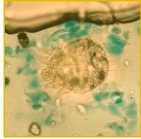


S l i d e 1	<p>Acariasis</p> <p><i>Mange, Scabies</i></p>	
S l i d e 2	<p style="text-align: center;">Overview</p> <ul style="list-style-type: none"> • Organism • History • Epidemiology • Transmission • Disease in Humans • Disease in Animals • Prevention and Control • Actions to Take 	<p>In today's presentation we will cover information regarding the organisms that cause acariasis and their epidemiology. We will also talk about the history of the disease, how it is transmitted, species that it affects (including humans), and clinical and necropsy signs observed. Finally, we will address prevention and control measures, as well as actions to take if acariasis is suspected.</p>
S l i d e 3	<p>THE ORGANISM(S)</p>	
S l i d e 4	<p style="text-align: center;">The Organism(s)</p> <ul style="list-style-type: none"> • Acariasis caused by mites <ul style="list-style-type: none"> - Class Arachnida - Subclass Acari • Numerous species • Ecological diversity • Multiple taxonomic schemes in use • Zoonotic and non-zoonotic species 	<p>Acariasis in animals is caused by a variety of mites (class Arachnida, subclass Acari). Due to the great number and ecological diversity of these organisms, as well as the lack of fossil records, the higher classification of these organisms is evolving, and more than one taxonomic scheme is in use. Zoonotic and non-zoonotic species exist.</p>
S l i d e 5	<p style="text-align: center;">Zoonotic Mites</p> <ul style="list-style-type: none"> • Family Sarcoptidae <ul style="list-style-type: none"> - <i>Sarcoptes scabiei</i> var. <i>hominis</i> - <i>S. scabiei</i> var. <i>canis</i> - <i>S. scabiei</i> var. <i>suis</i> - <i>S. scabiei</i> var. <i>equi</i> - <i>S. scabiei</i> var. <i>bovis</i> - <i>S. scabiei</i> var. <i>ovis</i> • <i>Notoedres cati</i> • <i>Trixacarus caviae</i> 	<p>The zoonotic species include the following mites. <i>Sarcoptes scabiei</i> causes sarcoptic mange (scabies) in humans and more than 100 other species of other mammals and marsupials. There are several subtypes of this organism including <i>S. scabiei</i> var <i>hominis</i>, <i>S. scabiei</i> var. <i>canis</i>, <i>S. scabiei</i> var <i>suis</i>, <i>S. scabiei</i> var. <i>equi</i>, <i>S. scabiei</i> var <i>bovis</i> and <i>S. scabiei</i> var <i>ovis</i>. Some of these variants are host specific, some are not, and some have partial host specificity. The host-specific variants can cause temporary dermatitis in other hosts, but do not reproduce except on their preferred host. <i>S. scabiei</i> var <i>hominis</i> causes human scabies. Humans can also be infested by the scabies mites of dogs, pigs, cattle, goats, sheep, horses, ferrets, water buffalo, llamas, camels and some wild or zoo animals (e.g. the Australian wombat). The zoonotic scabies mites</p>

infest humans transiently. They are not thought to multiply on humans and the infestation is self-limiting. *Notoedres cati* causes notoedric mange (feline scabies) in the Felidae and also infests a variety of other species. It can cause self-limiting dermatitis in humans. The guinea pig mite *Trixacarus caviae* mainly affects guinea pigs, but infestations resembling scabies have been reported in children.

[This photo shows a *Sarcoptes scabiei* mite in a skin scraping, stained with lactophenol cotton-blue. Source: Centers for Disease Control and Prevention, DPDx Image Library.]

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<p>Zoonotic Mites</p> <ul style="list-style-type: none"> • Family Psoroptidae <ul style="list-style-type: none"> - <i>Otodectes cynotis</i> • Family Cheyletiellidae <ul style="list-style-type: none"> - <i>Cheyletiella</i> spp. • Family Macronyssidae <ul style="list-style-type: none"> - <i>Ornithonyssus</i> spp. • Family Dermanyssidae <ul style="list-style-type: none"> - <i>Dermanyssus gallinae</i>, others

Most members of the family Psoroptidae affect only domestic animals (e.g. psoroptic mange). Rare, self-limiting human infestations with the ear mite *Otodectes cynotis* have been reported. *Cheyletiella yasguri*, *C. blakei* and *C. parasitovorax* (of the family Cheyletiellidae) cause cheyletiellosis in dogs, cats, rabbits, and some wild mammals. These parasites cause self-limiting dermatitis in humans, who are aberrant hosts. Three mites from the family Macronyssidae are known to cause dermatitis in humans. *Ornithonyssus bacoti* is found on rodents and small marsupials. It is often associated with black rats. *Ornithonyssus bursa* (tropical fowl mite) and *O. sylviarum* (Northern fowl mite) are found on birds. Two mites in the family Dermanyssidae will feed on humans, resulting in dermatitis. Both species spend most of their time in the environment, and drop off the host after feeding. *Dermanyssus gallinae* (chicken mite, red mite, roost mite, poultry mite) is a parasite of birds. *Liponyssoides sanguineus* is a parasite of small rodents.


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<p>Zoonotic Mites</p> <ul style="list-style-type: none"> • Family Trombiculidae <ul style="list-style-type: none"> - <i>Eutrombicula</i> - <i>Neotrombicula</i> - <i>Schoengastia</i> - <i>Euschoengastia</i> - <i>Acomatacarus</i> - <i>Siseca</i> - <i>Blankaartia</i>
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There are approximately 700 species of trombiculid mites (family Trombiculidae) that are free-living as nymphs and adults, but are parasitic as larvae. Also known as chiggers or harvest mites, some species can affect animals or humans. Genera known to infest humans include *Eutrombicula*, *Neotrombicula*, *Schoengastia*, *Euschoengastia*, *Acomatacarus*, *Siseca* and *Blankaartia*.

