

# Biogeographical Profiles of Shorebird Migration in Midcontinental North America

Biological Science Report  
USGS/BRD/BSR--2000-0003

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December 1999

By  
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Robert G. Waltermire  
M. Beth Dillon

Prepared in cooperation with Prairie Pothole Joint Venture

U.S. Department of the Interior  
U.S. Geological Survey

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## Introduction

Transcontinental shorebird migrants are dependent upon dynamic freshwater wetlands throughout the interior of North America for stopover resources. Because of the tremendous energy demands of these long distance migratory flights, stopover habitats and resources for rest and refueling are critical to the survival and successful reproduction of this group of birds. Management of dispersed and dynamic wetland habitats for the conservation of en route shorebird migrants is a challenge that requires a broadly integrated approach across many geographic regions.

Thirty-seven species of shorebirds commonly cross the interior plains of North America during spring and fall migrations. Population sizes of several of these species are believed to be declining, including black-bellied plover (*Pluvialis squatarola*), mountain plover (*Charadrius montanus*), whimbrel (*Numenius phaeopus*), sanderling (*Calidris alba*), semipalmated sandpiper (*C. pusilla*), least sandpiper (*C. minutilla*), stilt sandpiper (*C. himantopus*), and short-billed dowitcher (*Limnodromus griseus*) (Howe et al. 1989; Knopf 1994; Morrison et al. 1994); there is growing concern about the status of these species.

Different areas in the midcontinent appear to host very different assemblages of shorebirds (Skagen and Knopf 1993; Skagen 1997). The biogeographic

information described here will help identify the uniqueness of different regions of the plains to migrating shorebirds. Although shorebirds migrating along Atlantic and Pacific coastal areas are capable of long jumps between refueling stops, within the midcontinent region, the intermountain west, and the Pacific coast, some species move short, rather than long, distances between refueling sites (Skagen and Knopf 1994b; Iverson et al. 1996; Warnock and Bishop 1998). Maps of distribution patterns and chronology accounts can lend insight towards understanding migration strategies of the different shorebird species.

This report presents general distribution patterns of en route migrants that refuel in interior wetlands during migration. We provide information on the spatial and temporal occurrence and habitat requirements for individual species and groups of species with the intent that this information is used in guiding management efforts. We report general locations where shorebirds have been known to occur, whether regularly or occasionally, and do not suggest that individual sites are used by shorebirds every year. Yearly variation in numbers of shorebirds at specific sites is often great because shorebirds in the midcontinent respond quickly to changing habitat conditions (Skagen and Knopf 1994a; Warnock et al. 1998). The results of this project can be viewed on the Internet via the home page of the Midcontinent Ecological Science Center (MESC),

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Biological Resources Division, U.S. Geological Survey (BRD/USGS). The URL for this shorebird mapping project is:

<http://www.mesc.usgs.gov/shorebirds>

## Study Area and Methods

Our focal area ranges across three provinces in Canada (Alberta, Saskatchewan, and Manitoba) and 18 states of the United States (Montana, Wyoming, Nevada, Utah, Colorado, Arizona, New Mexico, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Texas, Minnesota, Iowa, Missouri, Arkansas, and Louisiana).

### *The Database*

We acquired shorebird survey and observational data from many sources (Table 1) in response to our requests (via letters, telephone, and e-mail). Major contributors included the International Shorebird Survey (Brian Harrington, Manomet Center for Conservation Sciences), Canadian Wildlife Service, Saskatchewan Wetland Conservation Corporation, U. S. Fish and Wildlife Service National Wildlife Refuges and National Parks in the focal states, Biological Resources Division of the U.S. Geological Survey, state natural heritage programs, and regional coordinators of the National Audubon Society Field Notes (NASFN). We visited and collected data from NASFN regional coordinators in Colorado, North Dakota, Iowa, Texas, and Oklahoma, and retrieved data from the Minnesota Ornithologist's Union archives, courtesy of R. Janssen. During each visit, we sorted through birding reports and miscellaneous data sent to the regional coordinators and photocopied data useful to the project. We obtained verbal permission from all contributors to use their data in summaries to be presented in a USGS document.

We determined geographic coordinates for most of the reported locations using sites on the Internet [Geographic Names Information System (GNIS), URL: <http://mapping.usgs.gov/www/gnis/>] and CD-ROMs at Colorado State University (MapExpert, GNIS)].

The database includes more than 33,000 records of observations and surveys conducted at about 3,000 sites (Fig. 1). Approximately one-fourth of the records (about 8,500) was contributed by the International Shorebird Survey. The types of data range from systematic and repeated surveys to non-systematic observations (Table 1). Although a few records date back to 1971, most (96%) of the records are from 1980 to 1996; 88% of the records are dated 1985 to 1996; and 65% are from 1990 to 1996. Observations and surveys were reported for approximately 2,300 sites from January through June (regardless of year)

and for about 1,600 sites from July through December (Fig. 1). Sites in Texas and Louisiana include both coastal and inland wetlands. The locations were distributed approximately within 5° latitudinal bands as follows: 14% in 25° to 30°; 14% in 30° to 35°; 12% in 35° to 40°; 32% in 40° to 45°; 23% in 45° to 50°; 4% in 50° to 55°; and 0.1% in 55° to 60°. Most (<98%) of the sites occur east of 115° W longitude (Fig. 1) and survey coverage in the states of Nevada and Idaho is minimal.

### *Data Analysis*

The shorebird distribution data were summarized using SAS (SAS 1990). Analyses were conducted for 37 individual species (Table 2; Latin names are provided) and for 12 species groups based on taxonomic group, body size, and migration distance (Table 2). Two species groups, all dowitchers and yellowlegs, enabled us to incorporate data for these two groups even though birds were not always identified to species. Species groups are:

- all shorebirds
- long distance migrants
- intermediate distance migrants
- short distance migrants
- all plovers
- small sandpipers (semipalmated sandpiper, western sandpiper, least sandpiper, white-rumped sandpiper, and Baird's sandpiper)
- medium sandpipers (greater yellowlegs, lesser yellowlegs, solitary sandpiper, spotted sandpiper, red knot, sanderling, pectoral sandpiper, dunlin, stilt sandpiper, buff-breasted sandpiper, short-billed dowitcher, and long-billed dowitcher)
- all small shorebirds (small sandpipers plus snowy plover, Wilson's plover, semipalmated plover, and piping plover)
- all medium shorebirds (medium sandpipers plus black-bellied plover, American golden plover, killdeer, mountain plover, ruddy turnstone, common snipe, Wilson's phalarope, and red-necked phalarope)
- all large shorebirds (black-necked stilt, American avocet, willet, whimbrel, long-billed curlew, Hudsonian godwit, and marbled godwit).

The migration distance categories (short, intermediate, and long) are defined in Skagen and Knopf (1993). These categories were based on a migration distance index (the weighted average of three distances between breeding and wintering areas: shortest distance, distance between estimated midpoints, and distance between extremes) roughly corresponding to the average

**Table 1.** Sources of shorebird data, including location(s), and person(s) who provided the data, type(s) of data, and year(s) encompassed by the data. Survey data are from repeated systematic surveys. Obs are observation data not from systematic surveys.

Source/location	Contact	Data type	Year(s)
Arkansas Audubon Society	Max Parker	Obs	1986–1995
Canadian Wildlife Service, Saskatchewan	Gerry Beyersbergen	Survey	1990–1993
International Shorebird Survey AR, AZ, CO, IA, KS, LA, MN, MO, MT, ND, NE, OK, SD, TX, UT	Brian Harrington	Survey	1975–1995
Minnesota Ornithologists' Union	Robert Janssen Peder Svingen	Obs	1986–1996
Miscellaneous Sources			
Boca Chica Beach, TX	Marty Bray	Survey	1992–1994
Great Salt Lake Region, UT	Peter Paton	Survey	1990–1993
Hornsby Bend Ponds, Austin, TX	Robin Doughty Barbara Parmenter	Survey	1993–1996
Playa Lakes Region, TX	Craig Davis	Survey	1993–1994
Northwestern North Dakota	Manuel DeLeon	Survey	1994–1995
Saskatchewan, Canada	J. Frank Roy <sup>a</sup>	Obs	1980–1995
Southern Louisiana	Ken Rosenberg	Survey	1986–1991
National Audubon Society Field Notes (NASFN)			
CO, NV, UT, WY	Hugh Kingery	Obs	1986–1996
IA, MT, ND, NE, OK, SD	Ron Martin Gordon Berkey	Obs	1986–1996
Iowa	Tom Kent	Obs	1986–1996
AR, CO, IA, IN, KS, MI, MN, MT, ND, NE, OK, Ontario	Joe Gryzbowski	Obs	1990–1996
Texas	Greg Lasley	Obs	1991–1996
Alberta, Manitoba, Saskatchewan	NASFN	Obs	1986–1995
National Park Service			
Big Bend National Park, TX	Mark Flippo	Obs	1986–1995
Homestead National Monument, NE	Rebecca Lacombe	Obs	1986–1996
Rocky Mountain National Park		Obs	1996
Glacier National Park, MT	Steve Gniadek	Obs	1986–1995
New Mexico Natural Heritage Program			
Holloman Air Force Base, NM	Kris Johnson	Survey	1994–1995
U.S. Fish and Wildlife Service, National Wildlife Refuges (NWR)			
Anahuac NWR, TX	Kim Harrigan	Survey	1995–1996
Arrowwood NWR, ND	Carmen Luna	Survey, Obs	1994–1996
Audubon/Lake Nettie NWR's and surrounding areas, ND	Craig Hultberg	Obs	1986–1996

**Table 1.** Concluded.

Source/location	Contact	Data type	Year(s)
U.S. Fish and Wildlife Service, National Wildlife Refuges (NWR) (con't)			
Bear River Migratory Bird Refuge, UT	Vicki Roy	Survey	1991–1996
Benton Lake NWR, MT	Stephen Martin	Obs	1965–1995
Bitter Lake NWR, NM	Sonia Najera	Survey	1986–1996
Brazoria/San Bernard/ Big Boggy NWR's, TX	Richard Speer	Survey	1995
Breton NWR, LA	James Harris	Piping plover census	1996
Browns Park NWR, CO	Suzanne Fellows	Obs	1989–1996
Buenos Aires NWR, AZ		Obs	1990–1996
Felsenthal NWR/Oakwood Unit, AR	Lake Lewis	Survey	1995–1996
Fish Springs NWR, UT	Jay Banta	Survey	1986–1996
Halfbreed/Hailstone/Spidel NWR's, MT	Mike Getman	Obs	1991–1993
Hagerman NWR, TX	Jim Williams	Survey	1990–1996
Imperial NWR, AZ	Carmen Kennedy	Survey	1993–1995
Laguna Atascosa, NWR, South Padre Island, TX	Tim Brush	Survey	1992–1994
Laguna Atascosa NWR, TX	Tim Brush Jeff Rupert	Survey	1995–1996
Lake Andes NWR, SD	Rick Cantu	Obs	1986–1996
Lee Metcalf NWR, MT		Obs	1991–1996
Matagorda NWR, TX	Felipe Prieto	Survey	1992–1995
Maxwell NWR, NM	Jerry French	Obs	1989–1995
National Bison Range, MT	Lynn Clark	Obs	1987–1996
North Platte/Crescent Lake NWR's, NE	Larry Malone	Survey	1986–1996
Rice Lake/Mille Lacs NWR's, MN	Christopher Lapp	Survey	1991–1996
Sequoyah NWR, OK	Craig Heflebower	Obs	1989–1996
Squaw Creek NWR, MO	Joanna Foster	Survey, Obs	1986–1996
Swan Lake NWR, MO	Bridget Olson	Obs	1995–1996
Salt Plains NWR, OK	Ron Shepperd	Survey	1989–1996
Selected NWR's in AR, LA, MS	Virginia Rettig <sup>a</sup>	Survey	1994
USGS, Biological Resources Division			
KS, ND, NE, OK, SD, TX	Susan Skagen	Survey	1989–1995
Wader Study Group Bulletin			
	Colwell et al. <sup>a</sup>	Survey	1984
	Dickson et al. <sup>a</sup>	Survey	1987
Western Hemisphere Shorebird Reserve Network			
Alberta, Manitoba, Saskatchewan, Canada	Morrison et al. <sup>a</sup>	Obs	1971–1994

<sup>a</sup>Data compiled from published reports. See Cited References.

# All Sites

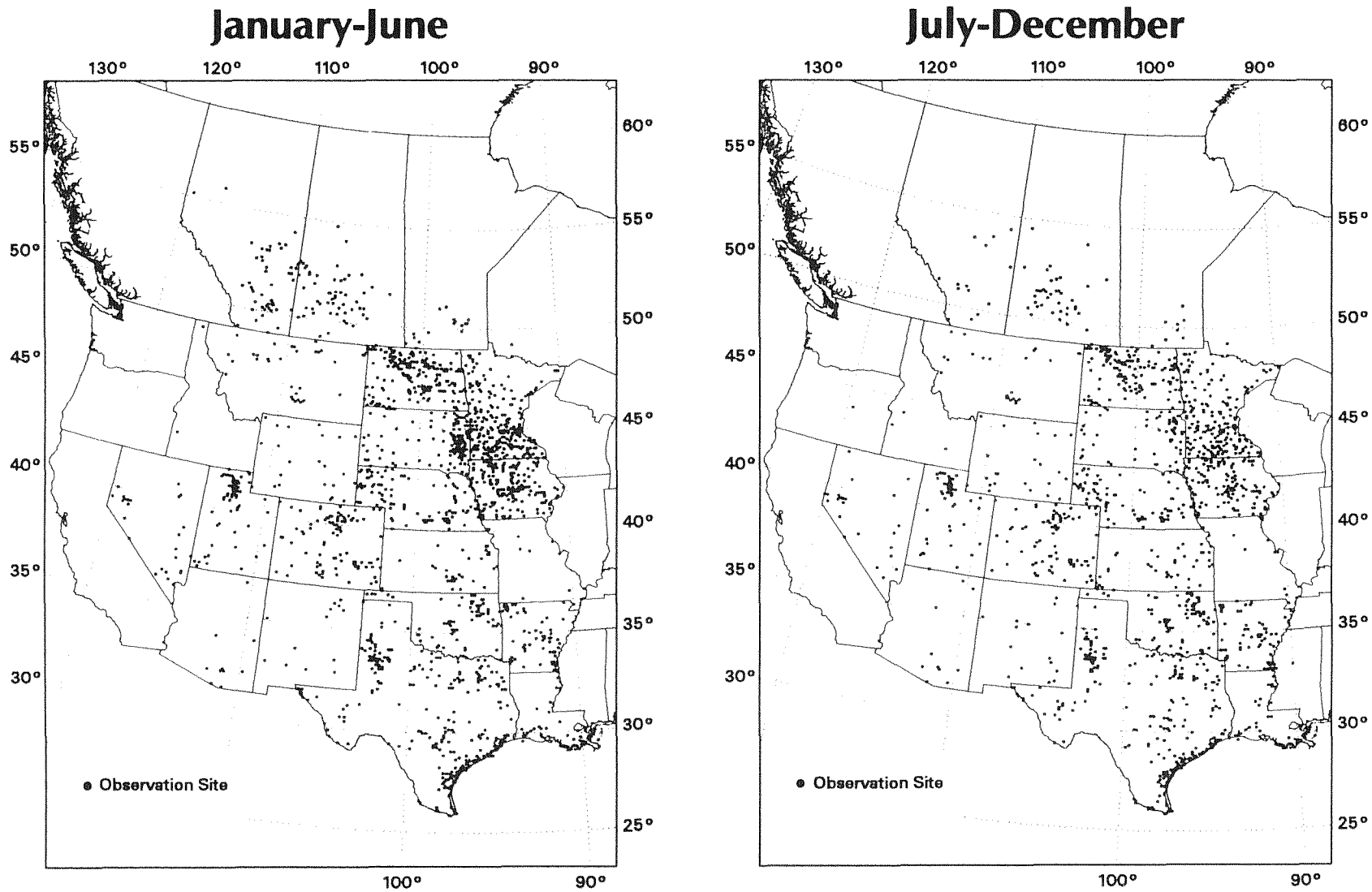


Fig. 1. Sites from which shorebird survey and observation data were collected.

**Table 2.** Shorebird species that commonly cross the North American interior during spring and fall migrations or that breed or winter in the midcontinent region. Body size is denoted by S (small, total body lengths of <190 mm); M (medium, body lengths range from 195–350 mm); and L (large, body lengths exceed 350 mm); after Skagen and Knopf (1993). Migration distances are denoted as S (short), I (intermediate), and L (long), after Skagen and Knopf (1993).

Common name	Scientific name	Body size	Migration distance	Selected references <sup>a</sup>
<b>Family Charadriidae</b>				
Black-bellied plover	<i>Pluvialis squatarola</i>	M	I	1–5
American golden plover	<i>P. dominica</i>	M	L	1–4, 6
Snowy plover	<i>Charadrius alexandrinus</i>	S	S	1–4, 7
Wilson's plover	<i>C. wilsonia</i>	S	S	1–4
Semipalmated plover	<i>C. semipalmatus</i>	S	I	1–4
Piping plover	<i>C. melodus</i>	S	S	1–4, 8
Killdeer	<i>C. vociferus</i>	M	S	1–4
Mountain plover	<i>C. montanus</i>	M	S	1–4, 9
<b>Family Recurvirostridae</b>				
Black-necked stilt	<i>Himantopus himantopus</i>	L	S	1–4
American avocet	<i>Recurvirostra americana</i>	L	S	1–4, 10
<b>Family Scolopacidae</b>				
Greater yellowlegs	<i>Tringa melanoleuca</i>	M	I	1–4, 11
Lesser yellowlegs	<i>T. flavipes</i>	M	I	1–4
Solitary sandpiper	<i>T. solitaria</i>	M	I	1–4, 12
Willet	<i>Catoptrophorus semipalmatus</i>	L	S	1–4
Spotted sandpiper	<i>Actitis macularia</i>	M	I	1–4, 13
Upland sandpiper	<i>Bartramia longicauda</i>	M	I	1–4
Whimbrel	<i>Numenius phaeopus</i>	L	I	1–4, 14
Long-billed curlew	<i>N. americanus</i>	L	S	1–4
Hudsonian godwit	<i>Limosa haemastica</i>	L	L	1–4
Marbled godwit	<i>L. fedoa</i>	L	S	1–4
Ruddy turnstone	<i>Arenaria interpres</i>	M	I	1–4
Red knot	<i>Calidris canutus</i>	M	I	1–4
Sanderling	<i>C. alba</i>	M	I	1–4
Semipalmated sandpiper	<i>C. pusilla</i>	S	I	1–4, 15
Western sandpiper	<i>C. mauri</i>	S	I	1–4, 16
Least sandpiper	<i>C. minutilla</i>	S	I	1–4, 17
White-rumped sandpiper	<i>C. fuscicollis</i>	S	L	1–4, 18
Baird's sandpiper	<i>C. bairdii</i>	S	L	1–4
Pectoral sandpiper	<i>C. melanotos</i>	M	L	1–4, 19
Dunlin	<i>C. alpina</i>	M	I	1–4, 20
Stilt sandpiper	<i>C. himantopus</i>	M	L	1–4, 21

Table 2. Concluded.

Common name	Scientific name	Body size	Migration distance	Selected references <sup>a</sup>
<b>Family Scolopacidae (con't)</b>				
Buff-breasted sandpiper	<i>Tryngites subruficollis</i>	M	L	1-4, 22
Short-billed dowitcher	<i>Limnodromus griseus</i>	M	I	1-4
Long-billed dowitcher	<i>L. scolopaceus</i>	M	I	1-4
Common snipe	<i>Gallinago gallinago</i>	M	S	1-4
Wilson's phalarope	<i>Phalaropus tricolor</i>	M	I	1-4, 23
Red-necked phalarope	<i>P. lobatus</i>	M	I	1-4

<sup>a</sup>References: 1-Hayman et al. (1986); 2-Griggs (1997); 3-National Geographic Society (1987); 4-Howell and Webb (1995); 5-Paulson (1995); 6-Johnson and Connors (1996); 7-Page et al. (1995); 8-Haig (1992); 9-Knopf (1996); 10-Robinson et al. (1997); 11-Elphick and Tibbitts (1998); 12-Moskoff (1995); 13-Oring et al. (1997); 14-Skeel and Mallory (1996); 15-Gratto-Trevor (1992); 16-Wilson (1994); 17-Cooper (1994); 18-Parmelee (1992); 19-Holmes and Pitelka (1998); 20-Warnock and Gill (1996); 21-Klima and Jehl (1998); 22-Lancot and Laredo (1994); 23-Colwell and Jehl (1994).

distance traveled (1,000s of km). The migration distance index of short distance migrants is <5, of intermediate distance migrants is 6-12, and long distance migrants is >14.

We divided all data into 24 time periods, beginning with days 1 and 16 of each month. For 50 sites with multiple subsites, numbers of birds of each species/species group were summed for all subsites for each 2-week time period to provide overall counts for the sites. A mean lat-long (latitude-longitude) calculated from the subsites was then assigned to the site. For 130 sites reported by more than one source, we standardized site names to avoid duplication.

We extracted the maximum number of individuals of each species and species group reported at each site/subsite for each time period. For the chronology histograms, maximum counts at sites/subsites for each species/species group and each time period were summed within 5° latitudinal bands (25°-30°; 30°-35°; etc). For the maps and Appendix, we subdivided the year into two parts, January through June and July through December, extracted the maximum number of individuals of each species/species group reported at each site/subsite regardless of year, and totaled these counts for lat-long cells (0.1° by 0.1°).

The spring and fall data were processed separately in an ARC/INFO point vector coverage. The spring and fall point coverages were intersected with a polygon vector

coverage which was divided into 100 km x 100 km grid. The values for each species and species group were summed within each cell and the resulting values were stored in the polygon vector coverage. Distributions of species and species groups were mapped with shading patterns to designate varying abundance. Distribution maps of species are presented in taxonomic order following the maps of species groups.

Histograms were constructed for each species and some species groups to describe timing of migration across seven 5° latitudinal bands. Because abundances differ between latitudinal bands, and because we wanted these figures primarily to portray timing, we used different scales for many of the bands. Shading patterns denote relative abundance (darker shades are used for greater numbers of birds). The chronology histograms are presented in concert with the distribution maps for each species in taxonomic order and for some of the species groups.

We used as an index of dispersion the number of sites hosting 60% of the total maximum of each species. We then categorized dispersion as broadly dispersed (60% of birds occurred in 10 or more sites), moderately dispersed (60% of birds occurred in 3 to 9 sites), or concentrated (60% of birds occurred in 1 or 2 sites).

There are limitations to our abilities to interpret the maps and histograms because the underlying data are from several sources and data types, because coverage is

not uniform, and because sites were not randomly or systematically chosen. These maps and summaries, therefore, are meant to provide baseline information on which to build in the future. All interpretations and statements are made with full recognition of the limitations of this database.

### *Identification of Important Sites*

In the Appendix, we present the total maximum counts recorded for each species and species group in descending order of abundance. The counts represent the sum of the maximum counts of each site within 0.1° x 0.1° lat-long cells. We also provide the names of major sites within the identified lat-long cells. The values for latitude and longitude represent the center of the cell. Species summaries are presented in taxonomic order. Because large numbers of shorebirds are notoriously difficult to count, and because we suspect some large counts to be overestimates, we transected counts of six species and the respective species groups.

The classification of areas as sites or subsites is problematic because the final maximum numbers differ whether an area is considered a site or a series of subsites. In general, large continuous areas that were divided into subsites for survey purposes (i.e., national wildlife refuges) were treated as one site. An exception to this is the Great Salt Lake area that we treated as several individual sites because of the vast area represented (>15,000 km<sup>2</sup> compared with <500 km<sup>2</sup> for other sites). Eight sites within the Great Salt Lake area contained 95% of the shorebird sightings. For reference, we also ran the programs treating Great Salt Lake as one site, and present the counts in the Appendix. In general, maximum counts at Great Salt Lake were 12% lower in spring and about 46% lower in fall using the single site analysis rather than the multiple subsite approach. This difference is consistent with greater concentration of birds in the spring.

Data from 112 playa lakes in northwestern Texas (Davis 1998 and unpublished data) were treated each as an individual site. The primary difference if we had treated the entire playa lake region as one site is that additional entries in the Appendix would appear for this region. The maximum number of killdeer in spring was 180, American avocets in spring was 810, and long-billed curlew in fall was 974.

## Results and Discussion

### *Map Interpretation*

We categorized the maps and assigned species to one of five general patterns of migration (Figs. 2 and 3) based on the January through June coverage. Species with little data on migration distribution or with little or no division between wintering and breeding areas (snowy plover, Wilson's plover, mountain plover, black-necked stilt, American avocet, and long-billed curlew) were not assigned to one of these general migration patterns. The five patterns, narrow band, widespread, narrow band and widespread, jumps, and crossband, are graphically portrayed in Fig. 2 and described below.

#### Narrow Band

This category includes all of the long distance migrants, five intermediate distance migrants, and one short-distance migrant (Fig. 3). During spring migration more than 90% of the maximum counts of these species were within a narrow band extending between 90° W (the easternmost areas in this study) and 100° W longitude, roughly from eastern Iowa to central Kansas (Fig. 2); this band curves westward to between 100° W and 115° W longitude in Canada. These species are dispersed south to north along this band, extending from 25° N to 55° N latitude, with a preponderance of sightings in the prairie potholes. This pattern may change with additional survey coverage, especially in Manitoba.

#### Narrow Band and Widespread

Many individuals of two species, least sandpipers and short-billed dowitchers, occurred throughout the focal area, yet a large component of their populations (80–90% of maximum counts) were within a narrow band described above. Although the two are classified as intermediate distance migrants, some individuals may be long distance migrants.

