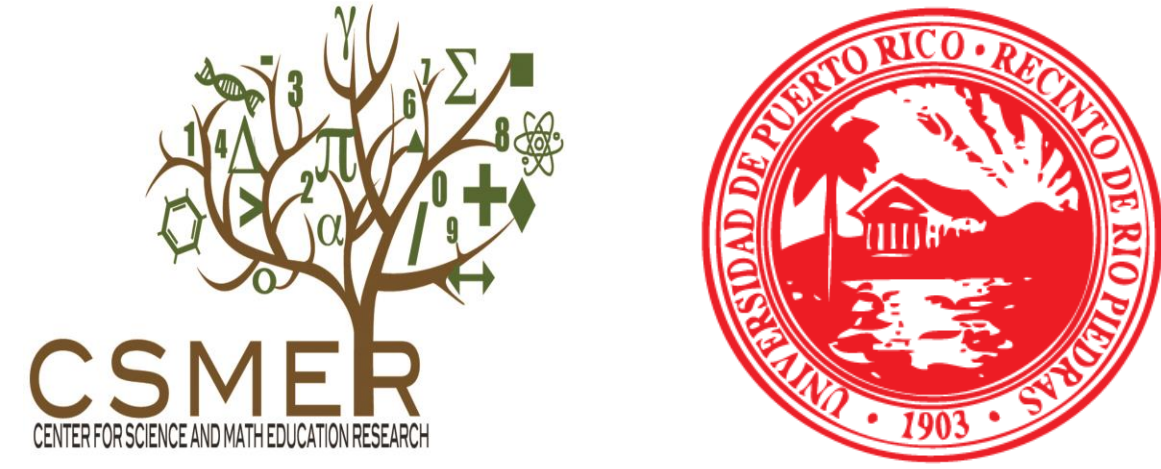


Evaluating the Locomotion Behavioral Response of *Xiphocaris elongata* to Ibuprofen (C₁₃H₁₈O₂) Exposure



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Introduction

Pharmaceutical pollutants in freshwater ecosystems are an emerging environmental concern (Ortúzar, et al., 2022) due their persistence and potential to disrupt aquatic life. Among these pollutants, over-the-counter (OTC) analgesics such as Ibuprofen are becoming progressively prevalent. Ibuprofen (C₁₃H₁₈O₂), a non-steroidal anti-inflammatory drug (NSAID), is commonly used for pain relief and treat inflammation, resulting in its frequent detection in rivers, lakes and streams (Chopra and Kumar, 2020). Its presence in freshwater has detrimental effects on the ecosystem. As a biological active compound, Ibuprofen is not completely removed by conventional water treatment process allowing traces that persists and accumulates continuously in water bodies.

