



Control of Parasitic Mites in Dogs and Cats

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ESCCAP

The Mews Studio, Portland Road
Malvern, Worcestershire, WR14 2TA

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INTRODUCTION

External or ectoparasites include a wide range of parasitic arthropods, which belong taxonomically to the order Acari (ticks and mites) and to the class Insecta [fleas, chewing and sucking lice, mosquitoes, flies and phlebotomes (sandflies)].

External parasites are important because:

- they may cause cutaneous lesions
- they can induce immunopathological responses
- they can transmit pathogens
- they may be zoonotic or transmit zoonotic infections
- they may interfere with the human – animal bond
- their control is part of maintaining healthy pets

In addition the following factors have clinical implications:

- cutaneous lesions may lead to secondary bacterial or fungal (*Malassezia* spp.) infections and various kinds of dermatitis
- the immune response induced, especially by ectoparasite saliva, may lead to allergic reactions with flea allergic dermatitis being the most important
- transmitted pathogens may cause diseases, the so called vector-borne diseases (VBDs), that are, in many cases, of more clinical relevance than the actual ectoparasite infestation itself
- ectoparasite infested pets may be a source for infestation of the pets' owners (e.g. fleas) which can be a serious nuisance
- the direct health implications of ectoparasite infestation can be more than skin deep: e.g. heavy blood-sucking arthropods can cause anaemia

In Europe, the increase in pet travel plus climatic changes will probably influence the present epidemiological situation of certain ectoparasites and the pathogens they carry, or may introduce into different regions. Rare diseases might increase in frequency due to increased importation or establishment of the causative agents and their vectors into presently non-endemic areas. For example, in the past few years canine babesiosis has been observed across central and northern Europe, emerging from the previous endemic regions around the Mediterranean basin and eastern European countries to more northern areas. Furthermore, within the European Union, removal of border controls under the Schengen Treaty and implementation of the PETS travel Scheme for the UK have led to easy travel between the various countries within continental Europe and, except for the UK and Scandinavian countries, there are no or limited customs controls of pet animals moving from one country to another. Whilst pets travelling with their owners account for a major part of the total pet movement, a large number of dogs and, to a lesser extent cats, are now being relocated by welfare organisations from, for example, Mediterranean countries to private households all over Europe. This is particularly significant as the Mediterranean is an area where infestations with numerous ectoparasites, or pathogens transmitted by them, are highly prevalent.

Veterinary medicinal products have to go through a rigorous testing process prior to their approval by European or National authorities and each indication for use has to be scientifically justified. Veterinarians are trained in the appropriate use of these compounds according to current national legislation.

Ectoparasitocidal compounds for companion animals can be used prophylactically or therapeutically to control ectoparasites. Visible infestations with fleas, lice or ticks require treatment to eliminate the infestation. However, most modern ectoparasiticides have a residual effect and thus can be used prophylactically to prevent re-infestation. Since many ectoparasites may act as vectors of various important companion animal diseases,

it is the aim of ESCCAP to produce a guideline which delivers comprehensive information and support, to assist both veterinarians and pet owners to successfully control ectoparasite infestation and prevent disease transmission to their pets.

There is a separate guideline produced by ESCCAP on vector borne diseases of companion animals (ESCCAP Guideline No. 5: Vector-Borne Diseases in Dogs and Cats).

For more information on endoparasite control see ESCCAP Guideline No. 1: Worm Control in Dogs and Cats.

For more information about dermatophytic fungi see ESCCAP Guideline No. 2: Ringworm Control in Dogs and Cats.

Tick and insect infestations have been addressed in ESCCAP Guideline No. 3, Part 1: Control of Parasitic Insects and Ticks in Dogs and Cats. This second part covers mite control.

Mites of cats and dogs belong to the subclass Acari and the suborders Mesostigmata, Prostigmata and Astigmata. Mites are, with few exceptions, host specific. This guideline covers parasitic mites of veterinary importance found on dogs and cats in Europe (Table 1).

I. BIOLOGY, CLINICAL SIGNS, DIAGNOSIS AND CONTROL

I.1. Demodectic Mange Mites

I.1.a Basic biology

Species

Canine demodicosis is mainly caused by one species, *Demodex canis*, commonly referred to as the follicle mite. Female mites are up to 0.3 mm long, males up to 0.25 mm. Fusiform-shaped eggs are 70-90 x 19-25 µm in size. Two further, morphologically different *Demodex* species have been described; *D. injai* is at least two times the size of *D. canis*, whereas a third species, whose proposed name is *Demodex cornei*, is much shorter and more compact. Whether these "long-bodied" and "short-bodied" mites are actually separate species remains to be confirmed.

Feline demodicosis is mainly caused by one species, *Demodex cati*. It is slightly longer and more slender than *D. canis*. Another species, *D. gatoi*, is distinctly shorter and broader. There is a third as yet unnamed species in cats that resembles *D. gatoi*, but has different morphological features. Currently *Demodex* mites are believed to be host specific.

Life Cycle

Demodex mites of dogs are considered to be physiological fauna of the skin and are found in small numbers on most dogs without any clinical signs. They spend their entire life in the lumen of hair follicles and, in heavy infestations, also invade the sebaceous glands; the unnamed "short-bodied" *Demodex* species are found in the stratum corneum. *Demodex* mites are unable to survive off their hosts. Newborn puppies typically acquire mites from their mothers through direct contact within the first few days of life, but usually they show no clinical signs of infestation. Female mites lay 20-24 eggs that develop through two six-legged larval stages and two eight-legged nymphal stages into eight legged, slender, cigar-shaped adults within approximately 3-4 weeks.

