

INSTITUTO DE BIOCÊNCIAS
PROGRAMA DE PÓS GRADUAÇÃO EM BIOLOGIA ANIMAL

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**COMPORTAMENTO DO FLAMINGO-CHILENO *Phoenicopterus chilensis* (AVES:
PHOENICOPTERIFORMES) NUMA LAGUNA DO SUL DO BRASIL**

UNIVERSIDADE FEDERAL DO RIO GRANDE DO SUL

PORTO ALEGRE

2021

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Dissertação apresentada ao Programa de Pós-Graduação em Biologia Animal, Instituto de Biociências da Universidade Federal do Rio Grande do Sul, como requisito parcial à obtenção do título de Mestre em Biologia Animal.

Área de concentração: Biologia e comportamento animal

Orientador: Dr. Caio José Carlos

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APRESENTAÇÃO

A presente dissertação de mestrado é apresentada conforme Resolução N°37/2018, deste Programa de Pós-Graduação em Biologia Animal (PPGBAN) da Universidade Federal do Rio Grande do Sul, que institui procedimentos e normas para apresentação e avaliação da Dissertação de Mestrado e da Tese de Doutorado. O texto principal desta dissertação está estruturado sob a forma de três artigos científicos, escritos em inglês, estruturados na forma de capítulos.

O primeiro capítulo denominado “*What do we know about flamingo behaviors? A systematic review of the ethological research on the Phoenicopteridae family*” é uma revisão sistemática da literatura relacionada ao comportamento das seis espécies de flamingo do mundo, avaliando as características destes trabalhos e fornecendo um panorama geral do estado da arte da etologia do grupo. Este capítulo foi construído sobre as normas da revista *Acta Ethologica* (Qualis A3) e submetido para a mesma.

O segundo capítulo denominado “*Behavioral repertoire of a wild population of Chilean Flamingos Phoenicopus chilensis in southern Brazil*” é um artigo voltado para análise descritiva e qualitativa dos comportamentos observados nos flamingos chilenos do Parque Nacional da Lagoa do Peixe. Este capítulo foi construído e estruturado de acordo com as normas do *Journal of Natural History* (Qualis B1).

Por fim, o terceiro capítulo chamado “*Activity budgets and behavior variation of a wild population of Chilean Flamingos (Phoenicopus chilensis) in southern Brazil*”. O capítulo debate os aspectos quantitativos do comportamento do flamingo chileno na Lagoa do Peixe, analisando a mudança na frequência e na duração das categorias comportamentais ao longo dos meses de observação. O artigo foi construído sobre as normas do *Journal of Field Ornithology* (Qualis A3).

De acordo com o Artigo 43º do Regimento do PPG-BAN, os artigos estão acompanhados de dois capítulos extras, escritos em português. O primeiro, a introdução geral, contém um breve panorama sobre os flamingos e a etologia do grupo, e traz os objetivos e os principais resultados obtidos nos trabalhos. O segundo, após o texto principal, apresenta as principais conclusões e faz uma síntese integrada das discussões promovidas pelos três artigos.

RESUMO

O flamingo chileno (*Phoenicopterus chilensis*) é uma espécie distribuída nas regiões temperadas da América do Sul, indo do Equador até o sul da Argentina, mas se deslocando para regiões no litoral sul do Brasil e do Uruguai durante a estação não-reprodutiva. São animais sociáveis e que apresentam variação comportamental ampla, influenciada pelas características do bando e do ambiente onde se encontram. Entender o comportamento desses animais é essencial para a compreensão de suas relações com o ambiente, auxiliando no manejo para a conservação desses animais na natureza, apesar de carecer de estudos nesse sentido para a espécie em território brasileiro. Com o objetivo de constatar qual o perfil dos trabalhos etológicos feitos com flamingos pelo mundo e qual o conhecimento disponível e discutido acerca deste tópico na comunidade científica, foi realizada uma revisão sistemática, verificando também as possíveis lacunas de conhecimento presentes no assunto e propondo sugestões sobre potenciais mudanças e perspectivas para a etologia do flamingo no mundo. A revisão feita com 24 diferentes combinações de palavras chaves em 3 plataformas diferentes resultou em 88 artigos finais, levados em consideração. Grande parte dos estudos foram realizados com as o Flamingo-comum e o Flamingo-americano, concentradas nos continentes do hemisfério norte e localizadas principalmente com animais em cativeiro. Detectou-se a necessidade de expandir os estudos de comportamento para as espécies sul-americanas e também incentivar estudos em populações de áreas naturais, onde o conhecimento gerado poderá promover ações de conservação e manejo adequado destes animais. Com o objetivo de constatar qual o perfil dos trabalhos etológicos feitos com flamingos pelo mundo e qual o conhecimento disponível e discutido acerca deste tópico na comunidade científica, foi realizada uma revisão sistemática. A revisão feita com 24 diferentes combinações de palavras chaves em 3 plataformas diferentes resultou em 86 artigos finais, levados em consideração. Grande parte dos estudos foram realizados com as o Flamingo-comum e o

