FRI NEWSLETTER

VOL 28, 2025

TRANSLATING KNOWLEDGE INTO IMPACT

RMK12 Fisheries R&D

KEMENTERIAN PERTANIAN DAN KETERJAMINAN MAKANAN
JABATAN PERIKANAN MALAYSIA

Fisheries Research Institute, Department of Fisheries Malaysia

MESSAGE FROM THE EDITOR

DEAR READERS,

I am proud to present our latest newsletter, Volume 28 (2025). This edition brings together a wide array of contributions, from technical papers and short communications to research updates and intellectual property highlights. Each piece offers a unique perspective on the challenges and opportunities that define our shared commitment to sustainability, biodiversity, and responsible resource management.

Among the many highlights:
- Scientific innovation shines through in studies on microplastic dynamics, molecular diagnostics, and bioinformatics approaches to aquatic animal health.
- Conservation and ecosystem health are front and centre, with insights into coral reefs, seagrass habitats, endangered marine species, and water quality assessments.
- Aquaculture advancements explore polyculture systems, biofloc technology, alternative feed strategies, and breeding success stories—from milkfish to banana shrimp.
- Biodiversity and species management are addressed through demersal surveys, tagging techniques, and live feed development for ornamental fish.
- Policy and innovation are reflected in intellectual property updates and strategic directions under the 12th Malaysia Plan.

I invite you to immerse yourself in these stories, findings, and reflections. May they inspire continued dialogue, innovation, and action in the year ahead.

Happy reading!

Wan Norhana Md Noordin

What's Inside?

FEATURES

TECHNICAL PAPER

SHORT COMMUNICATION

RESEARCH UPDATES

IP UPDATES

Sustainable Fisheries : Integrating Science and Technology

SALLEHUDIN J*, RYON S, ABDUL WAHAB A,
EFFARINA MFA & NOORUL AZLIANA J
Fisheries Research Institute
Kg. Acheh, 32000 Sitiawan, Perak
*sallehudin_jamon@dof.gov.my

INTRODUCTION

Sustainable fishing practices are essential for securing healthy marine ecosystems, economic stability, and social well-being, particularly the coastal communities (FAO, 2020). However to achieve sustainable fisheries, there are several significant challenges to overcomes, including overfishing, which leads to dramatic declines in fish populations, and climate change, which affects fish distribution and survival. Pollution harms aquatic life and disrupts ecosystems. Meanwhile habitat destruction from coastal development and destructive fishing practices further endangers fish populations. Illegal, unreported, and unregulated (IUU) fishing undermines management efforts, while socioeconomic factors, including poverty, hinder the adoption of sustainable practices, often causing conflicts between industrial and small-scale fishing communities.

This article discusses how science and technology could address the challenges and promote to empower sustainable fisheries management. Our focus is on the capture fisheries research and development (R&D) projects implemented in the 12th Malaysia Plan (MP).

IMPORTANCE OF SCIENTIFIC DATA IN FISHERIES MANAGEMENT

Scientific evidence is essential for fisheries management by providing insights into fish biology, ecology, and population dynamics (Hilborn & Walters, 1992). It helps analyse life cycles, reproduction, and environmental responses, while ecology studies help explain species interactions and habitat changes. Population dynamics research uses models to assess stock status, guiding a sustainable practice.

Key R&D scopes include:

- Assessing stock status using selected biological indicators like fish length and weight.
- Evaluating the spillover effect of Marine Protected Areas (MPAs) to support fish populations and local fisheries.
- Studying fish larvae distribution to understand recruitment patterns.
- Collecting data and mapping resources of shellfish and snails, ensuring the sustainable management of these important marine species, and reducing overexploitation.
- Conducting demersal surveys to assess fish stock status and guide management.

