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The contributions of museum collections and of records not involving collections to the knowledge of the bird species composition of the Pantanal, Brazil

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RESUMO. **As contribuições de coletas por museus e de registros sem coleta, ao conhecimento da composição das espécies de aves do Pantanal, Brasil.** O papel de expedições de coleta nacionais e do exterior, e de estudos não envolvendo coletas, ao conhecimento da avifauna do Pantanal foi examinado. Este estudo utilizou informações recentemente publicadas em uma revisão de registros de aves no Pantanal que envolveu pesquisa em coleções ornitológicas, revisão de literatura e comunicações pessoais. De 377 espécies coletadas no Pantanal, 331 (88%) foram depositadas em quatro museus nacionais, enquanto 323 espécies (86%) foram depositadas em 10 museus do exterior. Apesar desses números comparáveis, expedições nacionais e do exterior diferiram fortemente quanto ao período de sua realização. Expedições do exterior iniciaram coletas no século XIX e obtiveram maiores coleções até 1930s. Por outro lado, coletas por museus nacionais iniciaram-se no começo do século XX e obtiveram maiores números de espécies nas décadas de 1930 e 1940. Expedições de coletas menos expressivas foram conduzidas entre as décadas de 1950 e 1990, por museus do Brasil e do exterior, trazendo valiosas contribuições a inventários locais, mas obtendo somente espécies coletadas previamente no Pantanal por outras expedições. Assim, o número acumulado de espécies coletadas não sofre aumentos substanciais desde a década de 1940. Seis décadas marcadas por relativamente poucas publicações (1920s a 1970s) separam um período dominado por estudos envolvendo coleta de espécimes (1800s a 1910s) de outro marcado pelo domínio de publicações não considerando tal atividade (1980s até 2002). Como conseqüência, aumentos mais expressivos na riqueza acumulada de espécies ao longo do histórico de inventários são devido a expedições de coleta, enquanto aqueles aumentos em décadas mais recentes resultaram de estudos não envolvendo coletas. Expedições de coleta no Pantanal são recomendadas a fim de compensar o dramático declínio de tal atividade durante as últimas quatro décadas.
PALAVRAS-CHAVE: Aves, avifauna, coleção, inventário, museus, neotropical, Pantanal, planície.

ABSTRACT. The role of overseas and national collecting expeditions and of studies not involving collections to the knowledge of the Pantanal's avifauna was examined. This study used information recently published in a review of bird records in this wetland, involving research in museums, literature review, and personal communications. Of 377 species collected in the Pantanal, 331 (88%) were deposited in four Brazilian museums, while 323 (86%) were deposited in 10 foreign museums. Despite similar numbers, national and foreign expeditions differed strongly in their years of operation. Foreign expeditions were initiated in the 1800s and obtained major collections until the 1930s. On the other hand, national museums initiated expeditions in the early 1900s and achieved the highest species richness during the 1930s and 1940s. Relatively less extensive bird collecting conducted between the 1950s and the 1990s made valuable contributions to local inventories, but included only species previously collected in the Pantanal. Thus, overall species richness of collections has not increased substantially since the 1940s. Six decades with relatively few publications (1920s to 1970s) separate a period dominated by publications concerning collections (1800s to 1910s) from a subsequent period not involving collections (1980s to early 2000s). As a result, major increases in the accumulated bird species richness along the history of inventories were due to collecting expeditions, while in recent decades information was not the result of collections but rather from other field records. Collecting expeditions in the Pantanal are recommended to compensate for the dramatic decrease in such activity during the last four decades.
KEY WORDS: avifauna, bird, collection, inventory, museum, neotropical, Pantanal, wetland.

The first studies on birds in the Pantanal were conducted by Johann Natterer in the beginning of the nineteenth century (Brown 1986, Dubs 1992, Tubelis and Tomas 2003), and published in a major book on birds collected in Brazil (Pelzeln 1870). Posterior studies on the Pantanal's avifauna published until the early decades of the twentieth century involved primarily numerous collections, which were joined in a remarkable review on bird species found in the former state of Mato Grosso (Naumburg 1930). Since then, numerous expeditions have been conducted in the Pantanal by national and overseas institutions, as well as several studies not involving collections (Tubelis and Tomas 2003). This recent review revealed that the bird species richness found in the Pantanal is about 30% higher than that considered by previous publications (Brown 1986, Dubs 1992). Although Tubelis and Tomas (2003) have grouped the records of each species according to the occurrence or not of collection, no overall comparison concerning the relative contribution of studies involving, or not involving, collections of specimens were done.

Thus, this study aims to examine the contribution of col-

lections, and of records not involving collections, to the knowledge of the bird species composition found in the Pantanal. We also aim to make comparisons between the activities of Brazilian and overseas museums through the history of collecting inventories. Species richness and publications were distributed chronologically from the 1800s to the 2000s to examine patterns on temporal variation in bird recording in the Pantanal.

METHODS

The Pantanal

The limits of such wetland considered in this study were those presented by Silva and Abdon (1998). The Pantanal is located in the central portion of South America, where it comprises approximately 140 000 km^2 in the Brazilian territory and occupies about one third of the Rio Paraguai hydrographic basin (Godoi 1986). Further information on characteristics of this ecosystem can be found in references on abiotic factors (Adámoli 1986, Alfonsi and Camargo 1986, Carvalho 1986, Godoi 1986, Tarifa 1986, Hamilton *et al.* 1995, 1996) and vegetation (Prance and Schaller 1982, Ratter 1988, Prado *et al.* 1992, Schessl 1999).

