ANDREA JULIANA DÍAZ FORERO

Papagaios Neotropicais (*Amazona spp.*) em cativeiro: causas de morbidade e mortalidade durante o período 2009-2019

São Paulo

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Dissertação apresentada ao Programa de Pós-graduação em Patologia Experimental e Comparada da Faculdade de Medicina Veterinária e Zootecnia da Universidade de São Paulo para a obtenção do título de Mestre em Ciências.

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Prof. Dr. Antonio José Piantino Ferreira

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Parecer Consubstanciado da CEUA FMVZ

A Comissão de Ética no Uso de Animais da Faculdade de Medicina Veterinária e Zootecnia da Universidade de São Paulo, na reunião de 19/04/2021, **ANALISOU** e **APROVOU** o protocolo de estudo acima referenciado. A partir desta data, é dever do pesquisador:

1. Comunicar toda e qualquer alteração do protocolo.
2. Comunicar imediatamente ao Comitê qualquer evento adverso ocorrido durante o desenvolvimento do protocolo.
3. Os dados individuais de todas as etapas da pesquisa devem ser mantidos em local seguro por 5 anos para possível auditoria dos órgãos competentes.
4. **Relatórios parciais** de andamento deverão ser enviados **anualmente** à CEUA até a conclusão do protocolo.

Prof. Dr. Marcelo Bahia Labruna
Coordenador da Comissão de Ética no Uso de Animais
Faculdade de Medicina Veterinária e Zootecnia da Universidade de São Paulo

Camilla Mota Mendes
Vice-Coordenadora da Comissão de Ética no Uso de Animais
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Comissão de Ética no Uso de Animais
Faculdade de Medicina Veterinária e Zootecnia
Universidade de São Paulo

São Paulo, 21st April 2021

CERTIFIED

We certify that the Research "Captive Amazon Parrots (Amazona; Lesson, 1830): Causes Of Morbidity And Mortality. Retrospective Study Of Patients Submitted To The Avian Clinic Services Of The Pathology Department From Fmvz/Usp, São Paulo, Sp, Brazil", protocol number CEUAx 2896241120 (ID 001797), under the responsibility Antonio José Piantino Ferreira, agree with Ethical Principles in Animal Research adopted by Ethic Committee in the Use of Animals of School of Veterinary Medicine and Animal Science (University of São Paulo), and was approved in the meeting of day April 19, 2021.

Certificamos que o protocolo do Projeto de Pesquisa intitulado "Papagaios Neotropicais (Amazona; Lesson, 1830) Em Cativeiro: Causas De Morbidade e Mortalidade. Estudo Retrospectivo De Pacientes Atendidos Entre 2009-2019, pelo Serviço De Ambulatório De Aves Do Departamento De Patologia Da FMVZ/USP, São Paulo, SP, Brasil", protocolado sob o CEUAx nº 2896241120, sob a responsabilidade de Antonio José Piantino Ferreira, está de acordo com os princípios éticos de experimentação animal da Comissão de Ética no Uso de Animais da Faculdade de Medicina Veterinária e Zootecnia da Universidade de São Paulo, e foi aprovado na reunião de 19 de abril de 2021.

Prof. Dr. Marcelo Bahia Labruna
Coordenador da Comissão de Ética no Uso de Animais
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FOLHA DE AVALIAÇÃO

Autor: FORERO, Andrea Juliana

Título: Papagaios Neotropicais (Amazona spp.) em cativeiro: causas de morbidade e mortalidade durante o período 2009-2019

Dissertação apresentada ao Programa de Pós-graduação em Patologia Experimental e Comparada da Faculdade de Medicina Veterinária e Zootecnia da Universidade de São Paulo para obtenção do título de Mestre em Ciências.

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Prof. Dr.____

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Prof. Dr.____

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Dedico esse trabalho a minha amada mãe (*In memoriam*), que nunca mediu esforços para me ajudar a vencer. Por todo o carinho, dedicação, apoio e exemplo de caráter, resiliência e integridade, no qual tento me espelhar todos os dias.

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“Innovation is the key to the future, but basic research is the key to future innovation.”

Jerome Isaac Friedman

RESUMO

FORERO, A. J. **Papagaios Neotropicais (Amazona spp.) em cativeiro: causas de morbidade e mortalidade durante o período 2009-2019**. 170 f. Dissertação (Mestrado em Ciências) – Faculdade de Medicina Veterinária e Zootecnia, Universidade de São Paulo, São Paulo, 2023.

Os papagaios neotropicais são aves amplamente cobiçadas para serem animais de companhia, sendo comumente encontradas também em zoológicos, centros de reabilitação de animais silvestres, e coleções privadas de reprodução. Apesar da popularidade destes psitacídeos em cativeiro, estudos, extensos, detalhados e de longo prazo sobre dados de diagnóstico gênero-específicos são pouco comuns. Este estudo foi realizado com o objetivo determinar as causas de morbidade e mortalidade em papagaios cativos, do gênero Amazona (Lesson,1830), atendidos pelos Serviços de Ambulatório de Aves (SAA) e Patologia Animal (SPA) do Departamento de Patologia Veterinária (VPT), vinculados ao Hospital Veterinario (HOVET) da Faculdade de Medicina Veterinária e Zootecnia da Universidade de São Paulo (FMZ/USP), durante o período compreendido entre 2009 e 2019. Neste estudo foram analisadas informações de 791 aves (707 vivas e 84 mortas), que totalizaram 1033 histórias clínicas, das quais foram identificados 877 diagnósticos primários e, 84 relatórios *“post mortem”*, dos quais foram registados 109 diagnósticos, constituindo um tota de 1142 observações e 986 diagnósticos finais. Ao todo, os dados incluíram nove espécies do género. O sexo dos indivíduos foi frequentemente indeterminado (n=859/1142; 75,21 %), e os grupos etários mais representados foram os adultos (n = 838; 73,38 %) e os juvenis (n =201; 17,6%). Os prontuários pertenciam pedominatemente a aves mantidas como animais de estimação (n=1074/1142; 94,04%) que eram, em sua grande maioria alimentadas com dietas a base de sementes (n=631/1033; 61,08%). Estes papagaios apresentaram alta frequencia de diagnosticos com doenças não infecciosas (n=512; 51,93%) e, os subprocessos mais comuns foram metabólicos (n=189; 36,91%), físicos (n=148; 28,91%), neoplásicos (n=79; 15,43%), e degenerativos (n=41; 8,0%). Dentre as doenças infecciosas (n =329; 33,3%), os processos bacterianos foram os mais prevalentes (n=227; 69,0%), seguidos pelos virais (n =45; 13,68%), e com menor frequência os fúngicos (n=38; 11,55%), e parasitários (n=19; 5,78%). Por outro lado, o principal motivo para os tutores destas aves terem procurarado intervenção médica, foi devido à presença de sintomas respiratórios (n=191/1142), dermatológicos (n=137/1142) e gastrointestinais (n=120/1142). Em filhotes foram mais comuns as doenças infecciosas (n=19/30; 63,33%) principalmente causadas por bactérias (n=10/19; 52,63%) e fungos (n=4/19; 21,05%). As doenças mais comuns em animais juvenis foram as não infeciosas (n=74/154; 48,05%), sendo os processos fiscos os mais prevalentes (n=39/74; 52,70%). Em adultos como em juvenis predominaram a doenças não infecciosas (n=402/737; 54,54%), sendo mais comuns os processos metabólicos (n=154/737; 20,89%). E, em aves idosas as causas não infecciosas foram as mais prevalentes (n=23/33; 69,6%), representadas principalmente por processos neoplásicos (n=7/23; 30,43%), degenerativos (n=6/23; 26,08%) e metabólicos (n=6/23; 26,08%). Análises estatísticas foram utilizadas para verificar prevalência de doenças e sua associação a possíveis fatores de risco. Este estudo retrospectivo apresenta uma visão geral das causas de morbidade e mortalidade em estas espécies e estas informações podem servir como referência para orientar futuras investigações sobre a prevenção, diagnóstico e manejo das mesmas.

Palavras-chave: psitacídeos, papagaios neotropicais, doenças, prevalência, cativeiro, patologia, epidemiologia, Brasil.

ABSTRACT

FORERO, A. J. **Captive Neotropical Parrots (Amazona spp.): causes of morbidity and mortality over the 2009-2019 period.** 170 f. Dissertação (Mestrado em Ciências) – Faculdade de Medicina Veterinária e Zootecnia, Universidade de São Paulo, São Paulo, 2023.

Parrots of the neotropical region are well-known companion animals also kept in zoos, wildlife rehabilitation centers, and private breeding collections. Despite the popularity of captive psittacines, long-term, comprehensive studies of taxa-specific diagnostic data are uncommon. This study was conducted to determine the causes of morbidity and mortality in captive parrots from the Amazona genus (Lesson,1830), submitted to the Avian Ambulatory Service (SAA) and Animal Pathology Service (SPA) of the Veterinary Pathology Department (VPT) attached to the Veterinary Teaching Hospital (HOVET) of the University of São Paulo, School of Veterinary Medicine and Animal Science (FMZ-USP) during the 2009-2019 period. Information from 791 birds (707 alive and 84 dead) was assessed in this study with a total of 1033 clinical records reviewed, from those, 877 primary diagnoses were identified, and from the 84 postmortem reports, 109 diagnoses were registered, totalizing 1142 medical observations and 986 final diagnoses. All data included nine species from the genera. The sex of the individuals was often undetermined (n=859/1142; 75.21 %), and the most represented age groups were adults (n=838; 73.38 %) and juveniles (n=201; 17.6%). Most of the clinical data belonged to birds kept as pets (n=1074/1142; 94.04%) that were mostly fed a seed-based diet (n=631/1033; 61.08%). The most frequently diagnosed causes of morbidity in these parrots were non-infectious (n = 512; 51.93%), and the most common sub-processes were metabolic (n = 189; 36.91%), physical (n = 148; 28.91%), neoplastic (n =79; 15.43%), and degenerative (n = 41; 8.0%). Of the infectious diseases (n =329; 33.3%), bacterial processes were the most prevalent (n =227; 69.0%), followed by viral (n =45; 13.68%), and less frequently fungal (n = 38; 11.55%), and parasitic (n =19; 5.78%). The occurrence of respiratory (n=191/1142), dermatological (n=137/1142), and gastrointestinal (n=120/1142) symptoms, on the other hand, were the main reasons that prompted the caretakers of these birds to seek medical attention. The most common diseases in chicks were infectious diseases (n=19/30; 63.33%) mainly bacteria (n=10/19; 52.63%) and fungi (n=4/19; 21.05%). The most common diseases in juvenile animals were non-infectious (n=74/154; 48.05%), with physical processes being the most prevalent (n=39/74; 52.70%). In adults as in juveniles' non-infectious diseases predominated (n=402/737; 54.54%), with metabolic processes being most common (n=154/737; 20.89%).

And, in senior birds non-infectious causes were the most frequent (n=23/33; 69.6%), accounted primarily by neoplastic (n=7/23; 30.43%), degenerative (n=6/23; 26.08%) and metabolic (n=6/23; 26.08%) processes. Statistical analyses were used to verify prevalence of diseases and their association with possible risk factors. This retrospective study presents an overview of the causes of morbidity and mortality in these species and these findings can serve as a reference to guide future research on their prevention, diagnosis, and management.

Keywords: psittacines, amazon parrots, disease, prevalence, captivity, pathology, epidemiology, Brazil.

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INTRODUÇÃO

1. INTRODUÇÃO

A região Neotropical possui a maior diversidade de Psitacídeos do mundo e, o Brasil é o país com o maior número de espécies (PIACENTINI *et al.*, 2015). O gênero Amazona, que pode ser encontrado do norte da Argentina ao norte do México, é o mais diverso da família Psittacidae, com 36 espécies. De acordo com a Lista Vermelha da IUCN, metade (18) das espécies do gênero Amazona, estão globalmente ameaçadas e, 25 espécies, apresentam contagens populacionais em declínio (IUCN, 2022).

No Brasil, o gênero Amazona compreende 12 espécies, que estão em sua maior parte ameaçadas pelo comércio ilegal e pela destruição do habitat, ocupando o primeiro lugar entre as aves psitaciformes traficadas no país (CITES, 2022a; ICMBIO, 2011; ZULIAN; MILLER; FERRAZ, 2021). No entanto, outro desafio atual aos esforços de conservação da avifauna silvestre é a disseminação de doenças infecciosas (VAZ *et al.*, 2021). Como os papagaios são animais de estimação extremamente populares, isto devido às características já amplamente conhecidas, como as cores brilhantes, capacidade de mimetismo, inteligência e carisma, a demanda criada ao redor do mundo levou a um movimento internacional de mais de 19 milhões de aves traficadas desde 1975 (CITES, 2022b), o que aumentou, potencializando a disseminação de patógenos (IUCN, 2022; PIACENTINI *et al.*, 2015; SCHEFFERS *et al.*, 2019; VAZ *et al.*, 2021).

As potenciais ameaças às populações de papagaios silvestres colocadas pelo tráfico de animais de estimação, justificam a inclusão antecipada de toda a ordem Psitaciformes nos Apêndices da CITES (CITES, 2022a). Adicionalmente, o comércio internacional de papagaios também trouxe crescimento no número dessas aves sob cuidados humanos, como animais de estimação, em centros de triagem, conservação, reprodução e reabilitação, zoológicos e outros cenários de cativeiro (FORSHAW, 2017). Da mesma forma, nos últimos anos, o incremento na reprodução de psitacídeos em cativeiro, pode ter contribuído com esta taxa de crescimento; isto devido a que o Instituto Brasileiro do Meio Ambiente e dos Recursos Renováveis (IBAMA), por meio das Portarias 117 e 118 de 15 de outubro de 1997, normatizou a criação de espécies silvestres nativas e a comercialização de animais vivos, abatidos, partes e produtos da fauna nativa.

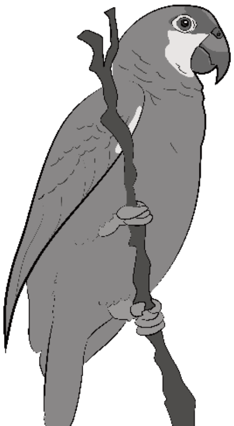
No Brasil, apesar de não haver dados oficiais e de ser legalmente proibida a criação de animais da fauna silvestre, sem permissão expressa do IBAMA (Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis), estima-se que grande número de papagaios, periquitos, jandaias e araras sejam criados em casa como animais de estimação, animais estes que em sua quase totalidade vêm da natureza e que, em boa parte dos casos, são mantidos em más condições pelos proprietários (CARCIOFI; PRADA, 1996; FOTIN; MATUSHIMA, 2005).

Muitas espécies de papagaios caracterizam-se por serem longevas (YOUNG *et al.*, 2012), e, os recentes avanços na criação, nutrição e cuidados veterinários, juntamente com a ausência de perigos extrínsecos como predação e trauma, possibilitaram que exemplares de vida selvagem, quando em cativeiro, vivessem além de sua vida média em situação de liberdade, aumentando a probabilidade de doenças relacionadas à idade (VOGELNEST; TALBOT, 2019). Além disso, as aves que são criadas e mantidas em cativeiro desenvolvem de forma frequente conjunto único de doenças que podem diferir substancialmente daquelas que ocorrem na natureza (por exemplo, cardiovasculares, neoplásicas, etc.) (GIBSON *et al.*, 2019; RICKLEFS; RICKLEFS, 2000). A maioria delas, relacionadas a uma série de questões de criação, bem como características comportamentais, fisiológicas ou genéticas entre as espécies, podem predispor as aves em cativeiro a doenças, incluindo infecções, distúrbios metabólicos e neoplasias (BEAUFRÈRE *et al.*, 2015; DORRESTEIN, 2003; NEMETH *et al.*, 2016; REAVILL; DORRESTEIN, 2010).

Além disso, variações geográficas nas práticas de manejo das aves silvestres (como biossegurança, técnicas de reprodução e criação, aquisição de aves, circunstâncias climáticas, etc.) podem afetar a prevalência de doenças, o que aponta a necessidade de avaliações que são relevantes para uma determinada região (GIBSON et al., 2019; MORISHITA et al., 1998; SMITH et al., 2018; WILDMANN et al., 2022).

O levantamento retrospectivo de dados relacionados a processos patológicos em papagaios neotropicais contribuirá como auxílio no conhecimento na clínica de aves silvestres, para a qual são necessários estudos específicos para cada taxa e especialidade veterinária, para que assim, possa ser fornecido a estas aves, o tratamento necessário com precisão, pois a importância do conhecimento das principais afecções que acometem essas espécies radica no impacto ao direcionar a conduta clínica do profissional médico veterinário para obtenção de diagnósticos, prognóstico e tratamentos adequados, além de se intensificar as orientações de manejo e prevenção das doenças mais prevalentes.

Assim, o presente estudo objetivou a realização de uma análise retrospectiva de processos patológicos que acometem psitacídeos neotropicais do gênero Amazona spp. (Lesson, 1830) submetidos à avaliação clínica e anatomopatológica, pelos Serviços de Ambulatório de Aves (SAA) e Patologia Animal (SPA) do Departamento de Patologia (VPT) e Hospital Veterinário (HOVET) da Faculdade de Medicina Veterinária e Zootecnia da Universidade de São Paulo (FMVZ/USP) durante o período compreendido entre 2009 e 2019.



OBJETIVOS

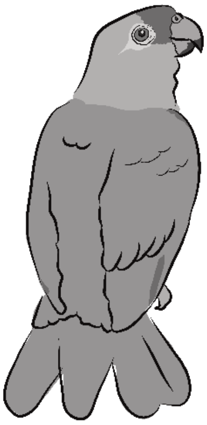
2. OBJETIVOS

2.1. OBJETIVO GERAL

Determinar as causas de morbidade e mortalidade em papagaios cativos, do gênero *Amazona* (Lesson,1830), atendidos pelos Serviços de Ambulatório de Aves (SAA) e Patologia Animal (SPA) do Departamento de Patologia (VPT), vinculados ao Hospital Veterinário (HOVET) da Faculdade de Medicina Veterinária e Zootecnia da Universidade de São Paulo (FMVZ/USP), durante o período de 2009-2019.

2.2. OBJETIVOS ESPECÍFICOS

1. Caracterizar a população de papagaios *Amazona* spp. mantidos em cativeiro, atendidos no SAA-SPA/HOVET/FMVZ-USP no período de 2009-2019;
2. Identificar os principais motivos de consulta pelos quais estes animais procuraram atendimento médico-veterinário;
3. Determinar a prevalência de doenças que acometem e causam a morte em papagaios neotropicais *Amazona* spp. cativos, segundo etiologia infecciosa ou não;
4. Identificar os processos patológicos e sistemas orgânicos mais acometidos;
5. Identificar possíveis fatores de risco associados às alterações/doenças mais prevalentes em papagaios neotropicais, por meio de modelos estatísticos.



REVISÃO DE LITERATURA

3. REVISÃO DE LITERATURA

3.1. AVES

As aves são vertebrados endotérmicos, caracterizados por membros torácicos transformados em asas, membros pélvicos destinados a locomoção bípede, presença de bico sem dentes, oviparidade de casca rígida, elevado metabolismo, um coração com quatro câmaras e um esqueleto pneumático forte e leve. A característica mais distintiva das aves, no entanto, são as penas, estruturas particulares que recobrem o corpo e que prontamente às diferenciam de qualquer outra classe do reino animal (SICK *et al.*, 1997).

A lista de aves de uma nação está longe de ser uma figura imutável, a quantidade depende das espécies errantes e migratórias que estão incluídas, bem como qual lista taxonômica está sendo seguida. Contudo, é comumente aceito por órgãos como a *BirdLife International*, *American Ornithologists' Union* e *Comitê Brasileiro de Registros Ornitológicos*, que o Brasil se encontra entre os três principais países do mundo em termos de abundância em avifauna, juntamente com a Colômbia e o Peru (PIACENTINI *et al.*, 2015).

Na primeira versão da Lista comentada das aves do Brasil pelo Comitê Brasileiro de Registros Ornitológicos, estimou-se que o país abrigava aproximadamente 1919 (mil novecentas e dezenove) espécies de aves (PIACENTINI *et al.*, 2015), no entanto, na versão publicada recentemente, foi demonstrado aumento de 4,3%, com 82 (oitenta e duas) espécies a mais, totalizando 1971 (mil novecentas e setenta e uma) espécies reconhecidas (PACHECO *et al.*, 2021).

O número de espécies endêmicas no Brasil aumentou 19,0% de acordo com Piacentini *et al.* (2015), como resultado de divisões taxonômicas e descrições de quatro novas espécies, sendo atualmente 293 (duzentos e noventa e três) no total. Esse número coloca o Brasil em terceiro lugar entre os países com o maior número de espécies de aves endêmicas do mundo, atrás apenas da Indonésia e da Austrália, ambos países insulares (IUCN, 2020).

3.2. AVES COMO ANIMAIS DE ESTIMAÇÃO

No Brasil, desde o período colonial, os animais têm sido amplamente utilizados pelas sociedades indígenas e pelos descendentes dos colonizadores europeus (ALMEIDA, 2005; ALVES, 2012; ROMEU; ALVES; ROSA, 2010). As aves têm sido registradas como uma das classes animais mais usufruídas pelas populações humanas. Dentre as práticas muito comuns entre as relações humanas–aves, mantê-las como animais de estimação é a mais frequente

(ALVES *et al.*, 2010; ALVES; LIMA; ARAUJO, 2013; FERNANDES *et al.*, 2012; LICARIÃO; BEZERRA; ALVES, 2013). Estudos apontaram que se trata de um costume ancestral e, como prova disto, estão os registros de populações indígenas sul-americanas, como por exemplo, os “Warao”, habitantes do delta do rio Orinoco, que apresentavam como animais de estimação aves selvagens, macacos, preguiças, roedores, patos, cães e galinhas (WILBERT, 1972). Segundo a antropóloga Basso (1973), os indígenas “Kalapalo” da região central do Brasil mantêm um apreço único pelas aves de estimação. A autora comparou a relação entre os “Kalapalo” e suas aves como semelhante àquela estabelecida tradicionalmente entre pais e filhos, pois são alimentadas, criadas e protegidas dentro dos limites da morada e, muitas vezes, são mantidas cativas. A manutenção de animais de estimação também foi registrada como sendo uma das principais atividades de lazer dos nativos “Barasana” do leste da Colômbia. Roedores, cães, papagaios, araras e uma enorme variedade de outras aves foram descritos como os animais de estimação mais comuns, embora anta, queixada, jaguatirica e, até onças também tenham sido listados (SERPELL, 1987).

Atualmente, a criação de aves silvestres em cativeiro é comum em todo o Brasil, tanto no meio rural como urbano (ALVES *et al.*, 2010; LICARIÃO; BEZERRA; ALVES, 2013; SICK *et al.*, 1997). Estas aves raramente provêm de criadores legalizados e, são em sua maioria capturadas na natureza (ALVES; LIMA; ARAUJO, 2013; FOTIN; MATUSHIMA, 2005; WRIGHT *et al.*, 2001; YOUNG *et al.*, 2012). Estudos recentes indicaram que, no comércio de animais exóticos, a classe das aves possui o maior número de espécies comercializadas (BUSH; BAKER; MACDONALD, 2014; CHAN et al., 2021; SCHEFFERS et al., 2019). Entre as ordens das aves, a ordem Psittaciformes (papagaios) é o grupo mais comercializado, principalmente como animais de companhia vivos, seguido por Passeriformes (pássaros), Falconiformes (falcões) e Columbiformes (pombos e rolinhas) (BUSH; BAKER; MACDONALD, 2014; FURNELL, 2019). Uma recente análise dos registros de comércio de aves vivas na Convenção sobre o Comércio Internacional de Espécies de Fauna e Flora Selvagens Ameaçadas de Extinção (CITES), indicou que aproximadamente 90.0% de todas as aves vivas comercializadas eram da ordem Psittaciformes (FURNELL, 2019).

No Brasil, o tráfico de animais selvagens, especialmente de aves, é um dos segmentos mais característicos do comércio ilegal. Este tipo de tráfico é realizado principalmente para fornecer espécies para colecionadores, zoológicos, cientistas, lojas de animais de estimação e mercados públicos em todo o mundo (WRIGHT *et al.*, 2001). A captura de animais selvagens para o comércio de animais de estimação tem sido identificada como a causa do declínio populacional de muitas espécies. Além da captura direta, muitas espécies acabam morrendo em alguma etapa da cadeia de comercialização ou tráfico. O comércio ilegal de aves silvestres no Brasil ilustra bem essa situação, com a maioria das aves silvestres comercializadas como animais de estimação morrendo antes mesmo de chegar ao seu destino (ALVES; LIMA; ARAUJO, 2013). Estima-se que a cada 10 (dez) animais capturados, apenas 1 (um) sobrevive (REDFORD, 1992).

Na atualidade, a criação de aves como animais de estimação no Brasil representa uma prática que atravessa as linhas de classe, bem como as barreiras raciais e étnicas. No país, a maioria das espécies de aves mantidas como animais de estimação pertencem às famílias das ordens Passeriformes e Psitaciformes. Espécies da família Psittacidae, por exemplo, que inclui papagaios, periquitos, araras e catatuas, estão entre as aves de estimação mais populares do mundo devido à sua capacidade de imitar as vozes humanas, bem como à sua inteligência, beleza e docilidade – estão atrás apenas dos cães e gatos em popularidade geral (ALVES; ROCHA, 2018; ROLDÁN *et al.*, 2014).

3.3. PSITTACIFORMES

A ordem Psittaciformes é um clado da classe das aves que engloba os usualmente denominados papagaios, araras, periquitos, cacatuas e loris. Essa ordem se conforma de três famílias e, foi bem descrita e ilustrada por Rowley (1997) e Collar (1997). Rowley, sugeriu 6 (seis) gêneros da família Cacatuidae (cacatuas) com 21 (vinte e uma) espécies. Collar (1997) descreveu 78 (setenta e oito) gêneros da família Psittacidae (papagaios, araras, loris) com 332 (trezentas e trinta e duas) espécies; e, por último, Bonaparte (1854) descreveu a família Strigopidae com dois gêneros e somente três espécies sobreviventes, todas estas ameaçadas de extinção.

A ordem Psittaciformes é comumente referida pelo termo genérico de psitacídeos. Estes, podem ser facilmente distinguidos de outras aves por características anatômicas peculiares, como cabeça grande em proporção ao corpo; bico curvo e arredondado, com uma cere proeminente; pescoço relativamente curto; pés preênseis e zigodáctilos, com os dígitos I e IV dirigidos caudalmente e os dígitos II e III cranialmente; papo bem desenvolvido; ausência de ceco; vesícula biliar geralmente ausente e, a glândula uropigiana apresenta tufos ou, em alguns gêneros como, por exemplo, Amazona, Pionus (HARCOURT-BROWN, 2010) e Brotogeris está ausente (SICK HELMUT et al., 1997).

As diferentes espécies encontram-se distribuídas pela área tropical do globo terrestre e irradiam-se para as áreas subtropicais e frias (SICK HELMUT et al., 1997). Estas, variam em tamanho, como a arara-azul (*Anodorhynchus hyacinthinus*), que mede 100cm e pesa 1500g, até papagaios-pigmeus (*Micropsitta pusio*) com pouco menos de 10cm e peso corporal de 11g (HARCOURT-BROWN, 2010; SICK HELMUT et al., 1997).

3.4. PSITACÍDEOS NEOTROPICAIS

O Brasil ocupa uma porção considerável da região Neotropical, que se estende desde o extremo norte da floresta tropical mexicana (20 graus de latitude norte) até o Cabo de Hornos (57 graus de latitude sul), abrangendo toda a América do Sul e Central e as ilhas das Antilhas (SICK HELMUT et al., 1997).

A região neotropical é caracterizada pela grande extensão da planície continental na América do Sul, que abriga a maior extensão contínua de florestas pluviais da Terra (Amazônia) e, pela robusta Cordilheira dos Andes, da qual o Brasil não participa. A avifauna desta região apresenta numerosas espécies endêmicas que nela evoluíram. De um total de 930 (novecentas e trinta) espécies da Amazônia, quase 44,0% são endêmicas, envolvendo cerca de 60 (sessenta) gêneros endêmicos; 6 (seis) espécies alcançam Trinidad, na costa da Venezuela (HAFFER, 1974).

A família Psittacidae compreende atualmente todos os gêneros dos psitacídeos do Novo Mundo, bem como os gêneros africanos Psittacus e Poicephalus (PROVOST; JOSEPH; SMITH, 2018; WINKLER; BILLERMAN; LOVETTE, 2020). Ao todo, são 173 (cento e setenta e três) espécies de 37 (trinta e sete) gêneros, dentre eles, os periquitos, papagaios, maracanãs e araras (WINKLER; BILLERMAN; LOVETTE, 2020). Os papagaios do Novo Mundo e da África vivem em uma ampla variedade de habitats arborizados, de floresta densa a floresta aberta e savana. Embora as árvores sejam essenciais para a maioria das espécies, que nidificam em cavidades, algumas espécies vivem em campo aberto, longe das árvores, onde nidificam em tocas ou fendas nas rochas (WINKLER; BILLERMAN; LOVETTE, 2020).

O Brasil é o país que abrange a maior diversidade de psitacídeos do planeta, abrigando 87 (oitenta e sete) espécies, sendo 52 (cinquenta e duas) espécies encontradas no Bioma Amazônia (PIACENTINI et al., 2015). Nos primeiros mapas, que datam de 1500 em diante, esta riqueza já era evidenciada, sendo este território designado como “Terra dos Papagaios” (“*Brasilia sive terra papagallorum”*) (SICK HELMUT et al., 1997).

Os psitaciformes, embora variem extremamente de tamanho, com representantes que apresentam peso corporal entre 25g (tuim) e 1,5kg (araras), compreendem uma ordem cujo reconhecimento é possível instantaneamente. Contudo, os psitacídeos neotropicais são muito homogêneos em comparação com os psitacídeos da região australiana. Isso se deve, em parte, ao fato de a América do Sul, a qual permaneceu isolada por muito tempo, ser algo uniforme geograficamente. No Brasil, fogem desta homogeneidade o anacã *(Deroptyus accipitrinus)* e o papagaio-de-cabeça-laranja *(Pyrilia aurantiocephala).* Quanto ao colorido, nos representantes brasileiros, predomina a cor verde, havendo frequentemente destaques em outras cores como vermelhos, azuis e amarelos nas rêmiges, retrizes, no encontro ou na borda das asas ou ainda nas coberteiras, causando notável efeito quando reveladas em voo ou em cortejos nupciais. Não há espécies brasileiras que desenvolveram um topete (a exemplo das cacatuas australianas). Mas há a tendência de formar um cocar, como aquele presente em Deroptyus (Anacãs). A região perioftálmica tende a ser nua em extensão variada; pode ser apenas um círculo estreito frequentemente destacado por colorido vivo (p. ex. em Anodorhvnchus, Aratinga, Pyrrhura, Brotogeris e Amazona) ou pode estender-se até a cere (Cyanopsitta) ou ocupar toda a face (Ara) e mesmo à base da mandíbula (SICK HELMUT et al., 1997).

3.5. PAPAGAIOS AMAZONA SPP

3.5.1. Taxonomia

A classificação científica dos animais pertence ao campo da taxonomia, a qual é fundamentada, principalmente, na morfologia e anatomia dos seres vivos estudados. A classe é dividida em ordens para expressar um parentesco mais próximo entre os animais. As ordens são divididas em famílias, as quais são baseadas em dados sobre origem, relações de parentesco, morfologia e etologia para classificação dos seres. O próximo táxon é o gênero, cuja interpretação pode ser subjetiva, sofrendo alterações segundo o surgimento de novos conceitos (SICK HELMUT et al., 1997). Enquanto a espécie, popularizado por Mayr e Dobzhansky (1963), dois grandes arquitetos da teoria neodarwiniana, que publicaram a seguinte definição: “espécies são grupos de populações naturais reais ou potencialmente intercruzantes, isoladas reprodutivamente de grupos similares”. Os autores enfatizaram o fato de que a espécie consiste em populações e, apresentam coesão interna devido ao programa genético, historicamente desenvolvido, compartilhado por todos os indivíduos que a compõe. Este é o conceito predominante na biologia, sendo a ortodoxia vigente, apesar de várias críticas a ele (MAYR, 1963).

O sistema de Linnaeus para nomear espécies é denominado de nomenclatura binomial. Cada espécie recebe um nome em latim, composto de duas palavras (daí, binomial), nomenclatura binomial, desenvolvida por Carolus Linnaeus, com a publicação de seu livro Systema Naturae, em 1735. Tratou-se de um trabalho que tentava organizar a vida animal em hierarquias, em grupos cada vez maiores baseados em suas similaridades: Espécie, Gênero, Família, Ordem e Reino, por exemplo. Ao longo dos anos, o trabalho de Linnaeus foi aperfeiçoado por outros pesquisadores. Assim, todos os organismos devem ser colocados em pelo menos sete táxons (Reino, Filo, Classe, Ordem, Família, Gênero e Espécie), um em cada uma das categorias obrigatórias (FAVRETTO, 2021).

A classe das aves é subdividida em aproximadamente 42 (quarenta e duas) ordens, 235 (duzentas e trinta e cinco) famílias e cerca de 2293 (dois mil duzentos e noventa e três) gêneros. Outras subdivisões as vezes são reconhecidas, tais como subclasses, superordens, subordens, tribos e subfamílias (ITIS, 2023).

O gênero Amazona, cujos integrantes são popularmente conhecidos como papagaios, possui o maior número de espécies da família Psittacidae, sendo 36 (trinta e seis), das quais 12 (doze) podem ser encontradas em território brasileiro e, incluem: *A. aestiva*, *A. amazônica*, *A. brasiliensis*, *A. festiva*, *A. rhodocorytha*, *A. pretrei*, *A. ochrocephala*, *A. vinacea*, *A. kawalli*, *A. farinosa*, *A. autumnalis* e *A.drufesniana* (CBRO, 2010; IUCN, 2020).

3.5.2. Características ecológicas

Os representantes do gênero Amazona distribuem-se por toda a América Central (incluindo o Caribe) e do Sul, e no Brasil, são encontrados em todos os biomas. A Amazônia abriga 7 (sete) espécies (*A.amazonica, A.autumnalis, A.festiva, A.kawalli, A.drufesniana, A. ochrocephala, A. farinosa*), seguida pela Mata Atlântica com 6 (seis) (*A. brasiliensis, A. aestiva, A.rhodocorytha, A. vinacea, A. brasiliensis, A. pretrei*); Cerrado com 3 (três) (*A. amazonica, A. farinosa e A. aestiva*), Pantanal e Caatinga com 2 (duas) (*A. amazonica e A. aestiva*), e Pampa com apenas 1 (uma) (*A. pretrei*). A região amazônica apresenta 3 (três) espécies endêmicas, *Amazona festiva*, *A. autumnalis* e *A. kawalli*. Na Mata atlântica os endemismos são representados por *A. brasiliensis, A. rhodocorytha* e *A. vinacea*. Além disso, espécies de distribuição mais ampla como *A. amazonica* e *A. aestiva* são encontradas em quase todos os biomas (ICMBIO, 2011).

Deste montante, o Ministério do Meio Ambiente reconheceu, na última atualização da lista oficial das espécies da fauna e flora ameaçadas de extinção, mediante a Portaria MMA nº 148, publicada em 07 de junho de 2022, 3 (três) espécies como ameaçadas de extinção (MMA, 2004), o que representa ¼ (um quarto) das espécies brasileiras, sendo elas: papagaio-de-peito-roxo, *A. vinacea* (KUHL, 1820), chauá, *A. rhodocorytha* (SALVADORI, 1890), e charão, *A. pretrei* (TEMMINCK, 1830). Todas essas espécies ameaçadas estão inseridas no bioma Mata Atlântica, que é um dos mais impactados pelas atividades humanas (ICMBIO, 2011).

Com relação às 4 (quatro) espécies ameaçadas da Mata Atlântica (MMA, 2004), *A. rhodocorytha* ocorre de Alagoas ao Rio de Janeiro, em altitudes inferiores a 900 metros, enquanto *A. vinacea* pode ser encontrada do centro-sul da Bahia ao Rio Grande do Sul (COLLAR, 1997). *A. pretrei* é encontrada em áreas distintas de reprodução e alimentação, nos estados do Rio Grande do Sul e Santa Catarina, respectivamente. Merecem destaque também as áreas de simpatria entre *A. vinacea* e *A. pretrei* no estado de Santa Catarina e de *A. vinacea* e *A. rhodocorytha* nas áreas do sul da Bahia ao Rio de Janeiro, região onde elas se encontram nos limites altitudinais de suas distribuições (ICMBIO, 2011).

3.5.3. Características biológicas

Estudos taxonômicos relacionados ao gênero Amazona levaram, nos últimos 25 anos, à descrição de uma nova espécie, *Amazona kawalli* (GRANTSAU; CAMARGO, 1989), além da proposta de novos arranjos taxonômicos, como a exclusão de "*Amazona xanthops*" do gênero (DUARTE; CAPARROZ, 1995) e sua alocação em gênero próprio, *Alipiopsitta* (CAPARROZ; PACHECO, 2006).

Papagaios do gênero Amazona são conhecidos por alcançarem longevidade importante quando criados em cativeiro, podendo viver cerca de 25 a 50 anos, isto, variando de acordo com alguns fatores, como o manejo, nutrição e a genética da ave (GRESPAN; RASO, 2014; MENCH *et al.*, 2018; MUNSHI-SOUTH; WILKISON, 2006; YOUNG *et al.*, 2012)

Estas espécies são monogâmicas e, acredita-se que os casais permanecem unidos ao longo da vida. Estes, nidificam em troncos ocos, embora exista grande competição entre as aves, mamíferos, como saguis e gambas e, invertebrados que ocupam estas cavidades, como abelhas, marimbondos e formigas, o que restringe a quantidade de ocos viáveis e assim, um fator limitante para as diversas populações de psitacídeos (SICK *et al.*, 1997)

Os ovos destes papagaios são de formato arredondado, brancos e relativamente pequenos, sendo chocados principalmente pela fêmea. A postura varia e resulta em média de 3 (três) a 4 (quatro) ovos (SICK HELMUT et al., 1997). O período de incubação é variável, podendo ser de 26 (vinte seis) dias, como comumente registrado em *A. aestiva*, *A. amazonica* e *A. vinacea*, a 28 (vinte oito) dias (ALLGAYER; CZIULIK, 2007) como em *Amazona festiva*. A reprodução não inibe totalmente o contato social do casal com o restante do bando, todavia, os casais se mantêm mais segregados durante a incubação, mas, parece que mesmo nessa época o macho continua a integrar um pouso coletivo. Os filhotes são altriciais, ou seja, eclodem desprovidos de penas, com os olhos fechados, completamente dependentes dos pais. Estes, permanecem no ninho, em média, por dois meses. A maioria das aves atinge a maturidade sexual por volta dos 2 anos, com início da fase reprodutiva entre 3 (três) e 6 (seis) anos em média e, esta ocorre apenas uma vez ao ano, no período de julho a dezembro (ALLGAYER; CZIULIK, 2007; CARRARA et al., 2008; CLUBB et al., 2015; GILARDI; MUNN, 1998; SICK HELMUT et al., 1997).

Embora não haja dados suficientes, estima-se que os papagaios neotropicais deste gênero, vivam aproximadamente de 20 (vinte) a 30 (trinta) anos na natureza. A predação é a principal causa de mortalidade em aves de vida livre e, para os psitacídeos neotropicais, os macacos, iraras *(Eira barbara)*, cobras (p. ex., Spilotes sp.), tucanos e aves de rapina, representam um grupo importante de predadores; razão pela qual as aves preferem buracos profundos (SALINAS-MELGOZA; SALINAS-MELGOZA; RENTOS, 2009). Pesquisas de doenças em animais de vida livre têm mostrado baixa prevalência de agentes infecciosos (STONE; MONTIEL-PARRA; PÉREZ, 2005; VAZ *et al.*, 2021), embora relatos de padrões de doenças e mortalidade em aves em cativeiro não sejam incomuns, poucos estudos analisaram especificamente os padrões de mortalidade e morbidade *ex-situ*. No entanto, evidências preliminares sugerem que esses animais tendem a apresentar maiores taxas de mortalidade e maior frequência de doenças infecciosas e oportunistas em condições de cativeiro (DONATTI *et al.,* 2014; ECHENIQUE *et al.,* 2020; FOTIN; MATUSHIMA, 2005; GIBSON *et al.,* 2019; JOHNE; MÜLLER, 1998; SÁNCHEZ; LEDESMA; MORALES, 2020).

3.5.4. Características fenotípicas

O gênero Amazona *(Lesson, 1830)* (SCHODDE *et al.*, 2013), está entre os mais conhecidos de todos os psitacídeos do novo mundo, isto devido principalmente a popularidade das suas espécies como aves de companhia. Estes papagaios são fenotipicamente caracterizados por seu tamanho médio a grande, variando entre os 25 aos 40 centímetros de comprimento e podem pesar de 350 a 700 gramas. Possuem um bico forte e pesado, cauda arredondada e, cere nu proeminente na base do bico (FORSHAW; COOPER, 1973; SICK *et al.*, 1997). As asas são arredondadas, largas e curtas, conferindo um constante bater de asas fácil de reconhecer. Papagaios deste gênero, são predominantemente verdes, de forma que a coloração da cabeça, peito, coberteiras das asas, rêmiges e retrizes são as principais características utilizadas para diferenciar os variados táxons. Os olhos têm um anel de cor branco-bronzeado ao seu redor e, a cere é desprovida de penas, mas muitos têm tufos semelhantes a cabelos. As cores do bico variam de castanho a completamente preto. Não apresentam dimorfismo sexual de plumagem, característica que dificulta a diferenciação entre machos e fêmeas a simples vista, à exceção de *Amazona pretrei* na qual os dois sexos têm cor predominante verde e, são diferenciados pela máscara vermelha e espelhos vermelhos das asas nos machos (SICK HELMUT et al., 1997).

3.5.5. Comportamento

Durante o dia, os papagaios de vida livre praticam, principalmente, dois tipos de atividades, como as de forrageamento e as de manutenção (BERGMAN; REINISCH, 2006). Atividades de forrageamento incluem a procura, seleção, manipulação e consumo. Os papagaios voam quilômetros em busca dos alimentos e gastam entre 4 e 8 horas do dia nestas atividades, das quais o consumo e a manipulação são as que representam maior gasto de tempo (ROZEK et al., 2010; SICK HELMUT et al., 1997; SPEER, 2014).

Os comportamentos de manutenção são aqueles que contribuem na limpeza do corpo e na conservação das penas. Incluem atividades como limpeza (grooming) e alisamento (preening) das penas, limpeza dos pés, banhos, coçar com os pés, alongamento, bocejar, dormir e, roer objetos. Durante a limpeza das penas, a ave puxa uma a uma com o bico, realiza leves bicadas que servem para recolocar bárbulas desconectadas. Geralmente precede o sono, enquanto o alongamento ocorre após o descanso, possivelmente para preparar o corpo para o voo e outras atividades (BERGMAN; REINISCH, 2006).

Os papagaios são aves sociáveis e de hábitos gregários, que vivem em bandos, compostos por pares e indivíduos jovens. Enquanto filhotes, a interação social é limitada aos pais e irmãos dentro do ninho. À medida que se tornam mais autônomos, os jovens aprendem a interagir com o bando e com o ambiente, localizando água e alimento (GILARDI; MUNN, 1998). O agrupamento em bandos é estimulado principalmente pela detecção e prevenção de predadores, mas também por recursos alimentares instáveis, o que garante assim maior segurança e eficiência no forrageamento (MEEHAN; GARNER; MENCH, 2003; SEIBERT, 2006; SICK *et al.*, 1997).

3.5.6. Dieta

Estudos envolvendo papagaios Amazona spp. e outros psitacídeos neotropicais demonstraram que as espécies deste grupo exploram o dossel das florestas e arbustos frutíferos, com ingestão de grande variedade de alimentos, como frutos, sementes, cascas, brotos, folhas e larvas de insetos (PIZO; SIMÃO; GALETTI, 1995; RAGUSA-NETTO; FECCHIO, 2006; SERAFINI *et al.*, 2011).