INNOVATIONS IN CAPTURE FISHERIES

Technological advancements in fishing gear have significantly contributed to sustainable fisheries by promoting eco-friendly and selective fishing practices (Nurul, 2022). Under 12th MP, studies have been conducted to improve gear specifications, including driftnets, traps, and trawls. One key innovation is the "bubu," or trap net designed that innovation won first place in the Department of Fisheries Malaysia, 2024 Innovation Competition (Anon, 2024)

Another invention is "Bubu Bintang," which has been proven effective for capturing demersal fish, enhancing fishing efficiency while reducing ecological impact. Additionally, mitigation techniques in longline tuna fisheries have been studied to minimise seabird bycatch, promoting more sustainable fishing practices. R&D on the specifications of Fish Aggregating Devices (FADs) to improve fish catch rates and encourage responsible fishing were also implemented.

REMOTE SENSING AND MONITORING TECHNOLOGIES

The Fish Site Identification application, used for targeting tuna catch, employs remote sensing to pinpoint optimal fishing sites (Hilde et al., 2018). By improving the accuracy of fishing efforts, it saves fuel and time, ultimately promoting sustainable practices in tuna fisheries.

INTEGRATING SCIENCE AND TECHNOLOGY

Advances in big data and machine learning are transforming fisheries science by enabling accurate stock assessments and adaptive management strategies. Tools like *A Stock Production Model Incorporating Covariates* (ASPIC), and predictive modelling provide valuable insights into fish populations and their dynamics. These technologies allow scientists to forecast stock status and evaluate the impacts of different management scenarios, improving decision-making processes. By combining collaborative efforts and advanced data analysis, fisheries management is becoming more innovative and effective. This integration promotes sustainable fishing practices and ensures the long-term health of marine ecosystems.

INTEGRATION OF SCIENCE AND TECHNOLOGIES IN CAPTURE FISHERIES MANAGEMENT: LOCAL CHALLENGES

The key obstacles of integration of science and technology in fisheries management are infrastructure and technical limitations. The limitations in data collection and monitoring systems such as vessel monitoring systems (VMS) and electronic reporting systems remain as significant hurdles. The small-scale fishers for instance are incapable of installing and maintaining this sophisticated machine. This may affect reliable fisheries data collection and analysis. In addition, inadequate computing infrastructure and database management systems hinder integration of diverse data such as catch reports, vessel tracking, and environmental characteristics.

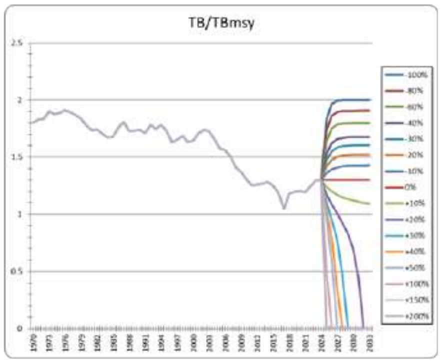
Other gaps include shortage of skilled personnel and scarcity of comprehensive training programs. Researchers need extensive training to interpret and utilise scientific data effectively. Capacity-building initiatives, including tailored education and training, can empower fishers to adopt new technologies and improve sustainability. Improved communication between scientists and local communities is essential for developing collaborative, locally relevant solutions.

The integration of scientific research and technological advancement in Malaysian marine capture fisheries presents complex challenges that require systematic solutions. Economic constraints pose fundamental research challenges, as studies need to examine not only the technical aspects of fishing gear innovation but also their economic viability for local fishing communities. Small-scale fishers in Malaysia face multiple interconnected challenges in adopting modern fishing practices and technologies. Many fishers struggle to secure funding for upgrading their vessels with modern navigation systems, fish-finding equipment, and sustainable fishing gear. The financial landscape is further complicated by unpredictable income streams due to seasonal variations and changing fish populations, while the lack of insurance and risk management tools leaves fishers vulnerable to equipment losses and natural disasters.

The integration of science and technology in fisheries management is also hampered by poor coordination between stakeholders and infrastructure limitations. Data sharing between government agencies, research institutions, and fishing communities remains fragmented, impacting evidence-based decision-making. Environmental challenges add another layer of complexity, as rapidly changing marine ecosystems driven by climate change require constant adaptation of fishing practices. Balancing technology adoption with environmental conservation goals while implementing effective monitoring systems to prevent overfishing presents ongoing challenges for the industry.

