Health of an *ex situ* population of raptors
(Falconiformes and Strigiformes) in Mexico: diagnosis of internal parasites

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Abstract: Successful programs for *ex situ* and *in situ* conservation and management of raptors require detailed knowledge about their pathogens. The purpose of this study was to identify the internal parasites of some captive raptors in Mexico, as well as to verify their impact in the health status of infected birds. Birds of prey were confiscated and kept in captivity at the Centro de Investigación y Conservación de Vida Silvestre (CIVS) in Los Reyes La Paz, Mexico State. For this, fecal and blood samples from 74 birds of prey (66 Falconiformes and eight Strigiformes) of 15 species, juveniles and adults from both sexes (39 males and 35 female), were examined for the presence of gastrointestinal and blood parasites. Besides, the oropharyngeal cavity was macroscopically examined for the presence of lesions compatible with trichomoniasis. Among our results we found that lesions compatible with *Trichomonas gallinae* infection were detected only in two Red-tailed hawks (*Buteo jamaicensis*) (2.7%); nevertheless, infected birds were in good physical condition. Overall, gastrointestinal parasites were found in 10 (13.5%) raptors: nine falconiforms (13.6%) and one strigiform (12.5%), which mainly presented a single type of gastrointestinal parasite (90%). *Eimeria* spp. was detected in Harris's hawk (*Parabuteo unicinctus*), Swainson's hawk (*Buteo swainsoni*), Red-tailed hawk (*B. jamaicensis*) and Great horned owl (*Bubo virginianus*); whereas trematodes eggs were found in Peregrine falcon (*Falco peregrinus*) and Swainson's hawk (*B. swainsoni*). Furthermore, eggs of *Capillaria* spp. were found in one Swainson's hawk (*B. swainsoni*), which was also infected by trematodes. Hemoprotozoarian were detected in five (6.7%) falconiforms: *Haemoproteus* spp. in American kestrel (*F. sparverius*) and *Leucocytozoon* spp. in Red-tailed hawk (*B. jamaicencis*). Despite this, no clinical signs referable to gastrointestinal or blood parasite infection were observed in any birds. All parasites identified were recorded for the first time in raptors from Mexico. Furthermore, this represents the first report for *T. gallinae*, trematodes, *Haemoproteus* spp. and *Leucocytozoon* spp. in raptors from Latin America. Diagnosis and control of parasitic infections should be a part of the routine in health care evaluations for *ex situ* raptor populations. Finally, this information is also valuable for *in situ* conservation actions on these birds. Rev. Biol. Trop. 59 (3): 1265-1274. Epub 2011 September 01.

Key words: raptors, gastrointestinal parasites, hemoparasites, conservation, captivity.

In the last decades, a substantial volume of medical information has become available as a result of the increased interest in raptors (Fix & Barrows 1990, Wendell *et al*. 2002, Naldo & Samour 2004). According to several studies, the most common causes of morbidity

in these birds are infectious and parasitic diseases, traumatic injuries, toxicosis, and metabolic or nutritional diseases (Fix & Barrows 1990, Deem *et al*. 1998, Wendell *et al*. 2002, Naldo & Samour 2004). Infectious diseases caused by bacterial, viral, fungal, and/or parasitic origin are common in wild and captive birds of prey (Deem 1999, Jones 2006). Though parasites are the most frequent pathogens in raptors, the gastrointestinal and respiratory tracts are most commonly affected by nematodes, trematodes, cestodes, acanthocephalans and protozoans (Baker *et al*. 1996, Aguilar 2001, Ferrer *et al*. 2004a, Ferrer *et al*. 2004b, Leppert *et al*. 2008, Silva *et al*. 2009). Overt clinical signs of parasitism are not common, subclinical parasitism may become evident during stress conditions, and heavy infections by gastrointestinal parasites may cause diarrhea, anorexia, emaciation, listlessness, and death (Baker *et al*. 1996, Morishita 1997, Freitas *et al*. 2002, Jones 2006).

