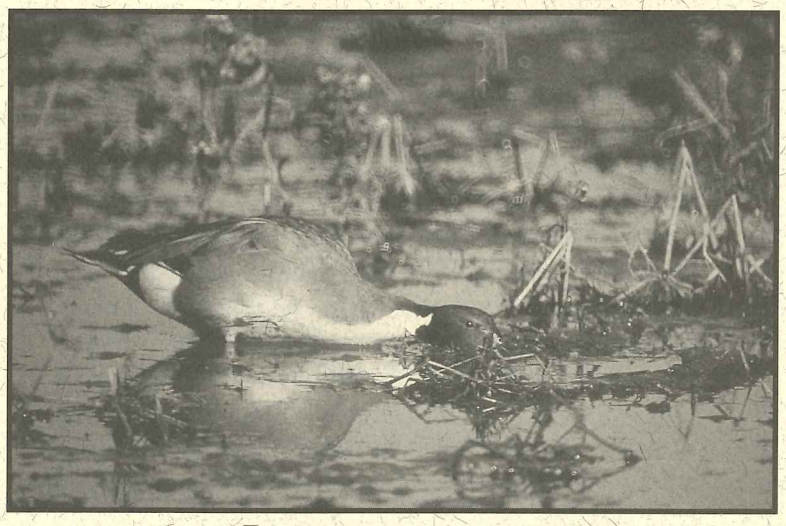
Valley Habitats

A Technical Guidance Series for Private Land Managers in California's Central Valley

WILDLIFE RESOURCES OF THE CENTRAL VALLEY, CALIFORNIA: THE NORTHERN PINTAIL

Number 13

The Northern Pintail (Anas acuta), or "Sprig," is the most abundant duck in California during winter, despite considerable population declines that began in the late 1970s. Considered to be the king of ducks by most California hunters, the Pintail's relatively large size, abundance, beauty, and culinary qualities are often cited. Pintails are elegantly colored ducks, slim in silouhette, and fast on the wing. Inherently wary, hunters know that Sprig come reluctantly to decoys and are taken most often while passing over the blind, rarely coming in with wings set and feet down. This natural wariness probably accounts for this species' relatively high annual survival rates, as determined by analyses of banding information, and large winter populations in California, despite years of poor production of young ducks during the long drought of the 1980s. As we enter the mid-1990s, there is cause for hope that the long drought is over for North America's Pintails.



Male Pintail feeding.

POPULATION STATUS AND HARVEST

The Pintail is one of the most abundant waterfowl species in North America, but the continental population has been subject to major fluctuations since formal breeding surveys began in the mid-1950s (Fig. 1). High populations existed in the 1950s and 1970s and record low numbers occurred during extensive prairie drought in the 1960s and mid-1980s to early 1990s. Winter population estimates for 1955-1995 ranged from 660,000 to 4 million in the Pacific Flyway (80% in California) compared with 260,000 to 1.8 million in the Central Flyway, 250,000 to 1.4 million in the Mississippi Flyway, 34,000-450,000 in the Atlantic Flyway, and 200,000-1.2 million in Mexico. These estimates vary widely, largely because fog and other adverse weather often limit aerial survey coverage. The proportion of North America's Pintails wintering in the Pacific Flyway seems to vary with the size of the continental population. For example, in the 1970s and early 1980s, a period of large continental populations, 65% of North America's wintering Pintails were recorded in the Pacific Flyway. In contrast, only 48% wintered in the Pacific flyway during the drought and low populations of the late 1980s and early 1990s.

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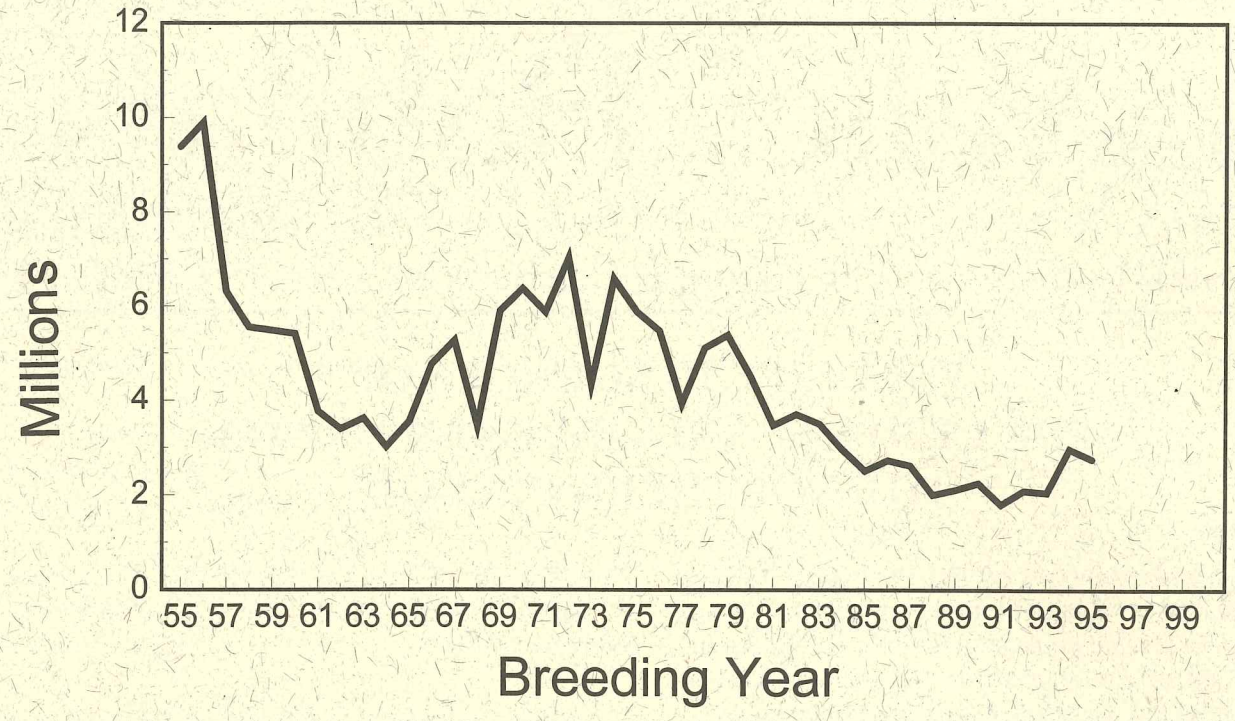

