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PREY COMPOSITION OF PEREGRINE FALCONS (*FALCO PEREGRINUS CASSINI*) PREYING UPON A MIXED-SPECIES SEABIRD COLONY IN ARGENTINE PATAGONIA

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Composición de la dieta de Halcones Peregrinos (*Falco peregrinus cassini*) depredando en una colonia mixta de aves marinas en la Patagonia Argentina.

Key words: Peregrine Falcon, *Falco peregrinus cassini*, avian predators, gulls, Patagonia, terns.

INTRODUCTION

Predation is one of the main factors determining breeding strategies in many seabird species (Lack 1968, Burger & Gochfeld 1994, Gaston 2004). Among avian predators, raptors such as eagles, owls and falcons regularly prey on seabird adults and offspring (Paine *et al.* 1990, Holt 1994, Hayward *et al.* 2010). The Peregrine Falcon (*Falco peregrinus*) has a cosmopolitan distribution (White *et al.* 2002), and is regularly found along coastal areas of Argentine Patagonia which are characterized by large seabird breeding assemblages (Yorio *et al.* 1999). Peregrine Falcons from coastal populations in the Northern Hemisphere have been shown to be important predators of seabirds (Ratcliffe 1980, Paine *et al.* 1990, Velarde 1993), but very little is known on the contribution of seabird prey to Peregrine Falcon diet in coastal Argentina. Few studies have quantified their diet in Patagonia, and they indicate that prey composition may vary depending on location (Ellis *et al.* 2002, Santillán *et al.* 2010). Our goal was to determine the prey composition and contribution of seabirds to the diet of a pair of Peregrine Falcons breeding near a mixed-species seabird colony on the coast of Argentine Patagonia.

METHODS

Study area and observations. The study was conducted in the Punta León Provincial Reserve

(43º04'S, 64º29'W), Chubut, Argentina. The coast in this area is characterized by extensive cliffs 30–100 m high with gravel beaches along the shoreline. A silt platform of ~ 5 ha lying to the seaward side of the cliffs and covered by vegetation is used for nesting by several species of seabird, including Royal Terns (*Thalasseus maximus maximus*; 450 pairs), Cayenne Terns (*Thalasseus sandvicensis eurygnathus*; 1050 pairs), Kelp Gulls (*Larus dominicanus*; 5600 pairs), Imperial Cormorants (*Phalacrocorax atriceps*; 3000 pairs), and Neotropic Cormorants (P*halacrocorax brasilianus*; 100 pairs) (Yorio *et al.* 1994, Gatto & Yorio 2009). Royal and Cayenne Terns arrive at Punta León during mid September and settle in a single colony during the second and third weeks of October (Yorio *et al.* 1994). First chicks hatch during the first and second weeks of November and stay at their nest until they are 20 days old, when they start to congregate in crèches (Quintana & Yorio 1997).

Between 20 November and 21 December 2006 we collected pellets and prey remains form a pair of Peregrine Falcons breeding in a cliff nest about 650 m south of the mixed-species seabird colony. No other Peregrine Falcon pair was found breeding in the area. Diet was assessed through the analysis of 23 prey remains and 15 pellets collected under the nest and two perching sites located 30 and 50 m from the nest. The nest was not visited to collect prey remains due to safety reasons. Samples were analyzed following standard techniques (Marti *et al.* 2007). Preys were identified from skulls, beaks, wing pairs, and whole feathers, using reference materials from the collection at the Vertebrate Lab of the University of Mar del Plata. Results are expressed as frequency of occurrence (the percentage of sampling units containing a particular prey type). In addition, *ad libitum* observations were made on Peregrine Falcon feeding behavior.

RESULTS AND DISCUSSION

Five types of prey were identified, all of which were birds (see Table 1). The most frequent prey items in pellets were *Thalasseus* terns, mainly Cayenne Terns (60.0%), followed by Passerines (35.0%), and other Charadriiformes (5.0%). Of the items found in prey remains, 91.3% corresponded to adult Cayenne Terns, followed by Royal Tern chicks (4.3%) and Kelp Gull chicks (4.3%).