10 catch scenarios (tons)	60% (-40%)	70% (-30%)	80% (-20%)	90% (-10%)	100%	110%	110%	120%	130%	140%
					Current catch (*)	MSY level				
	139,469	162,714	185,958	209,203	232,448	255,800	255,693	278,938	302,182	325,427
TB2025 < TBmsy	9	11	14	16	23	31	31	42	53	69
F2025 > Fmsy	4	6	8	11	16	34	34	71	93	100
TB2032 < TBmsy	4	5	7	8	15	66	66	91	100	100
F2032 > Fmsy	4	5	7	8	15	67	67	93	100	100

(*)The current catch level is the average catch in 3 recent years(2020-2022).



The risk analysis results show the matrix schedule and projections of TB/TBmsy, F/FMSY.
(Note: TB refers to total biomass, TBmsy is the biomass at maximum sustainable yield, F is fishing mortality, and FMSY is the fishing mortality at maximum sustainable yield)

FUTURE DIRECTIONS IN SUSTAINABLE FISHERIES MANAGEMENT

Future improvements in sustainable fisheries management could leverage biotechnology, such as genetic enhancements, molecular stock assessment, and DNA-based species identification. Advances in disease control, environmental monitoring, and sustainable feed development offer pathways to increased productivity while maintaining ecological balance.

RECOMMENDATIONS FOR POLICYMAKERS AND STAKEHOLDERS

a. Encourage partnerships between scientists and technologists to develop sustainable and practical solutions tailored to fisheries management needs (Garcia et al., 2014).
b. Prioritise education and training programs to empower fishers and stakeholders, bridging knowledge gaps and facilitating the adoption of new technologies.
c. Invest in studies on biotechnology, big data integration, and adaptive management to enhance fisheries sustainability (Zhang, 2021).
d. Involve fishers in decision-making to incorporate their knowledge, foster ownership, and improve compliance with management strategies.
e. Simplify regulatory frameworks and enhance communication among scientists, policymakers, and fishers to improve the efficiency and responsiveness of management practices (Paul et al., 2023).

CONCLUSION

The integration of science and technology is essential for addressing the complex challenges in fisheries management. Innovations in fishing gear, remote sensing, and data-driven decision-making have shown great potential for advancing sustainable practices. Global case studies highlight the success of collaborative efforts between scientists, technologists, and local fishers, resulting in improved stock management, regulatory compliance, and economic benefits for communities (Stephenson & McShane, 2015). Despite these advancements, challenges remain, including economic, social, and institutional barriers, as well as the need for education and training. Emerging technologies like biotechnology and artificial intelligence offer promising solutions, but targeted research and development are critical to ensure their effective and sustainable implementation.

References

1. Anon. (2024). KPI. Institut Penyelidikan Perikanan Kg. Acheh.
2. FAO (2020). State of World Fisheries and Aquaculture 2020: Sustainability in Action. Rome: Food and Agriculture Organization of the United Nations.
3. Garcia et al. (2014). Governance of marine fisheries and biodiversity conservation: interaction and co-evolution.
4. Hilborn & Walters (1992). Quantitative Fisheries Stock Assessment: Choice, Dynamics, and Uncertainty. New York: Chapman & Hall.
5. Hilde et al. (2018): The digital frontiers of fisheries governance: Fish attraction devices, drones, and satellites. *Journal of Environmental Policy & Planning*.
6. Nurul (2022). Innovative processing technologies for sustainable fisheries sectors. *Journal of Sustainability Science and Management*, 18 (9): 1-5.
7. Paul et al. (2023). The future of marine fisheries management and conservation in the United Kingdom: Lessons learnt from over 100 years of biased policy. *Marine Policy*, 147.
8. Stephenson & McShane (2015). WWF Global Conservation Programme Report 2015. WWF International, Gland, Switzerland.
9. Zhang (2021). Global fisheries management and community interest. *Sustainability*, 13: 8586.

