

PARASITES of FERAL SWINE



(Credit: Centers for Disease Control and Prevention)

(Credit: USDA APHIS WS)

Parasites are organisms that live on or in a host for all or part of their life cycle and get their food from, or at the expense of, the host. Broadly, the term parasite includes ectoparasites and endoparasites. Although flies and mosquitoes are considered ectoparasites because they are dependent upon a blood meal from a host for their survival, this term is generally used to refer to organisms such as ticks, fleas, lice, and mites that attach or burrow into the skin and remain there for relatively long periods of time. Other organisms (e.g., chiggers) may have ectoparasitic stages, but are free-living as adults. Through their feeding and reproductive activities, ectoparasites can transmit pathogens to humans, pets, livestock, and/or wildlife. Alternatively, endoparasites inhabit the internal organs and tissues of hosts, where they feed and reproduce. Although many of the parasites presented in this guide rarely cause disease in feral swine, they may be of aesthetic concern for hunters and wildlife professionals. This guide describes some of the more common and important parasites associated with feral swine and other mammals in the United States (U.S.) and some of the pathogens they can transmit. Also included are a few exotic parasites that have been or may be associated with feral swine should they become established.

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TICKS

There are numerous tick species that have varied temperature and habitat preferences with some being more active during summer months in warm and humid climates, while others prefer more arid habitats and are more active in cooler months. All ticks have at least one stage that feeds on the blood of their hosts, which makes them possible vectors for a number of pathogens that can be transmitted to humans, pets, livestock, wildlife and/or feral animals including swine. Ticks are classified as arachnids and have 3 mobile development stages:



Three families of ticks exist:

- Argasidae (soft ticks)
- Ixodidae (hard ticks)
- Nuttalliellidae (a single tick species that is not included in this brochure)

Single blood meals are required to progress to the nymph and adult stages. The transition/growth period from one stage to the next is called a molt.

Hard ticks:

- Larvae, one nymphal stage, and adults each feed once
- Have one to three hosts depending on tick species
- Hosts vary by tick species but can include:
 - Both molts occur on the same host (one-host ticks)
 - Nymph stage drops off to molt (two-host ticks)
 - Larva and nymph stages each drop off to molt (three-host ticks)
- Hosts can include:
 - Small animals (birds, lizards, and rodents)
 - Medium animals (wild turkeys, bobcats, coyotes, rabbits, raccoons, skunks, domestic cats and dogs)
 - Large animals (bears, deer, elk, feral swine, cougars, livestock, and humans)
- Have a rigid scutum (hard plate) and a prominent capitulum (head)

Soft ticks:

- Nymphs and adults feed multiple times
- Have many nymph stages- each requiring a blood meal before starting the next
- Are considered multi-host ticks
- Hosts can include:
 - Small animals (rodents)
 - Medium animals (dogs)
 - Large animals (livestock and deer as well as humans)
- Have no scutum and the capitulum is concealed
- Typically emerge at night to feed, usually without disturbing their sleeping hosts

Tick photos courtesy of the U.S. National Tick Collection: Georgia Southern University, Statesboro, Georgia and tick distribution maps from CDC, unless noted.

AMERICAN DOG TICK

(*Dermacentor variabilis*)



Female



Male

American dog ticks are three-host ticks. Larvae and nymphs commonly feed on small to medium animals such as rodents, coyotes, opossums, raccoons, and domestic cats and dogs, while adults also may feed on medium animals including domestic & feral swine, as well as humans.

Disease	Agent (Type)	Symptoms in humans	Transmission stage(s)	Other species affected
Ewingii ehrlichiosis	<i>Ehrlichia ewingii</i> (bacteria)	fatigue, fever, muscle pain, and nausea	nymph and adult	dogs
Rocky Mountain spotted fever	<i>Rickettsia rickettsii</i> (bacteria)	fever, muscle pain, nausea, rash, red eyes, and vomiting	larva, nymph, and adult	dogs
Tick paralysis	Tick saliva (salivary neurotoxin)	weakness and paralysis, reduced muscle tone starting in the legs & moving upward	adult	birds and mammals
Tularemia	<i>Francisella tularensis</i> (bacteria)	respiratory difficulty, red eyes, skin ulcers at bite site, sore throat, and tonsillitis	nymph and adult	most mammals



BLACKLEGGED TICK/DEER TICK

(*Ixodes scapularis*)



Female



Male



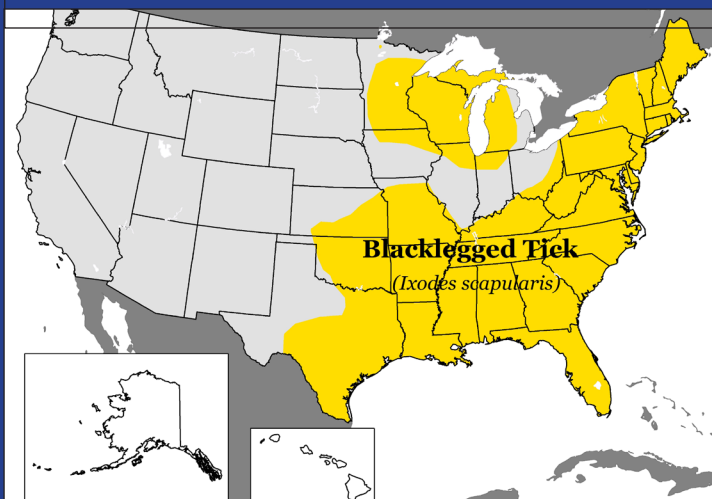
Nymph



Larva

Deer ticks are three-host ticks. Larvae and nymphs may feed on birds, rodents, raccoons, deer, domestic & feral swine, cattle, and domestic cats and dogs, as well as humans. Adults may feed on similar animals.

Disease	Agent (Type)	Symptoms in humans	Transmission stages	Other species affected
Babesiosis	<i>Babesia microti</i> (bacteria)	anemia, body aches, fatigue, fever, and nausea	nymph and adult	not known to cause disease in other species
<i>Borrelia miyamotoi</i>	<i>Borrelia miyamotoi</i> (bacteria)	body aches, fatigue, fever, headache, and joint pain	larva, nymph, and adult	not known to cause disease in other species
Ehrlichiosis	<i>Ehrlichia muris</i> -like (bacteria)	diarrhea, fever, muscle pain, rash, red eyes, and vomiting	nymph and adult	not known to cause disease in other species
Human granulocytic anaplasmosis	<i>Anaplasma phagocytophilum</i> (bacteria)	cough, fatigue, fever, muscle pain, and nausea	nymph and adult	dogs, horses, and ruminants
Lyme disease	<i>Borrelia burgdorferi</i> (bacteria)	acute: fatigue, fever, muscle and joint pain, rash, and swollen lymph nodes chronic: arthritis, encephalitis, heart palpitations, memory loss, and respiratory difficulty	nymph and adult	Dogs, horses
Powassan disease	Powassan disease (virus)	encephalitis, fatigue, fever, meningitis, neurological difficulties, seizures, and vomiting	larva, nymph, and adult	can infect foxes and squirrels; disease rare



BROWN DOG TICK

(*Rhipicephalus sanguineus*)



Female



Male

Brown dog ticks are three-host ticks, and are found throughout the U.S. Larvae, nymphs, and adults all prefer dogs, but may feed on domestic cats and raccoons, domestic & feral swine, and humans. *Rickettsia massiliae* has been found in brown dog ticks from Arizona, California, and Virginia, but the disease *R. massiliae* rickettsiosis has been reported only in dogs in California.

