and American widgeons (*Mareca americana*) constituting most of the remaining birds.

Four main duck concentration areas exist in the Valley, as follows: (1) the Fort Collins locality, (2) between Denver and Greeley, (3) west of Fort Morgan, and (4) between Brush and Julesburg. These areas are of approximately equal importance in regard to number of wintering ducks. All lie within the best corn-producing areas in Colorado.

Canada goose concentrations are not as great as those in the Arkansas Valley, but numbers have been increasing in the South Platte Valley for the past several years. Wintering goose populations now number about 10,000 birds. The Denver, Boulder and Fort Collins areas support around 8,000 of the total, the remaining 2,000 scattered about equally along the remainder of the Valley. Their resting habitat consists mostly of large lakes and reservoirs. Small grains, in both green and ripe stages, and corn are utilized as food.

Generally, the South Platte Valley supports about 70 percent of Colorado's total wintering duck population, but only about 15 percent of its wintering geese.

Harvest and Hunter Use—The South Platte Valley is the most important duck harvest area in Colorado, as previously implied. An average of about 80,000 ducks have been bagged annually here since 1954, when kill surveys were first initiated (Grieb and Hunter, 1966). However, figures for individual years have varied considerably with different season lengths

^aScientific names of birds according to A.O.U. (1957)



Figure 5—The South Platte Valley is Colorado's most important duck wintering region. Hunting is excellent and the duck harvest here ranks first in the state. (Photo by George Andrews)

and bag limits. The harvest reached a high of 145,000 during a year of liberal waterfowl seasons and a low of 18,500 in a year of restrictive hunting (Fig. 5).

Counties rank as follows in order of decreasing duck harvest: Weld, Larimer, Morgan, Boulder, Logan, Adams, Sedgwick, and Washington. The kill in these counties usually amounts to over 50 percent of the state total. Mallards constitute 90 percent or more of the total bag.

Duck hunting pressure in the Valley averages about 11,500 hunters annually, or about 50 percent of the state total. Pressure during any one year has varied from less than 7,000 to nearly 18,000 hunters for the reason outlined above. Pressure is greatest in Weld County, followed by Larimer, Boulder, Logan, Morgan, and Adams counties.

Goose hunting pressure and harvest in the South Platte are not nearly as great as in the Arkansas Valley. However, hunting is increasing in both valleys, and in 1965 the total estimated kill of 2,475 geese was attained by about 3,700 hunters (Grieb and Hunter, 1966). Figures for 1965 are more indicative of present, and probably future, conditions than figures for a number of years earlier because the large build-up in the goose population

at the western edge of the South Platte Valley during the past 2 years has greatly increased hunter participation and harvest. This increase has come about through the establishment of resident breeding flocks in the Denver, Boulder, and Fort Collins areas, which attract migrant geese to these localities. Counties contributing most to the harvest, and receiving the heaviest hunting pressure, include Larimer, Weld, Morgan, and Washington.

ARKANSAS VALLEY

General Description and Economy

The portion of the Arkansas Valley of greatest waterfowl interest extends from Pueblo east to the Colorado-Kansas line in a narrow band along the lower Arkansas River in southeastern Colorado (Fig. 3). Elevations range from a high of 4,695 feet at Pueblo to a low of 3,200 feet at the Colorado-Kansas boundary. Important tributary streams in this section include the Saint Charles, Huerfano, Apishapa, and Purgatoire rivers. Past erosion has resulted in the present land form of the Valley, known as the "Colorado Piedmont" section of the Great Plains province (Fenneman, 1931). Characteristics of this physiographic subdivision were discussed under the "South Platte Valley" section.

Climatic conditions in the Arkansas Valley are characteristic of the plains region and therefore similar to those in the South Platte Valley. Mean annual temperatures average about 5 degrees higher in the Arkansas Valley than in the South Platte Valley, while precipitation is generally a little less. Annual precipitation increases from west to east, with a low of about 12 inches at Pueblo and a high of 14.2 inches at Lamar (Colorado State Planning Division, 1964).

Manufacturing and agriculture constitute the major economy of the Arkansas Valley. The Colorado Fuel and Iron Company's steel mill at Pueblo is the dominant industrial feature. Farming contributes greatly to the economy of the area. Principal crops include small grain, corn, sugar beets, dry beans, hay, and commercial vegetables. Much of the agricultural economy is also derived from livestock and livestock products, cattle dominating. When completed, the Fryingpan-Arkansas Transmountain Water Diversion Project will increase development of the Arkansas Valley by providing more irrigation water and recreational opportunity (Colorado State Planning Division, 1964).

Waterfowl Resource

Breeding Populations—Good waterfowl breeding habitat is limited in the Arkansas Valley, but some is located along the Arkansas River in the form of marshes and seep areas. An estimated 5,000 ducks, mostly mallards, teals, and pintails, nest here. This figure is considerably less than in the better duck production areas in the San Luis Valley, North Park, and the South Platte Valley. The Arkansas Valley does not presently support a breeding goose population. Extremely hot, dry weather probably accounts for its low waterfowl production.

Wintering Populations—The Arkansas Valley below Pueblo constitutes an important wintering area for ducks and geese. Mid-winter counts conducted during a 19-year period (1948-1966 inclusive) yielded an average annual population of 82,108 ducks and 27,894 geese for the Valley. Populations of up to 250,000 ducks and 60,000 geese have been present. These winter concentrations occur mostly east of Fowler in association with large lakes, reservoirs, and riverbottoms in small-grain and corn-production areas. The portion of the Valley lying west of Fowler and east of Pueblo supports only small numbers of wintering waterfowl because of the scarcity of large water bodies on which the birds can take refuge.



Figure 6—Several large reservoirs in the Arkansas Valley provide important winter resting habitat for Canada geese. Most such reservoirs are also major goose harvest areas. (Photo by Richard M. Hopper)

The mallard is the most important duck in the Valley. The goose population is represented almost entirely by 2 of the small subspecies of Canada goose (*B. c. parvipes* and *B. c. hutchinsii*).

Approximately 20 percent of Colorado's wintering ducks occur in the Valley, while at least 80 percent of its wintering goose population is represented here. The Arkansas Valley is second only to the South Platte Valley in importance as a duck wintering area (Fig. 6).

Harvest and Hunter Use—Harvest of ducks in the Arkansas Valley during the 12-year period, 1954 to 1965, has averaged about 20,000 birds annually, or 15 percent of the state total (Grieb and Hunter, 1966). Yearly harvest has varied from 3,500 to almost 28,000 birds, as a result of changes in hunting regulations. Over 90 percent of the kill is mallards.

About 4,000 hunters account for the duck harvest each year, low and high years involving a calculated 1,350 and 6,700 hunters. The greatest hunting pressure and harvest are in Prowers, Pueblo, Bent, and Crowley counties.

The Arkansas Valley constitutes the most important goose harvest area in Colorado, with an average annual kill of about 13,200 birds since 1954 (Grieb and Hunter, 1966). The annual harvest has ranged from 7,300 to 17,700. Most of the kill occurs in the lower portion of the Valley in Baca, Kiowa, and Prowers counties, where the harvest amounts to more than 80 percent of the state total.

Arkansas Valley goose hunters varied in number from about 5,750 to nearly 10,000 during 1954-1965. The average annual hunting pressure amounted to slightly over 8,000 hunters, or about twice that of duck hunters. The Valley attracts about 50 percent of all Colorado goose hunters, and has the reputation of providing some of the best goose hunting in the nation.

SAN LUIS VALLEY

General Description and Economy

The San Luis Valley is the southernmost large park or intermountain basin in Colorado (Fig. 3), extending about 75 miles from north to south and terminating at the Colorado-New Mexico border. Bounded on the east by the Sangre de Cristo Mountains and on the west by the San Juan Range, the Valley is nearly 50 miles wide at its greatest width. The Rio Grande River, flowing through the central and southern parts of the Valley in a southeasterly direction, is joined here by the Alamosa and Conejos rivers, the main tributaries.

The San Luis Valley lies in the physiographic subdivision of the United States known as the "Southern Rocky Mountain" province (Fenneman, 1931). The basin has a relatively flat surface that rises rather gradually toward steep mountains to the north, east, and west. Elevations range from 7,000 feet at the south end to about 8,000 feet at the base of the mountains.

The San Luis Hills, 10 to 20 miles north of the Colorado-New Mexico line, were elevated across the Valley's drainage course at a comparatively late time. This created a huge fresh-water lake which ultimately filled with alternating beds of sand and clay, from which large supplies of artesian water are now derived. The beds of sand come to the surface near the edge of the basin, and all streams flowing out of the adjacent mountains into the northern half of the Valley are lost by percolation. This results in a "closed basin" situation in that portion of the Valley.

Climate in the Valley is characterized by cool, dry summers and cold winters, with an average of about 25 inches of snowfall annually. Mean annual temperature is about 42 degrees for the Valley floor as a whole. Precipitation is uniformly low throughout the Valley, with an average of about 7.7 inches annually (Colorado State Planning Division, 1964).

The economy of the Valley depends mainly on agricultural crops and livestock production. Important crops are commercial vegetables, potatoes, small grains, and hay. Sheep and cattle are the major types of livestock raised. The Valley also ranks high in wool production (Colorado State Planning Division, 1964).

Waterfowl Resource

Breeding Populations — The duck breeding population in the Valley has averaged about 55,000 birds annually in recent years, making it Colorado's most important breeding ground for ducks (Hopper and Rutherford, 1966).

Mallards usually constitute about 50 percent of this population, with gadwalls (*A. strepera*), blue-winged teals, cinnamon teals (*A. cyanoptera*), pintails, and redheads (*Aythya americana*) making up most of the remaining percentages.

A resident flock of about 500 Canada geese breed in the Valley, and is increasing through the efforts of the Bureau of Sport Fisheries and Wildlife and the Colorado Game, Fish and Parks Department. These geese were introduced from other areas; the Valley offers good potential for producing a harvestable surplus of the birds.

Numerous artesian wells located throughout the Valley create many water areas of great value to breeding waterfowl. Important among these are the large tracts of flooded hay and pasture lands. Drain ditches and some marshes also result from artesian flows. Other major wetlands are associated with the Valley river systems including oxbow ponds, marshes and sloughs.

Wintering Populations — The size of the wintering population of ducks in the Valley depends primarily on weather conditions. This is more or less true in the other 3 regions, but not to the extent found in the San Luis Valley. Its high elevation results in cold weather which serves to push many birds from the Valley during most years. Nearly 50,000 ducks have been observed during mid-winter counts, but the average post-season population consists of only about 20,000 birds. Most of the movement out of the Valley occurs after the hunting season.

Large numbers of ducks are present in the Valley during the fall months prior to severe cold weather, a population made up almost entirely of birds produced locally or in the adjacent mountains. Mallards, which comprise the largest segment, have a strong attraction to the Valley and little harvest of these birds occurs outside its confines.

This situation led to the establishment of experimental seasons, beginning in 1963, for evaluating the effects of hunting on fall-concentrated birds. Seasons since 1963 have been held between October 1 and October 18, in addition to the regular season. Pre-season population estimates averaged about 82,000 mallards for 1963-1965 (Geis et al., 1966), indicating the major importance of the fall as compared to the winter population in regard to recreational opportunity.

Geese wintering in the Valley are mainly the 500 resident breeding birds. A small flock of less than 1,000 migrant Canada geese sometimes winters in the southeastern portion of the Valley. More migrant geese will no doubt be attracted here, with an increase in the size and distribution of the resident flock.

Fall populations of ducks and geese utilize for resting habitat the numerous ponds, marshes, flooded meadows, and seep areas associated with riverbottoms and artesian well flows. Wintering birds are restricted to water areas kept free of ice by warm-water springs and artesian wells. Their diet consists mainly of barley.

Harvest and Hunter Use — Harvest of ducks in the San Luis Valley averaged about 16,300 birds annually (1954-1962) prior to the beginning of the experimental seasons in 1963 (Grieb and Hunter, 1963). Kills up to 22,000 birds were obtained during years of liberal seasons. However, the kill was as low as 3,700 ducks during years of restrictive regulations, just prior to the experimental seasons.

Experimental seasons of 1963-1965, plus regular seasons, produced annual harvests averaging about 17,500 ducks (Geis et al., 1966). Hunting pressure consisted of about 3,500 hunters each year, mainly during the experimental seasons, for regular seasons during this period were rather



Figure 7—October duck hunting in the San Luis Valley during the experimental season produced excellent bags and provided sportsmen a unique hunting experience. (Photo by Jack R. Grieb)

restrictive. Mallards made up 74 to 87 percent of the duck kill during the 3 experimental seasons to date (Fig. 7), and were even more important in the bag during the regular seasons. The greatest duck harvest occurs in Rio Grande County, followed by Saguache, Alamosa, and Conejos counties. About 10 percent of the state's total harvest and hunting pressure occurs in the San Luis Valley.

Goose harvests vary considerably from year to year in the Valley because they do not occur in the same number or for the same length of time each year. The estimated annual kill has been as low as 55 and as high as 800, with an average of about 250 annually for the period 1954 to 1964. Hunting pressure has ranged from 270 to 825 hunters during this 12-year period. Most of the harvest occurs in Conejos and Costilla counties. Portions of Alamosa, Conejos, and Rio Grande counties have been closed to goose hunting since 1960 to protect the resident breeding flock established there.

UNCOMPAHGRE-GUNNISON-COLORADO RIVER COMPLEX

General Description and Economy

The primary valley of western Colorado is a large trough marked by the course of the Uncompahgre River and its confluence with the Gunnison and Colorado rivers (Fig. 3). This is a relatively broad valley, 10 to 20 miles wide. Fertile irrigated lands, especially the river floodplains, occur in the Montrose, Delta and Grand Junction areas. Elevations vary from 5,800 feet at Montrose to about 4,600 feet at Grand Junction.

The physiography of this region belongs to the "Colorado Plateau" province (Fenneman, 1931). It lies at the eastern edge of the land form known as the "Canyon Lands." Mesas and deep, rugged canyons are characteristic of much of the area east and west of the large valley eroded by the Uncompahgre, Gunnison, and Colorado rivers.

Climate in the Uncompahgre-Gunnison-Colorado River complex consists of long, warm summers, much sunshine, and mild to moderate winters with little snowfall. The mean annual temperature is about 51 degrees. Precipitation averages about 8.5 inches annually, varying from 7.8 to 9.1 inches (Colorado State Planning Division, 1964).

The Uncompahgre-Gunnison-Colorado River system, like the other 3 major irrigated regions of Colorado, derives its economy from agriculture. Important crops include commercial fruits and vegetables, small grains, corn, sugar beets, dry beans, potatoes, and hay. Sheep and wool production also contribute significantly to the economy of the region (Colorado State Planning Division, 1964).

Waterfowl Resource

Breeding Populations—The Uncompahgre-Gunnison-Colorado River valleys are of minor importance in number of breeding waterfowl. Most wetland habitat is in the form of riverbottom, a large part of which offers little in the way of attractive nesting grounds. Ponds and marshes are in short supply in the entire region. Consequently, the breeding population of ducks is estimated at only about 2,500 birds, and is made up largely of mallards but also other dabbling ducks.

A few Canada geese inhabit the Colorado River west of Grand Junction during the spring and summer, but little nesting occurs at present. An attempt was made in 1967 to increase the nesting population of Canada geese on the Colorado River.

Wintering Populations—The Uncompahgre-Gunnison-Colorado River valleys support the smallest wintering waterfowl population found in the 4 major regions considered in this report. In fact, no more than 60 geese have been observed during mid-winter counts, probably because the area is mostly outside of their normal migration pattern. Most northern geese follow the Colorado River into Arizona and southern California.

A relatively small, but significant, population of about 25,000 ducks, or about 5 percent of the state total, winters in the Uncompahgre-Gunnison-Colorado region. These ducks, mostly mallards, find refuge in the inaccessible Black Canyon of the Gunnison River and in Ruby and Horsethief canyons of the Colorado River during the hunting season (Fig. 8). They readily move to other portions of these rivers and to the Uncompahgre River after the end of the hunting season. Feeding flights are made to corn and small grain fields in the Montrose, Olathe, Delta, and Grand Junction localities.

Harvest and Hunter Use—Harvest of ducks averaged about 10,000 annually in the Uncompahgre-Gunnison-Colorado area during the period 1954 to 1965 (Grieb and Hunter, 1966), with variations ranging from 3,500 to nearly 19,000. Counties rank as follows in decreasing order of harvest: Mesa, Delta, Montrose and Ouray. Hunters have varied in number from 850 to 2,150 during the same period. These harvest and hunter-use figures represent less than 10 percent of the state totals.

Very few geese are harvested in the Uncompahgre-Gunnison-Colorado region due to the absence of a significant wintering population. Most of the kill, which averages less than 50 birds annually, occurs when migrant geese stop in the area for a short period during their southern movements.



Figure 8—Large reservoirs are absent in the Uncompahgre-Gunnison-Colorado River region, but wintering ducks find safe resting places during hunting seasons in remote river canyons. (Photo by Wayne W. Sandfort)

RESULTS AND DISCUSSION

This section presents the results of the survey by regions, each discussed separately in the order covered in the field.

Table 1 compares the area covered in each of the 4 regions. The South Platte Valley is the largest in square miles and irrigated acreage, and the San Luis Valley ranks second. The Arkansas Valley covers only slightly more area than the Uncompahgre-Gunnison-Colorado River complex. Combined, the 4 regions comprise a total of 5,872 square miles, or 3,758,080 acres, or only about 5.6 percent of the state area. This relatively small percentage supports most of the state's migrating and wintering waterfowl, as well as most of its waterfowl hunting and harvest.

SOUTH PLATTE VALLEY

Counties containing appreciable amounts of irrigated land in the South Platte Valley include Adams, Boulder, Larimer, Logan, Morgan, Sedgwick, Washington, and Weld. Table 2 shows the number of sections selected for study in each county, varying widely because of the differential in amount of irrigated land by counties. Weld County was represented by 56, or about 41 percent, of the 137 sample sections in the South Platte Valley.

Amount of Wetlands

Tables 36-42 in Appendix A give acres and miles of wetlands in individual counties. They are arranged by county in order of increasing distance from Denver and show availability, quality, and quantity of wetlands to recreationists. Logan and Washington counties are combined in Table 41 because the latter contained only two study sections associated with irrigated land.

Study revealed that stream habitats make up progressively higher percentages of the wetland acreage as they flow eastward from the foothills and the Denver area. Lakes and reservoirs are progressively less numerous eastward. In Adams and Boulder counties, streams accounted for 0 and 10 percent, respectively, of the total wetland acreage, while lakes and reser-

**Table 1 — Size Comparison of the 4 Major Waterfowl Migration,
Wintering, and Harvest Regions in Colorado
(irrigated portions only)**

Region	Square Miles	Acres
South Platte Valley	2,465	1,577,600
San Luis Valley	1,552	993,280
Arkansas Valley	965	617,600
Uncompahgre-Gunnison- Colorado River complex	890	569,600
Totals	5,872	3,758,080

**Table 2 — Number of Study Sections in Irrigated Portion
of 8 Counties in the South Platte Valley**

County	No. of Study Sections	%
Adams	9	6.6
Boulder	12	8.8
Larimer	19	13.9
Logan	12	8.8
Morgan	20	14.6
Sedgwick	7	5.1
Washington	2	1.4
Weld	56	40.8
Totals	137	100.0

voirs represented about 31 percent and 81 percent, respectively. These 2 counties lie adjacent to the foothills and the Denver region (Fig. 3). On the other hand, the total wetland sample in Sedgwick County consisted only of riverbottom land. Of the 8 counties included in the inventory, Sedgwick County is the greatest distance from the foothills and major population centers.

