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CSIC Consejo Superior de Investigaciones Científicas
ICMAN Instituto de Ciencias Marinas de Andalucía

Integrating avoidance behavior and stress to understand how contamination affects the health and spatial distribution of fish in heterogeneously contaminated landscapes

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BrEStress
ENVIRONMENTAL STRESS IN AQUATIC ECOSYSTEMS

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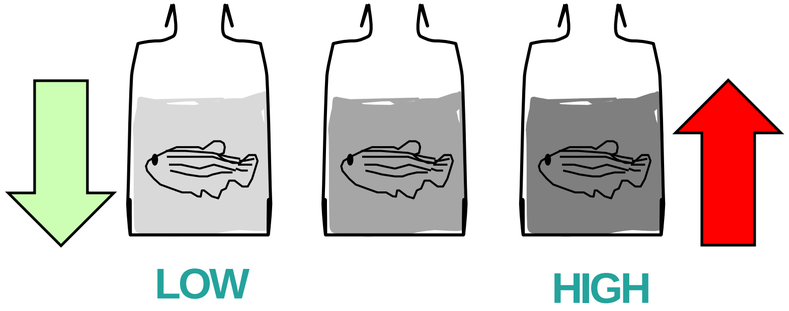
FIGHT – the traditional approach in ecotoxicology

