

Managing tick-related risk in outdoor environments

Negar Elmieh, MPH, PhD

NCCEH Webinar

May 31, 2023



National Collaborating Centre
for Environmental Health

Centre de collaboration nationale
en santé environnementale

Setting the stage. Ticks can...



Be found in many
environments

Setting the stage. Ticks can...



Be found in many environments



Can infect humans with pathogens

Setting the stage. Ticks can...



Be found in many environments



Can infect humans with pathogens



Survive and thrive across Canada

How can we design and manage parks, recreational areas, and residential properties to reduce tick-related risks?

July 2022

A review of ticks in Canada and health risks from exposure

By Negar Elmieh, MPH, PhD
In partnership with the National Collaborating Centre for Environmental Health



September 2022

The impacts of climate and land use change on tick-related risks

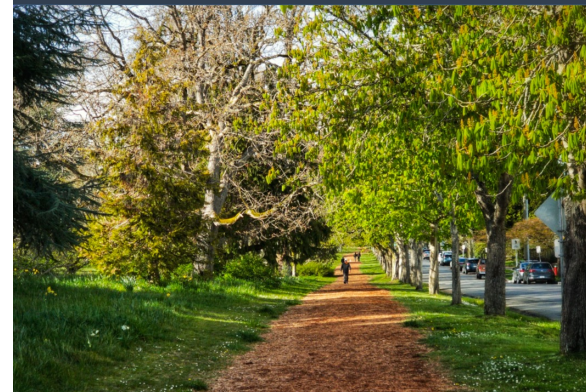
By Negar Elmieh, MPH, PhD
In partnership with the National Collaborating Centre for Environmental Health



March 2023

Review of environmental management strategies to reduce tick populations

By Negar Elmieh, MPH, PhD
In partnership with the National Collaborating Centre for Environmental Health



Ticks in a changing environment

FAST FACTS

- Ticks can be found in many environments, but are commonly found in wooded areas with leaf litter, tall grassy areas, shrub layers and along forest edges.
- Ticks can infect humans with pathogens that can lead to illnesses such as Lyme disease, anaplasmosis, and Babesiosis, among others.
- The number of places where ticks can survive and thrive in Canada is growing due to climate change, animal migration, deforestation and urbanization.
- Landscapes can be designed and managed to minimize tick and animal host (e.g., deer and rodents) habitats.

Poll
Question

What is your field of
practice/profession?

July 2022

A review of ticks in Canada and health risks from exposure

By Negar Elmieh, MPH, PhD

In partnership with the National Collaborating Centre for Environmental Health



Evidence review # 1

(synthesis of 92 literature sources)

