SEABIRDS OFF THE PACIFIC COAST OF PANAMA: OBSERVATION FREQUENCY, DISTRIBUTION AND SEASONALITY

AVES MARINAS EN LA COSTA DEL PACÍFICO DE PANAMÁ: FRECUENCIA DE OBSERVACIÓN, DISTRIBUCIÓN Y ESTACIONALIDAD

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Abstract: Little information has been added to our knowledge of Panama's Pacific coast seabirds since the last century. In order to increase and update our knowledge, systematic observations were made of seabirds on a total of 20 trips, conducted in 2010, then every year from 2012-2019 off the Pacific coast of Panama, and the percentage of all 1-hour observation periods during which each species was recorded according to location (continental shelf or continental slope/deep waters) and season (dry or wet) was calculated. Thirthy-nine species of seabirds of 11 different families during 120 1-hour observation periods were recorded. The most frequently detected species for all observations was *Fregata magnificens* (present in 65.8% of 1-hour observation periods), followed by *Sula leucogaster* (64.2%) and *Chlidonias niger* (63.3%). These observations increase our knowledge of seabird species occurring off the Pacific coast of Panama, adding three new species to the list of birds of Panama, and documenting another two with photographs for the first time, offering us an idea of the species that are within the reach of the pelagic avitourist.

Keywords: Seabirds, pelagic, continental shelf, continental slope, deep waters.

Resumen: Desde el siglo pasado, es poca la información que se ha agregado a nuestro conocimiento sobre las aves marinas de la costa del Pacífico de Panamá. Para mejorar esto, se realizaron observaciones sistemáticas de aves marinas en un total de 20 viajes, realizados en 2010 y cada año desde 2012-2019 frente a la costa del Pacífico de Panamá,
y se calculó el porcentaje de todos los períodos de observación de 1 hora durante los cuales cada especie se registró según su ubicación (plataforma continental o pendiente continental/aguas profundas) y estación (seca o lluviosa). Se registraron 39 especies de aves marinas de 11 familias diferentes durante 120 períodos de observación de 1 hora. La especie detectada con mayor frecuencia en todas las observaciones combinadas fue

Fregata magnificens (presente en el 65,8 % de los períodos), seguida de *Sula leucogaster* (64,2 %) y *Chlidonias niger* (63,3 %). Estas observaciones aumentan nuestro conocimiento sobre las especies de aves marinas que se encuentran frente a la costa del Pacífico de Panamá, agregando tres nuevas especies a la lista de aves de Panamá y documentando otras dos con fotografías por primera vez, y nos ofrecen una idea de las especies que están dentro del alcance del aviturista pelágico.

Palabras clave: Aves marinas, pelágico, plataforma continental, pendiente continental, aguas profundas.

INTRODUCTION

Seabirds are a taxonomically varied group that depend on the marine environment for at least part of their life cycle, are more threatened than all other groups of birds with similar numbers of species (Birdlife International, 2012). The priority conservation actions needed for these species consist of monitoring, determination of population size, distribution and trends, assessment of threats, life history and ecology, among others (Croxall et al., 2012).

For those aspects, the seabird species occurring off the Pacific coast of Panama are relatively well documented in terms of composition, especially those of the northern part of the Panama Bight. Birds at sea in the area have been surveyed by Murphy in 1925, 1941, and 1956 (1936; 1944a, b, c; 1956), Robins (1958) in July 1957, Loftin (1991) in 1968-1969, and Spear and Ainley (1999) from 1984 to 1991. The latter two works also provided data on relative abundance, distribution and seasonal occurrence of seabirds in both continental shelf and pelagic waters.

Since then, little has been added to our knowledge of Panama's Pacific coast seabirds. Ridgely and Gwynne (1989) list 58 species of seabirds, while Angehr and Dean (2010) list 69 species occurring off the Pacific coast of Panama. Over a period of 21 years, nine of these 11 additional species were added due to new observations for the country (the rest were added after reviewing old data and due to taxonomic splits).

The Pacific coast of Panama extends 1,700.6 km from the province of Darien in the East to the Burica Peninsula in the West. The Azuero Peninsula divides the Panamanian Pacific shelf into: a) the Gulf of Panama to the east, with a shelf area of 27,175 km2, b) the southern zone of the Azuero Peninsula between Punta Mala and Punta Mariato in the center and c) the Gulf of Chiriquí to the west, with a shelf area of 13,119 km2. In the northeastern part of the Gulf of Chiriquí is the Gulf of Montijo (Mate, 2006). This coast is an example of the biological and hydrological heterogeneity typical of Central America, with shallow thermoclines, up-

welling events and large patches of nutrients and chlorophyll roughly superimposed onto these events, giving evidence of high biological production, which in turn supports productive local fisheries (Cox & O'Dea 2007). The commercial and sport exploitation of these fisheries, especially the latter, offer a platform for the observation of pelagic seabirds, mainly from the Burica and Azuero Peninsulas, as well as from extreme eastern Darien province. Other activities, such as whale watching, temporarily offer opportunities for seabird watching since specialized pelagic birding trips are not offered on a regular basis in the country. This is due to the highly specialized character of the pelagic avitourist and the relatively small niche of avitourism in Panama, although growth is expected to be strong, and the country is listed among the main birding destinations, at least for United States consumers (Acorn Consulting, 2008).

METHODS

Objective

To describe the observation frequency, distribution and seasonality of the seabirds occurring off the Pacific coast of Panama.

Study site.

All observations were made off the Pacific coast of Panama, from eastern Darién Province (Piñas Bay) to western Chiriquí Province (Burica Peninsula). Observations were made on the continental shelf (0-200 m in depth, primarily in the Gulf of Montijo and the Gulf of Panama), the continental slope (201-800 m in depth), and deep waters (more than 800 m in depth).

