

Density of Shorebirds Breeding in the National Petroleum Reserve – Alaska.

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This report provides broad-scale density estimates of shorebirds breeding in the National Petroleum Reserve – Alaska (NPR-A). Landscape features and vegetation types were analyzed to determine their ability to predict breeding shorebird density. The survey design and GIS delineation of vegetation types were done by Dr. Jonathan Bart, U.S. Geological Survey, Boise, Idaho. Only a brief discussion of methods is presented. A full description can be found in: J. R. Bart and S. Earnst, 2002, Double sampling to estimate density and population trends in birds, *Auk* 119:36–45.

Methods

Surveys were conducted 4 years between 1998 and 2001 and were timed to correspond with the pre-and early incubation period of the breeding cycle; breeding shorebirds are most detectable during this period. For most years, plots were selected by a stratified random process at sites, on an annual basis, in the NPR-A. Site selection was dictated by access, and plot selection was restricted to these site clusters. In 2001, a random sample of 2-plot clusters were spread across the entire NPR-A. Strata were generally designated as upland and wetland and were sampled proportionally to their representative coverage.

Plot survey methods followed those described by Bart and Earnst (2002) and consist of one-time, extensive plot surveys to enumerate breeding pairs or territorial males and repeated, intensive surveys to determine the actual number of breeding pairs/territorial males on a plot. Detection ratios calculated from intensive surveys were used to adjust shorebird densities estimated from extensive surveys. Because observers differed in their survey efficiency, detection ratios were estimated each year and applied to year-specific density estimates from extensive plots (Table 1).

A vegetation covermap produced by the Bureau of Land Management and Ducks Unlimited, Inc. was used to designate vegetation types (Table 2). Areas of deep and turbid water were subtracted from the total plot area and the proportion of vegetation types were calculated for each plot. Based on field observations, vegetation types were combined into four composite types to describe plot and sites: 1) flooded – aquatic + low-centered polygons, 2) wet sedge-moss – non-patterned tundra + wet *Carex* + sedge meadow + moss-lichen, 3) tussock tundra, and 4) medium shrub. The wet/moist category was created because of the amount of water that floods these vegetation types when shorebirds are setting up their territories.

Primarily based on the year-specific cluster sampling, plots were grouped into 18 geographic areas (Figure 1.) For each site, mean densities were calculated for each species and for all species combined. Site means were used to examine broad-scale effects of environmental features on breeding shorebird density.

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Table 1. Year- and species-specific detection ratios used to adjust shorebird density estimates from extensive plot surveys in the National Petroleum Reserve – Alaska, 1998–2001.

	1998	1999	2000	2001
Black-bellied Plover	0.84	0.82	0.82	0.95
American Golden-Plover	0.60	0.82	0.82	0.85
Wimbrel	0.84	0.82	0.87	0.95
Bar-tailed Godwit	0.84	0.82	0.87	0.95
Ruddy Turnstone	0.93	0.82	0.82	0.93
Semipalmated Sandpiper	0.95	0.63	0.51	0.95
Western Sandpiper	0.84	0.82	0.82	0.95
White-rumped Sandpiper	0.84	0.82	0.82	0.95
Baird's Sandpiper	0.84	0.82	0.82	0.95
Pectoral Sandpiper	0.98	0.84	1.30	1.02
Dunlin	0.82	0.65	0.82	0.82
Stilt Sandpiper	0.84	0.82	0.82	0.95
Buff-breasted Sandpiper	0.84	0.82	0.82	0.95
Long-billed Dowitcher	0.84	0.82	0.82	0.95
Wilson's Snipe	0.84	0.82	0.82	0.95
Red-necked Phalarope	0.75	0.78	0.80	0.85
Red Phalarope	0.86	0.82	0.82	0.84

Table 2. Vegetation categories and types designated for shorebirds breeding in the National Petroleum Reserve – Alaska, 1998–2001.

Vegetation category	% water cover	Vegetation type	Analysis type
Water	>80%	clear water	-
		turbid water	-
		ice	-
Aquatic	51–80%	<i>Carex aquatalis</i>	flooded
		<i>Arctophila fulva</i>	
Flooded	26–50%	low-centered polygons	
		non-patterned ground	
Wet	10–25%	<i>Carex aquatalis</i>	wet sedge-moss
Moist	damp to <10%	sedge-grass meadow	
		moss/lichen	
		tussock tundra	
Dry	0%	dwarf shrub	-
		medium shrub	medium shrub
		tall shrub	-
		dry dunes	-
		sparsely vegetated	-
		barren	-

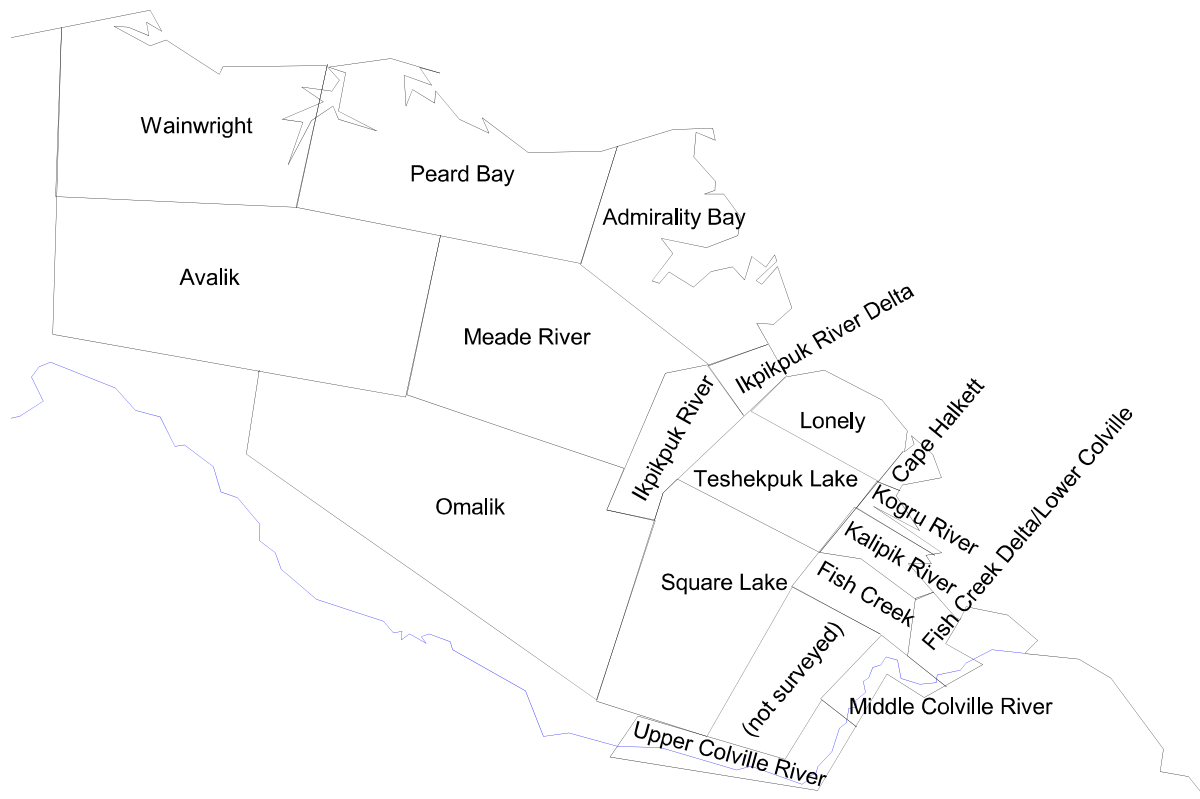


Figure 1. Delineation of breeding shorebird plot sites in the National Petroleum Reserve – Alaska, 1998–2001.

Results

Between 1998 and 2001, observers recorded 4,445 breeding shorebird pairs or territorial males, of 17 species, on 338 plots across the NPR-A. The number of plots surveyed at a site ranged from 11 to 39 plots (Table 3). The most abundant species encountered were the Semipalmated Sandpiper, Pectoral Sandpiper, and Red Phalarope (Table 4). Richness at sites ranged from 2 to 13 species, and total shorebird density varied from 0.74 to 135.81 pairs/territorial males per km² (Table 3).

Table 3. Mean physiographic and vegetation features, effort, and breeding shorebird density and richness on plots in the National Petroleum Reserve – Alaska, 1998–2001. Sites are ordered from east to west and north to south.