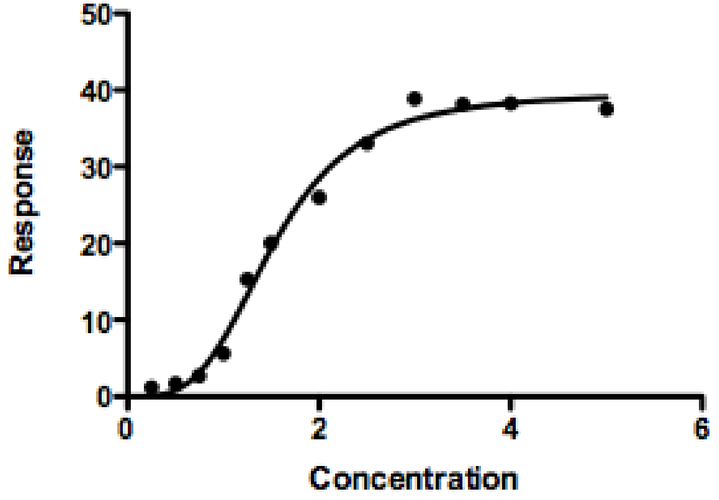
Option A: Fight

Equilibrium between fitness and homeostasis

Forced and mandatory **exposure**

EFFECT AND STRESS



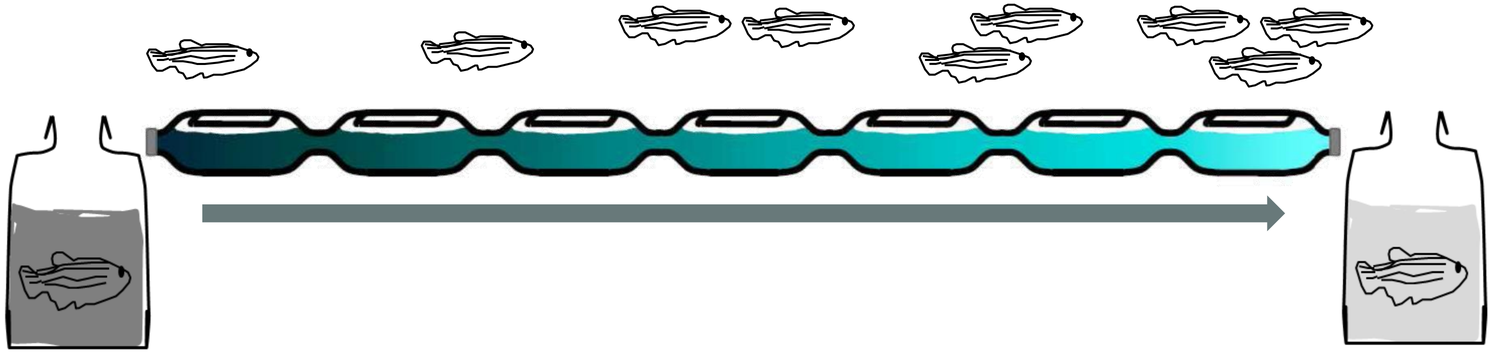


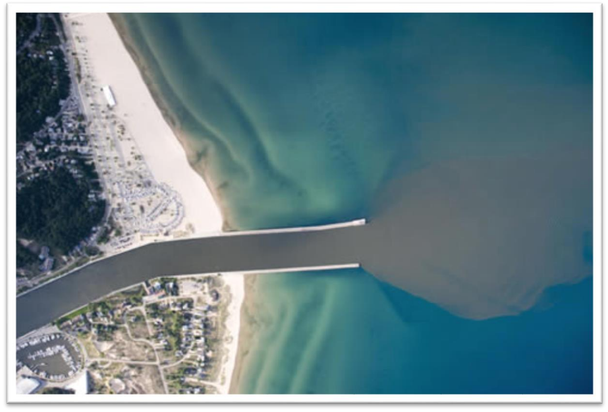
FLIGHT – chemically heterogeneous environments

Option B: Flight

✓ **Perspective from the individual:**

“No direct effect”





✓ **From an ecological perspective**

CONTAMINATION-DRIVEN SPECIES DISTRIBUTION

COST-BENEFITS APPROACH

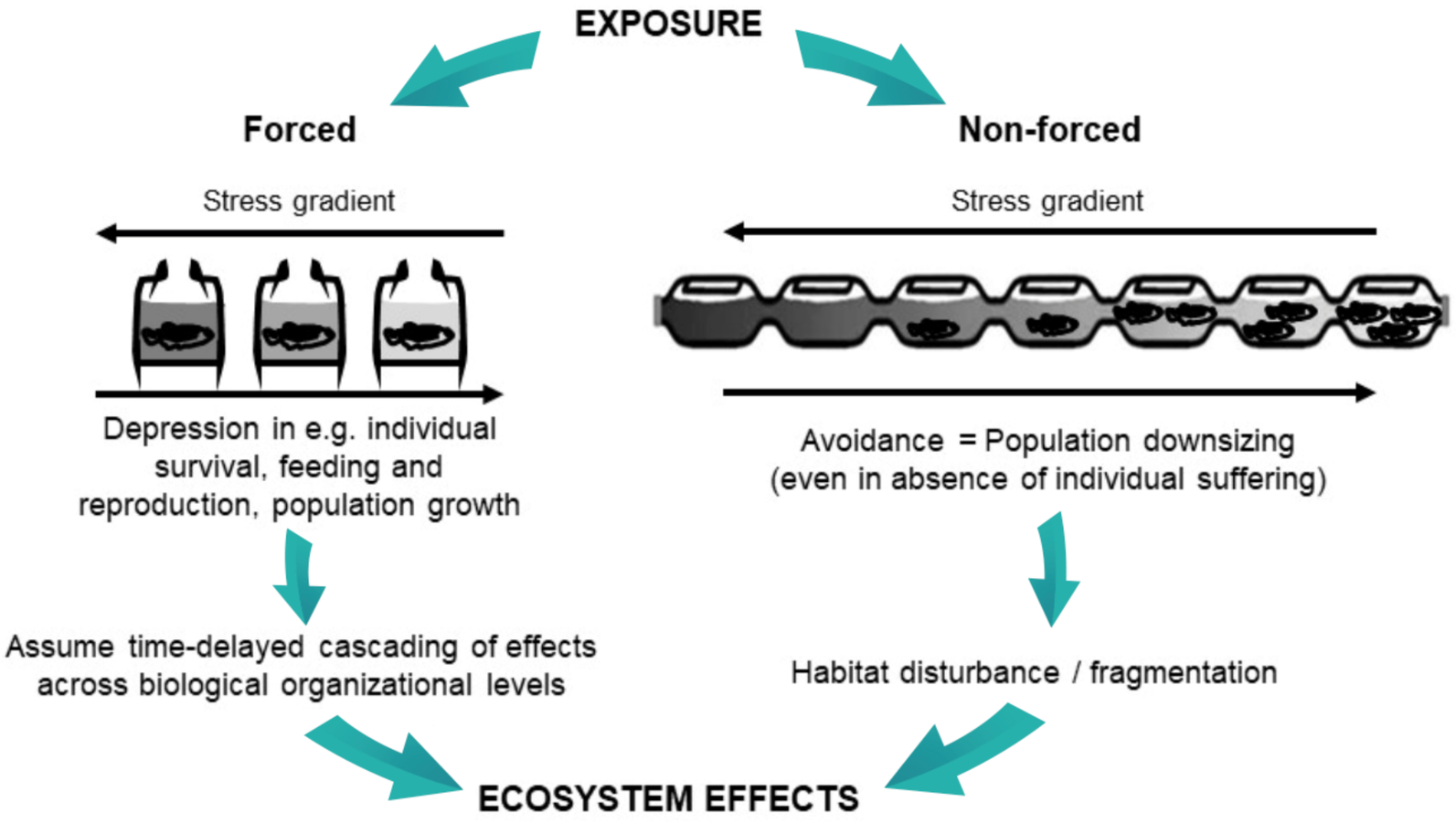
Contamination will be tolerable if the presence of resources or other elements compensates for the stress that contaminants produce.