Much debate exists regarding the pathogenicity of hemoparasites in raptors. Most researchers agree that *Plasmodium* spp. is of clinical significance and may result in signs of depression, weight loss, labored respiratory effort, anemia, and decreased appetite (Deem 1999, Jones 2006). This way, the diagnosis and control of parasitic infections should be part of the routine in protocols with captive raptors (Morishita 1997, Deem 1999). Furthermore, the review of morbidity and mortality causes in captive raptors, may provide insight about the health status and conservation of wild populations (Wendell *et al*. 2002, Deem *et al*. 2008). Besides, successful work in the field of conservation and management (*ex situ* and *in situ*) of raptors requires detailed knowledge about their pathogens (Baker *et al*. 1996, Morishita 1997, Morishita *et al*. 1998, Deem *et al*. 2008).

At present, several Mexican raptors are included in Appendices I and II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Peterson & Chalif 1989). Some endemic species of diurnal (Falconiformes) and nocturnal (Strigiformes) raptors are kept in captivity in Mexico, but studies about the parasite fauna in these birds are scarce (Santos-Morin 2010). Aiming to generate new information, the purpose of this search was to identify the internal parasites of some captive raptors in Mexico, as well as to determine their impact on their health status.

MATERIALS AND METHODS

Study population: Between January and December 2008, 74 raptors (66 Falconiformes and eight Strigiformes) of 15 species (Table 1), juveniles and adults from both sexes (39 males and 35 female), were evaluated for the presence of *Trichomonas gallinae*, gastrointestinal and blood parasites. The birds were confiscated by the Secretaria del Medio Ambiente y Recursos Naturales (SEMARNAT) because their breeders were not licensed to keep wildlife nor avian species. Birds were kept at the Centro de Investigación y Conservación de Vida Silvestre (CIVS) in Los Reyes La Paz (20º22'N, 98º59'W), Mexico State. The CIVS is located at an altitude of 2 250masl. The climate is hot and dry with a mean temperature of 16.4ºC and a relative humidity of 70%. Annual precipitation is 800-900mm.

Apart from the absence of licenses, other causes for admission at the CIVS included: acute traumatic injuries, electrocution , infectious diseases, orphaned young, metabolic and/or nutritional diseases. Since all the birds were originally found in several counties in Mexico, the information regarding their origins was unavailable.

All CIVS birds were long-term captive raptors. According to Morishita *et al*. (2001), free-living raptors are defined as birds that have been in captivity less than 24 hours, and were solely admitted because of acute traumatic injuries, thus increasing the probability of otherwise healthy subjects, free from seasonal dietary stresses, and with normal parasite burdens.

The 74 raptors lived in 12 enclosures, definided as following: A (n=8), B (n=11), C (n=4), D (n=8), E (n=3), F (n=6), G (n=7), H

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TABLE 1

Gastrointestinal and blood parasites of raptors kept in captivity at the Centro de Investigación
y Conservación de Vida Silvestre (CIVS) of Mexico, January to December 2008

Orden	Species	Examined	Infected	Internal parasites
Falconiformes	*Falco sparverius* (American kestrel)	8	4	*Haemoproteus* spp.
	F. peregrinus (Peregrine falcon)	3	2	Trematodes
	Caracara cheriway (Caracara)	6	-	
	Buteo swainsoni (Swainson's hawk)	3	3	*Eimeria* spp., Trematodes, *Capillaria* spp.
	B. nitidus (Grey hawk)	5	-	
	B. jamaicensis (Red-tailed hawk)	18	4	*Trichomonas gallinae, Eimeria* spp., *Leucocytozoon* spp.
	Buteo albicaudatus (White-tailed hawk)	1	-	
	Parabuteo unicinctus (Harris's hawk)	20	3	*Eimeria* spp.
	Buteogallus antrhacinus (Common black hawk)	1	-	
	Accipiter striatus (Sharp-shinned hawk)	1	-	
Strigiformes	*Bubo virginianus* (Great horned owl)	4	1	*Eimeria* spp.
	Strix virgata (Mottled owl)	1		
	Athene cunicularia (Burrowing owl)	1		
	Megascops asio (Eastern screech owl)	1		
	Tyto alba (Barn owl)	1		

(n=1), I (n=10), J (n=6), K (n=3) and L (n=7). Enclosures allow limited flight and included weather protected sites and resting perches. Cages were encompassed by wire or plastic screen net siding, and birds were exposed to ambient weather conditions. Enclosures were raked two or three times/week.

