

Annual occurrence of Red Knot *Calidris canutus rufa* at Punta Rasa, Samborombón Bay, Argentina, over a 30-year period (1985–2014)

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From 1985 to 2014, we monitored numbers of Red Knots *Calidris canutus* of the subspecies *rufa* occurring at Punta Rasa, Samborombón Bay, Buenos Aires province, Argentina during northward migration (March to April), and in the austral winter (mid-May to mid-August), when some knots, mainly immatures, remain in South America during the breeding season.

Numbers occurring during northward migration declined over the monitoring period from a peak of 3,640 in 1987 to 168 in 2014. This is consistent with the concurrent decline of the main Tierra del Fuego wintering population (though the percentage of the Tierra del Fuego population stopping at Punta Rasa also declined from 5.4% to 1.3%).

Numbers occurring at Punta Rasa during the austral winter have also declined, but not to the same extent and for the past decade more have been counted during the austral winter than during northward migration. Among those seen at Punta Rasa during the Arctic breeding season have been some with large amounts of rufous breeding plumage. The percentage of such birds has increased from 10–15% in 1987 to 19–54% during 2011–2014. Moreover, observations of individually marked birds show that some of those showing breeding plumage are mature adults, at least 3–7 years old.

Conservation actions are required to manage Punta Rasa for the small but important numbers of Red Knots that occur there. Further research is needed to determine why some mature adults do not go to their Arctic breeding grounds and thereby fail to contribute to reproduction.

Keywords

Red Knot

Calidris canutus rufa

over-summering

Punta Rasa

South America

INTRODUCTION

The Red Knot *Calidris canutus* is a globally distributed migratory shorebird with circumpolar Arctic breeding distribution and a non-breeding range that includes the coasts of all continents except Antarctica. This taxon is

represented by six recognized subspecies. Among them, *C. c. rufa* is the only one that reaches southern South America during the non-breeding season (Piersma & Davidson 1992; Tomkovich 2001). The main non-breeding areas of *C. c. rufa* are located along the coasts of southeastern United States and the Caribbean, Maranhão in Brazil,

