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Unusual Coastal Breeding in the Desert-nesting Gray Gull (*Leucophaeus modestus*) in Northern Chile

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Abstract.—The Gray Gull (*Leucophaeus modestus*) has the unique habit among gulls of nesting in the interior Atacama Desert, up to 100 km from the coast. During the 2014-2015 austral breeding season, two breeding colonies were recorded on the coast within 90 m of the shoreline in the Antofagasta Region, northern Chile. The new colonies ranged in size from 40 (Playa Grande) to 150 (Playa Brava) nests. Egg laying was synchronous in both colonies and most likely occurred in late November 2014, coinciding with egg laying in desert colonies. The colony at Playa Brava was successful, but the one at Playa Grande was deserted due to feral dog (*Canis familiaris*) attacks. The habitat used by Gray Gulls resembled that reported for desert colonies, with flat plains covered with small rocks, which provide protection to chicks from intense solar radiation. This unusual coastal nesting behavior could result in the modification of certain life history and behavioral traits in the Gray Gull (e.g., chick growth rates, energy expenditure, and foraging ranges), which have evolved to breed in severe desert conditions. We suggest that coastal breeding is adopted by Gray Gulls during El Niño years in response to reduced food supply. During El Niño years, Gray Gulls would move to the coast where access to food is better and thermoregulatory costs are lower, but predation is higher. During non-El Niño years, Gray Gulls would resume their ancestral desert-nesting strategy in which traveling distances between the coast and nesting grounds are considerable and thermoregulatory costs are higher, but predation risks are lower. Future observations should confirm if Gray Gulls continue breeding at coastal sites during El Niño years or if this becomes a regular behavior independent of oceanographic conditions. *Received 7 April 2015, accepted 12 May 2015.*

Key words.—breeding biology, coastal nesting, desert nesting, El Niño, Gray Gull, *Leucophaeus modestus*, northern Chile.

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Formerly included within the genus *Larus* (Remsen *et al.* 2015), the Gray Gull (*Leucophaeus modestus*) is a seabird endemic to western South America, ranging along the coast from Ecuador to southern Chile (Howell and Dunn 2007). While it forages exclusively in coastal habitats (Howell *et al.* 1974; Ryan *et al.* 1987), the nesting of this species has been confined exclusively to the barren Atacama Desert at distances up to 100 km from the nearest coastline (Goodall *et al.* 1945; Howell *et al.* 1974). This habit is unique among Laridae (Howell and Dunn 2007), and the Gray Gull is probably one of the few bird species capable of nesting in the interior Atacama Desert, the driest place in the world (Moffett 1969). Explanations for the evolution of the desert-nesting habits of the Gray Gull are uncertain. Howell *et al.* (1974) proposed that Gray Gulls may have gradually reached their current nesting sites in the barren desert in an attempt to avoid the more predator-occupied coast. Another hypothesis proposed by these authors suggests that the species moved inland to nest around inland lakes during the Pleistocene; this energetically expensive pattern may have persisted due to the scarcity of predators in the desert.

Since the first colonies were reported by Goodall *et al.* (1945), 11 nesting sites for this species have been reported in the literature, all located in the desert at distances between 25 and 100 km from the nearest coast and ranging in size between 50 and 12,000 pairs (Guerra *et al.* 1988b; Aguilar *et al.* 2013; Fig. 1). Most recently, however, a new colony

