TroCCAP

Tropical Council for Companion Animal Parasites

Guidelines for the control of ectoparasites of dogs and cats in the tropics

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Disclaimer

The guidelines presented in this booklet were developed by members of the Tropical Council for Companion Animal Parasites Ltd.

These best-practice guidelines are based on evidence-based, peer-reviewed, published scientific literature. The authors of these guidelines have made considerable efforts to ensure the information upon which they are based is accurate and up-to-date.

Individual circumstances must be considered where appropriate when following the recommendations in these guidelines.

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General considerations and recommendations

Veterinary significance

- Ectoparasites can cause direct injury to dogs and cats, including skin lesions and toxicosis (e.g. tick paralysis), and may eventually produce hypersensitivity reactions (e.g. flea allergy dermatitis).
- Blood-feeding ectoparasites (i.e. ticks, fleas, sucking lice, mosquitoes, phlebotomine sand flies, and triatomine bugs) can cause skin lesions, blood depletion and also act as vectors of a wide range of pathogenic microorganisms to dogs and cats.
- Some ectoparasites are intermediate hosts for cestodes (i.e. fleas and chewing lice for *Dipylidium caninum*).

Diagnosis

- Infestations by relatively large ectoparasites (e.g. ticks, fleas, and lice) usually can be
- Mite infestations should be diagnosed by microscopic examination of skin scrapings (for *Demodex* spp., *Sarcoptes scabiei*, and *Notoedres cati*), hair plucks (for *Lynxacarus radovskyi* and *Cheyletiella* spp.) or ear examination using an otoscope (specifically for *Otodectes cynotis*).

Treatment of existing infestations

- Existing ectoparasite infestations should be treated with licensed acaricides and insecticides as appropriate.
- In case of high flea infestation levels in dogs and cats, vacuuming and mechanical cleaning of cages or beds and bedding is important to eliminate possible sources of re-infestation.
- In some instances (e.g. high tick infestation levels in animal shelters), environmental treatment with proper acaricides may be necessary.

Prevention and control

- Dogs and cats living in the tropics should be protected from ectoparasite infestations throughout the year.
- Regular visual inspection and prompt removal of ticks is highly recommended to reduce the risk of tick-borne pathogen transmission.

Public health considerations

- Ectoparasites of dogs and cats can transmit a range of pathogenic microorganisms, some of which are zoonotic (e.g. *Bartonella henselae*, *Dipylidium caninum*, *Dirofilaria immitis*, *Leishmania infantum*, and *Rickettsia rickettsii*).
- Continuous year round ectoparasite control in areas where dogs and cats are known to carry zoonotic vector-borne pathogens is highly advised.

Ticks (Ixodida)

Ticks are relatively large ectoparasites of dogs and, less frequently, cats. In addition to direct damage to the skin and blood depletion, ticks can act as vectors of several pathogenic microorganisms.

Distribution

Ticks are widespread in the tropics. From a global perspective, brown dog ticks (**Fig. 1**) (*Rhipicephalus sanguineus* sensu lato) are the most common ticks infesting dogs and eventually cats in the tropics. Several other species from different genera (e.g. *Amblyomma*, *Dermacentor*, *Haemaphysalis*, *Hyalomma*, *Ixodes*, and *Ornithodoros*) may be found on dogs, cats, or both, in various countries across the tropics. In addition to *R. sanguineus* s.l., dogs can be infested by several tick species, including *Amblyomma aureolatum*, *A. oblongoguttatum*, *A. ovale*, *A. sculptum*, *A. tigrinum* (**Fig. 2**), *Ixodes boliviensis*, and *Ornithodoros brasiliensis* in the Neotropical region, *Haemaphysalis elliptica*, *Rhipicephalus pulchellus*, *R. armatus*, and *Amblyomma gemma* in Africa, and *R. haemaphysaloides* and *Haemaphysalis longicornis* in South East Asia and in areas where it was recently introduced in North America.

Figure 1. Heavy infestation with *Rhipicephalus sanguineus* s.l. in a dog from Kenya (*Image credit: Andrei D. Mihalca*)

Figure 2. Female of *Amblyomma tigrinum* parasitic on the ear pinna of a dog (*Image credit: Pablo Borras*)

Life cycle

With a few exceptions, ticks infesting dogs and cats have a three-host life cycle, with each developmental stage (larva, nymph, and adult) feeding on a different host. The duration of the tick life cycle (from egg to adult) may vary widely, depending on tick species and regions. Brown dog ticks (*R. sanguineus* s.l.) can complete more than one generation per year in the tropics. The time ticks spend feeding on a host ranges from a few days (for six-legged larvae and eight-legged nymphs) to several days (for females). While female hard ticks (family Ixodidae) take a single blood meal and lay a single batch of eggs, female soft ticks (family Argasidae) may take several blood meals and lay several batches of eggs [1].

Clinical signs

Infestation by a single or a few ticks (especially by small larvae) may go unnoticed in both dogs and cats. Massive infestations can result in multiple skin lesions and pruritus, which may favour secondary bacterial infections. High tick infestation levels, particularly by adult ticks, may result in severe blood depletion, potentially leading to anaemia. Some ticks (e.g. *O. brasiliensis*) can also inoculate toxins in dogs and cause local skin lesions and systemic illness, generally referred to as tick toxicosis. Clinical signs may include disseminated skin rash, pruritus, mucosal hyperaemia, lethargy, fever, and paralysis. Ticks may also transmit numerous pathogens, either by inoculation during blood feeding (e.g. *Babesia vogeli*, *Cercopithifilaria* spp., *Cytauxzoon felis*, *Ehrlichia canis*, *Rangelia vitalii*, and *Rickettsia rickettsii*) or when the animal ingests an infected tick (i.e. *Hepatozoon* spp.) [2]. For more information, see TroCCAP Guidelines for the diagnosis, treatment and control of canine and feline endoparasites in the tropics (https://www.troccap.com/).

Diagnosis

Tick infestations in dogs and cats can be diagnosed by visual inspection of preferred attachment sites (e.g. ears, armpits, inguinal region, periocular, and interdigital areas). Ticks can be collected and kept alive or preserved in ethanol (70% or higher concentration) for subsequent morphological or molecular identification.

Treatment

All visible ticks should be promptly removed from the infested animal to reduce the risk of pathogen transmission. In low to moderate infestation levels, ticks can be easily removed manually, with the aid of tweezers or any tick removal device. In high infestation levels (sometimes hundreds of ticks), manual removal may not be feasible and the use of a fast-acting systemic acaricides is recommended. Several acaricides (formulated as spot-on pipettes, collars, oral tablets, among others) are available in the veterinary market worldwide. The use of acaricides licensed for dogs and cats is advised. Highly concentrated synthetic pyrethroids (with the exception of flumethrin) [3] or amidines are toxic for cats.

Prevention

Dogs with outdoor access should be protected against ticks throughout the year. Even dogs living mostly indoors may be frequently exposed to ticks, for instance, when visiting parks or pet stores for grooming, bathing, hair cutting or nail trimming. Products with repellent and fast killing effects should be applied on a regular basis, as per label recommendations. The efficacy of available products may last for some weeks to several months.

Public health significance

Some ticks commonly found on dogs in some tropical countries may also infest and transmit pathogenic microorganisms to humans. For instance, *R. sanguineus* s.l. is a proven vector of *R. rickettsii* in some areas of United States and Mexico. As another example, *Amblyomma aureolatum* is also a vector of *R. rickettsii* in south-eastern Brazil.

References

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Fleas (Siphonaptera)

Fleas are small wingless insects that are external parasites of various animals, including dogs and cats. They may cause either direct injury to the skin or act as vectors or intermediate hosts for pathogenic organisms, such as bacteria and helminths. Some animals may also develop an allergic reaction to the flea's saliva.

