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NOTES ON BREEDING BIOLOGY AND ECOLOGY OF CHILEAN SKUA (*STERCORARIUS CHILENSIS*) IN SUB-ANTARCTIC ARCHIPELAGOS OF WESTERN PATAGONIA

Cristián G. Suazo[1,2], Aldo M. Arriagada[3], Luisa Baessolo[4], Macarena Castro[5,7], & Milton A. Salas[6]

[1]Laboratorio de Ecología, Departamento de Ciencias Básicas, Universidad de Los Lagos, Av. Fuchslocher 1305, Casilla 933, Osorno, Chile.

[2]Albatross Task Force - Chile, Birdlife International. *E-mail*: biosuazo@gmail.com

[3]Departamento de Zoología, Facultad de Ciencias Naturales y Oceanográficas, Universidad de Concepción, Barrio Universitario s/n, Casilla 160-C, Concepción, Chile.

[4]Programa de Educación e Investigación Biológica & Ambiental (Programa IBAM), Universidad de Los Lagos, Av. Fuchslocher 1305, Casilla 933, Osorno, Chile.

[5]Centro de Investigación en Ecosistemas de la Patagonia (CIEP), Ignacio Serrano 509, Coyhaique, Chile.

[6]Departamento de Medio Ambiente, Instituto de Fomento Pesquero (IFOP), Putemún s/n, Castro, Isla de Chiloé, Chile.

[7]*Current address:* Departamento de Biología, Facultad de Ciencias del Mar y Ambientales, Universidad de Cádiz, Avda. Saharahui s/n 11510, Puerto Real, Cádiz, Spain.

Resumen. – Notas en la biología y ecología reproductiva de la Skua Chilena (*Stercorarius chilensis*) en los archipiélagos subantárticos de la Patagonia occidental. – La skua Chilena *Stercorarius chilensis* es una especie endémica de las aguas subantárticas del sur de Sudamérica. Existen vacíos en nuestro entendimiento en aspectos básicos para esta especie que incluye desde morfometría hasta ecología reproductiva. En el presente estudio, presentamos información base en forma de notas acerca de la biología y ecología reproductiva de esta especie, basada en tres años de estudios en la isla Guamblín (44°S) en los archipiélagos subantárticos de la Patagonia occidental. Entre nuestros resultados, podemos destacar el importante rol de playas de arena, tanto para la mantención de nidadas, así como la protección de crías después de la eclosión. Es posible destacar un activo rol parental al momento de defender a las crías, con comportamientos más agresivos (e.g., descargas de excremento, persecución), tanto en presencia de conespecíficos, así como otras amenazas terrestres o aéreas para las crías. El crecimiento de estados tempranos de Skua Chilena, evidencia estrategias similares a lo registrado en otras aves marinas, al presentarse estados tempranos con pesos superiores a los registrados históricamente en adultos. Finalmente, en cuanto a la alimentación de esta especie, fue posible observar a lo largo de registros históricos, así como registros inéditos, el amplio espectro dietario y de estrategia oportunista de esta especie en esta parte de la Patagonia.

Abstract. – The Chilean Skua *Stercorarius chilensis* is an endemic species in sub-Antarctic waters of southern South America. Gaps exist in our understanding of basic aspects of this species ranging from morphometry to reproductive ecology. In this study, we present basic information in the form of notes on the biology and reproductive ecology of this species, based on three years of study on Guamblín island (44°S) in the sub-Antarctic islands of western Patagonia. Among our results, we highlight the important role of sandy beaches, both for the maintenance of nests, and protection of offspring after hatching. We emphasize an active parental role when defending their young, with more aggressive behaviors (e.g.,

discharge of excrement, persecution), both in the presence of conspecifics and other land or air threats to their brood. The early stages of growth of Chilean Skua, evidence of similar strategies to that recorded in other seabirds, with the presence of early stages with weights higher than those recorded historically in adults of this species. Finally, with regard to foods of this species we observed the wide dietary spectrum and opportunistic feeding strategies of this species reported in historical records and unpublished records from this part of Patagonia. *Accepted 11 June 2012.*

Key words: Chilean Skua*, Stercorarius chilensis*, breeding, morphometry, feeding, seabird, sub-Antarctic.

