



Health Challenges in Mud Crab Farming: An Overview of Diseases and Control Measures

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Mud crab (*Scylla* spp.) aquaculture has emerged as a rapidly expanding sector in tropical coastal regions due to its high economic value, nutritional importance, and livelihood support for coastal communities. However, the sustainability and productivity of this sector are increasingly threatened by a complex interplay of infectious and non-infectious diseases. This article provides a comprehensive overview of diseases affecting mud crab culture, integrating current knowledge on bacterial, viral, fungal, parasitic, and environmental stress-related disorders. Bacterial infections such as shell disease and vibriosis, viral pathogens including White Spot Syndrome Virus (WSSV), and fungal infections like *Lagenidium* and *Fusarium* significantly contribute to larval and adult mortality. Parasitic infestations and non-infectious conditions, including moulting abnormalities and environmental stress, further exacerbate production losses. Disease outbreaks are strongly influenced by poor water quality, inadequate nutrition, high stocking densities, and climate-driven environmental fluctuations, which compromise crab immunity and survival rates. Emerging pathogens and zoonotic bacteria also pose risks not only to aquaculture productivity but to public health through handling and consumption pathways. In addition, constraints such as limited seed supply, lack of formulated feed, and insufficient farmer training further hinder sustainable development of mud crab farming systems. This review emphasizes that effective disease management requires an integrated approach combining improved biosecurity, water quality management, scientific farming practices, and enhanced hatchery technologies. Strengthening institutional support, farmer awareness, and research on disease diagnostics and prevention is essential to mitigate risks. Ultimately, sustainable mud crab aquaculture depends on maintaining crab health, minimizing disease outbreaks, and adapting farming practices to changing environmental conditions, thereby ensuring long-term economic viability and ecological balance in coastal aquaculture systems.

Keywords: Mud crab culture; *Scylla* spp.; Disease management; WSSV; Pathogens; Aquaculture sustainability

Introduction

Mud crabs (*Scylla* spp.) represent one of the most commercially valuable crustacean resources in India and across tropical and subtropical regions worldwide. Their high market demand, nutritional value, and export potential have positioned mud crab aquaculture as an important component of coastal livelihoods and food security. Over the past few decades, aquaculture of mud crabs has expanded considerably in several Asian countries, particularly India, where traditional farming practices have evolved into economically significant small-scale enterprises. The predominant culture method in India involves the fattening of soft-shelled or recently moulted crabs, wherein individuals are held under controlled conditions for a short

duration to enhance their marketability. This relatively simple and low-input system has contributed to the development of a dynamic and sustainable aquaculture sector in many coastal regions. Species belonging to the genus *Scylla* are particularly valued due to their large body size, high meat yield, and premium market price both domestically and internationally. Among them, *Scylla tranquebarica* and *S. serrata* are commonly reported from Indian waters and are widely recognized for their aquaculture potential. However, taxonomic revisions have identified four distinct species within the genus, namely *Scylla serrata*, *S. tranquebarica*, *S. olivacea*, and *S. paramamosain* (Murak et al., 2026), highlighting the need for precise species identification in culture practices and research. In India, mud crab farming largely depends on the capture and fattening of “water crabs,” which are harvested once they attain desirable size and quality attributes, thereby ensuring high economic returns (Couch et al., 2012).

Significant contributions to the advancement of mud crab aquaculture have been made by institutions such as the Central Institute of Brackishwater Aquaculture (CIBA), which has undertaken extensive research on broodstock management, seed production, and larval rearing techniques (Jithendran et al., 2010). Despite these advancements, disease outbreaks remain one of the major constraints limiting productivity and sustainability in mud crab farming systems. The intensification of aquaculture practices, coupled with environmental fluctuations and suboptimal management conditions, has increased the susceptibility of crabs to a wide range of infectious and non-infectious diseases.

Understanding the complex interactions between host, pathogen, and environment is therefore essential for effective disease prevention and control. Diseases not only lead to significant economic losses through mortality and reduced growth but also pose risks to ecosystem health and, in some cases, public health. Furthermore, mud crabs can act as carriers or reservoirs of pathogens, facilitating their transmission within aquaculture systems and to other commercially important species. In this context, a comprehensive understanding of disease etiology, transmission dynamics, and management strategies is critical for ensuring the long-term sustainability of mud crab aquaculture (Bonami et al., 2011).