TECHNICAL PAPER

Environmental Drivers of Larvae and Microplastic Abundance in Eastern Straits of Johor: Insights from Correlation Analysis

[1]Fisheries Research Institute, 11960 Batu Maung, Pulau Pinang
[2]Fisheries Research Institute Kg. Acheh, 32000 Sitiawan, Perak
[3]Fisheries Conservation and Protection Division, Department of Fisheries Malaysia, Putrajaya

NAJIHAH M[1]*, NUR HIDAYAH A[2], ABDUL AZIM AA[1] & IZARENAH MR[3]
*najihah@dof.gov.my

INTRODUCTION

Microplastics (MP) contamination in marine environments is a pressing global issue due to its potential impact on aquatic organisms. MP, defined as plastic particles smaller than 5 mm, originate from various sources such as industrial waste, consumer products, and fishing activities. Once in the water column, MP interact with abiotic factors like salinity, pH, and temperature, as well as biotic components, including plankton and fish larvae (Qaiser et al., 2023). Fish larvae, being small and planktonic feeders, are particularly susceptible to MP ingestion, which may lead to developmental and physiological consequences. This study aims to assess the relationship between MP abundance, environmental parameters, and larvae abundance in the Eastern Straits of Johor region to better understand the risks associated with pollution.

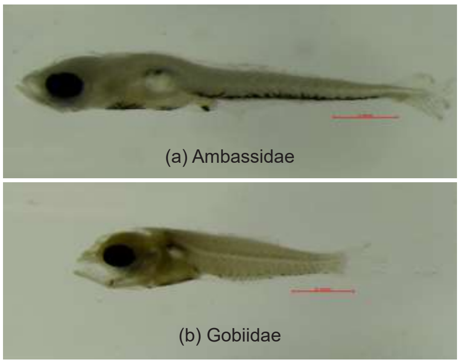
METHODS

Sampling was conducted across 11 stations in the Eastern Straits of Johor (**Figure 1**) in July 2024, measuring MP abundance in water samples alongside key environmental parameters.

MP were quantified using filtration and visual identification under a microscope. Larval abundance was estimated through net sampling and microscopic analysis. Water quality parameters, including dissolved oxygen (DO), temperature, conductivity, Total Dissolved Solid (TDS), salinity, pH, chlorophyll-a (Chl-a), and Phycoerythrin (PE), were recorded *in situ* at each station. Pearson correlation analysis was applied to assess relationships between MP abundance, larvae abundance, and environmental factors, while autocorrelation analysis was conducted to measure the correlation of each variable with itself over successive time lags.

RESULTS & DISCUSSION

The highest density of fish larvae recorded is in Station JT10 (358 ind/1000m^3), while the lowest density is in JT11 (19 ind/1000m^3). The most abundant family of fish larva found were Ambassidae and Gobiidae (**Figure 2**).



(a) Ambassidae

(b) Gobiidae

Figure 2: Most abundant family of fish larvae in Eastern Straits of Johor.

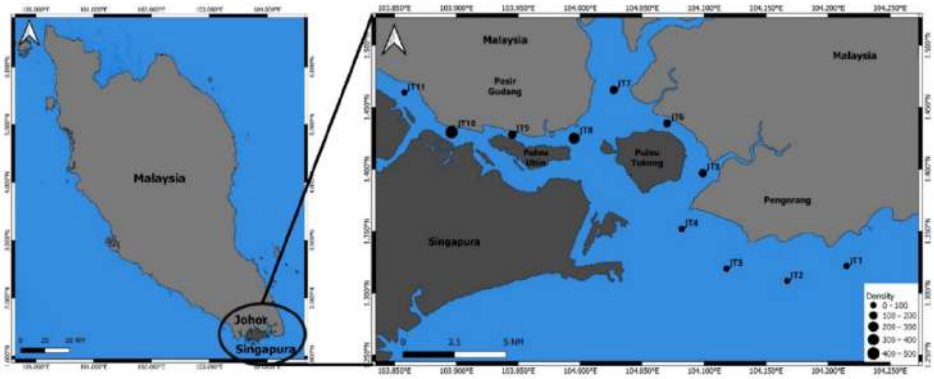


Figure 1: Eleven (11) sampling locations at the Eastern Straits of Johor.

Table 1: Correlation coefficients between environmental factors, larvae abundance, and MP abundance.

