METHOD DEVELOPMENT FOR MICROPLASTICS TOXICITY TESTING IN SOUTH AFRICAN FRESHWATER RESOURCES

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Introduction

- Plastic production increased dramatically worldwide
- Plastic is defined by its versatility, resistance and durability to degradation
- Degradation of plastic can take up to 100 years
  - It can vary due to typology
  - Oxygen availability
  - Presence of chemical addictive's
- Common polymer types: polypropylene (PP), polyethylene (PE), and polyvinyl chloride (PVC)

Lambert et al. 2017, Rist and Hartmann 2018

Introduction

- Plastic are found to be threat to freshwater and marine environment
  - Not recycled
  - Not properly disposed
- Up to 80% of litter is in plastic form, 10% of it end up to water resources annually
- Plastics can be extensively degraded and become brittle enough to fall apart into microsized powdery fragments

Microplastics in freshwater

- Microplastics are plastic particles with size range of

0.1 µm - 5 mm in size

- Types of microplastics:
  - Primary microplastics are introduced directly into the aquatic ecosystem via runoffs
  - Secondary microplastics are derived from degradation of fragmentation of mesoplastics or larger fragment

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Microplastics in freshwater

- Microplastics are described as emerging pollutants, accumulating aquatic environment all over the world
- They affect aquatic life, ecological processes and food security
- There is a growing evidence about the possible ecological effects of microplastics in freshwater environments

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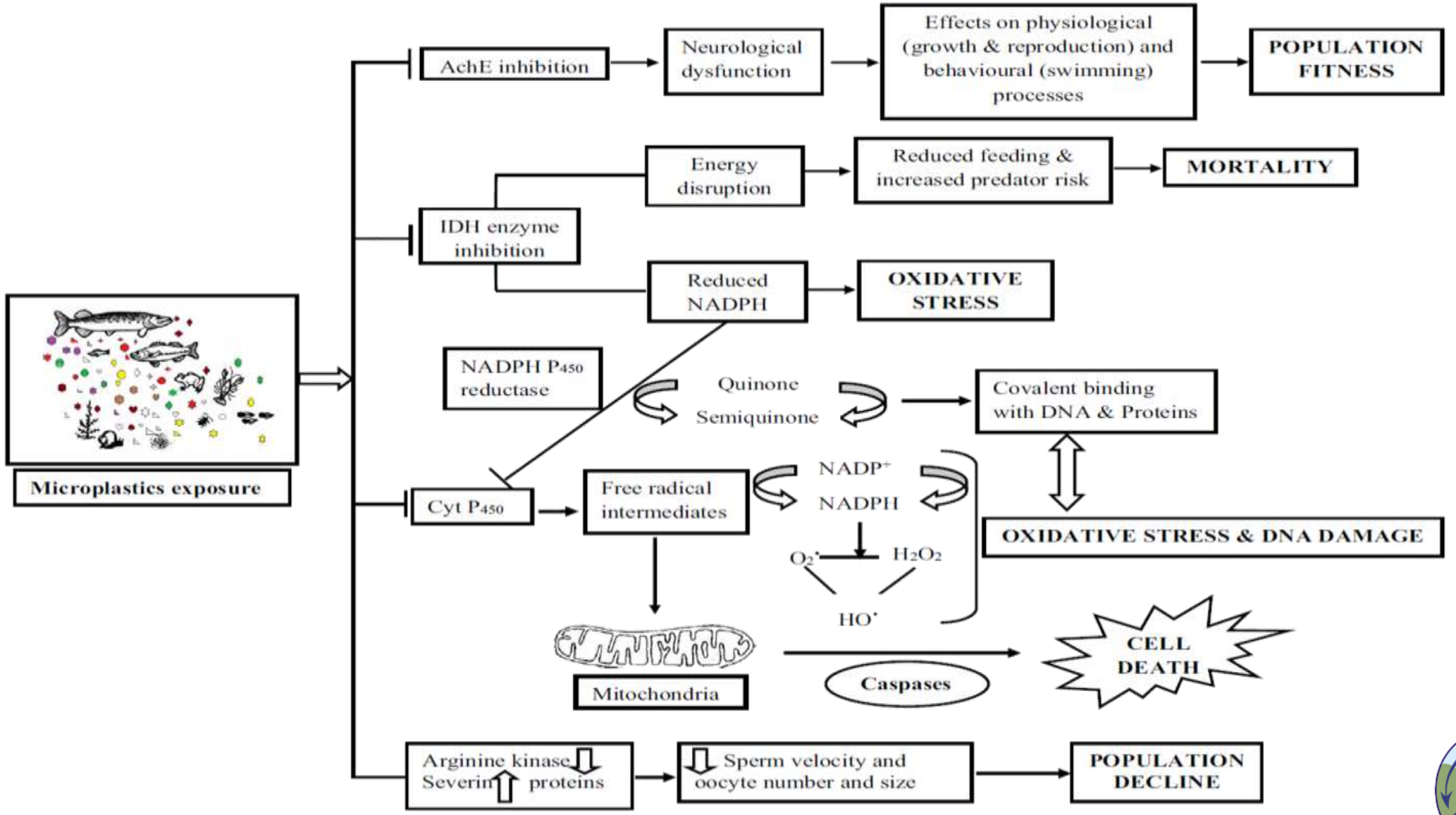

