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BRAZILIAN ORNITHOLOGY: HISTORY AND CURRENT TRENDS

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Resumo. – Ornitologia brasileira: história e tendências atuais. – O desenvolvimento das pesquisas ornitológicas no Brasil pode ser dividido em três fases: exploração estrangeira (1500 até metade do século XIX), a dos museus de história natural (metade do século XIX até anos 70) e a fase moderna (a partir dos anos 70), quando os pesquisadores associados a universidades passaram a ser maioria. A primeira fase foi marcada pela presença de naturalistas estrangeiros que coletaram um grande número de espécimes e informações da avifauna brasileira que foi depositado em museus principalmente europeus. Na segunda fase, a pesquisa ornitológica passou a ser realizada nos museus de história natural, instituições que foram criadas em cidades brasileiras grandes e desenvolvidas, usando instituições européias como modelos. A ênfase das pesquisas nesta fase foi dada à taxonomia e à documentação da distribuição geográfica das espécies. Os museus de história natural, entretanto, não tiveram como tradição a formação de recursos humanos. A terceira fase da ornitologia brasileira inicia-se quando os estudos sobre a avifauna começaram a ser desenvolvidos na crescente rede nacional de universidades. A ênfase inicial dos estudos nas universidades foi a pesquisa sobre a ecologia das espécies e comunidades. Isto proporcionou a criação de muitos grupos de pesquisa locais e, consequentemente, a qualificação acadêmica de várias gerações de ornitólogos brasileiros. Atualmente, a formação de novos ornitólogos se dá em cursos de pós-graduação nas áreas de zoologia, ecologia, genética e biologia geral. Uma análise dos resumos dos trabalhos apresentados nos Congressos Brasileiros de Ornitologia (promovidos regularmente pela Sociedade Brasileira de Ornitologia), observa-se uma tendência ao aumento de estudos quantitativos em relação aos descritivos. O número de estudos em ecologia e comportamento é maior quando comparado a outros temas. Um dos grandes desafios da ornitologia brasileira é integrar as informações coletadas pelos museus de história natural, universidades, institutos de pesquisa e organizações governamentais e não-governamentais para expandir o conhecimento teórico sobre aves, abrindo frentes inovadoras de investigação e promovendo estratégias consistentes para a conservação da rica avifauna brasileira.

Abstract. – The development of Brazilian ornithology can be divided into three phases: foreigner expeditions (1500 to mid-XIX century), the natural history museums (mid-XIX century to 1970s), and the modern phase (since 1970), when researchers associated to universities became the majority. The first phase was characterized by the presence of foreign naturalists (mostly Europeans) that collected a great number of specimens and information on the Brazilian avifauna. All these information was deposited in foreign museums. During the second phase, most of the scientific work was conducted in natural history museums, institutions created in the large and developed Brazilians cities with European institutions as models.

The research focus was mostly on taxonomy and geographic distribution of species. The natural history museums lacked the tradition of investing in the formation of human resources and new generations of ornithologists. The third phase started in the 1970s, and was characterized by the dominance of research conducted within the ever-growing system of public and private universities. The initial focus in universities was research on species and community ecology. The shift from museums to universities allowed the development of many new research groups, allowing young Brazilian ornithologists to receive formal training in ornithology. Currently, new ornithologists are formed in several graduate programs in zoology, ecology, genetics, and general biology. A simple analysis of abstracts presented in the Brazilian Ornithological Congress (regularly uphold by the Brazilian Ornithological Society) indicated a clear trend towards quantitative rather than qualitative studies. In addition, the number of studies in ecology and behavior is high compared to other topics. One of the major challenges of current Brazilian ornithology is to integrate information collected by natural history museums, universities, research institutes, governmental and non-governmental organizations to expand the theoretical knowledge on birds, opening new venues of innovative research as well as developing new approaches for the conservation of the rich Brazilian avifauna. *Accepted 21 November 2007.*

Key words: Birds, Brazil, museums, universities, ornithology, history.

DEVELOPMENT OF BRAZILIAN ORNITHOLOGY

The history of Brazilian ornithology can be divided into three major phases: a) the foreigner expeditions (from 1500 to mid XIX century), b) the natural history museums (from mid XIX century to 1970s), and c) the modern phase (since 1970s).

Foreigner explorations and the natural history museums phases. During the phase of foreign expeditions, from 1500 to the end of the 19th century, the information on Brazilian birds was mostly produced by European naturalists working for their natural history museums (Pinto 1979, Sick 1997). The only exception was Alexandre Rodrigues Ferreira, a Brazilian who conducted a successful expedition supported by Portugal (Goeldi 1982).

