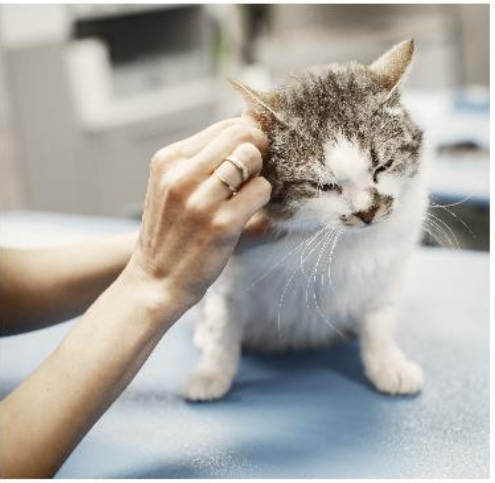
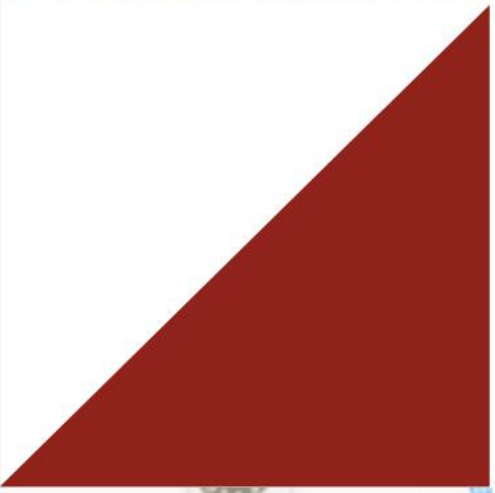
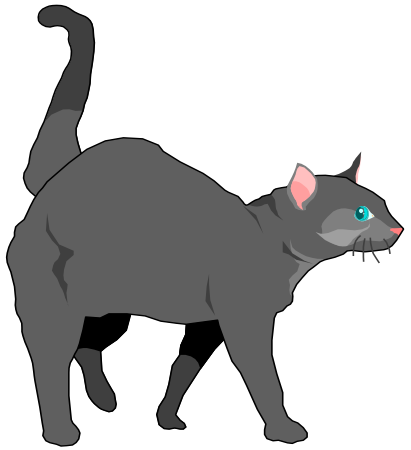




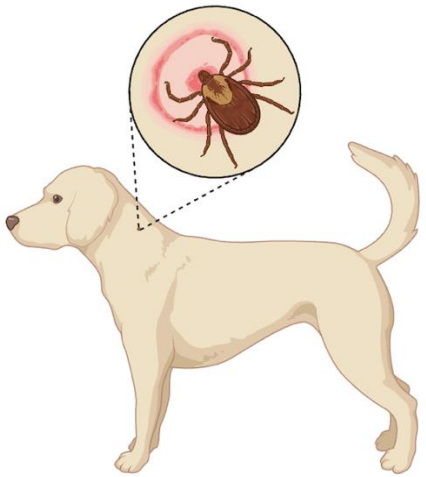
Updates on parasitic and vector-borne diseases and best practices in management in companion animals: focus on British Columbia



Dr Emily Jenkins (PhD, DVM, BScHon)

University of Saskatchewan | Western College of Veterinary Medicine

Western Canadian representative to the Canadian Veterinary Parasitology Consortium



Canadian Parasitology Expert Panel

FOR COMPANION ANIMALS

Canadian Guidelines for the Treatment of Parasites in Dogs and Cats

2009

CANADIAN PARASITOLOGY EXPERT PANEL GUIDELINES

for the Management of Parasites in Dogs & Cats

2019

https://research-groups.usask.ca/cpep/index.php

CPEP Jul 2025 – now the Canadian Veterinary Parasitology Consortium

Dr Christopher Fernandez Prada, FMV
Dr Emily Jenkins, WCVM
Dr Sawsan Ammar, UCVM
Dr Andrew Peregrine, OVC
Dr Victoria Wagner, FMV
Dr Nina Germitsch, AVC
Dr John Gilleard, UCVM

Not shown:
Dr Maria Jarque, WCVM
Dr Katie Clow, OVC

CVPC sponsors

- New this time:
- Diagnostic partners

- Industry partners provide financial support and valuable feedback from the profession, but do not have editorial control over the guidelines

PLATINUM:

SILVER:

BRONZE:

CVPC continues to advocate for individual, risk-based parasite prevention and control

- Why not have universal, one size fits all guidelines?
  - Leads to overtreatment of most pets (most have few or no parasites)
    - Concern for some clients
    - Major concern for anthelmintic resistance
  - Results in clients finding “over the counter”, “off the web” options due to $
- Why a risk based approach?
  - Both vet and the owner work together to assess and mitigate risks
  - Requires at least one annual visit for testing and to update risk profile (wellness pkg?)
  - Acknowledges strong regional and seasonal differences in parasites in Canada
  - Personalized medicine
  - Encourages non-pharmaceutical interventions and preserves drug efficacy

The 2019 Algorithm

At risk for fleas and/or ticks?

YES

Recommend flea and/or tick prevention

NO

Live in or travel to heartworm endemic region

YES

Recommend heartworm prevention

NO

Live in or travel to *Echinococcus* endemic region

YES

Recommend monthly cestocide IF HIGH RISK

NO

Low or high risk for GIN?

Recommend appropriate test +/- treat

ANIMALS UNDER 6 MONTHS: GI NEMATODES

At 2 weeks of age

Treat puppies and kittens **every 2 weeks**

At 8 weeks of age

Switch to a monthly schedule

At 6 months of age

Monthly or regular targeted treatments can be given based on the **individual risk** of the animal.

ANIMALS UNDER 6 MONTHS: GI NEMATODES

Puppies and kittens should ideally be treated with an anthelmintic effective against *Toxocara* spp. at the following frequency:

→ 2, 4, 6 and 8 weeks

→ Once a month until six months of age

This **early-start program*** ensures the elimination of:

- *Toxocara canis,* acquired before birth
- *Toxocara cati,* acquired through milk

* However, since most puppies and kittens don't see a veterinarian until 6 to 8 weeks of age, it may be necessary to provide anthelmintics to the breeder for earlier treatments.

ANIMALS UNDER 6 MONTHS: GI NEMATODES

Female dogs and **cats should be treated simultaneously with their offspring*** as they often develop infections alongside their young (Sprent 1961, Lloyd et al. 1983).

Alternatively, when puppies or kittens are acquired for the first time by their owner, they should be dewormed as follows:

- 3 treatments spaced 2 weeks apart
- 1 treatment per month until the age of 6 months

- Fecal examinations should be performed at least twice during the animal's first year of life (at 2–3 months and 7–9 months).
- The choice of products and treatment plan should be based on the parasites detected and their prevalence in the geographical area.

ALL ANIMALS

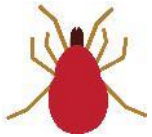
All dogs and cats should have at least one annual fecal screening test and be assessed for the risk of parasitic infection.

Gastrointestinal helminths

Cestodes

HW

Mites



Fleas

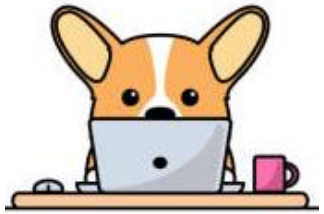
Ticks

You should consider:

Lifestyle	Geographic location and/or home environment	Health status

Ask pet owners the following questions to evaluate the animal's risk level

ALL ANIMALS: RISK ASSESSMENT



- ✓Are there young children, immunocompromised, or pregnant people in the household (YOPI)? In regular contact with the animal?
- ✓Is the dog or cat a service animal?
- ✓Do pets often come into contact with highly contaminated environments (e.g., dog parks, kennels)?
- ✓Do pets have access to wildlife such as rodents, rabbits, birds, or carcasses of livestock or wild cervids?
- ✓Do pets roam freely?
- ✓Are pets fed raw meat or organs?

ANIMALS > 6 MONTHS: GI NEMATODES

LOW-RISK ANIMALS
(If the answer was "no" to all questions)

- Perform fecal exams 1–2 times/year
- Treat based on fecal exam results and prevention needs
- Consider annual «safety treatment »

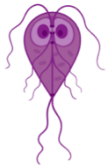
HIGH-RISK ANIMALS
(If there was a positive answer to any question)

- Perform fecal exams 3–4 times/year
- Prophylactic treatment and deworming based on fecal exam results and prevention needs:
  - Monthly for specific parasites*
  - 3–4 times/year for gastrointestinal nematodes

***monthly for ticks and heartworm in endemic regions and seasons**

***monthly year round for *Echinococcus* HIGH RISK PETS ONLY**

OTHER PARASITES



Treat pets for ***Giardia*** **only if they are symptomatic or live in high risk household**

Dogs in endemic areas for heartworm should start receiving monthly preventive treatments, no later than **two months of age, during the risk season**

Tick control products should be prescribed based on **regional and seasonal risks**, especially in areas endemic for *Ixodes spp.*

Dogs and cats in endemic areas for fleas should receive **preventive treatment during the risk season**

The new algorithm (still in beta)

Adapted from European guidelines

ESCCAP
EUROPEAN SCIENTIFIC COUNSEL COMPANION ANIMAL PARASITES®

Parasite Prevention Protocol for Dogs & Cats in Canada

Clinic handout based on CPEP + ESCCAP

Use a risk-based approach: assess age, lifestyle, travel, geography, household zoonotic risk, and parasite exposure.

1) Puppies & kittens (< 6 months)

- Deworm at 2, 4, 6, and 8 weeks, then monthly to 6 months
- Perform 2 fecal exams in the first 6 months
- Treat the nursing dam when appropriate

2) Low-risk adults

- 1–2 fecal exams per year
- Treat based on fecal results
- Typical profile: indoor lifestyle, no hunting, no raw diet, limited exposure

3) High-risk adults

- At least 2 fecal exams per year
- Minimum 3–4 broad-spectrum dewormings per year
- Quarterly parasite control is a practical default
- Higher risk: outdoor access, dog parks, kennel/cattery, prey access, scavenging, raw-fed pets, crowded multi-pet homes

4) Tapeworm / Echinococcus risk

- Risk factors: hunting, rodent access, raw offal, cervid/livestock organ exposure, endemic-area travel
- Use a praziquantel-containing cestocide
- Dose every 4–6 weeks, or monthly if ongoing high risk

5) Fleas, ticks, heartworm, protozoa

Fleas & ticks

- Use regional and seasonal prevention
- In Ixodes-risk areas, protect whenever temperatures are above 4°C

Heartworm

- If living in or travelling to endemic areas: monthly prevention during local mosquito season
- Common endemic-area schedule in Canada: June 1 to November 1
- Dogs: heartworm testing per clinic protocol and product label

Protozoa

- Prioritize hygiene: prompt feces removal, litter hygiene, sanitation
- Avoid raw feeding when possible
- Test and treat symptomatic positives or high-risk settings

Caution: Use only species-labeled parasite products. Never use permethrin/pyrethroid dog products on cats.

Decision Tree

START

Is the patient under 6 months old?

- Yes → **Juvenile protocol** — Deworm at 2, 4, 6, 8 weeks, then monthly to 6 months + 2 fecal exams in first 6 months
- No → **Adult protocol** — Perform annual risk assessment

High GI parasite exposure? — Outdoor access, prey/hunting, raw diet, dog park, kennel/cattery, scavenging, crowded multi-pet home, or zoonotic-risk household

- No → **LOW RISK** — 1–2 fecal exams/year; Treat based on results
- Yes → **HIGH RISK** — At least 2 fecal exams/year; Minimum 3–4 dewormings/year; Quarterly prevention is a practical default

Tapeworm / Echinococcus risk? — Rodents, hunting, raw offal, endemic area or travel there

- Yes → Add praziquantel-containing cestocide Every 4–6 weeks or monthly if ongoing high risk
- No → No routine extra cestocide unless indicated

Flea / tick risk?

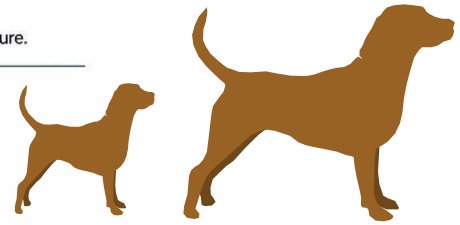
- Yes → Start species-appropriate flea/tick prevention; In Ixodes areas: protect whenever temperatures are above 4°C
- No → Reassess seasonally

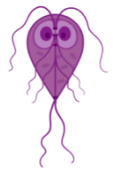
Heartworm-risk area or travel?

- Yes → Monthly heartworm prevention during local mosquito season (Common Canadian endemic-area schedule: June 1–November 1) Dogs: test per protocol
- No → No routine heartworm prevention unless travel or local risk changes

Diarrhea, breeder/shelter exposure, or protozoa concern?

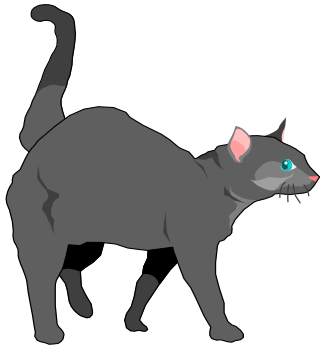
- Yes → Fecal / targeted protozoal testing + hygiene measures; Treat symptomatic positives
- No → Continue routine prevention plan





Adapt this protocol to local parasite prevalence, travel history, household risk, and approved product labels.
For veterinary clinic use.

Risk assessment and mitigation of *Toxoplasma gondii* for pregnant (or pre-pregnant) owners



- Routine precautions: avoid cleaning the litter box; gardening; consumption of undercooked meat, raw milk, unwashed produce & unfiltered water
- <1% of cats shedding at any given time: young, outdoor
- For highly concerned owner: consider serology

	Cat serology	Human serology	Action needed (along with routine precautions)
Best	+	+	Cat unlikely to shed, owner should be protected
	-	+	Prevention for cat*, owner should be protected
	+	-	Cat unlikely to shed but keep cat healthy (prevent recrudescence)
Worst	-	-	Highest levels of prevention for cat* and owner

*keep cat indoors, feed only commercial diet or cooked food

BC specific issues – old and new

- GI nematodes: roundworms, hookworms*
- Tapeworms*: Echinococcus multilocularis, Dipylidium caninum**

*Emerging Anthelmintic Drug Resistance

- Fleas (*Ctenocephalides felis, C. canis*)
- Ticks
  - *Ixodes pacificus*
  - *Dermacentor andersoni* and a new player in town! *D. similis*
- Tick borne diseases: *Borrelia, Anaplasma,* and *Ehrlichia*
- Heartworm – Okanagan? Elsewhere?

Gastrointestinal parasites in dogs and cats BC vs Canada, 2020-25 (data from CAPC)

Parasite	BC Dogs	Canada Dogs	BC Cats	Canada Cats
Roundworm (ascarids)	1.7%	2.5%	4.3%	5.3%
Hookworm	1.1%	1.4%	0.3%	0.4%
Whipworm	0.2%	0.25%	NA	NA
Dipylidium tapeworm*	0.4%	0.6%	1.3%	1.1%
Giardia	10.4%	11.2%	5.3%	5.3%

Roundworms (ascarids) are the most common helminth in dogs and cats

Giardia is even more common (bias to diarrheic animals?)

*2023-25

What CAPC data doesn't capture

- Travel history, reason for testing, methods used
- What type of roundworms?
  - ***Toxocara canis**** in 18.5% and *Toxascaris leonina* in 5.9% of 135 shelter dogs in BC in 2009-10
  - ***Toxocara cati**** in 9.5% of 95 shelter cats in BC 2009-10

Villeneuve et al., 2015
https://doi.org/10.1186/s13071-015-0870-x

- What type of hookworms?
  - ***Ancylostoma**** in 1.5% and *Uncinaria* in 0.7% of 135 shelter dogs in BC in 2009-10
- Other nematodes: *Capillaria/Eucoleus, Aelurostrongylus, Strongyloides stercoralis**
- Taeniid tapeworms, including *Echinococcus multilocularis**: described for first time as AE in BC dog in 2009 and intestinal infection in 2022
- Protozoans: *Cystoisospora, Cryptosporidium, Sarcocystis, Tritrichomonas*

***zoonotic**

Emergence of canine hookworm treatment resistance: Novel detection of *Ancylostoma caninum* anthelmintic resistance markers by fecal PCR in 11 dogs from Canada

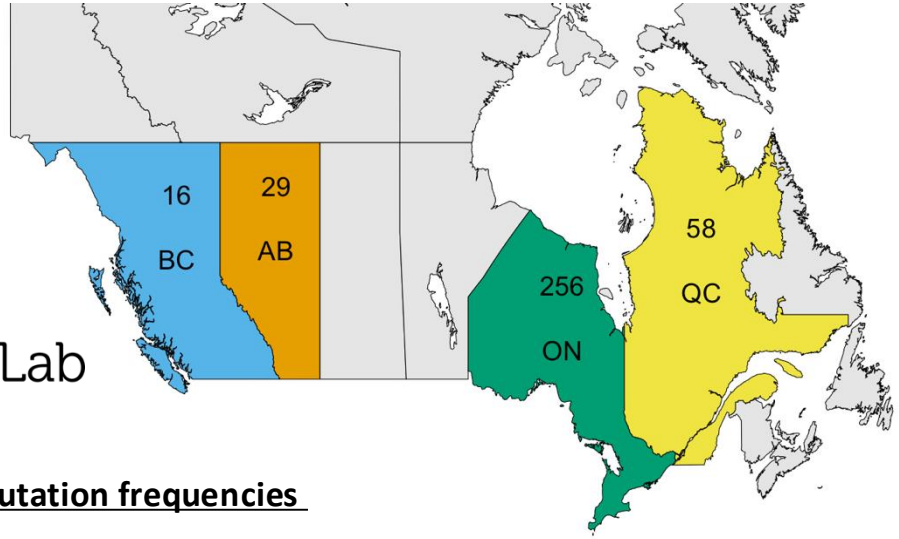
Michelle D. Evason DVM, DACVIM, J. Scott Weese DVM, DVSc, DACVIM, Benjamin Polansky DVM, DACVIM, and Christian M. Leuteneg...

View Mo

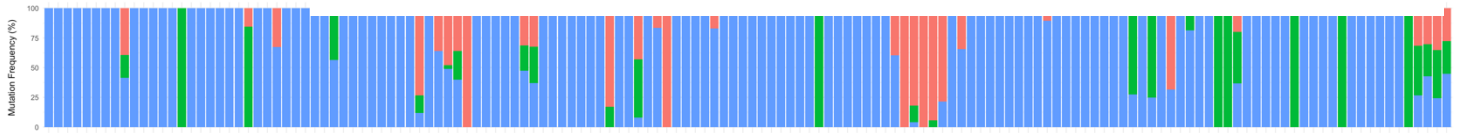
- Most dogs had persistent or intermittent GI signs
- Range of breeds and ages
- 4 had no travel outside Canada
- 6 (3 greyhounds) imported from US
- Single BC dog was US import
- Prevalence of *Ancylostoma*: 0.57% of 32,205 Cdn dogs

Mahya Dini

GilleardLab



134H and 167Y mutation frequencies



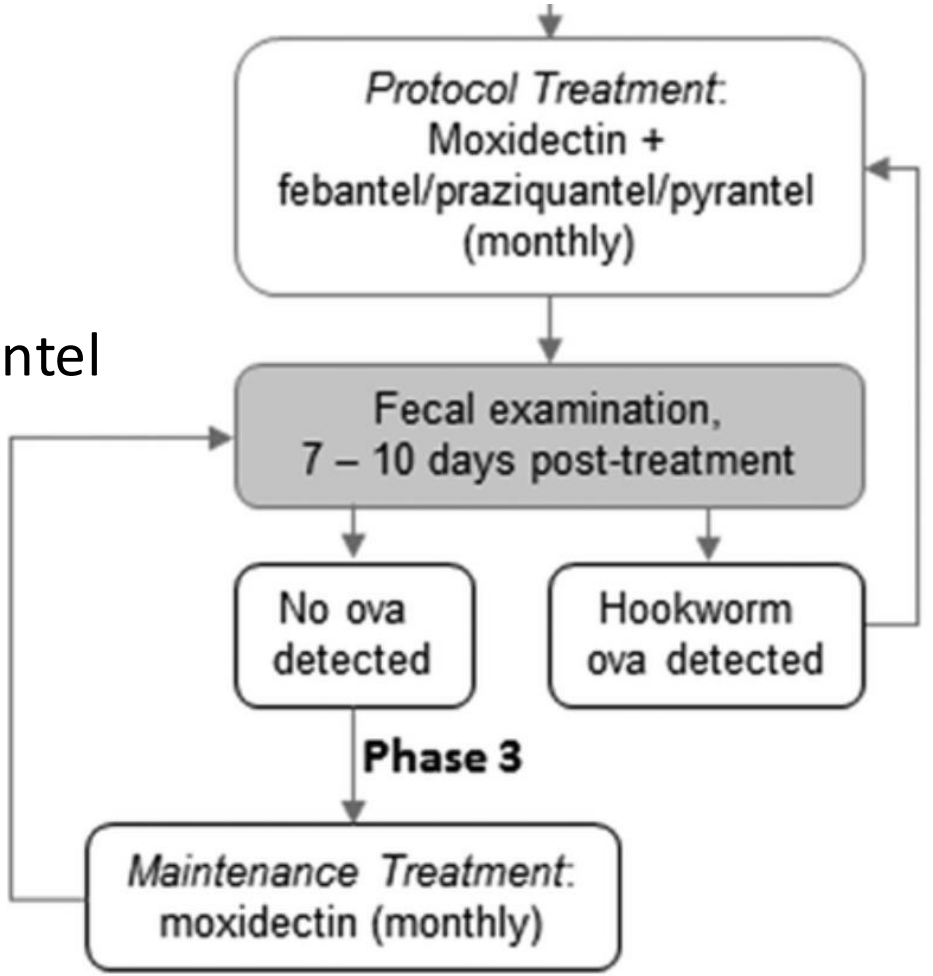
Same major alleles as in USA:
167Y(HT001) and 134H (HT006 and HT008)

Benzimidazole resistance genes

Mutation
F167Y
Q134H
Susceptible

How to manage refractory hookworm cases

- Confirm lack of efficacy using FEC Reduction Test
- Rule out reinfection and larval leak (strict hygiene)
- Try the triple drug combo:
  - Topical moxidectin and oral pyrantel/ febantel/praziquantel
  - Recheck feces within 7-10 d
  - If no eggs detected, monthly moxidectin for high risk
  - If eggs detected, triple treatment again (up to 3 times)
- If not cleared after 3 triple treatments
  - EDR for emodepside



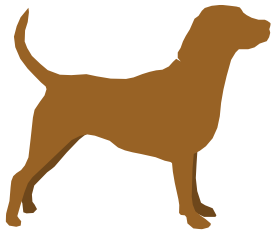
Combination Anthelmintic Treatment for Persistent *Ancylostoma caninum* Ova Shedding in Greyhounds

Lindie B. Hess BS, Laurie M. Millward DVM, Adam Rudinsky DVM, Emily Vincent BS, and Antoinette Marsh PhD

