

Vector-borne Disease and Zoos (Exotic Animals in Human Care)

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Webbing the Wild, LLC



For today

Veterinarians? Why?

Preventive Medicine

Zoology of VBD

One Health

Connection



Veterinarians

But don't you see puppies and kittens...



Introduction

- I work as a specialist in veterinary preventive medicine. My background is in vector-borne disease, initially in canine tick-borne disease and the impacts on human health.
- Put simply, we prevent animal diseases by tracking prevalent conditions and providing preventive measures and immunizations.

Preventive Medicine

We're not so different, you and I...

Veterinary Clinic Basics

Preventive annual screenings include:

Heartworm testing +/- (mosquito-borne)

Tick-borne illness screen

- Lyme
- Anaplasmosis
- Ehrlichiosis

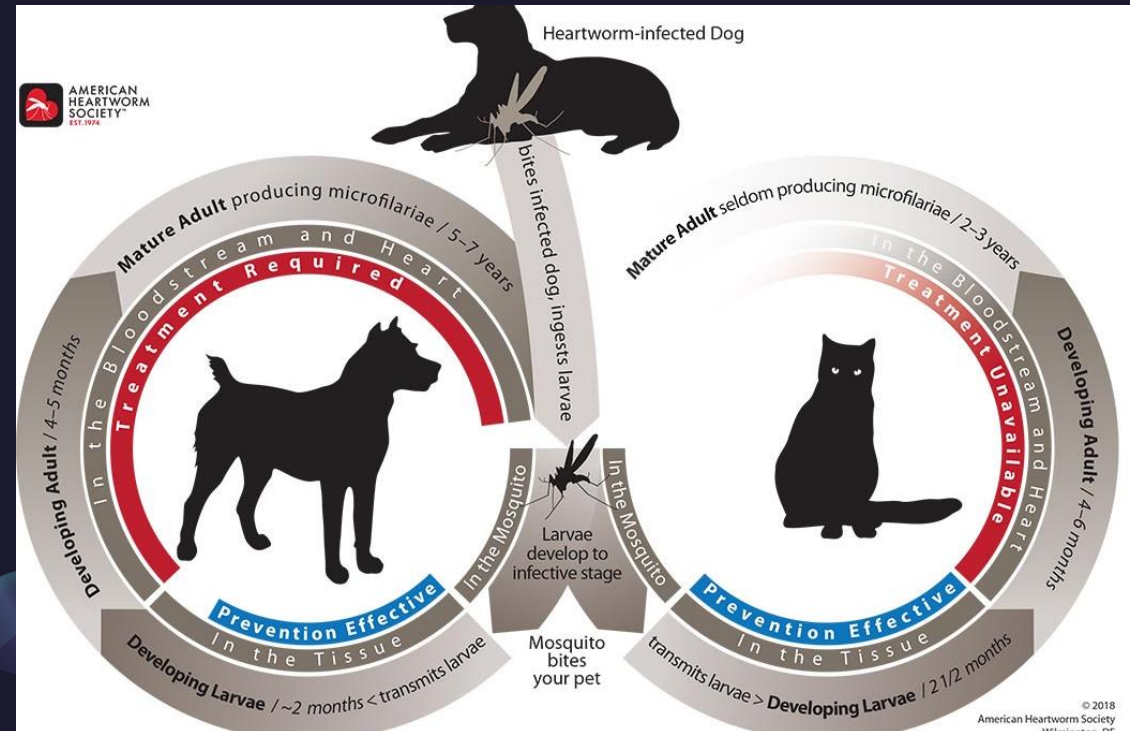
Vaccinations*



www.zoetisus.com



www.idexx.com

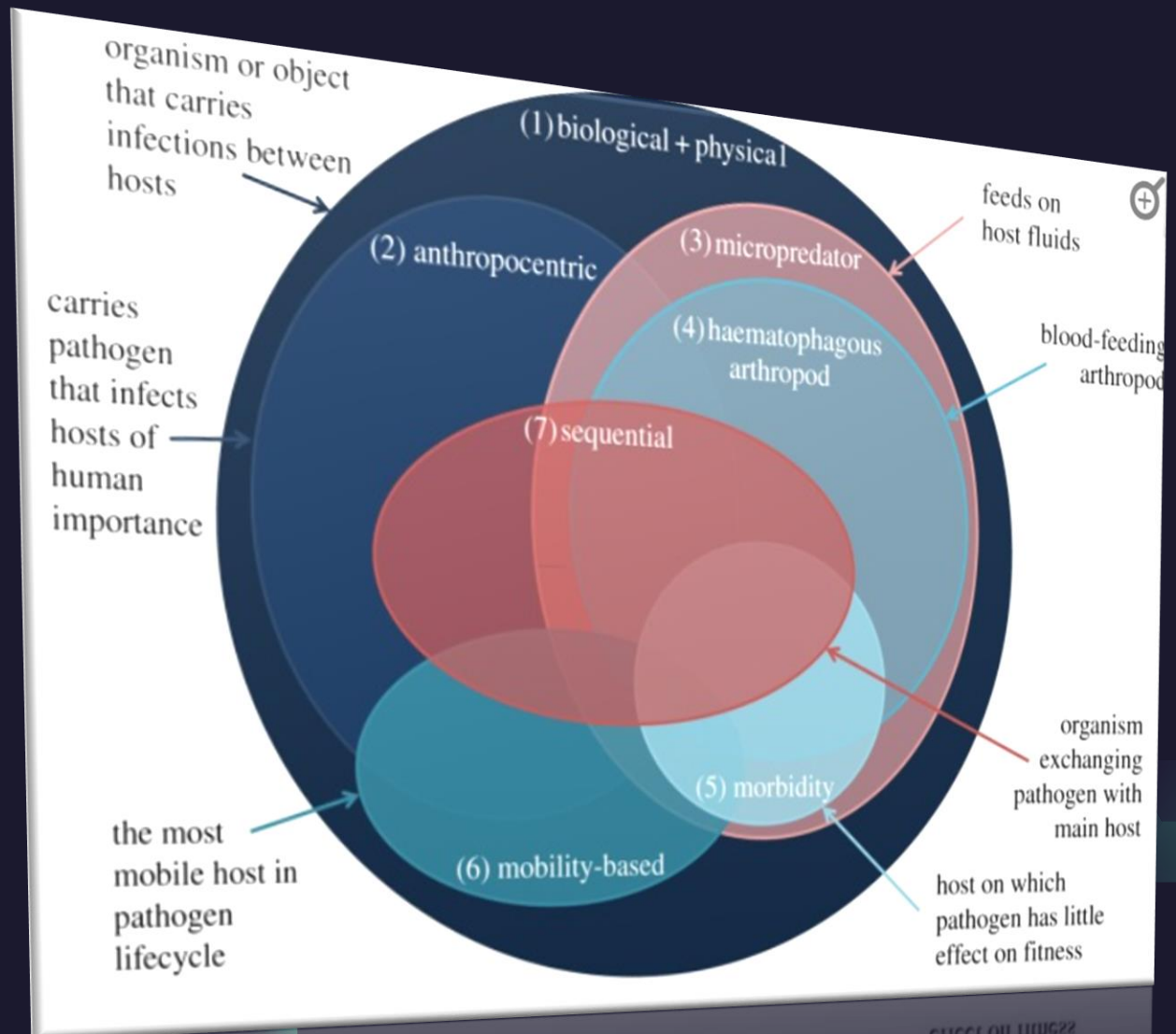


www.americanheartwormsociety.org

What is a vector?

“An organism or object that carries infections between hosts”

- Public Health; Rabies-vector
- Transmission Ecology; “-borne”
- ‘Haematophagous arthropod’



Domestic Animals → Exotic Animals

DOMESTIC

- Some data available to provide context, prevalence, and incidence of disease
- Preventive measures are widely accepted among animals living with humans mostly to limit the spread of disease to people
- Agricultural, economic, and social drivers require animals to be healthy

EXOTIC

- Limited data available – many times we must rely on published literature, screening tests, and apply treatments based on experience with a species
