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SPRING MIGRATION AND SUMMER DESTINATIONS OF NORTHERN PINTAILS FROM THE COAST OF SOUTHERN CALIFORNIA

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Abstract—To examine pathways, timing, and destinations during migration in spring, we attached satellite-monitored transmitters (platform transmitting terminals) to 10 northern pintails (*Anas acuta*) during February 2001, at Point Mugu, Ventura County, California. This is a wintering area on the southern coast of California. We obtained locations from five adult males and three adult females every 3rd day through August. Average date of departure from the wintering area was 15 March (*SE* = 3 days). We documented extended stopovers of ≥30 days for several northern pintails that could have accommodated nesting attempts (San Joaquin Valley, southwestern Montana, southern Alberta, north-central Nevada) or post-nesting molt (eastern Oregon, south-central Saskatchewan, northern Alaska, central Alberta). Wintering northern pintails from the southern coast of California used a wide range of routes, nesting areas, and schedules during migration in spring, which was consistent with the larger, wintering population in the Central Valley of California. Therefore, conservation of habitat that is targeted at stopover, nesting, and molting areas will benefit survival and management of both wintering populations.

Resumen—Para examinar las rutas, fenología, y destinos de la migración primaveral, sujetamos transmisores monitoreados por satélites (platform transmitting terminals, PTTs) a 10 patos golondrinos (*Anas acuta*) durante febrero del 2001 en Punta Mugu, condado de Ventura, California. Esta es un área invernal en la costa sureña de California. Obtuvimos las ubicaciones de cinco adultos machos y tres adultos hembras cada tercer día hasta finales de agosto. La fecha promedio de partida del área invernal fue el 15 de marzo (*SE* = 3 días). Documentamos paradas prolongadas de ≥30 días para varios patos golondrinos que pudieron acomodar intentos de anidación (valle del río San Joaquín, suroeste de Montana, sur de Alberta, centro-norte de Nevada) o muda de plumaje pos-anidación (este de Oregón, centro-sur de Saskatchewan, norte de Alaska, centro de Alberta). Los patos golondrinos invernantes de la costa del sur de California usaron una amplia gama de rutas, áreas de anidación, y horarios durante la migración en la primavera, que es consistente con la población más grande en el Valle Central de California. Por consiguiente, la conservación del hábitat orientada en las áreas de paradas, anidación y muda de plumaje beneficiará la supervivencia y el manejo de ambas poblaciones invernantes.

Recent studies of northern pintails (*Anas acuta*) in North America have described broad patterns of migration in spring, which biologically link wintering, migrational, and nesting regions. These studies used satellite-monitored telemetry to track migration from the Central Valley of California (Miller et al., 2005), the playa lakes and Gulf coast regions of Texas (Haukos et al., 2006), the Rio Grande Valley of New Mexico (Haukos et al., 2006), and several Atlantic coastal states (R. Malecki et al., in litt.). These areas support 75% of all wintering northern pintails in North America, with the largest numbers in the Central Valley (ca. 1–1,500,000), but several thousand spend winters in bays and wetlands along the Pacific coast including coastal southern California (Bellrose, 1980). Little is known of their routes, locations of stopovers, nesting destinations, and rates of travel during migration in spring. Such information would allow an assessment of how their seasonal migrations fit into the broader patterns of the larger population, especially that in the Central Valley.

The breeding population of northern pintails in North America has declined since the 1970s (United States Fish and Wildlife Service, in litt.), primarily reflecting long-term reductions in recruitment in important nesting regions (Miller and Duncan, 1999). However, recruitment could be affected by conditions of habitats that are encountered during winter and the spring migration (Raveling and Heitmeyer, 1989). Changes in landscapes at stopover areas in spring could eliminate foods that support reproduction (Krapu, 1974; Mann and Sedinger, 1993; Esler and Grand, 1994), thereby suppressing recruitment (Raveling and Heitmeyer, 1989) and altering migrational routes over the long term (Farmer and Wiens, 1998). Therefore, conservation of habitats in these areas is critical to long-term viability of populations.