The present review aims to provide a detailed overview of the major diseases affecting mud crab culture, with particular emphasis on *S. tranquebarica* and *S. serrata*, including their causative agents, clinical manifestations, and impacts on aquaculture systems (Saha et al., 2021). By synthesizing existing knowledge and highlighting emerging challenges, this study seeks to contribute to the development of effective disease management strategies and support the sustainable growth of mud crab farming.

Bacterial diseases

The primary challenge in mud crab hatchery technology continues to be related to cleanliness, particularly in preventing microbial infections such as bacteria and fungi. Aquaculturists and researchers are especially concerned about how natural feeds like trash fish, molluscs (such as mussel or clam meat), and farm waste can introduce microbial pathogens into both broodstock tanks and grow-out ponds. Effective hygiene practices, including regular cleaning of tanks and ponds, maintaining high water quality, and implementing biosecurity measures, are crucial to minimize these risks. (Lavilla-Pitogo et al., 2007) .



Filamentous bacterial disease: Filamentous bacteria such as *Leucothrix mucor*, *Thriothrix* spp, and *Flexibacter* spp can cause significant problems in mud crab hatcheries. They can lead to mortality by affecting the gills and causing secondary infections. Larvae infected with these bacteria exhibit reduced activity, poor feeding, and slowed growth (Pati et al., 2023). In crabs carrying eggs (berried crabs), these bacteria can infect the eggs, resulting in delayed embryo development, longer incubation periods, and increased egg mortality due to reduced oxygen exchange across the egg membrane (Sah et al., 2023).

Luminescent bacterial disease: Luminescent bacterial disease, caused by *Vibrio* species and related genera, is a severe and economically significant infection affecting a wide range of marine and estuarine crab species. This disease often arises as a secondary infection due to factors like poor water quality, stress, or inadequate nutrition (Pitogo et al., 2004). Symptoms in adult crabs include reduced appetite, slowed growth, darkened hepatopancreas, and high mortality rates. *Vibrio harveyi* is particularly problematic in crab larvae reared under hatchery conditions, where it spreads quickly, especially when hatchery conditions are less than optimal, thereby increasing its virulence. (Shanmuga Priya, 2008)

Bacterial Necrosis: This is a common disease observed in larvae, post-larvae and adults. It is variously termed as 'black spot', 'brown spot', 'burnt spot', 'shell disease' or chitinolytic bacterial disease (Saha et al., 2021). This is caused by the invasion of chitinolytic bacteria (gram -ve rods) such as *Vibrio* spp., *Pseudomonas* spp., *Aeromonas* spp., *Spirillum* spp. etc, which break down the chitin of the exoskeleton, leading to erosion and melanization (dark brown to black pigmentation) at the site of infection (Coates et al., 2022). *Vibrio harveyi* is known to be pathogenic to zoeal stages of mud crab at 102 - 103 colony forming unit.

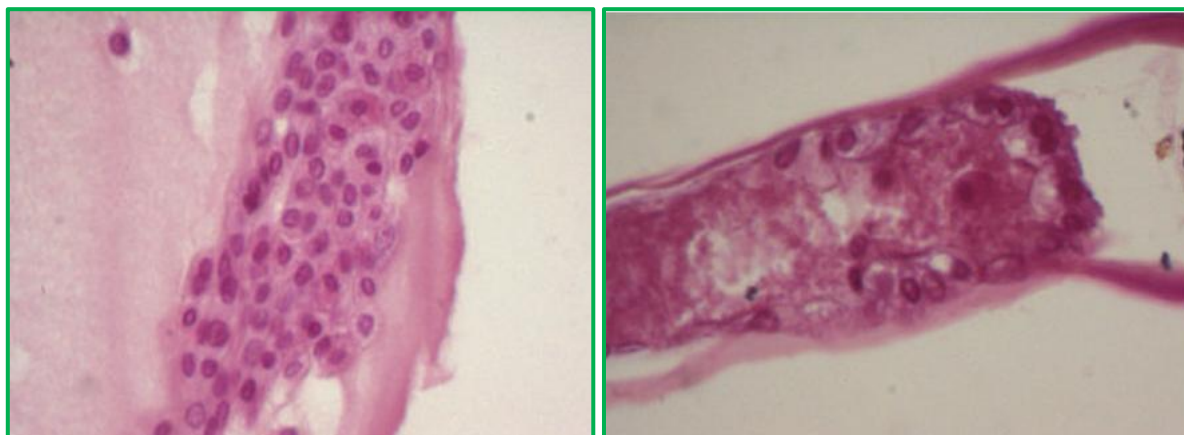
Table: Major Diseases in Mud Crab (*Scylla* spp.) and Their Impacts in Aquaculture