Records considered in this study

All bird records presented in a recent review on bird species found in the Pantanal (Appendix I in Tubelis and Tomas 2003) were considered in this study. It involved four major sources of records: 1) a literature review of studies published between 1870 and 2002; 2) research in ornithological collections of Brazilian museums: Fundação Museu de Ornitologia (FMO), in Goiânia; Museu de Zoologia da Universidade de São Paulo (MZUSP), in São Paulo; Museu Nacional (MNRJ), in Rio de Janeiro; 3) research in ornithological collections of American museums: The American Museum of Natural History (AMNH), in New York; The Field Museum (FMNH), in Chicago; The Museum of Comparative Zoology (MCZ), in Cambridge; The National Museum of Natural History (NMNH), in Washington; 4) unpublished records provided by ornithologists who visited the Pantanal in the 1990s. Further details on these sources of records can be found in Tubelis and Tomas (2003).

Chronological division

Dates of bird records (involving collection or not) and those of publications were grouped in the following chronological categories: 1800s (1825 to 1899), early 1900s (1900 to 1909), 1910s (1910 to 1919), 1920s (1920 to 1929), 1990s (1990 to 1999) and early 2000s (2000 to 2002). Some publications involving records without collection received special treatment. Eight publications having recorded birds in two of the periods mentioned above (Yamashita and Valle 1990, Antas 1994, Lourival and Fonseca 1997, Araújo 2001, Guedes *et al.* 2001, Antas 2002, Guedes 2002, Seixas *et al.* 2002) had their species placed in both chronological categories. For example, species recorded by Yamashita and Valle (1990) between 1979 and 1984 were considered as being recorded in the 1970s and in the 1980s. Also, 14 other publications not informing the dates of record (Sick 1979, Antas 1983, Sick 1984, 1986, Alho *et al*. 1988, Munn *et al.* 1989, Mittermeier *et al.* 1990, Yamashita 1992 a, b, Willis 1995, Sick 1997, Carciofi 2002, Galetti *et al.* 2002, Guedes and Seixas 2002) had their records placed in the decade of the publication and in the previous decade. For example, those species mentioned in Antas (1983) were included in the 1980s and in the 1970s.

Categories of species

Birds heard, seen and/or captured were considered records not involving colons. Specimens collected were classified according to the nationality (national or overseas) of expeditions responsible for their acquisition in the Pantanal. Only two types of situation deserve more detailed explanations. First, species collected by J. Hidasi in Poconé, Fazenda Rio Claro and Santa Rosa (1973 and 1974) and deposited overseas (NMNH and FMNH) were considered as collections obtained by national museums, because they were just purchased from the FMO. The same was adopted for species collected in Miranda in 1930 by staff of the MZUSP and deposited in the FMNH. However, such species were included in the richness of species currently found in overseas museums. Second, species present in the MCZ were considered as collections made by overseas institutions, even with labels of skins crediting the collections to staff of MZUSP. Such procedure was adopted because staff of MCZ came to the Pantanal and collected the specimens in association with staff of this Brazilian museum (Pinto 1945), and did not just purchase the specimens.

RESULTS AND DISCUSSION

Chronological distribution of collections by overseas and national institutions

Expeditions collecting birds in the Pantanal were entirely dominated by overseas museums during the 1800s (figure 1), when Johann Natterer (Pelzeln 1870) obtained most of the 196 species collected in this period. Collections made during the early 1900s totalled 148 species, most being obtained by overseas museums. The MNRJ was responsible for the 26 species collected by national museums, while most of the 130 species collected by overseas institutions were obtained during expeditions conducted by Mocquery (Ménégaux 1917) and Grant (Grant 1911a, b, c). The 1910s were marked by the collection of 200 species (figure 1). Of them, 112 species were obtained by Brazilian museums, mainly from expeditions coordinated by staff of the MZUSP. The bird skins obtained by overseas expeditions during the 1910s totalled 147 species, and were collected mainly by the Roosevelt expedition (Naumburg 1930). A relatively smaller sample of the Pantanal's avifauna (84 species) was obtained during the 1920s, when the MNRJ and the FMNH collected 40 and 61

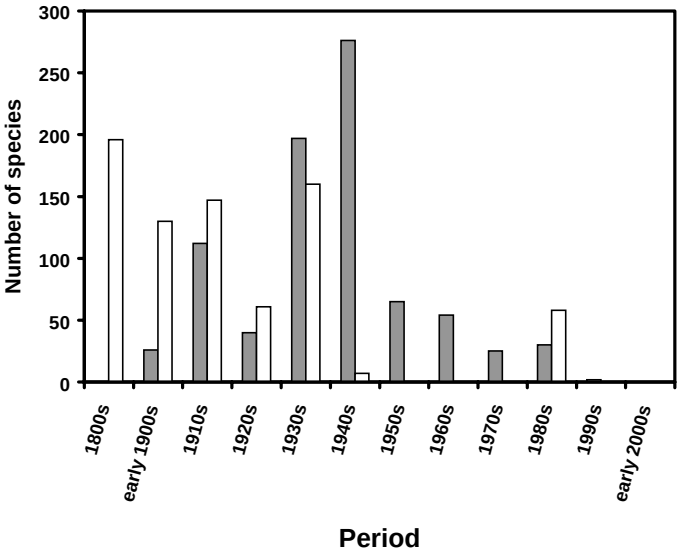

Figure 1. Chronological distribution of the number of bird species collected in the Pantanal wetland during expeditions conducted by Brazilain (grey bars) and overseas (white bars) institutions.

species, respectively. The 1930s, however, were a period marked by outstanding collections made by both Brazilian and overseas expeditions (figure 1), which summed 239 species. During this period, collections made by Rehn (Stone and Roberts 1934) and those obtained by the MCZ summed 160 species, and represented all the results of overseas expeditions. On the other hand, national expeditions were uniquely conducted by staff of the MZUSP, whose efforts obtained 197 species (Pinto 1932, 1938, 1940, 1944, Tubelis and Tomas 2003).