Figure 1. Annual breeding population indices for Northern Pintails in North America.

Pintail populations seem to be regulated not by harvest, but primarily by the rate at which young ducks are recruited into the fall population and, ultimately, the nesting population. This recruitment is influenced by interrelated factors, including predator populations, weather, farming practices, and habitat quality. The fragmented agricultural landscape in which breeding Pintails find themselves during the nesting seasons of the 1990s is not conducive to successful production or high survival of nesting hens. Not only have Pintails been forced to nest in smaller habitat tracts, but red fox, raccoon, striped skunk, and other hen and egg predators have increased in abundance as larger predators, such as the prairie wolf and coyote, have been eliminated or reduced. In addition, farming activities destroy thousands of nests in stubble fields that were once native prairie or other quality upland nesting cover. The end result is a decline in hen survival and fledging of young Pintails.

Banding studies and winter telemetry work demonstrate that annual and winter survival of adults is high relative to other species, and that hunting has minimal effect on the size of the continental population. With the very restrictive bag limits and season lengths in place until 1995, harvest rates for adult females (the percent of continental population of Pintails shot each year) were less than 3%, and less than 10% of annual mortality was attributable to hunting. However, harvest rates vary greatly among local or regional hunting areas, and because Pintails are very traditional where they winter, over-hunting could deplete local populations.

Survival Rates -- The recorded maximum longevity for Pintails in the wild is 21 years 4 months for a California-banded adult male. Annual survival rates based on leg-band recoveries of Pintails banded in late summer in the Klamath Basin, Southeast Alberta, and Southern Saskatchewan range up to 81%, depending on age and sex class - high rates compared to other duck species. Adults survive at a higher rate than immatures, and males have higher survival rates than do hens, because the latter are faced with severe predation losses during nesting. Telemetry studies indicate that winter survival of Pintails is high in the Sacramento Valley and the West Coast of Mexico, but lower in the San Joaquin Valley and the Suisun Marsh of California, and in Louisiana. Differential survival resulted from relative differences in the importance of hunting and natural mortality among regions.

Mortality -- Nesting hens and ducklings are very vulnerable to mammalian predators, especially red fox, mink, and coyote. Pintails are more vulnerable than most other species of ducks to predation by red fox, because Pintails nest early in the spring and often in sparse cover. For example, in a recent study, red foxes killed an estimated 16,000 Pintails (75% hens), or roughly 15% of all hens in a 13,500 km^2 area, in one year in the Dakotas. In winter, Bald Eagles, Peregrine Falcons, Northern Harriers, and Red-tailed Hawks take adults, as do certain mammalian predators. Pintails often nest in wheat stubble fields in Canada, and these nests are plowed under during preparation for spring planting.

Diseases kill thousands of Pintails each winter in California (See Valley Habitats No. 12). The two most important of these are avian cholera and avian botulism, both endemic and persistent problems in most winter habitats in the Central Valley and Klamath Basin. Botulism also affects Pintails in several fall migration areas in Canada. Tens of thousands of Pintails have perished in early fall botulism outbreaks in the Central Valley in the past, and cholera seems to take a steady toll every winter. Cholera is a relatively recent and increasing problem for Pintails.

THE NESTING SEASON

Distribution -- Pintails are found throughout the Northern Hemisphere during the breeding season. Because of this wide distribution, and the regular intermixing of populations via the pioneering nature of the species, (e.g., many Pintails that nest in Siberia winter in California), there is only a single race of Pintails worldwide. Major breeding populations occur in North America, Europe, Asia, and Russia. In North America, Pintails nest throughout Alaska, the Yukon and Northwest Territories and other northern "bush" regions, south to the mid-latitudes including most of California, the Great Basin, and the Northern Great Plains in the U.S. and Canada (Prairie Pothole Region) (Fig. 2). California's wintering Pintails are derived mainly from Alaska, southern Alberta and Saskatchewan, eastern Montana, and the Great Basin states. Pintail populations are high when the Prairie Pothole Region is wet, especially the unbroken grasslands of southeast Alberta, southwest Saskatchewan, the Dakotas, and northcentral Montana. During drought periods in the prairies, such as occurred during the 1980s, Pintail overfly the prairies and spend the summer in Alaska. Production of young ducks is low there because many hens simply do not nest. In normal or wet years, about 25% of the continent's Pintails summers in Alaska, but this increases to more than 50% during prairie drought.

