

What is mycobacteriosis?

Mycobacteriosis is a generic term that describes diseases caused by a group of bacteria (simple single-celled organisms) known as mycobacteria. Mycobacteria are widespread in the natural world, particularly in aquatic environments. A small fraction of mycobacterial species causes disease in animals and humans.

A newly described species of mycobacteria, *Mycobacterium shottsii*, is the type most commonly associated with the current outbreak of mycobacteriosis among striped bass in Chesapeake Bay. *M. shottsii* was first identified by VIMS scientists in 2001, and is present in 76% of infected bass. Striped bass from the Bay are also known to harbor multiple mycobacterial infections. Other infectious mycobacteria recovered from Bay bass include *M. abscessus*, *M. chelonae*, *M. fortuitum*, *M. marinum*, *M. neoarum*, *M. scrofulaceum*, and *M. simiae*.

The human health significance of *M. shottsii* is not yet known (see below). Concern is warranted because *M. shottsii* is closely related to *M. marinum*, the species most frequently responsible for mycobacterial infections of skin and soft tissue in humans. *M. marinum* is also considered the primary cause of mycobacteriosis in fish in aquarium, aquaculture, and natural settings. Other more distantly related species of mycobacteria include *M. tuberculosis* (the cause of pulmonary tuberculosis) and *M. leprae* (the cause of leprosy).

Although *M. shottsii* is in the same genus as *M. tuberculosis*, mycobacteriosis in humans is not the same disease as tuberculosis. *M. shottsii*, *M. marinum*, and other species of "environmental" mycobacteria are collectively termed "non-tubercular" mycobacteria to distinguish them from the species (*M. tuberculosis*, *M. bovis*, *M. africanum*) that cause tuberculosis.

What are the symptoms of mycobacteriosis in striped bass?

Mycobacteriosis of Chesapeake Bay striped bass is predominantly a visceral disease, infecting organs such as the spleen and kidneys. Internal signs of the disease typically include small grayish white nodules called granulomas in these organs. A small percentage of the infected fish also exhibit unsightly shallow, rough-surfaced, reddened, or darkly pigmented skin ulcers. Loss of scales is common in these ulcers. Infected fish sometimes exhibit significant weight loss. These disease symptoms are mainly observed in the summer and early fall. Fish exhibiting the unsightly skin ulcers are of greatest concern to anglers.

Can I contract mycobacteriosis by handling striped bass?

There is a slight potential for human infection from handling striped bass infected with *M. shottsii* and other mycobacteria. Concern is warranted because *M. shottsii* is closely related to *M. marinum*, a species known to pass from infected fish to humans via handling.

Anglers should thus:

- return any fish with skin lesions to the water
- wear gloves when handling striped bass
- take particular care if they have a cut, scrape, or abrasion on their hands or arms, and
- wash thoroughly with soap and water after coming into contact with fish or open water.

Do not keep or eat a fish that you would not buy in a fish market.

M. shottsii prefers growth at cooler temperatures than *M. marinum*. It seldom grows in laboratory cultures at 30°C (86°F), suggesting that it may not produce infections in humans. However, *M. ulcerans*, a related species that also prefers low growth temperatures in laboratory cultures, does cause skin infections in humans. Thus some caution is warranted.

Human infection by *M. marinum* following exposure to the marine environment probably requires a portal of entry and is often linked with trauma such as wounds from handling fish. *M. marinum* infections in humans are known by names such as "fish-handler's disease," "aquarium disease," and "swimming-pool disease" (exposure to *M. marinum* from swimming pools is now rare due to chlorination).

Can I contract mycobacteriosis by eating striped bass?

There is no evidence that humans can contract mycobacteriosis by consumption of cooked fish infected by *M. marinum* or *M. shottsii*. However, because of the risk of infection via handling (see above), any striped bass that exhibit external signs of mycobacteriosis (unsightly skin ulcers) should be released or disposed of. Do not keep or eat a fish that you would not buy in a fish market.

Any fish that are consumed should be cooked thoroughly. *M. shottsii*, one of the bacteria responsible for causing mycobacteriosis in striped bass, prefers to grow at temperatures below about 30°C (86°F), and is killed after heating to temperatures greater than 75°C (~170°F) for 20 minutes.

What are the symptoms of mycobacteriosis in humans?

It is not yet known whether *Mycobacterium shottsii* (the main species implicated in the current outbreak of striped bass mycobacteriosis in Chesapeake Bay) can infect humans. Concern is warranted because *M. shottsii* is closely related to *M. marinum*, a species known to cause disease in both humans and fish.

Primary symptoms of human infection by *M. marinum* include infections of the skin and soft tissues. Infection most typically becomes evident as reddish nodules on the hands. These may spread along the lymph system of the affected extremity.