Observations

Systematic observations of seabirds were made on a total of 20 trips, conducted in 2010, and every year from 2012-2019. Observations were made on two types of trips. The first were trips made specifically for the observation of pelagic seabirds, which extended to the continental shelf and deep waters. These were made with rented sport fishing boats up to 10 m long. Routes usually consisted of wide circuits in order to cover as large an area as possible. On these trips, we chummed at favorable sites, such as seamounts. On average, 15.1 km were covered for each one-hour period (range 3.5 - 34.6 km) during these trips. The second type were trips restricted to the continental shelf, to tourist sites on islands and for observation of other marine fauna. Consequently, the routes in these waters were generally straight transects. Observations were made from a wide variety of vessels, including small boats with outboard motors, sport fishing boats, and ferries, ranging from 5 to 35 m in length. Some of these trips allowed close inspection of seabird nesting colonies on rocky islets, especially in the Gulf of Panama. On average, 20.5 km were covered for each one-hour period (range 4.0- 42.8 km) during continental shelf trips. All observations were made during daylight hours.

Figure 1.
Plot of 1-hour observation periods off the Pacific coast of Panama. September 2010 - December 2019

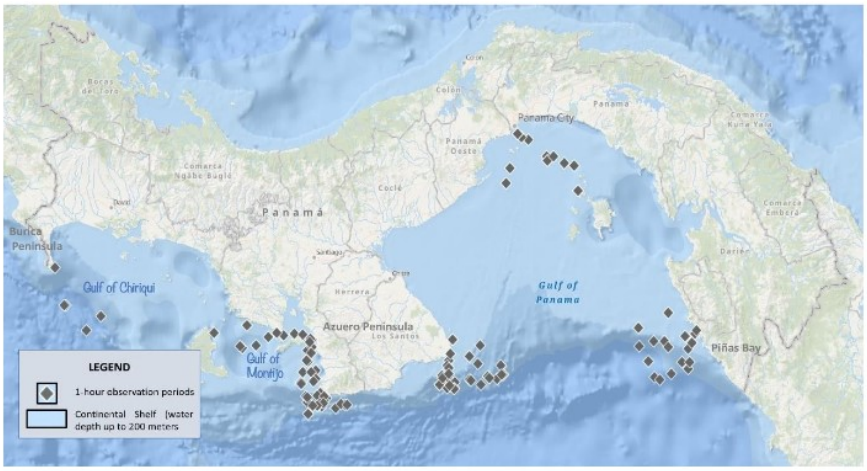

Figure 1.
Plot of 1-hour observation periods off the Pacific coast of Panama. September 2010 - December 2019
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For this report, seabirds include all members of the families Stercorariidae, Laridae, Phaethonidae, Oceanitidae, Hydrobatidae, Procellariidae, Fregatidae, Sulidae, Phalacrocoracidae, and Pelecanidae, plus the genus Phalaropus of Scolopacidae. Birds species, and the number of individuals of each species, were recorded as soon as they were identifiable (usually to species, but otherwise to the lowest taxonomic rank identifiable), at any distance from the observer. To the extent possible, photos were obtained of individuals to aid in the identification of difficult taxa. For each trip, the general weather, sea conditions, and position by GPS at the start of each 1-hour period during each trip were recorded. Seabirds seen from the mainland while at dock were not included.

From one to seven observers participated in each trip, with JAC present in all of them, thus giving consistency in the identification and recording of field data. All observations were recorded on eBird (www.ebird.org) and most photos were deposited in the Macaulay Library (www.macaulaylibrary.org) of the Cornell Laboratory of Ornithology.

Analysis

To make within-species comparisons, the percentage of all 1-hour observation periods during which each species was recorded according to location (continental shelf or continental slope/deep waters) and season (dry or wet), following Young and Zook (2016). For this work, dry season includes the months of December to April, and the wet season includes the months

of May to November. Because few 1-hour periods were spent on waters >800 m deep, these were combined with those from the continental slope. Spear and Ainley (1999) found little difference between seabird densities on the continental slope and water deeper than 2,000 m. Differences in detectability and distances traveled over 1-hour periods prevent density estimations or interspecific comparisons of abundance.

RESULTS

Thirty-nine species of seabirds of 11 different families were recorded during 120 1-hour observation periods, of which 24 were during dry season and 96 during wet season. The distribution of 1-hour observation periods between continental shelf and continental slope/deep waters was similar, with 58 and 62 periods respectively (Table 1). Six hours of rain were recorded during the study period, with no considerable swells on any trip. Taxonomy and species sequence follow AOU (1998) and subsequent supplements through Chesser et al. (2021).

Table 1.
Distributional, seasonal, breeding and conservation status of seabirds off the Pacific coast of Panama. September 2010 - December 2019.

