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## **California's Central Valley Wintering Waterfowl: Concerns and Challenges**

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Few places on the North American continent can boast of the concentrations of migratory birds that winter in the Central Valley of California. Long before agriculture and industrialization came west, this great valley served as a major wintering ground for millions of migratory birds. Fall flights of waterfowl, shorebirds, waders, raptors, and passerines returned annually to inhabit the vast wetland, riparian, and grassland habitats which covered the valley floor (Dasmann 1966, Bakker 1971).

Major changes in the Central Valley during the last century have profoundly influenced its physical and biological features. Wetland, riparian, and grassland habitats have been devastated by flood control, drainage, water diversion projects, and agricultural development. Waterfowl and other migratory birds that depend on these areas for vital wintering habitat face an uncertain future as world market demands continue to encourage agricultural, industrial, and urban growth in California.

Concerns for California's shrinking waterfowl habitat are not new. Indeed, over 30 years ago, Day (1949) described the habitat picture in the state as "discouraging." In the past, management and research efforts have focused mostly on breeding grounds. However, many species of waterfowl occupy wintering habitat for as long as eight months of the year. Furthermore, biologists have indicated that habitat quality on wintering grounds may have a major influence on waterfowl populations (Shannon 1965, Chabreck 1979, Heitmeyer and Fredrickson 1981). Recognition of the importance of wintering areas and concern for their losses have prompted increased emphasis on wintering populations and habitats in strategies for continental waterfowl management (Brace et al. 1981).

Our objectives are to describe the Central Valley as a wintering area for waterfowl, to identify problems confronting these waterfowl, to discuss current efforts to resolve these problems, and to recommend actions needed to improve waterfowl management.

### **Waterfowl Populations and Habitats**

Each year in early August the first flights of ducks from northern breeding areas begin arriving in the Central Valley. Populations increase through the fall and by late December peak at about 5.6 million ducks and geese. Overall, about 10–12 million waterfowl and hundreds of thousands of other water-related birds annually

winter in or pass through the valley. These birds originate mostly in breeding habitats primarily in Alaska and the provinces and territories of western Canada (Kozlik 1975). Based on midwinter surveys (Pacific Flyway Study Committee 1972–1981) a large-percentage of the Pacific Flyway waterfowl population winters here. Major species include whistling swans (*Cygnus columbianus*)—69 percent, Pacific white-fronted geese (*Anser albifrons frontalis*)—89 percent, lesser snow geese (*A. caerulescens caerulescens*)—90 percent, cackling Canada geese (*Branta canadensis minima*)—84 percent, pintails (*Anas acuta*)—76 percent, mallards (*A. platyrhynchos*)—25 percent, northern shovelers (*A. clypeata*)—77 percent, greenwinged teal (*A. crecca carolinensis*)—47 percent, American wigeon (*A. americana*)—62 percent, gadwalls (*A. strepera*)—50 percent, wood ducks (*Aix sponsa*)—93 percent, and canvasbacks (*Aythya valisineria*)—44 percent. The entire continental population of tule white-fronted geese (*A. a. gambelli*), endangered Aleutian Canada geese (*Branta canadensis leucopareia*), and all but a fraction of Ross' geese (*Anser rossii*), winter in the Central Valley. Altogether, about 60 percent of the Pacific Flyway waterfowl population and 18 percent of the continental population winters here.

The Central Valley extends 400 miles (640 km) nearly north and south through the heartland of California. Bounded on the east by the Sierra foothills and on the west by the Coast Ranges, the valley floor averages 40 miles (64 km) wide and encompasses 16,000 square miles (41,500 km<sup>2</sup>). The valley is divided into three major regions: the Sacramento Valley, draining southward; the San Joaquin Valley, draining northward; and the Delta and Suisun Marsh area where the Sacramento and San Joaquin river systems meet (Figure 1). Major drainage basins that make up the Sacramento Valley are the Butte, Colusa, Sutter, Yolo, and American. The San Joaquin Valley consists of the San Joaquin Basin in the north and the Tulare Basin, which forms a closed drainage system at the southern end of the valley. In the Sacramento Valley, flood waters are contained by a system of bypasses (diked agricultural lands) that direct Sacramento River overflow around major metropolitan areas and into the Delta. On a smaller scale, similar bypasses have been constructed along the San Joaquin River.