Feline demodicosis is a rare parasitic disease. The life cycle of *D. cati* is similar to *D. canis*. *D. gatoi* lives primarily in the stratum corneum.

Epidemiology

Canine demodicosis (demodectic mange) caused by *D. canis* is a common skin disease primarily of young dogs; disease due to *D. injai* or other *Demodex* spp. in dogs appears to be very rare. Newborn puppies usually acquire mites from their mothers via direct skin contact during nursing, therefore the first sites of infestation and lesions are the upper lip, eyelids, nose, forehead and ears. Over time, mites may colonise the skin over most of the body. *Demodex* spp. are host-adapted mites and do not infest other animal species. Although transmission of mites may occur during direct contact between older animals, the disease is not considered to be contagious since most animals that develop demodicosis are thought to suffer from an underlying condition, or a genetic defect that compromises their immune systems. Only *D. gatoi* in cats is believed to be transmitted directly between animals. The immunopathogenesis of the disease is not fully understood, and in most cases an underlying cause is not identified. However, excessive cortisone treatments, chemotherapy, and underlying cancer or hormonal diseases have all been associated with the development of demodicosis in individual animals. Accordingly, dogs and cats should be carefully evaluated for potential underlying causes of the disease. Although no specific immune deficiencies have been identified in affected dogs, some studies suggest that cellular immunity may be compromised in some individuals that develop demodicosis.

I.1.b Clinical signs

Dogs

Demodicosis generally occurs either as a localised or a generalised skin disease. Clinically a less severe squamous demodicosis and more severe pustular demodicosis may be distinguished.

Pruritus is not usually a feature in uncomplicated cases, but is sometimes seen with secondary bacterial pyoderma.

Canine Localised Demodicosis (CLD) usually occurs with highest incidence in dogs less than 6 months old, but can also be seen in dogs up to 2 years as one or several small, circumscribed, partially hairless patches, mainly on the face and the forelegs. However, it may also be seen in adult dogs. Based on empirical data from the American College of Veterinary Dermatology, up to five lesions are classified as localised demodicosis. Very often eyelids and a narrow periorbital strip are affected causing a “spectacled” appearance of the lesions. Most cases of juvenile-onset localised demodicosis appear as squamous demodicosis and are characterized by patches of dry alopecia, scaling, erythema, folliculitis and thickening of the skin. In most cases this form is non-pruritic. CLD is not generally serious and often resolves spontaneously within 6 to 8 weeks without treatment. Relapses are rare because the host has usually regained full immunocompetence.

Canine Generalised Demodicosis (CGD) may occur as juvenile or adult-onset demodicosis. According to the classification mentioned above, the generalised form is present if there are six or more localised lesions, if entire body regions (e.g. the head) are affected or if it presents as pododemodicosis.

Juvenile generalised demodicosis usually occurs in dogs up to 18 months of age, although this age is not an absolute cut-off. Depending on the underlying condition, it may resolve spontaneously, but in most cases requires treatment, otherwise it may develop into a severe debilitating disease.

The adult-onset form of generalised demodicosis usually occurs in dogs older than 4 years of age and although it can be very severe, it is rare. It usually develops after a massive multiplication of mites and is often a consequence of concurrent debilitating conditions such as hyperadrenocorticism, hypothyroidism, neoplasia, other systemic infectious diseases, or prolonged immunosuppression, which reduce the immune defence mechanisms of the affected animal.

The entire pathogenic mechanism of demodicosis still remains obscure, but it has been shown that dogs with chronic generalised demodicosis exhibit a reduced T-cell function. Whereas some studies suggest a genetic predisposition of certain dog breeds or families, others found a decrease of Th1 responses induced by the *Demodex* mites themselves. Although the hereditary nature of juvenile generalised demodicosis is not yet definitely proven, it is strongly recommended not to continue to breed from bitches which have had a litter of diseased puppies.

CGD may initially present as squamous demodicosis but frequently progresses to severe pustular demodicosis after secondary bacterial invasion of the lesions, which causes deep pyoderma, furunculosis and cellulitis. The skin becomes wrinkled and thickened with many small pustules which are filled with serum, pus or blood; this has resulted in the common name of “red mange” for this form of demodicosis. Affected dogs often have an offensive odour and this form very often develops into a severe, life-threatening disease that requires prolonged treatment. If present, any underlying condition needs to be addressed to maximise treatment success.

Cats

Demodicosis is a rare disease in cats. It usually occurs as a localised, squamous form with alopecia confined to the eyelids and the periocular region. Sometimes a generalised form will develop, especially if there is an underlying debilitating disease such as diabetes mellitus, FeLV or FIV.

Cats infested with *D. gatoi* are pruritic and may lick or groom affected areas excessively. *D. gatoi* dermatitis is not associated with underlying disease and mites may be transferred from cat to cat.

