REPRINT FROM
Calif. Fish and Game 75(3): 155–168 1989

DUCK HARVEST ON PUBLIC HUNTING AREAS IN CALIFORNIA[1]

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We summarized hunter visits and success, and the magnitude and species composition of the duck harvest recorded on California public hunting areas (PHAs) during 1950–87. Hunter visits and harvest increased during 1950–74 as new PHAs were added, then declined concurrently with duck populations. Of six geographic regions, the Sacramento Valley, with numerous PHAs and the largest duck concentrations, accounted for the largest portion of PHA hunter visits (28%) and harvest (35%). Duck population levels, regulations, and hunter numbers affected PHA hunter success. Success was highest during 1955–59 but declined with no consistent trend after 1960. Species vulnerability, abundance, distribution, and hunter preference affected harvest composition. Northern pintails, *Anas acuta*, averaged 27% of the PHA harvest but declined in importance after 1974. Green-winged teal, *A. crecca*, the most important species in southern regions, averaged 21% of the PHA harvest. Mallards, *A. platyrhynchos*, averaged 16% of the PHA harvest but increased in importance after 1974 to become the most common duck bagged after 1983. PHA harvest comprised a small (4–16%) portion of the total state harvest. However, this portion increased from 1950–70 because of increased hunter visits to new PHAs and after 1970 because hunter success on PHAs did not decline as on other areas. PHA hunters tended to harvest fewer preferred species and more vulnerable species, as proportions of total bag, than did other hunters. The continued decline in numbers of waterfowl hunters presents important challenges for management of waterfowl areas in California.

INTRODUCTION

California wintering grounds are critically important to North American waterfowl populations. About 60% of Pacific Flyway and 18% of North American waterfowl winter in California (Gilmer et al. 1982). Recent midwinter duck counts have exceeded 5 million (Figure 1, Pacific Flyway Study Committee 1951–84, U.S. Fish and Wildlife Service, unpubl. data) and 10–12 million waterfowl winter in or pass through the state. Moreover, California is the primary wintering area for several duck species. About 75% of the northern

[1] Accepted for publication May 1989.

pintails, *Anas acuta*, and 80% of the northern shovelers, *A. clypeata*, in the Pacific Flyway winter in California's Central Valley (U.S. Fish and Wildlife Service 1978).

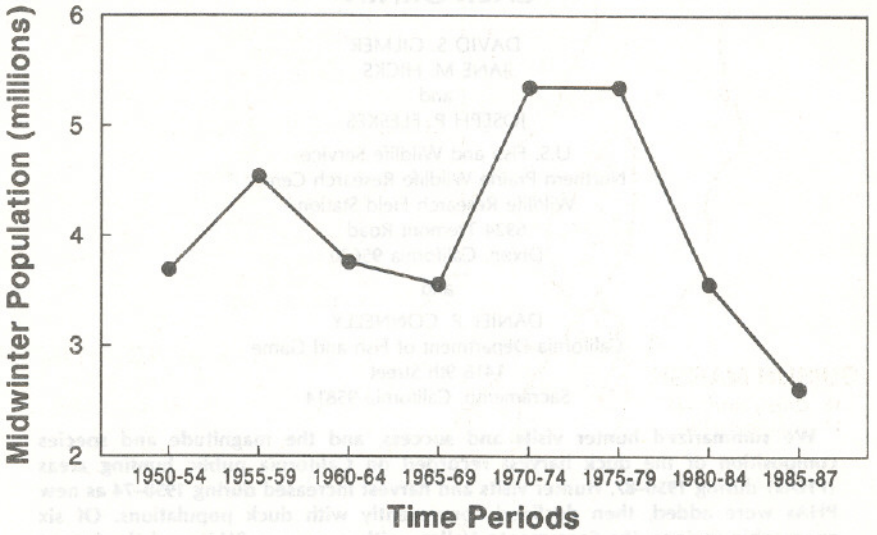


FIGURE 1. Average annual midwinter duck population in California by 5-year periods from 1950–87 (Pacific Flyway Study Committee 1951–84, U.S. Fish and Wildlife Service unpubl. data).

Before 1944, Klamath Basin National Wildlife Refuges (NWRs) in northeast California (Figure 2) were the only public lands in the state open to waterfowl hunting. In response to a heavy demand for waterfowl hunting opportunities and to preserve wetland habitats, an extensive public hunting area (PHA) network was subsequently established in California (Kozlik 1955). Currently, 20 state areas and 15 NWRs are open to waterfowl hunting in California.

Prime waterfowl hunting opportunities have enabled California hunters to harvest more ducks than do hunters in any other state, averaging 1.8 million ducks per year during 1971–80 (Carney et al. 1983). California duck hunting regulations (Figure 3, Bartonek et al. 1980) have been relatively stable and liberal compared to those in other flyways. Hunting seasons have ranged from a 44-day split season to a 95-day continuous season (average 83 days) and daily bag limits have varied from 5 to 7 ducks with restrictions some years on canvasbacks, *Aythya valisineria*, redheads, *A. americana*, wood ducks, *Aix sponsa*, and hooded mergansers, *Lophodytes cucullatus*. During 1952–58 and 1974, 2 to 4 additional northern pintails or American wigeon, *Anas americana*, were allowed. During 1985–87, only 1 female mallard, *A. platyrhynchos*, and 1 female northern pintail were permitted in the daily bag. Steel shot regulations were implemented in portions of Klamath Basin NWRs in 1984 and were gradually expanded to include the bulk of California PHAs by 1987.