Within the last 50 years, public works projects responding to water demands of agriculture and large metropolitan areas have produced a great network of artificial lakes and rivers interconnected by a system of aqueducts. The federally administered Central Valley Project and the associated State Water Project are the most important of these systems. A primary function of these massive conveyances is to transport water from major sources in northern California to arid regions in the south. This reliable water source, rich soils, and ideal climate have made California the nation's leading agricultural state for the past 25 years (Kahl 1979).

Virtually all waterfowl habitat in the Central Valley today is on public lands managed for wildlife or on lands of private duck hunting clubs. Wetlands on these areas total about 300,000 acres (121,000 ha) of marsh or other flooded habitat (Table 1). Most of these wetlands are seasonal and all are managed to some degree. Up to 96,000 more acres (39,000 ha) of habitat are created if the bypasses flood during the winter (F.E. Smith, personal communication). An additional 200,000–600,000 acres (81,000–243,000 ha) of harvested rice and other grain fields provide a food resource to waterfowl if these areas are unplowed or flooded.

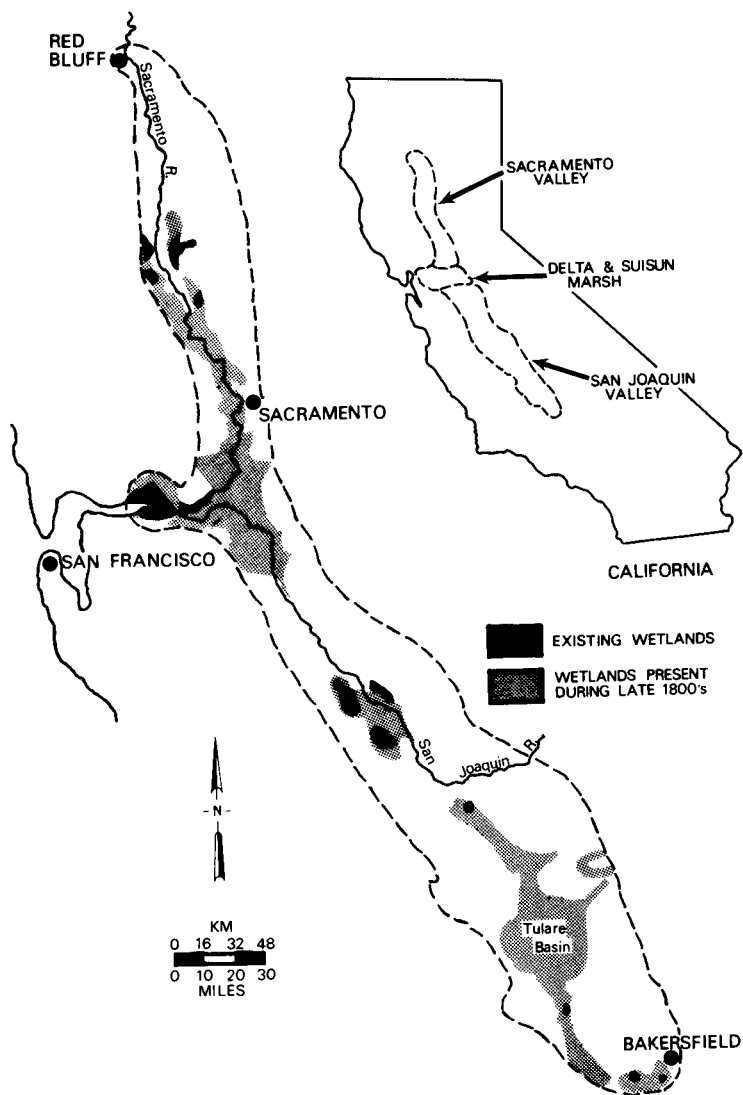


Figure 1. Major regions of the Central Valley of California and the distribution of wetlands in the Valley during the late 1800s compared to the present.