1.1.c. Diagnosis

Demodicosis due to *D. canis*, *D. injai*, and *D. cati* is diagnosed by microscopic examination of deep skin scrapings from small affected areas of alopecia. The skin should be squeezed before or during scraping to promote extrusion of *Demodex* mites from the hair follicles. The skin or the scraping instrument can be wetted with mineral oil to facilitate collection of the sample. In long haired dogs, the area to be scraped is gently clipped to minimize the loss of scraped material into the surrounding hair coat. Skin scrapings to identify

follicular *Demodex* species mites should be deep enough to result in capillary bleeding.

Alternatively, in uncooperative dogs, or in sensitive areas where scraping is difficult e.g., the feet, hairs may be plucked from an affected area and placed in mineral oil on a slide for microscopic examination. The area of skin selected should be similar in size to the area used for deep skin scrapings and as many hairs as possible should be plucked to maximise the diagnostic yield. Diagnosis depends on seeing the characteristic “cigar-shaped” mites or their eggs.

In cases with concurrent deep pyoderma, which in most cases is caused by *Staphylococcus pseudintermedius*, direct examination of the exudate from pustules, or fistulous draining tracts, may also reveal mites. Samples collected by squeezing the exudate onto a glass slide can be examined microscopically after adding mineral oil and a coverslip.

I.1.d. Control

Treatment

Dogs—Localised Demodicosis

Most cases of localised demodicosis resolve spontaneously within 6 to 8 weeks without treatment. Non-treatment of localized demodicosis allows identification of those patients with progressive disease. If treatment is desired, topical and/or systemic antibacterial therapy for the treatment of secondary bacterial infection may be initiated. There is currently no study-based evidence that the application of acaricides accelerates the healing process in localised demodicosis.

The use of any glucocorticoid-containing product, or any product acting via glucocorticoid receptors such as progestagens, is contraindicated and could encourage disease generalization. The animal's overall health should be evaluated with special consideration being given to conditions affecting the immune system such as poor husbandry, poor nutrition, and internal parasitism. Clinical examination with repeat skin scrapings every two to four weeks after initial diagnosis is indicated to monitor disease resolution or progression.

Dogs—Generalized Demodicosis

Generalized demodicosis may require extended, aggressive therapy to resolve the disease. Before initiating therapeutic measures, any factors affecting the animal's health status should be determined and any underlying diseases or conditions should be identified and treated accordingly. The prognosis and the possible need for costly and long term therapy need to be discussed with the owner.

Comprehensive treatment should include use of an effective acaricide, evaluation for any underlying disorders, with appropriate treatment when found, and antibiotic therapy when pyoderma is present. With adequate and intensive treatment protocols using appropriate products, remission can be achieved in up to 90% of cases after an average treatment period of three months. However, in individual dogs, remission may be achieved as late as 12 months after beginning therapy and in some dogs, microscopic remission is not possible despite marked clinical improvement. It is recommended that treatment must be continued for at least eight weeks after the first negative skin scraping. An animal can be regarded as completely cured of disease if no relapse occurs within 12 months after the end of the therapy. Relapses very often occur due to discontinued treatments.

Amitraz, a member of the formamidine family and moxidectin, a member of the macrocyclic lactones, are currently registered for the treatment of demodicosis. There is evidence from clinical case reports that other members of the macrocyclic lactones (particularly ivermectin) are also effective against *Demodex*, but one has to consider that these compounds are either not registered for cats and dogs, or not registered for this indication (milbemycin oxime has a label claim for demodicosis in Italy, France, Portugal, almost all eastern Europe). **WARNING:** The use of unlicensed compounds in dogs may cause severe adverse effects in some breeds. However, when licensed treatments have failed, the off-label use of ivermectin or milbemycin may be allowed following the required prescribing cascade. Statistical analysis of reported cases showed cure rates of up to 90% for ivermectin. As some dog breeds are known to be ivermectin-sensitive, the risk of side effects can be minimized by testing for the MDR-1 gene of the diseased dogs. Additionally, it has been recommended

to gradually increase the dosage starting with 0.05 mg ivermectin per kg body weight.

Amitraz as a 0.05% dip is applied topically every 5-7 days. To maximise skin contact for efficacy, clipping of the hair coat in long haired dogs is essential. The use of an antibacterial shampoo to remove crusts and bacteria before the first treatment is recommended. Dipping should be done in a well-ventilated area and protective clothing should be worn according to the manufacturer's instructions. Side-effects can mainly be attributed to alpha-adrenergic effects and may include increase of plasma glucose levels, hypersalivation, lethargy, ataxia, bradycardia, vomiting, dyspnoea, hypothermia, tremor and seizures (for details see the product label). Dogs should be allowed to air-dry or should be dried with a blow dryer after each application. In between applications dogs should not get wet.

Amitraz has recently been registered for the treatment of canine demodicosis in an amitraz plus metaflumizone combination which is applied monthly as a spot-on.

Milbemycin oxime, which is registered in a number of European countries to treat demodicosis at a dosage of 0.5 to 1 mg/kg per day until 2 negative skin scrapings at one month intervals.

Moxidectin (2.5 mg/kg body weight) in combination with imidacloprid is registered as a monthly spot-on for the treatment of demodicosis. Some evidence suggests that response was most favourable in dogs with mild to moderate disease. There are reports that efficacy is increased with frequency of application and weekly application showed better success rates than monthly application.

Cats

The localised form of demodicosis in cats resolves spontaneously in most cases, whereas generalised demodicosis requires treatment. There is no registered product for use in cases of demodicosis in cats. Lime sulphur dips have been reported to be effective. Dips should be performed weekly for 4 to 6 weeks with a 2% solution. As in canine demodicosis, feline demodicosis is often linked to other underlying diseases that should be treated as appropriate. Amitraz is registered for dogs only and should not be used in cats due to increased toxicity.

