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Incidence of Disease in Warmwater Fish Farms in the South-Central United States

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ABSTRACT—Case records for the years 1963-68 from the diagnostic laboratory at the Fish Farming Experimental Station, Stuttgart, Ark., were studied to determine seasonal incidences and/or interrelationships between various disease conditions. Seasonal occurrences were recorded for Trichodina, Ichthyophthirius, Scyphidia, Plistophora, Costia, Gyrodactylus, Dactylogyrus, Cleidodiscus, *and* Lernaea. *Summer infections of* Aeromonas hydrophila *showed a relationship to periods of oxygen depletion or low oxygen stresses. Graphs are presented identifying months when disease problems are most likely to occur and methods of avoiding outbreaks are discussed. Relationships between occurrences of particular organisms and water temperature, spawning seasons, and other stress periods are noted.*

The greatest incidence of disease was in April which had almost 50 percent more cases than July, the next highest month. Outbreaks occurred regularly throughout the period from March through July. Seventy-two percent of all cases occurred during these months. Only Lernaea *and myxobacterial infections had their greatest incidence outside this period.*

Warmwater fish culture is, to a major extent, restricted to pond culture. While the incubation of eggs and rearing of larval stages of some species may be done in artificial systems, upwards of 95 percent of all warmwater fish produced in the United States are reared in pond facilities.

INCIDENCE OF DISEASE ON FISH FARMS

The incidence of disease on fish farms has been documented by Meyer (1970) and Rogers et al. (1971). April is the most troublesome month of the year. Nearly one-fifth of all case histories recorded over a 5-year period at the Fish Farming Experimental Station, Stuttgart, Ark., occurred during this period. The number was one-third greater than during July, the next highest month. The season from 1 March through July is a continuous period of potential danger to fish stocks. This period embraces the spawning seasons of golden shiners (*Notemigonis crysoleucas*) and catfish (*Ictalurus punctatus*) and reflects the problems associated with infections in or on very young fish. Shiners spawn in late March, April, and May. Catfish begin spawning in late May and may continue through June into July.

It is relevant that large numbers of fish are handled during March and April, either for marketing, for stocking of broodfish, or for stocking fingerlings in rearing ponds. This handling stress is believed to be a factor in initiating some of the problems during this time of the year.

The low number of disease cases during December results from several factors. The harvest of fish from rearing ponds drastically reduces the number of stocked ponds during November and December. Fish which are not marketed at harvest are usually placed in holding ponds for winter storage, often under heavily crowded conditions. Apparently, parasite burdens do not have ample time to develop to troublesome levels in storage ponds until some time in January. The jump from three cases in December to 64 in January is believed to be a direct reflection of winter storage conditions (Meyer, 1970).

INCIDENCE OF PROTOZOAN INFECTIONS

Protozoans constitute the major etiological agents and were involved in 53 percent of the observed cases. Their primary effect is greatest on very young fish; hence, the peak incidence of protozoan epizootics occurs during and immediately following spawning periods of both shiners and catfish (Fig. 1).

Danger of parasitism is high from March through July. Young fish are vulnerable to diseases of parasitic origin and are involved in the majority of cases. Since the danger period embraces the spawning period of both shiners and catfish, the importance of having parasite-free broodfish cannot be overemphasized. Treatments should be made periodically throughout the year to keep parasite burdens on broodfish to a minimum. The effectiveness of prophylactic treatments is emphasized by a lower incidence of parasitic diseases on fish farms where prophylactic measures and sanitation were practiced.