## Problems Confronting Waterfowl

### *Habitat Resources*

In the span of little more than a century, native wetland areas in the Central

Table 1. Ownership of waterfowl habitat in the Central Valley, 1979.

	Wetland area (acres)			Total
	Private	Federal <sup>a</sup>	State <sup>b</sup>	
Sacramento Valley	59,800 <sup>c</sup>	23,500	8,400	91,700
Delta-Suisun Marsh	71,600 <sup>d</sup>	—	13,900	85,500
San Joaquin Valley	75,800	30,600	15,400	121,800
Total	207,200 <sup>e</sup>	54,100	37,700	299,000

<sup>a</sup>Includes total area for National Wildlife Refuges including: Sacramento, Delevan, Colusa, Sutter, San Luis, Merced, Kesterson, Kern, Pixley, and Butte Sink Wildlife Management Area.

<sup>b</sup>Includes total area for State Wildlife Areas including: Gray Lodge, Grizzly Island, Joice Island, Lower Sherman Island, Los Banos, Mendota, and Volta.

<sup>c</sup>Based on duck club survey (California Department of Fish and Game 1979). Includes only flooded areas. About 26,500 acres are native wetlands.

<sup>d</sup>Includes 18,000 acres of fresh marsh, brackish marsh, and riparian habitat in the Delta (Madrone Associates 1980) and 53,600 acres flooded in the Suisun Marsh (California Department of Fish and Game 1979).

<sup>e</sup>Total wetland and upland area in private duck clubs is 379,400 acres (California Department of Fish and Game 1979).

Valley have declined so drastically that they may now be described as small islands in a sea of agricultural and urban development. Before settlement, the state contained an estimated 5 million acres (2 million ha) of wetlands (Anderson and Kozlik 1964). About 4 million of this total were in the Central Valley. Closely associated with these wetlands were extensive riparian forests that covered about 900,000 acres (364,000 ha) (Katibah 1981). Recent estimates (U.S. Fish and Wildlife Service 1978) indicate that only about 6 percent of the original wetland area (Figure 1) and 11 percent of the riparian forest (Katibah 1981) now remains in the Central Valley.

Loss of native wetland habitat has been more pronounced in some regions of the Valley than in others. Most striking has been the disappearance of waterfowl habitats in the delta and the San Joaquin Valley, particularly the Tulare Basin where natural flooding once created huge water areas attracting millions of ducks (Dasmann 1966).

Encroachment by agriculture is the major threat to privately owned native marshes and grasslands in the Central Valley. The ecological, aesthetic, and recreational value of these areas has not competed effectively against strong economic incentives to grow cash crops such as cotton and rice. Operational costs of duck clubs and taxes on these lands have also been prime factors in the loss of wetlands (R.L. Gray, personal communication). Decline in hunting quality has contributed to habitat conversion in some instances.

Conversion of wetlands to rice, cotton, and other crops has caused major habitat losses in the Central Valley. Rice has been an important crop in California since 1912. Because of the aquatic nature of rice, marsh soils are ideal for its production. Total harvested acreage of rice increased from 238,000 acres (96,000 ha) in 1950 to 590,000 acres (239,000 ha) in 1981 (California Crop and Livestock Reporting Service 1981). Strong international markets during the last 5 years have stimulated rice production. In the Colusa Basin of the Sacramento Valley, wetlands declined

only slightly from about 15,000 acres (6,100 ha) in 1952 to 13,000 acres (5,300 ha) in 1970. But between 1970 and 1979, 7,000 more acres (2,800 ha) were lost. Land for conversion to rice production has come mostly from duck clubs (U.S. Fish and Wildlife Service 1979, Gray 1979).