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<p>HISTORY</p>

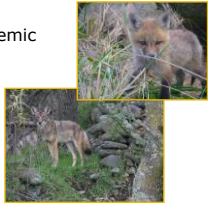
S l i d e g	<p style="text-align: center;">History</p> <ul style="list-style-type: none"> • Scabies <ul style="list-style-type: none"> - First described in biblical times • 1600s <ul style="list-style-type: none"> - Parasitic etiology discovered • 1700s <ul style="list-style-type: none"> - Other mite species described in humans and animals 	<p>Scabies was first described in biblical times. The parasitic etiology of scabies was discovered by the Italian scientist Giovanni Cosimo Bonomo in the late 1600s. By the mid-1700s, several others had described mites of humans and animals. [Source: Roncalli RA. The history of scabies in veterinary and human medicine from biblical to modern times. Vet Parasitol. 1987 Jul;25(2):193-8.]</p>
S l i d e 1 0	<p style="text-align: center;">History</p> <ul style="list-style-type: none"> • 1800s <ul style="list-style-type: none"> - Acariasis treatment improves <ul style="list-style-type: none"> • Livestock dipping • Successful in eradicating psoroptic mange from Australia and New Zealand 	<p>In the early 1800s, treatment of mange in animals was revolutionized by the practice of dipping. Dipping policies for sheep helped eradicate psoroptic mange from Australia and New Zealand by 1896.</p> <p>[This photo shows a cow moving through an ectoparasitic dip. Source: Scott Bauer/U.S. Department of Agriculture].</p>
S l i d e 1 1	<p style="text-align: center;">EPIDEMIOLOGY</p>	
S l i d e 1 2	<p style="text-align: center;">Geographic Distribution</p> <ul style="list-style-type: none"> • Worldwide <ul style="list-style-type: none"> - <i>Notoedres cati</i>, <i>Otodectes cynotis</i>, <i>Cheyletiella</i> spp., <i>Dermanyssus gallinae</i>, <i>Ornithonyssus bacoti</i>, chiggers - <i>Sarcoptes scabiei</i> <ul style="list-style-type: none"> • Certain varieties found in limited areas • Limited distribution <ul style="list-style-type: none"> - <i>Liponyssoides sanguineus</i>, <i>Ornithonyssus bursa</i>, <i>O. sylviarum</i> 	<p><i>Notoedres cati</i>, <i>Otodectes cynotis</i>, <i>Cheyletiella</i> spp., <i>Dermanyssus gallinae</i>, <i>Ornithonyssus bacoti</i> and chiggers are found worldwide. <i>Sarcoptes scabiei</i> is also found worldwide; however, its varieties are more limited in their distribution and may be rare or nonexistent in some countries. (e.g., <i>S. scabiei</i> var <i>equi</i> is rare in the U.S.) <i>Liponyssoides sanguineus</i> occurs in Asia, Europe, the U.S. and northern Africa. <i>Ornithonyssus bursa</i> is seen mainly in tropical and subtropical areas, including parts of the U.S. <i>O. sylviarum</i> occurs in Australia, New Zealand, and temperate parts of the northern hemisphere.</p>
S l i d e 1 3	<p style="text-align: center;">Morbidity and Mortality: Humans</p> <ul style="list-style-type: none"> • Human (non-zoonotic) scabies <ul style="list-style-type: none"> - Populations affected <ul style="list-style-type: none"> • Children under 15 years • Sexually active persons • Immunocompromised persons - About 300 million cases per year • Zoonotic acariasis <ul style="list-style-type: none"> - Self-limiting - Infestations not fatal 	<p>Human scabies is most common in children under 15 years, sexually active persons, and debilitated or immunocompromised individuals. Before the discovery of antibiotics, secondary bacterial infections could result in serious or fatal sequelae including septicemia, glomerulonephritis and acute rheumatic fever. With modern medicines, scabies is unlikely to result in long-term morbidity or mortality in healthy people, but untreated infestations can last for weeks to years. The World Health Organization estimates that there are about 300 million cases of scabies in the world each year. Norwegian scabies may be impossible to fully eradicate in immunocompromised individuals. Zoonotic mites do not reproduce on humans, and produce a self-limiting rash. The only morbidity is the temporary pruritus and discomfort, and infestations are not fatal.</p>

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**Morbidity and Mortality:
Animals**

- Sarcoptidae
 - Sporadic or epidemic
 - Domestic and wild animals
 - Fatal infections mainly in wild animals



Sarcoptic and notoedric mange can occur as sporadic cases or as epidemics, particularly in social animals. In addition to domestic animals such as pigs, epidemics have been reported in wild foxes, coyotes, wolves and lions. Asymptomatic carriers also exist. Sarcoptic and notoedric mange cause little morbidity when they are localized to small areas, but widespread lesions can result in emaciation, weakness and secondary bacterial infections, which may be fatal. Fatal infestations are mainly seen in wild animals. Sarcoptic mange may have played a role in the decrease in the lynx population in Sweden in the 1980s. Fatal infestations with *Trixacarus caviae* have also been reported in guinea pigs.

[These photos show two wildlife species susceptible to mange, red fox (top photo) and coyotes (bottom photo). Source: U.S. Fish and Wildlife Service National Digital Library.]

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**Morbidity and Mortality:
Animals**

- Morbidity only
 - Psoroptidae
 - Cheyletiellidae
 - Trombiculidae
- Young animals most affected
- Mortality reported
 - *Dermanyssus* spp.