Johnson and Grier (1988) concluded that 60% of migrating northern pintails in North America pass through northwestern Montana and southern Alberta during spring or proceed directly to far-northern breeding grounds. This conclusion generally was supported for northern pintails in the Central Valley (Miller et al., 2005). Our purpose was to examine the migration of northern pintails wintering on the southern coast of California to learn if they follow this broad pattern in spring. We used satellite-monitored telemetry to document routes, stopover regions, potential nesting and molting regions, and timing of migration in spring.

Materials and Methods—We captured northern pintails along the southern coast of California at Point Mugu, Ventura County. This was a wetland consisting of a lagoon, several managed wetlands, and the adjacent Point Mugu Navy Base (34°02′N, 119°08′W). Point Mugu is part of the coastal zone of southern California that is counted during the survey of waterfowl in midwinter to track trends in wintering populations, and several hundred to 2,000 northern pintails have been counted there annually (January) since the mid-1990s, including 300 in 2001, when our study was conducted (M. Wolder, in litt.). The broader study area included the Central Valley (Sacramento Valley in the north, San Joaquin Valley in the south, and Sacramento-San Joaquin Delta in between), the edge of the Great Basin in south-central Oregon and northeastern California (Miller et al., 2005), several other western states, North Dakota, southern and northern Canada, and Alaska.

We used a baited rocket-net and a swim-in funnel trap (Schemnitz, 1994) to capture northern pintails on the duck club at Ventura County Game Preserve at Point Mugu during 18–20 February 2001. We caught nine adult males and five adult females (Carney, 1992). We completed captures ca. 3 weeks prior to departure in spring, which allowed northern pintails time to adjust to their transmitters (Cox and Afton, 1998). We transported captured northern pintails in poultry crates to the headquarters of the duck club, where we attached satellite-monitored transmitters (platform transmitting terminals, PTT) to five females and five randomly chosen males. All ducks weighed ≥840 g, a benchmark established in earlier studies (Miller et al., 2005; Haukos et al., 2006). Average body mass ($\pm SE$) was 1,000 ± 10 g ($n = 5$; range 920–1,060 g) for males and 900 ± 10 g ($n = 5$; range 840–1,000 g) for females.

We fit each duck with a Model 100 PTT (Microwave Telemetry, Columbia, Maryland) that weighed 26 g (including harness and protective neoprene pad). PTTs were 2.5–2.8% of body mass of males and 2.6–3.1% for females (Caccamise and Hedin, 1985; Green et al., 2002). Each unit was 54 by 18 by 17 mm, included a 216-mm-long, nylon-coated, flexible-stranded, stainless-steel antenna protruding at a 45° angle from the back, and displayed contact information of the investigator. We attached each PTT dorsally between the wings with a harness made of 0.38-cm-wide Teflon ribbon (Bally Ribbon Mills, Bally, Pennsylvania; Miller et al., 2005). The completed harness included breast and body loops connected with a 2-3-cm strand along the keel with knots hardened with cyanoacrylate glue, and without metal clips or buckles (Malecki et al., 2001). We released the ducks as a group at ca. 1600 h at the site of capture. All ducks flew together back into the wetlands, suggesting a good likelihood of subsequent normal behavior (Cox and Afton, 1998). The Animal Care and Use Committees of the United States Geological Survey Western Ecological Research Center (approved 2 February 2000) and Humboldt State University (document 00/01.W.58.A) approved all procedures for capturing, handling, and marking animals.

We acquired data from satellites to monitor movements of northern pintails, in which polar-orbiting environmental satellites (NOAA) monitored signals from the PTTs and re-transmitted data to Argos, Inc., and to the data-collection system in Landover, Maryland (Argos, Inc., http://www.argos-system.org/). Personnel at Argos, Inc., calculated locations from the Doppler shift in transmission-frequency received by satellites as they approached and then moved away from the PTTs. All PTTs used the same ultra-high frequency (401.65 Mhz), but had individually assigned identification numbers. We programmed duty cycles so that life span of PTTs would last through the early post-nesting period (31 August). The basic 3-day duty cycle consisted of a repeating sequence of 6-h transmission periods, when the satellite recorded locations, followed by 72-h inactive periods. After mid-June, we used a 6-day duty cycle to conserve battery power. The PTT sensors recorded temperature of the unit, voltage of the battery, and motion of the bird, so that we could identify mortalities (Malecki et al., 2001) and differentiate between sedentary and flying ducks. We received raw data for locations of ducks via daily e-mails, which usually included >1 useable location/bird/transmission-day.