Article Category: Case Report **DOI:** 10.5326/JAAHA-MS-6904

Page Range: 160 – 166

https://www.sciencedirect.com/science/article/pii/S0304401725001475

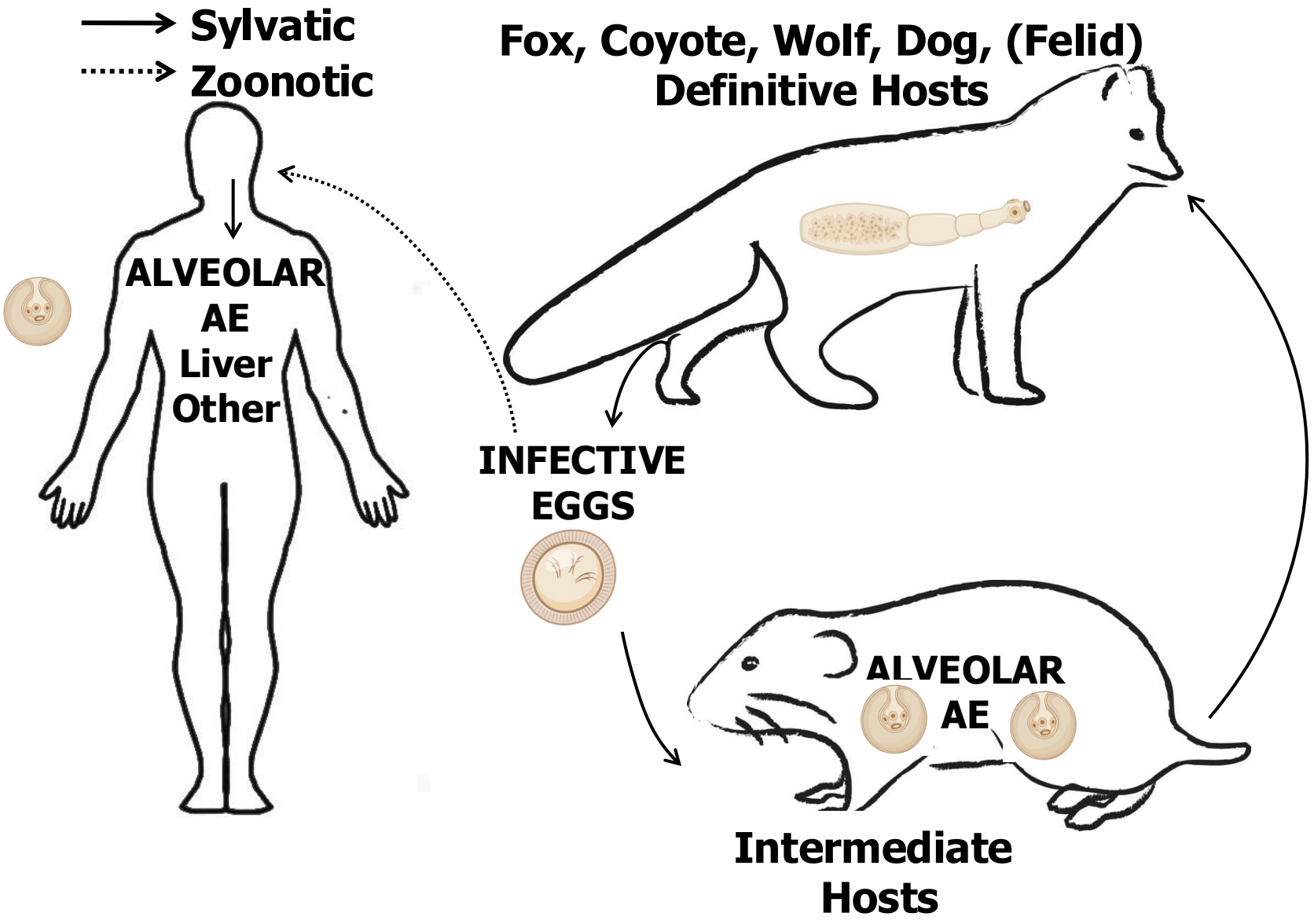


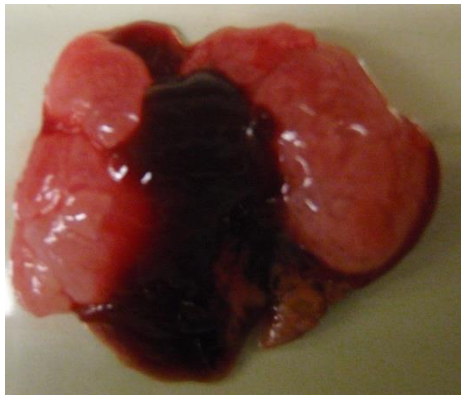
Prevalence of protozoans in shelter dogs and cats

Protozoan	Dog Can	Dog West	Dog BC	Cats Can	Cats West	Cats BC
Giardia	3.5	3.5	2.2	1.4	1.7	0
Cryptosporidium	3.0	2.2	1.5	1.3	2.9	2.1
Cystoisospora	10.4	12.3	**16.3**	14.0	10.3	10.5
Sarcocystis	4.5	11.8	3.0	0.2	0	**1.1**

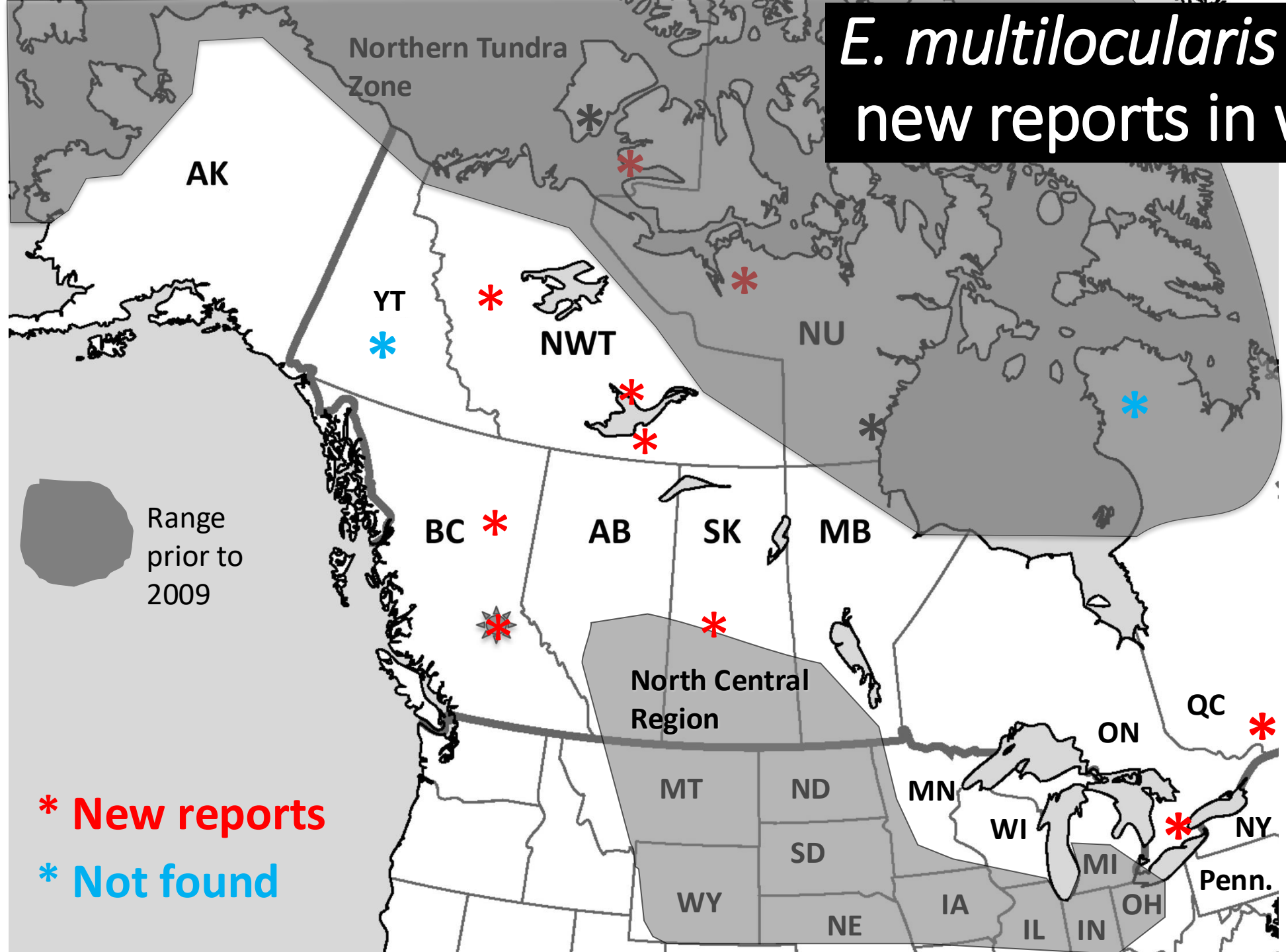
Villeneuve et al., 2015, https://parasitesandvectors.biomedcentral.com/articles/10.1186/s13071-015-0870-x

Echinococcus multilocularis





E. multilocularis new reports in wild canids



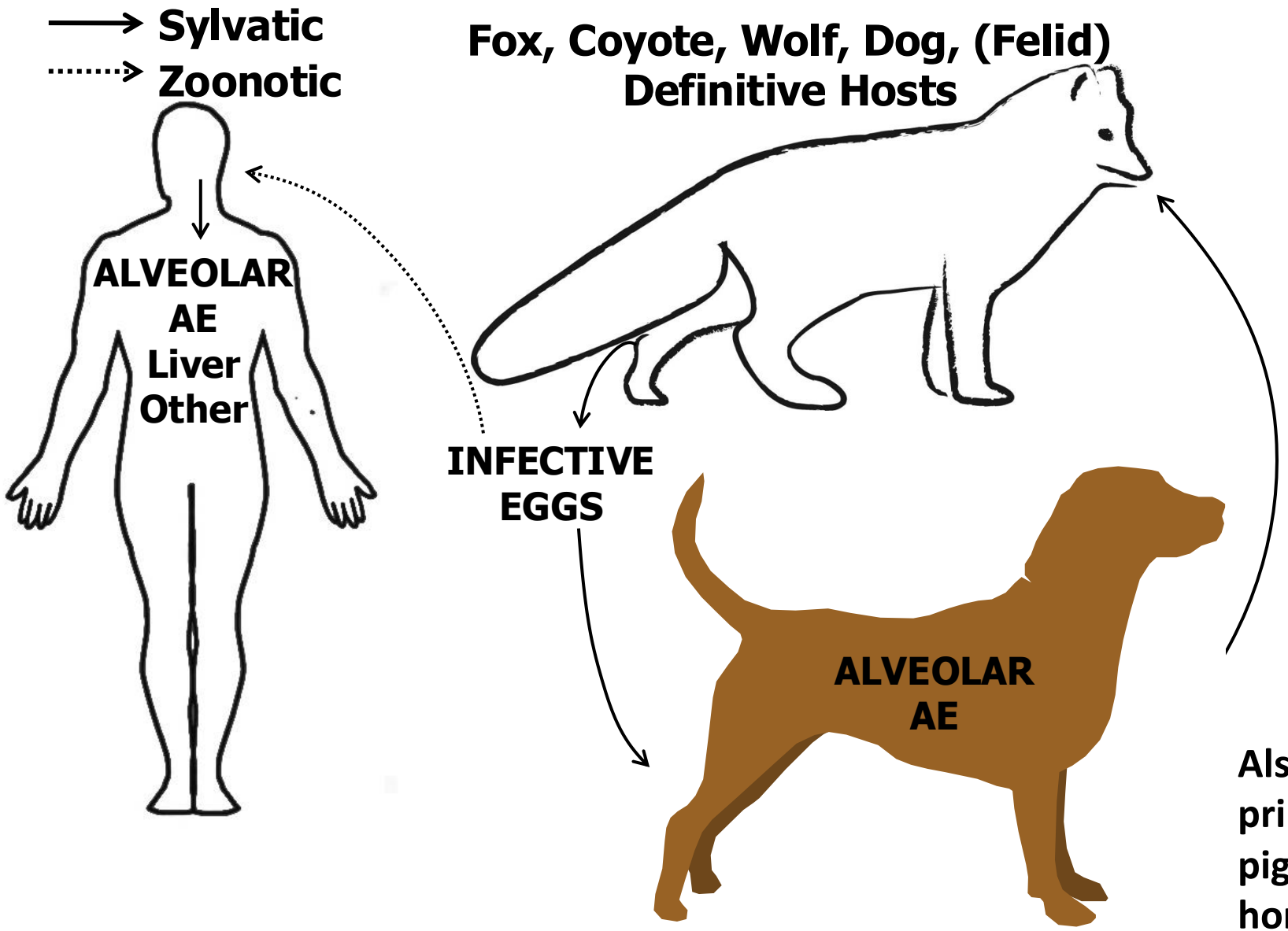
ON: 23% of 460 fox/coyote (Kotwa et al 2019)

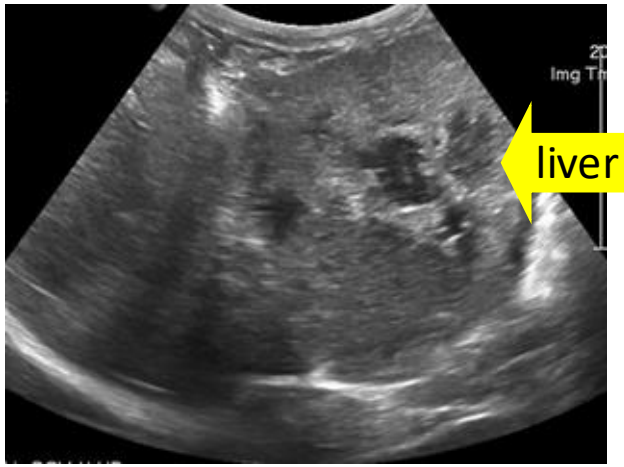
QC: 0% of 307 wolf/coyote/fox in 2016-2017 (Schurer et al 2018)

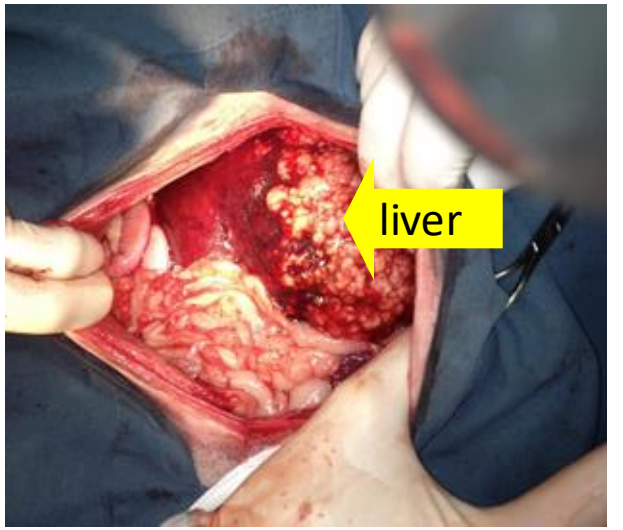
3.5% of 707 fox/coyote in 2020-21 (Arsenault et al 2022)

PEI: Detected in a fox in 2020
Robbins et al 2022

Echinococcus multilocularis







Also primates, pigs, horses…

Research Article | Open Access
Volume 2023 | Article ID 5224160 | https://doi.org/10.1155/2023/5224160

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Canine Alveolar Echinococcosis: An Emerging and Costly Introduced Problem in North America

Temitope U. Kolapo,[1] Allison Hay,[1] Karen M. Gesy,[2] Caroline F. Frey,[3] Jamie L. Rothenburger,[4] Danny J. Joffe,[5] Tim Spotswood,[5] Yanyun Huang,[6] Alessandro Massolo,[7,8,9] Andrew S. Peregrine,[10] Janet E. Hill,[1] and Emily J. Jenkins[1]

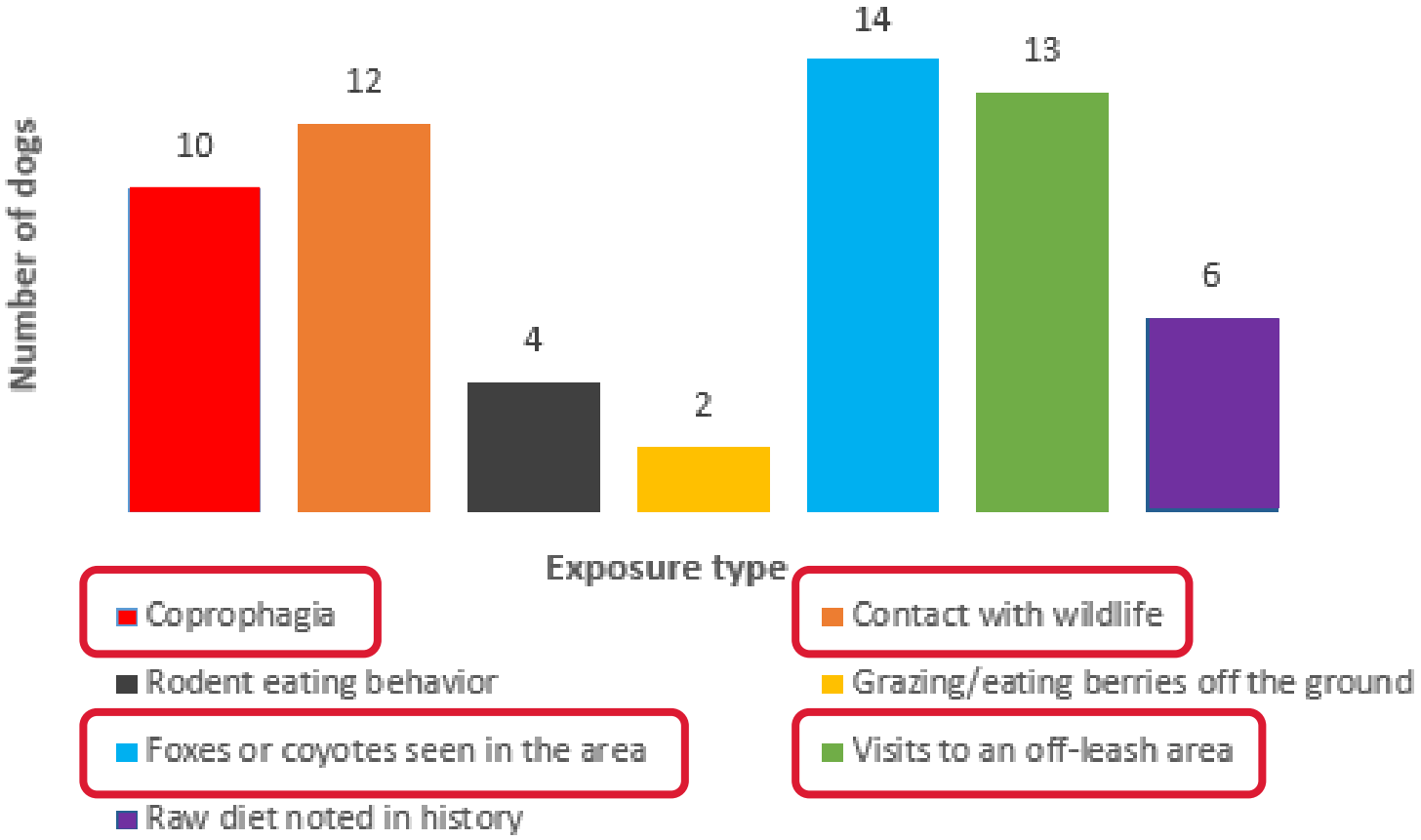
Show more

27 cases since 2009
Median age 4 yr (1 – 12)

Most common breeds:
- **Boxer (*n* = 5)**
- **Labrador Retriever (*n* = 4)**
- **Beagle (*n* = 3)**
- **German Shepherd (*n* = 3)**

- Canine AE is **increasingly common** in **AB & SK**; cases in MB & BC as well
- Risk factors: exposure to **foxes**, **coyotes**, and other **wildlife**; off-leash areas
- Untreated dogs had **16% survival** in the first 100 days vs 82% in treated
- **Direct costs** to the owner ranged from $1,317 to $12,655 CAD

How are dogs getting AE
IN WESTERN CANADA



How common is *E. multilocularis* in coyotes in western Canada?

26% in central BC
https://doi.org/10.1017/S0031182013000607

65% in Edmonton AB
https://doi.org/10.1017/S0022149X1800113X

25% in Calgary AB
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3471618/

72% in western SK
http://blog.healthywildlife.ca/a-survey-for-echinococcus-in-saskatchewan-coyotes/

7% in Winnipeg, Manitoba
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6615438/

Photo: Brent Doney

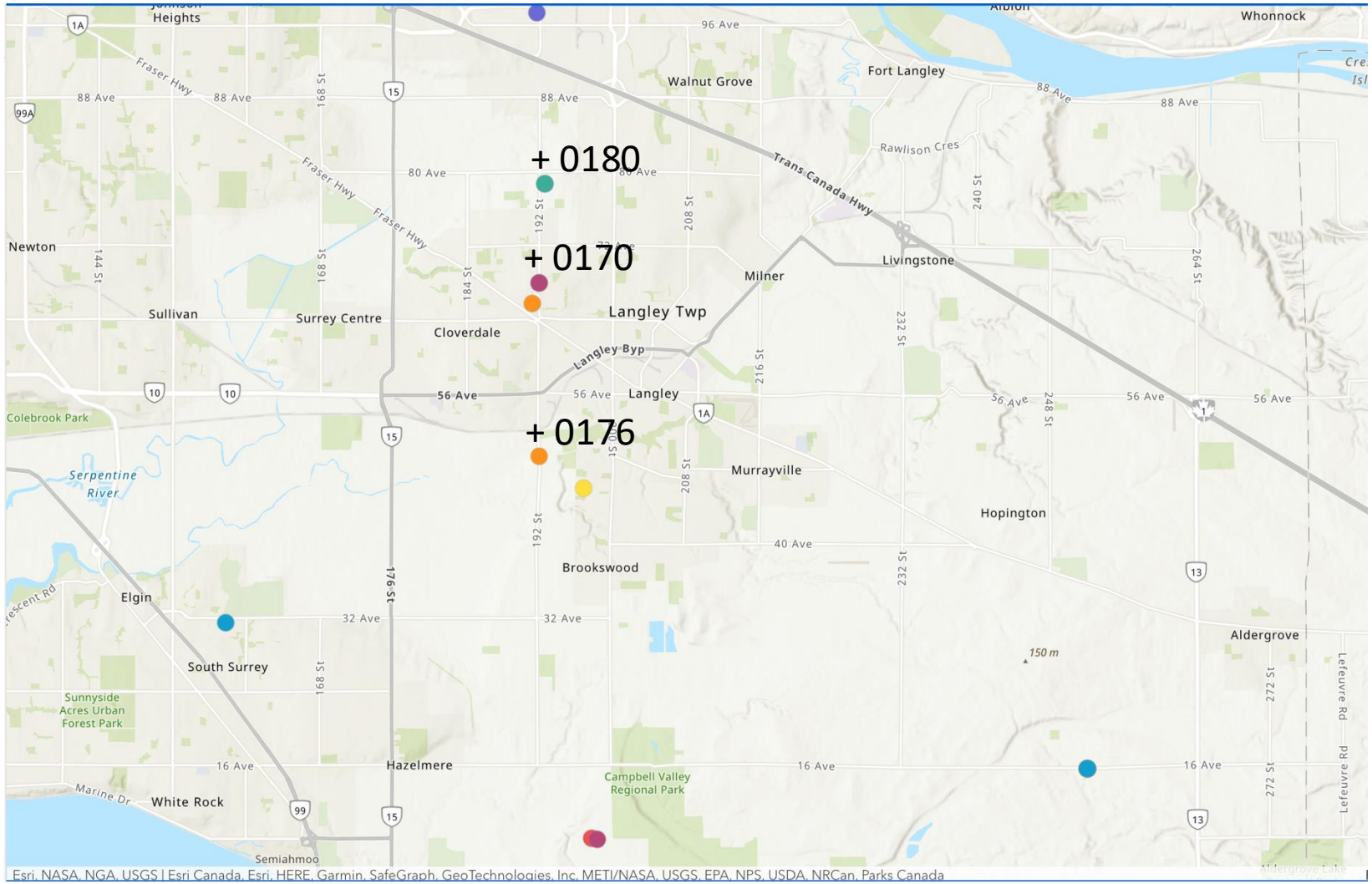
NB: study prevalence influenced by sample size, test methods, season of collection, age of hosts…

Recent detection of *E. multilocularis* (European E3/E4 strains) in coyotes in Langley/Surrey (Vancouver BC)

3/20 (15%) positive on fecal PCR and adult cestode recovery

Medium to high burdens (>100 adult cestodes)

