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Blood parasite presence in wildlife from Ecuador: first reports and systematic review

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Anahi Gabriela Hidalgo Cordero

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Anahi Gabriela Hidalgo Cordero

Calificación:

Nombre del profesor, Título académico: Eduardo Alfonso Díaz Alcázar, Ph.D.

Firma del profesor: _____

Quito, 21 de diciembre de 2018

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Firma del estudiante: _____

Nombres y apellidos: Anahi Gabriela Hidalgo Cordero

Código: 00122392

Cédula de Identidad: 1723924385

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RESUMEN

Los hemoparásitos, son organismos que viven en la sangre de un hospedador. Se encuentran distribuidos mundialmente e infectan a una gran variedad de mamíferos, aves, reptiles, peces y anfibios. Para este trabajo se analizaron los resultados de 275 frotis sanguíneos de animales silvestres en estado salvaje remitidos a nuestro Hospital de Fauna Silvestre. Se encontró hemoparasitos en 95 (34.5 %) muestras analizadas. Los géneros de hemoparasitos encontradas fueron: *Mycoplasma, Hepatozoon, Microfilaria, Anaplasma, Babesia, Trypanosoma y Ehrilichia*. *Mycoplasma* fue el género predominante, el cual se encontró en 78 mamíferos. Este es el primer reporte de *Mycoplasma* en mamíferos silvestres del Ecuador. Además, se realizó una búsqueda sistemática acerca de los géneros de hemoparásitos en las especies animales infectadas en nuestro estudio. Con la cual podemos aseverar que este estudio reporta por primera vez 21 especies de animales silvestres infectadas con uno de los siete géneros de hemoparasitos encontrados en nuestra investigación. Estableciendo un precedente para futuras investigaciones en el campo para Ecuador y para toda la región.
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Palabras clave: *Hemoparásitos, fauna silvestre en libertad, Mycoplasma, Hepatozoon, Microfilaria, Anaplasma, Babesia, Trypanosoma, Ehrilichia, Ecuador.*

ABSTRACT

Blood parasites are organisms that live in the blood of a host. They have a worldwide distribution and infect a wide variety of mammals, birds, reptiles, fish and amphibians. For this study, we analyzed 275 blood smears of free-ranging wildlife refered to our Wildlife Hospital. Hemoparasites were found in 95 (34.5%) samples analyzed. The genera of hemoparasites found were: *Mycoplasma, Hepatozoon, Microfilaria, Anaplasma, Babesia, Trypanosoma* and *Ehrilichia*. Mycoplasma was the predominant genus, which was found in 78 mammals. This is the first report of Mycoplasma in wild mammals of Ecuador. In addition, a systematic search was made about the genera of hemoparasites in the infected animal species in our study. With which we can assert that this study reports for the first time 21 wildlife species infected with one of the seven genera found in our research. Setting a precedent for further researches in the field for Ecuador and for the entire region.

Key words**:** *Blood parasites, free-ranging wildlife, Mycoplasma, Hepatozoon, Microfilaria, Anaplasma, Babesia, Trypanosoma, Ehrilichia, Ecuador.*

TABLA DE CONTENIDO

ÍNDICE DE TABLAS

ÍNDICE DE TABLAS SUPLEMENTARIAS

ÍNDICE DE FIGURAS

Blood parasite presence in wildlife from Ecuador: first reports and systematic review

Anahi Hidalgo[1], Verónica Barragán[2*], Cristian Ponce[1], Eduardo Díaz[1]

[1]Universidad San Francisco de Quito, Escuela de Medicina Veterinaria, [2] Universidad San Francisco de Quito, Colegio de Ciencias Biológicas y Ambientales

Abstract

Blood parasites are organisms that live in the blood of a host. They have a worldwide distribution and infect a wide variety of mammals, birds, reptiles, fish and amphibians. For this study, we analyzed 275 blood smears of free-ranging wildlife refered to our Wildlife Hospital. Hemoparasites were found in 95 (34.5%) samples analyzed. The genera of hemoparasites found were: *Mycoplasma, Hepatozoon, Microfilaria, Anaplasma, Babesia, Trypanosoma* and *Ehrilichia*. Mycoplasma was the predominant genus, which was found in 78 mammals. This is the first report of Mycoplasma in wild mammals of Ecuador. In addition, a systematic search was made about the genera of hemoparasites in the infected animal species in our study. With which we can assert that this study reports for the first time 21 wildlife species infected with one of the seven genera found in our research. Setting a precedent for further researches in the field for Ecuador and for the entire region.

Background

Parasites are organisms that need other live organism as host, and as a source of food and living place (Zelmer, 1998). The type that live in the blood of it host are called blood parasite or hemoparasites. Within this classification are bacteria, apicomplexans, hemoflagellates and filarias (Colwell, Dantas-Torres & Otranto, 2011). Usually, animals become infected through vectors, among them: ticks, fleas,

lice and mosquitoes (Santos, 2016, Colwell, Dantas-Torres & Otranto, 2011). Blood parasites have a worldwide distribution and infect a wide variety of mammals, birds, reptiles, fishes and amphibians, and other animals including humans (Coles, 1914; Khan et al., 1980; Barta & Desser, 1984; Waldenström et al., 2002).

Wildlife have nonspecific clinical signs when infected with blood parasites (Biggs et al., 2016). Anemia, lymphocytosis, hyperthermia and general weakness have been reported as the most common (Molyneux, 1986, Dennis, 1985). It has been shown that illness development might depend on the immunity of the patient, stage of the infection, age of the patient, and concomitant diseases (Fox et al., 2008; Dennis, 1985). In some cases, animals do not show clinical signs, these animals might be important reservoirs of the disease.

Unfortunately, there is limited information about the epidemiology, distribution, and disease of most blood parasites. However, increasing research efforts have been concentrated on selected blood parasites such as *Plasmodium* spp., *Leishmania* spp., and *Trypanososma cruzi*. Most of what we know have been generalized from these selected parasites. In the other hand, there is scare information about blood parasites such as *Mycoplasma*, *Anaplasma*, and *Ehrlichia*. Furthermore, the importance of wild animals on the transmission cycle of these hemoparasites is barley known.

In the present work we report the occurrence of seven genders of blood parasites in twenty-one not previously reported wildlife animal species. We complement our findings with a systematic review about what have been published on the presence of these parasites in the animal species where they were found. We consider that our results can contribute significantly to the knowledge on the presence of blood parasites in wildlife from different ecosystems.

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Methods

Specimen selection / collection / identification

We compiled the laboratory results of 273 blood samples that belonged to free-ranging wildlife animals. Animals came from multiple places in Ecuador, and included a variety of wildlife species. All animals were admitted (from April 2012 to July 2018) to the Veterinary Hospital of Universidad San Francisco de Quito (HDEV-USFQ) under the Ministry of Environment agreement number: 6250. Samples were analyzed by Vet-Lab (Quito-Ecuador) using published and standard laboratory methods. Blood smears were made by the wedge smear technique (Rodak, Fritsma & Doig, 2007) and observed for parasite presence with an optic microscope (Motic-BA210, Canada) connected to a camera (Moticam T2, Canada). Morphological identification was performed following standard protocols for *Mycoplasma spp.* (Sykes, 2010), *Hepatozoon spp*. (Campbell, 1996), *Microfilaria spp.* (Kelly, 1973), *Anaplasma spp.* (Little, 2010; Ferreira *et al.*, 2007), *Babesia spp.* (Campbell, 1996), *Ehrlichia spp.* (Hildebrandt et al., 1973) and *Trypanosoma spp.* (Bennett *et al*., 1973). If *Ehrlichia spp.* was suspected, a smear of the leukoplaque layer was performed to observe intracytoplasmic white cell and platelet morulae. The discrimination of *Trypanosoma spp.* with toxoplasma in its tachyzoite form, was made by the serological test Toxoplasma IgM EIA Test Kit (ACON, San Diego, CA, USA).

