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Microsporum mirabile and its teleomorph Arthroderma mirabile, a new dermatophyte species in the M. cookei clade.

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A case of an apparent infestation by *Proisotoma* spp. springtails (Collembola: Isotomidae) in a cat

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Conflict of Interest

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Abstract

This case report is presumed to be the first case of infestation of a cat by springtails which are small arthropods closely related to insects. The organisms, found by skin scrapings, were identified as *Proisotoma* spp. (Collembola: Isotomidae). The cat presented with dermatological lesions (itchy, furfuraceous dermatitis), and we speculate that they were due to this infestation. The pathogenic role of the Collembola was hypothesized because of the large number of organisms, the presence of eggs indicating an active reproduction cycle, the lack of other pathogens (fleas, mites or lice) and the clinical recovery accompanied by the disappearance of Collembola following treatment. The owner seemed to be affected by the infestation, because a few days after having purchased the cat, she developed a pruriginous papular dermatitis on the neck and the arms, which disappeared shortly after treatment of the kitten and a careful washing of all of its toys and other accoutrements.

Introduction

Springtail is the colloquial name given to a group of small arthropods closely related to insects that occur in soils throughout the world. Lubbock¹ introduced the scientific name Collembola (meaning 'the creature able to attach or glue itself to the body on which it stands') for springtails in 1873. Collembola are currently considered to be a monophyletic class of the Phylum Arthropoda, although their exact taxonomic position is still the subject of some debate.² They are wingless, with antennae always present, and range in size from 0.25 to 10 mm.^{2,3} Their common name

comes from the presence of a specialized appendage (furcula), formed by the fourth of six abdominal segments, that is used for jumping. They are among the most widespread and abundant terrestrial arthropods on Earth, being the major components of terrestrial ecosystems and soil communities, constituting an important portion of the animal biomass.^{2,3} In forest soils, they reach densities from 200 to 1,800 individuals /dm³, densities surpassed only by the acarid soil population.⁴

Although they are believed to be merely ubiquitous and harmless saprophytes, sporadic reports suggest that springtails can alter their behaviour and occasionally become parasitic. Such reports have involved a large variety of ecological situations and hosts (e.g. insects, crabs, toads, newts and starlings), with some cases being described in humans.^{3,5–11} To the authors' knowledge, an infestation of *Collembola*, with or without clinical signs of dermatitis, has never been reported in cats.

Case Report

A 3-month-old male bearded domestic long hair kitten presented with a history of generalized mild pruritus and diffuse scaling. The cat had bought 10 days previously in a pet shop that also handled ornamental garden plants. On that occasion, the owner also bought some plants and gadgets for the cat. The cat manifested dermatological signs immediately upon arriving home. The owner developed a pruritic papular dermatitis on the arms and the neck 6 days after the purchase of the cat. After a specialist consultation, a contact atopy or contact allergy to the cat was suspected. The owner referred to a suspected 'contamination' from the pet because of a sensation of 'something walking on her skin'. The kitten was not vaccinated and had never been treated for parasites before.

Dermatological examination of the cat revealed mild generalized dry scaling, particularly on the back and tail (Figure 1). Mycological examination for dermatophytic fungi, including the Wood's lamp test and direct microscopic evaluation of hair and culture was negative. Multiple skin scrapings, adhesive tape tests and coat brushings were performed in order to detect parasites such as mites, lice or fleas, and all tests were negative. In all samples, an unusual 'insect' was repeatedly noted (Figure 2), as were some egg-like structures. At the same time, a thorough microscopic examination of samples obtained from the cat's couch and other gadgets bought at the same shop detected the same organisms as found in the dermatological specimens.

A presumptive diagnosis of an unspecified insect infestation was made. The cat was treated with a selamectin spot-on formulation (Stronghold 15 mg; Pfizer Animal Health, Rome, Italy) administered every 15 days. All of the infested objects were carefully washed. By the time of the second treatment, the kitten's scaling and pruritus had decreased, and both had resolved within a few days of the second treatment. The owner's symptoms disappeared after the first treatment of the kitten and did not recur. The owner received no treatment. To date, 1 year later, both the cat and its owner are free from dermatological signs.

The 'insects' were not found on skin scrapings from the kitten taken following the selamectin treatment. The organisms were later identified at the Department of Evolutionary Biology of the University of Siena (Italy) as *Proisotoma* spp. (probably *Proisotoma minuta*; *Collembola*: *Isotomidae*). The uncertainty in the specific identification was due to the presence in the sample of immature organisms that were difficult to identify.

