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SUSTAINABLE STRATEGIES FOR THE MANAGEMENT OF ODONATA IN FISH FARMING: REVIEW AND IMPLICATIONS

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ABSTRACT

This study conducted a systematic review of the literature on the predation of Odonata larvae in fish farming, using databases such as Google Scholar and SciELO. The results showed that predation can reduce the survival of fingerlings by up to 30%, impacting the productivity of the nurseries. Alternative control methods, such as natural extracts and entomopathogenic fungi, were analyzed, which proved to be effective without the negative effects of agrochemicals, as well as the use of prey, such as Chironomidae. The research highlighted the importance of sustainable management strategies and the preservation of Odonata's diversity, which are essential for the health of aquatic ecosystems. In addition, the use of water quality monitoring technologies was considered essential to optimize the management of larvae.

Keywords: Chironomidae. Predation. Nurseries.

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INTRODUCTION

Fish farming is an exponentially growing economic activity in Brazil, contributing significantly to the production of animal protein and job creation (PeixeBR, 2023). However, this expansion faces substantial challenges that threaten the sustainability and economic viability of the sector. One of the obstacles is the predation of larvae, post-larvae and fry of fish, especially by larvae of aquatic insects, such as those of the order Odonata. These organisms, popularly known as dragonflies, have morphological and behavioral adaptations that make them efficient predators, and can cause substantial losses in fish ponds (Fonseca et al., 2004; Fortunato et al., 2020).

Studies show that predation by Odonata larvae can negatively impact the survival of fingerlings, reducing the available biomass and, consequently, affecting the productivity of cropping systems. In addition to direct losses, the presence of these predators can increase the operating costs of fish farmers, who are led to invest in control measures that often involve the use of agrochemicals, which can have negative consequences for the aquatic ecosystem and public health (Fortunato., 2020; Queiroz, 2017).

In this context, it is imperative to investigate the interactions between Odonata larvae and fish farming, focusing on the management strategies that can be implemented to mitigate predation. The existing literature points to the need for sustainable approaches that do not compromise the health of the aquatic environment.

This systematic review aims to consolidate the current knowledge on the influence of Odonata larvae on fish farming, analyzing the effectiveness of the available control methods and the implications of each approach for the sustainability of the sector. Through the analysis of relevant articles, it is expected to identify gaps in research and propose directions for future studies.

MATERIALS AND METHODS

BIBLIOGRAPHIC SURVEY

The bibliographic survey was carried out in four widely recognized academic databases: Google Scholar, SciELO, ScienceDirect and PubMed. The search was structured using keywords related to the interaction between Odonata larvae and fish farming, such as "predation by Odonata", "aquatic insect larvae in fish ponds" and "control of predation in fish farming". The search period covered articles published in the last 20 years, prioritizing the most recent studies that contributed to an updated understanding of the topic.

INCLUSION AND EXCLUSION CRITERIA

Considering the scarcity of studies specifically focused on the interaction between Odonata larvae and fish farming, a broad inclusion criterion was chosen, without the application of strict exclusion criteria. Thus, all relevant articles found were considered for analysis, regardless of their experimental design or methodology. This approach allowed for a more comprehensive exploration of the available evidence, capturing a broader spectrum of data on predation and control.

LITERATURE ANALYSIS

The analysis of this literature was carried out in a detailed way to enable the understanding of Odonata predation in fish farming, from its control methods focused on the sustainability of the sector to alternatives for the sector.

PRESTATION BY ODONATA

Odonata larvae are notable predators, feeding on small aquatic organisms, including fish fry. This predatory ability can result in significant losses for fish farmers, with studies indicating that predation can reduce fry survival by up to 30% (Corbet, 1999; Fonseca et al., 2004). These impacts raise concerns about the long-term sustainability of fish farming.

Soares et al. (2003), evaluated the predation of curimba post-larvae by different sizes of Odonata larvae. The results showed an increase in the number of curimba post-larvae consumed with the increase in the size of Odonata larvae, indicating that larger larvae are more effective predators. This effect on the fingerling population reinforces the need for management strategies that consider size dynamics and predation in aquatic environments, highlighting the importance of a balance between predators and prey.

Lacerda et al., 2011, evaluated the survival of P*. mesopotamicus* and *O. niloticus larvae* in relation to predation by *Pantala flavescens* of different sizes. We used 120 fish larvae and 24 Odonata larvae in 2 L aquariums, with fish larvae counts every 3 hours. The larval consumption by the intermediate-sized Odonatas was slightly higher, but without statistically significant difference. In contrast, larger Odonata larvae had lower consumption of fish larvae.