TYPES OF EXPOSURE

Broadening the paradigm about exposure and effect

heterogeneously contaminated landscape

HABITAT CONNECTIVITY



HYPOTHESIS AND GOAL

The Hypothesis

The presence of uncontaminated areas within a heterogeneous contamination landscape might reduce the population stress.

The Goal

To assess how the stress (measured as cortisol levels) in zebrafish (*Danio rerio*) varies as a consequence of the chemical heterogeneity and the presence of clean areas.

EXPOSURE **SYSTEM**

EXPERIMENTAL **DESIGN**

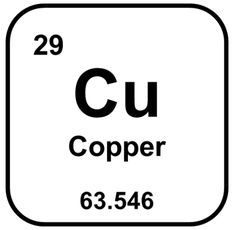
Test organisms

Zebrafish (length: 1.5 ± 0.5 cm;

weight: 0.170 ± 0.001 g; age: 2-3 months old)

Danio rerio

Test substance



Stress level (cortisol) – ELISA kit

Fish sampled after **12 h exposure**.

Fish from each scenario were euthanized with 2-phenoxyethanol (300 µg/L; ca. 1 min), dried on a paper towel, frozen in liquid nitrogen (-80 ºC) and stored at -20 ºC.

Cortisol analysis: Fish from the same scenario: 0.5 g; around 6 to 10 fish.