INTRODUCTION

The Chilean Skua (*Stercorarius chilensis*) is an endemic species of the sub-Antarctic which inhabits fjords and channels (Schlatter & Simeone 1999). This species is a common resident of both western (southeast Pacific) and eastern (southwest Atlantic) Patagonian coasts. On the western side, its breeding distribution ranges from Chiloé island (43°S) and to the eastern Patagonian coast at Chubut province (45°S) in Argentina (Yorio 2005). Its southern distribution includes the Wollaston Archipelago at Cape Horn (Clark *et al.* 1992) and the Diego Ramírez archipelago at the southern end of the South American shelf.

Chilean Skuas may be recognized as a common Patagonic species, yet, we identified several gaps in basic historical and scientific information on their regional breeding biology and ecology. Currently, we only have scattered information related to some prey items, breeding sites or diagnostic differences with respect to other southern skuas (Devillers 1978), or simple anecdotal records among a species list.

The Chilean Skua is associated at lower latitudes with coasts of the fjords and channels of western Patagonia (c. 44ºS) during the warmer seasons. It is identified as a common species in this region mainly because of the existence of breeding aggregations at higher latitudes during the Austral spring-summer (Kusch *et al.* 2007) which present a marked winter dispersion from breeding sites (Schiavini & Yorio 1995). It becomes evident that the status of Chilean Skuas as residents along the archipelagic system in the western Patagonia has not been clearly determined. It has been regarded as an abundant species among the fjords on this region (Devillers 1978), but few breeding sites have been reported beyond those in waters associated with the Cape Horn area.

There is very little baseline information of skuas in the sub-Antarctic archipelagos other than habitat use. This includes Chilean Skuas along the coast of Argentinean (eastern) Patagonia where it is reported to be one of the least studied marine birds, with no available information on basic aspects of its biology (Schiavini & Yorio 1995, Raya Rey & Schiavini 2000, Yorio 2005).

Our main objective of this study was to gather and record baseline information about Chilean Skuas' breeding biology and ecology in the sub-Antarctic archipelagos of western Patagonia, such as: brood traits, patterns of habitat use, parental behavior, and feeding habits during three breeding seasons.

STUDY AREA AND METHODS

Direct skua observations: breeding habitat distribution and territorial behavior. From 2007 to 2009 during February, we made systematic records of Chilean Skuas' abundance, distribution, and behavior during the breeding period on the east and southeast coast of the Guamblín Island National Park (thereafter Guamblín island; 44º50'S, 75º07'W), a protected area free from human presence. Guamblín island is the most ocean-exposed island of Chonos' Archipelago, Chilean Patagonia (Fig. 1). The