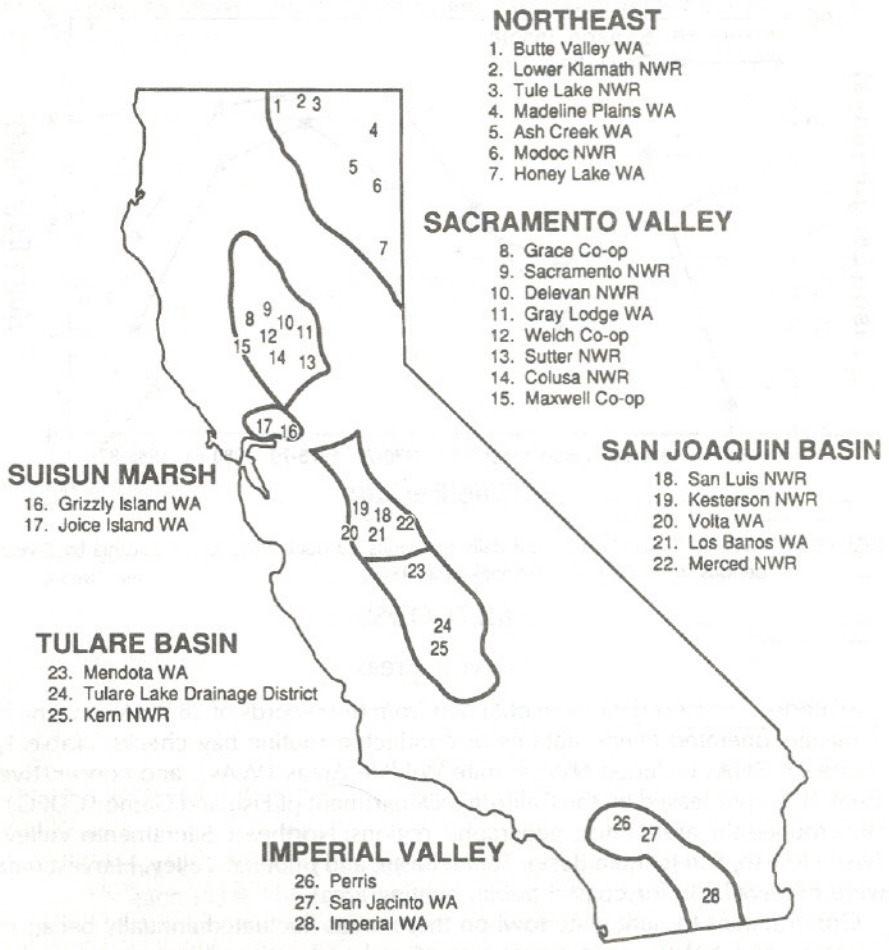


FIGURE 2. Location of geographic regions with public hunting areas in California.

In this paper we summarize species composition and regional differences in the duck harvest and trends in the participation and success of duck hunters on PHAs in California from records collected from 1950–87. These summaries will be useful to waterfowl managers as a historical record to predict future trends in species composition of the harvest on public areas and to compare harvest on public vs. that on private lands. Our information will provide a basis for obtaining better data at hunter check stations to meet changing requirements for population information and will assist in development of hunt programs on newly acquired areas. Most importantly, these summaries will focus attention on wetland habitat management specific to the species of interest including those that are declining and those that have increased in the harvest.

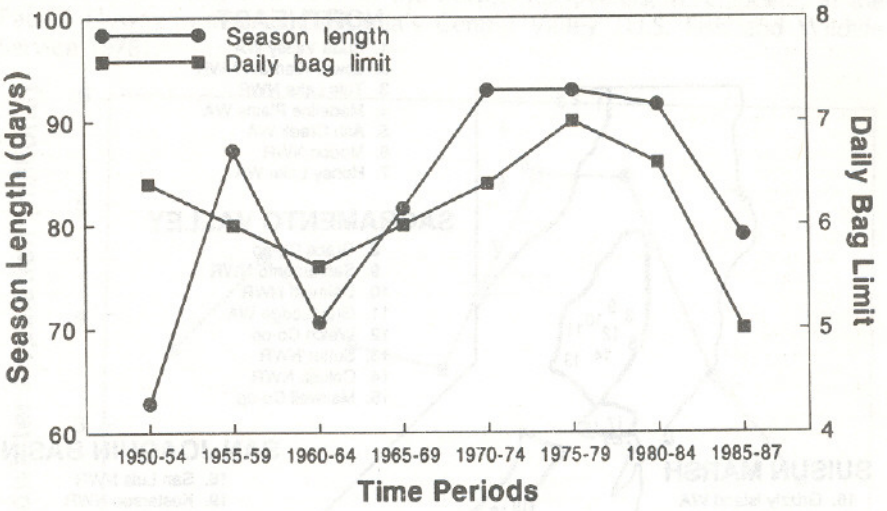


FIGURE 3. Average season lengths and daily bag limits for duck hunting in California by 5-year periods from 1950–87 (Bartonek et al. 1980).