All female coyotes, 2 juveniles



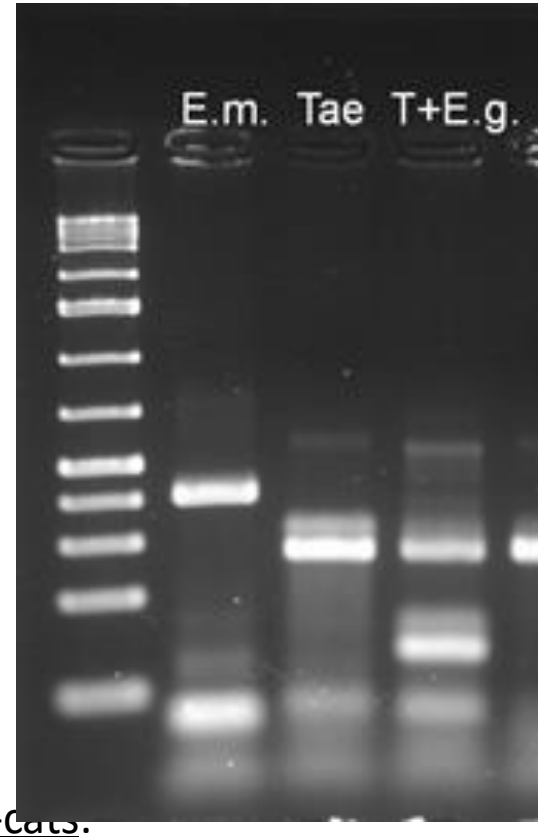
Diagnosis of canine AE

- Suspicion: medical imaging
  - ddx neoplasia, granuloma, other causes of cysts
- Suggestive: serology*, histopathology
  - Protoscolices present in 30-50% of cases
  - Misdiagnosis with other metacestodes?
- Definitive: immunohistochemistry*, PCR
  - Abdominocentesis fluid
  - Aspirated cyst contents
  - Biopsy, surgical resection

Sample: fresh, frozen, ethanol fixed
Lab: PDS/ZPRU, Guelph, Idexx, maybe Antech

*not routinely available in North America

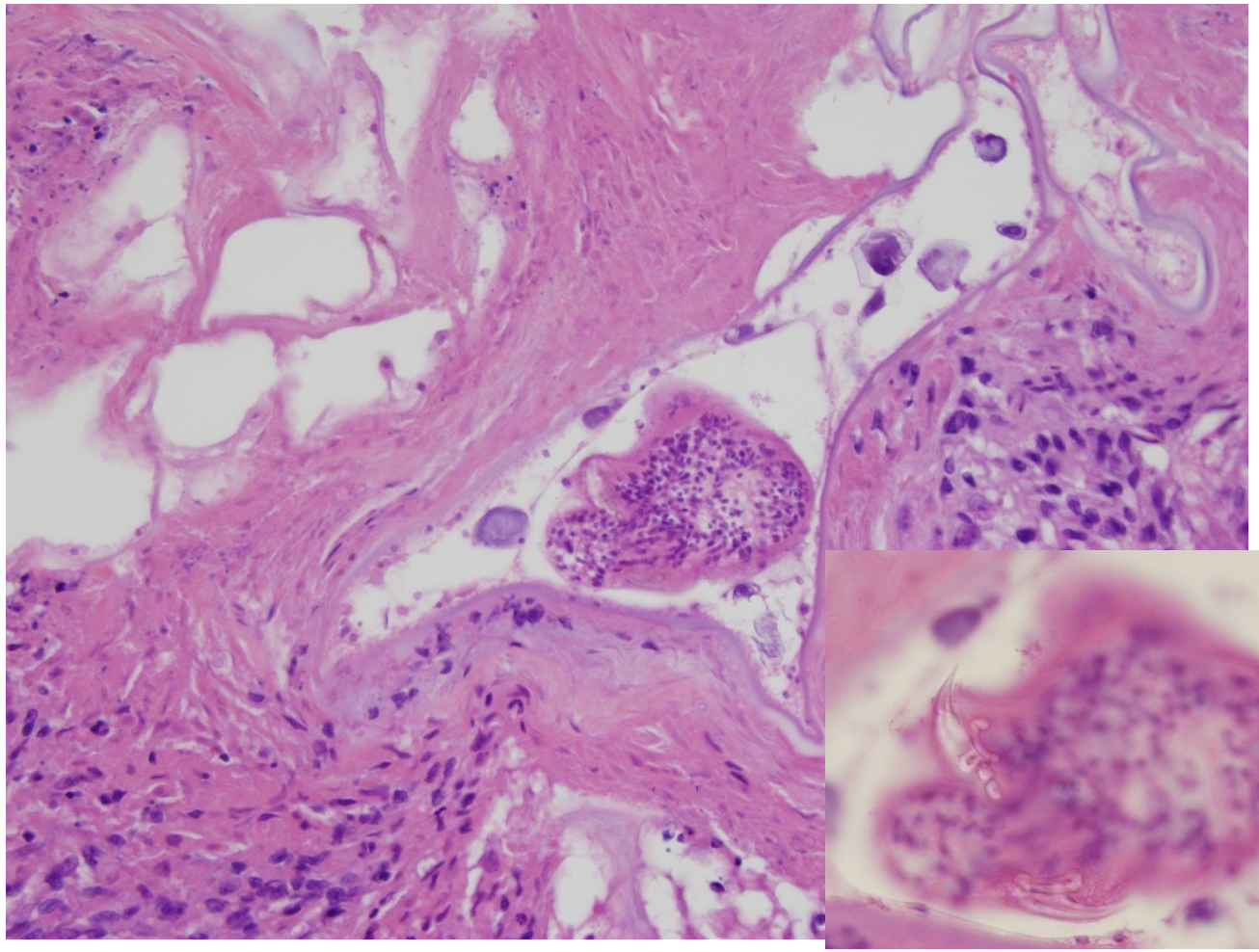
Trachsel et al 2007

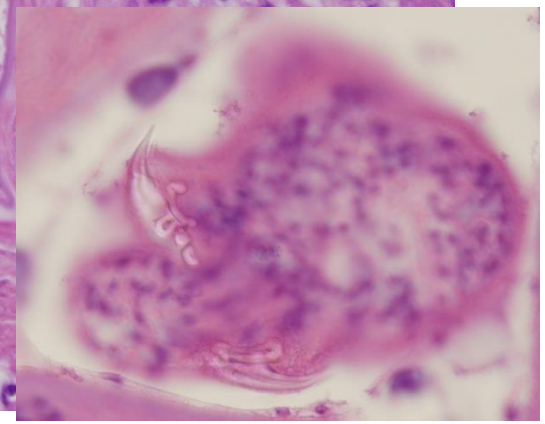


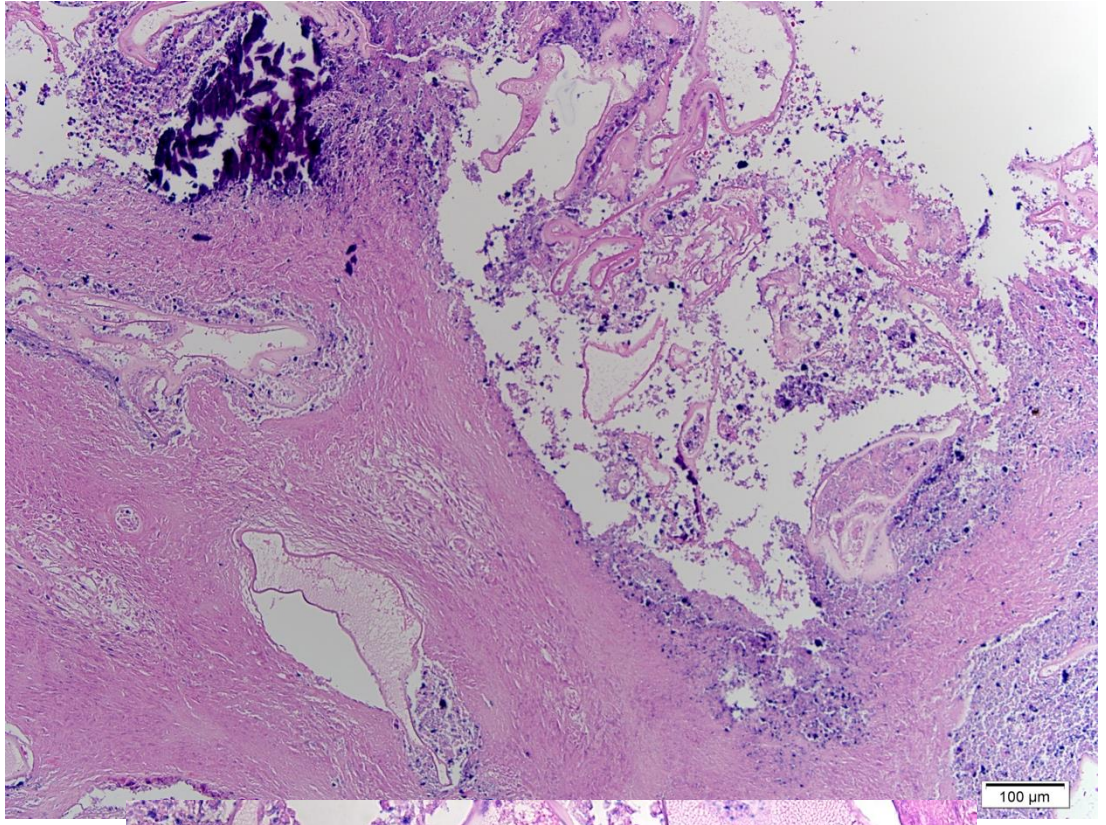
https://www.cliniciansbrief.com/article/echinococcus-spp-tapeworms-dogs-cats.

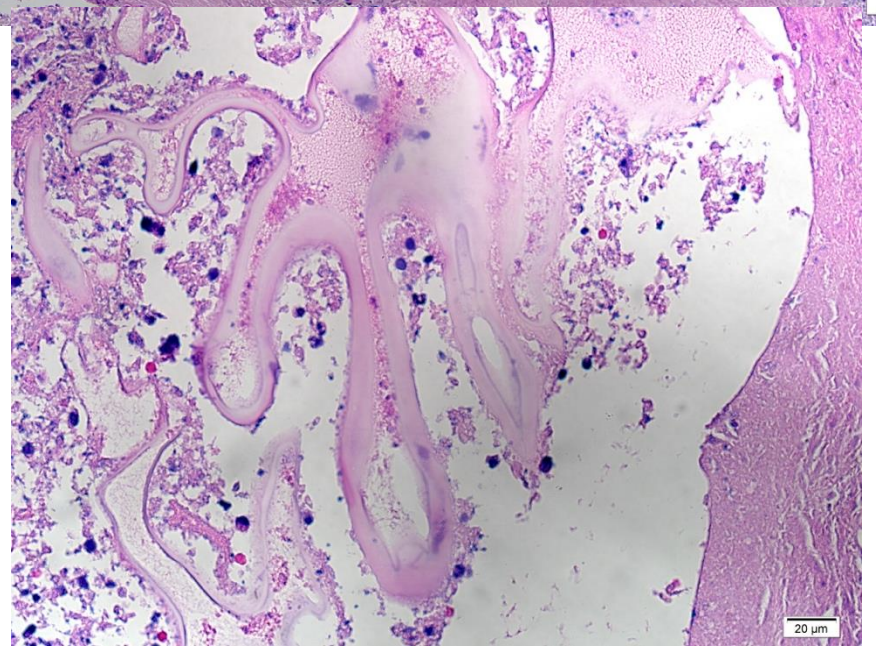
Histology canine AE

Ddx: metacestodes of *Taenia* or *Versteria* spp.





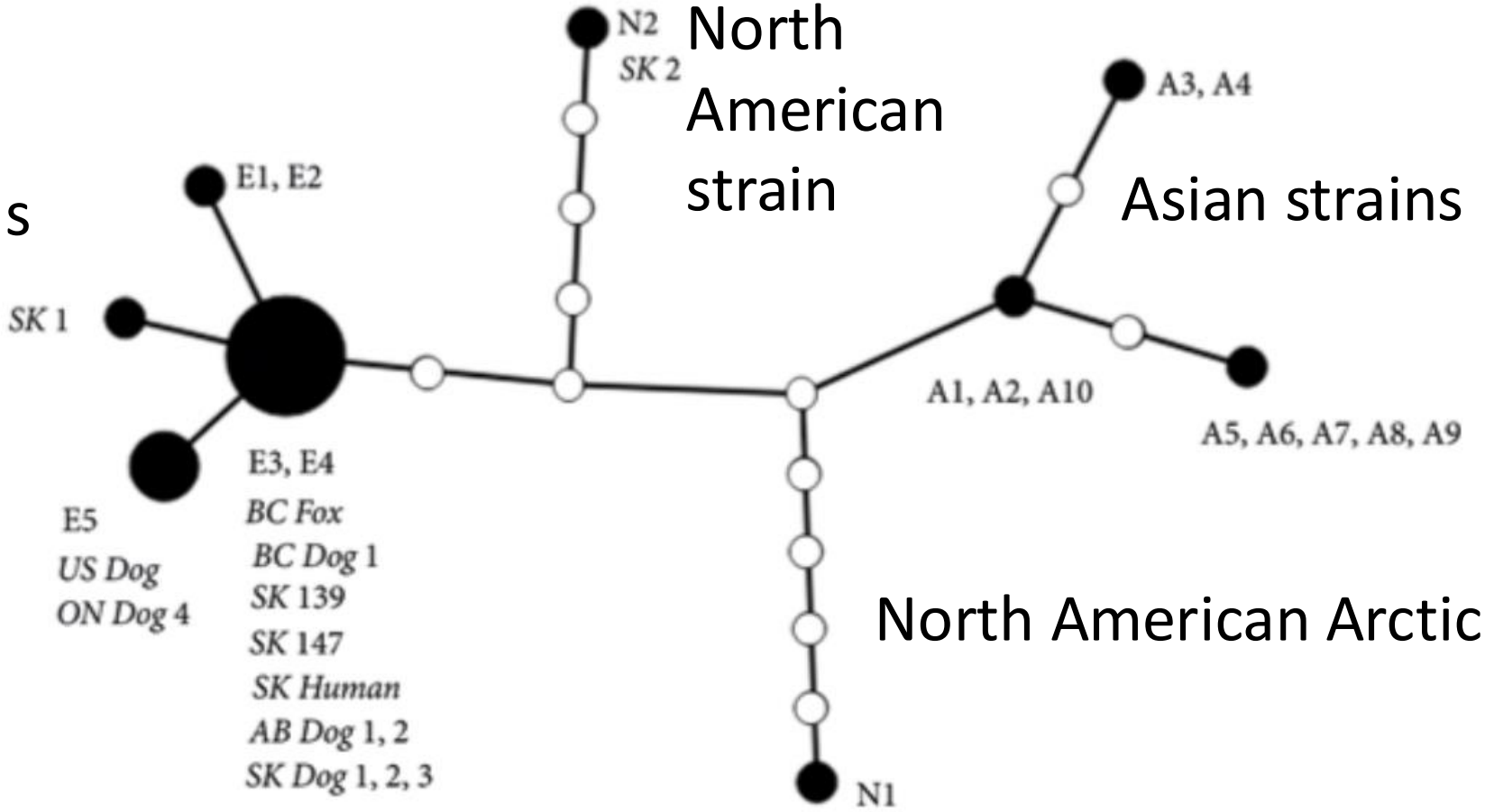




Molecular fingerprinting (haplotyping)

Central North American strain

European strains



Asian strains

Eastern Canada and USA

North American Arctic strain

Western Canada and USA

All canine AE typed so far are European strains with more zoonotic potential and pathogenicity…

Cases of canine AE track cases of human AE in western Canada: AB and SK

European *Echinococcus multilocularis* Identified in Patients in Canada

N ENGL J MED 381;4 NEJM.ORG JULY 25, 2019

The New England Journal of Medicine

Up to 40 human cases in Alberta

Molecular Evidence for Local Acquisition of Human Alveolar Echinococcosis in Saskatchewan, Canada

Janna M Schurer ✉, Polly Tsybina, Karen M Gesy, Temitope U Kolapo, Stuart Skinner, Janet E Hill, Emily J Jenkins

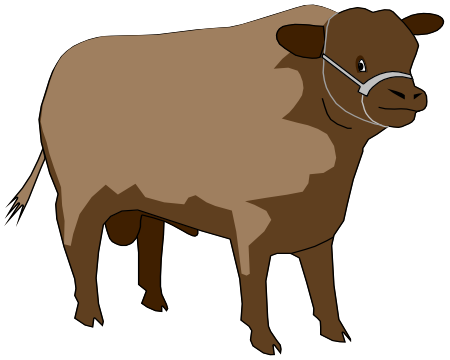
The Journal of Infectious Diseases, jiaa473,
https://doi.org/10.1093/infdis/jiaa473

At least 2-3 cases in Saskatchewan

AE in dogs was the early warning signal for human cases! New strains in town…

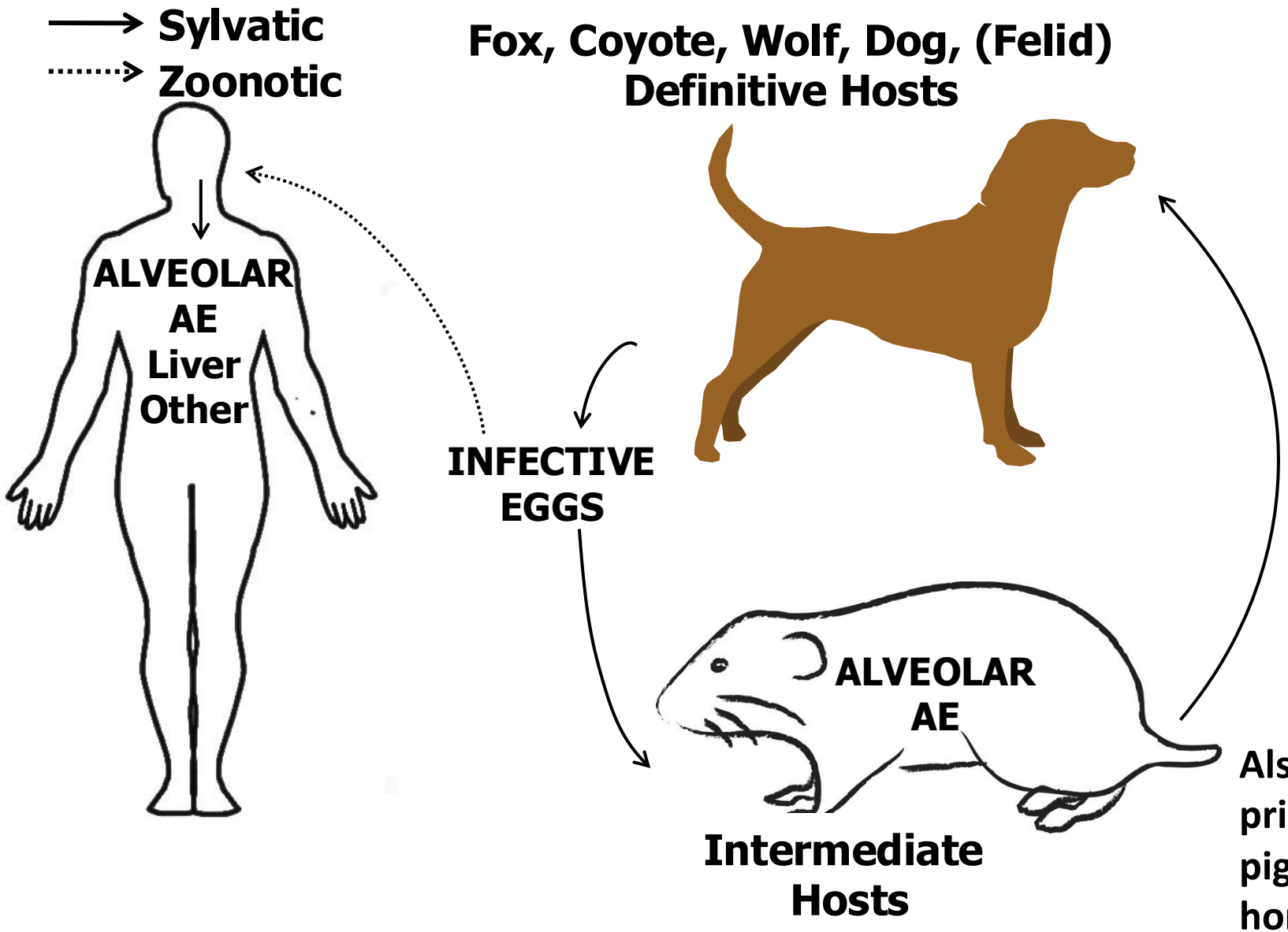
Management of
CANINE AE

- Collect fecal sample to determine if intestinal infection also present
- Treat with adult cestocide (initially)
  - i.e. praziquantel 5 mg/kg per os daily for 2 days
- Treat with larval cesto**static** drug (long-term/life-long)
  - i.e. albendazole 10 mg/kg per os daily with high fat meal for 2 years, or life
  - No labeled products in North America
  - Monitor blood for bone marrow toxicosis and elevated liver enzymes
- Surgical debulking/resection if clinically indicated
- Advise owner to consult health care provider
- Report to animal & public health authorities



https://www.cliniciansbrief.com/article/echinococcus-spp-tapeworms-dogs-cats.

Echinococcus multilocularis



What about dogs as definitive hosts with intestinal infections?

Highly underdiagnosed based on fecal flotation (30% sensitivity)

Increasingly diagnosed using sensitive PCR based methods

Intestinal infection with *Echinococcus multilocularis* in a dog

Alberta near border with Saskatchewan

Emily J. Jenkins PhD, DVM, Temitope U. Kolapo PhD, DVM, Maria P. Jarque MSc, DVM, Cecilia Ruschkowski DVM, and Caroline Frey DVM, DEVPC

View Less —

DOI: https://doi.org/10.2460/javma.23.02.0099

https://avmajournals.avma.org/view/journals/javma/261/9/javma.23.02.

Volume/Issue: Online Early Online Publication Date: 12 May 2023

Novel molecular diagnostic (PCR) diagnosis and outcome of intestinal *Echinococcus multilocularis* in a dog from western Canada

Kelowna region of British Columbia (BC)

Michelle D. Evason DVM, BSc, DACVIM, Emily J. Jenkins PhD, DVM, BScHon, Temitope U. Kolapo PhD, MSc

View More +

DOI: https://doi.org/10.2460/javma.23.03.0179

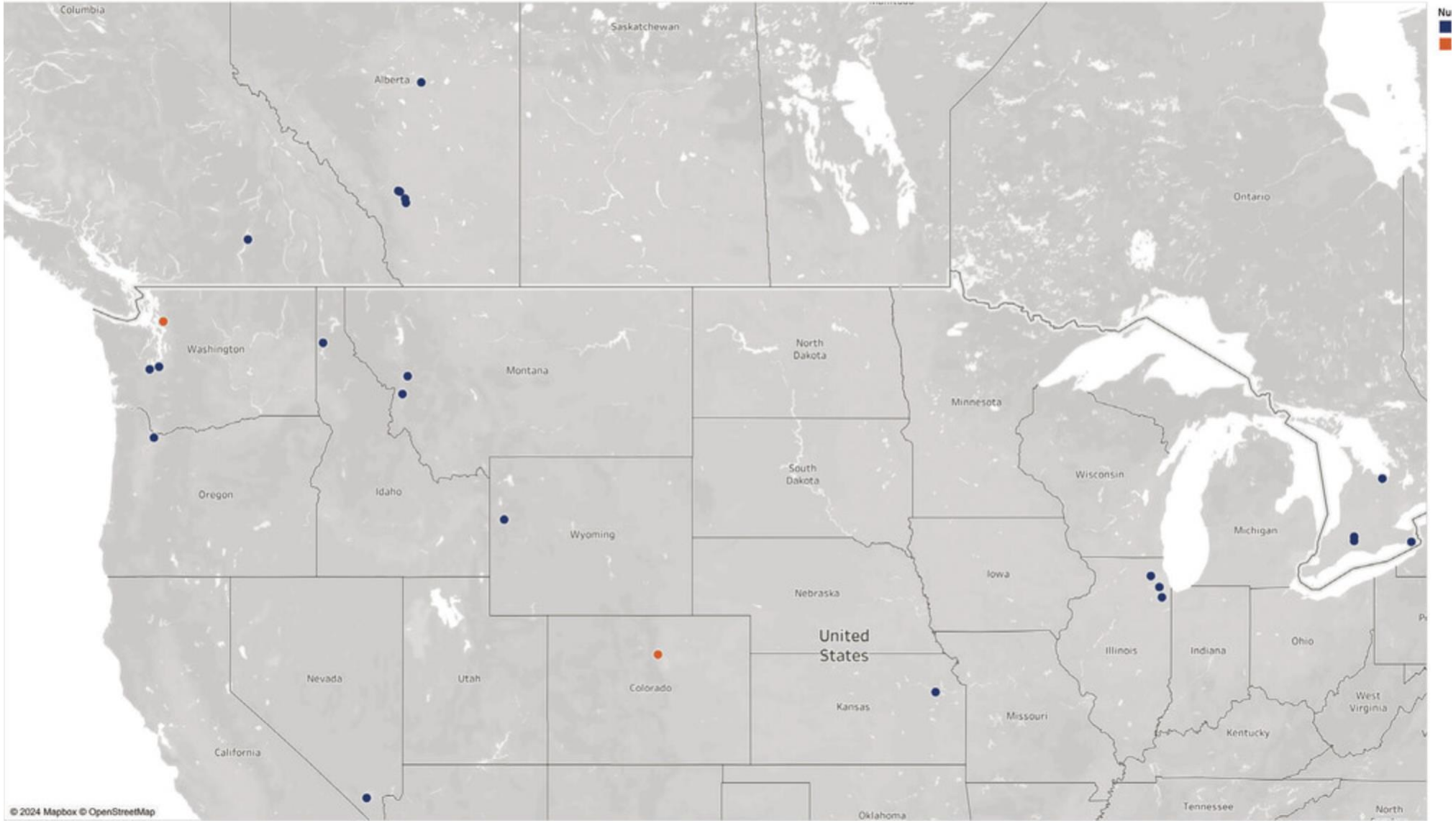
https://avmajournals.avma.org/view/journals/javma/261/9/javma.23.0

Volume/Issue: Volume 261: Issue 9 Online Publication Date: 23 May 2023

Emerging *Echinococcus* tapeworms: fecal PCR detection of *Echinococcus multilocularis* in 26 dogs from the United States and Canada (2022–2024)

Michelle D. Evason DVM, DACVIM ✉, Andrew S. Peregrine BVMS, PhD, DVM, DEVPC, DACVM, Emily J. Jenkins PhD, DVM, BScHon, Cecili...