	Percent of 1-hr periods recorded (%)						
	Continental Shelf			Continental Slope / Deep Waters			Overall per study period (n = 120)
Species[1]	Dec -Apr[2] (n = 14)	May- Nov (n = 44)	Overall (n = 58)	Dec -Apr[2] (n = 10)	May- Nov (n = 52)	Overall (n = 62)	
Scolopacidae							
Phalaropus lobatus (LC)	-	4.5	3.4	-	11.5	9.7	6.7
Stercorariidae							
Stercorarius maccormicki (LC)	-	-	-	-	1.9	1.6	0.8
Stercorarius pomarinus (LC)	7.1	-	1.7	30.0	7.7	11.3	6.7
Stercorarius parasiticus (LC)	-	-	-	10.0	3.8	4.8	2.5
Stercorarius longicaudus (LC)	-	-	-	-	3.8	3.2	1.7
Stercorarius sp.	7.1	-	1.7	40.0	3.8	9.7	5.8
Laridae							
Xema sabini (LC)	7.1	-	1.7	20.0	5.8	8.1	5.0
Leucophaeus atricilla (LC)	78.6	13.6	29.3	80.0	9.6	21.0	25.0
Larinae sp.	7.1	2.3	3.4	-	-	-	1.7
**Anous stolidus* (LC)	7.1	20.4	17.2	-	42.3	35.5	26.7
Anous minutus (LC)	7.1	-	1.7	-	-	-	0.8
**Onychoprion fuscatus* (LC)	-	2.3	1.7	-	44.2	37.1	20.0
**Onychoprion anaethetus* (LC)	7.1	29.5	24.1	50.0	42.3	43.5	34.2
Larosterna inca (NT)	-	2.3	1.7	-	-	-	0.8
Chlidonias niger (LC)	64.3	70.4	69.0	50.0	59.6	58.1	63.3
Sterna hirundo (LC)	21.4	4.5	8.6	10.0	15.4	14.5	11.7
Sterna paradisaea (LC)	-	-	-	-	1.9	1.6	0.8
Thalasseus maximus (LC)	21.4	11.4	13.8	-	-	-	6.7
Thalasseus sandvicensis (LC)	28.6	2.3	8.6	-	-	-	4.2
Thalasseus elegans (NT)	-	-	-	-	1.9	1.6	0.8
Sterninae sp.	7.1	18.2	15.5	-	13.5	11.3	13.3
Phaethontidae							

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Distributional, seasonal, breeding and conservation status of seabirds off the Pacific coast of Panama. September 2010 - December 2019.

*Breeds in Panama 1. UICN status: (LC) = Least Concern, (CR) = Critically Endangered, (VU) = Vulnerable, (NT) = Near Threatened, (DD) = Data Deficient 2. No observations were made in April

**Phaethon aethereus* (LC)	-	6.8	5.2	-	1.9	1.6	3.3
Oceanitidae							
Oceanites oceanicus (LC)	-	-	-	-	1.9	1.6	0.8
Hydrobatidae							
Hydrobates leucorhous (VU)	-	-	-	10.0	-	1.6	0.8
Hydrobates castro (LC)	-	-	-	-	1.9	1.6	0.8
Hydrobates tethys (LC)	7.1	25.0	20.7	40.0	69.2	64.5	43.3
Hydrobates melania (LC)	7.1	13.6	12.1	40.0	38.5	38.7	25.8
Hydrobates microsoma (LC)	14.3	-	3.4	40.0	10.8	27.4	15.8
Hydrobates sp.	-	4.5	3.4	-	3.8	3.2	3.3
Procellariidae							
Pseudobulweria rostrata (NT)	-	-	-	-	11.5	9.7	5.0
Procellaria parkinsoni (VU)	-	7.1	1.7	-	1.9	1.6	1.7
Ardenna pacifica (LC)	14.3	2.3	5.2	50.0	40.4	41.9	24.2
Ardenna grisea (NT)	-	-	-	-	3.8	3.2	1.7
Ardenna creatopus (VU)	-	-	-	-	7.7	6.4	3.3
Puffinus subalaris (LC)	21.4	25.0	24.1	50.0	86.5	80.6	53.3
Procellaridae sp.	-	-	-	30.0	3.8	8.1	4.2
Fregatidae							
**Fregata magnificens* (LC)	85.7	81.8	82.8	90.0	42.3	50.0	65.8
Sulidae							
Sula granti (LC)	-	-	-	-	21.1	17.7	9.1
**Sula nebouxii* (LC)	21.4	56.8	48.3	-	1.9	1.6	24.2
Sula variegata (LC)	-	9.1	6.9	-	-	-	3.3
**Sula leucogaster* (LC)	57.1	75.0	70.7	30.0	63.5	58.1	64.2
Sula sula (LC)	-	-	-	10.0	-	1.6	0.8
Sula sp.	-	-	-		1.9	1.6	0.8
Phalacrocoracidae							
**Nannopterum brasilianus* (LC)	28.6	34.1	32.8	-	-	-	15.8
Pelecanidae							
**Pelecanus occidentalis* (LC)	50.0	54.5	53.4	-	-	-	25.8

*Breeds in Panama

1. UICN status: (LC) = Least Concern, (CR) = Critically Endangered, (VU) = Vulnerable, (NT) = Near Threatened, (DD) = Data Deficient

2. No observations were made in April

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Distributional, seasonal, breeding and conservation status of seabirds off the Pacific coast of Panama. September 2010 - December 2019.

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Species diversity was greater in the wet season (36 species) than in the dry season (23 species). Although many species were recorded both over the continental shelf and in continental slope/deep waters (19 species), seven species were restricted to the continental shelf and 13 species to continental slope/deep waters (Table 2).

Table 2.
Distribution of seabirds off the Pacific coast of Panama according to water depth. September 2010 - December 2019.

Continental Shelf	Continental Shelf and Continental Slope / Deep Waters	Continental Slope / Deep Waters
Anous minutus	*Phalaropus lobatus*	*Stercorarius maccormicki*
Larosterna inca	*Stercorarius pomarinus*	*Stercorarius parasiticus*
Thalasseus maximus	*Xema sabini*	*Stercorarius longicaudus*
Thalasseus sandvicensis	*Leucophaeus atricilla*	*Sterna paradisaea*
Sula variegata	*Anous stolidus*	*Thalasseus elegans*
Nannopterum brasilianus	*Onychoprion fuscatus*	*Oceanites oceanicus*
Pelecanus occidentalis	*Onychoprion anaethetus*	*Hydrobates leucorhous*
	Chlidonias niger	*Hydrobates castro*
	Sterna hirundo	*Pseudobulweria rostrata*
	Phaethon aethereus	*Ardenna grisea*
	Hydrobates tethys	*Ardenna creatopus*
	Hydrobates melania	*Sula granti*
	Hydrobates microsoma	*Sula sula*
	Procellaria parkinsoni	
	Ardenna pacifica	
	Puffinus subalaris	
	Fregata magnificens	
	Sula nebouxii	
	Sula leucogaster	

