

Oological collections and egg collectors of Brazilian birds: an overview

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Abstract. Egg collections have been poorly studied and cataloged both in Brazil and overseas. In Brazil, there is a lack of both historical and current tradition of establishing and curating egg collections. This paper provides information about the size of collections, collecting dates, major collectors, geographic locations, and institutions holding egg sets of Brazilian birds. Through this effort, we recovered part of the history of Brazilian ornithology and provide general directions for those interested in studying egg sets deposited in scientific collections. We retrieved information from 5,888 egg sets collected in Brazil between 1818-2022, currently deposited at 45 institutions/museums. The four largest egg collections in Brazil are at MZUSP, MN, COMB and MPEG. However, around half of the egg sets are deposited in institutions from Europe (mainly at MLUH and ZMB in Germany, NMW in Austria, NHM in the UK, and CRRM in Romania) and the USA (mainly at the WFVZ). Most egg sets were collected between the 1890s and 1930s, and after 2010. In Brazil, 70% of the egg sets were collected in five Brazilian states (MG, SP, SC, PA, and RS). Overall, egg collecting was uneven in space and time. We traced ~330 egg collectors, but most egg sets were collected by José Caetano Guimarães Sobrinho, while Caio Guimarães Chagas was probably the greatest collection owner in Brazil. A recent increase in egg collecting shows a renewed interest in assembling this type of bird vouchers. A scientifically sustained, planned and ethical collection of eggs should continue in Brazil since the breeding biology of many species is still poorly known, and since egg sets are important to provide data for new studies on the ecology, evolution, and conservation of Brazilian birds.

Keywords. Collections; Data sets; History of Ornithology; Museum; Reproduction.

INTRODUCTION

Brazil has one of the richest (Pacheco *et al.*, 2021) and most threatened avifauna of the world (<http://datazone.birdlife.org/country/brazil>). Despite its rich avifauna, Brazil has a weak tradition of studying bird reproductive biology and life history (Heming *et al.*, 2013). Thus, there are still gaps in our knowledge about bird breeding (Monsalvo *et al.*, 2018), as is usual for a tropical country (Xiao *et al.*, 2017).

There is both a historical and current gap in the establishment and curation of egg collections in Brazil, which exist only in a few institutions (Aleixo & Straube, 2007; Fontana *et al.*, 2017). The few existent publications about Brazilian egg

collections and its collectors are from a century ago (Ihering, 1900, 1914; Rocha, 1911) and many prominent Brazilian authors have overlooked the importance of such collections. For example, Pinto (1945) lacked to mention the Museu de Zoologia da Universidade de São Paulo (MZUSP) egg collection in his description of 50 years of bird studies at the museum, though most of its information was already published (Ihering, 1900, 1914). In his seminal book, Sick (1997) lacked to mention any egg collection in Brazil, but only stated that some naturalists collected eggs in the country (*e.g.*, Friedrich Sellow, Emilie Snethlage, and Carlos Estevão). Also, recent publications about the history of ornithology and egg collecting rarely, if ever, mention collectors from Brazil or other

Arq. Zool., 54(1): 1-14, 2023

<https://doi.org/10.11606/2176-7793/2023.54.01>
<https://www.revistas.usp.br/azmz>

ISSN On-Line: [2176-7793](https://doi.org/2176-7793)
ISSN Printed: [0066-7870](https://doi.org/0066-7870)
ISNI: [0000-0004-0384-1825](https://doi.org/0000-0004-0384-1825)

Edited by: Luís Fábio Silveira
Received: 24/02/2022
Accepted: 04/08/2022
Published: 12/06/2023



Neotropical countries (Mearns & Mearns, 1998; Limbert, 2003; Duarte, 2006; Alves *et al.*, 2008; Purcell *et al.*, 2008; Birkhead *et al.*, 2014; Hauber, 2014; McGhie, 2017; but see Rounds, 1990; Crozariol, 2017).

Despite the lack of tradition of egg collecting in Brazil, bird eggs have been collected for at least 200 years by scientists, naturalists, amateurs, and natural history dealers worldwide (Barrow, 2000; Purcell *et al.*, 2008; Birkhead, 2016; Mason & Pfitzner, 2020). The motivation to collect eggs and other biological specimens was initially to create 'cabinets of curiosities', which later became museums, such as the museum of the Italian naturalist Ulisse Aldrovandi from 1617 (Birkhead, 2016) or the Musei Wormiani from 1655 (Raffaini, 1993). The oldest egg collection in a museum today is from the mid 1600's and belonged to the British naturalist Francis Willughby, currently housed at the Natural History Museum at Tring, UK (Violani & Rovati, 2010; Birkhead, 2016).

The peak of egg collecting in the world occurred between 1890's-1930's (Marini *et al.*, 2020). Egg collecting was so popular during this period that several journals about oology (*i.e.*, egg studies) were regularly published mainly in the USA, including "The Oölogist", "The Oölogist's Exchange", and "The Oölogist's Journal" (available at Biodiversity Heritage, <https://www.biodiversitylibrary.org>). Later, egg collecting became questioned and criticized (Newton, 1896; Grinnell, 1906; Storer, 1930), and many countries prohibited egg collecting totally or partially [*e.g.*, Migratory Bird Treaty Act, USA (1918); Protection of Birds Act, UK (1954); Wildlife Protection Law, Brazil ("Lei de Proteção à Fauna", 1967)]. Since then, the number of collectors and eggs collected decreased steeply, even in scientific collections, despite several potential uses (reviewed in Marini *et al.*, 2020).

Today, there are at least 5 million eggs (~2 million egg sets) collected during the last 200+ years, housed in ~300 institutions all over the World, though Brazilian institutions hold only ~0.3% of these egg sets (Marini *et al.*, 2020). A more detailed inventory of egg collections exists only for the 30 largest USA institutions, with a list of the number of egg sets by species deposited at each institution (Kiff & Hough, 1985). Other inventories provide only rough estimates of the number of egg sets deposited in institutions of Latin America (Escalante & Vuilleumier, 1989; Escalante, 2005), Europe (Roselaar, 2003; eBEAC, 2021), and Australia (Gill, 2006). The largest compilation of egg data is still the *Handbuch der Oologie*, published in German in 47 issues and 3,615 printed pages (Schönwetter & Meise, 1960-1992). This landmark remained largely unavailable and underused (Rahn & Paganelli, 1988; Maurer *et al.*, 2010) but, fortunately, it has been digitalized and can be freely downloaded through the Biodiversity Heritage Library (<https://www.biodiversitylibrary.org/item/124796>). Also available online is Schönwetter's entire hand-written catalogue in German (<http://nbn-resolving.de/urn:nbn:de:gbv:3:3-61469>).

Considering the importance and usefulness of oological collections, this paper provides an overview of egg collections made in Brazil and their collectors, evaluating: a) the number of egg sets deposited at the most

important museums in Brazil and overseas; b) the contributions of the most important egg collectors and researchers that studied bird breeding, and c) the temporal and spatial extent of the egg sets collected. An analysis of the taxonomic coverage at species level is under way but given that it requires a careful and detailed validation and the taxonomic resolution of thousands of records, it is out of the scope of this paper. With this account, we expect to encourage a better use of egg collections in breeding studies of Neotropical birds and help fulfill gaps in the history of Brazilian ornithology.

