Papéis Avulsos de Zoologia
Museu de Zoologia da Universidade de São Paulo

Volume 57(21):275-285, 2017
www.mz.usp.br/publicacoes
www.revistas.usp.br/paz
ISSN impresso: 0031-1049
ISSN *on-line:* 1807-0205

New range limit of the *Anopetia gounellei* (Aves: Trochilidae): state of art and a review on the updated area

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ABSTRACT

New technologies and the rapid amount of data help to improve and update the distribution of the species. Anopetia gounellei *(Broad-tipped Hermit, Trochilidae) is a poorly known hummingbird and has been recorded outside its formal range since 2009. Here we reviewed the records of the Broad-tipped Hermit, proposing new range limits and discussing the species ecoregional endemism. The species was recorded in a variety of vegetation, including caatinga and humid forest. Our updated range-limit suggest an increase of 80% from the previous range, exceeding the Caatinga limits, calling into question the endemism of the species to this biome, but confirming a close relationship with dry ecoregions in Brazil. Basic information about its biology is needed, and further studies about breeding and ecological requirements are recommended.*

Key-Words: Biome; Caatinga; Distribution; Endemism; Hummingbird-plant interaction.

INTRODUCTION

Species distribution and distributional range are popular topics in ecology today, helping to understand from community patterns to species biology (Collevatti *et al.,* 2013; Peischl *et al.,* 2015). In recent years, many studies have been developed to predict the consequences of climate and its impact on species range limits (Sunday *et al.,* 2012; Lenoir & Svenning, 2013). To address those studies, range limit information is commonly accessible through open databases such as BirdLife [www.birdlife.org], eBird [www.ebird.org] and GBIF [www.gbif.org]. These databases provide easy access to a large volume of data, and help to explore and understand global ecological patterns (Elith & Franklin, 2013; Silva *et al.,* 2014). However, due to the rapid pace of technological development and the increasing number of biological surveys, it is

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http://dx.doi.org/10.11606/0031-1049.2017.57.21

difficult to keep data on species distributional range updated and verified. This can affect studies that use these data, such as data on species diversity based on distribution models (Maldonado *et al.,* 2015).

The range limit of the hummingbird *Anopetia gounellei* (Boucard, 1891) is part of a large compilation of distribution maps and an example of the aforementioned problem. The species seems to be restricted to the northeastern Brazil, based on its range limits (BirdLife International, 2015). However, in 2002, the species was recorded in southeastern Brazil (16°23'S, 43°24'W) (Vasconcelos *et al.,* 2006), and in 2009 Araujo recorded the species in northeastern areas outside its range (07°28'15"S, 36°52'51"W). Additionally, the current conservation status of *A. gounellei* is least-concern, which could be a consequence of the lack of information about its population size, range size, or habitat quality (Hinkelmann *et al.,* 2015).

Anopetia gounellei is the only species representative of the subfamily Phaethornitinae restricted to the dry region of northeastern Brazil (Silva *et al.,* 2003; Hinkelmann *et al.,* 2015). Although not well-known (Hinkelmann *et al.,* 2015), the species may be the major pollinator of semiarid plants (*see* Demetrio, 2008; Neves *et al.,* 2011) and may contribute to floral maintenance (Ashman *et al.,* 2004; Aguilar *et al.,* 2006).

Considering available information about *A. gounellei* we are concerned about the consequences of the obsolete information available about its distribution. Therefore, our main objective is to conduct a review about this species and its distribution range limits. Further, this review discusses the species' endemism to the Caatinga ecoregion as commonly mentioned in the literature (*e.g.,* Cracraft, 1985; Stotz *et al.,* 1996; Pereira *et al.,* 2014).

MATERIAL AND METHODS

Data searching and literature review

We did an extensive literature review to update the distribution and ecological information of *A. gounellei.* The review process involved searching academic databases such as Google Scholar, Periódicos CAPES, Scielo, Science Direct and Scopus, using the following keywords, *"Phaethornis gounellei", "Anopetia gounellei",* "Broad-tipped Hermit" and "Rabo-branco-de-cauda-larga". The search period ranged from 1891 to 2015. We also included literature that was not identified through the database search, but of which we had previous knowledge. All records were examined and divided according to subject groups: bird surveys, the hummingbird-plant relationship – including pollination, taxonomy/phylogeny, reproduction, and 'other'. We searched these studies for information about reproduction, taxonomy and phylogeny, feeding behavior, plants visited, recorded climate and altitude, seasonality, and tolerance to human disturbance.

The records were gathered from the literature as well as from Centro Nacional de Pesquisa e Conservação de Aves Silvestres (CEMAVE), eBird (eBird, 2015) – only data approved by the eBird quality process –, from senior birdwatchers, and from the following scientific collections: Heretiano Zenaide (Universidade Federal da Paraíba), Museu Paraense Emilio Goeldi, Universidade Federal de Pernambuco, Museu de Zoologia da Universidade Estadual de Campinas, Fonoteca Neotropical Jacques Vielliard, Museu de Zoologia da Universidade de São Paulo, Museu de Zoologia da Universidade Estadual de Feira de Santana.

Data analysis

Based on the coordinates obtained from the database search and literature review we built a new range map for the species using the Geographic Information System (GIS) approach; analyses were performed in ArcGis 10.1 (ESRI, 2012). The GIS consisted of the political delimitation of Caatinga biome (MMA, 2015), the terrestrial ecoregions of the world (Olson *et al.,* 2001), the range limit of *A. gounellei* (BirdLife International, 2015) and the coordinates where the presence of *A. gounellei* was recorded. First, we generated buffers with 30 km for each recorded presence, as this is the maximum flight distance recorded for hummingbirds in a day (Sick, 1997); after that, we created a minimum convex polygon (MCP) using the same presence records. The MCP was then smoothed and approached the presence buffers to create the updated range limit (UR).

The UR area was compared with the old range limit (OR) area, and then the Caatinga ecoregion and biome. Further, we examined the ecoregion category of each presence record, and calculated the preponderance of presences according to each ecoregion using the bootstrapping resample technique (10,000 replicates) to avoid bias. The ecoregions were then classified as dry (Atlantic dry forest, Caatinga, Campo rupestre, Cerrado) or humid (Bahia coastal forest, Bahia interior forest, Caatinga enclaves moist forest, Maranhão babaçu forest, Pernambuco interior forest) to analyze the frequency of *A. gounellei* records.

RESULTS AND DISCUSSION

We identified 80 documents mentioning *A. gounellei.* However, 15 did not contain any specific information about *A. gounellei.* Of the 65 remaining documents (Appendix 1), 47 were research articles, 10 book chapters and eight thesis. When examined by subject area, the documents identified were categorized as bird surveys (36), hummingbird-plant relationship – including pollination (11), taxonomy/phylogeny (nine), reproduction (two), and other (seven).