Birds were fed three days/week with thawed chicks, mice or rats and given free access to water.

The health status of birds was evaluated and classified by their weight as follows: thin, good condition and obese (Greenacre 2003, Haire 2003).

For the parasite control, birds were dewormed (with fenbendazole or ivermectin) upon arrival and twice a year. This deworming was performed only in the presence of clinical signs. Periodically, infested birds were treated with organophosphorate dusting.

Additionally, birds were provided with veterinary medical attention and/or flight rehabilitation as needed.

Infection by *T. gallinae*: To study the clinical infection by *T. gallinae*, the oropharynx of birds were examined macroscopically, for presence of white and caseous lesions, or stomatitis as indicator for trichomonosis (Cooper 1978, Real *et al*. 2000, Krone *et al*. 2005). Unfortunately, confirmatory oropharyngeal swabs could not be performed.

Gastrointestinal parasites: Fecal sample collection was performed twice (with an interval of 15 days), two months after the last deworming. Seventy-four fresh fecal samples were collected from newspapers or plastic covers on the cage floor (for 12 hours) (Clyde & Patton 2000, Silva *et al*. 2009). Samples were transported in plastic bags on ice, and kept at 4ºC, for processing generally within one week (Freitas *et al*. 2002).

Fecal samples were analyzed for Sheather's flotation (hypersaturated sugar solution, density 1.3g) and sedimentation techniques (Baker *et al*. 1996, Freitas *et al*. 2002). When

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unsporulated coccidial oocysts were found during flotation examination, an aliquot was placed in a 2% potassium dicromate solution at 28ºC for at least 1 week, and the flotation procedure was then repeated (Freitas *et al*. 2002). Cysts, oocysts and eggs were identified by their morphology and size (Baker *et al*. 1996, Foreyt 2001, Freitas *et al*. 2002). Whenever possible, the parasites were identified to genus.

Blood parasites: A total of 74 blood samples were obtained by venepuncture of the medial metatarsal vein; thin blood smears were made and air dried (Muñoz *et al*. 1999, Leppert *et al*. 2008). At the laboratory, they were fixed in absolute methanol and stained with Giemsa's solution. Then, slides were examined with a high-power microscope under immersion oil (100X) for a total observation of 120 to 130 microscope fields for each smear (Muñoz *et al*. 1999). Because speciation of *Haemoproteus* and *Leucocytozoon* is difficult based on morphology alone (Ziman *et al*. 2004), only the genus was recorded.

RESULTS

In general, 52.7% of the raptors presented good physical condition. Thin and obese birds (31.1% and 16.2%, respectively) were also observed.

Infection by *T. gallinae*: The presence of caseous lesions (compatibles with the infection by *T. gallinae*) was observed in the oropharinx of two (2.7%) *Buteo jamaicensis* (Table 1). Nevertheless, the birds were in good physical condition.

Gastrointestinal parasites: Overall, the gastrointestinal parasites were found in 10 (13.5%) of 74 birds. Of the 66 falconiforms examined, nine (13.6%) were infected. In the case of strigiform infection, it was present only in one (12.5%) of the eight examined birds. The majority of birds (90%) were infected with a single type of parasite.

The following parasites were identified from the analyzed samples: oocysts of *Eimeria* spp., trematodes and *Capillaria* spp. eggs. *Eimeria* spp. was found in *Parabuteo unicinctus* (n=3), *B. swainsoni* (n=1), *B. jamaicensis* (n=1) and *Bubo virginianus* (n=1); whereas trematodes eggs were found in *Falco peregrinus* (n=2) and *B. swainsoni* (n=2). Eggs of *Capillaria* spp. were found in one *B. swainsoni*, which was also infected by trematodes (Table 1). Furthermore, no clinical signs, referable to parasite infection, were observed in any birds.