Figure 1 Pathways to the expression of toxicity and population decline following exposure to microplastics. Diagram taken from Anbumani and Kakkar (2018).

Microplastics as stressors

- Microplastics as physical stressor
  - Ingestion and uptake
  - Abrasion of soft and fleshy tissue of organisms
  - Entanglements
  - Microhabitat damage (indirect impact)

Size, shape and type

- Microplastics as chemical stressors (plasticizers):
  - Leaching of potentially toxic plasticizers (additives)
  - Plasticizers such as dibutyl phthalates have been reported to cause deleterious effects in aquatic organisms

- Microplastics as vectors
  - Microplastics bind to potentially toxic chemicals and pathogenic micro-organisms
  - Aid the transport of such toxic chemicals and pathogens

Project aim

- To evaluate the impacts of microplastics as a physical and chemical stressors in freshwater environment.

Specific objectives

- To conduct ecotoxicity test to examine effect of different major plastic types, sizes and shapes found in SA on Zebra fish Danio rerio, shrimps *caridina nilotica* and freshwater snails, *Melanoides tuberculate* and Algae

- To conduct ecotoxicity test to assess effect of selected plasticizers to different aquatic organisms

- To develop methods for toxicity testing to studying microplastics in South African freshwater systems

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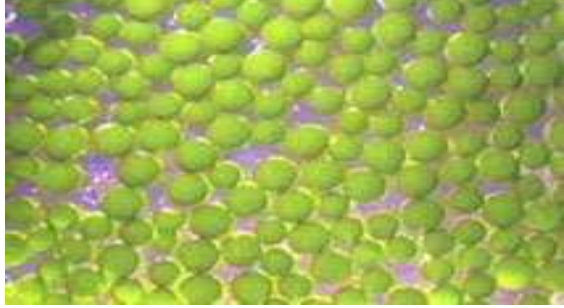
Methodology



Methods for ecotoxicology

- Test species selection
  - Organisms selected from multiple trophic level: freshwater snail *Melanoides tuberculate,* freshwater shrimps C*aridina nilotica,* zebra fish Danio rerio, and algae Selenastrum capricornutum

Methods for ecotoxicology – Objective 1

- **Microplastics as a physical stressor**
  - Microplastics size selection (≤ 20µ m)
  - Shapes - fragments and beads
  - Plastic types: e.g. polyethylene (PE), polypropylene (PP), polyvinyl chloride (PVC)
  - Concentration solutions based on sizes and shapes and predominant plastic type in SA
  - Five concentration each in replicates

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Methodology – objective 2

- Range finding concentration for plasticizers
- Addictive's types: e.g. Bisphenol A, Phthalate and Calcium stearate

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Exposure duration

Short term- 96 hours

- Fish
- Shrimps
- Snails
- LC 50, LC1, LC10 and NEC

Long term – 21 days

- Fish
- Shrimps
- Snails

- Algae – short term 46 hours
  - Long term 96 hours
- NEC and EC50 will be calculated