Taxonomy and Phylogeny

Anopetia gounellei was discovered by Edmond Gounelle (Pacheco, 2003) and described as a new species by Boucard in 1891; synonyms for the species are *Phaethornis gounellei* and *Threnetes longicauda* (Cory, 1915; Hellmayr, 1929). The relation between *A. gounellei* and its sister taxon *Phaethornis* were the subject of some studies (Hinkelmann & Schumamnn, 1997; Hinkelmann & Van den Elzen, 2003; Piacentinni, 2011). In 1921, Eugène Simon described *gounellei* as part of the new genus *Anopetia.* Thereafter, the taxon *gounellei* was moved between *Phaethornis* and *Anopetia* (Peters, 1945; Hinkelmann & Schumamnn, 1997; Hinkelmann & Van den Elzen, 2003; Piacentinni, 2011). Among recent publications, we found a phylogeny in which *A. gounellei* is shown to be closest to *Phaethornis,* but not inside the genus (Hinkelmann & Van den Elzen, 2003). Years later, *gounellei* was recognized again as *Phaethornis* (Piacentinni, 2011). The most recent article about hummingbird phylogeny did not include *A. gounellei* (McGuire *et al.,* 2009; McGuire *et al.,* 2014), but it is considered a member of the Hermits hummingbird (Phaethornitinae (McGuire *et al.,* 2009). On main bird lists – South America Classification Committee (SAAC, Remsen *et al.,* 2016), Brazilian Committee of Ornithological Records (Piacentinni *et al.,* 2015), and International Union for Conservation of Nature and Natural Resources red list (IUCN, 2015) the species is named as *Anopetia gounellei.*

The Hummingbird-plant relationship

Similar to other hummingbirds, *A. gounellei* requires a great amount of energy to accommodate its high metabolism, and this energy comes from plant nectar (Sick, 1997). Of the 11 studies on the hummingbird/plant relationship, nine described the plants which *A. gounellei* visits (Table 1). The visited plants consisted of 13 families and 25 species, four of them not recognized on the species level – Acanthaceae, Bignoniaceae, *Capparis* sp. and *Pavonia* sp. (Vasconcelos *et al.,* 2006; Machado, 2009). The majority of plant species presented the pollination syndrome of ornithophily (12) followed by entomophily (six), chiropterophily (four) and sphingophily (one). The total nectar volume and sugar concentration ranged from 53-1997 µl and 11-50% respectively (Vogel *et al.,* 2005; Lucena, 2007). The phenology and flowering regime varied from continuous to short annual periods (Machado, 2009; Machado, 2014).

All the visits reported were legitimate visits in which the bird contacted the fertile parts of the flowers, and *A. gounellei* can be considered as the effective pollinator of *Camptosema pedicellatum* Benth, *Jatropha mutabilis* Benth and *Helicteres velutina* K. Schum. (Demetrio, 2008; Neves *et al.,* 2011). *Anopetia gounellei* was reported foraging as traplining (17 studies) and low reward traplining (Moura, 2012), flying large routes on its search for nectar (Feinsinger & Colwell, 1978). Intraspecific agonistic interaction was reported only once while feeding (Moura, 2012). The plant species as well as the floral traits can be found in Table 1; *Capparis* sp. (Capparaceae) was reported by Vasconcelos *et al.* (2006) with no further information.

The frequency of visits was reported for 22 plant species, but with different calculation methods. However, low frequency (equal or less than three visits per hour) seemed to be a pattern and is reasonable for trapliner hummingbirds such as *A. gounellei.* Therefore, we believe that plants with regular visits during one day, such as *Camptosema pedicellatum* (Demetrio, 2008), or visited with a relative frequency above 20% (*see* Table 1) are used as food sources.

A tube-like shape and conspicuous colors are traits commonly associated with the flowers that *A. gounellei* uses as a feeding source (Table 1) and these traits are normally related to the pollination syndrome of ornithophily (Faegri & Pijl, 1980). *Anopetia gounellei* showed no restriction concerning pollination syndromes, visiting and feeding in a large number of plant species and behaving as generalist (*see* Floral Traits on Table 1). We found no information about arthropod consumption by *A. gounellei,* which seems to be an important aspect of other hummingbird species in arid and semi-humid areas (Remsen *et al.,* 1986; Stiles, 1995).

In contrast to its traplining generalist behavior, *A. gounellei* acted as a legitimate visitor in all reported visits as well as for species exclusively pollinated by

TABLE 1: Reported plants visited by *Anopetia gounellei,* floral traits, and references. NA – states for no data.

FAMILY	SPECIES	FLORAL TRAITS	AUTHOR
Acanthaceae	*Anisacanthus brasiliensis* Lindau	Infundibular, red	Machado, 2009
Apocynaceae	*Prestonia coalita* (Vell.) Woodson	Tubular, yellow	Machado, 2009
Asteraceae	*Lychnophora salicifolia* Mart.	Campanulatete, blue	Machado, 2014
Bignoniaceae	*Piriadacus erubescens* (DC.) Pichon[F]	Tubular, red	Machado, 2009
	Pyrostegia venusta (Ker Gawl.) Miers	Tubular, orange	Machado, 2009
	Bignoniaceae sp.	Infundibular, pink	Machado, 2009
	Setilobus simplicifolius K. Schum.[F]	Campanulatete, yellow	Machado, 2009
Bromeliaceae	*Neoglaziovia variegata* (Arruda) Mez[F]	Pseudotubular, purple/red	Moura, 2012
Cactaceae	*Melocactus bahiensis* (Britton & Rose) Luetzelb.[H]	NA	Olmos & Albano, 2012
	Pilosocereus catingicola (Gürke) Byles & G.D. Rowley	Campanulate, white	Lucena, 2007
	Pilosocereus gounellei F.A.C. (Weber) Byles & G.D. Rowley	Tubular, white	Lucena, 2007
	Pilosocereus pachycladus F. Ritter[F]	Tubular, white	Lucena, 2007; Moura, 2012
	Micranthocereus flaviflorus Buining & Brederoo	Tubular, orange	Moura, 2012
Euphorbiaceae	*Jatropha mutabilis* Benth	Disk, red	Neves *et al.,* 2011
Fabaceae	*Camptosema pedicellatum* Benth[F]	Tubular, red	Demetrio, 2008
	Mimosa lewisii Barneby	Capitulate, green/white	Vogel *et al.,* 2005
	Calliandra sessilis Benth.	Paintbrush, white/red	Machado, 2014
Malvaceae	*Pavonia glazioviana* Gürke	NA	Olmos & Albano, 2012
	Pavonia sp.[F]	Pseudotubular, red	Machado, 2009
	Helicteres velutina K. Schum.[H]	Tubular, red	Demetrio, 2008; Machado, 2009
Passifloraceae	*Passiflora luetzelburgii* Harms[H,F]	Tubular, red	Moura, 2012
Rubiaceae	*Manettia cordifolia* Mart.	Tubular, red	Machado, 2014
Sapindaceae	*Serjania coradinii* Ferrucci & Somner	Disk, white	Machado, 2009

[H] – Species exclusively pollinated by hummingbirds.

[F] – Feeding resource: species visited regularly during one day or having relative frequency of visit above 20%.

hummingbirds, *Passiflora luetzelburgii, Helicteres velutina* and *Melocactus bahiensis* (Machado & Lopes, 2004). However, its role in the vegetation community is not clear and *A. gounellei* could be an important key to the semiarid ecological community, including human systems, since it plays a role closely related to vegetal reproduction.

