

Husbandry and environmental enrichment – *what do fish need and has there been much progress*



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Aims

- What is Enrichment?
- Why are we doing it?
- What are we doing?



Definition

The aim of Environmental enrichment in zoos and aquariums is to provide an environment in which animals behave as closely as possible to their wild counterparts”

Sheperdson (1988)

Why?



Trying to promote natural behaviour

- No single standard for natural behaviour or environment.
- Range of natural behaviours exhibited in the wild dependent on habitat (biotic and abiotic).
- Need to describe desired behaviour, and benefits to the animals.

Why?

Improving welfare

- Abnormal behaviour often taken as an indicator of reduced welfare.
- Relationship between stereotypes and welfare is uncertain, behaviour may be adaptive!
- Use of techniques to occupy animals in harmless activities.

Why?

Validity of research

- Deviation from natural behaviour.
- Behavioural problems (e.g. aggression).
- Potential to adversely influence the the results of experimental studies.

Why?

Perception

- **Public image.**
- **Biologically relevant?**
- **Or an anthropomorphic whim?**

Why?

Increased biological production

- Boosting growth rate.
- Feed conversion.
- Reproductive ability.

Increased economic production

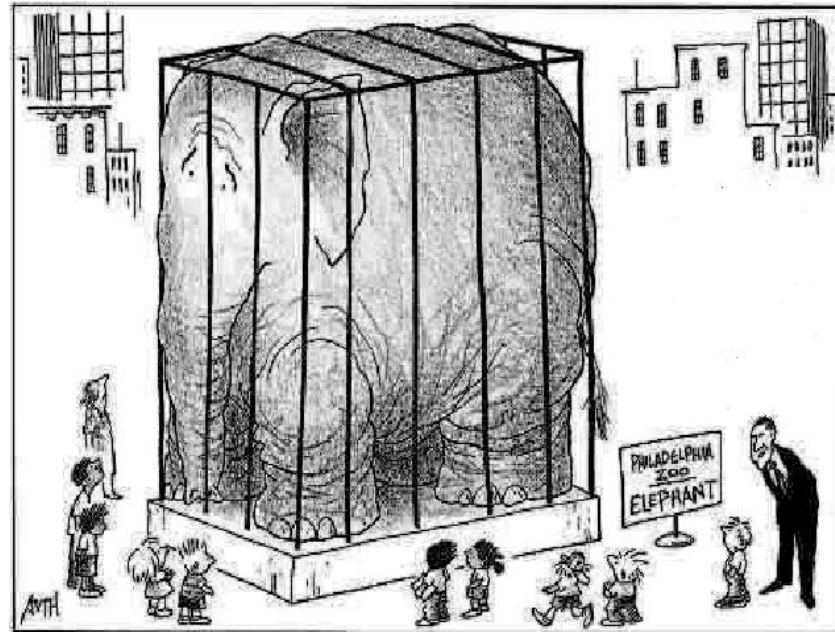
- Increased economic return.
- Net ethical benefit.

Note of Caution

“Enrichment attempts will fail if the environmental modifications have little functional significance to the animals, are not sufficiently focused to meet a specific goal or are based on an incorrect hypothesis regarding the causation and mechanisms underlying a problem.”

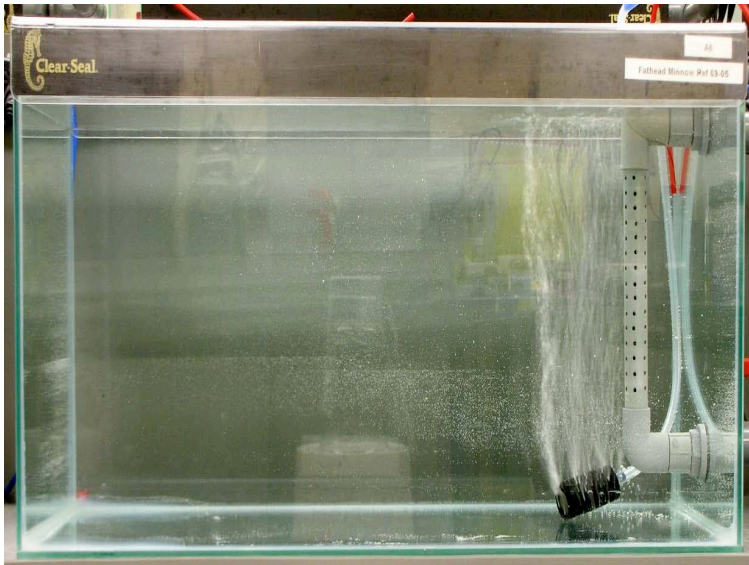
Newberry (1995)

So what do we actually do?