Systematic review

We performed a systematic review using an approach that followed PRISMA guidelines (see Checklist in Additional file 1). We searched Pubmed (https://www.ncbi.nlm.nih.gov/pubmed/) and Scholar Google (https://scholar.google.com/) using the strategy described in table 1. Our selection criteria included all published studies that

provided authentic information about the presence of the blood parasite gender, in the animal species of our interest, without restriction on the publication year or language. The search was performed on 30/10/2018. We excluded studies that had the following criteria: (i) did not report the gender of blood parasite in the animal species of our interest; (ii) findings in laboratory animals; (iii) duplicated publications or extension of analysis from an original study; (iv) studies where the presence of the blood parasite were negative (Flow diagram see Figure S1). For each manuscript we recorded country name, year of publication, specie of blood parasite and diagnostic technique (See Table S1).

Table 1 Search strategy and terms used to find studies reporting selected blood parasite in wildlife animals

Terms	1. mycoplasma, 2. hepatozoon, 3. microfilaria, 4. anaplasma, 5. babesia, 6. trypanosoma, 7. erhlichia, 8. Puma yaguarondi, 9. Leopardus pardalis, 10. Leopardus tigrinus, 11. Puma concolor, 12. Panthera onca, 13. Nasua nasua, 14. Potos flavus, 15. Lagothrix lagotricha, 16. Alouatta palliata, 17. Alouatta seniculus, 18. Cebus albifrons, 19. Cebus apella, 20. Saimiri sciureus, 21. Saguinus fuscicollis, 22. Cebuella pigmea, 23. Odocoileus peruvians, 24. Pudu mephistophiles, 25. Mazama rufina, 26. Choloepus didactylus, 27. Choloepus hoffmanni, 28. Melanosuchus niger, 29. Caiman crocodilus, 30. Boa constrictor.
Strategy	
PubMed	1 AND (8 OR 9 OR 10 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16 OR 17 OR 18 OR 19 OR 20 OR 21 OR 22 OR 23 OR 24 OR 25 OR 26 OR 27); 2 AND (28 OR 29 OR 30); 3 AND (28 OR 15 OR 13); 4 AND (18 OR 15 OR 21); 5 AND (21 OR 15 OR 25); 6 AND 26; 7 AND 25.
Scholar Google	1 AND 8; 1 AND 9; 1 AND 10; 1 AND 11; 1 AND 12; 1 AND 13; 1 AND 14; 1 AND 15; 1 AND 16; 1 AND 17; 1 AND 18; 1 AND 19; 1 AND 20; 1 AND 21; 1 AND 22; 1 AND 23; 1 AND 24; 1 AND 25; 1 AND 26; 1 AND 27 ; 2 AND 28; 2 AND 29; 2 AND 30; 3 AND 28; 3 AND 15; 3 AND 13; 4 AND 18; 4 AND 15; 4 AND 21; 5 AND 21; 5 AND 15; 5 AND 25; 6 AND 26; 7 AND 25.

Results

Findings from our research

Our records indicate that from April 2012 through July 2018, 275 free-ranging wildlife animals' blood samples were analyzed at our veterinary facility. We were able to recover results from samples that included 57 different animal species: 35 mammal species, 10 reptile species, and 12 bird species. Blood parasites were detected in 34.5% of analyzed samples (n=275): 43.4% in mammal samples (n=196) and 19.2% in reptile samples

(n=52). No positivity was registered in birds (n=27).

We found that *Mycoplasma spp.* was the most frequent blood parasite found in 78 of our positive samples from 20 different mammals species. Ten samples from 3 reptile species were positive for *Hepatozoon spp*. *Microfilaria spp*. was registered in 5 samples, from 2 mammal and 1 reptile species. *Anaplasma spp*. was registered in 4 samples from 3 primate species. Tree samples from 3 different mammal species were positive for *Babesia spp*., 1 mammal sample was positive for *Ehrlichia spp*., and another mammal sample was positive for *Trypanosoma spp*.

Table 2 Blood parasite presence in free-ranging wildlife

Blood parasite / **Animal species**	***Mycoplasma spp.***	***Hepatozoon spp.***	***Microfilaria spp.***	***Anaplasma spp.***	***Babesia spp.***	***Ehrlichia spp.***	***Trypanosoma spp.***
Mammals							
Puma yaguarondi	1/2						
Leopardus pardalis	14/39						
Leopardus tigrinus	2/4						
Puma concolor	6/6						
Panthera onca	3/7						
Nasua nasua	2/5		1/5				
Potos flavus	2/4*						
Lagothrix lagotrichia	5/12*^		1/12*	1/12*^	1/12*		
Alouatta palliata	1/4*						
Alouatta seniculus	1/1*						
Cebus albifrons	12/21*^			2/21*^			
Cebus apella	1/2						
Saimiri sciureus	12/22						
Saguinus fuscicollis	10/13*			1/13*	1/13*		
Cebuella pigmea	1/1*						
Odocoileus peruvians	1/2*						
Pudu mephistophiles	1/1*						
Mazama Rufina	1/3*^				1/3*^	2/3*^	
Choloepus didactylus	1/1*						
Choloepus hoffmanni	1/3*						
Bradypus tridactilus							1/3
Reptiles							
Melanosuchus niger		5/14*^	3/14^				
Caiman crocodilus		3/5					
Boa constrictor		2/5					
Total	78	10	5	4	3	2	1

* First report

^ Animals infected by more than one blood parasite (details are shown in Table S2)

Some animals were infected by more than one blood parasite. Precisely, tree mammals and tree reptiles were infected by two blood parasites and one mammal was infected by tree different blood parasites genera (see Table 3).

Table 3 : Number of free-ranging wildlife with multiple blood parasites infections

Blood parasite / Animal species	n	*Mycoplasma spp.*	*Hepatozoon spp.*	*Microfilaria spp.*	*Anaplasma spp.*	*Babesia spp.*	*Ehrlichia spp.*
Lagothrix lagotrichia	1	X			X		
Cebus albifrons	2	X			X		
Mazama Rufina	1	X				X	X
Melanosuchus niger	3		X	X			

n, number of animals infected

Findings from our systematic review on blood parasites in wildlife

We identified a total of 56 studies that met our selection criteria (Table S1). Publications from 1944 through 2018 from multiple countries around the world were included, being Brazil the country where most (n=37) of these publications took place. Based on our selection criteria we were also able to include studies from French Guiana (n= 3), Peru (n=1), USA (n=4), Colombia (n=1), Mexico (n=1), and 5 studies were performed in two or more countries (3 in Brazil/Panama, 1 Middle East, 1 in Europe/Tanzania/Brazil). We included four studies that didn't report the localities from where animals were collected.

Blood parasite positivity in most studies (n=21) was determined by polimeraze chain reaction (PCR), followed by blood smear microscopic observation (n=13).

After the systematic review we can assure that the present study reports for the first time the occurrence of *Mycoplasma spp.* in the following animal species: *Potos flavus, Lagothrix lagotrichia, Alouatta palliata, Alouatta seniculus, Cebus albifrons, Saguinus fuscicollis, Cebuella pigmea, Odocoileus peruvians, Pudu mephistophiles, Mazama rufina,*

Choloepus didactylus and *Choloepus hoffmanni*. Of *Anaplasma spp.* in the following animal species: *Lagothrix lagotrichia*, *Cebus albifrons* and *Saguinus fuscicollis.* Of *Babesia spp.* in the following animal species: *Lagothrix lagotrichia*, *Saguinus fuscicollis* and *Mazama rufina.* Of *Microfilaria spp.* in *Lagothrix lagotrichia*. Of *Ehrlichia spp.* in *Mazama rufina*. Of *Hepatozoon spp.* in *Melanosuchus niger*.

