HUNTING SUCCESS IN THE CENTRAL VALLEY, CALIFORNIA, DURING 1995-96 COMPARED WITH PREVIOUS YEARS

Central Valley Habitat Joint Venture
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EXECUTIVE SUMMARY

The annual May survey across North America recorded large numbers of ponds and breeding pairs of game ducks in 1995. Many species were at or above long-term averages and population goals. Again, in July, large numbers of ponds were recorded and brood indices were high. As a result, the U.S. Fish and Wildlife Service predicted that the continental fall flight of waterfowl in fall 1995 would be the largest since 1984. As a result, hunting regulations were liberalized (bag limit increased to 6 ducks [2 pintails]; season length increased to 93 days) and expectations for good hunting were high. However, by the end of the hunting season, many hunters in California were dissatisfied with their success and blamed increased sanctuary on public lands in the San Joaquin Valley and increased acreage of flooded rice fields in the Sacramento Valley for holding large numbers of waterfowl. These concerns have important implications for the management of public and private lands, and for the efforts of the Central Valley Habitat Joint Venture (CVHJV) to increase the extent of hunted and unhunted wetlands in the Central Valley.

The Technical Committee of the CVHJV was directed to assess hunter success in 1995-96 compared to recent years, and provide explanations for documented differences and similarities. The Technical Committee reviewed: 1) harvest data from the annual parts collection and hunter questionnaire surveys of the U.S. Fish and Wildlife Service, and from public hunting areas and a sample of private duck clubs in the Sacramento and San Joaquin Valleys; 2) waterfowl population data from aerial and ground surveys; 3) climatological data; and 4) information on the extent and composition of wetland habitats that existed in 1985 (before the initiation of the CVHJV) and in 1995.

The Technical Committee determined that public anticipation of large numbers of waterfowl migrating to California during 1995-96 was partly to blame for the perception of poor hunting success. Reality did not meet these expectations for many hunters, especially in the northern San Joaquin Valley. The pronouncements of increased waterfowl populations and greater hunting opportunities forthcoming for winter 1995-96, carried by the media and reported by conservation organizations and government agencies, failed to adequately explain that most of the increases were probably going to occur in the Central and Mississippi Flyways. Fall flight predictions and resultant hunting regulations are based on continental estimates. The Pacific Flyway portion of the continent had good to excellent nesting habitat conditions, but not substantially different from spring 1994-95. Thus, Pacific Flyway states should not have expected the kind of large increase in ducks in 1995-96 as portrayed in the media. In fact, U.S. Fish and Wildlife Service data show that duck harvest increased about 46% nationwide and 60% in the Mississippi Flyway in 1995-96 compared to 1994-95, but harvest increased only 31% in California.

The Technical Committee found that there has been a steady decline in California's waterfowl harvest since 1970 because of declining numbers of hunters, declining waterfowl numbers, shorter hunting seasons, and smaller bag limits, especially for pintails. However, total harvest increased substantially in 1995-96 in most counties in California, including Merced, and Merced County continued as the number one harvest county in California. Increased harvest resulted

from the longer season, larger bag limit, increased hunter success overall, a small increase in the number of hunters, and an increase in hunter-days afield. Overall, Merced County duck harvest increased from 1988 through 1995-96, and the Merced County harvest has ranked first or second every year in the United States, probably because of the high concentration of wetlands, hunting clubs, public hunting areas, and waterfowl found there. Total harvest and harvest of all species increased in Merced County in 1995-96 compared with the previous decade. Green-winged teal continued to be the most numerous duck in the San Joaquin Valley harvest, whereas mallards were more important in the Sacramento Valley. As a percentage of the California duck harvest, Merced County declined somewhat in 1995-96 compared with 1994-95, but the decline was small compared with historical patterns and the long-term trend shows an increase in the percentage of statewide harvest in Merced County. The harvest in the Sacramento Valley, as a percentage of the California duck harvest, increased in most counties from 1994-95 to 1995-96.

The Technical Committee found that hunter success (average waterfowl kill per hunter per day) since 1991-92 was high, and similar, between a sample of northern San Joaquin Valley (n = 8) and Sacramento Valley (n = 8) duck clubs (2.4 - 3.5 birds/hunter-day), but lower on public hunting areas (0.6 - 2.6 birds/hunter-day) in both valleys. Success overall has steadily increased since 1992-93 on the clubs. San Joaquin Valley clubs enjoyed higher success rates than did Sacramento Valley clubs in 1993-94 and 1994-95, but Sacramento Valley clubs had better success in 1995-96.

Hunter success declined on all National Wildlife Refuge (NWR) and State Wildlife Area (SWA) hunting areas in the northern San Joaquin Valley in 1995-96 compared to 1994-95, but the decline was small by historical standards. On a small sample of private duck clubs (n = 8), success in 1995-96 increased (n = 4 clubs) or declined somewhat (n = 4 clubs) compared with 1994-95, but all success rates remained within normal ranges since 1991. The number of ducks taken by these clubs increased steadily since 1991, and there was a marked increase in green-winged teal taken in 1995-96. Proportionate harvest among species did not change much over the study period. In contrast, hunter success in the Sacramento Valley increased, in some cases markedly, in 1995-96 compared to 1994-95 and previous years on all public hunting areas (except Upper Butte Basin SWA) and on the sample of duck clubs. Total ducks shot, especially mallards, increased in 1995-96, but proportionate species composition of the kill did not change much compared with previous years.

Hunter success on Grassland clubs was high opening week each year since 1991-92, but declined until the "splits" occurred. Success remained at this low level during the period in 1995-96 that would have been included in a split. This period, often referred to in the past as the "November doldrums," lived up to its reputation and hunter success was very poor. Hunter success increased in week 7 or 8, (when hunting resumed during the seasons with splits), and remained high for several weeks, then declined toward the end of the seasons. In 1995-96, hunter success was lower in the week that would have been the second opener. Thereafter, success was within normal ranges until week 13 or 14 when it increased markedly owing to weather conditions conducive to harvest and an influx of new ducks.

The Technical Committee concluded that total harvest and hunter success in 1995-96, as measured by the annual parts collection and hunter questionnaire surveys, and the limited duck club and complete public area harvest surveys, did not differ enough from recent trends to warrant major changes in habitat or harvest management at this time. However, success on individual clubs was variable. Our club sample was small and probably did not account for all this variation, and all public areas in the San Joaquin Valley had lower success than in 1994-95. Maintenance of acceptable levels of hunting success is important to CVHJV wetland conservation programs, and the hunting public must be kept informed about factors that control the availability of waterfowl and hunter success.

Hunter success could have been influenced by many factors in 1995-96. The Federal furlough in December and January could have depressed hunter success because NWR's were closed. Sanctuaries were, thus, temporarily increased in size, possibly holding more ducks, and public hunters were denied access at a time hunting success was improving. Hunter success did drop in the first week of January (last week of the furlough) in the sample of Grassland clubs, but other evidence for a furlough effect was not available to the Technical Committee. The proportion of young in the harvest (age ratios) in 1995-96 was lower than in 1994-95 (but still well within normal limits), indicating that the increased breeding populations in spring/summer 1995, as measured by the May surveys across North America, did not meet expectations for improved production. A lower proportion of young birds in the fall population in California could account for lower than expected success in some areas. However, success was not uniformly lower in the San Joaquin Valley in 1995-96 (total harvest increased), and success was better in the Sacramento Valley compared with previous years. Thus, relatively fewer young in the populations did not consistently account for lower hunting success.

Weather patterns probably had an overwhelming effect on hunting success in 1995-96. Fall was warm, calm, and dry during the early part of the waterfowl migration period and duck hunting season. These conditions prevailed until mid-December when storms finally reached California. Early fall averaged 6 degrees (F) warmer than the long-term averages, and no rain fell until mid-December in the Central Valley. Only 2 days with wind in excess of 10 mph occurred in the San Joaquin Valley during the hunting season in 1995-96, whereas there were 11 in the Sacramento Valley. As a result of this warm, calm, dry fall and early winter, duck migration to California was delayed and ducks that were present adopted conservative movement patterns. The peak count of waterfowl in the Klamath Basin did not occur until late November, four to six weeks later than normal, and this count was nearly double the numbers counted at this time in previous years. Warm conditions prevailed through early winter, and the Midwinter Waterfowl Inventory (MWI) in early January resulted in the highest number of ducks in that area since the 1980's. Thus, large numbers of ducks remained in the Klamath Basin longer than normal and were unavailable for harvest in the Central Valley. Reports of poor hunting success came also from the Pacific Northwest, again owing to mild weather.

Waterfowl were abundant in the Central Valley in 1995-96, exceeding numbers recorded there since 1987-88. In the Sacramento Valley, periodic ground counts on the Sacramento NWR

Complex showed that all duck species, except for pintails, were more abundant in 1995-96 compared with recent years. In the San Joaquin Valley, periodic aerial counts in the Grasslands showed duck numbers similar in 1994-95 and 1995-96. Counts these two years were the highest since 1985-86. Within the northern San Joaquin Valley, periodic count data showed a marked proportionate shift by waterfowl to NWR's and the Los Banos Sewer Ponds concurrent with a decline in proportionate use of SWA's. This has occurred as overall wintering waterfowl populations generally increased in the Grasslands area during the last three to four years. The annual MWI in the Sacramento Valley showed an increased proportion of ducks found on private lands, primarily flooded rice. Total ducks counted by the MWI in 1995-96 was the highest since 1984 for the entire state, the Sacramento Valley, the San Joaquin Valley, and Northeast California. All counts were well above 1984-96 averages. However, weather was clear and calm during the survey in 1996 enabling ducks to be easily counted. In contrast, January 1995 surveys were delayed and hampered by rain and fog, and ducks were not easily observed or counted. Thus, waterfowl could have been undercounted in 1995, suggesting that there was no real increase in ducks in 1996. As percentages of statewide totals, the Sacramento Valley showed no long-term trend in MWI counts, and there has been a long-term increase (since 1984) in the proportion of ducks found in the San Joaquin Valley. The Technical Committee concluded that predictions for increased numbers of ducks in the Fall Flight may have been verified by surveys in California, but whether or not more ducks wintered in California in 1995-96, warm and dry weather reduced hunting success by reducing local movements of waterfowl already in the Central Valley and delaying migration of additional birds to California.

The CVHJV and other programs have been successful in increasing the quality and extent of wetland habitats available to wintering waterfowl. Total managed wetland acreage in the Central Valley has increased from 115,228 acres in 1985 to 138,882 acres in 1995. Farming practices in the Sacramento Valley (unrelated to CVHJV programs) have increased the amount of flooded rice fields from about 60,000 (6,000 acres in sanctuary) in 1985 to approximately 150,000 (40,000 acres in sanctuary) in 1995. Managed wetland sanctuary acreage increased in the Sacramento Valley from 11,814 acres (24% of total managed wetlands) in 1985 to 16,672 acres (25% of total managed wetlands) in 1995. When flooded rice fields, hunted and unhunted, are included, 16% of flooded habitat (wetland plus rice) was sanctuary in 1985 and 26% in 1995. In the San Joaquin Valley, managed wetland sanctuary increased from 3,476 acres (5.3% of total managed wetlands) in 1985 to 4,711 acres (6.5% of total managed wetlands) in 1995. The density of ducks on wetland sanctuaries (ducks per wetland sanctuary acre) in 1995 and 1996 (98 and 134, respectively) in the Sacramento Valley was not much different from 1985 and 1986 (99 and 140, respectively). When rice is included, however, ducks/total sanctuary acre in the Sacramento Valley dropped to 65.7 in 1985, 92.8 in 1986, 28.9 in 1995, and 39.3 in 1996. In the San Joaquin Valley, density on sanctuaries was 83 ducks/acre in 1995 and 137 ducks/acre in 1996, increases over the 47 ducks/acre in 1985 and 63 ducks/acre in 1986. The greater acreage and proportionate size of sanctuary in the Sacramento Valley, greater hunting success there in 1995-96, and the lower density of ducks on sanctuaries (managed wetland plus rice) in the Sacramento Valley in 1995-96, suggests that increased sanctuary in the San Joaquin Valley was not the primary influence on hunting success there in 1995-96. However, with the increased use

of NWR sanctuaries and the Los Banos sewer ponds in the northern San Joaquin Valley, local harvest patterns among duck clubs and public areas may have changed within the traditional harvest areas. Some clubs may have benefitted from the changed distribution of roosting birds at the same time others may have experienced reduced hunter success. The Technical Committee did not have data available to examine this hypothesis.

In summary, the Fall Flight Forecast of 1995-96 was probably too optimistic for the Pacific Flyway. Wintering numbers of ducks in California may have increased over 1994-95, but survey conditions were poor in 1994-95, possibly resulting in an undercount. Excellent survey conditions in 1995-96, allowing a complete count, may have accounted for the increase in ducks that actually occurred in 1994-95. Overall, Merced County harvest remains high. Production of young ducks did not meet expectations during the 1995 nesting season, even though the breeding populations were at or above long-term levels, but age ratios in the harvest were within long-term averages. Fall/winter weather was warm and dry, delaying migration to California and reducing movements of ducks that were present; record numbers of ducks remained in the Klamath Basin. The hunting season for some hunters in 1995-96 was excellent, and for others was very poor, a result not unlike most years. Total harvest increased in the Sacramento Valley and the San Joaquin Valley, including Merced County. However, hunter success generally declined or remained unchanged in the northern San Joaquin Valley (sampled clubs and public areas) and improved in the Sacramento Valley compared to 1994-95. Hunter success in all areas in 1995-96 was well within ranges experienced during the last 10 years. Hopefully, with a return to more normal fall/winter weather in the future, hunter success will be more aligned with expectations. The CVHJV needs to improve evaluation of wetland and agricultural lands projects to determine effects on waterfowl distribution and abundance, and to predict effects on traditional wetlands and hunting regions.

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INTRODUCTION

The 1995-96 waterfowl hunting season was characterized by greater than normal expectations for success. The annual May survey across North America recorded large numbers of ponds and breeding pairs of game ducks in 1995. Many species were at or above long-term averages and population goals. Again, in July, large numbers of ponds were recorded and brood indices were high. As a result, the U.S. Fish and Wildlife Service predicted that the continental fall flight of waterfowl in fall 1995 would be the largest since 1984. Based on this prediction, hunting regulations were liberalized significantly (93 day season; bag limit of 6 ducks per day [2 pintails]). In spite of this, and the fact that many hunters did very well, many other waterfowlers in California reported below average success, and some reported the worst hunting they had ever experienced. While these reports were especially prevalent in the northern San Joaquin Valley, and the Grasslands area of Merced County in particular, reports of poor success were widespread from all Pacific Flyway coastal states (U.S. Fish and Wildlife Service, Portland, Oregon, unpubl. data). Hunting success throughout California was viewed as subpar at best during the first half to three-quarters of the long season, but improved markedly after storms began to impact California from mid-December until the close of the season on January 21st. Many hunters believe that changes are occurring to historical patterns of hunter success within traditional wetland areas as the result of large scale habitat restoration, intensive wetland enhancement on private lands, expansion of sanctuaries, and vast flooding of harvested rice fields sponsored or encouraged by the Central Valley Habitat Joint Venture (CVHJV). Such concern may reduce support for CVHJV habitat management programs if they are perceived to reduce hunter success in traditional hunting areas. This report is an attempt to answer these concerns by reviewing factors that influenced the 1995-96 hunting season in comparison with recent years. Using the best information available, this report summarizes harvest data obtained by the U.S. Fish and Wildlife Service from their parts collection (wing bee) and hunter questionnaire surveys, and hunting success data from public and private lands in the Sacramento and northern San Joaquin Valleys. These results are interpreted with respect to: 1) weather conditions during migration and winter; 2) chronology of fall migration; 3) waterfowl distribution and abundance within California; and 3) the size of wetland sanctuaries relative to wetland extent.

This report was compiled by biologists working through the Technical Committee of the CVHJV. Time was donated to obtain and compile data from various sources and write the report. The work group was lead by Michael Miller, National Biological Service, Dixon, California. He was assisted by Brad Bortner, Migratory Bird Coordinator, U.S. Fish and Wildlife Service, Portland, Oregon; Gary Kramer and Greg Mensik, Sacramento National Wildlife Refuge (NWR); Dennis Woolington, San Luis NWR; Tim Poole, Grassland Water District; Glenn Rollins, Dave Smith, and Dan Yparraguirre, California Department of Fish and Game; Dr. Bob McLandress of California Waterfowl Association; Dr. Fritz Reid of Ducks Unlimited; and Dr. John Eadie of the University of California at Davis. The group benefitted by rice field flooding data compiled by John Day and Ed Burns (National Biological Service) and Dr. Mike Bias (Ducks Unlimited), and from assistance provided by other biologists assigned to refuges, field stations, and regional and central offices.

DATA COLLECTION

Only readily available data were used in this analysis. We assumed that hunting success would most likely be a product of: 1) weather conditions during migration and hunting season; 2) fall migration chronology; 3) local waterfowl population size (including age and species composition) and distribution during the hunting season; and 4) extent of wetlands, agricultural lands, and sanctuary size relative to the area available for hunting. We compiled waterfowl harvest data from the U.S. Fish and Wildlife Service's nationwide and county harvest records (compiled from parts collection and hunter questionnaire surveys), NWR's and State Wildlife Areas (SWA's), and from a small sample of private duck clubs. We defined hunter success as the average number of waterfowl shot and retrieved per hunter per day. We used periodic ground counts on the Sacramento NWR Complex, periodic aerial counts in the Grasslands and the Klamath Basin, and the annual Midwinter Inventory (MWI) on public and private areas to estimate waterfowl abundance and distribution, and document migration chronology. We used Climatological Data Reports (U.S. Dept. of Commerce, National Weather Service) and California Department of Water Resources for temperature, rainfall, and wind speed data. We obtained CVHJV, California Dept. of Fish and Game, and U.S. Fish and Wildlife Service wetland data to determine the extent of sanctuaries and total wetlands that existed in 1985, before the CVHJV, and in 1995. The proportion of flooded rice that was hunted was estimated by Ducks Unlimited from a phone survey of rice growers participating in Valley Care, and by the National Biological Service from data obtained from road side transects in Butte, Colusa, and Glenn Counties..

RESULTS

WATERFOWL HARVEST AND HUNTER SUCCESS

Nationwide and California Harvest.-- Duck harvest in the United States in 1995-96 increased 46% above numbers taken in 1994-95. The harvest increased 60% in the Mississippi Flyway and 41% in the Atlantic Flyway compared to only 29% in the Pacific and 31% in the Central Flyways. Hunter numbers increased 4% to 8% nationwide, except there was a 13% decline in the Atlantic Flyway. There was an 11% decline in hunter-days in the Atlantic Flyway, but increases occurred of 10% in the Central and 11% in the Mississippi Flyways, and 22% in the Pacific Flyway. Harvest increased 31%, hunter numbers increased 5%, and hunter-days increased 29% in California in 1995-96 compared to 1994-95. Thus, harvest increased at a greater rate in the eastern flyways, even though hunter-days increased at higher rates in California and the Pacific Flyway.

Harvest by County.-- We examined the trend in annual duck harvest in California by county from 1961-62 through 1995-96. These data are estimates from the annual parts collection (wing bee) and mail questionnaire surveys conducted by the U.S. Fish and Wildlife Service. [Note: On Figures 1, 2, and 3, annual harvest estimates by county were not readily available from 1961 to 1981, so 10 year average harvests were used for this period]. Immediately noticeable is the

general decline in estimated total harvest statewide starting about 1970, after having increased steadily since 1961 (Figure 1). This resulted from a long-term decline in the number of waterfowl hunters, a nearly concurrent decline in waterfowl populations, shorter hunting seasons, and smaller bag limits, especially for pintails. However, there was a sizeable increase in harvest in 1995-96 to a level not seen since the 1980's, probably a function of the longer season, higher bag limit (limited effect, see below), a small increase in the numbers of hunters (about 60,500 in 1994-95 and about 64,000 in 1995-96; California Department of Fish and Game data), increased hunter-days, and increased hunter success (see below). The increase seems to have occurred in all counties (Figure 1), and Merced County remains the number one harvest county in California. In fact, Merced County has been the first or second harvest county in the United States since the 1960's, no doubt reflecting the high concentration of wetlands, hunting clubs and public areas, and wintering waterfowl found there. Overall, duck harvest increased in Merced County from 1988 (or earlier) to 1995-96, and the harvest in the county is only slightly less than the combined harvest of Butte, Glenn, Colusa, and Sutter Counties in the Sacramento Valley (Figure 1).

Merced County has maintained a greater proportion of the large 1960's and 1970's harvests than have the other counties and continues to exceed all other counties in percentage of the California duck harvest (Figure 2). Merced County's overall proportionate harvest declined somewhat in 1995-96 compared to 1994-95, but this decline was small by historical standards as declines of greater magnitude (and increases) have occurred often in the past (Figure 2). Percentage harvest increased in nearly all Sacramento Valley counties (Figure 2). There is little evidence from these data that the distribution of the harvest in California has changed through 1995-96, except that there has been a disproportionate decline in the duck harvest in Solano County (Figure 2).

Species Composition of the Merced County Harvest.--We next examined changes in species composition of the harvest (annual wing bee and hunter questionnaire data) from Merced County through 1995-96 (Figure 3). Total harvest of important species increased substantially in Merced County in 1995-96, continuing a trend started in the late 1980's (Figure 3). Mallards, green-winged teal, and pintails have traditionally made up more than two-thirds of the Merced County harvest. There was an increase in the harvest of these species in 1995-96. The harvest of pintails nearly doubled compared with 1994-95 and the harvest of green-winged teal increased almost 50%. Since the early 1980's, the pintail harvest has declined markedly, so the increase in 1995-96 was encouraging. The long decline in pintail harvest coincided directly with reduced populations and the restrictive season and bag limit regulations.

Hunter Success on Duck Clubs.-- We next examined localized hunter success trends on public hunting areas (NWR's and SWA's) and a small sample of private duck clubs in the Sacramento Valley (Butte Sink, District 10, Willow Creek, Lurline Creek areas) and the San Joaquin Valley (North and South Grasslands area). Nearly 40 clubs were asked to contribute harvest data, and 16 responded with useful and timely information. This is a small sample of clubs, which may not be representative, and results should be interpreted with caution. The Technical Committee established 2.0 birds/hunter-day as the benchmark for good shooting.