Nesting Habitats -- Pintails destined to spend the fall and winter in California use a variety of nesting habitats depending upon the region. In Alaska, Pintails nest on wet sedge or grass meadows, slough and river banks, pond shores, and in tidal habitats. In the Prairie Pothole Region, pairs use shallow temporary to semi-permanent wetlands and low upland cover. Nests often are located far from water, and can be found primarily in upland fields, along roadsides or fence rows, and in pastures. When wet, the vast grasslands of southeast Alberta and southwest Saskatchewan are favored habitats from which a large share of California-bound Pintails are produced. This area consists of native and irrigated prairie and shallow natural and constructed wetlands. Ducks Unlimited Canada has been active in this area using irrigation water to create pair and brood ponds that favor Pintails. In California, nesting Pintails have been found in high densities on the small grassy islands of Lower Klamath National Wildlife Refuge (NWR) on the Oregon-California border, in upland habitats of Suisun Marsh, and in the Grasslands of the San Joaquin Valley. When Tulare Lake floods after heavy winter snows in the southern Sierra, many Pintails remain to nest in that region. Almost no Pintails nest in the Sacramento Valley.

In Alaska, adults and their young use large brackish to moderately alkaline marshes with submerged aquatic vegetation. On the prairies, and in California, broods are most likely to be found in seasonal and semipermanent wetlands with emergent cover, such as cattail and bulrush. In all instances, brood water must be very productive, with abundant invertebrate and seed food resources, and well-provided with emergent escape cover.

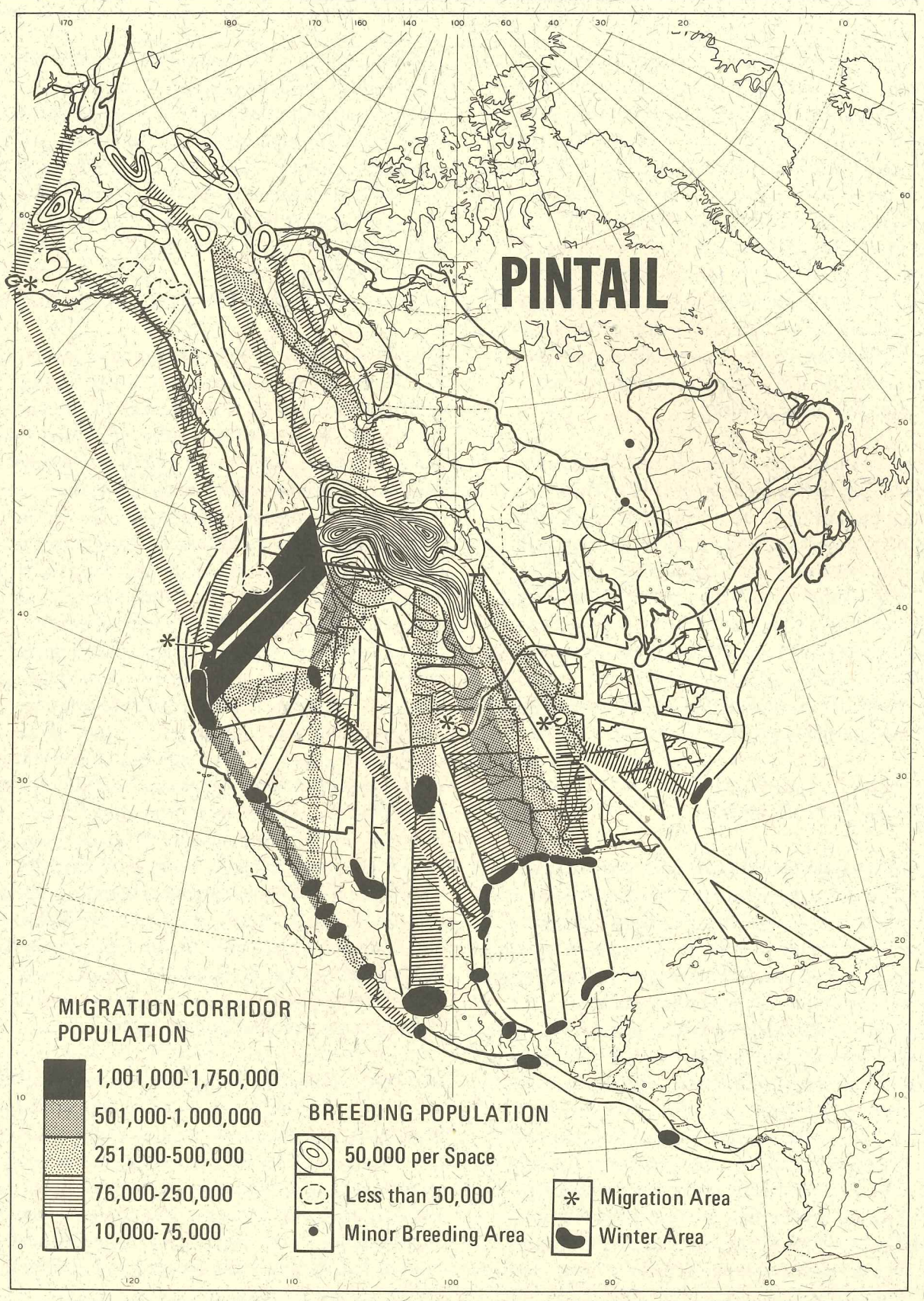

Figure 2. Pintail nesting and wintering regions, and migration corridors in North America (From Bellrose 1980 - See suggested reading).

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Nesting Season Food Habits -- Invertebrate and other high protein foods are particularly important to nesting hens throughout the Pintail's range, with up to 75% of the diet made up of various animals, including midge larvae, snails, crustacea and earthworms. Pintails nesting in Alaska require a larger proportion of plant material in their diet, about 70%, than do prairie-nesting birds. Ducklings feed on insect larvae, snails, and crustacea almost exclusively during the first couple of weeks. Later, more plant material, mainly seeds of various marsh plants, are included in the diet. California-nesting Pintails are assumed to have a diet dominated by invertebrates, but little direct information is available. Ducklings, too, depend upon invertebrate foods for rapid growth and feather development. Brood ponds must be rich in these resources.