Cheyletiellosis and ear mites usually cause only morbidity; deaths are not seen. Young animals tend to be more severely infested with *Cheyletiella* spp., while adult dogs and cats often have light infestations. *Otodectes cynotis* is particularly common in kittens. Some cats may be able to tolerate small colonies without symptoms. In most mammalian species, chiggers result in temporary pruritus and dermatitis, but deaths are not seen. In birds, large numbers of chiggers can cause death from starvation and exhaustion. *Dermanyssus gallinae* and *Ornithonyssus bursa* are mainly a problem on small rural poultry farms and in breeder flocks. They are uncommon in commercial poultry layer operations where the birds are raised in cages. *O. sylviarum*, which completes its life cycle on the birds, is more common on modern poultry farms and is an important parasite of poultry in the U.S. These mites may all lower productivity in poultry. Deaths have been reported in cage birds parasitized by *D. gallinae*. Debility and deaths have also been reported in laboratory and pet rodents infested by *O. bacoti*.

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TRANSMISSION

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Transmission: General

- Highly contagious
- Close contact often required
- General life cycle
 - Females lay eggs on host or in environment
 - Egg hatches into larva
 - Larva → nymph → adult
 - Direct contact with susceptible host

All of the acariases are highly contagious for susceptible species. Close contact may be required if the mites are few and do not survive well in the environment (e.g. some forms of sarcoptic mange), but transmission occurs readily if large numbers of mites are present. Animals with sub-clinical infestations can also spread mites. Female mites lay their eggs either on the host or in the environment. The egg hatches into a larva, which generally passes through two nymphal stages to become an adult. All of the mites that cause acariasis are transmitted by direct contact. The importance of fomites in transmission varies with the species of mite and its survival in the environment.

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- Transmission: Sarcoptidae**
- Burrowing mites
 - Live in skin tunnels
 - Complete entire life cycle on host
 - Do not survive in environment
 - Transmitted by pregnant female mites
 - Close contact usually required

The Sarcoptidae are burrowing mites and live in tunnels in the skin. These mites complete their entire life cycle on the host, and do not survive for long periods in the environment. Sarcoptic mange is mainly spread by the impregnated female mites. Most animals and humans infested with *S. scabiei* carry few mites and prolonged contact is usually necessary for transmission. Some people and animals, particularly those that are immunosuppressed, carry extremely large numbers of mites and transmit them easily. *Notoedres cati* is a burrowing mite with a life cycle similar to that of *Sarcoptes scabiei*. Notoedric mange is mainly transmitted by the nymphs and larvae, which move freely about the surface of the skin. *N. cati* may live for a few days off the host.

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• Life Cycle
– *Sarcoptes scabiei* var *hominis*

Image source: CDC

This image, from the Centers for Disease Control and Prevention (CDC), illustrates the life cycle of *Sarcoptes scabiei* var. *hominis*.

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- Transmission: Psoroptidae and Cheyletiellidae**
- Non-burrowing mites
 - Live on skin surface
 - Feed on skin scales
 - Suck tissue fluids or blood
 - Zoonotic species complete life cycle on host
 - Can survive briefly in environment

Members of the families Psoroptidae and Cheyletiellidae are non-burrowing mites. They remain on the surface of the skin, and feed on skin scales or suck tissue fluids or blood. The zoonotic members of these families must complete their life cycle on the host, but can survive for a short period of time in the environment.

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- Transmission: Macronyssidae**
- Non-burrowing mites
 - Can survive in the environment
 - Transmitted via fomites
 - Nymphs and adults
 - Feed on blood
 - Larvae
 - Do not feed

The Macronyssidae are non-burrowing mites. The three zoonotic species can survive for a period of time in the environment, and can be transmitted on fomites. *Ornithonyssus sylviarum* spends its entire life on its avian hosts. The nymphs and adults feed on blood; the larvae, which molt into nymphs in approximately eight hours, do not feed.

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- Transmission: Dermanyssidae**
- Non-burrowing mites
 - Zoonotic species
 - Feed on birds during day
 - Hide in environment at night
 - Eggs laid in environment
 - Can survive for prolonged periods without feeding

The Dermanyssidae are non-burrowing mites. The two zoonotic species spend most of their time in the environment, and drop off the host after feeding. *Dermanyssus gallinae* spends much of its life in the environment. It feeds on birds' blood and tissue fluids at night and hides in nearby cracks and crevices during the day. The eggs are laid in the environment. *D. gallinae* adults can survive in the environment for prolonged periods without feeding; poultry houses can remain infested for six months after all of the birds are removed.

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**Transmission:
Trombiculidae**

- Chiggers
 - Parasitic only in larval stages
 - Free-living nymphs and adults
 - Live on invertebrates and decaying plant materials
 - Hatched larvae feed on tissue juices of animals

Chiggers are parasitic only in their larval stage. The free-living nymphs and adults live on invertebrates (or their eggs) and decaying plant material. These mites lay their eggs on the ground or on low bushes or grass. The hatched larvae feed on the tissue juices of birds, reptiles, mammals or invertebrates, then drop to the ground to develop into nymphs. Humans and domestic animals can act as hosts for the larvae of some species.

