

FORUM SCHEDULE

Toxoplasmosis:
A Threat to Hawaii's Wildlife and Public Health
William S. Richardson School of Law
Classroom 2

March 31, 2018
9:00am - 12:00pm

9:00 - 9:10	<u>Introduction & Opening Remarks</u> Scott Glenn , Director, OEQC Makaala Kaaumoana , OEQC Environmental Council Information & Outreach Committee
9:10 - 9:30	<u>What is Toxoplasmosis?</u> Thierry Work, DVM, MS , Wildlife Disease Specialist/Field & Lab Research, USGS
9:30 - 9:50	<u>The Science of Toxoplasmosis</u> Kenton Kramer, PhD , Associate Professor, Department of Tropical Medicine, John A Burns School of Medicine William Gosnell, PhD , Associate Professor, Department of Tropical Medicine, John A Burns School of Medicine
9:50 - 10:10	<u>DLNR Policy Issues and Pending Legislation</u> (no slides) Bruce Anderson, PhD , Administrator, DLNR Division of Aquatic Resources
10:10 - 10:30	Break
10:30 - 10:50	<u>Impacts of Toxoplasmosis on Protected Species</u> Michelle Barbieri, DVM, MS , Wildlife Veterinary Medical Officer, NOAA Pacific Islands Fisheries Science Center, Protected Species Division Angela Amlin , Hawaiian Monk Seal Recovery Coordinator, NOAA Fisheries Pacific Islands Regional Office
10:50 - 11:10	<u>Human Dimensions of Cat Management with Insights on Toxoplasmosis</u> Kirsten Leong, PhD , Social Scientist, NOAA Pacific Islands Fisheries Science Center Christopher Lepczyk, PhD , Professor, School of Forestry and Wildlife Sciences, Auburn University (participating via Skype)
11:10 - 11:30	<u>Looking Forward: Current Policy Framework and Potential Directions</u> Joshua Atwood, PhD , Invasive Species Coordinator, Division of Forestry and Wildlife, DLNR
11:30 - 12:00	Q&A and Open Discussion

Toxoplasmosis

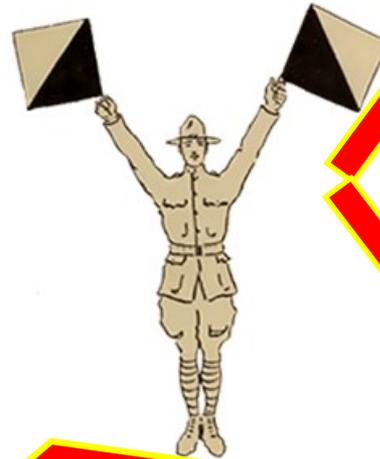
Thierry M. Work
USGS-National Wildlife Health Center
Honolulu Field Station

Honolulu Field Station

Technical assistance

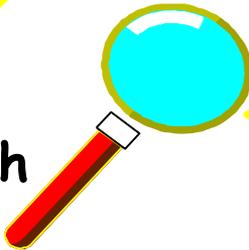


Outreach

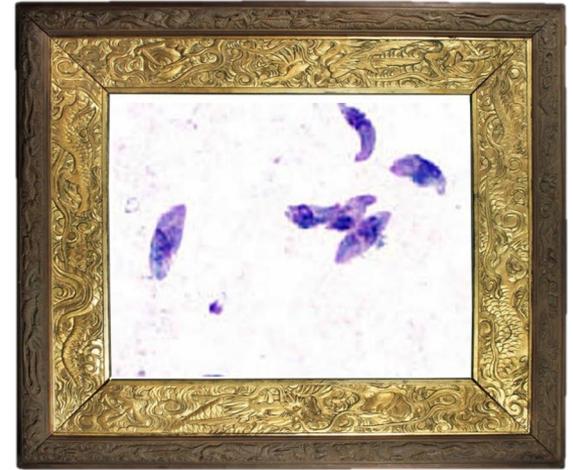
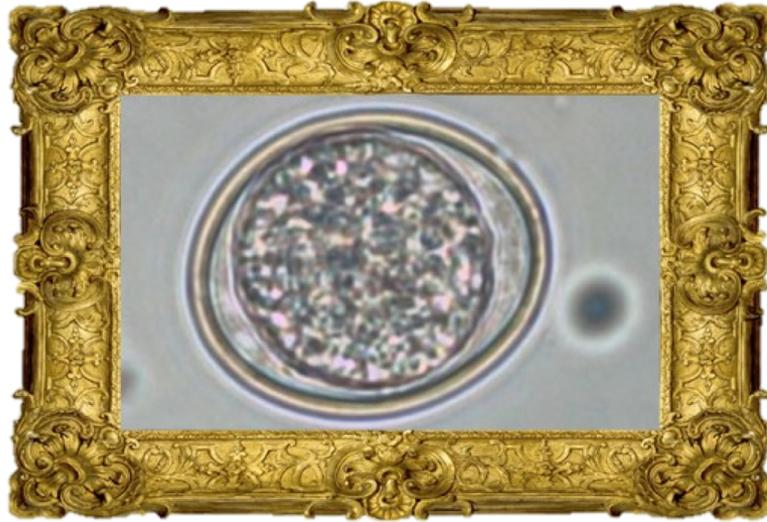


Management

Research

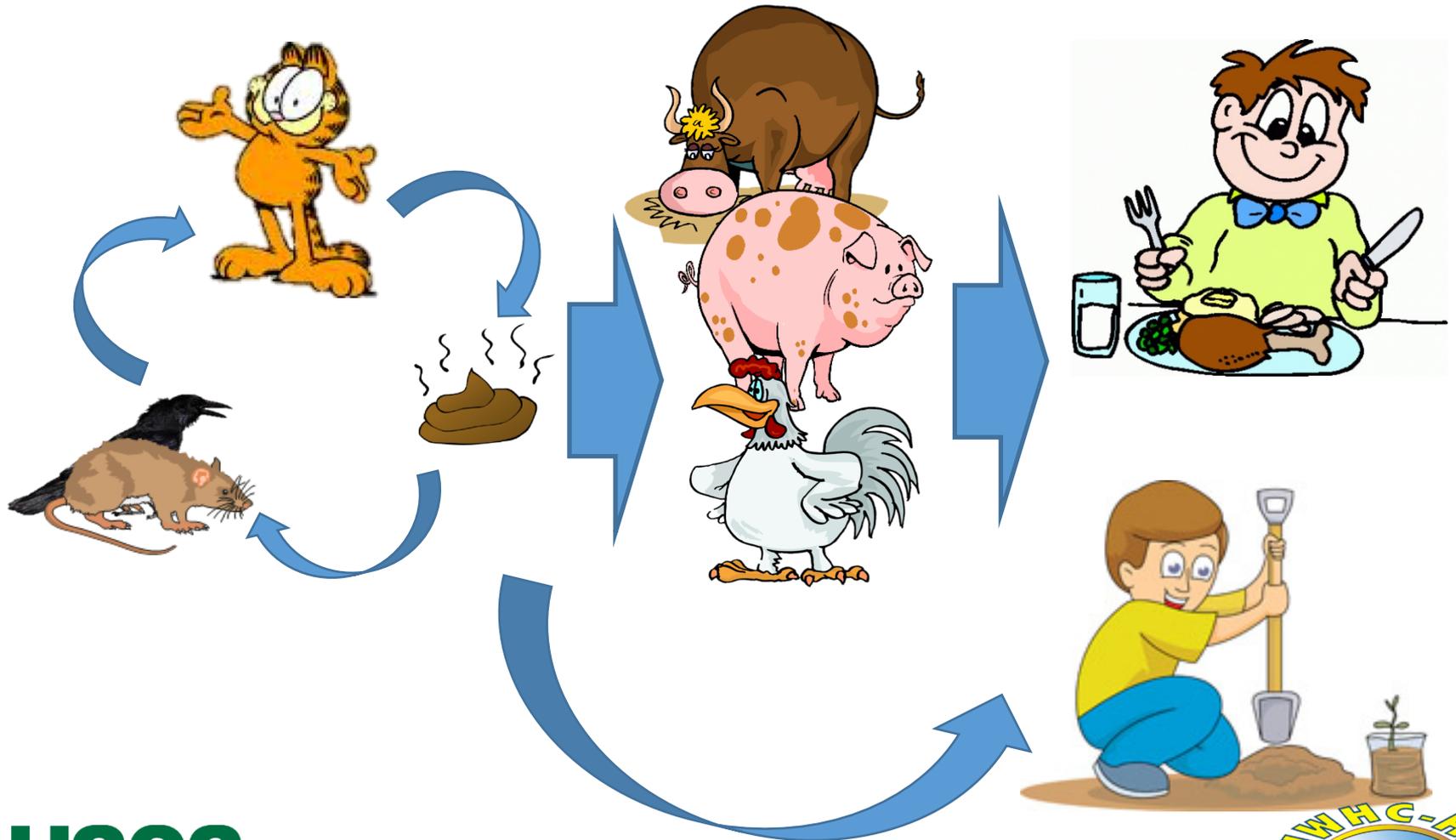


Toxoplasmosis is caused by a parasite (*Toxoplasma gondii*)

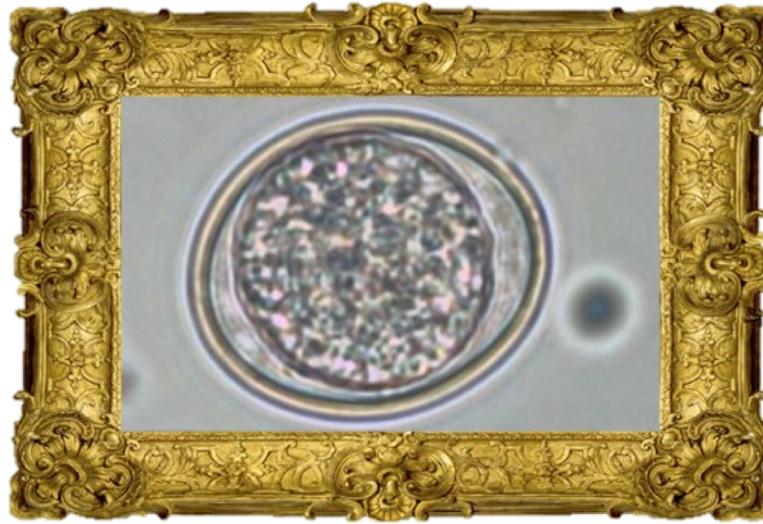


Family portrait

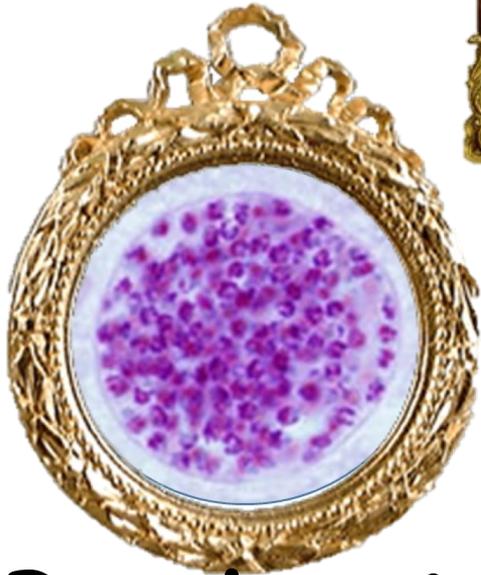
T. Gondii life cycle



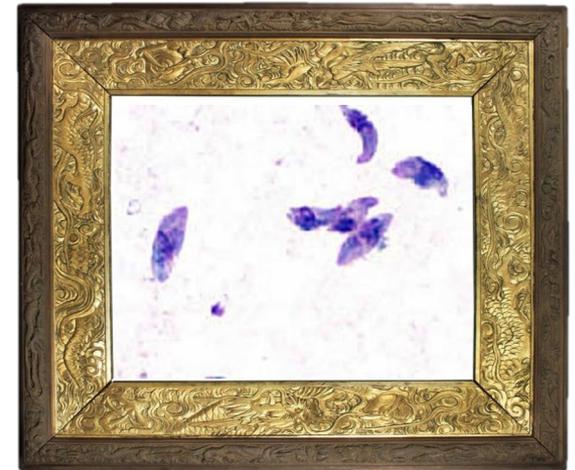
T. gondii family portrait



Oocyst

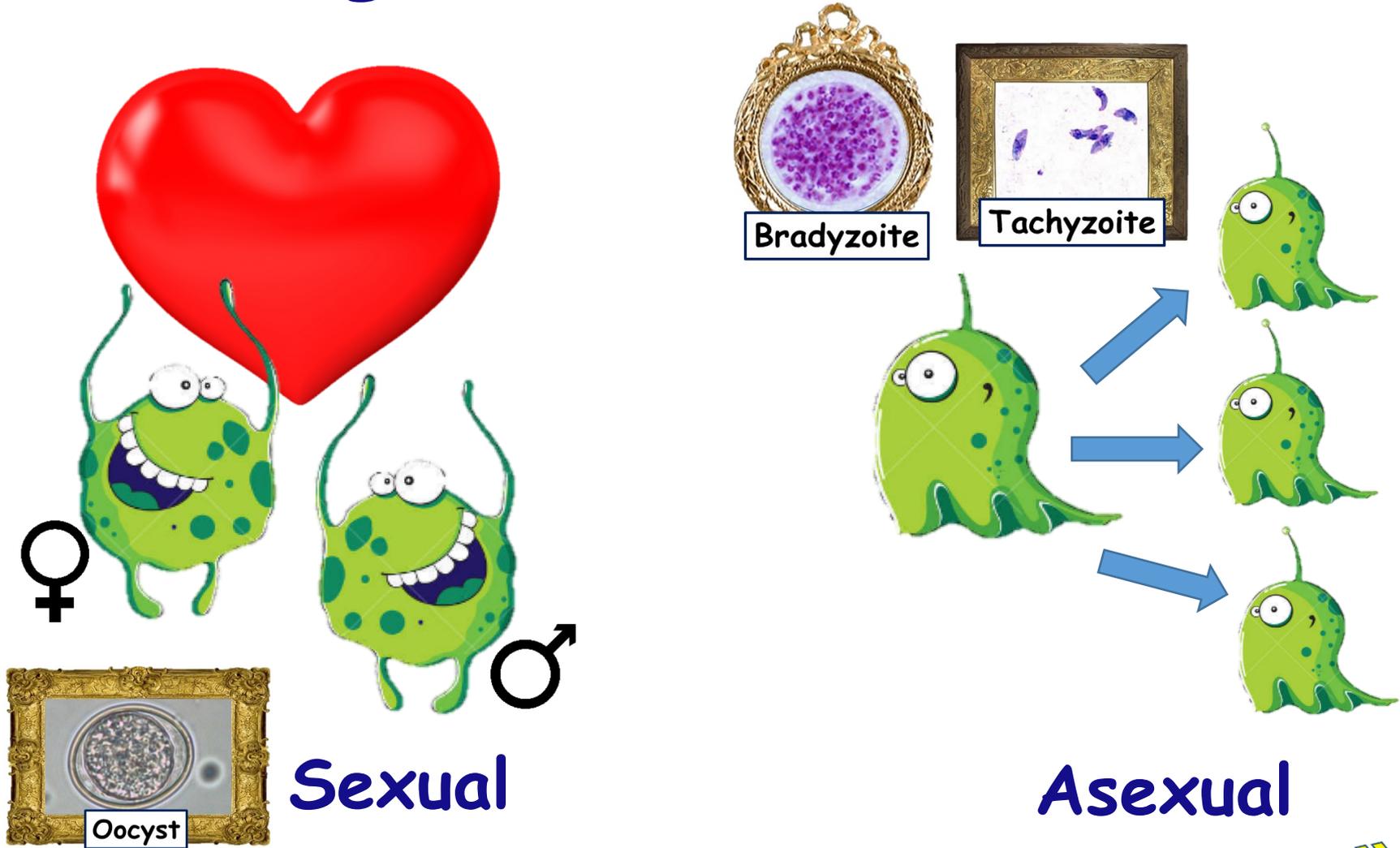


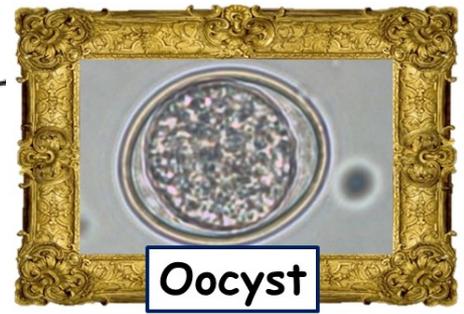
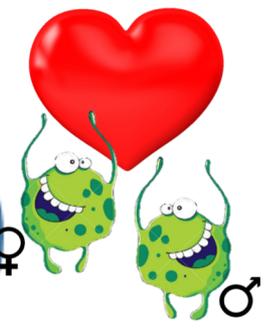
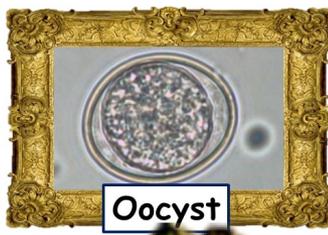
Bradyzoite