Nesting Behavior/Activities -- Pintails allocate their time to several functions during the nesting season, whether in Alaska, the Canadian prairies, or in California. Nesting hens spend 25% of their time feeding after arrival in nesting regions. Feeding increases to 40% of the time during the prelaying and egg laying periods, and 60% of the time during incubation breaks. This food provides energy and nutrients to produce the eggs for clutches; the size of clutches increases with increased quantity and quality of food available to nesting hens. Females feed more often than their mates, but males spend more time alert, looking for predators and other Pintails. Pintail males spend a good amount of time chasing other females away from areas that their mates frequent. These chase flights result in wide spacing of nesting pairs. As nesting proceeds, social interactions between the male and female decline markedly, and males begin to migrate to marshes to molt, often at considerable distances from the nesting region.

Nesting Phenology -- Pairs begin to form in early winter, and virtually all females are paired well before the nesting season. For example, in California, 55% are paired by mid-November and 96% by mid-February. Pintails arrive to nest in northeastern California in March. In southern Alberta, Pintails migrating from California arrive between March 22 and April 1. Pintails arrive in the Northwest Territories and Alaska from April 30 to 15 May. Timing of arrival is highly dependent upon weather and habitat conditions.

Pintails begin to nest during the first two weeks of April each year over a wide area of North America, including the Prairie Pothole Region, the Great Basin, northeastern California. In most years, Pintails are among the first ducks to nest, but early nesting is subject to weather delays. Pintails will nest later when springtime temperatures are low. In wet years, they will nest over an extended period, because increased availabilty of food for egg production allows unsuccessful hens to try several attempts at nesting.

Home Range -- Nesting Pintails do not defend territorial boundaries, but males do chase other females from a small area around their mate while they are in attendace at waiting areas during egg laying and early incubation. Home ranges of pairs extend over 1,200 acres.

Fidelity to Nesting Range -- Pintails will return to former nesting areas if habitat conditions are stable. Typically, however, being adapted to the arid grassland regions, this species roams over wide areas and sets up housekeeping where suitable water conditions are located. Biologists generally believe that it is the hen that leads her mate to the nesting region.

Nest Site -- Pintail nests consist of a simple bowl of grasses or other vegetative materials from around the nest. The pair may use old burrows or natural depressions, and the completed nest may be flush with or below ground level. Pintails characteristically nest in more open sites with less vegetative cover than do other upland-nesting ducks, but may also nest in small patches of brush or dense cover. Pintails will nest on recently burned land, in stubble fields, native pastures and grasslands, and in annual weeds. In northern California, the Lower Klamth NWR is host to several hundred pairs of Pintails each year, and many of these nest on the many small grassy islands in the shallow wetlands. At Suisun Marsh, Pintails nest in the upland fields along with Mallards (Anas platyrhynchos), and on brushed levees.

Eggs, Clutch Size, and Incubation -- One egg is laid per day in the early morning. Pintail eggs are pale olive green in color. Average clutch size seems to be smaller than for other North American ducks: 6.9 eggs in prairie grasslands, 7.0 in Colorado, 7.5 in Alaska, 7.8 in Utah and California, and 8.0 in prairie parklands in Canada. Adults lay larger clutches than do yearlings, and first nests have larger clutches than subsequent renests. Pintails incubate their clutch for 22-24 days, beginning when the last egg is laid. All eggs hatch within 24 hours of each other, and the young stay in the nest for about 24 hours after all have hatched before the hen leads them to water. Pintail hens incubate through the night, but take two short breaks to forage or preen during the day after first covering the eggs with down.

Nest and Hen Success -- The proportion of nests in which at least one egg hatches is called nest success. Nest success varies from only 3% to more than 50% over the breeding range of Pintails, depending on weather, predator populations, and habitat. Over a wide area of the intensively farmed area of the Canadian prairies, nest success averaged only 7% (0-31%) in a recent investigation. Predation accounted for 70% of nest losses, and 17% of nests in grain stubble were lost to agricultural tillage. However, in unbroken grassland habitats of southern Alberta and Saskatchewan, Pintail nest success was higher (64%). In California, nest success has ranged from 28% in the Central Valley to 37% in northeastern plateaus.

The proportion of hens which, sometime during the breeding season, successfully incubate a clutch until the eggs hatch is called hen success. This is a function of nest success and the number of times a hen will nest again after early nesting attempts fail. Hen success must be estimated using marked populations and has not been directly measured for Pintails..

Brood Care and Dispersal of Flighted Young -- The hen attends the brood for 4-6 weeks after hatching, and hens perform elaborate distraction displays to lead predators away from their broods. Hens abandon the brood when they are capable of flight. Males rarely accompany hens with broods; nearly all males leave before the eggs even hatch. The activities, movements, and dispersal patterns of flighted young are not well known, but band recoveries of Pintails banded as "locals" give some clues for dispersal. Ducklings banded in the Dakotas, Minnesota, and Manitoba usually are recovered in the area where banded. Ducklings banded in Alaska, Alberta, and Saskatchewan largely are recovered in the Pacific Flyway, particularly California. Young Pintails banded at Los Banos Wildlife Area (WA) in the Grasslands and at Gray Lodge WA in the Sacramento Valley were recovered largely in California. Some young were found to move north into Idaho, Alberta, and British Columbia after being banded in the fall in California.

FALL AND SPRING MIGRATION

Extensive leg-banding studies since the early 1900s have documented the twice annual migrations between nesting and wintering regions. Banding has indentified fall migration stopover areas as well. One of the most important is the Klamath Basin in northeast California and southern Oregon.