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DISEASE IN HUMANS

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Human Scabies

- Severe pruritus
 - Especially at night
 - Papular rash or nodules
 - Burrows pathognomonic
 - Secondary infections possible
- Norwegian scabies
 - Severe form found in immunocompromised people



The most prominent symptom of human scabies (*Sarcoptes scabiei* var *hominis*) is severe pruritus, particularly at night. The head and neck are usually spared, except in infants and young children. There may also be a papular rash, particularly on the shoulder blades, webbed spaces of the fingers, feet, belt line, scrotum, penis, breast, or the folds of the wrist, elbow or knee. Pink, red, tan or brown nodules, ranging in size from 2-20 mm, may also be seen. Burrows (thin, slightly elevated, pinkish-white or grayish-brown, 2-5 mm long straight or curved lines) are pathognomonic. A dot at one end of the burrow indicates the presence of a mite. Complications may include secondary bacterial infections. A more severe form of scabies (Norwegian or crusted scabies) is found sometimes in immunocompromised persons, the elderly, and mentally incompetent individuals. In this form, there are large numbers of mites, discrete vesicles and extensive thick crusts on the skin, but pruritus may be slight or absent. Nail dystrophy and scalp lesions may also be seen. Secondary lesions, the result of scratching, may include scratches, generalized eczematous dermatitis, erythroderma (generalized exfoliative dermatitis) and hyperpigmentation.

[This photo shows a human hand with *Sarcoptes scabiei* var. *hominis* infestation. Source: CDC Public Health Image Library.]

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Zoonotic Scabies

- Highly pruritic
- Lesions on the arms, chest, abdomen, thighs
- No classic "burrows"
- Usually self-limiting

Zoonotic scabies is also highly pruritic but the lesions usually occur on the arms, chest, abdomen and thighs. In humans, the zoonotic varieties of *Sarcoptes scabiei* are generally believed to cause vesicles, papules and other symptoms of dermatitis, but not classic burrows. However, in one case, burrows caused by *S. scabiei* var *canis* were found in the skin by histopathology. Zoonotic scabies is almost always self-limiting; the mites usually disappear within a few days, and the clinical signs resolve in 1 to 3 weeks unless the person becomes reinfested.

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Other Acariases

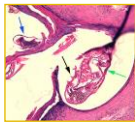
- Other causes of transient dermatitis
 - *Notoedres cati*
 - *Trixacarus caviae*
 - *Cheyletiella* spp.
 - *Dermanyssus gallinae*
 - *Liponyssoides sanguineus*
 - *Ornithonyssus* spp.
 - Chiggers

Other mites can also cause transient dermatitis in humans. *Notoedres cati* causes typical scabies signs in humans. The infestation is self-limiting within several weeks. *Trixacarus caviae*, a parasite of guinea pigs, can cause pruritic skin lesions on the hands, arms or neck similar to scabies. *Cheyletiella* spp. can cause a pruritic, mild dermatitis, mainly on the abdomen, chest, arms and legs. The bites of *Dermanyssus gallinae*, *Liponyssoides sanguineus*, *Ornithonyssus bacoti*, *O. sylviarum* and *O. bursa* can be painful or pruritic and may cause irritation and localized dermatitis. In some cases, the dermatitis can become severe and the area may remain swollen for days. Most of the mites cause papules, but vesicles, urticaria and hemorrhagic necrosis are also reported with *O. bursa*. *L. sanguineus* can transmit *Rickettsia kauri*, which causes human vesicular rickettsiosis (rickettsialpox). Chiggers can cause severe dermatitis, followed by allergic reactions. The first symptom is usually a tiny red papule, with intense and painful pruritus. A wheal develops soon afterward, often with extravasation of blood. Excoriations from scratching, serous exudates and pustules may develop. Some of these bites can remain painful for a week or longer. Some species of chiggers can transmit scrub typhus.

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Diagnosis

- Human scabies
 - Rash
 - Presence of burrows
 - Skin scraping
- Zoonotic mites
 - Identification of mites (difficult)
 - Infested animals/environment are suggestive



Human scabies is usually diagnosed by the appearance of the rash and the presence of burrows. Burrows can be revealed by applying topical tetracycline, which is retained by the burrows and fluoresces under a Woods lamp. They can also be localized with ink. This disease can be confirmed by the demonstration of the mites, eggs or feces in a skin scraping (or by the removal of a mite from a burrow), under 40X magnification. Zoonotic scabies and other mite infestations are also diagnosed in humans by identifying the mites; however, finding any mites is often difficult. Transparent tape can be used to pick up mites from the skin. An important diagnostic clue is the presence of mites on animals. *Dermanyssus gallinae* and other avian and rodent mites sometimes appear as red dots on the skin when they are feeding, and may be visible in the environment. They can be found in homes by vacuuming the area and examining the dust by flotation (the mites will float to the surface).

[This photo shows a microscopic view of *Sarcoptes scabiei* mites in a skin biopsy, stained with H&E. Both an adult (green arrow) and an egg (blue arrow) can be observed. Note also the presence of cuticular spines (black arrow) on the adult. Source: CDC DPDx Image Library.]

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Treatment

- Human scabies
 - Acaricides
 - Oral antihistamines
 - Topical antipruritics/anesthetics
 - Antibiotics (secondary infections)
- Zoonotic mites
 - Symptomatic therapy
 - Treat infested animals/environment

Acaricides used to treat human scabies include topical lotions containing permethrin, lindane or crotamiton, as well as ivermectin. Pruritus can persist for 1 to 2 weeks after successful treatment. Oral antihistamines and topical antipruritics/ anesthetics can be used for the pruritus. Antibiotics may be necessary for secondary infections. Human infestation with zoonotic mites requires only symptomatic therapy such as anti-pruritic or anti-inflammatory medications. Treatment of the affected animals and/or the environment will eliminate the infestation in human contacts.