Discussion

In this research we found that the genera *Mycoplasma* infected a variety of mammals agreeing with several studies (Silva et al., 2007; Willi et al., 2007; Vieira, 2009). In a French Guyana study was reported the presence of Apicomplexa, *Trypanosomatidae* and *Filaroidea* in mammals and reptiles similar to our results (De Thoisy, Michel, Vogel & Vié, 2000). Nevertheless, there the most common blood parasite in mammals was *Trypanosoma sp*. contrary to our where was *Mycoplasma spp*. We also found that the genera *Hepatozoon* infected just reptiles agreeing with most of the studies done (Reardon & Norbur, 2004; Zamudio & Ramirez, 2007; Harris, Maia & Perera, 2011; Vilcins et al., 2009), but not with others that report the presence of *Hepatozoon* in few mammals (De Thoisy, Michel, Vogel & Vié, 2000; Ayala, D'Alessandro, Mackenzie & Angel, 1973). In a USA study was reported de presence of *Ehrlichia* in deer as same as in our study (Dawson, 1996). In several studies in Brazil were reported the presence of *Trypanosoma* in the same species of sloth in which we found the same genera (Da Silva et al., 2004; Carme, 2000; Cunha, 1944). Another study in Brazil reported the presence of *Anaplasma* in primates as same as a study in Kenya of *Babesia* agreeing with our results but in different species (Soares, 2017; Maamun, 2011). In a Camerun study was reported the presence of *Haemoproteus spp.*, *Leucocytozoon spp.*, *Plasmodium spp*., *Trypanosoma spp*. and *microfilarias*

(Kirkpatrick & Smith, 1988) in several birds nevertheless we did not found any bird infected.

The difference in the findings may due to variation in the diagnostic techniques. As is known, the sensitivity change between diagnostic techniques. It varies from an 84% in blood smear to a 95% in PCR for detecting *Babesia microti* (Krause, 1996). In the identification of *Plasmodium*, the sensitivity varies in blood smears to a 50% and 65% (Ndao et al., 2004; Scopel et al., 2004). Nevertheless the specificity for both techniques was 100% in all the studies.

There exist scarce information about blood parasites in wildlife in Ecuador. There are only 11 published studies, of which 9 were in birds, study of Moens & Pérez-Tris (2016) in 56 birds species from Yasuni, and they found *Haemoproteus* and *Plasmodium*; study of Mantilla et al. (2016) in American sparrows (*Zonotrichia capensis*) found *Haemoproteus erythrogravidus*; study of Levin et al. (2013) in Galapagos penguin (*Spheniscus mendiculus*), yellow warbler (*Setophaga petechia aureola*) and medium ground finch (*Geospiza fortis*) found *Plasmodium*; study of Svensson-Coelho et al. (2013) in 4 bird families found *Haemoproteus* and *Plasmodium*; study of Merkel et al. (2007) in Galapagos penguins (*Spheniscus mendiculus*) and flightless cormorants (*Phalacrocorax harrisi*) found *microfilaria spp .*; study of Deem *et al*. (2010) in Galapagos penguins (*Spheniscus mendiculus*) and flightless cormorants (*Phalacrocorax harrisi*) found *Toxoplasma gondii;* study of Travis et al. (2006) in Galapagos penguin (*Spheniscus mendiculus*) found *microfilaria spp*.; study of Valkiunas et al. (2010) in Galapagos Dove (*Zenaida galapagoensis*) found *Haemoproteus;* study of Levin et al. (2009) in Galapagos penguins (*Spheniscus mendiculus*) found *Plasmodium;* only 1 of them in mammals, Pinto et al. (2015) in 4 bat species found *trypanosoma* and 1 of them in reptiles by Medrano et al. (2017) but all the analyzed snakes were negative.

It should be noted that within these 11 studies only 5 genera of blood parasites are described: *Haemoproteus, Plasmodium*, *Toxoplasma*, *Microfilaria* and *Trypanosoma*. This evidence the poor information about wildlife in Ecuador.

This systematic review shows that even if many of the animal species are from the Amazon, which is the shelter of millions of species, and it is conform by Brazil, Bolivia, Peru, Ecuador, Colombia, Venezuela, Guyana, Suriname and French Guiana (Redford, 1992; Whitehead, 2002) there are none published study within our search parameters in Venezuela, Ecuador, Bolivia, Guyana nor Suriname. And most of the studies included where done in the four remaining countries, being Brazil the one with plenty of them. Being this an attention call to all the countries of the region to invest on research of blood parasite epidemiology in wildlife. Because understanding the evolution and ecology of zoonotic blood parasites is crucial to prevent outbreaks diseases and to determine the foci of possible emerging infectious diseases (EID) (Woolhouse & Gatage-Sequeria, 2005; Keesing et al., 2010). It should be noted that different wildlife species can act as reservoirs of pathogens, posing a threat to domestic animals and humans (Daszak et al., 2000; Moens & Pérez-Tris, 2016).

Conclusions

The present research revealed the presence of *Mycoplasma spp.* in *Potos flavus, Lagothrix lagotrichia, Alouatta palliata, Alouatta seniculus, Cebus albifrons, Saguinus fuscicollis, Cebuella pigmea, Odocoileus peruvians, Pudu mephistophiles, Mazama rufina, Choloepus didactylus* and *Choloepus hoffmanni.* Of *Anaplasma spp.* in *Lagothrix lagotrichia, Cebus albifrons* and *Saguinus fuscicollis.* Of *Babesia spp.* in *Lagothrix lagotrichia, Saguinus fuscicollis* and *Mazama rufina.* Of *Microfilaria spp.* in *Lagothrix lagotrichia*. Of *Ehrlichia spp.* in *Mazama rufina*. and of *Hepatozoon spp.* in *Melanosuchus niger* for the first time,

which indicated the limited information about blood parasites in wildlife of the region. Being the first research in Ecuador that involved three animal class (mammals, reptiles and birds) and the first published study of *Mycoplasma* in mammals in the country. Also, the second published study of blood parasites that involved mammals and reptiles in Ecuador. All blood parasites genera found constitute a potential zoonotic risk and therefore their finding is of high importance for public health.

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Supplementary files

Table S 1: Presence of Mycoplasma, Hepatozoon, Microfilaria, Anaplasma, Babesia, Trypanosoma and Ehrilichia in the animal species of the study

Country	Publication year	Blood parasite	Animal specie	Diagnostic technique	Animal status	Reference number
Brazil	2009	*Mhf*[I]	*Puma concolor*	PCR	free-ranging /captive	60
		Mhf	*Leopardus tigrinus*			
		Mhf, CMhm[I, I]	*Leopardus pardalis*			
Brazil	2016	*CMhm / Ca. M. haematoparvum*	*Panthera onca*	PCR	captive	14
		Hemoplasma	*Puma yagouaroundi*			
Brazil	2006	*Ca. Mycoplasma turirensis*	*Leopardus tigrinus*	PCR	free-ranging /captive	33
		Ca. Mycoplasma turirensis	*Leopardus pardalis*			
Brazil	2011	*CMhm*	*Panthera onca*	PCR	captive	4
		CMhm	*Puma concolor*			
		Mhf / CMhm	*Leopardus tigrinus*			
		CMhm	*Leopardus pardalis*			
		CMhm	*Puma yagouaroundi*			
Brazil	2017	*Mycoplasma haemocanis/Mhf*	*Nasua nasua*	PCR	free-ranging	25
		CMhm	*Leopardus pardalis*			
Brazil	2017	*CMhm*	*Panthera onca*	PCR	captive	58
		CMhm	*Puma concolor*			
		CMhm	*Leopardus tigrinus*			
Worldwide (europe, tanzania and brazil)	2007	*CMhm*	*Puma concolor*	PCR	free-ranging /captive	94
		CMhm	*Leopardus tigrinus*			
		CMhm / Ca. Mycoplasma turicensis	*Leopardus pardalis*			
Brazil	2017	*Mhf /Mycoplasma sp*	*Nasua nasua*	PCR	captive	18
Brazil	2017	*Mycoplasma spp*	*Nasua nasua*	PCR/ serological	free-ranging	88