Distribution

Ctenocephalides felis (**Fig. 1**) is the most common flea found on dogs and cats around the world [1], especially in urban areas. Other species that affect dogs and cats are *C. canis*, *Pulex irritans* (**Fig. 2**), *Xenopsylla cheopis*, and to a lesser extent, *Spilopsyllus cuniculi*, *Echidnophaga gallinacea* and *Archeopsylla erinacei.* Pets in Latin America or sub-Saharan Africa can parasitized by *Tunga penetrans* females.

Figure 1. *Ctenocephalides felis* (*Image credit: Georgiana Deak*)

Figure 2. *Pulex irritans* (*Image credit: Georgiana Deak*)

Life cycle

Adult fleas locate hosts by visual and thermal detection and jump onto the fur of dogs and cats. Both male and female fleas are hematophagous. Female *Ctenocephalides* spp. initiate egg laying within 24–36 h after taking their first blood meal and can lay 40–50 eggs per day on their host. The eggs fall down into the environment to continue the cycle. After 1–3 days, the larvae hatch from the egg. Larvae are found in the environment, feeding on organic matter and flea faeces. The late third instar empties its gut contents before forming a cocoon and pupation. The pupa is the best protected and resistant life stage of a flea. Adults emerge from the cocoon due to vibrations and heat originating from the host. For this, the life cycle of fleas (especially *C. felis* or *C. canis*) can be extended from 21 days over one and a half years.
Nearly 95% of the flea life cycle occurs in the environment which is contaminated by the immature stages (eggs, larvae, and pre-emerged fleas in their cocoons), which represent the source of infestation.

Clinical signs

Fleas cause irritation and discomfort in pets (**Fig. 3**). Cutaneous lesions (such as erythema, alopecia and/or dermatitis) can occur as a result of intense scratching. *Tunga penetrans* females penetrate the skin, causing local cutaneous lesions, such as hyperkeratosis, pigmentation, and oedema (**Fig. 4**), also favouring secondary bacterial infections. However, cats are more tolerant to flea bites than dogs.

Figure 3. Heavy infestation with *Ctenocephalides felis* in a puppy (*Image credit: Andrei D. Mihalca*)

Figure 4. Skin lesions and oedema caused by *Tunga penetrans* in a puppy (*Image credit: Filipe Dantas-Torres*)

Some animals develop an allergic dermatitis (FDA - flea allergic dermatitis) due to certain allergenic components present in the fleas' saliva as well as individual factors of each patient. Fleas are vectors of different diseases around the tropics such as *Bartonella henselae* and *Rickettsia felis*. *Ctenocephalides felis* and *C. canis* are also intermediate hosts of *Dipylidium caninum* which is a very common tapeworm in dogs and cats. Very heavy infestations in kittens and puppies can result in anaemia.

Diagnosis

The diagnosis is made by observing the adult fleas or locating flea "dirt" (faeces of adult fleas) on the animal. Adult fleas are most frequently found on the neck, the lumbosacral area and the abdomen. Flea faeces can be found in the same locations. The faeces have "comma shaped" form and a reddish coloration due the fleas' hematophagous diet. Adult fleas can be preserved in ethanol (70% or higher concentration) for subsequent morphological or molecular identification.

Treatment

Treatment should be based on the regular application of antiparasitic drugs to the pet as well as on the control of the stages in the environment. For cats and dogs, there are topical products (such as fipronil and imidacloprid) or oral therapies (such as spinosad and isoxazolines). It is essential to respect the dosage range and the application measures of the product, which should be indicated by a veterinarian[1].

Prevention

In order for the treatment to be successful, it must be accompanied by measures focused on potentially infested areas of the environment (e.g., sleeping areas, carpets, and furniture). For these areas, frequent cleaning with a vacuum cleaner and the application of specific products such as methoprene (an insect growth regulator.) can be useful.
In tropical areas, the prevention of flea infestations must be done throughout the year. The different products used for this purpose (e.g. spot on, tablets, and collars) have different periods of protection ranging from weeks to months.

Public health significance

Fleas that may infest dogs and cats may transmit various pathogens to humans, including the bacteria *Bartonella henselae*, *Rickettsia felis*, *Yersinia pestis*, and the tapeworms *Dipylidium caninum*, *Hymenolepis diminuta*, and *Hymenolepis nana*.

References

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Lice (Phthiraptera)

Lice are dorsoventrally flattened, small wingless insects that live in close contact with the skin and hair of their hosts. They may cause direct injury to the skin and act also as vectors or intermediate hosts of pathogens such as *Trichodectes canis* for *Dipylidium caninum*, and *Heterodoxus spiniger* for *Acanthocheilonema reconditum*. According to their feeding habits they are classified as sucking lice or chewing lice. The species found on companion animals include *Linognathus setosus* (sucking lice), and *T. canis* and *H. spiniger* (both chewing lice). Cats have only chewing lice (*Felicola subrostratus*). Heavy infestations are usually seen in winter [1,2].

Distribution

Trichodectes canis (**Fig. 1**) and *L. setosus* (rarer in South America) are distributed worldwide. *Heterodoxus spiniger* (**Fig. 2**) is found mainly in warm tropical or subtropical regions (not Europe). *Felicola subrostratus* (**Fig. 3**) is present in Asia, Australia, Europe, North, Central and South America and the Caribbean [3].

Figure 1. *Trichodectes canis* (*Image credit: Georgiana Deak*)

Figure 2. *Heterodoxus spiniger* (*Image credit: University of Melbourne parasitology image library*)

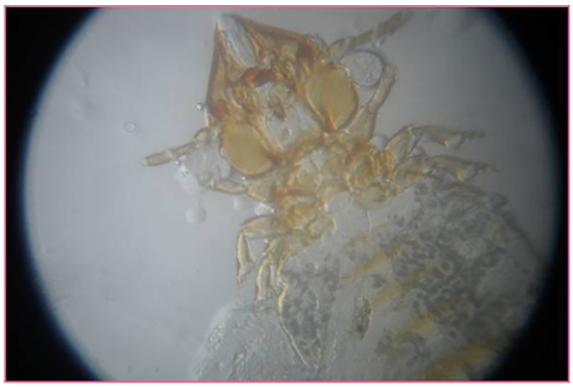

Figure 3. *Felicola subrostratus* (*Image credit: Gabriela Pérez Tort*)

Life cycle

Lice develop through an incomplete metamorphosis. All of them spend their entire life on the host and display a high order of host specificity. The eggs or nits are glued by the female to the hair shaft. The duration of the life cycle varies according to species [1].

Clinical signs

Usually, the owners do not notice lice infestations on their pets and they are found only at a more thorough examination of the fur (**Figs. 4, 5)**. In dogs, pruritus is the main clinical sign. A rough, dry, matted coat can be observed as well as erythema, scaling, crusting, and hair loss (specifically around ears, neck, shoulders, groin, and rectal regions). Restless behaviour is sometimes noticed by the owner. Anaemia is possible, especially in young or immune-suppressed animals, caused by blood loss due to heavy *L. setosus* infestations, and less frequently *T. canis* or *H. spiniger* infestations.

Figure 4. *Trichodectes canis* infestation in a dog (*Image credit: Gabriela Pérez Tort*)

Figure 5. *Trichodectes canis* infestation in a dog (*Image credit: Andrei D. Mihalca*)

In cats, scratching is the main sign, associated with a rough, dry coat, crusting, or scaling. Predilection sites include face, back and pinna causing non-specific skin lesions characterized by scaling, papules, and crusts. The degree of pruritus is variable and damage to the skin from scratching may result in alopecia and crusts, inflammatory excoriation. Louse infestations in cats are infrequently diagnosed. Heavy infestations occur typically only in animals incapable of grooming such as very young animals or diseased cats with underlying severe conditions (e.g., feline leukaemia virus and feline immunodeficiency virus)

Diagnosis

Trichodectes canis are yellow-coloured and run around very quickly. The head is much wider than the thorax and they measure approximately 2 mm in length. They are usually found on the head (especially the ears), the back and the tail. *Linognathus setosus* have pincer-like tarsal claws for clinging to the hairs of their hosts. The thorax is wider than the head. They measure 1.5 to 2.5 mm in length, and are grey to dusk red. These lice have sedentary habits and move slowly.

