Fungal organisms are ubiquitous in the environment of reptiles. The effectiveness of the reptilian immune system in combating infection is influenced by multiple factors and husbandry plays an important role. In most outbreaks or individual cases of mycosis, poor husbandry is implicated including sanitation, overcrowding, stress and heating failures. Other influences on the immune system include overall health, nutritional status, brumation, seasonal changes and age.

**Chrysosporium anamorph of Nannizziopsis vriesii (CANV)**

CANV, also referred to as “yellow fungus disease,” is a keratinophilic ascomycetous fungus of the order Onygenales. This organism has been isolated as a primary pathogen from cases of fungal dermatitis in multiple lizard species (chameleons, geckos (Figure 1, below), bearded dragons, green iguanas) and salt water crocodiles, and a related fungus has been isolated from mycotic lesions in snakes (discussed separately). Although husbandry and environmental factors are involved in the development of CANV dermatitis, the exact mechanism of infection is not well understood. The fungus is typically found in warm, humid environments and can be transmitted through contact with infected animals or contaminated substrates.

*Figure 1. Gecko with CANV dermatitis near right lip commissure*
stressors may play a role, the organism appears to act as a primary pathogen in some species.

Most CANV infections present as cutaneous with a variable appearance of small vesicles or bullae, which collapse and become crusty and brown. Lesions may be hyperkeratotic at first, progressing to necrosis and sloughing leaving raw lesions in the dermis. If untreated, infection may progress to involve underlying muscle and bone. Transmural extension into the coelom and viscera is also possible. The disease may progress rapidly or the clinical course can be protracted.

CANV is thought to be contagious among bearded dragons. Reports of CANV infections in humans are infrequent and the source of the human infections is unknown. Treatment with itraconazole (10 mg/kg/24 h PO) or ketoconazole (20 mg/kg/24 h PO) has been reported to be effective in some cases. Treatment is continued for a minimum of 2-4 weeks in conjunction with correction of inappropriate environmental/husbandry conditions.

**Ophidiomyces ophiodiicola**

While CANV is rarely associated with disease in snakes, a genetically related fungus has been implicated as the causative agent of so called “snake fungal disease (SFD)” – a sometimes fatal syndrome of skin lesions in terrestrial snakes.

SFD appears to be an emerging disease of snakes. The causative agent, *Ophidiomyces ophiodiicola*, was first identified as the cause of an outbreak of disfiguring facial lesions in timber rattlesnakes in the northeastern United States and has since been detected in 34 snake species in several states. While most SFD surveillance has focused on wild snakes there are a number of reports of SFD in captive snakes, including in species commonly kept as companion animals such as corn snakes, ball pythons, and king snakes.

![Figure 2. Snake skin, GMS, *Ophidiomyces ophiodiicola* hyphae and arthroconidia (arrow).](image)

Similar to CANV infections in pet reptiles, most SFD infections are typically limited to the skin and subcutis. Affected snakes exhibit ulcerative, scabbed, or disfiguring lesions of the head, face, and ventral scales. Skin abrasions are thought to be a risk factor for SFD; however, the fungus can colonize and invade intact skin. In wild snakes, these lesions are commonly observed after emergence from hibernation. While CANV infections are reportedly transmissible between individuals, data to support horizontal transmission of SFD is lacking. Environmental contamination likely plays a role in disease transmission, and studies have shown that bleach is an effective disinfectant whereas chlorhexidine, Simple Green, and Spectricide are not. While antifungal therapy has reportedly been ineffective at treating SFD, increased ecdysis aided by adequate light and heat

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exposure may be curative in some snakes. Suspected cases of SFD in free-ranging snakes should be reported to your state wildlife agency.

A presumptive diagnosis of CANV and SFD can be made on histopathology of skin biopsies based on the characteristic morphologic features of the fungus. Fungal stains reveal hyaline septate hyphae, 2-4 um wide, mostly parallel walled with occasional swelling and sparse haphazard branching. Characteristic boxcar shaped arthroconidia (Figure 2) are often found at the epidermal surface. Fungal culture, PCR and sequencing are necessary for a definitive diagnosis.

REFERENCES


IMAGE CREDITS

• Figure 1. Gecko
  Image courtesy of Elliott Jacobson, DVM, PhD, DACZM; Professor Emeritus of Zoological Medicine; SACS, 2015 SW 16th Ave; College of Veterinary Medicine, University of Florida; Gainesville, Florida 32610.
• Figure 2. Arthroconidia
  Image courtesy of Elizabeth Elsmo, DVM, Diplomate ACVP - Anatomic Pathology; Marshfield Labs, Veterinary Services.
F. Yvonne Schulman, DVM, Diplomate ACVP

Dr. Yvonne Schulman completed her undergraduate degree at Harvard University and is a graduate of Tufts University School of Veterinary Medicine. She was in small animal practice prior to completing a residency in pathology at Angell Memorial Animal Hospital in Boston, MA and a residency in pathology at the Smithsonian Institution’s National Zoological Park in Washington, DC. After her residencies, Dr. Schulman was awarded a fellowship at the Armed Forces Institute of Pathology (AFIP) in Washington, DC, where she was subsequently hired as a staff pathologist and appointed Head of the WHO Collaborating Center for Worldwide Reference on Comparative Oncology. Dr. Schulman became a diplomate of the American College of Veterinary Pathologists in anatomic pathology in 1992 and has worked for Marshfield Labs Veterinary Services since 1993.

Starting with a 2-year pathology residency at the Smithsonian Institution’s National Zoological Park and through her career at the Armed Forces Institute of Pathology and at Marshfield Labs, Dr. Schulman has studied exotic, zoo and wildlife pathology for more than 25 years. She has coauthored 18 papers on diseases of exotic, zoo and wild animals and has been a member of the American Association of Zoo Veterinarians (AAZV) since 1991.

Anne Kincaid, DVM, Diplomate ACVP

Dr. Anne Kincaid received her DVM at the Ohio State University and completed pathology residency training at the Johns Hopkins University Division of Comparative Medicine. While at Hopkins, she did extensive pathology for the Baltimore Zoo and the National Aquarium in Baltimore. Her interest in exotic animal pathology continued while she was assistant director of Veterinary Diagnostic Services of Maryland Medical Laboratory, Inc. and during her time as a staff pathologist for Antech Diagnostics. Dr. Kincaid is a diplomate of the American College of Veterinary Pathologists and joined Marshfield Labs in 2006. She has broad experience in a variety of species including amphibians, reptiles, birds, pocket pets and a recent interest in fish.

Elizabeth (Betsy) Elsmo, DVM, Diplomate ACVP

Dr. Betsy Elsmo is a graduate of the University of Wisconsin (UW) where she achieved a bachelor’s degree in wildlife ecology prior to receiving her DVM at the School of Veterinary Medicine. She spent a year as a research fellow at the USGS National Wildlife Health Center in Madison, focusing on avian immunology. She completed an anatomic pathology residency at the University of Georgia College of Veterinary Medicine (UGA) where she had a joint appointment at the Southeastern Cooperative Wildlife Disease Study. Dr. Elsmo joined the staff of Marshfield Labs in October 2016.

Dr. Elsmo has experience with a wide variety of species - from wood frog tadpoles to African elephants, including animals from free-ranging wildlife populations, zoological collections, and exotic pets. She has a strong interest in pathology of avian and reptile species, and particularly enjoys learning about new and emerging diseases that may affect these animals.