Discussion

Springtails (*Collembola*) are usually found outdoors in moist environments, where they feed on fungi, algae and decaying vegetable matter, in a variety of biological systems that include terrestrial, freshwater and shoreline–marine aquatic. They are traditionally believed to be entirely saprophagous, phytophagous and / or mycophagous detritivores, and are considered pests principally because of the possibility of domestic infestations, which occur through windows, doors and vent pipes, or via merchandise or ornamental plants. Potted plants can serve as sources, with the *Collembola* emerging from the damp soil (incidental infestations). After entering a house, they crawl about and are often trapped in sinks and washbasins. They are most commonly found where there are sources of moisture, such as the kitchen and bathroom, where they hide in very small cracks. They may also occur in damp wall voids.^{3,6,12–14} Accordingly, springtails are regularly collected during epidemic investigations of human dermatitis outbreaks. As they are not well known, they are often mistakenly blamed for the outbreak, whereas further investigation may reveal some other cause for the dermatitis.^{13,15,16}

Nevertheless, springtails have been found in the following circumstances that suggest an occasional parasitic role: feeding upon nesting ants, flies and conspecific dead springtails;¹¹ infesting bumblebees;¹⁷ infesting insect eggs;^{18–20} parasitizing moth larvae (*Delia radicum*);²¹ infesting hermit crabs;^{8,9} living in the gut of an avian louse (*Myrsidea* spp.);²² associated with nesting mammals; ^{11,23–26} infesting starlings (*Sturnus vulgaris*);⁷ and associated with dermatological lesions in horses.²⁷ There have been several case reports of human dermatitis, with papular and pruriginous lesions or a crawling sensation, in which *Collembola* have been found. These cases involved patients ranging from young children to elderly adults, and were often associated with a variety of outdoor occupations (e.g. gardening and farming) and contacts with domestic and wild animals. Frequently, the initial presentation was ‘atypical’ pruritic dermatitis, involving more than one inhabitant, for which mites, lice or other common arthropods could not be demonstrated as the aetiological agent.^{3,5,6,13,14,28–31}

Collembola have recently been claimed as the true cause of disease in some patients afflicted with the so-called delusory parasitosis, a psychiatric condition also known as Ekbom’s syndrome (ES),³² characterized by the perception that one’s body is infested by mites or insects, despite evidence to the contrary.³³ Those afflicted with ES experience visual and tactile hallucinations perceived as ‘bugs’ crawling in or on the skin. The conviction that they are infested is reinforced by their observation of particles described as sparkly, crusty, crystal-like, white or black specks, and / or fibres. These infestations are perceived as tactile sensations (e.g. stinging, itching and / or crawling) and visualized in a variety of forms. Sufferers attempt to remove parasites by picking and digging into the skin, producing excoriation, scarification and lacerations.

While ES has been characterized as rare by the medical community, it is a condition frequently encountered by pest control staff and entomologists.³⁴ By the time a patient presents to the dermatologist, it is not uncommon that they have been seen by many doctors and specialists.^{34–42} For a diagnosis of primary ES, the possibility of valid infestation must first be eliminated.³⁴ Accordingly, it has recently been hypothesized that some patients afflicted with ES may really be infested with ‘bugs’. In a clinical study of 20 patients with ES, 18 were found to have evidence of the presence of springtails.³² Unfortunately, this report was not based on the finding of *Collembola* in skin scrapings, but on ‘images of them’ in digital pictures of skin scrapings.¹⁶

To the authors’ knowledge, the present report is the first case of an apparent infestation by springtails in a cat. The organisms were identified as *Proisotoma* spp. (probably *P. minuta*), a greyish brown, common and widespread species, usually found in decaying organic matter, that can occur in large numbers in the soil and reaches a maximal length of 1.1 mm.³ The cat presented with dermatological lesions, and we speculate that they were due to this infestation. In