Disease	Agent (Type)	Symptoms in humans	Transmission stages	Other species affected
Canine ehrlichiosis	<i>Ehrlichia canis</i> (bacteria)	diarrhea, fever, muscle pain, rash, red eyes, and vomiting	nymph and adult	dogs
<i>Rickettsia massiliae</i> rickettsiosis	<i>Rickettsia massiliae</i> (bacteria)	fever, headache, rash, and skin sloughing at bite site	nymph and adult	dogs
Rocky Mountain spotted fever	<i>Rickettsia rickettsii</i> (bacteria)	fever, muscle pain, nausea, rash, red eyes, and vomiting	larva, nymph and adult	dogs



GULF COAST TICK

(*Amblyomma maculatum*)



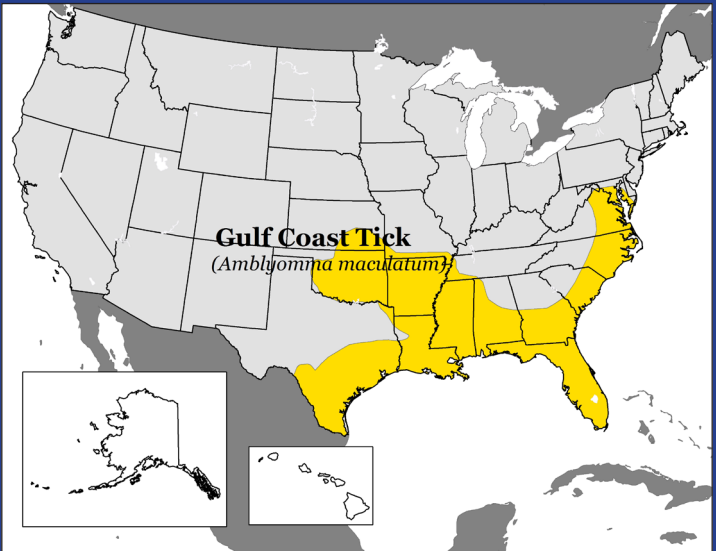
Female



Male

Gulf coast ticks are three-host ticks. Larvae and nymphs commonly feed on rodents and quail, while adults may feed on medium to large animals, such as coyotes, raccoons, deer, domestic & feral swine, wild turkeys, and cattle, as well as humans.

Disease	Agent (Type)	Symptoms in humans	Transmission stages	Other species affected
American boutonneuse fever	<i>Rickettsia parkeri</i> (bacteria)	fever, headache, rash, and skin sloughing at bite site	larva, nymph, and adult	not known to cause disease in other species



LONE STAR TICK

(*Amblyomma americanum*)



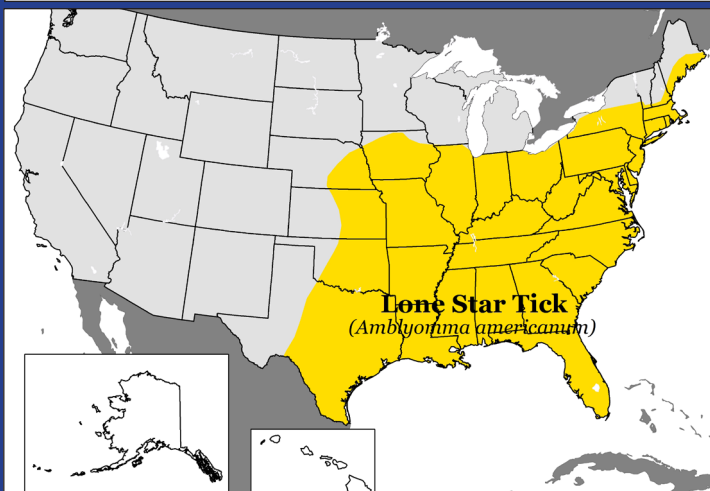
Female



Male

Lone star ticks are three-host ticks. Larvae, nymphs, and adults commonly feed on quail, raccoons, domestic & feral swine, deer, wild turkeys, cattle, and domestic cats and dogs, as well as humans. Heavy infestations can cause extensive tissue damage.

Disease	Agent (Type)	Symptoms in humans	Transmission stages	Other species affected
Ehrlichiosis	<i>Ehrlichia chaffeensis</i> , <i>Ehrlichia ewingii</i> , and <i>Ehrlichia</i> sp. (Panola Mountain <i>Ehrlichia</i>) (bacteria)	diarrhea, fever, muscle pain, rash, red eyes, and vomiting	nymph and adult	dogs
Heartland virus	<i>Phlebovirus</i> (virus)	diarrhea, fatigue, fever, muscle pain, and nausea	nymph and adult	none known
Bourbon virus	<i>Thogotovirus</i> (virus)	Fever, headache, decrease appetite, muscle aches, nausea, vomiting, diarrhea and maculopapular rash	nymph and adult	none known
Alpha-gal meat allergy	Antibody response to sugar molecule found in non-human animals (allergen)	anaphylaxis, severe allergic reaction including diarrhea, decreased blood pressure, respiratory distress, and vomiting, history of a Lone Star tick bite and subsequent ingestion of red meat	larva, nymph, and adult	not known to cause disease in other species
Southern tick associated rash illness (STARI)	Currently unknown	fatigue, fever, muscle pain, and large rash at bite site	nymph and adult	not known to cause disease in other species
Tularemia	<i>Francisella tularensis</i> (bacteria)	respiratory difficulty, red eyes, skin ulcers at bite site, sore throat, and tonsillitis	nymph and adult	most mammals



PACIFIC COAST TICK

(*Dermacentor occidentalis*)



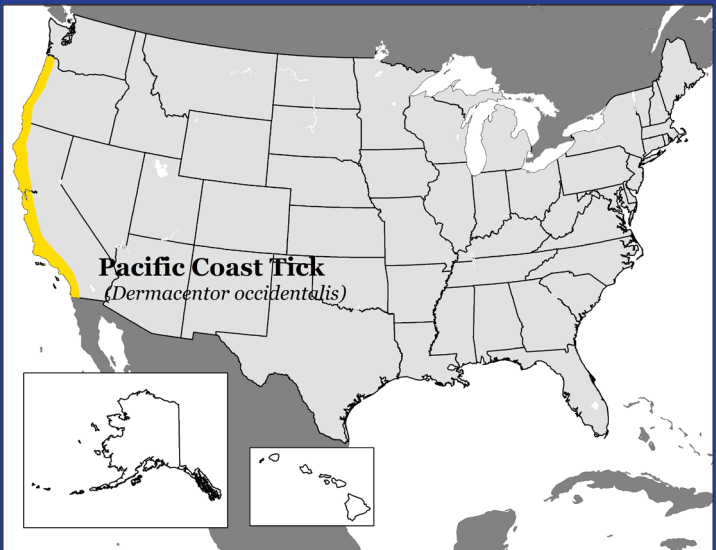
Female



Male

Pacific coast ticks are three-host ticks. Larvae and nymphs often feed on rodents, while adults may feed on raccoons, deer, domestic & feral swine, domestic cats and dogs, and cattle, as well as humans.

Disease	Agent (Type)	Symptoms in humans	Transmission stages	Other species affected
364D Rickettsiosis	<i>Rickettsia phillipi</i> (bacteria)	fever and skin sloughing at bite site	nymph and adult	not known to cause disease in other species
Bovine anaplasmosis	<i>Anaplasma marginale</i> (bacteria)	not known to affect humans	nymph and adult	cattle
Rocky Mountain spotted fever	<i>Rickettsia rickettsii</i> (bacteria)	fever, muscle pain, nausea, rash, red eyes, and vomiting	larva, nymph and adult	dogs



ROCKY MOUNTAIN WOOD TICK

(*Dermacentor andersoni*)



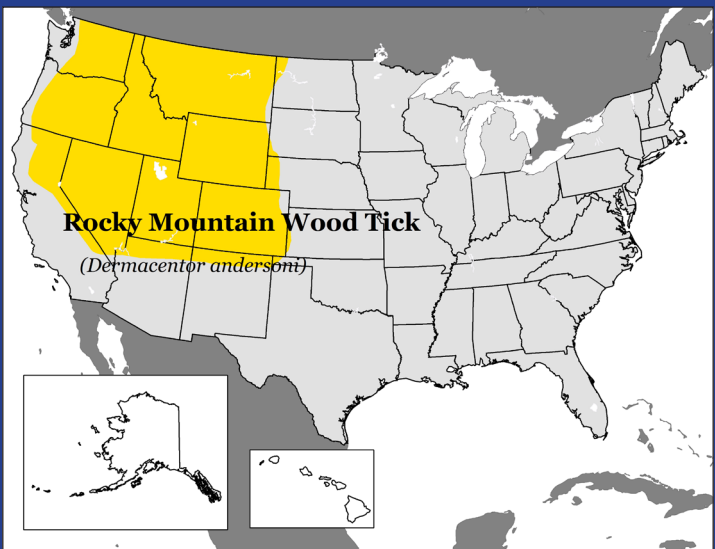
Female



Male

Rocky Mountain wood ticks are three-host ticks. The larvae and nymphs often feed on rodents, while adults may feed on raccoons, deer, domestic & feral swine, cattle, and domestic cats and dogs, as well as humans.