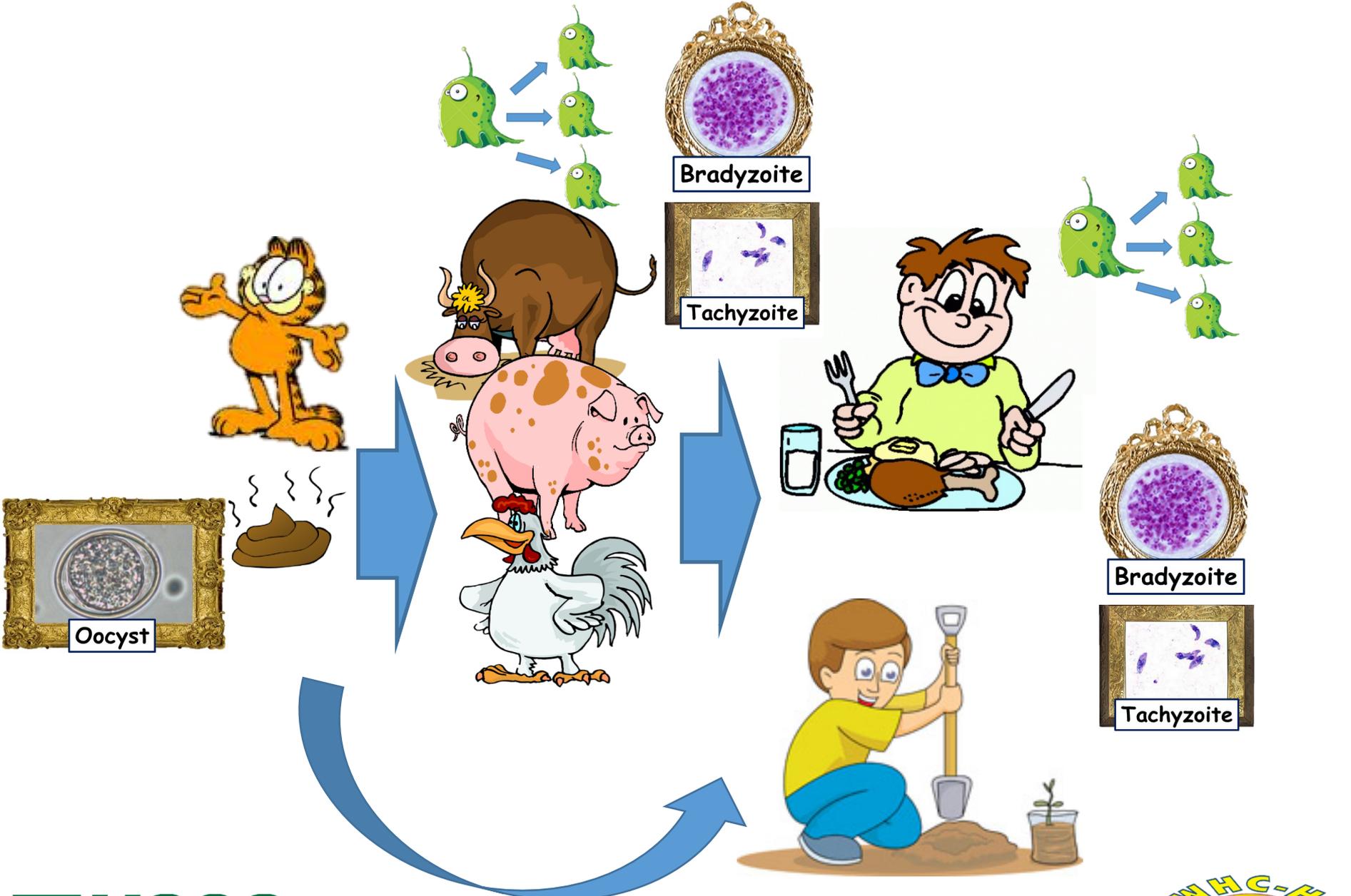


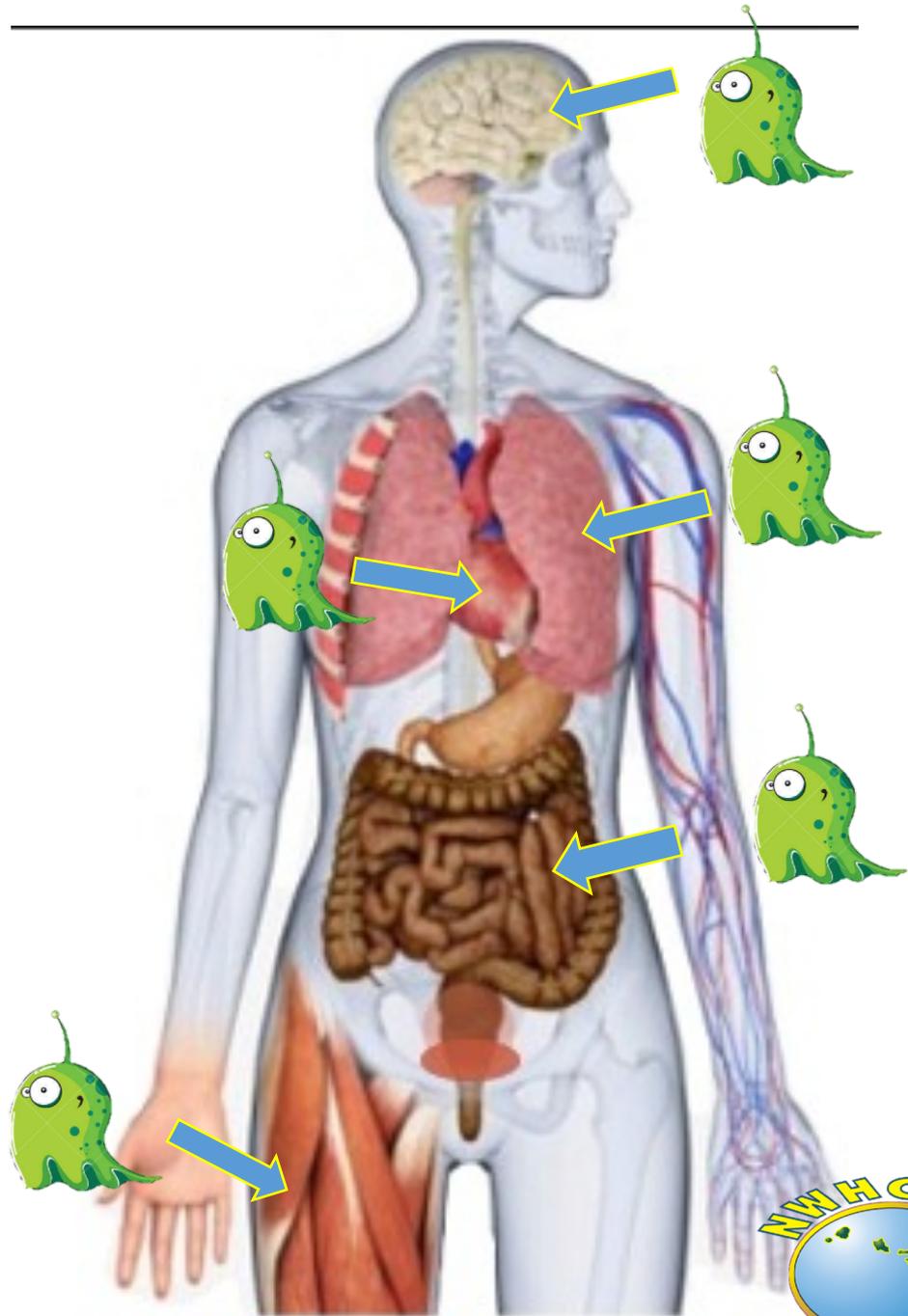
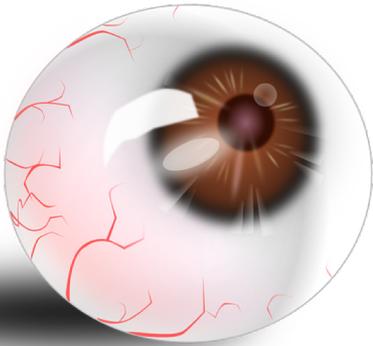
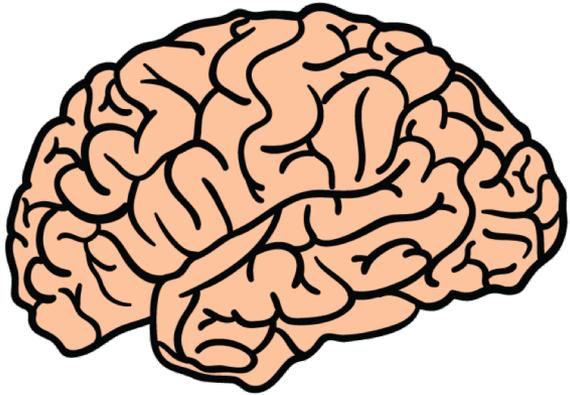
Tachyzoite

(*T. gondii* reproduction)

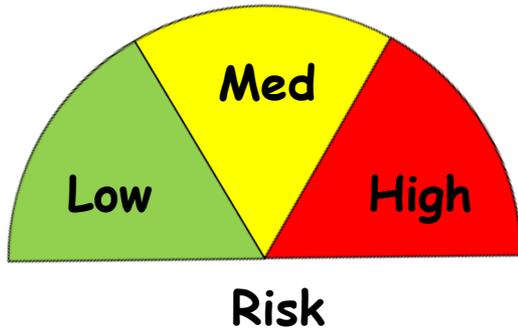








T. Gondii and pregnancy



First trimester

2nd trimester

3rd trimester

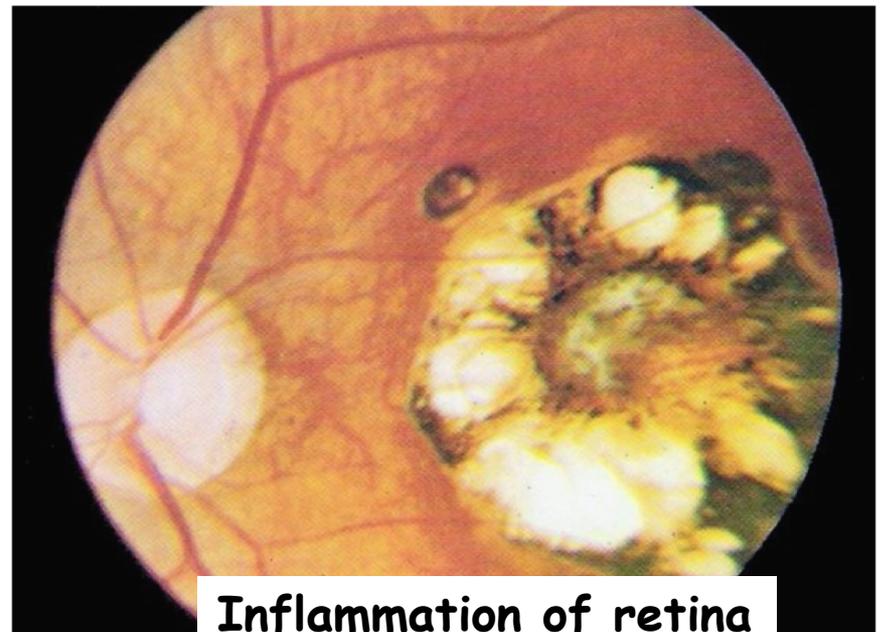
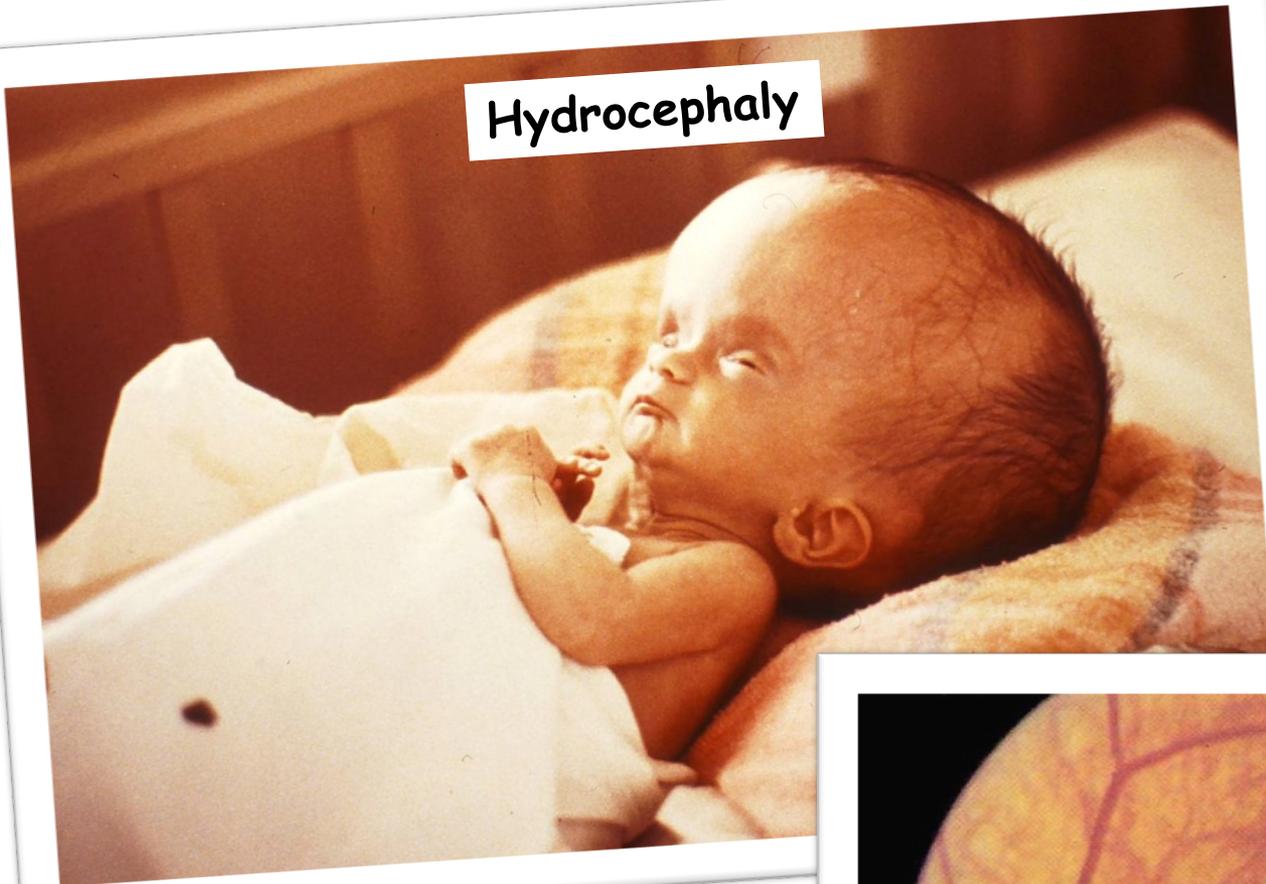


Risk of developing congenital disease



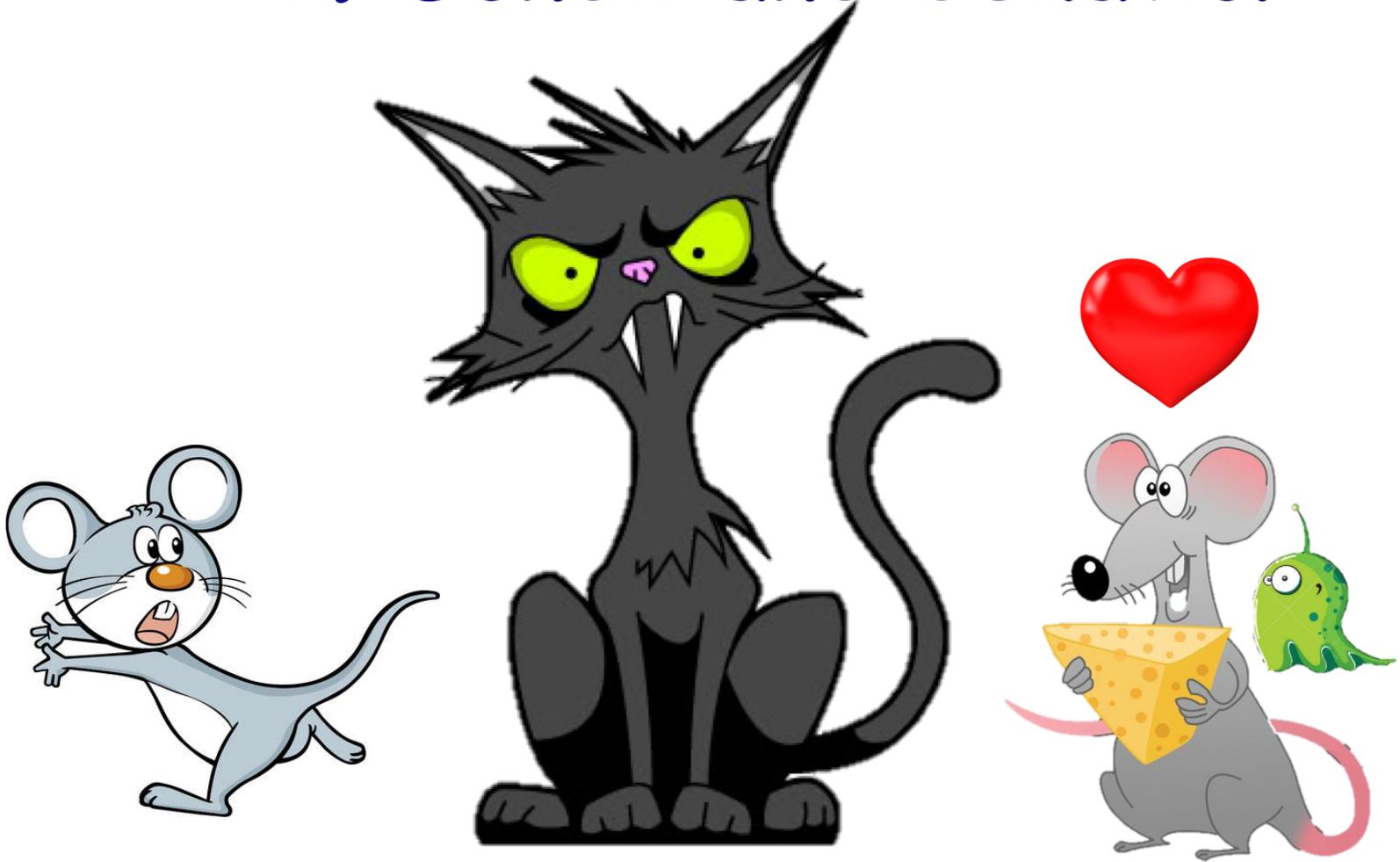
Severity of congenital disease

Hydrocephaly

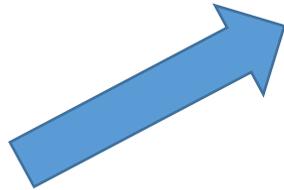
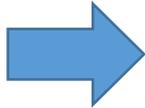


Inflammation of retina

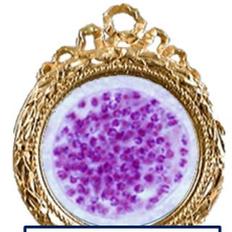
T. Gondii and behavior



T. Gondii Clinical signs



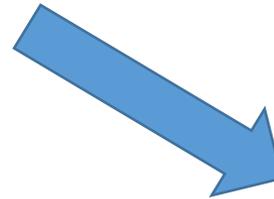
Altered
behavior?



Bradyzoite



Bradyzoite



Inflammation
of various
organs -> death



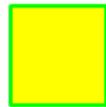
Tachyzoite





Hawaiian crow

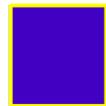
Range



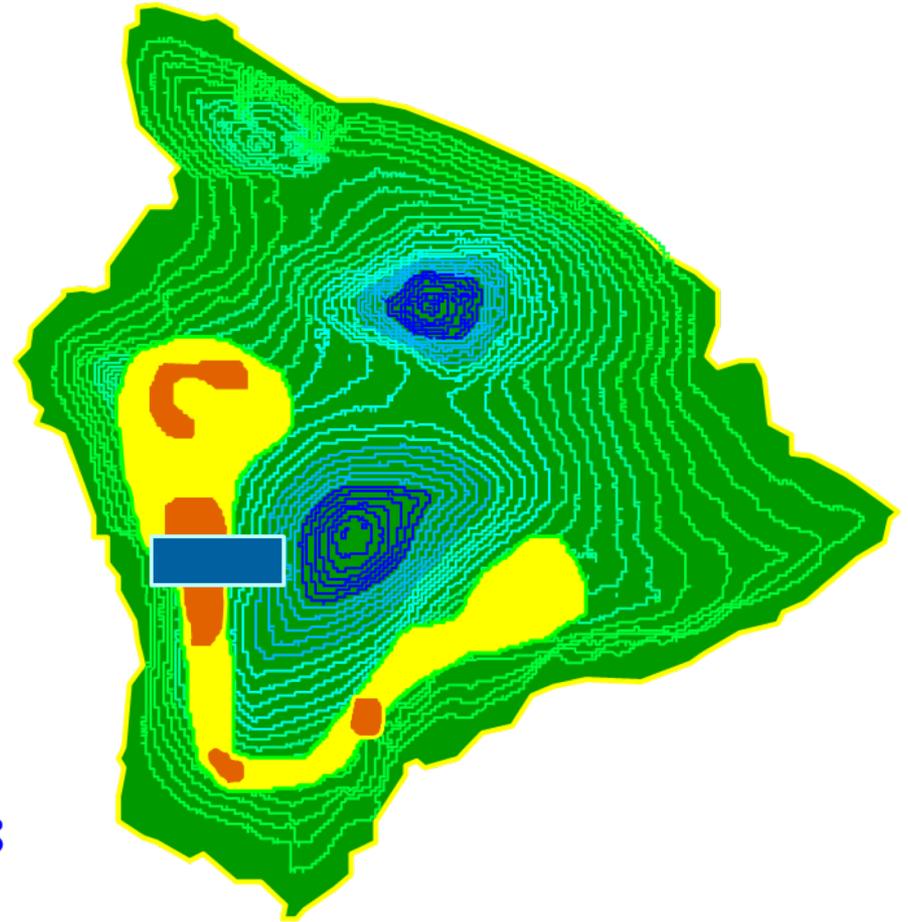
1890s



1970-80s

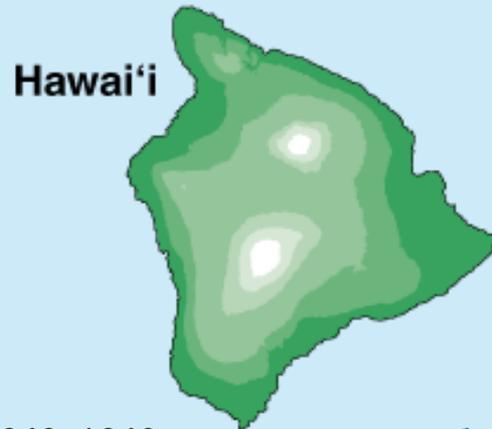
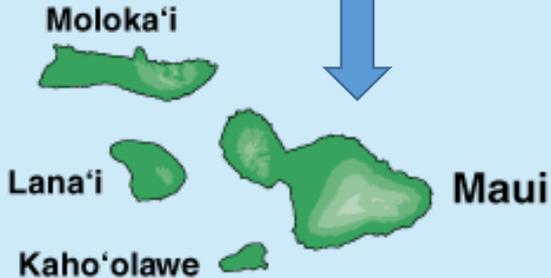
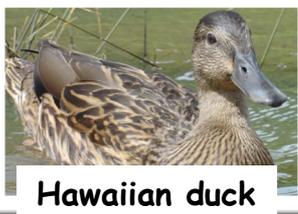


Present





O'ahu



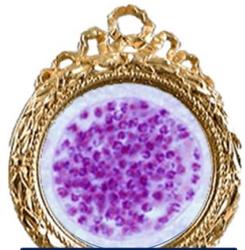
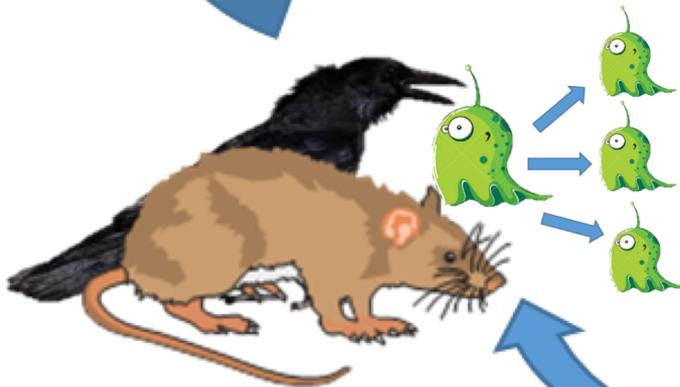
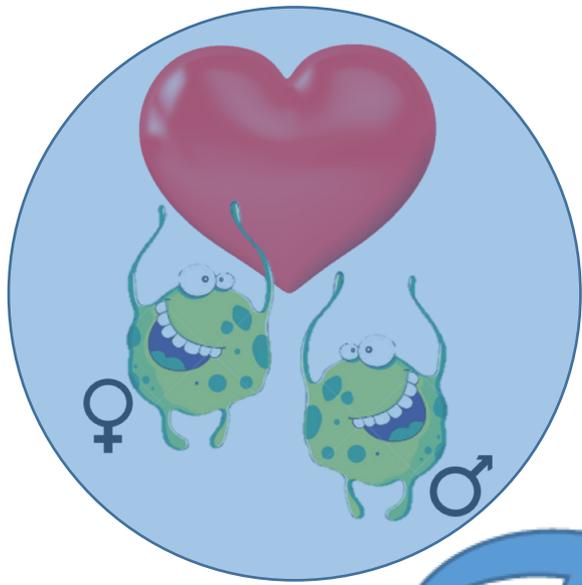
J Parasitol 2002, 88:1040-1042.



