

FISH PREY OF THE PERUVIAN TERN *STERNULA LORATA* ALONG THE NORTHERN COAST OF CHILE

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ABSTRACT

VILINA, Y.A., PASTENES, L., MUNIZAGA, B., TORO, F., NEIRA-SOTO, A. & MOLINA-BURGOS, B.E. 2024. Fish prey of the Peruvian Tern *Sternula lorata* along the northern coast of Chile. *Marine Ornithology* 52: 45–49.

Scarce information is available on the trophic ecology and feeding habitats of the Peruvian Tern *Sternula lorata*. We searched 15 Peruvian Tern colonies along the coast of northern Chile during the breeding seasons of 2008 to 2018 to evaluate the tern's main food source. We collected samples of prey remains found near nests as well as prey items regurgitated by chicks and adults during our visits. We found that the Peruvian Tern is mainly piscivorous, secondarily feeding on some cephalopods and euphausiids. Pacific Saury *Scomberesox saurus* and Paloma Pompano *Trachinotus paitensis* were the main prey found near nests, but regurgitated prey was dominated by the Peruvian Anchoveta *Engraulis ringens*. Fish prey sizes ranged from 36 to 192 mm. These findings expand existing knowledge of the feeding ecology of this endangered seabird during its breeding season.

RESUMEN

Existe escasa información disponible sobre la ecología trófica y los hábitats de alimentación del gaviotín chico *Sternula lorata*. Buscamos en 15 colonias del gaviotín chico a lo largo de la costa del norte de Chile durante las temporadas de reproducción de 2008 a 2018 para evaluar la principal fuente de alimento del gaviotín. Recolectamos muestras de restos de presas encontradas cerca de los nidos, así como presas regurgitadas por polluelos y adultos durante nuestras visitas. Encontramos que el gaviotín chico es principalmente piscívoro, alimentándose secundariamente de algunos cefalópodos y eupáusidos. La agujilla *Scomberesox saurus* y el Pampanito *Trachinotus paitensis* fueron las principales presas encontradas cerca de los nidos, pero las presas regurgitadas fueron dominadas por la anchoveta peruana *Engraulis ringens*. El tamaño de las presas de los peces osciló entre 36 y 192 mm. Estos hallazgos amplían el conocimiento existente sobre la ecología alimentaria de esta ave marina en peligro de extinción durante su temporada de reproducción.

Key words: Anchoveta, fish prey, Pacific Saury, Peruvian Tern, trophic ecology

INTRODUCTION

Studies of seabird feeding ecology are essential to understanding their life history and population dynamics. Food is a critical resource and a key determinant in their use and choice of habitat (Jenouvrier *et al.* 2005), and variation in diet can indicate variations in environment (Hulsman *et al.* 1989, Barrett *et al.* 2007). Terns are mostly piscivorous, having a worldwide distribution among coastal marine, riverine, or wetland habitats. The diets of different terns have been examined using several methods, including direct observation of chicks and parents (Paiva *et al.* 2006, Ismar *et al.* 2014), identification of abandoned prey items inside a colony (Cтры *et al.* 2006), examination of regurgitates and feces (Alfaro *et al.* 2011, Correia *et al.* 2016), and recently, stable isotope analysis (Ismar *et al.* 2014).

The Peruvian Tern *Sternula lorata* is listed as Endangered on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (BirdLife International 2019), with the

main threats to its survival related to human disturbance, including recreational activities, off-road driving, and the presence of feral dogs, among others (Zavalaga *et al.* 2009). This species is endemic to the coastal Humboldt Current, from the Gulf of Guayaquil, Ecuador, to the coast of Antofagasta, Chile (Murphy 1936, Harrison 1985, Del Hoyo *et al.* 1996). It is resident on the shores of Peru and northern Chile and is a visitor to central-northern Ecuador outside of the breeding season (Harrison 1985, Del Hoyo *et al.* 1996). The breeding season of Peruvian Tern in northern Chile falls between August and January, after which time it moves to the north (Vilina 1998, Vilina *et al.* 2009). Its nesting habitat is on the coastal plains and may extend over 3 km inland. The species may nest in solitude or within a colony (Del Hoyo *et al.* 1996, Vilina 1998, Zavalaga *et al.* 2008), although in the latter case nests are typically separated by over 150 m.