MATERIALS AND METHODS

Museum searches

We first acquired information about the size of the hundreds of egg collections existent in Brazil (Aleixo & Straube, 2007; Fontana *et al.*, 2017), Latin America (Escalante, 2005), North America (Kiff, 1979) and Europe (Roselaar, 2003). Most of these egg collections are unavailable in online databases, such as the Arctos Collaborative Collection Management Solution (<http://arctos.database.museum>), the Global Biodiversity Information Facility (<https://www.gbif.org>), and VertNet (<http://vertnet.org>). Also, some collections were not digitized, and most remain uninventoried. We visited 36 egg collections between 2014-2022 considering their size, locality, and accessibility. We also retrieved information from egg sets of museums available in the online databases above. Though a complete sampling of all 300+ egg collections is prohibitively expensive, and time consuming, other private or institutional collections might still add hundreds of Brazilian egg records.

In Brazil, we visited 11 egg collections, including the four largest: Museu de Zoologia da Universidade de São Paulo, São Paulo (MZUSP), Museu Nacional, Rio de Janeiro (MN), Coleção Ornitológica Marcelo Bagno, Brasília (COMB), and Museu Paraense Emílio Goeldi, Belém (MPEG). We also visited seven of the small scale collections that proved to hold important collections, namely the Museu de Zoologia do Instituto de Biologia da Universidade Federal Rural do Rio de Janeiro, Seropédica (IB/UFRJ), Museu de Ciências Naturais, Porto Alegre (MCN), Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre (MCP), Museu de História Natural do Ceará Prof. Francisco Dias da Rocha, Fortaleza (MHNC), Associação de Pesquisa e Preservação de Ecossistemas Aquáticos, Fortaleza (AQUASIS), Reserva Ecológica do Instituto Brasileiro de Geografia e Estatística, Brasília (IBGE), and Museu de Biologia Prof. Mello Leitão, Santa Teresa (MBML). We were unable to find some egg collections listed in Aleixo & Straube (2007) even after contact with local professionals, such as the collections at Universidade Regional de Blumenau, Blumenau (CZFURB) and at Museu de Zoologia João Moojen de Oliveira, Viçosa (MZUFV). Three other collections contacted had no or very few egg sets with specific collecting

date and location: Fundação Museu de Ornitologia de Goiânia, Goiânia (MOG-FMOG), Museu de Zoologia Adão José Cardoso, Campinas (ZUEC), and Museu de História Natural de Taubaté, Taubaté (MHNT). Very small collections (< 50 listed egg sets at Aleixo & Straube, 2007), such as the Museu de História Natural Capão da Imbuia, Curitiba (MHNCL), were neither visited nor had their information retrieved.

In other Latin American countries, we visited six collections: Museo Argentino de Ciencias Naturales, Buenos Aires, Argentina (MACN), Museo de La Plata, La Plata, Argentina (MLP), Fundación Miguel Lillo (FML), San Miguel de Tucumán, Argentina, Instituto de Investigación de Recursos Biológicos Alexander von Humboldt, Vila de Leyva, Colombia (IAvH-CJM), Museo Nacional de Costa Rica, San José, Costa Rica (MNCR) and Museo de Zoología da Universidad de Costa Rica, San José, Costa Rica (MZUCR).

In the USA, we visited seven collections: the Western Foundation of Vertebrate Zoology, Camarillo, CA (WFVZ), American Museum of Natural History, New York, NY (AMNH), Smithsonian National Museum of Natural History, Washington, D.C. (NMNH), Delaware Museum of Natural History, Wilmington, DE (DMNH), Museum of Comparative Zoology, Harvard University, Cambridge, MA (MCZ), California Academy of Sciences, San Francisco, CA (CAS), and San Bernardino County Museum, Redlands, CA (SBCM). The egg collections from the Field Museum of Natural History, Chicago, IL (FMNH, <https://collections-zoology.fieldmuseum.org>), Florida Museum of Natural History, Gainesville, FL (FMNH), Peabody Museum of Natural History, Yale University, New Haven, CT (YPM, <https://collections.peabody.yale.edu/search>), and Museum of Vertebrate Zoology, Berkeley, CA (MVZ, <https://mvz.berkeley.edu>) were accessed by their websites or through data files provided by curators.

In Europe, we visited 12 collections: Natural History Museum, Tring, England (NHMUK), National Museums of Scotland, Edinburgh, Scotland (NMS), Museum für Naturkunde, Berlin, Germany (ZMB), Zentralmagazin Naturwissenschaftlicher Sammlungen, Martin Luther University Halle-Wittenberg, Halle, Germany (MLUH), Staatliches Naturhistorisches Museum, Braunschweig, Germany (SNMB), Museum d'Histoire Naturelle de Genève, Geneva, Switzerland (MHNG), Naturhistorisches Museum Bern, Bern, Switzerland (NMBE), Nationaal Natuurhistorisch Museum, Leiden, The Netherlands (RMNH), Naturhistorisches Museum, Vienna, Austria (NMW), Muséum National d'Histoire Naturelle, Paris, France (MNHN), Musée Zoologique de l'Université Louis Pasteur et de la Ville de Strasbourg, Strasbourg, France (MZS), and Cris-Rivers Region Museum, Oradea, Romania (CRRM).

Data treatment

We photographed all the egg sets collected in Brazil and thousands of other clutches from the Neotropical region in the museums visited, together with their data slips or cards. Egg sets represent "a collection unit with

its own registration number or/and clear separation from other such units. These sets may contain an entire clutch, several eggs from more than one clutch or incomplete clutches. Thus, generally the number of egg sets is higher than the number of egg clutches but lower than the count of individual eggs." (Marini *et al.*, 2020). All eggs were also visually screened for additional information written on them, sometimes unavailable on egg labels/cards. Original species identification, collection date and locality, and collector name from each egg set were inserted in a database, including the egg sets which we had only online access. We searched for similar patterns of collection dates and localities among egg sets to fill gaps of information that a given egg set might have. When available, published information were used to fill gaps of information (*i.e.*, lack of data, locality, or collector) or double check the information from slips/cards. A taxonomic resolution and update of the taxonomy of original species identification is under way. We excluded from our collector analysis egg sets without identification of the collector, and egg sets collected by ~20 expeditions and museums since there are multiple or unidentified collectors, dealers or collection owners that were not the true collectors.

RESULTS

We recorded 49,782 egg sets from the Neotropical region from 52 institutions/museums, of which 5,888 were collected in Brazil between 1818-2022 (Fig. 1) with at least specific locality data, specific collecting data or collector. We excluded from this account egg sets of uncertain origin, including: 167 egg sets without country of origin but very likely from Brazil since they were deposited at Brazilian institutions which seldom have egg sets from other countries; 15 egg sets possibly from Brazil, but with a question mark on their locality; and 79 egg sets that described the locality as being 'South America' or 'Amazon' deposited at museums overseas, some of which could also be from Brazil. We also did not consider 109 egg sets deposited at Brazilian institutions originated from captive birds, though they might be useful for some analyses. Finally, we did not consider thousands of eggs deposited at Museu Nacional probably collected in Brazil

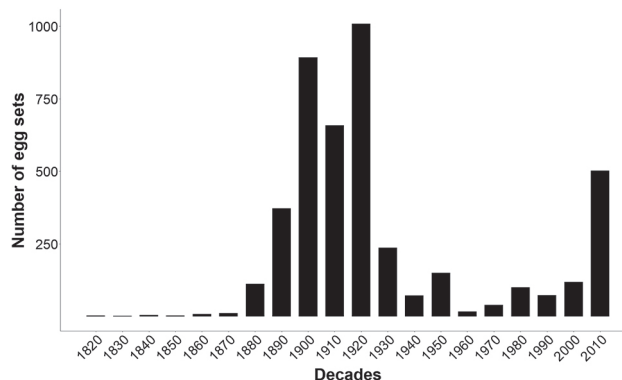


Figure 1. Distribution of 5,888 egg sets of birds from Brazil collected by decade between 1818-2022.

belonging to a “Travassos Collection” but without any specific information except species name.