Many colored fruit dove



Cat family (Felidae) play a critical role



Bradyzoite

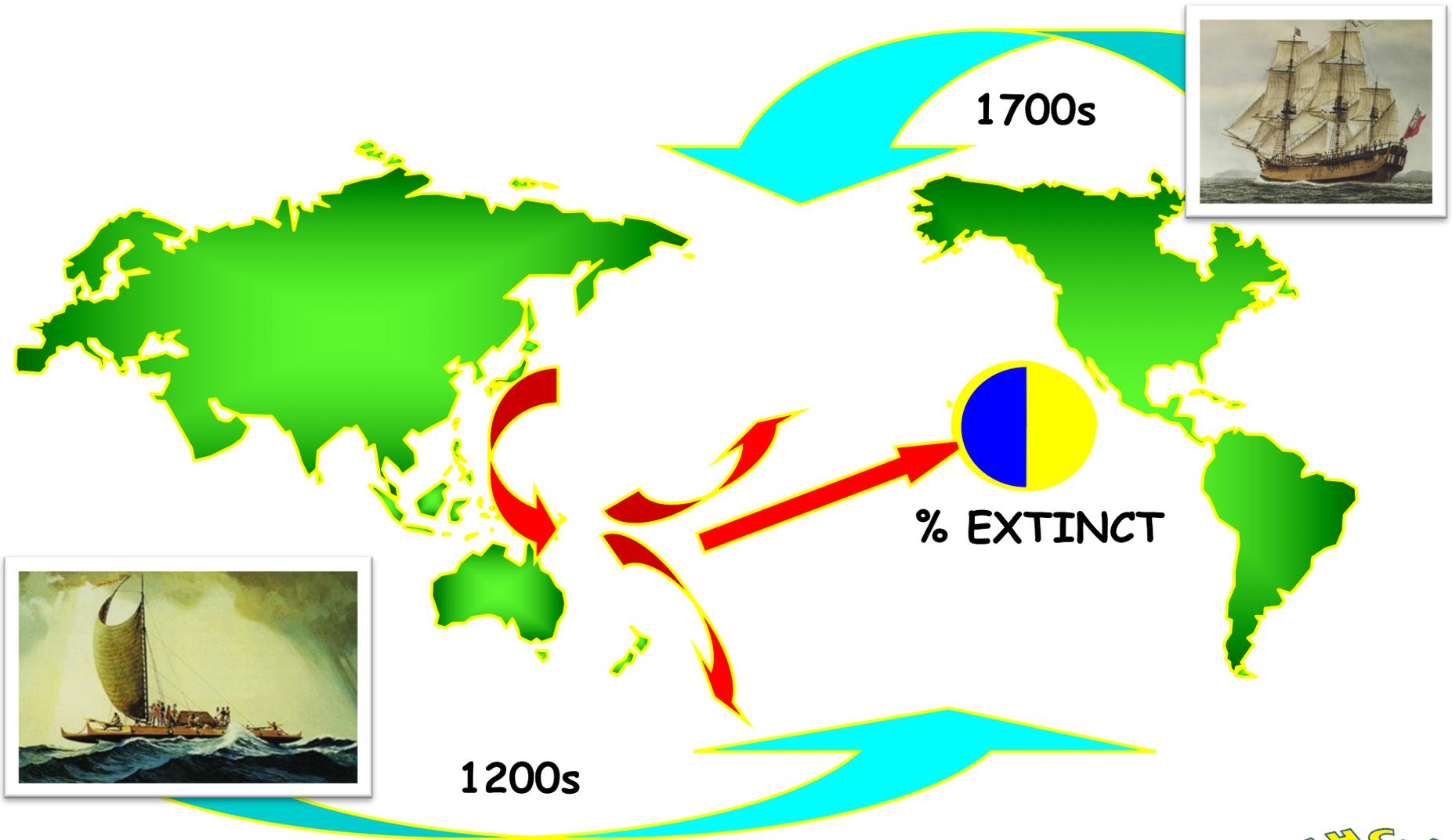


Tachyzoite

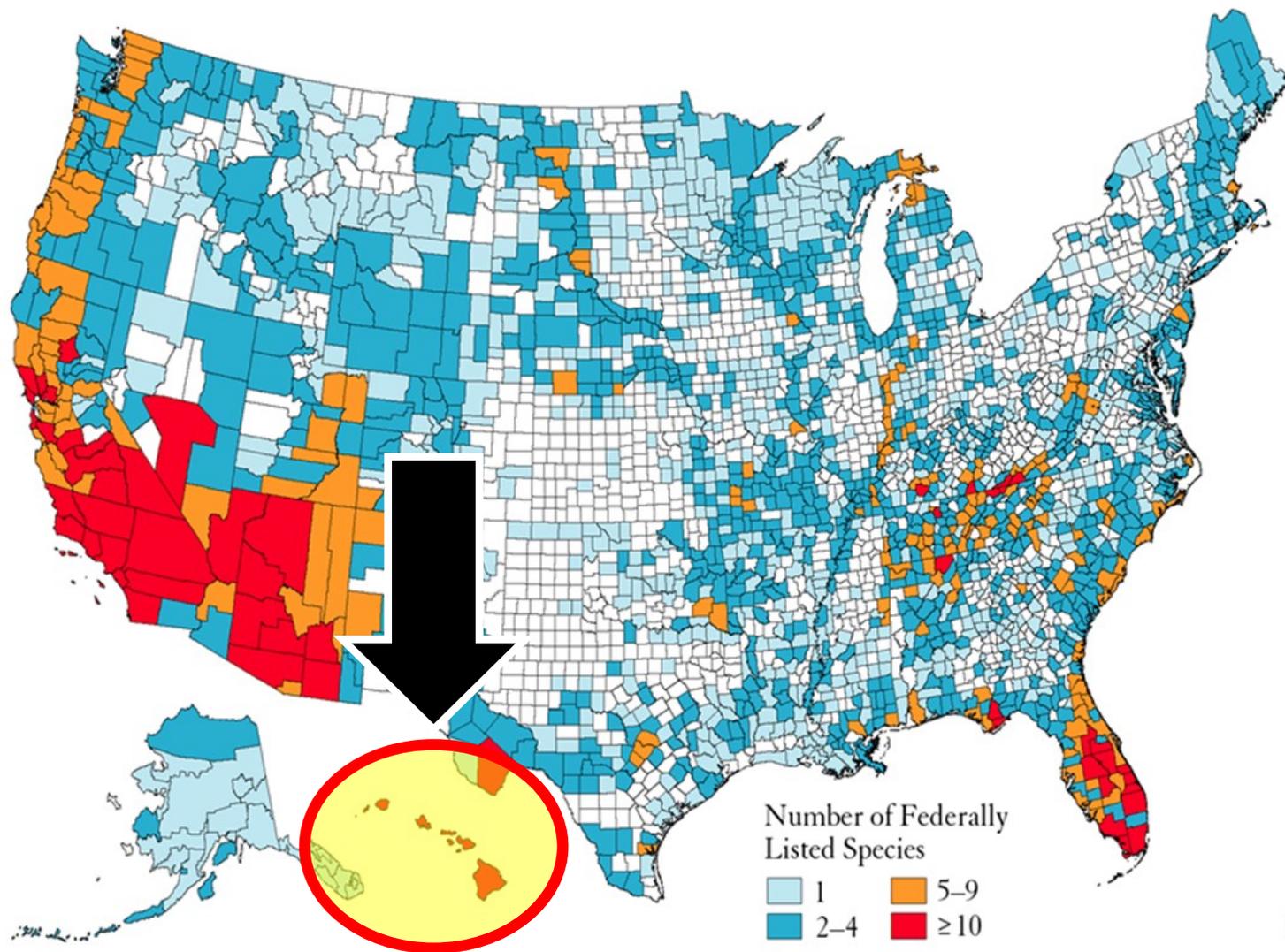
Toxoplasma is absent where cats are absent



Hawaiian Archipelago



Endangered species clustered in subset of counties



Different reproductive strategies and immune defenses



Islands



Continents

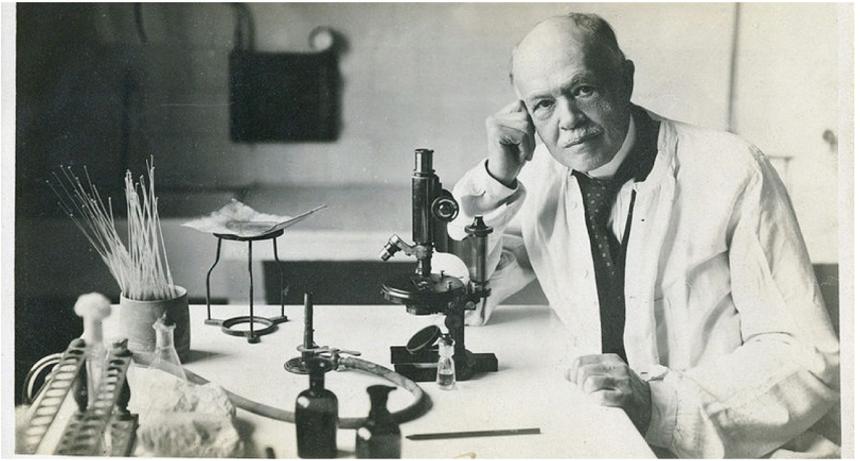


Google "Honolulu Field Station"

thierry_work@usgs.gov

Toxoplasma gondii

- 1908
 - Nicolle and Manceaux observe parasites in the blood, spleen, and liver of a North African rodent, *Ctenodactylus gondii*.
- 1939
 - Wolf *et al* identify *T. gondii* in an infant girl
- 1942
 - Sabin proposed typical clinical signs of congenital toxoplasmosis



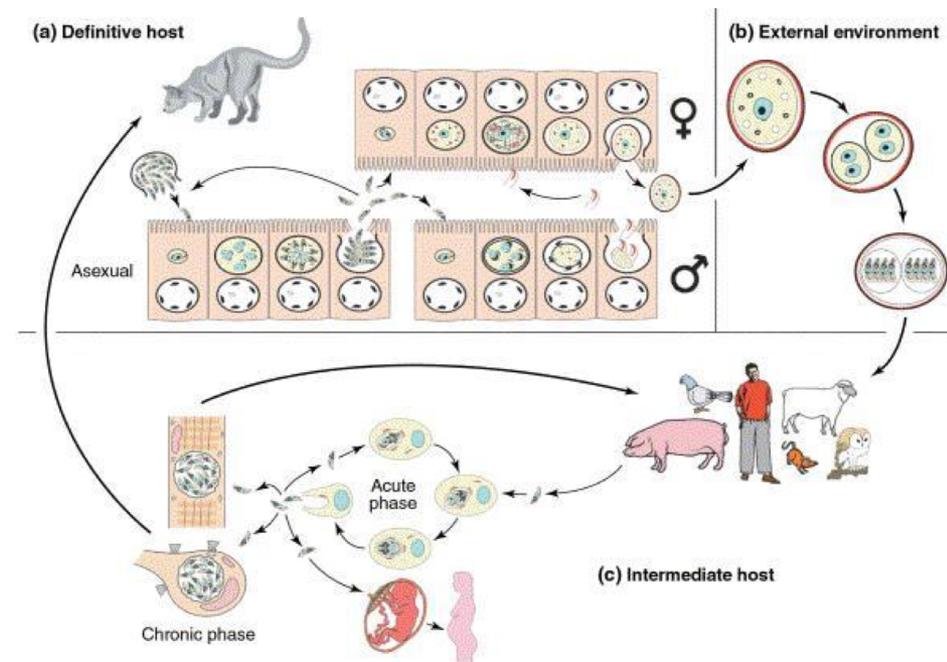
Toxoplasma gondii

■ 1968

- Severe and potentially fatal disease of adults in several cases of toxoplasma encephalitis were found in patients with hematologic cancers.

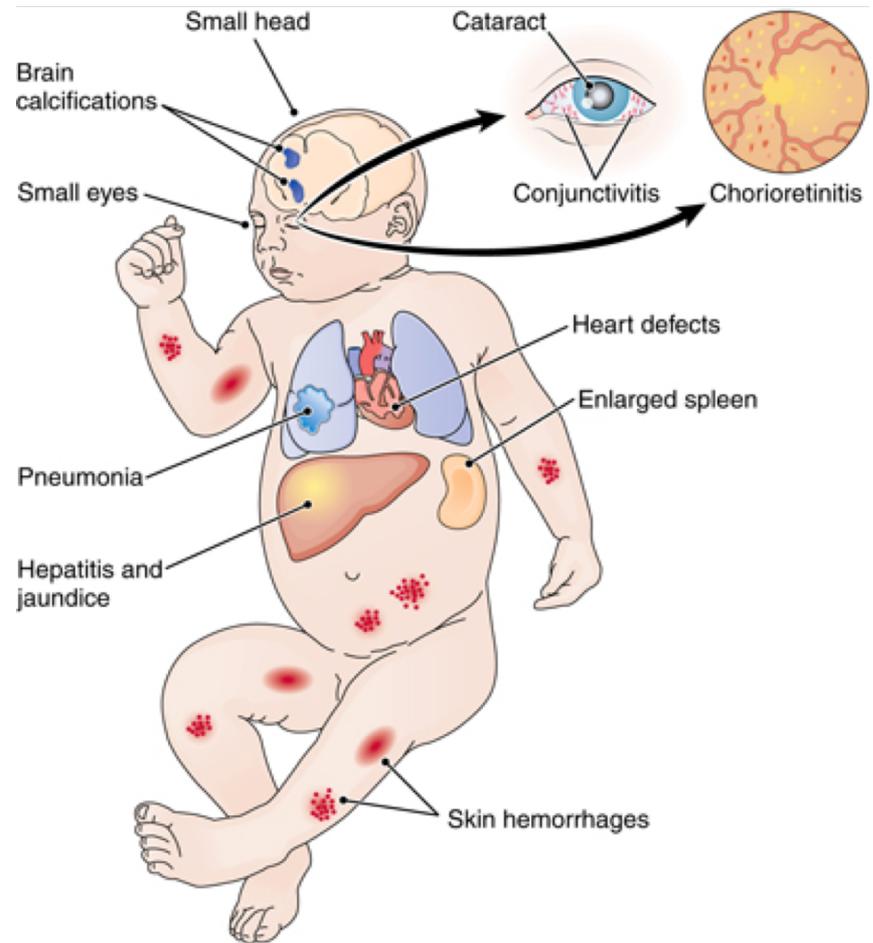
■ 1970

- Frenkel *et al* described the lifecycle



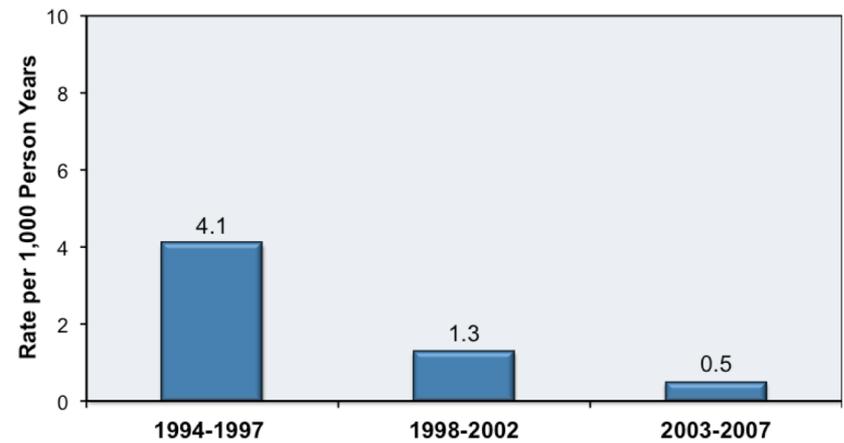
TORCH

- Common infections associated with congenital anomalies
 - ❑ Toxoplasmosis,
 - ❑ Other Agents,
 - ❑ Rubella,
 - ❑ Cytomegalovirus,
 - ❑ Herpes Simplex.



Toxoplasma gondii

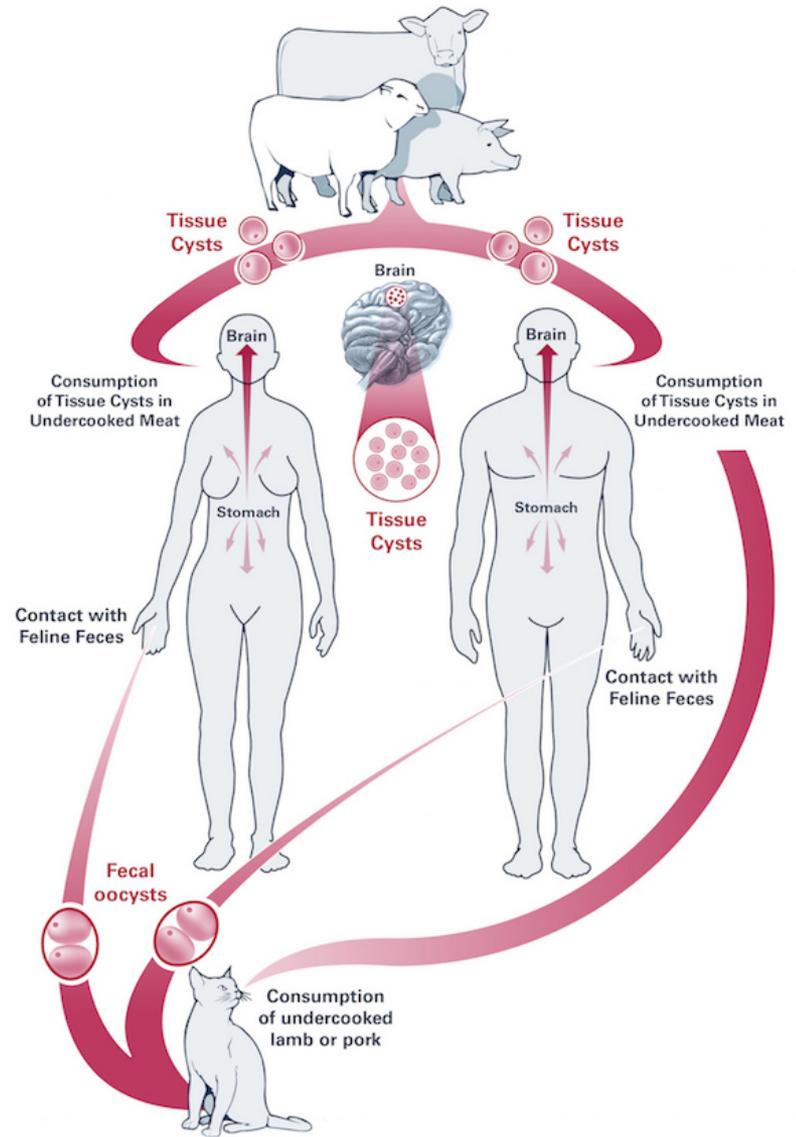
- 1983 HIV.....