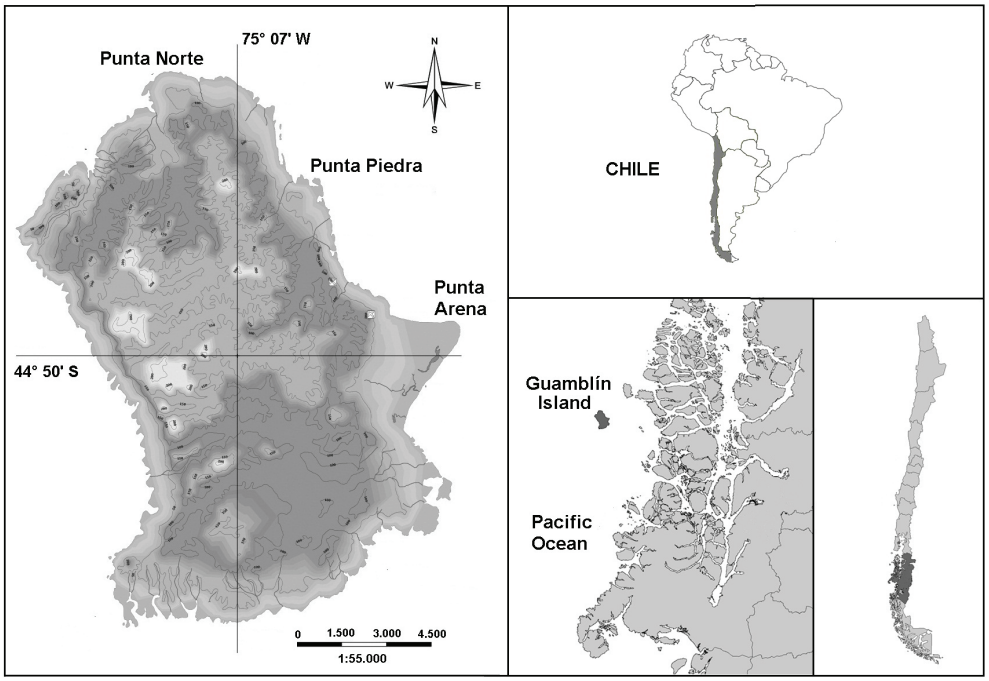

FIG. 1. Guamblín island in Chonos' Archipelago (44°50'S). The sandy beach of Punta Arena is the central point of reference on the east-southeastern coast of the island with observations of Chilean Skuas.

sheltered coastal area of the island presents extensive sandy beaches and a system of dunes in the higher areas (i.e., terraces between 0.3 and 2.5 m high) with marshes separating the beaches from the inland Myrtaceae forest (e.g., *Luma apiculata*) at the base of the slope at the end of the littoral terrace (Ramírez *et al.* 2004).

We made daily records on adult breeding and non-breeding distribution along the sandy beaches of east coast of Guamblín island, such as Punta Arena (Fig. 1). For each identified breeding pair, non-breeding pair, or individual, we determined mean distance to the nearest breeding pair (m). In addition, from recording points (distributed in function of individuals' presence and considering a distance of observation from individuals between 100–150 m) we described individual activity both in adult and brood during periods of 30 min. During this time, we emphasized the description of: (1) adult and brood individuals' response to territory intrusions by conspecifics and other sources of risk, such as potential predators (e.g., terrestrial or aerial species); (2) the territory intruder's behavior, and (3) a description of habitat attributes particularly on territories occupied by breeding pairs, such as sources of shelter for broods, food, and freshwater for both adult and brood.

Brood and parental records: brood's morphometric parameters and adult attendance. An updated list of morphometric measurements (± 0.1 mm) from pre-fledglings – birds with brighter reddish brown plumage in their lower parts and with bluish grey tarsus (Devillers 1978) of one month old – and downy young of one week old (Schlatter pers. com.) are also included

and compared with historical published data (Murphy 1936, Humphrey *et al.* 1970, Devillers 1978). These measures included morphometric parameters, such as wing, tarsus, culmen, tail, and total body length (mm). Body mass (g) was also reported. Finally, together with the previous described records on adult and pre-fledgling habitat use, we used the same 30 min observation periods to characterize behavior related to brood-parent interaction. Among these we identified and described: (1) parental attendance/brood defense; (2) feeding behavior of adults with brood presence including identification of feeding strategy as reported by (Ashmole 1971), and (3) potential prey when its identification was possible in the field (e.g., direct attacks, prey remains).

RESULTS AND DISCUSSION

Adult spatial distribution and abundance. 16 pairs of Chilean Skuas were found assisting their pre-fledglings and recognized as breeding pairs. A group of 12 clustered individuals with adult breeding plumage were also observed frequently performing long-calls (Devillers 1978) but without observed breeding assistance. These two categories were observed throughout the 11.7 km of sandy-bottom beaches in the east coast of Guamblín island. Finally, 12 scattered non-breeding adults (without presence of reddish plumage) were distributed mainly around the mid and upper zones of the beach both north and south of the reproductive pairs centrally located on the sandy coastal line (Fig. 1). Mean distance between these marginal distributed non-breeding individuals and reproductive pairs was 180 ± 75 m.