Brazil	2018	*Mhf / CMhm*	*Panthera onca*	PCR	free-ranging	35
Brazil	2015	*Mycoplasma sp.*	*Panthera onca*	PCR	captive	38
USA	2016	*Mhm, Mhf.tc*	*Puma concolor*	PCR	free-ranging	37
USA	2018	*CMhm*	*Puma concolor*	PCR	free-ranging	43
USA	2011	*CMhm*	*Puma concolor*	PCR	free-ranging	4
Middle east	2017	*CMhm*	*Leopardus tigrinus*	PCR	free-ranging /captive	36
Brazil	2008	*Mycoplasma*	*Puma yagouaroundi*	PCR	captive	38
Brazil	2012	*micoplasma hemotropico*	*Cebus apella*	PCR	free-ranging /captive	17
	1972	-	*Saimiri sciureus*	-	-	2
	1984	-	*Saimiri sciureus*	-	-	1
Brazil	2015	*Candidatus Mycoplasma kahane*	*Saimiri sciureus*	PCR	free-ranging /captive	9
Brazil	2003	- -	*Caiman crocodilus Boa constrictor*	-	free-raning	71
Brazil	2003	*Hepatozoon caimani*	*Caiman crocodilus*	blood smear	free-raning	48
Brazil	2017	*hepatozoon sp., quizas H. caimani*	*Caiman crocodilus*	pcr	free-ranging	83
Brazil	2017	-	*Caiman crocodilus yacare*	blood smear / pcr	free-ranging / captive	10
Brazil	2004	-	*Caiman crocodilus yacare*	blood smear	free-ranging	50
Perú	2011	*Hepatozoon caimani*	*Caiman crocodilus*	blood smear	captive	77
Brazil	2004	*Hepatozoon cf. terzii*	*Boa constrictor*	blood smear	-	72
Brazil	2005	*Hepatozoon terzii*	*Boa constrictor*	blood smear	free-ranging	79
Usa	2011	*Hepatozoon ayorgbor*	*Boa constrictor*	pcr	pet	3
Brazil	2006	*Hepatozoon sp.*	*Boa constrictor*	blood smear	captive	54
Brazil	2002	*H. terzii*	*Boa constrictor*	Blood smears	free-ranging	62
Brazil	2003	*hepatozoon spp.*	*Boa constrictor*	Blood smears	free-ranging	67
French guiana	2000	*Hepatozoon sp.*	*Boa constrictor*	Blood smears	free-ranging	26
Brazil	2018	*Hepatozoon sp.*	*Boa constrictor*	blood smear / pcr	captive	89
Brazil	2008	*hepatozoon spp.*	*Boa constrictor*	blood smear	free-ranging	61
Colombia	2007	*Hepatozoon spp*	*Boa constrictor*	blood smear	free-ranging	96

Brazil	2010	*hepatozoon spp.*	*Boa constrictor*	blood smear	captive	52
Brazil	2017	*Hepatozoon cevapii*	*Boa constrictor*	pcr	free-ranging/ captive	88
Brazil	2018	*hepatozoon spp.*	*Boa constrictor*	blood smear / pcr	free-ranging/ captive	11
Mexico	1969	*hepatozoon fusifex sp.*	*Boa constrictor*	blood smear / culture	free-ranging	6
Brazil	2017	*Microfilaria*	*Melanosuchus niger*	blood	free-ranging	70
Brazil	2010	*microfilaria*	*Nasua nasua*	hemoculture /blood smear	free-ranging/ captive	68
Brazil	2017	*Dirofilaria repens*	*Nasua nasua*	Knott's concentration technique	free-ranging/ domestic dogs	65
Brazil	2015	*microfilaria*	*Nasua nasua*	blood smear/ microhematocrit centrifuge technique (MHCT)/ hemoculture	free-ranging	69
French Guiana	2000	*Filaria*	*Nasua nasua*	blood smear	free-ranging	26
Brazil	2017	*Microfilaria*	*Nasua nasua*	blood smear/ molecular analisis (PCR)	free-ranging	86
French Guiana	2001	*Endotrypanum schaudinni*	*Choloepus didactylus*	blood samples / enzyme electrophoresis	free-ranging	13
Brazil	2004	*Trypanosoma rangeli*	*Choloepus didactylus*	culture of blood	free-ranging/ human	21
Brazil/Panama	2004	*T. rangeli*	*Choloepus didactylus*	pcr amplificaction	free-ranging	22
Brazil/Panama	2007	*T. rangeli*	*Choloepus didactylus*	morphologycal, biological and molecular	-	20
brazil/panama	2002	*T. mesnilbrimonti*	*Choloepus didactylus*	morphologycal, biological and molecular	free-ranging	28
	2000	*Trypanosoma cruzi*	*Choloepus didactylus*	-	-	13
Brazil	1979	*trypanosoma sp.*	*Choloepus didactylus*	Blood smears and impression-	free-ranging	48

				smear from some organs		
Brazil	1996	*Endotrypanum*	*Choloepus didactylus*	enzyme polymorphism	-	34
Brazil	1944	*Endotrypanum schaudinni*	*Choloepus didactylus*	blood and culture	captive	19

[1] *Mhf, Mycoplasma haemofelis*
[1 1] *CMhm, Candidatus Mycoplasma haemominutum*