METHODS

Harvest Areas

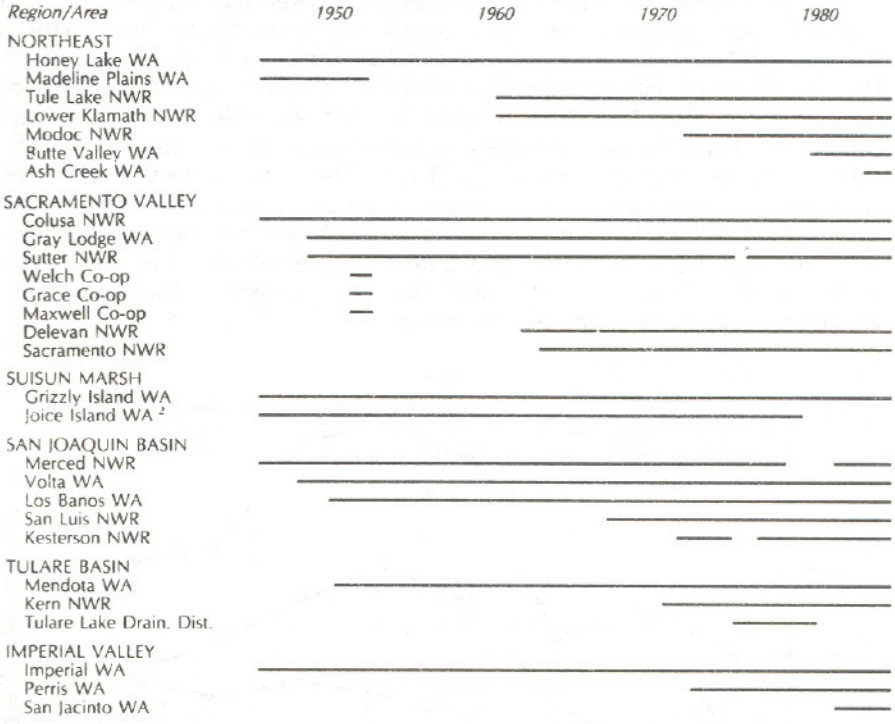
Waterfowl harvest data were obtained from the records of 28 PHAs on which managers operated check stations or conducted routine bag checks (Table 1, Figure 2). PHAs included NWRs, state Wildlife Areas (WAs), and cooperative areas (Co-ops) leased by the California Department of Fish and Game (CDFG). We grouped the areas into 6 geographic regions: Northeast, Sacramento Valley, Suisun Marsh, San Joaquin Basin, Tulare Basin, and Imperial Valley. Harvest data were not available for coastal public hunting areas.

Opportunities to hunt waterfowl on these areas fluctuated annually because: (i) WAs and NWRs were sometimes closed to hunting; (ii) tracts open to hunting within a specific hunting area varied; and (iii) potential hunting capacity varied because of changes in allowable hunting methods (e.g., blinds, free roaming) and flooded acreage.

Data Collection

Numbers and species of ducks killed and total numbers of hunter visits per year were obtained for each area. We define a hunter visit as 1 individual visting a PHA 1 day to hunt waterfowl. CDFG employees recorded these data at check stations on all areas except Tule Lake, Lower Klamath, and Modoc NWRs. U.S. Fish and Wildlife Service (USFWS) employees conducted bag checks of about 80% of the hunters (10% before 1975) on Tule Lake and Lower Klamath NWRs (E. H. McCollum, pers. comm.) and of about 50% of the hunters on Modoc NWR (E. C. Bloom, pers. comm.). Total car counts and average number of hunters per car were made on these NWRs to derive an estimated total daily harvest of each species.

TABLE 1. Years Duck Harvest Data were Collected from Individual Public Hunting Areas in California, 1950–87 [1].



[1] Hunting programs were in operation on Honey Lake, Madeline Plains, and Imperial WAs and Klamath Basin NWRs before 1950 (Kozlik 1955, Gilmer et al. 1986).
[2] Combined with Grizzly Island in 1983.

We summed daily harvest of each species and total hunter visits for the entire season for each PHA. For certain summaries we pooled harvest data for each region into 5-year time periods (3 years for most recent period). Data were analyzed separately for northern pintail, mallard, American wigeon, northern shoveler, green-winged teal, *Anas crecca,* other dabbling ducks (including gadwall, *A. stepera,* cinnamon teal, *A. cyanoptera,* blue-winged teal, *A. discors,* wood duck, fulvous whistling duck, *Dendrocygna bicolor,* and unknown dabblers), and diving ducks (including canvasbacks, redheads, ring-necked ducks, *Aythya collaris,* scaup, *Aythya* spp., goldeneyes, *Bucephala* spp., bufflehead, *B. albeola,* ruddy ducks, *Oxyura jamaicensis,* scoters, *Melanitta* spp., mergansers, *Mergus* spp., and unknown divers).

RESULTS

Statewide Harvest on PHAs

Average annual hunter visits to California PHAs and average annual duck harvest peaked during 1970–74 and declined thereafter (Figure 4). The greatest number of hunter visits (166,646) occurred during 1970 (1970–71 hunting season) and the largest annual harvest (299,230 ducks) occurred during 1974.