Site	Latitude (°N)	Longitude (°W)	Elevation (m)	Distance to coast	% flooded	% wet sedge-moss	% tussock tundra	% med. shrub	Number of plots	Plot area (km ²)	Density (no./km ²)	No. of species
Lower Colville/Fish Creek Delta	70.21	151.36	10	20	49.5	26.9	18.8	0.2	15	1.241	24.08	13
Middle Colville River	69.98	151.57	25	45	24.4	11.9	21.1	30.9	12	0.313	9.13	6
Cape Halkett	70.80	152.50	1	7	48.9	43.1	7.3	0.0	18	0.190	137.06	8
Kogru River	70.59	152.25	0	1	33.1	41.1	12.6	0.0	24	0.262	86.92	9
Kalipik River	70.42	152.01	11	5	48.3	30.8	11.2	0.0	35	0.141	50.01	9
Fish Creek	70.21	152.27	29	29	47.9	33.8	10.0	0.0	39	0.215	65.92	11
Lonely	70.84	153.48	1	3	32.0	45.8	13.1	1.6	14	0.319	73.76	10
South Teshekpuk Lake	70.30	153.60	26	79	24.1	46.6	25.4	0.1	17	0.153	82.33	10
Square Lake	69.64	153.23	118	102	24.8	16.5	19.7	0.8	18	0.165	44.93	10
Upper Colville River	69.43	152.20	139	110	3.8	5.0	14.3	22.5	21	0.174	0.74	2
Ikpikpuk River Delta	70.71	154.54	1	12	50.0	44.9	1.8	1.6	27	0.183	135.81	11
Ikpikpuk River	70.25	154.83	21	61	38.0	44.8	12.1	3.4	17	0.247	98.25	12
Admiralty Bay	70.88	155.59	3	10	42.4	45.9	7.3	1.0	16	0.151	122.64	10
Meade River	70.28	156.20	24	64	23.4	42.5	29.5	3.5	14	0.161	95.44	12
Omalik	69.54	155.56	163	138	6.2	25.2	8.6	15.5	11	0.162	9.17	6
Peard Bay	70.65	158.35	16	21	18.9	52.1	22.6	1.5	12	0.165	75.60	9
Wainwright	70.04	161.11	32	29	11.7	41.1	24.7	0.5	14	0.160	47.86	10
Avalik	69.85	159.32	92	79	6.1	15.9	20.5	0.5	14	0.161	35.67	8

Table 4. Total number of territorial males/pairs estimated on 338 plots surveyed in the National Petroleum Reserve – Alaska, 1998–2001. Species are ordered by decreasing abundance.

	No. of pairs/ territorial males
All species	4,445
Semipalmated Sandpiper	1,153
Pectoral Sandpiper	943
Red Phalarope	669
Red-necked Phalarope	435
Long-billed Dowitcher	353
Dunlin	343
Black-bellied Plover	160
Stilt Sandpiper	122
American Golden-Plover	111
Bar-tailed Godwit	52
Western Sandpiper	44
Wilson's Snipe	17
Ruddy Turnstone	13
Wimbrel	12
Buff-breasted Sandpiper	11
White-rumped Sandpiper	5
Baird's Sandpiper	2

Environmental features

Many physiographic features and vegetation types were highly correlated (Table 5). Information obtained on plots corresponds with general knowledge about the physiographic and vegetation patterns of the NPR-A. Sites could be grouped into 4 categories based on their vegetation features (Table 6). Site elevations are illustrated in Figure 2.

Table 5. Pearson correlation coefficients for mean physiographic features and vegetation types measured on breeding shorebird plots at 18 sites in the National Petroleum Reserve – Alaska, 1998–2001.

	Latitude	Longitude	Elevation	Distance to coast	% flooded	% wet sedge-moss	% tussocks
Latitude	1.00						
Longitude	-0.05	1.00					
Elevation	-0.88	0.12	1.00				
Distance to coast	-0.86	0.12	0.91	1.00			
% flooded	0.67	-0.52	-0.72	-0.71	1.00		
% wet sedge-moss	0.82	0.27	-0.70	-0.57	0.42	1.00	
% tussocks	-0.30	0.36	-0.07	0.26	-0.51	-0.09	1.00
% medium shrub	-0.53	-0.25	0.45	0.45	-0.44	-0.64	0.05

Table 6. Vegetation characteristics of site plots surveyed for breeding shorebirds in the National Petroleum Reserve – Alaska, 1998–2001.

Flooded + wet sedge-moss >85%
Admiralty Bay, Cape Halkett, Ikpikuk River Delta
Flooded + wet sedge-moss 65–85%, wet sedge-moss >40%
Ikpikuk River, Kogru River, Lonely, Meade River, Teshekpuk Lake, Peard Bay
Flooded + sedge-moss 65–85%, flooded >40%
Fish Creek, Fish Creek Delta, Kalipik River
Flooded + wet sedge-moss <65%, medium + tall shrub <10%
Avalik, Square Lake, Wainwright
Flooded + wet sedge-moss <65%, medium + tall shrub >10%
Middle Colville River, Omalik, Upper Colville River

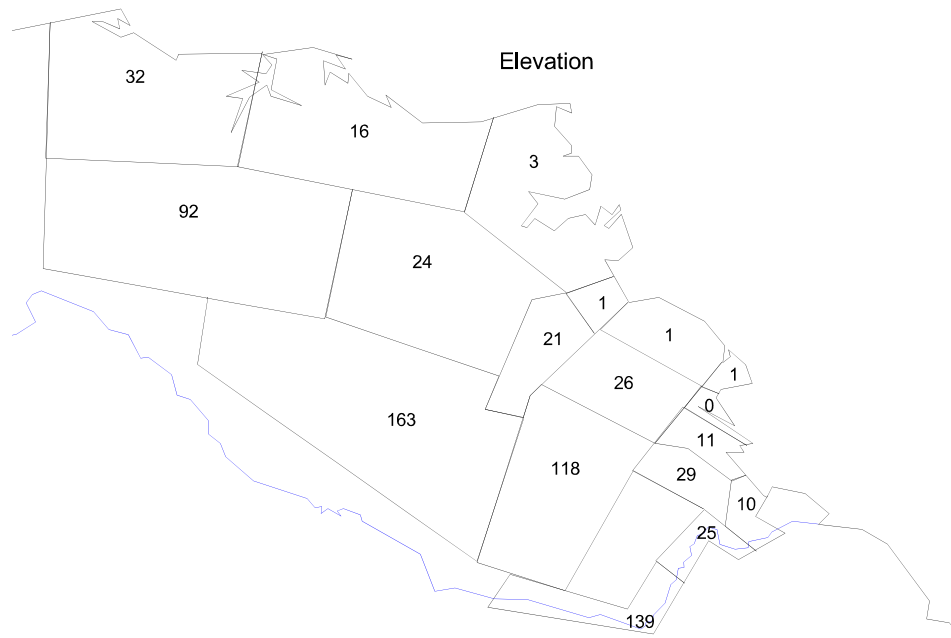


Figure 2. Mean elevation (m), by geographic area, on plots surveyed for breeding shorebirds in the National Petroleum Reserve – Alaska, 1998–2001.

All Shorebird Species

Latitude was the best predictor of shorebird density for all species combined (Figure 3). The greatest densities occurred at sites with high percentages of flooded and wet sedge-moss vegetation types; densities were lowest inland where sites were drier and had more shrubs (Figure 4). Densities were intermediate at sites with moderate percentages of flooded and wet sedge-moss tundra. Aside from 3 plots at Square Lake (which were dominated by Semipalmated Sandpipers, Long-billed Dowitchers, and Red-necked Phalaropes), the highest individual plot densities were recorded at the most northern northern latitudes (Figure 5). Species richness tended to be greater at more northern latitudes, but patterns were not as clear as density (Figure 6).

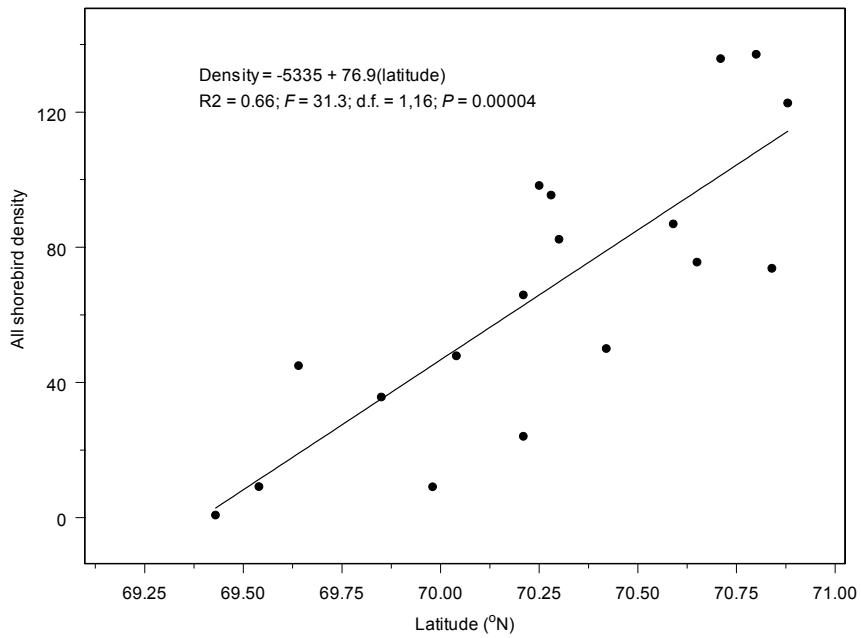


Figure 3. Influence of latitude (°N) on the density of shorebirds breeding at sites in the National Petroleum Reserve – Alaska, 1998–2001.

