What is known about the enigmatic Gulf of Guinea band-rumped storm petrels Hydrobates cf. castro?

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What is known about the enigmatic Gulf of Guinea band-rumped storm petrels *Hydrobates* cf. *castro*?

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Summary.—We present what is known about the Gulf of Guinea band-rumped storm petrels *Hydrobates* cf. *castro* to identify priority areas for research and conservation. Addressed are: occurrence in the Gulf of Guinea, including museum specimens, at-sea records, observations on the islands, and potential breeding sites; seasonality, the timing of breeding inferred from condition of trapped birds and birds at sea in primary moult; morphology, including biometrics, structure, plumage aspect; aerial vocalisations at the suspected breeding grounds; and taxonomy. The first photographs and sonograms pertaining to this population to be published are also presented. The evidence indicates that this storm petrel is present in the Gulf of Guinea year-round. It almost certainly breeds on São Tomé during both the wet and long dry seasons, and breeding is probably protracted, possibly seasonal. Morphology indicates a degree of distinctiveness and aerial vocalisations suggest possible taxonomic affinities with Cape Verde Storm Petrel *H. jabejabe*. Our observations are provisional and further research is required. The three most pressing matters for future research are clarifying taxonomy, locating breeding colonies and identifying key threats.

Taxa included in the band-rumped storm petrel complex (*Hydrobates castro*, sensu lato) breed in the North Atlantic, South Atlantic and North Pacific Oceans (Brooke 2004, Howell & Zufelt 2019; Fig. 1a). Taxonomic relationships among these cryptic black-and-white taxa are poorly understood, although several species have been recognised in recent years (e.g. Friesen *et al*. 2007, Bolton *et al*. 2008, Deane 2011, Silva *et al*. 2016). Band-rumped storm petrels in the Gulf of Guinea (*Hydrobates* cf. *castro*—hereafter Gulf of Guinea Storm Petrel), in the equatorial east Atlantic, are known from only a small number of museum specimens, and at-sea and over-land records. However, fishermen on São Tomé and Príncipe are familiar with black-and-white storm petrels under the name ‘canimboto’ or ‘caniboto’, suggesting that it is a common bird around the islands. The sole attempt to clarify the general status of the Gulf of Guinea Storm Petrel was published more than 20 years ago and it failed to clarify the taxonomy or to confirm the existence of a breeding population (Monteiro *et al*. 1997, available from the authors). Here we update and expand upon published information to identify priority areas for research and conservation, including data on specimens, at-sea and over-land observations, possible nesting sites, seasonality, and describe this population’s biometrics, structure, plumage aspect and vocalisations, illustrated by the first published photographs and sonograms.

Occurrence in the Gulf of Guinea

**Study area.**—The Gulf of Guinea (00°20’N, 06°44’S) is located off the Atlantic Ocean coast of Central Africa. It is crossed by a volcanic arc that produced the oceanic islands
of Annobón, São Tomé and Príncipe, and the continental island of Bioko (Fig. 1). Max. altitudes are: Annobón 598 m, São Tomé 2,024 m, Príncipe 948 m and Bioko 3,011 m. The mountains are very steep and there are several inland as well as coastal cliffs. The islands’ climate at sea level is consistently hot year-round, but the rugged topography gives rise to a strong rainfall gradient and lower temperatures at higher altitudes (Jones et al. 1991). There is a long dry season between mid May and early September, a short one between late December and early February, and two wet seasons covering the rest of the year. The mountainous centres of the islands still harbour relatively extensive and well-preserved patches of old-growth forest where most of the native bird species persist (Lima et al. 2017).

Historical records.—J. V. Barbosa du Bocage acquired what was presumably a Gulf of Guinea Storm Petrel collected ‘far offshore’ São Tomé by fishermen around 1891 (Salvadori 1903 in Amadon 1953, Christy 1996, Jones & Tye 2006). It was held at the Museu Nacional de História Natural e da Ciência da Universidade de Lisboa, but almost certainly was lost in a huge fire in 1978 (J. Alves & R. Figueira in litt. 2018). J. G. C. & V. Correia collected four

Figure 1. Gulf of Guinea Storm Petrel Hydrobates cf. castro distribution maps (background world map: Sandvik 2019). (a) global distribution of Band-rumped Storm Petrel H. castro. At-sea distribution shown in green (Howell & Zufelt 2019) and breeding colonies by circular symbols: white—one distinct seasonal population, grey—two distinct seasonal populations, black—protracted breeding season (Friesen et al. 2007). The red rectangle indicates the Gulf of Guinea. (b) At-sea observations in the Gulf of Guinea. Letter codes explained in Table 1. The green rectangle indicates São Tomé. (c) Observations on São Tomé. Numeric codes explained in Table 1. Grey lines in the background = 100 m altitudinal isolines; the thick black line = borders of Obô Natural Park; and the thin black line = border of the park’s buffer zone.
### TABLE 1
Observations of band-rumped storm petrel *Oceanodroma cf. castro* in the Gulf of Guinea. Under Location, the general locality is provided in parentheses: ST = São Tomé, PR = Príncipe, GG = Gulf of Guinea, and the subsequent numbers and letters indicate the codes used in the maps.