Harvested rice fields in private duck club ownership are usually reflooded in the fall to provide waterfowl hunting areas. Similarly, some ranchers also reflood their ricelands and lease them for hunting. These fields provide important feeding areas for some species of waterfowl. However, the uniform condition of ricelands reduces the diversity of food, cover, and water depth offered by marshlands; consequently a wide range of birds, including many waterfowl species, dependent on native habitats may not benefit from this conversion. For example, species dependent on marsh habitat such as gadwalls and northern shovelers may be impacted by this loss more than pintails and mallards.

Wetland losses in the southern part of the Central Valley have been caused by conversion to cotton and a variety of row crops. A 65,000-acre (26,000-ha) area of private duck clubs known as the Grasslands represents the largest tract of waterfowl habitat in the San Joaquin Valley. Large concentrations of ducks are attracted there by extensive native pasture and abundant seasonal wetlands. In spite of its value to waterfowl, 3,255 acres (1,320 ha) of habitat (19 duck clubs) were converted to croplands between 1971 and 1981. About 55 percent of this loss has occurred in the last two years (G.W. Kramer, personal communication).

Destruction of riparian forests throughout the Central Valley has reduced the availability of habitat important for food and cover (Hurst et al. 1980). This has resulted in a lowered carrying capacity for waterfowl, such as wood ducks, and dozens of other avian species that depend on these areas for wintering as well as breeding habitat.

A less obvious loss of habitat occurs when some private clubs drain flooded areas when the waterfowl hunting season closes. This practice may eliminate valuable feeding areas in late winter when adequate food becomes most critical. Loss of each parcel of habitat, no matter how small, causes a decline in the quantity and diversity of habitat available to sustain wintering waterfowl and other wildlife.

### *Water Resources*

Water of sufficient quantity and quality is a major limiting factor for wetlands and waterfowl populations in the Central Valley. Legislation governing the allocation of surface water by the Central Valley Project and the State Water Project has assigned higher priority to agricultural and municipal needs than to fish and wildlife requirements (U.S. Water and Power Resources Service 1980). About 87 percent of the water provided by these systems is used for irrigation (Kahrl 1979). Increased demands from agricultural and municipal users will severely curtail the availability of water in the future (U.S. Water and Power Resources Service 1980). Of nine National Wildlife Refuges in the Central Valley, only three have adequate water rights or ground water sources to reasonably guarantee their future water supply. The optimum management of waterfowl habitat on refuges requires about 200,000 acre-feet (81,000 ha-m) per year (U.S. Fish and Wildlife Service 1981). The average amount received annually is about 140,000 acre-feet (57,000 ha-m). However, only 40,000 acre-feet (16,000 ha-m) are reasonably secure, and even this

amount could be reduced in critical periods. State Wildlife Areas and private duck clubs are faced with a similar problem. Such water restrictions severely limit the effective management and potential expansion of waterfowl habitat in the Central Valley.

Another problem that concerns waterfowl managers is the prospect of major new water development projects (i.e., enlargement of Shasta dam and the Cottonwood Creek project). The increased water storage capability of these projects would reduce winter flooding of bypasses in the Sacramento Valley. Additional water provided by these projects may prove beneficial to waterfowl, but it could also stimulate expansion of agricultural development at the expense of native wetlands.

Periodic droughts in California have placed hardships on all water users, but waterfowl habitat has been particularly vulnerable. During critical periods, water allocations to managed wetland habitat may be reduced by as much as 75 percent (R.F. McVein, personal communication). Restricted water supplies during the 1976–1977 drought forced refuges to reduce the amount of marsh habitat. Waterfowl areas in the San Joaquin Valley without adequate ground water sources were most affected. For example, in 1977 Kern refuge maintained only 30 percent of the usual wetland acreage (T.J. Charmley, personal communication).

Ground water is not a dependable or reasonable source for the maintenance of wetland habitat in the San Joaquin Valley. Serious ground water overdraft has lowered water tables and increased pumping costs. Furthermore, utility rates have more than tripled in recent years (R. Oser, personal communication).