Environmental	Larvae abundance	MP abundance
MP Abundance	+0.617	-
Temperature	+0.455	+0.465
Dissolved Oxygen (DO)	+0.332	-0.389
Chlorophyll-a (Chl-a)	+0.097	+0.195
Phycoerythrin (PE)	+0.173	+0.147
pH	-0.116	-0.576
Conductivity	-0.382	-0.158
Total Dissolved Solids (TDS)	-0.416	-0.212
Salinity	-0.420	-0.216

The correlation analysis, as observed in **Table 1,** indicates that MP abundance is the most influential factor positively associated with larval abundance (r = 0.617). This relationship suggests that areas with higher MP concentrations may provide favourable conditions for larvae, possibly due to shared environmental factors such as nutrient availability or hydrodynamic processes that retain MP and planktonic organisms in the same locations.

Additionally, temperature (r = 0.455) and DO (r = 0.332) show moderate positive correlations with larval abundance, reinforcing the importance of warm, oxygen-rich waters for larval survival and development. Conversely, salinity (r = -0.420), TDS (r = -0.416), and conductivity (r = -0.382) exhibit moderate negative correlations, indicating that larvae tend to thrive in fresher waters with lower mineral content. These findings highlight the potential impact of water quality on larval distribution, emphasising the need to monitor changes in salinity and dissolved solids that may affect recruitment and population dynamics in aquatic ecosystems.

The correlation patterns also reveal that MP abundance is strongly linked to larval abundance (r = 0.617) and temperature (r = 0.465), suggesting that warmer conditions may enhance MP retention or transport in the water column. The positive association with chlorophyll-a (r = 0.195) and PE (r = 0.147) suggests that MP may accumulate in productive areas with high biological activity, possibly through interactions with organic matter or biofilm formation. On the other hand, pH exhibits the strongest negative correlation with MP abundance (r = -0.576), indicating that more alkaline conditions may promote microplastic degradation, settlement, or reduced buoyancy. Dissolved oxygen (r = -0.389) also negatively correlates with MP abundance, which could be linked to microbial interactions or decomposition processes that reduce MP persistence. Weak negative correlations with salinity, TDS, and conductivity suggest that MP are more abundant in less saline environments, possibly due to differences in hydrodynamics and dilution effects. These insights underscore the complex interactions between microplastics and environmental factors, highlighting the importance of further research into the mechanisms governing MP distribution in aquatic systems.

The autocorrelation analysis (**Figure 3**) reveals a distinct periodic pattern, with a strong negative correlation (-0.662) at lag 3, suggesting a cyclical fluctuation in MP levels over time. This pattern could indicate seasonal variations in MP transport, accumulation, or removal processes, potentially influenced by hydrodynamic conditions, rainfall events, or anthropogenic discharges (Xia et al., 2021). In contrast, larval abundance shows a relatively stable trend up to lag 2 (0.726) before declining at lag 4 (-0.257), suggesting a moderate temporal dependence that diminishes over time. The observed fluctuations in both MP and larval abundance imply that external environmental factors, such as changes in water flow, temperature shifts, or pollution sources, may play a significant role in determining their distribution over time. Understanding these temporal patterns is crucial for predicting MP exposure risks in aquatic ecosystems and assessing potential ecological impacts on larval populations.

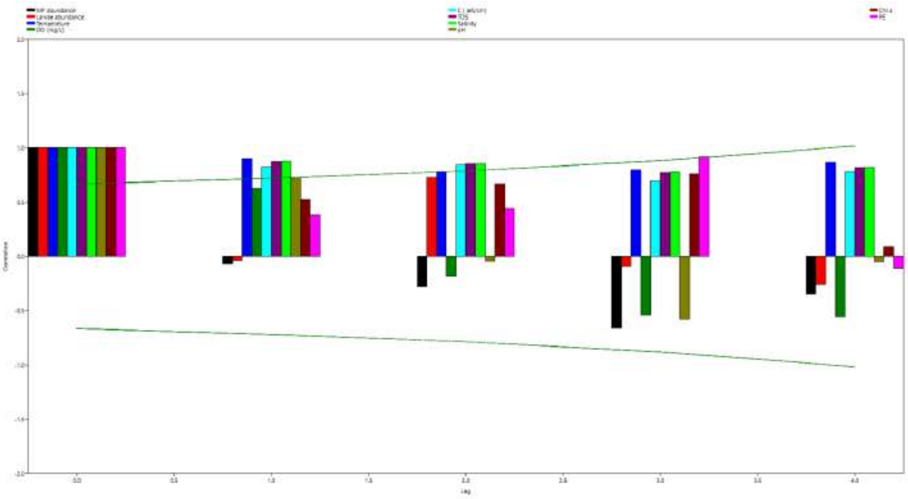


Figure 3: Autocorrelation analysis of environmental factors, larvae abundance, and MP abundance across different lag intervals.