Reproduction and associations

Information about reproduction of *A. gounellei* is scarce, consisting of only two nest reports and one description (Lima *et al.,* 2008; Lima *et al.,* 2010; Moura, 2012). The nest reports dated from February (Lima *et al.,* 2008; Lima *et al.,* 2010) and December (Moura, 2012). In a similar period other studies reported no molting or brood patch (November to December), and males were reported vocalizing at the same time, reminiscent of a reproductive display (December) (Roos *et al.,* 2006; Olmos & Albano, 2012). This information suggests a likely breeding season between December and February, since the nest reports are restricted to these months.

The nests were described as elongated and spindle shaped, and both of them had two eggs (Lima *et al.,* 2008; Lima *et al.,* 2010). The nest structures were attached beneath a leaf of *Cnidoscolus urens* (L.) Arthur (Euphorbiaceae) – a stinging plant; families such as Heliconiacea and Arecaceae are also used in the same way (Ruschi *apud* Lima *et al.,* 2008; Lima *et al.,* 2010). The nest descriptions, as well as the nest position, were similar to *Phaethornis* one, where the structure attached to the leaf underside causes a fold protecting the nest (Sick, 1997); this accounts for yet another characteristic that relates *A. gounellei* to the genus *Phaethornis* and could help in the discussion of genus.

Lima *et al.* (2010) also reported a parental behavior of *A. gounellei:* the male inspected the nest during the incubation period and also after hatching. An association with *Allodectes* mites was reported by Silva (2013) and once *A. gounellei* was reported use for hunting game (Teixeira *et al.,* 2014).

Human disturbances and forest dependency

The sensitivity to human disturbances and forest dependency of *A. gounellei* are mainly based on Stotz *et al.* (1996) and Silva *et al.* (2003). Stotz *et al.* (1996) does not address any of these issues in relation to *A. gounellei,* and Silva *et al.* (2003) report the species as forest-dependent, with a high sensitivity to human disturbance. On the other hand, some studies recorded the species occurrence in open or semi-open areas, as well as, with medium sensitivity and forest-independent (Willis, 1992; Roda & Carlos, 2004; Albano & Girão, 2008; Santos, 2008). Three studies reported *A. gounellei* flying in intermediate vegetation stratum, or understory (Stotz *et al.,* 1996; Machado, 2009; Silveira & Machado, 2012), and many others in areas close to human disturbance (Olmos *et al.,* 2005; Vasconcelos *et al.,* 2006; Farias, 2007; Dornelas *et al.,* 2012; Silva *et al.,* 2012). Three research articles discussed human disturbance specifically: two registered *A. gounellei* only in undisturbed areas and one recorded the species in both undisturbed and disturbed areas (Silva, 2009; Lyra-Neves *et al.,* 2012; Nunes & Machado, 2012).

None of the main references to sensitivity or forest dependency has a judicious source of knowledge or sufficient field observations to draw conclusions about the preferences of *A. gounellei.* Only Silva *et al.* (2003) provided a description of the levels of forest dependency, but how they assigned sensitivity is unclear. Thus, we considered the forest dependency description of Silva *et al.* (2003) and adapted it for sensitivity so that (1) high sensitivity: species that only occur in human-undisturbed environments; (2) low sensitivity: species that commonly occur in human-disturbed environments; (3) medium sensitivity: species that occur in a mix of human-disturbed and undisturbed environments.

High sensitivity and forest dependence are commonly assigned to *A. gounellei,* but recent field observations recorded the species on open and semi-open areas as well as on disturbed habitats. However, these presence records were always near forest or native vegetation patches (*see* Roda & Carlos, 2004; Albano & Girão, 2008; Nunes & Machado, 2012). Therefore, further studies must address this question, but at our best knowledge *A. gounellei* has medium sensitivity to human disturbances and it is semi-dependent on the forests.

Environmental conditions

In general, the studies reported a regional climatic condition; only two studies reported climatic conditions where *A. gounellei* is resident (Machado, 2009; Moura, 2012). They reported an annual mean temperature from 18°C to 22°C, and mean annual rainfall ranging from 700 mm to 1.300 mm. The climate classification varied among authors, field areas and classification systems. For the Köppen system we were able to find presence records on dry semiarid (Bsh), tropical with dry winter (Aw), tropical with dry summer (As) and humid tropical with dry winter and temperate summer (Cwb) (Sick *et al.,* 1987; Dornelas *et al.,* 2012; Machado, 2014; Ruiz-Esparza *et al.,* 2015) areas, and for the IBGE system the climate varied among semiarid, subtropical with moderate humidity and tropical with rainy summer (Neves *et al.,* 2011; Nunes & Machado, 2012; Las-Casas *et al.,* 2012a, b; Ruiz-Esparza *et al.,* 2012; Silva *et al.,* 2012; Silveira & Machado, 2012).

Anopetia gounellei was reported at many altitudes, from lowlands, 40-50 m high, to 1000-1191 m high (Olmos, 1993; Stotz *et al.,* 1996; Roda & Carlos, 2004; Vasconcelos & D'Angelo, 2007; Silva *et al.,* 2012; Sousa *et al.,* 2012; Pereira *et al.,* 2014). At the highest altitudes many studies reported more humid vegetation such as seasonal semi-deciduous forest and ombrophilous forest (Parrini *et al.,* 1999; Pacheco, 2003; Farias *et al.,* 2005; Albano & Girão, 2008; Demetrio, 2008; Santos *et al.,* 2012). Humid vegetation also appeared in lowlands (Silva, 2009; Silva *et al.,* 2012; Ruiz-Esparza *et al.,* 2015). However, the majority of vegetation recorded belongs to the caatinga type, ranging from shrubby caatinga to dense arboreal caatinga (Silva *et al.,* 2003; Olmos *et al.,* 2005; Leal *et al.,* 2006; Vasconcelos *et al.,* 2006; Farias, 2007; Araujo *et al.,* 2012; Olmos & Albano, 2012); cerrado and rocky fields were also reported but in a small number (Dornelas *et al.,* 2012; Machado, 2014; Pereira *et al.,* 2014).

Studies concerning seasonality of *A. gounellei* reported the species on caatinga and humid vegetation in both dry and rainy seasons, as well as resident and occasional (Olmos, 1993; Santos, 2004; Leal *et al.,* 2006; Santos *et al.,* 2012; Silva *et al.,* 2012; Silveira & Santos, 2012; Ruiz-Esparza *et al.,* 2015). We found only one seasonality record for cerrado-like vegetation which reported *A. gounellei* as occasional on an area close to caatinga, and during a severe drought (Machado, 2014).

The authors did not report weather conditions specifically of the field area or period, but instead reported general aspects of the region. Further, many studies reported *A. gounellei* as occasional and did not discuss the climatic aspect in detail, nor did they reveal the true climatic conditions when the record was made. For this reason, we were not able to determine the climatic conditions that limit *A. gounellei* occurrence. Detailed studies, such as niche modeling and natural history, are still necessary to explore the climate and altitude conditions that *A. gounellei* can endure.

Species range and ecoregions

A century after its discovery *A. gounellei* has been registered in the states of Piauí, Ceará, Bahia, and Minas Gerais (Cory, 1915; Simon, 1921; Sick *et al.,* 1987). In 2003 a new state was added, Pernambuco (Pacheco, 2003), and in the XXI century other states of northeastern Brazil were reported – Sergipe, Paraíba, Alagoas and Rio Grande do Norte (Araujo *et al.,* 2012; Diniz *et al.,* 2012; Lyra-Neves *et al.,* 2012; Silva *et al.,* 2012; Fernandes-Ferreira *et al.* 2014).