The 1940s were characterized by remarkable dominance of species obtained by national museums (figure 1) due to participation of numerous national institutions, which collected an outstanding richness of 276 species. The most relevant achievements in terms of number of species were those obtained by the MZUSP, the MNRJ, the Museu da Fauna, the Instituto Oswaldo Cruz, the Instituto Tecnológico and the Fundação Rockfeller (Moojen *et al*. 1941, Travassos and Freitas 1942, Pinto 1948, Schubart *et al.* 1965, Aguirre and Aldrighi 1983, 1987, Pacheco and Bauer 1994, Tubelis and Tomas 2003). However, seven species collected by the MCZ (Tubelis and Tomas 2003) were the unique achievements of overseas museums, and did not add new species to the overall richness obtained in this decade.

The contribution of collections to the knowledge of the Pantanal's bird species composition was relatively smaller during the 1950s, when 65 species were obtained, uniquely by national institutions (figure 1). National institutions achieving greatest results in this period were the same of the 1940s (Travassos *et al.* 1957, Sick 1961, Schubart *et al*. 1965, Aguirre and Aldrighi 1983, Aguirre 1984, Aguirre and Aldrighi 1987, Tubelis and Tomas 2003). The majority of these species were deposited in the MNRJ. The 1960s were marked by even smaller collections (54 species), with no participation of overseas expeditions. All these records were firstly published in Tubelis and Tomas (2003) and result primarily from efforts of Hidasi (FMO). During this period, six species were also collected by MZUSP.

Overseas museums did not sample the Pantanal during the 1970s (figure 1), when only 25 species were collected, mostly by the FMO (published in Tubelis and Tomas 2003). Birds were collected again by overseas institutions during the 1980s, when Dubs obtained 58 species for the Zoologisches Museum der Universität Zürich (Dubs 1983). Collections made by national museums (30 species) were basically the result of FMO's activities (Tubelis and Tomas 2003), totalling 72 species for this decade. Only two species were collected during the 1990s: one by the FMO, and other by the MZUSP. No species have been collected in the Pantanal during the early 2000s (figure 1).

The accumulated bird species richness obtained along the period of collecting inventories (figure 2) leads to some key conclusions. The relatively high number of species collected by overseas museums in the 1800s kept increasing considerably until the 1910s, after which few additional species were obtained by such museums. The relatively lower species richness collected by national museums until the early 1900s increased considerably until more recent dates (the 1940s). As a result, the contribution of overseas institutions to the knowledge of the Pantanal's species composition was much greater than that achieved by national institutions until the 1930s. This situation ended in the next decade, when national institutions accumulated a slightly higher number of species than overseas museums (figure 2). This small difference in the number of species remained practically stable until the recent past. A stability in the overall bird species richness obtained by both national and overseas institutions occurred since the 1950s (figure 2). This might have resulted from the absence of extensive bird collecting after the 1940s (figure 1) and because less remarkable collections conducted since the 1950s contributed to local inventories, but obtained only species previously collected through the Pantanal.

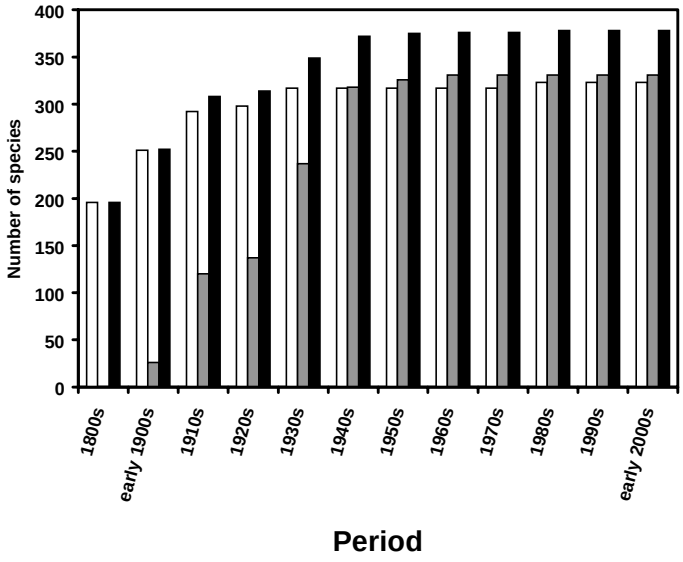

Figure 2. Accumulated number of bird species collected in the Pantanal wetland by national (grey bars) and overseas institutions (white bars), and by both together (black bars).

Material in ornithological collections of Brazilian museums

A total of 331 species were found in national museums. The most outstanding numbers were found in the MNRJ and in the MZUSP, while relatively lower numbers were found in the FMO and in the Museu de Biologia Professor Mello Leitão (table 1).