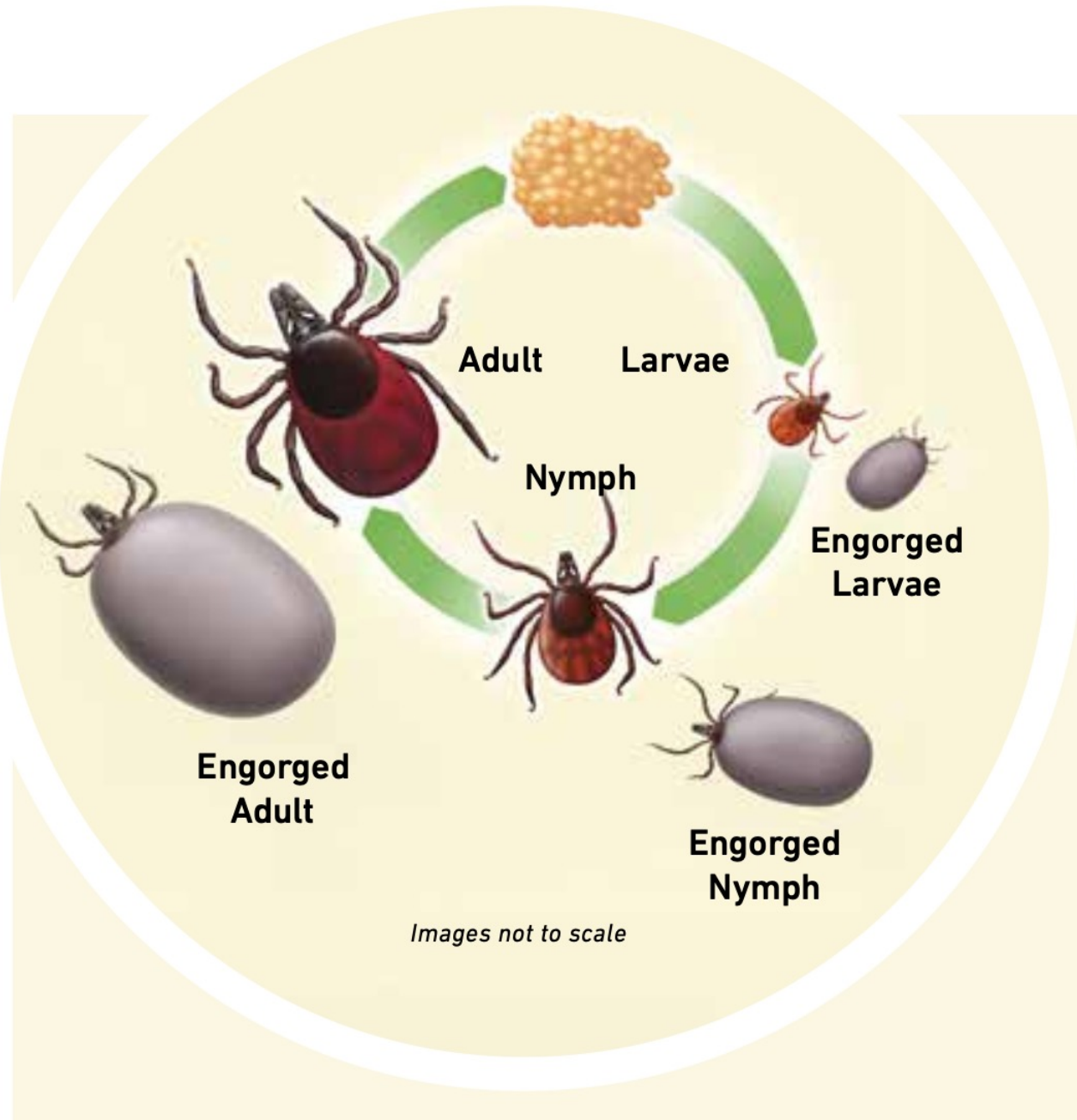


National Collaborating Centre
for Environmental Health

Centre de collaboration nationale
en santé environnementale

ncceh.ca

TICK LIFE CYCLE AND HABITAT

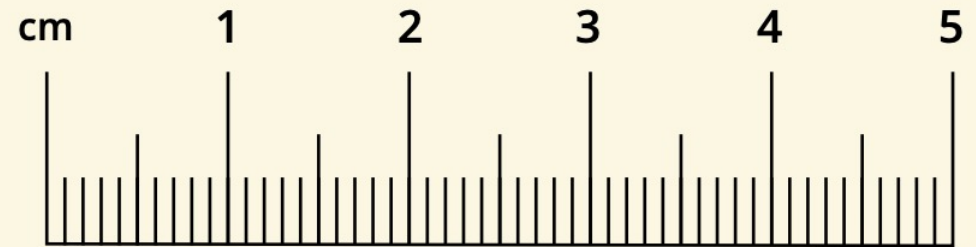


Ticks are small arthropods. They are slow moving and their bodies have a flat tear drop shape. They go through 3 life stages:

Larvae | 6-legged, become engorged after feeding

Nymph | 8-legged, become engorged after feeding

Adult | 8-legged, become engorged after feeding



Larvae

Nymph

Adult

Engorged Adult

shown at 1.5x actual size

Poll
Question

What environments are ticks
commonly found in across
Canada?

SPECIES / COMMON NAME	TYPICAL RANGE*	HABITAT PREFERENCES
<i>Ixodes scapularis</i> Blacklegged tick	East of Rocky Mountains	Prefer high moisture areas; often found in leaf litter and under forest canopy.
<i>Ixodes pacificus</i> Western blacklegged tick	West of Rocky Mountains	

SPECIES / COMMON NAME	TYPICAL RANGE*	HABITAT PREFERENCES
<i>Ixodes scapularis</i> Blacklegged tick	East of Rocky Mountains	Prefer high moisture areas; often found in leaf litter and under forest canopy.
<i>Ixodes pacificus</i> Western blacklegged tick	West of Rocky Mountains	
<i>Dermacentor variabilis</i> American dog tick	Eastern Canada <i>Eastern AB and SK, MB, ON, QB, NB, NS</i>	Prefer drier environments; often found in grass and shrubs.
<i>Dermacentor andersoni</i> Rocky mountain wood tick	Western Canada <i>BC, AB, SK</i>	

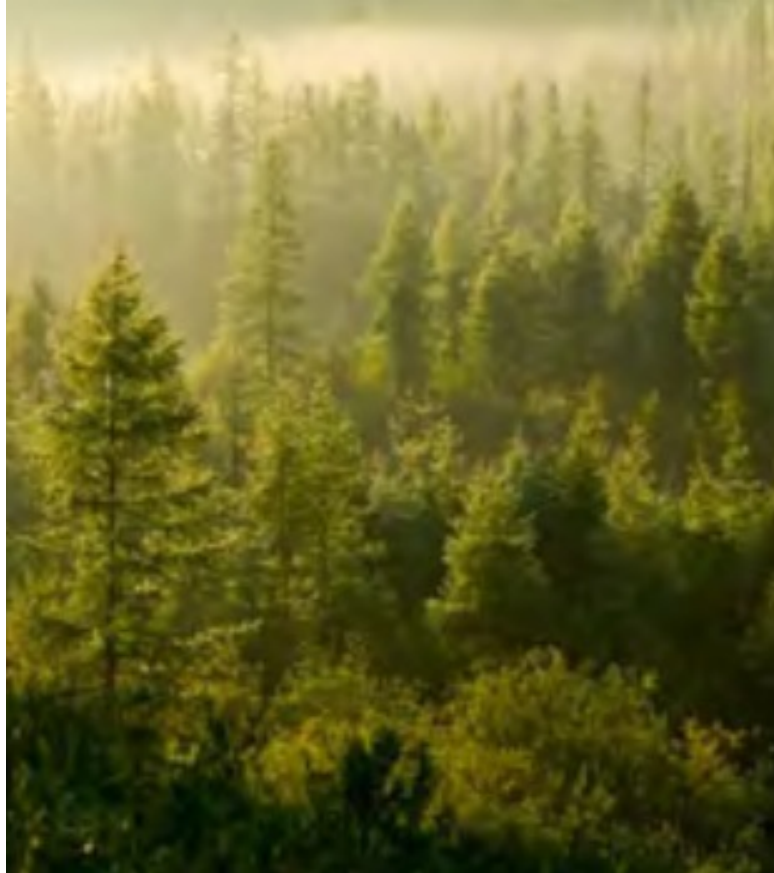
SPECIES / COMMON NAME	TYPICAL RANGE*	HABITAT PREFERENCES
<i>Ixodes scapularis</i> Blacklegged tick	East of Rocky Mountains	Prefer high moisture areas; often found in leaf litter and under forest canopy.
<i>Ixodes pacificus</i> Western blacklegged tick	West of Rocky Mountains	
<i>Dermacentor variabilis</i> American dog tick	Eastern Canada <i>Eastern AB and SK, MB, ON, QB, NB, NS</i>	Prefer drier environments; often found in grass and shrubs.
<i>Dermacentor andersoni</i> Rocky mountain wood tick	Western Canada <i>BC, AB, SK</i>	
<i>Amblyomma americanum</i> Lone Star	Canada wide	Often found in wooded areas and leaf litter.

*Typical range is represented by research available as of 2023. Surveillance is limited in many areas and this information could be an underrepresentation of the actual presence of ticks in a particular area.