Blood parasites: Hemoparasites (Apicomplexa, Haemosporida) were found in five (6.7%) birds. *Haemoproteus* spp. was found in four *F. sparverius,* and *Leucocytozoon* spp. in one *B. jamaicencis* (Table 1).

DISCUSSION

Many parasitic pathogens of birds of prey are opportunistic and can be easily managed or averted with proper preventive measures related to captive management, husbandry and diet, and veterinary care (Morishita 1997, Morishita *et al*. 1998, Deem 1999, Freitas *et al*. 2002, Joseph 2006, Willette *et al*. 2009). The knowledge of parasites commonly found in raptors contributes and help ensure prompt, appropriate and judicious control measures (Baker *et al*. 1996, Joseph 2006, Silva *et al*. 2009, Willette *et al*. 2009). Despite this, there are limited studies about the parasites of raptors in Latin America.

Trichomoniasis is the most important parasitic disease of raptors, and has been reported worldwide in these birds (Boal *et al*. 1998, Deem 1999, Real *et al*. 2000). According to Fowler (2001), the trichomoniasis is more frequent in strigiforms than in falconiforms. However, in this study, lesions compatible with trichomoniasis were found solely in two Red-tailed hawks (*B. jamaicensis*) newly-arrived to the CIVS. It is likely that the birds were infected upon arrival at CIVS, since in this Center birds were not fed with pigeons or other columbiforms, the main primary hosts of *T.*

gallinae, a sarcomastigophoran protozoa (Real *et al.* 2000, Krone *et al.* 2005).

Most of the strains of *T. gallinae* are found in the upper digestive tract of their hosts, and are considered to be non-pathogenic; however, others are highly virulent and are responsible for proliferative lesions on the tongue and oropharyngeal surfaces (Cooper & Petty 1988, Samour *et al.* 1995, Real *et al.* 2000, Aguilar 2001, Sansano-Maestre *et al.* 2009). Studies revealed marked differences in pathogenicity and virulence among different strains of *T. gallinae* from pigeons and birds of prey (Sansano-Maestre *et al.* 2009). The bird may have difficulty swallowing and, in severe infections, may be emaciated because of its inability to eat (Boal *et al.* 1998, Deem 1999). Nevertheless, affected birds may have good physical condition, and after the appropriate treatment, lesions disappear (Real *et al.* 2000, Jones 2006). Capillariasis, candidiasis, hypovitaminosis A and bacterial abscesses may also cause oral lesions, similar to those of trichomonad infections, especially in the early stages (Deem 1999, Krone *et al.* 2005, Jones 2006). Capillariasis is different from trichomoniasis and is often more extensive, with lesions in mouth, oropharynx, esophagus, crop, small intestine and cecum (Deem 1999). Candidiasis is often secondary to an underlying inmunocompromising condition or prolonged antibiotic therapy (Deem 1999, Jones 2006). In this study, despite of clinic diagnosis, lesions disappeared after the treatment with metronidazole. For the first time, lesions compatible with trichomoniasis are recorded in raptors for Latin America. Further research is needed to investigate the prevalence of *T. gallinae* infections in birds of prey of the region.

Several gastrointestinal parasites frequently reported in raptors worldwide (Hoberg *et al.* 1989, Ferrer *et al.* 2004a, Ferrer *et al.* 2004b) were not identified in this study. Failure to identify some parasites may be due to differences in the geographic distribution of the hosts and/or parasites, the feeding habits of host species, and the material origin (Baker *et al.* 1996). Most studies used samples from

