

Artificial Reef Design: Integrating Biological and Aesthetic Features for Conservation and Water Management



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INTRODUCTION & AIM

The growing disconnection between people, economic activities, and natural ecosystems weakens the relationship with the environment and its intrinsic value. In the face of climate, energy and biodiversity crises, it is essential to seek new approaches to mitigate the negative effects of human practices. This study intends to evaluate the integration of artificial reefs implemented in two ways: in-water (ARIW) and out-of-water (AROW). ARIW has the function of protecting ecosystems and promoting biodiversity, while AROW acts as decorative consumer goods, financing ARIW and increasing consumers environmental awareness. In addition, ARIW can be designed with sensors to monitor aquatic habitats and incorporated into bioactive systems to contribute to water management and purification in hydrological systems.

The objectives include evaluating how this dual approach of artificial reefs with biological and aesthetic characteristics influence communities connection to water ecosystems and increase environmental awareness, examining the viability and durability of the materials used to produce the reefs, and developing guidelines for implementing replicable reefs in different ecological systems and water bodies, also regarding monitoring systems. This project aims at demonstrating how design can be a catalyst for sustainable value chains and innovative business models, promoting conscious consumption, water management and environmental conservation.

METHOD

The methodology covers a literature review, material selection, iterative digital modeling and prototype and testing, with the support of experts in aquatic biology (Fig. 1).

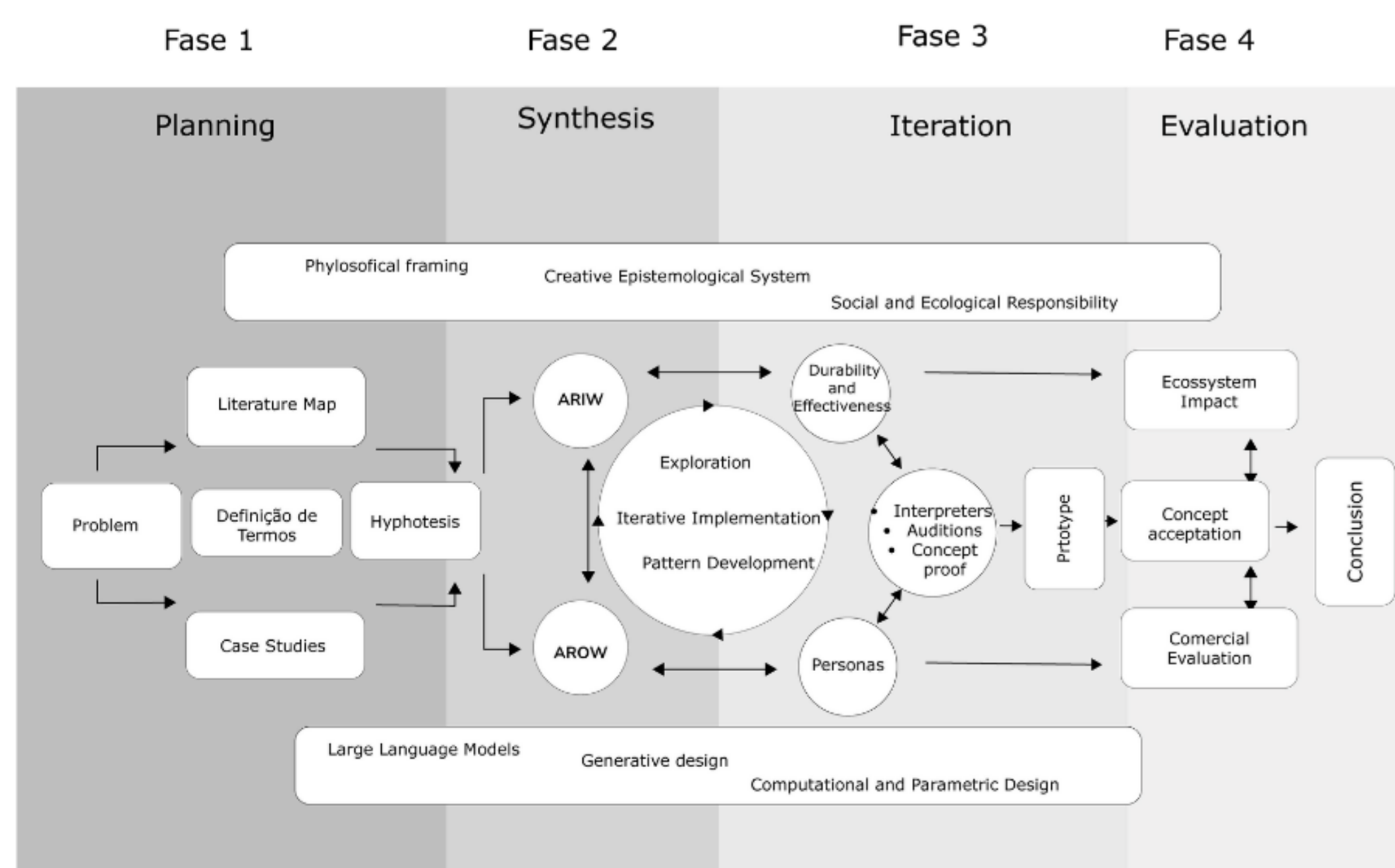


Fig. 1 - Method

After the literature review, critical points and opportunities will be identified for material selection and the development of replicable and applicable patterns. This process will be conducted using sketches and digital modeling, with small-scale intermediate implementations carried out with the support of scientists. For the development of the aesthetic component aimed at human interaction (AROW) concept testing methods with target audiences will be employed (Fig. 2).

