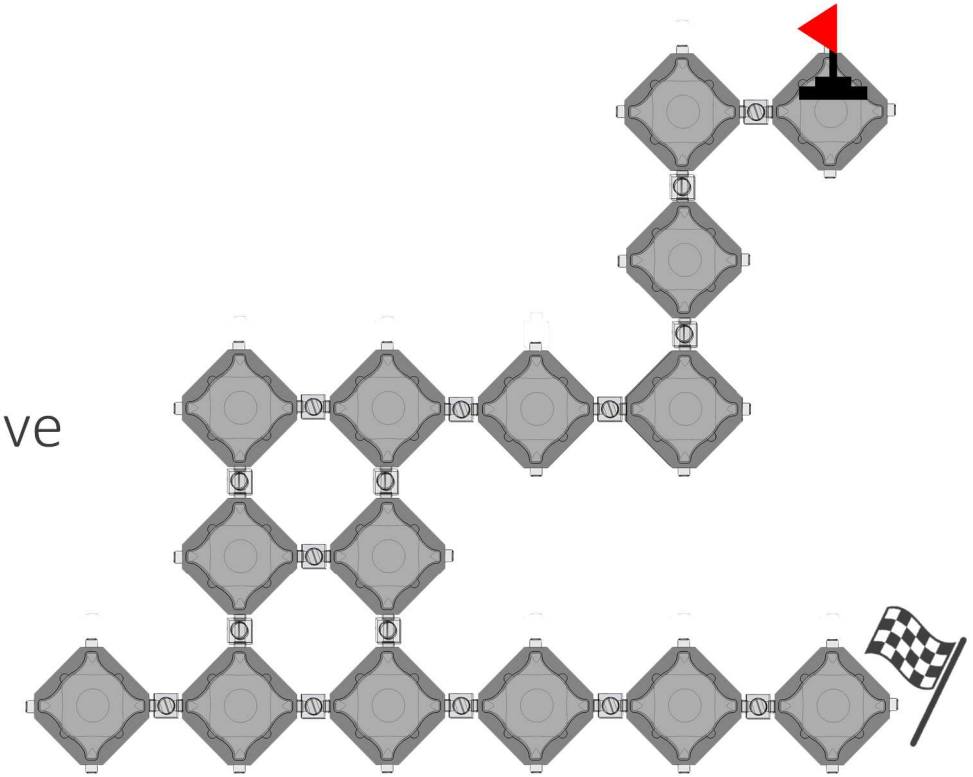
GETTING OVER LETHAL TEST

Habitat (re)colonisation, a new perspective for ecotoxicological studies



Andrea Cordero-de-Castro, João R.S. Pontes, Rui Ribeiro, Isabel Lopes, Matilde Moreira-Santos, Eloísa Ramos-Rodríguez, Gema Parra, Cristiano V.M. Araújo

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CSIC Consejo Superior de Investigaciones Científicas
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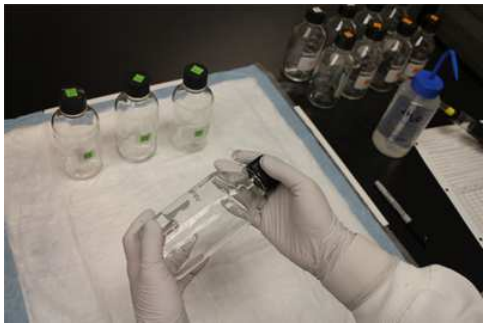
FORCED EXPOSURE

Continuous exposure of the organism to a toxic agent with no option to escape.

1

EASY TO USE

2

UNEQUIVOCAL CONCENTRATION-EFFECT (DOSE-RESPONSE) RELATIONSHIP AT THE INDIVIDUAL LEVEL

3

EASILY INTERPRETABLE RESULTS

4

PARTIAL ECOLOGICAL RELEVANCE

FORCED EXPOSURE

DIFFERENT SCENARIOS → assumes all organisms as passive bystanders of this toxicity (Lefcort et al., 2004).