Water quality is sometimes a problem for wetland management. Surface water used to flood waterfowl habitat is mostly reused irrigation water. In the Sacramento Valley this water is generally of adequate quality, but in the San Joaquin Valley, salinity problems may reduce the value of water sources. Water quality problems resulting from decreased flows from the Sacramento-San Joaquin River System may threaten the future of the Suisun Marsh by allowing seawater intrusion (Miller et al. 1975, Rollins 1981).

### *Agricultural Practices*

Crop production in the Central Valley is constantly changing as new tillage practices, genetic strains of plants, and irrigation and harvest methods are developed. As native wetlands are lost, waterfowl become more dependent on certain agricultural lands for food resources. A shift in cropping patterns on these lands could significantly alter the Central Valley's waterfowl carrying capacity (Kozlik 1974, Smith 1981) or the activity patterns of these birds (Michny 1979).

Large numbers of waterfowl can subsist in the Central Valley during winter because waste rice represents a vast food source that, for some species, partly offsets the reduction of natural wetland habitat. However, this situation is changing because new rice strains that mature more rapidly and allow harvesting with less waste are now available. Modern land leveling and effective use of herbicides are becoming standard practices (Rutger and Brandon 1981) which eliminate the habitat diversity characteristic of older rice farming methods. For instance, land leveling produces large rectangular rice fields and eliminates most of the contour levees which normally provide a source of native marsh plants valuable to waterfowl for food and cover.

Biologists have speculated that the dramatic increase in corn production on the Delta, in combination with field flooding for leaching and hunting following harvest, resulted in increased use of this area by pintails (Michny 1979). The long term availability to waterfowl of harvested Delta corn must be assessed with caution; economic factors that contributed to such a rapid increase in corn acreage could also produce an equally spectacular decline.

Production of barley, wheat, and safflower in rotation with cotton is a well established practice in the Tulare Basin. Harvested grain fields, pre-irrigated before planting cotton, provide valuable habitat for the traditional August arrival of pintails. However, serious salinity problems in the Tulare Basin are prompting the installation of tile drainage systems that may bring an end to the farming practices responsible for attracting large populations of wintering waterfowl (G.W. Kramer, personal communication).

### *Disease and Environmental Contaminants*

Waterfowl in the Central Valley are forced to concentrate on habitat that has declined over the years. Crowded conditions, poor habitat quality, and adverse weather may contribute to the spread of disease. Botulism and avian cholera are chronic waterfowl disease problems. In some years, deaths attributed to botulism in the state have exceeded 250,000 (Hunter et al. 1970). Similarly, avian cholera losses in California one winter exceeded 70,000 birds (Rosen 1971). According to Friend (1981), the Central Valley, along with three other areas in North America, has developed into an avian cholera enzootic area. Over 33,000 waterfowl killed by disease were picked up during the 1980–81 winter season on public and private lands in California (U.S. Fish and Wildlife Service, unpublished report). In recent years lead poisoning has been found in 3 to 10 percent of the total number of dead waterfowl examined annually from sampled areas (U.S. Fish and Wildlife Service and California Department of Fish and Game, unpublished reports).

The impact of environmental contaminants on waterfowl wintering in the Central Valley has not been adequately examined, but the intensive agriculture common to the region and its heavy dependence on chemicals provide cause for concern. About 17 percent of all pesticides used in the United States are applied in California (S.M. Nash, personal communication). In 1980 over 121 million pounds (55 million kg) of registered pesticides were used in the state; about 55 percent of this was applied in counties located in the Central Valley (California Department of Food and Agriculture 1981).

### *Urban Populations*

Already the most populous state (23.8 million), California is expected to reach 28 million by 1990 (California Population Research Unit 1981). The most significant impact of this increase will be an even greater demand on the limited spatial and water resources of the state. Loss of private duck hunting clubs to agricultural development causes more hunters to seek recreation on public hunting areas. Between 1970 and 1979, the average seasonal hunting capacity of 14 managed areas in the Central Valley was 92,000 hunter visits. On the average, demand for hunting on these areas was at capacity, and in some areas it exceeded available quotas by as much as 27 percent. An estimated 3–4 million people annually spend



some time viewing wildlife in the Central Valley (U.S. Fish and Wildlife Service 1981).