During territory defence encounters we observed one flying member of a recorded breeding pair (minimum reaction radius of c. 120 m), do a brief foot grabbing of a non-reproductive intruder. Another encounter among reproductive individuals of separate pairs ended with submissive behaviour performed by the territory invader which behaved as if its leg was injured when attacked from the heights by the territory defender. We noted that reproductive pairs actively defended territories corresponding to sites with beached kelp as a refuge mosaic for broods and freshwater streams (n = 10) which were longer and had greater flow along the beaches, a fact that might explain the significant preference that Chilean Skuas show for freshwater baths and consumption recorded on these same beaches during the 1980's decade (Schlatter pers. com.).

Territorial behavior: adult and brood responses under the presence of risk. A potential aerial predator, a single Peregrine Falcon (*Falco peregrinus cassini*) was attacked by four adult skuas when it overflew a pre-fledgling Chilean Skua. Skuas also attacked an adult Ashy-headed Goose (*Chloephaga poliocephala*) walking near a pre-fledgling; the goose was knocked down several times onto the sand by an adult Skua which pecked its legs.

In the absence of their parents, pre-fledgling individuals mainly rested cryptically on the sand during the day among beached patches of giant kelp (*Macrocystis pyrifera*). In the presence of their parents, pre-fledglings remained between 10 and 40 m from their rest site. When potential terrestrial threats (e.g., walking heterospecific birds, other conspecifics, human) approached within 400 m, pre-fledglings started a "hidden walk" towards the adults (walks accompanied with wings folded to the body and head looking forward but under the shoulders). Pre-fledglings' escape occurred together with the adults overflying the intruder and discharging excrement from above. In contrast, less agonistic behaviors described among nesting neighbors were recorded from breeding pairs of Chilean Skuas in high density colonies

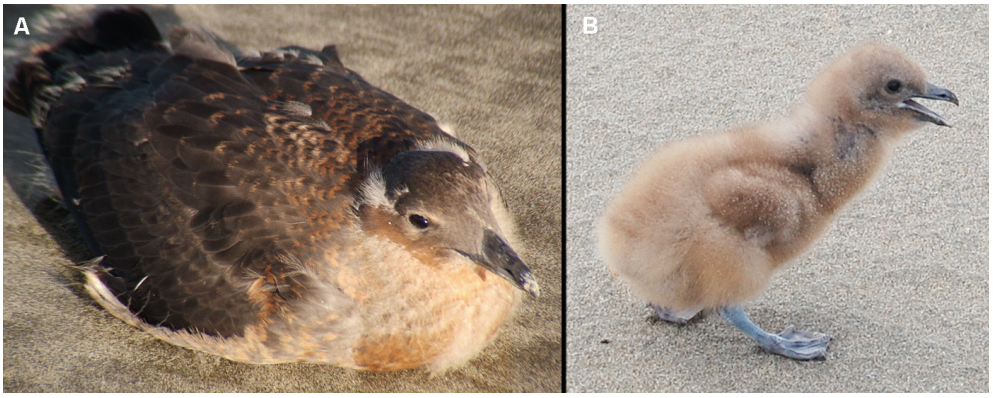

FIG. 2. One month pre-fledging (A), and one week downy young (B) of Chilean Skua in Guamblín island.

(Devillers 1978), unlike the behavior of these more dispersed breeding individuals.

Beaches were used by older chicks where two abandoned nests, behind the system of dunes, were observed. These nests were built with crushed grass over a simple depression in the ground (Humphrey *et al.* 1970). Nevertheless, in this study we recorded pre-fledglings returning at night and/or under certain weather conditions (e.g., during storms and strong waves conditions) to the dunes for shelter.