Collecting period

These egg sets started being collected in Brazil around 1818 but remained sparsely collected until the 1880's, when egg collecting became popular (Fig. 1). From 1880's on, egg collecting increased and continued as a common practice until the 1920's when it peaked (17% of the egg sets). Nearly half of the egg sets of Brazilian birds were collected between 1890-1929 (Fig. 1). From the 1930's on, egg collecting decreased until the 1960's. From the 1970's on, egg collecting increased again, with a peak in the 2010's, when more eggs were collected than in the previous seven decades.

The oldest records we found are from a collection of 30 egg sets collected between 1818-1835 by Johann Natterer and deposited at NMW. Also old are two egg sets of Great Kiskadee *Pitangus sulphuratus* from Brazil collected in 1820 (NHM 1901-11-30-65-67 and 1902.10.25.965-6) but with no specific locality, date and collector. Around the same time, Auguste de Saint-Hilaire collected three eggs of Greater Ani *Crotophaga major* probably in 1822 at Rio de Janeiro (MNHN 390-392). These egg sets are probably among the oldest known from the Neotropical region, together with one egg set of Magellanic Tapaculo *Scytalopus magellanicus* from Bío-Bío, Chile (ZMB unnumbered) collected in 1814 by an unknown collector.

Collectors from early 1800's include other naturalists without eggs deposited in the collections visited so far. Even though Wied studied the nesting biology of Brazilian birds between 1815-1818 (Wied, 1831-1833), we found no reference to him in none of the 52 egg collections we assessed. Friedrich Sellow worked and collected in Brazil between 1814-1831 (Sick, 1997, pg. 50), collected nests and eggs (Stresemann, 1948, 1954), but we found none in collections, what can be a result of poor labelling of Sellow's specimens (Rego et al., 2013). Robert and Richard Schomburgk travelled in South America including Brazil between 1835-1844 and provided information about the breeding period of some species (Sick, 1997). Later, Carlos Euler described nests and eggs of Brazilian birds based on studies conducted from 1862-1866 in the state of Rio de Janeiro (Euler, 1867a, b, c, 1868), latter published in Portuguese (Euler, 1900), but again we found no reference to him in the collections we visited. Thus, if these persons collected eggs, they are either unrecorded in the collections we visited, or their records and egg sets were lost.

Collecting localities

Most egg collections from Brazil were limited to a few regions (Fig. 2), mainly in five states: Minas Gerais (n = 1,420 egg sets), São Paulo (n = 839), Santa Catarina (n = 752), Pará (n = 564), and Rio Grande do Sul (n = 474).

Around 24% of the egg sets from Brazil were collected in Minas Gerais, mostly at the central-southeastern part of the state (municipalities of Arcos and Dores do Indaiá) (Fig. 2). Around 32 people collected these Minas Gerais eggs, but mostly José Caetano Guimarães Sobrinho (n = 937 egg sets, 64%). The egg sets from Minas Gerais were originally in private collections, but are now deposited at 24 museums, mainly at MN (n = 403), CRRM (n = 171), COMB (n = 139) and MZUSP (n = 121).

Egg sets collected in São Paulo, were obtained mainly in the southeastern part of the state (municipalities of Iguape, n = 284 and the municipality of São Paulo n = 134) (Fig. 2). There are 75 listed collectors for the state, but mainly Ricardo Krone (n = 221) and, João Leonardo Lima (n = 83), probably because many of the collectors worked for or sold eggs to MZUSP (Pinto, 1945; Grola, 2012). These egg sets are now deposited in 25 museums but most (53%) at MZUSP (n = 483), NMW (n = 91) and ZMB (n = 65).

Egg collecting in Santa Catarina was also independent of any major museum, similarly to Minas Gerais, but was related to Germans or German descendants which travelled or lived mostly around 'Colônia Hansa Humboldt' (currently Corupá), Joinville, Blumenau, and Araranguá (Fig. 2). There are 42 possible collectors, including several apparently non-professional oologists, but mainly Fritz Hofmann (n = 281 egg sets). These egg sets are now at 19 museums, mainly overseas (n = 722, 96%), mostly (n = 643) at collections from German-speaking countries, namely Germany (MLUH = 358, SNMB = 89 and ZMB = 57), Austria (NMW = 85), and Switzerland (NMBE = 48 and MHNG = 6).

In Pará, similarly to São Paulo, egg collection was associated with an institution (MPEG), and collected mainly in the northeastern part of the state, around Belém (n = 178) and Santo Antônio do Prata (n = 149) (Fig. 2). Around 48 people appear as collectors, but most egg sets were collected by Emilie Snethlage (n = 243) and Carlos Estevão (n = 120). These egg sets are at 13 museums, but mainly at MPEG (n = 277) and MZUSP (n = 124).

In Rio Grande do Sul, egg collecting occurred in many localities, but mostly in the eastern part of the state in the municipalities of Itaqui (n = 67), Rio Grande (n = 66), and São Lourenço (n = 58) (Fig. 2). Around 68 people are listed as collectors, but mainly Ernest Garbe (n = 76) and Christiano Euslen (n = 55). Today, these egg sets are at 19 museums, but mostly at MZUSP (n = 163), MCP (n = 102), and MCN (n = 74). Part of the egg collection from Rio Grande do Sul, now at MZUSP and MCN, was received from the former “Museu do Estado” (currently Museu Julio de Castilhos), Porto Alegre, Rio Grande do Sul, without specific localities and dates, being even questionable if they were collected in Rio Grande do Sul.