#### Jump

Four species of intermediate distance migrants (ruddy turnstone, red knot, sanderling, and dunlin; Fig. 3) that winter along the Texas coast appear to overfly much of



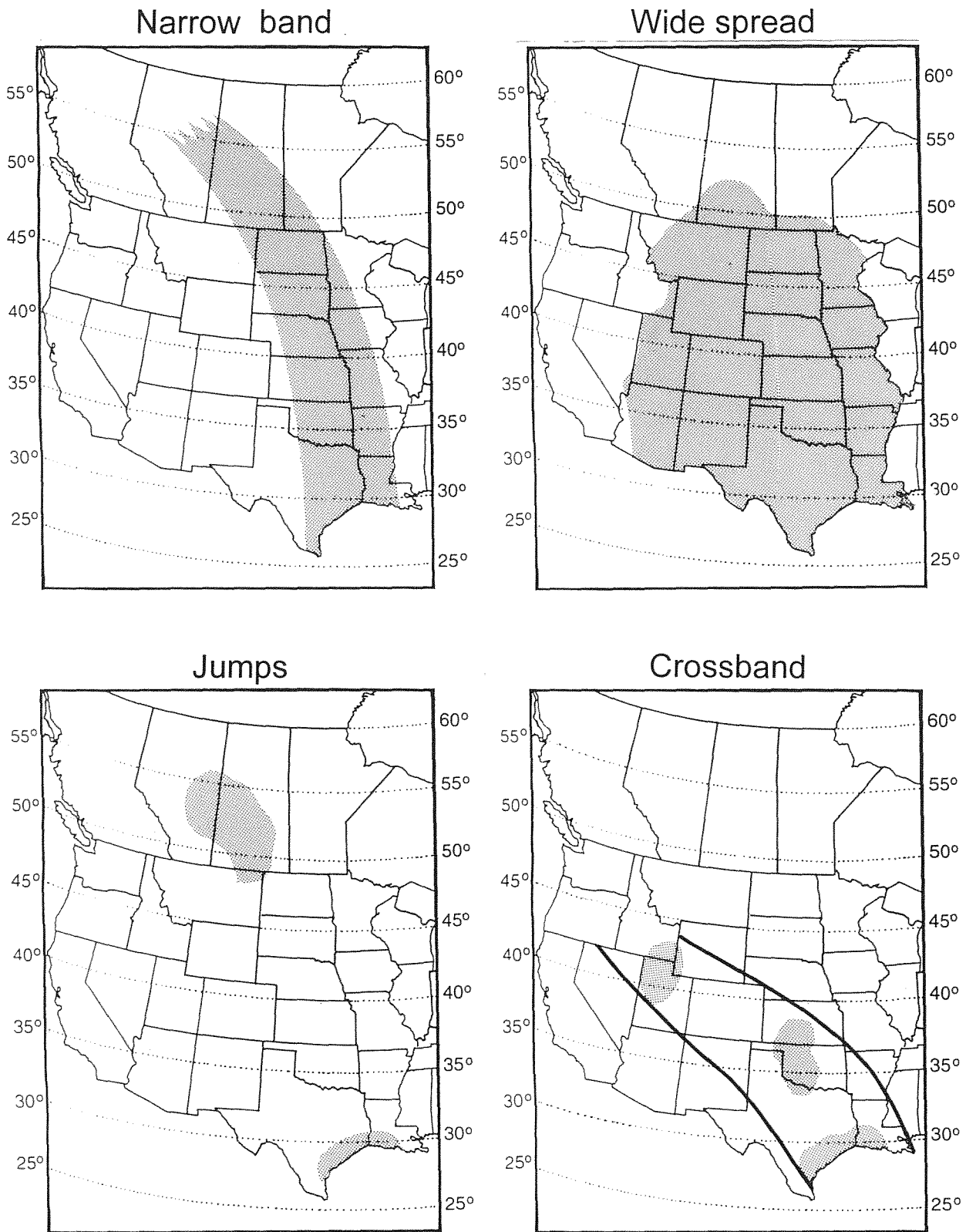


Fig. 2. Patterns of migration exhibited by shorebirds based on January through June coverages.

Migration pattern	Migration Distance		
	Short	Intermediate	Long
Narrow band	Piping plover	Upland sandpiper Semipalmated sandpiper Semipalmated plover Greater yellowlegs Lesser yellowlegs	American golden plover Hudsonian godwit White-rumped sandpiper Baird's sandpiper Pectoral sandpiper Buff-breasted sandpiper Stilt sandpiper
Narrow band and widespread		Least sandpiper Short-billed dowitcher	
Jump		Ruddy turnstone Red knot Sanderling Dunlin	
Widespread	Killdeer Willet Marbled godwit	Black-bellied plover Solitary sandpiper Spotted sandpiper Whimbrel Long-billed dowitcher Wilson's phalarope Red-necked phalarope	
Crossband		Western sandpiper	

Fig. 3. Classification of shorebirds by migration pattern and migration distance.

the plains. Sightings of these migrants in the central plains are infrequent and of relatively small numbers, but large numbers have been recorded in one or more northerly areas.

### Widespread

Several intermediate distance migrants and short-distance migrants that breed in the U.S. (Fig. 3) were distributed broadly throughout our focal area, although some occurred in large numbers at a few sites. Birds that migrate through Western Nevada generally use the Pacific Flyway (Warnock et al. 1998).

### Crossband

Western sandpipers (Fig. 3) winter along the coasts of the southern U.S., Central America, and northern South America, and breed in northwestern Alaska. During spring migration across the interior, this species is found in the greatest numbers between the Texas coast and the Great Salt Lake region and is infrequently sighted in the Northern plains.

### *Migration Chronology*

The chronology histograms are intended to portray timing rather than spatial distribution or abundance; coverage and abundances differ between latitudinal bands. The histograms suggest two general patterns, hereafter called the quick passage and graduated arrivals. The Hudsonian godwit best represents the first pattern. Most (>90%) of the sightings occur in the midcontinent region during short time periods, late-April and May, and the sightings occur concurrently in latitudinal bands from 25° N to 50° N, suggesting that birds in need of refueling/resting fall out at several places regardless of latitude. There is no suggestion that individual birds stop more than once in this path. White-rumped sandpipers, which also pass through the plains during a short time period, represent a variant of this quick passage pattern. The earliest arrivals of this species, however, stop in the south, first appearing along the Texas coast (25–30° N) in late April and first occurring between 35° N and 55° N during early May. White-rumped sandpipers depart the Texas coast by late May, yet remain in the northern bands (35° N–55° N) into early June.

American golden plovers depict the second pattern, graduated arrivals, most clearly. The plovers first appear along the Texas coast (25–30° N) in late February/early March and disperse from there by late April. Their arrival dates farther north correspond with latitude, becoming later with increasing latitude. They arrive in 30–35° N

in late March, 40–45° N in late April, and 50–55° N in early May. Semipalmated sandpipers also show a graduated pattern, arriving in 25–35° N in late March, from 35° N–45° N in April, and from 45° N–55° N in May. A more gradual arrival pattern is demonstrated by stilt sandpipers; they appear in substantial numbers on the Texas coast in February, move northward from 30° N–40° N in early April, appear between 40° N and 50° N in early May, and in 50°–55° N in late May.

Although the chronology histograms may suggest patterns, we cannot distinguish between different explanations for these patterns without further analyses or additional data. For example, graduated arrivals in different latitudinal bands may suggest that individuals are making short flights while moving northward. But this same pattern may occur if later arriving individuals settled north of earlier arriving individuals.

### *Spring Migration of the Genus Calidris - Preliminary Interpretations*

This document provides insights about migration strategies of individual species and can be used to formulate new hypotheses and to evaluate existing ones. We demonstrate this with preliminary interpretations of spring migration patterns of 10 species comprising the genus *Calidris*.

Wintering habitat, migration distance, and breeding destination in concert appear to determine spring migration distribution. For example, five species in the genus *Calidris* that winter predominantly in the South American interior (semipalmated sandpiper, white-rumped sandpiper, Baird's sandpiper, pectoral sandpiper, and pectoral sandpiper) are considered "narrow band" migrants, those that occur mainly between 90° W and 100° W longitude as they cross the midcontinent region. Calidridines that winter in more northerly interior habitats are more widespread in distribution during migration. Least sandpipers winter in the southern United States and throughout Central and northern South America and are classified as "narrow band and widespread" because although they occur primarily between 90° W and 100° W longitude, they also range more westerly during migration.

The occurrence of birds all along the "narrow band", coupled with gradual arrival patterns at more northerly latitudes, suggest that some species make flights of short to intermediate distances ["hops" and "skips"; Piersma (1987)] rather than long distances ("jumps") between stopover sites. Semipalmated sandpipers, least sandpipers, and Baird's sandpipers are the most likely of the calidridines to "hop"; they are gradual in arrival pattern and broadly distributed along the "narrow band".

Least sandpipers are considered more “diffuse” and less concentrated at stopover sites than other calidridines (Cooper 1994). Highly variable fat levels and flight range estimates of semipalmated sandpipers suggest that many individuals departing central Kansas are not capable of long flights (Skagen and Knopf 1994b).

Pectoral sandpipers also probably make several feeding stops punctuated by short flights during northward migration across the North American interior (Farmer and Wiens 1999). An abnormally high count (18,700) in central Kansas in late May somewhat obscures the “gradual arrival” pattern in our chronology histograms. However, other counts in central Kansas average less than 300 during late May. Male and female pectoral sandpipers may differ in spring migration strategies. Farmer and Wiens (1999) conclude that female pectoral sandpipers are both time minimizers and energy maximizers, whereas males are strictly time minimizers in spring migration. Males migrate through Oklahoma earlier than females (Oring and Davis 1966; Holmes and Pitelka 1998).

Stilt sandpipers appear to have somewhat longer inter-stop flights, concentrations of stilt sandpipers along the Gulf Coast and in Kansas, North Dakota, and Saskatchewan but not elsewhere indicate that migration movements involve flights of hundred of miles (Klima and Jehl 1998). An alternative explanation for the patterns of gradual arrivals and broad distribution along the narrow band is that later migrants may settle to refuel at more northerly sites than earlier arrivals. Currently, we have no additional evidence to distinguish between these alternative hypotheses.

In contrast to the calidridines discussed above, white-rumped sandpipers do not arrive more gradually at more northerly latitudes. Rather, they appear to arrive at latitudes between 35° N and 55° N almost simultaneously and do so all along the south-north “narrow band”, suggesting the concurrent termination of longer flights. Estimates of flight distances of birds departing the central plains (Skagen and Knopf 1994b), however, suggest that most birds do need to refuel before reaching their breeding grounds. White-rumped sandpipers employ both “short-distance multiple-stop” and long-distance non-stop” flight patterns when crossing South America (Harrington et al. 1991; Parmelee 1992) and probably do so across North America as well.

Calidridine species that winter exclusively in coastal habitats are more likely to make long flights to specific regions during spring migration than interior wintering birds. We categorized the migration strategies of three *Calidris* species (red knot, sanderling, and dunlin) as “jump” because they appear to overfly the central plains

as they proceed northward. During migration, red knots occurred in the largest numbers along the Gulf Coast and shores of large lakes of Saskatchewan, but not elsewhere. Red knots that breed in western North America are believed to winter along the southern Pacific and southern Atlantic and Gulf Coasts of North America and in southern coastal regions of South America, whereas breeders from Greenland and northeast Canada cross the North Atlantic to winter in western Europe (Hayman et al. 1986). If this is so, the birds recorded in Saskatchewan may have been refueling after a long flight from the Gulf and southern Atlantic coasts. Although some red knots are present along the Gulf Coast throughout the winter, a large influx of birds in late April and early May indicates that migrants from more southerly wintering areas use these areas as stopovers as well. This species is believed to typically make long flights between stopover sites (Hayman et al. 1986).

Sanderlings occurred in the largest numbers along the Gulf Coast, the Great Salt Lake area, and along shores of large lakes of Saskatchewan and Alberta, and only small flocks were recorded elsewhere. Sanderlings traveling northward along the Pacific Coast of South America apparently continue north through Texas and the Central Plains (Myers et al. 1990); this species is known to typically fly long distances between sites (Hayman et al. 1986). That they occur in large numbers in Saskatchewan and not elsewhere in the Central Plains is consistent with a jump strategy, but whether sanderlings in Saskatchewan originate on the Pacific or Gulf coasts is not clear.

Dunlin wintering on the Gulf Coast (*Calidris alpina hudsonia*) appear to overfly the Central Plains, but to occur regularly and in large numbers in the Prairie Pothole Region of eastern North and South Dakota. The limited numbers recorded in the midcontinent except the Dakotas suggest that birds migrating through the interior may fly directly from Gulf Coast wintering sites to the Prairie Potholes before their final flight to the breeding grounds (Warnock and Gill 1996).

The migration pattern exhibited by the Western sandpiper differs from all other calidridines crossing the midcontinent. Our findings support the earlier interpretations of a “diagonal” migration (Senner and Martinez 1982; Butler et al. 1996) of western sandpipers especially during southward migration and of smaller numbers in the interior during spring migration (Wilson 1994). Three birds banded in British Columbia have been recaptured in Kansas (Senner and Martinez 1982; Butler et al. 1996) supporting the ideas that some individuals are splitting off the Pacific Coast route to cross portions of the continent (Senner and Martinez 1982).

### *Habitat Requirements*

Habitats used by shorebirds migrating across the midcontinent region include a variety of types, including beaches; tidal flats; sand flats; alkali lakes; margins of lakes, ponds, wetlands and reservoirs; plowed and fallow agricultural fields; sewage treatment plants; and lagoons. We describe the range of microhabitats used by foraging birds in the species accounts in terms of water depth and vegetation structure. Sources contributing to this information include Helmers (1992), Hayman et al. (1986), and Birds of North America accounts.

Because in general, body size is a useful indicator of the water depths used by foraging birds, we grouped species accordingly to facilitate management applications. In general, small shorebirds require relatively unvegetated wet mud and shallow water of depths ranging to 5 cm, medium sandpipers and yellowlegs up to 10 cm, and large shorebirds up to 20 cm.

### *Management Applications*

This document can be used to identify areas critical to migrating shorebirds, to assist in decisions on conservation and acquisition efforts, and to provide planners and land managers with a perspective of scale necessary to properly manage for migrating shorebirds in the interior of North America. In addition to highlighting key migratory stopover areas, the maps also demonstrate the expanse of landscape used by shorebirds, supporting the idea that many shorebird species depend upon the accumulative effect of many smaller wetlands over a large area (Skagen and Knopf 1993; Skagen 1997).

This document can help ensure that habitat management activities coincide with shorebird use of habitats. Land managers can use the distribution maps to determine what species or groups of shorebirds are expected to occur in areas of interest, use the chronology histograms to predict the timing of migration, and use the species accounts to ascertain the preferred wetland microhabitats. For example, wetlands in eastern South Dakota host many small sandpipers throughout May. If possible, land managers should provide substrates that are bare or only sparsely vegetated and covered with water no deeper than 5 cm to accommodate these birds. Medium sandpipers, common in central and northern North Dakota from late July through the end of September, use a variety of habitats with up to 12 cm of water. American golden plovers, which use sparsely vegetated wetlands

and fields with up to 8 cm of water, are prevalent in eastern North Dakota from mid-September to mid-October.

Ideally, management for shorebirds in the midcontinent will take place within the broader context of integrated wetland management for a diversity of wildlife species and will take a landscape approach that is based on the paradigm of wetland habitats as dynamic systems (Laubhan and Fredrickson 1993, 1997; Skagen 1997). As such, a reasonable goal is not to provide the required microhabitats for migrating birds at the same wetlands each season if doing so compromises wetland health. Rather, we should assure that sufficient suitable habitats occur somewhere on the larger landscape. Interior-migrating shorebirds have evolved with unpredictable stopover resources and are able to find suitable microhabitats in a temporally dynamic and spatially complex landscape.

## **Distribution Maps and Migration Information for Species Groups and 37 Shorebird Species**

On pages 16 to 113, distribution maps for two time periods (January–June and July–December) are provided for species groups (all shorebirds, long distance migrants, intermediate distance migrants, short distance migrants, all plovers, small sandpipers, medium sandpipers, all small shorebirds, all medium shorebirds, and all large shorebirds) and for 37 shorebird species in taxonomic order (see Table 2 for order). The shading patterns on the distribution maps indicate the sum of the maximum number of birds recorded at each site regardless of year within a 100 km<sup>2</sup> cell. Refer to the Appendix for more specific count information and locations. Histograms portraying the timing of migration across 5° latitudinal bands from 25°N to 55°N are provided for all species and most species groups. See the Data Analysis section for further explanation of methods. The locations with the greatest number reported for each species/species group are based on information from the Appendix.

Chronology histograms were constructed by summing the maximum number of species/species group reported at each site across seven 5° latitudinal bands for 24 time periods, two time periods per month. Note that there are different scales on the various graphs, identified by shading patterns denoting relative abundance (darker shades are used for greater numbers of birds). The chronology histograms are intended to portray timing

rather than spatial distribution or abundance; coverage and abundances differ between latitudinal bands.

Range maps were constructed using information contained in Hayman et al. (1986), Morrison and Ross (1989), Howell and Webb (1995), and respective Birds of North America accounts. On the range maps, solid black denotes breeding range, the stippled pattern denotes winter range, and the hatched pattern denotes year-round residency.

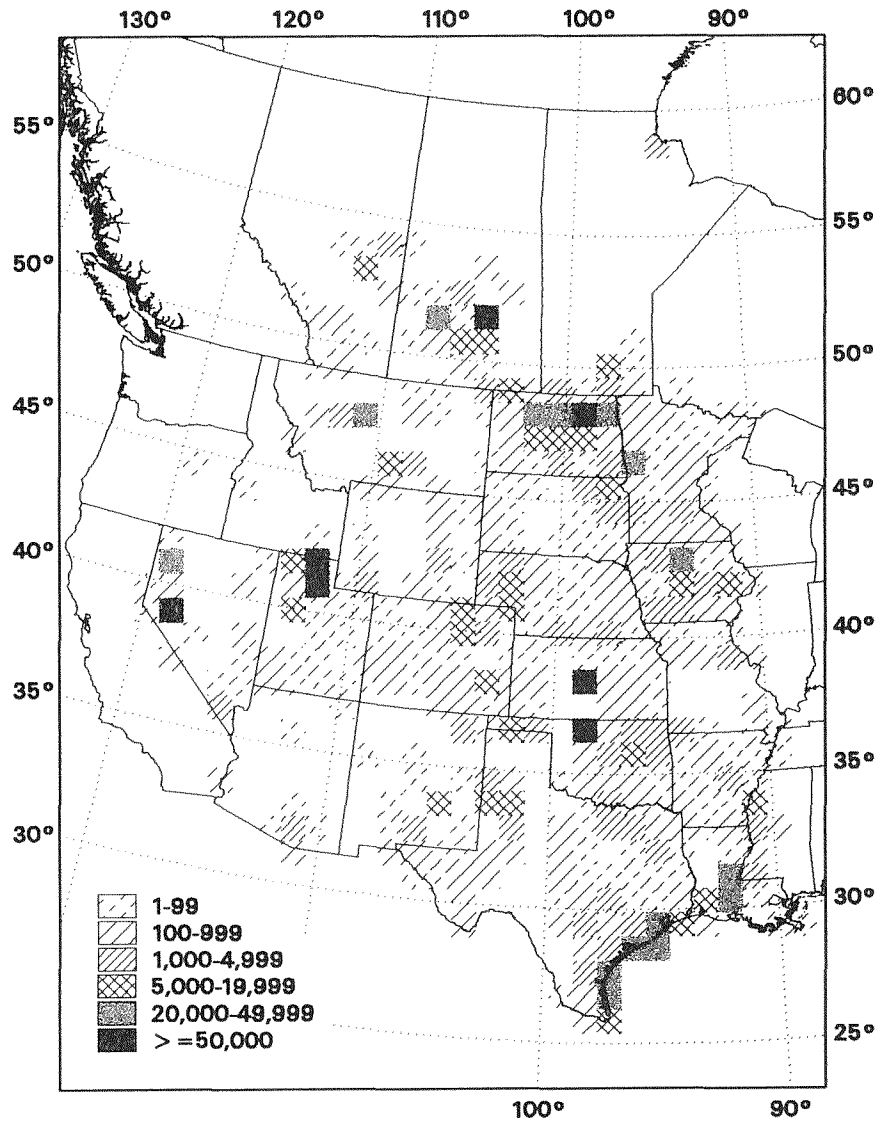
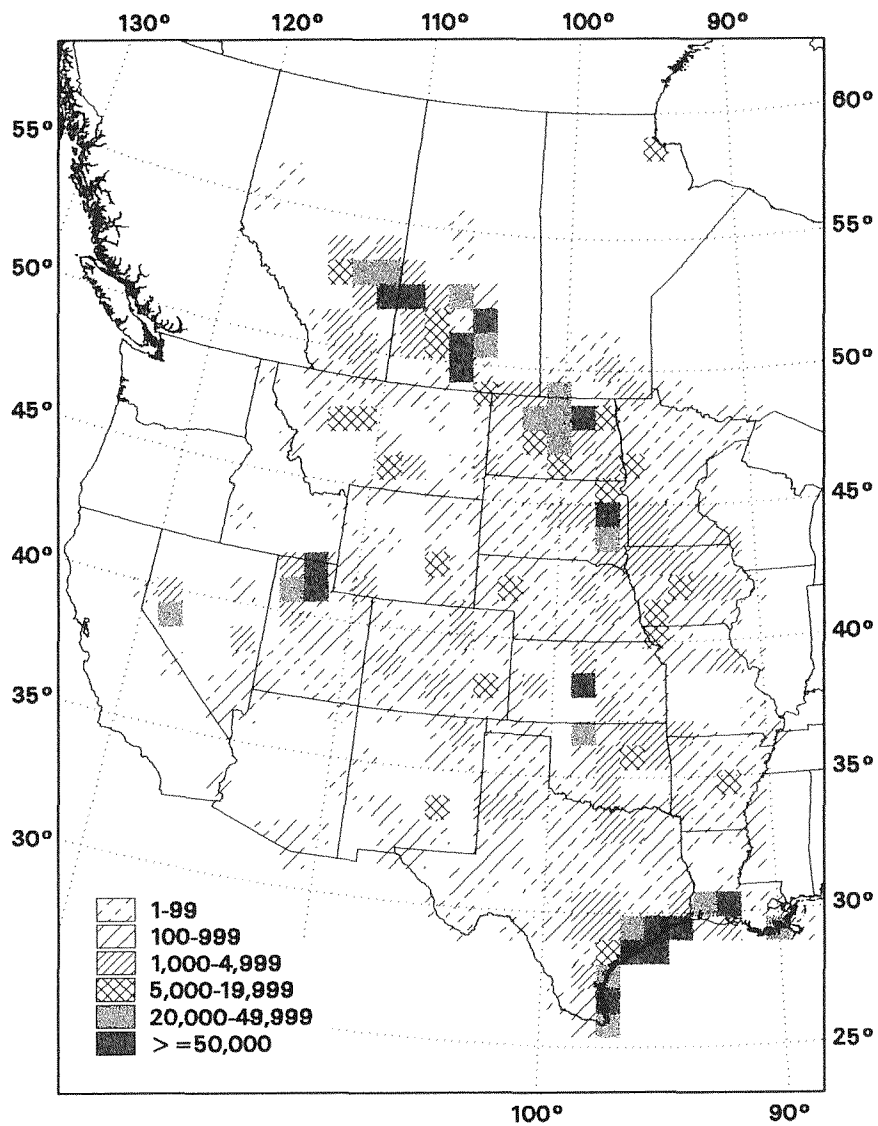
Reference to Figs. 2 and 3 will help in identifying overall patterns relative to migration distance (see maps for species grouped by migration distance). The distribution maps for species groups based on body size can be used in concert with the chronology histograms to suggest guidelines for land managers. Species were grouped by body size as an overall indicator of habitat requirements relative to water depth.