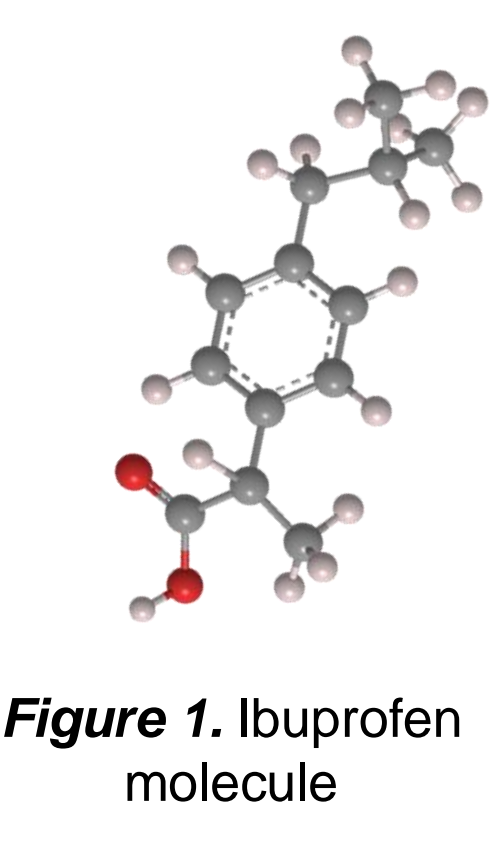


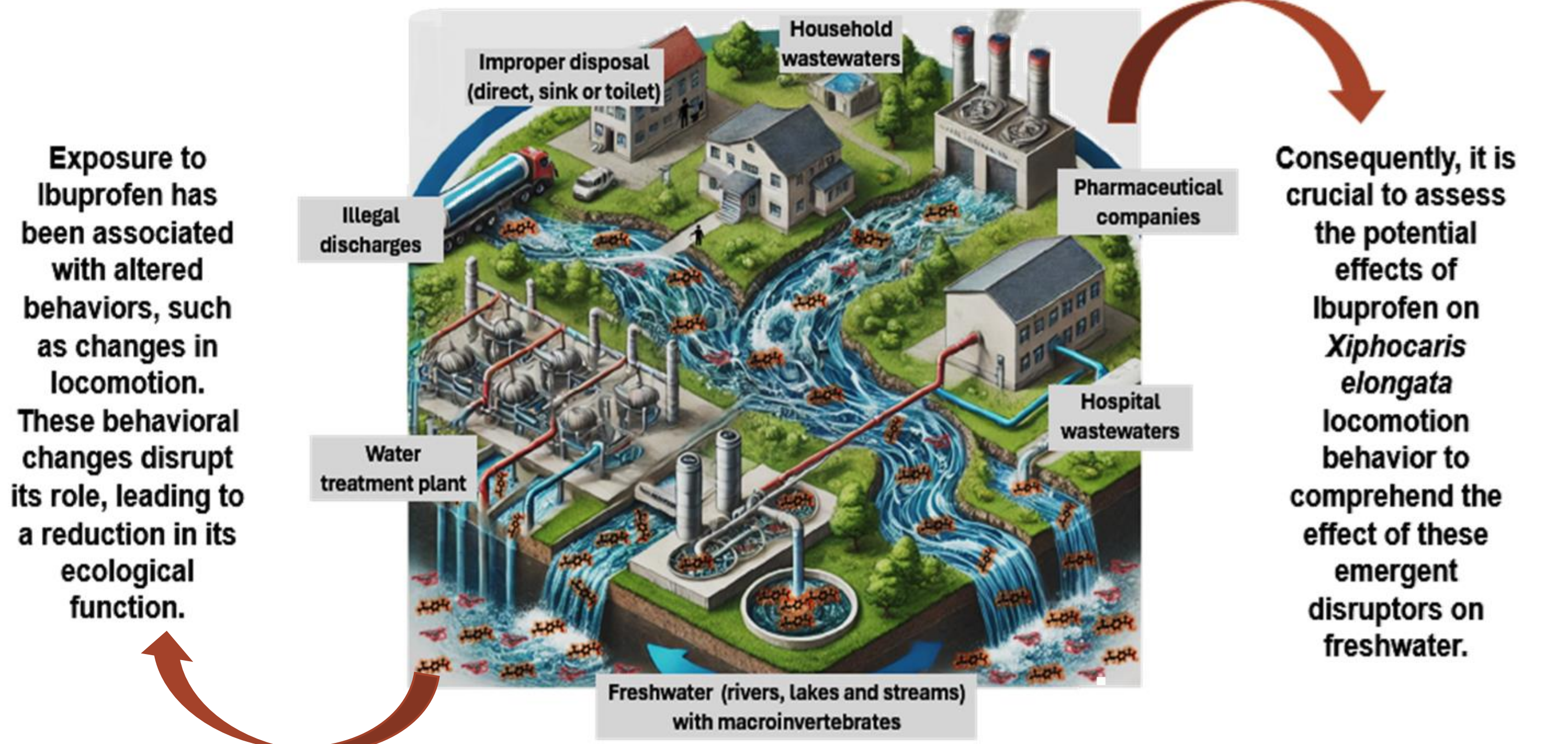
Figure 2. *Xiphocaris elongata*

Studies have shown than even a low concentration of Ibuprofen can impact the behavior, physiology and reproductive success of aquatic organisms, in special for macroinvertebrates (Labuto, et. al., 2022; Jan-Roblero & Cruz-Maya, 2023; Blasco & Trombini, 2023; Mazhandu & Mashifana, 2024). Macroinvertebrates play a crucial role in freshwater as indicators of water quality, essential in food webs energy and ecosystem processes. Once Ibuprofen reaches aquatic environments, it causes detrimental effects on macroinvertebrates, like *Xiphocaris elongata*.