Table 2.
Distribution of seabirds off the Pacific coast of Panama according to water depth. September 2010 - December 2019.
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The most frequently detected species in all observations combined was Fregata magnificens (present in 65.8% of 1-hour observation periods), followed by Sula leucogaster (64.2%) and Chlidonias niger (63.3%). Relative frequencies were similar if considering only 1-hour observation periods over the continental shelf (Fregata magnificens 82.8%, Sula leucogaster 70.7%, and Chlidonias niger 69.0%). However, considering only 1-hour observations periods in continental slope/deep waters, Puffinus subalaris (80.6%) was the most common species, followed by Hydrobates tethys (64.5%) and Chlidonias niger and Sula leucogaster (both 58.1%). Ten species were recorded only once during our study, all of them represented by single individuals, except for Oceanites oceanicus (see species account). Of the 39 species recorded, nine are known to breed in Panama, four are considered Near Threatened and three are considered Vulnerable, according to IUCN Red List categories (Table 1; Birdlife International 2020).

DISCUSSION

Species Accounts

Phalaropus lobatus (Red-necked Phalaropus): Single individuals or small groups were present from August to November, and larger flocks (up to 51 birds) in May, when birds were mostly in alternate plumage. This species was more frequently seen over continental slope/deep waters. Loftin (1991) found large flocks to be present in the Gulf of Panama August-November, and just one record in February-March.

Stercorarius maccormicki (South Polar Skua): One individual off the southeastern Azuero Peninsula over deep waters, harassing an *Onychoprion* tern in November, was the only sighting during the study. It is considered a rare visitor to offshore waters on the Pacific coast of Panama, with records in February, March, July, September, and November (Wetmore, 1965; Ridgely & Gwynne 1989). The species has not yet been documented by specimens or definitive photographs for Panama.

Stercorarius pomarinus (Pomarine Jaeger): The most frequently encountered jaeger during the study period, observed from November to March. They were recorded both as single individuals or in groups of up to three, sometimes robbing food items from smaller species, and almost never following the boat. Due to the difficulty of identifying jaegers at sea, Loftin (1991) reported data for them only as a group, recording them in October-November and January-April, with positive identifications of this species in October-November. There are no specimens for Panama; one mentioned by Ridgely and Gwynne (1989) is an error for the following species (Wetmore, 1965). Reported to be an uncommon to at times common transient on both coasts of Panama (Ridgely & Gwynne, 1989); Olson (1993) found them to be common in western Bocas del Toro (Caribbean Sea) in January-April.

Stercorarius parasiticus (Parasitic Jaeger): The few individuals positively identified occurred exclusively over continental slope/deep waters. The number of individuals that could be identified only as Stercorarius sp. (Table 1) exceeded those positively identified as

S. parasiticus or *S. longicaudus*, so the true numbers of these two species may be underestimated. Loftin (1991) collected two specimens in the Gulf of Panama; other specimens have been collected on the Caribbean coast (Wetmore, 1965; Olson, 1993). Reported to be an uncommon transient and winter visitor by Ridgely and Gwynne (1989).

Stercorarius longicaudus (Long-tailed Jaeger): Two intermediate-form juveniles seen on 25 October 2014 off the eastern Azuero Peninsula over deep waters were positively identified only after reviewing photos (Figure 2A). These represented the third record for Panama of this species (at the time it was the second known report; Jones & Komar, 2016). This is the most pelagic of the three jaeger species and is probably a rare transient off the coast of Panama (Ridgely & Gwynne, 1989). Loftin (1991) collected the only specimen for Panama in the Gulf of Panama. There is also a somewhat uncertain sight record from the Caribbean coast (Wetmore, 1985; Ridgely & Gwynne, 1989).

Xema sabini (Sabine's Gull): This elegant species was seen accompanying mixed flocks of gulls and terns. Recorded in this study in November-December and May, consistent with its status as a passage migrant in Panama, predominantly over deep waters but also over the continental shelf in the Gulf of Montijo. Loftin (1991) found it to be common to abundant in the Gulf of Panama in October-November and February-June.

Leucophaeous atricilla (Laughing Gull): Recorded in 25.0% of 1-hour periods of this study, especially over the continental shelf and during the dry season. Loftin (1991) recorded it as being abundant in the Gulf of Panama from December-March, with a few birds present in November and in May-June. The most common gull in Panama, with some individuals, mostly immatures, present through the northern winter (Ridgely & Gwynne, 1989).

Anous stolidus (Brown Noddy): Groups of 30 to 55 birds were seen off the Azuero Peninsula, especially resting on rocky islets off Punta Naranjo on the southwestern corner of the peninsula. Most of the birds seen over continental shelf waters were near this site, which is at the edge of the continental slope. Elsewhere, one to a few individuals were seen over deep waters of western and eastern Panama, usually with flocks of *Chlidonias niger* or resting on floating debris. The species breeds in Panama on the Islas Frailes del Sur off the southern Azuero Peninsula, where 50 pairs were found nesting in 2005 (Angehr & Kushlan, 2007). Although no specimens have been collected there, the expected form at this site is ridgewayi (Wetmore, 1965), which also breeds on islands off the west coast of Mexico and at Cocos Island off Costa Rica. The only specimen from the Pacific coast of Panama, collected in the Gulf of Panama, has been identified as *galapagoensis*. (Loftin, 1991), endemic to the Galapagos Islands. However, the subspecific identity of the

Colombian breeding populations (which are much closer than the geographically distant Galapagos Islands) is unknown. The subspecies nesting on Malpelo Island has not been determined (López-Victoria & Estela, 2006) and nothing is known about the ecology, population or seasonality of the form nesting on Rocas de Octavia, near the border with Panama (Estela et al., 2010).