- Regulation
- Avoidance
- Conformity (Willmer et al., 2000)

ECOTOXICOLOGY ULTIMATE GOAL

To determine and predict the effects of pollutants on large spatial scales.

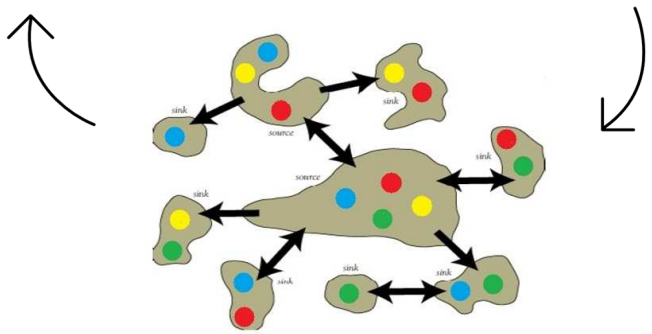
ecological effects at the level of

Community

Ecosystem

WHAT ARE THE EFFECTS OF POLLUTANTS ON THE ECOSYSTEM AND THEREFORE ON BIODIVERSITY?

Ecological concept of (re)colonization



SPATIAL DISTRIBUTION OF ORGANISMS ACCORDING TO POLLUTION

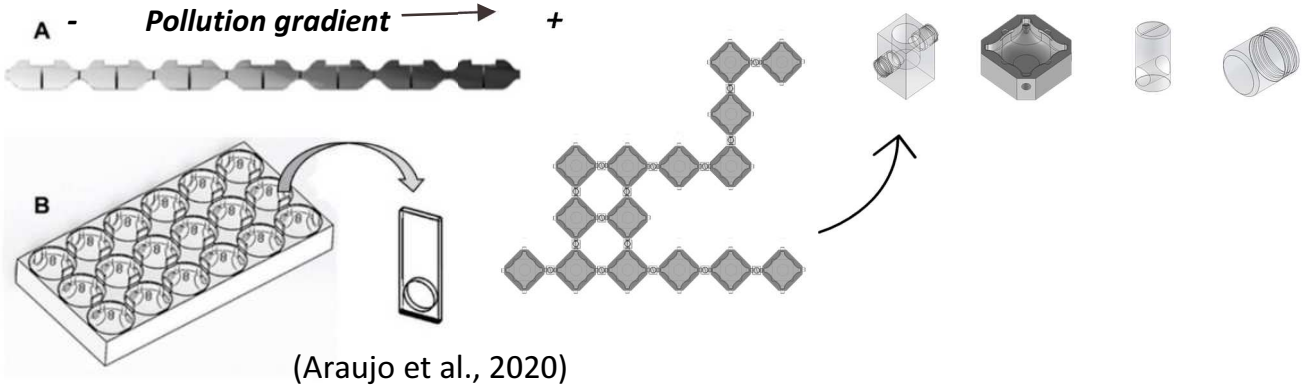
<u>Non-forced multi-compartmentalized exposure systems</u>

