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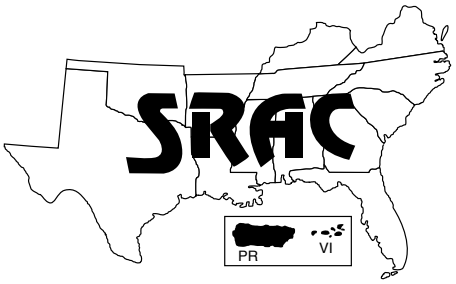

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Aeromonas Bacterial Infections — Motile Aeromonad Septicemia

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Bacterial infections, caused by motile members of the genus *Aeromonas*, are among the most common and troublesome diseases of fish raised in ponds and recirculating systems. The widespread distribution of these bacteria in the aquatic environment and the stress induced by intensive culture practices predisposes fish to infections. Motile aeromonad infections have been recognized for many years and have been referred to by various names, including motile aeromonad septicemia (MAS), motile aeromonad infection (MAI), hemorrhagic septicemia, red pest, and red sore. In this publication, they are referred to simply as **aeromonas** infections. *Aeromonas* bacteria causing these infections are called **aeromonads**.

Whether acting alone or in mixed infections with other organisms, the motile aeromonads are responsible for significant financial losses annually. All species of fish, scaled and unscaled, are susceptible to infection. Under certain conditions mortalities can approach 100 percent.

Aeromonas infections also occur in other vertebrates, including frogs, turtles, alligators and, sometimes, humans.

Cause

Aeromonas hydrophila, *A. sobria*, *A. caviae*, and possibly other aeromonads, are capable of producing disease in fish. While all members of this group are small, motile, gram-negative, rod-shaped bacteria and all share certain biochemical characteristics, their scientific names are constantly under revision and subject to change in the future. Numerous strains of these bacteria exist, and they vary greatly in their ability to cause disease. In general, strains isolated from the environment are less pathogenic than those isolated from diseased fish. The marked genetic diversity among different aeromonad strains has made it difficult to develop effective vaccines. A non-motile aeromonad (*Aeromonas salmonicida*), not discussed here, produces severe losses in salmon, trout, goldfish and koi.

Factors causing disease outbreaks

Motile aeromonads are among the most abundant bacteria found in fresh water aquatic environments. They also occur in brackish waters, but are found less frequently as salinity increases above 15 parts per thousand (about half the strength of seawater). Aeromonads are facultative, which means they are capable of utilizing nutrients present in water and surviving for long periods in the absence of host fish. They occur in the greatest numbers in organically rich waters, such as those found in ponds and other aquaculture systems. These bacteria can also be isolated from the skin and intestinal tracts of healthy fish, from pond mud, aquatic plants and certain protozoan parasites. These factors make the elimination of this group of bacteria from fish rearing systems impossible.

Aeromonads are considered to be opportunistic pathogens, capable of producing disease only in weakened populations of fish or as secondary invaders in fish suffering from other diseases.

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Aeromonas infections in largemouth bass and other scaled fish are sometimes associated with infestation by the protozoan parasite *Epistylis* sp. Environmental stress factors, particularly those associated with poor water quality conditions, enhance the development of disease. These factors include high water temperatures, high ammonia and nitrite levels, pH disturbances, and low dissolved oxygen levels. Heavy parasite burdens, overcrowding, high organic loads in the water, spawning activity, seining activities, rough handling and transport also may lead to outbreaks of disease. Serious episodes of stress, such as oxygen depletion or cases of brown blood disease (caused by nitrite toxicity), often are followed by outbreaks of aeromonas infection within a week.

Aeromonas infections are more common in warmwater and temperate species than in coldwater fish. Infections can occur in any age fish, but losses are usually most severe in fry and small fingerlings. Outbreaks are usually seasonal, with peaks in the spring to early summer and in the fall when water temperatures are between 65 to 85º F. Spring outbreaks may be related to decreased disease resistance in fish that are in poor condition from overwintering or after spawning. Extensive handling and transport of young fish in the fall also may cause outbreaks. Aeromonas infections do not follow strict temperature ranges and have been reported during every month of the year. Although rarely found in the winter, aeromonads have been isolated from lesions associated with winter kill (winter fungus).