They are found on the head, the eyelids and on the ventral part of the neck and chest. *Heterodoxus spiniger* has a subtriangular head. The thorax is longer than wide, while the head is wider than long. They measure 2.5 mm and are typically found anywhere on the host, moving around rapidly. *Felicola subrostratus* is characterized by the triangular shape of the anterior portion of the head which is wider than the thorax, and measures 1.2 to 1.5 mm. They are found on the head, the back, the ear pinna and rarely inside the auditory canal [4].

Treatment

All products are effective only against active stages on hosts (nymphs and adults) whereas eggs are not affected. Topical or systemic treatments are available. The following drugs can be used: i) fipronil: 10% fipronil spot-on (as per label), twice, 2 weeks apart. In very young puppies 0.25% fipronil pump spray 6 ml/kg, topically, twice, 2 weeks apart. It can be used in dogs and cats aged 2 days; ii) imidacloprid: topically; repeat after 4 weeks or if it is a puppy two weeks apart; iii) selamectin: spot-on (as per label), twice 2 weeks apart. Treatment administered every 2 weeks at least four times may be more effective; iv) moxidectin spot on applied every 2 weeks, two times; and v) single oral fluralaner is effective against *L. setosus* [5]. Animals with severe anaemia may require blood transfusions and supportive care. Search for *Dipylidium caninum* proglottids or prescribe praziquantel.

Prevention

Prophylactic use of imidacloprid, fipronil, moxidectin or selamectin monthly is effective in preventing louse infestations, but avoidance of infested animals is also recommended.

Public health significance

Lice are highly host specific so cat or dog lice do not parasitize humans. Lice are vectors of *D. caninum* for dogs and cats and *A. reconditum* for dogs. Sporadic cases of human infection by *D. caninum* have been described in the literature, but there is no *bona fide* evidence showing that lice are acting in the transmission of this parasite to humans.

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Phlebotomine sand flies (Phlebotominae)

Phlebotomine sand flies are small flying, blood-feeding insects that can transmit *Leishmania* parasites to mammalian hosts, including humans, dogs and cats, in addition to other pathogens (bacteria and viruses) to humans.

Distribution

Phlebotomine sand flies are distributed worldwide. In Europe, Asia and Africa, species implicated as vectors of *Leishmania* parasites are included in the genus *Phlebotomus*. In the Americas, vector species were traditionally included in the genus *Lutzomyia*, but a newly proposed classification system has included vector species in additional genera (e.g. *Nyssomyia* and *Psychodopygus*).

Life cycle

Phlebotomine sand flies have four developmental stages: egg, larva (four instars), pupa and adult. Both males and females feed on sugary secretions (from plants or from honeydew produced by aphids) [1]. Additionally, females also need to feed on blood for egg development. After taking a blood meal and mating with a conspecific male, the female digests the ingested blood and produces a batch of eggs. Most females need a single blood meal to produce the eggs, but some females will take multiple blood meals in a single gonotrophic cycle. Eggs are laid by the female on soil, typically in microhabitats that are rich in organic matter. Under laboratory conditions (25–28°C and 70–95% relative humidity), first-instar larvae emerge in 12–19 days, pupae in 25–59 days, and adults in 35–69 days [2].

Clinical signs

Phlebotomine sand fly bites may eventually produce localized mild skin lesions in the bite wound. Considering the minimal amount of blood ingested by female phlebotomine sand flies, significant blood depletion is unlikely even in dogs and cats highly exposed to these insects.

Diagnosis

Phlebotomine sand flies can be collected from the environment using mouth aspirators or a range of insect traps, including light traps and sticky traps. Collected specimens should be placed in a glass vial containing ethanol (70% or higher concentrations) for subsequent morphological or molecular identification.

Treatment

Phlebotomine sand flies are temporary ectoparasites and treatment of existing infestations is not applicable (see *Prevention*).

Prevention

Phlebotomine sand fly bites can be prevented by using repellent products with proven efficacy against these insects. Several spot-on pipettes and collars containing synthetic pyrethroids (e.g. deltamethrin, flumethrin, and permethrin) are available in the veterinary market for protecting dogs and, eventually, cats (i.e. flumethrin-impregnated collar). Protection may last from one up to 12 months [4], depending on the product and phlebotomine sand fly species. Dogs and cats at risk of exposure to phlebotomine sand fly bites should be protected year-round.

Public health significance

Phlebotomine sand flies can transmit a range of *Leishmania* species to dogs and cats (e.g. *Leishmania infantum*, *L. amazonensis*, *L. braziliensis*, and *L. mexicana*), all of which are zoonotic [3].

References

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Mosquitoes (Culicidae)

Mosquitoes are a large and diverse group of flying insects, comprising over 3,500 species. Females are hematophagous and require vertebrate blood for egg development. Males are nectarivorous and do not feed on blood. Mosquitoes can cause irritation from feeding, but their primary importance is due to their formidable role as vectors of disease agents. Mosquitoes, together with ticks are the most important vectors of disease in animals and humans with regard to the number of pathogens that they transmit.

Distribution

Mosquitoes are distributed throughout the world. Their range is dependent by the availability of hosts and habitats for development. Such habitats include natural or artificial aquatic or humid areas like water bodies, riparian woodlands, swamps, tree holes, ponds, ditches, or artificial containers (e.g. tires, bird baths, rain barrels, and gutters).

Life cycle

The life cycle of mosquitoes is complex and includes four stages: egg, larva, pupa, and adult. The presence of water is essential for completing their life cycle. Gravid females lay their eggs in water or on moist surfaces close to the water's edge. Eggs are laid either singly or in clusters. Larvae (**Fig. 1, 2**) use an egg tooth present on their head to emerge from eggs and breathe using their spiracles which connets them to the surface. The larvae moult several times before becoming a pupa. From the pupa (which does feed) adults emerge (**Fig. 3, 4**). Under ideal conditions, the complete life cycle of mosquitoes requires about 4 days, but can take longer, in species which undergo diapause or hibernation.

Figure 1. Larvae of *Aedes albopictus* (*Image credit: Andrei. D Mihalca*)

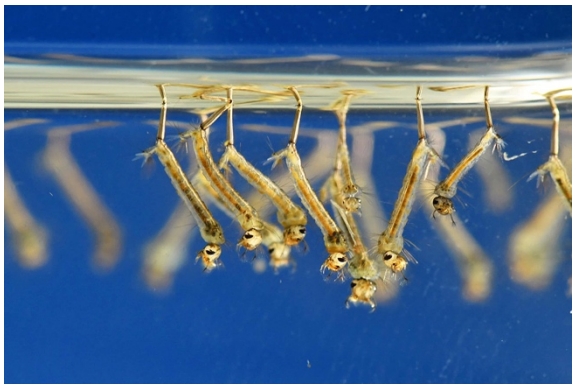

Figure 2. *Culex* larvae (*Image credit: Andrei. D Mihalca*)

Figure 3. *Aedes albopictus* feed on a human (*Image credit: Andrei. D Mihalca*)

Figure 4. *Anopheles* adults resting on a wall (*Image credit: Andrei. D Mihalca*)

Clinical signs

Mosquitoes annoy animals, cause blood loss, and transmit disease agents. Also, the toxins injected at the time of biting may cause systemic effects. People and animals may suffer a mild to intense pruritus. The feeding of large numbers of swarming mosquitoes can cause significant anaemia in animals. Mosquitoes are known for spreading agents of humans diseases, including malaria, yellow fever virus, dengue virus, Japanese encephalitis virus, St. Louis encephalitis virus, West Nile meningoencephalitis virus, zika virus, Chikungunya virus, and lymphatic filariasis. In veterinary medicine, they are best known as the intermediate hosts (and vectors) for the filarial worms *Dirofilaria immitis* and *D. repens*, but also as vectors of the eastern and western equine encephalomyelitis viruses, Venezuelan equine encephalitis virus, among others.