This situation may be explained as follows: Streams are normally more numerous near the foothills and they are smaller and contain less bottomland than those on the plains further east. Large acreages of riverbottom are associated with the South Platte River in Logan and Sedgwick counties, as contrasted to the small acreage along Boulder Creek in Boulder County. Further, irrigated land in Sedgwick and other counties toward the eastern boundary of the state is restricted to a narrow strip on either side of the South Platte River, whereas irrigated land near the foothills extends many miles beyond the borders of natural waterways. In the random selection of study sections along the lower part of the river there was, therefore, greater likelihood of including riverbottom land. At the western edge of the Valley, where irrigated farming is more important than further east, lakes and reservoirs are notably more numerous in Boulder and Larimer counties, where 81 percent and 70 percent, respectively, of the wetlands in the sample were of these types and associated marginal land (Tables 37 and 39, Appendix A).

Tables 3 and 4 show the combined water composition of all study sections in the irrigated portion of the Valley, and the proportion of the total in each wetland category. A total of 205 wetland areas, excluding ditches and canals, were observed on the 137 sections, an average of 1.50 each. The wetland acreage in the sample amounted to slightly over 7,100 acres, or 52 acres per square mile. The average linear distance of flowing water per square mile was 0.19 mile for streams and 0.71 mile for ditches and canals.

Table 3 — Water Composition by Categories of 137 Study Sections in Irrigated Portion of South Platte Valley

Wetland Category	No. Areas	Average No. Areas per Section	Surface Water, Acres	Average No. Acres per Section	Marginal Land, Acres	Average No. Acres per Section	Total Acres	Average No. Acres per Section	Miles	Average No. Miles per Section
Lakes and reservoirs	36	0.26	2,039.0	14.9	623.5	4.6	2,662.5	19.4	...	...
Ponds and marshes over 5 acres	52	0.38	189.2	1.4	536.1	3.9	725.3	5.3	...	...
Ponds and marshes less than 5 acres ^a	95	0.70	...	...	...	...	172.8	1.3	...	...
Streams	22	0.16	223.7	1.6	3,330.4	24.3	3,554.1	25.9	26.1	0.19
Ditches and canals	...	...	...	...	...	...	...	...	96.8	0.71
Totals	205 ^b	1.50	2,451.9	17.9	4,490.0	32.8	7,114.7 ^b	51.9	122.9	0.90

^a Only total acres determined for areas of 5 acres or less

^b Excluding ditches and canals

Table 4 — Proportion of Wetlands by Categories in 137 Study Sections in Irrigated Portion of South Platte Valley

Wetland Category	No. Areas	%	Surface Water, Acres	%	Marginal Land, Acres	%	Total Acres	%	Miles	%
Lakes and reservoirs	36	17.6	2,039.0	83.2	623.5	13.9	2,662.5	37.4	...	...
Ponds and marshes over 5 acres	52	25.4	189.2	7.7	536.1	12.1	725.3	10.2	...	...
Ponds and marshes less than 5 acres ^a	95	46.3	...	...	...	...	172.8	2.4	...	...
Streams	22	10.7	223.7	9.1	3,330.4	74.0	3,554.1	50.0	26.1	21.2
Ditches and canals	...	...	...	...	...	...	...	...	96.8	78.8
Totals	205 ^b	100.0	2,451.9	100.0	4,490.0	100.0	7,114.7 ^b	100.0	122.9	100.0

^a Only total acres determined for areas of 5 acres or less

^b Excluding ditches and canals

Ponds and marshes of less than 5 acres appear to be the predominant wetland category in the South Platte Valley, for about 46 percent of the 205 wetland areas in the sample occurred in this category (Table 4). However, small ponds and marshes contain less than 3 percent of the total wetland acreage. Lakes and reservoirs accounted for approximately 83 percent of the total surface acres of water, but streams with large acreages of associated bottomlands accounted for about three-fourths of the marginal land. Stream habitats constituted 50 percent, and lakes and reservoirs 37 percent, of the wetland total on the 137 sections. These 2 categories made up nearly 90 percent of the total wetland acreage. Their importance to wintering ducks and geese and to waterfowl hunters is, therefore, very evident. These wetlands, because of their extent, offer perhaps the greatest potential for the development of waterfowl production habitat and public hunting ground in the South Platte Valley of Colorado.

Table 5 presents the total projected acres and linear miles of wetlands in the irrigated portion of the Valley. Weld County, with almost 650,000 acres, and Sedgwick County with about 60,000 acres, contain the largest and smallest acreage of irrigated land in the 8 counties sampled. The large area of irrigated land in Weld County is due to its size and location in the heart of the irrigated region of the Valley. In Sedgwick County, irrigated land is restricted to a narrow strip adjacent to the South Platte River.

Wetlands per sample section averaged 19.6 acres in Weld County and 118.3 acres in Logan County. Weld County is flatter with fewer depressions than the other counties, accounting for the low average. The large figure for Logan County is explained by the importance of riverbottoms in the irrigated portion. The $\pm t .05$ standard error for each average (Table 5) indicates, in most cases, wide variation among study sections within counties, undoubtedly the result of relatively small sample sizes. When samples for all counties were combined to determine the average wetland acreage per section, a smaller $t .05$ standard error was obtained (51.9 ± 16.4). Projected, a total wetland acreage of $127,934 \pm 40,426$, or 8.1 ± 2.6 percent of the irrigated portion of the Valley, is indicated.

Streams occurred in only 22 of the 137 study sections. Many study sections with 0 miles of streams contributed greatly to the pronounced variation in the average per section by counties and for all counties combined (Table 5). Average miles of stream per section for the 8 counties was 0.19 ± 0.08 , the projected figure being 468.4 ± 197.2 miles for the irrigated portion of the Valley.

As would be expected, ditches and canals are much more common than streams in the Valley. According to the sample, Larimer County contains more miles of ditches and canals than any other Valley county, having an average of 1.33 ± 0.46 miles per section. The extensive network of ditches and canals is needed to transport water to and from the large number of reservoirs. An average of 0.71 ± 0.14 mile per section for all counties indicated a total estimated mileage of $1,750.2 \pm 345.1$ for the irrigated portion of the Valley (Table 5).

Table 6 presents a summary of wetland data for the irrigated portion of the Valley. Projected number and acres for the various wetland categories are included for the Valley as a whole.

Wetland Types

In number, type "5" wetlands (open fresh water, Fig. 12) are more common in the Valley than any other water area over 5 acres in size (Table 7). Type "5" made up about 57 percent of the larger water areas in the 137 sections, while types "1" and "4" (seasonally flooded basins or

**Table 5 — Projected Acres and Linear Miles of Wetlands in Irrigated
Portion of South Platte Valley**

County	Total Irrigated Land ^a		Total Wetlands ^b		Projected Total, Acres
	Sections	Acres	Average No. Acres/Section in Sample ^d	%	
Adams	156	99,840	22.4±23.4	3.5± 3.6	3,494± 3,650
Boulder	223	142,720	47.4±46.2	7.4± 7.2	10,750±10,303
Weld	1,015	649,600	19.6±10.4	3.1± 1.6	19,894±10,556
Larimer	336	215,040	83.4±26.1	13.0± 4.1	28,022± 8,770
Morgan	353	225,920	78.7±24.4	12.3± 3.8	27,781± 8,613
Logan	288 ^c	184,320	118.3±94.8	18.5±14.8	34,070±27,302
Sedgwick	94	60,160	61.9±98.9	9.7±15.4	5,819± 9,297
Totals	2,465	1,577,600	51.9±16.4	8.1± 2.6	127,934±40,426

^a Study areas from which sample sections were selected

^b Excluding ditches and canals

^c Includes 30 sections in Washington County, 2 of which were study sections

^d ± t .05 standard errors

County	Total Irrigated Land ^a		Streams		Ditches and Canals	
	Sections	Acres	Average No. Miles/Section in Sample ^c	Projected Total, Miles	Average Miles/Section in Sample	Projected Total, Miles
Adams	156	99,840	...	...	0.36±0.34	56.2± 58.0
Boulder	223	142,720	0.14±0.18	31.2± 40.1	0.44±0.53	98.1±118.2
Weld	1,015	649,600	0.07±0.08	71.0± 81.2	0.76±0.24	771.4±243.6
Larimer	336	215,040	0.35±0.34	117.6±114.2	1.33±0.46	446.9±154.6
Morgan	353	225,920	0.16±0.19	56.5± 67.1	0.56±0.31	197.7±109.4
Logan	288 ^b	184,320	0.47±0.45	135.4±129.6	0.54±0.41	155.5±118.1
Sedgwick	94	60,160	0.62±0.86	58.3± 80.8	0.27±0.34	25.4± 32.0
Totals	2,465	1,577,600	0.19±0.08	468.4±197.2	0.71±0.14	1,750.2±345.1

^a Study areas from which sample sections were selected

^b Includes 30 sections in Washington County, 2 of which were study sections

^c ± t .05 standard errors

**Table 6 — Summary of Wetlands Data for Irrigated Portion
of South Platte Valley**

Wetland Types and Projections	No.	%
No. of study sections	137	100
No. of wetlands/study section ^a	1.50	
Lakes and reservoirs	0.26	17.6
Ponds and marshes over 5 acres	0.38	25.4
Ponds and marshes less than 5 acres	0.70	46.3
Streams	0.16	10.7
Acres of wetlands/study section ^a	51.9	
Lakes and reservoirs	19.4	37.4
Ponds and marshes over 5 acres	5.3	10.2
Ponds and marshes less than 5 acres	1.3	2.4
Streams	25.9	50.0
Total wetland percentage/study section ^a	—	8.1
Miles of streams/study section	0.19	
Miles of ditches and canals/study section	0.71	
Total sections of irrigated land	2,465	
Total acres of irrigated land	1,577,600	
Total projected no. of lakes and reservoirs	640 ^b	
Total projected no. of ponds and marshes over 5 acres	937	
Total projected no. of ponds and marshes less than 5 acres	1,701	
Total projected acres of wetlands ^a	127,934	
Total projected miles of streams	468	
Total projected miles of ditches and canals	1,750	

^a Excluding ditches and canals

^b Actual count of permanent lakes and reservoirs

**Table 7 — Wetland Type Classification of 110 Water Areas^a in
Irrigated Portion of South Platte Valley**

Wetland Type	No.	%	Acres	%
"1"	23	20.9	3,577.7	51.5
"3"	3	2.7	36.6	0.5
"4"	21	19.1	351.8	5.1
"5"	63	57.3	2,975.8	42.9
Totals	110	100.0	6,941.9	100.0

^a Excluding ponds and marshes less than 5 acres and ditches and canals.

flats and deep fresh marsh; Figs. 9 and 11) made up approximately 20 percent each. This is not surprising, since ponds, lakes, and reservoirs are particularly prevalent in the Valley and each is in the type "5" category. Type "3" wetlands (shallow fresh marsh; Fig. 10) accounted for less than 3 percent of the 110 water areas over 5 acres in size (Table 7). Types "1", "3" and "4" would occur with greater frequency if wetlands of less than 5 acres were considered. Small areas of these 3 types appear to be characteristic of intensively farmed lands, where irrigation waste-water and seepage from ditches and canals contribute to their formation. (See Appendix B for descriptions of wetland types).



Figure 9—Type "1" wetlands (seasonally flooded basins or flats). Margins of draw-down reservoirs are included in this type. (Photo by Jack R. Grieb)

Although type "5" wetlands were greatest in number, type "1" accounted for the greatest acreage (Table 7), amounting to 51.5 percent of the total (excluding areas less than 5 acres). Type "5" made up only about 43 percent. This agrees closely with Table 4, showing that streams and associated bottomland accounted for 50 percent of all wetland acreage. River-bottom was by far the most common type "1" wetland. The aggregate acreage of wetlands of less than 5 acres would probably not significantly affect the percentages given.

Recreational Use

In the South Platte Valley sample, 110 wetland areas over 5 acres in size were rated for recreational and general wildlife value. Types of use — private, public, leased, or none — in each of the 8 counties are presented in Table 43-48 of Appendix A. Table 8 lists the types of recreational use for the 8 counties combined. Hunting, fishing, or boating rights were classified as "none" when conditions were not suitable to such uses. Table 9 shows ownership of the 110 wetlands.

Hunting — Although hunting on wetlands is not necessarily restricted to waterfowl shooting, ducks and geese are normally of primary concern where water areas occur. The interpretations and conclusions that follow emphasize this type of hunting.

Of the 110 wetlands in the sample, 51, or 46.4 percent, were open to public hunting (Table 8), amounting to 60 percent of the wetland acreage excluding areas of less than 5 acres. Nineteen, or 17.2 percent, of the 110 wetlands, and nearly one-fourth (23 percent) of all wetland acreage was leased for hunting. Sportsmen could not obtain permission to hunt on 40 (36.4 percent) of the 110 wetlands, or 16.8 percent of the total wetland acreage.

Relatively large variation in these percentages existed among the counties, as shown in Tables 43-48, Appendix A. Wetlands open to public



Figure 10—Type "3" wetlands (shallow fresh marsh) may contain up to six inches of surface water during the growing season. (Photo by Richard M. Hopper)

hunting ranged from 22.2 percent in Adams County to 100 percent in the 3 eastern counties combined (Logan, Washington, and Sedgwick). Wetland acreage available for public hunting varied from 12.3 and 17.3 percent, respectively, in Weld and Adams counties, to 100 percent in the 3 easternmost counties. In contrast, the percentage of wetlands leased for hunting decreased from 33.3 in Adams County to 0 in Logan, Washington, and Sedgwick counties combined. The area of leased wetlands also had the widest range between these 2 county groups, 47.3 percent and 0 percent, respectively.

The number of wetlands closed to public hunting, other than those privately leased, ranged from 0 percent in Logan, Sedgwick, and Washington counties to 50 percent in Morgan County. Adams, Boulder, Larimer, and Weld counties also showed percentages similar to Morgan County. On an acreage basis, this group of wetlands varied from 0 percent in the 3 easternmost counties to nearly 42 percent in Weld County. Graphic representation of these relationships is shown in Figure 13.

The graphed values indicate a general increase in public hunting privilege with increase in distance from the foothills and Denver, as previously stated. Conversely, there appeared to be a decrease in number and acreage of wetlands leased as hunting areas. Fewer leased wetlands, plus the increased tendency of landowners to grant permission to hunt in lightly populated regions, probably account for more public hunting in the more eastern counties. A greater number of leased wetlands near important population center is to be expected because of proximity and accessibility, making for reduced expense and allowing more actual hunting time.

Large wetlands were most valuable for leasing because of their attractiveness to hunting clubs. Although Boulder County is close to the Denver area, it contains few wetlands of sufficient size to be attractive to hunting clubs. The importance of leased wetlands in Weld County (Fig. 13) grows out of the fact that it is the closest county to Denver with an extensive riverbottom mileage.



Figure 11—Type "4" wetlands (deep fresh marsh) are characterized by emergent vegetation and hold one to three feet of surface water during the growing season. (Photo by Richard M. Hopper)

Fishing—About 57 percent of wetlands over 5 acres in size provided little or no fishing because game-fish populations were lacking due to unsuitable waters (Table 8). Thirty-one, or 66 percent, of the remaining 47 wetlands were open to public fishing, and the other 16 were divided about equally between private and leased fishing. Public fishing was permitted on about 75 percent of the total acreage of the 47 wetlands (including marginal land). There seemed to be no apparent pattern in fishing rights with respect to distance from the foothills and population centers to the Colorado-Nebraska line.

Boating—Ninety, or 82 percent, of the 110 wetlands over 5 acres in size were undesirable for pleasure-boating and water skiing because of their small size or because they were of a stream nature. Only wetlands with more than 75 acres of open water were considered of sufficient size to allow safe public use. Five, or 25 percent of the remaining 20 wetlands were closed to pleasure-boating and associated activities. Public and leased boating was offered on 7 wetland areas each, or 35 percent, with only one, or 5 percent, limited to private use. Although leased areas made up a large number of the desirable boating sites, public boating areas accounted for over 3 times as much acreage as those leased.

Importance of Leasing—Twenty-two, or 20 percent of the 110 wetlands involved were leased for one or more recreational uses, hunting being the primary interest. Hunting rights were leased on 19, or 86 percent, of the 22 areas, of which 10 were for hunting only. The remaining 3 areas were leased for fishing or boating only. Since hunting was restricted to only 3 leased areas, it is doubtful if there is much conflict between fishing and/or boating and hunting on leased land. Indeed, this is to be expected, since these sports are active during different times of the year. Likewise, conflict would seem to be slight where unleased areas are concerned. Leasing of wetlands



Figure 12—Type "5" wetlands (open fresh water). Emergent vegetation, if present, is restricted to a narrow border at the edge of the water area. (Photo by Richard M. Hopper)

for hunting is apparently causing greater reduction than fishing or boating leases in both number and acreage of wetlands open to the public. However, landowners who prohibit all hunting on wetlands, except by themselves or friends, are presently more important in restricting public hunting than private leases. Both are effective in reducing the amount of land on which public hunting is permitted.

Type of Ownership

Table 9 shows ownership of the 110 sample wetlands over 5 acres in size in the South Platte Valley. Private and company ownership accounted for 102, or 92.7 percent. Only 8, or 7.3 percent, are on public land. However, public ownership contributed almost 11 percent of the sample acreage.

ARKANSAS VALLEY

Arkansas Valley counties containing significant amounts of irrigated land are Bent, Crowley, Otero, Prowers, and Pueblo. Fifty-three sections were selected as a sample for the Valley. Table 10 lists the number of study sections in each county.