Hunter success peaked during 1955–59 (Figure 4) with the greatest success (2.9 ducks per visit) in 1956. After 1960, success was lower but no consistent trend occurred. Annual success after 1960 ranged from 1.1 ducks per hunter visit in 1977 (second year of a 2 year drought in California) to 2.1 ducks per visit in 1967. Northern pintails accounted for 27% of the harvest overall but declined in importance after the 1950s (Figure 5). For example, northern pintails composed 39% of the average annual harvest during 1950–54 but only 18% by 1985–87. Green-winged teal accounted for 20% of the harvest overall and increased in importance after the 1950s. Mallards accounted for 16% of the harvest overall, increased in importance in the 1980s, and became the most common duck harvested after 1983. Other species important in the harvest were northern shovelers (13%) and American wigeon (12%). No other species exceeded 5% of the harvest overall.

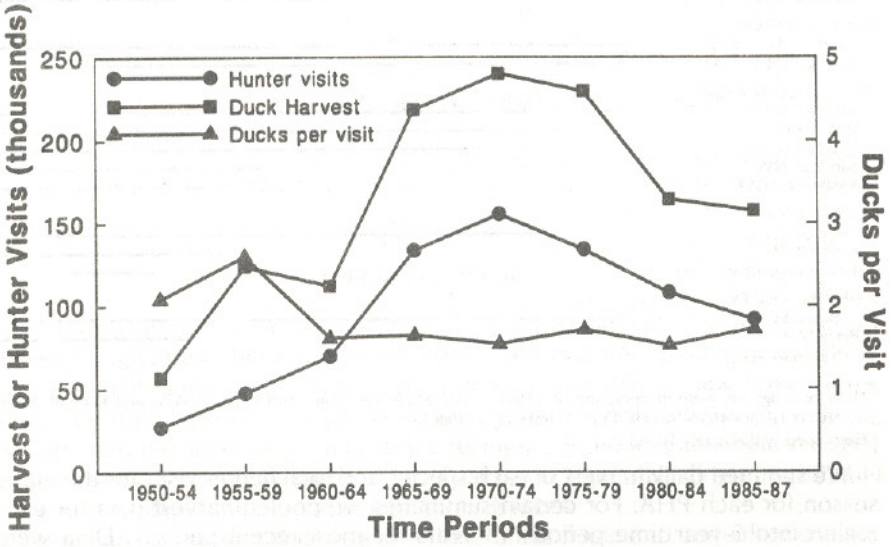


FIGURE 4. Average number of hunter visits, ducks harvested and hunter success (ducks per visit) on public hunting areas in California by 5-year periods from 1950–87.

Regional Harvest

Northeast—About 21% of the total harvest on PHAs occurred in the Northeast. Tule Lake and Lower Klamath NWRs accounted for most (86%, 1962–87) of the Northeast duck harvest. Data for these refuges were available only after 1962 (Table 1), thus explaining the marked increase in hunter visits and total harvest during 1960–69 (Figure 6). Hunter visits, which composed 27% of the total, and harvest declined in the region after 1974. Conversely, hunter success gradually increased after the early 1960s and by 1985–87 success was similar to 1955–59 peak values. Mallards and northern pintails were the primary species harvested (Figure 7), comprising >60% of the average total harvest for all periods. The apparent inverse relationship between these two species was more pronounced than in other regions in California. American wigeon gradually increased in importance in the harvest after 1955–59.

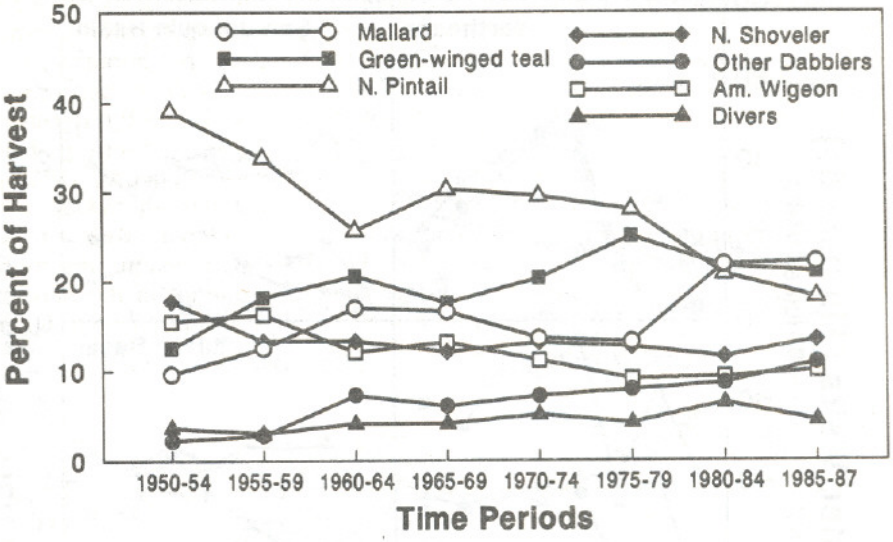


FIGURE 5. Average species composition of the duck harvest on public hunting areas in California by 5-year periods from 1950–87.