EXPERIMENTAL **DESIGN**

Danio rerio

29
Cu
Copper
63.546

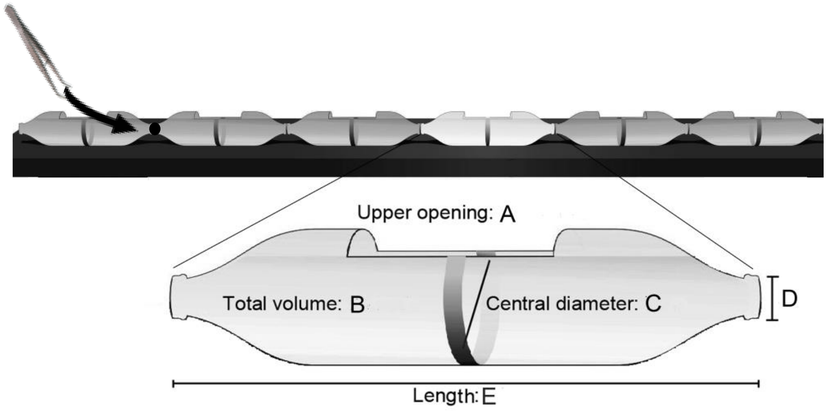
Control without contamination

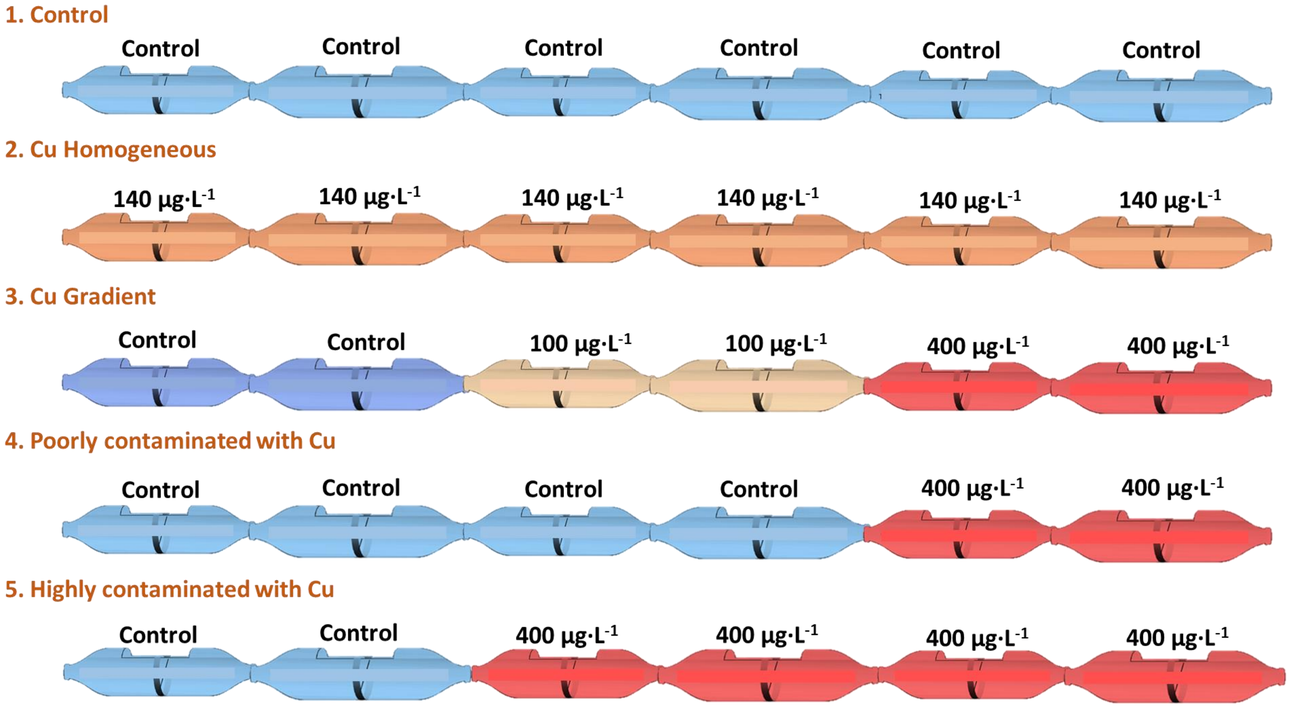
Homogeneous contamination scenario

Gradient of contamination

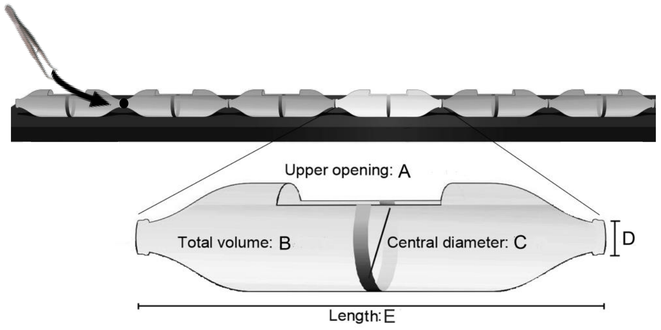
Spatially limited contamination

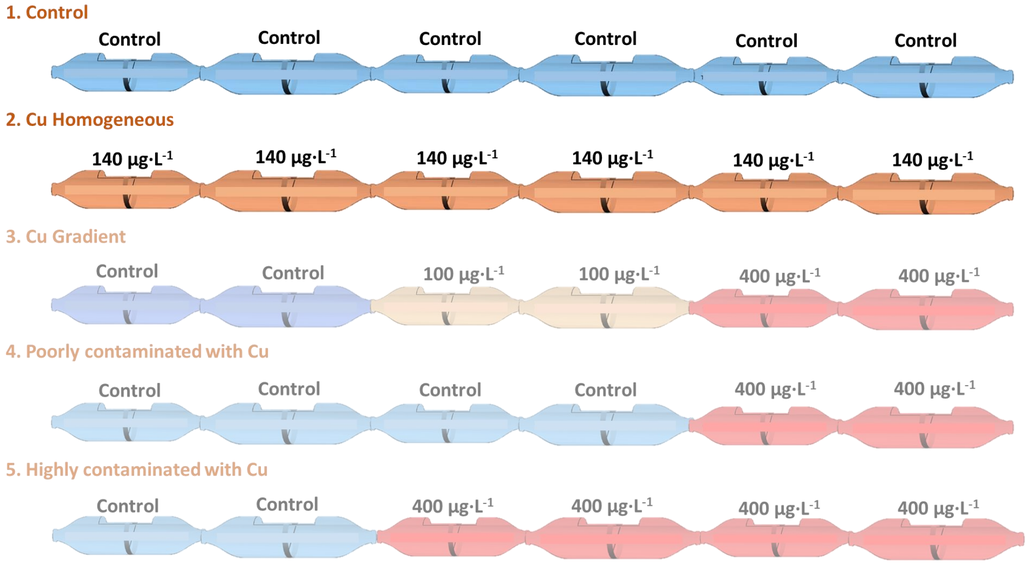
Spatially extended contamination