RESULTS & DISCUSSION

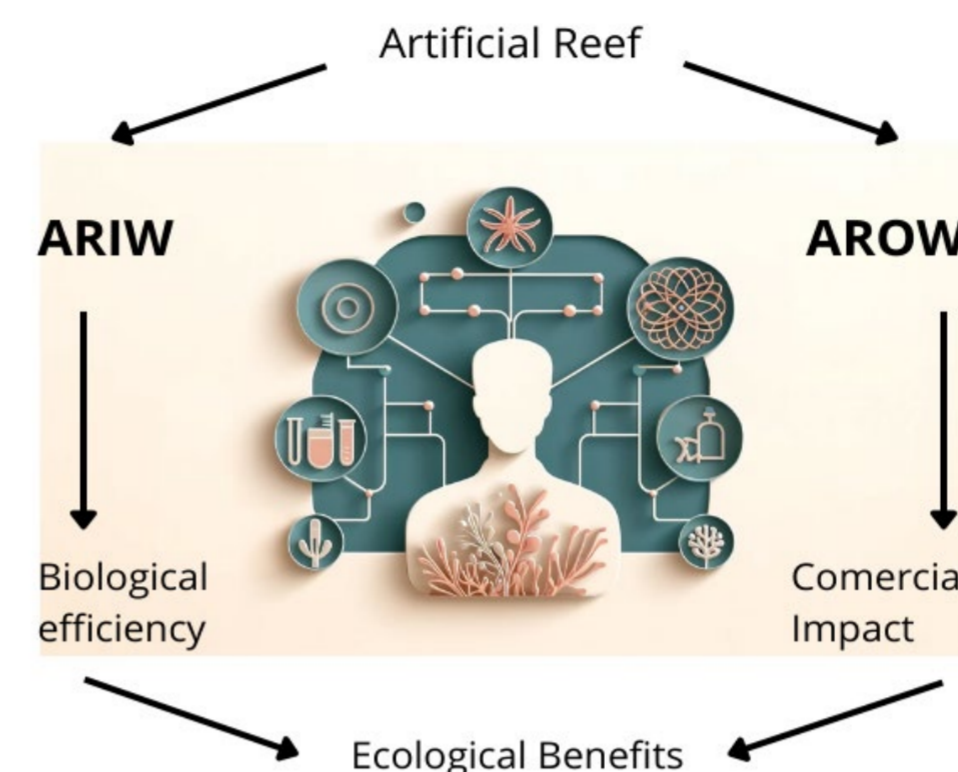


Fig. 2 - Workflow



Fig. 3 - ARIW

The project outcomes for artificial reefs, both underwater (ARIW) (Fig.3) and out of water (AROW), could include:

- **Improved Modeling Processes:** Working with aquatic biologists to adapt artificial reefs for different ecosystems through an iterative, efficient approach (Fig. 4).
- **Monitoring Systems Testing:** perform integration of monitoring systems in ARIW units which include efficient data collection and analysis processes, whether using biological sampling techniques or electronic imaging technology, sensors and artificial intelligence.(Fig 5).
- **Diverse Business Models:** Exploring theoretical models using advertising to target various population groups for wide acceptance, and financing ARIW.
- **Decorative Objects:** Developing decor items AROW (Fig. 6) inspired by artificial reefs, from home decor to accessories like jewelry, fostering emotional ties to marine conservation.

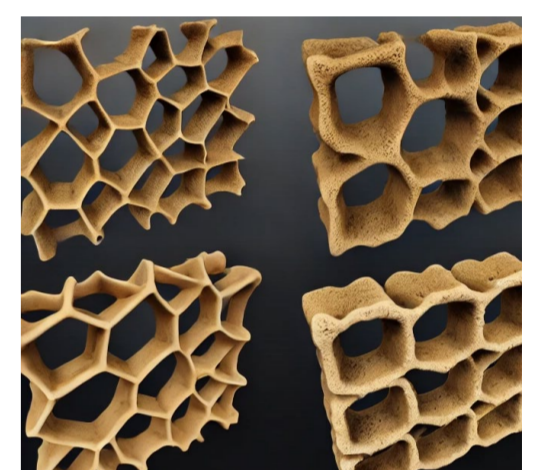


Fig. 4- Iterative process

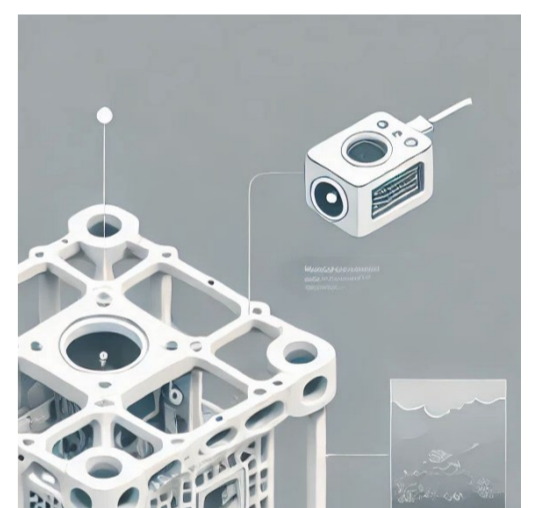


Fig. 5- Monitoring Systems



Fig. 6- AROW

CONCLUSION/FUTURE WORK

Overall, these initiatives aim to be integrated into a sustainable funding model supported by the sales of out of water reefs (AROW) to ensure the financial viability of artificial reefs projects while promoting widespread direct and indirect environmental benefits. The sales revenue will help fund further research and development, ensuring continuous improvement and adaptation of the artificial reefs to meet ecological needs. This project can show how technology, science and design can collaborate to solve environmental challenges and promote balance between humans and the environment generating new value propositions.

Acknowledgments

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