As the number of resource users increases relative to the amount and distribution of wildlife habitat, it will become increasingly difficult to provide adequate opportunities for recreation and even more difficult to provide esthetically pleasing experiences. These demands must be met if managers are to maintain the public's interest in the waterfowl resource.

## **Current Efforts To Resolve Problems**

### *Habitat Preservation*

Concerns for habitat preservation prompted the U.S. Fish and Wildlife Service to prepare guidelines in 1976 for implementing the Migratory Bird Land Acquisition program. The Central Valley was ranked high in a nationwide priority system developed for this effort. Development of a comprehensive plan for wetland preservation (U.S. Fish and Wildlife Service 1978) was the first step in starting the program in California. Funds are obtained by the sale of Federal Migratory Bird Hunting and Conservation stamps. To date, most of the funds designated for California have been used in the Grasslands area where perpetual easements have been obtained on 11,700 acres (4,700 ha). The goal for the Grasslands is to acquire easements on a total of 48,000 acres (19,400 ha). In the Butte Sink of the Sacramento Valley, 1,154 acres (470 ha) have been protected by easement or fee purchase.

The Water Bank Program of the U.S. Department of Agriculture was originally implemented to encourage the preservation of waterfowl breeding habitat. Some provisions of this program are important for protection of wintering habitat. In the Central Valley, 22,810 acres (9,200 ha) are currently protected by Water Bank agreements (R.F. Schultze, personal communication).

The California State Legislature has been active in wetland protection. In 1976 they passed the California Wetlands Preservation Act. This legislation was broadened by the passage of Senate Concurrent Resolution No. 28 in 1979. These documents officially recognized the need to protect and restore California's wetlands. The 1979 resolution directed the Department of Fish and Game to prepare a plan by December 1982 to increase the amount of wetlands in California by 50 percent. Although this requirement does not mandate the implementation of any recommendations, it sets the stage for future legislation. Other significant state legislation that benefits waterfowl includes the 1977 Suisun Marsh Preservation Act, which protects this marsh and adjacent areas from land use changes.

### *Water for Wetlands*

Fish and wildlife have traditionally been given low priority in the allocation of water by the Central Valley Project (CVP) and State Water Project (SWP). Authorization to protect and conserve these resources was not included as a function of the projects. Furthermore, the impacts of water development projects on fish and wildlife have not been fully recognized until recently (U.S. Bureau of Reclamation 1978), and adequate laws to insure protection of these resources are not available. Therefore, an issue of significant importance to future water supplies for waterfowl

habitat in the Central Valley is the proposed reauthorization of the CVP. This legislation would give fish and wildlife equal consideration with other project purposes when allocating future CVP water supplies (see U.S. Water and Power Resources Service 1980).

Outlook for the reauthorization of the CVP is not optimistic at this time. However, for the future, Bureau of Reclamation administrators intend to fulfill some refuge needs from CVP water supplies. Negotiations between the California Department of Fish and Game, and the CVP, and SWP are being made to insure that future water needs of wildlife areas are given equal priority with agriculture and municipal needs.

Pumping ground water has created high operating costs for some refuges. Recent negotiations between the Fish and Wildlife Service and the Western Area Power Administration have tentatively resulted in provisions for low cost power for refuges. This agreement would be effective for 12 years and result in an estimated annual saving of about one million dollars in utility costs by 1994 (R. Oser, personal communication).