Figure 2.
Noteworthy photographic records of seabirds off the Pacific coast of Panama. September 2010 - December 2019. ***A.*** *Long-tailed Jaeger (Stercorarius longicaudus). Photo by Rafael Luck.* ***B.*** *Black Noddy (Anous minutus). Photo by Jan Cubilla/Macaulay Library.* ***C.*** *Inca Tern (Larosterna inca). Photo by Jan Cubilla/Macaulay Library.* ***D.*** *Leach's Storm-Petrel (Hydrobates leucorhous). Photo by Jan Cubilla/Macaulay Library*

Figure 2.
Noteworthy photographic records of seabirds off the Pacific coast of Panama. September 2010 - December 2019.
A. Long-tailed Jaeger (Stercorarius longicaudus). Photo by Rafael Luck. **B.** Black Noddy (Anous minutus). Photo by Jan Cubilla/Macaulay Library. **C.** Inca Tern (Larosterna inca). Photo by Jan Cubilla/Macaulay Library. **D.** Leach's Storm-Petrel (Hydrobates leucorhous). Photo by Jan Cubilla/Macaulay Library

Anous minutus (Black Noddy): One adult on 4 December 2016 over the continental shelf off the western Azuero Peninsula was the second record for Panama and the first to be documented with photographs (Figure 2B). The bird was feeding with a mixed flock of Black and Common Terns over a school of Bonito (Sarda sp.). The closest breeding colony is at Malpelo Island south of Panama (López-Victoria & Estela, 2006).

Onychoprion fuscatus (Sooty Tern): This species was recorded only during the wet season, in 20.0% of 1-hour periods overall, mostly over continental shelf/deep waters, where it was seen alone or flocks accompanying mixed flocks of other tern species and shearwaters. The greatest numbers were seen off Azuero Peninsula, including juveniles. The species is known to breed on the Islas Frailes, with approximately 3000 nests in 2005, making it the largest single seabird colony in Panama (Angehr & Kushlan, 2007).

Onychoprion anaethetus (Bridled Tern): This species was more widespread and frequent than the Sooty Tern, detected in 34% of 1-hour periods overall, both over the continental shelf and over continental slope/deep waters, year-round. This species breeds on the Islas Frailes, with approximately 50 nests in 2005 (Angehr & Kushlan, 2007), and also on islets near Coiba Island, with 16 nests in 2012 (Angehr et al., 2014).

Larosterna inca (Inca Tern): One adult of this beautifully patterned species followed the boat from Punta Mala into continental shelf waters on 11 September 2010, perching on the bow where it was photographed (Figure 2C). The bird seemed to be in good physical condition. It was the first documented report for this species in Panama since its invasion into the Gulf of Panama during the very strong El Niño Southern Oscillation (ENSO) event of 1983-1984 (Reed, 1988; Ridgely & Gwynne, 1989; Angehr & Dean, 2010). Its occurrence in Panamanian waters was probably associated with the moderate ENSO event of 2010, although no other vagrant seabird from the Humboldt current was recorded that year (Buitrago-Rosas et al., 2020).

Chlidonias niger (Black Tern): One of the most frequently seen species, present in 63.3% of 1-hour periods overall. Flocks up to 260 individuals were a common sight year round during the study, both over the continental shelf and continental slope/deep waters. With 2,050 individuals counted, this was the most abundant species in absolute numbers. Frequently seen over schools of Bonito (Sarda sp.) over the continental shelf or Yellow-finned Tuna (*Thunnus albacares*) and cetaceans over continental slope/deep waters. This species is a boreal migrant to Panama, most birds during the northern summer being immatures (Wetmore, 1965), although it is present year-round. Loftin (1991) found the species to be the most abundant seabird in the Gulf of Panama, with some recorded on every cruise, and flocks of up to 3,000 reported. Spear and Ainley (1999) found it to be the most abundant species over the continental shelf in the Panama Bight, and also among the commonest species over deeper water.

Sterna hirundo (Common Tern): Present from September to December and in May, in low numbers; predominantly over continental slope/deep waters, but also over the continental shelf in the Gulf of Montijo. Birds in alternate plumage were seen in May. Loftin (1991) found some present all year in the Gulf of Panama, but most numerous September-October and December-March.

Sterna paradisaea (Arctic Tern): On 5 May 2018, an adult in alternate plumage was seen and photographed off eastern Darien province in deep waters with a mixed flock of Common and Sooty Terns, feeding over a school of Yellowfin Tuna and Short-beaked Common Dolphins (*Delphinus delphis*). It was just the fifth record for Panama (third documented by photographs) at the time. The paucity of records of this species in Panama is probably due to lack of coverage by experienced observers in pelagic waters, where it is probably a regular passage migrant.

Thalasseus maximus (Royal Tern): This conspicuous species was only seen over the continental shelf close to the coast, where it was detected in 13.8% of 1-hour periods. Loftin (1991) observed a few in the Gulf of Panama in November-December and August.

Thalasseus sandvicensis (Sandwich Tern): As with the previous species, it was only seen over the continental shelf close to the coast, where it was detected in 8.6% of 1-hour periods.

Thalasseus elegans (Elegant Tern): The only record during this study was of one individual feeding offshore from Punta Naranjo over deep waters, on 14 May 2017. It was a in a mixed flock of Black and Sooty Terns and Brown Noddies. The rarest of the genus, as with other *Thalasseus* terns, this species is mostly coastal in Panama.

Phaethon aethereus (Red-billed Tropicbird): Only four individuals (all immatures) were recorded, in different 1-hour periods in September and October, over the continental shelf of the Gulf of Montijo and adjacent deep waters. The birds invariably were seen alone, showing some interest on the boat. The species breeds locally in the western Caribbean of Panama but is rare in the Pacific side. Loftin (1991) reported seeing 3 immatures in the Gulf of Panama in September-October. In the eastern Pacific, it breeds on Malpelo Island, in the Galapagos, and possibly on islands off Costa Rica (Pitman et al., 1995; López-Victoria & Estela, 2006; Vallely & Dyer, 2018).