Amount of Wetlands

Tables 49-53 in Appendix A list acres and linear miles of wetlands in individual counties. The sample revealed that stream habitats make up most of the wetland acreage in all counties except Crowley, where streams account for only 22.1 percent of the wetland acreage in the sample. Other counties ranged from 65.1 percent in Bent County to 99.5 percent in Pueblo County. In Crowley County, lakes and reservoirs, comprising 75.6 percent of the wetland acreage, are much more important than streams. The 2 counties with the lowest percentages of stream habitat, Crowley and Bent,

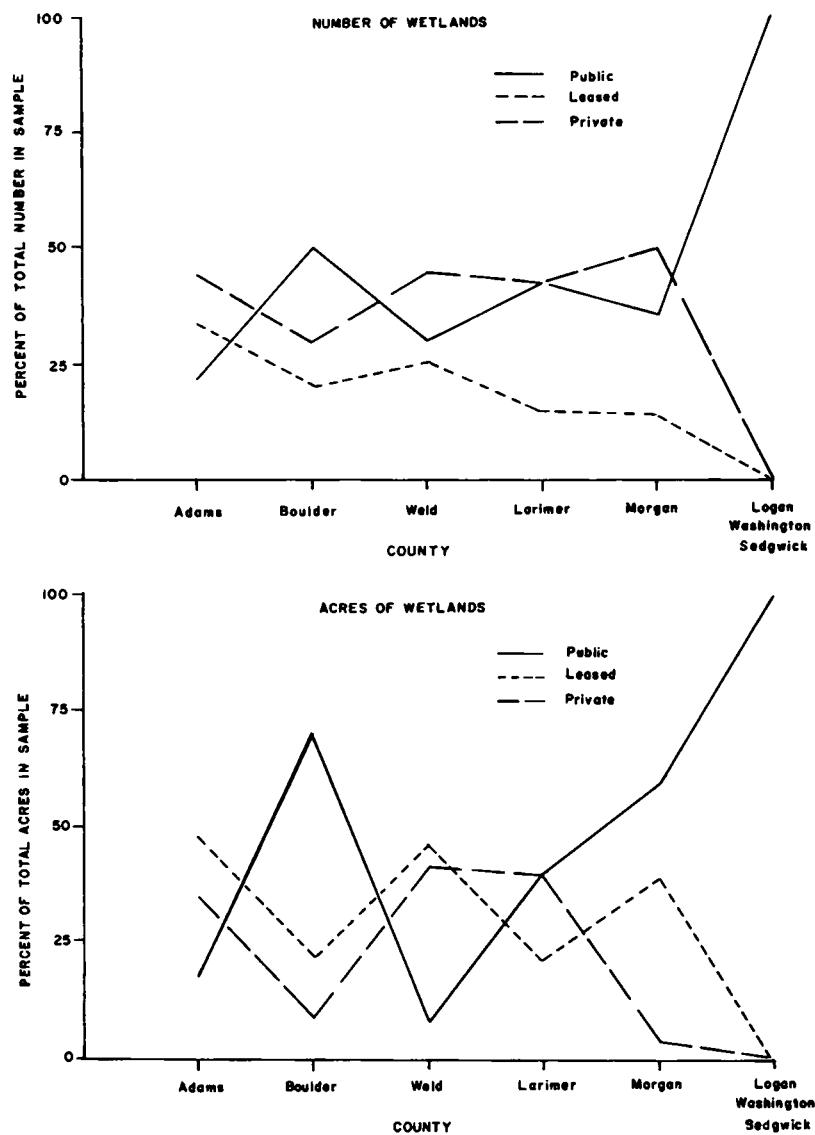


Figure 13—Number and acres of wetlands in the South Platte Valley, in percentages, in sample sections classified as public, leased and private hunting grounds. (Graph by Richard M. Hopper)

Table 8 — Recreational Use of 110 Wetland Areas^a in Irrigated Portion of South Platte Valley

Type of Use	Hunting				Fishing				Boating			
	No. Areas	%	Acres	%	No. Areas	%	Acres	%	No. Areas	%	Acres	%
Private	40	36.4	1,186.4	16.8	7	6.4	304.7	4.3	1	0.9	191.7	2.7
Public	51	46.4	4,243.3	60.2	31	28.2	2,259.3	32.0	7	6.4	1,416.5	20.1
Leased	19	17.2	1,624.0	23.0	9	8.2	429.6	6.1	7	6.4	459.4	6.5
None	..	..	..	..	63	57.2	4,060.1	57.6	95	86.3	4,986.1	70.7
Totals	110	100.0	7,053.7	100.0	110	100.0	7,053.7	100.0	110	100.0	7,058.7	100.0

^a Excluding ponds and marshes less than 5 acres and ditches and canals

Table 9 — Ownership of 110 Wetland Areas^a in Irrigated Portion of South Platte Valley

Ownership	No.	%	Acres	%
Corporation or company	22	20.0	2,066.2	29.0
Private	80	72.7	4,289.4	60.3
Public	8	7.3	759.1	10.7
Totals	110	100.0	7,114.7	100.0

^a Excluding ponds and marshes less than 5 acres and ditches and canals.

Table 10 — Number of Study Sections in Irrigated Portion of 5 Counties in the Arkansas Valley

County	No. of Study Sections	%
Bent	12	22.6
Crowley	7	13.2
Otero	12	22.6
Prowers	16	30.3
Pueblo	6	11.3
Totals	53	100.0

are the only ones with appreciable acreages of lakes and reservoirs. A noticeable lack of lakes and reservoirs accounts for the importance of riverbottoms in the other 3 counties.

Riverbottom land in Pueblo County amounted to an average of slightly over 200 acres per section, more than twice as much as in the next highest county. The significance of stream habitat in Pueblo County is due to restriction of irrigated land to a narrow strip on each side of the Arkansas River. In other counties irrigated land tends to extend over a wider belt eastward, riverbottom sections becoming a less important part of the total.

The situation described is the opposite of the South Platte Valley, where irrigated land is restricted to a narrower band eastward along the South Platte River. The Arkansas River receives few major tributaries from Pueblo to the Colorado-Kansas line. Rough topography and a narrow valley prevent extensive irrigated farming in Pueblo County, but the acreage gradually increases in the 4 remaining counties as the valley broadens toward the east.

Tables 11 and 12 present water composition and proportion of wetlands by categories in the sample. Fifty-eight wetland areas, excluding ditches and canals, were observed on 53 sections, an average of 1.09 wetlands per section. The total acreage of wetlands on these sections was 6,163.9 acres, or 116.3 acres per square mile. The average linear distance of running water per square mile was 0.40 mile for streams and 0.31 mile for ditches and canals.

The appreciable difference between the average acreage of wetlands per section in the South Platte (51.9) and the Arkansas valleys (116.3) is due to the larger number of reservoirs per square mile of irrigated land in the latter.

In number, ponds and marshes of less than 5 acres were the predominant wetland category in the Arkansas Valley, just as in the South Platte. Fifty percent of the 58 wetlands in the sample were in this category (Table 12). However, small ponds and marshes represented only 0.4 percent of the total wetland acreage in the 53-square mile sample.

Lakes and reservoirs accounted for approximately 90 percent of the total surface acres of water, while streams, with relatively large associated bottomlands, made up about 95 percent of the total acreage of marginal land. Streams constituted almost 70 percent and lakes and reservoirs about 27 percent, of the wetland acreage on the study sections. These 2 categories comprised approximately 96 percent of all wetland acreage, and emphasize why the Arkansas Valley can never be an important waterfowl production area without considerable habitat development. The importance of riverbottoms and lakes and reservoirs to wintering ducks and geese and to waterfowl hunters in the Valley is evident. Development of combination waterfowl production, wintering, and hunting habitat on these wetland categories should make them equal in value to any other portion of the state.

Table 13 projects acres and linear miles of wetlands in the irrigated portion of the Arkansas Valley. Wetland acres per sample section, by counties, amounted to: Prowers 53.9, Otero 32.2, Bent 134.2, Crowley 205.9, and Pueblo 210.6.

Bent County has a large area of irrigated land on both sides of the Arkansas River, but John Martin Reservoir increases wetland acreage per section in this county. The irrigated portion of Crowley County is featured by a large reservoir acreage (Lake Meredith and Lake Henry) and considerable riverbottom land, accounting for its large wetland area. Pueblo County contains no lakes or reservoirs in the irrigated portion, but the

Table 11 — Water Composition by Categories of 53 Study Sections in Irrigated Portion of Arkansas Valley

Wetland Category	No. Areas	Average No. Areas per Section	Surface Water, Acres	Average No. Acres per Section	Marginal Land, Acres	Average No. Acres per Section	Total Acres	Average No. Acres per Section	Miles	Average No. Miles per Section
Lakes and reservoirs	4	0.07	1,649.6	31.1	...	...	1,649.6	31.1	...	...
Ponds and marshes over 5 acres	4	0.07	3.1	0.3	196.5	3.7	219.6	4.2	...	...
Ponds and marshes less than 5 acres ^a	29	0.55	...	...	...	...	23.2	0.4	...	...
Streams	21	0.40	175.6	3.3	4,095.9	77.3	4,271.5	80.6	21.4	0.40
Ditches and canals	...	...	...	...	...	...	...	...	16.2	0.31
Totals	58^b	1.09	1,838.3	34.7	4,292.4	81.0	6,163.9^b	116.3	37.6	0.71

^a Only total acres determined for areas of 5 acres or less

^b Excluding ditches and canals

Table 12 — Proportion of Wetlands by Categories in 53 Study Sections in Irrigated Portion of Arkansas Valley

Wetland Category	No. Areas	%	Surface Water, Acres	%	Marginal Land, Acres	%	Total Acres	%	Miles	%
Lakes and reservoirs	4	6.9	1,649.6	89.7	...	...	1,649.6	26.7	...	...
Ponds and marshes over 5 acres	4	6.9	13.1	0.7	196.5	4.6	219.6	3.6	...	...
Ponds and marshes less than 5 acres ^a	29	50.0	...	...	...	...	23.2	0.4	...	...
Streams	21	36.2	175.6	9.6	4,095.6	95.4	4,271.5	69.3	21.4	56.9
Ditches and canals	...	...	...	...	...	...	...	...	16.2	43.1
Totals	58^b	100.0	1,838.3	100.0	4,292.4	100.0	6,163.9^b	100.0	37.6	100.0

^a Only total acres determined for areas of 5 acres or less

^b Excluding ditches and canals

**Table 13 — Projected Acres and Linear Miles of Wetlands in Irrigated
Portion of Arkansas Valley**

County	Total Irrigated Land ^a		Total Wetlands ^b		Projected Total, Acres
	Sections	Acres	Average No. Acres/Section in Sample ^c	%	
Bent	225	144,000	134.2±144.5	21.0±22.6	30,195±32,512
Crowley	133	85,120	205.9±224.4	32.2±35.1	27,385±29,845
Otero	215	137,600	82.2± 67.7	12.8±10.6	17,673±14,556
Prowers	280	179,200	53.9± 49.9	8.4± 7.8	15,092±13,972
Pueblo	112	71,680	210.6±209.8	32.9±32.8	23,587±23,498
Totals	965	617,600	116.3± 48.0	18.1± 7.5	112,046±46,320

^a Study areas from which sample sections were selected

^b Excluding ditches and canals

^c ± t .05 standard errors

County	Total Irrigated Land ^a		Streams		Ditches and Canals	
	Sections	Acres	Average No. Miles/Section in Sample ^b	Projected Total,	Average No. Miles/Section in Sample	Projected Total,
				Miles		Miles
Bent	225	144,000	0.26±0.40	58.5± 90.0	0.28±0.34	63.0± 76.5
Crowley	133	85,120	0.39±0.46	51.9± 61.2	0.06±0.14	8.0± 18.6
Otero	215	137,600	0.53±0.40	114.0± 86.0	0.54±0.46	116.1± 98.9
Prowers	280	179,200	0.28±0.32	78.4± 89.6	0.27±0.27	75.6± 75.6
Pueblo	112	71,680	0.81±0.74	90.7± 82.9	0.30±0.58	33.6± 65.0
Totals	965	617,600	0.40±0.17	386.0±164.0	0.31±0.15	299.2±144.8

^a Study areas from which sample sections were selected

^b ± t .05 standard errors

relatively narrow strip of irrigated land on either side of the Arkansas River yields a high average wetland acreage, in the form of riverbottom, per square mile.

Wetlands in the Arkansas Valley averaged 116.3 ± 48.0 acres per sample section, indicating a projected acreage of $112,046 \pm 46,320$ or 18.1 ± 7.5 percent, of the irrigated Valley land.

Streams were present in only 20, or 37.7 percent, of the 53 sample sections. Sections with no streams contributed to the wide variation in average number of miles per section, by county and all counties combined (Table 13). There was an average of 0.40 ± 0.17 mile per section for the 5 counties; the projected figure for the irrigated portion of the Valley was 386.0 ± 164.0 miles.

Intensity of irrigated farming increased by county as follows, defined by average miles of ditches and canals per section: Crowley 0.06, Prowers 0.27, Bent 0.28, Pueblo 0.30, and Otero 0.54. Ditches and canals averaged

Table 14 — Summary of Wetlands Data for Irrigated Portion of Arkansas Valley

Wetland Types and Projections	No.	%
No. of study sections	53	100.0
No. of wetlands/study section ^a	1.09	—
Lakes and reservoirs	0.07	6.9
Ponds and marshes over 5 acres	0.07	6.9
Ponds and marshes less than 5 acres	0.55	50.0
Streams	0.04	36.2
Acres of wetlands/study section ^a	116.3	—
Lakes and reservoirs	31.1	26.7
Ponds and marshes over 5 acres	4.2	3.6
Ponds and marshes less than 5 acres	0.4	0.4
Streams	80.6	69.3
Total wetland percentage/study section	—	18.1
Miles of streams/study section	0.40	—
Miles of ditches and canals/study section	0.31	—
Total sections of irrigated land	965	—
Total acres of irrigated land	617,600	—
Total projected no. of lakes and reservoirs	14 ^b	—
Total projected no. of ponds and marshes over 5 acres	77	—
Total projected no. of ponds and marshes less than 5 acres	531	—
Total projected acres of wetlands ^a	112,046	—
Total projected miles of streams	386	—
Total projected miles of ditches and canals	299	—

^a Excluding ditches and canals

^b Actual count of permanent lakes and reservoirs

Table 15 — Wetland Type Classification of 42 Water Areas^a in Irrigated Portion of Arkansas Valley

Wetland Type	No.	%	Acres	%
"1"	17	40.5	4,078.4	66.7
"3"	2	4.8	164.9	2.7
"4"	1	2.3	26.9	0.4
"5"	22	52.4	1,849.8	30.2
Totals	42	100.0	6,120.0	100.0

^a Excluding ponds and marshes less than 5 acres and ditches and canals.

0.31 \pm 0.15 mile per section for all counties, giving a total estimated mileage of 299.2 \pm 144.8 for the irrigated part of the Valley (Table 13). Table 14 is a summary of wetland inventory data for the irrigated portion of the same area.

Wetland Types

In number, type "1" and "5" wetlands were more common in the Arkansas Valley than other water areas over 5 acres in size (Table 15). This was expected since riverbottoms (type "1") and lakes, reservoirs, and stream channels (type "5") constitute about 93 percent of the total number of wetlands in the region. Type "3" and "4" wetlands made up the remaining percentage. These 2 marsh types are more representative of wetlands smaller than 5 acres. (See Appendix B for descriptions of wetland types).

Type "1" wetlands accounted for more acreage than any other type because of extensive riverbottoms (Table 15), which made up about 67 percent of the wetland acreage in the sample (excluding areas less than 5 acres). Type "5" made up only about 30 percent of the total, despite the large number of areas. However, most type "5" wetlands were in the form of stream channels, which cover less acreage than adjacent bottomland. Only about 3 percent of the total wetland acreage was marsh (type "3" and "4"), a further indication of the limited waterfowl production habitat in this region.

Recreational Use

Twenty-eight wetlands over 5 acres in area were rated for recreational and wildlife value. Types of recreational use, whether private, public, leased, or none, are presented in Table 16. Hunting, fishing, and boating rights were listed as "none" when areas were not suitable for these activities. Table 17 shows ownership of the 28 areas.

Hunting — Of the 28 large wetlands, 23, or 82.1 percent, were open to public hunting (Table 16), and constituted 83.3 percent of the total wetland acreage (excluding areas of less than 5 acres). None of the 28 wetlands were leased for hunting. Areas where no hunting of any kind was allowed, except by the landowner and his personal friends, accounted for the remaining percentage. There was a definite contrast between the South Platte and Arkansas valleys concerning hunting opportunity.

Fishing — Only about 18 percent of the number and 27 percent of the area (more than 5 acres) were suitable for sport fishing. All were open to the public. The remainder provided little or no fishing because of shallow or turbid waters or for other reasons (Table 16).

Boating — The number of lakes and reservoirs large enough for pleasure-boating are definitely limited in the irrigated portion of the Arkansas Valley. Nearly 86 percent of the 28 sample wetlands were totally unsuitable for boating or water skiing because they were too small or of a winding stream nature. Of the 4 remaining areas, public and leased boating occurred on 2 wetlands each.

Type of Ownership

Table 17 shows ownership of the 28 sample wetlands over 5 acres in size. Private and corporation or company ownership involved 26, or 92.8 percent. Only 2 (7.2 percent) were owned by the public, but these made up 11 percent of the sample acreage. Almost identical percentages were found in the South Platte Valley.

Table 16 — Recreational Use of 28 Wetland Areas^a in Irrigated Portion of Arkansas Valley

Type of Use	Hunting				Fishing				Boating			
	No. Areas	%	Acres	%	No. Areas	%	Acres	%	No. Areas	%	Acres	%
Private	5	17.9	1,020.2	16.7	..	..	..	..	..	..	..	..
Public	23	82.1	5,106.8	83.3	5	17.9	1,669.6	27.2	2	7.1	560.1	9.1
Leased	..	..	..	..	..	..	..	..	2	7.1	1,089.5	17.8
None	..	..	..	..	23	82.1	4,457.4	72.8	24	85.8	4,477.4	73.1
Total	28	100.0	6,127.0	100.0	28	100.0	6,127.0	100.0	28	100.0	6,127.0	100.0

^a Excluding ponds and marshes less than 5 acres and ditches and canals

Table 17 — Ownership of 28 Wetland Areas^a in Irrigated Portion of Arkansas Valley

Ownership	No.	%	Acres	%
Corporation or company	6	21.4	1,572.4	25.5
Private	20	71.4	680.1	63.5
Public	2	7.2	3,911.4	11.0
Totals	28	100.0	6,163.9	100.0

^a Excluding ponds and marshes less than 5 acres and ditches and canals

Table 18 — Number of Study Sections in Irrigated Portion of 4 Counties in the San Luis Valley

County	No. of Study Sections	%
Alamosa	30	34.5
Conejos	17	19.5
Rio Grande	14	16.1
Saguache	26	29.9
Totals	87	100.0



Figure 14—Type "1-A" wetlands (seasonally flooded pasture and hay land). This type results when native pasture and hay lands are purposely flooded with irrigation water for growing livestock forage. (Photo by Lee E. Yeager)

SAN LUIS VALLEY

Survey of the San Luis Valley included the irrigated portions of Alamosa, Conejos, Rio Grande, and Saguache counties. Small acreages of other than irrigated land were also included because of their periodic wet condition and resultant importance to waterfowl. The additional acreage is included in Table 1.

Table 18 gives the number of sections studied in each county. Of the total of 87, most were in Alamosa and Saguache counties.

Amount of Wetlands

Tables 54-57, Appendix A, give acres and linear miles of wetlands on the 87 sections surveyed in the San Luis Valley. Study revealed that ponds and marshes over 5 acres accounted for most of the wetland acreage in each of the 4 counties. These wetlands made up 52.5 to 99.2 percent of the total area in Rio Grande and Saguache counties, respectively. Most of this acreage is attributed to lands periodically flooded in the management of pasture and hayland. The Bureau of Sport Fisheries and Wildlife (1955) considers this type a subdivision of type "1" wetlands (seasonally flooded basins and flats) and designates it as type "1-A" (Fig. 14). Such land represents a valuable segment of the waterfowl habitat in the San Luis Valley, particularly as production habitat.

Streams and associated marginal land constituted a large percentage of the wetland acreage in both Alamosa and Rio Grande counties, 40.2 percent and 46.4 percent, respectively. On the other hand, samples in Conejos and Saguache counties contributed less than one percent of the wetland acreage to stream habitat. This situation is explained by the presence of the Rio Grande River in Alamosa and Rio Grande counties and its absence in the other 2 counties.