- Preventive measures are widely accepted to prevent disease in endangered animals
- Social and economic aspects of keeping high profile animals healthy

Heartworm Prevention Considerations

MANED WOLF

- Asymptomatic
- Pos + test with annual antigen screening
- Treated with AHS canine protocol
- Recovered without incident
- Typical prevention:
 - Oral ivermectin monthly

OTHER SUSCEPTIBLE SPECIES:

- Asian small-clawed otter
- Red panda
- Sand cat
- Black-footed cat
- Fishing cat
- Tiger
- Serval
- Binturong
- Meerkat
- Clouded leopard/Jaguar



What is the big deal?

- Canids are reported to have less adverse effects from treatment of *D. immitis*
 - Treatment is more effective in canids than felids, procyonids, mustelids and herpestids
 - Treatment sensitivities: river otters, ferrets, and red pandas
 - NO approved adulticide in felids
 - WHAT do we do to treat these other species? – Hopefully, step up prevention! But how?
- HOW was maned wolf exposed? Which species? Which reservoir?
 - Mosquitoes carrying HW disease >70 species
 - → **TOP 5 include: *Aedes*, *Anopheles*, *Culex*, *Psorophora*, *Mansonia spp.***
 - Definitive hosts include coyotes, jackals, foxes, wolves, otters
 - Wildlife reservoirs are wolverines, coyotes, deer, bears, and raccoons
 - Known vectors of other “heartworms” include black flies (*D. ursi*) and seal louse (*A. odendhali*)

Maned Wolves

- Heartworm Disease
- Mosquito Control
 - WNV, EEE, LACV
- Other Vector-borne diseases
 - Lyme, Rickettsia, Ehrlichia, Babesia, Anaplasma, Bartonella, hemotropic Mycoplasma, Leishmaniasis



Zoology of Vector-borne diseases

Lions, tigers, and bears, oh (how)?

