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The Ring-necked Pheasant (Phasianus colchicus) in California: Current Status and Factors Possibly Related to Population Trends

FINAL DATA SUMMARY

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EXECUTIVE SUMMARY

This "Data Summary" summarizes information on pheasant population dynamics and factors possibly related to pheasant population dynamics in California from the mid-1940s to 2013. This report updates and expands upon information on pheasant population status provided in "Management Plan for the Ring-necked Pheasant in California" (Hart 1990) and sets the stage for a formal modeling effort to relate pheasant population dynamics in California to changes in habitat, pesticides, diseases, predators, competitors, harvest, precipitation, and other factors.

Data on pheasant abundance and possible related factors were gathered from online sources, published and unpublished reports, and by contacting staff at all state wildlife areas and federal national wildlife refuges in California as well as managers of large private land programs and others that could have pheasant data. Data were compiled by county or local area whenever possible to facilitate planned modeling and summarized in this report for a) California overall, b) the six California Department of Fish and Wildlife administrative regions (Northern, North Central, Bay-Delta, Central, South Coast, Inland Deserts), and c) specific areas (e.g., National Wildlife Refuges, State Wildlife Areas) within each region.

Pheasant population trends indexed by harvest (Annual Game Take Survey and Public Hunting Area Check Stations), state-wide (Breeding Bird Survey and Christmas Bird Count), and local (rooster crowing counts, nesting surveys, road surveys of chicks and hens, flush counts) surveys varied somewhat by index and region but for all indices and in all regions, results consistently indicate that current pheasant populations are at or near historic lows.

Numerous factors, potentially interacting and with multiplicative and compounding impacts, are possibly related to pheasant population dynamics in California. Although area of land for cropland and other agriculture did not change greatly during 1945-2013, habitat value of those lands for pheasants likely decreased as land idling decreased, farming intensity increased, and crops providing nesting or winter habitat decreased. Changes in types and amounts of pesticides applied for agriculture or human health (i.e., mosquito abatement) in response to the West Nile Virus (WNV) that first became prevalent in California in 2004, may have further reduced the carrying capacity of the California landscape by reducing invertebrate food for chicks and adults. In addition, increases in some avian predators (e.g., ravens) and competitors (i.e., wild turkeys) may have further lowered productivity of pheasants in California.

BACKGROUND

The first successful ring-neck pheasant population in the western United States was established in the Willamette Valley of Oregon in 1881. In 1889, California began introducing this strain of pheasant directly from the Oregon stock. This population was of Chinese origin and proved to be better adapted to California's climate than previously released subspecies originating from England. In an attempt to establish viable wild populations of pheasants across California, a large system of game farms used to rear pheasants for stocking was developed in the early 1900's and by the early 1950's, nearly 1 million pheasants had been planted in every county of California. The most successful pheasant introductions were associated in regions with habitats that consisted primarily of irrigated crop land (i.e., grain) within the Sacramento Valley rice belt, the Sacramento-San Joaquin River Delta, north San Joaquin Valley, and Klamath Basin in northeastern CA. Due to the success of pheasant introductions, California implemented its first state-wide pheasant hunting season in 1933, and subsequently, the ring-necked pheasant developed into a valued upland game bird in California.

The "Management Plan for the Ring-necked Pheasant in California" (Hart 1990) summarized information on population status of pheasants up through 1986. Data on pheasant population status have not been summarized since then. However, harvest survey information show that pheasant harvest has declined precipitously (Figure 1).

Numerous factors can contribute to changes in reported harvest including changes in reporting accuracy as well as changes in factors that impact pheasant populations. Thus, additional information is needed to better understand the status of pheasants in California and factors that impact their populations. To help guide pheasant management in California, we summarized all available data on the population status of pheasants in California, as well as data on a variety of factors that could potentially impact pheasant populations. In a follow-up analysis, we plan to utilize these data to model relationships of pheasant population dynamics and factors to evaluate weight of evidence for importance of each factor to California pheasant population dynamics.

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STUDY AREA

We summarized data indexing pheasant abundance and the factors possibly impacting pheasant abundance for a) California overall, b) the six CDFW administrative regions (Figure 2), and for c) specific areas (e.g., National Wildlife Refuges, State Wildlife Areas) within each region. In addition, we created databases that, when possible, were county-specific, to allow modeling of pheasant abundance and related factors in the next phase of the project. The six California regions, and major pheasant areas within each, are as follows:

1) **Northern Region -*Klamath Basin and other Northern CA*** - including Klamath Basin NWR complex (Tule Lake NWR, Lower Klamath NWR) Butte Valley WA, Shasta Valley WA, Modoc NWR, Ash Creek WA, Honey Lake WA, Humboldt Bay NWR, northwestern coastal Wildlife Areas, irrigated coastal pastures and private agricultural lands in Klamath Basin dominated by barley cultivation.
2) **North Central Region -*Primarily Sacramento Valley*** - including the Sacramento NWR Complex (Sacramento, Delevan, Colusa, Sutter, Llano Seco, Sac River units), Gray Lodge, Upper Butte Basin, and Yolo WAs, privately managed wetland and upland complexes, and rice and other agricultural lands.
3) **Bay-Delta Region - *San Francisco Bay-Suisun Marsh-Delta* -** including San Francisco Bay NWR, Grizzly Island WA, Stone Lake NWR, private Suisun Marsh ducks clubs, and agricultural and other lands throughout the Delta, Suisun Marsh and San Francisco Bay.
4) **Central Region - *Primarily San Joaquin Valley* -** including San Luis NWR and Merced NWR complexes, Volta, Los Banos, China Island, Mud Slough & other state WA units, private duck hunting lands, and grasslands, pastures and other lands in the Grassland Ecological Area, Mendota WA, and Kern-Pixley NWR and private agricultural lands in the Tulare Basin.
5) **South Coast Region –** including San Felipe Valley and Hollenbeck Canyon WA and private lands.
6) **Inland Desert Region –** including San Jacinto WA, Salton Sea NWR, Imperial WA, Private, and private lands.

METHODS

PHEASANT ECOLOGY

We searched the literature for California studies of the ecology of pheasants. We summarized information from these studies to a) provide localized information on pheasant populations, b) an understanding of factors impacting their ecology and c) help develop theories on potentially important causal factors of ring-neck pheasant population change in California.

PHEASANT POPULATION STATUS

We gathered, compiled, and summarized existing published reports, unpublished reports, and data sets on population status of ring-necked pheasants in California. We contacted managers or biologists at all state wildlife areas and federal national wildlife refuges, managers of large private land programs, and others that could have pheasant data. We synthesized existing information to determine and summarize statewide, regional (e.g., Northern Region, Central Region), and local (e.g., Mendota WA) pheasant population status and trends. These indexes or indicators of pheasant population status are described below:

Harvest and Hunter data

We obtained harvest and hunter data from two sources: a) The *Annual Game Take Survey (AGTS)* and b) *Public Hunting Area Check Stations*. The *AGTS* is an annual statewide mail survey that has been conducted since 1948 and provides data on annual harvest, hunters and hunter success (harvest/hunter) by county. The survey (Appendix 1) is mailed to approximately 10 - 12% of licensed hunters in California. Generally 20 - 25% of those receiving survey forms submit harvest information to the California Department of Fish and Wildlife, representing 3 – 5% of licensed hunters in CA (Hart 1990). During the survey period 1948-1980, harvest of wild pheasants was not separated from game farm pheasants in annual harvest summaries. In 1981, the survey requested hunters to submit only numbers of wild pheasants harvested. Beginning in 1992 the AGTS requested that hunters report their harvest of game farm pheasants separately from their harvest of wild pheasants and game farm and wild pheasant harvests were summarized separately. *Public Hunting Area Check Stations* provided data on daily harvest, hunter numbers, and average bag per hunter (i.e., hunter success). Although most hunters entering Public Hunting Areas focus their harvest effort on ducks, when calculating hunter success, we assumed any hunter entering a Public Hunting Area during pheasant hunting season could harvest a pheasant if encountered and thus was a pheasant hunter. Thus, unlike for the AGTS, hunter numbers reported from Public Hunting Area check stations do not differentiate between duck and pheasant hunters. As a result, unlike AGTS, where numbers of pheasant hunters decline as abundance of wild pheasants decline, on Public Hunting Areas, hunter numbers are mostly unrelated to abundance of wild pheasants and average pheasant bag (i.e. average pheasant bag = total pheasant kill / total hunters) varies more directly with pheasant abundance (i.e., likelihood of a hunter encountering and harvesting a pheasant varies directly with hunter abundance). Harvest data were provided by 6 National Wildlife Refuges (NWR) and 15 state Wildlife Areas (WAs) in California. Harvest data from NWR's included: Sacramento NWR Complex (1955-1962; 1987-2012), San Luis NWR Complex (1987-2012), Imperial NWR (1987–2012), Kern NWR (1987-2012), and Sonny Bono Salton Sea NWR (1998-2012). Harvest data from state WAs included: Ash Creek WA (1987-2012), Butte Valley WA (1987-2012), Honey LakeWA (1987-2012), Shasta Valley WA (1987-2012), Willow Creek WA (1987-2012), Upper Butte Basin WA (1987-2012), Gray Lodge WA (1953-2012), Yolo WA (1997-2012), Grizzly Island WA (1955-2012), Volta WA (1987-2012), North Grasslands WA (1990-2012), Los Banos WA (1987-2012), Mendota WA (1987-2012), San Jacinto WA (1987-2012), and the Lake Perris State Recreational Area (1987-2012).

Breeding Bird Survey

The Breeding Bird Survey (BBS) was developed in 1965 and became fully operational in 1968 (Sauer et al. 1997). Currently, there are over 3,700 BBS routes across the continental US and Canada, of which nearly 3,000 are surveyed annually. There are currently 228 BBS routes in California. Routes are randomly located in order to sample habitats that are representative of the entire region. Surveys are conducted during the peak of nesting season (primarily May in California). Each route is 24.5 miles long, with a total of 50 stops located every 0.5 mile interval along the route. At each stop a three-minute point count is conducted and observers record all birds heard or seen within 0.25 mile of the stop. Data from each stop are then totaled over the entire 50 stop route. Data are used to produce an index of abundance rather than a complete count of breeding bird populations. The BBS has become the primary source of long-term, large scale population data for more than 400 North American Breeding Bird Species (Ziolkowski et al. 2010). We present both total birds counted, and because the number of California routes completed each year varied somewhat, average birds per route.

Christmas Bird Count

The Christmas Bird Count (CBC) is the longest running volunteer survey in the world. The survey has occurred annually since 1900 and is conducted during 14 December– 5 January. Survey sampling units consist of nearly 2,400 designated "count circles", (each 15 miles in diameter, located throughout North America. A minimum of 10 observers record all birds seen within designated "count circles". Data is submitted to the National Audubon Society where it is compiled and summarized in Audubon's CBC database (National Audubon Society 2010. The Christmas Bird Count Historical Results [online]. Available http://www.christmasbirdcount.org [2014]). When combined with BBS data, the CBC data provides evidence of how bird populations have changed in time and space over the past 100 years. Although pheasants are not highly visible, and CBC count precision for the species is likely low, the CBC is still likely a reliable index to large scale population changes. Similar to the BBS, the number of routes surveyed each winter varied over time so we present both total birds counted and the average number of birds counted per route.

Pheasant (Rooster) Crowing Counts

Rooster pheasant crowing counts are generally conducted in April and May as roosters establish harems and defend territories prior to nesting season. The counts can be used to determine peaks in breeding activity and may be effectively used as an annual index to follow trends in breeding populations (Kimball 1949, Rice 2003). Observers conduct counts on pre-established routes approximately 30 – 45 minutes before sunrise. Route lengths vary but should be long enough to obtain a representative sample of the selected regions pheasant population. Observers listen on average 3 minutes at stops spaced far enough apart to limit crowing count duplication (~ 0.5 mi interval). Surveys are conducted only during good weather conditions (e.g., wind speed < 10mph; no precipitation).

The earliest crowing count surveys used to monitor pheasant populations in California were conducted by CDFW for many years during the 1950's (Hart 1990). Unfortunately, these records are unavailable. We have however obtained, and summarize pheasant crowing count data from areas in 4 California regions. These include A) Northern Region: Copic Bay 1996 - 2004, Lower Klamath and Tule Lake NWR 1996 - 2004, Butte Valley WA 1990 – 2006, and Honey Lake WA 1997 – 2001, 2012; B) North Central Region: Upper Butte Basin WA (i.e., Llano Seco, Howard Slough, and Little Dry Creek Units) 1993 – 1996, 2012 – 2013, and private lands enrolled in the Conservation Reserve Enhancement Program (CREP; administered by the Farm Services Administration and Natural Resources Conservation Service. Lands enrolled in this program were agricultural fields that were committed to be removed from cultivation for 10 years. Fields ranged in area from 12 acres to 174 acres and were either fallowed, planted with a cover crop, or with a native plant seed mixture. Surveys were conducted at 6 different properties in Colusa and 6 different properties in Yolo Counties) 2004 – 2005; C) Bay Delta Region, including: Grizzly Island WA 1956 – 1959, 1989 – 2013; and D) Central Region, including western Fresno County 1971 – 1998 (paired 14-mile transects along the California Aqueduct comparing pheasant use of planted strip habitat vs. control [non-planted] areas), and Mendota WA 1991 – 2013. We were unable to locate pheasant crowing count data from the South Coast Region and the Inland Deserts Region.

Nesting Surveys

Nest searches were conducted at Honey Lake and Ash Creek WAs (1987 – 1988) and Tule Lake NWR (1988) in the Northern Region, at Colusa NWR (1987 - 1988, 2003 – 2005, 2011), Delevan NWR (1987 – 1988, 2011), Gray Lodge WA (1987 – 1988), and private land (fallow rice ground vegetated by weedy annual grasses and forbs, fields planted with a cover-crop [primarily vetch based seed mixtures], fields planted with cereal grain crops [winter wheat, oat], and fields planted with native grass mixtures) associated with Sacramento Valley rice cultivation (1990 – 1991, 2002 – 2006, 2008 – 2011) in the North Central Region, at Grizzly Island WA (1987 – 2012) in the Bay Delta Region; and at Mendota WA (1988 – 1991) in the Central Region.

The primary technique used to discover nests during these surveys included the use of a rope-drag pulled by 4-wheel all-terrain vehicles through selected upland habitats. Nests would be located by marking the site in which a sitting hen flushed as the rope passed over her. The technique was developed by Klett et al. (1986) for use during waterfowl nesting studies in the Prairie Pothole Region and modified by McLandress et al. (1996) for use in California habitats. However, because pheasants exhibit a much higher nest attentiveness rate compared to nesting ducks, this technique greatly underestimates pheasant nest density (because pheasant hens rarely flushed off nests from the rope disturbance; or pheasant hens walk off nests undetected and flush away from nest site). While these data do not provide precise estimates of pheasant nest density they do serve as an index of population changes over time and differences among regions.

Road Surveys

Roadside (or strip) surveys are generally initiated in June following the earliest observations of newly hatched pheasant broods. These surveys are conducted on established routes (often the same routes used during earlier spring crowing count surveys) by two individuals (one observer and one recorder) during late afternoon. Information recorded includes numbers and estimated age of chicks in broods observed, and numbers of hens with and without broods. Counts should not be made in inclement weather (i.e., wind should not exceed 10 mph, not conducted during rain). Surveys provide data on hen density, brood density, and chicks per hen. Thus, brood counts provide managers a measure of seasonal production that may be used to broadly predict the upcoming fall harvest in a given area (Hart 1990, Rice 2003).We obtained and summarized roadside survey data that was collected from areas in four regions including the a) Northern Region: Tule Lake Basin, Morgan Ranch, Cook Ranch, Surprise Valley, Tule Lake NWR, Lower Klamath NWR (1963, 1968 – 1969; not all years contain data from all areas, all areas surveyed were in Modoc and Siskiyou Counties), and Honey Lake WA 1973 - 1994; b) North Central Region,: Sacramento Valley Co-op properties (1961 – 1962), Gray Lodge WA (1956 – 1981), Upper Butte Basin WA (1993 – 1995, 2012 – 2013), and Sacramento NWR Complex (1988 –

2012); c) Bay Delta Region: Grizzly Island WA (1957 – 2013); and d) Central Region: Merced NWR (1973 – 1994), Mendota WA (1955 – 2013), North Grasslands WA (Salt Slough and China Island Units 1994 – 2006), Los Banos WA (1956 – 2002), and routes followed in the Merced Area (1967 – 1994), Oakdale Area (1967 – 1994), and Madera Area (1961 – 1976). We were unable to obtain pheasant roadside survey data from the South Coast Region and the Inland Deserts Region.

Flush Counts

Pheasant flush counts are used to determine age and sex ratios of local pheasant populations. Flush counts are conducted after juvenile pheasants have become independent of hens (8 – 9 weeks of age) but can still be identified as juvenile using plumage characteristics (e. g., tail feather shape). In California, this time period generally occurs during the first two weeks of August (Hart 1990). Flush counts are conducted by a team of about 2 – 4 observers, systematically moving through the selected upland field between 0900 – 1500h. Age, sex and number of pheasants flushed are recorded and summarized by site.

We obtained and summarized pheasant flush count data that were collected from the a) Northern Region: Tule Lake NWR (1960 – 1968); b) North Central Region: M&T Ranch (2002-2004 [private], Upper Butte Basin WA (2—2-2008), Gray Lodge WA (2005 – 2008), Yolo Bypass WA (2003 – 2004), and private lands enrolled in the Conservation Reserve Enhancement Program (CREP) located in Solano, Yolo, and Colusa Counties (2002 – 2005); c) Bay Delta Region: Grizzly Island WA (2001 – 2005); and d) Central Region: Los Banos WA (2003 – 2004), North Grasslands WA (2003 – 2004), and Mendota WA (2003 – 2004).

FACTORS POSSIBLY RELATED TO PHEASANT POPULATION DYNAMICS

We used on-line and other sources to identify, gather, and compile by county, and summarize by region, existing information on factors hypothesized to impact or be related to pheasant population dynamics in California. These factors are outlined and described below.

Landscape Changes

We used United States Department of Agriculture (USDA) census data (USDA 2014a) and crop data (USDA 2014b) to categorize land use practices by area or management that may affect nesting, brood rearing, or wintering habitat for pheasants or their predators. We also included land use practices that likely provide no benefit or may have negative impact on pheasants (by replacing land uses that are more beneficial to pheasants, providing habitat for predators, or attracting nesting pheasants to where they have low success or high mortality). State-wide land use practices over the period 1945 – 2007 are categorized as cropland used for pasture, cropland used for crops, cropland idled, and special use lands. Special Use Lands include those associated with defense and industrial land use, rural parks and wildlife areas, rural transportation, and miscellaneous farmland. We summarized regional crop acreages that may provide nesting habitat including: winter wheat (1945 – 2013), spring wheat (1974 – 2013), barley (1954 – 2013), oats (1974 – 2011), seed vegetation (i.e., rye grass, alfalfa, clover, sudan grass, vetch, other; 1980 – 2012), and lands enrolled in the Conservation Reserve Program (1986 – 2013). Regional land use practices that may provide wintering/foraging habitat include: rice (1953 – 2012), corn (1959 – 2012), sorghum (1972 – 2008), and safflower (1980 – 2012). Regional land use of cover types that provide no benefit or may have negative impact on pheasants include: grapes (i.e., raisin, table, wine, unspecified; 1980 – 2012), nut trees (i.e., almonds, pistachios, English, black walnuts; 1980 – 2012), fruit trees (i.e., apples, apricots, cherries, citrus unspecified, dates, figs, grapefruit, kiwi fruit, lemons, nectarines, olives, oranges, peaches, pears, plums, prunes, tangelos, tangerines/mandarins; 1980 – 2012), cotton (1980 – 2012), sugar beets (1975 – 2012), and hay (i.e., alfalfa, grain, green chop hay, wild hay; 1980 – 2012).

Pesticides

Pesticides applied to the landscape for agriculture or mosquito abatement that can impact pheasants and/or their foods. We provide a description of use trends over time for various classes of pesticides and summarize county-specific data (total pounds applied annually) from the California Department of Pesticide Regulation (http://www.cdpr.ca.gov) by region for: a) public health (i.e., mosquito abatement) chemicals, b) neonictonoids and other selected insecticides, and c) all pesticides combined.

Predators

Predation of nests, chicks, and adults may be an important factor limiting pheasant populations. Numerous species of birds and mammals in California have been identified as predators of pheasant adults, chicks, or eggs. A variety of reptiles, primarily snakes, have also been identified as egg predators. We summarized BBS and CBC data to index abundance of potential avian predators. We entered and summarized data from annual CDFW Licensed Fur Trappers' and Dealers' Report as an index of abundance for specific mammalian predators.

Disease

A variety of diseases are known to kill or negatively impact birds, including pheasants and their avian predators (Friend and Franson 1999). Types and prevalence of diseases, and especially any new diseases could increase mortality or increase pesticide spraying for disease vectors that could reduce pheasant food supplies. We summarized information on prevalence of selected diseases (e.g., West Nile).

Competitors

Wild turkeys have reportedly been observed chasing pheasants and interfering with attempts by roosters to attract hens. We summarized AGTS, BBS and CBC data to index abundance of wild turkeys in California.

Weather

Weather, especially precipitation, has been correlated to annual variation in abundance of some avian species. Precipitation can impact growth, productivity, and survival of vegetation and insects and thus the availability of pheasant foods (insects and seeds), egg hatchability, and survival of nests, chicks (and in extreme cases) adults. We obtained and graphed precipitation data from one weather station in each of the six California region (Northern: Tulelake, North Central: Willows, Bay-Delta: Vacaville, Central: Los Banos, South Coast: Palmdale, Inland Desert: Victorville, http://www.ipm.ucdavis.edu/WEATHER/index.html). We summed annual precipitation from all these stations to provide an index of annual statewide precipitation.

Hunting Pressure

Varying levels of hunting pressure and harvest may be related to pheasant population dynamics. In addition to summarizing annual harvest and numbers of pheasant hunters estimated by the AGTS and the harvest and numbers of hunters tallied at individual Public Hunting Area check stations, we summarized harvest regulation (i.e., bag limit and season duration) data available from the CDFW website and files.

Licensed Game Bird Clubs and Pen-reared Pheasants

Licensed game bird clubs and the pen-reared (game farm) pheasants they release could impact wild pheasant populations through competition (by clubs and released pheasants) for habitat and resources, interbreeding and increasing susceptibility to disease, or buffering the effects of predators or harvest. We summarized information on licensed game bird clubs collected by CDFW, some of which was previously summarized in the 1990 Pheasant Management Plan (Hart 1990).

RESULTS

CALIFORNIA STUDIES OF PHEASANT ECOLOGY

Pheasant ecology was studied in the North Region (Klamath Basin), North Central Region (Sacramento Valley), Bay-Delta Region (Suisun Marsh), and Central Region (Mendota WA) using radio telemetry.

North Region (Klamath Basin) (Grove et al. 1998, 2001). Pheasants were radio tracked at Tule Lake NWR and Lower Klamath NWR in 1991-92 and 1992-93. Pheasants were in poorer condition, a lower proportion of hens nested, nest success was lower, fewer young per hen were produced, and annual survival was lower in the more intensively farmed Tule Lake NWR than at Lower Klamath NWR. Mammals were responsible for 62%, birds 26%, and fire, flood and farming 12% of the failed initial nests of radiotagged hens. Adult mortalities were due to Golden Eagles (53%), winter kill (14% but 35% suspected during 1992-93), mammals (17%), northern harriers and unknown raptors (10%), avian tuberculosis (3%), and machinery-roadkill (3%). No direct mortalities of adults were detected from organophosphorus insecticide but 68% of the adults tested exhibited brain cholinesterase inhibition; 2 young pheasants were killed by direct insecticide toxicity but no young were radiotagged so extent of mortality is unknown. The loss of insects killed by insecticide use may have contributed to food shortages of young pheasants, indirectly influencing survival.

North Central Region (Sacramento Valley) (Ramey et al. 2000, 2004). Wild (some were trans-located before release) and pen-reared pheasants were radio tracked mid-September to mid-November at two Sutter County sites to evaluate potential impacts of rodent bait poisons. Survival during the 9-week study was lower for pen-reared (28%) than for wild pheasants (62%; but all wild mortalities were trans-located birds, none released at capture field died). Most mortality was due to avian or mammalian predation with pen-reared pheasants more vulnerable to predation than wild pheasants. Baits lost substantial potency (>30%) during their exposure to field conditions after 24 hours; no baits were found in pheasants, and no pheasants died as a result of the baiting.

Central Region and Bay-Delta Region (Mendota Wildlife Area, Suisun Marsh) (Brueggemann and Hart 2003, Hart et al. 2009, Feldheim 1999). Based on the following results from a radiotracking study (1990-94) and other research, the authors concluded that poor chick survival due to lack of insect foods is likely limiting pheasant populations in California:

-Planting dense nesting cover did not increase nesting or production.

-Home range of hens in spring was 10-43 acres.

-Wetland edges not selected for brood rearing.
-Mar to Aug hen survival was 53-63%, annual survival about 40%.
-Nesting success high (81-87%) with 11% depredation.
-Only 16-19% chicks survived 5 weeks (vs. 29-57% in Midwest; >25% needed)
-Recruited young to fall was low 1.2 per brood (less than needed for stable pop).
-Most chick mortality occurred when dependent on insects and other arthropods.
-Chick survival inversely related to brood range (if no fool lots of travel searching).
-Moist sites contained high density of insects compared to dry sites
-Wet springs often associated with increased pheasant populations and harvest
-DUHU increased pheasant harvest

PHEASANT POPULATION STATUS

Harvest Trends-AGTS and Public Hunting Area Check Stations

Annual data were available on total harvest (i.e., total bag), numbers of hunters, and hunter success (average bag = total bag/total hunters) from the AGTS and a variety of individual public hunting area check stations.

Based on the AGTS, state-wide pheasant harvest declined greatly, but with a concurrent decline in pheasant hunters, average bag per hunter has stayed relatively steady during 1948-2012 (Figure 1). Total annual pheasant harvest in California was consistently greater than 500,000 birds in the 1950's and 1960's, peaking in 1963 with an estimated harvest over 800,000. Following severe drought conditions in 1971-1972 California's pheasant harvest in 1972 was the lowest recorded in 22 years. Though a modest rebound was reported in 1973 -1974, state-wide pheasant harvest again declined and during 1976-1980 remained near 1972 levels. Reported state-wide harvest declined further in 1981, when the AGTS methodology changed by asking hunters to report only wild pheasants harvested. After a slight rebound in 1983, state-wide harvest has declined steadily since, and for the most recent 5-year period, has fallen to well below 100,000 birds (Figure 1). Number of pheasant hunters tracked pheasant harvest and annually approached 300,000 in the late 1960's. As with pheasant harvest, hunter numbers started to decline in mid-1970 and this negative trend has continued through the last 40 years. The most recent estimate of the number of pheasant hunters in California was under 28,000 (2010 hunting season). With hunter numbers and pheasant harvest declining in concert, average bag per hunter over time has remained fairly stable (Figure 1).

Annual trends in pheasant harvest, hunter numbers (Figure 3), and average pheasant bag estimated varied somewhat among regions and areas within those regions.

Northern Region (Region 1): The majority of pheasant harvest in the Northern Region occurs in the northeastern counties of Shasta, Siskiyou, Modoc, and Lassen which also includes the Klamath Basin, which supports the highest pheasant populations in the region.

Based on the AGTS, pheasant harvest in the Northern Region was greatest through the late 1940s and 1950s averaging between 40,000 – 50,000 birds annually. Harvest decreased in the early 1960s and stabilized through the mid 1980s at about 35,000 birds annually. After 1983, pheasant harvest dropped to below 20,000 birds and has been consistently less than 10,000 birds over the last 25 years (Figure 4).

Hunter check station harvest data was collected at Honey Lake (Dakin Unit: 1987 – 2013, Fleming Unit: 2003-2013), Shasta Valley (1993 – 2013), Ash Creek (1987 – 2013), Butte Valley (1987 – 2013), and Willow Creek (1989 – 2013) WAs. Harvest and hunter numbers in this region are notably lower than for those in the North Central, Central, and Bay-Delta regions. The greatest pheasant harvest in this region occurred on the Honey Lake WA. On the Dakin Unit of Honey Lake WA pheasant harvest was greater during 1987-1999 (range = 141-484) than during 2000-2013 (range = 12-148, Figure 5A). Hunters visiting Honey Lake's Dakin Unit declined since 1996 (Figure 5B) but their average bag generally tracked total harvest and was greater during 1987-1999 (range = 0.09-0.37) than during 2000-2013 (range = 0.03-0.15, Figure 5C). On Honey Lake's Fleming Unit during 2002-2013, total pheasant harvest and average bag mostly tracked each other whereas total hunters ranged from 402-803; each value peaked in 2006 and was at or near its lowest levels in 2013 (Figure 6). On Shasta Valley WA, total pheasant harvest was >200 (peaked at 313) during 1994-1998 but declined to <200 thereafter (Figure 7A); average bag generally tracked harvest whereas hunter numbers showed no consistent trend and peaked in 2013 (Figure 7). Few pheasants were harvested on Ash Creek WA before 1996, and thereafter, total bag and average bag varied annually with no consistent trend; hunter numbers increased after 1995 with no consistent trend through 2013 (Figure 8). Few pheasants were harvested on t Butte Valley (high year: 1997, 23 birds, Figure 9) or Willow Creek (6 pheasants shot in 1996; Figure 10).

North Central Region (Region 2): Based on AGTS results, the North Central Region, primarily the Sacramento Valley, is the most important pheasant production region in California (Hart 1990), consistently supporting the highest pheasant harvest in the state (Figure 3). Pheasant harvest in this region was highest in the 1950s through the early 1960s when over 300,000 pheasants were harvested each year (Figure 3 and Figure 11). Harvest peaked in 1957 with over 330,000 pheasants taken. However, beginning in the early 1970s the trend in pheasant harvest has been negative. Through the most recent 20 year period (1994-2013) pheasant harvest has on average been below 100,000 birds annually. Pheasant hunter numbers declined along with pheasant harvest; thus, average bag showed no consistent trend although the most recent averages were among the lowest recorded (Figure 11). Pheasant hunter numbers peaked in 1969 at 86,000 but since 1994 has fallen below 25,000 hunters each year; the most recent estimate was only 13,000 pheasant hunters in 2010.

Hunter check station data were collected from Gray Lodge and Upper Butte Basin Wildlife Area ((UBBWA, including Little Dry Creek Unit in 1990-1991; Little Dry Creek, Howard Slough, and Llano Seco in 1992 – 2013), Yolo Wildlife Area, and at the Sacramento National Wildlife Refuge Complex (including Sacramento, Delevan, Colusa, and Sutter Refuges in 1955 – 2013).

The decline in harvest has been especially severe on the Gray Lodge WA. Once the premier pheasant hunting refuge in the Sacramento Valley, pheasant harvest on Gray Lodge WA dropped from a high of 2,752 roosters in 1983 to less than 100 in 2013 (Figure 12). The trend in number of hunters visiting Gray Lodge during pheasant season was positive during the period 1953 – 1985, peaking at nearly 6,500 hunters in 1985. Although hunter numbers during pheasant season dipped to just under 5,000 hunters in 1987, hunter numbers remained stable at approximately 4,500 through 2012. In 2013 however, hunter numbers during the pheasant season on Gray Lodge dropped to less than 1,300. Following several years of high pheasant hunting success during 1953 – 1967, average pheasant bag at Gray Lodge declined but was stable through the early 1990s at approximately 0.4 pheasants per hunter. By 1998, the average pheasant bag began to drastically decline and this trend continued through its current level of less than 0.1 pheasants per hunter since 2006 (Figure 12).

Pheasant hunting on the UBBWA, which is approximately 5 miles north of Gray Lodge WA, was initiated shortly after the first unit of the wildlife area (Little Dry Creek) was open to the public in 1990. At Little Dry Creek Unit, total harvest increased to a peak of 788 in 1996 and average bag was immediately high, peaking at 0.8 pheasants per hunter in 1996 (Figure 13). After 1996, hunter numbers at the Little Dry Creek Unit continued to increase but total pheasant harvest and average bag declined drastically through 1999 and consistently through 2007; pheasant harvest and average bag remained at a low level through 2012. At the Howard Slough Unit, total harvest remained relatively high through 2000 but declined thereafter even though hunter numbers continued to increase; average bag declined from about 0.6 pheasants per hunter in 1992 to 0.04 pheasants per hunter in 2013 (Figure 14). At the Llano Seco Unit, total harvest and average bag declined starting the second year of hunting (1993) whereas hunters during the pheasant season increased steadily throughout 1992-2013 (Figure 15).

At the Sacramento NWR Complex (SNWRC) in the Sacramento Valley, pheasant harvest statistics are available for the period 1955 – 2013, although data are incomplete up to 1987. Annual total pheasant harvest at SNWRC varied widely during 1955-1986. For instance, peak pheasant harvest on SNWRC occurred in 1960 (1,618 birds) followed with the lowest recorded pheasant harvest on the complex in 1962 (180 birds). Harvest increased and appeared to stabilize in the mid 1970’s through 2000, but declined sharply over the last 13 years despite increasing hunters (Figure 16). The decline in hunter success during this period was consistent with the decline in total annual harvest (Figure 16). A comparison of complete data for 1987-2013 from the individual refuges (i.e., Sacramento [Fig.17], Delevan [Fig. 18], Colusa [Fig. 19], and Sutter [Fig. 20] NWRs) that comprise SNWRC reveals several trends including: a) total harvest and average bag during 1987-1998 declined at Sacramento and Sutter NWRs but increased at Delevan and Colusa NWRs, b) total harvest and average bag on all these NWRs declined steadily during 1999-2006 and remained low through 2013; c) hunters during the pheasant season increased (Sacramento, Delevan, Colusa NWRs) or remained similar (Sutter NWR) during 1987-2013.

Located in the Yolo Bypass between the cities of Sacramento and Davis, the Yolo WA was created in 1995. Historic land use on the area was predominately agriculture (i.e., rice, grain, irrigated pasture/alfalfa) and wildlife habitat was developed in stages shortly after land acquisition. As a result, pheasant harvest and average bag were initially very low through the first four pheasant seasons but before increasing substantially to a peak in 2003 (Figure 21). . However, pheasant harvest and average bag fell sharply in 2004 and remained low thereafter through 2013 despite hunter numbers increasing from 244 in 1997 to 4,792 in 2013.

Bay Delta Region (Region 3): Based on AGTS data, annual pheasant harvest in the Bay Delta Region ranged between 100,000-183,000 birds during 1948 – 1980 (but declined drastically thereafter with <30,000 harvested annually since 2000 and the most recent estimate from 2012 totaling 15,000 birds (Figure 22A). Hunter numbers during 1970-2010 declined in concert with harvest and thus average bag increased slightly over time (Figure 22).

Hunter check station harvest data in in the Bay Delta Region was collected during 1955-1994 from Grizzly Island WA, 1995 from Grizzly Island and Joice Island WA’s, 1996-1999 from Grizzly Island, Joice Island, and Island Slough WA’s, and 2000-2012 from Grizzly Island, Joice Island, Island Slough, and West Family WA’s. All areas are located in the Suisun Marsh so harvest results were pooled into one graph (Figure 23). Trends in annual total harvest and average bag were similar; both varied greatly with no consistent trend during 1955-1966, increased during 1967-1986, decreased, stabilized, then recovered during 1987-1995, were highly variable but with decreasing trend during 1996-2008; and remained at low levels 2009-2013 (Figure 23). The highest pheasant harvest years occurred in 1962 (1,330 birds) and 1963 (1,739 birds). Harvest averaged close to 400 birds through 1981 increasing to over 1,000 birds each year from 1984 – 1986. Following two highly productive years in 1995 and 1996, total pheasant bag began a downward trend over the next 17 years. Only 202 pheasants were harvested at Grizzly Island and the other WAs in 2013 (Figure 23). Numbers of hunters spiked to 8,080 in 1986 but otherwise varied between 1,873 - 6,135 with no consistent trend. Data on harvest of wild and planted game farm pheasants at Grizzly Island WA were available for 1990-2012 and show a relatively consistent harvest of game farm pheasants that supplemented the variable wild pheasant harvest each year (Figure 23-2).

Central Region (Region 4): Based on AGTS data, the Central Region pheasant harvest tracked numbers of pheasant hunters, with an increasing trend during1948-1970 and declining trend thereafter (Figure 24). The decline was especially severe during 1974-1986 and thereafter harvest and numbers of hunters were at low levels and continued to decline. Except for a large spike in 1996, average bag remained relatively constant.

Hunter check station harvest data in the Central Region were collected in the Grasslands Ecological Area of the northern San Joaquin Valley from public hunting areas established well before 1988 including Los Banos WA (data available 1972 – 2013), Merced NWR (data availabe1972 – 2013), Volta WA (data available 1987 – 2013), and San Luis NWR Complex (Kesterson, North and South Freitas, and West Bear Creek Units; data available 1987 - 2013), and public hunting areas established more recently including (China Island (1990-2013) , Gadwall (1995-2013), and Salt Slough (1993-2013) units of the North Grassland WA. Data were also collected at Mendota WA (1987 – 2013) and Kern NWR (1987 – 2013) in the southern San Joaquin Valley.

In the Grasslands Ecological Area, pheasant harvest varied among public hunting areas but some trends were apparent. During 1972-1988, harvest and average bag was high but highly variable (see Los Banos WA [Figure 25] and Merced NWR [Figure 26]. During 1989-1995 (years vary somewhat among areas) harvest and average bag declined and then recovered (see Los Banos WA [Figure 25], San Luis NWR [Figure 27], and Volta WA [Figure 28]). During 1996-2013, harvest and average bag trended downward, albeit variable among years (see Los Banos WA [Fig. 25], San Luis NWR [Fig. 27], Volta WA [Fig. 28], China Island WA [Fig. 29], and Salt Slough WA [Fig. 30]) except for no trend at the Gadwall WA (Fig. 31). Notably, at China Island WA, harvest and average bag spiked greatly along with numbers of hunters in 1994 but harvest and average bag declined rapidly over the next 4 years and remained low thereafter (Fig. 29).

Trends at Mendota WA (Figure 32) were similar to public hunting areas in the Grasslands Ecological Area (e.g., San Luis NWR complex [Fig. 27]) with harvest and average bag increasing to a peak in 1994 and then declining to lows by 2007. Between 1987-2012 pheasant hunters at Mendota WA were most successful in the mid 1990's when annual harvest ranged between 300 – 500 birds (peak harvest in 1993; 500 birds). However, fewer than 70 birds were harvested annually during the most recent 6-year period (2008-2013). Data on harvest of wild and planted game farm pheasants at Mendota WA have been kept most years since 1955 and show harvest of wild pheasants was greatest in 1955, 1960s-1970s, 1993, and 2006 (Figure 32-2). No game farm pheasants were tallied during some years, including 1979-1984, but with low wild pheasant harvest, game farm pheasants comprised most of the harvest in recent years

(Figure 32-2). At the southern end of the Central Region in the Tulare Basin, pheasant harvest on the Kern NWR has been negligible since 1987 (Figure 33).

South Coast (Region 5): The South Coast Region has historically supported the lowest pheasant populations in California (Hart 1990). Based on AGTS data, pheasant harvest in the South Coast Region started out very modestly in the late 1940's with less than 5,000 birds taken each year through 1950 (Figure 34). Annual pheasant take increased incrementally the following 10 years to over 36,000 birds harvested in 1963, but within two years pheasant harvest had dropped back down below 10,000 birds. Currently annual harvest estimates fall between 2,500 – 5,000 birds for this region (Figure 34).

We have no pheasant harvest information from public hunting area check stations or other specific sites within the South Coast Region.

Inland Deserts (Region 6): Based on AGTS data, pheasant harvest within the Inland Deserts Region was similar to Region 1 (Figure 3) during the 1950s-mid 1970s ranging between 40,000 – 60,000 birds annually (Figure 35); but pheasant harvest declined sharply in 1979 when less than 18,000 birds were harvested. The decline continued but stabilized at 8,000 – 10,000 birds through 2005. Current estimates of harvest for this region indicate continued decline with approximately 5,000 birds taken each year. Decline in numbers of pheasant hunters closely tracks the decline in total pheasant harvest for the region and thus average bag showed no consistent trend (Figure 35).

Pheasant harvest at specific sites in the Inland Desert Region was collected from San Jacinto WA (1987 – 2012), and the Imperial (1987 – 2012) and Sonny Bono Salton Sea (1998 – 2012) NWR's. Pheasant harvest at San Jacinto WA peaked in 1995 with 130 birds taken. Harvest success was inconsistent over the following 10 years, but did indicate a negative trend over time (Figure 36). At Imperial NWR, pheasant harvest was relatively high for the five year period 1998 – 2002, and harvest peaked in 2000 with 73 birds taken. Following 2 additional good years (2004 and 2005) pheasant harvest dropped to only 10 birds harvested through the 2006 – 2013 period (Figure 37). There are no records of pheasants being harvested on the Sonny Bono Salton Sea NWR.

Breeding Bird Survey (BBS)

Breeding Bird Survey (BBS) data indicate an increasing pheasant population in California during 1968-1988 and a decreasing pheasant population during 1989-2009. Total pheasant detections along BBS routes statewide were initially low when the BBS became operational in the late 1960's but as BBS transects were added total pheasant detections increased and stabilized; starting in 1974, trends in total pheasant detections and average detections per BBS route were similar. Average detections of pheasants per BBS route increased to peaks in 1983 and 1988 but declined sharply through 1994 and remained at low levels thereafter (Figure 38) Pheasant detections for years 2011 and 2012 were the lowest recorded since the survey started in 1968 (Figure 38).

Average pheasant detections per BBS route in each region (Figure 39) show that although timing of peak pheasant abundance likely differed among the major regions (i.e., Northern:1984 and 1988, North Central:1989, Bay-Delta: 1969, Central: 1971 and 1984), populations in all regions did subsequently decline, and since at least 2000, remain at or near record lows. In the Northern Region, averages initially declined but then stabilized throughout the 1970s, spiking in 1984 and 1988 before steadily declining to record lows in 2012. In the North Central Region, average detections were relatively stable throughout 1970-mid 1980s, peaking in 1989, but then steadily declining 1990-2000 and remaining at record lows through 2012. The decline occurred earliest in the Bay-Delta (although early data are questionable in all regions due to few BBS routes) with average detections remaining low after 1972 and especially during 2011-2012. In the Central Region, average pheasant detections were high through the 1970's and mid 1980's but declined sharply 1984-1990 and remain at record lows 1991-2012. Pheasant detections were too few to track trends in the South Coast and Inland Deserts regions).

Christmas Bird Counts (CBC)

Total pheasant detections during CBC surveys and average number of pheasant detections per CBC route in California varied greatly among years. Total pheasant detections increased to a peak in the early 1980s before declining to near record lows by 2012 (Figure 40A). Average pheasant detections per CBC route fluctuated widely through and showed no consistent trend though about 1985 and then steadily declined to near record lows by 2012 (Figure 40B).

Average pheasant detections per CBC route were highly variable among years and exhibited different patterns among the six regions (Figure 41). In the North and North Central Region pheasant detections were greatest in the 1950's. The peek average number of pheasants detected per route in the North Region was 253 birds in 1955 and fluctuated widely through the early 1980's with a last peak of 129 birds per sampling unit detected in 1983. Since that peak, average detections declined and the CBC index has remained relatively stable and below 20 birds per route. The decline in detections within the North Central Region occurred earlier than in the North Region. By the late 1950's pheasant detections dropped substantially and were consistently below 25 birds per route through 1985.In the Bay Delta Region, average pheasant detections ranged between 20 – 45 birds per route up through 1996. But, since the late 1990's the trend in pheasant detections has been negative with the most recent count averaging only 6.5 birds per route in 2012. Average pheasant detections have been consistently low in the Central Region, but detection rate increased four-fold during 1971 – 1987. Shortly thereafter, detection rates dropped back down and since 1995 the average number of pheasants has ranged between 1 – 2 birds per route. A similar detection pattern is exhibited in the Inland Deserts Region where modest levels of pheasant detections were recorded in the 1950's and 1960's but increased substantially during the early 1970's through the early 1980s. Over the last 10 years, an average of < 1 pheasant was detected per route in the Inland Deserts Region. The average number of pheasant detections in the South Coast Region has been consistently low, fluctuating between 0 – 2 birds over the duration of the CBC.

Rooster Pheasant Crowing Counts

Rooster pheasant crowing count data were available from only a few years and areas in the Northern and North Central regions. Crowing counts were generally greater in the North Central Region than in the Northern Region.

Northern Region (Region 1): Pheasant crowing counts in the Klamath Basin on Tule Lake NWR, the nearby Copic Bay area, and Lower Klamath NWR averaged 1.2 – 5.6 during 1996-2004 (Figure 42). Average number of rooster crowings declined on all Klamath Basin areas during 1999-2002. Pheasant rooster crowing counts on two other areas in the Northern Region ranged from 0-14 annually with counts on Butte Valley WA declining from 14 in 2001 to 0 in 2006 (Figure 43).

North Central Region (Region 2): On units of the Upper Butte Basin WA (UBBWA) average number of rooster crowings per station was highest at Little Dry Creek followed by

Llano Seco and was lowest at Howard Slough (Figure 44). At Little Dry Creek, crowing counts were fairly consistent among years and ranged from a low of 43 crowings per station (1994) to a high of 57 crowings per station (1993). Crowing counts were annually more variable at both Howard Slough and Llano Seco. At Howard Slough and Llano Seco, average crowings per station were lowest in 1993 (15 and 21, respectively) and highest in 1994 with 32 crowings per station at Howard Slough and 49 crowings per station at Llano Seco. Crowing count surveys were resumed at UBBWA in 2012 – 2013. Average crowing counts were again highest at Little Dry Creek (27 and 35 crowings/station in 2012 and 2013, respectively), but were lower than recorded in 1993-1996 (Figure 44).

At private lands enrolled in the Conservation Reserve Enhancement Program (CREP), crowing counts averaged higher in Yolo County (15.7 and 15.5 crowings per station in 2004 and 2005, respectively) than in Colusa County (9.4 and 8.9 crowings/station in 2004 and 2005, respectively; CDFW unpublished data). Average crowings per station was highly variable among fields in both Yolo (range: 0-49.9; .3-43.8 in 2004 and 2005, respectively) and Colusa (range: 1.3-20.3; .7-17.5 in 2004 and 2005, respectively) counties (Figure 45). Average crowing counts were also higher in fallowed fields than in native grass fields, cover crop fields, rice fields, or row crop fields (Figure 46).

Bay Delta Region (Region 3): Grizzly Island WA surveys show that the average number of rooster crowings counted per station during 1956-1959 (18.6-30) was greater than during 1989-2002 (8.7-25.3) and 2002-2012 (5.3-16.2, Figure 47). The count in 1989 (19.3) was similar to the last count conduced 30 years earlier in 1959 (21.7); however, by 1993, the average was down to 10.4 crowings per station. Counts varied annually but overall the trend was increasing during 1994 -1999 (peaking at 25.3 per station in 1999) and decreasing thereafter (low of 5.3 in 2010).

Central Region (Region 4): Through the 1970's and early 1980's, average number of rooster crows along the California Aqueduct in western Fresno County were slightly greater along the route planted with strips of *Atriplex sp.* compared to the control (non-planted) route (Figure 48). However, by the mid 1980's differences between the two route types became negligible, as average rooster crows per station approached zero (Figure 48). At Mendota WA, average crowings counted per station was highest during 1993 – 1994 (11 per station) and ranged between 2.9 – 7.9 crowings per station with no consistent trend during 1995-2007 (Figure 49). However, after spiking to 7.6 in 2007, counts declined to 1.7 by 2010 and were only 2.4 in 2013 (Figure 49).

South Coast (Region 5): **N**o data available for this region.

Inland Desert (Region 6): No data available for this region.

Nesting Effort

Nesting data are limited for ring-necked pheasants in California. Most nesting data available on pheasants was collected in association with waterfowl production surveys (McLandress et al. 1996) in the Central Valley (i.e., North Central and Central Regions), Bay Delta Region and in northeastern California (i.e., Northern Region). Because nest searches were conducted only in the late 1980's in the Northern and Central Regions, we are unable to determine trends in pheasant nesting effort within these two regions. However, longer term data (1987-2012) are available from sites in the North Central and Bay Delta regions and results show that pheasant nest densities in these two regions were substantially lower during 2000-2012 then during the 1980s and 1990s.

Northern Region (Region 1): At Honey Lake and Ash Creek WA nest searches were conducted within a combination of pasture and seasonal wetland habitats during 1987 – 1989 (McLandress et al. 1996). Approximately 450 acres were searched annually during this period and pheasant nests located included 4 in 1987 (no hatches), 8 in 1988 (4 hatches), and 4 in 1989 (2 hatches). In addition, 12 pheasant nests (2 hatches) were discovered during nest searches within approximately 100 acres of roadside ditch banks, grassland, and seasonal wetland habitats at Tule Lake NWR in 1988 (California Waterfowl Association [CWA], Unpublished data).

North Central Region (Region 2): Nest searches were conducted within seasonal wetland and grassland habitat on Sacramento National Wildlife Refuge Complex (SNWRC) and Gray Lodge Wildlife Area. Area searched among years ranged from 570 – 790 acres (McLandress et al. 1996). Field crews discovered 77 pheasant nests (approximately one nest per 15 acres in 1987 and one nest per 21 acres in 1988) of which 20 successfully hatched. Small scale nest searches within selected fields (151 acres total) were resumed at SNWRC during 2003-2005 and 2011 but no pheasant nests were discovered (CWA, unpublished data).

In Sacramento Valley's rice growing region, nest searches were completed during three different periods. On private lands in the Sacramento Valley, nest searches were conducted within 1,700 acres of agricultural habitat during 1990 – 1991. Field crews discovered 62 pheasant nests (Yarris and Loughman 1990, Loughman et al. 1991). Nests were located in fallow rice fields (n=48) and cover-crop fields (n=14). In 2002 – 2006 nearly 3,000 acres of fallow rice ground, cereal grain, and native grasses were systematically searched yielding the discovery of 7 pheasant nests (Matchett et al. 2006). Nests were located in fallow rice fields (6 nests) and one field planted with native grasses (1 nest). In 2008 – 2011 nest searches were completed within 1,400 acres of planted cover crop fields adjacent to rice but no pheasant nests were discovered (California Waterfowl 2013).

Bay-Delta Region (Region 3): At Grizzly Island WA, nest searches were conducted within managed upland fields and seasonal wetland habitats during 1987 – 2012. Area searched ranged between 650 and 800 acres annually, and the same general area was searched each year. Field crews discovered 110 pheasant nests (45 hatched). The majority of pheasant nests were discovered in the 1980s (47 nests in 3 years) and 1990s (60 nests in 10 years) whereas during 2000 – 2012 only 3 pheasant nests were located during searches.

Central Region (Region 4): At Mendota WA nest searches were conducted within managed upland fields and seasonal wetland habitats during 1988 – 1991. Approximately 250 acres were searched each year and 8 pheasant nests (4 hatches) were discovered.

South Coast (Region 5): No data available.

Inland Desert (Region 6): No data available.

Road Surveys-Hen and Brood Counts

Pheasant hen and brood surveys were conducted in 4 of the 6 regions. We were unable to locate road survey data from the South Coast and Inland Desert Regions. Data from the Northern Region is reported as total birds detected (rather than birds per mile) because survey mileage was not available. Among the three other regions, a negative trend in production was evident over time (especially from the mid-1980s to the 2000s).

Northern Region (Region 1): Earliest pheasant production surveys in the Northern Region took place in the Tule Lake Basin in 1963. The recorded number of hens per mile on that survey was less than 1 (Figure 50). Surveys in the Tule Lake Basin resumed in 1968 – 1969 and hen density was similar to that recorded in 1963. Chick density was not recorded in 1963 but was just under 3 chicks per mile in 1968. Pheasant production improved the following year as chicks per mile more than doubled in 1969 (Figure 50).

At Honey Lake WA, total number of broods, juveniles, and hens were recorded during 1973 – 1981 and 1984 – 1994. Through 1973 – 1981, hen and brood numbers were similar and ranged between 10 – 30 birds (broods). Number of juveniles ranged between 50 – 75 birds (Figure 51). Pheasants increased in 1984 – 1994 at Honey Lake WA as both hen and brood numbers more than doubled from the earlier period (Figure 51). Total number of juvenile birds also increased during 1984 – 1994 (Figure 51).

North Central Region (Region 2): Pheasant densities varied somewhat among areas but were consistently lower during the most recent decade than during earlier years. On Gray Lodge WA, hen density (hens per mile) increased from 1.9 in 1956 to 5.3 by 1960 but then declined to 1.4 and remained between 1.4-2.2 hens per mile until surveys stopped in 1981(Figure 52B). Trends in Gray Lodge chick densities during the 1950s – 1960s were similar to hen density trends but during 1969-1980 chick density trended upward whereas hen density remained low, suggesting that production per hen increased during this period (Figure 52B). Pheasant density was substantially greater on Gray Lodge WA (3.4 hens/mi.; 5.8 chicks/mi.) than on co-op properties (0.9 hens/mi.; 1.64 chicks/mi) during the two years (1961 – 1962) both areas were surveyed (Figure 52). Surveys conducted at the UBBWA show much lower chick densities during 2012-2013 (0.19-0.46 per mile, Figure 53B) than during 1993-1995 (2.11-3.62 per mile, Figure 53A). At Sacramento NWR Complex, hen and chick density varied annually with no consistent trend during 1988-2000; however, densities declined during 2001-2012 and since 2008 have been at or near record lows (Figure 54). During the years chick surveys were conducted on both UBBWC and Sacramento NWR Complex (i.e., 1993, 1994, 1995, 2012) chick densities on Sacramento NWR Complex were similar to (1994, 1995) or greater than (>2x in 1993, 3x in 2012) on UBBWC. In the one year (2012) that hens were surveyed on both areas, hen density was similarly low on Sacramento NWR Complex (0.29/mile) and UBBWA (0.36/mile).

Bay Delta Region (Region 3): Pheasant production at Grizzly Island WA was modest in the 1950s and 1960s but showed marked increases in the 1970s and mid-1980s, peaking in 1985 at nearly 8 chicks per mile (Figure 55). Following the good production years of the 1980s, chick density crashed in the early 1990s before rebounding in the mid-1990s and early 2000s. However, by 2012 chick densities were at record lows. Hen densities were less variable than chick densities but followed similar trends (Figure 55).

Central Region (Region 4): Pheasant abundance trends during 1955-2013 were similar at 5 different locations in in the northern San Joaquin Valley (Figure 56). Pheasant abundance at Merced NWR and in the Merced area was low (yet, numbers were fairly steady) from the late 1960s up through the late 1980s, but in the 1990s pheasant densities approached zero (Figure 56A, B). Pheasant abundance in the Madera area was highest in the 1970s (peaking in 1973) but, steadily declined into the early 1980s (Figure 56C). Both hen and chick densities were highest at the Oakdale area in the late 1960s with hen densities ranging between 3 – 4 birds/mile and chick densities ranging between 6 – 8 birds/mile (Figure 56D). The pheasant population at Mendota WA followed similar trends in abundance as the other Central Region sites – low, but steady numbers into the 1980s with a sharp decline thereafter to current near-negligible numbers (Figure 56E).

South Coast (Region 5): No data available from this region.

Inland Desert (Region 6): No data available from this region.

Flush Counts

Pheasant flushing counts to determine age ratios (juveniles per adult) and sex ratios (males per female) at selected pheasant breeding areas were available from 4 of 6 regions – no data available from South Coast or Inland Deserts Regions. Regional flush count surveys generally contained less than 5 years of data; thus, determining trends in production is not possible. Total number of pheasants flushed was highest at sites in the North Central Region (specifically UBBWA and GLWA).

Northern Region (Region 1): In the Tule Lake Basin, flush count surveys were conducted at Tule Lake NWR, and surrounding private ground during 1960 – 1968. Pre-season sex ratio during this period ranged between 0.15 - 0.78 rooster/hen; in 2 of 3 years post-season sex ratios were lower (i.e., fewer roosters per hen) than in pre-season (Figure 57).

North Central Region (Region 2): Flush count surveys were conducted at both private land associated with agricultural production (M&T Ranch and CREP) and public wildlife areas (UBBWA, GLWA, and Yolo Bypass WA) during 2002 – 2008. Total number of pheasants flushed and age ratios (juveniles per adult) varied annually on each area (Figures 58 - 62). Although no long-term data were available, there was some indication that on private lands, pheasant abundance and age ratios were better maintained on CREP fields (Figure 62) than non-CREP fields (Figure 58).

Bay Delta Region (Region 3): Flush count surveys at Grizzly Island WA revealed a growing pheasant population during 2001 – 2003 as both total birds flushed and age ratio increased each year (peaking in 2003). However, pheasant abundance and age ratios declined sharply in 2004 – 2005 (Figure 63).

Central Region (Region 4): Flush count surveys were conducted 2003 – 2004 at Salt Slough WA, Los Banos WA, and Mendota WA. Pheasant age ratios were lower in 2004 than in 2003 at all sites (Figures 64 – 66). Overall numbers of pheasants flushed during surveys in the Central Region (Figures 64-66) was lower than at most sites in the other Regions (Figures 58-63).

South Coast (Region 5): No data available for this region.

Inland Desert (Region 6): No data available for this region.

Egg Salvage

Egg salvage data were not available or did not include data on egg hatching rates.

Comparison of Pheasant Population Indices (AGTS, BBS, CBC)

Statewide indices of pheasant populations all indicate a steep decline in pheasant abundance starting in the late-1970s (AGTS), mid-1980s (CBC), or late-1980s (BBS) that resulted in record low populations during 2000-2012 (Figure 67). Regional AGTS, BBS, and CBC were more variable and results of AGTS differed more vs. BBS and CBC, although all still indicated record low pheasant abundance during at least the last decade in the 4 main pheasant regions (i.e., North, North Central, Bay-Delta, Central, Figures 68-73).

Changes in Abundance of California Quail and Mourning Doves

Trends in statewide populations of other game birds could be informative to understanding factors impacting pheasant populations. Trends in statewide populations California quail and mourning doves differed among abundance indices. Harvest data from the

AGTS indicated a consistent decline in total bag and numbers of hunters for both quail (Figure 74) and doves (Figure 75) after the late-1960s or early 1970s, with record low harvest and hunter numbers during the most recent decade. Numbers of hunters declined along with total harvest resulting in a relatively stable average bag per hunter for both species. In contrast, BBS data (1968-2012) indicated no change for state-wide abundance of California quail and slowly declining abundance of mourning dove (Figure 76C). Average detections per CBC route indicated increasing abundance of both quail and doves during 1912-1960s and variable abundance but no trend during1970-2012 (Figure 76C).

Comparing abundance indices among the three species, statewide AGTS harvest suggest similar population trends for pheasants (Fig. 1A), quail (Fig. 74A) and doves (Fig. 75A) with abundance declining since the early 1970s (albeit more steeply for pheasants than for quail and doves). However, abundance trends based on BBS and CBC were not consistent among species. For pheasants, BBS (Fig. 76A) and CBC (Fig. 77A) agree with the AGTS harvest (Fig. 1A), indicating record low pheasant populations since the late 1990s. However for quail and doves, AGTS harvest (Figs. 74A and 75A) suggests a decline after the early 1970s whereas BBS (Fig. 76C) and CBC (Fig. 77C) indicate only a moderate decline (doves-BBS) or no consistent trend. Regional results (AGTS: Figs. 3, 78 and 79; BBS: Figs. 80-85; CBC: Figs. 86-91) were mostly similar with state-wide results.

FACTORS POSSIBLY RELATED TO PHEASANT POPULATION DYNAMICS

Numerous factors, potentially interacting and with multiplicative and compounding impacts, may be related to pheasant population dynamics in California. Data on each of these factors (that will be modeled in the next phase of the project to evaluate strength of evidence for their impact on pheasant population dynamics in California) are summarized here.

Landscape-Land Use Changes

Most of the California is comprised of forest and rangeland (Figure 92A) but the California landscape changed during 1945-2013. Total area of forest-use lands and cropland used for pasture declined while urban area and special use area (primarily parks and wildlife areas) increased (Figure 92). Within the Central Valley, the primary range of pheasants in California, cropland dominated the landscape (Figure 93). In addition, extensive loss of wetlands occurred (1.5 million ha in 1906; 485,600 ha in 1922; 220,415 ha in 1960; 172,000 ha in 1977 (United States Fish & Wildlife Service [USFWS] 1978); and 53,930 ha to 83,000 ha by 2003-2006 (USFWS and U.S. Bureau of Reclamation 2003, CVJV 2006) as wetlands were drained for urban and agricultural uses.

Although area of land for cropland and other agriculture did not change greatly in California during 1945-2013 (Figure 92), agricultural census data collected about every 5 years from 1949-2007 (2012 available soon) illustrate how farming intensity and crops on those lands changed and likely impacted the pheasant habitat value of agricultural lands. Herein, we summarize currently available information on how changes to the agricultural landscape has impacted overall pheasant habitat and specifically as nesting, brood-rearing, and winter habitat for pheasants as well as habitat for pheasant predators.

Pheasant habitat on agricultural lands- Because the vast majority of the Central Valley is agricultural land, agricultural programs, crop prices, and postharvest treatment practices have a large impact on the habitat value of the agricultural landscape for pheasants. Especially impactful has been changes in agricultural subsidy programs that have altered the amount of cropland idled each year. Originally, farmland programs were annual land idling or specific commodity idling programs during the 1930s-1985 (i.e., Conservation Adjustment Program in 1933-35, Agricultural Conservation Program (ACR) in 1936-47, Soil Bank in 1956-70, Cropland Adjustment Program in 1966-77, Acreage Reduction Programs [includes ACR, Paid Land Diversion, Payment-In-Kind] 1961-96). However, annual crop idling commodity programs were gradually reduced and replaced with the Conservation Reserve Program (CRP) during 1986-95. In 1996, non-CRP annual crop idling programs were completely eliminated and replaced with increases in subsidized crop insurance (Figure 94 [copied from Lubowski et al. 2006]). However, CRP acreage in California (Fig. 95C), and especially in the Central Valley, is relatively minimal, and thus, loss of non-CRP crop idling programs has greatly reduced idled acres and resulted in increased farming intensity (i.e., increased the percent of the landscape under active cropping) in California and especially in the Central Valley.

Overall in California during 1949-2007, the area of rangeland increased 1949-1964 but then declined back to 1949 levels; harvested cropland remained relatively stable (Figure 95A). “Other Cropland” which is a much smaller portion of the agricultural landscape than harvested cropland but includes idle cropland, failed cropland cultivated fallow, and cropland planted in cover crops that may provide important pheasant habitat, was greatest during 1949-1969 and in the mid-1980s but declined to record lows during 1997-2007 (Figure 95B). Acreage idled due to the Federal Crop Reduction program also peaked in the mid-1980s before being eliminated in the early 1990s (Figure 95C). Also, sub-types of “Other Cropland” changed, with cultivated fallow declining1949-2007, idle cropland peaking in the mid-1980s, and CRP acreage at a low, albeit slightly increasing level during 1982-2007 (Figure 95C). [Note: We have not yet found data on number of California acres enrolled in the Soil Bank program (1956-70) in California. The Soil Bank Program was similar to the current CRP program and we currently assume no California acres were enrolled in the Soil Bank Program.]

Trends in land use during 1949-2007 varied among regions. Trends in rangeland varied somewhat but like for California, rangeland area peaked in 1964 and then declined in all region. Most change in area of harvested cropland occurred during 1949-1959 and thereafter harvested cropland area was fairly stable most regions except for continued increase in the Central Region and decrease in the Bay-Delta Region (Figure 96). Trends in area of “Other Cropland”, area idled due to the Federal Crop Reduction programs, and CRP area, mirrored the California trends except for the Central Region which showed two peaks (1964, 1987) in “Other Cropland” area (Figure 97). Most acreage idled due to the Federal Crop Reduction programs was in the Central and North Central regions. Trends in sub-types of “Other Cropland” varied somewhat among regions (Figure 98) but were mostly similar to overall California (Figure 95C).

Pheasant nesting habitat- Quality pheasant nesting cover requires vegetation undisturbed by farming operations that provides good concealment from predators and is ideally located near brood habitat.

Northern Region (Region 1): Land use practices that are important for nesting pheasants in the Northern Region include primarily grain crops that are harvested after the pheasant nesting season has ended (typically mid-summer). Historically, barley was the most important grain crop planted in the region, with over 100,000 acres planted through the 1950’s. However, planted barley acreage started to decline in the 1960’s and currently remains a fraction of what it once was (Figure 99). Other grain crops beneficial to nesting pheasants (e.g., winter wheat, spring wheat, oats, and various forbs planted for seed) have also realized declines in planted acreage (Figures 100 – 103). Similarly, uplands enrolled in the US Department of Agriculture (USDA) Conservation Reserve Program (CRP) have also declined in this region (Figure 104).

North-Central Region (Region 2): At the turn of the 20th century, habitat in the Sacramento Valley was predominately comprised of dry land grain (e.g., barley and wheat) cultivation, native grasslands and poorly controlled waterways (Willson 1979). Newly introduced pheasants responded very well to these habitat conditions. As rice cultivation (and the spring-summer irrigations associated with rice) became the principle agricultural commodity in the Valley (1940-1950's) pheasant numbers increased significantly and the region supported the highest pheasant densities in the State (Hart 1990). Farming practices that greatly contributed to successful pheasant propagation during this period included a system of rotating rice and winter wheat, or simply fallowing fields after a given number of growing seasons to rest the soil. The combination of abundant nesting habitat (within fallowed/wheat fields) and ample food resources attributed to spring and summer irrigations in rice allowed breeding pheasant numbers to grow and expand throughout the Valley.

With the advent of field laser-leveling and increased herbicide and pesticide application beginning in the late 1960s, farming practices became more efficient, and cultivated rice acreage increased significantly in the Sacramento Valley (Figure 105). In order to preserve rice market stability, farm programs that regulated the amount of rice planted in a given growing season were implemented via Farm Bill legislations. Under the US Department of Agriculture (USDA) Acreage Conservation Reserve Program (ACR) of early farm bills, growers were required to set-aside a portion (typically 5-45%, determined annually) of their rice ground and not plant it with a rice crop. This idled acreage was frequently vegetated with volunteer grasses and forbs and provided additional nesting habitat for pheasants and many other wildlife species (Yarris and Loughman 1990, Loughman et al. 1991).

Changes in land management also occurred following implementation of the 1996 Farm Bill. This version of the farm bill included a significant shift in a farm policy that was historically based on price support and subsidy-based programs to one that was more of a free market model. The end goal of this shift was to have U.S. agriculture increase its global market share. The ACR program was discontinued and growers were encouraged to follow world market signals to determine how much to plant. Since 1996, the area of planted rice has been less than 500,000 acres only twice (Figure 105). The increase in rice acreage came at the expense of winter wheat and fallowed idle ground – two vital nesting habitats for pheasants. As in the Northern Region, acreage for all cereal grain crops that may benefit nesting pheasants has declined in the North Central Region (Figures 99 – 103). And, while CRP acreage was steady from 1987 to the mid-2000s, this beneficial pheasant nesting habitat mostly occurred in the foothills and has also been in recent decline (Figure 104).

Bay-Delta Region (Region 3): In the Bay Delta Region, barley was the most important cereal grain crop with nearly 200,000 acres planted annually in the 1950s. However, over time planted acreage of barley declined similarly to that within other regions (Figure 99). Planted acreage of winter wheat increased in the Bay Delta Region during the 1970s and may have lessened the negative impact of the decline in barley acreage. By the mid-1990s winter wheat acreage also declined along with all other notable cereal grain crops in the region (Figures 100 – 103). Though impacting a smaller area than planted grain, the area of CRP fields increased through the 2000s in the Bay Delta (Figure 104).

Central Region (Region 4): As found in other California regions, barley was the most important cereal grain planted in the Central Region. Nearly 1 million acres were planted in the region during the 1950s (Figure 99). The decline in barley acreage planted in this region mirrored the decline throughout California. Though planted acreage of winter wheat fluctuated over time it has generally remained well over 200,000 acres (Figure 100). Of most significance for nesting pheasants in the Central Region, is upland area enrolled in CRP. Though substantial declines in field enrollment have occurred since the early 1990's, there remains over 50,000 acres of CRP uplands in the region (Figure 104).

South Coast (Region 5): Crop patterns were mostly similar to other regions; acres of CRP declined after the mid-1990s (Figs. 99-104).

Inland Deserts (Region 6): Historically, pheasant breeding populations in the Inland Deserts Region benefitted by an abundance of nesting habitat provided by planted barley in the 1950s (Figure 99). As barley acreage began its precipitous decline in the late 1960s planted acreage of winter wheat increased through the early 1980s, but declined shortly thereafter to a very limited area (Figure 100). Currently, insignificant levels of other cereal grain crops beneficial to nesting pheasants are planted in the region (Figures 101 – 103) and CRP enrollment in the region is almost zero (Figure 104).

Pheasant brood-rearing habitat- Quality pheasant brood habitat provides adequate cover from predators and high densities of foods (esp. invertebrates) for chicks that is ideally located near nesting cover. In California's arid climate, this usually requires irrigated or wetland environments. Thus, wetland edge and seasonal wetlands that are mostly dry during summer, as well as grassy uplands interspersed among wetland complexes provides important brood-rearing and nesting habitat for pheasants. Wetland loss in California has been extensive. The estimated 1.6–2 million ha of wetlands in CVCA pre-European settlement were reduced to 1.5 million ha in 1906; 485,600 ha in 1922; 220,415 ha in 1960; 172,000 ha in 1977 (United States Fish & Wildlife Service [USFWS] 1978); and 53,930 ha in 2003 (USFWS and U.S. Bureau of Reclamation 2003), which represents a 97% loss. However, loss estimates vary, ranging from a 91% loss by 1990 (Dahl 1990) to a 96% loss by 2006, based on 83,000 ha of managed wetlands in 2006 (CVJV 2006). Historically, about 40% of CVCA wetlands occurred in San Joaquin Valley, with 60% in the Sacramento Valley, Delta, and Suisun Marsh (USFWS 1978) but the magnitude of loss and types of wetland habitats remaining differ by region.

Northern Region (Region 1): About 85–90% of KLBA's original wetlands have been lost, with only about 60,000 ha remaining (Akins 1970; Bottorff 1989). In 1905, the U.S. Bureau of Reclamation initiated the Klamath Reclamation Project; 3 large storage reservoirs, hundreds of diversion structures, >2,260 km of canals, and a 2.4 km tunnel, now deliver water throughout KLBA (Hathaway and Welch 2002).

North-Central Region (Region 2): Wetland loss in Sacramento Valley was also severe, but many wetlands in Sacramento Valley were converted to rice fields. These rice fields not only can (if left unplowed and unflooded) retain higher wintering value for pheasants than the cotton, orchards, and non-grain croplands that dominate the San Joaquin Valley landscape (Fleskes et al. 2005b), but also require spring and summer water delivered via a landscape of ditches and canals that under some circumstances results in moist environments, green vegetation and insect foods for pheasant chicks.

Bay-Delta Region (Region 3): Wetland loss in Delta was also severe, but many wetlands in Delta were converted to grain fields. These grain fields not only can (if left unplowed) retain higher wintering value for pheasants than the cotton, orchards, and non-grain, but also require spring and summer water delivered via a landscape of ditches and canals that under some circumstances results in moist environments, green vegetation and insect foods for pheasant chicks.

Central Region (Region 4): The southern San Joaquin Valley had the largest block of wetlands, but most were lost by the 1920s with conversion of Tulare Lake (once the largest freshwater lake west of the Mississippi River) and associated wetlands to agricultural lands (Kirk 1994).

South Coast (Region 5): Wetland loss along the South Coast was also severe.

Inland Deserts (Region 6): This region did not have a high density of wetlands.

Pheasant winter habitat-Quality winter habitat provides adequate cover from predators and inclement weather and either provides adequate foods (primarily seeds) or is located near food sources. Land with dense vegetative cover such as acres enrolled in long-term land idling programs such as the Soil Bank Program [1956-1970, also called Conservation Reserve Program] and the Conservation Reserve Program (1986-2014) and harvested grain fields that have standing stubble or stalks that are not disked, plowed, or flooded, and unharvested sugar beets (esp. if weedy or near food sources) can provide quality winter habitat. Changes in area of idled lands (Figs. 94-98, Fig. 104), cereal grain crops (Figs. 99-103), rice (Fig. 105), sugar beets (Fig. 106), sorghum (Fig. 107), corn (Fig. 108), and safflower (Fig.109) may impact winter habitat area and winter survival of pheasants. The Northern Region is the one California region that receives heavy snowfall in important pheasant areas. Thus, extent and quality of wintering habitat can greatly impact losses to exposure (i.e. winter kill) in the region and cropping patterns and farming practices that reduce residual vegetation can greatly impact pheasant abundance, especially during and after severe winters (e.g., 1992-93, Grove et al. 2001). Sacramento Valley's winter landscape changed dramatically following two significant acts of legislation in the 1990's that may have negatively impacted winter habitat for pheasants. The first of which was the California Rice Straw Burning Reduction Act of 1991 (California AB 1378). Stemming primarily from air quality concerns this Act basically removed burning as the primary tool rice growers used to remove post-harvest rice stubble. Popular alternative methods of stubble disposal include incorporation into soil (via disk) and fall/winter flooding (Hill et al. 1999). As a result, the Sacramento Valley has realized a substantial increase in winter-flooded rice fields (Fleskes et al. 2005b, Miller et al. 2010). This change in land management significantly reduced the amount of dry upland cover and waste grain availability for pheasants and may contribute to lower over-winter pheasant survival.

Negative agricultural land uses-Agriculture crops that likely reduces the carrying capacity of the landscape for pheasants includes crops that replace more beneficial crops for pheasants and provide nesting habitat for crows, ravens, and other avian predators of pheasants (e.g., orchards, Figs. 110, 111), have little value as pheasant habitat (e.g., grapes [Fig. 112], cotton Fig. 113]), or attract pheasants to an environment where they will likely suffer high mortality and/or low nest success (e.g., hay fields Fig. 114]). Area of nut orchards (Figure 110), and grapes (Fig. 112) increased in all major pheasant regions; fruit tree orchards (Fig. 111) increased or had no trend in the Northern, North Central Region but declined in the Bay Delta, South Coast, and Inland Deserts regions. Most cotton is grown in the Central and Inland Deserts regions and cotton area declined in both these regions. Cotton was introduced in the North Central Region in the mid-1990s and peaked at about 20,000 acres in 2001 before declining to about 2000 acres by 2011. Hay acreage was relatively stable in all regions except in the South

Coast Region where acreage declined from about 60,000 acres in 1980 to about 20,000 acres during 1990-2011 (Figure 114).

Pesticide Use for Agriculture and Mosquito Abatement

Pesticides applied to the landscape for agriculture, or mosquito abatement can impact pheasants and/or their foods**.** With numerous urban areas and about 2.8 million ha of irrigated agricultural lands in Central Valley (Budd et al. 2009), a wide variety of agricultural and urban chemicals have the potential to greatly impact pheasant populations by reducing food supplies, especially insect prey for chicks, and survival of eggs, chicks and adults. Although impacts on pheasants have not been studied, pesticide acute toxicity has been found to be a better correlate than agriculture intensification to the decline of other grassland bird species in North America (Mineau and Whiteside 2013). Central Valley waters are laden with up to 40,000 tons of contaminants annually (Bunn et al. 2007), including chemical fertilizers, herbicides, and pesticides, and from San Joaquin Valley soils, trace elements such as selenium that can concentrate to dangerous levels in wetland organisms (Ohlendorf et al. 1986). In addition, the estrogenic activity of some agricultural chemicals is a potential concern for both wildlife and humans (Johnson et al. 1998).

The types of pesticides used in California have changed over time (Wells 2011). Persistent organochlorine insecticides, such as DDT, which were banned in 1972, have given way to organophosphate and carbamate pesticides, and an increasingly potent class of pyrethroid insecticides (Weston et al. 2004). Even more recently (starting in the 1990s), neonicontinoids, the first new class of insecticides introduced in the last 50 years, were introduced in response to widespread insect resistance and growing health and safety concerns of organophosphates. Neonicontinoids are now the most widely-used insecticides in the world with nearly 300 neonicontinoid products registered for use in California. Neonicontinoids have been linked to honey-bee colony collapse, and have been called “the new DDT” because of their persistent toxicity in the environment to aquatic invertebrates, birds, and other wildlife (Monbiot 2013). The American Bird Conservancy called for the ban of neonicontinoid products in March 2013 (American Bird Conservancy 2013).

Wetlands and flooded agricultural lands in California are interspersed among large centers of human population. Concerns over the possible role of wetlands in harboring vectors of human diseases such as equine encephalitis, and since 2004, West Nile virus, has led to establishment of mosquito abatement districts which periodically treat wetlands, flooded fields, and other standing water to reduce mosquitos. Human health concerns due to presence of WNV have led to greatly increased mosquito abatement activities in California after 2004. Four families of larvicides (Bacterial products [Bti, Bs], surface agents [films, oils], insect growth regulators [methoprene, dimilin], chemical [organophosphate “temephos”]) and two families of adulticides (organophosphate insecticides [malathion, naled), natural and synthetic pyrethroids [permethrin, resmethrin, sumithrin, deltamethrin]) are registered for use in California (California Department of Public Health 2008). Many of these not only kill mosquitoes but also other invertebrates (http://www.epa.gov/opppmsd1/PR_Notices/pr2005-1.pdf).

Mosquito Abatement-California county-specific data on pesticide use (pounds applied) during 1990-2012 indicates that the amounts and types of chemicals used for human health (i.e., mosquito abatement) has changed over time and varied among regions. For California overall during 1990-2012, total pounds of human health pesticides applied peaked in 2006 (Figure 115A; >7 million pounds of sodium hypochlorite [bleach] used in San Francisco County in

1991-1992 excluded). Petroleum (i.e., oils) comprised most of the total human health pesticides used (>7 million pounds of sodium hypochlorite [bleach] used in San Francisco County in 1991-1992 excluded) except during 2008-2012. Among selected mosquito abatement pesticides, Bacillus Thuringiensis, Naled, and Piperonyl Butoxide use increased after 2004 (the year West Nile became established in California) whereas use of malathion declined (Fig. 115B).

Trends in use of human health pesticides varied somewhat among regions. Like for California overall, in most regions, petroleum comprised most of the human health pesticides applied during 1990-2006 (Figure 116). However, non-petroleum pesticides were important in the North Central Region throughout 1990-2012 and in the Central Region after 2007 (Figure 116). Use of specific non-petroleum human health pesticides was highly variable among years and regions; most notable was the spike in use of Bacillus Thuringiensis (Bt) in the Central Region in 2011 and Piperonyl Butoxide in several years and regions (Figure 117).

Other Selected Pesticides: California county-specific data indicates that the amounts and types of selected insecticides used for purposes other than human health (i.e., primarily for agricultural purposes) has changed over time and varied among regions during 1990-2012. For California overall during 1990-2012, use of 11 select insecticides had widely different use trends with Chlorpyrifos, Carbofuron, Methyl Parathion, Carbaryl, and Malathion decreasing, the 3 neonicotinoids (esp. Imidacloprid) increasing, and Permethrin, Copper Sulfate, and Lambda Cyhalothrin no consistent trend (Figure 118).

Regional use trends of the 11 select insecticides (Figure 119-124) were mostly similar to the overall use trends for California (Figure 118). The North Region had relatively low use of the 11 insecticides with only Copper Sulfate >100,000 pounds. The North Central Region used much more Copper Sulfate (1-3 million pounds per year) than any other region. The Bay-Delta, Central, South Coast and Inland Desert also used fairly large amounts of Copper sulfate and also had significant use of of Chlorpyrifo. Lambda Cyhalothrin pesticide use was relatively low except its use spiked in 2004 in the Central Region (Figure 122A). The Central Region had the highest use of Carbaryl and Malathion.