THE DIVERSITY OF ODONATA AND ITS ECOLOGICAL IMPLICATIONS

The diversity of Odonata in fish farming environments is fundamental for the dynamics of aquatic ecosystems. The research by Garcia Junior et al. (2021) in Amapá highlights the role of these species in regulating populations of other aquatic insects. The

presence of a rich and balanced diversity is crucial for the health of ecosystems (de Faria et al., 2022; Lacerda et al., 2023). When this biodiversity is threatened, an ecological collapse can occur that not only affects fish farming, but also water quality and the integrity of aquatic habitats.

The conservation of biodiversity in fish farming ponds should be a priority. Fortunato et al. (2021) identified 12 genera of Odonata in nurseries in southern Minas Gerais, with *Miathyria* and *Erythemis* being the most relevant. Understanding the characteristics of each gender and their food preferences allows for more targeted management, which is essential to mitigate predation.

Fonseca et al. (2004), on the other hand, highlight the presence of *Pantala*, as the most predominant genus in fish farming tanks in the central region of Minas Gerais, demonstrating again the abundance of Libellulidae in these environments.

IMPACTS OF AGROCHEMICALS AND THE NEED FOR SUSTAINABLE METHODS

Although Odonata predation is challenging, Queiroz (2017) noted that the use of agrochemicals, such as Cypermethrin and methyl parathion, may offer a temporary solution. However, these chemicals also raise concerns about water contamination and fish health. The side effects on aquatic biodiversity are undeniable. The search for more sustainable control methods is urgent. For example, Tomazelli et al. (2011) demonstrated that Melia azedarach extract is effective in reducing Neuraeschna larvae, suggesting natural alternatives for management.

The study by Cesnik and Queiroz (2004) proposed the use of entomopathogenic fungi (*Beauveria bassiana*, *Metarhizium anisopliae* and *Verticillium lecanii*) as a sustainable alternative for the control of these pests.

Integrated and sustainable management is vital to minimize the impacts of Odonata larvae. The introduction of Chironomidae species, as suggested by Fortunato et al. (2023), may divert attention from Odonata larvae, increasing the supply of available prey and reducing predation on fingerlings. This approach not only decreases predatory pressure, but also enriches biodiversity and the resilience of the aquatic ecosystem.

In addition, biological control practices and the conscious management of aquatic habitats are essential. Creating diverse environments that favor coexistence between predators and their prey promotes a healthy aquatic system. Water quality management and monitoring of the health of aquatic organisms are critical to ensuring that management practices do not result in unwanted adverse effects.

ECONOMIC CONSIDERATIONS AND SUSTAINABILITY

The economic losses associated with predation by Odonata are a growing concern for fish farmers, directly impacting the profitability of operations. Developing sustainable management practices not only helps to reduce these losses but also promotes the health of aquatic ecosystems.

Education and training of fish farmers on ecological interactions and best management practices are key to responsible production.

In addition, raising awareness about the importance of biodiversity and ecosystem health is vital. Investments in research and innovation, focusing on biological control techniques and sustainable management, can provide significant economic benefits in the long term. Therefore, fish farmers should take a proactive approach towards Odonata management, ensuring a balance between production and conservation.

THE ROLE OF TECHNOLOGY AND RESEARCH IN SUSTAINABLE FISH FARMING

Technological advancement in fish farming offers new prospects for the sector (Zhao et al., 2021). In recent decades, innovations such as water quality monitoring sensors, precision aquaculture techniques and ecosystem modeling have made it possible to improve management practices and with research, this can be included for the management of Odonata larvae in aquaculture production systems.

Integrating real-time data on fish health and the presence of Odonata can facilitate rapid and informed interventions, minimizing losses and promoting a healthy aquatic environment. In addition, ongoing research into the biology and ecology of Odonata larvae is critical. Understanding the dynamics of their populations and their interactions with the aquatic environment can provide valuable insights for the development of more effective management strategies.

CONCLUSION

Fish farmers face complex and multifaceted challenges related to predation by Odonata. Factors such as resistance to the use of bioinsecticides, variability in Odonata populations, and climate change affecting aquatic ecosystems require an adaptive and innovative approach.

To address these challenges, future research should focus on new technologies and methodologies for managing Odonata larvae. This includes the development of specific traps and the detailed analysis of trophic interactions. The implementation of biodiversity

monitoring programs in fish farming environments is equally necessary, as it can provide valuable data on the population dynamics of Odonata, allowing fish farmers to make informed and effective decisions.

Collaboration between researchers, fish farmers, and government agencies is essential for the development of policies and practices that promote the sustainability and health of aquatic ecosystems. The impact of Odonata larvae on fish farming is a complex phenomenon that requires a multidisciplinary and integrated approach. Predations by these larvae can cause significant losses, making it crucial to develop effective and sustainable control strategies.

The search for a balance between fish production and environmental conservation is fundamental. Future research should focus on innovative and sustainable methods for the management of Odonata in aquaculture systems, ensuring that production occurs in a responsible and ecologically balanced manner.

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