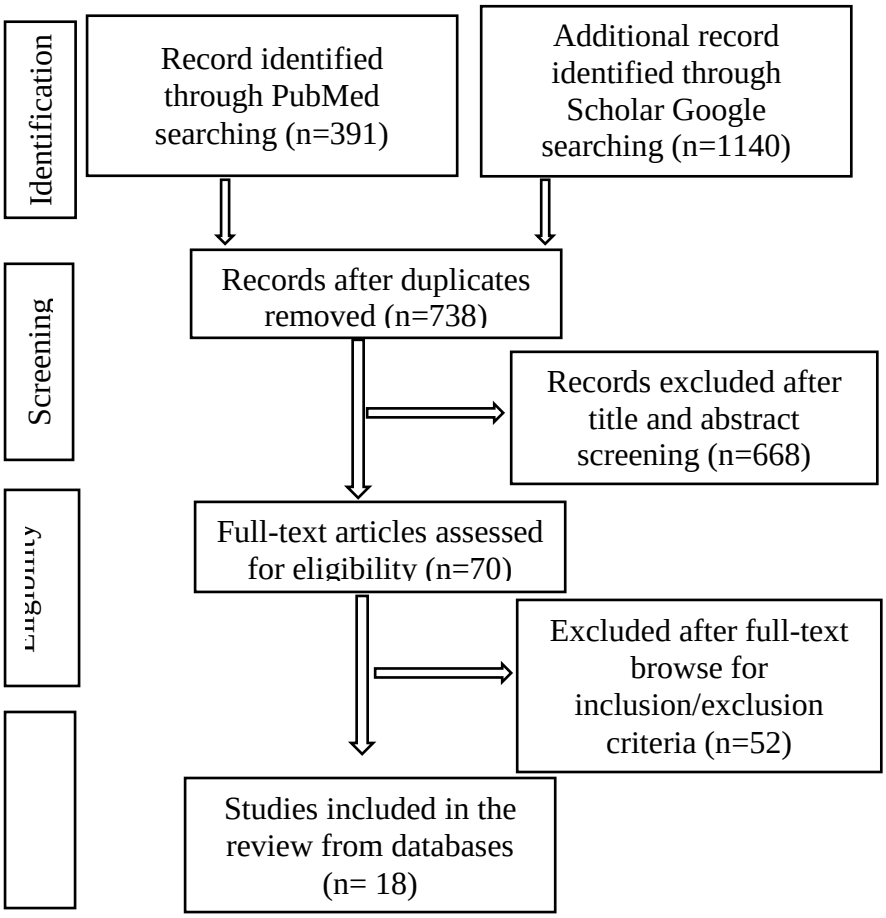

Figure S 1: Flow diagram of database searches from Mycoplasma

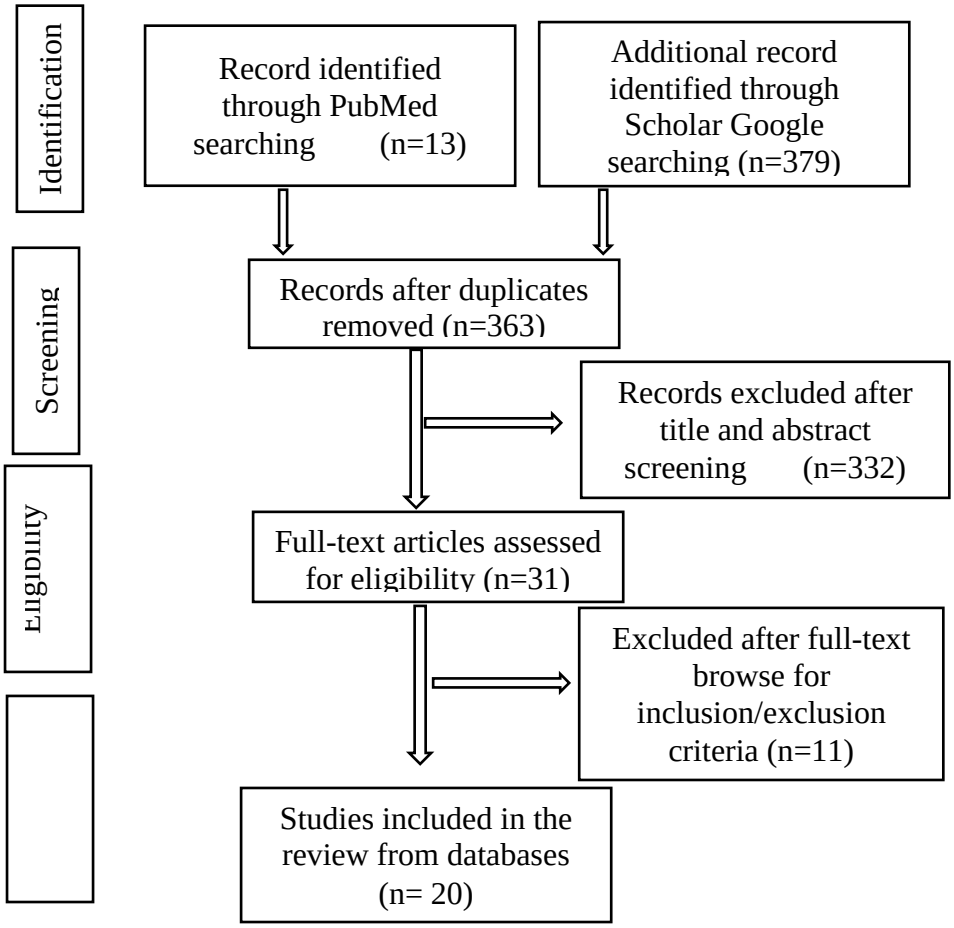

Figure S 2 Flow diagram of database searches from Hepatozoon

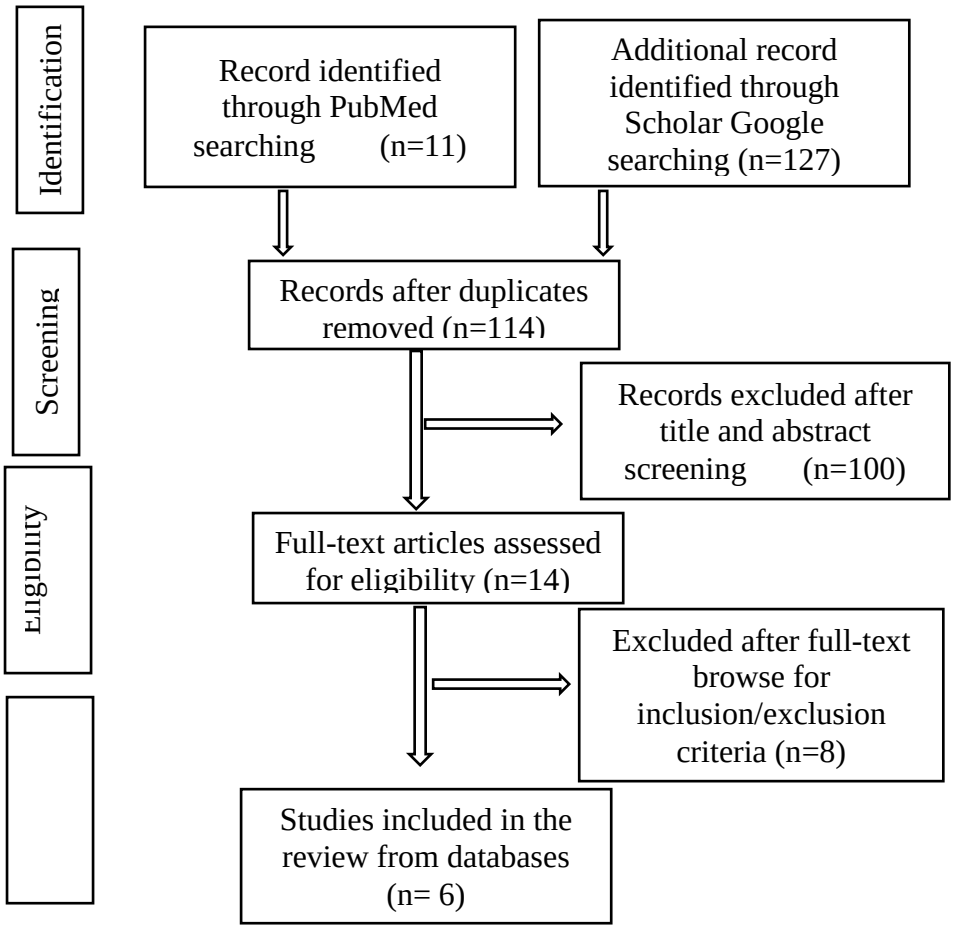

Figure S 3 Flow diagram of database searches from Microfilaria

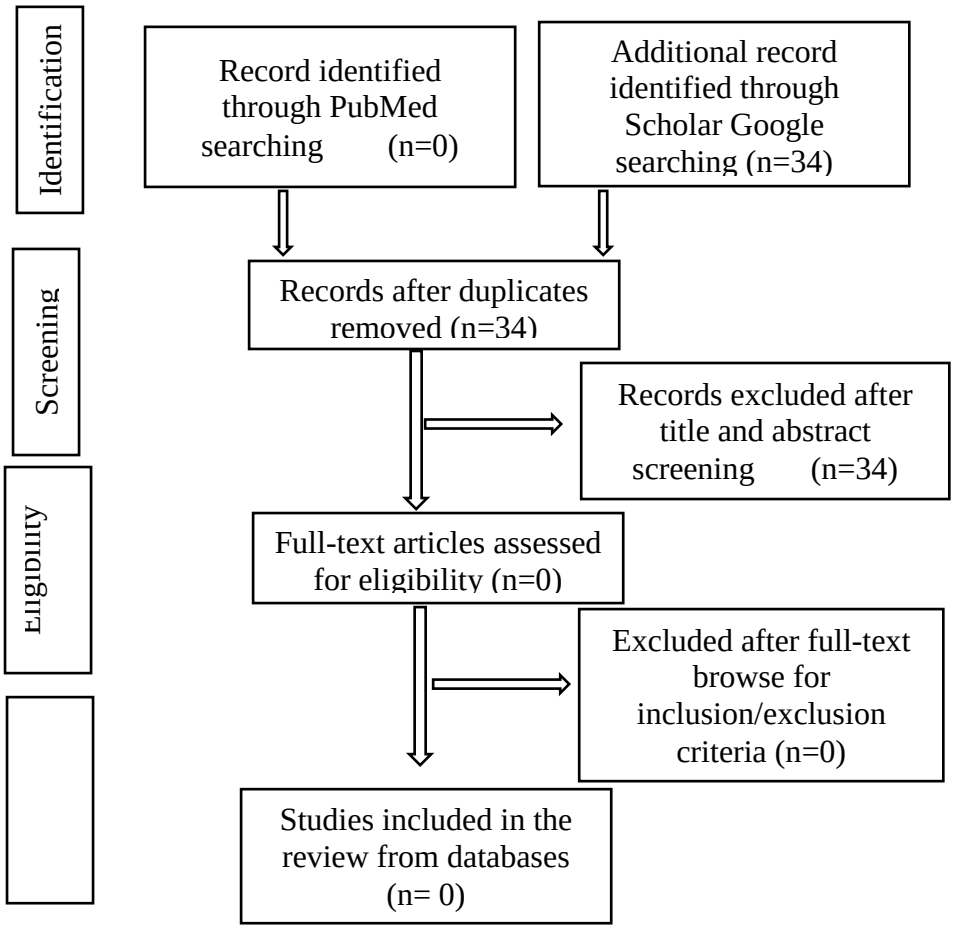

Figure S 4 Flow diagram of database searches from Anaplasma

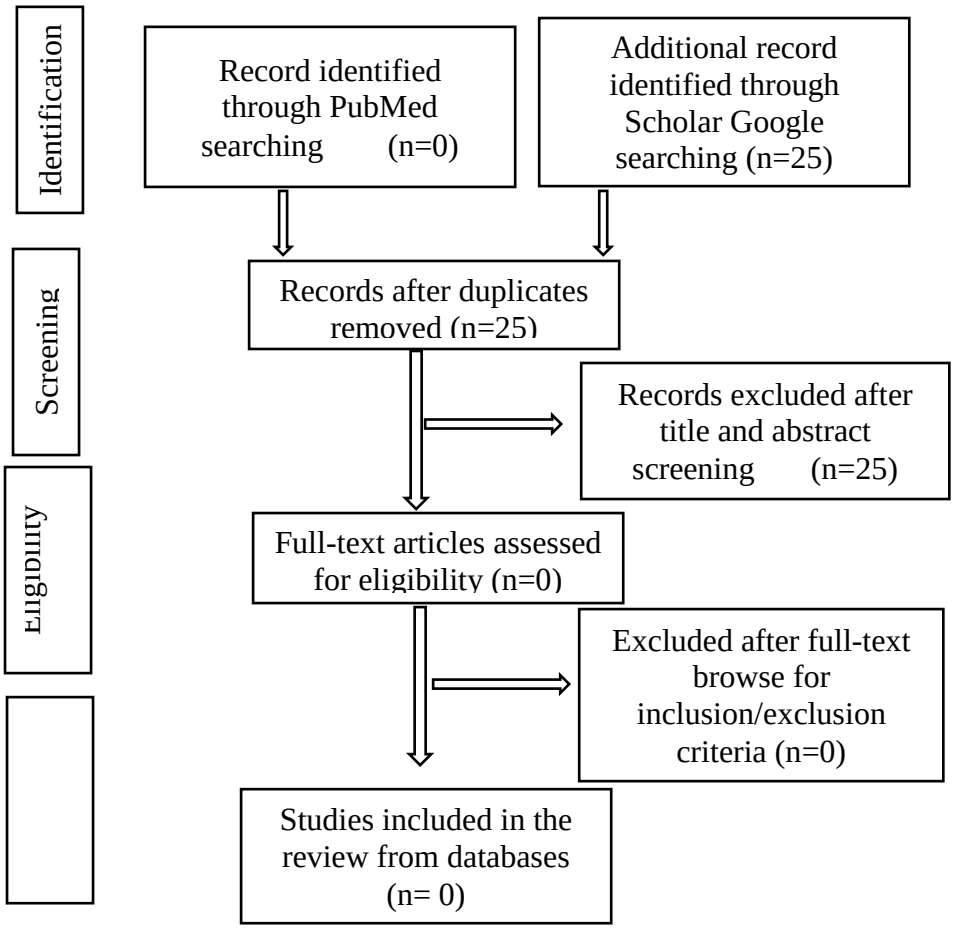

Figure S 5 Flow diagram of database searches from Babesia

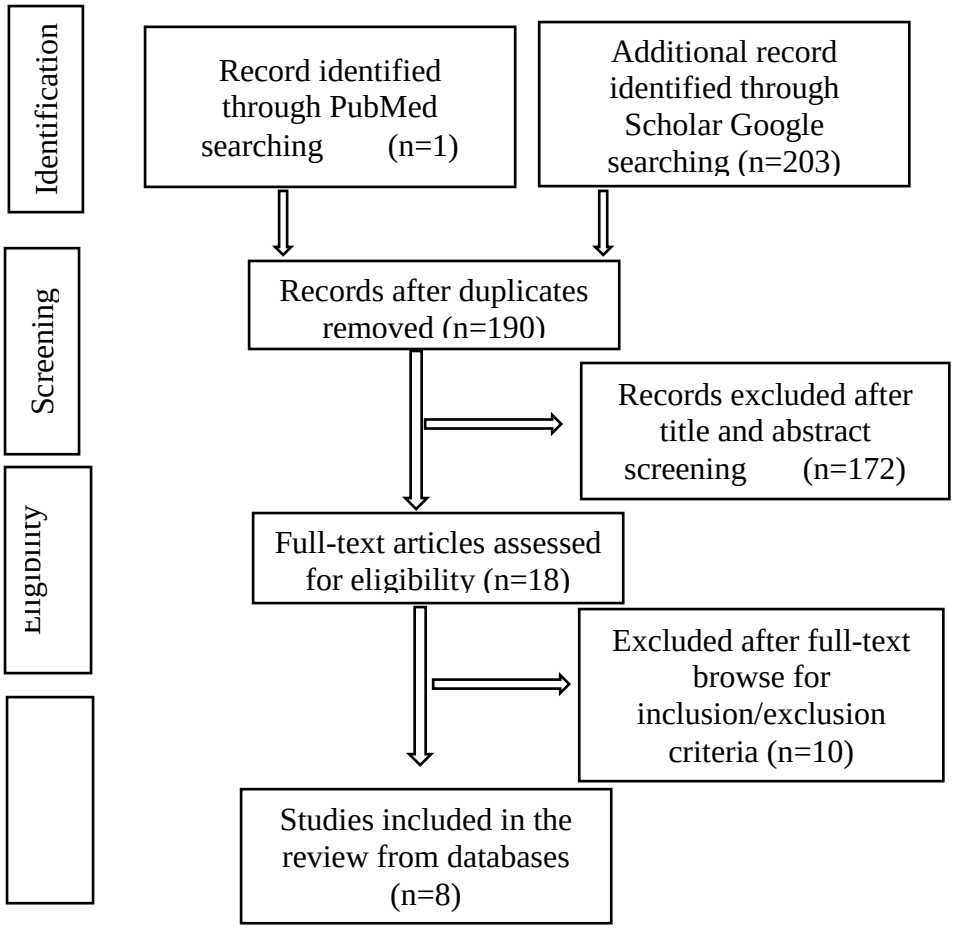

Figure S 6 Flow diagram of database searches from Trypanosoma

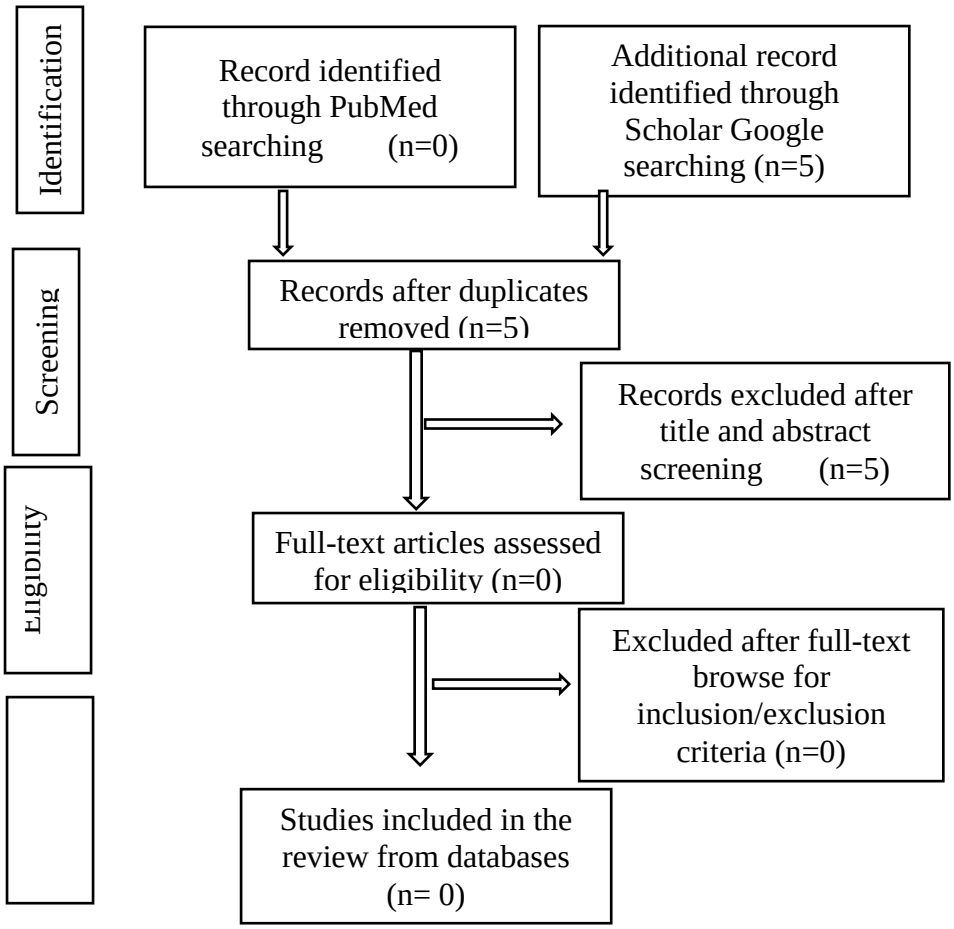

Figure S 7 Flow diagram of database searches from Ehrlichia

Table S 2: Results of the blood parasites research in blood smears of our study

Nombre cientifico	Fecha	Clase	Prueba	Tipo de Muestra	Resultado
Alouatta palliata	02/05/16	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Alouatta palliata	31/12/13	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Alouatta palliata	02/05/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Alouatta palliata	03/03/16	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Alouatta seniculus	16/12/13	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Arctocephalus galapagoensis	07/07/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Ateles fusciceps	12/01/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Ateles fusciceps	27/01/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Ateles fusciceps	20/10/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Ateles fusciceps	26/11/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Ateles fusciceps	21/03/18	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Ateles fusciceps	09/10/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Bassaricyon neblina	14/08/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Bassaricyon neblina	12/05/18	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Boa constrictor	15/06/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Hepatozoon spp.
Boa Constrictor	22/08/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Hepatozoon spp.
Boa constrictor	03/12/14	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Boa constrictor	10/03/15	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Boa constrictor	27/09/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Bothrops spp.	27/09/16	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Bradypus tridactilus	23/09/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Bradypus tridactilus	18/09/16	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Trypanosoma spp.
Bradypus tridactilus	18/10/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Caiman crocodilus	14/06/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Hepatozoon spp.
Caiman crocodilus	04/06/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Hepatozoon spp.
Caiman crocodilus	01/07/16	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo

Caiman crocodilus	14/06/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Caiman crocodilus	29/04/18	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Hepatozoon spp.	
Cebuella pigmea	26/12/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	
