NEW ZEALAND MARINE DEPARTMENT

FISHERIES TECHNICAL REPORT
No. 86

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INTRODUCTION

This report is not intended to cover all aspects of hatchery hygiene but just those aspects more closely related to disease and disease transmission.

The author recently conducted a survey of New Zealand trout hatcheries for any sign of whirling disease caused by Myxosoma cerebralis under a grant-in-aid from the Marine Department. In the process of arranging the types of samples required I visited all the active hatcheries in New Zealand. Generally the standard of hygiene was good but there is always room for improvement in the best of hatcheries. The aim of this report is to help hatchery managers and organisations concerned with hatcheries reduce the chance of severe infections reducing productivity.

THE NATURE OF INFECTIOUS DISEASE AND ITS TRANSMISSION IN FISH

All wild populations of animals have parasites and micro-organisms present. These form an important means of population control. Some stocks may have 60% or more of their mortality as a result of various diseases according to recent, unpublished, data by Canadian workers. In many cases, however, particularly where animals are introduced into new habitats without the majority of their parasites being introduced with them, mortalities will be low except under stress conditions. Parasites which normally cause little damage may become killers under conditions of high temperature or salinity, lack of food, lack of available oxygen or when fish are under crowded conditions (White, 1940, Hewitt, 1971). The most difficult task for a young parasite is finding a host, and then infecting it. For this reason most parasites produce many thousands of offspring of which the majority are normally lost for lack of a home. Only a few survive to carry on the next generation. But if fish are crowded together (as they must be in a hatchery) or are in a weakened condition both finding and penetration by parasites may

be easier and their numbers are then likely to build up to a level where mortality of the host far exceeds usual levels.

PARASITES IN NEW ZEALAND TROUT AND SALMON

Very few studies have been conducted on the parasites and diseases of New Zealand freshwater fish. Of the fifteen species so far recorded (Hewitt and Hine, in press) many are larval forms with a wide range of local hosts. Although more research is required, it seems as though many typical salmonid parasites known overseas are not present in New Zealand. I know of no work published on the microbiology of New Zealand salmonids, but it is likely that at least some overseas disease organisms are absent. In general, overseas salmonids seem to be more heavily infested with parasites and pathogenic viruses and bacteria. However, this is not to say that serious disease organisms are not present in New Zealand. The recent finding of whirling disease caused by Myxosoma cerebralis in a South Island hatchery (now closed down) and occasional heavy losses in other hatcheries show only too clearly that no one rearing fish in a confined space can afford to be complacent about disease risks. Most hatchery managers are acutely aware of this fact and this is reflected in a marked increase in cleanliness in a number of hatcheries over recent years.

THE MOST LIKELY AVENUES OF INFECTION FOR HATCHERY STOCKS

Once an infection is established it is usually impossible to find out for sure how it entered the hatchery. However, with a knowledge of the life cycles of at least some of the parasites likely to be involved and of the extremely hardy nature of spores, larvae and other stages even under extreme conditions some reasonable guesses can be made.

The most likely source of initial infection in probable order of risk are:

1. The introduction of diseased fish.
2. Contamination by diseased wild fishes (not necessarily trout or salmon) in the water supply. The disease may not be sufficiently advanced in wild stocks for symptoms to be obvious and it is wise practice to assume that any wild fish is infectious.
3. Contamination of water supplies or ponds by birds (droppings, bodies, etc.) or by water snails.
4. Contamination by diseases carried on or in ova obtained from diseased hatcheries or from wild stocks.
5. Contamination from equipment used to handle or carry fish or ova.
6. Disease organisms carried into the hatchery on vehicles or footwear which have been in contact with wild fish or with hatcheries with disease problems.

MEASURES WHICH MAY BE TAKEN TO DECREASE THE RISK OF INITIAL INFECTION

1. Fish should not normally be introduced into hatchery premises. All stock should normally be brought in as ova, either from a reputable and experienced hatchery or from wild stock which have been stripped away from the hatchery. Where brood stock have to be obtained from another hatchery as adult fish (in a case of emergency) they should be certified as disease-free by a qualified parasitologist. The ova should be thoroughly clean, at least by thorough washing and preferably by the use of a suitable disinfectant such as Povidone-Iodine.

2. Hatchery stocks should be supplied with clean spring or sub-surface water directly from the source or brought to the hatchery through pipes. Open waterways should be avoided. If open waterways are used they must be kept clear of fish and snails and should not have overhanging trees that might encourage birds. River water should not normally be used. Little is known of the availability of spring and artesian water in this country. The quality of river and spring water is so good for most purposes that little water

prospecting has been done. However good underground sources are already known in many areas. New Zealand has a water run-off of about four times the world average (Volker, 1971) and so it can be expected that there should be no shortage. Any new water source must be tested before use to ensure that it is chemically suitable.