Flamingo-americano, concentradas nos continentes do hemisfério norte e localizadas principalmente com animais em cativeiro. Detectou-se a necessidade de expandir os estudos de comportamento para as espécies sul-americanas e também incentivar estudos em populações de áreas naturais, onde o conhecimento gerado poderá promover ações de conservação e manejo adequado destes animais. A segunda e terceira parte do trabalho foi realizada a partir de saídas mensais de campo ao Parque Nacional da Lagoa do Peixe, no litoral médio do RS, totalizando 99.8 horas totais de observação. Foram detectados 41 comportamentos diferentes divididos em 5 categorias: Alimentação, Locomoção, Manutenção, Social Agonista e Social Não-Agonista. Detectou-se comportamentos semelhantes aos já registrados na literatura, principalmente relacionados a espécies sul-americanas que compartilham ambientes semelhantes aos Flamingos Chilenos na Lagoa do Peixe. Destaca-se também a grande variedade de comportamentos sociais realizados na lagoa, indicando que estas áreas servem para mais do que apenas forragear e descansar fora da estação reprodutiva. Além disso, detectou-se variação significativa na frequência, na duração ou em ambos para as categorias comportamentais ao longo dos meses, indicando uma forte influência de aspectos climáticos, como temperatura, pluviosidade e vento, mas também de aspectos populacionais, como densidade do bando e estágio do ciclo reprodutivo, nos comportamentos observados na lagoa.

Palavras-chaves: comportamento; comportamento social; etologia; flamingo chileno; lagoa do peixe; Parque Nacional da Lagoa do Peixe;

ABSTRACT

The Chilean flamingo (*Phoenicopterus chilensis*) is a species distributed in the temperate regions of South America, going from Ecuador to the south of Argentina, but moving to regions on the southern coast of Brazil and Uruguay during the non-reproductive season. They are sociable animals and have wide behavioral variation, influenced by the characteristics of the flock and the environment in which they are found. Understanding the behavior of these animals is essential for understanding their relationship with the environment, assisting in the management for the conservation of these animals in the wild, despite the lack of studies in this regard for the species in Brazilian territory. In order to verify the profile of ethological work done with flamingos around the world and what knowledge is available and discussed about this topic in the scientific community, a systematic review was carried out, also checking the possible knowledge gaps present in the subject and proposing suggestions on potential changes and perspectives for flamingo ethology in the world. The review made with 24 different combinations of keywords on 3 different platforms resulted in 88 final articles, taken into consideration. A large part of the studies were carried out with the Common Flamingo and the American Flamingo, concentrated in the northern hemisphere and located mainly with animals in captivity. It was detected the need to expand studies of behavior for South American species and also to encourage studies in populations of natural areas, where the knowledge generated will be able to promote conservation actions and adequate management of these animals. The second and third part of the work was carried out from monthly field trips to the Lagoa do Peixe National Park, on the middle coast of RS, totaling 99.8 total hours of observation. 41 different behaviors were detected, divided into 5 categories: Feeding, Locomotion, Maintenance, Social Agonist and Social Non-Agonist. Behaviors similar to those already recorded in the literature were detected, mainly related to South American species that share environments

similar to the Chilean Flamingos in Lagoa do Peixe. Also noteworthy is the great variety of social behaviors carried out in the lagoon, indicating that these areas serve more than just foraging and resting outside the breeding season. In addition, a significant variation in frequency, duration or both was detected for the behavioral categories over the months, indicating a strong influence of climatic aspects, such as temperature, rainfall and wind, but also of population aspects, such as flock density and stage of the reproductive cycle, in the behavior observed in the lagoon.