Total Pesticide Use: The total amount of pesticides applied annually to the California environment varied greatly during 1990-2012 but was greatest in 1993-1998, 2005, and 2011 (Figure 125). Annual amounts and patterns of use varied among regions (Figure 126). The Central Region had much greater pesticide use than the other regions and is unique among regions in that current use at or near the peak for the 1990-2012 interval (Figure 126).

Change in Diseases

West Nile Virus (WNV) first became prevalent in California in 2004 (Hayes et al. 2005, Wheeler et al. 2009) and has been associated with declines of corvids and other avian species in California (Koenig et al. 2007, Wheeler et al. 2009). Although pheasants are thought to be resistant to the virus, as evidenced by presence of antibodies found in about 20% of individuals in Iowa (Zhou and Bogenschutz 2014) pheasants are listed as one of 198 species known to be fatally affected by WNV in North America (Komar 2003).

Change in Predator Community

Avian-Potential avian predators of pheasants include several hawk species, great-horned owls, ravens, and crows. The CBC provides data on abundance during 1912-1967 and both the CBC and BBS provide data on abundance during 1968-2012. These data indicate that overall abundance of avian predators in California was greater during the last decade than during earlier years due to increasing or stable population trends for nearly all avian predators (Figs. 69-70) with only a few exceptions (BBS indicates recent decline for golden eagles [69E], crows [69H], and northern harriers [69I] but not supported by CBC data [Fig. 70]). Regional results (BBS: Figs. 73-78; CBC: Figs 79-84) were more variable but mostly consistent with state-wide results. Crow and raven surveys at the Sacramento NWR complex during 1979-2013 indicate no trend for crows but a large increase in ravens starting in 1990 (Figure 127), especially at Sacramento and Delevan NWRs (Figure 128).

Mammalian-Potential mammalian predators of pheasants (adults, chicks, eggs) include the striped skunk, spotted skunk, raccoon, opossum, coyote, red fox, badger, bobcat, mink, weasel species, ground squirrel species, and rat species. Feral and free-ranging cats (Felis catus) can also be important predators (http://www.dfg.ca.gov/wildlife/nongame/nuis_exo/dom_cat/index.html) on birds, especially near urban areas. Red fox (Vulpes vulpes) in lower elevations of California (i.e., the Central Valley) were until recently, all thought to be non-native (Lewis et al. 1999) and managed as such (http://www.dfg.ca.gov/wildlife/nongame/nuis_exo/red_fox/index.html). However, recent genetic analysis indicates red fox in Sacramento Valley are distinct and likely native (Moore et al. 2009). Change in red fox status and management could increase predation of pheasants and their nests (Lewis et al. 1999). Furbearer harvest records from CDFW provide information on abundance of some potential mammalian predators of pheasants, although interpretation is difficult because numerous factors (e.g., fur prices, regulations) in addition to species abundance influence trapping effort and harvest. Annual harvest of most furbearers varied similarly among species and regions, peaking during the mid-1970s to mid-1980s (Figures 129-135). Exceptions include harvest of mink, which peaked state-wide and in most regions during the mid-1950s (except mid-1960s in North Central Region) and species or regions with very low and erratic harvest (e.g., weasel in all regions, badger and striped skunk in Bay-Delta Region). Abundance of feral and free ranging cats has likely increased along with populations of humans. We found no data on changes in abundance of ground squirrels, rats, or snakes.

Change in Wild Turkey Abundance

Wild turkey populations have, like in many parts of North America, greatly increased in California, expanding from foothill regions into the Central Valley during the last two decades (Gardner 2004). All three population indices indicate wild turkey abundance in California has increased greatly starting in the late-1980s (AGTS: Fig. 136, BBS: Fig. 69B, CBC: Fig. 70B.) and is currently at or near record highs. Unlike for pheasants, quail, and doves, average number of turkeys bagged per hunter increased along with total harvest and hunter numbers (Fig. 110). Regional AGTS, BBS, and CBC data for wild turkeys were more variable than for California but data also indicate that wild turkey abundance increased greatly starting in the late-1980s and is currently at or near record highs in all regions except the Inland Deserts (AGTS: Fig. 137, BBS: Figs. 73-78, CBC: Figs. 79-84).

Annual Variation in Precipitation

Precipitation data summed across all regions shows high annual variation in total water year and spring precipitation with no long-term sustained trends (Figure 138). Relatively wet periods included the mid-1950s, mid-1960s, late 1970s-early 1980s and mid-1990s. Relatively dry periods include the late 1950s, 1971, late-1980s, late-1990s and mid-2000s (Figure 138).

Regional data also showed high annual variation, with precipitation greatest in the North Central and Bay Delta regions (Figure 139).

Change in Harvest Pressure

Change in impacts of harvest on pheasant abundance could occur due to change in hunting pressure from changing numbers of hunters or harvest regulations. Based on the AGTS, changes in numbers of pheasant hunters mirrored pheasant harvest (Figure 1). However, on individual NWRs and WAs, numbers of hunters (albeit mostly targeting waterfowl) increased as pheasant harvest declined (e.g., Figs. 12-20). Pheasant hunting season during 1953-2013 opened in mid-late November and closed in late November to mid-late December, depending upon season duration which increased during 1953-2013 (Table 1, 10 days in 1953-1954, 16-17 days 1955-1969, 30 days in 1970, 23-25 days in 1971-1982, 30 days 1983-2001, 44 days 2002-2012). Daily bag limits for pheasants throughout 1953-2013 was 2 during the first 2 days and then either 2, 3 (1993-2013), or 4 (1956-1960) for the remainder of the season. Except for a few years (1955-1957, 1966), only roosters were allowed in most of the state but hens were allowed in southern counties (e.g., Los Angeles, Orange, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barabara, Ventura) up until 1991(?) (hens were also allowed to be taken by archery and falconry hunters).

Licensed Game Bird Clubs and Pen-reared Pheasants

Data from licensed pheasant hunting clubs indicate an expansion in acreage of clubs and numbers of pen-reared pheasants released from 1947-1970 (Table 2). Acres and birds released stabilized and then declined 1971-1986 (Tables 2 and 3) and 1992-1993 (Table 4) but by 2001 release totals were again >100,000 in Zone A (parts of California with significant populations of wild pheasants) and >200,000 in Zone B (parts of California with few if any wild pheasants). Number of pen-reared pheasants remained at a high level during 2001-2004 but declined somewhat thereafter (Table 5). Data from 1992-1993 show most clubs and club acreage are in the North Central and Bay Delta region (Table 4). Data from 1947-1970, show a large but decreasing portion of pheasants harvested on licensed game bird clubs were wild pheasants, more than half were hens; and large acreages were in clubs in both Zone A and B (Table 5).

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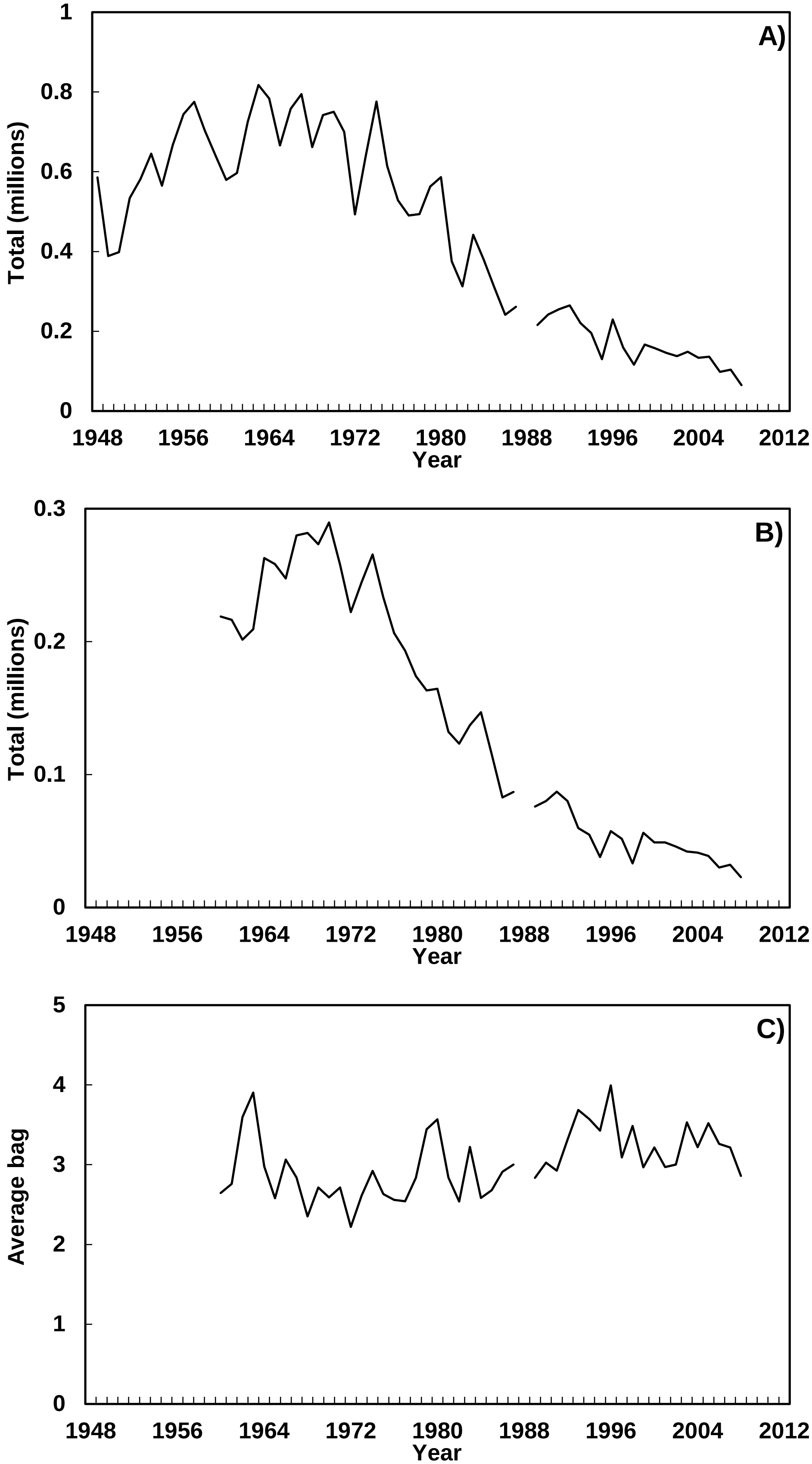


Figure 1. Annual Game Take Survey (AGTS) estimated statewide pheasant A) total bag (total harvest), B) numbers of pheasant hunters, and C) average bag per pheasant hunter.

Figure 2. California Regions. (In this report, Yolo county is included only in Region 2 and Sacramento and San Joaquin counties are included only in Region 3. Figure modified from CDFW Wildlife Areas by Region map).

	1 - Northern Region:Del Norte, Humboldt, Lassen, Mendocino, Modoc, Shasta, Siskiyou, Tehama and Trinity counties
	2 - North Central Region :Alpine, Amador, Butte, Calaveras, Colusa, El Dorado, Glenn, Lake, Nevada, Placer, Plumas, Sierra, Sutter, Yolo and Yuba counties
	3 - Bay Delta Region: Alameda, Contra Costa, Marin, Napa, Sacramento, San Mateo, Santa Clara, Santa Cruz, San Francisco, San Joaquin, Solano, and Sonoma counties
	4 - Central Region: Fresno, Kern, Kings, Madera, Mariposa, Merced, Monterey, San Benito, San Luis Obispo, Stanislaus, Tulare and Tuolumne counties
	5 - South Coast Region: Los Angeles, Orange, San Diego, Santa Barbara and Ventura counties
	6 - Inland Deserts Region: Imperial, Inyo, Mono, Riverside and San Bernardino counties

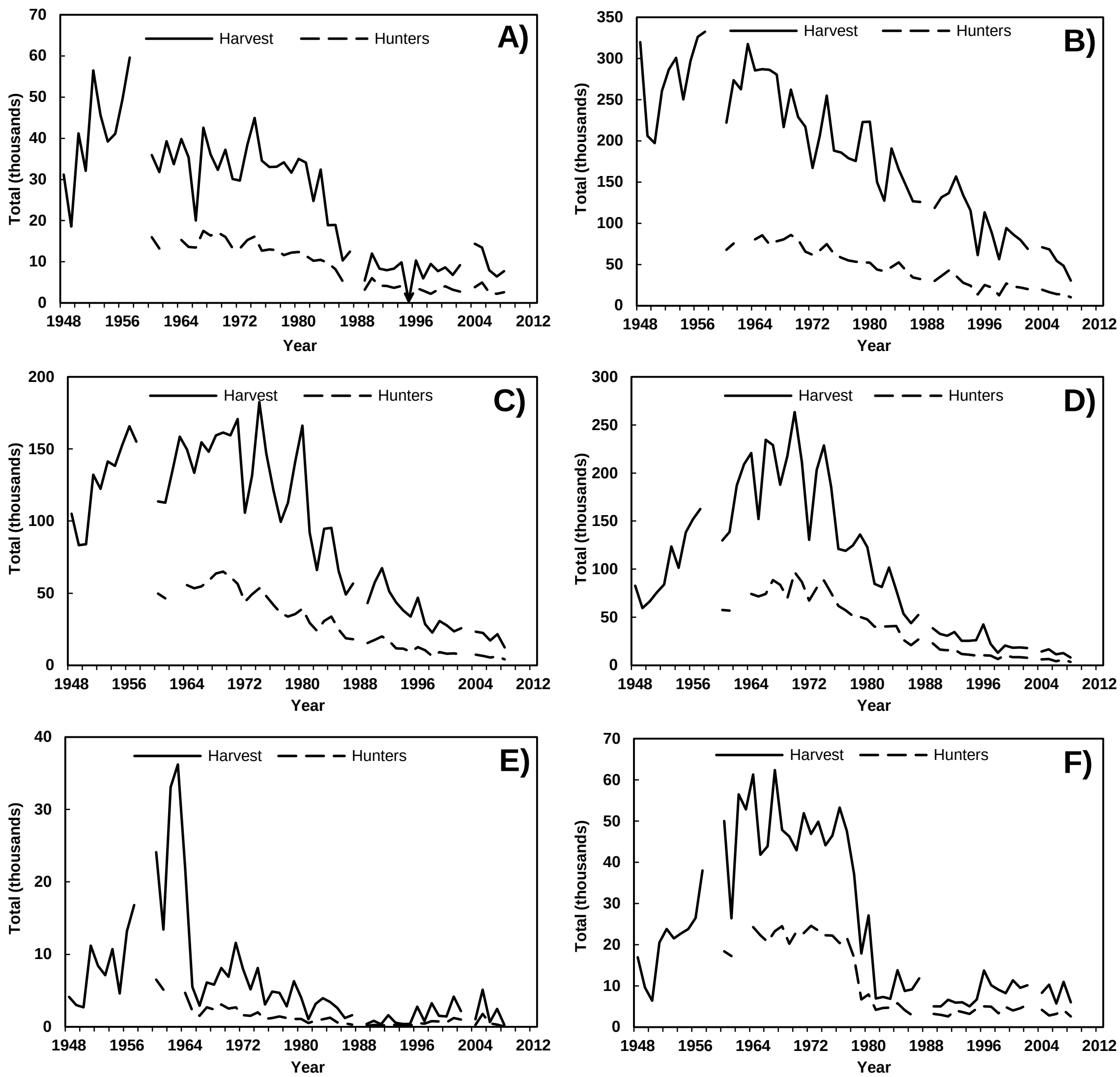


Figure 3. Total pheasant harvest and pheasant hunters estimated by the AGTS during 1948-2012 in the (A) Northern Region, (B) North Central Region, (C) Central Region, (D) Bay-Delta Region, (E) South Coast, and (F) Inland Deserts Region.

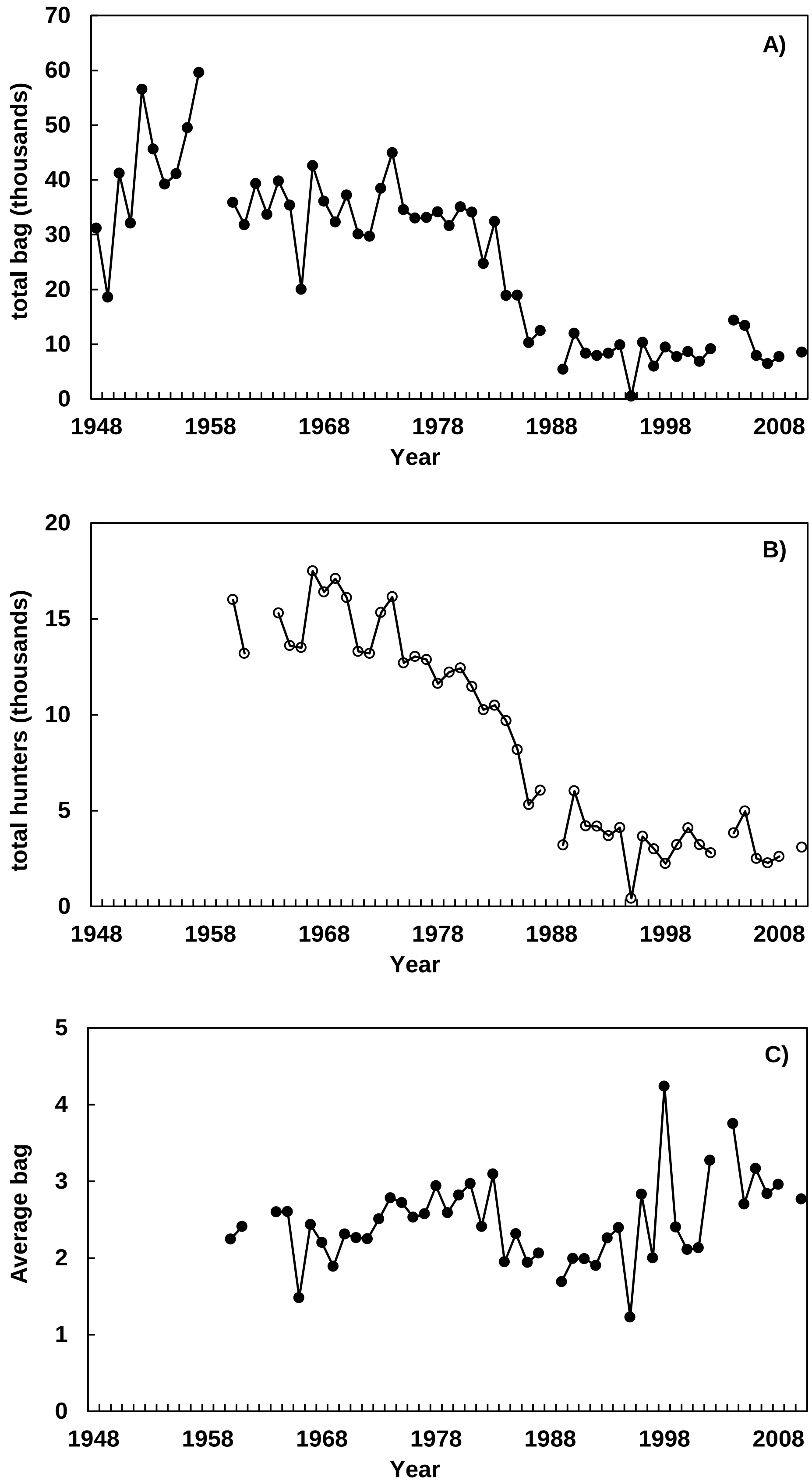


Figure 4. Northern Region A) pheasant bag, B) pheasant hunters, and C) average hunter bag; Annual Game Take Survey 1948 – 2010.

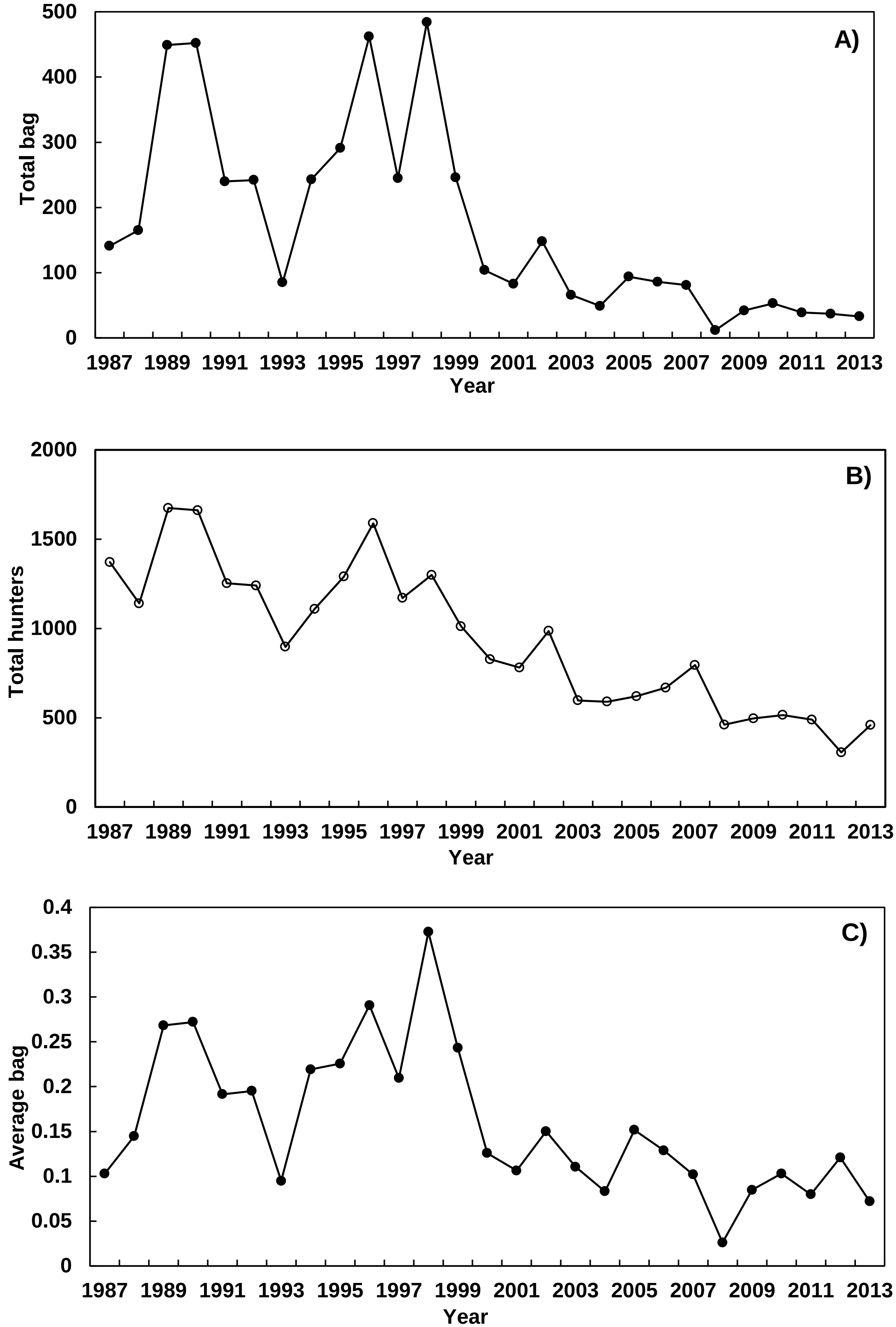


Figure 5. Pheasant A) bag, B) hunters during pheasant season, and C) average pheasant bag per hunter at Honey Lake WA (Dakin Unit) 1987 – 2013.

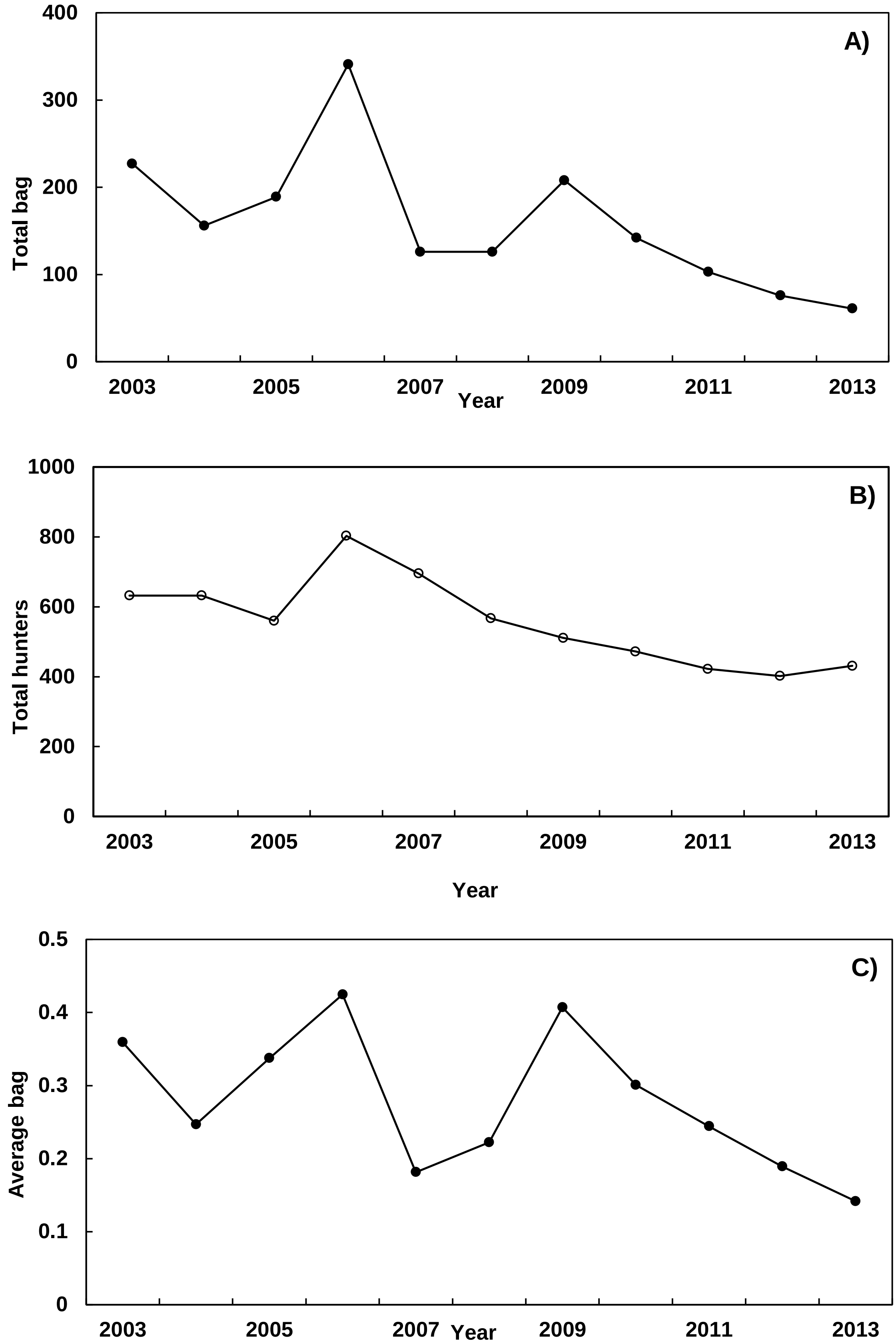


Figure 6. Pheasant A) bag, B) hunters during pheasant season, and C) average pheasant bag per hunter at Honey Lake WA (Fleming Unit) 2003 – 2013.

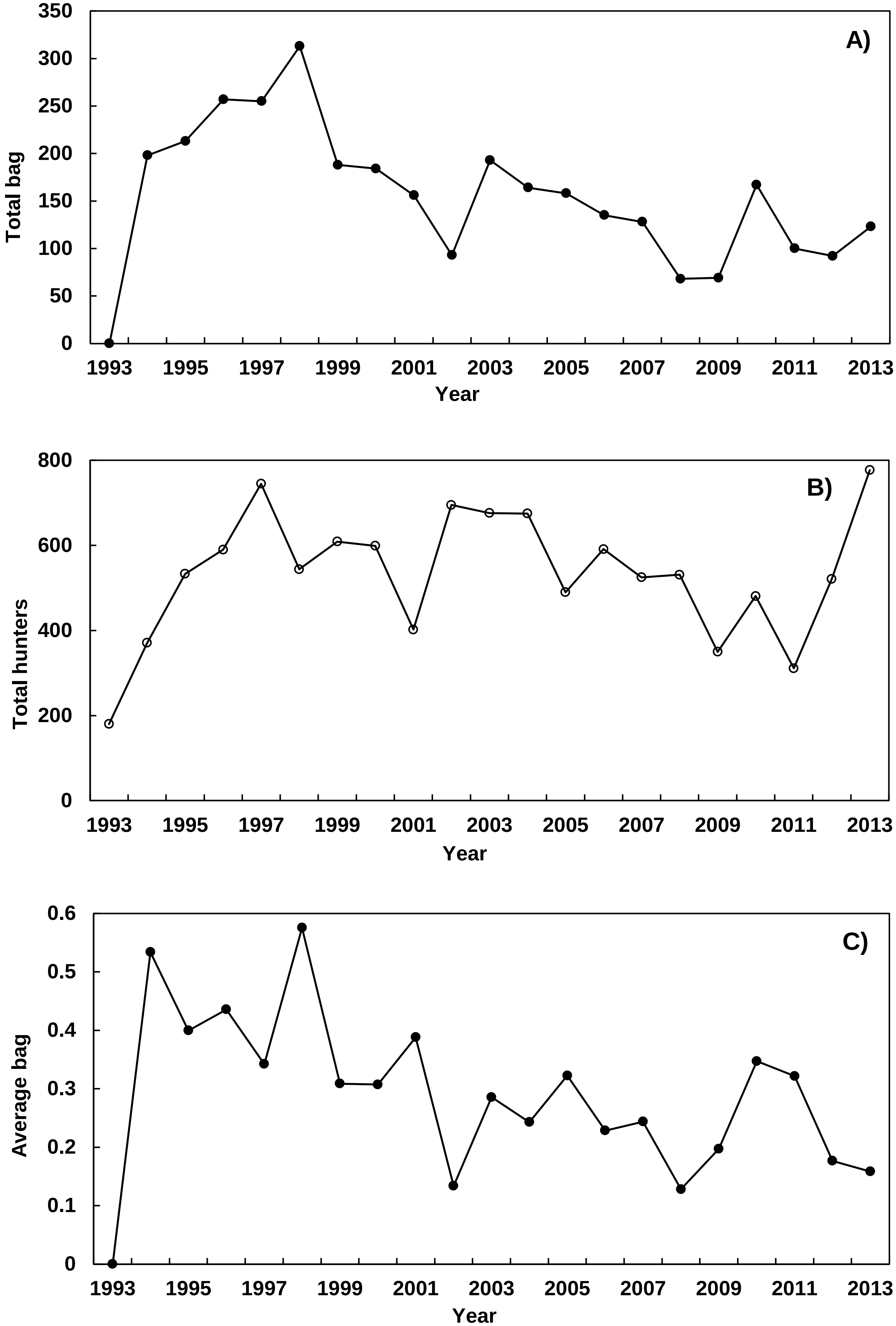


Figure 7. Pheasant A) bag, B) hunters during pheasant season, and C) average pheasant bag per hunter at Shasta Valley WA 1993 – 2013.

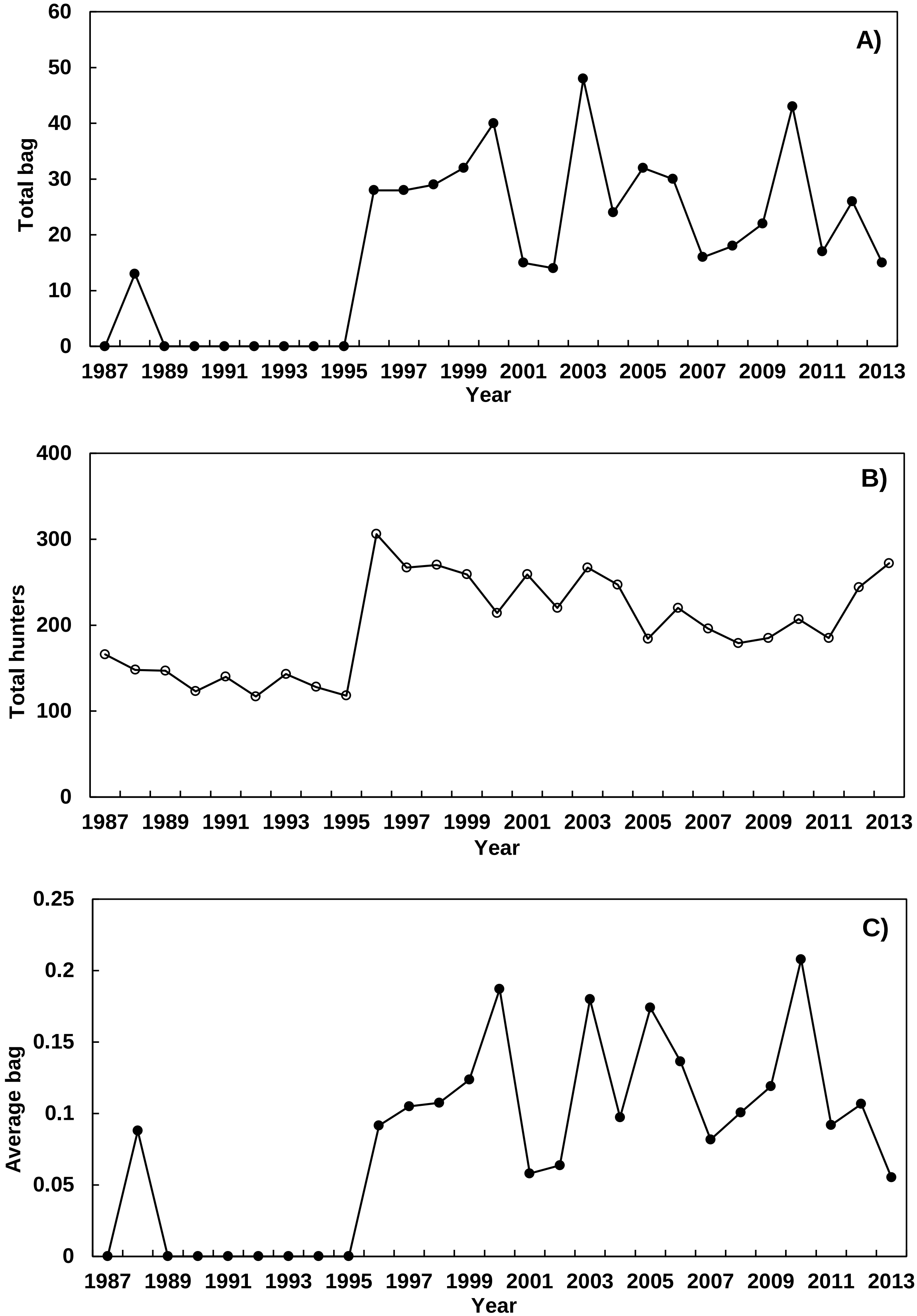


Figure 8. Pheasant A) bag, B) hunters during pheasant season, and C) average pheasant bag per hunter at Ash Creek WA 1987 – 2013.

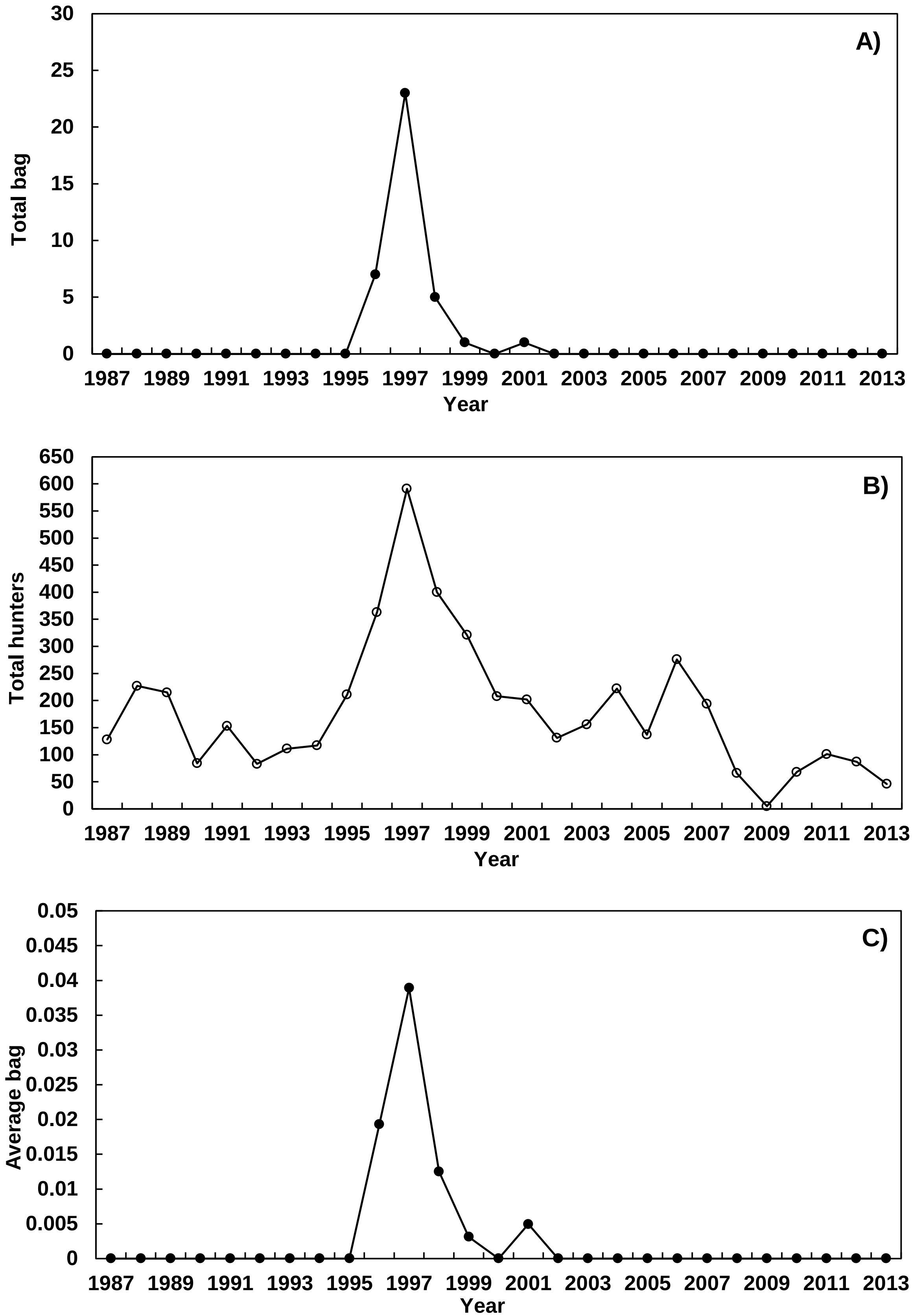


Figure 9. Pheasant A) bag, B) hunters during pheasant season, and C) average pheasant bag per hunter at Butte Valley WA 1987 – 2013.

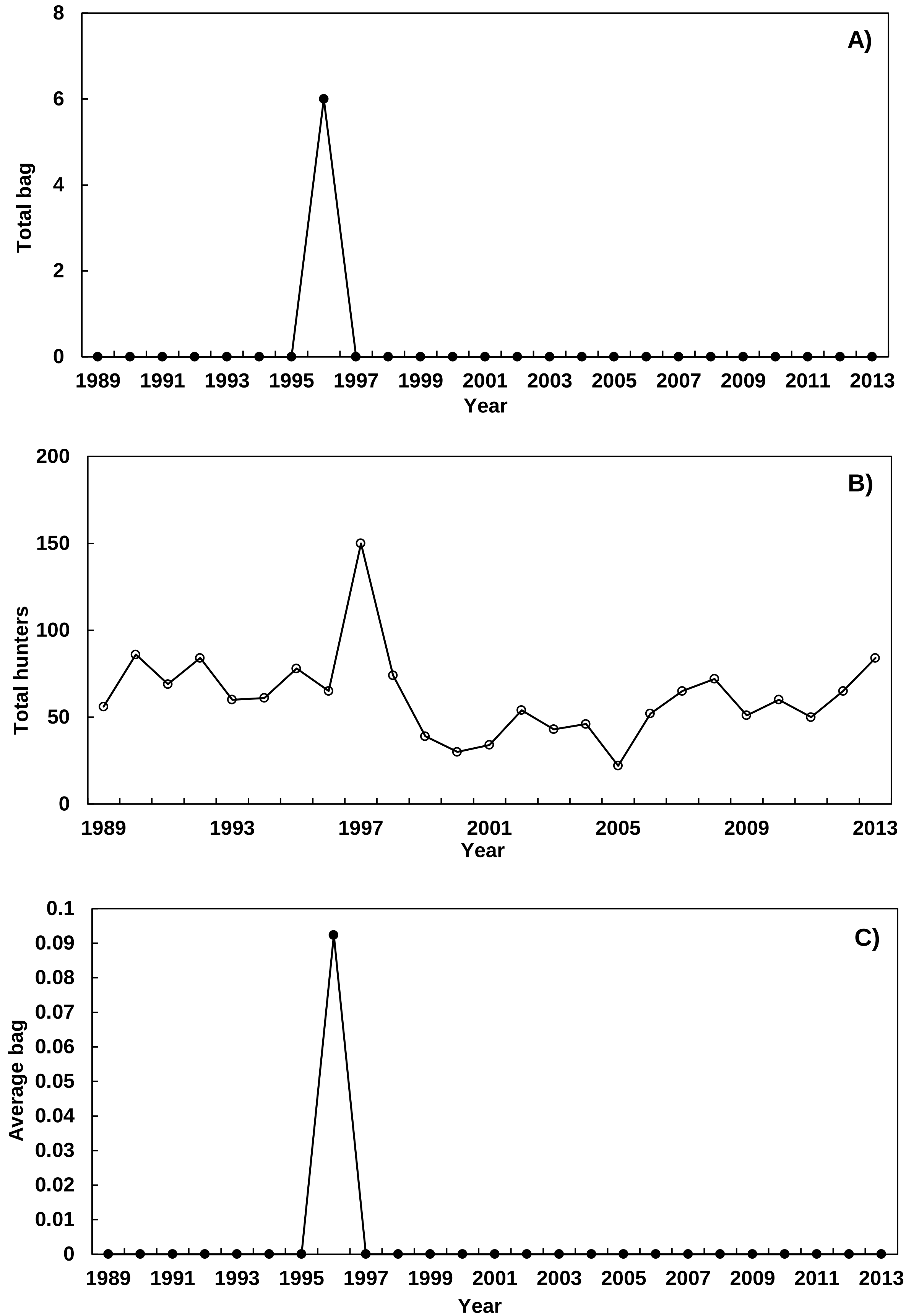


Figure 10. Pheasant A) bag, B) hunters during pheasant season, and C) average pheasant bag per hunter at Willow Creek WA 1989 – 2013.

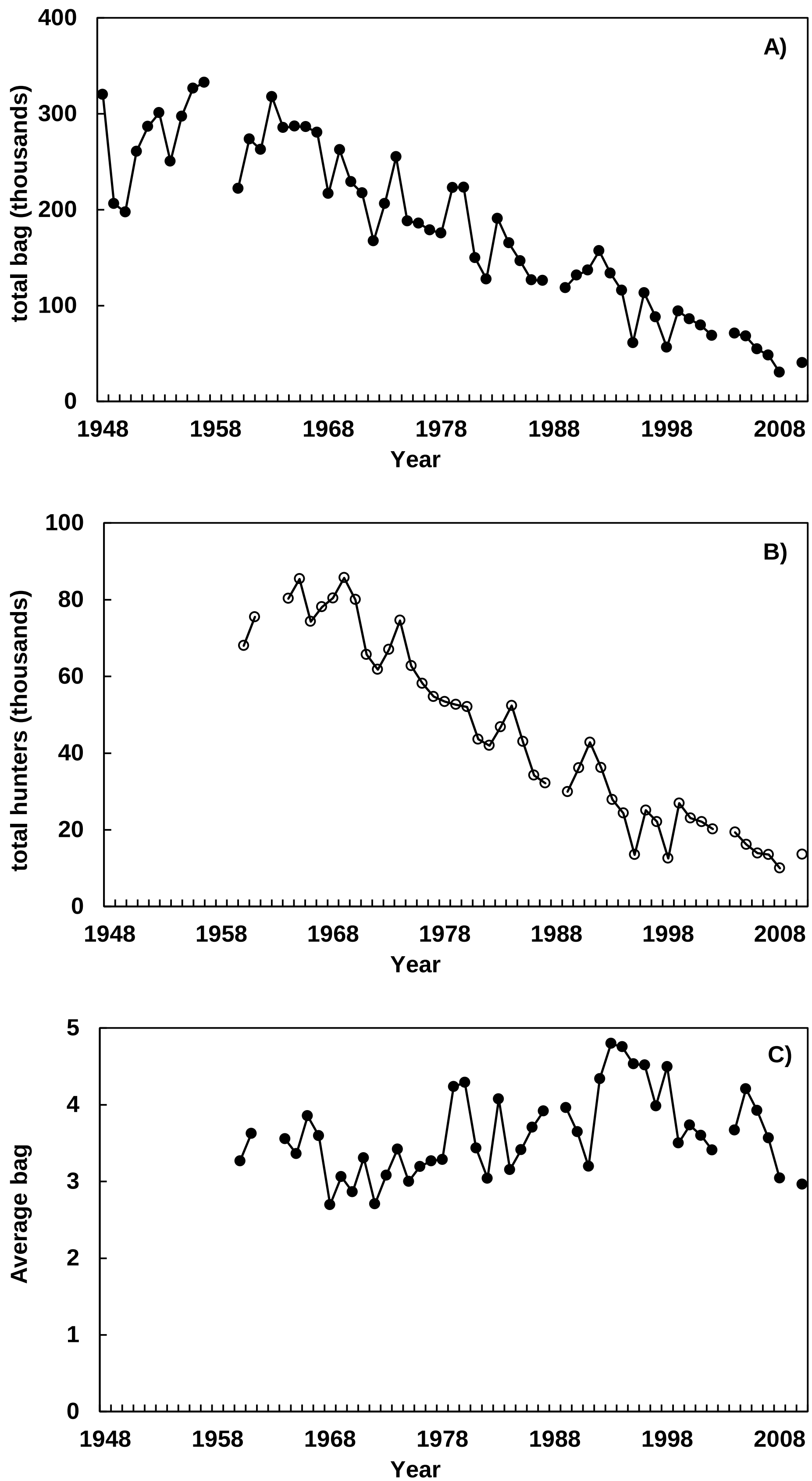


Figure 11. North Central Region A) pheasant bag, B) pheasant hunters, and C) average hunter bag; Annual Game Take Survey 1948 – 2010.

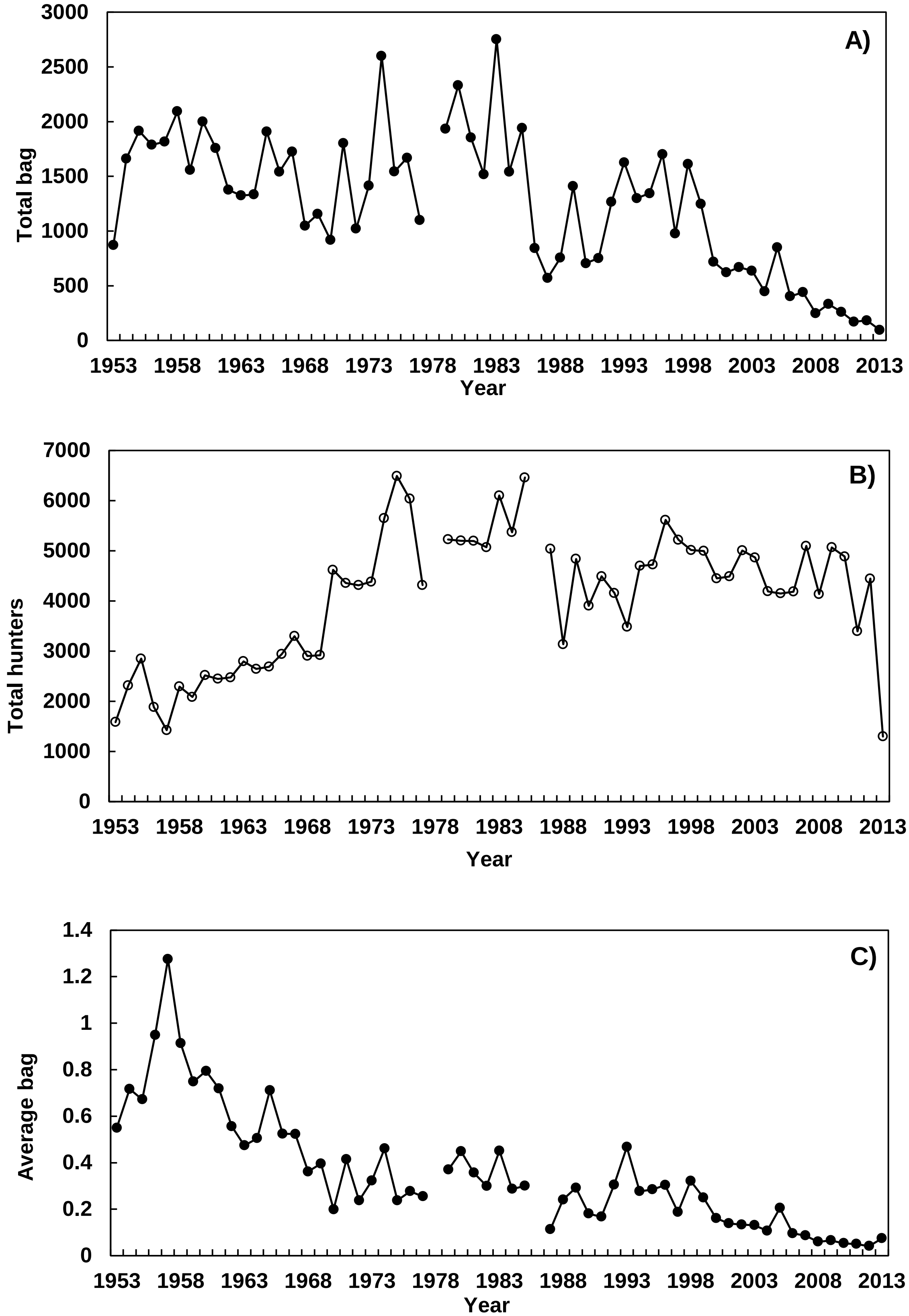


Figure 12. Pheasant A) bag, B) hunters during pheasant season, and C) average pheasant bag per hunter at Gray Lodge WA 1953 – 2013.

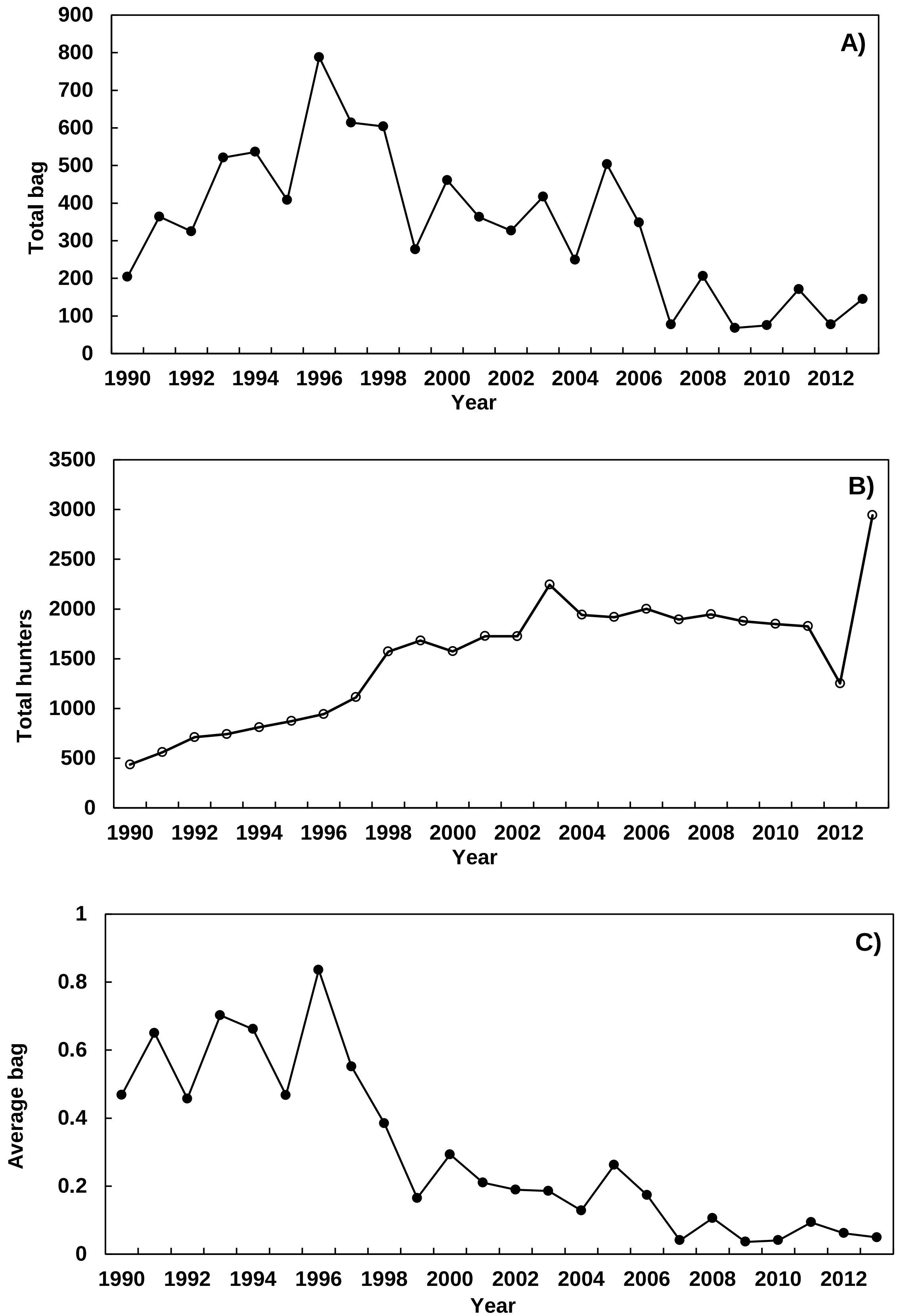


Figure 13. Pheasant A) bag, B) hunters during pheasant season, and C) average pheasant bag per hunter at Upper Butte Basin WA (Little Dry Creek Unit) 1990 – 2013.

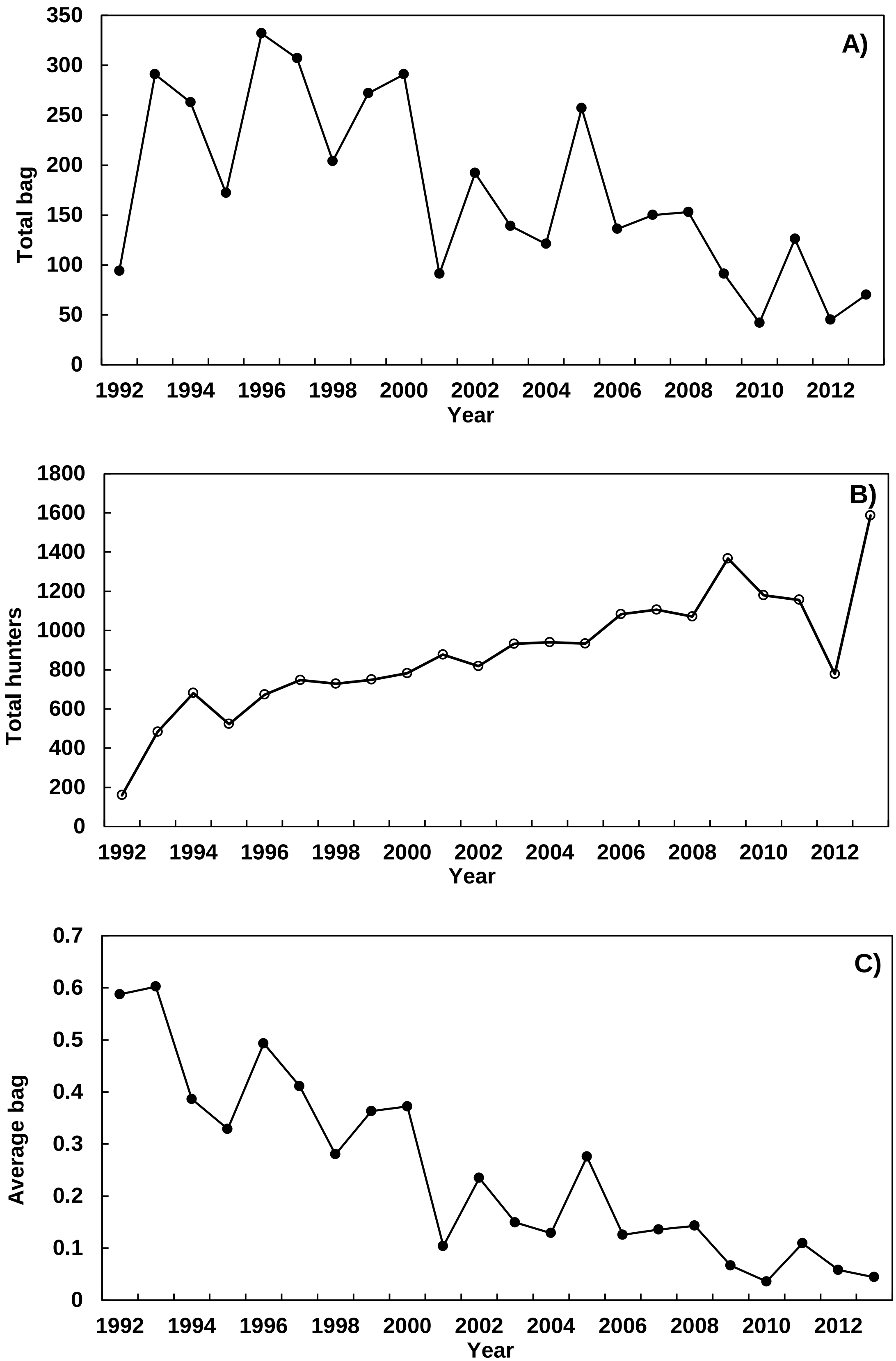


Figure 14. Pheasant A) bag, B) hunters during pheasant season, and C) average pheasant bag per hunter at Upper Butte Basin (Howard Slough Unit) 1992 – 2013.

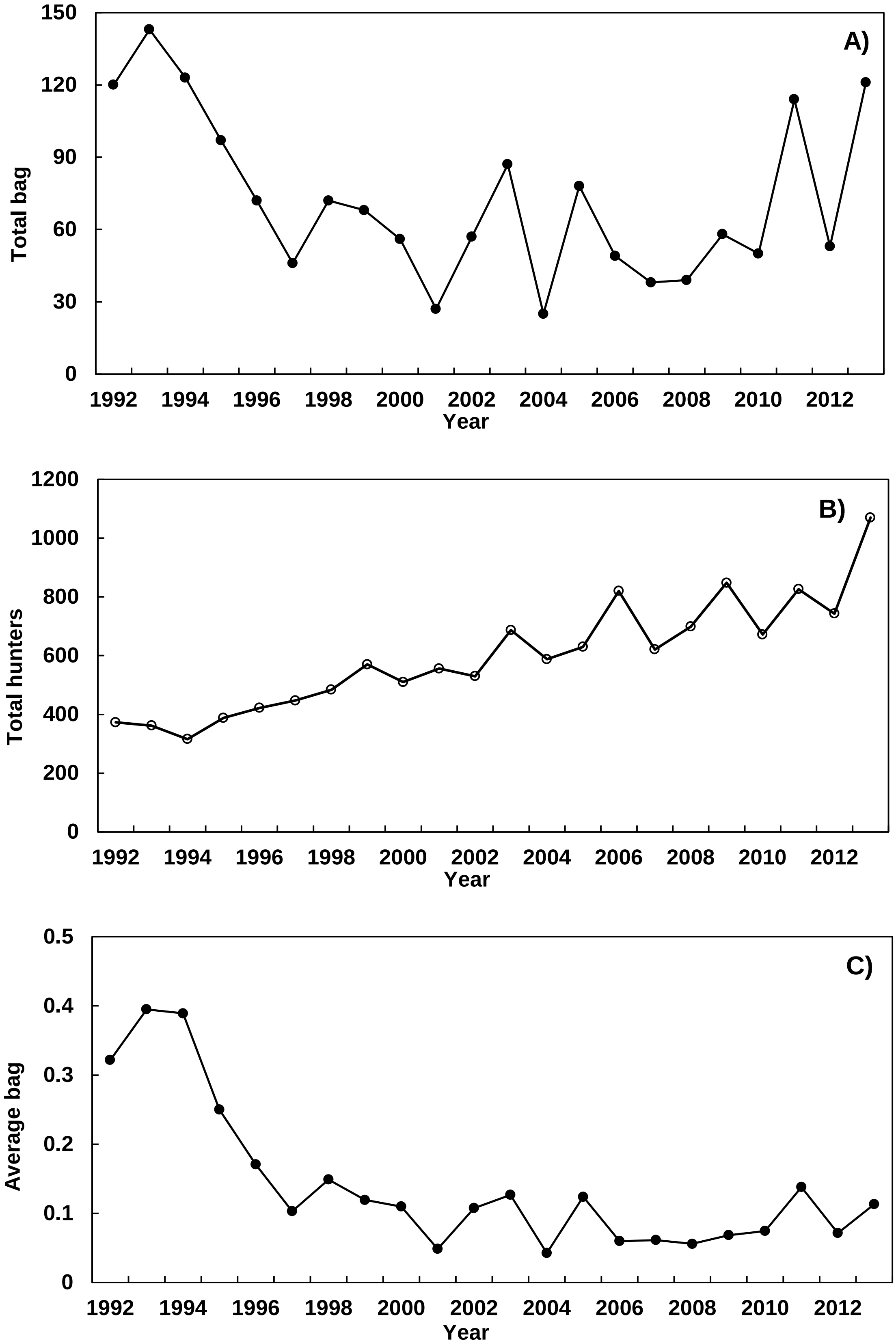


Figure 15. Pheasant A) bag, B) hunters during pheasant season, and C) average pheasant bag per hunter at Upper Butte Basin WA (Llano Seco Unit) 1992 – 2013.

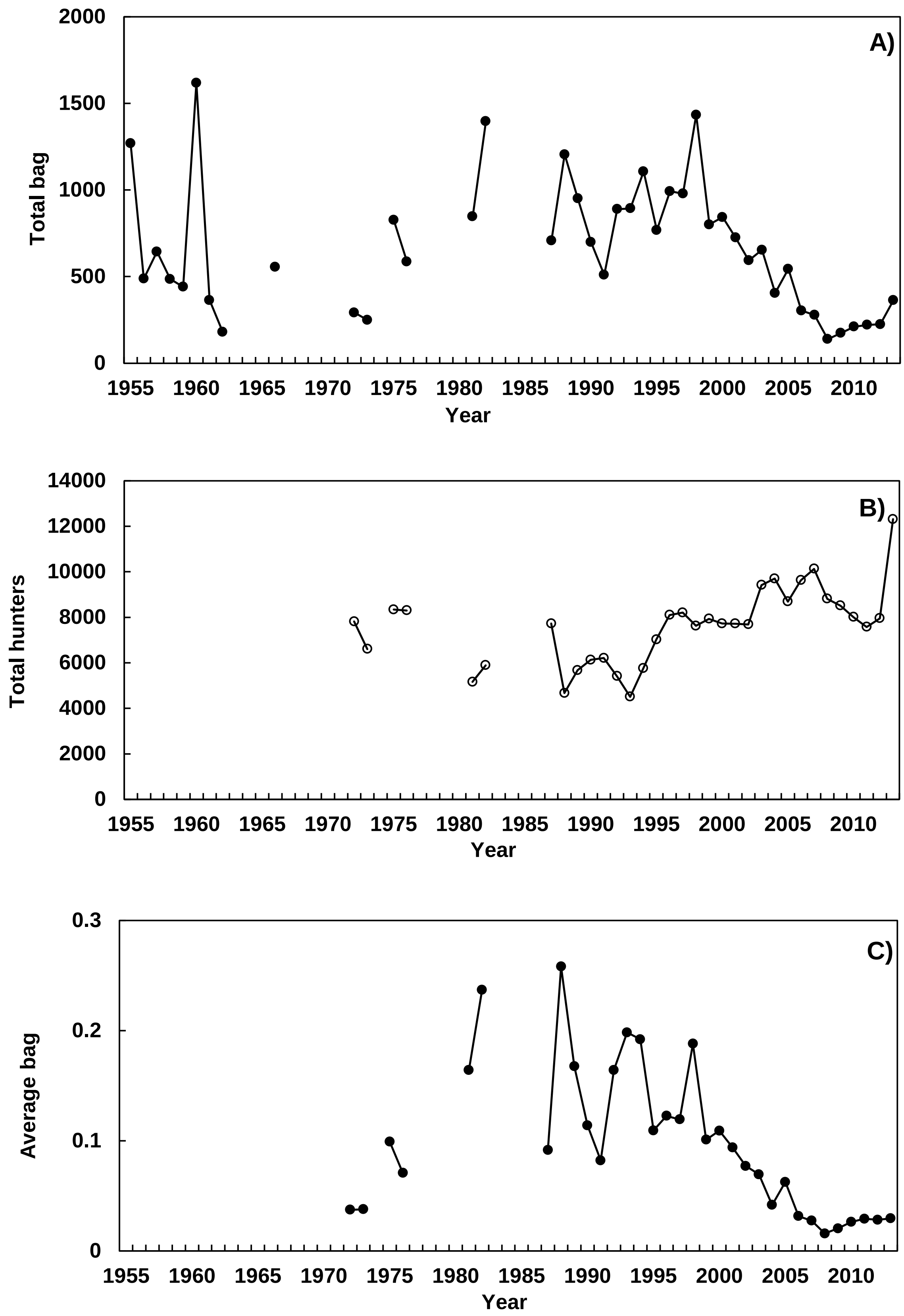


Figure 16. Pheasant A) bag, B) hunters during pheasant season, and C) average pheasant bag per hunter at the Sacramento NWR Complex 1955 – 2013.

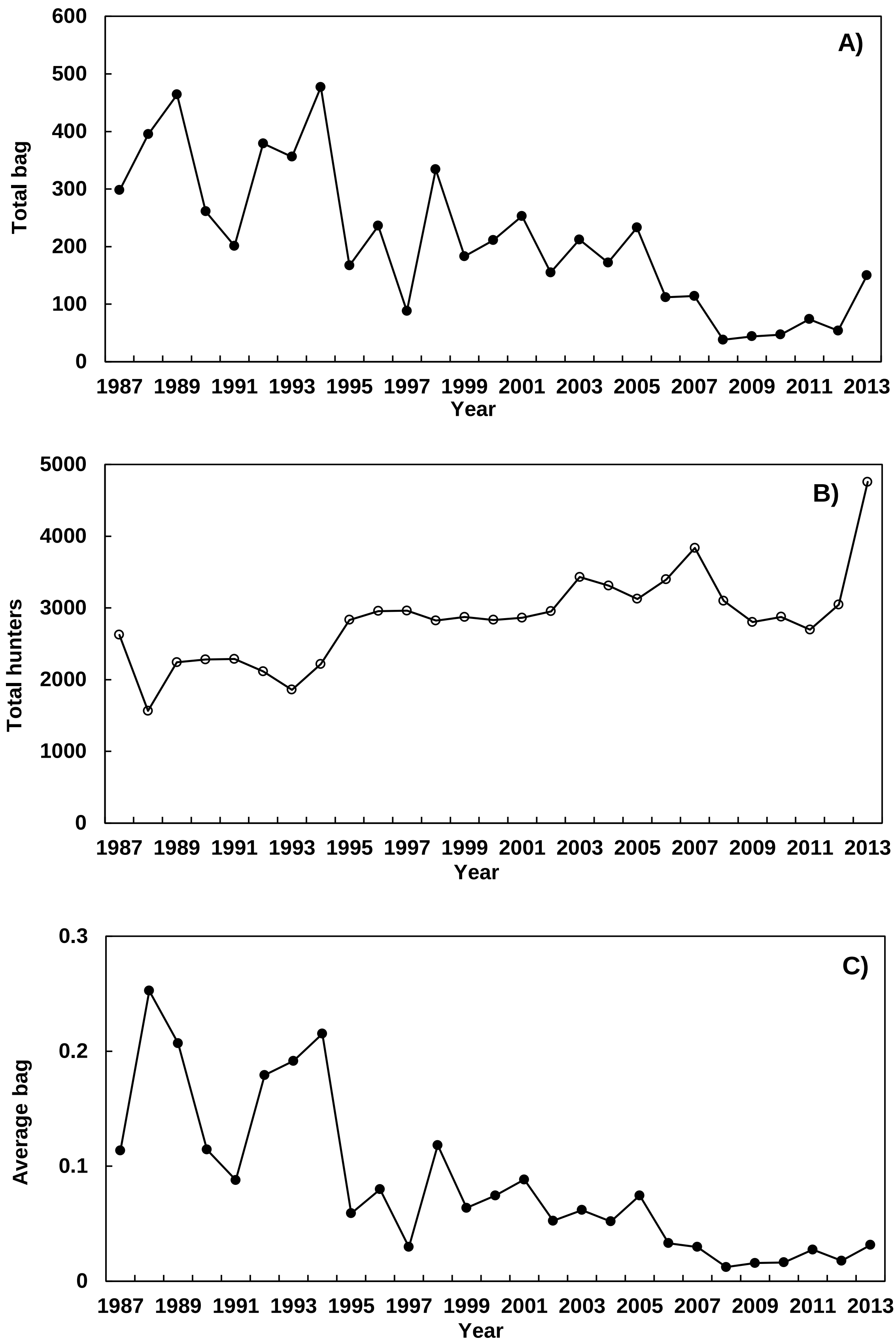


Figure 17. Pheasant A) bag, B) hunters during pheasant season, and C) average pheasant bag per hunter at Sacramento NWR 1987 – 2013.

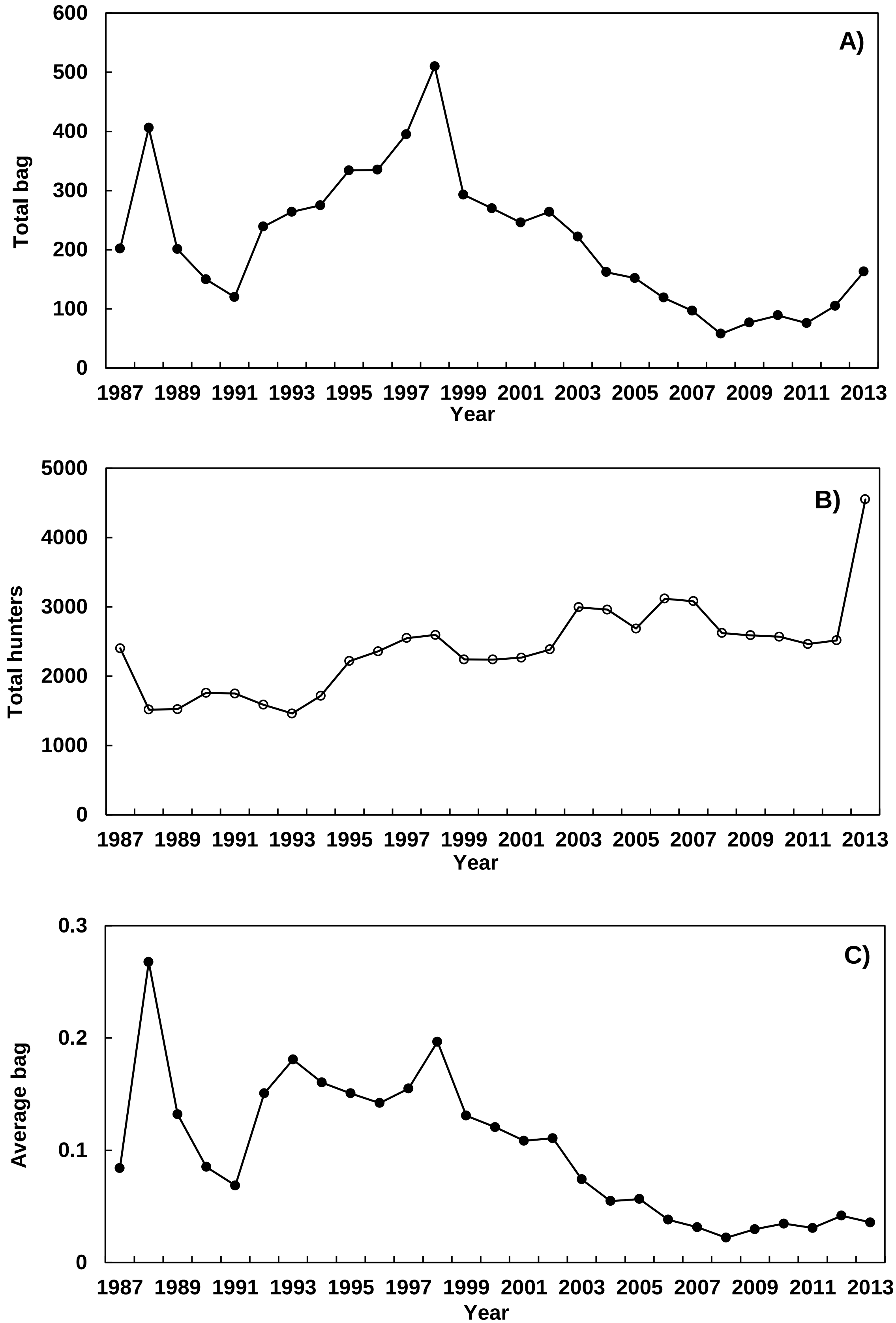


Figure 18. Pheasant A) bag, B) hunters during pheasant season, and C) average pheasant bag per hunter Delevan NWR 1987 – 2013.

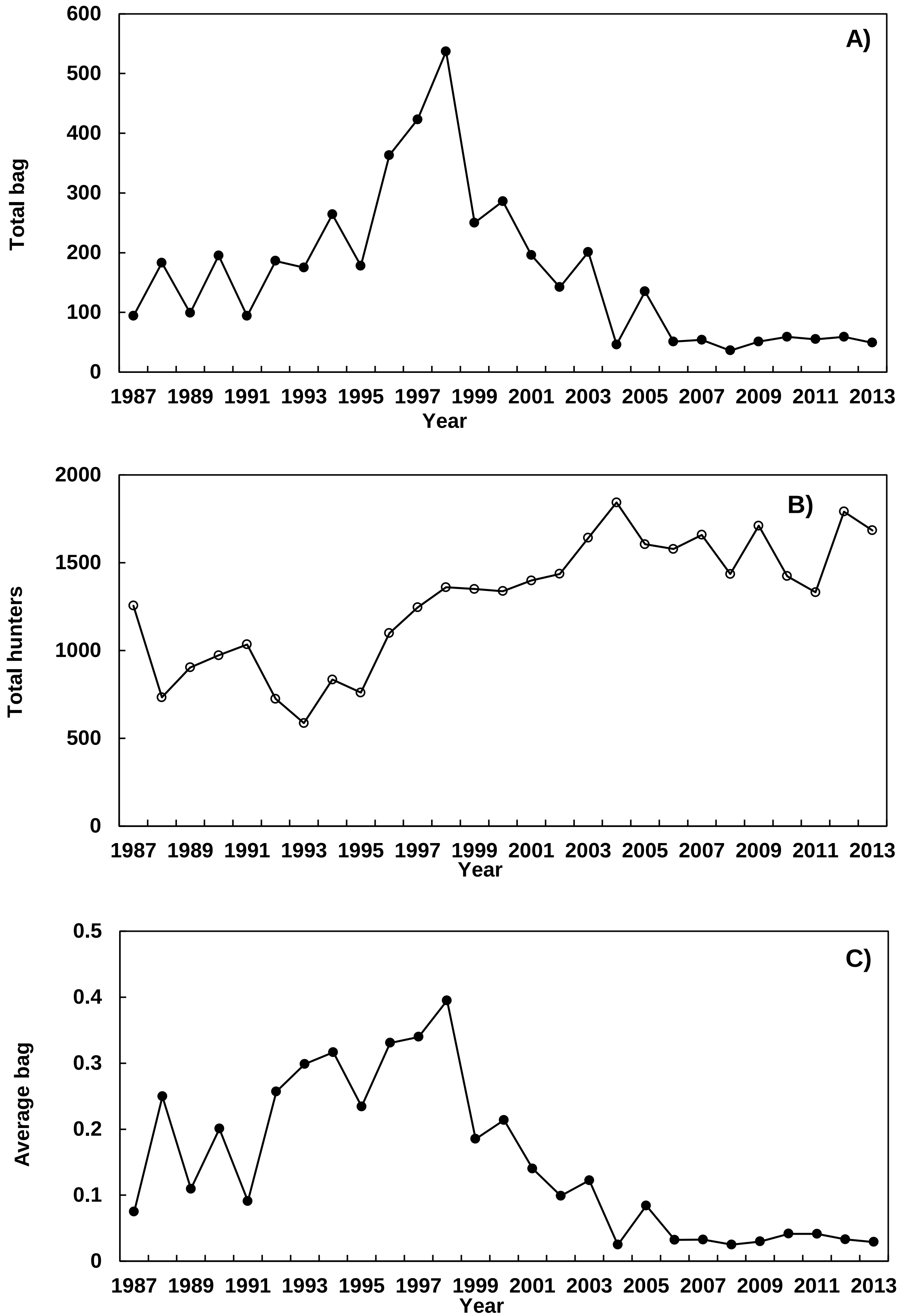


Figure 19. Pheasant A) bag, B) hunters during pheasant season, and C) average pheasant bag per hunter at Colusa NWR 1987 – 2013.

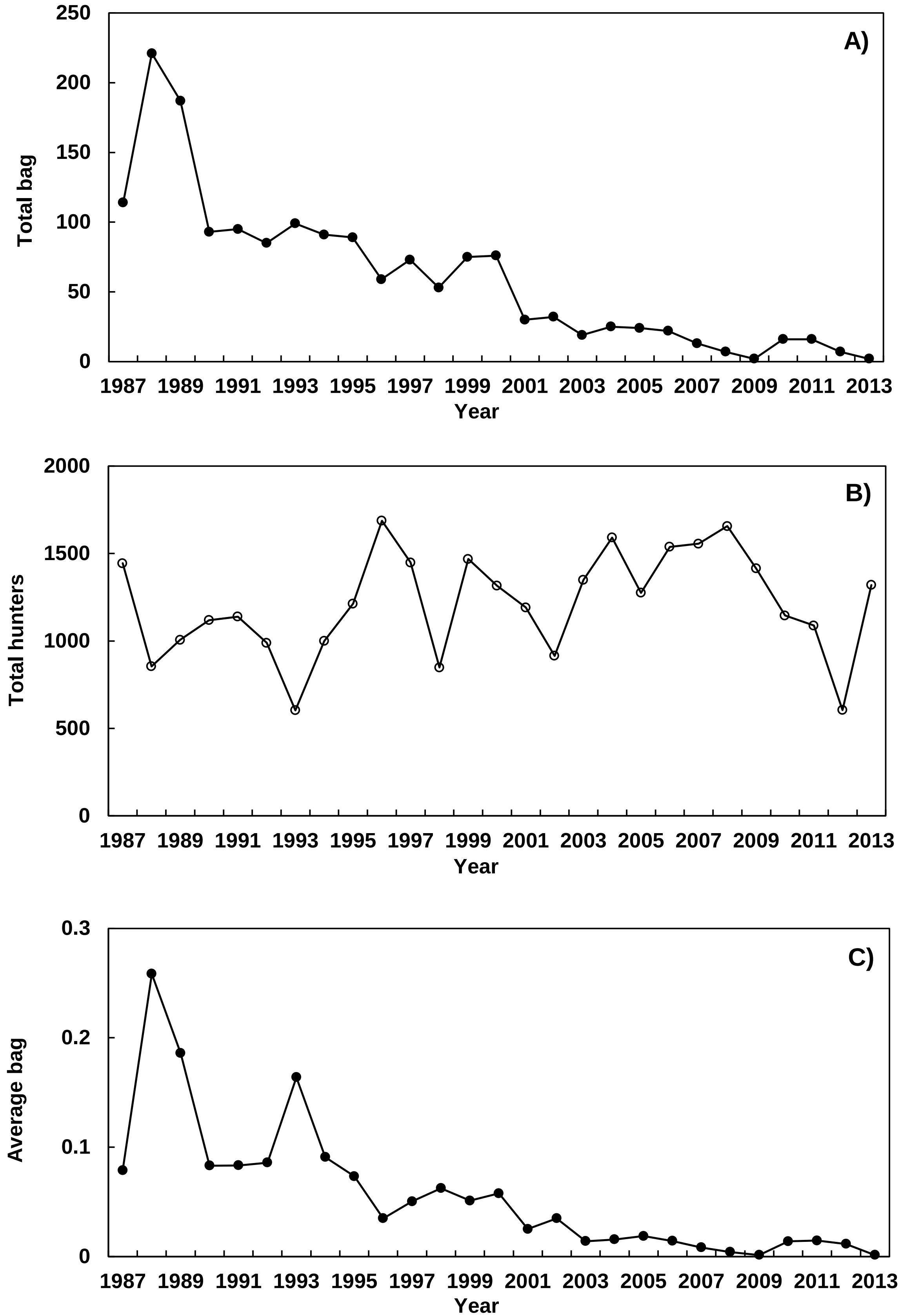


Figure 20. Pheasant A) bag, B) hunters during pheasant season, and C) average pheasant bag per hunter at Sutter NWR 1987 -2013.