3. Where older fish are kept outside in open ponds or raceways these should be protected as far as possible from fouling by birds. Trees should not be grown in the immediate vicinity of the ponds. Ponds should be surrounded by a reasonable area of concrete or gravel rather than grass. In some cases it may be necessary to use scarecrows, dogs or some other means to discourage birds from approaching ponds. Roofing over ponds may be economic in areas where bird-borne disease developed into a serious problem.

4. Used equipment should not be brought in from other hatcheries. Where ova are sent from one hatchery to another they should be forwarded in new, non-returnable containers.

5. Water run-off into ponds should be prevented. A lip, a few inches high, around the edge of the pond will generally be sufficient. The lip should be right at the edge of the pond to prevent staff or members of the public stepping over it and carrying contaminants to the pond itself.

6. Vehicles used for the transportation of fish between hatcheries or districts should be thoroughly washed down with 4% free-chlorine solution (see section on disinfection below).

THE COURSE OF INFECTIONS IN HATCHERIES

Even with the careful use of all possible precautions some diseases will still find their way into hatcheries. Fungus and some other diseases can be carried by wind blown spores, for example, and there is no sensible protection from these. It is very seldom that a disease will cause high mortality as soon as it is introduced. Often there is a slow build-up of infection over two or more years. For example, Uspenskaya (1957, p. 52-53) reports a gradual build-up of Myxosoma cerebralis infection over a period of four years in the

"Ropsha" hatchery in Gostilits. Often, as in this case, there is a slow increase of mortality over several years and then sudden mass mortality when some critical level of infection is reached or some change in environmental stress takes place.

PREVENTING DISEASE BUILD-UP IN HATCHERIES

With the effect of stress on the course of disease in mind and an understanding of the usual process of gradual build-up, there are a number of steps that can be taken to prevent the spread of disease within a hatchery even after it has been introduced. The major steps are:

1. To reduce stress.
   - (a) The use of strong healthy fish as parents, fish that are well adapted for survival in the wild.
   - (b) Careful feeding programmes, with particular emphasis on vitamin requirements. A most important aspect and the most neglected in New Zealand.
   - (c) Provision of clean, well-oxygenated water with a pH as close to 7 as possible. The range of 6.3 to 8.5 is generally suitable.
   - (d) Prevention of over-crowding in troughs, ponds and raceways. A proper balance between the number of fish, water temperature, water flow and oxygen content of the water is essential.
2. To kill larval stages and spores and to restrict spread.
   - (a) Water should be supplied individually to each fish container. Even the common practice of using tiered troughs in pairs should be avoided where possible. The less contact fish have with the wastes of other fish the better.

(b) Absolute cleanliness is essential in ponds and troughs but the amount of cleaning necessary will depend to some extent on the rate of water flow, the type of feed and the amount of sunlight. Older style containers and troughs should be cleaned twice a week and almost as often for many ponds and raceways. Any accumulation of food wastes and faeces must be avoided. Algal growth tends to collect on this material and any tendency to algal growth indicates a need for more frequent cleaning. Old wooden troughs are hard to clean properly and should either be surfaced with fibre-glass or some other suitable material or replaced by plastic, stainless steel or concrete containers. Properly designed containers can be largely self-cleaning. Earth bottomed ponds are impossible to keep clean and should not be used. Gravel-bottom ponds are hard to keep clean without expensive equipment. They are necessary for artificial spawning grounds but generally have no place in a hatchery.

(c) Ponds not in use should be cleaned thoroughly and disinfected (see below). Where necessary they should be repainted or resurfaced annually.

METHODS OF DISINFECTION

The problem with most methods of killing parasites is that they will also kill fish. For this reason the cure of fish disease (as with human disease) is a complex task which should be undertaken with the aid of expert assistance. The methods discussed here are not useful for curing disease but are aimed at preventing disease by disinfecting objects that are brought into contact with fish and also by the thorough cleansing of ponds and troughs when these are free of fish for some period of time.

The actual method used will depend on the conditions at the particular hatchery. Clearly hatcheries cannot afford to cleanse themselves at the cost of adding to pollution and perhaps poisoning fish in streams into which their waste water flows.

Disinfection methods must, of course, be reasonably inexpensive, use readily available chemicals or equipment, and be effective against a wide range of organisms. Even boiling is not effective against all pathogens.