Cebus albifrons	10/12/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Cebus albifrons	20/04/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	
Cebus albifrons	18/12/12	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	
Cebus albifrons	23/07/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	
Cebus albifrons	23/07/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	
Cebus albifrons	23/07/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	
Cebus albifrons	23/07/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	
Cebus albifrons	23/07/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	
Cebus albifrons	23/07/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	
Cebus albifrons	07/11/13	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Cebus albifrons	23/07/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Cebus albifrons	20/07/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	
Cebus albifrons	28/08/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	Anaplasma spp.
Cebus albifrons	12/02/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	
Cebus albifrons	23/07/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Cebus albifrons	30/10/13	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Cebus albifrons	03/10/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Cebus albifrons	15/07/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Cebus albifrons	21/05/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Cebus albifrons	21/05/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Cebus albifrons	09/03/16	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	Anaplasma spp.
Cebus apella	18/10/13	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	
Cebus apella	20/05/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Cerdocyon thous	02/09/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Chelonia mydas	07/07/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	

Chelonia mydas	07/07/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Choloepus didactylus	18/09/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Choloepus hoffmanni	13/10/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Choloepus hoffmanni	12/05/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Choloepus hoffmanni	28/11/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Coragyps atratus	13/10/16	Ave	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Coragyps atratus	18/10/16	Ave	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Coragyps atratus	18/10/16	Ave	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Crocodylus acutus	27/09/16	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Crocodylus acutus	07/07/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Crocodylus acutus	27/09/16	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Dasyprocta punctata	20/10/16	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Dasypus novemcinctus	23/02/18	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Eira barbara	23/05/18	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Eretmochelys imbricata	07/07/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Eretmochelys imbricata	08/07/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Eretmochelys imbricata	07/07/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Geochelone denticulata	31/05/16	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Geochelone