2

THE ROLE OF IMPROVED HUSBANDRY PRACTICES

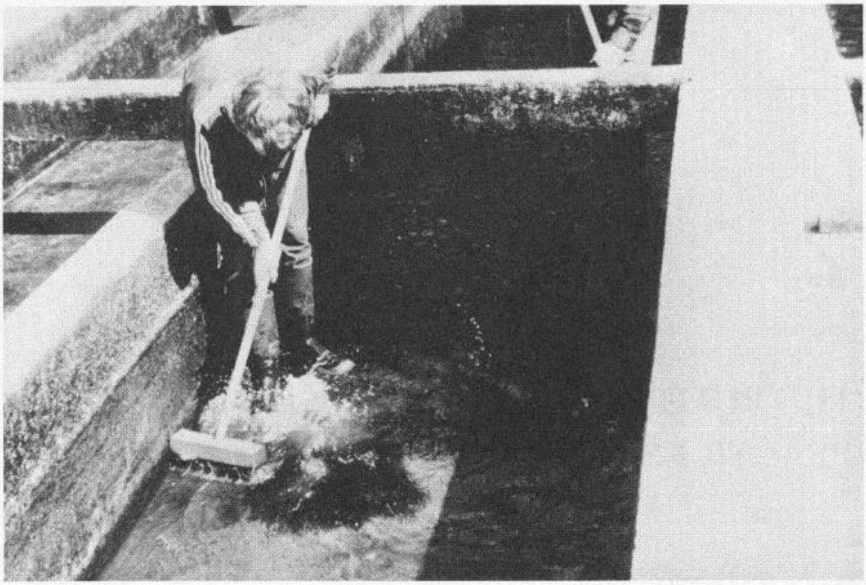
R.H. GRIFFITHS
New York Department of
Environmental Conservation
Albany, NY

and

J.W. WARREN
U.S. Department of the Interior
Fish and Wildlife Service
La Crosse, WI

One of the primary objectives of fish culture is the production of quality fish that are vigorous and healthy. Procedures for rearing salmonids have been described in detail by Davis (1953) and updated by Leitritz and Lewis (1980). Successful fish husbandry is an indication that good environmental conditions have been provided by the rearing facility. Improvements in fish husbandry practices can be used to reduce the effects of adverse environmental conditions, to overcome deficiencies in facility design, and to reduce the frequency and severity of stresses which contribute to the occurrence of disease.

Fish cultural practices must be coordinated with the construction and layout of the facility, the kinds of fish being reared, and the quantity and quality of the available water supply. Problems that lead to the occurrence of disease have been built into some facilities (Needham 1977). Water supplies may be too limited for the number of rearing units, may carry disease agents, or may be supersaturated with nitrogen gas. In recent years, water recirculating and reconditioning systems have been developed to squeeze the maximum fish production out of available water supplies. The frequency of mechanical and environmental breakdowns increases with the complexity of the facility (Buss



Regular cleaning of rearing ponds eliminates accumulated organic wastes, and removes a potential reservoir for fish pathogens (Ontario Min. of Nat. Res.)

1981). Westers and Pratt (1977) compared single-use, straight raceways with recirculating water systems in Burrows ponds and found that the single-use raceways produced more fish of better quality. The apparent reason for this was related to environmental conditions. In single-use raceways, fish spend much of their time at the head end of the raceway near the water source. Poorer water quality at the lower end of the raceway was avoided. In recirculating raceways, a less than optimal environment was present throughout the system from which the fish could find no respite.

Problems associated with fish stocks themselves can have far-reaching effects. Inbreeding can reduce the genetic diversity needed for survival and for resistance to a variety of diseases. In many situations, broodstock lines are maintained because of tradition rather than because of sound genetics. If a broodstock population is infected with viruses or bacteria which can be transmitted from parents to progeny with eggs, the spread of disease can be rapid. Hatchery programs have been responsible for the transfer of a number of diseases through shipments of eggs and fish (Kimura and Awakura 1977; Busch and Lingg 1975). In the case of direct transfers of fish from hatchery to hatchery, the chances of spreading infectious diseases and parasites are greatly increased. Careful planning of production programs is needed and specific information on the disease status of all potential sources of eggs and fish is imperative.

PLANNING FOR DISEASE PREVENTION AND CONTROL TO IMPROVE FISH HUSBANDRY

Fish disease surveillance is as important as adequate rearing facilities, quality fish feed, trained personnel and good fish transport equipment. Accurate and timely information from a fish health laboratory can be valuable when production programs are being planned and sources of eggs and fish are being identified. The avoidance of disease problems by careful planning is far less costly than problems that must be corrected after they occur. Effective fish health inspection and hatchery disease classification schemes can help administrators and fish culturists prevent the spread of serious diseases. Information derived from disease surveillance programs is also useful in directing fish disease research studies, planning the rehabilitation of facilities, and in guiding the improvement of fish cultural practices.