Distribution Maps and  
Migration Information for  
Species Groups and 37  
Shorebird Species

# All shorebirds

## January-June

## July-December



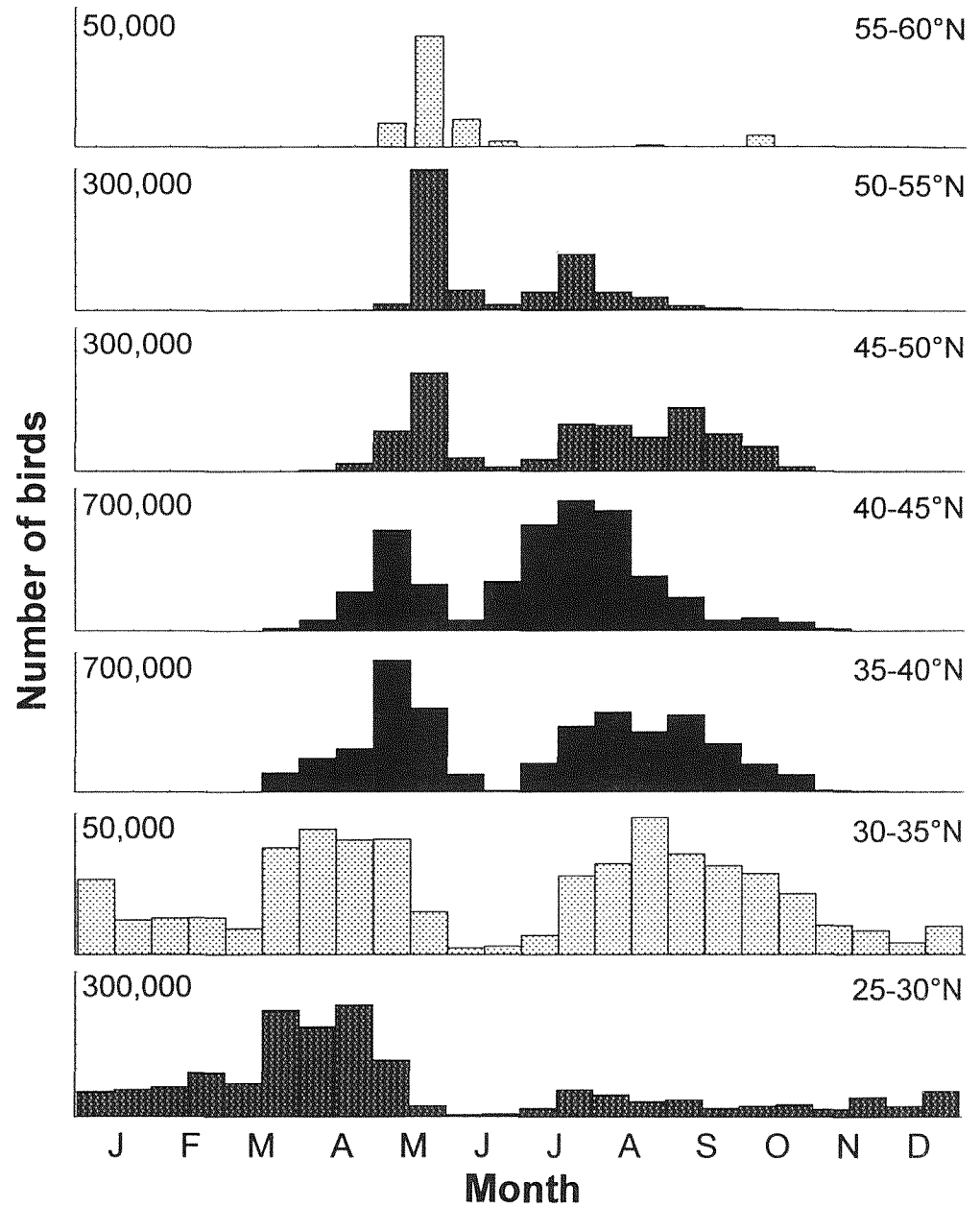


## All Shorebirds

Fifteen sites with highest counts:

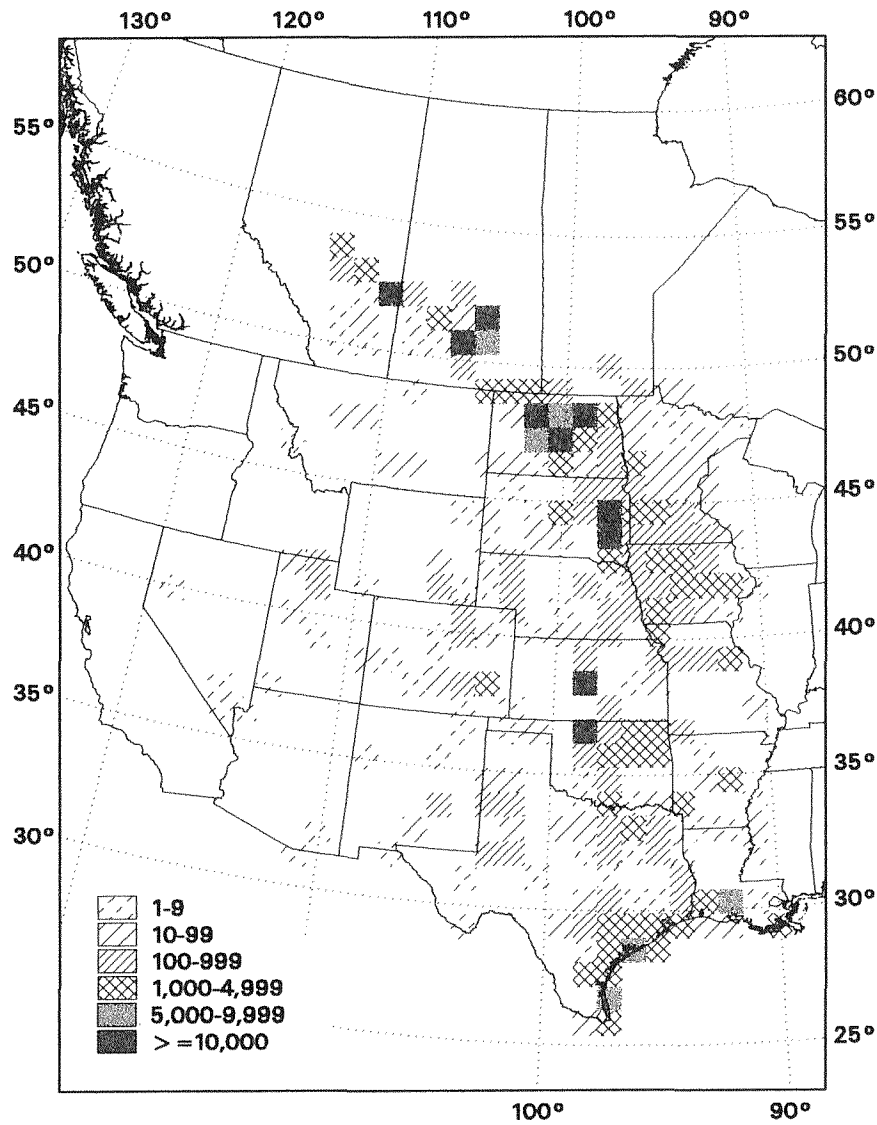
(see Appendix for more information)

- Cheyenne Bottoms Wildlife Management Area, Kansas
- Great Salt Lake area, including Bear River  
National Wildlife Refuge, Utah
- Quill Lakes, Saskatchewan
- Lahontan Valley, Nevada, including Carson Lake  
and Stillwater National Wildlife Refuge
- Laguna Atascosa National Wildlife Refuge, Texas
- Minnewaukan Flats, Devil's Lake, North Dakota
- Chaplin Lakes, Saskatchewan
- Old Wives Lake, Saskatchewan
- Salt Plains National Wildlife Refuge, Oklahoma
- Bolivar Flats, Galveston Island, Texas
- Brazoria National Wildlife Refuge, Texas
- 19 km west of Luck Lake, Saskatchewan
- Between Duson and Crowley, Louisiana
- Devil's Lake, North Dakota

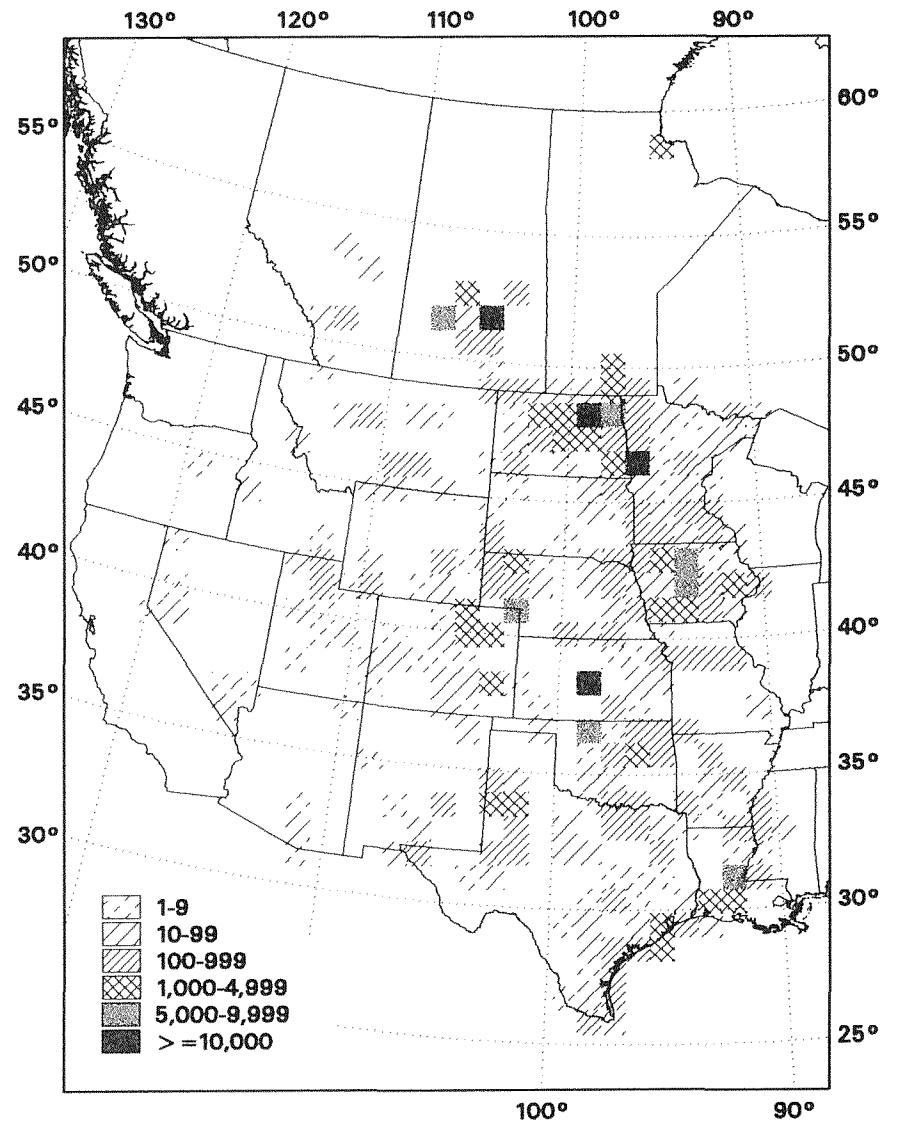


# Long distance migrants

## January-June



## July-December



## Long Distance Migrants

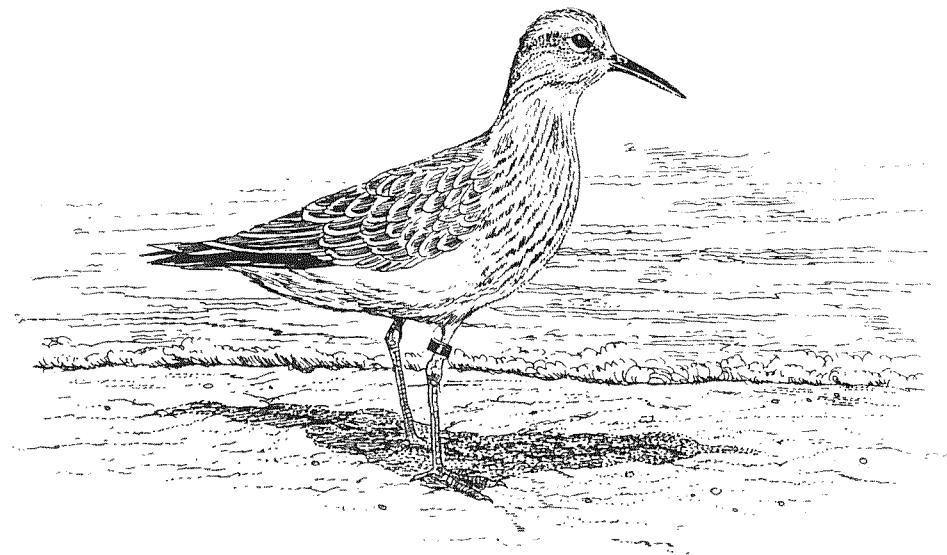
American Golden-Plover  
Hudsonian Godwit  
White-rumped Sandpiper  
Baird's Sandpiper  
Pectoral Sandpiper  
Stilt Sandpiper  
Buff-breasted Sandpiper

**Body Size:** Small, medium, large

**Foraging Guild:** Terrestrial/aquatic prober/gleaner

**Six sites with highest counts:** (see Appendix for more information)

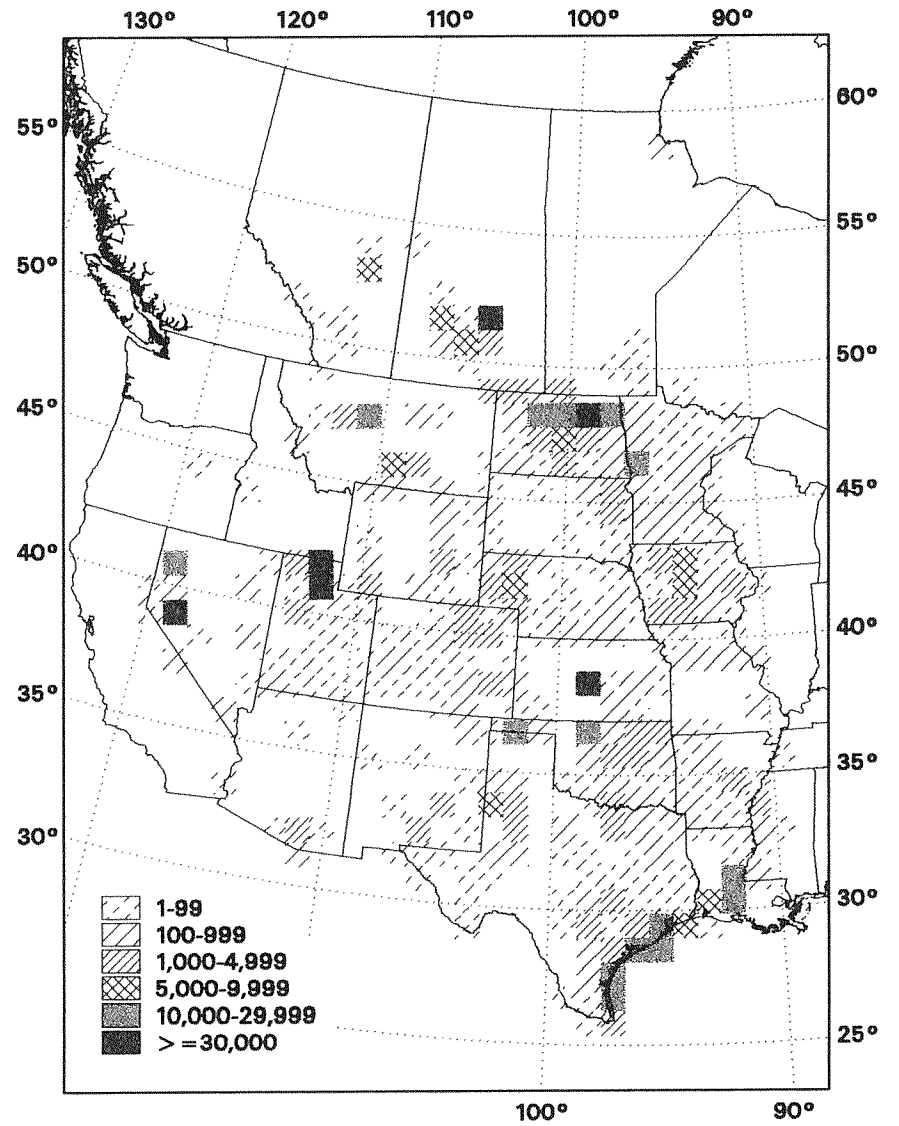
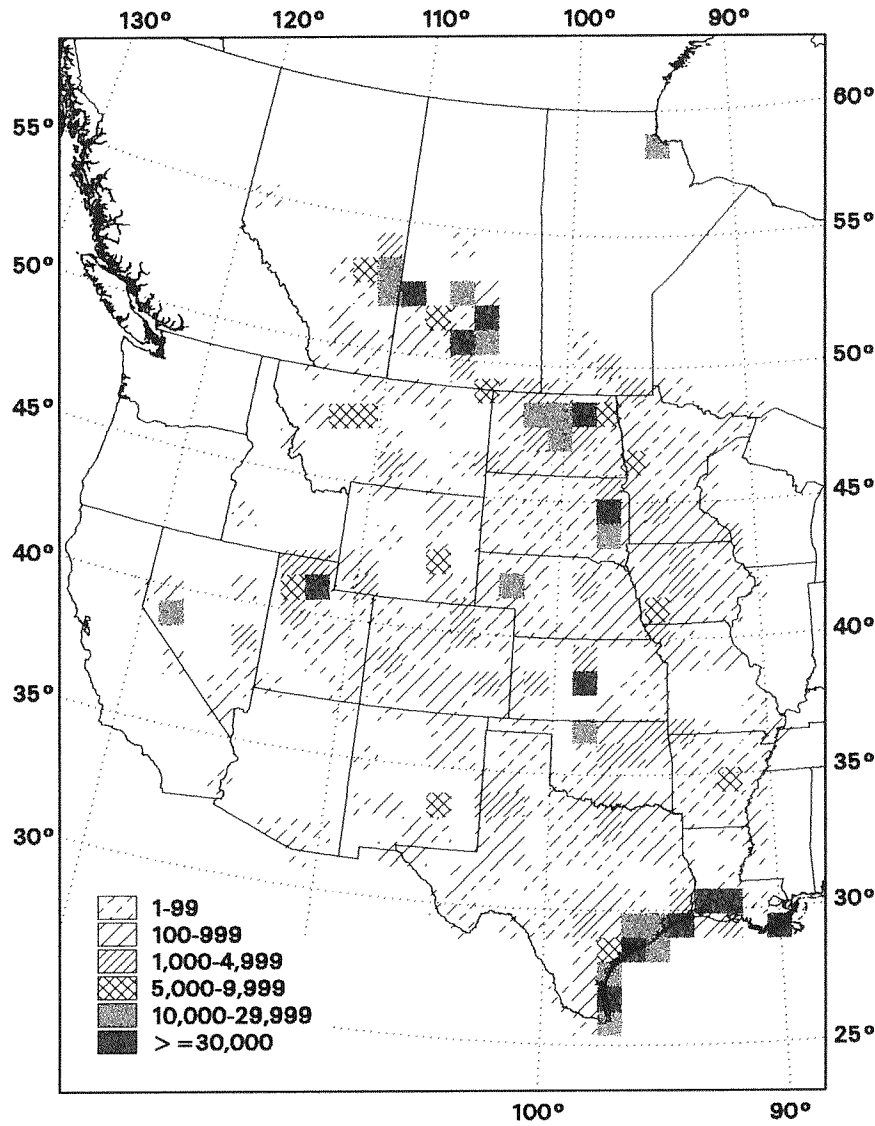
Cheyenne Bottoms Wildlife Management Area, Kansas  
Minnewaukan Flats, Devil's Lake, North Dakota  
Quill Lakes, Saskatchewan  
Chaplin Lakes, Saskatchewan  
Dry Lake, Clark County, South Dakota  
Salt Plains National Wildlife Refuge, Oklahoma



# Intermediate distance migrants

## January-June

## July-December



## Intermediate Distance Migrants

Black-bellied Plover	Sanderling
Semipalmated Plover	Semipalmated Sandpiper
Greater Yellowlegs	Western Sandpiper
Lesser Yellowlegs	Least Sandpiper
Solitary Sandpiper	Dunlin
Spotted Sandpiper	Short-billed Dowitcher
Upland Sandpiper	Long-billed Dowitcher
Whimbrel	Wilson's Phalarope
Ruddy Turnstone	Red-necked Phalarope
Red Knot	

**Body Size:** Small, medium, large

**Foraging Guild:** Terrestrial/aquatic prober/  
gleaner/pelagic gleaner

**Six sites with highest counts:** (see Appendix for more information)

Cheyenne Bottoms Wildlife Management Area, Kansas

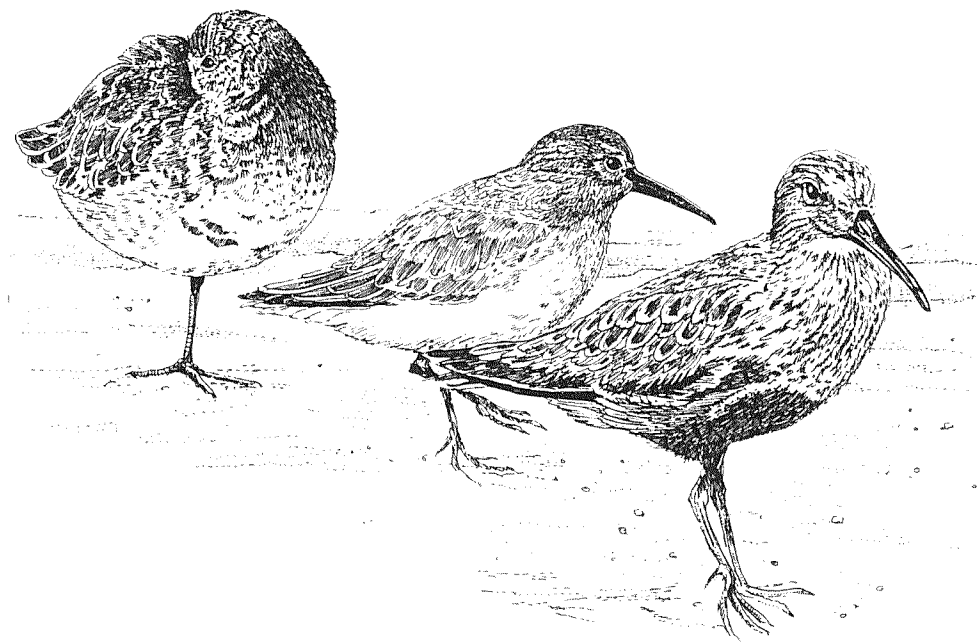
Great Salt Lake area, Utah

Quill Lakes, Saskatchewan

Laguna Atascosa National Wildlife Refuge, Texas

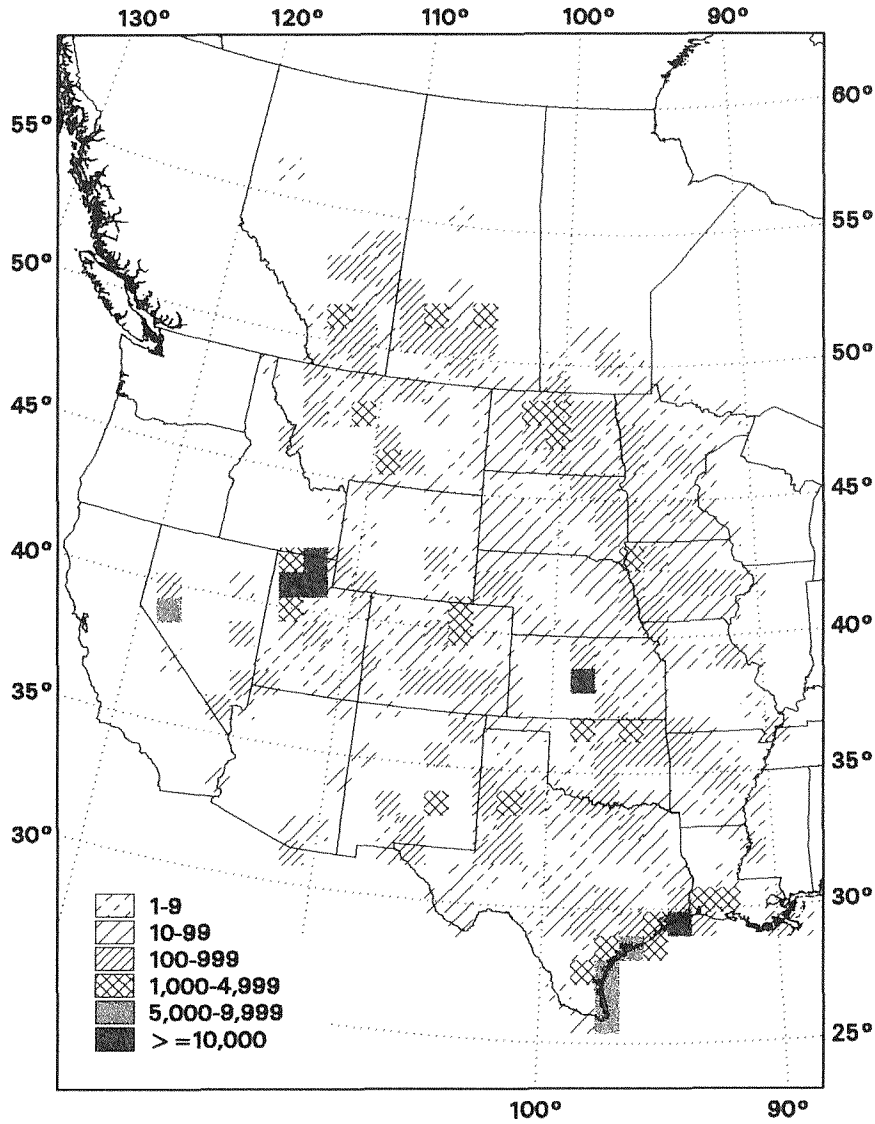
Lahontan Valley, Nevada, including Carson Lake  
and Stillwater National Wildlife Refuge

