Mite Infestations In Theraphosid Spiders.

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Introduction

Mite and other ectoparasite infestations can occur in both mygalomorph and araneomorph spiders. These are often associated with distress, disease and death. Severe ectoparasite infestations can require veterinary intervention. Knowledge of how infestation takes hold is invaluable in understanding how to successfully prevent and treat this presentation.

Figure 1 : Stereomicroscopic image of an acarine mite found on a theraphosid spider.

There are several different types of ectoparasites that can be found on captive theraphosids; this article will be specifically discussing 'mites' as these are commonly encountered. Mites are often members of the acari subclass, which is within the arachnida class (**Figure 1**). Novice keepers can often incorrectly identify any number of species, such as various insect species and springtails, as 'mites'. Mites are commonly reported in the literature and have been associated with disease and even death in several arachnid species (Masan et al., 2012; Montalva et al., 2016; Paré and Dowling, 2012). Our understanding of arachnid parasitology is still limited. More study is required to understand the variability and diversity of mite populations within theraphosids and arachnids. The authors are currently running an ongoing project on identifying the different mites found within captive theraphosid and other arachnid populations with some success. This article will provide an overview of the authors current understanding, alongside some treatment recommendations.

In order to identify mites and establish how infestations can occur it is important to understand some of their basic characteristics. Some mites are very host specific, struggling to feed on another species, but other mites can be opportunistic and will feed from several different sources. This will help narrow down possible suspects when confronted with an ectoparasite in vivo. All ectoparasites, including mites, can vary greatly in size. This can be seen in honeybees who are hosts to two main species: *Acarapis woodi* and *Varroa destructor*. *Acarapis woodi* is present in the respiratory trachei; these are often less than 0.175 millimetres long (Delfinado-Baker and Baker, 1982). In comparison, varroa mites (*Varroa destructor*) are very large at 1-1.8 millimetres long (Chantawannakul et al., 2016; Sammataro et al., 2000). The varroa mites would be the size of dinner plates if the bees were human sized.

Figure 2 : Presumed acari mite present near the oral cavity of *Hogna ingens* (Desertas wolf spider).

illegal trading. Taking care to buy captive-bred spiders from reputable known sources can be the most crucial way of reducing the risk of introducing mites into a collection.

Another source of infestation can be native arachnids and invertebrates that are in contact with a collection. Native arachnids are often well-adapted to dealing with native ectoparasites, but exotic arachnids may be more susceptible due to not being previously exposed. Commensal mites in one species may become pathogenic when introduced to another. Theraphosids that are endemic to warmer and more humid environments may be immunocompromised in a cooler climate and thus be more susceptible to parasitic infestation.

Additionally, mite species who primarily feed from invertebrates will often specialise by developing anatomical features that allow them to penetrate the cuticle or gain entry to the respiratory system. Mites will often be found around the mouth cavity (as shown in **Figure 2**), on the external cuticle, around the epigastric furrow and around or in the book lung slits. When suspecting a mite infestation it is important to include these areas in any inspections.

Mites can be present on both captive-bred and wild-caught specimens, but are more common in the latter. This occurs especially after being shipped, where spiders are often rapidly collected in close proximity, packaged and then transported. The stress and enclosed space of shipping provides an ideal environment for mites to significantly increase in numbers (a dramatic example shown in **Figures 3** and **4**). Those that are collecting specimens for export are often paid dependent on numbers of specimens rather than quality and health of individuals and this can therefore result in reduced vigilance or inspection for mites prior to shipping, especially in cases of

Mites and other diseases can spread dramatically through a collection when there isn't an appropriate isolation and biosecurity protocol in place. The author recommends an isolation period of at least 28 days within a separate room. It is also important for good biosecurity measures to be in place between the isolation room and the main collection room. A shorter isolation period for feed invertebrates (around 7 days where appropriate) is also recommended. Ideally, feed invertebrates would be bred in-house to prevent the introduction of disease. In addition to this, any uneaten prey invertebrates should be discarded rather than being re-fed to another theraphosid. Reintroduction of a rejected insect into the feed stock should be avoided. This reduces the likelihood of transmission of disease or mites from the collection into the feed invertebrate stock, thus preventing transmission from there to other animals in the collection.

Treatment

The most established method of treating mites is physical removal (Pellett et al., 2015; Pizzi, 2011).