Table 19 — Water Composition by Categories of 87 Study Sections in Irrigated Portion of San Luis Valley

Wetland Category	No. Areas	Average No. Areas per Section	Surface Water, Acres	Average No. Acres per Section	Marginal Land, Acres	Average No. Acres per Section	Total Acres	Average No. Acres per Section	Miles	Average No. Miles per Section
Lakes and reservoirs	...	...	...	...	...	...	...	...	...	...
Ponds and marshes over 5 acres	54	0.62	43.2	0.5	10,687.2	122.8	10,730.4	123.4	...	...
Ponds and marshes less than 5 acres ^a	74	0.85	...	...	...	...	158.4	1.8	...	...
Streams	15	0.17	115.4	1.3	1,932.4	22.2	2,047.8	23.5	17.0	0.20
Ditches and canals	...	...	...	...	...	...	...	...	58.4	0.67
Totals	143 ^b	1.64	158.6	1.8	12,619.6	145.0	12,936.6 ^b	148.7	75.4	0.87

^a Only total acres determined for areas of 5 acres or less

^b Excluding ditches and canals

Table 20 — Proportion of Wetlands by Categories in 87 Study Sections in Irrigated Portion of San Luis Valley

Wetland Category	No. Areas	%	Surface Water, Acres	%	Marginal Land, Acres	%	Total Acres	%	Miles	%
Lakes and reservoirs	...	...	...	...	...	...	...	...	...	...
Ponds and marshes over 5 acres	54	37.8	43.2	27.2	10,687.2	84.7	10,730.4	82.9	...	...
Ponds and marshes less than 5 acres ^a	74	51.7	...	...	...	...	158.4	1.3	...	...
Streams	15	10.5	115.4	72.8	1,932.4	15.3	2,047.8	15.8	17.0	22.5
Ditches and canals	...	...	...	...	...	...	...	...	58.4	77.5
Totals	143 ^b	100.0	158.6	100.0	12,619.6	100.0	12,936.6 ^b	100.0	75.4	100.0

^a Only total acres determined for areas of 5 acres or less

^b Excluding ditches and canals

Few lakes and reservoirs exist in the area studied. The Russell Lakes, Mishak Lakes, San Luis Lake, Adams Lake, and Home Lake are the only ones of a permanent nature. None were encountered on study sections in the 4 counties. The importance of flooded haylands to waterfowl in the San Luis Valley is enhanced by the absence of lakes and reservoirs.

Tables 19 and 20 present water composition and the proportion of wetlands in each category for the irrigated portion of the San Luis Valley. A total of 143 areas, excluding ditches and canals, were observed on 87 sections, an average of 1.64 wetlands per section. Wetlands totaled 12,936.6 acres, and averaged 148.7 acres per square mile. Running water per square mile averaged 0.20 mile for streams and 0.67 mile for ditches and canals.

Ponds and marshes of less than 5 acres were the predominant wetland category, as to number, in the San Luis Valley, just as in the South Platte and Arkansas valleys. Slightly over 50 percent of the 143 wetlands areas in the sample fell into this category (Table 20). However, these areas contributed only 1.3 percent of the total wetland acreage.

Ponds and marshes over 5 acres, consisting primarily of seasonally flooded haylands, made up 82.9 percent of the total wetland acreage for all San Luis Valley study sections. Streams and associated marginal land accounted for only 15.8 percent, much less than in the South Platte and Arkansas valleys.

Table 21 presents the total projected acreage and linear miles of wetlands in the irrigated portion of the Valley. Nearly 1,000,000 acres of irrigated land exists in the Valley, with Alamosa and Saguache counties contributing about two-thirds of the total.

The average wetland acreage per sample section, by counties, was as follows: Rio Grande 106.7, Alamosa 111.0, Conejos 155.8, and Saguache 210.1. Rio Grande and Alamosa counties showed the lowest figures because irrigated farming is practiced more intensively here than in the other 2 counties. The Rio Grande River, flowing through Rio Grande and Alamosa counties, provides water readily available for an intensified farming operation. Row crops and small grains form an important part of the agricultural economy in these 2 counties, whereas Conejos and Saguache counties emphasize the production of cattle on pasture and hayland. The abundance of pasture and hay land in Conejos and Saguache counties explains the greater wetland acreages per section. A projected wetland acreage of $230,782 \pm 71,438$, or 23.2 ± 7.2 percent, of the irrigated portion of the Valley is indicated.

Streams were present in only 15, or 17.2 percent, of the 87 study sections. A large number of study sections had 0 miles of streams, but nevertheless this category contributed greatly to variation in the mean number of miles per section for each county and for all counties combined (Table 21). Average miles of streams per sample section for the 4 counties was 0.20 ± 0.12 , with a projected figure of 310.4 ± 186.2 miles for the irrigated portion of the Valley.

Ditches and canals averaged 0.67 ± 0.18 mile per study section for all counties combined, resulting in a total estimated figure of $1,039.8 \pm 279.4$ miles for the irrigated part of the Valley (Table 21). Table 22 is a summary of wetlands inventory data for irrigated land in the San Luis Valley.

Wetland Types

In number, type "1-A" wetlands (seasonally flooded pasture and hay land, Fig. 14), are more common in the San Luis Valley than other types with respect to water areas of 5 acres or more (Table 23). They constituted 78 percent for the 4 counties involved.

Table 21 — Projected Acres and Linear Miles of Wetlands in Irrigated Portion of San Luis Valley

County	Total Irrigated Land ^a		Total Wetlands ^b		Projected Total, Acres
	Sections	Acres	Average No. Acres/Section in Sample ^c	%	
Alamosa	540	345,600	111.0± 69.4	17.4±10.8	59,940±37,476
Conejos	299	191,360	155.8±111.0	24.3±17.3	46,584±33,189
Rio Grande	251	160,640	106.7± 99.6	16.7±15.6	26,782±25,000
Saguache	462	295,680	210.1±105.4	32.8±16.5	97,066±48,695
Total	1,552	993,280	148.7± 46.0	23.2± 7.2	230,782±71,438

^a Study areas from which sample sections were selected

^b Excluding ditches and canals

^c ± t .05 standard errors

County	Total Irrigated Land ^a		Streams		Ditches and Canals	
	Sections	Acres	Average No. Miles/Section in Sample ^b	Projected Total, Miles	Average No. Miles/Section in Sample	Projected Total, Miles
Alamosa	540	345,600	0.29±0.26	156.6±140.4	0.52±0.33	280.8±178.2
Conejos	299	191,360	0.17±0.20	50.8± 59.8	0.66±0.38	197.3±113.6
Rio Grande	251	160,640	0.26±0.42	65.3±105.4	1.12±0.52	281.1±130.5
Saguache	462	295,680	0.07±0.10	32.3± 46.2	0.62±0.35	286.4±161.7
Totals	1,552	993,280	0.20±0.12	310.4±186.2	0.67±0.18	1,039.8±279.4

^a Study areas from which sample sections were selected

^b ± t .05 standard errors

Table 22 — Summary of Wetlands Data for Irrigated Portion of San Luis Valley

Wetlands Types and Projections	No.	%
No. of study sections	87	100.0
No. of wetlands/study section ^a	1.64	—
Lakes and reservoirs	—	—
Ponds and marshes over 5 acres	0.62	37.8
Ponds and marshes less than 5 acres	0.85	51.7
Streams	0.17	10.5
Acres of wetlands/study section ^a	148.7	—
Lakes and reservoirs	—	—
Ponds and marshes over 5 acres	123.4	82.9
Ponds and marshes less than 5 acres	1.8	1.3
Streams	23.5	15.8
Total wetland percentage/study section ^a	—	23.2
Miles of streams/study section	0.20	—
Miles of ditches and canals/study section	0.67	—
Total sections of irrigated land	1,552	—
Total acres of irrigated land	993,280	—
Total projected no. of lakes and reservoirs	12 ^b	—
Total projected no. of ponds and marshes over 5 acres	962	—
Total projected no. of ponds and marshes less than 5 acres	1,319	—
Total projected acres of wetlands ^a	230,782	—
Total projected miles of streams	310	—
Total projected miles of ditches and canals	1,040	—

^a Excluding ditches and canals

^b Actual count of permanent lakes and reservoirs

Table 23 — Wetland Type Classification of 59 Water Areas^a in Irrigated Portion of San Luis Valley

Wetland Type	No.	%	Acres	%
"1"	9	15.2	2,231.9	17.5
"1-A"	46	78.0	9,948.5	78.0
"3"	1	1.7	455.0	3.6
"4"	2	3.4	79.7	0.6
"5"	1	1.7	35.4	0.3
Totals	59	100.0	12,750.5	100.0

^a Excluding ponds and marshes less than 5 acres and ditches and canals

Type "1" wetlands were the next most common type, but accounted for only 15.2 percent of all wetlands in the 87 sections studied. The number of type "3", "4", and "5" wetlands over 5 acres in size was very low, as indicated in Table 23. However, most wetlands of 5 acres or less would be expected to fall into these 3 types.

Type "1" and "1-A" wetlands were also first in acreage among the types represented, representing about 95 percent. Types "3", "4", and "5" combined made up less than 5 percent of the wetland acreage on all study sections, excluding wetlands of less than 5 acres.

Recreational Use

Fifty-nine wetlands over 5 acres in area were rated for recreational and wildlife value in the irrigated portion of the Valley. Types of recreation, whether private, public, leased, or none, are given in Table 24 for the 4-county sample.

This information is shown by county in Tables 58-61 of Appendix A. Table 25 shows ownership for the 59 wetlands.

Hunting — Of 59 large wetlands, 45, or 76.3 percent, were open to public hunting (Table 24). Private hunting, other than leases, accounted for the remaining 14 (24.4 percent) wetlands. All counties except Rio Grande exhibited the same degree of public hunting opportunity. In Rio Grande County, only 2 of 9 samples (22.2 percent) featured public hunting. Hunting pressure was heavier here than in the other counties, and explains the reluctance of landowners to permit public use. Much of the best hunting in the Valley occurs in Rio Grande County because of the large duck population; thus, many landowners prefer to retain hunting privileges for themselves and friends. However, the presence of Monte Vista National Wildlife Refuge and the Rio Grande Management Area, both in Rio Grande County, compensate somewhat for this situation. None of the 59 wetlands were leased for hunting at the time of the survey. However, a few gun clubs are known to own or lease wetlands in the Russell Lakes area and along the Rio Grande River. At the time of the survey it appeared that leased rights formed a small segment of hunting on wetlands in the Valley.

Table 21 lists a projected figure of 230,782 acres of wetlands in the irrigated portion of the San Luis Valley, of which an estimated 75.6 percent, or 174,471 acres, represents the portion open to public hunting. However, it should be noted that 78 percent of this total consists of seasonally flooded haylands (type "1-A"). These wetlands offer little in the way of duck hunting in the fall and winter because they normally do not contain surface water to attract ducks. An exception may be the experimental duck season in early October, when pastures or hay land may still hold some surface water. This means that hunting is restricted largely to 22 percent of the wetlands, or to areas other than pastures and hay land, such as ponds, marshes, riverbottoms, ditches and canals. Therefore, with the exclusion of ditches and canals, only about 50,772 acres of wetlands in the Valley can be classed as huntable, while only 38,384 acres represent wetlands open to the public. These figures may be somewhat greater during the experimental season.

Fishing — Only about 10 percent of the number and 12 percent of the acreage of wetlands sampled over 5 acres in size were suitable for sport fishing. All are located on the Rio Grande River in Alamosa and Rio Grande counties. All were open to the public. The remaining 90 and 88 percent, respectively, provide no fishing because game-fish populations were intolerant of the shallow or intermittent waters (Table 24).

Boating — Lakes and reservoirs of sufficient size for pleasure-boating and water skiing are essentially absent in the irrigated portion of the Valley. Water areas suitable for these recreations were not encountered on any of the 59 wetlands surveyed. San Luis Lake provides the only recreation of this nature in the portion of the Valley studied.

Type of Ownership

Table 25 shows ownership of the 59 wetlands over 5 acres in size. Corporation or company ownership was not represented. Private ownership accounted for 55, or 93.2 percent, with only 4, or 6.8 percent, in public ownership. Public ownership is very similar to that in the South Platte and Arkansas valleys, 7.3 percent and 7.2 percent, respectively, in regard to numbers of wetlands. Only 3.4 percent of the sample acreage was in public ownership. This has been increased somewhat in recent years with the expansion of Monte Vista National Wildlife Refuge and the purchase of Alamosa National Wildlife Refuge.

Table 24 — Recreational Use of 59 Wetland Areas^a in Irrigated Portion of San Luis Valley

Type of Use	Hunting				Fishing				Boating			
	No. Areas	%	Acres	%	No. Areas	%	Acres	%	No. Areas	%	Acres	%
Private	14	23.7	3,111.2	24.4	..	..	..	..	..	..	..	..
Public	45	76.3	9,639.3	75.6	6	10.2	1,588.3	12.4	..	..	..	..
Leased	..	..	..	..	..	..	..	..	..	..	..	..
None	..	..	..	..	53	89.8	11,162.2	87.6	59	100.0	12,750.5	100.0
Totals	59	100.0	12,750.5	100.0	59	100.0	12,750.5	100.0	59	100.0	12,750.5	100.0

^a Excluding ponds and marshes less than 5 acres and ditches and canals

Table 25 — Ownership of 59 Wetland Areas^a in Irrigated Portion of San Luis Valley

Ownership	No.	%	Acres	%
Corporation or company	0	0.0	0.0	0.0
Private	55	93.2	12,492.9	96.6
Public	4	6.8	443.7	3.4
Totals	59	100.0	12,936.6	100.0

^a Excluding ponds and marshes less than 5 acres and ditches and canals

Table 26 — Number of Study Sections in Irrigated Portion of 4 Counties on the Western Slope

County	No. of Study Sections	%
Delta	19	38.8
Mesa	16	32.6
Montrose	12	24.5
Ouray	2	4.1
Totals	49	100.0

UNCOMPAHGRE-GUNNISON-COLORADO RIVER COMPLEX

The irrigated portions of Delta, Mesa, Montrose, and Ouray counties comprised the Western Slope survey, and were represented by a total of 49 study sections (Table 26).

Amount of Wetlands

Tables 62-64 in Appendix A show acres and linear miles of wetlands on sample areas representing the Western Slope. In the survey, Montrose and Ouray counties were combined because the latter contained only 2 sample sections. Streams comprised most of the wetland acreage in Delta and Mesa counties. Wetlands in this category made up 92.6 percent of the acreage in Delta County and 95.6 percent in Mesa County. However, in Montrose and Ouray counties, combined, stream habitat accounted for only 29.2 percent, while ponds and marshes over 5 acres in area constituted 60.9 percent. The Uncompahgre River is the only large stream contiguous to irrigated portions of Montrose and Ouray counties, whereas Delta and Mesa counties support 2 or more major streams each. The Gunnison, North Fork of the Gunnison, and the Uncompahgre rivers occur in Delta County, and both the Colorado and Gunnison rivers cross Mesa County.

Few lakes and reservoirs occur in the irrigated portion of the Western Slope. Crawford, Fruitgrowers and Mack Mesa reservoirs, and Highline, Patton's and Sweitzer lakes, plus a few small, unnamed lakes are the only ones of a permanent nature. None were encountered on study sections in the 4 counties. The importance of stream habitat to waterfowl, particularly wintering waterfowl, on the Western Slope is indicated by the scarcity of lakes and reservoirs.

Tables 27 and 28 show water composition and the proportion of wetlands in each category for the irrigated portion of the Western Slope. Ninety-five wetland areas, excluding ditches and canals, were encountered on 49 samples, an average of 1.94 per section. The total wetland acreage was 1,512.4, or 30.9 acres per square mile. Running water per square mile was 0.38 mile for streams and 0.21 mile for ditches and canals.

Ponds and marshes of less than 5 acres accounted for the greatest number of wetlands on the Western Slope, just as in other irrigated regions of Colorado. About 72 percent of the 95 wetlands in the sample were in this category (Table 28), but made up less than 5 percent of the wetland acreage. Streams and associated marginal land represented 85 percent of the wetland acreage in the sample, while ponds and marshes of 5 acres or more contributed only about 10 percent.

Table 29 presents the projected acreage and linear miles of wetlands in the irrigated portion of the Western Slope, where about 570,000 acres of irrigated land have been developed.

The average acreage of wetlands per section by counties was: Montrose and Ouray, 15.4; Delta, 27.9; and Mesa, 47.9. The low figure for Montrose and Ouray counties reflects the relatively small amount of stream habitat as compared to the other 2 counties. The wetland acreage in Mesa County was almost twice as much as in Delta County. Although both contain 2 or more sizeable rivers, Mesa County is further downstream where the rivers (Colorado and Gunnison) and associated marginal lands are more extensive.

Acres of wetlands per sample section averaged 30.9 ± 16.3 , giving a projected total of $27,501 \pm 14,507$ acres, or 4.8 ± 2.5 percent of the irrigated portion of the Western Slope. The Uncompahgre-Gunnison-Colorado River complex has the smallest acreage of the 4 major waterfowl regions in the state.