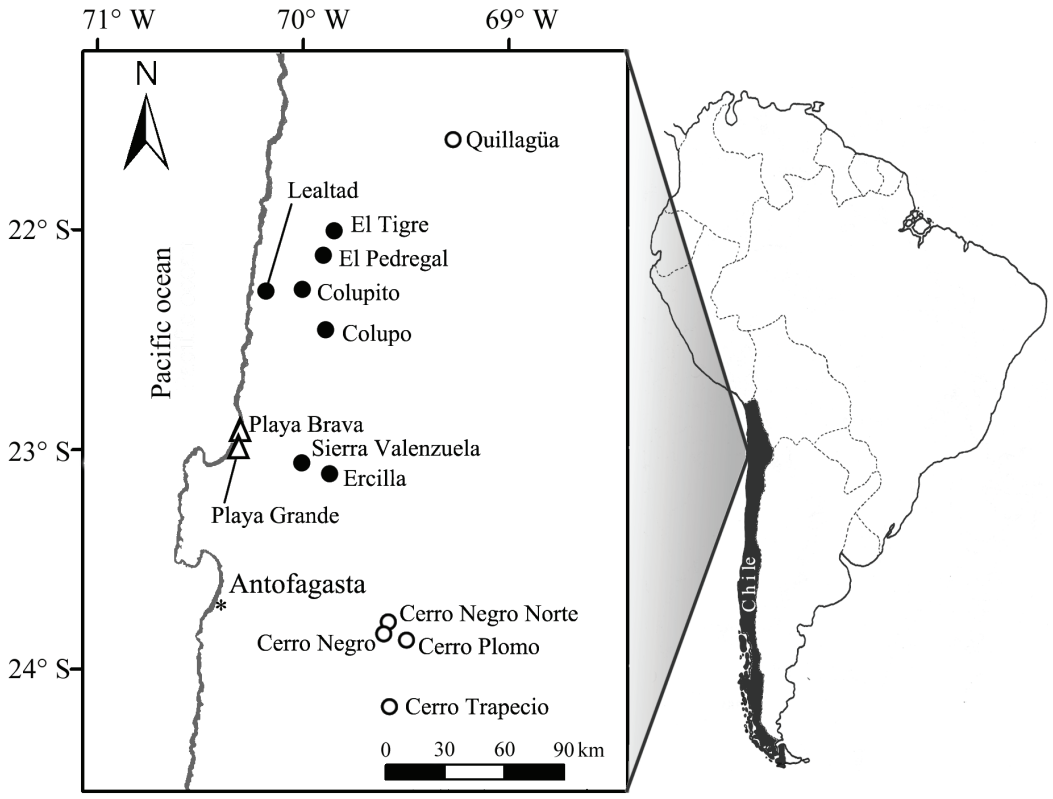

Figure 1. Location of Gray Gull colonies in northern Chile. Open circles indicate colonies active as of January 2015, filled circles indicate colonies with no recent activity. Open triangles indicate the two new coastal breeding sites described in this study.

was discovered at Quillagua (Fig. 1), and a preliminary estimate suggests that it may contain up to 30,000 pairs (R. A. unpubl. data). Gray Gulls are known to shift nesting sites from one location to another within a few decades (Aguilar *et al.* 2013). The reasons for such colony dynamics are not well understood, and explanations may include natural predation and human perturbation associated with mining and vehicle raids (Aguilar *et al.* 2013). In this note, we report the unusual establishment of two nesting sites of Gray Gulls on the coast of northern Chile.

Methods

In early January 2015, local residents reported two new colonies of Peruvian Terns (*Sternula lorata*) at local beaches north of Antofagasta in northern Chile (Fig. 1). Upon survey on 5 and 6 January, it was determined that two colonies of Gray Gulls (not Peruvian Terns) were actually present.

The first colony was located at Playa Brava (22° 57′ S, 70° 18′ W) within 20-90 m of the coastline and 78 km north of Antofagasta (Fig. 1), and extended over a flat plain with sandy substrate covered with small rocks (Fig. 2). This colony was visited weekly until late February (mainly between 10:00 and 12:00 hr). During each visit, we counted the adults, chicks and fledglings at the colony with 10x42 binoculars and a 60x spotting scope. The second colony was situated at Playa Grande (23° 01′ S, 70° 20′ W) within 50-60 m of the coastline and 9 km south of Playa Brava (Fig. 1). Habitat was similar to that described for the Playa Brava colony.

Results and Discussion

At the time of the first visit on 5 January 2015, the Playa Brava colony contained approximately 150 nests: 74% contained only eggs, 6% contained eggs and chicks and 20% contained only small (< 1 week old) chicks (Fig. 2). By late February, this colony produced 107 fledglings (Fig. 3).

Figure 2. Adult Gray Gull shading a chick at the coastal colony of Playa Brava, northern Chile. Photograph by R. Aguilar.

The Playa Grande colony was inspected on 6 January 2015 and included 40 nests: 93% contained only eggs, 3% contained eggs and chicks and 4% contained small chicks. On the following day, this colony was totally deserted and footprints of feral dogs

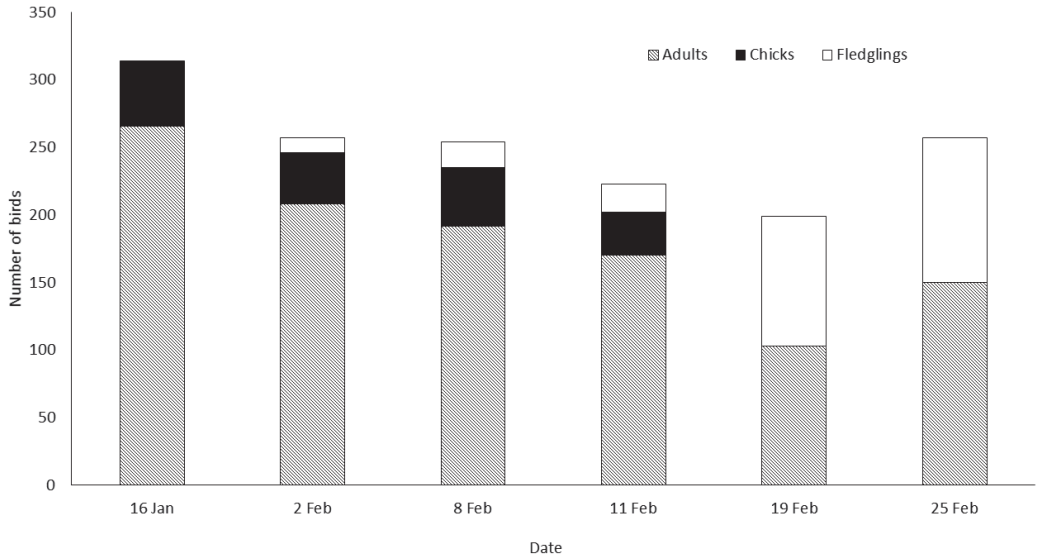

Figure 3. Counts of Gray Gulls (adults, chicks and fledglings) at the coastal colony of Playa Brava between January and February 2015.