Keywords: behavior; chilean flamingo; ethology; lagoa do peixe; national park; social behavior;

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INTRODUÇÃO GERAL

Phoenicopteridae é o clado que inclui as seis espécies viventes de flamingos, as quais estão divididas em três clados menos inclusivos correspondentes aos gêneros *Phoenicopterus*, *Phoenicoparrus* e *Phoeniconaias* (Torres et al. 2014; Gill & Donsker 2019). São aves aquáticas de médio a grande porte, cuja plumagem tem uma coloração variando entre o vermelho e o róseo (del Hoyo et al. 1992; Brown & King 2005). Possuem hábito gregário, formando bandos de dezenas a milhares de indivíduos (Pickering et al. 1992) e, geralmente, ocorrem no entorno de áreas úmidas/alagadas, como por exemplo, lagos rasos e lagunas, mas também em zonas salinas e regiões litorâneas (Boyle et al. 2004). As aves da família são microfiltradoras e se alimentam, principalmente, de microrganismos que compõem as comunidades bentônicas e planctônicas dos corpos aquáticos, possuindo complexas modificações no aparato alimentar para se adaptar a esse hábito peculiar de forrageio (Zweers et al., 1995). Espécies como o Flamingo-comum *Phoenicopterus roseus* e Flamingo-americano *Phoenicopterus ruber* possuem distribuição na Europa e na América central, respectivamente, e são amplamente populares na cultura pop Ocidental. Outras espécies como o Flamingo-menor *Phoeniconaias minor*, que ocorre na África, e as três espécies sul-americanas, Flamingo-chileno *Phoenicopterus chilensis*, Flamingo-andino *Phoenicoparrus andinus* e o Flamingo-de-James *Phoenicoparrus jamesi*, ainda são menos conhecidas pelo público em geral e poucos estudados pela comunidade acadêmica, quando comparadas pelas demais espécies. (Delany & Scott 2006) (Figura 1).

O flamingo-chileno é uma espécie emblemática das regiões temperadas da América do Sul, distribuindo-se desde o centro-oeste do Equador e Peru até a Terra do Fogo, no sul da Argentina (del Hoyo et al. 1992). A estação reprodutiva ocorre na primavera e no verão do hemisfério sul, entre os meses de setembro a março, quando os animais formam casais em colônias reprodutivas, geralmente em regiões alagadas e de altitude elevada do centro-norte

da Argentina (Antas 1994; Sosa 1999; Derlindati et al. 2014). Durante os meses de inverno, após estação reprodutiva, com a diminuição da quantidade de alimento ocasionada pela queda de temperatura e alterações na salinidade, bandos deslocam-se para regiões mais baixas e com maior oferta de alimentos (Romano et al. 2005; Romano et al. 2009), como a costa do Rio Grande do Sul, sul do Brasil, onde são abundantes entre os meses de abril e setembro (Bencke et al. 2010). Uma das importantes áreas de permanência dessa espécie fora do ambiente reprodutivo é o Parque Nacional da Lagoa do Peixe, localizado no litoral médio do RS, único local do Brasil onde a espécie pode ser vista durante todo o ano, servindo de animal símbolo desta unidade de conservação (Figura 2) (Belton 1986; Somenzari et al. 2018; Delfino & Aldana-Ardila 2020). Apesar disso, pouco ainda se sabe sobre a ecologia e o comportamento destes animais dentro do parque (Delfino & Aldana-Ardila 2020).