Table 27 — Water Composition by Categories of 49 Study Sections in Irrigated Portion of Western Slope

Wetland Category	No. Areas	Average No. Areas per Section	Surface Water, Acres	Average No. Acres per Section	Marginal Land, Acres	Average No. Acres per Section	Total Acres	Average No. Acres per Section	Miles	Average No. Miles per Section
Lakes and reservoirs	...	...	...	...	...	...	...	...	...	...
Ponds and marshes over 5 acres	5	0.10	...	...	154.0	3.1	154.0	3.1	...	...
Ponds and marshes less than 5 acres ^a	68	1.39	...	...	...	...	72.3	1.5	...	...
Streams	22	0.45	335.3	6.84	950.8	19.4	1,286.1	26.3	18.9	0.38
Ditches and canals	...	...	...	...	...	...	...	...	10.5	0.21
Totals	95 ^b	1.94	335.3	6.84	1,104.8	22.5	1,512.4 ^b	30.9	29.4	0.59

^a Only total acres determined for areas of 5 acres or less

^b Excluding ditches and canals

Table 28 — Proportion of Wetlands by Categories in 49 Study Sections in Irrigated Portion of Western Slope

Wetland Category	No. Areas	%	Surface Water, Acres	%	Marginal Land, Acres	%	Total Acres	%	Miles	%
Lakes and reservoirs	..	..	..	..	..	..	..	..	..	..
Ponds and marshes over 5 acres	5	5.3	..	..	154.0	13.9	154.0	10.2	..	..
Ponds and marshes less than 5 acres ^a	68	71.6	..	..	..	..	72.3	4.8	..	..
Streams	22	23.1	335.3	100.0	950.8	86.1	1,286.1	85.0	18.9	64.3
Ditches and canals	..	..	..	..	..	..	..	..	10.5	35.7
Totals	95 ^b	100.0	335.3	100.0	1,104.8	100.0	1,512.4 ^b	100.0	29.4	100.0

^a Only total acres determined for areas of 5 acres or less

^b Excluding ditches and canals

Table 29 — Projected Acres and Linear Miles of Wetlands in Irrigated Portion of Western Slope

County	Total Irrigated Land ^a		Total Wetlands ^b		Projected Total, Acres
	Sections	Acres	Average No. Acres/Section in Sample ^c	%	
Delta	356	227,840	27.9±23.7	4.4±3.7	9,932± 8,437
Mesa	293	187,520	47.9±41.4	7.5±6.5	14,035±12,130
Montrose and Ouray	241	154,240	15.4±17.5	2.4±2.7	3,711± 4,218
Totals	890	569,600	30.9±16.3	4.8±2.5	27,501±14,507

^a Study areas from which sample sections were selected

^b Excluding ditches and canals

^c ± t .05 standard errors

County	Total Irrigated Land ^a		Streams		Ditches and Canals	
	Sections	Acres	Average No. Miles/Section in Sample ^b	Projected Total, Miles	Average No. Miles/Section in Sample	Projected Total, Miles
Delta	356	227,840	0.45±0.27	160.2± 96.1	...	...
Mesa	293	187,520	0.47±0.27	137.7± 79.1	0.53±0.35	155.3±102.6
Montrose and Ouray	241	154,240	0.20±0.28	48.2± 67.5	0.14±0.18	33.7± 43.4
Totals	890	569,600	0.38±0.15	338.2±133.5	0.21±0.13	186.9±115.7

^a Study areas from which sample sections were selected

^b ± t .05 standard errors

Table 30 — Summary of Wetlands Data for Irrigated Portion of Western Slope

Wetland Types and Projections	No.	%
No. of study sections	49	100.0
No. of wetlands/study section ^a	1.94	—
Lakes and reservoirs	0.00	—
Ponds and marshes over 5 acres	0.10	5.2
Ponds and marshes less than 5 acres	1.39	71.6
Streams	0.45	23.2
Acres of wetlands/study section ^a	30.9	—
Lakes and reservoirs	0.00	—
Ponds and marshes over 5 acres	3.1	10.2
Ponds and marshes less than 5 acres	1.5	4.8
Streams	26.3	85.0
Total wetland percentage/study section ^a	—	4.8
Miles of streams/study section	0.38	—
Miles of ditches and canals/study section	0.21	—
Total sections of irrigated land	890	—
Total acres of irrigated land	569,600	—
Total projected no. of lakes and reservoirs	7 ^b	—
Total projected no. of ponds and marshes over 5 acres	89	—
Total projected no. of ponds and marshes less than 5 acres	1,237	—
Total projected acres of wetlands ^a	27,501	—
Total projected miles of streams	338	—
Total projected miles of ditches and canals	187	—

^a Excluding ditches and canals

^b Actual count of permanent lakes and reservoirs

Table 31 — Wetland Classification of 35 Water Areas^a in Irrigated Portion of Western Slope

Wetland Type	No.	%	Acres	%
"1"	16	45.7	997.4	70.6
"3"	3	8.6	37.4	2.6
"4"	1	2.8	71.9	5.1
"5"	15	42.9	307.5	21.7
Totals	35	100.0	1,414.2	100.0

^a Excluding ponds and marshes less than 5 acres and ditches and canals

Streams averaged 0.38 ± 0.15 linear mile per study section for the region, giving a total of 338.2 ± 133.5 miles for the irrigated land in the 4 sample counties (Table 29). Ditches and canals per sample section averaged 0.21 ± 0.13 linear mile, the projected figure being 186.9 ± 115.7 miles for the irrigated portion of the Western Slope. A summary for the region is given in Table 30.

Wetland Types

Type "1" and "5" wetlands were predominant as to number of areas on the Western Slope (Table 31). These 2 types were of about equal importance and together comprised 88.6 percent of all wetlands larger than 5 acres, reflecting the preponderance of streams (type "5") and associated marginal land (type "1"). Type "3" and "4" were the only other wetlands observed, both in small numbers. (See Appendix B for descriptions of wetland types.)

On an acreage basis, type "1" was best represented, having nearly 71 percent of the total, the result of the large amount of riverbottom. Type "5",

**Table 32 — Recreational Use of 21 Wetland Areas^a in
Irrigated Portion of Western Slope**

Type of Use	Hunting				Fishing				Boating			
	No. Areas	%	Acres	%	No. Areas	%	Acres	%	No. Areas	%	Acres	%
Private	3	14.3	94.0	6.6	1	4.8	33.6	2.3	..	..	..	..
Public	18	85.7	1,320.2	93.4	13	61.9	1,105.0	78.2	..	..	..	..
Leased	..	..	..	..	..	..	..	..	..	..	..	..
None	..	..	..	..	7	33.3	275.6	19.5	21	100.0	1,414.2	100.0
Totals	21	100.0	1,414.2	100.0	21	100.0	1,414.2	100.0	21	100.0	1,414.2	100.0

^a Excluding ponds and marshes less than 5 acres and ditches and canals

**Table 33 — Ownership of 21 Wetland Areas^a
in Irrigated Portion of Western Slope**

Ownership	No.	%	Acres	%
Corporation or company	1	4.8	49.7	3.3
Private	16	76.2	1,250.0	82.6
Public	4	19.0	212.7	14.1
Totals	21	100.0	1,512.4	100.0

^a Excluding ponds and marshes less than 5 acres and ditches and canals

consisting only of stream channels, made up about 22 percent of the acreage. Type "3" and "4" were also of minor importance in regard to acreage.

Recreational Use

Twenty-one wetland areas over 5 acres in size were rated for recreational and wildlife value. Recreational use, whether private, public, leased, or none, is indicated in Table 32 for all sections in the 4 counties. This information is not shown by counties because of the relatively small number of wetlands involved.

Hunting — Of the 21 large wetlands in the sample, 18, or 85.7 percent, were open to public hunting (Table 32). They amounted to 93.4 percent of the total wetland acreage sampled, excluding areas of less than 5 acres. The 3 remaining areas (14.3 percent) were closed to hunting except by landowners and their friends.

None of the 21 wetlands were leased for hunting at the time of the survey. A few gun clubs undoubtedly exist, but this survey indicated that leased rights presently have little or no effect on public hunting on wetlands in the region.

Fishing — Fifteen, or 71.4 percent, of the 21 wetlands were suitable for sport fishing, 13 of which were open to the public. Fishing was prohibited on one area because of conflicting interests, while another was subject only to private fishing. The remaining 6 provided no fishing of any type because of shallow or intermittent waters (Table 32).

Boating — Lakes and reservoirs of sufficient size for pleasure-boating and water skiing are scarce in the irrigated portion of the Western Slope. Waters suitable for such recreation were not encountered on any of the sample sections. Only Crawford Reservoir, Fruitgrowers' Reservoir, and Sweitzer Lake are large enough to provide boating and skiing.

Type of Ownership

Table 33 shows ownership of the 21 sample wetlands over 5 acres in size. Public ownership accounted for nearly one-fifth (19 percent), or almost 3 times the percentage found in the South Platte, Arkansas, and San Luis valleys. The percentage of sample acreage under public ownership was also greatest on the Western Slope (14.1 percent). Large acreages of public land administered by the Bureau of Land Management on the Western Slope contributes mainly to this difference.

CONCLUSIONS AND RECOMMENDATIONS

PUBLIC HUNTING OPPORTUNITY

Table 34 indicates the 4 major waterfowl regions of Colorado in public hunting opportunity, ranked in order of increasing opportunity: South Platte Valley, Arkansas Valley, San Luis Valley, and the Uncompahgre-Gunnison-Colorado River complex. Ranking is based on acres of wetlands open to public hunting per hunter and the percentage of wetlands and wetland acreage open to public hunting in each region. During the period of study (1960-1965), the South Platte Valley offered the lowest acreage of wetlands open to public hunting per hunter, 6.1 acres. The remaining 3 regions were nearly equal in this respect, each showing about 19 acres per hunter.

**Table 34 — Public Hunting Opportunity in the 4 Major
Waterfowl Regions of Colorado, 1960-1965**

Region	Estimated No. of Wetlands Open to Public Hunting, %	Estimated Wetland Acreage Open to Public Hunting, %	Estimated Wetlands Open to Public Hunting, Acres	Average Annual No. of Waterfowl Hunters (1960-1965)	Estimated Wetlands Open to Public Hunting, Acres/Hunter
South Platte Valley	46.4	60.2	77,016	12,538	6.1
Arkansas Valley	82.1	83.3	103,334	5,353	19.3
San Luis Valley	76.3	75.6	38,384 ^a	1,977	19.4
Western Slope	85.7	93.4	25,686	1,374	18.7

^a Does not include any type "1-A" wetlands

The South Platte Valley also showed the lowest percentage of wetlands and wetland acreage open to public hunting, 46.4 percent and 60.2 percent, respectively; and the Uncompahgre-Gunnison-Colorado River region offered the highest percentage, respectively, 85.7 percent and 93.4 percent. The Arkansas Valley and the San Luis Valley ranked very close to the Western Slope.

It is indicated, therefore, that the greatest need for public waterfowl hunting grounds, and having the highest priority in land acquisition, are in the South Platte Valley. Competition for hunting space is greater here because it receives more hunting pressure than the other 3 regions. Hunter competition leads landowners to close wetlands to hunting and, conversely, encourages private groups to lease or purchase them for personal use.

The Arkansas Valley holds second highest acquisition priority because: (1) potential hunting pressure is higher in the Arkansas Valley than in the other 2 regions, due to greater human population; (2) research should result in more liberal duck hunting seasons in the Arkansas Valley than now occur; and (3) the Bureau of Sport Fisheries and Wildlife has established a second National Wildlife Refuge in the San Luis Valley which eventually will provide more space for the hunting public.

The San Luis Valley occupies third priority for wetlands acquisition, and the Uncompahgre-Gunnison-Colorado region has the lowest priority. The latter has the least potential hunting pressure of the 4 regions and the largest percentage of wetlands open to public hunting.

Additional conclusions and recommendations for each region follow.

South Platte Valley

Leasing of wetlands for hunting and closure of wetlands to hunting are most pronounced in the South Platte Valley counties closest to Denver. Likewise, public hunting increases progressively with increased distance from Denver. This circumstance suggests that wetlands acquisition in the immediate future should be concentrated in counties adjacent to Denver — Adams, Boulder, Larimer, and Weld.

It is recommended that expansion of acquisition in the South Platte Valley be initiated immediately. First, wetlands leasing by private groups has probably declined recently because of restrictive duck seasons in this and other portions of the Central Flyway; second, short seasons and reduced bag limits have given sportsmen less incentive to buy duck stamps or to spend money on private hunting lands. The near future appears to hold promise of more liberal duck seasons as a result of improved conditions on the breeding grounds, and research aimed at identifying lightly shot mallard populations; and these developments will probably stimulate new interest in wetlands leasing by private groups and individuals. In view of this situation, it is recommended that the Department of Game, Fish and Parks concentrate effort in locating, evaluating, and acquiring the most attractive wetlands available for public hunting use as soon as possible.

It is also recommended that acquisition in the South Platte Valley during the next 10 years (1968-1978) include at least 5 major public waterfowl hunting areas, totaling about 25,000 acres. This acreage would accommodate about 5,000 hunters during each waterfowl season.

The Department should be alert to the possibility of acquiring public hunting grounds at some distance from Denver in order to distribute hunters more evenly over the Valley. Wetlands some distance from Denver, such as in Morgan, Logan, and Sedgwick counties, are largely of the riverbottom type, occurring along the South Platte River. They constitute, therefore, the greatest potential for public hunting land acquisition in this region.

Arkansas Valley

Information obtained in the Arkansas Valley indicates that loss of public hunting on private lands is not presently affected by private hunting leases. Some land is closed to hunting, but apparently the public has little trouble in getting permission to hunt on private holdings. This region has considerably fewer people than the South Platte region, and consequently, much lighter hunting pressure. Likewise, the demand for wetlands leasing is less, apparently directly proportional to hunting pressure.

There is need for immediate expansion of wetlands acquisition in the Arkansas Valley, even though it may appear that such is not required at present. With the advent of the Fryingpan-Arkansas Project, the following events will likely occur in the Valley: (1) more water for municipalities, irrigation, and recreation; (2) large increase in population due to an expanded economy; (3) higher recreational demands, including increases in hunting pressure; (4) greater demand for public recreation facilities, including hunting areas; (5) increased intensity of irrigated farming, resulting in a loss of wildlife habitat, including wetlands; and (6) increased value of land, resulting in higher acquisition costs. Finally, current Department research, as stated, is attempting to justify more liberal duck hunting seasons in eastern Colorado.

What is done in the way of wetlands acquisition in the Arkansas Valley during the next 10 years (1968-1978) will significantly affect public recreational activities in this region in the future. Because the cost of land will assuredly not decrease, acquisition costs will be geared to the length of time elapsing before purchase. Acquisition needs in the Arkansas Valley include at least 3 major public waterfowl shooting areas of about 5,000 acres each, accommodating about 3,000 hunters annually. One such area should be established near Pueblo.

San Luis Valley

Wetlands use in the San Luis Valley is largely limited to hunting because of the scarcity of suitable fishing and boating waters. The survey revealed that loss of public hunting on private lands had not been affected by private leasing prior to the waterfowl hunting season of 1963, except in Rio Grande County. The San Luis Valley has a much lower human population than the South Platte or Arkansas valleys, and major population centers are at least 100 miles away. This situation resulted in relatively low hunting pressure prior to 1963, and the demand for lease areas for hunting was likewise low.

Superficially, it appears that extensive wetlands acquisition is not required in the San Luis Valley. However, a definite future need exists in the light of an experimental duck season since 1963, in addition to the regular waterfowl season later in the fall and winter.

Increased public hunting pressure in the San Luis Valley will be met in part by the newly acquired Alamosa National Wildlife Refuge. Even so, it is recommended that the Department purchase 2 additional wetland areas during the next 10 years (1968-1978) in order to distribute more effectively hunting pressure in the Valley and obtain the maximum allowable use of the waterfowl resource. One public hunting area should be in the southern and one in the northern portion of the Valley where large tracts of recreational land are presently lacking.

The tremendous reproductive potential of waterfowl in the San Luis Valley, particularly on intensively managed wetlands, makes acquisition of wetlands still more justifiable. Production habitat can be developed and managed in conjunction with early-season harvest habitat in the Valley without distracting from the potential of either.

Uncompahgre-Gunnison-Colorado River Complex

Loss of hunting opportunity on private lands has not yet occurred on the Western Slope because of private leasing of wetlands, for hunters appear to have little difficulty in obtaining permission to hunt on private property. In addition, public lands are more abundant here than in the other 3 regions. The Bureau of Land Management administers a large acreage, including some riverbottom tracts. The Department of Game, Fish and Parks owns and manages some important waterfowl hunting lands, including the Escalante Management Area (2 units totalling 1,140 acres) and Sweitzer Lake (207 acres). These factors, coupled with relatively low hunting pressure, decrease landowner animosity and competition for space by sportsmen, thereby reducing the demand for leasing rights. Waterfowl hunters numbered only about 1,300 in the Uncompahgre-Gunnison-Colorado region in 1965 (Greib and Hunter, 1966), representing 50 percent of the total hunting waterfowl on the entire Western Slope.

The importance of small irrigated valleys to waterfowl hunting on the Western Slope is apparent. However, considering the relatively low human population and the great distance from major population centers, it is doubtful that pressure will increase very rapidly the next few years. For reasons presented here and above, immediate expansion of wetlands acquisition is not needed on the Western Slope.

However, wetlands acquisition should not cease here; rather, it should continue at the present pace until there is demonstrated need for change. Ideally, the Department should be prepared to accelerate acquisition at any time in order to meet increased public shooting demand that may result from quality hunting seasons or more liberal regulations.

In order to keep the public hunting situation well in hand in the Uncompahgre-Gunnison-Colorado region, the Department should begin evaluation of wetlands and accumulation of acquisition sites on a priority basis.

WETLANDS RATING SYSTEM

An important objective of this survey, as stated, was development of a method for rating wetlands in terms of acquisition value as public waterfowl hunting grounds. Since the states have an obligation to provide habitat contributive to the welfare of the resource as a part of their role to the continental waterfowl management program, it is imperative that the rating method consider this factor. Such a system would permit the Department Lands Division or the Regions to evaluate all wetlands in a standard way, enabling purchase or lease of the best possible areas with funds available. The rating method presented here is subject to change as new ideas and concepts of waterfowl management and wetlands ecology are developed (Fig. 15).

Listed below are the specific criteria that should be considered in rating wetlands for possible acquisition. The listing is not necessarily in order of importance. Figure 15 is the form recommended for use in collecting information, discussed in detail under appropriate headings.

Location of Wetlands

Conclusions and recommendations previously given emphasize the need for public hunting opportunity and wetlands acquisition in the 4 major waterfowl regions of Colorado, ranked as follows in acquisition priority.

1. South Platte Valley
2. Arkansas Valley
3. San Luis Valley
4. Uncompahgre-Gunnison-Colorado River complex

COLORADO WETLANDS RATING FORM

1. Location:
 A. Major waterfowl region _____
 B. County _____ Legal description _____
2. Size of Wetland Area:
 A. Acres of wetlands _____ Acres of uplands _____
 B. Total acres _____
3. Category of Wetland: (check one)
 A. Riverbottom _____ Name of river _____ River channel included? _____
 B. Warm-water area outside of riverbottom _____ Name of area _____
 C. Small lake, pond, or marsh _____ Name of area _____
4. Amount of Waterfowl Resting Habitat and Hunting Opportunity:
 A. Amount of warm-water area:
 1. Main river channel: Acres _____ Miles _____
 2. Side channels and seep ditches: Acres _____ Miles _____
 3. Sloughs: Acres _____ Miles _____
 4. Total acres _____ Total miles _____
 5. Acres of warm-water/acre of total area _____
 Percent of total area _____
 6. Miles of warm-water/acre of total area _____
 B. Length of time water areas remain ice-free:
 1. Amount ice-free regardless of temperatures: Acres _____
 Percent of total warm-water acreage _____ Miles _____
 Percent of warm-water mileage _____
 2. Amount ice-free during all except extreme temperatures:
 Acres _____
 Percent of total warm-water acreage _____ Miles _____
 Percent of total warm-water mileage _____
 C. Permanency of warm-water areas:
 1. Do any of the warm-water areas ever go dry? _____
 2. Frequency of dry period _____
 3. Time of year of dry period _____
 4. Amount of warm-water area that goes dry: Acres _____
 Percent of total warm-water acreage _____ Miles _____
 Percent of total warm-water mileage _____
5. Need for Development: Does this area, in its present condition, provide desirable waterfowl resting habitat and hunting opportunity? _____
6. Development Potentials:
 A. Topography: Acres of land with less than 1% of slope _____
 Percent of total area _____
 B. Availability of water for development:
 1. Does this land have existing water rights? _____
 Amount of water rights _____
 2. Does this land have existing wells? _____ Pumps? _____
 Capacity of wells _____ Pumps _____
 3. Amount of water available/acres of developable land _____
 4. How much land is it physically possible to apply available water to? Acres _____ Percent _____
 C. Ability of soil to hold water
 1. List soil types, depths, and percent of developable land each occupies _____
 2. List soil textures and percent of developable land each occupies _____
7. Distance from Major Waterfowl Refuge Areas

Name of Refuge Areas (list all within 25 miles)	Distance (Miles)
_____	_____
_____	_____
_____	_____
8. Other Recreational Potentials
 A. Hunting (other than waterfowl)
 1. Species present _____
 2. Amount of present habitat: Acres _____ Percent of total area _____
 3. Condition of habitat
 a. Grazing intensity: None _____, Light _____, Moderate _____, Heavy _____
 b. Density of cover: Sparse _____, Moderate _____, Heavy _____
 B. Fishing
 1. Amount of water area over 8 feet deep: Acres _____
 Percent of total area _____
 2. Amount of water area fed by warm-water seeps or springs:
 Acres _____ Percent of total area _____
 3. Salinity of water _____
 C. Trapping: Species of fur animals known to commonly inhabit area _____
 D. Camping and picnicking: Good _____, Fair _____, Poor _____
 E. Nature Study: Good _____, Fair _____, Poor _____
9. Cost
 A. Total cost of area _____
 B. Cost per acre _____

Figure 15—Form recommended for use in rating wetlands for potential acquisition as public waterfowl hunting areas.