A search in the reference books of the MZUSP resulted in 101 species whose records had not been published in references on this collection (Pinto 1938, 1940, 1944, 1948). Most of them were collected in Salobra (83 species), while less expressive numbers of species were collected at Cáceres (8), Faz. São Pedro (8), Santo Antônio (4), Porto Jofre (2) and Aquidauana (1). The reference book of the MNRJ collection also reveals skins of bird species from several localities in the floodplain. Most species were collected at Porto Quebracho (164 species) and Salobra (105 species), while considerable smaller number of species were collected at Corumbá (39), Cáceres (22) and Faz. Palmeiras (4). Part of

Table 1. Bird species richness found in overseas and national museums, and the period of their collection in the Pantanal.

Museum	Number of species	Period of Collection
Brazilian Museums		
Fundação Museu de Ornitologia	78	1960s, 1970s, 1980s, 1990s
Museu de Biologia Professor Mello Leitão	12	1950s
Museu de Zoologia da USP	257	1910s, 1930s, 1940s, 1950s, 1980s, 1990s
Museu Nacional do Rio de Janeiro	269	early 1900s,1910s,1920s,1940s,1950s,1970s
Total - Brazilian museums	331	–
Overseas Museums		
Academy of Natural Sciences of Philadelphia	144	1930s
American Museum of Natural History	160	1800s, early 1900s, 1910s
British Museum	82	1800s, early 1900s
Field Museum	67	1920s, 1930s, 1970s
Museum of Comparative Zoology	42	1910s, 1930s, 1940s
Musei di Zoologia ed Anatomia Comparada da Universitá di Torino	61	1800s
Muséum National d'Histoire Naturelle	86	early 1900s
National Museum of Natural History	5	1800s, 1970s
Naturhistorisches Museum Wien	137	1800s
Zoologisches Museum der Universität Zürich	58	1980s
Total – overseas museums	323	–
Total - Brazilian and overseas museums	377	–

this collection has been published previously (Moojen *et al*. 1941, Travassos and Freitas 1942, Pacheco and Bauer 1994).

Of a total of 78 species found in the FMO, most (46 species) were collected at Poconé during the 1960s. From the 1960s until the 1990s, Hidasi collected birds at Poconé (50 species), Corumbá (22), Aquidauana (10), Santo Antônio (3), Miranda (3) and Cáceres (1). This material has been published recently (Tubelis and Tomas 2003). Those bird records concerning the Museu de Biologia Professor Mello Leitão were published by Ruschi (1955).

Material in ornithological collections of overseas museums

Overseas museums containing specimens collected in the Pantanal are more numerous than Brazilian museums, but the total species richness in overseas museums is slightly lower that in national museums (table 1). Three museums have more than 100 species. Of the 160 species deposited in the American Museum of Natural History, 156 had their records published many decades ago (Allen 1891, 1892, 1893, Cherrie 1916, Cherrie and Reichenberger 1923, Naumburg 1930), while records of 12 species were published only recently (Tubelis and Tomas 2003). The Academy of Natural Sciences of Philadelphia has 144 species (Stone and Roberts 1934), while The Naturhistorisches Museum Wien pursuits 137 species (Pelzeln 1870).

Other museum obtaining considerable species richness was The British Museum, whose records were published in Grant (1911a, b, c) and in several volumes of the Catalogue of Birds in the British Museum (compiled by Naumburg 1930). A comparable number of species was deposited in the Muséum National d'Histoire Naturelle, whose records were published in Ménéguax (1917) and Simon (1912). Lower number of species was obtained by the Field Museum, whose records were published only recently (Tubelis and Tomas 2003). Similar species richness were obtained by The Musei di Zoologia da Universitá di Torino (Salvadori 1895, 1900) and by the Zoologisches Museum der Universität Zürich (Dubs 1983). The Museum of Comparative Zoology obtained most of its species by conducting collecting expeditions with the MZUSP (Pinto 1945, Tubelis and Tomas 2003). A much lower number of species found in the National Museum of Natural History was published only in the most recent review on the Pantanal's avifauna (Tubelis and Tomas 2003). Recent research concerning the Pantanal's avifauna has not been conducted in the collections of the European museums (Tubelis and Tomas 2003). Thus, this study might have underestimated the species richness currently deposited in European museums.

Chronological distribution of publications

Publications concerning only collections comprised 41% of all studies on bird species in the Pantanal and dominated the publications until the 1920s. Since then, the number of such studies published per decade became low, disappearing completely after the 1980s (table 2). Research involving only records without collection was firstly published in the 1970s (Reichholf 1976, Sick 1979). This kind of publication be-

Table 2. Chronological distribution of the number of publications on bird species recorded in the Pantanal. Publications were divided according to the type of record in each study: those with only collection (C), those with no collection (N), and those with these two types of records (CN).

Period	C	N	CN	Total
1800s	18	0	1	19
early 1900s	5	0	0	5
1910s	10	0	0	10
1920s	2	0	0	2
1930s	2	0	3	5
1940s	3	0	2	5
1950s	2	0	0	2
1960s	3	0	0	3
1970s	0	2	0	2
1980s	3	8	2	13
1990s	0	30	2	32
early 2000s	0	21	0	21
All periods	48	61	10	119

came considerably more common during the 1980s. Numerous studies published during the 1990s, and between 2000 and 2002, strongly contributed to place such investigations as the most frequent type of publication on the Pantanal's avifauna (table 2).