Public Health Considerations

As *Demodex* mites are host specific, there is no zoonotic potential in either canine or feline demodicosis.

1.2. Sarcoptic Mange Mites

1.2.a. Basic biology

The family Sarcoptidae consists of three genera of veterinary importance namely *Sarcoptes*, *Notoedres* and *Knemidocoptes*, the latter being especially important in domestic poultry and cage birds. They are all small obligate parasites which spend their entire life cycle on the host, so that transmission is mainly through close contact. In general they burrow in the superficial layers of the skin and the lesions thus caused result in various forms of mange. Morphologically these mites are similar with circular bodies and short legs.

The genus *Sarcoptes* contains a single species, *Sarcoptes scabiei*, which causes sarcoptic mange in a wide range of mammalian hosts, but strains have developed which are largely host-specific with the possibility to temporarily infest other mammals, which explains the zoonotic transmission from dogs to their owners. The condition is well recognised in both human and veterinary medicine and the human disease is generally referred to as scabies

Species

Sarcoptes scabiei (var. *canis*) is the canine sarcoptic mange mite.

Life Cycle

The adult mites which are small and round (up to 0.4 mm in diameter), feed superficially on the skin forming small burrows and feeding pockets. Mating usually takes place on the skin surface and the female mite then burrows more deeply in the upper layers of the epidermis feeding on the fluid and debris resulting from tissue

damage. In the tunnels and side-tunnels thus created it lays eggs for a period of several months; these hatch in 3-5 days and most of the six-legged larvae crawl on to the skin surface to continue their development. They in turn burrow into the superficial layers of the skin and hair follicles where they moult through two nymphal stages to become adults. The pre-patent period from egg to adult stage is 2-3 weeks.

Epidemiology

Transmission to new hosts from infested individuals is by direct or indirect contact, most likely by transfer of larvae from the skin surface. *S. scabiei* var. *canis* can be highly prevalent in the fox population and can be responsible for a high mortality. Especially in urban areas in the UK or central Europe, transmission of mites from the fox population to the dog population has been observed. Sarcoptic mange is often seen in stray dogs. It is known that *S. scabiei* can survive for a few weeks off their hosts, so contaminated bedding or grooming equipment could be a source of infestation. Infestation by host-adapted strains of *S. scabiei* between different host species usually results in a temporary infestation. Clinical disease in humans after contact with affected dogs is very common.

1.2.b. Clinical signs

The ears, muzzle, elbows and hocks are predilection sites for *S. scabiei*, but in severe infestations lesions may extend over the entire body. Initial lesions are visible as erythema with papules, which are then followed by crust formation and alopecia. Intense pruritus is characteristic of sarcoptic mange and this can lead to self-inflicted traumatic lesions. Dogs may begin to scratch before lesions become obvious and it has been suggested that the degree of pruritus may be exacerbated by the development of hypersensitivity to mite allergens. Without treatment the disease progresses and lesions spread across the whole skin surface; dogs may become increasingly weak and emaciated.

1.2.c. Diagnosis

Probably the most useful diagnostic feature of canine sarcoptic mange is the intense itching which accompanies the disease; in cases of dermatitis with no itch, sarcoptic mange can be eliminated from the differential diagnosis. The ear edge is the most commonly affected site and when rubbed this elicits a scratch reflex in 90% of dogs.

Clinical diagnosis should be confirmed by examination of several, rigorous, superficial skin scrapings for the characteristic mites. Although the direct confirmation of the mites is highly recommended, the sensitivity of skin scrapings can be as low as 20%. The diagnostic yield is greatly increased if mineral oil is applied directly to large areas of affected skin before being scraped off and examined microscopically. Commercially available ELISAs helped to improve diagnosis considerably. Although sensitivity and specificity of serological tests may reach 90%, it must be considered that antibodies are not detectable until at least 5 weeks after infestation and that serological results have always to be interpreted in relation to clinical signs and other diagnostic results. The quality, especially concerning specificity, of different ELISA tests is variable, and cross-reactions with dust mites could occur.

1.2.d. Control

Because of the protected predilection site of the parasites in the skin, its life cycle and the requirement to kill all of the mites to prevent the recurrence of disease, systemic treatments are necessary and proved to be effective. Registered treatments include selamectin and moxidectin in combination with imidacloprid, both as a single treatment repeated after four weeks. Milbemycin oxime is registered for treatment of sarcoptic mange in Italy and Sweden. Some authors recommend increasing the frequency of application. Amitraz wash (0.05%), (not approved in this indication in all countries) should be repeated at weekly intervals until skin scrapes are negative for mites, or until three weeks after clinical signs have disappeared. Specific treatments should be preceded or accompanied by suitable washes to soften and remove crusts. Unfortunately the availability of effective acaricidal compounds for use in small animals is limited in many European countries. In severely affected animals pruritus and self-inflicted trauma may be reduced by the short term administration of corticosteroids (3-4 days) in association with acaricidal therapy.

Sarcoptic mange is highly contagious and affected dogs should be isolated from other animals while undergoing treatment. In multi-dog households and kennels it is advisable to treat all in-contact animals.