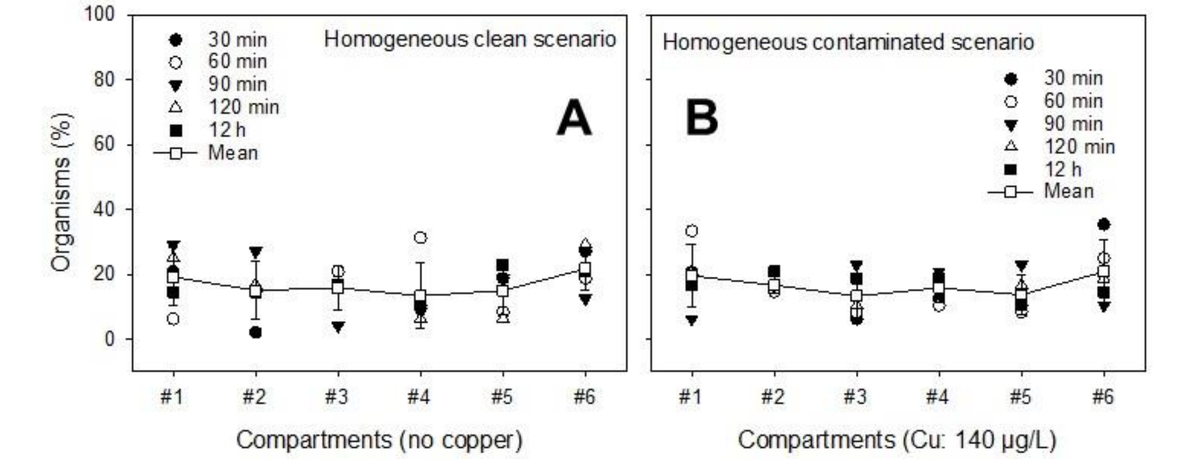


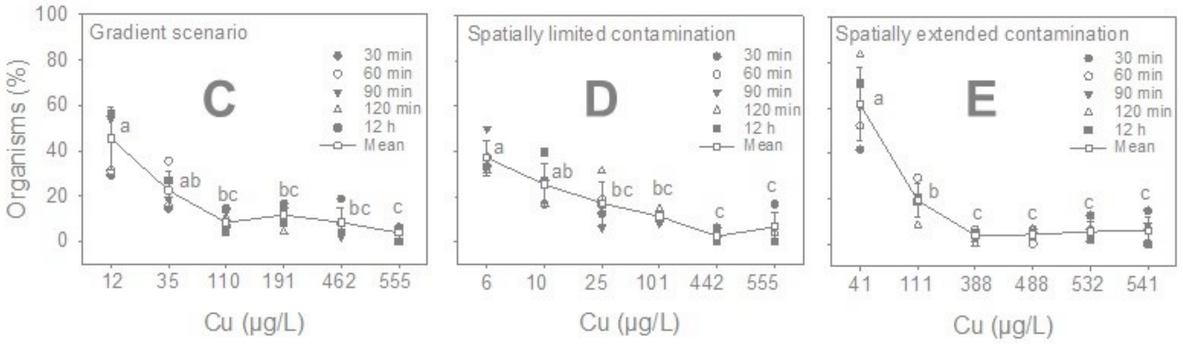


RESULTS: **AVOIDANCE**

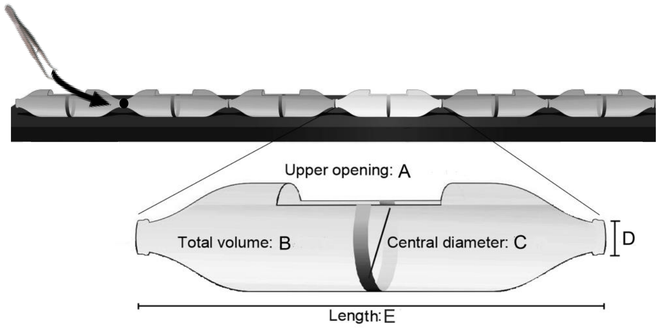




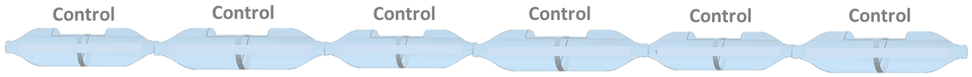




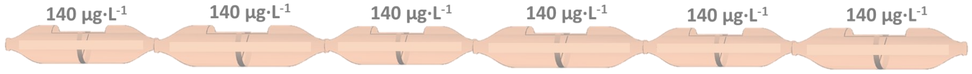
RESULTS: **AVOIDANCE**



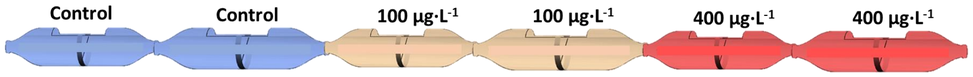
1. Control



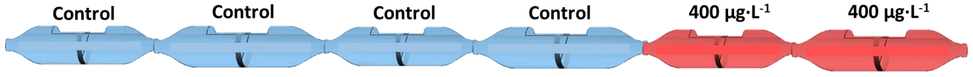
2. Cu Homogeneous