Minnewaukan Flats, Devil's Lake, North Dakota

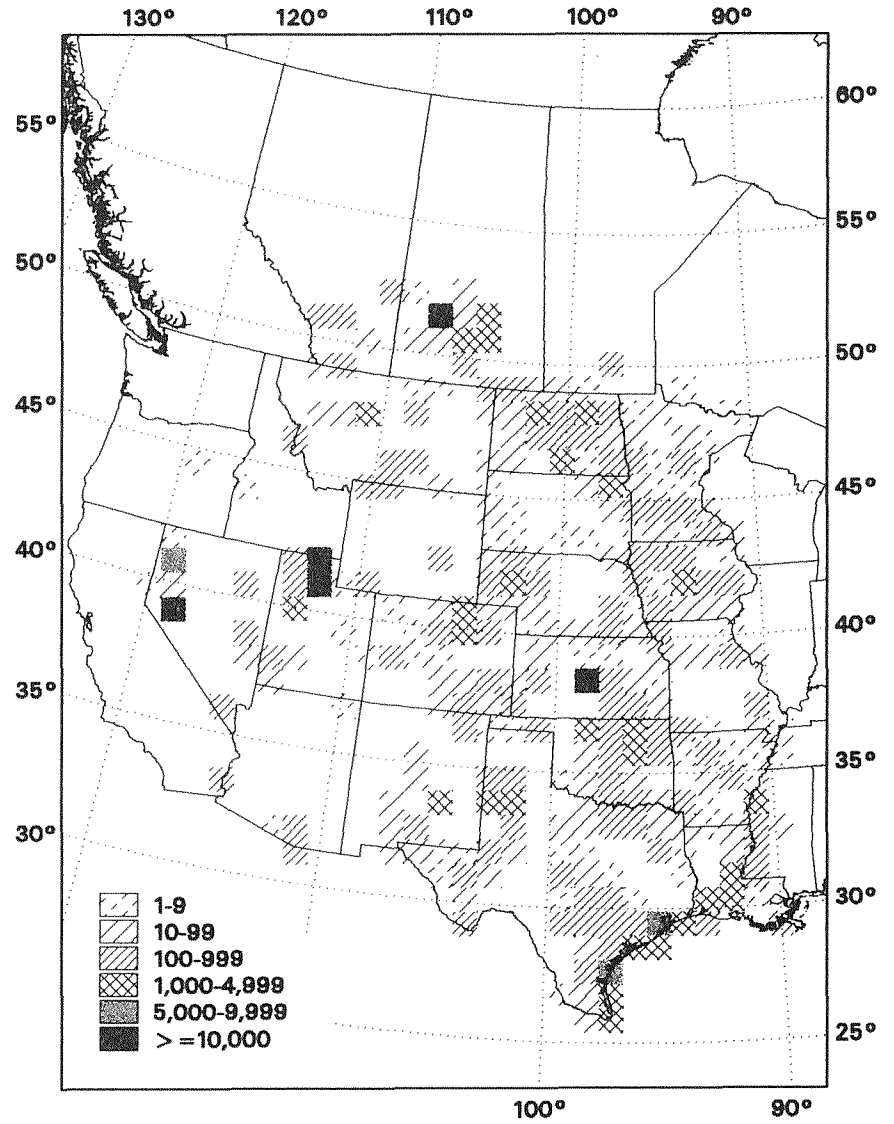


# Short distance migrants

## January-June



## July-December



## Short Distance Migrants

Snowy Plover  
Piping Plover  
Wilson's Plover  
Killdeer  
Mountain Plover  
Black-necked Stilt  
American Avocet  
Willet  
Long-billed Curlew  
Marbled Godwit  
Common Snipe

**Body Size:** Large

**Foraging Guild:** Terrestrial/aquatic prober/  
gleaner/sweeper

**Six sites with highest counts:** (see Appendix for more information)

Great Salt Lake area, Utah

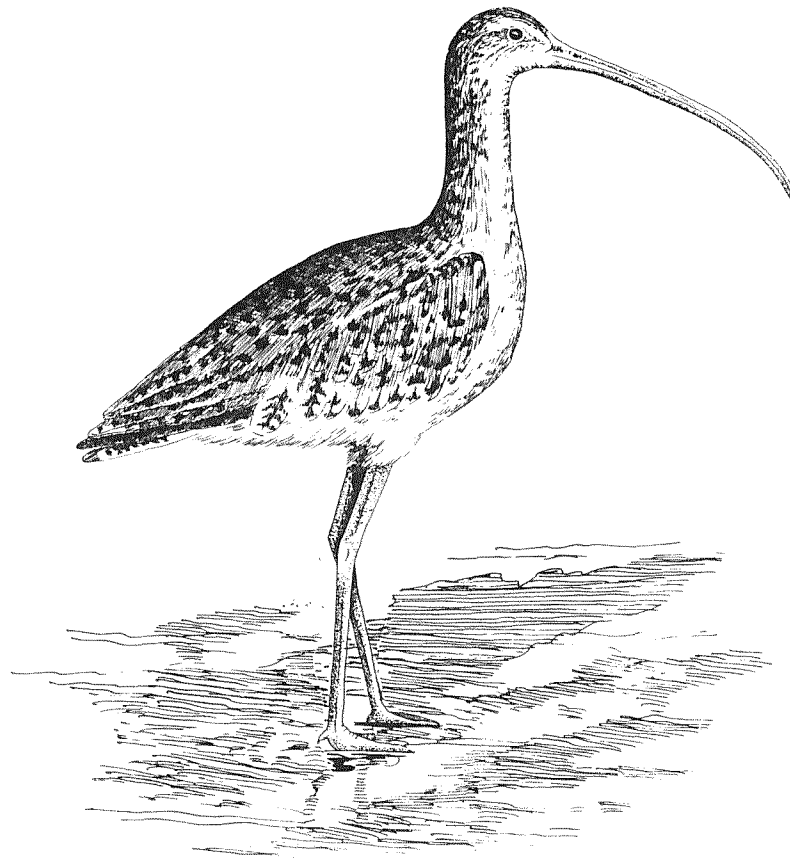
Lahontan Valley, Nevada, including Carson Lake  
and Stillwater National Wildlife Refuge

Cheyenne Bottoms Wildlife Management Area, Kansas

Bolivar Flats, Galveston Island, Texas

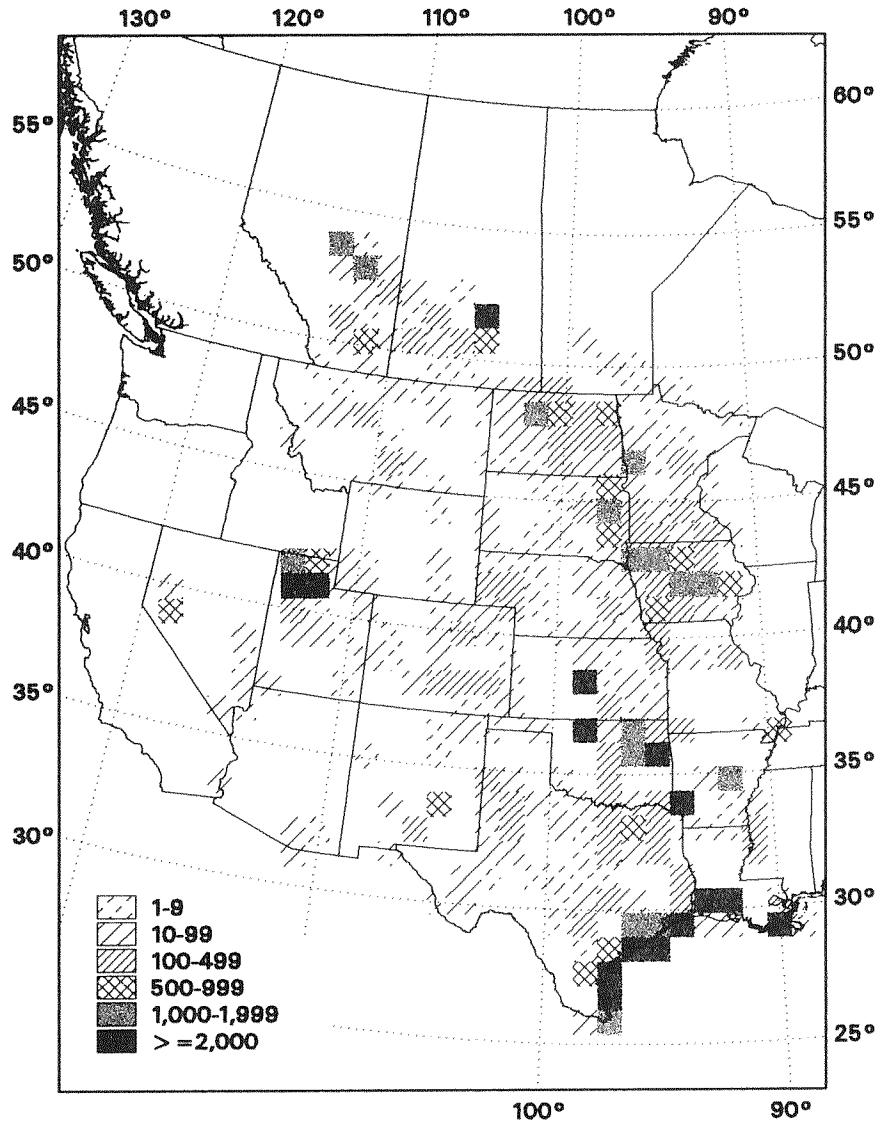
19 km west of Luck Lake, Saskatchewan

Boca Chica Beach, Cameron County, Texas

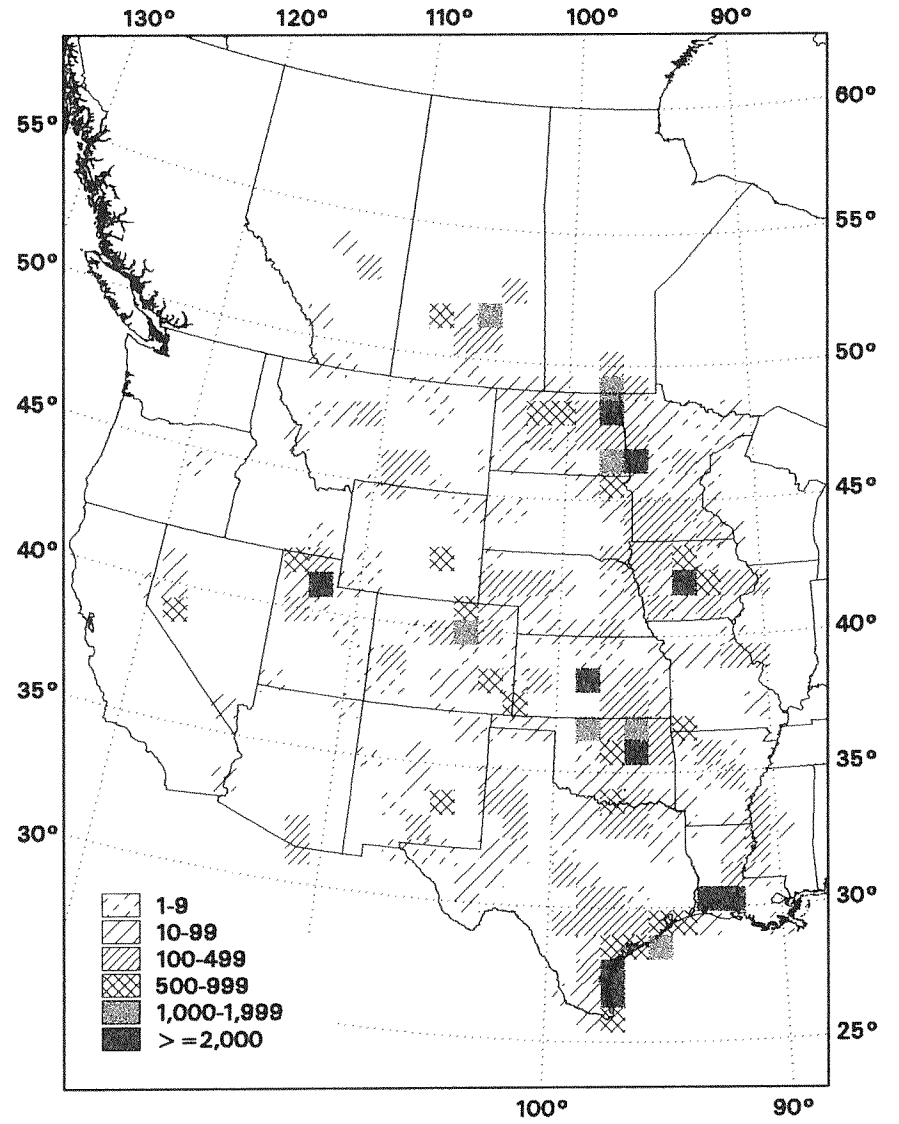


# All plovers

## January-June



## July-December





**All Plovers**

- Black-bellied Plover
- American Golden-Plover
- Snowy Plover
- Wilson's Plover
- Semipalmated Plover
- Piping Plover
- Killdeer
- Mountain Plover

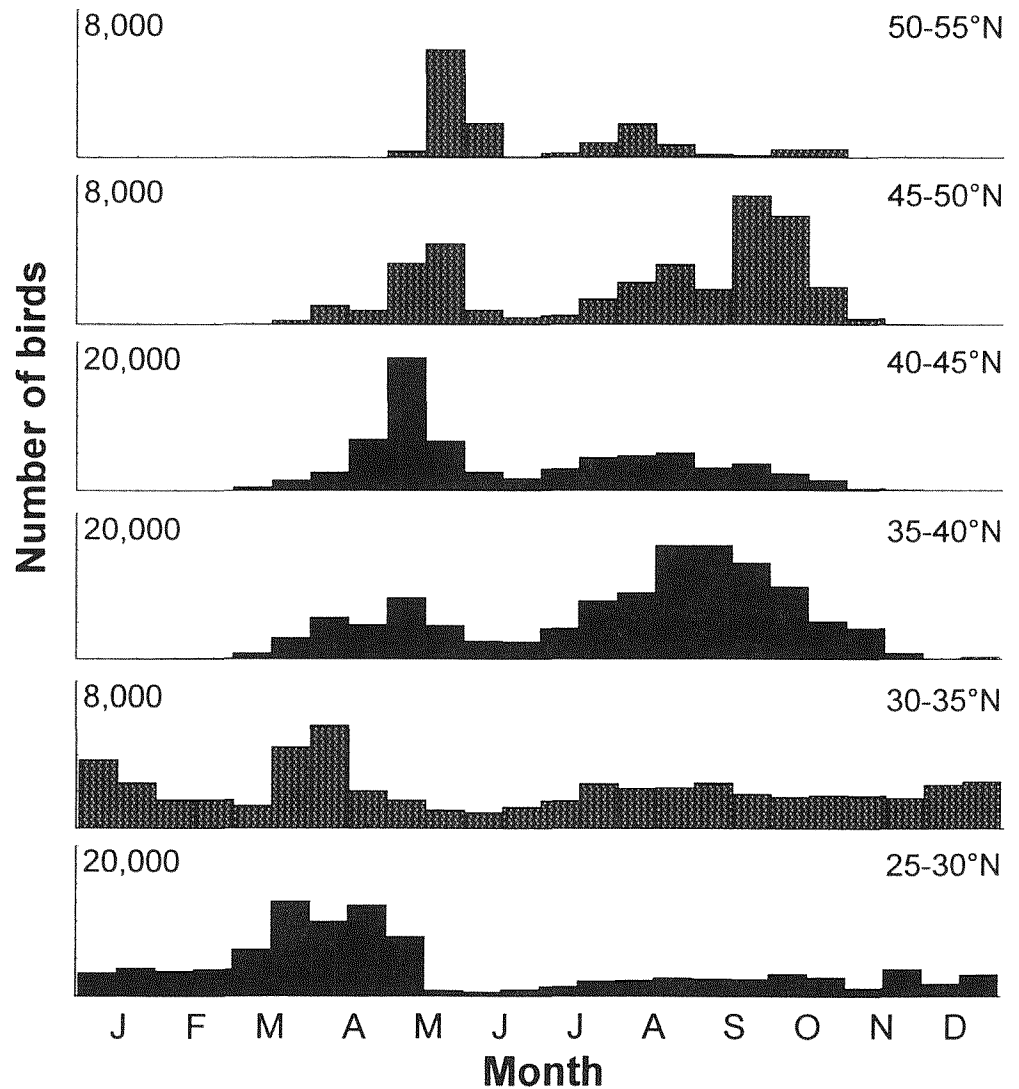
**Body Size:** Small, medium

**Foraging Guild:** Terrestrial/aquatic gleaner

**Foraging Habitat:** Water depth - dry/wet to 2/10 cm;  
vegetation cover - bare to dense

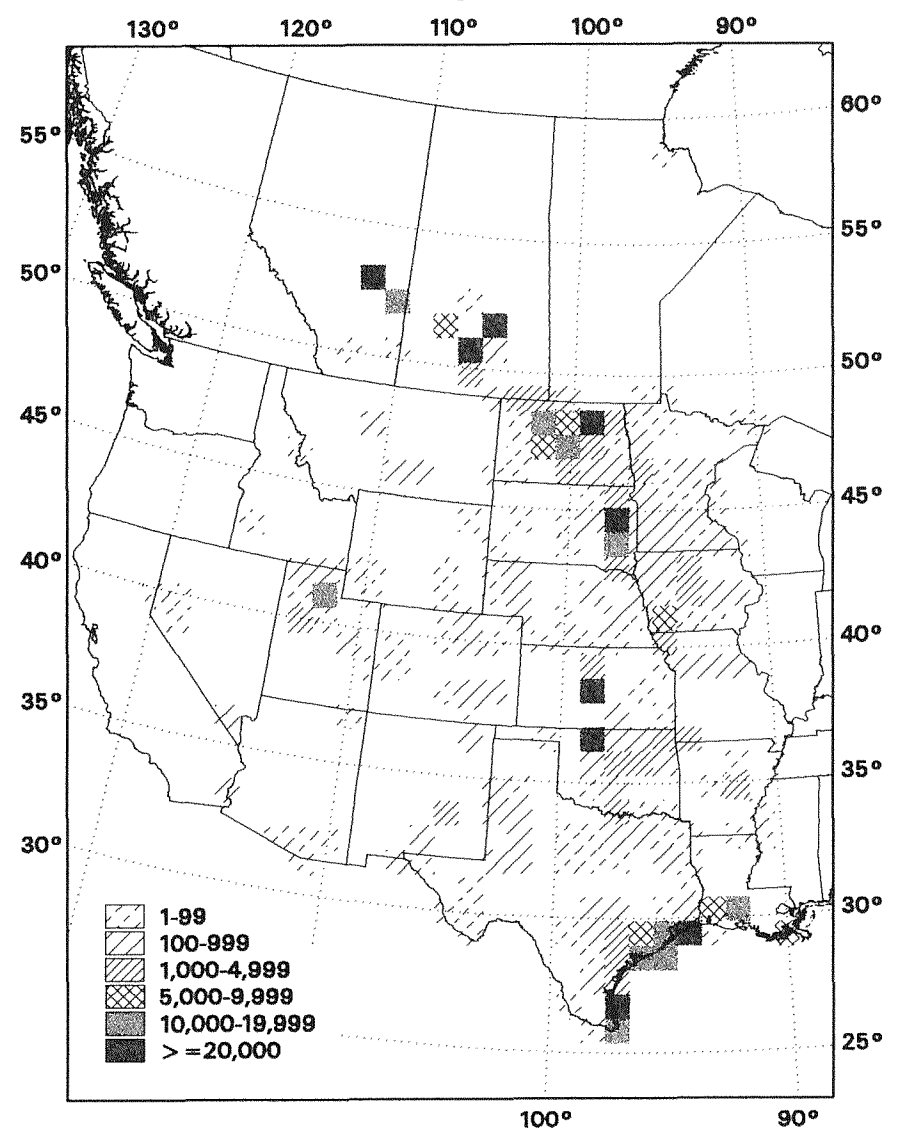
**Six sites with highest counts:** (see Appendix for more information)

- Great Salt Lake area, Utah
- Cheyenne Bottoms Wildlife Management Area, Kansas
- Laguna Atascosa National Wildlife Refuge, Texas
- North Dakota State University, Fargo, North Dakota
- Between Duson and Crowley, Louisiana
- Salt Plains National Wildlife Refuge, Oklahoma

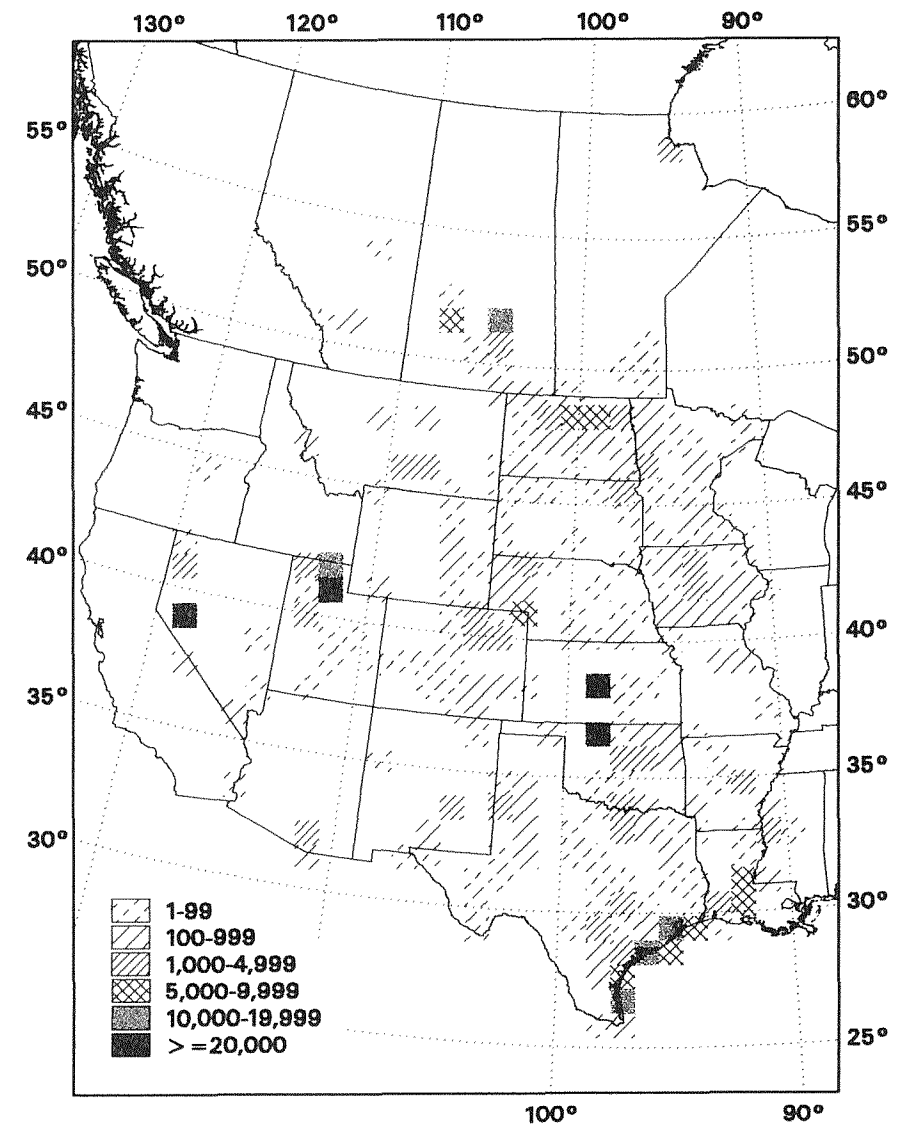


# Small sandpipers

## January-June



## July-December



### Small Sandpipers

Semipalmated Sandpiper  
 Western Sandpiper  
 Least Sandpiper  
 White-rumped Sandpiper  
 Baird's Sandpiper