Collectors

We found reference to ~330 people in the labels/cards as collectors of at least one egg set in Brazil, though some of them might have been the field collector, whereas others could be collection owners or dealers. Among these collectors, we briefly describe the contributions of

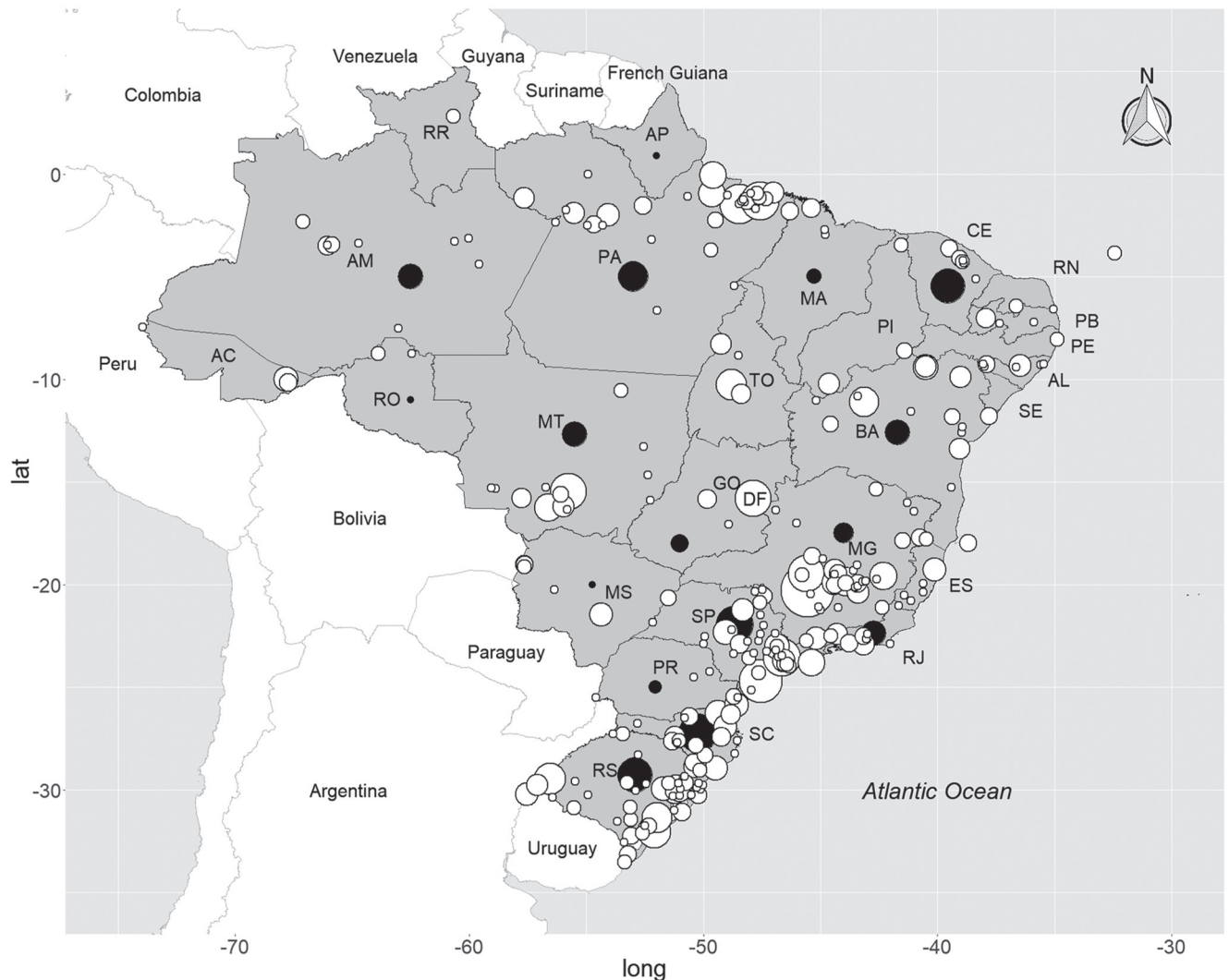


Figure 2. Geographic distribution of 5,888 egg sets of birds from Brazil collected between 1818-2022. White circles represent egg sets with specific locality (state and municipality), and black circles egg sets detailing only the state where they were collected. The size of the circles represents the number of egg sets collected in each locality.

those who made the most expressive collections, listing the name of each collector, the period when they collected eggs, and the institutions where their collections are stored. Collectors were ranked by number of egg sets deposited in museums.

José Caetano Guimarães Sobrinho (1899-1933)

Guimarães Sobrinho was the greatest egg collector from Brazil, with 939 egg sets (> 2,000 eggs) of 161 species from Arcos and Dores do Indaiá, Minas Gerais. The egg sets he collected are housed at 20 museums, but mostly at MN (n = 384 egg sets), CRRM (n = 154), DMNH (n = 105), MZUSP (n = 66), NHM (n = 44), and WFVZ (n = 36). The number of egg sets he collected is probably much higher, since we found reports that he owned a collection of 3,800-4,500 eggs (Marini *et al.*, 2018). Complementing the information from Marini *et al.* (2018), Guimarães Sobrinho was born in 1881 and part of his egg collection was acquired by MZUSP (Machado, 1939). He was an active egg collector but published only two breeding biology notes (Guimarães Sobrinho, 1932a, b).

Carlos Estevão (1922-1930)

He collected 338 egg sets in Belém, Pará (Estevão, 1926), of which 120 are deposited at MZUSP. Estevão breeding records appear in his own publication (Estevão, 1926) and were studied by Pinto (1953).

Fritz Hofmann (1903-1943)

He collected 282 egg sets mostly in Joinville, São Bento do Sul and Corupá (formerly the German colony Hansa Humboldt), Santa Catarina. The egg sets he collected are housed mainly at MLUH (n = 277).

Emile Snethlage (1906-1928)

She collected 262 egg sets mainly in Pará, but also in Maranhão, Amazonas, Espírito Santo, and Minas Gerais. The egg sets she collected are housed at MPEG (n = 177) and at MN (n = 85). Several of her data slips were located at MN without the eggs. Many of her breeding records were published (Snethlage & Schreiner, 1929;

Sneathlage, 1935a, b) and her historiography and list of publications were published by Junghans (2008).

Ricardo Krone (1889?-1906)

We recorded 237 egg sets collected by "Krone", most of which ascribed to Ricardo Krone or simply to Krone. Ricardo Krone, born Sigismund Ernst Richard Krone, collected 231 egg sets mainly in Iguape, São Paulo, but also in a few other localities in São Paulo, which are deposited at eight institutions, but mostly MZUSP (n = 128) and NMW (n = 85). Also, three egg sets were collected by Anna Krone in 1922. Many egg sets collected by Krone were sold to MZUSP, and are listed at Ihering (Ihering, 1900: 263; Grola, 2012). Unfortunately, most egg sets collected by Krone lack collection date. Similarly, Pinto (1945) calls attention to the possibility that the '1900' date of most part of Krone's skin specimens might refer to the date the collection was registered at MZUSP, instead of the collection date.

Otmar Reiser (1903)

He collected 220 eggs at several localities in the northeast of Brazil, in Bahia, Pernambuco and Piauí (Reiser, 1910, 1925, 1929), but we were able to find only 70 egg sets which are housed at the NMW. Part of his expeditions were described by Pacheco (2004).

Ernst Garbe (1900-1920)

He collected 168 egg sets mostly in Rio Grande do Sul, Bahia, and São Paulo, which are deposited at MZUSP (n = 167), and one at ZMB. He first sold specimens to MZUSP (Grola, 2012), and then in 1902 became a travelling naturalist of MZUSP (Pinto, 1945), with his expeditions described by Pacheco (2004) and Garbe (2018).

Caio Guimarães Chagas (1934?-1956)

Chagas probably held the largest private egg collection from the Neotropical region, though only 166 egg sets referring to him either as the collector or the collection owner were located at five museums, mostly at the WFVZ (n = 134) and NMNH (n = 29). A large part of his collection (~5,000 eggs) was recently located by us and is privately owned by his heirs in Nova Lima, Minas Gerais, though unavailable for analysis.