Personnel at Argos, Inc., estimated accuracy of each location (location-class). For location-class 3, 2, 1, and 0, in which ≥4 transmissions (messages) were received by the satellite, Argos, Inc., rated accuracy as <150, 150–350, 350–1,000, and >1,000 m, respectively. Accuracy was not provided for location-class A (three messages were received), location-class B (two messages were received), and location-class Z (latitude and longitude was provided if >1 message was received), but was assumed to be less on average (Miller et al., 2005). Personnel at Argos, Inc., automatically tested the plausibility of locations by using four checks: error of the estimate of the location, continuity of the frequency of transmission, distance from the previous location, and velocity between these locations. The number of these checks that supported the particular location as correct (0–4) yielded a nonparametric index, the number of positive plausibility checks (Argos, Inc., in litt.).

For a given location-class, Argos, Inc., expressed accuracy as the probability that 67% of locations would be within stated limits. Therefore, high-quality locations could have been inaccurate, while those of poor quality might have been accurate (Britten et al., 1999; Hatch et al., 2000; Hays et al., 2001). To account for this, we used a filtering program (United States Geological Survey, http://alaska.usgs.gov/science/biology/spatial/douglas.html) that retained the one location that best represented each northern pintail during each day of transmission, the selected location (Miller et al., 2005). This program incorporated acceptable distances between consecutive locations, velocities, and bearings between consecutive-movement vectors to reduce errors. We used our biological knowledge to manually select from filtered locations to determine selected locations for the final dataset. For example, we usually chose locations with location-class 3, 2, or 1, and locations where several locations of similar accuracy occurred in a cluster. We favored locations closest to the previous or subsequently selected locations or both (redundancy; Petersen et al., 1999), the one with the largest index for number of positive plausibility checks (Butler et al., 1998) and number of messages (Hatch et al., 2000), and the central one in homogeneous habitats (Petersen et al., 1999). For positions in heterogeneous landscapes, we favored the location most biologically plausible (Ely et al., 1997). We considered locations of poor quality (location-class Z and B) only if verified by redundancy (Petersen et al., 1999).

We could not determine if ducks with PTTs that remained at one site (defined as a limited geographic area used by northern pintails) for an extended time, actually attempted to nest or underwent a flightless period associated with molt of wing feathers (Austin and Miller, 1995). Therefore, we conservatively categorized restricted movements at a given site for ≥30 days during respective nesting and molting periods as such attempts (Miller et al., 1992, 2005).

We used Arc/Info version 9.3 and Arcview version 9.3 GIS software (Environmental Systems Research Institute, Redlands, California) to analyze and plot selected locations (decimal degrees of latitude and longitude) to delineate routes of migration on 1:1,000,000-scale digital charts of the Western Hemisphere. We define a stopover area as a site used for ≥1 selected locations before again moving northward. A region of use is a large geographic area, usually a portion of a state or province. We defined dates of departure from any given site as the median date between the last selected location at the previous site and the first selected location at the new site. We estimated dates of arrival similarly, but if the gap between sequential dates was >10 days, we did not calculate dates of departure or arrival (Martell et al., 2001). Migration, as opposed to a local movement, is defined as a move northward from a stopover in winter or spring without return. We estimated efficiency of collection of data with a day index (number of days on which we received ≥1 useable selected location divided by the potential number of days on which a location could have been received; Miller et al., 2005), and a location index (total number of locations obtained divided by total hours of transmission; Harris et al., 1990).

Results—We censored two females for which we lost contact within 1 day after their release. We lost contact with male 12888 and female 12894 on 2 and 3 May, respectively (Table 1). Four transmitters (male 12889, male 12892, female 12893, and female 12896) reached or exceeded the end of their programmed life span of 31 August. The remaining two northern pintails transmitted until 23 June (male 12887) or 9 July (male 12891). Hunters shot and reported three males with PTTs from 3 weeks to >3 months after we lost contact with the birds (Table 1).