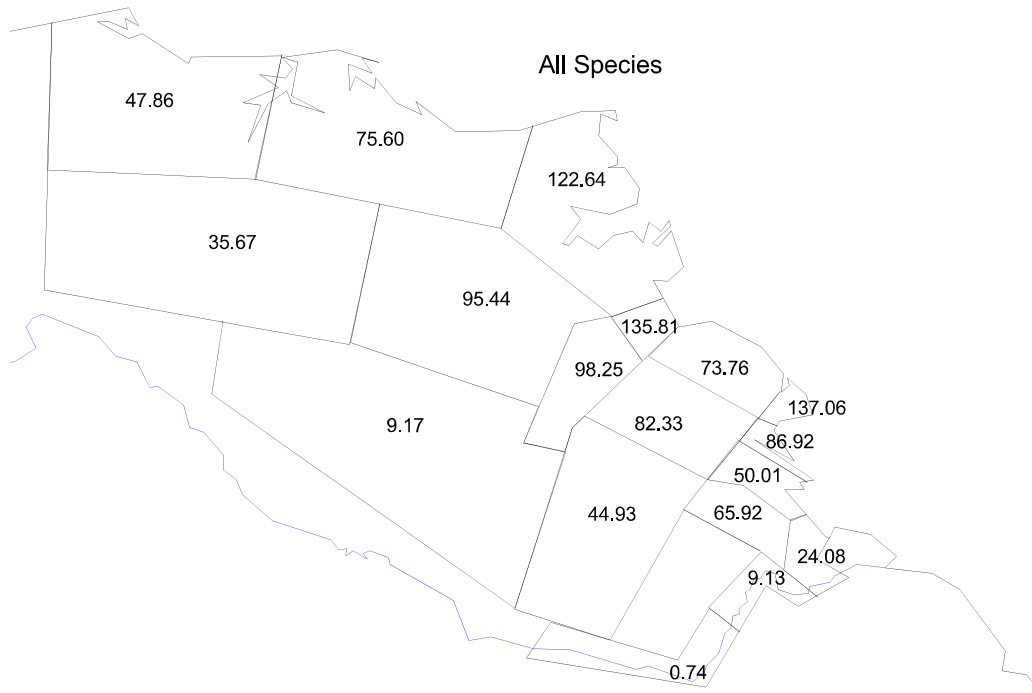


Figure 4. Breeding shorebird densities (pairs/territorial males per km²) at sites in the National Petroleum Reserve – Alaska, 1998–2001.

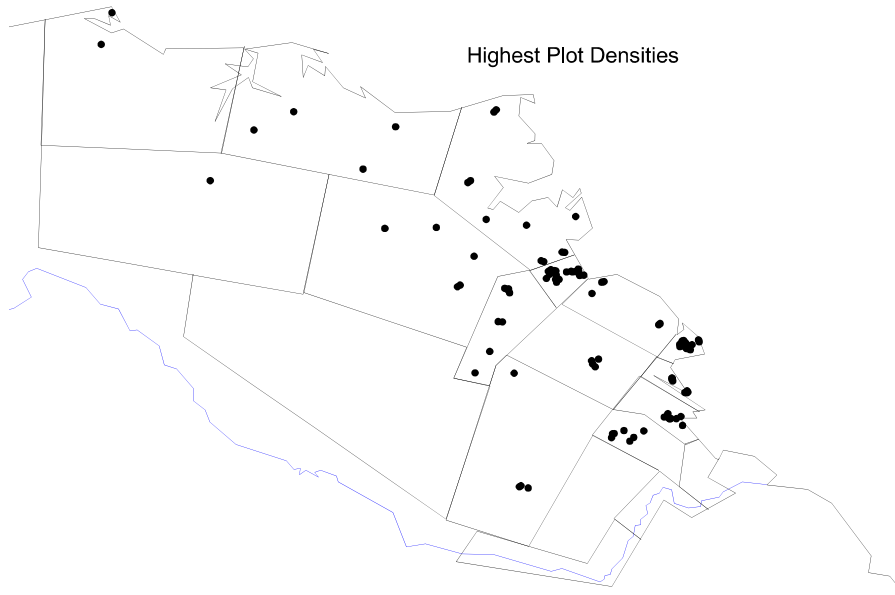


Figure 5. Location of breeding shorebird densities that were >89 pairs/territorial males per km² (upper 30% of all densities) on plots surveyed in the National Petroleum Reserve – Alaska, 1998–2001.

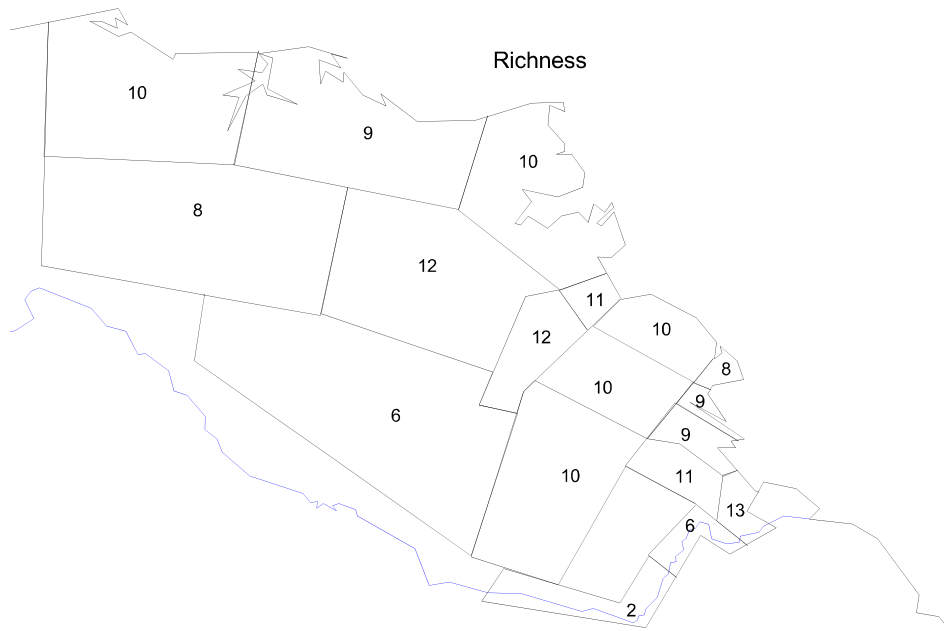


Figure 6. Breeding shorebird richness among sites in the National Petroleum Reserve – Alaska, 1998–2001.

Individual species accounts follow.

Black-bellied Plover (Pluvialis squatarola)

Black-bellied Plovers tended to be most abundant in the wetter, north-central portions of the NPR-A (Figure 7). They were particularly abundant along the Ipikpuk River, including the delta. The low abundance of plovers at Cape Halkett might be due to lack of micro-relief in the area. Black-bellied Plovers were absent from sites with moderate percentages of shrubs.

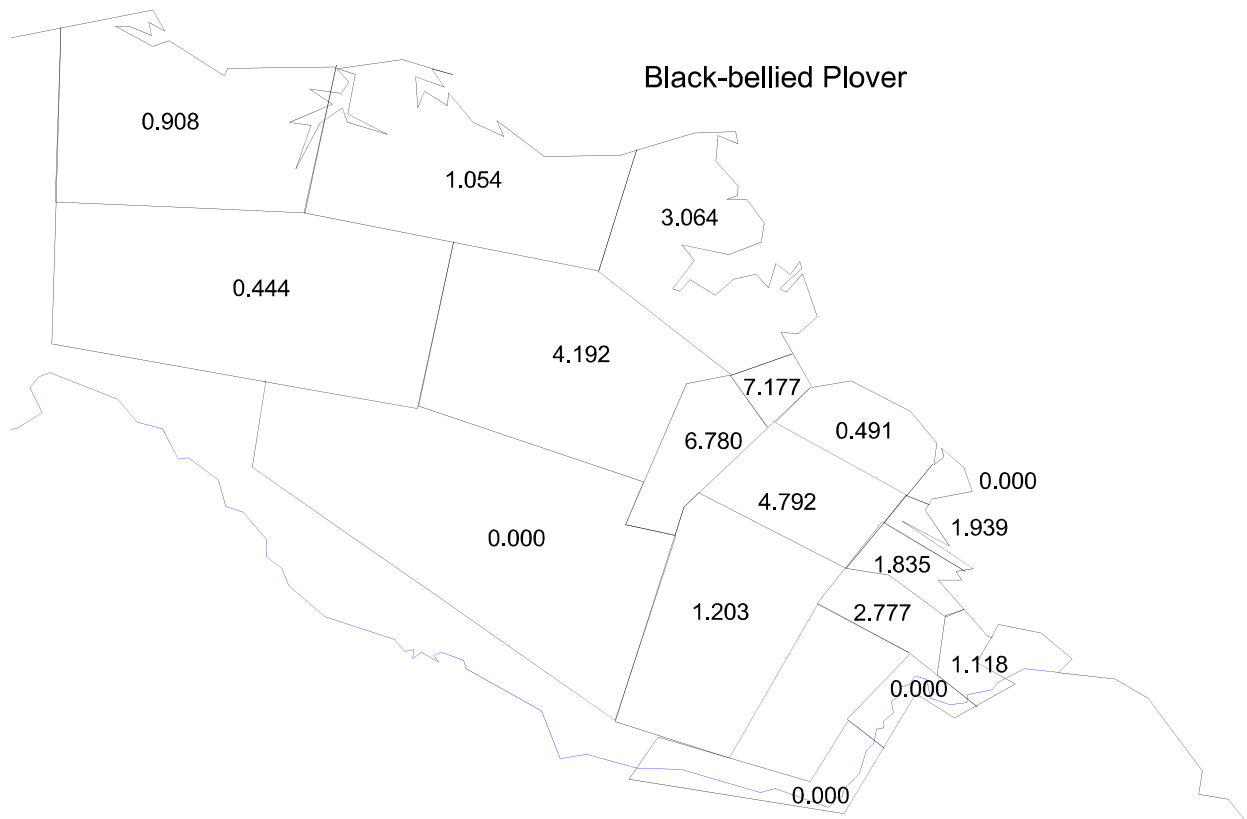


Figure 7. Density (pairs/territorial males per km²) of Black-bellied Plovers breeding in the National Petroleum Reserve – Alaska, 1998–2001.

