THE COLONISATION BY GREAT CRESTED NEWTS *(TRITURUS CRISTATUS)* OF A WATER BODY FOLLOWING TREATMENT WITH A PISCICIDE TO REMOVE A LARGE POPULATION OF STICKLEBACKS *(GASTEROSTEUS ACULEATUS)*

ALISTAIR G MCLEE and ROB W SCAIFE

Cleveland Wildlife Trust, Bellamy House, Brighouse Business Village Riverside Park, Middlesbrough, TS2 1RT. Cleveland County, England.

INTRODUCTION

Predation of new larvae occurs at all stages of their obligate aquatic phase. Invertebrate predators include the adults and larvae of diving beetles (Dytiscidea) and the nymphs of dragonflies (Ansioptera), whilst a wide range of vertebrates will also take newt larvae. Such predators range from fish, adult newts themselves to aquatic birds (Frazer 1983). The impact of such predation will depend upon various factors eg the numbers of predators, the availability of alternative prey, density of submerged plants for cover, time of the year, etc.

The effects of a large population of fish upon the reproductive success of newts has been reported together with the observation that larvae of Smooth Newts *(Triturus vulgaris)* are less susceptable to fish predation than the larvae of Great Crested Newts. It has been suggested that the tendency of the larvae of Great Crested Newts to swim in more open water renders them more vulnerable to fish predation. It has been often observed that the introduction of fish species, for example Three Spined Stickleback, to waters in which Great Crested Newts breed, will eventually eliminate this amphibian, by the prevention of sufficient recruitment to the adult population (Cooke & Frazer, 1976; Beebee, 1980; Banks & Laverick, 1986; Bell, 1970).

Great Crested Newts are as a result, found in waters which naturally have no fish present, or where fish are unable to predate effectively due to vegetation, or those ponds where persistant fish populations are eradicated by the periodic drying up of the water body.

This paper describes an experiment in which a water body was treated with a piscicide to kill a large population of sticklebacks. The colonisation by Great Crested Newts was observed the same season.

LOCATION

The experimental site was a concrete tank with sloping walls of external dimensions 8m by 13m, having an average water depth of 0.90m. The only source of water was from precipitation. The tank was one of five sunk to ground level in a wooded nature reserve belonging to British Chrome and Chemicals Ltd, of Harcross Chemicals, Urlay Nook, near Yarm in County Cleveland, England. During the Second World War the area was an airfield and the tanks were distributed across the site to serve as emergency sources of water in the event of fire. Today the site is some 12 hectares, of which 30% is covered with conifers, the remainder being scrub woodland and rough grass area. Great Crested and Smooth Newts together with Common Frogs *(Rana temporaria)* and Toads *(Bufo bufo)* breed on the site in the other water bodies. The experimental pond had a large population of sticklebacks present and only Common Toads use it as a breeding site. No aquatic plants were noted in the pond, which historically remained an opaque grey/green colour throughout the entire year.

The population of fish was estimated by the technique of Mark/Recapture (Lincoln Index). Sixty two fish were hand netted and marked by the removal of a dorsal spine. Only 2 marked individuals out of 82 were recaptured some 30 minutes later. Although the data were statistically invalid, it was estimated that a population of the order of 2000 to 3000 was present.

Formula $N = \frac{S_1 \times S_2}{R}$

where
- N = total number of population
- S_1 = first capture number
- S_2 = second capture number
- R = number of recaptures

NB 7-10% of S_1 need to be recaptured for reasonable accuracy

METHODOLOGY

The piscicide employed was a commercial formulation containing rotenone at a concentration of 5% w/v. Rotenone is a naturally occurring, organic compound found in the tissues of certain plants (Pharmaceutical Press, 1979; Reynolds, 1982). Under the name of "Derris" it has use as a horticultural insecticide, being sold at a concentration of 0.25% w/v. As a piscicide it has use in commercial fish farms to remove fish species prior to restocking; and in natural waters to remove coarse fish or trout, before restocking with juvenile game fish (Walker, 1975; Schnick, 1974).

Being a naturally synthesised molecule, it is biodegradable as well as being rendered inactive by alkaline pH, light, oxygen or adsorption onto particulates in water (Pharmaceutical Press, 1979; Reynolds, 1982; Tifa Square, 1991). Its attractiveness as a biocide is its rapid disappearance from the environment. Rotenone acts as a contact piscicide and when dispersed in water it is particularly, but not specifically, toxic to fish. The reason for the particular sensitivity of fish is possibly because they are active respirers with proportionally large semi-permable membranes across which water flows, ie gills. Clearly no piscicide is solely selective for fish even at low concentrations and some invertebrates would be affected. However this impact on the population is regarded as slight (Morrison, 1977). Against this effect one must consider the impact of the fish population itself upon invertebrate numbers and species diversity.

