RECENT CHANGES IN THE WINTER DISTRIBUTION AND ABUNDANCE OF ROCK SANDPIPERS IN NORTH AMERICA

JOSEPH B. BUCHANAN, Cascadia Research Collective, 218½ W. Fourth Avenue, Olympia, Washington 98501 and Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, Washington 98501

The North American population of the Rock Sandpiper (*Calidris ptilocnemis*) winters along the Pacific coast from the Bering Sea to northern California (AOU 1998). In Alaska, where it is the most abundant winter resident shorebird (Gill and Tibbitts 1999), the species uses substrates of soft or coarse sediment (Gill and Tibbitts 1999), whereas rocky shorelines are the primary habitat in the southern part of its range (Paulson 1993). Rock Sandpipers are rarely encountered away from the coast (Campbell et al. 1990). Perhaps because of their close association with rugged or isolated coasts, little is known about their winter population status.

Paulson (1993) suggested that winter populations have declined in the Pacific Northwest but was uncertain whether the apparent decline is limited to that region or reflects a more widespread change in population abundance. In this paper, I use data from annual Christmas Bird Counts (CBC) throughout the winter range of the Rock Sandpiper to assess the winter population status of this species.

METHODS

To evaluate recent trends in winter populations of Rock Sandpipers, I tallied results from CBCs conducted in Alaska (9 count sites), British Columbia (6 sites), Washington (4 sites), Oregon (6 sites), and California (5 sites) where Rock Sandpipers have been detected on at least 10% of the counts since 1968–69 (see below and Table 1). The CBC is an annual single-day event involving volunteers who count as many birds as they can within a 12-km radius circle (see Bock and Root [1981] for additional details about the CBC).

A number of researchers have suggested methods for standardizing CBC data prior to analysis (e.g., Bock and Root 1981). Standardization of count data is an important consideration for many species because the level of observer effort may be correlated with a species' abundance (Bock and Root 1981). In this analysis, however, I used the actual count data rather than an index value (i.e., birds/party hour) because I found no positive relationships between observer effort and the abundance of Rock Sandpipers (Spearman rank correlation; $r_s < 0.26$, $P > 0.25$ in all cases).

I originally intended to use regression analysis (Neter et al. 1990) to assess relationships between abundance of Rock Sandpipers and year of count. In many cases, however, I was unable to perform adequate data transformations (to normalize data distributions) because of high variability in the counts, particularly from Alaska, where Rock Sandpiper abundance may change as birds move within or among estuaries (Gill and Tibbitts 1999).

Table 1 Numbers of Rock Sandpipers Recorded on Christmas Bird Counts[a]

	Before 1982–83			After 1982–83					
Site	Mean	SE[b]	n^c	Mean	SE	n	Trend	t	P
Alaska									
Adak	—	—	—	88.82	(24.86)	11	*d*	*d*	*d*
Cordova	71.33	(29.53)	12	45.67	(32.99)	12	=	1.72	>0.25
Homer	463.70	(200.92)	10	1045.36	(293.29)	14	+	1.82	<0.05
Glacier Bay	376.36	(66.91)	11	735.50	(179.03)	10	+	1.95	<0.05
Juneau	209.88	(92.59)	8	107.36	(38.42)	14	=	1.73	>0.10
Kodiak	178.00	(50.38)	9	83.93	(15.26)	14	–	2.13	<0.025
Narrow Cape	36.00	—	1	32.07	(10.10)	14	*d*	*d*	*d*
Sitka	6.83	(5.55)	6	12.21	(8.52)	14	=	0.39	>0.25
Valdez	133.33	(133.33)	3	176.00	(96.24)	12	*d*	*d*	*d*
British Columbia									
Masset	—	—	—	15.50	(13.66)	14	*d*	*d*	*d*
Nanaimo	0.18	(0.18)	11	4.29	(1.57)	14	+	1.71	<0.025
Skidegate	—	—	—	39.43	(12.91)	14	*d*	*d*	*d*
Sooke	—	—	—	3.17	(1.29)	12	*d*	*d*	*d*
Sunshine	17.67	(17.17)	3	15.54	(3.83)	13	*d*	*d*	*d*
Victoria	19.07	(5.10)	14	5.43	(1.68)	14	–	4.75	<0.0005
Washington									
Grays Harbor	27.30	(4.63)	10	5.92	(1.46)	12	–	4.75	<0.0005
Oregon									
Coos Bay	5.13	(1.87)	8	1.55	(0.69)	11	–	2.01	<0.05
Tillamook	12.21	(2.23)	14	3.57	(1.11)	14	–	3.47	<0.001
Yaquina	7.33	(2.65)	9	0.93	(0.34)	14	–	2.99	<0.005

[a]Mean values before and after 1983 compared with two-sample *t* test. Counts with fewer than three Rock Sandpipers per year not included.