denticulata	31/05/16	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Geochelone denticulata	03/07/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Geochelone denticulata	03/07/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Geochelone denticulata	03/07/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Geochelone denticulata	03/07/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Geochelone denticulata	03/07/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Geochelone nigra	07/12/12	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Geochelone nigra	07/12/12	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Geochelone nigra	07/12/12	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Geochelone nigra	07/12/12	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Geochelone nigra	07/12/12	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo

Geochelone nigra	07/12/12	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Geochelone nigra	07/12/12	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Geochelone nigra	07/12/12	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Geochelone nigra	07/12/12	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Geochelone nigra	18/02/16	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Geranoaetus melanoleucus	29/12/17	Ave	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Geranoaetus melanoleucus	12/09/17	Ave	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Harpia harpyja	02/07/14	Ave	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Iguana iguana	29/07/14	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Iguana iguana	15/04/15	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Lagothrix lagotricha	20/05/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Lagothrix lagotricha	23/05/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Lagothrix lagotricha	12/06/12	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Babesia spp.	
Lagothrix lagotricha	07/07/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	
Lagothrix lagotricha	12/06/12	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	
Lagothrix lagotricha	04/10/13	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	
Lagothrix lagotricha	22/08/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	
Lagothrix lagotricha	22/04/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Lagothrix lagotricha	22/01/16	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Lagothrix lagotricha	07/07/16	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Lagothrix lagotricha	07/07/16	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Microfilaria spp.	
Lagothrix lagotricha	25/09/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	Anaplasma spp.
Leopardus pardalis	26/06/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	
Leopardus pardalis	27/12/13	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	
Leopardus pardalis	26/06/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	
Leopardus pardalis	26/06/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	
Leopardus pardalis	26/06/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	
Leopardus pardalis	26/06/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	
Leopardus pardalis	10/06/16	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	