Figura 1. Espécies de flamingo do mundo. a) Flamingo-chileno (*Phoenicopterus chilensis*); b) Flamingo-americano (*Phoenicopterus ruber*); c) Flamingo-comum (*Phoenicopterus roseus*); d) Flamingo menor (*Phoeniconaias minor*); e) Flamingo andino (*Phoenicoparrus andinus*); f) Flamingo-de-James (*Phoenicoparrus jamesi*). Imagens: Wikipédia/Distribuição.



Os flamingos, no geral, apresentam um repertório comportamental bastante diversificado, especialmente por causa da sua sociabilidade (Rose et al. 2014; Rose 2017) e das diferentes estratégias de forrageio (Kahl 1975; Brown & King 2005). Além disso, as exibições comportamentais dessas aves parecem ser influenciadas por sua morfologia peculiar (e.g., pescoço e membros pélvicos alongados, que permitem maior amplitude de movimento) (Brown & King, 2005) e pelos diferentes ecossistemas em que ocupam ao longo de seus ciclos de vida (Bildstein et al. 1991; Antas 1994; Brown & King 2005; Derlindati et al. 2014; Anderson & Laughlin 2014). Essas aves desempenham um papel crucial nesses ambientes, atuando como grandes consumidores na teia alimentar dos ecossistemas aquáticos (Hurlbert & Chang 1983; Hurlbert et al. 1986), mas contribuindo também para a dinâmica temporal desses locais, por meio do estabelecimento e alteração das relações ecológicas (i.e competição, predação, cooperação) com demais espécies que convivem com o flamingo ao longo do tempo, impactando tanto o local de origem quanto os de invernada (Mallory et al. 2006; Telleria et al. 2008).

Figura 2. Flamingos chilenos no Parque Nacional da Lagoa do Peixe. Na esquerda, bando de flamingos chilenos realizando comportamento sincronizado chamado de “Head Flapping”. À direita, três flamingos chilenos de idades diferentes presentes na lagoa. Imagens: Delfino & Aldana-Ardila (2020).



A compreensão dos comportamentos dessas aves é fundamental para estabelecer as relações entre os indivíduos e o ecossistema. Entender quais são os comportamentos destes animais dentro de áreas de conservação, em qual contexto são realizados e como estes comportamentos variam numa escala temporal é importante para entender como os diversos fatores ecológicos e ambientais, como clima, oferta de alimento, impacto humano e outros, influenciam na dinâmica de vida dos indivíduos e diretamente afetam padrões da população vivente no local. Estudos etológicos nesse sentido, são uteis na resolução de diversas problemáticas, como questões relacionadas a preferência e seleção de territórios (Fretwell 1969; Devries et al. 2018), hierarquização das relações sociais dentro do bando por idade e/ou por sexo (Marra 2000) e identificação de fatores chave que influenciam no desenvolvimento desses animais, facilitando a criação de planos de manejo para esta espécie no seu ambiente natural (Brown & King 2005). Além disso, estudos do comportamento possuem um forte impacto etnobiológico e na produção de conteúdos de educação ambiental e divulgação científica (Sutherland 1998; Reed 2002). Logo após a aparência e aspectos morfológicos, o comportamento é a informação mais facilmente observada, acessada e interpretada pelo público em geral ao ver os animais (Greggor et al. 2019), portanto estudos etológicos tem forte potencial de chegar a comunidade e promover ações de conservação desses animais, ainda mais considerando-se o status de animal símbolo que flamingos chilenos possuem (Delfino & Aldana-Ardila 2020).

Nesse sentido, diversos trabalhos foram realizados com outras espécies da família: *Phoenicopterus ruber* (e.g. Bildstein et al. 1991b; Mawhinney 2008; Beauchamp, 2016), *Phoenicopterus roseus* (e.g. Tourenq et al. 1995; Boudjema et al. 2006), *Phoeniconaias minor* (e.g. Brown 1971; Kumssa & Bekele 2014) e *Phoenicoparrus andinus* (e.g. Indgren & Pickering 1997; Mascitti & Castañera 2006; Derlindati et al. 2014). Em relação a *Phoenicopterus chilensis*, algumas pesquisas etológicas também foram desenvolvidas, como