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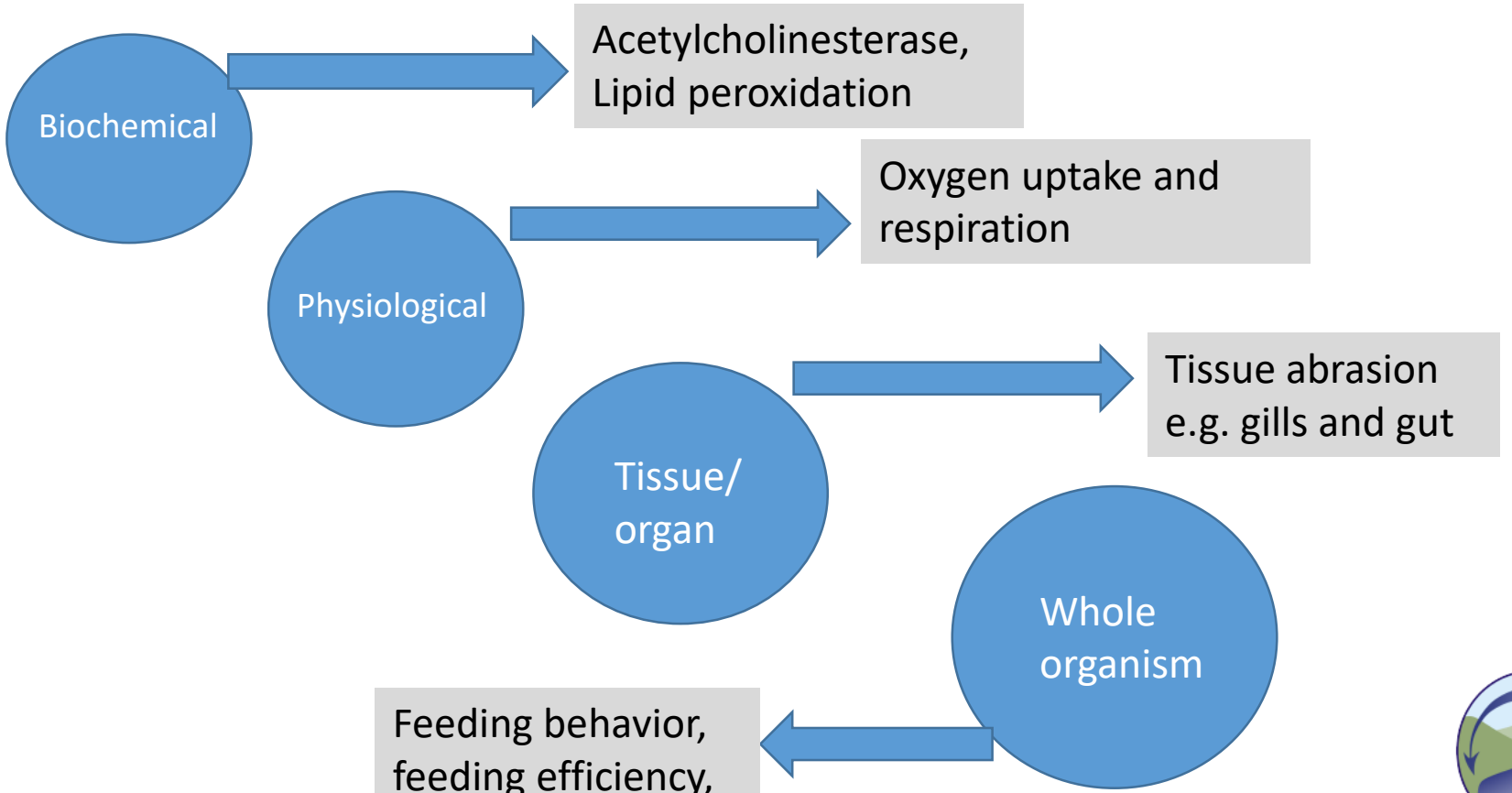
Methodology