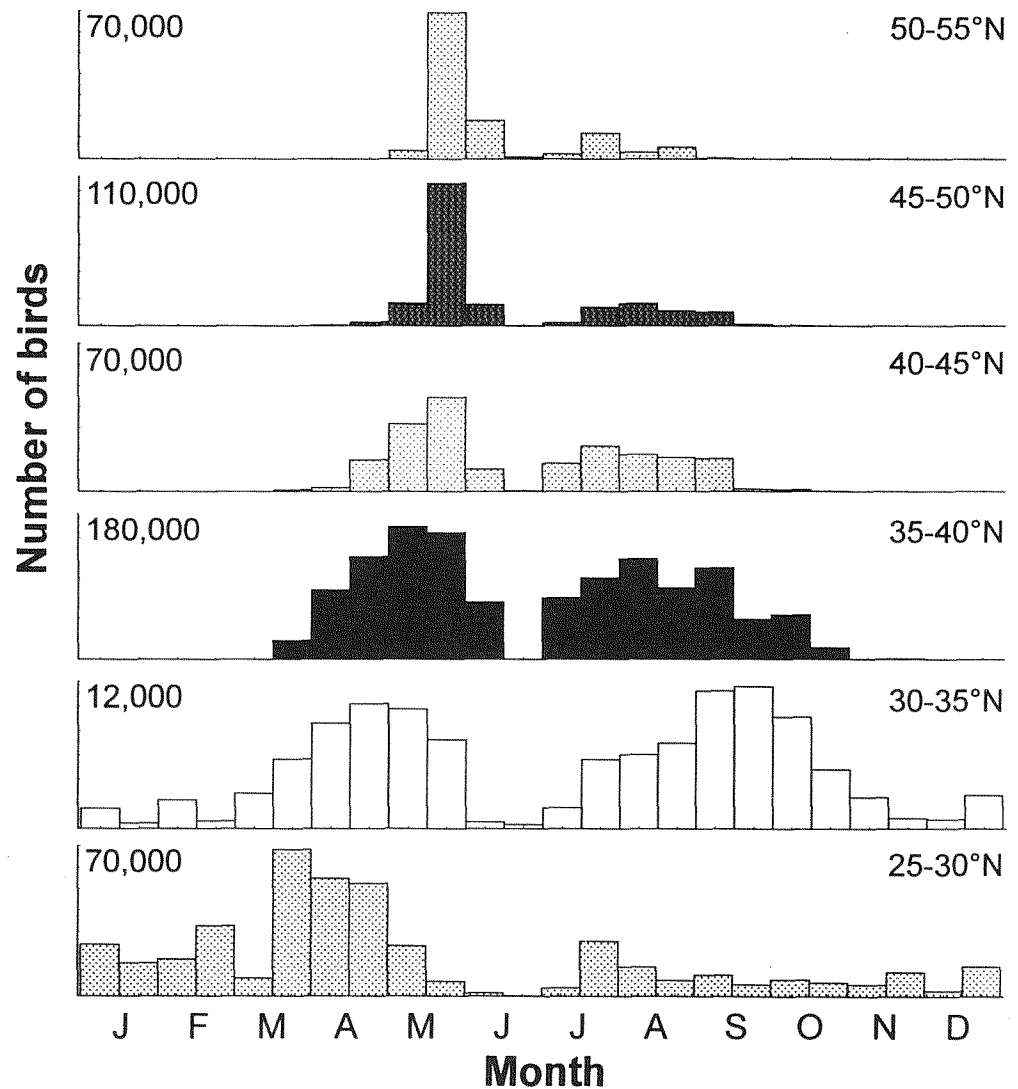
**Body Size:** Small

**Foraging Guild:** Aquatic prober/gleaner

**Foraging Habitat:** Water depth - wet to 4/5 cm;  
 vegetative cover - bare to sparse

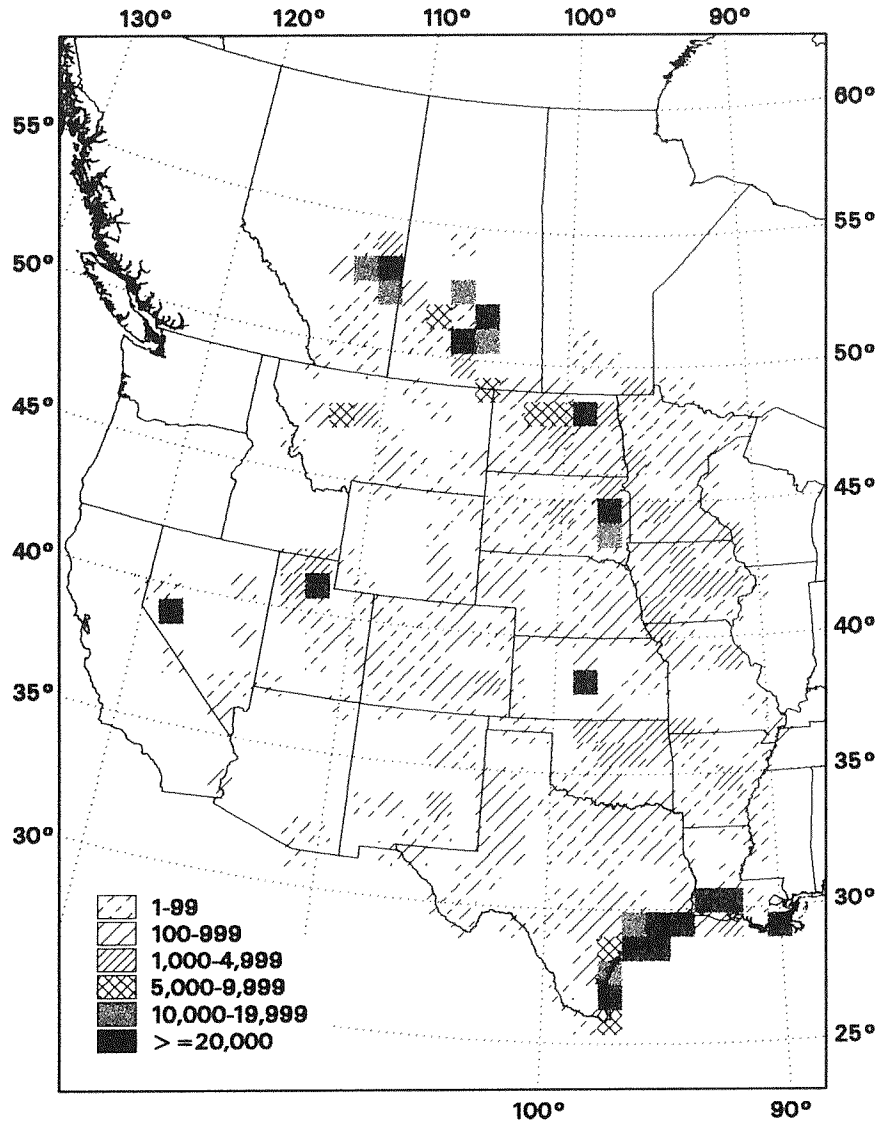
**Six sites with highest counts:** (see Appendix for more information)

Cheyenne Bottoms Wildlife Management Area, Kansas  
 Laguna Atascosa National Wildlife Refuge, Texas  
 Minnewaukan Flats, Devil's Lake, North Dakota  
 Quill Lakes, Saskatchewan  
 Salt Plains National Wildlife Refuge, Oklahoma  
 Carson Lake, Nevada

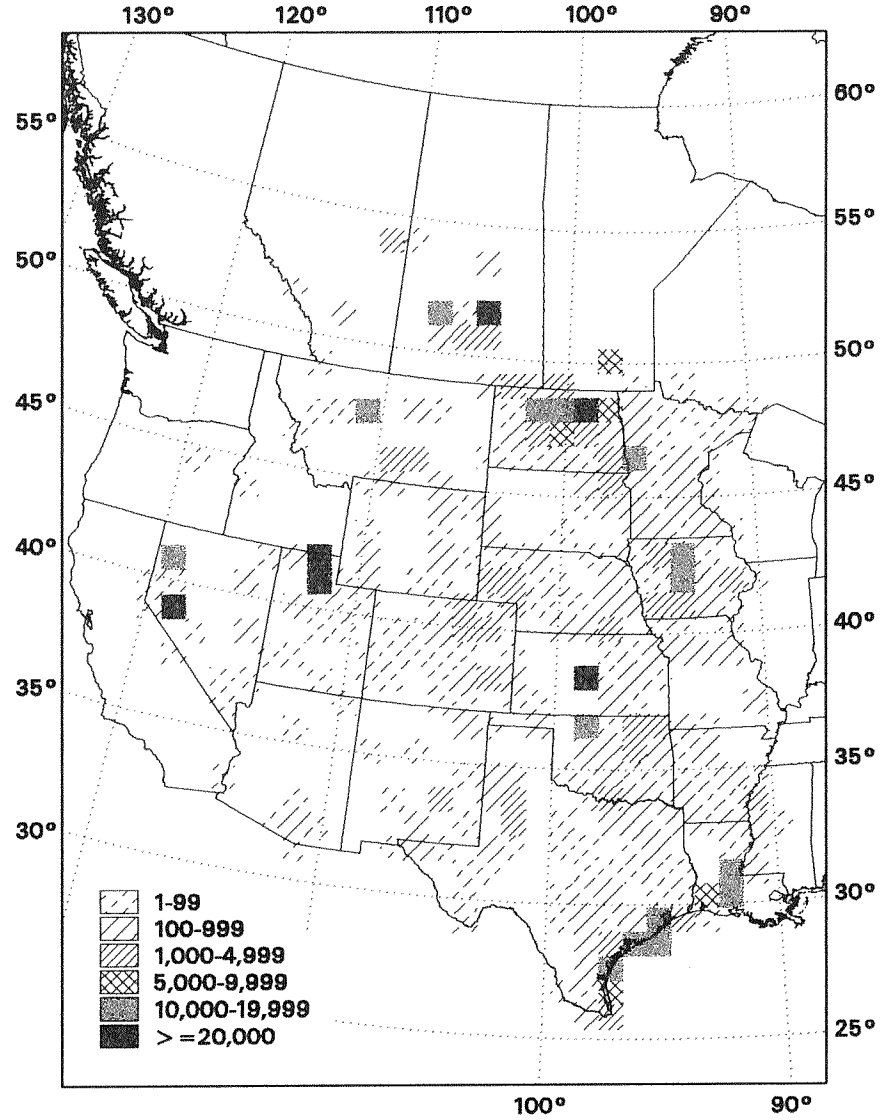


# Medium sandpipers

## January-June



## July-December



## Medium Sandpipers

Greater Yellowlegs  
 Lesser Yellowlegs  
 Solitary Sandpiper  
 Spotted Sandpiper  
 Upland Sandpiper  
 Red Knot  
 Sanderling  
 Pectoral Sandpiper  
 Dunlin  
 Stilt Sandpiper  
 Buff-breasted Sandpiper  
 Short-billed Dowitcher  
 Long-billed Dowitcher

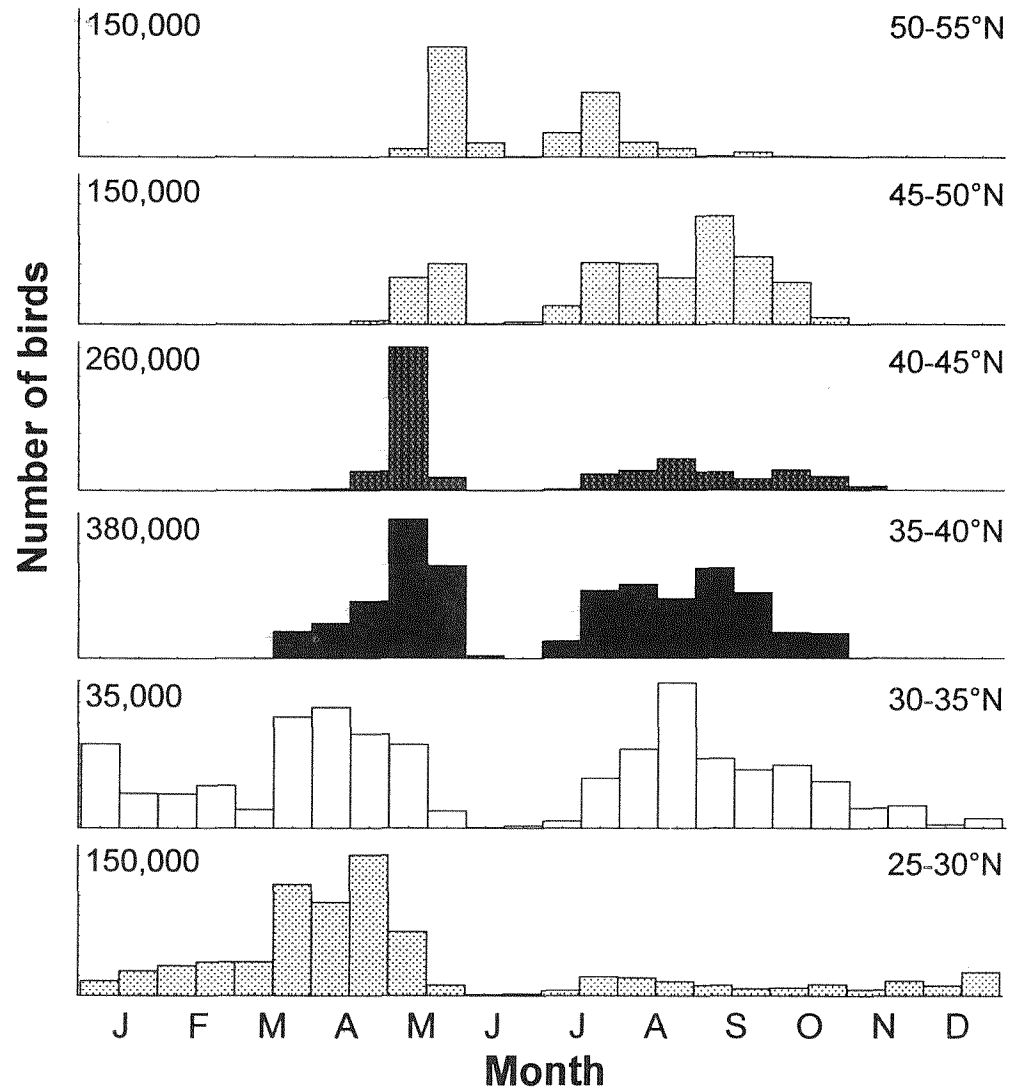
**Body Size:** Medium

**Foraging Guild:** Aquatic prober/gleaner

**Foraging Habitat:** Water depth - dry/wet to 3/12 cm;  
 vegetative cover - bare to dense

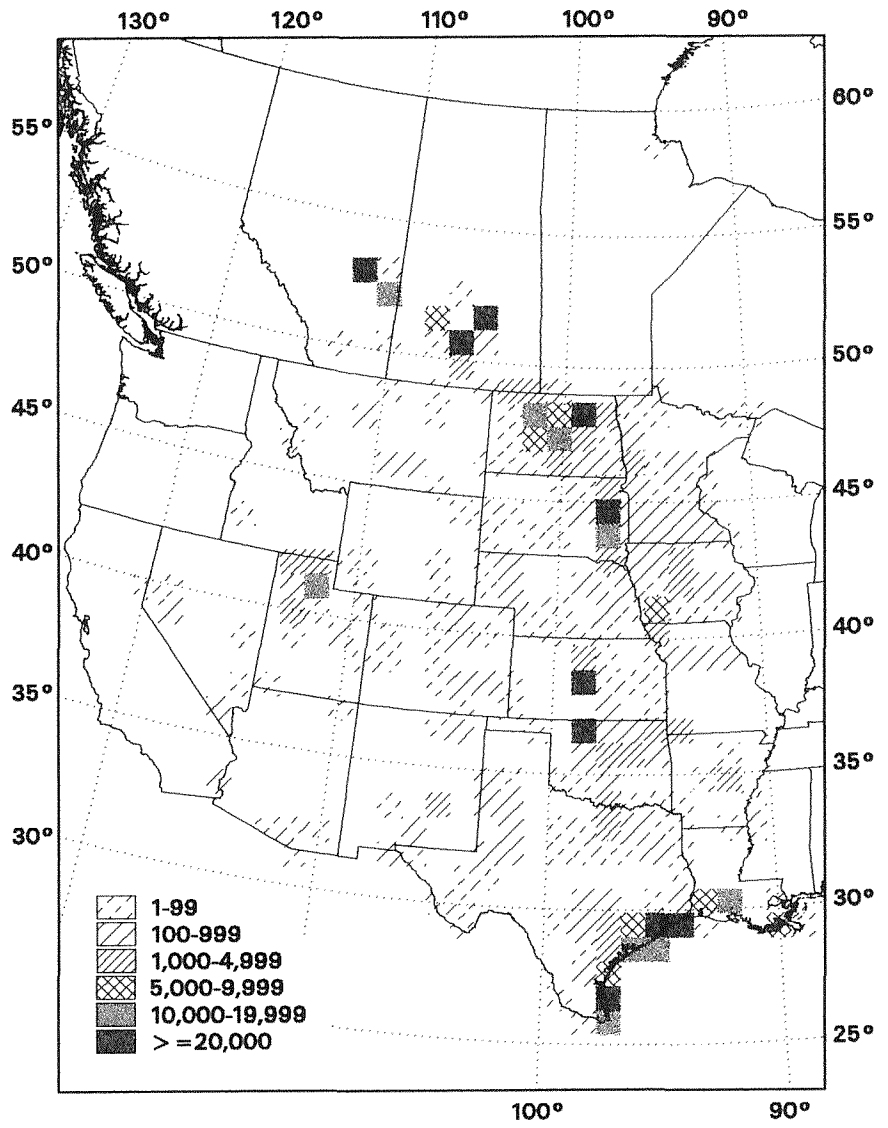
**Six sites with highest counts:** (see Appendix for more information)

Cheyenne Bottoms Wildlife Management Area, Kansas  
 Great Salt Lake area, Utah  
 Quill Lakes, Saskatchewan  
 Minnewaukan Flats, Devil's Lake, North Dakota  
 Lahontan Valley, Nevada, including Carson Lake  
 and Stillwater National Wildlife Refuge  
 Laguna Atascosa National Wildlife Refuge, Texas

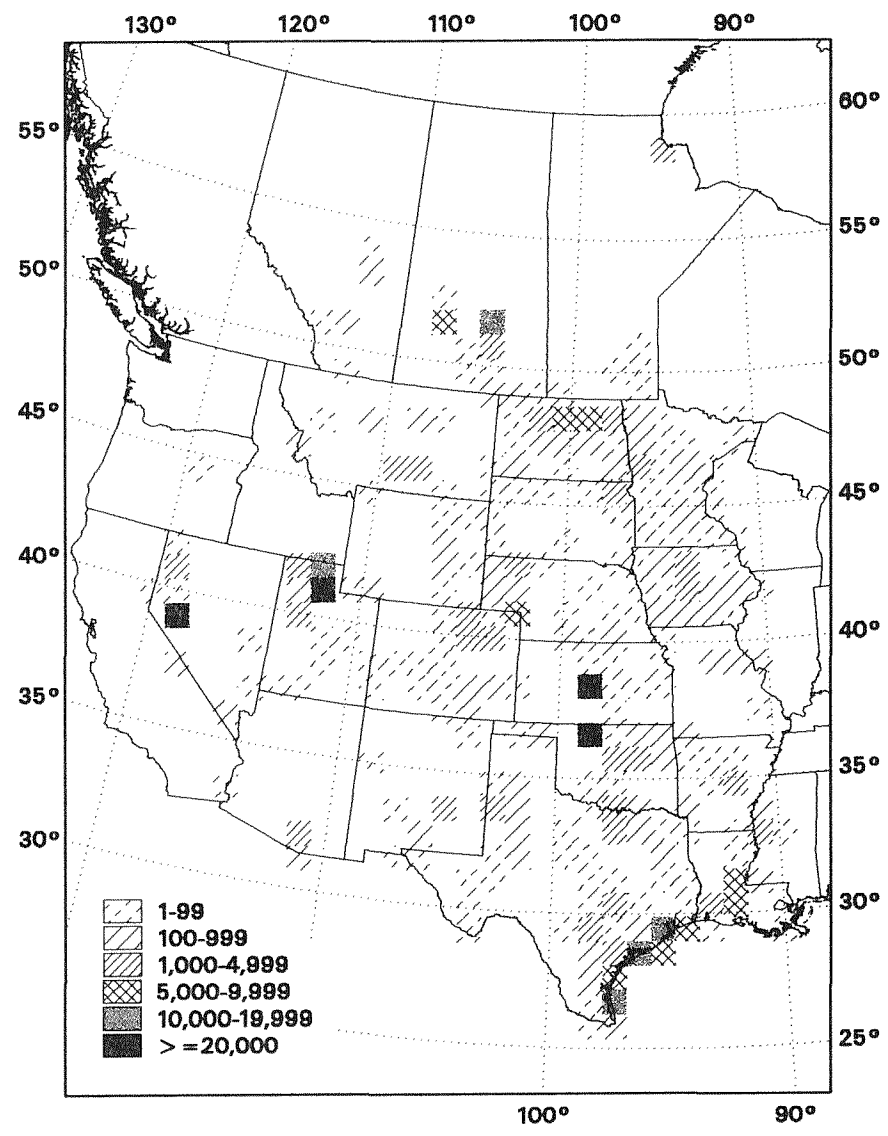


# All small shorebirds

## January-June



## July-December



**Small Shorebirds**

- Snowy Plover
- Wilson's Plover
- Semipalmated Plover
- Piping Plover
- Semipalmated Sandpiper
- Western Sandpiper
- Least Sandpiper
- White-rumped Sandpiper
- Baird's Sandpiper

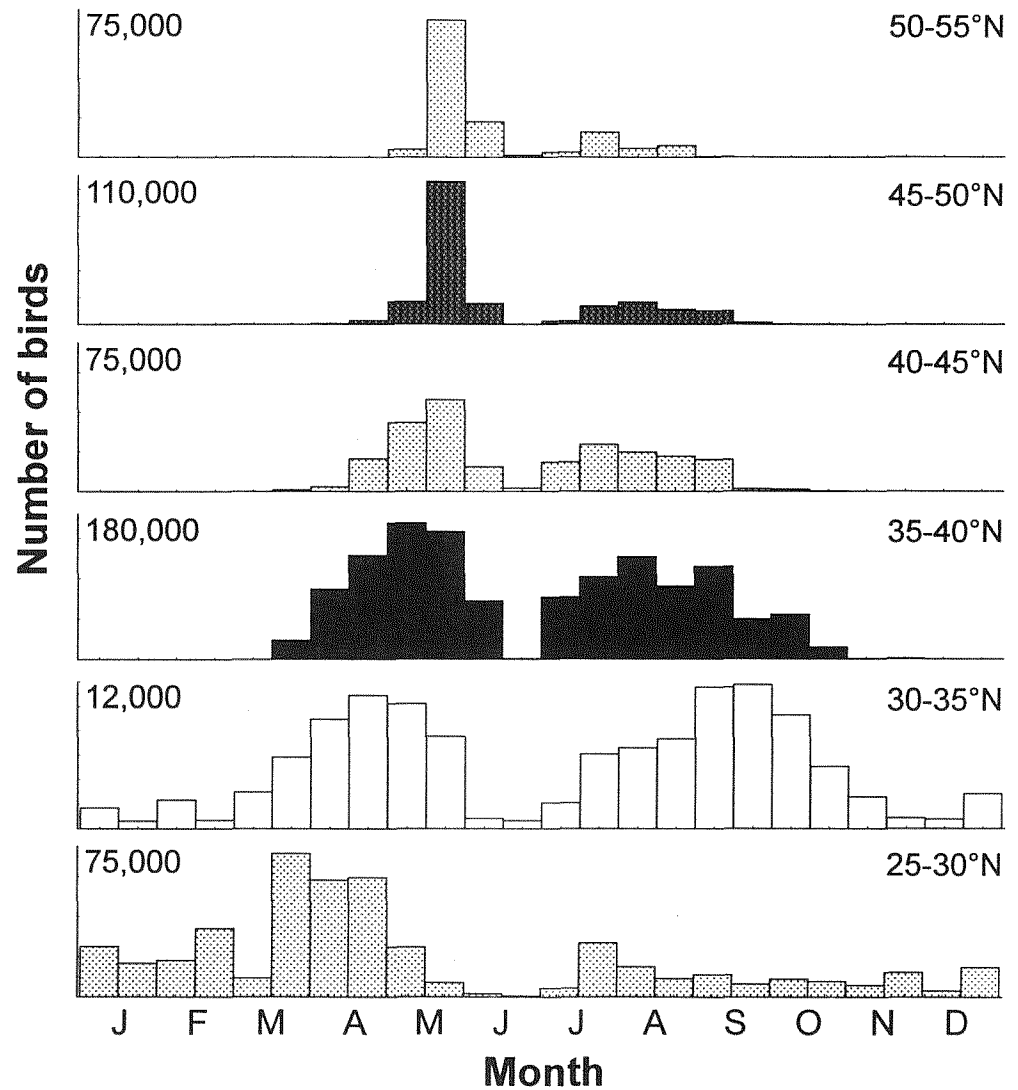
**Body Size:** Small

**Foraging Guild:** Terrestrial/aquatic prober/gleaner

**Foraging Habitat:** Water depth - dry/wet to 3/5 cm;  
vegetative cover - bare to sparse

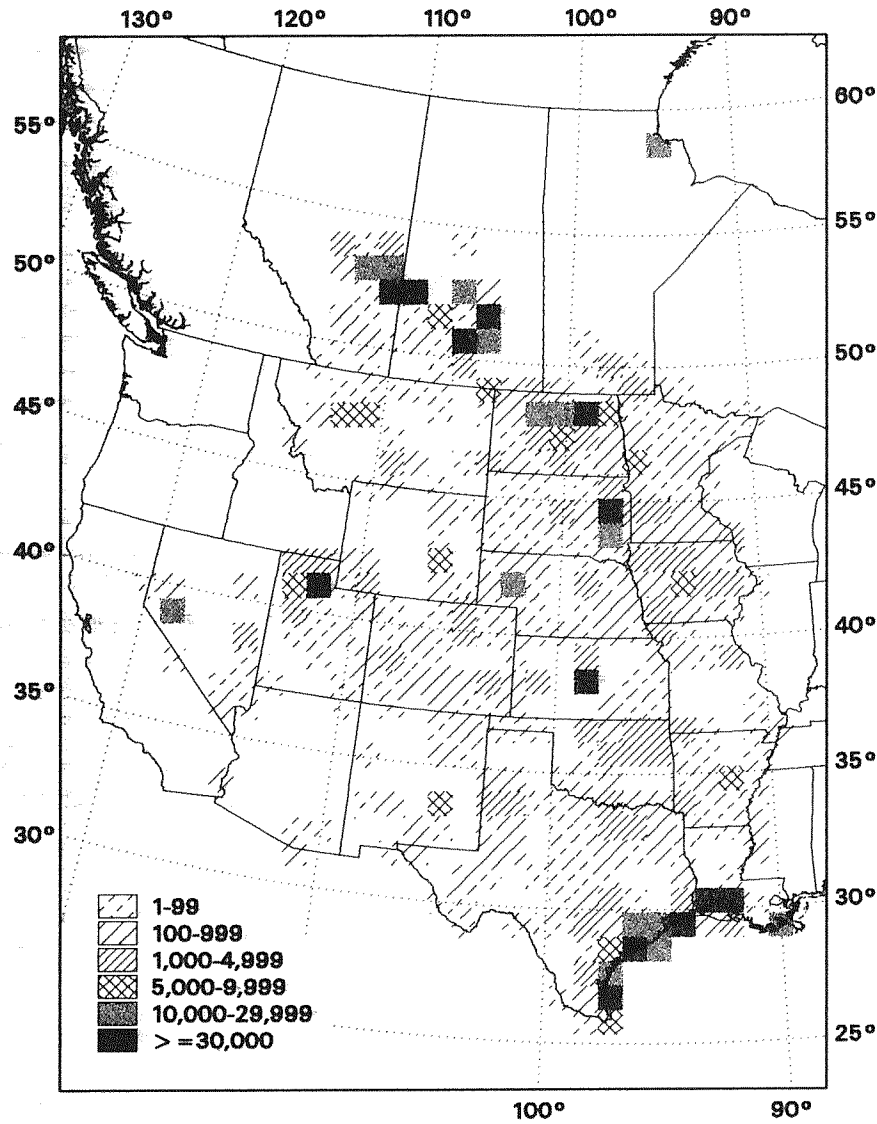
**Six sites with highest counts:** (see Appendix for more information)

- Cheyenne Bottoms Wildlife Management Area, Kansas
- Laguna Atascosa National Wildlife Refuge, Texas
- Minnewaukan Flats, Devil's Lake, North Dakota
- Quill Lakes, Saskatchewan
- Salt Plains National Wildlife Refuge, Oklahoma
- Carson Lake, Nevada

