CHANGES IN WINTER ABUNDANCE OF THE RUDDY TURNSTONE ALONG THE COAST OF CALIFORNIA

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ABSTRACT: We used data from Christmas Bird Counts (CBCs) to demonstrate a significant decline over the last 28 years of the Ruddy Turnstone (*Arenaria interpres*) population wintering along the coast of California. Of the seventeen CBCs with analyzable data, eight revealed significant decreases, but none revealed an increase. The average number of Ruddy Turnstones counted since 1990 has decreased by 43% compared to the average prior to 1990. Declines were noted on CBCs from north of San Francisco to San Diego. Older data from some of the California CBCs suggested that the higher numbers of turnstones recorded in the late 1970s and 1980s may have reflected a period of unusually high abundance, perhaps part of a cyclic change. Several factors may have contributed to the decrease of the Ruddy Turnstone in California. However, we suspect that the most important is climate change, possibly related to the long-term fluctuations of sea-surface temperature known as the Pacific decadal oscillation. There may have been a decline in the quality of intertidal habitats along the California coast, affecting wintering populations of the Ruddy Turnstone and possibly of the Wandering Tattler (*Heteroscelus incanus*).

Among the most cosmopolitan of birds, the Ruddy Turnstone breeds across the northern arctic regions of North America, Greenland, Europe, and Asia. It can be found wintering on the shores of every continent except Antarctica (Hayman et al. 1986). It is a common spring and fall migrant and uncommon but regular winter visitor along the California coast, mainly south of Mendocino County (Small 1994, Nettleship 2000). In winter it forages in the rocky intertidal zone on a wide variety of invertebrates but also uses a wide range of habitats and takes a great variety of prey (Shuford et al. 1989, Whitfield 1990, Gill 1997, Nettleship 2000, Smart and Gill 2003).

The overall population of the Ruddy Turnstone seems to be relatively stable. The International Shorebird Survey (Howe et al. 1989) covered the period from 1972 to 1983 and found no statistically significant trend at migratory stopover sites on the east coast of North America. Clark et al. (1993) measured peak numbers in migration at Delaware Bay from 1986 to 1992 and found no trend. Sagar et al. (1999) found no discernable trend in wintering (austral summer) Ruddy Turnstones in New Zealand from 1983 to 1994. In Britain, surveys reviewed by Austin et al. (2000) covering the period 1969–1996 found no significant population changes. Rehfisch et al. (2003), however, comparing more complete surveys in Britain in winter 1984-85 to those in winter 1997–98, detected a decline of 16%.

With the exception of local observations from Southeast Farallon Island and nearby coasts (Pyle and DeSante 1994), Monterey County (Roberson 2002), and Santa Cruz County (D. Suddjian pers. comm.), there have been no reports of a general decline in Ruddy Turnstones wintering in California.

Winter is a particularly good time to survey Ruddy Turnstone populations because this species is extraordinarily faithful to its winter sites (Metcalfe and Furness 1985, Summers et al. 1989, Burton and Evans 1997) and relatively sedentary within them (Pearce-Higgins 2001). The changes in abundance shown by our analysis of California Christmas Bird Count (CBC) data, while not significant in terms of the worldwide population of Ruddy Turnstones, suggest that some localized phenomena have affected this subset of birds on its wintering grounds, in its breeding range, or at its migratory stopover points. We examined several factors that might have affected numbers of California's wintering Ruddy Turnstones.

METHODS

We took the following steps to minimize the problems associated with using CBC data to analyze long-term population trends:

1. Wherever possible, we consulted with count compilers to determine if any of the observed data on turnstones could have been affected by changes in observers, changes in geographic coverage (especially changes that could have caused double counting or birds to be missed), changes in time of day or tidal periods when appropriate habitats were counted, or major alterations in local habitat or access to that habitat. On this basis, we eliminated the Santa Maria–Guadalupe CBC because the compiler had concerns that changes in geographic coverage may have affected the reliability of the data.
2. We used data only from CBCs in which the number of observers and hours of observation exceeded 48 party hours, equivalent to at least 6 parties counting for at least 8 hours each. Because Ruddy Turnstones are not widespread and each CBC usually found all or nearly all the birds in a few specific areas, this effort should have been adequate. We did not use count-wide party-hours to normalize data among counts because that would tend to reduce artificially the numbers of birds from well-covered circles.
3. We included data only from circles that had been counted in least 26 of the 28 years from 1976 to 2003 to eliminate CBCs that were not run regularly during this period.
4. We included only CBCs that found, on average, more than five Ruddy Turnstones per year to eliminate CBCs where this species is rare or irregular.
5. All CBC data obtained from the National Audubon Society's website (www.audubon.org/bird/cbc) were checked with the local compilers. When discrepancies were found, the local compilers' data were used.