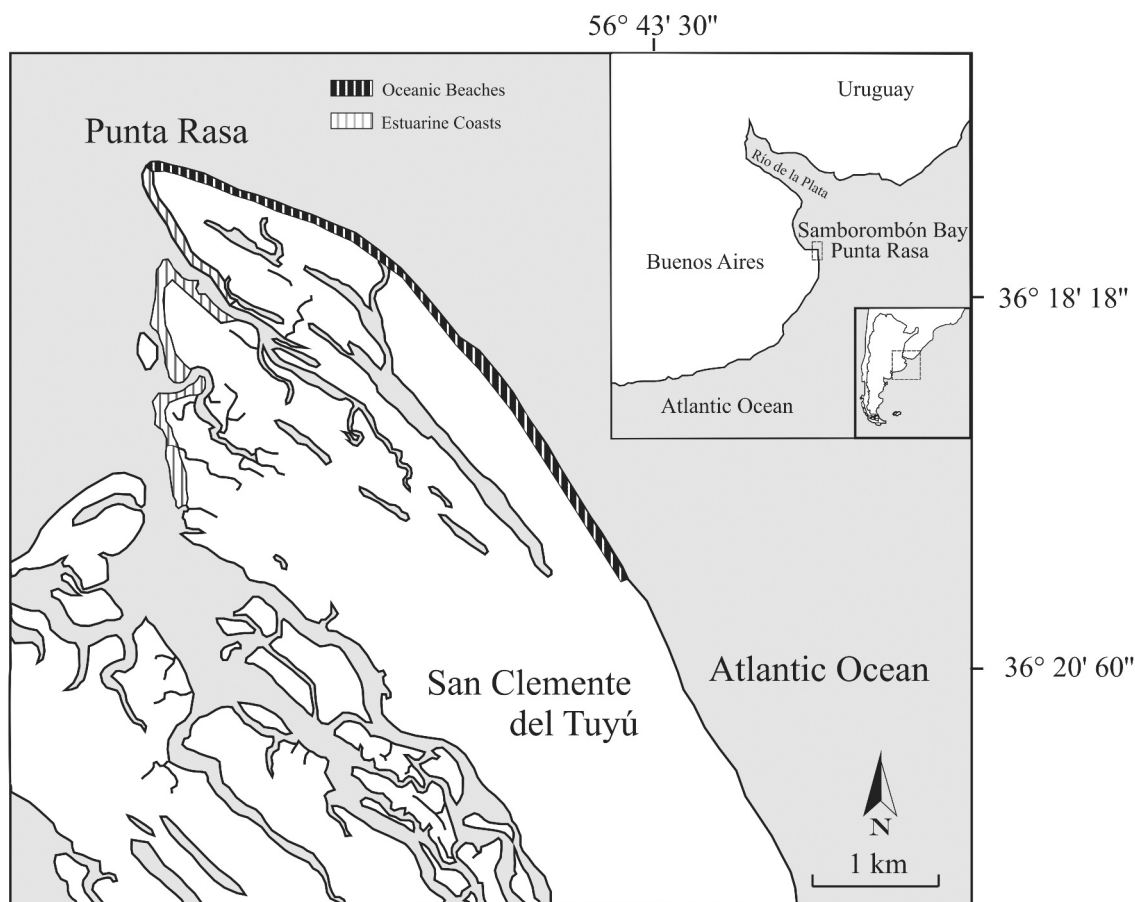


Fig. 1. Map of the study area showing the estuarine coasts to the west and the oceanic beaches to the east of Punta Rasa. The insets show the location of Punta Rasa and Samborombón Bay in Buenos Aires province, Argentina, and in southern South America.

and Tierra del Fuego in southern Argentina and Chile (Morrison & Ross 1989, Niles *et al.* 2008, Baker *et al.* 2013). Trends clearly indicate a significant decline in the last two decades for all non-breeding populations. Birds of Tierra del Fuego, in particular, which numbered 67,500 individuals in the mid 1980s, fell to *ca.* 13,000 by 2011 (Morrison & Ross 1989, Andres *et al.* 2012) and have remained in the range 10,000–15,000 up to 2015 (R.I.G. Morrison, pers. comm.).

This sandpiper is one of the most extensively studied shorebirds in the world. Research, monitoring, and conservation efforts have focused mainly on the three different stages of the adult annual cycle: breeding (e.g. Morrison *et al.* 2005), migration (e.g. Atkinson *et al.* 2005), and non-breeding (e.g. Morrison *et al.* 2004). Less attention has been paid to non-migrants sometimes referred in the literature as 'over-summering' individuals: 'over-summering' here refers to 'boreal-breeding birds which fail to migrate north and remain in the south far away from their breeding region during the boreal summer' as defined by McNeil *et al.* (1994). In our study it refers to individuals present in the Southern Hemisphere during the austral winter (boreal summer). Such birds can be adult individuals, but most are sexually immature birds. According to Niles

et al. (2008), most of the juveniles of the Tierra del Fuego population remain in South America during their first breeding season but their distribution is largely unknown. There are no previous studies focused on over-summering *rufa* Red Knots, but there are several published records, most of which refer to southern Brazil along the coasts of Rio Grande do Sul (Belton 1984, Vooren & Chiaradia 1990, Brusco 2011, Disconzi 2012, Scherer & Petry 2012). In the latter region, groups ranging from *ca.* 30 to 1,000 individuals have been reported frequently, suggesting regular use of the area (maximum counts were obtained on the coasts of Lagoa do Peixe to Pinhal; Belton 1984, Brusco 2011). In Argentina, over-summering Red Knots are known from three localities in Buenos Aires province (Punta Rasa, Mar Chiquita and Claromec o), involving small groups to *ca.* 600 birds (Blanco *et al.* 1992, Ferrero 2001, Blanco & Carbonell 2011, Mart nez-Curci *et al.* 2015b). Finally, there are several records of small over-summering flocks observed in Uruguay (mainly from Rocha, reviewed by Azpiroz *et al.* in press) and isolated reports of small numbers from Venezuela (Azpiroz & Rodr guez-Ferraro 2006; Mart nez 2008; Mart nez & Giner 2011); Per  (L pez-Lan s & Blanco 2005; Acuy Y nac & Pulido Capurro 2006) and Ecuador (Santander *et al.* 2013).