Only two attempts to update information on the range limit of *A. gounellei* were made: by Araujo in 2009 and by Piacentinni in 2011. However, there were no discussion or new limits traced for the range limit in their work. Our UR (data available upon request) expanded the occurrence area 76% (OR area 535,970 km^2, UR area 944,051 km^2), and occurrences from 2010 to 2015 were spread over the north-south and east-west limits (Fig. 1). When overlapped with the Caatinga biome and ecoregion limits, the UR revealed no restriction to these areas and surpasses them by 116,809 km^2 and 212,217 km^2, respectively (Fig. 2).

No information was found on *A. gounellei* population size, though it is considered uncommon despite its great number of records (Hinkelmann *et al.,* 2015). The species is resident and endemic of Brazil (Piacentinni *et al.,* 2015), but has been described as endemic of caatinga (Cracraft 1985; Grantsau, 1988; Stotz *et al.,* 1996; Parrini & Pacheco, 1997; Parrini *et al.,* 1999). Our analysis reveals that *A. gounellei* can be found beyond the ecoregion and biome Caatinga limit and in a variety of vegetation, and therefore can no longer be considered endemic of any Caatinga, whether biome, vegetation or ecoregion (Fig. 1 and Fig. 2) as accepted today.

The maps and analysis revealed that *A. gounellei* occurs mainly in dry ecoregions (bootstrap confidence interval: 178-186 records, $N = 192$ and $P = 0.05$), with the majority of records and range within Caatinga ecoregion (Fig. 2) – bootstrap confidence interval: 156-169 records, $P = 0.05$. It demonstrates that the reported caatinga endemism of *A. gounellei* is in fact a result of its close relationship with dry areas, and may have been misled due to the species' abundance inside the Caatinga limits or due to biased sample effort. Further, we want to stress here that the relationship to dry areas may not be restricted only to naturally dry areas, but also to dry areas caused by deforestation (Chakravarty *et al.,* 2012), where *A. gounellei* could act as an opportunist resulting in range expansion.

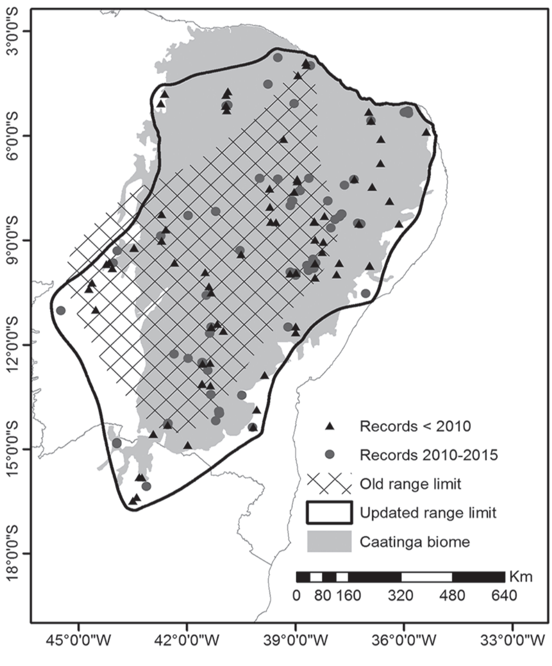

FIGURE 1: Updated distributional range of *Anopetia gounellei* overlaid with the older range limit, the Caatinga biome (by Ministério do Meio Ambiente, Brazil) and the presence records. The occurrence was expanded over 400.000 km^2 and records from 2010 to 2015 (the year after the first record outside the range limit) are spread over the north-south and east-west limits. It is possible to observe on the south and southwestern areas of the range many records outside the Caatinga biome limit

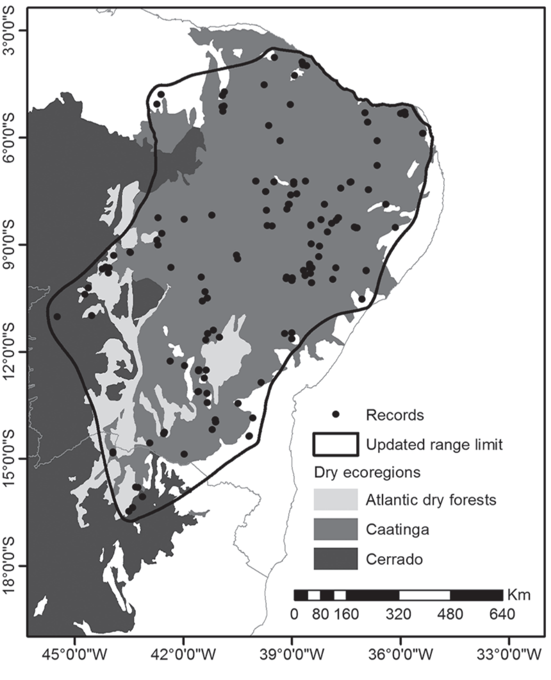

FIGURE 2: Updated distributional range limit of *Anopetia gounellei* overlapped with the dry ecoregions; others ecoregions were avoided for the sake of clarity. The range is not restricted to the Caatinga ecoregion, going beyond it by more than 212,000 km^2. However, few records are outside the dry ecoregion limits, and even they are close to their limits

However, this relation, as well as any climatic constrain of *A. gounellei,* requires further examination to be better understood.

The expansion of *A. gounellei* range limits reported here may be caused by the same reason the species was assigned as endemic – sample effort concentrated in easy access areas or bird hotspots (great richness and easy observation of birds). However, the majority of records date from 2000, and the expansion could also be a result of species' dispersion due to environmental suitability or stress (*see* Machado, 2014), climate change (*e.g.,* Henry, 2012; Ławicki, 2014) or population increase (*e.g.,* Guevara *et al.,* 2011). Further, the broad range and expansion, the variety of vegetation registered, and feeding on plant species with various traits all support the hypothesis that *A. gounellei* is a generalist and, potentially, a winner species (McKinney & Lockwood, 1999), which facilitates expansion. Detailed studies on species niche and historical records should be accessed to better understand the reasons for the expansion and the biological responses of *A. gounellei,* clarifying the main drivers of *A. gounellei* population dynamics and the true plant-hummingbird relation.

RESUMO

Devido ao rápido avanço da tecnologia e informação, é difícil manter dados sobre as espécies e suas áreas de ocorrência atualizados. O beija-flor Anopetia gounellei *(rabo-branco-de-cauda-larga) tem sido registrado fora dos seus limites de distribuição conhecidos desde de 2009. Fizemos aqui uma ampla revisão da literatura com o objetivo de atualizar sua área de ocorrência, com o intuito de propor um novo limite de distribuição e discutir o endemismo ecorregional. A maior parte da literatura tratava sobre levantamentos de Aves. Os principais aspectos abordados na revisão da literatura foram a taxonomia e as plantas visitadas. Diversos tipos de vegetações foram reportadas, incluindo tanto caatinga quanto vegetações úmidas. A área de ocorrência atualizada excedeu em 80% da área de ocorrência antiga.* Anopetia gounellei *foi principalmente reportado em ecorregiões secas. Os resultados não sustentam o endemismo de* A. gounellei *para a caatinga e confirmam uma relação muito próxima com ecorregiões secas. As informações biológicas sobre* A. gounellei *são escassas, sendo sua reprodução e seus limitantes ambientais áreas prósperas para estudos sobre sua conservação.*

Palavras-Chave: Bioma; Caatinga; Distribuição; Ecorregião; Endemismo; Interação planta/beija-flor.