Disease	Agent (Type)	Symptoms in humans	Transmission stages	Other species affected
Colorado tick fever	<i>Coltivirus</i> (virus)	body aches, fatigue, fever, sore throat, and vomiting	nymph and adult	not known to cause disease in other species
Rocky Mountain spotted fever	<i>Rickettsia rickettsii</i> (bacteria)	fever, muscle pain, nausea, rash, red eyes, and vomiting	larva, nymph, and adult	dogs
Tick paralysis	Tick saliva (salivary neurotoxin)	muscle paralysis	nymph and adult	most mammals
Tularemia	<i>Francisella tularensis</i> (bacteria)	red eyes, skin ulcers at bite site, sore throat, respiratory difficulty, and tonsillitis	nymph and adult	most mammals



SOFT TICKS

(*Ornithodoros coriaceus*)



Female

Male

(*Ornithodoros hermsi*)



Female

Male

(*Ornithodoros parkeri*)



Female

Male

(*Ornithodoros turicata*)

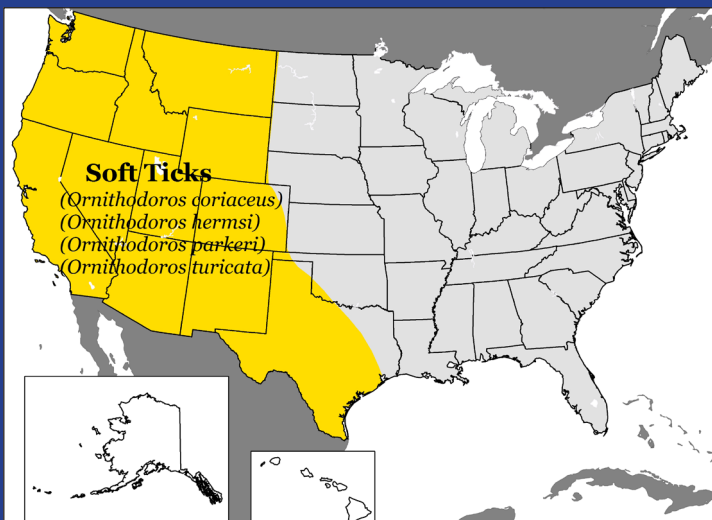


Female

Male

Ornithodoros ticks are multi-host soft ticks. *Ornithodoros coriaceus* habitat ranges from sea level to 7,500 feet, and larvae, nymphs, and adults often feed on mule deer and cattle. *Ornithodoros hermsi* primarily lives at altitudes above 1,500 feet, and larvae, nymphs, and adults often feed on squirrels and chipmunks. *Ornithodoros parkeri* and *O. turicata* primarily live at altitudes below 1,500 feet, and larvae, nymphs, and adults often feed on ground squirrels, prairie dogs, and burrowing owls. Each of these *Ornithodoros* soft ticks also may feed on humans, especially in environments where soft ticks live in the walls and floors of rural buildings and cabins.

Disease	Agent (Type)	Symptoms in humans	Transmission stages	Other species affected
Epizootic bovine abortion	<i>Pajaroellobacter abortibovis</i> (bacteria)	not known to affect humans	nymph and adult	cattle (via the bite of <i>O. coriaceus</i>)
Tick-borne relapsing fever	<i>Borrelia hermsi</i> , <i>Borrelia parkeri</i> , and <i>Borrelia turicata</i> (bacteria)	fever, headache, joint pain, and muscle pain	nymph and adult	dogs (<i>Borrelia turicata</i> via the bite of <i>O. turicata</i>)



WESTERN BLACKLEGGED TICK

(*Ixodes pacificus*)



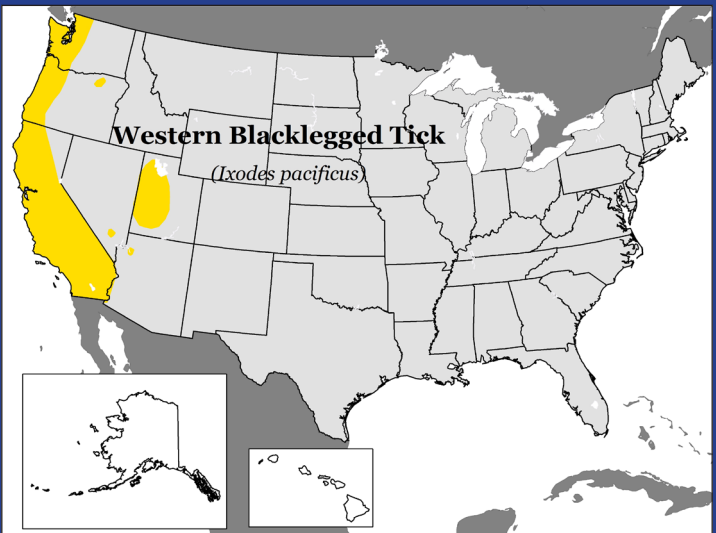
Female



Male

Western blacklegged ticks are three-host ticks. Larvae often feed on birds, lizards, and rodents. Nymphs may feed on birds, lizards, rodents, foxes, opossums, rabbits, raccoons, and deer, as well as humans. Adults may feed on black bears, domestic & feral swine, cattle, and domestic cats and dogs, as well as humans.

Disease	Agent (Type)	Symptoms in humans	Transmission stages	Other species affected
<i>Borrelia miyamotoi</i>	<i>Borrelia miyamotoi</i> (bacteria)	body aches, fatigue, fever, headache, and joint pain	larva, nymph, and adult	not known to cause disease in other species
Human granulocytic anaplasmosis	<i>Anaplasma phagocytophilum</i> (bacteria)	cough, fatigue, fever, muscle pain, and nausea	nymph and adult	dogs, horses, and ruminants
Lyme disease	<i>Borrelia burgdorferi</i> (bacteria)	Acute: fatigue, fever, muscle and joint pain, rash, & swollen lymph nodes Chronic: arthritis, encephalitis, heart palpitations, memory loss, neck stiffness, and respiratory difficulty	nymph and adult	dogs and horses



WINTER TICK

(*Dermacentor albipictus*)



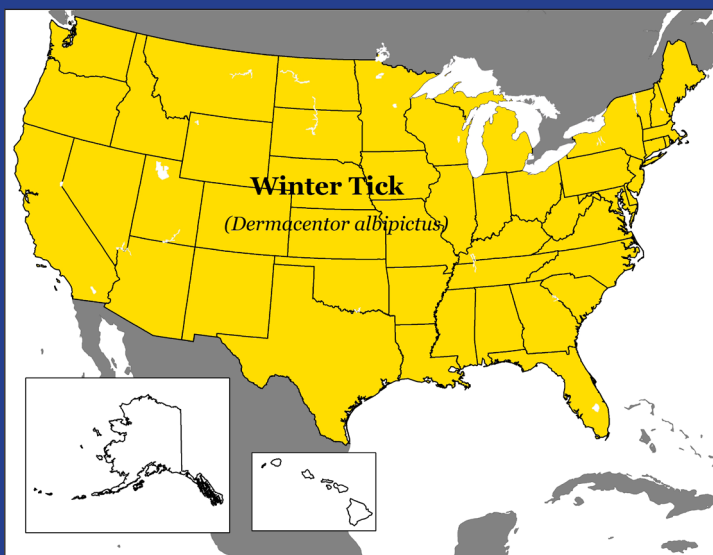
Female



Male

Winter ticks are one-host ticks, and are found throughout the continental U.S. Larvae, nymphs, and adults feed on the same animal to complete their life cycle. Members of the Cervidae family including black-tailed deer, caribou, elk, moose, mule deer, and white-tailed deer are the preferred hosts, but within this group, moose are the main hosts. Winter ticks also may feed infrequently on bighorn sheep, bison, black bears, coyotes, feral swine, pronghorn antelope, cattle, and horses. Winter tick infestations on moose can cause significant hair loss, weight loss, anemia, and death. This condition has been called “ghost moose disease” due to the pale appearance of moose with significant hair loss.