| Date       | Type of encounter | Location                      | Observations                                                                                                                | Source                  |
|------------|-------------------|-------------------------------|---------------------------------------------------------------------------------------------------------------------------|-------------------------|
| c.1891     | Captured          | ‘far offshore’ (ST)           | Acquired by J. V. Barbosa du Bocage from Angola fishermen; presumed lost in 1978, during a fire at the Museu Nacional de História Natural e da Ciência da Univ. de Lisboa | J. Alves & R. Figueira in litt. |
| 15 Nov 1928| House lights (captured) | Roça Jou (ST-1, c.150 m)       | Adult female: plumage slightly worn and gonads small                                                                     | Correia diaries 1928-29 |
| 10 Dec 1928| House lights (captured) | Roça Jou (ST-1)                | Juvenile male: fresh plumage and gonads small; adult male: plumage slightly worn and gonads swollen                       | Correia diaries 1928-29 |
| 14 Dec 1928| House lights (captured) | Roça Jou (ST-1)                | Adult male: plumage slightly worn and gonads large                                                                       | Correia diaries 1928-29 |
| 24 Mar 1997| Chum              | 8–19 km east of Santana (ST-A) | 11                                                                         | Monteiro et al. (1997)  |
| 18 Jul 1997| At sea (visual)   | Near Tinhosas (PR-B)          | One in flight at 13.30 h                                                | Monteiro et al. (1997)  |
| 23 Jul 1997| Chum (visual)     | (ST-A)                        | 20—one adult caught and measured (Table 2) had a fully bare brood patch                                                   | Monteiro et al. (1997)  |
| 29 Jul 1997| Chum (visual)     | (ST-A)                        | Five                                                                      | Monteiro et al. (1997)  |
|            | House lights      | Pousada da Boa Vista (ST-2, c.800 m) | One, between Príncipe and Tinhosas                                      | Jones & Tye (2006)      |
| 3 Sep 2001 | Sight             | (PR)                          | In flight                                                                  | J. Drummond (eBird)     |
| Apr 2009   | Aural             | Nova Moka (ST-2, c.800 m)     | Adult: plumage slightly worn (Figs. 14–15, c.400 m)                                                                      | RFL                     |
| 12 Aug 2009| Camp lights (captured) | Monte Carlo camping site (ST-3) | Adult: plumage slightly worn (Figs. 14–15, c.400 m)                                                                      | N. Borrow et al.        |
| 6 Apr 2011 | At sea (visual)   | (GG- C)                       | Seen at 14.50 h, 11 m above sea level, from the bridge of the small cruiser MV Prince Albert II (now MV Silver Explorer). 51 total: 31 not determined, 12 not in moult (Figs. 6, 7, 12), six moult (see text; Figs. 6, 8-13) | RLF & WHW               |
| 13 Sep 2013| Flushed (visual)  | Vieira Machado (ST-4, 373 m)   | One caught in a liana, in native forest at 12.42 h                                                                         | RFL & A. Santana        |
| 1–19 Jun 2015| Visual           | Cambumbé (ST-5, 861 m)        | At least six in native forest, at 18.50 h                                                                                | A. Santana              |
| 21 Sep 2015| Aural             | Monte Carlo (ST-3)            | Several heard in native forest, flying above the canopy after sunset                                                     | RFL (eBird)            |
| 11 Dec 2015| Visual            | Mesa do Pico (ST-6, c.1,900 m) | One in flight                                                             | A. Coelho & G. Oquiongo |
| 28 Mar 2016| Aural             | Macambrará (ST-7, c.1,300 m)   | One vocalising in flight above the canopy of secondary forest                                                            | RFL (eBird)            |
| 2 Aug 2016 | Aural             | Monte Carlo camp site (ST-3)   | One heard in native forest, flying above the canopy at 19.20 h                                                          | RFL (eBird), PV         |
| 8–10 Aug 2016| Aural            | Cambumbé (ST-5)               | Several                                                                   | PV et al.               |
| 10–13 Aug 2016| Aural            | Monte Carlo camp site (ST-3)   | Several                                                                   | PV et al.               |
| 21 Sep 2016| Aural             | Macambrará (ST-7)             | Several                                                                   | MM                      |
| 20 Jan 2017| Chum              | (PR)                          | None recorded                                                              | Bollen et al. (2018)    |
| 4 Feb 2017 | ? (PR-D)          |                               | Two                                                                       | B. Bronkhorst, in Bollen et al. (2018) |
| 5 Aug 2017 | Aural             | Monte Carlo camp site (ST-3)   | 25                                                                        | J. Smith (eBird)        |
Figures 2–4. Four specimens of Gulf of Guinea Storm Petrel *Hydrobates* cf. *castro* collected by J. G. C. & V. Correia, at Roça Jou, São Tomé, 15 November–14 December 1928, now at the American Museum of Natural History (AMNH), New York, left to right (above) and top to bottom (right): AMNH 268390, AMNH 268388, AMNH 268387 and AMNH 268389; note prominent buff ulnar bars, relatively small white ‘rump patch’, and the relatively large size and dark plumage of AMNH 268390 (Angus Wilson & Robert L. Flood).
specimens at Roça Jou, in the south-west of São Tomé in late 1928 (Location 1 in Fig. 1c, Table 1). The birds entered a house at night, during heavy rain and thunderstorms, attracted by lights; the skins are at the American Museum of Natural History, New York (Figs. 2–4).