Brood and parental records: brood's morphometric parameters and adult attendance. We measured 14 pre-fledglings and one downy young (Fig. 2; Table 1). These young attempted to escape by flapping wings and flight. Others tried to escape by a hidden walk towards the swash zone in the lower part of the beach. Pre-fledglings were frequently of greater weight than adult Chilean Skuas (Table 1), a phenomenon also noted in other seabirds that store fat prior to their first flight attempt (Reid *et al.* 2000). Although the morphometric data have only one individual of one week old as reference, we noted that pre-fledgling individuals of one month age can reach an average of 1499 g (n = 14), corresponding to seven times the total body mass recorded at one week old. At one month of age, pre-fledglings can exceed by 5% and 22% the maximum body mass recorded for adult females and peak that of males, respectively, of this species in Tierra del Fuego (Humphrey *et al.* 1970, Table 1).

From the limited historical record of the morphometry of the Chilean Skua, it is probable that adult females are larger than adult males in most morphometric traits except culmen length. In turn, gaps in basic information on the species prevent us to make inferences with certainty concerning the same parameters between resident skuas from the Pacific when compared to individuals recorded in the Atlantic.

During our fieldwork, only one pre-fledgling regurgitated without handling, apparently as a response to facing human presence as a threat. Although our present study focused on visual records of prey, such as beached remains or direct attacks, we also collected this regurgitated pellet which had a total wet weight of 15.36 g and comprised 100% of Fuegian sprat (*Sprattus fuegensis*) as the only recognizable material. This identified item included: backbone, pectoral fins, and diagnostic head or mouth bones (Aranis *et al.* 2007). Adult skuas are likely to obtained these prey items through aerial piracy on other birds

TABLE 1. Measurements of pre-fledging (PF) and downy young (DO) of Chilean Skuas on Guamblín island (± 0.1 mm), and adult records from Murphy (1936) (RM); Humphrey *et al.* (1970) (PH) for Tierra del Fuego, and Devillers (1978) (PD) with adult average measures from Chile (n = 2), Falklands (n = 2), and Argentina (n = 3). Guamblín island measurements are from 2007 (n = 2 PF), 2008 (n = 10 PF), and 2009 (n = 3, with two PF and one DO).

Individuals	Body mass (g)	Wing	Tarsus	Culmen	Tail	Total length
$(R.M)_{male}$	-	390–398	60.6–72.3	49.4–56.1	140–158.4	-
$(R.M.)_{female}$	-	387–411	66–70	51–56	135.6–143	-
$(P.H.)_{male}$	1193–1224.5	-	-	-	-	-
$(P.H.)_{female}$	1433	-	-	-	-	-
$(P.D.)_{Chile\ 1}$	-	394	69.1	47.8	-	-
$(P.D.)_{Chile\ 2}$	-	409	67.5	51.9	-	-
$(P.D.)_{Falklands\ 1}$	-	410	69.0	49.8	-	-
$(P.D.)_{Falklands\ 2}$	-	376	67.4	43.7	-	-
$(P.D.)_{Argentina\ 1}$	-	411	70.2	47.7	-	-
$(P.D.)_{Argentina\ 2}$	-	405	70.0	49.8	-	-
$(P.D.)_{Argentina\ 3}$	-	385	68.0	47.1	-	-
$PF_{1\ (2007)}$	1880	297	68.5	46.6	124	198
$PF_{2\ (2007)}$	1320	278	64.4	44.2	112	159
$PF_{1\ (2008)}$	1250	281	63.5	43.1	-	158
$PF_{2\ (2008)}$	1333	271	65.4	43.5	-	164
$PF_{3\ (2008)}$	1926	280	68.4	48.2	-	198
$PF_{4\ (2008)}$	2015	334	68.0	46.5	-	202
$PF_{5\ (2008)}$	1485	305	61.6	42.5	-	160
$PF_{6\ (2008)}$	1489	294	62.4	43.2	-	170
$PF_{7\ (2008)}$	1577	281	63.3	42.6	-	185
$PF_{8\ (2008)}$	1200	263	64.2	41.3	-	148
$PF_{9\ (2008)}$	1780	294	64.1	42.1	-	187
$PF_{10\ (2008)}$	1680	284	64.0	43.8	-	190
$PF_{1\ (2009)}$	1080	-	70.0	41.0	-	-
$PF_{2\ (2009)}$	980	-	65.0	43.0	-	-
$DO_{1\ (2009)}$	203	76	24.0	20	-	-