Planning during the development of new fish cultural facilities provides an opportunity to accommodate improved husbandry practices and fish health protection. An adequate supply of clean, fresh water which is free of resident fish is one of the most important assets a facility can have. The species, sizes, and numbers of fish to be reared must be geared to the available water supply. These factors will determine the number and design of rearing units. Requirements for rearing unit sanitation between uses must be considered in the selection of construction materials and in the isolation of one unit from another. A fish barrier at the lower end of the facility should be included in the site plan to prevent contact between cultured fish and wild fish downstream from the hatchery. These features help to provide a good cultural environment and should be addressed during the design and construction of new production facilities and also during the rehabilitation of older hatcheries. Improvements can be made in existing programs, but it is often costly and difficult to accomplish without disrupting on-going production operations.

DISEASE CONTROL AND HATCHERY MANAGEMENT

The Ontario program for 'Fish Health Protection in the Provincial Fish Culture System' (A. J. Sippel, Ontario Min. Nat. Res., Toronto, personal communication) contains a brief section dealing with disease control and hatchery management. Most elements of fish husbandry are directly related to fish health protection. Consequently, wherever healthy fish are successfully reared, sound husbandry practices must be already in use. Diligence, persistence, and a firm commitment to the protection of fish health and to the production of quality fish lie at the heart of successful fish cultural programs. Required procedures include:

1. Minimizing stresses on cultured fish
2. Prevention of the introduction of serious (designated) diseases
3. Confinement of disease outbreaks to affected rearing units
4. Miizing losses from disease outbreaks
5. Learning from past disease outbreaks to minimize future disease losses

Many other factors and numerous inter-relationships also affect the outcome of the interactions among fish and their pathogens. Successful fish health protection is the result of the successful management of these factors.

MINIMIZING STRESS

According to Wedemeyer et al. (1976), the prevention of fish diseases through proper environmental management requires an understanding of how environmental factors and stresses affect the physiology of culture fish. Environ-

Taking routine inventory of size and weight of fish in ponds is an important husbandry practice (Ontario Min. of Nat. Resources)

mental conditions and their improvement through better fish cultural techniques can have a significant bearing on the outcome of host/pathogen/ environment interactions. Wedemeyer et al. listed five important methods for improving husbandry practices:

1. Maintain water quality characteristics within the requirements of the species being reared.
2. Keep population densities regulated at levels low enough to prevent crowding stress and thus minimizing disease problems.
3. Learn to recognize environmental stress factors. Minimize or eliminate handling and other sources of stress and use prophylactic medication to prevent the activation of latent infections.
4. When stress is unavoidable, allow sufficient recovery time, based on the physiological disturbances involved, before again handling or stressing fish.
5. Use salt solutions (0.3% for salmonids) to mitigate stresses associated with handling and transportation.

Techniques that minimize environmental stress can be applied at all installations, old or new. Aeration devices used to remove excess gasses from inflowing water are a leading example. ‘Packed columns’ (Owsley 1981) are simple aerators made from 1.52 m lengths of plastic pipe, packed with appropriately-sized Koch rings, through which the inflowing water tumbles and splashes to establish atmospheric equilibrium. Packed columns effectively reduce supersaturated nitrogen gas levels associated with disease problems, impaired growth, and other conditions which are often difficult to diagnose.

Grading fish leads to more equitable size distribution in ponds (Ontario Min. of Nat. Res.)

DISEASE PREVENTION

Specific methods of fish disease prevention are reviewed in detail in other chapters of this Guide. The minimization of stress is related to the environmental aspects of the host/pathogen/environment relationship so disease prevention focuses on improving the disease resistance of the host and on the reduction or elimination of virulent pathogens.

Disease cannot occur unless a pathogen is introduced into the fish cultural system. Eggs or fish from uninfected sources have the best chance to remain free of infectious diseases if they are reared in clean water and in clean facilities. It is not a good practice to expose uninfected fish to diseases to 'toughen' them for possible future encounters with infectious agents after their release from the hatchery. Ensuing outbreaks can be severe in dense hatchery populations which are more conducive to the spread of infectious disease than conditions encountered in the natural waters where fish can seek preferred environmental conditions. If a specific survival problem has been identified, the best approach is to use immunization techniques to help fish ward off future infections. Species selection, nutrition, genetic diversity, sanitation, and the judicious use of prophylactic chemicals can all be used to help prevent diseases and to enhance the post-stocking survival of hatchery fish.

At large hatcheries, an extensive crew may be required to handle fish during the administration of a vaccine or antibiotic. This crew is injecting adult lake trout (U.S. Fish and Wildl. Serv.)

DISEASE DETECTION AND CONTROL

Major improvements in the health and survival of cultured fish can be made by careful disease surveillance. Some fish culturists are hesitant to ask for professional assistance with their fish disease problems. Some producers fear the unknown, some fear adverse publicity, while others merely consider losing a certain percentage of their stock to disease as a routine part of the cost of doing business. Severe and costly problems can be avoided by early detection, accurate diagnosis and prompt corrective action.