Fall Migration -- The most important fall migration routes to California are from Alaska and the Canadian prairies to the Klamath Basin and the Central Valley, many via the marshes surrounding the Great Salt Lake (Fig. 2). Many Pintails probably migrate directly over the ocean to California from the Alaskan Penninsula. In contrast to a commonly held view, few Pintails that migrate to the Central Valley go farther south into Mexico. Radio-telemetry studies show that Sacramento Valley wintering Pintails, once they arrive in the fall, rarely go farther south, most not even into the Delta or San Joaquin Valley. Only about 5% of the females radio-tagged in fall in the San Joaquin Valley went to Southern California or Mexico, although the percentage was greater when early season habitat was reduced and for birds captured in the Tulare Basin. Most Pintails that migrate to Mexico seem to be from a population moving south on the east side of the Sierras, many stopping in the Salton Sea region on the way. More than 80% of Alaska-banded Pintails migrate to Pacific Flyway wintering areas in fall, most to California. Two-thirds of Alberta-banded and 50% of Saskatchewan-banded Pintails migrate to California.

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Pintails are one of the first ducks to migrate south in the fall, and many can be observed on Sacramento and San Joaquin Valley WAs and NWRs as early as the first week of August. Many people think these early migrants are juveniles because of their generally brown coloration However, nearly all are adult males in "eclipse" plumage. During the next couple of months, molt is active as the drakes take on their bright nuptial plumage. As fall progresses, females and the current year's young fly south and join the drakes in the wintering regions. By late October, a good mix of each age and sex are present in California. The early fall migration of Pintails demonstrates that weather plays little role in early movements. Pintails present in the Klamath Basin in late fall migrate en masse to the Central Valley when freezing weather settles over that area, usually in November.

Fall Migration Habitat -- In the fall, large numbers of Pintails that ultimately will find their way to California for the winter, stage at Mills Lake in the Northwest Territories. Thousands of Pintails have been banded at this location over the years and many recoveries occur in California. Pintails arriving in California in late summer-early fall can be found using managed moist-soil wetlands on refuges, wildlife areas, and duck clubs in the Central Valley, and managed semi-permanent wetlands and seasonally flooded marshes and grain fields in northeastern California. Especially important in the Central Valley are open units with dense swamp timothy and emergent units with watergrass. Brackish wetlands are used in San Francisco Bay, Suisun Marsh, and other, smaller, coastal bays.

Spring Migration -- Spring migration begins early for Pintails. They begin to leave the Central Valley in February and, by the end of March, most have departed. Principal spring staging areas include the Klamath Basin, especially Tule Lake and Lower Klamath NWRs and eastern Oregon, Central Montana, and Puget Sound. Spring migration tends to be slower than fall migration, because the "snow line" is changeable and many birds probably retrace their paths when spring storms bring snow and freezing temperatures. A variable, but relatively small number of Pintails that winter in California, primarily southern California, migrate north to the nesting grounds via the Central Flyway, undertaking what has become known as a "round robin migration."

Spring Migration Habitat -- In spring, Pintails migrating from California use the large marshes in northeastern California, especially Lower Klamath NWR, as well as the high desert marshes of eastern Oregon. In the Northwest Territories of Canada, Pintails use extensive wetlands and open bays of Great Slave Lake. Migrating Pintails use river lowlands, deltas, wetlands, and flooded or puddled agricultural fields throughout the Pacific Flyway for foraging and resting.

Food Habits During Migration -- In fall, Pintails staging in Alaska prior to migration to California, consume a diet dominated by plant matter, especially sedge achenes; clams are also important at that time. Sago pondweed and wigeongrass are important to Pintails in Utah's Bear River marshes in fall, and in the Klamath Basin, red goosefoot seeds, alkali bulrush seeds, and invertebrates dominate foods consumed from marshes. Pintails also consume waste barley seeds in harvested fields surrounding Lower Klamath and Tule Lake NWRs. During spring migration, Pintails probably consume waste grains from harvested fields, invertebrates from small snowmelt ponds, and seeds from marsh plants and weeds.

THE WINTERING PERIOD

Winter Range of Pintails -- The winter range of Pintails is relatively narrow compared with the wide distribution of breeding ducks. In North America, the primary wintering regions are associated with the East, West, and Gulf Coasts. California winters more Pintails than any other state, and most are found in the Central Valley. Large numbers are present in Texas, Louisiana, and Arkansas in the midcontinent region, and in South Carolina on the Atlantic Coast, and on the West Coast of Mexico. In California, the Central Valley, San Francisco Bay, and the Delta of the Sacramento and San Joaquin Rivers are the prinicipal wintering regions. In the Pacific Northwest, the Columbia River estuary, Willamette Valley, Central Washington, and the Skagit River Delta in Puget Sound are critical wintering grounds. In Mexico, the

bays and agricultural lands on the West Coast are the most heavily used wintering habitats. Banding studies show a high fidelity to these wintering regions, more so than to nesting areas. Thus, status of wetlands and agricultural lands in wintering regions plays a direct role in continental health of Pintail populations.

Winter Habitats -- In California, Pintails wintering inland use a wide variety of shallowfreshwater habitats provided by NWRs, state WAs, and private duck clubs, most of which are characterized by large shallow marshes with minimal emergent cover. Whether in the Butte Sink or Colusa Trough in the Sacramento Valley, the Sacramento-San Joaquin Delta, or in the Grasslands of the San Joaquin Valley, Pintails favor the wide open spaces of large, shallow, and open wetlands and flooded grain fields. The majority of favored Pintail habitat is privately owned, either as duck clubs or agricultural fields. Pintails rely on flooded agricultural habitats, especially rice, wheat, and corn, in the Central Valley and Delta to supply needed food throughout the winter. Pintails forage extensively in dry grain fields during fall and winter in the Klamath Basin of Northeast California. Coastal winter habitats include salt ponds, tidal flats, open bays, and diked freshwater wetlands surrounding San Francisco Bay and other major bays from Humboldt to San Diego. The brackish, managed wetlands of the Suisun Marsh provide critical fall and winter habitat for Pintails in the greater San Francisco Bay-Delta area.