Publications providing information on both specimens collected, and records not involving collection, comprised a minor portion (8%) of the studies on bird species recorded in the Pantanal (table 2). Six of them were published several decades ago (Pelzeln 1870, Naumburg 1930, Pinto 1932, Stone and Roberts 1934, Pinto 1940, 1948) and had as major results outstanding checklists of species collected, which were complemented with additional comments on few species only observed during such expeditions. The other four publications of this category were published more recently. They were major checklists of the Pantanal wetland (Brown 1986, Dubs 1992) and two publications joining comparable numbers of species collected and not collected (Dubs 1983, Pacheco and Bauer 1994).

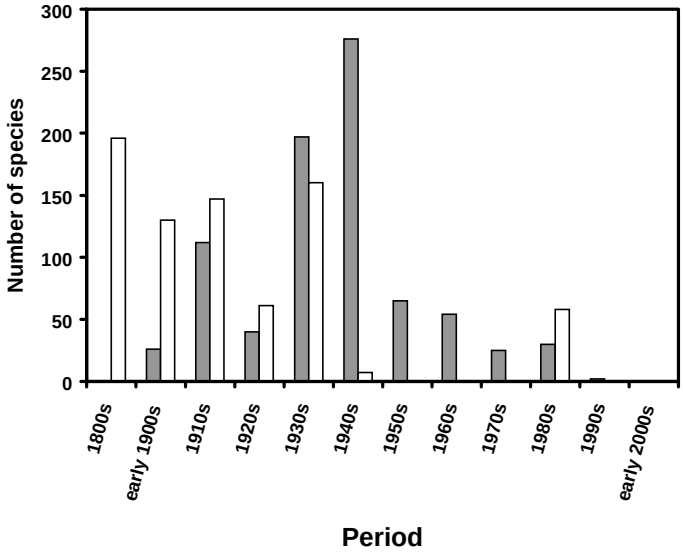

Figure 3. Accumulated bird species richness recorded in the Pantanal wetland by collecting expeditions (grey bars) and by investigations not involving specimen collection (white bars), and by both together (black bars).

A comparison of investigations involving or not involving collection of specimens

Of 463 species found in the Pantanal, 433 (93%) were recorded by investigations not involving collection, while 377 species (81%) were obtained by collecting expeditions. This higher species richness recorded by non-collecting methods occurred only since the 1980s (figure 3). It occurred because such methods were not so common in the Pantanal prior to this period (table 2), thus usually occasioning the recording of less than 50 species per decade until the 1970s (figure 3). A great part of these records were observations of particular species not collected during expeditions by museums (see Pelzeln 1870, Naumburg 1930, Stone and Roberts 1934, Pinto 1932, 1940, 1948). Also, this period of poor contribution by studies not involving collection was marked and anticipated by extraordinary participation of collecting expeditions. Such collections were the major responsible for the overall species richness recorded in the Pantanal between 1800s and 1970s (figure 3).

The total bird species richness recorded by both methodologies presented two major increases along the history of inventories (figure 3). A gradual increase occurred between 1800s and 1940s, as a major result of overseas expeditions, while the other increase occurred between 1970s and 1990s, due to the conduction of studies not involving collection. Thus, investigations conducted from 1940s to 1970s basically did not record additional species to the overall species richness recorded in the Pantanal, but improved local inventories through this wetland.

CONCLUSION

Two remarkable changes in bird recording occurred along the history of inventories in the Pantanal. First, a dominant participation of overseas museums in promoting knowledge of the bird species composition until the 1920s was replaced by the dominance of national institutions since the 1930s. Second, the greater contribution of collecting expeditions to the recording of species until the 1970s was reversed in the 1980s, when studies involving birds seen, heard and/or captured increased in numbers.

Collecting expeditions targeting the Pantanal's avifauna should be conducted by national museums due to several reasons. First, collecting expeditions had a major role in promoting the knowledge of the Pantanal's species composition (this study). Therefore, collections would certainly help reversing the current unsatisfactory situation of inventories through great part of the wetland (Tubelis and Tomas 2003).

Second, the Pantanal's avifauna has not been the primary target of great part of extensive collecting expeditions, which have spent relatively longer periods in other regions of central South America (see Pelzeln 1870, Allen 1891, 1892, 1893, Salvadori 1895, 1900, Grant 1911a, b, c, Naumburg 1930, Pinto 1945, 1948, Vanzolini 1993). Third, the overall bird species richness collected in the Pantanal has not been suffering substantial increases during the last five decades. Fourth, besides promoting knowledge of species distribution and taxonomy, collections could improve the understanding of the biology of species. For example, although the existence of detailed studies on migratory movement (Cintra and Yamashita 1990) and on food requirements (Schubart *et al.* 1965), such aspects of the avifauna would be better understood with further collections.

Collectors should provide more detailed information on the localities sampled. Numerous expeditions conducted in the Pantanal have not informed if the specimens were obtained in the floodplains or in the highlands of municipalities (Tubelis and Tomas 2003). Geographic coordinates, and even details on the sampled habitat and on the surrounding landscape, could be informed in labels identifying specimens, or in reports, by future expeditions. Besides improving or pioneering local and regional inventories, bird collectors could consider a recently updated checklist of bird species found in the Pantanal (Tubelis and Tomas 2003) in order to obtain species not collected previously in this wetland. The lack of such kind of consideration by collectors in the past decades was likely a major reason occasioning the stability in the overall species richness collected since the 1950s.