A systematic program of health checkups can effectively prevent serious disease outbreaks and can prevent the inadvertent transfer of diseases to other rearing units or to other fish hatcheries. An effective disease surveillance program coupled with regular professional diagnostic and inspection services can do much to identify disease problems. Appropriate control measures can then be developed that will cause the least possible disruption of fish cultural operations.

LEARNING FROM PAST EXPERIENCES

A hatchery superintendent nearing retirement age commented that he did not have thirty years of experience but that he had, instead, 'one year's experience, thirty times over'. Many hatchery operations seem to be managed in a similar way. Serious deficiencies that may have been built into a facility may cause recurring disease problems. Inappropriate management decisions on the kinds and numbers of fish that must be reared at a facility can also contribute to the difficulties encountered. The fish culturist may be little more than a bystander in such situations. Many fish cultural inventions and many research studies have developed as after-the-fact remedies for ailments that can be attributed to the facility itself or to the program being carried out. Basic corrective action is required. In some situations, good progress is possible. In others, the program is pressed forward in spite of the difficulties. The purpose of fish disease control policies and improved husbandry practices is to help hatchery personnel cease doing the things that have created problems in the past, and to apply the knowledge gained from these experiences to facilitate the production of quality fish at minimal cost in the future. This may be difficult medicine to swallow because the required changes may necessitate the alteration of traditional programs or reductions in the numbers of fish produced.

CONCLUSION

Improved husbandry practices begin with basic fish cultural decisions. From the moment that a decision is made to hatch and rear fish, a succession of decisions is initiated that ultimately leads to the design and construction of facilities and to the acquisition of fish stocks. Fish culturists and fish pathologists are then called upon to meet production objectives and to prevent fish health problems that may have been irrevocably built into the program just as solidly as the concrete used to build the facility. Technological advances in disease detection, prevention, and control occasionally make it possible to successfully culture fish that are free of most serious diseases. Certain diseases, especially those that are vertically transmitted from parent to progeny through contaminated eggs, become established in fish populations and defy control, thereby vividly demonstrating the necessity for aggressive containment and prompt eradication efforts.

A multifaceted, integrated fish disease control program directed toward all stages of the disease process and sources of infection may be required. Bacterial kidny disease (BKD) in cultured coho salmon is a good example of a complex, deeply entrenched infectious disease problem in the Great Lakes basin and on the west coast of North America. In retrospect, it is interesting to speculate about the savings of fish, money, time, and effort that could have been realized if early outbreaks of BKD, whirling disease, and infectious pancreatic necrosis had been relentlessly pursued with quarantine, eradication procedures, and facility rehabilitation procedures, rather than accommodated by the rearing of additional numbers of fish to make up for disease losses. Perhaps little would have been gained. On the other hand, the fact that there exists a perceived need for this Guide is, in itself, testimony that improved husbandry practices are needed, and that certain infectious diseases threaten to cause intolerable economic losses in both the public and private sectors.

REFERENCES

Busch, R.A., and A. J. Lingg. 1975. Establishment of an asymptomatic carrier state infection of enteric redmouth disease in rainbow trout *(Salmo gairdneri).* J. Fish. Res. Board Can. 32: 2429-2432.

Buss, K.W. 1981. An approach to functional, economical, and practical fish culture through better bio-engineering, p. 227-234. In Bio-Eng. Sympos. Fish Cult., Am. Fish Soc., Fish Cult. Sec., Publ. 1, Bethesda, MD.

Davis, H.S. 1953. Culture and diseases of game fish. Univ. of Calif. Press., Berkeley, CA. 332 p.

Kimura, T., and T. Awakura. 1977. Current status of diseases of cultured salmonids in Hokkaido, Japan, p. 124-160. In Proc. Int. Symp. Dis. Cult. Salm., Tavolek, Inc., Seattle, WA.

Leitritz, E., and R. C. Lewis. 1980. Trout and salmon culture (Hatchery methods). Publ. No. 4100, Div. Agri. Sci., U. of Cal., Berkeley. 197 p.

Needham, E.A. 1977. The salmonid pathologist in 1977, p. 8-15. In Proc. Int. Symp. Dis. Cult. Salm., Tavolek, Inc., Seattle, WA.

Owsley, D.E. 1981. Nitrogen gas removal using packed columns. p. 71-82 In Bio-Eng. Symp. Fish Cult., Am. Fish. Soc., Fish Cult. Sec., Publ. 1. Bethesda, MD.

Wedmeyer, G.A., F.P. Meyer, and L. Smith. 1976. Book 5: Environmental stress and fish diseases. TFH Publications Inc., Neptune City, NJ. 192 p.

Westers, H., and K. M. Pratt. 1977. Rational design of hatcheries for intensive salmonid culture based on metabolic characteristics. Prog. Fish-Cult. 39: 157-165.