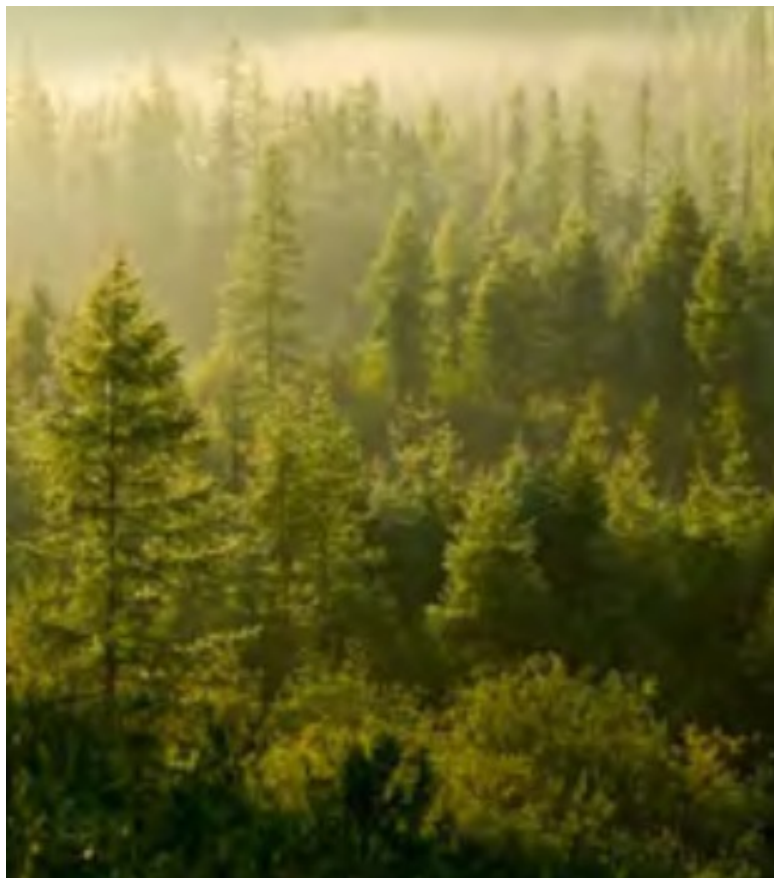
Common and new landscapes



Common and new landscapes



Common and new landscapes



Overview of tick vectors and pathogens

	Pathogen	Primary tick vector(s)	Geographic range ⁺	Nationally reportable	Estimated incidence (per 100,000 population)
Bacteria	<i>Anaplasma phagocytophilum</i>	<i>Ixodes scapularis</i> <i>Ixodes pacificus</i> <i>Ixodes spinipalpis</i>	BC, AB, SK, MB, ON, QC, NB, NL NS, PEI	No	1.54 in 2018 (Manitoba) ²²
	<i>Borrelia burgdorferi</i>	<i>Ixodes scapularis</i> <i>Ixodes pacificus</i>	BC, AB, SK, MB, ON, QC, NB, NS, NL, PEI	Yes	7.0 in 2019 ²³
	<i>Borrelia hermsii</i>	<i>Ornithodoros hermsi</i>	BC	No	-
	<i>Borrelia mayonii</i>	<i>Ixodes scapularis</i> <i>Ixodes angustus</i>	BC, ON	No	-
	<i>Borrelia miyamotoi</i>	<i>Ixodes scapularis</i> <i>Ixodes pacificus</i>	BC, AB, MB, ON, QC, NC, NS, NL, PEI	No	-
	Rocky Mountain spotted fever (<i>Rickettsia rickettsia</i>)	<i>Dermacentor variabilis</i> <i>Dermacentor andersoni</i> <i>Rhipicephalus sanguineus</i>	BC, AB, SK, ON, NS	No	0.2 in 2019 (British Columbia) ²⁴
	Tularemia (<i>Francisella tularensis</i>)	<i>Dermacentor variabilis</i> <i>Dermacentor andersoni</i> <i>Amblyomma americanum</i>	Canada wide	Yes	0 in 2022 ²⁴
Parasite	<i>Babesia</i>	<i>Ixodes scapularis</i> <i>Ixodes angustus</i>	BC, MB, ON, QC, NC, NS	No	0.9 in 2019 (United States) ²⁵
Virus	Powassan virus	<i>Ixodes cookei</i> <i>Ixodes marxi</i> <i>Ixodes spinipalpis</i> <i>Ixodes scapularis</i> <i>Dermacentor andersoni</i>	MB, ON, QC, NB, NS, PEI	No	-

Overview of tick vectors and pathogens

	Pathogen	Primary tick vector(s)	Geographic range ⁺	Nationally reportable	Estimated incidence (per 100,000 population)
Bacteria	<i>Anaplasma phagocytophilum</i>	<i>Ixodes scapularis</i> <i>Ixodes pacificus</i> <i>Ixodes spinipalpis</i>	BC, AB, SK, MB, ON, QC, NB, NL, NS, PEI	No	1.54 in 2018 (Manitoba) ²²
	<i>Borrelia burgdorferi</i>	<i>Ixodes scapularis</i> <i>Ixodes pacificus</i>	BC, AB, SK, MB, ON, QC, NB, NS, NL, PEI	Yes	7.0 in 2019 ²³
	<i>Borrelia hermsii</i>	<i>Ornithodoros hermsi</i>	BC	No	-
	<i>Borrelia mayonii</i>	<i>Ixodes scapularis</i> <i>Ixodes angustus</i>	BC, ON	No	-
	<i>Borrelia miyamotoi</i>	<i>Ixodes scapularis</i> <i>Ixodes pacificus</i>	BC, AB, MB, ON, QC, NC, NS, NL, PEI	No	-
	Rocky Mountain spotted fever (<i>Rickettsia rickettsia</i>)	<i>Dermacentor variabilis</i> <i>Dermacentor andersoni</i> <i>Rhipicephalus sanguineus</i>	BC, AB, SK, ON, NS	No	0.2 in 2019 (British Columbia) ²⁴
	Tularemia (<i>Francisella tularensis</i>)	<i>Dermacentor variabilis</i> <i>Dermacentor andersoni</i> <i>Amblyomma americanum</i>	Canada wide	Yes	0 in 2022 ²⁴
Parasite	<i>Babesia</i>	<i>Ixodes scapularis</i> <i>Ixodes angustus</i>	BC, MB, ON, QC, NC, NS	No	0.9 in 2019 (United States) ²⁵
Virus	Powassan virus	<i>Ixodes cookei</i> <i>Ixodes marxi</i> <i>Ixodes spinipalpis</i> <i>Ixodes scapularis</i> <i>Dermacentor andersoni</i>	MB, ON, QC, NB, NS, PEI	No	-

