

Ophidiomyces Ophiodiicola : Snake fungal disease and its Characteristics

Richard Simon*

Department of Anatomy and Histology, Agricultural University, Sylhet, Bangladesh

Perspective

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***For Correspondence:**

Richard Simon, Department of Anatomy and Histology, Agricultural University, Sylhet, Bangladesh
E-mail: simon123@gmail.com

ABOUT THE STUDY

Since 2006, there has been a marked increase in the number of reports of severe and often fatal fungal skin infections in wild snakes in the eastern USA. The emerging condition, referred to as snake fungal disease (SFD), was initially documented in rattlesnakes, where the infections were believed to pose a risk to the viability of affected populations. The disease is caused by *Ophidiomyces ophiodiicola*, a fungus recently split from a complex of fungi long referred to as the *Chrysosporium* Anamorph of *Nannizziopsis Vriesii* (CANV). Here we review the current state of knowledge about *O. ophiodiicola* and SFD. In addition, we provide original findings which demonstrate that *O. ophiodiicola* is widely distributed in eastern North America, has a broad host range, is the predominant cause of fungal skin infections in wild snakes and often causes mild infections in snakes emerging from hibernation. This new information, together with what is already available in the scientific literature, advances our knowledge of the cause, pathogenesis and ecology of SFD. However, additional research is necessary to elucidate the factors driving the emergence of this disease and develop strategies to mitigate its impacts.

The general descriptor 'SFD' was coined early in the investigation. At the time, it was unclear whether the infections shared a common etiology or whether multiple species of fungi were involved. The initial cases of SFD implicated *Chrysosporium ophiodiicola* as the possible causative agent. Subsequent genetic studies revealed *C. ophiodiicola* to be a cryptic member of the *Chrysosporium* Anamorph of *Nannizziopsis Vriesii* (CANV), a complex of morphologically similar fungi associated with skin infections in reptiles. Phylogenetic studies of CANV fungi revealed they were paraphyletic, and this resulted in the transfer of most taxa to other genera, including reassignment of *C. ophiodiicola* to the monotypic genus *Ophidiomyces*. Onygenales includes some of the most medically significant

fungal pathogens of animals, including *Blastomyces*, *Histoplasma*, *Coccidioides*, *Paracoccidioides*, *Microsporium* and *Trichophyton*.

Historical observations of skin disease in wild snakes further challenge the hypothesis that *O. ophiodiicola* was recently introduced to eastern North America. Cases of dermatitis are often referred to as 'hibernation blisters' or 'hibernation sores' by field biologists because lesions are most often seen as snakes emerge from hibernation. Observations of such skin lesions have been reported for decades although the aetiologies were only rarely explored. We investigated the prevalence of skin lesions compatible with 'hibernation sores' and found that 41% of wild snakes at our study sites had signs of dermatitis post-emergence from hibernation (the electronic supplementary material). We collected samples from a subset of these affected snakes and detected *O. ophiodiicola* from lesions in 74% of the animals tested; furthermore, histopathologic findings were consistent with SFD (the electronic supplementary material). Similarly, snakes examined from Virginia had a 38% prevalence of gross skin lesions, most of which were mild despite being associated with *O. ophiodiicola*. Although *O. ophiodiicola* cannot be definitively implicated as the cause of disease in older reports of 'hibernation sores,' these findings raise the possibility that the fungus could have been present in North America prior to recent reports of severe disease.

Emerging fungal diseases pose a significant threat to wildlife health. Fungi, more so than other pathogens, possess characteristics that make them capable of causing massive population declines and extinction of their hosts. *Ophidiomyces ophiodiicola* has many traits of a well-adapted pathogen, including a broad host range and the ability to survive in the environment. As a result, SFD poses a major challenge for snake conservation.