Note: Although sarcoptic mange is rare in cats, there have been a few confirmed cases. The clinical signs in such cases are reported to be similar to those of notoedric mange.

1.3. Notoedric Mange Mites

1.3.a. Basic biology

The genus *Notoedres* closely resembles *Sarcoptes* both in behaviour and morphology, being a small burrowing parasitic mite which can cause mange. *Notoedres cati* is the only species of veterinary importance and this occurs mainly in cats; infestation is not readily transferable to other animals but cases have been recorded in dogs, rabbits, hamsters, wild cats and canids. Although infestation with *N. cati* has been reported from all European countries it is rare in some and tends to be local in distribution in others. Cat notoedric mange is not considered as zoonotic, or only exceptionally and transiently.

Species

Notoedres cati

Life Cycle

The life cycle of *Notoedres cati* is similar to that of *S. scabiei* in that it is spent entirely on the host and the female mites burrow in the upper layers of the skin creating winding tunnels. Unlike *S. scabiei*, they tend to aggregate in small groups forming small nests. Eggs deposited in the skin tunnels hatch within a few days and larvae crawl on to the skin surface where they form moulting pockets in which development to nymph and adult stages occur. The adult male seeks a female on the surface or in a moulting pocket. The time taken for development from egg to adult stage is 1-3 weeks.

Epidemiology

Notoedric mange is highly contagious and tends to occur in local outbreaks. Transmission is by close direct or indirect contact, probably by the transfer of larvae or nymphs between hosts. The disease can spread rapidly in groups of cats or kittens.

1.3.b. Clinical signs

Early signs of infestation are local areas of hair loss and erythema on the edges of the ears and the face. This is followed by greyish-yellow, dry crusting and skin scaling, which progresses to hyperkeratosis with thickening and wrinkling of the skin in severe cases. These clinical signs are accompanied by intense pruritus and scratching, which often results in skin excoriations and secondary bacterial infection. Lesions may spread from the head and neck to other parts of the body when grooming or through simple contact. Untreated animals may become severely debilitated and die.

1.3.c. Diagnosis

This is relatively easy, as there are few other skin diseases of cats which present with intensely pruritic lesions round the head and ears. The small round mites with their characteristic concentric "thumb print" dorsal striations are relatively easy to demonstrate microscopically in skin scrapings. As differential diagnosis, *D. gatoi*, *N. autumnalis*, or *Sarcoptes* sp. should be excluded. Occasionally humans in contact with affected animals may show a mild dermatitis due to a transient infestation.

1.3.d. Control

There are currently no licensed treatments, but systemic use of macrocyclic lactones (e.g. selamectin) has been used successfully and should be applied as described for sarcoptic mange. Before application of an appropriate acaricide, animals should be washed with an anti-seborrheic preparation to soften and remove skin crusts. Treatment should be repeated until there is a marked clinical improvement and for a minimum of at least 4

weeks. It is important to treat all in-contact animals and replace any contaminated bedding. With early treatment, the prognosis is generally good.

1.4. Otodectic Mange Mites

Ear mites, *Otodectes cynotis*, are a cause of aural irritation and discomfort in dogs, cats and ferrets. Infestation may affect one or both ears. Infrequently the mites may cause dermatitis across the body of the animal.

1.4.a. Basic biology

The entire life cycle is spent on the host, with transfer from animal to animal probably occurring through close contact. Larval ear mites hatch from eggs approximately four days after they are laid by adult female mites. Within approximately three weeks larvae develop through two nymphal stages and eventually to adults. Adult males attach to the second nymphal stage with their suckers, anticipating that the nymph will develop into an adult female. Attachment at the nymphal stage appears essential for egg-laying to occur.

1.4.b. Clinical signs

Ear mites can occur in any age group of cats or dogs, but are more common in puppies and kittens and more frequent in cats than dogs. *O. cynotis* are surface dwellers and may be seen as small, motile, white spots in the external ear canal; infestation is typically accompanied by a brown, waxy discharge. Whilst ear mites may be tolerated without clinical signs in some animals, especially cats, there may be a history of pruritus with ear scratching or rubbing and self-inflicted trauma. The pinna and ear canal may be erythematous.

1.4.c. Diagnosis

Diagnosis may be reached by seeing the characteristic brown ear wax similar in consistency to ground coffee, and mites in the external ear canal using an otoscope. Where necessary, samples of wax and debris can be collected from the affected ear canal using a cotton swab or similar. The ear canal may be inflamed and examination and sample collection may be painful for the animal, so care should be taken to have the animal suitably restrained. The cotton swab should be rolled onto a microscope slide and examined directly under low magnification. Alternatively, a drop of water, alcohol or liquid paraffin can be added to help to break up the debris. A coverslip can then be applied and the slide examined microscopically at x40 magnification. Ear mites are identified by their long legs, typical of surface mites. The two anterior pairs of legs in all mite stages each end in an unjointed pedicel and sucker.

1.4.d. Control

Ear mites may be treated with local administration of ear drops with acaricidal activity or with a systemic spot-on product containing selamectin or moxidectin in combination with imidacloprid. Depending on the treatment chosen, application may have to be repeated at intervals to eliminate the infestation. In multi-animal households and kennels it is advisable to treat all in-contact animals.

1.5. Fur Mites

Cheyletiella spp. mites can infest dogs, cats and rabbits. Whilst infestation may be well tolerated by some individuals, in others it can cause irritation and discomfort. The mites will also feed on humans, causing a localised dermatitis.