For cleaning gear a method must be used which will not run the risk of poisoning fish stocks. Methods include keeping a bucket of concentrated sodium chloride (salt) or potassium permanganate solution available. Gear which is used in a pond can then safely be dipped into this after use. This cleansing should be routine. It is, of course, particularly important when gear that has been used in one pool is to be used later in another. Gumboots or other footwear worn by hatchery staff must be frequently disinfected.

For cleaning pools when they are not in use a number of methods are available, none entirely satisfactory. Two of the better ones are:

1. Steam cleaning. There are a number of commercial steam cleaning firms throughout New Zealand. Provided a firm can be found that is reliable and not too expensive it might well pay to have ponds steam cleaned annually. However, great care must be taken. Normal steam cleaning operations use superheated steam at about 104°C. This is not hot enough to act as a really satisfactory disinfectant. For disinfection a heat of 115 - 130°C is much more satisfactory. Steam cleaning equipment can be set in this way but is more expensive to run at these temperatures particularly where you want the job done slowly enough to allow the part being cleaned to reach this temperature also. It is for this reason that you must be sure that the operator is reliable and will not readjust his equipment to a more economic (for him) setting as soon as you turn your back.

2. Chlorination. Chlorine is a very toxic substance and is therefore very useful in killing unwanted organisms in ponds, etc. It has one very severe drawback. For use as a disinfectant a concentration of about 2% free chlorine is necessary. Unfortunately rainbow trout are killed by about 0.08 parts per million of chlorine and brown trout by about 0.01 parts per million (Pike, 1971). This does not rule out its use however, provided the proper precautions are taken. Many methods of application are possible but the following should ensure the safety of fish stocks:

(a) At a time when a pool is not required for use drain it and clean the walls of any algae, etc.

(b) Using lithium hypochloride or calcium hypochloride (available from Shell Oil) or HTH ("swimming pool" packs are easily available) mix up a solution with a free chlorine content of 2% - 3%.

(c) Scrub the walls and floor of the pond, trough, etc., with this solution, making up a fresh solution at frequent intervals.

(d) The solution should all be retained within the pool during the washing process and left for two or three days after which the pool should be filled to near its usual level and tested for the presence of chlorine. (A kit is available from Paterson Candy Ltd, P.O. Box 9065, Auckland, which is designed for use by swimming pool owners and is very easy to use. However, note that the reagent used is bleached by levels of chlorine over 5 parts per million and will not give a reading over this level, and also that the reagents used deteriorate with time and should not be stored for too long before use.)

(e) If chlorine is still detectable allow the water to stand for a further period to allow the ultra-violet light in sunlight to liberate the chlorine.

(f) In cases of emergency, where the pond or trough is required soon after cleaning or difficulty is found in removing traces of chlorine from equipment held inside away from the action of sunlight then the chlorine can be immediately neutralised by adding sodium thiosulphate (available from photographers' suppliers). It should be added slowly until a negative result is obtained from the test-kit.

Note: Chlorine is also poisonous to man. Under normal conditions the process suggested should be completely safe. However, if the work is being done under hot, windless conditions, people should not work inside the ponds for too long at a time and someone not involved in the cleaning process should keep a watch on them for any signs of distress. Protective clothing should always be worn and respirators are sometimes necessary.

KEEPING RECORDS

Should serious disease strike, it is essential that as much information as possible should be available to people called in to eradicate it. Part of the information that will be required will be:

1. Periodic scientific reports on water quality. If beyond the society's capabilities D.S.I.R. will normally either conduct tests or advise on where to get them done.

2. Daily records of temperature and frequent pH readings.

3. Daily records of mortality and of anything unusual about the appearance of dead fish. The Marine Department should be notified of any unusual circumstances.

4. Details of feeding patterns and the material used for feed.

5. Careful records of entry into the hatchery of stock, of the areas in which liberations are made, and any transfer of stock to other hatcheries. No transfer of fish between districts should be made without contacting the Marine Department.

6. Records of any unusual events such as sudden changes in water flow, unusual agricultural activity (spraying, etc.) in the area.

7. Details of any modifications made to the layout of the hatchery including plans of the layout.

Such records should be carefully stored and kept as long as storage space allows. In some cases parasitologists may be interested in events which occurred in the hatchery many years before.

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LITERATURE CITED AND REFERENCES

Apart from a few very specific citations, I have tried to avoid cluttering up this account with references in order to make it easier for people with little technical training to read. The information contained comes from a variety of sources, including conversations with hatchery managers, parasitologists, university students and others interested in hatchery hygiene in New Zealand, Canada and the United States. Some of the information has come from texts and research and review papers and the more important of these are included with the literature cited in the list below.

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