ACKNOWLEDGMENTS

We are grateful to the Universidade Estadual de Feira de Santana and to the Program in Modelagem em Ciências da Terra e do Ambiente for the infrastructure and software processing support, and to Fundação de Amparo a Pesquisa do Estado da Bahia for the master's scholarship. In addition, we would like to thank the ornithologists Jean Júnior Barcik, Reinaldo Brito, Sérgio Cedraz, Pablo Cerqueira, Dira Coutinho, Fernando Flores, Marcelo Holderbaum, Jeremy Minns, Jefferson Bob, Marcos Crozariol, John Medcraft, Alex Mesquita, Sérgio Leal, Almir Távora and Francisco Sagot-Martins, the Grupo Ornitológico Potiguá and to the Centro Nacional de Pesquisa e Conservação de Aves Silvestres.

REFERENCES

Aguilar, R.; Ashworth, L.; Galetto, L. & Aizen, M.A. 2006. Plant reproductive susceptibility to habitat fragmentation: review and synthesis through a meta-analysis. *Ecology Letters,* 9:968-980.

Albano, C. & Girão, W. 2008. Aves das matas úmidas das serras de Aratanha, Baturité e Maranguape, Ceará. *Revista Brasileira de Ornitologia,* 16(2):142-154.

Araujo, H.F.P. 2009. Amostragem, estimativa de riqueza de espécies e variação temporal na diversidade, dieta e reprodução de aves em área de caatinga, Brasil. (*Ph. D. Dissertation*) Universidade Federal da Paraíba, João Pessoa.

Araujo, H.F.P.; Vieira-Filho, A.H.; Cavalcanti, T.A.A. & Barbosa, M.R.V. 2012. As aves e os ambientes em que elas ocorrem em uma reserva particular no Cariri paraibano, nordeste do Brasil. *Revista Brasileira de Ornitologia,* 20:365-377.

Ashman, T.-L.; Knight, T.M.; Steets, J.A.; Amarasekare, P.; Burd, M.; Campbell, D.R.; Dudash, M.R.; Johnston, M.O.; Mazer, S.J.; Mitchell, R.J.; Morgan, M.T. & Wilson, W.G. 2004. Pollen limitation of plant reproduction: ecological and evolutionary causes and consequences. *Ecology,* 85(9):2408-2421.

BirdLife International. 2015. *Species factsheet: Anopetia gounellei.* Available at: www.birdlife.org. Acessed in: 08/10/2015.

Boucard, A. 1891. Notes on rare species o humming birds and descriptions of several supposed new species in Boucard's museum. *The Humming Bird,* 1(3):17-18.

Chakravarty, S.; Ghosh, S.K.; Suresh, C.P.; Dey, A.N. & Shukla, G. 2012. Deforestation: causes, effects and control strategies. *In:* Akais, O.C. (Ed.). *Global perspectives on sustainable forest management.* InTech. p. 3-29. DOI.

Collevatti, R.G.; Lima-Ribeiro, M.S.; Diniz-Filho, J.A.F.; Oliveira, G.; Dobrovolski, R. & Terribile, L.C. 2013. Stability of Brazilian seasonally dry forests under climate change: inferences for long-term conservation. *American Journal of Plant Sciences,* 4:792-805.

Cory, C.B. 1915. Descriptions of new birds from South America and adjacent islands. *Field Museum of Natural History: Ornithological Series,* 1(8):301-302.

Cracraft, J. 1985. Historical biogeography and patterns of differentiation within the South American avifauna: areas of endemism. *Ornithological Monographs,* (36):49-84.

Demetrio, K.M. 2008. Fenologia e biologia reprodutiva de duas espécies ornitófilas do Parque Nacional do Catimbau, Buíque, PE. (*Ph. D. Dissertation*). Universidade Federal de Pernambuco, Recife.

Diniz, M.G.; Mazzoni, L.G.; D'Angelo-Neto, S.; Vasconcelos, M.F.; Perillo, A. & Benedicto, G.A. 2012. Historical synthesis of the avifauna from the rio São Francisco basin in Minas Gerais, Brazil. *Revista Brasileira de Ornitologia,* 20(3):329-349.

Dornelas, A.A.F.; Paula, D.C.; Santo, M.M.E.; Sanchez-Azofeifa, G.A. & Leite, L.O. 2012. Avifauna do Parque Estadual da Mata Seca, norte de Minas Gerais. *Revista Brasileira de Ornitologia,* 20(3):378-391.

eBird. 2015. *eBird: An online database of bird distribution and abundance* [web application]. Ithaca: Cornell Lab of Ornithology. Available at: www.ebird.org. Accessed in: 02/02/2015.

Elith, J. & Franklin, J. 2013. Species distribution modeling. *Encyclopedia of biodiversity,* 6:692-705.

ESRI (Environmental Systems Resource Institute). 2012. *ArcGIS 10.1.* California, ESRI, Redlands.

Faegri, K. & Pijl, L. 1980. *The principles of pollination ecology.* Oxford, UK, Pergamon Press.

Farias, G.B. 2007. Avifauna em quatro áreas de caatinga strictu senso no centro-oeste de Pernambuco, Brasil. *Revista Brasileira de Ornitologia,* 15(1):53-60.

Farias, G.B. 2009. Aves do Parque Nacional de Catimbau, Buíque, Pernambuco, Brasil. *Atualidades Ornitológicas,* (147):36-39.

Farias, G.B.; Girão, W.A.S. & Albano, C.G. 2005. Diversidade de aves em áreas prioritárias para a conservação da Caatinga. *In:* Araujo, F.S.; Rodal, M.J.N. & Barbosa, M.R.V. (Orgs.). *Análise das variações da biodiversidade do bioma Caatinga: suporte a estratégias regionais de conservação.* Brasília, Ministério do Meio Ambiente. p. 204-226.

Feinsinger, P. & Colwell, R.K. 1978. Community organization among Neotropical nectar-feeding birds. *American Zoologist,* 18:779-795.

Fenster, C.B.; Armbruster, W.S.; Wilson, P.; Dudash, M.R. & Thomson, J.D. 2004. Pollination syndromes and floral specialization. *Annual Review of Ecology, Evolution and Systematics,* 35:375-403.

Fernandes-Ferreira, H.; Nascimento, H.; Lima, D.C.; Gurgel-Filho, M. & Alves, R.R.N. 2014. História da zoologia no estado do Ceará parte I: vertebrados continentais. *Gaia Scientia,* 8(1):99-120.

Grantsau, R. 1988. *Os beija-flores do Brasil: uma chave de identificação para todas as formas de beija-flores do Brasil.* Rio de Janeiro, Expressão e Cultura.

Guevara, E.A.; Santander, T.G.; Mueces, T. & Pierre-Yves, H. 2011. Population growth and seasonal abundance of the neotropic cormorant (*Phalacrocorax brasilianus*) at highland lakes in Ecuador. *The Waterbirds Society,* 34(4):499-503.

Hartert, E. 1897. Various notes on humming-birds. *Ibis Series,* 39(3):423-435.