Early diagnosis and prompt treatment key

Challenges:

- Non-specificity of tick-borne infections
- Potential for co-infections with more than one pathogen
- Many people unfamiliar with risks

Populations at risk of complications

- Immunocompromised
- Older adults
- Pregnancy and breastfeeding due to limited treatment options

Populations at risk of exposure to ticks

Risk of human exposure

Populations at risk of exposure to ticks

Risk of human exposure

\propto


amount of time spent outdoors in tick habitats

Populations at risk of exposure to ticks

Risk of human exposure

\propto

amount of time spent outdoors in tick habitats



- Tall grass
- Brush/shrubs
- Leaf litter

Populations at risk of exposure to ticks

Risk of human exposure

\propto

amount of time spent outdoors in tick habitats

Children 5-14

Adults 55-79

Males

Tall grass

Brush/shrubs

Leaf litter

Activities that can increase risk

RECREATIONAL

Hiking
Fishing
Hunting
Camping
Golfing

DAILY

Gardening
Walking your dog
Playing outside

OCCUPATIONAL

Landscaping
Tree planting

SEASONAL ASPECTS: Ticks most active between spring and late autumn

BE PREPARED WHEN OUTDOORS



Take action: minimize your risk of tick encounters

Outdoor

- Avoid high-risk areas with high grass and leaf litter.
- Walk on cleared trails.
- Wear light-coloured clothing covering arms and legs (to easily spot ticks on clothing).
- Tuck clothing (e.g. pants into socks, shirt into pants).
- Wear closed-toed shoes to create a barrier for skin.
- Conduct regular checks for crawling ticks.
- Apply insect repellents approved in Canada.*
- Wear permethrin-treated clothing. In Canada, this is approved for those over the age of 16. Permethrin sprays and liquids for treating one's own clothes are not approved in Canada.

Returning indoors

- Check clothing and gear for unattached ticks.
- Change from your outdoor clothes and put them in the dryer, on high heat, for at least 10 minutes to kill ticks.
- Take a shower/bath to rinse unattached ticks.
- Thoroughly check yourself and pets for tick(s). You should check your whole body as ticks can attach anywhere.
- Pay close attention to your head, hairline, behind your ears, waist, belly button, between the legs, and behind your knees. A hand-held mirror is helpful to see all body parts.
- Promptly remove tick(s) using a fine point tweezer, grasping ticks neck at a 90-degree angle. Wash the area with soap and water.
- Keep tick in a jar with moist cotton ball, submit to your health provider for testing. See this instructional video: shorturl.at/hmrJK

Poll Question

Have you personally taken
action to minimize your risk of
tick encounters?

September 2022

The impacts of climate and land use change on tick-related risks

By Negar Elmieh, MPH, PhD

In partnership with the National Collaborating Centre for Environmental Health



Evidence review # 2 (synthesis of 85 literature sources)