Disease	Agent (Type)	Symptoms in humans	Transmission stages	Other species affected
Bovine anaplasmosis	<i>Anaplasma marginale</i> (bacteria)	not known to affect humans	nymph and adult	cattle
Ghost moose disease	<i>Dermacentor albipictus</i> (arachnid)	does not affect humans	larva, nymph, and adult	moose, and infrequently elk



TROPICAL BONT TICK (EXOTIC)

(*Amblyomma variegatum*)



Female



Male

Tropical bont ticks are three-host ticks. Although originally from Africa, the tropical bont tick was introduced into the Caribbean in the 19th century, and is now established on several Caribbean islands including Antigua, Guadeloupe, and Marie-Galante. The tropical bont tick is not present in the U.S. In the Caribbean, larvae and nymphs occasionally feed on small animals, such as cattle egrets and mongooses, but most larvae and nymphs, and all adults feed on medium to large animals such as cattle, goats, horses, and sheep. If introduced to the U.S. mainland, the host range for this tick could include most wild mammals, feral swine, and ground-dwelling birds. Several pathogens are associated with this tick including *Rickettsia africae*, *Dermatophilus congolensis*, and *Ehrlichia ruminantium*.

Disease	Agent (Type)	Symptoms in humans	Transmission stage(s)	Other species affected
African tick bite fever	<i>Rickettsia africae</i> (bacteria)	fever, headache, muscle pain, skin sloughing at the bite site, and swollen lymph nodes	larva, nymph, and adult	not known to cause disease in other species
Dermatophilosis	<i>Dermatophilus congolensis</i> (bacteria)	does not affect humans	adult	ruminants, especially cattle
Heartwater	<i>Ehrlichia ruminantium</i> (bacteria)	not thought to affect humans	nymph and adult	ruminants, especially cattle

CATTLE FEVER TICKS (EXOTIC)

(*Rhipicephalus microplus* and *R. annulatus*)



Female



Male

The cattle fever ticks are three-host ticks native to South Asia, but they have been introduced to many parts of the world by the movement of cattle. These ticks represent a significant threat to the United States cattle industry because they can transmit two parasites (*Babesia bovis* and *B. bigemina*) to cattle. Following their introduction to the New World, they were widespread in the Eastern U.S., but after a successful eradication and control campaign are now only found in southern Texas. Control measures are still in place to continue the eradication of these ticks from the U.S. and to prevent reintroduction from Mexico and other Central and South American countries. In addition to cattle, large wildlife species (e.g., deer or nilgai) can serve as hosts for the ticks and it is possible that feral swine would also serve as a host.

LONGHORNED TICK OR BUSH TICK (EXOTIC)

(*Haemaphysalis longicornis*)



Female

Nymph

Larvae

(Credit: J. Occhi)

Longhorned ticks are three-host ticks that are native to East Asia but have been introduced and become established in numerous other regions including Australia, New Zealand, and several Pacific islands. In 2017, this tick was found on a sheep in New Jersey and subsequently has been detected in Arkansas, Maryland, North Carolina, Pennsylvania, Virginia and West Virginia. The current host list includes livestock, horses, dogs, cats, deer, opossum and raccoons. Surveillance continues so new hosts and locations are expected. This tick species can transmit numerous pathogens within its native range and in some introduced areas. Interestingly, this tick can reproduce parthenogenetically so many invasive populations consist of only female ticks.

MITES

Mites are small, arachnid parasites that live and feed on the skin of their hosts and have 4 developmental stages:

- Egg
- Larva
- Nymph
- Adult

Mites can cause disease via:

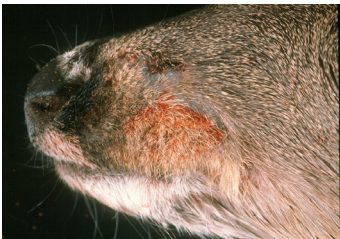
- feeding activities
- reproductive activities that involve burrowing into skin to deposit eggs

Mites tend to be:

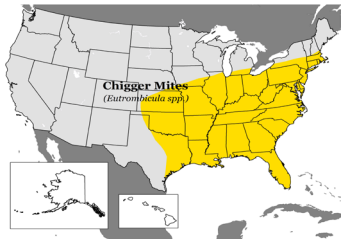
- more active during colder months
- generally adaptable and capable of feeding on a variety of species
- opportunistic parasites that readily move between individual hosts and/or species; however, some mites prefer certain species and can spend their entire life cycle on the same animal.

Some individual animals and humans can have severe allergic reactions to mite infestations. Mange is a general term referring to an infestation with mites, with the type of mange often determined by the species of mite involved. Cases of mange may be more obvious in colder months.

CHIGGER MITE (*Eutrombicula* spp.)



White-tailed deer with chiggers (Credit: SCWDS)

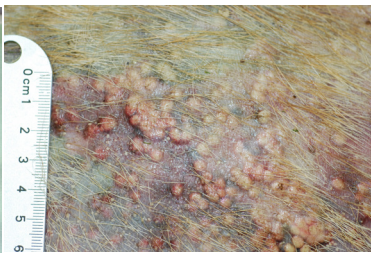


Chigger mites, often called “chiggers,” or “red bugs,” can be orange, red, or yellow, and opportunistically feed on a wide variety of animals, as well as humans. The larval stage is parasitic, while the nymph and adult stages usually feed on invertebrates or plants. An infestation with larval chigger mites, called trombiculiasis, is caused by chigger feeding, which involves dissolving skin cells via the mite’s saliva, and results in allergic dermatitis in humans. Chiggers are usually most active in the evening, and are often encountered in warm, wet climates.

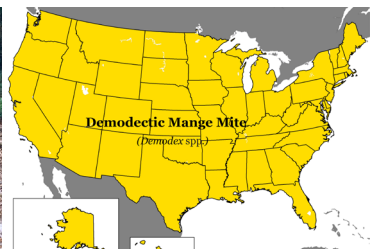
Disease	Agent (Type)	Symptoms in humans	Causative stage	Other species affected
Allergic dermatitis	<i>Eutrombicula</i> mite (arachnid)	dermatitis, hair loss, intense itching, scabs, secondary bacterial infections, and ulcers	larva	various livestock, wildlife, poultry, and pets

DEMODECTIC MANGE MITE

(*Demodex* spp.)



White-tailed deer with demodectic mange (Credit: SCWDS)



Black bear with demodectic mange (Credit: FWC)

Demodectic mange mites tend to be host species-specific, and the mites spend their entire life cycle on the same animal. These mites live in hair follicles and sebaceous glands of the skin, where they feed on oil, skin cells, and debris. In healthy hosts, the relationship between the mites and the host is considered commensal (the mites benefit from the host without causing any harm). However, mites can multiply to harmful levels causing demodectic mange. This usually occurs in hosts with compromised immune systems or other factors negatively affecting their health. The species names often reflect host-specificity, including *Demodex bovis* (cattle), *D. canis* (dogs), *D. odocoilei* (white-tailed deer), and *D. phylloides* (domestic and feral swine). *Demodex folliculorum* and *D. brevis* are specific to humans.

Disease	Agent (Type)	Symptoms in humans	Causative stages	Other species affected
Demodectic mange	<i>Demodex</i> species mites (arachnid)	boils, dermatitis, hair loss, itching, secondary bacterial infections, and ulcers	larva, nymph, and adult	various mammal species with each affected by its host-specific species of <i>Demodex</i>

SCABIES MITE

(*Sarcoptes scabiei*)



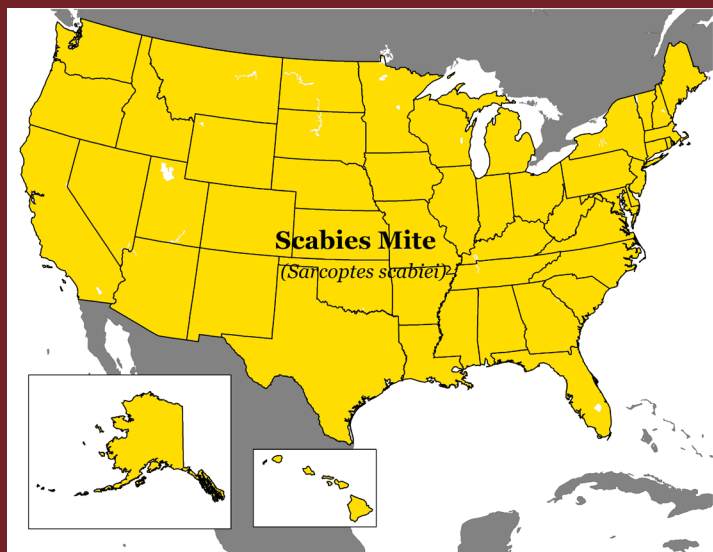
Red fox with sarcoptic mange (Credit: SCWDS)