American Golden-Plover (Pluvialis americana)

American Golden-Plovers were most abundant along the Ikpikuk River, Teshekpuk Lake, and Kogru River. Sites with moderate amounts of flooded wet sedge-moss had the greatest densities of plovers. Densities along the coast tended to be lower than those at inland sites (Figure 8).

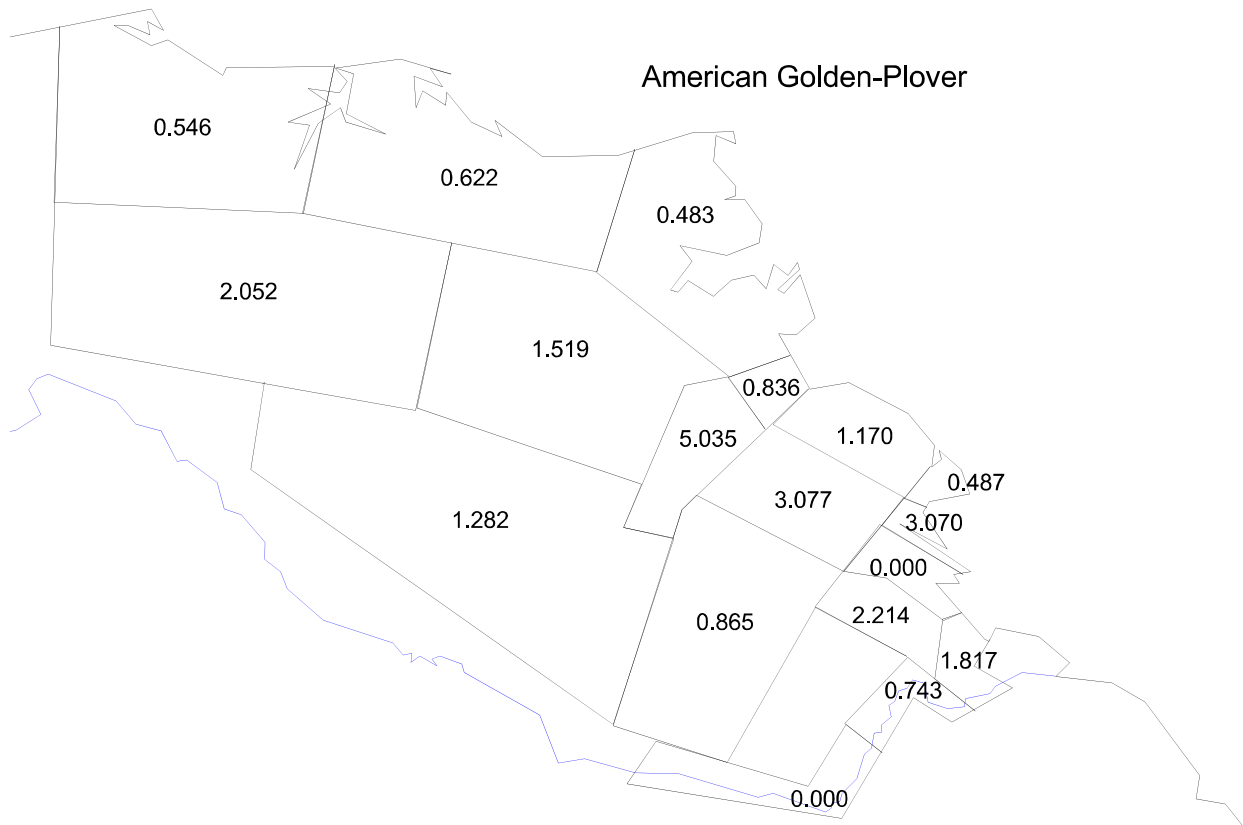


Figure 8. Density (pairs/territorial males per km²) of American Golden-Plovers breeding in the National Petroleum Reserve – Alaska, 1998–2001.

Whimbrel (Numenius paheopus)

Observations of Whimbrels were restricted to single plots along the Ikpikpuk River, lower and Upper Colville River, Fish Creek, and at Square Lake (Figure 9).

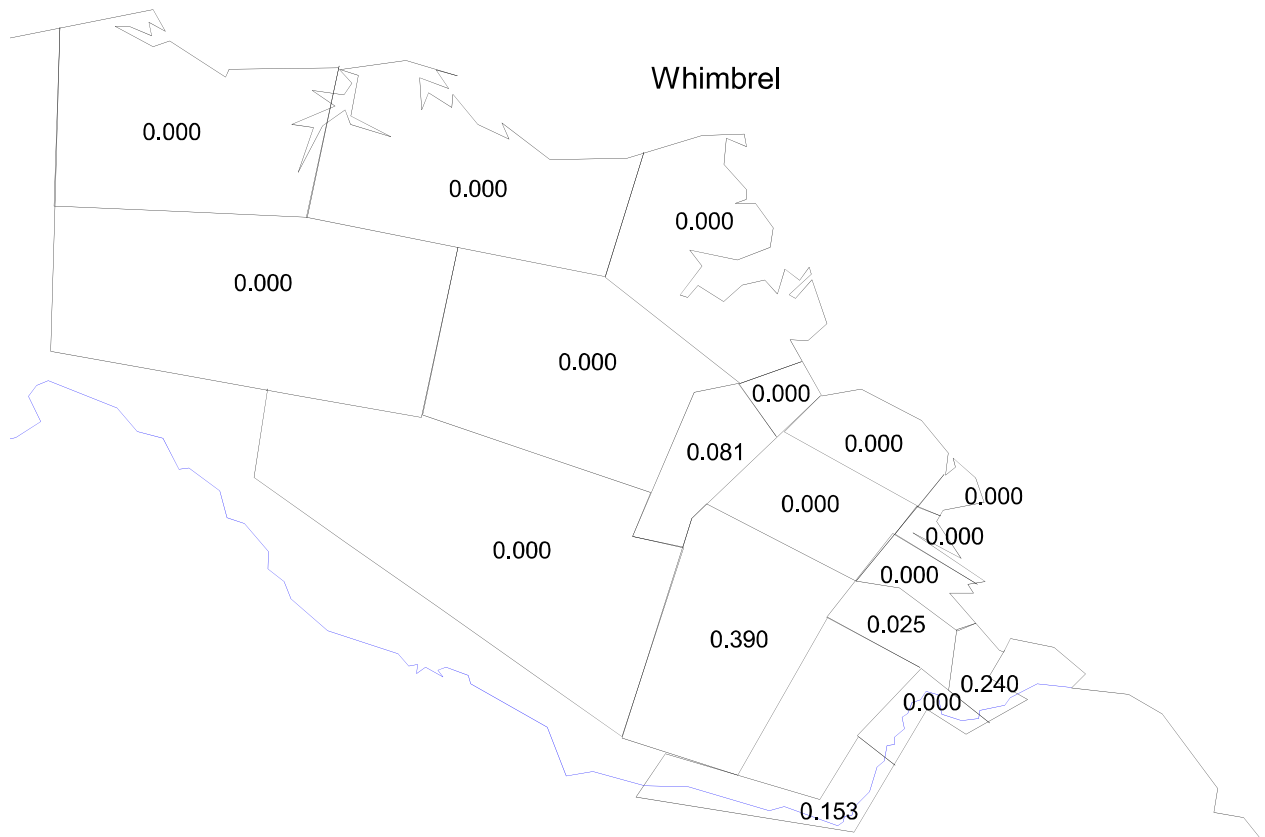


Figure 9. Density (pairs/territorial males per km²) of Whimbrels breeding in the National Petroleum Reserve – Alaska, 1998–2001.

Bar-tailed Godwit (Limosa haemastica)

Bar-tailed Godwits were infrequently encountered on plots in the NPR-A. Breeding birds were densest along the Ipikpuk River (Figure 10). Godwits seem to favor terraces of rivers and streams for breeding sites.