We received a total of 1,257 locations during February–August, from which we obtained 264 useable locations. Additionally, we obtained another 76 locations yielding 25 useable locations during 1 September to mid-October. Collection of data encompassed 284 transmission-days (days when a transmitted location was expected) and 1,704 transmission hours (transmission-days times 6 h/transmission) through August. We received 4.66 locations/bird/day (days with ≥1 locations), with an average day index of 93.0% and an average location index of 0.78 locations/h of transmission.

Northern pintails remained in the vicinity of Point Mugu 10–35 days after attachment of

TABLE 1—Platform-transmitting-terminal (PTT) number and sex, body mass at time of capture, date of departure, and subsequent northern regional locations and inclusive Julian dates of northern pintails (*Anas acuta*) after being fitted with satellite transmitters at Point Mugu, Ventura County, California, February 2001.

PTT	Sex	Mass (g)	Date of departure	Regions used after departure from Point Mugu (inclusive Julian dates)							Fate of northern pintail
				Region 1	Region 2	Region 3	Region 4	Region 5	Region 6	Region 7	
12887	Male	1,040	1 March	Northeastern California (60–87)	Southwestern Montana (88–91)	Southern Alberta (92–119)	Central Alberta (119–122)	Northern Alberta (123–146)[a]	—	—	No contact > Julian date 174[b]
12888	Male	1,020	11 March	Central Nevada (70–120)	Southern Idaho (121–122)	—	—	—	—	—	No contact > Julian date 122
12889	Male	990	11 March	Central Utah (70–81)	Southern Idaho (81–98)	Northwestern Montana (99–105)	Southern Alberta (106–133)	Northwest Territories. (134–172)	Northern Yukon (172–187)	Northern Alaska (188–249)[a]	No contact > Julian date 279[c]
12891	Male	920	16 March	Sacramento-San Joaquin Delta (75–90)	Suisun Marsh (90–115)	Sacramento Valley (116–119)	Northeastern California (119–150)	Southern Oregon (150–156)	Northeastern California (156–190)	—	No contact > Julian date 190[d]
12892	Male	1,060	26 March	Morro Bay (85–112)	Eastern Sacramento-San Joaquin Delta (113–119)	Sacramento Valley (119–133)	Eastern Washington (133–136)	Southern Alberta (137–200)	Central Alberta (201–233)	—	No contact > Julian date 233
12893	Female	1,000	26 March	San Joaquin Valley (85–123)	Sacramento Valley (124–171)	Central Oregon (172–200)	Southeastern Oregon (201–233)[a]	—	—	—	No contact > Julian date 251
12894	Female	840	17 March	San Joaquin Valley (76–117)	Sacramento-San Joaquin Delta (118–123)	—	—	—	—	—	No contact > Julian date 123
12896	Female	850	14 March	San Joaquin Valley (73–130)	Southeastern Oregon (130–162)	Southwestern Washington (162–169)	Northwestern Montana (170–200)	Southwestern Saskatchewan (201–263)	Southeastern Saskatchewan (264–271)	Northwestern North Dakota (272–286)	No contact > Julian date 286

[a] Does not include any more-southerly locations used after reaching northernmost region, because the moves would be considered as autumn migration, hence the break in Julian dates between the last region and when contact was lost.
[b] Shot near Brooks, Alberta, Canada, on 3 October 2001.
[c] Shot on a private club near Lake Perris, California, in mid-November 2001.
[d] Shot on a private club southwest of Ogden, Utah, on 28 November 2001.