Hog with sarcoptic mange (Credit: M. Campos Pereira)

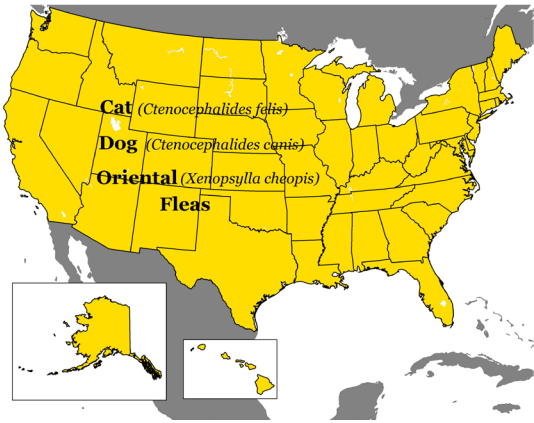
There are several subspecies of this mite, each typically preferring a certain host species, but cross-species infection is common. Humans may become infected with almost any subspecies. Sarcoptic mange causes severe allergic dermatitis, which occurs in humans when mites burrow deeply into the skin, forming tunnels in which they live, feed, and lay eggs.

Disease	Agent (Type)	Symptoms in humans	Causative stages	Other species affected
Sarcoptic mange	<i>Sarcoptes scabiei</i> mite (arachnid)	dermatitis, hair loss, intense itching, scabs, and secondary bacterial infections	larva, nymph, and adult	various mammals including bears, coyotes, red fox, cattle, and domestic cats and dogs



FLEAS

Fleas are small, flightless insect parasites that 1) occur throughout the U.S., 2) feed on the blood of a wide variety of hosts, including humans, and generally prefer warm, wet climates. Fleas have four developmental stages: egg, larva, pupa and adult. As fleas feed, they defecate and lay eggs in bunches on the skin or hair of the host. Flea saliva can cause severe allergic reactions in dogs and cats. The fleas described in this section are found throughout the U.S.



DOMESTIC CAT and DOG FLEAS

(*Ctenocephalides felis* and *Ctenocephalides canis*)



Cat flea (Credit: National History Museum London)

Domestic cat and dog fleas, as the names imply, primarily feed on domestic cats and dogs, and can spend their entire life cycles on the same animal. However, they are highly adaptable, and also can live and feed on a wide variety of animals including domestic and feral swine.

Disease	Agent (Type)	Symptoms in humans	Causative stage	Other species affected
Allergic flea dermatitis	<i>Ctenocephalides felis</i> and <i>Ctenocephalides canis</i>	intense itching, and secondary bacterial infections	adult	birds, livestock, wildlife, and domestic cats and dogs
Cestodiasis	<i>Dipylidium caninum</i> (parasitic tapeworm)	gastrointestinal discomfort and anal itch	adult	domestic cats and dogs
Flea-borne spotted fever	<i>Rickettsia felis</i> (bacteria)	chills, fever, headache, possible rash, and/or neurological signs	adult	not known to cause disease in other species
Murine typhus	<i>Rickettsia typhi</i> (bacteria)	chills, fever, headache, possible rash, and/or neurological signs	adult	not known to cause disease in other species

ORIENTAL RAT FLEA

(*Xenopsylla cheopis*)



(Credit: Natural History Museum London)



Fox squirrel with flea dermatitis (Credit: SCWDS)

The oriental rat flea most likely was introduced from Asia to the U.S. in the early 20th century, but now occurs throughout the country wherever its preferred hosts (rats) are found. It primarily feeds on rodents, especially rats, ground squirrels, and prairie dogs. The oriental rat flea typically spends its entire life cycle on the same animal, but it is highly adaptable and can feed on a variety of animals including bobcats, coyotes, ferrets, foxes, Florida panthers/mountain lions, and domestic cats and dogs, as well as humans.

Disease	Agent (Type)	Symptoms in humans	Transmission stage	Other species affected
Plague	<i>Yersinia pestis</i> (bacteria)	chills, fever, headache, swollen and painful lymph nodes near bite site, abdominal pain, bleeding in the skin and other organs, severe weakness, and death	adult	prairie dogs, ground squirrels, black-footed ferrets, bobcats, domestic cats, and mountain lions
Murine typhus	<i>Rickettsia typhi</i> (bacteria)	chills, fever, headache, possible rash, and/or neurological signs	adult	not known to cause disease in other species

FLIES

Flies are small, often winged, insects that generally feed on a variety of hosts. Flies have 4 developmental stages: egg, larva, pupa, and adult. Although many species of flies exist, those presented in this section are significant to human health, livestock, pets, wildlife, or are commonly encountered or mistaken for other ectoparasites. Blow flies are flies that can cause disease through their feeding and reproductive activities. Adult blow flies generally do not feed on hosts, but their larvae (maggots) feed on host tissues. Disease caused by the parasitic infestation of blow fly larvae can cause death to the host.

NEW WORLD SCREWORM (EXOTIC) (*Cochliomyia hominivorax*)



Key deer from Florida with severe screwworm infestation (Credit: U.S.



(Credit: USDA APHIS Wildlife Services)

The New World screwworm is a type of blow fly that was eradicated from the U.S. in the 1950s, but reintroductions and outbreaks have occurred since then, most recently in 2016, and all were eradicated. The New World screwworm is the larval stage of the blow fly *Cochliomyia hominivorax*. Adult female flies lay eggs in skin openings (wounds, tick bite sites, and newborn navels) of warm-blooded animals including humans. Within hours the larvae hatch and begin feeding on the host's living tissue. If left untreated, New World screwworm infestation often is fatal.

Disease	Agent (Type)	Symptoms in humans	Causative stage	Other species affected
New World screwworm infestation	<i>Cochliomyia hominivorax</i> (parasitic insect)	wound site swelling, pain, skin reddening, itchiness, bloody discharge from the wound, and presence of larvae (maggots)	larva	warm-blooded animals

LICE

Lice are small parasitic insects that live on the hair of warm-blooded hosts and have 3 developmental stages: egg, nymph, and adult. Lice can cause disease through their feeding activities when severe infestations (pediculosis) cause anemia and/or dermatitis via damaged host hair and skin. Infestations may be more noticeable in winter when lice congregate for warmth.

In general, lice are species-specific and tend to spend their entire lives on the hairs of a single animal. However, lice may move between individuals of their preferred host species when in close contact. Some individual animals can be predisposed to heavy infestations, and can serve to maintain lice populations in a group or herd, resulting in disease in livestock and/or wildlife.

Lice are classified as:

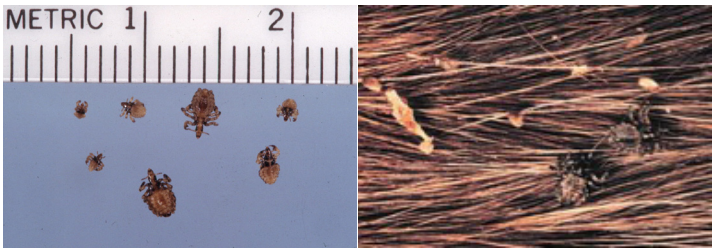
- Bloodsucking lice pierce the skin of their hosts and feed on blood (Order Anoplura)
- Chewing lice live among hairs and feed on skin and debris (Order Mallophaga), and are not covered in this guide.

BLOODSUCKING LICE

Bloodsucking lice presented in this section are found in the U.S.

HOG LICE

(*Haematopinus suis*)



(Credit: SCWDS)

Hog lice primarily feed on swine, including feral swine. Hog lice often live and feed on their hosts without causing harm. However, they can cause disease in swine that are sick and/or immunocompromised.