Figures 3 and 4 : Example of mite infestation in a recently shipped wild-caught *Cyriopagopus vonwirthi*. Note the wet appearance around the prosomal-opisthosomal junction.

The authors prefer surgical spirit applied to the mites with either a cotton wool bud or with a very fine watercolour brush prior to removal to aid detachment and reduce the likelihood of reattachment. They use stereomicroscopy to very carefully find and remove eggs (**Figure 5**), these can often be missed with the naked eye and are most commonly found on the distal aspect of limbs, as well as around the oral cavity and the prosomal-opisthosomal junction. Egg removal reduces the number of treatments required to completely eliminate an ectoparasite infestation. Although effective at killing mites (effectively shown in **Figure 6**) treatment with alcohol will cause some low level damage to the chitin and chitinous hairs, the chitinous hairs will lose some of their natural rigidity and quality. This is a mild side effect of treatment and will typically resolve when the theraphosid next moults.

Physical mite removal can be performed by an experienced keeper if they wish to remove mites from their own spider, particularly in a well acclimatised and docile individual. A good appreciation of health and safety is needed as even docile spiders will flick hairs or become agitated when mites are being removed. The authors would recommend wearing gloves and safety goggles to mitigate the risk of urticating hair exposure during physical mite removal, even in a well-known spider. Veterinary involvement becomes more indispensable when mites are found on defensive or stress-prone species; in these situations veterinary anaesthesia can help with mite removal while reducing stress and associated damage. Anaesthesia can be essential for removing eggs using stereomicroscopic visualisation as this requires a very still patient. The authors would not recommend refrigeration or freezing as a method of anaesthesia as these methods are both excessively stressful, damaging and ineffective (Cooper, 2011).

Physical removal is only part of the treatment and must be supplemented with environment and management changes. The majority of mites will live within the local environment and therefore, if mites are found, substrate change and enclosure disinfection or change should be undertaken. In the case of repeat infestations enclosures may need to be discarded and entire setups be reconfigured to reduce the rate of transmission/risk of reinfection. Multiple treatments and substrate changes/enclosure disinfections over an extended period may be needed to eradicate mites completely.

Alternative treatment options have been reported within the literature. Ivermectin has been utilised in spiders and other invertebrates (Pizzi, 2009) and is administered in a similar way to ethanol; it is applied in a dilute solution directly to the mites in order to remove and kill them. Anecdotally, other insecticides have been used or have been proposed but such methods are reliant on the active ingredient being more toxic to mites than the host animal. Insecticides are indiscriminate between commensal mites, pathogenic mites and the host spider. The authors prefer to avoid insecticides where