The diet of Peruvian Tern has never been described in detail. Limited available information indicates that the species feeds along coastlines, mainly on small fishes (e.g., Peruvian Anchoveta

Engraulis ringens) and a crustacean of the genus *Euphausia* (Murphy 1936). Zavalaga *et al.* (2008) noted 11 prey items in two colonies of Peruvian Tern in Peru, including two prey species, the Chilean Silverside *Odontesthes regia* and Mote Sculpin *Normanichthys crockeri*. However, this information is not sufficient to determine the full scope of the species' diet. Given the Endangered status of Peruvian Tern, it is essential to describe its feeding habits, particularly during the breeding season, in order to inform the development of future conservation strategies.

To achieve the latter goal, we conducted a field study by visiting 15 Chilean nesting areas of Peruvian Tern during the breeding season (September–January) from 2008 to 2018. During this effort, we collected prey remains found near individual nests as well as prey items regurgitated by chicks and adults.

MATERIALS AND METHODS

The study area covered approximately 650 km of coastline along northern Chile, from Arica (18°28'S, 70°18'W) at the border with Peru, to Mejillones, Chile (23°10'S, 70°25'W) in Antofagasta Province (Fig. 1). The northern sector of this area is not accessible by land and, therefore, is not well studied. This area is part of the coast of the Atacama Desert and receives scarce to no rainfall; however, rain is more abundant to the north of this area. Thus, vegetation

is almost nonexistent inside the Peruvian Tern nesting sites on the coastal plains. The Peruvian Tern is a cryptic species, its breeding is asynchronous, and the nests it creates in the desert plains are scattered and separated by more than 150 m (YAV unpubl. data). All sites were visited at least twice in each breeding season (3 d/visit, on average) during 2008 to 2018. From 2016 to 2018, only the southern area was prospected by foot and vehicle. The only other seabird species found nesting in the study area was the Snowy Plover *Charadrius nivosus* (Vilina *et al.* 2009). In our surveys, we found 15 Peruvian Tern coastal nesting sites (Fig. 1). These included colonies at (1) Arica, (2) Pozo Toyo, (3) Iquique, (4) Caramucho, (5) Quinteros, (6) Patillos, (7) Puerto Patache, (8) Playa Ike-Ike, (9) Playa Arenosa, (10) Chipana, (11) Cobja, (12) Michilla, (13) Guala Guala, (14) Hornitos, and (15) Mejillones-Chacaya. During surveys, researchers and park rangers from the Foundation for the Sustainability of the Peruvian Tern collected both the remains of prey found in the colonies and spontaneously regurgitated food from some chicks and adults. Freshly dead fish were placed in bottles with alcohol, whereas dehydrated fish were deposited in plastic bags, and all properly labeled. All prey items were identified to the lowest possible taxonomic level in the laboratory using a taxonomic key (Chirichigno 1974).

All prey fish were measured for standard length (SL), body depth (BD), and head length (HL); measurements were obtained with a Vernier caliper to an accuracy of ± 1 mm.