Since 1991-92, average daily hunter success on sampled Sacramento Valley duck clubs (n = 8) ranged between about 2.6 and 3.5 birds/hunter-day, and on San Joaquin Valley duck clubs (n = 8) from 2.4 to 3.2 birds/hunter-day (Figure 4). Clubs in both valleys experienced increased hunter success since 1992-93, but the San Joaquin Valley clubs enjoyed comparatively better success than Sacramento Valley clubs in 1993-94 and 1994-95, whereas Sacramento Valley clubs had better hunting in 1995-96. Essentially, no change in hunter success occurred on the sample of Grassland clubs between 1994-95 and 1995-96, whereas Sacramento Valley club average success increased markedly (Figure 4).

San Joaquin Valley: The sampled South Grassland and North Grassland clubs had similar hunter success annually, except for South Grassland club number 2, which averaged less successful (Figure 5). Success in 1995-96 was higher, within normal ranges, than in other years for four clubs, and lower, but within normal ranges, for the others. The number of ducks taken on these eight clubs increased steadily from 1992-93 to 1995-96. The marked increase in 1995-96, primarily consisted of green-winged teal (Figure 6). However, the proportionate harvest for each species has changed very little among years (Figure 7).

We also examined hunter success by week with data available for the sampled Grassland clubs to see if harvest patterns had changed over time (Figure 8). Years 1991-92 through 1994-95 were split seasons, whereas 1995-96 was a continuous season. Hunter success was high on the first opening week each year, but declined until the split occurred. Hunter success remained at that low level during the period in 1995-96 that would have corresponded to a split. This period was often referred to in the past, before the era of split seasons, as the "November doldrums" because of the traditionally poor hunting. Hunters were reacquainted with this pattern in 1995-96, and inclusion of data from this period lowered overall hunter success rates. In week 7 or 8, (when hunting resumed during the split season years), hunting success was again very high, remained at relatively high levels for several weeks, then declined toward the end of the season. In 1995-96, hunter success was lower in the week that would have been the second opener, probably because ducks were conditioned to hunting during the previous weeks and weather was mild. Thereafter, hunter success was within normal ranges until weeks 13 and 14, when it increased markedly, probably reflecting weather conditions conducive to harvest and to an influx of new ducks (e.g., late migration from Klamath Basin: see sections on fall weather and migration).

Sacramento Valley: In the Sacramento Valley, 8 duck clubs provided data on their hunting success (Figure 9). By all accounts, 1995-96 was the best year since 1990-91. On all sampled clubs, hunter success increased over that of the previous 5 years, and there has been a steady increase in hunter success over the period of study on most clubs. These clubs were located in major harvest areas in the Sacramento Valley, and were near Sacramento NWR (Willow Cr #1 and #2) and Delevan NWR (Lurline Cr), in Butte Sink (Bsink #1, #2, and #3), and in District 10 (Dist 10 #1 and #2) near Marysville. Total number of ducks shot, especially mallards, increased markedly in 1995-96 compared to the previous 4 years (Figure 10). However, the proportionate species composition has changed little among years (Figure 11). No data on weekly harvest rates were readily available for Sacramento Valley clubs.

Hunter Success on Public Hunting Areas.-- In the San Joaquin Valley, public hunters experienced lower hunter success in 1995-96 than in 1994-95 for total ducks, but results were generally well within the normal range of success recorded during the last decade, with values ranging between 0.5 to 2.6 birds/hunter-day (Figures 12-16). For individual species, especially pintail and wigeon, success actually increased in 1995-96 on some of the San Joaquin Valley areas. Conversely, green-winged teal were harvested in lower numbers on all public areas in the San Joaquin Valley except at Los Banos SWA.

Hunter success tended to be higher in 1995-96 on Sacramento Valley public shooting areas (NWR's and SWA's) relative to the previous 2 or 3 years. However, 1995-96 values were not unusually high and fell within average values, which ranged between 1.3 to 2.6 birds/hunter-day, during the last decade (Figures 12-16). An exception to this trend was the Upper Butte Basin SWA, which recorded a 63% decline in hunter success for total ducks since 1993 (Figure 12) and a 67% decline for mallards since 1990 (Figure 14). These changes suggest that habitat types are changing over time.

Hunter Success and the Daily Bag.-- There has been some interest in comparing hunter success as a percentage of the daily bag limit over time. This would be legitimate if the bag limit, season length, and hunter effort remained consistent from year to year. However, limits and season lengths have been changed often, and hunter numbers have declined making such direct comparisons impossible. Also, and very importantly, hunter success does not correspond directly with bag limit. This is because as the bag limit increases, fewer hunters achieve it. This was examined with detailed harvest analyses by the Office of Migratory Bird Management of the U.S. Fish and Wildlife Service (Figure 17). The information shows, for example, if we start with a daily bag limit of 7 mallards and change to 6 the next year (a 14% reduction), we can expect only an imperceptible proportionate decline in harvest. Changing the daily bag limit from 6 to a 5 (a 17% reduction), yields not much more of a change in harvest, and so on. It is only with lower limits, such as 2 or 3, that changing the bag limit by one mallard results in any practical change in harvest. This is because few hunters achieve a full daily bag until that limit is down to 2 or 3 birds per day. Therefore, we did not examine harvest as a percent of daily bag limit for this report.

In summary, harvest increased in the Pacific Flyway and California in 1995-96, but at a lower rate than for the eastern flyways. Harvest increased in all California counties in 1995-96 to levels of the 1980's, probably the result of the longer season, higher bag limits, a greater number of hunters, increased hunter-days, and higher hunter success overall, and, perhaps, increased abundance of waterfowl. Proportionate Merced County harvest decreased somewhat in 1995-96, but Merced remained the number one harvest county in California and number two in the nation. Hunter success in the Sacramento Valley increased markedly from 1994-95 to 1995-96 on public areas (except Upper Butte Basin SWA) and sampled private duck clubs. In the San Joaquin Valley, some sampled private clubs did somewhat better and others somewhat worse compared with previous years. However, hunter success declined on all San Joaquin Valley public hunting areas compared with 1994-95. Hunter success on sampled Sacramento Valley duck clubs was

similar to, or lower than, success on a similar number of Grassland clubs from 1991-92 through 1994-95. Only in 1995-96 did hunter success in the Sacramento Valley exceed that in the Grasslands. On public areas, hunter success was slightly higher in the Sacramento Valley compared to the San Joaquin Valley. Species composition of the harvest differed between the two valleys, with mallards more common in the Sacramento Valley and green-winged teal dominating in the San Joaquin Valley. However, these differences are typical and have existed for many years.

FACTORS AFFECTING HUNTER SUCCESS

Federal Furlough.--Hunter success in 1995-96 could have been depressed on all public and some private areas by the closure of NWR's during the Federal furlough. The furlough occurred in late December through the first week of January, and temporarily increased NWR sanctuary sizes. More ducks could have been held away from hunted lands. The furlough occurred just when hunting success was improving, and the potential absence of higher success rates that would have occurred then may have lowered hunter success overall. There didn't appear to be a furlough effect (reduced hunter success) in the Sacramento Valley (see following sections), but in the Grasslands, there was a decline in hunter success on sampled clubs in week 12 of the hunting season, corresponding with the first week in January and the last week of the furlough. The overall relationship remains speculative, however, and the main effect of the furlough was to reduce hunter opportunity on public areas during a time of improving success.

Proportion of Young Ducks in the Harvest.--The age ratio (young per adult) in the annual harvest is an index of the success of the nesting effort the previous spring. Since young ducks are more vulnerable to being shot than are adults, it is generally assumed that in years with a large proportion of young ducks in the population, hunter success increases, assuming harvest conditions (e.g., weather, regulations, habitat extent) remain constant. For example, the 1993-94 and 1994-95 hunting seasons were generally considered to be good ones throughout California. Age ratios in the harvest were comparatively high those years for most species (Figure 18). Age ratios in 1995-96 were lower than in 1993-94 and 1994-95, but were not particularly unusual compared with the previous 5 years, being higher than some years and lower than others. The increase in the continental breeding population index in spring 1995 probably resulted from excellent production in 1994, and breeding populations of most species were at or above long-term averages in 1995. Unfortunately, the production rate (as measured with age ratios in the harvest) of young ducks in the Pacific Flyway portion of surveyed areas was not as good as expected in 1995 given the good continental habitat conditions and the large breeding population. The resulting lower than anticipated proportion of young ducks in the fall/winter populations partially explains lower than expected hunter success in some parts of California, but, many areas had excellent success in 1995-96.

Weather Conditions During Fall.-- By all accounts, fall and early winter 1995 were warm and dry in northeastern California and the Central Valley. These warm conditions prevailed in Oregon and Washington, as well, with the addition of record rains. For example, in November

and December 1995, average high temperatures in Tulelake, Willows, and Los Banos were all greater than 6 degrees (F) above normal (Figure 19). These high temperatures were unprecedented compared to the previous 5 years, when November and December temperatures were near-normal or below normal. Temperatures were above normal in October 1995 in the Central Valley, but were slightly below normal in Tulelake. Rainfall was well below normal in October and November in the Central Valley (no rain fell), but increased markedly beginning in mid-December (Figure 20). Thus, warm dry weather prevailed well into December, both in the main wintering region of the Central Valley, and in the Pacific Flyway's most important fall staging area, the Klamath Basin (northeastern California-southern Oregon). In mid-December, severe storms impacted California. Accompanying drenching rains effectively ended the long dry spell, but temperatures remained above normal. Frost was rarely reported anywhere in the Central Valley during the entire winter.

High winds are conducive to harvest, but only two windy days (>10 mph average daily wind speed) occurred in the San Joaquin Valley in the entire 1995-96 hunting season compared with 12 in 1994-95 (Figure 21). Both days, December 12 and January 16, were non-shoot days (Tuesdays). This contrasts with 11 windy days in the Sacramento Valley in 1994-95 and 1995-96. There were 5 to 16 days of wind most years in the Sacramento Valley (Figure 21).

In summary, fall and early winter 1995 were much warmer and drier than normal in the Central Valley, less windy in the San Joaquin Valley, and warmer than normal in the Klamath Basin and points north (warm and wet in the Pacific Northwest).

Chronology of Fall Migration.-- Waterfowl population counts from the Klamath Basin illustrate progress of the fall migration for the last six years (Table 1). Survey data were collected between September 5 and mid-January. Waterfowl abundance in the Klamath Basin in 1995 was similar to previous years through October 5. In contrast, the late October 1995 census was the lowest recorded during the 6 year period, indicating that several hundred thousand birds probably had moved to the Central Valley, but new ducks had not yet migrated to the Basin, reflecting the warm and wet weather conditions in the Pacific Northwest that encouraged waterfowl to remain north of California. The early November census was the second highest during the six year period, very similar to the 1990 count of 1.6 million, indicating that some birds had moved to the Basin and had not yet migrated to the Central Valley. By late November, a record number of waterfowl were present in the Klamath Basin - 1.85 million compared with the more typical three-quarters of a million. Thus, large numbers had finally arrived from the north. In early December, relatively high numbers remained, in fact the highest total reported during the six year period for that date. The next count was the Midwinter Inventory (MWI) conducted the first week of January 1996. Again, the number of birds recorded was the largest in the last six years. In contrast, the final count in January 1996 showed that virtually all waterfowl had left the Basin, and this was the lowest number for late January during the six year period. Severe cold had moved into the Basin and the Pacific Northwest, moving most waterfowl into the Central Valley by mid-January.

In summary, benign weather probably delayed migration of large numbers of waterfowl to the Klamath Basin until late November and to the Central Valley until December. The calm, dry weather during the hunting season limited waterfowl movements, thus reducing hunting success. Stormy weather did not begin in California until mid-December, and peak winter counts were achieved then.

Distribution and Abundance of Wintering Populations.-- It is widely believed that the number of waterfowl present in a local area directly affects hunting success - the larger the number of birds, the better the hunting. However, previous field studies have shown this is not always the case. For example, in California there has been little relationship between the MWI of ducks and duck harvest by year (Figure 22). The Technical Committee, however, believed it was important to document regional population sizes in relation to the expectation of a large Fall Flight for 1995-96 to see if hunting success could be related to distribution of ducks within the Central Valley.

Waterfowl Counts: Periodic waterfowl counts used in the following sections were, for the most part, obtained on Wednesday shoot days during daylight. Thus, data overemphasize the role of NWR and SWA sanctuaries in the overall habitat mosaic in the Central Valley, which is heavily dependent upon private duck clubs and agricultural lands to support wintering populations. Nonetheless, for annual comparative purposes, these counts are adequate.

Sacramento Valley Periodic Counts: We used ground counts of waterfowl at the Sacramento NWR Complex to describe waterfowl population trends in the Sacramento Valley since 1987-88. Similar data are not available for SWA's or private lands, so the Sacramento NWR data serve only as an index to populations. In the Sacramento Valley, all 1995-96 counts were higher for all species except pintails (Table 2, Figures 23-26). Pintail numbers exceeded half a million, well within the range of the last several years. Thus, there appeared to be more ducks in the Sacramento Valley in 1995-96 compared with previous years.

San Joaquin Valley Periodic Counts: We used results of California Department of Fish and Game aerial surveys conducted once or twice monthly (September to January) since 1985-86 throughout the Grasslands and Mendota SWA to document waterfowl population trends. Flights are normally scheduled on shoot days under the assumption that the majority of birds will be concentrated in non-hunted sanctuaries, and thus, will be more accurately counted than if scattered throughout the Grasslands on nonshoot days. In 1995-96, counts were high, and very similar to counts in 1994-95 for September, October, November and December (Table 3). These two recent year counts were well above totals occurring back through 1985-86 for all four months, and were similar to those recorded in the 1970's. Thus, ducks were abundant in the Grasslands in 1995-96 relative to previous years.

In the San Joaquin Valley, population data were available for both public and private wetlands (Figures 27 and 28). The relative proportions of waterfowl on federal, state, and duck club areas, obtained from peak population counts each year (Figure 27), show a dramatic shift from

sanctuaries on SWA's to sanctuaries on NWR's. Most of this change occurred since 1993-94. For example, of all waterfowl counted on peak days since 1993-94, 57-74% were on NWR's compared with 16-43% in previous years. The average counts on shoot days (Figure 28) also showed a marked increase in use of NWR's and decreased use of SWA's, but this trend started in the late 1980's (Figure 27). However, using either the peak or average counts, the proportion of waterfowl recorded on combined public lands has changed little relative to private duck clubs over the 10-year period. During this time, waterfowl significantly increased their use of the Los Banos sewer ponds, which serve as unhunted sanctuaries. No obvious trend is apparent on private lands, a not unexpected result, because most counts are conducted on shoot days beginning in mid-morning when few ducks are using the clubs. However, variation was high in numbers of birds on private clubs because at least two of the counts, 1988-89 and 1992-93, were on non-shoot days when large numbers of ducks were on private lands. No trend in the use of San Luis Reservoir was evident over the study period.

In summary, north San Joaquin Valley (Grasslands) periodic counts show no trend in the proportion of waterfowl using combined state and federal areas during the study period, but waterfowl have markedly increased proportionate use of NWR'S and the Los Banos sewer ponds over the past several years compared with SWA's . This is occurring as overall waterfowl populations have increased markedly in the Grasslands in the last three to four winters. We have no explanation for this shift among sanctuaries, but it may be a function of increasing numbers of wintering waterfowl relative to sanctuary carrying capacity and/or changing habitat management of NWR's and SWA's. The number of ducks present on periodic counts in the Grasslands in 1995-96 was similar to 1994-95.

Midwinter Inventory: In the Sacramento Valley, the MWI data show increased proportionate use of private lands since 1984 compared with public lands (Figure 29). For example, proportionate use of public land decreased from a range of 72-90% from 1984 to 1991, to about 55% from 1994 to 1996. The large change in 1992 (Figure 29) resulted from stormy weather preceding counts which moved most ducks off of NWR's and SWA's. The increased daytime use of private lands in the Sacramento Valley since 1991 seems to be related to dispersal of waterfowl from NWR and SWA sanctuaries to the new, large acreage of flooded rice fields, most of which are not hunted or are hunted rarely, irregularly, or with much less intensity than traditional clubs. However, January counts also reflect use of flooded by-passes (Yolo, Sutter) during the counts in recent wet years. These by-passes had not often flooded during the winters of the mid to late 1980's and early 1990's due to the long drought in California.

We next compared numbers and proportions of wintering populations among regions within the Central Valley. Total ducks in 1995-96 was the highest since 1984 for the entire state, the Sacramento Valley, the San Joaquin Valley, and Northeast California (Table 4). All 1995-96 counts were well above 1984-96 averages, and 36% more ducks were counted in 1995-96 in the Sacramento Valley and 65% more in the San Joaquin Valley compared with 1994-95. However, weather was clear and calm during the MWI in January 1996. This allowed ducks to easily be counted throughout the state. In contrast, January 1995 surveys were delayed and hampered,

with incomplete coverage, by fog and rain. Thus, waterfowl were probably undercounted in 1995, suggesting that there may have been no real increase in ducks in 1996's count. In either event, as a percentage of the statewide total (Figure 30), the Sacramento Valley showed no long-term trend with annual proportions ranging from 48% to 78%. The proportion in the Sacramento Valley in 1995-96 (62%) was just above the long-term average of 60.5%. In contrast, in the San Joaquin Valley, there has been a long-term increase in the proportion of ducks since about 1988 (Figures 30 and 31). We have no explanation for the relatively sharp decline in the proportion of ducks in the San Joaquin Valley from about 1977 through 1981 (Figure 31). The value of 18% of wintering ducks in the San Joaquin Valley in 1996 was well above the long-term average of 13.5%. No obvious trend was apparent for Northeast California, but the proportion of total ducks there in 1996 was the highest recorded since 1987.

In summary, the annual MWI showed a substantial increase in the use of flooded rice lands in the Sacramento Valley in recent years. Total ducks increased to levels well above average in all regions of California in 1996. Ducks have increased proportionately in the San Joaquin Valley since 1988, but no trend is evident for the Sacramento Valley. Higher counts in 1995-96 could partially be explained by different weather conditions during the MWI between 1994-95 and 1995-96.

Extent of Wetlands, Flooded Grain, and Sanctuaries, 1985 and 1995.-- This section examines the amount of managed wetland and flooded agricultural habitats in the Central Valley, including percent sanctuary present in 1985, the year prior to initiation of the CVHJV, and in 1995. We recognize that unmanaged, naturally flooded acreage on NWR's, SWA's, and private lands are not included in this analysis of managed wetlands. These irregularly flooded lands, (e.g., riparian areas, slough channels, flood plains, vernal pools), may provide hunting and sanctuary at times, but are usually dry during the hunting season. In addition, these lands are very difficult to quantify and were not expected to have a profound impact on the issues addressed in this report. Data for habitat extent were difficult to obtain and values in some instances, such as Central Valley-wide wetlands, hunted and unhunted lands, and flooded and unhunted rice, are only crude estimates; thus, results must be interpreted with caution. Specific acreage acquired for federal and state ownership, sanctuaries, hunted areas, and managed wetlands were provided by the appropriate U.S. Fish and Wildlife Service and California Department of Fish and Game offices in the Sacramento and San Joaquin Valleys.

Sacramento Valley Wetlands: There have been marked increases in both state and federal holdings in the Sacramento Valley (Table 5). For example, over 3,569 acres of new hunted wetland acres (87% increase) and 1,390 acres of new sanctuary acres (80% increase) were added to the state system since 1985. Most of this increase resulted from development of the three units of the Upper Butte Basin SWA. A small area (30 acres) was added to the hunting area at Delevan NWR, and 333 acres at Sutter NWR were transferred from hunted to unhunted status. Overall, unhunted area increased on Sacramento Valley NWR's by about 1,938 acres (19% increase), most on the Sacramento River and Delevan NWR's, and there was a 303 acre reduction (5% decrease) in hunted acres (Table 5).

On private areas sponsored by nongovernment organizations (NGOs) in the Sacramento Valley (Table 5), major additions to the wetland base occurred at the Cosumnes Preserve south of Sacramento and at the Audubon-Wattis sanctuary near Butte Sink. Neither of these areas was present in 1985, and together they accounted for over 1,760 acres of wetland habitat in 1995, most unhunted (230 acres of Cosumnes Preserve are used for youth duck hunts).

Private duck club wetland acreage also increased over the study period, owing to federal and state easement programs (U.S. Fish and Wildlife Service and California Dept. of Fish and Game), and the federal wetland reserve program (Natural Resource Conservation Service). In the Sacramento Valley, about 9,300 acres have been added to the private wetland total as a result of these programs. We assume, for purposes here, that all of these private wetlands were hunted; however, some large clubs maintained small sanctuaries.

Although the acreage of wetland sanctuaries increased in the Sacramento Valley since 1985, the amount of hunted habitat increased as well. As a result, the proportion of sanctuary was about 24% of total wetland acres in 1985 and about 25% in 1995, virtually no change (Table 6).