During the phase of natural history museums, since the second half of the 19th century, the scientific study of birds was conducted only in natural history museums, institutions that had been created in some of the large and rich cities of Brazil, following European models. Three museums gave a remarkable contribution to ornithology: Museu Nacional (currently part of the Universidade Federal do Rio de Janeiro), Museu Paraense Emílio Goeldi (currently a research institute associated to Ministério da Ciência e Tecnologia), and Museu de Zoologia da Universidade de São Paulo. During this phase, research was focused on taxonomy and geographic distribution of species. Sometimes, other aspects of bird biology were also investigated by museum ornithologists. Emilie Snethlage, from Museu Goeldi, produced an excellent introduction on Brazilian birds' eggs (Snethlage & Schreiner 1929); Olivério Pinto, from Museu de Zoologia da Universidade de São Paulo, wrote a classic study on bird reproduction in Belém (Pará) region, based on the nests, skins and eggs from collections made by Carlos Estevão (Pinto 1953); Fernando Novaes, from Museu Goeldi, conducted pioneer studies of bird communities, first for restingas (Novaes 1950), and later for Amazonian ecosystems (Novaes 1958, 1969, 1970, 1973). Finally, Helmut Sick (Museu Nacional) was remarkable for his detailed studies on ecology and behavior of Brazilian birds (see Gonzaga 1991).

During this phase, ornithologists at natural history museums, particularly foreigners,

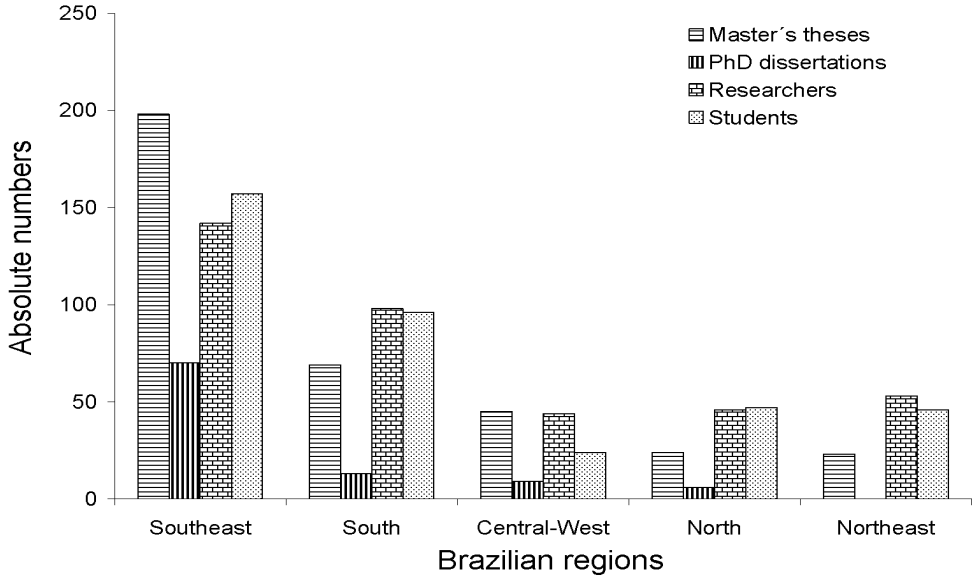

FIG. 1. Number of master's theses, PhD dissertations, researchers and students listed in the Lattes database of curriculum and institutions of science and technology areas in Brazil (Conselho Nacional de Desenvolvimento Científico e Tecnológico – CNPq) according to their distribution in Brazilian regions (*http://lattes.cnpq.br/index.htm*, *http://dgp.cnpq.br/buscaoperacional/do*, *http://servicos.capes.gov.br/capesdw/resumo.html*, searched in April 2007).

did not invest time and efforts for building new generation of Brazilian ornithologists. The few exceptions were Helmut Sick and Fernando Novaes, perhaps due to their formal academic education. For more detailed information about the development of Brazilian ornithology during this phase, see Alves & Silva (2000).

The modern phase. Since the 1970s, there was a remarkable development of universities in Brazil. As a consequence, there was a need to have more professionals with graduate studies to teach the ever-growing number of young students that were starting their undergraduate studies. Brazilian universities hired both foreigner and Brazilian ornithologists that had no or almost no connections with the ornithology work previously developed in natural history museums. This new generation of ornithologists working in Brazil mostly focused their research on ecology and behavior, which impressive body of theory had just began to be built.