Winter Food Habits -- Winter foods in California are dominated by marsh seeds from managed wetlands and waste grains in harvested rice, wheat, and corn (Central Valley), waste barley (Klamath Basin), and native marsh seeds (Suisun Marsh and other coastal areas). October through March, the diet is more than 95% vegetative, primarily seeds. Invertebrates are important throughout winter in the San Joaquin Valley, but are present in the diet of Sacramento Valley Pintails in large amounts only during fall and late winter-spring. Midge (Chironomidae) larvae are the most important invertebrate food during the wintering period. Important marsh seeds include swamp timothy (Heleochloa schenoides), watergrass (Echinochloa crusgalli), flatsedges (Cyperus spp.), and smartweeds (Polygonum spp.) throughout the Central Valley, and fat hen (Atriplex patula), alkali bulrush (Scirpus robustus), and brass buttons (Cotula coronipofolia) in Suisun Marsh.

Winter Behavior/Activities -- Winter activity varys depending on wintering region, but in California, specifically the Sacramento Valley, Pintails spend a large share of the day foraging in marshes in early fall and winter, but increasingly rely on night feeding in flooded rice fields as fall progresses. In the San Joaquin Valley, night feeding occurs in marshlands because agricultural foods, largely, are not used. Wintering hens spend more time feeding and resting than males do, but males swim and court more often than females do. Courting and formation of pairs begin in October, but peak in December and January when courtship flights can be seen throughout the Central Valley.

Winter activities by large groups of Pintails include local flights between roosting and night time feeding locations and long range interregional shifts between various basins. For example, telemetry studies in the Central Valley show that sanctuaries provided by federal refuges and state wildlife areas provide day time roosting sites. At night, Pintails leave these roosts to feed in other wetland areas or in flooded or dry rice or corn fields, returning to the roosts before sunrise. Storms, fog, and wind all distrupt this pattern, dispersing Pintails over a wider area.

Interregional movements of Pintails vary by winter location (Fig. 3). For example, from 1987-89, adult female Pintails were radio-tagged in the Sacramento Valley at Sacramento and Delevan NWRs. The birds were trapped in August and early September, fitted with a radio, released, and monitored daily through mid March each year. The data revealed that these birds rarely if ever left the Sacramento Valley (defined as north of Interstate 80) during the entire winter. The small percentage that did leave, did so in December, and stayed in the nearby Delta and Suisun Marsh for an average of only 16 days before returning to the Sacramento Valley. Thus, once Pintails arrive in the Sacramento Valley, they tend to spend most of their time there - all winter. In contrast, two other studies, one in which Pintails were radio-tagged in Suisun Marsh and the other in which Pintails were marked throughout the San Joaquin Valley (the Grasslands, Mendota WA and Tulare Basin), showed that these