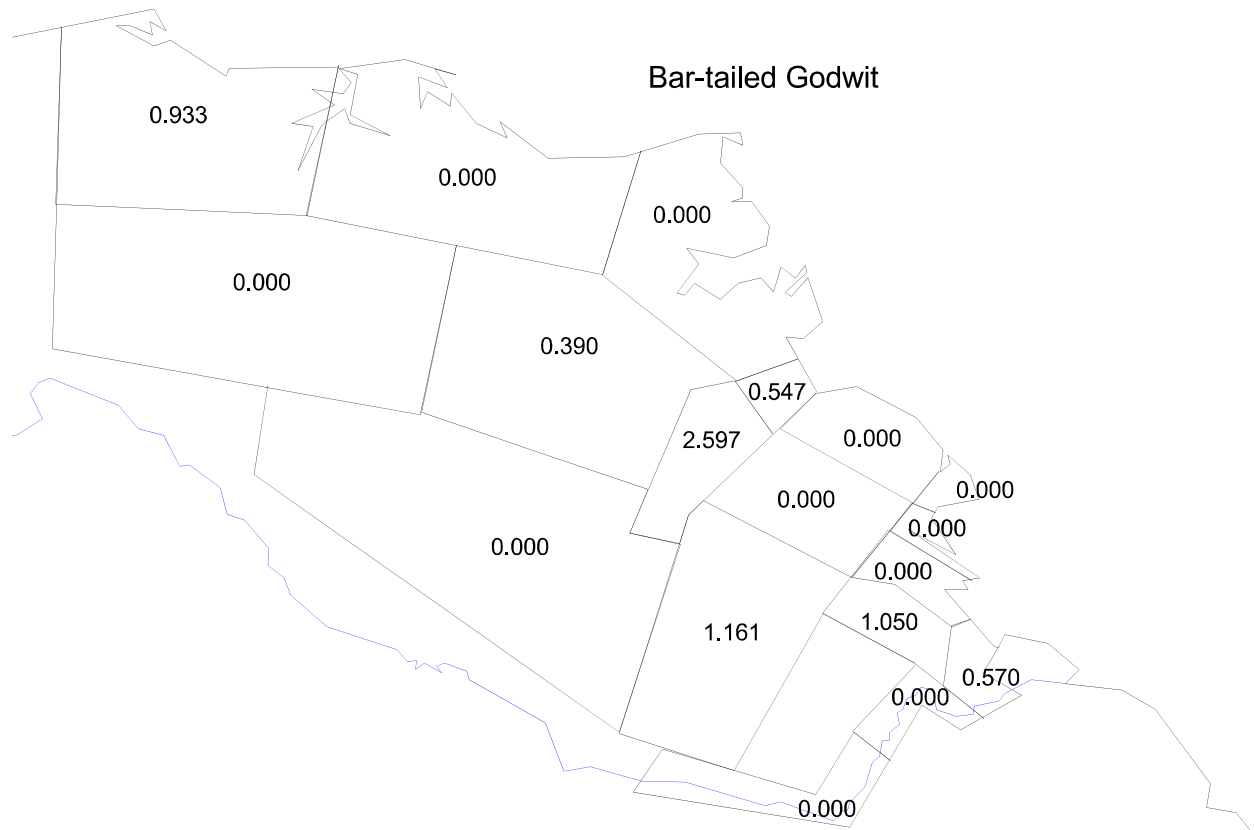


Figure 10. Density (pairs/territorial males per km²) of Bar-tailed Godwits breeding in the National Petroleum Reserve – Alaska, 1998–2001.

Semipalmated Sandpiper (Calidris pusilla)

Semipalmated sandpipers were densest in the northeastern portion of NPR-A (Figure 12). Densities tended to be greater at sites in the east-central NPR-A than on the coast. Densities in the 2 most western sites of NPR-A ranged from 3.19 to 4.17 pairs/territorial males per km² and were low (0.00–0.32) in the shrubbiest portions of the eastern NPR-A.

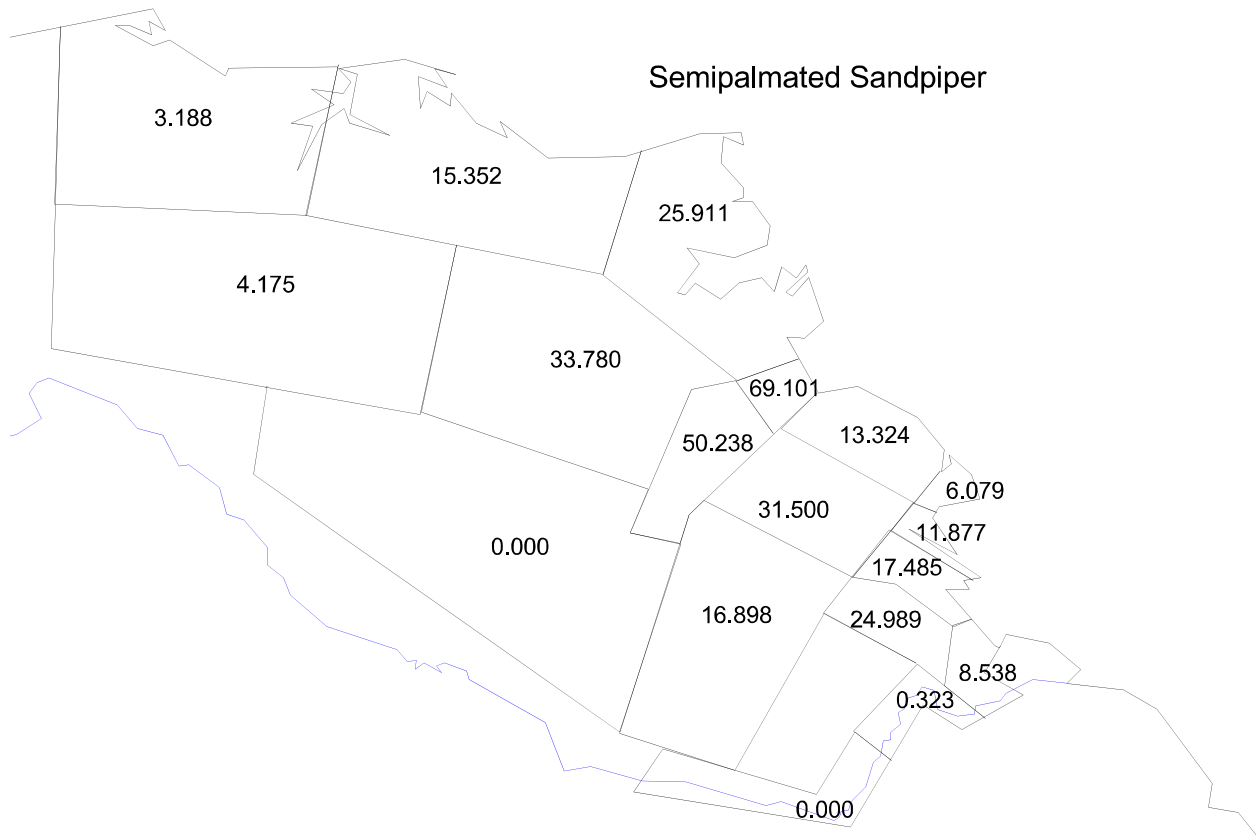


Figure 12. Density (pairs/territorial males per km²) of Semipalmated Sandpipers breeding in the National Petroleum Reserve – Alaska, 1998–2001.

Western Sandpiper (Calidris mauri)

Western Sandpipers were only recorded on plots in the western half of the NPR-A (Figure 13), where densities were greatest along the coast. Western Sandpipers were not recorded east of 156.08°W. Coastal northwestern sites are wetter than western inland sites.

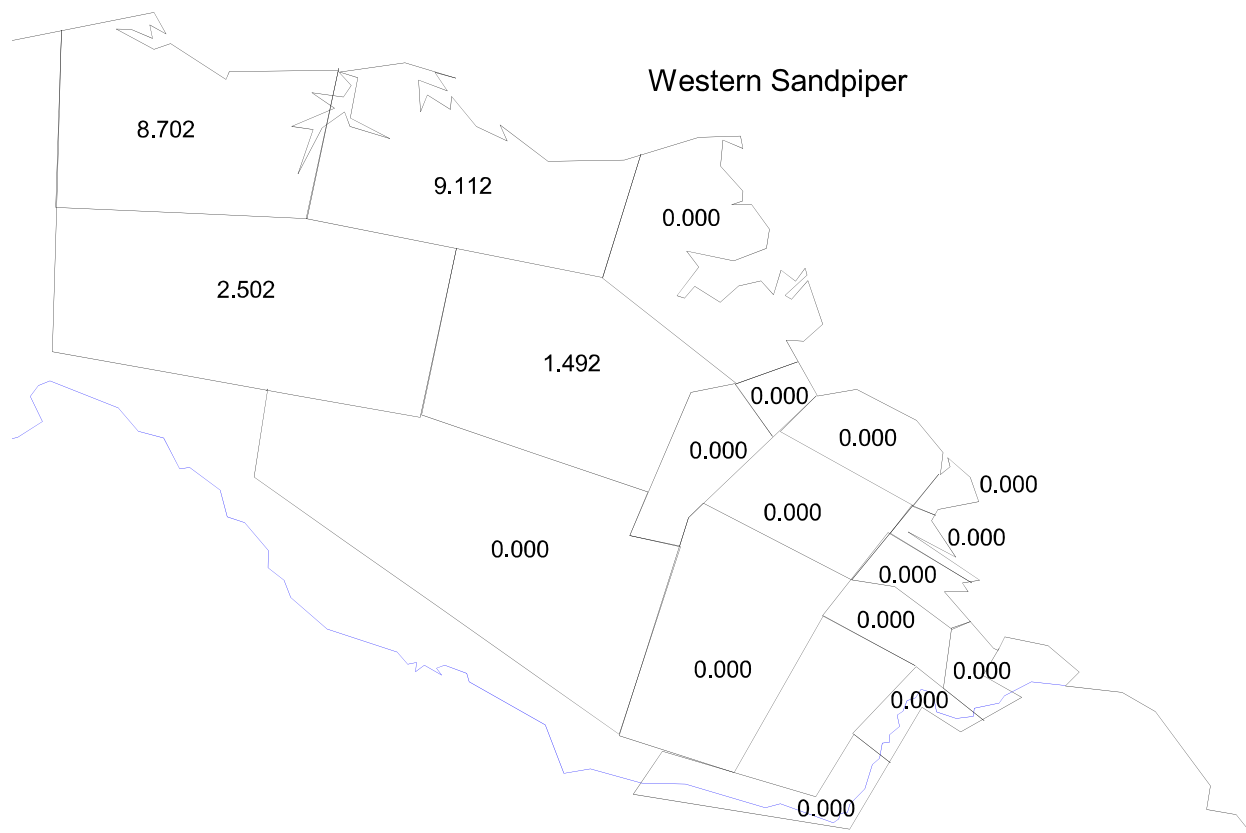


Figure 13. Density (pairs/territorial males per km²) of Western Sandpipers breeding in the National Petroleum Reserve – Alaska, 1998–2001.