From these very few university professors, the Brazilian ornithology expanded exponentially. Paynter (1991) documented that the number of publications on Brazilian birds augmented rapidly since the mid-1970s. Two governamental agencies, Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) and Coordenação de Aperfeiçoamento de Pessoal de Ensino Superior (CAPES), supported the graduate studies of several Brazilian ornithologists in Brazil and abroad. As a consequence, the number of graduate programs that had ornithology as one of its major research lines grew remarkably. The number of theses and dissertations on ornithology increased during 1980s

(Borges 1995) compared to the previous decade, and increased threefold in the 1990s (Borges & Uejima 2000). Theses and dissertations were more frequently on ecology and behavioral rather than on other subjects, reflecting the trends in research topics experienced since the 1970s.

Currently, new ornithology researchers can get formal scientific training at several graduate programs (zoology, ecology, genetics and related areas) across the whole country. Institutions that include these programs with finished dissertations and thesis from 1970 to 2004 are in Appendix 1 (according to Borges 1995 and Portal CAPES: *http://servicos.capes.gov.br/capesdw/resumo.html*, using search terms like "ornitologia", "avifauna" and "aves"). The total number of PhDs in ornithology working in Brazil and recorded searching CV Lattes/CNPq (see site below) was 117. The highest concentration of institutions is in southeastern (14) and southern (11) regions.

From 1970 to 2004, 98 theses and 359 dissertations on ornithology were produced (excluding those related to aviculture), with 89% of them since 1992. These studies were concentrated in central-southern Brazil (Fig. 1), with the southeastern region having the highest number of researchers, students (*http://lattes.cnpq.br/index.htm*; *http://dgp.cnpq.br/buscaoperacional/do* using search term: "ornitologia"), and institutions.

The growth of graduate programs since the 1970s promoted the development of new research groups in ornithology, and therefore an increase in publications. From early 1970s to the end of that decade, the number of publications on Brazilian birds more than doubled (Paynter 1991), whereas the number of publications increased three-fold towards the 1980s (from approximately 17 to 56 per year, respectively). Oniki & Willis (2002) produced a list of Brazilian ornithological publications from almost 500 years (1500 to 2002), and more information about recent publications can be found in Revista Brasileira de Ornitologia (RBO). Within Latin America, Brazil, Argentina and Mexico are the countries with the highest bird-related scientific production (Paynter 1991).

Since the mid-1970s, several new bird journals have been launched, but several of them (Sociedade Ornitológica Mineira – SOM, Charão, Anais da Sociedade Sul-RioGrandense de Ornitologia, Sulornis, SOBoletim, Atobá and Boletim CEO) had short existences (Paynter 1991). The first journal covering the whole country and topics was Ararajuba (presently RBO), published annually since 1990 by the Brazilian Ornithological Society (Sociedade Brasileira de Ornitologia, SBO). This society, presently with 550 members from Brazil and other countries, was officially founded in 1984 (Alves & Silva 2000), aiming to integrate ornithologists through congresses and publications. Beyond the publication of RBO, the SBO promotes the Brazilian Ornithological Congresses (Congresso Brasileiro de Ornitologia - CBO). Since 1996, the RBO has been published twice a year. A total of 14 volumes and 25 numbers have been published so far, counting 163 papers, 183 scientific notes and 17 reviews. The SBO also organizes and/or supports ornithological discussion groups such as Núcleo de Coleções Científicas, Comitê Brasileiro de Registros Ornitológicos, and Núcleo de Observadores de Aves.

The Centro de Estudos de Migrações de Aves (CEMAVE) was created in 1977 by Instituto Brasileiro de Desenvolvimento Florestal (IBDF) to organize and coordinate the bird banding network in Brazil, as well as to help execute actions and political decisions to conserve wild birds and their habitats (*http://www.ibama.gov.br/cemave*). Since 1992 it is named Centro Nacional de Pesquisa para Conservação de Aves Silvestres (but the acronym CEMAVE has not changed), and cur-