em Farrell et al. (2000), Perdue et al. (2011), Anderson & Laughlin (2014) e Barbéris et al. (2014), entre outros, sendo em sua maioria realizados em ambiente de cativeiro ou, quando em ambiente natural, feito em colônias reprodutivas em ambiente andino. Carecem assim estudos etológicos e ecológicos acerca da espécie em território brasileiro, mais especificamente no sul-rio-grandense, importante ponto de descanso e forrageio desses animais durante o inverno e um dos poucos ambientes onde ocorrem de modo natural e ao longo de todo ano (Somenzari et al. 2018, Delfino & Aldana-Ardila 2020). Soma-se a isso, o fato da espécie ser considerada “Quase Ameaçada” (BirdLife International 2020) e estar passando por diminuição populacional, que tende a se acentuar nas próximas três gerações (Marconi et al. 2011) e das ameaças humanas ao principal local de invernada destes animais no Brasil, o Parque Nacional da Lagoa do Peixe. Esse local vem sofrendo de maneira sistemática pressões do poder público e da iniciativa privada para a diminuição do status de conservação, o que aumentam os riscos sobre essa UC, fazendo-se urgente a produção de maior conhecimento sobre espécie, o que auxiliará na criação de planos de manejo e na orientação de meios de conservação mais eficientes (Delfino & Aldana-Ardila 2020).

Com o objetivo de constatar qual o perfil dos trabalhos etológicos feitos com flamingos pelo mundo e qual o conhecimento disponível e discutido acerca deste tópico na comunidade científica, foi realizada uma revisão sistemática, verificando também as possíveis lacunas de conhecimento presentes no assunto e propondo sugestões sobre potenciais mudanças e perspectivas para a etologia do flamingo no mundo. A revisão feita com 24 diferentes combinações de palavras chaves em 3 plataformas diferentes resultou em 86 artigos finais, levados em consideração. Grande parte dos estudos foram realizados com as o Flamingo-comum e o Flamingo-americano, concentradas nos continentes do hemisfério norte e localizadas principalmente com animais em cativeiro. Detectou-se a necessidade de expandir os estudos de comportamento para as espécies sul-americanas e também incentivar

estudos em populações de áreas naturais, onde o conhecimento gerado poderá promover ações de conservação e manejo adequado destes animais.

A segunda e terceira parte do trabalho foi realizada a partir de saídas mensais de campo à Lagoa do Peixe, totalizando 99.8 horas totais de observação. Foram detectados 41 comportamentos diferentes divididos em 5 categorias: Alimentação, Locomoção, Manutenção, Social Agonista e Social Não-Agonista. Detectou-se comportamentos semelhantes aos já registrados na literatura, principalmente relacionados a espécies sul-americanas que compartilham ambientes semelhantes aos Flamingos Chilenos na Lagoa do Peixe. Destaca-se também a grande variedade de comportamentos sociais realizados na lagoa, indicando que estas áreas servem para mais do que apenas forragear e descansar fora da estação reprodutiva. Além disso, detectou-se variação significativa na frequência, na duração ou em ambos para as categorias comportamentais ao longo dos meses, indicando uma forte influência de aspectos climáticos, como temperatura, pluviosidade e vento, mas também de aspectos populacionais, como densidade do bando e estágio do ciclo reprodutivo, nos comportamentos observados na lagoa.

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CONCLUSÕES GERAIS

Estudos de comportamento dos flamingos chilenos em ambiente natural na América do Sul ainda são incipientes. Na revisão sistemática da literatura da área, confirmamos a tendência de que certas espécies (Flamingo-comum e Flamingo-americano) dominam estes tipos de estudos, feitos principalmente em seus continentes do norte hemisférico e em cativeiro, enquanto estudos de comportamentos na América do Sul e na África, com espécies destes locais, e em ambiente natural eram minoria. Vendo a necessidade de preencher essa lacuna de conhecimento, ainda mais devido a falta de estudos ecológicos e etológicos com os Flamingos Chilenos do Parque Nacional da Lagoa do Peixe, partimos para análises qualitativas e quantitativas do comportamento destes animais no local.