Baird's Sandpiper (Calidris bairdii)

Baird's Sandpipers were only recorded on 2 plots, 1 on the coast at Lonely and 1 southeast of Atkasook (Figure 15). Baird's and White-rumped Sandpipers reach their greatest breeding abundances in mid- and high arctic Canada.

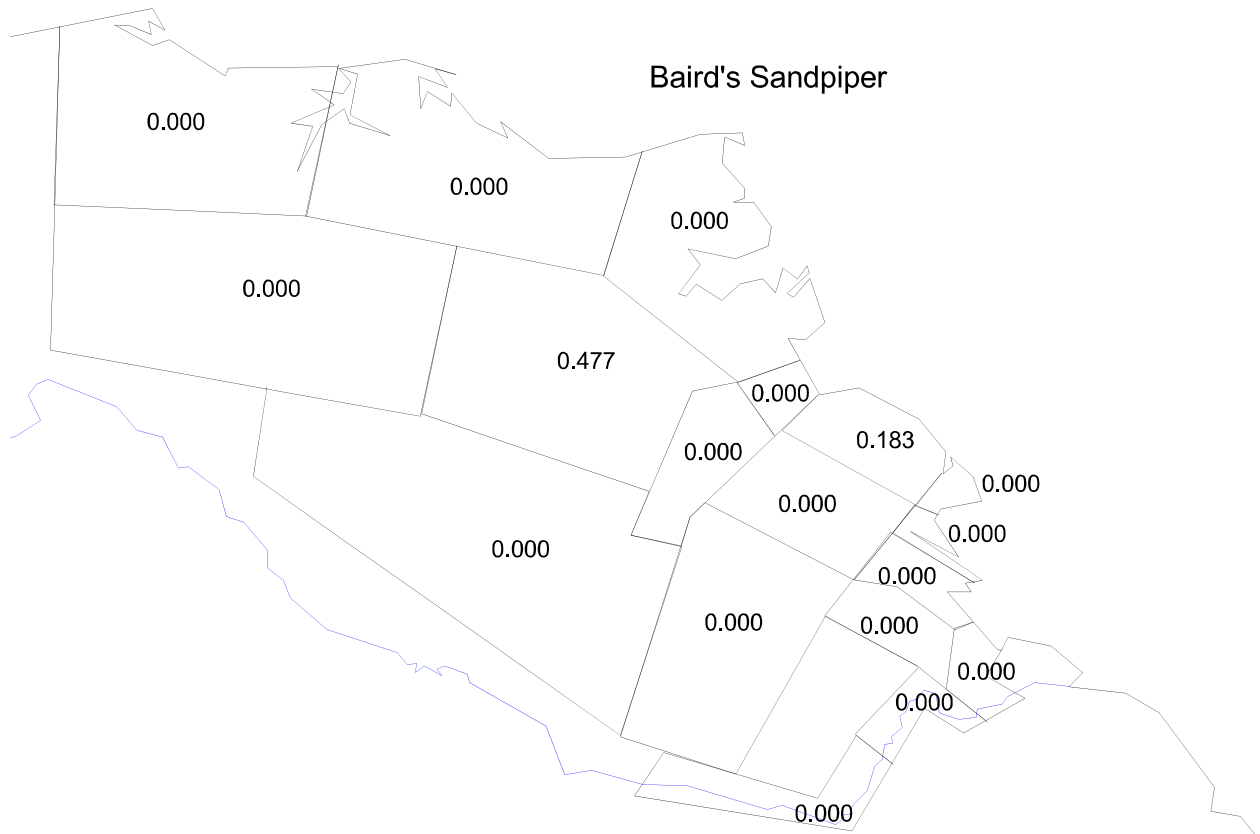


Figure 15. Density (pairs/territorial males per km²) of Baird's Sandpipers breeding in the National Petroleum Reserve – Alaska, 1998–2001.

Pectoral Sandpiper (Calidris melantos)

Pectoral Sandpipers occurred at all sites except for the Upper Colville River (Figure 16). Densities were greatest in the vicinity of Admiralty Bay, Cape Halkett, and Kogru River, and decreased with decreasing latitude. Densities separated well among northeastern coastal sites (14.7–34.3 pairs/territorial males per km²), central and western sites (4.2–10.0 per km²), and the most southern sites (0.0–2.8 per km²).

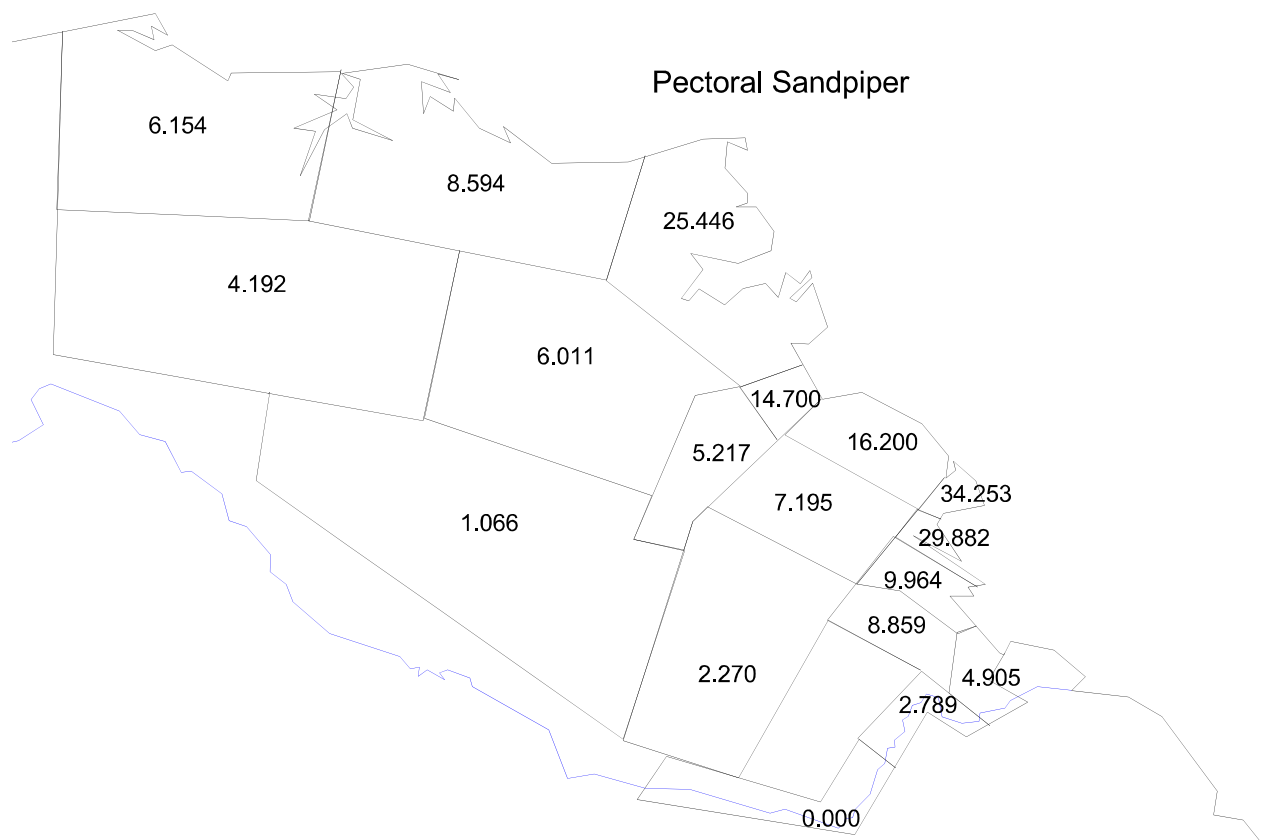


Figure 16. Density (pairs/territorial males per km²) of Pectoral Sandpipers breeding in the National Petroleum Reserve – Alaska, 1998–2001.

Dunlin (Calidris alpina)

Densities of Dunlins followed patterns similar to Pectoral Sandpipers; they were denser along the coast (Figure 17). However, dunlin densities were higher farther to the west, in the Peard Bay region, than those of Pectoral Sandpipers. Densities separated well among the most northern coastal sites from the Kuk River to the Kogru River (12.1–23.8 pairs/territorial males per km²), east-central and westernmost sites (0.9–7.6 per km²), and the southernmost inland sites (0.0 per km²). Mean plot densities were greatest in the vicinity of Admiralty Bay, Lonely, and Cape Halkett.