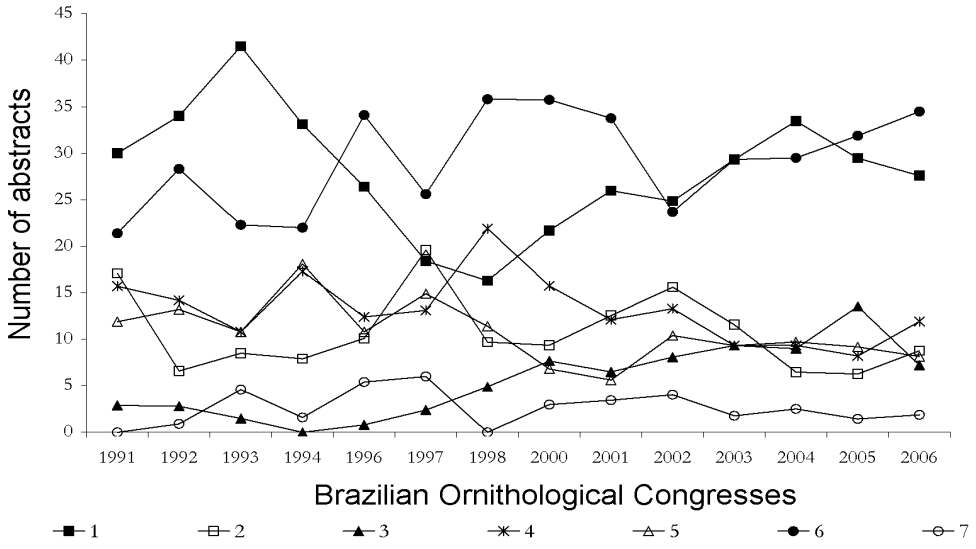

FIG. 2. Variation in the number of abstracts presented in Brazilian Ornithological Congresses (Congressos Brasileiros de Ornitologia - CBOs) from 1991 to 2006, according with research subjects (1: faunistic/biogeography, 2: behavior/foraging, 3: systematic/evolution, 4: breeding, 5: conservation/management, 6: population/community ecology, and 7: others).

rently has 387 recorded bird banders, including 188 seniors (experienced bird banders). As expected, the southeastern and southern regions concentrate 68% of the bird banders, while the large Amazonia, in the northern region (which houses a high bird diversity), has only 4%. In 2005 CEMAVE launched a new bi-annual journal "Ornithologia" to publish bird banding activities in Brazil. Two volumes have been published so far, totaling 17 papers.

TRENDS OF BRAZILIAN ORNITHOLOGY

To assess current trends in Brazilian ornithological research, we analyzed the abstracts of the 14 CBOs carried out to date. Although congress abstracts are not as accurate as scientific papers to analyze the progress of ornithological studies, they can provide good indicators on what topics have been investigated by young ornithologists across the country, as a hint also of research trends.

Before the CBOs, ornithologists convened during the Brazilian Zoological Congress. Since 1991, the CBOs have occurred annually, except in 1995 and 1999. Between the 1st (1991) and the 14th (2006) CBO, the number of abstracts increased from 71 in 1991 to 319 (349.3%). There was also a marked increase in the number of authors in this period (79 to 543). The relation between the number of authors and that of abstracts (number of authors divided by abstracts) was 1.1 in 1991 and 1.7 in 2006, with the highest number of authors per abstract recorded in 2005 (2.0 authors/abstract).

The abstracts were classified in seven topics: faunistic/biogeography, behavior/foraging, systematic/evolution, breeding, conservation/management, population/community

ecology, and others (Fig. 2). The productivity related to these topics showed much variation. However, population/community ecology presented the largest increase in number of abstracts: approximately 60% from 1991 to 2006, confirming the prediction by Alves & Silva (2000) that this theme would continue its upward trend.

There was an ascendant trend for quantitative studies relative to descriptive ones (Alves & Silva 2000) from 1991 to 1998, and this trend continued towards 2005. The total increase in the relative frequency of quantitative abstracts during this period was 62.5% (ranging from 32.4% in 1991 to 52.7% in 2005), which seems to be a general tendency for the biological sciences (Zar 1984).

PERSPECTIVES

In the last four decades, Brazilian ornithology has developed rapidly, mainly due to the expansion of research in universities in the 1970s, in addition to that of natural history museums. As a consequence, greater interest was generated in ecology and behavior, when compared to topics studied in natural history museums (inventories, systematics and biogeography). More recently, systematics/evolution areas have been expanding, perhaps because museums are incorporating new qualified researchers linked with graduate programs.

