

# *Nothrus* mite as a potential cause of exacerbation of pruritus in a cat

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## Abstract

**Objectives** Morphological and molecular approaches were used to identify arthropods associated with feline pruritus. The literature associated with the arthropod genus identified was reviewed.

**Methods** On two occasions (summer 2020 and summer 2021), the owner of a cat with seasonal pruritus (commenced 2020) found the cat's bed was substantially infested with arthropods suspected of being associated with exacerbated pruritus. The pruritus was largely itching and hair loss, particularly on the abdomen, and flaking skin patches. On the second occasion (2021), examples of the arthropods were sent to the parasitology laboratory at the Norwegian University of Life Sciences for identification. They were examined by stereomicroscopy and tentatively identified based on morphology. DNA was extracted, and identification confirmed by PCR and sequencing. The literature was reviewed to determine whether this arthropod genus has previously been considered to be associated with pruritus or the infestation of mammals.

**Results** Based on morphological characteristics, the arthropods were tentatively identified as *Nothrus* species mites. This was confirmed by PCR. A literature review found no previous reports of pruritus or other clinical signs associated with *Nothrus* species mites, and mites were not found on the cat. However, this mite has previously been found on small mammals at densities exceeding that expected of incidental stragglers.

**Conclusions and relevance** The large number of *Nothrus* species mites could have exacerbated the cat's pruritus. By publishing this study, we hope to alert veterinarians to the possibility that *Nothrus* species mites may cause or exacerbate pruritus in cats.

**Keywords:** Ectoparasite; mite; *Nothrus* mite; pruritus

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## Introduction

Pruritus, an uncomfortable, irritating sensation resulting in scratching, along with excessive grooming, licking, biting, rubbing and, often, changes in skin appearance, is one of the most common reasons for pet owners to bring their animals to a veterinary clinic. The Small Animal Veterinary Surveillance Network in the UK reports that between May 2018 to June 2019, 2.2% of cats attending consultations at veterinary clinics were there for the investigation or treatment of pruritus.<sup>1</sup> Pruritus is not a specific disease but a clinical sign, and determining the reason for it enables appropriate treatment. Generally, the most common causes of pruritus in animals are parasites,

infections, allergic skin diseases and miscellaneous causes such as cutaneous neoplasia.<sup>2</sup> Among parasitic agents associated with pruritus in small animals are fleas (and flea allergy dermatitis [FAD]), *Sarcoptes scabiei* (cause of

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sarcoptic mange), *Notoedres cati* (cause of notoedric mange), *Cheyletiella* species (cause of *Cheyletiella* dermatitis), *Otodectes cynotis* (ear mite), *Neotrombicula autumnalis* (harvest mite infestation), *Felicola subrostratus* (feline chewing louse, most commonly associated with elderly or diseased cats) and *Demodex* species, most frequently *Demodex gatoi* (cause of demodicosis). *Leporacarus gibbus* (rabbit fur mite) has also been reported to be associated with dermatitis in a cat.<sup>3</sup> Although pruritus may be caused by primary diseases, it may also be affected by a variety of factors that may modulate the itch.<sup>4</sup> However, other factors, such as allergens or bacterial infections, may exacerbate pruritus elicited from another cause.<sup>5</sup> Thus, there is a broad range of differential diagnoses for the cause of pruritus. This means that, despite being very common, identifying the cause, managing the case and applying appropriate treatment can be challenging; this is also the case in human medicine.<sup>6</sup>

Interestingly, one of the most common causes of atopic disease, including pruritus, in both people and dogs is non-parasitic mites, specifically house dust mite (HDM) and, potentially, storage mites.<sup>7</sup> Indeed, an exaggerated immunological reaction against environmental allergens, including specifically from HDM and storage mites, is also considered to be associated with between 12% and 32% of all feline dermatological cases, and also with the common inflammatory pruritic disease, feline atopic skin syndrome.<sup>8,9</sup>

In this short communication we wish to alert veterinarians and other interested parties to the potential for another, apparently non-parasitic, mite that exacerbates pruritus in cats.

## Materials and methods

An adult neutered male domestic shorthair cat of unknown history (acquired by the current owner in around 2004 at approximately 2 years of age) with long-term (>1 year, from 2020) pruritus had been previously prescribed fluralaner spot-on (Bravecto) and, subsequently, a lotilaner tablet (Credelio) for flea control as a part of management for assumed FAD. Fleas (species unidentified, but probably *Ceratophyllus gallinae* or, possibly, *Ctenocephalides felis felis*) had previously been found on the cat, and bird fleas (*C. gallinae*) were found inside the house every spring. According to the owner's observations, the pruritus seemed seasonal, being greatest in spring and summer and decreasing substantially during the winter. The pruritus was particularly apparent on the abdomen, legs, rear and ears, and hair loss was apparent on the underside of the front legs, abdomen (total hair loss) and back paws. Small round haemorrhagic crusts were visible on the abdomen. In the winter period, the fur on the abdomen grew back in association with reduced itching. The cat was treated with spot-on fipronil