1.5.a. Basic biology

Species

Dog:

Cheyletiella yasguri

Cat:

Cheyletiella blakei

Rabbit:

Cheyletiella parasitivorax

Life Cycle

The entire life cycle takes approximately three weeks and is spent on the host, although female mites can survive for up to ten days in the environment. Adult female mites lay eggs that are attached to the coat. These hatch and develop through two nymphal stages prior to becoming adults. Transfer from host to host occurs readily and rapidly between animals in close contact. Cheyletiellosis is common in kennels, young and weak animals seem to be more susceptible.

I.5.b. Clinical signs

Dogs and cats are infested with distinct species: *Cheyletiella yasguri* infesting dogs and *Cheyletiella blakei* infesting cats. However, these species may not be strictly host-specific. The mites may be well tolerated in some animals with excessive scaling being the only clinical sign, while in other animals pruritus in variable degrees may be present. The large, 0.5 mm mites may be seen as white spots moving amongst the skin scales, hence the term "walking dandruff". Affected areas may show erythematous and crusting lesions which may appear as miliary dermatitis in cats. Humans may also be infested, particularly around the waist and arms.

I.5.c. Diagnosis

There are several ways of collecting material for microscopic examination to identify mites and thus confirm the diagnosis. Brush or comb the animal's coat and collect the debris in a petri dish, universal container or paper envelope. Alternatively, apply a Sellotape strip to the affected area and then apply the strip to a microscope slide sticky side down. It is also possible to lightly trim the coat, carry out a superficial skin scrape and collect the debris in a suitable container. After sample collection, the debris may be examined in a petri dish using a stereo microscope (x40 total magnification) and mites may be seen walking amongst the debris. To examine an individual mite more closely, it may be placed on a microscope slide with a drop of water and covered with a coverslip. *Cheyletiella* spp. mites have legs that protrude beyond the periphery of the mite's hexagonal body, a "waist", legs with "combs" on the end and palps with powerful claws at the anterior end. *Cheyletiella* spp. eggs may be seen attached to hairs. Since infected dogs or cats may groom excessively, eggs that have passed through the intestinal tract are sometimes detected on faecal examination.

I.5.d. Control

Infected animals can be treated with a suitable topical acaricide, but there is a general lack of licensed preparations. Studies have shown that topical applications of selamectin, moxidectin or fipronil and systemic administration of milbemycin oxime are highly effective against *Cheyletiella*. Depending on the duration of activity of any compound, treatment may need to be repeated to eliminate the infestation. Treatment of in-contact animals, particularly of the same species, is recommended, even if they are showing no signs of infestation. Cleaning of the environment, including washing the bedding and vacuum cleaning, helps to eliminate any mites in the environment.

Public Health Considerations

Owners may be transiently infested after contact with infested animals and develop skin rash.

I.6. Harvest Mites (Chigger Mites)

There are other mite infestations in dogs and cats that are often less frequent and are characterised either by their seasonal nature, or by their geographic distribution; these are harvest mites which are responsible for the condition known as trombiculosis.

The two species that cause trombiculosis in dogs and cats are: *Neotrombicula* (syn. *Trombicula*) *autumnalis* and *Straelensia cynotis*.

Neotrombicula (Trombicula) autumnalis

I.6.a. Basic biology

The adult mites lay their eggs in decomposing vegetable matter and in a few days the eggs hatch into six-legged larvae; these are of a characteristic orange colour and about 0.2-0.3 mm in length. Only the larvae are parasitic. In temperate climates, larvae become active in dry, sunny conditions at temperatures exceeding +16°C. This often occurs between July and October; thus the term "harvest mite". The larvae climb onto the vegetation where they wait for passing hosts. There is no transfer from animal to animal and after attaching themselves to their hosts they feed for several (5-7) days on enzymatically liquefied tissue, epithelial secretions or blood. Thereafter, they detach and continue their development. The subsequent stages (nymphs and adults) live as free-living stages on the ground. To complete the life cycle may take 50-70 days or more.

Harvest mites are resistant to adverse climatic conditions and female mites can live for more than 1 year. In areas with temperate climate there is usually one generation per year, but in warmer areas they may complete more than one cycle per year.

I.6.b. Clinical signs

Cutaneous lesions are usually found in ground-skin contact areas like the head, ears, legs, feet, and ventral areas. The lesions are highly pruritic. Macroscopically they are very peculiar due to the bright orange colour of the larval mites. Severe hypersensitivity reactions have been observed in case of repeated infestation.

I.6.c. Diagnosis

Gross observation of the lesions, together with the time of year and the history of affected dogs and cats having been in the countryside, are often sufficient for a diagnosis. The larval mites can also be seen fairly easily without magnification.

Occasionally it may be necessary to confirm harvest mite infestation by taking skin scrapings and where mites are found in the interior of the external ear canal, especially in cats, it is important to differentiate these from *Otodectes*.

I.6.d. Control

Control of trombiculosis is difficult due to the fact that reinfestations are frequent in animals exposed to these mites.

Fipronil (in both dogs and cats) and synthetic pyrethroids (exclusively in dogs) can be successfully used to kill the mites, as can other compounds based on organophosphates and/or carbamates.