We believe that Chagas has probably exchanged many egg sets with other collectors throughout his life, since 29 egg sets (17.6% of the eggs sets located) are from eight South American countries, with overlapping dates with the Brazilian egg sets in his collection. The 166 egg sets from Brazil, are mainly from Dores do Indaiá and Nova Lima, Minas Gerais (n = 79). Many of his egg sets (n = 81) lack specific locality, and refer only to "central Brazil", "Amazonia" or "north Brazil". Also, four clutches ascribed to him, collected between 1917-1930, might have instead been collected by one of his uncles (J.C. Guimarães Sobrinho and A.C. Guimarães), since the majority of

Chagas egg sets span from 1934 to 1956. Since some of his egg sets have doubtful identification, and since he received egg sets from other collectors, we recommend care and future validation of his egg sets. More details about him were described at Marini *et al.* (2018).

Johannes Natterer (1818-1835)

He is probably one of the first collectors of eggs in Brazil and in the Neotropical region, with collections dated back to 1818. He collected 125 eggs (Papavero, 1971) of which we photographed 78 belonging to 30 egg sets deposited at the NMW. Since most of his notes were lost during a fire in 1848 (Sick, 1997), details about the eggs collected by him, especially locality and date, are so far unavailable. von Pelzeln (1868-1870) published some notes on the nests and eggs collected by Natterer, whose biography was published by Goeldi (1896), Ihering (1902), Schiffter (1993) and Straube (2000).

Herbert Huntington Smith (1882-1884)

He collected 116 egg sets between 1882-1884 during his expedition to Chapada dos Guimarães, Mato Grosso, all deposited at the AMNH. The results of his expedition were published by Allen (1891, 1892, 1893a), including a paper with oological notes (Allen, 1893b). Also, a brief biography and a synthesis of his contributions are presented by Kunzler *et al.* (2011).

Francisco Dias da Rocha (1903-1908)

Dias da Rocha (Pacheco, 2004; Telles & Borges-Nojosa, 2009) made one of the few, but large, egg collections from northeastern Brazil, of which we located 109 egg sets probably collected in the state of Ceará. Though his collection remained unknown for about 100 years, these egg sets are currently housed at Museu do Ceará and AQUASIS (Fortaleza, Ceará) (n = 102), and MZUSP (n = 7). The scientific value of these egg sets is very limited, since many egg sets have only common names in Portuguese, and all lack specific localities and dates. Also, a comparison of the species of these egg sets with those from his publication (Rocha, 1911) revealed differences, requiring further studies of his contribution.

Des Murs (1836?-1842?)

Marc Athanese Parfait Oeillet Des Murs (1804-1878), shortly Des Murs, collected around 100 egg sets in Brazil sometime between 1836 and 1842 (Heermann 1853, Des Murs 1855). These eggs were originally deposited at the oological collection of The Academy of Natural Sciences of Philadelphia (Heermann 1853), but latter donated to the WFVZ. We photographed 73 of these egg sets at the WFVZ and one at MNHN. Most egg sets had only Brazil as the locality, but 14 are from Rio de Janeiro, and six from Bahia. The eggs at the WFVZ are currently being curated and the whole collection of eggs belonging to Des Murs still requires deeper analysis.

Wilhelm Ehrhardt (1908-1909)

Ehrhardt collected 97 egg sets in Santa Catarina, probably all near Corupá. His egg sets are deposited mostly at SNMB (n = 89) along with several nests. After 1899, MZUSP acquired specimens (not necessarily eggs) from Ehrhardt collected in 'Colônia Hansa' (Pinto, 1945), but there are only four records at MZUSP with Ehrhardt as collector of egg sets.

João Leonardo Lima (1899-1917)

João L. Lima, also a travelling naturalist of MZUSP (Pinto, 1945) collected 87 egg sets in São Paulo, mainly in the municipality of São Paulo, which are deposited at the MZUSP, and one egg set at ZMB. To avoid confusion, it is important to mention that José Lima, his son, also collected 13 egg sets in São Paulo between 1930-1938, mostly in Itatiba. José Lima started to travel and collect with his father in 1926 (Pinto, 1945). Also, a collector named "Luiz" (not mentioned in Pinto, 1945) collected 23 egg sets between 1900-1903, and in 1917, mainly in São Paulo municipality, which are deposited at MZUSP and might have been collected with João L. Lima.

R. Franke (1911-1912)

Franke was based at Joinville, Santa Catarina, and collected 82 egg sets apparently from the state, all deposited at the NMW. We consider that some of his egg identifications require careful revision, what coincides with the information given by Sick (1997: 58) that his material had questionable localities. Also, information in the labels show that Max Schönwetter questioned three of his identifications. Thus, we recommend care and further validation of his records.

Helmut Sick (1943-1979)

Helmuth Sick made one the greatest contributions to the study of the breeding biology of Brazilian birds (Sick, 1997 and references therein). However, he collected only 75 egg sets in Espírito Santo, Mato Grosso, Minas Gerais, Pará, Rio de Janeiro, São Paulo, and Santa Catarina, all of them deposited at MN (n = 70) and MLUH (n = 5). Interestingly, five of his egg sets deposited at MN (*Elaenia* sp., MN 530, *Vireo olivaceus*, MN 532, *Conopophaga melanops*, MN 537) and MLUH (*Nyctibius griseus*, MLUH 1909a; *Megarhynchus pitangua* MLUH 2562a), were collected during World War II in 1943-1944, probably when he was imprisoned at Ilha Grande, RJ, between March 1942 and December 1944 (Gonzaga, 1991).

Hermann von Ihering (1880?-1916?)

Ihering published one of the most important accounts about the breeding biology of Brazilian birds (Ihering, 1900, 1914), and was for a long period director of MZUSP (Pinto, 1945), but he collected only a few egg sets. We found only 21 egg sets ascribed to him from

São Paulo, Rio Grande do Sul and Minas Gerais, deposited at ZMB, MLUH, MZUSP, NHM, and NMBE. His activities at MZUSP are described by Pinto (1945) and Grola (2012), and his biography was presented by Nomura (2012).

Institutions

The 5,888 egg sets we retrieved with at least some specific data are housed in 52 institutions, of which 51% are in Brazil (n = 3,028), mainly at MZUSP (n = 1,008), MN (n = 706), COMB (n = 515), and MPEG (n = 316). The other half egg sets are housed at museums in Europe and North America, but mainly at MLUH (n = 493), WFVZ (n = 296), NMW (n = 282), ZMB (n = 276), NHM (n = 251), and CRRM (n = 203).

Brazilian Collections

There are dozens of ornithological collections in Brazil, of which 22 had information accessed by Aleixo & Straube (2007). Of these 22 collections, we personally visited and collected data on seven of them, including the four largest in Brazil. Egg collections with no or a few (< 100) eggs/nests, which probably mean less than 30 egg sets, had no information available or were not visited. We retrieved information from three ornithological collections not listed by Aleixo & Straube (2007) (Zoological collection of IBGE, Brasília, DF; Museu do Ceará, Fortaleza, CE; and a collection of eggs currently stored at the AQUASIS, Fortaleza, CE). There are probably only a few egg sets in other public institutions in Brazil that we had not visited and are still poorly known, such as the collection from Museu de Zoologia da Escola de Farmácia de Ouro Preto, Ouro Preto, MG (Vasconcelos *et al.*, 2014) and the Museu Elias Lorenzutti, Linhares, ES (Lorenzutti & Almeida, 2006).