Adicionalmente, as diferenças sazonais na abundância e disponibilidade de fontes de alimento, bem como nas necessidades nutricionais e, consequentemente, o comportamento de forrageamento, são inatas à dieta natural dos papagaios, o que faz com que esta seja extremamente ampla e variável (KALMAR, 2011; KILPP; SOMENZARI; SCHUNCK, 2015; PÉRON; GROSSET, 2014; SERAFINI *et al.*, 2011; SICK *et al.*, 1997)

Poucos são os trabalhos que avaliaram a dieta alimentar de papagaios, podendo ser citados os trabalhos de Snyder et. al. (1987) com *Amazona vittata* (SNYDER; WILEY; KEPLER, 1987); Martuscelli (1995) com *Amazona brasiliensis* (MARTUSCELLI, 1995); Araújo (2007) com *Alipiopsitta xanthops* (ARAÚJO, 2007); Prestes *et al*. (2008) com *Amazona pretrei* (PRESTES; MARTINEZ, 2008) e Kilpp; *et al.* (2015) com o papagaio-de-peito-roxo (*Amazona vinacea*) (KILPP; SOMENZARI; SCHUNCK, 2015) do qual se sabe que, possui forte associação com as florestas de araucária em grande parte de sua distribuição, principalmente no sul e sudeste do Brasil, porém poucos são os relatos sobre seu comportamento alimentar e apenas alguns trabalhos apresentaram informações de sua dieta, com destaque para o pinhão (*Araucaria angustifolia*) (KILPP; SOMENZARI; SCHUNCK, 2015; SICK *et al.*, 1997).

Na pesquisa realizada por Seixas (2009), no Pantanal do Mato Grosso do Sul, foi observado que papagaios verdadeiros (*A. aestiva*) consumiram fragmentos/partes de quarenta e oito espécies vegetais, entre sementes, folhas, flores, polpa de frutos carnosos, como cajá, bocaiúva, embaúba, jenipapo, goiaba e figos, além de terra de cupinzeiro. As sementes, principalmente de frutos secos, como às do Ipê-roxo e Aroeira, corresponderam a 67,0% da dieta. Na seca, as flores foram o segundo item mais consumido (SEIXAS, 2009).

Quando comparadas com as demandas energéticas em vida livre, as necessidades em cativeiro são substancialmente reduzidas (CARCIOFI; PRADA, 2000). Assim, o balanceamento nutritivo das aves de vida livre deve atender as necessidades nutricionais e promover maior acúmulo de energia, pois sua sobrevivência está sujeita a condições climáticas, estacionais e nutricionais muito variáveis, sendo as reservas corporais fundamentais para épocas de escassez alimentar e de reprodução (MACHADO; SAAD, 2000).

Algumas espécies de papagaios de vida livre podem consumir mais de 80 espécies de vegetais, as quais compoem dietas altamente nutritivas, que apresentam altos teores de ácidos graxos, moderados de proteína e relativamente baixos de carboidratos. Portanto, acreditava-se erroneamente que essas aves precisavam de dietas mais energéticas em cativeiro, sem considerar as diferenças no nível de atividade e oferta de alimentos nos dois ambientes (SAAD et al., 2007).

As dietas consumidas pelos psitacídeos em seus ambientes naturais raramente podem ser reproduzidas em cativeiro, devido à grande variedade de itens, disponibilidade sazonal e custos econômicos. Neste cenário, muitas dietas são propostas, na maioria, por componentes alimentares oferecidos *ad libitum*, porém, normalmente inadequados para atender as necessidades nutricionais (KALMAR, 2011). A exemplo disto, as dietas a base de mistura de sementes são as mais comum e amplamente administradas a papagaios de diversas espécies mantidos em cativeiro. As dietas de sementes inteiras são prontamente ingeridas pelos papagaios e muitas vezes são consideradas como dieta natural (ULLREY; ALLEN; BAER, 1991).

Tem sido amplamente divulgado que as dietas a base de sementes como única fonte de alimentos são desequilibradas em aminoácidos, contêm quantidades excessivas de gordura e são deficientes em elementos essenciais como sódio, cálcio, manganês, fósforo, ferro, zinco, selênio, iodo e vitaminas A, D, K, B-12, riboflavina, ácido pantotênico, colina e niacina. No entanto, tutores acreditam erroneamente que oferecem alimentação adequada (KOUTSOS; MATSON; KLASING, 2001; OROSZ, 2014; PERLMAN, 2016; PÉRON; GROSSET, 2014; PERPIÑÁN, 2015).

A manifestação das deficiências resultantes permanece subclínica por períodos prolongados e, quando os sintomas clínicos surgem, eles geralmente são inespecíficos e permanecem sem diagnóstico (KOUTSOS; MATSON; KLASING, 2001; OROSZ, 2014; PERLMAN, 2016; PÉRON; GROSSET, 2014; PERPIÑÁN, 2015). Outras dietas comerciais comumente oferecidas aos papagaios contêm misturas de frutas e vegetais secos ou cristalizados, sementes e “kibbles” em tamanhos variados (KOUTSOS; MATSON; KLASING, 2001). Porém, devido ao comportamento alimentar seletivo bem documentado dos papagaios, os nutrientes consumidos pelas aves são limitados nessas misturas, o que demonstra evidente preferência das sementes sobre outros itens oferecidos (BRIGHTSMITH, 2012; KALMAR et al., 2010).

Uma das principais vantagens das dietas peletizadas ou extrusadas em relação às misturas de sementes, inclui a prevenção do comportamento alimentar seletivo e a possibilidade de uma formulação adequada segundo as diretrizes nutricionais disponíveis (WERQUIN; DE COCK; GHYSELS, 2005). Então, novamente, o valor nutritivo não é o único problema nas estratégias alimentares. O custo da alimentação, por exemplo, é geralmente maior em dietas processadas, em comparação com as misturas de sementes. Ainda assim, faltam informações em relação aos possíveis benefícios à saúde das aves, quando alimentadas com dietas comerciais processadas (“rações”). O estudo publicado por Ullrey e colaboradores (1991) apontou aumento significativo na porcentagem de filhotes em oito espécies de papagaios avaliadas após mudança de dieta: mistura de sementes para alimentos extrusados, ambas associadas a vegetais e frutas *ad libitum* (ULLREY; ALLEN; BAER, 1991). Todavia, embora indicativo, os resultados não podem ser extrapolados para todas as aves, bem como todas as dietas comerciais (KALMAR, 2011).

3.5.7. Conservação

O Brasil é responsável pela gestão do maior patrimônio natural do mundo, com mais de 120 mil espécies de animais. Entre estas espécies, 1.173 constam na Lista Oficial da Fauna Brasileira Ameaçada de Extinção (MMA, 2014). Dentre as 234 espécies de aves constantes da Lista Oficial, estão os papagaios do gênero Amazona (PIACENTINI *et al.*, 2015).

No Brasil, o gênero Amazona compreende 12 espécies, que estão em sua maior parte ameaçadas pelo comércio ilegal e pela destruição do habitat, ocupando o primeiro lugar entre as aves psitaciformes traficadas no país (FERNANDES *et al.*, 2012; ICMBIO, 2011; WRIGHT *et al.*, 2001). Como os papagaios são animais de estimação extremamente populares, isto devido às características já descritas, como as cores brilhantes, capacidade de mimetismo, inteligência e carisma, a demanda criada ao redor do mundo levou a um movimento internacional de mais de 19 milhões de aves comercializadas desde 1975 ("CITES Trade Database", 2022).

As possíveis ameaças às populações de papagaios silvestres colocadas pelo tráfico de animais de estimação justificam a inclusão antecipada de toda a ordem Psitaciformes nos Apêndices da CITES (CITES, 2022a). Além disso, o comércio internacional de papagaios também trouxe crescimento no número dessas aves sob cuidados humanos, como animais de estimação, em centros de triagem, conservação, reprodução e reabilitação, zoológicos e outros cenários de cativeiro (FORSHAW, 2017).

De acordo com a Lista Vermelha de Fauna Ameaçada da IUCN, entre as 36 espécies do gênero Amazona distribuídas mundialmente, duas estão extintas; quatro estão em situação crítica de perigo; cinco ameaçadas; oito listadas como vulneráveis e sete como quase ameaçadas. Das 12 espécies que ocorrem no território brasileiro, cinco constam nesta lista, sendo duas classificadas como vulneráveis (*A. rhodocorytha*; *A. pretrei*), uma classificada como ameaçada de extinção (*A.vinacea*) e duas quase ameaçadas (*A. brasiliensis*; *A. drufesniana*) (IUCN, 2020).

A perda de habitat é uma ameaça ao gênero, especialmente naqueles biomas que foram mais sujeitos ao desmatamento, como a Mata Atlântica do Brasil. Lar de sete espécies da Amazônia, a Mata Atlântica é a segunda maior floresta tropical da América do Sul (RIBEIRO *et al.*, 2011) e é um foco global de biodiversidade (RIBEIRO *et al.*, 2009). O bioma perdeu quase 90,0% de sua cobertura florestal desde o início da colonização européia (RIBEIRO *et al.*, 2009), e apenas 1,0% de sua extensão original está atualmente incluída em áreas protegidas

(RIBEIRO *et al.*, 2011). De acordo com uma projeção para 2070, a região da Mata Atlântica perderá habitat de aves a uma taxa de 1,2% a 3,3% por década – a maior taxa de perda estimada por esse estudo para qualquer região do mundo (POWERS; JETZ, 2019).

Embora a destruição do habitat e pequenos tamanhos de ninhadas possam contribuir para a redução das populações de psitacídeos neotropicais, o comércio ilegal de filhotes é a principal causa de seu declínio (WRIGHT *et al.*, 2001). A caça furtiva de papagaios é uma atividade econômica impulsionada pela demanda do comércio ilegal de animais de estimação (FERNANDES *et al.*, 2012; LOPES; LAMA; DEL LAMA, 2007; ZULIAN; MILLER; FERRAZ, 2021). Wright *et al.* (2001) relataram preços médios nos Estados Unidos de US$ 575,00 para espécie de papagaio-do-mangue (*A. amazônica*), US$ 711,00 para papagaio-verdadeiro (*A. aestiva*) e US$ 2.150,00 para a papagaio-da-várzea (*A. festiva*). Também calcularam as taxas de mortalidade por saques de ninhos de 23 estudos envolvendo psitacídeos neotropicais, os quais representaram 4.024 tentativas de nidificação, em 21 espécies de 14 países, com dados registrados de 1979 a 1999. A média geral de saques foi de 30,0% (WRIGHT et al., 2001).

O papagaio-verdadeiro tem sido reconhecido como a espécie mais traficada; estima-se que entre 1982 e 1986, aproximadamente 51.000 exemplares foram exportados para a Argentina (BEISSINGER; BUCHER, 1992). Isso supera o número total de indivíduos de todas as espécies amazônicas exportados para todos os outros países e, devido à população relativamente pequena da Amazônia na Argentina, Sick Helmut *et al.* (1997) propuseram que a maioria desses psitacídeos foi capturada no Brasil (SICK HELMUT et al., 1997).

3.6. MEDICINA AVIÁRIA

Embora a medicina veterinária moderna tenha evoluído ao longo dos séculos, a medicina de aves é considerada um campo relativamente novo. Atualmente, os médicos veterinários de aves podem administrar e atender bandos de aves comerciais, tratar aves de companhia, aves de falcoaria, cuidar da vida selvagem e administrar espécimes de zoológicos e outras coleções; no entanto, o caminho que leva a uma gama tão ampla de oportunidades não tem sido simples (ARRISON *et al.*, 2009).

É importante considerar os ambientes em que as aves evoluíram. Eras de pressão seletiva resultaram em aves que se adaptaram a dietas, habitats e ameaças específicas e, doenças podem ocorrer quando as condições de cativeiro diferem. Um exemplo disto é a deficiência de vitamina A, uma preocupação comum em papagaios do gênero Amazona, nativos das florestas tropicais do novo mundo (POLLOCK; KLAPHAKE; WELLEHAN, 2016). Em contraste, a indução de hipovitaminose A em calopsitas adultas é difícil de acontecer e, a toxicose por vitamina A é relativamente fácil de induzir, sendo que estas aves evoluíram em ambientes áridos, onde a vitamina A pode ser relativamente escassa (KOUTSOS *et al.*, 2003). Diante deste contexto, tratar todas as espécies de psitacídeos de forma idêntica do ponto de vista nutricional pode levar a alterações clínicas significativas.

Quando se trata das aves como pacientes, deve-se lembrar desta classe como uma das mais diversas, taxonomicamente falando e, cada taxa é única, tendo desenvolvido características anatômicas, fisiológicas e comportamentais que permitem a competição efetiva em um nicho ecológico específico. Não existem informações científicas suficientes disponíveis, particularmente no que diz respeito às variações nas adaptações da dieta das aves, características comportamentais e resposta a preparações de medicamentos e agentes infecciosos (COLES, 2007; POLLOCK; KLAPHAKE; WELLEHAN, 2016; RITCHIE; HARRISON; HARRISON, 1994)

O clínico deve compensar por meio da aplicação de amplo sistema médico de verificação e equilíbrio baseado no uso de inúmeras ferramentas diagnósticas e terapêuticas. As decisões de gestão médica para um gênero específico dentro de um pedido devem ser baseadas na interpretação de várias mudanças que indicam que uma alteração é de fato uma anormalidade. Por enquanto, os médicos veterinários de aves continuarão sendo obrigados a diagnosticar e tratar muitos problemas médicos subjetivamente até que os resultados dos esforços de pesquisa aviária comecem a satisfazer a demanda por informações (COLES, 2007)

A doença surgirá inevitavelmente se as necessidades biológicas, psicológicas e comportamentais da ave não forem satisfeitas. É ainda mais provável que o veterinário detecte os primeiros sinais de doença em uma ave de uma determinada espécie pelo fato de estar familiarizado com as características comportamentais e biológicas, bem como com as particularidades médicas associadas a um determinado táxon. Como resultado, dirigir uma abordagem baseada em evidências permitirá que os clínicos prestem os melhores cuidados aos seus pacientes aviários e melhorem as abordagens com o advento de novos dados (CHASTAIN; VELLIOS, 2018; TULLY; DORRESTEIN; JONES, 2009).

3.7. ESTUDOS RETROSPECTIVOS E SUA IMPORTÂNCIA NA MEDICINA AVIÁRIA

A investigação retrospectiva é a análise observacional dos acontecimentos após a sua ocorrência (MANN, 2003). Os estudos de casos retrospectivos, são definidos como estudos observacionais que descrevem resultados de múltiplos casos ou relatórios sem manipulação experimental dos dados que foram previamente recolhidos para outro fim (como por exemplo, o diagnóstico do paciente) (HESS; FAARC, 2004).

Estudos retrospectivos são importantes em muitos campos da investigação médica e veterinária, especialmente quando as doenças de interesse são raras ou pouco detectadas, os mecanismos da doença não são bem compreendidos, ou existem questões éticas ou de conservação com a realização de estudos prospectivos ou experimentais(MANN, 2003). Além disso, especialmente em espécies pouco comuns, os estudos prospectivos podem não ser realizados por falta de financiamento ou apoio logístico (ALLGAYER; CZIULIK, 2007; FOTIN; MATUSHIMA, 2005; VANSTREELS *et al.*, 2010).

As análises retrospectivas, semelhantes às revisões de literatura, aglutinam informação de várias fontes para tirar conclusões que seriam difíceis de fazer num contexto experimental, uma vez que as questões colocadas estão frequentemente fora do âmbito da investigação experimental e, não são testadas. Estas análises são clinicamente relevantes, uma vez que descrevem a apresentação de certas condições que podem informar clínicos e profissionais de saúde para formular um diagnóstico, ou podem ajudar na descoberta etiológica, sugerindo relações, que podem depois ser verificadas. Por exemplo, a associação insuspeita entre aterosclerose e infecção por Chlamydia spp. foi sugerida num estudo de caso retrospectivo de aterosclerose em psitacídeos, embora esta associação tenha sido efetuada mais tarde (PILNY *et al.*, 2012).

Do mesmo modo, as lesões histológicas, bem como os fatores de risco associados à doença de dilatação proventricular foram descritos num estudo retrospectivo por Doneley, Miller e Fanning (2007), antes da identificação do agente causador (vírus nascidos de aves) por pirosequência em 2008 (HONKAVUORI *et al.*, 2008).

Estudar a prevalência e distribuição das doenças é um dos objetivos mais comuns dos estudos de casos retrospectivos. Avaliar a prevalência de uma doença, definida por lesões específicas ou por uma etiologia específica. Os estudos focados no táxon utilizam uma coorte definida de sujeitos de estudo (espécie, género, população geográfica etc.) e calculam a prevalência da(s) doença(s) de interesse. Por exemplo, Smith *et al.* (2018) estudaram aves de rapina selvagens em Ontário, Canadá, para melhor caracterizar as doenças presentes nesta população, avaliando e resumindo os resultados dos relatórios de patologia (SMITH *et al.*, 2018). Em papagaios neotropicais cativos (Amazona spp.), Hvenegaard *et al.* (2009) delinearam a prevalência de várias doenças oculares neste gênero (HVENEGAARD *et al.*, 2009). Em taxas para as quais pouco se sabe sobre a incidência ou prevalência de doenças, torna-se muitas vezes necessário um âmbito taxonômico mais amplo.

Descrever a prevalência de doenças dentro de taxas específicas permite aos diagnosticadores refinar o seu âmbito de diagnósticos diferenciais quando apresentados com lesões numa determinada espécie. Estudos retrospectivos focados na doença reduzem o âmbito da investigação a uma doença específica e, são frequentemente utilizados na avaliação dos fatores de risco (por exemplo, espécie, idade, sexo, doenças simultâneas) associados à incidência de doença. Por exemplo, Beaufrère *et al*. (2013) estudaram a aterosclerose em psitacídeos com o objetivo de descrever os géneros, grupo(s) etário(s) e sexo mais afetados e, como as concentrações de lipídios plasmáticos se correlacionaram com as lesões (HUGUES BEAUFRÈRE; MÉLANIE AMMERSBACH, 2013). Com base nos resultados deste estudo, os autores propuseram que as caturritas (*Myiopsitta monachus*) poderiam servir como uma espécie “modelo” de psitacídeo-aterosclerose útil para estudos futuros (BEAUFRÈRE *et al.*, 2019).

Estes tipos de estudos podem revelar tendências notáveis e levar a investigações de teste de hipóteses dirigidas à patogênese de doenças específicas e, potencialmente, levar a mais investigações sobre a causa, patogênese e fatores de risco associados.

Além disso, uma aplicação comum de estudos retrospectivos em medicina veterinária clínica é no auxílio para determinação de indicadores prognósticos. Heidner *et al.* (1991) descreveram as taxas de sobrevivência de cães com diferentes tipos de tumores cerebrais (HEIDNER *et al.*, 1991). Embora não tenham sido realizados estudos análogos em psitacídeos, um trabalho retrospectivo, resumiu os parâmetros sanguíneos normais numa variedade de espécies a partir de dados clínicos arquivados (CAPITELLI; CROSTA, 2013), o que ajudará a recolher dados prognósticos por meio de intervalos de referência normais específicos da espécie, demostrando assim que dados recolhidos esporadicamente podem ser coligidos e utilizados para guiar na toma de decisões médicas, procedimentos e, a melhorar os métodos de diagnóstico e prognóstico.

CAPÍTULO 1

4. CAPÍTULO 1: CAPTIVE NEOTROPICAL PARROTS (*AMAZONA SPP.*) IN SÃO PAULO, BRAZIL: A 10-YEAR RETROSPECTIVE STUDY OF THE CAUSES OF MORBIDITY AND MORTALITY

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ABSTRACT

Parrots of the Neotropical region are well-known companion animals also kept in zoos, wildlife rehabilitation centers, and private breeding collections. Despite the popularity of captive psittacines, long-term, comprehensive studies of taxa-specific diagnostic data are uncommon. This study was performed to evaluate diagnostic data, including the cause(s) and contributors to death, and therefore to assess trends in disease prevalence in captive amazon parrots submitted to the Avian Ambulatory Service (SAA) and Animal Pathology (SPA) of the Department of Pathology (VPT) and HOVET/FMVZ-USP, São Paulo, Brazil. Information from 791 birds (707 alive and 84 dead) was assessed in this study with a total of 1033 clinical records reviewed, from those, 877 primary diagnoses were identified, and from the 84 *"post mortem"* reports, 109 diagnoses were registered, totalizing 1142 medical observations and 986 final diagnoses, all data included nine species from the genera. Parrots were often diagnosed with noninfectious diseases (n=512; 51.93%), and the most common subprocesses were metabolic (n=189; 36.91%), physical (n=48; 28.91%), neoplastic (n=79; 15.43%), and degenerative (n=41; 8.0%). Infectious diseases (n=329; 33.3%) were most commonly bacterial (n=227; 69.0%) and viral (n=45; 13.68%), but also included fungal (n=38; 11.55%), and parasitic (n=19; 5.78%). Exploratory statistical analyses, used to guide further research, revealed significant correlations and associations among disease processes, and age categories. This retrospective study has been conducted over 10 years and provides a broad overview of disease prevalence among these birds that can serve as a benchmark to guide further investigations of disease surveillance affecting these species.

KEYWORDS:

Psittacines, Amazon parrots, Disease, Prevalence, Captivity, Pathology, Epidemiology, Brazil.

4.1. INTRODUCTION

The Neotropics possess the greatest Psittacidae diversity in the world and Brazil is the country with the largest number of species (PIACENTINI *et al.*, 2015). The genus Amazona, which is found from northern Argentina to northern Mexico, is the most diversified among the Psittacidae family, with 36 species and, according to the IUCN Red List, one-half (18) of the *Amazona* species are globally threatened, and 25 species, have declining population levels (IUCN, 2022).

In Brazil, the Amazona genus comprises 12 species, which are most threatened by illegal trade and habitat destruction, ranking first among psittacine birds trafficked in the country. Nonetheless, another current challenge to wildlife conservation efforts is the dissemination of infectious diseases. As parrots are extremely popular pets, the demand created around the world has led to an international movement of over 19 million birds since 1975 (CITES, 2022a) which triggers the spread of pathogens (IUCN, 2020; PIACENTINI *et al.*, 2015).

The potential threats to wild parrot populations posed by the exotic pet trade warrant the early listing of the entire order Psittaciformes in the Appendices of CITES (CITES, 2022b). Moreover, the international parrot trade also brought growth in the number of these birds under human care, as pets, in screening, conservation, breeding, and rehabilitation centers, zoos and other captive settings scenarios (FORSHAW, 2017).

Many parrot species have a long lifespan (YOUNG *et al.*, 2012) and recent advances in husbandry, nutrition, and veterinary care along with the absence of extrinsic dangers such as predation and trauma, have made it possible for captive wildlife to live beyond their average life span in a free-ranging situation, increasing the likelihood of age-related disorders (VOGELNEST; TALBOT, 2019). In addition, birds that are bred and kept in captivity often develop a unique set of diseases that can differ substantially from those that occur in wild (ex, cardiovascular, neoplastic) (GIBSON *et al.*, 2019; RICKLEFS; RICKLEFS, 2000). Most of them, related to a range of husbandry issues as well as behavioral, physiological, or genetic traits among species may predispose captive birds to disease, including infections, metabolic disorders, and neoplasia (BEAUFRÈRE *et al.*, 2013; DORRESTEIN, 2003; NEMETH *et al.*, 2016). Furthermore, geographical variations in wildlife birds' management practices (such as biosecurity, breeding and rearing techniques, bird acquisition, climatic circumstances, and so on) might affect disease prevalence, highlighting the need for assessments that are relevant to a given region (GIBSON *et al.*, 2019; MORISHITA *et al.*, 1998). To the extent of our knowledge, this is the first port that assesses the widespread prevalence and pathological manifestation of diseases in Brazil that are specific to a taxonomic taxon of psittacine birds.

The objectives were: (1) to characterize the population of captive amazon parrots, presented to the Avian Ambulatory Service (SAA) and Animal Pathology (SPA) of the Department of Pathology (VPT) and HOVET/FMVZ-USP; (2) to identify the main reasons for which these animals required veterinary medical attention; (3) to describe the prevalence of diseases affecting captive neotropical parrots from the Amazona genus; (4) to report the pathological processes and organic systems most described.

4.2. MATERIAL AND METHODS

4.2.1. Study site

Our study was conducted at the Avian Ambulatory Service (SAA) and Animal Pathology (SPA) - VPT/HOVET/FMVZ-USP, located in São Paulo, Brazil.

4.2.2. Study population

Original medical records and *"post mortem"* reports from Psittacines of the Amazona genus species (LESSON, 1830) admitted to Avian Ambulatory Service (SAA) and Animal Pathology (SPA) of the Department of Pathology (VPT) and HOVET/FMVZ-USP, between January 2009 and December 2019, were reviewed.

4.2.3. Data extraction and database formatting

Clinical and *"*post- mortem*"* data from patient medical records and necropsy reports were retrieved and compiled into a computerized database, created using Microsoft® Excel 2017, to include, for each case, demographic data such as individual record serial number, given by the hospital register system, species, using the scientific nomenclature which for species of birds occurring in Brazilian territory followed the Brazilian Committee of Ornithological Records (CBRO, 2014), and for species of international occurrence followed The World Bird Database (AVIBASE, 2023); sex and age. As amazon parrots are nondimorphic species, sex was determined in some cases through historic, DNA sexing, or at *"post mortem"* examination. Age was considered as the one reported by the caregivers when available and then delimited into four categories: 'chick', 'juvenile', '"chick", "juvenile", "adult,' and 'senior', in accordance with the", and, "senior", according to age at, sexual maturity, and the average lifespan for the genus (SICK *et al.*, 1997; YOUNG *et al.*, 2012). Furthermore, consultation and clinical exam- related variables as well as final diagnoses were gathered. More detailed information about the demographic data extraction is found in chart 1.

Chart 1 - Individual criteria and short descriptions used for demographic data collection.

Criteria	***Description***	
Id	Individual record serial number	Given by the hospital register system
Species	Binominal scientific name	
	If the species was not specified but the popular name coincided coincide with the genus it was classified as: unspecified	When identify the taxonomic genus of the bird was not possible, records were not considered
Sex	Male/ female	Identified through historic, DNA sexing, or postmortem examination
	When the sex was not possible to identify it was classified as: undetermined	
Age	Age at the time of consultation reported by the caregiver	When an estimate of the age was not reported, it was classified as: unspecified
Age category	Chick	Hatch to fledging: 0 to 5 months
	Juvenile	After fledging to achieve sexual maturity: 5 months to 5 years
	Adult	Sexual maturity to average lifespan: 5 to 45 years
	Senior	Older than average lifespan: older than 45 years

Consultation-related variables assembled were submission date, origin, consultation emergency, and presenting complaint. These two last ones were not included for birds presented dead at submission. For the submission date, the year was divided into seasons. For the origin category, three subdivisions were created, and this included 'household environment' which means the animal submitted came as a pet driven by its caregiver. 'Sao Paulo wildlife screening center's (CETAS)’, which means these individuals were captive at these centers and may have origins such as illegal wildlife trade, apprehensions made by the Environmental Military Police, Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA), Civilian, Municipal and Federal Police inspections; or could be rescued by the City Hall, Fire Departments, Urban Parks, Private Companies or even brought by common citizens, to these centers. Third option within this category, is 'breeding facilities'. As Brazilian policies allowed the breeding of this species for commercial and noncommercial porpoises and there was not always complete information available about it, they were grouped in this category.

The type of consultation included nonurgent consultation such as 'checkup consultations' for animals submitted for routinary tests as preventive health evaluation, handling corrections, and other processes such as clipping wings, trimming nails, or sexing DNA tests. 'Scheduled consultations' included those when the bird presents some notable signs of diseases or behavioral alterations, leading to the responsibility to look after medical attention and report these symptoms. The last classification is 'emergency consultation' for animals submitted to the hospital without previous scheduling because of the acute presentation of the symptoms or the suspect of the life of the patient to be compromised.

As presenting complaints, where analyzed the caregivers reported symptoms and the clinical exam described signs. A maximum non-established number of entries were recorded and then grouped into ten categories: cloacal prolapse, neurological symptoms, abnormal mass, respiratory symptoms, coelomic distension, gastrointestinal disorder, trauma-related symptoms, musculoskeletal symptoms, behavioral disorder, dermatologic alteration, ocular symptoms, and nonspecific acute symptoms. Detailed information about the collection of data related to the consultation is found in chart 2.

Chart 2 - Individual criteria and short description used to collect variables related to consultation.

Criteria	***Description***	
Submission date	Spring	October to December
	Summer	January to March
	Autumn	April to June
	Winter	July to September
Origin	Household environment	The animal submitted came as a pet drive by its caregiver
	Wildlife screening centers	Individuals were captive at these centers and may have different origins
	Breeding facilities	Allowed facilities with commercial and noncommercial porpoises
Type of consultation	Checkup	Birds submitted for a preventive health evaluation, apparently healthy individuals
	Scheduled consultations	Apparently sick individuals lead to the bird's caregiver to look after medical attention
	Emergency consultation	Animals submitted to the hospital without previous scheduling
Presenting complaint	Cloacal prolapse	External visualization of inner tissue protrudes through the vent opening
	Neurological symptoms	Seizures, ataxia, head tilt, irresponsive state of consciousness
	Abnormal mass	Presences of an outgrowing mass
	Respiratory symptoms	Sneeze, wheeze, cough, nasal discharge, dyspnea, tail bobbing, periocular swelling
	Coelomic distension	Referrals as the swollen abdomen or homogeneous distension of the ventral coelomic cavity
	Gastrointestinal disorder	Diarrhea, melena, biliverdinuria, and other droppings alterations in color, quantity, and aspect, regurgitation, vomit, chronic anorexia
	Trauma- related symptoms	Symptoms reported after a traumatic episode history as bleeding, injuries, cuts, wounds, lacerations, and evident fractures
	Musculoskeletal symptoms	Alterations in perching, sore feet, and wings, lameness, reluctance to walk, or fly
	Behavioral disorder	Screaming, biting, self-mutilation, excessively flapping wings, aggressiveness, or regurgitation tower- specific members, masturbation
	Dermatologic alteration	Abnormal feather structure or development, changes in feather color, feather loss without picking, feather picking, overgrown beak and or claws, lesions of the feet, peeling, pruritus, and stress bars
	Ocular symptoms	Swollen, red eyes, eye or nostril discharge, facial swelling, sensitivity to light, cloudy or glassy eyes, blepharospasm, blindness
	Nonspecific acute symptoms	Lethargy, weakness, anorexia

The clinical exam variables collected were general condition, subclassified into active, moderately depressed, severely depressed, and dead. Body condition score was entered as ranked by the clinician or pathologist, following the traditional five-point system proposed by Welle (1995), where BCS is determined by palpation of the muscles and fat coverage of the sternum. The scale guide stablishes a score from 1 (as the less) to 5, being cachectic, lean, ideal, overweight, and obese (WELLE, 1995). Body weight in grams, and main diet component as the elements offered on the regular basis, reported by the owners/caregivers, were all assessed and then arrayed, into four categories (HESS; MAULDIN; ROSENTHAL, 2002; STAHL *et al.*, 1998) described in chart 3.

Chart 3 - Individual criteria and short description used to extract and code variables related to the clinical exam.

Criteria	*Description*		
General condition	Active		This classification was obtained through analyses of caregivers reports, symptoms and physical examination observations registered on every bird clinical record
	Moderately depressed		
	Severely depressed		
	Dead		
Body condition score (BCS)	1	Emaciated	If BCS was not specified in the clinical record, the necropsy report, or some complementary diagnostic test like radiography, BCS was classified as: missing
	2	Lean	
	3	Ideal	
	4	Overweight	
	5	Obese	
Body weight (BW)	BW in grams at clinical examination		If Weight was not recorded it was classified as: *unspecified*
Main diet	Seed mixture		Commercial mixtures based on birdseed, peanuts, and sunflower
	Formulated diet		Report diets as hand-feeding formula, and “ração”, giving the intention of proper commercial parrot food
	Fruits and vegetables		Apple, banana, orange, berries, broccoli, carrot, capsicum, corn cabbage, beetroot, beans, cucumber, and other common greens consumed by humans, either raw or cooked
	Human food		Industrialized products as cheese, milk, coffee, cookies, crackers and table food as bread, beans, rice, pasta, and any other type of cooked and seasoned food for human consumption or natural foods cooked and seasoned

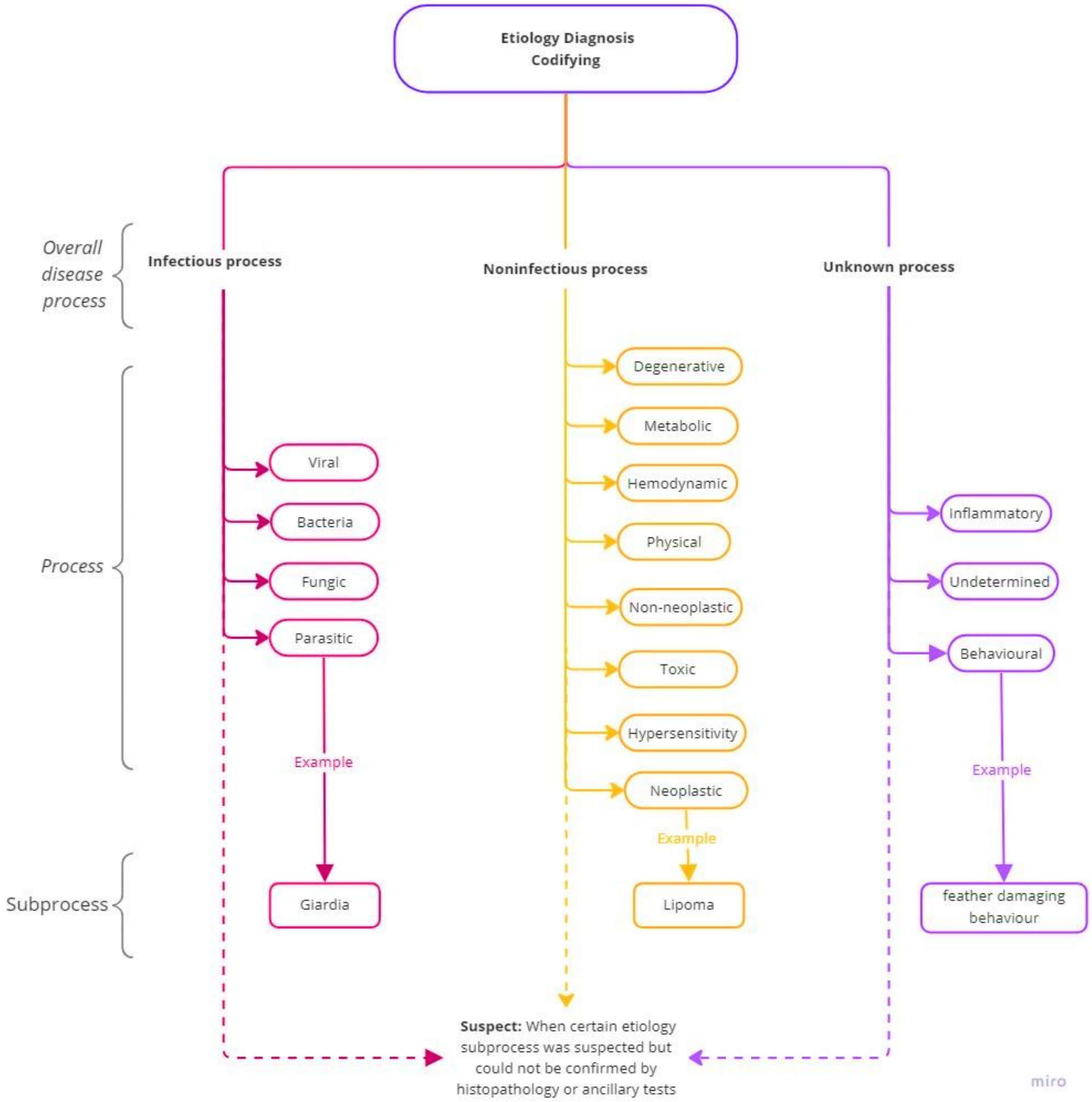
4.2.4. Codifying final diagnoses

All final diagnoses for each bird were ranked to indicate the relative importance in causing disease and were coded as a “primary” or “non-primary” disease process, and then broadly coded by etiological ‘disease process’ and ‘body system’ affected (GIBSON *et al.*, 2019; MARTIN, 2018; NEMETH *et al.*, 2016; SMITH *et al.*, 2018; WILDMANN *et al.*, 2022). The primary cause of morbidity was defined as the main condition responsible for the bird’s need for treatment (GIBSON *et al.*, 2019). When several possible causes were identified in the same bird, clinical history and complementary studies were critical to determine the primary cause of morbidity. Non-primary disease processes were concomitant diagnosed process that could be contributory to disease, but not the primary cause of it.

Causes of morbidity and mortality were classified according to etiological disease process into infectious, non-infectious, and unknown (GIBSON *et al.*, 2019; MORISHITA *et al.*, 1998; RAHMAWATI, 2018; SMITH *et al.*, 2018; WILDMANN *et al.*, 2022). When possible, subcategories were determined to increase the precision of the data. For infectious etiologies, subprocesses like: Viral-Circovirus, Fungal-Aspergillus spp. were coded if histological lesions (i.e., viral inclusions) were highly suggestive or pathognomonic or ancillary tests confirmed involvement of a specific agent. When infectious etiology was suspected but could not be confirmed by histopathology or ancillary tests, the subprocess for that final diagnosis was indicated as “suspect”. When infectious etiological agents were identified histologically, or by laboratory tests (i.e., aggregates of bacteria, fungal hyphae, viral inclusions) and a specific etiology was not reported, diagnoses were coded as “unspecified”.

The noninfectious category was subdivided into degenerative, metabolic, hemodynamic, physical, neoplastic, non-neoplastic, toxic and hypersensitivity (GIBSON *et al.*, 2019). Degenerative diseases included osteoarthritis, cataracts, atrophy, cirrhosis, and insufficiency such as renal and cardiac. Metabolic or nutritional diseases include atherosclerosis, diabetes, gout, hemosiderosis, hypothyroidism, vitamin A deficiency, lipidosis of the liver and other organs, nutritional secondary hyperparathyroidism, nutritional deficiency, and obesity. Hemodynamic processes included ascites, congestion, hematoma, hematuria, hemorrhage, infraction, melena. Physical disease process includes traumas which grouped nonspecific traumatic process such as contusion or concussions and lower casuistic traumatic process such as burns and bites. Other processes included within the physical category were rupture, asphyxiation, egg bound, foreign body disease, fracture, hernia, impaction, luxation, prolapse and strangling. These classified processes implied that a hemodynamic or physical disturbance was confirmed, and there were no factors indicating infectious etiology or other available information to associate it to a specific etiology. Neoplastic disease was identified by histopathological examination and for those cases whit highly suggestive but not conclusive histologic or cytologic results, and in addition to other ancillary test such as imaging exams result confirming the presence of a mass, were classified as neoplastic suspects. Non-neoplastic disease was identified by histopathology or cytopathology examination. Toxicoses included only those cases in which a specific toxic agent was identified according to clinical history, signs, and/or lesions compatible with that agent. As hypersensitivity, categorized process were only those strictly specified as allergies process into the medical records.

Chart 4 - Codification of final diagnoses by etiology.



The sources used to assign the categories mentioned above were the physical examination carried out by the veterinarian at the time of admission; information from the caregiver's reports, the case history; and when available, complementary studies such as radiology, hematology, blood chemistry, cytology, gross pathology, histopathology, microbiology, and parasitology.

The unknown category was applied when after the diagnostic studies the cause could not be determined, or the studies were insufficient to specify the cause of morbidity or mortality. This category was subclassified into three, inflammatory process which could be originated from infectious and noninfectious etiology. Behavioral alterations, since they are recognized as a multifactorial etiologic process and represent a challenge for the avian veterinarian practitioner, the etiology was in the great majority unidentified. These were classified into abnormal sexual behavior, aggression and feather damaging behavior. Undetermined classification was used as a subcategory for those cases with no final diagnosis.

In order to use to the best advantage of the data and to provide material for future associations, each final diagnosis was also widely categorized by the “body system” affected. When possible, subcategories were determined to increase the precision of the data.

4.2.5. Statistical analyses

The prevalence of demographic information, illness processes/subprocesses, and afflicted body systems were all described using descriptive statistics. Because most birds had multiple final diagnoses, the total amount of all disease processes was greater than the number of birds in the database. Estimates of disease prevalence were expressed as the proportion of birds in the database affected by at least one of a given disease process or subprocess (n=791). Primary disease processes were also described out of the total number of birds. For the purposes of this study, “prevalence” refers to the frequency observed in the given population submitted for clinical and postmortem examination, since necropsy reports could identify multiple diseases processes in a singular individual, two categories were stablished, those process identified as the cause of dead were categorized as “mortality”, so they can be used to describe mortality rates, and were also included in the overall prevalence count of disease presentation. For processes diagnosed postmortem and that could contribute but not cause the death of the animals, were categorized as “morbidity” since they were also affecting the bird.

4.3. RESULTS

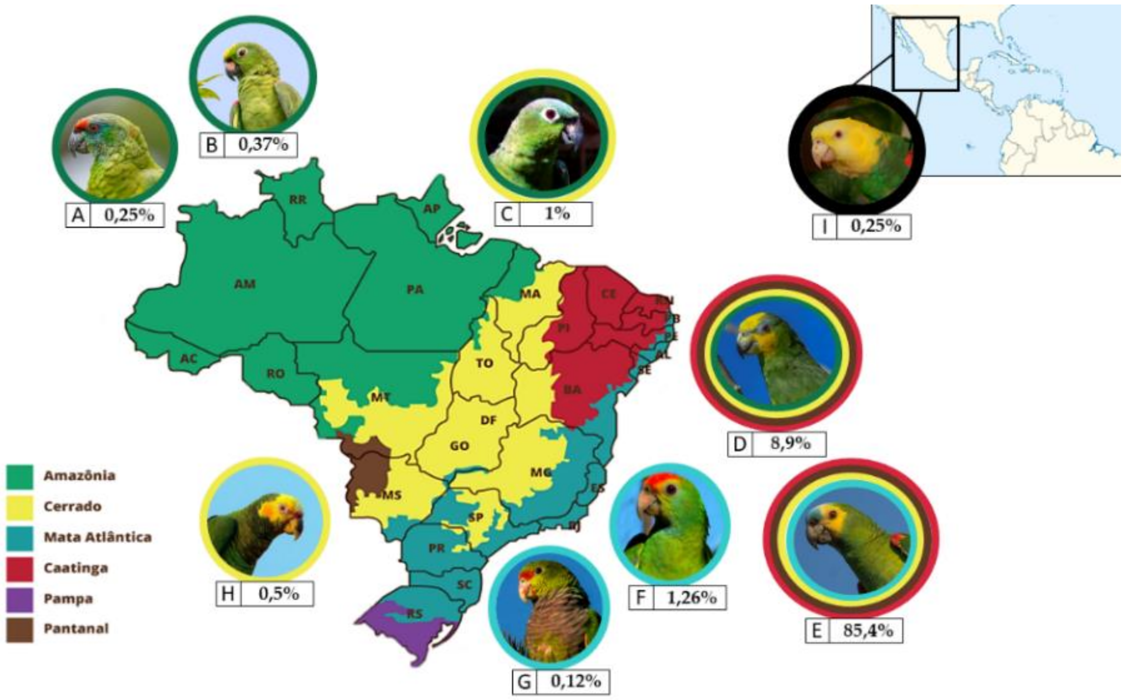
Demographic data

A total of 872 (753 alive and 119 dead) amazon parrots were submitted to the SAA and SPA – VPT/HOVET/FMVZ-USP between January 2009 and December 2019, but only information from 791 birds (707 alive and 84 dead) were available and included in this study. From the alive birds that attended to the SAA-SPA, a total of 1033 clinical records were reviewed, and from the 84 *“post mortem”* report, 109 diagnoses were registered (84 causes of mortality and 25 of morbidity).

Nine species from the genera were represented, with the most common species being

A. aestiva (n=676; 85.46%) and *A. amazonica* (n=71; 8.97%). Less common submissions included *A. rhodocorytha* (n=10; 1.26%), *A. farinosa* (n=8; 1.0%) and *A. xanthops* (n=4; 0.5%), the other species frequencies are in the figure 1.

Figure 1 – Amazon parrot species submitted to the Avian Ambulatory Service and Animal Pathology of the Department of Pathology (VPT) and HOVET/FMVZ-USP, between January 2009 and December 2019 and their geographic natural occurrence.