After consulting the commercial (Tifa Square, 1991) and scientific literature (Meadows, 1973; Burress, 1982; Chandler & Marking, 1982) it was decided to dose the compound so as to give a final concentration of 0.2 mg/l in the pond itself. This was done by measuring the water volume of the pond (66m) and adding an appropriate volume of Chem-fish Regular 5% Rotenone (the commercial formulation marketed by Tifa Square). In order to ensure uniform application of the chemical, the 5% formulation was dispersed in 3.0 l of tap water prior to being distributed over the pond surface using pressurised garden pesticide spraying equipment.

The application took place as a single event on 2/5/92 and the exercise took some 7 minutes to perform. The water temperature was 15°C and that of the air 11°C. Fish were not observable at the time.

RESULTS

Four days after the application some 20, large, dead sticklebacks were seen on the surface and removed. When an area of the bottom was dredge netted many smaller dead fish were noted.

The anticipated natural detoxification of the rotenone was confirmed seven days after application, when a sample of the water was removed and approximately 100 small toad tadpoles were added to it. After 2 days there had been no deaths and it was decided to restock the pond with toad tadpoles which had been previously translocated before spraying. They went on to grow and metamorphose normally that year.

Regular observations over the following months, showed no live fish to be visible and in fact adult Great Crested and Smooth Newts were seen in the now clear water. A variety

of submerged aquatic plants were introduced to enhance the pond's water quality and also to provide cover for any newt larvae which may have been developed from eggs laid earlier. In July of the same year, well developed newt larvae were observed and subsequently trapped and identified as Smooth and Great Crested.

CONCLUSION AND DISCUSSION

This simple study has shown that a small pond, heavily populated with sticklebacks, can, after treatment with a rotenone based piscicide, be colonised rapidly by Great Crested Newts from adjacent breeding sites. Although no studies were made of the effect of the addition of the chemical on the invertebrate population, these remained, recovered or recolonised and there was an adequate prey population sufficient to allow the development of newt larvae. Also large invertebrates such as adults of Great Diving Beetle were observed.

In any experiment it is difficult to prove the negative – in this case the total absence of sticklebacks, but the authors intend to continue to monitor the pond to see if a fish population re-establishes itself. The authors believe that this technique has potential for reclaiming Great Crested Newt breeding sites which have been lost as a result of the arrival of predatory fish species. Any decision to attempt to make a site once again suitable for newt breeding will depend upon various factors. One consideration certainly should be the method by which fish came to the pond in the first place. Was it a deliberate action by man, or a once off large flooding incident or regular flooding from a water with a fish population, etc? Also to be considered are all dimensions of a re-introductgion programme of newt species if natural recolonisation is deemed unlikely. Special consideration should be given to the suitability of terrestrial environment and the possibility of vandalism.

Piscicide applications to larger or physically more complicated water bodies than that described here, would require careful forethought and close attention to the supplier's application instruction for the piscicide. Furthermore, the deliberate addition of a piscicide to any water body in England and Wales requires the permission of the National Rivers Authority (NRA). Strict constraints and conditions concerning the application must be met (see Table 1 for a summary). The permission of the landowner must also be sought of course.

Ideally, the authors would have liked to have treated the water body earlier before adult amphibia (in this case – toads) had started to return to breed. Late February/early March would have been better. A further benefit of an early spring treatment is that there would be little chance of fish overwintering as eggs and so being relatively immune to this contact biocide.

The entire population of sticklebacks was not totally destroyed. Some 250 individuals were trapped before treatment and released in a nearby stream (Nelly Burdon's Beck) which had recently had its water quality improved and was now capable of supporting fish life.

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TABLE 1

Salmon Freshwater Fisheries Act 1975 – Use of Noxious Substance. (Section 5(2))

Permission required from NRA and Ministry of Agriculture Fisheries and Food:– Information required.

Site Details

Name and address of individuals seeking permission
Name, location and grid reference of site
Area of water to be treated
Duration of treatment
Water static or flowing (volume flow rate)

Method of Application

Reason for choice of piscicide as opposed to other methods
Type, concentration and formulation of active component
How will it be applied to water
Previous experience with piscicide
Containment plans

Risk Assessment

Will water be used for human consumption?
Access of livestock to water before substance has disappeared
Effect on target species
Effect on species of conservation value eg. amphibians and scarce invertebrates

Public Liability

This rests solely with the applicant.

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