Incidence of Toxoplasma Encephalitis in US.
The HIV Outpatient Study 1994-2007

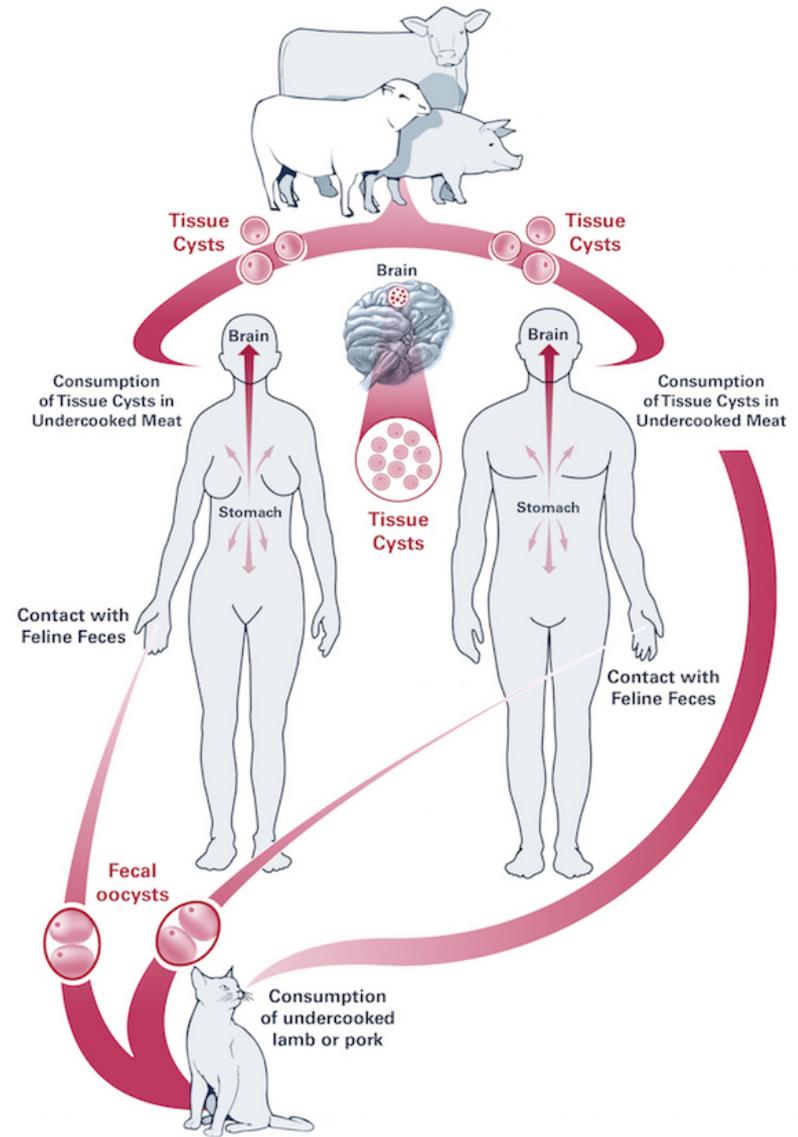
Transmission

- Food-borne
 - Eating undercooked, contaminated meat
 - Beef, pork, lamb and venison
 - Eating food that was contaminated by knives, utensils, cutting boards, or other foods that had contact with raw, contaminated meat



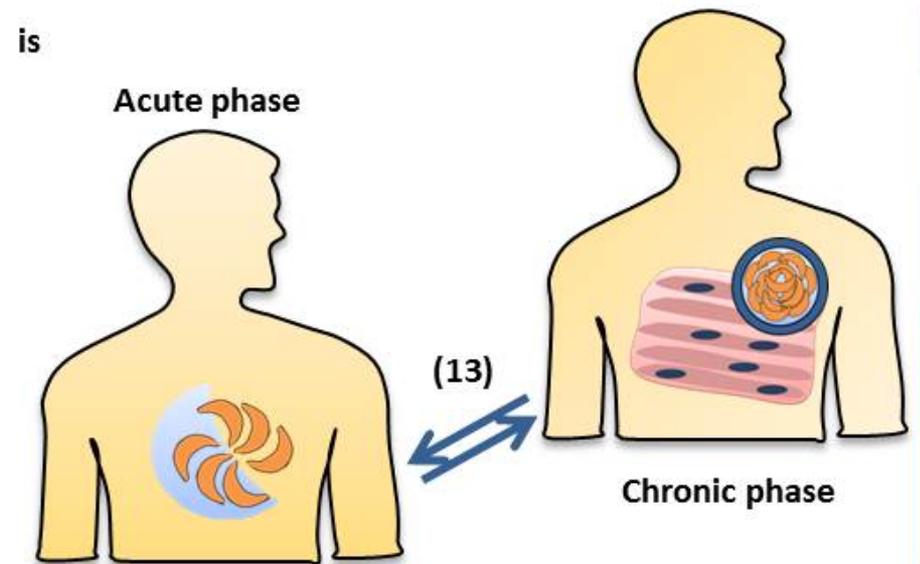
Transmission

- ❑ Accidental
 - ❑ Ingestion of oocysts after cleaning a cat's litter box when the cat has shed *Toxoplasma* in its feces
 - ❑ Ingestion of anything that has come into contact with a cat's feces that contain *Toxoplasma*
 - ❑ Ingestion of oocysts in contaminated soil



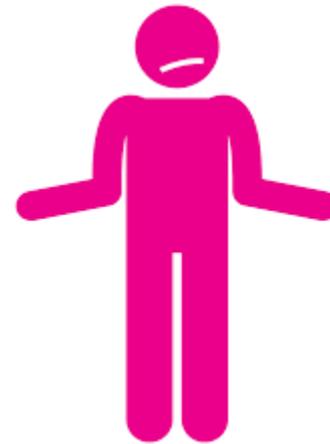
Infection vs. Disease

- *Toxoplasma* infects a large proportion of the world's human population but it is an uncommon cause of disease.
 - Certain individuals are at high risk for severe or life-threatening disease
 - Congenitally infected fetuses and newborns
 - Immunologically impaired individuals.



Toxoplasmosis

- Immunocompetent Individuals
 - Only 10% to 20% of cases are symptomatic
 - When clinical manifestations are present
 - Most often a painless cervical lymphadenopathy but any or all lymph node groups may be enlarged.
 - Fever, malaise, night sweats, myalgias, sore throat, arthralgias, maculopapular rash may be present.



Congenital Toxoplasmosis

- Generally:
 - A woman has been infected before becoming pregnant, the unborn child will be protected because the mother has developed immunity.
 - A woman is pregnant and becomes newly infected during or just before pregnancy, she can pass the infection to her unborn baby.
 - Damage to the unborn child is often more severe the earlier in pregnancy the transmission occurs.
 - Miscarriage
 - Stillborn child
 - Child born with signs of toxoplasmosis
 - Abnormal enlargement or smallness of the head
 - Infants infected before birth often show no symptoms at birth but may develop them later in life

CONGENITAL TOXOPLASMOSIS The TETRAD!

4 C's

C - Cerebral
Calcifications

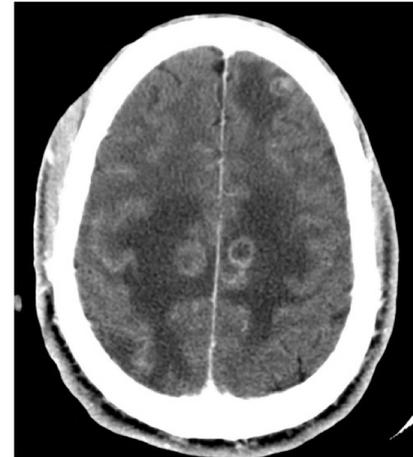
C - Cephaly(micro)
Cephalus(hydro)

C - Chorioretinitis

C - Convulsions

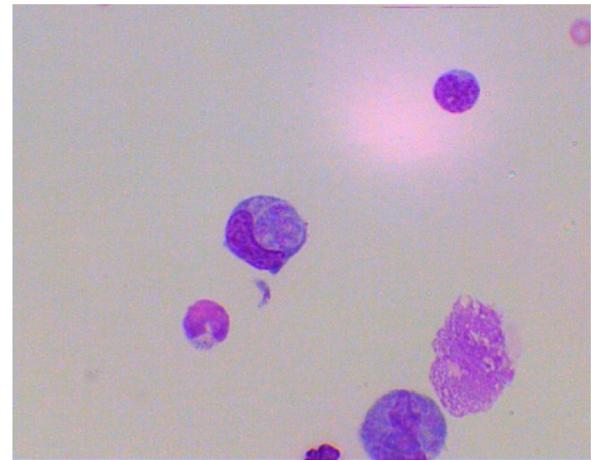
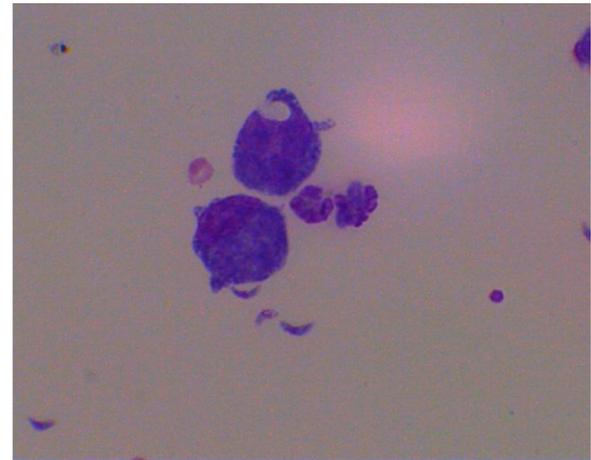
Toxoplasmosis

- Immunocompromised individuals may experience severe symptoms.
 - Clinical manifestations of toxoplasmosis in AIDS patients commonly reflect:
 - Infection of the brain
 - Encephalitis
 - Infection of the lung
 - Pneumonitis
 - Infection of the eye
 - Chorioretinitis



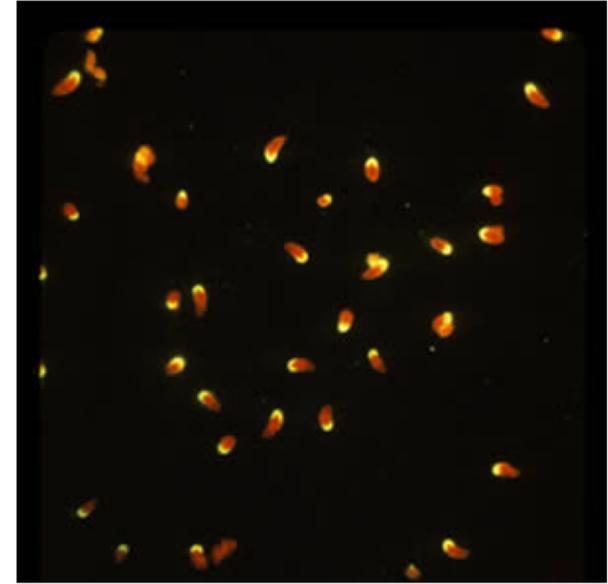
Laboratory Diagnosis

- Toxoplasmosis may be documented by:
 - Parasites in patient specimens
 - Detection of parasite genetic material by PCR
 - Serologic (antibody) testing is the routine method of diagnosis.



Serologic Diagnosis

- Dx usually made by detection of *Toxoplasma*-specific IgG, IgM.
 - Dye test
 - Sabin–Feldman dye test
 - Indirect fluorescent antibody test (IFA)
 - Enzyme immunoassays
 - ELISA, immunoblots

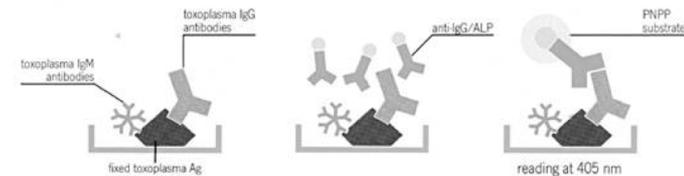


Toxo-IgG EIA-Kit

Enzyme immunoassay (sandwich technique)
for the determination of toxoplasma IgG antibodies

PRINCIPLE

Specific antibodies in serum bind with the toxoplasma antigen coated onto a solid phase (strip); only IgG antibodies bind with the alkaline phosphatase labelled anti-IgG conjugate; the complex formed is revealed by hydrolysis of the enzyme substrate: p-nitrophenyl phosphate (PNPP). Automated reading at 405 nm.



Immunodiagnostic Algorithm

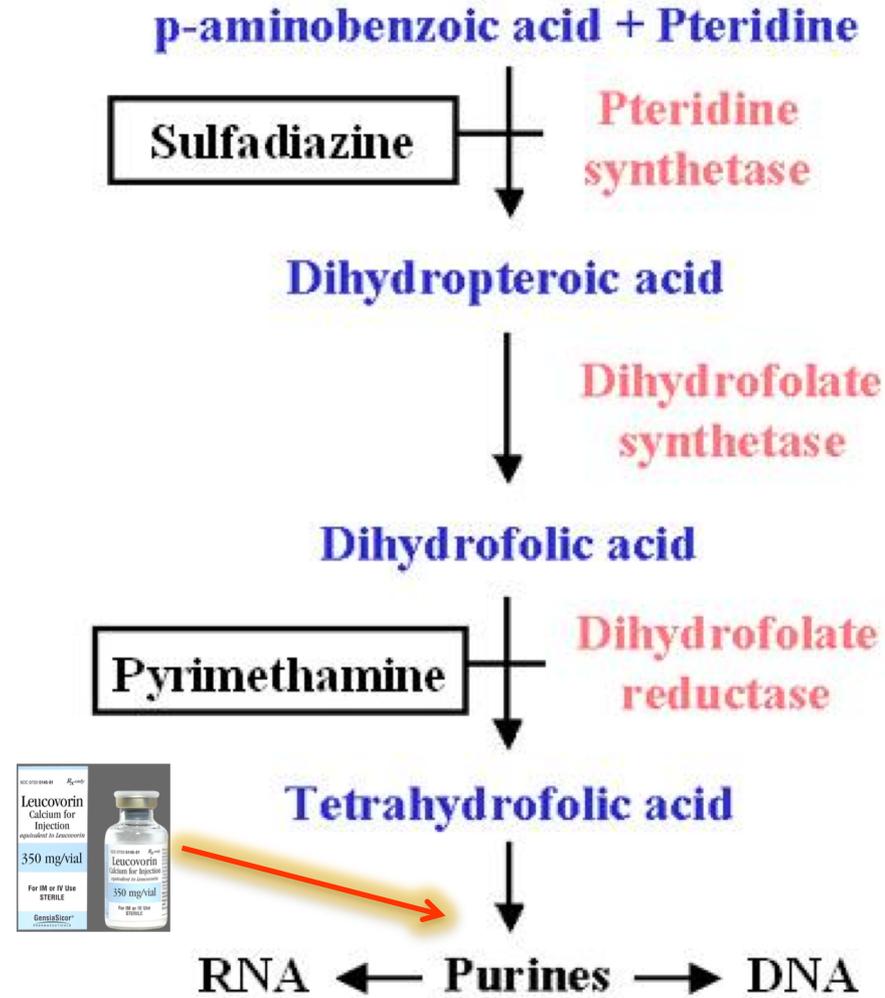
IgG result	IgM result	Report/interpretation for humans*
Negative	Negative	No serological evidence of infection with <i>Toxoplasma</i> .
Negative	Equivocal	Possible early acute infection or false-positive IgM reaction. Obtain a new specimen for IgG and IgM testing. If results for the second specimen remain the same, the patient is probably not infected with <i>Toxoplasma</i> .
Negative	Positive	Possible acute infection or false-positive IgM result. Obtain a new specimen for IgG and IgM testing. If results for the second specimen remain the same, the IgM reaction is probably a false-positive.
Equivocal	Negative	Indeterminate: obtain a new specimen for testing or retest this specimen for IgG in a different assay.
Equivocal	Equivocal	Indeterminate: obtain a new specimen for both IgG and IgM testing.
Equivocal	Positive	Possible acute infection with <i>Toxoplasma</i> . Obtain a new specimen for IgG and IgM testing. If results for the second specimen remain the same or if the IgG becomes positive, both specimens should be sent to a reference laboratory with experience in diagnosis of toxoplasmosis for further testing.
Positive	Negative	Infected with <i>Toxoplasma</i> for more than 1 year.
Positive	Equivocal	Infected with <i>Toxoplasma</i> for probably more than 1 year or false-positive IgM reaction. Obtain a new specimen for IgM testing. If results with the second specimen remain the same, both specimens should be sent to a reference laboratory with experience in the diagnosis of toxoplasmosis for further testing.
Positive	Positive	Possible recent infection within the last 12 months, or false-positive IgM reaction. Send the specimen to a reference laboratory with experience in the diagnosis of toxoplasmosis for further testing.

*except infants

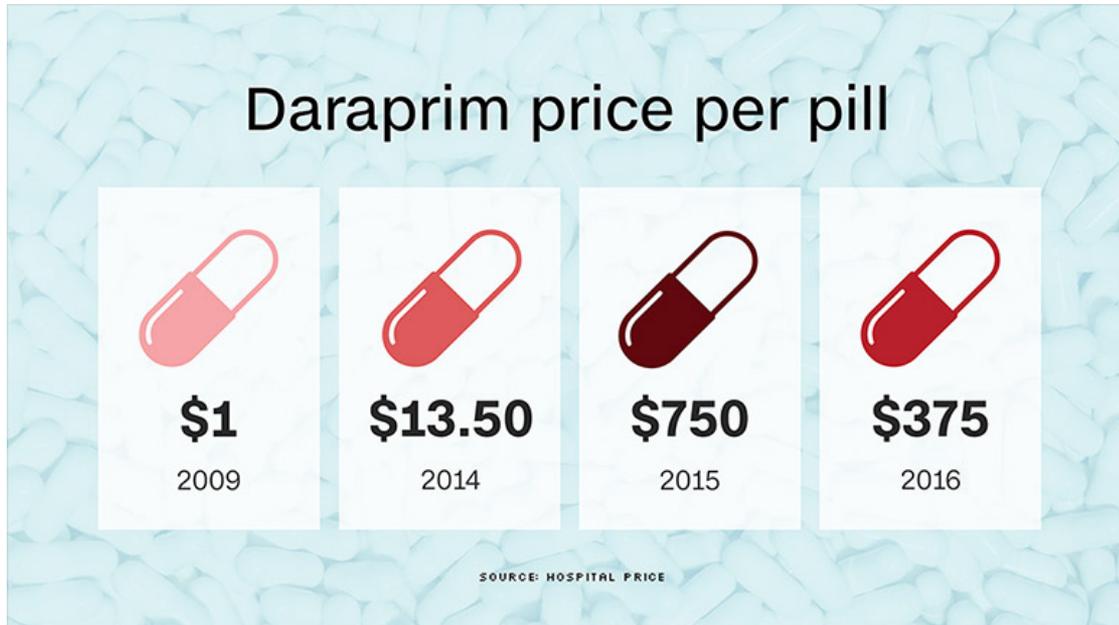
Current commercial assays in the US are NOT FDA approved for *in vitro* diagnostic use in infants

Treatment

- Most healthy people recover without treatment.
 - The most effective therapeutic course is pyrimethamine plus sulfadiazine for 6 weeks.
 - Leucovorin (ie, folinic acid) should be administered concomitantly to prevent bone marrow suppression.
 - Careful attention to dosing regimen is necessary because it differs depending on patient variables
 - Immune status,
 - Pregnancy



“Pharma-Bro” Martin Shkreli



- Martin Shkreli was a relatively unknown hedge-fund dude. And then, in 2015, Shkreli’s company, Turing Pharmaceuticals, bought the patent for Daraprim (pyrimethamine) and hiked the price up from \$13.50 a pill to \$750.