necropsies, whereas this study was based in coprologic analysis. With necropsy material, the helminths are most prevalent in wild and captive raptors (Hoberg *et al.* 1989, Ferrer *et al.* 2004a, Ferrer *et al.* 2004b), whereas protozoa are most prevalent in coprologic surveys (Baker *et al.* 1996, Silva *et al.* 2009). Gastrointestinal parasites found in this study are reported in many species of captive and wild raptors worldwide (Greenwood *et al.* 1984, Baker *et al.* 1996, Freitas *et al.* 2002, Silva *et al.* 2009); however, *Eimeria* spp., trematodes and *Capillaria* spp. were recorded for the first time in birds of prey from Mexico. Similar to the report of Baker *et al.* (1996) in raptors from United States, the birds had single infections; whereas the mixed infections were most prevalent in captive strigiforms from Brazil (Silva *et al.* 2009). Coccidia and trematodes were also diagnosed in a coprologic survey of wild and captive falconiforms and strigiformes from United States (Baker *et al.* 1996); whereas Coccidia and Strongylida were found in fecal samples from captive strigiforms from Brazil (Silva *et al.* 2009).

Eimeria spp. is one of the most reported Coccidia in birds of prey, perhaps because it is a directetly transmitted parasite; furthermore, oocysts are very resistant to adverse environmental conditions (Baker *et al.* 1996, Freitas *et al.* 2002). In this survey, *Eimeria* spp. was found in Swainson's hawk (*B. swainsoni*), Red-tailed hawk (*B. jamaicensis*), Harris's hawk (*P. unicinctus*) and Great Horned owl (*Bubo virginianus*). The Coccidia *Caryospora uptoni* has been recorded in *B. jamaicensis*; while *Eimeria* sp., *Caryospora* sp. and *Frenkelia*-like were found in *B. jamaicensis*, and *Eimeria* sp. in *B. virginianus* (Lindsay & Blagburn 1986, Baker *et al.* 1996). *Cryptosporidium* spp. was detected by Ziehl-Neelsen technique in captive *Bubo virginianus* and *Tyto alba* (Barn owl) from Brazil (Silva *et al.* 2009).

Trematodes eggs were found only in falconiformes, such as the Peregrine falcon (*F. peregrinus*) and Swainson's hawk (*B. swainsoni*). Baker *et al.* (1996) detected trematodes eggs in falconiformes and strigiformes from

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United States. Common trematode genera from raptors include: *Strigea*, *Parastrigea*, *Neodiplostomum*, *Brachylaima* and *Brachylecithum* (Greenwood *et al*. 1984, Ferrer *et al*. 2004a, Ferrer *et al*. 2004b, Sanmartín *et al*. 2004). It is not possible to identify trematode genera based in the eggs morphology (Greenwood *et al*. 1984). *Strigea falconis* and *Neodiplostomum attenuatum* are frequently reported in *F. peregrinus,* and are transmitted by small vertebrates that are frequent prey items for this raptor (Greenwood *et al*. 1984, Sanmartín *et al*. 2004). This is the first finding of trematodes eggs in fecal samples in raptors from Latin America.

Infections by *Capillaria* spp. are recorded in raptors worldwide (Hoberg *et al*. 1989, Deem 1999, Ferrer *et al* 2004a, Ferrer *et al*. 2004b, Sanmartín *et al*. 2004). In the present survey, this nematode was found only in the falconiform Swainson's hawk (*B. swainsoni*), whereas Baker *et al*. (1996) detected the presence of *Capillaria* spp. eggs in falconiforms and strigiforms. According to Fowler (2001), *Capillaria* spp. is prevalent in wild (78%) than in captive (7%) strigiforms from North and South America.

In captivity, the birds live in persistent contamined cages, supporting reinfections despite periodic dewormings (Freitas *et al*. 2002). Deworming drugs (fenbendazole or ivermectin) used in the CIVS are not effective against some gastrointestinal parasites detected in this study (*Eimeria* spp. and trematodes), which underlie the importance of coprologic examination as a parameter for deworming (Freitas *et al*. 2002). Moreover, a report of suspected fenbendazole toxicity with bone-marrow suppression in several species of birds, should alert practitioners to adecuatelly monitor raptors receiving this drug (Deem 1999).