National Collaborating Centre
for Environmental Health

Centre de collaboration nationale
en santé environnementale

ncceh.ca

Climate change

Temperature

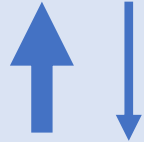
Humidity

Precipitation

Extreme weather events

Climate change

Temperature



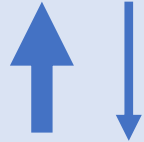
Humidity

Precipitation

Extreme weather events

Climate change

Temperature



Humidity

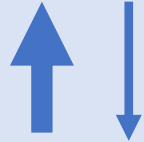


Precipitation

Extreme weather events

Climate change

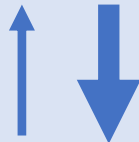
Temperature



Humidity



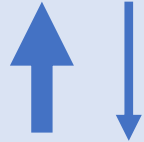
Precipitation



Extreme weather events

Climate change

Temperature



Humidity



Precipitation



Extreme weather events

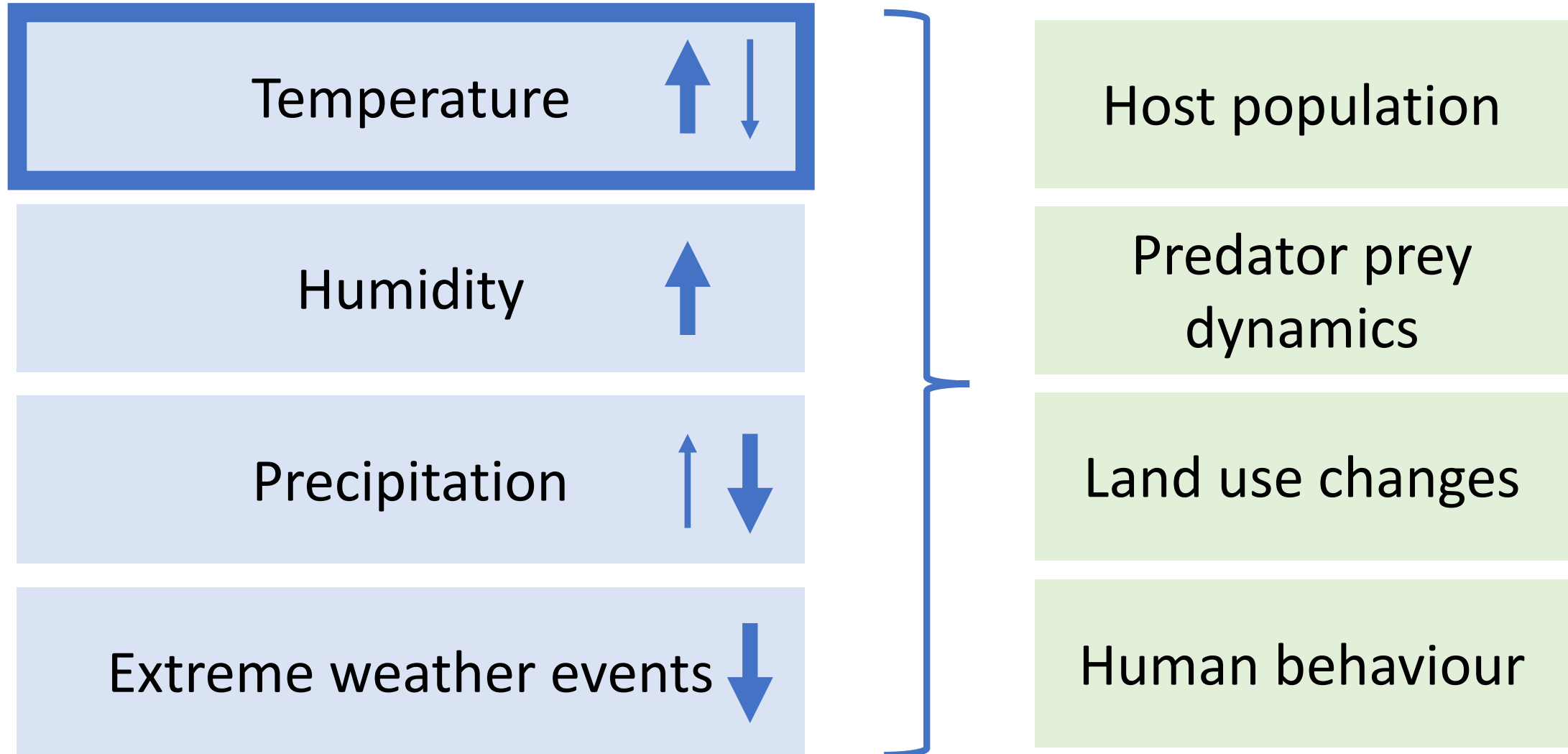


Poll Question

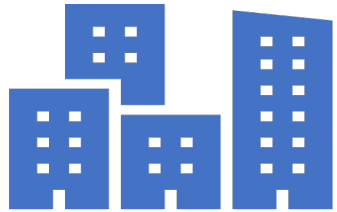
Of the climate variables, which do you think is the most important predictor of tick population establishment?

Climate variables: temperature, humidity, precipitation, extreme weather events

Climate change



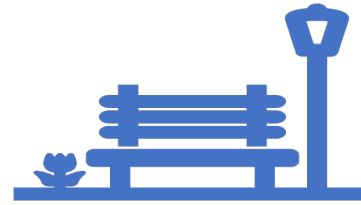
Land use changes in urban, suburban, and rural areas are increasing suitable tick habitats



Housing
development in
forested areas



Landscaping



Playgrounds



Green spaces

Forest Fragmentation



1. ↑ density of deer populations
2. ↓ species diversity
3. ↑ potential human exposure to ticks

A map of Canada with a yellow background and black outlines for provinces and territories. A curved black line runs across the southern part of the country, representing the current range of ticks. Three large blue arrows point upwards from the bottom of the map, indicating the direction of expansion. The text 'Range of ticks will expand northwards by 35-55km/year' is centered over the map.

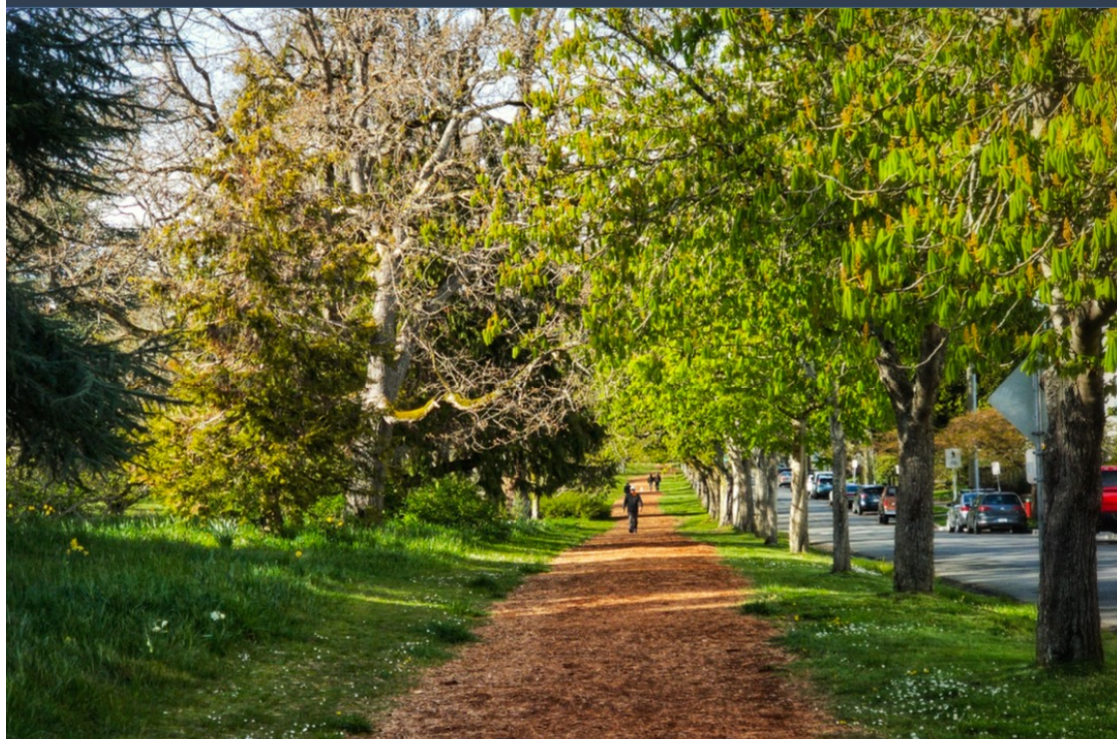
Range of ticks will expand
northwards by 35-55km/year

March 2023

Review of environmental management strategies to reduce tick populations

By Negar Elmieh, MPH, PhD

In partnership with the National Collaborating Centre for Environmental Health



Evidence review # 3

(synthesis of 106 literature sources)



National Collaborating Centre
for Environmental Health

Centre de collaboration nationale
en santé environnementale

ncceh.ca

What we know:

- Ticks can be found in many environments across urban, suburban, and recreational areas
- Common challenge: Many visitors to parks and recreational areas are not from the geographical area and potentially unfamiliar with risks

Question

- How best to manage ticks in outdoor environments, across scales, to limit tick related risks?