Adaptation of Brazilian biomes map showing the natural occurrence of native species. A. *Amazona festiva*, B. *Amazona ochrocephala*, C. *Amazona farinosa*, D. *Amazona amazonica*, E. *Amazona aestiva*, F. *amazona rhodocorytha*, G. *Amazona vinacea*, H. *Aliopiopsitta xanthops*, I. *Amazona oratrix.*

Females (n=176; 15.41%) were slightly more represented than males (n=107; 9.36%), and 859 bird files (75.21 %) had unidentified sex. Adults were the most common age category (n=838; 73.38 %) followed by juveniles (n=201; 17.6%), chicks (n=37; 3.2%), and seniors (n=*32;* 2.97%); age data was not recorded for 32 birds (2.8%). The distribution of sex and age groups are summarized in table 1.

Table 1 – Distribution of demographic variables, sex, and age group.

Sex	Age group										
	Chick	%	Adult	%	Juvenile	%	Senior	%	Unspecified	%	Total
Female	10	27.0	142	16.9	16	8.0	2	5.9	6	18.8	176
Male	6	16.2	69	8.2	26	12.9	1	2.9	5	15.6	107
Undetermined	21	56.8	627	74.8	159	79.1	31	91.2	21	65.6	859
Total	37		838		201		34		32		1142

Consultation related variables

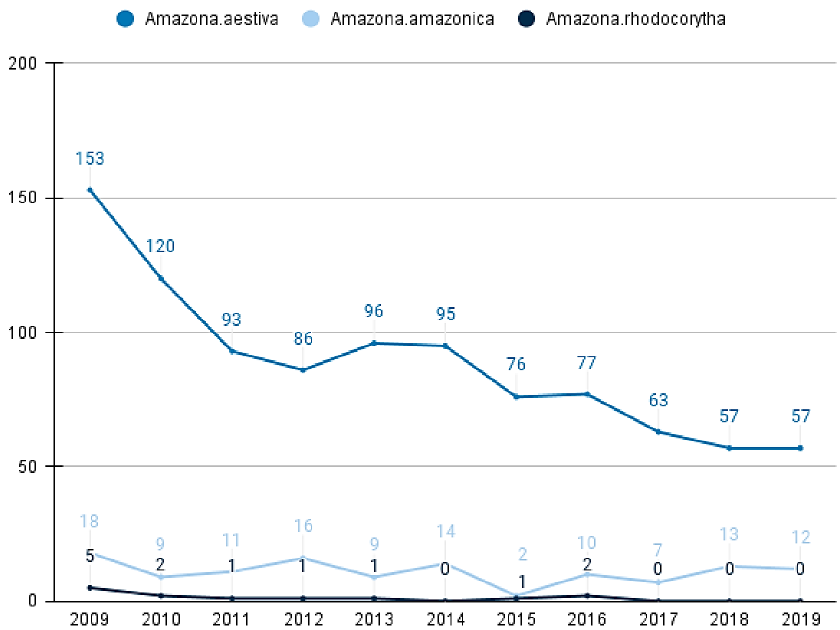
Submission date: submissions were distributed as follows: 25.31 % (n=289) in summer, 20.05% (n=229) in spring, 30.47% (n=348) in autumn, and 24.17% (n=276) in winter. Seasonal admissions for the different amazon species presented is summarized in table 2.

Table 2 – Seasonal submission of amazon parrot species to the Avian Ambulatory Service and Animal Pathology of the Department of Pathology (VPT) and HOVET/FMVZ-USP, between January 2009 and December 2019.

Species	*Season*								
	Autumn	%	Spring	%	Summer	%	Winter	%	Total
Amazona aestiva	285	81.9	195	85.2	259	89.6	234	84.8	973
Amazona amazonica	46	13.2	26	11.4	20	6.9	29	10.5	121
Amazona farinosa	5	1.4	1	0.4	0	0.0	2	0.7	8
Amazona festiva	2	0.6	0	0.0	0	0.0	0	0.0	2
Amazona ochrocephala	2	0.6	0	0.0	0	0.0	1	0.4	3
Amazona oratrix	2	0.6	0	0.0	1	0.3	0	0.0	3
Amazona rhodocorytha	2	0.6	4	1.7	3	1.0	4	1.4	13
Amazona vinacea	0	0.0	0	0.0	0	0.0	1	0.4	1
Amazona xanthops	1	0.3	1	0.4	1	0.3	1	0.4	4
Unspecified	3	0.9	2	0.9	5	1.7	4	1.4	14
Total	348		229		289		276		1142

A significant decreasing tendency was observed in the quantity of consultations per year during the last ten years. Complete information about the distribution of consultation per species during the study period is found in complementary annex number 1. An annual variation of admissions for the most frequent species reflects this more clearly and it is shown in the figure 2.

Figure 2 - Annual variation of admissions for the most frequent captive amazon species submitted to the Avian Ambulatory Service and Animal Pathology of the Department of Pathology (VPT) and HOVET/FMVZ-USP, between January 2009 and December 2019.



Origin: most of the clinical records belong to birds from household environments, kept as pets (n=1013; 98.0%) followed by birds from breeding facilities (n=13; 1.2%). At *"post mortem"* reports, origin of the birds was similarly represented, being most of the diagnoses from pet birds (n=61; 55.96%) but in this scenario followed by animals from wild animal screening centers (n=35; 32.11%) (for complete information about the bird origin consult the table 3).

Table 3 – Origin of the captive amazon parrots submitted to the Avian Ambulatory Service and Animal Pathology of the Department of Pathology (VPT) and HOVET/FMVZ-USP, between January 2009 and December 2019.

Origin	***Clinic Observations***	***% Percent***	***Necropsy Observations***	***% Percent***
Breeding facility	13	1.25	13	11.92
Household pet	1013	98.06	61	55.96
Wild Animal Screening Centre	7	0.67	35	32.11
Total	1033		109	

Type of consultation: The most common type of consultation was scheduled consultations with 69.0% of all the observations of this study (n=789/1142), followed by checkups with 13.66% (n=156/1142), and finally, emergencies with 7.7% (n=88/1142). The remaining observations correspond to the necropsy diagnoses retrieved from the eighty-four reports that were 109 in total, corresponding to a 9.54% of all data. The distribution for consultation type and age group are summarized in the table 4.

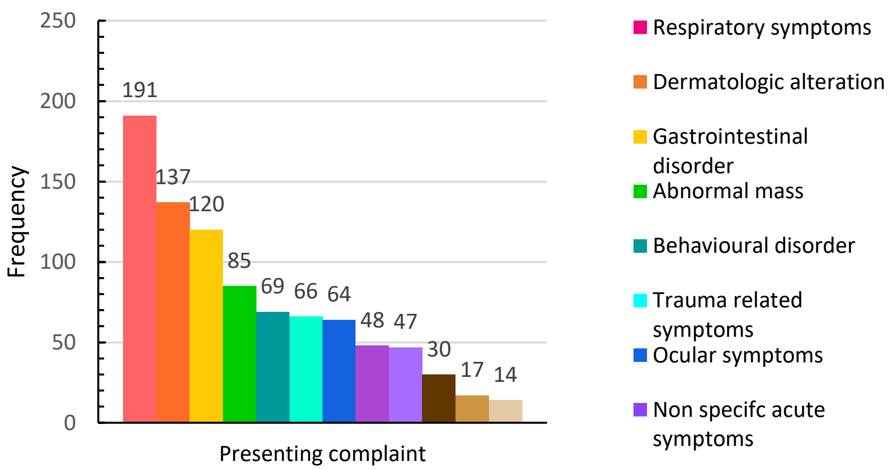
To arrange in a more detailed way the data, the reasons for checkup query were classified, the subcategories resulting were trimming wing/clipping nails, management orientation, preventive checkup, and sexing, with the trimming wing/clipping nails being the most frequent reason for pursuing checkup appointment consultation (48.7%; n=76/156) followed by management orientation seeking (28.0%; n=44/156) (Table 11).

Table 4 - Distribution of type of consultation and age categories.

Consultation type	*Age group*										
	Chick	*%*	*Adult*	*%*	*Juvenile*	*%*	*Senior*	*%*	*Unspecified*	*%*	*Total*
Scheduled consultation	21	56.8	607	72.4	127	63.2	26	76.5	8	25.0	789
Checkup	6	16.2	102	12.2	44	21.9	3	8.8	1	3.1	156
Emergency	1	2.7	64	7.6	19	9.5	4	11.8	0	0.0	88
NA/Necropsy	9	24.3	65	7.8	11	5.5	1	2.9	23	71.9	109
Total	37		838		201		34		32		1142

Presenting complaint: symptoms like sneeze, wheeze, cough, nasal discharge, dyspnea, tail bobbing, and periocular swelling classified as respiratory symptoms were the most common reported presenting complaint at time of consultation with 26.0% (n=191/1142), followed by dermatologic alterations (n=137/1142) and gastrointestinal disorders (n=120/1142). The frequency of presenting complaints is best illustrated in figure 3.

Figure 3 - Frequency of the different presenting complaints registered for captive amazon parrots during the study period.



We detected significant differences between seasons when respiratory symptoms were analyzed, being more prevalent in autumn (16.9%, n=59). A significantly higher number of birds admitted due to dermatologic alterations were observed in winter, as well as respiratory symptoms. Admissions due to behavioral disorders (25/69) a trauma related (23/66) were more prevalent in summer. The association between presenting complaint at time of admission and type of consultation is summarized in the table 5.

Table 5- Distribution and frequency of presenting complaints and type of consultations for captive amazon parrots submitted to the Avian Ambulatory Service and Animal Pathology of the Department of Pathology (VPT) and HOVET/FMVZ-USP, between January 2009 and December 2019.

Presenting complaint	*Emergency*	*%*	*Scheduled consultation*	*%*	*Checkup*	*%*
Abnormal mass	1	1.14	84	10.65	0	0.0
Behavioral disorder	1	1.14	68	8.62	0	0.0
Cloacal prolapse	2	2.27	15	1.990	0	0.0
Coelomic distention	0	0.0	30	3.880	0	0.0
Dermatologic alteration	0	0.0	130	16.48	8	66.7
Gastrointestinal disorder	6	6.82	111	14.07	3	25..0
Musculoskeletal symptoms	9	10.23	38	4.82	0	0.0
NA/Necropsy	0	0.0	0	0.0	0	0.0
Neurologic symptoms	2	2.27	12	1.52	0	0.0
Nonspecific acute symptoms	20	22.73	28	3.55	0	0.0
Ocular symptoms	2	2.27	62	7.86	0	0.0
Respiratory symptoms	16	18.18	174	22.05	1	8.3
Trauma related symptoms	29	32.95	37	4.69	0	0.0
Total	88	100.0	789	100.0	12	100.0

This distribution of presenting complaints and type of consultations shows some remarkable trends, as registered for emergency consultations the most frequent presenting complaint were the symptoms grouped into the trauma related symptoms 32.9% and the nonspecific acute symptoms 22.73%. For scheduled consultation the most frequented registered complaints were respiratory and dermatologic symptoms (22%, 16.4%), and for checkup appointments there, dermatologic alterations takeover the first place with 66.7%.

Clinical exam variables

General condition: to present in a context the general condition is shows as its distribution over the type of consultations, better illustrated in table 6. The most common type of consultation was scheduled consultation, with 69.0% of all consultations, and the general condition of the patients within this category were frequently reported as active/ normal 58.93%. The second most common consultation were checkups with 13.0% and 99.0% of these animals were outlined as active. The number of animals presented as emergencies was 88 (7.7% of all consultations), being most of the patients reported as severely depressed

(47.7%).

Table 6 – Frequency of the *general condition* over the type of consultation reported for amazon parrots submitted to the Avian Ambulatory Service and Animal Pathology of the Department of Pathology (VPT) and HOVET/FMVZ-USP, between January 2009 and December 2019.

General condition	*Checkup*	*Percent*	*Emergency consultation*	*Percent*	*Scheduled consultation*	*Percent*	*total*
Active	155	99.35	10	11.36	465	58.93	630
Moderately depressed	1	0.64	36	40.990	292	37.0	329
Severely depressed	0	0	42	47.72	32	4.05	74
total	156		88		789		

Body condition score: most of the birds were classified as presenting an ideal body condition score (3/5) 45.09%, followed by under conditioned score or lean birds (2/5) 16.7%, and overweight (4/5) 9.8%, distribution and frequency of body condition score is present below.

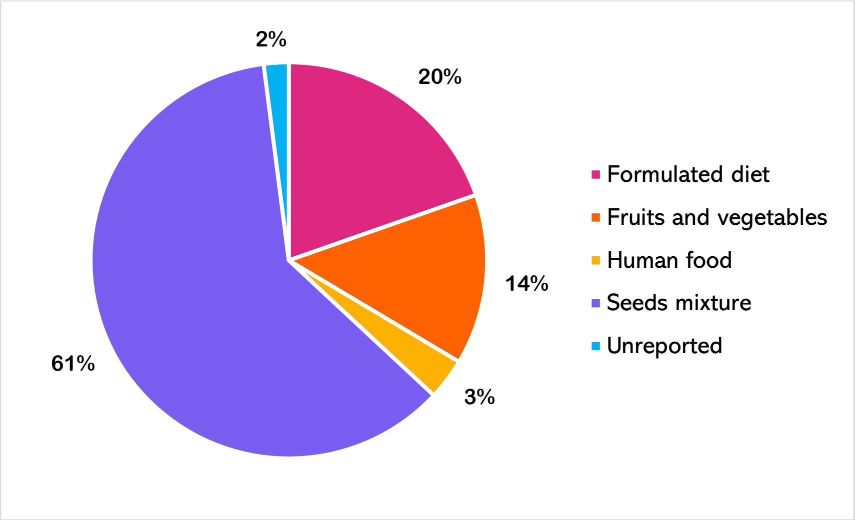
Table 7 – Body condition score reported for amazon parrots submitted to the Avian Ambulatory Service and Animal Pathology of the Department of Pathology (VPT) and HOVET/FMVZ-USP, between January 2009 and December 2019 and its distribution over age categories.

Body Condition Score	*Age Group*											
	Chick	%	**Adult**	%	**Juvenile**	%	**Senior**	%	**Unsp**	%	**Total**	%
1- Emaciated	2	6.3	44	6.6	6	3.6	3	11.5	0	0.0	55	4.8
2- Lean	9	28.1	141	21.3	30	18.1	7	26.9	4	26.7	191	16.7
3- Ideal	20	62.5	356	53.8	116	69.9	14	53.8	9	60.0	515	45.1
4- Over weight	1	3.1	96	14.5	11	6.6	2	7.7	2	13.3	112	9.8
5- Obese	0	0.0	25	3.8	3	1.8	0	0.0	0	0.0	28	2.4
Total	32		662		166		26		15		901	

Unsp = unspecified.

Main diet: the dietary profile arranged in categories according to the elements offered on the regular basis, reported by the caregivers of amazon parrots kept in captivity, in Sao Paulo, during the study period was mostly represented by seeds mixture (n=631/1033). As the second most reported, there is formulated diet (n=203/1033), then fruits and vegetables (n=144/1033) and human food (n= 35/1033), there were 109 observations coded as NA, that corresponded to birds dead at submission. 1142). Its frequency ist represented in figure 4 hereunder.

Figure 4 - Dietary profile observed for amazon parrots kept in captivity, in Sao Paulo, Brazil.



Diagnosed disease processes and subprocesses.

A total of 1142 clinical observation where registered from 791 birds, the number of returns for bird, ranged from 2 to 10, with a mean of 2.8 times and a standard deviation of 1.8. A total of 1033 final diagnoses were reported from these birds.

Table 8 – Consultations per bird during the period study.

Number Of Consultations	***"n"***	***Percent***
One (1)	593	74.96
More than one (>1)	198	25.03
Total	791	100.0

Birds affected by non-infectious disease processes were the most common (*n*=512; 51.3%) and were diagnosed most frequently with metabolic (*n*=189; 36.91%), physical (n=148; 28.91%), neoplastic (n=79;15.43%), and degenerative process (n=41; 8.0%). Birds affected by infectious disease processes (*n*=329; 33.37%) were most affected by bacterial (*n*=227; 69.0%), and viral disease processes (*n*=45; 13.68%). Birds affected by undetermined disease processes comprised 14.7% (*n*=145) of birds in the database. Figure 5 provides a hierarchical breakdown of the main disease processes and subprocesses diagnosed.

A summary of all disease processes and subprocesses is provided in the table hereunder.

Table 9 – List of diagnosed processes in captive amazon parrots submitted to the Avian Ambulatory Service and Animal Pathology of the Department of Pathology (VPT) and HOVET/FMVZ-USP, between January 2009 and December 2019.

Overall disease process	***Process***	***Subprocess***	***diagnoses***	***n=1142***
Infectious	Viral	Viral sus	25	2.2
		Bornavirus	9	0.8
		Circovirus	5	0.4
		Polyomavirus	3	0.3
		Poxvirus	2	0.2
		Herpesvirus	1	0.1
		Total	**45**	**3.9**
	Bacterial	Bacterial sus	88	7.7
		Unspecified	53	4.6
		Staphylococcus spp	14	1.2
		Escherichia coli	9	0.8
		Klebsiella pneumoniae	7	0.6
		Salmonella	7	0.6
		E. coli & Klebsiella spp	6	0.5
		Enterobacter spp	5	0.4
		Enterococcus spp	5	0.4
		Klebsiella spp & Proteus spp	4	0.4
		Pseudomonas spp	4	0.4
		Streptococcus spp	4	0.4
		Citrobacter freuundi	3	0.3
		Mycobacterium tuberculose	3	0.3
		Bacillus spp	2	0.2
		Mycoplasma spp	2	0.2
		Proteus spp	2	0.2
		Pseudomonas spp	2	0.2
		Yersinia spp	2	0.2
		Chlamydia spp	1	0.1
		Clostridium spp	1	0.1
		Corynebacterium spp	1	0.1
		Morganella spp	1	0.1
		Mycobacterium spp	1	0.1
		Total	**227**	**20.0**
	Fungal	*Candida spp*	17	1.5
		Aspergillus spp	8	0.7
		Fungal sus	4	0.4
		Unspecified	4	0.4
		Macrorhabdus ornithogaster	2	0.2
		Chrysosporium spp	1	0.1
		Malassezia spp	1	0.1
		Mycrosporum canis	1	0.1
		Total	**38**	**3.3**
	Parasitic	Parasitic sus	6	0.5
		Capillaria spp	3	0.3
		Giardia spp	3	0.3
		Lice	2	0.2
		Cestode	1	0.1
		Eimeria spp	1	0.1
		Knemidocoptes spp	1	0.1
		Nematode	1	0.1
		Sarcocystis spp	1	0.1
		Total	**19**	**1.7**

Overall disease process	*Process*	*Subprocess*	*diagnoses*	*n=1142*
Noninfectious	Degenerative	Cataracts	14	1.2
		Osteoarthritis	14	1.2
		Atrophy	4	0.4
		Cirrhosis	4	0.4
		Insufficiency	4	0.4
		Necrosis	1	0.1
		Total	**41**	**3.6**
	Hemodynamic	Hemorrhage	6	0.5
		Ascites	3	0.3
		Melena	3	0.3
		Congestion	1	0.1
		Hematoma	1	0.1
		Hematuria	1	0.1
		Infarction	1	0.1
		Total	**16**	**1.5**
	Hypersensitivity	Unspecified	14	1.2
		total	**14**	**1.2**
	Metabolic	Lipidosis	56	4.9
		Lipidosis sus	45	3.9
		Obesity	29	2.5
		Nutritional deficiency	19	1.7
		Hypovitaminosis A	13	1.1
		Gout	9	0.8
		Nutritional secondary hyperparathyroidism	5	0.4
		Atherosclerosis	5	0.4
		Diabetes	3	0.3
		Haemosiderosis	3	0.3
		Hypothyroidism	1	0.1
		Hypovitaminosis A	1	0.1
		Total	**189**	**16.5**
	Neoplastic	Lipoma	28	2.5
		Neoplastic sus	27	2.4
		Carcinoma	11	1.0
		Lymphoma	6	0.5
		Lipossarcoma	2	0.2
		Fibrosarcoma	1	0.1
		Leiomioma	1	0.1
		Melanoma	1	0.1
		Osteosarcoma	1	0.1
		Seminoma	1	0.1
		Total	**79**	**6.9**
	Non neoplastic	Metaplasia	6	0.5
		Xanthoma	6	0.5
		Cyst	5	0.4
		Papilloma	2	0.2
		Total	**19**	**1.7**
	Physical	Trauma	47	4.1
		Fracture	35	3.1
		Rupture	25	2.2
		Prolapse	16	1.4
		Impaction	7	0.6
		Foreign body disease	6	0.5
		Hernia	4	0.4
		Aspiration	3	0.3
		Luxation	2	0.2
		Strangling	2	0.2

		Egg bound	1	0.1
		Total	**148**	**13.0**
	Toxic	Heavy metal	3	0.3
		Polytetrafluoroethylene	1	0.1
		Rodenticide	1	0.1
		Toxic sus	1	0.1
		Total	**6**	**0.5**
Overall disease process	***Process***	***Subprocess***	***diagnoses***	***n=1142***
Unknown	Behavioral	Feather damaging behavior	45	3.9
		Hypersexual behaviors	12	1.1
		Aggressive behavior	3	0.3
		Total	**60**	**5.3**
	Inflammation	Keratouveitis	9	0.8
		Keratoconjunctivitis	6	0.5
		Tracheitis	5	0.4
		Arthritis	4	0.4
		Airsacculitis	2	0.2
		Pneumonia	2	0.2
		Encephalitis	1	0.1
		Total	**29**	**2.5**
	Undetermined	Undetermined	36	3.2
		Sudden death	9	0.8
		Seizure	7	0.6
		Amaurosis	1	0.1
		Anemia	1	0.1
		Hyperestrogenism	1	0.1
		Lymphoid depletion	1	0.1
		Total	**56**	**4.9**
Overall disease process	***Process***	***Subprocess***	***diagnoses***	***n=1142***
Healthy population	Check up	Trimming wing/ Clipping nails	76	6.7
		Management	44	3.9
		Preventive check up	23	2.0
		Sexing	13	1.1
		Total	**156**	**13.7**

Infectious disease

A total of 329 diagnoses corresponded to primary infectious disease, being 45 of them of viral etiology, this implies 13.69% of infectious diseases and only 3.9% of all the processes retrieved, with more than half of the subprocesses in this category classified as suspect (25/45; 55.0%), meaning that the background history, clinical presentation of the symptoms, and ancillary tests were highly suggestive of viral infection yet no specific tests like molecular detection of viral DNA or RNA, were performed in the case of 22 (n=22/25) individuals and came as negative in the case of 3 (n=3/25).

The most frequent diagnosed viral subprocess was Bornavirus (n=9/45), affecting mostly adults (n=7/9), 1 juvenile and 1 chick, this last two individuals and other 4 birds were reported as moderately depressed, 2 as severely depressed, and 1 as active. The active individual was 20 years old of unknown sex, adult, which's complaint at time of consultation was categorized as behavioral disorder for it was reported to perform FDB.

The most common affected system was the alimentary system (n=6/9) and only 1 individual was registered to displayed neurologic symptoms, which was also 1 of the 2 individuals with severely depressed state of consciousness. The second most reported virus was Circovirus (n=5/45) which was diagnosed only in adult parrots, being the youngest 17 years old and the eldest 33 years old, with a variate display of symptoms, 2/5 were reported as presenting gastrointestinal disorder, 2/5 as presenting dermatologic alteration and 1/5 presenting neurologic symptoms and presented as severely depressed. This last one was confirmed as coinfected with bornavirus, and it's the same bid described previously as AVB infected with neurological condition. The most common affected system was the integumentary system (n=4/9), determined this way as the clinician reported it to be the main system of concern and from which the viral DNA was identified.

The bacterial infections were found to be the most frequently infectious etiology to be diagnose, being identified in 227 cases, representing 69.0% of infectious diagnoses and 20.0% of all processes reviewed. Like viral infections, the suspect category was the most prevalent with 38.7% of the bacterial cases (n=88/227) followed by the unspecified category (n=53/227; 23.3%). In the suspect cases, clinical symptoms, background history, ancillary tests such as hematology, treatment and clinician annotations were indicative of bacterial suspect without isolation of an agent, then in the unspecified category there were specific proves of an agent such as cytology or histopathology identification of a bacteria related to the lesions or even performed the isolation of an agent with no success on its identification. On the other hand, bacterial etiology agents common identified were *Staphylococcus spp*., *Escherichia coli*, and *Klebsiella spp*. (Figure 5). The first one being coded as involved in a variety of affected systems such as auditory (n=1/14), respiratory (n=9/14), integumentary (n=3/14) and ocular (n=1/14). And the las tow being mainly involved as affecting the respiratory (n=17/22) and alimentary system (n=5/22).

Fungal infections were scarcely reported as diagnosed with only 38 cases representing 3.3% of all processes recorded and 11.5% of infectious diseases. *Candida spp*. infection was the most diagnosed, followed by *Aspergillus spp*. Candidiasis manifested primarily in the alimentary system (n=13/17) including the oral cavity in 9 of the 13 cases. Aspergillosis manifested primarily in the respiratory system (n=7/8) including the lungs and air sacs in 6 cases and the sinuses in 1 case. Besides the respiratory system it was also identifies as affecting the heart (n=1/8).

Parasitic infections were diagnosed in 19 cases, indicating 5.7% of infectious cases, and 1.7% of all process. Parasitic infection suspect was the most frequent coded category followed by *Giardia spp.* and *Capillaria spp.*, both manifested only in the alimentary system (n=6/6), however one of the birds diagnosed with giardiasis, was reported with dermatologic alteration as presenting complaint. Parasitic infections caused by these agents were mainly diagnosed in juvenile parrots being 2/3 by Giardia and the same for Capillaria, totalizing 4/6 with only 2 adults affected.

Noninfectious disease

Noninfectious diseases were the most prevalent overall processes, with 51.93% of all diagnosed diseases. Metabolic diseases processes were the most commonly recorded noninfectious causes of morbidity. Overall, 272 diagnoses were categorized as metabolic, and 189 of them were classified as the primary cause of morbidity, meaning that many birds were diagnosed with simultaneous metabolic disorders. Hepatic lipidosis was the most frequently diagnosed subprocess followed by the suspect cases of this disease. The noninfectious hepatopathy, determined as the “lipidosis suspect” group was characterized by animals presenting compatible symptoms, relatable clinical backgrounds, and fitting but not sufficient ancillary test results. The profile of captive amazon parrots diagnosed with hepatic lipidosis or its suspect is composed by an adult bird (87.0%; 84.0%), of undetermined sex (75.0%; 77.0%), feed with seed mixture (50.0%; 53.0%), with a body condition score varying between ideal (37.0%; 42.0%) and overweight (33.0%; 20.0%), that attend to the Avian Ambulatory presenting rather, a dermatologic alteration (41.0%; 53.0%) such as overgrowing nails and beaks, yellowish, blackish or greasy feathers and stress bars, gastrointestinal disorder symptoms (17.8%; 33.0%), such as greenish, blackish, yellowish and greasy feces, progressive inappetence and anorexia, emesis and diarrhea, or coelomic distention (17.8%; 6.6%). The majority of the consultations were scheduled (87.0%; 100.0%) and most of these patients were presented with an active status of consciousness at the time of consultation (53.0%; 62.0%).

Obesity was the third most prevalent metabolic subprocess, it was identified as the primary cause of morbidity in 15.0% of the metabolic cases (n=29). However, it was mostly diagnosed as secondary disease, accounting for 53.0% (44/83) of all metabolic disorders identified as concomitant, implying that the bird was not taken to the veterinary hospital as result this, but rather because of another identified cause. Obesity-diagnosed parrots were mainly adults 79.0% (n=23) scored with different BCS, as we see 13.79% (n=4) were scored at the physical examination as ideal, 55.0% (n=16) as overweight, and 24.0% (n=7) as obese if we contrast with those who have obesity as a secondary diagnose, ideal were 20.0% (9/44), overweight were 52.0% (23/44), obese 15.0% (7/44) and 11.0% (5/44) had no BSC reported.

The most common affected body system by metabolic disorders, was the hepatic which was reported in 101/189 cases (53.44%), followed by systemic disorders in 47/189 (24.87%) and the integumentary in 14/189 cases (7.41%).

Physical disease processes were identified in 148 cases, comprising 28.9% of all disease noninfectious causes established. Trauma, was the most prevalent subprocess, followed by fracture. Trauma was coded in 47/148 cases, meaning 31.67% of all physical disorders and 4.1% of all processes registered. It was reported as affecting a wide variety of systems like alimentary (n=4/47), integumentary (n=2/47), ocular (n=6/47) and code as affecting multiple organic systems in seven opportunities. Above all the systems, the musculoskeletal was the most affected by trauma, being attributed in 59.5% of the cases (n=28/47), and from these 85.7% occurring in a pelvic limb (n=24/28). Trauma cases were code as emergency consultations in 17 times (36.17%) and these were primary occupied by systemic coded traumas (7/7) and ocular traumas (5/6).

Fractures were diagnosed 35 times, consolidating 23.6% of all physical disorders, and 3.1% of all processes recorded. It manifested in two systems, being musculoskeletal affected in 80.0% of the cases (n=28 /35), and alimentary in 20.0% (n=7/35), this last one represented by the beak 100.0% of the times. Pelvic limbs made up the majority of the musculoskeletal system's reported injuries (82.0%; n=23/28), and the tibiotarsus was the most commonly fracture bone with 65.0% of entries (n=15/23). Fractures were often registered as emergencies (71.0%; n=25/35) and regularly the existence of a previous trauma was known (n=17/35; 48.0%). When the history of a previous event related to the fracture was ignored, the most common symptoms were those classified as musculoskeletal as alterations in perching, sore members, lameness, unwillingness to walk or fly (n=9/35; 25.7%) and in 40.0% of the events, the birds was described as moderately depressed (14/35).

Rupture was the third most common physical subprocess, being diagnosed 25 times, 80.0% of them (n=20) were cases of cervical air sac rupture and 4 of the infraorbital sinuses.

In 20 cases the presenting complaint was coded as dermatologic alteration because of the evident subcutaneous emphysema, and only in 4 cases was reported history of a traumatic event; frequently the bird was reported as active (n=22/25; 88.0%).

From the 148 physical processes, 6 were in chicks and 5 of them (83.0%) were related to hand feeding mistakes distributed as follows: 2 cases of aspiration with formula, 1 trauma case due to crop burn with overheated formula, 2 foreign body disease and 1 of them progressing to crop impaction.

Neoplastic diagnoses were recorded 79 times, which represents 15.0% of the noninfectious diseases, and 6.9% of all the all the observations entered (n=79/1142). The most common subprocess within this category were lipoma, neoplastic suspect, and carcinoma (figure 5). Lipoma was diagnosed in 28 cases 25 (89.2%) of them affecting mainly the integumentary system, other systems coded were the musculoskeletal (n=2/28) and the respiratory (n=1/28) as it was in the oral the choana's. The most common regions for lipoma diagnoses were the abdominal region (n=19/28; 67.85%), pericloacal (n=4/28; 14.28%) and pelvic limb (n=3/28; 10.71%). Birds diagnosed with lipoma were fluently over conditioned, being BCS 4 and 5 reported in 53.0% of the cases (n=15/28). Neoplastic suspect was the second most common subprocess (n=27/79) and in 44.0% of the cases, the suspected neoplasia was lipoma (n=12/27) however, in these situations, a final diagnosis was not confirmed, however the results of complementary exams performed, as ultrasonography, histopathology or cytology, suggested and adipose tissue formation. Carcinoma was diagnosed in 11 cases (13.9%) affecting different systems, the alimentary was recorded in 4 cases (36.36%) being diagnosed in diverse organs as, intestines (n=1/4), proventriculus (n=1/4), oral cavity (n=1/4) and cloaca (n=1/4). The respiratory system was recorded in 3 cases (27.27%), being diagnoses the 3 times (100.0%) in the choana's. The hepatic system was recorded in 3 cases (27.27%), all of them diagnosed as cholangiocarcinoma and finally, the urogenital system was recorded in 1 case (9.09%) in the kidney. Only in 3 times the presenting complaint was abnormal mass (27.27%). It was highly diagnosed in diseased birds (n=5/11; 45.45%) and most of the times the birds were reported as underscored with BCS 2/5 (n=8/11; 72.72%).

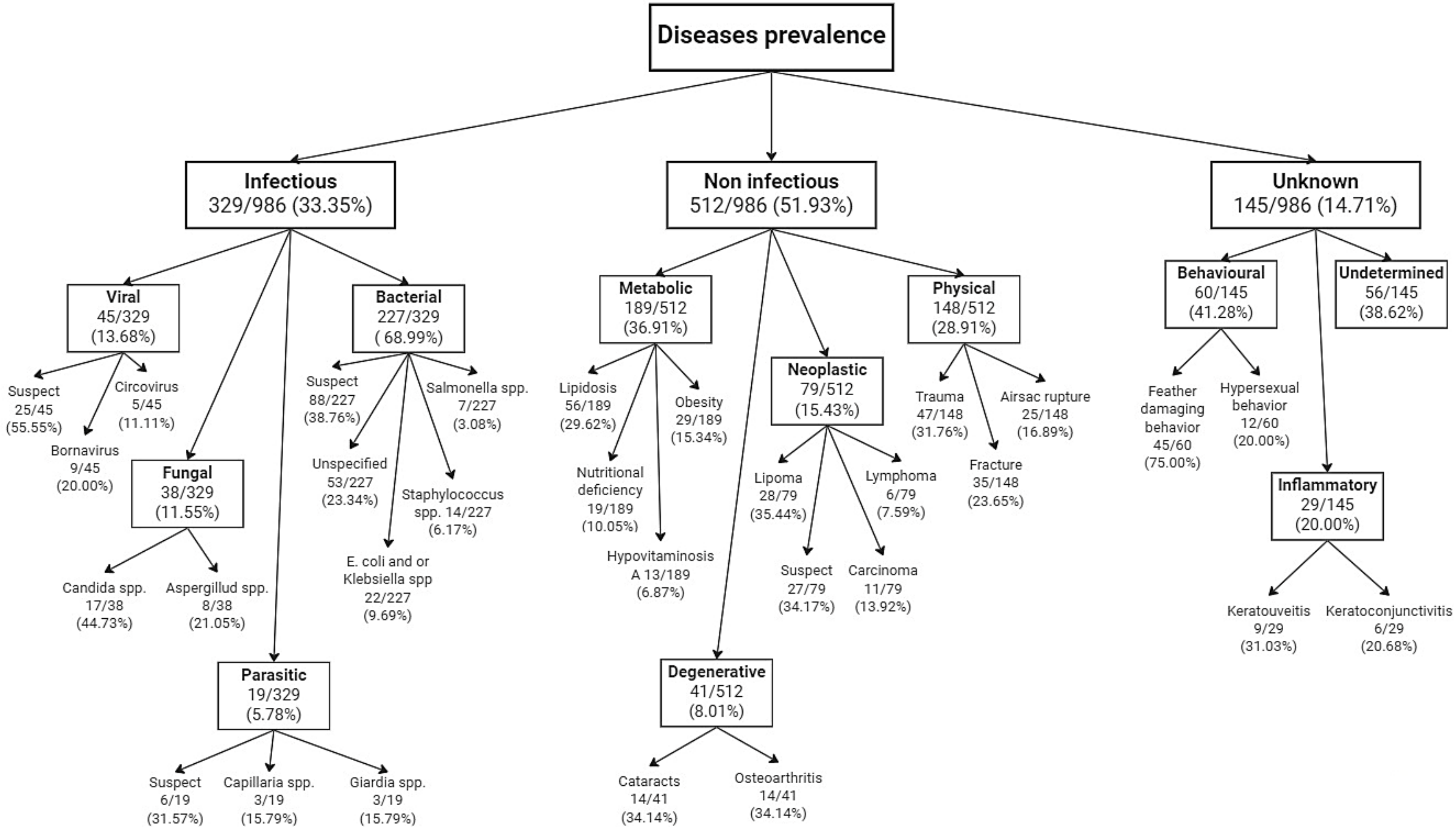
Degenerative age-related disorders were identified in 41 times as the main cause of morbidity, implying 8.01% of noninfectious disorders and 3.6% of all processes retrieved. Cataracts were diagnosed in 14 cases, 7 of them as unilateral and 7 as bilateral totalizing 21 eyes diagnosed, 15 in mature state and 6 in immature state. It affected only adult (8/14) and senior (6/14) birds being the youngest 6 years old.

Osteoarthritis was diagnosed in 14 cases, all the birds were adults, being the youngest 8 years old. In 12 of the cases, it affected the pelvic limb (85.71%) and only in 2 cases (14.28%) the thoracic limb. It was diagnosed as bilateral in 8 times (57.14%), unilateral in 4 (28.57%) and affecting more than 1 pair of joints in 2 cases (14.28%). Totalizing 26 joints diagnosed, 13 of these (50.0%) were identified as affecting the ankle joint (intertarsal joint), 10 annotations (38.46%) corresponded to the knee joint (femur, tibiotarsus, patella), 2 annotations (7.69%) corresponded to the hip joint (coxofemoral) and other 2 (7.69%) to the elbow joint (humerus-ulna-radius). Often the birds were reported as moderately depressed (n=9/14).

Unknow etiology

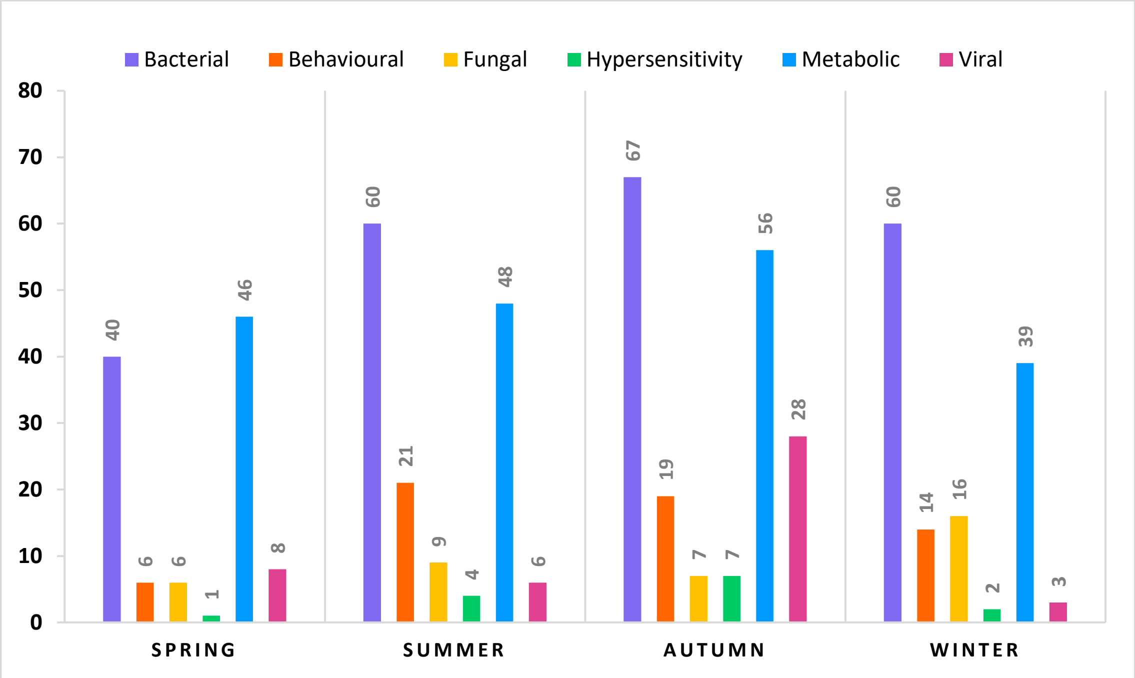
Disorders from unknown etiology were coded in 145 cases, it represents 14.71% of disease prevalence (n=145/986) and 12.69% of all the observations registered (n=145/1142). The most prevalent process was coded as behavioral (n=60/145) since these alterations could be originated by a wide spectrum of causes. This category represented 41.28% of all process from unknown/unestablished etiology, and 5.3% of all process entered. Three subprocess were identified within this category; these were feather damaging behavior, hypersexual behavior, and aggressive behavior. FDB wat he most frequently diagnosed disorder (n=45/60; 41.28%), the most impacted areas where the breast area (n=14/45; 31.11%) and pelvic limbs (n=12/45; 26.66%), nevertheless other regions included dorsal region (n=7/45; 15.55%), thoracic limbs (n=4/45; 8.88%), and in 8 cases (17.77%) it was described as generalized, affecting all the body, remining feathers on the head area. FDB affected mostly adults (n=39/45; 86.66%) and only six juveniles (13.33%) being the youngest 0.6 months old. Hypersexual behaviors represent the 20% of all behavioral disorders (n=12/60), and the most reported subprocess was regurgitation towards a specific member of the family (n=5/12; 41.66%) followed by aggression towards the partner of its closest caregiver (4/12; 33.33%) and masturbation (n=3/12; 25.0%). Hypersexual behaviors were frequently diagnosed in spring and summer seasons (n=9/12;75.0%).

Figure 5- Dendrogram depicting the number of birds affected by the most common primary disease processes and subprocesses diagnosed in a database of psittacines submitted to the Avian Ambulatory Service and Animal Pathology of the Department of Pathology (VPT) and HOVET/FMVZ-USP.



The distribution between some diseases process and season are shown in the figure 6.

Figure 6 - Seasonal distribution of Amazon parrots diagnosed with a selected group of disorders.



Mortality

Mortality was attributed to infectious etiologies 43 birds (51%), being the viral infections the most prevalent (n=24/43; 55.8%) and 22 of these (91.6%) were coded viral suspect, since viral inclusion were observed but no further investigation was performed to identify the agent, the requisition exam and the clinic of the birds was compatible with Avipoxvirus infection symptoms, and all the birds had a origin the same wildlife screening center. Bacterial infections were the second most common cause of death (n=14/43; 11.76%) and *Salmonella spp*. was responsible for 50% of these cases (n=7/14). All the parrots infected with *Salmonella spp.* were from the same wildlife screening center, who reported the death of 52 *Amazona spp*. between March and April 2017, almost, all the deaths were sudden without symptoms, many with food into the digestive system. Distribution of mortality causes, and origin of the birds is shown in figure 7. In 38.0% (n=32/84) of the necropsy reports, noninfectious diseases were identified as cause of mortality, being metabolic and neoplastic disease process the most common diagnoses with 31.0% each (n=10). Diagnostic data from 84 dead amazon parrots are summarized in the table 10.

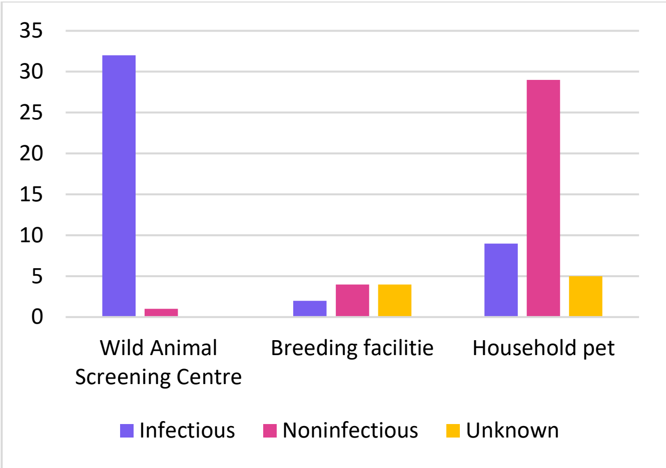
Table 10 – Complete list of the causes of mortality in captive amazon parrots submitted to the Animal Pathology Service, VPT-FMZ/USP.

