

EXPOSURE TO INSECTICIDES INHIBITS EMBRYO DEVELOPMENT AND EMERGENCE IN ATLANTIC SALMON (*Salmo salar* L.)

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Introduction

In England and Wales, the practice of dipping sheep in insecticide solutions often occurs during the Atlantic salmon's spawning season and in close proximity to spawning tributaries. The general concern is that insecticides such as cypermethrin and diazinon may enter the watercourse and disrupt salmon reproduction. The present study attempted to assess the impact of environmental levels of two insecticides on salmon fertilisation rates and the subsequent survival and development of the embryos.

Methods

- Groups of 600 eggs were each fertilised with a mixture of milt from 6 males.
 - During fertilisation eggs were exposed to pesticide-dosed water for 2 minutes.
 - Embryos were then left to develop in clean water in separate artificial redds.
 - Temperature, emergence and mortality were monitored daily.
- In a separate experiment, the effect of cypermethrin on egg weight was studied.
- Eggs and milt were fertilised and laid out in 6 separate tanks.
 - Embryos were exposed to water-borne cypermethrin at various concentrations for a 10-day period.
 - Embryos were then placed in clean water and samples of 10 eggs removed regularly over a period of 47 days. Wet weight was recorded.



Salmon eggs at the eyed stage
© D. Hoop, University of Stirling



Newly emerged salmon alevins
© Anasir Image Library/USFWS



Atlantic salmon fry approximately one-month after emergence
© WaterbedWatch Salmon Society

Results

The exposure of eggs and milt to cypermethrin during mixing reduced fertilisation rates. After exposure to 0.1 µg/l¹ cypermethrin, the fertilisation rate was 47% of the control group.

Exposure to cypermethrin and diazinon during fertilisation affected both the total number of fry that emerged and the timing of the emergence.

Fewer fry successfully hatched following exposure to cypermethrin and 0.05 µg/l¹ diazinon compared to the other treatment groups.

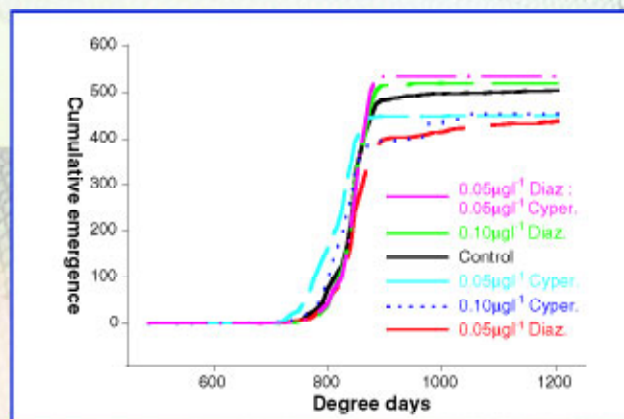
Exposure to 0.05 µg/l¹ cypermethrin caused fry to emerge earlier and exposure to 0.05 µg/l¹ diazinon caused fry to emerge later compared to the control.

Disruption to the normal pattern of emergence was greater when embryos were exposed to the pesticides separately, rather than in combination.

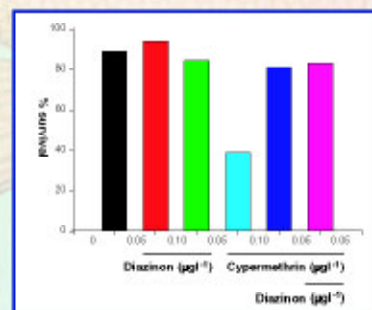
There was a higher incidence of developmental abnormalities in fry following exposure to both pesticides. The most common deformity was curvature of the spine.

Exposure to cypermethrin reduced the subsequent survival of the fry. There was only a 39% survival of fry to 1 month after emergence, compared to 89% in the control group.

There was a decrease in mean egg weight following a 10 day exposure period to cypermethrin.



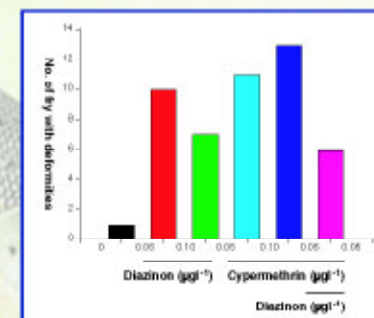
Cumulative emergence of fry following exposure to the insecticides cypermethrin and diazinon at fertilisation. Degree days = the number of days after fertilisation multiplied by the water temperature over the period



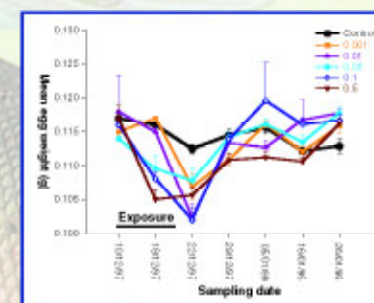
% of emerged salmon fry surviving to 1 month following exposure to cypermethrin and diazinon at fertilisation



Developmental abnormalities in salmon fry exposed to insecticides during fertilisation



Number of salmon fry with deformities following exposure to cypermethrin and diazinon at fertilisation



Mean (±SEM) wet weights of salmon embryos following a 10-day exposure to cypermethrin (n=10)

Conclusions

Exposure for a brief period to environmentally relevant concentrations of pesticides, reduced fertilisation rates, disrupted the timing of emergence, as well as the subsequent fitness and survival of the fry.

There was greater disruption in the pattern of emergence when eggs were exposed to the pesticides separately compared to the pesticides in combination at equivalent concentrations. This indicates an antagonistic effect.

Fertilisation in contaminated waters may affect the viability of salmon embryos and fry. This may have implications for juvenile survival and recruitment into the population.