Diagnosis

Mosquito infestations can be diagnosed by visual inspection of life cycle stages in or near water bodies or identification of adult mosquitoes actively feeding on animals. Mosquitoes can be collected and preserved in ethanol (70% or higher concentration) for subsequent morphological or molecular identification.

Treatment

Mosquitoes are temporary ectoparasites and treatment of existing infestations is not applicable (see *Prevention*).

Prevention

Control of mosquitoes should be done using integrated pest management. This involves the use of registered repellents and insecticides, minimizing exposure, and elimination breeding sites.

Biological control can be accomplished with fish such as *Gambusia affinis* or *Fundulus* spp., which feed on mosquito larvae. *Bacillus thuringiensis israelensis* is used as a biological control method against larval mosquitoes and its use is part of public health strategies against mosquitoes in some tropical countries (e.g. Brazil).

Chemical larval control (used in formulations such as dust, powder, water soluble liquid, emulsion, oil-soluble liquid, granule, pellet, and briquette) applied to waterways include light mineral oils, organophosphates and insect growth regulators. Their use depends on the mosquito species and its biology, the type of habitat, method of application, or chemical composition of the water. Mineral oils applied over water surfaces prevent larvae and pupae from accessing oxygen. Methoprene interferes with metamorphosis and emergence.
Certain formulations used in dogs (such as those based on isoxazolines) contribute to the decrease of mosquito populations but also to a reduction in the risk of *D. immitis* transmission [1].

Public health significance

Mosquitoes are recognized vectors of numerous pathogens to humans, including *Plasmodium* spp. and numerous viruses (e.g. dengue, zika and chikungunya, and yellow fever viruses). Numerous cases of human infection by *D. immitis* and *D. repens* have been reported in the international literature [2], but the number of cases is probably underestimated, as most infections are subclinical.

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Eye flies (Steganinae)

Eye flies of the subfamily Steganinae are unique drosophilids presenting a zoophilic behaviour. They feed on lachrymal secretions (i.e. lachryphagy) of a range of animals, including dogs and cats. They are vectors of *Thelazia callipaeda* (the oriental eyeworm).

Distribution

Phortica variegata is the vector of *T. callipaeda* in Europe and the United States [1]. *Phortica okadai*, *Phortica magna*, and *Amiota nagatai* are vectors of *T. callipaeda* in Asian countries.

Life cycle

There is limited information about the life cycle of Steganinae eye flies. *Phortica variegata* has four developmental stages: egg, larva (three instars), pupa and adult. Under laboratory conditions (21°C temperature and 60% relative humidity), first-instar larvae hatch in 2–12 days, pupae in 7–18 days, and adults in 9–18 days [2].

Clinical signs

Dogs and cats are unlikely to present clinical signs due to the direct parasitism of eye flies. Clinical signs like conjunctivitis and excessive lachrymation are usually associated with *T. callipaeda* ocular infections, rather than eye fly parasitism itself.

Diagnosis

Eye flies may be collected by netting around animal eyes or using fruit baits. Specimens can be preserved alive and identified by a trained entomologist, using suitable morphological keys. Damaged specimens can be identified genetically by DNA sequencing of target genes.

Treatment

Eye flies are temporary ectoparasites and treatment of existing infestations is not applicable (see Prevention).

Prevention

There are no commercial products with proven repellent efficacy against eye flies. Exposure to these insects can be reduced by avoiding areas where they are known to be present (generally wooded environments), especially during summertime at dusk and dawn.

Public health significance

Phortica variegata, *P. okadai*, *P. magna*, and *A. nagatai* are biological vectors of *T. callipaeda*, which is a zoonotic nematode. Several human cases have been described in Europe and Asia.

References

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Louse fly (*Hippobosca longipennis*)

Louse flies are permanent blood-sucking ectoparasites of a wide variety of mammals and birds, including dogs and cats, with a significant role as a nuisance and also important as vectors.

Distribution

The most common louse fly of companion animals is *Hippobosca longipennis* (**Fig. 1**), also known as the dog louse fly. It can be found on cats, but at a much lower frequency. This louse fly feeds also on a large variety of wild carnivores and occasionally on humans. It is widespread on dogs in semi-arid and arid regions of Africa and the Middle East, with reports in warm parts of Asia (i.e. India) and Europe. They were introduced accidentally to the United States, but after targeted control measures, they have been eradicated. Occasionally, other species can be found on dogs and cats (e.g. *Lipoptena fortisetosa*) [1].

Figure 1. Detail of a *Hippobosca longipennis* (*Image credit: Andrei D. Mihalca*)

Figure 2. Massive infestation with *Hippobosca longipennis* on a dog (*Image credit: Andrei D. Mihalca*)

Life cycle

Both the males and the females are permanent blood-sucking parasites of warm-blooded hosts. The females live for several months and are larviparous. For larviposition, the females leave the host and deposit a single larva each time on soil, crevices or cracks of tree barks. Overall, they lay less than 10 larvae during their lifespan. The larvae become pupae a few hours after deposition and remain in this stage for approximately 3-4 weeks before becoming adults.

Clinical signs

Louse flies are usually found buried in the fur of dogs and more rarely in the fur of cats. In heavy infestations, they can cause mechanical irritation, discomfort/nuisance (animals can be restless), pruritus, local skin lesions (**Fig. 2**) and anaemia.

Hippobosca longipennis is a demonstrated vector for the filarial nematode *Acanthocheilonema dracunculoides* [2,3] and it is a potential intermediate host of an undescribed *Acanthocheilonema* species [3]. It is also a mechanical phoretic carrier for *Cheyletiella yasguri* [3].

Diagnosis

Louse flies can be diagnosed by visual inspection of the body surface, mainly dorsal parts of the body and neck, as well as the chest, or by gently touching these areas by hand, when flies are easily detected under the fur coat. Usually they hide in the fur, by “diving”. If they fly, this is only for very short distances.

Treatment

There is no scientific evidence on the efficacy of insecticides against *H. longipennis*. Reports from zoos in the United States where these parasites have been introduced on wild carnivores imported from Africa mention the efficacy of methoxychlor, malathion and carbaryl-sulphur dust formulations.

Prevention

There is no information on the efficacy of ectoparasitic formulations in the prevention of the infestation with *H. longipennis*.

Public health significance

Normally, *H. longipennis* will not feed on humans. However, when in the vicinity of dogs with heavy infestations, these louse-flies can land on humans, but bites seem to be very rare. There are reports that louse flies can facilitate the zoonotic transmission of *C. yasguri* mites.

References

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Myiasis (maggot infestation)

Myiases are parasitic conditions of humans and animals, often with a severe clinical picture, even death, caused by larvae of various flies, known as maggots or grubs. These larvae feed on live or necrotic tissues of their host. Dogs are more commonly infested than cats.

Distribution

Dogs and cats can develop various types of myiases. In tropical areas, the most common species involved are: *Cordylobia anthropophaga* (**Figs. 1, 2**) (Africa), *Dermatobia hominis* (South America) (**Fig. 3**), *Cochliomyia hominivorax* (South America) and *Cuterebra* spp. (North America) (**Fig. 4**). Other species can also opportunistically affect dogs and/or cats such as *Musca* spp., *Calliphora* spp., *Sarcophaga* spp., *Wohlfahrtia magnifica*, *Lucilia sericata*, *Phaenicia eximia*, and *Oestrus ovis* [1,2].