Sacramento Valley—About 28% of the average annual visits and 35% of the total harvest on PHAs occurred in the Sacramento Valley where an average of 43% of all ducks wintering in California was located (U.S. Fish and Wildlife Service 1978). Gray Lodge WA was the major harvest site, accounting for 37% of the regional total. Hunter visits and total harvest increased abruptly to peak during 1965–69 (Figure 6), largely due to the addition of Delevan and Sacramento NWRs to the hunting program (Table 1). Harvest declined after 1965–69 and hunter visits declined gradually after a peak in the early 1970s. Hunter success peaked in 1955–59, as in most other regions, but declined with no consistent trend after 1960. Mallards and northern pintails were the primary species in the hunter's bag but the harvest is best described as a "mixed bag" (Figure 7).

Suisun Marsh—Grizzly Island and Joice Island WAs (combined beginning in 1983) were the only PHAs in this region. The region accounted for about 9% of the total annual harvest and 9% of the hunter visits. Hunter visits gradually increased until 1970–74, then declined (Figure 6). Total harvest reflected hunter success more than in other regions. Hunter success peaked during 1955–59, as in other regions, but declined steeply after 1965–69. Related to the decline in hunting success was the decline in the northern pintail harvest (Figure 7). A long-term decline of this magnitude did not occur in other species or regions. Mallards, relatively unimportant until the 1980s, and green-winged teal increased in the bag as pintails declined. Diving ducks were relatively important in this region compared to other regions, peaking at 15% of the harvest during 1980–84.

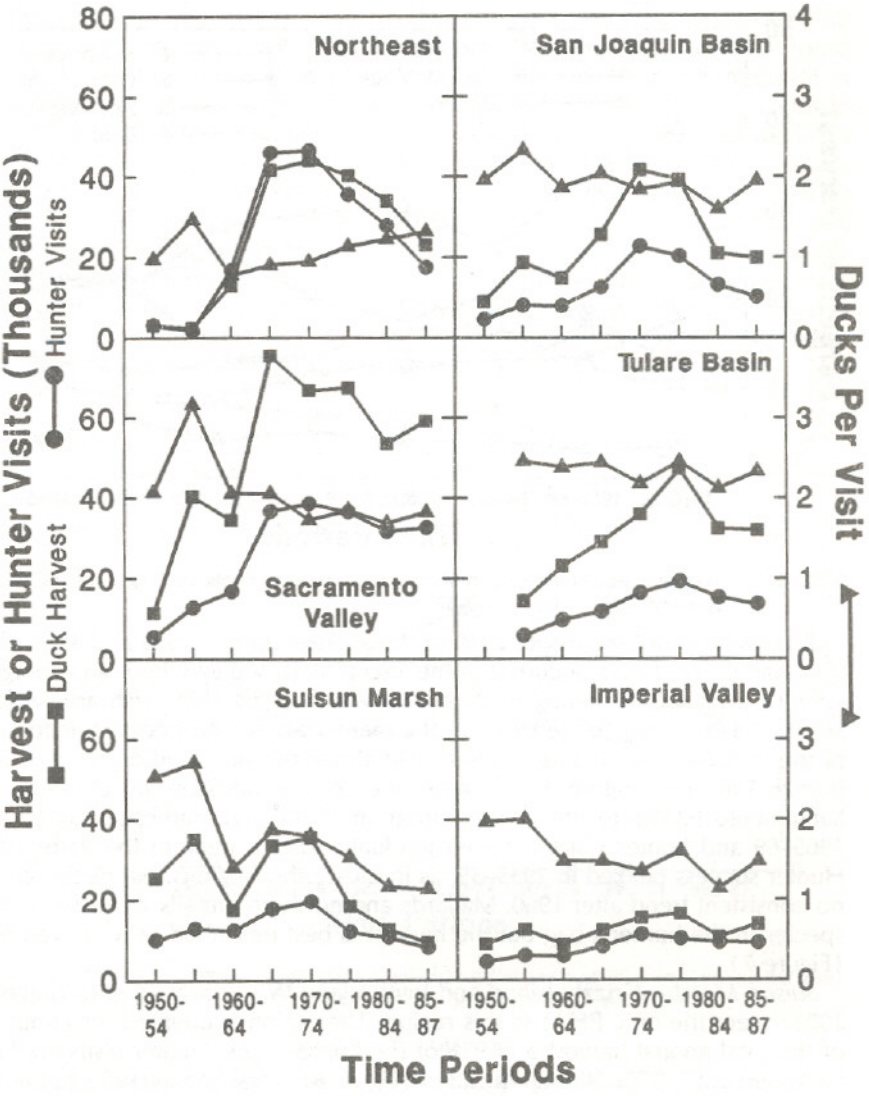


FIGURE 6. Average annual hunter visits, ducks harvested and hunter success (ducks per visit) on public hunting areas in six geographic regions of California by 5-year periods from 1950–87.

San Joaquin Basin—About 17% of the duck harvest and 14% of the hunter visits on PHAs occurred in this region. Volta WA, Los Banos WA, and San Luis NWR each accounted for nearly a third of the regional harvest. Hunter visits and total harvest followed patterns similar to those in other regions (Figure 6). Hunter success peaked during 1955–59 as in other regions, but declined, with no apparent trend, after 1960.Green-winged teal remained the dominant duck in the hunter's bag for over 25 years, while mallards increased as northern pintails declined (Figure 7).