Hellmayr, C.E. 1929. A contribution to the ornithology of northeastern Brazil. *Field Museum of Natural History. Zoological Series,* 12:1-526.

Henry, P. 2012. Distributional and altitudinal range extensions for birds from Ecuador. *Boletín SAO,* 20(2):89-106.

Hinkelmann, C. & Schuchmann, K. 1997. Phylogeny of the hermit hummingbirds (Trochilidae: Phaethornithinae). *Studies on Neotropical Fauna and Environment,* 32:142-163.

Hinkelmann, C. & Van Den Elzen, R. 2003. Verwandtschaftsbeziehungen bei schattenkolibris (Gattung Phaethornis, Aves, Trochilidae), Ein Methodenvergleich. *Bonner Zoologische Beiträge,* 2:35-49.

Hinkelmann, C.; Kirwan, G.M. & Boesman, P. 2015. Broad-tipped hermit (*Anopetia gounellei*). *In:* Del Hoyo, J.; Elliott, A.; Sargatal, J.; Christie, D.A. & de Juana, E. (Eds.). *Handbook of the Birds of the World Alive.* Barcelona, Lynx Edicions. Available at: www.hbw.com. Accessed in: 21/02/2015.

IUCN. 2015. *The IUCN red list of threatened species.* Version 2014.3. Available at: www.iucnredlist.org. Accessed in: 03/02/2015.

Las-Casas, F.M.G.; Azevedo-Júnior, S.M. & Dias-Filho, M.M. 2012a. The community of hummingbirds (Aves: Trochilidae) and the assemblage of flowers in a caatinga vegetation. *Revista Brasileira de Biologia,* 72(1):51-58.

Las-Casas, F.M.G.; Azevedo-Júnior, S.M. & Dias-Filho, M.M. 2012b. Community structure and bird species composition in a caatinga of Pernambuco, Brazil. *Revista Brasileira de Ornitologia,* 20(3):302-311.

Ławicki, L. 2014. The Great White Egret in Europe: population increase and range expansion since 1980. *British Birds,* 107:8-25.

Leal, F.C.; Lopes, A.V. & Machado, I.C. 2006. Polinização por beija-flores em uma área de caatinga no município de Floresta, Pernambuco, nordeste do Brasil. *Revista Brasileira de Botânica,* 29(3):379-389.

Lenoir, J. & Svenning, J.C. 2013. Latitudinal and elevational range shifts under contemporary climate change. *Encyclopedia of Biodiversity,* 4:599-611.

Lima, P.C.; Grantsau, R.; Cássia, R.; Lima, F.R.; Lima-Neto, T.N.C. & Silva, L.E.S. 2010. Ninhos de espécies ameaçadas, endêmicas e outras de comportamento reprodutivo pouco conhecido, na pátria da Arara-Azul-de-Lear (Anodorhynchus Leari) (Psittaciformes: Psittacidae), destacando-se novos dados sobre o comportamento reprodutivo do besourinho-de-cauda-larga (*Phaethornis gounellei*) (Apodiformes: Trochilidae) a descrição do ninho da choca-do-nordeste (*Sakesphorus cristatus*) (Passeriformes: Thamnophilidae) e do jacucaca (*Penelope jacucaca*) (Galliformes: Cracidae). *Atualidades Ornitológicas,* (153):69-161.

Lima, P.C.; Silva, L.E.S. & Lima-Neto, T.N.C. 2008. Primeiro registro documentado do ninho de Phaethornis Gounellei (Boucard, 1891) na pátria da Anodorhynchus Leari (Bonaparte, 1858): uma homenagem aos 80 anos de Rolf Grantsau. *Atualidades Ornitológicas,* (141):18-19.

Lucena, E.A.R.M. 2007. Fenologia, biologia da polinização e da reprodução de Pilosocereus Byles & Rowley (Cactaceae) no nordeste do Brasil. (*Ph. D. Dissertation*). Universidade Federal de Pernambuco, Recife.

Lyra-Neves, R.M.; Azevedo-Júnior, S.M.; Telino-Júnior, W.R. & Larrazábal, M.E.L. 2012. The birds of the Talhado do São Francisco natural monument in the semi-arid brazilian northeast. *Revista Brasileira de Ornitologia,* 20(3):268-289.

Machado, C.G. 2009. Beija-Flores (Aves: Trochilidae) e seus recursos florais em uma área de caatinga da Chapada Diamantina, Bahia, Brasil. *Zoologia,* 26(2):255-265.

Machado, C.G. 2014. A comunidade de beija-flores e as plantas que visitam em uma área de cerrado ralo da Chapada Diamantina, Bahia, Brasil. *Bioscience Journal,* 30(5):1578-1587.

Machado, I.C. & Lopes, A.V. 2004. Floral traits and pollination systems in the Caatinga, a brazilian tropical dry forest. *Annals of Botany,* 94(3):365-376.

Maldonado, C.; Molina, C.I.; Zizka, A.; Persson, C.; Taylor, C.M.; Albán, J.; Chilquillo, E.; Ronsted, N. & Antonelli, A. 2015. Estimating species diversity and distribution in the era of big data: to what extent can we trust public databases? *Global Ecology and Biogeography,* 24:973-984.

Mcguire, J.A.; Witt, C.C.; Remsen Jr, J.V.; Corl, A.; Rabosky, D.L.; Altshuler, D.L. & Dudley, R. 2014. Report molecular phylogenetics and the diversification of hummingbirds. *Current Biology,* 24(8):910-916.

Mcguire, J.A.; Witt, C.C.; Remsen, J.V.; Corl, A.; Rabosky, D.L.; Altshuler, D.L. & Dudley, R. 2009. A higher-level taxonomy for hummingbirds. *Journal of Ornithology,* 150:155-165.

McKinney, M.L. & Lockwood, J.L. 1999. Biotic homogenization: a few winners replacing many losers in the next mass extinction. *Trends in Ecology and Evolution,* 14(11):450-453.

MMA (Ministério do Meio Ambiente). 2015. *Download de dados geográficos.* Available at: www.mapas.mma.gov.br/i3geo/datadownload.htm. Accessed in: 06/02/2015.

Moura, A.D.C. 2012. *Beija-flores (Aves: Trochilidae) e as plantas em que forrageiam em uma comunidade de caatinga de altitude da Chapada Diamantina, Bahia.* (*M. S. Dissertation*). Universidade Estadual de Feira de Santana, Feira de Santana.

Neves, E.L.; Machado, I.C. & Viana, B.F. 2011. Sistemas de polinização e de reprodução de três espécies de Jatropha (Euphorbiaceae) na caatinga, semi-árido do Brasil. *Revista Brasileira de Botânica,* 34(4):553-563.

Nunes, C.E.C. & Machado, C.G. 2012. Avifauna de duas áreas de caatinga em diferentes estados de conservação no Raso da Catarina, Bahia, Brasil. *Revista Brasileira de Ornitologia,* 20(3):215-229.

Olmos, F. 1993. Birds of Serra da Capivara National Park, in the 'caatinga' of north-eastern Brazil. *Bird Conservation International,* 3:21-36.

Olmos, F. & Albano, C. 2012. As aves da região do Parque Nacional Serra da Capivara (Piauí, Brasil). *Revista Brasileira de Ornitologia,* 20:173-187.