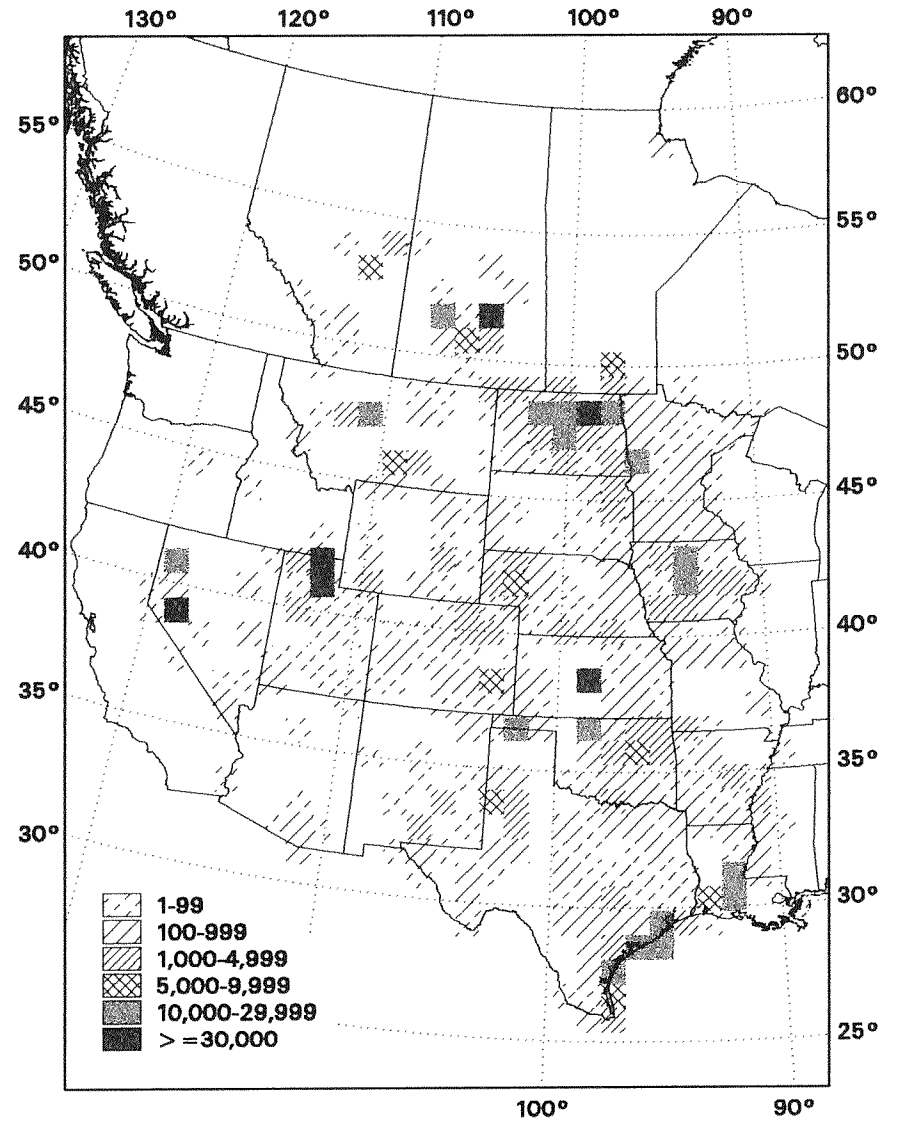


# All medium shorebirds

## January-June



## July-December





## Medium Shorebirds

Black-bellied Plover	Sanderling
American Golden-Plover	Pectoral Sandpiper
Killdeer	Dunlin
Mountain Plover	Stilt Sandpiper
Greater Yellowlegs	Buff-breasted Sandpiper
Lesser Yellowlegs	Short-billed Dowitcher
Solitary Sandpiper	Long-billed Dowitcher
Spotted Sandpiper	Common Snipe
Ruddy Turnstone	Wilson's Phalarope
Red Knot	Red-necked Phalarope
Upland Sandpiper	

**Body Size:** Medium

**Foraging Guild:** Terrestrial/aquatic prober/  
gleaner/pelagic gleaner

**Foraging Habitat:** Water depth - dry/wet to 2/12/deep;  
vegetative cover - bare to dense

**Six sites with highest counts:** (see Appendix for more information)

Cheyenne Bottoms Wildlife Management Area, Kansas

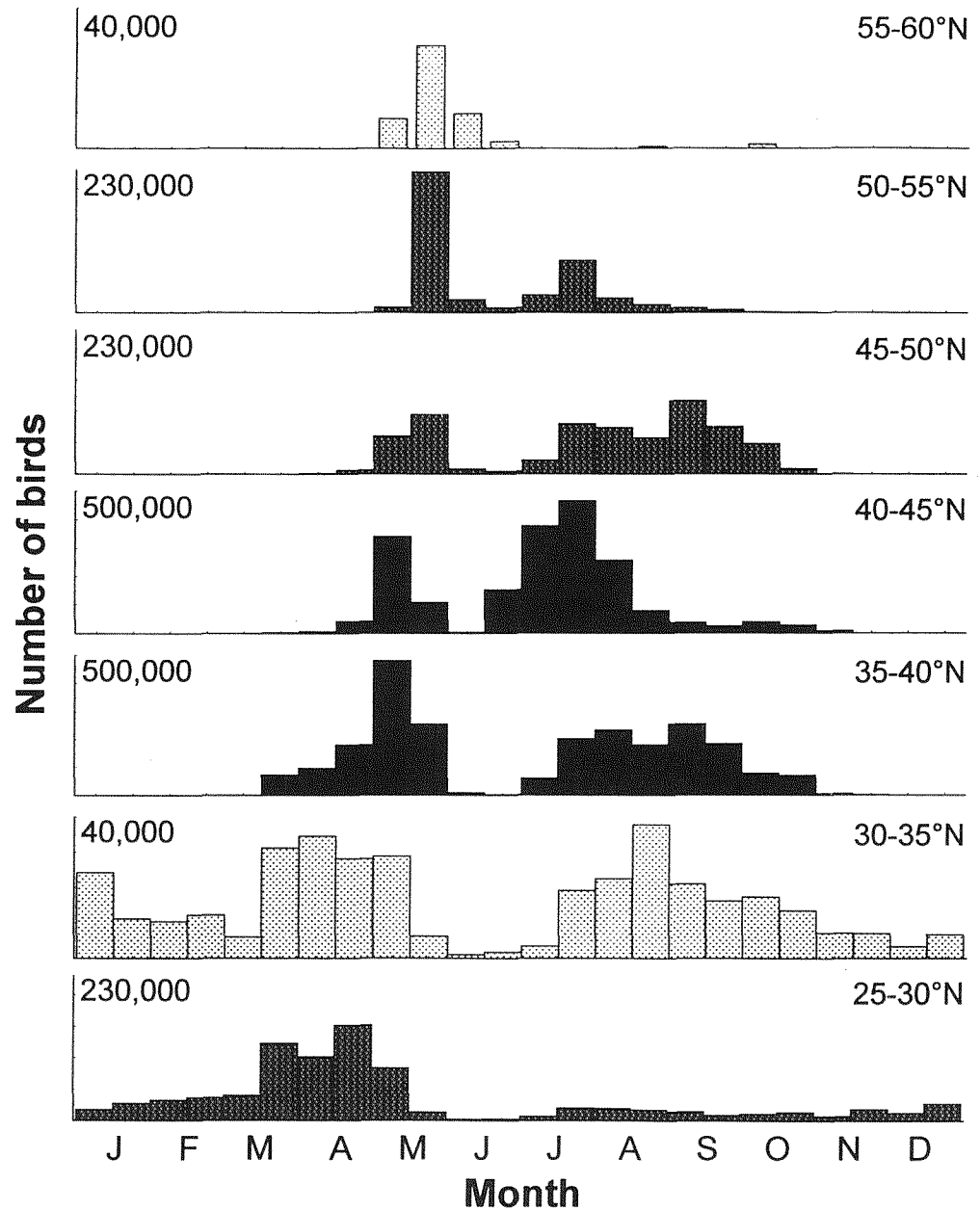
Great Salt Lake area, Utah

Quill Lakes, Saskatchewan

Minnewaukan Flats, Devil's Lake, North Dakota

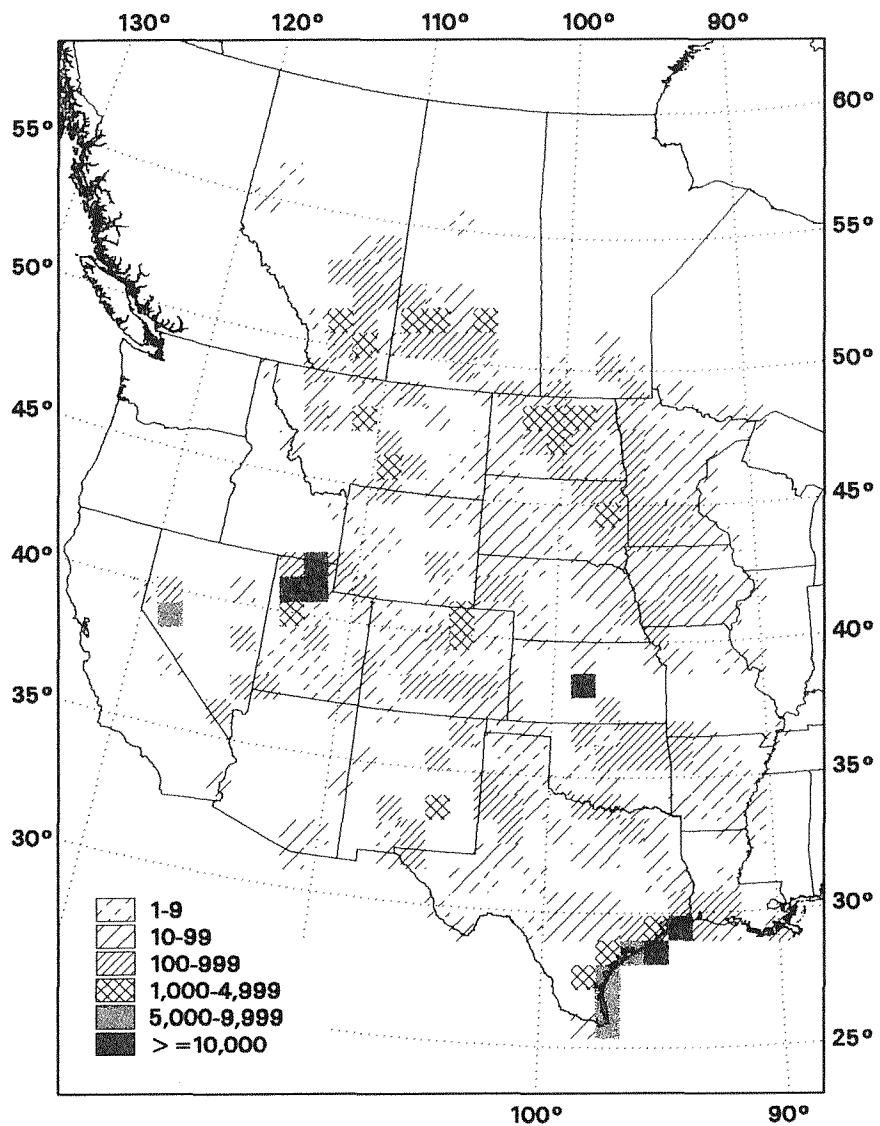
Lahontan Valley, Nevada, including Carson Lake  
and Stillwater National Wildlife Refuge

Laguna Atascosa National Wildlife Refuge, Texas

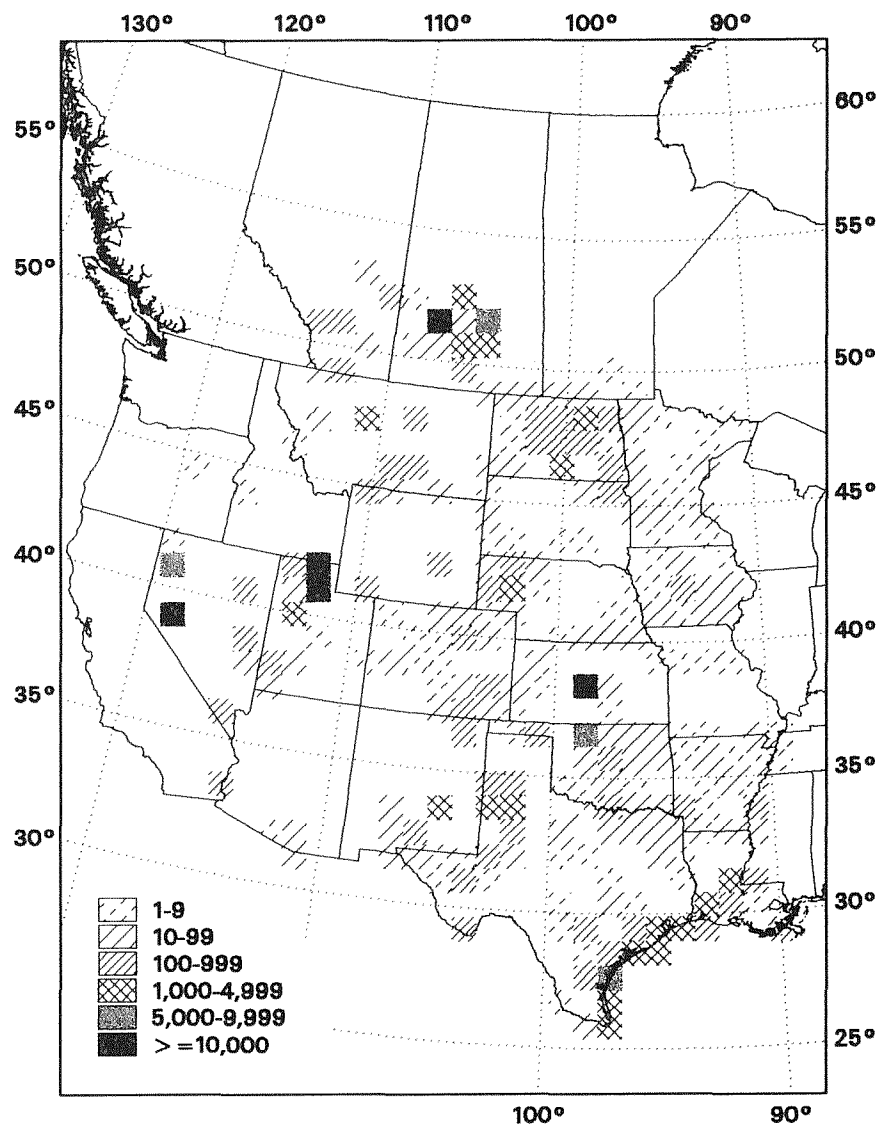


# All large shorebirds

## January-June



## July-December



## Large Shorebirds

Black-necked Stilt  
 American Avocet  
 Willet  
 Whimbrel  
 Long-billed Curlew  
 Hudsonian Godwit  
 Marbled Godwit

**Body Size:** Large

**Foraging Guild:** Terrestrial/aquatic prober/  
 gleaner/sweeper

**Foraging Habitat:** Water depth - dry/1cm to 9/20 cm;  
 vegetative cover - bare to dense

**Six sites with highest counts:** (see Appendix for more information)

Great Salt Lake area, Utah

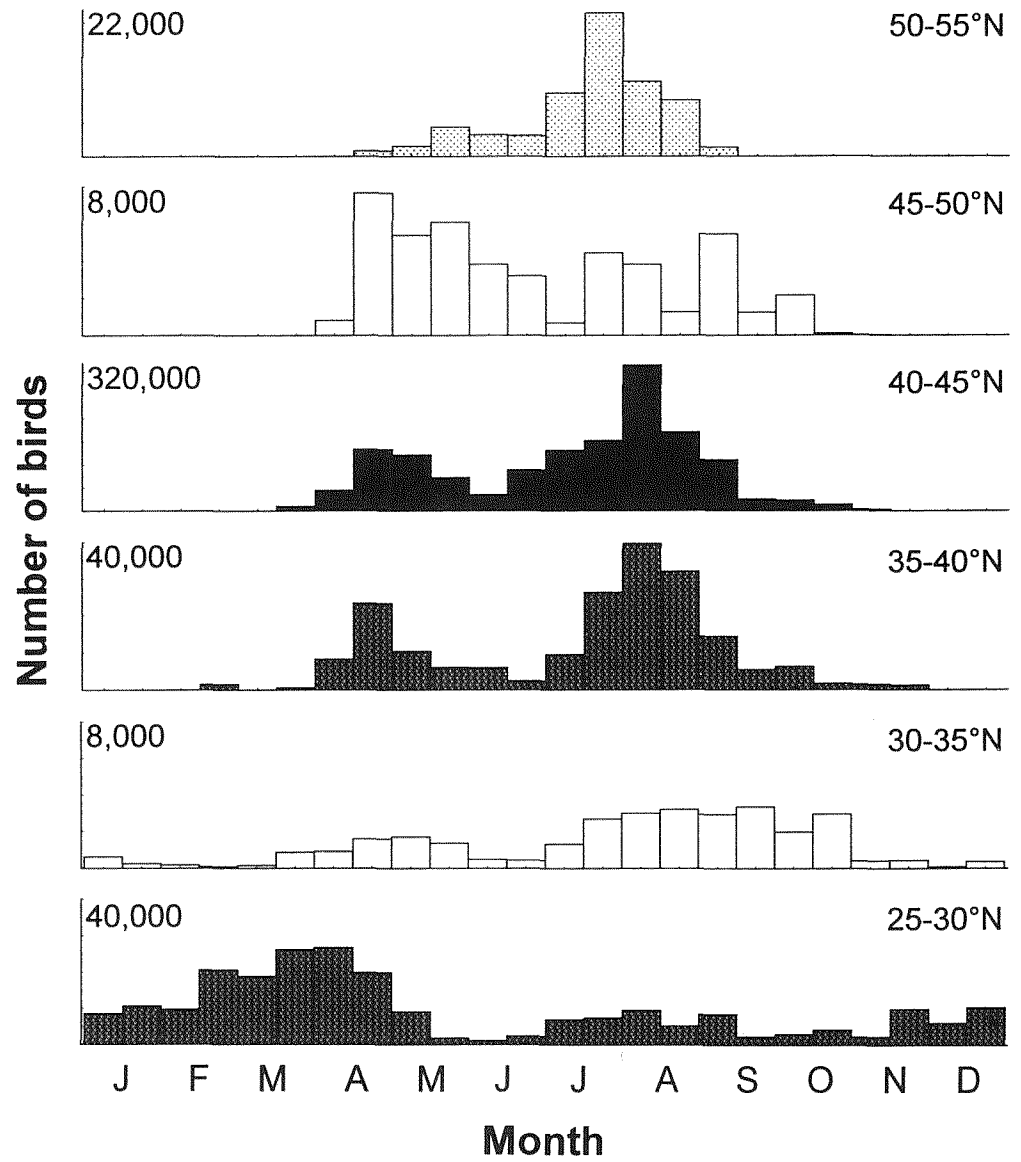
Lahontan Valley, Nevada, including Carson Lake  
 and Stillwater National Wildlife Refuge

Bolivar Flats, Galveston Island, Texas

Cheyenne Bottoms Wildlife Management Area, Kansas

19 km west of Luck Lake, Saskatchewan

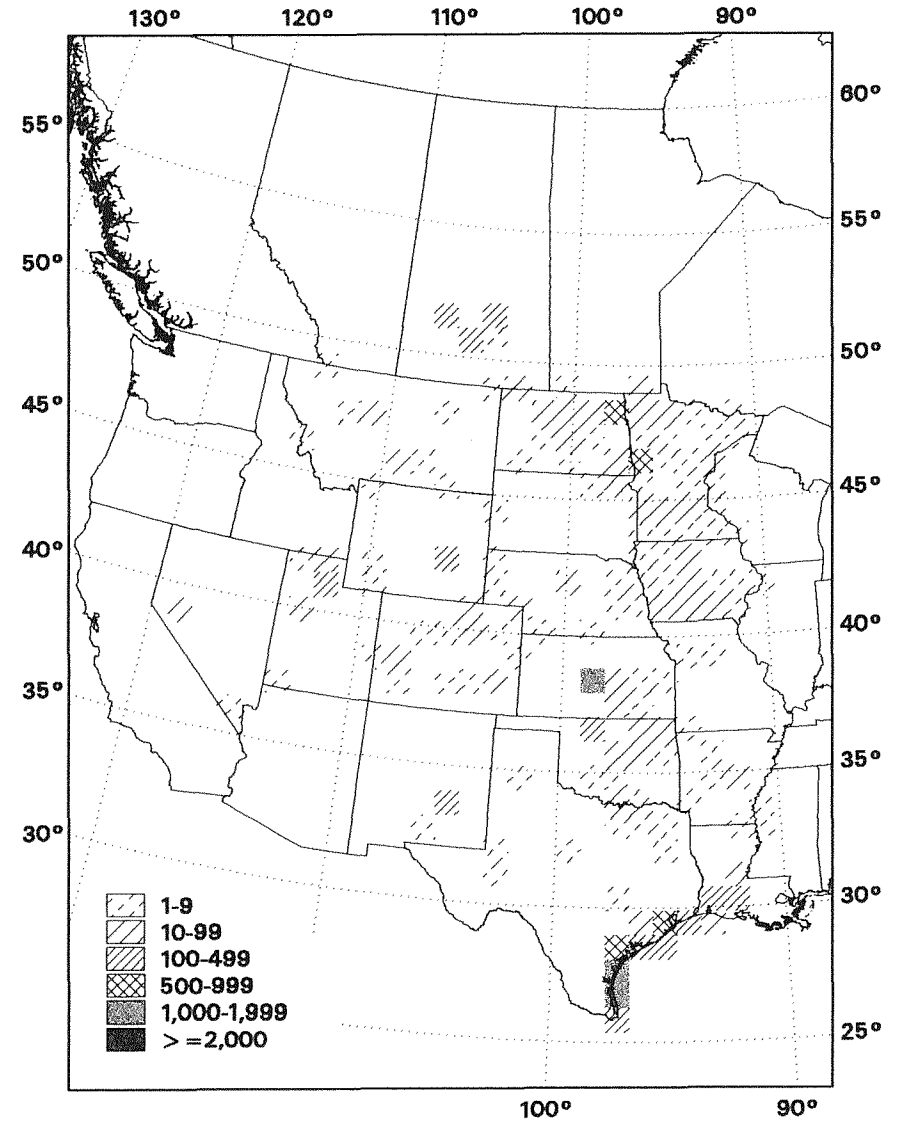
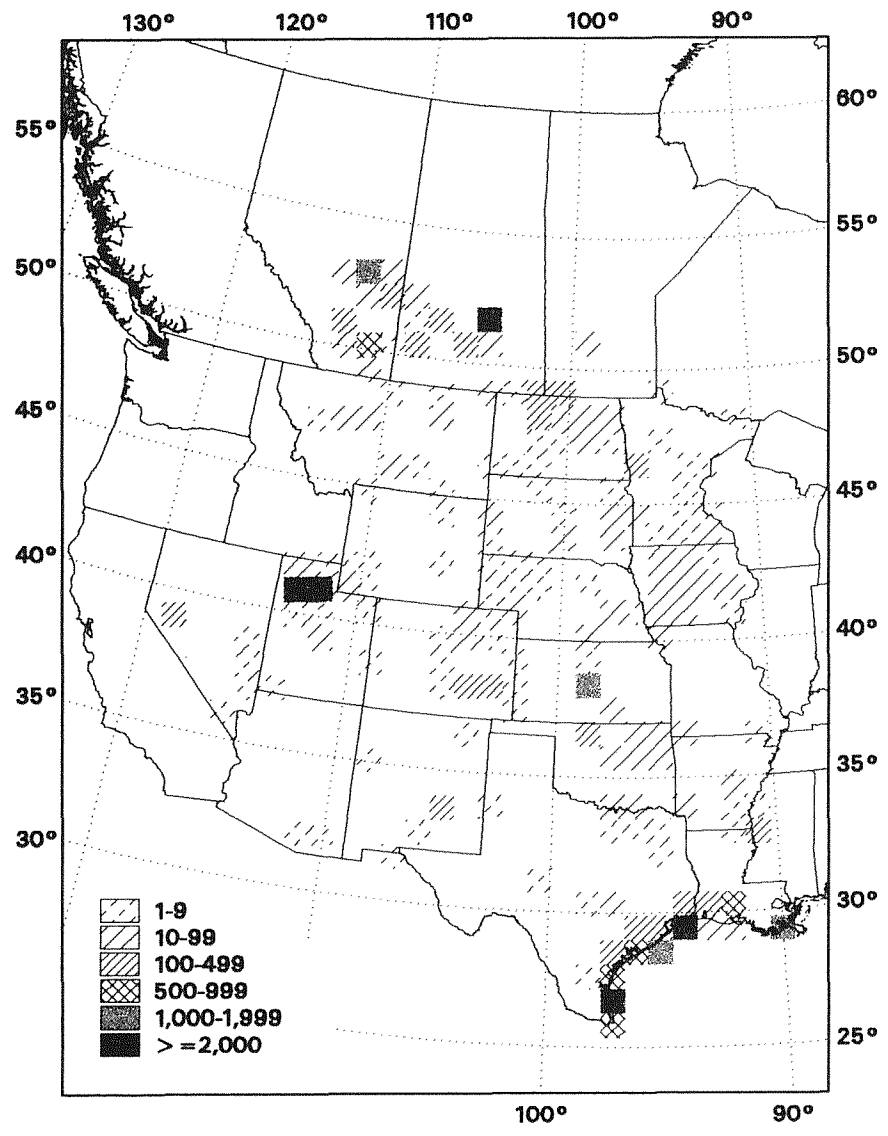
San Bernard National Wildlife Refuge, Texas