Figure 1. Adult *Cordylobia anthropophaga* (*Image credit: Andrei D. Mihalca*)

Figure 2. Removal of *Cordylobia* larva *anthropophaga* from a nodule in a dog (*Image credit: Andrei D. Mihalca*)

Figure 3. L3 of *Dermatobia hominis (Image credit: Andrei D. Mihalca*)

Figure 4. L3 of *Cuterebra* spp. (*Image credit: Pablo Borras*)

Life cycle

Only the larvae are parasitic, while the adults are free-living. Myiases can be obligatory, facultative or accidental and larvae can be found on/in the host's body. Agents of obligatory myiases cannot complete their life cycle without a host. The life cycle is variable according to the species. Some species are oviparous and lay the eggs in wounded or infected skin. The three larval instars feed on the host tissues and the fully developed L3 drops from the host to the ground where it pupates and later becomes an adult. *Cordylobia anthropophaga* lay the eggs on sandy ground where the larvae hatch and subsequently attach to the host and bury under the skin where they develop quickly. In the case of *C. hominivorax*, the eggs are deposited at the edges of open wounds, but also in and around natural orifices. *Cuterebra* spp. lay the eggs on the ground, close to the burrows of their hosts. Females of *Dermatobia* glue their eggs to other insects (usually mosquitoes) which subsequently pass the larvae when they land on a potentially suitable host. Some others such as *W. magnifica* are larviparous and lay the larvae on wounded or intact skin, close to natural orifices.

Clinical signs

Myiases are classified as cutaneous, dermal, subdermal, ocular, nasopharyngeal, gastrointestinal and urogenital. The screw-worm myiases produced by *C. hominivorax* and *Chrysomya bezziana* are traumatic myiases affecting the skin but also the underlying tissues. They start on pre-existing wounds like scratches, bites of other arthropods, including ticks, or castration wounds. The furuncular myiasis caused by *C. anthropophaga* (also known as the Tumbu fly) is common in dogs in sub-Saharan Africa and is characterized by the presence of nodules over the lateral and dorsal parts of the body (**Fig. 5**). Sometimes the nodules present in the middle a small opening where the larva will emerge. Former nodules are also visible as slightly indurated areas, with a central crust (**Fig. 5**). Puppies are particularly affected. Facultative myiases affect particularly weak or injured animals (**Fig. 6**). Infested animals are restless. Lesions consist of exudative dermatitis and dermatonecrosis, often with a bad smell. Often the lesions are infected with bacteria.

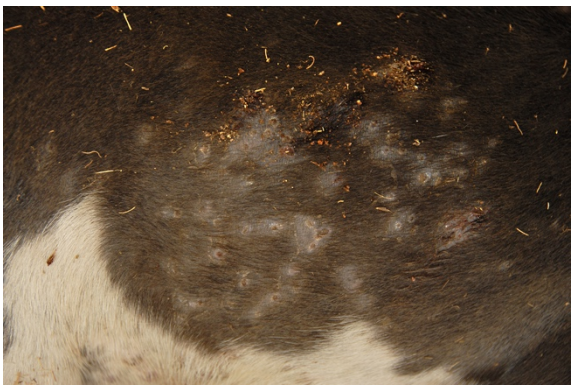

Figure 5. Furuncular myiasis produced by larvae of *Cordylobia anthropophaga* (*Image credit: Andrei D. Mihalca*)

Figure 6. Ocular myiasis in a dog following a three-day decubitus because of an injury (*Image credit: Andrei D. Mihalca*)

Diagnosis

Larvae can be diagnosed by visual inspection of the wounds and natural orifices. Presence of nodules produced by *C. anthropophaga* under the skin can be identified at a gentle palpation. Species identification requires expertise from a specialist.

Treatment

Visible eggs and larvae should be removed and the site thoroughly cleaned and disinfected. Systemic antibiotic therapy and/or analgesics may be required. In the case of a subcutaneous location, surgical removal might be required. The efficacy of insecticides has been only scarcely investigated, with systemic or topical macrocyclic lactones and isoxazolines shown to be efficient.

Prevention

Animals with wounds (surgical or other) and new-borns with an unhealed navel should be kept out of the reach of flies. If this is not possible, wounds must be protected and an insecticide/repellent should be applied to prevent landing of flies.

Public health significance

Dogs and cats are either accidental hosts of myiases causing flies of other animals or part of the host spectrum of generalist species. Most species affecting dogs and cats are zoonotic, but the transmission from pets to humans is not direct. However, dogs are important reservoirs in certain regions (i.e. in sub-Saharan Africa for *Cordylobia*).

References

[1] Beugnet F ,Halos.L Guillot J, Textbook of clinical parasitology in dogs and cats, 1st. edition. 2018. Ed. Servet

[2] Pezzi M, Bonacci T, Leis M, Mamolini E, Marchetti MG, Krčmar S, Chicca M, Del Zingaro CNF, Faucheux MJ, Scapoli C. Myiasis in domestic cats: a global review. Parasit Vectors. 2019;12:372.

Tsetse flies (*Glossina* spp.)

Tsetse flies are medium to large blood-sucking ectoparasites of a wide variety of reptiles, birds, and mammals, including dogs and cats. Their importance resides in their ability to transmit various species of *Trypanosoma*, the agents of the disease known as Nagana.

Distribution

Tsetse flies are widely distributed through sub-Saharan Africa, over a 10 million km^2 area within the so-called “tsetse belt”, including arid and semi-arid to sub-humid and humid regions. There are over 30 tsetse fly species, all belonging to the genus *Glossina* [1] (**Figs. 1, 2**).

Figure 1. Adult *Glossina* sp. feeding on a human (photo Andrei D. Mihalca)

Figure 2. Adult unfed *Glossina* sp. (photo Andrei D. Mihalca)

Life cycle

Both the adult males and the females are hematophagous. Females are sexually receptive even before the first blood meal, while males require several blood meals for becoming fertile. Females usually mate only once per lifetime. After fertilization, the female tsetse flies retain their egg in the oviduct, where it hatches after approximately 4 days. The larviposition takes place after 5 more days, as L3. It immediately buries itself in the ground and starts pupariation. After 30 more days, the adult emerges. One female is able to produce 2-3 larvae during its life [1].

Clinical signs

The bites of tsetse flies are painful and can cause local irritation of the skin and nuisance. However, the most important significance of tsetse flies is their vector role in the transmission of protozoans of the genus *Trypanosoma*, agents of severe diseases in livestock, pets, wildlife and humans.

Dogs can be infected by several tsetse-borne *Trypanosoma* such as *T. brucei brucei*, *T. brucei rhodesiense*, *T. brucei gambiense*, and *T. congolense*. In cats, tsetse-borne trypanosomiases are known only from experimental infections.

Diagnosis

Tsetse flies feed only shorty on dogs. They can be collected using nets or special traps and their identification to species level should be done by trained entomologists using morphological keys or genetic tools.

Treatment

Tsetse flies are temporary ectoparasites and treatment of existing infestations is not applicable (see *Prevention*).

Prevention

Tsetse flies can be controlled in the environment by using traps, bush clearing or fly screens (for indoor dogs). There are no clinical studies on the efficacy of repellents used on dogs against tsetse flies.

Public health significance

Dogs can be reservoirs of zoonotic tsetse-borne *Trypanosoma* species, agents of the human sleeping sickness or a disease known as Nagana in livestock.

References

[1] Russell RC, Otranto D, Wall RL. The Encyclopedia of Medical & Veterinary Entomology. 2013, CAB International.

Demodectic mites (*Demodex* spp.)

The genus *Demodex* is represented by a group of highly host specific mites, with elongated bodies that have adapted to living within hair follicles. Various species affect domestic dogs and cats. By means of genetic studies, it has been demonstrated that *D. canis* and *D. injai* are different species infecting dogs. Cats are affected by *D. cati* and *D. gatoi*.

Distribution

Demodex cati and *D. canis* have a worldwide distribution. *Demodex gatoi* and *Demodex injai* has been reported in the United States, Europe and South America [1].