Sacramento Valley Agricultural Lands: Flooded rice fields in the Sacramento Valley provide extensive habitat and hunting opportunity. In 1985, an estimated 60,000 acres of harvested rice was flooded, most to provide for duck hunting (M. Miller, D. Sharp, D. Gilmer, and W. Mulvaney. 1989. Rice available to waterfowl in harvested fields in the Sacramento Valley, California. Calif. Fish and Game 75:113-123) (Table 6). About 6,000 acres of this flooded area was not hunted, most in the Upper Butte Basin, and served as sanctuary. The situation in 1995 was much different. An estimated 150,000 acres were flooded (F. Reid, Ducks Unlimited, Inc., Sacramento, CA). To derive an estimate of hunted flooded rice in 1995, we used unpublished data from the Ducks Unlimited phone survey of rice growers participating in Valley Care and the National Biological Service's road side survey of rice field treatments. Both of these surveys indicate that about 70% of flooded rice was hunted in 1994-95 and 1995-96. Specifically, the DU data sampled about 45,000 acres of flooded rice on 70 farms, and of this, 69% was hunted (varied from 30% to 98% depending on county). The National Biological Service roadside data sampled over 12,500 acres and 72% of the flooded acreage was hunted (1994-95). Thus, 30%, or 45,000 acres (.30 x 150,000 acres), may have been sanctuary in 1995-96. However, because not all of these acres were flooded simultaneously, owing to sequential flooding schedules among farms and fields, and the number of days hunted ranged from 1 to 7 days/week (3.64 days/week average), we lowered the estimate to 40,000 acres of flooded rice that may have remained essentially unhunted in 1995. This area probably remained unhunted because the increased flooding (from the existing 60,000 acres to the recent 150,000 acres) resulted from changes in farming practices designed to decompose rice straw, rather than to provide duck hunting opportunity or change waterfowl distribution. This situation resulted from waterfowl interests working with the rice industry to benefit waterfowl given the impending elimination of rice field burning, the traditional method of straw management. Alternatives to burning and flooding generally are not friendly to waterfowl (e.g., plowing, alternative crops). Thus, in the Sacramento Valley, it is likely that the largest share of new lands unavailable to hunting are private farm

lands. We do not know how many more years this situation will prevail. Some information suggests there is a lag time, after rice growers begin using the flooding option to decompose straw, before they open their lands to hunting, and DU, California Waterfowl Association, and Fish and Wildlife Service offices have been contacted by land owners wanting information on setting up hunting programs in flooded rice. It is possible at some point that most of the new flooded rice will be hunted regularly enough to effectively minimize their sanctuary function.

The percentage of sanctuary in the Sacramento Valley in 1985 would have been 16.3% when flooded rice fields are included in the total wetland figure, because most rice was hunted then, but was still three times that of the San Joaquin Valley (Table 6). In 1995, using the 40,000 acre estimate of sanctuary, total NWR, SWA, and rice habitat sanctuary would have been 56,672 acres, or about 26% of total wetlands/flooded rice in the Sacramento Valley, four times the proportion of sanctuary in the San Joaquin Valley (Table 6). The immediate effect of these large, flooded areas was a wider dispersal of waterfowl. For example, during aerial surveys, concentrations of up to 80,000 waterfowl were recorded in unhunted rice fields. The local effect of this new distribution of ducks on hunter success could not be analyzed for this report.

The Delta, portions of which are in the Sacramento and San Joaquin Valleys, also contains sanctuary, but it is difficult to quantify. Of the 30,000 acres of flooded agricultural lands in the Delta in 1995 (Table 6), primarily corn, wheat, and asparagus, about 1,000 acres might qualify as permanent sanctuary. We elected to ignore most aspects of Delta habitats for this analysis because the transitory nature of the habitat on many of the islands (lands flooded to manage salt content of soils and to control weeds) makes an exact accounting impractical for our analysis.

San Joaquin Valley Wetlands: Several new units, totaling 10,860 acres, have been added to the SWA system in the San Joaquin Valley. This has resulted in an increase of nearly 3,000 acres in restored, managed wetlands, and a large area of native pastures, sloughs, and vernal pools that we have not considered for our analysis.

Nearly 3,350 acres of managed wetland habitat have been added to the hunted land base on SWA's since 1985 (a 32% increase), but unhunted habitat declined by 70 acres (5% decrease) (Table 7). The addition of Salt Slough, the Gadwall Unit, and sizeable increases at Los Banos and Mendota accounted for the increases of managed wetlands on SWA's.

On the NWR's, a total of 20,300 acres have been acquired since 1985. However, most of this acreage is comprised of uplands, former agricultural lands, vernal pools, and flood plains that are usually dry during the waterfowl season. Actual managed wetlands on these new federal lands total about 1,100 acres of restored wetlands and 975 acres of pre-existing wetlands.

About 767 acres were added to the hunted acreage (50% increase), and 1,308 acres to the unhunted acreage (66% increase) on NWR's in the Grasslands since 1985 (Table 7). Most of the hunted acreage addition occurred at Kesterson NWR (Freitas and Blue Goose Units), with a small increase at San Luis NWR. Unhunted acreage was added at Merced, San Joaquin River

NWR, and the Arena Plains unit (Table 7).

Acreage of wetlands on private clubs in the northern San Joaquin Valley changed little, with only about 650 acres of agricultural lands restored as managed wetlands since 1985 as the result of state and federal programs. Thus, most wetland restoration there has occurred on SWA's and NWR's. However, extensive habitat enhancement has occurred on existing duck club wetlands and this has improved the overall quality of habitat for wintering waterfowl in the Grasslands.

In the San Joaquin Valley, the acreage of sanctuary increased together with the total increase in wetlands (Table 6). The proportion of sanctuary increased from 5.3% of total San Joaquin Valley wetlands in 1985 to 6.5% in 1995 (Table 6).

In summary, between 1985 and 1995, there has been an increase of 4,858 acres of wetland sanctuary in the Sacramento Valley and 1,235 acres in the San Joaquin Valley, and an increase of 3,496 acres of hunted habitat in the Sacramento Valley and 4,115 acres in the San Joaquin Valley. Total wetland sanctuary increased in the Sacramento Valley from 11,814 acres in 1985 to 16,672 acres in 1995, and from nearly 3,476 acres to 4,711 acres in the San Joaquin Valley. Total hunted acres increased from 10,507 acres to 14,003 acres in the Sacramento Valley, and from 12,531 acres to 16,646 acres in the San Joaquin Valley. Flooded rice fields increased from 60,000 acres in 1985 to 150,000 acres in 1995, and we assumed that 6,000 acres of this was sanctuary in 1985 and 40,000 acres in 1995. The proportion of sanctuary in the San Joaquin Valley increased from 5.3% in 1985 to 6.5% in 1995. In the Sacramento Valley, excluding rice fields, the proportion of sanctuary was 24% in 1985 and 25% in 1995, four times that in the San Joaquin Valley. When flooded rice is included in total sanctuary, the proportion of sanctuary in the Sacramento Valley was 16.3% in 1985 and 26.2% in 1995, the latter virtually the same as the proportion of wetland sanctuary.

Density of Ducks on Sanctuaries.-- The density of ducks held on sanctuaries during the hunting season may affect hunter success in surrounding hunted wetlands and flooded agricultural habitats. Theoretically, as the number of ducks increases on a sanctuary above some threshold density, more and more ducks will leave the area and become vulnerable to harvest. We have no data on what threshold densities would be, or even if this theory is correct, but we elected to compare density on sanctuaries between the Sacramento and northern San Joaquin Valleys (Grasslands plus Mendota). We assumed that an area with the highest density of ducks per acre on sanctuaries potentially could have the best hunting, everything else (e.g., weather, hunting pressure, days hunted per week, etc.) being equal, once some maximum threshold density was reached. We estimated total ducks per sanctuary acre for the Sacramento and San Joaquin Valleys by dividing total ducks counted on the MWI by total unhunted acres (Table 6) on combined NWR and SWA habitats. Results showed that in 1996, the density of ducks on wetland sanctuaries was the same in the Sacramento (134 ducks/acre) and San Joaquin Valleys (137 ducks/acre), and was similar between the two valleys in 1995 (Table 8). Also, densities did not change much on wetland sanctuaries in the Sacramento Valley between the 1980's (99-140 ducks/acre) and 1995 (98 ducks/acre) and 1996 (134 ducks/acre), but density increased markedly between the two time periods in the San Joaquin Valley (from 47-63 ducks/acre to 83-137

ducks/acre) (Table 8). Density declines markedly from the 1980's (65.7 - 92.8 ducks/acre) to 1995-96 (28.9 - 39.3 ducks/acre) in the Sacramento Valley when flooded rice fields are included in the analysis (Table 8). Thus, if high duck density increased harvest opportunity, 1995-96 should have been better than 1994-95 in the San Joaquin Valley, and better in 1995-96 compared with the Sacramento Valley. In actuality, however, since hunter success declined on San Joaquin Valley public areas and the trend was inconsistent on duck clubs, the greatest hunter success in 1995-96 was associated with the high proportion of wetland sanctuary and total (rice plus wetlands) sanctuary, and the lowest density of ducks per total sanctuary acre, which occurred in the Sacramento Valley (Table 6, 8)..

CONCLUSIONS

Hunting results for California presented in this report may or may not verify individual hunters' perceptions, depending upon location hunted. Reports of poor hunting were common in the Pacific Northwest as well as in California. Total harvest increased substantially in most counties in California, including Merced, in 1995-96, and Merced County continued as the number one harvest county in California. The harvest of all species increased in Merced County in 1995-96 compared with the previous decade. Green-winged teal continued to be the most numerous duck in the San Joaquin Valley harvest, whereas mallards were more important in the Sacramento Valley. As a percentage of the California duck harvest, Merced County declined somewhat in 1995-96 compared with 1994-95, but the decline was small compared with historical patterns and the long-term trend shows an increase in the percentage of statewide harvest in Merced County. The harvest in the Sacramento Valley, as a percentage of the California duck harvest, increased in most counties from 1994-95 to 1995-96. Hunter success in the Sacramento Valley, as measured on most public areas (not Upper Butte Basin SWA) and on sampled private clubs was markedly better than during the preceding years. Overall, success was similar on sampled clubs in the Grasslands in 1995-96 compared to 1994-95 and preceding years. However, on public areas in the San Joaquin Valley, hunter success declined in 1995-96 compared with 1994-95, but the magnitude of the decline was no greater than has occurred several times in the past and success was still well within the normal range of values of the past several years. Except for public hunters in the San Joaquin Valley and at the Upper Butte Basin SWA in the Sacramento Valley, hunter success in 1995-96 was, on average, either better, equal to, or slightly worse than previous years on the areas sampled. Our sample of duck clubs may not have been representative because the sample was small and it was not obtained randomly, but club results generally followed overall county harvest trends for 1995-96 based on the annual U.S. Fish and Wildlife Service parts collection and hunter questionnaire surveys.

The Federal furlough and lower than expected proportions of young ducks in the winter populations could have depressed hunter success in 1995-96. However, weather patterns probably had the greatest influence. The fall and winter of 1995-96 were unusually mild in the Klamath Basin and in the Central Valley. No rain fell in the Central Valley until the first storms arrived in mid-December. Temperatures were at least 6 degrees (F) above normal in November

and December in both areas and the number of windy days during the hunting season was abnormally low in the San Joaquin Valley. Unusually large numbers of ducks remained in the Klamath Basin, and probably farther north as well, during November and December. An above normal number of birds were still present in the Basin during the MWI in early January. A very cold period followed, which moved most waterfowl south into the Central Valley for the last week or two of the hunting season. The numbers of waterfowl recorded in the Central Valley in 1995-96 was higher than in the past several years, and occurred concurrently with large numbers of birds present in the Klamath Basin. However, MWI results in 1995 could have been biased low because of poor weather conditions during the survey, making it seem as if numbers of ducks had increased in 1996 when MWI counts, obtained under ideal survey conditions, were complete. In any event, waterfowl seemed to be at least as abundant as in recent years during the early and mid-part of the hunting season, but the unseasonably mild weather had to be the major factor which reduced hunter success at that time. Hunting improved later in the season when storms finally began, and freezing weather pushed ducks south from northern staging areas.

Periodic aerial surveys on shoot days in the Grasslands documented a shift in waterfowl distribution from SWA's to NWR's and to the Los Banos sewer ponds since the early 1990's . This shift occurred as overall populations of ducks increased in the Grasslands area. Shoot day counts do not accurately reflect the distribution of ducks within the Grasslands in the early hours of shoot days nor on nonshoot days. In the Sacramento Valley, MWI data indicate a steady increase in the use of private lands by waterfowl in early January. This seems to reflect increased day time use of flooded rice fields that are rarely or irregularly hunted, and of flooded by-passes.

Central Valley Habitat Joint Venture programs have succeeded in increasing the extent of wetlands, both public and private, in the Central Valley between 1985 and 1995. Sanctuary acreage has increased in the Sacramento and San Joaquin Valleys. Wetland sanctuary as a proportion of total wetlands remained essentially unchanged in the Sacramento Valley since 1985 (from 24% in 1985 to 25% in 1995 of total managed wetlands), and remained unchanged (26.2%) in 1995 when including flooded rice (40,000 acres of sanctuary). In 1985, a markedly lower proportion of sanctuary existed if rice habitats are included (16.3% of total managed wetlands plus flooded rice). Proportionate sanctuary in the San Joaquin Valley was much less than in the Sacramento Valley, but increased from 5.3% of total managed wetlands in 1985 to 6.5% in 1995. The larger amount and proportion of sanctuary in the Sacramento Valley corresponds with the larger numbers of waterfowl recorded there compared to the San Joaquin Valley. However, hunter success on sampled Sacramento Valley duck clubs was similar to or lower than success on a similar number of Grasslands clubs from 1991-92 through 1994-95. Only in 1995-96 did hunter success on these clubs in the Sacramento Valley exceed those in the Grasslands. High hunter success in 1995-96 was associated with the larger extent and proportion of sanctuary and lower duck densities on sanctuaries found in the Sacramento Valley.

Finally, abundance of waterfowl does not always predict hunter success. Total duck harvest in California from year to year has not followed annual changes in waterfowl numbers as measured with the MWI. Thus, if 1995-96 was a poorer season than previous years for some, it wouldn't

be the first time that populations have increased while harvest declined or changed little in response. Weather conditions have an overwhelming influence on harvest. Fall Flight projections, and the publicity surrounding them, will continue to guide expectations for hunter success. Unfortunately, the Fall Flight Forecast is based on a continental evaluation of the status of waterfowl and wetland habitats. Nesting regions important to the Pacific Flyway were not in that much better condition in 1995 than in 1994. Expectations were considerably higher than breeding ground conditions warranted, and western hunters, perhaps, should not have expected a large increase in wintering populations and hunter success in 1995-96. In fact, nationwide duck harvest increased 46% (60% increase in the Mississippi Flyway) in 1995-96 compared with 1994-95, but California's harvest increased only 31%. The higher waterfowl populations recorded in 1995-96, if not artifacts of improved survey conditions, could have reflected the excellent production and carry over from 1994-95.

RECOMMENDATIONS

This analysis has highlighted the need for better evaluation of CVHJV wetland restoration and enhancement projects. Information is needed not only on whether Joint Venture wetland and agricultural habitat goals are met, and on documentation of waterfowl population responses to the new or enhanced wetlands, but also on the effects that changes in waterfowl abundance and distribution may have in traditional hunting areas. A method needs to be developed to keep the hunting public informed of the progress of the fall flight relative to weather, the applicability of the Fall Flight Forecast to the Pacific Flyway, the distribution of wintering waterfowl throughout the Pacific Flyway during the hunting season, the progress of wetland restoration projects and their effects on waterfowl distribution and abundance, and the progress and results of wetland and agricultural land enhancements to benefit waterfowl. Information on the influence of sanctuaries on local and regional distribution and harvest of wintering waterfowl is needed. Good estimates are needed of total flooded rice in the Sacramento Valley, both in extent and timing, waterfowl use of these lands, and on the proportion of flooded rice that is hunted, never hunted, and irregularly hunted. A strong evaluation effort is needed as part of the CVHJV to avoid misconceptions about effects of Joint Venture activities. Evaluation should be accompanied by an intensive conservation education outreach program to fully inform the hunting public on a regular basis about Joint Venture objectives, progress, and problems. If the issue of hunting success relative to the factors we examined in this report continue to be a point of concern, then a more detailed analysis will be required using data sets which were not available to the Technical Committee.

Table 1. Periodic waterfowl survey results in Klamath Basin (numbers in thousands)

	5 Sep	20 Sep	5 Oct	20 Oct	5 Nov	20 Nov	5 Dec	5 Jan	> 15 Jan
1990-91	643	598	1,173	1,660	1,595	1,183	654	351	81
1991-92	329	915	1,676	1,548	1,042	807	432	318	242
1992-93	820	907	1,001	1,179	520	472	362	17	no count
1993-94	567	688	993	1,140	1,007	774	198	151	236
1994-95	572	938	1,400	1,091	891	365	135	171	no count
1995-96	461	635	1,028	791	1,474	1,855	706	359	54

Data are Basin-wide, public and private lands

Table 2. Monthly duck populations on Sacramento NWR Complex (numbers in thousands)

	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96
Sep	208	223	161	215	316	197	226	373
Oct	289	412	401	475	557	531	687	928
Nov	989	772	662	705	1,081	1,093	1,139	1,445
Dec	1,087	1,053	665	513	887	1,164	1,128	no count -furlough
Jan	no count -flooding	622	586	297	642	632	no count -flooding	1,293

Data are monthly averages

Table 3. Monthly total waterfowl populations in the Grasslands of the San Joaquin Valley (numbers in thousands of birds)

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96
SEP	36	123	157	88	95	91	81	107	164	310	204
OCT	79	199	271	315	no count	169	292	361	398	788	716
NOV	1,463	564	337	266	550	233	no count	593	867	809	819
DEC	no count	523	591	433	no count	442	735	843	808	1,024	1,000

Table 4. Distribution of Ducks in California based on the annual Midwinter Inventory, 1984-96 (numbers in thousands).

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Total Calif	5,315	2,163	2,525	2,035	3,265	2,002	2,610	2,717	2,323	2,020	2,771	2,437	3,592
Sac Valley	3,805	1,171	1,653	987	2,555	1,247	1,386	1,432	1,266	1,088	1,740	1,638	2,228
SJ Valley	657	164	220	342	210	171	359	479	272	477	404	392	645
NE Calif	148	136	34	222	121	99	180	65	229	28	142	149	378

Table 5. Hunted and Nonhunted Wetland Acreage on NWRs and State Wildlife Areas, Sacramento Valley

Area	1985			1995			Acreage Changes	
	Hunted	Nonhunted	Total	Hunted	Nonhunted	Total	Hunted	Nonhunted
UBB Little Dry Creek	-	-	-	1,695	900	2,595	+1,695	+900
UBB Howard Slough	-	-	-	980	450	1,430	+980	+450
UBB Llano Seco	-	-	-	760	-	760	+750	0
Gray Lodge	4,121	1,746	5,867	4, 255	1,786	6,041	+134	+40
DFG Subtotal	**4,121**	**1,746**	**5,867**	**7,690**	**3,136**	**10,826**	**+3,569**	**+1,390**
Sacramento NWR	2,500	4,785	7,285	2,500	4,785	7,285	0	0
Delevan NWR	1,678	2,487	4,185	1,708	2,792	4,500	+30	+305
Colusa NWR	1,016	2,004	3,020	1,016	2,004	3,020	0	0
Sutter NWR	1,192	792	1,984	859	1,125	1,984	-333	+333
Sac R. NWR	-	-	-	-	1,200	1,200	-	+1,200
Stone Lakes NWR	-	-	-	-	100	100	-	+100
FWS Subtotal	**6,386**	**10,068**	**16,454**	**6,083**	**12,006**	**18,089**	**-303**	**+1,938**
Cosumnes Preserve	-	-	-	230	1,030	1,260	+230	+1,030
Audubon Wattis	-	-	-	-	500	500	0	+500
Private NGO Subtotal	**-**	**-**	**-**	**230**	**1,530**	**1,760**	**+230**	**+1,530**
Grand Total	**10,507**	**11,814**	**22,321**	**14,003**	**16,672**	**30,675**	**+3,496**	**+4,858**

Table 6. Acres of managed wetland habitat in the Sacramento and North San Joaquin Valleys, total acres of flooded rice in the Sacramento Valley, and flooded crops in the Delta, 1985 and 1995

	Sac Valley		N. San Joaquin	
	1985	1995	1985	1995
Public	22,321	30,675	16,007	21,357
Duck clubs	26,700	36,000	50,200	50,850
Total	49,021	66,675	66,207	72,207
Sanctuary	11,814	16,672	3,476	4,711
Sanctuary %	24.1	25.0	5.3	6.5
Flooded Rice	60,000	150,000	-------	-------
Rice sanctuary	6,000	40,000	-------	-------
Total sanctuary %	16.3	26.2	5.3	6.5
Flooded Ag (Delta)	------	30,000	-------	-------

Table 7. Hunted and Nonhunted Wetland Acreage on NWRs and State Wildlife Areas, Northern San Joaquin Valley

Area	1985			1995			Acreage Changes	
	Hunted	Nonhunted	Total	Hunted	Nonhunted	Total	Hunted	Nonhunted
Salt Slough	-	-	-	984	0	984	+984	0
Gadwall Unit	-	-	-	475	-	475	+475	0
Los Banos	1,884	535	2,419	2,588	462	3,050	+704	-73
Volta	2,360	65	2,425	2,294	65	2,359	-66	0
Mendota	6,314	900	7,214	7,565	900	8,465	+1,251	0
DFG Subtotal	10,558	1,500	12,058	13,906	1,427	15,333	+3,348	-73
San Luis NWR	1,268	1,527	2,795	1,385	1,446	2,831	+335	-81
Kesterson NWR	490	-	490	1,105	501	1,606	+615	+501
Merced NWR	215	449	664	250	815	1,065	+35	+366
Arena Plains NWR	-	-	-	-	344	344	0	+344
SJ R. NWR	-	-	-	-	178	178	0	+178
FWS Subtotal	1,973	1,976	3,949	2,740	3,284	6,024	+985	+1,308
Grand Total	12,531	3,476	16,007	16,646	4,711	21,357	+4,333	+1,235

Table 8. Average number of wintering ducks (MWI) per sanctuary acre in the Sacramento and San Joaquin Valleys, 1985-86 and 1995-96

	Sacramento Valley		San Joaquin Valley
	Wetlands	Plus rice	Wetlands
1985	99.1	65.7	47.2
1986	139.9	92.8	63.3
1995	98.2	28.9	83.2
1996	133.6	39.3	136.9