We did not access private collections, such as the collection of José Indiani (Crozariol, 2018), and the collection of Carlos G. Chagas in Nova Lima, MG, mentioned above. In other countries, old egg collections still with collectors' heirs have been donated to scientific institutions (Joseph, 2011; Marini *et al.*, 2020), helping to improve our knowledge of the history of ornithology and to increase our knowledge of birds' biology, also making such material available to the public. Finally, the 2.000+ eggs deposited at the exhibit of "Ovolândia: Coleção de ovos da fauna silvestre" at 'Usina Ouro Branco' of Gerdau S/A, Ouro Branco, Minas Gerais (<https://www7.fiemg.com.br/publicacoes-internas/EducacaoAmbientaGerdau>), were not considered since they lack data cards/labels, except the information that the collection was started in the 1920's at Formiga, Minas Gerais. Below we briefly describe the major egg collections in Brazil, ordered by size.

Museu de Zoologia da Universidade de São Paulo (MZUSP), São Paulo, SP

This is the largest egg collection in Brazil with useful data, with 1,008 egg sets from Brazil, collected between ~1889 and 2010. Most egg sets are from São Paulo

(n = 480), Rio Grande do Sul (n = 163), Pará (n = 124), and Minas Gerais (n = 121). Most were collected by Ernest Garbe (n = 156), Ricardo Krone (n = 141), and Carlos Estevão (n = 119). It also has 234 egg sets from other Neotropical countries, mainly from Argentina (n = 140) and Venezuela (n = 50), as well as egg sets from North America and Europe. Part of this collection was described by Ihering (1900, 1914), and Pinto (1945) and Grola (2012) briefly described the origin of some egg sets.

Museu Nacional (MN), Rio de Janeiro, RJ

This collection has 706 egg sets with some specific data, collected between 1896 and 2013, mainly in Minas Gerais (n = 403), Pará (n = 71), and Rio de Janeiro (n = 67). Most egg sets were collected by J.C. Guimarães Sobrinho (n = 380), Emile Snethlage (n = 85), and Helmut Sick (n = 70). The MN collection also has thousands of eggs belonging to a 'Travassos Collection', which were not considered in this analysis due to lack of specific data except species identification. Part of the MN collection was described by Peixoto-Velho (1932).

Coleção Ornitológica Marcelo Bagno (COMB), Brasília, DF

This young egg collection has 515 egg sets collected between 1983 and 2022, mostly in Distrito Federal (n = 181), Minas Gerais (n = 139), Mato Grosso (n = 67), and Tocantins (n = 62). This collection is the result of the efforts of several researchers, and is responsible for most part of the increase in egg sets collected in Brazil after 2010.

Museu Paraense Emílio Goeldi (MPEG), Belém, PA

This collection has 316 egg sets collected between 1894 and 2004, mostly in Pará (n = 278), mainly by Emile Snethlage (n = 177) and mainly other museum associates.

Museu de Zoologia do Instituto de Biologia da Universidade Federal Rural do Rio de Janeiro (IB/UFRRJ), Seropédica, RJ

This collection has 162 egg sets collected between 1920 and 1977, but mostly between 1920-1938 at Dores do Indaiá, Minas Gerais (n = 158). These older eggs were purchased in 1939 by the former "Escola Nacional de Agronomia" (ENA) (currently the Universidade Federal Rural do Rio de Janeiro, UFRRJ) (Ministério da Agricultura, 1940) and were probably collected either by J.C. Guimarães Sobrinho or his brother A.C.S. Guimarães Jr. (more details in Marini et al., 2018).

Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul (MCP), Porto Alegre, RS

This young collection has 112 egg sets collected between 1994 and 2016, mostly in Rio Grande do Sul (n = 104), by several collectors from Rio Grande do Sul.

Museu de Ciências Naturais (MCN) da FZBRs, Porto Alegre, RS

This is also a young collection with 95 egg sets collected between 1971 and 2017, mostly in Rio Grande do Sul (n = 74) and Santa Catarina (n = 16), by several collectors from Rio Grande do Sul. This collection also has dozens of egg sets apparently from early 1900's probably donated to MCN around 1910 by the "Museu do Estado" (currently Museu Julio de Castilhos). The origin of these egg sets is uncertain though labels have Rio Grande do Sul as the locality, and thus require further evaluation.

Museu do Ceará (MC) and AQUASIS, Fortaleza, CE

Francisco Dias da Rocha was a naturalist (Telles & Borges-Nojosa, 2009) that collected hundreds of egg sets at Ceará (Rocha, 1911) though the whereabouts of this collection was unknown for almost a century. Today, part is deposited at MC and part at AQUASIS after being rescued from an abandoned deposit at a public school in Ceará (W. Girão, pers. comm.). This collection of 102 egg sets was collected apparently between 1903-1908, probably in Ceará, but has very little specific data, and species are identified only by their common Portuguese names. It has historical importance since it is still the largest egg collection from northeast Brazil, followed by Reiser's (1910), but requires further treatment and investigation.

Overseas Collections

There are ~300 egg collections in the World (Marini et al., 2020), of which many have eggs collected in Brazil. The two largest ones are the Natural History Museum (NHM), at Tring, UK, with 450,000 egg sets from all over the world (Roselaar, 2003) and the Western Foundation of Vertebrate Zoology (WVZ), Camarillo, USA, with 275,000 egg sets from all over the world (Roselaar, 2003; Marini et al., 2020). Among the hundreds of egg collections from Europe (Roselaar, 2003) we visited six of the 10 largest, including the NHM, besides other smaller ones. Many other collections were contacted but provided no information. The USA and Canada have 107 egg collections with at least 200 egg sets (Kiff, 1979; Kiff & Hough, 1985). Of these, we visited (or had online access) to nine of the 10 largest, including the WVZ. Among the Latin American collections (Escalante & Vuilleumier, 1989; Escalante, 2005) we visited six, but found very few [(MACN (n = 1 egg set photographed, and n = 112 egg sets listed in catalogs), IAVH-CJM (n = 13)] or no (MLP, FML, MNCR, MZUCR) egg sets from Brazil. Below we describe briefly the major (> 100 egg sets) egg collections from overseas ordered by number of egg sets from Brazil.

Zentralmagazin Naturwissenschaftlicher Sammlungen, Martin Luther University Halle-Wittenberg (MLUH), Halle, Germany

This collection holds the largest egg collection of Brazilian birds outside Brazil, with 493 egg sets collected

between ~1850 and 1950 in 10 states but mostly in Santa Catarina (n = 359). It consists mainly of Schönwetter's egg collection which is listed at his hand-written catalogue and at his book (Schönwetter & Meise, 1960-1992). Identification of original egg collectors is difficult since most egg sets are referred only to previous owners, but Fritz Hofmann collected 277 egg sets. Besides Schönwetter's, this collection also holds 18 egg sets collected by Hermann Burmeister between 1850-1854 in Brazil, though with little specific data in the labels. It is important to stress that Sick (1997, pg. 54) states that the bird data provided by Burmeister is unsure, thus this material requires more investigation before use. Curiously, the Burmeister egg collection also has one hard-shelled egg of the mollusk "*Bulimus*" (probably *Borus moritzianus*).