Oceanites oceanicus (Wilson's Storm-Petrel) Four individuals seen on 11 September 2010 off the southeastern Azuero Peninsula were the only ones recorded during the study period. The species was previously known from Panamanian waters from a specimen taken in the Gulf of Panama in August 1969, identified as the subspecies *O. o. chilensis* (Loftin, 1991), breeding on islets off Cape Horn. It is probably a regular offshore passage migrant since it is uncommon but regular farther north (Jehl, 1974).

H*ydrobates leucorhous* (Leach's Storm-Petrel): An individual photographed on 22 December 2019 off southeastern Azuero Peninsula was the only record during the study (Figure 2D). The bird showed a relatively long bill, long and deeply forked tail and an Ainley' scale value for uppertail-covert class 9-10 (Ainley, 1980; Howell, 2012), consistent with the ssp. chapmani, all important features to differentiate from formerly conespecific H. socorroensis and H. cheimomnestes, not known to occur in Panama. The species was previously known for Panama by specimens of the ssp. chapmani collected off Azuero Peninsula in 1925 (Ridgely & Gwynne, 1989).

Hydrobates castro (Band-rumped Storm-Petrel): One sighting off southeastern Azuero on 11 September 2010 of a single individual was the first report for Panama. Crossin (1974) reported two sight records without details from "near Panama" (mapped as being from south of the Azuero Peninsula), obtained by the Smithsonian Institution's Pacific Ocean Biological Survey Program conducted between 1963-1968. Young and Zook (2016) reported sightings

of a total of three individuals on two surveys off Costa Rica in in 2007 and 2008, and Stiles and Skutch (1989) reported sightings from Costa Rica in the Gulf of Nicoya and near Cocos Island.

*Hydrobates tethys (*Wedge-rumped Storm-Petrel): The most frequently encountered storm- petrel both over the continental shelf and in continental slope/deep waters, particularly in the wet season. Present in 43.3% of all 1-hour periods, and 64.5% of 1-hour periods in continental slope/deep waters). There are two subspecies, both of which have been collected in Panama. The nominate, breeding in the Galapagos, has been collected in September, and

*H. t. kelsall*i, breeding on islands off the coast of Peru, has been collected in February, March, August, and September (Wetmore, 1965). The subspecies differ only in size (Wetmore, 1965; Harrison, 1983; Carboneras, 1993; Onley & Scofield, 2007) and as far as known are not identifiable at sea. Birds in flight-feather molt were recorded from May to July. Birds with fresh flight feathers were recorded mainly from August to December; however, some birds with fresh flight feathers were recorded from May to July. The two subspecies breed at somewhat different times, nominate in early winter and kelsalli earlier, from early autumn to winter (Onley & Schofield, 2007), so that the presence of birds with fresh flight feathers in Panama at different times suggests that our observations include members of both populations. Loftin (1991) recorded the species in the Gulf of Panama between April and November, with a peak in June-August. Robins (1958) found it common in July 1957 between Taboga and Piñas Bay, one or two being visible every hour of the cruise, and up to eight seen off Piñas Bay.

Hydrobates melania (Black Storm-Petrel): Fairly common, present in 25.8% of 1-hour periods. Like the previous species, it was recorded mainly in continental slope/deep waters and in the wet season. Obvious flight-feather molt was seen in May, June and July. Loftin (1991) found the species present on every cruise except January, being most numerous February-June and November. Robins (1958) observed the species only three times in July 1957, all records being near Piñas Bay. Murphy (1956) reported finding the species "very frequently" in November off western Panama and in the Gulf of Panama.

Hydrobates microsoma (Least Storm-Petrel): The least frequently recorded of the three regular Hydrobates storm-petrels in Panamanian waters, present in 15.8% of 1-hour periods. In contrast, Loftin (1991) found it to be the most abundant storm-petrel in the Gulf of Panama, recorded most months and with peaks in February-April and August.

Pseudobulweria rostrata (Tahiti Petrel): Exclusively recorded in deep waters and in the wet season from June to October. An individual seen off southeastern Azuero Peninsula on 11 September 2010 was the first record for Panama (Jones & Komar, 2011), while birds recorded on 25 October 2014, also off the southeastern Azuero Peninsula, were the first to be documented photographically (Jones & Komar, 2016; Figure 3A). Up to five birds were

seen together off the Burica Peninsula on 30 June 2019, the highest count for a single 1-hour period during the study.

Procellaria parkinsoni (Parkinson's Petrel): One was seen and photographed (the first photographic confirmation of this species for Panama) on 5 May 2018 off Piñas Bay in eastern Darien province. The bird was in obvious wing molt (Figure 3B; compare similar wing pattern of bird pictured in Jehl, 1974). It was seen in waters 100 m deep, associated with shearwaters and Black Terns. A second sighting was later made in deep waters, probably of the same individual based on similar wing molt. Previous sight records for Panama are from March, April, June and November, over deep and continental shelf waters (Ridgely & Gwynne, 1989). The species is an uncommon to fairly common nonbreeding visitor off Middle America, mainly March-October (Howell, 2012).