One of the highest published counts of over-summering Red Knots is from Punta Rasa, Buenos Aires province, Argentina ($n = 600$; Blanco *et al.* 1992). At this site, observations of at least nine other over-summering Nearctic migrant species have been reported (Martínez-Curci *et al.* 2014, 2015b). Although this area was identified as a critical stopover site for Red Knots during northbound migration from their major non-breeding grounds in Tierra del Fuego (Blanco *et al.* 1992, Niles *et al.* 2008), limited information on Red Knot numbers is available for the last two decades (Martínez-Curci *et al.* 2015b). Our aim is to describe the abundance patterns of Red Knots at Punta Rasa over the last 30 years and to reevaluate the importance of the area for migratory and over-summering individuals on the basis of the minimum number of birds present annually during austral autumn (northward migration) and winter ('over-summering').

STUDY AREA AND METHODS

This study was conducted at Punta Rasa, which forms the southern tip of Samborombón Bay, Buenos Aires province, Argentina ($36^{\circ}17'S$, $56^{\circ}46'W$), a site recognized as being of international importance within the Western Hemisphere Shorebird Reserve Network (WHSRN 2012). Punta Rasa is a sandbar located between two ecosystems: the estuarine coasts of Río de la Plata to the west and the Atlantic Ocean to the east. Our study area includes the shorelines located to the west and to the southeast of Punta Rasa (Fig. 1; hereafter 'the Punta Rasa area'). It is affected by low-amplitude ($<1.5m$) semidiurnal tides with brackish mesohaline waters. The estuarine coasts, largely inaccessible, are characterized by a gentle slope where large muddy intertidal flats ($>300m$) are exposed during low tide (Isacch *et al.* 2006). The oceanic beaches are characterized by a small intertidal zone ($<15m$) composed of fine sand sediments (Bértola & Morosi 1997). This strip of sandy beaches is negatively impacted by human activity: it faces the town of San Clemente del Tuyú which is one of the most important tourist destinations in Buenos Aires province (hundreds of thousands of tourists annually). The area is used by Red Knots as roosting and feeding sites during both low and high tides (Martínez-Curci *et al.* 2015a).

We conducted 200 counts for Red Knots from 1985 to 2014. Surveys were developed by park rangers (EB from 1985 to 1995; JS from 1987 to 1990; GB from 1987 to 2010) as part of a monitoring program of the area; and by biologists (NSMC and ABA from 2009 to 2014) in the framework of a PhD thesis. Annual counts were performed during two seasons: (1) austral autumn (100 counts from March to April), when Nearctic shorebirds are engaged in northward migration; and (2) austral winter (100 counts from mid-May to mid-August), when Nearctic shorebirds that remain in South America are over-summering (Blanco *et al.* 1992).

The study area was covered through non-systematic surveys. Counts were made along the coasts from a vehicle or by walking, using binoculars (8x or 10x) and

telescopes (20–60x), with varying frequency among years (Fig. 2), except for 2012 when surveys were conducted at least once a week. Data for some years were obtained from the literature: Blanco *et al.* (1992) for 1989 and Alemany (2000) for 1995, 1997, 1999 and 2000. We use the maximum recorded count as an estimate of the minimum number of individuals present in the area for each year and season. The proportion of the number of individuals using the Punta Rasa area in relation to the non-breeding Tierra del Fuego population size was calculated using published estimates: 67,500 individuals non-breeding in Patagonia and Tierra del Fuego in the mid 1980s (Morrison & Ross 1989), 30,460 in 2002–2003 (Morrison *et al.* 2004), 17,800 in 2008–2009 (Dey *et al.* 2011) and ca. 13,000 in 2011–2012 (Andres *et al.* 2012). Finally, from March to July 2011 to 2014 we conducted supplementary periodic surveys at Punta Rasa in order to detect individually marked Red Knots that had been previously banded at other sites of the flyway and might provide evidence of the presence of adult over-summering birds.

RESULTS

The maximum annual count of Red Knots during northward migration at Punta Rasa peaked at 3,640 in 1987 (Fig. 2). Lower numbers were recorded in 1985 and 1986, but fewer surveys were carried out in those years. After 1987, numbers declined almost continuously with maximum counts of less than 100 from 2007 to 2013 followed by a slight increase to 168 in 2014 (Fig. 2).

Counts of Red Knots occurring at Punta Rasa during the austral winter also peaked in 1987 at 640, but then they fluctuated with a count as high as 500 in 2001 (Fig. 2). In most years from 2007 to 2014, austral winter counts were low but more knots were recorded then than during northward migration.