Western Foundation of Vertebrate Zoology (WFVZ), Camarillo, USA

This collection has 296 egg sets collected between 1836? and 1956, mostly in Minas Gerais (n = 89), Rio de Janeiro (n = 14), Santa Catarina (n = 13), and Amazonas (n = 12). Most egg sets were collected by C.G. Chagas (n = 134), Des Murs (n = 73), and J.C. Guimarães Sobrinho (n = 36), among others. This collection is very well organized with cards and photos of the eggs available online (<https://www.wfvz.org>).

Naturhistorisches Museum (NMW), Wien, Austria

This collection has 282 egg sets, collected between 1818 and 1923, mostly in São Paulo (n = 91), Santa Catarina (n = 85), and Bahia (n = 39). Most sets were collected by Ricardo Krone (n = 85), Franke (n = 82), Otmar Reiser (n = 69) and J. Natterer (n = 30), among many others. This collection has the oldest eggs collected in Brazil, with 30 egg sets collected by J. Natterer between 1818-1835, but most without specific date and locality, even in Pelzeln (1868-1870).

Museum fur Naturkundem (ZMB), Berlin, Germany

This collection has 276 egg sets collected between 1864? and 1912, mostly in São Paulo (n = 65), Santa Catarina (n = 57), and Rio Grande do Sul (n = 41), and 78 without indication of the state. Most egg sets (n = 169) lack specific data about the collector. The ZMB collection is divided in three major parts, the main collection, a second part that belonged to Nehr Korn and a third part that belonged to Treskow. Part of the egg sets were published by Nehr Korn (1899, 1910, 1914), but without specific localities and collecting date.

Natural History Museum (NHM), Tring, England

This collection has 251 egg sets collected between 1820 and 2007, mostly in Minas Gerais (n = 45), Rio Grande do Sul (n = 36), São Paulo (n = 32) and Rio de Janeiro (n = 23), and 77 without indication of the state

and municipality. Most egg sets also lack specific date about the collector, but only the collection it came from, except for 44 egg sets collected by J.C. Guimarães Sobrinho. Part of the egg sets were published in a series of five catalogues (Oates, 1901, 1902; Oates & Reid, 1903, 1905; Ogilvie-Grant, 1912).

Cris-Rivers Region Museum (CRRM), Oradea, Romania

This collection has 203 egg sets collected between 1882 and 1932, mainly in Minas Gerais (n = 171) and collected by J.C. Guimarães Sobrinho. Part of the specific data from this collection was retrieved from Béczi (1971).

American Museum of Natural History (AMNH), New York, USA

This collection has 180 egg sets collected between 1875 and 1956. Most egg sets are from Mato Grosso (n = 141) and were collected by Herbert H. Smith (n = 116), Emil Kaempfer (n = 30) and George K. Cherrie (n = 23).

Naturhistorisches Museum Bern (NMBE), Bern, Switzerland

This collection has 123 egg sets collected between 1875 and 1932. Most egg sets are from Santa Catarina (n = 60) and São Paulo (n = 29), and were collected by several people, but most have only the name of the former collection it belonged.

DISCUSSION

Our analysis fills a gap of knowledge, provides general directions for those interested in using egg sets deposited in scientific collections for their studies, and recovers part of the history of Brazilian ornithology. The relatively few egg sets deposited at Brazilian institutions is probably a result of lack of historical tradition of egg collecting by scientific institutions and relatively limited number of institutions and resources directed to natural history collections. A strong tradition in breeding studies is found in Argentina, for example, that has almost twice the number of publications about breeding biology than Brazil and nearly ten times the number of clutch size records for a single bird sub-family (Heming *et al.*, 2013). The USA also has a larger number of publications and clutch records than Brazil, while Venezuela and Ecuador have fewer publications but a larger number of records (Heming *et al.*, 2013).

It seems clear that the influence of British collectors and researchers had a profound impact on the tradition of studying breeding biology and egg collecting across the New World. In Brazil, on the other hand, many collectors came mostly from German speaking countries, and had only a few people studying breeding biology. As a colony of Portugal, scientific institutions and research itself were inexistent or poorly supported in Brazil until 1808.

However, after 1808 with the opening of international commerce in Brazil and after Maria Leopoldina of Austria married with Prince Dom Pedro (latter Dom Pedro I) in 1817, it was established the "Austrian Scientific Mission" with scientific expeditions by Bavarian and Austrian naturalists such as Johann Baptist von Spix, Karl F.P. von Martius and Johann Natterer (Vanzolini, 1996; Sick, 1997: 51; Ambiel, 2014). As a result, Brazil had few historical studies of the breeding biology of birds until late XIX century (ex.: Euler, 1900; Ihering, 1900). Goeldi (1894) also published a review and personal reports of breeding of Brazilian birds. In the first half of the XX century, important scientific contributions on the breeding of Brazilian birds were made by Carlos Estevão (Estevão, 1926; Pinto, 1953) and Emile Snethlage, and more recently by Helmut Sick in 1940's-1980's (Sick, 1997). This limited number of researchers with weak interest in collecting eggs in Brazil impacted the egg collecting patterns, and the egg collections we see now (see below) and left a weak tradition and heritage of breeding biology studies.

Spatial distribution

The spatial bias observed in Brazilian egg collecting reflects well bias patterns reported globally, in which specimen collection occurs mainly close to more accessible localities and research institutions (Kadmon *et al.*, 2004; Boakes *et al.*, 2010; Vale & Jenkins, 2012). Also, this spatial pattern is coincident with the occupation of the Brazilian territory in the beginning of 1900's where most ornithological research had been traditionally concentrated (Aleixo & Straube, 2007). However, most part of Brazil remains without breeding biology studies and egg collections. The three major Brazilian museums (MZUSP, MN, and MPEG) had active skin collecting mainly in the first half of the 20th century and fostered in parallel egg collecting.

Temporal distribution

Most egg sets were collected between 1890's and 1930's, similarly to the period of egg collecting around the World (Marini *et al.*, 2020). The second half of the 20th century had a drastic decrease in skin collecting (Freyman & Schuchmann, 2005), apparently a few decades after the reduction of egg collecting, probably because of conservation concerns. However, the last three decades had a resurgence of skin collecting, especially in Brazil, whereas egg collecting had a resurgence only since 2010's. Fortunately, more recently some researchers in several states started egg collections, especially with field expeditions held by COMB in regions with scarce egg collecting in Brazil, such as the states of Acre, Tocantins, and Paraná. This recent increase in egg collecting probably occurred because of a recent increase of breeding biology studies in Brazil by several research groups.