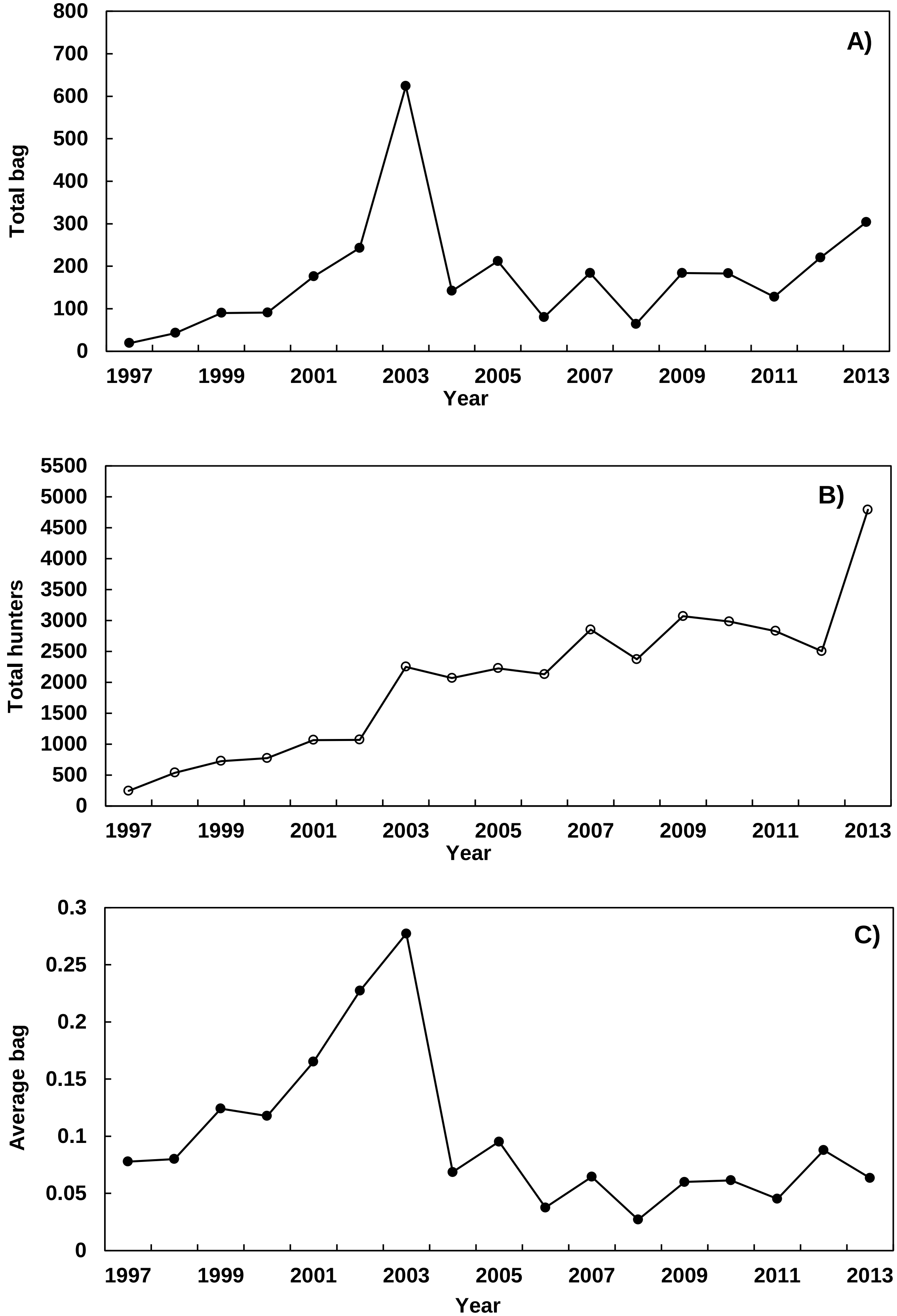


Figure 21. Pheasant A) bag, B) hunters during pheasant season, and C) average pheasant bag per hunter at Yolo WA 1997 – 2013.

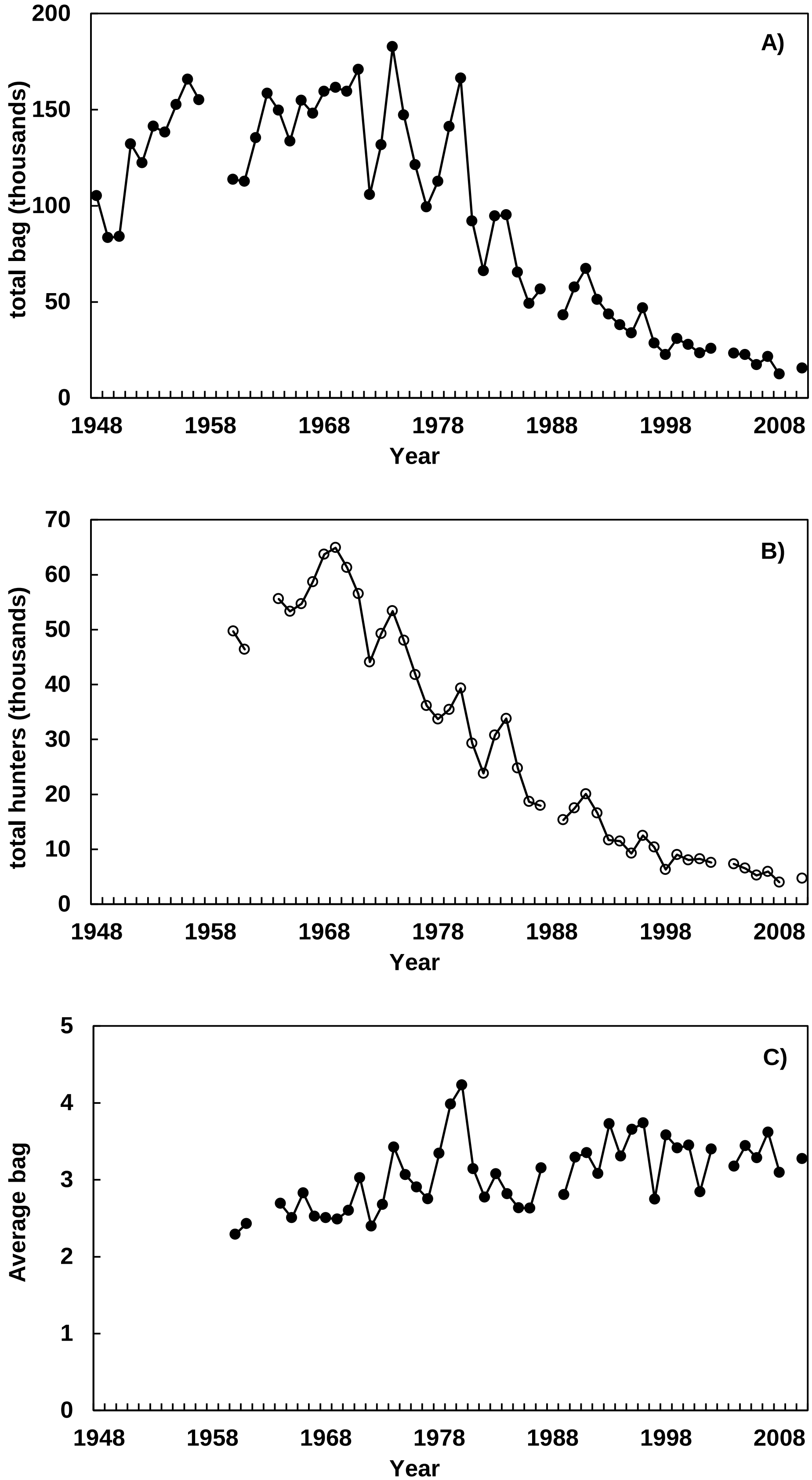


Figure 22. Bay Delta Region A) pheasant bag, B) pheasant hunters, and C) average hunter bag; Annual Game Take Survey 1948 – 2010.

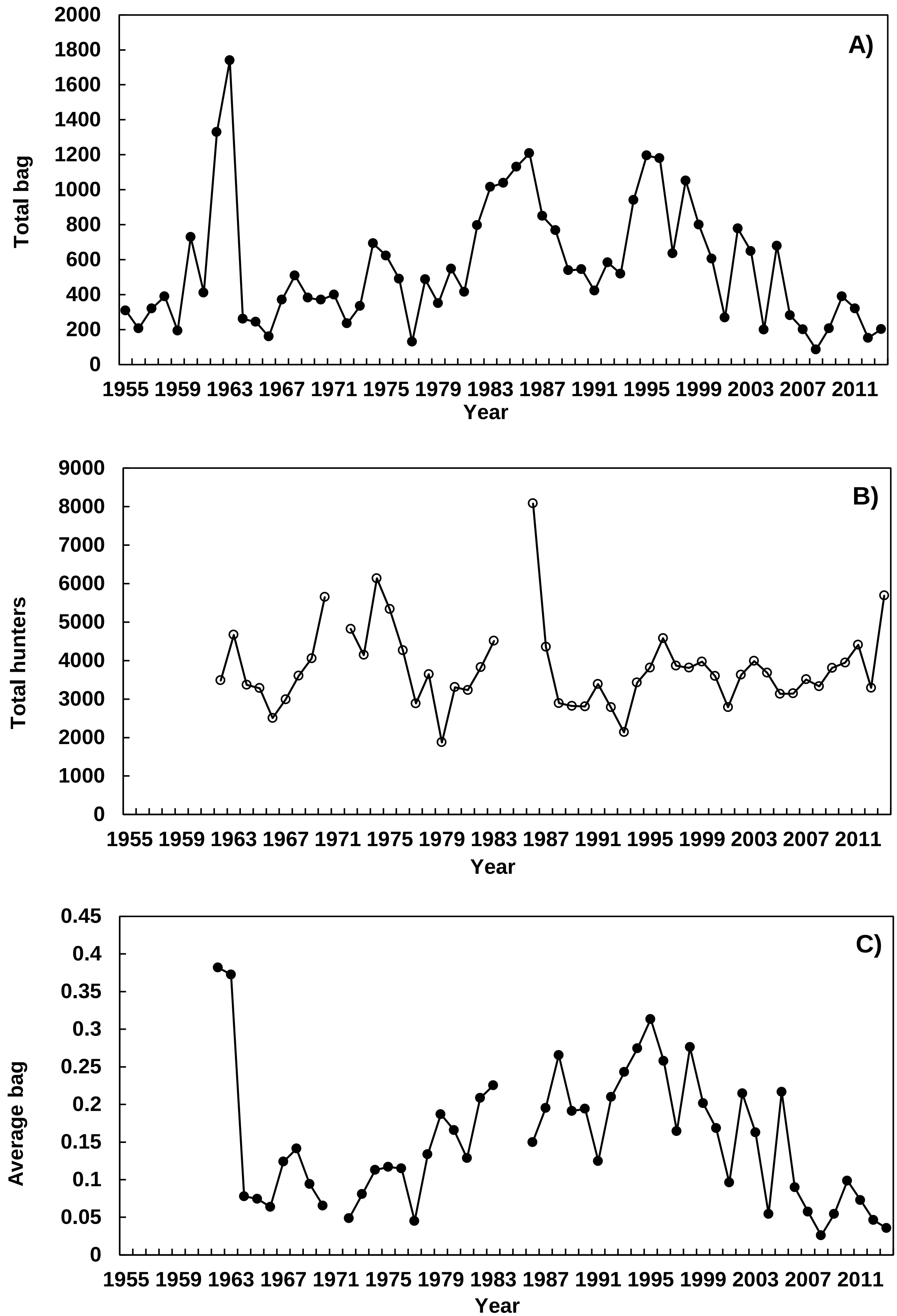


Figure 23. Pheasant A) bag, B) hunters during pheasant season, and C) average pheasant bag per hunter at Suisun Marsh (including: Grizzly Island WA, Joice Island WA, Island Slough WA, Goodyear Slough WA, West Family WA) 1955 – 2013.

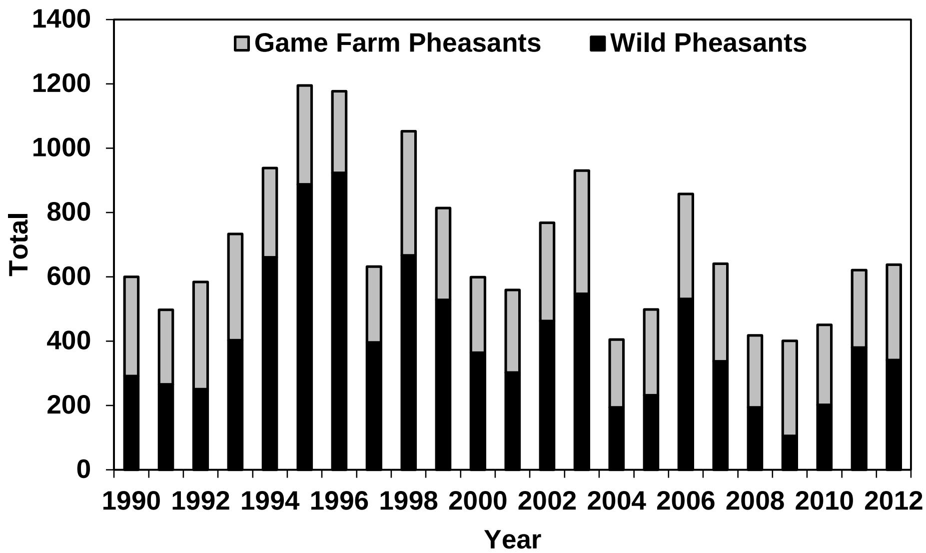


Figure 23-2. Harvest of Wild and Game Farm pheasants at Grizzly Island Wildlife Area, 1990-2012.

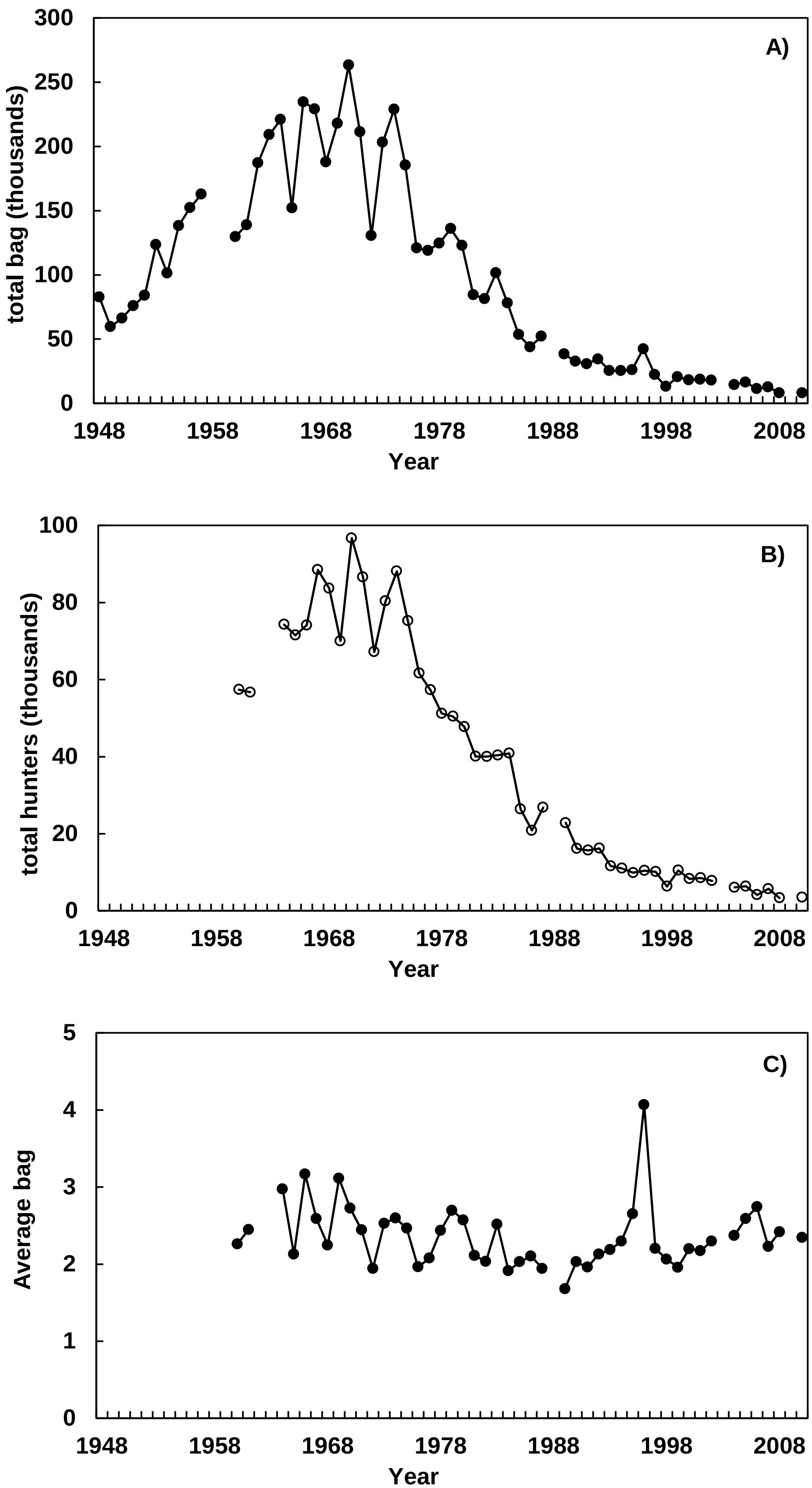


Figure 24. Central Region A) pheasant bag, B) pheasant hunters, and C) average hunter bag; Annual Game Take Survey 1948 – 2010.

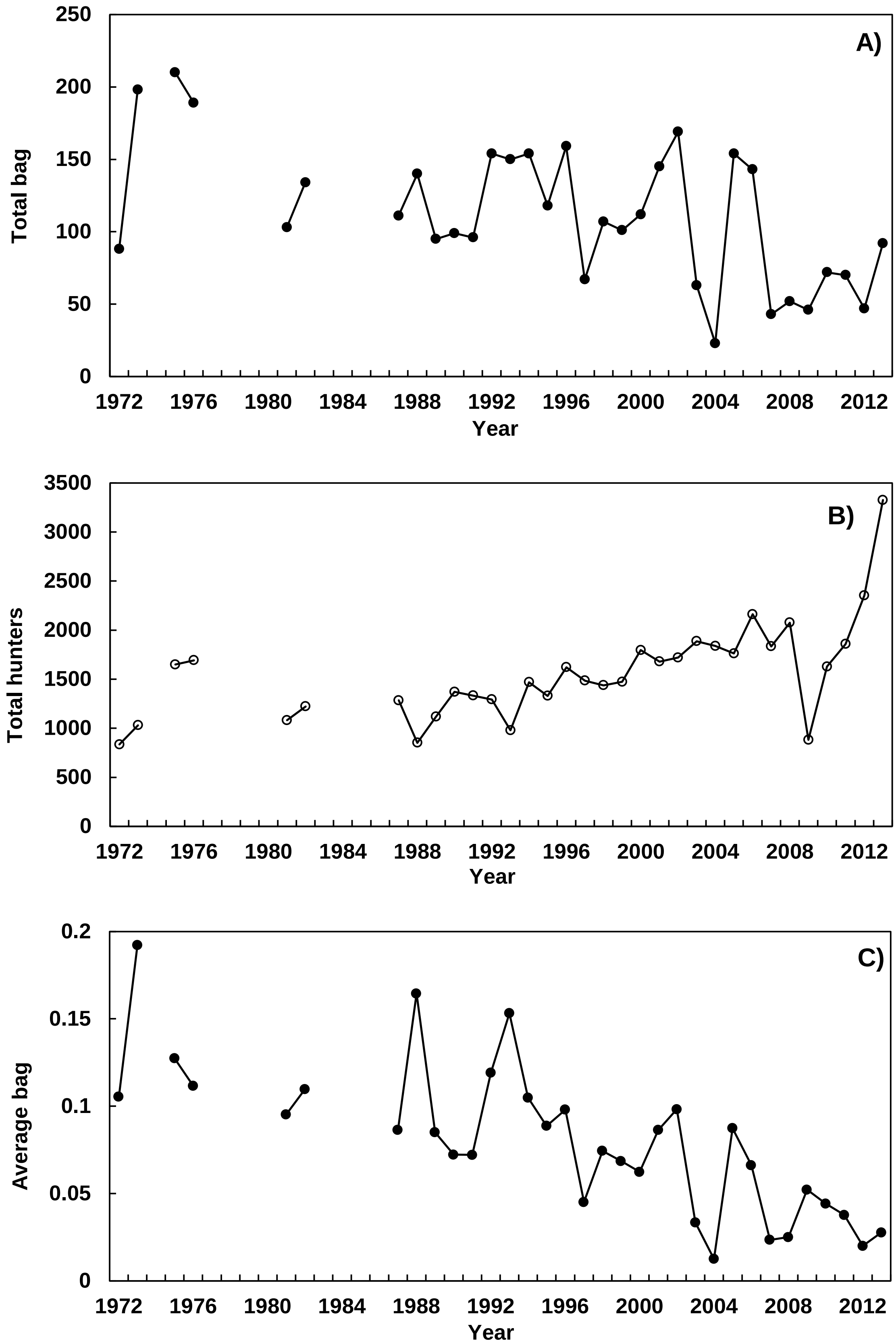


Figure 25. Pheasant A) bag, B) hunters during pheasant season, and C) average pheasant bag per hunter at Los Banos WA 1972 – 2013.

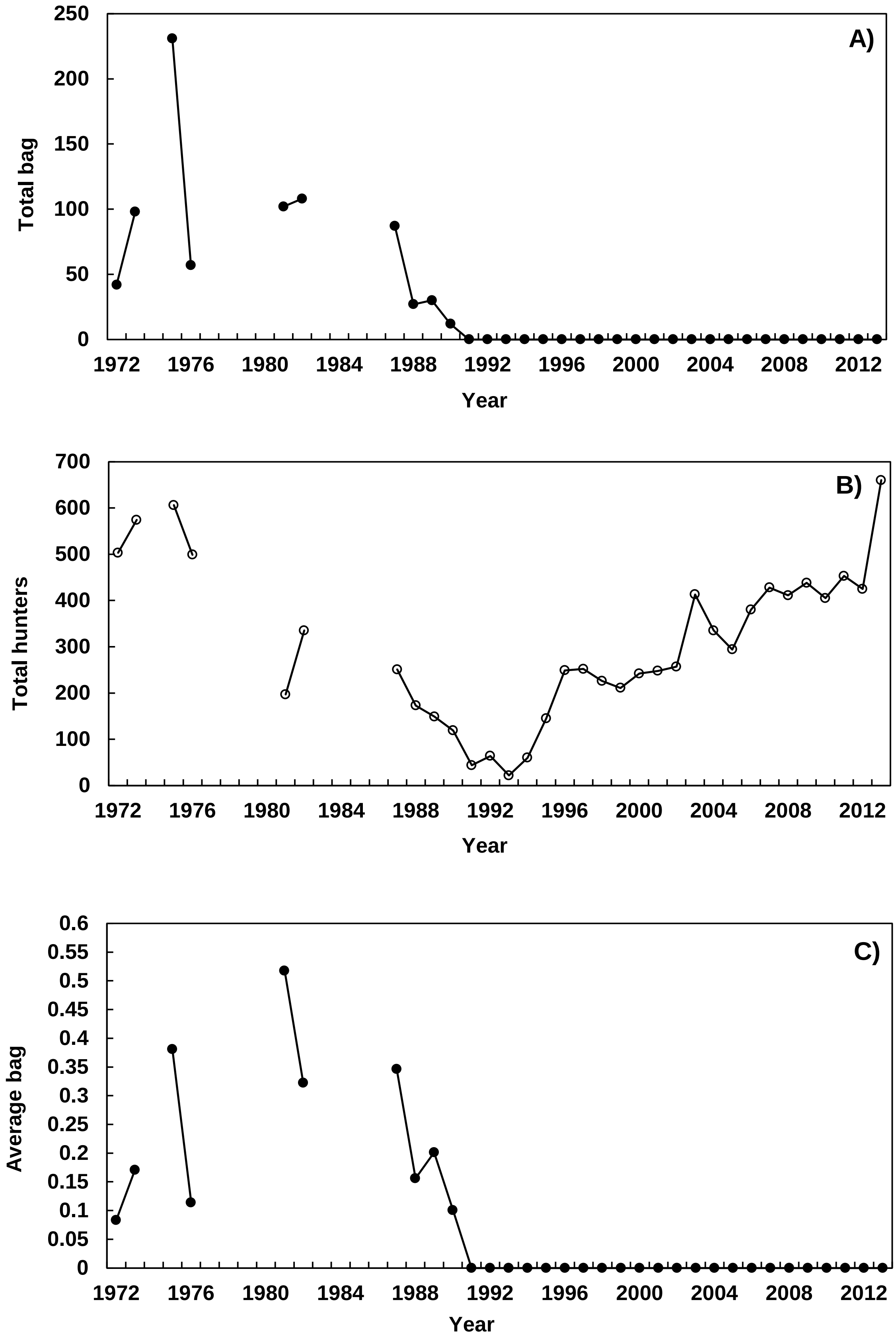


Figure 26. Pheasant A) bag, B) hunters during pheasant season, and C) average pheasant bag per hunter at Merced NWR 1972 – 2013.

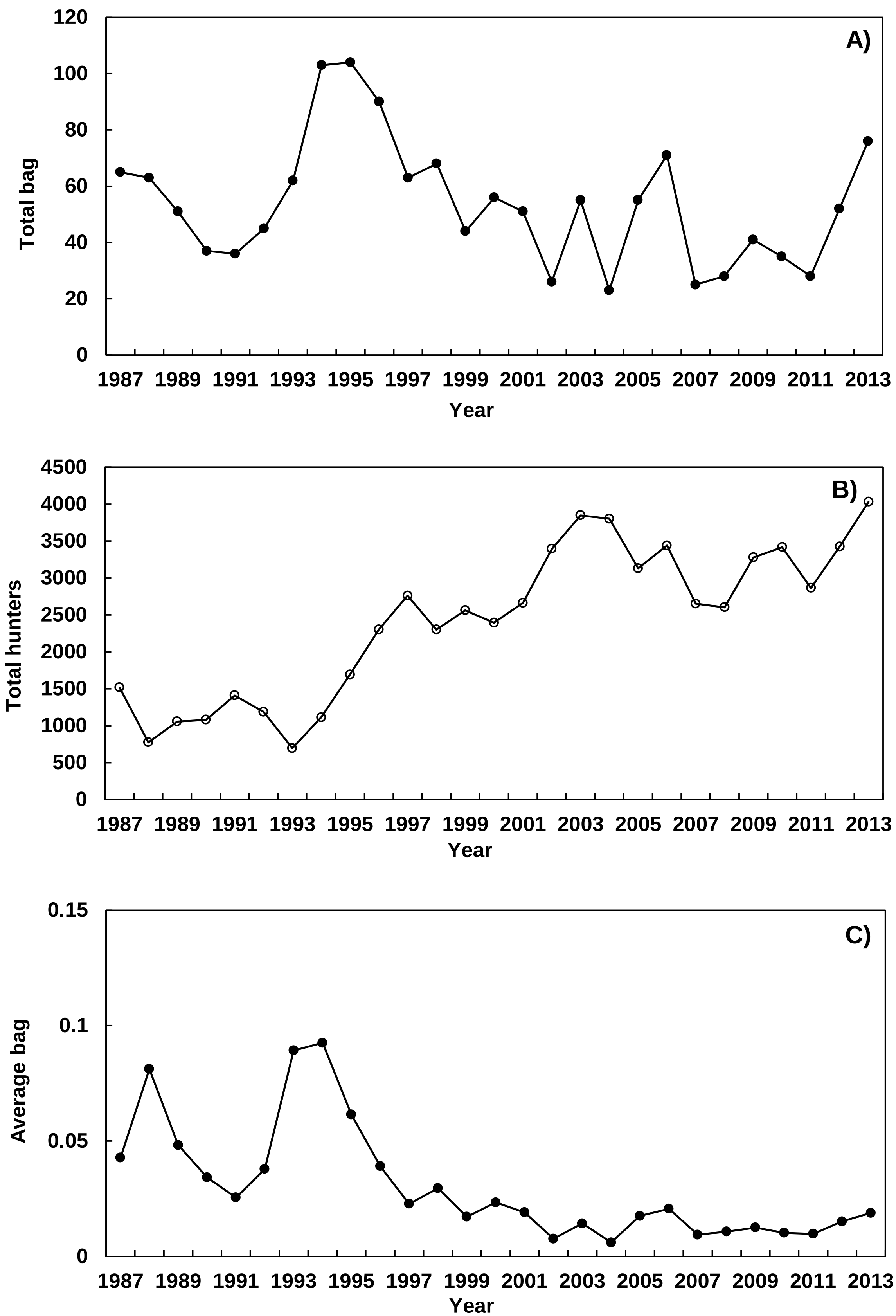


Figure 27. Pheasant A) bag, B) hunters during pheasant season, and C) average pheasant bag per hunter at San Luis NWR Complex 1987 – 2013.

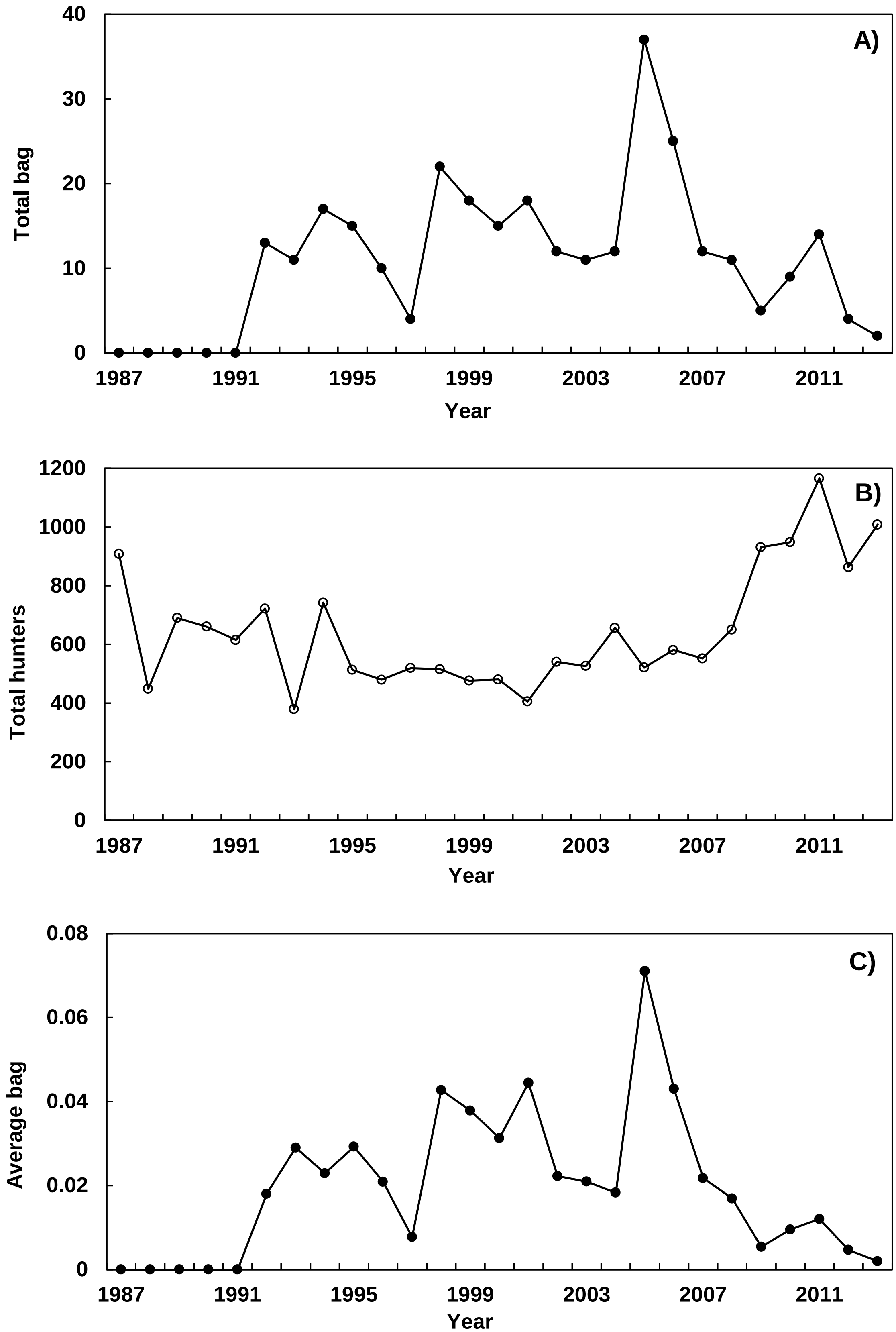


Figure 28. Pheasant A) bag, B) hunters during pheasant season, and C) average pheasant bag per hunter at Volta WA 1987 - 2013.

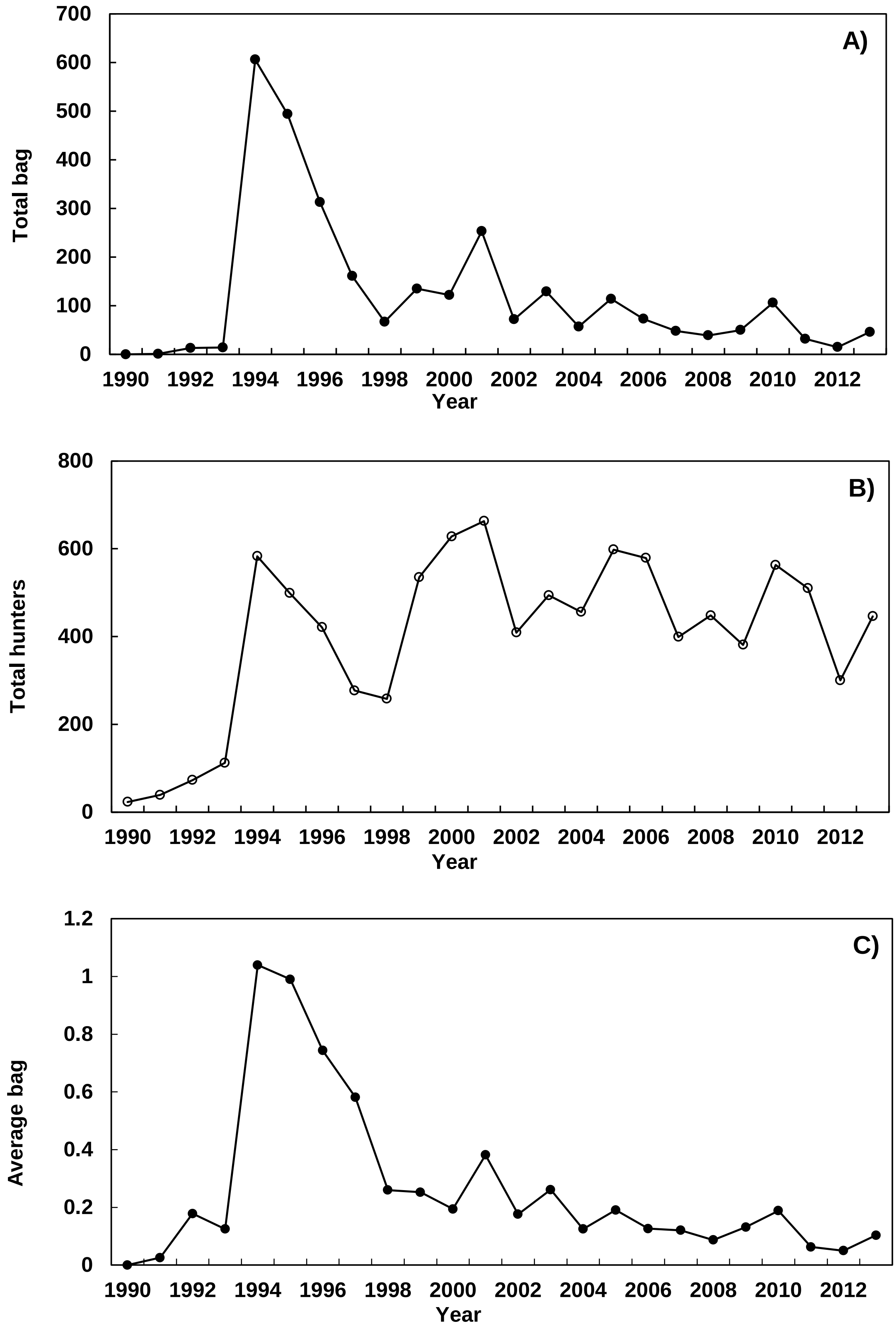


Figure 29. Pheasant A) bag, B) hunters during pheasant season, and C) average pheasant bag per hunter at North Grasslands WA (China Island Unit) 1990 – 2013.

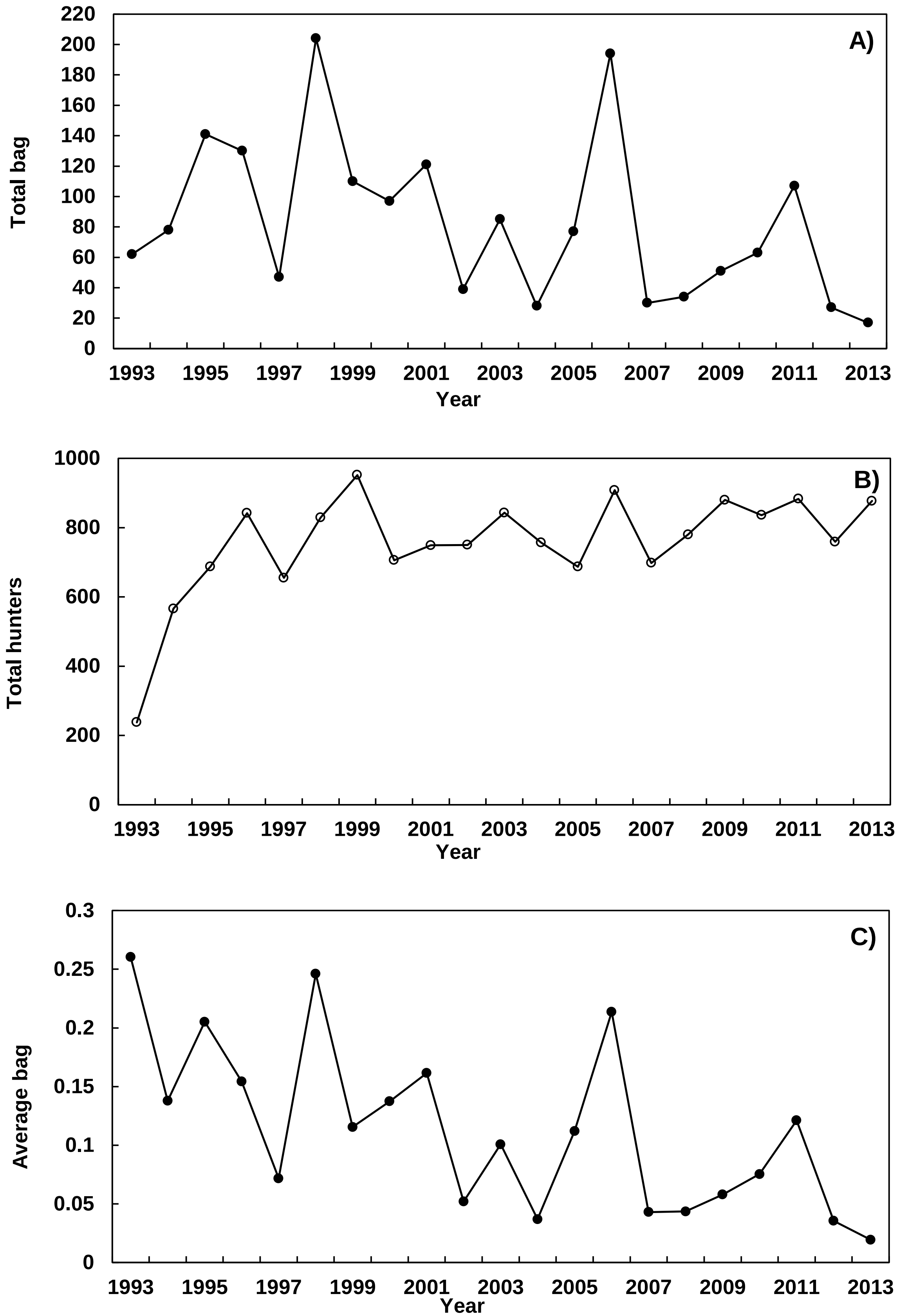


Figure 30. Pheasant A) bag, B) hunters during pheasant season, and C) average pheasant bag per hunter at North Grasslands WA (Salt Slough Unit) 1993 – 2013.

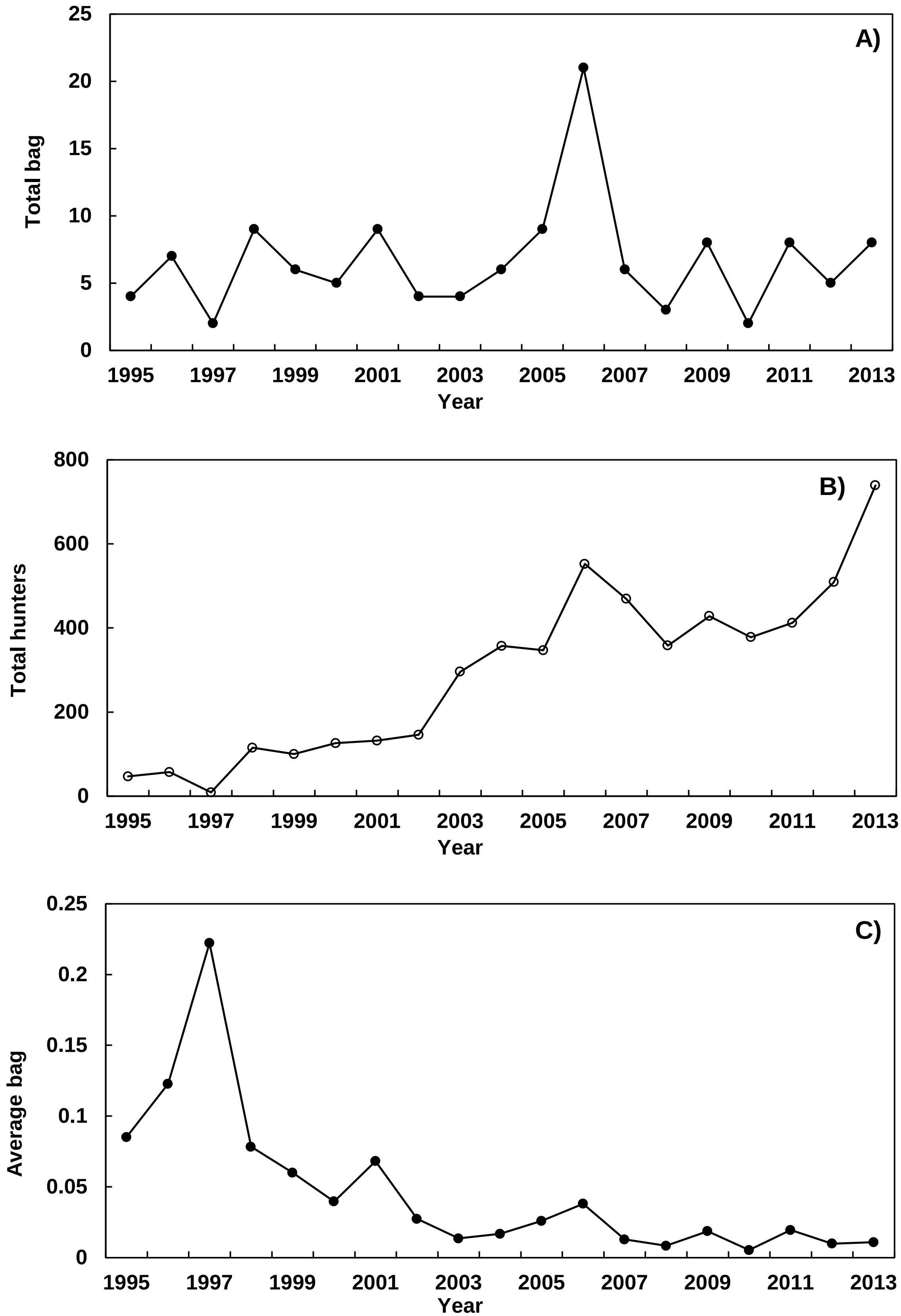


Figure 31. Pheasant A) bag, B) hunters during pheasant season, and C) average pheasant bag per hunter at North Grasslands WA (Gadwall Unit) 1995 – 2013.

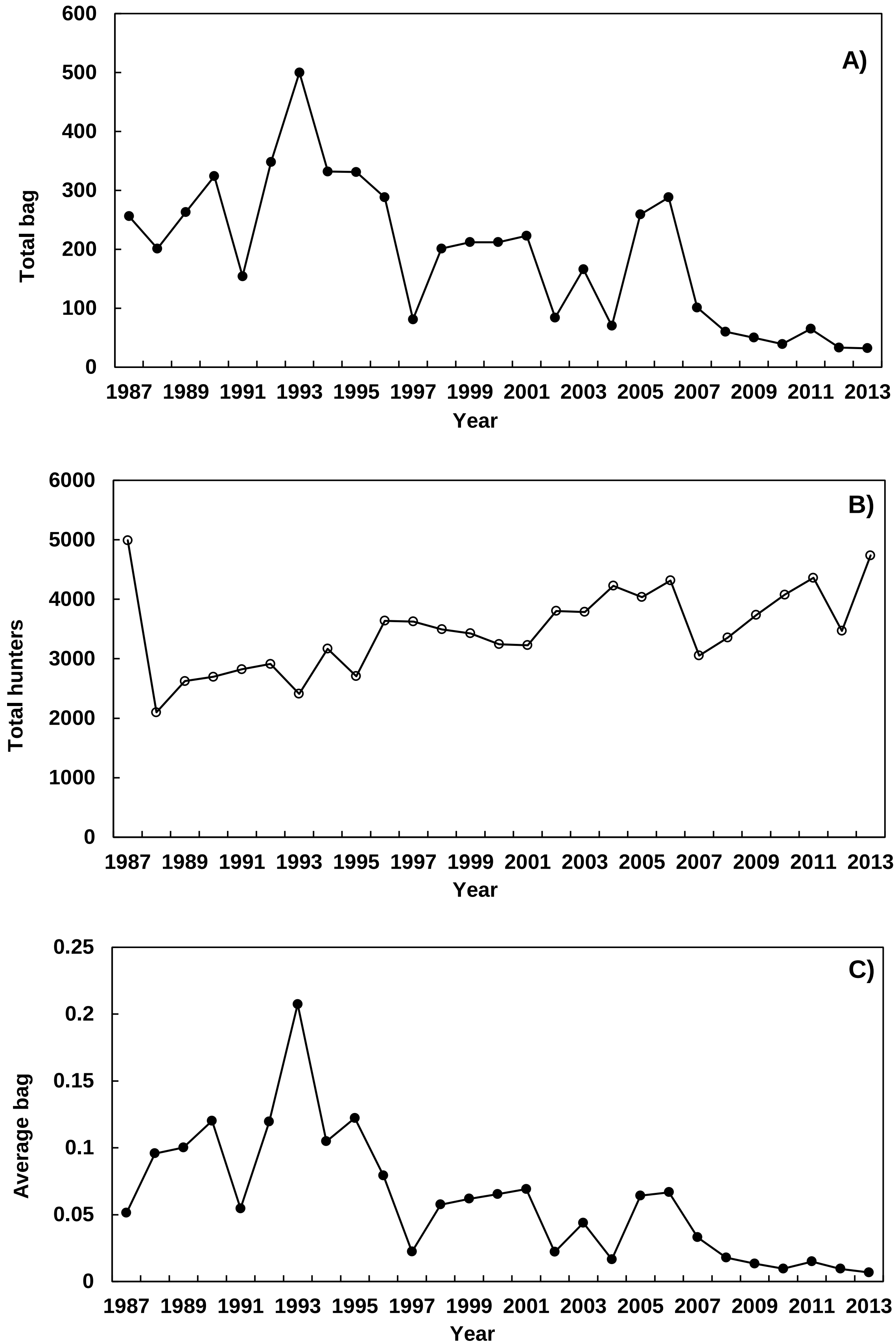


Figure 32. Pheasant A) bag, B) hunters during pheasant season, and C) average pheasant bag per hunter at Mendota WA 1987 – 2013.

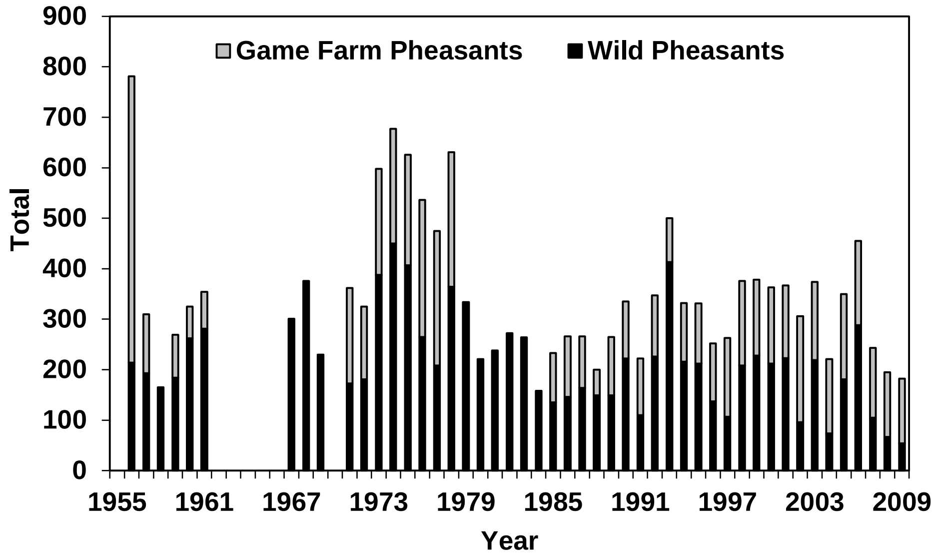


Figure 32-2. Harvest of Wild and Game Farm pheasants at Mendota Wildlife Area, 1955-2009.

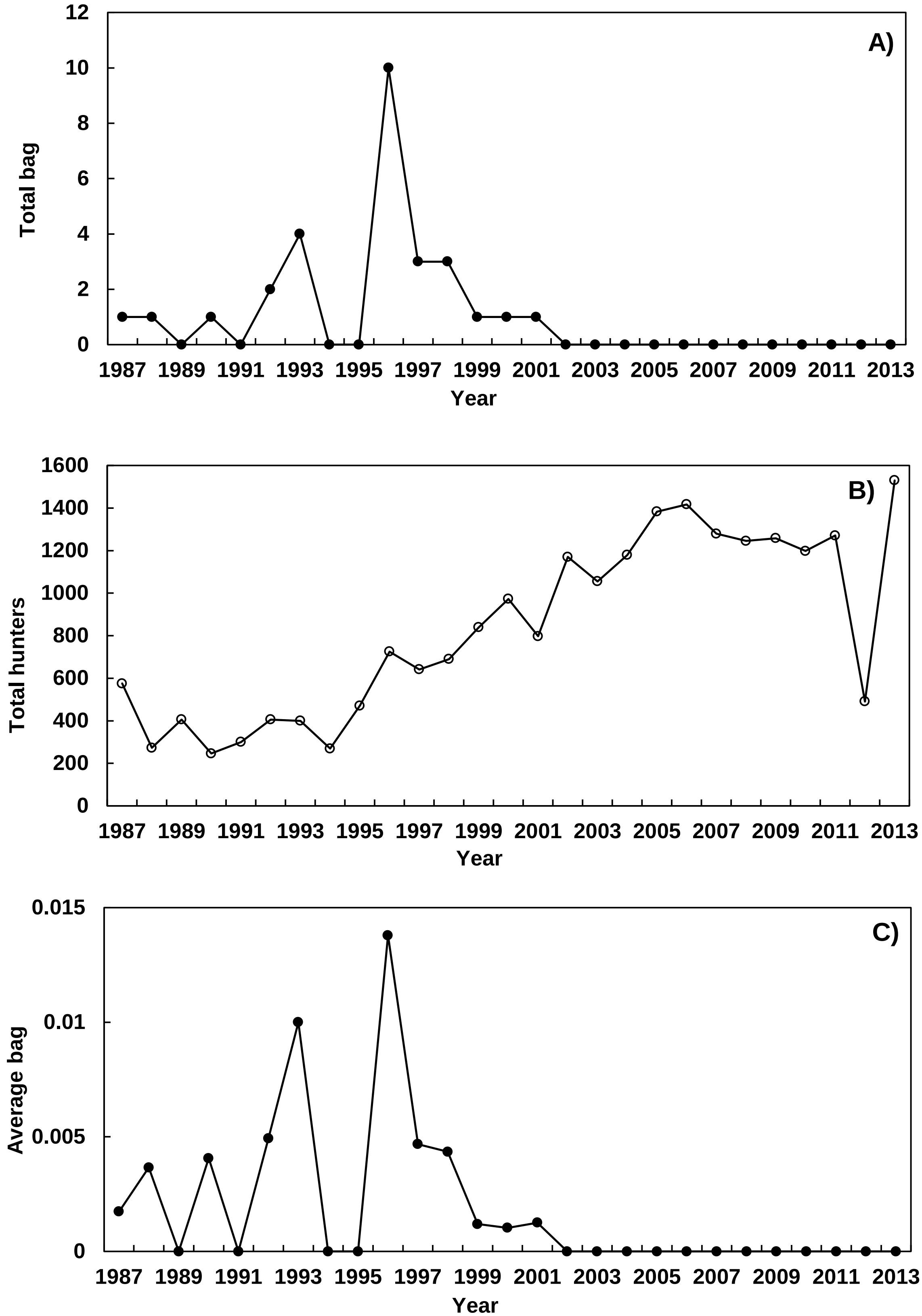


Figure 33. Pheasant A) bag, B) hunters during pheasant season, and C) average pheasant bag per hunter at Kern NWR 1987 – 2013.

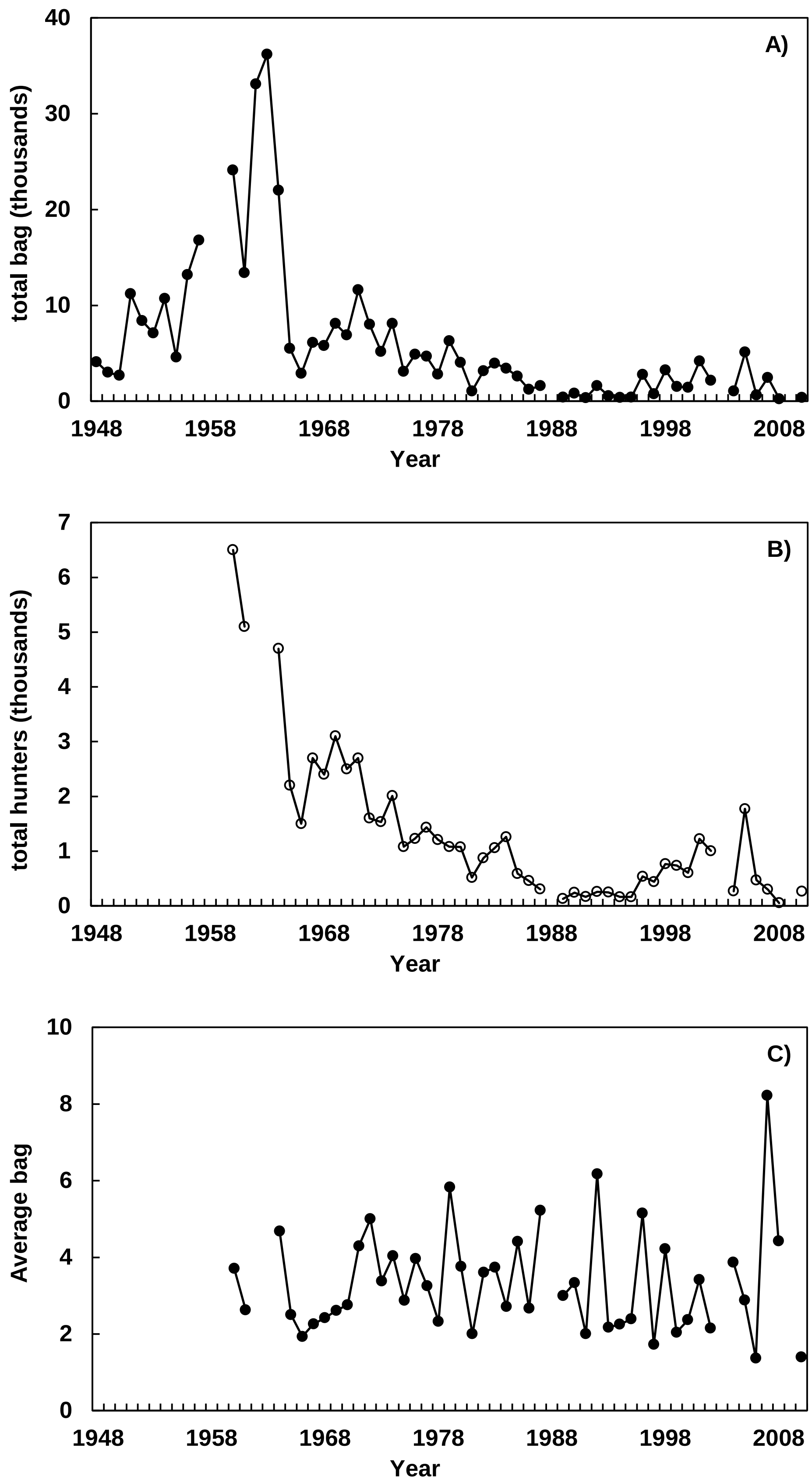


Figure 34. South Coast Region A) pheasant bag, B) pheasant hunters, and C) average hunter bag; Annual Game Take Survey 1948 – 2010.

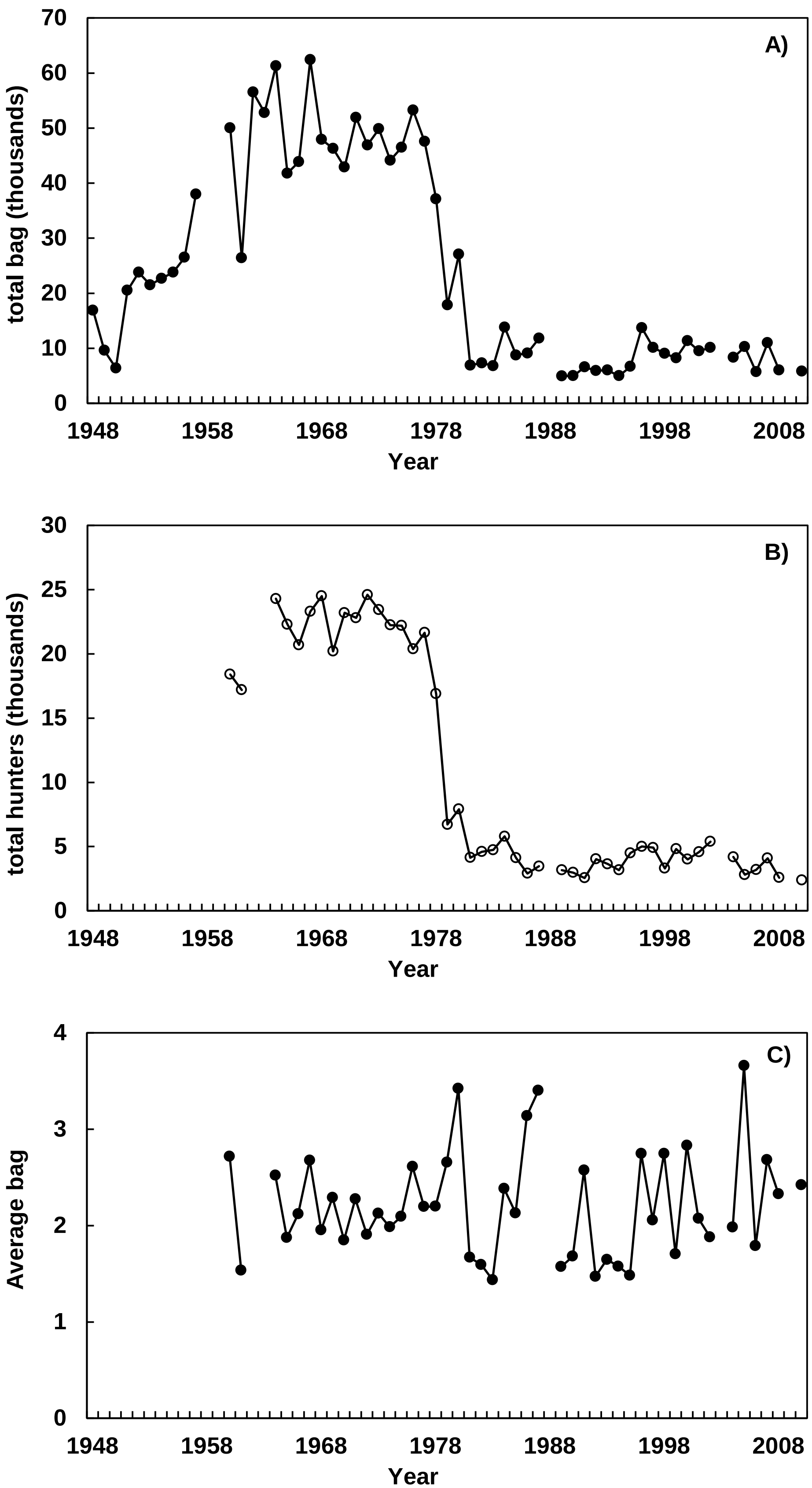


Figure 35. Inland Deserts Region A) pheasant bag, B) pheasant hunters, and C) average hunter bag; Annual Game Take Survey 1948 – 2010.

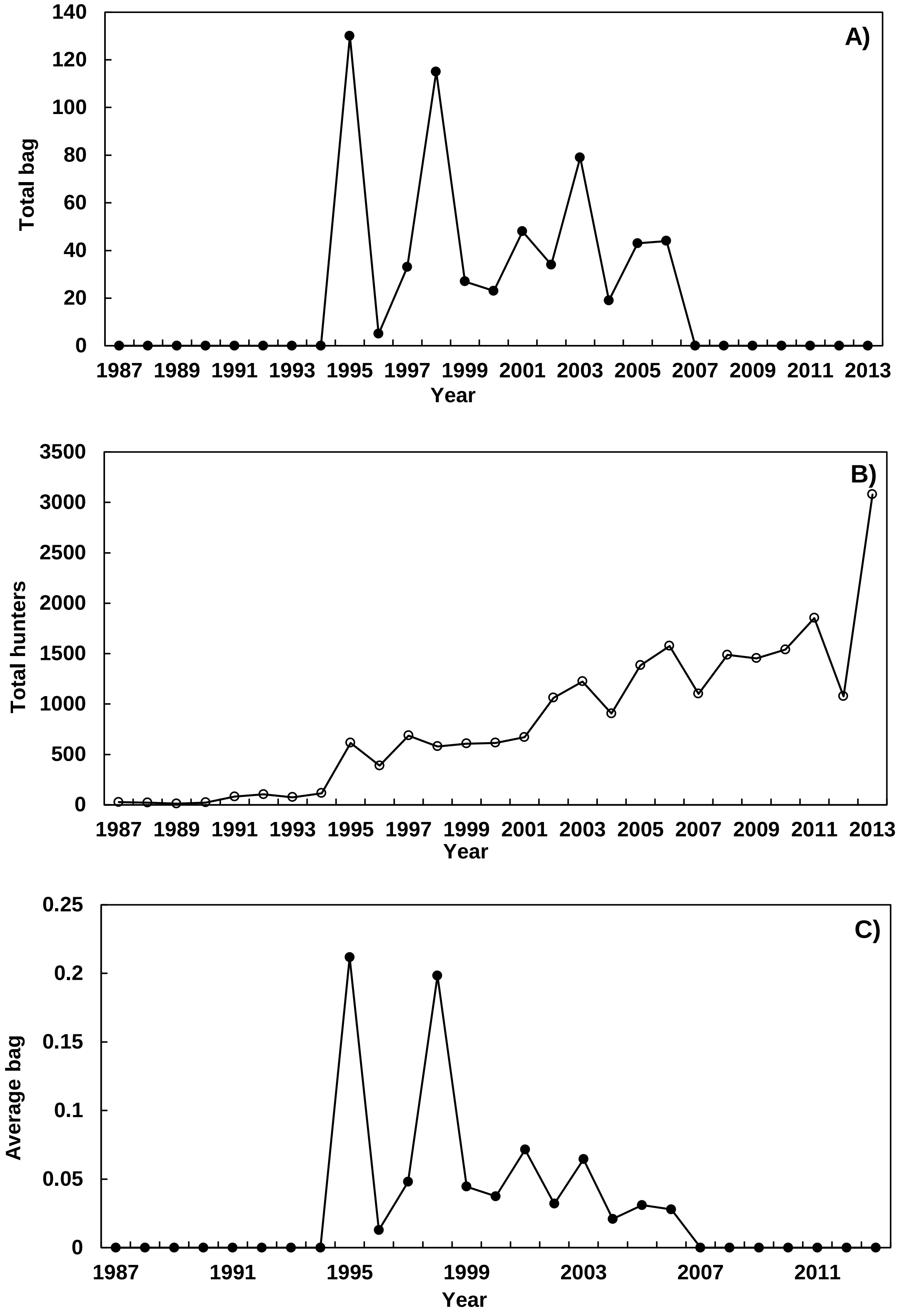


Figure 36. Pheasant A) bag, B) hunters during pheasant season, and C) average pheasant bag per hunter at San Jacinto WA 1987 – 2013.

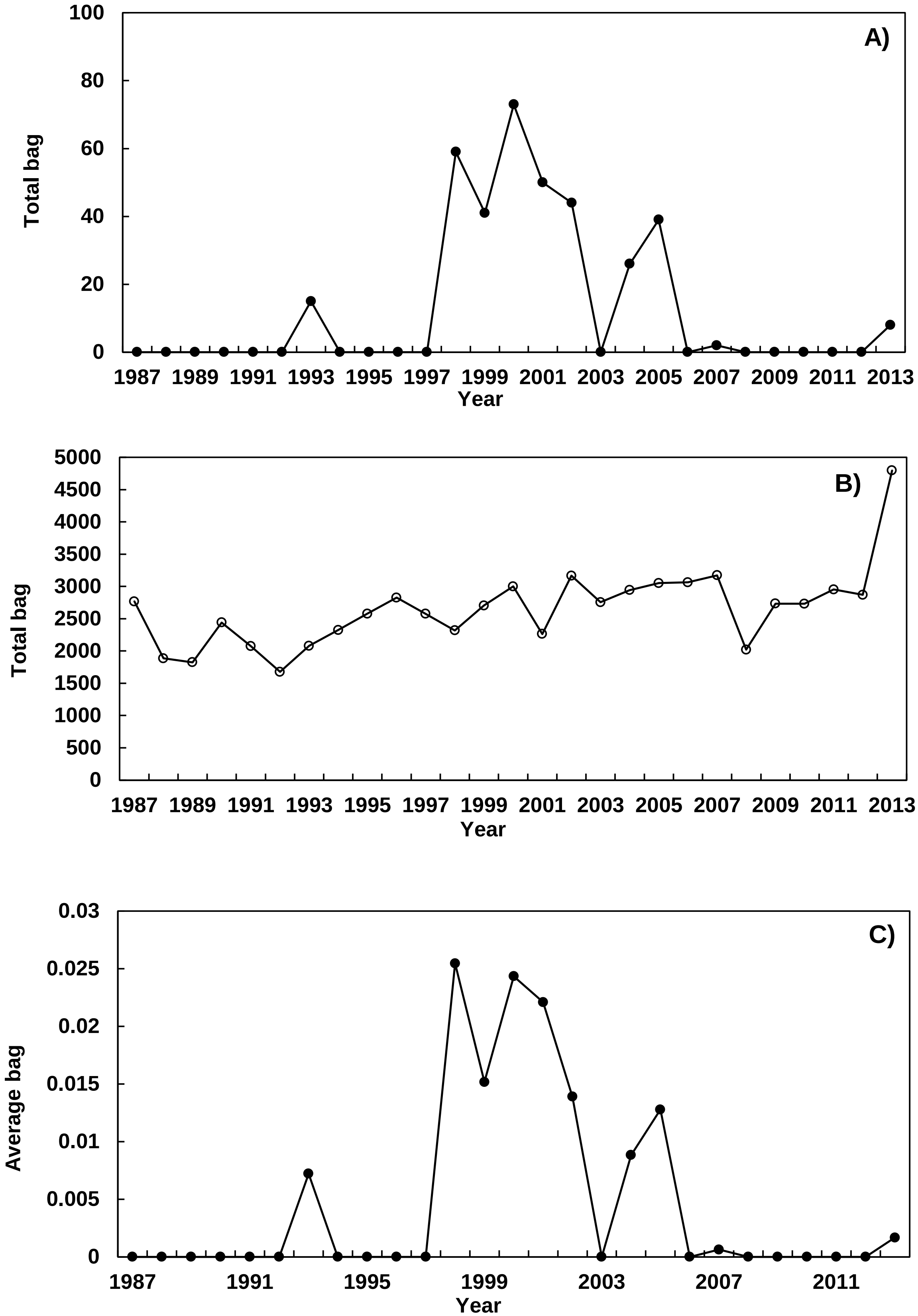


Figure 37. Pheasant A) bag, B) hunters during pheasant season, and C) average pheasant bag per hunter at Imperial NWR 1987 – 2013.

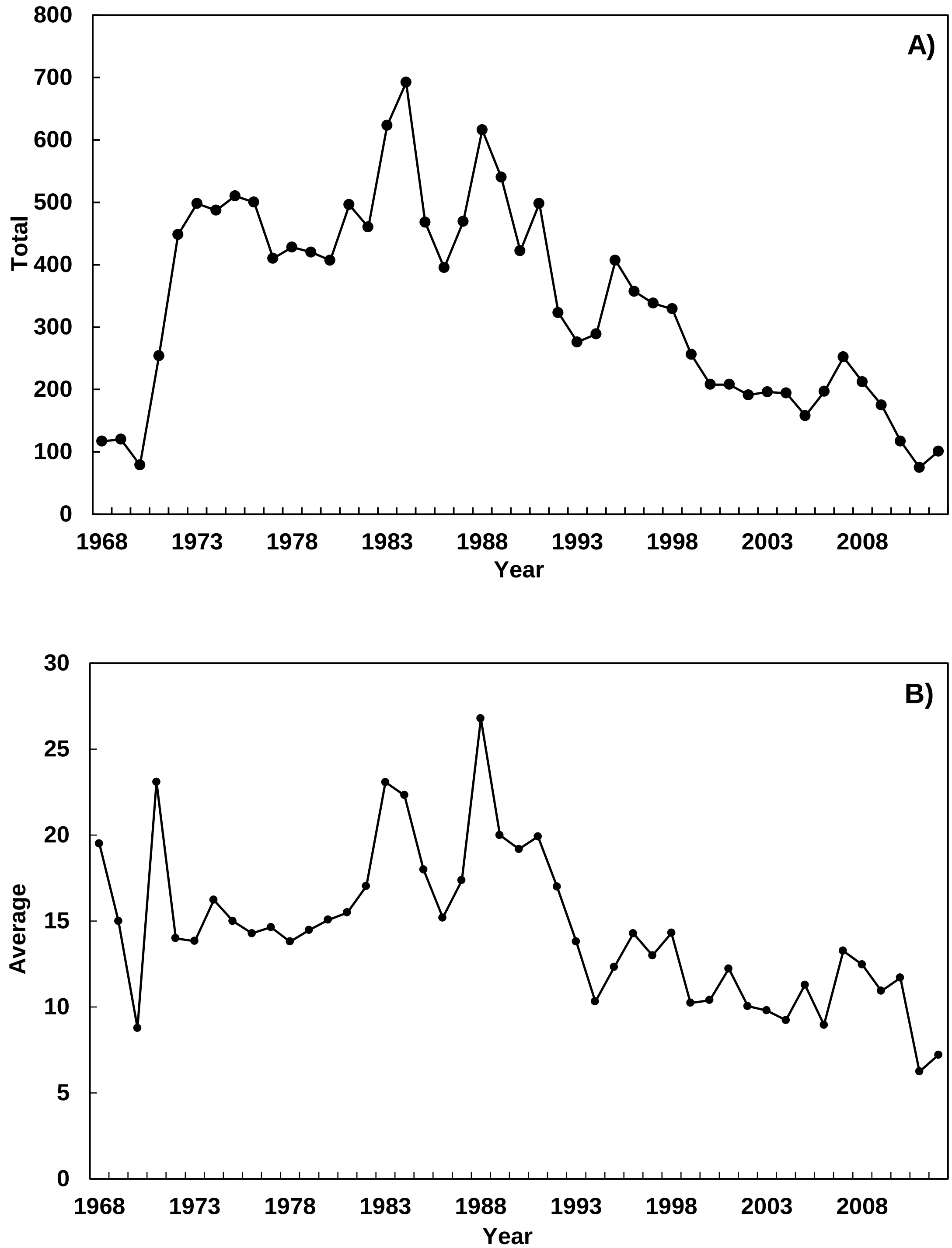


Figure 38. California statewide pheasant A) total Breeding Bird Survey detections and B) average Breeding Bird Survey detections per transect, 1968 – 2012.

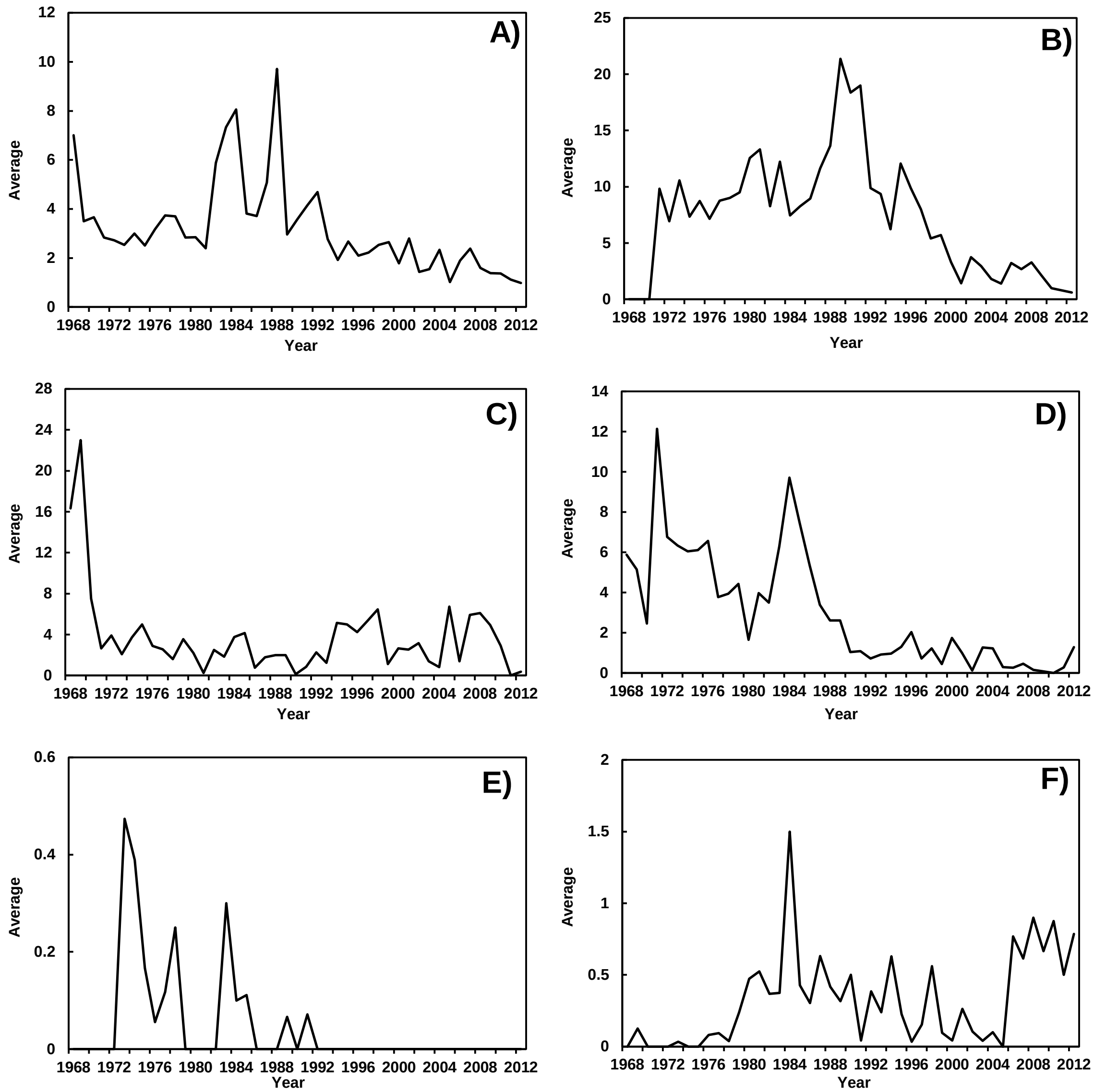


Figure 39. Average pheasant Breeding Bird Survey detections per transect in A) Northern, B) North Central, C) Bay Delta, D) Central, E) South Coast, and F) Inland Deserts Regions, 1968 – 2012.