→ ecologically relevant

→ chemically heterogeneous environments

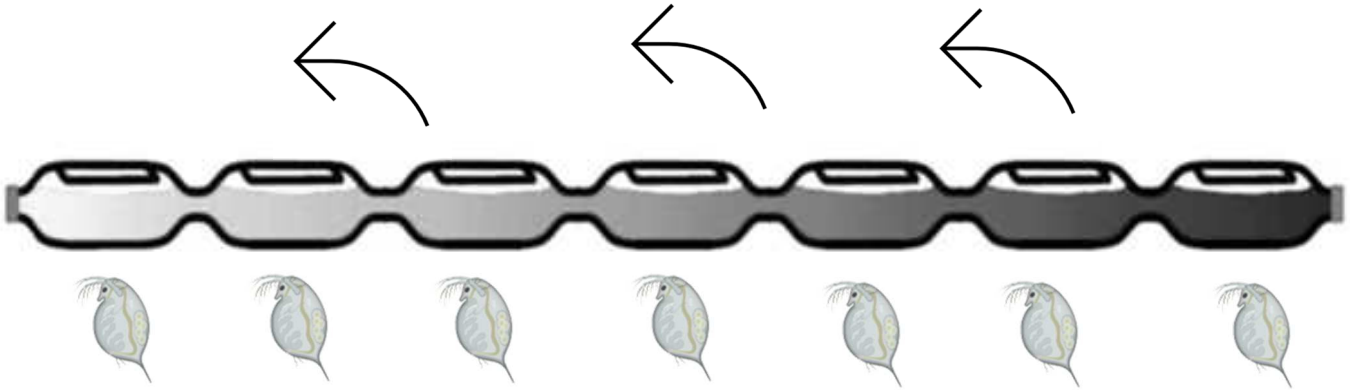
→ avoidance and preference responses linked to actual spatial displacement

(Lopes et al., 2004; Moreira- Santos et al., 2008; Araujo et al., 2016).

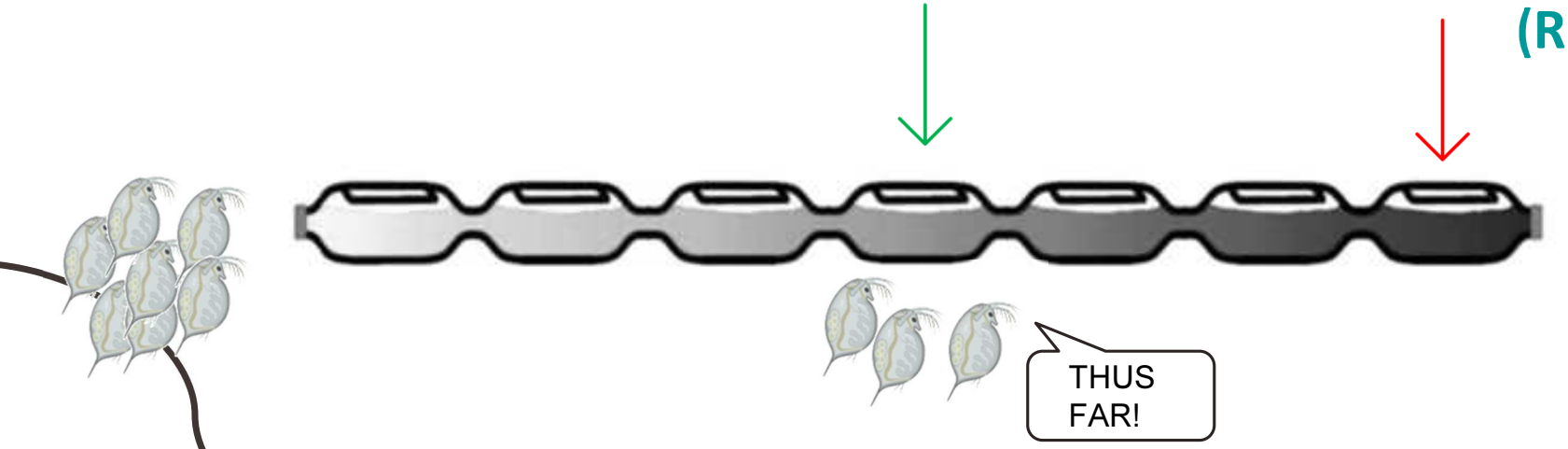


(Araujo et al., 2020)

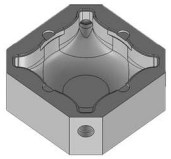
ESCAPE



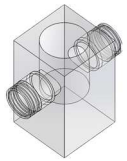
(RE)COLONIZATION



REVIEW AIMS: OPEN FOUR FRONTS OF DISCUSSION



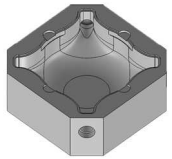
1 The **avoidance-(re)colonization hypothesis** states that stressor-driven migration could predict the extent of population establishment in recovering habitats.