Finally, investigations not involving specimen collections also had a major role in obtaining information on the bird species occurring in the wetland. Such studies dominated the ornithological research in the Pantanal during the last twenty years, and hopefully will keep increasing in numbers. As collecting expeditions, such type of research will be essential to direct management, programs and strategies targeting biodiversity conservation in the Pantanal.

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REFERENCES

Adámoli, J. (1986) A dinâmica das inundações no Pantanal, p. 51-61. *In*: EMBRAPA-CPAP (ed.) *I Simpósio sobre recursos naturais e sócio-econômicos do Pantanal*. Corumbá: EMBRAPA.

Aguirre, A. C. (1984) Esclarecimento sobre o pica-pau *Trichopicus cactorum*. *Boletim FBCN* 19:155-156.

——— (1987) *Catálogo das aves do museu da fauna: segunda parte.* Rio de Janeiro: IBDF.

Aguirre, A. C. and A. D. Aldrighi (1983) *Catálogo das aves do museu da fauna: primeira parte.* Rio de Janeiro: Companhia Souza Cruz.

Alfonsi, R. R. and M. B. P. Camargo (1986) Condições climáticas para a região do Pantanal Mato-Grossense, p. 29-42. *In*: EMBRAPA-CPAP (ed.) *I Simpósio sobre recursos naturais e sócio-econômicos do Pantanal*. Corumbá: EMBRAPA.

Alho, C. J. R., T. E. Lacher and H. C. Gonçalves (1988) Environmental degradation in the Pantanal ecosystem. *BioScience* 38:164-171.

Allen, J. A. (1891) On a collection of birds from Chapada, Mato Grosso, Brazil, made by Mr. Herbert H. Smith. Part I – Oscines. *Bull. Amer. Mus. Nat. Hist.* 3:337-380.

——— (1892) On a collection of birds from Chapada, Mato Grosso, Brazil, made by Mr. Herbert H. Smith. Part II – Tyrannidae. *Bull. Amer. Mus. Nat. Hist.* 4:331-350.

——— (1893) On a collection of birds from Chapada, Mato Grosso, Brazil, made by Mr. Herbert H. Smith. Part III – Pipridae to Rheidae. *Bull. Amer. Mus. Nat. Hist.* 5:107-158.

Antas, P. T. Z. (1983) Migration of nearctic shorebirds (Charadriidae and Scolopacidae) in Brazil – flyways and their different seasonal use. *Wader Study Group Bulletin* 39:52-56.

——— (1994) Migration and other movements among the lower Paraná River valley wetlands, Argentina, and the south Brazil/Pantanal wetlands. *Bird Conserv. Intern.* 4:181-190.

——— (2002) Notas sobre *Penelope ochrogaster* na reserva Particular do Patrimônio Natural do SESC-Pantanal, Brasil. *Bull. Cracid Specialist Group* 14:3-9.

Araújo, A. C. (2001) *Flora, fenologia de floração e polinização em capões do Pantanal Sul Mato-grossense*. Tese de doutorado. Campinas: Unicamp.

Brown Jr., K. S. (1986) Zoogeografia da região do Pantanal Mato-grossense, p. 137-182. *In*: EMBRAPA-CPAP (ed.) *I Simpósio sobre recursos naturais e sócio-econômicos do Pantanal*. Corumbá: EMBRAPA.

Carciofi, A. C. (2002) Estudos sobre nutrição de psitacídeos em vida livre: o exemplo da arara-azul (*Anodorhynchus hyacinthinus*), p. 63-98. *In*: Galetti, M. and M. A. Pizo (eds.) *Ecologia e conservação de psitacídeos no Brasil.* Belo Horizonte: Melopsittacus Publicações Científicas.

Carvalho, N. O. (1986) Hidrologia da Bacia do Alto Paraguai, p. 43-49. *In*: EMBRAPA-CPAP (ed.) *I Simpósio sobre recursos naturais e sócio-econômicos do Pantanal*. Corumbá: EMBRAPA.

Cherrie, G. K. (1916) Some apparently undescribed birds from the collection of the Roosevelt South American Expedition. *Bull. Amer. Mus. Nat. Hist.* 35:183-190.

Cherrie, G. K. and E. M. B. Reichenberger (1923) Descriptions of proposed new birds from Brazil and Paraguay. *Amer. Mus. Nov.* 58:1-9.

Cintra, R. and C. Yamashita (1990) Habitáts, abundância e ocorrência das espécies de aves do Pantanal de Poconé, Mato Grosso, Brazil. *Papéis Avulsos de Zoologia* 37:1-21.

Dubs, B. (1983) *Vögel des südlichen Mato Grosso.* Bern: Verbandsdruckerei-Betadruck.

——— (1992) *Birds of southwestern Brazil. Catalogue and guide to the birds of the Pantanal of Mato Grosso and its border areas.* Küsnacht: Bretona.

Galetti, M., P. R. Guimarães Jr and S. J. Marsden (2002) Padrões de riqueza, risco de extinção e conservação dos psitacídeos neotropicais, p. 17-26. *In*: Galetti, M. and M. A. Pizo (eds.) *Ecologia e conservação de psitacídeos no Brasil.* Belo Horizonte: Melopsittacus Publicações Científicas.