Collectors

Historically, egg collecting was undertaken both by scientists and egg collectors or dealers from several countries (Birkhead, 2016; Mason & Pfitzner, 2020). In Brazil, however, egg collectors and dealers were apparently scarce, except for a few persons from Minas Gerais and Santa Catarina, and the exchange and commercial trades of eggs from Brazil were weaker than in other Neotropical countries, such as Argentina. Scientists had a smaller contribution for egg collecting in Brazil than amateurs, and no naturalist/scientist made outstanding contributions, which suggests that eggs were not the focus of their research. Major resident collectors (*e.g.*, J.C. Guimarães Sobrinho, C. Estevão, R. Krone, E. Garbe, C.G. Chagas, F. Dias da Rocha, and J.L. Lima) usually collected for years or decades at one or a few localities usually close to where they resided or worked. For foreign collectors (*e.g.*, O. Reiser, E. Snethlage, H.H. Smith, J. Natterer, G.K. Cherrie), most collections were made at one or several regions but during a short period of time. Amateur egg collectors gave an important contribution to the collections in Brazil (*e.g.*, J.C. Guimarães Sobrinho), but some of them lacked to keep specific date and locality about egg sets that could be valuable for scientific purposes (*e.g.*, C.G. Chagas), or had questionable data (*e.g.*, R. Franke). Dozens of recent (> 1980) collectors were omitted here since none collected large number of egg sets, and since most are still active probably holding collections yet unavailable.

Institutions

Egg sets are spread in so many institutions that studying all of them is difficult, time consuming, and expensive, especially since only around half of all egg sets from Brazil are deposited at Brazilian institutions. Increasing the visits to the smaller egg collections overseas would represent a huge effort, but probably will add little to the knowledge of the breeding biology of Brazilian birds, though could add data about hundreds of Neotropical species. Thus, we consider that our research effort represents a reliable picture of the egg sets collected in Brazil until late 2010's. However, our analysis struggled with the fact that several egg collections are poorly stored and curated, and lack specific locality and date about the egg sets. For example, the thousands of eggs deposited at MN belonging to a 'Travassos Collection' could nearly double the number of egg sets of Brazilian birds if we were able to recover the information from each egg set. Also, the private collection of C.G. Chagas at Nova Lima, MG, with thousands of eggs, if transferred to a public institution could also add considerably to our knowledge.

Recommendations

Scientific collections will increase their usefulness if made more accessible (Graham *et al.*, 2004; Peterson

et al., 2005). However, the number of egg collections catalogued, digitized, and available online is still very small, but with some remarkable exceptions, specially the large WFVZ collection (<https://www.wfvz.org>), but also CAS (<https://researcharchive.calacademy.org>), FMNH (<https://collections-zoology.fieldmuseum.org>), MVZ (<https://mvz.berkeley.edu>), and YPM (<https://collections.peabody.yale.edu/search>). Portals such as the Arctos Collaborative Collection Management Solution (<http://arctos.database.museum>), the Global Biodiversity Information Facility (<https://www.gbif.org>), VertNet (<http://vertnet.org>), and Species Link (<https://specieslink.net>), give access and facilitate the retrieval of egg data deposited in several institutions, including those that lack their own web database. The low number of institutions at this level of accessibility reflects lack of investment. Improving data usage, however, requires both open access to data, but also standards for data storage and mechanisms for feedback that allow improving data quality (Cicero *et al.*, 2017). The process to make collection information available is costly in time, human, and physical resources. Simple tasks usually need well-trained staff. For example, very often the information on slip cards is hard to be read (due to calligraphy) and copying the information to databases might be slow. Also, it is also desirable that egg sets are photographed, preferentially together with a scale, but the equipment may be costly. Additionally, such delicate specimens need well trained staff taking as much time they need to handle them. The tradition and methods of egg collecting was almost lost, but recommendations for the preparation, use and curation of egg collections were published by Rockwell (1908), McNair (1987), Sutcliffe (1993), Walters (1994), Limbert (2003), and Corado (2005). Therefore, it is necessary to increase investments both in personal, training and equipment resources to make egg collections accessible.

Egg sets without specific locality and specific collecting date are of limited scientific value for most studies but can be very useful for destructive analyses (Russell *et al.*, 2010). However, recent development of genetic barcoding of eggshell collections can allow the identification of these eggs and improve the reliability and use of egg collections (Grealy *et al.*, 2021). Egg sets that lack locality, many collected before 1900, could have their habitat reconstructed and their region traced with isotopic analyses (Barrick, 1998; Johnson *et al.*, 1998; Niespolo *et al.*, 2020).

Private egg collections were not considered here mainly because of their restricted access, and because their usefulness to scientific studies is often limited. For example, the egg collections from 'Ovolândia' cited above and from 'Museu do Enéas' (Marini *et al.*, 2018), lack specific locality, date and collector. However, donations of private collections to public institutions could make them highly useful for a broad public and help fill the gaps of knowledge still existent, as has been done in Australia (Joseph, 2011).

A scientifically sustained, planned and ethical collection of eggs (Winker *et al.*, 1991; Remsen, 1995, 1997; Vuilleumier, 1998; Collar, 2000; Joseph, 2011; Rocha *et al.*,

2014) should continue in Brazil since the breeding biology of many species is still poorly known and since egg sets can be useful for ecological, evolutionary and conservation studies (review in Marini *et al.*, 2020). The extensive and even overexploited egg collecting by private collectors as a hobby, common in Europe and North America among other countries between 1880's and 1930's (Grinnell, 1906; Storer, 1930; Kiff, 1989), did not occur in Brazil and in most Neotropical countries. Also, it might never occur due to increased environmental awareness and the current environmental legal and institutional framework existent in Brazil and other countries.

CONCLUSIONS

The fact that egg collections of Brazilian birds are very poorly represented either in Brazil or overseas, and the fact that Brazilian collections hold a very small proportion (0.3%) of the world egg sets, indicate the need to improve Brazilian egg collections. The poor historical tradition of studying birds' breeding biology in Brazil compared to other countries (Heming *et al.*, 2013) is already being changed by current scientists. The available egg sets are widespread in dozens of museums, but for those interested in using museum egg sets in their studies, MZUSP is the place to start in Brazil together with the available online collections. José Caetano Guimarães Sobrinho was probably the greatest egg collector in Brazil, and his nephew, Caio Guimarães Chagas, was probably the greatest collection owner in Brazil. The formidable collection assembled by this family of oologists deserves additional studies and cataloging, and efforts to trace out the whereabouts of remaining part of their collections, including their data slips/cards. A recent increase in egg collecting shows a renewed interest in assembling this type of bird vouchers, which is important to provide resources for new studies on the ecology, evolution, and conservation of Brazilian birds.

AUTHORS' CONTRIBUTIONS: MÂM: Conceptualization, Supervision, Writing – original draft; MÂM, NMH, NOMS, MAA, LEL: Funding acquisition; Methodology, Data curation, Writing – review and editing; All authors actively participated in the discussion of the results, they reviewed and approved the final version of the paper.

CONFLICTS OF INTEREST: Authors declare there are no conflicts of interest.

FUNDING INFORMATION: The first author is grateful to Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) (number process: 473281/2013-9), to Fundação de Apoio a Pesquisa do Distrito Federal (FAP-DF) (number process: 0193.000839/2015), and to Capes-PrInt/PPG Ecologia-UnB for grants to support this research. NOMS is grateful to Delaware Museum of Natural History and FAP-DF (number process: 00193.00001247/2018-24) for grants to support this research. NMH received a postdoc fellowship from Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), MAA received a PhD fellowship and LEL and MÂM received research fellowships from CNPq.

ACKNOWLEDGMENTS: We thank several members of the Laboratório de Ecologia e Conservação de Aves for helping with museum visits and data curation. We thank curators and managers for providing information, and for their efforts to conserve, correct, and caretake the egg collections.

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