Leopardus pardalis	04/07/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Leopardus pardalis	29/09/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Leopardus pardalis	23/06/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Leopardus pardalis	08/12/16	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Leopardus pardalis	26/06/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Leopardus pardalis	08/12/16	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Leopardus pardalis	26/08/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Leopardus pardalis	26/08/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Leopardus pardalis	04/09/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Leopardus pardalis	26/06/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Leopardus pardalis	13/06/13	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Leopardus pardalis	26/06/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Leopardus pardalis	04/09/13	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Leopardus pardalis	26/06/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Leopardus pardalis	26/06/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Leopardus pardalis	26/06/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Leopardus pardalis	27/12/13	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Leopardus pardalis	26/06/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Leopardus pardalis	26/06/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Leopardus pardalis	26/06/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Leopardus pardalis	26/06/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Leopardus pardalis	26/06/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Leopardus pardalis	09/12/16	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Leopardus pardalis	02/06/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Leopardus pardalis	18/08/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Leopardus pardalis	09/01/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Leopardus pardalis	18/08/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Leopardus pardalis	18/08/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Leopardus pardalis	22/11/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo

Leopardus pardalis	07/04/18	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo		
Leopardus pardalis	07/05/18	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo		
Leopardus pardalis	16/06/18	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.		
Leopardus tigrinus	18/02/16	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.		
Leopardus tigrinus	01/08/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.		
Leopardus tigrinus	09/01/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo		
Leopardus tigrinus	10/04/18	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo		
Leopardus tigrinus	04/06/18	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo		
Lontra longicaudis	17/03/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo		
Lycalopex culpaeus	03/12/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo		
Lycalopex culpaeus	06/12/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo		
Lycalopus culpaeus	17/01/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo		
Lycalopus culpaeus	14/02/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo		
Lycalopus culpaeus	03/10/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo		
Lycalopus culpaeus	18/11/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo		
Lycalopus culpaeus	13/11/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo		
Lycalopus culpaeus	20/11/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo		
Lycalopus culpaeus	27/04/12	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo		
Lycalopus culpaeus	23/05/12	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo		
Mazama rufina	12/03/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	Ehrilichia spp.	Babesia spp.
Mazama rufina	19/05/16	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Ehrilichia spp.		
Mazama rufina	12/09/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo		
Melanosuchus niger	07/06/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Hepatozoon spp.	Microfilaria spp.	
Melanosuchus niger	07/06/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Hepatozoon spp.		
Melanosuchus niger	07/06/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Hepatozoon spp.	Microfilaria spp.	
Melanosuchus niger	04/06/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Hepatozoon spp.	Microfilaria spp.	
Melanosuchus niger	14/06/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Hepatozoon spp.		
Melanosuchus niger	14/06/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo		

Melanosuchus niger	14/06/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Melanosuchus niger	07/06/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Melanosuchus niger	14/06/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Melanosuchus niger	14/06/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Melanosuchus niger	14/06/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Melanosuchus niger	14/06/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Melanosuchus niger	14/06/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Melanosuchus niger	14/06/17	Reptil	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Morphnus guianensis	30/05/18	Ave	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Nasua nasua	21/09/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Nasua nasua	09/03/16	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	
Nasua nasua	12/09/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	
Nasua nasua	31/10/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Nasua nasua	28/11/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Microfilaria spp.	
Odocoileus peruvians	26/08/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	
Odocoileus peruvians	12/11/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Orthopsittaca manilata	17/10/16	Ave	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Panthera onca	31/10/16	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Panthera onca	18/09/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Panthera onca	18/02/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Panthera onca	12/04/12	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	
Panthera onca	05/01/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	
Panthera onca	18/11/16	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.	
Panthera onca	30/04/18	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Parabuteo unicinctus	27/06/14	Ave	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Parabuteo unicinctus	10/06/16	Ave	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Pelecanus occidentalis	07/07/17	Ave	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Pelecanus occidentalis	07/07/17	Ave	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Pionnus sordidus	17/06/14	Ave	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	

Pithecia aequatorialis	07/07/16	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Pithecia aequatorialis	04/07/18	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Potos flavus	04/11/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Potos flavus	09/03/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Potos flavus	02/09/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Potos flavus	22/10/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Pudu mephistophiles	24/04/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Puma concolor	22/12/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Puma concolor	12/04/12	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Puma concolor	12/04/12	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Puma concolor	12/04/12	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Puma concolor	22/12/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Puma concolor	22/12/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Puma yaguarondi	02/06/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Puma yaguarondi	28/01/18	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Saguinus fuscicollis	12/03/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Anaplasma spp.
Saguinus fuscicollis	09/05/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Babesia spp.
Saguinus fuscicollis	09/05/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Saguinus fuscicollis	05/06/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Saguinus fuscicollis	30/03/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Saguinus fuscicollis	04/11/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Saguinus fuscicollis	02/05/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Saguinus fuscicollis	28/05/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Saguinus fuscicollis	08/05/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Saguinus fuscicollis	28/05/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Saguinus fuscicollis	03/06/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Saguinus fuscicollis	18/06/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Saguinus fuscicollis	18/06/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Saguinus nigricolis	02/12/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo

Saguinus nigricolis	17/12/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Saimiri sciureus	08/04/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Saimiri sciureus	11/04/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Saimiri sciureus	07/10/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Saimiri sciureus	23/04/13	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Saimiri sciureus	08/07/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Saimiri sciureus	07/09/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Saimiri sciureus	07/09/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Saimiri sciureus	20/06/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Saimiri sciureus	14/07/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Saimiri sciureus	06/09/12	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Saimiri sciureus	12/03/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Saimiri sciureus	30/03/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Saimiri sciureus	30/03/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Saimiri sciureus	22/04/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Saimiri sciureus	10/01/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Saimiri sciureus	22/08/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Saimiri sciureus	28/04/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Saimiri sciureus	10/09/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Saimiri sciureus	16/03/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Saimiri sciureus	05/03/18	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Saimiri sciureus	28/07/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Mycoplasma spp.
Saimiri sciureus	15/04/18	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Sarcorhamphus papa	27/04/17	Ave	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Sarcorhamphus papa	26/10/16	Ave	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Spheniscus humboldti	07/07/17	Ave	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Spheniscus humboldti	07/07/17	Ave	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Spheniscus humboldti	29/12/15	Ave	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo
Spheniscus humboldti	29/12/15	Ave	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo

Sula nebouxii	07/07/17	Ave	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Sula nebouxii	07/07/17	Ave	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Sula nebouxii	07/07/17	Ave	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Tamandua tetradactyla	18/07/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Tamandua tetradactyla	28/07/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Tapirus pinchaque	14/11/16	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Tapirus pinchaque	06/04/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Tremarctos ornatus	09/04/14	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Tremarctos ornatus	22/10/16	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Tremarctos ornatus	30/08/17	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Tremarctos ornatus	13/05/13	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Tremarctos ornatus	12/12/13	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Tremarctos ornatus	06/07/15	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Tremarctos ornatus	04/01/18	Mamífero	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Vultur gryphus	25/03/16	Ave	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Vultur gryphus	21/10/15	Ave	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Vultur gryphus	26/10/15	Ave	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Vultur gryphus	26/10/15	Ave	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	
Vultur gryphus	10/04/15	Ave	Investigacion de Hemoparasitos	Frotis Sanguineo	Negativo	