Toxoplasma gondii infections in Hawaii's protected species

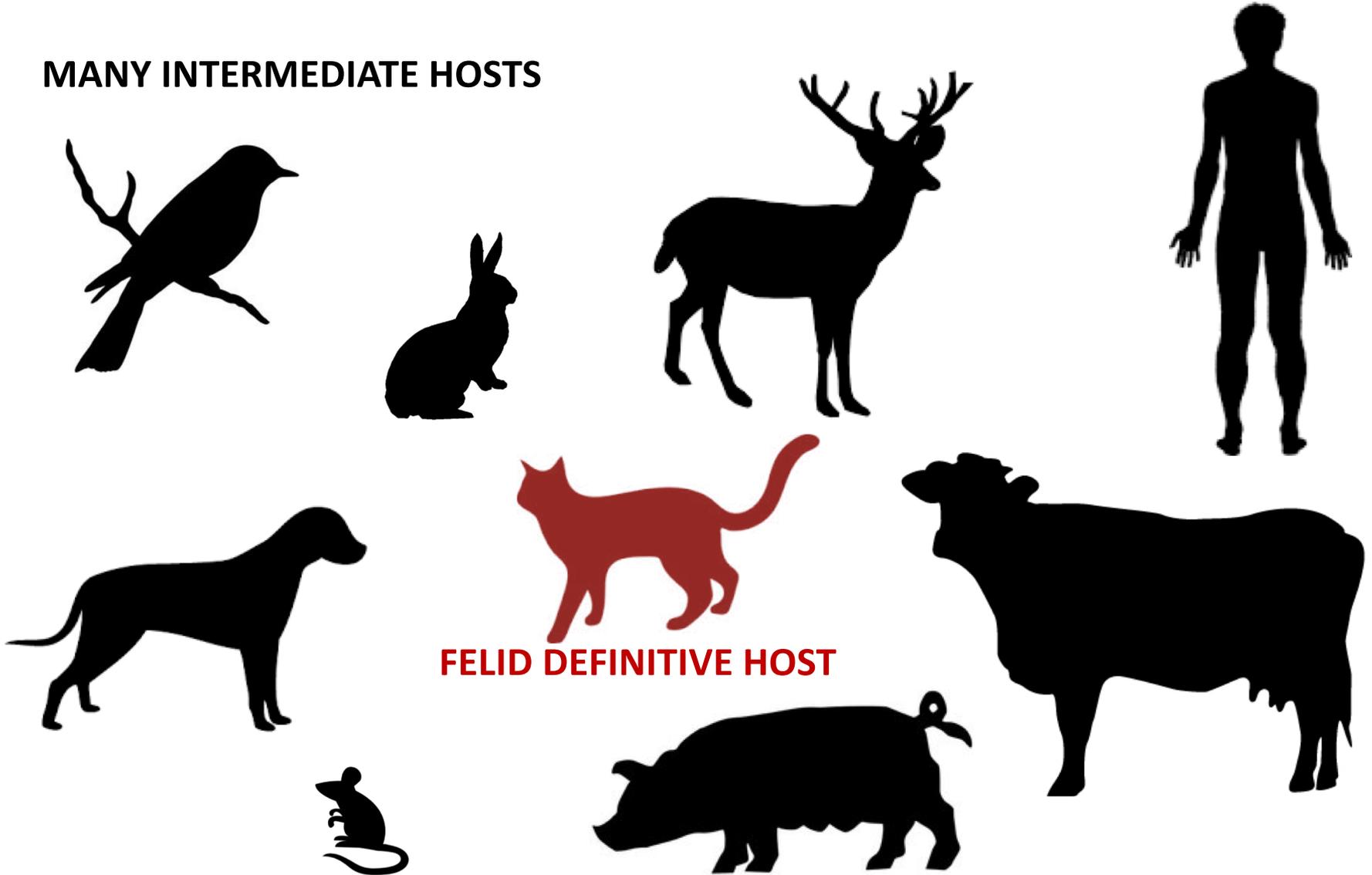
Michelle Barbieri¹, Angela Amlin², Charles Littnan¹

¹NOAA Pacific Islands Fisheries Science Center

²NOAA Pacific Islands Regional Office

T. gondii infections are widespread.

MANY INTERMEDIATE HOSTS



FELID DEFINITIVE HOST

T. gondii infection can cause:

No ill effects

Delayed (latent) effects

Mental illness/neurological disease

Miscarriage/abortion/stillbirth

Birth defects

Heart, liver failure

Severe disease of multiple organs

Death



Toxoplasmosis = a Neglected Parasitic Infection targeted by CDC for public health action.

<https://www.cdc.gov/parasites/toxoplasmosis/index.html>

Deaths of at least two spinner dolphins in Hawaii have been attributed to toxoplasmosis.

(K. West/HPU pers. comm; Migaki et al. 1990)

Death as a result of:

Adrenal glands destruction

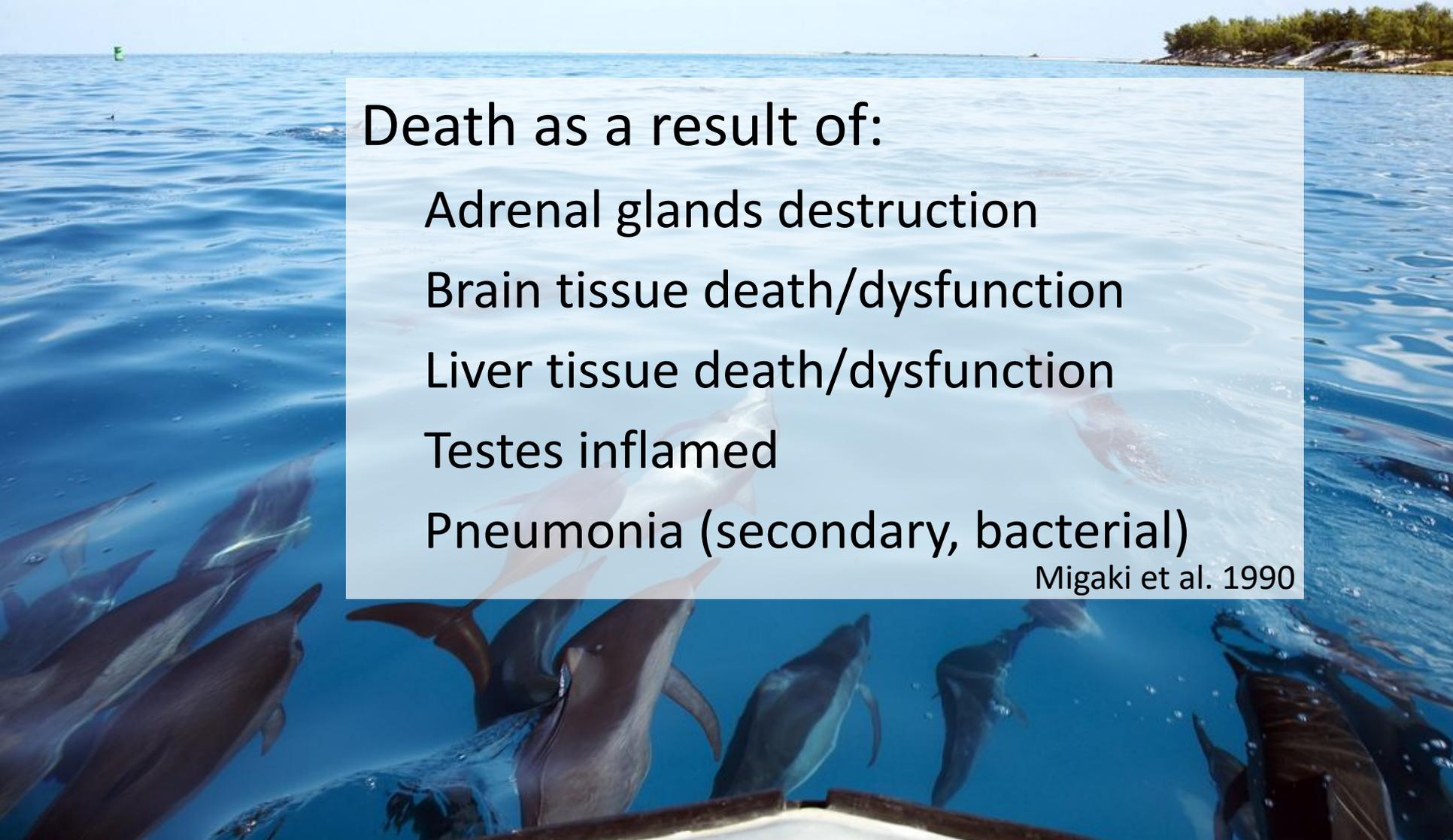
Brain tissue death/dysfunction

Liver tissue death/dysfunction

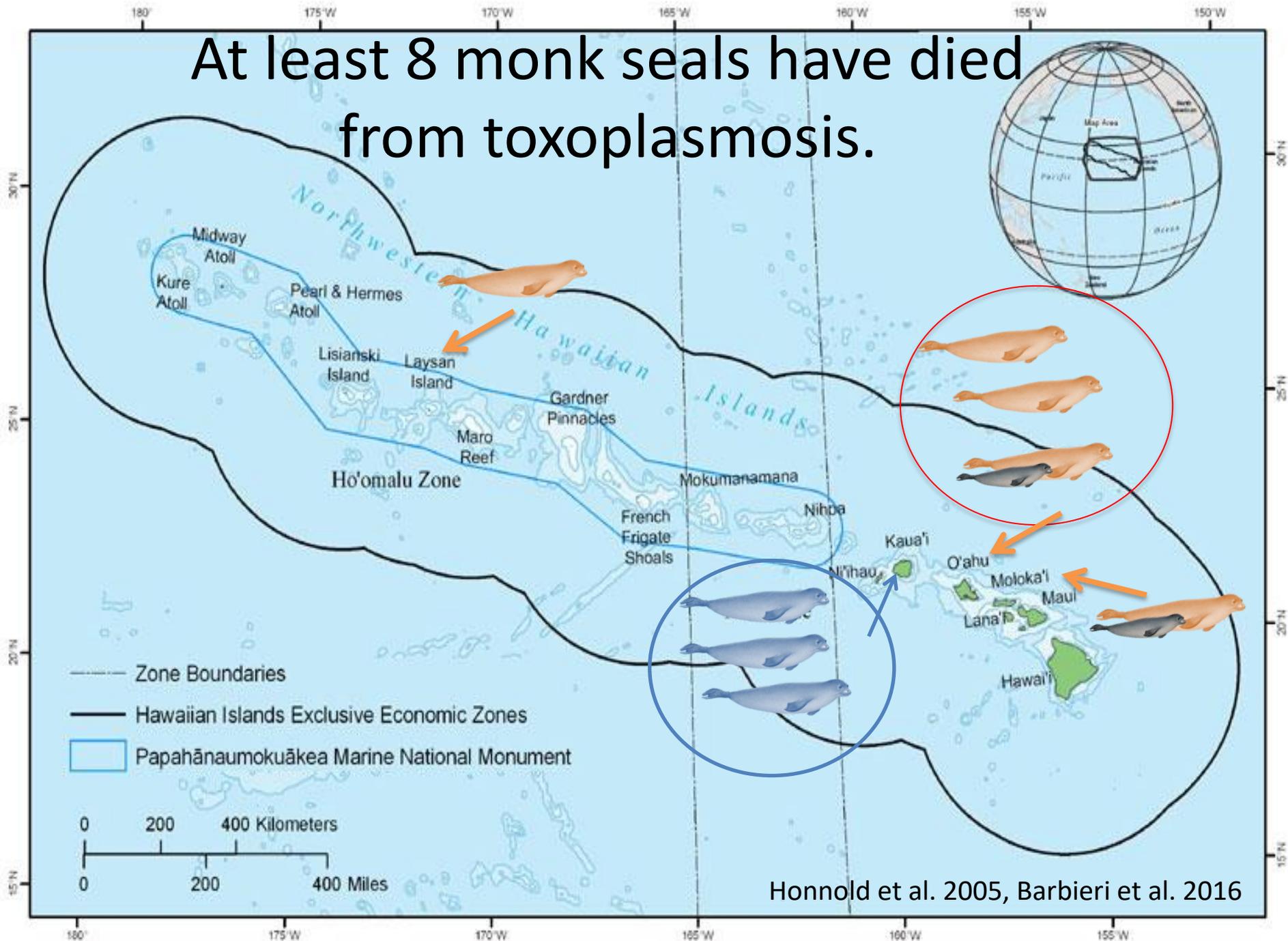
Testes inflamed

Pneumonia (secondary, bacterial)

Migaki et al. 1990



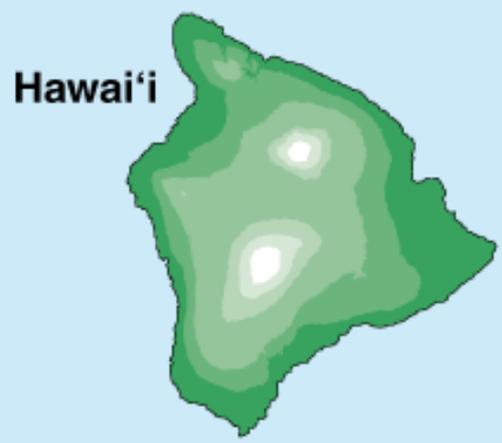
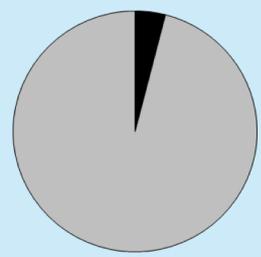
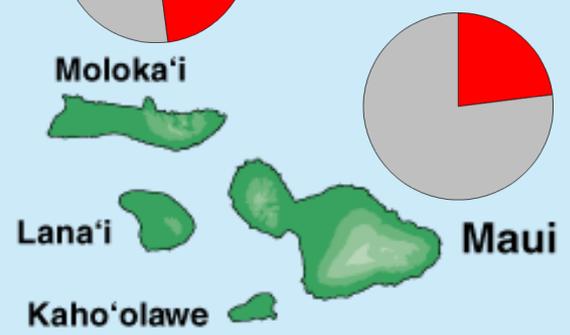
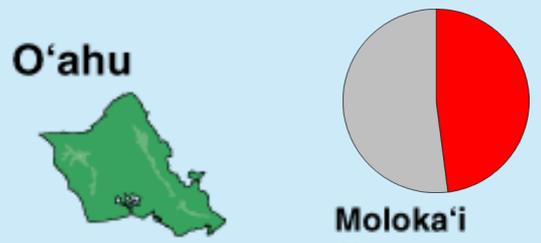
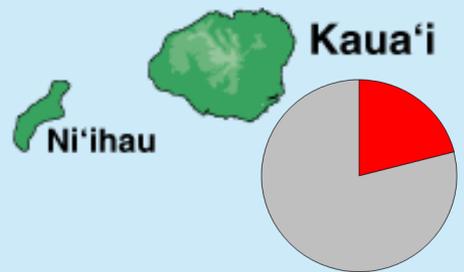
At least 8 monk seals have died from toxoplasmosis.



Honnold et al. 2005, Barbieri et al. 2016

Toxoplasmosis in Hawaii's birds





Percent infected
Mortality *T. gondii*



J Wildl Dis 2016, 52(2):253-257.
Slide courtesy of T. Work, USGS

Toxoplasmosis in monk seals: A rapid, painful decline

Muscle & blubber inflammation → extreme pain

Lung disease, difficulty breathing

Brain dysfunction

Heart dysfunction

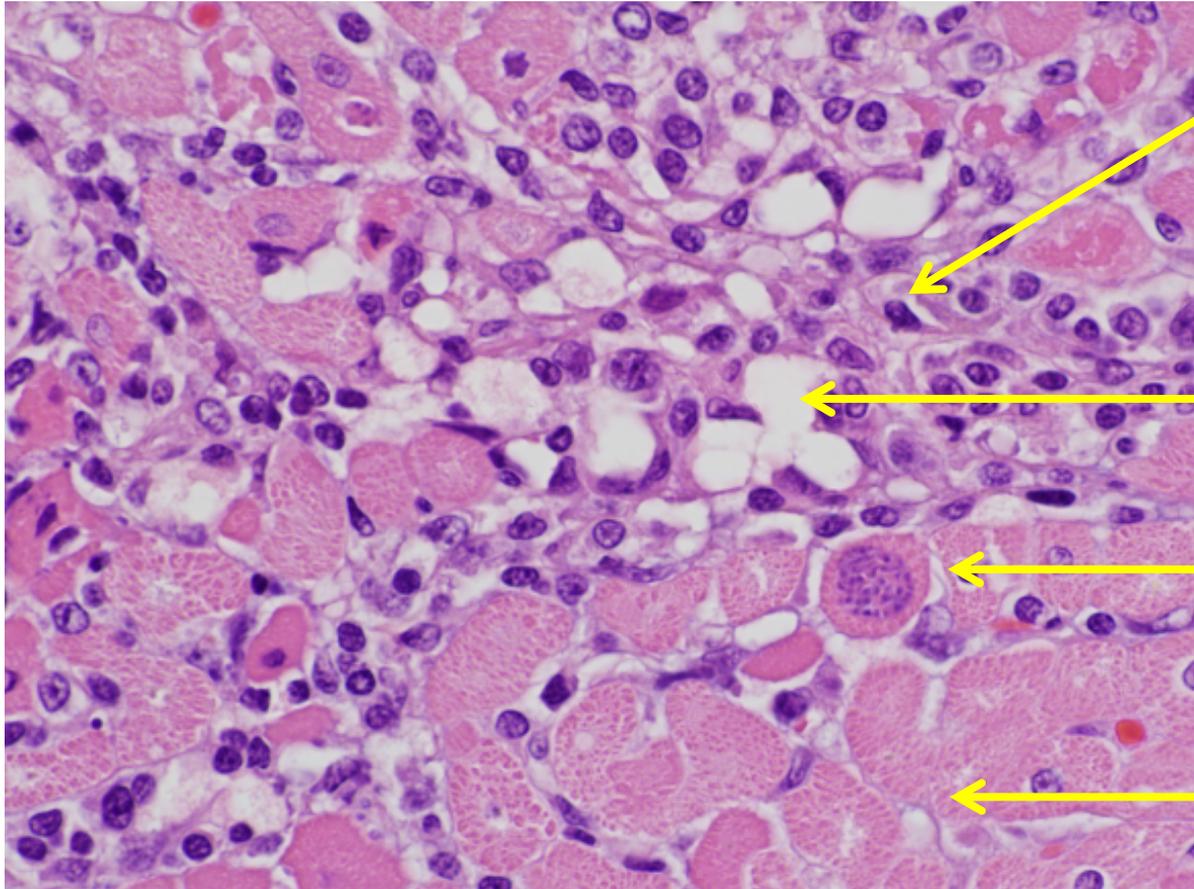
Liver disease



RB24, Ko Olina, 2015

→ Abortion, multiple organ failure and death

Evidence of disease: heart muscle



Inflammatory cells
(purple dots)

Destroyed/dead
heart cells
(white spaces)

Toxoplasma
(special stains confirm –
not shown)

Heart muscle cells
(light pink)

Exposure to *T. gondii*

Documented worldwide:

Arctic, Antarctic, temperate,
tropics

Many species:

Aquatic & terrestrial mammals,
birds, fish



Case Study:

Threatened Sea Otters in California

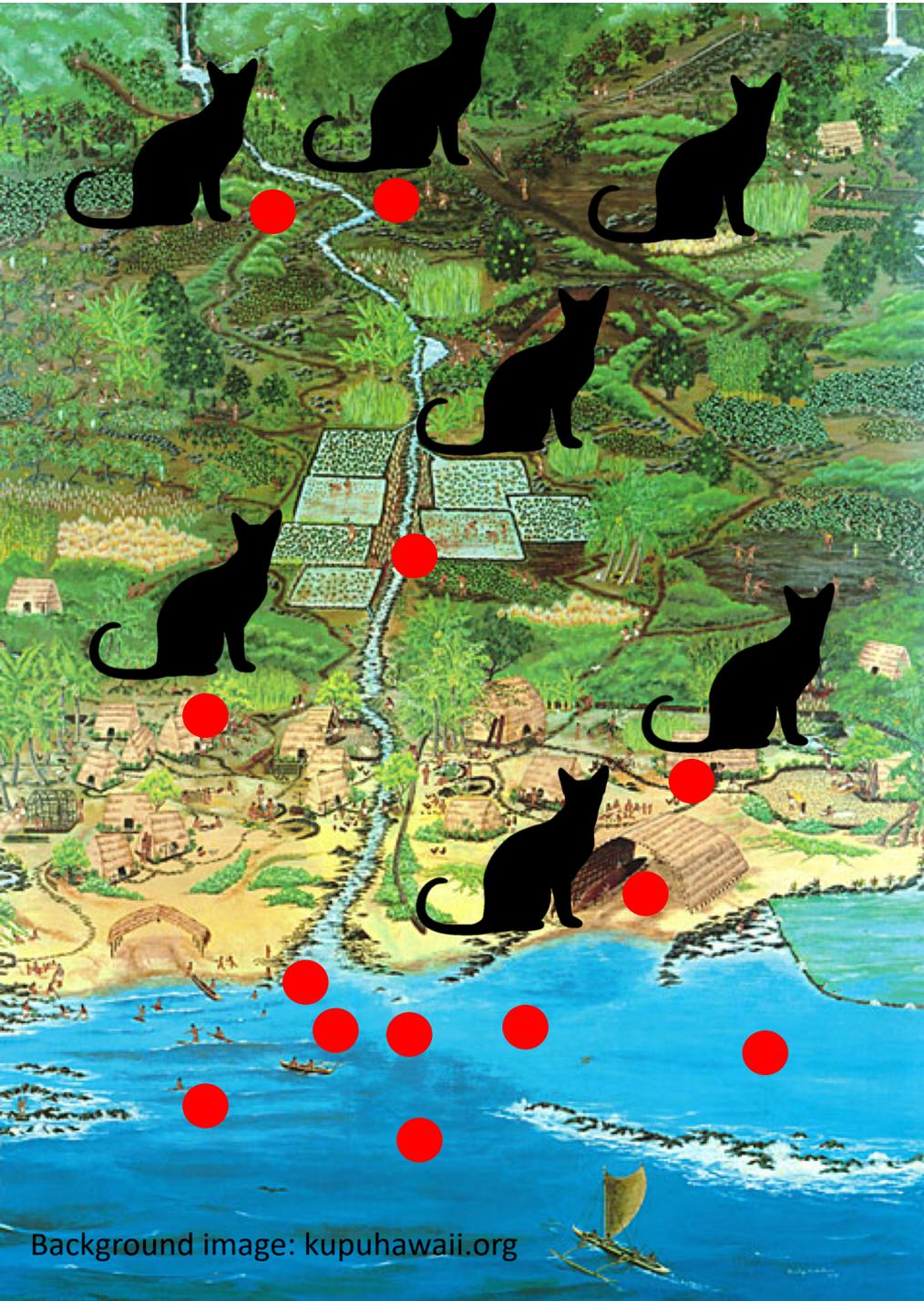
1990's: Toxoplasmosis discovered as significant cause of mortality

Filter-feeders (ex: clams) concentrate oocysts (eggs) from the water them in their tissues (Miller et al. 2008, Massie et al. 2010)

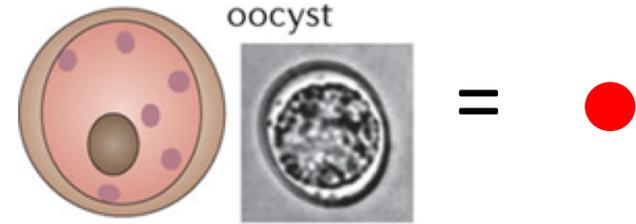
Toxoplasmosis more common in otters living close to high terrestrial runoff (watershed drainages)



Miller et al. 2002, Kreuder et al. 2003, Conrad et al. 2005



Mauka to Makai



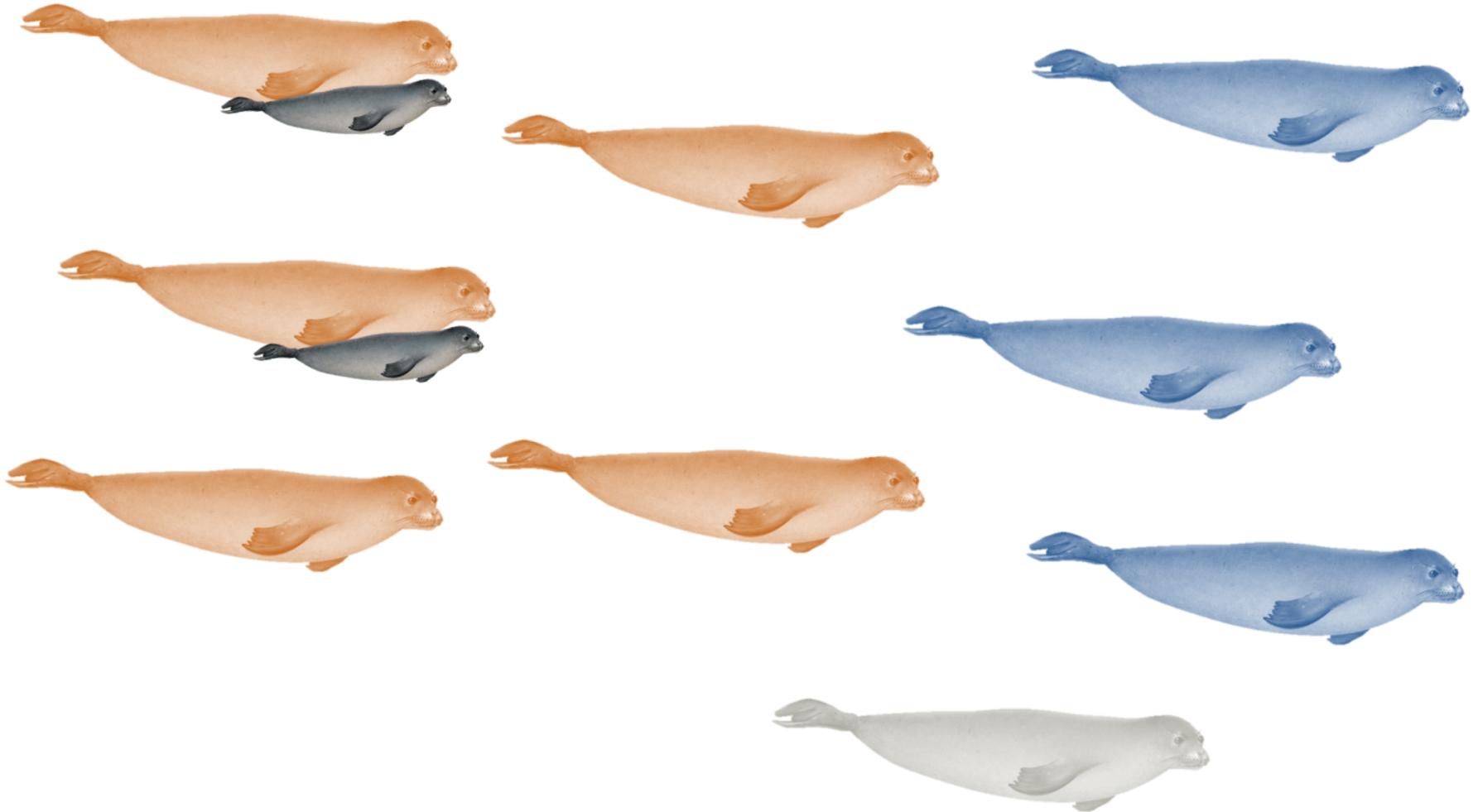
Eggs survive months to years.

One cat → millions of eggs
over 1-2 weeks.

Est. 50,000-300,000 feral cats
on Oahu.

1 egg → infection.

At least 8 monk seals have *died* from toxoplasmosis.



At least 8 monk seals have *died* from toxoplasmosis,
but the population impacts are greater.



**More seals die than are found dead.
The loss of 1 female = loss of future reproductive output.**

Mitigating the threat



Monk seal with toxoplasmosis → necropsy



Monk seal with ingested fish hook → returned to wild

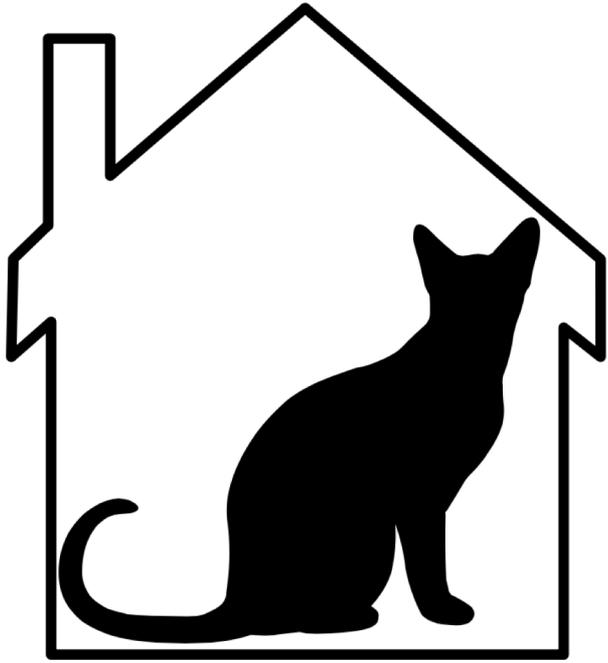
Vs.

Treatment of toxoplasmosis: Ideal vs. **Reality**

1. Early disease detection in wildlife? **Impractical.**
2. Make diagnosis? **It's often too late.**
3. Treat using safe and effective drugs and protocols? **Highly limited options.**
4. Prevention! Vaccinate? **No suitable vaccines.**

Treatment is not a good mitigation strategy.

Solutions



Keeping cats
exclusively indoors
will help Hawaii's
native wildlife.



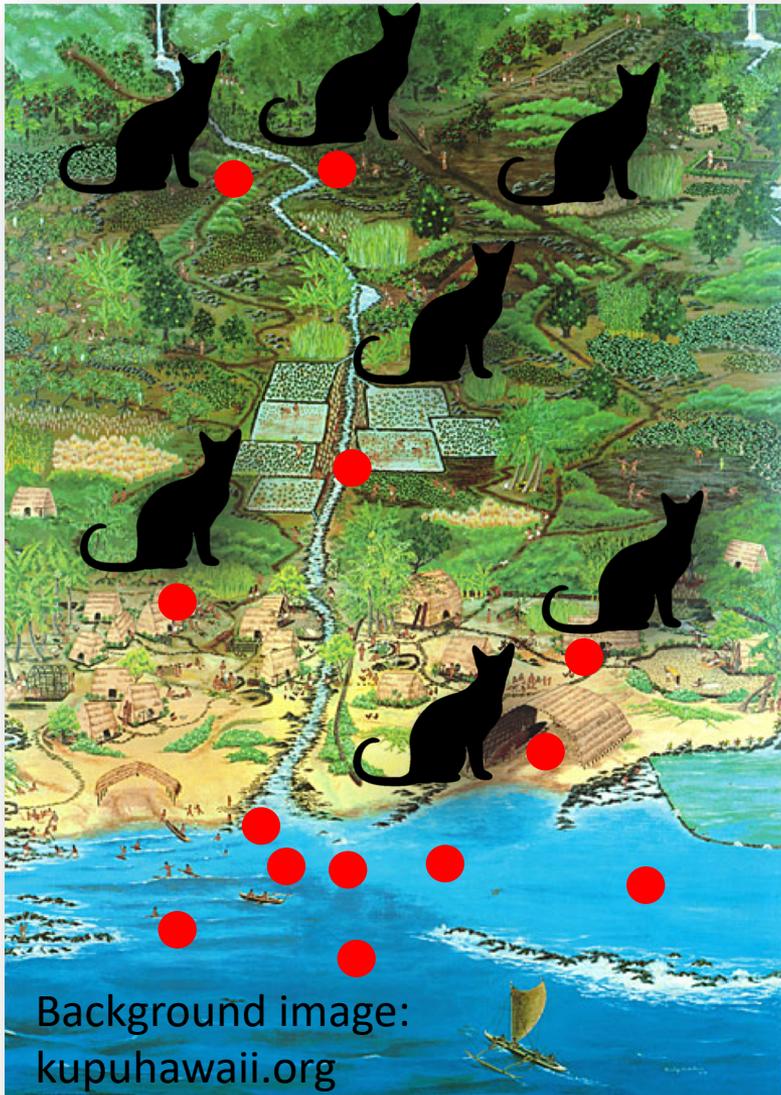
RECAP!

What do you really need to know?



Cats...

- Contaminate the marine environment from mauka to makai.
- Are the ultimate source of all *T. gondii* infections.
- Enable *T. gondii* to persist.
- Still shed eggs even if spayed/neutered.



Background image:
kupuhawaii.org

Protected Species

Number of mortalities is an underestimate.

- More likely die than are found dead
- Loss of future reproductive output

Treatment of sick wildlife is not an effective, long-term solution





Mahalo



Photo credit: DB Dunlap



**NOAA
FISHERIES**

**Pacific Islands
Fisheries
Science Center**

Alternative Cats: How Facts about Toxoplasmosis Can Become Controversial

Kirsten Leong

Toxoplasmosis Forum, March 31, 2018
William S. Richardson School of Law

Toxoplasmosis and Outdoor Cat Management

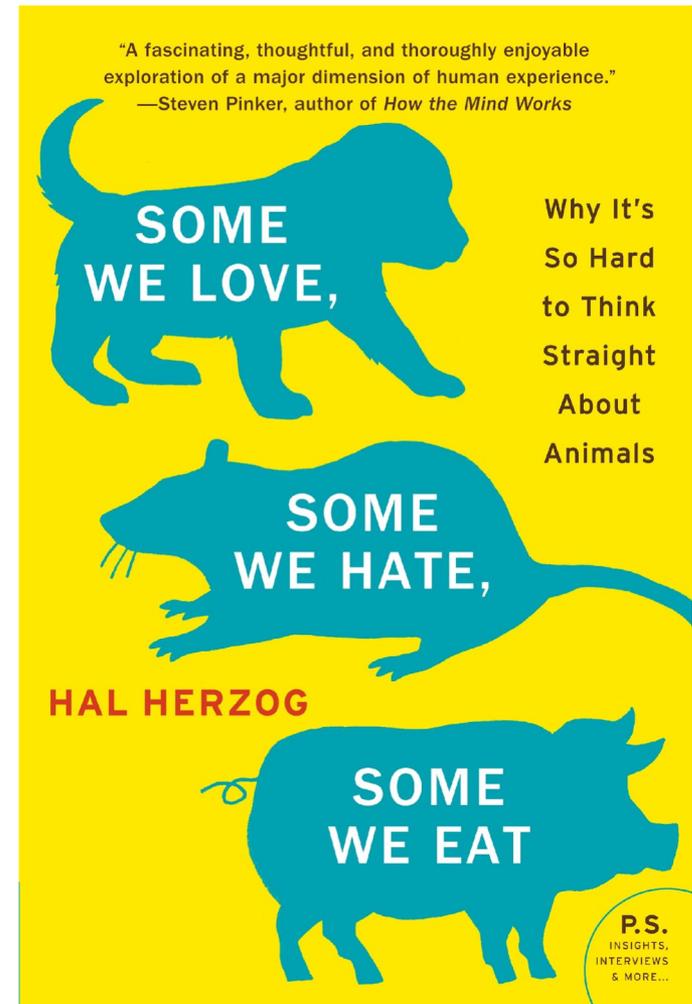
- Scientists are learning more about negative impacts of toxoplasmosis on wildlife
- Outdoor cats are the main pathway for toxoplasmosis on the landscape
- Simple Solution: manage outdoor cat populations
- Complex Problem: Decades of intractable conflict between wildlife professionals and cat welfare professionals over how to manage outdoor cats

Social Science and Outdoor Cat Management

- Growing body of literature on the human dimensions of outdoor cat management
- Uses social science to understand people's beliefs, attitudes, and values related to cat management
- Studies have identified areas of common ground, but this has not resulted in shared management approaches
- Our current work looks at underlying conflicts that, if recognized, might help us move forward

Animals and Society

- Societies create rules for how to think about different species of animals
- Different rules may apply to a species depending on context
- When animals are not in the expected societal context, there can be conflict as rules are created



What is a cat?

- Cats have had a long history of affiliation with people
- Predominant societal reference as domestic animal and pet



Ancient Egyptian relief, 1350 BC



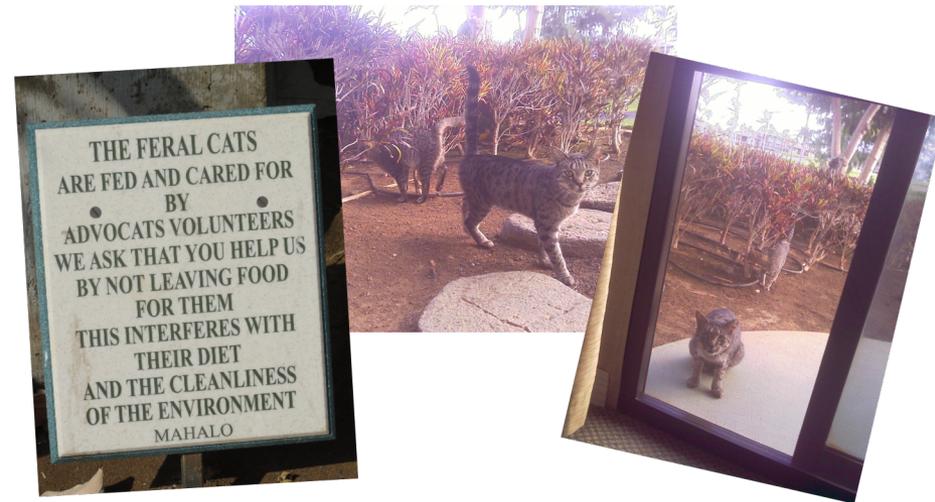
German painting, 1872



Medieval Italian manuscript, 1445
Photograph by Emir O. Filipović.

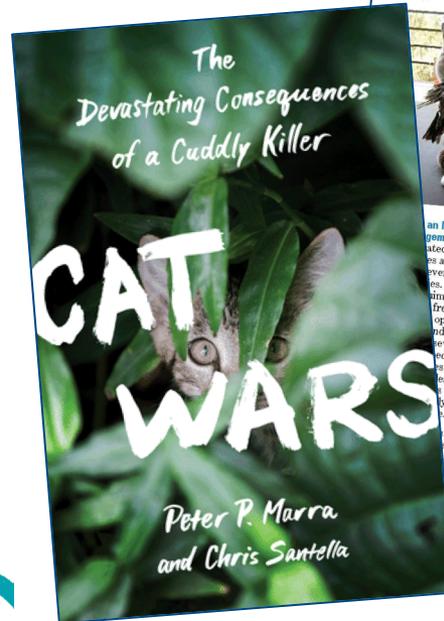
In today's society, what is an outdoor cat?

- Colony/community cats
- Cat Sanctuaries (Lanai)
- Trap-Neuter-Return endorsed by > 60 U.S. municipalities as the only management option

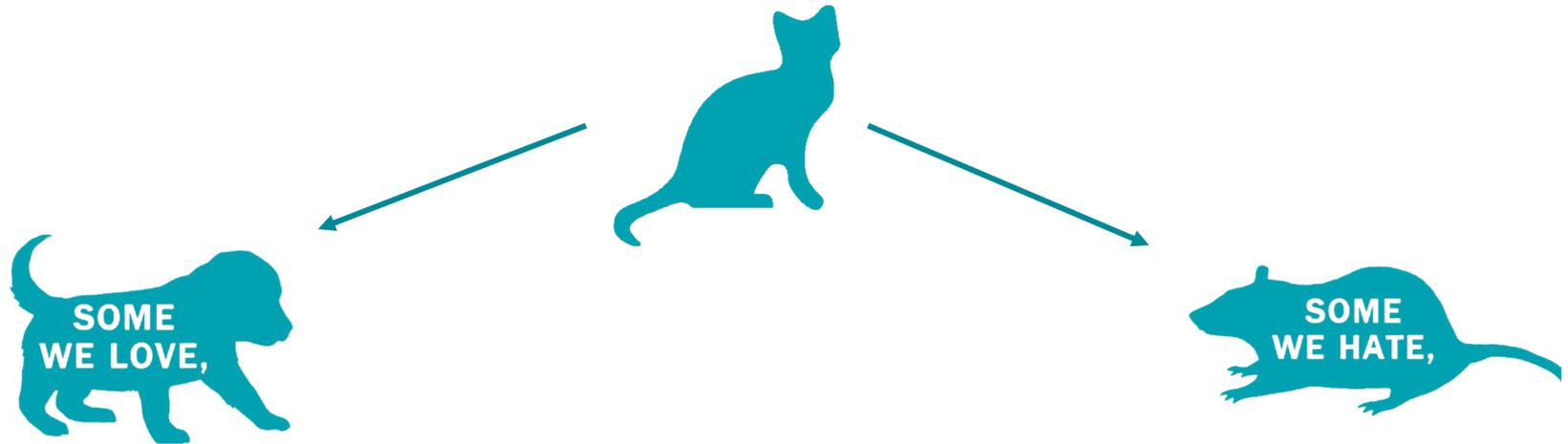


In today's society, what is an outdoor cat?