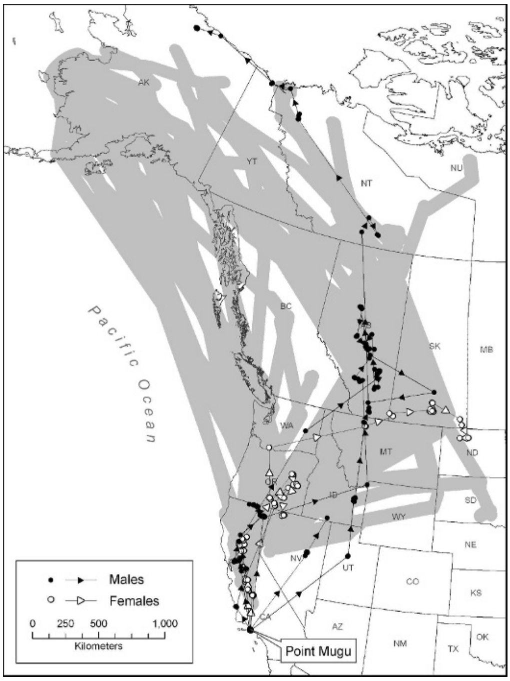

FIG. 1—Spring migratory paths of adult male and female northern pintails (*Anas acuta*) with satellite-monitored transmitters attached to them at Point Mugu,Ventura County, California, in February 2001. Gray shading indicates the generalized paths of migration in spring 2001 from the Central Valley of California (from Miller et al., 2005).

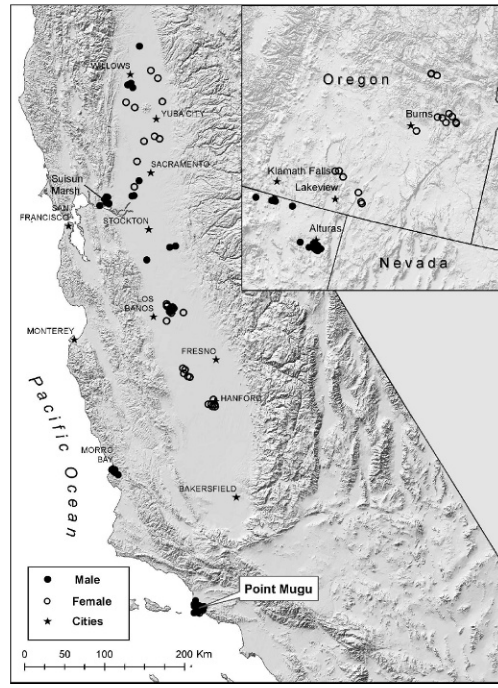

FIG. 2—Locations used in the Central Valley of California, northeastern California, and southeastern Oregon by adult male and female northern pintails (*Anas acuta*) with satellite-monitored transmitters attached to them at Point Mugu, Ventura County, California, in February 2001.

PTTs, moving among Mugu Lagoon, ponds at the duck club, and the Pacific Ocean for various lengths of time prior to departure. After departure, males and females tended to use different migratory pathways (Fig. 1). All three females first moved to the San Joaquin Valley (Table 1). They used areas near Hanford, southeast of the Mendota Wildlife Area, and then Merced National Wildlife Refuge (Fig. 2). Female 12894 then moved to the Sacramento-San Joaquin River Delta where the PTT failed. Female 12893 moved to the Sacramento Valley, where it used a variety of public and private wetland areas, then migrated to central Oregon in the John Day River Valley and southeastern Oregon at Malheur National Wildlife Refuge (Fig. 2). The third female (12896) moved from the San Joaquin Valley to southeastern Oregon, using Warner Valley, Malheur National Wildlife Refuge, Lake Abert, and Chewaucan Marsh. This female later moved to the Columbia Basin in eastern Washington, northwestern Montana at Lake Francis, southern Saskatchewan near Cypress Lake, Moose Jaw, Old Wives Lake, and Estevan, and finally south to northwestern North Dakota near Souris National Wildlife Refuge (Fig. 1).