Ardenna pacifica (Wedge-tailed Shearwater): The most frequently recorded Ardenna shearwater, present in 24.2% of 1-hour periods, mostly over continental slope/deep waters, from September to December and in May. Our lack of records from January to March, when most of the published records off Costa Rica and Panama have occurred (Howell, 2012), is probably due to lack of coverage of deep waters during those months. Flocks up to 300 individuals were seen feeding with other shearwaters (especially Puffinus subalaris), boobies, and terns. Birds in heavy wing molt were seen in November and December (probably from Mexican and Hawaiian populations; Howell, 2012). Most individuals recorded were light morph, with only few dark morphs. Two specimens have been taken in Panama, one in either phase, off Darien in March 1941 (Wetmore, 1965). Ridgley and Gwynne (1989) reported three additional sight records between 1930 and 1976, and Loftin (1991) provisionally assigned some sightings to this species but did not make a positive identification. Based on the small number of records, this species has previously been considered a rare vagrant off Panama (Ridgely & Gwynne, 1989; Angehr & Dean, 2010), but this survey and other recent records suggest that it is a common to very common winter visitor off Panama's Pacific coast. The closest breeding site to Panama is the Revillagigedo Islands off western Mexico (Harrison, 1983).

Figure 3.
Noteworthy photographic records of seabirds off the Pacific coast of Panama. September 2010 - December 2019. ***A.*** *Tahiti Petrel (Pseudobulweria rostrata). Photo by Rafael Luck.* ***B.*** *Parkinson's Petrel (Procellaria parkinsoni). Photo by Jan Cubilla/Macaulay Library.* ***C.*** *Pink-footed Shearwater (Ardenna creatopus). Photo by Rafael Luck.* ***D.*** *Peruvian Booby (Sula variegata). Photo by Jan Cubilla/Macaulay Library. Peñón de San José, Panama. 9 Aug 2014*

Figure 3.

Noteworthy photographic records of seabirds off the Pacific coast of Panama. September 2010 - December 2019. **A.** Tahiti Petrel (Pseudobulweria rostrata). Photo by Rafael Luck. **B.** Parkinson's Petrel (Procellaria parkinsoni). Photo by Jan Cubilla/Macaulay Library. **C.** Pink-footed Shearwater (Ardenna creatopus). Photo by Rafael Luck. **D**. Peruvian Booby (Sula variegata). Photo by Jan Cubilla/Macaulay Library. Peñón de San José, Panama. 9 Aug 2014

Ardenna grisea (Sooty Shearwater): Only two individuals were positively identified during the study, one in deep waters off the southeastern Azuero Peninsula on 25 October 2014, and one off Piñas Bay, in eastern Darien province, on 5 May 2018. No photos were obtained. Of note is that several birds initially identified as Sooty Shearwaters in the field were determined to be dark morph *Ardenna pacifica* after prolonged views or after reviewing photos. *Loftin (1991) reported the species occurring in the G*ulf of Panama from June to September, most commonly in August. Robins (1958) reported eight sightings in the Gulf of Panama between Taboga Island near Panama City and Piñas Bay, all but one of single birds, between 15-26 July 1957. Specimens have been taken in the Gulf of Panama in February, June, and July (Wetmore, 1965). The species was reported by Ridgely and Gwynne (1989) as a fairly common transient, mostly June-September, with a few at other times. However, Spear and

Ainley (1999) reported observing only seven individuals in the Panama Bight on ten cruises between 1984-1991 (although it is not clear how many of these were actually in Panamanian waters). A similar study to ours off Costa Rica failed to detect any individuals on 11 offshore trips from 2006 to 2010 (Young & Zook, 2016). Our findings also suggest this species may not be as regular or common in the region as

previously believed. The species is not expected to occur regularly off Panama nor Central America since these waters are outside the species' main migration track due to several oceanographic features (Howell, 2012; Shaffer et al., 2006). Its presence off Central America may be related to food-poor years in the Humboldt Current (Howell, 2012).

Ardenna creatopus (Pink-footed Shearwater): A group of three individuals photographed on 25 October 2014 off the southeastern Azuero Peninsula was the first record for Panama (Jones & Komar, 2016; Figure 3C). Three other records, all of single birds, were obtained in May, July and November in deep waters. Months of occurrence suggest this is a passage migrant off Panama's Pacific coast.

Puffinus subalaris (Galapagos Shearwater): The most frequently recorded procellarid during the study, present in 53.3% of 1-hour periods overall, in both dry and wet seasons and over the continental shelf and, especially, in continental shelf/deep waters, where it was present in 80.6% of 1-hour periods. Birds copulating, or attempting to copulate, were seen on May off Piñas Bay, in eastern Darien province. All but one of the birds documented by photographs were of the light-winged type. Dark-winged and light-winged types may represent different species (Howell, 2012; Howell & Zufelt, 2019). Loftin (1991) found that the distribution of observations in the Gulf of Panama was bimodal, occurring in April- August and October-December, suggesting seasonal migration. However, Snow (1965) reported the species to nest year-round in the Galapagos Islands, its only breeding site. Robins found the species only near Piñas Bay in July 1957, where 15 were present, and not recorded elsewhere in the Gulf of Panama. Murphy (1956) found the species abundant off western Panama in late November, with hundreds seen on 30 November. He also reported that on an earlier cruise in these waters, B. Shimada observed that large number of shearwaters, believed to be this species, "descended on decks, sung in pairs, and even copulated."

Fregata magnificens (Magnificent Frigatebird): The most frequently encountered species during the study, although usually in low numbers, except on transects over the continental shelf near breeding colonies. The species breeds in Panama in both the Gulf of Panama and the Gulf of Chiriquí (Angehr & Kushlan, 2007; Angehr et al., 2014).

*Sula granti (*Nazca Booby): One to up to three individuals were seen, exclusively on deep waters during the wet season. Typically seen resting on floating debris. When seen flying, individuals invariably showed little interest in the boat. Only adult birds were seen. Loftin

1991) found them, usually small numbers, in September-November and April-June, but observed an exceptional 71 individuals in June between the Pearl Islands and Piñas Bay in Darien. The closest breeding sites to Panama are the Galapagos and Malpelo Islands (Pitman & Jehl, 1998), the latter being the closest site to Panama. Masked Booby *Sula dactylactra* potentially occurs in the study area but none were identified during this study by the authors. The closest breeding sites to Panama are Isla del Coco off Costa Rica, where small numbers breed (Montoya, 2008), and in larger numbers on Clipperton Island off Mexico (Pitman & Jehl, 1998). Young and Zook (2016) recorded both species regularly off Costa Rica, but observations of Masked Booby were mainly west of those of Nazca Booby.