View More +



Control and treatment of *Echinococcus multilocularis* in dogs as definitive hosts

- Control: prevent access to intermediate hosts (rodents)
- Goal of tx: halt environmental contamination with immediately infective, highly resistant eggs (public and animal health considerations)
- Eggs resistant to most chemicals (ethanol, formalin) and freezing at -20°C
- Killed by -80°C for 3-5 days; +60°C for <5 min; dryer on high for 20 min; 10% bleach for 20 min
- Several adult cestocides labeled for use (praziquantel)
- Administer monthly **for high risk dogs**

Live in or travel to endemic region?

YES

All of western Canada

NO

Does the dog eat cervid carcasses?

YES

Rx praziquantel within 4-6 wks of exposure

NO

Does the dog eat wild rodents?

YES

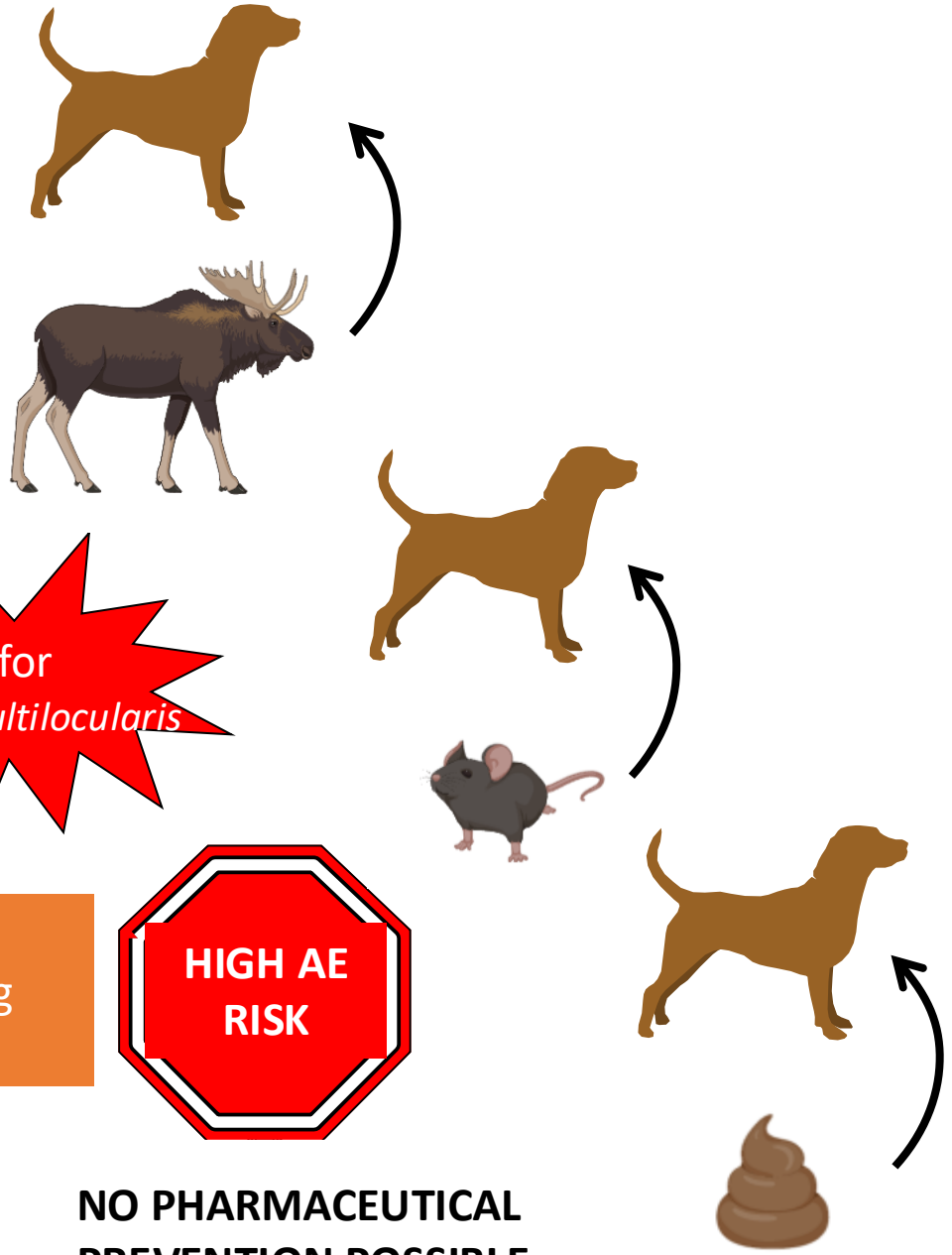
Rx praziquantel monthly, year round

NO

Does dog eat coyote/fox/wolf/dog poop?

Risk for *E. canadensis*

Risk for *E. multilocularis*



HIGH AE RISK

NO PHARMACEUTICAL PREVENTION POSSIBLE

Adult cestocides (PZ) have no activity against AE

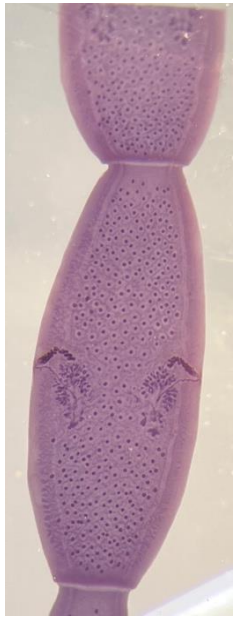
Prophylactic treatment with larval cestostatic drug (ABZ) is not recommended

PROVINCIALLY REPORTABLE DISEASE

- Jan 2018: *E. multilocularis* reportable in **animals** in Ontario (R.R.O. 1990, Reg. 557).
- July 2018: *E. multilocularis* in people in Ontario notifiable to public health (Ontario Regulation 135/18).
- Jan/Apr 2018: *E. multilocularis* in people notifiable to public health in Alberta (https://open.alberta.ca/publications/echinococcosis#summary)
- Feb 2023: Provincially notifiable in **animals** in Québec, notify MELCCFP
- https://cdn-contenu.quebec.ca/cdn-contenu/adm/min/agriculture-pecheries-alimentation/sante-animale/maladies-animales/maladies-a-declarer/FI_avis_maladies-a-declarer-veterinaires_anglais_MAPAQ.pdf
- Annually notifiable by labs to Canadian Food Inspection Agency (presence/absence)

Flea Tapeworm

Dipylidium caninum



Lives in small intestine of dogs and cats

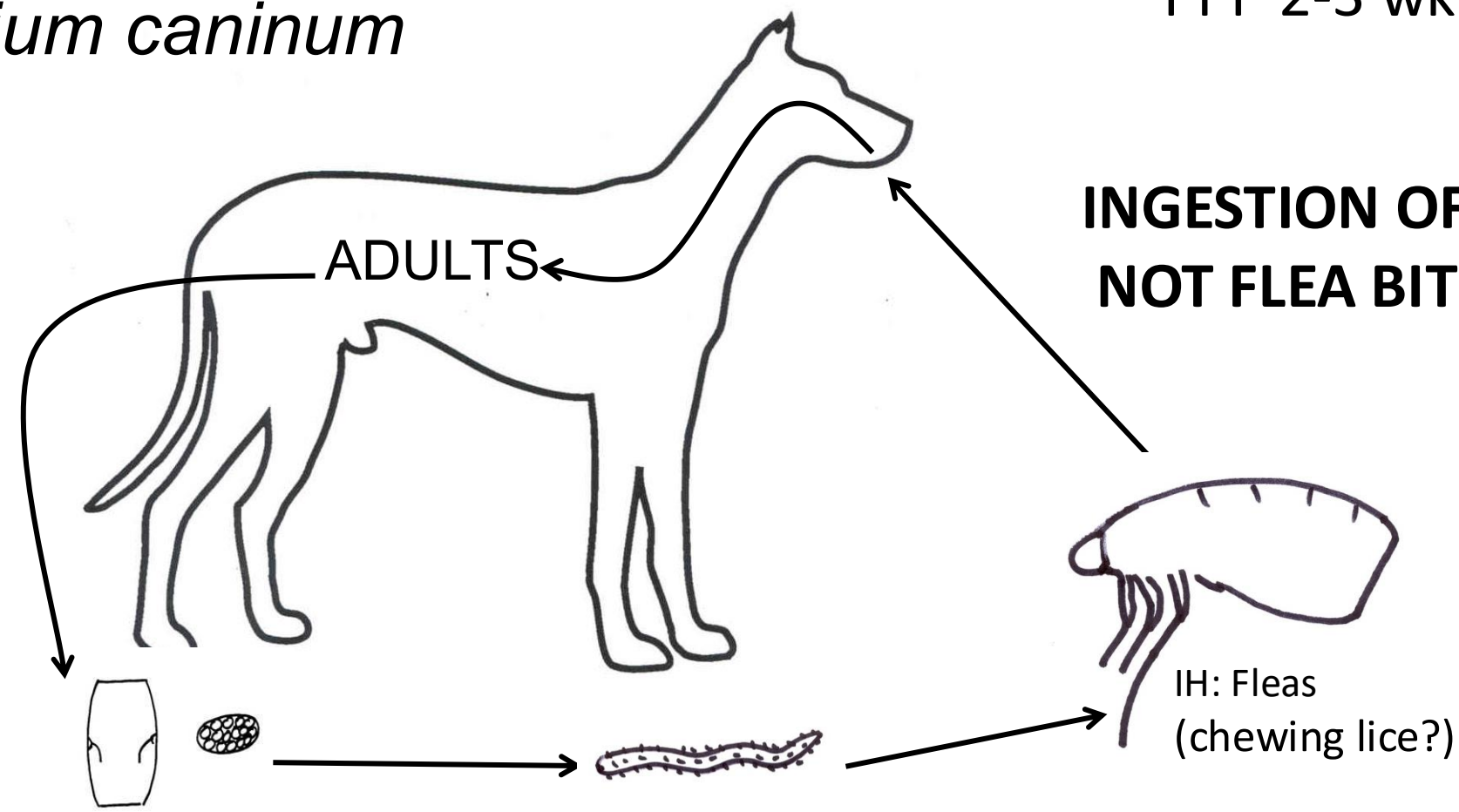
Recent molecular evidence shows specialized dog and cat strains, but cross infection possible

Comparative Genomic Analysis and Species Delimitation: A Case for Two Species in the Zoonotic Cestode *Dipylidium caninum*

by Jeba R. J. Jesudoss Chelladurai [1,*], Aloysius Abraham [2], Theresa A. Quintana [1], Deb Ritchie [1] and Vicki Smith [1]

LIFE CYCLE
Dipylidium caninum

PPP 2-3 wk



GRAVID SEGMENTS AND EGG PACKETS

FLEA LARVA WITH CYSTICERCOID

FLEA INTERMEDIATE HOST WITH CYSTICERCOID

Dipylidium caninum: Egg Packets

YOU WILL ALMOST NEVER SEE THESE!

Diagnosis and Control of *Dipylidium*

- Diagnosis based on detection of egg packets (☹) or segments in feces (most likely)
- Flea control imperative; treatment ”failures” often flea-related
- Several cestocides labeled for dogs and cats
- Treat all pets in household
- **Use only if segments are observed or antigen/PCR positive**
  - Not routinely
  - And this is why:

Am. J. Trop. Med. Hyg., 00(0), 2018, pp. 1–5
doi:10.4269/ajtmh.18-0533

Praziquantel Resistance in the Zoonotic Cestode *Dipylidium caninum*

Jeba Jesudoss Chelladurai,[1] Tsegabirhan Kifleyohannes,[2] Janelle Scott,[3] and Matthew T. Brewer[1]*

Should we be worried
ABOUT RESISTANCE TO PZ?

- Cestodes in general are slow mutators – can self fertilize (hermaphroditic), reproduce asexually (clones), and have low genetic diversity
- Reports of acquired resistance in *Dipylidium caninum* (flea tapeworm) in dogs, and innate resistance of *Dibothriocephalus latum* (fish tapeworm)
- Both of these tapeworms are metre(s) long, ribbon-like, fleshy tapeworms
- *Dipylidium caninum* is under intense selection pressure due to perceived treatment failures, poor flea control, and high visibility of fleas and segments
- *Echinococcus* spp. tapeworms are < 1 cm long, primarily reservoired in untreated wildlife (refugia), and remain sensitive to praziquantel at label doses even in Europe (long-standing use against *E. multilocularis*)
- Best practice – a **RISK** based approach to use of adult cestocides

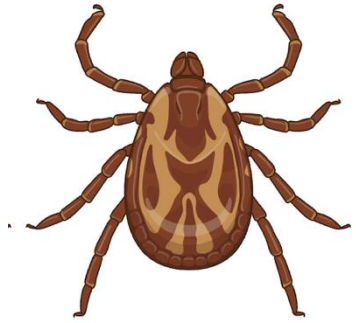
QUESTION TIME

Finished the poop part

On to the blood suckers!

Dermacentor andersoni

Rocky Mountain Wood Tick



3 host tick

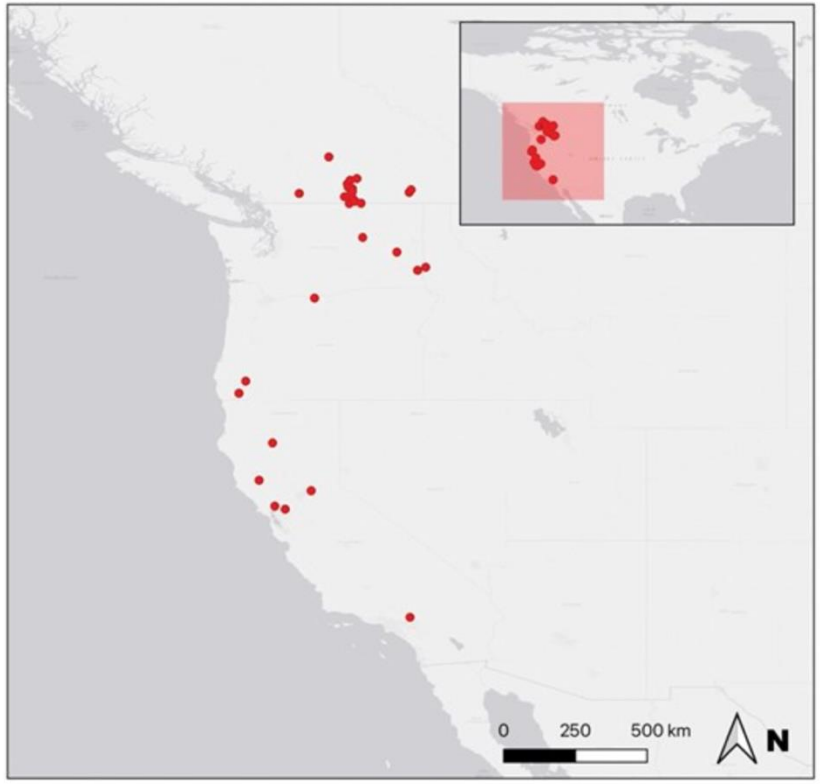
Rocky Mountain Spotted Fever (rickettsia)
Tularemia (bacteria)
Colorado Tick Fever (virus)
*TICK PARALYSIS in interior BC (toxin, not pathogen)

Dominant tick in BC and AB
Pathogen prevalence in western Canada very low

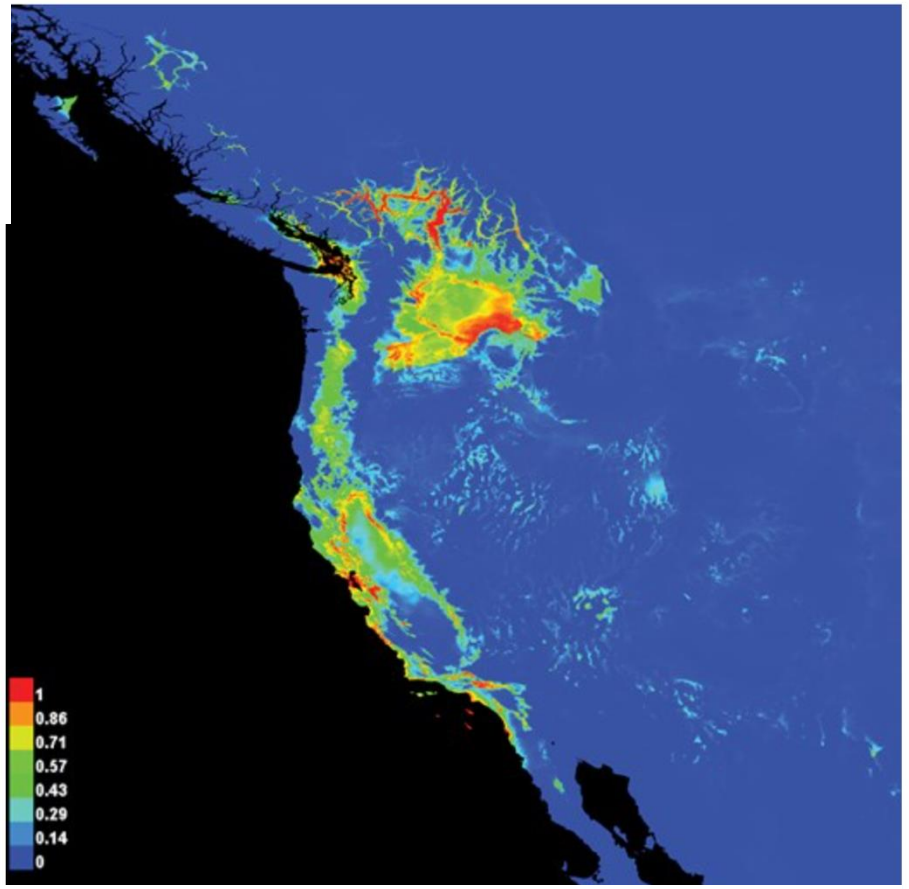
Dermacentor species (Acari: Ixodidae) in western Canada, with detection of *Dermacentor similis*

Grace K Nichol ✉, Paula Lado, Louwrens P Snyman, Shaun J Dergousoff, J Scott Weese, Amy L Greer, Katie M Clow

Journal of Medical Entomology, Volume 62, Issue 1, January 2025, Pages 123–129, https://doi.org/10.1093/jme/tjae133



Dermacentor similis

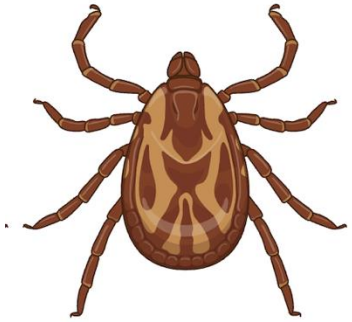


Current and future ecological niche of *Dermacentor similis* Lado (Acari: Ixodidae) in western North America

Grace K Nichol ✉, Manisha A Kulkarni, Shaun J Dergousoff, J Scott Weese, Amy L Greer, Katie M Clow

Dermacentor similis

Western (American) Dog Tick

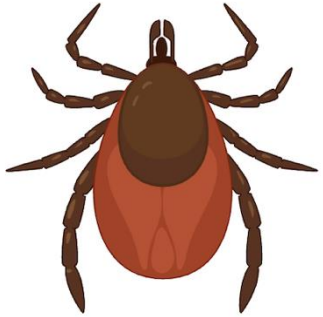


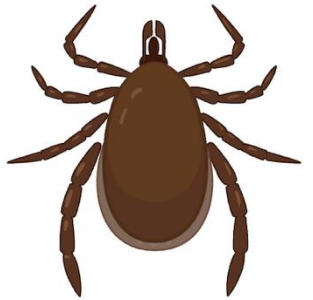
3 host tick

Rocky Mountain Spotted Fever (rickettsia)?
Tularemia (bacterium)?
Ehrlichia (rickettsia)?