Topical spray treatments may be repeated every 3-5 days in order to prevent reinfestation. Frequent spraying of the commonly affected areas such as paws and ventral abdomen may be more effective than less frequently applied spot-on preparations.

Straelensia cynotis

The biology of this mite is still unknown, although it is thought to be similar to other Trombiculidae, but there are some important differences. For example, the period of feeding on the host is much longer than in *Neotrombicula* with an average of 3 months in cases so far described.

This trombiculid mite causes straelensiosis, an emerging disease reported in the last decade from southern France, northern Spain and Portugal. This is also a mite infestation characterised by a marked seasonality, with cases appearing mostly between September and November. As this period coincides with the hunting season straelensiosis often occurs in hunting dogs, or in dogs that have contact with woodlands and foxes' dens, which may be a natural habitat for *S. cynotis*. Small wild mammals have also been considered potential hosts for this trombiculid mite.

Cutaneous lesions affecting dorsal areas of the body including the head are common in all reported clinical cases; these include maculae that may progress to erythematous, alopecic nodules and papules. In contrast to

neotrombiculosis, the degree of pruritus varies from case to case; straelensiosis appears to be primarily non-pruritic, with pruritus only appearing when there is a secondary infection. Typically the infestation is very painful. Diagnosis is through observation of the typical six-legged larvae, usually present in dilated hair follicles of biopsies from affected skin. The histopathological lesions of pseudoepitheliomatous hyperplasia of follicular origin and abundant perifollicular mucinosis are considered pathognomonic of this disease because they are present in all reported cases.

Treatment based on a combination of systemic macrocyclic lactones and antibiotics may result in complete cure and prevent possible secondary infestations. The conventional topical acaricidal treatments for mites have not produced satisfactory results. Total remission occurs in almost all reported cases within 6-12 months. More studies are needed to provide further knowledge on this recently described parasitic infestation.

I.7. Canine Nasal Mites

Pneumonyssoides (Pneumonyssus) caninum

I.7.a. Basic biology

The life cycle of this infrequently occurring parasite is still not completely known. It is assumed that these mites are permanent parasites of the nasal cavities and paranasal sinuses, especially the ethmoid. In the published reports, there is no evidence of the presence of nymphs and for this reason it is believed that the larvae evolve directly into adults; the time needed to complete one generation remains unknown. The adults are visible macroscopically and the females reach a length of 1-1.5 mm and a width of 0.6-0.9 mm.

The most likely mode of transmission is by direct contact between dogs, considering the active movements of the larvae which can be detected in the nostrils of affected animals. Indirect transmission by fomites such as bedding, and in cages and kennels cannot be ruled out since these parasites can survive for up to 20 days away from the host.

This infestation has been described in recent years with a high prevalence in countries in northern Europe (Sweden, Norway, and Denmark), although isolated cases have been described in other European countries.

I.7.b. Clinical signs

The clinical signs described vary depending on the parasite burden, from an absence of any signs to severe cases of nasal discharge, sneezing, fatigue, and head-shaking. In very severe cases purulent rhinitis and sinusitis may occur.

I.7.c. Diagnosis

The inaccessible localisation makes *in vivo* diagnosis difficult and except in rare cases the presence of nasal mites is detected *postmortem*.

Nasal discharge, collected using a catheter for retrograde nasal flushing, can be examined under a microscope, although this is considered of limited diagnostic value.

Observing the mites in their predilection sites using nasal endoscopy is feasible. Also anaesthesia with halothane can force the mites to abandon the nasal passage, and they can then be visualised.

In Sweden, an ELISA has been developed to detect mite-specific antibodies.

I.7.d. Control

Different ectoparasiticides have been tested in the treatment of this parasitosis with variable results. Although only milbemycin oxime is registered for the treatment of canine nasal mites in Italy and Norway, macrocyclic lactones such as selamectin, moxidectin and milbemycin have proven to be the most effective. Three treatments at an interval of 7 to 14 days are recommended.

II. IMPACT OF PET HEALTH AND LIFESTYLE FACTORS

Some mite infestations, notably scabies and demodicosis, can be associated with poor nutrition, concomitant immunosuppression or ill-health.

The seasonal harvest mite infestations are typically acquired in late summer, often in well-defined geographical locations. Scabies infestation in foxes may be a source of scabies for dogs.

III. RESISTANCE

Some mite infestations or diseases, for example demodicosis, can be recalcitrant to treatment. Suspicion of acaricidal resistance of e.g. *Cheyletiella* spp. against ivermectin, has been reported from clinicians in the US, however sound studies on resistance of canine and feline mites against acaricides are lacking.

IV. ENVIRONMENTAL CONTROL OF ECTOPARASITES

Environmental treatment including washing bedding and vacuum cleaning is important to eliminate possible sources of reinfestation in the case of those mites that can survive for a period off the host such as *Cheyletiella* spp. and *Sarcoptes scabiei*.

It may be possible to avoid infestation with trombiculids by avoiding infested areas whilst larval mites are active.

V. OWNER CONSIDERATIONS IN PREVENTING ZONOTIC DISEASES

Generally important preventive measures for pet owners in terms of ectoparasites include:

- reducing wherever possible the risk of a pet acquiring infestation
- controlling pet ectoparasite infestations through regular diagnostic testing and/or repeated application of appropriate ectoparasiticides, particularly for ticks and parasitic insects
- minimizing exposure, especially of children, to potentially contaminated environments
- practising good personal hygiene

People at risk of exposure to zoonotic parasites or any other zoonotic pathogen should be advised of the health risks and made aware that such risks are generally increased during pregnancy, or when there is an existing illness or immunosuppression.