Nas observações e descrições etológicas, encontrou-se 41 comportamentos diferentes, distribuídos em 5 categorias distintas relacionadas com as principais funções ligadas a estes comportamentos: Alimentação, Locomoção, Manutenção, Social Agonista e Social Não-Agonista. Detectou-se a grande variedade de comportamentos de alimentação, mas também a grande quantidade de comportamentos sociais, nestes animais. Detectou-se também a presença de comportamentos já descritos para flamingos em outros trabalhos, tanto em cativeiro como em ambientes naturais. Apesar das variações comportamentais relatadas, diferenças comportamentais pareceram estar relacionadas não ao gênero ou a espécie, mas sim aos ambientes onde estas espécies se encontravam e onde os trabalhos foram realizados. Nossas descrições comportamentais se assemelham às encontradas em trabalhos realizados na Argentina, com exceção da ausência de comportamentos reprodutivos. Apesar da falta de comportamentos reprodutivos, o que já era esperado, encontraram-se um rico repertório de comportamentos sincronizados e não agonistas, possível indicativo da presença de comportamentos pré-reprodutivos no local, contrariando a ideia de que a Lagoa do Peixe era um local exclusivo para forrageio e descanso desses animais.

Por fim, nas quantificações, nossos dados confirmaram que categorias comportamentais como Alimentação e Manutenção dominaram as exibições observadas durante o estudo, mas chama a atenção a proporção de comportamentos sociais, agonistas e não agonistas, observados, que ocuparam cerca de $\frac{1}{4}$ das observações. Categorias comportamentais apresentaram variações significativas na frequência, na duração ou em ambas durante os meses de estudo, principalmente durante Agosto e Setembro, evidenciando a influência de fatores climáticos, como temperatura, vento e pluviosidade, e fatores populacionais, como número de indivíduos, densidade do bando e período no ciclo de vida nas exibições comportamentais destes animais.

O seguinte trabalho de dissertação serve para demonstrar a importância de trabalhos de observação e comportamento em populações de locais fora do ambiente de reprodução e reforça a importância de ambientes e unidades de conservação para espécies como o Flamingo-Chileno. Nosso Trabalho ajuda no entendimento de que a Lagoa do Peixe é mais do que um lugar de descanso e alimentação destes animais e reforça a ideia de que existe uma população estável e vivente dentro do parque que pode ser visualizada durante o ano inteiro. O parque é crucial para esta população, bem como sua conservação e preservação frente às pressões ambientais e políticas que a unidade de conservação sofre. A construção de conhecimento sobre o comportamento destes animais no parque, o entendimento de seu repertório e da dinâmica etológica dos flamingos chilenos no local ajuda na construção de materiais que possam auxiliar em medidas de educação ambiental, conservação e manejo dentro do Parque Nacional.

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1. Kilkenny, C., Browne, W. J., Cuthill, I. C., Emerson, M. & Altman, D. G. (2010) Improving bioscience research reporting: the ARRIVE guidelines for reporting animal research. *PLoS Biol.* **8**, e1000412. [open access [link](#)]

2. Webster, M. M. & Rutz, C. (2020) How STRANGE are your study animals? *Nature* **582**, 337–340. [open access [link](#)]

References

Citation

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- Negotiation research spans many disciplines (Thompson 1990).
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Manuscript Format

GENERAL GUIDELINES

Prepare manuscripts carefully with attention to all details. Manuscripts that depart from these guidelines will be returned without review.

- Assemble manuscripts in this order: title page, abstract, text (Introduction, Methods, Results, Discussion, Acknowledgments, and Literature Cited), Tables, Figure legends, and Figures (with figures submitted as separate files in Manuscript Central). It is not appropriate to combine Results and Discussion sections.
- In the Introduction, given the particular focus of your study, provide relevant background information, explaining what is known, what is not known (what question or questions remain), and why additional study (your study) was needed; conclude by stating the objective or objectives of your study.