At-sea observations.—In 1997, three chumming sessions east of Santana, São Tomé, recorded Gulf of Guinea Storm Petrel, of which one was caught using a net (Location A in Fig. 1b, Tables 1–2). The same year one was observed in flight near the Tinhosas Islands (Location B in Fig. 1b, Table 1; Monteiro et al. 1997). In 2011, 51 Gulf of Guinea Storm Petrels were recorded midway between Príncipe and Benin, at the edge of the continental shelf, including 18 rafting birds (Location C in Fig. 1b, Table 1, Figs. 5–13). In 2017, none was found near Príncipe’s 100 m-depth contour during two chumming sessions, but two were seen near Príncipe at the 1,000 m contour (Location D in Fig. 1b, Table 1; Bollen et al. 2018).

We add a caveat for records without documentation, as black-and-white storm petrels are notoriously difficult to identify at sea and safe identification requires an experienced eye or good photographs (Flood & Fisher 2013). It is thus possible that Gulf of Guinea Storm Petrel and migrant black-and-white storm petrel species reported in the region have sometimes been confused: Wilson’s Storm Petrel Oceanites oceanicus, European Storm Petrel Hydrobates pelagicus, Leach’s Storm Petrel H. leucorhoa and Black-bellied Storm Petrel Fregetta tropica (Christy & Clarke 1998, Jones & Tye 2006, Dowsett et al. 2017). It is also possible that representatives from other populations of the band-rumped storm petrel complex visit the region.

Observations on the islands and potential breeding sites

There are multiple strong indications that band-rumped storm petrels breed in the Gulf of Guinea, but no conclusive proof (Fig. 1, Table 1; Jones & Tye 2006). It had been suggested that Gulf of Guinea Storm Petrel could nest on the islets around São Tomé and Príncipe (Amadon 1953, Harris 1969, Williams 1984, Christy 1996). However, instead of evidence of breeding, surveys found an abundance of predatory land crabs Johngarthia weileri that would pose a threat to nesting storm petrels (Monteiro et al. 1997, Valle et al. 2016, Bollen et al. 2018). Nevertheless, it would be prudent to resurvey all of the islets.

Gulf of Guinea Storm Petrel probably breeds on the main islands, and most evidence points to nesting on São Tomé (Naurois 1983, Monteiro et al. 1997). In addition to the Correias’ specimens, collected in south-west São Tomé, storm petrels have been attracted to the lights of the hostel Pousada Boa Vista, in the centre of the island (Banko et al. 1991, Monteiro et al. 1997), and to the lights of the EMOLVE palm oil factory, in the south-east of

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**TABLE 2**

Gulf of Guinea Storm Petrel Hydrobates cf. castro measurements (mm). Measurements of the 1928 birds (Amadon 1953, Harris 1969) were slightly amended following cross-checks with the museum specimens (RLF). Method for measuring the ‘rump patch’ is described in the text. The 1997 individual had the following additional measurements: head to bill tip 40.1 mm, bill depth at nostrils 6.9 mm and bill depth at gonys 5.5 mm (Monteiro et al. 1997).

| AMNH reg. no. | Date       | Sex / age | Wing | Bill | ‘Rump patch’ |
|---------------|------------|-----------|------|------|--------------|
| 268390        | 15 Nov 1928| Female    | 171  | 16.8 | 26           |
| 268387        | 10 Dec 1928| Male      | 156  | 17.0 | 24           |
| 268388        | 10 Dec 1928| Male      | 160  | 17.3 | 25           |
| 268389        | 14 Dec 1928| Male      | 160  | 15.5 | 25           |
| n/a           | 23 Jul 1997| -         | 165  | 16.3 | -            |