In contrast to the females, no male moved to the San Joaquin Valley directly from Point Mugu. In fact, three of the five males bypassed the Central Valley entirely, arriving first in either northeastern California at Modoc National Wildlife Refuge (12887), north-central Nevada in Huntington and Newark valleys (12888), or north-central Utah at Utah Lake (12889; Figs. 1 and 2; Table 1). The male (12887) at Modoc National Wildlife Refuge moved to Hebgen Lake in southwestern Montana and southern Alberta near Calgary, then it continued north to Camrose southeast of Edmonton and Utikima Lake in northern Alberta. The male (12888) from Nevada moved north to the Snake River in southern Idaho near Burley, where we lost contact. The male (12889) from Utah also migrated to the Snake River, at Idaho Falls, and north to Market Lake, then to northwestern Montana near Cutbank and southern Alberta in the Milk River Ridge area, continuing on to the Great Slave Lake region and the McKenzie River Delta in the Northwest Territories, the northern coast of Yukon, and the National Petroleum Reserve on the North Slope of Alaska (Fig. 1). The fourth male (12891) migrated from Point Mugu to the Sacramento-San Joaquin Delta (Stone Lakes National Wildlife Refuge), Suisun Marsh, the northern Sacramento Valley, and northeastern California (Modoc National Wildlife Refuge). It remained in south-central Oregon and northeastern California using Modoc National Wildlife Refuge, Lower Klamath National Wildlife Refuge, Clear Lake National Wildlife Refuge, and Butte Valley Wildlife Area in northeastern California, and White Line Reservoir in southern Oregon. The fifth male (12892) moved north from Point Mugu to Morro Bay on the southern coast, then inland to Woodward Reservoir just east of the Sacramento-San Joaquin Delta, the Sacramento Valley (Sacramento National Wildlife Refuge), eastern Washington (Sylvan Lake), and southern Alberta near Hanna. This male used the Marion Lake, Sullivan Lake, and Forster Reservoir areas northwest and south of Hanna before moving to the Wakomoa Lake area north of Edmonton.

Northern pintails with PTTs began to migrate from Point Mugu on 1 March, and the average date of departure was 15 March (Julian date = 74, $SE = 3$ days, range = Julian date 60–85, 90% confidence limits = Julian date 69, 79). There was no correlation between date of departure and body mass at time of capture ($r = 0.02$, $df = 6$, $P > 0.1$). Northern pintails migrated along many routes on different schedules (Fig. 3). No female with a PTT moved together with a male that had a PTT. As birds left Point Mugu, individuals began appearing in the San Joaquin Valley, Sacramento-San Joaquin Delta, south-central Oregon, and northeastern California, Idaho, Nevada, Utah, and western Montana almost simultaneously. Individual birds arrived in the Prairie Pothole Region from 2 April (male 12887) to 20 July (female 12896), and in Alaska on 7 July (male 12889; Table 1).

Length of stay in several regions suggested that northern pintails might have made nesting attempts or remained to molt. Female 12893 spent 33 days (20 July–21 August) at Malheur

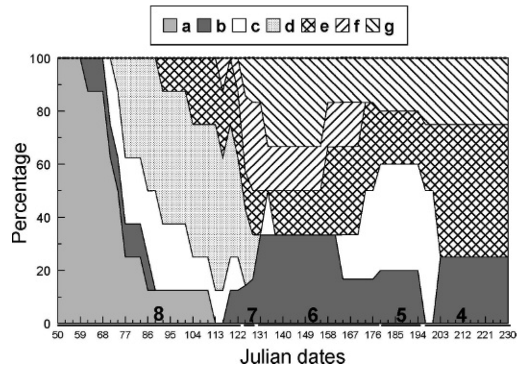

FIG. 3—Percentage of regional distribution at 3-day intervals during February to mid-August 2001 of adult male and female northern pintails (*Anas acuta*) with satellite-monitored transmitters attached to them at Point Mugu, Ventura County, California, in February 2001: a) Point Mugu; b) southern Oregon, northwestern Nevada, northeastern California; c) Intermountain West; d) San Joaquin Valley-Sacramento-San Joaquin Delta-Suisun Marsh; e) Prairie Pothole Region (southern Alberta and Saskatchewan, North Dakota); f) Sacramento Valley; g) Alaska and northern Canada (Northwest Territories, Yukon, northern Alberta). Numbers over horizontal lines are size of samples, and the lines span the dates to which they apply.