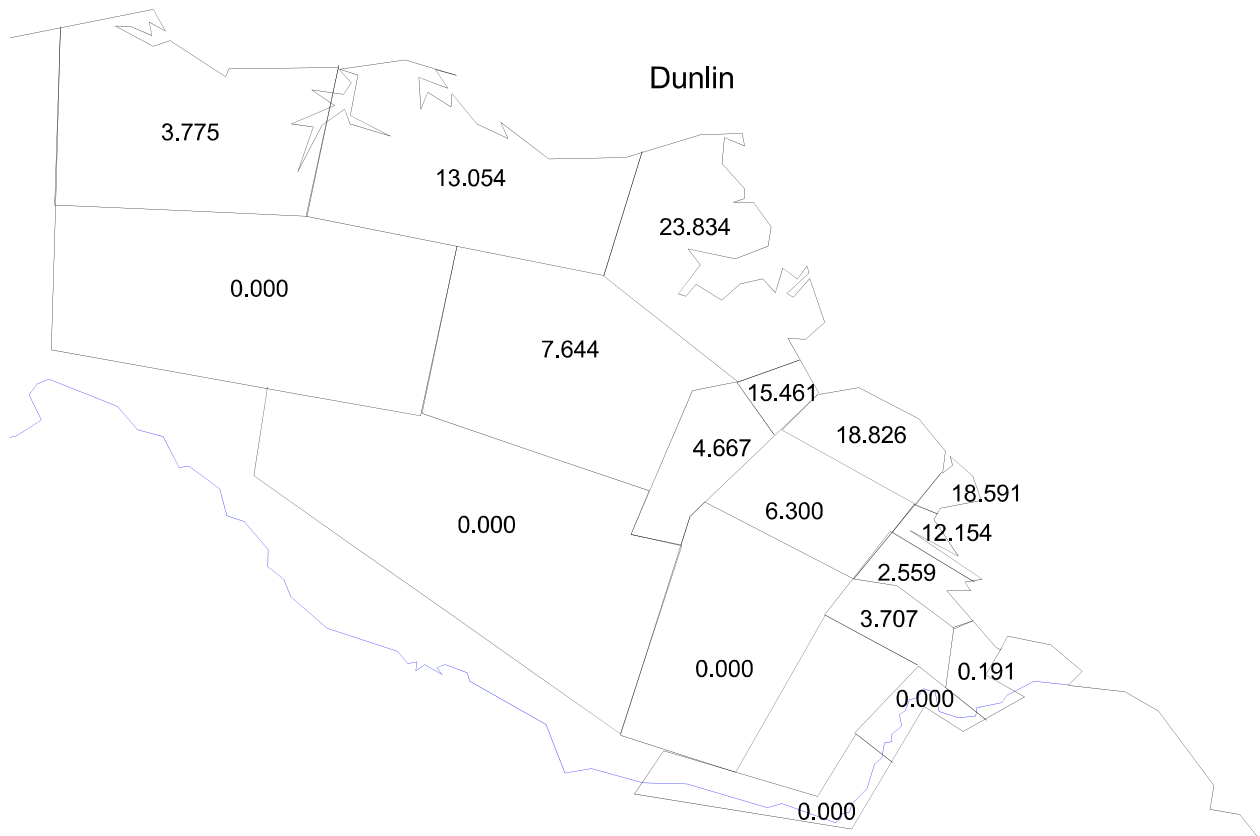


Figure 17. Density (pairs/territorial males per km²) of Dunlins breeding in the National Petroleum Reserve – Alaska, 1998–2001.

Stilt Sandpiper (Calidris himantopus)

Stilt Sandpipers reached their greatest densities in the east-central section of the NPR-A (Figure 18). Stilt Sandpipers were absent west of Admiralty Bay (156.1°W), north of Atkasook (70.5°N), and along the middle and upper Colville River. East of Admiralty Bay, and excluding the Upper and Middle Colville River, Stilt Sandpiper densities were influenced by the distance from the coast: 1) 0–15 km, 0.00–0.23 pairs/territorial males per km²; 2) 16–25 km, 1.51 pairs/territorial males per km²; 3) 25–90 km, 2.38–3.12 pairs/territorial males per km²; and 4) >90 km, 1.15–1.68 pairs/territorial males per km².

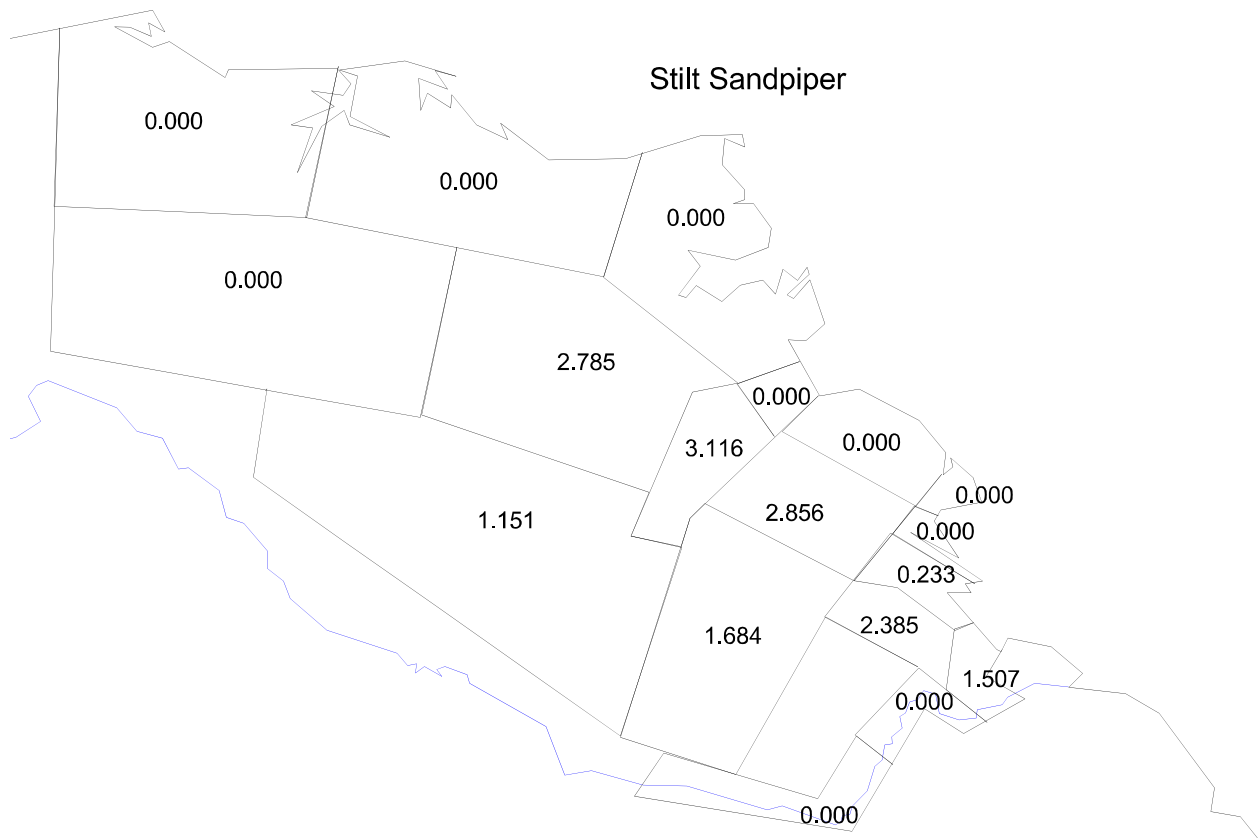


Figure 18. Density (pairs/territorial males per km²) of Stilt Sandpipers breeding in the National Petroleum Reserve – Alaska, 1998–2001.

Long-billed Dowitcher (Limnodromus scolopaceus)

Patterns of Long-billed Dowitcher densities generally followed those of the Stilt Sandpiper; the greatest densities occurred in the east-central portion of the NPR-A (Figure 20). Unlike stilts, dowitchers were moderately dense in western portions of the NPR-A. Densities were lowest at the shrubbiest sites.