Clinical signs or symptoms

Signs of disease associated with aeromonas infection are non-specific and may be easily confused with other diseases. Infections vary greatly in appearance and may be seen in the skin only, as an internal systemic disease (septicemia), or as a combination of both. Outbreaks may be chronic (long-term) and affect only small numbers of fish or may produce acute (intense and short-term) infections accompanied by rapidly increasing, high mortality rates.

In unscaled fish (e.g., catfish), there is often fraying and reddening of fins (Fig. 1), accompanied by irregular, variably sized areas of depigmentation (paleness) that can develop anywhere on the body surface. The skin overlying these sites is eventually lost, exposing the muscle below (Fig. 2). These open sores or ulcers may remain superficial or they can be extensive and invade deeply into muscle, revealing underlying bone in some cases (Fig. 3). These ulcers often have ragged white margins bordered by a narrow zone of hemorrhage. In scaled fish

Figure 1. Channel catfish with severe erosion of the anal and caudal fins caused by Aeromonas sobria. *Skin at the fin bases is swollen and bright red from hemorrhage. (Photo by Al Camus)*

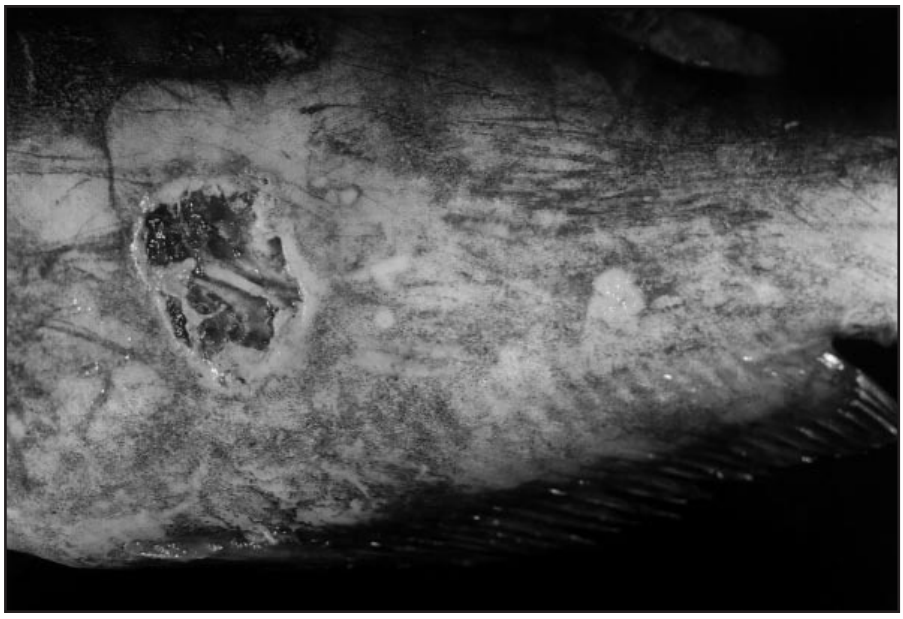

Figure 2. Channel catfish with a shallow skin ulcer caused by Aeromonas sobria. *Margins of the ulcer are white and ragged. Muscle tissue can be seen beneath the ulcerated skin. (Photo by John Hawke)*

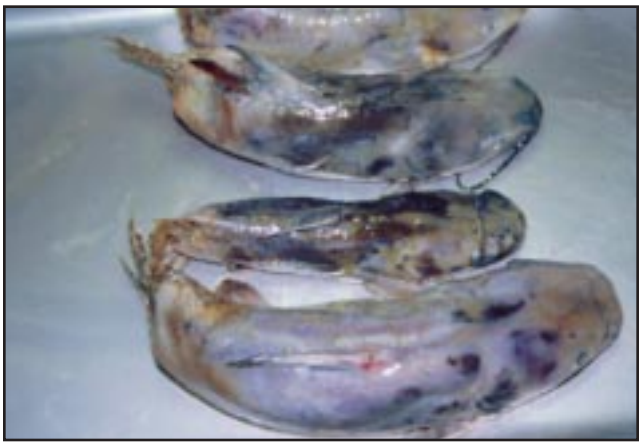

Figure 3. These channel catfish infected with Aeromonas hydrophila*, which caused complete erosion of the caudal peduncle, were captured alive. In this particular case, the disease ran its course in this pond, mortalities stopped, and no treatment of the surviving catfish population was needed. (Photo by Bob Durborow)*