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DISEASE IN ANIMALS

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**Species Affected:
Sarcoptidae**

Species	Host(s)
<i>Sarcoptes scabiei</i> var. <i>hominis</i>	Humans
<i>S. scabiei</i> var. <i>canis</i>	Dogs, cats, pigs, foxes, rabbits
<i>S. scabiei</i> var. <i>suis</i>	Pigs, dogs, rabbits
<i>S. scabiei</i> var. <i>bovis</i>	Cattle
<i>S. scabiei</i> var. <i>equi</i>	Horses
<i>S. scabiei</i> var. <i>ovis</i>	Sheep, goats, camels
<i>S. scabiei</i> var. <i>caprae</i>	Goats, cattle, sheep, dogs

More than a hundred species of mammals and marsupials can be infested by *Sarcoptes scabiei*. Humans can be temporary hosts for the scabies mites of dogs, pigs, ferrets, cattle, goats, sheep, horses, water buffalo, camels, llamas and some wild or zoo animals (e.g. the Australian wombat). The hosts for *S. scabiei* subtypes include the following:

- *S. scabiei* var *hominis* causes scabies in humans.
- *S. scabiei* var. *canis* causes scabies in dogs. It can also infest other mammals, including cats, pigs, foxes, rabbits and guinea pigs, for varying periods of time.
- *S. scabiei* var. *suis* causes scabies in pigs. In one study, this variant could be transferred to dogs or rabbits only transiently.
- *S. scabiei* var *bovis* causes scabies in cattle.
- *S. scabiei* var. *equi* causes scabies in horses
- *S. scabiei* var *ovis* causes scabies in sheep. This parasite can also affect goats and camels.
- *S. scabiei* var *caprae* causes scabies in goats. This parasite can also affect cattle, sheep and dogs.

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**Species Affected:
Other Acariases**

Species	Host(s)
<i>Notoedres cati</i>	Cats, dogs, rabbits, foxes, others
<i>Trixacarus caviae</i>	Guinea pigs
<i>Cheyletiella yasguri</i>	Dogs, cats, rabbits
<i>Cheyletiella blakei</i>	Cats
<i>Cheyletiella parasitovorax</i>	Rabbits, cats
<i>Otodectes cynotis</i>	Dogs, cats, ferrets, others
<i>Ornithonyssus bursa</i>	Chickens, turkeys, ducks, others
<i>O. sylviarum</i>	Chickens, turkeys, other birds
<i>O. bacoti</i>	Rodents, mice, rats, hamsters
<i>Dermanyssus gallinae</i>	Chickens, turkeys, pigeons
<i>Liponyssoides sanguineus</i>	Mice, small rodents
Chiggers	Mammals, birds

Notoedres cati causes notoedric mange (feline scabies) in members of the Felidae including domestic cats, lynxes, cheetahs, leopards, ocelots and bobcats. It can also affect non-Felidae including dogs, rabbits, foxes, civets, rodents, bats, coatis, and raccoons. Humans are an aberrant host. *Trixacarus caviae* is mainly found in guinea pigs but has been reported in humans. *Cheyletiella* spp. have a predilection for certain hosts, but can readily infest other species. Humans are an aberrant host. *C. yasguri* is most often found on dogs but can affect cats that are in close contact with an infested dog. Rabbits have been infected experimentally. *C. blakei* is the pre-dominant species in cats. *C. parasitovorax* causes cheyletiellosis in rabbits and cats. *Otodectes cynotis* affects many species of carnivores including dogs, cats, ferrets, and wild animals. There are very few reports of human infestation. *Ornithonyssus bursa* is found on birds including chickens, turkeys, ducks, pigeons, sparrows, starlings and myna birds. It will feed on mammals if birds are not available. *O. sylviarum* infests chickens, turkeys and many other birds. It can be found on mammals including rats, mice and humans, but reproduces only on birds. *O. bacoti* is found on rodents and small marsupials including mice, rats and hamsters. *Dermanyssus gallinae* is found on birds including chickens, turkeys, pigeons and canaries. Dogs, cats and humans are accidental hosts. *Liponyssoides sanguineus* is normally a parasite of small rodents such as mice. Chiggers can affect many species of mammals including humans, and birds.

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Sarcoptic Mange


- Incubation period
 - 10 days to 8 weeks
- Symptoms caused by allergic reaction to the parasite
- Hallmark signs
 - Intense pruritus
 - Begins on hairless parts of body
 - Alopecia then becomes generalized

The incubation period for *S. scabiei* var *canis* in dogs is 10 days to 8 weeks. Pigs experimentally infected with *S. scabiei* var *suis* become symptomatic in 2 to 11 weeks. Most of the symptoms of sarcoptic mange are caused by allergic reactions to the parasite, and the incubation period is generally longer the first time an animal is infested. The hallmark of sarcoptic mange is intense pruritus. The mites prefer relatively hairless parts of the body, and the initial lesions often occur in these locations. As the alopecia spreads, the rash often becomes generalized. Severe untreated cases can be fatal, particularly in wildlife; deaths are usually the result of secondary bacterial infections.

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Sarcoptic Mange: Dogs

- Lesion locations
 - Ventral chest, abdomen
 - Ears
 - Periorbital region
 - Elbows
 - Legs
- Intensely pruritic papular rash
- Secondary infections common



In dogs, the lesions are often found first on the ventral chest and abdomen. Other common locations are the ears, periorbital region, elbows and legs. The typical lesion is an intensely pruritic papular rash with thick yellowish crusts. Scratching and rubbing can lead to a variety of lesions, including erythema, ulcers, bleeding and hemorrhagic crusts. Peripheral lymphadenopathy can be seen and emaciation can occur in severe cases. Secondary bacterial infections are common. Asymptomatic carriers may exist. Scabies incognito can be seen in meticulously groomed dogs. This form is characterized by constant pruritus but few or no lesions other than mild erythema and occasional excoriations.

