



Managing the Microbial Community of Marine Fish Larvae: A Holistic Perspective for Larviculture

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OPEN ACCESS

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Specialty section:

This article was submitted to
Aquatic Microbiology,
a section of the journal
Frontiers in Microbiology

Received: 26 February 2018

Accepted: 19 July 2018

Published: 27 August 2018

Citation:

Vadstein O, Attramadal KJK, Bakke I,
Forberg T, Olsen Y, Verdegem M,
Giatsis C, Skjermo J, Aasen IM,
Gatesoupe F-J, Dierckens K,
Sorgeloos P and Bossier P (2018)
Managing the Microbial Community of
Marine Fish Larvae: A Holistic
Perspective for Larviculture.
Front. Microbiol. 9:1820.
doi: 10.3389/fmicb.2018.01820

The availability of high-quality juveniles is a bottleneck in the farming of many marine fish species. Detrimental larvae-microbe interactions are a main reason for poor viability and quality in larval rearing. In this review, we explore the microbial community of fish larvae from an ecological and eco-physiological perspective, with the aim to develop the knowledge basis for microbial management. The larvae are exposed to a huge number of microbes from external and internal sources in intensive aquaculture, but their relative importance depend on the rearing technology used (especially flow-through vs. recirculating systems) and the retention time of the water in the fish tanks. Generally, focus has been on microbes entering the system, but microbes from growth within the system is normally a substantial part of the microbes encountered by larvae. Culture independent methods have revealed an unexpected high richness of bacterial species associated with larvae, with 100–250 operational taxonomic units associated with one individual. The microbiota of larvae changes rapidly until metamorphosis, most likely due to changes in the selection pressure in the digestive tract caused by changes in host-microbe and microbe-microbe interactions. Even though the microbiota of larvae is distinctly different from the microbiota of the water and the live food, the microbiota of the water strongly affects the microbiota of the larvae. We are in the early phase of understanding larvae-microbe interactions *in vivo*, but some studies with other animals than fish emphasize that we so far have underestimated the complexity of these interactions. We present examples demonstrating the diversity of these interactions. A large variety of microbial management methods exist, focusing on non-selective reduction of microbes, selective enhancement of microbes, and on improvement of the resistance of larvae against microbes. However, relatively few methods have been studied extensively. We believe that there is a lot to gain by increasing the diversity of approaches

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Table of Contents Larviculture Of Marine Fish Problems And Perspectives

1. Understanding the eBook Larviculture Of Marine Fish Problems And Perspectives
 - The Rise of Digital Reading Larviculture Of Marine Fish Problems And Perspectives
 - Advantages of eBooks Over Traditional Books
2. Identifying Larviculture Of Marine Fish Problems And Perspectives
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Larviculture Of Marine Fish Problems And Perspectives
 - User-Friendly Interface
4. Exploring eBook Recommendations from Larviculture Of Marine Fish Problems And Perspectives
 - Personalized Recommendations
 - Larviculture Of Marine Fish Problems And Perspectives User Reviews and Ratings
 - Larviculture Of Marine Fish Problems And Perspectives and Bestseller Lists
5. Accessing Larviculture Of Marine Fish Problems And Perspectives Free and Paid eBooks
 - Larviculture Of Marine Fish Problems And Perspectives Public Domain eBooks
 - Larviculture Of Marine Fish Problems And Perspectives eBook Subscription Services
 - Larviculture Of Marine Fish Problems And Perspectives Budget-Friendly Options

6. Navigating Larviculture Of Marine Fish Problems And Perspectives eBook Formats
 - ePub, PDF, MOBI, and More
 - Larviculture Of Marine Fish Problems And Perspectives Compatibility with Devices
 - Larviculture Of Marine Fish Problems And Perspectives Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Larviculture Of Marine Fish Problems And Perspectives
 - Highlighting and Note-Taking Larviculture Of Marine Fish Problems And Perspectives
 - Interactive Elements Larviculture Of Marine Fish Problems And Perspectives
8. Staying Engaged with Larviculture Of Marine Fish Problems And Perspectives
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Larviculture Of Marine Fish Problems And Perspectives
9. Balancing eBooks and Physical Books Larviculture Of Marine Fish Problems And Perspectives
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Larviculture Of Marine Fish Problems And Perspectives
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Larviculture Of Marine Fish Problems And Perspectives
 - Setting Reading Goals Larviculture Of Marine Fish Problems And Perspectives
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Larviculture Of Marine Fish Problems And Perspectives
 - Fact-Checking eBook Content of Larviculture Of Marine Fish Problems And Perspectives
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
 - Integration of Multimedia Elements

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