this regard, the initial presentation was very similar to that described in the human literature 3,5,6,13,14,28–31 [i.e. ‘atypical’ dermatitis in the absence of common pathogens, ruled out by accurate diagnostic procedures (multiple skin scrapings, cultures, adhesive tape tests)]. However, it is known that the presence of other ectoparasites (e.g. Cheyletiella spp., Notoedres cati and fleas) cannot be totally ruled out on basic laboratory testing, even if performed with great care, and our findings must be interpreted with some caution. There are other factors, however, that support the pathogenic role of the Collembola, such as the large number of organisms, the presence of eggs indicating an active reproduction cycle, and clinical recovery accompanied by the disappearance of Collembola following treatment. Collembola were rapidly eliminated after one treatment with topical selamectin. This drug was employed according to the first presumptive diagnosis on an ‘unspecified insect’ infestation, as it can be effective through blood meals, feeding on cutaneous debris and by contact. The contact route was probably more important in the rapid elimination, as Collembola are unlikely to feed on an animal host.^{3,5,16} The very rapid recovery may also support the hypothesis of Collembola infestation, as the more common ectoparasites normally need at least two treatments for complete recovery.

It is hard to determine the pathogenic mechanism by which the springtail could have caused the dermatological signs, because very little is known about the irritant, allergic or parasitic potential of Collembola.¹⁶ Dasgupta and Dasgupta^{10,11} demonstrated Collembola (*Hypogastrura* spp. and *Seira indica*) feeding on the blood of newts and toads, and attracted to and actively feeding on moist blood films from red pandas (*Ailurus fulgens*), suggesting that some species of Collembola are capable of biting. However, this has not been confirmed in other animals or humans.¹⁶ Moreover, Pescott⁵ stated that the chewing mouthparts of most Collembola are incapable of biting and, except for a single case of erroneously termed ‘myiasis’ of the nasal sinuses associated with the springtail *Isotoma olivacea*,⁴³ there is no recorded case of Collembola burrowing into anything or being found imbedded in any tissue.³ Accordingly, it has been hypothesized that, apart from a crawling sensation because of Collembola walking and hopping on the skin, cases of dermatitis may be the result of the allergic / irritant effect of Collembola proteins. A mild, localized allergic response to the hair-like setae present on springtails, or tissue / integument exposed after crushing of the arthropod from scratching, is reported in human medicine literature as the cause of itching and the appearance of cutaneous lesions.^{5,13} Mertens³¹ described a patient who seemed to have developed an allergy from sitting on the cushion of a rattan chair populated by the springtail *Seira domestica*. However, such allergic reactions have never been extensively investigated, and in the reported cases of Collembola affecting humans, little if any evidence of an allergic action exists.^{3,16} Moreover, in a recent study on two patients with dermatitis suspected to be caused by the springtail *Drepanura* spp., IgE antibodies to springtail proteins were not detected in sera from the patients, and the skin tests both with the Collembola extract and with crushed whole organisms were negative in both patients and in the volunteers used as negative control subjects. The authors suggest that other organisms and organic matter that are also found in the moist environment inhabited by the springtails might instead be responsible for the disease.¹⁶ The cutaneous signs in this kitten, as thought in most human cases,³ should not be attributed to a ‘true’ parasitosis but rather to a transitory infestation, during which the movements of the arthropods may have caused pruritus and the other clinical signs, possibly involving an allergic or irritating action.

This infestation appeared to involve an animal, the environment and, presumably, a person. The human involvement, however, can only be suspected, as we could not recover springtails from the owner’s lesions. This is nevertheless common in cases of zoonotic mite infestations, when amelioration of lesions after the pets are treated indirectly confirms zoonotic transmission. The

pet showed the clinical signs the same day the owner bought it together with its cat bed and some gadgets. Therefore, it is reasonable to assume that the infestation derived from the place of purchase. It is impossible to establish whether the infestation of the owner was transmitted through contact with the cat, its gadgets or the plants bought in the same shop. In any case, the human clinical signs are not attributable to a zoonotic disease, because the pet was at most a passive carrier of an organism harboured from the environment. According to Euzéby,⁴⁴ this kind of infestation may be called at most a 'pseudozoonosis'. As noted above, the owner seemed to suffer a mild, transient infestation, and all symptoms disappeared without the need for therapy, after treatment of the kitten and careful washing of all of its toys and accoutrements.

In conclusion, this is the first case of an apparent infestation by springtails in a cat. There is a strong suspicion that these organisms were responsible for the clinical signs observed in the cat and its owner, although other parasitic causes, as discussed above, cannot be ruled out definitively.

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Figure 1. Dermatological presentation of the apparent springtail infestation. Mild generalized dry scaling localized on the back and tail of the cat gave the coat a dull appearance.



Figure 2. Skin scraping from the cat's back, showing a wingless "insect" later identified as a springtail.