M. shottsii and *M. marinum* are slow-growing organisms. *M. marinum* grows well at 30-33°C (86-91°F), but not at the normal human body core temperature of 37°C (98.6°F). This helps explain why *M. marinum* tends to infect the extremities, which are cooler than the body core. *M. shottsii* prefers a cooler temperature (23°C or 73°F) and grows poorly or not at all at 30°C under laboratory conditions.

What should I do if I suspect I might have been exposed to mycobacteriosis?

Anyone who suspects they may have been exposed to mycobacteriosis from handling infected striped bass should contact their physician and inform them of the nature of the exposure.

Is fish mycobacteriosis related to Pfiesteria?

No. Although *Pfiesteria* has been implicated in causing skin lesions in fishes, it is a single-celled algae rather than a bacterium. For more information on *Pfiesteria*, visit the VIMS *Pfiesteria* web pages at www.vims.edu/pfiesteria/

How prevalent is mycobacteriosis among Chesapeake Bay striped bass?

Studies conducted by VIMS scientists from 1999-2001 showed that mycobacteria could be cultured from the spleens of 76% of striped bass recovered from the Chesapeake Bay (Potomac River to Virginia Beach). Seventy-six percent of these infected fish are positive for *M. shottsii*. *M. shottsii* is not only the most common species of mycobacteria in striped bass, but typically occurs at much higher densities than any other mycobacterium in co-infections. This means that anglers are more likely to be exposed to *M. shottsii* than other mycobacterial species. Whether *M. shottsii* poses a threat to human health is not yet known (see above). A fall 2002 survey by VIMS scientists of striped bass health in the York, Rappahannock, Potomac, and Nanticoke rivers indicates that mycobacteriosis is again present in the fish. However, the degree of its prevalence or severity will not be known until the researchers complete their

analyses, a process that takes several months. Some fish, especially in the Rappahannock, had skin lesions and some were "skinny" or underweight. Strippers with similar conditions have been observed every year since 1997, starting mainly in the summer and early fall.

Does mycobacteriosis affect other Chesapeake Bay fish species?

According to available data for Chesapeake Bay, the current outbreak of fish mycobacteriosis is limited to striped bass. However, other fish species have not been studied as intensively as striped bass, and many species have not been examined at all.

How might mycobacteriosis be affecting the striped bass population in Chesapeake Bay?

There is insufficient data to determine whether mycobacteriosis is affecting the striped bass population in Chesapeake Bay. Anecdotal evidence from fishing tournaments shows that younger stripers (below 24 inches long) are sometimes emaciated yet show no external or internal signs of the disease, whereas older fish (greater than about 24" long) commonly exhibit external lesions and infected internal organs but are otherwise robust and healthy. Thus the relationship between "skinny" bass and mycobacteriosis is presently not clear.

What is the history of mycobacteriosis in Chesapeake Bay?

The occurrence of mycobacteriosis in striped bass (*Morone saxatilis*) from Chesapeake Bay was first noted in 1997. Previous outbreaks of mycobacteriosis in wild striped bass have occurred in Pacific estuaries. Following the Chesapeake Bay outbreak, VIMS scientists isolated a new species of mycobacteria associated with skin and visceral lesions that they named *Mycobacterium shottsii*. This new species is closely related to *M. marinum* and *M. ulcerans*.

It is unknown how long mycobacteria may have been causing disease in Bay striped bass.

What is the focus of mycobacteriosis research at VIMS?

VIMS researchers are working to understand the extent and severity of the disease in Chesapeake Bay striped bass, the environmental conditions in the Bay that influence development of the disease, and potential impacts on striped bass stocks. The VIMS effort is part of a larger cooperative study with investigators from the USGS National Fish Health Research Laboratory in West

Virginia, from the Virginia Marine Resource Commission, and from institutions and agencies in Maryland. For more information see www.vims.edu/myco .

How is mycobacteriosis diagnosed in striped bass?

To determine whether a striped bass is infected with mycobacteriosis, researchers must first remove tissue from a fish under sterile conditions. Tissue is typically taken from the spleen, as this is an organ that helps remove bacteria from the blood. The next step is to slice the tissue thinly enough so that a section can be viewed under a light microscope. Staining and other techniques help researchers determine whether any mycobacteria and/or characteristic lesions are present in the fish tissue.

To identify the particular species of bacteria present, the researchers must isolate the bacterial cells from the fish tissue and grow them in pure culture on agar in petri dishes. Because *Mycobacterium shottsii*, the species primarily responsible for mycobacteriosis in striped bass, is such a slow-growing organism, it takes at least 2 months to grow a sufficient number of these bacteria for positive identification.

To speed up the identification process, VIMS researchers are using molecular techniques that allow rapid detection of mycobacterial species from small tissue samples. Development of genetic fingerprinting techniques will aid in identifying the species present.