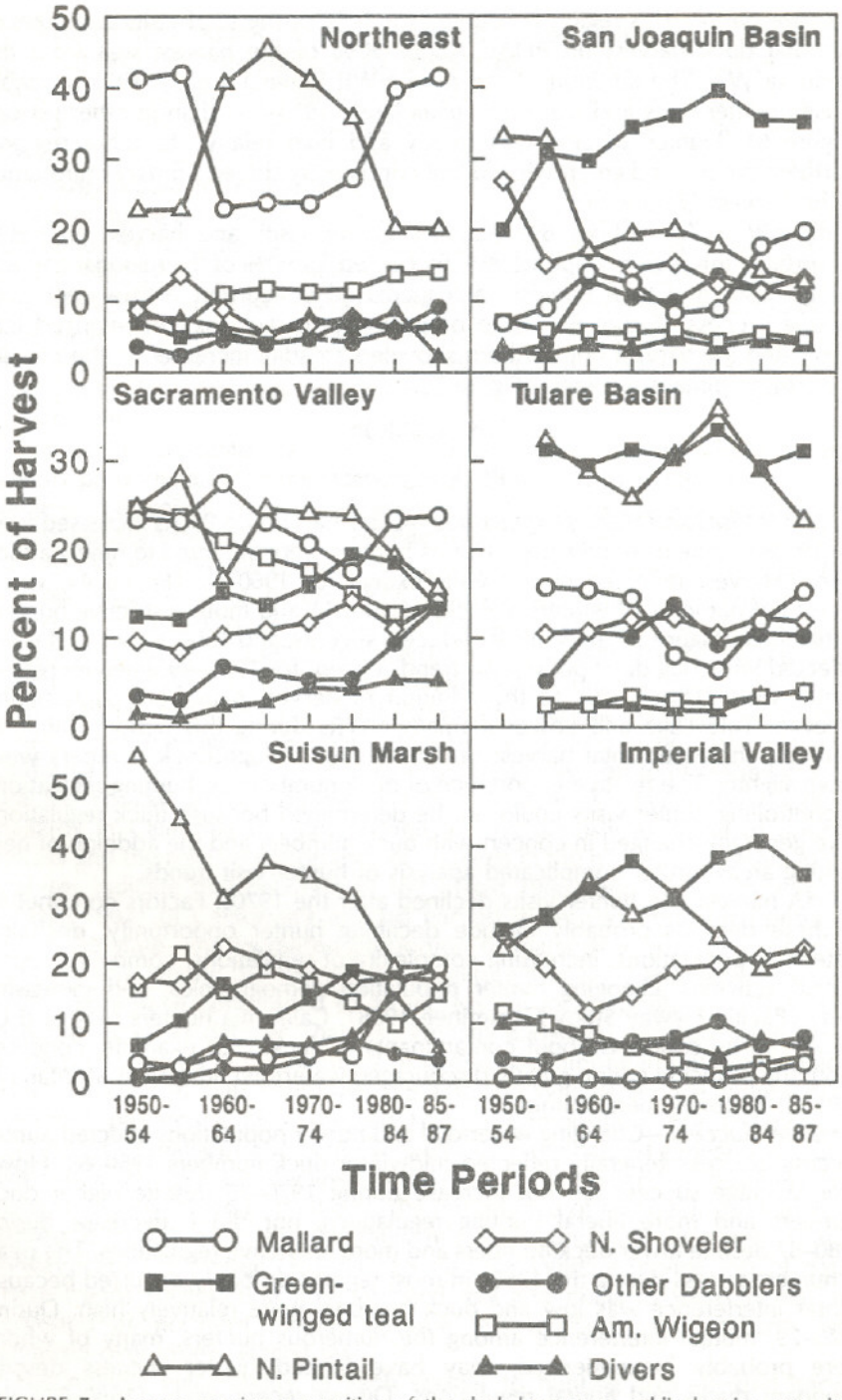


FIGURE 7. Average species composition of the duck harvest on public hunting areas in six geographic regions of California by 5-year periods from 1950–87.

Tulare Basin—This region accounted for 14% of the total visits and 10% of the total duck harvest on PHAs. About 90% of the harvest was from the Mendota WA. The addition of the Kern NWR hunting area in 1973 probably caused hunter visits and harvest to peak later (1975–79) than in other regions (Figure 6). Hunter success was steady and high relative to other regions. Northern pintails and green-winged teal consistently shared primary importance in the harvest (Figure 7).

Imperial Valley—About 8% each of hunter visits and harvest on PHAs occurred in this region. Imperial WA accounted for 90% of the regional harvest. Hunter visits and total harvest each increased concurrent with a decline in hunting success (Figure 6). As in other southern regions, green-winged teal dominated the harvest but northern shovelers steadily increased in the harvest as northern pintails declined (Figure 7).

DISCUSSION

PHA Harvest

Hunter Visits and Harvest Magnitude—Duck harvest on PHAs increased from the 1950s to a peak in the early 1970s as hunters were attracted to newly added PHAs. Harvest reflected hunter visits except for 1960–64 (Figure 4), when decreased numbers of wintering ducks (Figure 1) and more restrictive hunting regulations (Figure 3) may have reduced success and total harvest. Harvest reflected wintering duck population trends except for 1965–69 when increased hunter visits (largely due to the addition of harvest data from Sacramento, Delevan, Tule Lake and Lower Klamath NWRs during this period; Table 1) markedly increased total harvest on PHAs even though duck numbers were down slightly. The relative importance of duck numbers vs. hunting regulations in controlling hunter visits could not be determined because duck regulations have generally changed in concert with duck numbers and the addition of new hunting areas further complicated analysis of hunter visit trends.