Overall disease process	***Process***	***Subprocess***	***diagnoses***	***Percent N=84***
	Viral	Viral suspect	22	18.485
		Polyomavirus	1	0.848
		Poxvirus	1	0.848
		Total	24	20.162
	Bacterial	Bacterial sus	2	1.687
		Mycobacterium spp	1	0.848
		Mycoplasma spp	1	0.848
		Pseudomonas spp	1	0.848
		Salmonella spp	7	5.888
		Unspecified	2	1.687
		Total	14	11.767
	Fungal	*Aspergillus spp*	1	0.848
		Macrorhabdus ornithogaster	1	0.848
		Total	2	1.687
	Parasitic	*Eimeria spp*	1	0.848
		Cestode	1	0.848
		Nematode	1	0.848
		Total	3	2.525

Overall disease process	***Process***	***Subprocess***	***diagnoses***	Percent N=84
Noninfectious	Degenerative	Cirrhosis	1	0.848
		Atrophy	1	0.848
		Total	2	1.687
	Hemodynamic	Congestion	1	0.848
		Hemorrhage	3	2.525
		Total	4	3.364
	Metabolic	Lipidosis	1	0.848
		Gout	4	3.364
		Haemosiderosis	2	1.687
		Atherosclerosis	3	2.525
		Total	10	8.4
	Neoplastic	Carcinoma	5	4.202
		Lymphoma	3	2.525
		Neoplastic sus	2	1.687
		Total	10	8.4
	Non-neoplastic	Metaplasia	1	0.848
	Physical	Aspiration	3	2.525
		Foreign body disease	1	0.848
		Rupture	1	0.848
		Total	5	4.2
	Toxic	Toxic sus	1	0.848

Overall disease process	***Process***	***Subprocess***	***diagnoses***	Percent N***(n***=84***)***
Unknown	Inflammation	Pneumonia	2	1.687
		Airsacculitis	2	1.687
		Total	4	3.364
	Undetermined	Undetermined	4	3.364
Total			84	

Figure 7 **-** Distribution of mortality causes and origin of the birds.



Common Processes and systems

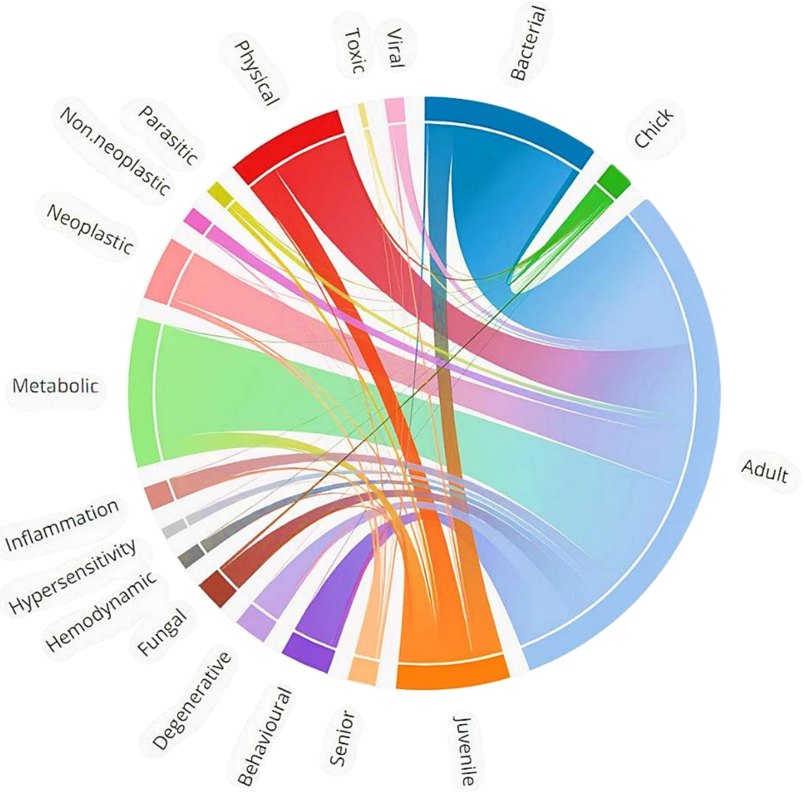
There were 37 observations recorded for chicks, 7 of them (18.91%) were from preventive consultations/checkups. Chicks were frequently affected by infectious processes (n=19/30; 63.33%) and bacterial were the most common subprocess (n=10/19; 52.63%) followed by fungal (n=4/19; 21.05%), viral (3/19; 15.7%), and parasitic (2/19; 10.52%). The noninfectious processes (n=11/30) accounted for 36.66% of all diseases reported, with the physical subprocess being the most prevalent (n=6/11; 54.5%), followed by two metabolic occurrences (18.1%), both of which were nutritional secondary hyperparathyroidism.

Juveniles had a total of 201 observations, 157 were disease diagnoses, and 44 (21.89%) corresponded to preventive consultations. The most prevalent overall disease process was the noninfectious (n=74/154; 48.05%). Physical (n=39/74; 52.70%) and metabolic (n=24/74; 32.43%) were the most common disease processes coded, reflecting the general prevalence of disease. Noninfectious causes of disease were identified in 52 cases (33.12%) and bacteria stand for 82.69% (n=43/52) of these events.

Observations for adults were 72.38% of all the observations entered (n=838/1142), 101 (12.05%) corresponded to preventive consultations and 737 to diagnosed disorders (89.94%). Similar to the juvenile category, the non-infectious disorders accounted for the highest prevalence of the overall disease processes (n=402/737; 54.54%). Therefore, same trends were observed for the subprocesses, being metabolic (n=154/737; 20.89%) and physical (n=100/737; 13.56%) the most coded. The same pattern was seen in infectious diseases (n=227/737; 30.80%), where the most common cause was bacterial process (n=173/227; 76. 21%).

Senior birds had 34 observations, three of them from preventive consultations (8.82%) and 31 disorders registered (91.17%). Noninfectious causes of morbidity were the 69.6% (n=23/33), represented mostly by neoplastic (n=7/23; 30.43%), degenerative (n=6/23; 26.08%) and metabolic (n=6/23; 26.08%) subprocesses.

Figure 8 - Distribution of disease process by age groups.



This diagram represents flows or connections between several entities (called nodes) here represented ad disease processes and age categories. Each entity is represented by a fragment on the outer part of the circular layout. Then, arcs are drawn between each entity. The size of the arc is proportional to the importance of the flow.

The frequency of affecting body systems are summarized in tables 11 and 12.

Table 11- Frequency of affected organic systems.

System	*Number (n)*	*Percent*
Alimentary	147	12.879
Auditory	2	0.182
Body cavity	6	0.535
Cardiovascular	12	1.050
Endocrine	6	0.535
Hematopoietic	1	0.091
Hepatic	115	10.071
Integumentary	150	13.131
Lymphoid	4	0.353

Musculoskeletal	93	8.141
NA	171	14.979
Nervous	15	1.313
Ocular	62	5.434
Respiratory	238	20.848
Systemic	108	9.464
Urogenital	12	1.050
Total	**1142**	100.**0**

NA= Corresponds to 156 observations from healthy birds that were presented to Avian Ambulatory Service for checkups/ preventive consultations and 15 observations from birds diagnosed with behavioral disorders (Hypersexual behavior and aggressive behavior).

Table 12 - Distribution of primary affected systems by disease process.

Overall disease process	Process	Primary Body System Affected	Cases	n=1142
Infectious	Viral	Alimentary	8	0.7
		Hepatic	1	0.1
		Integumentary	6	0.5
		Nervous	1	0.1
		Respiratory	4	0.4
		Systemic	25	2.2
		Total	45	3.9
	Bacterial	Alimentary	29	2.5
		Auditory	2	0.2
		Body cavity	1	0.1
		Hepatic	2	0.2
		Integumentary	22	1.9
		Lymphoid	1	0.1
		Musculoskeletal	5	0.4
		Ocular	15	1.3
		Respiratory	141	12.3
		Systemic	9	0.8
		Total	227	19.9
	Fungal	Alimentary	20	1.8
		Cardiovascular	1	0.1
		Integumentary	2	0.2
		Lymphoid	1	0.1
		Ocular	1	0.1
		Respiratory	13	1.1
		Total	38	3.3
	Parasitic	Alimentary	15	1.3
		Integumentary	3	0.3
		Musculoskeletal	1	0.1
		Total	19	1.7
Overall disease process	Process	Primary Body System Affected	Cases	n=1142
Noninfectious	Degenerative	Alimentary	1	0.1
		Cardiovascular	2	0.2
		Hepatic	5	0.4
		Musculoskeletal	14	1.2
		Ocular	17	1.5
		Urogenital	2	0.2
		Total	41	3.6
	Hemodynamic	Alimentary	3	0.3
		Body cavity	3	0.3
		Integumentary	3	0.3
		Nervous	1	0.1

		Ocular	1	0.1
		Respiratory	4	0.4
		Urogenital	1	0.1
		Total	16	1.4
	Hypersensitivity	Integumentary	4	0.4
		Respiratory	10	0.9
		Total	14	1.2
	Metabolic	Alimentary	3	0.3
		Cardiovascular	5	0.4
		Endocrine	4	0.4
		Hepatic	101	8.8
		Integumentary	14	1.2
		Musculoskeletal	5	0.4
		NA	3	0.3
		Ocular	1	0.1
		Respiratory	5	0.4
		Systemic	44	3.9
		Urogenital	4	0.4
		Total	189	16.5
	Neoplastic	Alimentary	8	0.7
		Body cavity	1	0.1
		Cardiovascular	2	0.2
		Endocrine	1	0.1
		Hepatic	4	0.4
		Integumentary	37	3.2
		Lymphoid	1	0.1
		Musculoskeletal	4	0.4
		Nervous	2	0.2
		Ocular	3	0.3
		Respiratory	10	0.9
		Systemic	2	0.2
		Urogenital	4	0.4
		Total	79	6.9
	Nonneoplastic	Alimentary	2	0.2
		Cardiovascular	1	0.1
		Integumentary	11	1.0
		Respiratory	5	0.4
		Total	19	1.7
	Physical	Alimentary	45	3.9
		Integumentary	2	0.2
		Musculoskeletal	60	5.3
		Ocular	6	0.5
		Respiratory	27	2.4
		Systemic	7	0.6
		Urogenital	1	0.1
		Total	148	13.0
	Toxic	Nervous	1	0.1
		Respiratory	1	0.1
		Systemic	4	0.4
		Total	6	0.5

Overall disease process	Process	Primary Body System Affected	Cases	n=1142
Unknown	Behavioral	Integumentary	45	3.9
		NA	15	1.3
		Total	60	5.3
	Inflammatory	Musculoskeletal	4	0.4

	Nervous	1	0.1
	Ocular	15	1.3
	Respiratory	9	0.8
	Total	29	2.5
Undetermined	Alimentary	10	0.9
	Body cavity	1	0.1
	Cardiovascular	1	0.1
	Endocrine	1	0.1
	Hematopoietic	1	0.1
	Hepatic	2	0.2
	Integumentary	1	0.1
	Lymphoid	1	0.1
	Nervous	9	0.8
	Ocular	3	0.3
	Respiratory	9	0.8
	Systemic	17	1.5
	Total	56	4.9

4.4. DISCUSSION

Several species of wild, exotic, and unconventional domestic animals are kept as pets, and despite the fact that it is impossible to determine the exact number of pet birds in Brazil because the data varies so widely between sources, it is generally accepted that birds (including parrots, finches, and canaries) are the third most popular companion animal in the country, after dogs and cats respectively (IPB, 2022).

Proper nutritional, environmental and sanitary management conditions are necessary for their healthy maintenance in captivity (ENGEBRETSON, 2006). By conducting this survey, an overview of the attendance at the Avian Clinical Service was drawn. In this study it was shown that amazon parrots are widely desired and kept as pets, representing 24.0% of the total birds that attended to the Avian Clinical Service from the VPT-HOVET/FMVZ-USP during the 10-year study period.

Birds are the most popular taxonomic class of terrestrial vertebrates in the exotic pet trade, with Psittacines and Passerines being the most sought after (ALVES et al., 2010; ALVES; LIMA; ARAUJO, 2013; BUSH; BAKER; MACDONALD, 2014; CHAN et al., 2021; CITES, 2022; MARINI; GARCIA, 2005). Some research supports this, showing the prevalence of these orders when it comes to birds kept in as pets that attends to veterinary hospitals looking for medical assistance (CASTRO, 2010; FOTIN; MATUSHIMA, 2005; MURER, 2020; SANTOS et al., 2008).

Psittacine birds analyzed in this study represented 8 of the 12 currently, existing Amazon species that occur in Brazil and 9 of the 36 recognized species in the world. The *A. aestiva* (85.0%) and *A. amazonica* (8.0%) species were the most represented species in this as in other studies conducted in in the city of São Paulo (CASTRO, 2010; FOTIN; MATUSHIMA, 2005; HVENEGAARD *et al.*, 2009; SÁNCHEZ; LEDESMA; MORALES, 2020; SINHORINI, 2008). This could be attributed due to the high availability of acquisition by keepers, either from the illegal trafficking of species or from commercial breeders (HALLE, 2018; IUCN, 2022; SCHEFFERS *et al.*, 2019; WRIGHT *et al.*, 2001; ZULIAN; MILLER; FERRAZ, 2021). The parrot's species *Amazona rhodocorytha*, *Amazona vinacea* and *Alipiopsitta xanthops*, although few, are unoriginal to the study region, and are included in the red book of the International Union for Conservation of Nature as endangered species (IUCN, 2022). The illegal acquisition of these animals may be due to lack of knowledge and specific opportunities. The festive amazon (*Amazona festiva*) occurrence is associated with forest (especially Várzea) and its distribution in Brazil occurs within the amazon rain forest biome (IUCN, 2022), the animals found to be presented at the hospital were originally from a breeding facility as well as the occurrence of the individuals of Amazona oratrix species.

The record of animals of undefined sex was the most frequent (859 from 1142), followed by females (176) and males (101), this is a commonly reported limitation of data retrospective studies in birds, especially with conducted over neotropical species which in its majority do not have sexual dimorphism, as in the study of Breaufere *et al*. (2019) where a multicenter retrospective study on 652 pathology submissions (411 necropsies and 243 biopsies) from quaker parrots was performed by recording the final pathological diagnoses, age, and sex for each bird. Data for age, sex, or both were missing in 31.4%, 30.2%, and 10.5% of cases, respectively (unknown or unreported on submission sheets) and were assumed to be missing at random. Since these birds do not have sexual dimorphism (BEAUFRÈRE *et al.*, 2019).

Most observations are from patients coded as BCS 3/5 (57.0%), but the attribution of this BCS category is considered subjective, and varies from observer to observer, furthermore, wrong assessments are made since there's no standardized scales for parrots (BURTON *et al.*, 2014), and the observer was transient over time, recalling numerous individuals responsible for these assignments. The percentile occupied by animals between the emaciated, overweight an obese animals represent 21.6% of the patients' observations, its concerning, considering those as non-healthy body condition scored, and, although this information could be biased, for the same reasons discussed previously, miscoding those conditions its hard, as a noticeable sternum makes identification simple (CHITTY, 2016).

Body condition score (BCS) is the measure of the nutritional status of an animal represented mainly by the size of its energy reserves. In birds this condition is related to the biological fitness of the individual, as it has effects on its behavior, reproductive success, and survival (BLUMS *et al.*, 2005; WENKER *et al.*, 2022). The results found in other studies for birds BCS are similar to those observed by Ecco et al., (2009), who reported it as correlated to the presence of disease in sick parrots of various species. The weight of dead specimens may be another indication of the course of various diseases. Therefore, frequent monitoring of the weight of parrots in triages, including by sampling, may be another tool for indirect assessment of the health of the groups and allow diagnosis (WELLE, 1995).

Regarding feeding, a large amount of data was obtained demonstrating how it is still unclear to most caregivers what the specific needs of these species are, even though its popularity as pet birds is not recent (BRIGHTSMITH, 2012; CUMMINGS *et al.*, 2022; HESS; MAULDIN; ROSENTHAL, 2002; PETZINGER; BAUER, 2013), they remain to be usually kept in small cages and fed on mainly sunflower seeds. This diet, rich in fats and poor in minerals and vitamins, is responsible for several metabolic and cardiovascular diseases mainly, among others, that affect the quality of life of similar birds (SAAD *et al.*, 2007; ULLREY; ALLEN; BAER, 1991). In addition, seeds allow little podomandibular manipulation, a very important feeding activity for parrots (KALMAR *et al.*, 2010). Therefore, dietary correction, with the introduction of species-specific feed, fruits and vegetables, can be a tool to increase welfare and reduce behavioral alterations (KALMAR, 2011).

From the 1033 clinical histories reviewed from living animals, 76.0% of them where from scheduled consultations, most patients within this category 58.9% (465/789) where presented to the hospital in an active general condition, which could mean that the animal presented some change evident to the owner, but without modifying its general condition, this means, the animal could present a tumor, a discharge, a change in stool, or in behavior but without alteration in its level of consciousness. Alert (normal), decreased (depressed, apathetic) and furthermore 37.0% (292/789) of the record reported animals moderately depressed, which is in agreement with the literature when it is referred that birds hide diseases, making it difficult for owners to identify if the bird is sick, and what is the degree of real emergency of the symptoms presented, because o level of consciousness its apparently normal most of time, leading people to ignore the symptoms. Only 4.0% of the scheduled consultation where from animals severely depressed (32/789), most animals within this general condition category (56.0%) attended to the hospital for emergency consultations (42/74). This emergency consultations represent the category with the smaller number of records with only an 8.0% (88/1033) of which 47.7% (42/88) of the records reported animals presented severely depressed, symptoms associated with these clinical presentations where in 78.0% grouped either in acute nonspecific symptoms (42.0%) as acute anorexia, lethargy, severe dyspnea, or respiratory symptoms (35.0%) such as discharges, sneezing, wheezing, respiratory noises and dyspnea. Forty percent (36/88) of the emergency consultations where animals reported moderately depressed, the other 11.0% (10/88) where all physical process, fractures more specifically, 8 of them (80.0%) of the pelvic limb, 1 wing and 1 of the beak, meaning that animals with no evidence of break limbs, blood, evident historic of trauma to the caregiver, or exposure of a bone cand be undiagnosed, because of their apparently normal or active general state.

Numerous illnesses that affect companion birds all around the world have its foundations in poor nutrition, poor husbandry, and lack of owner knowledge, either directly or indirectly (MURPHY *et al.*, 2016). These concerns are like those that have been identified as pertinent to canine welfare (BUCKLAND *et al.,* 2014). The rates presented here provide population-level data on the prevalence of spontaneous disease in a cohort of captive amazon parrots, which may aid in estimating actual health threats in the region.

Infectious diseases

Since infection does not always result in apparent sickness or fatality leading to submission for postmortem inquiry, as found in this study for viral infections, the incidence of infection may even understate the true rate. Viral disease process represented 13,6% (n=45/329) of all infectious processes and only 4,5% (45/986) of all diagnoses. The most common subprocess was the determined as ´´viral suspect´´ (n=25/45), followed by bornavirus infections with only 9 cases, in contrast to other studies of prevalence of infectious diseases in Brazil, as in Philadelpho *et al*. (2014) tested 112 psittacines for ABV and obtained 28,57% of positive birds with 22 of the being from Amazona genus. In Canada, Gibson *et al.* (2019), reviewed postmortem reports from 185 psittacine birds and viral infection represented 52.0% of infectious processes and with the most common agent being AVB 59.0%. A recent study investigated natural PaBV infections in South American parrots in two Brazilian breeding facilities a commercial and a conservationist. Infection was found in 73.7% of the birds analyzed, indicating that this virus has spread widely between the two institutions. From the birds examined in aviary A, 66.7% displayed clinical symptoms, 100.0% had proventricular dilatation disease (PDD)-specific lesions, 100.0% exhibited mild to severe proventricular dilatation, and 88.9% were PaBV-positive (SILVA *et al.*, 2020).

This could represent a high rate of undiagnosed positive birds, which is concerning considering the virulent characteristic of the agent since has been reported as a potential risk for endangered populations of psittacines under captivity conditions as is the case of the Spix Macaw (DEB; BORJAL; BARKLE, 2008). The spread of infectious pathogens such as ABV is a constant threat for the survival of these species in the wild and to species conservation projects. The majority of ABV research has centered on caged birds. Reaffirmed by Nagel *et al.* (2014) who looked into 86 wild psittacine birds in Brazil and discovered signs of a long-term, natural ABV infection.

The prevalence and etiologies responsible for bacterial infections in the present work are consistent with previous studies (BANGERT *et al.*, 1988; DONELEY, 2009; MARQUES *et al.*, 2021; MLADENOV; POPOVA, 2020; SÁNCHEZ; LEDESMA; MORALES, 2020). Enterobacterial disease, for example, is common in captive psittacines and the prevalence observed in the present study (approximately 13.0% of all bacterial diagnoses) is comparable to the estimated prevalence estimated in other Brazilian studies (AKHTER *et al.*, 2010; DE SOUZA LOPES *et al.*, 2015; DEB; BORJAL; BARKLE, 2008; HIDASI *et al.*, 2013; MACHADO *et al.*, 2018). However, common trends reported for bacterial agents in neotropical parrot species, such as Mycobacterium spp. and Chlamydia spp. were not found in this study. Additionally, to this, the low prevalence of viral and parasitic diagnoses and the high prevalence of the categories ‘’viral suspect’’ and ‘’bacterial suspetc’’ may be explained somehow in the fact the clinician depends entirely on the economic capacity of those responsible for the animal to pay for bacterial cultures, PCRs, and other specific tests as serial coproparasitological examinations, as well as time availability and interest per owner. Beyond the need for better screening and proactive, evidence-based preventative intervention, this presents additional hurdles for veterinarians working to provide preventative health care for birds. Despite modest regional variations, these difficulties are generally influenced by the specifics of the pet trade as well as cultural, economic, and ethnic factors. Some of these concerns are highlighted in this study's analysis from a South American perspective.

Almost half of mortality causes were attributed to infectious etiologies, with twenty two suspected cases of Avipoxvirus in parrots from a wildlife screening center, which has been reported to be lethal for these species in the literature (CUBAS; SILVA; CATÃO-DIAS, 2014; GERLACH, 1994; PHALEN, 2005), furthermore the disease is widely reported in Passeriformes and less common in Psittaciformes, and its estimated than 5% of the wild bird population in Brazil is made up of healthy carriers of poxvirus (RITCHIE BW., 1997). However, disease transmission is linked to host immunosuppression. This disease can affect birds of all ages, and the degree of disease susceptibility varies by virus strain as well as avian species, with mortality rates ranging from 20% to 100% (ESTEVES *et al.*, 2014; GODOY; MATUSHIMA, 2010; RITCHIE BW., 1997). Poxvirus is spread through direct contact with food, water, secretions, and contaminated dust, as well as indirectly through insect bites. Many arthropod species serve as mechanical vectors for the virus. Vector transmission is common in confined birds in trafficking operations because these birds are typically kept in small, overcrowded cages with inadequate ventilation. Since traffic it's a frequent origin for amazon kept in wildlife screening centers (ECHENIQUE *et al.*, 2020; SCHEFFERS *et al.*, 2019; VANSTREELS *et al.*, 2010), factors like those above mentioned and in addition to enclosures of close proximity to a wide variety and huge population of other birds species can be powerful contributors (ESTEVES *et al.*, 2014; GODOY; MATUSHIMA, 2010).

Noninfectious diseases

Noninfectious diseases were the most common finding affecting captive amazon parrots. From these, metabolic was the most prevalent disease process and affected 203 birds with 142 being reported as the main diagnosis. Overall, 272 diagnoses were categorized as metabolic, and 189 of them were classified as the primary cause of morbidity, meaning that many birds were diagnosed with simultaneous metabolic disorders.

Hepatic lipidosis was the most frequently diagnosed subprocess followed by the suspect cases of this disease. The noninfectious hepatopathy, determined as the ´´lipidosis suspect´´ group was characterized by animals presenting compatible symptoms, relatable clinical backgrounds, and fitting but not sufficient ancillary test results. Liver disease has been widely mentioned as common among companion psittacines birds, nevertheless, its diagnosis is difficult and clinical symptoms are frequently nonspecific (RITCHIE; HARRISON; HARRISON, 1994).

In this study, the most commonly reported clinical signs were the categorized as dermatologic sings (41.0%), broadly represented by overgrowing nails and beaks, however other alterations also reported were yellowish/blackish feathers, greasy feathers, pruritus, overgrowing beaks leading to its extreme deformity, poor feather quality and stress bars. Overgrowing beaks and nails are physical examination findings considered specific for hepatic disease, and the other mentioned integumentary complaints are also discussed to be associated, although very loosely (COWAN, 2017; HARRISON; MCDONALD, 2006; LUMEIJ, 1994; SHI-YEE HUNG; SLADAKOVIC; DIVERS, 2019). Beak trimming should not be needed if the bird eats an appropriate diet and uses the beak for normal behaviors. If keratin builds up along the lateral aspects of the beak, this can be smoothed using a rotary sanding tool (LUMEIJ, 1994; MENCH et al., 2018).

People with icterus frequently present pruritus, which is thought to be brought on by the buildup of irritating bile salts in the skin(GRUNKEMEYER, 2010; HOCHLEITHNER; HOCHLEITHNER, 2011; LUMEIJ, 1994). Clinical symptoms of pruritus and feather picking have been observed in birds suffering from liver disease (BEAUFRÈRE, 2022; GRUNKEMEYER, 2010; MONTESINOS *et al.*, 2016; SHI-YEE HUNG; SLADAKOVIC; DIVERS, 2019), and in this study pruritus by its own was classified as a dermatologic alteration, but pruritus in addition with feather picking, or feather damaging, involving altered behavior in a repetitive manner, being chronic evidenced by the caregiver were categorized as behavioral alteration, and no bird with hepatic lipidosis diagnose was classified as presenting this complaint, however within the metabolic disease group, all the birds presenting behavioral alterations (n=6/189) were arranged into the nutritional deficiency subprocess, and in 4 the integumentary systems was identified as the main system affected.

As report by the literature clinical indications of dietary deficiency frequently arise first in the integument, but these early indicators are so frequently found that they may not be seen as abnormal (HARRISON; MCDONALD, 2006), some findings are consistent and may be related to this statement such as the profile of the neotropical parrot diagnosed with hepatic lipidosis or its suspect in this study, who in 87,50% of the cases was submitted to the Avian Clinical Service for a scheduled consultation, and considering 30.0% of this birds were reported as moderately depressed at time of consultation, could mean that caregivers may have probably observed slight and progressive changes, but disregarded them until they appear more evident and the consciousness state of the bird begins to be compromised.

As the second most presented clinical signs by the fatty liver diagnosed parrots, gastrointestinal alterations, where mainly represented by progressive anorexia, biliverdinemia and yellowish urates, which have been broadly recognized as strong indication of liver disease since this discoloration is the result of increased excretion of biliverdin (biliverdinuria), which is the most important bile pigment in birds (GRUNKEMEYER, 2010; HOCHLEITHNER; HOCHLEITHNER, 2011; LUMEIJ, 1994; PERLMAN, 2015; SHI-YEE HUNG; SLADAKOVIC; DIVERS, 2019). Since liver disease in birds can be fatal if not diagnosed early, an accurate method of detecting early hepatic pathology is essential (BEAUFRÈRE, 2022; KOLLIAS; KOLLIAS, 2010; STANFORD, 2005). Physical processes were the second most common diagnose from the no infectious category. Emergencies from traumatic injuries are relatively common and can have various causes such as wounds, bites, fractures, burns, electric shock, freezing or others (CASTRO, 2010; GIBSON *et al.*, 2019; MATTIELLO, 1995; MURER, 2020). Because birds have little SC tissue, open wounds easily result from these injuries, which could easily become contaminated (JENKINS, 2016).

Fractures are the most common musculoskeletal abnormalities (CASTRO, 2010; EVANS, 1986), and those of the long bones of the wings and pelvic limbs are the major causes of assistance to birds (ARNAUT, 2006; MCCARTNEY, 1994). In this study trauma without specific lesion was the most prevalent physical subprocess followed by fracture and air sac rupture. The most common affected system was musculoskeletal as widely report by previous studies (ARNAUT, 2006; CASTRO, 2010; MURER, 2020), followed by alimentary due to maxillary and mandibular fractures, and as is expected in third position the respiratory system due to the air sac ruptures, which in 90% of the cases corresponded to the cervical air sac.

In a study carried out by Arnaut (2006), where 201 birds seen at the Teaching Veterinary Hospital (HOVET-FMVZ/USP) from 2000 to 2004 with some radiographic alteration in the skeletal system were radiographed. The study showed that orthopedic conditions caused by trauma were the most frequent (46.77%), with 74.47% of the birds affected by fractures, 25.53% by dislocations, and 10.64% by bone amputations. According to the classification by order of animals, the Psittaciformes were the most prevalent (68.09%). In this study dislocations were poorly reported and in contrasty to other retrospective studies, air sac rupture occupied an important percentile into the prevalence of physical subprocess.

Neoplastic disease is common in pet birds, particularly in psittacines. In this study, neoplastic were the third more common disorders and lipoma the most prevalent tumor, affecting as expected, mainly the integumentary system, in previous regional studies this trend was also observed as reported by Sinhorini (2008) subcutaneous lipomas were the most commonly found tumors (33/102, 32.4%), and the birds presenting lipomas were mostly obese parrots (Amazona spp.) (SINHORINI, 2008). The retrospective analysis of 19 cases of pet birds undergoing diagnostic and/or therapeutic surgical operations for neoplastic disease manifested by the presence of visible masses at the HOVET- FMVZ/USP. The Blue fronted Parrot (*Amazona aestiva*), which made up the majority of the birds having surgery and the most common tumor was a lipoma (CASTRO et al., 2016). Subcutaneous lipomas were the most commonly found tumors (33/102; 32.4%), confirming the findings of Petrak and Gilmore (1969). The birds presenting lipomas were mostly obese parrots (Amazona spp.) The high incidence of neoplasms in these birds may be due to assisted inbreeding, their longer lifespan, which increases the exposure time to potential carcinogenic environmental agents, and the consequent risk of genetic errors or mutations. Pet birds with neoplastic diseases are currently more frequently submitted veterinarians before death possibly because the medical care improvements for oncologic patients (SÁNCHEZ; LEDESMA; MORALES, 2020).

Degenerative/age related.

Cataracts were the degenerative/age related most common diagnose process, these results are consistent with previous studies, as a strong related regional reference Hvenegaard *et al*. (2009) made an analysis of 57 Amazon parrots referred to the Ophthalmology Service, Veterinary Teaching Hospital, (HOVET/FMVZ-USP), from 1997 to 2006 was done retrospectively to determine the frequency and types of ocular abnormalities. Cataracts were the most frequently seen condition, appearing in 24 of the 114 eyes analyzed (57 parrots).

Age and female sex are both risk factors for atherosclerosis (BEAUFRÈRE et al., 2015), however, the sample size in the current investigation did not provide statistical confirmation of these tendencies. On the other hand, all occurrences of atherosclerosis were, descriptively speaking, seen in post-fledging birds, predominantly adults. According to Beaufrère *et al*. (2011), atherosclerosis is frequently subclinical until lesions become severe, which is consistent with our finding that less than half of atherosclerosis final diagnoses were deemed primary.

Until recently, geriatric medicine had been a neglected area of avian medicine (DONELEY, 2013). Infectious diseases, inadequate diets, and poor husbandry meant that most pet birds did not live long enough to develop geriatric conditions. As the knowledge base of avian medicine, nutrition, and proper husbandry has grown, so has the life span of pet birds increased. Most pet birds have the potential to live 20−80 years, depending on their size. With pet birds living longer, the incidence of geriatric-onset diseases, including cataracts, neoplasia, arthritis, and cardiovascular disease, has increased.

Concussions

While evaluating one decade of data on the Brazilian Amazon parrots population admitted to Avian Ambulatory Service and to the Animal Pathology Service from the Veterinary Teaching Hospital (HOVET) and Veterinary Pathology Department (VPT) of the University of São Paulo, School of Veterinary Medicine, and Animal Science (USP-FMVZ), there was evidence that:

The studied population was composed primarily of native species, and could be split into two distinct groups, a big majority belonging to the heavily trafficked species A *aestiva* and *A. amazonica*; and a minority belonging to another seven Amazon Parrot species, being three of them Listed as Threatened Species. The sex of the patients was often undermined, and the most represented age groups were adult and juveniles kept as pets and fed mainly on seed-based diets.

The main reasons for which these birds required veterinary medical attention were due to bacterial and metabolic diseases. And, on the other hand, the major cause for the animals caregivers to seek after medical intervention was due to the presence of respiratory, dermatological, and gastrointestinal symptoms.

The present study describes the prevalence of diseases among captive amazon parrots, with major highlight of disorders that can be prevented or handled by a better understanding of species-specific requirements, including suitable adjustments to husbandry and general aviary management with a long-term goal of reducing stress levels., such as, bacterial infections, hepatic lipidosis, obesity and trauma.

This study verified trends on organic systems affected described in literature with the most common being the respiratory system, affected frequently by infectious diseases, mainly bacteria, the integumentary affected primarily by neoplastic disorders, behavioral alterations, and bacterial infections. And finally, the alimentary system mostly altered by infectious etiologies such as bacteria, fungus and parasites, and a wide variety of physical processes. Identifying trends in disease prevalence and health risks to individual birds is important for successful colony management.

This study gathered enough information to characterize the population of captive amazon parrots, presented to the Avian Clinical Service and Animal Pathology Service at VPT/FMVZ-USP during the study period, to identify the main reasons for which these animals required veterinary medical attention and describes the prevalence of diseases, and affected systems in this cohort of birds.

The present study's strength is its enormous data collection, which enables general conclusions applicable to a specific genus to focus research topics and direct further studies. Despite this, there are a few limitations to the current study that need to be considered.

Limitations

It might be difficult to draw meaningful statistical inferences from lengthy retrospective studies that include a diverse variety of species and disorders. It is frequently impossible to collect large enough sample sizes to thoroughly examine any one disease, and the classification of diseases or disease categories as required for statistical analysis can be This study gathered enough information to characterize the population of captive amazon parrots, presented to the Avian Clinical Service and Animal Pathology Service at

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It might be difficult to draw meaningful statistical inferences from lengthy retrospective studies that include a diverse variety of species and disorders. It is frequently impossible to collect large enough sample sizes to thoroughly examine any one disease, and the classification of diseases or disease categories as required for statistical analysis can be arbitrary. As a result, the usefulness of disease classifications may be limited.

4.5. REFERENCES

AKHTER, J.; HOSSAIN, M. T.; ISLAM, M. T.; SIDDIQUE, M. P.; ISLAM, M. A. Isolation and Identification of Microflora from Apparently Healthy Caged Parrots of Dhaka Zoo of Bangladesh. **Bangl. J. Vet. Med**, v. 8, n. 1, p. 5–10, 15 ago. 2010. Disponível em: <http://www.parrotsanctuary.co.uk>.

ALVES, R. R. N.; LIMA, D. F. J. R.; ARAUJO, H. F. P. The live bird trade in Brazil and its conservation implications: An overview. **Bird Conservation International**, v. 23, n. 1, p. 53–65, mar. 2013.

ALVES, R. R. N.; NOGUEIRA, E. E. G.; ARAUJO, H. F. P.; BROOKS, S. E. Bird-keeping in the Caatinga, NE Brazil. **Human Ecology**, v. 38, n. 1, p. 147–156, fev. 2010.

ARNAUT, L. D. S. **Estudo radiográfico das afecções do sistema esquelético em aves Estudo radiográfico das afecções do sistema esquelético em aves**. 2006. University of São Paulo, São Paulo, 2006.

AVIBASE. **Avibase - Bird Checklists of the World**. Disponível em: <https://avibase.bsc-eoc.org/checklist.jsp>. Acesso em: 22 jan. 2023.

BANGERT, R. L.; CHO, B. R.; WIDDERS, P. R.; STAUBER, E. H.; WARD, A. C. S. A Survey of Aerobic Bacteria and Fungi in the Feces of Healthy Psittacine Birds. **Avian Diseases**, v. 32, n. 1, p. 46–52, 1988.

BEAUFRÈRE, H. Blood Lipid Diagnostics in Psittacine Birds. **Veterinary Clinics of North America - Exotic Animal Practice**, v. 25, n. 3, p. 697–712, 1 set. 2022.

BEAUFRÈRE, H.; AMMERSBACH, M.; REAVILL, D. R.; GARNER, M. M.; HEATLEY, J. J.; WAKAMATSU, N.; NEVAREZ, J. G.; TULLY, T. N. Prevalence of and risk factors associated with atherosclerosis in psittacine birds. **Journal of the American Veterinary Medical Association**, v. 242, n. 12, p. 1696–1704, 2015.

BEAUFRÈRE, H.; REAVILL, D.; HEATLEY, J.; SUSTA, L. Lipid-Related Lesions in Quaker Parrots (Myiopsitta monachus). **Veterinary Pathology**, v. 56, n. 2, p. 282–288, 1 mar. 2019.

BLUMS, P.; NICHOLS, J. D.; HINES, J. E.; LINDBERG, M. S.; MEDNIS, A. Individual quality, survival variation and patterns of phenotypic selection on body condition and timing of nesting in birds. **Oecologia**, v. 143, n. 3, p. 365–376, abr. 2005.

BRIGHTSMITH, D. J. Nutritional levels of diets fed to captive amazon parrots: Does mixing seed, produce, and pellets provide a healthy diet? **Journal of Avian Medicine and Surgery**, v. 26, n. 3, p. 149–160, set. 2012.

BUCKLAND, E. L.; CORR, S. A.; ABEYESINGHE, S. M.; WATHES, C. M. Prioritisation of companion dog welfare issues using expert consensus. **Animal Welfare**, v. 23, n. 1, p. 39–46, fev. 2014.

BURTON, E. J.; NEWNHAM, R.; BAILEY, S. J.; ALEXANDER, L. G. Evaluation of a fast, objective tool for assessing body condition of budgerigars (Melopsittacus undulatus). **Journal of Animal Physiology and Animal Nutrition**, v. 98, n. 2, p. 223–227, abr. 2014.

BUSH, E. R.; BAKER, S. E.; MACDONALD, D. W. Global trade in exotic pets 2006-2012. **Conservation Biology**, v. 28, n. 3, p. 663–676, 2014.

CASTRO, P. F. **Afecções cirúrgicas em aves: estudo retrospectivo**. 2010. Universidade de São Paulo, São Paulo, 2010.

CASTRO, P. F.; FANTONI, D. T.; MIRANDA, B. C.; MATERA, J. M. Prevalence of Neoplastic Diseases in Pet Birds Referred for Surgical Procedures. **Veterinary Medicine International**, v. 2016, n. Figure 2, 2016.

CBRO. **Lista das aves do Brasil. 11ª Edição.Comitê Brasileiro de Registros Ornitológicos.**1 jan. 2014. Disponível em: <www.cbro.org.br>.

CHAN, D. T. C.; POON, E. S. K.; WONG, A. T. C.; SIN, S. Y. W. Global trade in parrots – Influential factors of trade and implications for conservation. **Global Ecology and Conservation**, v. 30, 1 out. 2021.

CHITTY, J. R. Physical examination. **Ferret Medicine and Surgery**, p. 75–84, 2016.

CITES. **Convention on International Trade in Endangered Species of Wild Fauna and Flora; Trade Database**. Disponível em: <https://trade.cites.org/#>. Acesso em: 16 nov. 2022a.

CITES. **Checklist of CITES species**. Disponível em: <https://checklist.cites.org/#/en/search/cites_appendices%5B%5D=I&output_layout=alphabetical&level_of_listing=0&show_synonyms=1&show_author=1&show_english=1&show_span

ish=1&show_french=1&scientific_name=Psittaciformes&page=1&per_page=20>. Acesso em: 29 set. 2022b.

COWAN, M. Liver and Lipid Disorders. Em: 25th AAVAC Annual Conference, 2017, Auckland. [...]. Auckland: Association of Avian Veterinarians Australasian Committee Ltd, 2017. v. 25, p. 6–10.

CUBAS, Z. S.; SILVA, J. C. R.; CATÃO-DIAS, J. L. **Tratado de animais selvagens: medicina veterinária**. São Paulo: Roca, 2014.

CUMMINGS, A. M.; HESS, L. R.; SPIELVOGEL, C. F.; KOTTWITZ, J. J. An Evaluation of Three Diet Conversion Methods in Psittacine Birds Converting from Seed-Based Diets to Pelleted Diets. **Journal of Avian Medicine and Surgery**, v. 36, n. 2, p. 145–152, 1 jul. 2022.

DE SOUZA LOPES, E.; MACIEL, W. C.; HOLANDA DE ALBUQUERQUE, Á.; MACHADO, D. N.; GONÇALVES DE AMORIM BEZERRA, W.; HORN VASCONCELOS, R.; LIMA, B. P.; AUGUSTO, G.; GONÇALVES, M.; SIQUEIRA DE CASTRO TEIXEIRA, R. Prevalence and Antimicrobial Resistance Profile of Enterobacteria Isolated from Psittaciformes of Illegal Wildlife Trade. **Acta Scientiae Veterinariae**, v. 43, p. 1–9, 2015.

DEB, A.; BORJAL, R.; BARKLE, M. Evaluation of avian paramyxovirus. serology and crop biopsy for the diagnosis of proventricular dilatation disease in captive spix's macaws (Cyanopsitta spixii). Em: EuropeanAssociation of Zoo- and Wildlife Velerinarians , 2008, Leipzig, Germany. [...]. Leipzig, Germany: 2008. p. 239–242.

DONELEY, B. AVIAN GERIATRICS. (Association of Avian Veterinarians Australasian Committee) Em: Proceedings Singapore, 2013, [...]. University of Queensland, 2013. p. 160–167.

DONELEY, R. J. T. Bacterial and Parasitic Diseases of Parrots. **Veterinary Clinics of North America - Exotic Animal Practice**, v. 12, n. 3, p. 417–432, 2009.

DORRESTEIN, G. M. Diagnostic Approaches and Management of Diseases in Captive Passerines. **Seminars in Avian and Exotic Pet Medicine**, v. Volume 12, n. 1, p. 11–20, jan. 2003.

ECCO, R.; PREIS, I. S.; S MARTINS, N. R.; R VILELA, D. A.; SHIVAPRASAD, H. L. An Outbreak of Chlamydiosis in Captive Psittacines. **Braz J Vet Pathol**, v. 2, n. 2, p. 85–90, 2009. Disponível em: <www.bjvp.org.br>.

ECHENIQUE, J. V. Z.; SOARES, M. P.; ALBANO, A. P. N.; BANDARRA, P. M.; SCHILD, A. L. Diseases of wild birds in southern Rio Grande do Sul, Brazil. **Pesquisa Veterinaria Brasileira**, v. 40, n. 2, p. 121–128, 1 fev. 2020.

ENGEBRETSON, M. The welfare and suitability of parrots as companion animals: A review. **Animal Welfare**, v. 15, n. 3, p. 263–276, 2006.

ESTEVES, F.; MARIN, S.; RESENDE, M.; SILVA, A.; COELHO, H.; BARBOSA, M.; APARECIA, N.; DE RESENDE, J.; TORRES, A.; MARTINS, N. Avian Pox in Native Captive Psittacines, Brazil, 2015. **Emerging Infectious Diseases**, v. 20, n. 1, p. 6–12, 2014.

EVANS, S. **Textbook of Veterinary Diagnostic Radiology**. Philadelphia: W.B. Saunders Company, 1986. 522–532 p.

FORSHAW, J. M. **Vanished and vanishing parrots: Profiling extinct and endangered species**. Clayton, Australia: CSIRO PUBLISHING, 2017. 261–290 p.

FOTIN, C. M. P.; MATUSHIMA, E. R. **Levantamento prospectivo dos animais silvestres, exóticos e domésticos não convencionais, em cativeiro domiciliar, atendidos em clínicas**

particulares no município de São Paulo: aspectos do manejo e principais afecções. 2005. Universidade de São Paulo, 2005.

GERLACH, H. Viruses. *Em*: HARRISON, G. J.; RITCHIE, B. W.; HARRISON, L. R. **Avian Medicine: Princilpes and Application**. [s.l.] Wingers Pub, 1994. p. 862–949.

GIBSON, D. J.; NEMETH, N. M.; BEAUFRÈRE, H.; VARGA, C.; EAGALLE, T.; SUSTA, L. Captive Psittacine Birds in Ontario, Canada: a 19-Year Retrospective Study of the Causes of Morbidity and Mortality. **Journal of Comparative Pathology**, v. 171, p. 38–52, 1 ago. 2019.

GODOY, S. N.; MATUSHIMA, E. R. A survey of diseases in passeriform birds obtained from illegal wildlife trade in São Paulo City, Brazil. **Journal of Avian Medicine and Surgery**, v. 24, n. 3, p. 199–209, set. 2010.

GRUNKEMEYER, V. L. Advanced diagnostic approaches and current management of avian hepatic disorders. **Veterinary Clinics of North America - Exotic Animal Practice**, v. 13, n. 3, p. 413–427, 1 set. 2010.

HALLE, B. O. Bird's-eye view: Lessons from 50 years of bird trade regulation & conservation in Amazon countries. **Traffic report**, n. December, p. 1–198, 2018.