- Feral cats included in pest management plans, invasive species plans
- Cats depicted as “cuddly killer”



Toxoplasmosis and outdoor cats



- Goal: cat welfare
- Non-negotiable: TNR
- Toxoplasmosis: used as a reason to kill cats

- Goal: wildlife welfare
- Non-negotiable: culling
- Toxoplasmosis: clear impacts on wildlife

Management of Alternative Cats?

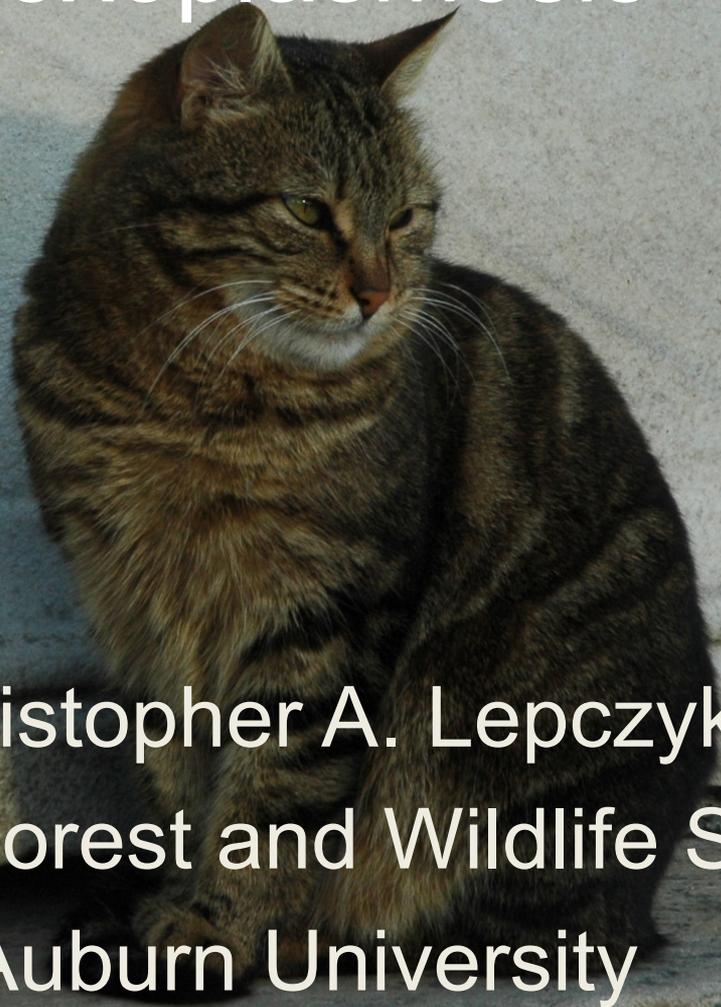
- Facts that support one worldview can be seen as threatening another worldview
- Alternative contexts for outdoor cats:
 - Indoor/outdoor pets
 - Stray/colony/semi-owned
 - “Mountain cats,” no relationship with people
- Move from “one-size-fits-all” to collaboratively develop societal rules for cats in different contexts
- Work on areas of shared societal rules (e.g., prevent abandonment, encourage adoption)

Questions?



A lap for every cat

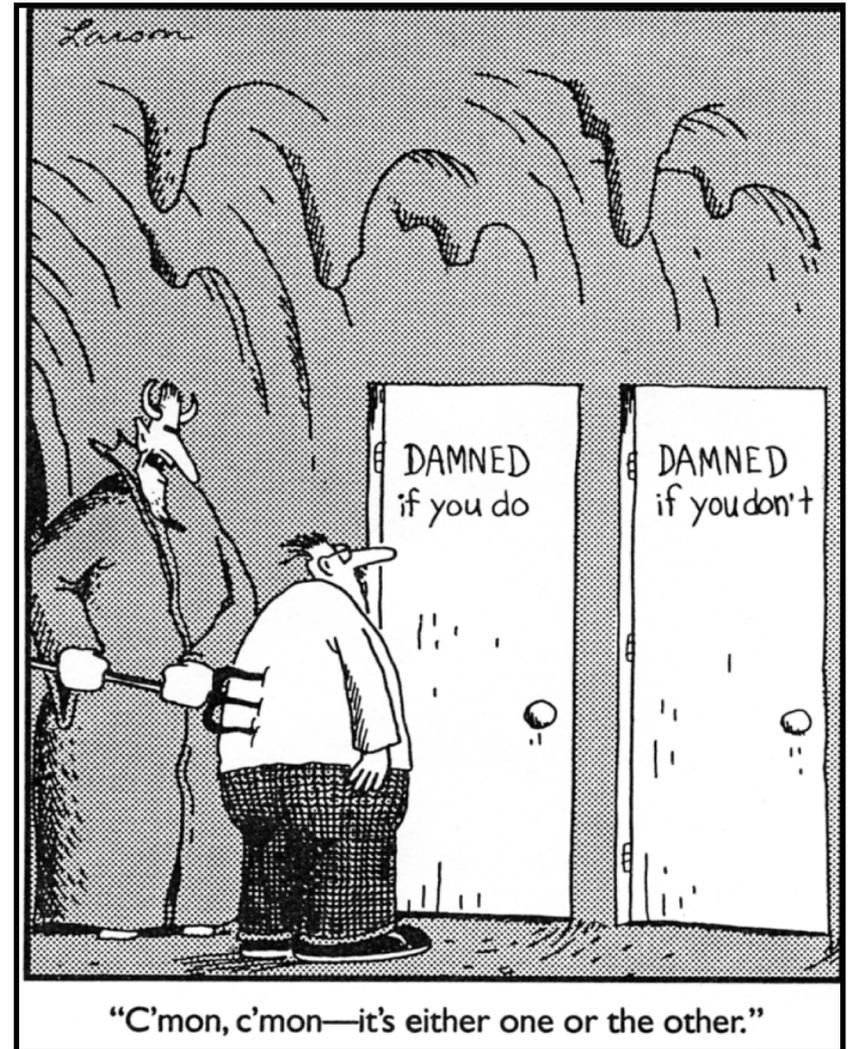
Human Dimensions of Cat Management with Insights on Toxoplasmosis



Christopher A. Lepczyk
School of Forest and Wildlife Sciences
Auburn University

Human Dimensions of Wildlife

“The real problem of wildlife management is not how we shall handle the animals... the real problem is one of human management.”
—Aldo Leopold (1943)



Differentiating Cat Terminology

- Common Terms
 - Outdoor
 - Free-roaming
 - Free-ranging
 - Stray
 - Feral
 - Community
- ***Ultimately, all outdoor cats pose a problem, thus can be considered ecologically similar***

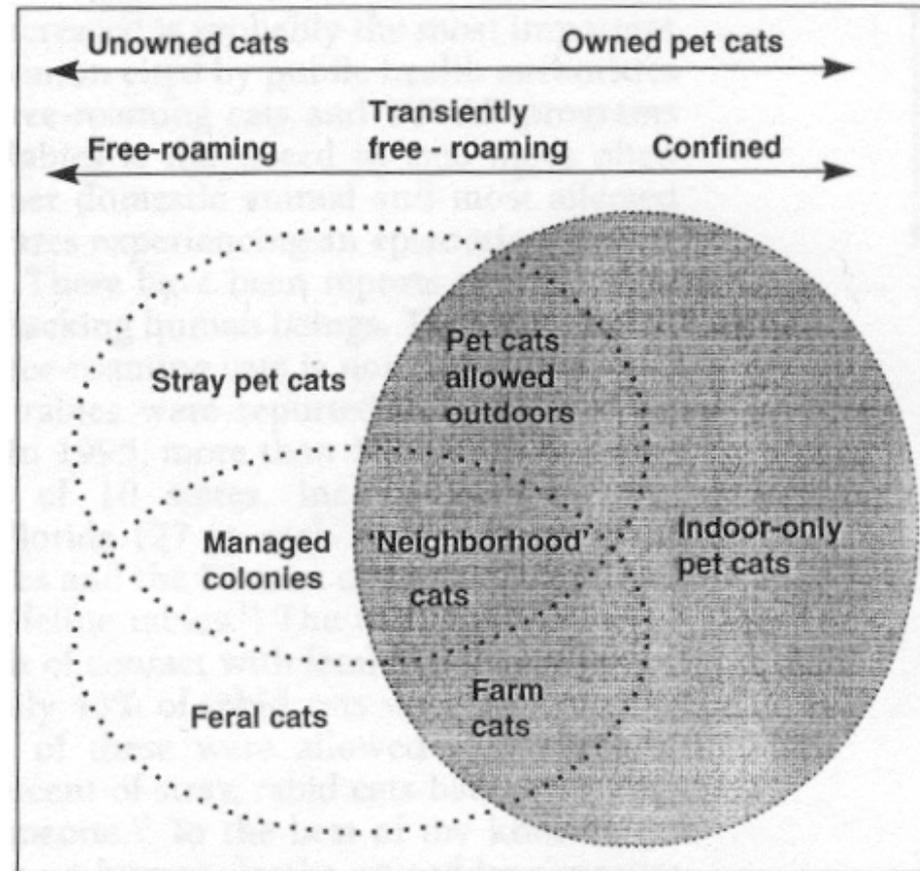
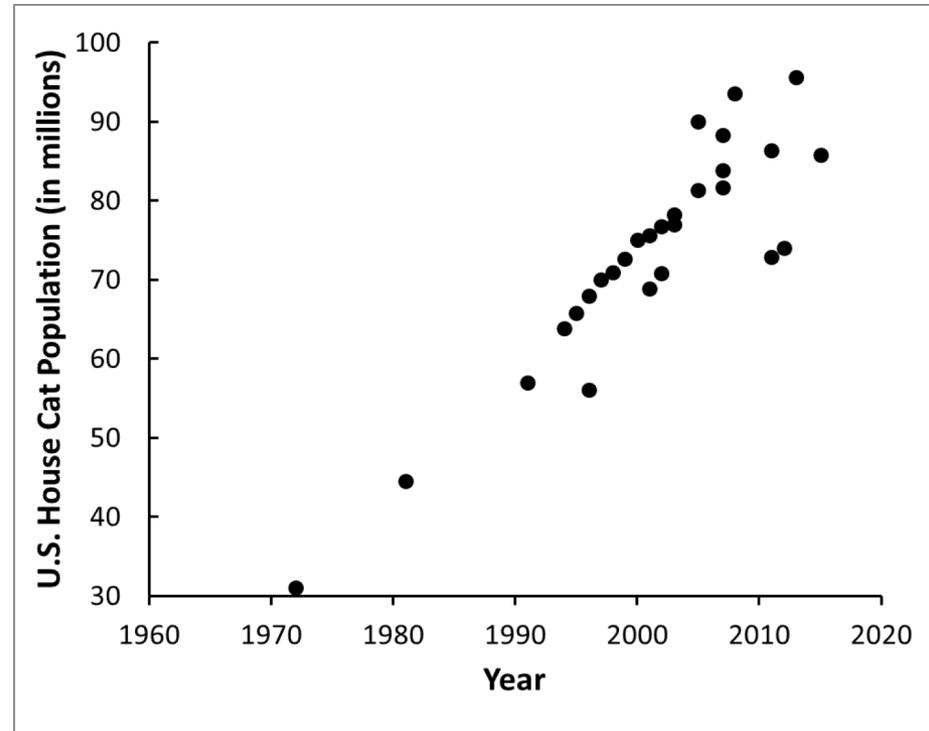


Figure 1—Conceptual diagram of cat populations.

Patronek 1998

United States Cat Population

- ~90 million pet cats
- ~65% (~60 million) pet cats allowed outdoors
- 60-100 million stray/feral/semi-feral cats
- ~120-160 million outdoor cats in U.S.



Lepczyk & Duffy 2018. Ecology and Management of Terrestrial Vertebrate Invasive Species in the United States.

Contemporary Issues Related to Feral Cats

- Wildlife predation
- Invasive species
- Public nuisance
- Cat colonies
- TNR
- Depredation by top predators
- Shorter lifespan
- Lack of humane conditions
- Lack of spay-neuter laws
- Lack of licensing
- **Disease transmission**



Cat Diseases

Table 1

Diseases of management concern in domestic cats. In some cases, methods and extent of transmission remain little known.

Disease	Scientific Name	Classification	Cat Acquisition	Transmission	Health Concern		Reference
					Cat	Human	
Rabies		Virus	Saliva, bites	Saliva, bites	x	x	Craven et al. (1993)
Avian flu	Influenza A subtype H5N1	Virus	Prey	Inhalation	x	x	Kuiken et al. (2004)
Feline calicivirus	FCV	Virus	Direct, fluids	Direct, fluids	x		Radford et al. (2007)
Feline herpesvirus	FeHV	Virus	Direct, fluids	Direct	x		Gaskell et al. (2007)
Feline panleukopenia	FPV	Virus	Direct	Direct, fluids	x		Squires (2013)
Feline leukemia	FeLV	Virus	Fluids	Fluids	x		Hardy et al. (1977)
Feline immunodeficiency	FIV	Virus	Direct	Bites	x		Courchamp and Pontier (1994)
Murine typhus	<i>Rickettsia typhi</i>	Bacteria	Fleas	Fleas		x	Roberts and Ellis-Pegler (2001)
Rickettsiosis	<i>Rickettsia felis</i>	Bacteria	Fleas	Fleas		x	Perez-Osorio et al. (2008)
Rocky mountain spotted fever	<i>Rickettsia rickettsii</i>	Bacteria	Ticks	Ticks		x	Kelly et al. (2004)
Cat scratch fever	<i>Bartonella</i> spp.	Bacteria	Fleas	Bites, scratches		x	Kelly et al. (2005)
Gastroenteritis	<i>Cryptosporidium</i> spp.	Protozoa	Water, food, feces	Feces		x	Matos et al. (2004)
	<i>Giardia</i> spp.	Protozoa	Water, food, feces	Feces		x	Huang and White (2006)
	<i>Helicobacter</i> spp.	Bacteria	Direct, feces?	Feces		x	Heilmann and Borchard (1991)
	<i>Campylobacter</i> spp.	Bacteria	Feces	Feces		x	Deming et al. (1987)
Plague	<i>Yersinia pestis</i>	Bacteria	Prey, carrion	Fleas, bites	x	x	Gage et al. (2000)
Yersiniosis	<i>Y. enterocolitica</i>	Bacteria	Prey, food	Feces		x	Yanagawa et al. (1978)
Pseudotuberculosis	<i>Y. pseudotuberculosis</i>	Bacteria	Feces, prey?	Feces		x	Fukushima et al. (1989)
Tularemia	<i>Francisella tularensis</i>	Bacteria	Prey	Direct, inhalation		x	Sjöstedt (2007)
Q fever	<i>Coxiella burnetii</i>	Bacteria	Ticks	Inhalation		x	Karakousis et al. (2006)
Visceral and ocular larva migrans	<i>Toxocara cati</i>	Helminth	Prey, Direct	Feces		x	Chorazy and Richardson (2005)
Toxoplasmosis	<i>T. gondii</i>	Protozoa	Prey	Inhalation/feces	x		Teutsch et al. (1979)
Lyme disease	<i>Borrelia</i> spp.	Bacteria	Ticks	Ticks		x	Burgess (1992)
Trypanosomiasis chagas disease	<i>Trypanosoma cruzi</i>	Protozoa	Bug	Bug		x	Enriquez et al. (2014)
Hookworm cutaneous larva migrans	<i>Uncinaria stenocephala</i>	Nematode	Soil	Feces		x	Bowman et al. (2010)
	<i>Ancylostoma tubaeforme</i>	Nematode	Soil	Feces		x	Green et al. (2001)
	<i>Ancylostoma ceylanicum</i>	Nematode	Soil	Feces		x	Bowman et al. (2010)
	<i>Ancylostoma braziliense</i>	Nematode	Soil	Feces		x	Bowman et al. (2010)
Equine protozoal myeloencephalitis	<i>Sarcocystis neurona</i>	Protozoa	Prey, carrion?	Feces		(Horses) ^a	Stanek et al. (2003)

^a The disease is a health concern to horses.

Human Dimensions Research on Toxoplasmosis

- Few studies evaluate how people consider wildlife diseases, particularly outside of game species
- Little socioecological research on knowledge and attitudes related to the disease itself
 - For instance, how individuals perceive and understand the disease and potential human and wildlife health impacts
- However, research has been conducted related to cats and management, which has implications for the disease

Evaluating Knowledge About Cats

- Surveyed two groups of stakeholders across entire US in 2011
 - Cat colony caretaker (n = 338)
 - Bird conservation professional (n = 239)
- Feral cats are a reservoir for disease

	Disagree strongly	Disagree a little	Neither agree nor disagree	Agree a little	Agree strongly
Colony Caretaker	72%	14%	8%	5%	1%
Conservation Professional	4%	8%	26%	28%	35%

Assessing Stakeholder Attitudes on Cats

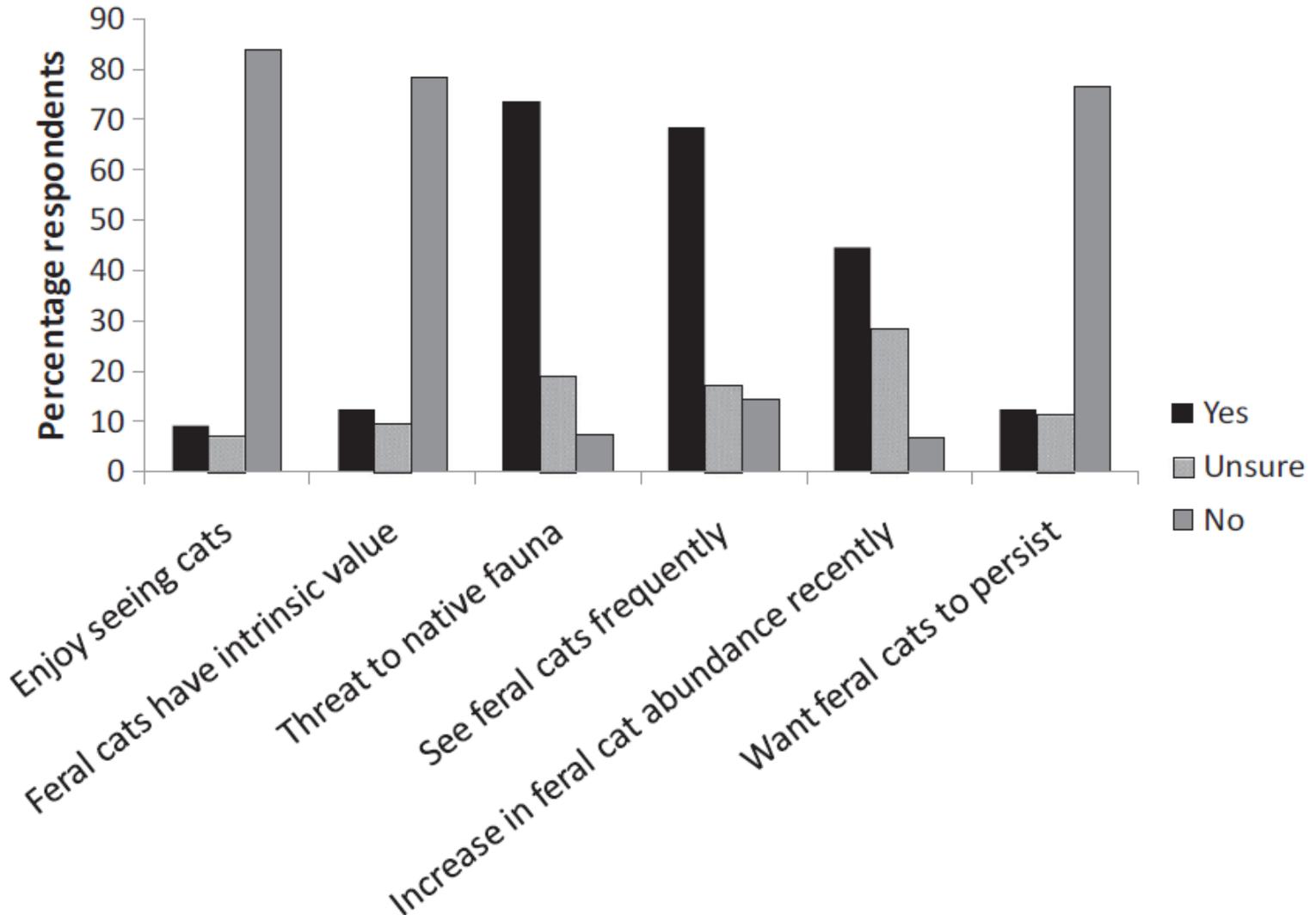
- Broadly evaluated different stakeholder groups across a range of cities and nations
- In depth evaluation of stakeholders
- Survey disseminated to 5,407 people from 6 stakeholder groups across Hawaiian Islands:
 1. Agriculturalists (n = 373)
 2. Animal welfare activists (n = 277)
 3. Conservation professionals (n = 698)
 4. Hunters (n = 1650)
 5. Native Hawaiians (n = 49)
 6. Public (n = 2,360)