Problem

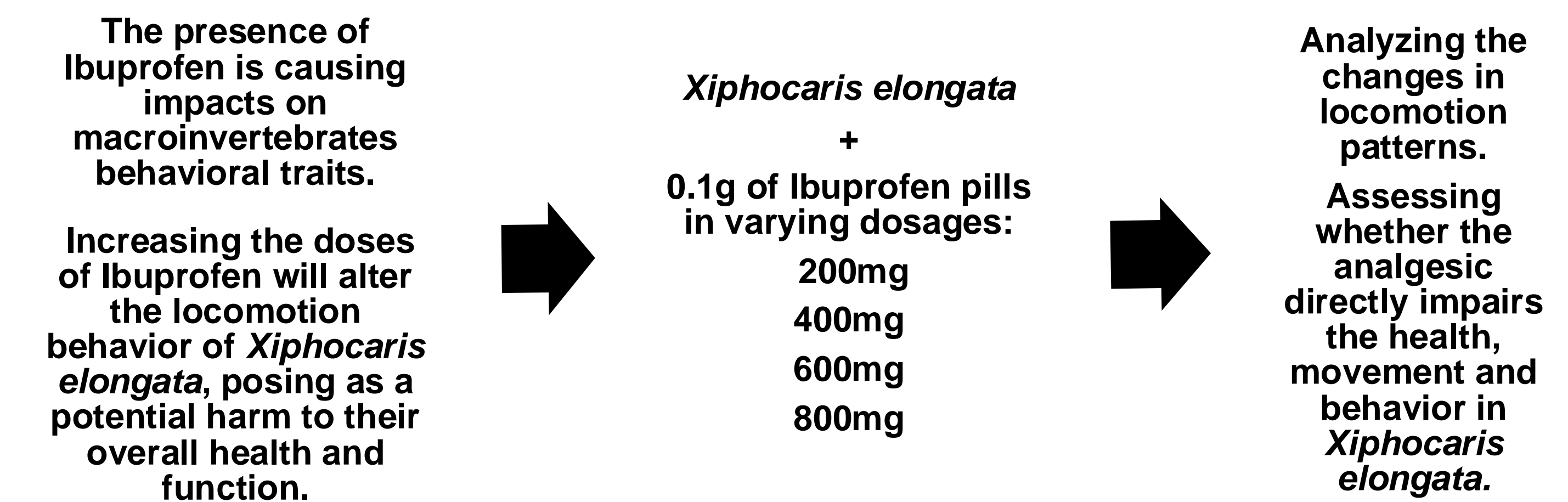
Recent studies have highlighted the emerging presence of OTC analgesics in freshwater and their potencial role in the decline of macroinvertebrate populations, as well as behavioral changes, especially among *Xiphocaris elongata*. The presence of Ibuprofen in lakes, rivers and streams primarily originates from various sources, including household wastewaters, pharmaceuticals companies, illegal discharges, improper disposal by individuals, hospital wastewaters and effluents from water treatment plants.