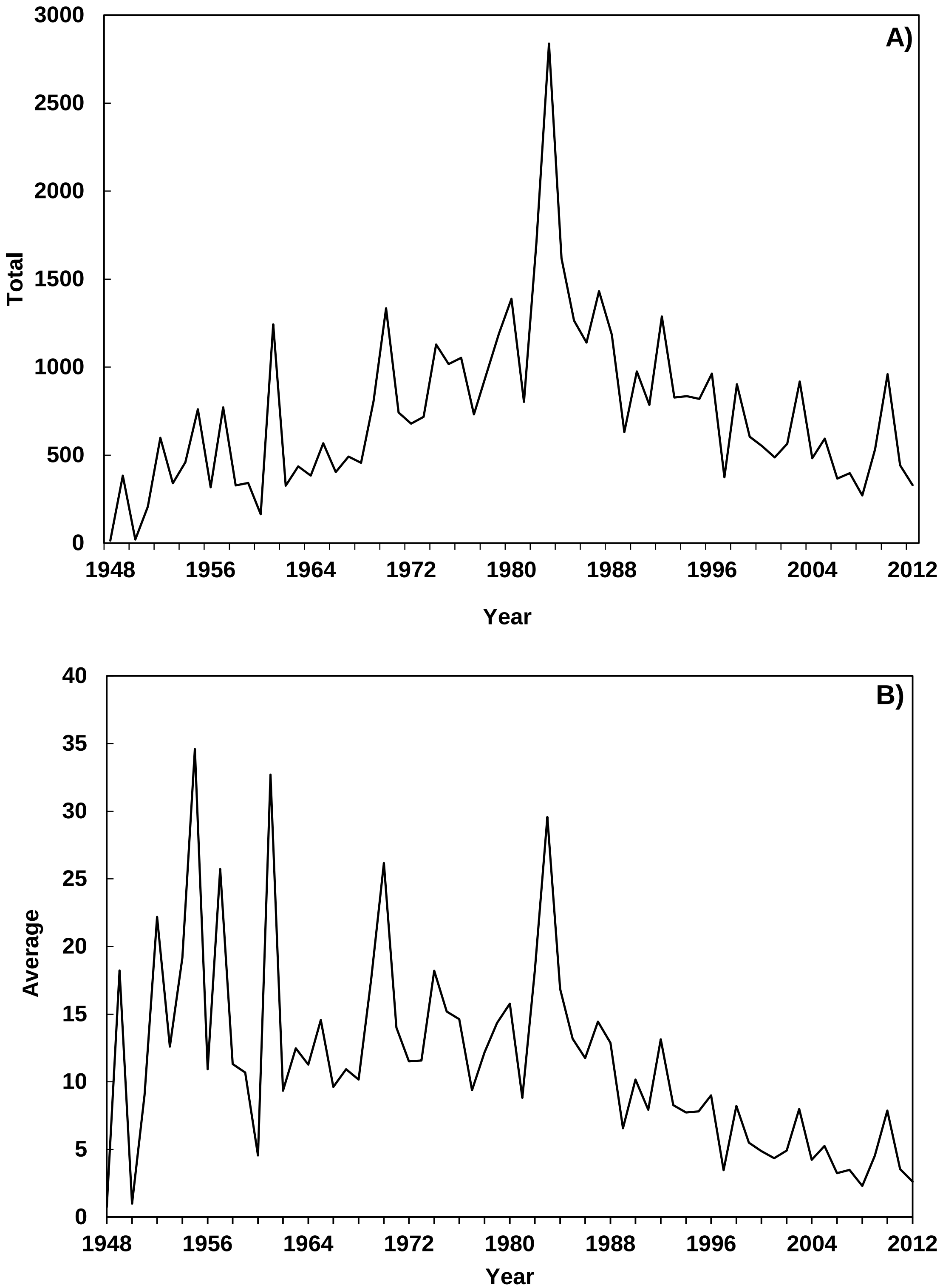


Figure 40. California Statewide pheasant A) total Christmas Bird Count survey detections, and B) average Christmas Bird Count survey detections per sampling unit, 1948–2012.

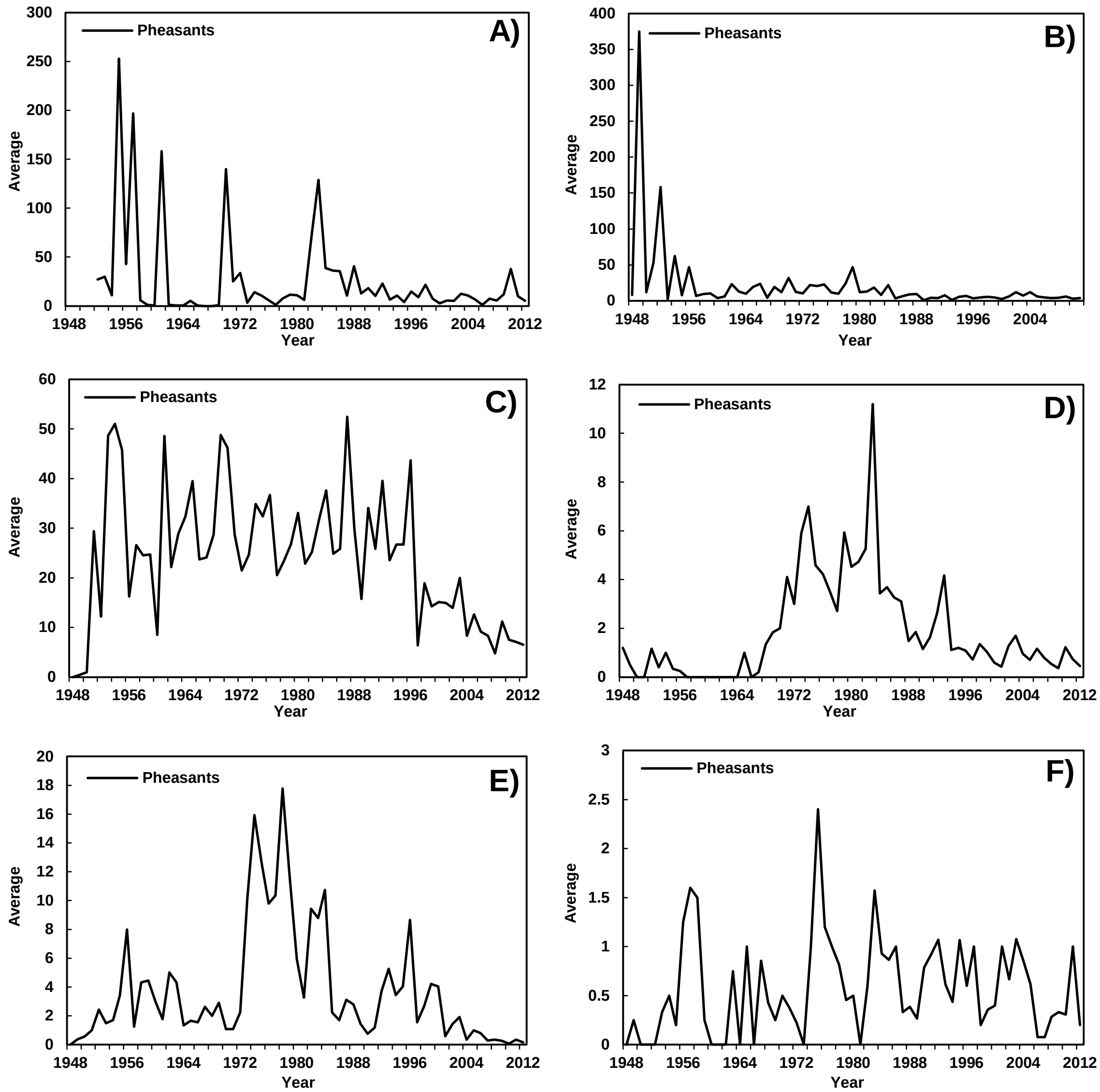


Figure 41. Average pheasant Christmas Bird Count survey detections per sampling unit in A) Northern, B) North Central, C) Bay Delta, D) Central, E) South Coast, and F) Inland Desert regions, 1948–2012.

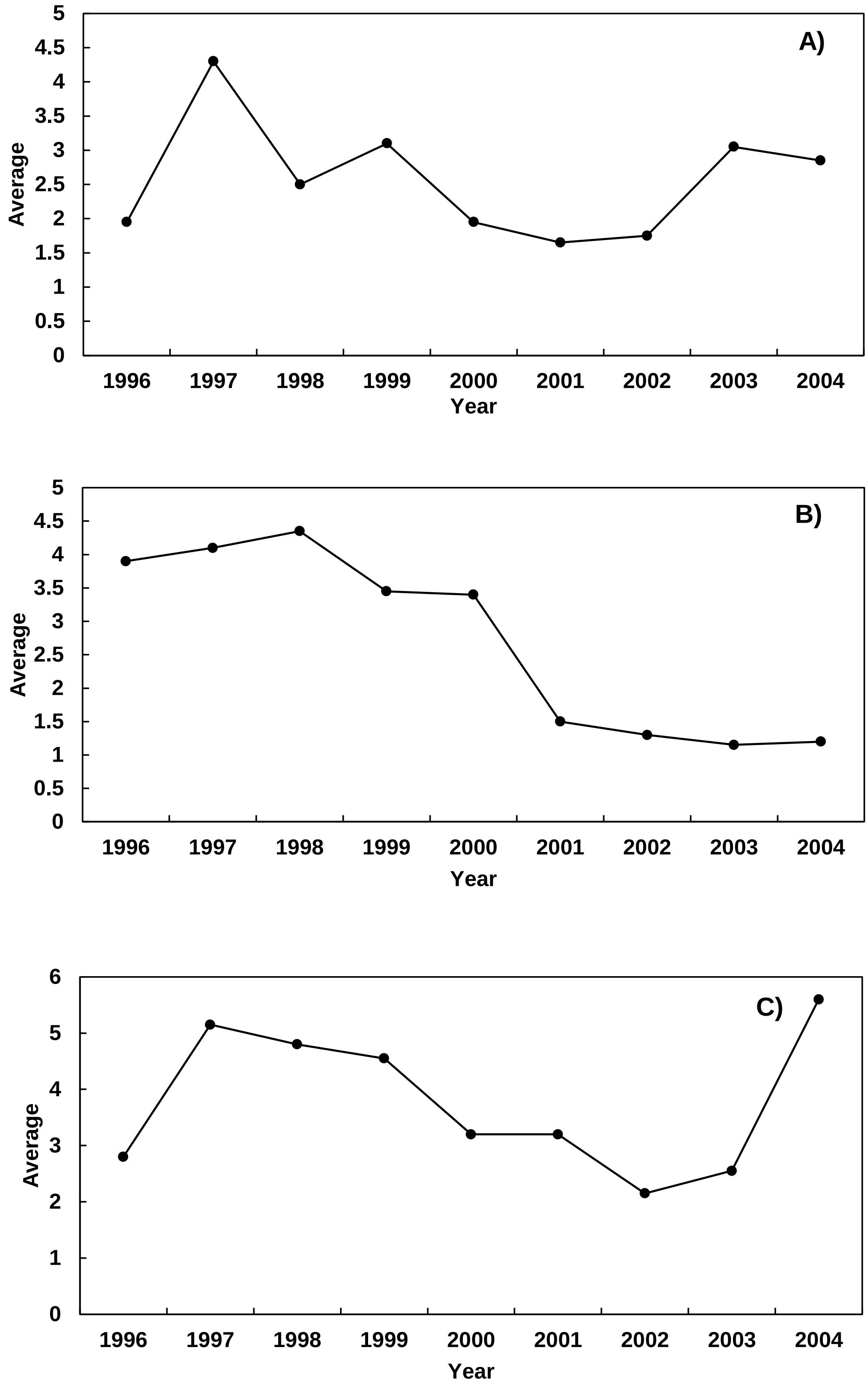


Figure 42. Average annual pheasant crowing counts at A) Tule Lake NWR, B) Copic Bay, and C) Lower Klamath NWR, 1996 – 2004.

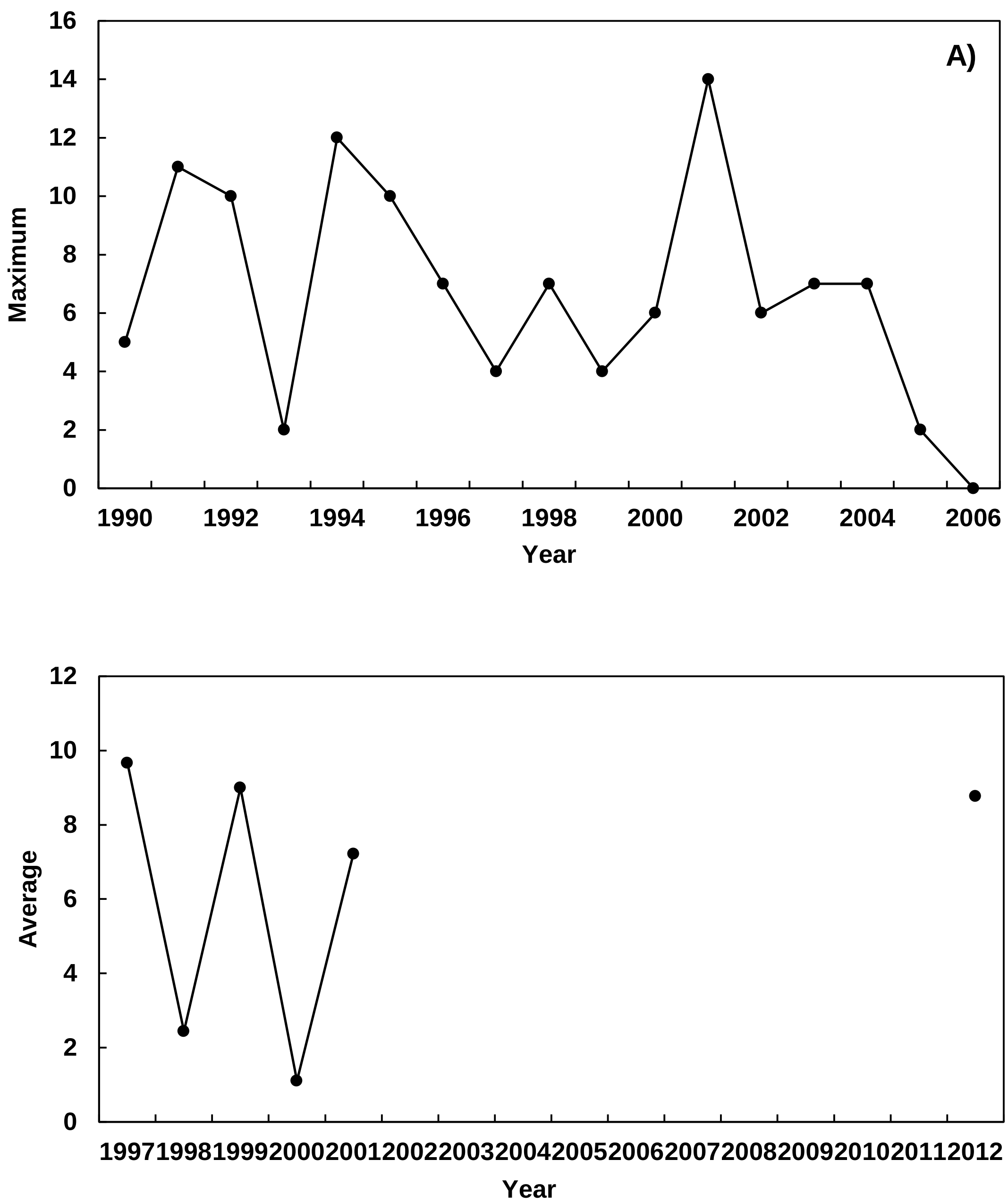


Figure 43. Maximum annual pheasant crowing counts at A) Butte Valley WA, 1990 – 2006 and average annual crowing counts at Honey Lake WA, 1997 – 2001 and 2012.

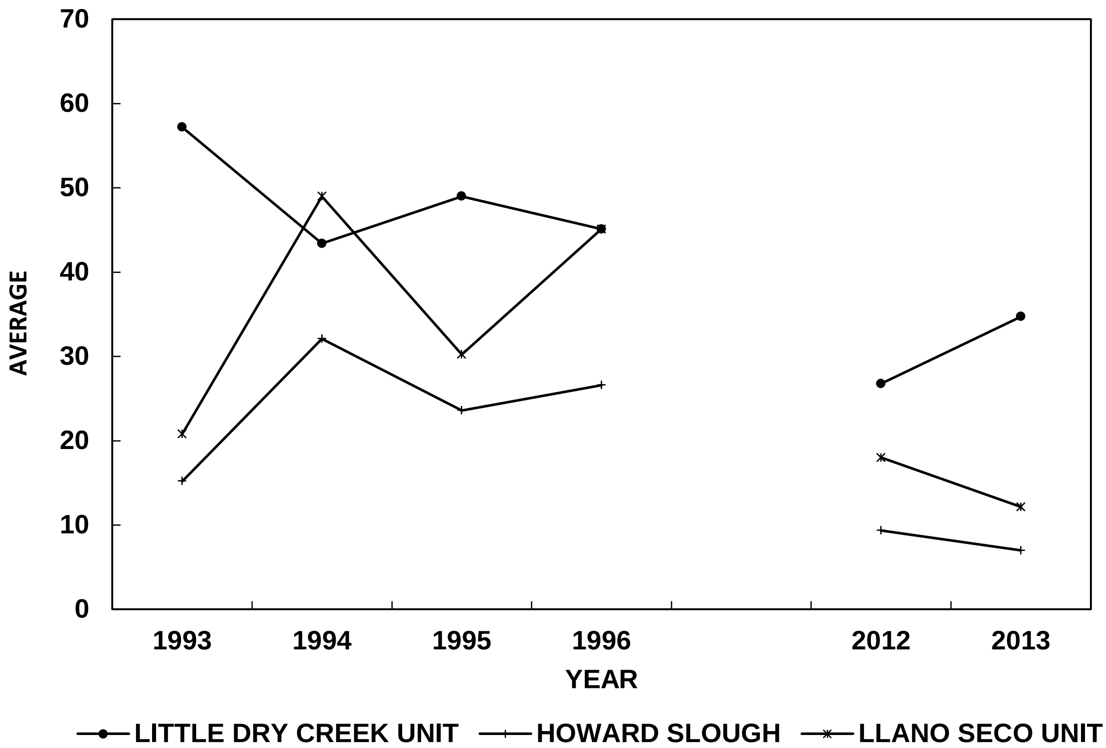
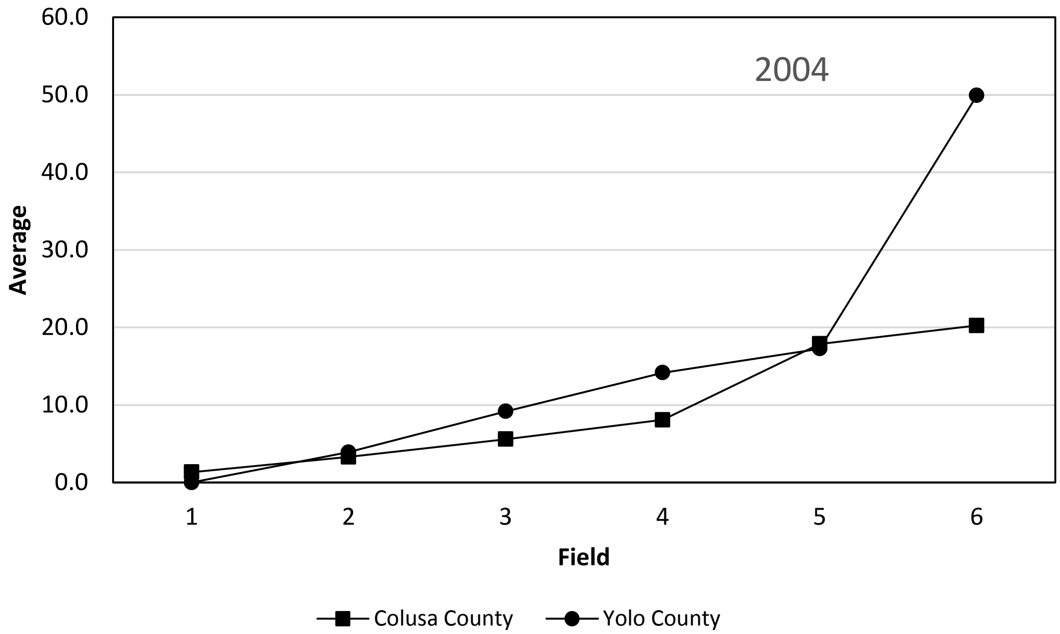


Figure 44. Annual average pheasant crowing counts at the Upper Butte Basin WA, 1993 – 1996 and 2011 – 2012.



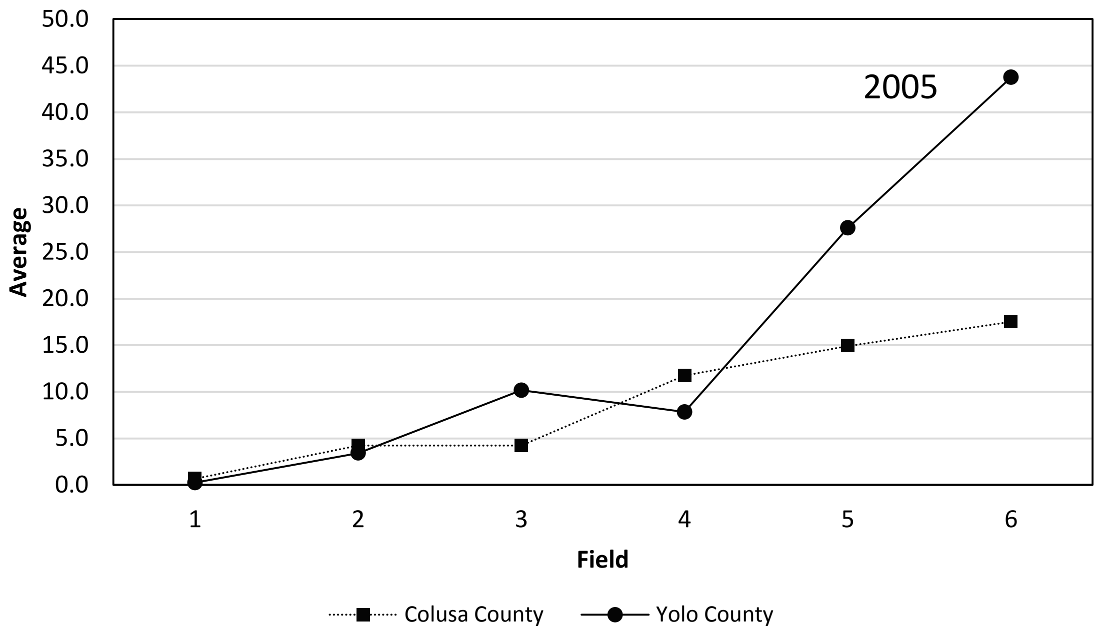


Figure 45. Average pheasant crowing counts at fields enrolled in California's Conservation Reserve Enhancement Program, 2004 – 2005.

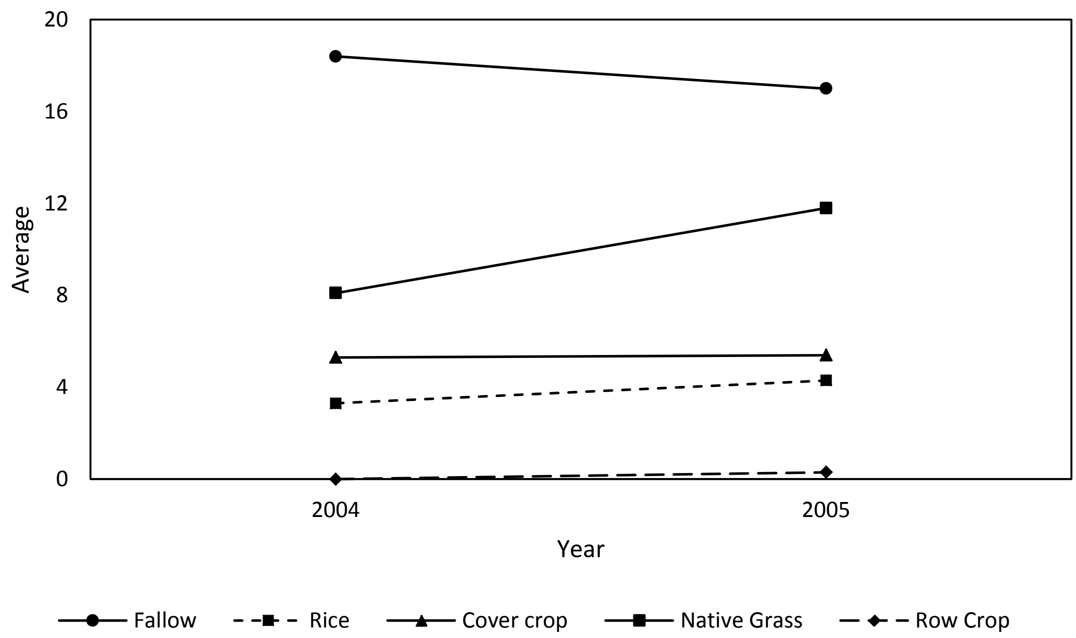
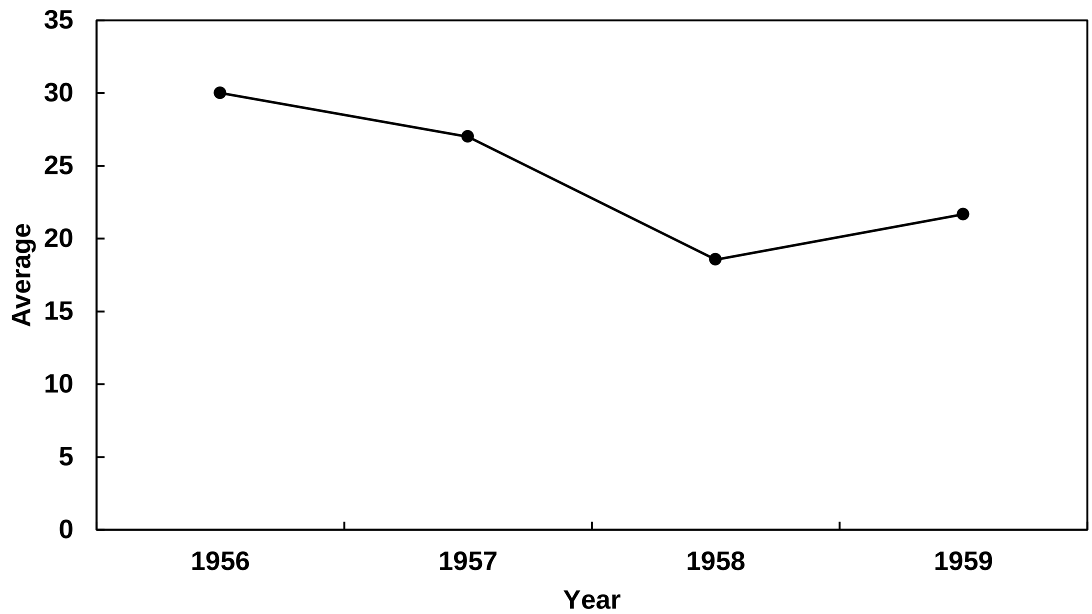


Figure 46. Average pheasant crowing counts at CREP fields in Colusa and Yolo Counties by habitat type, 2004 – 2005.



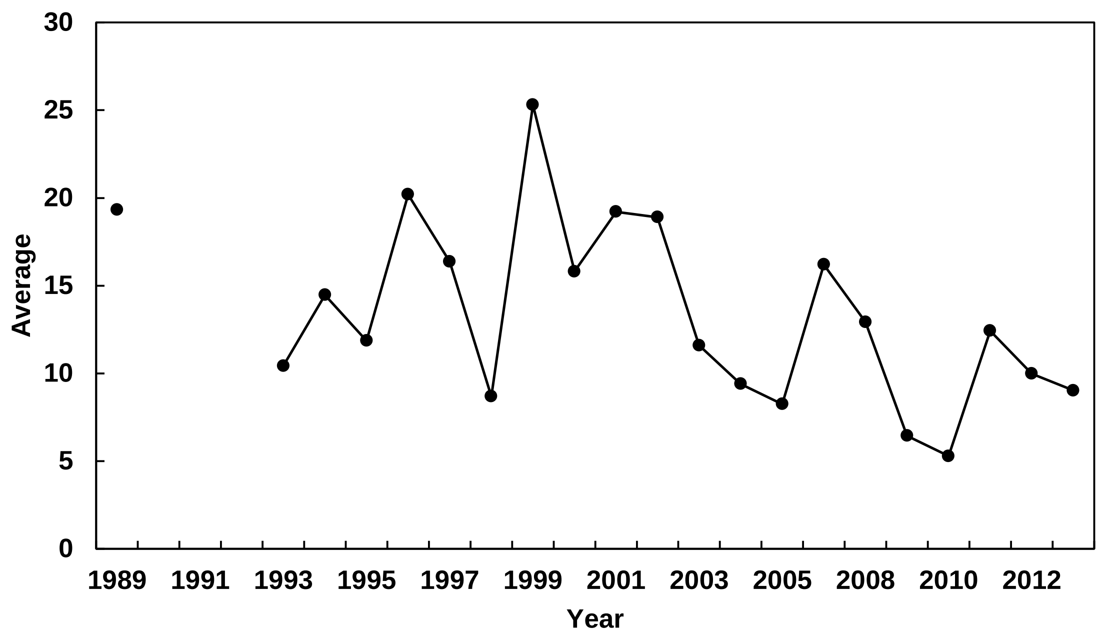


Figure 47. Average pheasant crowing counts at Grizzly Island WA, 1956 – 1959 and 1989 – 2013.

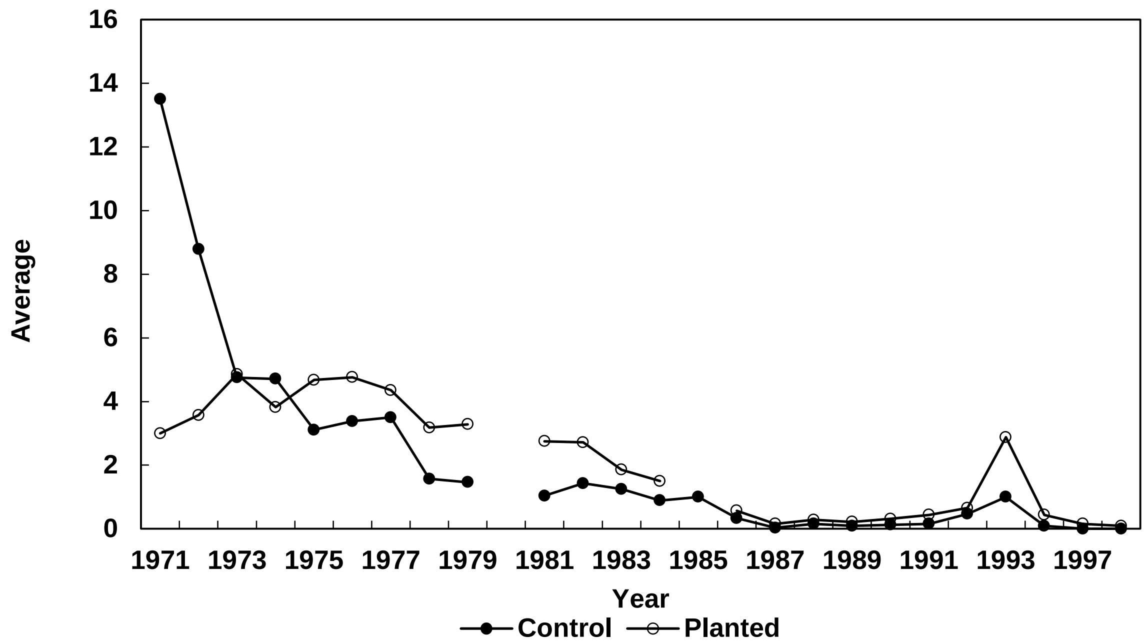


Figure 48. Average pheasant crowing counts at routes near Fresno, CA at control and planted areas, 1971 – 1998.

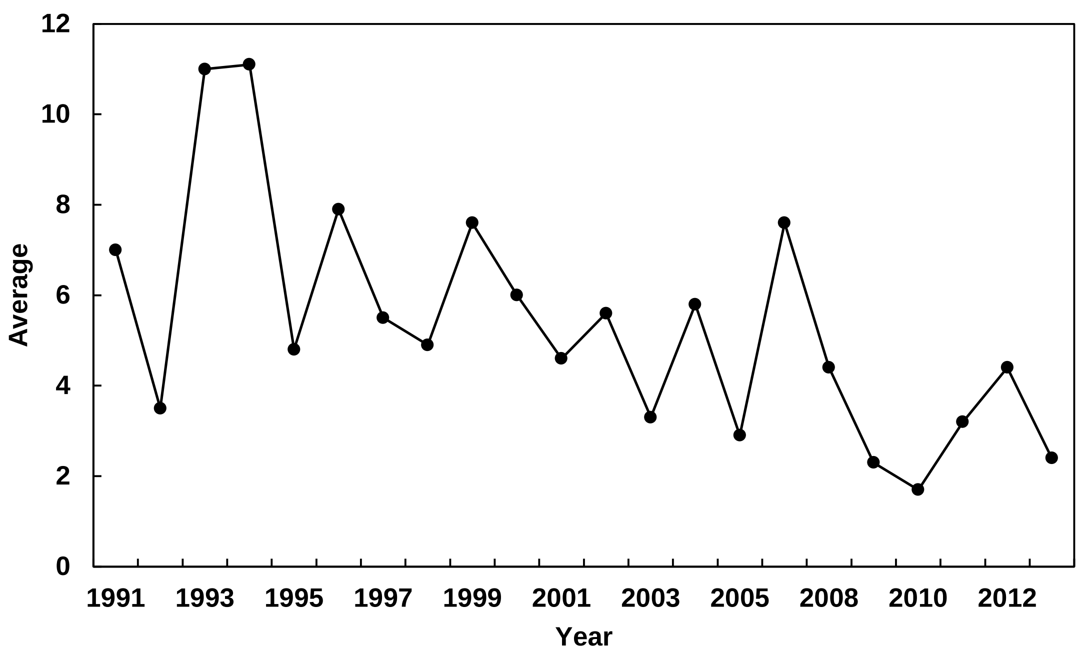


Figure 49. Average pheasant crowing counts at Mendota WA, 1991 – 2013.

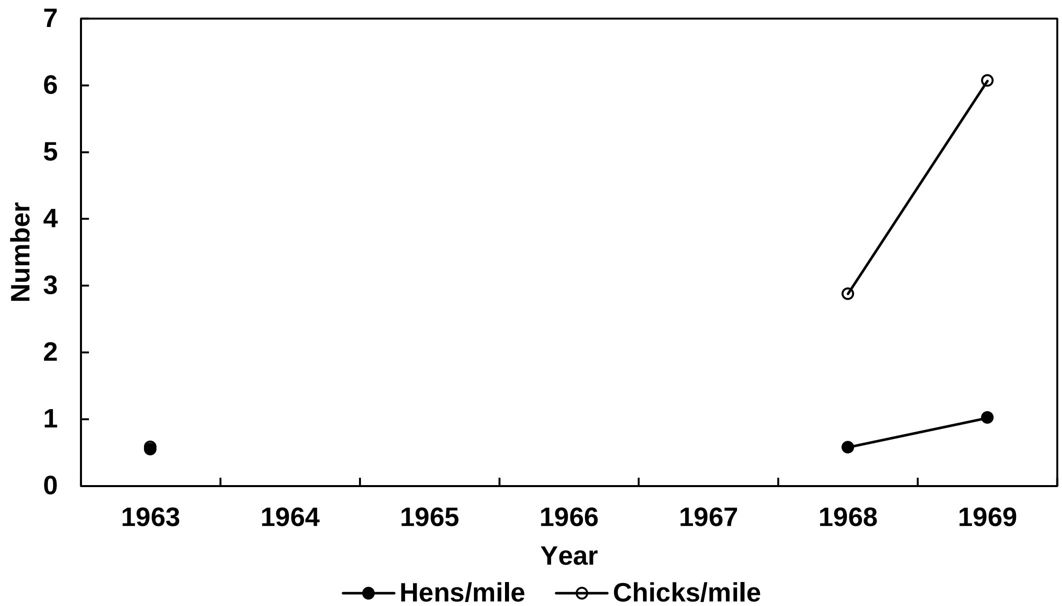


Figure 50. Northern Region average pheasant abundance and production, 1963 and 1968 – 1969. Areas surveyed included: private lands in the Tule Lake Basin and Surprise Valley, and Tule Lake and Lower Klamath NWR's.

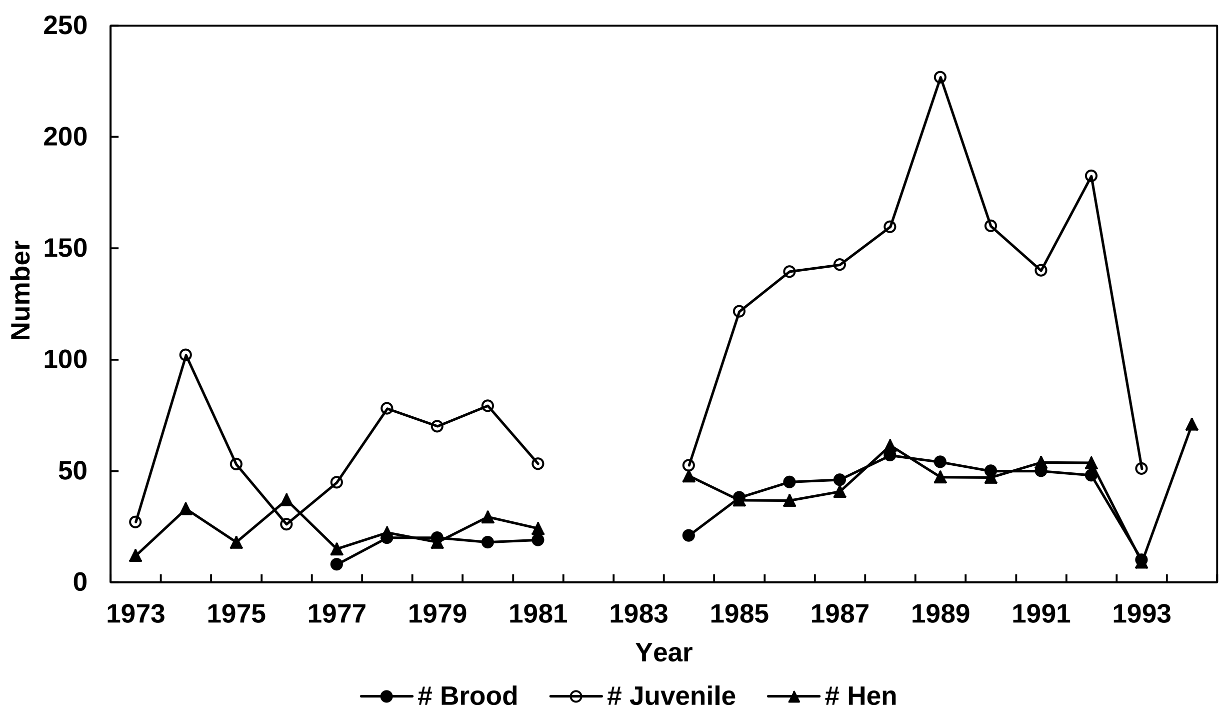


Figure 51. Number of broods, juveniles, and hens detected on road surveys at Honey Lake WA, 1973 – 1981 and 1984 – 1994.

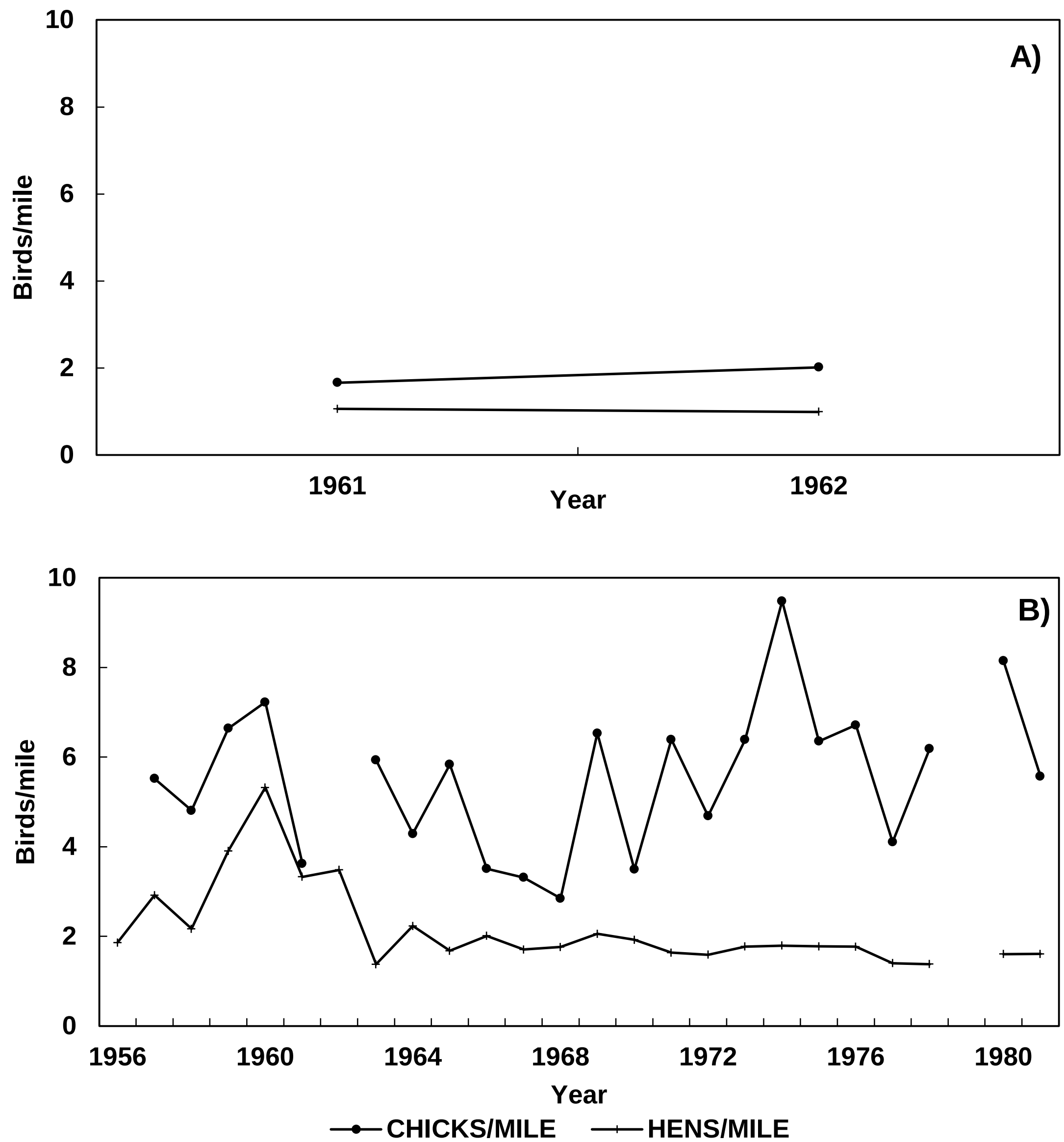


Figure 52. Pheasant production and abundance at A) Co-Op properties, 1961 – 1962 and B) Gray Lodge WA, 1956 – 1981.

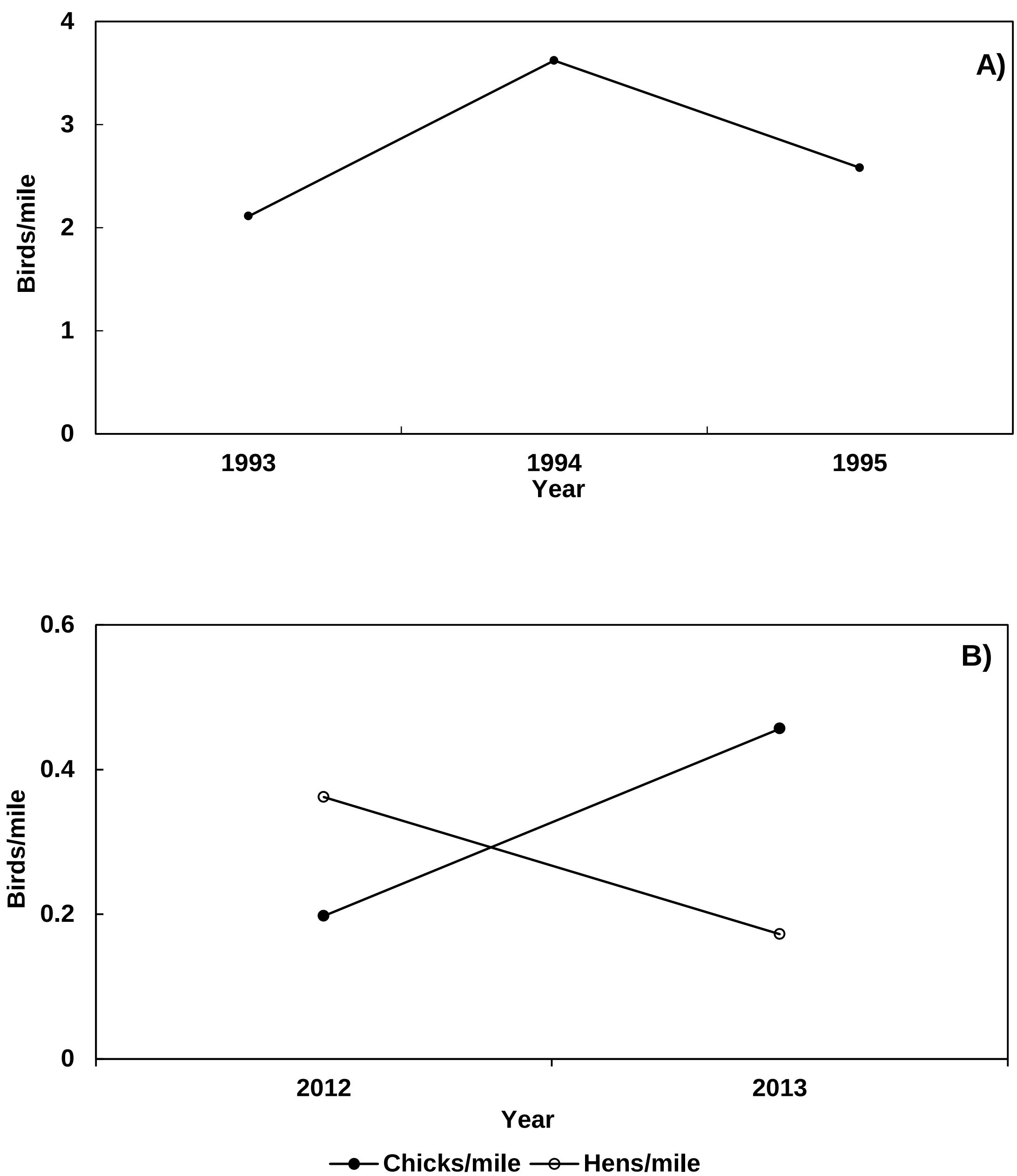


Figure 53. Pheasant production and abundance at Upper Butte Basin WA, A) 1993 – 1995 and B) 2012 – 2013.

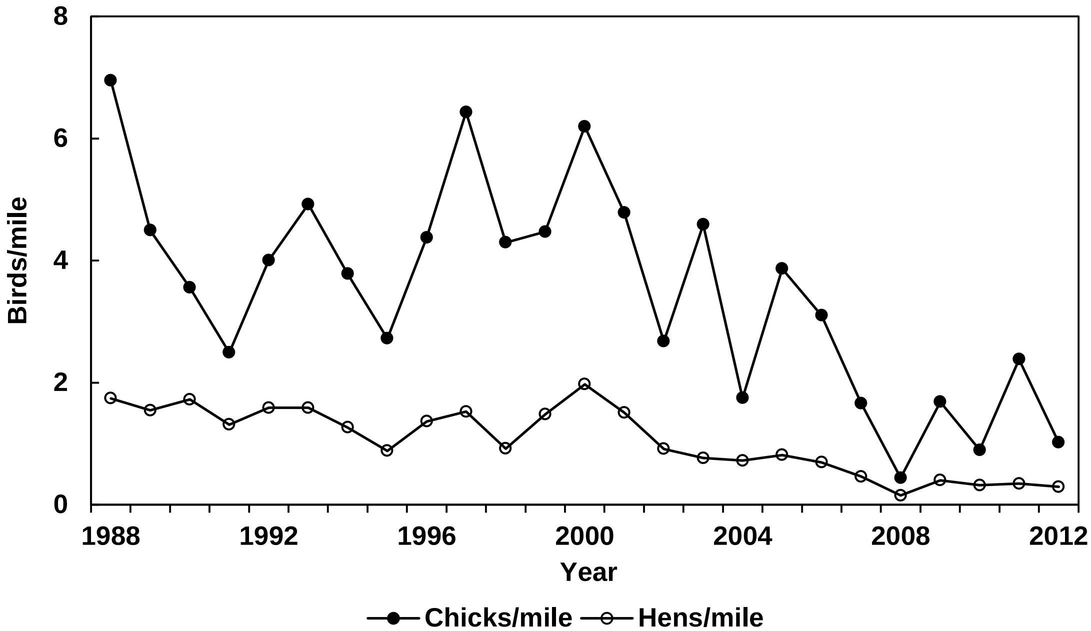


Figure 54. Pheasant production and abundance at Sacramento NWR Complex, 1988 – 2012.

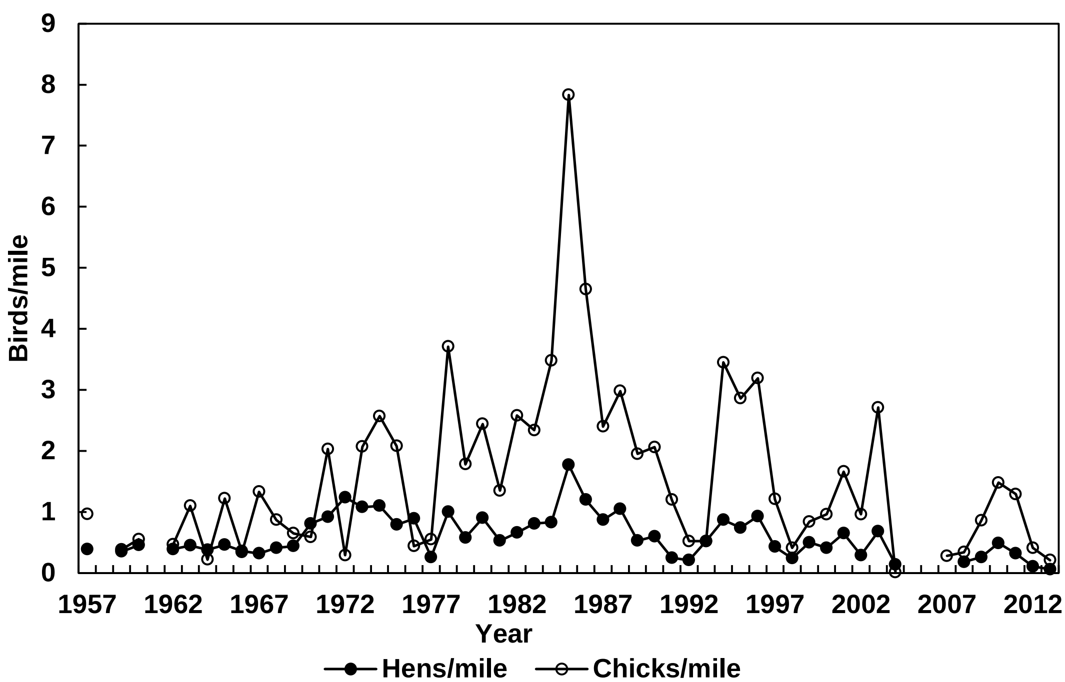
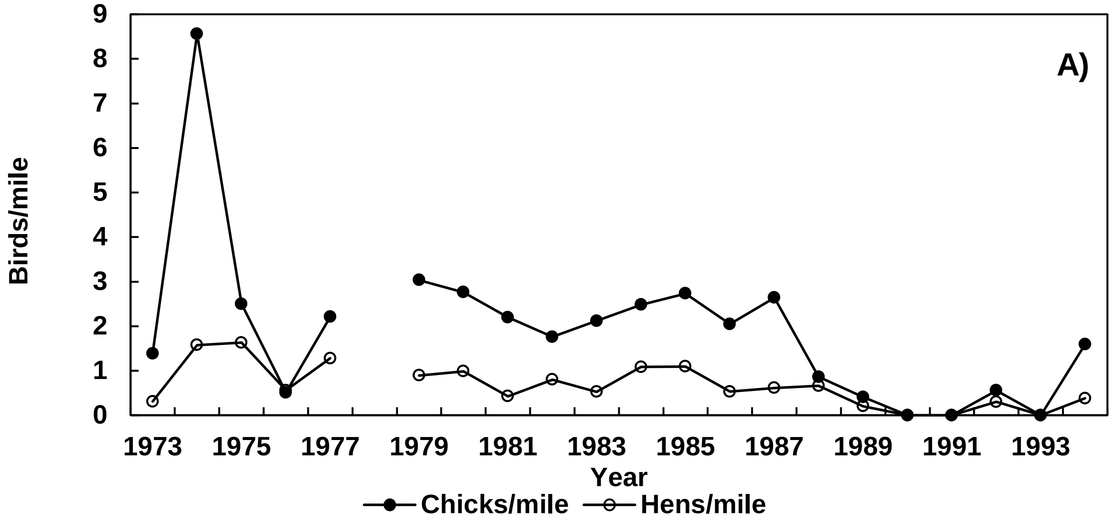
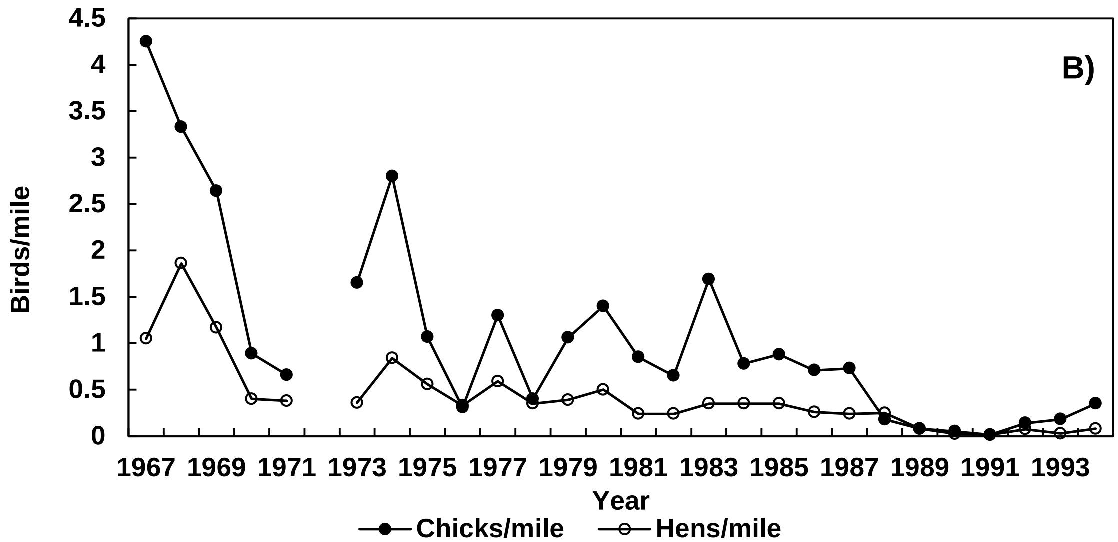


Figure 55. Pheasant production and abundance at Grizzly Island WA, 1957 – 2013.





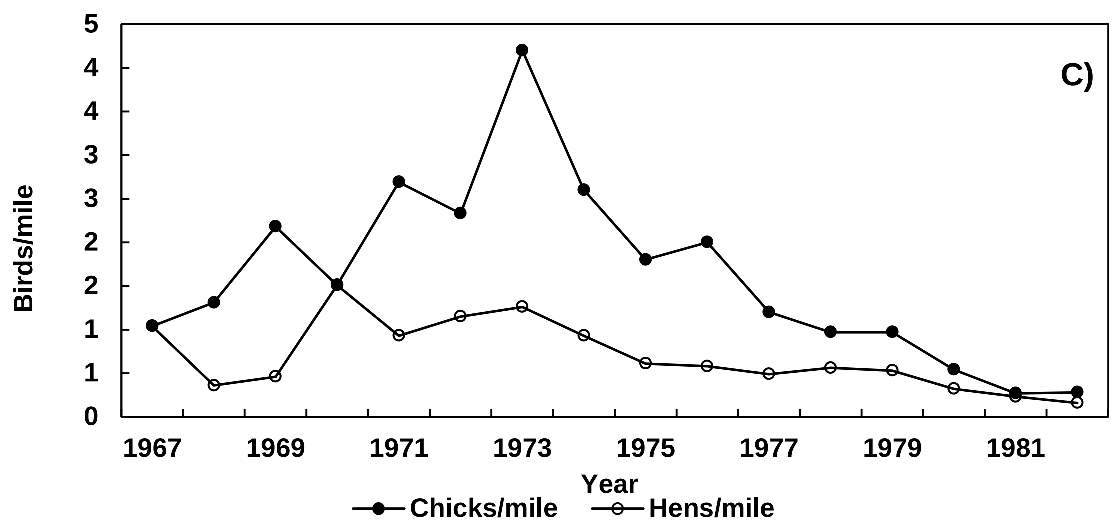
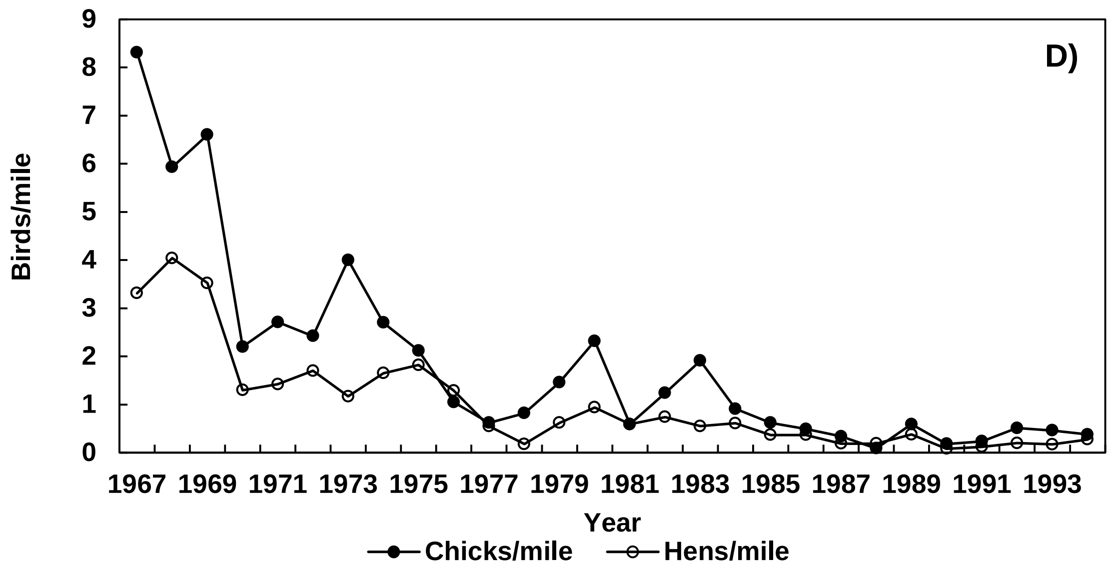


Figure 56. Central Region pheasant production and abundance at sites including A) Merced NWR, 1973 – 1994; B) Merced Area, 1967 – 1994; C) Madera Unit, 1967 – 1982; D) Oakdale Area, 1967 – 1994; and E) Mendota WA, 1955 – 2013.



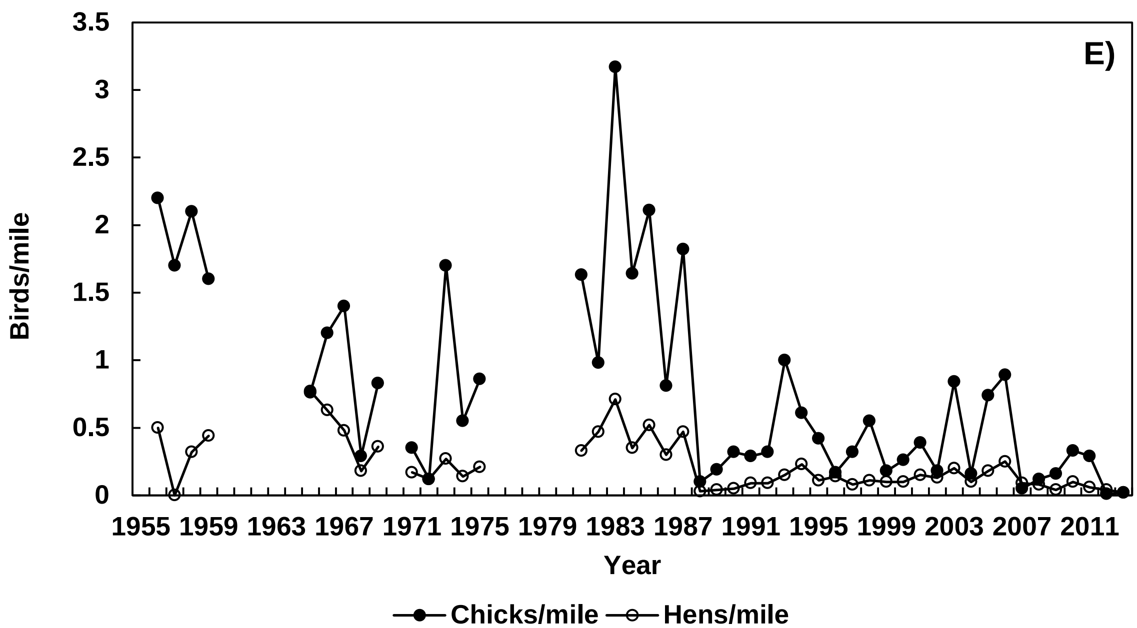


Figure 56 (cont.). Central Region pheasant production and abundance at sites including A) Merced NWR, 1973 – 1994; B) Merced Area, 1967 – 1994; C) Madera Unit, 1967 – 1982; D) Oakdale Area, 1967 – 1994; and E) Mendota WA, 1955 – 2013.

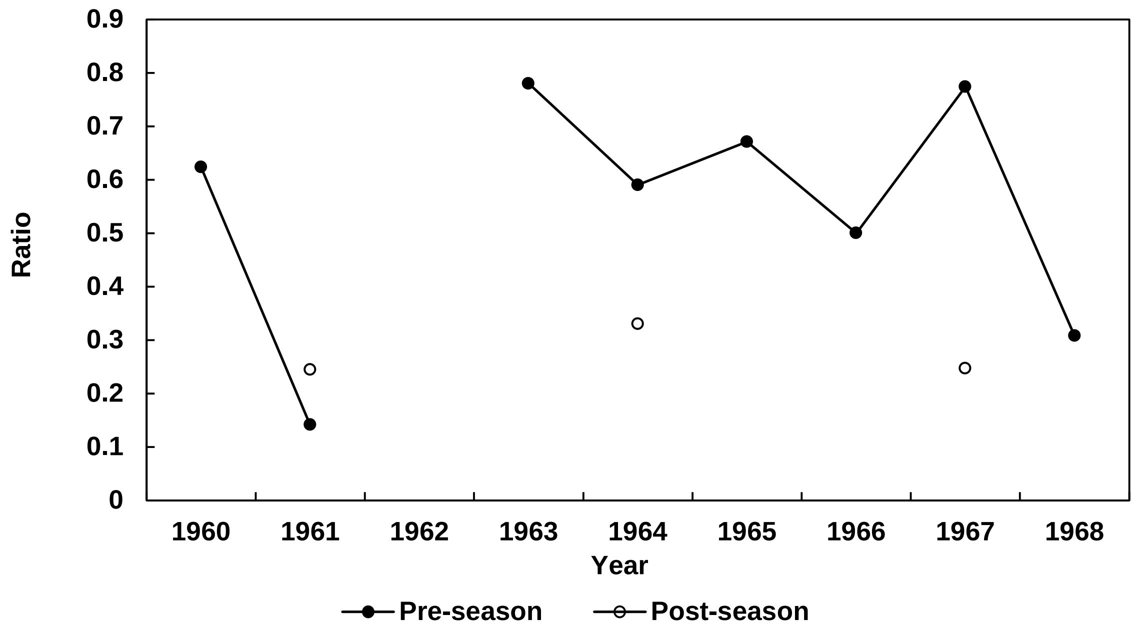


Figure 57. Pre- and Post-season pheasant flush counts on Tule Lake NWR and surrounding private ground in the Tule Lake Basin, 1960 – 1968.

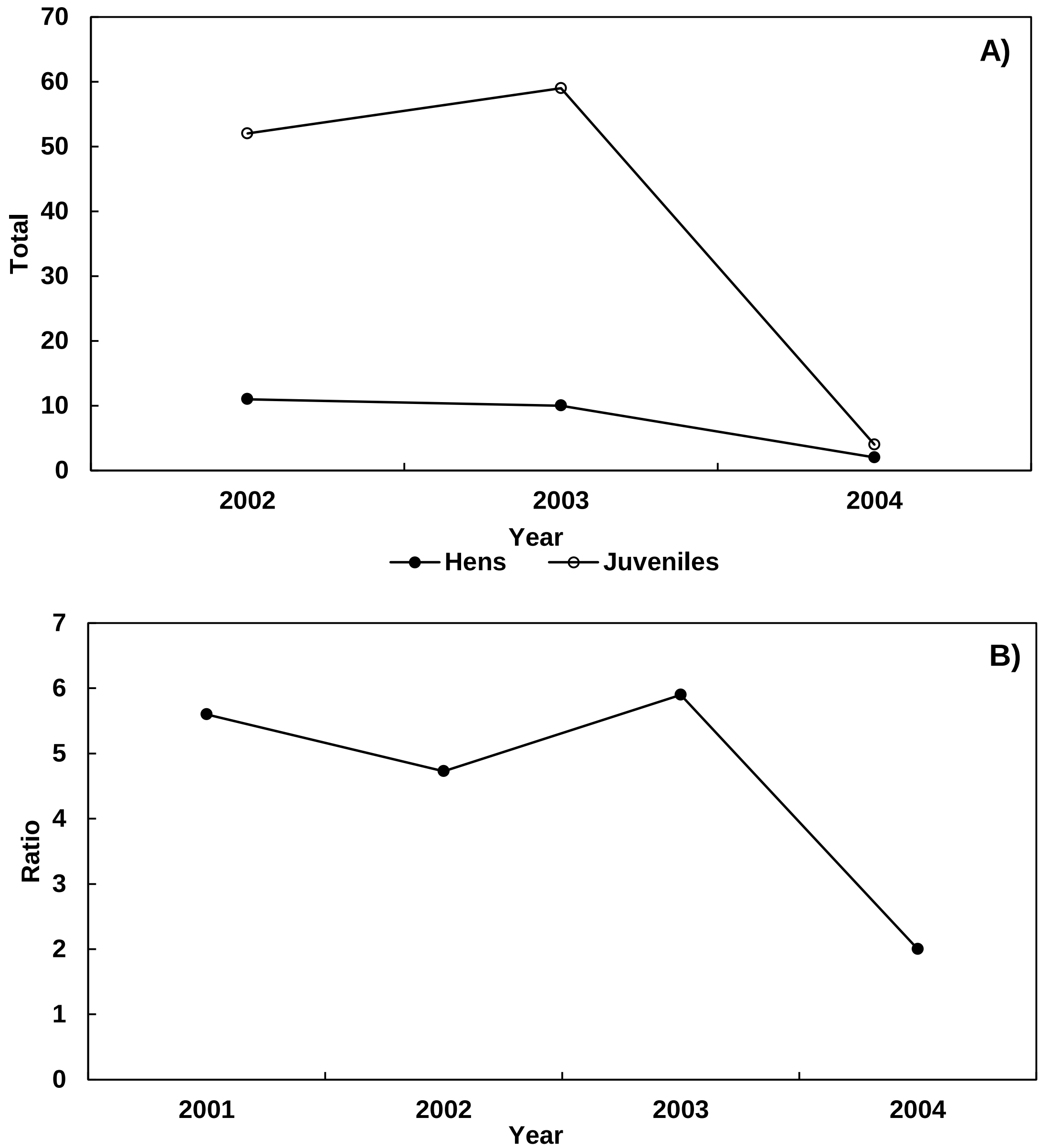
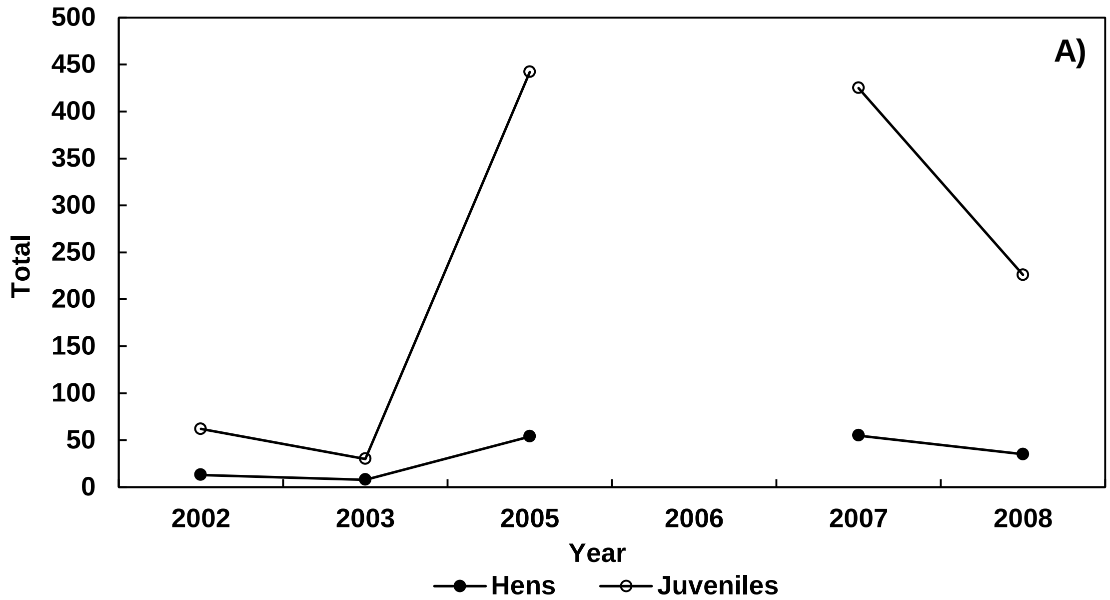


Figure 58. Total A) count and B) age ratio (juvs per adult) of pheasants flushed on surveys in north Butte County at M&T Ranch, 2001 – 2004.



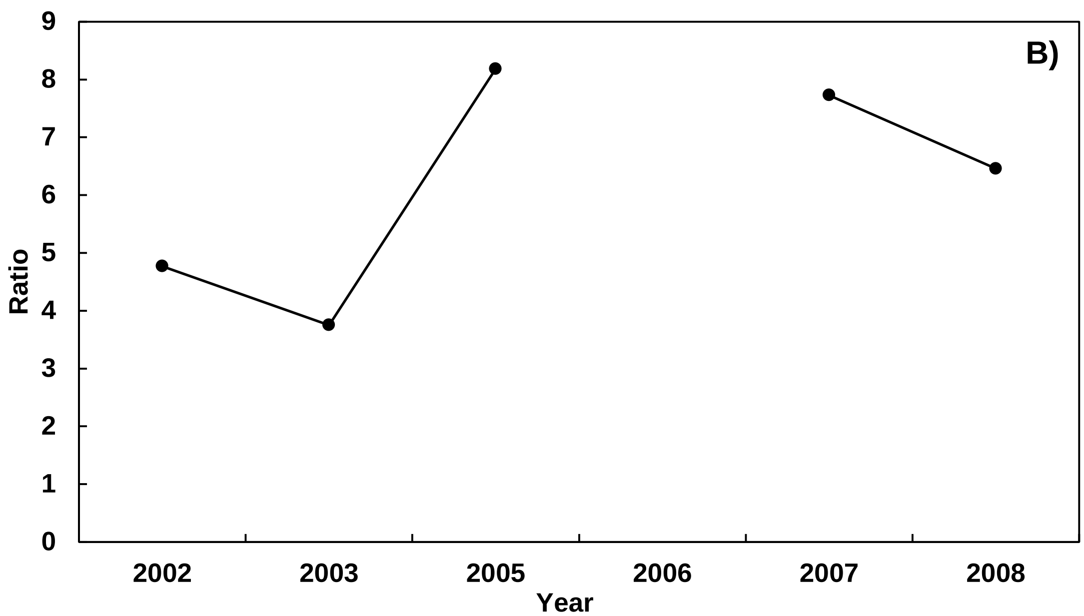


Figure 59. Total A) count and B) age ratio (juvs per adult) of pheasants flushed on surveys at Upper Butte Basin WA (Howard Slough and Little Dry Creek Units), 2002 – 2005 and 2007 – 2008.

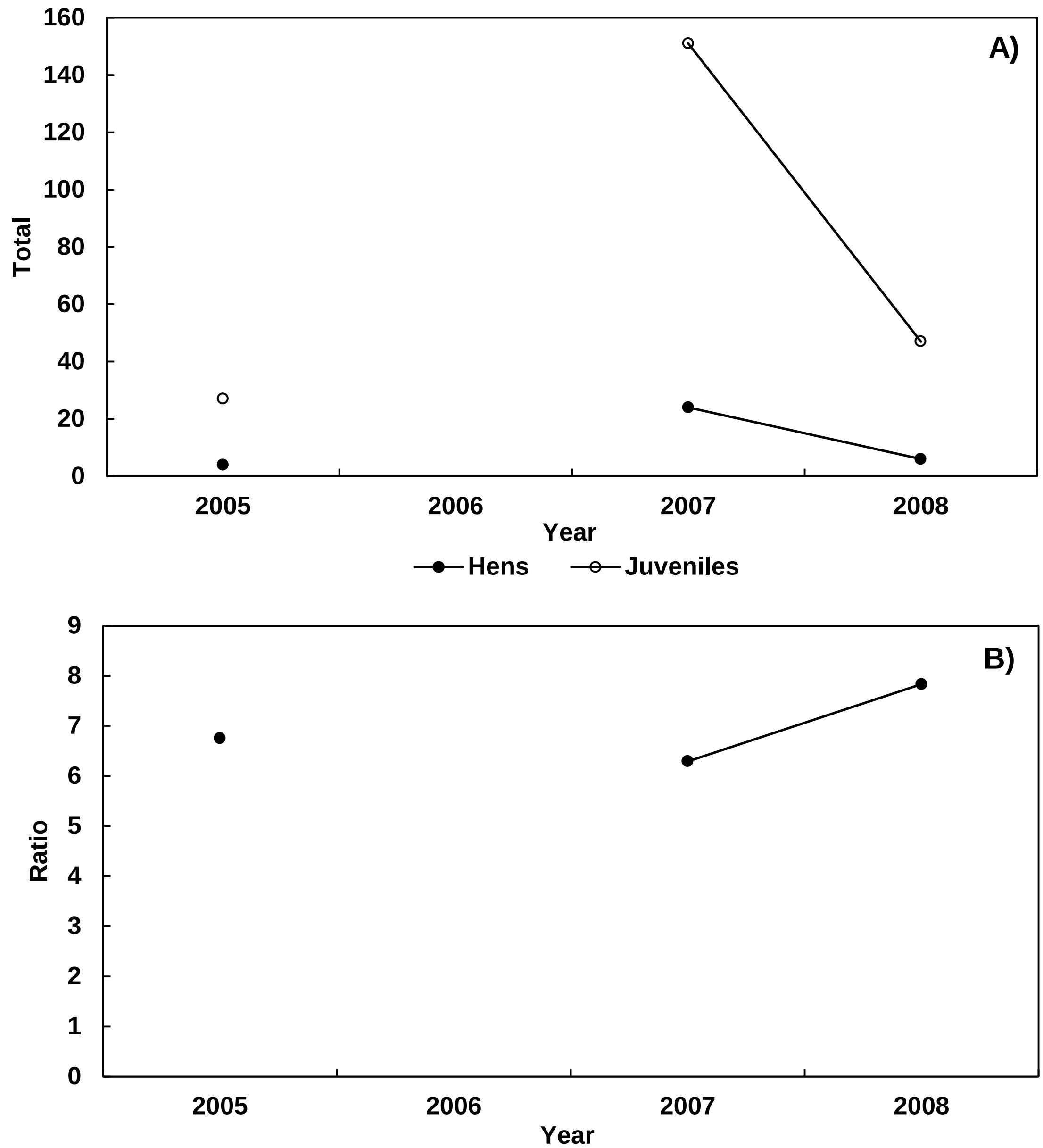


Figure 60. Total A) count and B) age ratio (juvs per adult) of pheasants flushed on surveys at Gray Lodge WA, 2005 – 2008.

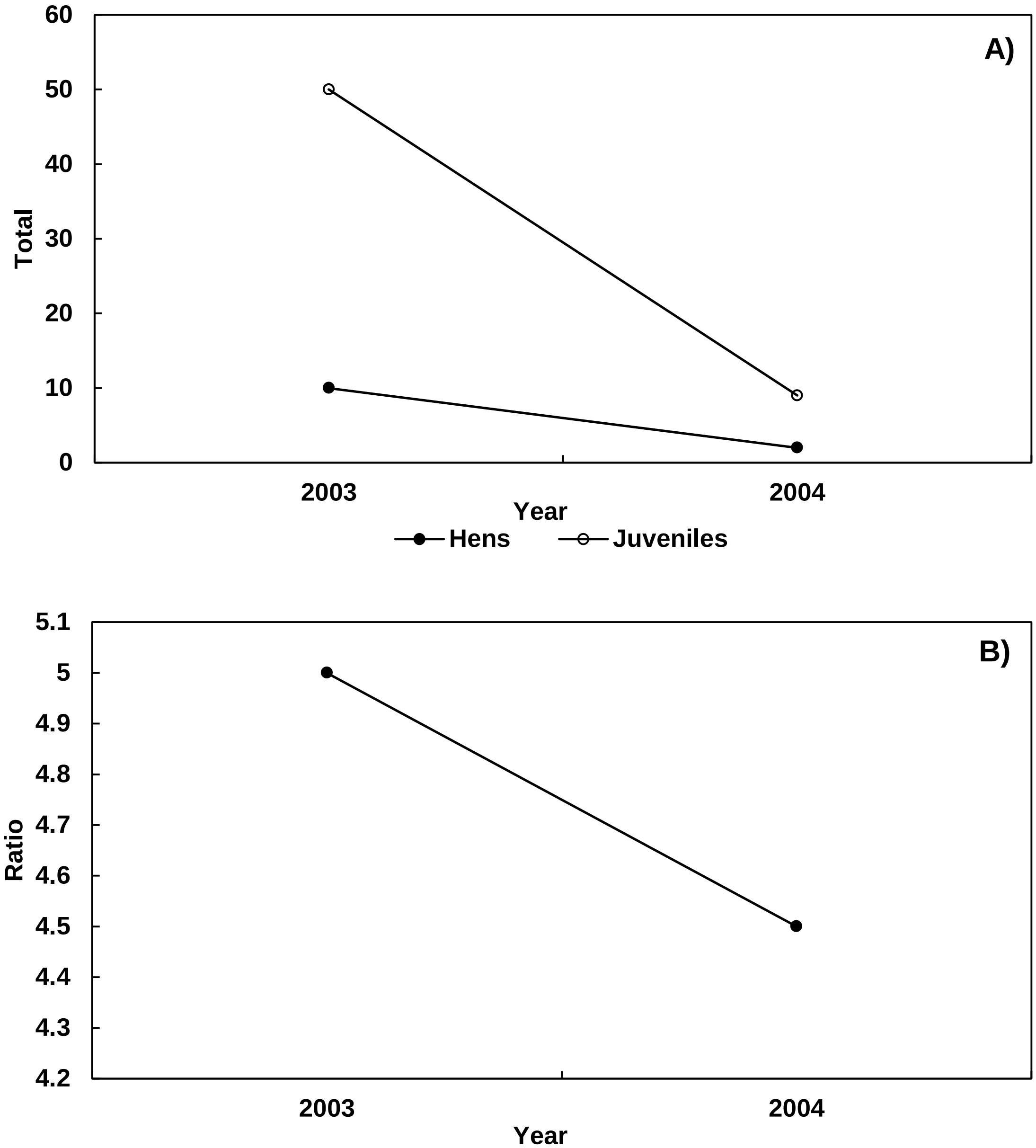


Figure 61. Total A) count and B) age ratio (juvs per adult) of pheasants flushed on surveys at Yolo Bypass WA, 2003 – 2004.