It was further concluded that, in the South Platte Valley, Adams, Boulder, Larimer, and Weld counties should receive higher priority than the other counties in this region. Counties in the other 3 regions were not given priority ranking.

Size of Wetland Area

It is recommended that the Department concentrate on acquiring rather large wetland areas, not less than 640 acres, including uplands adjacent to wetlands, because: (1) it is highly probable that large wetlands can be purchased at a lower cost per acre than small ones; (2) development and maintenance time and costs would probably be less for several large areas as opposed to many small, scattered areas of about the same total acreage; (3) large wetlands add more to total waterfowl production, wintering habitat, and public hunting than smaller wetlands, and (4) larger areas are more likely to include a variety of habitat types, thereby producing a variety of game, further justifying their acquisition.

There is one exception to the foregoing recommendation: some wetlands, such as riverbottoms, may be purchased in small tracts and then added to by acquiring adjacent tracts. In this case, the initial purchase may consist of less than 640 acres, but the ultimate purchase would total more than this acreage. This procedure should be considered only when all lands involved rank high in the overall rating system.

Wetland Categories

Waterfowl hunting seasons are set in Colorado to favor the harvest of mallards and Canada geese, first, because of the preponderance of these two species during the fall and winter, and second, because these species are most preferred by hunters. The main northern flights of mallards and geese do not arrive in Colorado until the first or second week in November, and hunting seasons generally open at about this time. The exception is in the San Luis Valley where the experimental season begins on October 1 and directs hunting pressure on locally produced mallards.

Most ponds and marshes are frozen over by the time large numbers of mallards and Canada geese reach Colorado in November. These wetlands may not be frozen during years of mild weather, but normally by this time or shortly thereafter open water is limited to lakes, reservoirs, stream channels, and warm-water seep ditches and sloughs, mainly in riverbottoms. Open water becomes even more limited as the winter progresses, but in the aggregate these areas constitute the resting habitat for the ducks and geese during the main hunting season. Usually 2 feeding flights are made daily to surrounding corn and small grain fields.

Ducks in eastern Colorado rest primarily on lakes and reservoirs to escape hunting pressure. In the San Luis Valley, they obtain safety on the limited number of reservoirs and closed portions of the 2 National Wildlife refuges. Western Slope ducks find refuge in remote river canyons. All of these areas are unavailable or inaccessible to the hunters, yet they serve the purpose of holding ducks in the regions for potential harvest.

None of the wetlands in the San Luis Valley are frozen during the experimental duck hunting season in early October. These lands consist mainly of ponds, marshes, seep ditches, river channels, and riverbottom sloughs. Irrigation has been terminated by this time and little flooded hay land exists. Ducks make 2 feeding flights daily to grain fields. Harvest occurs on all types of wetlands, but riverbottoms account for the largest segment, mainly because they constitute at least 50 percent of the total wetland acreage available for hunting during October.



Figure 16—Riverbottoms are attractive to ducks during and after the hunting season because they offer warm, open water, protection during stormy weather, and proximity to food in harvested grain fields. (Photo by Bud Smith)

Most of the duck harvest elsewhere in Colorado occurs in riverbottoms and in other areas where warm-water habitat is found. The heaviest harvest is during cold, windy, storm periods when the birds move off reservoirs and other refuges to seek protection from the elements. Riverbottoms usually offer the best protection at this time. Comparatively little of the duck harvest occurs on lakes and reservoirs or in grain fields.

Following close of the hunting season, most ducks move into riverbottoms and other warm-water areas where they spend the remainder of the winter. Riverbottoms, having warm-water seep areas and stream channels, are preferred over lakes and reservoirs as winter resting habitat because they provide more open water and loafing area and a greater degree of protection from low temperatures and cold winds (Fig. 16).

In contrast, geese utilize lakes and reservoirs as resting habitat during the entire winter, and few are found in riverbottoms at any time. Feeding flights are made to corn and small-grain fields, mostly during legal shooting hours between sunrise and sunset. At least 80 percent of the goose harvest occurs in fields. Most of the remaining harvest takes place on firing lines at lakes and reservoirs. The different feeding times of ducks and geese explain the difference in harvest areas of the 2 groups.

The main points concerning waterfowl use by habitat categories are: (1) wetlands most important to fall and winter populations of ducks in Colorado include lakes and reservoirs, stream channels, warm-water seep ditches and sloughs in riverbottoms, and warm-water seep ditches and sloughs in areas other than riverbottoms; (2) most of the duck harvest occurs on wetlands associated with riverbottoms; (3) lakes and reservoirs constitute wetlands most valuable to fall and winter populations of geese in Colorado; and (4) lakes and reservoirs account for most of the goose harvest on wetlands, but by far the greatest harvest occurs in grain fields.

The habitat types mentioned represent the best potential for waterfowl wintering habitat and public hunting grounds acquisition. However, condi-

tions vary with respect to possibility and practicality of acquisition and, as a result, one category may have greater potential than others. Each category is discussed in detail in the following:

Lakes and reservoirs are most valuable from the waterfowl management standpoint as refuges for ducks and geese during the hunting season. They improve hunting and increase harvest by holding birds in a locality where they become potentially available to hunters. They also serve a secondary function as harvest areas, particularly for geese. This secondary value is the only reason the Department would need control of lakes and reservoirs, because the refuge function would exist regardless of ownership. Wetlands of this category will always be present in the irrigated regions as long as there is need for storing large volumes of water for irrigation.

Most lakes and reservoirs are owned by corporations or companies composed of private individuals or groups who depend upon them for irrigation and general livelihood. Purchase of such waters is not only next to impossible, but also impractical. The cost is prohibitive, and the Department's interest would be limited to the management of recreational rights. It would be easier and more economical to obtain such rights through lease agreements or similar contractions, and some reservoirs are presently operated by the Department in this manner. It is recommended that the Department attempt to secure recreational rights on important lakes and reservoirs and associated lands not already under state management, regardless of location. This goal seems feasible because it involves only about 30 areas. Other types of public use, such as fishing, boating, water skiing, swimming, camping, picnicking, etc. further justify the lease of these large water bodies.

Warm-water seep ditches and sloughs other than in riverbottoms occur on or adjacent to irrigated farmland. Such areas are attractive to ducks, especially during very cold weather, and they often provide excellent hunting. However, acquisition of ditches or sloughs by the Department is not practical because most are part of company-owned irrigations systems and must be maintained as such. Also, the cost would be prohibitive. In addition, appreciable stretches of this narrow wetland category would need to be purchased to provide a substantial amount of public hunting. This would involve many individual owners of irrigated land on either side of the waterways, resulting in serious public access and public relations problems. Consideration should be given to leasing of warm-water areas where conditions are favorable, but this wetland category should not be in highest priority.

Acquisition of croplands for waterfowl use and harvest is not practical except on a very limited basis. Even if attractive croplands were purchased, there would be no assurance that birds would use them because of the vast amount of croplands available. Private leasing of croplands for waterfowl hunting is not common, for hunters do not want to limit themselves to particular fields that may never be visited by feeding ducks or geese.

By contrast, high quality wetlands, being much more limited in area than croplands, are certain to receive waterfowl use. This is where private groups and individuals concentrate their leasing activities. Control of specific croplands adjacent to wetlands may contribute greatly to management of the area. Acquisition by the Department should be restricted to such situations.

This leaves riverbottoms with the greatest potential for acquisition as waterfowl wintering habitat and public hunting ground. Considering abundance, variety of habitats, preference by waterfowl, high quality hunting, large waterfowl harvest, ease of access, and low cost, it is not surprising that riverbottom land holds this high rating. The riverbottom type

provides open water for waterfowl and hunting during the entire fall and winter, regardless of temperature. Most wetlands other than riverbottoms freeze over early and, as a result, supply waterfowl resting and harvest habitat for only a short period during the fall and winter.

A priority list of wetland categories would contain the following for all major waterfowl regions in Colorado except the San Luis Valley:

1. Riverbottoms (also contain warm-water wetlands)
2. Warm-water wetlands other than riverbottoms
3. Small lakes, ponds, and marshes

The last 2 categories should be reversed in the San Luis Valley because of the probability of continued early duck-hunting seasons prior to freezing weather. Here, small lakes, ponds, and marshes offer greater potential for waterfowl use and harvest than warm-water wetlands.

As mentioned, large lakes and reservoirs are not considered in this rating system because of the feasibility of Department control of recreational rights through leases or similar agreements. Croplands would be at the bottom of the priority list.

Waterfowl Resting Habitat and Hunting Opportunity

Obviously, wetlands of greatest value for acquisition are those providing maximum waterfowl resting habitat and hunting opportunity year after year and for the longest time during the fall and winter. These conditions can best be found on permanent wetlands that hold large quantities of ice-free water, even during the coldest weather. Wetlands that freeze-up early have little value for hunting. Wetlands, therefore, should be rated according to the amount of warm-water area, permanency, and the length of time they remain ice-free. High-priority areas should have the following characteristics:

Amount of Warm-water Area—The greater the area of warm-water per acre or mile of riverbottom the greater the potential for waterfowl use and hunting. Therefore, the number of acres and miles of stream channel, warm-water seep ditches, and warm-water sloughs present per unit area of wetland should be determined before establishing priority. This information can be obtained from aerial photographs.

Length of Time Water Areas Remain Ice-free—All so-called "warm-water" wetlands do not stay ice-free for the same length of time during the fall and winter. Most remain open during the moderately cold weather commonly experienced in Colorado, but some freeze over more readily than others when extremely cold temperatures occur. Some warm-water wetlands stay ice-free even during the coldest weather (Fig. 17). For each wetland rated the area of ice-free warm water, regardless of temperature, should be determined. Stream channels would rank high, but warm-water seep areas would be more important in this respect. Landowners and other local residents are the best source of information, but inspection by personnel rating wetlands would also be necessary.

Permanency of Wetlands—Some warm-water seep ditches and sloughs may go dry periodically. The frequency and time of year this occurs is very important in evaluation. Obviously, permanent wetlands merit the highest priority, while lands dry during the fall and winter hold the lowest priority. Information on permanency and seasonal occurrence of water can be obtained from landowners or other local people.

Need For Development

In rating wetlands for acquisition it should be determined whether each area, in its present condition, provides desirable waterfowl resting habitat and hunting opportunity. The answer reflects the amount of devel-



Figure 17—This warm-water seep ditch on riverbottom land near Fort Morgan receives heavy duck use all winter because it never freezes over, regardless of temperature. (Photo by Bud Smith)

opment required, and thus the amount of additional expense above the purchase price. Practically, the Department must acquire wetlands that possess waterfowl resting and harvest habitat so that development in the interest of increased quality can be held to a minimum.

Some wetlands present excellent opportunities for development, but offer little in the way of existing fall and winter waterfowl resting and harvest habitat. Such areas are likely to demand a high purchase price, in some instances as high as areas already providing resting and harvest habitat.

Development Potential

Even though a wetland may be characterized by favorable existing habitat, it should also be rated according to its potential for additional habitat through development. The following points should be considered in rating wetlands in regard to development possibilities:

Topography — Most types of development require that lands have a slope of less than one percent, and evaluation should give consideration to this factor. Comparison with other areas will determine where it ranks in priority as to topography.

Water Available for Development — Development cannot be undertaken without a source of water. It is, therefore, necessary that wetlands have water rights or wells in order to rank high in development potential. The following should be determined for each area rated: (1) presence or absence of existing water rights and/or wells; (2) amount of water rights and/or capacity of wells; (3) amount of water available per acre of land to be developed (less than 1 percent of slope); and (4) physical possibility of applying water to the land.

Ability of Soil to Hold Water—Retention of water depends on characteristics of surface soil and the subsoil at the development site. Light, sandy soils will not hold water, and the retention of surface water over such soils is impossible for significant lengths of time. On the other hand, heavy soils of sufficient depth, such as clay and clay-loams, prevent surface waters from draining away at a rapid rate. Soil types and depths should, therefore, be determined for each area prior to development. Soils maps, available from local Soil Conservation Service offices, are highly useful in evaluations to this end.

Distance From Major Waterfowl Refuge Area

Hunting pressure forces most waterfowl to rest on large lakes and reservoirs during the hunting season, giving such areas an important refuge function. Large water bodies also serve as focal points for birds going through their daily activities. During hunting seasons, waterfowl are more likely to use wetlands close to rather than distant from refuge areas. As a result, wetlands within 10 miles of main refuges should receive the highest priority in acquisition. The purchase of high-quality wetlands within 10 miles of main refuge areas should result in a significant contribution in improving the harvest of given flocks of birds.

Other Recreational Potentials

In line with the present "multiple use" concept of public lands and the ever-increasing demand for recreation of all types, it is important that not only waterfowl hunting but other recreational potentials be considered in rating wetlands for possible acquisition. Land can be used for waterfowl hunting only a month or two each year; its ability to provide other types of recreation during the remaining months should further justify acquisition (Fig. 18).



Figure 18—Wetlands attain their highest recreational value when they offer both waterfowl and upland hunting and provide suitable places for camping, picnicking, boating and nature study. (Photo by Harold M. Swope)

Other recreational uses of wetlands include: (1) hunting for game other than waterfowl; (2) fishing; (3) trapping; (4) camping; (5) picnicking; and (6) nature study. The number of recreational uses and the extent to which they occur on each wetland should be the basis for rating in this category. The greater the potential use in an area, of course, the higher it should rank in this respect.

The following information on hunting for other than waterfowl should be collected for each wetland under consideration: (1) species; (2) amount of habitat (acreage and percent of total area); and (3) conditions of habitat. Riverbottoms rank high in number of species because they provide greater habitat variety than other wetlands. In Colorado, ring-necked pheasants (*Phasianus colchicus*), bobwhite quail (*Colinus virginianus*), mourning doves (*Zenaidura macroura*), cottontails (*Sylvilagus* spp.)^a, squirrels (*Sciurus niger*), mule deer (*Odocoileus hemionus*), white-tailed deer (*O. virginianus*), and raccoons (*Procyon lotor*) are common game species regularly occurring in riverbottoms.

The amount of habitat available to game species, as related to the size of an area, will give an indication of the extent of its hunting potential. The higher the percentage of suitable habitat on a wetland area, the higher it should rank in the rating system.

Condition of habitat is important regardless of area abundance. This factor determines the amount of game an area is capable of producing and holding, and ultimately determines the hunting potential of the area. Condition of the habitat is usually affected most by livestock grazing (Figs. 19 and 20). Heavy grazing has practically denuded some wetlands of vegetation, resulting in low-value game range. Such lands may require years to return to productive condition, and their hunting potential may be retarded accordingly. One exception is where riverbottom vegetation, particularly tall grasses, is exceptionally dense and heavy. Controlled grazing on such lands may improve both habitat quality and hunting conditions.

In rating the grazing factor, each should be classified according to grazing intensity: none, light, moderate, or heavy. As an additional check on habitat condition, the vegetation should be classed as sparse, moderate, or heavy as to density. Except for waterfowl, the heavier densities are preferred by most game species characteristic of western riverbottom types.

The fishing potential of wetlands should be based on the area, depth, and salinity of water. Larger water areas with depths of 8 feet or more offer the best fishing possibilities. Some sizeable waters, such as riverbottom sloughs, possess fishing potential but lack the necessary depth. However, in many cases, they are fed internally by warm-water seeps or springs, thereby eliminating the need for this usually prescribed water-depth characteristic.

The potential for fur trapping is greatest where the largest number of fur animal species exist, usually determined by acreage and habitat quality and variety. Riverbottoms, usually with a variety of habitats, support more kinds of fur animals than ponds and marshes with fewer types. A list based on these criteria should be prepared for each wetland area rated.

The most attractive camping and picnicking sites contain shade trees, and the abundance of shade trees determines their potential for these recreational activities. At one extreme are riverbottoms with closed tree stands, while at the other extreme are ponds and marshes completely devoid of trees. The former usually provide good camping and picnicking sites; the latter offer little or no recreational opportunity of this nature. On the basis

^a Scientific names of mammals according to Miller and Kellogg (1955)



Figure 19—Ungrazed riverbottom showing understory vegetation of a density suitable for many kinds of wildlife. (Photo by Richard M. Hopper)



Figure 20—Heavily grazed riverbottom with sparse growth of understory vegetation of little food and cover value to wildlife. (Photo by Richard M. Hopper)

of tree occurrence, each wetland area should be rated as good, fair, or poor in appraising its camping and picnicking usefulness. Dryness of ground and insect pests are other considerations.

All wetlands are of considerable value for nature study, but students can observe a wider variety of plant and animal life on some areas than on others. Diversified areas should receive the highest ratings in this category. Value for nature study should be classed as good, fair, or poor for each area rated, based on the variety of plant and animal life present.

Cost

Initial cost of wetlands must necessarily constitute a segment of the rating system. However, too much emphasis on this point may result in the elimination of some high-quality wetlands from consideration for acquisition. For a wetland area that ranks very high in all other categories, cost should be a relatively minor factor. Post-acquisition development costs should also be evaluated.

The major function of cost is its use as the final factor in ranking 2 or more wetlands of otherwise equal value, as determined by the rating system. A priority list of potential acquisition sites should first be developed without considering initial costs because many wetlands will not be available for purchase, and in such cases landowners will not quote selling prices. Costs in these cases can be considered only as price quotations become available.

SUMMARY

1. Wetlands inventory objectives were to: (1) determine the amount and distribution of wetlands in the 4 major waterfowl wintering regions of Colorado — the South Platte Valley, the Arkansas Valley, the San Luis Valley, and the Uncompahgre-Gunnison-Colorado River complex; (2) determine the number and amount of wetlands leased for hunting and other recreational purposes; and (3) develop a method of rating wetlands as public hunting areas.

2. Table 35 summarizes and compares wetland inventory data for the 4 major waterfowl wintering regions. Streams and their associated bottomlands contributed the largest percentage of the total wetland acreage by regions, as follows: Uncompahgre-Gunnison-Colorado River complex, 85 percent; Arkansas Valley, 69.3 percent; South Platte Valley, 50 percent; and San Luis Valley, 16 percent. In the San Luis Valley, ponds and marshes over 5 acres in area make up about 83 percent of the wetland acreage.

**Table 35 — Summary and Comparison of Wetland Inventory Data
for the 4 Major Waterfowl Harvest Regions in Colorado**

Wetland Categories and Amounts	Region			
	South Platte Valley	Arkansas Valley	San Luis Valley	Western Slope
No. of wetlands/section	1.50	1.09	1.64	1.94
Acres of wetlands/section ^a	51.9	116.3	148.7	30.9
Miles of streams/section	0.19	0.40	0.20	0.38
Miles of ditches-canal/section	0.71	0.31	0.67	0.21
Total no. of lakes-reservoirs	640	14	12	7
Total no. of ponds-marshes	2,638	608	2,281	1,326
Total acres of wetlands ^a	127,934	112,046	230,782	27,501
Total miles of streams	468	386	310	338
Total miles of ditches-canal	1,750	299	1,040	187

^a Excluding ditches and canals

3. In the South Platte River Valley, stream types represent progressively higher percentages of all wetlands with increase in distance from the Denver area to the Colorado-Nebraska line. Lakes and reservoirs became less important as to acreage west to east. In contrast, stream habitats in the Arkansas Valley are dominant in both eastern and western counties, while wetlands in the central portion consisted mostly of lakes and reservoirs.