High soil salinity affecting about 400,000 acres (162,000 ha) of irrigated farmland in the San Joaquin Valley poses a serious threat to agricultural productivity (San Joaquin Valley Interagency Drainage Program 1979). A solution for this problem involves a system to manage and dispose of saline waters recovered from subsurface tile drains. One alternative method of disposal includes the creation of 64,000 acres (26,000 ha) of new or restored wetland habitats to receive these waters (San Joaquin Valley Interagency Drainage Program 1979). Although salt load in this water is high (up to 15 mmhos/cm EC), preliminary evaluation indicates that it has potential for marsh management (Ives et al. 1977). The Fish and Wildlife Service and the Department of Fish and Game have proposed a study to evaluate methods to use this water as a supplementary source for maintaining waterfowl habitat in the arid portions of the San Joaquin Valley. Assembly Bill No. 1376, recently passed by the California Legislature, prohibits the discharge of any San Joaquin Valley agricultural drainage water until a program to evaluate the feasibility of its use in managing waterfowl wintering habitat has been funded and initiated.

### *Research Accomplishments*

Information obtained from numerous studies by resource agencies and academic institutions have expanded our knowledge of waterfowl ecology in the Central Valley. The Department of Fish and Game, over many years, has conducted research on a wide range of waterfowl related topics. California universities have been particularly involved in studies of the basic aspects of waterfowl biology. More recently, the Fish and Wildlife Service has initiated ecological studies identified as critical to management needs. These studies provide a source of information for addressing waterfowl problems and refining future research objectives.

### **Recommendations For Research and Management**

People have become more aware and knowledgeable of resource issues during the past decade. Increased public attention focused on wildlife issues requires that management's decisions be based on the most accurate and credible information available. Studies designed to address specific and critical questions are required

to assure accurate information for waterfowl management. The dynamic nature of the Central Valley requires that research be responsive to changing conditions associated with human impacts on the environment.

Topics that should be emphasized by research include:

1. Evaluate alternative water sources for managing wetland habitat.
2. Develop methods of using available water most effectively.
3. Assess winter food and other requirements of key species and the ability of major habitats to provide these resources.
4. Develop and evaluate methods to obtain better quantitative data on abundance and distribution of waterfowl.
5. Evaluate the influence of weather, agriculture, and hunting on the distribution and abundance of waterfowl.
6. Evaluate the cause, chronology, and magnitude of non-hunting mortality.
7. Assess the physical condition and reproductive potential of waterfowl relative to winter habitat conditions.

Topics that should be emphasized by management include:

1. Develop means to encourage landowners to preserve wetlands.
2. Complete the National Wetland Inventory in the Central Valley.
3. Monitor land use changes that influence waterfowl activity and threaten habitat.
4. Develop a plan to secure long term water sources for federal, state, and private waterfowl habitats.
5. Implement management strategies for public waterfowl areas that will enhance their carrying capacity for wintering waterfowl.

## **Conclusions**

Today, as it did a century ago, the Central Valley provides wintering habitat for millions for waterfowl. This seems remarkable because much of the native habitats that waterfowl traditionally depended on in the Valley have been systematically eliminated over the years. Some agricultural lands provide alternative food sources for waterfowl; yet the ability of these areas to supply all requirements for wintering waterfowl populations is questionable. Furthermore, such changes may result in shifts in species composition of wintering populations over the long term.

The interest of resource managers has recently focused on wintering grounds because habitat losses on these areas have reached alarming proportions. Our understanding of the activities and requirements of wintering waterfowl is inadequate to advise managers struggling to prevent further habitat losses and attempting to effectively manage protected areas. New evidence that relates winter habitat conditions to the productivity of waterfowl adds increased urgency for the management of these habitats.

Recently, the Fish and Wildlife Service has directed research effort towards evaluation of the relation between waterfowl populations and wintering habitat in the Central Valley. We think this effort is long overdue. Waterfowl management problems in the Central Valley are complex. Solving these problems necessitates the collective expertise of federal and state resource managers, researchers, private groups, landowners, and legislators. Concerted efforts must be directed to identify the most important waterfowl problems or issues and to effectively allocate resources to accomplish desired objectives. Innovative research and management methods

will be required to accomplish more with fewer resources. Great potential for cooperative effort exists.

The challenge to resource managers in the Central Valley is to maintain a place for waterfowl in a dynamic environment that is heavily impacted by human activity. At risk are a major ancestral wintering area for migratory birds and the opportunities for the use of these resources by future generations.

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