# Black-bellied Plover

## January-June

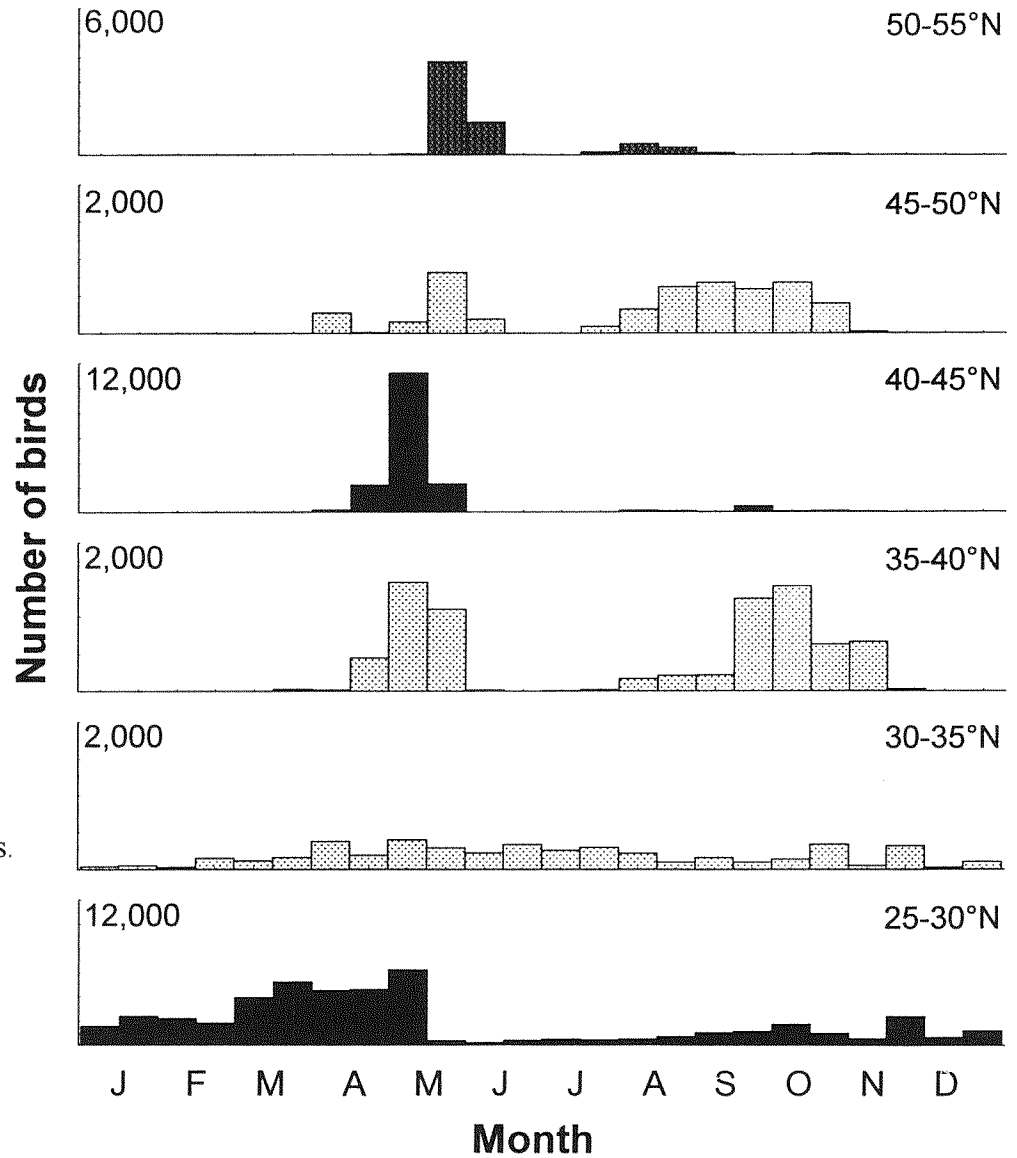
## July-December



**Black-bellied Plover (*Pluvialis squatarola*)**

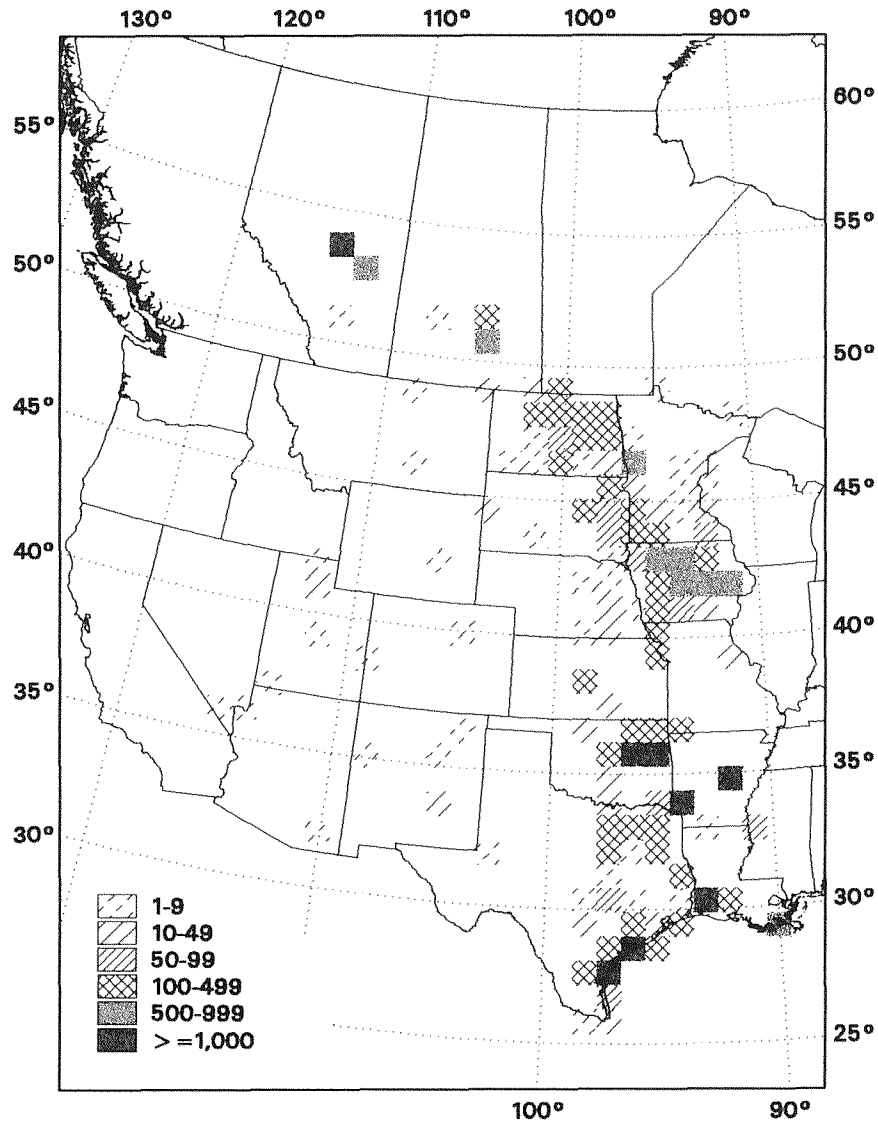


**Body Size:** Medium  
**Foraging Guild:** Terrestrial/aquatic gleaner  
**Foraging Habitat:** Water depth - wet to 10 cm;  
 vegetative cover - bare to dense  
**Migration Distance:** Intermediate  
**Migration Pattern:** Widespread  
**Dispersion:** Broadly dispersed; 60% of total maximum sightings occur in 10 spring and 14 fall 0.1° lat-long blocks.  
**Six sites with highest counts:** (see Appendix for more information)  
 Great Salt Lake area, Utah  
 Laguna Atascosa National Wildlife Refuge, Texas  
 Quill Lakes, Saskatchewan  
 Grand Terre, Jefferson Parish, Louisiana  
 Bolivar Flats, Galveston Island, Texas  
 Beaverhill Lake, Alberta

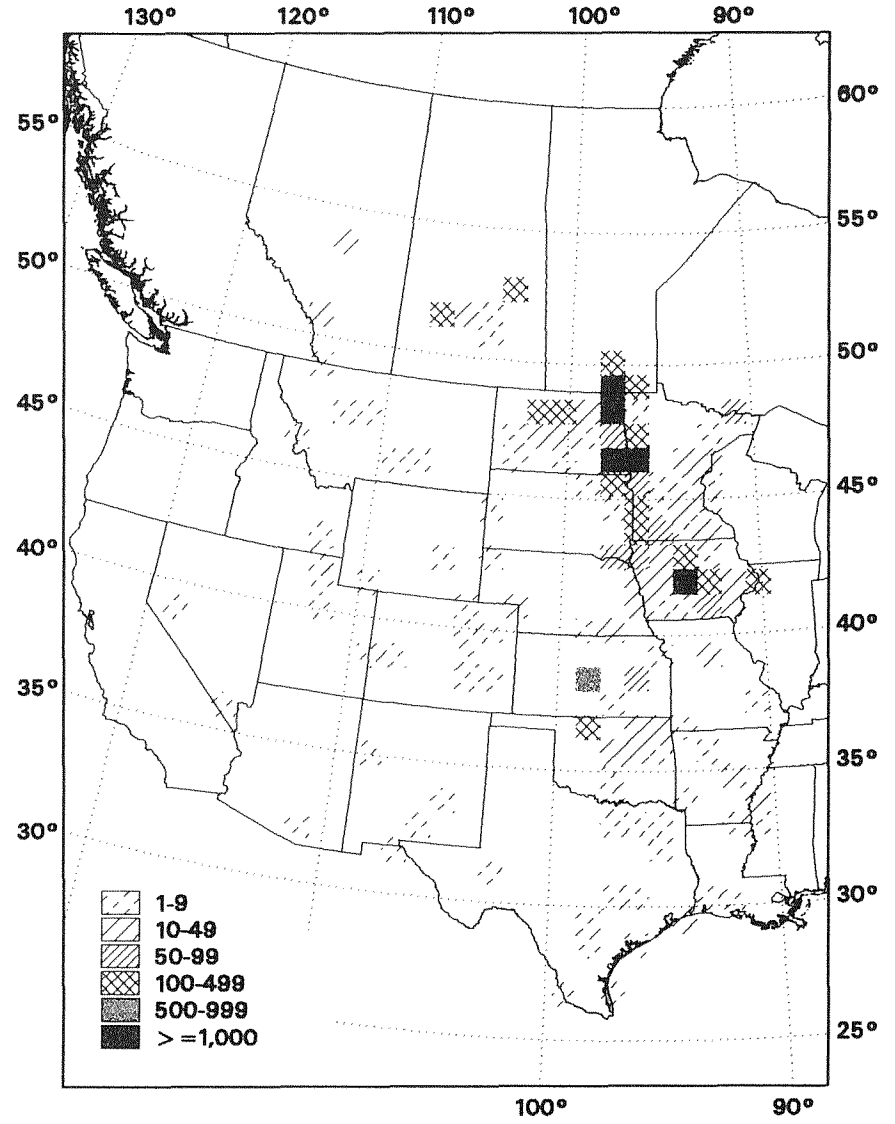


# American Golden Plover

## January-June



## July-December



**American Golden-Plover (*Pluvialis dominica*)**



**Body Size:** Medium

**Foraging Guild:** Terrestrial/aquatic gleaner

**Foraging Habitat:** Water depth - dry to 8 cm;  
vegetative cover - bare to sparse

**Migration Distance:** Long

**Migration Pattern:** Narrow Band

**Dispersion:** Broadly to moderately dispersed; 60% of total maximum sightings occur in 27 spring and 7 fall 0.1° lat-long blocks.