Disease Type	Causative Agent	Key Impact on Culture	References
Bacterial diseases	<i>Vibrio</i> spp., <i>Aeromonas</i> spp., <i>Pseudomonas</i> spp.	Shell lesions, reduced growth, mortality	(Saha et al., 2023)
Luminescent bacterial disease	<i>Vibrio harveyi</i>	Rapid larval mortality, hatchery losses	(Wang et al., 2011)
Viral disease (WSSV)	White Spot Syndrome Virus	Carrier state, reduced moulting, transmission risk	(Bonami et al., 2011).
Fungal infections	<i>Lagenidium</i> , <i>Fusarium</i> , <i>Haliphthoros</i>	Egg and larval mortality, tissue damage	(Lio Po et al., 2002)
Parasitic diseases	<i>Hematodinium</i> spp., protozoans	Weakness, reduced market value	(Kvingedal et al., 2006)
Non-infectious disorders	Environmental stress, poor nutrition	Moulting failure, deformities, low survival	(Farag et al., 2023)
Zoonotic bacterial risk	<i>Vibrio</i> spp.	Public health risk, occupational hazards	(Saha et al., 2021)

Viral disease

In crab culture only White Spot Syndrome Virus (WSSV) has been reported among wild and farmed mud crabs in India, although the reality that four viruses Muscle Necrosis Virus, Reovirus, Baculovirus, and White Spots Syndrome Virus have previously been discovered in mud crabs, *S. serrata* throughout the Asiatic region (Wang et al., 2011). The majority of them are associated with WSSV from mud crabs that were infected both naturally and in experiments (Apine et al., 2023).

White Spot Syndrome Virus (WSSV): Mud crabs are recognized as WSSV carriers and vectors even though they do not exhibit any symptoms of the disease (Lo et al., 1996). In many Asian nations, natural WSSV infections have been discovered in mud crabs both from farmed and wild-caught in various stages. The mud crab *S. serrata* was shown to have WSSV of about 60% of its benthic larvae in both natural and laboratory conditions (Chen et al., 2000). Although the reality that mud crabs are known to carry viruses, there haven't been many studies conducted in India on the subject (Somboonna et al., 2010). Symptoms are in-apparent and the crab can maintain the experimental WSSV infection for many months, though moulting frequency gets reduced (Lavilla-Pitogo et al., 2007). In India, the natural prevalence of WSSV in crab is about 5%, while in culture ponds it is about 30%. WSSV infection could be either by vertical transmission from wild broodstock or horizontal transmission during monoculture as WSSV infected wild crabs are often found in culture ponds (Lavilla-Pitogo et al., 2007).



Fungal diseases

In Japan and the Philippines, three fungi namely *Lagenidium*, *Atkinsiella*, and *Haliphthoros*—have been associated with mud crab egg mortality (Bian et al., 1980; Bian and Egusa, 1980; Lio Po et al., 2002). Indonesian researchers have discovered that mud crab eggs and larvae are susceptible to fungal infection of the species *Lagenidium*.

larval Mycosis: Larval mycosis caused by *Fusarium* spp., *Lagenidium* spp., and *Sirolopidium* spp. are significant threat to crab larvae, often occurring as a secondary infection. The fungi thrive in areas of dead or damaged tissue resulting from wounds or other infections, leading to difficulties in movement due to the growth of fungal mycelia. In severe cases involving *Lagenidium*, highly branched, non-septate mycelia invade extensively throughout the body, replacing all tissues and protruding through the outer layer (Liew et al., 2023). To combat these infections and improve the survival and development of infected megalopa, preventive treatments involving alternating doses of 5 to 10 µg/l formalin and 0.05 to 0.1 µg/l trifluralin have been proven effective compared to untreated controls. These measures underscore the importance of proactive management in aquaculture to minimize the impact of fungal infections on crab larvae (Armstrong et al., 1976)

Parasitic diseases

The majority of the crabs have been found to be infested with epicomensals, metazoan or protozoan parasites. They are classified as metazoans (helminths under microcephalid trematode metacercaria, *Levinseniella* sp., metacestodes like *Polypocephalus* sp. and dorylaimoid nematode, and two cirriped crustaceans, *Octolasmis* sp. and *Chelonbia* sp.), as well as protozoans (*Haematodinium* sp., *Epistylis* sp., and *Acinata* sp.) (Liew et al., 2024). Mud crabs have also rarely been found to contain symbionts of the species of *Vorticella* oysters, polychaetes, hydrozoans, amphipods, and turbellarians (Kvingedal et al., 2006).