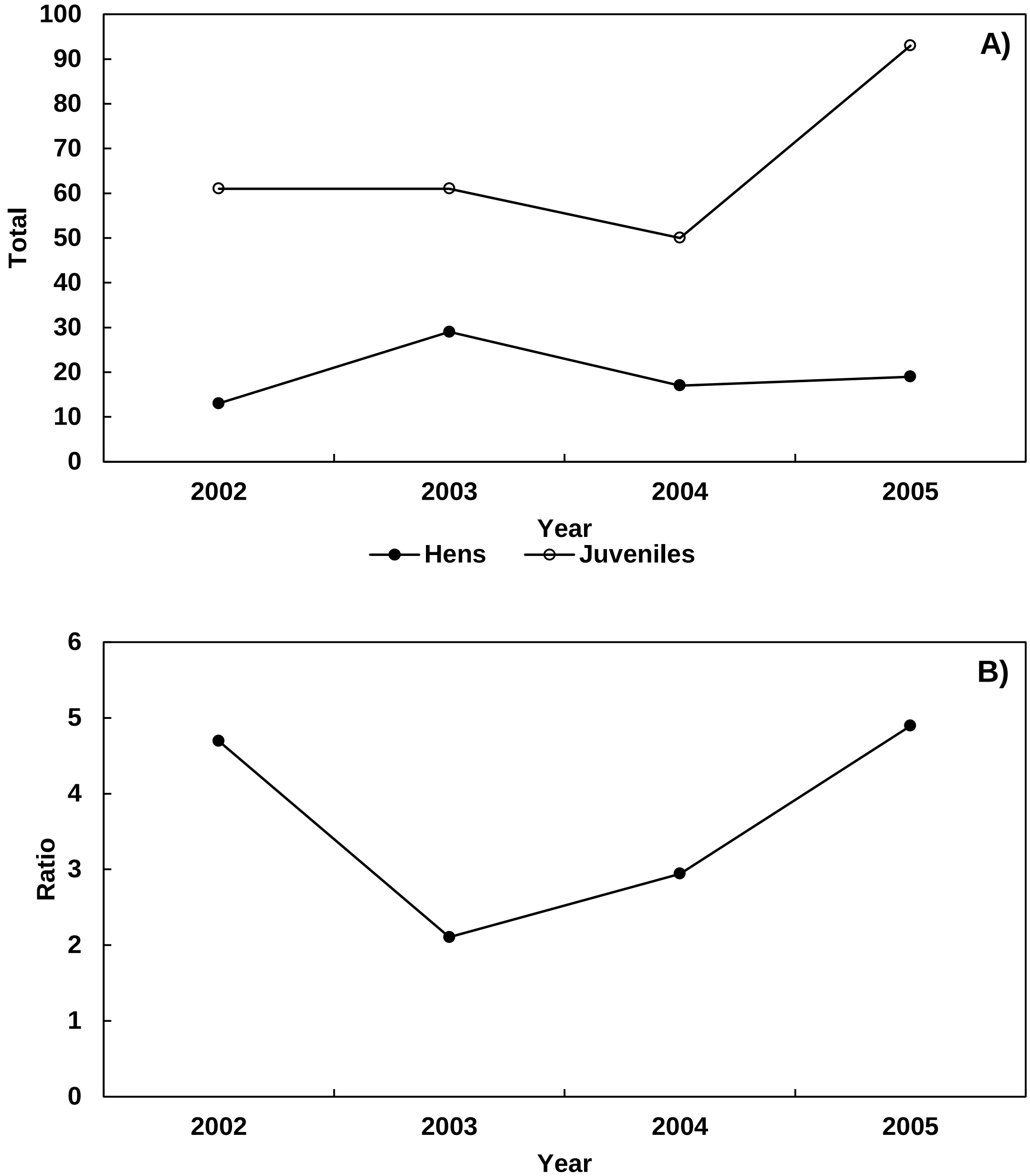


Figure 62. Total A) count and B) age ratio (juvs per adult) of pheasants flushed on surveys at fields enrolled in CREP, 2002 – 2005.

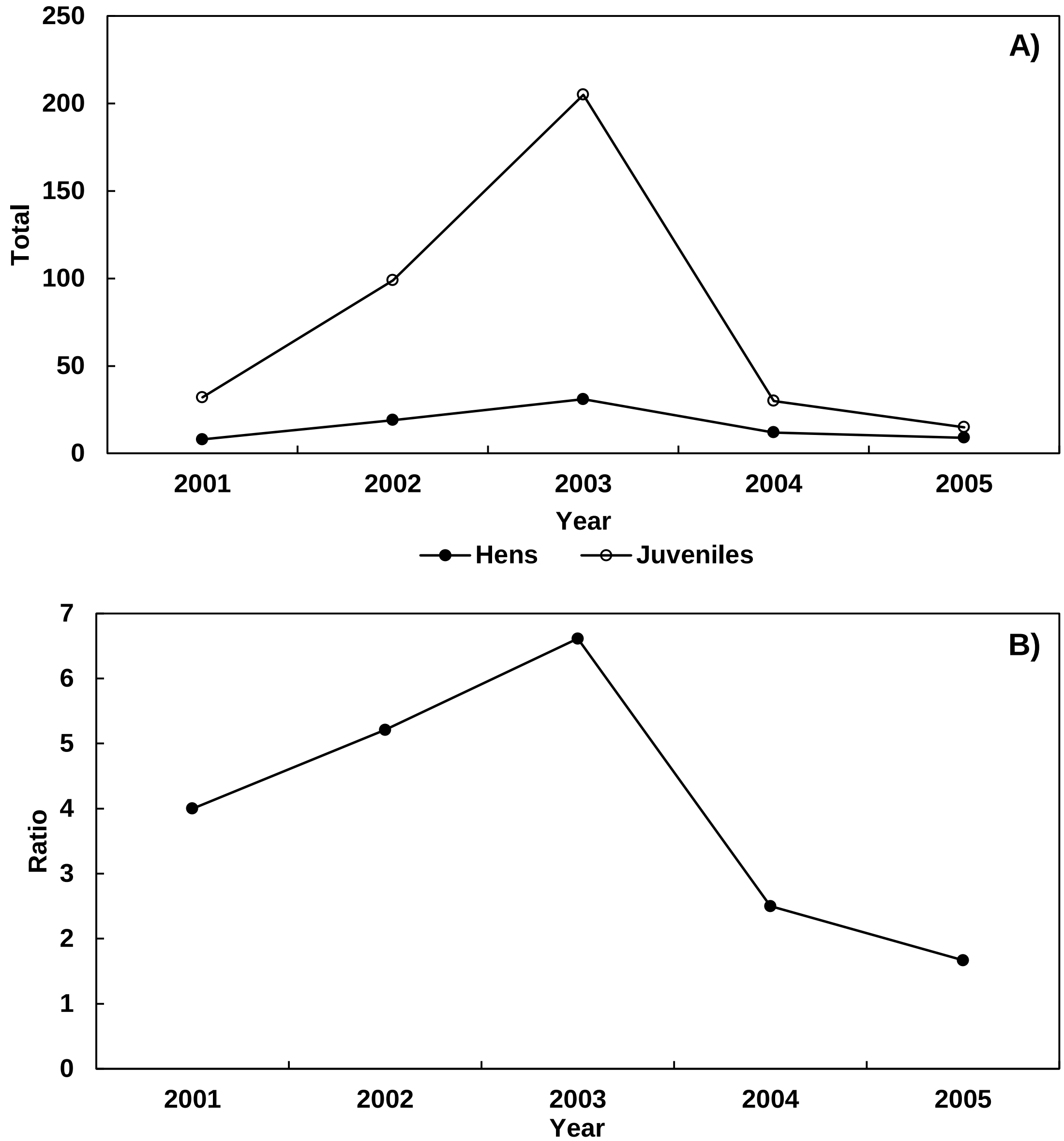


Figure 63. Total A) count and B) age ratio (juvs per adult) of pheasants flushed on surveys at Grizzly Island WA, 2001 – 2005.

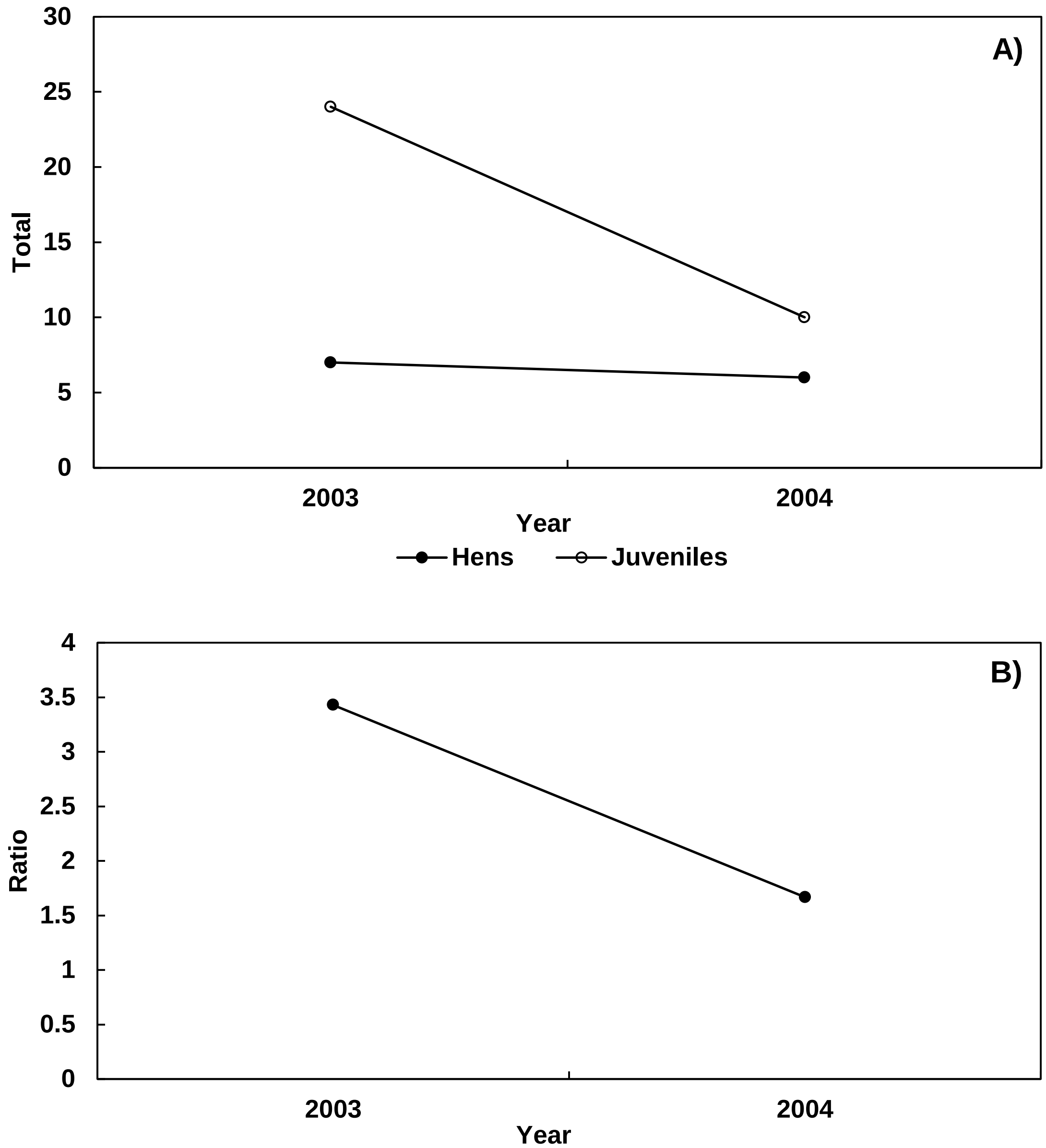


Figure 64. Total A) count and age ratio (juvs per adult) of pheasants flushed on surveys at North Grasslands WA (Salt Slough Unit), 2003 – 2004.

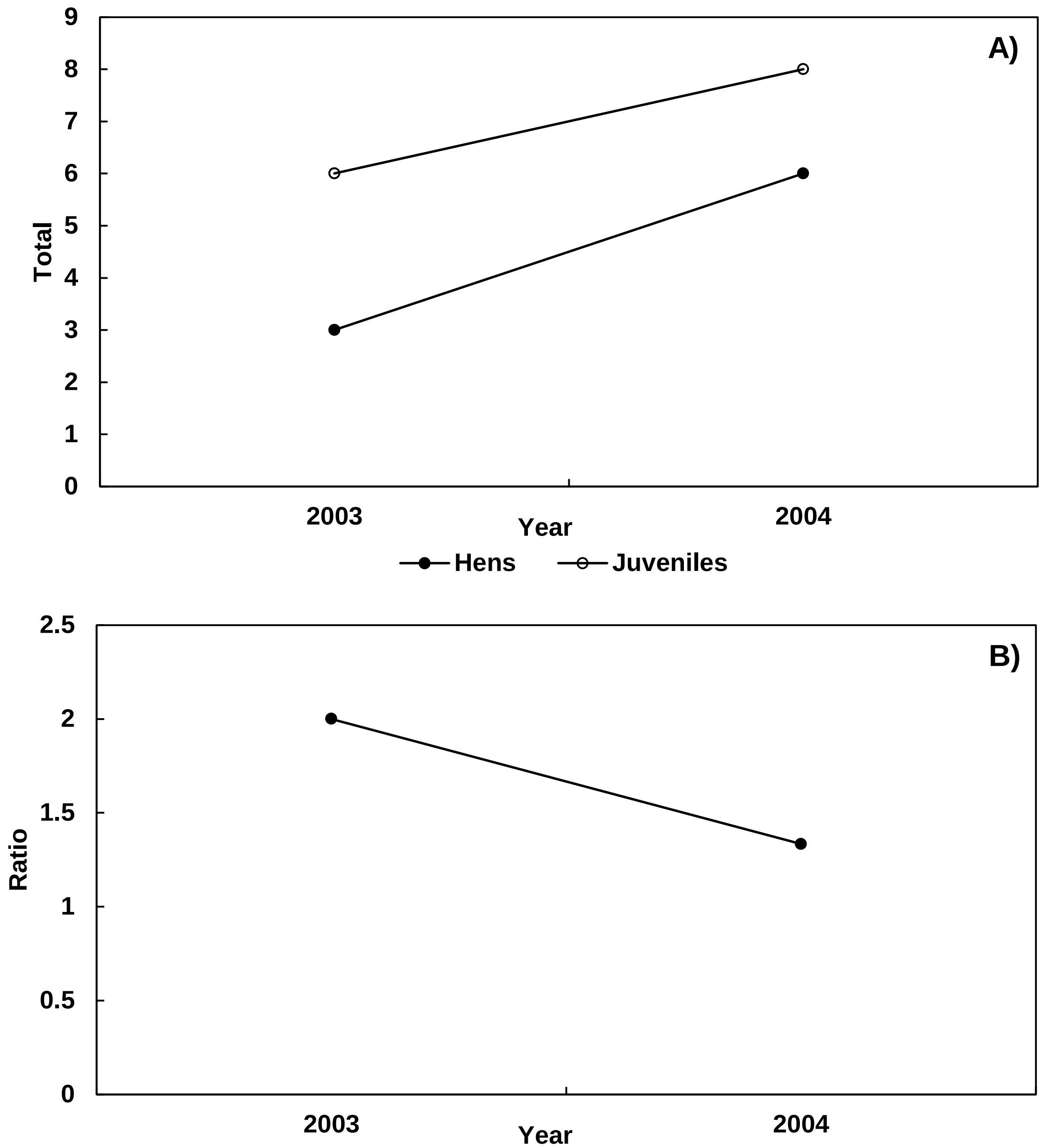


Figure 65. Total A) count and B) age ratio (juvs per adult) of pheasants flushed on surveys at Los Banos WA, 2003 – 2004.

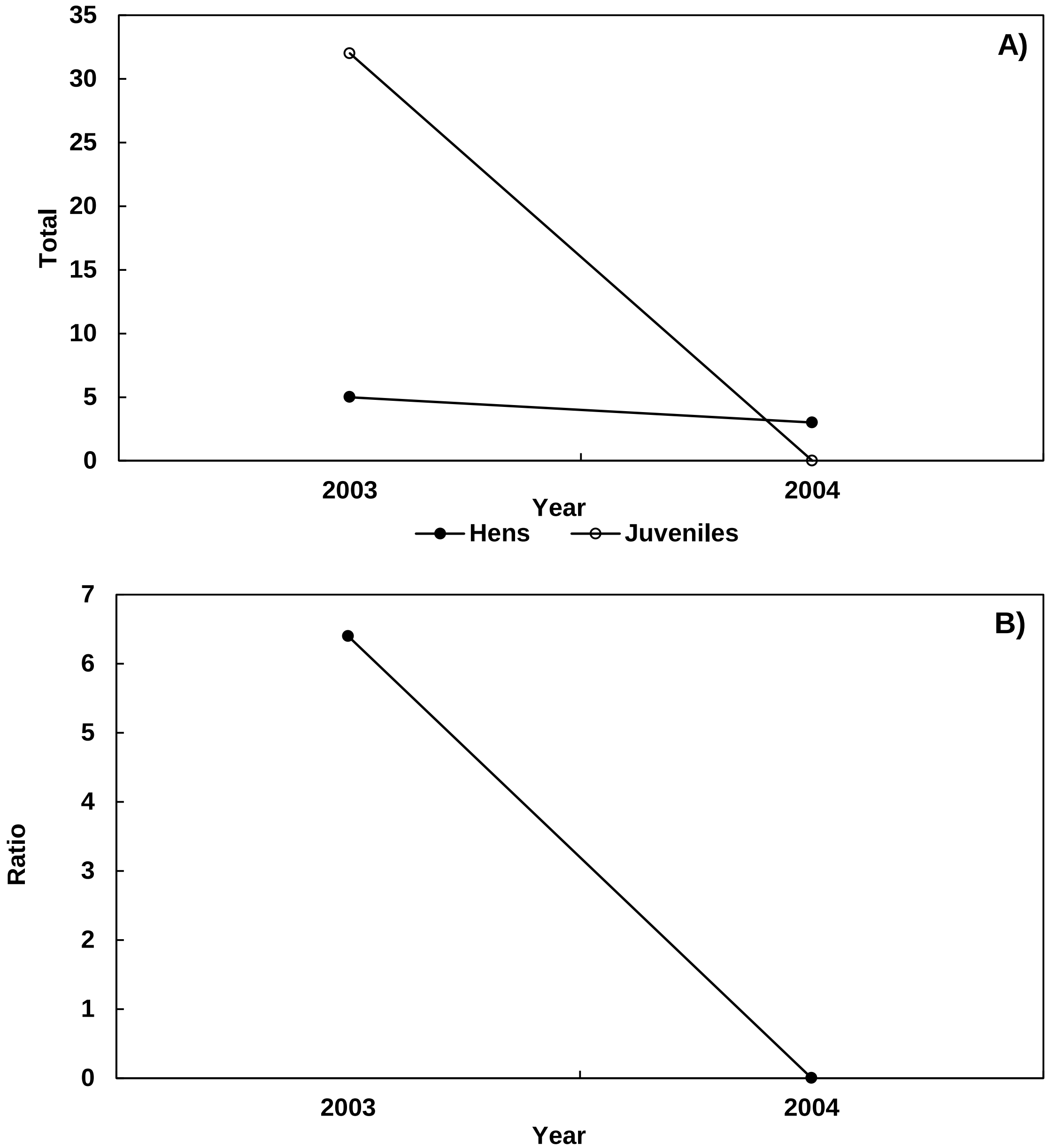


Figure 66. Total A) count and B) age ratio (juvs per adult) of pheasants flushed on surveys at Mendota WA, 2003 – 2004.

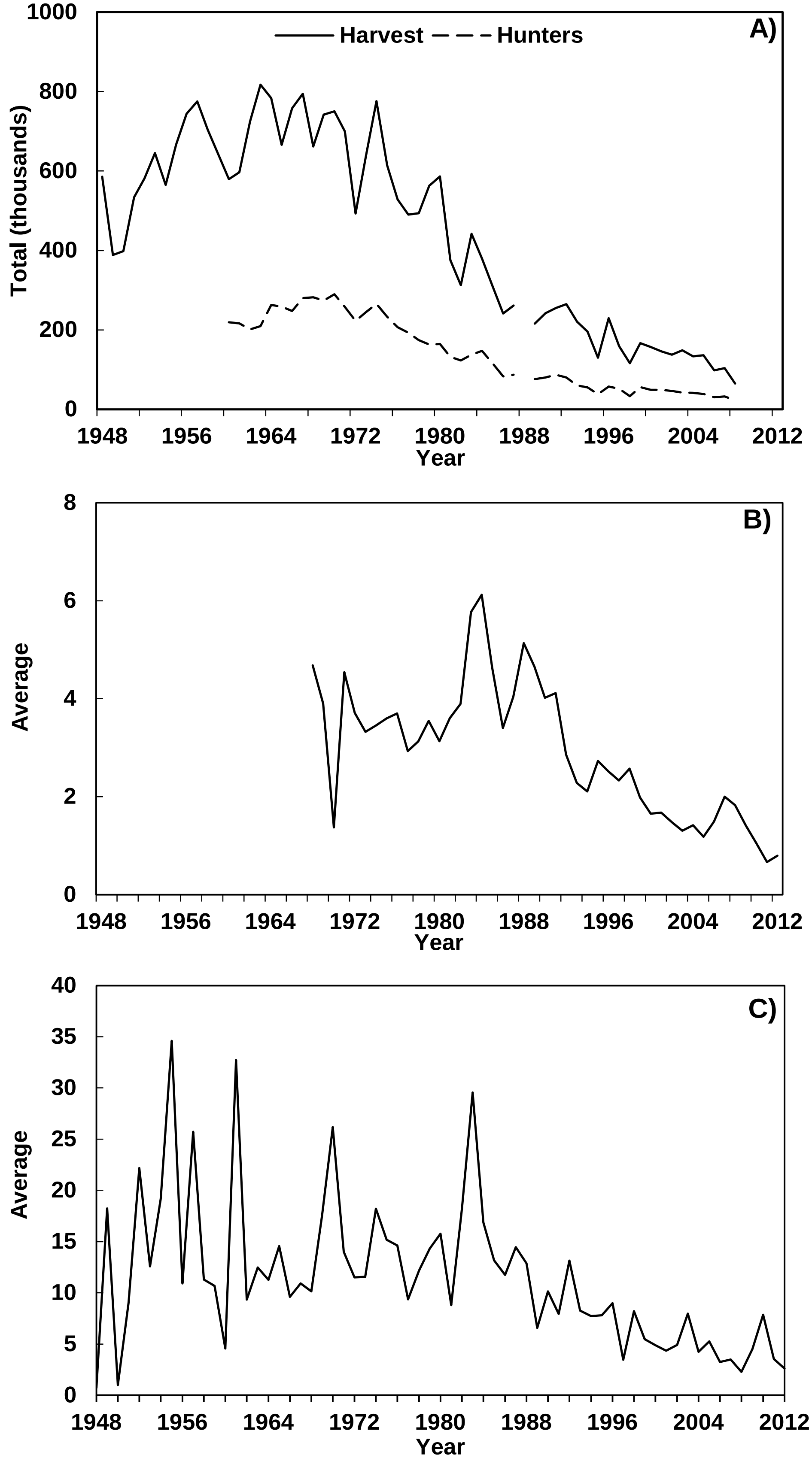


Figure 67. California Statewide Pheasant A) total harvest (bag) and hunters, B) average Breeding Bird Survey detections per route, and C) average Christmas Bird Count detections per route, 1948–2012.

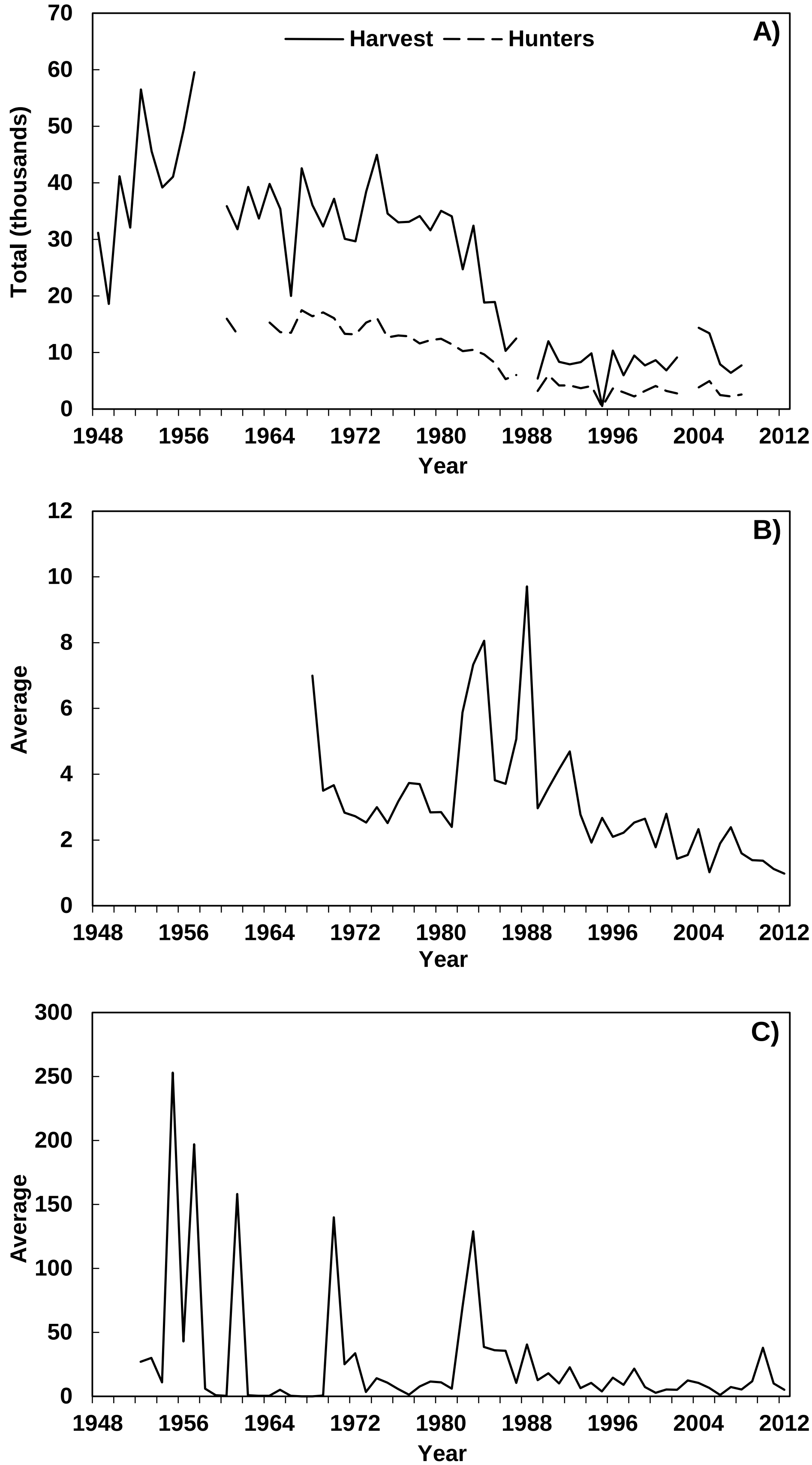


Figure 68. Northern Region pheasant A) total harvest (bag) and hunters, B) average Breeding Bird Survey detections per route, and C) average Christmas Bird Count detections per route, 1948–2012.

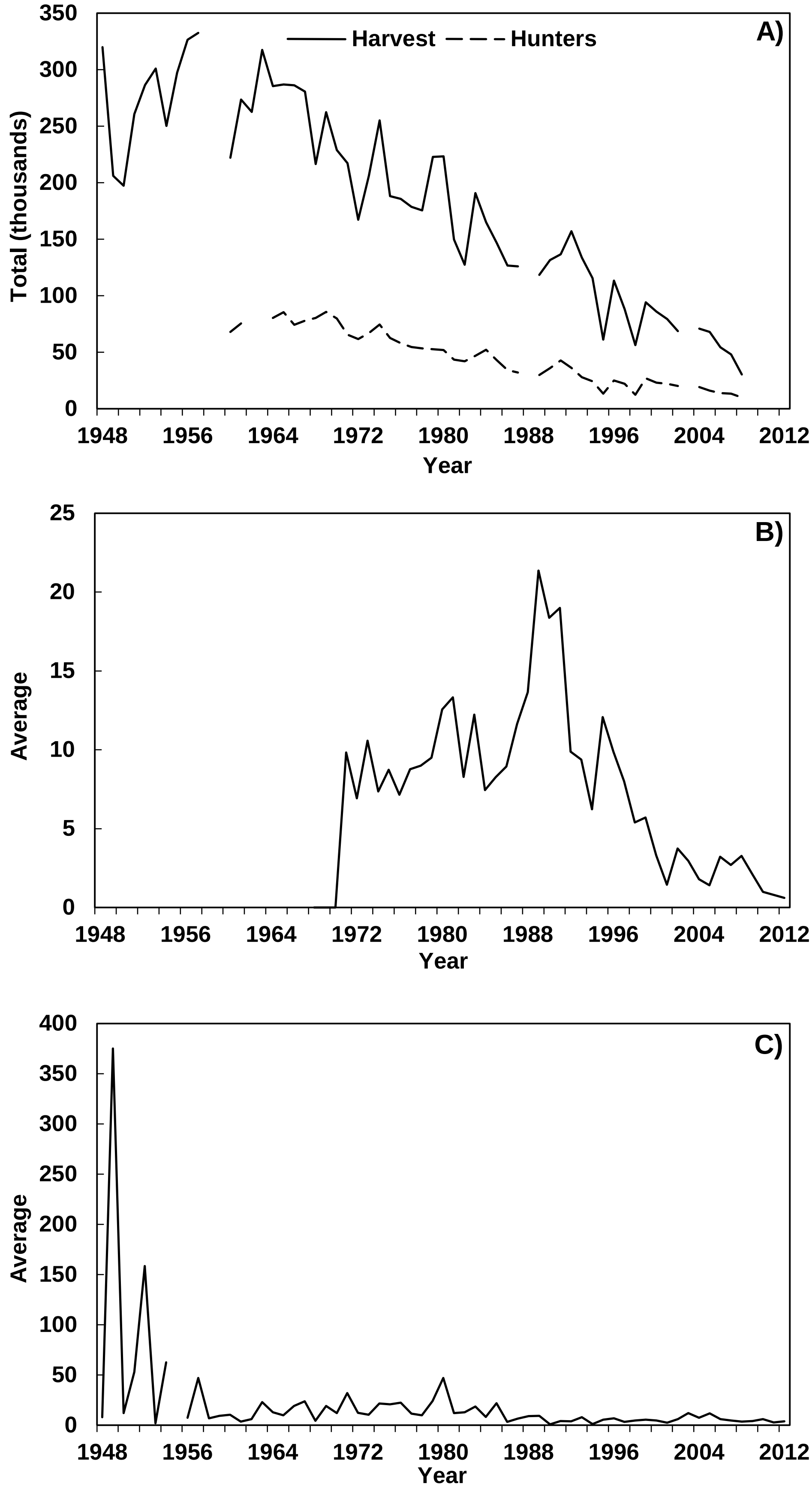


Figure 69. North Central Region pheasant A) total harvest (bag) and hunters, B) average Breeding Bird Survey detections per route, and C) average Christmas Bird Count detections per route, 1948–2012.

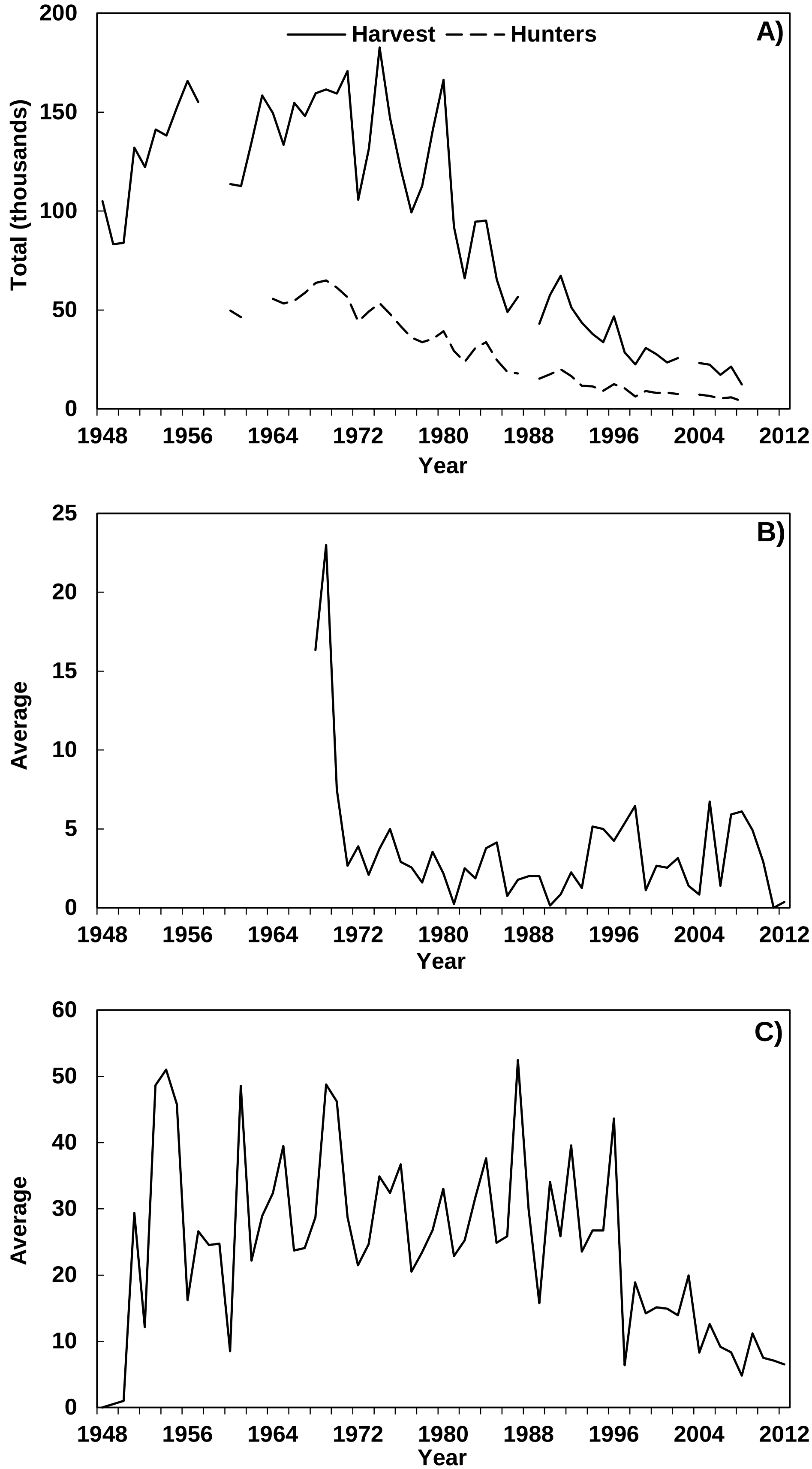
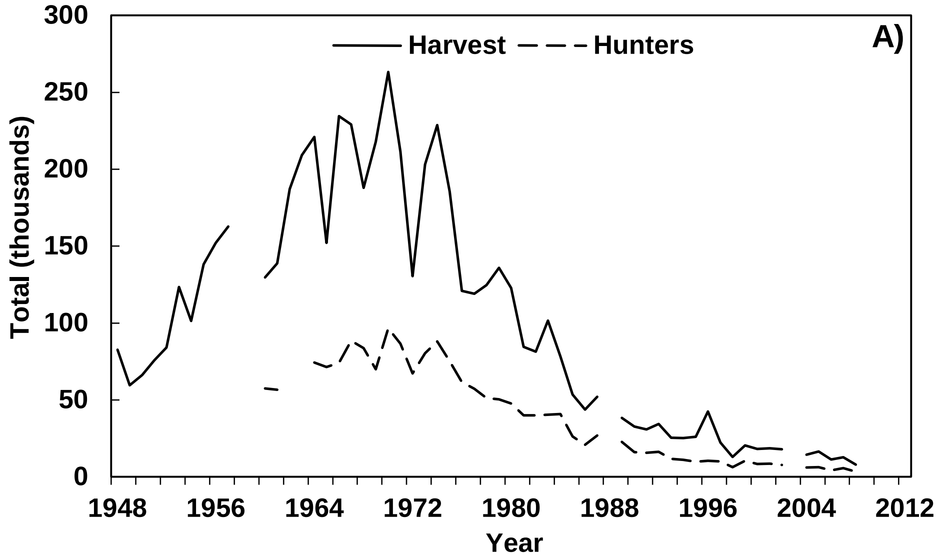
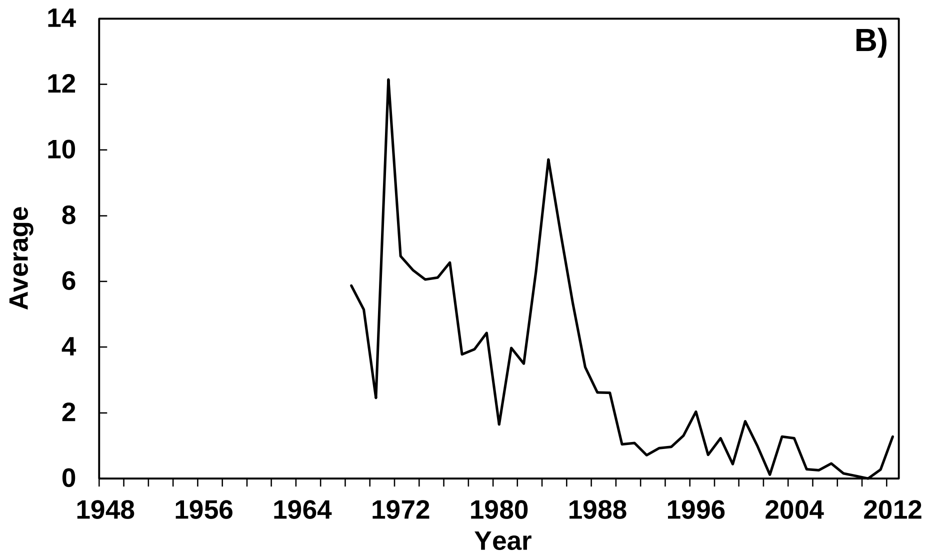


Figure 70. Bay-Delta Region pheasant A) total harvest (bag) and hunters, B) average Breeding Bird Survey detections per route, and C) average Christmas Bird Count detections per route, 1948–2012.





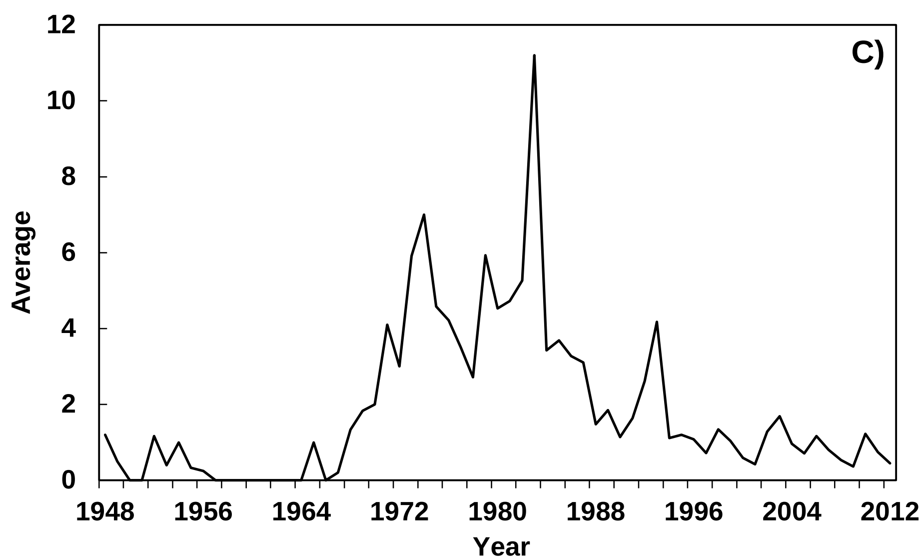


Figure 71. Central Region pheasant A) total harvest (bag) and hunters, B) average Breeding Bird Survey detections per route, and C) average Christmas Bird Count detections per route, 1948–2012.

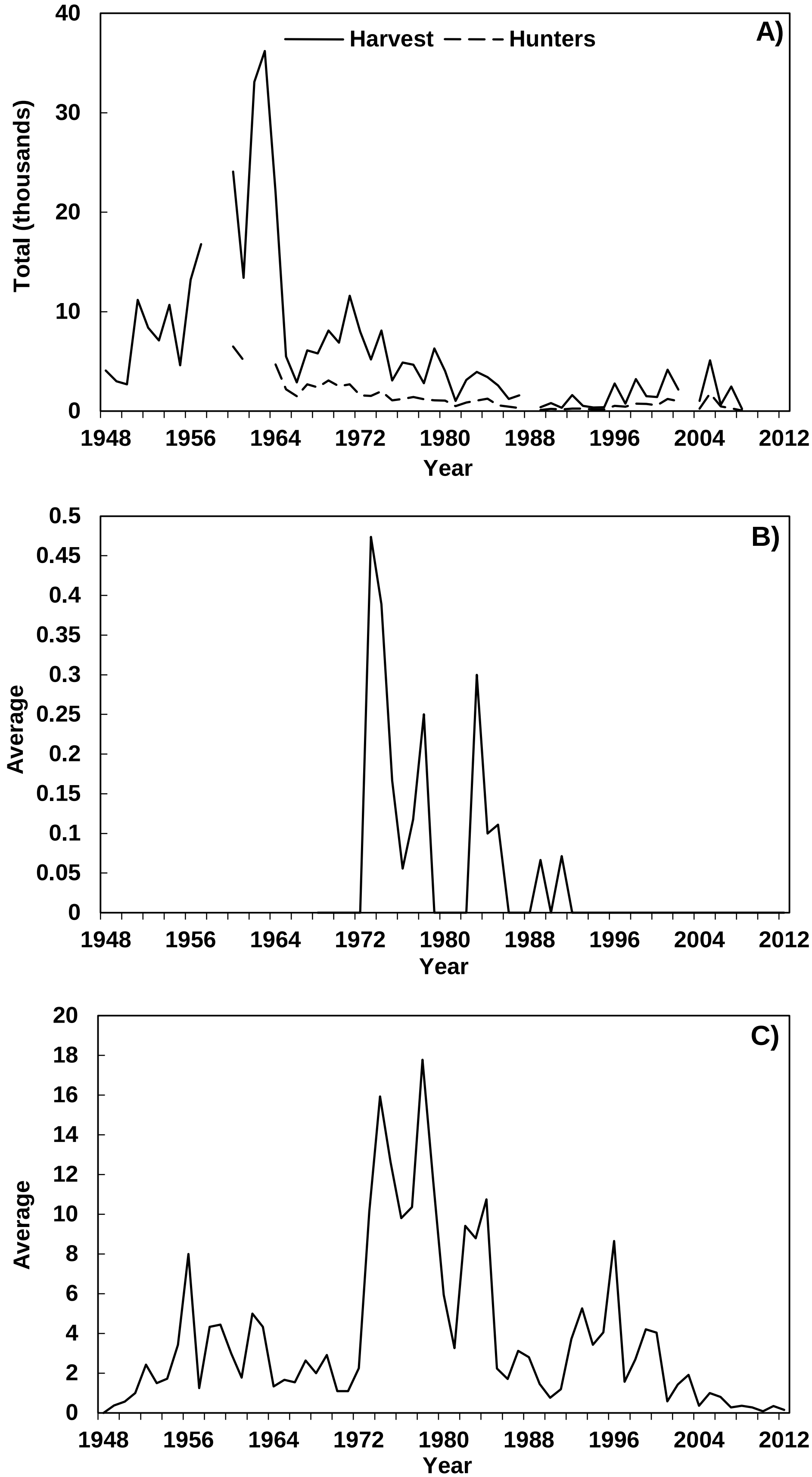


Figure 72. South Coast Region pheasant A) total harvest (bag) and hunters, B) average Breeding Bird Survey detections per route, and C) average Christmas Bird Count detections per route, 1948–2012.

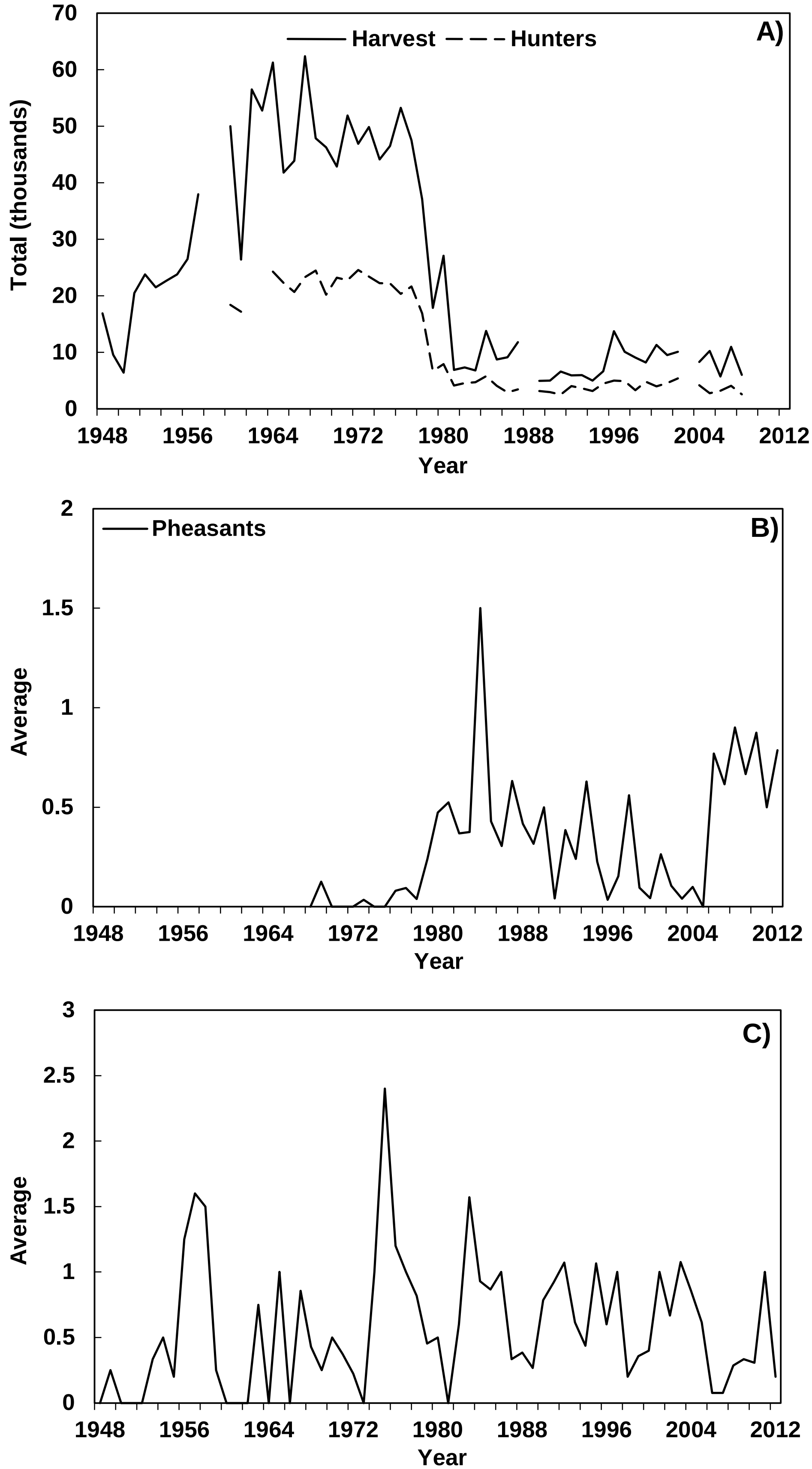


Figure 73. Inland Deserts Region pheasant A) total harvest (bag) and hunters, B) average Breeding Bird Survey detections per route, and C) average Christmas Bird Count detections per route, 1948–2012.

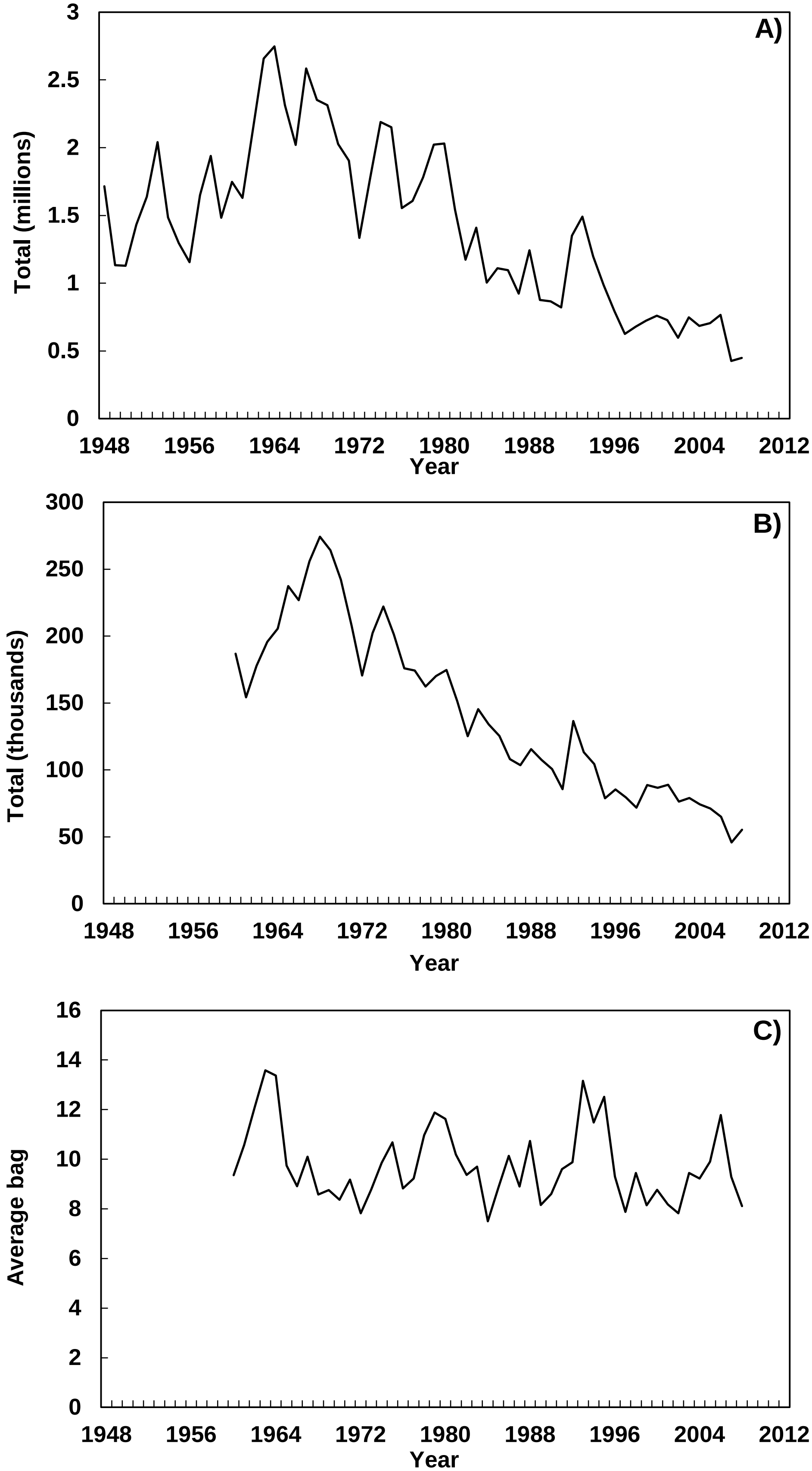


Figure 74. California statewide Annual Game Take Survey of California quail A) harvest, B) quail hunters, and C) average bag.

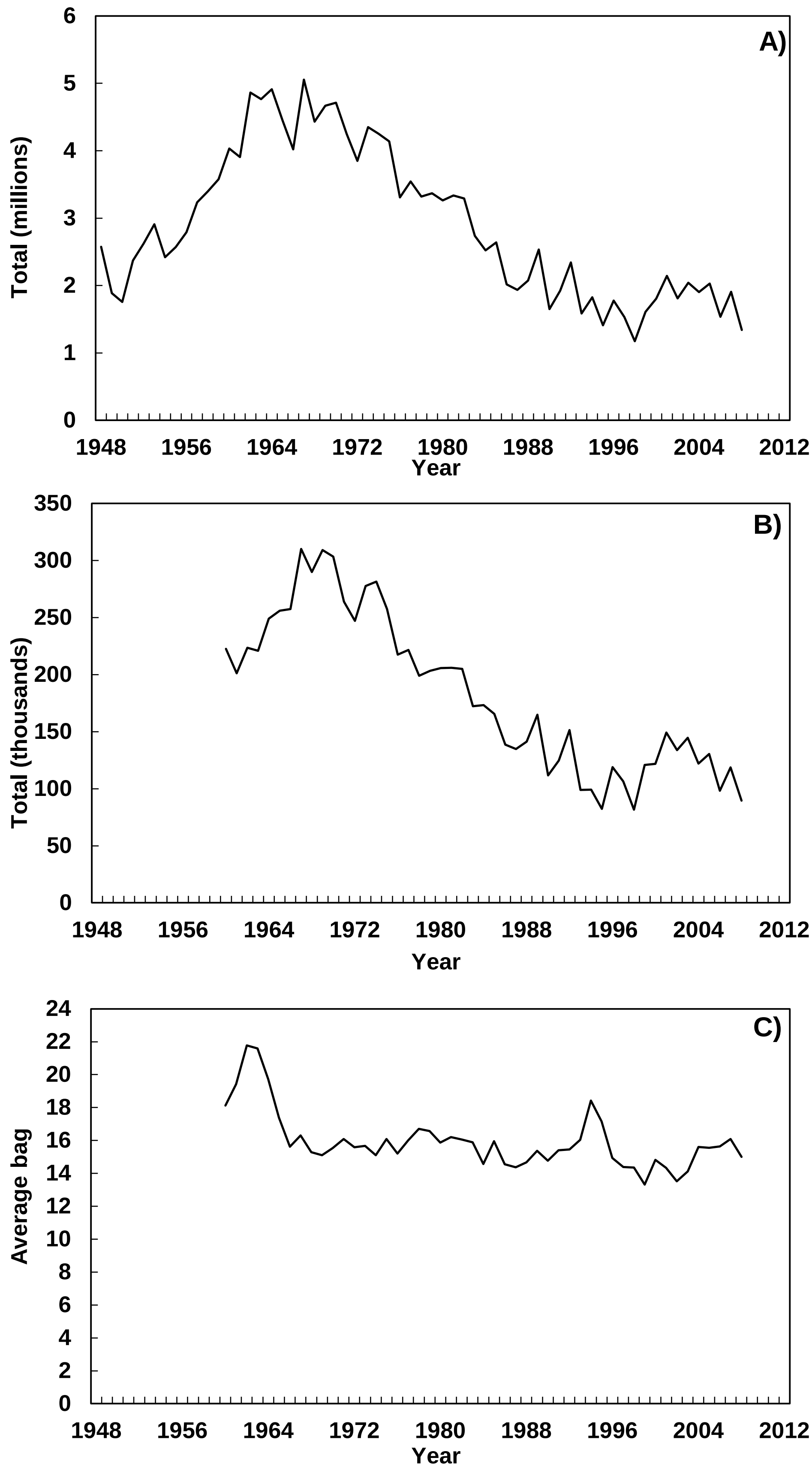


Figure 75. CA Statewide Annual Game Take Survey of mourning dove A) harvest, B) dove hunters, and C) average bag.

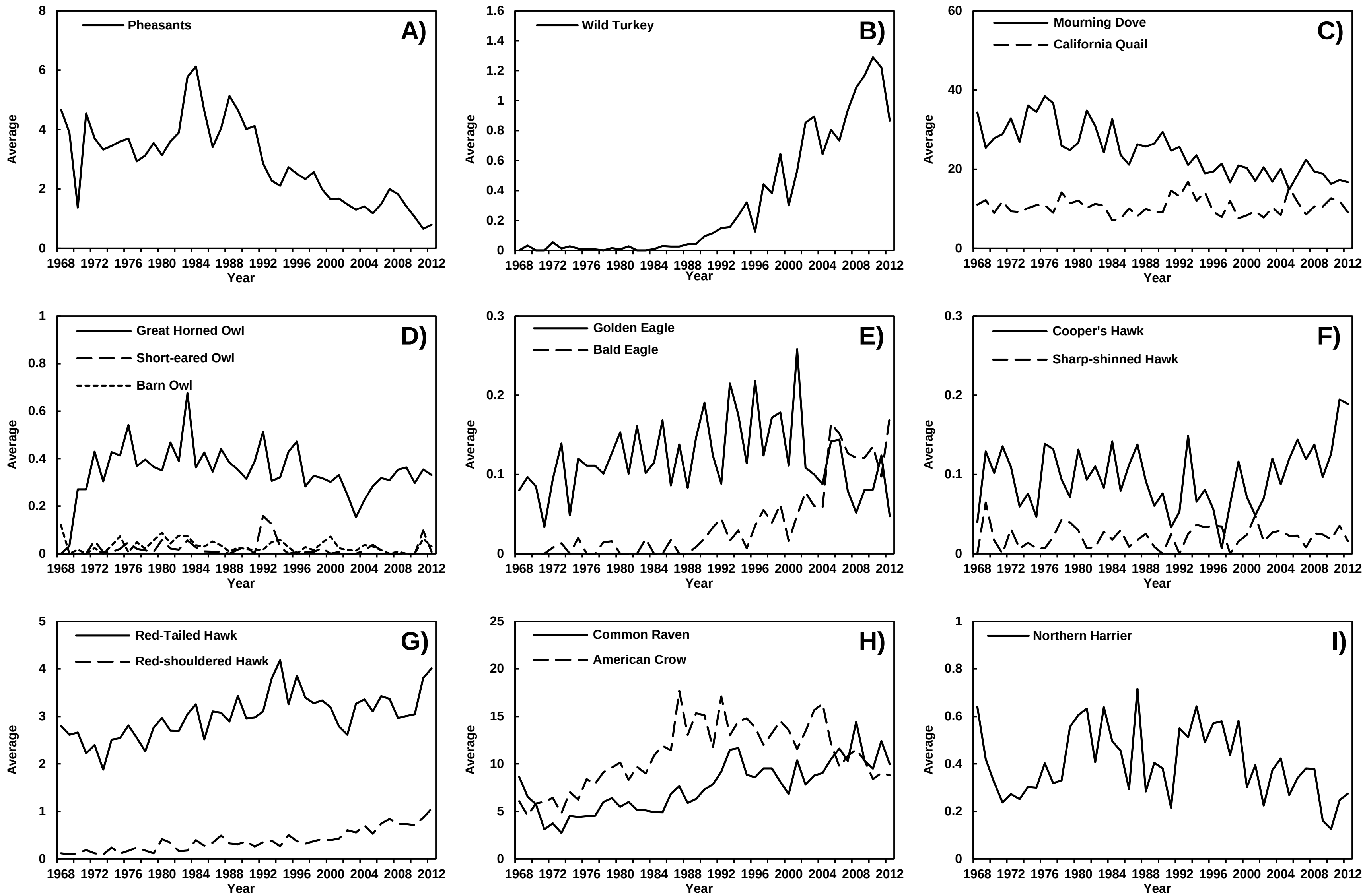


Figure 76. California statewide average Breeding Bird Survey detections per route for A) Pheasants, game birds, including B) Wild Turkey C) Mourning Dove and California Quail, as well as potential aerial predators, including D) Great Horned Owl, Short-eared Owl and Barn Owl, E) Golden Eagle and Bald Eagle, F) Cooper's Hawk and Sharp-shinned Hawk, G) Red-tailed Hawk and Red-shouldered Hawk, H) Common Raven and American Crow, and I) Northern Harrier, 1968-2012.

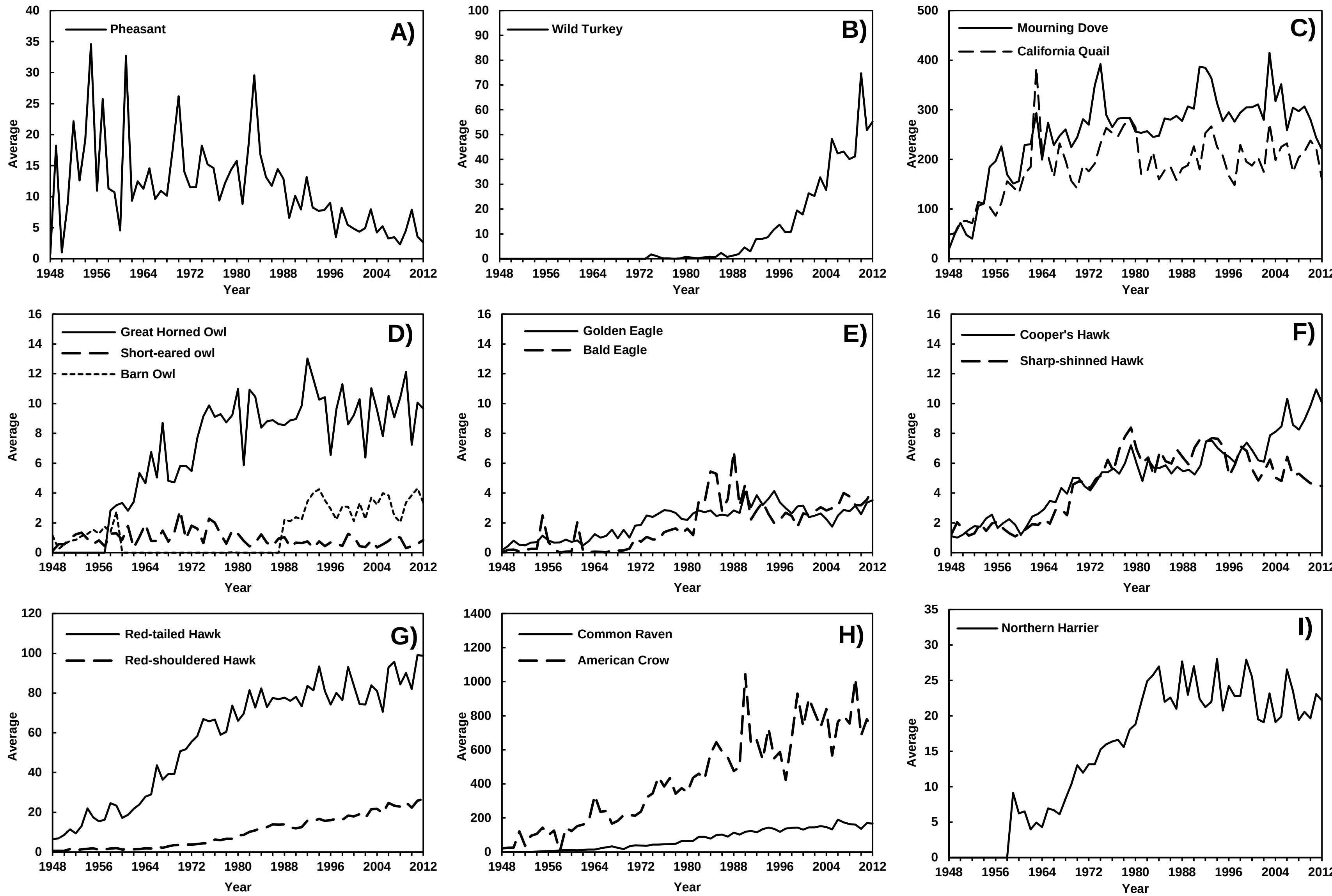


Figure 77. California statewide average Christmas Bird Count detections for A) Pheasants, game birds, including B) Wild Turkey, C) Mourning Dove and California Quail, as well as potential aerial predators, including D) Great Horned Owl, Short-eared Owl and Barn Owl, E) Golden Eagle and Bald Eagle, F) Cooper's Hawk and Sharp-shinned Hawk, G) Red-tailed Hawk and Red-shouldered Hawk, H) Common Raven and American Crow, and I) Northern Harrier, 1948–2012.

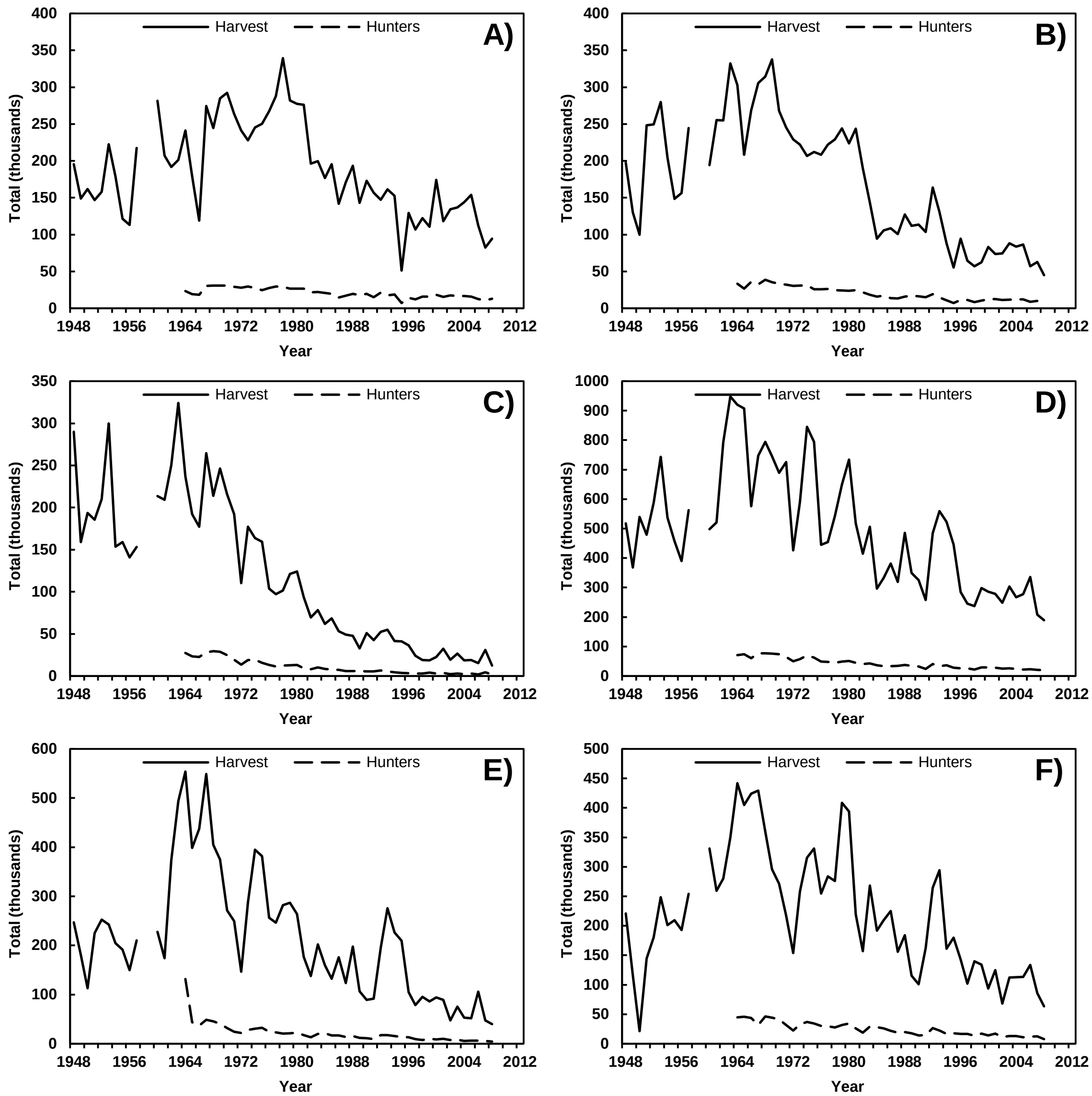


Figure 78. Annual Game Take Survey California quail harvest and quail hunters for the A) northern region, B) north central region, C) bay delta region, D) central region, E) south coast region, F) inland desert region.

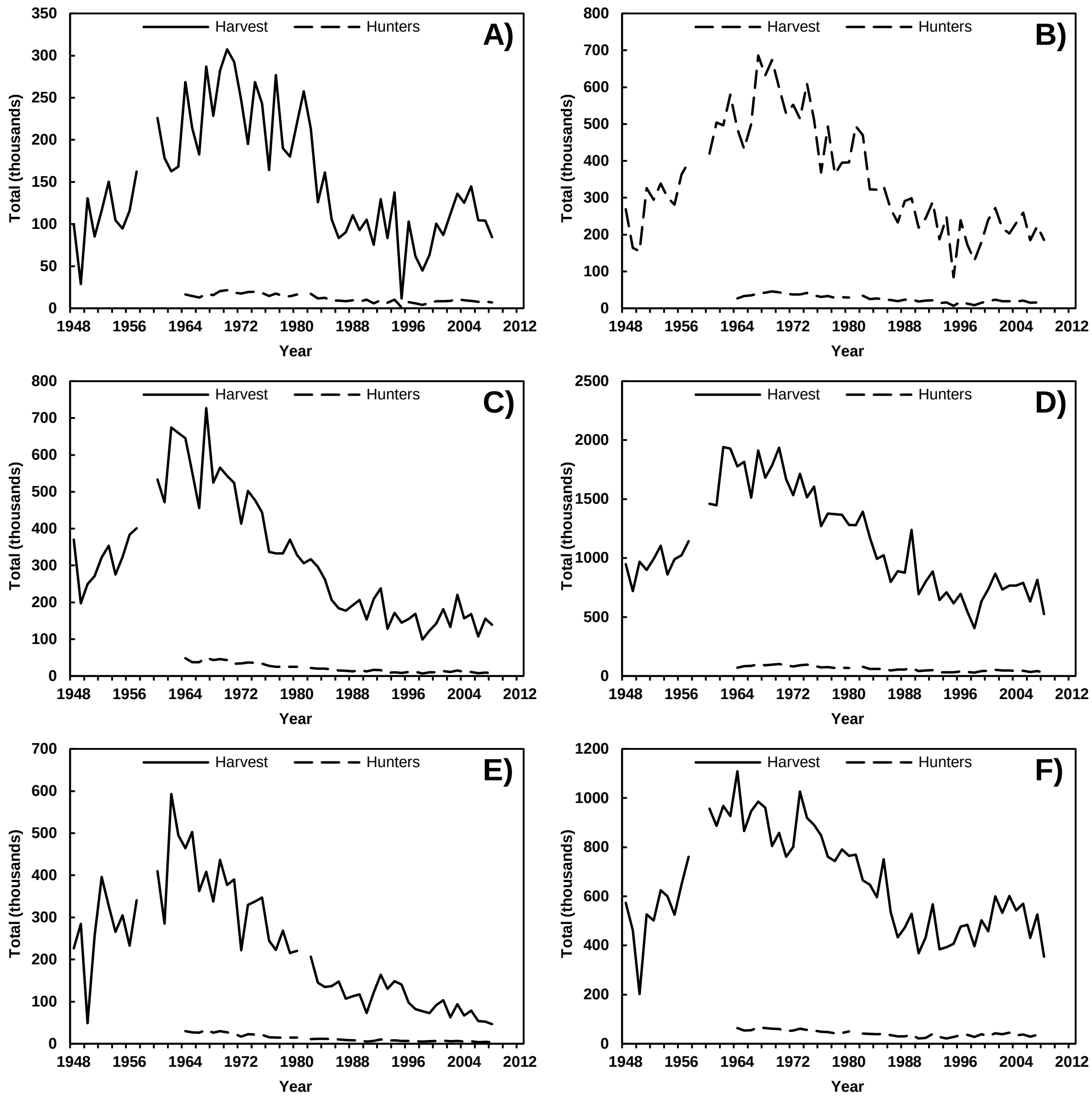


Figure 79. Annual Game Take Survey mourning dove harvest and dove hunters for the A) northern region, B) north central region, C) bay delta region, D) central region, E) south coast region, F) inland desert region.

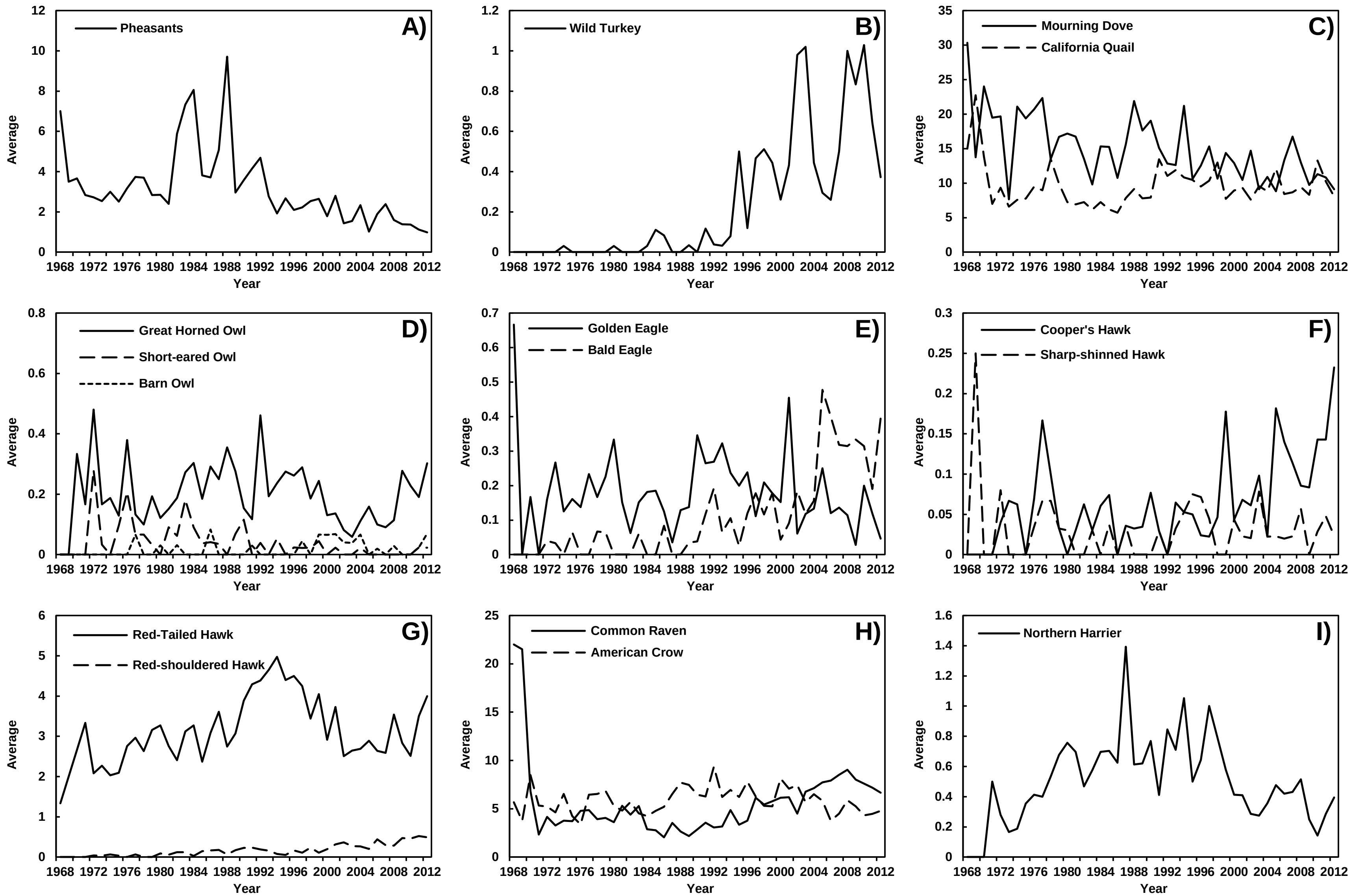


Figure 80. Region 1 average Breeding Bird Survey detections per route for A) Pheasants, game birds, including B) Wild Turkey C) Mourning Dove and California Quail, as well as potential aerial predators, including D) Great Horned Owl, Short-eared Owl and Barn Owl, E) Golden Eagle and Bald Eagle, F) Cooper's Hawk and Sharp-shinned Hawk, G) Red-tailed Hawk and Red-shouldered Hawk, H) Common Raven and American Crow, and I) Northern Harrier, 1968-2012.

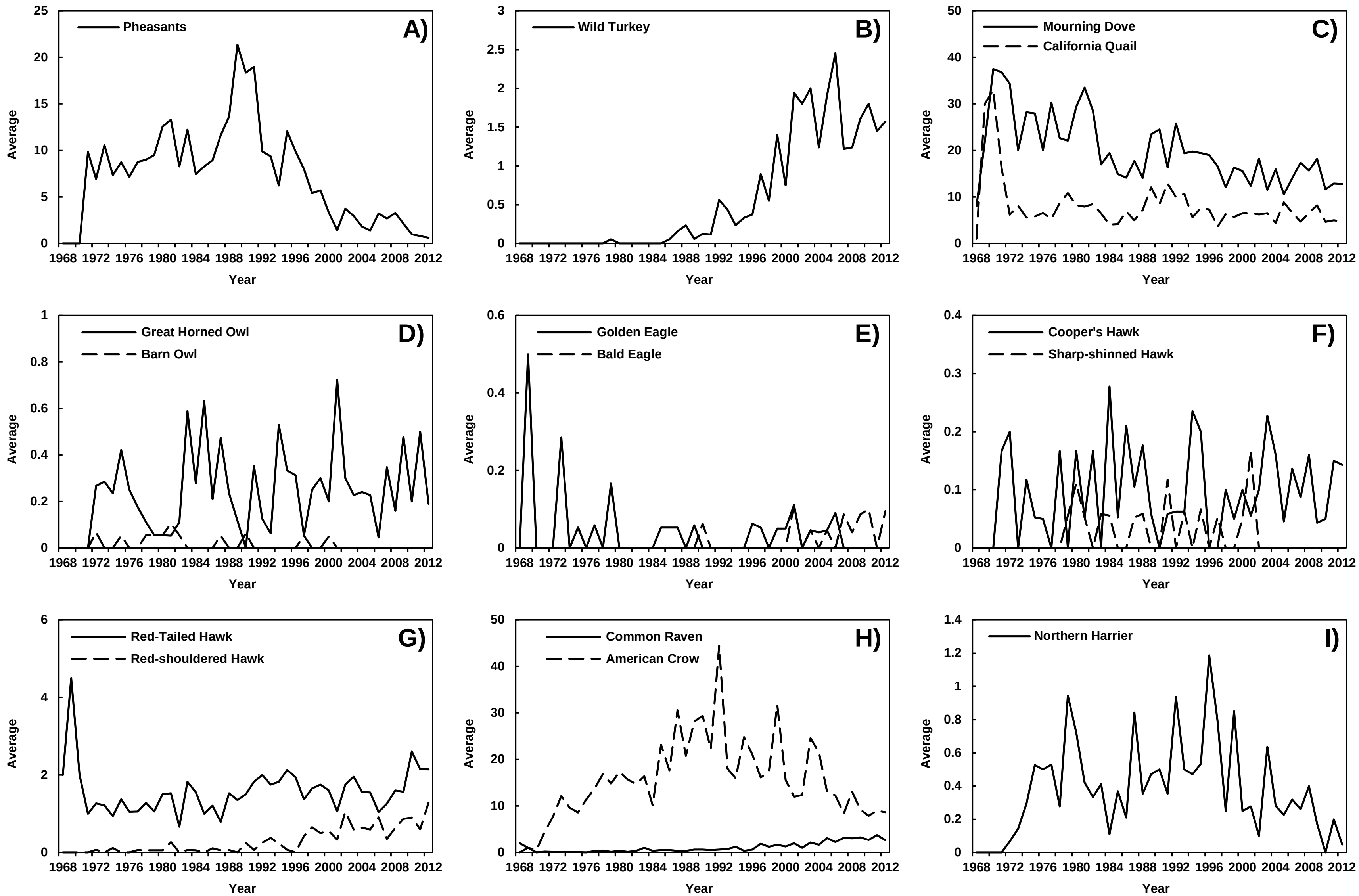


Figure 81. Region 2 average Breeding Bird Survey detections per route for A) Pheasants, game birds, including B) Wild Turkey C) Mourning Dove and California Quail, as well as potential aerial predators, including D) Great Horned Owl and Barn Owl, E) Golden Eagle and Bald Eagle, F) Cooper's Hawk and Sharp-shinned Hawk, G) Red-tailed Hawk and Red-shouldered Hawk, H) Common Raven and American Crow, and I) Northern Harrier, 1968-2012. Note: There were not enough data to include Short-eared Owl.