[b]SE, standard error.

[c]*n*, number of years a CBC was conducted.

[d]Data insufficient for two-sample analysis.

While visually inspecting scatter plots of the count data I noted a regionwide pattern of population change in the early to mid-1980s (Figure 1). Because of the timing and range of the pattern I suspected a relationship to the 1982–83 El Niño–Southern Oscillation event. Consequently, I used a one-tailed two-sample *t* test at each site to determine whether counts between 1968–69 and 1981–82 were greater than those between 1983–84 and 1996–97, using data from only those circles where counts were made in >75% of the years between 1968 and 1997. In addition, I used regression analysis for Narrow Cape/Kalsin Bay (Alaska) and Skidegate (British Columbia) data because either $\log_{10}$ or polynomial transformations were possible and the number of years with CBC data prior to 1982–83 was too small for a two-sample analysis; these two regression analyses covered periods ending in 1996–97 and beginning in 1981–82 and 1983–84, respectively.

RESULTS

Rock Sandpipers were recorded regularly in 19 CBC circles, throughout most of their winter distribution (Table 1). Wintering Rock Sandpipers reached their greatest abundance in three count circles in Alaska: Homer (high of 3400 in 1995–96; six counts >1000), Glacier Bay (1708 in 1987–88; three counts >1000), and Valdez (1100 in 1989–90). Their abundance varied substantially from year to year in these and other count circles, particularly in Alaska. Rock Sandpipers occurred in lower numbers in all other count circles; their scarcity in many circles in Washington (i.e., Bellingham, Seattle, San Juan Islands Archipelago; all means <1.0/year), Oregon (i.e., Columbia River Estuary, Coos Bay, Florence; all <3.0/year), and California (i.e., Del Norte County, Crystal Springs, Farallon Island, Monterey Peninsula; all <1.0/year) precluded statistical analysis except for the circles indicated below.

The abundance of Rock Sandpipers was significantly lower in six count circles after 1982–83 than before (Table 1), and their abundance declined in two other circles monitored only since about this time: Narrow Cape/Kalsin Bay, Alaska: $\log_{10}$ (abundance) = 18.79 – 0.177 (year), $r^2 = 0.37$, $P = 0.029$; Skidegate, British Columbia: abundance = 15,123.7 - 327.1 (year) + 1.77 (year)^2, $r^2 = 0.66$, $P = 0.0028$). Conversely, their abundance increased in three count circles, particularly Homer and Glacier Bay, the two coastal Alaskan CBC circles where the species is most abundant (Table 1). The third count circle (Nanaimo) supported very few Rock Sandpipers in any year. Abundance did not change significantly in three Alaskan count circles (Cordova, Juneau, Sitka; Table 1), although the trend for the first two was negative. There were no clear patterns of change in four count circles (Adak and Valdez, Alaska; Masset and Sooke, British Columbia), although year-to-year variability and a lack of data prior to 1981-82 prevented formal analysis.

DISCUSSION

Although the Rock Sandpiper has always been considered an uncommon or rare and local winter resident in coastal British Columbia, Washington,