Newly discovered lookalike of *D. variabilis* in southern BC

Ixodes pacificus
Western Black legged ticks
3 host ticks





Anaplasma phagocytophilum
Borrelia burgdorferi (Lyme disease)
Borrelia miyamotoi (relapsing fever)
Babesia microti
Powassan virus

Note that there are many other species of *Ixodes* on wildlife

HARD TICKS – IXODIDAE

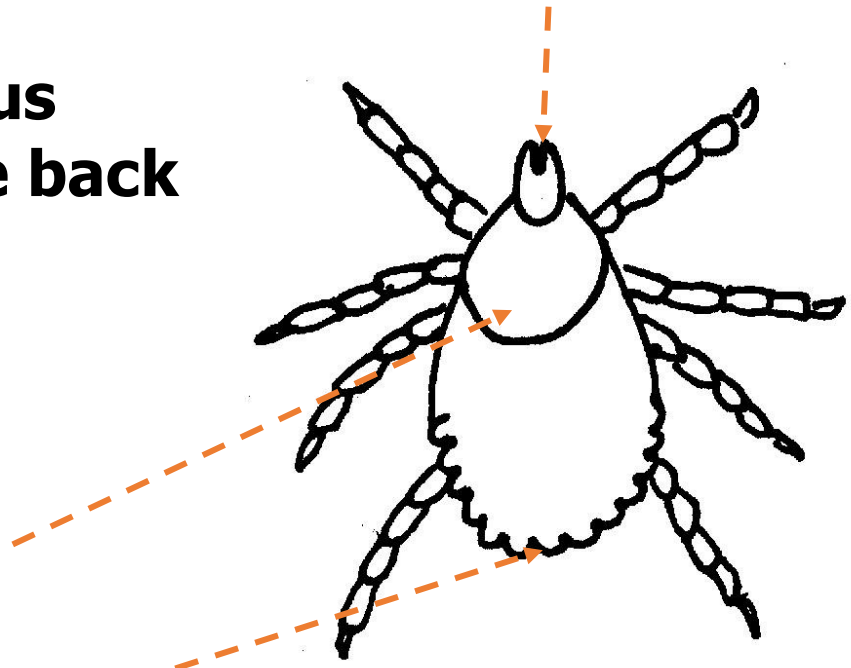
Vary in shape and size of mouthparts

Capitulum

Sexual dimorphism obvious
Males: scutum over whole back
Females: anterior scutum

Scutum may be ornate

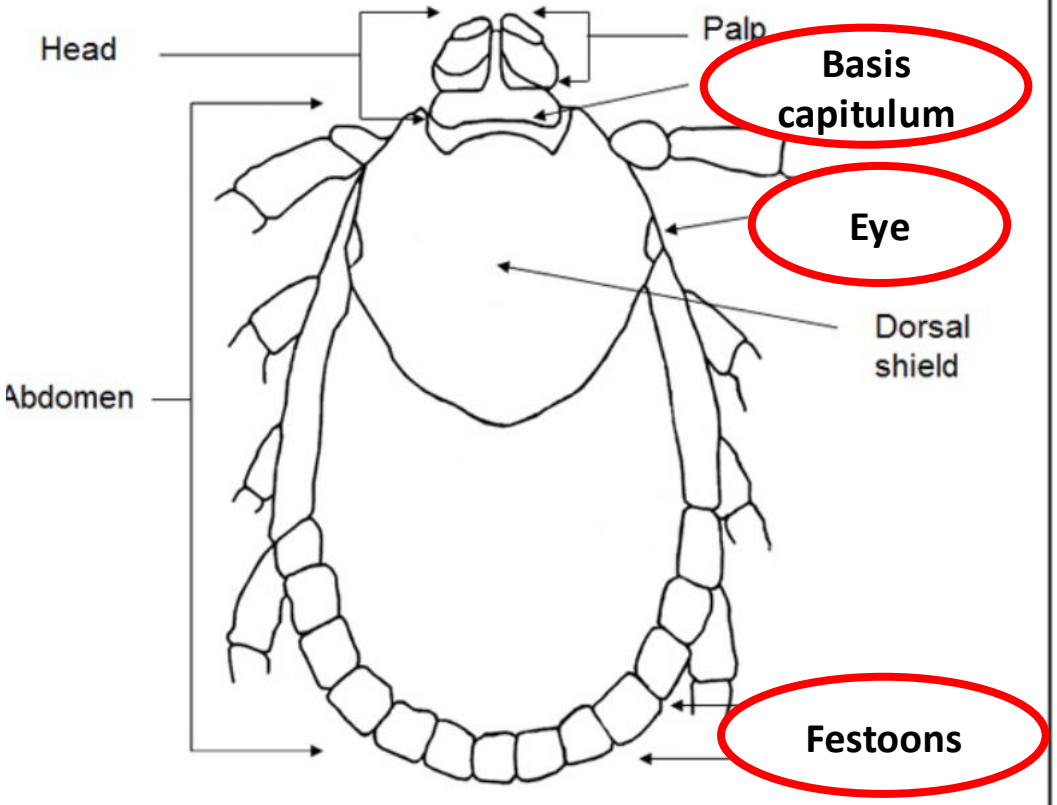
Festoons may be present



DORSAL VIEW OF FEMALE TICK

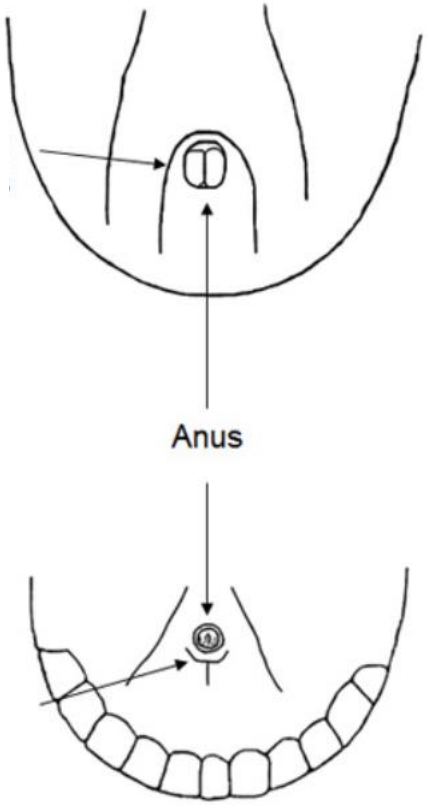
Diagnostically useful tick anatomy

DORSAL

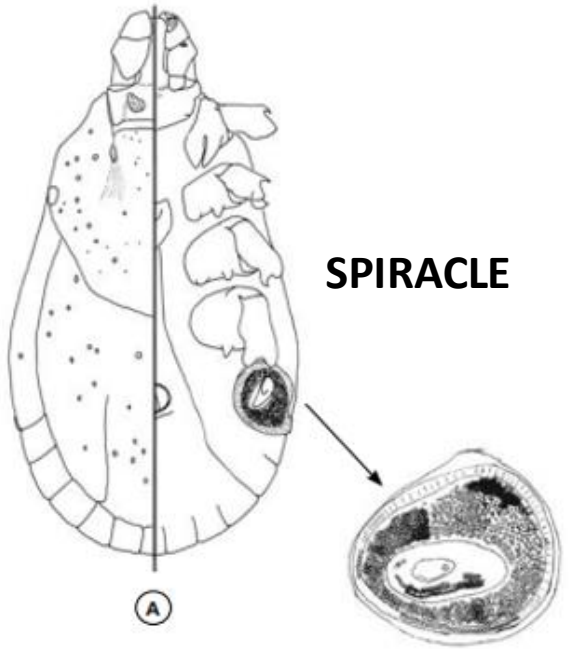


VENTRAL

Anal groove ANTERIOR to anus



Anal groove POSTERIOR to anus



SPIRACLE

Shape
Number & size of goblet cells

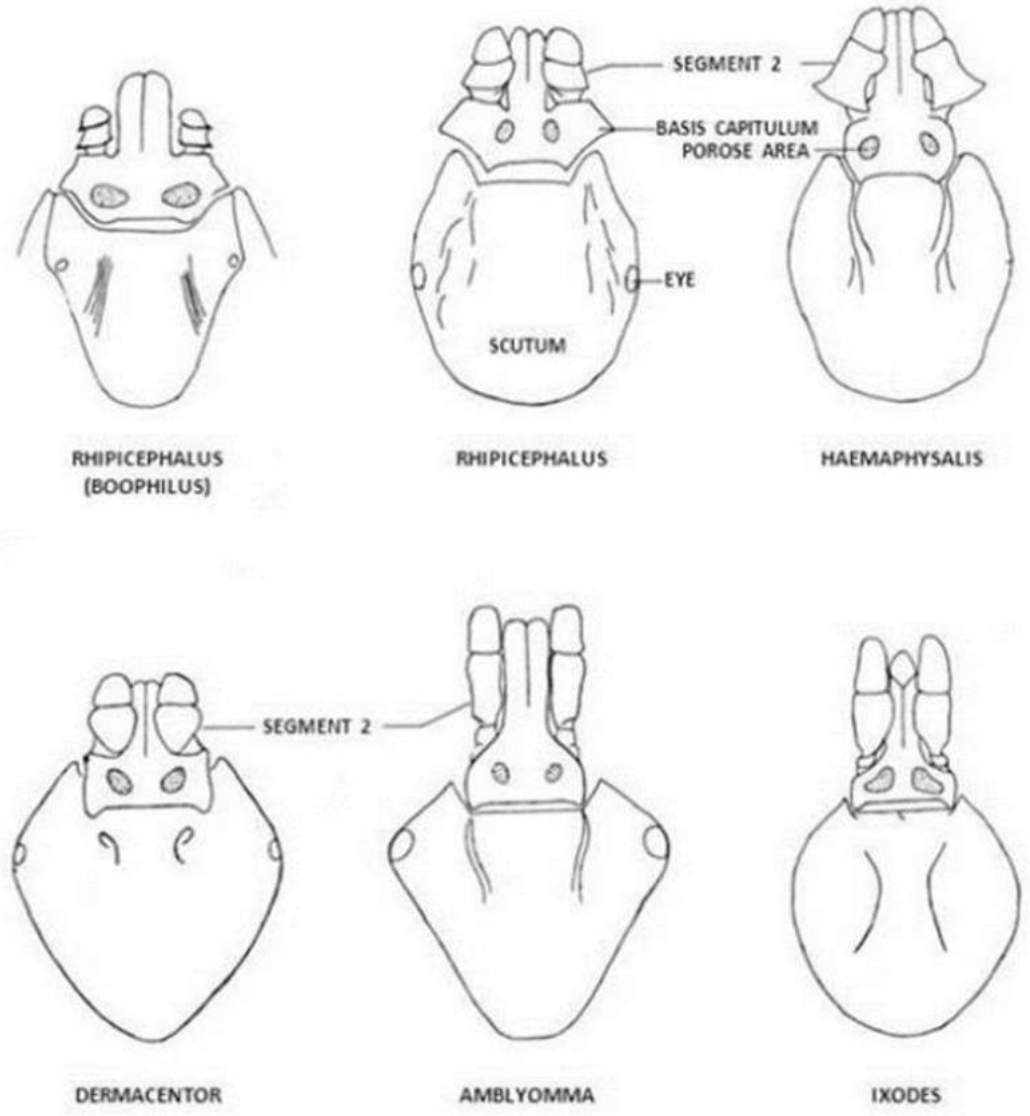
https://www.inspq.qc.ca/en/it-tick

https://biologicalsurvey.ca/public/Bsc/Controller/Page/AGR-001-Ticks-Monograph.pdf

Shape of scutum of female tick

Length and shape of capitulum

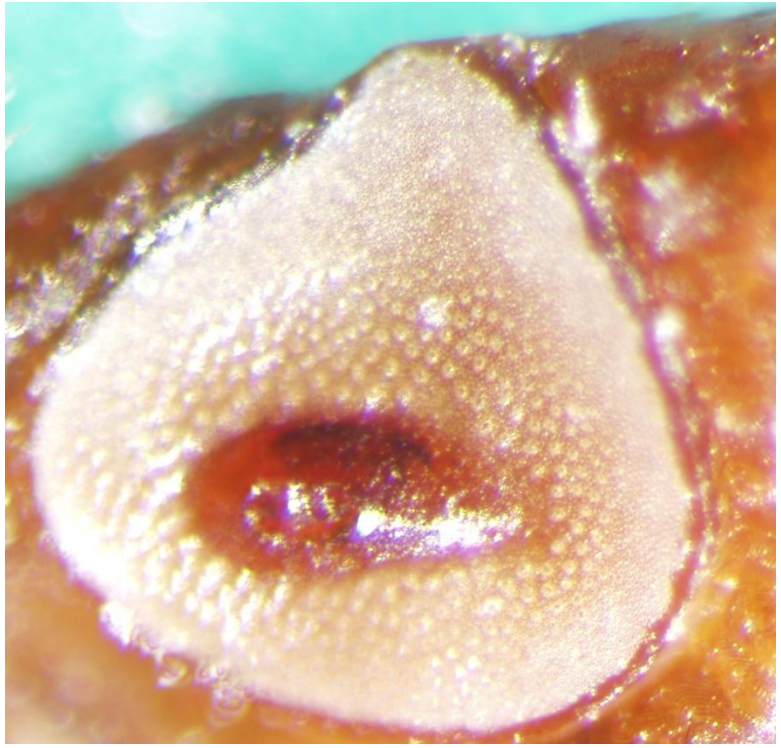
Shape of basis capitulum



Used by permission, USDA APHIS, Agriculture Handbook No. 485.

Dermacentor spp.

Spiracles

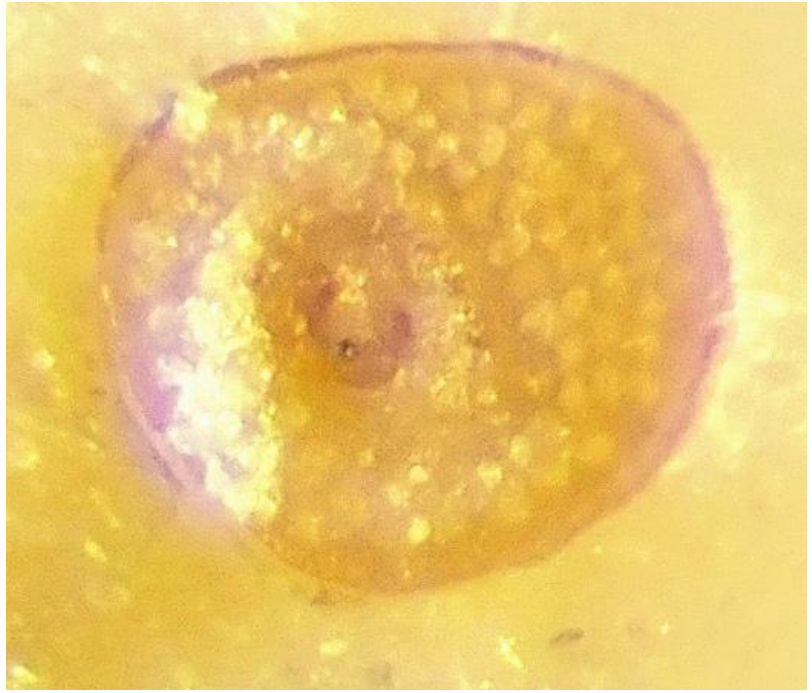


Dermacentor variabilis

Pear shaped,
many fine goblet cells

Dermacentor andersoni

Tear drop shaped,
fewer, larger goblet cells



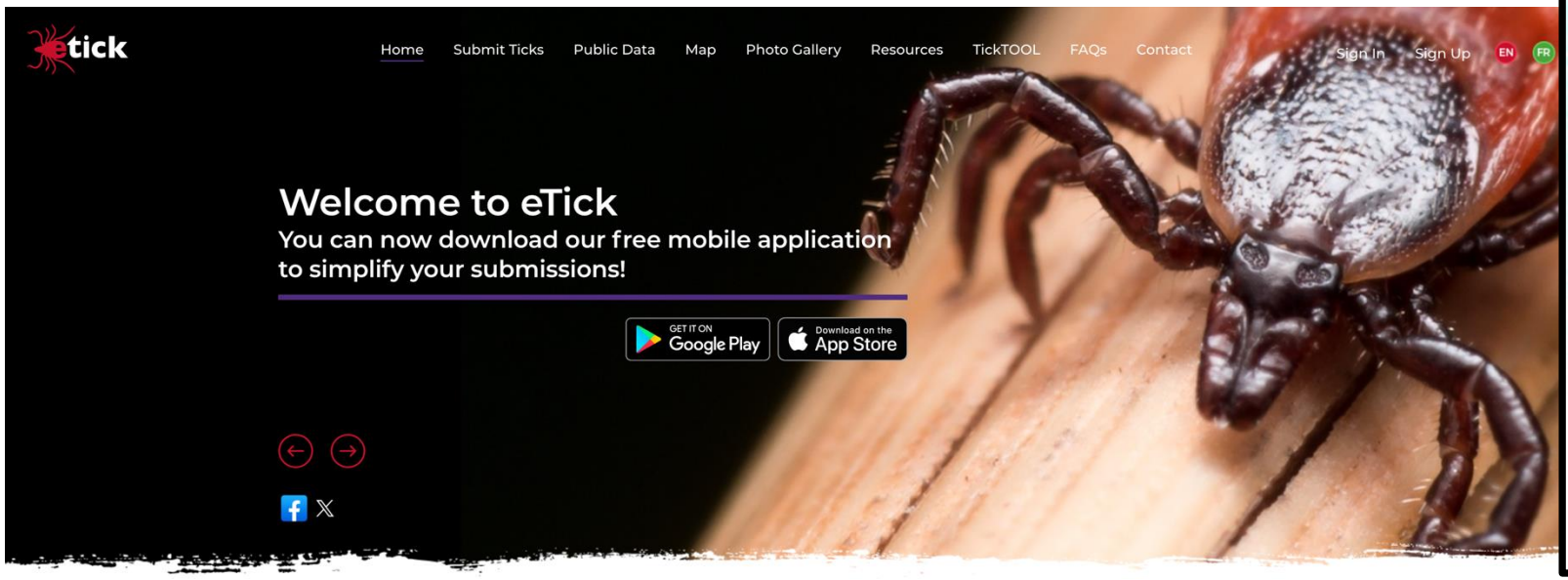
Dermacentor albipictus

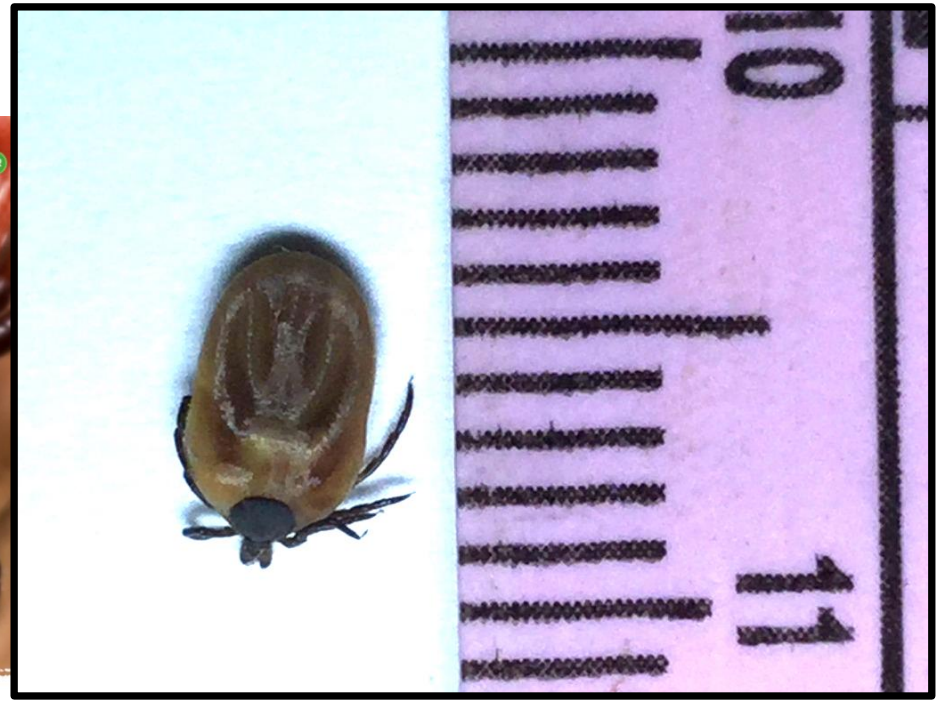
Circular,
few, large goblet cells

Let’s practice!

Checklist

- Location and season
- Sex: male or female?
- Fed status? Partially or fully engorged?
- Stage: Size? larvae (6 legs), nymph (8 legs, smaller, no genital pore), or adult (genital pore present)
- Scutum: ornate? Splatter or dot? Shape for female? Eyes?
- Festoons?
- Capitulum: long, parallel mouthpart or short, angled mouthparts
- Basis capitulum: rectangular or hexagonal?
- Anal groove: anterior or posterior to anus?
- Major health concerns: Paralysis? Vector borne diseases? Allergies?





- Since 2018, 85,000 ticks identified, most submitted by the public
- Users receive tailored information identifying species of the tick they encountered within 2 business days
- Users make rapid informed decisions, see maps and numbers for their area
- Passive surveillance to detect shifts in endemic and foreign ticks

BC contribution to eTick surveillance

Figure 7. Cumulative number of valid submissions made in each province and territory on the eTick platform since 2017. Provinces and territories are listed in increasing order based on cumulative valid submissions.

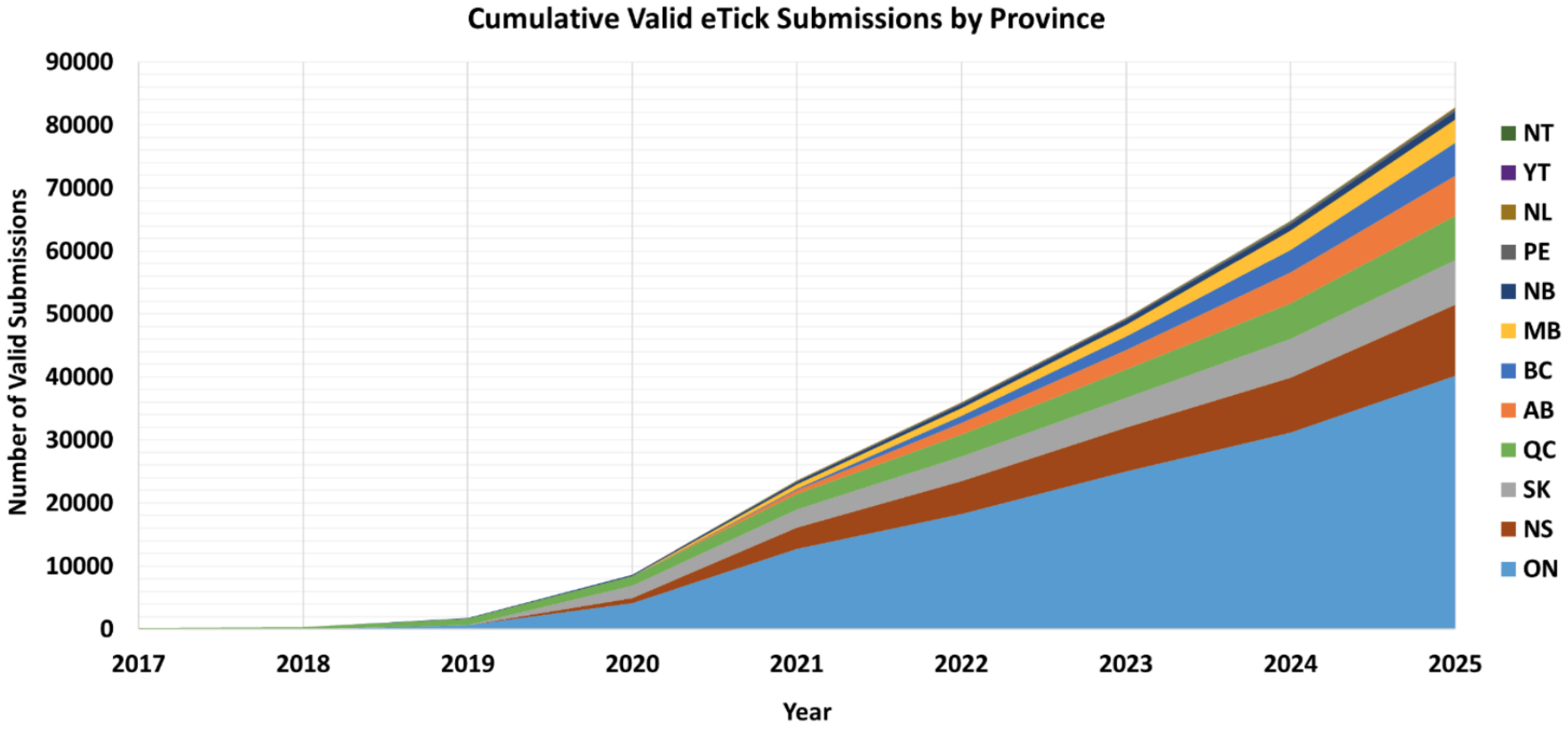


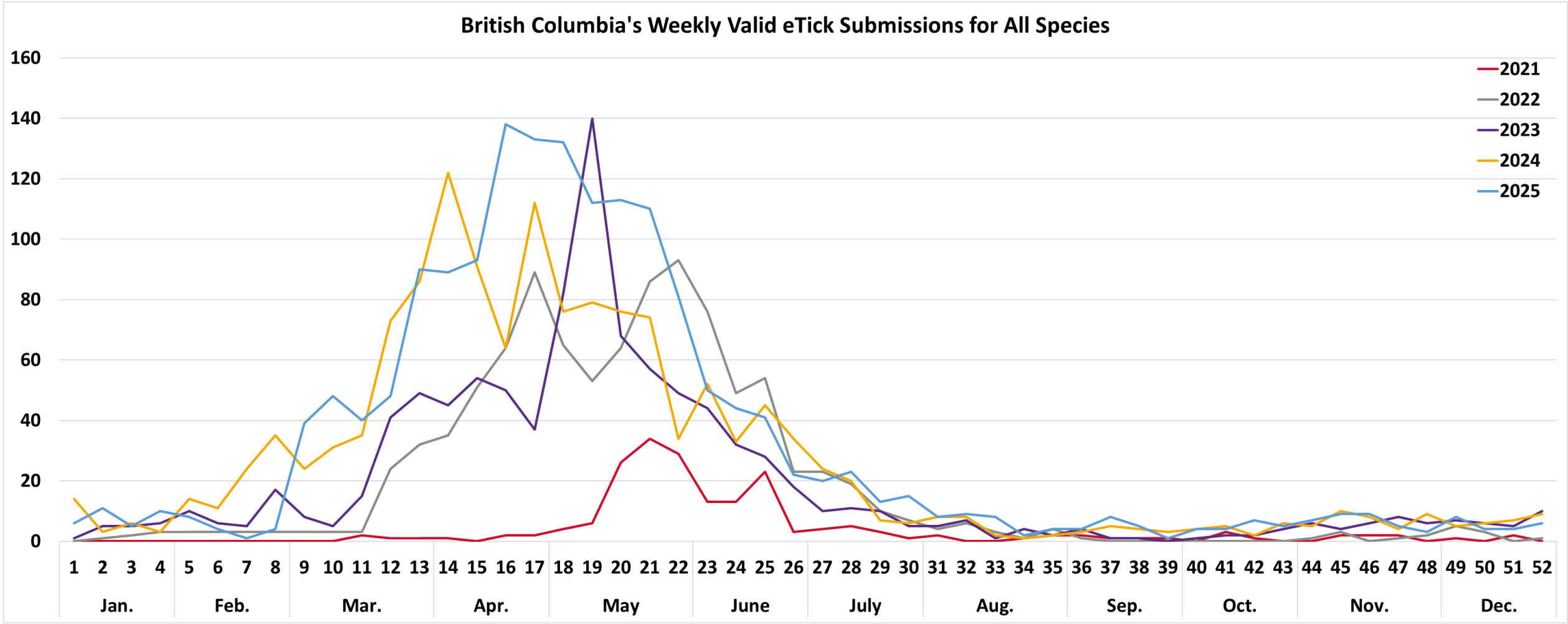
Table 4. eTick submission breakdown by self-reported profession for each participating province and territory's residents in 2025. Submissions lacking an answer to the profession question were excluded from this table.