Figure 1. California Duck Harvest Trends by County

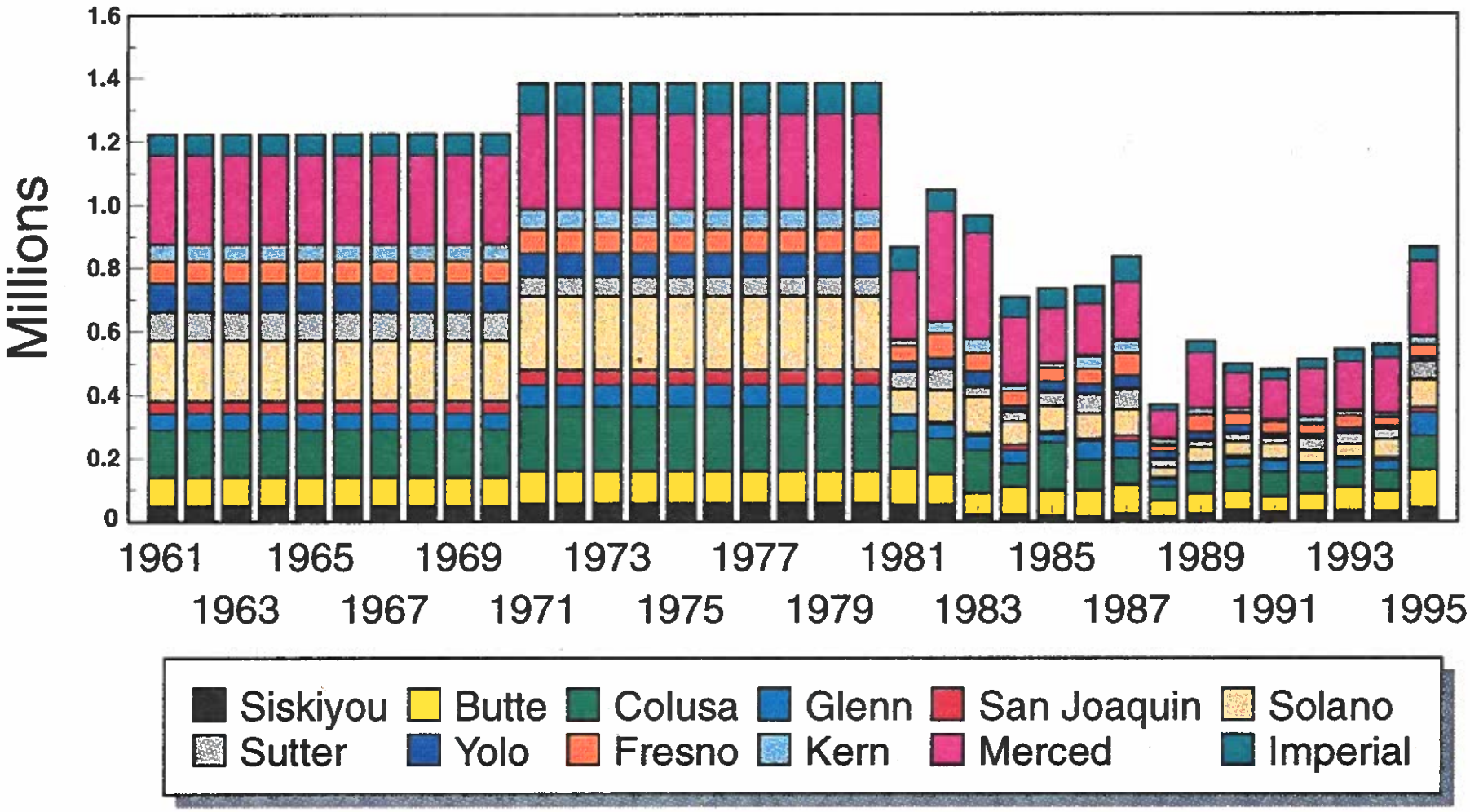


Figure 2. Proportion of California Duck Harvest by County, 1961-62 through 1995-96 seasons.

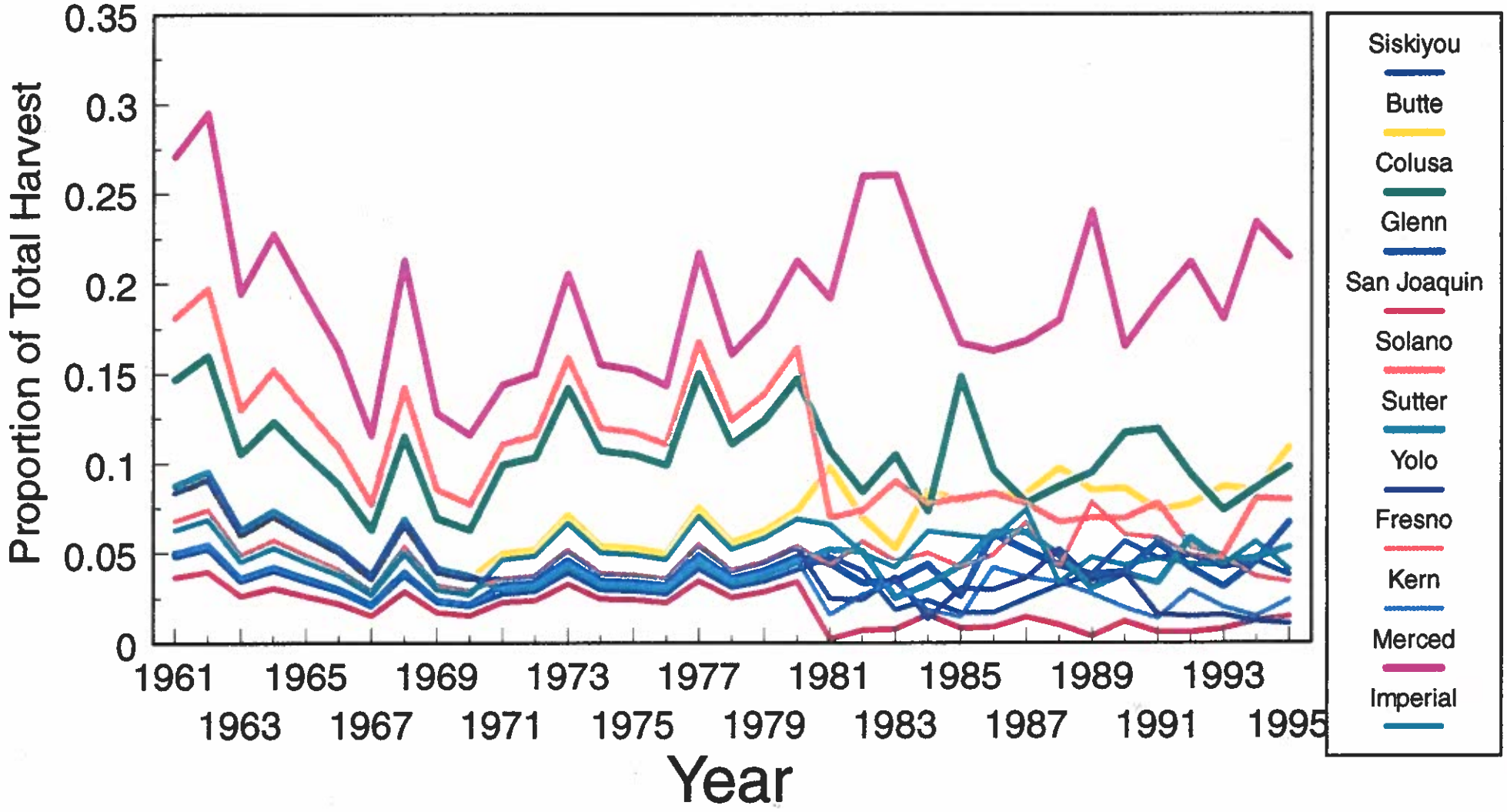


Figure 3. California Duck Harvest Trend in Merced County

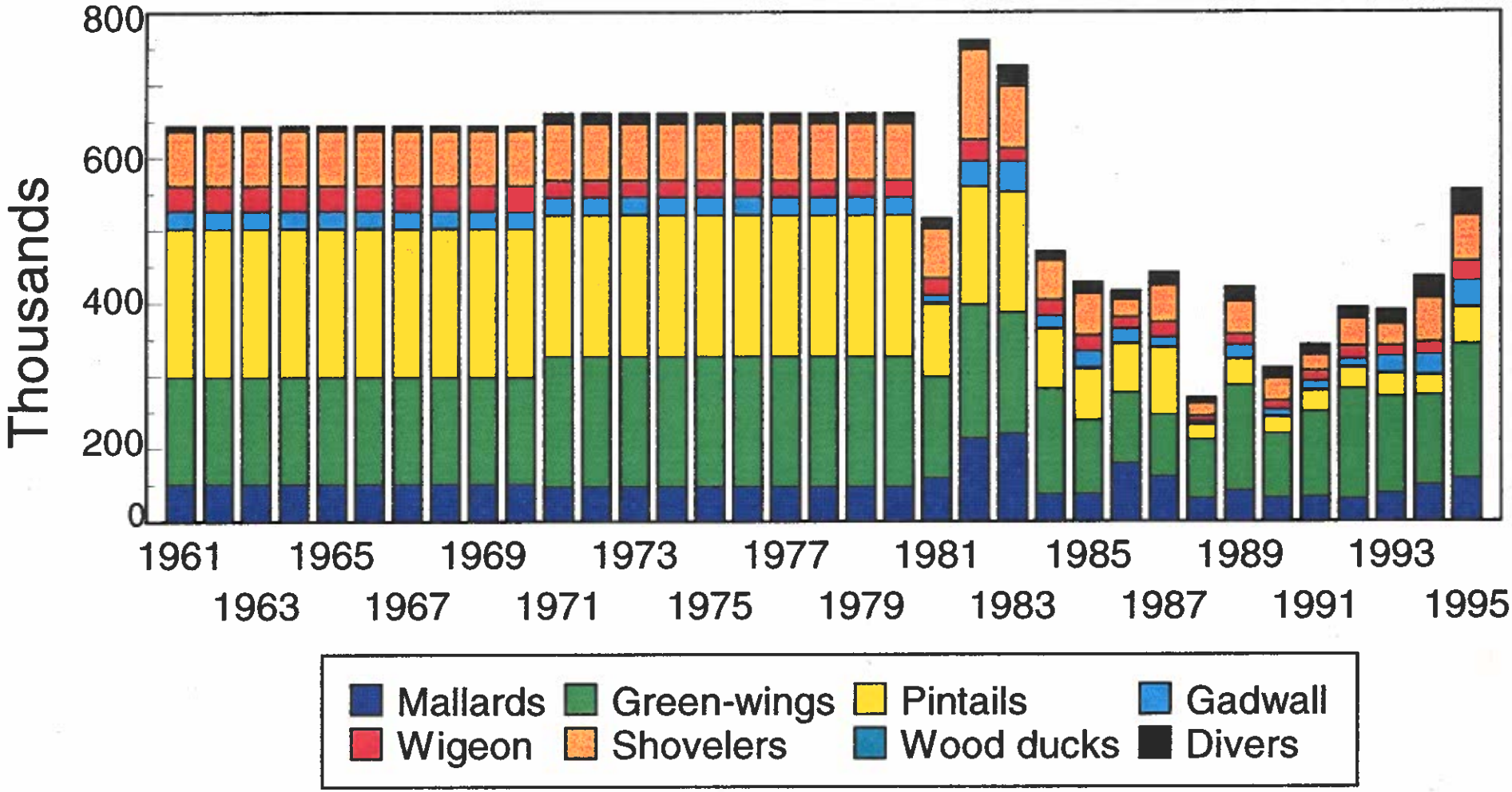


Figure 4. Hunter Success at sampled Private Clubs in the Grasslands and SacValley, 1991-96

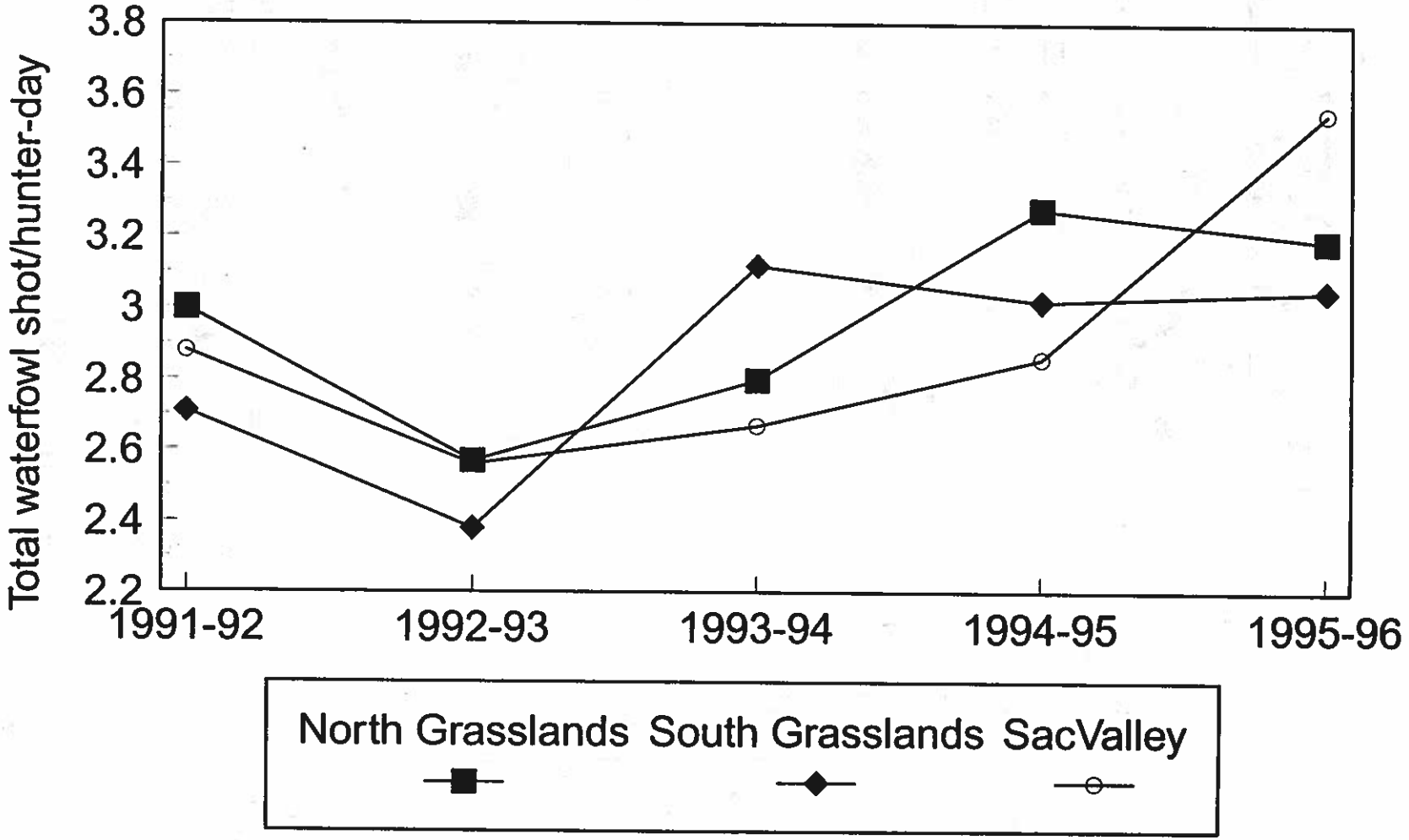


Figure 5. Hunter Success on a sample of San Joaquin Valley Duck Clubs, 1991-95

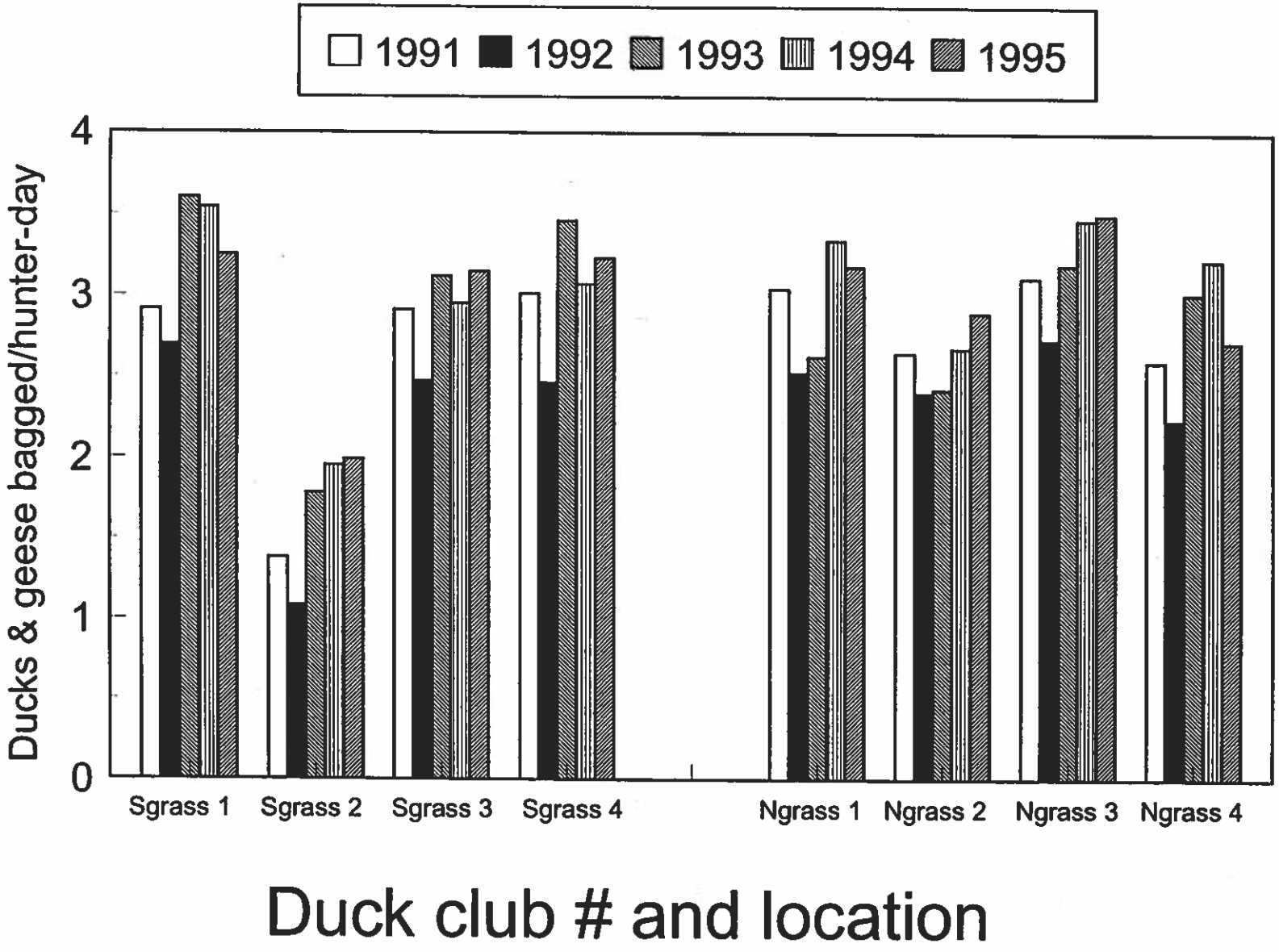


Figure 6. Species Composition of the Duck Harvest, Grasslands Private Duck Clubs, 1991-95

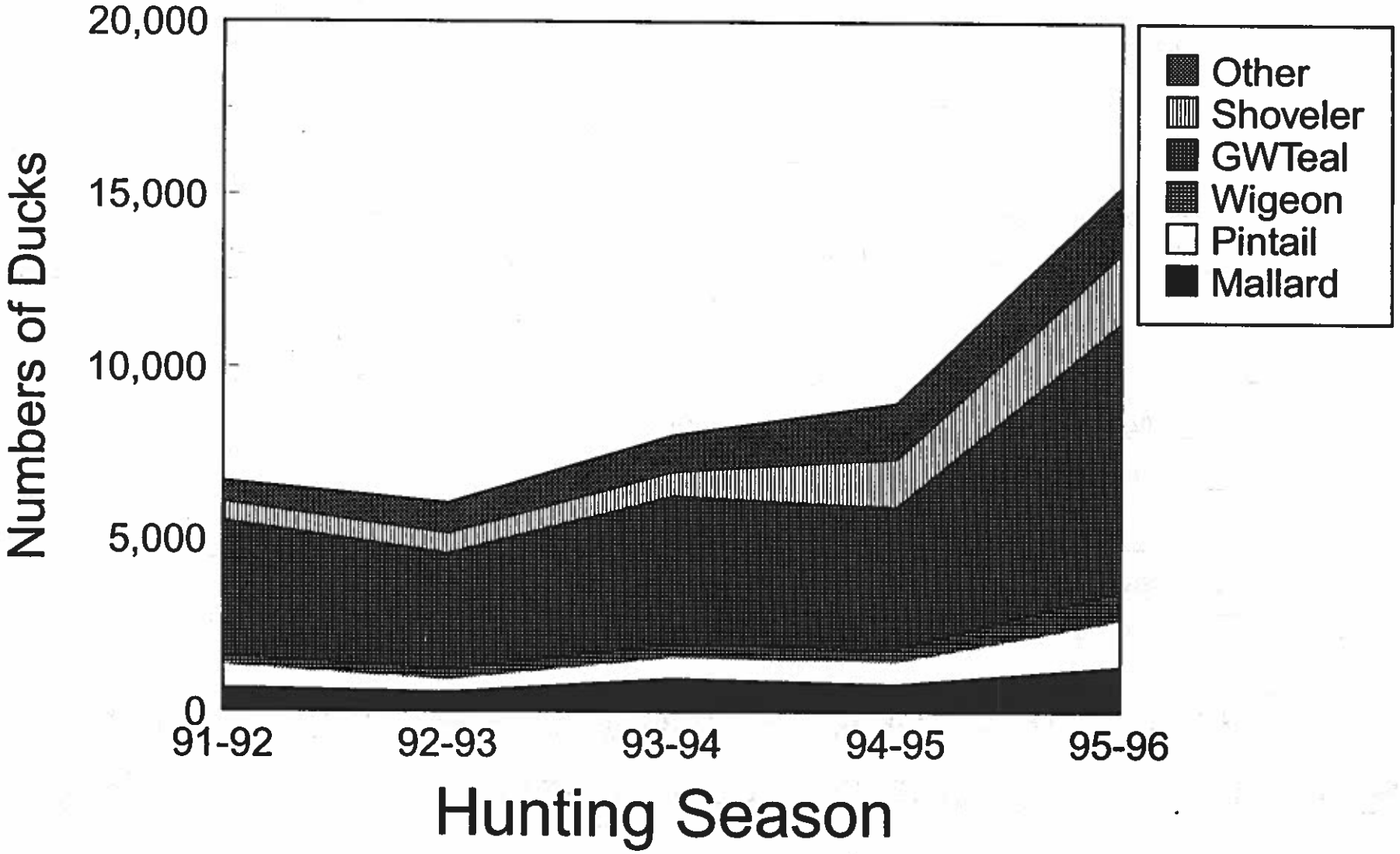


Table 7. Hunted and Nonhunted Wetland Acreage on NWRs and State Wildlife Areas, Northern San Joaquin Valley