(e.g., largemouth bass), skin lesions begin as small hemorrhages within scale pockets (Fig. 4) that can rapidly expand to larger areas. Affected scales are eventually lost and ulcers form. Aeromonas infection may also include any or all of the following external signs: exophthalmia (popeye), abdominal distention (swelling of the abdomen), and pale gills. Scaled fish often accumulate edema (fluid) in their scale pockets. This condition, called lepidorthosis, creates a roughened or bristled appearance.

Figure 4. Skin hemorrhaging under the scales is especially apparent in the caudal peduncle of this largemouth bass infected with Aeromonas hydrophila*. The pale white liver in the front of the body cavity and the mottled kidney at the top rear of the cavity are clinical signs of internal aeromonas infection. (Photo by Bob Durborow)*

Skin lesions caused by aeromonads often have fungus or columnaris bacteria present. Fish affected only with skin lesions may continue to feed and survive for extended periods, despite the presence of severe ulceration (Fig. 3). Daily mortalities associated with this chronic form of disease may be low, but can rise to high levels over time.

The internal or septicemic form of disease typically follows a more acute course with a sudden onset of relatively high mortalities. Affected fish usually do not eat and commonly will be seen swimming lazily near the water's surface or in shallow areas of a pond. If disturbed, the fish move into deeper water, but typically return to the surface within a short period of time. The internal organs may be enlarged, reddened or pale, or have a mottled pattern of deep red hemorrhage interspersed with pale areas of tissue destruction or necrosis (Fig. 4). Organs with significant tissue necrosis become weak and are easily damaged when handled. The intestinal tract typically will be devoid of food, reddened, and filled with cloudy yellow or bloody fluid and mucus. The abdomen may be filled with clear, cloudy or bloody fluid. The gall bladder will be filled with large amounts of green bile. Highly virulent (deadly) strains may cause sudden mortalities with few external or internal signs of disease. Losses from aeromonas infections seldom exceed 50 percent; however, mortality is strongly influenced by the general health status of the fish population, stress level, and virulence of the particular bacterial strain infecting the fish. Mortalities occasionally approach 100 percent in fry and small fingerlings.

Diagnosis

Because aeromonas infection may mimic other diseases, sick fish should be submitted to a diagnostic laboratory for a complete evaluation that includes bacterial identification and antibiotic sensitivity testing to determine which antibiotic will best treat the infection. Motile aeromonads grow on most common culture media in 24 hours, but complete identification and antibiotic sensitivity testing will usually require an additional 24 to 48 hours.

Several fish, showing signs typical of the diseased population as a whole, should be collected, sealed in plastic bags without adding water, and placed in a cooler surrounded by ice or ice packs (see SRAC publication number 472, *Submitting a Sample for Fish Kill Investigation*). Also, a water sample from the pond or culture system should be submitted in a clean container. Whenever possible, moribund fish (alive but near the point of death) should be collected. Avoid submitting fish that are obviously decomposed or have been floating dead. Well-iced fish collected fresh can usually be used for diagnostic purposes for about 24 to 48 hours. Do not freeze samples; freezing seriously hinders diagnostic evaluation. Consult your local diagnostic laboratory for specific details concerning sample submission.

Prevention and treatment

Whenever aeromonas outbreaks occur, every attempt should be made to identify and eliminate sources of environmental stress. This alone will often correct the disease problem. Avoid handling

fish when they are in a weakened state or when environmental conditions are less than optimal. Fish should never be handled or transported during an aeromonas outbreak.