4. Only 46 percent of all wetlands of more than 5 acres were open to public hunting, 1960-1965, in the South Platte Valley. Another 17.2 percent were leased, and the remainder were open to hunting only by landowners and their friends. Public hunting privileges increased and the number and area of leased wetlands decreased with distance eastward from the Denver area to the Colorado-Nebraska line.

5. A high percentage of wetlands over 5 acres in area was open to public hunting in the Arkansas Valley, 82 percent; San Luis Valley, 76 percent; and Uncompahgre-Gunnison-Colorado rivers, 86 percent. Wetlands closed to public hunting by landowners represented the remaining percentages. Leasing of wetlands for hunting was not encountered in these 3 regions, but some is known to occur. Since completion of the wetlands inventory in the San Luis Valley in 1963, an increase in leasing has been noted, doubtless due to increased hunting induced by experimental duck hunting seasons.

6. Only about 7 percent of all wetlands over 5 acres in area were under public ownership in the South Platte, Arkansas, and San Luis valleys. Percentages of wetland acreages in public ownership were 10.7, 11.0, and 3.4 percent, respectively, for these 3 regions. Nineteen percent of the number, and 14 percent of the acreage were owned by the public in the Uncompahgre-Gunnison-Colorado region. Public land administered by the Bureau of Land Management, including riverbottom land, contributed to the larger percentage on the Western Slope.

7. It is recommended that the Department compete with individuals and clubs in acquisition of high-quality wetlands for recreational purposes. Required is a program of locating, evaluating, and acquiring wetland-type lands in the 4 major waterfowl harvest regions of Colorado.

8. On the basis of public hunting opportunity and amount of private leasing, the 4 major harvest regions should be ranked as follows in wetlands acquisition priority: (1) South Platte Valley, (2) Arkansas Valley, (3) San Luis Valley, and (4) Uncompahgre-Gunnison-Colorado valleys.

9. An immediate expansion of wetland acquisition should be initiated in the South Platte River Valley counties adjacent to Denver (Adams, Boulder, Larimer, and Weld), where public hunting opportunity is presently most restricted. During the next 10 years (1968-1978) it is recommended that the Department of Game, Fish and Parks acquire at least 5 major public waterfowl hunting grounds, totaling about 25,000 acres, in these counties.

10. It is recommended that the Department expand wetlands acquisition as soon as possible in the Arkansas Valley to take advantage of increased recreational potential accruing from the Fryingpan-Arkansas Project. Acquisition in the Arkansas Valley during the next 10 years should include at least 3 major public waterfowl shooting grounds averaging about 5,000 acres each.

11. The experimental duck hunting season in the San Luis Valley, likely to continue, necessitates expansion of wetland acquisition in this region, where additional lands are needed to accommodate increasing hunting pressure. Two wetland areas aggregating 10,000 acres are recommended for purchase during the next 10 years.

12. The public presently has little trouble finding a place to hunt waterfowl in the Uncompahgre-Gunnison-Colorado area. As a result, wetlands acquisition here should neither cease nor expand, but continue at present pace until there is need for change.

13. It is recommended that every effort be made to lease or otherwise obtain management rights for public recreational activities on selected lakes and reservoirs, not already under state control, in the 4 major waterfowl wintering regions. Only about 30 areas qualify.

14. A method for rating wetlands as to value for wintering and public hunting was devised as a part of the wetlands survey. This rating system will permit the Lands Division and the Regions to evaluate wetlands in a standard manner and enable the Department to purchase or lease the best areas with funds available.

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APPENDIX A

Table 36 — Water Composition by Categories of 9 Study Sections in Irrigated Portion of Adams County

Wetland Category	No. Areas	Average No. Areas per Section	Surface Water, Acres	Average No. Acres per Section	Marginal Land, Acres	Average No. Acres per Section	Total Acres	%	Average Total Acres per Section	Miles	Average No. Miles per Section
Lakes and reservoirs	3	0.33	41.9	4.7	20.9	2.3	62.8	31.1	7.0	..	..
Ponds and marshes over 5 acres	6	0.67	11.1	1.2	104.1	11.6	115.2	57.1	12.8	..	..
Ponds and marshes less than 5 acres ^a	13	1.44	..	..	..	..	23.8	11.8	2.6	..	..
Streams	..	..	..	..	..	..	..	..	..	..	..
Ditches and canals	..	..	..	..	..	..	..	..	..	3.2	0.36
Totals	22 ^b	2.44	53.0	5.9	125.0	13.9	201.8 ^b	100.0	22.4	3.2	0.36

^a All wetlands of 5 acres or less given as total acreage

^b Excluding ditches and canals

Table 37 — Water Composition by Categories of 12 Study Sections in Irrigated Portion of Boulder County

Wetland Category	No. Areas	Average No. Areas per Section	Surface Water, Acres	Average No. Acres per Section	Marginal Land, Acres	Average No. Acres per Section	Total Acres	%	Average Total Acres per Section	Miles	Average No. Miles per Section
Lakes and reservoirs	6	0.50	260.7	21.7	199.3	16.6	460.0	80.8	38.3	..	..
Ponds and marshes over 5 acres	2	0.17	6.5	0.5	37.7	3.1	44.2	7.8	3.7	..	..
Ponds and marshes less than 5 acres ^a	5	0.41	..	..	..	..	7.9	1.4	0.7	..	..
Streams	2	0.17	9.7	0.8	47.1	3.9	56.8	10.0	4.7	1.2	0.14
Ditches and canals	..	..	..	..	..	..	..	..	..	5.3	0.44
Totals	15 ^b	1.25	276.9	23.0	284.1	23.6	568.9 ^b	100.0	47.4	6.5	0.58

^a All wetlands of 5 acres or less given as total acreage

^b Excluding ditches and canals

Table 38 — Water Composition by Categories of 56 Study Sections in Irrigated Portion of Weld County

Wetland Category	No. Areas	Average No. Areas per Section	Surface Water, Acres	Average No. Acres per Section	Marginal Land, Acres	Average No. Acres per Section	Total Acres	%	Average Total Acres per Section	Miles	Average No. Miles per Section
Lakes and reservoirs	7	0.12	258.4	4.6	96.1	1.7	354.5	32.3	6.3	..	..
Ponds and marshes over 5 acres	15	0.27	82.6	1.5	127.7	2.3	210.3	19.2	3.8	..	..
Ponds and marshes less than 5 acres ^a	38	0.68	..	..	..	..	78.8	7.2	1.4	..	..
Streams	5	0.09	44.1	0.8	408.3	7.3	452.4	41.3	8.1	4.2	0.07
Ditches and canals	..	..	..	..	..	..	..	..	..	42.5	0.76
Totals	65 ^b	1.16	385.1	6.9	632.1	11.3	1,096.0 ^b	100.0	19.6	46.7	0.83

^a All wetlands of 5 acres or less given as total acreage

^b Excluding ditches and canals

Table 39 — Water Composition by Categories of 19 Study Sections in Irrigated Portion of Larimer County

Wetland Category	No. Areas	Average No. Areas per Section	Surface Water, Acres	Average No. Acres per Section	Marginal Land, Acres	Average No. Acres per Section	Total Acres	%	Average Total Acres per Section	Miles	Average No. Miles per Section
Lakes and reservoirs	18	0.95	912.1	48.0	193.0	10.2	1,105.1	69.8	58.2	..	..
Ponds and marshes over 5 acres	10	0.53	34.5	1.8	77.0	4.0	111.5	7.0	5.9	..	..
Ponds and marshes less than 5 acres ^a	21	1.10	..	..	..	..	38.8	2.4	2.0	..	..
Streams	5	0.26	42.5	2.2	287.0	15.1	329.5	20.8	17.3	6.7	0.35
Ditches and canals	..	..	..	..	..	..	..	..	..	25.2	1.33
Totals	54 ^b	2.84	989.1	52.0	557.0	29.3	1,584.9 ^b	100.0	83.4	31.9	1.68

^a All wetlands of 5 acres or less given as total acreage

^b Excluding ditches and canals

Table 40 — Water Composition by Categories of 20 Study Sections in Irrigated Portion of Morgan County

Wetland Category	No. Areas	Average No. Areas per Section	Surface Water, Acres	Average No. Acres per Section	Marginal Land, Acres	Average No. Acres per Section	Total Acres	%	Average Total Acres per Section	Miles	Average No. Miles per Section
Lakes and reservoirs	1	0.05	558.0	27.9	51.6	2.6	609.6	38.7	30.5	..	..
Ponds and marshes over 5 acres	10	0.50	33.1	1.7	49.9	2.5	83.0	5.3	4.2	..	..
Ponds and marshes less than 5 acres ^a	8	0.40	..	..	..	..	8.2	0.5	0.4	..	..
Streams	3	0.15	36.7	1.8	836.3	41.8	873.0	55.5	43.6	3.2	0.16
Ditches and canals	..	..	..	..	..	..	..	..	..	11.2	0.56
Totals	22^b	1.10	627.8	31.4	937.8	46.9	1,573.8^b	100.0	78.7	14.4	0.72

^a All wetlands of 5 acres or less given as total acreage

^b Excluding ditches and canals

Table 41 — Water Composition by Categories of 14^a Study Sections in Irrigated Portion of Logan and Washington Counties

Wetland Category	No. Areas	Average No. Areas per Section	Surface Water, Acres	Average No. Acres per Section	Marginal Land, Acres	Average No. Acres per Section	Total Acres	%	Average Total Acres per Section	Miles	Average No. Miles per Section
Lakes and reservoirs	1	0.07	7.9	0.6	62.6	4.5	70.5	4.3	5.0	..	..
Ponds and marshes over 5 acres	9	0.64	21.4	1.5	139.7	10.0	161.1	9.7	11.5	..	..
Ponds and marshes less than 5 acres ^b	10	0.71	..	..	..	..	15.3	0.9	1.1	..	..
Streams	4	0.29	60.7	4.3	1,348.6	96.3	1,409.3	85.1	100.7	6.6	0.47
Ditches and canals	..	..	..	..	..	..	..	..	..	7.5	0.54
Totals	24^c	1.71	90.0	6.4	1,550.9	110.8	1,656.2^c	100.0	118.3	14.1	1.01

^a Only 2 study sections in Washington County

^b All wetlands of 5 acres or less given as total acreage

^c Excluding ditches and canals

Table 42 — Water Composition by Categories of 7 Study Sections in Irrigated Portion of Sedgwick County

Wetland Category	No. Areas	Average No. Areas per Section	Surface Water, Acres	Average No. Acres per Section	Marginal Land, Acres	Average No. Acres per Section	Total Acres	%	Average Total Acres per Section	Miles	Average No. Miles per Section
Lakes and reservoirs	..	..	..	..	..	..	..	..	..	..	..
Ponds and marshes over 5 acres	..	..	..	..	..	..	..	..	..	..	..
Ponds and marshes less than 5 acres ^a	..	..	..	..	..	..	..	..	..	..	..
Streams	3	0.43	30.0	4.3	403.1	57.6	433.1	100.0	61.8	4.3	0.62
Ditches and canals	..	..	..	..	..	..	..	..	..	1.9	0.27
Totals	3 ^b	0.43	30.0	4.3	403.1	57.6	433.1 ^b	100.0	61.8	6.2	0.89

^a All wetlands of 5 acres or less given as total acreage

^b Excluding ditches and canals

Table 43 — Recreational Use of 9 Wetland Areas^a in Irrigated Portion of Adams County

Type of Use	Hunting				Fishing				Boating			
	No. Areas	%	Acres	%	No. Areas	%	Acres	%	No. Areas	%	Acres	%
Private	..	..	..	..	..	..	..	..	..	..	..	..
Public	2	22.2	30.6	17.3	4	44.5	67.9	38.4	..	..	..	..
Leased	3	33.3	83.7	47.3	3	33.3	83.7	47.3	..	..	..	..
None	4	44.5	62.7	35.4	2	22.2	25.4	14.3	9	100.0	177.0	100.0
Totals	9	100.0	177.0	100.0	9	100.0	177.0	100.0	9	100.0	177.0	100.0

^a Excluding ponds and marshes less than 5 acres and ditches and canals

**Table 44 — Recreational Use of 10 Wetland Areas^a in
Irrigated Portion of Boulder County**

Type of Use	Hunting				Fishing				Boating			
	No. Areas	%	Acres	%	No. Areas	%	Acres	%	No. Areas	%	Acres	%
Private	3	30.0	57.5	8.5	1	10.0	23.6	3.5	..	..	..	..
Public	5	50.0	475.2	70.6	3	30.0	424.4	63.0	1	10.0	358.8	53.3
Leased	2	20.0	140.6	20.9	1	10.0	99.2	14.7	1	10.0	99.2	14.7
None	..	..	..	..	5	50.0	126.1	18.8	8	80.0	215.3	32.0
Totals	10	100.0	673.3	100.0	10	100.0	673.3	100.0	10	100.0	673.3	100.0

^a Excluding ponds and marshes less than 5 acres and ditches and canals

**Table 45 — Recreational Use of 27 Wetland Areas^a in
Irrigated Portion of Weld County**

Type of Use	Hunting				Fishing				Boating			
	No. Areas	%	Acres	%	No. Areas	%	Acres	%	No. Areas	%	Acres	%
Private	12	44.4	426.1	41.8	5	18.5	268.6	26.4	1	3.7	191.7	18.8
Public	8	29.7	124.9	12.3	8	29.7	159.5	15.7	..	..	..	..
Leased	7	25.9	467.2	45.9	1	3.7	16.7	1.6	2	7.4	39.3	3.9
None	..	..	..	..	13	48.1	573.4	56.3	24	88.9	787.2	77.3
Totals	27	100.0	1,018.2	100.0	27	100.0	1,018.2	100.0	27	100.0	1,018.2	100.0

^a Excluding ponds and marshes less than 5 acres and ditches and canals

Table 46 — Recreational Use of 33 Wetland Areas^a in Irrigated Portion of Larimer County

Type of Use	Hunting				Fishing				Boating			
	No. Areas	%	Acres	%	No. Areas	%	Acres	%	No. Areas	%	Acres	%
Private	14	42.4	589.3	38.1	1	3.0	12.5	0.8	..	..	..	..
Public	14	42.4	625.4	40.5	13	39.4	912.1	59.0	4	12.1	377.6	24.4
Leased	5	15.2	330.9	21.4	4	12.1	230.0	14.9	4	12.1	320.9	20.8
None	..	..	..	..	15	45.5	391.0	25.3	25	75.8	847.1	54.8
Totals	33	100.0	1,545.6	100.0	33	100.0	1,545.6	100.0	33	100.0	1,545.6	100.0

^a Excluding ponds and marshes less than 5 acres and ditches and canals

Table 47 — Recreational Use of 14 Wetland Areas^a in Irrigated Portion of Morgan County

Type of Use	Hunting				Fishing				Boating			
	No. Areas	%	Acres	%	No. Areas	%	Acres	%	No. Areas	%	Acres	%
Private	7	50.0	50.8	3.2	..	..	..	..	..	..	..	..
Public	5	35.7	913.2	58.3	1	7.1	609.6	38.9	1	7.1	609.6	38.9
Leased	2	14.3	601.6	38.5	..	..	..	..	..	..	..	..
None	..	..	..	..	13	92.9	956.0	61.1	13	92.9	956.0	61.1
Totals	14	100.0	1,565.6	100.0	14	100.0	1,565.6	100.0	14	100.0	1,565.6	100.0

^a Excluding ponds and marshes less than 5 acres and ditches and canals

Table 48 — Recreational Use of 17 Wetland Areas^a in Irrigated Portions of Logan, Sedgwick, and Washington Counties

Type of Use	Hunting				Fishing				Boating			
	No. Areas	%	Acres	%	No. Areas	%	Acres	%	No. Areas	%	Acres	%
Private	..	..	..	..	..	..	..	..	..	..	..	..
Public	17	100.0	2,074.0	100.0	2	11.8	85.8	4.1	1	5.9	70.5	3.4
Leased	..	..	..	..	..	..	..	..	..	..	..	..
None	..	..	..	..	15	88.2	1,988.2	95.9	16	94.1	2,003.5	96.6
Totals	17	100.0	2,074.0	100.0	17	100.0	2,074.0	100.0	17	100.0	2,074.0	100.0

^a Excluding ponds and marshes less than 5 acres and ditches and canals

Table 49 — Water Composition by Categories of 12 Study Sections in Irrigated Portion of Bent County

Wetland Category	No. Areas	Average No. Areas per Section	Surface Water, Acres	Average No. Acres per Section	Marginal Land, Acres	Average No. Acres per Section	Total Acres	%	Average Total Acres per Section	Miles	Average No. Miles per Section
Lakes and reservoirs	2	0.17	560.1	46.7	..	..	560.1	34.8	46.7	..	..
Ponds and marshes over 5 acres	..	..	..	..	..	..	..	..	..	..	..
Ponds and marshes less than 5 acres ^a	4	0.33	..	..	..	..	1.1	0.1	0.1	..	..
Streams	3	0.25	30.9	2.6	1,018.8	84.9	1,049.7	65.1	87.5	3.1	0.26
Ditches and canals	..	..	..	..	..	..	..	..	..	3.4	0.28
Totals	9 ^b	0.75	591.0	49.3	1,018.8	84.9	1,610.9 ^b	100.0	134.3	6.5	0.54

^a All wetlands of 5 acres or less given as total acreage

^b Excluding ditches and canals

Table 50 — Water Composition by Categories of 7 Study Sections in Irrigated Portion of Crowley County

Wetland Category	No. Areas	Average No. Areas per Section	Surface Water, Acres	Average No. Acres per Section	Marginal Land, Acres	Average No. Acres per Section	Total Acres	%	Average Total Acres per Section	Miles	Average No. Miles per Section
Lakes and reservoirs	2	0.29	1,089.5	155.6	..	..	1,089.5	75.6	155.6	..	..
Ponds and marshes over 5 acres	1	0.14	8.7	1.2	19.1	2.7	27.8	1.9	4.0	..	..
Ponds and marshes less than 5 acres ^a	6	0.86	..	..	..	..	5.6	0.4	0.8	..	..
Streams	4	0.57	18.9	2.7	299.5	42.8	318.4	22.1	45.5	2.7	0.39
Ditches and canals	..	..	..	..	..	..	..	..	..	0.4	0.06
Totals	13 ^b	1.86	1,117.1	159.5	318.6	45.5	1,441.3 ^b	100.0	205.9	3.1	0.45

^a All wetlands of 5 acres or less given as total acreage

^b Excluding ditches and canals

Table 51 — Water Composition by Categories of 12 Study Sections in Irrigated Portion of Otero County