Landscape design considerations

- 1 **Create clear pathways.** Use hardscaping materials such as gravel, stones, bare soil, and cedar chips or sawdust to create a path or to delineate a border at least 3 inches wide. Research shows that woodchip borders along trails effectively suppress *Ixodes scapularis* activity.
- 2 **Select plants to limit deer and/or rodents.** This may also increase insect biodiversity limiting ticks. Consider ornamental deer and rodent resistant plants (e.g. lavender, rosemary, pennyroyal, daffodil, iris, Russian sage). Plant selection will vary according to climate. A landscape specialist can be consulted to guide regional plant selection and their placement.
- 3 **Increase sun exposure and decrease humidity** through landscape design principals. This can help to reduce tick survival since sun exposure and limited humidity can dessicate ticks.
- 4 **Use fencing where possible** to limit deer and other host animal movement throughout the landscape. This reduces the risk of ticks becoming dispersed in an environment through animal hosts.
- 5 **Prune plants** regularly (e.g., trees, shrubs, and bushes).
- 6 **Maintain lawn** by keeping grass short.
- 7 **Remove yard waste** such as leaf litter, brush/log piles, weeds, and debris.
- 8 **Stack wood neatly** in dry area away from the house or other buildings.
- 9 **Move seating and play structures into open areas** at least 3 yards away from landscape perimeter. Mark area with a 3 inch woodchip border.

Insecticides as a last resort:

- Chemical measures (acaricides, pyrethroids, and permethrin) can be used to complement landscape design and management to limit tick populations in certain areas.
- Consult a certified pest management specialist to see if your park, recreational area, or property is a good candidate for chemical measures.

Landscape design considerations

- 1 **Create clear pathways.** Use hardscaping materials such as gravel, stones, bare soil, and cedar chips or sawdust to create a path or to delineate a border at least 3 inches wide. Research shows that woodchip borders along trails effectively suppress *Ixodes scapularis* activity.
- 2 **Select plants to limit deer and/or rodents.** This may also increase insect biodiversity limiting ticks. Consider ornamental deer and rodent resistant plants (e.g. lavender, rosemary, pennyroyal, daffodil, iris, Russian sage). Plant selection will vary according to climate. A landscape specialist can be consulted to guide regional plant selection and their placement.
- 3 **Increase sun exposure and decrease humidity** through landscape design principals. This can help to reduce tick survival since sun exposure and limited humidity can dessicate ticks.
- 4 **Use fencing where possible** to limit deer and other host animal movement throughout the landscape. This reduces the risk of ticks becoming dispersed in an environment through animal hosts.
- 5 **Prune plants** regularly (e.g., trees, shrubs, and bushes).
- 6 **Maintain lawn** by keeping grass short.
- 7 **Remove yard waste** such as leaf litter, brush/log piles, weeds, and debris.
- 8 **Stack wood neatly** in dry area away from the house or other buildings.
- 9 **Move seating and play structures into open areas** at least 3 yards away from landscape perimeter. Mark area with a 3 inch woodchip border.

Competing public health priorities

Insecticides as a last resort:

- Chemical measures (acaricides, pyrethroids, and permethrin) can be used to complement landscape design and management to limit tick populations in certain areas.
- Consult a certified pest management specialist to see if your park, recreational area, or property is a good candidate for chemical measures.

Poll Question

In your personal or professional life, do you foresee yourself implementing these landscape design considerations to reduce the risk of ticks?

So what can we do?

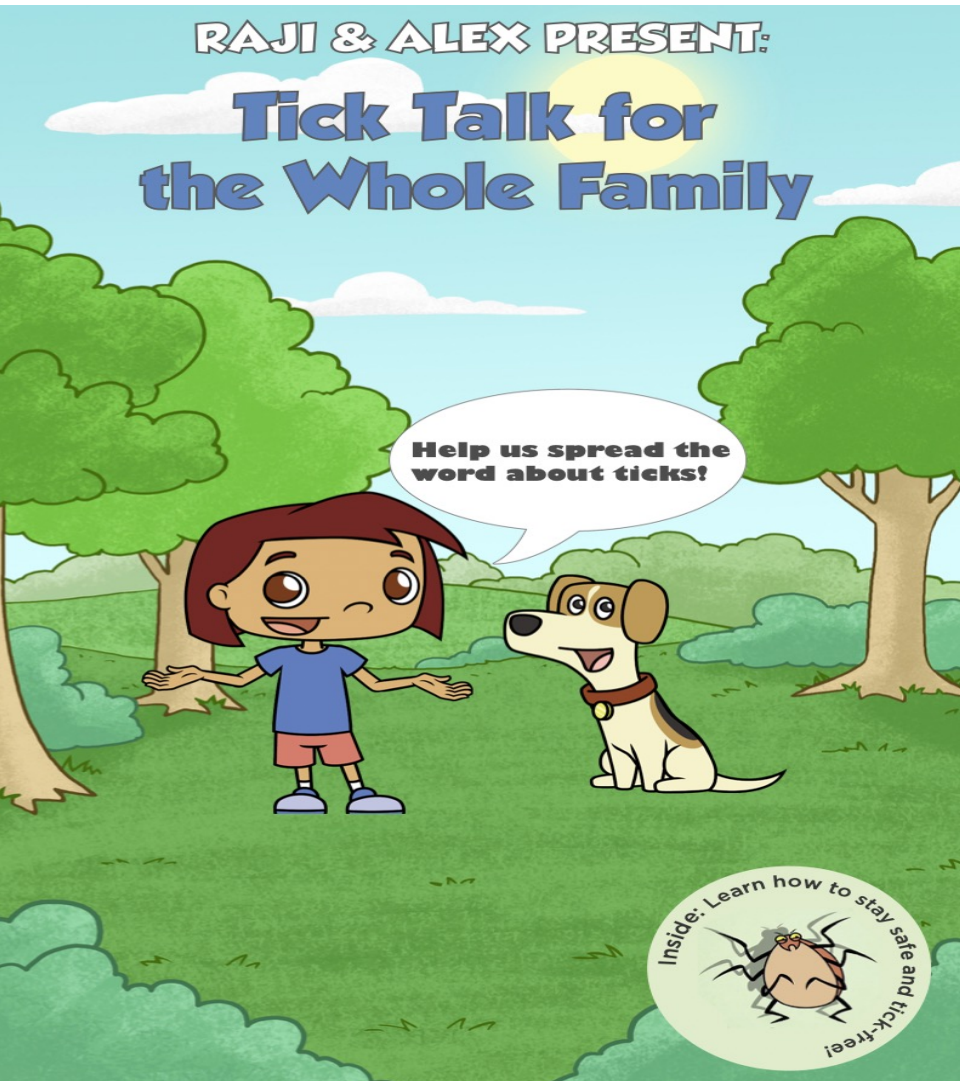
Design and manage
outdoor
environments to
minimize risk