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Figures 5–13. Gulf of Guinea Storm Petrels *Hydrobates* cf. *castro*, midway between Principe and Benin, at the edge of the continental shelf, 6 April 2011. The raft in Figs. 5–6 had 17 birds. Note the narrow white ‘rump patch’. In Fig. 7, note the prominent ulnar bars in what appears to be relatively fresh plumage and the suggestion of a notched tail tip. In Figs. 8–9 note the early stages of primary moult with pp3/4–p10 old, worn plumage evident in the abraded tips to the outer primaries and untidy ulnar bars, thigh patch, and square tail tip. In Figs. 10–11, the dark replaced inner primaries contrast strongly with the old bleached and worn pp6/7–10. In Figs. 12–13, the moulting bird is almost midway through primary moult with pp7–10 old (William H. Wagstaff).

the island (R. Fonseca *in litt*. 2018). Since 2009, further evidence that reaffirms the likelihood of breeding on São Tomé comprises mostly nocturnal aural records near rugged terrain covered by native forest (Fig. 1c, Table 1). In addition, one was trapped and photographed
Evidence is scant that Gulf of Guinea Storm Petrel breeds on other islands. Surveys for nocturnal birds on Principe found no evidence of it (PV & MM pers. obs.). On Annobón, a ‘black bird a little smaller than White-capped Noddy Anous minutus’ was said to have ‘its abode’ in the interior (Barrena 1911, Basilio 1957). However, the few ornithological studies

in native forest near Monte Carmo, in south-central São Tomé, presumably attracted to camp lights (Location 3 in Fig. 1c, Figs. 14–16). Since then, Gulf of Guinea Storm Petrel has been recorded regularly at this location and in the environs (Table 1).

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on this small island have found no evidence of breeding storm petrels (Jones & Tye 2006, Sloan 2017). A survey of Bioko is required.

Breeding in mountainous equatorial forests, perhaps on inland cliffs as suggested above, would be quite unique among band-rumped storm petrels. In the Atlantic Ocean, there is some evidence of inland breeding in the Cape Verdes (Hazevoet 1995; V. Bretagnolle in litt. 2019), although they typically nest at low elevations in relatively barren rocky and boulder-strewn areas, in crevices, under lava scree, in the remains of walls, and in burrows constructed by White-faced Storm Petrels Pelagodroma marina (Hazevoet 1995, Bolton et al. 2008; RLF pers. obs.). At several locations, invasive predators restrict breeding to offshore islets and rock stacks. In the Pacific Ocean, breeding occurs in the equatorial Galápagos Islands in crevices and burrows (Swash & Still 2005, Smith & Friesen 2007), and in the tropical Hawaiian Islands in crevices within a cinder cone caldera and sparsely vegetated steep cliffs, with small groups breeding in wetter more vegetated areas (Raine et al. 2017, Galase 2019).

Seasonality

Gulf of Guinea Storm Petrel is present in the region year-round, both at sea and on land (Table 1, Fig. 17). It is present off all oceanic islands and has been observed over the Guinea Rise on which the islands are situated (Fig. 1, Table 1; Robins 1966, Harrison & Steele 1989). Local fishermen report that black-and-white storm petrels are commoner at sea during the long dry season, between mid May and early September (Monteiro et al. 1997, Bollen et al. 2018). However, research into seasonality is minimal and so we draw upon two indicators of breeding season—nesting condition and primary moult.

**Breeding condition.**—The Gulf of Guinea Storm Petrel captured east of São Tomé on 23 July 1997 had a fully bare brood patch (Monteiro et al. 1997). Two of the specimens at Roça Jou on 10 and 14 December 1928 had swollen / enlarged gonads. These observations, together with records year-round (Table 1, Fig. 17), indicate either a protracted breeding season or two distinct nesting seasons: one around December, during the wet season, and the other around July, during the long dry season.

**Primary moult.**—Adult band-rumped storm petrels undertake a complete post-breeding moult that commences at a late stage during chick rearing, while juveniles undertake their first complete moult c.10 months post-fledging, approximately two months earlier than adults (Howell 2010, 2012, Flood & Fisher 2013). The ten primaries are replaced sequentially from the innermost to the outermost (from p1 to p10) and grow at a steady rate (Flood & Fisher 2013, Ryan 2014). Six of the 18 birds photographed at sea between Príncipe and Benin on 6 April 2011 were in primary moult (Table 1). Progress of primary moult is staggered—pp3/4–p10 old, pp6/7–p10 old, p7–p10 old, p9–p10 old, and p10 old—and consistent with a protracted breeding season. Primary moult consistent with two distinct nesting seasons would be synchronised. For example, in the Gulf Stream, off North Carolina, in May–June 80–90% of band-rumped storm petrels have just 3–4 old outer primaries, while the other 10–20% are not in primary moult (respectively, cool- and hot-season breeders from Macaronesia) (Howell 2012). We do not know if the primary moult of the 12 non-mouling birds was staggered or synchronised because the photographs are
of insufficient quality to assess plumage wear—from fresh to heavily worn—necessary to
gauge duration since completing moult.