Under these criteria, 17 California CBCs provided data sufficient for analysis of the Ruddy Turnstone's population trends (Figure 1). Using these same criteria, with data for the same period from the same 17 count circles, we analyzed results for five additional species typical of rocky shorelines: the Black Turnstone (*Arenaria melanocephala*), Black Oystercatcher (*Haema-*

Figure 1. The 17 CBC circles used for Ruddy Turnstone analysis. Locations approximate and circles are not to scale. From north to south, the circles are West Sonoma (WS), Point Reyes (PR), Oakland (OAK), Crystal Springs (CS), Hayward–Fremont (HF), Año Nuevo (AN), Santa Cruz (SC), Moss Landing (ML), Monterey Peninsula (MP), Morro Bay (MB), Santa Barbara (SB), Malibu (MA), Los Angeles (LA), Palos Verdes Peninsula (PV), Orange County Coastal (OC), Oceanside/Vista/Carlsbad (OVC), and San Diego (SD).

topus bachmani), Surfbird (*Aphriza virgata*), Wandering Tattler (*Heteroscelus incanus*), and Whimbrel (*Numenius phaeopus*).

We chose 1976 as the beginning of our study period because the number of count circles that meet our criteria of consistent compilation and adequate effort decreases rapidly before that year. Also, checking with compilers about

local changes is difficult or impossible with counts older than 1976. We did analyze a limited number of counts going back to 1962, but we have reduced confidence in those data.

We assigned data from all counts to the earlier of the two calendar years covered by each count period; for example, a CBC conducted in January 1979 is recorded as a 1978 count.

We determined the statistical significance of any change over time by means of paired *t* tests comparing the period 1976–89 to 1990–2003. Any observed changes were considered significant at a probability of $p < 0.01$.

Information on band recoveries was compiled from the United States Geological Survey Bird Banding Laboratory database. Whenever possible, we supplemented and confirmed these data by contacting the original bander.

RESULTS

Ruddy Turnstone Numbers

The Ruddy Turnstone declined on 8 of the 17 California CBCs analyzed (Table 1). The species did not increase significantly on any California CBC. Declines were geographically widespread and, in many cases, dramatic (Figure 2). CBCs in Monterey, Santa Cruz, and Orange counties typically reported 20–50 birds per year in the 1980s but fewer than 10 per year after then. San Diego reported well over 100 Ruddy Turnstones on every count from 1976 to 1984 but has exceeded 100 only twice in the 19

Table 1 Change in Numbers of Ruddy Turnstones in 17 California Christmas Bird Count Circles

CBC circle	Average 1976–89	SD[a]	Average 1990–2003	SD	*p*
West Sonoma	43	28	29	12	NS[b]
Point. Reyes	19	7	1	1	<0.0001
Oakland	24	14	7	5	<0.01
Crystal Springs	22	14	9	7	<0.01
Hayward–Fremont	21	18	21	18	NS
Año Nuevo	10	7	1	3	<0.001
Santa Cruz	37	16	14	16	<0.01
Moss Landing	41	19	36	33	NS
Monterey Peninsula	28	13	7	9	<0.01
Morro Bay	5	7	4	3	NS
Santa Barbara	3	2	7	5	NS
Malibu	18	13	15	9	NS
Los Angeles	24	10	24	13	NS
Palos Verdes	13	10	14	11	NS
Orange County coastal	23	11	4	3	<0.0001
Oceanside	3	2	8	5	NS
San Diego	123	45	59	28	<0.001
Average of all circles	27	4	15	5	<0.0001

[a]SD, standard deviation.

[b]NS, not significant; $p > 0.01$.

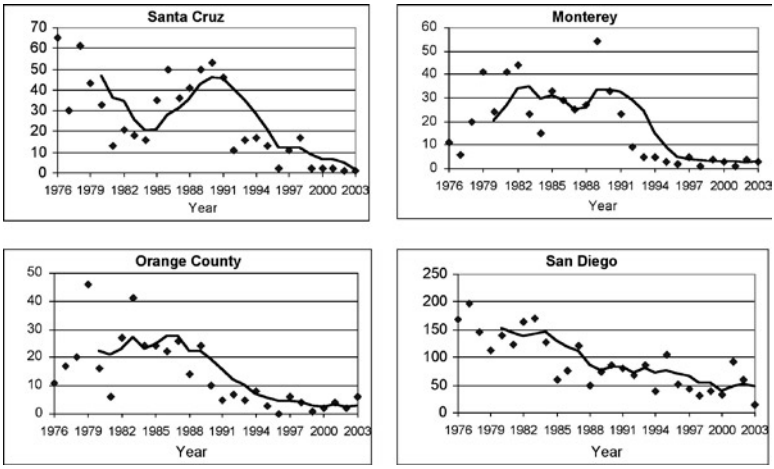

Figure 2. Scatter plots of Ruddy Turnstone abundance with 5-year moving average, 1976–2003, at selected CBC circles in California.