INCIDENCE OF BACTERIAL INFECTIONS AND OXYGEN DEPLETIONS

Parasitic diseases cause the greatest number of cases but their overall economic effect is much less than that of bacterial disease (Fig. 2). Problems of parasitic etiology are usually less acute (although nonetheless serious) and the owner often has an extended

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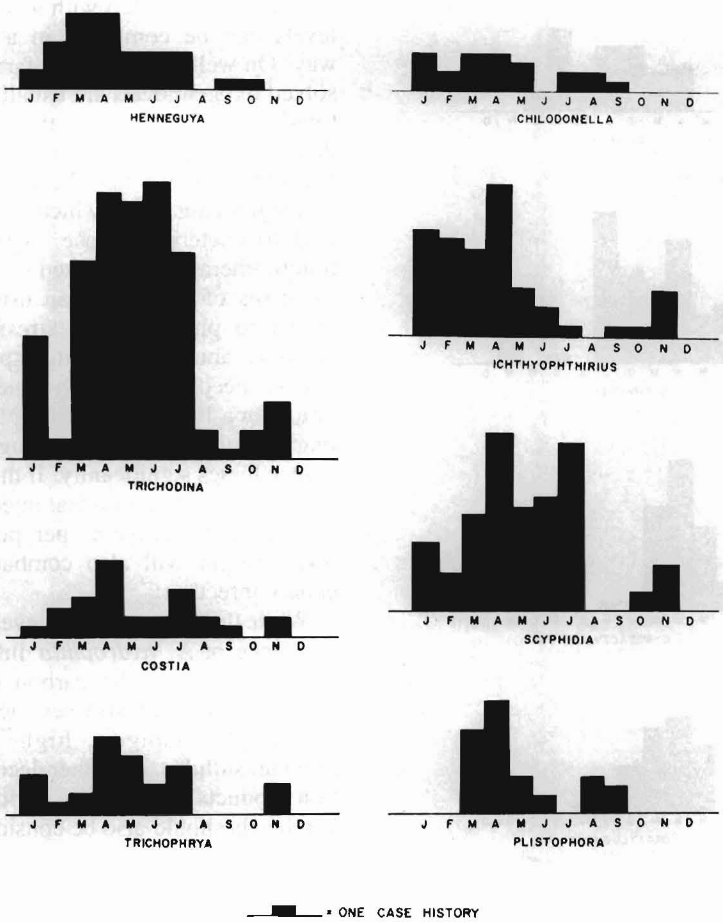

Figure 1.—The monthly incidence of selected protozoan infections reported on warmwater fish farms during a 5-year period.

period during which diagnosis and treatment are possible. This is not true in the case of bacterial disease. The course of most bacterial diseases is rapid and terminal unless early diagnosis and prompt treatment are applied (Robinson et al., 1970).

Next to the danger of oxygen depletion, bacterial disease must be considered as a major threat to the successful production of edible-sized fish.

Pseudomonas infections occur infrequently throughout the year but are not abundant enough to indicate any periodicity.

Aeromonas hydrophila infections are most prevalent during June, July, and August, but a peak has also been noted in April. This two-peak occurrence reflects differences in hosts. Outbreaks in April are usually associated with spawning activity of golden shiners but may also reflect temperature stresses as suggested by Snieszko (1954). Epizootics in June, July, and August involve catfish in rearing ponds and coincide with periods when oxygen levels are lowest. The bacterial infections occur from 10 days to 2 weeks following the period when the fish have been subjected to stresses associated with low levels of dissolved oxygen. While total depletions cause mortalities due to suffocation, oxygen levels of 3 ppm or less will cause severe stress.

The apparent coincidence of parasitic reproduction with fish spawning indicates that fish culturists should examine stocks of fry and small fingerlings for the presence of parasites. Failure to do so can result in major losses.

Parasite problems encountered in young-of-the-year fish can, with few exceptions, be traced to parasitized broodfish. Some farmers, who make no effort to reduce the number of parasites on adult fish prior to spawning, suffer losses of 1-hour-old-catfish fry due to *Trichodina*. Open-pond spawning methods in which adults and their offspring are left in the same pond throughout the growing season also result in more parasite problems than the practice of moving egg-laden mats (in the case of shiners) to rearing ponds or the use of artificial hatching units for catfish.