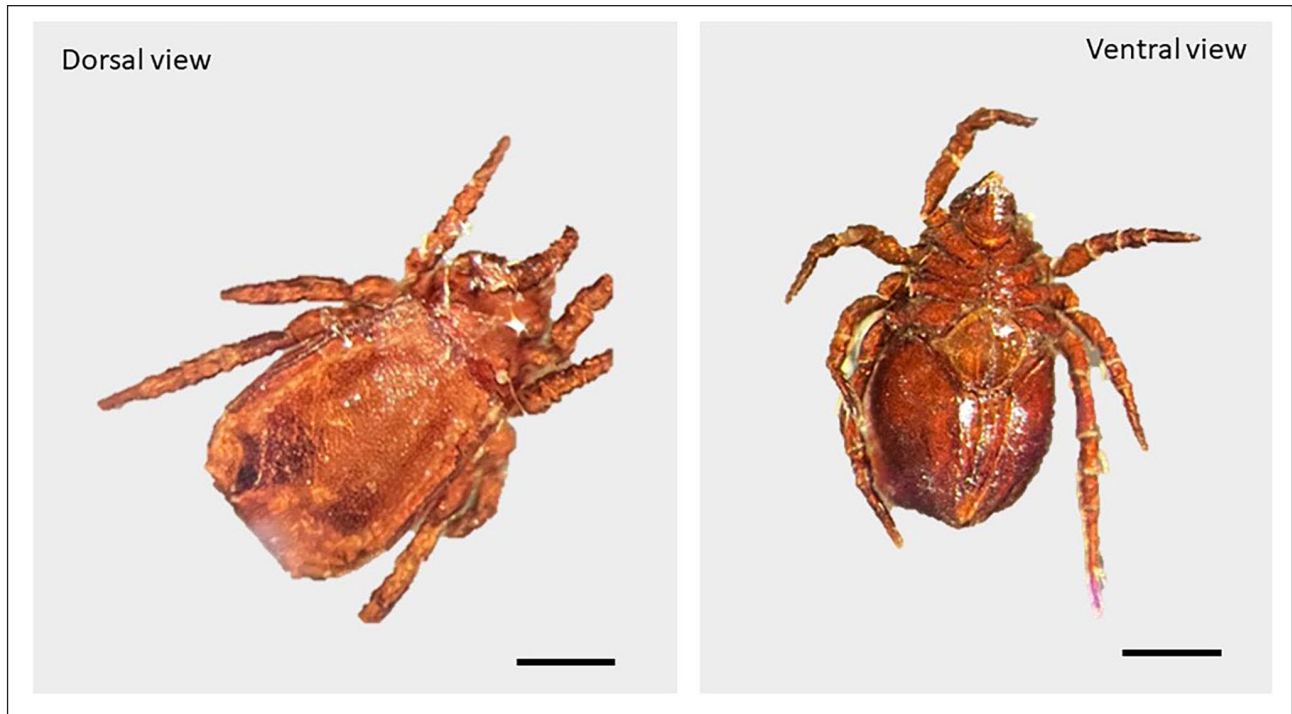
fipronil/S-methoprene fipronil (Frontline), imidacloprid and moxidectin (Advocate) and an ivermectin (Ivomec) injection, all of which had a limited effect. However, fluralaner treatment (which was prescribed around 7 months after commencement of the pruritus) resulted in an apparent improvement. Treatment with prednisolone and anti-allergenic medications had also been tried without noticeable effect. A repellent collar was not used.

The cat was a family pet, living in central Norway, and, as well as being in the family home, had continuous access to the outdoors. The cat chose to be mostly outside during the summer and autumn, with considerable hunting of rodents. The family also owned a dog that was treated prophylactically against ectoparasites with various preparations (eg, ivermectin [Ivomec], fluralaner [Bravecto] and fipronil fipronil/S-methoprene fipronil/permethrin [Frontline]), but has never been found to be infested with ectoparasites.

In summer 2021, the owner found that the cat's bed was substantially infested with arthropods that were suspected to be associated with the exacerbated pruritus. The arthropods were in the bed where the cat lay, directly after the cat had been lying there. Similar arthropods had been found in the cat's bed the previous summer (2020). On neither occasion were the mites found on the cat itself. At the time of this event the cat and dog shared a bed, although the cat sometimes also slept in other place (on chairs, etc). The occurrence of the arthropods on the cat's blanket coincided with a period of considerable pruritus, both in 2020 and 2021, with extensive itching and small haemorrhagic crusts at various places on the skin. It is unclear whether these were the result of miliary dermatitis or due to self-trauma. The owner also felt unpleasant itching in the hands following contact with the cat and bedding.

Fleas and other parasites were not detected on the cat or in the house on either occasion. Combing of the cat at the veterinary clinic did not reveal any further mites; the carrier used to transport the cat to the clinic was not examined.