Olmos, F.; Silva, W.A.G. & Albano, C.G. 2005. Aves em oito áreas de caatinga no sul do Ceára e oeste de Pernambuco, nordeste do Brasil: composição riqueza e similaridade. *Papéis Avulsos de Zoologia,* 45(14):179-199.

Olson, D.M.; Dinerstein, E.; Wikramanayake, E.D.; Burgess, N.D.; Powell, G.V.N.; Underwood, E.C.; D'amico, J.A.; Itoua, I.; Strand, H.E.; Morrison, J.C.; Loucks, C.J.; Allnutt, T.F.; Ricketts, T.H.; Kura, Y.; Lamoreux, J.F.; Wettengel, W.W.; Hedao, P.H. & Kassem, K.R. 2001. Terrestrial ecoregions of the world: a new map of life on earth. *BioScience,* 51(11):933.

Pacheco, J.F. 2003. As aves da caatinga – uma avaliação histórica do conhecimento. *In:* Silva, J.M.C.; Tabarelli, M.; Fonseca, M.T. & Lins, L.V. (Orgs.). *Biodiversidade da Caatinga: áreas e ações prioritárias para a conservação.* Brasília, Ministério do Meio Ambiente. p. 187-250.

Paixão, R.M.C. 2012. *Avifauna da estação ecológica do Raso da Catarina, Bahia, Brasil.* (*Ph. D. Dissertation*). Universidade Estadual da Paraíba, João Pessoa.

Parrini, R. & Pacheco, J.F. 1997. Seis novos registros de aves para o estado de Minas Gerais. *Atualidades Ornitológicas,* 80:6.

Parrini, R.; Raposo, M.A.; Pacheco, J.F.; Carvalhães, A.M.P.; Melo-Júnior, T.A.; Fonseca, P.S.M. & Minns, J. 1999. Birds of the Chapada Diamantina, Bahia, Brazil. *Cotinga,* 11:86-95.

Peischl, S.; Kirkpatrick, M. & Excoffier, L. 2015. Expansion load and the evolutionary dynamics of a species range. *The American Naturalist,* 185(4):E81-E93.

Pereira, G.A. & Azevedo-Júnior, S.M. 2011. Estudo comparativo entre as comunidades de caatinga em Pernambuco. *Revista Brasileira de Ornitologia,* 19(1):22-31.

Pereira, G.A.; Medcraft, J.; Santos, S.S. & Fonseca-Neto, F.P. 2014. Riqueza e conservação de aves em cinco áreas de caatinga no nordeste do Brasil. *Cotinga,* 36:16-26.

Peters, J.L. 1945. *Checklist of birds of the world.* Cambridge, Harvard University Press.

Piacentinni, V.Q. 2011. *Taxonomia e distribuição geográfica dos representantes do gênero Phaethornis Swainson, 1827 (Aves: Trochilidae).* (*Ph. D. Dissertation*). Universidade de São Paulo, São Paulo.

Piacentinni, V. de Q.; Aleixo, A.; Agne, C.E.; Maurício, G.N.; Pacheco, J.F.; Bravo, G.A.; Brito, G.R.R.; Naka, L.N.; Olmos, F.; Posso, S.; Silveira; L.F.; Betini, G.S.; Carrano, E.; Franz, I.; Lees, A.C.; Lima, L.M.; Pioli, D.; Schunck, F.; Amaral, F.R. do; Bencke, G.A.; Cohn-Haft, M.; Figueiredo, L.F.A.; Straube, F.C. & Cesari, E. 2015. Annotated checklist of the birds of Brazil by the Brazilian Ornithological Records Committee/Lista comentada das aves do Brasil pelo Comitê Brasileiro de Registros Ornitológicos. *Revista Brasileira de Ornitologia,* 23(2):91-298.

Remsen, J.V.; Areta, J.I.; Cadena, C.D.; Claramunt, S.; Jaramillo, A.; Pacheco, J.F.; Pérez-Emán, J.; Robbins, M.B.; Stiles, F.G.; Stotz, D.F. & Zimmer, K.J. 2016. Version [29/07/2016]. *A classification of the bird species of South America.* American Ornithologists' Union. Available at: www.museum.lsu.edu/~Remsen/SACCBaseline.htm. Accessed in: 29/07/2016.

Remsen, J.V.; Stiles, F.G. & Scott, P.E. 1986. Frequency of arthropods in stomachs of tropical hummingbirds. *Auk,* 103:436-441.

Roda, A.S. & Carlos, C.J. 2004. Composição e sensitividade da avifauna dos brejos de altitude do estado de Pernambuco. *In:* Porto, K.C.; Cabral, J.J.P. & Tabarelli, M. (Eds.). *Brejos de altitude em Pernambuco e Paraíba história natural, ecologia e conservação.* Brasília, Ministério do Meio Ambiente. p. 211-228.

Roos, A.L.; Nunes, M.F.C.; Sousa, E.A.; Sousa, A.E.B.A.; Nascimento, J.L.X. & Lacerda, R.C.A. 2006. Avifauna da região do lago de Sobradinho: composição, riqueza e biologia. *Ornithologia,* 1(2):135-160.

Ruiz-Esparza, J.; Santos, C.S.; Cunha, M.A.; Ruiz-Esparza, D.P.B.; Rocha, P.A.; Beltrão-Mendes, R. & Ferrari, S.F. 2015. Diversity of birds in the Mata do Junco State Wildlife Refuge, a remnant of the Atlantic Forest of northeastern Brazil. *CheckList,* 11(3). DOI.

Ruiz-Esparza, J.M.; Rocha, P.A.; Ribeiro, A.S. & Ferrari, S.F. 2012. The birds of the Serra da Guia in the caatinga of Northern Sergipe. *Revista Brasileira de Ornitologia,* 20:290-301.

Santos, M.P.D. 2004. As comunidades de aves em duas fisionomias da vegetação de caatinga no estado do Piauí, Brasil. *Ararajuba,* 12(2):113-123.

Santos, M.P.D. 2008. Bird community distribution in a cerrado-caatinga transition area, Piauí, Brazil. *Revista Brasileira de Ornitologia,* 16(4):323-338.

Santos, M.P.D., Santana, A.; Soares, L.M.S. & Sousa, S.A. 2012. Avifauna of Serra Vermelha, southern Piauí, Brazil. *Revista Brasileira de Ornitologia,* 20(3):199-214.

Schunck, F.; Piacentini, V. de Q.; Souza, E.A. de; Sousa, A.E.B.A. de; Rego, M.A.; Albano, C.; Nunes, M.F.C.; Favaro, F. de L.; Neto, I.S.; Mariano, E.F.; Lima, D.M.; Las-Casas, F.M.G. de; Rodrigues, R.C. & Fonseca Neto, F.P. 2012. Birds of the lower middle São Francisco river. *Revista Brasileira de Ornitologia,* 20(3):350-364.

Sick, H. 1997. *Ornitologia Brasileira.* Rio de Janeiro, Editora Nova Fronteira.

Sick, H.; Gonzaga, L.P. & Teixeira, D.M. 1987. A arara-azul-de-lear, Anodorhynchus Leari Bonaparte, 1856. *Revista Brasileira de Zoologia,* 3(7):441-463.