- The Methods section should include sufficient details for the study to be repeated, and should contain a subsection describing the statistical tests and procedures used. Cite statistical software (e.g., SAS) and any other analysis programs here and in the Literature Cited. If reporting the results of analyses using the information theoretic method, describe and justify the *a priori* hypotheses and models in the candidate set, identify exploratory hypotheses, and state the criterion used to evaluate models, e.g., second-order AIC corrected for small sample sizes (AIC_c) and Akaike weights (w_i). If you list a product, supply the name and location of the manufacturer. Give equipment model numbers.
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- Place the first author's last name and the page number (starting with the abstract on page 2 and continuing through the Literature Cited) in the upper right corner of each page.
- Write in the active voice and use U.S. English and spelling throughout the manuscript, except for foreign literature citations.
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Authors should use recent issues of the Journal as a guide in preparing their manuscripts.

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phrases (in alphabetical order) that describe the subject of the paper; these should not duplicate words in the title. The Spanish title and abstract will be prepared for all articles accepted for publication.

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- English and scientific names of a species should be given the first time it is mentioned in the text. Scientific names should be in italics. Bird names should follow the AOU Check-list of North American Birds and supplements (checklist.aou.org/taxa/), the AOU South American Classification Committee Checklist for South American Birds (<http://www.museum.lsu.edu/~Remsen/SACCCountryLists.htm>), or, outside the Americas, the Avibase Clements Checklist (<http://avibase.bsc-eoc.org/checklist.jsp>).
- The first letter of common names of bird species should be capitalized.
- Use metric units.
- Do not insert either a comma or a space in numbers less than 10 000 (e.g., 1232 swallows). For numbers greater than 9999, separate the hundreds and thousands places using a comma, e.g., 22,432 Broad-winged Hawks.
- Use these unit abbreviations: second, sec; minute, min; hour, hr; month, mo; week, wk; year, yr.
- Use the 24-hour clock (e.g., 05:00 and 17:00) and 'continental' dating (10 March 2012).
- Define all symbols, abbreviations, and acronyms but minimize their use.
- Test statistics and degrees of freedom should be given with all P-values. P-values should be written as $P = 0.025$. Give exact values even for non-significant results ($P = 0.67$ rather than $P > 0.05$ or NS). Statistical tests should be clearly specified, and degrees of freedom provided as a subscript to the test statistic (e.g., $F_{3,12}$).
- Italicize the following: N (sample size), P (probability), t (t-test), F (F-ratio), U (Mann-Whitney U-test), r (simple correlation coefficient; Pearson r), z (Wilcoxon test), rs (Spearman rank-order correlation), R (multiple regression coefficient), and G (G-test).
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Examples of other citation styles:

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HOOGLAND, J. L., AND P. W. SHERMAN. 1976. Advantages and disadvantages of Bank Swallow (*Riparia riparia*) coloniality. *Ecological Monographs* 46: 33–58.

Book

SHARPE, R. S., W. R. SILCOCK, AND J. G. JORGENSEN. 2001. Birds of Nebraska: their distribution and temporal occurrence. University of Nebraska Press, Lincoln, NE.

Book Chapter

ROGERS, C. A., R. J. ROBERTSON, AND B. J. STUTCHBURY. 1991. Patterns and effects of parasitism by *Protocalliphora sialia* on Tree Swallow nestlings. In: Bird-parasite interactions: ecology, evolution and behaviour (J. E. Loye and M. Zuk, eds.), pp. 123–139. Oxford University Press, Oxford, UK.

Thesis or Dissertation

BROWN, C. R. 1985. The costs and benefits of coloniality in the Cliff Swallow. Ph.D. dissertation, Princeton University, Princeton, NJ.

Tables. -- Each table should be double-spaced throughout on a separate page. Place the tables after the Literature Cited. Tables should be numbered sequentially and include a concise and informative title. Do not use additional sentences after the Table's title; material necessary to clarify the table should be presented as footnotes to the table. Tables should supplement, not duplicate, material in the text or figures. Tables should be understandable without reference to the text. Do not use vertical lines in the table; use horizontal lines for the main heading and the end of the table, but not in the body of the table.

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