The end of the breeding season of an adult Gulf of Guinea Storm Petrel can be estimated
from its progress in primary moult (Howell 2012, Flood & Fisher 2013). Fifty percent of the
primary mass is in the outermost three primaries (p8–p10) meaning that primary moult
is c.25% complete when it reaches p5, halfway when it reaches p8, and a little over three-quarters by the time it reaches p10. Band-rumped storm petrels might take c.24 weeks to
complete primary moult based on the timeframe within which entire populations moult
(e.g. Bolton et al. 2008). Accordingly, when a bird starts moulting p8 it has concluded its
breeding c.12 weeks earlier.

Based on the above parameters and assuming moulting birds were adults, the range
for the end of breeding season for these birds is from late November to late February
(6–22 weeks prior to 6 April). If the moulting birds were juveniles, the range for the end of
fledging is between late September and late December. Both calculations coincide with the
dates of the juvenile collected by the Correias on 10 December. Reasonable adjustments to
‘24 weeks’ do not result in significantly different estimates.

**Morphology**

Band-rumped storm petrel populations in the Atlantic Ocean are poorly differentiated
morphologically, and the main characters that separate them are depth of the white ‘rump
patch’ and thigh patches, the tone of dark feathers not attributable to the ageing process,
depth of tail notch / fork, body mass, the length of the bill, tarsus, wing and tail, as well as
voice (Bolton et al. 2008, Robb et al. 2008, Shirihai 2009, Flood & Fisher 2013). Typically, hot-
season birds are fork-tailed and tend to have greater body mass, longer and deeper bills, and
longer wings (Deane 2011).

Depth of the white ‘rump patch’ is the percentage of the length of the tail that is
white, measured along the mid-dorsal line of the tail. The white ‘rump patch’ of specimens
collected by the Correias is exceptionally shallow for band-rumped
storm petrels, with a mean depth 25% (Figs. 2, 4) vs. 32.3–38.3% in
populations globally (Harris 1969). This depth is borne out in birds
photographed in the Gulf of Guinea (Figs. 5–14).

Depth of the white ‘thigh patch’ is measured by calculating
how far it extends from the fold over of the ‘rump patch’ towards
the mid-ventral line of the underparts. Depth of the thigh patch is
c.50%, similar to Macaronesian band-rumped storm petrels, but
much less than the estimated 80% or more in birds breeding in
April on Ascension and St Helena (RLF pers. obs.).

Photographs of Gulf of Guinea Storm Petrels mainly show square-ended tails (Figs. 5–14), unlike Atlantic Ocean hot-season
taxa (Deane 2011). A photograph from March and another from
April suggest a notch in the tail tip, although this could be an effect
of angle (Figs. 7, 18).

We have measurements for just five Gulf of Guinea Storm
Petrels (Table 2). Mean wing length is 162.4 mm, or 160.25 mm
if we exclude the 171 mm of an exceptionally large adult female
(AMNH 268390). In either case, the mean wing length for Gulf
of Guinea Storm Petrel exceeds that of populations worldwide,
whose averages range from 147.2 mm to 156.5 mm (Harris 1969).
The long wing of AMNH 268390 (Amadon 1953) exceeds the

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longest-winged individuals from the Azores cool-season (166 mm, \(n = 129\)), Azores hot-
season (169 mm, \(n = 209\)), and Cape Verde populations captured in June (165 mm, \(n = 52\)),
and it is equalled only by the longest Cape Verde bird trapped in November (\(n = 85\)) (Bolton
et al. 2008, Deane 2011). AMNH 268390 is also darker in plumage than the other specimens
(Figs. 2–3). The mean bill length of Gulf of Guinea Storm Petrel is 16.6 mm, also exceeding
that of populations worldwide presented by Harris (1969), whose averages range from 14.4
to 15.5 mm, while V. Bretagnolle (in litt. 2019) reports that bill length of Gulf of Guinea
Storm Petrel lies within the upper range of 660 specimens of band-rumped storm petrels
he has measured.