PHA harvest and hunter visits declined after the 1970s. Factors contributing to these declines probably include declining hunter opportunity, declining waterfowl populations, increasing complexity of regulations, competing recreational activities, changing hunter population demographics, and increasing costs (Pacific Flyway Study Committee 1988). California hunters may also be influenced by concerns about contaminants in ducks. For example, concerns about the pesticide endrin greatly discouraged waterfowl hunting in Montana in 1981 (J. Bartonek, pers. comm.).

Hunter Success—Changing waterfowl and hunter populations affected hunter success. Success generally reflected midwinter duck numbers 1950–69. However, average success did not increase during 1970–79 despite higher duck numbers and more liberal hunting regulations, nor did it decrease during 1980–87 despite lower duck numbers and more restrictive regulations. The peak in hunter success during the 1950s in most regions probably occurred because hunter interference was low and duck numbers were relatively high. During 1970–79, mutual interference among the numerous hunters, many of whom were probably inexperienced, may have limited hunter success despite abundant ducks and liberal regulations. During recent years (1980–87) the fewer hunters, most of whom were experienced, probably interfered less with

each other (total hunter capacity exceeded hunter visits annually 1978–87 by up to 43%). Thus, hunter success did not decline despite fewer ducks and lower limits. Modern duck hunters are better equipped, more skillful, and more willing to spend money on their sport than were their predecessors (see Miller 1986). The former are probably able to harvest ducks under conditions which previously would have resulted in lower hunter success.

Hunter success trends differed among regions. In contrast to other regions, success on PHAs in the Northeast has increased since the 1960s. We speculate this resulted from establishment of hunter quotas and reduced hunting hours imposed at Klamath Basin NWRs in the 1970s and from increased numbers of over-wintering ducks (J. Hainline, pers. comm.). In recent years, restrictive goose hunting regulations may have caused Klamath Basin hunters to shift their attention to ducks, thereby increasing duck hunting success (E. H. McCollum, pers. comm.).

The decline in hunter success was most evident in regions where northern pintails predominated in the harvest (e.g. Suisun Marsh). Success was more stable in the regions with more varied harvest (e.g. Sacramento Valley).

Harvest Composition—Changes over time in the species composition of the harvest closely reflected changes in the relative abundance of these species in the populations being hunted. For instance, as recently as January 1980 biologists recorded over 3.7 million northern pintails in California during midwinter surveys; in 1987 they recorded only 572,000 (Pacific Flyway Study Committee 1951–84, U.S. Fish and Wildlife Service unpubl. data). The decline in the northern pintail harvest in all regions of California reflected these trends.

Waterfowl managers generally attribute the decline of northern pintails in California since the 1970s to chronic drought on key northerly nesting grounds (Pacific Flyway Study Committee 1987). Conversely, midwinter counts of mallards in California did not decline as precipitously as those of northern pintails and the relative importance of mallards in the harvest increased. Recent analyses indicate that between 51.1% (Trost 1986) and 57.7% (Munro and Kimball 1982) of California's mallard harvest is derived from birds produced within the state. The increased proportion of mallards in the harvest became most obvious during the wet years in California in the 1980s when excellent habitat may have contributed to an increase in local populations. The recent increase in "other dabbler" harvest, (mostly gadwalls), was probably caused by recent increases in the numbers of gadwalls wintering in California (Pacific Flyway Study Committee 1951–84, U.S. Fish and Wildlife Service unpubl. data).

Hunter preference also affected harvest composition. For instance, the importance of mallards and green-winged teal in the harvest generally increased when northern pintails declined. However, during years of relatively high mallard abundance (e.g. 1980–87), the importance of green-winged teal in the harvest declined even though their relative abundance increased (Pacific Flyway Study Committee 1951–84, U.S. Fish and Wildlife Service unpubl. data). These trends suggest that green-winged teal and mallards were increasingly harvested as northern pintails became less available, but mallards were preferred over green-winged teal.

The relative vulnerability of each species to hunting also affected harvest composition. Compared to their relative abundance (proportion of midwinter total duck count), northern pintails were under-represented in the harvest on

PHAs whereas green-winged teal were over-represented. The tendency of northern pintails to gather in large flocks may make hunting them relatively difficult, especially on PHAs where hunter interference can be severe. High vulnerability of green-winged teal to hunting (Bellrose 1944) may have caused this species to be harvested disproportionately relative to their abundance. However, the small size and dispersed nature of green-winged teal may have caused their winter populations to be underestimated.

Overall, the northern shovelers have been important and consistent ducks in the harvest on PHAs. The relatively high proportion of northern shovelers killed by waterfowlers on Imperial Valley PHAs, in spite of their low desirability (Bellrose 1976), may be because of the species' availability and vulnerability (see Van Den Akker and Wilson 1951) and the limited abundance of more desirable species.