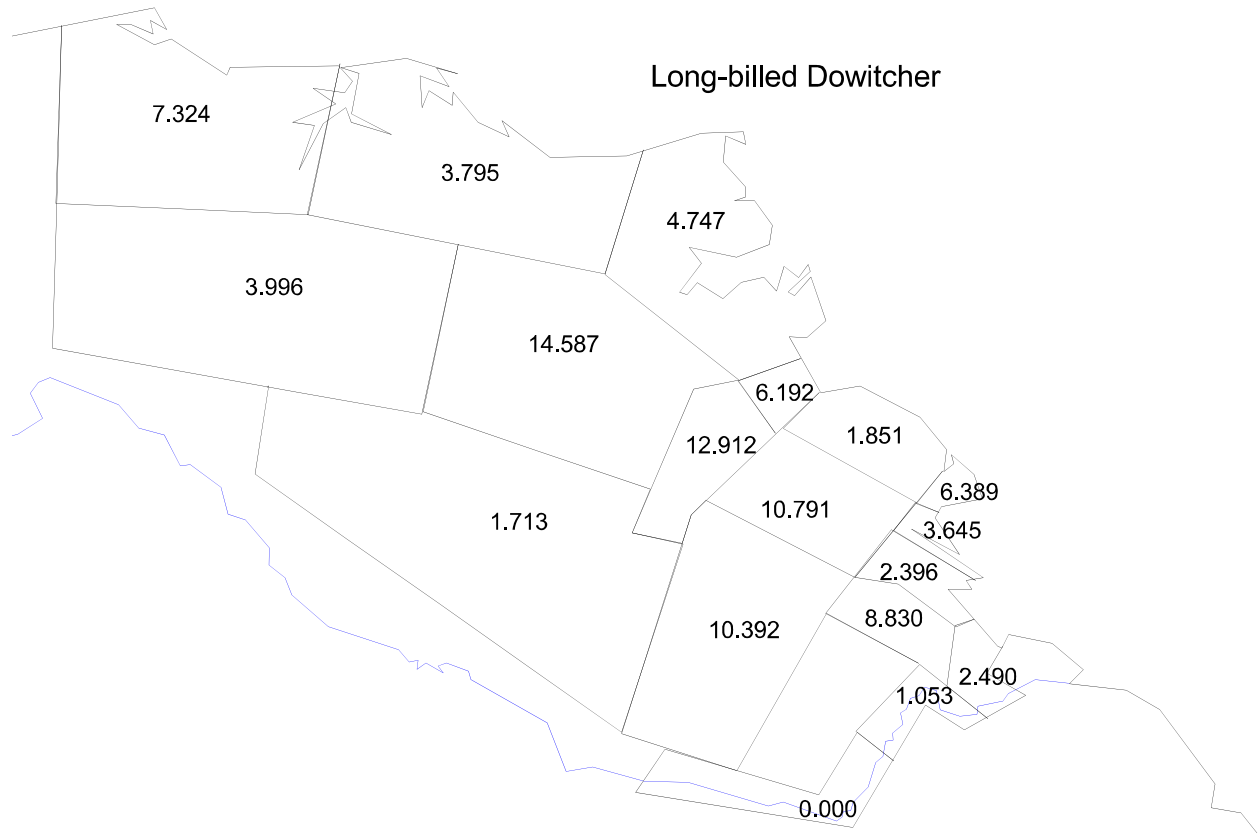


Figure 20. Density (pairs/territorial males per km²) of Long-billed Dowitchers breeding in the National Petroleum Reserve – Alaska, 1998–2001.

Red-necked Phalarope (Phalaropus lobatus)

Red-necked Phalaropes were generally denser away from the coast in the central portion of the NPR-A (Figure 22). Red-necked Phalaropes were recorded in the greatest densities in west-central portion of the NPR-A and in low densities along the Colville River and at the Kogru River.

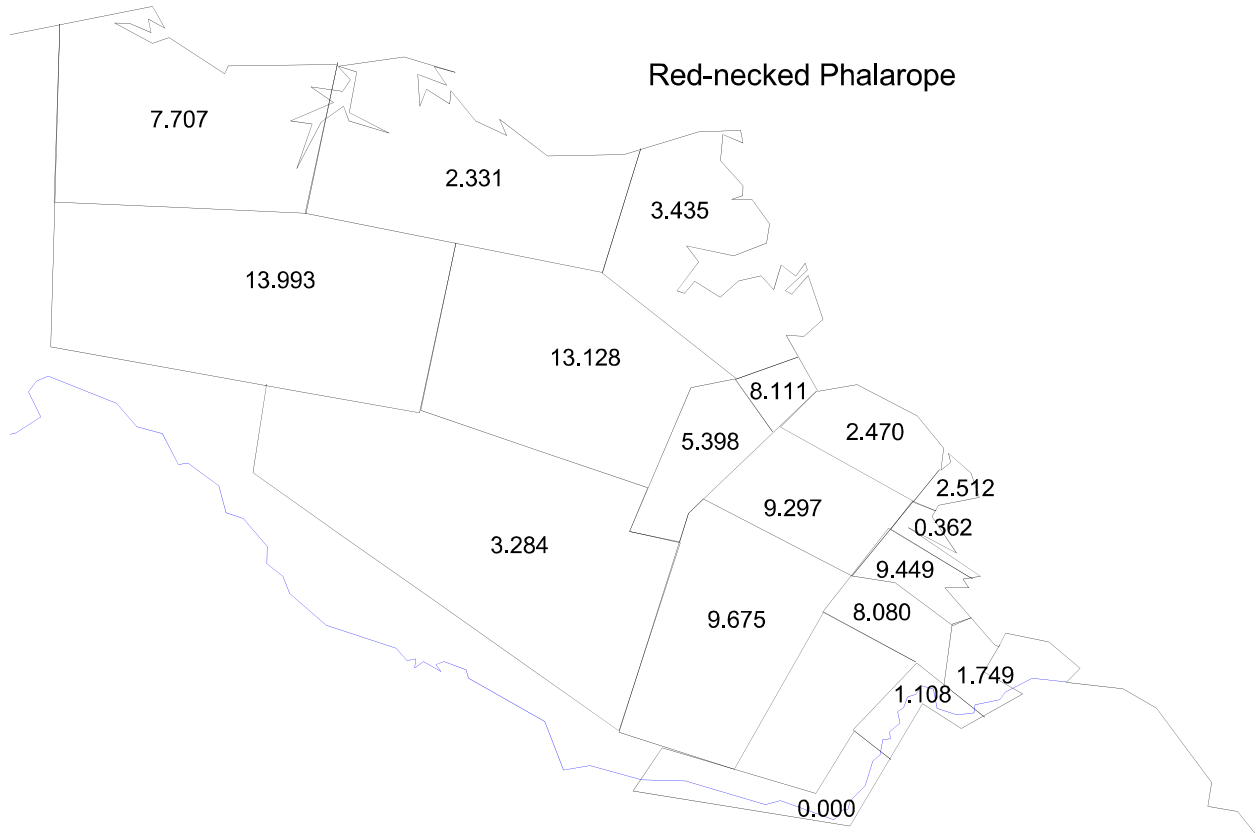


Figure 22. Density (pairs/territorial males per km²) of Red-necked Phalaropes breeding in the National Petroleum Reserve – Alaska, 1998–2001.

Red Phalarope (Phalaropus fulicaria)

Red Phalaropes were densest along the coast east of the Kuk River (Figure 23). Mean density at Cape Halkett was twice the density of any other site. Densities were substantially lower away from the coast and were absent along the Middle and Upper Colville River.

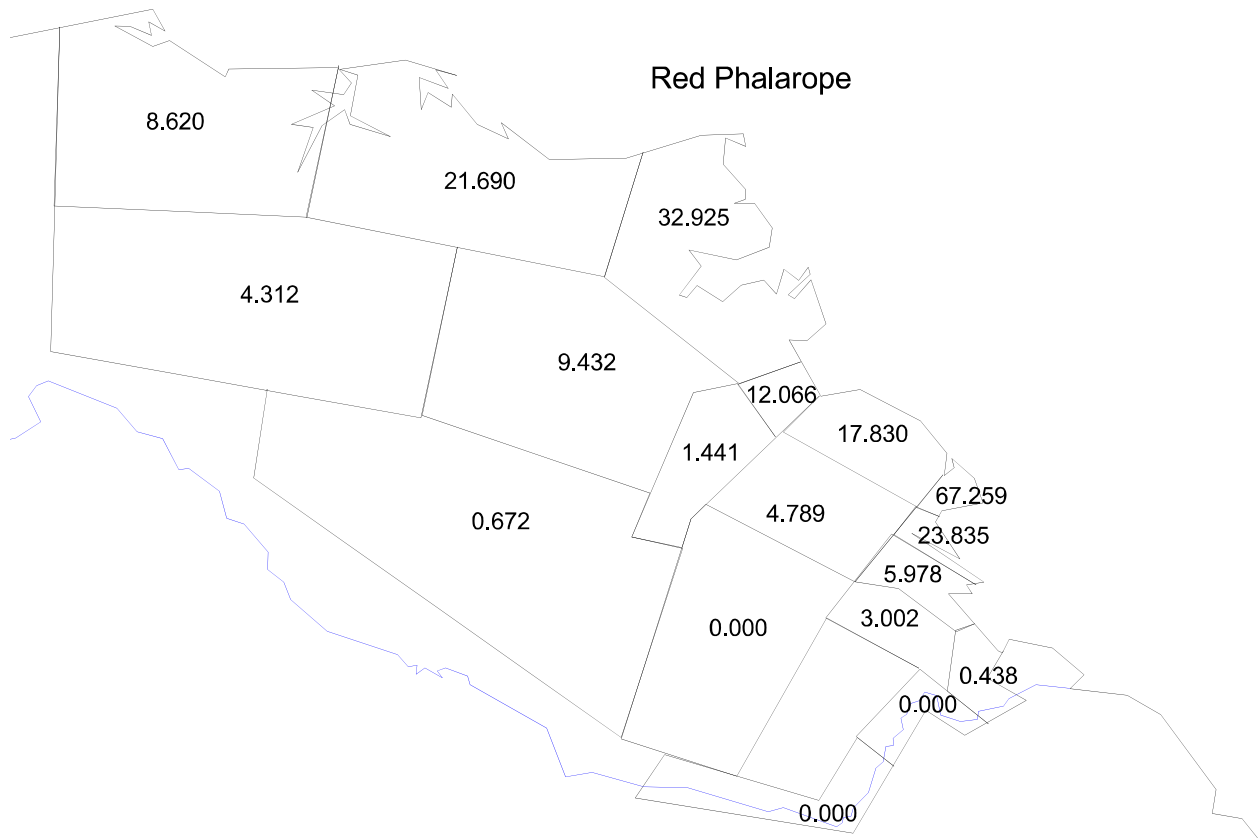


Figure 23. Density (pairs/territorial males per km²) of Red Phalaropes breeding in the National Petroleum Reserve – Alaska, 1998–2001.