A. Non-infectious diseases

Deformities: A failure or delay in the moulting cycle from zoea to megalopa during the hatching period, due to the attachment of the remaining exoskeleton for several hours, leads to abnormal swimming behavior and a failure to eat food. The failure or delay of moulting can be attributed to various factors like as poor nutrition and environmental conditions (Quinitio and Parado-Esteva, 2003).

B. Other diseases: A novel shell disease affecting *S. serrata*, discovered in Australia, is of non-infectious origin and its cause remains uncertain. This condition is identified by irregularly shaped circular lesions often referred to as 'rust spot shell disease' (Andersen et al., 2010). It exhibits distinctive histopathological changes and poses a potential threat to the marketability of mud crabs (Farag et al., 2023). Notably, this disease has not yet been documented in Indian waters.

In India, there are no known zoonotic illnesses derived from mud crabs. Since crab and its meat are typically prepared before ingestion, there is no chance of infection for humans. However, during the processing of crab flesh, infection with bacteria that lead to human diseases may occur, thus food safety laws should be strictly followed.

Disease Prevention and Management Strategies

Effective disease prevention in mud crab (*Scylla* spp.) aquaculture relies on an integrated approach that combines biosecurity, environmental management, and improved husbandry practices. Given the limitations of therapeutic interventions in aquatic systems, emphasis must be placed on preventive strategies that reduce pathogen introduction and enhance host resilience.

Biosecurity measures are fundamental to minimizing disease outbreaks. This includes screening of broodstock and seed, disinfection of equipment, and restriction of uncontrolled movement of live crabs between farms and markets. Such measures reduce the risk of pathogen introduction and cross-contamination within culture systems. Maintaining strict hygiene protocols in hatcheries and grow-out ponds is particularly critical during early life stages when crabs are highly vulnerable to infections (Jithendran et al., 2009).

Water quality management plays a central role in disease control. Optimal levels of dissolved oxygen, salinity, and temperature must be maintained to reduce physiological stress and suppress opportunistic pathogens. Poor water conditions are closely associated with bacterial proliferation and increased disease susceptibility, emphasizing the need for regular monitoring and timely corrective actions (Somboonna et al., 2010).

Hatchery management and stocking practices also significantly influence disease dynamics. High stocking densities increase stress, aggression, and pathogen transmission, while proper density regulation improves survival and growth. Similarly, maintaining clean rearing systems and avoiding the use of contaminated natural feeds can prevent the introduction of harmful microorganisms (Coates et al., 2022).

Nutritional management is equally important in enhancing disease resistance. Balanced and high-quality feed supports immune function and reduces vulnerability to infections. The use of fresh, pathogen-free feed sources and the development of formulated diets are essential steps toward sustainable aquaculture practices.

In recent years, there has been increasing emphasis on alternatives to antibiotics, including probiotics, immunostimulants, and environmentally friendly disease control strategies. These approaches not only reduce the risk of antimicrobial resistance but also promote a more sustainable and eco-friendly aquaculture system.

Conclusion

Diseases in mud crab (*Scylla* spp.) aquaculture arise from a diverse range of biological agents, including viruses, bacteria, fungi, and parasites, often interacting with environmental and management-related stressors. Their occurrence is multifactorial and frequently exacerbated under intensive farming conditions. The increasing expansion of mud crab culture, coupled with practices such as high stocking density and movement of live stock, has contributed to the emergence and spread of both existing and new diseases. Effective disease management in mud crab farming cannot rely on eradication strategies alone, as aquatic systems inherently favor pathogen persistence and transmission. Instead, a holistic and preventive approach is essential, integrating improved water quality management, optimized nutrition, biosecurity measures, and scientific culture practices. Strengthening research on disease diagnostics, host–pathogen interactions, and sustainable farming techniques will further support this objective. Ultimately, maintaining the health of cultured mud crabs is fundamental to achieving sustainable aquaculture. A balanced approach that combines ecological awareness, technological advancement, and responsible management practices will be key to minimizing disease risks and ensuring the long-term productivity and resilience of the mud crab farming sector.

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