Haemoproteus spp., *Leucocytozoon* spp., *Plasmodium* spp. and *Trypanosoma avium* are the hematozoa recorded in birds of prey worldwide (Deem 1999, Muñoz *et al*. 1999, Remple 2004, Ishak *et al*. 2008, Krone *et al*. 2008, Leppert *et al*. 2008). Nevertheless, this is a first record of *Haemoproteus* spp. and

Leucocytozoon spp. in captive American kestrels (*F. sparverius*) and Red-tailed hawk (*B. jamaicensis*), respectively, in Latin America. *Haemoproteus* spp. and *Leucocytozoon* spp., detected only in falconiforms, were also reported by researchers in United States, Canada, Panama and Italy (Maloney *et al*. 1984, Sacchi & Prigioni 1984, Ziman *et al*. 2004). On the contrary, *Leucocytozoon* sp. was the most prevalent blood parasite from falconiforms from a recovery center in Spain (Muñoz *et al*. 1999). *H. tinnunculus* and *H. elani* have been recorded in kestrels worldwide, whereas *L. toddi* is the only species reported to occur in falconiforms (Maloney *et al*. 1984, Olsen & Gaunt 1985, Krone *et al*. 2008).

B. jamaicensis (Red-tailed hawk) and *B. swainsoni* (Swainson's hawk) were the raptors that presented greater diversity of internal parasites, so these should receive special attention in captive bird conditions.

Evaluated raptors presented good physical condition and no clinical signs referable to gastrointestinal or blood parasite infections were observed in any birds, probably due to the mild nature of the infections in captive animals (Baker *et al*. 1996, Freitas *et al*. 2002, Silva *et al*. 2009). Raptors are infrequently affected clinically by overt parasitism, but subclinical parasitism may become evident during stress conditions, which is frequent in captivity and heavy infections by gastrointestinal parasites that may cause diarrhea, anorexia, emaciation, listlessness, and death (Baker *et al*. 1996, Morishita 1997, Freitas *et al*. 2002). Much debate exists regarding hemoparasites pathogenicity in raptors, which have been associated to decreased body condition of birds during breeding season in many regions (Deem 1999, Leppert *et al*. 2008). Latent hemoprotozoal infection may be activated in critically ill raptors, yet may not harm the host (Maloney *et al*. 1984). According to Olsen & Gaunt (1985) weakened or injured raptors with hemoprotozoal infection had longer rehabilitation time and a higher mortality rate than those without infection.

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Captive breeding programs are aimed to maintain genetically viable, healthy populations for subsequent release into the wild (Daszak *et al*. 2000, Daszak *et al*. 2001). The CIVS has a release program of some rehabilited raptors, which may occur in protected areas of Mexico. According to Daszak *et al*. (2000, 2001), the potential transfer of pathogens into previously unexposed wild populations in often sensitive protected areas, represents a serious challenge to conservation efforts. This can impinge on release programs even when no apparent disease (like subclinical parasitism) is observed. Diagnosis of parasites in raptors in the CIVS is very important to avoid the accidental introduction of a pathogenic (or potencially pathogenic) parasite to a new (or native) host species or population in wildlife. The process of host-parasite cointroduction, termed "pathogen pollution" (Cunningham 1996, Daszak *et al*. 2000), may have a heightened ecological impact by conferring competitive advantage to the invading host, a phenomenon known as "apparent competition" or "parasite-mediated competition" (Cunningham *et al*. 2003). In United States, three subspecies of Spotted owl (*Strix occidentalis caurina*, *S. o. occidentalis* and *S. o. lucida*) are threatened by habitat loss and the range expansion of the Barred owl (*S. varia*) (which is also a source of novel pathogens, such as blood parasites), potentially harmful for threatened Spotted owls (Ishak *et al*. 2008). Pathogen pollution may have significant implications for animal welfare, endangering the conservation status of wildlife due to biodiversity loss (Daszak *et al*. 2000, Cunningham *et al*. 2003).

According to Daszak *et al*. (2000), the conservation community has drawn up guidelines to prevent the release of animals carrying pathogens. Unfortunately, the main recommendations are currently underused: of almost 700 terrestrial vertebrate translocations (within conservation programs) between 1973 and 1986 in the United States, Australia, Canada and New Zealand, 24% occurred without any disease screening and fewer than 25% involved investigations into causes of death of the translocated animals (Daszak *et al*. 2000).