Area	1985			1995			Acreage Changes	
	Hunted	Nonhunted	Total	Hunted	Nonhunted	Total	Hunted	Nonhunted
Salt Slough	-	-	-	984	0	984	+984	0
Gadwall Unit	-	-	-	475	-	475	+475	0
Los Banos	1,884	535	2,419	2,588	462	3,050	+704	-73
Volta	2,360	65	2,425	2,294	65	2,359	-66	0
Mendota	6,314	900	7,214	7,565	900	8,465	+1,251	0
DFG Subtotal	10,558	1,500	12,058	13,906	1,427	15,333	+3,348	-73
San Luis NWR	1,268	1,527	2,795	1,385	1,446	2,831	+117	-81
Kesterson NWR	490	-	490	1,105	501	1,606	+615	+501
Merced NWR	215	449	664	250	815	1,065	+35	+366
Arena Plains NWR	-	-	-	-	344	344	0	+344
SJ R. NWR	-	-	-	-	178	178	0	+178
FWS Subtotal	1,973	1,976	3,949	2,740	3,284	6,024	+767	+1,308
Grand Total	12,531	3,476	16,007	16,646	4,711	21,357	+4,115	+1,235

Figure 8. Weekly Average Hunter Success in the Grasslands, 1991-92 to 1995-96

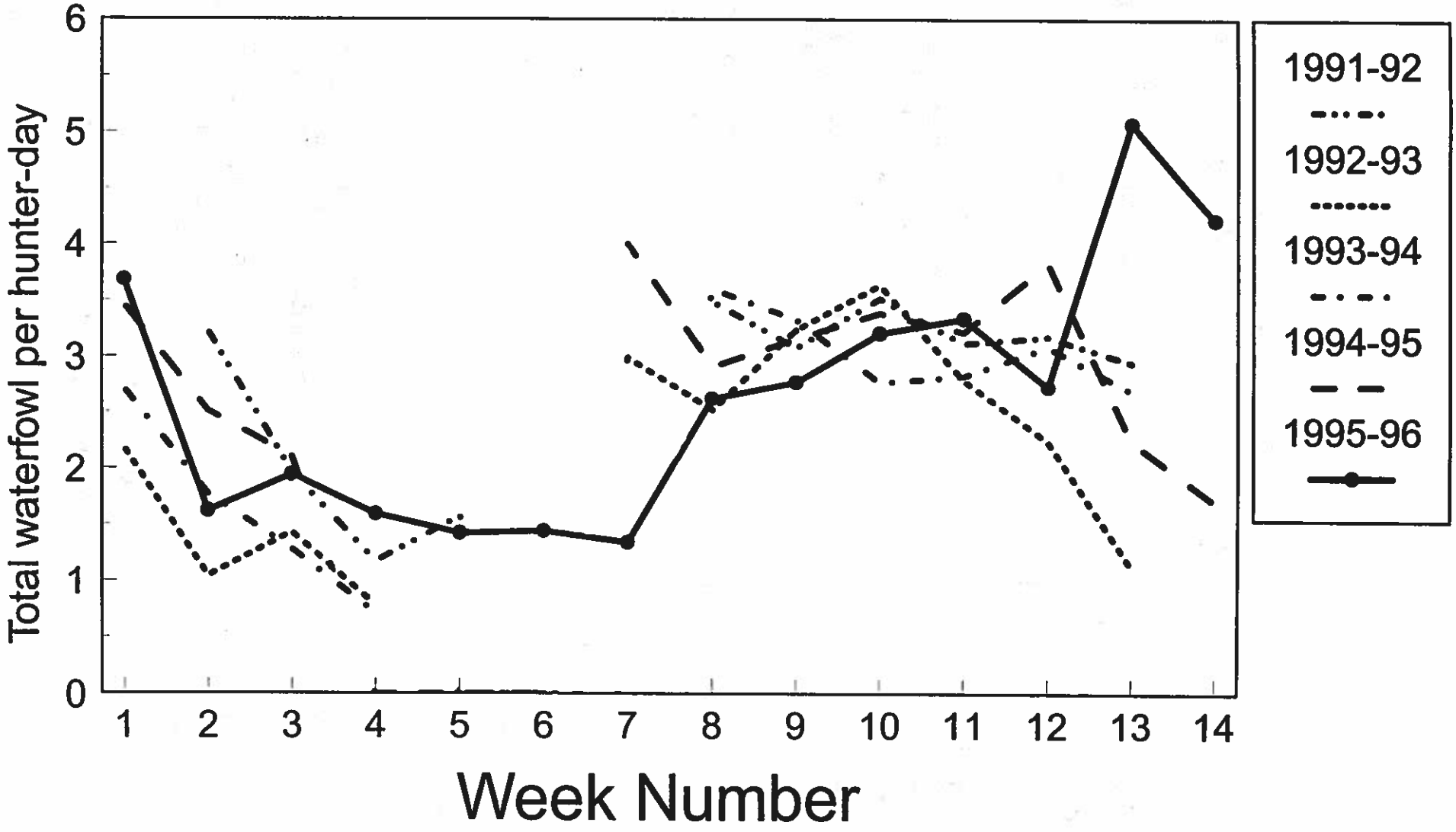


Figure 9. Hunter Success on a sample of Sacramento Valley Duck Clubs, 1990-95

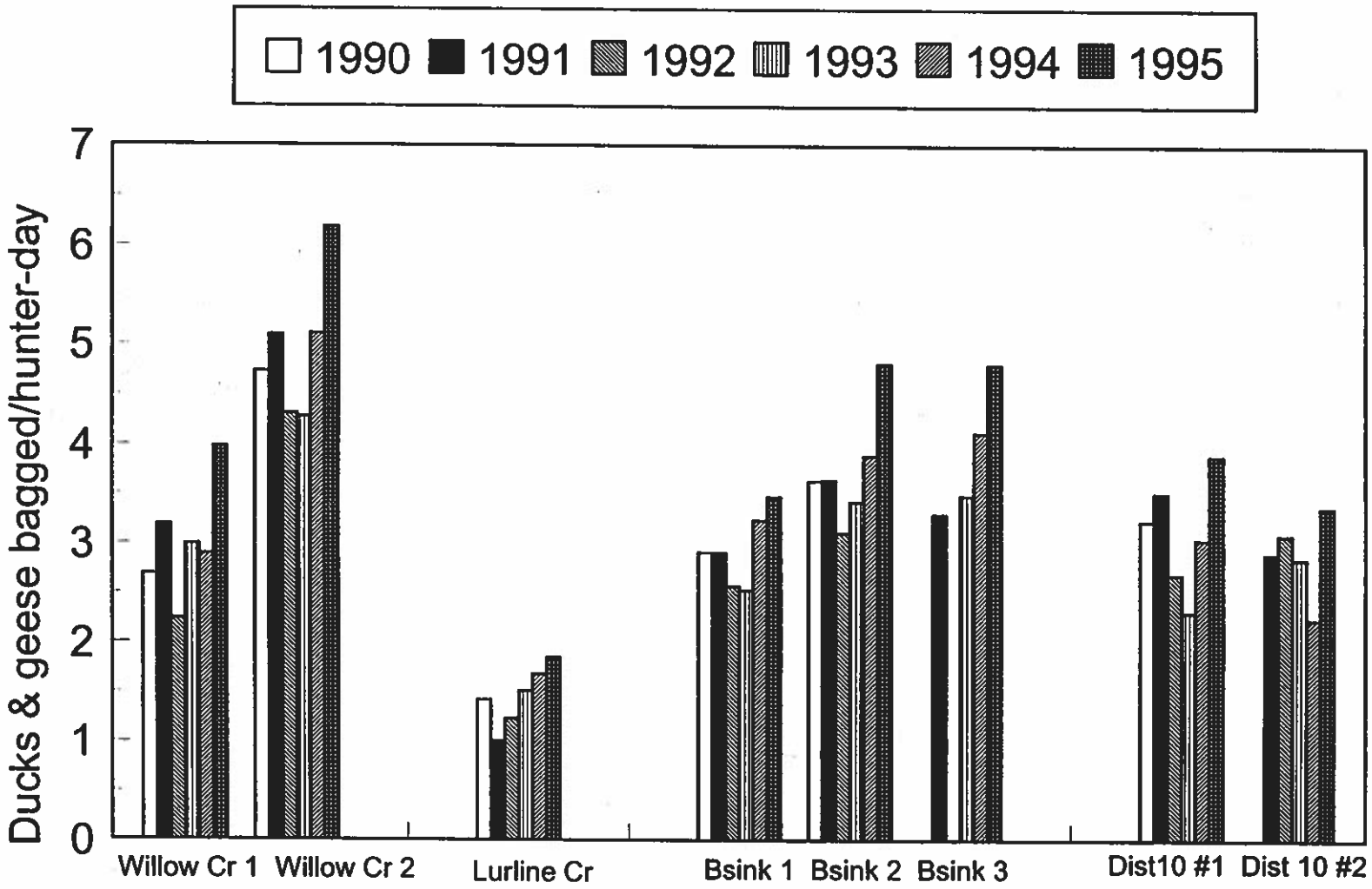


Figure 10. Species Composition of the Duck Harvest, sampled Sacramento Valley Private Duck Clubs, 1991-95

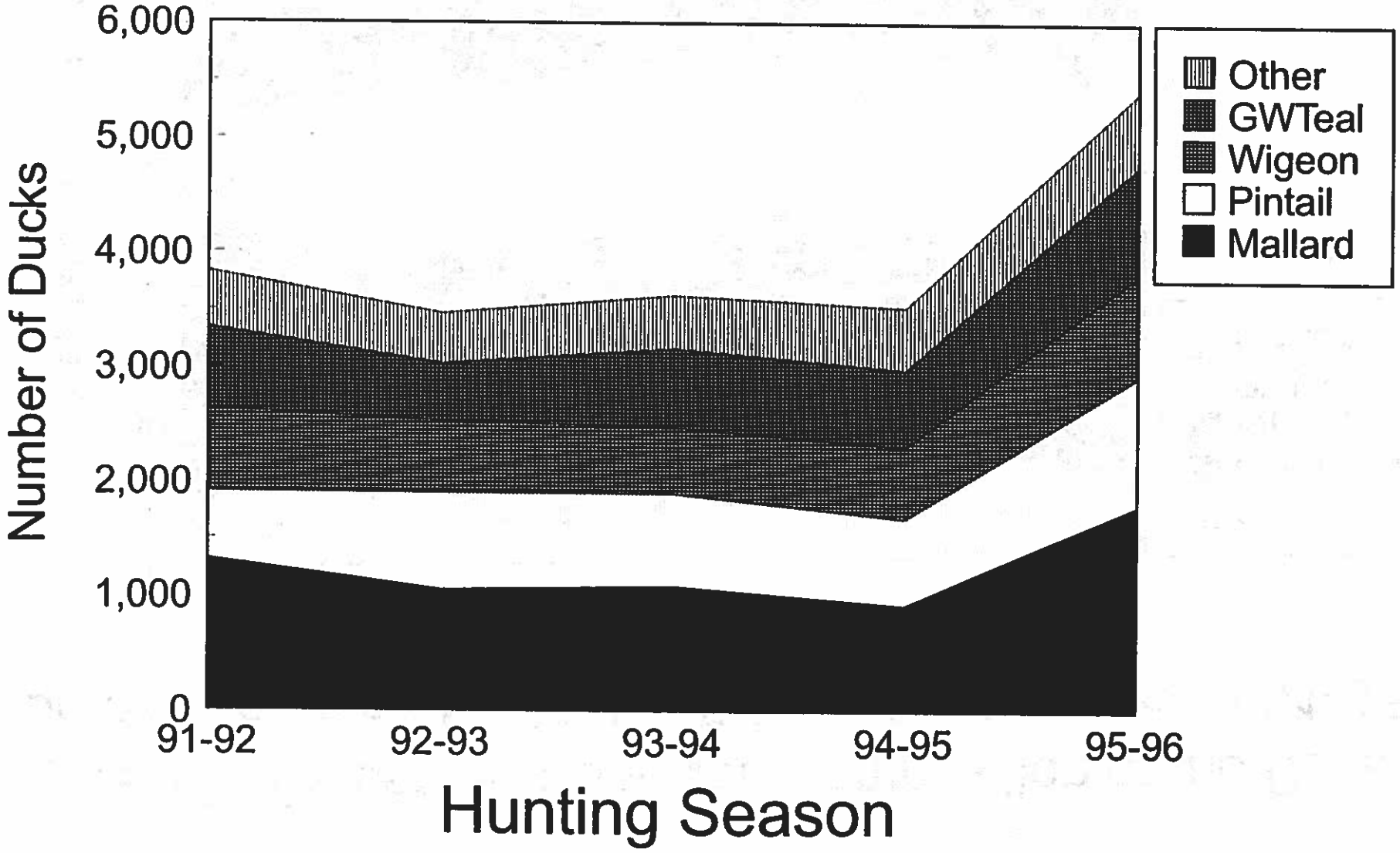


Figure 11. Percentage Species Composition of the Duck Harvest, sampled SacValley Private Duck Clubs, 1991-95

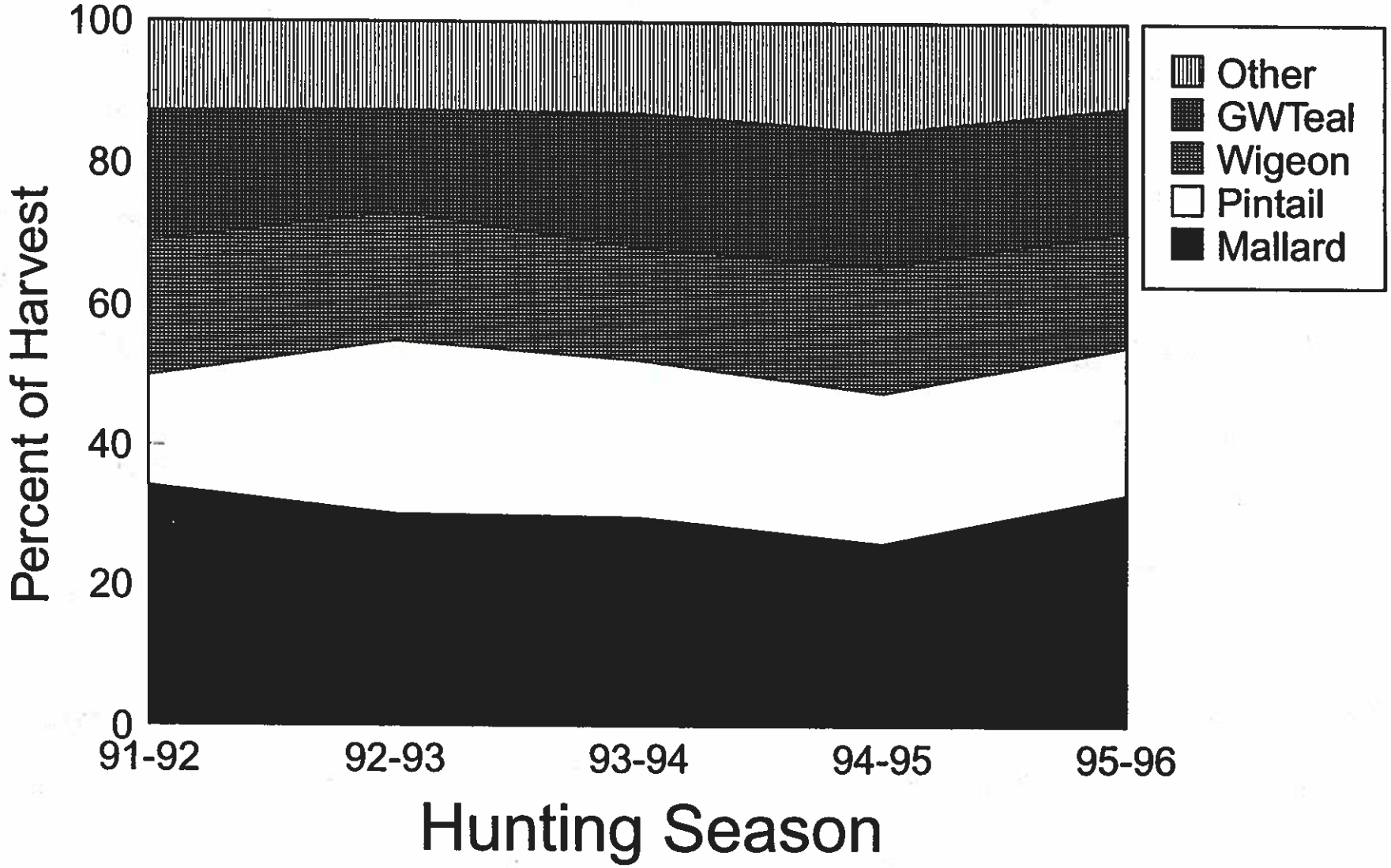
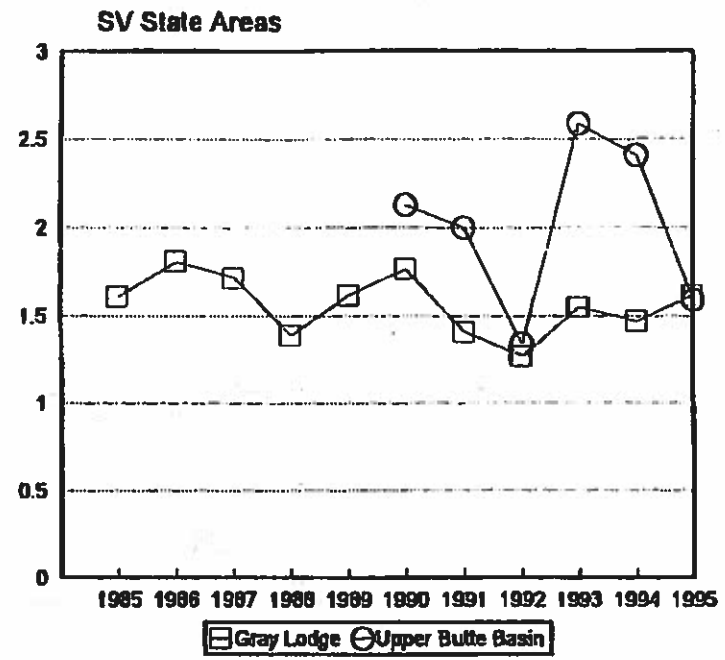
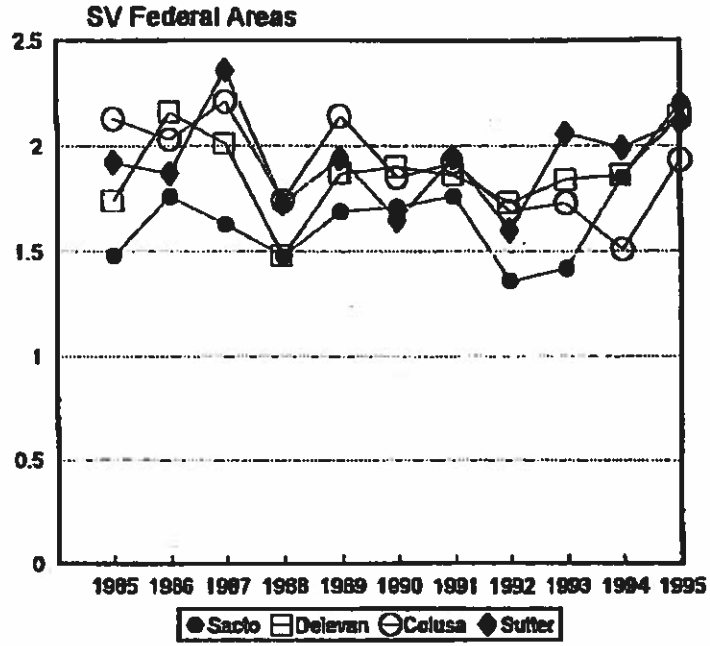
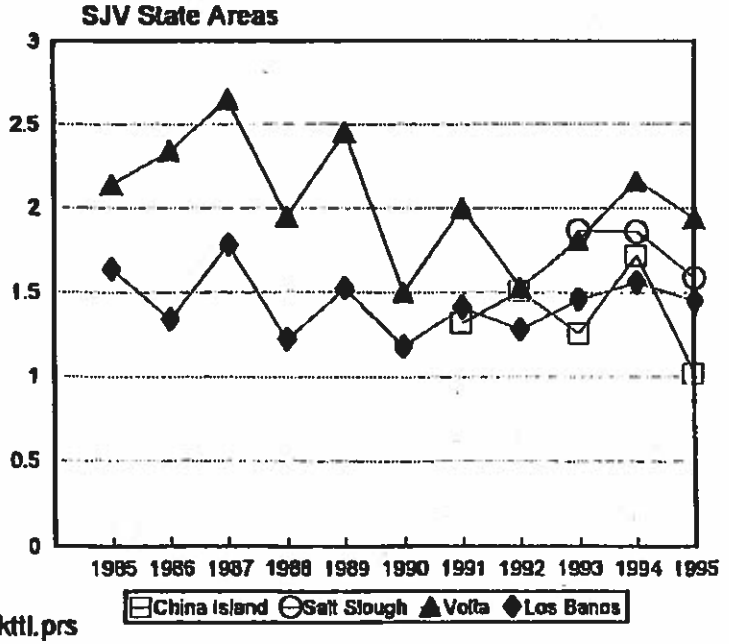
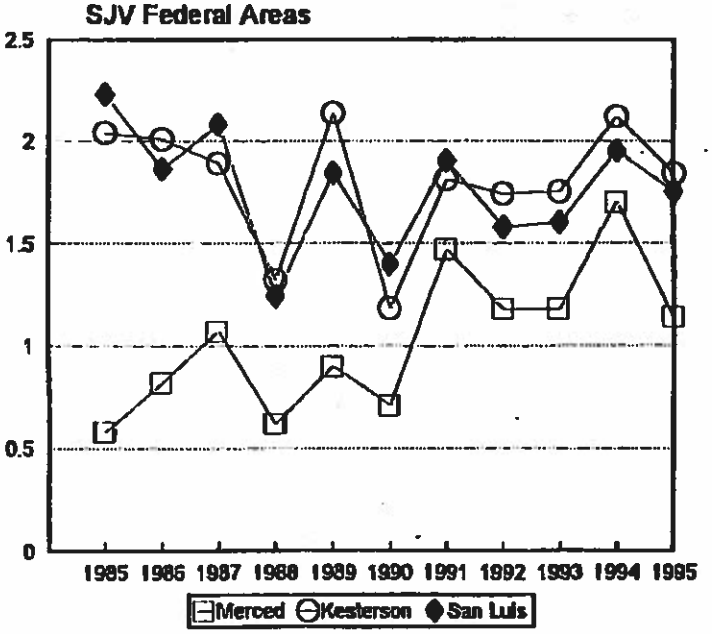