2 **Change** in the **direct relationship between avoidance and (re)colonization** if the contaminated area is more attractive (e.g., food availability or lower predation pressure) than the uncontaminated area to which organisms should migrate.

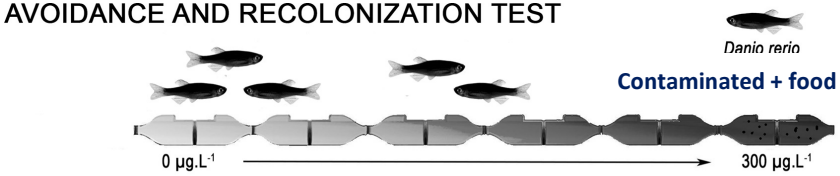
3 **Difficulty predicting** (re)colonization when **pollutants attract** organisms or produce **lethargy.**

4 Use of vertebrate (re)colonization as a **more humane alternative** to lethal assays.



1

Avoidance-(re)colonization hypothesis: states that stressor-driven migration could predict the extent of population establishment in recovering habitats.



(Islam et al., 2019)

Fish moved towards les contaminated areas regardless of the presence of food

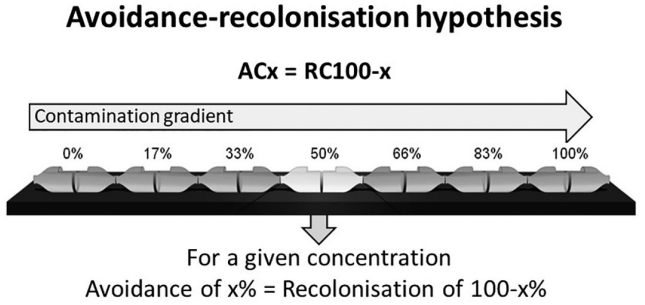
ACx / RC100-x = 2.5

ACx: [ ] which produces an x% avoidance

RCx: [ ] which produces 100-x% (re)colonization

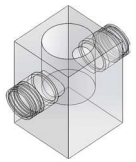
H_0: ACx = RC100-x

(Araujo et al., 2018)



- Recolonization of habitats in recovery (exp. + controlled).
- Reliability of ecological models → improves management decisions.

THE POTENTIAL FOR RECOLONIZATION CAN BE PREDICTED BY AVOIDANCE TESTING IN NON-FORCED EXPOSURE SYSTEMS.



2

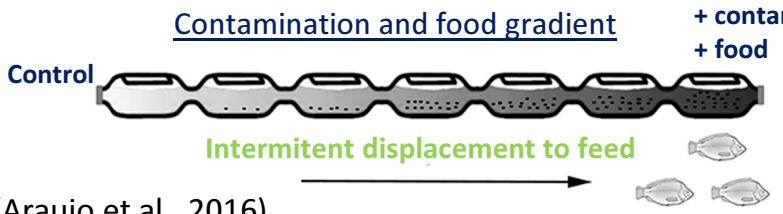
Change in the **direct relationship between avoidance and (re)colonization:** whether the contaminated area is more attractive than the uncontaminated zone to which organisms should migrate.