Silva, D.P.; Gonzalez, V.H.; Melo, G.A.R.; Lucia, M.; Alvarez, L.J. & De Marco-Júnior, P. 2014. Seeking the flowers for the bees: integrating biotic interactions into niche models to assess the distribution of the exotic bee species Lithurgus huberi in South America. *Ecological Modelling,* 273:200-209.

Silva, H.M. 2013. *Ectoparasitos associados a aves de um fragmento de floresta estacional decidual no Rio Grande do Norte, Brasil.*

(*Ph. D. Dissertation*). Universidade Federal do Rio Grande do Norte, Natal.

Silva, J.M.C.; Souza, M.A.; Bieber, A.G.D. & Carlos, C.J. 2003. Aves da Caatinga: status, uso do habitat e sensitividade. *In:* Leal, I.R.; Tabarelli, M. & Silva, J.M.C. (Orgs.). *Ecologia e conservação da Caatinga.* Recife, Editora Universitária – Universidade Federal de Pernambuco. p. 237-274.

Silva, M.; França, B.R.A.; Irusta, J.B.; Souto, G.H.B.O.; Oliveira-Júnior, T.M.; Rodrigues, M.C. & Pichorim, M. 2012. Aves de treze áreas de caatinga no Rio Grande do Norte, Brasil. *Revista Brasileira de Ornitologia,* 20:312-328.

Silva, M.S. 2009. *Os efeitos das atividades antrópicas sobre as comunidades de aves na região do município de José de Freitas, Piauí, Brasil.* (*Ph. D. Dissertation*). Universidade Federal do Piauí, Teresina.

Silveira, L.F. & Santos, M.P.D. 2012. Bird richness in Serra das Confusões national park, Brazil: how many species may be found in an undisturbed caatinga? *Revista Brasileira de Ornitologia,* 20:188-98.

Silveira, M.H.B. & Machado, C.G. 2012. Estrutura da comunidade de aves em áreas de caatinga arbórea na bacia do rio Salitre, Bahia, Brasil. *Revista Brasileira de Ornitologia,* 20(3):161-172.

Simon, E. 1921. *Histoire naturelle des Trochilidae (Synopsis et Catalogue).* Paris, E. Mulo. p. 16-257.

Sousa, A.E.B.A.; Lima, D.M. & Lyra-Neves, R.M. 2012. Avifauna of the Catimbau National Park in the brazilian state of Pernambuco, Brazil: species richness and spatio-temporal variation. *Revista Brasileira de Ornitologia,* 20(3):230-245.

Stiles, F.G. 1995. Behavioral, ecological and morphological correlates of foraging for arthropods by the hummingbirds of a tropical wet forest. *The Condor,* 97(4):853-878.

Stone, W. & Roberts, H.R. 1934. Zoological results of the Matto Grosso expedition to Brazil in 1931: III. Birds. *Proceedings of the Academy of Natural Sciences of Philadelphia,* 86:363-97.

Stotz, D.F.; Fitzpatrick, J.W.; Parker III, T.A. & Moskovits, D.K. 1996. *Neotropical birds: ecology and conservation.* Chicago, The University of Chicago Press.

Sunday, J.M.; Bates, A.E. & Dulvy, N.K. 2012. Thermal tolerance and the global redistribution of animals. *Nature Climate Change,* 2(9):686-690.

Teixeira, P.H.; Thel, T.N.; Ferreira, J.M.R.; Azevedo-Júnior, S.M.; Telino-Junior, W.R. & Lyra-Neves, R.M. 2014. Local knowledge and exploitation of the avian fauna by a rural community in the semi-arid zone of northeastern Brazil. *Journal of Ethnobiology and Ethnomedicine,* 10:81. DOI.

Vasconcelos, M.F. & D'angelo-Neto, S. 2007. Padrões de distribuição e conservação da avifauna na região central da Cadeia do Espinhaço e áreas adjacentes, Minas Gerais, Brasil. *Cotinga,* 28:27-44.

Vasconcelos, M.F.; D'angelo-Neto, S.; Kirwan, G.M.; Bornschein, M.R.; Diniz, M.G. & Silva, J.F. 2006 Important ornithological records from Minas Gerais state, Brazil. *Bulletin of British Ornithologists' Club,* 126(3):212-238.

Vogel, S.; Lopes, A.V. & Machado, I.C. 2005. Bat pollination in the NE brazilian endemic Mimosa lewisii: an unusual case and first report for the genus. *Taxon,* 54(3):693-700.

Willis, E.O. 1992. Zoogeographical origins of eastern brazilian birds. *Ornitologia Neotropical,* 3(1):1-15.

Aceito em: 23/04/2017
Publicado em: 12/06/2017
Editor Responsável: Luís Fábio Silveira

APPENDIX 1

Table: Literature review of *Anopetia gounellei* by source and subject.

SOURCE	SUBJECT (QUANTITY)	REFERENCES
Authors	bird survey (4)	Sick *et al.,* 1987; Sick, 1997; Olmos & Albano, 2012; Araujo, 2009
	taxonomy/phylogeny (6)	Hartert, 1897; Cory, 1915; Simon, 1921; Hellmayr, 1929; Peters, 1945; Grantsau, 1988
	hummingbird-plant relation (2)	Moura, 2012; Machado, 2014
	reproduction (1)	Lima *et al.,* 2008
	other (1)	Stotz *et al.,* 1996
Periódicos CAPES	bird survey (1)	Santos *et al.,* 2012
	hummingbird-plant relation (1)	Las-Casas *et al.,* 2012a
Google Scholar	bird survey (31)	Stone & Roberts, 1934; Olmos, 1993; Parrini *et al.,* 1999; Pacheco, 2003; Silva *et al.,* 2003; Santos, 2004; Roda & Carlos, 2004; Farias *et al.,* 2005; Olmos *et al.,* 2005; Roos *et al.,* 2006; Vasconcelos *et al.,* 2006; Farias, 2007; Vasconcelos & D'Angelo, 2007; Albano & Girão, 2008; Santos, 2008; Farias, 2009; Pereira & Azevedo-Júnior, 2011; Araujo *et al.,* 2012; Diniz *et al.,* 2012; Dornelas *et al.,* 2012; Lyra-Neves *et al.,* 2012; Nunes & Machado, 2012; Paixão, 2012; Ruiz-Esparza *et al.,* 2012; Schunck *et al.,* 2012; Silva *et al.,* 2012; Silveira & Machado, 2012; Silveira & Santos *et al.,* 2012; Sousa *et al.,* 2012; Pereira *et al.,* 2014; Ruiz-Esparza *et al.,* 2015
	taxonomy/phylogeny (3)	Hinkelmann & Schuchmann, 1997; Hinkelmann & Van den Elzen, 2003; Piacentinni 2011
	hummingbird-plant relation (6)	Machado & Lopes, 2004; Vogel *et al.,* 2005; Leal *et al.,* 2006; Lucena, 2007; Demetrio, 2008; Las-Casas *et al.,* 2012b
	reproduction (1)	Lima *et al.,* 2010
	other (6)	Cracraft, 1985; Willis, 1992; Silva, 2009; Silva, 2013; Fernandes-Ferreira *et al.* 2014; Teixeira *et al.,* 2014
Scielo	hummingbird-plant relation (2)	Machado, 2009; Neves *et al.,* 2011

Number in parentheses indicates the number of studies by subject.