Life cycle

Demodex canis (**Fig. 1**) lives in hair follicles. It is acquired by puppies from the mother while nursing. Very small numbers of *Demodex* will not produce disease. *Demodex injai* is about twice the length of *D. canis* and is found mainly in the sebaceous glands. *Demodex cati* (**Fig. 2**) lives in the hair follicles of the eyelids, chin, face and ears and inside the ear canal. It is acquired by kittens from the mother while nursing. *Demodex gatoi* are located in the stratum corneum and the disease is contagious.

Figure 1. *Demodex canis* (*Image credit Pablo Borras*)

Figure 2. *Demodex cati* (*Image credit: Gabriela Pérez Tort*)

Clinical signs

Demodicosis is the most common dermatological disease in young dogs (between 3 and 6 months). The disease can develop in young animals that have a congenital defect at T lymphocytes and therefore cannot control the multiplication of *D. canis;* hence these dogs harbour a much larger mite population. Most common lesions include circumscribed areas of erythema and alopecia around the eyes, mouth and head (generally the first lesions to appear). These lesions can be easily misdiagnosed as ringworm, so a confirmatory microscopic diagnosis is recommended.

The disease can stop or progress to generalized demodicosis (more than five lesions), when the skin becomes coarse, dry, and erythematous ("red mange") (**Fig. 3**).

Figure 3. Generalized demodicosis in a puppy (photo Andrei Daniel Mihalca)

Concomitant staphylococcal pyoderma is common in generalized cases; pustules develop, break open, and ooze and pruritus appears. This can be a life-threatening disease. The onset of the disease in older dogs is generally associated with a generalized immunodeficiency, diabetes mellitus, Cushing's disease, systemic lupus erythematosus, chemotherapy, or hypothyroidism (in this case the feet are generally affected, a condition known as pododemodicosis). *Demodex injai* appears most often associated with dorsal seborrheic dermatitis. Pyoderma may be seen but it is a rare complication [2]. The disease produced by *D. cati* does not develop in young cats but is generally associated with an underlying disease, such as diabetes mellitus, Cushing's disease, feline leukaemia, systemic lupus erythematosus, feline immunodeficiency, or toxoplasmosis. The use of glucocorticoids was associated with clinical signs on the head produced by *D. cati*. Two forms of demodicosis are recognized in cats: localized and generalized, with lesions such as alopecia, erythema, scabs, otitis, or seborrhoea. In cats, pyoderma and pruritus are uncommon. The main clinical signs associated with *D. gatoi* include moderate to intense pruritus, alopecia in some areas, erythema, self-inflicted excoriations in the face, neck, elbow, inner side of legs and flanks, and otitis. As with *D. cati*, it can be localized and generalized.

Diagnosis

Diagnosis is based on deep skin scrapings of the lesions and observation under a microscope of the cigar shaped mites with very short legs. In *D. canis*, females measure 250-300 x 40 µm and males 200-250 x 40 µm (For *D. cati*, females are 220 x 30 µm; males 182 x 20 µm). *Demodex canis* eggs are 70-90 µm (for *D. cati*: 70.5 x 21 µm), with fusiform appearance. Eggs and mites can also be found in faecal flotations from infected animals. The use of an adhesive tape preparation with skin squeezing has proved useful, particularly in sensitive areas such as around the eyes, lips or interdigital spaces.

Treatment

While clinical signs of localized infestations in dogs can resolve without treatment, generalized infestations, require treatment for over two months after the animal is clinically cured and no mites are found in skin scrapings. Various drugs were shown to be effective for the treatment of canine demodicosis: milbemycin oxime (2 mg/kg, per day, orally), ivermectin (400 mcg/kg orally every day), moxidectin topical once a week or moxidectin 400 mcg orally every day, fluralaner every three months, sarolaner topical once a month, afoxolaner repeated at 14 days and then once a month. In cats, the following treatment options were demonstrated to be efficient: milbemycin oxime (1 mg/kg per day orally), ivermectin (400 mcg/kg orally every day), moxidectin topical once a week, fluralaner topical, sarolaner topical once a month. In cats and old dogs, a diagnosis for the underlying disease should always be considered.

Prevention

Male or female dogs with generalized demodicosis should not be bred. Queens with demodicosis should not be bred.

Public health significance

None.

References

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Sarcoptic mites (*Sarcoptes scabiei*)

Sarcoptic mange is a highly contagious and the most pruritic cutaneous disease of dogs.

Distribution

Sarcoptes scabiei (**Fig. 1**) causes sarcoptic mange or scabies of humans, dogs, foxes, horses, cattle, and other mammals. *Sarcoptes scabiei* infests a wide range of hosts, but a significant degree of host specificity is known in this parasite, so when interspecific transmission does occur, the resulting dermatitis tends to be atypical and transient.

Life cycle

Sarcoptic mites do not survive for long in the environment; hence transmission is primarily via direct contact between animals. The *Sarcoptes* female lays eggs in burrows in the epidermis. After the larvae hatch from the eggs, they leave the tunnels and move to the skin surface. The larva migrates through the skin and then prepares a moulting burrow to moult to a nymph. The adults are present as early as 12 days after the larva hatches. After moulting, the females remain in their moulting burrow, but males usually leave in search of females. When males meet a female meet, they tunnel down to it and copulate. The life cycle takes 18 to 21 days.

Figure 1. *Sarcoptes scabiei* (*Image credit: Georgiana Deak*)

Figure 2. Sarcoptic mange in a dog (*Image credit: Andrei Daniel Mihalca*)

Clinical signs

Sarcoptic mange usually starts on relatively hairless areas of skin and may later generalize. In dogs, the lateral aspect of the elbow and the pinna of the ear are favourite starting places (**Fig. 2**); the lesions consist of follicular papules, erythema, crusts of blood and dry serum, and excoriations caused by intense scratching.

Dogs with chronic disease, and generalized lesions show seborrhoea, severe skin thickening, fold formation, crusting, peripheral lymphadenopathy, and emaciation; dogs so affected may even die. Asymptomatic carriers may exist. Although *S. scabiei* is not commonly reported from cats, symptoms such as extensive hair loss over the ears, head, neck, abdomen, and tail, and thickened, scaly, and wrinkled skin on the abdominal region have been reported in kittens [1].

Diagnosis

The diagnosis is reached by identification of the mites or eggs in deep skin scrapings. This is easily achieved in puppies, but it is more difficult to recover the mites or the eggs from old dogs or chronically affected pets. Scrapings should be done in non-excoriated areas. Mites are 250 to 500 µm, rather circular in shape. They may also be seen in faecal flotations. Eggs are ellipsoidal and measure around 250 µm. For a clinical diagnosis, the oto-podal reflex is also useful.

Treatment

Various treatment options are effective in the treatment of scabies in dogs: selamectin: (once a month, topical,), ivermectin (250-400 mcg/kg, repeat on day 10, injectable), moxidectin (once a month, topical), milbemycine oxime (2 mg/kg, three doses separated for 7 days, orally), fluralaner (every 3 months, orally), sarolaner (once a month, orally), afoxolaner (repeated at 14 days, orally), fipronil (three to six shots per kg, repeated every 7 days, spray, in puppies under 1 month and a half). All dogs in contact with a diseased dog should also be treated [2,3].

Prevention

Avoid contact with diseased dogs or use preventative use of moxidectin or selamectin monthly.

Public health significance

If pregnant women or immunosuppressed people are in contact with dogs with mange they can develop lesions on arms, chest or thighs.

References

[1] Bowman DD, Hendrix CM, Lindsay DS, Barr SC. Feline Clinical Parasitology. 2002, Iowa State University Press.

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[3] Miller WH Jr, de Jaham C, Scott DW, Cayatte SM, Bagladi MS, Buerger RG. Treatment of canine scabies with milbemycin oxime. Can Vet J. 1996;37:219-221.

