Tetracycline marking of coregonids at the time of egg fertilization

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ABSTRACT

Tetracycline marking of otoliths can be achieved by osmotic importation at fertilization when hardening is conducted in tetracycline solutions. Marks produced are recognizable even in fish of catchable size without a very extensive otolith preparation. The method can contribute to estimations of stocking efficiency and to discern recruits of natural and artificial reproduction.

Introduction

Since 1852, when the first hatchery was built in Switzerland for the incubation of Arctic char eggs (Wanger, 1896) stock-enhancement by stocking has become a management tool of increasing importance: nowadays 157 hatcheries (one per 260 km²!) produce 700 million fry and 25 million fingerlings and yearlings (BUWAL). Most of the fry stocked are coregonids (95 %) incubated in 44 hatcheries.

For several decades, stocking was justified by the heavy human impact altering the conditions for natural reproduction. In recent years it has, however, been possible to halt or even to reverse the eutrophication process in several lakes. Nevertheless, the well-established measures for enhancing the stocks have not yet been abandoned. Considering that about 50 % of the coregonids caught in the spawning fishery are not ripe, and assuming favourable conditions for natural reproduction, it has to be concluded that continued stocking could lead to a contraproductive reduction of the reproductive potential and weaken the stocks.

Although the validation of stocking efficiency has hardly ever been tried (Müller, 1990), abandoning the stocking programs is obviously feasible only if the efficiency of natural reproduction is evident.

Model estimations (Todd, 1986; Pedroli, 1986; Hartmann, 1986, 1987; Eckmann et al., 1988) as well as in-situ tests for successful natural reproduction (Müller, in press) have so far not been able to eliminate former doubts (Hartmann, 1989;
Eckmann and Gaedke, 1989). Cessation of stocking to demonstrate the efficiency of natural reproduction is considered to be too risky and has consequently not been taken into consideration. Marking experiments with external tags can only be made with large fish, and internal tags, e.g. coded wire, are applicable only to coregonids of at least 50 mm (Meng et al., 1986). Due to the lack of information on natural mortality occurring between the fry stage and the age of externally or internally tagged fish (fingerlings or bigger), estimations of the stocking value of these larger fish cannot be transposed to the fry usually stocked. For these reasons, a marking method for eggs and fry applying biotags or chemicals (Ruhlé and Grieder 1989) must be used.

The antibiotic tetracycline, when introduced into the body of fish or other vertebrates, is known to produce marks on bony structures, e.g. otoliths or scales, recognizable when observed under fluorescent light. In other experiments (Weber and Ridgway, 1962, 1967; Meunier, 1972, 1974; Meunier and Boivin, 1972, 1978; Nagiec and Nagiec, 1988) the marking substance was introduced by injection or with food. The injection method, however, cannot be applied to small fish, and the ingestion method is problematic since food intake may be irregular or living food-items difficult to infuse with tetracycline. The exposition of larvae and fry to tetracycline solutions (Dabrowski and Tsukamoto, 1986) leads to low and irregular marking frequencies and requires a lot of tetracycline when mass-markings are made.

Since 1979 we have consequently attempted to design a different concept for tetracycline incorporation and marking (Ruhlé and Grieder, 1989): we assume that the water needed for hardening of artificially fertilized salmonid eggs is a transportation medium for the tetracycline that is supposed to maintain its marking ability during storage in the yolk liquid and act as marking substance when calcification begins. Scientists informed about our experiments predicted this concept to be unavailing. Initial experiments conducted with coregonids were therefore suspended for several years. However, experiments with brown trout (Salmo trutta) and rainbow trout (Oncorhynchus mykiss) eggs indicate that the method functions in principle (Ruhlé and Grieder, 1989). The present paper discusses its applicability to coregonids.

Materials and Methods

In three experiments conducted between 1979 and 1990 (Table 1) eggs and milt (obtained from Lake Constance Blaufelchen Coregonus lavaretus, wiped dry before stripping) were well mixed and immediately poured in tetracycline (tetracycline-hydro-chloride C_{22}H_{24}N_{2}O_{8}HCL purum Fluka 98 %) solutions of different concentration where hardening took place. In another experiment, Blaufelchen fry were exposed to a tetracycline solution.

In experiment 1, conducted in 1979/80 as a feasibility study, tetracycline solutions of a very large concentration range were applied (Table 1). The concentration of the solutions applied in later experiments (2 and 4) already considered the results of this first experiment.