Some of the knots seen at Punta Rasa during the austral winter from 2011 to 2014 were in basic plumage with yellowish-green legs and clearly identifiable as being in their first year (Hayman *et al.* 1986), whereas others exhibited variable amounts of rufous breeding plumage indicating that they were in their second year or older (Fig. 3). The percentage of birds exhibiting breeding plumage varied as follows: 19% in 2011, 54% in 2012, 50% in 2013 and 35% in 2014.

Seven of the knots seen at Punta Rasa during the austral winter carried inscribed leg flags that had been fitted at other locations in Argentina or the United States. In view of the age-class of these birds when they were originally captured, their minimum ages at the time they were seen 'over-summering' at Punta Rasa could be established. One was at least one year old, two at least two years old, one at least three years old, one at least four years old, one at least five years old and one at least seven years old (Table 1). Five of the seven marked birds were resighted at Punta Rasa several times over one to two months.

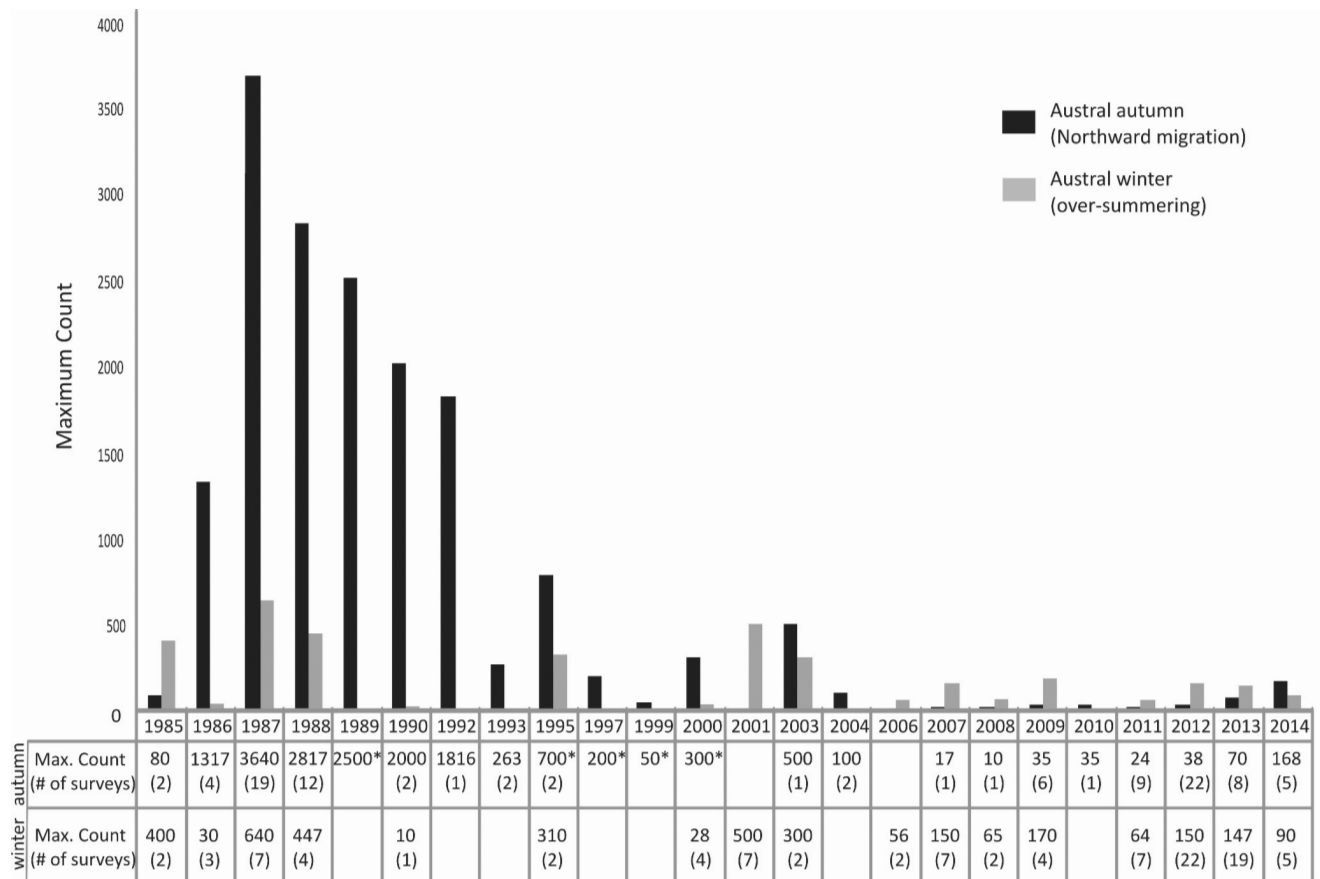


Fig. 2. Red Knot maximum counts (Max. Count) during austral autumn (northward migration) and austral winter (over-summering) from 1985 to 2014. The number of surveys (# of surveys) conducted during each season and year are shown in parentheses; * indicates that the maximum count was obtained from the literature (Blanco *et al.* 1992, Alemany 2000). Blank cells represent seasons for which no information is available.

DISCUSSION

Punta Rasa was identified as an important Red Knot stopover site 25 years ago on the basis of northbound migrating birds (Blanco *et al.* 1992; Niles *et al.* 2008). Red Knots were more abundant in the Punta Rasa area during austral autumn (northward migration) than during the austral winter (over-summering) in the late 1980s and early 1990s. This pattern, however, has switched in the last decade (Fig. 2). For the early period (1985–2000), before the drastic decline in numbers in Tierra del Fuego (Morrison *et al.* 2004), the maximum count of northward migrating birds (3,640 individuals) was obtained in 1987 and represented *ca.* 5.4 % of the Tierra del Fuego non-breeding population at the time. In contrast, for the later period (2001–2014) the maximum count (500 individuals) was obtained in 2003 and represented approximately 1.6% of the Tierra del Fuego non-breeding population in 2002–2003. The maximum count of the last decade (168 individuals in 2014) accounts for *ca.* 1.3% of the Tierra del Fuego population estimate (based on the most recent published numbers in 2011–2012). This suggests a reduction in the proportion of individuals from the Tierra del Fuego population that currently use the Punta Rasa area during northward migration. Although the causes