On the second occasion, a few of the arthropods were collected by the owner into a clean container and delivered, without preservative, to the veterinarian (II) for identification. These were forwarded to the parasitology laboratory at the Norwegian University of Life Sciences, where the arthropods were examined by stereomicroscopy with a zoom function. For confirmation of presumptive identification, DNA was extracted from one mite using bead-beating and DNeasy Blood and Tissue Kit (Qiagen), and the isolated DNA subjected to PCR, with primers targeting the small subunit ribosomal RNA (SSU rRNA) gene, according to Dabert et al.<sup>10</sup> The amplicon (950 base pairs) was sequenced in both directions at a commercial facility and the sequences assembled using



**Figure 1** Dorsal and ventral view of a *Nothrus* species mite under stereomicroscopy. Bar = 200  $\mu$ m

Geneious Prime, Version 2022 (www.geneious.com). Following identification, a literature search was conducted to determine whether the mite identified had previously been associated with pruritus or associated with infestation of cats or other mammals.

## Results

Based on the morphological and morphometric characteristics, the arthropods were identified as probably being oribatid mites of the *Nothrus* species genus (Figure 1).

Comparison of the PCR amplicon contig with sequences in GenBank demonstrated 100% similarity with previously deposited sequences (KY922216.1, KP325072.1, EF091425.2), indicating *Nothrus* species. The sequence obtained here has been deposited in GenBank (accession number ON866945).

Given that *Nothrus* species mites are not usually considered parasitic, and the cat was already being treated with fluralaner, additional treatment was not recommended. Environmental measures (washing cat bedding and vacuuming surrounding areas) were suggested, along with checking the cat and its bedding regularly for these mites, and any other arthropods that could exacerbate the pruritus. According to the owner's observations, the pruritus improved following implementation of these measures, approximately 1 month after application of the fluralaner. It is unclear whether the main reason for the reduction in pruritus was the cleaning measures or the fluralaner, or a combination of both.

## Discussion

*Nothrus* species mites are in the order Oribatida (suborder Enarthronota, family Nothridae) of which there are tens of thousands, potentially hundreds of thousands, of different species. As with other oribatid mites, *Nothrus* species mites (of which there are >70 different species) are free-living, and most are saprophagous and important for decomposition. However, some are omnivorous or fungivorous; in addition, some species may be predatory, feeding, for example, on other mites or nematodes. Although some oribatid mites are recognised as intermediate hosts of various species of tapeworm, including those of veterinary importance within the family Anoplocephalidae, no species of the mites themselves are considered parasitic on mammalian hosts. However, a 1962 study of wild rabbits in UK<sup>11</sup> reported a surprisingly high presence of *Nothrus* species mites, with 45 mites found on 22 different rabbits of 374 examined from throughout UK, with one rabbit having 16 mites and several harbouring a few. This unexpectedly high presence of *Nothrus* species mites, occurring to about the same extent as *Ixodes ricinus* ticks, led the authors to speculate a biological relationship between the mites and rabbits, rather than the mites being accidental stragglers.<sup>11</sup> These authors also cited work from Russia,<sup>12</sup> in which the occurrence of *Nothrus* species mites in nests of small mammals in the Leningrad district is apparently reported; we were unable to access the original article, which is in Russian. Mead-Briggs and Hughes<sup>11</sup> also noted that, based on the work of previous

researchers, some species of *Nothrus* species mites have a predatory manner of feeding. Associations between the Norway rat (*Rattus norvegicus*) and various mites, including a species of *Nothrus* species mite, have also been noted from the Kermadec Islands.<sup>13</sup>

Despite *Nothrus* species mites being found on two occasions in the cat's bed in the case described here, we are hesitant to conclude that *Nothrus* species mites were the underlying cause of the cat's pruritus. However, it does seem possible that the large number of mites that, presumably, had been on the cat, despite not being observed by the owner, could have exacerbated the condition. This could either have been due to physical irritation or an underlying hypersensitivity to direct contact with the mites themselves or with mite faecal constituents, such as some proteases and chitin, as identified as important with HDM atopic disease.<sup>14</sup> Alternatively, this could be due to an indirect effect from fungal or bacterial elements associated with the mites.<sup>14</sup> We were unable to investigate any of these possibilities.

## Conclusions

Here we report on a *Nothrus* species mite infestation as a possible cause of exacerbated pruritus in a cat. Owner alertness to the possible involvement of particular potential agents in exacerbating feline pruritus is important, along with the dissemination of information on such cases. We propose that large numbers of some arthropods that are not usually considered to have a pathogenic effect may, nevertheless, cause or exacerbate pruritus.

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**Conflict of interest** The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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**Ethical approval** The work described in this manuscript involved the use of non-experimental (owned or unowned) animals. Established internationally recognised high standards ('best practice') of veterinary clinical care for the individual patient were always followed and/or this work involved the use of cadavers. Ethical approval from a committee was therefore not specifically required for publication in *JFMS Open Reports*. Although not required, where ethical approval was still obtained, it is stated in the manuscript.

**Informed consent** Informed consent (verbal or written) was obtained from the owner or legal custodian of all animal(s)

described in this work (experimental or non-experimental animals, including cadavers) for all procedure(s) undertaken (prospective or retrospective studies). For any animals or people individually identifiable within this publication, informed consent (verbal or written) for their use in the publication was obtained from the people involved.

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