Figure 12. Total ducks shot per hunter-day at San Joaquin and Sacramento Valley Public areas, 1985-95





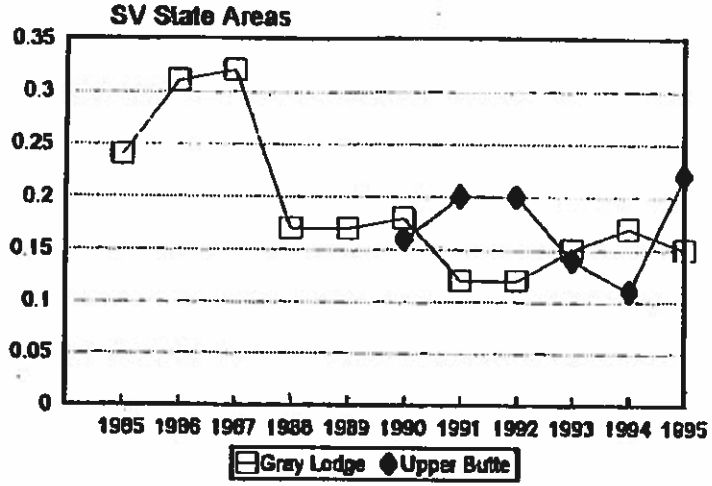


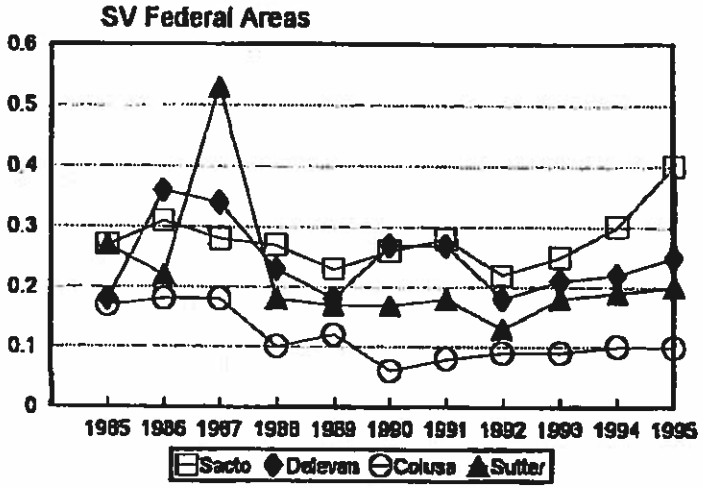


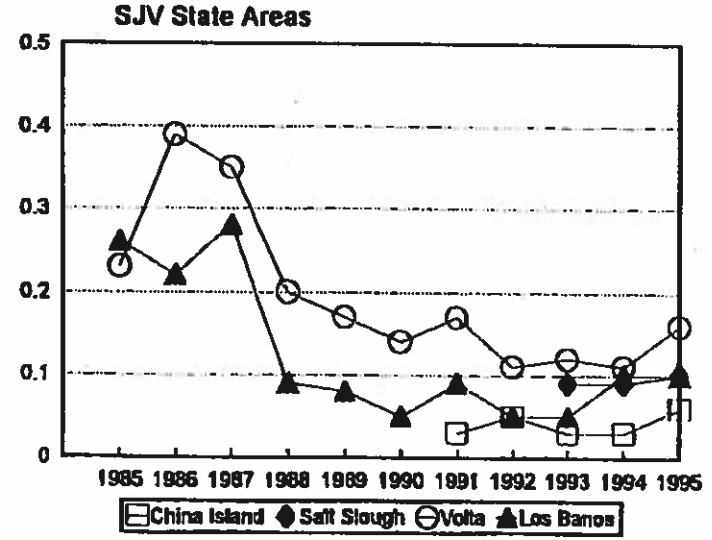
* Duck Total/Hunter Total

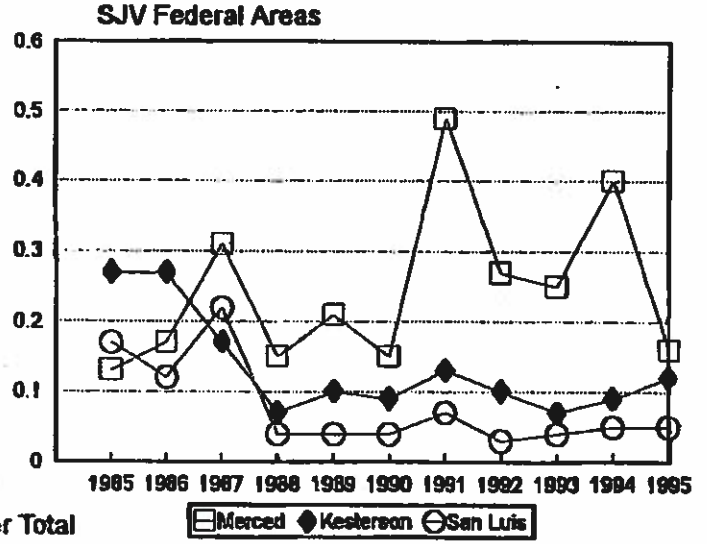
ducktl.prs

Figure 13. Total pintails shot per hunter-day at San Joaquin and Sacramento Valley public areas, 1985-95





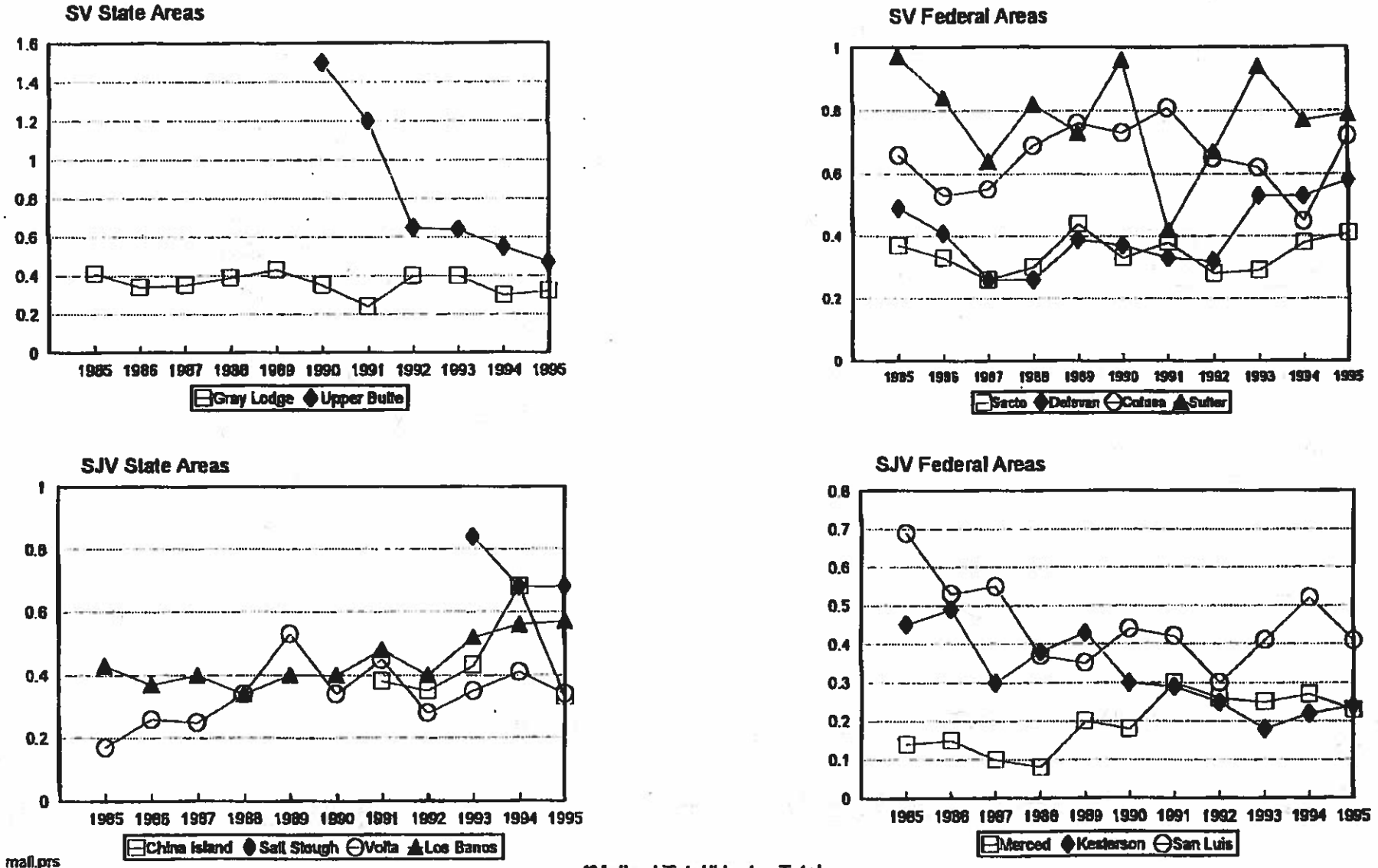




*Northern Pintail Total/Hunter Total

nopi.prs

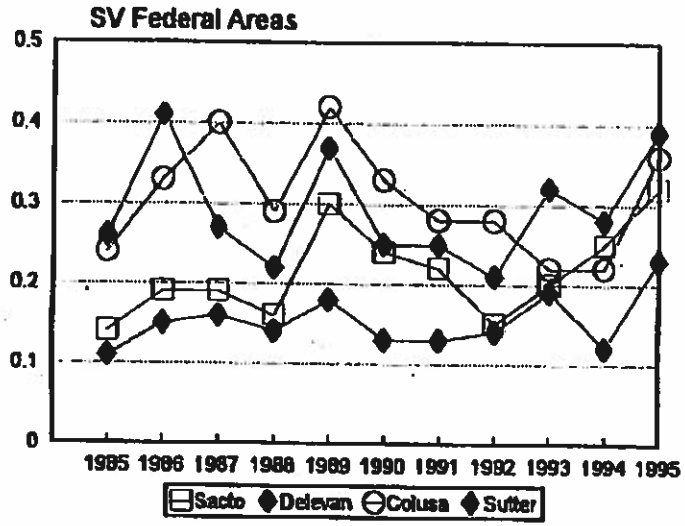
Figure 14. Total mallards shot per hunter-day at San Joaquin and Sacramento Valley public areas, 1985-95

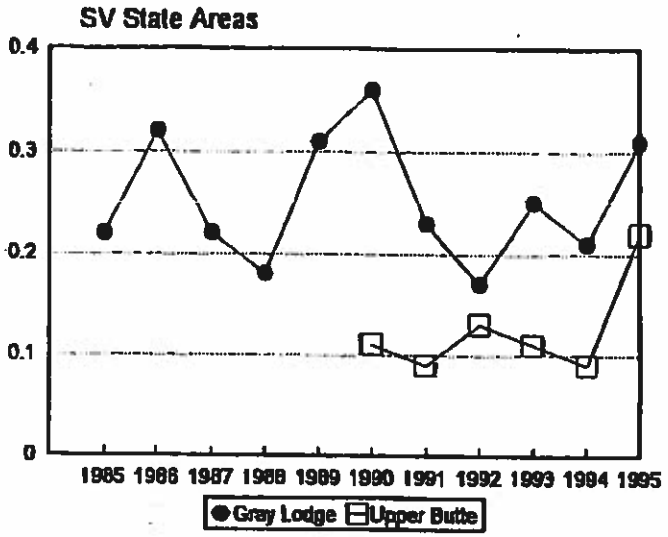


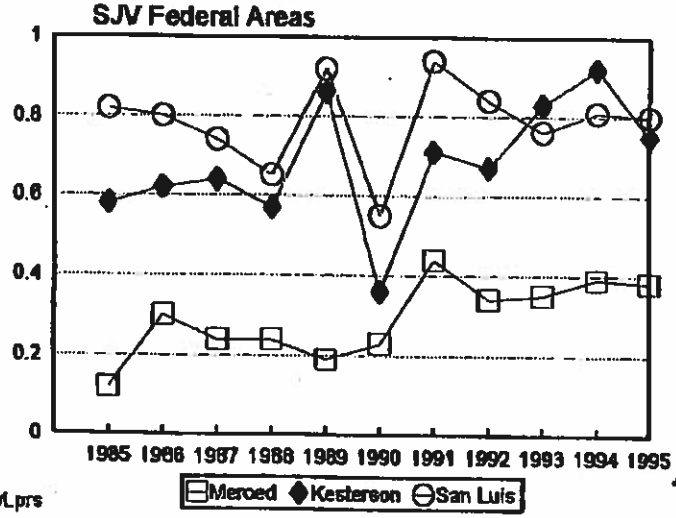
mall.prs

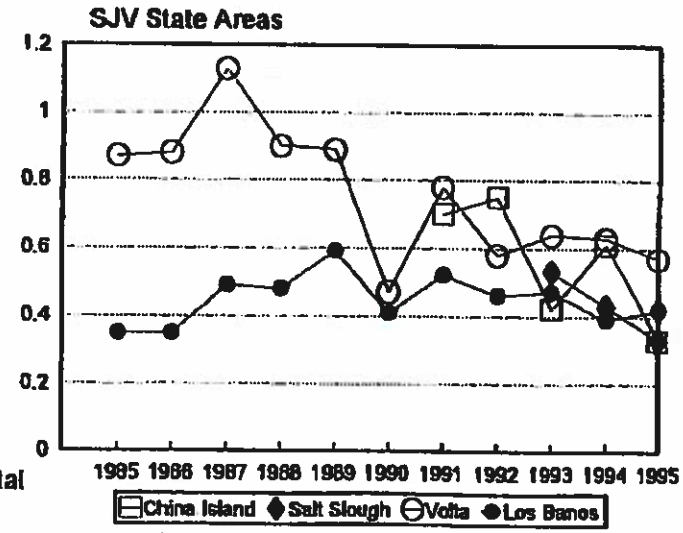
*Mallard Total/Hunter Total

Figure 15. Total green-winged teal shot per hunter-day at San Joaquin and Sacramento Valley public areas, 1985-96





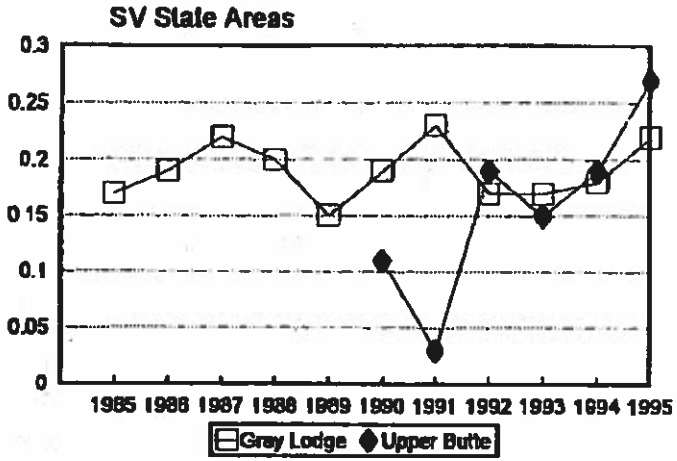


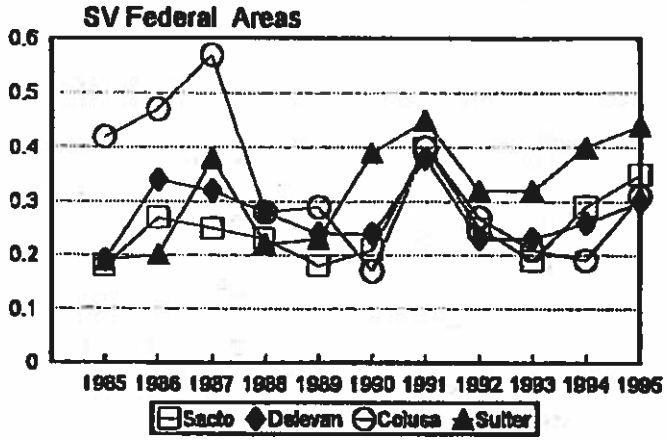


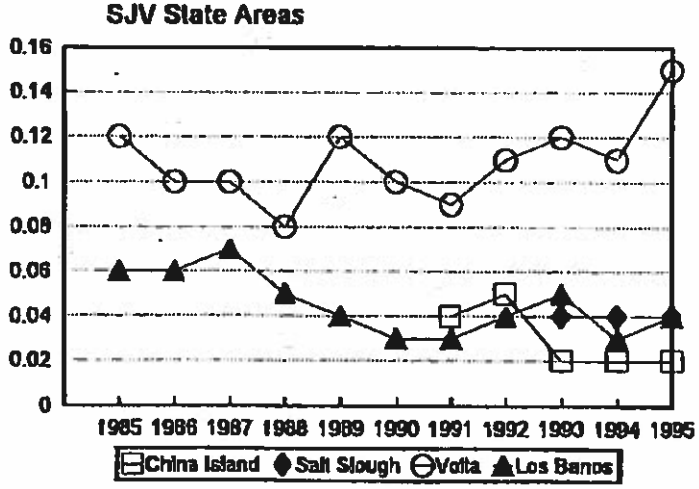
agwt.prs

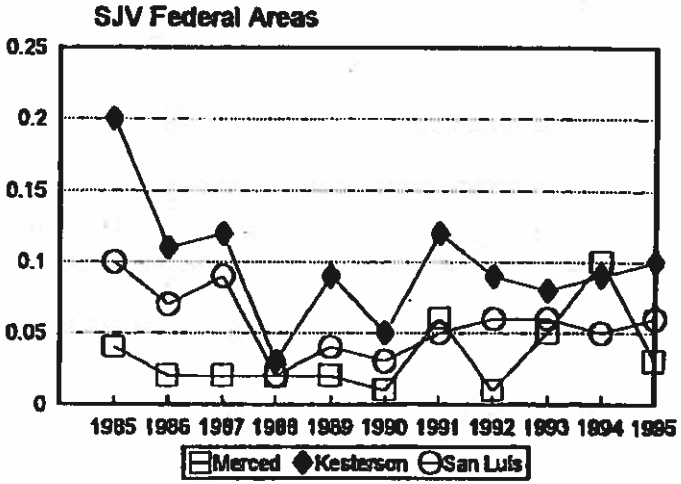
*Greenwing Teal Total/Hunter Total

Figure 16. Total wigeons shot per hunter-day at San Joaquin and Sacramento Valley public areas, 1985-95