subsequent years. Declines are highly significant when averaged over all 17 CBCs. During the 14 years from 1990 to 2003 the average number of Ruddy Turnstones per CBC was more than 40% lower than in the previous 14 years.

Other Rocky Shoreline Species

Using averages per usable CBC, we detected a decline in the Wandering Tattler (62% decline, $p < 0.0001$) and an increase in the Whimbrel (38% increase, $p < 0.0001$). The Black Oystercatcher, Black Turnstone, and Surfbird showed no trend.

Pre-1976 Data

Six of the eight CBCs that showed a significant change in Ruddy Turnstone numbers 1976–2003 had usable data back to 1962. These CBCs showed a peak in numbers during the late 1970s and the 1980s (Figure 3). Ruddy Turnstones increased significantly on all of these CBCs from 1962–75 to 1976–89. There was no significant difference in Ruddy Turnstone numbers between the early period (1962–75) and the recent years (1990–2003).

DISCUSSION

As discussed by Sauer and Link (2002), the use of Christmas Bird Count data for assessing population trends is problematic. Many of these problems are apparent when one attempts to compile data on species that are generally widespread, difficult to detect, or difficult to identify. However, the Ruddy Turnstone is a better candidate for use of CBC data because it is generally

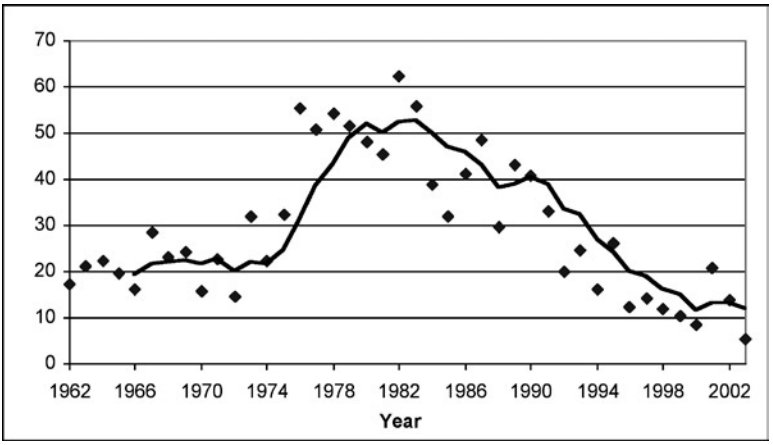

Figure 3. Scatter plot of average Ruddy Turnstone abundance with 5-year moving average, 1962–2003, from six CBC circles (Oakland, Crystal Springs, Santa Cruz, Monterey, Orange County, and San Diego) along the coast of California.

found within a very small subset of any given count circle and is relatively easy to detect and identify.

We conclude that there has been a significant and widespread decline the in number of Ruddy Turnstones wintering along the California coast in the last 28 years. Our observations apply only to the California wintering population. There is no compelling evidence that the species is in general decline, and the California population represents a tiny fraction of the total numbers of the Ruddy Turnstone.

The widespread nature of this decline suggests that a common factor may be affecting the whole of California's wintering population. Interestingly, data collected prior to 1976 from six CBCs suggests that the relatively large numbers of the Ruddy Turnstone recorded from the late 1970s through the 1980s were unusual or part of a cyclic change. Hoffman (1927) and Grinnell and Miller (1944) stated that the Ruddy Turnstone wintered in small numbers along the California coast during the first half of the 20th century.

Factors that, singly or in combination, could explain the observed decline over the last three decades include

1. redistribution of the California population to other areas
2. decreased reproduction or survival on the breeding grounds
3. decreased survival during migration
4. decreased winter survival along the California coast due to degradation of foraging habitat, increased predation, and/or increased competition with other species.

Re-distribution of the California Population

As noted earlier, the Ruddy Turnstone's winter site fidelity is extraordinarily strong (Metcalfe and Furness 1985, Summers et al. 1989, Burton and

Evans 1997, Pearce-Higgins 2001). It is therefore unlikely that this decline represents a change in this species' wintering distribution.