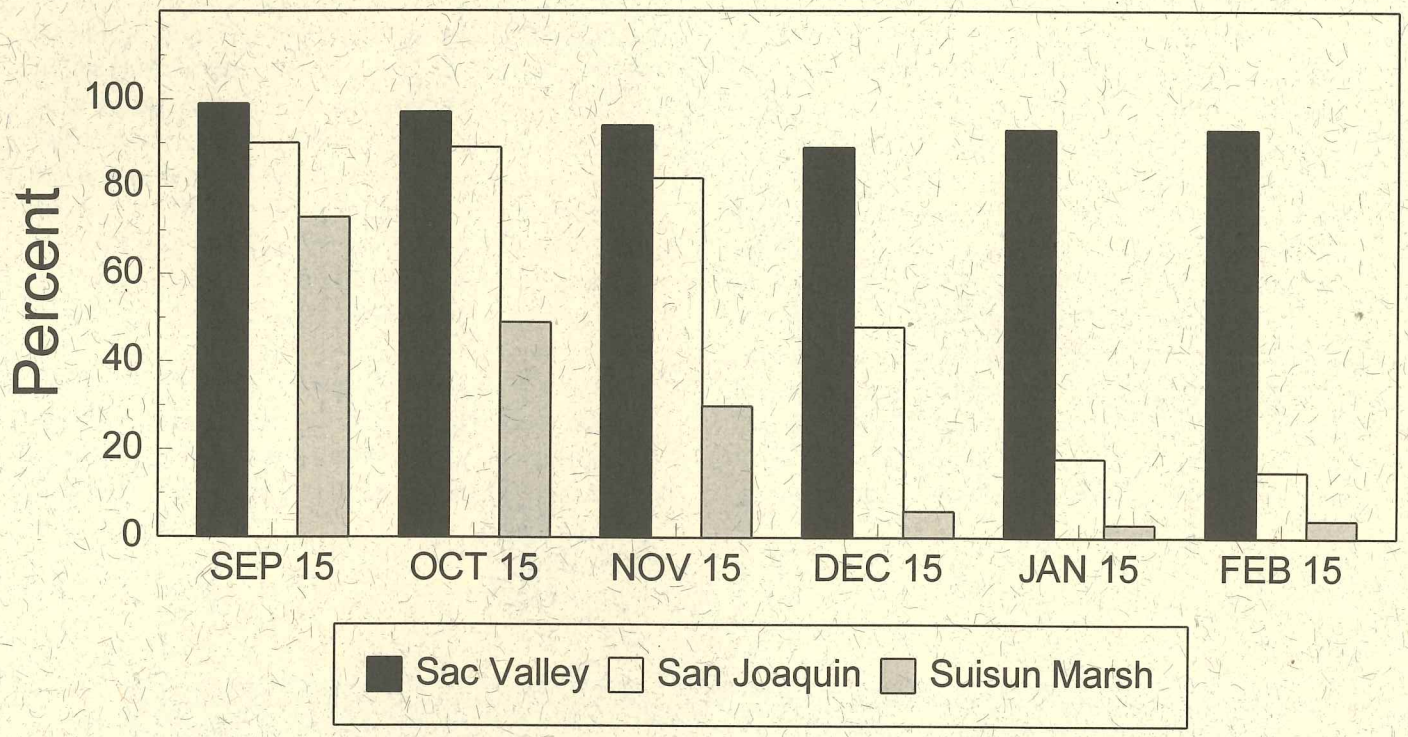


Figure 3. Seasonal distribution (percentage) of all female Pintails radio-tagged in the Sacramento Valley, San Joaquin Valley, and Suisun Marsh.

Pintails were far less attached to their region of marking. Suisun-tagged pintails, almost immediately, began to drift to the east into the flooded wheat fields of the Delta, and some into the Sacramento Valley. By the end of December each of two years, virtually all the of the Suisun-tagged Pintails had moved to the Sacramento Valley. Similarly, Pintails radio-tagged in early fall in the San Joaquin Valley moved to the Delta and Sacramento Valley by late December and January each of three years. Thus, the Sacramento Valley receives Pintails from wintering areas farther south and must provide food and habitat for these birds, as well as for the Pintails that have been there the entire winter. The importance of Sacramento Valley wetlands and agricultural habitats, especially rice, cannot be overestimated. We do not know whether these movements are historical, or result from food shortages in the regions of origin. Fig. 4 shows typical winter-time movements of individual female pintails radio-tagged in the Sacramento Valley, San Joaquin Valley, and Suisun Marsh.

CONSERVATION AND FUTURE STUDIES

Conservation of Pintails in California and the Pacific Flyway depends upon full implementation of the objectives of the Central Valley Habitat Joint Venture, including restoration and perpetual protection of managed marshlands in the Central Valley and acquisition of full water allotments to refuges, wildlife areas, and duck clubs as detailed in the Central Valley Project Improvement Act. Habitat efforts of the Pacific Coast Joint Venture and the Intermountain West Joint Venture also will contribute to Pintail conservation. Private duck clubs and public areas need to continue to provide wetland habitats preferred by Pintails, specifically, open, shallow marshes with abundant food supplies. Pintails are more vulnerable than most species to prairie droughts and future low continental populations will require abundant, productive winter habitats to help sustain Pintail populations until water returns to the prairies.