**Six sites with highest counts:** (see Appendix for more information)

North Dakota State University, Fargo, North Dakota

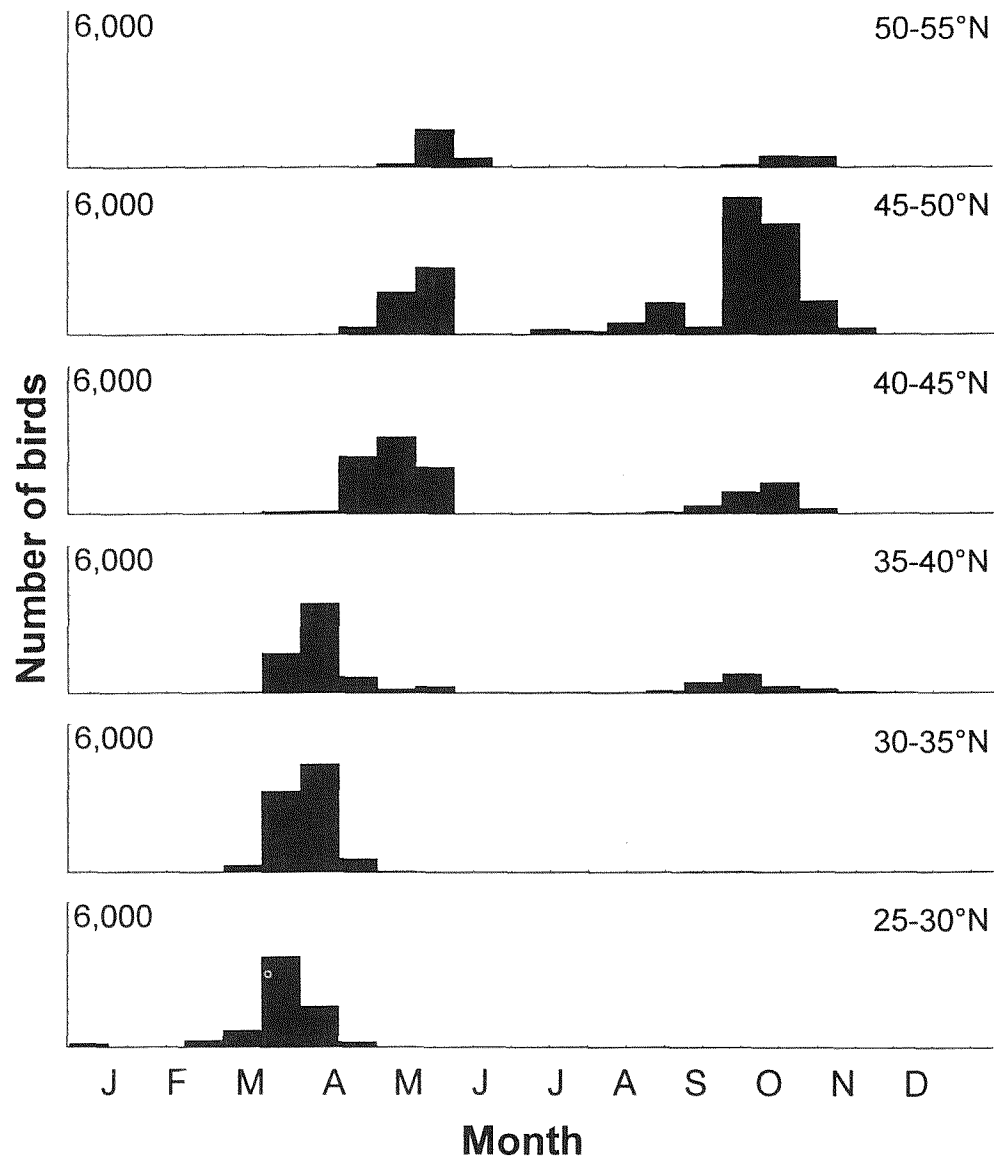
Highway 108, Miller County, Arkansas

Rice fields, Cameron County, Louisiana

Spruce Grove, west of Edmonton, Alberta

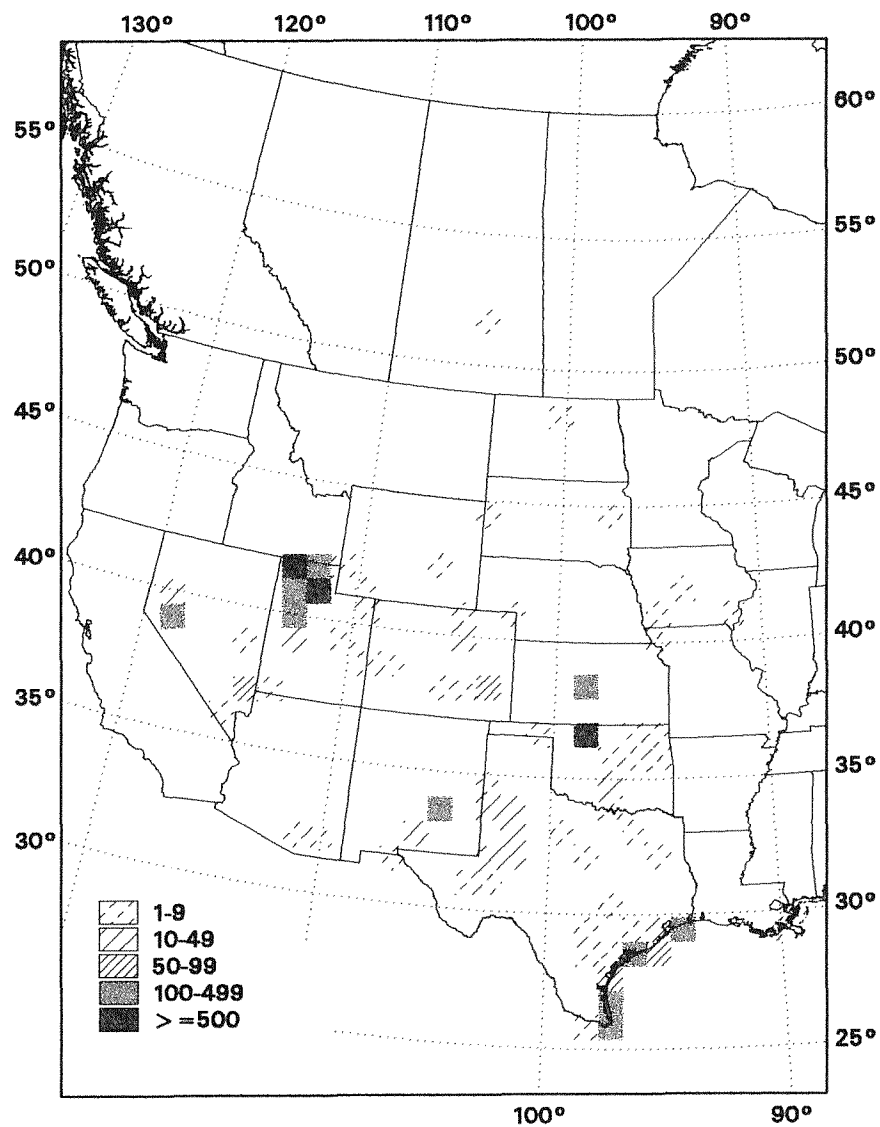
Casselton, North Dakota

Jordan, Manitoba

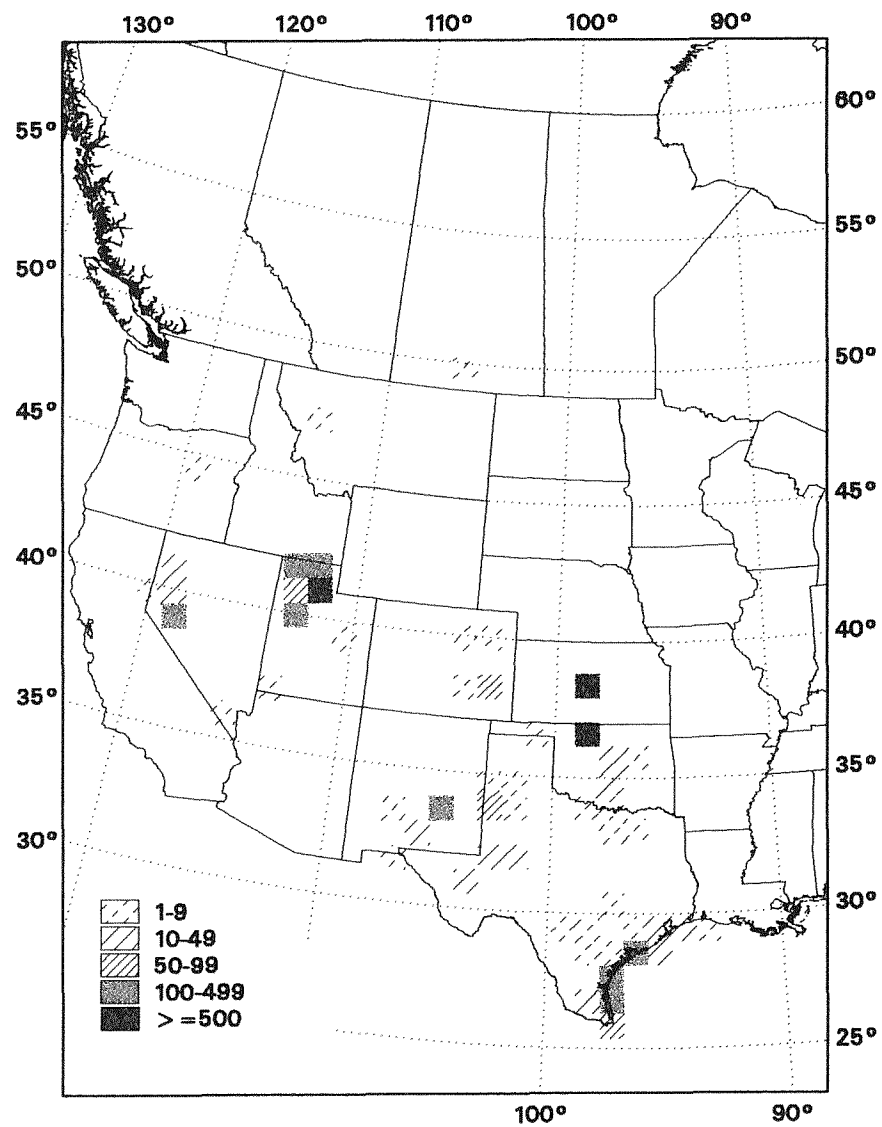


# Snowy Plover

## January-June



## July-December

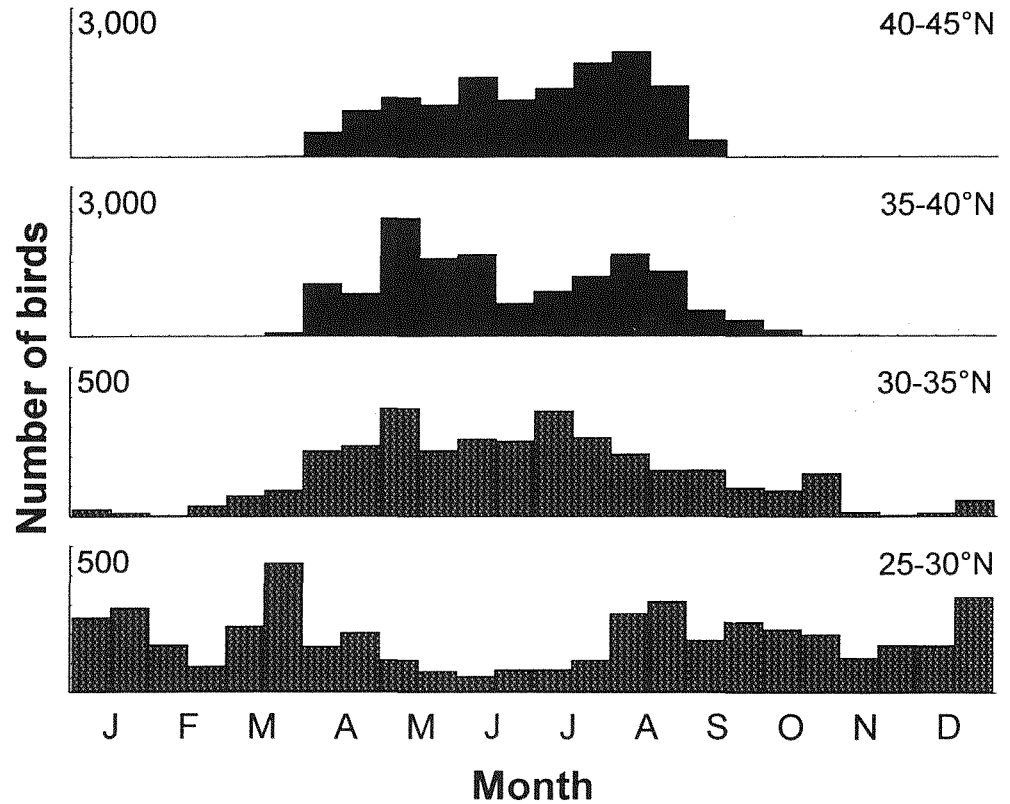




**Snowy Plover (*Charadrius alexandrinus*)**



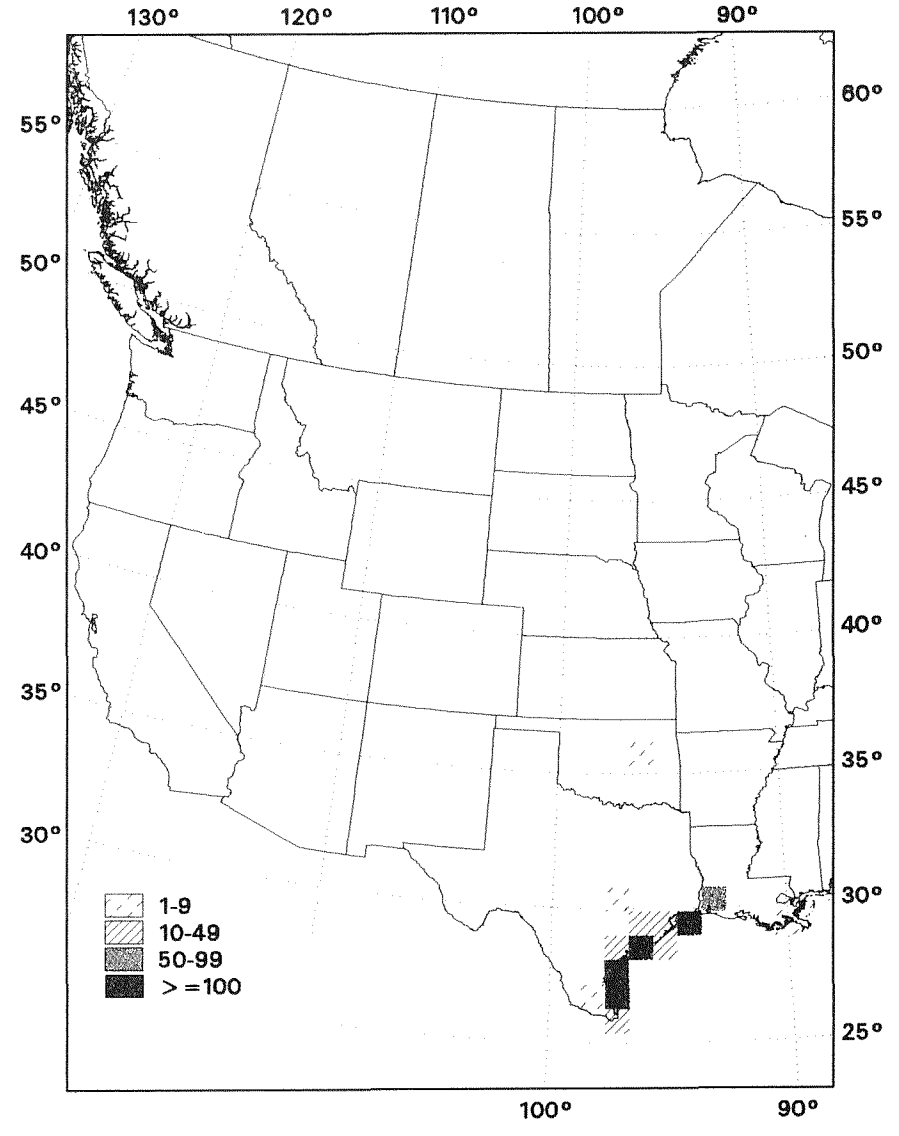
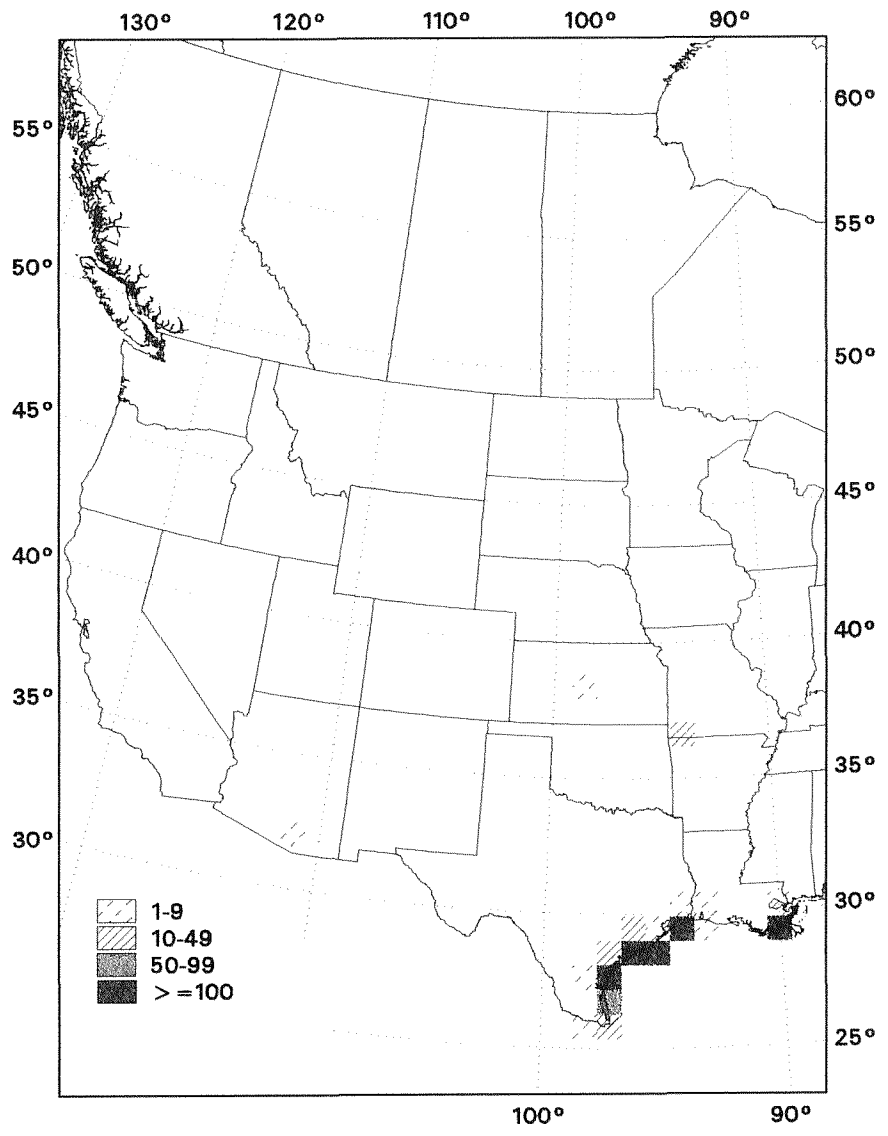
- Body Size:** Small
- Foraging Guild:** Terrestrial/aquatic gleaner
- Foraging Habitat:** Water depth - dry to 3 cm;  
vegetative cover - bare to sparse
- Migration Distance:** Short
- Migration Pattern:** Not assigned
- Dispersion:** Moderately dispersed; 60% of total maximum sightings occur in 8 spring and 9 fall 0.1° lat-long blocks.
- Six sites with highest counts:** (see Appendix for more information)
  - Salt Plains National Wildlife Refuge, Oklahoma
  - Great Salt Lake area, Utah
  - Stillwater National Wildlife Refuge, Nevada
  - Quivira National Wildlife Refuge, Kansas
  - Bitter Lake National Wildlife Refuge, New Mexico
  - Cheyenne Bottoms Wildlife Management Area, Kansas



# Wilson's Plover

## January-June

## July-December



**Wilson's Plover (*Charadrius wilsonia*)**



**Body Size:** Small

**Foraging Guild:** Terrestrial/aquatic gleaner

**Foraging Habitat:** Water depth - dry to 3 cm;  
vegetative cover - bare to sparse

**Migration Distance:** Short

**Migration Pattern:** Not assigned

**Dispersion:** Moderately dispersed; 60% of total maximum sightings occur in 5 spring and 4 fall 0.1° lat-long blocks.

**Six sites with highest counts:** (see Appendix for more information)

Padre Island National Seashore, Texas

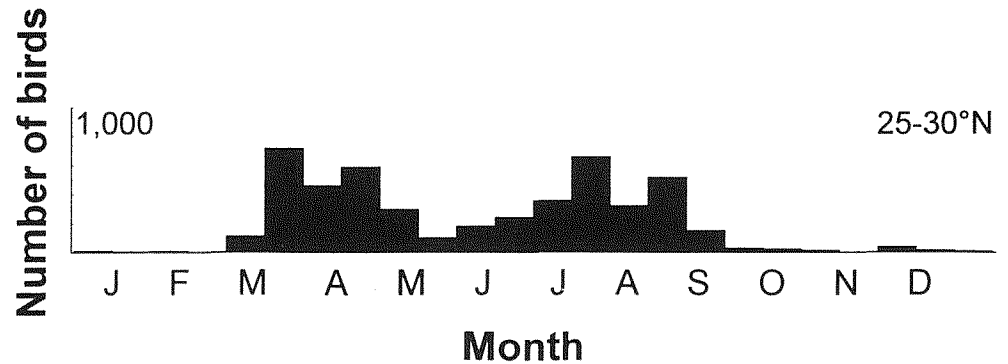
San Luis Pass, Galveston Island, Texas

Laguna Atascosa National Wildlife Refuge, Texas

Bolivar Flats, Galveston Island, Texas

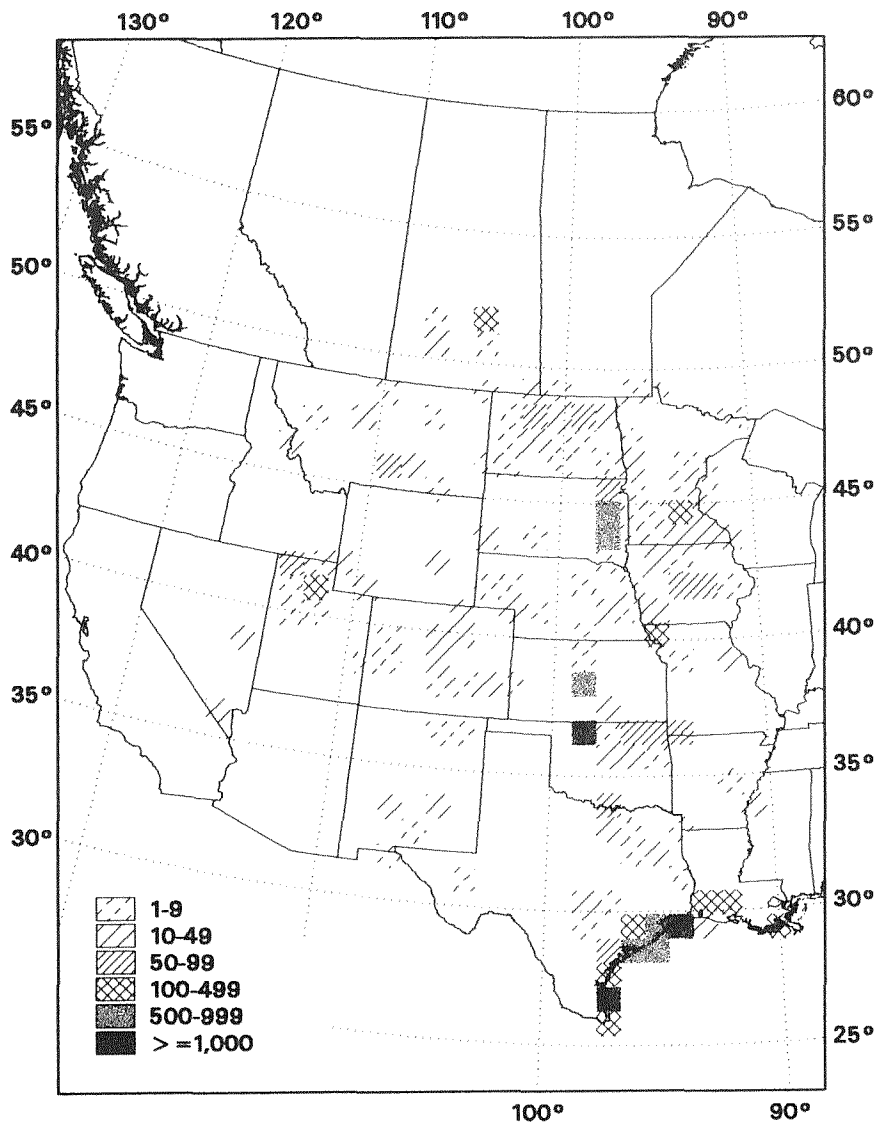
Matagorda National Wildlife Refuge, Texas

Airport, Port Aransas, Texas

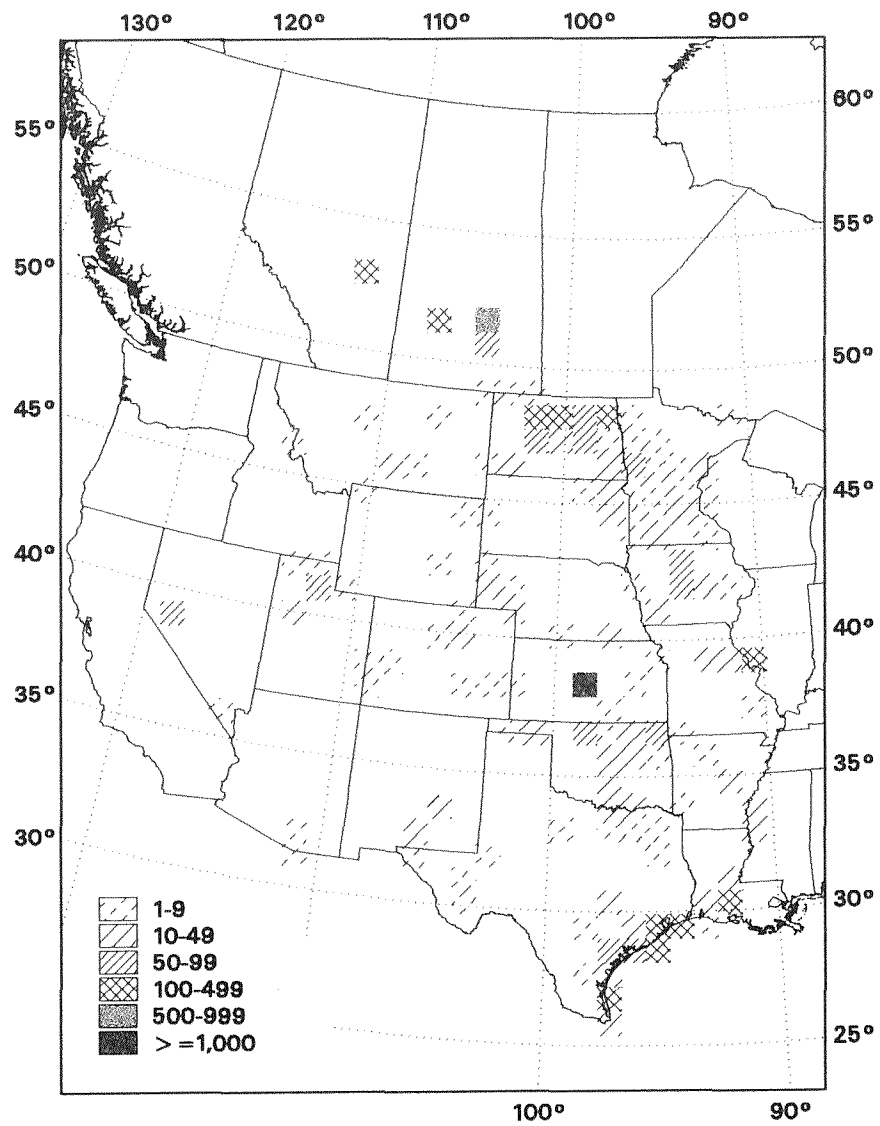


# Semipalmated Plover

## January-June



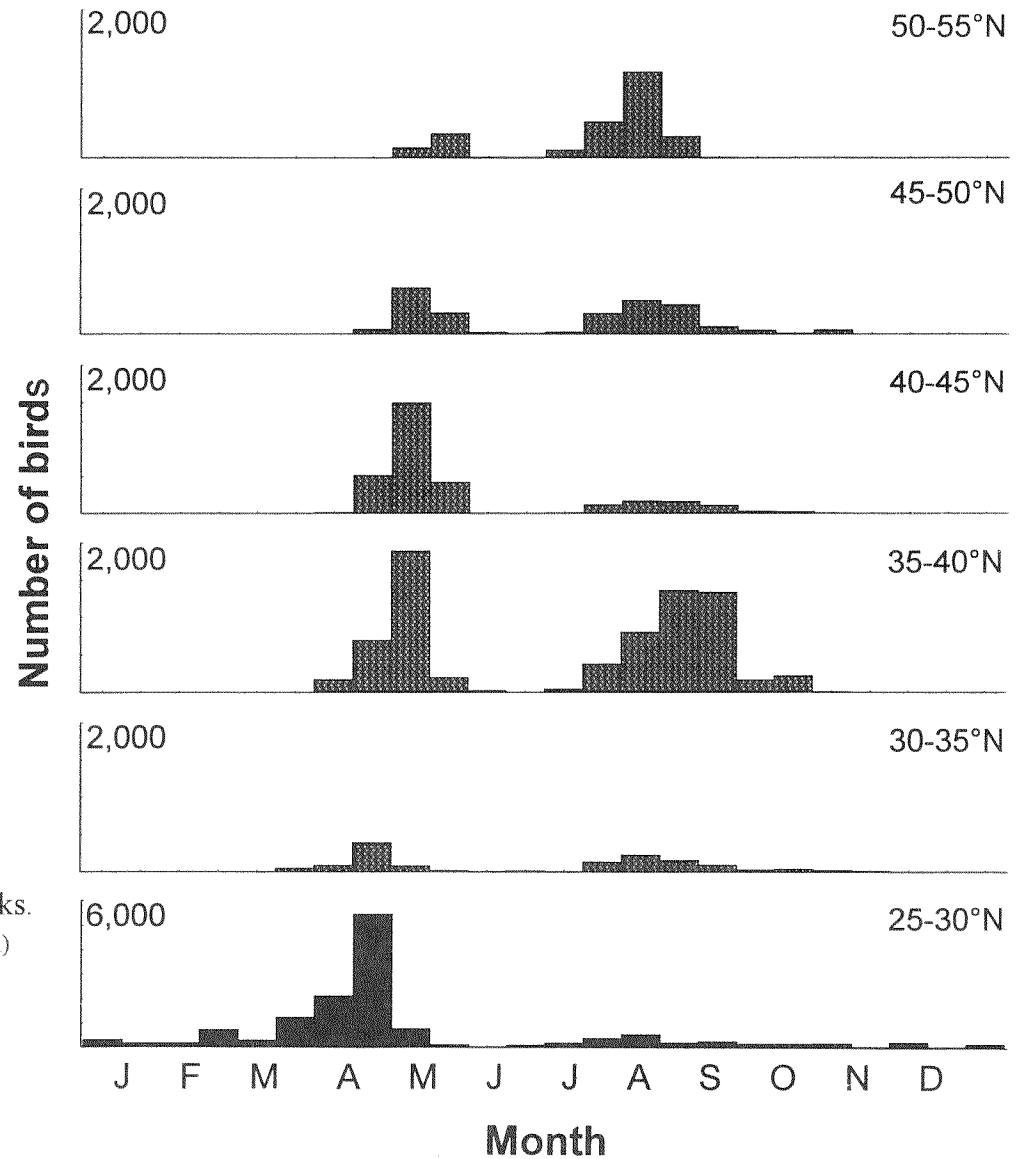
## July-December



**Semipalmated Plover (*Charadrius semipalmatus*)**

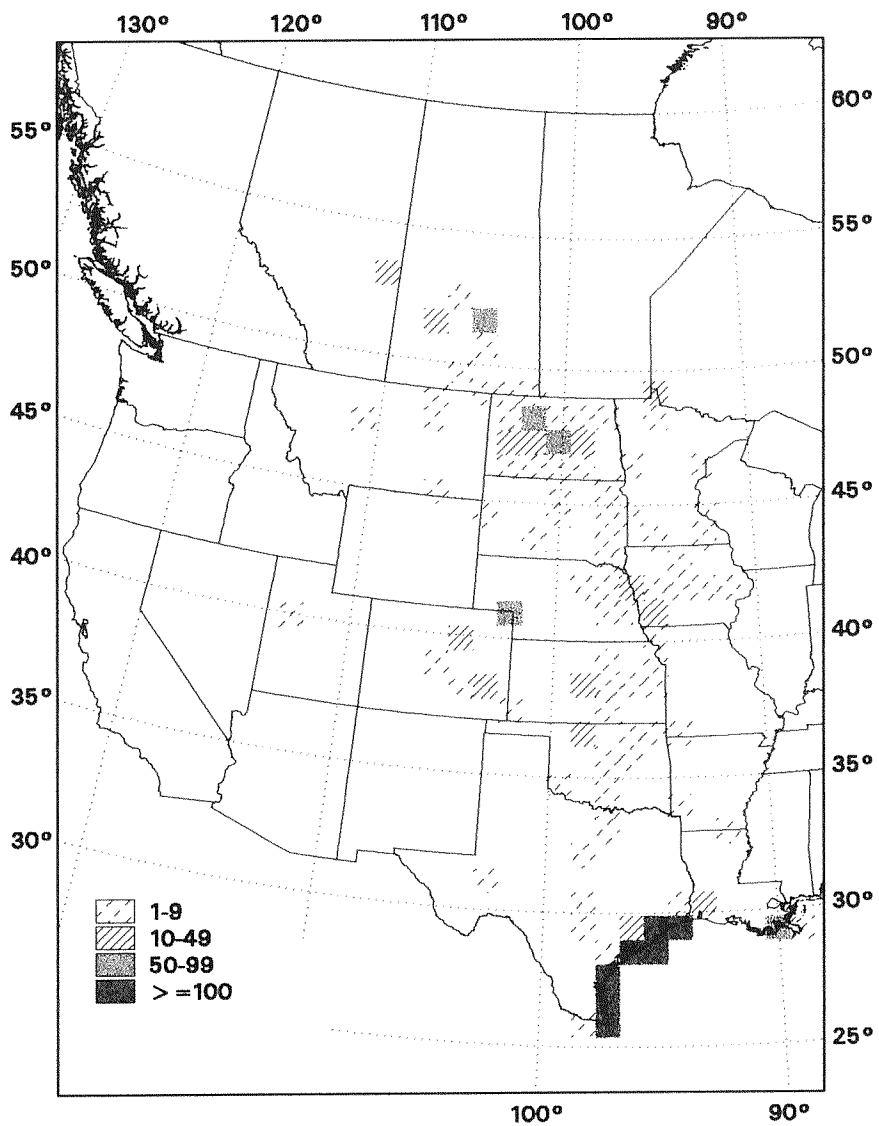


**Body Size:** Small  
**Foraging Guild:** Terrestrial/aquatic gleaner  
**Foraging Habitat:** Water depth - wet to 3 cm;  
 vegetative cover - bare to sparse  
**Migration Distance:** Intermediate  
**Migration Pattern:** Narrow Band  
**Dispersion:** Broadly dispersed; 60% of total maximum  
 sightings occur in 13 spring and 11 fall 0.1° lat-long blocks.  
**Six sites with highest counts:** (see Appendix for more information)  
 Chambers County, Texas  
 Laguna Atascosa National Wildlife Refuge, Texas  
 Cheyenne Bottoms Wildlife Management Area, Kansas  
 Salt Plains National Wildlife Refuge, Oklahoma  
 Brazoria National Wildlife Refuge, Texas  
 Quill Lakes, Saskatchewan

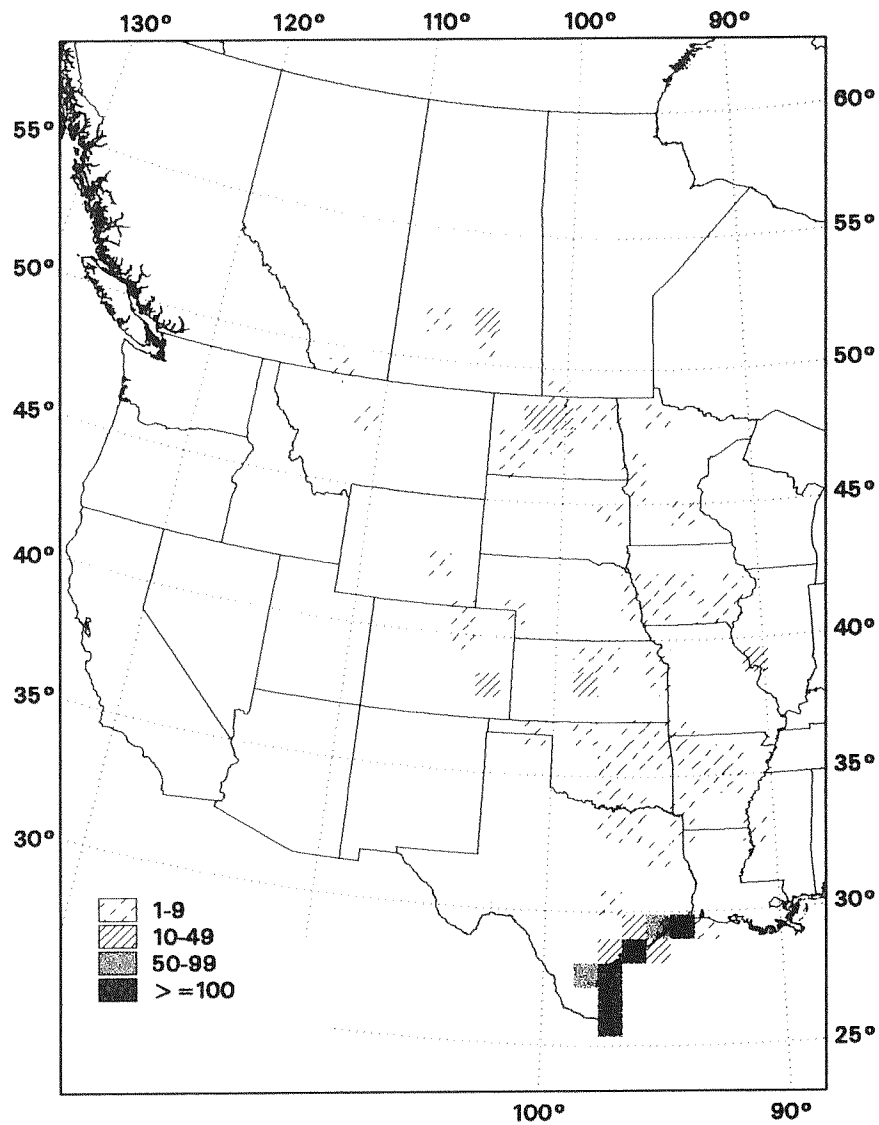


# Piping Plover

## January-June



## July-December



**Midcontinent Ecological Science Center**

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**U.S. Department of the Interior  
U.S. Geological Survey**

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