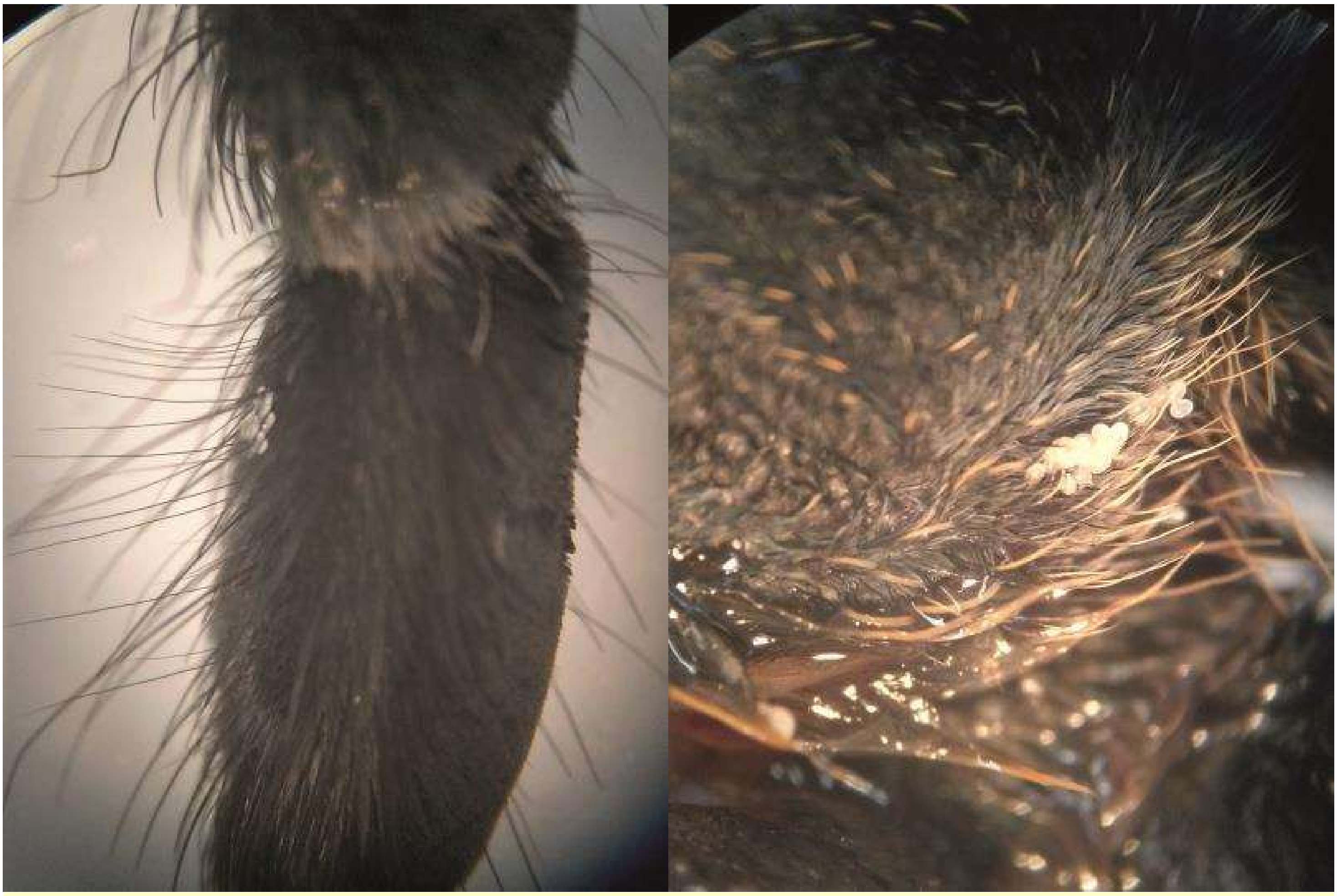

Figure 5 : Mite eggs attached to the base of chitinous hairs on the distal aspect of the leg (left) and near the opisthosomal-prosomal junction.

possible due to the anecdotal association between insecticide administration and dyskinesia syndrome (Pellett et al., 2015). Fipronil, pyrethroids and neonicotinoids have been specifically used to chemically exterminate spider and scorpion populations (Novaes et al., 2011), so it is important to acknowledge the risk of using insecticides as treatment. The susceptibility of theraphosids to insecticide treatment is likely very species-dependent and the knowledge of their safe use is limited. Such methods may be considered if large numbers of animals are affected and physical removal is too labour-intensive to be effective. In this case the increased risk is outweighed by the benefit of reducing mite numbers quickly. Veterinary advice is strongly recommended should medical treatment of this sort be considered. Over-infestation in large collections may be a clinical sign rather than the cause of disease, so some investigation into the underlying health of representative animals within the collection may be warranted to determine if there are any underlying problems (i.e. bacterial, fungal or viral disease).

Conclusion

Mites present a common problem within the domestic theraphosid population. The factors making a spider more susceptible to infestation and the mite species present within wild and domestic populations are still not fully understood. More study is needed to fully understand how parasites interact with arachnids. Regular observation and inspection of animals within a collection is important for identifying a problem before it spreads or results in excessive suffering. Treatment can be attempted in more docile species by an experienced keeper and should be followed by environmental changes. Prevention is better than cure and good isolation protocols alongside good observation should reduce the risk of mite infestation to a collection. In cases of defensive or stressed individuals, veterinary intervention may be required to assist treatment.

Acknowledgements

The authors would like to acknowledge the contributions of Ray Gabriel and Danielle

Figure 6 : Image of *Cyriopagopus vonwirthi* included in figure 2 and 3 following treatment.

Sherwood, Steve Trim and Carol Trim and the team at Venomtech, The Veterinary Invertebrate Society, Caroline Howard of Askham Bryan College as well as the BIAZA terrestrial invertebrate working group.

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