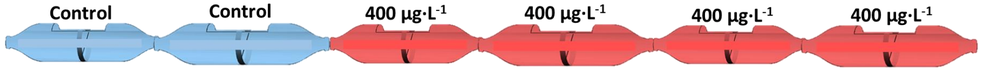
3. Cu Gradient

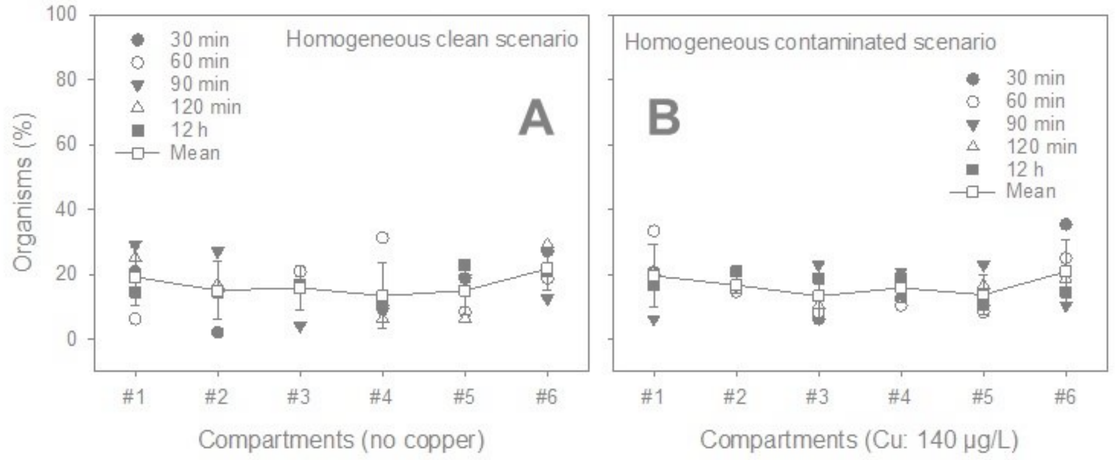


4. Poorly contaminated with Cu



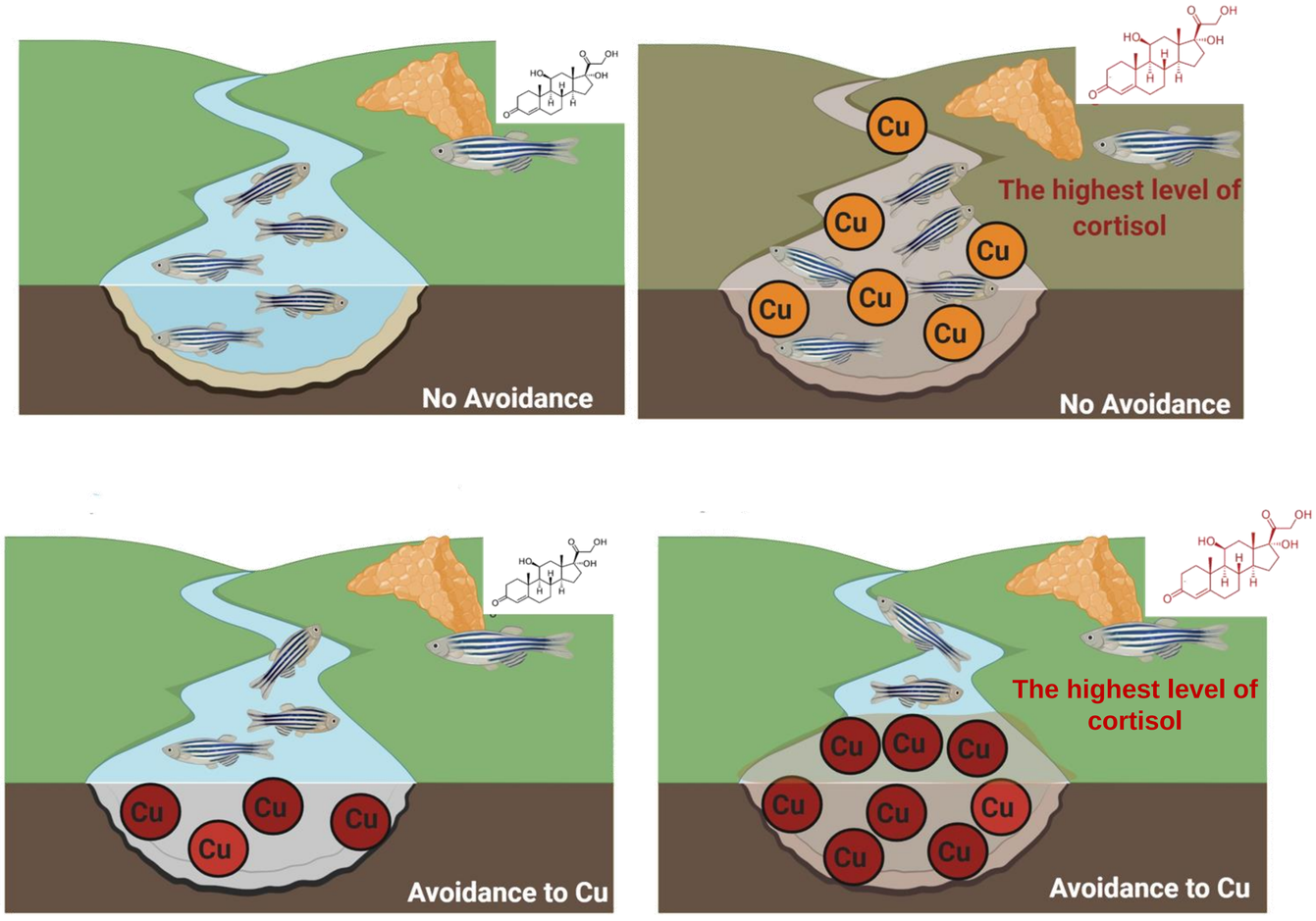
5. Highly contaminated with Cu





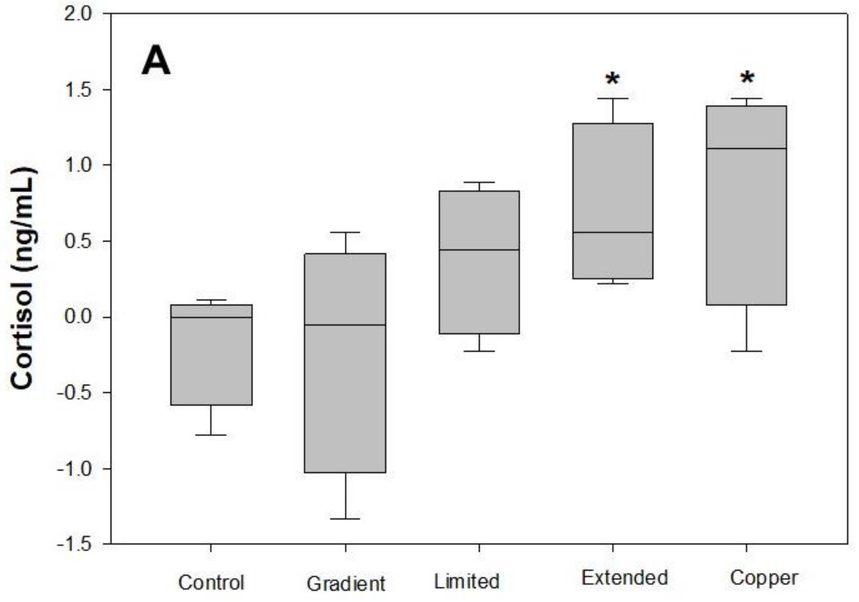
RESULTS: **STRESS (cortisol levels)**

Different landscapes



Traditional stress approach

Cortisol levels



CONCLUSIONS

- In a **heterogeneously contaminated landscape**, it is expected that **fish avoid the most contaminated areas to reduce the stress** caused by the continuous exposure to contaminants.

- This **reduction in the stress** (levels of cortisol) seems to be directly related to the **availability of clean areas** to which organisms are expected to flee.

FINAL CONSIDERATION

We wish:

- to draw attention to the importance of considering the **connectivity of habitats** and their **chemical heterogeneity** in environmental risk assessments and

- to make **an appeal to preserve clean areas** in ecosystems due to their potential role as **escape zones to alleviate stress**

ACKNOWLEDGEMENTS

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¡GRACIAS!

OBRIGADO!

THANK YOU!