Our results show that seabirds were the main prey of Peregrine Falcons breeding at Punta León. Results agree with previous studies which indicate that birds are the main food resource of Peregrine Falcons (Oro & Tella 1996, White *et al.* 2002), and that in coastal environments falcons consume mainly seabirds and shorebirds in relation to their availability (Peres & Peres 1985, Paine *et al.* 1990, Velarde 1993, Oro 1996a, Castellanos *et al.* 2006, Beauchamp 2008, Olsen *et al.* 2008). Moreover, the subspecies *F. peregrinus pealei* of the North Pacific coasts is considered a seabird specialist (Gaston 2004). The main prey species identified in both pellets and prey remain samples at our study site was the Cayenne Tern, and the higher consumption of this tern species likely reflects both its availability (> 2000 breeding individuals) and relatively small size (~ 0.25 kg, being the smaller in the mixed-species colony). In addition, Cayenne Terns breeding at Punta León generally depart from the colony towards their feeding grounds heading southwest parallel to the coastline (Gatto 2009), thereby going by falcon perches along the cliff. Observations in the study area indicated that Peregrine Falcons spotted and chased prey from these cliff perches near their nest (i.e. sit-and-wait hunting strategy), being all these attacks on adult Cayenne Terns. Interestingly, Royal Tern adults were barely represented in falcon diet, despite their relative abundance in the mix-species seabird colony. This species has been

TABLE 1. Percentage of total occurrence (%) and number of prey (Np) identified in prey remains and pellets of *Falco peregrinus cassini* in Patagonia Argentina.

Prey species	Prey remains (N = 23)		Pellets(N = 15)	
	%	Np	%	Np
Thalasseus sandvicensis eurygnathus	91.30	21	60	12
Thalasseus maximus maximus	4.35	1	-	-
Larus dominicanus	4.35	1	-	-
Unidentified Charadriiforms	-	-	5	1
Unidentified Passerines	-	-	35	7

previously recorded as secondary prey of Peregrine Falcons in Mexico (Velarde 1993, Castellanos *et al.* 2006). However, Royal Tern chicks, as well as Kelp Gull chicks, were recorded in prey remains. Falcons were observed circling and diving to capture 20 day old chicks of these two species, showing they also captured prey on the ground as recorded in other studies (Oro 1996b, Ellis *et al.* 2002). As in other regions, Passerines were also taken, but overall terns constituted the bulk of prey consumed by Peregrine Falcons at Punta León. Several other tern species have been recorded worldwide as Peregrine Falcon prey, including the Common Tern (*Sterna hirundo*; Nisbet 1992, Castellanos 2006), Elegant Tern (*Sterna elegans*; Velarde 1993), Roseate Terns (*Sterna dougallii*; Nisbet 1992), South American Tern (*Sterna hirundinacea*; McNutt 1981), and Inca Tern (*Larosterna inca*; Zavalaga 1997, Figueroa & Stucchi 2008).

No Kelp Gull adults were preyed upon despite the large number of individuals breeding at Punta León (> 11,000 birds). Gulls ranging in size between 0.18 and 0.55 kg have been reported as prey of Peregrine Falcons worldwide (Ratcliffe 1980, Velarde 1993, Oro 1996a, Castellanos 2006, Collins *et al.* 2014). Kelp Gulls may not be an attractive prey item given their relatively larger size (~ 1 kg), as although Peregrine Falcons can take seabirds up to that size (Gaston 2004) they tend to capture on average smaller prey (< 0.6 kg; Paine *et al.* 1990). However, occasional attacks on adult Kelp Gulls have been observed in Patagonia (Ellis & Gliski 1980, Santillán *et al.* 2010) and in Peru (Stucchi & Figueroa 2010). Previous research at another coastal location in Patagonia, Ría Deseado (47°45'S, 65°56'W), showed that Peregrine Falcons mostly prey on Rock Pigeons (*Columbia livia*) with only a minor contribution of seabird prey, despite their relatively high availability in the area (Santillán *et al.* 2010), very likely reflecting the relatively large size of main species at this breeding seabird assemblage (gulls, cormorants, and penguins; Gandini & Frere 1998).

Our observations were conducted from mid November to mid December, during the late Peregrine Falcon chick stage and after chicks fledged (late November), so their consumption of seabirds earlier in the breeding season cannot be ruled out. It should be noted that Cayenne Tern remains were also observed during mid September in the same breeding season (W. Svagelj pers. comm.), when terns start to arrive at the breeding site (Yorio *et al.* 1994). It should be also considered that the analysis of pellet or prey remains may not correctly reflect the presence of different types of prey, and thus may yield biased results (Marti 1987, Simmons *et al.* 1991, Rosenfield *et al.* 1995). Although the combined analysis of pellets and prey remains, as used in this study, may allow a more accurate

estimate of raptor diet (Simmons *et al.* 1991, Oro & Tella 1996), further studies complementing these methodologies with direct observations of prey deliveries and based on a larger sample size should be implemented in the study area.

Our results suggest that seabirds, particularly terns, can be an important component of Peregrine Falcon diet in the study area. Studies in the Northern Hemisphere have shown that even a couple or few Peregrine Falcon individuals can have a significant effect on the associated seabird assemblage through direct or indirect effects (e.g. predation, protective association, among others; see Paine *et al.* 1990, Hipfner *et al.* 2011). Further studies need to assess the effects of Peregrine Falcons on adult survival and breeding success of seabirds breeding at Punta León, particularly the Cayenne Tern.

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