Figure 3. Pathways through which Ibuprofen enters freshwater.



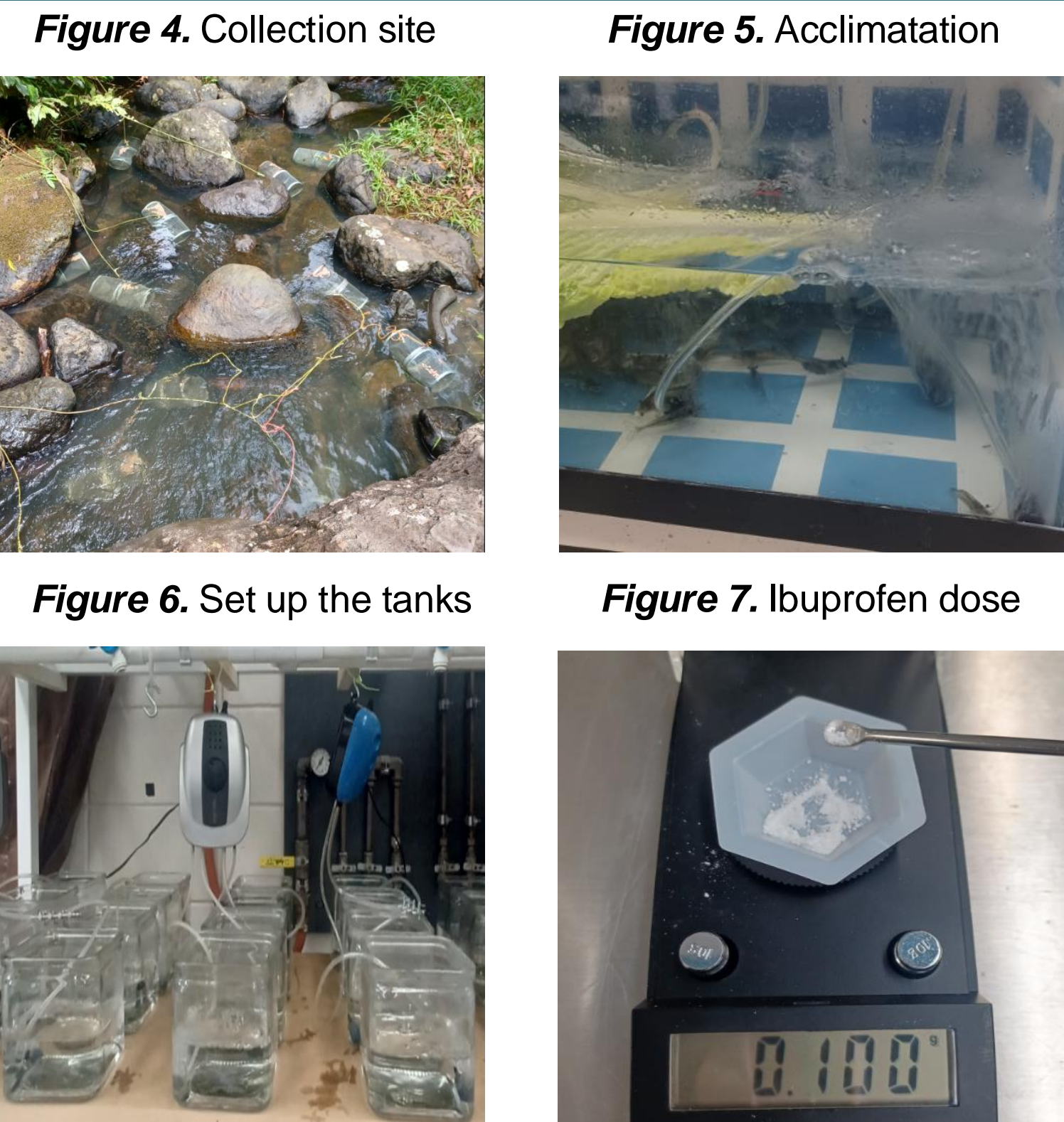
Ibuprofen concentrations (in other countries) ranges from 2 to 10 µg/L; humans secrete 0.1g of Ibuprofen in urine after digestion. Due its poor solubility, Ibuprofen binds with organic materials, accumulates, and contributes to its persistence in freshwater ecosystems.