[This photo shows a dog with marked alopecia, erythema, crusting, and excoriation of the face, ears, and ventral neck due to sarcoptic mange. Source: J. Noxon, Iowa State University.]

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Sarcoptic Mange: Pigs

- Lesion locations
 - Head (around eyes, nose, ears)
 - Hind legs
- Clinical signs
 - Erythema
 - Macules, papules
 - Scabs, erosions, abrasions, cracks
- Secondary infections common

In pigs with acute scabies, the lesions usually appear first on the head, particularly around the eyes, nose and ears. They quickly spread to the hind legs due to scratching and may become generalized. The affected skin is erythematous and inflamed, and may have macules, papules, scabs, erosions, abrasions, ulcers or cracks. It can eventually become roughened, wrinkled and thickened. Secondary bacterial infections and myiasis can occur. In many pigs, the symptoms disappear within 12 to 18 weeks without treatment. Pigs that recover from acute scabies can carry mites in the ears. These animals may be asymptomatic or they may have small hyperkeratotic, crusted lesions in the ear canal. Chronic infections also occur.

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Sarcoptic Mange: Cattle and Sheep

- Lesion locations
 - Head and neck
 - Above scrotum or udder
 - Inner surface of thighs
- Clinical signs
 - Papules, crusts, alopecia
 - Thickened skin
 - Severe pruritus

In cattle, the lesions may start on the head and neck, or above the scrotum or udder and on the inner surface of the thighs. The lesions may include papules, crusts and alopecia, and the skin thickens and develops large folds. Pruritus is severe. In sheep, the lesions affect the non-woolly skin, and typically start on the head and face.


<p>S I d e 3 7</p>	<p style="text-align: center;">Sarcoptic Mange: Horses</p> <ul style="list-style-type: none"> • Lesion locations <ul style="list-style-type: none"> - Head, neck - Shoulders • Clinical signs <ul style="list-style-type: none"> - Papules, vesicles, crusts - Alopecia, crusting, lichenification - Severe pruritus - Emaciation, weakness 	<p>In horses, the earliest symptom is severe pruritus, particularly of the head, neck and shoulders. The initial lesions are papules and vesicles, which later form crusts. Alopecia, crusting and lichenification, with skin folds, are seen as the infestation progresses. Although untreated infestations can spread to the rest of the body, parts of the body protected by long hair and the lower extremities are not usually affected. Emaciation, weakness and anorexia can be sequelae.</p>
<p>S I d e 3 8</p>	<p style="text-align: center;">Notoedric Mange</p> <ul style="list-style-type: none"> • Also known as feline scabies • Intensely pruritic • Lesion locations <ul style="list-style-type: none"> - Pinna of ear, face, eyelids, neck - Paws - Perineal • Clinical signs <ul style="list-style-type: none"> - Papules, alopecia, crusts, thickened skin 	<p>Notoedric mange is intensely pruritic, with the possible exception of infestations in bobcats, lynxes and ocelots. The lesions typically start on the pinna of the ear, and quickly spread to the face, eyelids, back of the neck, and paws. Perineal lesions are also common, as the result of the cat's habit of sleeping in a curled position. The initial papular rash may progress to erythema, areas of partial or complete alopecia, dense tightly adherent yellow-to-gray crusts, and thickened, wrinkled hyperkeratinized skin. The lymph nodes may be enlarged. Severe untreated cases can be fatal, particularly in wildlife.</p>
<p>S I d e 3 9</p>	<p style="text-align: center;"><i>Trixacarus caviae</i></p> <ul style="list-style-type: none"> • Pruritus in guinea pigs • Lesion locations <ul style="list-style-type: none"> - Trunk - Inner thighs - Neck, shoulders • Clinical signs <ul style="list-style-type: none"> - Yellow scales or crusts - Infertility, abortion, death 	<p>In newborn guinea pigs infested with <i>Trixacarus caviae</i>, pruritus may become evident within 72 hours of birth and skin lesions within 3 to 4 weeks of birth. In mature guinea pigs, the symptoms develop in 10 to 50 days. <i>T. caviae</i> can cause alopecia, pruritus and severe dermatitis in guinea pigs. Commonly affected areas include the trunk, inner thighs, neck and shoulders. The skin in affected areas may be dry or oily, with yellow scales and crusts, and the hair is easily removed. Infertility, abortions, seizures and deaths have been reported. Some infestations can be asymptomatic, and may become clinical if the animal is stressed by pregnancy, transport or other factors.</p>
<p>S I d e 4 0</p>	<p style="text-align: center;">Cheyletiellosis</p> <ul style="list-style-type: none"> • Lesion locations <ul style="list-style-type: none"> - Back • Pruritus mild to moderate • Clinical signs <ul style="list-style-type: none"> - Erythema - Excoriation - Hair loss 	<p>Cheyletiellosis most often affects the back. In cats and dogs, the typical lesion is a dry, scaly dermatitis with dandruff. Pruritus is usually mild or moderate, but can be severe. In some cases, there may also be erythematous, excoriated lesions, hair loss or generalized lesions. Cats may develop miliary dermatitis. A form characterized by multiple areas of crusting, scabs and alopecia, which resembles a dermatophyte infection, has also been described. <i>C. yasguri</i> causes clinical signs mainly in puppies, but adult dogs can be asymptomatic carriers. Cats can also carry <i>Cheyletiella</i> spp. asymptotically. Rabbits may be asymptomatic or there may be loose hair, which can be pulled out in clumps, and oily, scaly, erythematous, alopecic patches on the back and head. Dandruff is usually visible in the fur. <i>Cheyletiella parasitovorax</i> can serve as a vector for the rabbit myxoma virus.</p>