(Ashmole 1971), particularly the Imperial Cormorant (*Phalacrocorax atriceps*) as previously noted for southern Argentina (Raya Rey & Schiavini 2000), or the South American Tern (*Sterna hirundinacea*) which also breeds on the island (AMA pers. observ.). In other colonies in southern Chile, such as on Guafo island (43°61'S, 74°75'W), skuas were also observed in association with cormorant colonies (Clark 1984). It is worth noting that the Fuegian sprat is a dominant prey item of Imperial Cormorants (Ferrari *et al.* 2004), although current literature recorded only anecdotal observations (Reinhardt *et al.* 2000) for Chilean Skuas' diet.

We observed feeding activities of Chilean Skuas involving direct attacks by a couple of non-reproductive individuals over a flock of numerous Sooty Shearwaters (*Puffinus griseus*) about 150 m from the beach during the shearwaters' evening movements towards their nesting sites in the island's forests. Despite the lack of hunting success by skuas on shearwaters, we found dead individuals of this

latter species scattered on the beach sections also used by skuas. Concerning Chilean Skuas predating on other seabirds, the species has been observed capturing birds – most likely prions (genus *Pachyptila*) – at Guafo and Noir Islands (Clark *et al.* 1984, Kusch *et al.* 2007).

Small breeding colonies of the Chilean Skua studied at Cape Horn reported the following among their prey remains: a Blue Petrel (*Halobaena caerulea*), a juvenile White-chinned Petrel (*Procellaria aequinoctialis*), Sooty Shearwater, Magellanic Diving-petrel (*Pelecanoides magellani*), and unidentified cormorants and seals (Clark *et al.* 1992). For this region, the Chilean Skua was also considered as a potential predator of ground-nesting birds in the Cape Horn province, such as the Upland Goose (*Chloephaga picta*) (Schütler *et al.* 2009, Ibarra *et al.* 2010).

Current feeding observations included abandoned eggs and moribund chicks of Black-browed Albatross (*Thalassarche melanophrys*) and Grey-headed Albatross (*T. chrysostoma*) at Diego Ramírez archipelago (CGS pers. observ.). Other observed prey on these islands were adults of the Blue Petrel (known from aerial pursuit; Ashmole 1971) and fledgings of this species at the burrow entrances. Another avian prey recorded in the southern distribution range of Chilean Skuas were chicks of the Rockhopper Penguin (*Eudyptes chrysocome*), mainly at the edge of exposed colonies as also recorded at Staten island, Argentina (Liljesthröm *et al.* 2008).

Clearly, additional studies on the breeding biology of Chilean Skuas in Patagonia are needed. Interactions of skuas with Imperial Cormorants or shearwaters have an impact on the breeding success of skuas (Schlatter pers. com.). On the other hand, it is unknown if any trophic relationships exist between skuas and industrial trawl or longline fisheries except for kleptoparasitic events on other seabird species, such as Kelp Gull (*Larus dominicanus*) and Pink-footed Shearwater (*Puffinus creatopus*) feeding on discards (CGS pers. observ.). Meanwhile, there are reports on attempts by skuas to feed on artisanal fisheries offal and discards during the Austral summer (Ojeda *et al.* 2011). Information on the Chilean Skua's diet is mainly based on reports of its feeding habits in Tierra del Fuego and data from other breeding areas as described by Reinhardt *et al.* (2000). However, it remains unknown whether patterns for aspects of its breeding biology and ecology differ significantly across its breeding range.

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