Vocalisations

Study of the vocalisations of band-rumped storm petrels has contributed to our
understanding of the taxonomic relationships between distinct populations in the Atlantic
(Robb et al. 2008). On São Tomé, most aerial vocalisation was noted in June–September after

![Figure 19. Aerial vocalisation of Gulf of Guinea Storm Petrel Hydrobates cf. castro, near Monte Carmo, Obô
Natural Park, São Tomé, 9 August 2016 (19.25 h) (Philippe Verbelen). Short purring is visible between
seconds 1.0 and 2.0, before the chatter call starts. Reversed ‘v’ notes are visible in the mid-section between
seconds 2.5 and 3.0, and these are similar to the structure of chatter calls of Cape Verde Storm Petrels H.
jabejabe (cf. Fig. 22). XC473562.](image)

![Figure 20. Aerial vocalisation of Gulf of Guinea Storm Petrel Hydrobates cf. castro, Ribeira Peixe, Obô Natural
Park, São Tomé, 8 August 2016 (19:16 h) (Philippe Verbelen). The large number of notes in a downward spiral
at the end of the chatter call is similar to Cape Verde Storm Petrel H. jabejabe (M. Robb in litt. 2016). XC473563.](image)
nightfall, from around 18.15 h onwards and peaking at c.19.00 h. The birds were probably flying to nesting sites.

On 8–13 August 2016, we employed directional microphones in combination with headphones to sound-record flight calls and to locate potential nest sites. Storm petrels were heard calling intensively in the vicinity of Monte Carmo just above the canopy, along forested ravines, and within forested gullies where breeding is suspected (Fig. 16).

The aerial vocalisation of Gulf of Guinea Storm Petrels (Figs. 19–21) has three parts: the opening purr, a long middle section of chatters, and ends with a short flourish. However, there is considerable variation in aerial calls and only a few recordings capture aerial purring or the concluding flourish. Background noise made detailed interpretation of sonograms difficult. Nevertheless, an important observation is the notable similarity with the aerial vocalisation of Cape Verde Storm Petrel (Fig. 22).

Vocalisations of Cape Verde Storm Petrel include many more chatter notes than those published for other populations of band-rumped storm petrel (Robb et al. 2008). Also, the climax of pitch and intensity in Cape Verde Storm Petrel usually is reached during the long middle section, while the calls of other band-rumped storm petrels become louder at the end (Robb et al. 2008). Gulf of Guinea Storm Petrel vocalisations appear to share the distinct
features of Cape Verde Storm Petrel. Purring calls recorded at burrow nest sites have proven important when comparing vocalisations of band-rumped storm petrels (Robb et al. 2008), but no nest of Gulf of Guinea Storm Petrel has been found. A selection of our Gulf of Guinea Storm Petrel sound-recordings are available on www.xeno-canto.org.

Taxonomy

Band-rumped storm petrels were treated as monotypic for many years (Cramp & Simmons 1977, Warham 1990, Brooke 2004). Recently, significant genetic structure and restricted gene flow have been recorded in Atlantic populations (Friesen et al. 2007). Gulf of Guinea Storm Petrel might represent an unnamed taxon (Jones & Tye 1988). The differences in the principal morphological characters from those of other band-rumped storm petrel populations support this hypothesis (Harris 1969). Similarities between the aerial vocalisations of Gulf of Guinea Storm Petrel and Cape Verde Storm Petrel suggest some taxonomic affinity. Several island groups in the Atlantic hold taxonomically distinct allochronous populations (Friesen et al. 2007, Silva et al. 2016), and we do not discard this possibility for Gulf of Guinea Storm Petrel, especially given evidence of a prolonged breeding season. Proof that Gulf of Guinea Storm Petrel represents a different taxon requires additional evidence from morphology, vocalisations and genetics.

Conclusion

The Gulf of Guinea oceanic islands are relatively small, but support an exceptionally large number of endemic bird species (Stattersfield et al. 1998). Like so many other oceanic islands, their biodiversity faces a variety of threats, including habitat loss, over-exploitation, and introduced invasive and predatory species (Jones et al. 1991, Ndang’ang’a et al. 2014). Add to this the tiny potential breeding range and Gulf of Guinea Storm Petrel, if classified taxonomically, will almost certainly qualify as threatened (Gascoigne 1995).

The most concerning threat to the storm petrel is the large number of non-native mammals (Dutton 1994). Predatory Black Rats Rattus rattus and feral cats Felis catus are well known for their devastating impact on seabird colonies (e.g. Zino et al. 2001, Madeiros 2005, Pinet et al. 2009). Other introduced mammals—such as African Civet Civettictis civetta, feral pigs Sus scrofa and Mona Monkey Cercopithecus mona— are also likely to negatively impact the storm petrel. The problem is exacerbated by the presence of these species in the remote and mountainous terrain of potential breeding colonies, where conservation efforts will be challenging. Furthermore, legal protection given to the best-preserved forest under the Obô Natural Park remains largely ineffective (Lima et al. 2017).

The three most pressing issues for future work on Gulf of Guinea Storm Petrel are clarifying its taxonomy, locating breeding colonies and establishing the threats to those sites. Additionally, it is important to gain a better understanding of phenology and ecology, both at sea and on land, including dispersive and migratory behaviour, and to assess population size and conservation status.

