

Polar cod and Goliat: how an oil spill may affect lipid metabolism

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A Why we care

- Polar cod is an abundant and important food source in the Arctic.¹
- In the Arctic, decreasing ice cover has increased oil exploration and the risk of oil spills.²
- Previous research has identified the long-term effects of oil spills on exposed biota.³ However, more research is needed to understand the possible sub-lethal effects on arctic species.

Our objective

was to investigate how lipid metabolism genes are affected by oil exposure and food quantity in spawning female polar cod.

- 1 Hop and Gjøsæter, 2013, Mar. Biol. Res.
2 Harsem et al., 2011, Energy Policy
3 Peterson et al., 2003, Science
4 Sheridan, 1994, Comp. Biochem. Physiol.

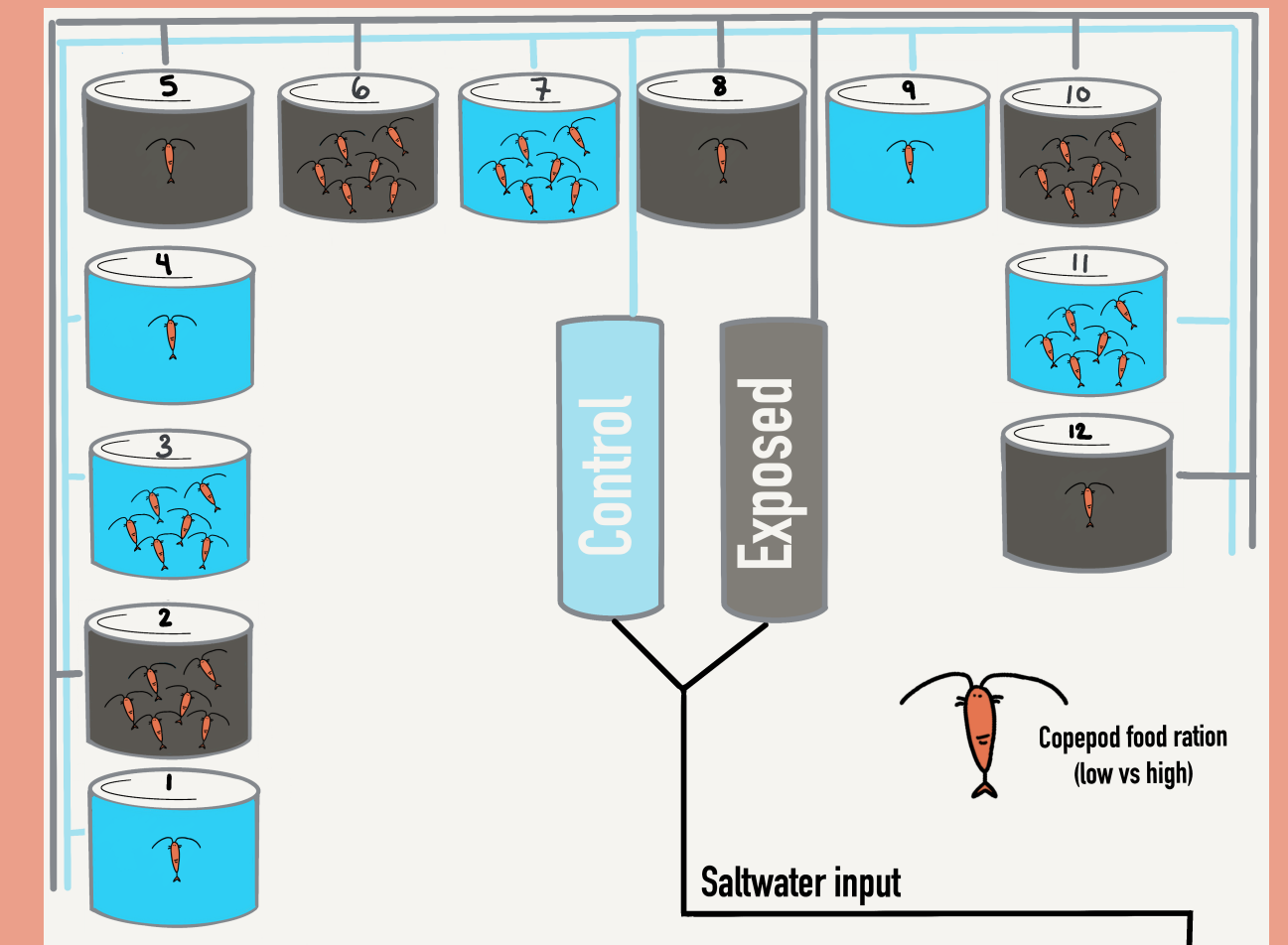
Lipid metabolism is the conversion, break-down, and use of lipids within a cell. These processes govern how much energy is stored and available to be used for processes such as growth and reproduction.⁴