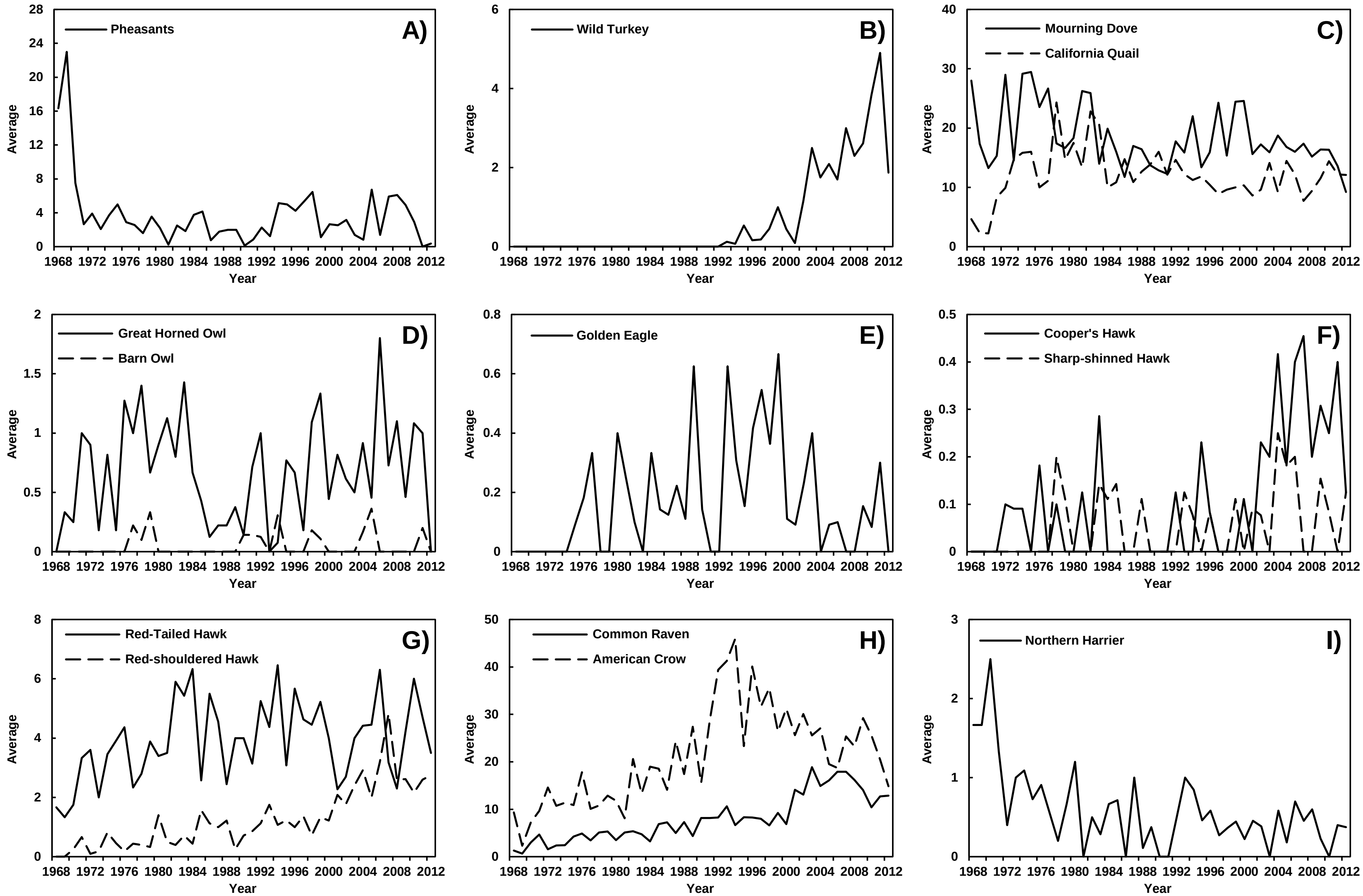


Figure 82. Region 3 average Breeding Bird Survey detections per route for A) Pheasants, game birds, including B) Wild Turkey C) Mourning Dove and California Quail, as well as potential aerial predators, including D) Great Horned Owl and Barn Owl, E) Golden Eagle, F) Cooper’s Hawk and Sharp-shinned Hawk, G) Red-tailed Hawk and Red-shouldered Hawk, H) Common Raven and American Crow, and I) Northern Harrier, 1968-2012. Note: There were not enough data to include Short-eared Owl or Bald Eagle.

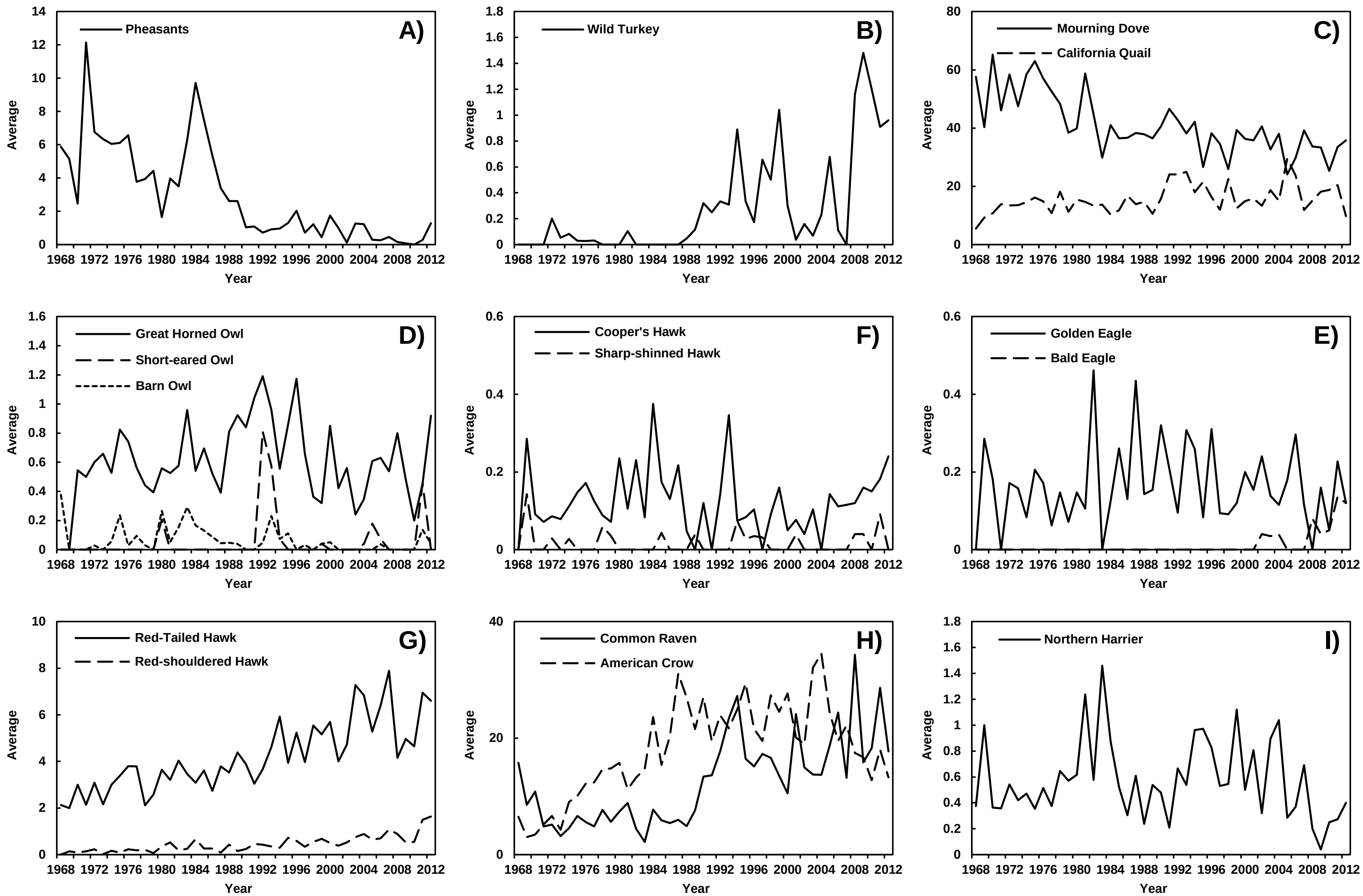


Figure 83. Region 4 average Breeding Bird Survey detections per route for A) Pheasants, game birds, including B) Wild Turkey C) Mourning Dove and California Quail, as well as potential aerial predators, including D) Great Horned Owl, Short-eared Owl and Barn Owl, E) Golden Eagle and Bald Eagle, F) Cooper's Hawk and Sharp-shinned Hawk, G) Red-tailed Hawk and Red-shouldered Hawk, H) Common Raven and American Crow, and I) Northern Harrier, 1968-2012.

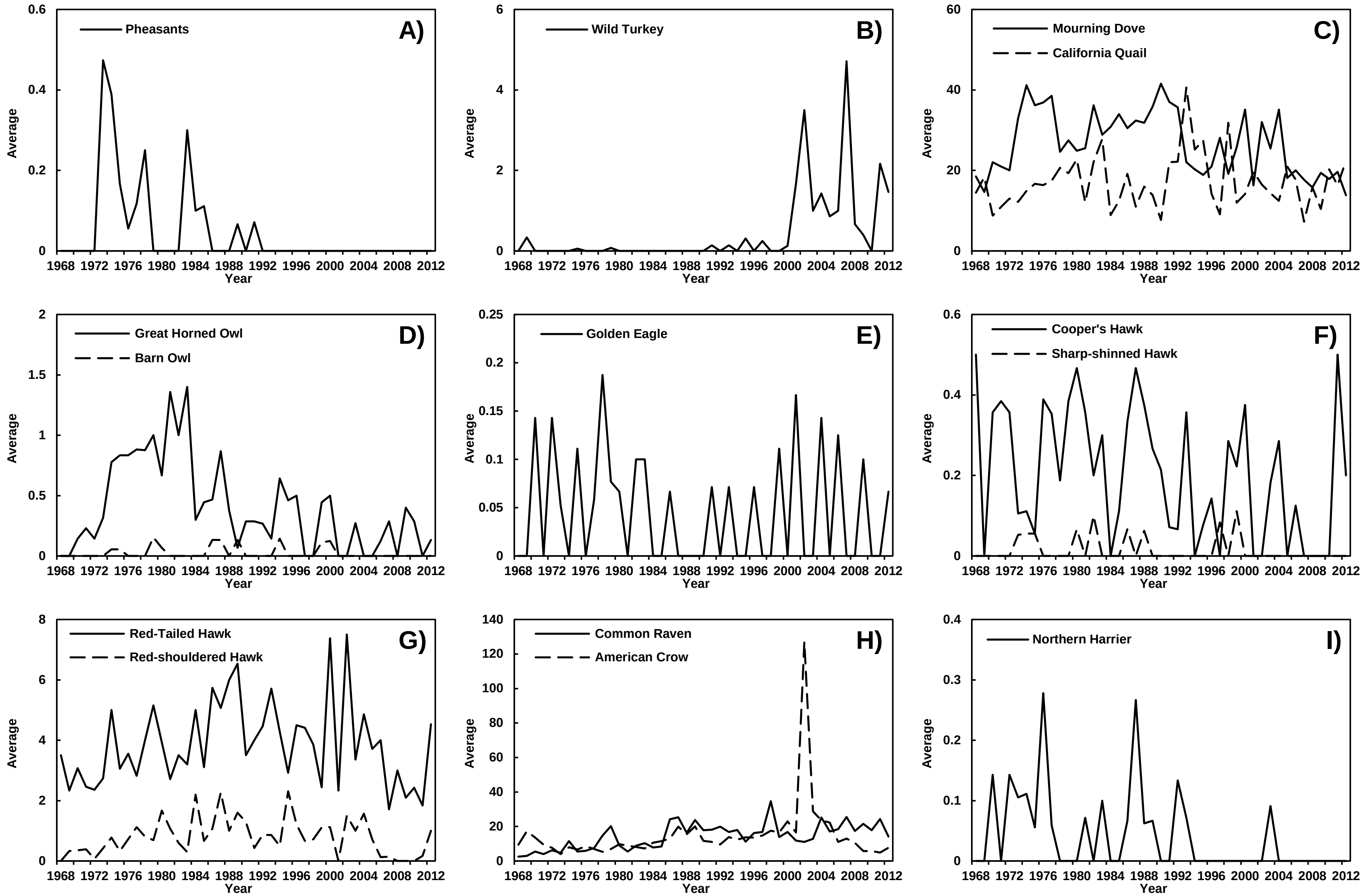


Figure 84. Region 5 average Breeding Bird Survey detections per route for A) Pheasants, game birds, including B) Wild Turkey C) Mourning Dove and California Quail, as well as potential aerial predators, including D) Great Horned Owl and Barn Owl, E) Golden Eagle, F) Cooper's Hawk and Sharp-shinned Hawk, G) Red-tailed Hawk and Red-shouldered Hawk, H) Common Raven and American Crow, and I) Northern Harrier, 1968-2012. Note: There were not enough data to include Short-eared Owl and Bald Eagle.

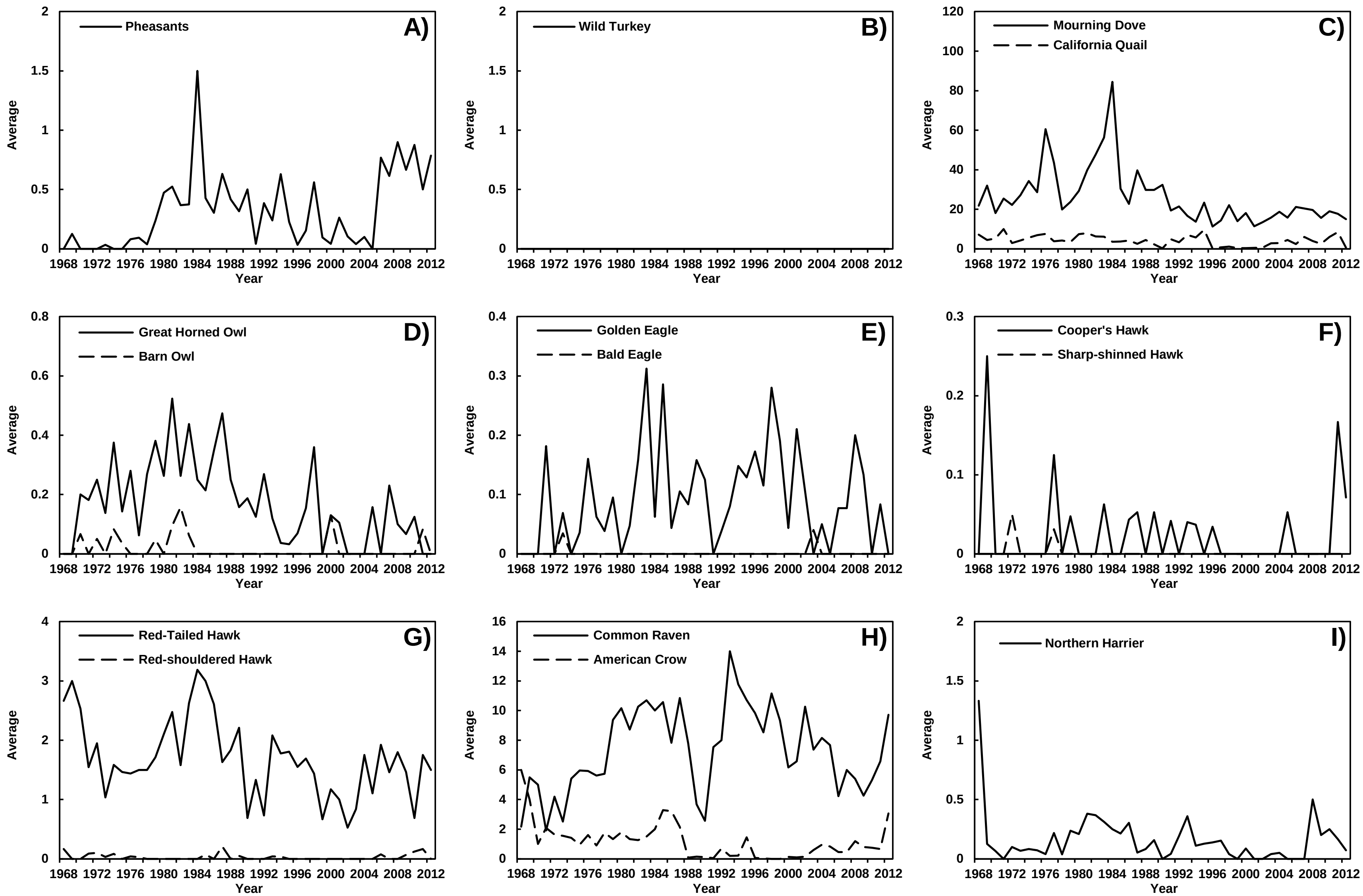


Figure 85. Region 6 average Breeding Bird Survey detections per route for A) Pheasants, game birds, including B) Mourning Dove and California Quail, as well as potential aerial predators, including C) Great Horned Owl and Barn Owl, D) Golden Eagle and Bald Eagle, E) Cooper's Hawk and Sharp-shinned Hawk, F) Red-tailed Hawk and Red-shouldered Hawk, G) Common Raven and American Crow, and H) Northern Harrier, 1968-2012. Note: There were not enough data to include Wild Turkey, Short-eared Owl and Bald Eagle.

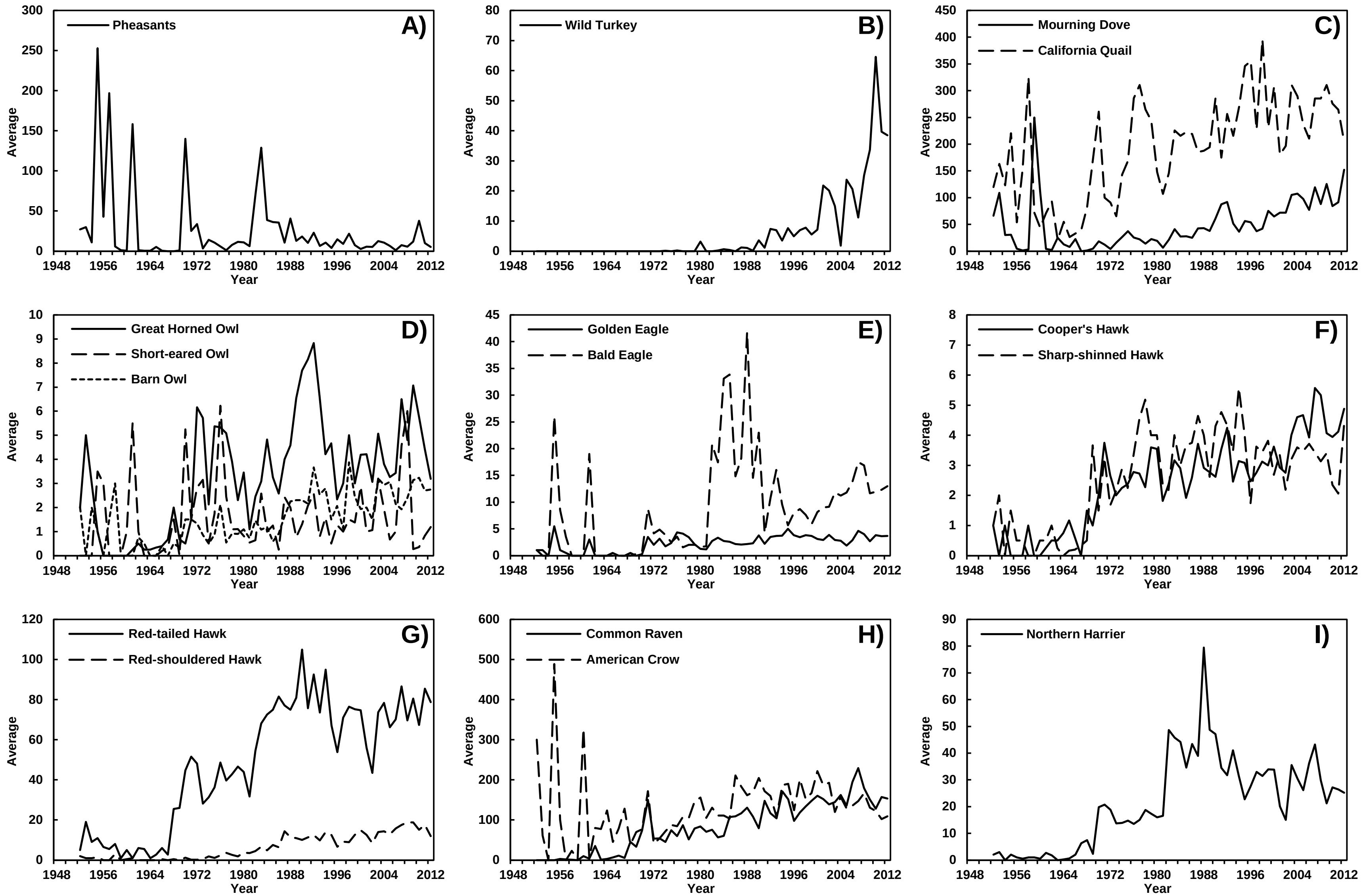


Figure 86. Region 1 average Christmas Bird Count detections for A) Pheasants, game birds, including B) Wild Turkey, C) Mourning Dove and California Quail, as well as potential aerial predators, including D) Great Horned Owl, Short-eared Owl and Barn Owl, E) Golden Eagle and Bald Eagle, F) Cooper's Hawk and Sharp-shinned Hawk, G) Red-tailed Hawk and Red-shouldered Hawk, H) Common Raven and American Crow, and I) Northern Harrier, 1948–2012.

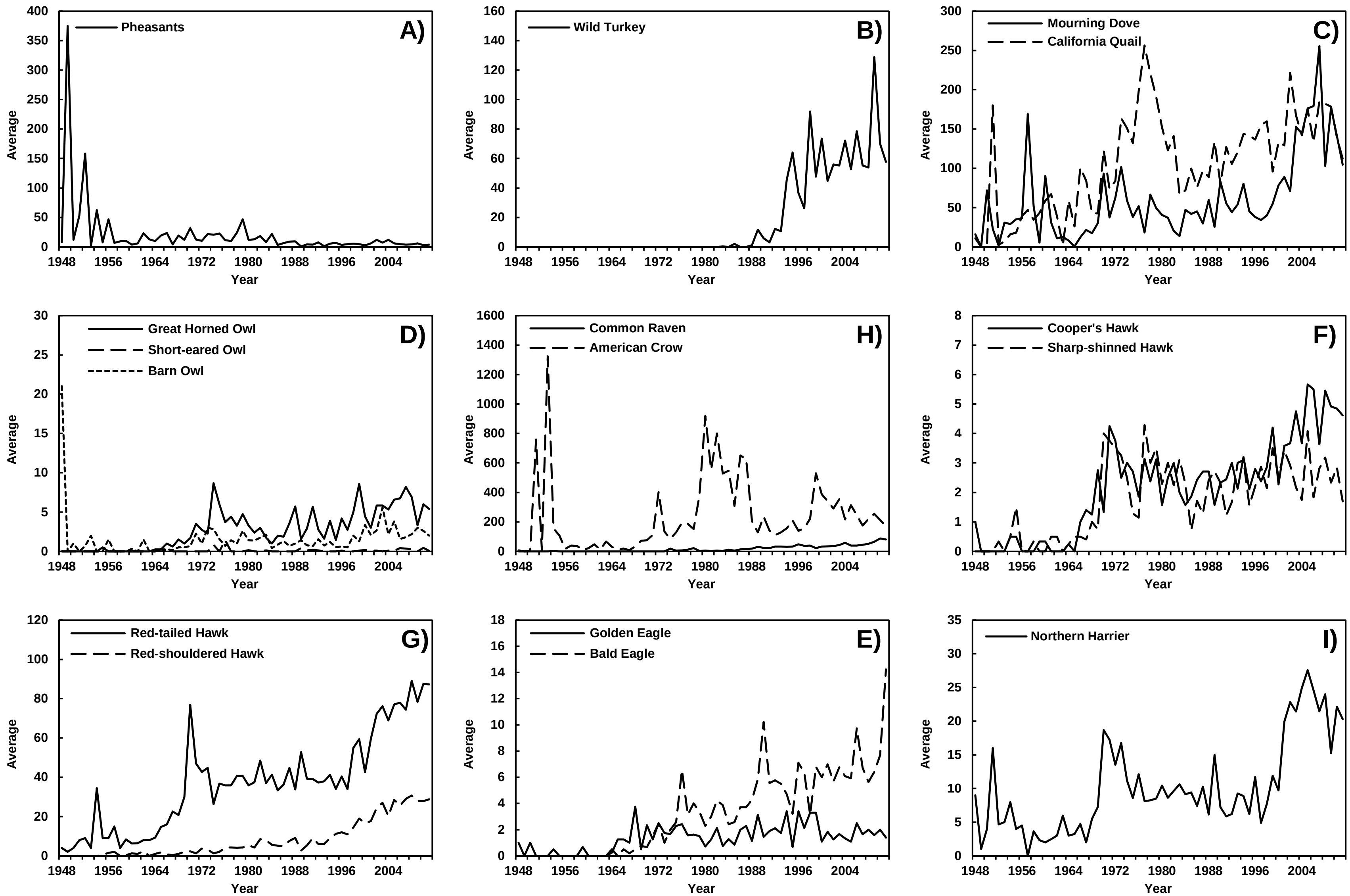


Figure 87. Region 2 average Christmas Bird Count detections for A) Pheasants,game birds, including B) Wild Turkey, C) Mourning Dove and California Quail, as well as potential aerial predators, including D) Great Horned Owl, Short-eared Owl and Barn Owl, E) Golden Eagle and Bald Eagle, F) Cooper's Hawk and Sharp-shinned Hawk, G) Red-tailed Hawk and Red-shouldered Hawk, H) Common Raven and American Crow, and I) Northern Harrier, 1948–2012.

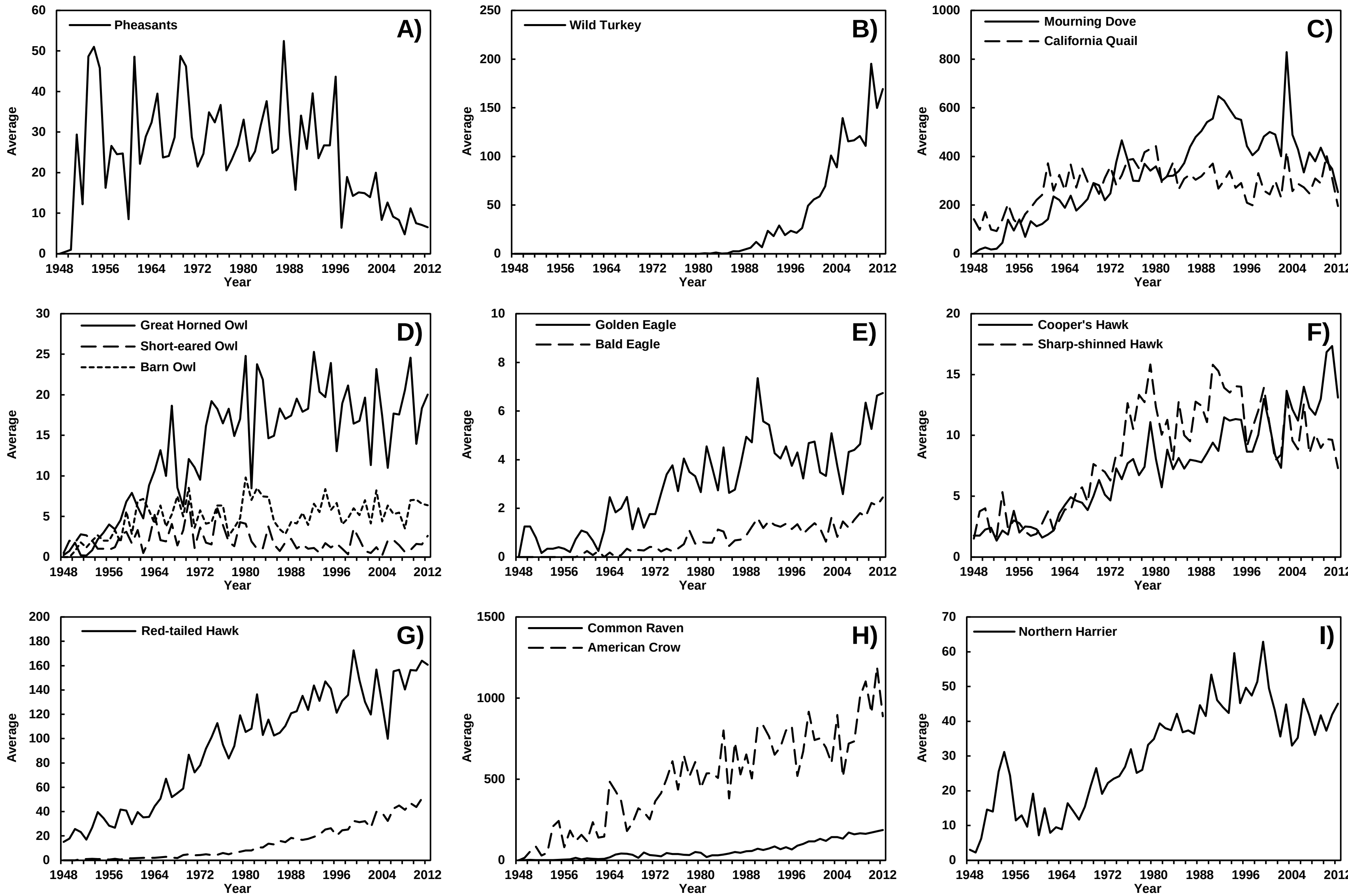


Figure 88. Region 3 average Christmas Bird Count detections for A) Pheasants, game birds including B) Wild Turkeys, C) Mourning Dove and California Quail, and potential aerial predators, including D) Great Horned Owl, Short-eared Owl and Barn Owl, E) Golden Eagle and Bald Eagle, F) Cooper's Hawk and Sharp-shinned Hawk, G) Red-tailed Hawk and Red-shouldered Hawk, H) Common Raven and American Crow, and I) Northern Harrier, 1948–2012.

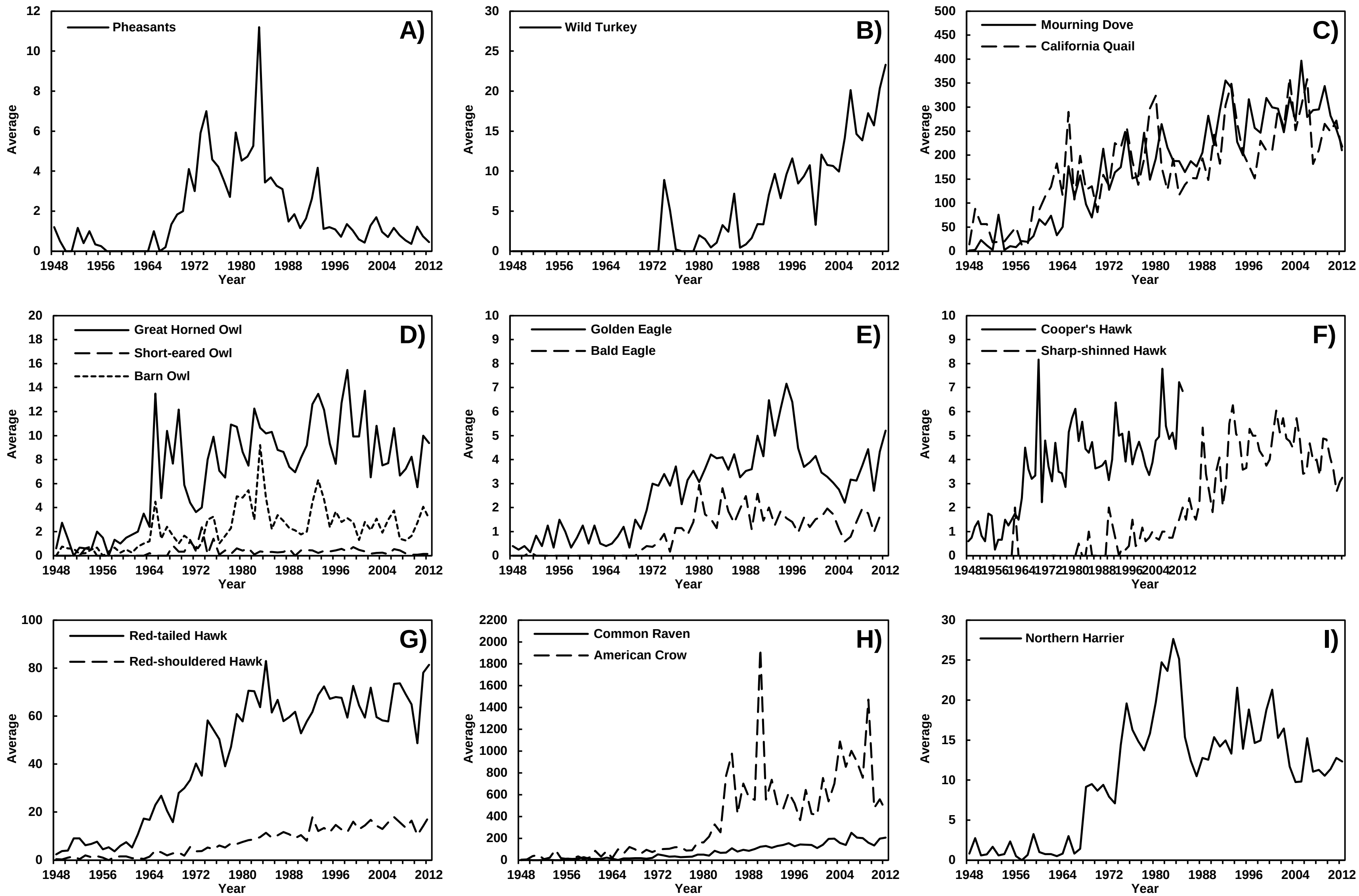


Figure 89. Region 4 average Christmas Bird Count detections for A) Pheasants, game birds, including B) Wild Turkey, C) Mourning Dove and California Quail, as well as potential aerial predators, including D) Great Horned Owl, Short-eared Owl and Barn Owl, E) Golden Eagle and Bald Eagle, F) Cooper's Hawk and Sharp-shinned Hawk, G) Red-tailed Hawk and Red-shouldered Hawk, H) Common Raven and American Crow, and I) Northern Harrier, 1948–2012.

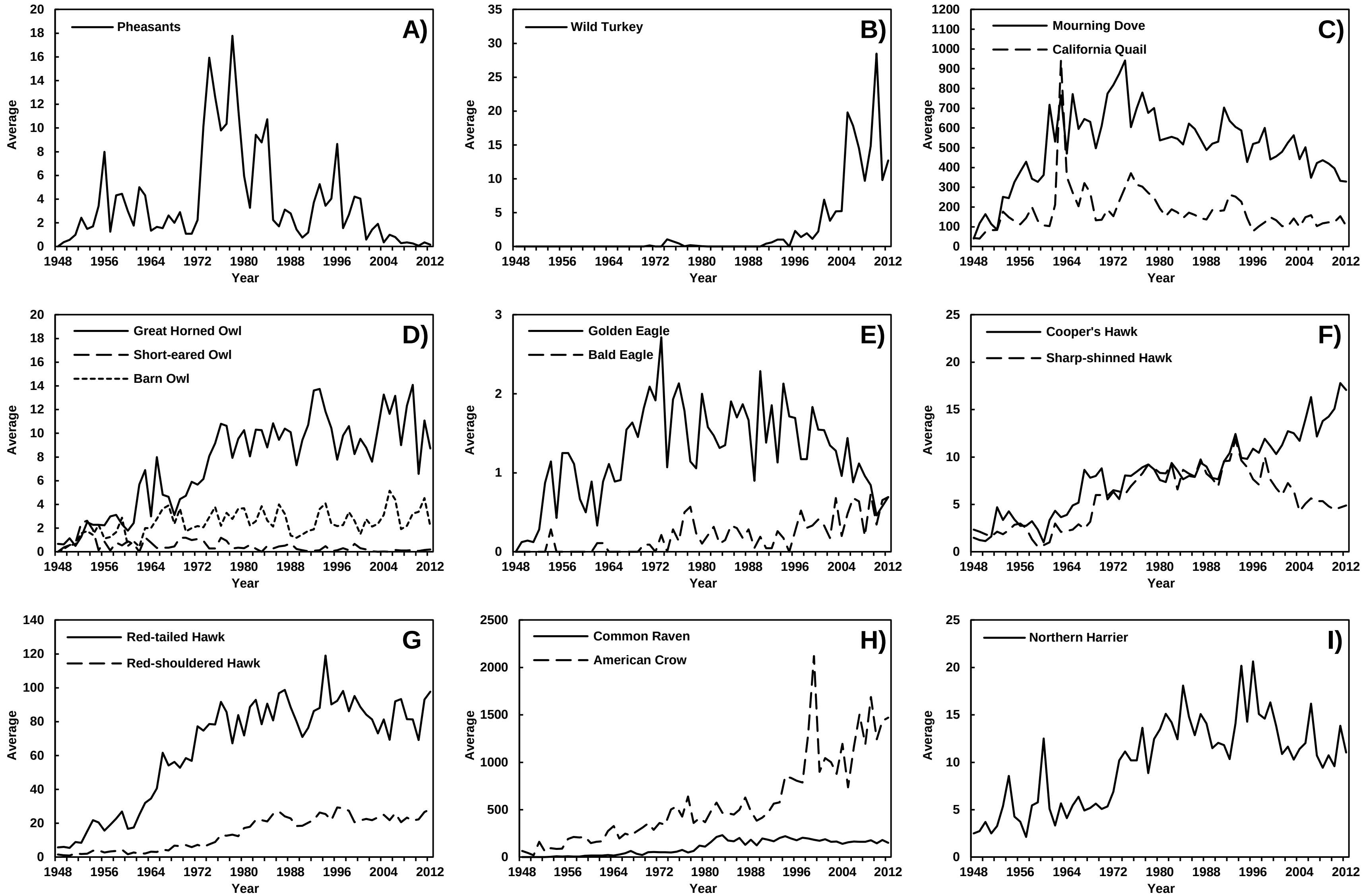


Figure 90. Region 5 average Christmas Bird Count detections for A) Pheasants, game birds, including B) Wild Turkey, C) Mourning Dove and California Quail, as well as potential aerial predators, including D) Great Horned Owl, Short-eared Owl and Barn Owl, E) Golden Eagle and Bald Eagle, F) Cooper's Hawk and Sharp-shinned Hawk, G) Red-tailed Hawk and Red-shouldered Hawk, H) Common Raven and American Crow, and I) Northern Harrier, 1948–2012.

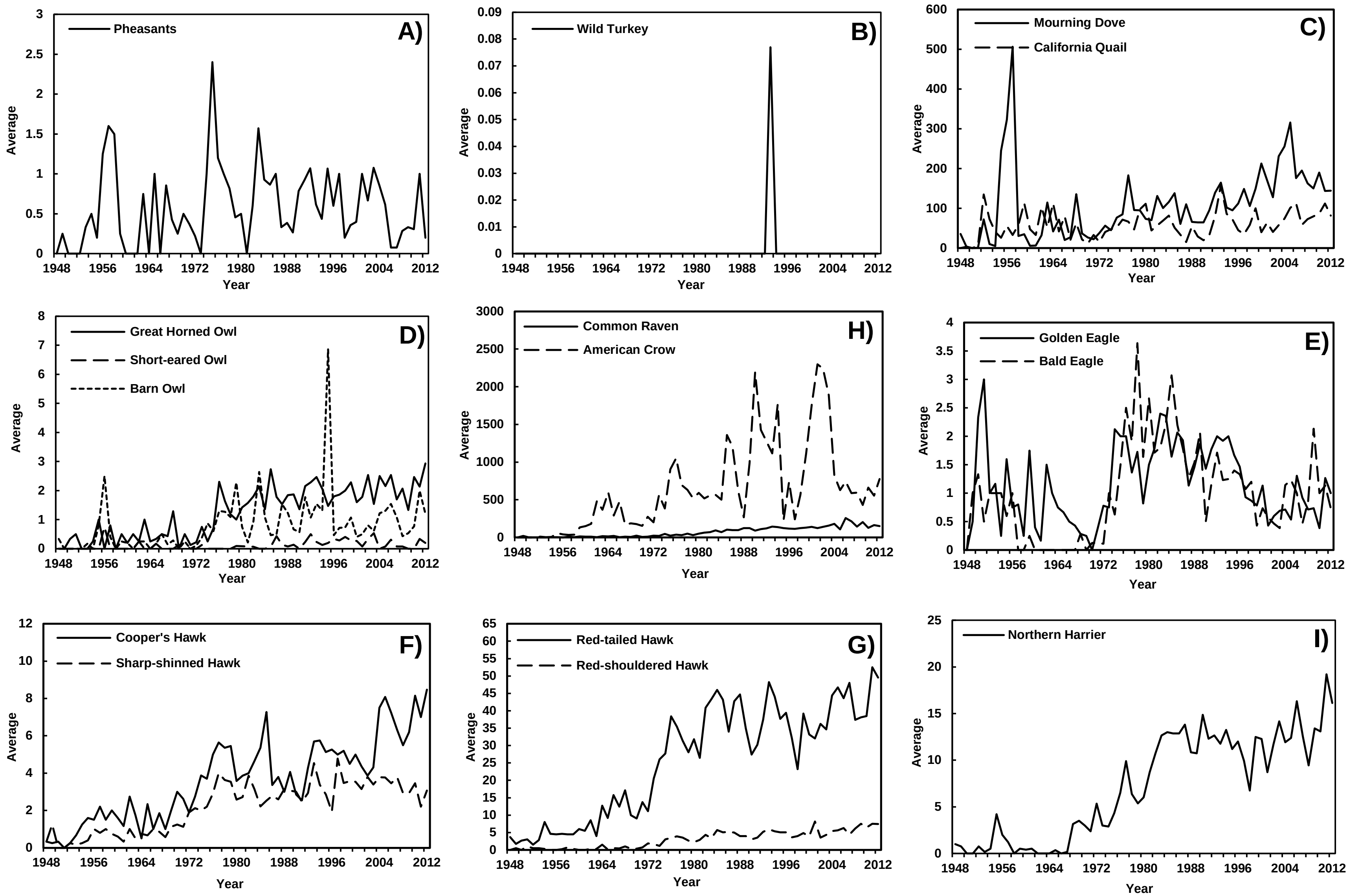
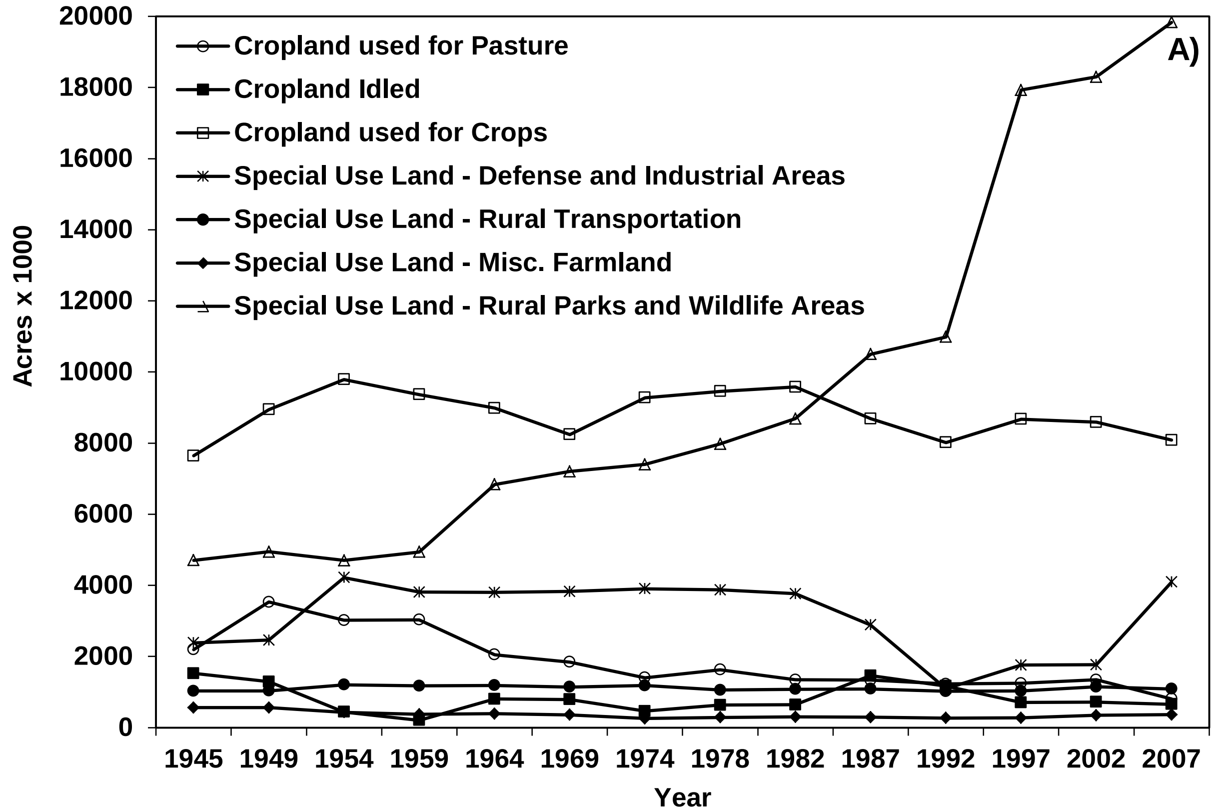


Figure 91. Region 6 average Christmas Bird Count detections for A) Pheasants, game birds, including B) Wild Turkey, C) Mourning Dove and California Quail, as well as potential aerial predators, including D) Great Horned Owl, Short-eared Owl and Barn Owl, E) Golden Eagle and Bald Eagle, F) Cooper's Hawk and Sharp-shinned Hawk, G) Red-tailed Hawk and Red-shouldered Hawk, H) Common Raven and American Crow, and I) Northern Harrier, 1948–2012.



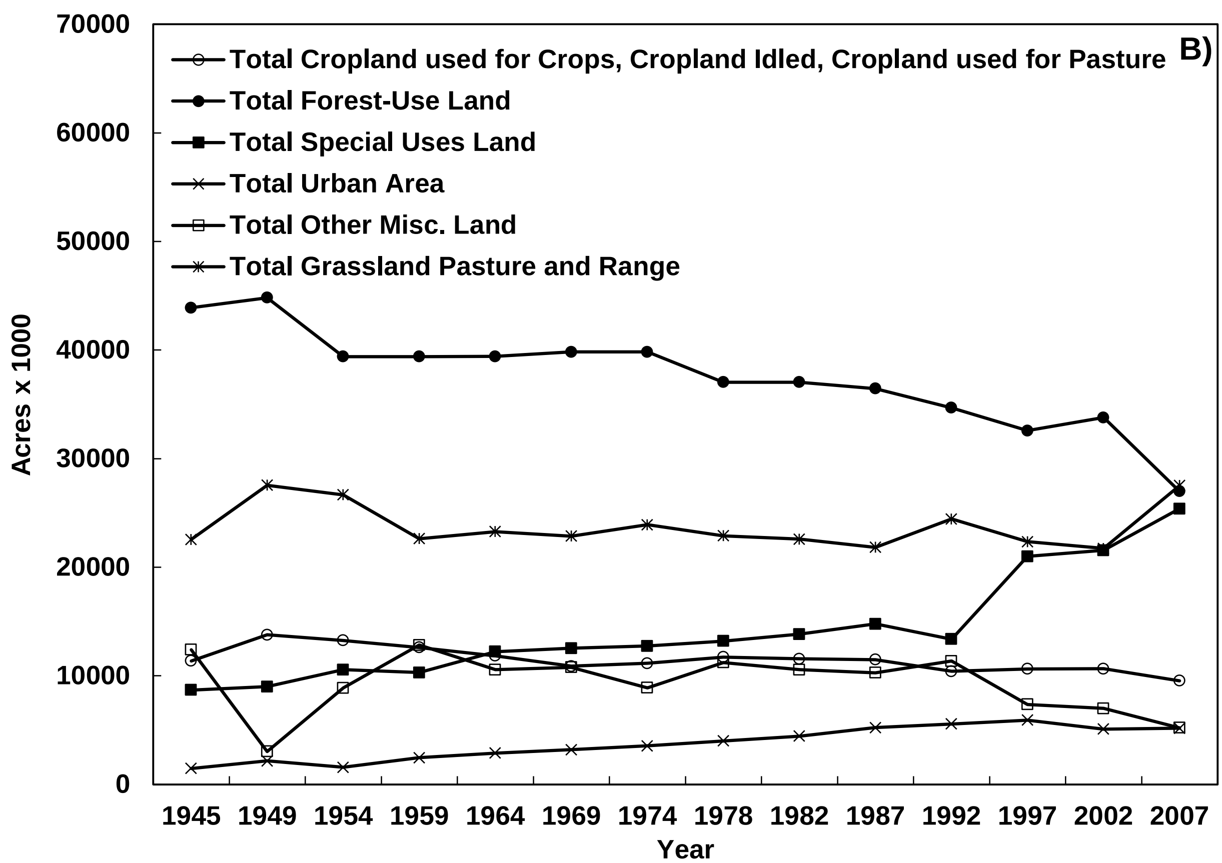


Figure 92. State-wide A) combined and B) specific land use practices in California, 1945 – 2007.

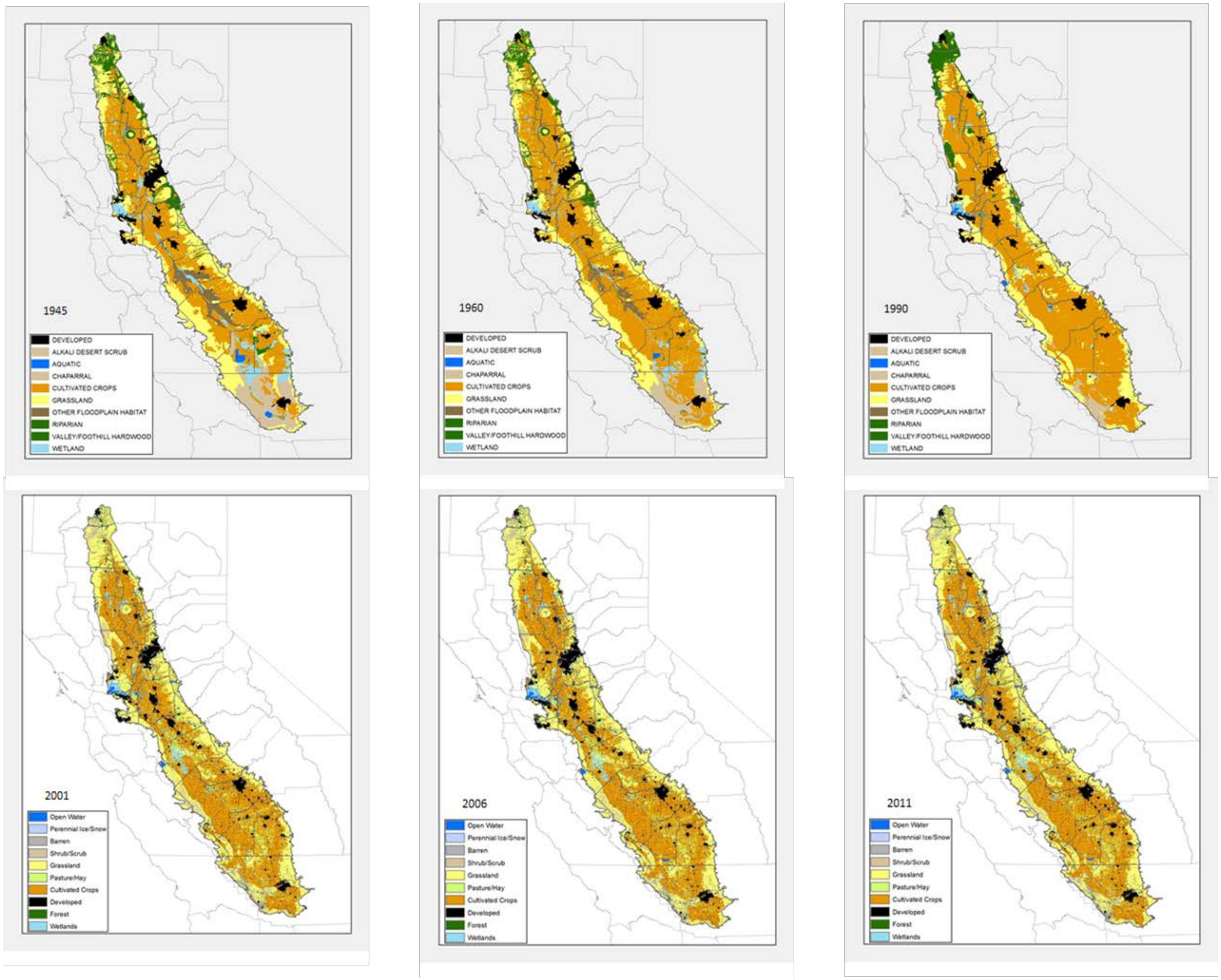


Figure 93. Central Valley landscape 1945-2011 (1945, 1960, and 1990 “Developed” (i.e., urban) area based on 1990 data).

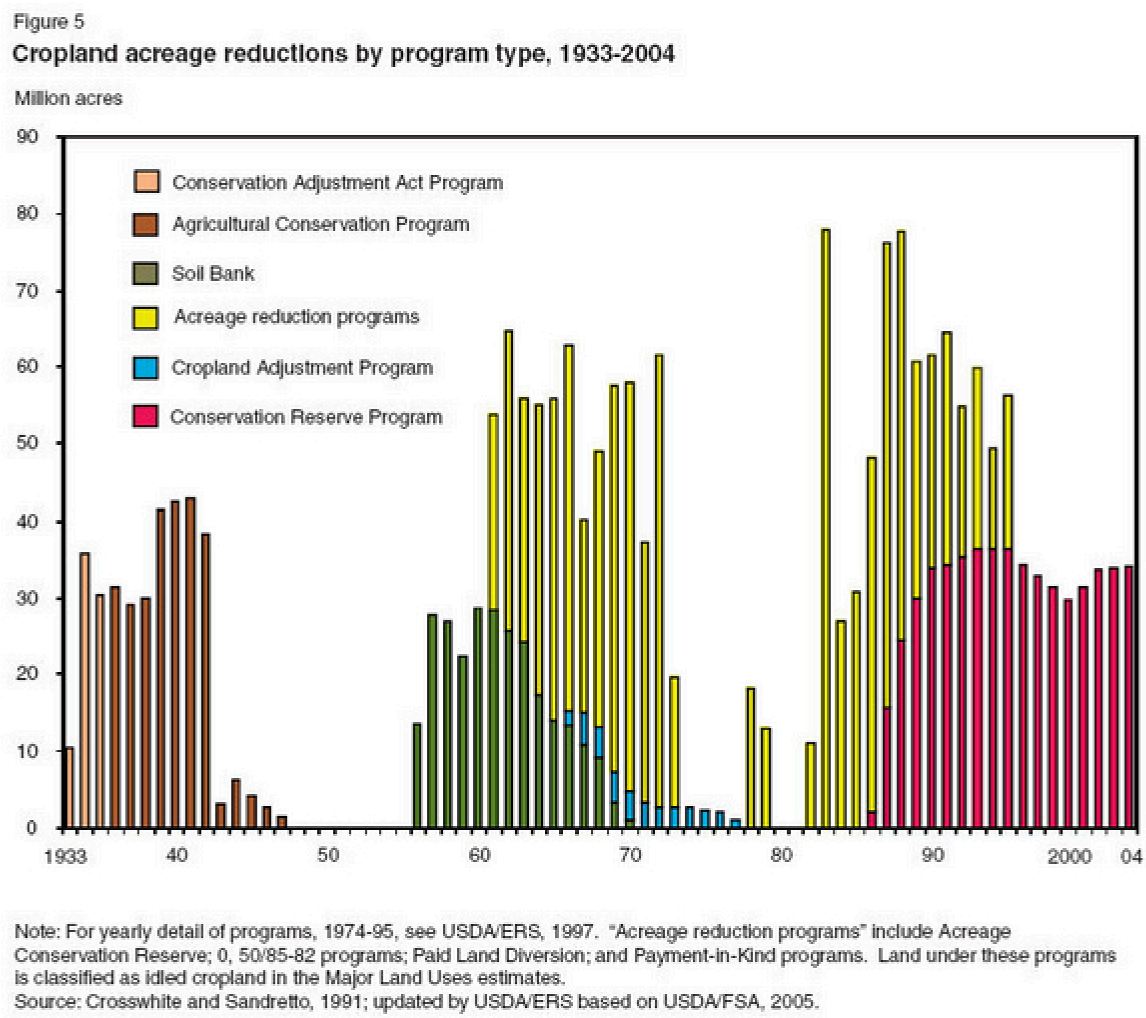


Figure 94. Cropland acreage reductions in the United States by federal program, 1933-2004.

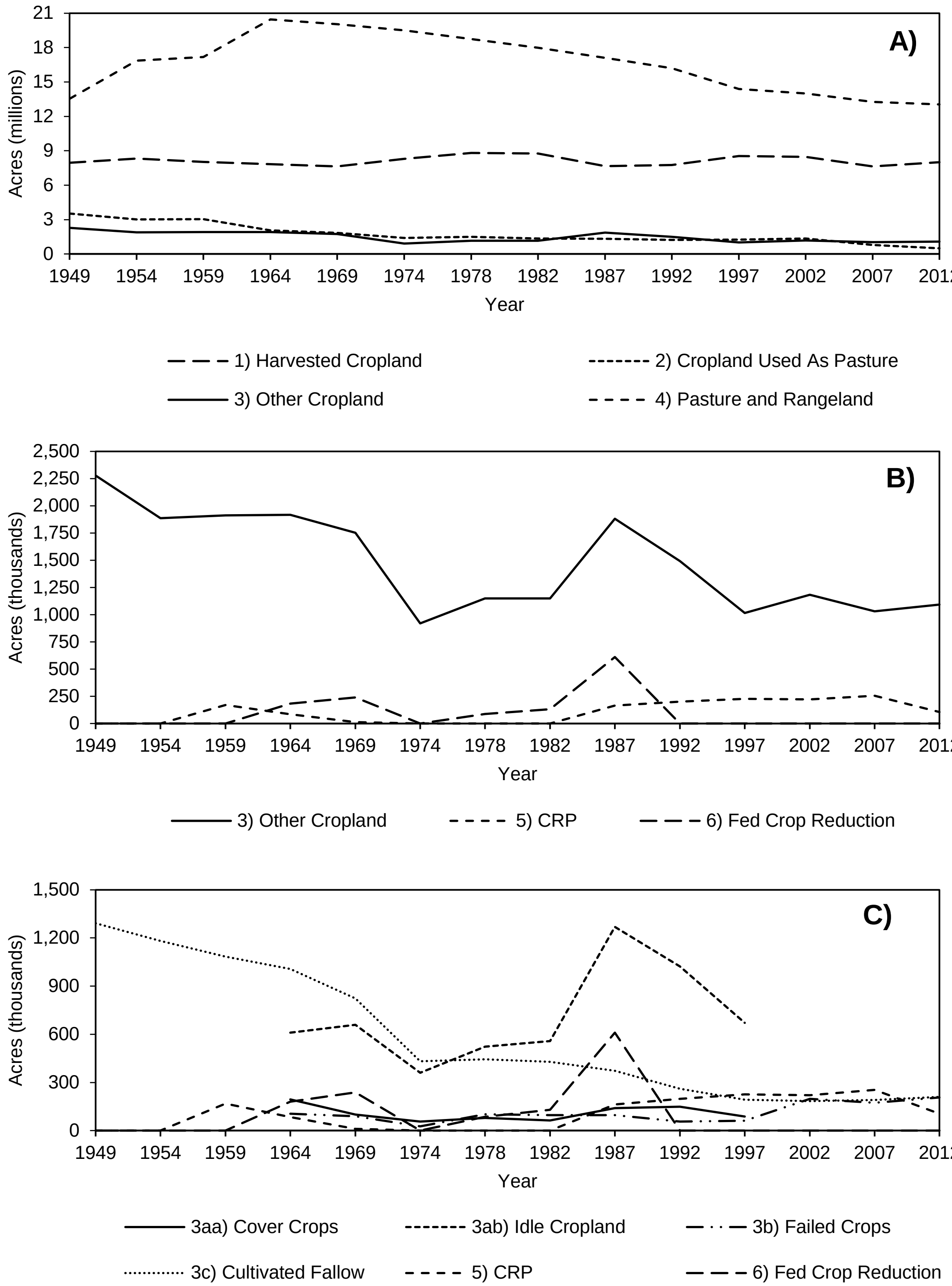


Figure 95. California land area in A) pasture-rangeland and types of cropland (harvested, used as pasture, other), B) Other Cropland, Conservation Reserve Program (CRP [Soil Bank Program acres during 1956-1970]), and Federal Crop Reduction (annual commodity programs), C) subtypes of “Other Cropland, CRP, and Federal Crop Reduction, 1949-2012 (USDA Agricultural Census data).

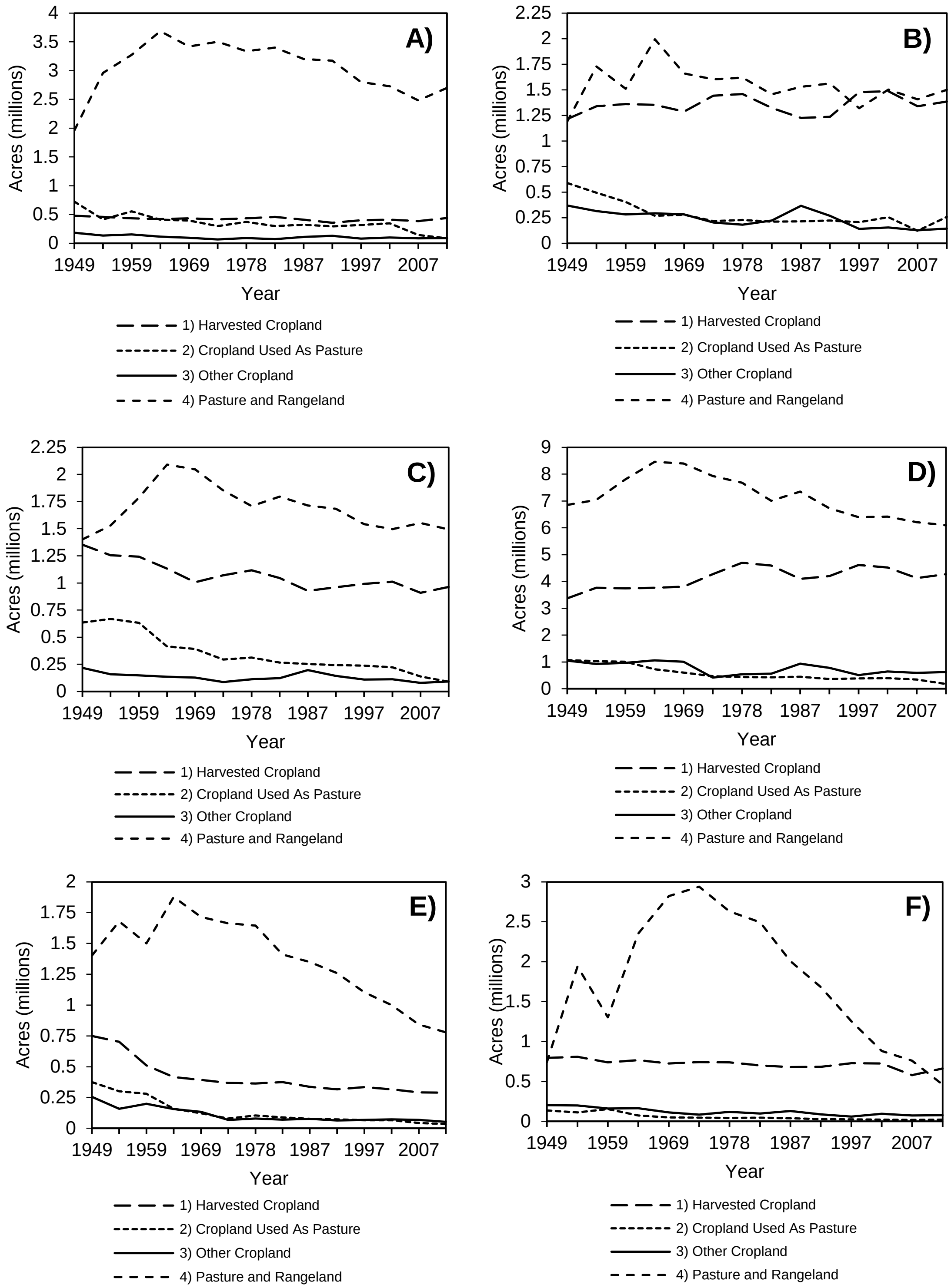


Figure 96. Land area in pasture-rangeland and types of cropland (harvested, used as pasture, other) in A) Northern, B) North Central, C) Bay Delta, D) Central, E) South Coast, and F) Inland Deserts regions in California, 1949-2007 (USDA Agricultural Census data).

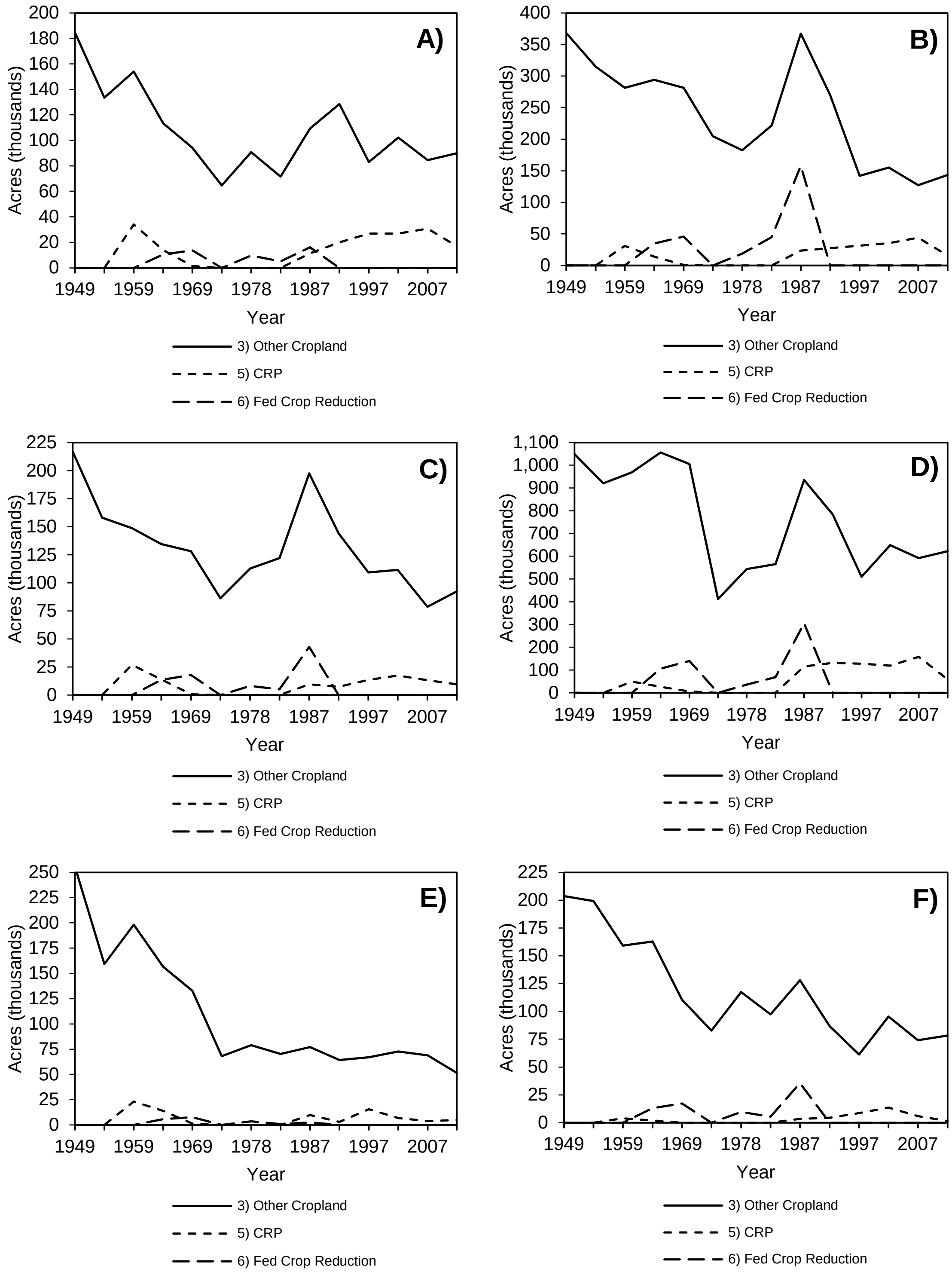


Figure 97. Land area in “Other Cropland”, Conservation Reserve Program (CRP, includes Soil Bank Program acres during 1956-1970), and Federal Crop Reduction (annual commodity programs) in the A) Northern, B) North Central, C) Bay Delta, D) Central, E) South Coast, F) Inland Deserts regions of California, 1947-2012 (USDA Agricultural Census data).

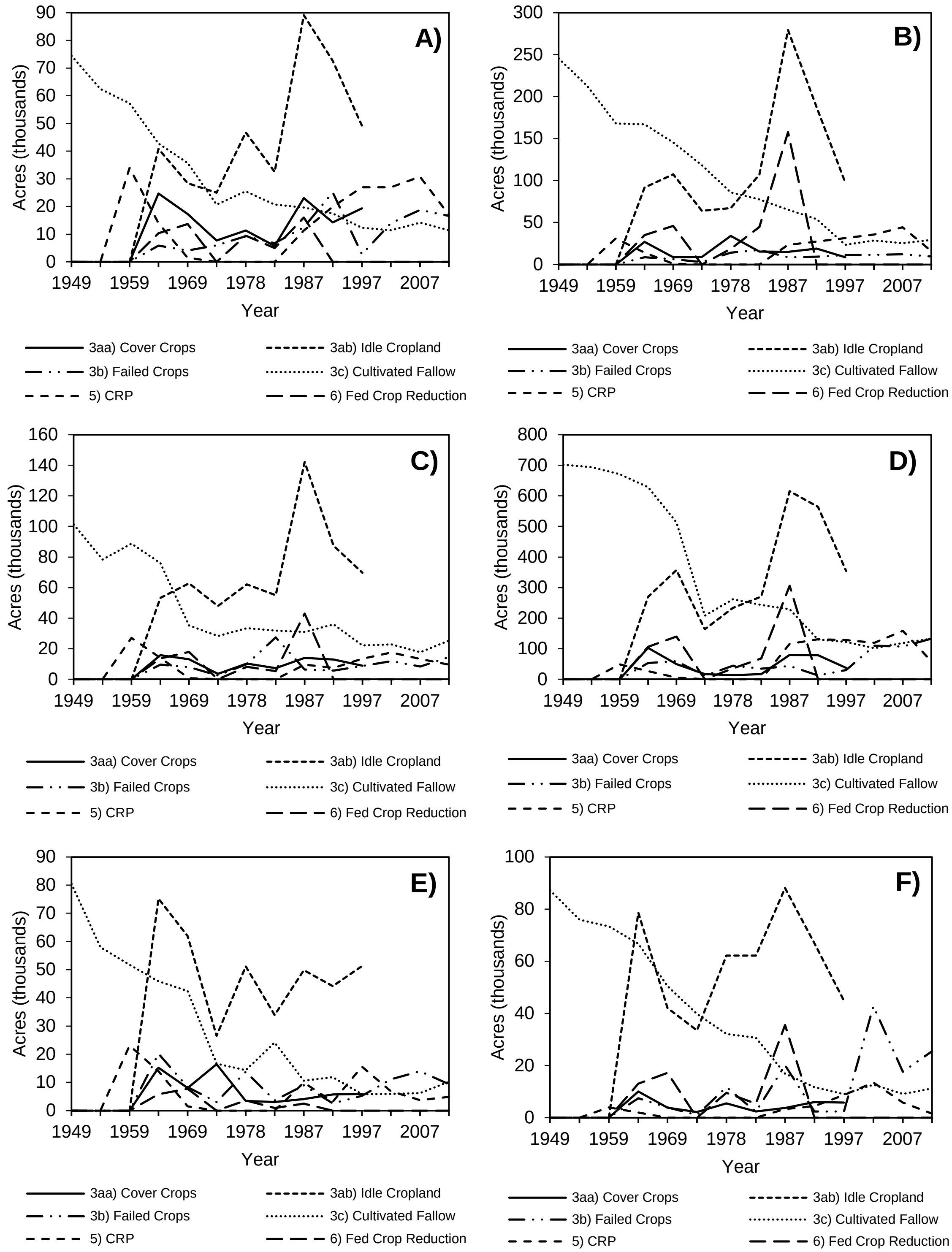


Figure 98. Land area in subtypes of "Other Cropland, Conservation Reserve Program (CRP, includes Soil Bank acres during 1956-1970), and Federal Crop Reduction in the A) Northern, B) North Central, C) Bay Delta, D) Central, E) South Coast, F) Inland Deserts regions of California, 1949-2007 (USDA Agricultural Census data).

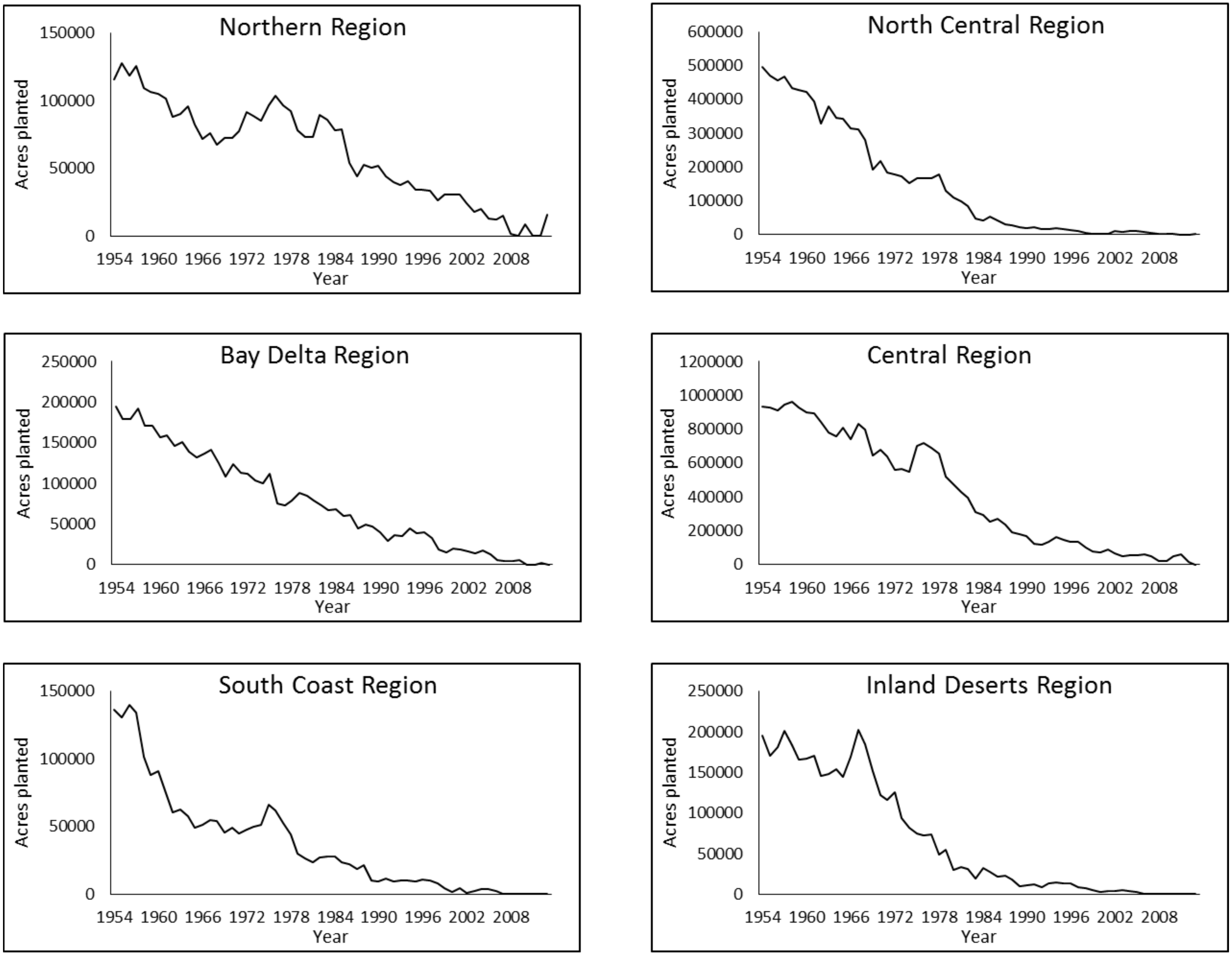


Figure 99. Regional planting of barley in California, 1954 – 2013.

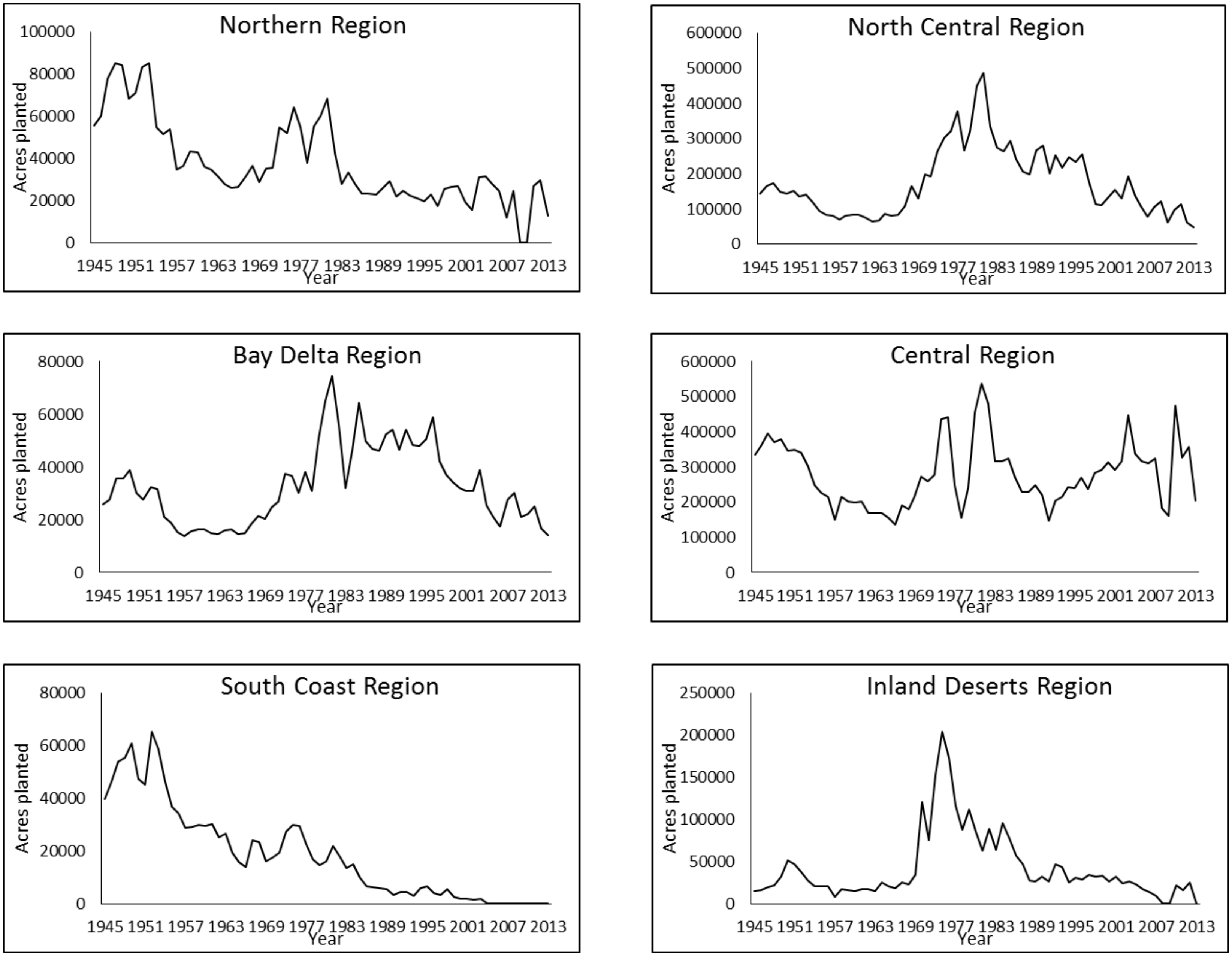


Figure 100. Regional planting of winter wheat in California, 1945 – 2013.