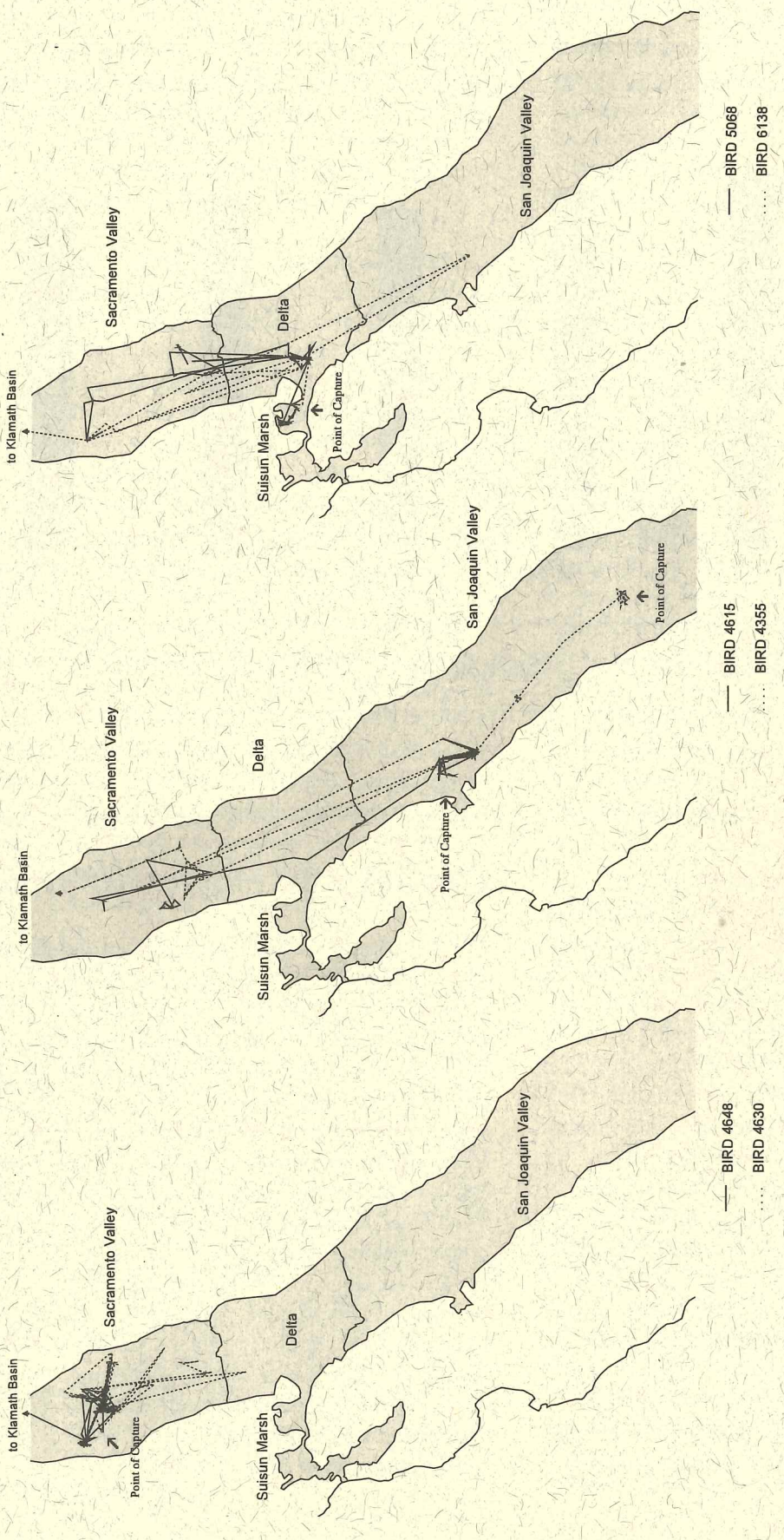
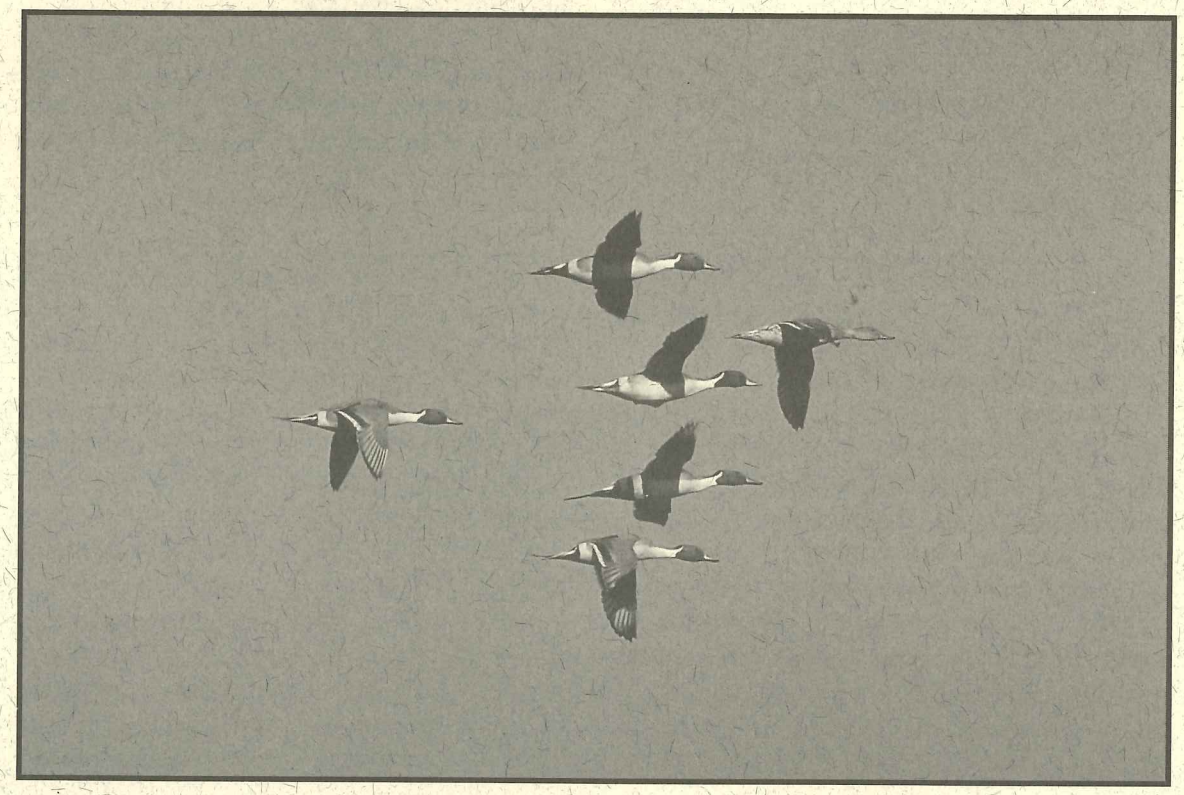


Figure 4. Regional movements of individual female Pintails radio-tagged in the Sacramento Vlley (4a), San Joaquin Valley (4b), and Suisun Marsh (4c).

Pintails are managed as one continental population by the U.S. Fish and Wildlife Service. This strategy overlooks possibly important interregional differences in population size, mortality, and productivity. Long-term nesting studies over a variety of geographic areas would allow for estimation of geographic variation in recruitment rates. Large scale telemetry work is needed to delineate the relationship between nesting and ultimate wintering areas. Habitat management techniques need to be developed to enhance nesting effort, nest success, and recruitment.

On wintering areas, such as California, information is needed on the response of wintering populations to provision of restored wetland habitats and flooded agricultural habitats, and to increasing urbanization of agricultural and native habitats due to human population growth. Food habits information is needed for spring staging areas, and on the significance of competition with other waterfowl species for wetland and agricultural food resources. We need to better understand daily energy expenditure during winter to estimate the quantity of food and habitat required to support winter populations. We need to know if body condition during winter affects reproductive success the following spring. The relationships between harvest, natural mortality, and annual and winter survival are still not well understood. The introduction of cotton to the Sacramento Valley is cause for concern because of the potential for conflict with rice production, and hence, the availability of rice for consumption by wintering Pintails.



One female Pintail pursued by five male Pintail in courtship flight.

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