Chemical treatments with potassium permanganate ($KMnO_4$), at a rate of 2 to 4 parts per million (milligrams/liter), are sometimes useful in the treatment of infections limited to the skin. Potassium permanganate treatments are of greatest value when fish are feeding poorly or not at all, and medicated feed is not an option. Potassium permanganate is presently on deferred status by the Food and Drug Administration; it may be used but is not officially approved.

Systemic infections can only be successfully treated by the use of medicated feeds containing antibiotics. For medicated feeds to be effective, it is essential that an early diagnosis is made and that the fish be fed as soon as possible, before the disease causes them to stop eating. Treatment with medicated feeds will not be effective if a large portion of the fish population has already stopped feeding. Usually there is not enough time to wait for the results of antibiotic sensitivity tests. Sensitivity testing, however, may indicate that a different, more effective medicated feed should be used.

Oxytetracycline (Terramycin®) is approved for control of motile aeromonad infections in catfish. Sulfadimethoxine plus ormetoprim (Romet®) is approved for controlling *Edwardsiella ictaluri* (ESC) infections in catfish.

Terramycin® medicated feed, available as a sinking pellet, is administered at a rate of 25 to 37.5 milligrams of active drug per pound of fish per day for a period of 10 days. Actual feeding rates vary according to the strength of the medicated feed mixture. A 2.5 g/lb (grams of oxytetracycline/pound of feed) formulation is fed at a rate of 1 to 1.5 percent body weight per day, while a 1.25 g/lb formulation is fed at 2 to 3 percent body weight per day. The FDA has established a 21-day withdrawal period following Terramycin® administration before fish or salmonids can be marketed for human consumption.

Romet® medicated feed, available as a floating pellet, is fed at a rate of 23 mg of active drug per pound of fish per day for 5 days, followed by a 3-day withdrawal period before catfish may be sold for human consumption (salmonids have a 42-day withdrawal period). Romet® may be milled into feed at concentrations ranging from 5.6 to 6.6 pounds of drug premix per ton of feed. The amount of medicated feed to be fed daily will vary with the specific formulation, but the dosage of 50 mg/kg/day remains the same. Palatability problems are associated with Romet® feeds, particularly at the higher concentrations, and fish may initially refuse to consume it. This problem may be alleviated to some degree by increasing the amount of fish meal (for more desirable flavor) or by adding the drug to the feed at a lower concentration and increasing the amount that is fed daily. Infected catfish fingerlings are now commonly fed Romet 30® formulated at 11.1 pounds of premix per ton of feed (the tag on the bag will indicate the formulation). This particular formulation is fed to the fish at 3 percent of their body weight each day for 5 days. Romet® is a heat-stable drug, so it can be formulated into a floating pellet. Use of a floating pellet is advantageous because it allows producers to observe feeding responses in diseased fish populations.

Romet B® is the form of Romet® that can be bought by individuals to mix into their own feed. The recommended dosage is 10.1 g of the Romet B® premix per 100 pounds of fish per day for 5 days. The amount of feed to be fed (calculated as a percent of body weight) for various concentrations is listed in the table below.

The Romet B® is first mixed with corn oil or 5 percent gelatin (1 gallon of oil per 200 pounds of feed), then is applied to a floating pelleted feed to give a uniform coating (a cement mixer works well for this). The coated feed should be air-dried and used immediately or rebagged and stored for no more than 6 months in a cool, dry environment. The drug has a long shelf life even after addition to feed but the nutritional value of the feed will become degraded with prolonged storage. No feed should ever be used if it has become moldy.

Before any treatment is initiated an evaluation of feeding activity, value of the fish, daily mortality, and potential future losses should be weighed against the cost of treatment. It should also be noted that the improper use of Terramycin® and Romet® medicated feeds has led to the emergence of aeromonad strains resistant to one or both drugs. These antibiotics should be fed at the full therapeutic dose for the full number of days recommended on the label. At lower-than-recommended doses and feeding rates, the bacteria are better able to adapt to the drugs by mutating and developing resistance to the antibiotic's lethal effects.

Feed intake of fish (% body weight)	Pounds of Romet B® premix per ton of feed
0.5	88.8
1	44.4
2	22.3
3	14.8
4	11.1
5	8.9
6	7.4

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