For all these reasons, in conservation centers such as the CIVS, a health assessment that includes physical examination, fecal and blood parasite evaluation, hematology and plasma biochemical analysis should be performed routinely (trimestrial or half-yearly) in incoming and long-term captive raptors. Much debate exists regarding endoparasites treatment in captive animals and there is no consensus, since for some authors the loss of host-specific parasites from species in captive breeding programs is also a substantial threat to biodiversity conservation (Daszak *et al*. 2000, Cunningham *et al*. 2003). In addition to ethical obligations to preserve parasite assemblages along with their more favored hosts, the maintenance of established host-parasite relations may be important for the overall well-being of the host species, both at an individual (maintenance of immunity) and at a population level (maintenance of genetic diversity) (Daszak *et al*. 2000, Cunningham *et al*. 2003). For some researchers, some raptors parasites are opportunistic, thereby captive infected birds should be treated (Morishita 1997, Deem 1999, Morishita *et al*. 2001, Joseph 2006, Willette *et al*. 2009).

Findings from this study have been used to make recommendations to the Secretaria del Medio Ambiente y Recursos Naturales (SEMARNAT) for improvements in husbandry and veterinary care of this *ex situ* population. Furthermore, due to the fact that the CIVS is also a rehabilitation center of wild birds of prey, the knowledge of the causes of morbidity and mortality of incoming and long-term captive raptors, may provide insight into the health status and conservation of wild populations which should be studied in the future.

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RESUMEN

El éxito de los programas de conservación de rapaces (*ex situ* and *in situ*) requiere de un conocimiento detallado de sus patógenos. El objetivo de este estudio fue identificar los parásitos internos de rapaces en cautiverio en México, así como verificar su repercusión en el estado de salud de las aves. Las mismas fueron estudiadas, decomisadas y mantenidas en el Centro de Investigación y Conservación de Vida Silvestre (CIVS) en Los Reyes La Paz, estado de México. Las muestras de heces y sangre de 74 rapaces (66 Falconiformes y ocho Strigiformes) de 15 especies, juveniles y adultos de ambos sexos (39 machos y 35 hembras), fueron examinadas para analizar la presencia de parásitos gastrointestinales y sanguíneos. Asimismo, la cavidad orofaríngea fue evaluada macroscópicamente para verificar la presencia de lesiones compatibles con trichomoniasis. Lesiones compatibles con la infección por *Trichomonas gallinae* fueron detectadas en dos (2.7%) *Buteo jamaicensis*; no obstante, las aves infectadas estaban en buena condición física. En general, los parásitos gastrointestinales fueron encontrados en 10 (13.5%) rapaces: nueve (13.6%) Falconiformes y uno (12.5%) Strigiformes; los cuales presentaron un único tipo de parásito gastrointestinal (90%). *Eimeria* spp. fue detectada en *Parabuteo unicinctus*, *B. swainsoni*, *B. jamaicensis* y *Bubo virginianus*; mientras que los tremátodos lo fueron en *Falco peregrinus* y *B. swainsoni*. *Capillaria* spp. fue diagnosticada únicamente en *B. swainsoni*. Los hemoparásitos fueron encontrados en 6.7% de los Falconiformes: *Haemoproteus* spp. en *F. sparverius* y *Leucocytozoon* spp. en *B. jamaicencis*. No fueron observados signos clínicos relacionados con la infección por los parásitos internos. Todos los parásitos identificados son reportados por primera vez en rapaces de México. De tal manera que, *T. gallinae*, y los trematódos: *Haemoproteus* spp. y *Leucocytozoon* spp. son reportados en rapaces en Latinoamérica por primera vez. El diagnóstico y control de las infecciones parasitarias deberían ser parte de la rutina de los cuidados de salud de poblaciones de rapaces *ex situ*. Además, la información obtenida es de gran valor para la conservación *in situ* de estas aves.

Palabras clave: rapaces, parásitos gastrointestinales, hemoparásitos, conservación, cautiverio.

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