End point selection: Chronic and acute effects



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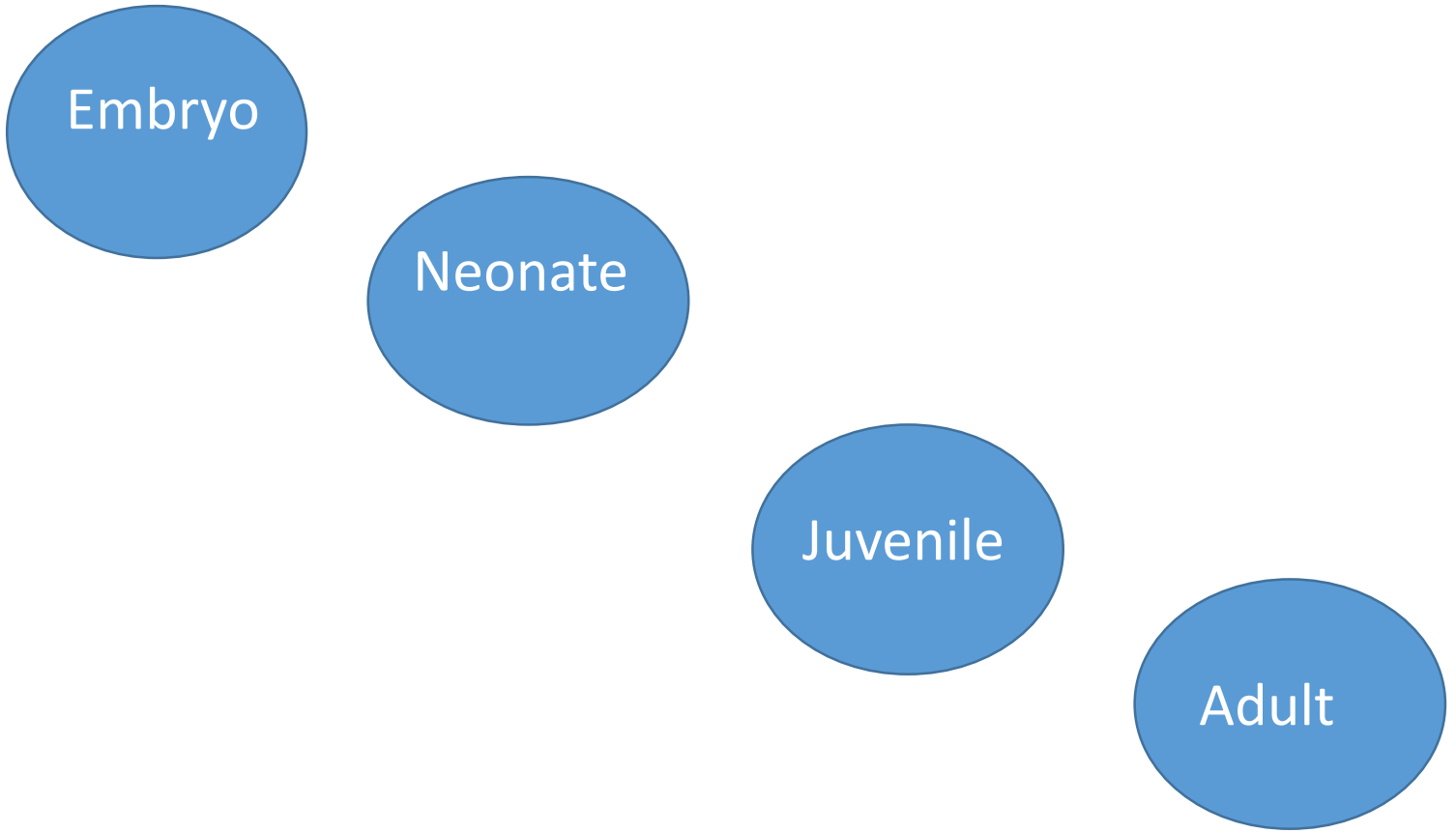
Methodology

Life stages (where applicable) of organisms to be exposed – Shrimp, Fish and Freshwater snails



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Expected Outcomes

- Method to get microplastics in solution
- Develop appropriate toxicity end points
- To develop a protocol or procedures:
  - Microplastics particles
  - Plasticizer
- Methods for ecotoxicity testing of microplastics found in South African freshwater systems

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