***Dirofilaria immitis* in an African lion (*Panthera leo*)**

M. R. RUIZ DE YBÁÑEZ,
C. MARTÍNEZ-CARRASCO, J. J. MARTÍNEZ,
J. M. ORTIZ, T. ATTOUT, O. BAIN

Dirofilaria immitis is a significant pathogen of dogs; it is fairly common in wild canids and occurs sporadically in various other wild and captive mammals (Abraham 1988). However, feline heartworm has been diagnosed with increasing frequency over the past few years and is now recognised as being a potential cause of serious disease in cats and other felids (Atkins and others 2000, Murata and others 2003). It is generally accepted that in areas where canine dirofilariosis is endemic, cats are also at risk of infection, although their infection levels are approximately one-fifth of those in dogs (Brown and others 1999). In cats, the infection is characterised by a low burden, often of only one or two individual nematodes; microfilaraemia is transitory and of low intensity, although naturally infected individuals are usually amicrofilaraemic (Prieto and others 2001). This short communication describes the first diagnosis of *D immitis* infection in an African lion (*Panthera leo*).

A 20-year-old male African lion, which had been born and kept at Aitana Safari Park, Alicante, Spain, died after a prolonged period of depression, weight loss and poor physical condition. No clinical signs of dirofilariosis, such as diarrhoea or coughing, had been observed. At postmortem examination

J. Zoo An. Med. 12: 20-22, 1981

HEARTWORMS IN A BENGAL TIGER (*Panthera tigris*)

S. Kennedy, D.V.M.*
S. Patton, Ph.D.*

Introduction

A 6-year old female Bengal tiger raised at the Knoxville Zoological Park, was found dead at mid-day in her outside enclosure. She had appeared to be normal that morning and had no history of illness. At necropsy, 15 nematodes were found in the right ventricle in the area of the pulmonic




Article Full-text available

Detection of *Dirofilaria immitis* in a brown bear (*Ursus arctos*) in Greece

September 2017 · *Helminthologia* 54(3)

DOI: [10.1515/helm-2017-0033](https://doi.org/10.1515/helm-2017-0033)

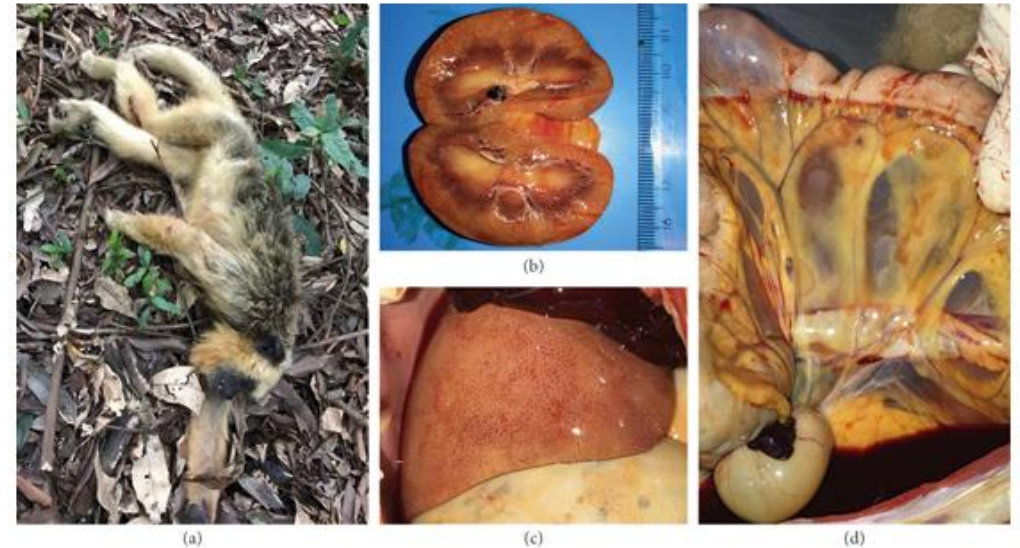
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 Elias Papadopoulos ·  Anastasia Komnenou · T. Poutachides · [Show all 6 authors](#) ·  Alexandros A Karamanlidis