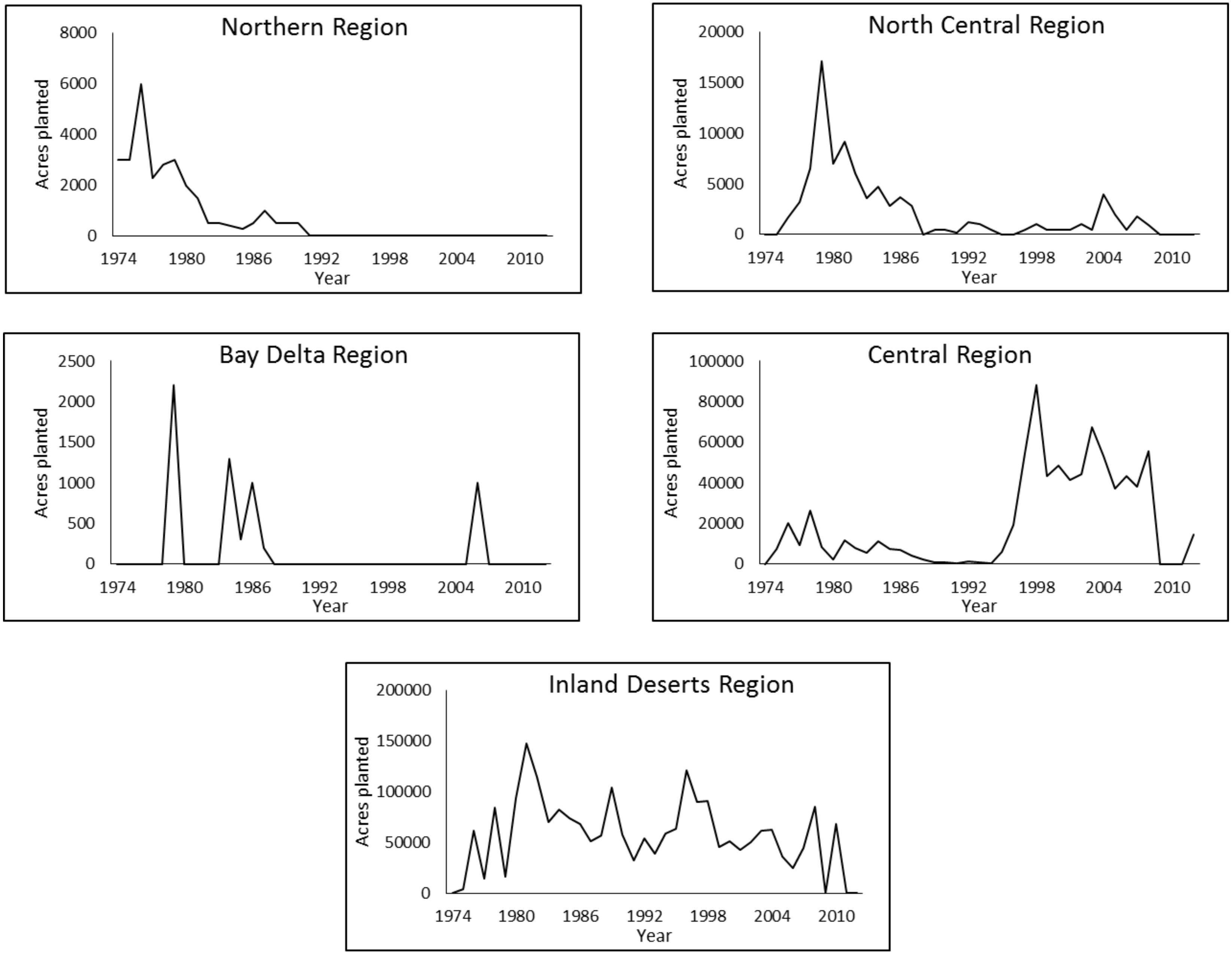


Figure 101. Regional planting of spring wheat (Durum) in California, 1974 – 2013.

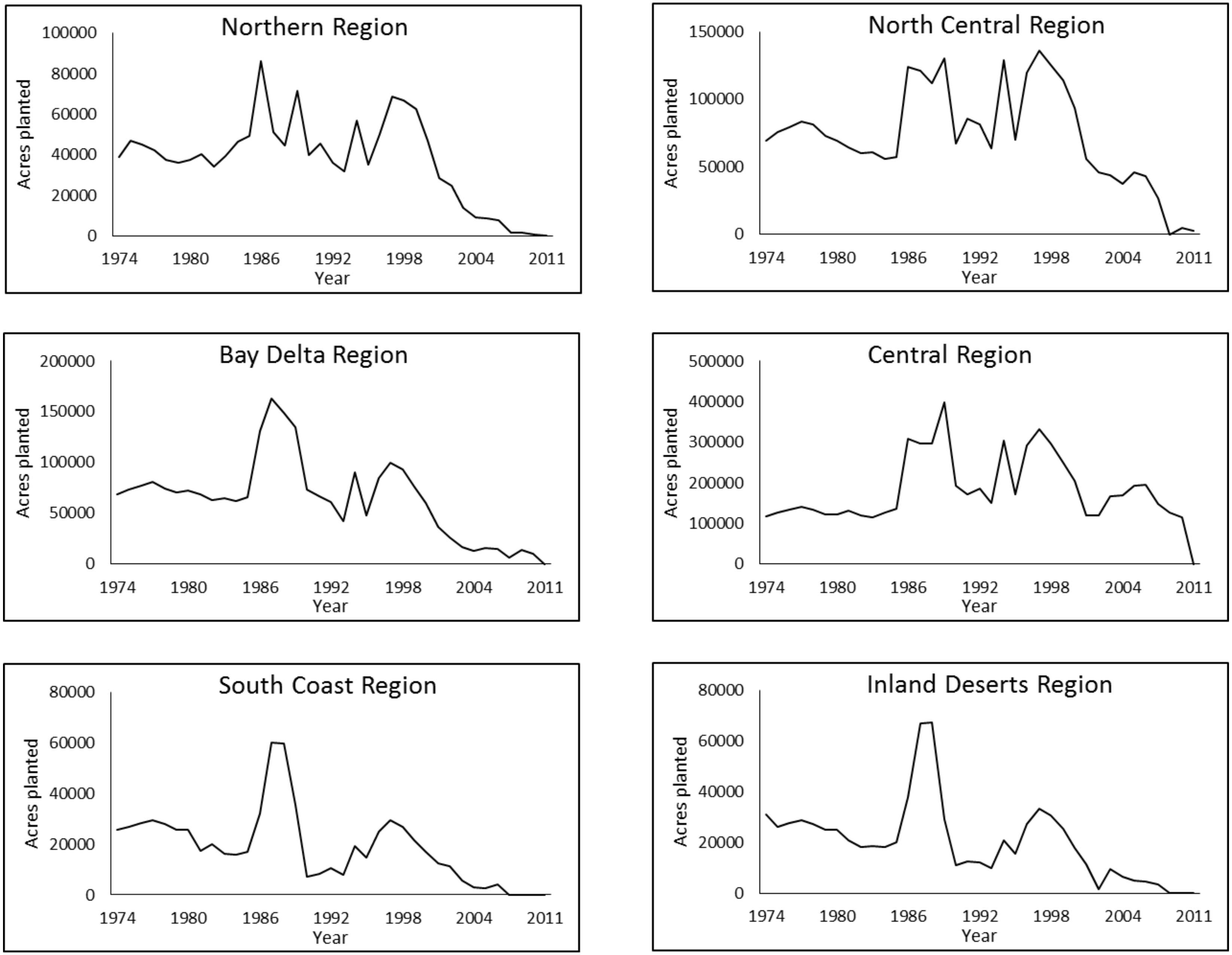


Figure 102. Regional planting of oats in California, 1974 – 2013.

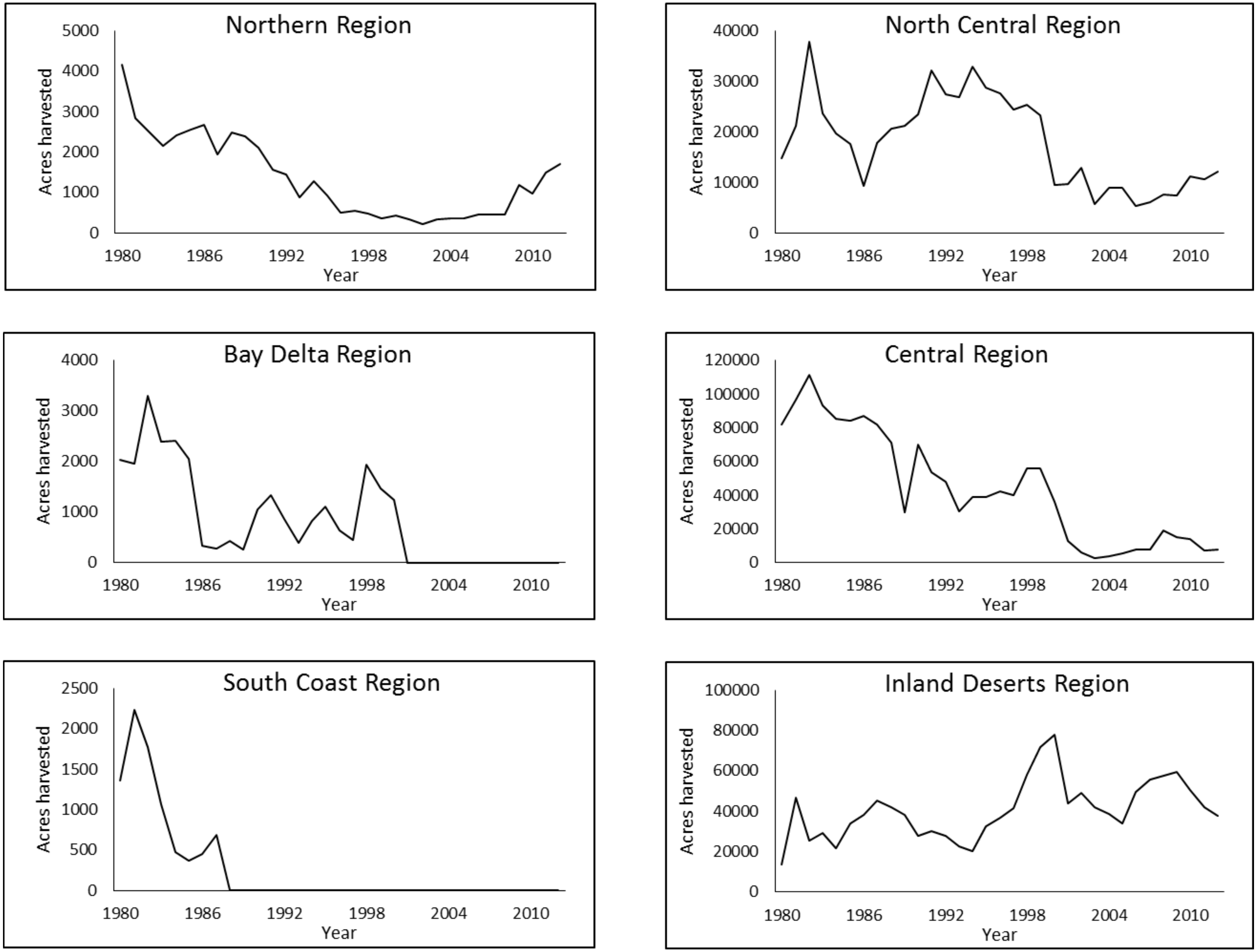


Figure 103. Regional planting of upland crops for seed in California, 1980 – 2013.

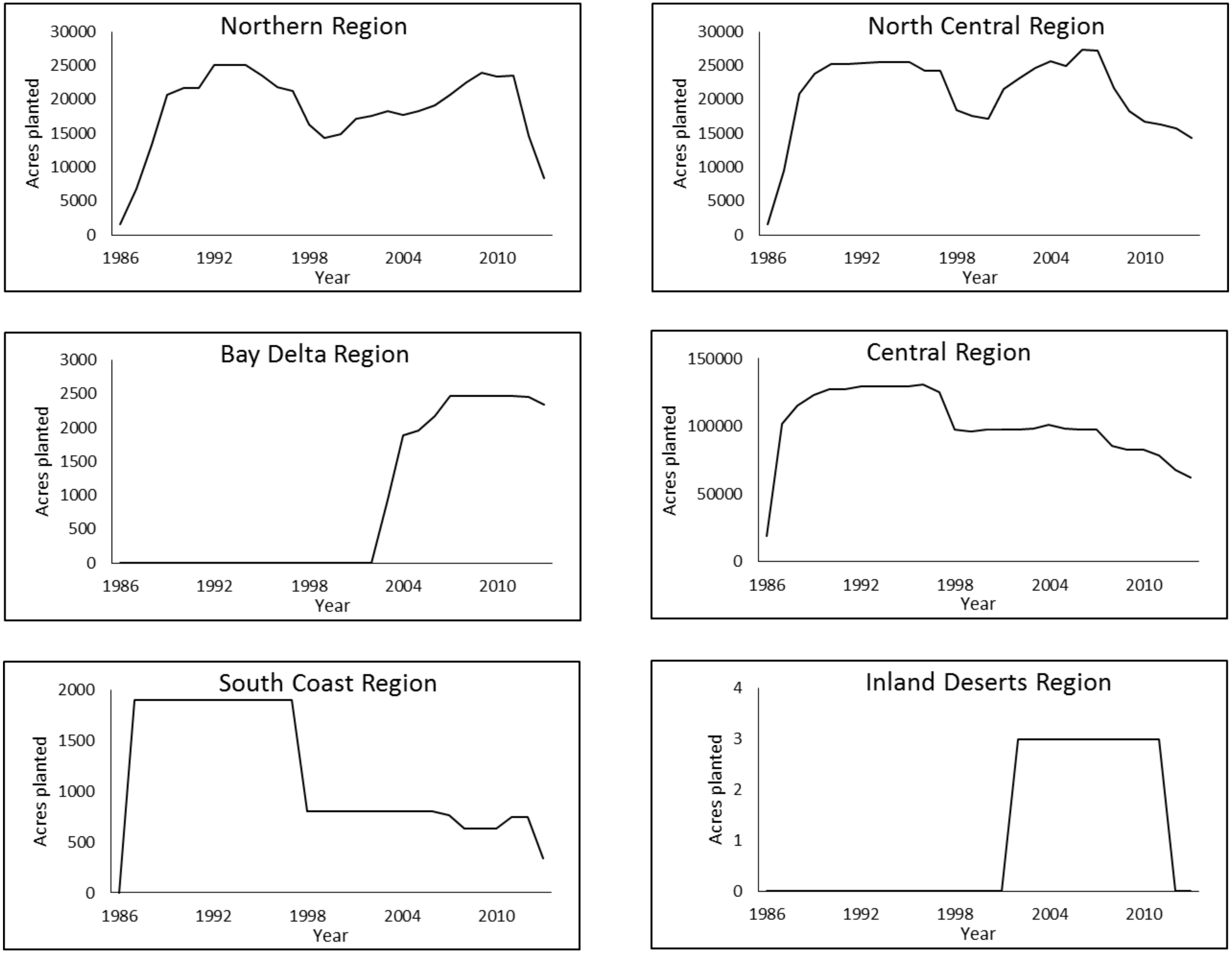


Figure 104. Regional area in the Conservation Reserve Program (CRP) in California, 1986 – 2013.

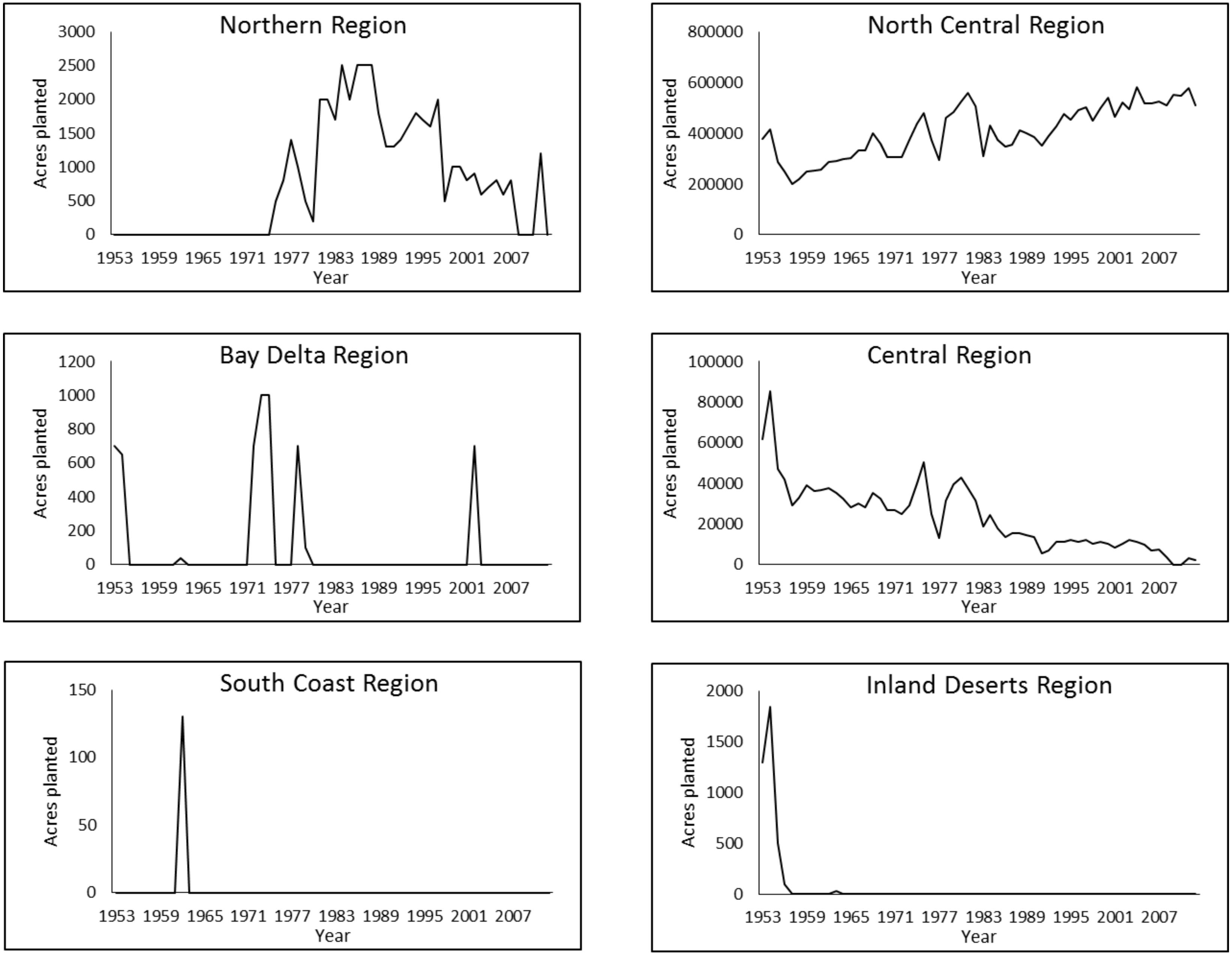


Figure 105. Regional planting of rice in California, 1953– 2012.

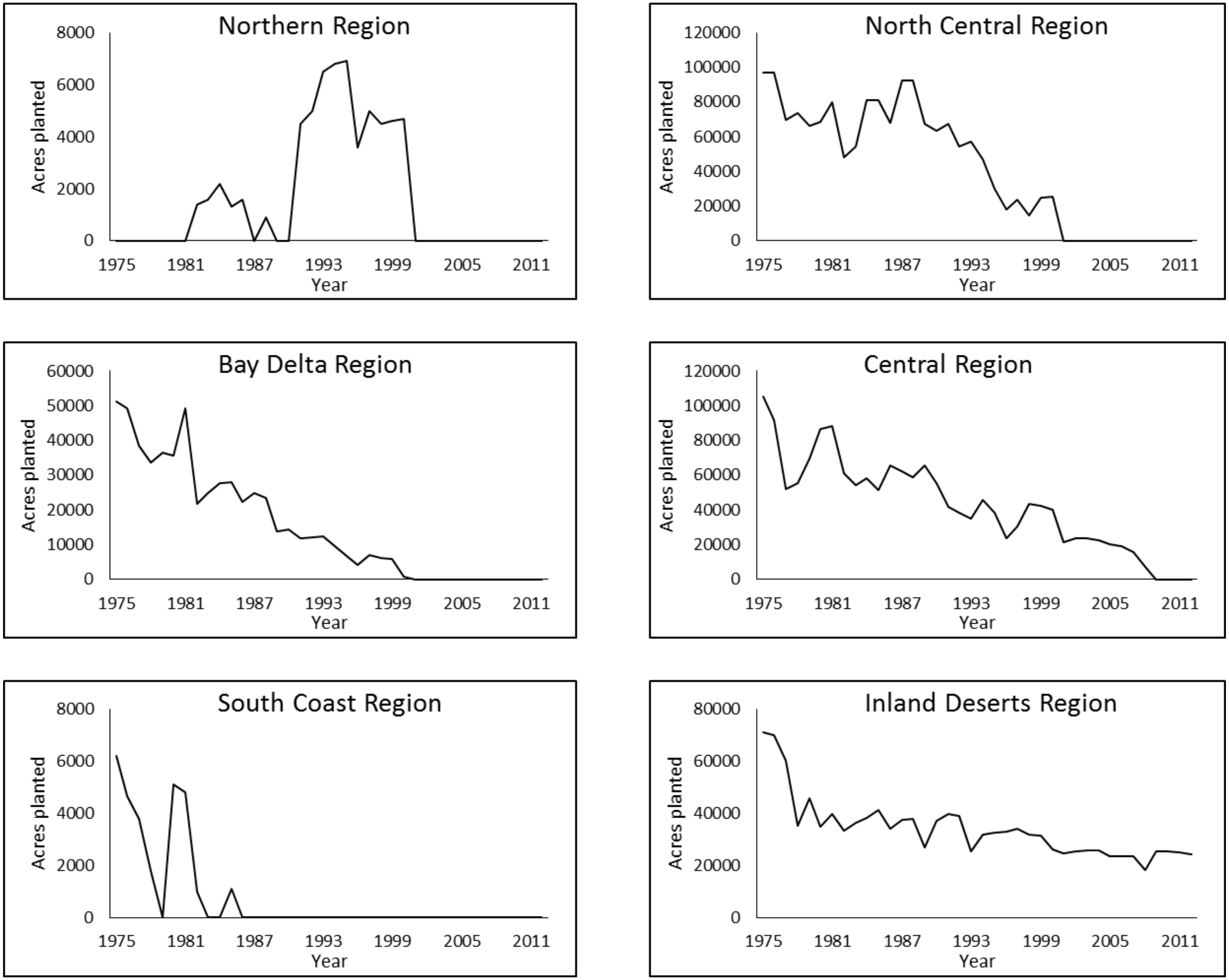


Figure 106. Regional planting of sugar beets in California, 1975–2011.

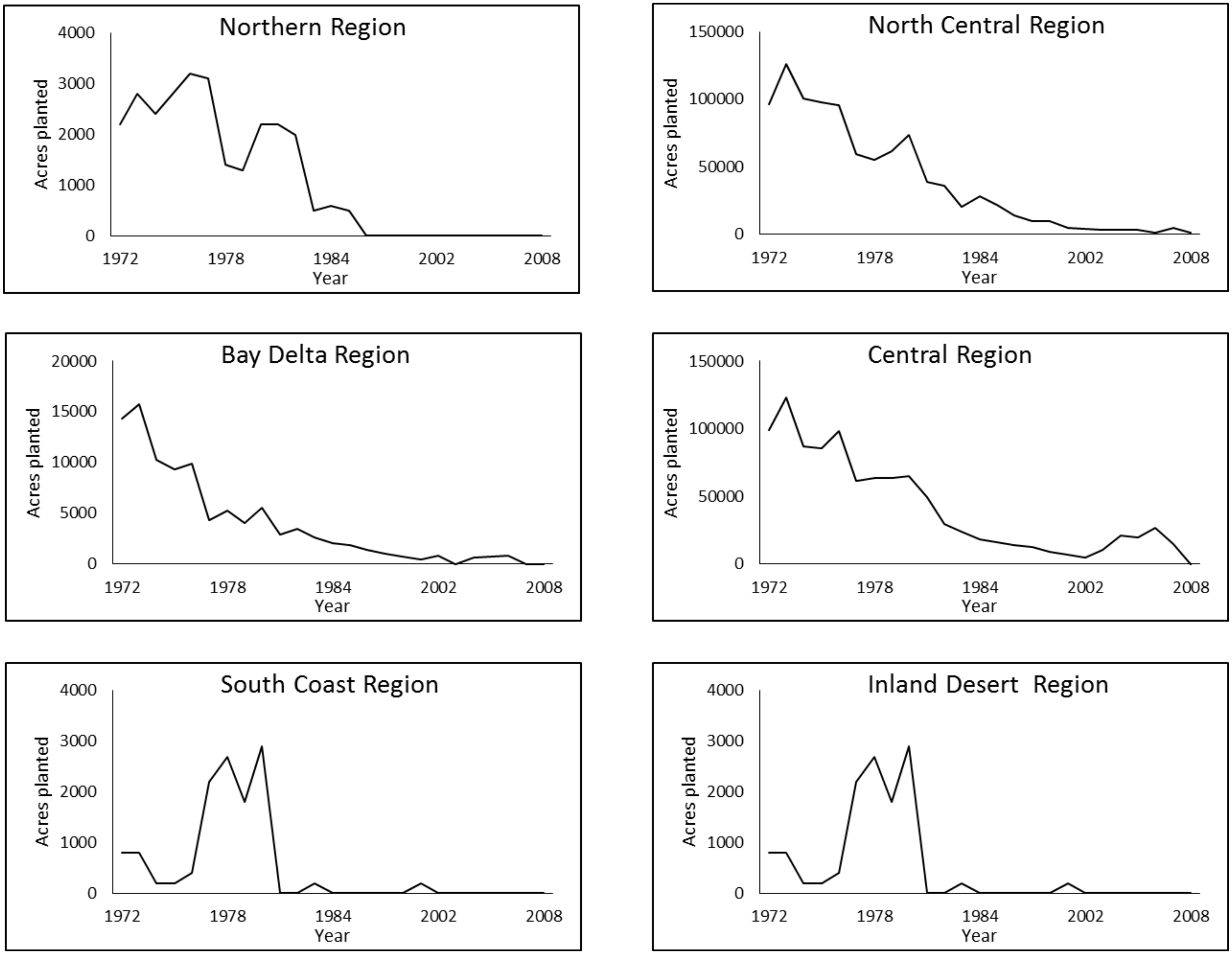


Figure 107. Regional planting of sorghum in California, 1977-2008.

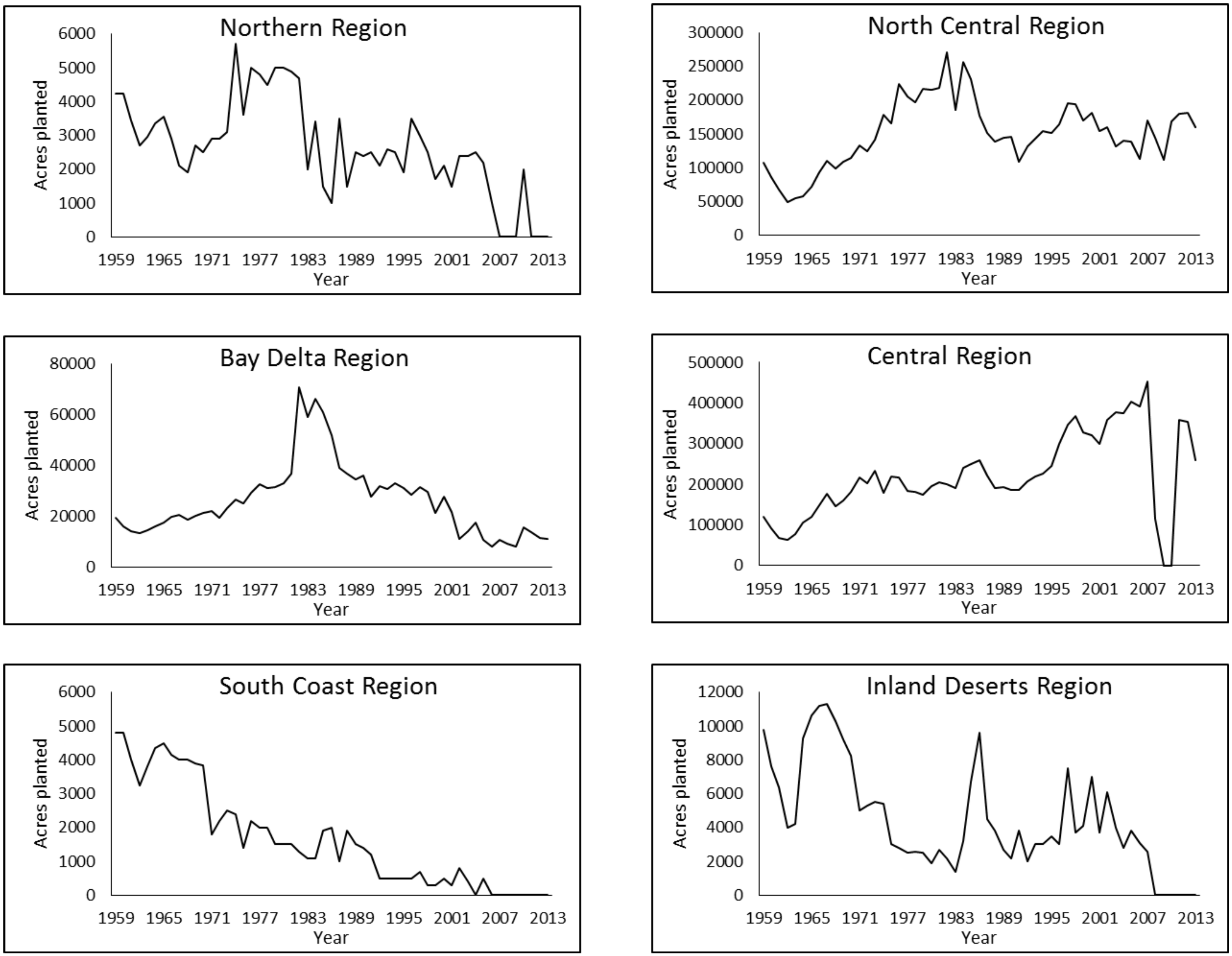


Figure 108. Regional planting of corn in California, 1959-2013.

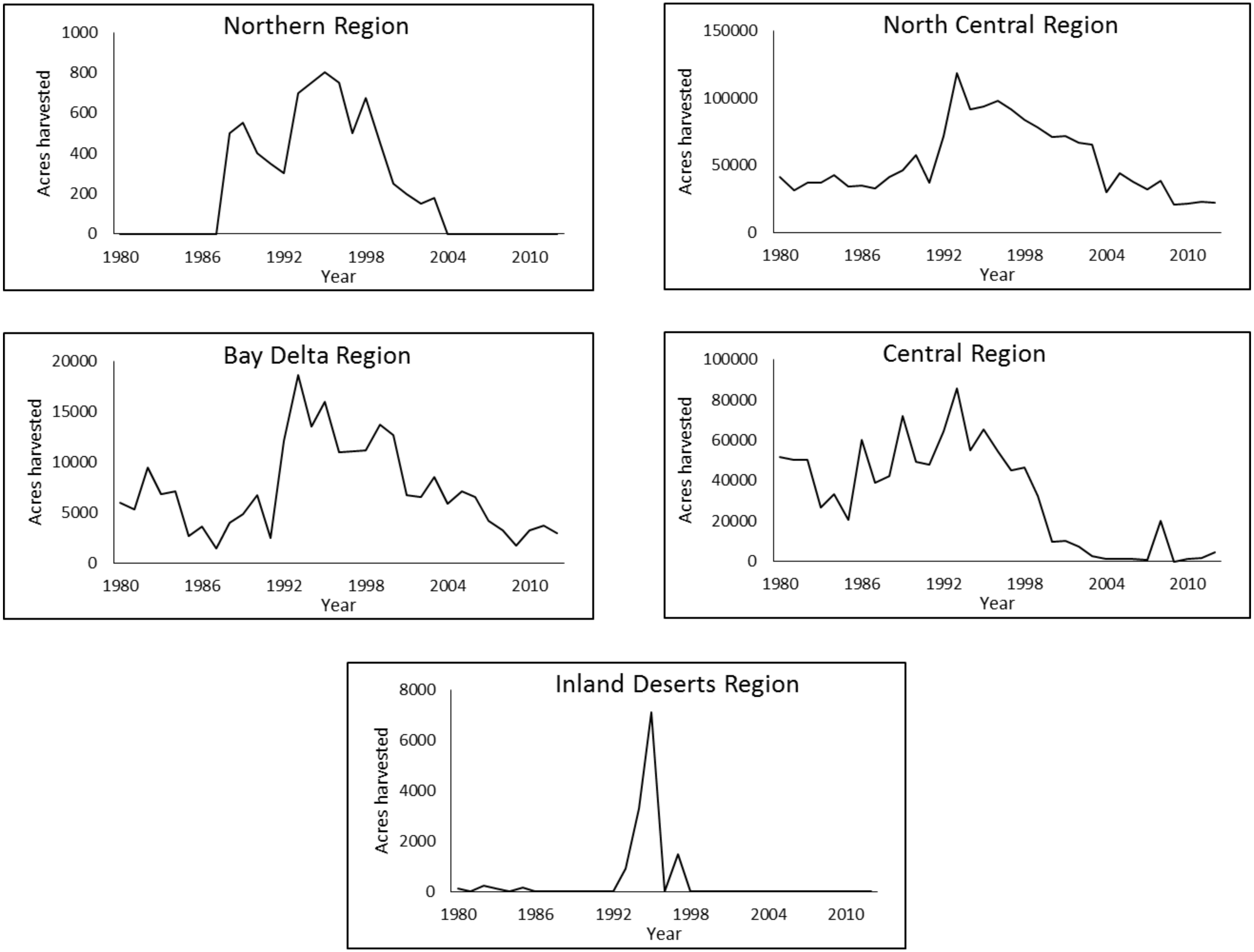


Figure 109. Regional planting of safflower in California, 1980-2013 (none listed for South Coast Region).

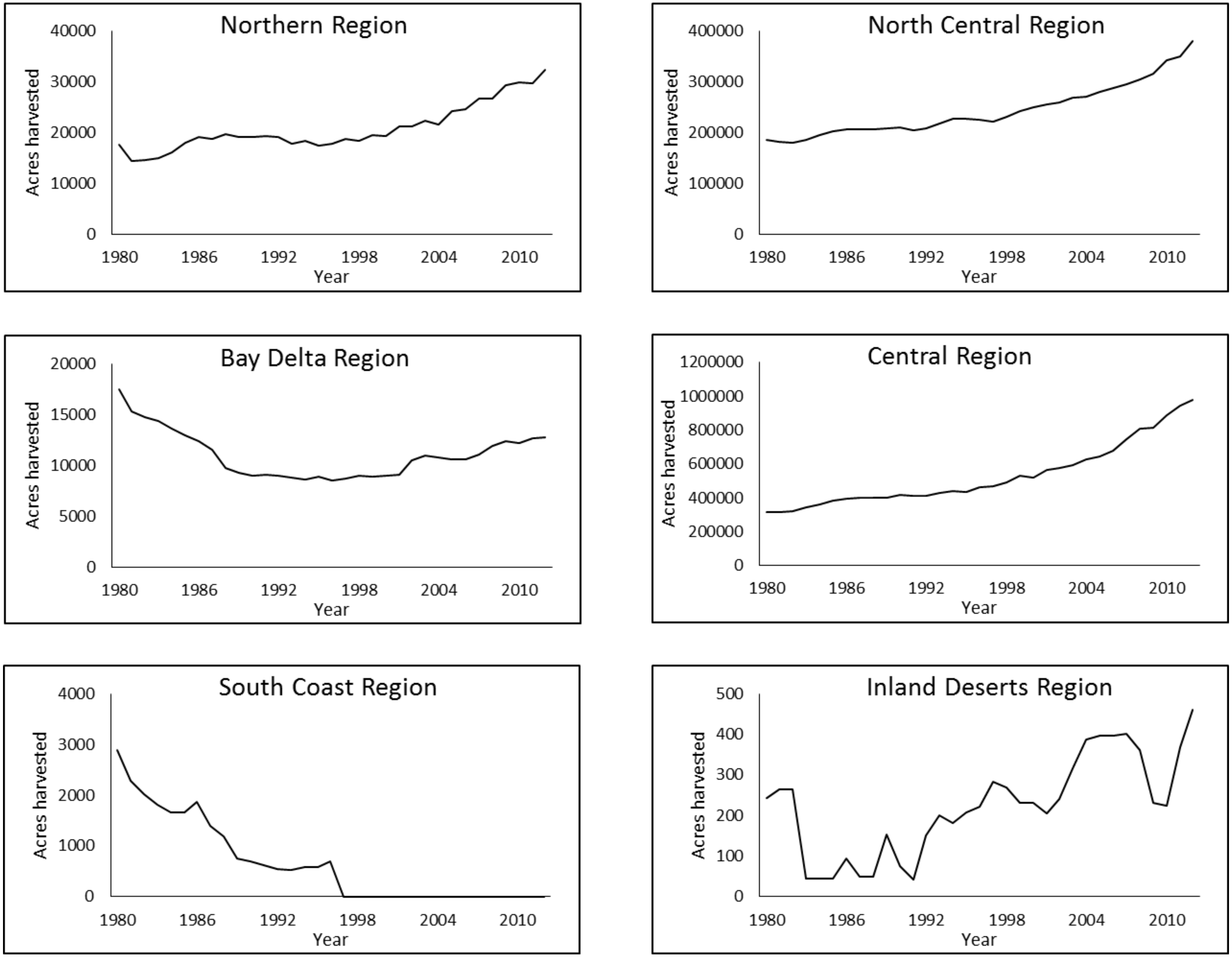


Figure 110. Regional nut tree harvest in California, 1980-2013.

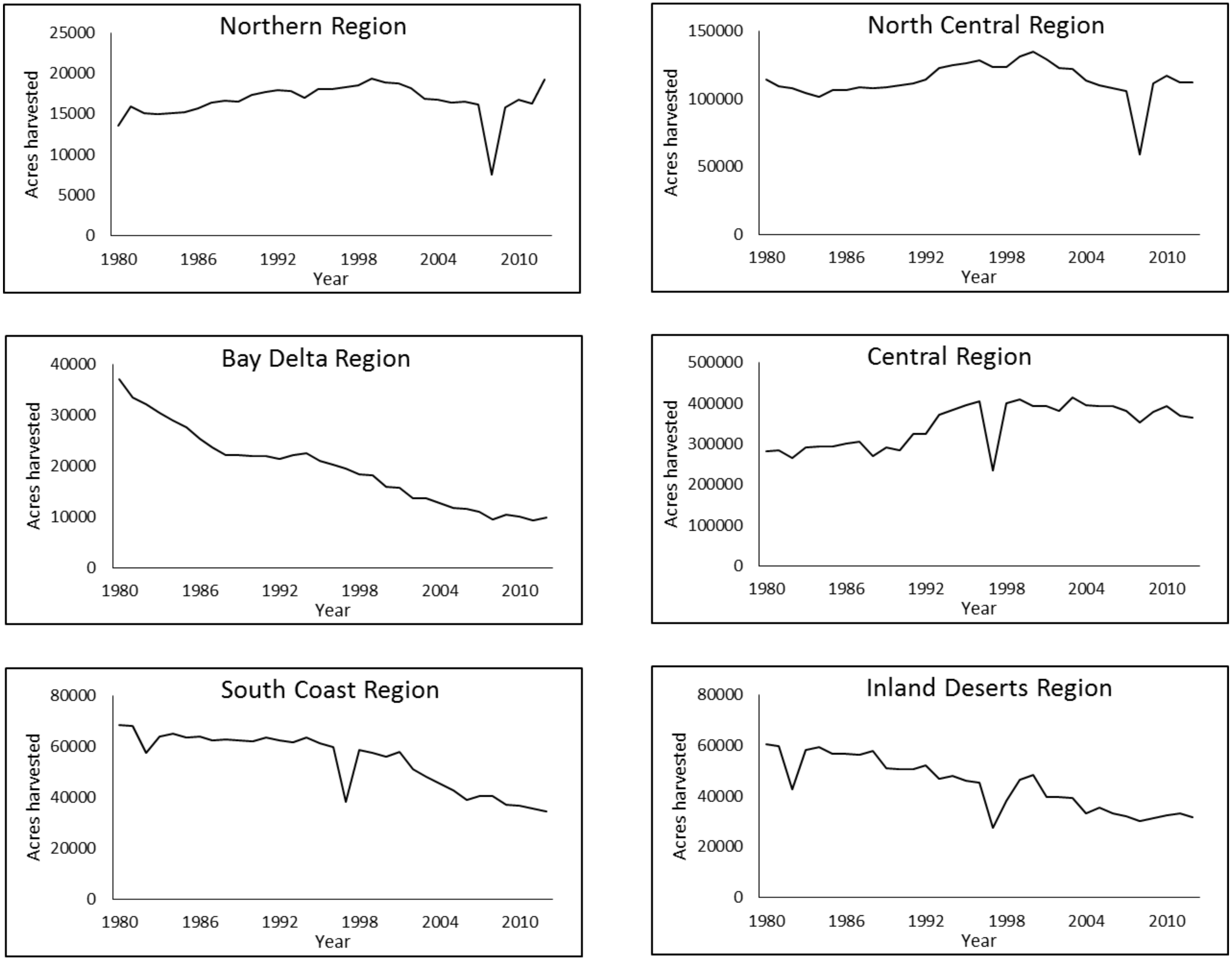


Figure 111. Regional fruit tree harvest in California, 1980-2013.

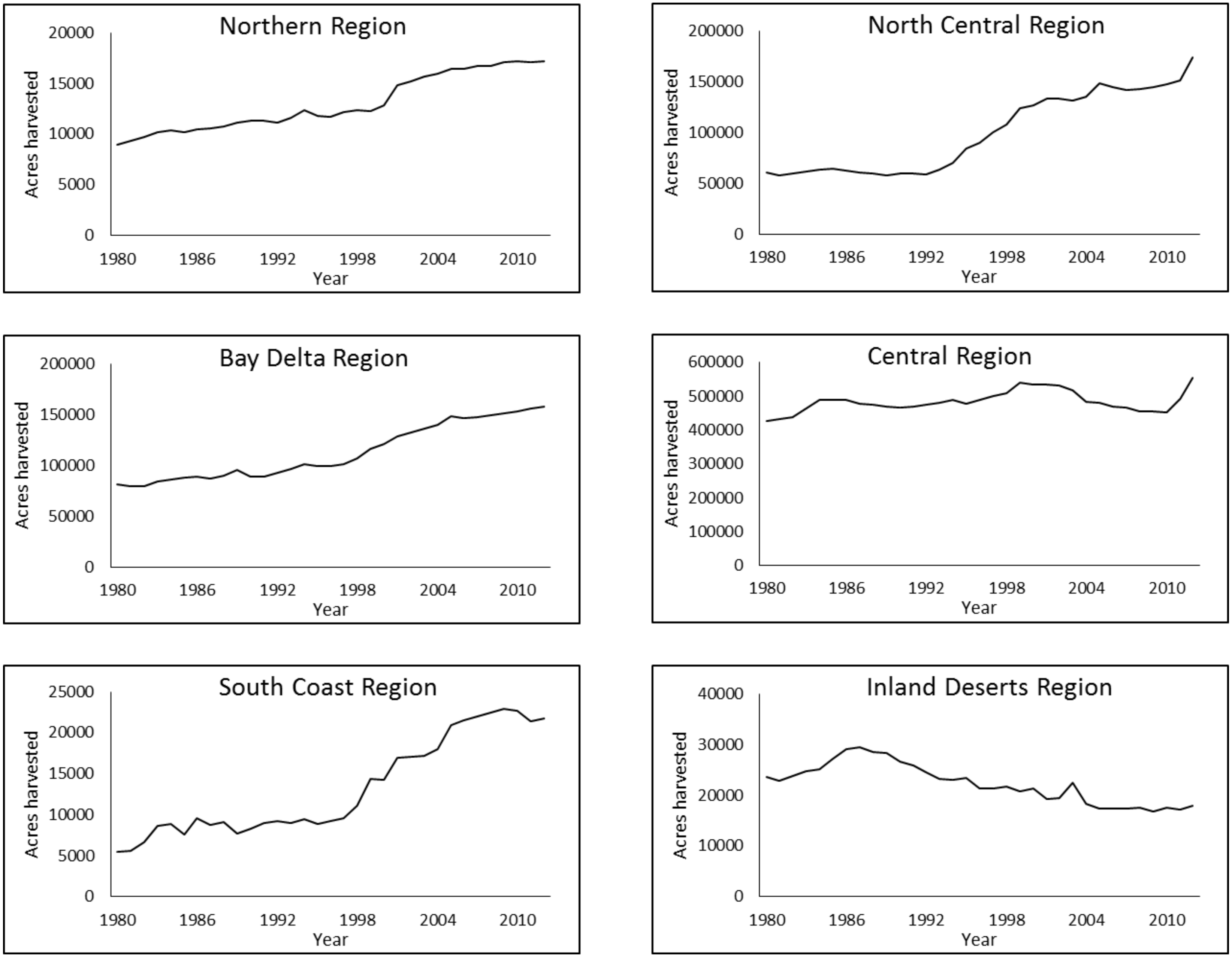


Figure 112. Regional grape harvest in California, 1980-2013.

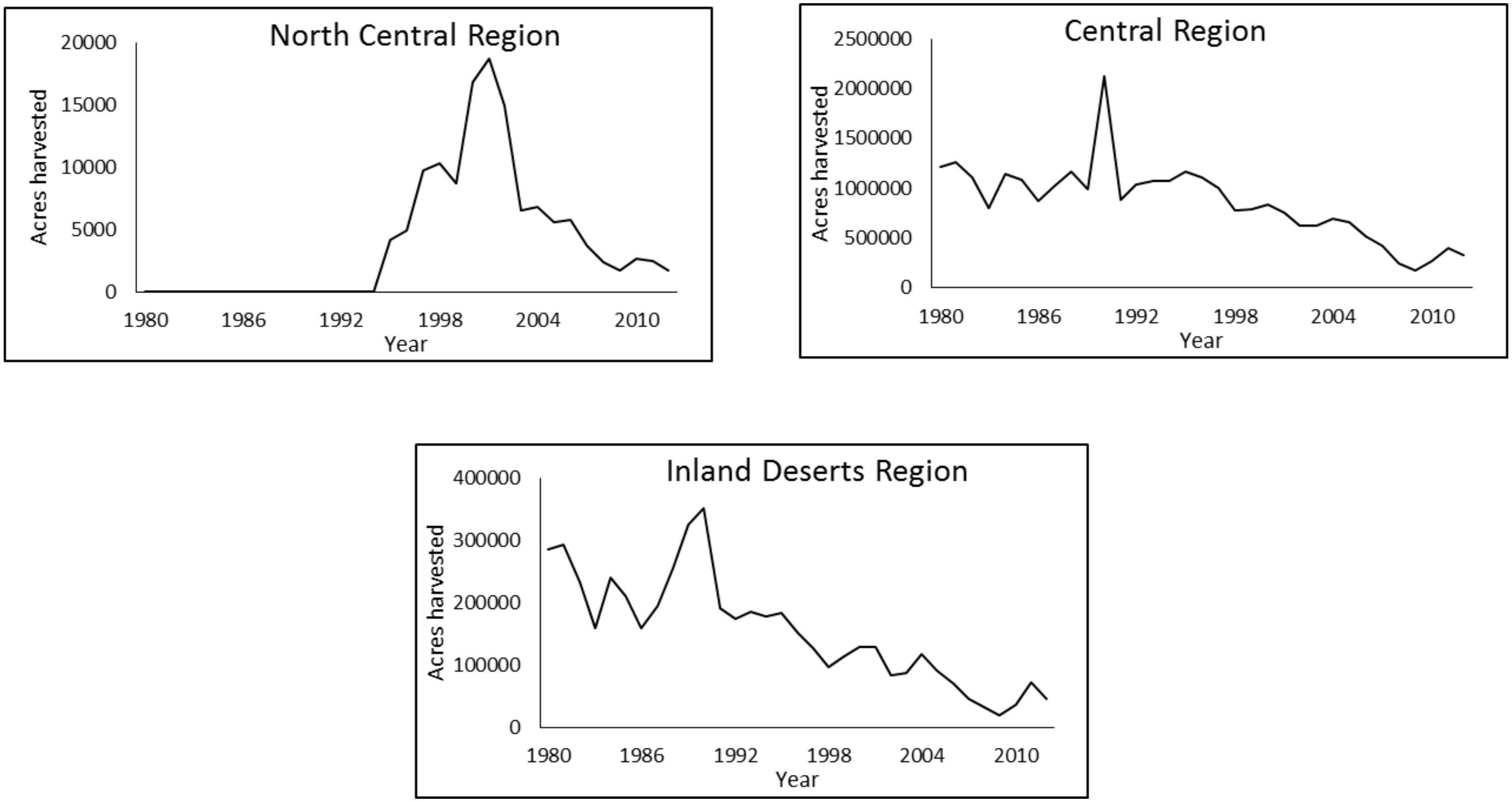


Figure 113. Regional cotton harvest in California, 1980-2010 (none listed for North, Bay-Delta, or South Coast regions).

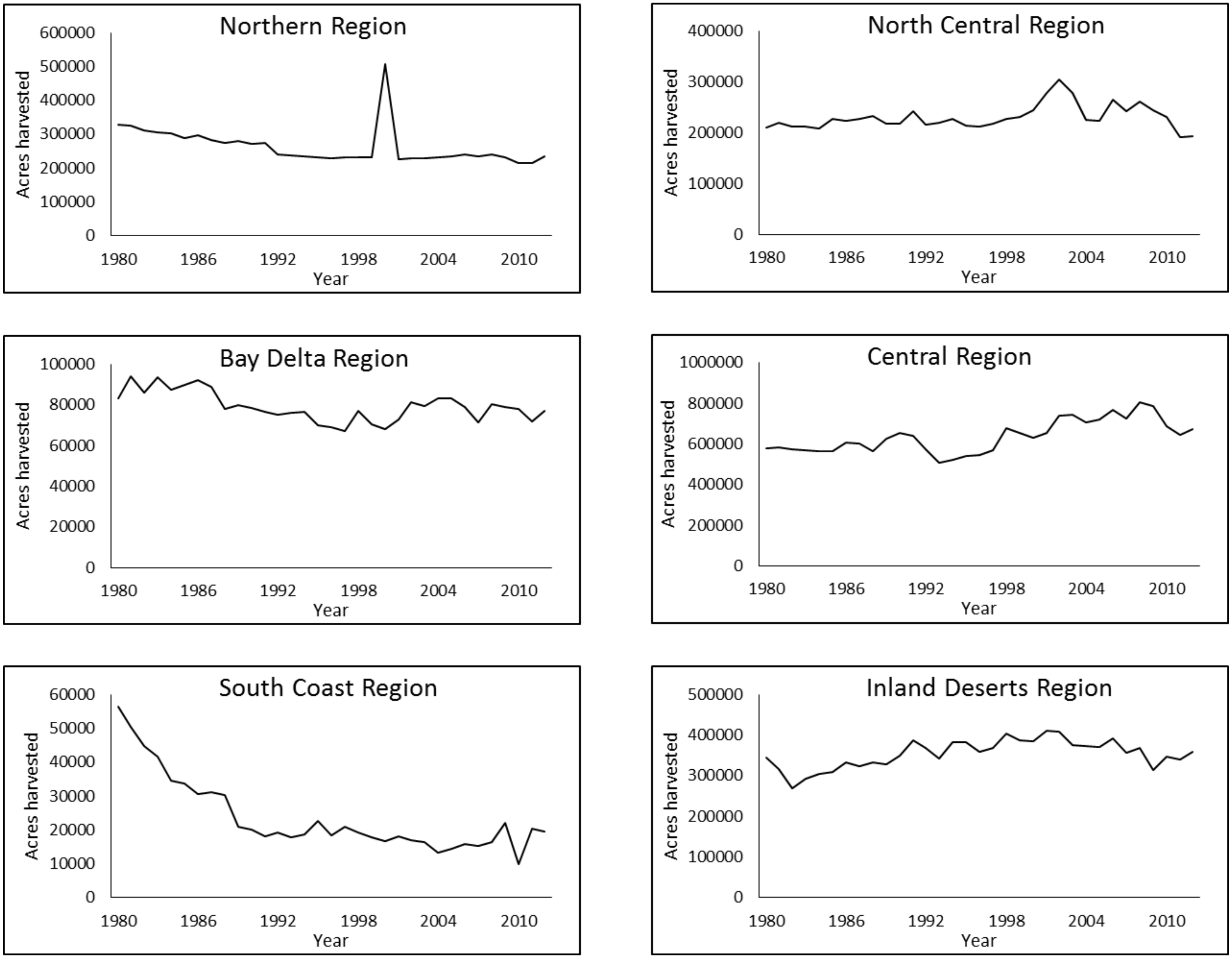
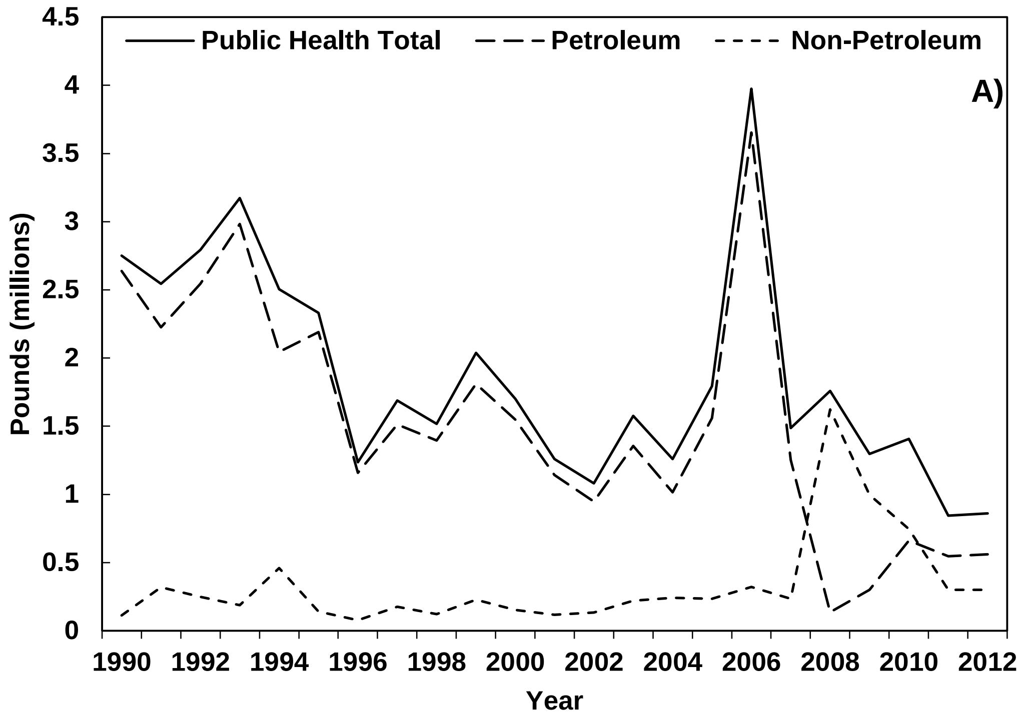


Figure 114. Regional hay harvest in California, 1980-2013.



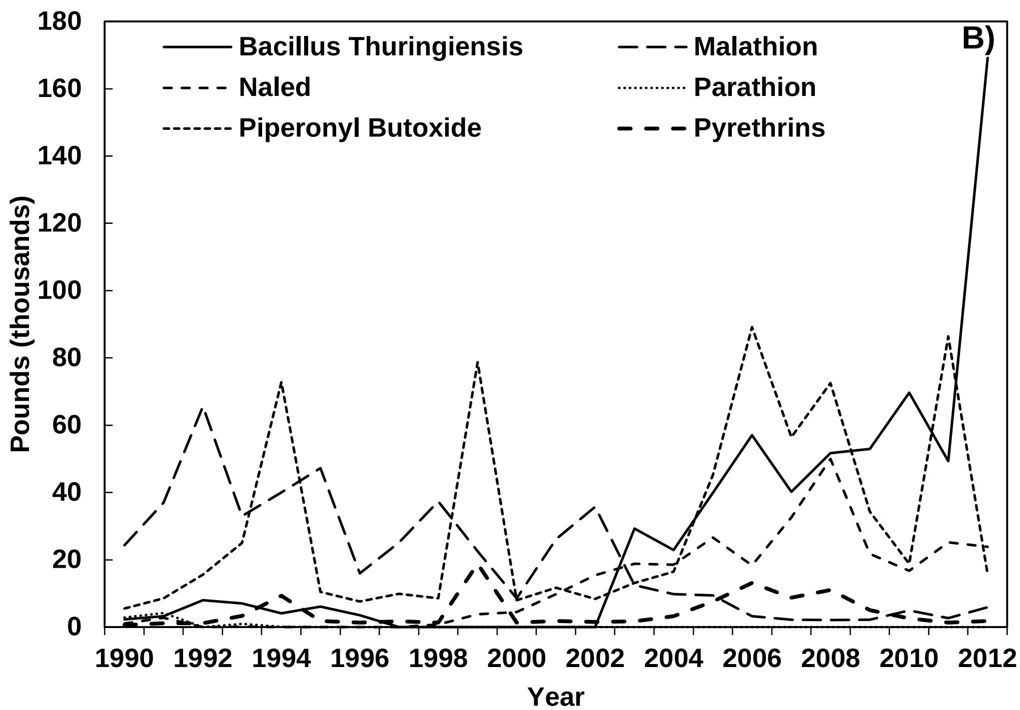


Figure 115. California statewide use of A) petroleum, non-petroleum, and total public health pesticides and B) six select pesticides for public health, 1990-2012.

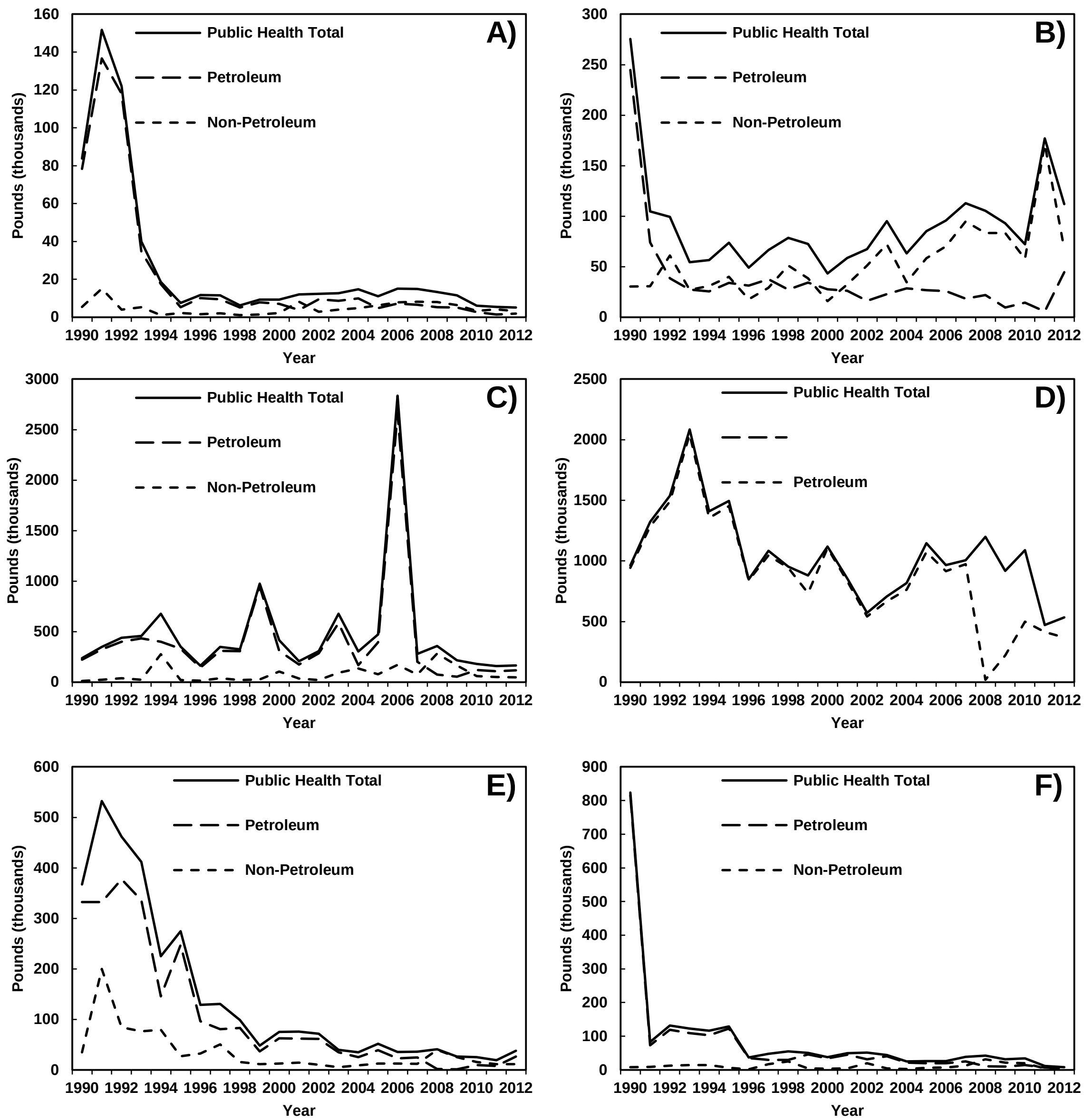


Figure 116. Use of petroleum, non-petroleum, and total public health pesticides in the A) North, B) North Central, C) Bay-Delta, D) Central, E) South Coast, and F) Inland Deserts regions in California, 1990-2012.

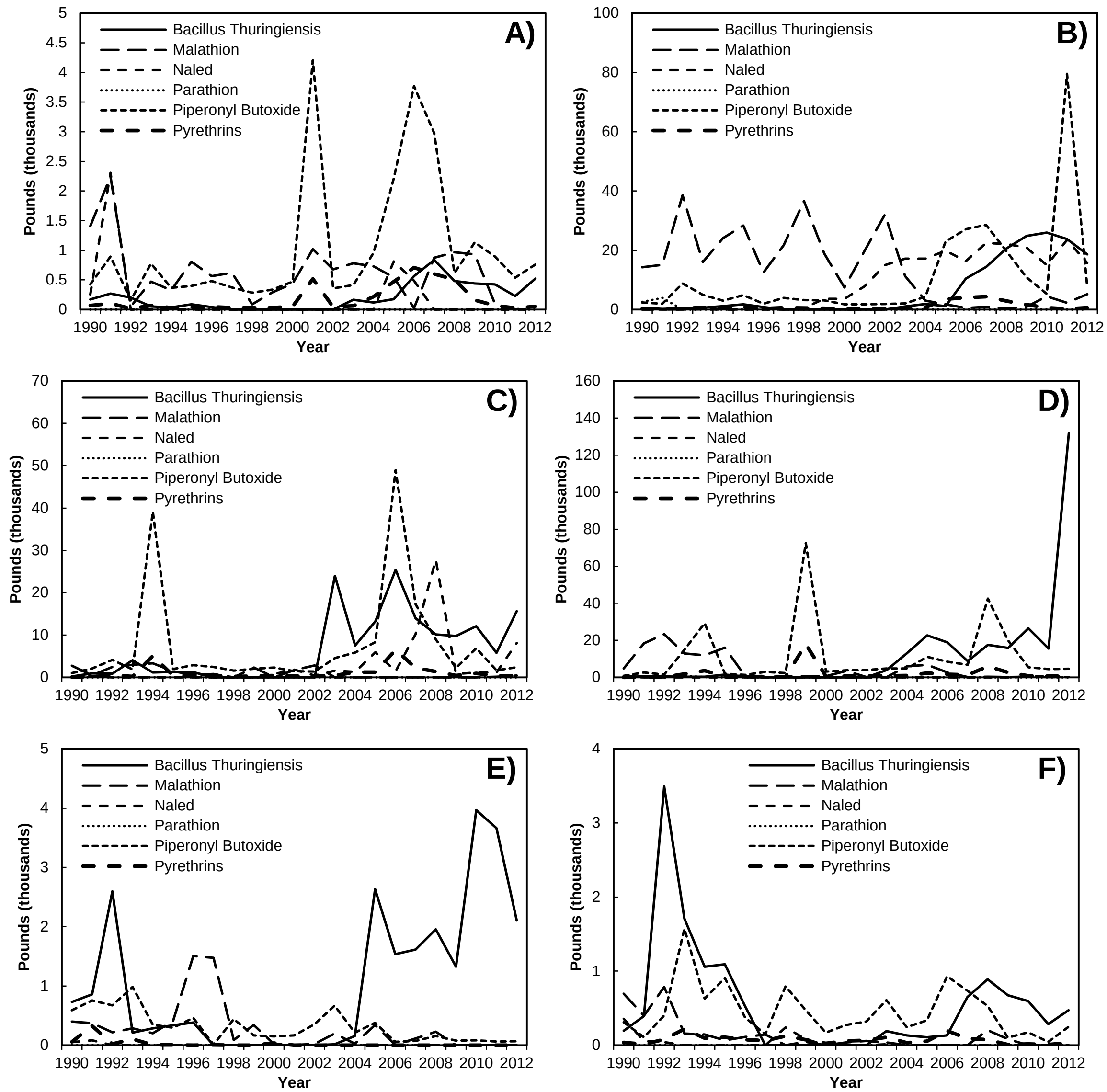


Figure 117. Use of six select insecticides for public health in the A) North, B) North Central, C) Bay-Delta, D) Central, E) South Coast, and F) Inland Deserts regions in California, 1990-2012.

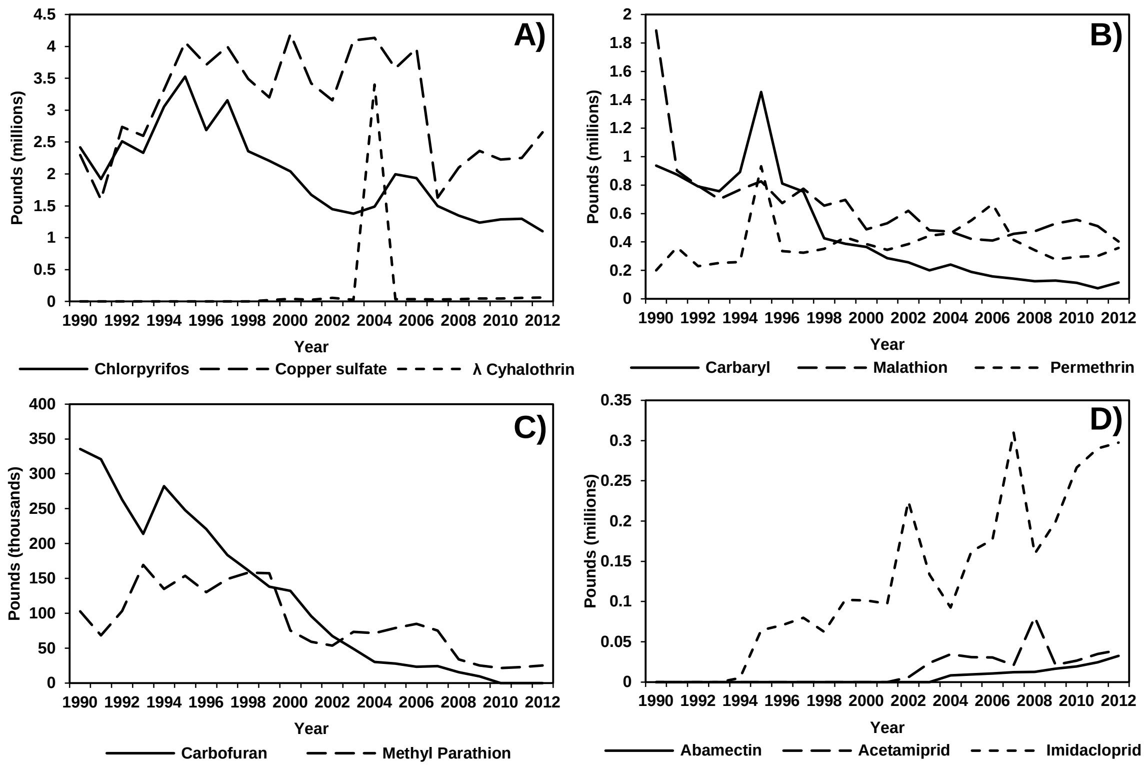


Figure 118. California statewide use of A) Chlorpyrifos, Copper Sulfate and λ Cyhalothrin, B) Carbaryl, Malathion and Permethrin, C) Carbofuran and Methyl Parathion, and D) Abamectin, Acetamiprid and Imidacloprid (neonicotinoid) pesticides, 1990–2012 [A, B, D millions of pounds, C in thousands of pounds).

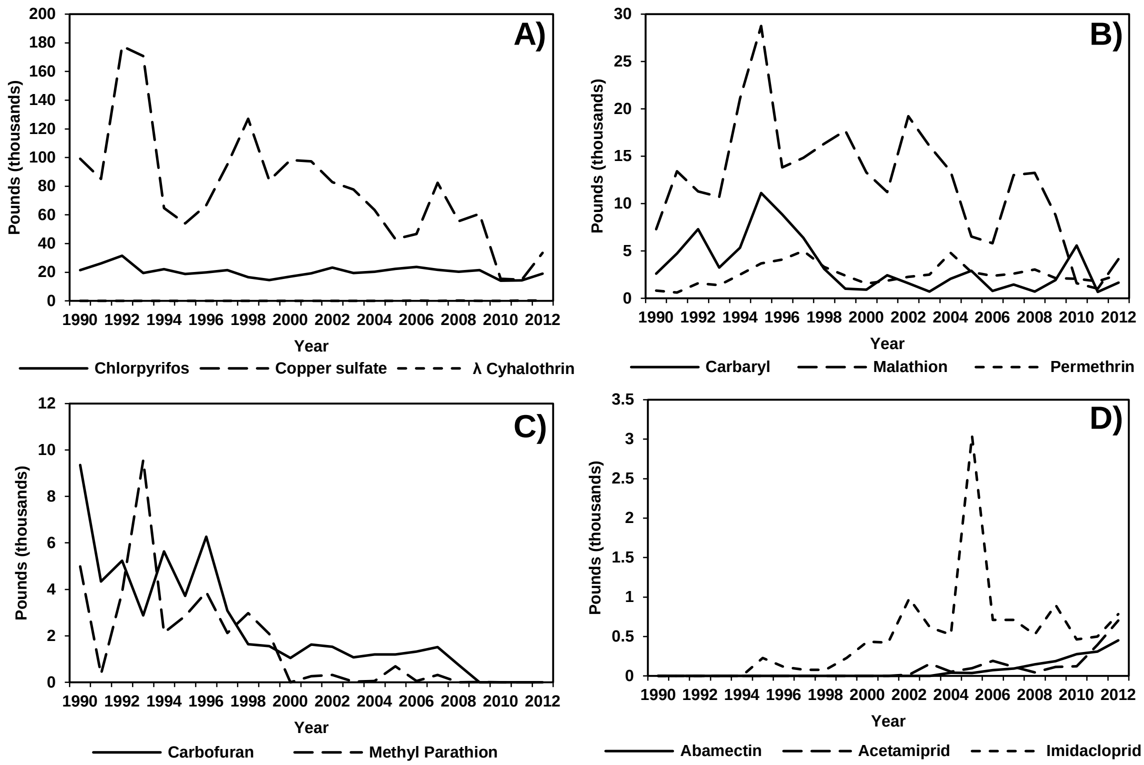


Figure 119. California North Region use of A) Chlorpyrifos, Copper Sulfate and λ Cyhalothrin, B) Carbaryl, Malathion and Permethrin, C) Carbofuran and Methyl Parathion, and D) Abamectin, Acetamiprid and Imidacloprid (neonicotinoid) pesticides, 1990–2012.

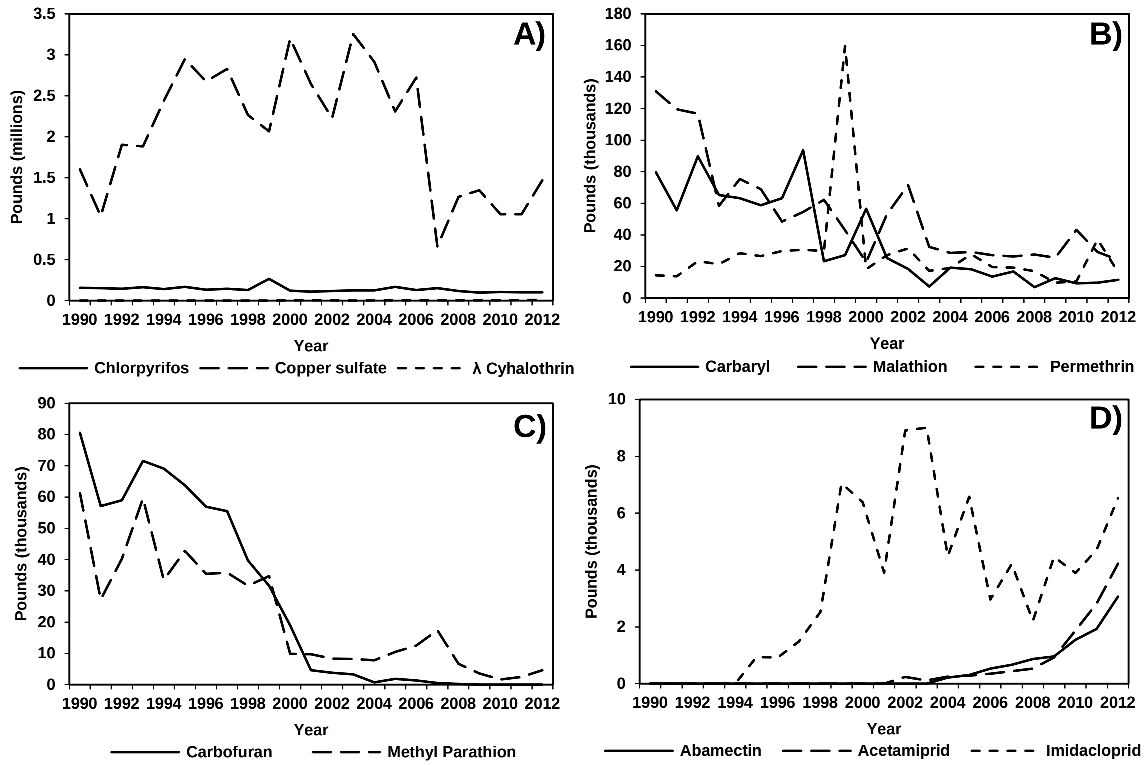


Figure 120. California North Central Region use of A) Chlorpyrifos, Copper Sulfate and λ Cyhalothrin, B) Carbaryl, Malathion and Permethrin, C) Carbofuran and Methyl Parathion, and D) Abamectin, Acetamiprid and Imidacloprid (neonicotinoid) pesticides, 1990–2012 (A in millions of pounds, B,C, D in thousands of pounds).

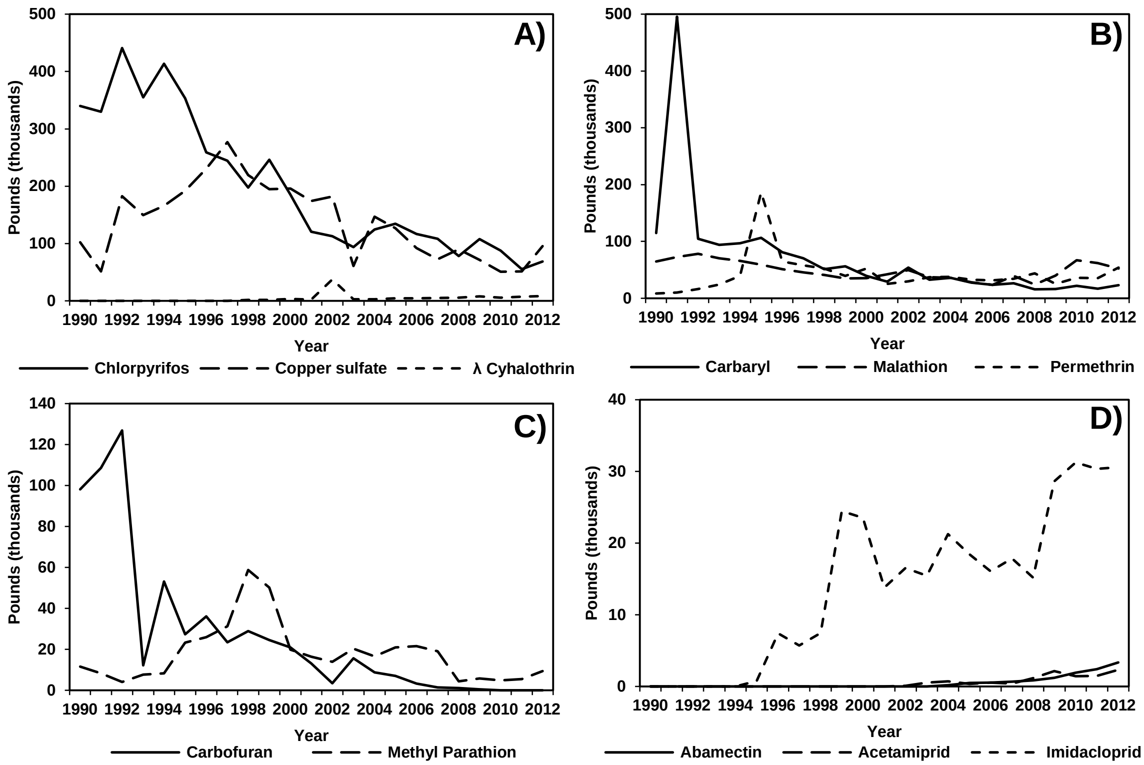


Figure 121. California Bay-Delta Region use of A) Chlorpyrifos, Copper Sulfate and λ Cyhalothrin, B) Carbaryl, Malathion and Permethrin, C) Carbofuran and Methyl Parathion, and D) Abamectin, Acetamiprid and Imidacloprid (neonicotinoid) pesticides, 1990–2012.