Subtle enrichments

Husbandry tank



Subtle

- Schooling fish group housed.
- Dawn/dusk photoperiod.
- Different feeds used to encourage a range of behaviours.
- Appropriate flow for species held.
- Possible interaction with diffuser.

Ontological guide for housing and feeding OECD fish species

Species	Ontology	Housing						Feeding									
		Density			Flow (cms ⁻¹)			Ration			Live			Dry		Wet	
		Individual	Pair /spawn group	Group	Slow (0-3)	Medium (3-10)	Fast (>10)	Low (Maintenance)	Medium (Conditioning)	High (Growth)	Rotifer	Brine shrimp	Other	Flake	Pellet	Slurry	Paste
<i>Cyprinus carpio</i> Carp	Firstfeed			X	X				X	X	X	X	X			X	X
	Fry			X	X				X	X		X	X	X		X	X
	Juvenile			X	X	X	X	X	X	X		X	X	X	X	X	X
	Adult	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
<i>Fimephales promelas</i> Fathead Minnow	Firstfeed			X	X				X	X	X	X	X			X	X
	Fry			X	X	X			X	X		X	X	X		X	X
	Juvenile			X	X	X		X	X	X		X	X	X		X	X
	Adult	X	X	X	X	X		X	X	X		X	X	X	X	X	X
<i>Carasus auratus</i> Goldfish	Firstfeed			X	X				X	X	X	X	X			X	X
	Fry			X	X				X	X		X	X	X		X	X
	Juvenile			X	X	X	X	X	X	X		X	X	X	X	X	X
	Adult	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
<i>Orzias latipes</i> Medaka	Firstfeed			X	X					X	X	X	X			X	X
	Fry			X	X					X	X	X	X			X	X
	Juvenile			X	X			X	X	X		X	X	X		X	X
	Adult	X	X	X	X	X		X	X	X		X	X	X		X	X
<i>Cyprinodon variegatus</i> Sheepshead	Firstfeed			X	X					X	X	X	X			X	X
	Fry			X	X	X				X	X	X	X			X	X
	Juvenile			X	X	X		X	X	X		X	X	X		X	X
	Adult	X	X	X	X	X	X	X	X	X		X	X	X		X	X
<i>Oncorhynchus mykiss</i> Trout	Firstfeed			X	X					X	X	X	X			X	X
	Fry			X	X	X			X	X		X	X			X	X
	Juvenile		X	X	X	X	X	X	X	X		X	X	X		X	X
	Adult	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X
<i>Psetta maxima</i> Turbot	Firstfeed			X	X					X	X	X	X			X	X
	Fry			X	X					X	X	X	X			X	X
	Juvenile			X	X			X	X	X		X	X	X		X	X
	Adult		X	X	X	X		X	X	X		X	X	X		X	X
<i>Danio rerio</i> Zebrafish	Firstfeed			X	X					X	X	X	X			X	X
	Fry			X	X	X				X	X	X	X			X	X
	Juvenile	X	X	X	X	X	X		X	X		X	X	X		X	X
	Adult	X	X	X	X	X	X	X	X	X		X	X	X		X	X

Where next?

- **Enrichment attempts often seem to be based on:**
 - **Anthropomorphic feeling.**
 - **Convenience.**

Rather than biological and functional utility.
- **Need for scientific justification for current techniques.**

Where next cont. ?

AZ Initiated a research programme to identify suitable techniques for the identification and quantification of effects.

- *Jenny Landin* (GWR, University of Plymouth/University of Exeter)
- Looking at enrichment techniques and effects of temperate species

- *Luanne Wilkes* (BBSRC, University of Exeter)
- Looking at enrichment techniques and effects on tropical species

What have they found so far?