Godoi Filho, J. D. (1986) Aspectos geológicos do Pantanal Mato-Grossense e de sua área de influência, p. 63-76. *In*: EMBRAPA-

CPAP (ed.) *I Simpósio sobre recursos naturais e sócio-econômicos do Pantanal*. Corumbá: EMBRAPA.

Grant, C. H. B. (1911a) List of birds collected in Argentina, Paraguay, Bolívia, and Southern Brazil, with field notes. part I Passeres. *Ibis* 5:80-137.

——— (1911b) List of birds collected in Argentina, Paraguay, Bolívia, and Southern Brazil, with field notes. Part II Picariae-Anatidae. *Ibis* 5:317-350.

——— (1911c) List of birds collected in Argentina, Paraguay, Bolívia, and Southern Brazil, with field notes. Part III Columbidae to Rheidae. *Ibis* 5:459-478.

Guedes, N. M. R. (2002) El Proyecto del Guacamayo jacinto Anodorhynchus hyacinthinus en el Pantanal Sur, Brasil, p. 163-174. *In*: Congresso Mundial sobre Papagayos. Conservando Los Loros y Sus Habitats V. Tenerife: Ed. Loro Parque.

Guedes, N. M. R. and G. H. F. Seixas (2002) Métodos para estudos de reprodução de psitacídeos, p. 123-140. *In*: Galetti, M. and M. A. Pizo (eds.) *Ecologia e conservação de psitacídeos no Brasil*. Belo Horizonte: Melopsittacus Publicações Científicas.

Guedes, N. M. R., P. Scherer-Neto, A. C. Carciofi, K. Werther, I. Biasia, A. A. Giovanardi and M. L. Cavalheiro (2001) Order Psittaciformes (Parrots, Macaws, Conures), p. 146- 178. *In*: Fowler, M. E. and Z. S. Cubas (eds.) *Biology, medicine and surgery of South American wild animals*. Ames: Iowa State University Press.

Hamilton, S. K. (1996) Inundation patterns in the Pantanal wetland of South America determined from passive microwave remote sensing. *Archiv Fur Hydrobiologie* 137:1-23.

Hamilton, S. K., S. J. Sippel and J. M. Melack (1995) Oxygen depletion and carbon-dioxide and methane production in waters of the Pantanal wetland of Brazil. *Biogeochemistry* 30:115-141.

Lourival, R. F. F. and G. A. B. Fonseca (1997) Análise de sustentabilidade do modelo de caça tradicional, no Pantanal da Nhecolândia, Corumbá, MS, p 123-172. In: Valladares-Pádua, C. and R. E. Bodmer (eds.) *Manejo e Conservação de Vida Silvestre no Brasil*. Brasília: MCT - CNPq.

Ménégaux, A. (1917) Etude d´une Collection d´Óiseaux du Matto Grosso. *Rev. Franç. D´Orn*. 9:24-88.

Mittermeier, R. A., I de G. Câmara, M. T. J. Pádua and J. Blanck (1990) Conservation in the Pantanal of Brazil. *Oryx* 24:103-112.

Moojen, J., J. C. Carvalho and H. S. Lopes (1941) Observações sobre o conteúdo gástrico das aves brasileiras. *Memórias do Instituto Oswaldo Cruz* 36:405-444.

Munn, C. A., J. A. Thomsen and C. Yamashita (1989) The Hyacinth Macaw, p. 404-419. *In*: W. J. Chadler (ed.) *Audubon wildlife report*. New York: Academic Press.

Naumburg, E. M. B. (1930) The birds of Mato Grosso, Brazil: a report on the birds secured by the Roosevelt-Rondon expedition. *Bull. Amer. Mus. Nat. Hist*. 60:1-431.

Pacheco, J. F. and C. Bauer (1994) A coleção de aves preparadas por Adolf Schneider em Porto Quebracho, Mato Grosso do Sul, Brasil, em 1941. *Nótulas Faunísticas* 64:1-6.

Pelzeln, A. (1870) *Zur Ornithologie Brasiliens. Resultate de von Johann Natterers reisen in den Jahren 1817 bis 1835*. Wien: Witwe e Sohn.

Pinto, O. M. O. (1932) Resultados ornithológicos de uma excursão pelo Oeste de São Paulo e Sul de Matto Grosso. *Revista do Museu Paulista* 17:689-826.

——— (1938) Catálogo das aves do Brasil. Primeira parte. Aves não passeriformes e Passeriformes não Oscines excluída a Família Tyrannidae e seguintes. *Revista do Museu Paulista* 22:1-566.

——— (1940) Nova contribuição à ornitologia de Mato Grosso. *Arquivos de Zoologia* 2:1-37.

——— (1944) *Catálogo das aves do Brasil, 2ª parte. Ordem Passeriformes (continuação): superfamília Tyrannoidea e Subordem Passeres*. São Paulo: Secretaria Agricultura de São Paulo.

——— (1945) Cinquenta anos de investigação ornitológica. *Arquivos de Zoologia* 4:1-80.

——— (1948) Notas e impressões naturalísticas de uma viagem fluvial a Cuiabá. *Boletim do Museu Paraense Emílio Goeldi* 10: 331-354.

Prado, D. E., P. E. Gibbs, A. Pott and V. J. Pott (1992) The Chaco-Pantanal transition in southern Mato Grosso, Brazil, p. 451-470. *In*: P. A. Furley, J. A. Proctor and J. A. Ratter (eds.) *Nature and dynamics of forest-savanna boundaries*. London: Chapman & Hall.