Disease	Agent (Type)	Symptoms in humans	Causative stages	Other species affected
Hog lice pediculosis (severe infestation)	<i>Haematopinus suis</i> (parasitic insect)	does not affect humans	nymph and adult	domestic swine and feral swine

ECTOPARASITE PREVENTION

Although it may not be feasible to completely avoid exposure to ticks and other ectoparasites, minimizing the risks of exposure can help reduce the incidence of disease. The following are offered as suggestions to help minimize exposure to ectoparasites:

- Treat clothing and exposed skin with 20 – 30% DEET, or treat clothing with 0.5% Permethrin prior to outdoor activity
- Conduct a full body check for ectoparasites in areas including under the arms, behind the knees, the head (hair and ears), and navel
- Bathe or shower (preferably within 2 hours) after being outdoors to more easily find & remove any ectoparasites
- Conduct thorough checks of pets and outdoor gear
- Increase vigilance for ectoparasites in warmer months when they are most active
- Wash clothes in hot water, and tumble dry on high heat
- Contact your physician if you suspect tick-borne or other ectoparasite disease exposures and exhibit any symptoms

ENDOPARASITES

Endoparasites are parasites that spend all or part of their life cycle inside a host in order to complete their development. Some of the endoparasites presented in this section can cause disease in their swine hosts, as well as in humans. Other endoparasites presented are not known to cause disease in swine or humans, but may be of concern if/when they are encountered by hunters, wildlife professionals, or the public. The endoparasites in this section are from five groups:

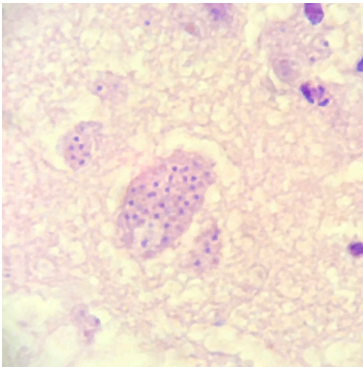
- Protozoans – single celled parasites
- Trematodes - flukes
- Cestodes - tapeworms
- Nematodes - roundworms
- Acanthocephalans – thorny-headed worms

All of these groups have very different morphologies and specialized life cycles. This section is not intended to serve as a complete list of endoparasites of swine and/or humans; however, a more complete list is provided in the Table at the end of this brochure.

PROTOZOANS

Protozoan endoparasites are a diverse group of organisms that includes the flagellates, ciliates, amoebas, and apicomplexans. This latter group is particularly diverse and includes enteric parasites, such as coccidians, tissue-dwelling parasites, such as *Sarcocystis* and *Toxoplasma gondii*, and blood-dwelling parasites such as *Babesia*. This group has a great deal of life cycle variability from species to species with some being directly transmitted, some that use invertebrate vectors, and others that use vertebrate intermediate hosts.

TOXOPLASMOSIS (*Toxoplasma gondii*)



Microscopic image of *T. gondii* (Credit: SCWDS)

Toxoplasma gondii is a microscopic protozoan parasite that undergoes sexual development in the digestive tracts of felines. Infected felines shed *T. gondii* oocysts (eggs) in their feces that sporulate in the environment and become infective. Warm-blooded animals, including birds and mammals (including swine and humans), can become infected intermediate hosts via ingestion of these infective oocysts or by ingestion of infected tissues of other intermediate hosts. In infected intermediate hosts, *T. gondii* transform into the next developmental stage and colonize tissues. Humans infected with *T. gondii* have Toxoplasmosis, and clinical signs may be minimal, or severe and reflective of the tissues affected. Toxoplasmosis is of particular concern for humans with weaker immune systems such as children, older adults, and the immunosuppressed. If a *T. gondii*-naïve woman becomes infected with *T. gondii* during pregnancy, the parasite can cause fetal death, malformations, and underdeveloped mental capacity. *Toxoplasma gondii* has a worldwide distribution, coinciding with feline populations.

TREMATODES

Trematodes are endoparasites mainly of the mammalian digestive tract and liver that are commonly referred to as flukes. Flukes are a type of flatworm, and as the name implies, the physical appearance of adult trematodes is thin, wide, and smooth. Trematode life cycles are similar, and begin with the adult trematode shedding eggs into the environment via the host feces. Water is required for further development for most species. If eggs are shed into water, free-swimming first stage larvae (miracidia) will hatch and seek out a snail intermediate host. Within the snail, the parasite undergoes additional developmental and asexual replication. Cercariae are released from the snails and this stage either attaches to aquatic vegetation where they encyst into metacercariae or penetrate the skin of second intermediate hosts. Transmission to the definitive host occurs when these metacercariae, from the environment or within 2nd intermediate hosts, are ingested.

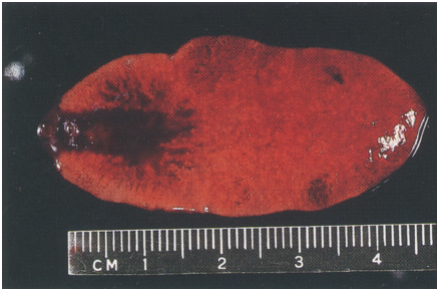
CATTLE LIVER FLUKE

(*Fasciola hepatica*)

&

GIANT LIVER FLUKE

(*Fascioloides magna*)



Giant Liver Fluke (Credit: SCWDS)

Giant Liver Flukes (*Fascioloides magna*) may achieve sizes of approximately 10 centimeters long by four centimeters wide, and cattle liver flukes (*Fasciola hepatica*) are approximately two centimeters by 1 centimeter. Swine become infected by eating vegetation that has encysted infective-stage liver flukes on the surface. Cattle and sheep are the normal hosts for *Fasciola hepatica* and white-tailed deer and other cervids are the normal hosts for *Fascioloides magna*. The geographic distributions of these fluke species are presumed to coincide with, and be limited to those of the natural hosts and the intermediate snail hosts. Disease associated with liver fluke infestations in swine is uncommon. The parasite only rarely infects humans as one would have to consume raw infested livers.

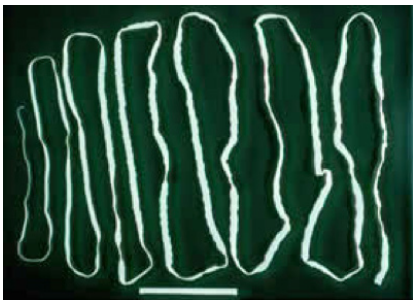
CESTODES

Cestode endoparasites are commonly referred to as “tapeworms” due to the physical appearance of their adult stage. Adult tapeworms lack true digestive tracts, and instead ingest host-provided nutrients through a specialized integument (skin) while they are attached to the lining of the host’s intestines. Because surface area helps tapeworms maximize feeding efficiency, they –as the name implies- appear flat; i.e. like a strip of tape. The size of adult tapeworms varies considerably by species but some can reach lengths of approximately four meters. Tapeworm life cycles are similar, and involve development stages from egg, to larva, to adult; however, some cestodes require more than one intermediate host during the larval stage. Adult tapeworms produce larva-containing eggs that are shed with host feces into the environment, where an intermediate host ingests them and development continues. Pseudophyllidean tapeworms require two or more intermediate hosts to complete their larval stages, whereas cyclophyllidean tapeworms require only one.

CYCLOPHYLLIDEAN TAPEWORMS

PORK TAPEWORM

(*Taenia solium*)



(Credit: CDC)

The pork tapeworm is an endoparasite of the digestive tract that can achieve a length of approximately three meters. Swine become infected with the pork tapeworm by eating eggs in the environment that contain infective-stage larvae. Swine are intermediate hosts for *T. solium*, and following ingestion the larvae colonize multiple tissues including the liver and skeletal muscle where they develop into second stage larvae (cysticercus). These cysticerci larvae are infective for the pork tapeworm definitive host: humans. Humans become infected by eating raw or undercooked pork containing cysticerci. Development to the adult stage takes place in the human digestive tract, and eggs are shed to complete the life cycle. Humans infected with adult *T. solium* worms have Taeniasis, and may experience no clinical signs, or they may experience stomach and abdominal pain, and weight loss. However this parasite is most important to human health when transmission of *T. solium* cysticerci occurs via ingestion of eggs from the environment. In this case, humans serve as intermediate hosts (similar to swine), and *T. solium* larvae may become encysted in the brain and/or skeletal muscle. This condition is called Cysticercosis, and can result in severe neurological signs, including seizures. *Taenia solium* has a worldwide distribution.