Wetland Category	No. Areas	Average No. Areas per Section	Surface Water, Acres	Average No. Acres per Section	Marginal Land, Acres	Average No. Acres per Section	Total Acres	%	Average Total Acres per Section	Miles	Average No. Miles per Section
Lakes and reservoirs	..	..	..	..	..	..	..	..	..	..	..
Ponds and marshes over 5 acres	1	0.08	2.3	0.2	24.6	2.0	26.9	2.7	2.2	..	..
Ponds and marshes less than 5 acres ^a	11	0.92	..	..	..	..	8.8	0.9	0.7	..	..
Streams	6	0.50	55.8	4.6	894.4	74.5	950.2	96.4	79.2	6.4	0.53
Ditches and canals	..	..	..	..	..	..	..	..	..	6.5	0.54
Totals	18 ^b	1.50	58.1	4.8	919.0	76.5	985.9 ^b	100.0	82.1	12.9	1.07

^a All wetlands of 5 acres or less given as total acreage

^b Excluding ditches and canals

Table 52 — Water Composition by Categories of 16 Study Sections in Irrigated Portion of Prowers County

Wetland Category	No. Areas	Average No. Areas per Section	Surface Water, Acres	Average No. Acres per Section	Marginal Land, Acres	Average No. Acres per Section	Total Acres	%	Average Total Acres per Section	Miles	Average No. Miles per Section
Lakes and reservoirs	..	..	..	..	..	..	..	..	..	..	..
Ponds and marshes over 5 acres	2	0.12	2.1	0.1	162.8	10.2	164.9	19.1	10.3	..	..
Ponds and marshes less than 5 acres ^a	6	0.38	..	..	..	..	1.1	0.1	0.1	..	..
Streams	4	0.25	27.1	1.7	668.9	41.8	696.0	80.8	43.5	4.4	0.28
Ditches and canals	..	..	..	..	..	..	..	..	..	4.2	0.26
Totals	12 ^b	0.75	29.2	1.8	831.7	52.0	862.0 ^b	100.0	53.9	8.6	0.54

^a All wetlands of 5 acres or less given as total acreage

^b Excluding ditches and canals

Table 53 — Water Composition by Categories of 6 Study Sections in Irrigated Portion of Pueblo County

Wetland Category	No. Areas	Average No. Areas per Section	Surface Water, Acres	Average No. Acres per Section	Marginal Land, Acres	Average No. Acres per Section	Total Acres	%	Average Total Acres per Section	Miles	Average No. Miles per Section
Lakes and reservoirs	..	..	..	..	..	..	..	..	..	..	..
Ponds and marshes over 5 acres	..	..	..	..	..	..	..	..	..	..	..
Ponds and marshes less than 5 acres ^a	2	0.33	..	..	..	..	6.6	0.5	1.1	..	..
Streams	4	0.67	42.9	7.2	1,214.3	202.4	1,257.2	99.5	209.5	4.8	0.81
Ditches and canals	..	..	..	..	..	..	..	..	..	1.8	0.30
Totals	6 ^b	1.00	42.9	7.2	1,214.3	202.4	1,263.8 ^b	100.0	210.6	6.6	1.11

^a All wetlands of 5 acres or less given as total acreage

^b Excluding ditches and canals

Table 54 — Water Composition by Categories of 30 Study Sections in Irrigated Portion of Alamosa County

Wetland Category	No. Areas	Average No. Areas per Section	Surface Water, Acres	Average No. Acres per Section	Marginal Land, Acres	Average No. Acres per Section	Total Acres	%	Average Total Acres per Section	Miles	Average No. Miles per Section
Lakes and reservoirs	..	..	..	..	..	..	..	..	..	..	..
Ponds and marshes over 5 acres	16	0.53	0.6	..	1,910.5	63.7	1,911.1	57.4	63.7	..	..
Ponds and marshes less than 5 acres ^a	29	0.97	..	..	..	..	80.8	2.4	2.7	..	..
Streams	6	0.20	66.8	2.2	1,272.5	42.4	1,339.3	40.2	44.6	8.7	0.29
Ditches and canals	..	..	..	..	..	..	..	..	..	15.7	0.52
Totals	51 ^b	1.70	67.4	2.2	3,183.0	106.1	3,331.2 ^b	100.0	111.0	24.4	0.81

^a All wetlands of 5 acres or less given as total acreage

^b Excluding ditches and canals

Table 55 — Water Composition by Categories of 17 Study Sections in Irrigated Portion of Conejos County

Wetland Category	No. Areas	Average No. Areas per Section	Surface Water, Acres	Average No. Acres per Section	Marginal Land, Acres	Average No. Acres per Section	Total Acres	%	Average Total Acres per Section	Miles	Average No. Miles per Section
Lakes and reservoirs	..	..	..	..	..	..	..	..	..	..	..
Ponds and marshes over 5 acres	11	0.65	..	..	2,619.3	154.1	2,619.3	98.9	154.1	..	..
Ponds and marshes less than 5 acres ^a	11	0.65	..	..	..	..	20.5	0.8	1.2	..	..
Streams	4	0.23	9.2	0.5	..	..	9.2	0.3	0.5	2.9	0.17
Ditches and canals	..	..	..	..	..	..	..	..	..	11.1	0.66
Totals	26 ^b	1.53	9.2	0.5	2,619.3	154.1	2,649.0 ^b	100.0	155.8	14.0	0.83

^a All wetlands of 5 acres or less given as total acreage

^b Excluding ditches and canals

Table 56 — Water Composition by Categories of 14 Study Sections in Irrigated Portion of Rio Grande County

Wetland Category	No. Areas	Average No. Areas per Section	Surface Water, Acres	Average No. Acres per Section	Marginal Land, Acres	Average No. Acres per Section	Total Acres	%	Average Total Acres per Section	Miles	Average No. Miles per Section
Lakes and reservoirs	..	..	..	..	..	..	..	..	..	..	..
Ponds and marshes over 5 acres	7	0.50	42.6	3.0	741.9	53.0	784.5	52.5	56.0	..	..
Ponds and marshes less than 5 acres ^a	5	0.36	..	..	..	..	16.3	1.1	1.2	..	..
Streams	3	0.21	33.5	2.4	659.9	47.1	693.4	46.4	49.5	3.7	0.26
Ditches and canals	..	..	..	..	..	..	..	..	..	15.6	1.12
Totals	15 ^b	1.07	76.1	5.4	1,401.8	100.1	1,494.2 ^b	100.0	106.7	19.3	1.38

^a All wetlands of 5 acres or less given as total acreage

^b Excluding ditches and canals

Table 57 — Water Composition by Categories of 26 Study Sections in Irrigated Portion of Saguache County

Wetland Category	No. Areas	Average No. Areas per Section	Surface Water, Acres	Average No. Acres per Section	Marginal Land, Acres	Average No. Acres per Section	Total Acres	%	Average Total Acres per Section	Miles	Average No. Miles per Section
Lakes and reservoirs	..	..	..	..	..	..	..	..	..	..	..
Ponds and marshes over 5 acres	20	0.77	..	..	5,415.5	208.3	5,415.5	99.2	208.3	..	..
Ponds and marshes less than 5 acres ^a	29	1.11	..	..	..	..	40.8	0.7	1.6	..	..
Streams	2	0.08	5.9	0.2	..	..	5.9	0.1	0.2	1.7	0.07
Ditches and canals	..	..	..	..	..	..	..	..	..	16.0	0.62
Totals	51 ^b	1.96	5.9	0.2	5,415.5	208.3	5,462.2 ^b	100.0	210.1	17.7	0.69

^a All wetlands of 5 acres or less given as total acreage

^b Excluding ditches and canals

**Table 58 — Recreational Use of 19 Wetland Areas^a in
Irrigated Portion of Alamosa County**

Type of Use	Hunting				Fishing				Boating			
	No. Areas	%	Acres	%	No. Areas	%	Acres	%	No. Areas	%	Acres	%
Private	1	5.3	124.6	3.8	..	..	..	..	..	..	..	..
Public	18	94.7	3,118.0	96.2	3	15.8	1,330.5	41.0	..	..	..	..
Leased	..	..	..	..	..	..	..	..	..	..	..	..
None	..	..	..	..	16	84.2	1,912.1	59.0	19	100.0	3,242.6	100.0
Totals	19	100.0	3,242.6	100.0	19	100.0	3,242.6	100.0	19	100.0	3,242.6	100.0

^a Excluding ponds and marshes less than 5 acres and ditches and canals

**Table 59 — Recreational Use of 11 Wetland Areas^a in
Irrigated Portion of Conejos County**

Type of Use	Hunting				Fishing				Boating			
	No. Areas	%	Acres	%	No. Areas	%	Acres	%	No. Areas	%	Acres	%
Private	2	18.2	117.9	4.5	..	..	..	..	..	..	..	..
Public	9	81.8	2,501.4	95.5	..	..	..	..	..	..	..	..
Leased	..	..	..	..	..	..	..	..	..	..	..	..
None	..	..	..	..	11	100.0	2,619.3	100.0	11	100.0	2,619.3	100.0
Totals	11	100.0	2,619.3	100.0	11	100.0	2,619.3	100.0	11	100.0	2,619.3	100.0

^a Excluding ponds and marshes less than 5 acres and ditches and canals

**Table 60 — Recreational Use of 9 Wetland Areas^a in
Irrigated Portion of Rio Grande County**

Type of Use	Hunting				Fishing				Boating			
	No. Areas	%	Acres	%	No. Areas	%	Acres	%	No. Areas	%	Acres	%
Private	7	77.8	1,281.7	87.0	..	..	..	..	..	..	..	..
Public	2	22.2	191.4	13.0	3	33.3	257.8	17.5	..	..	..	..
Leased	..	..	..	..	..	..	..	..	..	..	..	..
None	..	..	..	..	6	66.7	1,215.3	82.5	9	100.0	1,473.1	100.0
Totals	9	100.0	1,473.1	100.0	9	100.0	1,473.1	100.0	9	100.0	1,473.1	100.0

^a Excluding ponds and marshes less than 5 acres and ditches and canals

**Table 61 — Recreational Use of 20 Wetland Areas^a in
Irrigated Portion of Saguache County**

Type of Use	Hunting				Fishing				Boating			
	No. Areas	%	Acres	%	No. Areas	%	Acres	%	No. Areas	%	Acres	%
Private	4	20.0	1,587.0	29.3	..	..	..	..	..	..	..	..
Public	16	80.0	3,828.5	70.7	..	..	..	..	..	..	..	..
Leased	..	..	..	..	..	..	..	..	..	..	..	..
None	..	..	..	..	20	100.0	5,415.5	100.0	20	100.0	5,415.5	100.0
Totals	20	100.0	5,415.5	100.0	20	100.0	5,415.5	100.0	20	100.0	5,415.5	100.0

^a Excluding ponds and marshes less than 5 acres and ditches and canals

**Table 62 — Water Composition by Categories of 19 Study Sections in
Irrigated Portion of Delta County**

Wetland Category	No. Areas	Average No. Areas per Section	Surface Water, Acres	Average No. Acres per Section	Marginal Land, Acres	Average No. Acres per Section	Total Acres	%	Average Total Acres per Section	Miles	Average No. Miles per Section
Lakes and reservoirs	..	..	..	..	..	..	..	..	..	..	..
Ponds and marshes over 5 acres	1	0.05	..	..	11.8	0.6	11.8	2.2	0.6	..	..
Ponds and marshes less than 5 acres ^a	14	0.74	..	..	..	..	27.7	5.2	1.5	..	..
Streams	10	0.53	98.7	5.2	391.2	20.6	489.9	92.6	25.8	8.6	0.45
Ditches and canals	..	..	..	..	..	..	..	..	..	..	..
Totals	25 ^b	1.32	98.7	5.2	403.0	21.2	529.4 ^b	100.0	27.9	8.6	0.45

^a All wetlands of 5 acres or less given as total acreage

^b Excluding ditches and canals

Table 63 — Water Composition by Categories of 16 Study Sections in Irrigated Portion of Mesa County

Wetland Category	No. Areas	Average No. Areas per Section	Surface Water, Acres	Average No. Acres per Section	Marginal Land, Acres	Average No. Acres per Section	Total Acres	%	Average Total Acres per Section	Miles	Average No. Miles per Section
Lakes and reservoirs	..	..	..	..	..	..	..	..	..	..	..
Ponds and Marshes over 5 acres	1	0.06	..	..	10.7	0.7	10.7	1.4	0.7	..	..
Ponds and marshes less than 5 acres ^a	33	2.07	..	..	..	..	23.2	3.0	1.4	..	..
Streams	9	0.56	222.5	13.9	510.7	31.9	733.2	95.6	45.8	7.5	0.47
Ditches and canals	..	..	..	..	..	..	..	..	..	8.5	0.53
Totals	43 ^b	2.69	222.5	13.9	521.4	32.6	767.1 ^b	100.0	47.9	16.0	1.00

^a All wetlands of 5 acres or less given as total acreage

^b Excluding ditches and canals

Table 64 — Water Composition by Categories of 14 Study Sections in Irrigated Portion of Montrose and Ouray Counties

Wetland Category	No. Areas	Average No. Areas per Section	Surface Water, Acres	Average No. Acres per Section	Marginal Land, Acres	Average No. Acres per Section	Total Acres	%	Average Total Acres per Section	Miles	Average No. Miles per Section
Lakes and reservoirs	..	..	..	..	..	..	..	..	..	..	..
Ponds and marshes over 5 acres	3	0.21	..	..	131.5	9.4	131.5	60.9	9.4	..	..
Ponds and marshes less than 5 acres ^a	21	1.51	..	..	..	..	21.4	9.9	1.5	..	..
Streams	3	0.21	14.1	1.0	48.9	3.5	63.0	29.2	4.5	2.8	0.20
Ditches and canals	..	..	..	..	..	..	..	..	..	2.0	0.14
Totals	27 ^b	1.93	14.1	1.0	180.4	12.9	215.9 ^b	100.0	15.4	4.8	0.34

^a All wetlands of 5 acres or less given as total acreage

^b Excluding ditches and canals

APPENDIX B

List and description of wetland types encountered in the survey in Colorado (Martin et al., 1953; and U.S. Fish and Wildlife Service, 1955). Common and scientific names of plants after Martin et al., (1953).

Type 1—*Seasonally flooded basins or flats*—Soil covered with water or waterlogged during variable seasonal periods, but well drained during much of the growing season. Located on riverbottoms, along borders of drawn-down reservoirs, and in shallow potholes and other shallow depressions. Vegetative cover normally consists of grasses (Gramineae), sedges (Cyperaceae), smartweeds (*Polygonum* spp.), and annual weeds.

Type 1-A wetlands are pasture and hay land periodically flooded with irrigation water during the spring, summer, and early fall for producing livestock forage. Vegetation consists primarily of a mixture of grasses, sedges, and rushes (Juncaceae).

Type 3—*Shallow fresh marshes*—Soil normally waterlogged and sometimes covered with as much as 6 inches of water during the growing season. Vegetation may nearly fill shallow lake basins, potholes, or sloughs, may border deep marshes on the landward side of such depressions, or may adjoin irrigation systems. Common plants consist of grasses, sedges, rushes, bulrushes (*Scirpus* spp.), spikerushes (*Eleocharis* spp.), cattails (*Typha* spp.), arrowheads (*Sagittaria* spp.), and smartweeds.

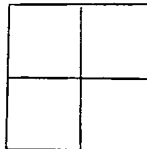
Type 4—*Deep fresh marshes*—Marshy depressions covered with one to 3 feet of water during the growing season. Marsh vegetation may nearly fill shallow lake basins, potholes, or sloughs, or may border open water in such depressions. Emergent vegetation includes such plants as cattails, reed (*Phragmites communis*), and bulrushes. In open areas, pondweeds (*Potamogeton* spp.), naiads (*Najas* spp.), coontail (*Ceratophyllum demersum*), watermilfoils (*Myriophyllum* spp.), waterweeds (*Anacharis* spp.), duckweeds (*Lemna* spp., *Spirodela* spp.), and other aquatics may occur.

Type 5—*Open fresh water*—Open water of variable depth in which emergent vegetation is restricted to a narrow border. Ponds, lakes and reservoirs are included in this type. Open water may completely occupy lake and pond basins, potholes, sloughs, ditches, canals, or stream beds, or it may be fringed with marsh. Vegetation (mainly at depths less than 6 feet) includes pondweeds, naiads, coontail, watermilfoils, and muskgrasses (*Chara* spp.).

1. Area name _____ Location _____ T _____ N; R _____ W; S _____
2. Date of survey _____ Observer(s) _____
3. Type of area: Reservoir Lake Marsh Slough River Stream
 A-Estimated acres of water area _____ Estimated acres of adjacent marginal land _____
 B-Type of surrounding area: Agricultural Grazing Flat Rolling etc. _____
 C-Use of surrounding area _____
4. Source of water: Spring fed Ditch from _____ Stream (name) _____
 A-When filled _____ When used _____ Fluctuation in vertical feet _____
 Ever go dry _____ How often _____ Season of dry period _____
 B-Water available: Spring Fall Every year _____
5. Owned now by _____
6. Access controlled by _____
7. Use of area now: Irrigation Stock Recreation None
 A-Recreation: Hunting Private Public None Leased
 Fishing Private Public None Leased
 Boating Private Public None Leased Water Ski _____
 B-Lessee and cost/year _____
 C-Hunting records available: Yes No
8. Acres of public land contained _____ (show location on sketch)
9. Federal funds used in construction or improvement: Yes No
10. Type of waterfowl use: Ducks Geese
 A-Species and number seen during survey _____
 B-Ducks:
 Spring: Species and number _____ # days _____
 Summer: Species nesting _____ # broods _____
 Fall: Species and number _____ # days _____
 Winter: Species and number _____ # days _____
 C-Geese:
 Spring: Number of geese _____ # days _____
 Summer: Number of breeding pair _____ Number broods _____ Number molting _____
 Fall: Date arrive _____ Number of geese _____ Number days _____
 Winter: Number of geese _____ # days _____
11. Production benefits: Water in spring _____ Every year _____
 A-Nesting cover: Percent of area _____ Types _____
 B-Brood cover: Percent of area _____ Escape cover _____
 C-Floating vegetation: Present Absent
12. Hunting benefits: Species and number using: _____
 A-Natural foods _____ Type(s) _____
 B-Distance to agricultural crops _____ Type(s) _____
 C-Distance to Refuge area _____ Name of Refuge area _____
 D-Water in: Fall Winter Freeze over yearly _____ Time of freeze-up _____
 E-Cover for blinds _____ Number of possible blinds _____
 F-Number of hunters will accommodate at one time _____ Distance from and name of area of hunter supply _____
 G-If this area is not leased, is hunting permitted if permission is asked: Yes _____ No _____
 H-Does the owner plan to drain or reclaim this area in the future: Yes _____ No _____
13. Potential for other hunting:
 A-Dove: Good Fair Poor None. Pheasant & Quail: Good Fair Poor None.
 Rabbit and Squirrel: Good Fair Poor None.
14. Recreational Potential:
 A - Fishing: Trout Warm Water Now _____ Possible _____
 Boating: Type _____ Now _____ Possible _____
 Camping and Picnic Areas: Now _____ Possible _____ Facilities _____
15. Observer's opinion of area for recreation and waterfowl use and need for public use.

16. Available for lease (long term) or purchase:
 Lease Purchase
 Now _____ (term of current lease) _____
 Future _____ (term of possible lease) _____
 Never _____
17. Photo: Yes No. Film pack # _____ Negative # _____ (attach photo to final form)
18. Additional comments:

19. Sketch of area:





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