The discovery of new taxa (see Alves & Silva 2000, Marini & Garcia 2005) indicate that knowledge of bird biodiversity in Brazil is far from being complete. New techniques for morphological, behavioral and genetic analyses associated to a conceptual change in systematics (according to Alves & Silva 2000) are helping to answer new taxonomic questions. However, biogeography needs further investigation, despite Brazil's contribution toward changes in the dominant paradigms to explain the distribution and diversification of Neotropical birds (see Alves & Silva 2000). New ornithologists need to be trained in the use of geographic information systems (GIS) due to the demands of modern biogeography associated with conservation issues (Cavalcanti 2000, Oren 2000, Pimm 2000). One good example of an integrative study using biogeography, landscape ecology and conservation was developed by Borges (2004) in Amazônia (Parque Nacional do Jaú). Natural history museums' collections are very important in this process, providing organized data bases. In addition, these data are crucial for answering questions on ecology and evolution of Brazilian birds (e.g., ecomorphology, sexual dimorphism, migration patterns, and reproduction, among others).

The great majority of Neotropical birds still lack basic information concerning their biology, ecology and behavior. Such studies are especially necessary for endemic and/or threatened species. Endemic species are more prone to extinction due to habitat fragmentation and loss (Pimm *et al.* 1995, Marini 2000). Integrative studies using basic data on breeding, density, and demographic attributes are needed to plan and expand conservation strategies and actions. A recent and excellent example of this kind of research was developed by Soares (2007) with the White-banded Tanager (*Neothraupis fasciata*), a Cerrado endemic or almost endemic in Central Brazil.

The use of genetic techniques has intensified in several areas such as systematics, breeding, behavior and conservation. The continuity of these studies is important to provide subsidies for conservation actions (Miyaki & Alves 2006). There is a lack of studies in some areas of interest, such as energetics (physiology) (Bryant 2000), interactions between birds, other animal and plant species, including their implications in natural and sexual selection (Colwell 2000), and migration. Regarding migration, we have a fragmented and inconsistent database that needs

to be integrated. Conservation issues such as species translocations are also interesting to approach (Marini & Marinho-Filho 2006).

The main cause of bird extinctions in Brazil is habitat loss due to the expansion of the human activities throughout the country. Continuous and standardized field work is necessary, especially in remote and hardly accessed areas. These studies can generate useful information for conservation plans and to indicate priority areas for conservation. To accomplish this, more ornithologists need to be trained and stimulated to work far from the large urban centers. SBO, mostly through its annual meetings, has an important role in stimulating, updating and integrating individuals interested in scientific ornithological studies in different parts of the country. The Brazilian ornithological community is currently facing the challenges, not only of generating further knowledge, but also of integrating basic information from natural history museums, universities, and research organizations to formulate and test hypotheses, and to extend and diversify bird studies.

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APPENDIX 1. Institutions with academic programs that concluded dissertations and thesis from 1970 to 2004, according to Portal CAPES (*http://servicos.capes.gov.br/capesdw/resumo.html and Borges*, 1995).

North Region: Instituto Nacional de Pesquisas da Amazônia, Museu Paraense Emílio Goeldi/Universidade Federal do Pará.

Northeast Region: Universidade Estadual de Feira de Santana, Universidade Estadual de Santa Cruz, Universidade Estadual do Ceará, Universidade Federal da Paraíba, Universidade Federal de Pernambuco, Universidade Federal Rural de Pernambuco, Universidade Federal do Piauí, Universidade Federal do Rio Grande do Norte.

Central-West Region: Universidade de Brasília, Universidade Federal de Goiás, Universidade Federal de Mato Grosso do Sul , Universidade para o Desenvolvimento do Estado e da Região do Pantanal , Universidade Federal de Mato Grosso.

Southeast Region: Universidade Federal de Minas Gerais, Universidade Federal de Uberlândia, Pontifícia Universidade Católica de Minas, Universidade Federal de Lavras, Universidade Federal de Viçosa, Universidade Federal do Rio de Janeiro, Universidade do Estado do Rio de Janeiro, Fundação Oswaldo Cruz, Universidade Federal Fluminense, Universidade Federal Rural do Rio de Janeiro, Universidade de São Paulo, Universidade Estadual Paulista, Universidade Federal de São Carlos, Universidade Estadual de Campinas.

South Region: Universidade Estadual de Londrina, Universidade Estadual de Maringá, Universidade Federal do Paraná, Universidade Federal de Santa Catarina, Universidade do Vale do Itajaí, Universidade Federal do Rio Grande do Sul, Universidade Federal de Pelotas, Universidade Federal de Santa Maria, Universidade do Vale do Rio dos Sinos, Fundação Universidade de Rio Grande, Pontifícia Universidade Católica do Rio Grande do Sul.