Arboviral Diseases

ORTHOFLAVIVIRUS* INFECTIONS; Flaviviridae

- WNV – Vector: *Culex* and *Aedes* spp. (*Cx. restuans* amplifying in birds; while *Cx. pipiens*, *Cx. salinarius* are bridge vectors)
 - Reservoir: birds (robins, finches, sparrows)
- SLEV – Vector: *Cx. pipiens*, *Cx. quinquefasciatus*
 - Reservoir: birds (sparrows), primates (Brazil)
- YFV – Vector: *Aedes* and *Haemogogus* spp.
 - Reservoir: primates (non-human and human)
- Zika – Vector: *Aedes aegypti* and *Ae. albopictus*
 - Reservoir: unknown; Non-human primates can be infected



Arboviral Diseases

ORTHOFLAVIVIRUS* INFECTIONS; Flaviviridae

- JEV (Australasia) – Vector: *Culex* spp. (*Cx. annulirostris* and *Cx. tritaeniorhynchus*)
 - Reservoir: wading birds (herons, egrets), bats, where pigs are amplifying hosts
 - JEV Threat to US Swine Industry:
<https://www.swinehealth.org/jev-threat/>
- Usutu virus (Europe) – Vector: *Culex* spp.
 - Reservoir: blackbirds, magpies
 - North American house sparrows as competent hosts;
<https://journals.asm.org/doi/10.1128/msphere.00295-22>



Upper photo: <https://www.youtube.com/watch?v=gC8BKNdZTlc>

Lower photo: <https://aphascience.blog.gov.uk>

Arboviral Diseases

Formerly BUNYAVIRIDAE*

- LACV – orthobunyavirus; peribunyaviridae
 - Vector: *Ochlerotatus triseriatus*
 - Reservoirs: squirrels, chipmunks, mice, rabbits
- RVFV (Africa) – phlebovirus; phenuiviridae
 - Vector: *Aedes* and *Culex* spp.
 - Reservoirs: domestic ruminants and camels

Upper photo: <https://www.nycgovparks.org/learn/wildlife-in-new-york-city/chipmunks-in-new-york-city-parks>

Lower photo: <https://www.slideshare.net/ILRI/rvf-in-kenyan-pastoral-livestock>



Rift Valley fever in Kenyan pastoral livestock: Individual-based demographic model to analyse the impact of Rift Valley fever

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Arboviral Diseases

Formerly BUNYAVIRIDAE*

- STFSV (Asia) – phlebovirus; phenuiviridae
 - Vector: *Haemaphysalis longicornis*
 - Reservoirs: unidentified; seroprevalence in at least 15 species
- HRTV (United States) – bandavirus; phenuiviridae
 - Vector: *Amblyomma americanum*, *Haemaphysalis longicornis*
 - Reservoirs: unidentified; high seroprevalence in white-tailed deer, raccoons, horses



Arboviral Diseases

TOGAVIRIDAE (Alphaviruses)

- EEEV – Vector: *Culiseta melanura* (*Cs. melanura* amplifying in birds; while *Ochlerotatus sollicitans* and *Coquillettidia perturbans* are bridge vectors)
 - Reservoir: passerine birds, possible overwintering in turtles and snakes
- WEEV – Vector: *Culex tarsalis*
 - Reservoir: passerine birds
- VEEV – Vector: *Culex*, *Aedes*, *Psorophora* spp.
 - Reservoir: wild rodents, possibly bats
- CHIKV – Vector: *Aedes aegypti* and *Ae. albopictus*
 - Reservoir: wild primates (Africa), lab investigation of reptiles and amphibians



Upper photo: www.aaep.org; Lower photo: www.inaturalist.org



“One Health” is a partnership

Vector studies protect animals and humans

Further research is needed

DENGUE – SEARCH FOR AN ANIMAL RESERVOIR

Animals as potential reservoirs for dengue transmission: A systematic review

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MALARIA – ZONOTIC CHALLENGES

Primate malaria: An emerging challenge of zoonotic malaria in Indonesia

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How to Connect with veterinarians

Surveillance tools

Maintenance and pest control

System operations and evaluation

Vector and Zoo/Wildlife Research

Lincoln Park Zoo

NCSU Vector Borne Disease
Diagnostic Laboratory

Nashville Zoo with Tennessee
Dept of Health; Cornell and
Univ. of Arkansas

Suffolk Mosquito Control
partnership

- Urban Wildlife Institute
- Identification of vector-borne illness by serology and molecular panels (Ex. North Carolina black bear and 4 species of hemotropic Mycoplasmas - 2017)
- Bloodmeal analysis of mosquitoes in local birds and zoo animals (2023)
- Mosquito bloodmeal analysis to determine host species (2021)
 - *Ae. albopictus* – cats, opossum, white-tailed deer and humans
 - *Cx. pipiens* – American robin and northern cardinal, cats and opossum less in summer



In Summary

Animal and human health are interconnected, and we can learn this from some cool exotic species along the way.

Specific interests see contact on next slide.

Thank You

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