Specifically owners should be warned about the potential zoonotic risk of canine sarcoptic mange and cheyletiellosis. Harvest mites may also attack humans.

Other mites do not pose a zoonotic risk.

VI. STAFF, PET OWNER AND COMMUNITY EDUCATION

Protocols for the control of parasitic infestation should be communicated by the veterinarian to veterinary clinic staff and to pet owners. Awareness of the potential risk of ectoparasite infestations and any zoonotic implications should be promoted to the medical profession, especially paediatricians, through information brochures. Cooperation between the medical and veterinary professions should be encouraged and its benefits underlined especially in the case of potential zoonoses.

Pet owners should be informed about the potential health risks of parasitic infestation, not only to their pets, but also to family members and all people living within the vicinity of their pets.

Additional information and resource materials can be obtained at www.esccap.org.

TABLES

Table 1: Mites of dogs and cats of veterinary medical importance in Europe

Sub order	Dog	Cat
Prostigmata	<i>Demodex canis</i> <i>Demodex injai</i> <i>Demodex sp. (cornei)</i> <i>Cheyletiella yasguri</i> <i>Neotrombicula (Trombicula) autumnalis</i> <i>Straelensia cynotis</i>	<i>Demodex cati</i> <i>Demodex gatoi</i> <i>Demodex spp</i> <i>Cheyletiella blakei</i> <i>Neotrombicula (Trombicula) autumnalis</i>
Mesostigmata	<i>Pneumonyssoides caninum</i>	
Astigmata	<i>Sarcoptes scabiei (var. canis)</i> <i>Otodectes cynotis</i>	<i>Notoedres cati</i> <i>Otodectes cynotis</i>

APPENDIX 1 - BACKGROUND

ESCCAP (European Scientific Counsel Companion Animal Parasites) is an independent, not-for-profit organisation that develops guidelines and promotes good practice for the control and treatment of parasites in companion animals. With the proper advice the risk of diseases and parasitic transmission between animals and humans can be minimised. ESCCAP aspires to see a Europe where companion animal parasites no longer threaten the health and wellbeing of animals and humans.

There is a great diversity in the range of parasites and their relative importance across Europe and the ESCCAP guidelines summarise and highlight important differences which exist in different parts of Europe and, where necessary, specific control measures are recommended.

ESCCAP believes that:

- Veterinarians and pet owners must take measures to protect their pets from parasitic infestations.
- Veterinarians and pet owners must take measures to protect the pet population from risks associated with travel and its consequent potential to change local parasite epidemiological situations through the export or import of non-endemic parasite species.
- Veterinarians, pet owners and physicians should work together to reduce the risks associated with zoonotic transmission of parasitic diseases.
- Veterinarians should be able to give guidance to pet owners regarding risks of parasite infestation and diseases and measures which can be taken to minimise these risks.
- Veterinarians should attempt to educate pet owners about parasites to enable them to act responsibly not only for their own pet's health but for the health of other pet animals and people in their communities.
- Veterinarians should wherever appropriate undertake diagnostic tests to establish parasite infestation status in order to provide the best possible advice.

To achieve these objectives, ESCCAP produces guidelines in two formats:

- A detailed guideline for veterinary surgeons and veterinary parasitologists
- A summarised guideline which can be used by both veterinarians and pet owners

Both versions of each guideline can be found at www.esccap.org.

Disclaimer:

Every effort has been taken to ensure that the information in the guideline, which is based on the authors' experience, is accurate. However the authors and publishers take no responsibility for any consequence arising from the misinterpretation of the information herein nor is any condition or warranty implied. ESCCAP emphasises that national, regional and local regulations must be borne in mind at all times before following ESCCAP advice. All dose-rates and indications are provided for guidance. However, vets should consult individual data sheets for details of locally approved treatment regimens.

APPENDIX 2 - GLOSSARY

Acaricide (acaricidal compound) = Acaricides are compounds that act against ectoparasites belonging to the Class Arachnida, sub-class Acari by zoological nomenclature.

Application = Like treatment, but describing the various forms of veterinary medicinal products which can be given (applied) to animals, such as sprays, spot-ons, pour-ons, oral products, injectables etc.

Control = General term comprising 'therapy' and 'prevention (prophylaxis)'.

Ectoparasiticide = Compound developed for the on-animal use as a therapeutic agent to eliminate any existing ectoparasite infestation and prevent reinfestation.

Prevention = Measures taken prior to any infestation of the pet animal with ectoparasites, to prevent the establishment of an infestation. Prevention for an extended period may be achieved by the use of a product with persistent activity for certain periods of time following application.

Therapy = Any medical intervention to cure a disease; this includes the use of veterinary medicinal products (treatment), to eliminate an existing parasite infestation.

Treatment = Application of veterinary medicinal products (medication) as deemed necessary based on any given diagnosis.

Control of Parasitic Mites in Dogs and Cats

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ESCCAP Secretariat
The Mews Studio, Portland Road, Malvern,
Worcestershire, WR14 2TA, United Kingdom
Tel: 0044 (0) 1684 568998
Fax: 0044 (0) 5603 102013
Email: esccap@btinternet.com
Web: www.esccap.org