HARRISON, G. J.; MCDONALD, D. Nutritional Considerations Section II. *Em*: HARRISON G.J.; LIGHTFOOT T.L. **Clinical Avian Medicine**. Palm Beach: Spix Publishing, Inc., 2006. p. 108–140.

HESS, L.; MAULDIN, G.; ROSENTHAL, K. Estimated nutrient content of diets commonly fed to pet birds. **Veterinary Record**, v. 150, p. 399–404, 2002.

HIDASI, H. W.; NETO, J. H.; MORAES, D. M. C.; LINHARES, G. F. C.; DE SÁ JAYME, V.; ANDRADE, M. A. Enterobacterial detection and escherichia coli antimicrobial resistance in parrots seized from the illegal wildlife trade. **Journal of Zoo and Wildlife Medicine**, v. 44, n. 1, p. 1–7, mar. 2013.

HOCHLEITHNER, M.; HOCHLEITHNER, C. Evaluating and Treating the Liver. *Em*: HARRISON, G. J.; LIGHTFOOT, T. L. **Clinical Avian Medicine**. Palm Beach: Spix Publishing, Inc., 2011. p. 441–451.

BEAUFRÈRE, H.; AMMERSBACH, M.; REAVILL, D. R.; GARNER, M. M.; HEATLEY, J. J.; WAKAMATSU, N.; NEVAREZ, J. G.; TULLY, T. N. Prevalence of and risk factors associated. **Journal of the American Veterinary Medical Association**, v. 242, p. 1696–1704, 15 jun. 2013.

HVENEGAARD, A. P.; SAFATLE, A. M. V.; GUIMARÃES, M. B.; FERREIRA, A. J. P.; BARROS, P. S. M. Retrospective study of ocular disorders in Amazon parrots. **Pesquisa Veterinária Brasileira**, v. 29, n. 12, p. 979–984, 2009.

IPB. **Censo Pet IPB– Instituto Pet Brasil**. Disponível em: <https://institutopetbrasil.com/fique-por-dentro/amor-pelos-animais-impulsiona-os-negocios-2-2/>. Acesso em: 15 fev. 2023.

IUCN. **IUCN Red List of Threatened Species**. Disponível em: <https://www.iucnredlist.org/resources/summary-statistics#Summary%20Tables>. Acesso em: 20 dez. 2022.

IUCN. **IUCN Red List of Threatened Species**. Disponível em: <https://www.iucnredlist.org/search?taxonomies=22673595&searchType=species>. Acesso em: 29 dez. 2022.

JENKINS, J. R. Critical Care of Pet Birds: Avian Critical care Triage Trauma Shock Fluid therapy. **Veterinary Clinics of NA: Exotic Pet**, v. 19, n. 2, p. 501–512, 2016. Disponível em: <http://dx.doi.org/10.1016/j.cvex.2016.01.014>.

KALMAR, I. **Features of psittacine birds in captivity: focus on diet selection and digestive characteristics**. Merelbeke, Belgium: Ghent University, 2011.

KALMAR, I. D.; VEYS, A. C.; GEEROMS, B.; REINSCHMIDT, M.; WAUGH, D.; WERQUIN, G.; JANSSENS, G. P. J. Effects of segregation and impact of specific feeding behaviour and additional fruit on voluntary nutrient and energy intake in yellow-shouldered amazons (Amazona barbadensis) when fed a multi-component seed diet ad libitum. **Journal of Animal Physiology and Animal Nutrition**, v. 94, n. 6, dez. 2010.

KOLLIAS, G. V; KOLLIAS, H. W. Feeding Passerine and Psittacine Birds. *Em*: HAND, M. S.; THATCHER, C. D.; REMILLARD, R. L.; ROUDEBUSH, P.; NOVOTNY, B. J. **Small Animals Clinical Nutrition**. 5th. ed. Topeka: Mark Morris Institute, 2010. p. 1255–1269.

LUMEIJ, J. Hepatology. *Em*: **Avian medicine: principles and application**. Florida: Wingers Publishing, 1994. p. 523–537.

MACHADO, D. N.; LOPES, E. S.; ALBUQUERQUE, A. H.; HORN, R. v.; BEZERRA, W. G. A.; SIQUEIRA, R. A. S.; LOPES, I. T.; NUNES, F. P.; TEIXEIRA, R. S. C.; CARDOSO, W. M. Isolation and antimicrobial resistance profiles of enterobacteria from nestling grey-breasted parakeets (Pyrrhura griseipectus). **Revista Brasileira de Ciencia Avicola**, v. 20, n. 1, p. 103–110, 1 jan. 2018.

MARINI, M. A.; GARCIA, F. I. Bird Conservation in Brazil. **Conservation Biology**, v. 19, n. 3, p. 665–671, 2005.

MARQUES, A. R.; LIMA, B. P.; TEIXEIRA, R. S. C.; ALBUQUERQUE, Á. H.; LOPES, E. S.; MACIEL, W. C.; BELEZA, A. J. F.; ALENCAR, T. R. Zoonotic bacteria research and analysis of antimicrobial resistance levels in parrot isolates from pet shops in the city of

Fortaleza, Brazil. **Pesquisa Veterinaria Brasileira**, v. 41, 2021.

MARTIN, L. F. **Retrospective study on the species distribution and common diseases inexotic pets presented to the Clinic for Zoo Animals, Exotic Pets and Wildlife, University of Zurich from 2005 to 2014**. 2018. University of Zurich, Zurich, 2018.

MATTIELLO, R. **EMERGENCIAS EN AVES DE COMPAÑÍA**. Buenos Aires: Facultad de Ciencias Veterinarias-UBA, Argentina, 1995.

MCCARTNEY, W. T. Orthopedic injuries in pigeons. **The Veterinary record**, v. 134, n. 2, p. 305–307, 1994.

MENCH, J.; PAUL-MURPHY, J.; KLASING, K.; CUSSEN, V. True parrots (Psittacoidea). *Em*: JAMES YEATES. **Companion Animal Care and Welfare: The UFAW Companion Animal Handbook**. Sussex, UK: John Wiley & Sons Ltd, 2018. p. 338–355.

MLADENOV, G.; POPOVA, T. P. Problematic infections in parrots - streptococcal and enterococcal infections, diagnostics and control. **Tradition and modernity in veterinary medicine**, v. 5, n. 1, p. 65–72, 2020.

MONTESINOS, A.; SANDMEIER, P.; ARCA-RUIBAL, B.; BEAUFRERE, H.; SANCHEZ-MIGALLON, D.; SAGGESE, M. 13. Systemic Diseases: Disorders of the Integument. *Em*: SAMOUR, J. **Avian Medicine.** Missouri: Mosby, 2016. p. 359–433.

MORISHITA, T. Y.; FULLERTON, A. T.; LOWENSTINE, L. J.; GARDNER, I. A.; BROOKS, D. L. Morbidity and Mortality in Free-Living Raptorial Birds of Northern California: A Retrospective Study, 1983-1994. **Journal of Avian Medicine and Surgery**, v. 12, n. 2, p. 78–81, jun. 1998. Disponível em: <https://www.jstor.org/stable/30133153>.

MURER, L. **Estudo Retrospectivo De Laudos de Necropsias em Animais Domésticos e**

Silvestres do LCDPA -julho de 2018 A dezembro de 2019 A 2020. 2020. Universidade Federal de Santa Maria, Santa Maria, 2020.

MURPHY, J. P.; KOCH, V. W.; BRISCOE, J. A.; VINKE, C. M.; SCHOEMAKER, N. J.; MEIJBOOM, F. L. B.; VAN ZEELAND, Y. R. A.; ENDENBURG, N.; GREENACRE, C. B. Advancements in Management of the Welfare of Avian Species. *Em*: SPEER, B. **Current Therapy in Avian Medicine, and Surgery**. Missouri: Elsevier, 2016. p. 669–720.

NEMETH, N. M.; GONZALEZ-ASTUDILLO, V.; OESTERLE, P. T.; HOWERTH, E. W. A 5-Year Retrospective Review of Avian Diseases Diagnosed at the Department of Pathology, University of Georgia. **Journal of Comparative Pathology**, v. 155, n. 2–3, p. 105–120, 1 ago. 2016.

PERLMAN, J. Nutrition and Nutritional Management. *Em*: SAMOUR, J. **Avian Medicine**. Missouri: Elsevier Health Sciences, 2015. p. 25–35.

PETZINGER, C.; BAUER, J. E. Dietary considerations for atherosclerosis in common companion Avian species. **Journal of Exotic Pet Medicine**, v. 22, n. 4, p. 358–365, out. 2013.

PHALEN, D. N. Implications of viruses in clinical disorders. *Em*: HARRISON, G. J.; LIGHTFOOT, T. L. **Clinical Avian Medicine**. Florida: Spix Publishing, 2005. p. 573–586.

PIACENTINI, V. de Q.; ALEIXO, A.; AGNE, C. E.; MAURÍCIO, G. N.; PACHECO, J. F.; BRAVO, G. A.; BRITO, G. R. R.; NAKA, L. N.; OLMOS, F.; POSSO, S.; SILVEIRA, L. F.; BETINI, G. S.; CARRANO, E.; FRANZ, I.; LEES, A. C.; LIMA, L. M.; PIOLI, D.; SCHUNCK, F.; AMARAL, F. R.; BENCKE, G. A.; COHN-HAFT, M.; FIGUEIREDO, L. F. A.; STRAUBE, F. C.; CESARI, E. Annotated checklist of the birds of Brazil by the Brazilian Ornithological Records Committee / Lista comentada das aves do Brasil pelo Comitê Brasileiro de Registros Ornitológicos. **Revista Brasileira de Ornitologia**, v. 23, n. 2, p. 91–

298, 2015.

RAHMAWATI, I. P. A Retrospective Study of Morbidity In Captive Columbiformes Housed In Bristol Zoo Gardens And Wild Place Project, United Kingdom From 2000-2017. **Open Acces Int. J. Trop. Vet. Biomed. Res**, v. 3, n. 1, p. 17–24, 2018. Disponível em: <www.jurnal.unsyiah.ac.id/IJTVBR>.

RICKLEFS, R. E.; RICKLEFS, R. E. Intrinsic aging-related mortality in birds. **JOURNAL OF AVIAN BIOLOGY**, v. 31, n. 2, p. 103–111, jun. 2000.

RITCHIE, B. W.; HARRISON, G. J.; HARRISON, L. R. **Avian medicine: principles and application**. Lake Worth, Fla.: Wingers Pub, 1994. 1384 p.

RITCHIE BW. **Avian Viruses: Function and Control.** Lake Worth: Wingers Publishing, 1997.

SAAD, C. E. do P.; FERREIRA, W. M.; BORGES, F. M. de O.; BOSCOLI, L. L. AVALIAÇÃO NUTRICIONAL DE RAÇÕES COMERCIAIS E SEMENTE DE GIRASSOL PARA PAPAGAIOS-VERDADEIROS (Amazona aestiva) Nutricional evaluation of commercial foods and sunflower seed for blue-fronted parrot (Amazona aestiva). **Ciência e Agrotecnologia**, n. 5, p. 1493–1499, 2007.

SÁNCHEZ, G. F.; LEDESMA, R. I.; MORALES, S. E. A retrospective study of neoplasms in ornamental and pet birds diagnosed at the Hospital de Aves of the Universidad Nacional Autónoma de México (2007-2014). **Brazilian Journal of Veterinary Pathology**, v. 13, n. 1, p. 1–11, 2020.

SANTOS, G. G. C.; MATUELLA, G. A.; CORAIOLA, A. M.; SILVA, C. S.; LANGE, R. R.; C, A. S. G.; MATUELLA, G. A.; CORAIOLA, A. M.; SILVA, L. C.; LANGE, R. R. Doenças de aves selvagens diagnosticadas na Universidade Federal do Paraná (2003-2007) 1.

v. 28, n. 11, p. 565–570, 2008.

SCHEFFERS, B. R.; OLIVEIRA, B. F.; LAMB, I.; EDWARDS, D. P. Global wildlife trade across the tree of life. **Science**, v. 366, n. 6461, p. 71–76, 2019. Disponível em: <https://www.science.org>.

SHI-YEE HUNG, C.; SLADAKOVIC, I.; DIVERS, S. J. Diagnostic value of plasma biochemistry, haematology, radiography and endoscopic visualisation for hepatic disease in psittacine birds. **Veterinary Record**, p. 1–8, 2019. Disponível em: <http://veterinaryrecord.bmj.com/>.

SICK, H.; HAFFER; JÜRGEN; ALVARENGA, H. F.; PACHECO, J. F.; BARRUEL, P. **Ornitologia brasileira**. Rio de Janeiro: Nova Fronteira, 1997. 912 p.

SILVA, A. S. G.; RASO, T. F.; COSTA, E. A.; GÓMEZ, S. Y. M.; DA SILVA MARTINS, N. R. Parrot bornavirus in naturally infected brazilian captive parrots: Challenges in viral spread control. **PLoS ONE**, v. 15, n. 6, 1 jun. 2020.

SINHORINI, J. A. **Neoplasias em aves domésticas e silvestres mantidas em domicílio_ avaliação anatomopatológica e imunoistoquímica**. 2008. Universidade de São Paulo, 2008.

SMITH, K. A.; CAMPBELL, G. D.; PEARL, D. L.; JARDINE, C. M.; SALGADO-BIERMAN, F.; NEMETH, N. M. A retrospective summary of raptor mortality in Ontario, Canada (1991–2014), including the effects of West Nile virus. **Journal of Wildlife Diseases**, v. 54, n. 2, p. 261–271, 1 abr. 2018.

STAHL, S.; VM, D.; KRONFELD, D.; CVIM, D. A.; CVN, D. A. Veterinary Nutrition of Large Psittacines. **Seminars in Avian and Exotic Pet Medicine**, v. 7, n. 3, p. 128–134, 1998.

STANFORD, M. Significance of cholesterol assays in the investigation of hepatic lipidosis and atherosclerosis in psittacine birds. **ExoticDVM**, v. 7, n. 3, p. 28–34, 2005.

ULLREY, D. E.; ALLEN, M. E.; BAER, D. J. Formulated Diets versus Seed Mixtures for Psittacines. **The Journal of Nutrition**, v. 121, n. suppl_11, p. S193–S205, 1 nov. 1991. Disponível em: <https://doi.org/10.1093/jn/121.suppl_11.S193>.

VANSTREELS, R. E. T.; TEIXEIRA, R. H. F.; CAMARGO, L. C.; NUNES, A. L. V.; MATUSHIMA, E. R. Impacts of animal traffic on the Brazilian Amazon parrots (Amazona species) collection of the Quinzinho de Barros Municipal Zoological Park, Brazil, 1986-2007. **Zoo Biology**, v. 29, n. 5, p. 600–614, set. 2010.

VOGELNEST, L.; TALBOT, J. J. Quality-of-Life Assessment and End-of-Life Planning for Geriatric Zoo Animals. **Fowler's Zoo and Wild Animal Medicine Current Therapy,** , v. Volume 9, p. 83–91, 2019.

WELLE, K. R. Body condition scoring in companion birds. Em: **Proceedings of Association of Avian Veterinarians Conference and Expo**, 1995, Philadelphia. [...]. Philadelphia: 1995. p. 487–490.

WENKER, E. S.; KENDRICK, E. L.; MASLANKA, M.; POWER, M. L. Fat scoring in four sparrow species as an estimation of body condition: a validation study. **Journal of Field Ornithology**, v. 93, n. 2, 2022.

WILDMANN, A. K.; CUSHING, A. C.; PFISTERER, B. R.; SULA, M. J. M. Retrospective Review of Morbidity and Mortality in a Population of Captive Budgerigars (Melopsittacus undulates). **Journal of Zoo and Wildlife Medicine**, v. 53, n. 2, p. 433–441, 1 jun. 2022.

WRIGHT, T. F.; TOFT, C. A.; ENKERLIN-HOEFLICH, E.; GONZALEZ-ELIZONDO, J.; ALBORNOZ, M.; RODRÍGUEZ-FERRARO, A.; ROJAS-SUÁREZ, F.; SANZ, V.; TRUJILLO, A.; BEISSINGER, S. R.; BEROVIDES, V. A.; GÁLVEZ, X. A.; BRICE, A. T.;

JOYNER, K.; EBERHARD, J.; GILARDI, J.; KOENIG, S. E.; STOLESON, S.; MARTUSCELLI, P.; MICHAEL MEYERS, J.; RENTON, K.; RODRÍGUEZ, A. M.; SOSA-ASANZA, A. C.; VILELLA, F. J.; WILEY, J. W. Nest Poaching in Neotropical Parrots. **Conservation Biology**, v. 15, n. 3, jun. 2001.

YOUNG, A. M.; HOBSON, E. A.; LACKEY, L. B.; WRIGHT, T. F. Survival on the ark: Life-history trends in captive parrots. **Animal Conservation**, v. 15, n. 1, p. 28–43, fev. 2012.

ZULIAN, V.; MILLER, D. A. W.; FERRAZ, G. Endemic and threatened Amazona parrots of the Atlantic Forest: An overview of their geographic range and population size. **Diversity**, v. 13, n. 9, 1 set. 2021.

CAPÍTULO 2

5. CAPÍTULO 2: PREVALENCE OF METABOLIC DISEASES AND ASSOCIATE RISK FACTORS IN CAPTIVE AMAZON PARROTS

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ABSTRACT

Amazon parrots have been anecdotally described as susceptible to a wide range of spontaneous metabolic disorders and lesions resulting from excessive lipid accumulation; nevertheless, epidemiologic information is scarce. A ten-year retrospective study on 1033 clinical records and 84 postmortem reports from amazon parrots was conducted by recording the final diagnoses, age, sex, body condition score, and diet of each bird. The prevalence of metabolic diseases and lipid metabolism-related disorders was reported. The chi-square test was used to triage variables, and the variables with a p-value ≤ 0.20 were included in multiple logistic regression analyses to explore the association between the outcomes metabolic disease, lipid-related lesions, and obesity and the variables sex, health status, diet, body condition score, and age group which represented the risk factors. Metabolic disorders were the most common cause of morbidity (n=189/512; 36.91%) and mortality (n=11/32; 34%) within the noninfectious disease group (n=512/986) affecting captive neotropical parrots with the most common metabolic subprocess being lipidosis (n=56/189; 29.6%) followed by hepatic lipidosis suspect (n=45/189; 23.8%) and obesity (n=29/189; 15.3%). Parrots with a non-ideal body condition score were found to be more susceptible to developing a metabolic disorder (p<0.05), and this chance gets relevantly higher for obese individuals (OR, 4.13, 95% CI, 2.2- 7.6; p<0.05). Health status and age group were observed to be a potential risk factors, where non-juvenile birds and birds with more than one diagnosed disorder were found to have more probability of developing lipid-related disorders than juvenile and healthy parrots (p<0.05). Our findings, confirm the high prevalence of metabolic disorders in captive amazon parrots and this epidemiological data that may be useful to avian clinicians, and pathologists, working with this species.

KEYWORDS: neotropical parrots, captivity, metabolic, nutrition, obesity, Amazona spp.

5.1. INTRODUCTION

Amazon parrots are medium to large size, short-tailed psittacines belonging to the *Amazona* genus. This genus contains approximately thirty-six species (depending on the classification), the majority of which have a green body with different colored heads, wings, and tails (SICK *et al.*, 1997). These neotropical parrots are native to South America, Central America, and the Caribbean, and they are among the most common species in Brazil, being found in all biomes (IUCN, 2022).

As a result, of their popularity as pets, the worldwide demand carried out an international movement of nearly nineteen million birds over the last 45 years (CITES, 2022b). To supply this illegal parrot trade, individuals are captured from nature, mainly through the poaching of nestlings, which is the primary cause of population decline (WRIGHT *et al.*, 2001). The exotic pet trade also brings a growing number of these birds being maintained in diverse types of captive environments, not just as pets and aviary collections but also in screening, conservation, and rehabilitation centers and zoos, as occurs in Brazil (FORSHAW, 2017; LOPES; LAMA; DEL LAMA, 2007).

It is well known that birds kept in captivity face quite different environmental requirements from their wild conspecifics, especially regarding nutrition (KALMAR, 2011). For confined parrots, seed-based diets, and blends are widely used as the main sustenance element, due to their great palatability, low cost, and large availability (KOUTSOS; GELIS; ECHOLS, 2016; PÉRON; GROSSET, 2014).

It has been widely reported that seed diets as the only source of food are imbalanced in amino acids, contains excessive amounts of fat, and are deficient in essential elements like minerals sodium, calcium, manganese, phosphate, iron, zinc, selenium, and iodine and as well in vitamins A, D, K, B-12, riboflavin, pantothenic acid, choline, and niacin. However, many caregivers erroneously believe that they offer suitable nutrition. Several avian health issues have been linked to such deficits, such as hypocalcemic convulsions, egg binding, renal illness, nutritional secondary hyperparathyroidism, gout, skin, and feather anomalies, and immunodeficiencies (KOUTSOS; MATSON; KLASING, 2001; OROSZ, 2014; PERLMAN, 2015; PÉRON; GROSSET, 2014; PERPIÑÁN, 2015).

Additionally, the excessive fat content in these diets fed to largely inactive birds moreover contribute to problems such as obesity, fatty liver disease, cardiac disease, atherosclerosis, and other lipid metabolism-related problems (OROSZ, 2014; PERPIÑÁN, 2015).

Other common commercial parrot diets contain mixtures of dried fruits and vegetables, seeds, and pellets in varied sizes (KOUTSOS; MATSON; KLASING, 2001). But because of parrots' well-documented selective eating behavior, the nutrients consumed by the birds are limited in these mixtures (BRIGHTSMITH, 2012; KALMAR *et al.*, 2010)

Among the variety of food types offered to pet parrots, table foods and homemade diets are quite common but often imbalanced and normally contain commercial ingredients lacking in nutrients when compared to foods found in a parrot's natural environment (BRIGHTSMITH, 2012; ENGEBRETSON, 2006; PÉRON; GROSSET, 2014; STAHL *et al.*, 1998).

Malnutrition is a major contributor to health issues in captive psittacine birds and its manifestation often remains subclinical for long periods but can become life-threatening over time. Furthermore, poor nutrition may adversely impact natural defense barriers and suppress the immune system, making the birds more vulnerable to infectious diseases (HARRISON, 1998).

Several publications corroborate medium to high prevalence in captive psittacines in Europe, north and south America, but no genera-specific studies are published. The most commonly reported metabolic disorders are malnutrition, hypovitaminosis A, obesity, and non-infectious hepatopathies (BRIGHTSMITH, 2012; GIBSON *et al.*, 2019; HARCOURT-BROWN, 2010; MARTIN, 2018; OROSZ, 2014; SPEER *et al.*, 2016; VANSTREELS *et al.*, 2010; WILDMANN *et al.*, 2022).

Within the metabolic disease group, a particular category recognized as lipid-related disorders has been widely reported and some parrot species seem to be more prone to developing them. These disorders are either directly related to dyslipidemia alterations or secondarily through metabolic dysfunction of broad metabolic pathways. In neotropical parrots, the reported conditions of this group include common diseases such as atherosclerotic diseases, fatty tumors such as lipoma and liposarcoma, xanthomas, hepatic lipidosis, obesity, and less common conditions such as corneal lipidosis, renal lipidosis, systemic xanthogranulomatous, and many others (BEAUFRÈRE *et al.*, 2014, 2019; BRIGHTSMITH, 2012; COWAN, 2017; GUSTAVSEN *et al.*, 2016; LEVINE, 2003).

In avian medicine, obesity is the most prevalent and serious metabolic disorder seen. It starts to develop when the dietary energy content is insufficient to meet the energy demands of regular metabolic functions as well as the energy consumed (HARRISON; RITCHIE; HARRISON, 1994).

In the wild, parrots can fly hundreds of miles per day and spend at least half their waking hours foraging (LIGHTFOOT; NACEWICZ, 2006). Contrary to this, captive parrots are usually housed in cages or aviaries and provided with food. According to previous research, when caged alone, orange-winged parrots (*Amazona amazonica*), were inactive 90% of the time they were awake (ROZEK *et al.*, 2010).

A working definition of obesity for domestic mammal pets was proposed as between 10 and 20% or more above over ideal body weight (TOLL *et al.*, 2010). The estimated prevalence of overweight and obesity in dogs ranges between 18 and 44% depending on the dog populations studied and, on the evaluation, techniques used (COLLIARD *et al.*, 2006; MCGREEVY *et al.*, 2005; ROBERTSON, 2003; TOLL *et al.*, 2010).

In cats, studies conducted in a variety of countries revealed a prevalence of overweight and obesity ranging from 6 to 52% (ALLAN *et al.*, 2000; COLLIARD *et al.*, 2009; LUND *et al.*, 2005). Figures for avian pets are lacking and no study of this type has been published.

Obesity in companion birds is mostly caused as a result of multiple factors such as feeding excessive amounts of inappropriate foods or high oil seeds, a lack of exercise, and increased food intake due to boredom (ENGEBRETSON, 2006; KOLLIAS; KOLLIAS, 2010; KOUTSOS; MATSON; KLASING, 2001).

Risk factors are an individual’s quantifiable traits that predict how likely it is for them to develop clinical disease. This concept does not imply a connection through cause but suggests that risk factors must occur before the disease (FUSTER; TOPOL; NABEL, 2005). Of all metabolic diseases, only atherosclerosis has been epidemiologically thoroughly investigated among psittacine birds. In humans, risk factors for the atherosclerotic disease include lifestyle (alcohol and tobacco intake, stress, physical activity, stress, and obesity) biochemical and physiological abnormalities, and personal factors such as genetics, sex, and age (ECKARDSTEIN, 2005; FUSTER; TOPOL; NABEL, 2005).

In birds, genetic risk factors are present in quails and in White-Carneau pigeons that are particularly prone to trial atherosclerosis (SAXENA *et al.*, 1990; SHIH; PULLMAN; KAO, 1983). In parrots, predisposed species have been proposed, and age, diet, and dyslipidemia are frequently mentioned as potential risk factors (BAVELAAR; BEYNEN, 2004; BEAUFRÈRE *et al.*, 2014; FRICKE *et al.*, 2009), but these have not been confirmed by studies that used a large representative parrot sample and robust statistical methods.

The aim of this retrospective study was to report the prevalence and basic epidemiological risk factors associated with metabolic disorders in captive Amazon parrots, admitted to the Avian Ambulatory Service and/or to the Animal Pathology Service from the

Veterinary Teaching Hospital (HOVET) and Veterinary Pathology Department (VPT) of the University of São Paulo, School of Veterinary Medicine, and Animal Science (USP-FMVZ), between January 2009 and December 2019.

5.2. METHODS

5.2.1. Study population

Original medical records and post-mortem reports from psittacine birds of the Amazona genus species (LESSONS,1830) admitted to the Avian Ambulatory Service and Animal Pathology from the Department of Veterinary Pathology (VPT) and HOVET/FMVZ-USP, between January 2009 and December 2019 were reviewed.

5.2.2. Data extraction and database formatting

Clinical and post-mortem data from patient medical records and necropsy reports were retrieved and compiled into a computerized database, created using Microsoft® Excel 2017, to include, for each case, demographic data such as individual record serial number, given by the hospital register system, species, using the scientific nomenclature which for species of birds occurring in Brazilian territory followed the Brazilian committee of ornithological records (CBRO, 2014), and for species of international occurrence followed The World Bird Database (AVIBASE, 2023) sex and age. As amazon parrots are nondimorphic species, sex was determined in some cases through historic, DNA sexing, or at postmortem examination.

Age was considered as the one reported by the caregivers when available and then delimited into four categories: “chick”, “juvenile”, “adult”, and “senior”, in accordance with the age at sexual maturity and the average lifespan for the genus (SICK *et al.*, 1997; YOUNG *et al.*, 2012). Furthermore, consultation and clinical exam-related variables as well as final diagnoses were gathered. More detailed information about the demographic data extraction is found in chart 1.

Chart 1- Individual criteria and short descriptions used for demographic data collection.

Criteria	***Description***	
Id	Individual record serial number	Given by the hospital register system
Species	Binominal scientific name	
	If the species was not specified but the popular name coincided with the genus it was classified as unspecified	When identifying the taxonomic genus of the bird was not possible, records were not considered
Sex	Male/ female	Identified through historic, DNA sexing, or postmortem examination

	When the sex was not possible to identify it was classified as undetermined	
Age	Age at the time of consultation reported by the caregiver	When an estimate of the age was not reported, it was classified as unspecified
Age category	Chick	Hatch to fledging: 0 to 5 months
	Juvenile	After fledging to achieve sexual maturity: 5 months to 5 years
	Adult	Sexual maturity to average lifespan: 5 to 45 years
	Senior	Older than average lifespan: older than 45 years

Consultation-related variables assembled were submission date, origin, consultation emergency, and presenting complaint. These two last ones were not included for birds presented dead at submission. For the submission date, the year was divided into seasons. For the origin category, three subdivisions were created, and this included 'household environment' which means the animal submitted came as a pet driven by its caregiver. 'Sao Paulo wildlife screening center's (CETAS)’, which means these individuals were captive at these centers and may have origins such as illegal wildlife trade, apprehensions made by the Environmental Military Police, Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA), Civilian, Municipal and Federal Police inspections; or could be rescued by the City Hall, Fire Departments, Urban Parks, Private Companies or even brought by common citizens, to these centers. Third option within this category, is 'breeding facilities'. As Brazilian policies allowed the breeding of this species for commercial and noncommercial porpoises and there was not always complete information available about it, they were grouped in this category.

The type of consultation included nonurgent consultation such as 'checkup consultations' for animals submitted for routinary tests as preventive health evaluation, handling corrections, and other processes such as clipping wings, trimming nails, or sexing DNA tests. 'Scheduled consultations' included those when the bird presents some notable signs of diseases or behavioral alterations, leading to the responsibility to look after medical attention and report these symptoms. The last classification is 'emergency consultation' for animals submitted to the hospital without previous scheduling because of the acute presentation of the symptoms or the suspect of the life of the patient to be compromised.

As presenting complaints, where analyzed the caregivers reported symptoms and the clinical exam described signs. A maximum non-established number of entries were recorded and then grouped into ten categories: cloacal prolapse, neurological symptoms, abnormal mass, respiratory symptoms, coelomic distension, gastrointestinal disorder, trauma-related symptoms, musculoskeletal symptoms, behavioral disorder, dermatologic alteration, ocular symptoms, and nonspecific acute symptoms. Detailed information about the collection of data related to the consultation is found in chart 2.

Chart 2 - Individual criteria and short description used to collect variables related to consultation.

Criteria	***Description***	
Submission date	Spring	October to December
	Summer	January to March
	Autumn	April to June
	Winter	July to September
Origin	Household environment	The animal submitted came as a pet drive by its caregiver
	Wildlife screening centers	Individuals were captive at these centers and may have different origins
	Breeding facilities	Allowed facilities with commercial and noncommercial porpoises
Type of consultation	Checkup	Birds submitted for a preventive health evaluation, apparently healthy individuals
	Scheduled consultations	Apparently sick individuals lead to the bird's caregiver to look after medical attention
	Emergency consultation	Animals submitted to the hospital without previous scheduling
Presenting complaint	Cloacal prolapse	External visualization of inner tissue protrudes through the vent opening
	Neurological symptoms	Seizures, ataxia, head tilt, irresponsive state of consciousness
	Abnormal mass	Presences of an outgrowing mass
	Respiratory symptoms	Sneeze, wheeze, cough, nasal discharge, dyspnea, tail bobbing, periocular swelling
	Coelomic distension	Referrals as the swollen abdomen or homogeneous distension of the ventral coelomic cavity
	Gastrointestinal disorder	Diarrhea, melena, biliverdinuria, and other droppings alterations in color, quantity, and aspect, regurgitation, vomiting, chronic anorexia
	Trauma-related symptoms	Symptoms reported after a traumatic episode history as bleeding, injuries, cuts, wounds, lacerations, and evident fractures
	Musculoskeletal symptoms	Alterations in perching, sore feet, and wings, lameness, reluctance to walk, or fly
	Behavioral disorder	Screaming, biting, self-mutilation, excessively flapping wings, aggressiveness or regurgitation tower-specific members, masturbation
	Dermatologic alteration	Abnormal feather structure or development, changes in feather color, feather loss without picking, feather picking, overgrown beak and or claws, lesions of the feet, peeling, pruritus, and stress bars
	Ocular symptoms	Swollen, red eyes, eye or nostril discharge, facial swelling, sensitivity to light, cloudy or glassy eyes, blepharospasm, blindness
	Nonspecific acute symptoms	Lethargy, weakness, anorexia

The clinical exam variables collected were general condition, subclassified into active, moderately depressed, severely depressed, and dead. Body condition score was entered as ranked by the clinician or pathologist, following the traditional five-point system proposed by Welle (1995), where BCS is determined by palpation of the muscles and fat coverage of the sternum. The scale guide stablishes a score from 1 (as the less) to 5, being cachectic, lean, ideal, overweight, and obese (WELLE, 1995). Body weight in grams, and main diet component as the elements offered on the regular basis, reported by the owners/caregivers, were all assessed and then arrayed, into four categories (HESS; MAULDIN; ROSENTHAL, 2002; STAHL *et al.*, 1998) described in chart 3.

Chart 3 - Individual criteria and short description used to extract and code variables related to the clinical exam.

Criteria	***Description***		
General condition	Active		This classification was obtained through analyses of caregivers reports, symptoms and physical examination observations registered on every bird clinical record
	Moderately depressed		
	Severely depressed		
	Dead		
Body condition score (BCS)	1	Emaciated	If BCS was not specified in the clinical record, the necropsy report, or some complementary diagnostic test like *radiography, BCS was classified as missing*
	2	Lean	
	3	Ideal	
	4	Overweight	
	5	Obese	
Body weight (BW)	BW in grams at clinical examination		If BW was not recorded it was classified as unspecified
Main diet	Seed mixture		Commercial mixtures based on birdseed, peanuts, and sunflower
	Formulated diet		Report diets as hand-feeding formula, and ´´ração´´, giving the intention of proper commercial parrot food
	Fruits and vegetables		Apple, banana, orange, berries, broccoli, carrot, capsicum, corn cabbage, beetroot, beans, cucumber, and other common greens consumed by humans, either raw or cooked
	Human food		Industrialized products as cheese, milk, coffee, cookies, crackers and table food as bread, beans, rice, pasta, and any other type of cooked and seasoned food for human consumption or natural foods cooked and seasoned

5.2.3. Final diagnoses

All final diagnoses for each bird were ranked to indicate the relative importance in causing disease and were coded as a “primary” or “non-primary” disease process, and then broadly coded by etiological ‘disease process’ and ‘body system’ affected (GIBSON *et al.*, 2019; MARTIN, 2018; NEMETH *et al.*, 2016; SMITH *et al.*, 2018; WILDMANN *et al.*, 2022). The primary cause of morbidity was defined as the main condition responsible for the bird’s need for treatment (GIBSON *et al.*, 2019). When several possible causes were identified in the same bird, clinical history and complementary studies were critical to determine the primary cause of morbidity. Non-primary disease processes were concomitant diagnosed process that could be contributory to disease, but not the primary cause of it.

Causes of morbidity and mortality were classified according to etiological disease process into infectious, non-infectious, and unknown (GIBSON *et al.*, 2019; MORISHITA *et al.*, 1998; RAHMAWATI, 2018; SMITH *et al.*, 2018; WILDMANN *et al.*, 2022). The noninfectious category was subdivided into degenerative, metabolic, hemodynamic, physical, neoplastic, non-neoplastic, toxic and hypersensitivity.

For this study the metabolic diagnoses were selected, and this group included atherosclerosis (KOUTSOS; GELIS; ECHOLS, 2016), diabetes (BANDYOPADHYAY, 2017; GANCZ *et al.*, 2007; SITBON *et al.*, 1980; WALLIS; RAFFAN, 2020), gout (SPEER *et al.*, 2016), hemosiderosis (PERPIÑÁN, 2015), hypothyroidism, vitamin A deficiency (HARRISON; MCDONALD, 2006; HENSEL, 2010), hepatic lipidosis and other organs

(GRUNKEMEYER, 2010; LAPINHA, 2022; STANFORD, 2005), nutritional secondary hyperparathyroidism (HOPPES, 2022), nutritional deficiency and obesity (GIBSON *et al.*, 2019; KOUTSOS; GELIS; ECHOLS, 2016; PERLMAN, 2015). The sources used to assign the categories mentioned above were the physical examination carried out by the veterinarian at the time of admission; information from the caregiver's reports, the case history; and when available, complementary studies such as radiology, hematology, blood chemistry, cytology, gross pathology, histopathology, microbiology and parasitology.

The ‘unknown category was applied when after the diagnostic studies the cause could not be determined, or the studies were insufficient to specify the cause of morbidity or mortality. In order to use to the best advantage of the data and to provide material for future for future associations, each final diagnosis was also widely categorized by the 'body system' affected.

5.2.4. Statistical analysis

The prevalence of demographic information, illness processes/subprocesses, and afflicted body systems were all described using descriptive statistics. Because most birds had multiple final diagnoses, the total amount of all disease processes was greater than the number of birds in the database. Estimates of disease prevalence were expressed as the proportion of birds in the database affected by at least one of a given disease process or subprocess (n= 791). Primary disease processes were also described out of the total number of birds. For the purposes of this study, 'prevalence’ refers to the frequency observed in the given population submitted for clinical and postmortem examination, since necropsy reports could identify multiple diseases processes in a singular individual, two categories were stablished, those process identified as the cause of dead were categorized as ´´mortality´´, so they can be used to describe mortality rates, and were also included in the overall prevalence count of disease presentation. For processes diagnosed postmortem and that could contribute but not cause the death of the animals, were categorized as ´´morbidity´´ since they were also affecting the bird.

A univariate analysis was performed to explore the association between the outcome metabolic disease, lipid related lesions, and obesity and the variables sex, obesity, health status, diet, body condition score, and age group which represented the risk factors to be associated (for better understating outcome and risk factors are explain in tables 1 and 2). Here, the chi-square test was used to triage each variable, while the variables with a p-Value ≤ 0.20 were included in multiple logistic regression analysis. The final multivariate logistic regression model was fitted by using backward elimination. In both univariate and multivariate model approaches, the regression coefficient with their 95% confidence interval (CI 95%) was exponentiated to access odds ratio values.

The software for the statistical analysis was the R statistical software v. 4.1.1 (R CORE TEAM, 2021) with RStudio editor using the following packages: tidyverse (WICKHAM *et al.*, 2019), and epiR (STEVENSON et al., 2020).

Table 1. Outcomes Variables.

Subset	*Description*
Metabolic disease	Birds with metabolic diseases diagnoses as primary cause of morbidity
Lipid related lesions	Included only specific histopathological diagnoses commonly related to lipid dysmetabolism, were coded as separate binary variables (i.e., present or absent). Binary variables included the following: hepatic lipidosis, atherosclerosis, xanthoma, lipoma or liposarcoma, splenic lipidosis, renal lipidosis and corneal lipid deposition (Suspected lipidosis was not included)
Obesity	All birds with obesity diagnose as primary or concomitant disease

Table 2. Variables tested as risk factors.

Variables	*Description*	*Control group*
Sex	Male and female	Male
Health status	This binary variable included the presence or absence of a concomitant disease at the time of examination	The criterion for control selection was to be a parrot from the genera and to be healthy at clinical examination, for that reason, birds presented to the hospital for routine checkups with no symptoms of diseases were used
Diet	Seed mixture, fruits and vegetables, human food	Formulated diet
Body condition score	1,2,4,5	3
Age group	Chick, adult, senior	Juvenile
Obesity	present	absent

5.3. RESULTS

Demographic data

A total of 872 (753 alive and 119 dead) amazon parrots were admitted to the Avian Clinical service and Animal Pathology of the Department of Pathology (VPT) and HOVET/FMVZ-USP, between January 2009 and December 2019, but only information from 791 birds (707 alive and 84 dead) was available and included in this study. From the live birds that attended to the Avian Ambulatory Service, a total of 1033 clinical records were reviewed and from these, 877 morbidity causes were identified. From the 84 postmortem reports, 109 diagnoses were registered (84 causes of mortality and 25 of morbidity).

Most of the clinical records belonged to birds from household environments, kept as pets (n=1013; 98.0%) followed by birds from breeding facilities (n=13;1.2%). At postmortem reports, origin of the birds was similarly represented, being most of the diagnoses from pet birds (n=61; 55.96%) but in this scenario followed by animals from wild animal screening centers (n=35; 32.11%).

Nine species from the genera were represented, with the most common species being *A. aestiva* (n=676; 85.46%) and *A. amazonica* (n=71; 8.97%). Less common admissions included *A. rhodocorytha* (n=10; 1.26%), *A. farinosa* (n=8; 1.0%), *A. xanthops* (n=4; 0.5%), *A. ochrocephala* (n=3; 0.37%), *A. oratrix* (n=2; 0.25%), *A. festiva* (n=2; 0.25%), and *A. vinacea* (n=1; 0.1%). Females (n=176; 15.41%) were slightly more represented than males (n=107; 9.36%), and 859 birds (75.21%) had unidentified sex. Adults were the most common age category (n=838; 73.38%) followed by juveniles (n=201; 17.6%), chicks (n=37; 3.2%), and seniors (n=32; 2.97%); age data were not recorded for 32 birds (2.8%).

The dietary profile of amazon parrots kept in captivity observed in the study period is shown in figures 1 and 2.

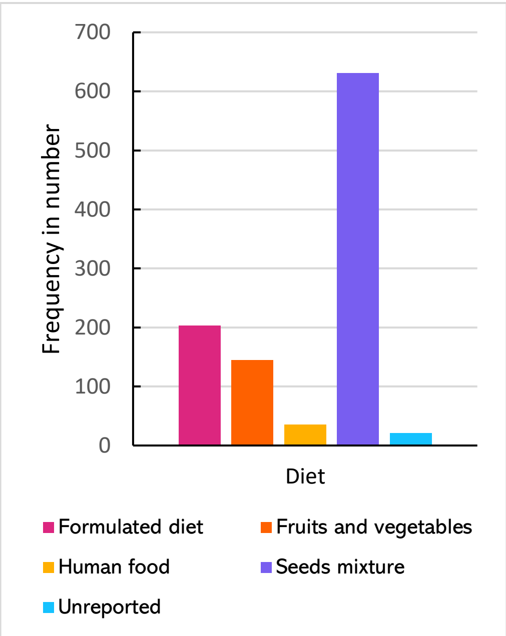

Figure 1 - General dietary profile overserved in the study.

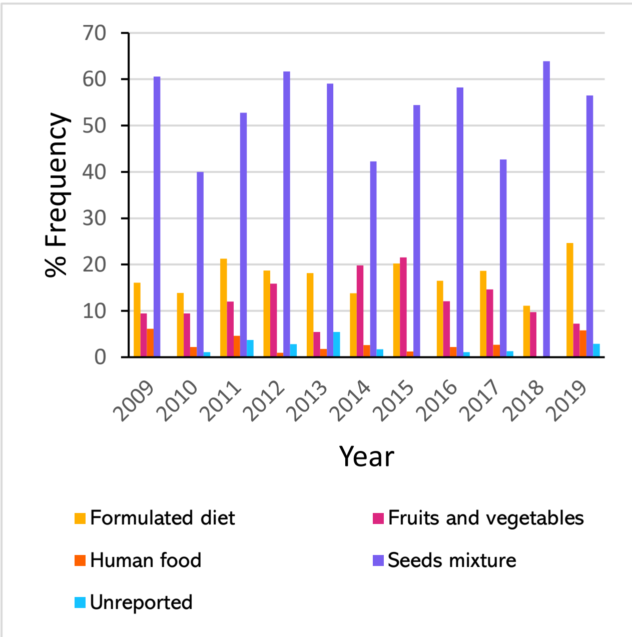

Figure 2 - Variations on dietary profile of captive amazon parrots, over the 10 years period observed in the study.

Most of the birds were classified as presenting an ideal body condition score (45.1%), followed by under conditioned score or lean birds (16.7%), and overweight (9.8%), information about BCS was missing in 241 cases. Distribution and frequency of body condition scoring is present in Table 3.

Table 3. Percentage of the body condition score for captive amazon parrots observed in this study.