CANINE AND FELINE TAPEWORM

(*Taenia hydatigena*)



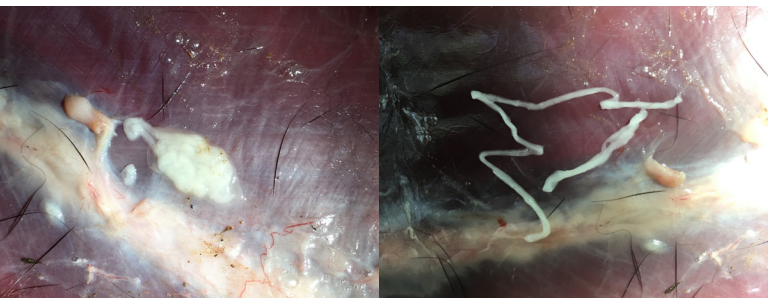
Porcine muscle containing numerous cysticerci (Credit: Uffe Christian Braae)

Numerous canid and felid hosts can serve as final hosts for *Taenia hydatigena*. The life cycle is similar to the pork tapeworm with numerous hosts, including pigs, harboring the cysticercus stage. The larval stage will superficially look like pork tapeworm.

PSEUDOPHYLLIDEAN TAPEWORMS

SPARGANOSIS TAPEWORM

(*Spirometra* spp.)



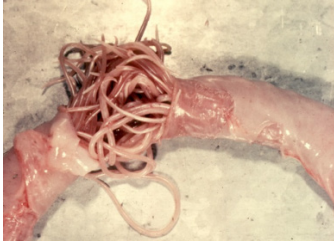
Spirometra parganum in the subcutaneous tissue of a feral pig (undisturbed on left and stretched out on right) (Credit: M. Yabsley)

Spirometra spp. are pseudophyllidean tapeworms (cestodes) that live in the digestive tract of final hosts and require two or more intermediate hosts to complete their life cycle. The first intermediate host is a copepod. When infected copepods are ingested by a second intermediate host, the larvae (sparganum) migrate through the tissues until they are ingested by a definitive host. Swine can serve as second intermediate hosts of *Spirometra* spp. and larvae are found in the skeletal muscle and connective tissues. Humans also can serve as second intermediate hosts and can become infected by drinking water containing infected copepods or by ingesting raw or undercooked pork or meat from an infected second intermediate host. Human infection is called Sparganosis, and clinical signs are reflective of the tissues affected. Neurological signs including headaches, weakness, and seizures can result from larvae migrating through the brain or spinal cord. *Spirometra* spp. tapeworms have worldwide distribution.

NEMATODES

Nematode endoparasites are a diverse group of roundworms with life cycle variability from species to species. Different groups of nematodes inhabit varying organ systems in their hosts.

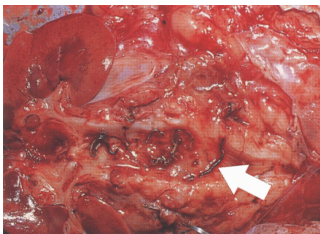
ASCARID WORM/SWINE ROUNDWORM (*Ascaris suum*)



(Credit: SCWDS)

The swine roundworm is a nematode endoparasite of the digestive tracts of swine. Adults can reach lengths of approximately 30 centimeters. Swine become infected with the swine roundworm by eating eggs in the environment that contain infective-stage larvae. Ascarid eggs are environmentally persistent. When eggs are ingested, larvae migrate through the lungs and liver where they can cause significant lesions “termed milk spots.” Swine are the normal host for this endoparasite, and the distribution of *A. suum* is presumed to coincide with that of domestic and feral swine. Disease associated with ascarid infestations in swine is uncommon, but young swine may develop a cough, fever, and difficulty gaining weight. The parasite is generally considered distinct from the human ascarid worm *Ascaris lumbricoides*; however, some researchers believe these species can hybridize and that *A. suum* is a rare zoonotic disease agent.

KIDNEY WORM (*Stephanurus dentatus*)

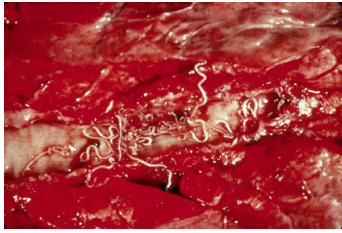


(Credit: SCWDS)

The kidney worm is a kidney nematode endoparasite, reaching lengths of approximately 40 millimeters. Adults are found within ureters and in perirenal fat. Swine can become infected with kidney worms by ingesting infective-stage larvae from the environment, ingesting earthworms that have ingested larvae and harbor them in their tissues, via direct penetration of skin by these larvae, or through transplacental transmission from female to offspring. Swine are the normal host for this endoparasite, and although the distribution of *S. dentatus* is presumed to coincide with that of domestic and feral swine, the prevalence is highest in the southern and mid-southern states. Disease associated with kidney worm infestations in swine is uncommon, but some infected swine may develop emaciation and/or weakness in the hind quarters. In domestic pigs, unthriftiness and rare deaths may occur. The parasite is not known to infect humans.

LUNG WORMS

(Six species of *Metastrongylus*; most common species include *M. apri*, *M. pudendotectus*, and *M. salmi*)



Adult *Metastrongylus* worms in the trachea of a feral pig (Credit: SCWDS)

Lung worms are pulmonary nematode endoparasites, reaching lengths of approximately 60 millimeters. Swine become infected with lung worms by eating earthworms containing infective-stage larvae. Swine are the normal host for this endoparasite, and the distribution of *Metastrongylus* spp. is presumed to coincide with that of feral swine. Disease associated with lung worm infestations in swine is uncommon; however, infected and immunocompromised swine may develop pneumonia. The parasite is not known to infect humans.

NODULAR WORMS

(*Oesophagostomum dentatum* and *O. brevicaudum*)

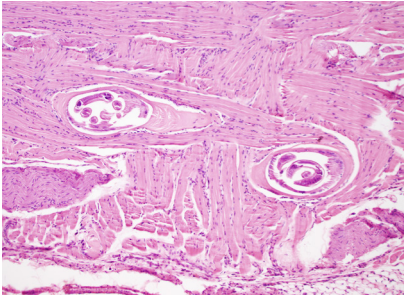


Nodules of *Oesophagostomum* in the wall of a pig intestine (Credit: Food and Agricultural Organization of the United Nations)

Nodular worms are nematode endoparasites of the digestive tracts of swine, and can reach lengths of approximately 20 millimeters. Swine become infected by eating infective-stage larvae in the environment. Ingested larvae invade the intestinal walls and become encysted, forming nodules. Inflammatory responses to these nodules can result in damage to the intestinal tract, severe diarrhea, and death. When they become fully developed, adult nodular worms move to the lumen of the digestive tract, and eggs are shed in the feces to complete the life cycle. Swine are the normal host for this endoparasite, and the distribution of nodular worms is presumed to coincide with that of feral swine. The parasite is not known to infect humans.

TRICHINELLOSIS WORM

(*Trichinella spiralis* and other *Trichinella* spp.)



Microscopic image of *Trichinella* in muscle (Credit: Bobbi Pritt)

Trichinella spp. are microscopic nematode endoparasites of the digestive tracts and muscle tissues of swine, humans, and other mammals. Swine and humans become infected via ingestion of infective-stage, encysted *T. spiralis* larvae in muscle tissues. Ingested larvae invade the intestines and develop into adult worms that produce next generation larvae that leave the digestive tract and encyst in muscle tissues in order to complete the life cycle. Thus, a single host serves as a definitive host and intermediate host and transmission is via carnivory. Humans infected with *Trichinella* spp. have Trichinellosis (also known as Trichinosis), and clinical signs may include swelling around the eyes, fever, abdominal pain, diarrhea, and vomiting. *Trichinella spiralis* has a worldwide distribution in swine and other *Trichinella* spp. occur in a variety of wildlife species.