Species distribution also affected harvest composition. More mallards have been overwintering in the Northeast, particularly the Klamath Basin NWRs, since the 1970s (J. Hainline, pers. comm.). In this region longer exposure to hunting may have increased their harvest relative to northern pintail. Green-winged teal were harvested most heavily in the three southern regions. Their southern distribution in winter (Bellrose 1976) and their vulnerability (Bellrose 1944) may explain the high incidence of green-winged teal in the harvest there. The proportion of American wigeon gradually declined in the Sacramento Valley (where they were a primary species in the 1950s) and Imperial Valley harvests. Declines in the wintering population and reduced availability of grasslands for foraging (U.S. Fish and Wildlife Service 1978) may explain their reduced importance in the Sacramento Valley harvest. Harvest of American wigeon increased in the Northeast so possibly more were wintering there. A possible but unverified shift to wintering areas in Mexico by American wigeon formerly wintering in the Imperial Valley (suggested by Rienecker 1976) may be responsible for their decline in the southern harvest.

Amount of rainfall in winter appeared to affect the harvest of diving ducks. Heavy rainfall created major open water habitats such as flooded bypasses (see Gilmer et al. 1982) and croplands in the Central Valley, attracting some diver species inland from their normal wintering habitats in San Francisco Bay and coastal areas. Major increases in the kill of divers occurred during the wet period of 1980–84. The proportion of divers harvested in the Suisun Marsh nearly doubled (to 15%) during that period.

PHAs vs. Entire State

Harvest Magnitude, Hunter Visits and Success—Harvest on PHAs comprised a small portion of the total state harvest. During 1961–87, an average of about 190,000 ducks was harvested annually on PHAs compared to estimates for the entire state of 1.6 million determined by the USFWS waterfowl parts survey (J. Bartonek, pers. comm.) and 2.4 million determined by the CDFG mail questionnaire (California Department of Fish and Game, unpubl. data).

Trends in annual harvest for the entire state and for PHAs were generally similar, except that PHA harvest as a proportion of total state harvest increased steadily as estimated by the CDFG mail questionnaire (1950s, 3%; 1960s, 6%; 1970s, 8%; 1980s, 10%; California Department of Fish and Game, unpubl. data)

and the USFWS waterfowl parts survey (1960s, 11%; 1970s, 12%; 1980s, 16%; J. Bartonek, pers. comm.). Addition of new PHAs and the associated increase in hunter visits probably accounted for much of the rise in relative importance of harvest on PHAs during 1950–70. However, after that period no major PHA was added and hunter visits to PHAs as a proportion of total California hunter days (J. Bartonek pers. comm.) increased only slightly (1960s, 11%; 1970s, 12%; 1980s, 13%). Thus, after 1970 the increased importance of harvest on PHAs was probably because hunter success on public areas did not decline as on other areas. Although annual fluctuations in hunter success were similar for PHAs and the entire state (J. Bartonek, pers. comm.), and annual success on PHAs during 1961–70 averaged lower than statewide estimates (mean difference = −26%, range = −34% to −12%), this difference diminished after 1970 (mean difference = 0%, range = −18% to +14%). During the last 4 years of the study, hunter success on PHAs averaged 9% (3% to 14%) greater than state estimates. We speculate that during the recent years of low duck numbers a higher proportion of wintering ducks occurred on NWRs and WAs. Thus, hunting success and hunter visits (to a smaller degree) on private areas apparently declined.

Species Composition—The species composition of harvest on PHAs 1961–87 was similar to estimates for the state (J. Bartonek, pers. comm.), except that preferred species (e.g. northern pintails and mallards) composed a slightly lower proportion of the bag on PHAs than did more vulnerable species (e.g. green-winged teal and northern shovelers). The largest differences were for northern pintails (26.5% vs. 31.5%), green-winged teal (21.0% vs. 17.1%), and northern shovelers (12.5% vs. 8.8%) for PHAs vs. the entire state. Differences may have been caused by unknown biases in mail surveys, differences in habitat between public and private hunting areas, absence of public hunting opportunities in certain key locations (e.g. coastal areas, Sacramento-San Joaquin River Delta, "District 10" east of Gray Lodge WA), and increased difficulty in harvesting preferred species on PHAs because of greater hunter interference.

CONCLUSIONS

The public hunting program in California has provided opportunity for thousands of hunters to participate in a quality waterfowl hunting experience. Loss of habitat since the 1950s, particularly in the Central Valley, has made PHAs increasingly important for waterfowling. Decline in wintering northern pintail populations, changes in hunter attitudes, and numerous other factors have influenced harvest on PHAs. Perhaps the most significant aspect of our summary was the steady decline in hunter visits to PHAs during the last 15 years. This trend is reflected throughout the nation (U.S. Fish and Wildlife Service, unpubl. data) and indicates a loss of interest in the sport of waterfowling. The long term outcome of this pattern is unclear but the potential ramifications are worrisome. Waterfowl hunters have been among the staunchest supporters of wetland preservation programs. If this group continues to diminish, these waterfowl conservation programs are likely to suffer. Resource managers must look for new and innovative strategies to maintain California's valuable wetland and waterfowl resources.

ACKNOWLEDGEMENTS

We thank numerous California Department of Fish and Game and U.S. Fish and Wildlife Service personnel who collected data used in this paper. J. C. Bartonek, J. L. Hainline, F. M. Kozlik, E. H. McCollum, A. W. Miller, T. L. Shaffer, J. Y. Takekawa, and D. R. Yparraguirre gave helpful comments on early drafts. M. L. Casazza assisted with figure preparation. M. R. Miller provided editorial assistance and A. E. Williamson typed the manuscript.

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