Notoedric mites (*Notoedres cati)*

Notoedric mange, commonly known as feline scabies, is a rare, extremely contagious condition caused by *Notoedres cati* mites. The disease is characterized by severe itching [1].

Distribution

Notoedres cati is found worldwide and it affects cats, rabbits, rats and occasionally people.

Life cycle

The females of *Notoedres cati* (**Fig. 1**) lay eggs in burrows in the epidermis. After the larvae hatch, they leave the tunnels, move to the skin surface, migrate through the skin and then prepare a moulting burrow. The life cycle is otherwise very similar to the one described for *Sarcoptes*.

Figure 1. *Notoedres cati* (microscopic aspect) (*Image credit: Georgiana Deak*)

Figure 2. Mange caused by *Notoedres cati* in a cat (*Image credit: Andrei D. Mihalca*)

Clinical signs

Itching is the main sign due to intense pruritus. Clinical signs also include alopecia, and the formation of grey crusts and scale on the skin. Partial hair removal on the head, perineum and fore legs can be observed during the first phases of the sickness. Face mange of cats (**Fig. 2**) caused by *N. cati* starts on the medial edge of the pinna of the ears and then spreads over the ears, face, paws, and hindquarters by contiguity and contact. The reactions can be severe especially in young cats, with weight loss, fever, and alopecia. If the cat is immunosuppressed, the disease can be life threatening and lead to death [2,3]. Young cats and those with chronic infestation can become debilitated, develop leucocytosis and eosinophilia. They may undergo self-mutilation.

Diagnosis

These mites can be easily visualized in deep skin scrapings. The mites have a spherical shape, between 220 and 400 µm, and its anus is located on the dorsal part of its body.

Treatment

All the cats living in the same household should be treated. The following options are available: ivermectin (400 µg/kg, two applications 12 days apart, injectable). Ivermectin (200-400 µg/kg once a week for 3 weeks, orally), moxidectin (1 mg/kg, once a month), selamectin (6 mg/kg, once), selamectin + sarolaner (once, topical), fipronil (3 shots/kg, every 7 days, three times, spray, for kittens under 1 month and a half).

Prevention

Prevention can be achieved through antiparasitic drugs such as selamectin (6 mg/kg, one monthly application) or moxidectin (once a month, topically).

Public health significance

Some people owning a cat with *Notoedres* mange developed a pruritic rash on their arms and forearms.

References

[1] Bowman DD, Hendrix CM, Lindsay DS, Barr SC. Feline Clinical Parasitology. 2002, Iowa State University Press.
[2] Guaguère E, Prelaud P. A practical guide to feline dermatology, 1999, Merial.
[3] Beugnet F ,Halos.L Guillot J, Textbook of clinical parasitology in dogs and cats, 1st. edition. 2018. Ed. Servet

Ear mites (*Otodectes cynotis*)

Ear mites often infest the external ear, causing inflammation in dogs and cats, especially in those bred in kennels and catteries or kept in shelters.

Distribution

Otodectes cynotis has a worldwide distribution and it occurs in the ears of dogs, cats, ferrets and various wild carnivores.

Life cycle

All the stages of these mites live in the external ear canal, on the skin surface. It can present erratic localizations such as: head, neck, interscapular area and footpads. The eggs (**Fig. 1**) are glued to the ear canal by a secretion produce by the female. The eggs require approx. 4 days of incubation. The life cycle includes a larva, a protonymph and a deutonymph. As soon as the adult male emerges from a deutonymph cuticle it will seek out a female deutonymph and they will mate (**Fig. 2**). The egg to-egg cycle takes approximately 18 to 28 days. Long latency periods can be observed in adult animals with no clinical signs up to a situation of immunosuppression (e.g. glucocorticoid therapy) and then lots of mating couples can be observed in the ear canal with flourishing signs.

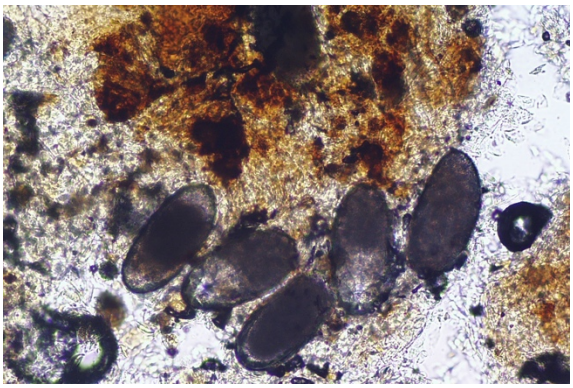

Figure 1. Eggs of *Otodectes cynotis* (*Image credit: Andrei Daniel Mihalca*)

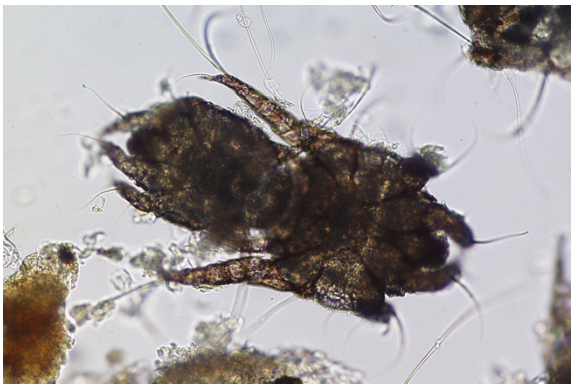

Figure 2. Male and female during copula *Otodectes cynotis* (*Image credit Andrei Daniel Mihalca*)

Clinical signs

Generally, *O. cynotis* infests both ears of affected animals, but infestations can be asymptomatic. Sometimes, a foul odour can be smelled. A very dark exuding waxy material is present in the ear canal (**Fig. 3**), but in some cats a grey, sandy, or flake-like material can be seen. The most common clinical signs are auricular pruritus, head shaking, and external otitis. In very severe cases, self-mutilation and vestibular syndrome can develop.
Lesions on the body due to generalized infestations with *O. cynotis* have been reported in cats and dogs [1,2].

Figure 3. External otitis in a cat with otodectic mange (*Image credit: Andrei Daniel Mihalca*)

Diagnosis

Mites can be seen through the otoscope or they can be picked up from the ear canal with a cotton swab and observed under a microscope. The adult males are 274 to 362 µm in length. The ovigerous female is between 345 and 451 µm in length. The eggs are white, oval, slightly flattened on one side, and 166 to 206 µm long. Mating couples can also be observed more commonly especially in puppies or kittens or in immunosuppressed animals.

Treatment

All infected domestic cats and dogs must be treated, together with all the co-housed carnivores, even if no signs of infestation are present. The following treatment options are available: ivermectin (0.4 mg/kg, repeat on day 15, injectable) selamectin (6 mg/kg, repeat on day 30, topically), moxidectin (repeat on day 30 topically), sarolaner (repeat on day 30 orally, for dogs) sarolaner + selamectin (topically for cats), afoxolaner (repeat on day 30 orally for dogs), fluralaner orally for dogs.

Prevention

All contact animals should be treated. This is a classical kennel or cattery disease, often skipped at the first consultation or when pets are brought for their vaccines. On these occasions, the ear canal of puppies and kittens should always be thoroughly examined in order to prevent the development of the disease.

Public health significance

Rare cases have been reported in humans [3].

References

[1] Bowman DD, Hendrix CM, Lindsay DS, Barr SC. Feline Clinical Parasitology. 2002, Iowa State University Press.

[2] Beugnet F ,Halos.L Guillot J, Textbook of clinical parasitology in dogs and cats, 1st. edition. 2018. Ed. Servet

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Fur mites (*Lynxacarus radovskyi*)

Lynxacarus radovskyi is one of the two main fur mites found on cats. Unlike *Demodex* spp. and *Notoedres cati,* skin scraping is not necessary for diagnosis, because the mite lives on the hair and not in or on the skin. The mites are <0.55 mm long with a cylindrical body, dorsally arched with the head ventrally directed. Co-infestations with lice and fleas are not uncommon; however, *L. radovskyi* can and frequently does occur on its own. *Lynxacarus radovskyi* has been found on a dog living in close contact with infested cats. Treatment of the cats resolved the infestation on the dog, which did not require treatment.