Support and fund
research and
surveillance efforts

Support policies and
land use practices
that minimize tick
related risks

Risk communication

Risk communication through web and visual media



<https://shorturl.at/nADJ0>



<https://www.spraysafeplaysafe.org/films.html>



The Tick App

Your On-The-Go Tick Expert

<https://shorturl.at/ckCUZ>

**WEES NIET GEK.
DOE DE TEKENCHECK.**



<https://www.tekenbeten.be>



The Tick App

Your On-The-Go Tick Expert

<https://shorturl.at/ckCUZ>

WEES NIET GEK.
DOE DE TEKENCHECK.

<https://www.tekenbeten.be>

Be a citizen scientist!

Encounter a tick? Submit a photo with date and location to www.etick.ca for no-cost identification by a professional. This helps to map tick species to a geographical area and time of year and track changes over time.





How to create effective signs to increase awareness?



Ticks in a changing environment

FAST FACTS

- Ticks can be found in **many environments**, but are commonly found in wooded areas with leaf litter, tall grassy areas, shrub layers and along forest edges.
- Ticks can infect humans with pathogens that can lead to illnesses such as Lyme disease, anaplasmosis, and Babesiosis, among others.
- The number of places where ticks can survive and thrive in Canada is growing due to climate change, animal migration, deforestation and urbanization.
- Landscapes can be designed and managed to minimize tick and animal host (e.g., deer and rodents) habitats.



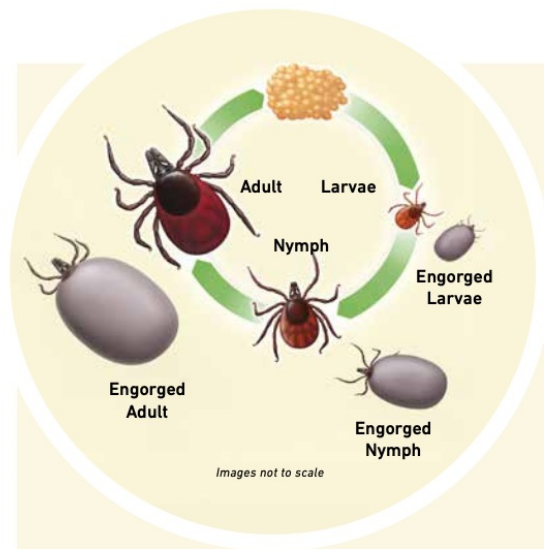
National Collaborating Centre
for Environmental Health
Centre de collaboration nationale
en santé environnementale

May 2023

www.nccch.ca

<https://shorturl.at/aeqCV>

TICK LIFE CYCLE AND HABITAT



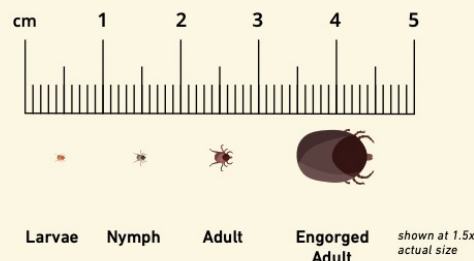
Images not to scale

Ticks are small arthropods. They are slow moving and their bodies have a flat tear drop shape. They go through 3 life stages:

Larvae | 6-legged, become engorged after feeding

Nymph | 8-legged, become engorged after feeding

Adult | 8-legged, become engorged after feeding



Tick species and habitats

SPECIES / COMMON NAME	TYPICAL RANGE*	HABITAT PREFERENCES
<i>Ixodes scapularis</i> Blacklegged tick	East of Rocky Mountains	Prefer high moisture areas; often found in leaf litter and under forest canopy.
<i>Ixodes pacificus</i> Western blacklegged tick	West of Rocky Mountains	
<i>Dermacentor variabilis</i> American dog tick	Eastern Canada Eastern AB and SK, MB, ON, QB, NB, NS	Prefer drier environments; often found in grass and shrubs.
<i>Dermacentor andersoni</i> Rocky mountain wood tick	Western Canada BC, AB, SK	
<i>Amblyomma americanum</i> Lone Star	Canada wide	Often found in wooded areas and leaf litter.

* This table represents available research as of 2023. Surveillance is limited in many areas and this information could be an underrepresentation of the actual presence of tick species in a particular area. The range of tick species will also change with climate change.