	Total			AB			BC		
	#	%	% Valid	#	%	% Valid	#	%	% Valid
Members of the Public	21620	89.0	73.9	1287	67.2	74.9	1676	79.4	74.8
Veterinarians	1235	5.1	85.7	532	27.8	89.5	320	15.2	89.1
Health Professionals	843	3.5	75.2	51	2.7	82.4	85	4.0	69.4
Other/Prefer not to Answer	585	2.4	66.7	44	2.3	68.2	29	1.4	58.6
Total	24283			1914			2110		

Table 9. Valid eTick submissions by host type in British Columbia for 2021-2025.

Host (Valid)	2021	2022	2023	2024	2025	Total
On an animal	57	313	471	657	618	2116
On a human	115	513	397	617	927	2569
Free in the environment	24	153	137	151	122	587

Annual variation in tick encounters in BC based on eTick data 2021-25



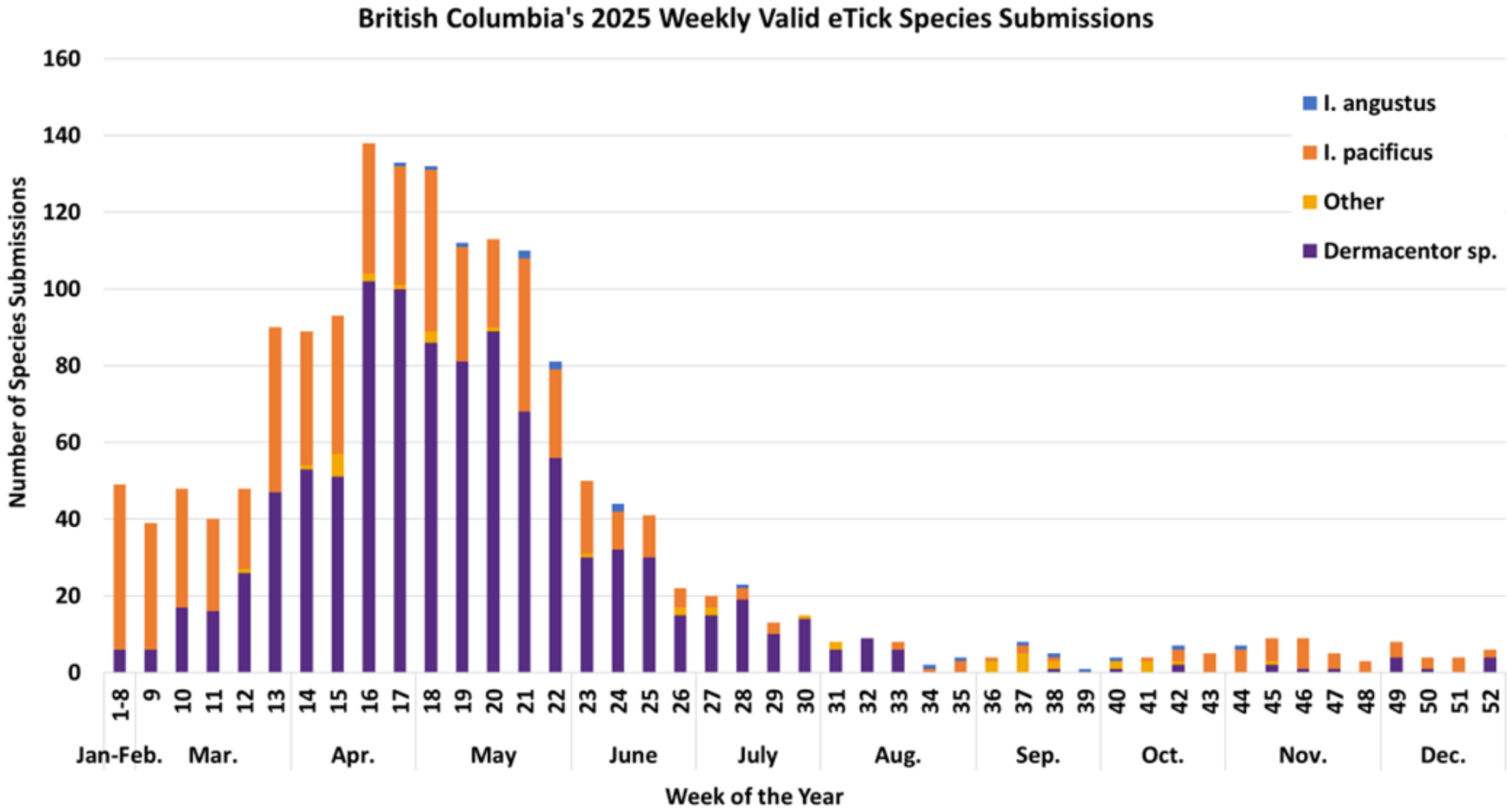
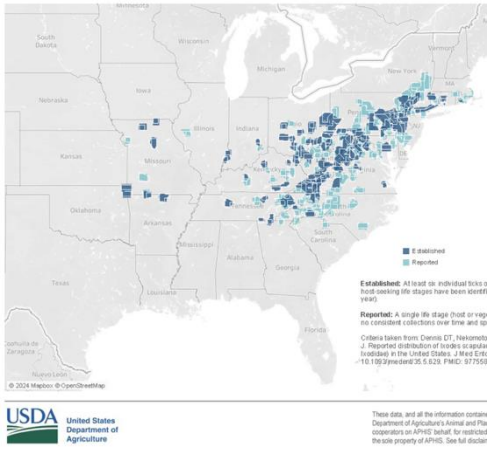

British Columbia's 2025 Weekly Valid eTick Species Submissions
Number of Species Submissions
160
140
120
100
80
60
40
20
0
I. angustus
I. pacificus
Other
Dermacentor sp.
1-8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
Jan-Feb.
Mar.
Apr.
May
June
July
Aug.
Sep.
Oct.
Nov.
Dec.
Week of the Year

Table 8. eTick submissions in British Columbia for 2021-2025.

Species	2021	2022	2023	2024	2025	Total
Dermacentor sp.	103	680	525	832	1007	3147
I. scapularis	0	0	1	0	6	7
I. kingi	0	0	0	1	0	1
I. pacificus	80	258	437	507	602	1884
I. angustus	7	9	22	34	18	90
I. rugosus	0	0	1	0	0	1
I. auritulus	1	0	3	14	16	34
I. hearlei	1	0	0	0	0	1
I. spinipalpis	3	29	13	33	13	91
A. maculatum	0	1	0	0	0	1
R. sanguineus	1	1	3	2	5	12
H. leporispalustris	0	0	0	1	0	1
O. megnini	0	1	0	1	0	2

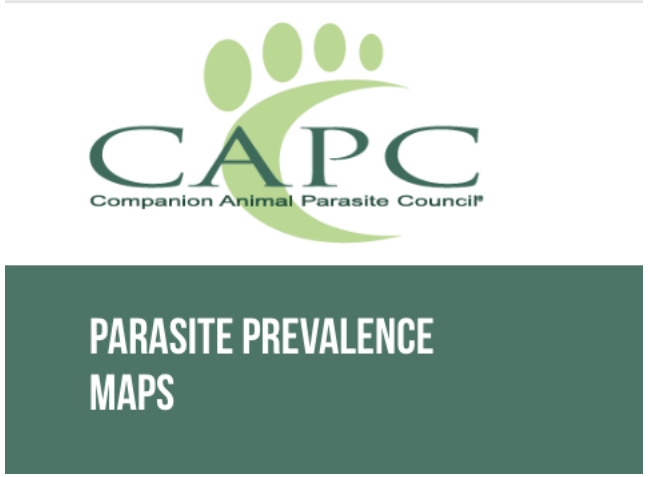
Ticks and TBDz not established in Canada

- *Rhipicephalus sanguineus* (brown dog tick)
  - *Rickettsia ricketsii, Ehrlichia*
- *Amblyomma americanum* (Lone Star Tick)
  - *Cytauxzoon, Ehrlichia*
- *Amblyomma maculatum* (Gulf coast tick)
  - *Hepatozoon*
- *Haemaphysalis longicornis* (Long horned tick)
  - *Theileria orientalis*



Maps from
https://www.cdc.gov/ticks/about/where-ticks-live.html
https://www.aphis.usda.gov/livestock-poultry-disease/cattle/ticks/asian-longhorned

Tick (*Ixodes*!) borne disease testing in dogs



https://capcvet.org/maps/#/

- Serology for antibodies to *Borrelia burgdorferi, Anaplasma phagocytophilum, A. platys, Ehrlichia canis, E. ewingii* (often with antigen test for heartworm, *Dirofilaria immitis*)
- Data from participating clinics and diagnostic laboratory services (Idexx, Antech, and Zoetis)
- Do not consider travel history of dog
- Do not consider motivation for testing
- Results reflect place of testing, not location of exposure!

Provincial differences in % positive dogs for *Ixodes* tick borne diseases, CAPC data 2020-25

Province	*Borrelia*	*Anaplasma*	*Ehrlichia*
BC	0.6%	3.5%	5.1%
AB	0.9%	1.9%	3.1%
SK	1.3%	2.2%	0.3%
MB	3.5%	2.9%	0.3%
Western Canada	2.8%	2.9%	1.3%
Canada	4.0%	1.9%	0.9%

Changes over time (CAPC, 2014-19 & 20-25)

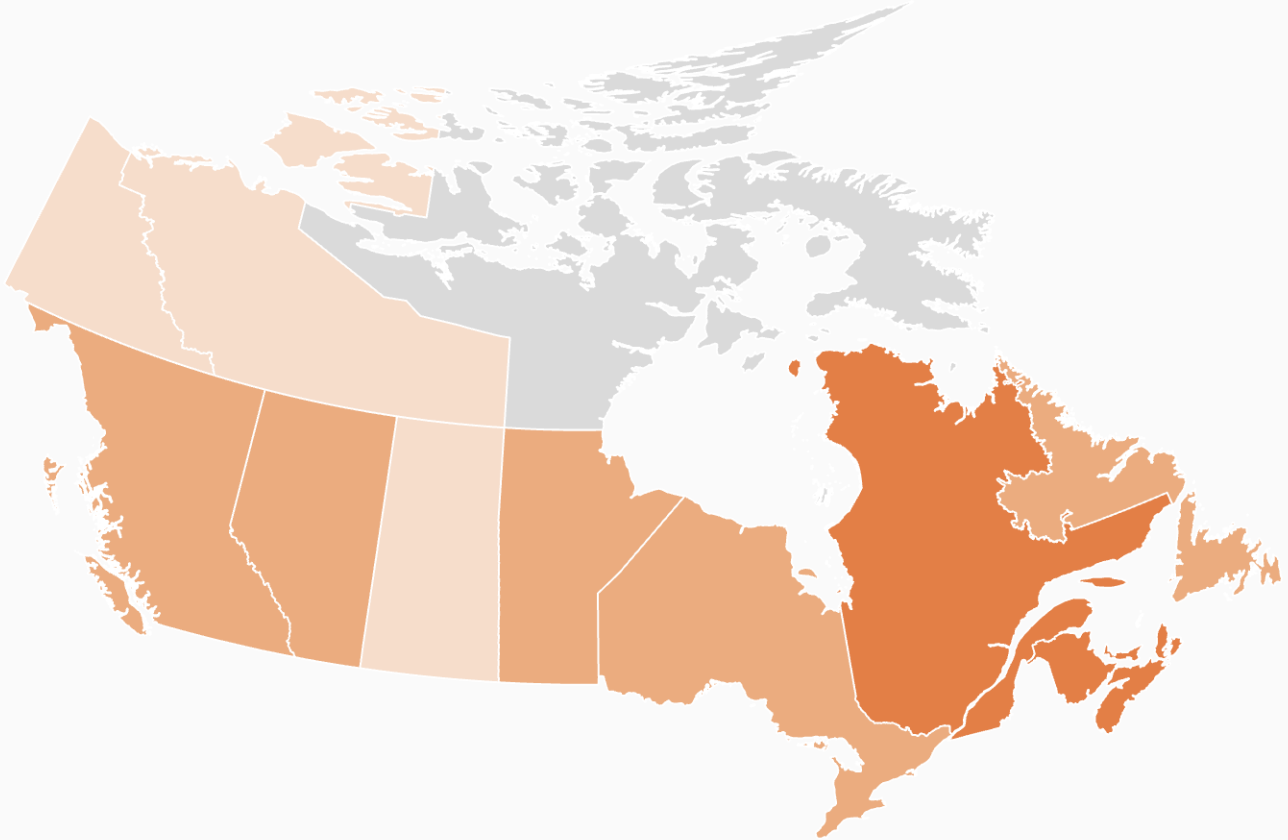
	Borrelia		*Anaplasma*		*Ehrlichia*	
	2014-19	2020-25	2014-19	2020-25	2014-19	2020-25
BC	0.3%	0.6%	1.7%	3.5%	4.1%	5.1%
W. Canada	3.1%	2.8%	1.2%	2.9%	0.6%	1.3%
Canada	3.0%	4.0%	0.5%	1.9%	0.7%	0.9%

Testing in BC has increased from 1740 tests 2014-19, to 29,766 tests 2020-25
Prevalence of Lyme in BC has doubled, but remains low relative to rest of Canada
Prevalence of *Anaplasma* has doubled in BC and increasing overall
BC (and Alberta) have weirdly high prevalence of *Ehrlichia*

TICK BORNE DISEASE AGENTS | LYME DISEASE | DOG | 2025 | ALL YEAR

CLICK ON A REGION TO VIEW PREVALENCE DATA

SWITCH TO USA



INFECTION RISK

LOW HIGH

learn about map data

LYME DISEASE

CANADA

TESTED POSITIVE

1 in 20

5.14%

POSITIVE CASES

24,164

explain this data

TOTAL TESTED

469,858

explain this data

GET UPDATES

TICK BORNE DISEASE AGENTS | ANAPLASMOSIS | DOG | 2025 | ALL YEAR

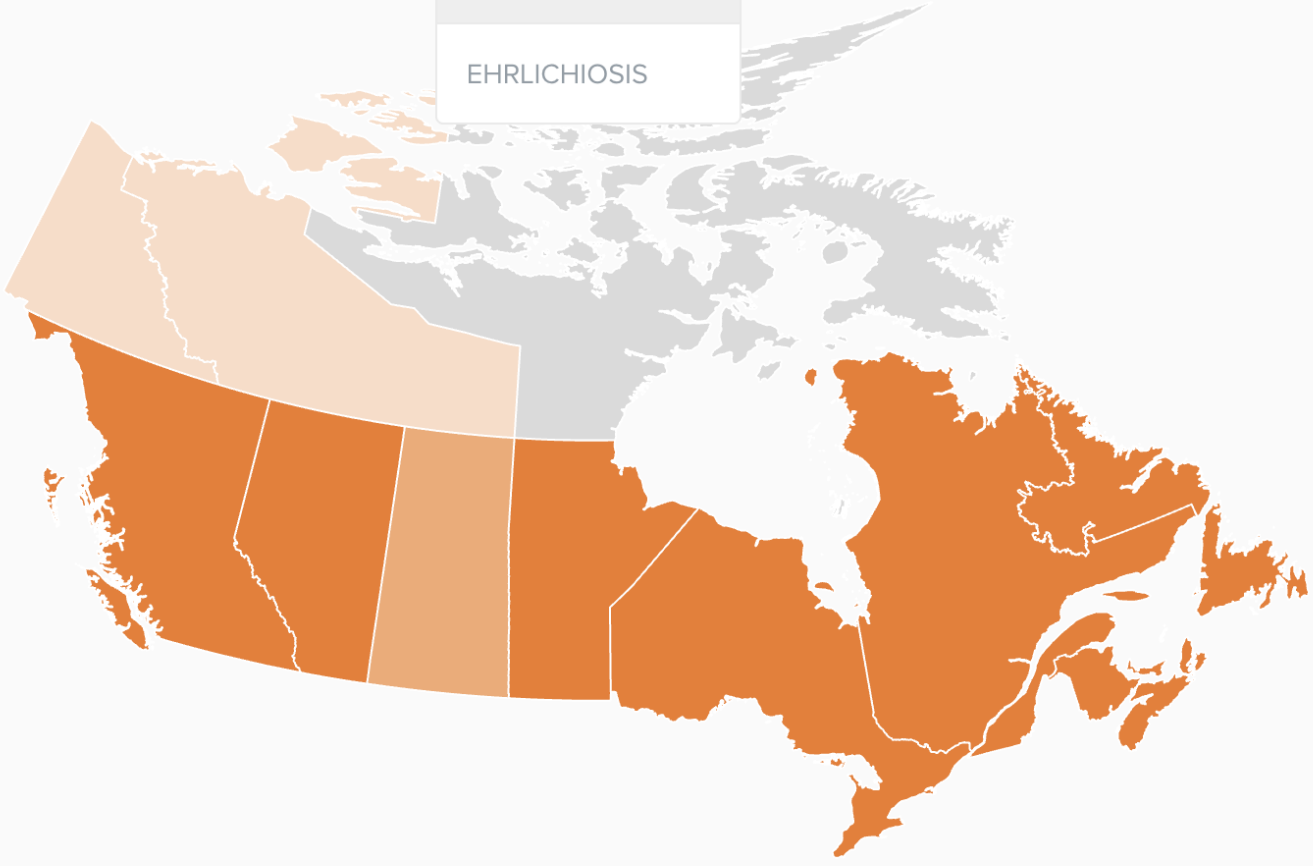
CLICK ON A REGION TO VIEW PREVALENCE DATA