*American Wigeon Total/Hunter Total

amwi.prs

Figure 17. Change in Mallard Harvest at Various Daily Bag Limits

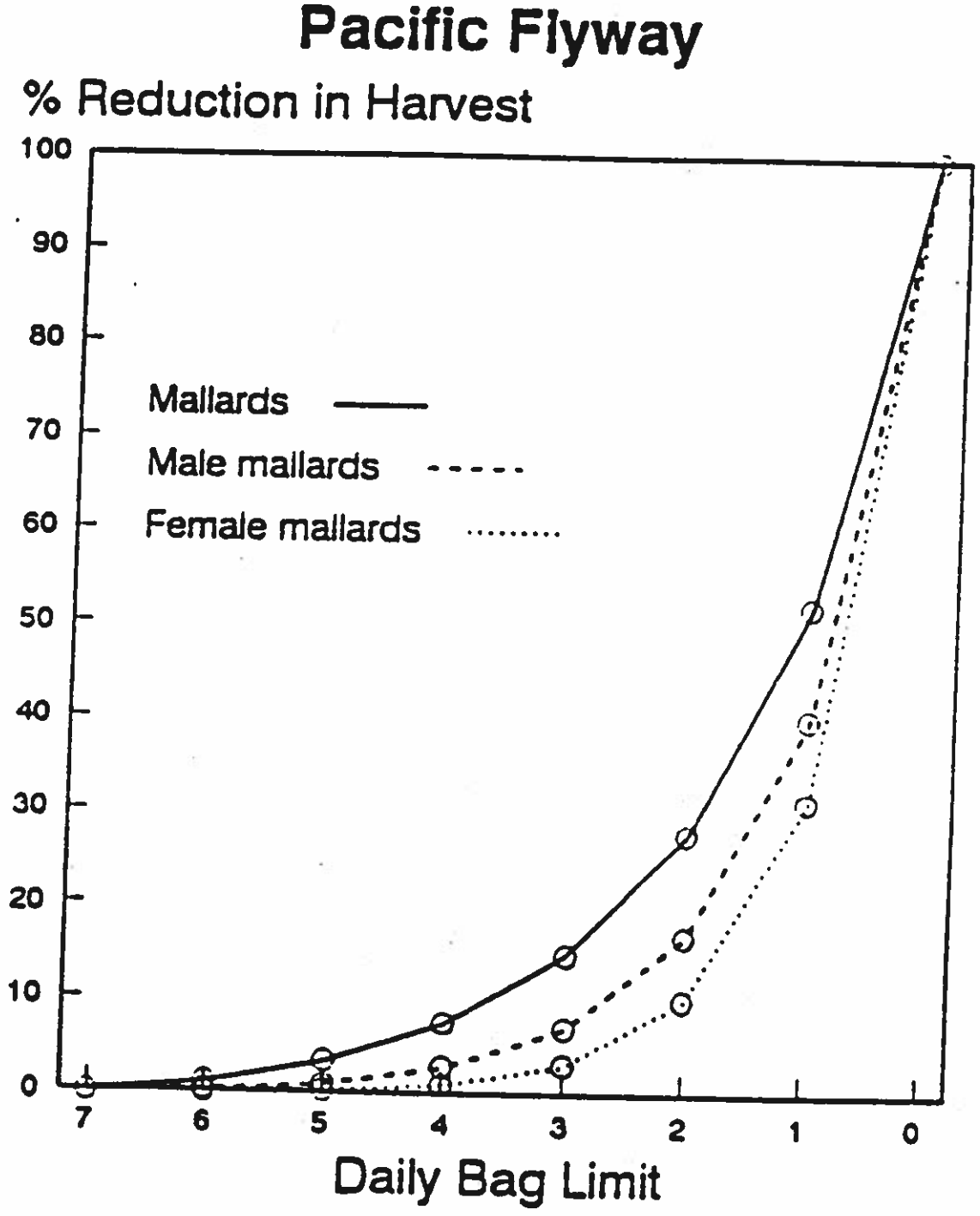


Figure 18. Age Ratios in dabbling duck harvest in the Pacific Flyway, 1990-95

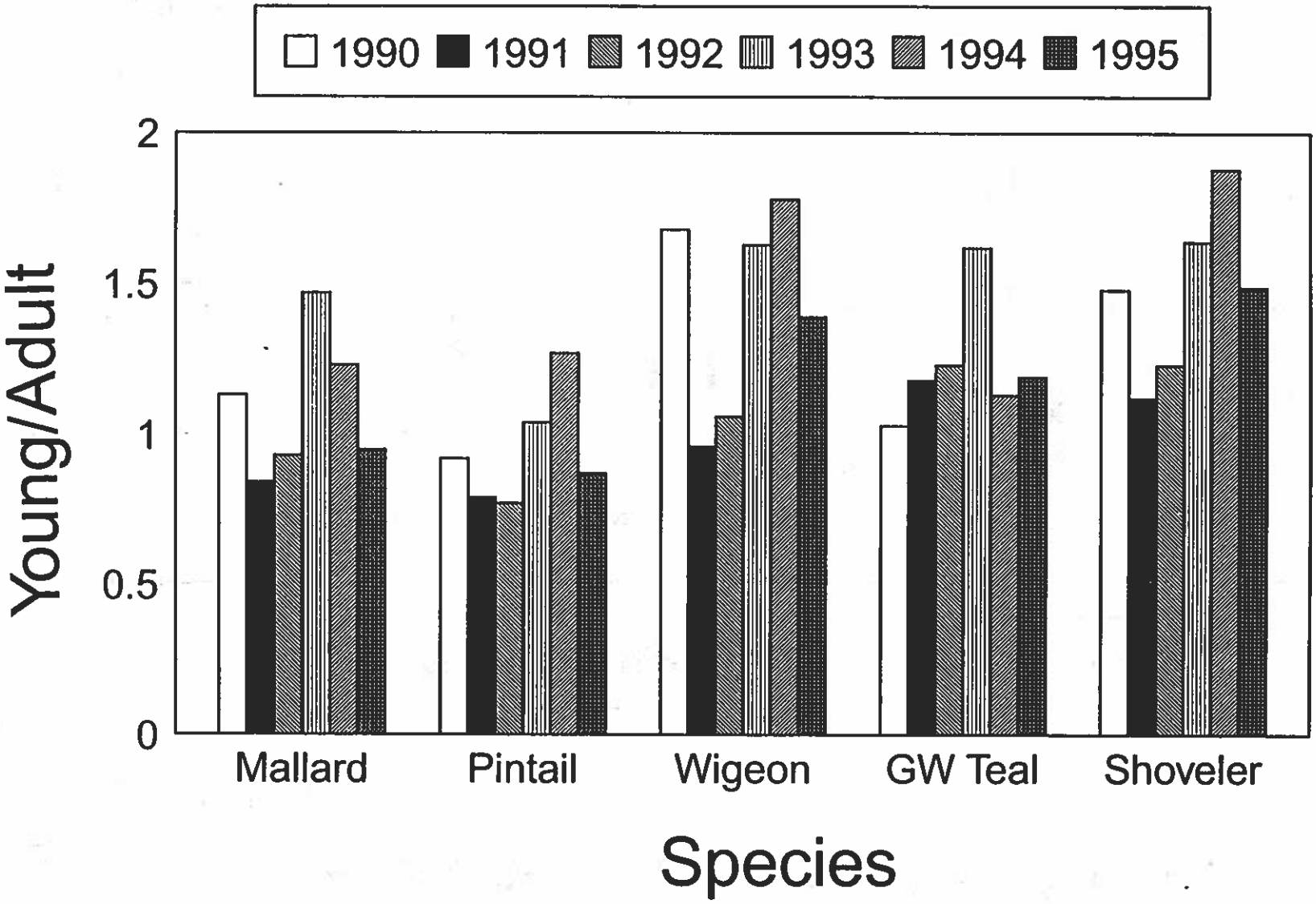


Figure 19. Departure from normal high temperature in Fall 1990-95

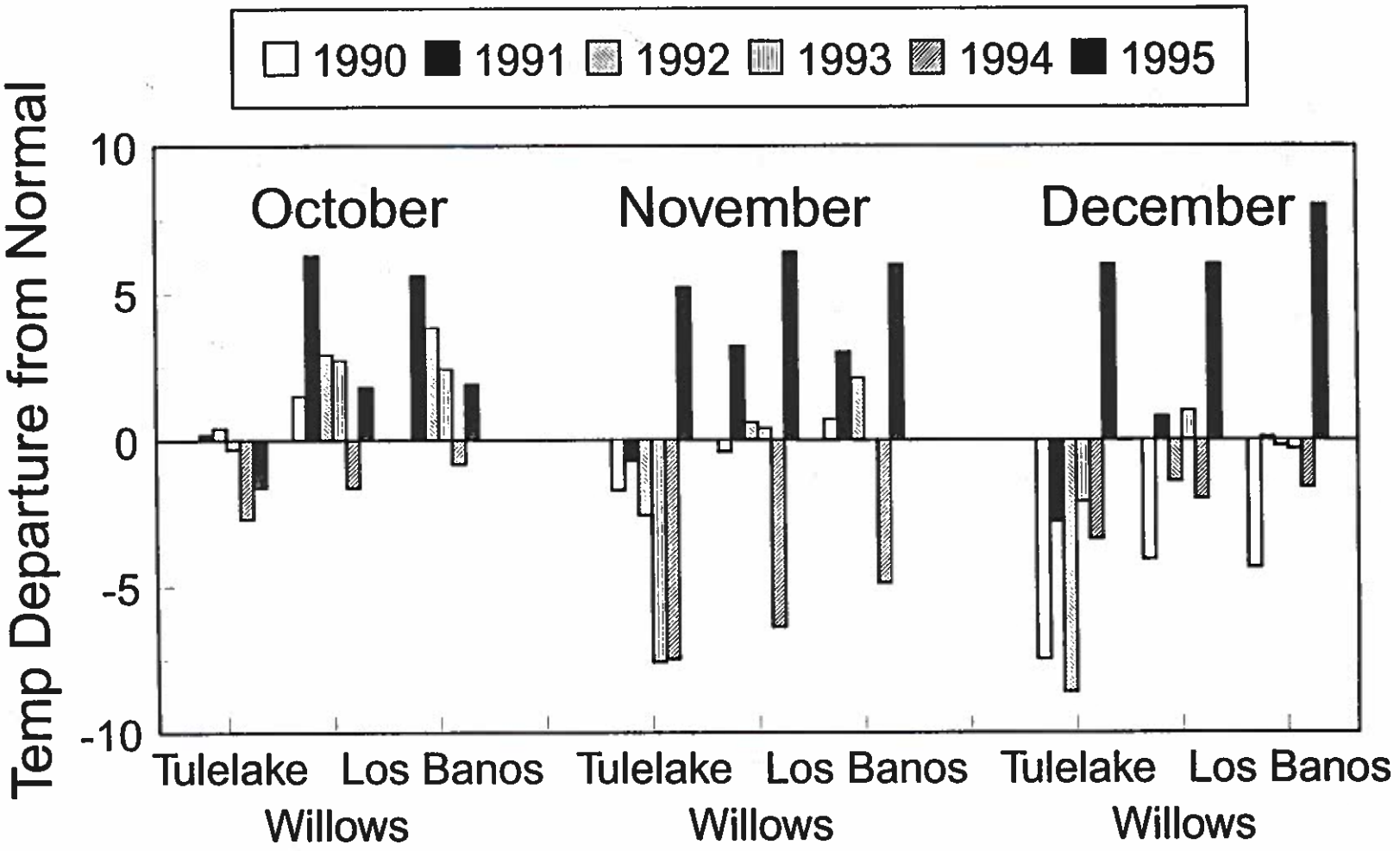


Figure 20. Departure from normal rainfall fall-winter 1995-96

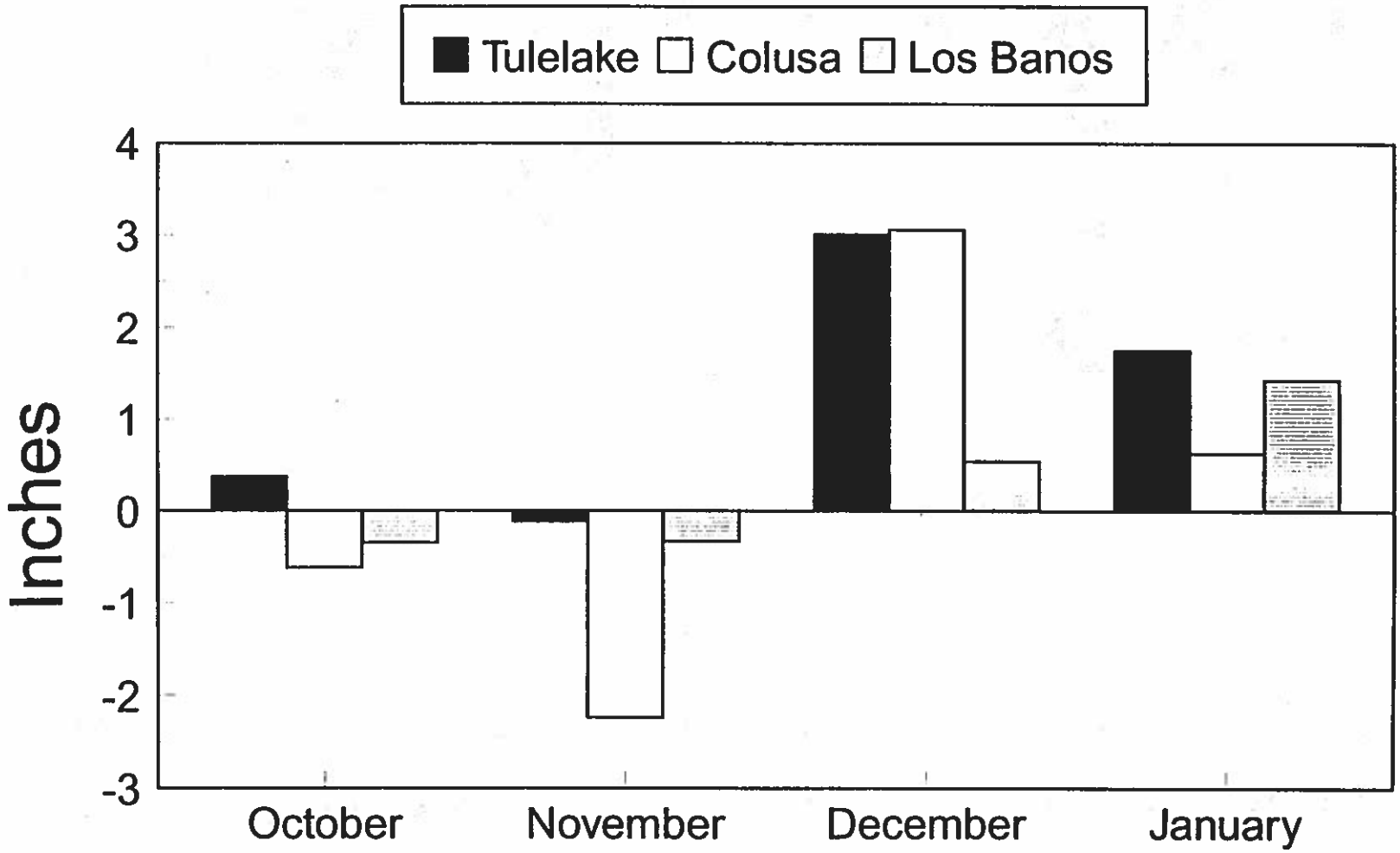


Figure 21. Number of Days During October-January in which Average Daily Windspeed Exceeded 10 mph

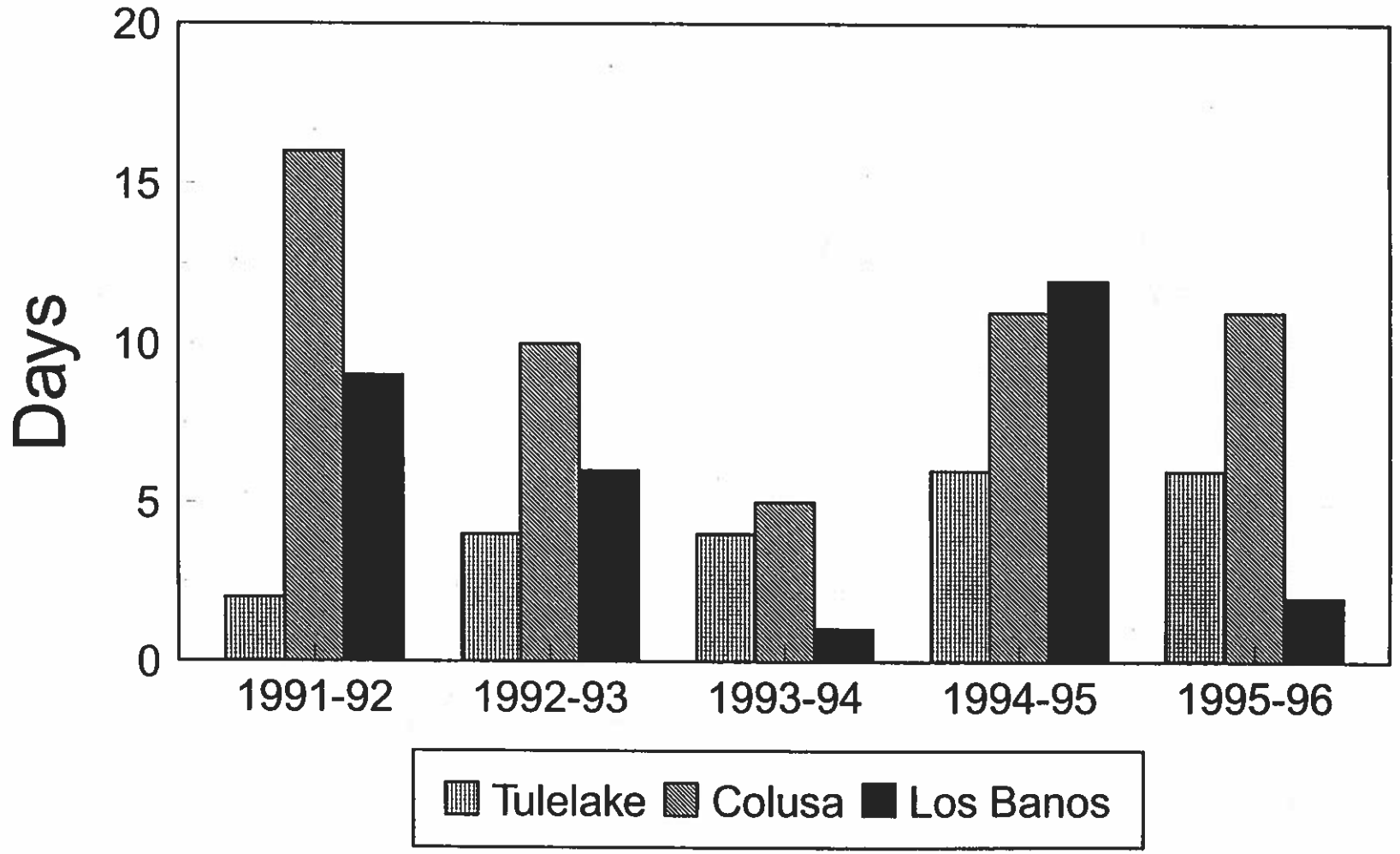


Figure 22. Comparison of midwinter waterfowl populations (MWI) and total duck harvest in California, 1961-95

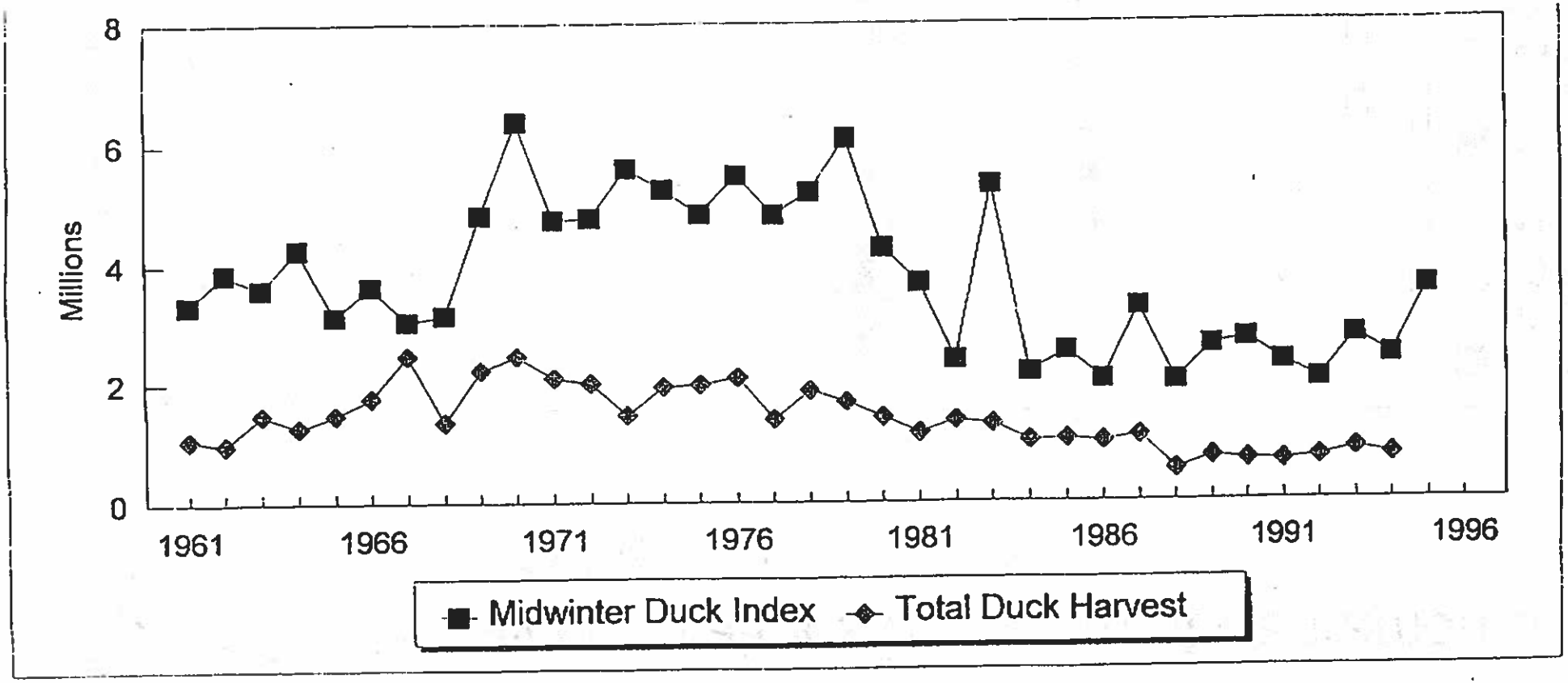


Figure 23. Pintail populations by month at Sacramento NWR Complex, 1988-89 to 1995-96