Hypothesis, Objectives and Justification



Methodology

Phase 1: *Xiphocaris elongata* Collection, Laboratory Acclimatization, and Ibuprofen Preparation



Phase 2: Tank Preparations and Exposure Testing

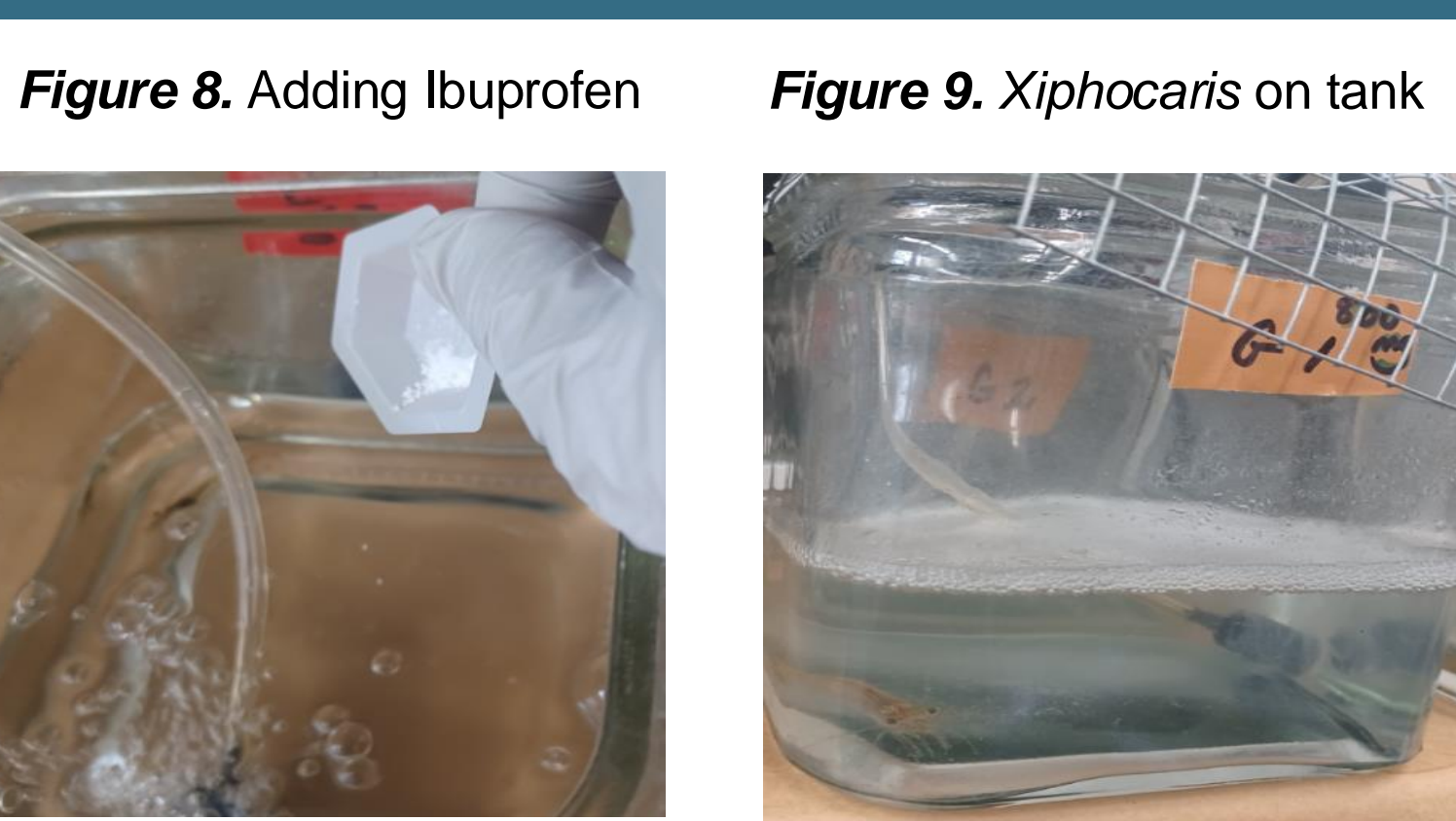
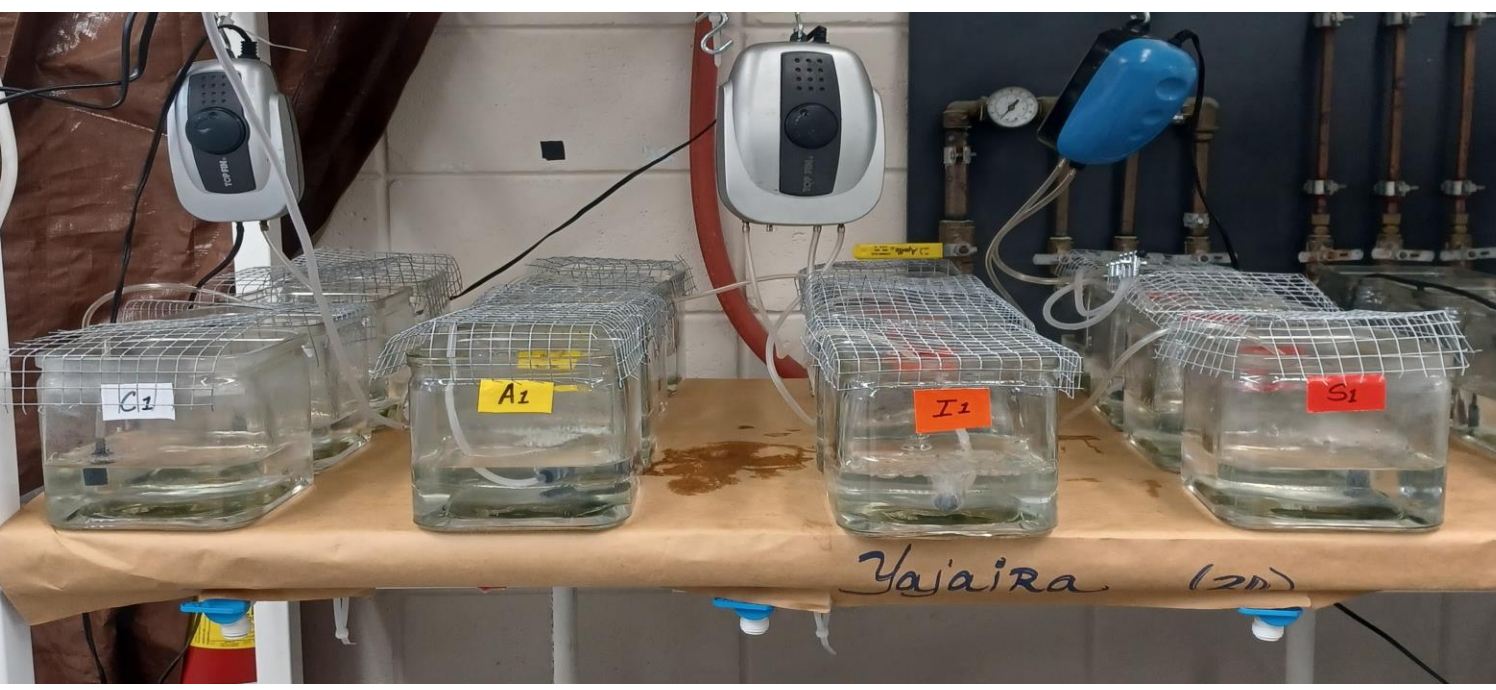