of this decline have not been explicitly investigated, it is worth noting that, despite its legal protection status, environmental conditions at Punta Rasa have deteriorated significantly over the last two decades. Recreational tourism activities have increased significantly in recent years, particularly during the austral summer and autumn, when the birds are present. Major disturbances for shorebirds in the area are associated with vehicle transit and sport activities such as kite-surfing and kite-buggying along the coast (Martínez-Curci *et al.* in press). The 30-year trend at Punta Rasa is consistent with data from other areas within Argentina. In fact, large reductions in numbers of Red Knots have also been reported for other important migratory stopover sites. An approximate 60% decline was recorded at Río Gallegos (Santa Cruz) between 1998 and 2005; a 93.5% decline at Península Valdés (Chubut) between 1981 and 2005; and a 67% decline at San Antonio Oeste (Río Negro) between 1990 and 2005 (Niles *et al.* 2008). In this period, San Antonio Oeste was the most important migratory stopover site in Argentina during northbound migration, accounting for 25–50% of the Tierra del Fuego population. Smaller numbers are found at the above-mentioned sites, as well as in the Bahía Blanca area (González *et al.* 2004, Baker *et al.* 2013).



Fig. 3. Almost half the flock of over-summering Red Knots recorded at Punta Rasa during the 2013 austral winter. The photograph was taken on 22 May 2013 and shows 62 birds of which about half are in basic plumage (and therefore probably first-year birds) and the other half have advanced or complete alternate plumage indicating that they may be second-year birds or older (photo: N.S. Martínez-Curci).

We have also observed a drop in numbers of over-summering Red Knots in the Punta Rasa area during the last 30 years. This decline, however, was less pronounced than that for birds on northward migration (Fig. 2). Unlike austral autumn patterns, the proportion of individuals from the Tierra del Fuego population that use Punta Rasa during the austral winter (over-summering) seems to have remained stable during the study period. The maximum number of over-summering birds observed in the Punta Rasa area in the late 1980s and early 1990s ($n = 640$ in 1987) represented about 0.95% of the non-breeding population size, whereas the maximum count of over-summering birds in the last decade ($n = 170$ in 2009) accounted for approximately 0.96% of the Tierra del Fuego population estimate in 2008–2009.