Trichodina is the most commonly encountered protozoan parasite and is especially serious to young fish. Newly hatched channel catfish fry have been observed to be so heavily infected with this parasite that the fish do not survive beyond 1 hour. Young golden shiners which are heavily infected usually fail to feed. *Trichodina* also causes problems to crowded fish held in winter storage ponds, as evidenced by the number of cases during January.

Farmers who hold fingerlings and broodfish in the same ponds often encounter "Ich" disease. The occurrence of wild fish in rearing ponds is considered to be a primary factor in the introduction of *Ichthyophthirius*. Farmers who are successful in preventing the entry of wild fish have fewer parasite problems.

This low oxygen stress is considered to be a major factor in outbreaks which occur in rearing ponds and gives a further indication of the relationship of disease to water conditions in the ponds. Low oxygen levels in ponds pass unobserved on many fish farms and the role of low oxygen in initiating bacterial infections is often unsuspected. Periods during which low oxygen levels are common correspond to the periods indicated on the graph for oxygen depletions. The number of occurrences of sublethal oxygen depletions, however, is actually much higher.

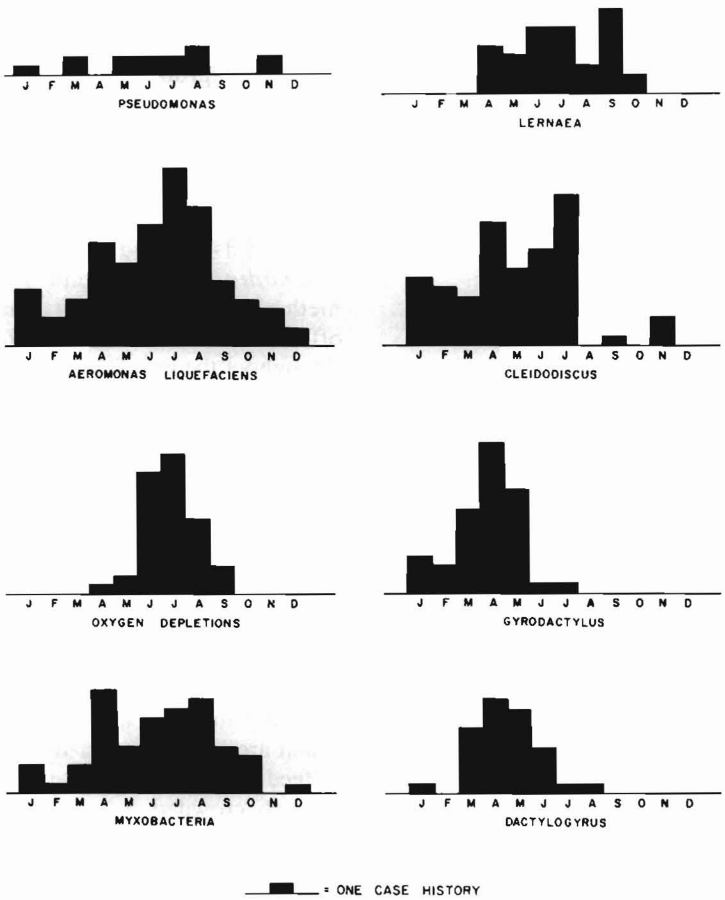

Figure 2.—The monthly incidence of bacterial infections, oxygen depletions, *Lernaea* and monogenetic trematode infestations reported on warmwater fish farms during a 5-year period.

Myxobacterial infections are common on golden shiners during their spawning season and occur on channel catfish fingerlings after handling in April. A second and somewhat broader peak involves both species of fish during June, July, and August, again corresponding closely to periods when pond conditions are poorest and oxygen levels are lowest. Although ice cover is uncommon in the fish farming area, outbreaks of myxobacterial infections occur whenever ice persists for longer than 7 days on storage ponds. Deteriorating pond conditions under the ice are believed to be related to the onset of infections due to myxobacteria.