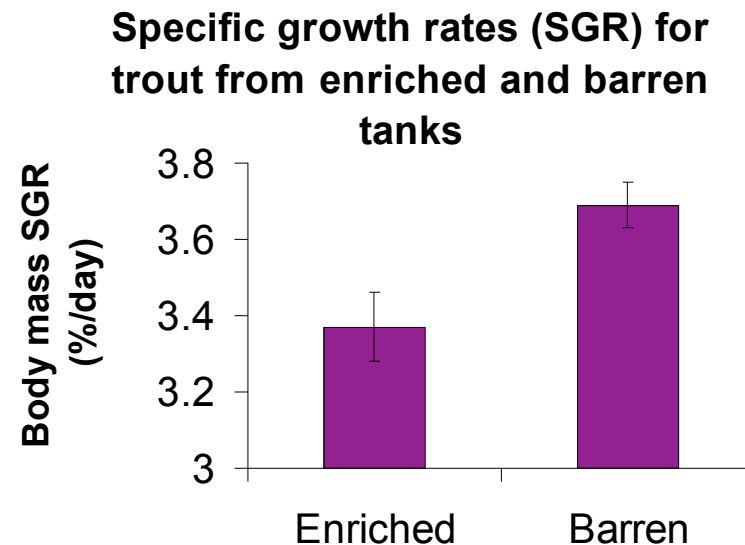
Jenny Landin

- Looked at the effects of adding 'hides' as a form of enrichment for juvenile rainbow trout
 - Study conducted as per regulatory growth study
 - All tanks were barren for the 1st half of the study
 - Hides were then added to half of the tanks for the 2nd half of the study
 - Mean specific growth (SGR) rate was compared

What have they found so far cont.?

Results

- SGR was significantly lower in the 'enriched tanks'
P=0.014
- Adding hides did not improve welfare with regards to growth



What have they found so far cont.?

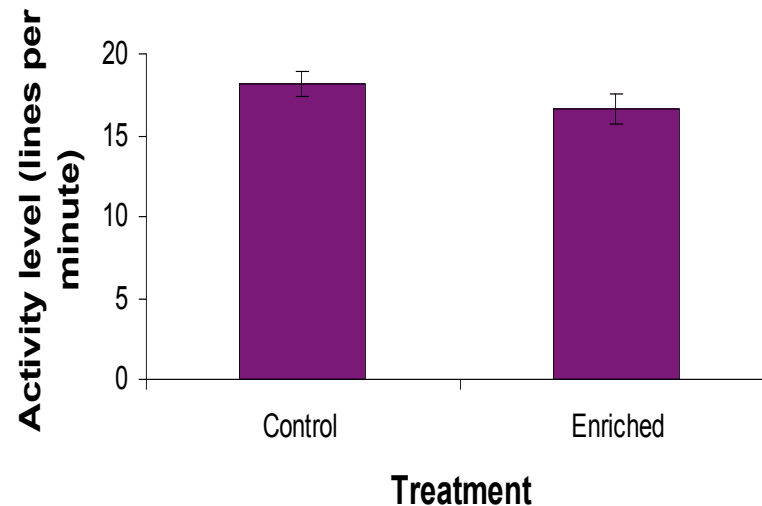
Luanne Wilkes

- Looked at the effects of adding a simple form of enrichment as a refuge for juvenile zebrafish
 - 3D structure designed to create a refuge that would be suitable for use in a regulatory ecotox study
 - Tanks were split into 3D grids and activity was measured
 - Shoaling density was measured
 - At the end of the whole body cortisol was measured using commercially available kits

What have they found so far cont.?

Results

- So significant difference in activity level between the two treatments



- No significant difference in cortisol concentration in different treatment

What next?

- **Different types of enrichment tools**
- **Different species**
- **Further methods of examining the effects of enrichment as no single measure will provide a complete answer**
 - **Behavioural**
 - **Physical**
 - **Biochemical**

The End

With Thanks to:
Dr Tim Williams
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Jenny Landin
and
Luanne Wilkes

References

- Landin *et al*, (2009) Welfare and enrichment criteria for fish used in research. SEB Poster presentation
- Newberry R. Environmental enrichment: increasing the biological relevance of captive environments. *Appl Anim Behav Sci* 1995;44:229–43
- Sheperdson, D.J. (1988). Environmental enrichment in the zoo. : 45-53.
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