Cost-benefit balance

↑[ ] acid effluent from the mine → ↑ TSS + organic compounds

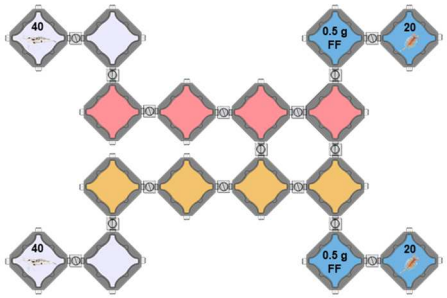
encouragement to explore and colonize new environments

(Araujo et al., 2018)



(Araujo et al., 2016)

1st [ ] dependent avoidance
2nd food → avoidance pattern altered



Copper
Kairomone
Food

Palaemons varians

(Salvatierra et al., 2021)
not published

- Avoidance of high concentrations of copper.
- Preference exposure to copper vs kairomone.
- **(Re)colonization** preference transit zone kairomone vs copper + kairomone.

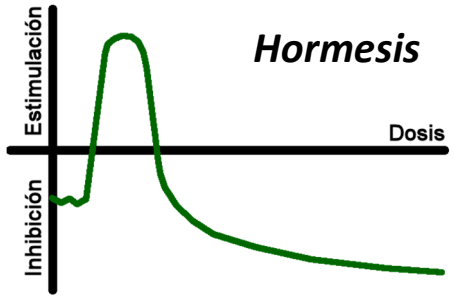
SYNERGISTIC OR ANTAGONISTIC FACTORS

food/contamination/predation

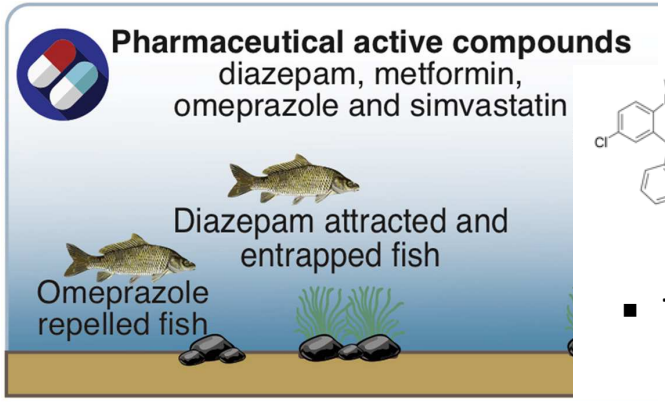
RELEVANT ROLE IN HABITAT CHOICE

3

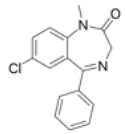
Difficulty predicting (re)colonization: whether pollutants **attract** organisms or produce **lethargy**.



dose-response phenomenon



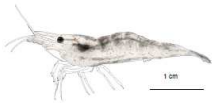
(Jacob et al., 2021)

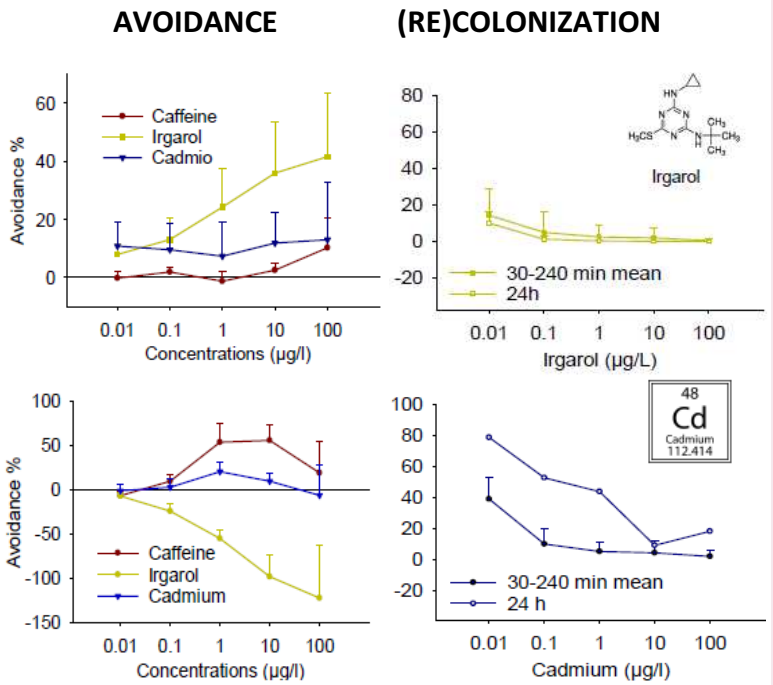


attractive at lethal concentrations!