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References:

Amadon, D. 1953. Avian systematics and evolution in the Gulf of Guinea: the J. G. Correia collection. Bull. Amer. Mus. Nat. Hist. 100: 393–452.

Banko, W. E., Banko, P. C. & David, E. 1991. Specimens and probable breeding activity of the Band-rumped Storm-petrel on Hawaii. Wilson Bull. 103: 650–655.

Barrena, N. 1911. La Isla de Annobón. Un paso para su conocimiento. Bull. Amer. Mus. Nat. Hist. 100: 393–452.

Bollen, A., Matilde, E. & Barros, N. 2018. An updated assessment of the seabird populations breeding at Príncipe and Tinhosas. Ostrich 89: 47–58.

Boulton, M., Smith, A. L., Gómez-Díaz, E., Friesen, V. L., Medeiros, R., Bried, J., Roscales, J. L. & Furness, R. W. 2008. Monteiro’s Storm-petrel Oceanodroma monteiri: a new species from the Azores. Ibis 150: 717–727.

Brooke, M. 2004. Albatrosses and petrels of the world. Oxford Univ. Press.

Carboneras, C., Jutglar, F. & Kirwan, G. M. 2019. Band-rumped Storm-petrel (Hydrobates castro). In del Hoyo, J., Elliott, A., Sargatal, J., Christie, D. A. & de Juana, E. (eds.) Handbook of the birds of the world Alive. Lynx Edicions, Barcelona (retrieved from https://www.hbw.com/node/52592 on 12 February 2019).

Christy, P. 1996. Ornithologie de São Tomé et de Príncipe. Unpubl. Rep. Agreco-CTFT.

Christy, P. & Clarke, W. V. 1998. Guía des oiseaux de São Tomé et Príncipe. ECOFAC, São Tomé.

Cramp, S. & Simmons, K. E. L. (eds.) 1977. The birds of the Western Palearctic, vol. 1. Oxford Univ. Press.

Dowsett, R. J., Atkinson, P. W. & Caddick, J. A. 2017. Checklist of the birds of Príncipe. http://www.africanbirdclub.org (accessed 2 January 2018).

Dutton, J. 1994. Introduced mammals in São Tomé and Príncipe: possible threats to biodiversity. Biodiver. Conserv. 3: 927–938.

Flood, R. L. & Fisher, E. A. 2013. North Atlantic seabirds: storm-petrels & Bulwer’s Petrel. Second edn. Pelagic Birds & Birding Multimedia Guides, Scilly.

Friesen, V. L., Smith, A. L., Gómez-Díaz, E., Bolton, M., Furness, R. W., González-Solis, J. & Monteiro, L. R. 2007. Sympatric speciation by allochrony in a seabird. Proc. Natl. Acad. Sci. USA 104: 18589–18594.

Galase, N. K. 2019. First confirmed Band-rumped Storm Petrel Oceanodroma castro colony in the Hawaiian Islands. Marine Orn. 47: 25–28.

Gascoigne, A. 1995. A lista vermelha de animais ameaçados de São Tomé e Príncipe. ECOFAC, São Tomé.

Harris, M. P. 1969. The biology of storm-petrels in the Galápagos Islands. Proc. Calif. Acad. Sci. (4)37: 65–166.

Harrison, M. J. S. & Steele, P. 1989. ICBP / EEC forest conservation mission to São Tomé and Príncipe, January–March 1989. Report on conservation education and training. International Council for Bird Preservation, Cambridge, UK.

Hazevoet, C. J. 1995. The birds of the Cape Verde Islands: an annotated check-list. BOU Check-list No. 13. British Ornithologists’ Union, Tring.

Howell, S. N. G. 2010. Molt in North American birds. Houghton Mifflin Harcourt, Boston & New York.

Howell, S. N. G. 2012. Petrels, albatrosses & storm-petrels of North America. Princeton Univ. Press.

Howell, S. N. G. & Zufelt, K. 2019. Oceanic birds of the world: a photo guide. Princeton Univ. Press.

Jones, P. J. & Tye, A. 1988. A survey of the avifauna of São Tomé and Príncipe. International Council for Bird Preservation, Cambridge, UK.

Jones, P. J. & Tye, A. 2006. The birds of Príncipe, São Tomé and Annobón: an annotated checklist. BOU Checklist No. 22. British Ornithologists’ Union & British Ornithologists’ Club, Peterborough.

Jones, P. J., Burlison, J. P. & Tye, A. 1991. Conservação dos ecossistemas florestais na República Democrática de São Tomé e Príncipe. IUCN, Gland.