B What we did

Experiment

- Polar cod were divided into experimental groups and an oil spill was simulated. Oil exposure was controlled through a gravel-column system that exposed fish to the water-soluble fraction (WSF) of crude oil and replicated natural weathering.⁵
- A subset of fish (6-8 per tank) were sampled prior to oil exposure, during spawning, and post-spawning.

Tank set-up



Experimental groups

Food	Low	High
Oil	3 tanks x 30 ind	3 tanks x 30 ind
Control	3 tanks x 30 ind	3 tanks x 30 ind

For the BIO299 project

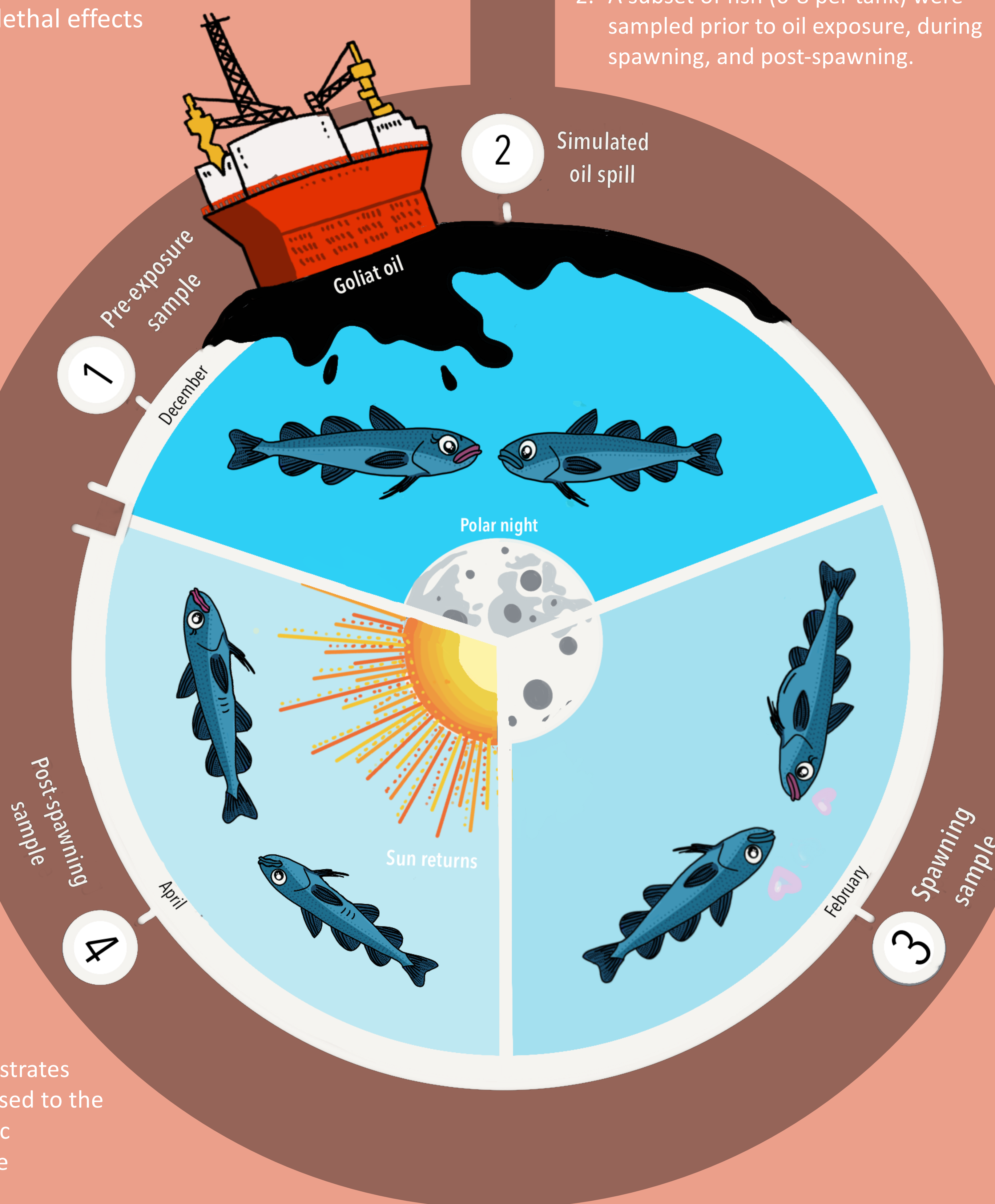
- Gene expression in spawning females was measured using Quantitative Polymerase Chain Reaction (qPCR).
- Gene expression levels were compared between experimental groups.⁶