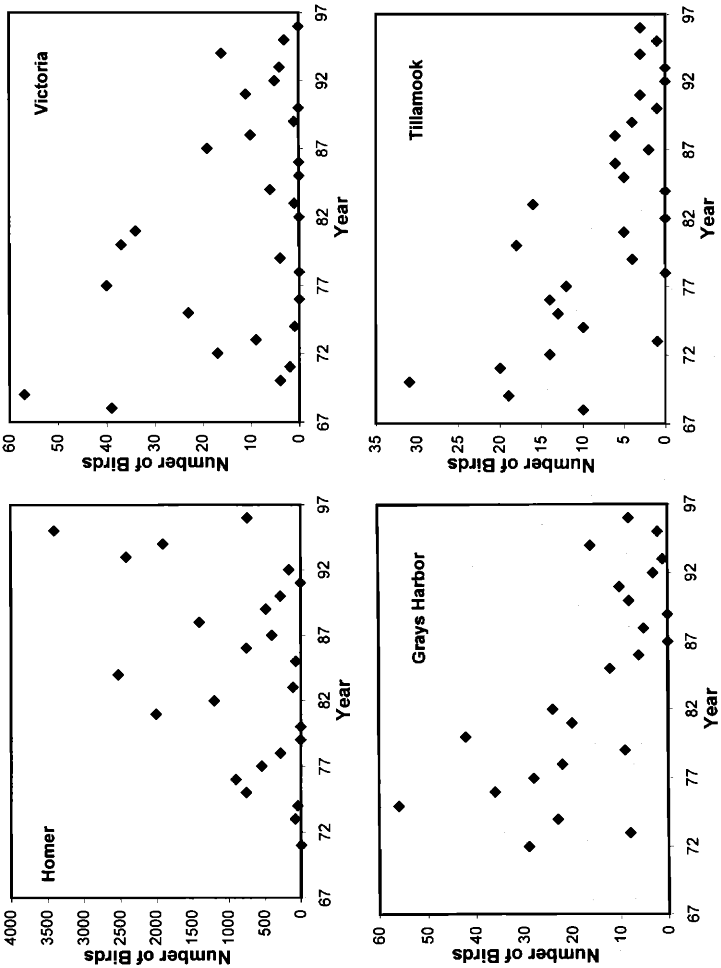

Figure 1. Scatter plots of Rock Sandpiper abundance at selected CBC count circles along the west coast of North America.

Oregon, and California (Gabrielson and Jewett 1940, Jewett et al. 1953, Campbell et al. 1990, Small 1994), my analyses clearly support Paulson's (1993) suggestion of a recent decline in wintering populations in that region. This decline was widespread, rapid, and appeared to include some areas of Alaska. It appeared to coincide, however, with a substantial increase at Homer and Glacier Bay, the two most important wintering areas (among the CBC circles) in Alaska. The decline in the more southerly wintering areas may therefore reflect a range contraction rather than an actual population decline.

The reason for the observed changes in Rock Sandpiper distribution and abundance is not understood. The Rock Sandpiper occupies rugged and often remote habitats during winter, and it occurs in many areas other than CBC circles, particularly in Alaska (e.g., Cook Inlet; Gill and Tibbitts 1999). Shoreline searches of areas outside of CBC circles have produced low numbers in the southern part of its winter distribution (e.g., Wahl 1996), and it is unlikely that the declines noted in British Columbia, Washington, Oregon, and California can be explained by local shifts in distribution. Because the decrease was rapid and widespread, a possible explanation must account for changes in environmental conditions over large regions.

El Niño affects atmospheric and oceanic conditions over vast portions of the earth, resulting in intense coastal storms, an increase in the elevation of sea level, decreased salinity, and higher water temperature (Glynn 1988). These conditions can affect species and communities directly (e.g., via nutrient depletion) or indirectly (e.g., via emigration from nutrient-deficient regions) (Glynn 1988). Such changes can be either transient or long-term. The 1982–83 El Niño was, at the time, considered to be the most significant known to science (Glynn 1988). Since that time, however, a persistent oceanic warming in the California Current and Gulf of Alaska has been documented (Fahrbach et al. 1991, Royer 1993, Veit et al. 1996). Various seabird species in the northeastern Pacific have experienced pronounced population changes during the past two decades (Pearcy and Schoener 1987, Wilson 1991, Ainley et al. 1994, Veit et al. 1996, Wahl and Tweit in press), most likely in response to reduced food supplies (e.g., fish; Hodder and Graybill 1985) associated with oceanic warming. Because Rock Sandpipers forage on rocky shorelines, the manner in which El Niño or oceanic warming might affect their food source is unclear, although two explanations seem plausible. First, it is possible that higher sea levels and more turbulent wave action disturbed the foraging zone or food sources. In Washington, however, Paine (1986) found no substantial or lasting changes in an intertidal mussel community following the 1982–83 El Niño.

Second, it is possible that nutrients were reduced in response to an increase in water temperature (Glynn 1988). McLain (1984) found a reduction in biological productivity in the California Current in association with El Niño warming. Prolonged changes in oceanographic conditions and fish populations in the Gulf of Alaska appear to have begun about 1980 (see Piatt and Anderson 1996). Although many marine species in the Gulf of Alaska were affected negatively by these changes (Piatt and Anderson 1996), Rock Sandpiper numbers appeared to increase at two (and likely other) important wintering areas and overall show no signs of a decline. Although oceanic warming may have affected the Rock Sandpiper's distribution, the relationships I found are correlative and do not demonstrate cause and effect. Rock Sandpiper numbers, however, have not increased in the southern portion of the species' winter range since the initial decline. Additional research is necessary to identify factors that influence the distribution and abundance of Rock Sandpipers on their wintering grounds.

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