Body Condition Score	Age Group										
	Chick	(%)	Juvenile	(%)	Adult	(%)	Senior	(%)	Unsp	(%)	Total
1- Emaciated	2	6.25	6	3.61	44	6.65	3	11.54	0	0.00	55
2- Lean	9	28.13	30	18.07	141	21.30	7	26.92	4	26.67	191
3- Ideal	20	62.50	116	69.88	356	53.78	14	53.85	9	60.00	515
4- Overweight	1	3.13	11	6.63	96	14.50	2	7.69	2	13.33	112
5- Obese	0	0.00	3	1.81	25	3.78	0	0.00	0	0.00	28
Total	32	100.00	166	100.00	662	100.00	26	100.00	15	100.00	901

Unsp= Unspecified

Metabolic disease prevalence

A total of 1142 clinical observations where registered from 791 birds, the number of returns for bird, ranged from 2 to 10, with a mean of 2.8 times and a standard deviation of 1.8. A total of 986 morbidity cases were recorded from these birds. Noninfectious diseases were the main cause of morbidity (n=512; 51.93%), being the metabolic diseases process the most prevalent (n=189; 36.91%), followed by physical (n=148; 28.9%), and neoplastic (n=79; 15.43%).

From all the registers, clinical and postmortem, metabolic diseases represented 16.5% of the casuistic (n=189/1142). Casuistic includes the medical records from birds that were presented in good health conditions, seeking for routinary vet care and general management information. For the Avian Ambulatory casuistic, metabolic disease was reported in 16.06% of the cases (n=166/1033), and its prevalence over identified morbidity process was 18.92% (n=166/877). For the Animal Pathology Service casuistic, metabolic disease was identified in 27.38% of the cases (n=23/84), and 47.82% of them (n=11/84; 13.0%) were reported as the main cause of death. All the metabolic alterations registered, and its prevalence are listed in the table 4.

Table 4. Complete list of metabolic alterations diagnosed in captive Amazon during the 10-year study period.

Metabolic disease subprocess	*Primary diagnoses*	*% (n=189)*	*Live birds*	*% (n=166)*	*Dead birds*	*%(n=23)*	*Cause of death*	*%(n=11)*	*Secondary diagnoses*	*% (n=83)*
Lipidosis	56	29.63	50	30.12	6	26.091	1	9.091	15	18.071
Lipidosis suspect	45	23.81	45	27.11	0	0.0	0	0.0	0	0.0
Obesity	29	15.34	29	17.475	0	0.0	0	0.0	44	53.01
Nutritional deficiency	19	10.05	19	11.45	0	0.0	0	0.0	18	21.697
Hypovitaminosis A	14	7.41	13	7.83	1	4.35	0	0.0	6	7.232
Gout	9	4.768	0	0.0	9	39.13	5	45.45	0	0.0
Nutritional secondary hyperparathyroidism	5	2.65	5	3.01	0	0.0	0	0.0	0	0.0
Atherosclerosis	5	2.65	1	0.6	4	17.394	3	27.273	0	0.0
Diabetes	3	1.596	3	1.81	0	0.0	0	0.0	0	0.0

Haemosiderosis	3	1.596	0	0.0	3	13.04	2	18.18 9	0	0.0
Hypothyroidism	1	0.53	1	0.6	0	0.0	0	0.0	0	0.0
Total	189		166		23		11		83	

Adipose tumors represented 37.97% (30/79) of neoplasia diagnosed based on biopsy submissions. Lipid related disorders registered, and its prevalence are listed in the table 5.

Table 5. Lipid related disorders diagnosed in Captive Amazon parrots between 2009 and 2019.

Process	*Primary diagnoses*	*%Overall prevalence n=986*	*%Prevalence over lipid related lesions n=98*
Atherosclerosis	5	0.5	5.1
Hepatic lipidosis	55	5.6	56.1
Corneal lipid deposition	1	0.1	1.0
Splenic lipidosis/ renal lipidosis	1	0.1	1.0
Xanthoma	6	0.6	6.1
Lipoma	28	2.8	28.6
Liposarcoma	2	0.2	2.0
Total	98	100	100

Affected systems and organs.

The most common affected body system by metabolic disorders, was the hepatic which was reported in 101/189 cases (53.44%), followed by systemic disorders in 47/189 (24.87%) and the integumentary in 14/189 cases (7.41%). In that order the most frequent reported disorder to affect the hepatic system was lipidosis, with an overall prevalence of 28.57 % (n=54). As the most frequent process with systemic involvement, obesity had a prevalence of 14.8% (n=28), and affecting the integumentary system, well whether just keratinized tissue from beak and feet or generalized changes over theses tissues and additionally feathers were affected, the overall process within this tissues manifestations was nutritional deficiency in 100% of the cases reported affecting this system, with an overall prevalence over metabolic processes of 7.41% (n=14) if we consider that hypovitaminosis is a type of specific diagnose of deficiency, which had an overall prevalence of 3.7% of all metabolic diagnoses.

Table 6. Body systems and organs affected by metabolic diseases.

System	*Organ*	*Disorder*	*Cases*	*%(n=189)*
Alimentary	Oral Cavity/ Beak	Nutritional Deficiency	2	1.06
		Hypovitaminosis A	1	0.53
		Total	3	1.59
Cardiovascular	Great Vessels/ Heart	Atherosclerosis	5	2.65
				0
Endocrine	Pancreas	Diabetes	3	1.59
	Thyroid	Hypothyroidism	1	0.53
		Total	4	2.12

				0
Hepatic	Liver	Lipidosis	54	28.57
		Lipidosis Sus	45	23.81
		Hemosiderosis	2	1.06
		Total	101	53.44
				0
Integumentary	Beak	Hypovitaminosis A	3	1.59
	Feet	Hypovitaminosis A	4	2.12
	Generalized Feathers and Skin	Nutritional Deficiency	7	3.7
		Total	14	7.41
				0
Musculoskeletal	Long Bones	Nutritional Secondary Hyperparathyroidism		2.65
	Tibiotarsus		2	0
	Femur		2	0
	Humerus		1	0
		Total	5	2.65
				0
Ocular	Cornea	Lipidosis	1	0.53
				0
Respiratory	Upper Respiratory Tract	Hypovitaminosis A	2	1.06
	Lungs	Haemosiderosis	1	0.53
	Lungs, Air Sacs	Obesity	1	0.53
	Non-Specific	Nutritional Deficiency	1	0.53
		Total	5	2.65
				0
Systemic	Non-Specific	Obesity	28	14.81
		Nutritional Deficiency	9	4.76
	Generalized Feathers, Skin, Oral Cavity	Hypovitaminosis A	4	2.12
	Generalized Organs	Gout	5	2.65
	Coelomic Cavity	Lipidosis	1	0.53
		Total	47	24.87
				0
Urogenital	Kidney	Gout	3	1.59
	Ureter	Gout	1	0.53
		Total	4	2.12
Total			189	100

In order to understand the clinical scenario of common reported metabolic disorders we rearranged variables and its frequency over the diagnoses distribution in Table 7.

Therefore, we have that the profile of captive amazon parrots diagnosed with hepatic lipidosis or its suspect is composed by an adult bird (87.0%, 84.0%), of undetermined sex (75.0%, 77.0%), feed with seed mixture (50.0%, 53.0%), with a body condition score varying between ideal (37.0%, 42.0%) and overweight (33.0%, 20.0%), that attend to the Avian Ambulatory presenting rather, a dermatologic alteration (41.0%, 53.0%) such as overgrowing nails and beaks, yellowish, blackish or greasy feathers and stress bars, gastrointestinal disorder symptoms (17.8%, 33.0%), such as greenish, blackish, yellowish and greasy feces, progressive inappetence and anorexia, emesis and diarrhea, or coelomic distention (17.8%, 6.6%). The majority of the consultations were scheduled (87.0%, 100.0%) and most of these patients were presented in an active status of consciousness at time of consultation (53.0%, 62.0%). For obesity variable frequency was very similar, adult bird (79.0%), of undetermined sex (75.0%) feed daily of seeds (68.9%), scored as overweight and obese (55.0%, 24.0%), with a variety of complains as respiratory symptoms (31.0%) mainly, elaborate breathing, coelomic distention (24.0%) and dermatologic alterations (20.0%). The big majority of consultations where scheduled (89.6 %) and most animals were active (93.0%). In contrast to this, some disorders were mainly diagnosed in deceased animals, trough postmortem examinations, such as gout (100.0%) and atherosclerosis (80.0%).

Table 7. Distribution of individual demographic, consultation, and clinical variables over different metabolic diseases diagnoses**.**

	Variable	*Lipidosis*		*Lipidosis sus*		*Obesity*		*Nutritional deficiency*		*Hypovitaminosis A*		*Gout*		*Nutritional secondary hyperparathyroidism*		*Atherosclerosis*		*Diabetes*		*Haemo-siderosis*		*Hypo-thyroidism*	
		N	*% (56)*	*N*	*% (45)*	*N*	*% (29)*	*N*	*% (19)*	*N*	*% (14)*	*N*	*% (9)*	*N*	*% (5)*	*N*	*% (5)*	*N*	*% (3)*	*N*	*% (3)*	*N*	*% (1)*
Environment	Breeding facility	-	-	-	-	-	-	-	-	-	-	-	-	1	20	2	40	-	-	-	-	-	-
	Wild Animal Screening Centre	-	-	-	-	-	-	-	-	-	-	-	-	1	20	-	-	-	-	-	-	-	-
	Household pet	56	100	45	100	29	100	19	100	14	100	9	100	3	60	3	60	3	100	3	100	1	100
Age	Chick	-	-	-	-	-	-	-	-	-	-	-	-	2	40	-	-	-	-	-	-	-	-
	Juvenile	3	5.4	4	8.9	5	17.2	5	26.3	2	14.3	2	22.2	2	40	-	-	-	-	1	33.3	-	-
	Adult	49	87.5	38	84.4	23	79.3	14	73.7	12	85.7	7	77.8	-	-	5	100	3	100	2	66.7	1	100
	Senior	4	7.1	1	2.2	1	3.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Unspecified	-	-	1	2.2	-	-	-	-	-	-	-	-	1	20	0	0	-	-	-	-	-	-
Sex	Female	9	16.2	7	15.6	2	6.9	1	5.7	2	14.3	3	33.3	-	-	3	60	-	-	3	100	-	-
	Male	5	8.9	3	6.8	7	24.1	1	5.7	1	7.1	5	55.6	-	-	1	20	-	-	-	-	-	-
	Undetermined	42	75.0	35	77.8	22	75.9	17	89.5	11	78.6	1	11.1	5	100	1	20	3	100	-	-	1	100
Diet	Seeds mixture	28	50.0	24	53.3	20	68.9	14	73.7	10	71.4	1	11.1	3	60	1	20	1	33.3	-	-	1	100
	Formulated diet	13	23.2	9	20.0	2	6.9	2	10.5	-	-	-	-	1	20	-	-	1	33.3	-	-	-	-
	Fruits and vegetables	7	12.5	9	20.0	4	13.8	3	15.8	2	14.3	1	11.1	1	20	-	-	1	33.3	-	-	-	-
	Human food	2	3.6	3	6.7	3	10.3	1	5.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	NA	7	12.5	-	-	-	-	-	-	1	7.1	7	77.8	-	-	4	80	-	-	3	100	-	-
	Unreported	-	-	-	-	-	-	-	-	1	7.1	-	-	-	-	-	-	-	-	-	-	-	-
Body Condition Scoring	1	-	-	1	2.2	-	-	-	-	-	-	-	-	-	-	2	40	3	100	-	-	-	-
	2	5	8.9	4	8.9	-	-	6	31.6	4	28.6	5	55.6	4	80	-	-	-	-	1	33.3	-	-
	3	21	37.5	19	42.2	4	13.8	7	36.8	6	42.9	-	-	1	20	1	20	-	-	2	66.7	1	100
	4	19	33.9	9	20.0	16	55.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5	3	5.4	-	-	7	24.1	-	-	-	-	2	22.2	-	-	1	20	-	-	-	-	-	-
	Unreported	8	14.3	12	26.7	2	6.9	6	31.6	4	28.6	2	22.2	-	-	1	20	-	-	-	-	-	-
Presenting complaint	Coelomic distention	10	17.9	3	6.7	7	24.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Dermatologic alteration	23	41.1	24	53.3	6	20.7	10	52.6	11	78.6	-	-	-	-	-	-	-	-	-	-	1	100
	Gastrointestinal disorder	10	17.9	15	33.3	1	3.4	2	10.5	1	7.14	1	11.1	-	-	-	-	2	66.7	-	-	-	-
	Non specific acute symptoms	4	7.1	2	4.4	1	3.5	-	-	-	-	1	11.1	-	-	-	-	-	-	-	-	-	-
	NA*	6	10.7	-	-	3	10.3	-	-	1	7.1	7	77.8	-	-	4	80	-	-	3	100	-	-

	Ocular symptoms	1	1.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Respiratory symptoms	2	3.6	1	2.2	9	31.0	1	5.3	1	7.1	-	-	-	-	1	20	-	-	-	-	-	-
	Behavioral disorder	-	-	-	-	-	-	6	31.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Neurologic symptoms	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	33.3	-	-	-	-
	Musculoskeletal symptoms	-	-	-	-	2	6.9	-	-	-	-	-	-	5	100	-	-	-	-	-	-	-	-
	Checkup	-	-	-	-	3	10.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Type of consultation	Emergency consultation	1	1.8	-	-	-	-	-	-	-	-	1	11.1	-	-	-	-	-	-	-	-	-	-
	Scheduled consultation	49	87.5	45	100	26	89.7	19	100	13	92.9	1	11.1	5	100	1	20	3	100	-	-	1	100
	necropsy	6	10.7	-	-	-	-	-	-	1	7.1	7	77.8	-	-	4	80	-	-	3	100	-	-
	Active	31	55.4	28	62.2	27	93.1	18	94.7	13	92.9	0	0	2	40	-	-	-	-	-	-	1	100
General. condition	Dead	6	10.7	-	-	-	-	-	-	1	7.1	7	77.8	-	-	4	80	-	-	3	100	-	-
	Moderately depressed	17	30.4	16	35.6	2	6.9	1	5.3	-	-	1	11.1	3	60	1	20	3	100	-	-	-	-
	Severely depressed	2	3.6	1	2.2	-	-	-	-	-	-	1	11.1	-	-	-	-	-	-	-	-	-	-
	Total	56		45		29		19		14		9		5		5		3		3		1	

NA* *Not available, for deceased animals and animals that attended for routinary checkups with no reported symptoms. Lipidosis sus=Lipidosis suspect.*

Risk factors

Overall, the lipid accumulation lesions group had significantly increased odds of occurrence along with the diagnosis of obesity (OR, 16.8; 95% CI, 8,8–31.8; p<0.05), health status (OR, 3.9; 95% CI, 2.5–6.2; p<0.005), body condition score (OR, 2.3/non ideal; 95% CI, 1.5–3.5; p<0.05) and age group (OR, 3.4/non juveniles; 95% CI, 1.4–8.0; p<0.002). In contrasts, there was no effect of age group on the odds of the metabolic disease group, however the odds increased with the concurrent diagnosis of obesity (OR, 4.13, 95% CI, 2.2- 7.6; p<0.05), health status (OR, 2.1, 95% CI, 1.4- 3.2; p<0.05) and body condition score as well (OR, 2.1, 95% CI, 1.4- 3.2; P<0.05).

Health status as the presence of concomitant disease process, was found to significantly increase the odds for obesity (OR, 3.9; 95% CI, 2.5–6.2; p<0.05), as well increases with age group (OR, 3,4/non juvenile; 95% CI, 1.4–8.0; p<0.002) and body condition score (OR, 2.3/non ideal; 95% CI, 1.5–3.5; p<0.05) while no significant association was observed between obesity and sex (p=0.03) or between obesity and diet (p=0.2).

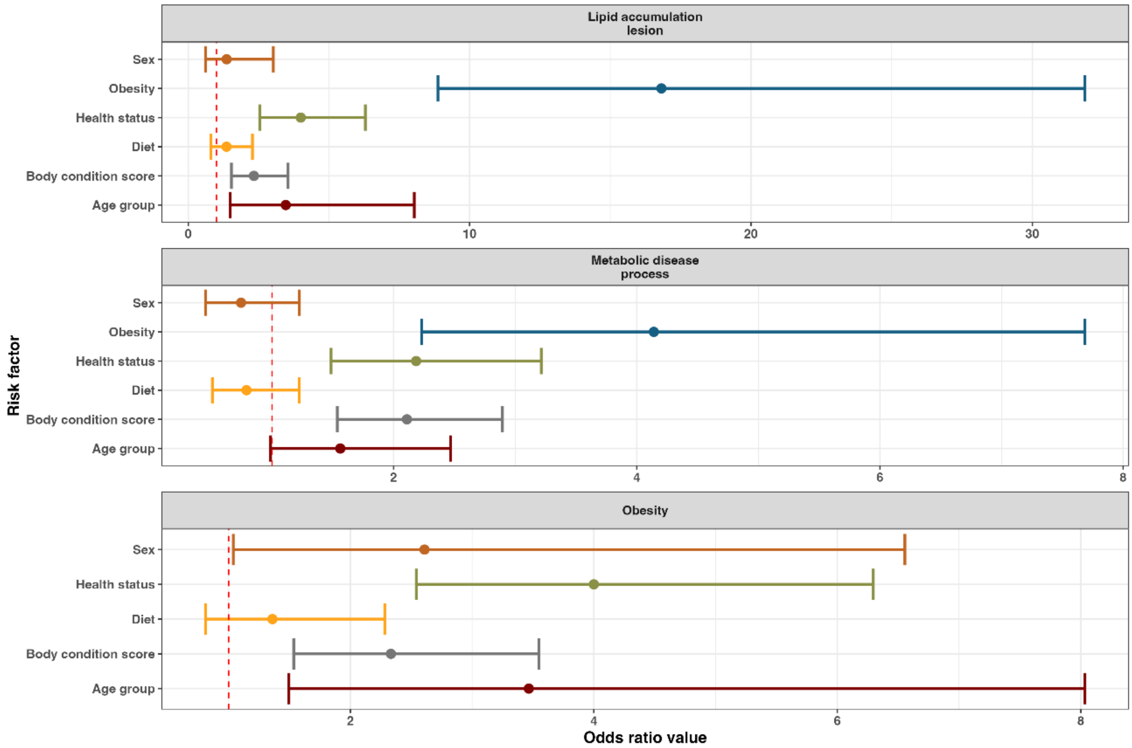

Figure 3 - Odds ratio values obtained for the variables tested on the lipid accumulation lesion, metabolic disease, and obesity outcomes.

5.4. DISCUSSION

Metabolic disease prevalence

Noninfectious diseases were the most common finding affecting captive amazon parrots. From these, metabolic was the most prevalent disease process and affected 203 birds with 142 being reported as the main diagnosis. Overall, 272 diagnoses were categorized as metabolic, and 189 of them were classified as the primary cause of morbidity, meaning that many birds were diagnosed with simultaneous metabolic disorders.

Hepatic lipidosis was the most frequently diagnosed subprocess followed by the suspect cases of this disease. The noninfectious hepatopathy, determined as the "lipidosis suspect" group was characterized by animals presenting compatible symptoms, relatable clinical backgrounds, and fitting but not sufficient ancillary test results. Liver disease has been widely mentioned as common among companion psittacines birds, nevertheless, its diagnosis is difficult and clinical symptoms are frequently nonspecific (RITCHIE; HARRISON; HARRISON, 1994).

In this study, the most commonly reported clinical signs were the categorized as dermatologic sings (41.0%), broadly represented by overgrowing nails and beaks, however other alterations also reported were yellowish/blackish feathers, greasy feathers, pruritus, overgrowing beaks leading to its extreme deformity, poor feather quality and stress bars. Overgrowing beaks and nails are physical examination findings considered specific for hepatic disease, and the other mentioned integumentary complaints are also discussed to be associated, although very loosely (COWAN, 2017; HARRISON; MCDONALD, 2006; LUMEIJ, 1994a; MONTESINOS *et al.*, 2016; SHI-YEE HUNG; SLADAKOVIC; DIVERS, 2019). Beak trimming should not be needed if the bird eats an appropriate diet and uses the beak for normal behaviors. If keratin builds up along the lateral aspects of the beak, this can be smoothed using a rotary sanding tool (LUMEIJ, 1994a; MENCH *et al.*, 2018).

People with icterus frequently present pruritus, which is thought to be brought on by the buildup of irritating bile salts in the skin (GRUNKEMEYER, 2010; HOCHLEITHNER; HOCHLEITHNER, 2011; LUMEIJ, 1994a). Clinical symptoms of pruritus and feather picking have been observed in birds suffering from liver disease (BEAUFRÈRE, 2022; GRUNKEMEYER, 2010; MONTESINOS *et al.*, 2016; SHI-YEE HUNG; SLADAKOVIC; DIVERS, 2019), and in this study pruritus by its own was classified as a dermatologic alteration, but pruritus in addition with feather picking, or feather damaging, involving altered behavior in a repetitive manner, being chronic evidenced by the caregiver were categorized as behavioral alteration, and no bird with hepatic lipidosis diagnose was classified as presenting this complaint, however within the metabolic disease group, all the birds presenting behavioral alterations (n=6/189) were arranged into the nutritional deficiency subprocess, and in 4 the integumentary systems was identified as the main system affected.

As report by the literature, clinical indications of dietary deficiency frequently arise first in the integument, but these early indicators are so frequently found that they may not be seen as abnormal (HARRISON; MCDONALD, 2006), some findings are consistent and may be related to this statement such as the profile of the neotropical parrot diagnosed with hepatic lipidosis or its suspect in this study, who in 87.5% of the cases was submitted to the veterinary hospital for a scheduled consultation, and considering 30.0% of this birds were reported as moderately depressed at time of consultation, could mean that caregivers may have probably observed slight and progressive changes, but disregarded them until they appear more evident and the consciousness state of the bird begins to be compromised.

As the second most presented clinical signs by the fatty liver diagnosed parrots, gastrointestinal alterations, where mainly represented by progressive anorexia, biliverdinemia and yellowish urates, which have been broadly recognized as strong indication of liver disease since this discoloration is the result of increased excretion of biliverdin (biliverdinuria), which is the most important bile pigment in birds (GRUNKEMEYER, 2010; HOCHLEITHNER; HOCHLEITHNER, 2011; LUMEIJ, 1994a; PERLMAN, 2015; SHI-YEE HUNG; SLADAKOVIC; DIVERS, 2019).

Since liver disease in birds can be fatal if not diagnosed early, an accurate method of detecting early hepatic pathology is essential (BEAUFRÈRE, 2022; KOLLIAS; KOLLIAS, 2010; STANFORD, 2005). Currently, the avian clinician needs to rely on a combination of analytical techniques to reach a specific diagnosis in the broad category of liver disease. Most blood assays used in veterinary pathology labs for exotic pets are extrapolated from standard mammalian tests and have not been validated for other species (DAVIES, 2000; GRUNKEMEYER, 2010; REDROBE, 2000; SHI-YEE HUNG; SLADAKOVIC; DIVERS, 2019; SPEER *et al.*, 2016). Although the suspicion of liver disease can be raised by biochemical analysis of blood samples, there doesn't seem to be any association between changes in liver enzyme concentrations and histopathologic alterations in the liver (SHI-YEE HUNG; SLADAKOVIC; DIVERS, 2019). One study produced normal ranges for triglycerides, total cholesterol, HDL and LDL in African grey parrots fed with both, seed and pellet diets. Despite the two dietary groups' varying dietary fat contents, the cholesterol measurements were not significantly different. Although the previously cited study showed that dietary fat could affect cholesterol levels, the diets used in that study had extremely high levels of saturated fat, which would not be used in captive parrots housed under normal circumstances (STANFORD, 2005). However, a significant difference was seen between the values obtained for the *Pionus spp*. group and the corresponding values in the *P. Erithacus* (African grey parrot); this occurred despite the *Pionus spp.* group being fed a diet with a lower saturated fat content than either of the diets used for the African grey parrots. This appears to suggest that there is a genetic difference in cholesterol metabolism in parrots and humans, which could explain why some species are particularly prone to cholesterol metabolism disorders (STANFORD, 2005).

Traditionally, South American species fed on diets very low in fat in the wild, essentially being consumers of fruit (KILPP; SOMENZARI; SCHUNCK, 2015; PRESTES; MARTINEZ, 2008; SERAFINI *et al.*, 2011). The variation also demonstrates that different psittacine species should have specific diets developed for individual species requirements.

Shi-Yee Hung, et al. (2019) reviewed clinical records of 28 companion Psittaciformes from a Veterinary Teaching Hospital (2007–2016) with endoscopic liver biopsies, liver histopathology, radiography, complete blood count (CBC) and plasma biochemistry. Only 11 of 28 psittaciforms (39.3%) had physical examination findings considered specific for hepatic disease (COWAN, 2017; DAVIES, 2000; STANFORD, 2005). The signs reported included yellow urates (n=1), biliverdinuria (n=2), bruising (n=1), melena (n=1), overgrown beak/talons (n=3) and feather destruction (n=4) and seventeen patients (60.7 %) displayed non-specific signs. Most patients had histories that included at least one to two non-specific signs of hepatopathy, reflecting the difficulty of diagnosis reviewed in the literature (SHI-YEE HUNG; SLADAKOVIC; DIVERS, 2019). The fact that less than half of the Psittaciformes showed the clinical signs considered to be specific reaffirms that clinical signs of liver disease are truly varied and that none is reliable. Hematological abnormalities were not useful beyond non-specific information about systemic health. In the same study, elevated AST with normal CPK was not observed. All elevations in AST were accompanied with elevations in CPK; normal CPK always coincided with normal AST. Since there are many confounding influences on the AST levels and this has shown that individually these values agree poorly with histology, the commonly used pairing of elevated AST with normal CPK as indicative of hepatocellular damage is not a useful screening tool as studies have suggested previously (BEAUFRÈRE, 2022; BUYSE; DECUYPERE, 2015). Also, companion Psittaciformes with endoscopic liver biopsies generally had nonspecific histories and presentations with specific clinical signs appearing in less than half of cases (SHI-YEE HUNG; SLADAKOVIC; DIVERS, 2019). Since hepatic was observed that accumulations occurred in nearly half of patients and excessive nutrients contribute to the pathogenesis, an extensive dietary history and client education are crucial in the diagnosis and treatment of liver disease. Plasma biochemistry, hematology, radiography and endoscopic visualization were not sensitive to diagnosis of liver disease and agreed poorly with histopathology (DAVIES, 2000; KOUTSOS; GELIS; ECHOLS, 2016; LANGLOIS; JONES, 2001; LAPINHA, 2022; LUMEIJ, 1994a; REDROBE, 2000; STAHL *et al.*, 1998; STANFORD, 2005). When liver disease is suggested by biochemistry, the likelihood of disagreement with hepatic histopathology is high (SHI-YEE HUNG; SLADAKOVIC; DIVERS, 2019). Of all the antemortem diagnostics, the most important modality is a liver biopsy, since neither biochemistry, hematology, radiography nor endoscopic visualization provides reliable predictive information (BANDYOPADHYAY, 2017; BEAUFRÈRE, 2022; CAPITELLI; CROSTA, 2013; CASTRO, 2010; CUBAS; SILVA; CATÃO-DIAS, 2014; HENSEL, 2010; PINTO *et al.*, 2016).

Obesity was the third most prevalent metabolic subprocess, it was identified as the primary cause of morbidity in 15% of the metabolic cases (n=29), however, it was mostly diagnosed as secondary disease, and it represented 53% (44/83) of all the metabolic disorders identified as concomitant, this means that the bird was not taken to the veterinary hospital as a result of this, rather, it was presenting a complaint due to another identified cause. Obesity-diagnosed parrots were mainly adults 79% (n=23) scored with different BCS, as we see 13.79% (n=4) were scored at the physical examination as ideal, 55% (n=16) as overweight, and 24% (n=7) as obese if we contrast with those who have obesity as a secondary diagnose, ideal were 20% (9/44), overweight were 52% (23/44), obese 15% (7/44) and 11% (5/44) had no BSC reported, this can be explained by understanding the way clinical records are filled at the avian clinical service, as the responsible for filling up the animal history and physical examination is extremely varied, and changes constantly, and the scale used is based on a subjective interpretation of the patient body mass, having little anatomical keys to rely on.

Most patients were reported as active (93%) and in 3 cases the diagnosis was during a checkup consult meaning this disease can be underestimated and in the author's experience considering the tendency of the bird owner to seek veterinary help when the stage of the condition is relatively advanced, and in addition with the difficulty of the pet owner to identify when the bird is overweight, the number of undiagnosed parrots with obesity its hypothesized to be very high, and in consequence its prevalence. A similar scenario is described for other pet species such as cats, where owners underestimated their cat's BCS based on a visual scale, believing that normal-sized cats were underweight. This interfered with their conduct, made them feed more, and helped promote their weight increase, improving the chances that they will become overweight as they age (COLLIARD *et al.*, 2009).Perhaps a more accurate grading system should be developed in avian medicine, for obesity management and preventive education, flock management and so much more. In the meanwhile, veterinarians should assist pet owners by instructing them on how to identify an ideal BC.

In this study, the most commonly presented set of symptoms for obesity-diagnosed patients were respiratory (31%, n=9/29), and the respiratory system was identified as the main affected in only 2.6% of the cases (n=5/189) being attributed to obesity on just one occasion, the other cases where assign as nonspecific systemic alteration, since more than one system was affected, furthermore is interesting how the cardiovascular system was only attributed to being affected by the specific disease as atherosclerosis mainly in deceased parrots (4/5), when is well known that obesity affects the cardiovascular system in other species increasing cardiac workload by increasing total blood volume and cardiac debt (ALPERT, 2001). Obesity is considered a volume-expansion disease that causes increased cardiac output, increased plasmatic and extracellular fluid volume, increased cardiac chronotropism, systolic and diastolic ventricular dysfunction, and increased arterial blood pressure in humans, cats, and dogs (JOLES, 1998). Also, excess fat tissue raises the body's metabolic demand, resulting in hyperdynamic circulation, structural changes in the ventricles, increased ventricular mass, and cavity dilation, therefore, obesity is associated with left ventricle hypertrophy, dilation, and diastolic dysfunction, as well as occasionally systolic dysfunction (SOKMEN *et al.*, 2013). This was evidenced by dos Santos *et al.* (2022) who determined the echocardiographic parameters of *Amazona aestiva* individuals with differing BCS, obtaining that the group of obese parrots presented lower right ventricle dimensions in diastole than lean parrots. The fractional shortening was considerably lower in obese parrots than in parrots with lean and ideal body condition (DOS SANTOS *et al.*, 2022).

However, the detailed description of macroscopic alterations of the heart were rarely seen in the necropsy reports and so was the evaluation of the cardiac system in live birds, which could be related to the access of the avian clinic to this service within the hospital department’s administration and the availability of information and qualified staff. In contrast to hepatic lipidosis and obesity, some disorders were only or mainly diagnosed in deceased animals, through postmortem examinations, such as gout (100.0%) and atherosclerosis (80.0%).

Gout prevalence in this study was very low, in studies with a high quantity of reviewed postmortem records and that included different psittacine taxas of captive parrots in north America, gout was one of the most prevalent metabolic diseases reported (GIBSON *et al.*, 2019).

It is often hard to confirm an assessment of renal dysfunction in birds because clinical manifestations are commonly nonspecific and secondary changes caused by renal disease frequently complicate matters (LUMEIJ, 1994b).

This was reflected in this study since all gout cases were postmortem diagnosed, and from these only in one case the articular form was reported as also present. From live birds attended at the Avian Ambulatory Service from VPT/FMVZ-USP, one was an adult bird of 30 years old, underscored BCS 2/5 that was attended at the clinic for an emergency consultation, presenting nonspecific acute symptoms described as lethargy and anorexia, was classified as severely depressed, and at physical examination presented swollen joints of pelvic limbs which were suspected to be articular deposition of uric acid leading the diagnostic suspect. The other case was a juvenile parrot, 5 months old, underscored BCS 2/5, who was assisted for presenting mainly gastrointestinal disorders, this were emesis, anorexia, diarrhea, hematochezia, and a moderately depressed state of consciousness. Both animals died during the consultation and only in the adult parrot was recognized as the cause of death.

Literature described that visceral gout will rapidly lead to death of the affected animal. This hypothesis is supported by the fact that inflammation and tophi formation are rare with visceral gout, because the condition has a rapidly fatal course (LUMEIJ, 1994b). But this believe seems controversial, since the chronic form of gout is characterized by deposition of crystals as tophi, and this is the form of disease clinically diagnosed in birds and reptiles (DUNCAN, 2015; NEOGI, 2011).

As occurs in this study, all cases presented a visceral form and most of them were generalized (n=5) with crystal uric deposition reported above diverse organs at the coelomic cavity, indicating an advanced state of evolution of the disease, and being 4 cases limited to the urogenital system. From all gout cases it was indeed attributed to be cause of death in 5 of 9 (55.0%) cases and the other 4 were attributed to diverse etiologies such as asphyxiation (n=2), bacterial infection (n=1) and aerossaculitis (n=1), which were the same cases with gout restricted to the urogenital system. Overall metabolic subprocess identified as cause of death, gout represented 45.0% (n=11) being the primary identified cause responsible.

In larger data reviewed study published by Gibson et al., (2019) gout was considered a primary cause of death in 44/392 affected from metabolic disorders and all except two cases of gout were described as the presence of urate crystals in the kidneys and 18 birds (40.9% of cases of primary urate nephrosis) also had visceral urate deposits, which can’t be compared to our study in terms of prevalence since our number of cases was very low. In similarity with our survey, other Brazil studies on captive parrots’ disease prevalence such as in Wild Animals

Clinic (AAS) of the Veterinary Hospital of the Federal University of Paraná (HV-UFPR), Santos et al. (2008) found the prevalence of gout extremely low, being 0.52% (n=2/253).

Even though gout is considered a consequence of renal disease, the chronic form common seen in pet birds lead this disease to a widespread form, with multiple systems affected, which if better explored could boost the likelihood of diagnosis in live animals, such is the case for cardiovascular system. In one study, pericardial effusion, accompanied by moderate to marked hepatomegaly, was identified in 6.0% of 107 psittacine birds submitted for necropsy. Among these birds, pericardial effusion had occurred with infectious disease and visceral gout or was accompanied by right ventricular dilatation and ascites consistent with right-sided congestive heart failure. Fitzgerald and Beaufrère (2015) reported, 43 cases of pericardial disease, pericardial effusion, or a combination of both were reviewed is. visceral gout occurred in 12 cases (28.0%).

Since animals presented dead, did not apport dietary information, no associations could be made, however, it was believed that when bird are provided with dietary protein in excess, the surpluses protein is catabolized and the nitrogen released is converted to uric acid, leading to resulting gout (LUMEIJ, 1994b). Furthermore, elevated dietary protein alone does not seem to be the underlying etiology of gout in all avian species because diets as high as 70.0% protein failed to induce gout in adult cockatiels (KOUTSOS *et al.*, 2014).

Other factors that seem to be associated with development of gout in addition to excessive dietary protein, are exposure to cold, moisture, dehydration and vitamin A or B12 deficiency, as well as viral infections in some bird species (LI *et al.*, 2022; POLLOCK, 2006). In the study published by Nemeth et al. (2016), gout was diagnosed uncommonly, and most often affected the kidneys of psittacines (133/22). All birds had urate deposition (gout), which was characterized as visceral, and most manifested as tubulointerstitial nephritis with intratubular urate tophi (NEMETH *et al.*, 2016).

In the present study, atherosclerosis was diagnosed uncommonly, representing only 2.6% (n=5/189) of all primary metabolic disorders diagnosed, and just 0.5% (n=5/986) overall prevalence of this survey. As mentioned, it was meanly diagnosed postmortem, being diagnosed in just 1 live individual, an 8 years old, male parrot who presented respiratory symptoms described as breathless, and moderately depressed, who was diagnosed through x ray imaging, where mineralization of the aorta's route and the brachiocephalic trunk's vessels was evidenced. All animals diagnosed were, adults ranging from 8 to 22 years old, in all cases, atherosclerosis was identified in the great vessels of the heart and the characterization of the diagnosed considering the severity and types of lesions was not available.

On the contrary of our study, atherosclerosis is highly reported as one of the most common metabolic diseases in psittacine birds, on studies based on anatomopathological findings (BEAUFRÈRE *et al.*, 2019; GIBSON *et al.*, 2019; NEMETH *et al.*, 2016; WILDMANN *et al.*, 2022).

Cardiovascular illness represents a serious threat to the quality of life and lifespan of many bird species, and its diagnosis is typically, if not always, determined after postmortem inspection (BEAUFRÈRE *et al.*, 2013).

Albicker-Rippinger and Hoop (1999) assessed 170 pathology reports at University of Zurich, Switzerland, from 1991 to 1997, and atherosclerosis occupied the top three more common disorder in Amazon parrots, with 17.0% prevalence (ALBICKER-RIPPINGER P; HOOP RK, 1999). On the other side at the same study site, research on presumptive diagnoses for Amazon parrots presented at the Clinic for Zoo Animals, Exotic Pets and Wildlife, from 1994 to 2003, atherosclerosis was mentioned in no case (LANGENECKER, 2006). In a lately review made by Martin (2018) from 2005 to 2014 atherosclerosis settled at top 10 presumptive diagnoses with 3.0% prevalence. This is statement consistent with our study findings, since 80% of the atherosclerosis diagnostic were given through necropsy (MARTIN, 2018).

In a review of 107 avian necropsies, 36.0% of the birds had grossly identifiable cardiovascular lesions and 99.0% had cardiac lesions on histopathology, indicating that cardiac disease is presently a very common, yet undiagnosed, condition in avian medicine (STANFORD, 2005).

In this survey metabolic disorder affecting the cardiovascular system were only represented by atherosclerosis. The incidence of atherosclerosis in captive parrots is reported to be 5.0-12.6%. As in mammals, atherosclerosis in psittacine birds appears to have a genetic component; African grey parrots appear to be most susceptible followed by Amazon parrots, and cockatoos and macaws are less frequently represented. A high plasma LDL concentration is a risk factor for atherosclerosis in man, budgerigars, and quail, and this would be expected to be the case in parrots (STANFORD, 2005).

Atherosclerosis is observed commonly in the great vessels of the aged psittacine heart, and is most often diagnosed in cockatiels, Amazon parrots, African grey parrots and macaws, and sporadically in other species (REAVILL; DORRESTEIN, 2010). Risk factors for atherosclerosis include age (8 years), sex (females), inactivity, high-fat diet and concurrent conditions such as reproductive disease, hepatic disease or myocardial fibrosis (BEAUFRÈRE *et al.*, 2013, 2014; REAVILL; DORRESTEIN, 2010).

In this study diabetes was diagnosed in 3 cases, all adults parrots from 7, 9 and 29 years old, sex undetermined, feed with different diets, being one registered as mainly feed with seeds, another fruits and vegetables and the older one with formulated diet, all of them were underscored, BCS 2/5, all birds were categorized as moderately depressed at consultation and the symptoms presented in common were polyuria, polydipsia, polyphagia, progressive loss of weight, one of the cases presented steatorrhea, and the elder bird presented important neurologic symptoms described as syncope an seizures. All birds were diagnosed alive, based on clinical signs, background history, glycose values reported as high from glucometer, and, in the elder parrot, blood values for glucose as high as 930mg/dL were registered. In addition, dipstick results for urine glucose were 110 mmol/L (++++). When this study was completed, all the animals had passed away. Only in one case necropsy was stated as requested.

Endocrine pancreatic dysfunction manifests as either hyperglycemia or hypoglycemia. The most common syndrome in birds is diabetes mellitus (DM)—the failure to adequately constrain blood glucose levels (OROSZ; MONKS; DE MATOS, 2016). Insulin has a less clear-cut role in glucose metabolism in birds, where glucagon, which is released by the alpha cells of the pancreatic islets, is thought to be the main hormone that controls blood sugar levels. Therefore, rather than hypoinsulinaemia, glucagon excess or insufficient insulin: glucagon ratios have been hypothesized as the causes of avian diabetes (SITBON *et al.*, 1980). Obesity, high amounts of endogenous or exogenous corticosteroids or progestogens, and elevated levels of other hormones (such as glucagon, growth hormone, and adrenaline) have also been found as factors for peripheral insulin resistance (associated with type-two diabetes) (CANDELETTA *et al.*, 1993; GANCZ *et al.*, 2007; PILNY, 2008).

Histologically, visible destruction of B cells within the pancreatic islets (which would be consistent with human type 1 DM) has been documented in avian species (PILNY, 2008). Etiologies include diseases that only afflict the pancreas, such as chronic lymphocytic pancreatitis and those affecting multiple organs but also causing pancreatic inflammation or destruction, including iron storage disease, peritonitis (especially reproductively related in hen birds), paramyxovirus infection, and herpesvirus infection (HAZELWOOD RL, 2000; PILNY, 2008). Ultimately, any pathologic process causing widespread pancreatic inflammation or destruction could progress to involve the pancreatic islets (OROSZ; MONKS; DE MATOS, 2016). In this study no histological information was available, which is warranted for further conclusions.

Diabetes prevalence in captive parrots is not known, since is rare condition, with the single cases recorded as clinical reports, however, not being part of epidemiological studies leads to the conclusion that the prevalence found in this survey can be considered as important.

Overall, the metabolic disease group

From all the primary morbidity causes recorded in this study, the prevalence of metabolic disease group was 19.16% (n=189/986) and from the noninfectious disease process it was the most frequent diagnosed group with 36.91% (n=189/512). For the Avian Clinical Service casuistic, metabolic disease was reported 16.06% (n=166/1033) and for the Animal Pathology Service casuistic, this group was identified in 27.38% of the cases (n=23/84). This indicates that the cohort amazon parrots held in captivity in Sao Paulo, Brazil, over the past ten years require veterinary medical care due to the high prevalence of these disorders, whose causes are primarily attributable to errors in management of environment, regular nourishment, and behavior. It is of great interest that, even though the species and number of individuals included in the current study were markedly different from previous studies around the world, and despite varying captive settings and administration in several nations, little variation in prevalence of metabolic diseases was observed.

Martin (2018) analyzed patient records describing consultations for privately owned exotic pets presented between 2005 and 2014 to the Clinic for Zoo Animals, Exotic Pets and Wildlife of the University of Zurich, and the results provided information on the most prevalent species presented as well as their most prevalent diseases. For amazon Parrots the most common diagnoses were occupied by respiratory tract disorder and dermatologic disorders, this last one largely constituted by overgrown beak and claws with 89%, and even though their study didn't classify the disorders by etiology this mentioned symptoms were broadly associated to a metabolic cause, and as the third most frequent, hepatic disorders with 16.0% (MARTIN, 2018). In a ten years retrospective study of captive psittacines, Gibson *et al.* (2019) found that birds were most commonly affected by noninfectious disease processes (n=1076; 58.2%) and were diagnosed frequently with degenerative (n=465; 25.1%), and metabolic (n=392; 21.2%) disorders. The most common metabolic diseases included atherosclerosis, gout and hemosiderosis (GIBSON *et al.*, 2019).

Nemeth et al. (2016) analyzed 827 avian samples, most of them from birds submitted to the University of Georgia from 2006 to 2011 to verify common disease etiologies, and some of the more prevalent metabolic diseases found in parrots, were hepatic accumulations of lipid and atherosclerosis which the authors associated with husbandry and genetic factors (NEMETH *et al.*, 2016).

Brazilian published studies related to neotropical parrot's species, don't frequently include large epidemiological reviews and when seen retrospectives surveys include a wide variety of taxon and often focuses on a specific veterinarian fields, such as ophthalmology (HVENEGAARD *et al.*, 2009), chirurgic and orthopedic (CASTRO; FANTONI; MATERA, 2013), imageology (ARNAUT, 2006; PRAES, 2013), and infectious diseases (SANTOS et al., 2008).

Some Brazilian retrospective studies about neotropical parrot disease prevalence described vague found disorders and don't attributed causality, as is the case of the Amazon parrots collection of the Quinzinho de Barros Municipal Zoological Park, Brazil, 1986–2007, in which necropsies were frequently inconclusive, and one of the most common lesions is reported as liver disease (6.2%) (VANSTREELS *et al.*, 2010).

Fotin (2005), investigated disease patterns of exotic pets at Sao Paulo city and found that at least 64% of the psittacines were illegally owned, most of them kept in poor housing and husbandry conditions. Noninfectious diseases were responsible for about half of the cases (51.1 %), most of them traumas, neoplasia, nutritional disorders.