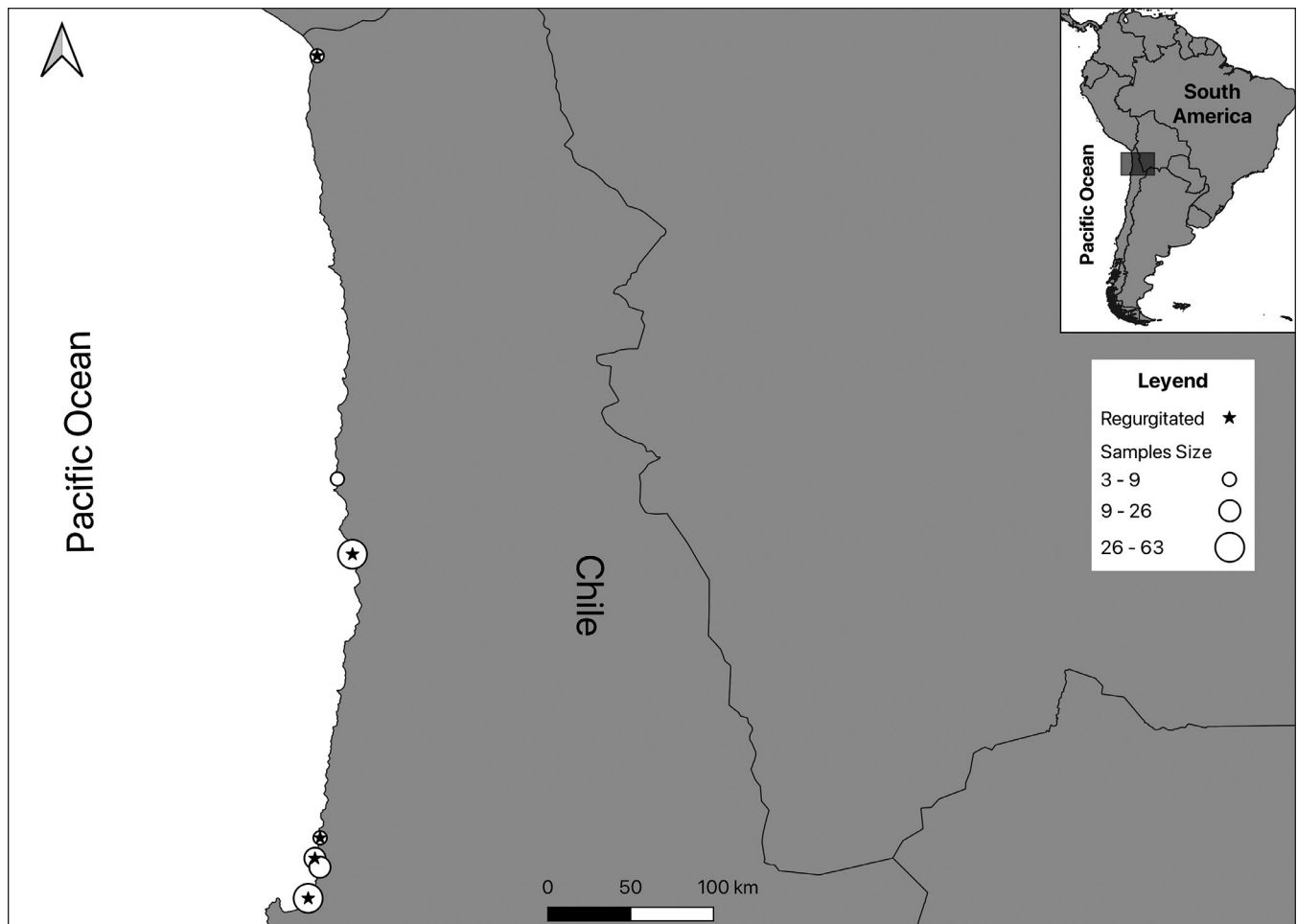


Fig. 1. Map showing breeding colonies along the northern coast of Chile where prey samples were obtained. Increasing prey sample sizes are depicted with circles of increasing size, and stars indicate regurgitated samples.

RESULTS

A total of 146 fish prey items were found inside seven colonies. We identified 10 taxa, seven of which could be identified to the species level; two samples could not be identified due to disintegration. The species identified were mainly pelagic fishes, namely Peruvian Anchoveta, Chilean Silverside, Paloma Pompano *Trachinotus paitensis*, Pacific Saury *Scoberesox saurus*, Mote Sculpin, and Sardine *Sardinops sagax*. All samples of these prey were adults, except the Paloma Pompano, which were all juveniles. In addition, we identified juveniles of some littoral fishes: Peruvian Morwong *Cheilodactylus variegatus* and one species from the Blenniidae family. The most common prey species were Pacific Saury and Paloma Pompano, at 42 individuals each. Peruvian Morwong and the Combtooth blenny were the least frequent prey species. None of the prey species were at all sites (Table 1).