LYME DISEASE

ANAPLASMOSIS

EHRLICHIOSIS

SWITCH TO USA



INFECTION RISK

LOW HIGH

learn about map data

ANAPLASMOSIS

CANADA

TESTED POSITIVE

1 in 30

3.33%

POSITIVE CASES

15,628

explain this data

TOTAL TESTED

469,851

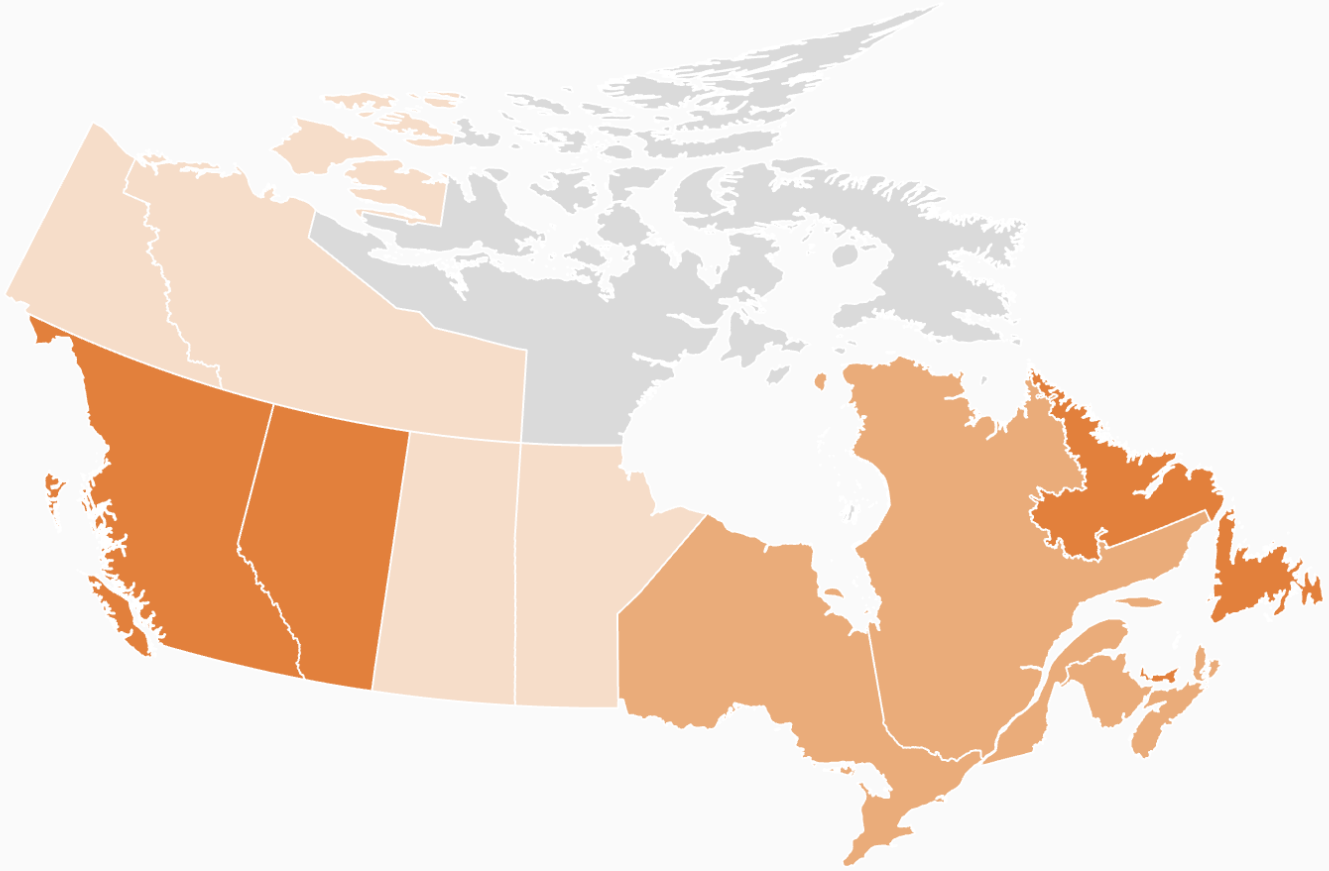
explain this data

GET UPDATES

TICK BORNE DISEASE AGENTS | EHRLICHIOSIS | DOG | 2025 | ALL YEAR

CLICK ON A REGION TO VIEW PREVALENCE DATA

SWITCH TO USA



INFECTION RISK

LOW HIGH

learn about map data

EHRLICHIOSIS

CANADA

TESTED POSITIVE

1 in 100

0.94%

POSITIVE CASES

4,396

explain this data

TOTAL TESTED

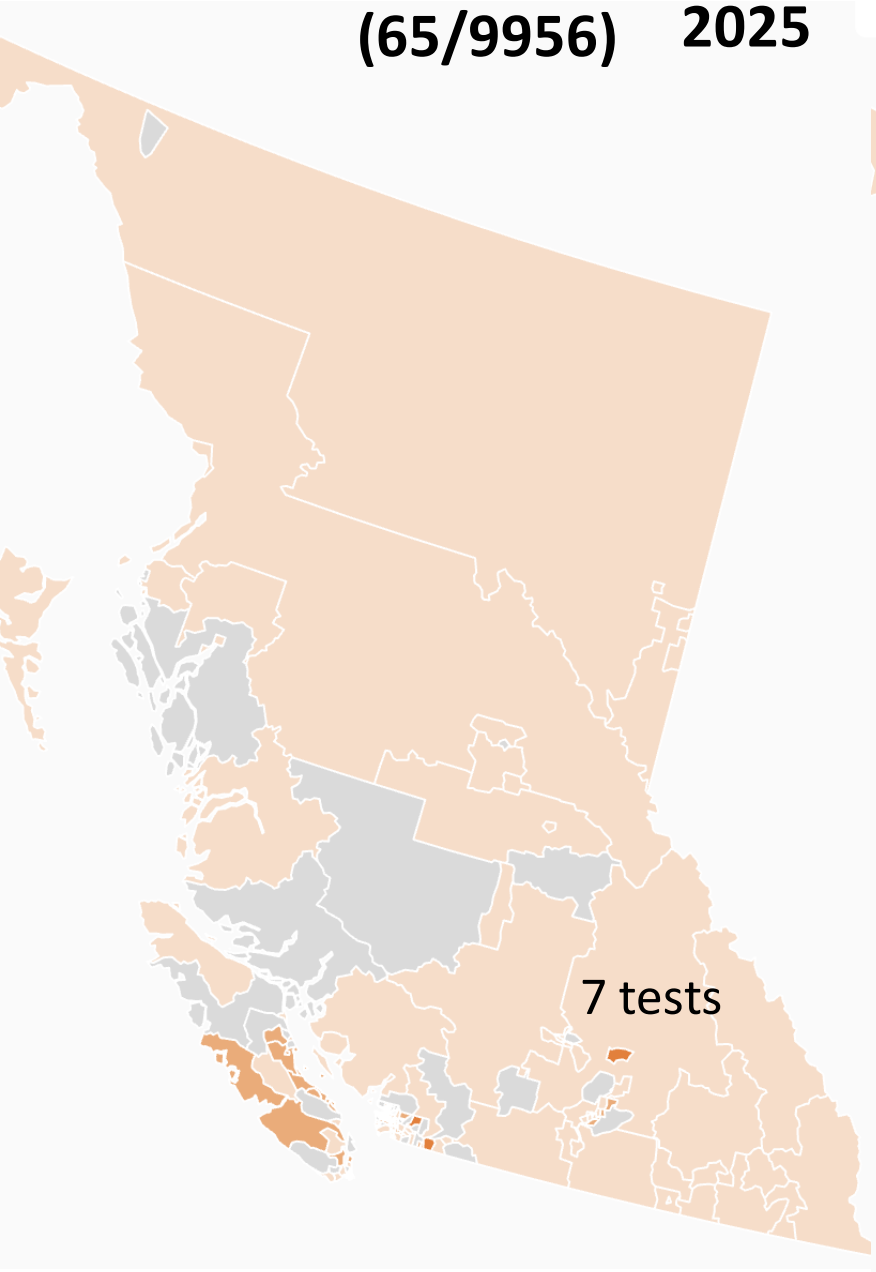
469,851

explain this data

GET UPDATES

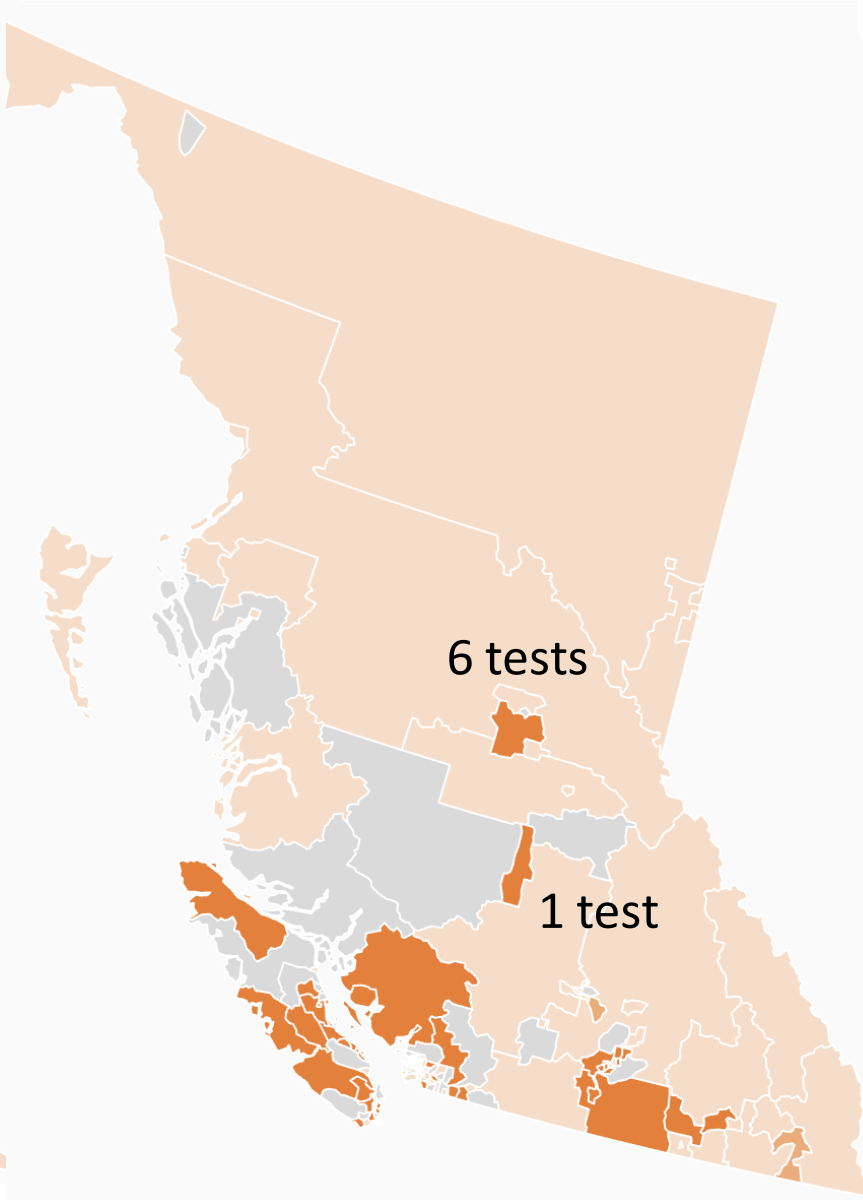
0.65%
(65/9956)

Lyme
2025



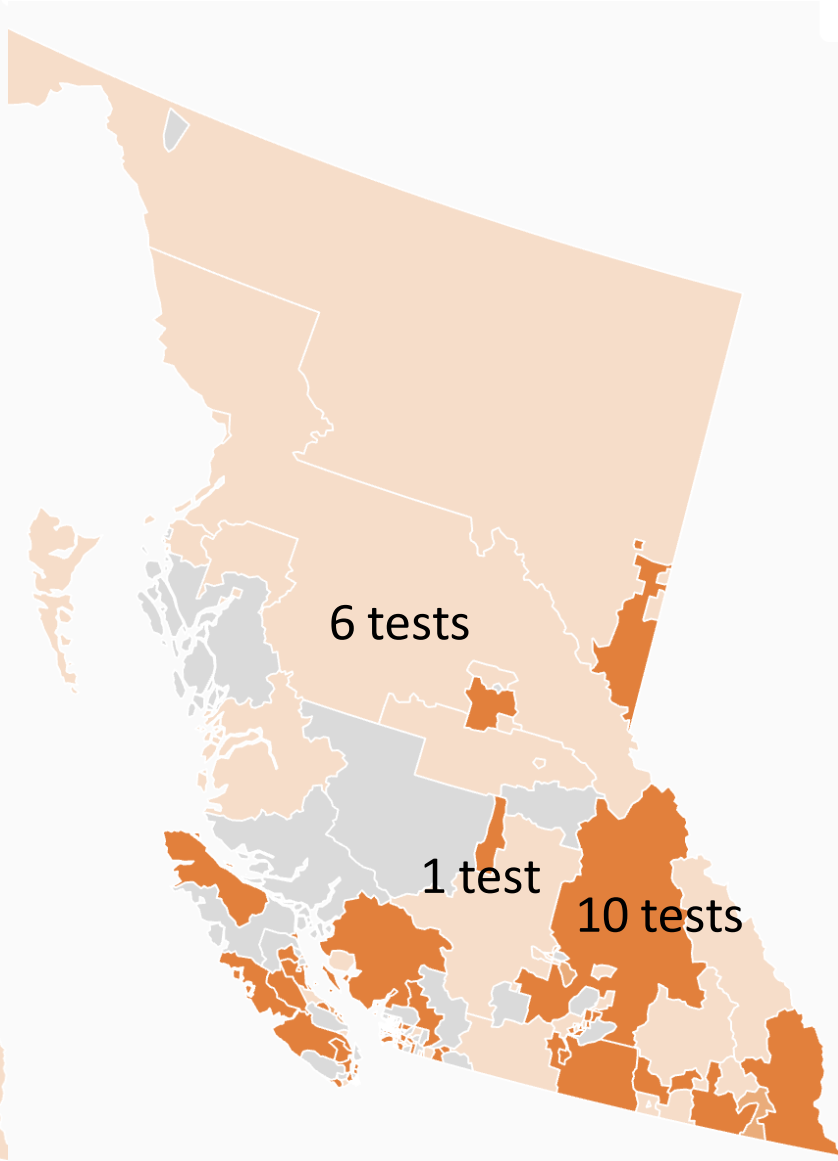
3.12%
(311/9956)

Anaplasma
2025

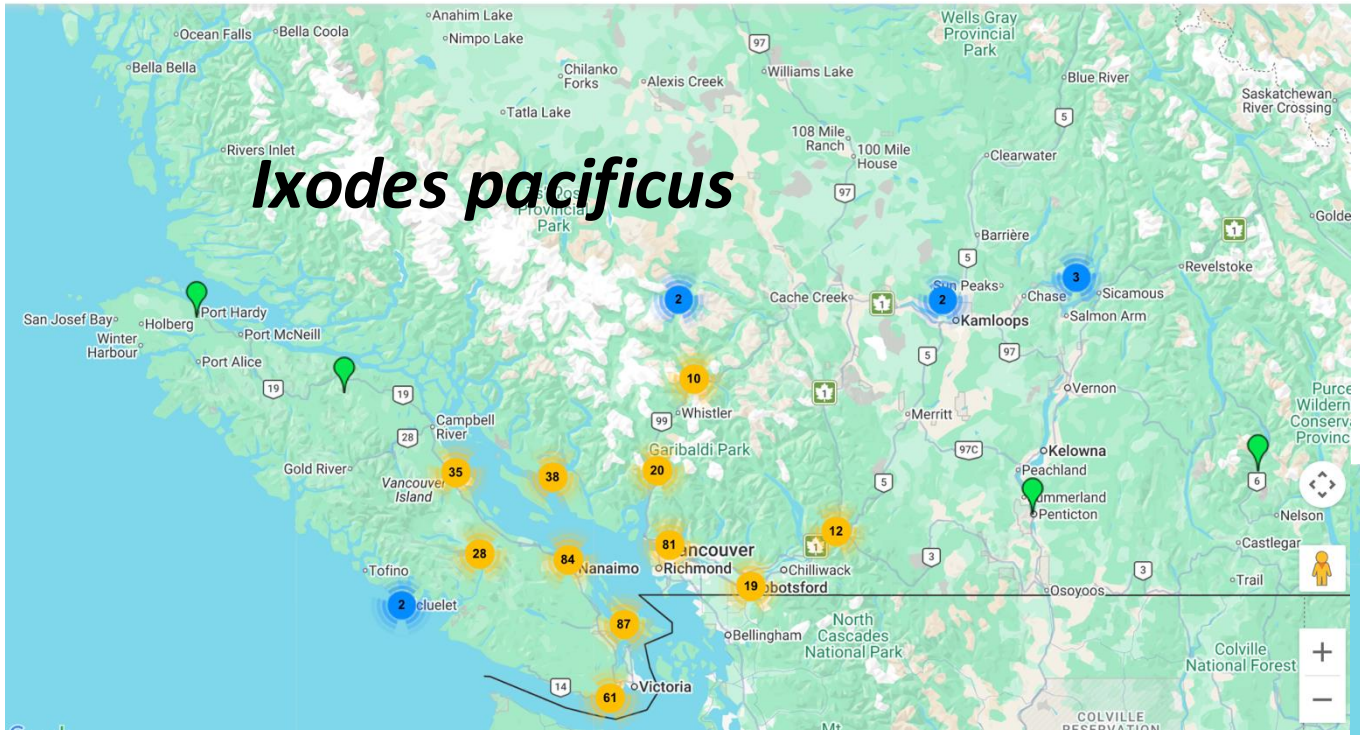


3.23%
(322/9956

Ehrlichia
2025

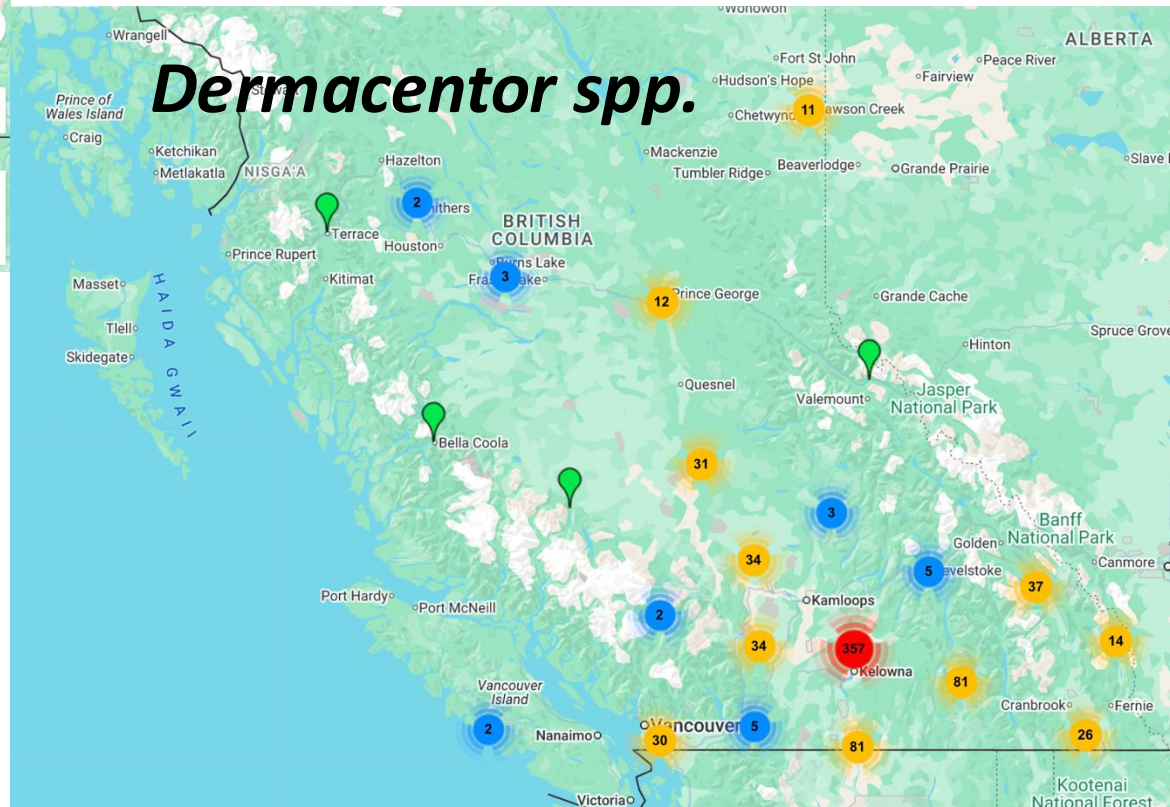


Etick data for BC 2024

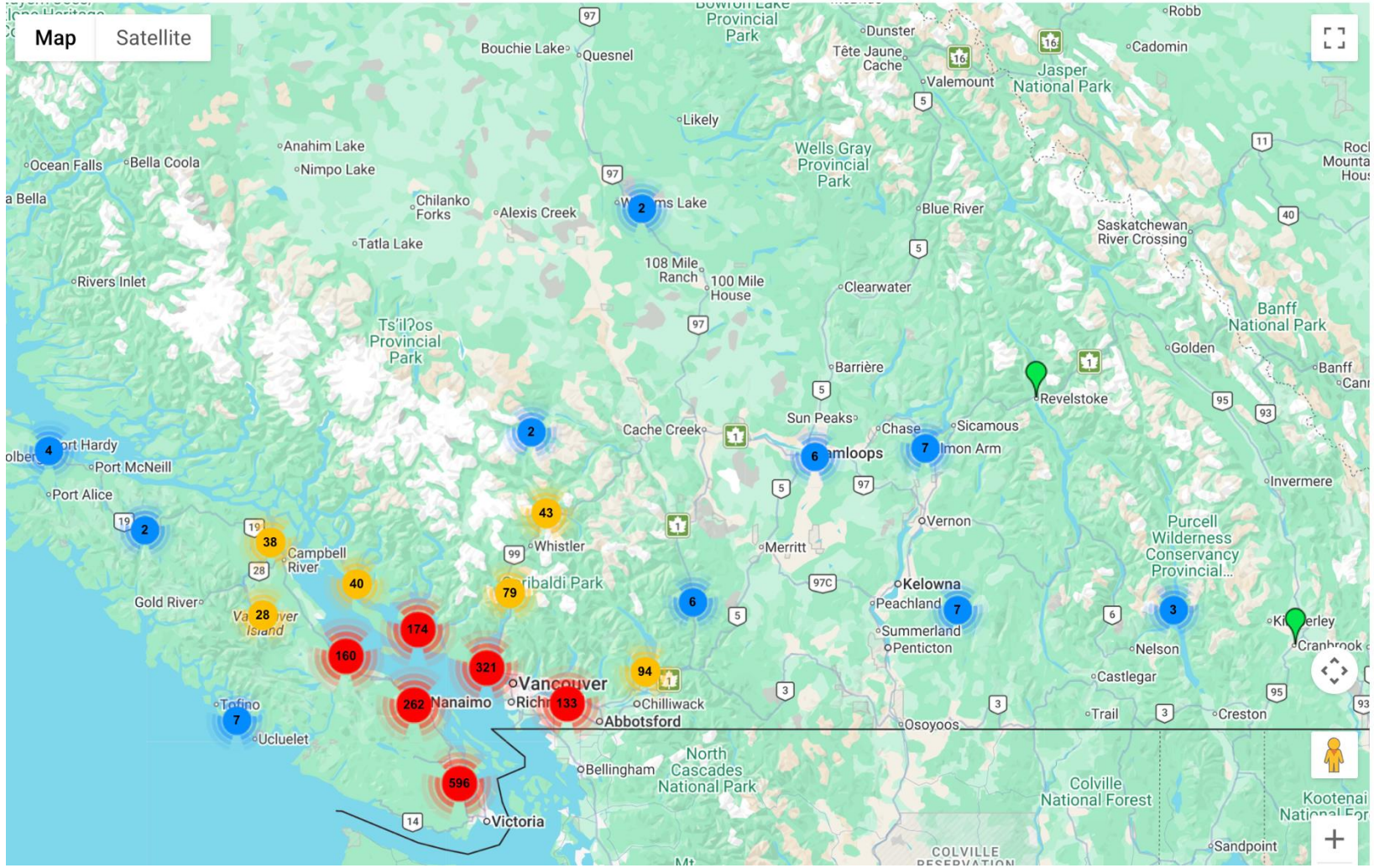


Higher prevalence of *Anaplasma* (presumably *A. phagocytophilum*) in Victoria region is consistent with presence of *Ixodes pacificus*

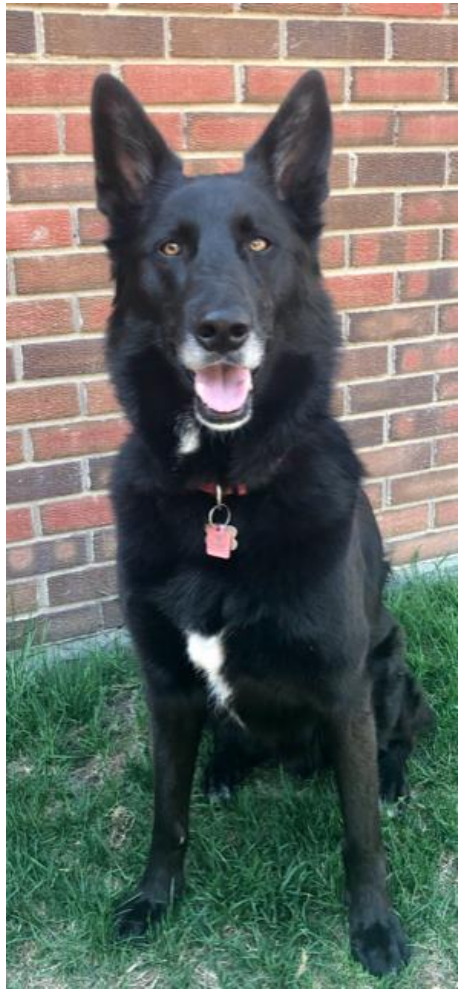
Higher prevalence of *Anaplasma* (presumably *A. phagocytophilum*) in Okanagan is confusing since the predominant ticks are *Dermacentor* spp., which do not transmit *Anaplasma phagocytophilum or A. platys*



Etick data 2020-present: all reports of *Ixodes pacificus* in BC



Case study



- Pierre, 3.5-year old German Shepherd
- May 30, 2020: After walking dog at urban park in Saskatoon, found tick, identified as female *Ixodes scapularis*
- June 1: first dose of isoxazoline
- July 1: second dose of isoxazoline
- July 4: neurological episode (adverse drug rxn?)
- Mid July: dog +ve on 4Dx test for Lyme disease
- August: tick +ve on PCR for *Borrelia burgdorferi*
- August 8: second neurological episode
- Monitor urine, treat for Lyme Disease

Many thanks to Leslie Read, Pierre's owner!
& Maarten Voordouw, Prasobh Thampy, Kylie Cousins, Pratap Kafle

Testing ticks for tick borne pathogens

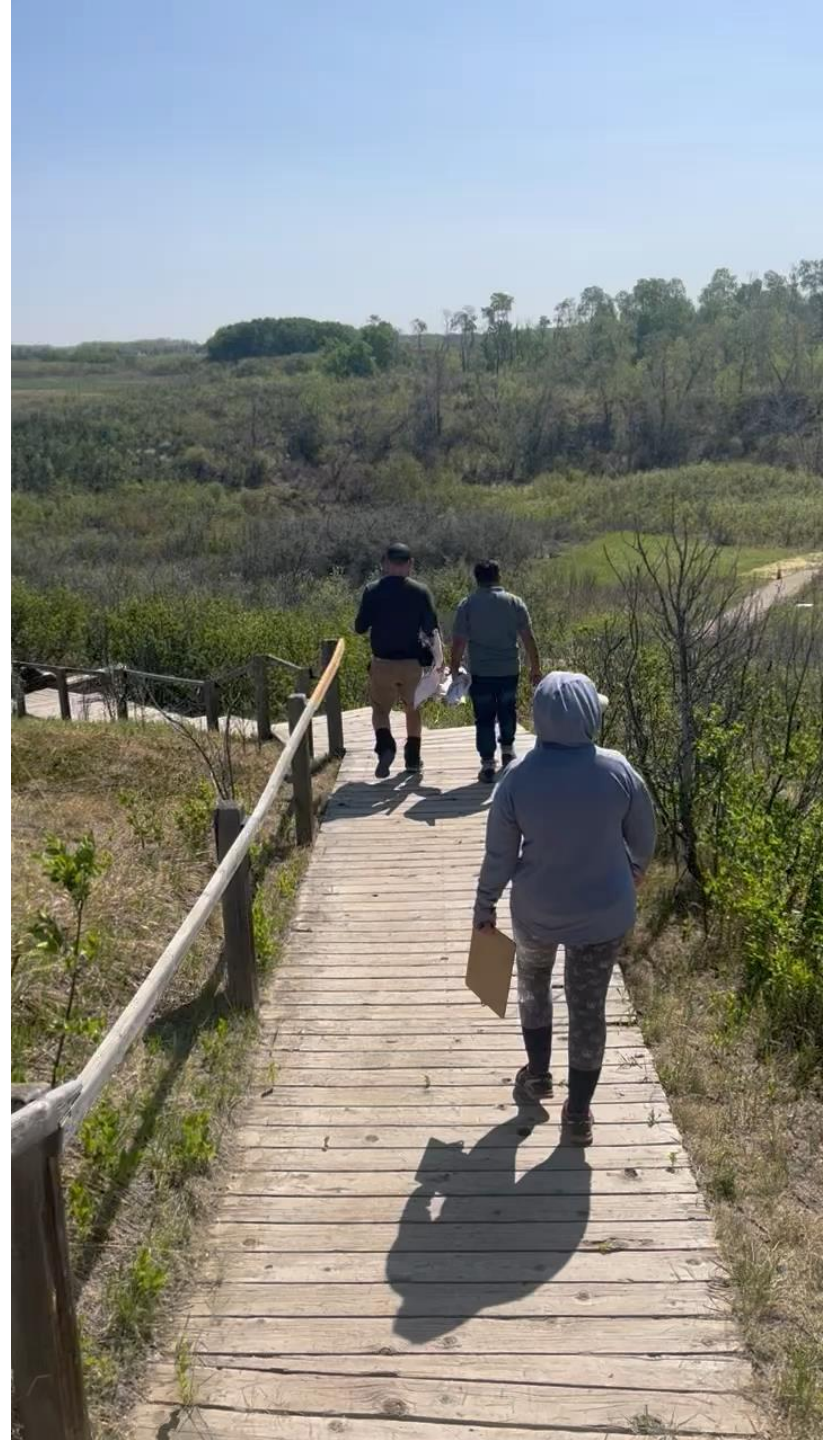
- PCR of *Ixodes scapularis* for DNA of *Borrelia* spp., *Babesia* spp., *Anaplasma phagocytophilum etc* by National Microbiology Laboratory (human lab)

- What does a positive in a tick mean? A negative?