Echenique et al (2020), analyzed necropsy protocols from 2000-2018 of the federal University of Pelotas, Rio Grande do Sul, Brazil, with a total of 413 cases from 21 bird orders of all cases, 55 (13.31%) corresponded to metabolic/nutritional diseases and concluded that metabolic diseases were the main cause of death in wild birds from southernmost Brazil (CARVALHO, 2004), studied postmortem reports of psittacine birds examined at the Pathology Diagnostic Laboratory of the Veterinary Teaching Hospital of the Federal University of Parana, Brazil, from January 1994 to December 2002. The metabolic diseases diagnosed during histopathologic examination remain in the top 3 most common, a prevalence was reported as follow, infectious diseases (32.94%); hydro-hemodynamic disturbances (22.35%); metabolic diseases (14.12%). All cases of metabolic diseases (14.12%) were of hepatic fatty transformation.

In recent study of necropsy reports on domestic and wild animals from the central laboratory for diagnosing avian pathologies at the Federal University of Santa Maria, 2018-2019, in this study 91.87% (n=192/209) of the animals examined were birds, which were widely represented by the Psittacidae family 21.53% (n=45/209), it was found that in 50.24% (105/209) the origin of the alterations was nutritional related being the most frequent diagnose (MURER, 2020).

The group named as lipid related disorders was formed by commonly related lipid dysmetabolism and besides 4 of the metabolic diseases, include 3 disorders, 2 neoplastic being lipoma and liposarcoma and 1 non neoplastic being xanthoma. Adipose tumors represented 37.97% (30/79) of neoplasia diagnosed, and lipoma was the most common tumor overall al neoplastic disorders 35.44% (28/79) and from the adipose tumors group 93.33% (28/30). Other studies of psittacine birds' neoplasia diagnoses in Sao Paulo, Brazil, had reported similar high prevalence (CASTRO *et al.*, 2016). These authors reviewed diagnostic and therapeutic surgical procedures at the Small Animal Surgery Department of the Veterinary Hospital of the School of Veterinary Medicine and Animal Science, University of Sao Paulo (FMVZ/USP), over an eight-year period and found the Blue-fronted parrot (*Amazona aestiva*) was the most prevalent species (36.84%; 7/19). Malignant and benign tumors accounted for 31.57% (6/19) and 68.42% (16/19) of lesions, respectively. All benign tumors in this sample were lipomas and were more commonly diagnosed in birds in the genus *Amazona* (92.30%; 12/13).

A retrospective study (2000-2004) and prospective investigation (2005-2006) of the neoplastic cases from the Avian Clinical Service of the Veterinary Teaching Hospital and Department of Veterinary Pathology at FMVZ/USP, was performed from a total of 102 neoplastic cases, lipomas were the most frequent tumors 32.4% (33/102) being 19 of them reported in obese neotropical parrots (SINHORINI, 2008).

This Brazilian studies of the neoplastic prevalence of tumor in parrots, as well as our studies are consistent with literature elsewhere and all authors suggests that high energy diets may play a role in the etiology of lipomas, along with genetic predisposition (ALTMAN, 1997; CASTRO *et al.*, 2016; CASTRO; FANTONI; MATERA, 2013; LIGHTFOOT, 2005; REAVILL, 2004; SINHORINI, 2008).

Risk factors

The presence of concomitant disease process, reflecting on the overall health status of the bird could be consider as a risk factor for developing metabolic disease (OR 2.1; 95% CI, 1.4- 3.2; $p<0.05$), lipid related disorders (OR 3.9; 95% CI, 2.5–6.2; $p<0.005$), and more specifically obesity (OR 3.9; 95% CI, 2.5–6.2; $p<0.05$).

Gibson et al., (2019b), found that metabolic diseases were commonly diagnosed as concomitant among individuals, and that more than one metabolic disorder was diagnosed in many cases. In a 5 year retrospective study in Georgia, metabolic disorders where not common diagnosed as primary cause of disease but as concomitant disorders as the case of hepatic lipidosis hepatic lipidosis was considered the primary or sole disease process in 10 birds, but was more commonly observed concurrently with other conditions, such as atherosclerosis (n=7), neoplasia (e.g. lymphoma and adenocarcinoma; n=2), as well as viral (e.g. reovirus, circovirus and polyomavirus; n=5), bacterial (e.g. bacterial cloacitis, enterotyphlocolitis, pneumonia, septicemia and mycobacteriosis; n=7) and fungal (e.g. M. ornithogaster, Aspergillus spp., Candida spp. and Encephalitozoon spp.; n=6) (NEMETH *et al.*, 2016).

As well it has been widely proposed that individuals diagnosed with some disorders as obesity, cachexia, malnourishment, hypovitaminosis and other metabolic/nutritional disorders are more propense to continue to develop metabolic syndromes an disorders as consequence (ECHENIQUE *et al.*, 2020; HARRISON; MCDONALD, 2006; MONTESDEOCA *et al.*, 2017; PERLMAN, 2015), and has been suggested that not only metabolic but as well affecting the overall system of the bird leading lading to behavioral changes, and highest chances to susceptibility to infectious disease (HARPER; SKINNER, 1998; HENSEL, 2010; LANGLOIS, 2021; LIGHTFOOT; NACEWICZ, 2006; MONTESINOS *et al.*, 2016; PERLMAN, 2015; SALERNO *et al.*, 2019; ZUCCA, 2016).

Age was found to be a risk factor for lipid related disorders meaning that non juvenile birds have more chances to develop disorders related to lipid metabolism alterations. This age effect was also reported for lipid related lesions in quaker parrots where the odds of adult parrots (OR, 3.9/10 years) (BEAUFRÈRE *et al.*, 2019).

As amazon parrots do not present sexual dimorphism and most of the data belong to clinical reports, sex was missing in 75% of the cases, meaning that the lower results of odds ratio from sex can’t be used to proposed further conclusions. However it is common in avian medicine to sex being report as unknown since sits not common, for caregivers to know or want to spend money on knowing the sex of the birds, especially in the bird owner profile of this study and considering that as reported in previous study (FOTIN; MATUSHIMA, 2005), a high number of animas are obtain through illegal routes of commerce, no sex identification came with the animals as seeing in individual bough legally. To limit selection bias and loss of information, the missing values can be dealt with via a multiple imputation procedure. A bootstrap-based expectation-maximization-Bayesian algorithm can be used to perform multiple imputations by missing value, creating data sets (BEAUFRÈRE *et al.*, 2019).

In egg-laying chickens, hepatic lipidosis is also strongly associated with vitellogenesis, intensive egg production, and blood estradiol concentration as estrogens drastically enhance hepatic lipogenesis in hens (ALVARENGA *et al.*, 2011). This mechanism is also suspected to occur in other female birds, including in Psittaciformes (BEAUFRÈRE, 2022; BEAUFRÈRE *et al.*, 2019; BUYSE; DECUYPERE, 2015; COWAN, 2017). However, male sex and not female sex was significantly associated with hepatic lipidosis in quaker parrots (BEAUFRÈRE *et al.*, 2019). A similar trend was found for atherosclerosis and other lipid accumulation lesions, where male sex was a significant risk factor in this species. Therefore, female lipid physiology and its dysregulation are unlikely to be a significant factor in the development of hepatic lipidosis in quaker parrots, and other causes or risk factors that explain such a high prevalence in this species should be investigated. Effects associated with male hormones are prominent in mammals and should be explored further in parrots. Since this study was retrospective in nature, major risk factors that could be associated with hepatic lipidosis such as diet and concurrent dyslipidemia could not be explored.

In this study animals were feed mainly with seeds mixtures. Nevertheless, diet information and associations are biased, because although most of the clinical records had diet information, birds were rarely fed with only one type of diet, here we grouped food items in categories for statistical purposes, but quantity of food and frequency was missing in almost all cases. Another limitation for diet analysis is that the person who fields the clinical reports is not always the same subject, it changes constantly through the years so diet questions from anamnesis and diet annotations, as the number of items considered, and the order of importance that given is very vague and subjective. As an evidence of this is that the control group for univariable model, were the formulated diet fed parrots, but in many cases from the author experience, the clinical record of the parrot described as it is fed from ‘‘ração’’ which means formulated diet, but most of the birds owner considered that seed mixtures in addition to nuts and some pellets is formulated diet, as the commercial packages of this mixtures are common presented the proper formula for feeding psittacines birds, but even though this misconception is common, is frequent to happen that the person responsible for obtaining the information misses to made an appropriate clarification to solve this, ant wrote it down inducing to the understanding that they are feed with proper commercial pellets.

It’s common for retrospective studies based on necropsy reports to be unable to analyzed major risk factors such as diet, husbandry, and results of diagnostic test, furthermore, all this information is available in the database created from clinical reports for this study and provides a tool for futures analyses. Even though in this study no association was found between diet and metabolic disorders, this in widely mentioned as potential risk factor (BAVELAAR; BEYNEN, 2004; BEAUFRÈRE *et al.*, 2013; BÉLAND *et al.*, 2021; BRIGHTSMITH, 2012; PÉRON; GROSSET, 2014; PETZINGER; BAUER, 2013; SHIH; PULLMAN; KAO, 1983; WILSON, 2004), and should be better approached for futures studies. A prove of this, are experimental studies were transitioning from sunflower seeds to balanced diets reduced serum glucose, triglycerides, cholesterol, and AST ($p<0.05$) and increased red blood cell, hemoglobin, lymphocyte, monocyte, and leucocyte counts ($p<0.01$). Radiographs indicated a decreased hourglass ($p=0.015$) and a reduced heart-liver ratio after ingesting the processed feeds ($p<0.05$). Feed processing did not affect blood cell counts, serum biochemistry or radiographic examinations. In general, parrots tended to prefer the extruded diet and didn't need a lot of starch gelatin to adequately digest the feed. The birds' health and metabolism increased after consuming the processed foods (DI SANTO *et al.*, 2019).

High-energy diets and sedentary lifestyles predispose companion Psittaciformes to hepatic lipidosis and obesity, particularly Amazon parrots (SHI-YEE HUNG; SLADAKOVIC; DIVERS, 2019). As expected, metabolic diseases had significantly increased odds of occurring in obese parrots (OR 4.13, 95% CI, 2.2-7.6; $p<0.05$). Obesity and dyslipidemias, which are lipid abnormalities brought on by other illnesses, genetics, or environmental factors in persons, are two of the most well-known and discussed risk factors for diseases such atherosclerosis (BEAUFRÈRE *et al.*, 2013, 2014).

Low levels of HDL and elevated levels of LDL, total cholesterol, and triglycerides are risk factors for lipid metabolic disorders in humans (FUSTER; TOPOL; NABEL, 2005) The increased levels of LDL are caused by a variety of conditions, such as obesity, sedentary lifestyles, and diets high in saturated fat (GUYTON, 2006).

It is plausible to believe that pet Amazon parrots have raised lipid and lipoprotein levels because they are frequently obese, inactive, and eat a high-fat diet, which could put them at risk for atherosclerotic disease. A range of illnesses are frequently seen in captive Amazon parrots, and abnormalities in the lipoprotein panel are one of these ailments (RAVICH *et al.*, 2014).

Obesity is one of these disorders, which is fueled by high-fat meals and inactivity. High fat consumption is a result of diets that are primarily made of seeds, whereas commercial pelleted meals offer a proper mix of nutrients and discourage selective feeding (HARRISON; MCDONALD, 2006; LEVINE; PRACTICE, 2003; OROSZ, 2014; TOLL *et al.*, 2010).

In one study, budgerigars (Melopsittacus undulatus), another species considered to be prone to obesity in captivity, were fed two groups either a seed mix or a specially designed diet. Triglyceride levels were noticeably higher in the group that gave seeds (FISCHER *et al.*, 2006).

Another budgerigar study compared body weight gains in birds fed a seed mixture to those given pellets. 83% of the budgerigars fed the seed diet gained weight, which was the case for all the animals. ten percent of their initial weight (DE VOE; TROGDON; FLAMMER, 2004)

Similar research on African grey parrots (*Psittacus erithacus*) revealed that those fed a high-fat meal had plasma cholesterol concentrations that were considerably greater than those fed a diet with reduced fat levels (STANFORD, 2005).

Both obesity and eating a high-fat diet are significant risk factors for the onset of atherosclerotic disease in humans and are likely to do the same in birds (BAVELAAR;

BEYNEN, 2004; ECKARDSTEIN, 2005; SHIH; PULLMAN; KAO, 1983; WILSON, 2004). However, future studies linking obesity to specific illnesses must be conducted.

Diabetes mellitus, hepatic lipidosis, and congestive heart failure are among the serious effects of obesity in all species (ACHARI; JAIN, 2017; ALPERT, 2001; SOKMEN *et al.*, 2013; TOLL *et al.*, 2010). Given these similarities between humans and captive Amazon parrots, it's critical to comprehend the significance of measuring blood lipoprotein levels in pet parrots, which here because of the nature of the study was not assessed. However, remains this approach for future investigations (RAVICH *et al.*, 2014)

Conclusions

In conclusion, this study documents the high prevalence of metabolic disorders in captive Amazon parrots and brings the importance of considering improving diagnostic methods to assess high known frequented illness in live birds. As well to start recognizing and addressing obesity as a disease which for it must be considered when referring to epidemiological studies of disorder prevalence in captive neotropical parrots.

This study serves as a reminder that it is unlikely that the epidemiology of common noninfectious illnesses is uniform among psittacine species, and that it is important to provide species-specific information rather than aggregating data to avoid obscuring species-specific trends. Therefore, the data base created for this epidemiological study represented a potential tool for further analysis.

With the publication of this study, clinicians and pathologist may now be more aware that Amazon parrots are more prone than other psittacine species to a variety of disorders linked to lipid dysmetabolism. This research further supports the use of Amazon parrots as animal models for research on obesity, hepatic lipidosis, atherosclerosis, and other lipid metabolism disorders given the great vulnerability of these birds to them.

Create a preventive health consciousness, and enhanced screening and interventions may have a significant preventative value for nutrition, husbandry, behavior, and the welfare of companion bird species.

Retrospective studies depend on the hospital departments effectiveness on using standardized techniques for gathering information and keeping records, utilizing empowered staff as part of client-centered practice strategies to assist screening and interventions. These specifics are tempered by a thorough grasp of risk factors in the region and how they relate to problems with health and welfare.

Limitations of the study

A survey carried out over clinical reports filled by an extremely high amount of clinician individuals is likely to be bias, so the reliability of the survey results is potentially limited when referring to anamnesis signalment and data such as, body condition score, diet habits, and lifestyle. Also because of the high demand of the avian clinical service, the limited hierarchy responsible senior veterinarians, may result hard to keep tract of every case record, resulting in unfilled /missed data and lack of complementary diagnosis test results annexed to the clinical reports. In addition, key risk factors such as, histological results of biopsies, diet, lifestyle, and clinical pathologic analytes could not be investigated deeply in this study and may provide more explanations to the reasons for the reported high prevalence of lipid-related and metabolic in Amazon parrots.

5.5. REFERENCES

ACHARI, A. E.; JAIN, S. K. Adiponectin, a therapeutic target for obesity, diabetes, and endothelial dysfunction. **International Journal of Molecular Sciences**, v. 18, n. 6, 2017.

ALBICKER-RIPPINGER P; HOOP RK. Krakheitsursachen bei Papageienvögeln (Psittaciformes) und Sperlingsvögeln (Passeriformes) eine Sektionsstatistik. **Tierärztliche Praxis Kleintiere/Heimtiere**, v. 27, p. 245–254, 1999.

ALLAN, F. J.; PFEIFFER, D. U.; JONES, B. R.; ESSLEMONT, D. H. B.; WISEMAN, M. S. A cross-sectional study of risk factors for obesity in cats in New Zealand. **Preventive Veterinary Medicine**, v. 46, p. 183–196, 2000.

ALPERT, M. A. Obesity cardiomyopathy: Pathophysiology and evolution of the clinical syndrome. Em: American Journal of the Medical Sciences, 4., 2001, [...]. Lippincott Williams and Wilkins, 2001. v. 321, p. 225–236.

ALTMAN, R. B. Soft tissue surgery. *Em*: ALTMAN R. B.; CLUBB S. L.; DORRESTEIN G. M.; QUESENBERRY K. **Avian Medicine and Surgery**. Philadelphia, Pa, USA: Saunders Company, 1997. p. 704–732.

ALVARENGA, R. R.; ZANGERONIMO, M. G.; PEREIRA, L. J.; RODRIGUES, P. B.; GOMIDE, E. M. Lipoprotein metabolism in poultry. **World’s Poultry Science Journal**, v. 67, n. 3, p. 431–440, 2011. Disponível em: <https://doi.org/10.1017/S0043933911000481>.

ARNAUT, L. D. S. **Estudo radiográfico das afecções do sistema esquelético em aves Estudo radiográfico das afecções do sistema esquelético em aves**. 2006. University of São Paulo, São Paulo, 2006.

AVIBASE. **Avibase - Bird Checklists of the World**. Disponível em: <https://avibase.bsc-eoc.org/checklist.jsp>. Acesso em: 22 jan. 2023.

BANDYOPADHYAY, S. Systemic clinical and metabolic diseases. *Em*: **Pet Bird Diseases and Care**. Springer Singapore, 2017. p. 167–252.

BAVELAAR, F. J.; BEYNEN, A. C. Atherosclerosis in parrots. A review. **Veterinary Quarterly**, v. 26, n. 2, p. 50–60, 2004.

BEAUFRÈRE, H. Blood Lipid Diagnostics in Psittacine Birds. **Veterinary Clinics of North America - Exotic Animal Practice**, v. 25, n. 3, p. 697–712, 1 set. 2022.

BEAUFRÈRE, H.; AMMERSBACH, M.; REAVILL, D. R.; GARNER, M. M.; HEATLEY, J. J.; WAKAMATSU, N.; NEVAREZ, J. G.; TULLY, T. N. Prevalence of and risk factors associated with atherosclerosis in psittacine birds. **Journal of the American Veterinary Medical Association**, v. 242, p. 1696–1704, 15 jun. 2013.

BEAUFRÈRE, H.; CRAY, C.; AMMERSBACH, M.; TULLY, T. N. Association of plasma lipid levels with atherosclerosis prevalence in psittaciformes. **Journal of Avian Medicine and Surgery**, v. 28, n. 3, p. 225–231, 1 set. 2014.

BEAUFRÈRE, H.; REAVILL, D.; HEATLEY, J.; SUSTA, L. Lipid-Related Lesions in Quaker Parrots (Myiopsitta monachus). **Veterinary Pathology**, v. 56, n. 2, p. 282–288, 1 mar. 2019.

BÉLAND, K.; FERRELL, S. T.; BEAUFRÈRE, H.; LAIR, S.; DESMARCHELIER, M. Impact of Dietary Fructose on the Lipid Profile in Six Macaws. **Journal of Avian Medicine and Surgery**, v. 35, n. 2, p. 196–203, 1 jun. 2021.

BRIGHTSMITH, D. J. Nutritional levels of diets fed to captive amazon parrots: Does mixing seed, produce, and pellets provide a healthy diet? **Journal of Avian Medicine and Surgery**, v. 26, n. 3, p. 149–160, set. 2012.

BUYSE, J.; DECUYPERE, E. Adipose Tissue and Lipid Metabolism. *Em*: SCANES, C. G. **Sturkie's Avian Physiology**. London: Elsevier Inc., 2015. p. 443–453.

CANDELETTA, S. C.; HOMER, B. L.; GARNER, M. M.; ISAZA, R. Association of Avian Veterinarians Diabetes Mellitus Associated with Chronic Lymphocytic Pancreatitis in an African Grey Parrot (Psittacus erithacus erithacus). **Source: Journal of the Association of Avian Veterinarians**, v. 7, n. 1, p. 39–43, 1993.

CAPITELLI, R.; CROSTA, L. Overview of Psittacine Blood Analysis and Comparative Retrospective Study of Clinical Diagnosis, Hematology and Blood Chemistry in Selected Psittacine Species. **Veterinary Clinics of North America - Exotic Animal Practice**, v. 16, n. 1, p. 71–120, 2013. Disponível em: <http://dx.doi.org/10.1016/j.cvex.2012.10.002>.

CARVALHO, P. **Alterações Patológicas Encontradas em Psitacídeos Mortos em Cativeiro de janeiro de 1994 a dezembro de 2002 no Estado do Paraná**. 2004. Universidade Federal do Paraná, Curitiba, 2004.

CASTRO, P. F. **Afecções cirúrgicas em aves: estudo retrospectivo**. 2010. Universidade de São Paulo, São Paulo, 2010.

CASTRO, P. F.; FANTONI, D. T.; MATERA, J. M. Restrospectivo cirurgicas. **Pesquisa Veterinária Brasileira**, v. 33, n. 5, p. 662–668, maio 2013.

CASTRO, P. F.; FANTONI, D. T.; MIRANDA, B. C.; MATERA, J. M. Prevalence of Neoplastic Diseases in Pet Birds Referred for Surgical Procedures. **Veterinary Medicine International**, v. 2016, n. 4096801, 2016.

CBRO. **Listas das aves do Brasil. 11ª Edição.Comitê Brasileiro de Registros Ornitológicos.**1 jan. 2014. Disponível em: <www.cbro.org.br>.

CITES. **Convention on International Trade in Endangered Species of Wild Fauna and Flora; Trade Database**. Disponível em: <https://trade.cites.org/#>. Acesso em: 16 nov. 2022.

COLLIARD, L.; ANCEL, J.; BENET, J.-J.; PARAGON, B.-M.; RALDINE BLANCHARD, G. Risk Factors for Obesity in Dogs in France. **American Society for Nutrition**, v. 136, n. 7, p. 1951s–1951s, 2006. Disponível em: <https://academic.oup.com/jn/article/136/7/1951S/4664731>.

COLLIARD, L.; PARAGON, B. M.; LEMUET, B.; BÉNET, J. J.; BLANCHARD, G. Prevalence and risk factors of obesity in an urban population of healthy cats. **Journal of Feline Medicine and Surgery**, v. 11, n. 2, p. 135–140, fev. 2009.

COWAN, M. **Liver and Lipid Disorders25th AAVAC Annual Conference**. Auckland: Association of Avian Veterinarians Australasian Committee Ltd, 2017. Disponível em: <www.aavac.com.au>.

CUBAS, Z. S.; SILVA, J. C. R.; CATÃO-DIAS, J. L. **Tratado de animais selvagens: medicina veterinária**. São Paulo: Roca, 2014.

DAVIES, R. R. Avian liver disease: Etiology and pathogenesis. **Seminars in Avian and Exotic Pet Medicine**, v. 9, n. 3, p. 115–125, 2000.

DE VOE, R. S.; TROGDON, M.; FLAMMER, K. Preliminary assessment of the effect of diet and L-carnitine supplementation on lipoma size and bodyweight in budgerigars (Melopsittacus undulatus). **Journal of Avian Medicine and Surgery**, v. 18, n. 1, p. 12–18, 2004.

DI SANTO, L. G.; BRAOS, L. B.; KAWANAMI, A. E.; OLIVEIRA, J. P.; CRUZ, N. R. N.; MENDONÇA, F. S.; PEIXOTO, M. C.; CARCIOFI, A. C. Feed processing effects on digestibility, palatability, excreta fermentation products and blood parameters in blue-fronted amazon parrots (Amazona aestiva). **Journal of Animal Physiology and Animal Nutrition**, v. 103, n. 1, p. 339–353, 1 jan. 2019.

DOS SANTOS, G. J.; ALEIXO, A. S. C.; HIPPÓLITO, A. G.; FERRO, B. S.; OKAMOTO, P. T. C. G.; LOURENÇO, M. L. G.; DE VASCONCELOS MACHADO, V. M.; RAMOS, P. R. R.; RAHAL, S. C.; TEIXEIRA, C. R.; MELCHERT, A. Are echocardiographic parameters affected by body condition scores in blue-fronted Amazon parrots (Amazona aestiva, Linnaeus, 1758)? **Veterinary Research Communications**, v. 46, n. 3, p. 749–755, 1 set. 2022.

DUNCAN, M. Gout in Exotic Animals. **Fowler's Zoo and Wild Animal Medicine, Volume**

8, p. 667–670, 1 jan. 2015.. Acesso em: 11 dez. 2022.

ECHENIQUE, J. V. Z.; SOARES, M. P.; ALBANO, A. P. N.; BANDARRA, P. M.; SCHILD, A. L. Diseases of wild birds in southern Rio Grande do Sul, Brazil. **Pesquisa Veterinaria Brasileira**, v. 40, n. 2, p. 121–128, 1 fev. 2020.

ECKARDSTEIN, A. von. Risk Factors for Atherosclerotic Vascular Disease. *Em*: KULKARNI, S. K. **Handbook of experimental pharmacology,** Berlin: Springer-Verlag Berlin Heidelberg, 2005. p. 71–105.

ENGEBRETSON, M. The welfare and suitability of parrots as companion animals: a review. 2006.

FISCHER, I.; CHRISTEN, C.; LUTZ, H.; GERLACH, H.; HÄSSIG, M.; HATT, J. M. Effects of two diets on the haematology, plasma chemistry and intestinal flora of budgerigars (Melopstittacus undulatus). **Veterinary Record**, v. 159, n. 15, p. 480–484, 7 out. 2006.

FITZGERALD, B. C.; BEAUFRÈRE, H. Cardiology. *Em*: BRIAN SPEER. **Current Therapy in Avian Medicine and Surgery**. St. Louis: Elsevier, 2015. p. 252–328.

FORSHAW, J. M. **Vanished and vanishing parrots: Profiling extinct and endangered species**. Clayton, Australia: CSIRO Publishing, 2017. 261–290 p.

FOTIN, C. M. P.; MATUSHIMA, E. R. **Levantamento prospectivo dos animais silvestres, exóticos e domésticos não convencionais, em cativeiro domiciliar, atendidos em clínicas particulares no município de São Paulo: aspectos do manejo e principais afecções**. 2005. Universidade de São Paulo, 2005.

FRICKE, C.; SCHMIDT, V.; CRAMER, K.; KRAUTWALD-JUNGHANNS, M. E.;

DORRESTEIN, G. M. Characterization of atherosclerosis by histochemical and immunohistochemical methods in African grey parrots (Psittacus erithacus) and Amazon parrots (Amazona spp.). **Avian Diseases**, v. 53, n. 3, p. 466–472, set. 2009.

FUSTER, V.; TOPOL, E. J.; NABEL, E. G. Risk factors: overview. *Em*: **Atherothrombosis and coronary artery disease**. Philadelphia: Lippincott Williams & Wilkins, 2005. p. 23–33.

GANCZ, A. Y.; WELLEHAN, J. F. X.; BOUTETTE, J.; MALKA, S.; LEE, S. E.; SMITH, D. A.; TAYLOR, M. Diabetes mellitus concurrent with hepatic haemosiderosis in two macaws (Ara severa, Ara militaris). **Avian Pathology**, v. 36, n. 4, p. 331–336, ago. 2007.

GIBSON, D. J.; NEMETH, N. M.; BEAUFRÈRE, H.; VARGA, C.; EAGALLE, T.; SUSTA, L. Captive Psittacine Birds in Ontario, Canada: a 19-Year Retrospective Study of the Causes of Morbidity and Mortality. **Journal of Comparative Pathology**, v. 171, p. 38–52, 1 ago. 2019.

GRUNKEMEYER, V. L. Advanced diagnostic approaches, and current management of avian hepatic disorders. **Veterinary Clinics of North America - Exotic Animal Practice**, v. 13, n. 3, p. 413–427, 1 set. 2010.

GUSTAVSEN, K. A.; STANHOPE, K. L.; LIN, A. S.; GRAHAM, J. L.; HAVEL, P. J.; PAUL-MURPHY, J. R. Effects of exercise on the plasma lipid profile in hispaniolan amazon parrots (Amazona ventralis) with naturally occurring hypercholesterolemia. **Journal of Zoo and Wildlife Medicine**, v. 47, n. 3, p. 760–769, 1 set. 2016.

GUYTON, A. C. Lipid metabolism. *Em*: GUYTON AC; HALL JE. **Textbook of Medical Physiology**. 11. ed. Philadelphia, PA: Elsevier Saunders, 2006. p. 840–851.

HARCOURT-BROWN, N. H. Psittacine birds. *Em*: TULLY, T. T.; DORRESTEIN, G. M.; JONES, A. K. **Handbook of Avian Medicine**. Philadelphia: W.B. Saunders, 2010. p. 138–

168.

HARPER, E. J.; SKINNER, N. D. Clinical Nutrition of Small Psittacines and Passerines. **Seminars in Avian and Exotic Pet Medicine**, v. 7, n. 3, p. 116–128, 1998.

HARRISON, G. J. Adapted from: Twenty Years of Progress in Pet Bird Nutrition Originally. **Journal of the American Veterinary Medical Association**, v. 212, n. 8, p. 1226–1230, 1998.

HARRISON, G. J.; MCDONALD, D. Nutritional Considerations Section II. *Em*: HARRISON G.J.; LIGHTFOOT T.L. **Clinical Avian Medicine**. Palm Beach: Spix Publishing, Inc., 2006. p. 108–140.

HARRISON, G. J.; RITCHIE, B. W.; HARRISON, L. R. Malnutrition. *Em*: BRANSON W. RITCHIE GREG J. HARRISON; LINDA R. HARRISON. **Avian Medicine: Princilpes and Application**. Florida: Wingers Pub., Lake Worth, 1994. p. 842–861.

HAZELWOOD RL. Pancreas. *Em*: WHITTOW GC. **Sturkie's avian physiology**. 5. ed. San Diego, CA: Academic Press, 2000. p. 539–556.

HENSEL, P. Nutrition and skin diseases in veterinary medicine. **Clinics in Dermatology**, v. 28, n. 6, p. 686–693, nov. 2010.

HESS, L.; MAULDIN, G.; ROSENTHAL, K. Estimated nutrient content of diets commonly fed to pet birds. **Veterinary Record**, v. 150, p. 399–404, 2002.

HOCHLEITHNER, M.; HOCHLEITHNER, C. 15. Evaluating and Treating the Liver. *Em*: HARRISON, G. J.; LIGHTFOOT, T. L. **Clinical Avian Medicine**. Palm Beach: Spix Publishing, Inc., 2011. p. 441–451.

HOPPES, S. **Exotic and Laboratory Animals - MSD Veterinary Manual**. Disponível em: <https://www.msdvetmanual.com/exotic-and-laboratory-animals/pet-birds/nutritional-diseases-of-pet-birds>. Acesso em: 12 fev. 2023.

HVENEGAARD, A. P.; SAFATLE, A. M. V.; GUIMARÃES, M. B.; FERREIRA, A. J. P.; BARROS, P. S. M. Retrospective study of ocular disorders in Amazon parrots. **Pesquisa Veterinária Brasileira**, v. 29, n. 12, p. 979–984, 2009.

IUCN. **IUCN Red List of Threatened Species**. Disponível em: <https://www.iucnredlist.org/search?taxonomies=22673595&searchType=species>. Acesso em: 29 dez. 2022.

JOLES, J. A. Obesity in dogs: Effects on renal function, blood pressure, and renal disease. **Veterinary Quarterly**, v. 20, n. 4, p. 117–120, 1998.

KALMAR, I. **Features of psittacine birds in captivity: focus on diet selection and digestive characteristics**. 2011. Ghent University, Merelbeke, Belgium, 2011.

KALMAR, I. D.; VEYS, A. C.; GEEROMS, B.; REINSCHMIDT, M.; WAUGH, D.; WERQUIN, G.; JANSSENS, G. P. J. Effects of segregation and impact of specific feeding behaviour and additional fruit on voluntary nutrient and energy intake in yellow-shouldered amazons (Amazona barbadensis) when fed a multi-component seed diet ad libitum. **Journal of Animal Physiology and Animal Nutrition**, v. 94, n. 6, dez. 2010.

KILPP, J.; SOMENZARI, M.; SCHUNCK, F. Dieta alimentar de Amazona vinacea no sul e sudeste de Santa Catarina, Brasil. **Atualidades Ornitológicas**, v. 183, p. 9–13, 2015.

KOLLIAS, G. v; KOLLIAS, H. W. Feeding Passerine and Psittacine Birds. *Em*: HAND, M.

S.; THATCHER, C. D.; REMILLARD, R. L.; ROUDEBUSH, P.; NOVOTNY, B. J. **Small Animals Clinical Nutrition**. 5th. ed. Topeka: Mark Morris Institute, 2010. p. 1255–1269.

KOUTSOS, E. A.; MATSON, K. D.; KLASING, K. C. Nutrition of birds in the order Psittaciformes: A review. **Journal of Avian Medicine and Surgery**, v. 15, n. 4, p. 257–275, 2001.

KOUTSOS, E. A.; SMITH, J.; WOODS, L. W.; KLASING, K. C. Nutrient Interactions and Toxicity Adult Cockatiels (Nymphicus hollandicus) Metabolically Adapt to High Protein Diets 1,2. **J. Nutr**, v. 131, 2014. Disponível em: <https://academic.oup.com/jn/article/131/7/2014/4686817>.

KOUTSOS, E.; GELIS, S.; ECHOLS, M. S. Foundations in avian nutrition. *Em*: SPEER, B. **Current Therapy in Avian Medicine and Surgery**. St. Louis: Elsevier, 2016. p. 142–176.

LANGENECKER, M. **Retrospektive Untersuchung zur Entwicklung der Artenverteilung und den häufigen Krankheitsbildern bei exotischen Heimtieren im Zeitraum von 1994 – 2003**. 2006. University of Zurich, 2006.

LANGLOIS, I. Medical Causes of Feather Damaging Behavior. **Veterinary Clinics of North America - Exotic Animal Practice**, v. 24, n. 1, p. 119–152, 2021. Disponível em: <https://doi.org/10.1016/j.cvex.2020.09.005>.

LANGLOIS, I.; JONES, M. P. Ventral abdominal hernia associated with hepatic lipidosis in a red lory (Eos bornea). **Journal of Avian Medicine and Surgery**, v. 15, n. 3, p. 216–222, 2001.

LAPINHA, M. I. **Doença hepática nutricional em psitacídeos**. 2022. Universidade de Lisboa, Lisboa, 2022.

LEVINE, B. S. Common Disorders of Amazons, Australian Parakeets, and African Grey Parrots. **Seminars in Avian and Exotic Pet Medicine**, v. 12, n. 3, p. 125–130, 2003.

LEVINE, B. S.; PRACTICE, C. A. Common disorders of Amazons, Australian Parakeets, and African Grey Parrot. **Seminars in Avian and Exotic Pet Medicine**, v. 12, n. 3, p. 125–130, 2003.

LI, L.; SUN, M.; ZHANG, Y.; LIAO, M. A Review of the Emerging Poultry Visceral Gout Disease Linked to Avian Astrovirus Infection. **International Journal of Molecular Sciences**, v. 23, n. 18, 1 set. 2022.

LIGHTFOOT, T. L. Overview of Tumors Overview of Tumors: Clinical Avian Neoplasia and Oncology. **Clinical Avian Medicine Volume II**, 2005.

LIGHTFOOT, T.; NACEWICZ, C. L. PSITTACINE BEHAVIOR. *Em*: BRADLEY BAYS, T.; LIGHTFOOT, T.; MAYER, J. **Exotic Pet Behavior — Birds, Reptiles, and Small Mammals**. Missouri: Saunders Elsevier, 2006. p. 51–101.

LOPES, I.; LAMA, M.; DEL LAMA, S. Genetic variability in three Amazon parrot species. **Braz. J. Biol**, v. 67, n. 4, p. 883–887, dez. 2007.

LUMEIJ, J. Hepatology. *Em*: **Avian medicine: principles and application.** Florida: Wingers Publishing, 1994a. p. 523–537.

LUMEIJ, J. T. Nephrology. *Em*: HARRISON, G. J.; RITCHIE, B. W.; HARRISON, L. R. **Avian medicine: principles and application.** . Florida: Wingers Pub, 1994b. p. 538–555.

LUND, E. M.; ARMSTRONG, J.; KIRK, C. A.; KLAUSNER, J. S. Prevalence and Risk

Factors for Obesity in Adult Cats from Private US Veterinary Practices. **International Journal of Applied Research in Veterinary Medicine**, v. 3, n. 2, 2005.

MARTIN, L. F. **Retrospective study on the species distribution and common diseases inexotic pets presented to the Clinic for Zoo Animals, Exotic Pets andWildlife, University of Zurich from 2005 to 2014**. 2018. University of Zurich, Zurich, 2018.

MCGREEVY, P. D.; THOMSON, P. C.; PRIDE, C.; FAWCETT, A.; GRASSI, T.; JONES, B. Prevalence of obesity in dogs examined byAustralian veterinary practices and the riskfactors involved. **Veterinary Record**, v. 156, p. 695–702, 28 maio 2005.

MENCH, J.; PAUL-MURPHY, J.; KLASING, K.; CUSSEN, V. True parrots (Psittacoidea). *Em*: JAMES YEATES. **Companion Animal Care and Welfare: The UFAW Companion Animal Handbook**. Sussex, UK: John Wiley & Sons Ltd, 2018. p. 338–355.

MONTESDEOCA, N.; CALABUIG, P.; CORBERA, J. A.; COOPER, J. E.; ORÓS, J. Causes of morbidity and mortality, and rehabilitation outcomes of birds in Gran Canaria Island, Spain. **Bird Study**, v. 64, n. 4, p. 523–534, 2017.

MONTESINOS, A.; SANDMEIER, P.; ARCA-RUIBAL, B.; BEAUFRERE, H.; SANCHEZ-MIGALLON GUZMAN, D.; SAGGESE, M. 13 - Systemic Diseases: Disorders of the Integument. *Em*: SAMOUR, J. **Avian Medicine (Third Edition)**. Mosby, 2016. p. 359–433.

MORISHITA, T. Y.; FULLERTON, A. T.; LOWENSTINE, L. J.; GARDNER, I. A.; BROOKS, D. L. Morbidity and Mortality in Free-Living Raptorial Birds of Northern California: A Retrospective Study, 1983-1994. **Journal of Avian Medicine and Surgery**, v. 12, n. 2, p. 78–81, jun. 1998. Disponível em: <https://www.jstor.org/stable/30133153>.

MURER, L. **Estudo Retrospectivo de Laudosde Necropsias dm Animais Domésticos e Silvestres do LCDPA - julho de 2018 a dezembro de 2019**. 2020. Universidade Federal de

Santa Maria, Santa Maria, 2020.

NEMETH, N. M.; GONZALEZ-ASTUDILLO, V.; OESTERLE, P. T.; HOWERTH, E. W. A 5-Year Retrospective Review of Avian Diseases Diagnosed at the Department of Pathology, University of Georgia. **Journal of Comparative Pathology**, v. 155, n. 2–3, p. 105–120, 1 ago. 2016.

NEOGI, T. Clinical practice: Gout. **N Engl J Med**, v. 364, p. 443–52, 3 fev. 2011. Disponível em: <www.fda.gov>.

OROSZ, S. E. Clinical avian nutrition. **Veterinary Clinics of North America - Exotic Animal Practice**, v. 17, n. 3, p. 397–413, 2014.

OROSZ, S. E.; MONKS, D.; DE MATOS, R. Clinical Endocrinology of the Protein Hormones. *Em*: **Current Therapy in Avian Medicine and Surgery**. [s.l.] ElSevier, inc., 2016. p. 378–399.

PERLMAN, J. Nutrition and Nutritional Management. *Em*: SAMOUR, J. **Avian medicine**. Missouri: Elsevier Health Sciences, 2015. p. 25–35.

PÉRON, F.; GROSSET, C. The diet of adult psittacids: Veterinarian and ethological approaches. **Journal of Animal Physiology and Animal Nutrition**, v. 98, n. 3, p. 403–416, 2014.

PERPIÑÁN, D. Problems of excess nutrients in psittacine diets. **Companion Animal**, v. 20, n. 9, p. 532–537, 2 set. 2015.

PETZINGER, C.; BAUER, J. E. Dietary considerations for atherosclerosis in common companion Avian species. **Journal of Exotic Pet Medicine**, v. 22, n. 4, p. 358–365, out.

2013.

PILNY, A. A. The Avian Pancreas in Health and Disease. **Veterinary Clinics of North America - Exotic Animal Practice**, v. 11, n. 1, p. 25–34, jan. 2008.

PINTO, F. E.; DE ANDRADE, T. U.; ENDRINGER, D. C.; LENZ, D. Haematological and serum biochemical reference values for captive blue-fronted amazon parrot: Blood reference values for Amazona aestiva. **Comparative Clinical Pathology**, v. 25, n. 3, p. 519–524, 1 maio 2016.

POLLOCK, C. Diagnosis and treatment of avian renal disease. **Veterinary Clinics of North America - Exotic Animal Practice**, v. 9, n. 1, p. 107–128, jan. 2006.

PRAES, P. L. **Estudo radiográfico retrospectivo das alterações do proventrículo em psitacídeos.** 2013. Universidade de São Paulo, São Paulo, 2013.

PRESTES, N. P.; MARTINEZ, J. Dieta alimentar do papagaio-charão (Amazona pretrei). *Em*: **Biologia da Conservação: estudo de caso com o papagaio-charão e outros papagaios brasileiros**. Passo Fundo: Universidade de Passo Fundo, 2008. p. 88–104.

RAHMAWATI, I. P. A Retrospective Study of Morbidity In Captive Columbiformes Housed In Bristol Zoo Gardens And Wild Place Project, United Kingdom From 2000-2017. **Open Acces Int. J. Trop. Vet. Biomed. Res**, v. 3, n. 1, p. 17–24, 2018. Disponível em: <www.jurnal.unsyiah.ac.id/IJTVBR>.

RAVICH, M.; CRAY, C.; HESS, L.; ARHEART, K. L. Lipid panel reference intervals for Amazon Parrots (Amazona species). **Journal of Avian Medicine and Surgery**, v. 28, n. 3, p. 209–215, 1 set. 2014.

REAVILL, D. R. Tumors of pet birds. **Veterinary Clinics of North America - Exotic**

Animal Practice, v. 7, n. 3, p. 537–560, 2004.

REAVILL, D. R.; DORRESTEIN, G. M. Pathology of Aging Psittacines. **Veterinary Clinics of North America - Exotic Animal Practice**, v. 13, n. 1, p. 135–150, 2010.

REDROBE, S. Treatment of avian liver disease. **Seminars in Avian and Exotic Pet Medicine**, v. 9, n. 3, p. 136–145, 2000.

RITCHIE, B. W.; HARRISON, G. J.; HARRISON, L. R. **Avian medicine: principles and application**. Lake Worth, Fla.: Wingers Pub, 1994. 1384 p.

ROBERTSON, I. D. The association of exercise, diet, and other factors with owner-perceived obesity in privately owned dogs from metropolitan Perth, WA. **Preventive Veterinary Medicine**, v. 58, n. 1–2, p. 75–83, 30 abr. 2003.

ROZEK, J. C.; DANNER, L. M.; STUCKY, P. A.; MILLAM, J. R. Over-sized pellets naturalize foraging time of captive Orange-winged Amazon parrots (Amazona amazonica). **Applied Animal Behavior Science**, v. 125, n. 1–2, p. 80–87, jun. 2010.

SALERNO, M.; FERRER, E.; WEI, S.; LI, X.; GAO, W.; OUELLETTE, D.; BALANO, A.; VASKA, P. Behavioral neuroimaging in birds using PET. v. 317, n. June 2018, p. 157–164, 2019.

SANTOS, G. G. C.; MATUELLA, G. A.; CORAIOLA, A. M.; SILVA, C. S.; LANGE, R. R.; C, A. S. G.; MATUELLA, G. A.; CORAIOLA, A. M.; SILVA, L. C.; LANGE, R. R. Doenças de aves selvagens diagnosticadas na Universidade Federal do Paraná (2003-2007) 1. v. 28, n. 11, p. 565–570, 2008.

SAXENA, K. B.; SINGH, L.; GUPTA, M.; WALLIS, E. S.; DE, B. Susceptibility to

SpontaneousAtherosclerosis in Pigeons: An Autosomal RecessiveTrait. **Euphytica**, v. 46, p. 143–148, 1990. Disponível em: <https://academic.oup.com/jhered/article/92/5/439/2187288>.

SERAFINI, P. P.; ANDRIGUETTO, J. L.; CAVALHEIRO, M. de L.; KLEMZ, C.; WARPECHOWSKI, M. B. Análise nutricional na dieta do Papagaio-de-cara-roxa Amazona brasiliensis no Litoral Sul do Estado de São Paulo. **Ornithologia**, v. 4, n. 2, p. 104–109, 2011.