Fourteen regurgitated samples were obtained from chicks; the predominant prey was Peruvian Anchoveta (35.7%), followed by Sardine (21.4%), small squids, and the Combtooth blenny (each 14.3%). Two samples (14.3%) could not be identified. Generally, each chick was found to have regurgitated only one prey species (although one chick regurgitated two individuals of the same prey species). Only one regurgitation was obtained from an adult whose regurgitate contained the remains of eight individuals of *Euphausia* species.

The sizes of fish prey in the samples found near the nests varied from 36 (Peruvian Morwong) to 192 mm (Pacific Saury) SL, with an average size of 73 ± 19 mm. By species, the Pacific Saury (102 ± 24 mm) was the most significant prey type, followed by the Chilean Silverside (87 ± 15 mm) and Peruvian Anchoveta (80 ± 20 mm). The smallest prey species were the Paloma Pompano and Peruvian Morwong (< 50 mm). The average BD of the fish prey was 19 ± 7 mm (Table 2). The average size of regurgitated fish from chicks was 58 ± 17 mm. In the two samples of squid, the mantle length (LM) was approximately 35 mm; the average total length of euphausiids (regurgitated by an adult tern) was 15 mm (Table 2).

DISCUSSION

In this study, data on the diet of Peruvian Tern on the Chilean coast across an appreciable portion of their breeding distribution

are provided for the first time. During our study, we identified 10 species of fish, krill, and squid that could have been used to feed chicks or employed during courtship and pair establishment.

In Chile, Murphy (1936) and Goodall *et al.* (1951) reported the presence of Peruvian Anchoveta and a small crustacean (genus *Euphausia*) as part of the diet of Peruvian Tern. In Peru, Zavalaga *et al.* (2008) noted the presence of Chilean Silverside and Mote Sculpin in two Peruvian Tern colonies. In addition, Amorós (2011) reported the presence of two anchovies near Peruvian Tern nests. All of the prey identified previously were also found in our study.

In addition, our research also identified additional fish species and other taxa, such as squid, not previously known as Peruvian Tern prey. However, this information is restricted to the breeding season. Ideally, this study should be extended to different times of the year and throughout the Peruvian Tern’s entire geographical distribution. According to B. Hasse and R. Ahlman (pers. comm.), during the winter migration (May–October) to northern Ecuador, the Peruvian Tern actively feeds along the coast and at commercial shrimp farms. This indicates that there may be potential differences in the prey consumed outside the breeding season.

Prey size can influence the reproductive success of terns. For example, Robertson *et al.* (2016) observed that in the Common Tern *Sterna hirundo*, parents that provided larger fish had higher numbers of chicks than did Arctic Terns *S. paradisaea*. During the non-breeding season, which Common Terns spend in coastal waters of Brazil, Argentina, and Chile, the diet of Common Terns consists primarily of fish (of different species than are consumed during the breeding season), including demersal fish, crustaceans, as well as terrestrial insects (Bugoni & Vooren 2004, Mauco & Favero 2004, Alfaro *et al.* 2011).

Together, the prey remains that we collected are a good indicator of the Peruvian Tern diet. The collection of samples near nests yielded eight different species of fish, and by incorporating regurgitated prey, we found that the terns also captured squid and krill. These results suggest differences among the sample types. The differences may be due to the low number of samples of regurgitated prey ($n = 15$) or may represent an ontogenic difference in the diet of

TABLE 1

Number of different prey species obtained at nesting sites of Peruvian Tern *Sternula lorata* in the north of Chile from 2008 to 2018