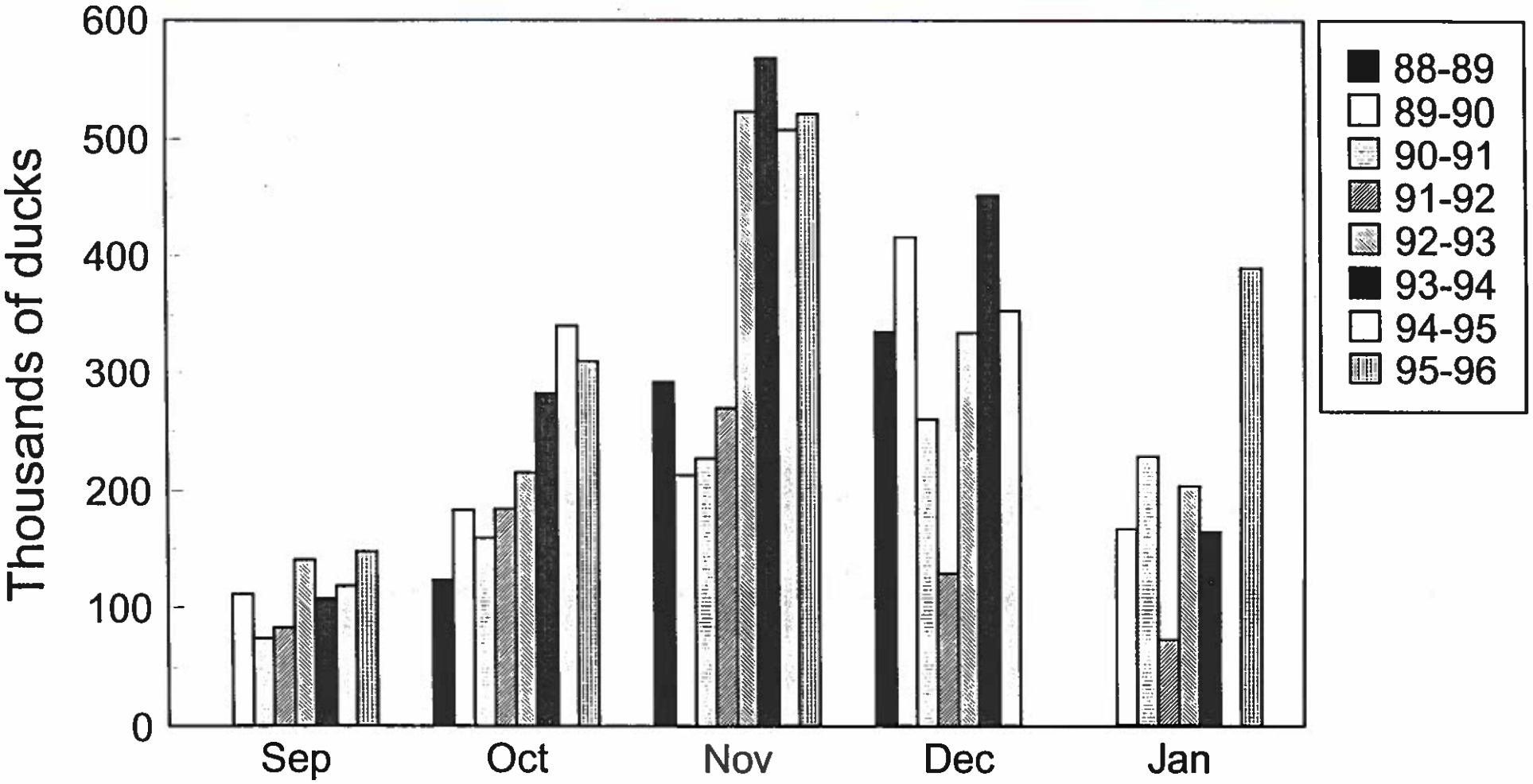


Figure 24. Mallard populations by month at Sacramento NWR Complex, 1988-89 to 1995-96

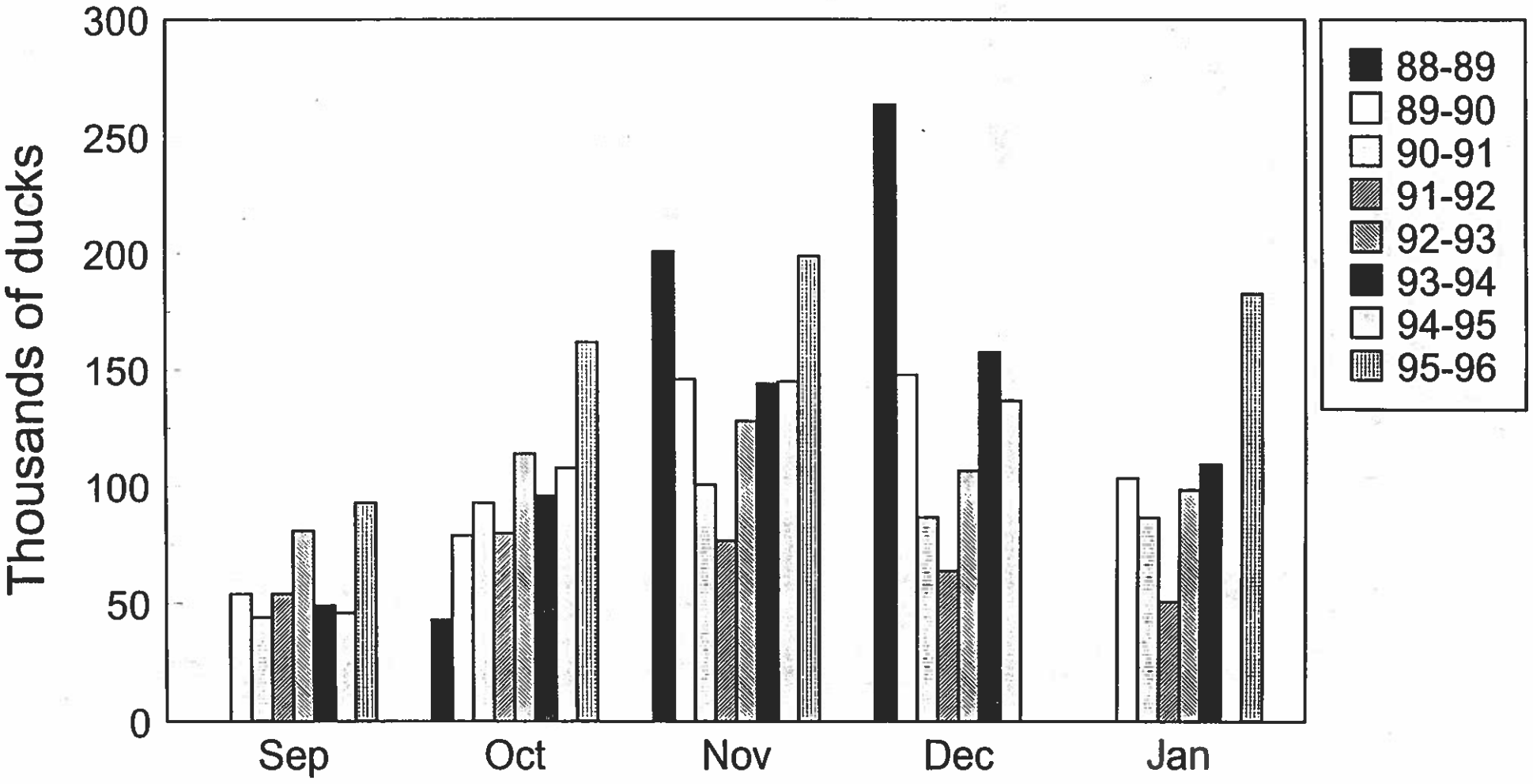


Figure 27. Percentage Distribution of waterfowl in the Grasslands based on Peak Counts by Year

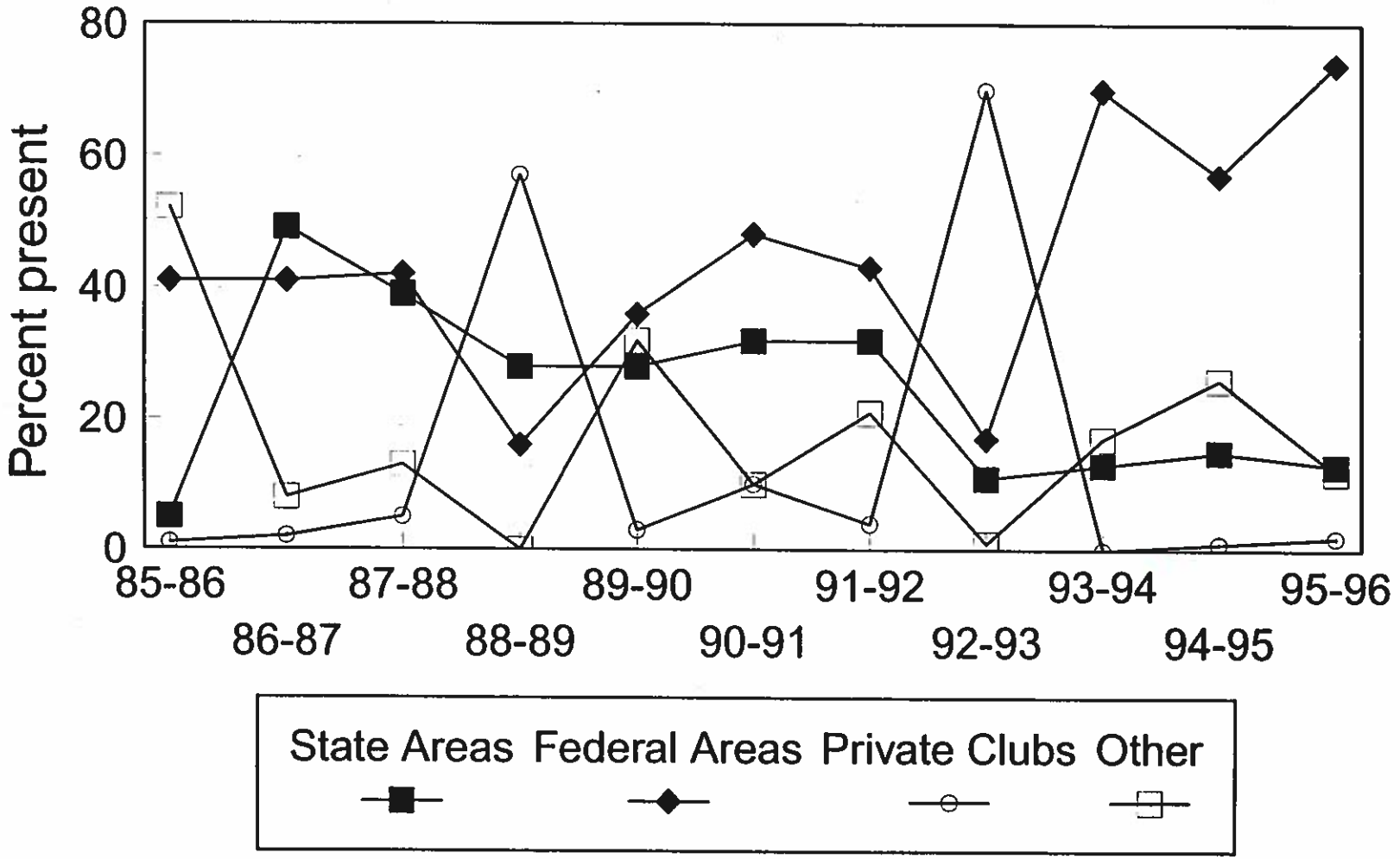


Figure 28. Percentage distribution of waterfowl in the Grasslands based on average shoot day counts by year

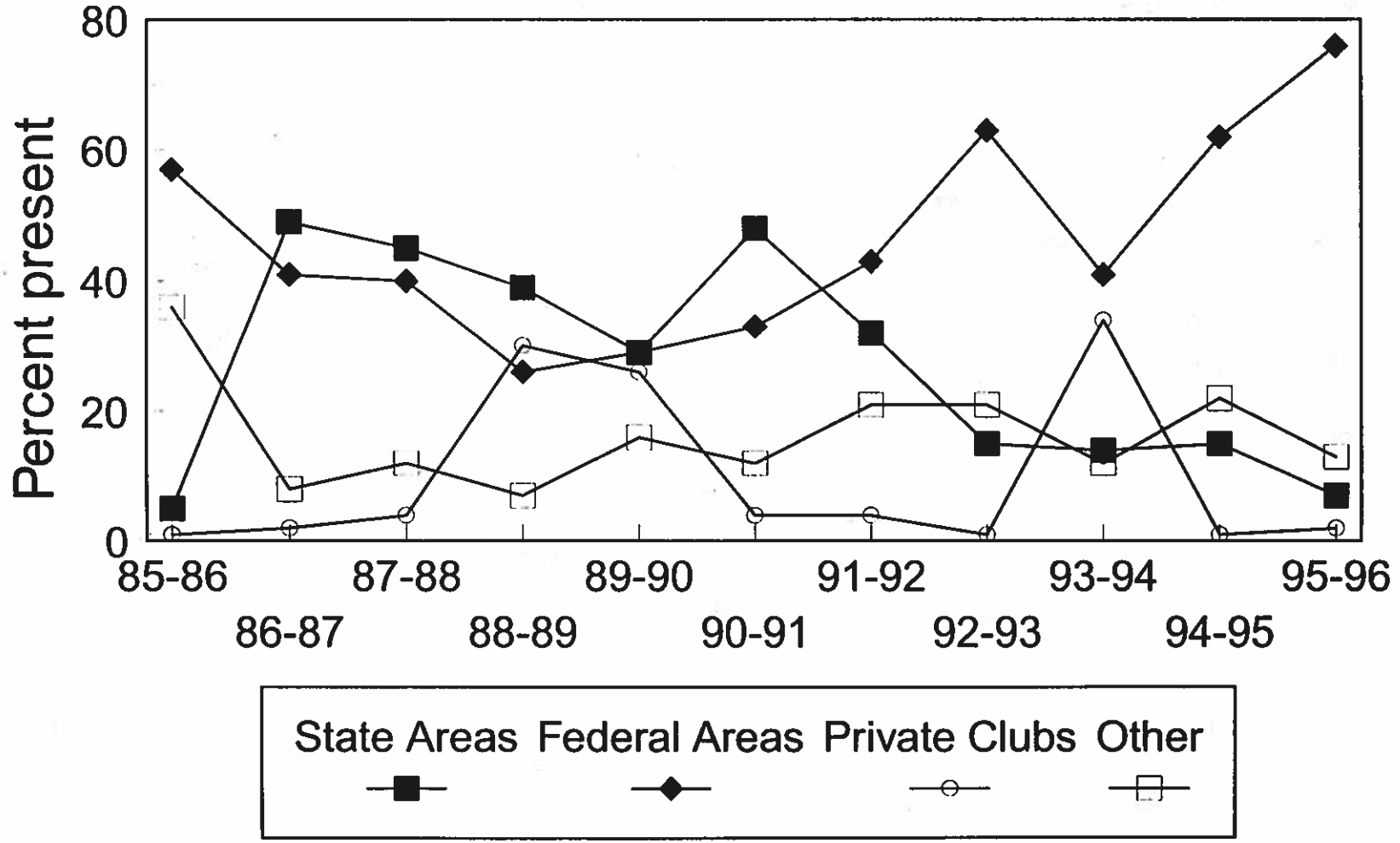


Figure 29. Percentage Distribution of Ducks on Public and Private lands in the Sac Valley based on Midwinter Inventories, 1984-1996

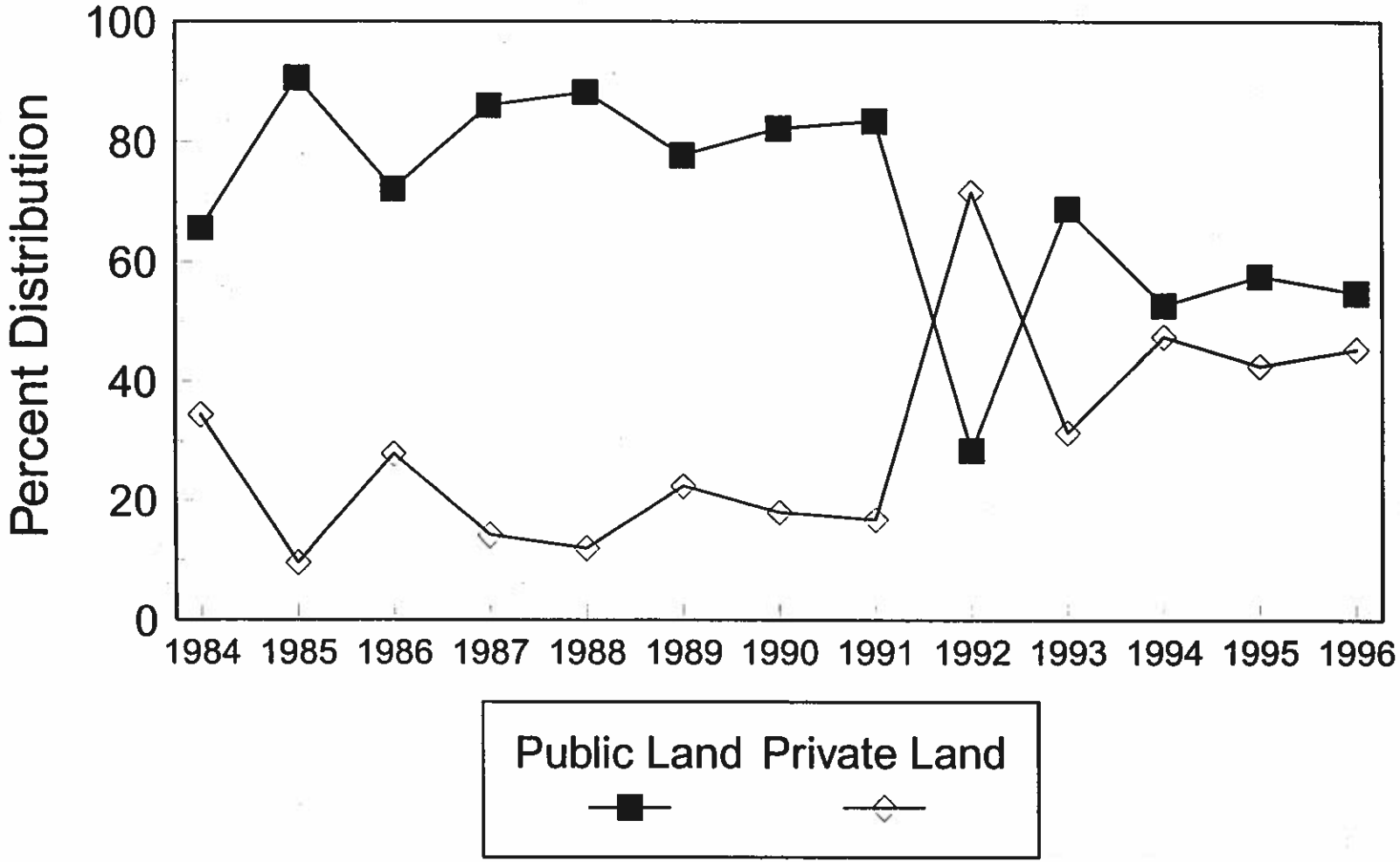


Figure 30. Regional Percentage Distribution of Ducks in California based on Midwinter Inventories, 1984-1996

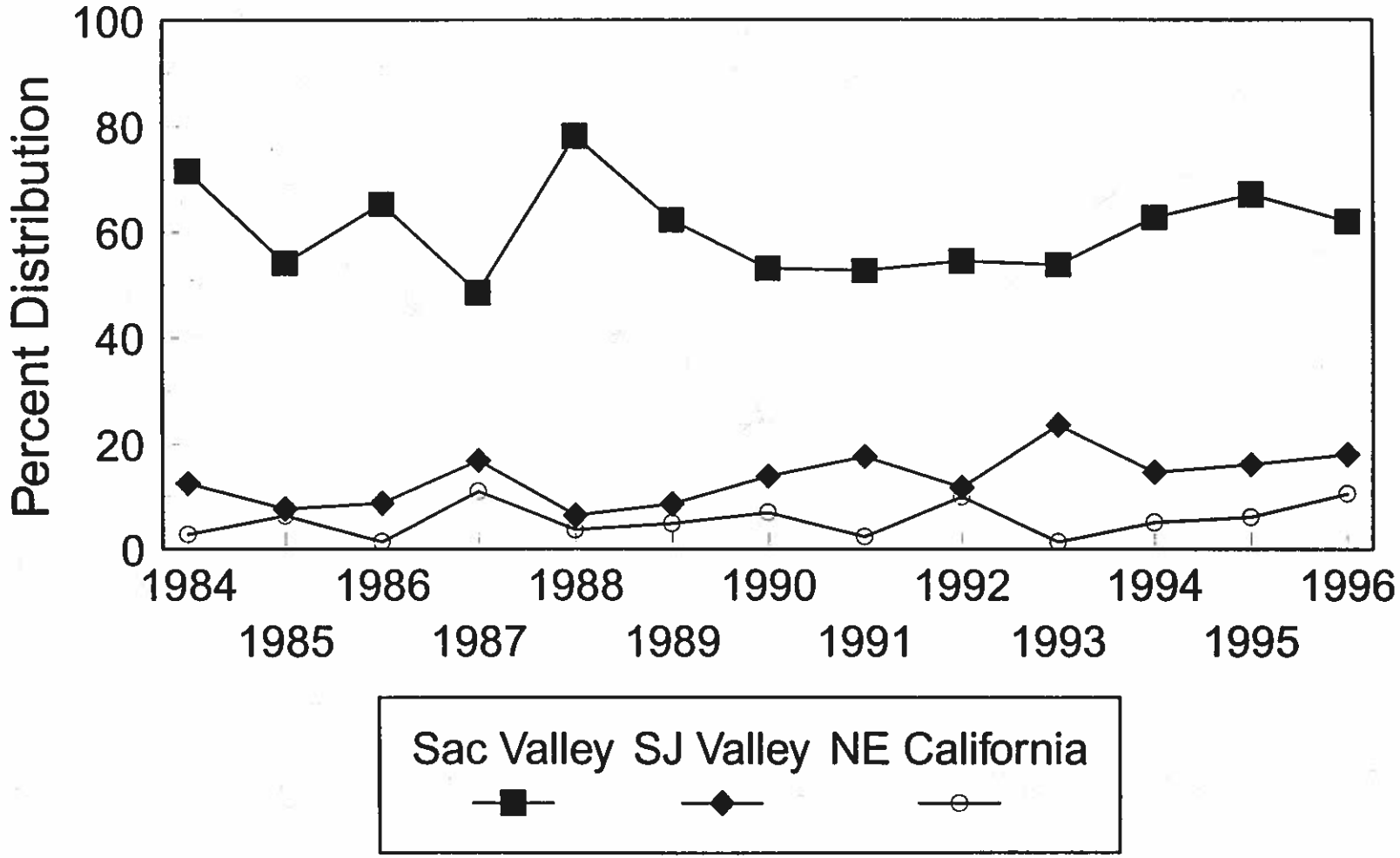


Figure 31. Proportion of ducks in the San Joaquin Valley (Midwinter Inventory)