- The mode of action might determine repellency or attractiveness.

Response variation





toxics

TOXIC ≠ REPELLENT

Review

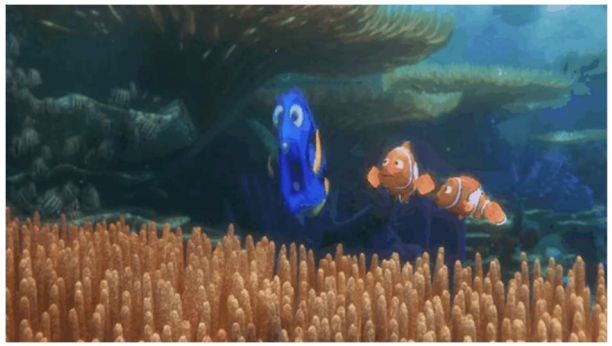
Not Only Toxic but Repellent: What Can Organisms' Responses Tell Us about Contamination and What Are the Ecological Consequences When They Flee from an Environment? (Araujo et al., 2020)

4

Vertebrate (re)colonization trials: a **more humane** alternative to lethal trials.

The consequences of avoidance and (re)colonization) → reduction in population density at the local level

→ response "ecologically analogous to mortality"



ECOLOGICAL Perspective

(concentrations that do not cause the death of organisms)

- critical biodiversity loss
- pollution-driven migration dynamics
- study of new concepts related to habitat colonization

ETHICAL Perspective

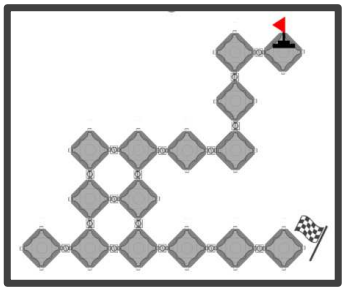
3R

- **Replacement**
- **Reduction**
- **Refinement**

- refining animal experimentation procedures by reducing anxiety, pain, distress

(Re)colonization studies…

1. Bring a **new perspective** on the risk of pollutants related to the alteration of spatial dynamics beyond the classic toxic effects.
2. Provide a **powerful tool** to predict the potential of contaminants to alter habitat.
3. **Assess the habitat selection** (choice between different stimuli) by organisms in scenarios altered by contamination (the cost-benefit balance).
4. Mark differences in the concepts of toxicity and repellency, thus **expanding** the **range of risk scenarios**.
5. Look for a **more ethical** use of vertebrates in ecotoxicology.



Acknowledgments

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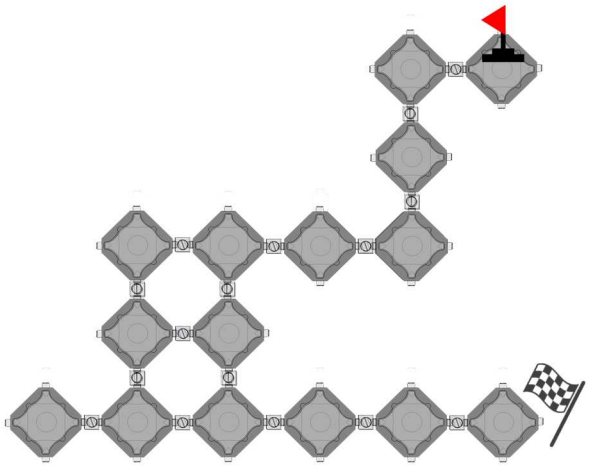
GETTING OVER LETHAL TEST

Thank you for your attention!



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