

Potential environmental enrichment for zebrafish used in regulatory toxicology

Submitted by

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To the University of Exeter as a thesis for the degree of Doctor of
Philosophy in Biological Sciences, *September 2011*.

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ABSTRACT

The aim of environmental enrichment is to alter the environment of a captive animal in a way that results in improved mental and physical welfare. The technique has been utilised effectively for many years for captive mammals in a variety of settings. However, until now it has never been considered as a way of improving the welfare of aquatic animals such as fish.

Fish that are used in regulatory toxicology studies are at present maintained solely in barren tank environments. Little is known about how these types of environments affect the well-being of the animals residing there and whether they impact either physiological health or behavioural repertoire. This thesis aims to address this gap in the knowledge regarding the potential for environmental enrichment to improve the welfare of fish used in regulatory toxicology. More specifically it looks at two types of enrichment and the effects of these on the commonly used model species, the zebrafish (*Danio rerio*).

The first type of enrichment studied was glass rod structures of varying heights provided to increase tank complexity and provide refuge. The glass structures did not produce any quantifiable benefits in unstressed fish and appeared to delay the formation of stable social hierarchies. When fish were stressed by a period of chasing, the presence of the glass rods appeared to reduce the magnitude of the cortisol response. Whilst this could be viewed as a potential benefit, it was felt that it would not outweigh the costs of this type of enrichment.

The second type of enrichment studied was provision of airstones. Again, no clear evidence was found that fish in tanks with airstones experienced an improvement in welfare. The main observation was the vast increase in mortality in tanks containing these airstones, in particular, those of a smaller size. Regardless of the physiological cause underlying this result, this can only be viewed as a negative consequence and one that appears to rule out airstones as an effective form of enrichment for this species and strain of fish.

It was also observed that both stress and the presence of enrichment influenced the absolute deviation from the mean in several endpoints. Since changes in endpoint variation will have effects both on the number of animals required to statistically measure environmentally relevant effects this is a factor that should be considered when researching methods of environmental enrichment.

Finally, results from these studies suggest the possibility that laboratory zebrafish do not require the addition of environmental enrichment to tanks in order to promote maximum welfare. Furthermore, as considerable costs would be involved in implementing many types of enrichment (relating to manufacture, cleaning, incompatibility of results with previous studies etc.) it is likely that observed benefits would have to be both substantial and well established in order for changes in regulatory guidelines to take place. For a species such as zebrafish that are extremely easy to breed and maintain in the laboratory with minimal amounts of disease, social problems or mortalities, it may be that current conditions are satisfactory.

ACKNOWLEDGEMENTS

Firstly I would like to thank my academic supervisor, Dr. Rod Wilson. He has offered unwavering support throughout my PhD and his constant role as “devil’s advocate” has taught me the importance of both thoroughness and objectivity. Despite a consistently huge workload, and the recent addition to his family, Rod has always made time for my questions and problems.

Secondly, and equally, I would like to offer sincere thanks to my industrial supervisor at AstraZeneca, Dr. Stewart Owen. Stewart has played a huge part in the undertaking of all studies based at Brixham Environmental Laboratories and, importantly, ensured that I was welcomed into the workplace there. His advice in the form of Stewart’s “nuggets” made sure that I was well guided throughout the project.

I would also like to thank all those who assisted in the setting up of studies and the substantial sampling work required. In particular, Gareth Readman, Kate Hurd, Yohanna Glennon, Lee Dunham, Jennifer Iles, Ross Brown, Lisa Bickley, Gareth LePage and Rhys Goodhead, who selflessly offered a substantial amount of time to assist me.

Finally, I would like to thank those people who have aided in a “moral support” capacity. My parents and sister who have all provided food, wine and a listening ear at particularly stressful times. Jenny Landin, who has supported me consistently and been through every stage of this process by my side. Marta Soffker, Okhyun Lee and Becks Hunter for friendship, support and advice when it was most needed. And finally, Rhys Goodhead, for unending cups of tea and an equally limitless amount of patience throughout the writing-up process.

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Wilkes, L., Owen, S., Readman, G., Sloman, K., Wilson, R., 2011. Environmental complexity as potential enrichment does not reduce stress in zebrafish but slows the establishment of social hierarchies. In submission: *Applied Animal Behaviour Science*.