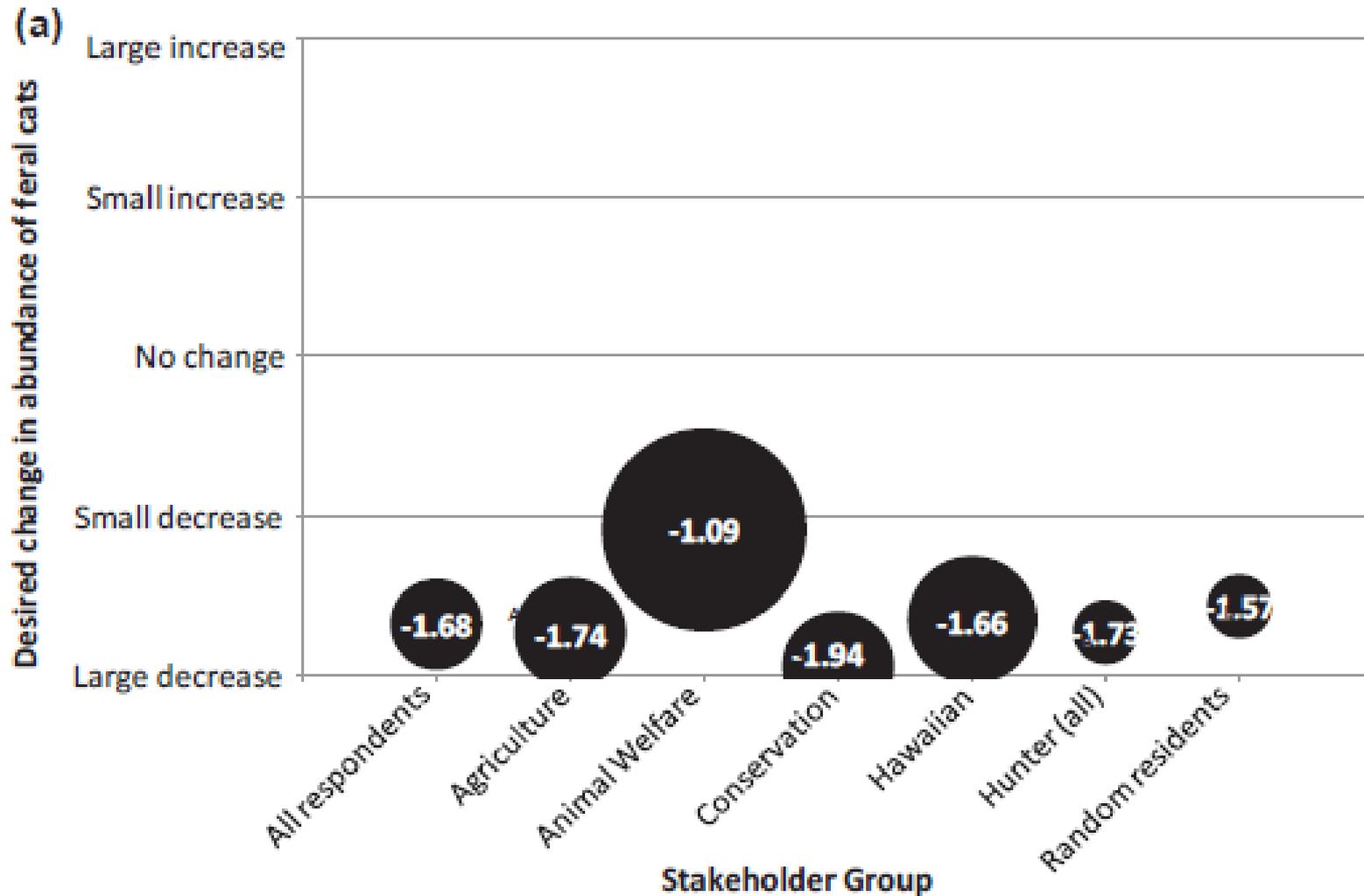
Stakeholder Attitudes on Cats

- Potential for conflict index (PCI) analysis found great consensus that outdoor cat abundance should decrease
- 84% of respondents did not enjoy seeing feral cats
- Only 12% assigned an intrinsic value to feral cats
- 73% believe feral cats threaten native fauna

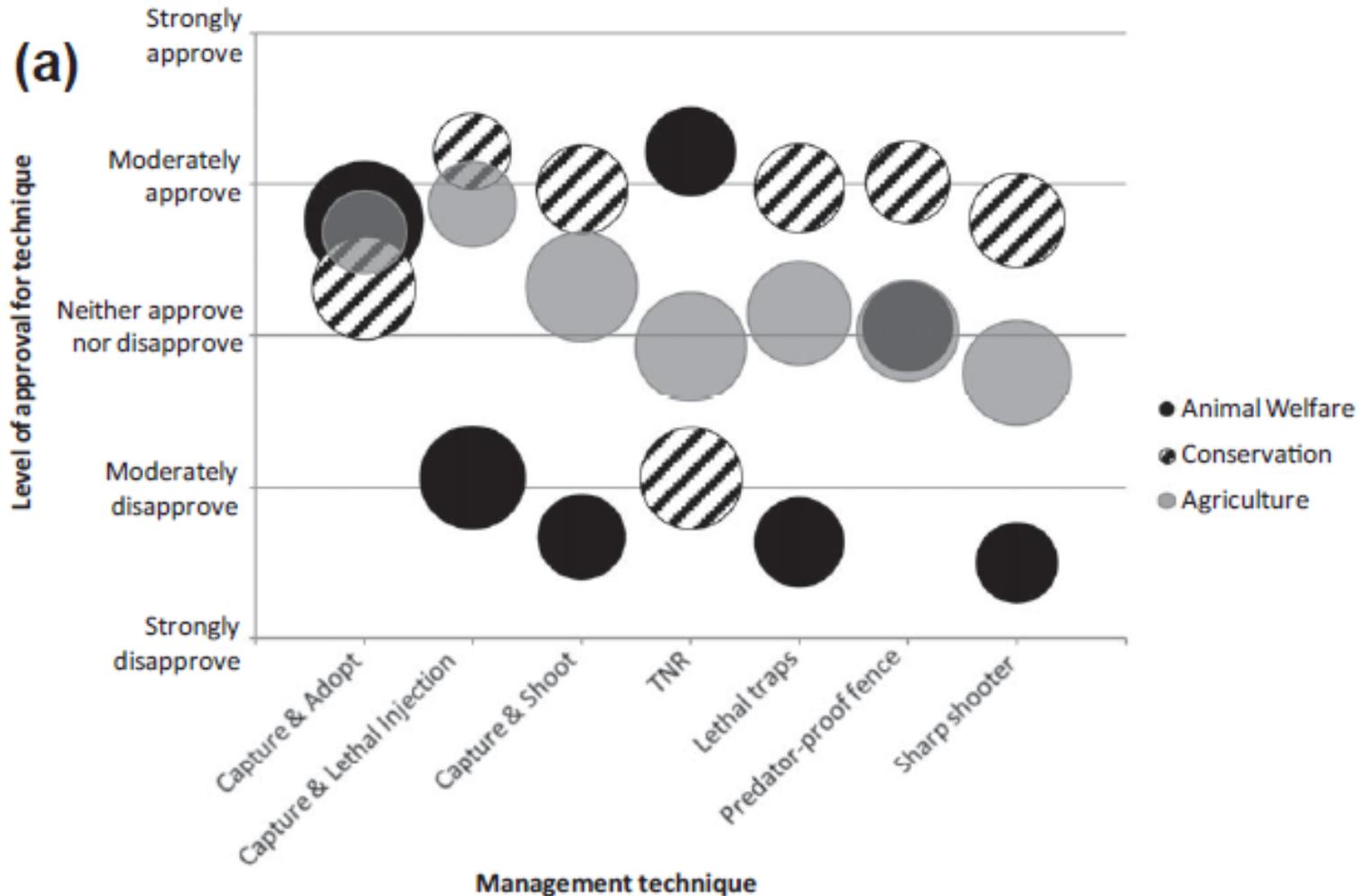
Stakeholder Attitudes on Cats



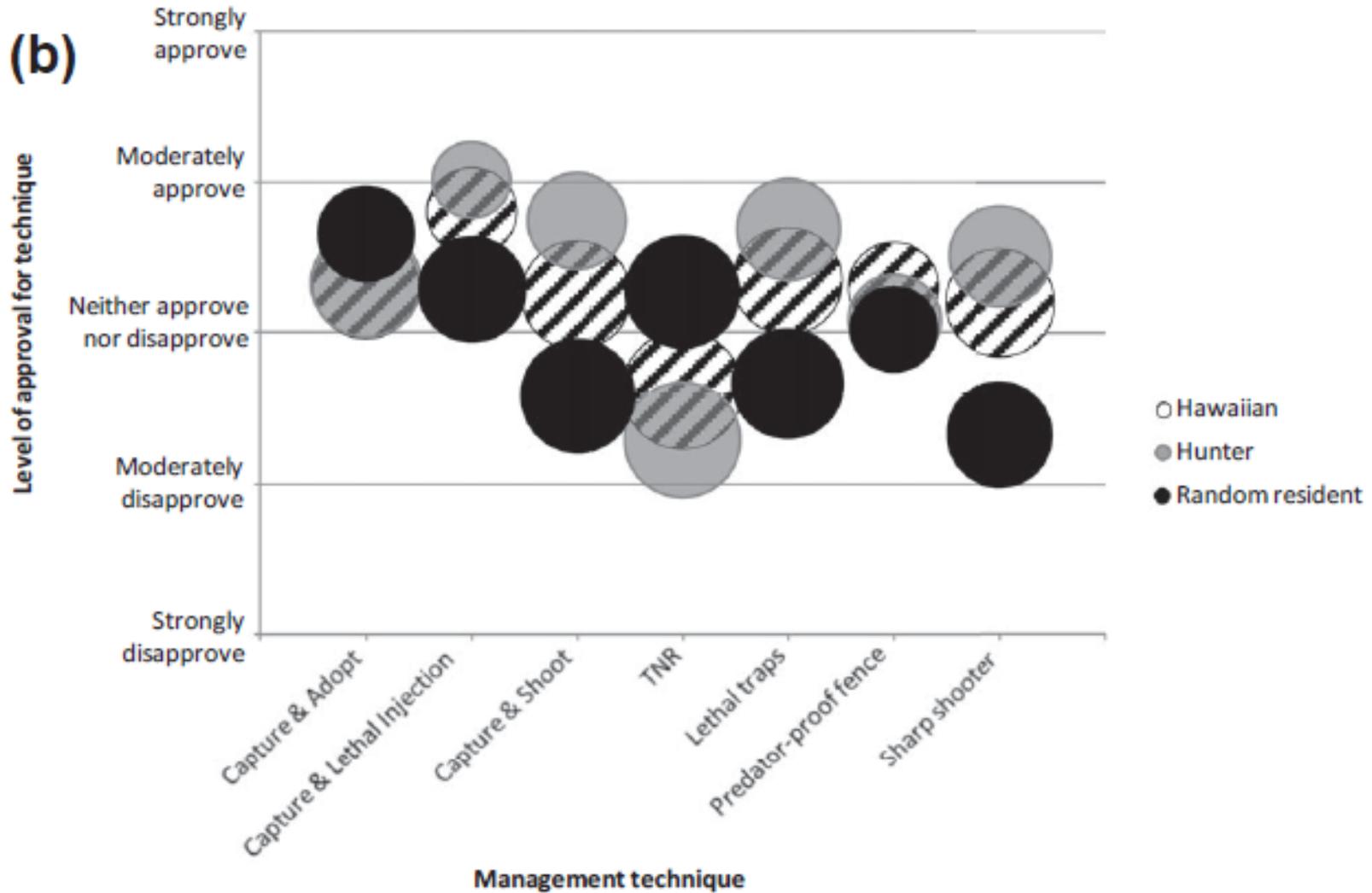
Stakeholder Attitudes on Cats



Stakeholder Attitudes on Cats



Stakeholder Attitudes on Cats



Stakeholder Attitudes on Cats

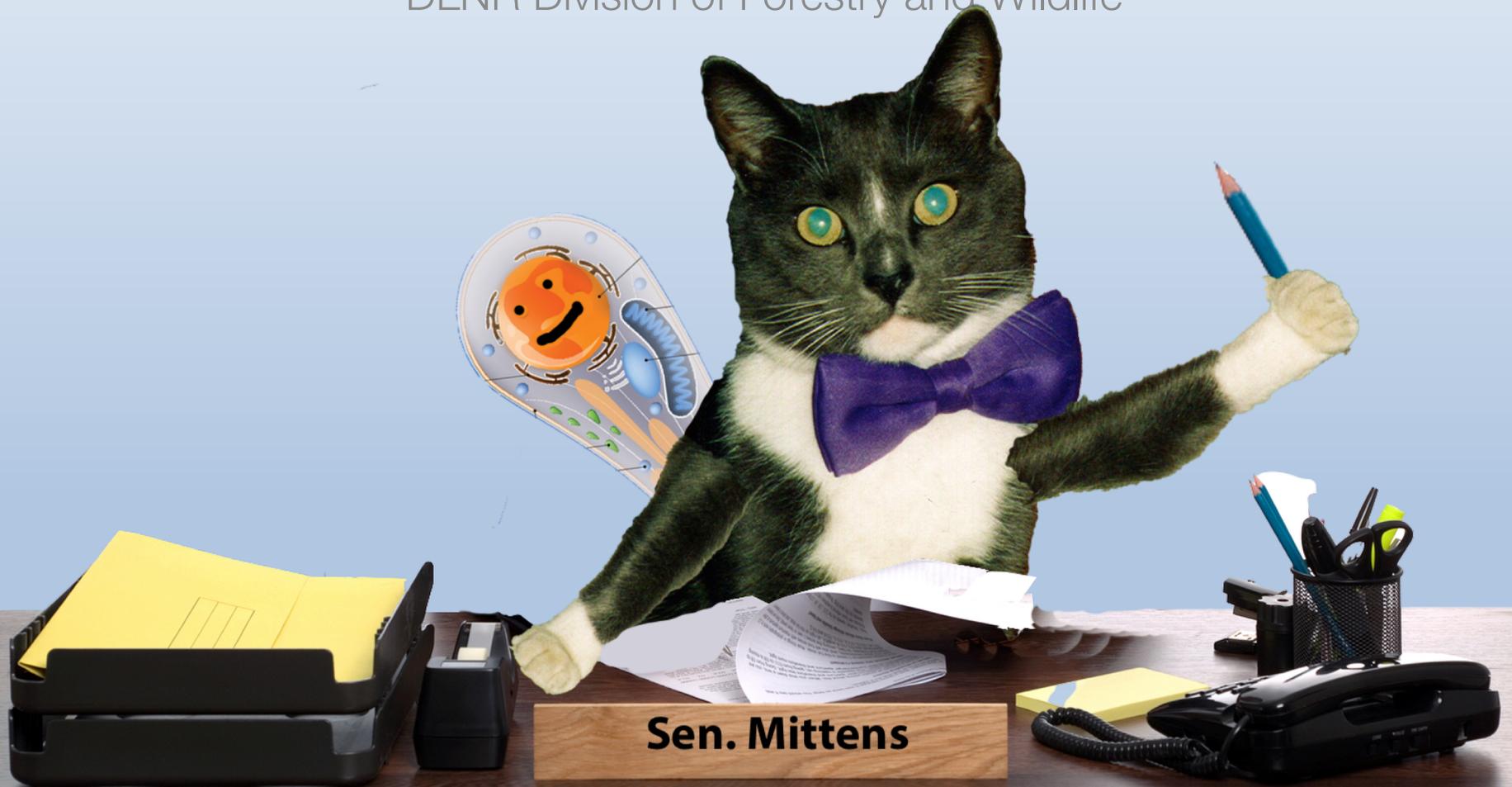
- Majority of respondents (78%) support permanently removing feral cats from the landscape
- Conservation planning models revealed live capture and lethal injection were most preferred
- TNR was least preferred technique for management
- Acceptability of each technique varied by stakeholder

Thanks



Looking Forward: Current Policy Framework and Potential Directions

Josh Atwood, Invasive Species Coordinator
DLNR Division of Forestry and Wildlife



DOFAW and Toxoplasmosis

- Native birds
 - Nene
 - Alala
 - Red-footed booby
- Game birds
 - Erckels francolin



DOFAW and Toxoplasmosis

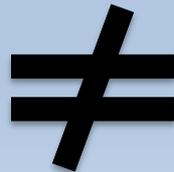
- Policy focus is on the vector (disease and predation)
- Are feral cats an invasive species?
 - Federal definition:
 - alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health
 - State definition:
 - harmful to the environment, economy, and/or human health, and
 - not native to Hawaii (i.e., species that were introduced by human assistance rather than by their own means of introduction).
- Definitions are context dependent and based on “harm.”
Pet cats, especially indoor cats, are not included

Legal Designations of Cats

- “Animal,” per HAR 4-29 (HDOA) in a chapter regarding import and movement with the intent to prevent rabies
- “Predator,” per HRS 183-D (DLNR)
- Domestic cat (*Felis catus*) appears in HAR 4-71 (HDOA) as an exclusion to the term “non-domesticated animal”
- Hawaii County defines “stray” cats as those “wandering or running at large, or found upon any public place or found not upon the lands of the owner” (County Code 4-1(r)(4))

Legal Designations of Cats

- No definition of “pet”
- DLNR’s definition of “feral” in HAR 13-124 is subjective:
 - “Having escaped or been released from domestication and reverted to a wild state.”
- Current policy designations tend to refer to cats at the species level, regardless of context



Who owns a cat?

- No statewide definition of “owner” pertaining to cats or pet animals
 - HRS 143-1 defines “owner,” but specifically for dogs: “every person owning, harboring, or keeping a dog.”
- Only the City and County of Honolulu has an ordinance defining ownership
 - “Any person owning, harboring, or keeping, or providing care or sustenance for a cat, whether registered or not, or having custody of a cat, whether temporarily or permanently.” (ROH 7-6.3)

Statewide Regulations

- Penalties for animal abandonment (HRS 143)
- Liable for proximate personal or property damage (HRS 663-9)
- “Persons responsible” for any animal in a State Park must clean up droppings and may be liable for costs of capture of the animal or restoration of any damages cause (HAR 13-146)

County Regulations

- City and County of Honolulu requires owners to sterilize cats older than 6 months (ROH 7-6.6) and provide them with an ID collar, tag, or microchip (ROH 7-6.2)
- Maui County requires all cats released for adoption to be neutered (CC 6.04.070)
- Hawaii County prohibits owners (undefined) from taking cats to county beach parks or businesses where food is sold (CC 4-18), and prohibits feces or other nuisances on any public areas (CC 4-19)

Federal Regulations

- Migratory Bird Treaty Act (16 U.S.C. § 703-712)
 - Unlawful at any time, by any means or in any manner, to pursue, hunt, take capture, kill, attempt to take capture, kill, possess, offer for sale... any migratory bird
- Endangered Species Act (6 U.S.C. § § 1531-1544)
 - Prohibits any person from harassing or harming any endangered or threatened species within the United States

Pending Legislation

- HB2593
 - Originally would have created a state trap-neuter-return program at Department of Health
 - Current version would exempt nonprofits conducting TNR from regulations regarding feeding and confinement of cats
- SCR36 / HR60
 - Urges state departments to implement TNR

Potential Future Directions

- Statewide requirements for neutering, including new arrivals into the State
- Statewide definitions for pet cats, owners, and feral cats
- Statewide licensing requirement
- Coordinating across counties for standard definitions and neutering requirements

Potential Future Directions

- Support for sanctuaries or other enclosure models
- Subsidies for catios
- Support for increased adoption, including outside Hawaii



Potential Future Directions

- Prohibitions on feeding cats in certain public areas
- Kauai Feral Cat Task Force model:
 - Map sensitive habitat for threatened & endangered species
 - Term-limited, managed TNR outside of these areas
 - At the end of term, all cats must be moved to private enclosures or taken to shelter