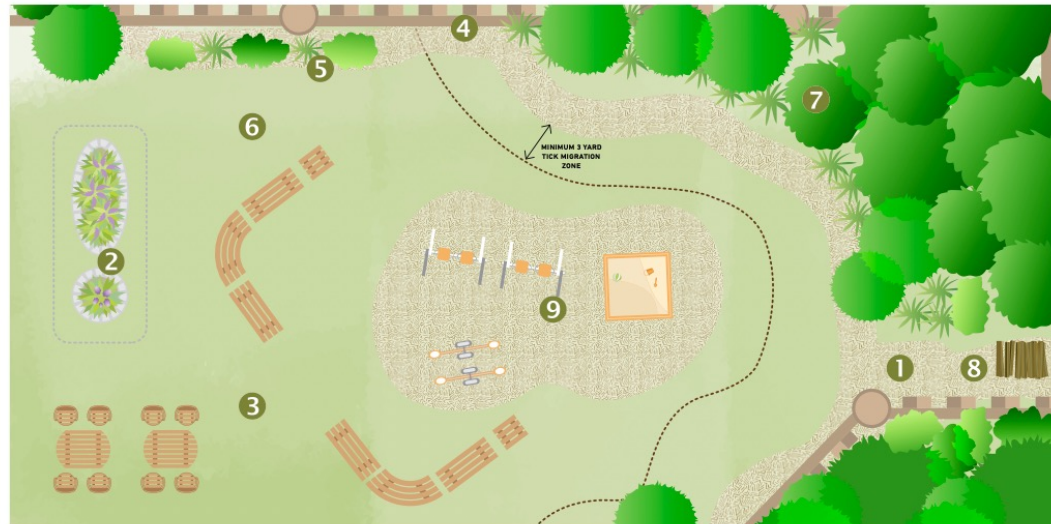
The range of ticks is expanding

- It is estimated that the range of ticks will expand northwards by 35-55 km per year.
- Increasing ambient temperature and high relative humidity can increase tick population and activity.



National Collaborating Centre
for Environmental Health
Centre de collaboration nationale
en santé environnementale

LANDSCAPE DESIGN TO MINIMIZE TICK HABITAT SUITABILITY



Landscape design considerations

- 1 Create clear pathways.** Use hardscaping materials such as gravel, stones, bare soil, and cedar chips or sawdust to create a path or to delineate a border at least 3 inches wide. Research shows that woodchip borders along trails effectively suppress *Ixodes scapularis* activity.
- 2 Select plants to limit deer and/or rodents.** This may also increase insect biodiversity limiting ticks. Consider ornamental deer and rodent resistant plants (e.g. lavender, rosemary, pennyroyal, daffodil, iris, Russian sage). Plant selection will vary according to climate. A landscape specialist can be consulted to guide regional plant selection and their placement.
- 3 Increase sun exposure and decrease humidity** through landscape design principals. This can help to reduce tick survival since sun exposure and limited humidity can desiccate ticks.
- 4 Use fencing where possible** to limit deer and other host animal movement throughout the landscape. This reduces the risk of ticks becoming dispersed in an environment through animal hosts.
- 5 Prune plants** regularly (e.g., trees, shrubs, and bushes).
- 6 Maintain lawn** by keeping grass short.
- 7 Remove yard waste** such as leaf litter, brush/log piles, weeds, and debris.
- 8 Stack wood neatly** in dry area away from the house or other buildings.
- 9 Move seating and play structures into open areas** at least 3 yards away from landscape perimeter. Mark area with a 3 inch woodchip border.

Insecticides as a last resort:

- Chemical measures (acaricides, pyrethroids, and permethrin) can be used to complement landscape design and management to limit tick populations in certain areas.
- Consult a certified pest management specialist to see if your park, recreational area, or property is a good candidate for chemical measures.



BE PREPARED WHEN OUTDOORS

Take action: minimize your risk of tick encounters



Outdoor

- Avoid high-risk areas with high grass and leaf litter.
- Walk on cleared trails.
- Wear light-coloured clothing covering arms and legs (to easily spot ticks on clothing).
- Tuck clothing (e.g. pants into socks, shirt into pants).
- Wear closed-toed shoes to create a barrier for skin.
- Conduct regular checks for crawling ticks.
- Apply insect repellents approved in Canada.*
- Wear permethrin-treated clothing. In Canada, this is approved for those over the age of 16. Permethrin sprays and liquids for treating one's own clothes are not approved in Canada.

Returning indoors

- Check clothing and gear for unattached ticks.
- Change from your outdoor clothes and put them in the dryer, on high heat, for at least 10 minutes to kill ticks.
- Take a shower/bath to rinse unattached ticks.
- Thoroughly check yourself and pets for tick(s). You should check your whole body as ticks can attach anywhere.
- Pay close attention to your head, hairline, behind your ears, waist, belly button, between the legs, and behind your knees. A hand-held mirror is helpful to see all body parts.
- Promptly remove tick(s) using a fine point tweezer, grasping ticks neck at a 90-degree angle. Wash the area with soap and water.
- Keep tick in a jar with moist cotton ball, submit to your health provider for testing. See this instructional video: shorturl.at/hmrJK

* INSECT REPELLENTS APPROVED IN CANADA

As of 2023, there are two approved personal insect repellents: DEET and Icaridin.

DEET The approved concentration varies according to age:	
> 12 years of age	30% DEET
2 – 12 years	10% DEET up to three times a day
6 months – 2 years	10% DEET once a day.
< 6 months	Not recommended for infants under 6 months, use mosquito net instead.
Icaridin Products containing up to 20% icaridin (also know as picaridin) are safe for children 6 months and older.	

Be a citizen scientist!

Encounter a tick? Submit a photo with date and location to www.etick.ca for no-cost identification by a professional. This helps to map tick species to a geographical area and time of year and track changes over time.



National Collaborating Centre
for Environmental Health
Centre de collaboration nationale
en santé environnementale



Scan the QR for more
information about this project.



This document can be cited as: National Collaborating Centre for Environmental Health. **Ticks in a changing environment (fact sheet)**. Vancouver, BC: NCCEH; 2023 May. Available from: <https://shorturl.at/fixQR>

FAST FACTS

- Ticks can be found in **many environments**, but are commonly found in wooded areas with leaf litter, tall grassy areas, shrub layers and along forest edges.
- Ticks can infect humans with pathogens that can lead to illnesses such as Lyme disease, anaplasmosis, and Babesiosis, among others.
- The number of places where ticks can survive and thrive in Canada is growing due to climate change, animal migration, deforestation and urbanization.
- Landscapes can be designed and managed to minimize tick and animal host (e.g., deer and rodents) habitats.

Thank you...

Dr. Leah Rosenkrantz

Dr. Anne-Marie Nicol

Dr. Lydia Ma

Dr. Sarah Henderson

Michele Wiens

Questions

Contact info:

nelmieh@gmail.com

Project website: <https://ncceh.ca/environmental-health-in-canada/health-agency-projects/managing-tick-related-risks-outdoor>