<p>S I d e 4 1</p>	<p style="text-align: center;"><i>Otodectes cynotis</i></p> <ul style="list-style-type: none"> • Lesion locations <ul style="list-style-type: none"> - Primarily ear canals • Highly pruritic • Lesions <ul style="list-style-type: none"> - Thick, reddish-brown crusts • Secondary infections common • May also see vestibular signs 	<p><i>Otodectes cynotis</i> mainly causes a highly pruritic otitis externa, and is associated with thick reddish-brown crusts in the ear canals. Its activity can lead to secondary bacterial or fungal infection, or vestibular signs including torticollis. Cats can sometimes tolerate moderate numbers of mites without clinical signs. Occasionally, the infestation spreads to the skin, particularly the head and neck, base of the tail and paws. On the skin, <i>O. cynotis</i> causes a pruritic dermatitis with redness, scaling and crust formation.</p>
<p>S I d e 4 2</p>	<p style="text-align: center;"><i>Dermanyssus gallinae</i></p> <ul style="list-style-type: none"> • Clinical signs in poultry <ul style="list-style-type: none"> - Anemia - Reduced laying - Pruritus • Clinical signs in dogs and cats <ul style="list-style-type: none"> - Erythema, papules, crust - Head, back, legs - Usually intensely pruritic 	<p>In poultry, <i>D. gallinae</i> can result in anemia and lower productivity including decreased weight gain in young birds, reduced egg laying in hens and decreased reproductive potential in males. Restlessness, anemia, excess preening, pruritus and deaths have been reported in cage birds. This mite also carries <i>Borrelia anserina</i>, which causes fowl spirochetosis. Infestations are rare in dogs and cats. The symptoms may include erythema, papules and crusts, especially on the head, back and legs. Red mites may be seen on the animal. The lesions are usually but not always intensely pruritic in mammals.</p>
<p>S I d e 4 3</p>	<p style="text-align: center;"><i>Ornithonyssus</i> spp.</p> <ul style="list-style-type: none"> • Clinical signs in poultry <ul style="list-style-type: none"> - Black, "dirty-looking" feathers - Cracks, scabs around cloaca - Decreased productivity - Pruritus may be severe • Vectors for: <ul style="list-style-type: none"> - Western equine encephalomyelitis - Murine typhus, Q fever, plague 	<p><i>Ornithonyssus bursa</i> and <i>O. sylviarum</i> result in blackened "dirty-looking" feathers, and may cause cracks and scabs around the cloaca. Productivity may be decreased. <i>O. bursa</i> can carry the Western equine encephalitis virus. In laboratory and pet rodents, <i>O. bacoti</i> can cause anemia, debility, weakness, decreased reproduction and deaths. Pruritus may be severe. This mite is a vector for murine typhus, Q fever and plague.</p>
<p>S I d e 4 4</p>	<p style="text-align: center;">Trombiculidiasis (chiggers)</p> <ul style="list-style-type: none"> • Lesion locations <ul style="list-style-type: none"> - On body parts in contact with ground • Clinical signs <ul style="list-style-type: none"> - Intensely pruritic papules - Alopecia - Scales, crusts, scabs - Wheals (horses) • May cause death in birds 	<p>Chiggers are usually found on parts of the animal that have been in contact with the ground. The symptoms in dogs and cats are variable. The bites usually result in intensely pruritic papules, followed by alopecia, scales, crusts and scabs. In some cases, the rash may be non-pruritic. On horses, wheals may also be seen. The yellow, orange or red larvae may be visible in the lesions. Large numbers of trombiculid mites on birds may result in depression, anorexia, and deaths from starvation and exhaustion</p>
<p>S I d e 4 5</p>	<p style="text-align: center;">Post Mortem Lesions</p> <ul style="list-style-type: none"> • Same as for live animals • Secondary infections possible • Wasting in severe infestations 	<p>Mites are parasites of the skin, and the lesions seen at necropsy resemble those in live animals. Secondary bacterial infections or signs of wasting may be seen in severe infestations with the Sarcoptidae.</p>

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Diagnosis

- Skin scrapings
 - Microscopic exam
- Direct observation
 - *Ornithonyssus* spp.
 - *Dermanyssus gallinae*
 - Chiggers
- Fecal exam (eggs)
- Histopathology



Acariasis is usually diagnosed by identifying the mites in skin scrapings or by other collection techniques; the mites are often found at the edges of the lesions. Living mites can be observed by warming them to 25-30C (77-86F), which stimulates them to move. Dead mites, and live mites from the smaller species, are more easily found after 10% potassium hydroxide (KOH) digestion of the sample. Mites can be identified under the microscope (40X) by their shape, size and morphology, using published illustrated keys. Scrapings for sarcoptic or notoedric mange are taken from areas of alopecia, or where papules are seen. Scabies mites can be very difficult to find, and numerous scrapings may be necessary. *Cheyletiella* spp. can be found in dandruff and hair tufts, as well as in skin scrapings. The mites can be found by brushing the fur, combing it with a flea comb, collecting skin debris with a vacuum cleaner, plucking hairs, or by examination of the material that adheres to a piece of trans-parent adhesive tape. Ear mites can be observed directly, using an otoscope. *Ornithonyssus bacoti*, *O. sylviarum*, *Dermanyssus gallinae* and chiggers may be seen with the naked eye when they are engorged. *D. gallinae* is found in the environment during the day and on the birds at night. *O. sylviarum* mites are found on the eggs, or on the birds by parting the feathers in the vent region. Mites or their eggs are sometimes found in the feces of pruritic animals, particularly cats, by fecal flotation. *Sarcoptes scabiei* and *Notoedres cati* can also be seen in skin biopsies by histopathology. An enzyme linked immunosorbent assay (ELISA), available in some countries, can diagnose sarcoptic mange by serology in some countries.