Reproduction or Survival on the Breeding Grounds

Band-recovery data for Ruddy Turnstones along the Pacific Coast are scant but suggest that at least some of this population breeds in the Colville River delta of Alaska. The subspecies that breeds in this area is *A. i. interpres* (Engelmoer and Roselaar 1998, J. Helmericks unpubl. data, *contra* Nettleship 2000), and this same subspecies migrates and winters along the Pacific coast of North America (Paulson 1993, Nettleship 2000). The absence of data that this subspecies has declined in North America significantly during the last few decades makes it unlikely that our observations were due to a general decline in survival of the Ruddy Turnstone on its breeding grounds. However, if the population of the Ruddy Turnstone wintering in California breeds in a limited geographic area, local changes could affect the species' reproductive success. Our current state of knowledge is not sufficient to determine where the California wintering population breeds or if it breeds in a single region or is dispersed over a larger area.

Survival During Migration

Degradation of migratory stopover sites important to this species could result in population declines. There has been extensive urban development along the Pacific Coast during this period, but the same is true of nearly all the world's habitat used by migrating Ruddy Turnstones. It is possible that the California population of the Ruddy Turnstone is particularly dependent on sites that have experienced local degradation or that there has been a widespread decline in the quality of stopover sites along the Pacific Coast.

Foraging Habitat Degradation

The intertidal zone along the California coast is publicly owned and has enjoyed a relatively high degree of protection over the past few decades (Thelander et al. 1994). Direct destruction or conversion of this foraging habitat therefore seems unlikely to be responsible for the Ruddy Turnstone's decline. However, less obvious forms of habitat degradation may have occurred, including changes in quality or abundance of prey as a result of pollution, climate change, or the introduction of alien species.

Pyle and De Sante (1994) looked at population changes in a large number of waterbird species on Southeast Farallon Island west of San Francisco and reviewed CBC data from nearby circles at Point Reyes and southern Marin County. Their findings correspond with ours. They reported decreases for the Ruddy Turnstone and Black Turnstone and a marginally significant increase for the Whimbrel. There was no clear trend for the Wandering Tattler on the island, but both CBC circles revealed statistically significant decreases for this species. These authors speculated that a local decrease in prey availability may have explained their observations.

Bradley and Bradley (1993) noted fluctuations in winter populations of the Black and Ruddy Turnstones correlated with the decline and subsequent restoration of kelp (*Macrocystis* spp.) forests off the Palos Verdes Peninsula.

One of the Ruddy Turnstone's principal foraging strategies in California is to rummage among piles of giant kelp washed up on beaches. According to the California Department of Fish and Game (Giant Kelp, Status of the Population, www.dfg.ca.gov/mrd/mlpa/response/kelp.pdf) and the Monterey Bay National Marine Sanctuary's kelp-management report of 3 October 2000 (King 2000), the extent of kelp forests off the California coast has declined over the past 30 years, and this decline might have affected the Ruddy Turnstone.

It is also possible that climate changes have degraded the quality of the intertidal foraging habitats. Annual fluctuations in sea-surface temperatures (El Niño and La Niña events) occurred sporadically over the period of our analysis. However, not the frequency nor the severity nor the duration of these events fits our data on the Ruddy Turnstone. But the Pacific decadal oscillation (PDO), the long-term fluctuation of sea-surface temperatures in the northeastern Pacific Ocean (Royer 1993, Hare and Francis 1995) may have a role in explaining our observations. Several studies have shown correlations between the PDO and populations of fish (Beamish and Bouillon 1993, Hare and Francis 1995, Francis et al. 1998) and seabirds (Ainley and Boekelheide 1990, Hunt et al. 1996, Peter Pyle pers. comm.). Although comparing our data to the PDO fluctuations of the last century does not suggest any obvious link, the widespread nature and long-term periodicity of the PDO are consistent with the nature of the declines we observed.

Increased Predation

Increased predation on Ruddy Turnstones could also have affected their winter survival. The total number of Peregrine Falcons found on the 17 California CBCs increased dramatically during the last two decades, coincident with the declines in the Ruddy Turnstone that we observed. However, Peregrine Falcon numbers were quite low throughout the 1960s and early 1970s, yet Ruddy Turnstone numbers on the six CBCs we analyzed as far back as 1962 were also low during those years. Moreover, it seems unlikely that increases in the Peregrine Falcon would have affected the Ruddy Turnstone more dramatically than other species of shorebirds.

Increased Competition

The observed increase in the Whimbrel during our study raises the possibility that interference competition has decreased numbers of the Ruddy Turnstone, although on the basis of prey preference (Skeel and Mallory 1996, Nettleship 2000) we would not expect much direct competition between these species.

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