- 5 Carls et al., 2000, Environ. Toxicol. Chem.
6 Livak & Schmittgen, 2001, Methods

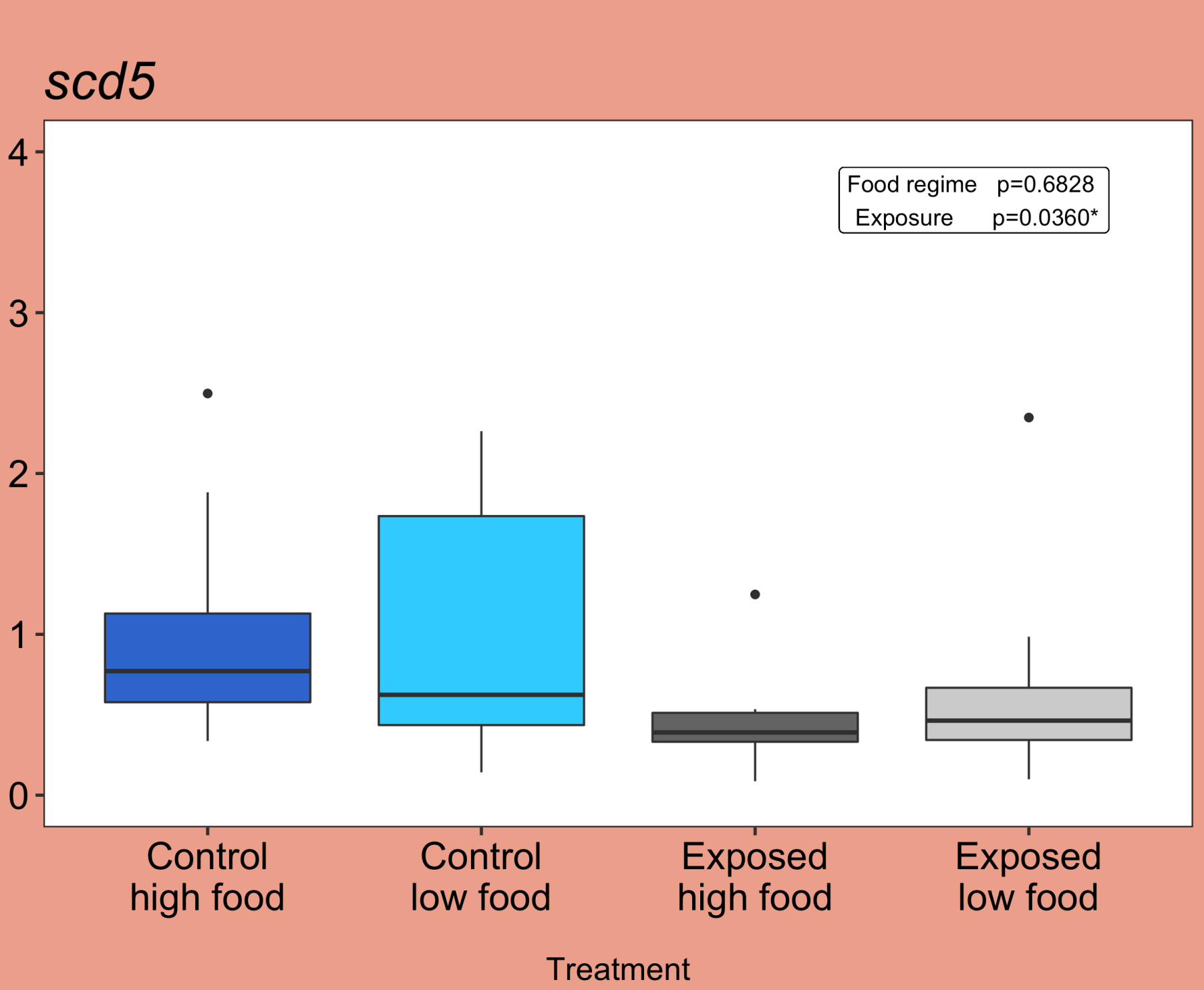
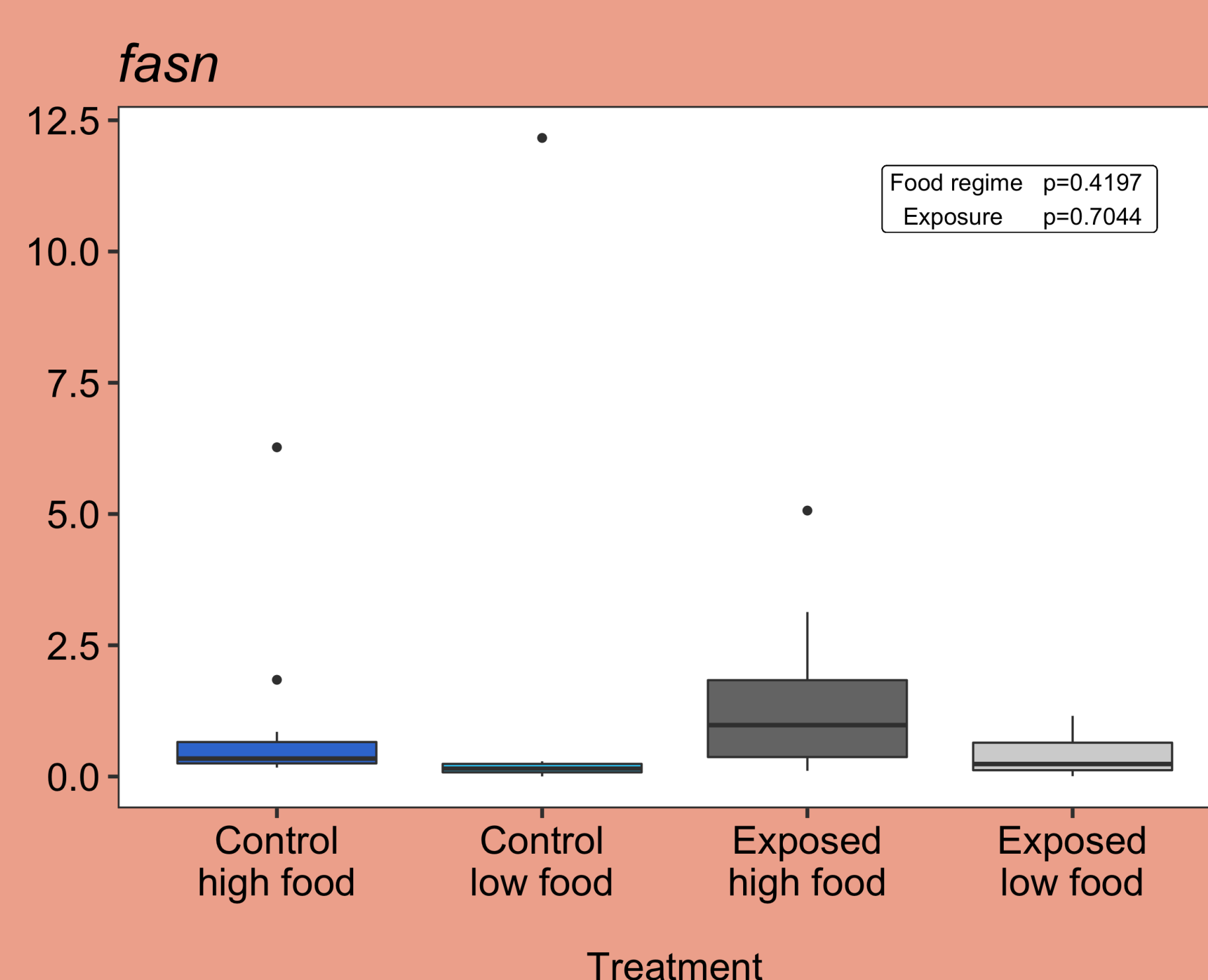
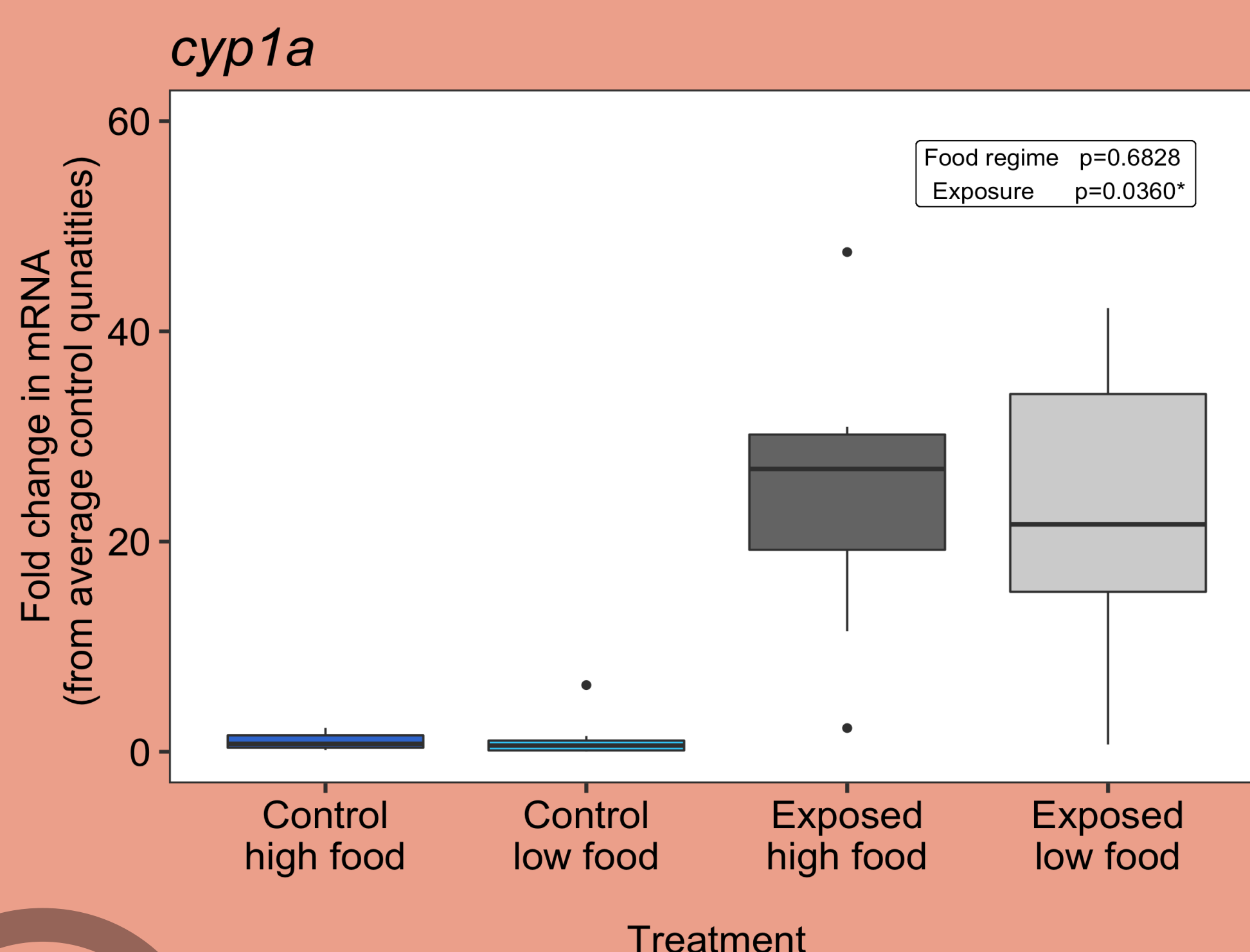
C What we found

spawning females n=51

A significant difference in *cyp1a* gene expression was identified. The *cyp1a* enzyme is important in the metabolism of foreign compounds and is generally found in low quantities in unexposed cells. The induction of the *cyp1a* gene during the experiment demonstrates that the fish were successfully exposed to the WSF of crude oil (Polycyclic aromatic hydrocarbon, PAH, compounds were bioavailable in the exposed fish).



The levels of five genes (*fasn*, *acly*, *scd5*, *scd*, *fabpl*) involved in lipogenesis, the storage of fats, were quantified and compared. Only Stearoyl-CoA desaturase (*scd5*) gene expression was significantly affected by crude oil exposure. Stearoyl-CoA desaturase catalyzes the formation of monosaturated fatty acids from saturated fatty acids.



D Conclusions

- The *cyp1a* gene induction indicates successful exposure to the WSF of crude oil.
- One of the five lipogenesis genes tested, *scd5*, was significantly affected by exposure.
- These findings suggest the majority of lipogenesis genes tested may not be sensitive to crude oil exposure at the level used in this experiment.

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