SHIH, J. C. H.; PULLMAN, E. P.; KAO, K. J. Genetic Selection, General Characterization, and Histology of Atherosclerosis-Susceptible and-Resistant Japanese Quail *. **Atherosclerosis**, v. 49, n. 1, p. 41–53, out. 1983.

SHI-YEE HUNG, C.; SLADAKOVIC, I.; DIVERS, S. J. Diagnostic value of plasma biochemistry, haematology, radiography, and endoscopic visualisation for hepatic disease in psittacine birds. **Veterinary Record**, p. 1–8, 2019. Disponível em: <http://veterinaryrecord.bmj.com/>.

SICK, H.; HAFFER; JÜRGEN; ALVARENGA, H. F.; PACHECO, J. F.; BARRUEL, P. **Ornitologia brasileira**. Rio de Janeiro: Nova Fronteira, 1997. 912 p.

SINHORINI, J. A. **Neoplasias em aves domésticas e silvestres mantidas em domicílio_ avaliação anatomopatológica e imunoistoquímica**. 2008. Universidade de São Paulo, 2008.

SITBON, G.; LAURENT, F.; MIALHE, A.; KRUG, E.; KARMANN, H.; GROSS, R.; STROSSER, M. T.; COHEN, L.; JEAN-MARIE, P.; FOLTZER, C.; MIALHE, P. Diabetes in Birds. **Horm. Metab. Res**, v. 12, p. 1–9, 1980.

SMITH, K. A.; CAMPBELL, G. D.; PEARL, D. L.; JARDINE, C. M.; SALGADO-BIERMAN, F.; NEMETH, N. M. A retrospective summary of raptor mortality in Ontario, Canada (1991–2014), including the effects of West Nile virus. **Journal of Wildlife Diseases**, v. 54, n. 2, p. 261–271, 1 abr. 2018.

SOKMEN, A.; SOKMEN, G.; ACAR, G.; AKCAY, A.; KOROGLU, S.; KOLEOGLU, M.; YALCINTAS, S.; AYDIN, M. N. O impacto da obesidade isolada na função do ventrículo direito em adultos jovens. **Arquivos Brasileiros de Cardiologia**, v. 101, n. 2, p. 160–168, 2013.

SPEER, B. L.; OLSEN, G. P.; DONELEY, R.; MONKS, D.; VERSTAPPEN, F.; YARTO-JARAMILLO, E.; ELLIOTT, D.; WESTON, M.; RIVERO, J.; MCDONALD, A. Common Conditions of Commonly Held Companion Birds in Multiple Parts of the World. *Em*: SPEER, B. L. **Current therapy in avian medicine and surgery**. St Louis: Elsevier, 2016. p. 777–793.

STAHL, S.; VM, D.; KRONFELD, D.; CVIM, D. A.; CVN, D. A. Veterinary Nutrition of Large Psittacines. **Seminars in Avian and Exotic Pet Medicine**, v. 7, n. 3, p. 128–134, 1998.

STANFORD, M. Significance of cholesterol assays in the investigation of hepatic lipidosis and atherosclerosis in psittacine birds. **ExoticDVM**, v. 7, n. 3, p. 28–34, 2005.

STEVENSON, M.; NUNES, T.; MARSHALL, J.; SANCHEZ, J.; THORN-TON, R.; REICZIGEL, J.; ROBISON-COX, J.; SEBASTIANI, P.; SOLYMOS, P.; YOSHIDA, K.; JONES, G.-O.; PIRIKAHU, S.; FIRESTONE, S.; KYLE, R.; POPP, J.-H.; JAY, M.; MAINTAINER, C. R. **Package “epiR” Title Tools for the Analysis of Epidemiological Data**. 2020.

TOLL, P. W.; YAMKA, R. M.; SCHOENHERR, W. D.; HAND, M. S. Obesity. *Em*: MICHAEL S. HAND; CRAIG D. THATCHER; REBECCA L. REMILLARD; PHILLIP ROUDEBUSH; BRUCE J. NOVOTNY. **Small Animal Clinical Nutrition**. [s.l.] Mark Morris Institute, 2010. p. 501–545.

VANSTREELS, R. E. T.; TEIXEIRA, R. H. F.; CAMARGO, L. C.; NUNES, A. L. V.;

MATUSHIMA, E. R. Impacts of animal traffic on the Brazilian Amazon parrots (Amazona species) collection of the Quinzinho de Barros Municipal Zoological Park, Brazil, 1986-2007. **Zoo Biology**, v. 29, n. 5, p. 600–614, set. 2010.

WALLIS, N.; RAFFAN, E. The Genetic Basis of Obesity and Related Metabolic Diseases in **Humans and Companion Animals**. 2020. Disponível em: <www.preprints.org>.

WELLE, K. R. Body condition scoring in companion birds. Em: **Proceedings of Association of Avian Veterinarians Conference and Expo**, 1995, Philadelphia. [...]. Philadelphia: 1995. p. 487–490.

WICKHAM, H.; AVERICK, M.; BRYAN, J.; CHANG, W.; MCGOWAN, L.; FRANÇOIS, R.; GROLEMUND, G.; HAYES, A.; HENRY, L.; HESTER, J.; KUHN, M.; PEDERSEN, T.; MILLER, E.; BACHE, S.; MÜLLER, K.; OOMS, J.; ROBINSON, D.; SEIDEL, D.; SPINU, V.; TAKAHASHI, K.; VAUGHAN, D.; WILKE, C.; WOO, K.; YUTANI, H. Welcome to the Tidyverse. **Journal of Open-Source Software**, v. 4, n. 43, p. 1686, 21 nov. 2019.

WILDMANN, A. K.; CUSHING, A. C.; PFISTERER, B. R.; SULA, M. J. M. RETROSPECTIVE REVIEW OF MORBIDITY AND MORTALITY IN A POPULATION OF CAPTIVE BUDGERIGARS (MELOPSITTACUS UNDULATES). **Journal of Zoo and Wildlife Medicine**, v. 53, n. 2, p. 433–441, 1 jun. 2022.

WILSON, P. The epidemiology of atherosclerotic disease. *Em*: LOSCALZO, J. **Molecular Mechanisms of Atherosclerosis.** Boca Raton: CRC Press, 2004. p. 3–28.

WRIGHT, T. F.; TOFT, C. A.; ENKERLIN-HOEFLICH, E.; GONZALEZ-ELIZONDO, J.; ALBORNOZ, M.; RODRÍGUEZ-FERRARO, A.; ROJAS-SUÁREZ, F.; SANZ, V.; TRUJILLO, A.; BEISSINGER, S. R.; BEROVIDES, V. A.; GÁLVEZ, X. A.; BRICE, A. T.; JOYNER, K.; EBERHARD, J.; GILARDI, J.; KOENIG, S. E.; STOLESON, S.; MARTUSCELLI, P.; MICHAEL MEYERS, J.; RENTON, K.; RODRÍGUEZ, A. M.; SOSA-

ASANZA, A. C.; VILELLA, F. J.; WILEY, J. W. Nest Poaching in Neotropical Parrots. **Conservation Biology**, v. 15, n. 3, jun. 2001.

YOUNG, A. M.; HOBSON, E. A.; LACKEY, L. B.; WRIGHT, T. F. Survival on the ark: Life-history trends in captive parrots. **Animal Conservation**, v. 15, n. 1, p. 28–43, fev. 2012.

ZUCCA, P. **Avian Intelligence, Clinical Behavior, and Welfare**. Elsevier Ltd, 2016. 8–24 p.

CONCLUSÕES

6. CONCLUSÕES

Na avaliação de uma década de dados sobre papagaios neotropicais do gênero Amazona spp. Atendidos pelos serviços de ambulatório de aves e patologia animal do VPT/FMV-USP, evidenciou-se que:

1. A população estudada foi composta principalmente de espécies nativas, e pôde ser dividida em dois grupos, uma grande maioria pertencendo às espécies amplamente traficadas *A. aestiva* e *A. amazonica*; e uma minoria pertencendo a outras sete espécies do mesmo gênero, sendo três delas listadas como espécies ameaçadas de extinção. O sexo dos indivíduos foi frequentemente indeterminado, e os grupos etários mais representados foram os adultos e os juvenis, mantidos como animais de estimação e alimentados principalmente com dietas baseadas em sementes.
2. As principais razões pelas quais estas aves precisaram de atenção médica veterinária foi devido a doenças bacterianas e metabólicas. E, por outro lado, a principal causa para os tutores destas aves procurarem uma intervenção médica foi devido à presença de sintomas respiratórios, dermatológicos e gastrointestinais.
3. O presente estudo descreve a prevalência de doenças em papagaios neotropicais em cativeiro, com grande destaque para as doenças que podem ser prevenidas ou tratadas através de uma melhor compreensão dos requisitos específicos das espécies, incluindo adequações apropriadas à criação e gestão geral das aves, como infecções bacterianas, lipidose hepática, obesidade e trauma e com o objetivo de longo prazo para a redução dos níveis de stress.
4. Este estudo verificou tendências nos sistemas orgânicos afetados descritos na literatura, sendo o mais comum o sistema respiratório, afetado frequentemente por doenças infecciosas, principalmente bactérias, o tegumentário afetado principalmente por distúrbios neoplásicos, alterações comportamentais, e infecções bacterianas. E, finalmente, o sistema alimentar alterado maiormente por etiologias infecciosas, tais como bactérias, fungos e parasitas, respectivamente, e por uma grande variedade de processos físicos.
5. A identificação de tendências na prevalência de doenças e riscos para a saúde, é importante para o sucesso da gestão de populações de aves.

Este estudo reuniu informação suficiente para caracterizar a população de papagaios neotropicais mantidos em cativeiro, que foram pelos serviços de ambulatório de aves patologia animal do VPT/FMV-USP durante o período do estudo, e, para identificar as principais causas de morbidade assim como os sistemas mais afetados

O ponto forte do presente estudo é a sua enorme recolha de dados, que permite conclusões gerais aplicáveis a um género específico para focar tópicos de investigação e orientar outros estudos.

7. REFERÊNCIAS

ALLGAYER, M.; CZIULIK, M. Captive psittacines breeding. **Revista Brasileira de Reprodução Animal,** v. 31, p. 344–350, 2007. Disponível em: <www.cbra.org.br>.

ALMEIDA A.V. Prescrições zooterápicas indígenas brasileiras nas obras de Guilherme Piso (1611-1679). *Em*: ALVES AGC; LUCENA RFP; ALBUQUERQUE UP. **Atualidades em Etnobiologia e Etnoecologia**. Recife, Brasil: Nuppea, Sociedade Brasileira de Etnobiologia e Etnoecologia, 2005. p. 47–60.

ALVES, R. R. N. Relationships between fauna and people and the role of ethnozoology in animal conservation. **Ethnobiology and Conservation**, v. 1, n. 2012, 4 out. 2012.

ALVES, R. R. N.; LIMA, D. F. J. R.; ARAUJO, H. F. P. The live bird trade in Brazil and its conservation implications: An overview. **Bird Conservation International**, v. 23, n. 1, p. 53–65, mar. 2013.

ALVES, R. R. N.; NOGUEIRA, E. E. G.; ARAUJO, H. F. P.; BROOKS, S. E. Bird-keeping in the Caatinga, NE Brazil. **Human Ecology**, v. 38, n. 1, p. 147–156, fev. 2010.

ALVES, R. R. N.; ROCHA, L. A. Fauna at Home: Animals as Pets. *Em*: UNIVERSIDADE ESTADUAL DA PARAÍBA. **Ethnozoology Animals in our Lives**. Campina Grande: Elsevier Inc., 2018. p. 303–321.

ARAÚJO, C. **Comportamento alimentar e a comunicação sonora do papagaio-galego Alipiopsitta xanthops (Spix) 1824, em fragmentos de cerrado do Distrito Federal e Goiás**. 2007. UNIVERSIDADE ESTADUAL DE CAMPINAS, Campinas, 2007.

ARRISON, G. R. E. G. J. H.; WORTH, L.; DIETS, B.; WORTH, L. **Avian Medicine: Principles and Application**. Lake Worth, Florida: Wingers Publishing, Inc, 2009. 2009 p.

BASSO, E. B. **The Kalapalo Indians of central Brazil, (Case studies in cultural anthropology)**. 1. ed. New York: Holt, Rinehart, and Winston, 1973. 21 p.

BEAUFRÈRE, H.; AMMERSBACH, M.; REAVILL, D. R.; GARNER, M. M.; HEATLEY, J. J.; WAKAMATSU, N.; NEVAREZ, J. G.; TULLY, T. N. Prevalence of and risk factors associated with atherosclerosis in psittacine birds. **Journal of the American Veterinary Medical Association**, v. 242, n. 12, p. 1696–1704, 2015.

BEAUFRÈRE, H.; REAVILL, D.; HEATLEY, J.; SUSTA, L. Lipid-Related Lesions in Quaker Parrots (Myiopsitta monachus). **Veterinary Pathology**, v. 56, n. 2, p. 282–288, 1 mar. 2019.

BEISSINGER, S. R.; BUCHER, E. H. Can Parrots Be Conserved Through Sustainable Harvesting? **BioScience**, v. 42, n. 3, p. 164–173, mar. 1992. Disponível em: <http://www.jstor.orgURL:http://www.jstor.org/stable/1311821Accessed:02/05/200800:12>.

BERGMAN, L.; REINISCH, U. S. Comfort behavior and sleep. *Em*: LUESCHER, A. U. **Manual of parrot behavior**. Iowa: Blackwell Publishing, 2006. p. 59–63.

BONAPARTE, C.-L. **Conspectus Systematis Ornithologiae**. Paris: L. Martinent, 1854. 0–48 p.

BRIGHTSMITH, D. J. Nutritional levels of diets fed to captive amazon parrots: Does mixing seed, produce, and pellets provide a healthy diet? **Journal of Avian Medicine and Surgery**, v. 26, n. 3, p. 149–160, set. 2012.

BUSH, E. R.; BAKER, S. E.; MACDONALD, D. W. **Global trade in exotic pets 2006-2012Conservation Biology**Blackwell Publishing Inc., 2014.

CAPARROZ, R.; PACHECO, J. F. A homonymy in Psittacidae: new name for Salvatoria Miranda-Ribeiro. **Revista Brasileira de Ornitologia**, v. 4, n. 2, p. 174–175, 2006.

CAPITELLI, R.; CROSTA, L. Overview of Psittacine Blood Analysis and Comparative Retrospective Study of Clinical Diagnosis, Hematology and Blood Chemistry in Selected Psittacine Species. **Veterinary Clinics of North America - Exotic Animal Practice**, v. 16, n. 1, p. 71–120, 2013. Disponível em: <http://dx.doi.org/10.1016/j.cvex.2012.10.002>.

CARCIOFI, A. C.; PRADA, F. **Avaliacao de dieta a base de sementes e frutas para**

papagaios (amazona sp.). Determinacoes da seletividade dos alimentos, consumo, composicao nutricional, digestibilidade e energia metabolizavel. 1996. Universidade de São Paulo, 1996.

CARCIOFI, A. C.; PRADA, F. **Contribuição ao estudo da alimentação da Arara-Azul (Anodorhynchus hyacinthinus, Psittacidae, aves) no Pantanal - MS. I- Análise química do Acurí (Scheelea phalerata) e da Bocaiúva (Acrocomia totai). II- Aplicabilidade do método de indicadores naturais para o cálculo da digestibilidade. III- Energia metabolizável e ingestão de alimentos**. 2000. Universidade de São Paulo, 2000.

CARRARA, L. A.; FARIA, L. C. P.; MATOS, J. R.; ANTAS, P. D. T. Z. Papagaio-de-peito-roxo Amazona vinacea (Kuhl) (Aves: Psittacidae) no norte do Espírito Santo: redescoberta e conservação Lucas. **Revista Brasileira de Zoologia**, v. 25, n. 1, p. 154–158, 2008.

CBRO. **LISTAS DAS AVES DO BRASIL**. Comitê Brasileiro de Registros Ornitológicos, 18 out. 2010. Disponível em: <www.ib.usp.br/ceo/nomespop.htm>.

CHAN, D. T. C.; POON, E. S. K.; WONG, A. T. C.; SIN, S. Y. W. Global trade in parrots – Influential factors of trade and implications for conservation. **Global Ecology and Conservation**, v. 30, 1 out. 2021.

CHASTAIN, C. B.; VELLIOS, L. Companion Birds. **Animal Handling and Physical Restraint**, p. 151–162, 2018.

CITES. **Checklist of CITES species**. Disponível em: <https://checklist.cites.org/#/en/search/cites_appendices%5B%5D=I&output_layout=alphabetical&level_of_listing=0&show_synonyms=1&show_author=1&show_english=1&show_spanish=1&show_french=1&scientific_name=Psittaciformes&page=1&per_page=20>. Acesso em: 29 set. 2022a.

CITES. **Convention on International Trade in Endangered Species of Wild Fauna and Flora; Trade Database**. Disponível em: <https://trade.cites.org/#>. Acesso em: 16 nov. 2022b.

CLUBB, S.; VELEZ, J.; GARNER, M. M.; ZAIAS, J.; CRAY, C. Health and Reproductive

Assessment of Selected Puerto Rican Parrots (Amazona vittata) in Captivity. **Journal of Avian Medicine and Surgery**, v. 29, n. 4, p. 313–325, 2015.

COLES, B. H. **Essentials of Avian Medicine and Surgery Third edition**. Leipzig, Germany: Blackwell Publishing Lt, 2007. 334–339 p.

COLLAR, N. J. Family Psittacidae (Parrots). *Em*: DEL HOYO, J.; ELLIOT, A. E.; SARGATAL, J. **Handbook of the Birds of the World**. Barcelona: Lynx Edition, 1997. p. 280–479.

DONATTI, R. V.; RESENDE, M.; JUNIOR, F. C. F.; MARQUES, M. V. R.; ECCO, R.; SHIVAPRASAD, H. L.; DE RESENDE, J. S.; DA SILVA MARTINS, N. R. Fatal Proventricular Dilatation Disease in Captive Native Psittacines in Brazil. **Avian Diseases**, v. 58, n. 1, p. 187–193, 2014.

DONELEY, R. J. T.; MILLER, R. I.; FANNING, T. E. Proventricular dilatation disease: An emerging exotic disease of parrots in Australia: Case report. **Australian Veterinary Journal**, v. 85, n. 3, p. 119–123, mar. 2007.

DORRESTEIN, G. M. Diagnostic Approaches and Management of Diseases in Captive Passerines. **Seminars in Avian and Exotic Pet Medicine**, v. Volume 12, n. 1, p. 11–20, jan. 2003.

DUARTE, J. M. B.; CAPARROZ, R. Cytotaxonomic analysis of Brazilian species of the genus Amazona (Psittacidae, Aves) and confirmations of the genus Salvatoria (Ribeiro, 1920). **Brasilian Journal of Genetics**, v. 18, p. 623–628, 1995.

ECHENIQUE, J. V. Z.; SOARES, M. P.; ALBANO, A. P. N.; BANDARRA, P. M.; SCHILD, A. L. Diseases of wild birds in southern Rio Grande do Sul, Brazil. **Pesquisa Veterinaria Brasileira**, v. 40, n. 2, p. 121–128, 1 fev. 2020.

FAVRETTO, M. A. **Aves do Brasil, vol I: Rheiformes a Psittaciformes**. 12. ed. Florianópolis: Mario Arthur Favretto, 2021. v. 112–13 p.

FERNANDES, F. H.; MENDONÇA, S. V.; ALBANO, C.; FERREIRA, F. S.; ALVES, R. R.

N. Hunting, use and conservation of birds in Northeast Brazil. **Biodiversity and Conservation**, v. 21, n. 1, p. 221–244, 2012.

FORSHAW, J. M. **Vanished and vanishing parrots: Profiling extinct and endangered species**. Clayton, Australia: CSIRO PUBLISHING, 2017. 261–290 p.

FORSHAW, J. M.; COOPER, W. T. **Parrots of the world**. Melbourne: Lansdowne, 1973. 198–310 p.

FOTIN, C. M. P.; MATUSHIMA, E. R. **Levantamento prospectivo dos animais silvestres, exóticos e domésticos não convencionais, em cativeiro domiciliar, atendidos em clínicas particulares no município de São Paulo: aspectos do manejo e principais afecções**. 2005. Universidade de São Paulo, 2005.

FURNELL, S. Strengthening CITES processes for reviewing trade in captive-bred specimens and preventing mis-declaration and laundering: A review of trade in Southeast Asian parrot species. **TRAFFIC**, p. 26, 2019. Disponível em: <https://trade.cites.org/>.

GIBSON, D. J.; NEMETH, N. M.; BEAUFRÈRE, H.; VARGA, C.; EAGALLE, T.; SUSTA, L. Captive Psittacine Birds in Ontario, Canada: a 19-Year Retrospective Study of the Causes of Morbidity and Mortality. **Journal of Comparative Pathology**, v. 171, p. 38–52, 1 ago. 2019.

GILARDI, J. D.; MUNN, C. A. Patterns of activity, flocking, and habitat use in parrots of the peruvian Amazon. **Condor**, v. 100, n. 4, p. 641–653, 1998.

GRANTSAU, R.; CAMARGO, HF. Nova especie brasiliera de Amazona (Aves, Psittacidae). **Revista Brasileira de Biologia 49(4): 1017-1020**, v. 49, n. 4, p. 1017–1020, 1989.

GRESPAN, A.; RASO, T. de F. Psittaciformes (araras, papagaios, periquitos, calopsitas e cacatuas). *Em*: **Tratado de animais selvagens: medicina veterinária**. São Paulo: Roca, 2014.

HAFFER, J. **Avian speciation in tropical South America**. 1. ed. Massachusetts: Nuttall Ornithological Club, 1974. 390 p.

HARCOURT-BROWN, N. H. Psittacine birds. *Em*: TULLY, T. T.; DORRESTEIN, G. M.; JONES, A. K. **Handbook of Avian Medicine**. Philadelphia: W.B. Saunders, 2010. p. 138–168.

HEIDNER, G. L.; KORNEGAY, J. N.; PAGE, R. L.; DODGE, R. K.; THRALL, D. E. Analysis of Survival in a Retrospective Study of 86 Dogs with Brain Tumors. **Journal of Veterinary Internal Medicine**, v. 5, n. 4, p. 219–226, 1991.

HESS, D. R.; FAARC, R. Retrospective Studies and Chart Reviews Introduction Case Series Case-Control Study Matched Case-Control Study Summary. **RESPIRATORY CARE,** v. 49, n. 10, p. 1171–1174, 2004.

HONKAVUORI, K. S.; SHIVAPRASAD, H. L.; WILLIAMS, B. L.; QUAN, P. L.; HORNIG, M.; STREET, C.; PALACIOS, G.; HUTCHISON, S. K.; FRANCA, M.; EGHOLM, M.; BRIESE, T.; LIPKIN, W. I. Novel Borna virus in psittacine birds with proventricular dilatation disease. **Emerging Infectious Diseases**, v. 14, n. 12, p. 1883–1886, dez. 2008.

HUGUES BEAUFRÈRE; MÉLANIE AMMERSBACH, Drury R. Reavill; Michael M. Garner; J. Jill Heatley; Nobuko Wakamatsu; Javier G. Nevarez; Thomas N. Tully. Prevalence of and risk factors associated. **Journal of the American Veterinary Medical Association**, v. 242, p. 1696–1704, 15 jun. 2013.

HVENEGAARD, A. P.; SAFATLE, A. M. V.; GUIMARÃES, M. B.; FERREIRA, A. J. P.; BARROS, P. S. M. Retrospective study of ocular disorders in Amazon parrots. **Pesquisa Veterinária Brasileira**, v. 29, n. 12, p. 979–984, 2009.

ICMBIO. **Plano De Ação Nacional Para A Conservação Dos Papagaios Da Mata Atlântica.PAN- Papagaios.** BRASÍLIA. 2011.

ITIS. **Integrated Taxonomic Information System - Report: Aves**. Disponível em: <https://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=174371#null>. Acesso em: 2 jan. 2023.

IUCN. **IUCN Red List of Threatened Species**. Disponível em:

<https://www.iucnredlist.org/resources/summary-statistics#Summary%20Tables>. Acesso em: 20 dez. 2022.

IUCN. **IUCN Red List of Threatened Species**. Disponível em: <https://www.iucnredlist.org/search?taxonomies=22673595&searchType=species>. Acesso em: 29 dez. 2022.

JOHNE, R.; MÜLLER, H. Avian polyomavirus in wild birds: Genome analysis of isolates from Falconiformes and Psittaciformes. **Archives of Virology**, v. 143, n. 8, p. 1501–1512, 1998.

KALMAR, I. **Features of psittacine birds in captivity: focus on diet selection and digestive characteristics**. Merelbeke, Belgium: Ghent University, 2011. .

KALMAR, I. D.; VEYS, A. C.; GEEROMS, B.; REINSCHMIDT, M.; WAUGH, D.; WERQUIN, G.; JANSSENS, G. P. J. Effects of segregation and impact of specific feeding behaviour and additional fruit on voluntary nutrient and energy intake in yellow-shouldered amazons (Amazona barbadensis) when fed a multi-component seed diet ad libitum. **Journal of Animal Physiology and Animal Nutrition**, v. 94, n. 6, dez. 2010.

KILPP, J.; SOMENZARI, M.; SCHUNCK, F. Dieta alimentar de Amazona vinacea no sul e sudeste de Santa Catarina, Brasil. **Atualidades Ornitológicas**, v. 183, p. 9–13, 2015.

KOUTSOS, E. A.; MATSON, K. D.; KLASING, K. C. Nutrition of birds in the order Psittaciformes: A review. **Journal of Avian Medicine and Surgery**, v. 15, n. 4, p. 257–275, 2001.

KOUTSOS, E. A.; TELL, L. A.; WOODS, L. W.; KLASING, K. C. Nutrient Requirements Adult Cockatiels (Nymphicus hollandicus) at Maintenance Are More Sensitive to Diets Containing Excess Vitamin A Than to Vitamin A-Deficient Diets 1,2. **Journal of nutrition,** v. 133, n. 6, p. 1898–1902, jun. 2003. Disponível em: <https://academic.oup.com/jn/article/133/6/1898/4688083>.

LICARIÃO, M. R.; BEZERRA, D. M. M.; ALVES, R. R. N. Wild birds as pets in Campina Grande, Paraíba State, Brazil: An Ethnozoological Approach. **Anais da Academia Brasileira**

de Ciencias, v. 85, n. 1, p. 201–213, 2013.

LOPES, I.; LAMA, M.; DEL LAMA, S. Genetic variability in three Amazon parrot species. **Braz. J. Biol**, v. 67, n. 4, p. 883–887, dez. 2007.

MACHADO, P. A. R.; SAAD, C. E. P. O futuro das rações para aves ornamentais e silvestres no Brasil. **Aves Revista Sul Americana de Ornitofilia**, v. 3, p. 37–40, 2000.

MANN, C. J. **Observational research methods. Research design II: Cohort, cross sectional, and case-control studiesEmergency Medicine Journal**BMJ Publishing Group, 2003.

MARTUSCELLI, P. Ecology and conservation of the red-tailed Amazon Amazona brasiliensis in south-eastern Brazil. . **Bird Conservation International,** v. 5, p. 225–240, 1995.

MAYR, E. **Animal Species and Evolution**. Cambridge: Belknap of Harvard University Press, 1963. 811 p.

MEEHAN, C. L.; GARNER, J. P.; MENCH, J. A. Isosexual pair housing improves the welfare of young Amazon parrots. **Applied Animal Behaviour Science**, v. 81, n. 1, p. 73–88, 2003.

MENCH, J.; PAUL-MURPHY, J.; KLASING, K.; CUSSEN, V. True parrots (Psittacoidea). *Em*: JAMES YEATES. **Companion Animal Care and Welfare: The UFAW Companion Animal Handbook**. Sussex, UK: John Wiley & Sons Ltd, 2018. p. 338–355.

MMA**.** Portaria MMA nº 148, de 7 de junho de 2022. **Diário Oficial da República Federativa do Brasil.** Brasil. Ministério do Meio Ambiente, 21 maio 2004.

MMA. Portaria MMA nº 444, de 17 de dezembro de 2014. **Diário Oficial da União: seção 01.** Brasil. Ministério do Meio Ambiente, 17 dez. 2014.

MORISHITA, T. Y.; FULLERTON, A. T.; LOWENSTINE, L. J.; GARDNER, I. A.; BROOKS, D. L. Morbidity and Mortality in Free-Living Raptorial Birds of Northern

California: A Retrospective Study, 1983-1994. **Journal of Avian Medicine and Surgery**, v. 12, n. 2, p. 78–81, jun. 1998. Disponível em: <https://www.jstor.org/stable/30133153>.

MUNSHI-SOUTH, J.; WILKISON, G. DIET INFLUENCES LIFE SPAN IN PARROTS (PSITTACIFORMES). **The American Ornithologists' Union**, v. 123, n. 1, p. 108–118, 2006.

NEMETH, N. M.; GONZALEZ-ASTUDILLO, V.; OESTERLE, P. T.; HOWERTH, E. W. A 5-Year Retrospective Review of Avian Diseases Diagnosed at the Department of Pathology, University of Georgia. **Journal of Comparative Pathology**, v. 155, n. 2–3, p. 105–120, 1 ago. 2016.

OROSZ, S. E. Clinical avian nutrition. **Veterinary Clinics of North America - Exotic Animal Practice**, W.B. Saunders, 2014.

PACHECO, J. F.; SILVEIRA, L. F.; ALEIXO, A.; AGNE, C. E.; BENCKE, G. A.; BRAVO, G. A.; BRITO, G. R. R.; COHN-HAFT, M.; MAURÍCIO, G. N.; NAKA, L. N.; OLMOS, F.; POSSO, S. R.; LEES, A. C.; FIGUEIREDO, L. F. A.; CARRANO, E.; GUEDES, R. C.; CESARI, E.; FRANZ, I.; SCHUNCK, F.; DE Q. PIACENTINI, V. Annotated checklist of the birds of Brazil by the Brazilian Ornithological Records Committee—second edition. **Ornithology Research**, v. 29, n. 2, p. 94–105, 1 jun. 2021.

PERLMAN, J. Nutrition and Nutritional Management. *Em*: SAMOUR, J. **Avian medicine**. Missouri, USA: Elsevier Health Sciences, 2016. p. 25–35.

PÉRON, F.; GROSSET, C. The diet of adult psittacids: Veterinarian and ethological approaches. **Journal of Animal Physiology and Animal Nutrition.** Blackwell Publishing Ltd, 2014.

PERPIÑÁN, D. Problems of excess nutrients in psittacine diets. **Companion Animal**, v. 20, n. 9, p. 532–537, 2 set. 2015.

PIACENTINI, V. de Q.; ALEIXO, A.; AGNE, C. E.; MAURÍCIO, G. N.; PACHECO, J. F.; BRAVO, G. A.; BRITO, G. R. R.; NAKA, L. N.; OLMOS, F.; POSSO, S.; SILVEIRA, L. F.; BETINI, G. S.; CARRANO, E.; FRANZ, I.; LEES, A. C.; LIMA, L. M.; PIOLI, D.;

SCHUNCK, F.; AMARAL, F. R.; BENCKE, G. A.; COHN-HAFT, M.; FIGUEIREDO, L. F. A.; STRAUBE, F. C.; CESARI, E. Annotated checklist of the birds of Brazil by the Brazilian Ornithological Records Committee / Lista comentada das aves do Brasil pelo Comitê Brasileiro de Registros Ornitológicos. **Revista Brasileira de Ornitologia**, v. 23, n. 2, p. 91–298, 2015.

PILNY, A. A.; QUESENBERRY, K. E.; BARTICK-SEDRISH, T. E.; LATIMER, K. S., BERGHAUS, R. D. Evaluation of Chlamydophila psittaci infection and other risk factors for atherosclerosis in pet psittacine birds. **Journal of the American Veterinary Medical Association**, v. 240, n. 12, p. 1474–1480, 2012.

PIZO, M. A.; SIMÃO, I.; GALETTI, M. DIET AND FLOCK SIZE OF SYMPATRIC PARROTS IN THE ATLANTIC FOREST OF BRAZIL. **Onitologia neotropical**, v. 6, p. 87–95, 1995.

POLLOCK, C.; KLAPHAKE, E.; WELLEHAN, J. F. X. Avian Medicine: An Overview. *Em*: SPEER, B. **Current Therapy in Avian Medicine and Surgery**. Oakley, California: Elsevier Health Sciences, 2016. p. 1–21.

POWERS, R. P.; JETZ, W. Global habitat loss and extinction risk of terrestrial vertebrates under future land-use-change scenarios. **Nature Climate Change**. Nature Publishing Group, 1 abr. 2019.

PRESTES, N. P.; MARTINEZ, J. Dieta alimentar do papagaio-charão (Amazona pretrei). *Em*: **Biologia da Conservação: estudo de caso com o papagaio-charão e outros papagaios brasileiros**. Passo Fundo: Universidade de Passo Fundo, 2008. p. 88–104.

PROVOST, K. L.; JOSEPH, L.; SMITH, B. T. Resolving a phylogenetic hypothesis for parrots: implications from systematics to conservation. **Emu - Austral Ornithology**, v. 118, n. 1, p. 7–21, 2 jan. 2018. Disponível em: <https://doi.org/10.1080/01584197.2017.1387030>.

RAGUSA-NETTO; FECCHIO, J. Plant Food Resources and The Diet of A Parrot Community In A Gallery Forest Of The Southern Pantanal (Brazil). **Braz. J. Biol**, v. 66, n. 4, p. 1021–1032, nov. 2006.

REAVILL, D. R.; DORRESTEIN, G. M. Pathology of Aging Psittacines. **Veterinary Clinics of North America - Exotic Animal Practice**, v. 13, n. 1, p. 135–150, jan. 2010.

REDFORD, K. H. The Empty Forest. **BioScience**, v. 42, n. 6, p. 412–422, jun. 1992.

RIBEIRO, M. C.; MARTENSEN, A. C.; METZGER, J. P.; TABARELLI, M.; SCARANO, F.; FORTIN, M.-J. The Brazilian Atlantic Forest: A Shrinking Biodiversity Hotspot. *Em*: ZACHOS, F.; HABEL, J. **Biodiversity hotspots: distribution and protection of conservation**. Berlin, Germany: Springer Berlin Heidelberg, 2011. p. 405–434.

RIBEIRO, M. C.; METZGER, J. P.; MARTENSEN, A. C.; PONZONI, F. J.; HIROTA, M. M. The Brazilian Atlantic Forest: How much is left, and how is the remaining forest distributed? Implications for conservation. **Biological Conservation**, v. 142, n. 6, p. 1141–1153, jun. 2009.

RICKLEFS, R. E.; RICKLEFS, R. E. Intrinsic aging-related mortality in birds. **Journal Of Avian Biology**, v. 31, n. 2, p. 103–111, jun. 2000.

RITCHIE, B. W.; HARRISON, G. J.; HARRISON, L. R. **Avian medicine: principles and application**. Lake Worth, Fla.: Wingers Pub, 1994. 1384 p.

ROLDÁN, C. B.; LÓPEZ, M. X.; ESPEJEL, I.; ARELLANO, E. Literature review of the use of birds as pets in Latin-America, with a detailed perspective on Mexico. **Ethnobiology and Conservation**, v. 3, n. 2014, 2014.

ROMEU, R.; ALVES, N.; ROSA, I. L. Trade of Animals Used in Brazilian Traditional Medicine: Trends and Implications for Conservation. **Human Ecology**, v. 38, n. 5, p. 691–704, out. 2010. Disponível em: <https://www.jstor.org/stable/40928157>.

ROWLEY. Family Cacatuidae (Parrots). *Em*: DEL HOYO, J.; ELLIOT, A. E.; SARGATAL, J. **Handbook of the Birds of the World**. Barcelona: Lynx Editions, 1997. p. 246–477.

ROZEK, J. C.; DANNER, L. M.; STUCKY, P. A.; MILLAM, J. R. Over-sized pellets naturalize foraging time of captive Orange-winged Amazon parrots (Amazona amazonica). **Applied Animal Behaviour Science**, v. 125, n. 1–2, p. 80–87, jun. 2010.

SAAD, C. E. do P.; FERREIRA, W. M.; BORGES, F. M. de O.; BOSCOLI, L. L. AVALIAÇÃO NUTRICIONAL DE RAÇÕES COMERCIAIS E SEMENTE DE GIRASSOL PARA PAPAGAIOS-VERDADEIROS (Amazona aestiva) nutricional evaluation of commercial foods and sunflower seed for blue-fronted parrot (Amazona aestiva). **Ciência e Agrotecnologia**, n. 5, p. 1493–1499, 2007.

SALINAS-MELGOZA, A.; SALINAS-MELGOZA, V.; RENTOS, K. Factors influencing nest spacing of a secondary cavity-nesting parrot: Habitat heterogeneity and proximity of conspecifics. **Condor**, v. 111, n. 2, p. 305–313, 2009.

SÁNCHEZ, G. F.; LEDESMA, R. I.; MORALES, S. E. A retrospective study of neoplasms in ornamental and pet birds diagnosed at the Hospital de Aves of the Universidad Nacional Autónoma de México (2007-2014). **Brazilian Journal of Veterinary Pathology**, v. 13, n. 1, p. 1–11, 2020.

SCHEFFERS, B. R.; OLIVEIRA, B. F.; LAMB, I.; EDWARDS, D. P. Global wildlife trade across the tree of life. **Science**, v. 366, n. 6461, p. 71–76, 2019. Disponível em: <https://www.science.org>.

SCHODDE, R.; REMSEN, J. v.; SCHIRTZINGER, E. E.; JOSEPH, L.; WRIGHT, T. F. Higher classification of new world parrots (psittaciformes; arinae), with diagnoses of tribes. **Zootaxa**, v. 3691, n. 5, p. 591–596, 24 jul. 2013.

SEIBERT, L. M. Social behavior of psittacine birds. *Em*: LUESCHER, A. U. **Manual of parrot behavior**. Iowa: Blackwell Publishing, 2006. p. 43–48.

SEIXAS, G. H. F. **ECOLOGIA ALIMENTAR, ABUNDÂNCIA EM DORMITÓRIOS E SUCESSO REPRODUTIVO DO PAPAGAIO-VERDADEIRO (Amazona aestiva) (Linnaeus, 1758) (Aves: Psittacidae), EM UM MOSAICO DE AMBIENTES NO PANTANAL DE MIRANDA, MATO GROSSO DO SUL,** 2009. UNIVERSIDADE FEDERAL DE MATO GROSSO DO SUL, Campo Grande, 2009.

SERAFINI, P. P.; ANDRIGUETTO, J. L.; CAVALHEIRO, M. de L.; KLEMZ, C.; WARPECHOWSKI, M. B. Análise nutricional na dieta do Papagaio-de-cara-roxa Amazona brasiliensis no Litoral Sul do Estado de São Paulo. **Ornithologia**, v. 4, n. 2, p. 104–109, 2011.

SERPELL, J. A. Pet-Keeping in Non-Western Societies: Some Popular Misconceptions. **Anthrozoös**, v. 1, n. 3, p. 166–174, set. 1987.

SICK, H.; HAFFER; JÜRGEN; ALVARENGA, H. F.; PACHECO, J. F.; BARRUEL, P. **Ornitologia brasileira**. Rio de Janeiro: Nova Fronteira, 1997. 912 p.

SMITH, K. A.; CAMPBELL, G. D.; PEARL, D. L.; JARDINE, C. M.; SALGADO-BIERMAN, F.; NEMETH, N. M. A retrospective summary of raptor mortality in Ontario, Canada (1991–2014), including the effects of West Nile virus. **Journal of Wildlife Diseases**, v. 54, n. 2, p. 261–271, 1 abr. 2018.

SNYDER, N. F. R.; WILEY, J. W.; KEPLER, C. B. **The Parrots of Luquillo: Natural History and Conservation of the Puerto Rican Parrot;** Los Angeles, California: Western Foundation of Vertebrate Zoology, 1987. xiii–384 p.

SPEER, B. Normal and abnormal parrot behavior. **Journal of Exotic Pet Medicine**, v. 23, n. 3, p. 230–233, 2014. Disponível em: <http://dx.doi.org/10.1053/j.jepm.2014.06.009>.

STONE, E. G.; MONTIEL-PARRA, G.; PÉREZ, T. M. A survey of selected parasitic and viral pathogens in four species of Mexican parrots, Amazona autumnalis, Amazona oratrix, Amazona viridigenalis, and Rhynchopsitta pachyrhyncha. **Journal of Zoo and Wildlife Medicine**, v. 36, n. 2, p. 245–249, 2005.

TULLY, T. N.; DORRESTEIN, G. M.; JONES, A. K. **Handbook of Avian medicine**. Philadelphia: Elsevier Limited, 2009. 85–100 p.

ULLREY, D. E.; ALLEN, M. E.; BAER, D. J. Formulated Diets versus Seed Mixtures for Psittacines. **The Journal of Nutrition**, v. 121, n. suppl_11, p. S193–S205, 1 nov. 1991. Disponível em: <https://doi.org/10.1093/jn/121.suppl_11.S193>.

VANSTREELS, R. E. T.; TEIXEIRA, R. H. F.; CAMARGO, L. C.; NUNES, A. L. V.; MATUSHIMA, E. R. Impacts of animal traffic on the Brazilian Amazon parrots (Amazona species) collection of the Quinzinho de Barros Municipal Zoological Park, Brazil, 1986-2007. **Zoo Biology**, v. 29, n. 5, p. 600–614, set. 2010.

VAZ, F. F.; SIPINSKI, E. A. B.; SEIXAS, G. H. F.; PRESTES, N. P.; MARTINEZ, J.; RASO, T. F. Molecular survey of pathogens in wild amazon parrot nestlings: Implications for conservation. **Diversity**, v. 13, n. 6, 1 jun. 2021.

VOGELNEST, L.; TALBOT, J. J. Quality-of-Life Assessment and End-of-Life Planning for Geriatric Zoo Animals. **Fowler's Zoo and Wild Animal Medicine Current Therapy,** , v. Volume 9, p. 83–91, 2019.

WERQUIN, G. J. D. L.; DE COCK, K. J. S.; GHYSELS, P. G. C. Comparison of the nutrient analysis and caloric density of 30 commercial seed mixtures (in toto and dehulled) with 27 commercial diets for parrots. **Journal of Animal Physiology and Animal Nutrition I**, v. 89, p. 215–221, 2005.

WILBERT, J. **Survivors of Eldorado: Four Indian Cultures of South America**. New York: Praeger, 1972. 96–97 p.

WILDMANN, A. K.; CUSHING, A. C.; PFISTERER, B. R.; SULA, M. J. M. RETROSPECTIVE REVIEW OF MORBIDITY AND MORTALITY IN A POPULATION OF CAPTIVE BUDGERIGARS (MELOPSITTACUS UNDULATES). **Journal of Zoo and Wildlife Medicine**, v. 53, n. 2, p. 433–441, 1 jun. 2022.

WINKLER, D. W.; BILLERMAN, S. M.; LOVETTE, I. J. **New World and African Parrots (Psittacidae), version 1.0.** Ithaca, NY, USA.: Cornell Lab of Ornithology, 2020.

WRIGHT, T. F.; TOFT, C. A.; ENKERLIN-HOEFLICH, E.; GONZALEZ-ELIZONDO, J.; ALBORNOZ, M.; RODRÍGUEZ-FERRARO, A.; ROJAS-SUÁREZ, F.; SANZ, V.; TRUJILLO, A.; BEISSINGER, S. R.; BEROVIDES, V. A.; GÁLVEZ, X. A.; BRICE, A. T.; JOYNER, K.; EBERHARD, J.; GILARDI, J.; KOENIG, S. E.; STOLESON, S.; MARTUSCELLI, P.; MICHAEL MEYERS, J.; RENTON, K.; RODRÍGUEZ, A. M.; SOSA-ASANZA, A. C.; VILELLA, F. J.; WILEY, J. W. Nest Poaching in Neotropical Parrots. **Conservation Biology**, v. 15, n. 3, jun. 2001.

YOUNG, A. M.; HOBSON, E. A.; LACKEY, L. B.; WRIGHT, T. F. Survival on the ark: Life-history trends in captive parrots. **Animal Conservation**, v. 15, n. 1, p. 28–43, fev. 2012.

ZULIAN, V.; MILLER, D. A. W.; FERRAZ, G. Endemic and threatened amazona parrots of the atlantic forest: An overview of their geographic range and population size. **Diversity**, v. 13, n. 9, 1 set. 2021.