Distribution

Lynxacarus radovskyi (**Fig. 1**) is widely distributed throughout much of the tropics including the Caribbean, South America and Asia. They have been found in Australia and New Zealand, Brazil, Fiji, India, Malaysia, the Philippines, southern United States (Florida and Texas), Hawaii, Puerto Rico and St. Kitts [1]. Prevalence varies depending on the population ranging from 1 to >75% of cats examined.

Figure 1. *Lynxacarus radovskyi* from an adhesive tape sample (*Image credit: Jennifer Ketzis*)

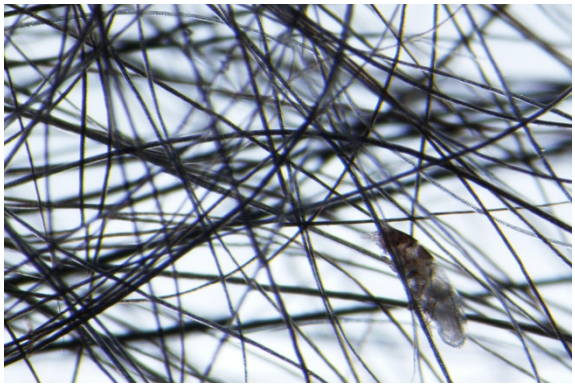

Figure 2. *Lynxacarus radovskyi* from a trichogram (*Image credit: Jennifer Ketzis*)

Life cycle

Lynxacarus radovskyi has a typical mite life cycle with all stages occurring on the cat. Eggs are glued to the hair and the nymphs and adults are found on the hair shafts. Time from egg to adult has not been confirmed.

Clinical signs

Cats can be asymptomatic or present with a dull, dry coat with a rust-coloured or “salt and pepper” appearance. Pruritus and alopecia might be more related to hypersensitivity than infestation level with alopecia being more frequent at the tail base and on the dorsal and lateral regions of the hind limbs.

Diagnosis

Trichograms (hair plucks) (**Fig. 2**) and the adhesive tape method (tape impression) are most commonly used with the mites and eggs visualized using a 4x or 10x objective [2]. While the mite can be found all over the cat's body, sampling the base of the tail and hind limbs can increase recovery; all mild mite infestations, however, can be challenging to diagnose and might require several samples [2]. Skin scraping is not a sensitive means of diagnosing *L. radovskyi*.

Treatment

No products are registered for the treatment of *L. radovskyi*. Fipronil, selamectin, moxidectin, fluralaner and other compounds used for ear mites, burrowing mites, fleas, ticks and lice, at the product label doses, have been used to effectively treat infestations [1,3]. Repeat treatments, as with other mites, are required. IGRs (e.g. lufenuron) are not effective.

Prevention

Most regular use of ectoparasiticides for fleas, ticks and other more common ectoparasite infestations can be used to prevent *L. radovskyi*.

Public health significance

Dermatitis and a papular rash have been reported in a person owning a highly-infested cat [4]. Lesions resolved once the infestation on the cat was treated.

References

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[2] Ketzis JK, Dundas J, Shell LG. *Lynxacarus radovskyi* mites in feral cats: a study of diagnostic methods, preferential body locations, co-infestations and prevalence. Vet Dermatol. 2016;27:425-e108.

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Fur mites (Cheyletiella)

Cheyletiella blakei (**Fig. 1**) infests cats and *Cheyletiella yasguri* (**Fig. 2**) infests dogs with other *Cheyletiella* spp. on other hosts such as *C. parasitivorax* on rabbits. While generally *Cheyletiella* is host specific, the highly contagious nature of the mite can result in transitory infestations from the preferred to non-preferred hosts. Co-infestation with fleas, lice or other mite species is not uncommon.

Distribution

Worldwide with prevalence varying based on location and management of the animals with <1% infested to over 50% infested in the case of feral cats.

Figure 1. *Cheyletiella blakei* (*Image credit: Jennifer Ketzis*)

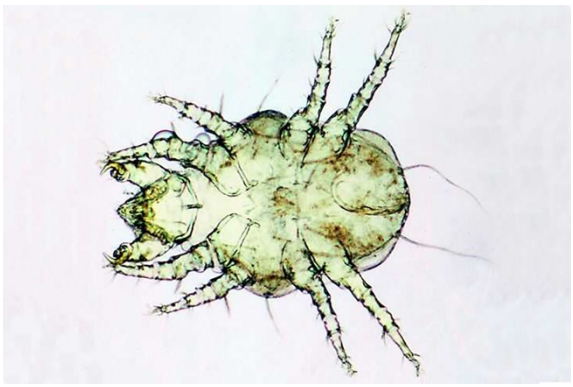

Figure 2. *Cheyletiella yasguri* (*Image credit: University of Melbourne parasitology image library*)

Life cycle

The life cycle is typical for mites with all stages on the cat or dog; egg to adult requires approximately 3-5 weeks. Adult survival off of the host is limited, although sufficient to allow some transmission via fomites.The mites do not burrow and live in the stratum corneum. Eggs are smaller than those of lice and are attached to hairs [1,2].

Clinical signs

Infestations can be asymptomatic with clinical signs related more to age of the animal, chronicity of the infestation and hypersensitivity to the mite bites than the number of mites present. Mild clinical signs include dull coat or scruffy coat with varying levels of scaling, crusting and pruritus with pruritus usually being minimal.
In very young animals or those with hypersensitivity, pruritus and the level of scaling can increase, alopecia (particularly along the back) can occur and excessive grooming from the irritation of the infestation can result in lesions such as miliary dermatitis. In dogs it can mimic flea allergy dermatitis.

Diagnosis

Diagnosis can be challenging in mild cases with low infestations. Skin scrapes, the adhesive tape method and combing (with examination of the dandruff) can be used to recover eggs and mites which are readily seen using the 4x or 10x objective. With combing, the debris and dandruff can be viewed under a microscope or on a dark surface with the movement of the mites visualized; hence the term “walking dandruff.” Superficial skin scrapings and debris from combing also can be digested with potassium hydroxide to enable better visualization of the mites. The adults are approximately 400-500 µm and can appear to have a waist. Four pairs of legs have combs instead of claws. The accessory mouthparts (palpi) terminate in hooks. Eggs, without an operculum, can be found on the hair and eggs and adults can occasionally be seen in faecal flotations from consumption during grooming.

Treatment

No products are registered for the treatment of *C. yasguri* and *C. blakei*. Fipronil, selamectin, ivermectin and other compounds used for ear mites, burrowing mites, fleas, ticks and lice, at the product label doses, have been used to effectively treat infestations [1,3,4]. Repeat treatments, as with other mites, are required. IGRs (e.g. lufeneron) are not effective. All cats and dogs in the household, even those not diagnosed with an infestation, should be treated to prevent transfer among the pets.
Environmental treatment (e.g. pyrethroid application) and treatment of grooming supplies and bedding, might be needed to prevent re-infestation. Animal bedding should be discarded or washed at temperatures >55°C.

Prevention

Regular use of ectoparasiticides for fleas, ticks and other more common ectoparasite infestations may be used to prevent *Cheyletiella* spp. infestations.

Public health significance

As with *L. radovskyi*, *C. yasguri* and *C. blakei* can transiently affect people with bites causing pruritus and pustular dermatitis which are sometimes mistaken as flea bites. Treatment of the infested dog or cat results in resolution of any clinical signs on the person [1,2].

References

[1] Bowman DD, Hendrix CM, Lindsay DS, Barr SC. Feline Clinical Parasitology. 2020. Iowa State University Press.
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[4] Ghubash R. Parasitic miticidal therapy. Clin Tech Small Anim Pract. 2006;21(3):135-144.