ANTIBIOTICS USED AS PROPHYLACTICS

Infections associated with stocking or handling can be reduced if handling is delayed until the fish have received a regimen of antibiotic treatment. Although spring stocking may be delayed slightly, the increased survival rate should more than justify the delay. Stresses due to handling may cause a bacterial infection to progress from a chronic to an acute stage. Similarly, fish handled in the summer frequently develop infections similar to bovine shipping fever syndrome. Antibiotic medication for 10 days prior to handling serves as an excellent preventive measure.

Stresses associated with low oxygen levels can be combated in a similar way. On well-managed fish farms, dissolved oxygen levels are usually monitored regularly. Anytime the level has dropped rapidly, the farmer should realize that the fish have been subjected to a significant stress which will likely lead to bacterial disease. Again, antibiotic therapy is indicated.

Losses of broodfish can usually be traced to physiological stresses and physical abuse during the spawning season. Feeding adult fish a medicated ration for a 10-day period prior to handling or to the onset of spawning should reduce losses significantly. If this is not possible, an intraperitoneal injection of 25 mg of Terramycin[1] per pound of body weight will also combat *Aeromonas* infection.

While the role of oxygen levels in the incidence of *A. hydrophila* infections appears obvious, the carbon dioxide role of spawning stresses, temperatures, pH changes, high carbon dioxide, sulfides, and other decomposition products associated with low oxygen levels should also be considered as possible factors.

TREATMENT DELIVERY SYSTEMS

Three basic treatment regimens are currently used in warmwater fish culture.

Bath Treatment

A bath treatment with selected chemicals for the removal of external parasites is the most common treatment regimen. These baths may be: 1) at low treatment rates for extended or indefinite periods; or 2) at high rates for rigidly specified times. Such applications are inefficient and expensive. Technique 1) is usually used for pond applications. A ton of catfish in a 1-acre pond averaging 4 feet deep would constitute only 0.018 percent of the mass

[1]Mention of trade names or commercial products does not imply endorsement by the National Marine Fisheries Service, NOAA.

by weight. This mean that 99.98 percent of the chemical is not utilized. The cost factor is readily apparent. In technique 2), the use pattern is restricted to small tanks or raceways. While chemical costs are usually low, labor and time requirements are significant.

Oral Treatment

Internal diseases of fish can be treated only if a delivery system is available to introduce the drugs internally. This means that either the fish must accept the medication voluntarily (as with their feed) or that the medication must be provided manually (usually by injection). The former technique can be used on those species which accept artificial feed only so long as the fish are not too sick to eat. Success with oral delivery systems is directly related to early, accurate diagnosis of the problem. Cost of oral delivery systems is low and effective. Labor requirements are also low.

Injection Treatment

Treatment by injection is currently practiced in the United States only on broodstock. The high value of each individual animal more than offsets the labor and time requirements of this delivery system. The technique is used widely in Europe as a measure to provide protection to young carp from bacterial disease during handling and stocking. It has proven effective and economically feasible in Europe because of low labor costs. Injection techniques require the handling of each fish. Even with the most modern injection systems available today, time and manpower requirements preclude the use of injection delivery systems on other than broodfish in the United States.

Further Delivery Systems Development Needed

A review of these treatment systems indicates the following unfilled needs.

1) No delivery system exists for treating systemic bacterial infections in pond-spawned fishes that do not accept artificial feeds.

2) No economical delivery system exists for mass injection of large numbers of fish prior to stocking.

3) No efficient treatment system exists for treating fish in ponds for external parasites or bacterial infections.

Considerations should also include delivery of potential vaccines for the immunization of fish. Although vaccines are still in formative stages, it is relevant that delivery systems be developed. Under the existing state of knowledge, it appears that the delivery of antigenic materials faces the same limitations as chemotherapy. New delivery systems and alternate cultural practices are needed if significant gains are to be achieved in improving fish health.

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