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Exploring enrichment enjoyed by Zebrafish

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How does different enrichment affect spatial distribution in laboratory Zebrafish?

Introduction

Throughout a long-term enrichment study being conducted at the University of Bristol Zebrafish aquarium, aquarium staff remarked that fish with physical gravel in their tanks appeared to spend more time grouped at the bottom of their tanks.

Many studies highlighted that gravel is a preferred enrichment of Zebrafish[1,2,3] therefore we were keen to explore this anecdotal evidence further, to ascertain if the spatial distribution of the Zebrafish was significantly linked to the presence of physical enrichment within the tanks and if this could be a potential indicator of enrichment efficacy.

Zebrafish having the ability to interact with their surroundings would mimic a more natural habitat and promote more typical behaviour of wild Zebrafish, leading to higher welfare standards opposed to the standard barren tanks currently used. We were interested in whether this effect was seen only with physical enrichment or if it could also be seen in the presence of a laminate insert of gravel enrichment.

Materials and method

1. 9 tanks were divided into three different categories (Figure 1):
   - 3 x standard control tanks
   - 3 x glass bead gravel tanks
   - 3 photographic insert tanks

Figure 1. Example of a photographic timepoint of the spatial distribution study.

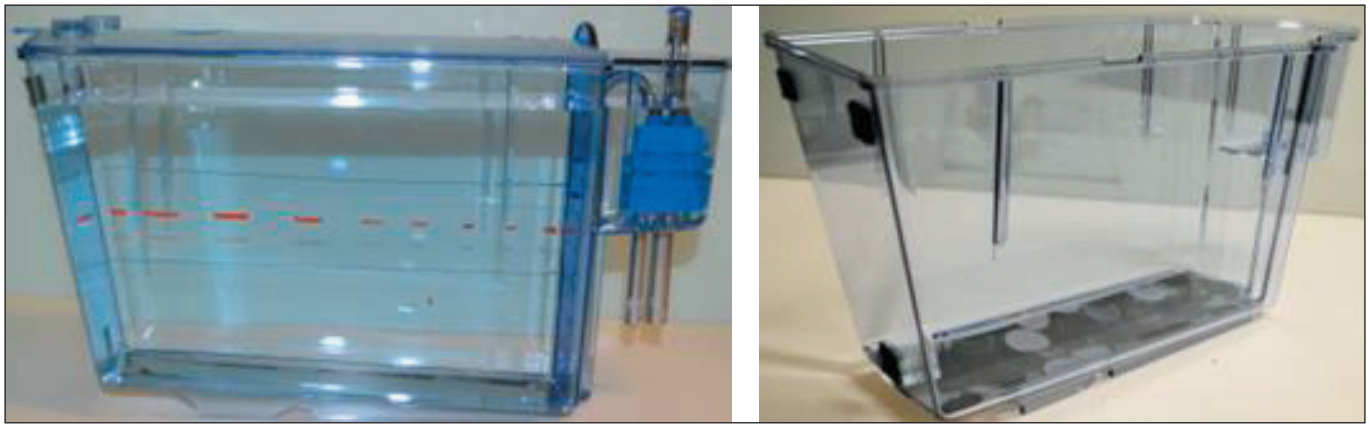

Figure 2. Tank marking layout and the laminate insert enrichment.

2. The individual tank spaces were divided into three sections of: top, middle and bottom. We also had a defined middle line on the tanks (Figure 2) to allow for more analysis options depending on the effect size.
3. At pre-set intervals the tanks were removed from their rack and placed into a designated photography room and left to habituate for 30 minutes.
4. After 30 minutes, a picture would be taken to capture the whereabouts of the Zebrafish in their tank.
5. We recorded on a table which section of the tank the fish were in alongside the enrichment tank they were in (Figure 3).

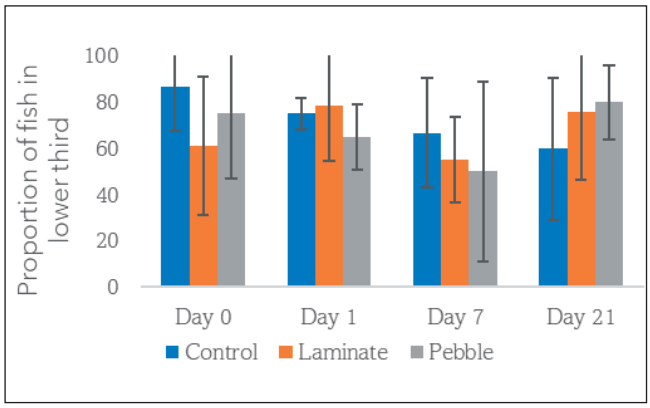

Figure 3. Proportion of Zebrafish present in the lower third of the study tanks (n=3) at photograph intervals throughout 21 days. The error bars show standard deviation.

Results

The data was statistically analysed with a generalised linear mixed model (with tank treatment as a fixed variable and photo session cohort as a random effect variable). Analysis showed no significant relationship between each enrichment type and the spatial distribution of Zebrafish ($p = >0.5$). Data from proportions of fish in the lower half of the tank was also not significantly related to enrichment presence.

Conclusion

This study highlighted the importance of investigating anecdotal evidence, as humans may be unconsciously biased to notice false patterns, especially when something is new or potentially a positive outcome. It is also possible that the behaviour of Zebrafish in a busy laboratory setting may differ to that of the Zebrafish we studied in a quiet, undisturbed environment.

Whilst there are other preference studies highlighting the value of the inclusion of physical enrichment for Zebrafish, this method of monitoring spatial distribution has not correlated with other such methods of enrichment evaluation.

Acknowledgements

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References

1 **Kistler, C., *et al.*** (2011). Preference for structured environment in Zebrafish (Danio rerio) and checker barbs (Puntius oligolepis). Applied Animal Behaviour Science, 135(4), pp.318-327.

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3 **DePasquale *et al.*** (2019). The impact of flow and physical enrichment on preferences in Zebrafish. Applied Animal Behaviour Science, 215, pp.77-81.