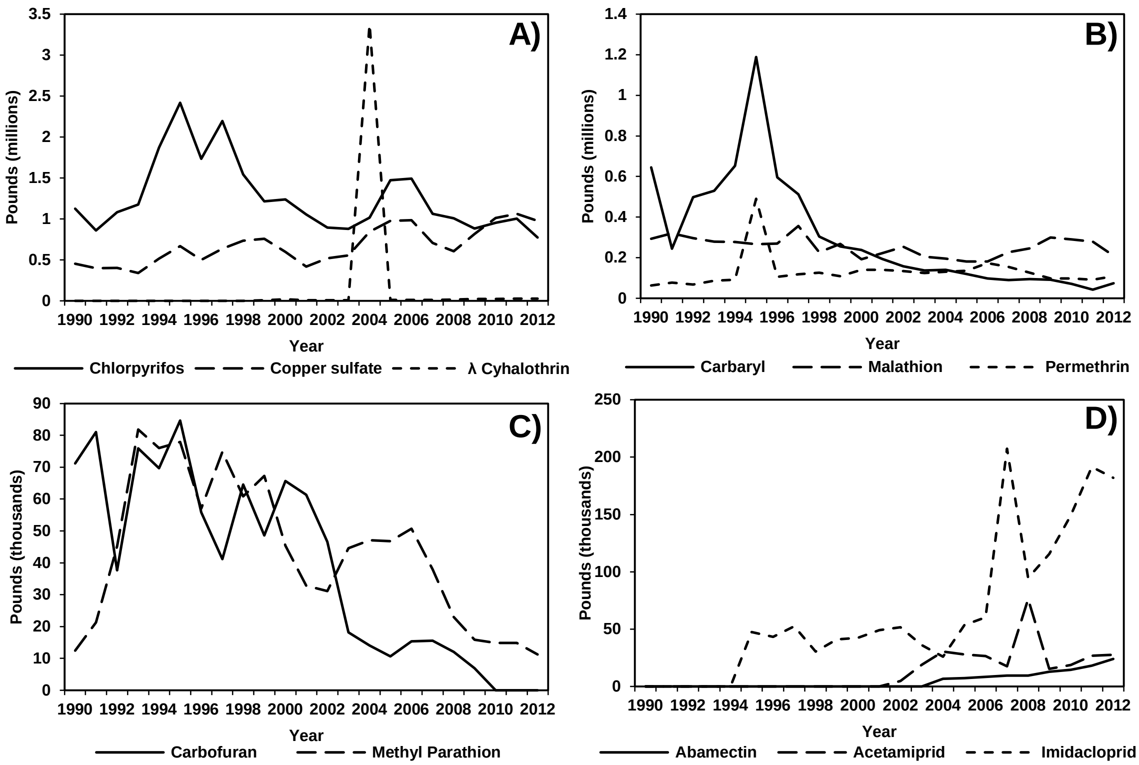


Figure 122. California Central Region use of A) Chlorpyrifos, Copper Sulfate and λ Cyhalothrin, B) Carbaryl, Malathion and Permethrin, C) Carbofuran and Methyl Parathion, and D) Abamectin, Acetamiprid and Imidacloprid (neonicotinoid) pesticides, 1990–2012 (A and B in millions of pounds, C, D in thousands of pounds).

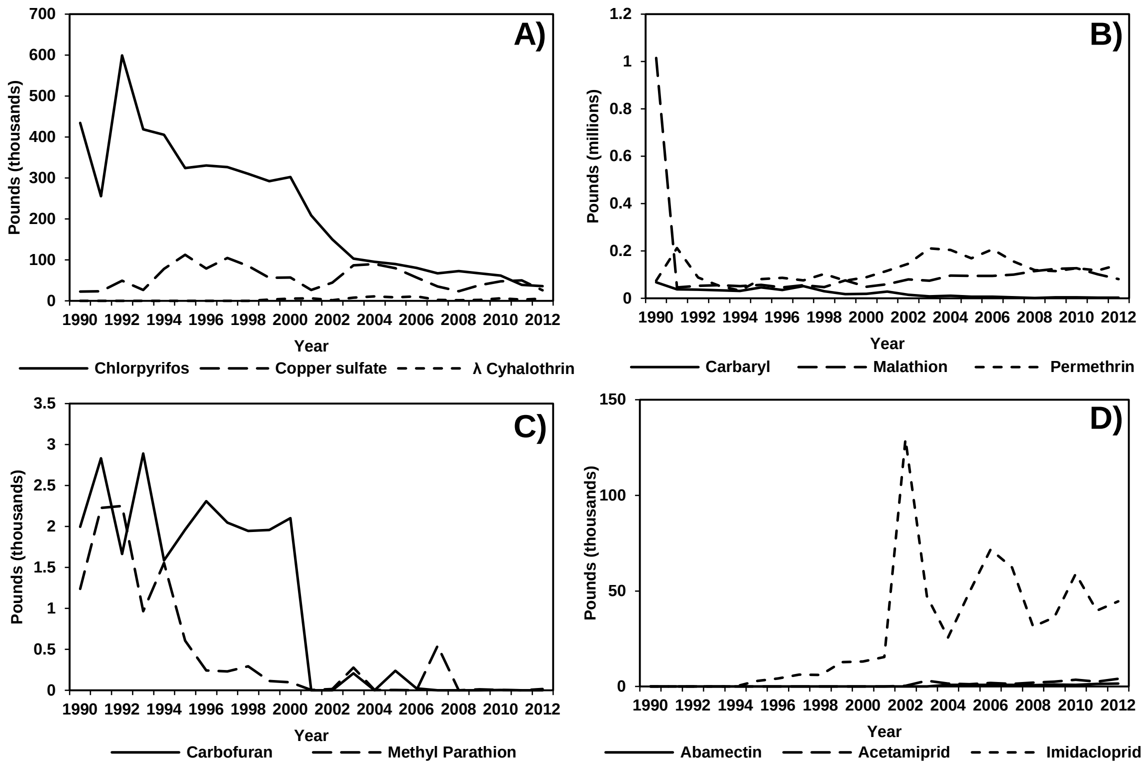


Figure 123. California South Coast Region use of A) Chlorpyrifos, Copper Sulfate and λ Cyhalothrin, B) Carbaryl, Malathion and Permethrin, C) Carbofuran and Methyl Parathion, and D) Abamectin, Acetamiprid and Imidacloprid (neonicotinoid) pesticides, 1990–2012 (B in millions of pounds, A, C, D in thousands of pounds).

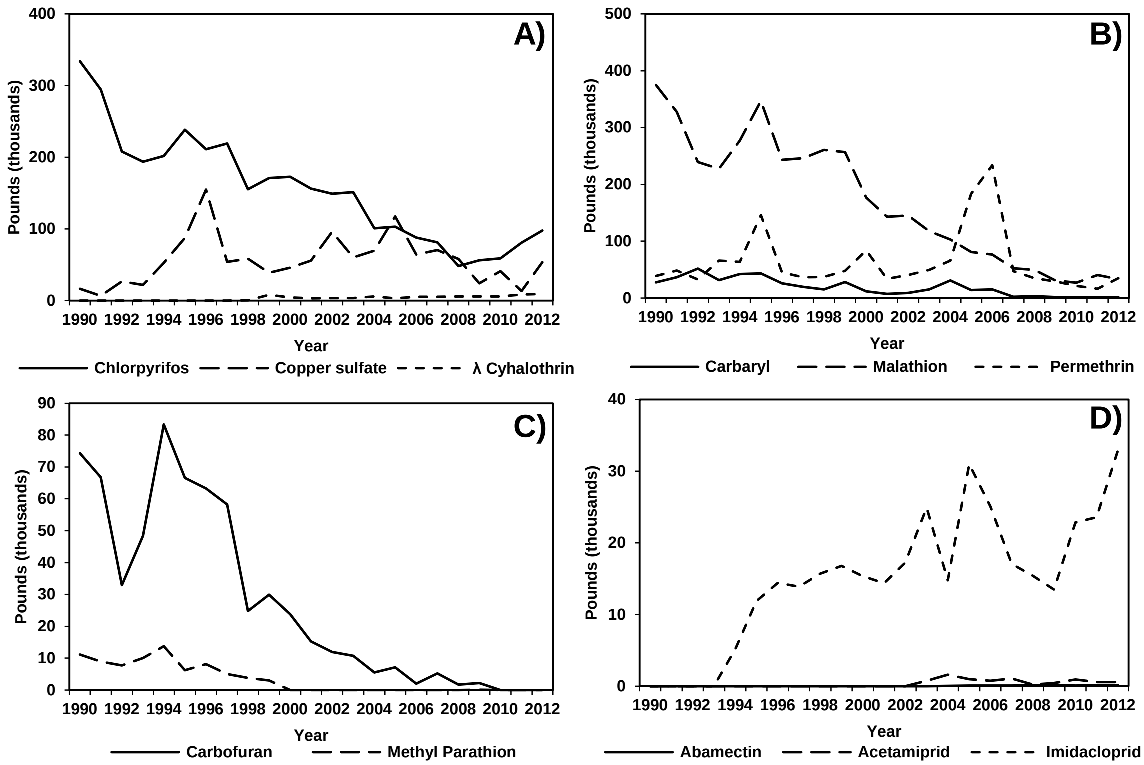


Figure 124. California Inland Deserts use of A) Chlorpyrifos, Copper Sulfate and λ Cyhalothrin, B) Carbaryl, Malathion and Permethrin, C) Carbofuran and Methyl Parathion, and D) Abamectin, Acetamiprid and Imidacloprid (neonicotinoid) pesticides, 1990–2012.

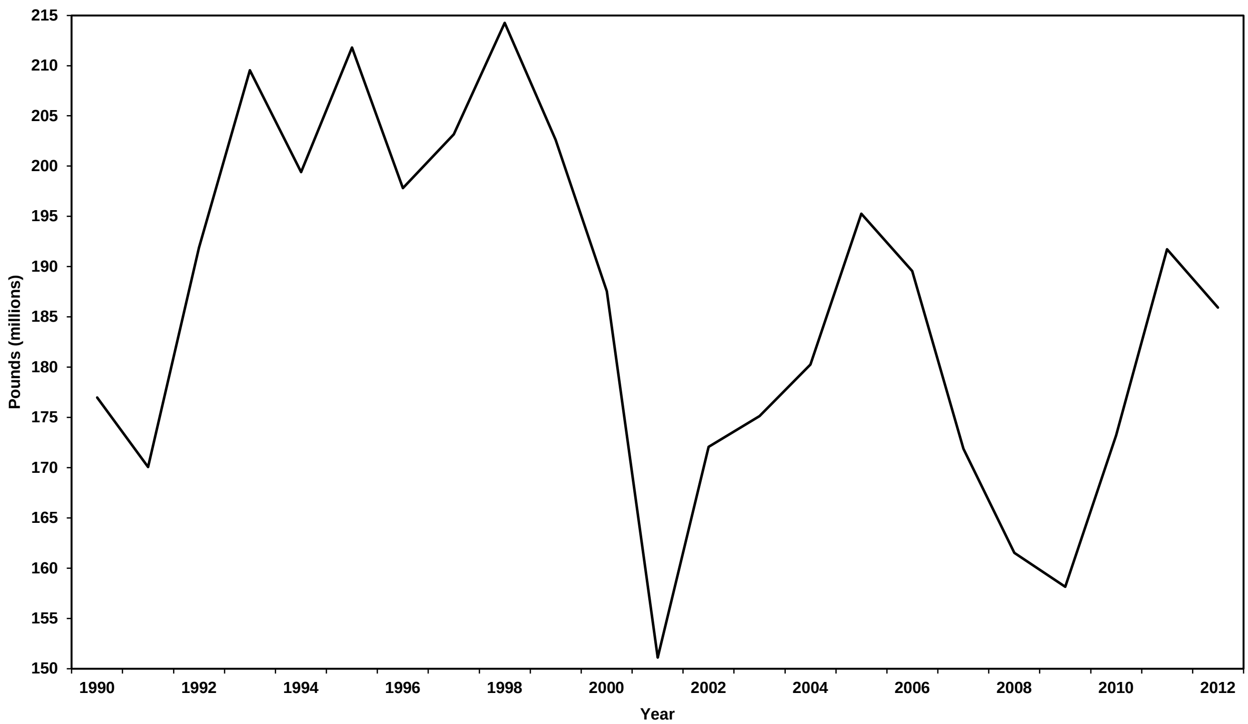


Figure 125. California state total use of all pesticides combined, 1990-2012.

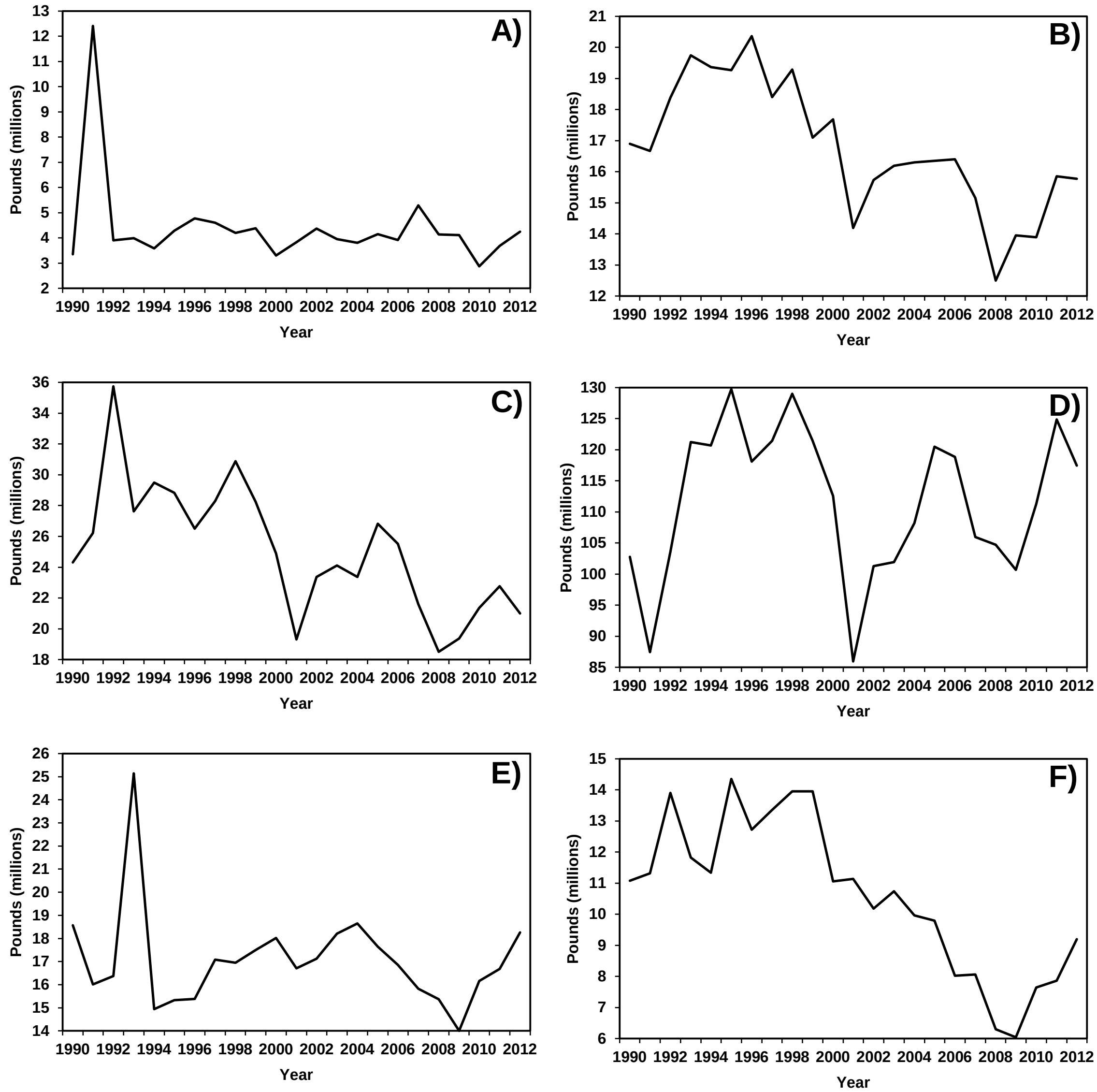


Figure 126. Use of all pesticides combined in the A) North, B) North Central, C) Bay-Delta, D) Central, E) South Coast, F) Inland Deserts regions of California, 1990-2012.

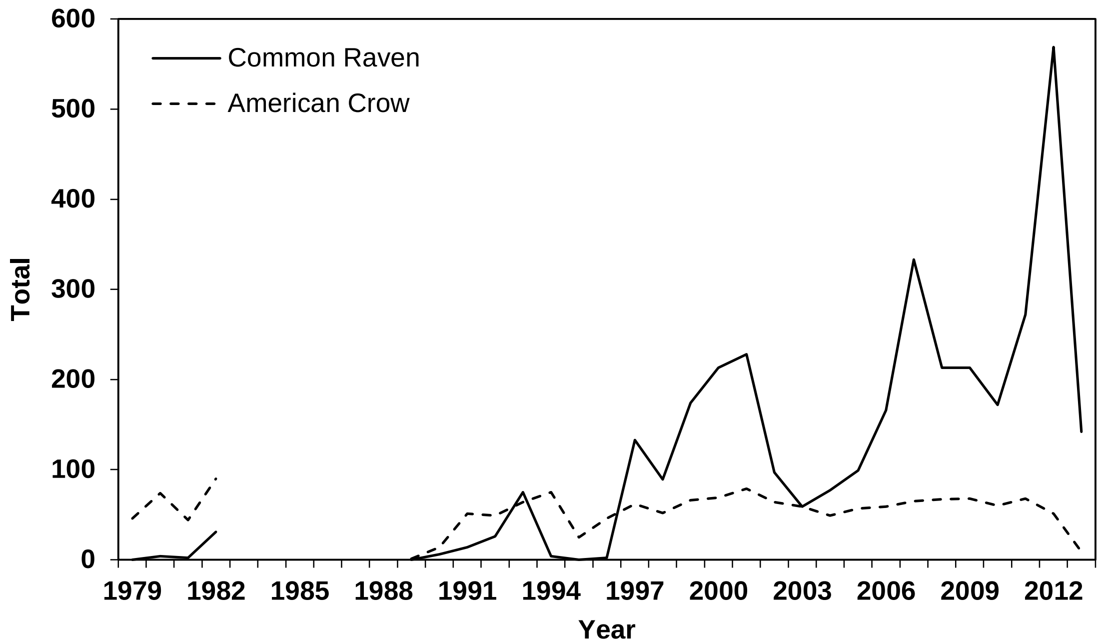


Figure 127. Common Raven and American Crow counts for the entire Sacramento National Wildlife Refuge Complex (Sacramento, Sutter, Colusa and Delevan total), 1979-2013.

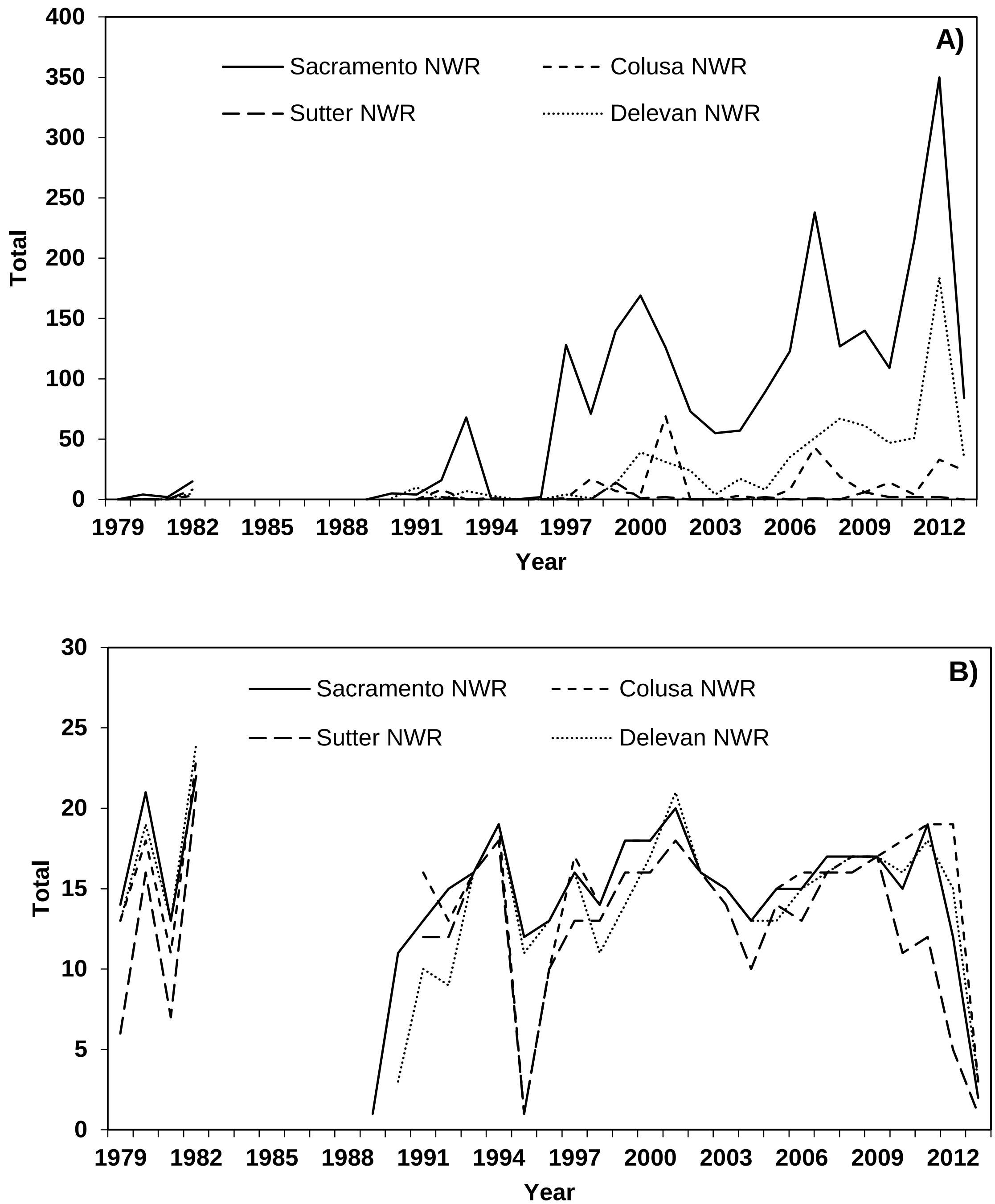


Figure 128. Total counts of A) Common Ravens and B) American Crows on Sacramento, Sutter, Colusa and Delevan National Wildlife Refuges, 1979-2013.

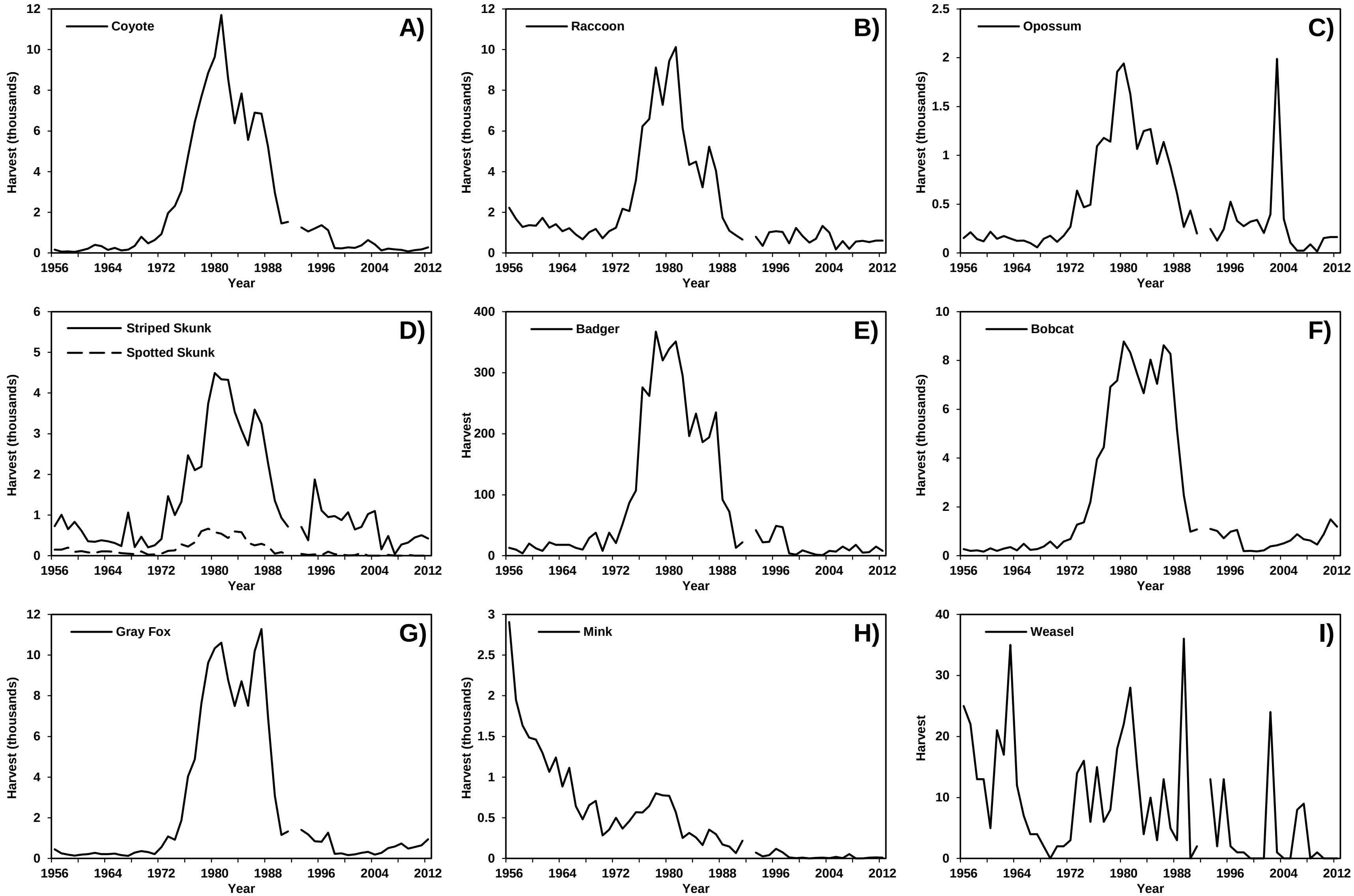


Figure 129. California statewide total fur harvest for A) Coyote, B) Raccoon, C) Opossum, D) Striped and Spotted Skunk, E) Badger, F) Bobcat, G) Gray Fox, H) Mink, and I) Weasel, 1956-2012.

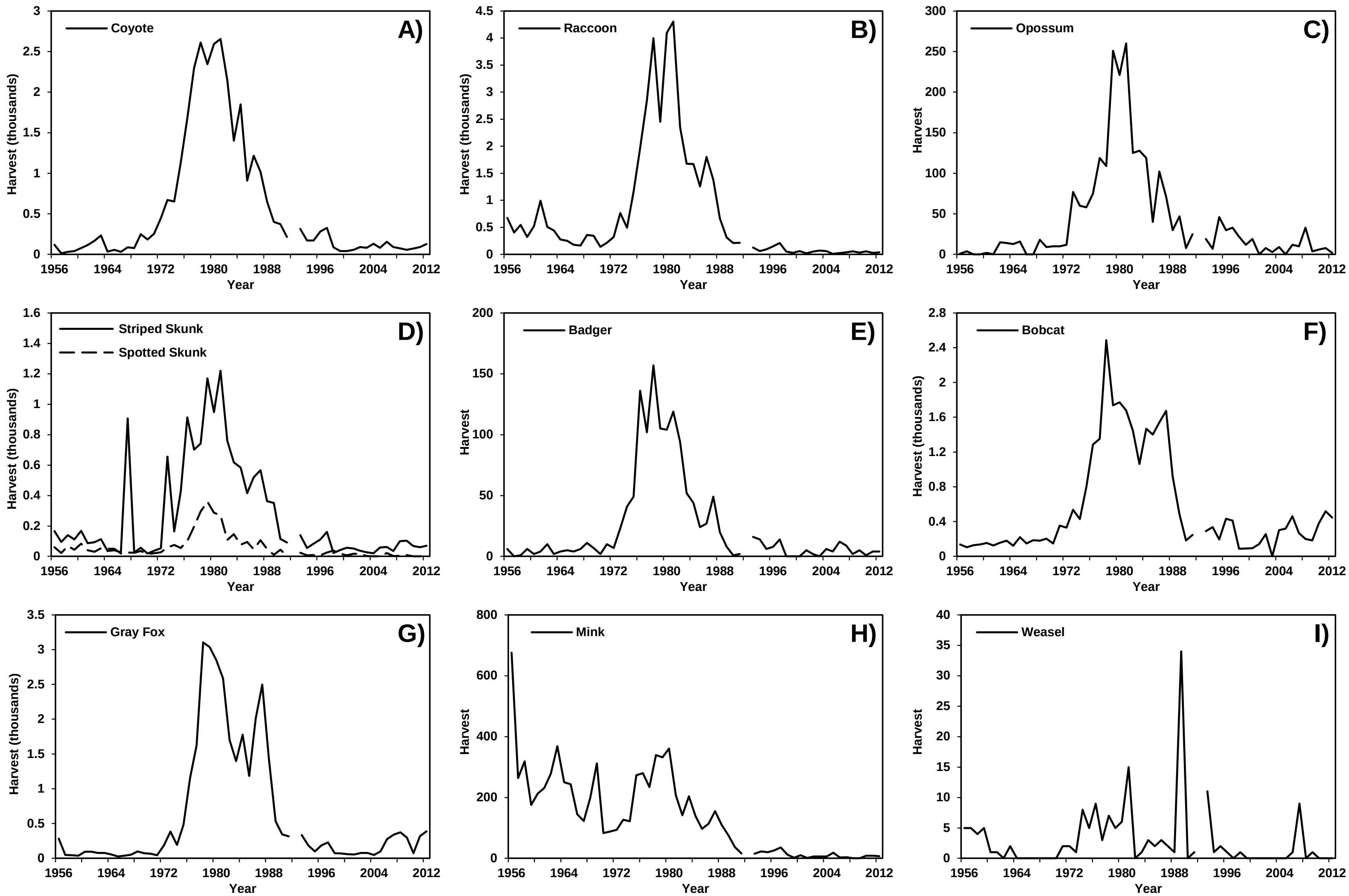


Figure 130. North Region fur harvest for A) Coyote, B) Raccoon, C) Opossum, D) Striped and Spotted Skunk, E) Badger, F) Bobcat, G) Gray Fox, H) Mink, and I) Weasel in California, 1956-2012.

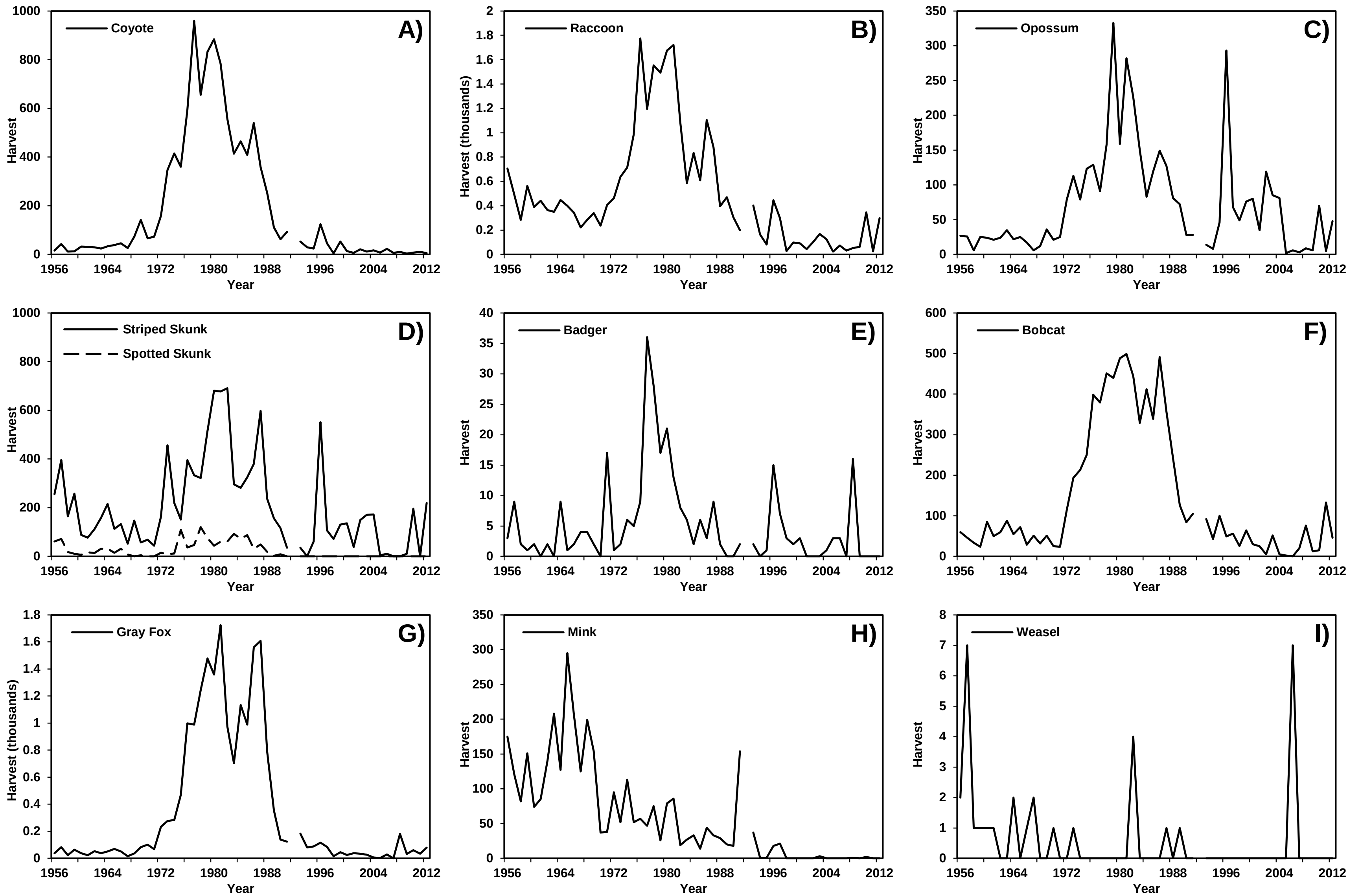


Figure 131. North Central Region fur harvest for A) Coyote, B) Raccoon, C) Opossum, D) Striped and Spotted Skunk, E) Badger, F) Bobcat, G) Gray Fox, H) Mink, and I) Weasel in California, 1956-2012.

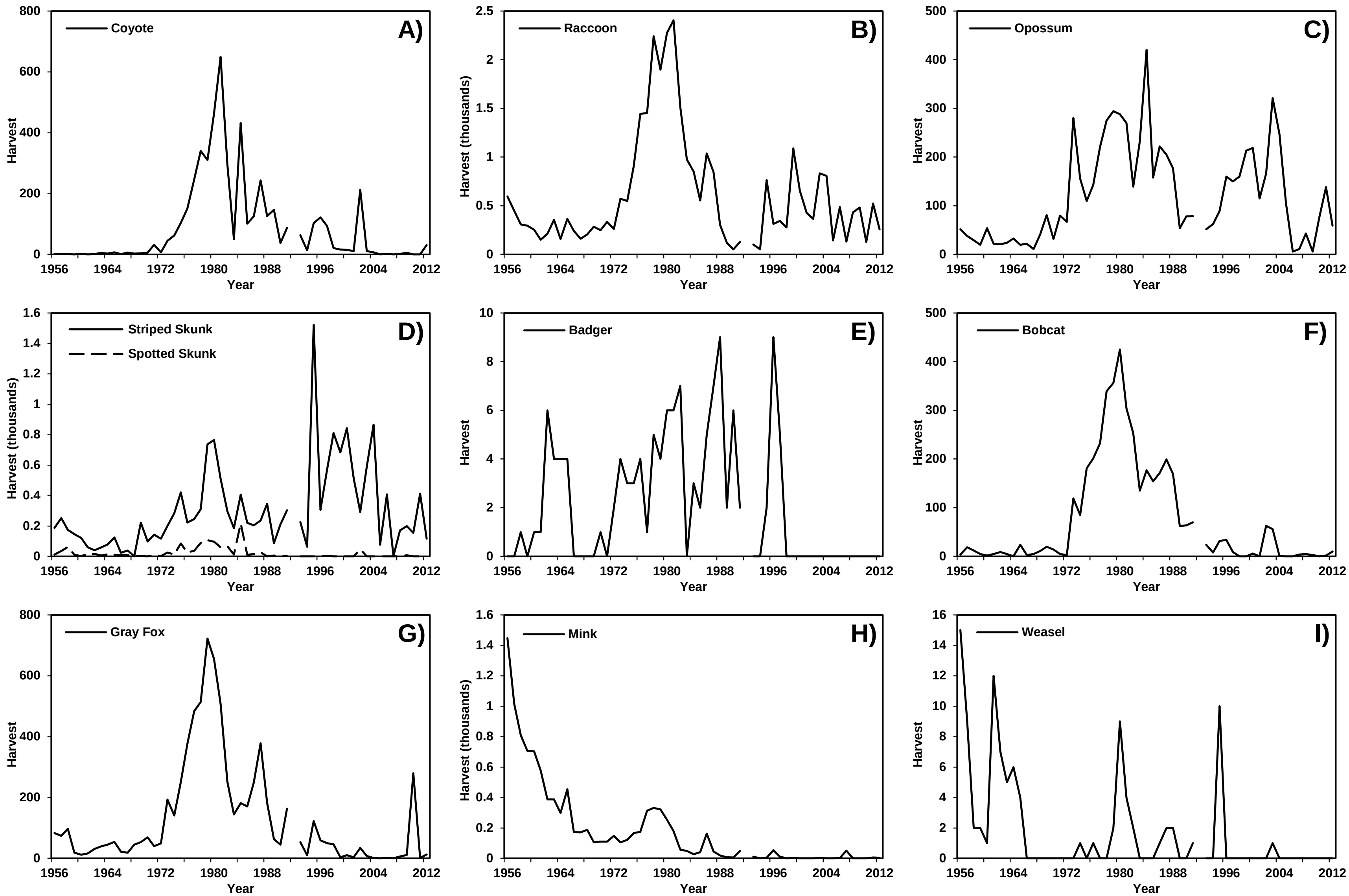


Figure 132. Bay-Delta Region fur harvest for A) Coyote, B) Raccoon, C) Opossum, D) Striped and Spotted Skunk, E) Badger, F) Bobcat, G) Gray Fox, H) Mink, and I) Weasel in California, 1956-2012.

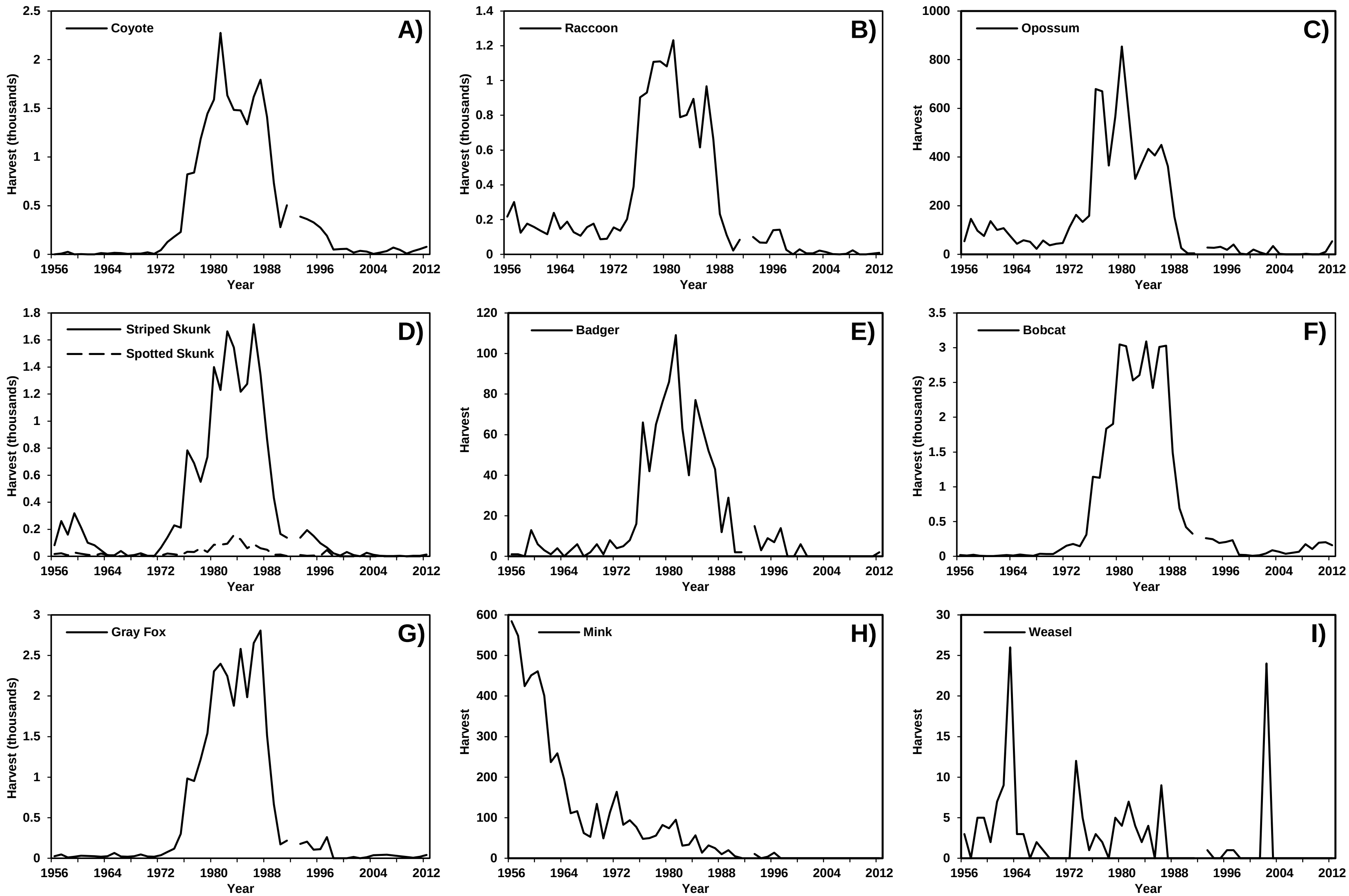


Figure 133. Central Region fur harvest for A) Coyote, B) Raccoon, C) Opossum, D) Striped and Spotted Skunk, E) Badger, F) Bobcat, G) Gray Fox, H) Mink, and I) Weasel in California, 1956-2012.

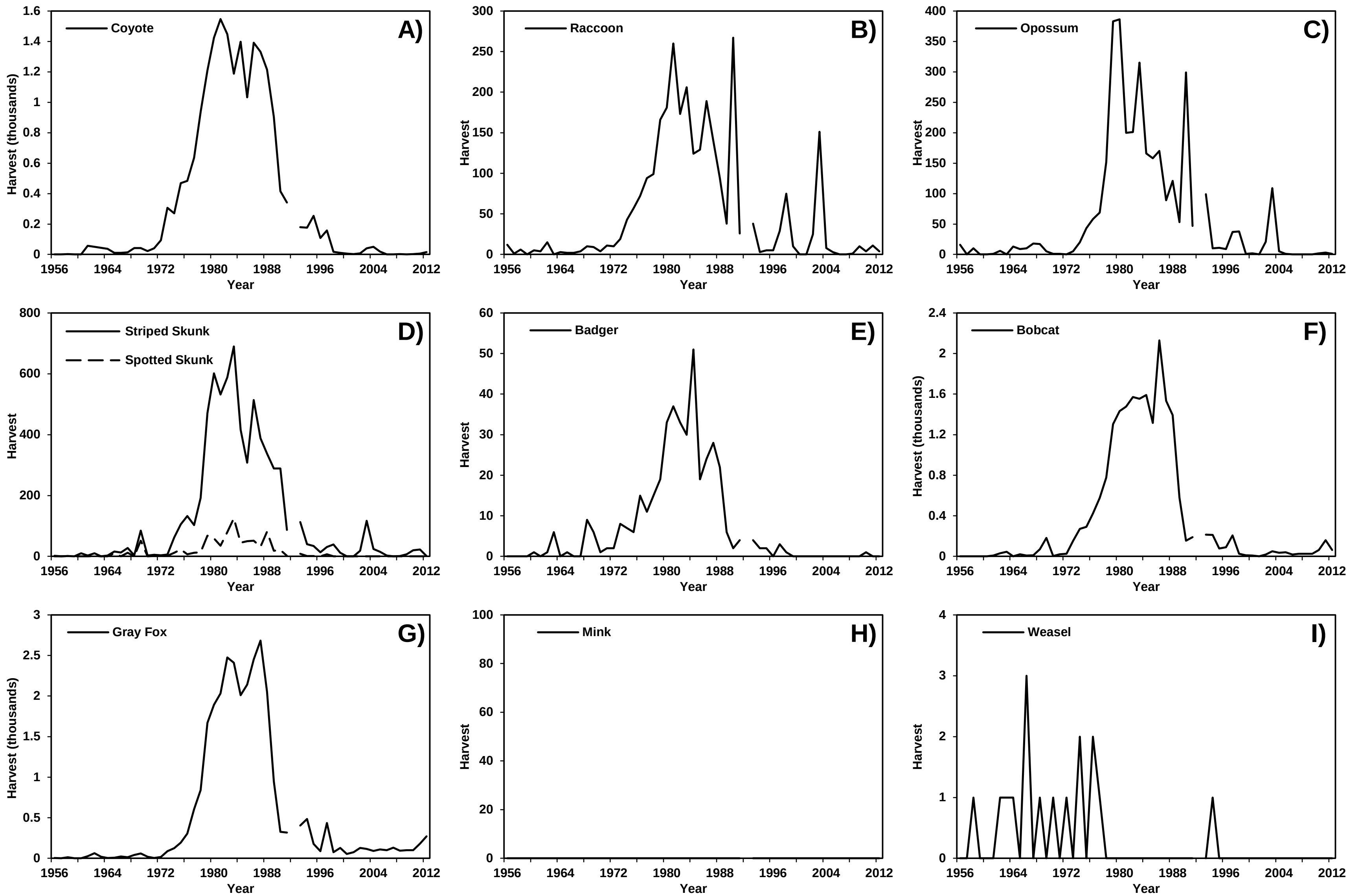


Figure 134. South Coast Region fur harvest for A) Coyote, B) Raccoon, C) Opossum, D) Striped and Spotted Skunk, E) Badger, F) Bobcat, G) Gray Fox, H) Mink, and I) Weasel in California, 1956-2012 (Note: there are no data for Mink).

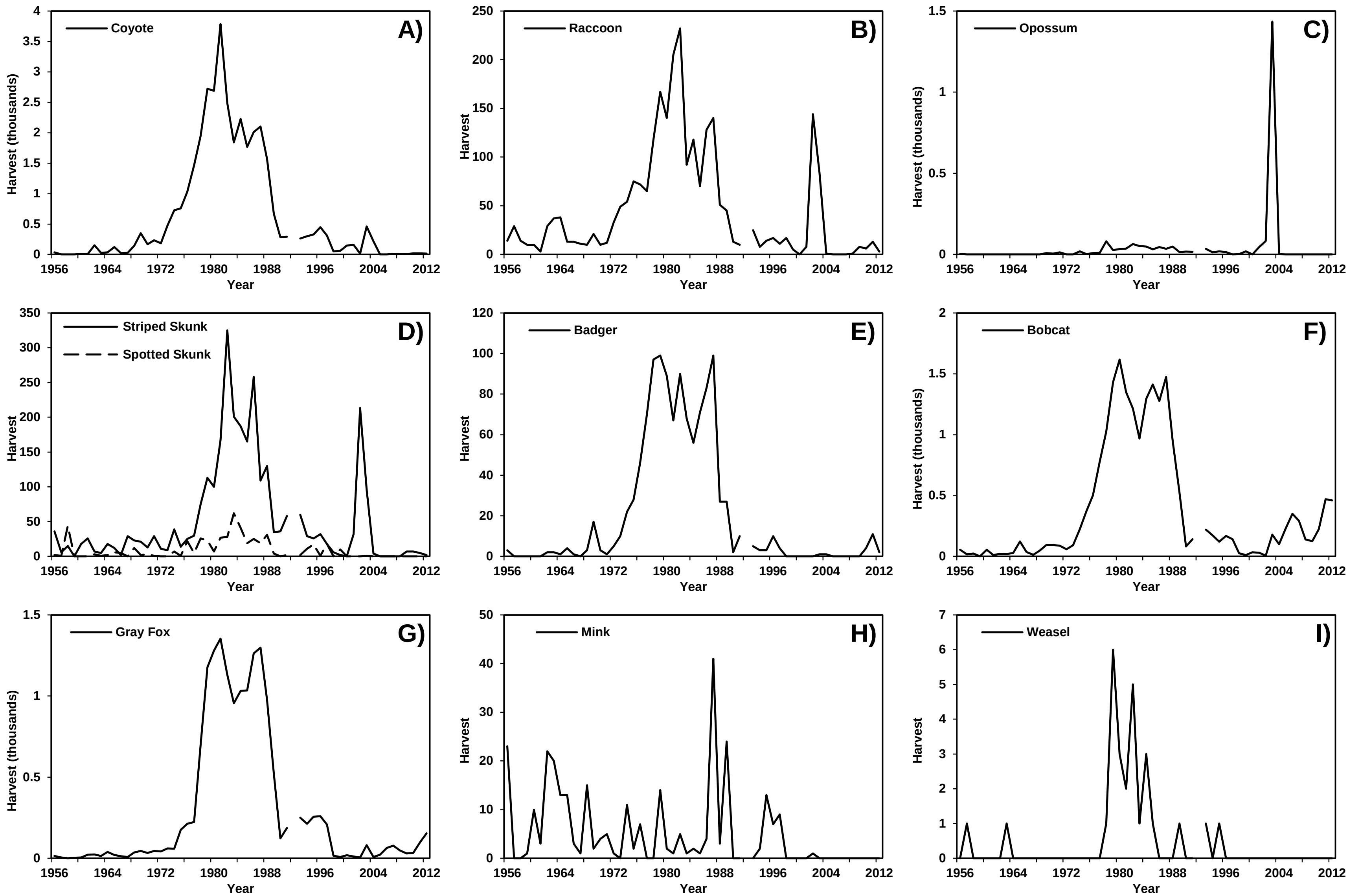


Figure 135. Inland Deserts Region fur harvest for A) Coyote, B) Raccoon, C) Opossum, D) Striped and Spotted Skunk, E) Badger, F) Bobcat, G) Gray Fox, H) Mink, and I) Weasel in California, 1956-2012.

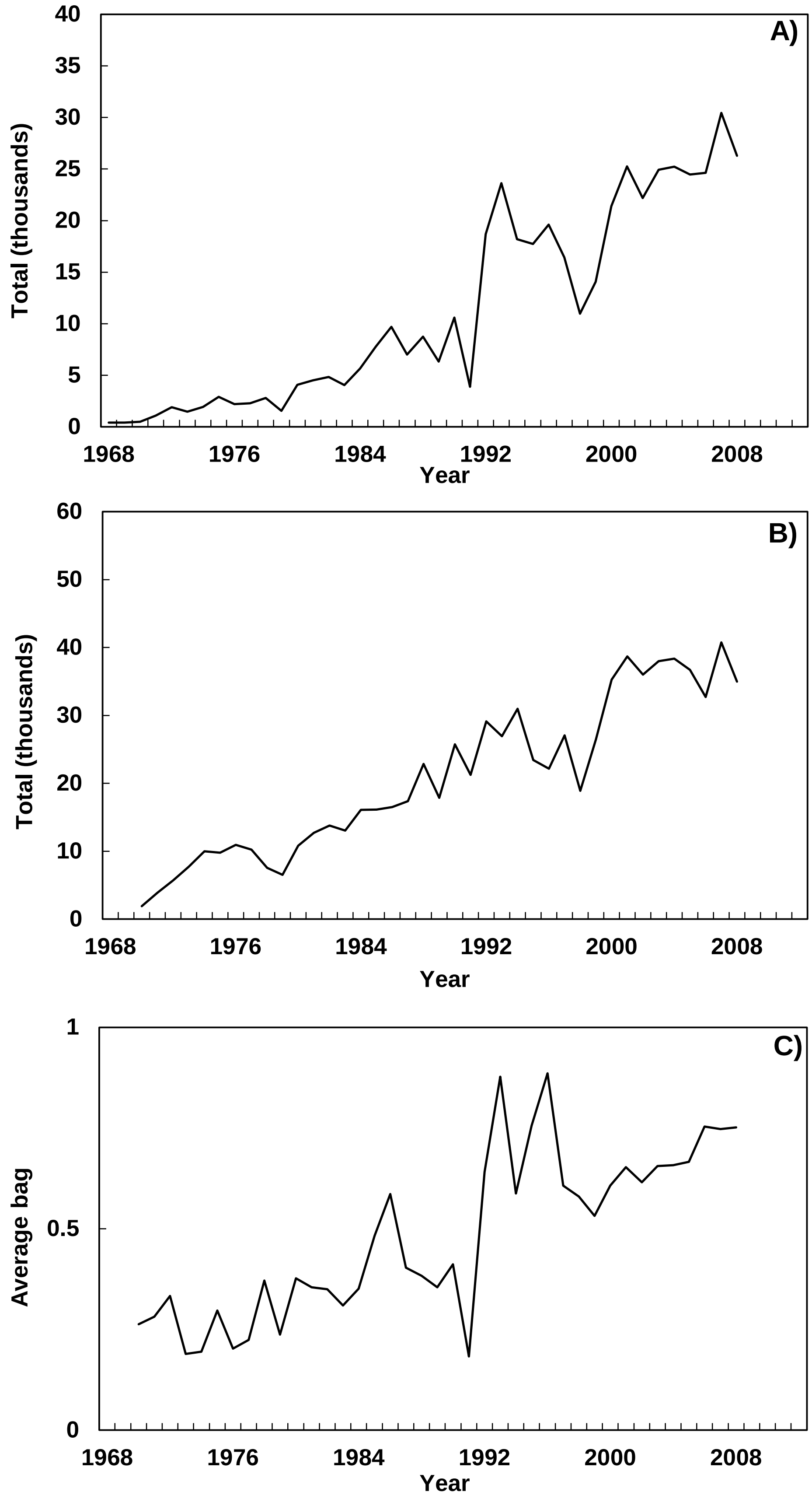


Figure 136. California Statewide Annual Game Take Survey for wild turkey A) harvest, B) turkey hunters, and C) average bag.

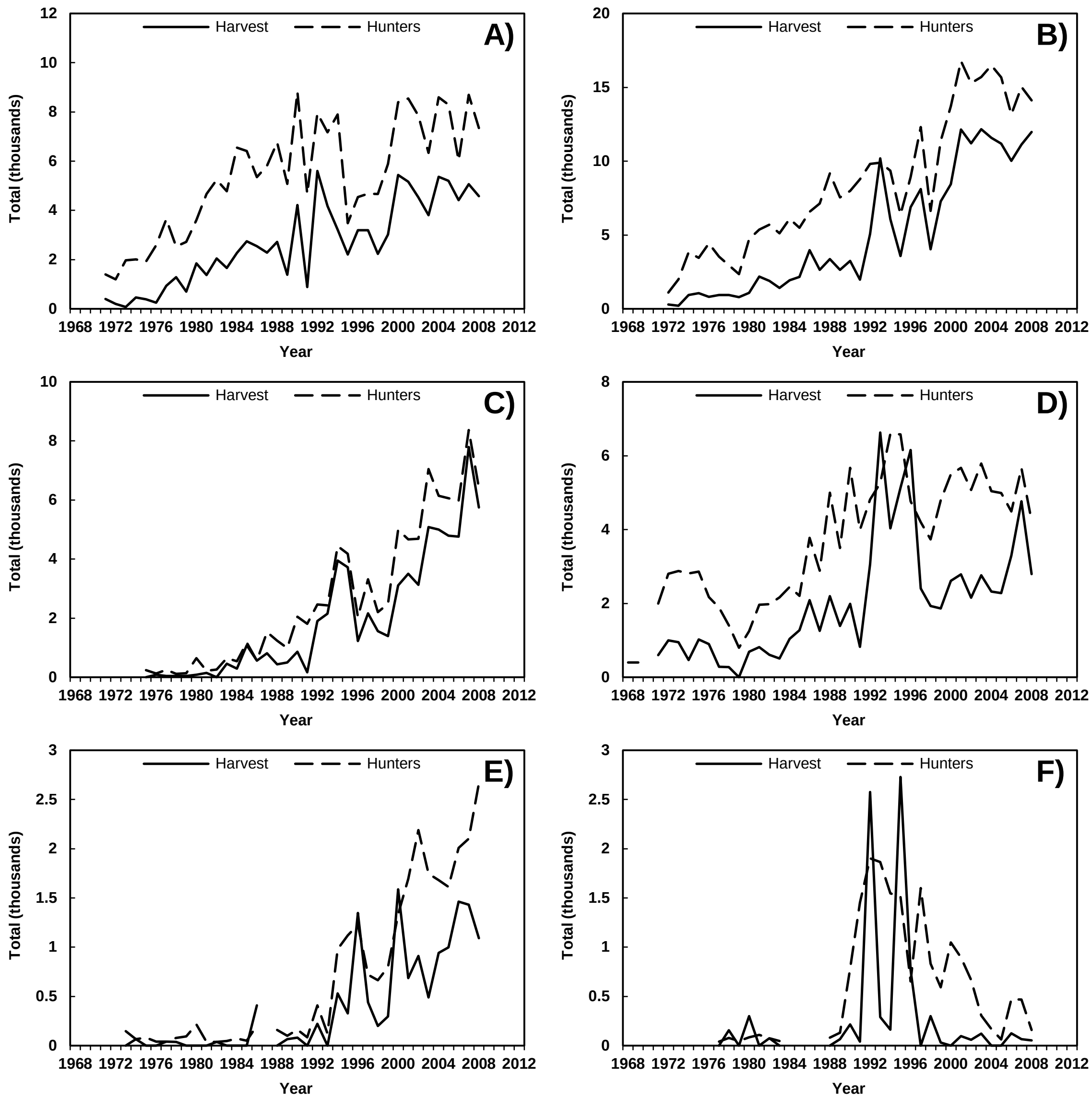


Figure 137. Annual Game Take Survey wild turkey harvest and turkey hunters for the A) North, B) North Central, C) Bay Delta, D) Central, E) South Coast, and F) Inland Deserts regions, California, 1968-2012.

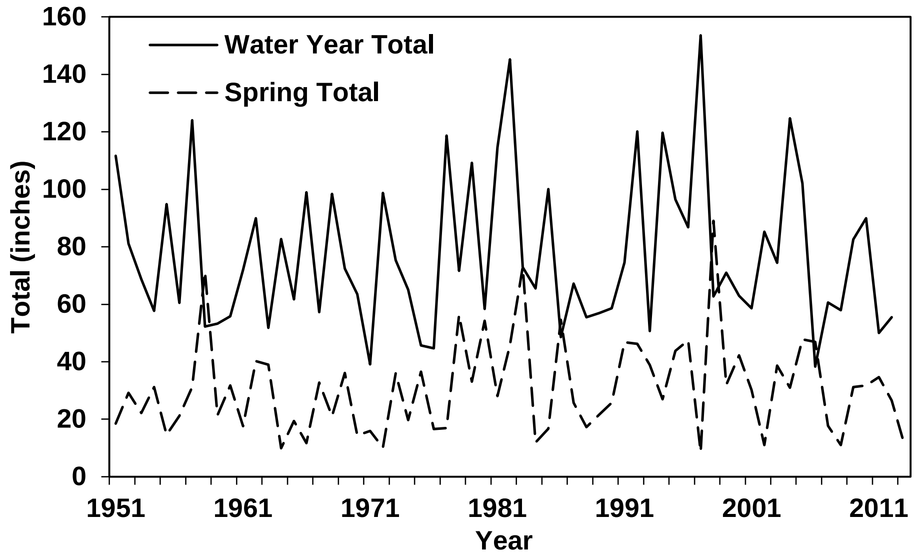


Figure 138. Index (6 regions summed) of total water year and total spring precipitation for California, 1951-2012.

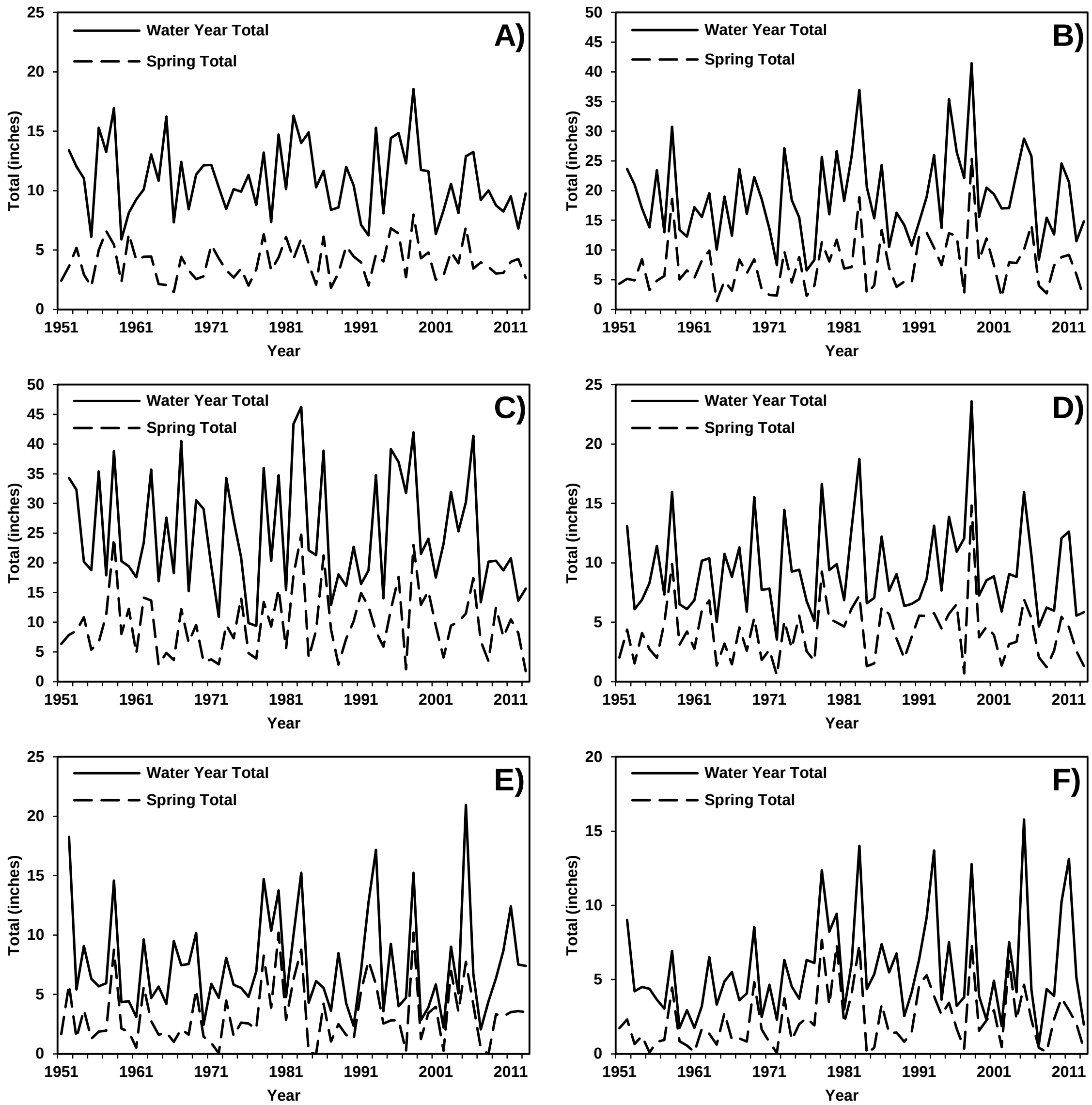


Figure 139. Total water year and spring precipitation for the A) North Region (Tulelake station), B) North Central Region (Willows station), C) Bay Delta Region (Vacaville station), D) Central Region (Los Banos station), E) South Coast Region (Palmdale station), and F) Inland Desert Region (Victorville station) in California, 1951-2012.

Table 1. Wild pheasant hunting seasons and regulations in California, 1953-2013.

Year	Start Month	Start Day	End Month	End Day	Season Length (days)	Daily Limit (1st Weekend)	Daily Limit (Remainder)
1953	11	21	11	30	10	2	2
1954	11	20	11	29	10	2	2
1955	11	19	12	4	16	2	2
1956	11	17	12	2	16	2	4
1957	11	16	12	1	17	2	4
1958	11	15	11	30	16	2	4
1959	11	14	11	29	16	2	4
1960	11	12	11	27	16	2	4
1961	11	11	11	26	16	2	2
1962	11	10	11	25	16	2	2
1963	11	23	12	8	16	2	2
1964	11	21	12	6	16	2	2
1965	11	20	12	5	16	2	2
1966	11	19	12	5	17	2	2
1967	11	18	12	3	16	2	2
1968	11	23	12	8	16	2	2
1969	11	22	12	7	16	2	2
1970	11	21	12	20	30	2	4
1971	11	13	12	5	23	2	4
1972	11	18	12	12	25	2	4
1973	11	17	12	10	24	2	4
1974	11	16	12	8	23	2	4
1975	11	15	12	7	23	2	4
1976	11	13	12	5	23	2	4
1977	11	12	12	4	23	2	4
1978	11	11	12	3	23	2	4
1979	11	10	12	2	23	2	4
1980	11	8	11	30	23	2	4
1981	11	14	12	6	23	2	4
1982	11	13	12	5	23	2	4
1983	11	12	12	11	30	2	4
1984	11	10	12	9	30	2	4
1985	11	9	12	8	30	2	4
1986	11	8	12	7	30	2	2
1987	11	14	12	13	30	2	2
1988	11	12	12	11	30	2	2
1989	11	11	12	10	30	2	2
1990	11	10	12	9	30	2	2
1991	11	9	12	8	30	2	2
1992	11	14	12	13	30	2	2
1993	11	13	12	12	30	2	3
1994	11	12	12	11	30	2	3
1995	11	11	12	10	30	2	3
1996	11	9	12	8	30	2	3
1997	11	8	12	7	30	2	3
1998	11	14	12	13	30	2	3
1999	11	13	12	12	30	2	3
2000	11	11	12	10	30	2	3
2001	11	10	12	9	30	2	3
2002	11	9	12	22	44	2	3
2003	11	8	12	21	44	2	3
2004	11	13	12	26	44	2	3
2005	11	12	12	25	44	2	3
2006	11	11	12	24	44	2	3
2007	11	10	12	23	44	2	3
2008	11	8	12	21	44	2	3
2009	11	14	12	27	44	2	3
2010	11	13	12	26	44	2	3
2011	11	12	11	25	44	2	3
2012	11	10	12	23	44	2	3
2013	11	9	12	22	44	2	3

Table 2. Pheasant release and harvest information from licensed game bird clubs in California Zone A (parts of the state having wild pheasants), 1947-1986 (copied from Hart 1990).

Year	No. Clubs	No. Acres	No. Hunter Permits	Pheasants Released	Total Bag
1947	20	25,991	1,895	7,208	3,867
1948	35	48,675	3,840	13,761	10,080
1949	40	43,776	5,412	20,720	11,514
1950	48	39,682	5,529	26,105	13,442
1951	59	51,427	8,743	32,127	18,847
1952	58	54,560	N/A	35,721	24,204
1953	68	60,317	N/A	39,668	26,701
1954	69	62,650	N/A	43,731	29,274
1955	83	72,536	15,162	49,765	31,526
1956	87	81,221	19,225	57,964	38,542
1957	90	84,257	20,808	62,000	43,202
1958	95	88,770	23,101	65,767	45,728
1959	102	98,248	26,327	70,553	48,264
1960	107	103,531	26,680	80,200	54,792
1961	110	107,348	32,204	89,233	62,967
1962	118	111,401	34,588	96,936	66,176
1963	134	120,934	40,399	115,160	81,828
1964	135	120,374	40,395	123,391	86,996
1965	127	115,106	33,737	97,774	68,410
1966	128	116,453	34,148	96,160	66,439
1967	124	111,896	35,222	98,638	68,559
1968	121	113,362	37,566	108,249	72,576
1969	130	115,614	39,210	107,873	73,695
1970	124	112,047	37,932	100,292	68,074

* Zone A and B areas started in 1956; clubs shown pre-1956 were in area later classified as Zone A.

Year	Number	Acres	Pheasants Released	Pheasants Bagged
1970	124	112,047	100,292	68,074
1971	122	109,983	110,638	75,415
1972	121	104,396	107,435	69,745
1973	119	99,223	97,119	66,955
1974	110	96,319	104,668	70,728
1975	103	91,594	104,375	69,551
1976	100	84,686	97,709	65,789
1977	96	80,894	97,464	65,858
1987	102	78,933	107,002	71,544
1979	90	71,188	108,545	70,999
1980	90	71,715	103,878	74,159
1981	91	74,028	97,892	68,367
1982	89	56,207	82,418	62,466
1983	96	71,654	91,916	65,383
1984	96	79,977	98,481	69,012
1985	107	82,073	109,860	76,698
1986	94	71,654	93,986	66,840

Table 3. Pheasant release and harvest information from licensed game bird clubs in California Zone B (parts of the state with few if any wild pheasants), 1970-1986 (copied from Hart 1990).

Year	Number	Acres	Pheasants Released	Pheasants Bagged
1970	79	72,714	209,903	152,936
1971	84	77,213	226,480	175,506
1972	88	83,868	220,766	167,992
1973	82	76,431	203,636	158,178
1974	75	73,002	195,072	148,523
1975	94	60,311	177,395	139,101
1976	64	68,076	170,778	136,263
1977	57	56,762	162,675	128,960
1978	52	53,240	160,196	128,065
1979	52	52,995	155,748	143,897
1980	51	47,318	168,369	133,403
1981	52	54,083	165,711	132,569
1982	54	55,839	169,394	136,232
1983	53	45,730	175,582	141,188
1984	46	37,770	199,173	162,319
1985	58	45,193	176,677	152,384
1986	51	47,644	169,943	142,316

Table 4. Number and area of Licensed Game Bird Clubs in California, 1992-1993

Zone	Number of Clubs	Acreage
A	103	67,209
B	58	59,692
total	161	126,901

Region	Number of Clubs	Acreage
North	8	8,492
North Central	105	76,237
Bay Delta	27	25,087
Central	11	7,468
South Coast	10	9,617
total	161	126,901

Table 5. Pheasant release and harvest information on licensed game bird clubs in California, 2001-2013.

Year	Zone	Season Total Released	Season Total Harvested	% Harvested/ Released	Season Total Hunters	Avg. Harvest/Hunter
2001	A	111732	79434	71.09	33999	2.34
	B	213710	172737	80.83	79250	2.18
2002	A	97452	69872	71.70	30678	2.28
	B	208456	166090	79.68	75628	2.20
2003	A	113760	81237	71.41	33611	2.42
	B	189764	152622	80.43	53867	2.83
2004	A	108991	77291	70.92	27952	2.77
	B	197844	158325	80.03	55673	2.84
2005	A	59008	41886	70.98	20560	2.04
	B	164707	80210	48.70	40929	1.96
2006	A	95085	67898	71.41	21878	3.10
	B	156371	122872	78.58	31607	3.89
2007	A	4098	2559	62.45	6619	0.39
	B	104931	84426	80.46	22255	3.79
2008	A	54720	37085	67.77	18075	2.05
	B	136887	106345	77.69	30987	3.43
2009	A	38701	27987	72.32	14222	1.97
	B	123974	97610	78.73	30257	3.23
2010	A	19679	13003	66.08	2012	6.46
	B	90478	92258	101.97	135839	0.68
2011	A	34892	23626	67.71	11861	1.99
	B	128001	102644	80.91	26203	3.92
2012	A	27215	17524	64.39	9412	1.86
	B	98682	79270	80.33	21245	3.73
2013	A					
	B					

Table 6. Percent wild birds, sex ratios of pheasants taken on licensed pheasant clubs in California Zone A (parts of state with wild pheasants), 1947-1967 and comparisons of zone A and B clubs (copied from Hart 1990).

Year	Birds Planted	% of Planted Birds Taken	Banded Bag	Wild Bag	Total Bag	% Wild Bag	Wild Bag/ 1,000 Acres
1947	7,208	14.8	1,068	2,799	3,867	72.3	107.6
1948	13,761	16.3	2,256	7,624	10,080	75.6	156.6
1949	20,720	12.0	2,493	9,021	11,514	78.3	206.0
1950	26,105	16.5	4,324	9,118	13,442	67.8	229.7
1951	32,127	21.1	6,809	12,038	18,847	63.8	234.0
1952	35,721	N/A	N/A	N/A	24,204	N/A	N/A
1953	39,668	34.3	13,624	13,077	26,701	48.7	216.8
1954	43,731	35.5	15,539	13,735	29,274	46.9	219.2
1955	49,765	35.5	17,714	13,812	31,526	43.8	190.4
1956	57,964	38.9	22,576	15,966	38,542	41.4	196.5
1957	62,000	43.6	27,069	16,133	43,202	37.3	191.4
1958	65,767	42.8	28,172	17,556	45,728	38.3	197.7
1959	70,553	45.5	32,146	16,118	48,264	33.3	164.0
1960	80,200	46.0	36,900	17,892	54,792	32.6	172.8
1961	89,233	47.1	42,103	20,864	62,967	33.1	194.3
1962	96,936	52.5	50,233	15,943	66,176	24.0	143.1
1963	115,160	51.1	58,935	22,893	81,828	27.9	189.3
1964	123,391	53.1	65,554	21,452	86,996	24.7	178.2
1965	97,774	50.3	49,134	19,276	68,410	28.2	167.5
1966	96,160	50.3	48,378	18,061	66,439	27.2	155.0
1967	98,638	51.2	50,462	18,097	68,559	26.4	161.7

Year	% Cocks	% Hens
1952	40.3	59.7
1953	41.7	58.3
1954	44.3	55.7
1955	37.9	62.1
1956	44.1	55.9
1957	45.9	54.1
1958	44.3	55.7
1959	41.3	58.7
1960	42.4	57.6
Average	42.5	57.5

	Number	Acres	Days Hunted	Pheasants Released	Pheasants Bagged
Zone A					
1956	87	81,221	19,225	57,964	38,542
1970	124	112,047	37,932	100,292	68,074
Zone B					
1956	18	14,966	6,036	30,601	15,868
1970	79	72,714	73,166	209,903	152,936

Appendix 1. Annual Game Take Survey form.

STEP 1 **PLEASE COMPLETE FORM AS FULLY AS POSSIBLE, THANK YOU.**

Age: [ ] **Gender** *(circle one)* Male / Female

Did you purchase a XXXX-XXXX CA Hunting License? *(circle one)* Yes / No

STEP 2 **I Did Not Hunt in CA** ☐

If you **DID NOT HUNT** in *California* from **FEB. 1, XXXX to Jan. 31 XXXX, Check the ABOVE box** and return survey. There is no need to complete steps 3 & 4.

STEP 3 Using the **Species & County Codes** provided, please indicate in the boxes below all **Species** you hunted, the number of **Days** hunted, the **County** hunted in, & the number of each species **Bagged.**

EXAMPLE: *If you hunted **wild pheasant** for **four days** in **Yolo County** and **bagged six** your entry would look like this:*

I	**I**			**4**	**5**	**7**			**6**

SPECIES		DAYS HUNTED			COUNTY HUNTED		BAG		

STEP 4 **WAS THIS YOUR FIRST YEAR HUNTING?** *(circle one)* Yes / No

SPECIES CODES

AA	DEER	MM	CALIFORNIA (VALLEY) QUAIL	ZZ	WILD TURKEY-*Harvested on LGBC**
BB	BEAR	NN	MOUNTAIN QUAIL	GH	MARMOT
CC	WILD PIG	OO	GAMBEL'S (DESERT) QUAIL	PQ	JACKRABBIT
DD	DUCKS	PP	MOURNING DOVE-*September season*	QR	COTTONTAIL RABBIT
EE	GEESE: DARK	QQ	MOUNRING DOVE-*Nov./Dec. season*	RS	TREE SQUIRREL
FF	GEESE: WHITE	RR	WHITE-WINGED DOVE	ST	GRAY FOX-Do not included trapped animals
GG	COMMON SNIPE	ED	EURASIAN COLLARED-DOVE	TU	RACCOON-Do not included trapped animals
HH	COOT/MOORHEN	SS	BAND-TAILED PIGEON-*Northern Zone*	UV	BADGER-Do not included trapped animals
II	PHEASANT-*Excluding LGBC**	TT	BAND-TAILED PIGEON-*Southern Zone*	VR	COYOTE-Do not included trapped animals
JJ	PHEASANT-*Harvested on LGBC**	UU	SOOTY (BLUE) GROUSE	WX	BOBCAT-Do not included trapped animals
KK	CHUKAR-*Excluding LGBC**	VV	RUFFED GROUSE		
LL	CHUKAR-*Harvested on LGBC**	WW	WHITE-TAILED PTARMIGAN		
XY	AMERICAN CROW	XX	WILD TURKEY-*Spring, Excluding LGBC**		
LM	OTHER (write species in species box)	YY	WILD TURKEY-*Fall, Excluding LGBC**		**LGBC: Licensed Game Bird Clubs are clubs that release pen-reared birds.*

COUNTY CODES

1.	Alameda	12.	Humboldt	23.	Mendocino	34.	Sacramento	45.	Shasta	56.	Ventura
2.	Alpine	13.	Imperial	24.	Merced	35.	San Benito	46.	Sierra	57.	Yolo
3.	Amador	14.	Inyo	25.	Modoc	36.	San Bernardino	47.	Siskiyou	58.	Yuba
4.	Butte	15.	Kern	26.	Mono	37.	San Diego	48.	Solano	99.	Unknown
5.	Calaveras	16.	Kings	27.	Monterey	38.	San Francisco	49.	Sonoma		
6.	Colusa	17.	Lake	28.	Napa	39.	San Joaquin	50.	Stanislaus		
7.	Contra Costa	18.	Lassen	29.	Nevada	40.	San Luis Obispo	51.	Sutter		
8.	Del Norte	19.	Los Angeles	30.	Orange	41.	San Mateo	52.	Tehama		
9.	El Dorado	20.	Madera	31.	Placer	42.	Santa Barbara	53.	Trinity		
10.	Fresno	21.	Marin	32.	Plumas	43.	Santa Clara	54.	Tulare		
11.	Glenn	22.	Mariposa	33.	Riverside	44.	Santa Cruz	55.	Tuolumne		

Appendix 2. Species list of common and scientific names by Class.

Class	Common Name	Scientific Name
Aves	**Red-tailed Hawk**	*Buteo jamaicensis*
	Coopers Hawk	*Accipiter cooperii*
	Sharp-shinned Hawk	*Accipiter striatus*
	Northern Harrier	*Circus cyaneus*
	Golden Eagle	*Aquila chrysaetos*
	Bald Eagle	*Haliaeetus leucocephalus*
	Great Horned Owl	*Bubo virginianus*
	Barn Owl	*Tyto alba*
	Short-eared Owl	*Asio flammeus*
	Ring-necked Pheasant	*Phasianus colchicus*
	Wild Turkey	*Meleagris gallopavo*
	California Quail	*Callipepla californica*
	Mourning Dove	*Zenaida macroura*
	American Crow	*Corvus brachyrhynchos*
	Common Raven	*Corvus corax*
Mammalia	**Striped skunk**	*Mephitis mephitis*
	Spotted Skunk	*Spilogale gracilis*
	Opossum	*Didelphis virginiana*
	Coyote	*Canis latrans*
	Red Fox	*Vulpes vulpes*
	Gray Fox	*Urocyon cinereoargenteus*
	Badger	*Taxidea taxus*
	Bobcat	*Lynx rufus*
	Mink	*Mustela sp.*
	Weasel	*Mustela sp.*
	Ground Squirrel	*Spermophilus sp.*
	Rat	*Rattus sp.*
Insecta	**Honey Bee**	*Apis mellifera*