Sula nebouxii (Blue-footed Booby): Almost exclusively recorded over the continental shelf, near the coast or breeding colonies on islands in the Gulf of Panama. The species is known to breed in Panama only in the Gulf of Panama (Angehr & Kushlan, 2007). The only record over deep waters was off the coast at the tip of the Burica Peninsula, in extreme western Panama (the westernmost record of this species for the country), a place where the 1000 m isobath passes less than 1 km from shore. Several hundreds were seen in the Gulf of Panama during 1-hour records in 2014 and 2015, probably representing an incursion from the Galapagos Islands (Lee & Komar, 2011), perhaps related to an ENSO event (Buitrago-Rosas et al., 2020). A similar incursion occurred during the ENSO event of 1983-1984 (Smith, 1990). Loftin (1991) reported the species in small numbers on every cruise.

Sula variegata (Peruvian Booby): This South American species was recorded in August 2014 and August 2015 in continental shelf waters in the Gulf of Panama, near the coast of Panama City, and in the northernmost Pearl Islands, where 3 to 38 individuals were seen on or near rocky islets (Figure 3D). Their presence in these waters was certainly associated with an ENSO event (Lee & Komar, 2011; Buitrago-Rosas et al., 2020). The only previous invasion of Panamanian waters occurred during the ENSO event of 1983-1984 (Ridgely & Gwynne, 1989), when thousands appeared in the Gulf of Panama, which might be a refuge from the effects of ENSO in their usual distribution in the Humboldt Current (Smith, 1990). Birds observed in 2014-2015 appeared to be in good condition. During the 1983-1984 event, Smith (1990) found that although Peruvian Boobies were in good condition when they first arrived in Panama, over the course of the next year many lost weight and most probably eventually died of starvation.

Sula leucogaster (Brown Booby): Common year-round, both over the continental shelf and continental slope/deep waters. This is the most widely distributed of the two breeding sulids in Panama, with nesting colonies on the Pacific coast in both the Gulf of Panama and the Gulf of Chiriquí (Angehr & Kushlan, 2007; Angehr et al., 2012). Loftin (1991)found it to be the second most abundant species after Black Tern, recorded on all cruises.

Sula sula (Red-footed Booby): Only one record during the study, an immature seen off the southeastern Azuero Peninsula on 22 December 2019, feeding with a mixed flock of terns,

shearwaters and boobies. The species is a vagrant in Panama, with most records being from the Caribbean coast (Ridgely & Gwynne, 1989; Angehr & Dean, 2010). The closest breeding site to Panama is Cocos Island off Costa Rica, and possibly on rocky islets off the southeastern Pacific coast of Costa Rica (Garrigues & Dean 2007).

Nannopterum brasilianus (Neotropical Cormorant): The few sightings of this species during the study were always near the coast or islands on the continental shelf, especially in the Gulf of Panama, the location of its main breeding colonies in Panama (Angehr & Kushlan, 2007; Kushlan et al., 2017).

Pelecanus occidentalis (Brown Pelican): Present in 53.4% of 1-hour periods over the continental shelf, especially in the Gulf of Panama, where the species is abundant. The species breeds in both the Gulf of Panama and the Gulf of Chiriquí (Angehr & Kushlan, 2007; Angehr et al., 2012). Recorded by Loftin (1991) on every cruise, but most common in January and February, near the start of the breeding season.

CONCLUSIONS

These observations include three species (*Hydrobates castro, Pseudobulweria rostrata and Ardenna creatopus*) added to the list of birds of Panama (Jones & Komar 2011; Jones & Komar, 2015), and provide the first documented evidence of occurrence in Panama of two additional species (*Anous minutus and Procellaria parkinsoni*). Some of these species probably have been overlooked. Also, increase our knowledge on seabirds species occurring off the Pacific coast of Panama and offer an idea of the species that are within the reach of the pelagic avitourist.

The methods implemented preclude the inclusion of mainly coastal species, specially of the family Laridae. Members of this family seen by the authors at coastal sites, but also at offshore waters during the study period by others observers were *Leucophaeus pipixcan, Larus delawarensis, Larus dominicanus, Sternula antillarum, Gelochelidon nilotica, Sterna forsteri and Rynchops niger* (www.ebird.org).

At the other hand, these additional four species were photographed off the Pacific coast of Panama during the study period by other observers (thus, not included in this study): *Creagrus furcatus* (Campos, 2015), *Gygis alba* (Gourad, 2019; Buitrago-Rosas et al., 2020), *Puffinus puffinus* (Hull, 2017) and *Sula dactylatra* (Groenendijk, 2017). A fifth species, Phalaropus lobatus, was accepted by the Panama Audubon Society's

Records Committee as a new, hypothetical species for Panama due to a sight report (Sociedad Audubon de Panama, 2021; Namitz, 2015). These additional species highlight the diversity of species that exists in the Panamanian Pacific and the need to explore the area in a more systematic way. This may result in the addition of new species and to exactly determine the importance of these waters for their life cycles.

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SEABIRDS OFF THE PACIFIC COAST OF PANAMA: OBSERVATION FREQUENCY, DISTRIBUTION AND SEASONALITY

AVES MARINAS EN LA COSTA DEL PACÍFICO DE PANAMÁ: FRECUENCIA DE OBSERVACIÓN, DISTRIBUCIÓN Y ESTACIONALIDAD

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