The autocorrelation results for DO, pH, salinity, and conductivity indicate strong persistence over time, suggesting long-term stability in water quality parameters. DO maintains a high correlation across multiple lags (0.825 at lag 1; 0.841 at lag 2), reflecting minimal short-term fluctuations and highlighting the resilience of oxygen levels in the aquatic system. Similarly, salinity and conductivity exhibit consistently high autocorrelation values (above 0.7), indicating their relative stability and potential dependence on long-term hydrological and climatic conditions. In contrast, pH demonstrates moderate temporal dependence (0.524 at lag 1; 0.669 at lag 2), with a gradual decline in correlation at higher lags, implying slow but progressive variability. These findings suggest that while MP and larval abundance fluctuate over time, key physicochemical properties of the water column remain relatively constant, reinforcing the need for continuous monitoring to identify environmental changes that may disrupt ecosystem balance.

CONCLUSION

This study reveals significant correlations between microplastic (MP) abundance, larvae, and environmental factors in the Eastern Straits of Johor. MP abundance positively correlates with larvae (+0.617) and temperature (+0.455), suggesting shared environmental drivers. Negative correlations with pH, salinity, TDS, and conductivity indicate MP are more prevalent in less saline, alkaline conditions. Temporal analysis showed cyclical MP fluctuations and moderate larval dependence, while water quality parameters remained relatively stable. These findings highlight complex interactions between MP and aquatic ecosystems, emphasising the need for continuous monitoring to understand and mitigate potential ecological impacts.

References

1. Qaiser et al. (2023). Microplastics in wastewaters and their potential effects on aquatic and terrestrial biota. Case Studies in *Chemical and Environmental Engineering*, 8: 100536.
2. Xia et al. (2021). Effects of seasonal variation and resuspension on microplastics in river sediments. *Environmental Pollution*, 286: 117403.

SHORT COMMUNICATION

Betanodavirus Infection in Marine Fish: A Hidden Threat

[1]National Fish Health Research Centre (NaFisH), 11960 Batu Maung, Pulau Pinang
[2]Aquatic Health Research Laboratory, International Islamic University Malaysia, 25200 Kuantan, Pahang

AZILA A[1]* & MOHD FIRDAUS N[2]
*azila@dof.gov.my

Betanodavirus (NNV) (Nodaviridae family) infections pose a significant threat to marine fish worldwide. Due to its widespread occurrence, the disease was removed from the WOAH-listed diseases in 2018. However, its prevalence in Malaysia can be considered high, based on studies by the National Fish Health Research Centre (NaFisH). These viruses, primarily responsible for viral nervous necrosis, are found in both wild and farmed fish, with devastating effects on aquaculture industries and biodiversity. While the threat of NNV is frequently overshadowed by other pathogens or environmental challenges, its impact can be both profound and long-lasting. This article delves into the biology of NNV, its ecological and economic consequences, and potential measures for managing this hidden threat to marine fish.

NNV causes brain and spinal cord degeneration in marine fish. To date, four strains are officially listed by the International Committee on the Taxonomy of Viruses (ICTV): red-spotted grouper nervous necrosis virus (RGNNV), barfin flounder nervous necrosis virus (BFNNV), tiger puffer nervous necrosis virus (TPNNV), and striped jack nervous necrosis virus (SJNNV). With over 100 affected species—including sea bass, cod, and tilapia—the virus has a global reach, now even impacting freshwater fish. Its ability to spread both horizontally and vertically, along with poor farm practices, makes it a persistent challenge for disease control in aquaculture.