WHIPWORM

(*Trichuris suis*)



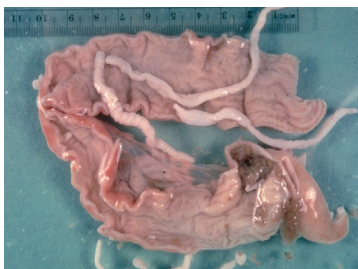
(Credit: Faculty of Tropical Agrisciences)

The whipworm (*Trichuris suis*) is a nematode endoparasite of the digestive tract of swine and can reach approximately 5 centimeters in length. As the name implies, the physical appearance of an adult *T. suis* resembles a whip, with a thinner anterior end and stouter posterior end. The whipworm embeds the thin anterior end in the lining of the swine intestine, and the stout end floats freely in the intestinal lumen. Eggs containing infective larvae are shed in the host feces; however, the egg will only hatch if ingested by swine, completing the life cycle. *Trichuris suis* eggs are environmentally hardy. Whipworm infections in adult swine typically are unremarkable; however, young animals with severe infections may have diarrhea, anorexia, and ill-thrift. *Trichuris suis* has a worldwide distribution, and may rarely infect humans.

ACANTHOCEPHALANS

Acanthocephalans begin in the environment as fully developed larva inside an egg. When the egg is ingested by an arthropod intermediate host, additional development results in an infective, encysted larval stage. Vertebrate hosts become infected via ingestion of the arthropod containing infective stage larvae. Acanthocephalans mature in the digestive tract of the vertebrate host, and larva-containing eggs are shed in the feces to complete the life cycle. Acanthocephalans rarely cause disease in their definitive hosts.

THORNY-HEADED WORM (*Macracanthorhynchus hirudinaceus*)



Intestine lumen containing acanthocephalan (Credit: SCWDS)

The thorny-headed worm is an acanthocephalan endoparasite of the swine digestive tract that can achieve a length of approximately 25 centimeters. Swine become infected with the thorny-headed worm by eating certain species of beetles that contain infective-stage larvae. Swine are the definitive host for this parasite although rare canine and human infections may occur. The distribution of *M. hirudinaceus* is presumed to coincide with that of feral swine. Disease associated with thorny-headed worm infestations in swine is uncommon.

ECTOPARASITE SUMMARY TABLE

Disease	Ectoparasite(s)	Agent Type	Affects Humans	Affects Livestock	Affects Wildlife
American Boutonneuse Fever	Gulf Coast Tick	Bacteria	Yes	No	No
Babesiosis	Blacklegged tick (Deer Tick)	Protozoan	Yes (some spp.)	No	No
Cestodiasis	Cat & Dog Fleas	Tapeworm	Yes	No	No
Colorado Tick Fever	Rocky Mountain Wood Tick	Virus	Yes	No	No
Demodectic Mange	<i>Demodex</i> Mites	Mite	Yes	Yes	Yes
Canine Ehrlichiosis	Brown Dog Tick	Bacteria	Yes	No	Yes
Chaffensis Ehrlichiosis	Lone Star Tick	Bacteria	Yes	No	No
Ewingii Ehrlichiosis	American Dog Tick & Lone Star Tick	Bacteria	Yes	No	No
Flea-Borne Spotted Fever	Cat Flea	Bacteria	Yes	No	No
Panola Mountain Ehrlichiosis	Lone Star Tick	Bacteria	Yes	No	No
Flea Dermatitis	Cat & Dog Fleas	Fleas	Yes	Yes	Yes
Ghost Moose Disease	Winter Tick	Tick	No	No	Yes
Heartland virus	Lone Star Tick	Virus	Yes	No	No
Human Granulocytic Anaplasmosis	Blacklegged Tick (Deer Tick) & Western Blacklegged Tick	Bacteria	Yes	No	No
Lyme Disease	Blacklegged Tick (Deer Tick) & Western Blacklegged Tick	Bacteria	Yes	No	No
Murine Typhus	Fleas	Bacteria	Yes	No	No
Pediculosis (Severe Infestation)	Lice	Lice	Yes	Yes	Yes
Plague	Oriental Rat Flea	Bacteria	Yes	Yes	Yes
Powassan Disease	Blacklegged Deer Tick	Virus	Yes	No	No
Rocky Mountain Spotted Fever	American Dog Tick, Brown Dog Tick, & Rocky Mountain Wood Tick	Bacteria	Yes	No	No
Sarcoptic Mange	Scabies Mite	Mite	Yes	Yes	Yes
Southern Tick-Associated Rash	Lone Star Tick	Unknown	Yes	No	No
Tick-Borne Relapsing Fever	Soft Ticks (<i>Ornithodoros</i> spp.)	Bacteria	Yes	No	No
Tick Paralysis	Ticks (multiple spp.)	Neurotoxin	Yes	Yes	Yes
Trombiculiasis	Chiggers	Mite	Yes	Yes	Yes
Tularemia	American Dog Tick, Lone Star Tick, & Rocky Mountain Wood Tick	Bacteria	Yes	Yes	Yes
364D Rickettsiosis	Pacific Coast Tick	Bacteria	Yes	No	No

EXOTIC ECTOPARASITE SUMMARY TABLE

Disease	Ectoparasite(s)	Agent Type	Affects Humans	Affects Livestock	Affects Wildlife
African Tick Bite Fever	Tropical Bont Tick EXOTIC	Bacteria	Yes	No	No
Babesiosis	Cattle Fever Ticks	Protozoan	No	Yes	Yes
Dermatophilosis	Tropical Bont Tick EXOTIC	Bacteria	No	Yes	Yes
Heartwater	Tropical Bont Tick EXOTIC	Bacteria	No	Yes	Yes
New World Screwworm Infestation	New World screwworm EXOTIC	Fly Larvae	Yes	Yes	Yes
Various (e.g., <i>Theileria</i> spp., <i>Babesia</i> spp., <i>Anaplasma</i> spp., <i>Ehrlichia</i> spp., <i>Borrelia burgdorferi</i> , <i>Rickettsia japonica</i> , Powassan virus, Severe fever with thrombocytopenia syndrome virus)	Longhorned tick or Bush Tick EXOTIC	Tick	Some	Some	Possibly

ENDOPARASITE SUMMARY TABLE

Disease	Endoparasite(s)	Agent Type	Affects Humans	Affects Livestock	Affects Wildlife
Toxoplasmosis	<i>Toxoplasma gondii</i>	Protozoan	Yes	Yes	Yes
Coccidiosis	<i>Eimeria</i> and <i>Isospora</i> spp.	Protozoan	No	No	No
Giardiasis	<i>Giardia</i> spp.	Protozoan	Yes	Possibly	No
Cryptosporidiosis	<i>Cryptosporidium</i> spp.	Protozoan	Yes	Possibly	No
Neosporiasis	<i>Neospora caninum</i>	Protozoan	No	Yes	Yes
<i>Sarcocystis</i> infection	<i>Sarcocystis miescheriana</i>	Protozoan	No	No	No
Balantidiasis	<i>Balantidium coli</i>	Protozoan			
Liver flukes	<i>Fasciola hepatica</i> and <i>Fascioloides magna</i>	Trematode	No	Yes	Yes
<i>Alaria</i> infection	<i>Alaria</i> spp.	Trematode	Possibly	No	No
Cysticercosis	Pork Tapeworm (<i>Taenia solium</i>)	Cestode	Yes	No	No
Sparganosis	Sparganosis Tapeworm (<i>Spirometra</i> spp.)	Cestode	Yes	No	No
Taeniasis	Pork Tapeworm (<i>Taenia solium</i>)	Cestode	Yes	No	No
Stomach worms	<i>Hylostrongylus rubidus</i> , <i>Ascarops strongylina</i> , and <i>Physocephalus sexalatus</i>	Nematode	No	No	No
Nodular worms	<i>Oesophagostomum</i> spp.	Nematode	No	X	X
Ascariids	<i>Ascaris suum</i>	Nematode	Yes	No	No
Strongyloidiasis	<i>Strongyloides ransomi</i>	Nematode	No	No	No
Whip worms	<i>Trichuris suis</i>	Nematode	No	No	No
Lung worms	<i>Metastrongylus</i> spp.	Nematode	No	No	No
Kidney worm	<i>Stephanurus dentatus</i>	Nematode	No	No	No
Trichinellosis	Trichinellosis worm (<i>Trichinella spiralis</i>)	Nematode	Yes	Yes	Yes

PREVENTION

This guide is intended as a general-use, quick-reference tool, and is not an official parasite identification resource. The misidentification of parasites can result in serious health and regulatory consequences. Always seek professional advice when seeking to identify parasites.

To learn more about feral swine and the bacterial and viral diseases they carry, see the contact information below where you can find another brochure titled 'Diseases of Feral Swine'.



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