Common name	Taxa	Arica	Pozo Toyo	Chipana	Michilla	Guala Guala	Hornitos	Mejillones	Total
Combtooth blenny	Blenniidae	–	–	–	–	–	–	1	1
Peruvian Morwong	<i>Cheilodactylus variegatus</i>	–	–	–	–	–	1	1	2
Anchovy	<i>Engraulis ringens</i>	–	–	1	1	1	1	2	12
Mote Sculpin	<i>Normanichthys crockeri</i>	–	2	2	3	1	4	12	24
Chilean Silverside	<i>Odontesthes regia</i>	1	2	4	1	–	4	3	15
Sardine	<i>Sardinops sagax</i>	–	–	2	–	–	–	4	6
Pacific Saury	<i>Scoberesox saurus</i>	1	1	14	–	3	12	10	41
Paloma Pompano	<i>Trachinotus paitensis</i>	1	–	5	4	4	3	19	36
Indeterminate	Sp. 1	–	–	–	–	–	–	1	1
	Sp. 2	–	–	–	–	–	1	–	1
TOTAL		3	5	28	8	9	26	59	139

TABLE 2
Summary of morphometric measurements of the prey of Peruvian Tern *Sternula lorata* in the north of Chile from 2008 to 2018

Taxa	# of samples	Mean standard length (mm)	Minimum length (mm)	Maximum length (mm)	Mean head length (mm)	Mean body depth (mm)
Blenniidae	1	2.3	-	-	0.6	0.6
Peruvian Morwong <i>Cheilodactylus variegatus</i>	2	4.4	3.6	5.2	1.4	2.1
Anchovy <i>Engraulis ringens</i>	12	7.1	4.7	9.6	1.9	1.3
Mote Sculpin <i>Normanichthys crockeri</i>	24	6.9	5.1	8.0	2.2	1.4
Chilean Silverside <i>Odontesthes regia</i>	15	8.7	6.1	10.6	1.8	1.5
Paloma Pompano <i>Trachinotus paitensis</i>	42	4.9	3.7	6.0	1.3	2.1
Sardine <i>Sardinops sagax</i>	6	7.4	6.1	9.4	1.6	1.4
Pacific Saury <i>Scomberesox saurus</i>	42	9.9	5.9	19.2	2.6	1.1

the Peruvian Tern since the regurgitated items mainly came from chicks. Only fishes were found in the samples obtained near nests; those items may have been “gifts” that males gave to females during courtship. Another explanation for these differences could relate to the fact that cephalopods degrade rapidly and Euphausiids are small, making it difficult to find them inside the colony. Indeed, the average size of regurgitated prey was smaller than prey found near the nests. This is consistent with the findings of other studies that have shown that the diet of terns—including prey size and species composition within the diet—can vary over the life stage of chicks (Hulsman *et al.* 1989, Catry *et al.* 2006, Ismar *et al.* 2014). The average prey size ranges reported here are similar to those reported for other small tern species, including the California Least Tern *Sterna antillarum browni* (Elliot *et al.* 2007), Little Tern *Sterna albifrons* in Portugal (Catry *et al.* 2006), and Damara Tern *Sternula balaenarum* in Namibia (Braby *et al.* 2011).

The most important prey in the regurgitated samples in our study was Peruvian Anchoveta, a species targeted by fisheries in the region. Although there was no evidence for its relevance in prey close to the nests, its importance in the Peruvian Tern diet may be underestimated because the anchovy is one of the main prey items for various seabirds that inhabit the area (e.g., the Peruvian Booby *Sula variegata*, the Guanay Cormorant *Leucocarbo bougainvillii*, and the Peruvian Pelican *Pelecanus thagus*; Bertrand *et al.* 2012). This fish is a very abundant resource in the study area, and according to Swartzman *et al.* (2008), during austral spring, it is usually close to the coast and, therefore, represents an easily accessible prey for various coastally-bound predators. Further work on the importance of anchovy to the Peruvian Tern is necessary given the alteration of anchovy abundance by human fisheries (Murphy 1981, Richards 2020).

Our results represent only a snapshot of the Peruvian Tern diet, and more specific analyses will clarify their diet throughout the breeding season. The findings of this study expand our understanding of the trophic ecology of the Peruvian Tern and can be used to inform future conservation actions.

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