Figure 10. Experimental tanks with Ibuprofen and *Xiphocaris*



Phase 3: Video recording and Locomotion tracking

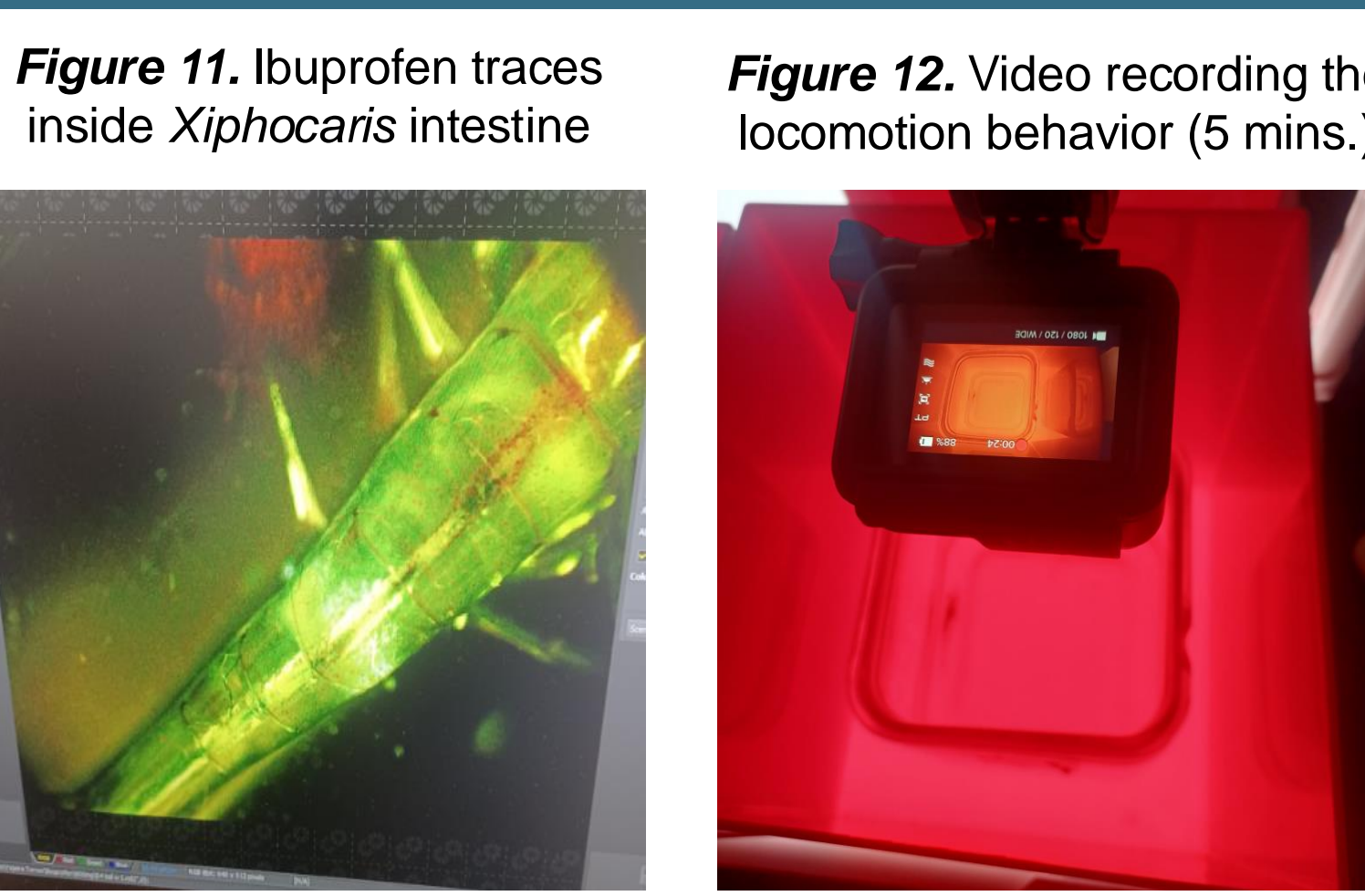
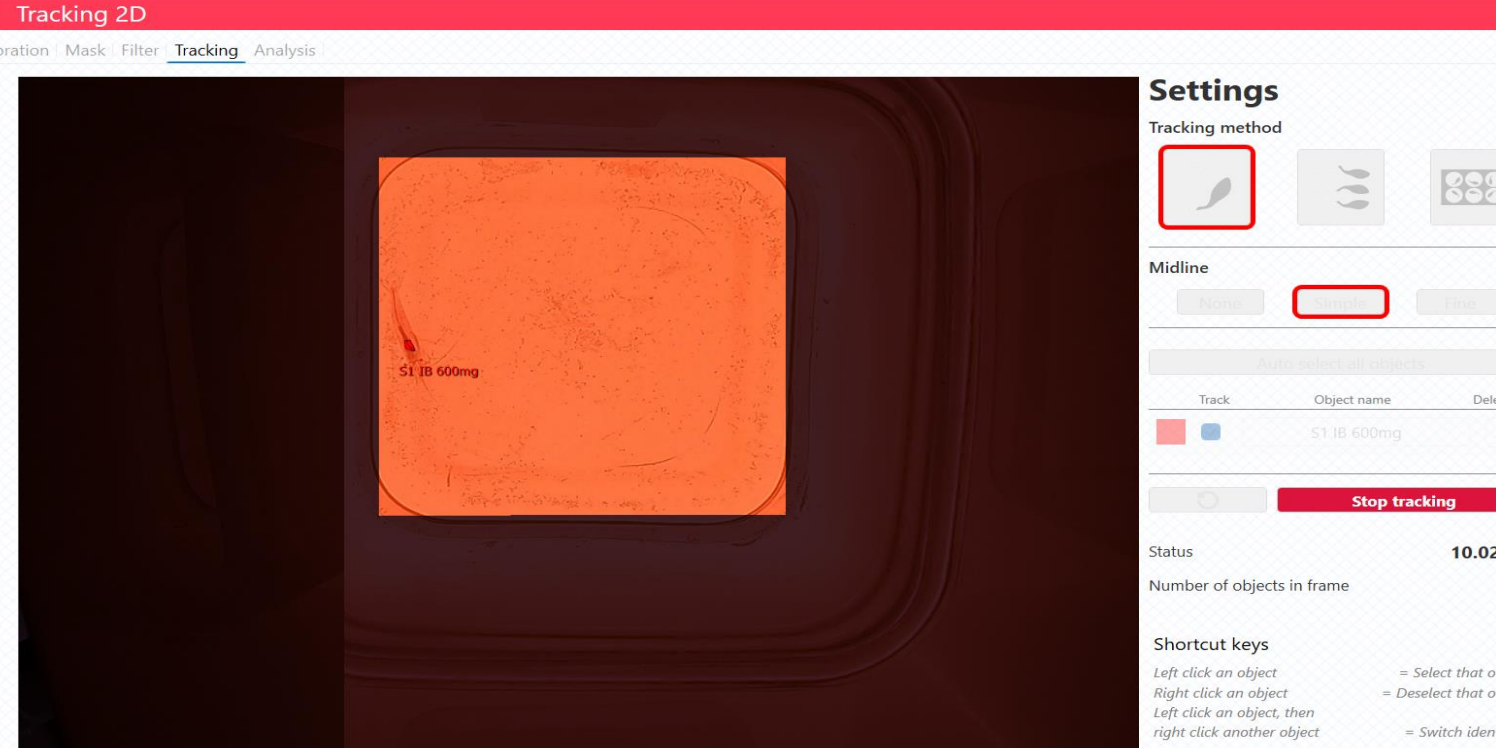
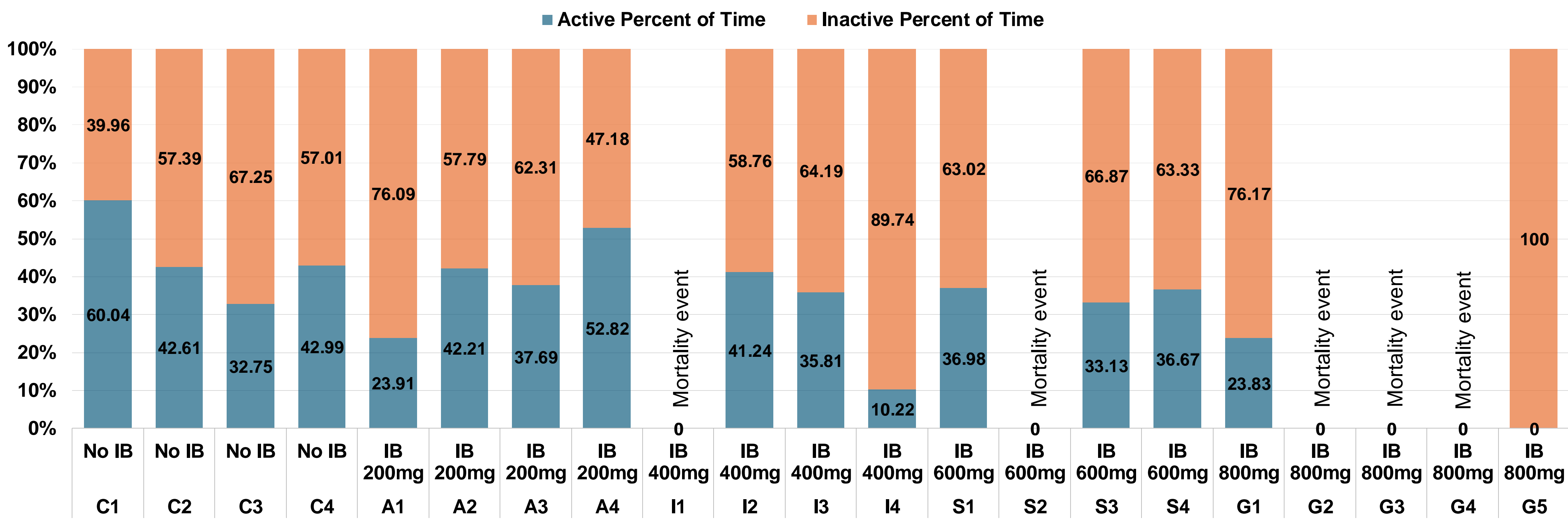