In young shorebirds, over-summering behavior is a conservative strategy that balances the cost of long-distance

migration against the probability of successful breeding (Summers *et al.* 1995). While most immature Red Knots spend their first year of life in their non-breeding area, and some may spend their second year of life there, an unknown number of mature *rufa* knots also remain in South America during the boreal summer (austral winter), far from their breeding grounds (Niles *et al.* 2008, Baker *et al.* 2013). Factors such as absent or delayed pre-migratory physiological condition or internal parasite infestation have been proposed to explain this behavior in sexually mature birds (McNeil *et al.* 1994). Studies carried out in Brazil have reported that most over-summering Red Knots were aged as first year based on their basic plumage and yellowish legs, with only a few individuals showing various amounts of alternate plumage (Belton 1984; Scherer & Petry 2012, Brusco 2011). Likewise, only 10–15% of birds observed in 1987 at Punta Rasa showed traces of rufous plumage (Blanco *et al.* 1992). In contrast,

Table 1. ‘Over-summering’ Red Knots marked with inscribed flags re-sighted at Punta Rasa during the austral winter. The minimum age was calculated by considering the difference between the ‘capture’ and ‘re-sight’ year and the age class at the date of capture when available: e.g. >two years old (Fo E7N and Fo U9Y) or one year old (Fo T8D). Fo = orange flag, Fl = lime flag (see Acknowledgements).

Flag code	Captured		Resighted at Punta Rasa		Minimum age (years)
	Date	Site	From	To	
Fo(T8D)	6 Dec 2010	Tierra del Fuego, Argentina	9 Jul 2011		2
Fl (LY5)	23 May 2008	Virginia, USA	17 May 2012	24 Jul 2012	5
Fl (V5J)	22 Mar 2011	South Carolina, USA	21 May 2012	24 Jul 2012	2
Fo (U9Y)	10 Apr 2012	Rio Negro, Argentina	24 Jul 2012		3
Fl (OC3)	18 Oct 2011	South Carolina, USA	20 Jun 2012	30 Jul 2012	1
Fo (U9Y)	10 Apr 2012	Rio Negro, Argentina	19 Jun 2013	22 Jul 2013	4
Fo (E7N)	26 Mar 2008	Rio Negro, Argentina	19 May 2013	16 Jul 2013	7

in recent years we have observed a variable and greater proportion of individuals with advanced or complete alternate plumage and darker legs (19–54% during 2011–2014), indicative of adult status (Fig. 3). In addition, on the basis of observations of individually marked birds we established that at least three over-summerers were not young birds; these were at least 4, 5 and 7 years old (Table 1). These data confirm the presence of mature individuals during austral winter in Argentina. More detailed studies are needed to estimate the incidence of adult birds among over-summering Red Knots flocks at Punta Rasa.

Based on re-sightings of the same marked individuals we established that some birds were present in the Punta Rasa area during two consecutive austral winters, and within a given season they stayed for at least two months (Table 1). Residence time, however, may be longer given that our surveys were conducted from March to July while Blanco *et al.* (1992) suggested that over-summering Red Knots abandon the area in mid August.

Information on the distribution of over-summering shorebirds is a relevant step towards the protection of key areas that facilitate the recruitment of young Red Knots and probably also the recovery of adults in presumably poor body condition.

That some adults that over-summer at Punta Rasa later migrate to the Northern Hemisphere is indicated by observations of Red Knot FoE7N (orange flag inscribed with E7N). After over-summering at Punta Rasa in 2013 when it was at least seven years old (Table 1), it was observed in Georgia, USA, during northward migration on 23–24 May 2015. Therefore, if this bird failed to migrate to the breeding grounds in 2013 because it was in some way debilitated, it had presumably recovered by 2015.

Our data confirm the importance of Punta Rasa for over-summering Red Knots and show that this small locality is used on a regular basis. Given that most reports of over-summering Red Knots are for the coasts of the Pampas biome (Southern Brazil, Uruguay and Buenos Aires province in Argentina), it is likely that this region plays an important role with respect to this behavior, thus deserving conservation actions. Future research should focus on this area in order to identify other regularly-used localities.

The greater proportion of over-summering knots showing extensive amounts of breeding plumage at Punta Rasa in recent years suggests that substantial numbers of mature adults are failing to migrate to the breeding grounds and contribute to reproduction. Therefore this might be a symptom of a population in trouble and a factor that should be investigated as a priority.

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