Prance, G. T. and G. B. Schaller (1982) Preliminary study of some vegetation types of the Pantanal, Mato Grosso, Brazil. *Brittonia* 34:228-251.

Ratter, J. A., A. Pott, V. J. Pott, C. N. Cunha and M. Haridasan (1988) Observations on woody vegetation types in the Pantanal and at Corumbá, Brazil. *Notes RBG Edinb*. 45:503-525.

Reichholf (1976) Camp fires and abundance of bird nests in the southern Mato Grosso Cerrados and Pantanal, Brazil. *J. Orn*. 117:464-465.

Ruschi, A. (1955) Algumas observações sobre a Trochilifauna da região do Pantanal Matogrossense, compreendida entre Cáceres e Tapirapoan, ou seja, entre o Pantanal Norte e encosta dos Parecis. *Boletim do Museu Biologia Prof. Mello Leitão* 17:1-19.

Salvadori, T. (1895) Uccelli raccolti nel Paraguai, nel Mato Grosso, nel Tucumã e nella Provincia di Salta. *Boll. Mus. Zool. Anat. Comp. Torino* 10:1-24.

——— (1900) Viaggio del Dr. A. Borelli nel Mato Grosso e nel Paraguai. V. Uccelli. *Boll. Mus. Zool. Anat. Comp. Torino* 15:1-19.

Schessl, M. (1999) Floristic composition and structure of floodplain vegetation in the northern Pantanal of Mato Grosso, Brazil. *Phyton* 39:303-336.

Schubart, O., A. C. Aguirre and H. Sick (1965) Contribuição para o conhecimento da alimentação das aves brasileiras. *Arquivos de Zoologia* 12:95-249.

Seixas, G. H. F., N. M. R. Guedes, J. Martinez and N. P. Prestes (2002) Uso de radiotelemetria no estudo de psitacídeos, p. 141-156. *In*: Galetti, M. and M. A. Pizo (eds.) *Ecologia e conservação de psitacídeos no Brasil*. Belo Horizonte: Melopsittacus Publicações Científicas.

Sick, H. (1961) Die Spechte *Trichopicus cactorum* und *Scapaneus leucopogon* in Brazilien. *J. Orn*. 102:401-403.

——— (1979) Notes on some Brazilian birds. *Bull. B. O. C*. 99: 115-120.

——— (1984) *Migrações de aves na América do Sul continental*. Brasília: Cemave.

——— (1986) Migrações de aves no Brasil, p. 153-187. *In*: Anais do II Encontro Nacional de Anilhadores de Aves. Rio de Janeiro: UFRJ.

——— (1997) *Ornitologia brasileira*. Rio de Janeiro: Editora Nova Fronteira.

Silva, J. S. V. and M. M. Abdon (1998) Delimitação do Pantanal brasileiro e suas sub-regiões. *Pesquisa Agropecuária Brasileira* 33: 1703-1711.

Simon, E. (1912) Note sur quelques Trochilidae du Mato Grosso (Brésil). *Bull. Mus. Hist. Nat. Paris* 18:500-502.

Stone, W. and H. R. Roberts (1934) Zoological results of the Mato Grosso expedition to Brasil in 1931, - Birds. *Proc. Acad. Nat. Sci. Phil*. 86:363-397.

Tarifa, J. R. (1986) O sistema climático do Pantanal. Da compreensão do sistema à definição de prioridades de pesquisa climatológica, p. 9-27. *In*: EMBRAPA-CPAP (ed.) *I Simpósio sobre recursos naturais e sócio-econômicos do Pantanal*. Corumbá: EMBRAPA.

Travassos, L. and J. F. T. Freitas (1942) Relatório da sexta excursão do Instituto Oswaldo Cruz, realizada à zona da Estrada de Ferro Noroeste do Brasil, em Novembro de 1941. *Memórias do Instituto Oswaldo Cruz* 37:259-286.

Travassos, L. , H. Travassos, A. R. Rego-Barros, D. O. Albuquerque, S. J. Oliveira, A. L. Castro and H. S. Lopes (1957) Excursão científica realizada nas zonas das Estradas de Ferro Noroeste do Brasil

e Brasil-Bolívia em janeiro e fevereiro de 1955. *Publicações Avulsas do Museu Nacional do Rio Janeiro* 20:1-19.

Tubelis, D. P. and W. M. Tomas (2003) Bird species of the Pantanal wetland, Brazil. *Ararajuba* 11:5-37.

Vanzolini, P. E. (1993) As viagens de Johann Natterer no Brasil, 1817-1835. *Papéis Avulsos de Zoologia* 38:17-60.

Willis, E. O. (1995) Black versus white waterbird colonies (Aves) in the Bolivian-Brazilian Pantanal. *Iheringia, Sér. Zool*., 78:95-97.

Yamashita, C. (1992a) Comportamento de ararauna (*Anodorhynchus hyacinthinus*), Psittacidae, Aves. *Anais de Etologia* 10:158-162.

——— (1992b) Nada azul com a arara azul. *O Charão* 17:4-7.

Yamashita, C. and M. P. Valle (1990) Sobre ninhais de aves do Pantanal do Município de Poconé, Mato Grosso, Brasil. *Vida Silvestre Neotropical* 2:59-63.