Lima, R. F., Sampaio, H., Dunn, J. C., Cabinda, G., Fonseca, R., Oquiongo, G., Oquiongo, J., Samba, S., Santana, A., Soares, E., Viegas, L., Ward-Francis, A., Costa, L. T., Palmeirim, J. M. & Buchanan, G. M. 2017. Distribution and habitat associations of the Critically Endangered bird species of São Tomé Island (Gulf of Guinea). Bird Conserv. Intern. 24: 455–469.

Madeiros, J. 2005. Recovery plan for the Bermuda Petrel (Cahow) Pterodroma cahow. Dept. of Conservation Services, Bermuda.

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Monteiro, L. R., Covas, R., Melo, M. P., Monteiro, P. R., Jesus, P., Pina, N., Sacramento, A. & Vera Cruz, J. 1997. Seabirds of São Tomé e Príncipe: the taxonomic status of the storm petrel Oceanodroma castro and conservation of the whole community. Rep. to BP / BirdLife International / Fauna & Flora International Conservation Programme.

Naurois, R. de. 1983. Les oiseaux reproducteurs des îles de São Tomé e Principe: liste systématique commentée et indications zoogéographiques. Bonn. Zool. Beitr. 34: 128–148.

Ndang’ang’a, P. K., Ward-Francis, A., Costa, L., Lima, R. F., Palmeirim, J., Tavares, J., Buchanan, G., Carvalho, M., Melo, M., Dallimer, M. & Valle, S. 2014. International Action Plan for the conservation of Critically Endangered birds on São Tomé: 2014–2018. BirdLife International, Cambridge.

Pinet, P., Salamolard, M., Probst, J. M., Russell, J. C., Jaquemet, S. & Le Corre, M. 2009. Barau’s Petrel Pterodroma barauii: history, biology and conservation of an endangered endemic petrel. Marine Orn. 37: 107–113.

Raine, A. F., Boone, M., McKown, M. & Holmes, N. 2017. The breeding phenology and distribution of the Band-rumped Storm-petrel Oceanodroma castro on Kaua’i and Lehua Islet, Hawaiian Islands. Marine Orn. 45: 73–82.

Robins, C. R. 1966. Observations on the seabirds of Annobón and other parts of the Gulf of Guinea. Stud. Trop. Oceanography 4: 128–133.

Robb, M., Mullarney, K. & the Sound Approach. 2008. Petrels night and day. The Sound Approach, Poole.

Ryan, P. 2014. Moul: the cost of annual renewal. African Birdlife March / April: 36–42.

Sandvik, B. 2019. World Borders Dataset. http://thematicmapping.org/downloads/world_borders.php (accessed on 12 February 2019).

Shirihai, H. 2009. The Zino’s Petrel at sea expedition II – and the best pelagic birding in the Western Palearctic. Birding World 22: 204–218.

Silva, M. F., Smith, A. L., Friesen, V. L., Bried, J., Hasegawa, O., Coelho, M. M. & Silva, M. C. 2016. Mechanisms of global diversification in the marine species Madeiran Storm-petrel Oceanodroma castro and Monteiro’s Storm-petrel O. monteiroi: insights from a multi-locus approach. Mol. Phy. & Evol. 98: 314–323.

Sloan, B. 2017. Bird records from Annobón, Equatorial Guinea, October 2016, including the first Squacco Heron Ardeola ralloides. Bull. Afr. Bird Cl. 24: 209–212.

Smith, A. L. & Friesen, V. L. 2007. Differentiation of sympatric populations of the band-rumped storm-petrel in the Galapagos Islands: an examination of genetics, morphology, and vocalizations. Mol. Ecol. 16: 1593–1603.

Stattersfield, A. J., Crosby, M. J., Long, A. J. & Wege, D. C. 1998. Endemic Bird Areas of the world: priorities for biodiversity conservation. BirdLife International, Cambridge, UK.

Swash, A. & Still, R. 2005. Birds, mammals and reptiles of the Galapagos Islands. Second edn. Christopher Helm, London.

Valle, S., Barros, N., Ramírez, I. & Wanless, R. M. 2016. Population estimates of the breeding birds of the Tinhasos Islands (Gulf of Guinea), the only major seabird colony in the eastern tropical Atlantic. Ostrich 87: 209–215.

Warham, J. 1990. The petrels: their ecology and breeding systems. Academic Press, London.

Williams, A. J. 1984. Breeding distribution, numbers and conservation of tropical seabirds on oceanic islands in the South Atlantic Ocean. Pp. 393–402 in Croxall, J. P., Evans, P. G. H. & Schreiber, R. W. (eds.) Status and conservation of the world’s seabirds. International Council for Bird Preservation, Cambridge, UK.

Zino, F., Oliveira, P., King, S. & Buckle, A. 2001. Conservation of Zino’s Petrel Pterodroma madeira in the archipelago of Madeira. Oryx 35: 128–136.