National Wildlife Refuge, a period that would coincide with the flightless period. Female 12894 spent 42 days at or near Merced National Wildlife Refuge in the San Joaquin Valley (17 March–27 April), and female 12896 spent 55 days at Merced National Wildlife Refuge (17 March–10 May), both periods corresponding to the local nesting season. Later, female 12896 spent 31 days at Lake Francis in southwestern Montana (19 June–19 July) and 46 days near Old Wives Lake in Saskatchewan (6 August–20 September). The former period could have been a late nesting attempt, and either period could have coincided with molt. Male 12887 spent 28 days (2–29 April) in southern Alberta near Calgary that could have represented a nesting attempt by its mate. Male 12888 spent 51 days (11 March–30 April) in Newark Valley in northern Nevada that could have been associated with a nesting attempt. Male 12889 spent 28 days in southern Alberta in the vicinity of Milk River Ridge (16 April–13 May) and 25 days on the McKenzie Delta in northern Yukon (28 May–21 June) that could have represented nesting attempts. This male subsequently spent 61 days on the North Slope of Alaska (7 July–5 September), during which it likely molted. Male 12892 may have been associated with a nesting attempt in southern Alberta during 17 March–19 July (63 days) and a molting period in central Alberta north of Edmonton during 20 July–22 August (34 days).

Discussion—Our sample of northern pintails was relatively small, but was similar to, or larger than, samples used in a 2-year study to track migration in spring from Texas (playa lakes, n = 7/year; Gulf Coast, n = 2 or 3/year) and New Mexico (Rio Grande Valley: n = 2 or 9/year; Haukos et al., 2006). Although increased size of samples could improve knowledge of variability (Miller et al., 2005), because of traditional migratory behavior in waterfowl (Bellrose, 1980), our smaller sample likely was adequate to describe the basic migratory routes.

Body mass of northern pintails at the time of capture was similar to that of other recent studies using satellite-monitored telemetry (Miller et al., 2005; Haukos et al., 2006), and efficiency in collection of data was consistent with previous studies. The 4.66 locations/day we received compared favorably with the 5.19 received by Miller et al. (2005) during their study in the Sacramento Valley. Similarly, the day index was >93% of potential days of transmission, slightly less than obtained by Miller et al. (2005; 96%), and the location index of 0.78, equaled the highest value reported by Harris et al. (1990), but was less than the 1.04 reported by Miller et al. (2005).

Males and females took divergent routes from Point Mugu. Likely, this resulted from our relatively small sample contributing to what was probably a chance occurrence. Nonetheless, northern pintails from the coast of southern California used an inland pattern of migration closely following that of northern pintails in the Central Valley during 2001 (Fig. 1; Miller et al., 2005). Therefore, it is likely that northern pintails on the southern coast contribute to the general pathways of migration from California. For example, three of the four northern pintails from Point Mugu that migrated through southern Canada arrived first in southern Alberta, similar to the 69% of ducks from the Sacramento Valley, and the fourth northern pintail from Point Mugu arrived first in southwestern Saskatchewan, similar to the 27% of northern pintails in the Sacramento Valley. These data support the assertions of Johnson and Grier (1988), who concluded that most western populations of northern pintails entered Canada through northwestern Montana and southern Alberta. In contrast, those from Texas and New Mexico entered southern Canada almost exclusively in southern Saskatchewan (Haukos et al., 2006). Some northern pintails from the coast of southern California joined populations that were wintering in the Central Valley in March, prior to, and during, their northward departure and used similar migratory pathways. Northern pintails from the Central Valley routinely used south-central Oregon and northeastern California as a first stop (>85%; Miller et al., 2005), but only three of eight northern pintails from Point Mugu did so. However, some could have departed from Point Mugu and joined the population in the Central Valley prior to our capturing ducks in late February, thereby, underestimating use of south-central Oregon and northeastern California.