(*Canis familiaris*) were present. Turkey Vultures (*Cathartes aura*) were scavenging on the recently abandoned eggs. No further monitoring of this colony was performed.

Breeding activity at both colonies seemed to be rather synchronous, although Playa Brava contained a higher proportion of nests with chicks, suggesting an earlier start. Judging by the size of the chicks at the time of the first visits (see Aguilar *et al.* 2013 and Guerra *et al.* 1988a for chick aging) and assuming an incubation period of 29-30 days (Howell *et al.* 1974; Aguilar *et al.* 1994), first eggs were most likely laid between the second and third week of November 2014. Aguilar *et al.* (2013) reported that in desert colonies Gray Gulls usually lay eggs from early November throughout December, so timing for both coastal sites seems to be aligned with desert colonies.

Nests were located in close proximity to small rocks, a strategy that has been described as crucial for chick survival in desert colonies as they provide protection against the intense solar radiation during the day and low temperatures and wind during the night (Guerra *et al.* 1988b). Although ambient temperatures during the day are considerably lower along the coast than in the barren desert (Luna-Jorquera *et al.* 2003), Gray Gulls seem to still seek this habitat feature in coastal colonies.

Despite regular scavenging by Turkey Vultures and foxes (*Lycalopex* spp.), it is usual to find abundant chick carcasses and egg shells from previous breeding seasons at Gray Gull colonies in the desert (R. Aguilar, pers. obs.). At Playa Brava, however, no old carcasses were found and only a few recently dead chicks and fledgling carcasses were present. This strongly suggests that no occupation has occurred in previous years at this site and that Gray Gulls bred for the first time at this locality during the 2014-2015 season. Additionally, Playa Brava was regularly visited in previous years for seabird counts and the presence of a Gray Gull colony was never detected.

This unusual coastal nesting behavior could result in the modification to some extent of certain life history traits in the Gray Gull, which has evolved several metabolic and behavioral strategies to breed in severe desert conditions that include high ambient temperatures during the day, low temperatures during the night, low air humidity and long distances to the foraging areas (Luna-Jorquera *et al.* 2003). For instance, Gray Gull chicks grow at reduced rates compared to other gull species, which is most likely to cope with the long foraging distances that limit chicks to a single daily meal (Guerra *et al.* 1988a); chicks from Playa Brava probably receive several meals during the day and this would likely increase their growth rates. Gray Gull embryos tolerate temperatures between 17 and 42 °C, an adaptation likely to overcome the strong thermal amplitude observed in the desert (Aguilar *et al.* 1998); it is conceivable that embryos in coastal colonies would have lower energy expenditure. Similarly, it is expected that incubating adults would dedicate less time in thermoregulation behaviors and thus have lower energy expenditure. On the other hand, these comparative advantages could be counteracted by a strong predation pressure along the coast as was observed at the Playa Grande colony.

While this is the first time that Gray Gulls have been reported to breed in coastal northern Chile, Zavalaga *et al.* (2008) mentioned "thousands" of Gray Gulls nesting at El Cangrejal beach along the Peruvian coast during the 1999-2000 austral breeding season. This colony, however, had very low success (only 60 fledglings) potentially due to intense predation by foxes and local fishermen. That same season, nearly 500 pairs attempted to nest at Independencia Island (also known as La Vieja Island) where birds were observed establishing nests and copulating, but no eggs were laid (I. García-Godos, pers. commun.). Together, the evidence for Chile and Peru suggests that Gray Gulls are not restricted to breeding in the interior Atacama Desert as previously thought, but that under certain circumstances they also are able to successfully breed in coastal areas.

It is interesting to note that coastal breeding in Peru occurred shortly after the 1997-1998 El Niño event and the coastal breeding

reported in this note occurred under a developing El Niño event. It is well known that during El Niño Gray Gull colonies in the desert suffer complete desertion (Guerra *et al.* 1988c), so it may be that during El Niño events some Gray Gulls abandon the desert-nesting strategy and shift to coastal breeding, at least temporarily. If this hypothesis is correct, during El Niño Gray Gulls would move to the coast where access to food is better and thermoregulatory costs are lower; these benefits, however, would be counteracted by higher predation risks (Zavalaga *et al.* 2008). During non-El Niño years, Gray Gulls would resume their ancestral desert-nesting strategy in which traveling distances between food sources and nesting sites are considerable and thermoregulatory costs are higher, but predation risks are comparatively much lower and restricted to native predators. Future field observations should confirm if Gray Gulls continue breeding at coastal sites during El Niño events or if this becomes a regular behavior independent of the prevailing oceanographic conditions.

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