- Be guided by the clinical picture and test results from the animal in front of you, not the tick!

Rickettsia (Rocky Mountain Spotted Fever) in *Dermacentor* spp.

- *D. variabilis* (n=40) (off leash dog park)
  - 3% prevalence of *Rickettsia montanensis*
  - No *R. rickettsii*
  - More likely to be colonized by pathogenic *Rickettsia*
  - Dominates human and canine encounters
- *D. andersoni* (n=36) (conservation area)
  - 100% prevalence of. *R. peacockii*
  - No *R. rickettsii*
  - Much less likely to transmit pathogenic *Rickettsia*
  - This tick is being outcompeted by *D. variabilis* in SK



Science

Tick-borne Rocky Mountain spotted fever spreading in Canada

Potentially deadly disease already found in Ontario and Quebec this year

Emily Chung · CBC News · Posted: Aug 20, 2025 7:09 AM CST | Last Updated: August 21, 2025

Listen to this article
Estimated 7 minutes

Quebec has reported a case of the potentially deadly tick-borne disease Rocky Mountain spotted fever. Infectious diseases specialist Dr. Isaac Bogoch says the infection is rare but can be deadly. It is easily treatable with antibiotics, he says, but prevention is key.

RMSF

BC has 0-3 human cases/year

Disease and pathogen	Ticks known to carry the pathogen in BC	Annual human incidence with BC-only exposure
Lyme disease *Borrelia burgdorferi*	*Ixodes* spp.	1–14 cases
Anaplasmosis *Anaplasma phagocytophilum*	*Ixodes* spp.	No reported cases*
Babesiosis *Babesia* spp.	*Ixodes* spp.	No reported cases*
Tularemia *Francisella tularensis*	*Dermacentor* spp.	0–2 cases
Rocky Mountain spotted fever *Rickettsia rickettsii*	*Dermacentor* spp.	0–3 cases
Tick paralysis (toxin mediated)	*Dermacentor* spp.	Not reportable, but known to occur rarely
Tick-borne relapsing fever *Borrelia hermsii*	*Ornithodoros hermsi*	0–7 cases per year

https://bcmj.org/bc-centre-disease-control/management-tick-bites-and-tick-borne-diseases-british-columbia

Tiered tick prevention

https://research-groups.usask.ca/cpep/index.php

- Client education
  - Modify behavior and environment
  - Tick checks and identification to genus level
  - Remove within 4-24 hrs
- Tick prevention
  - Repellents: topical insecticides, collars
  - Systemic: oral isoxazolines, topical spot-ons, injectable (1 yr)

- Testing and vaccination for Lyme disease?
  - Test only if clinical signs & plausible exposure
  - Vaccinate only if live in or travel to highly endemic regions (S. MB, ON, QC, NS, NB, eastern USA)

BC is NOT highly endemic for Lyme

Lyme disease and dogs

- A few dogs exposed in non-endemic regions
- Many dogs exposed in endemic regions
- Exposure detected using serological test **at least 6-8 weeks** after tick bite
- 95% will never develop clinical signs

Actions on a positive 4Dx test for Lyme disease in a dog

- Determine if the dog is ill
- Do a urinalysis (screen 2-3 times per year)
  - Immune mediated Lyme nephritis (proteinuria)
- If ill, or proteinuric:
  - Prescribe doxycycline (10 mg/kg/day x 30 days)
  - May clear spirochaete, or at least reduce numbers
  - NSAID if needed
- Quantitative C6 (QC6) serology - optional
  - Titre is significant if >30 U/mL
  - Helps monitor success of treatment (should drop)

TREATMENT?

- Plausible history of encounter(s) with competent tick vector(s); seasonal timing
- Evidence of **antibodies*** to *Borrelia*
- Clinical signs consistent with Lyme:
  - acute Lyme disease: fever, intermittent lameness, swollen joints, lymphadenopathy
  - chronic Lyme disease: polyarthritis, proteinuria, renal failure
- Neurological signs are atypical

- Doxycycline 10mg/kg oral every 24hr for 30 days
- Good tick prevention (high risk dog!)
- Vaccination for Lyme?
  - Natural protection short lived and OspC specific
  - 2 doses 2-4 wks apart

*bacteremia is transient and low; blood PCR unlikely to be informative

Treat or not to treat?

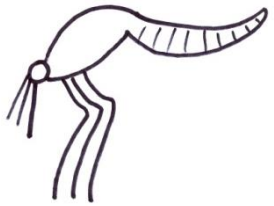
- Seropositive, no clinical signs, no proteinuria: 4/6 experts will NOT offer treatment

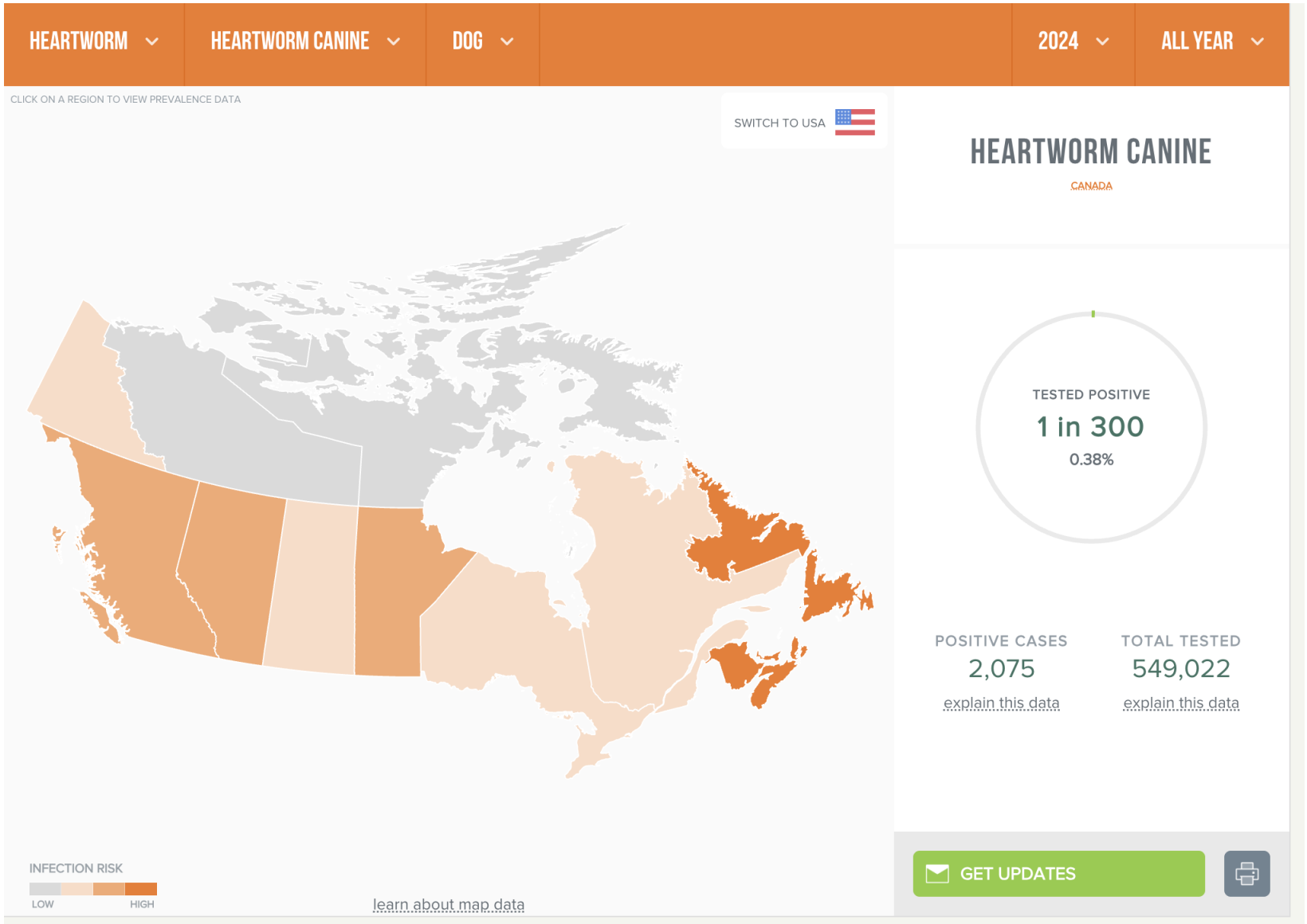
2018 ACVIM LYME CONSENSUS STATEMENT
https://www.onlinelibrary.wiley.com/doi/full/10.1111/jvim.15085

WHY?

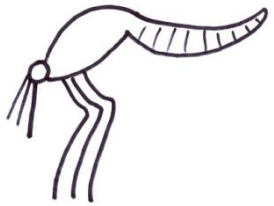
(1) Treatment of asymptomatic dogs promotes overuse of antibiotics
(2) No data showing treatment of healthy dogs decreases risk of illness
(3) Treatment may not clear bacteria from tissues
(4) Reinfection is common in dogs in endemic areas
(5) Dogs do not maintain transmission of Lyme

Heartworm (*Dirofilaria immitis*)





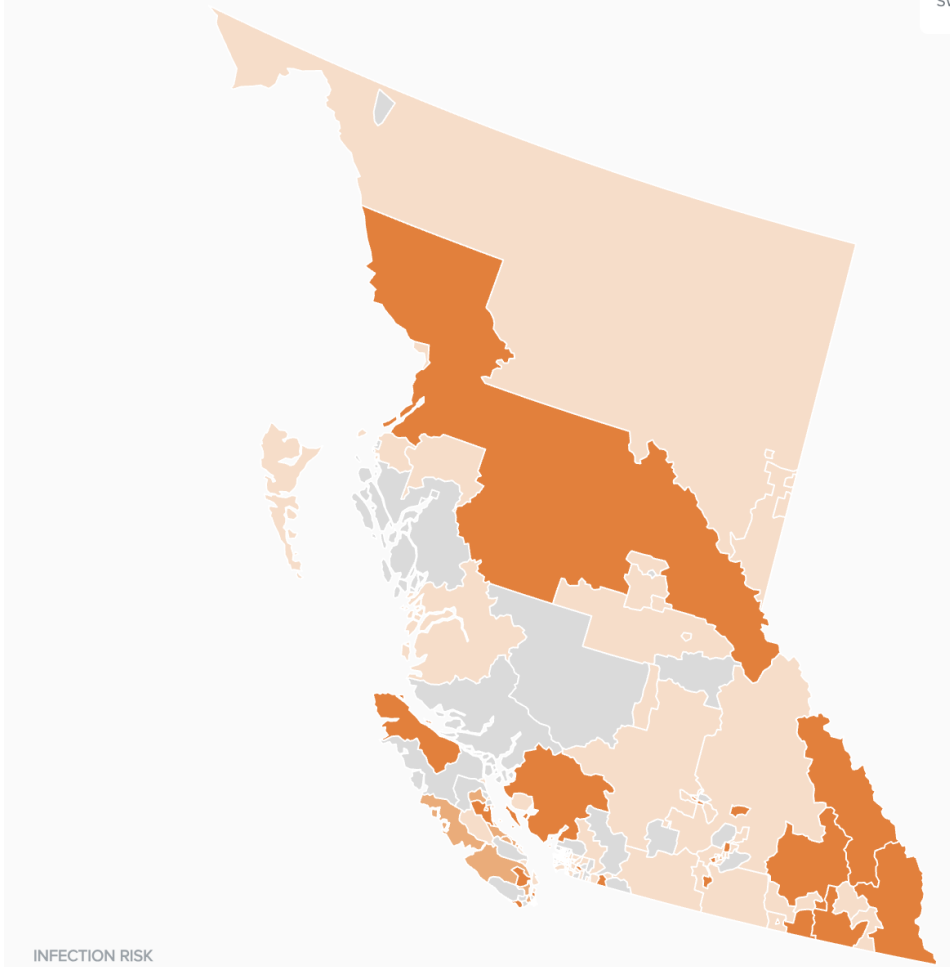
Heartworm (*Dirofilaria immitis*)



HEARTWORM | HEARTWORM CANINE | DOG | 2024 | ALL YEAR

CANADA → BRITISH COLUMBIA

SWITCH TO USA



learn about map data

HEARTWORM CANINE

CANADA → BRITISH COLUMBIA

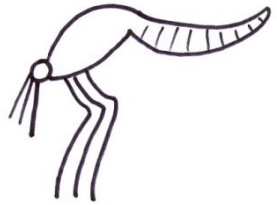
TESTED POSITIVE
1 in 100
0.97%

POSITIVE CASES
71
explain this data

TOTAL TESTED
7,357
explain this data

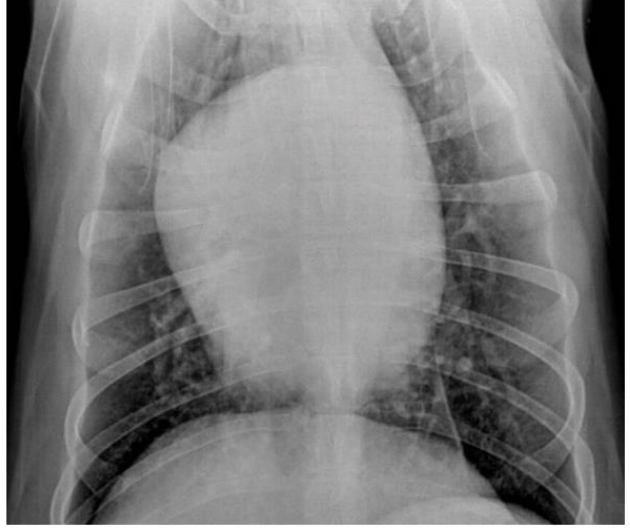
GET UPDATES

Heartworm in BC (CAPC data)



- BC overall: 1.6% 2020-25, 1.1% 2014-19
- Canada overall: 0.4% 2020-25, 0.4% 2014-19
- BC has 4x more dogs testing positive for heartworm than the rest of Canada, including known endemic regions of MB, ON, and QC
- Presence in Okanagan is compatible with previous reports of endemic transmission
- Presence in Victoria region is unexpectedly high – travel acquired cases? Possible endemic transmission?

Pathogenesis and clinical signs of heartworm



- Exercise intolerance, coughing, anorexia, weight loss
- Staging based on imaging (Stages 1-3, mild to severe)
- Severe cases: Right heart failure, hepatic congestion, ascites, syncope, death
- Parasite antigen/antibody complex deposition can cause glomerulonephritis & proteinuria
- Caval Syndrome (small dogs, rarely cats): worms block the tricuspid valve: requires immediate surgical removal
- Cats: Heartworm Associated Respiratory Disease (HARD)

Diagnosis of heartworm

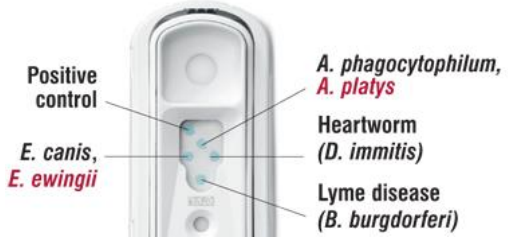
- History (geographic location, travel)
- Clinical signs
- Radiographs/ultrasound:
  - enlarged pulmonary arteries and right heart
  - may see worms, check for caval syndrome
- Diagnostic tests:
  - Dogs:
    - Antigen test (“SNAP”)
    - Microfilarial concentration test (modified Knotts)*
  - CATS:
    - Antibody test (plus or minus antigen test)

https://www.heartwormsociety.org/veterinary-resources/american-heartworm-society-guidelines

Idexx SNAP 4DX Plus Test

Looking for Heartworm Antigen:
DOGS

Positive 6-8 months after infection



Looking for Heartworm Antibody:
CATS

Positive within 2 months of infection

About 10% of the prevalence in dogs

Feline heartworm testing: CAPC BC data

Dirofilaria Antibody	2025	2024	2023	2022	2021	2020	2020-25
BC # positive	0	0	0	0	0	0	0
BC total tests	102	27	24	22	24	20	219
% positive	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Dirofilaria Antigen	2025	2024	2023	2022	2021	2020	2020-25
BC # positive	4	0	0	0	0	0	4
BC total tests	445	353	67	33	45	34	977
% positive	0.9	0.0	0.0	0.0	0.0	0.0	0.4

Heartworm testing recommendations

- Who? Pets living in or travel to endemic regions
- What test(s)? antigen, Knotts, or antibody (cats)
- Where? Annually in endemic regions
- When? At least 6 months after last possible exposure (spring in Canada)
- Why test?
  - prior to starting preventatives (anaphylaxis, masking)
  - if suspect non-compliance in endemic region
  - to monitor success of treatment
  - many drug companies will not cover the cost of adulticidal treatment if pets are not tested annually

HEARTWORM DRUGS

Preventatives (kill L3 and L4, low dose)

Monthly oral or topical macrocyclic lactones (ML)*

- Canada:
- Start 1 month after first possible exposure
- End 1 month after last possible exposure (May-Nov)
- USA: AHS recommends year round

Parenteral slow release ML

- 6 or 12 month products

Microfilaricides
(kill L1, high dose):
Ivermectin
Moxidectin

*Resistance developing

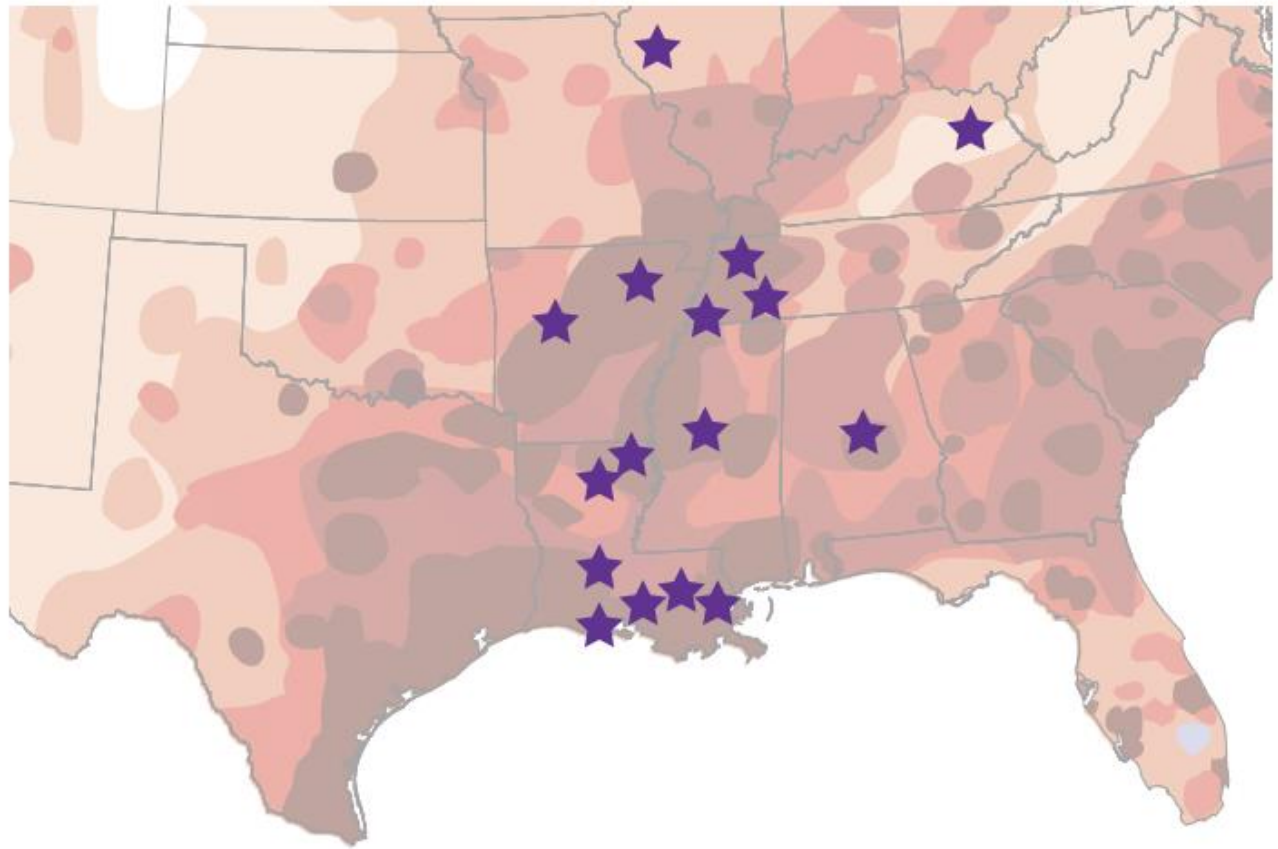
Adulticides
(arsenicals, kill adults):
Melarsomine
NOT in cats - toxic

Antibiotic for *Wolbachia*
Doxycycline

Mosquito control
Permethrin repellents
Isoxazolines

https://www.heartwormsociety.org/veterinary-resources/american-heartworm-society-guidelines

Figure 4. Known U.S. locations (★) of dogs infected with ML-resistant biotypes of *Dirofilaria immitis*.



https://d3ft8sckhnqim2.cloudfront.net/images/AHS_Canine_Guidelines_WEB_19JUN2025.pdf?1750365484

Heartworm treatment options

- **Activity restriction** to prevent pulmonary thromboembolism
- Adjunct therapy: corticosteroids, diuretics, vasodilators, oxygen
- Mosquito repellents/ectoparasiticides to reduce transmission
- Slow kill or non-arsenical or Moxy-Doxy:
  - Indications: Adulticide therapy not possible, ML resistance is not present, and clinical staging is <3 (mild to moderate)
  - Topical moxidectin (2.5 mg/kg) monthly for 10-18 months
  - 30 d doxycycline 5-10 mg/kg BID; repeat at 6 months
- Arsenical adulticide therapy (AHS recommended):
  - Monthly macrocyclic lactone (ML) at least twice
  - 30 d doxycycline 10 mg/kg BID
  - 2-3 doses of melarsomine 30 days apart

In summary…

- GI nematodes: BC does not have unusually high prevalence of roundworms or hookworms, but those present in southern BC are likely zoonotic; monitor for resistant hookworms
- Tapeworms*:* BC may be (newly) endemic for *Echinococcus multilocularis,* and need to be aware of canine AE and to treat **high risk** dogs
- Need to monitor for resistance to *Dipylidium caninum,* treat responsibly, and emphasize good flea control
- Low risk of Lyme disease, but high and increasing risk of *Anaplasma* and *Ehrlichia* – emphasize tick control (& rapid removal), especially Jan-June
- Remain aware of tick paralysis and Rocky Mountain Spotted fever, and submit unusual ticks for identification/testing
- Heartworm signal is concerning in Victoria area, and may still be circulating in Okanagan – monitor travel history in your positives to know if endemic