ENDOCRINE DISRUPTION IN FISH IN ENGLISH RIVERS: ADDRESSING THE POPULATION LEVEL EFFECTS QUESTION

Tyler, Charles R., Hamilton, Patrick, Paull, Greg, Coe, Toby, Soffka, Marta, Filby, Amy, Lange, Anke.

Biosciences, College of Life and Environemntal Sciences, The Hatherly Laboratories, University of Exeter, Exeter, EX4 4PS, U.K. Email:c.r.tyler@ex.ac.uk

Background:

Feminisation of male fish as a consequence of exposure to endocrine disrupting chemicals (EDCs) has been demonstrated to occur in freshwater ecosystems across the world and in some case the causative chemicals have been identified. One of the most extensive studies on feminisation of wild fish has been on roach (*Rutilus rutilus*) living in English rivers where exposure to wastewater treatment works (WWTW) effluents (and the EDCs they contain) induces a range of feminised phenotypes including intersex condition (the presence of developing eggs in the testis of males). Intersex roach have been found at 86 % of the UK river locations studied and *in vitro* data demonstrate that severely feminised fish have lowered sperm quality. Studies on fish in other river systems across the world have found evidence for feminisation in wild populations and in a range of different species. However, little is known on the impact of feminisation on the subsequent ability of those fish to breed, and essentially nothing is known about the impacts at the level of the population for any species studied. We have been conducting a series of studies on roach and zebrafish (as laboratory models with similar breeding systems to roach) to investigate the effects of the feminised responses seen in wild fish populations on their ability to breed, including responses on breeding behaviours. In this presentation we will provide recent data that provide some significant advancing in addressing the population level effects question of oestrogenic EDCs.

Methods:

We examined the ability of both intersex roach and roach exposed throughout their lives to a WWTW effluent to reproduce when competing with apparently normal males in breeding populations. In the first study roach from effluent-contaminated UK rivers were placed in large tanks, and allowed to breed and after breeding, the level of gonadal disruption, based on the number of oocytes present in the testes, was determined for each male. To assign parentage, both adult fish and fry were genotyped using variable DNA microsatellite loci, thus enabling assessment of the abilities of intersex fish to contribute to the next generation. In the second study, a very similar approach was adopted with fish that had been exposed throughout their lives to an oestrogenic WWTW effluent under controlled conditions. Further experiments have been conducted to investigate the effects of some of the oestrogenic EDCs contained in WwTW effluents on reproductive behaviour in zebrafish and how this impacts on breeding outcome.

Results and Conclusions:

Intersex was found to significantly impair reproductive success. For the most severely feminised fish within each tank, there was a relative decrease of 76%. In the study where fish were exposed to a WWTW effluent (full strength) throughout their lives, females were not impacted in their ability to breed, males however were feminised completely and contained ovaries. Some of these 'sex-reversed' males were able to breed but only with a very low success rate. Exposure to oestrogens was shown to affect behaviours in dominant fish in zebrafish breeding colonies, impacting on aggression and dominance hierarchies and parentage outcome. If such effects occur in wild populations of fish, this could have implications for the genetic structure in populations. In conclusion, our findings suggest that feminisation of male fish and effects of environmental oestrogens on behaviour are likely to be important determinants in reproductive performance and success in wild fish populations living in some freshwater environments.

.