Prior to our work, the only study of marked northern pintails on the southern coast of California consisted of those leg-banded at Point Mugu prior to the hunting season in 1958 (813 banded, 93 recovered in the hunting season following banding in California; W. C. Rienecker, in litt.). Excluding 67 direct recoveries (72% of total) that occurred on the southern coast of California, one (3.8%) of the remaining 26 occurred on the northern coast of California, three (11.5%) in the Sacramento Valley, 13 (50%) in the Sacramento-San Joaquin Delta region, and nine (34.6%) in the San Joaquin Valley. Six of eight northern pintails with PTTs used the San Joaquin Valley, Sacramento-San Joaquin Delta, or northeastern California as first stopovers. Recoveries of bands showed that ca. 28% (26 of the 93 direct recoveries) moved there during the hunting season. Both of these datasets demonstrate the close association between northern pintails on the coast of southern California and in the Central Valley.

Most northern pintails in North America nest in Alaska, northern Canada, or the Prairie Pothole Region (Bellrose, 1980; Austin and Miller, 1995). At least three males and one female migrated to these areas, and early loss of PTTs on one male and one female indicated this probably underestimates movements of northern pintails from the southern coast to northern nesting regions. However, the three females with PTTs first migrated to the San Joaquin Valley where northern pintails are known to nest (Anderson, 1956). On the basis of their extended stay in the region, at least two females may have attempted nesting. In contrast, males did not stop in the San Joaquin Valley. Although male 12892 and female 12893 spent time in the Sacramento Valley, northern pintails are not known to nest there (Anderson, 1957). Other likely nesting regions for mates of males with PTTs would have been Suisun Marsh, where significant nesting occurs (D. Laughman, in litt.), north-central Nevada at the edge of the nesting range (Bellrose, 1980; Austin and Miller, 1995), and southern Alberta in the Prairie Pothole Region (Bellrose, 1980; Austin and Miller, 1995). Size of the wintering population on the southern coast of California could vary with condition of wetlands in these regions (Smith, 1970), which demonstrates the potential for cross-seasonal effects of winter and condition of migratory habitats on recruitment in nesting regions. Northern pintails, mostly adult males and unsuccessful females, often make extended migrations to molt, whereas successful females tend to molt near their brood-rearing areas (Bellrose, 1980). Some important molting areas are central and southern Saskatchewan, the MacKenzie Delta, and the North Slope of Alaska (Austin and Miller, 1995), but areas in the western states are used as well (Bellrose, 1980). Females from Point Mugu likely attempted to molt at Malheur National Wildlife Refuge and in southern Saskatchewan, and males did so in central Alberta and on the North Slope of Alaska.

The first northern pintail to leave Point Mugu departed on 1 March, 1 month later than the first one to leave the Central Valley in 2001 (Miller et al., 2005). On average, northern pintails departed from Point Mugu on 15 March, or 1 week later than those in the Sacramento Valley (8 March, Julian date 67, $SE = 2$, range = 34–89, 90% confidence limits = Julian date 64–70; Miller et al., 2005). The asynchronous pattern of migration by northern pintails from the southern coast of California from one region to another was consistent with the diverse rates of migration in the Central Valley (Miller et al., 2005), and confirms the diversity of destinations in the nesting region, as shown by migratory pathways.

Date of departure from Point Mugu did not correlate with body mass at time of capture, which is consistent with northern pintails studied in the Central Valley (Miller et al., 2005), Texas, and New Mexico (Haukos et al., 2006). Mallards (*Anas platyrhynchos*) also migrated independent of condition (body mass divided by wing chord), but late-molting mallards migrated later than those molting earlier (Dugger, 1997). Adult female northern pintails undergo prebasic molt during winter in the Central Valley (Miller, 1986), and we suspect that this occurs in populations on the coast of southern California. Therefore, molt could control departure from Point Mugu, but we did not determine status of molt in our birds.

Northern pintails migrate from the coast of southern California following a diverse array of routes on asynchronous time schedules. This is particularly noteworthy given the relatively small wintering population in the region, and could complicate conservation measures to target the population. However, northern pintails from the southern coast comingle with the larger population in the Central Valley and likely are linked to the same nesting regions, although some from the southern coast likely nest in the San Joaquin Valley as well. Therefore, conservation of wetland habitats in the Central Valley and those associated with stopovers during migration in spring and more-northern traditional nesting areas important to the larger population (Miller and Duncan, 1999) will benefit the wintering population on the coast of southern California.

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