Figure 13. Running and analyzing the *Xiphocaris* locomotion behavior from the recording in LoliTrack v5 software.



Results – *Xiphocaris elongata* Locomotion Response

Table 1. Percentage of activity and inactivity of *Xiphocaris elongata* under different Ibuprofen doses (Exposure - 72 hours)



Results – LoliTrack v5 Heat Maps

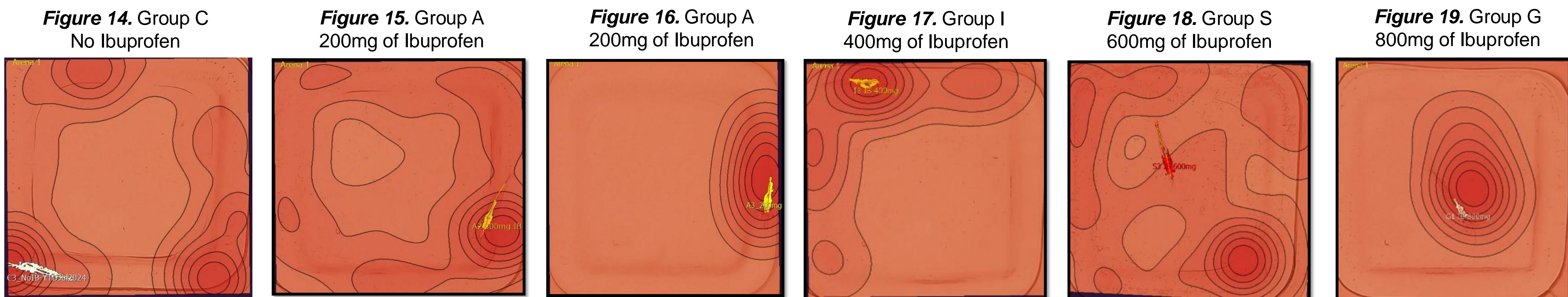
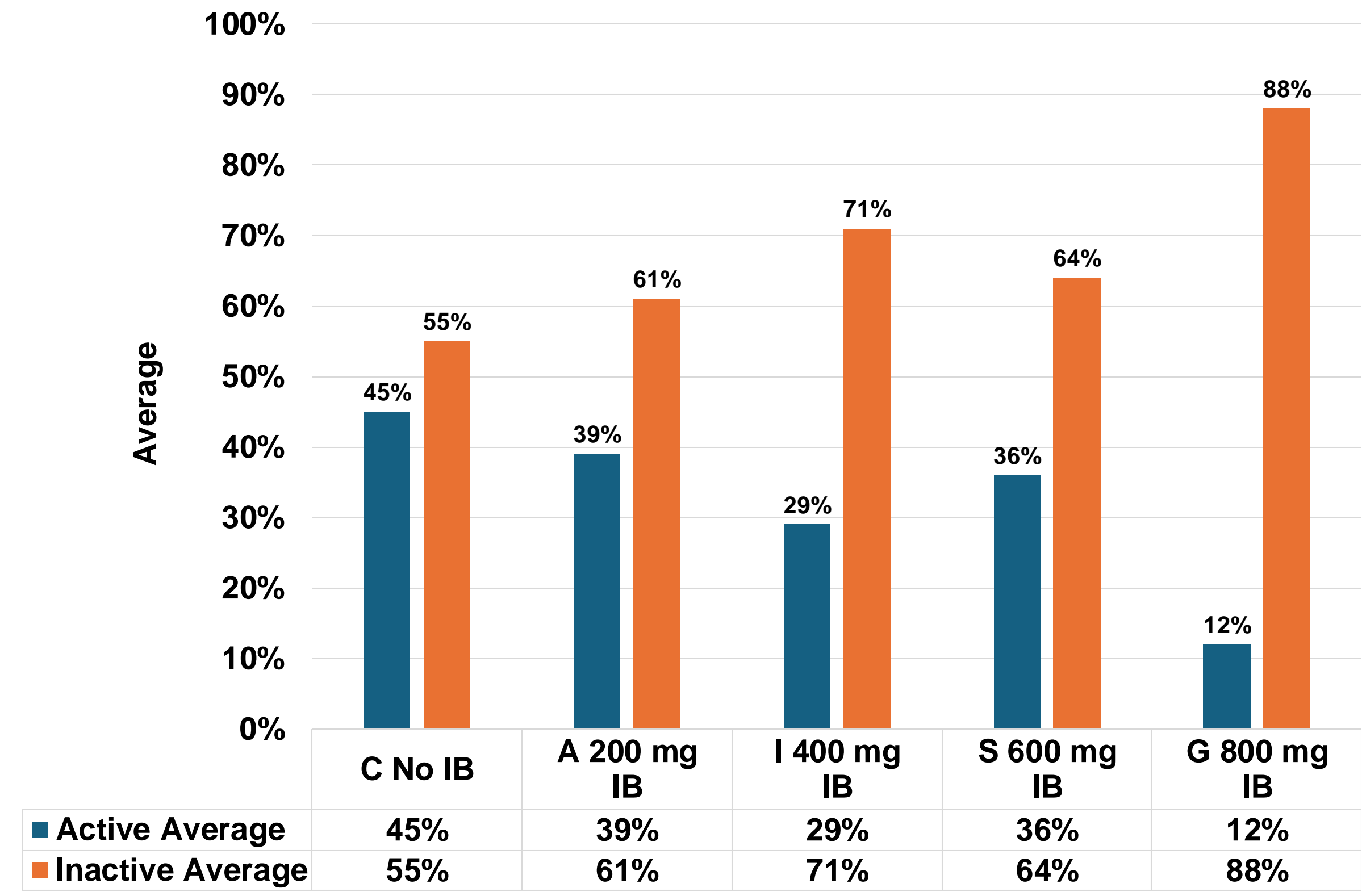


Table 2. Average of activity and inactivity of *Xiphocaris elongata* per Group



- Group C (No IB) – Active behavior is 45%, and inactive behavior was 55%. No deaths occurred, indicating normal baseline behavior without ibuprofen exposure.
- Group A (200 mg IB) – Active behavior was 39%, and inactive behavior was 61%. No deaths occurred, but activity level dropped slightly.
- Group I (400 mg IB) – Active behavior dropped to 29%, and inactivity raised to 71%. A 25% death rate was recorded, suggesting that this dose begins to have some lethal effects on *Xiphocaris*. Locomotion behavior was reduced considerably.
- Group S (600 mg IB) – Active behavior was 36%, and inactive behavior increases was 64%. A 25% death rate was recorded, suggesting that this dose have some lethal effects on *Xiphocaris*.
- Group G (800 mg IB) – Active behavior dropped drastically to 12%, and inactivity reached to 88%. The death rate increased significantly to 60%, indicating a severe toxic effect leading to minimal locomotion behavior and high lethality.

Conclusion and Recommendation

- Data showed that increasing doses of Ibuprofen significantly alter the locomotion behavior of *Xiphocaris elongata*, potentially posing harm to their overall health and function.
- As the Ibuprofen doses were higher, the activity level decreased, showing a corresponding rise in inactivity. The death rate analysis showed a progressive increased in mortality with higher Ibuprofen dosages.
- Further studies should focus on exploring chronic, and cumulative, exposure effects, as well as consider additional behavioral and physiological parameters. The study highlight the potential toxic effects of Ibuprofen on aquatic organisms, emphasizing the need for careful management of pharmaceutical pollutants in aquatic environments

Acknowledgements



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