[This photo shows the ventral view of a *Sarcoptes scabiei* mite specimen. Source: CDC Public Health Image Library.]

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Treatment

- Acaricides
 - Cattle
 - Sarcoptic mange reportable
 - Treatment performed under official supervision
- Antiseborrheic shampoo
- Glucocorticoids

Acaricides

Lime sulfur
Amitraz
Phosmet
Pyrethrins
Coumaphos
Malathion
Rotenone
Carbaryl
Ivermectin
Doramectin
Selamectin

Mite infestations are treated with acaricides including lime sulfur, amitraz, phosmet, pyrethrins, coumaphos, malathion, rotenone or carbaryl. The animal may be bathed first with an antiseborrheic shampoo to remove crusts and debris. Ivermectin is used to treat some mites, and doramectin has been used for sarcoptic mange in pigs. Selamectin has recently been reported to be effective for sarcoptic mange and cheyletiellosis. Sarcoptic mange in cattle is a reportable disease in the U.S. and treatment is performed under official supervision. Acaricide treatment is sometimes done in cases where acariasis is suspected, but mites cannot be found. This method is not foolproof, as treatment failures and relapses are possible. If the mites can survive for more than a few days in the environment, the animal’s surroundings must also be treated with an insecticide or acaricide. Infestations with chiggers are self-limiting and are not always treated with acaricides. The pruritus can be controlled with glucocorticoids.

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PREVENTION AND CONTROL

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- Actions to Take**
- Scabies
 - Not usually reportable
 - Consult your physician
 - Sarcoptic mange
 - Reportable in some states
 - Consult your veterinarian

Scabies is not reportable in most states. People that come into contact with known or suspected infected animals should consult a physician and follow the prescribed course of treatment. Sarcoptic mange in animals is reportable in many states. If a herd is known or suspected to contain infected animals, contact a veterinarian immediately.

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- Prevention in Humans**
- Zoonotic acariasis
 - Treat infested animals
 - Protective clothing
 - Insect repellants
 - Control birds nests
 - Control rodents/pests
 - Insecticides

Zoonotic acariases can be prevented by treating the infested pets, livestock, fowl or laboratory animals. Gloves, boots and protective clothing can decrease the risk of transmission when handling affected animals. Insect repellants and protective clothing may be helpful in environments infested with poultry mites. The mites from wild birds and rodents are best controlled by eliminating nests and roosting areas for birds near the home, and by controlling rodent pests. Insecticides and foggers can treat current infestations around the home. Insect repellents can help prevent infestation by chiggers. Avoidance of forested and swampy areas, particularly during the late summer and early fall, will also reduce the risk of exposure.

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- Prevention in Animals**
- Identify and treat
 - Disinfect fomites
 - Sarcoptic mange in cattle
 - Subject to federal controls
 - Quarantine and movement control
 - Herd control programs
 - Biosecurity
 - Depopulation



Sarcoptes scabiei, *Notoedres cati* and *Trixacarus caviae* do not survive for long periods in the environment. Most often, these mites are introduced on infested animals and prevention relies on identifying and treating such carriers. Control of fomites may also be necessary. Fomites are important in the transmission of mites such as *Cheyletiella* spp., *Otodectes cynotis*, *Ornithonyssus sylviarum*, *Ornithonyssus bursa*, *Ornithonyssus bacoti*, *Dermanyssus gallinae* and *Liponyssoides sanguineus*, which can survive for a longer period of time in the environment without feeding. Sarcoptic mange in cattle is subject to federal controls, including herd quarantine and restrictions on interstate movement from scabies-affected areas. Herd control programs, with periodic maintenance treatment, are used to control sarcoptic mange in pigs. New additions should also be treated before allowing them to enter the herd. Eradication is possible with strict biosecurity, isolation of newly introduced animals for at least 3-4 weeks, and regular monitoring and treatment of the herd. Depopulation and restocking has also been used for eradication.

[This photo shows two calves standing in a field. Source: Danelle Bickett-Weddle, CFSPH.]

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<p>Prevention in Animals</p> <ul style="list-style-type: none"> • Environment <ul style="list-style-type: none"> - Sanitation - Treatment with acaricides • Purchase of mite-free birds • Routine flea control • Insect repellants • Clean bedding (<i>T. caviae</i>)
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Sanitation and treatment of the environment with acaricides may also be important in prevention. Heavy *Dermanyssus gallinae* and *Ornithonyssus sylviarum* infestations are prevented by buying mite-free birds, and by sanitation. Routine flea control usually works as a preventative for cheyletiellosis. Chiggers are acquired from the environment. Insect repellents may help prevent infestations by chiggers. Avoidance of forested and swampy areas, particularly during the late summer and early fall, will also reduce the risk of exposure. These mites can be controlled on free range birds by keeping grass cut short and by dusting with sulfur or malathion. To prevent *T. caviae* infestations in guinea pigs, autoclaved, laboratory grade bedding should be used and should be changed regularly. Cages and other areas should be cleaned and rinsed with a dilute bleach solution.

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<p>Additional Resources</p> <ul style="list-style-type: none"> • Center for Food Security and Public Health <ul style="list-style-type: none"> - www.cfsph.iastate.edu • Centers for Disease Control and Prevention (CDC): Scabies <ul style="list-style-type: none"> - www.cdc.gov/scabies/ • World Health Organization <ul style="list-style-type: none"> - http://www.who.int/water_sanitation_health/diseases/scabies/en/
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