Since 2008, NNV research in Malaysia has focused on epidemiology, pathogenicity, and vaccine development. However, there remains a critical gap in effective prevention and control, particularly at the broodstock and fry levels. Partial sequences from local isolates deposited in GenBank highlight the intensity of efforts to understand the virus's virulence. Despite fry mortalities reaching up to 100%, underreporting by farmers due to its routine nature masks the true impact on the industry. This article discusses the hidden threats posed by NNV and evaluates whether they can be mitigated to safeguard aquaculture sustainability.

(i) Pathogenesis and Transmission

NNV severely impacts embryos and larvae, leading to near-total fry losses within 15 days post-hatch. This high early mortality limits fry availability, threatening industry growth and exports. To compensate, Malaysia imported 180.31 tonnes of live marine finfish in 2023, a practice that risks introducing transboundary pathogens. While such imports offer short-term relief, they perpetuate reliance on external sources and overlook the root cause: early-stage disease. This cycle not only masks the true scale of the issue but also endangers long-term sustainability.

Pathogenesis

NNV primarily targets the central nervous system (brain, spinal cord, and retina), causing extensive necrosis and characteristic clinical symptoms. It also disrupts peripheral nerves, exacerbating neurological dysfunction. Infection begins when the virus invades the intestinal epithelium, binds to host cell receptors, and enters via endocytosis (Muhammad-Safwan et al., 2024). Once inside the cell, viral RNA hijacks the host's machinery to replicate and produce viral proteins. The innate immune response activates interferons and cytokines, but NNV suppresses these defences. The adaptive immune response, including antibody production, is triggered but often insufficient, especially in young fish with underdeveloped immunity. Pathologically, the virus induces necrosis, leading to vacuolation, cell death, and immune cell infiltration. These neurological damages result in lethargy, loss of equilibrium, and spiral swimming—hallmark signs of viral nervous necrosis.

Transmission

Fish can contract NNV through both horizontal and vertical transmission. Vertical transmission occurs when the virus is passed from infected broodstock to offspring, potentially leading to widespread infections (Antonovics et al., 2017). Horizontal transmission stems from contaminated environments, where fish interact with infected water, surfaces, or other individuals (Kang et al., 2023), highlighting the need for strict biosecurity in aquaculture.

Environmental factors significantly influence infection severity. Temperature fluctuations, identified as a major predisposing factor (Muhammad-Safwan et al., 2024), weaken immune responses, making fish more susceptible. Additionally, primary infections by marine bacteria (e.g., *Vibrio* spp.) can facilitate secondary NNV infections (Atirah et al., 2019), revealing the complex interaction between bacterial and viral pathogens in aquaculture. Given these risks, comprehensive disease management strategies must target both viral and bacterial threats to safeguard fish health.

Vertical Transmission

Vertical transmission of NNV is a critical route of infection, particularly in aquaculture settings, where the virus can be passed from infected broodstock to their offspring through contaminated eggs. This mode of transmission occurs when the virus is present in the reproductive tissues of infected adult fish, allowing it to be incorporated into the eggs during their formation (Bandin & Souto, 2020). As a result, the developing embryos and larvae become infected even before hatching, leading to high mortality rates in early life stages. Vertical transmission is especially concerning in aquaculture because it facilitates the spread of the virus within hatcheries and can perpetuate infection cycles across generations. This route of transmission underscores the importance of screening broodstock for NNV and implementing strict biosecurity measures to prevent the introduction and spread of the virus in fish farming operations.

Horizontal Transmission

NNV spreads through waterborne transmission, as infected fish shed the virus via excretions, contaminating water and infecting cohabiting fish (Krishnan et al., 2021). In high-density farming, water circulation facilitates rapid spread, while direct contact in crowded tanks or net pens increases transmission risks. Additionally, contaminated equipment, nets, and fomites can further spread the virus without proper disinfection.

An often-overlooked risk is the use of wild fish as feed, as NNV infects over 100 fish species globally (Kang et al., 2023). Infected wild fish introduce the virus into aquaculture systems, bypassing biosecurity measures and triggering outbreaks. Understanding and addressing these transmission pathways is crucial in controlling NNV in marine aquaculture.

(ii) Introduction of the New Strain of NNV

NNV has been classified into four main strains: RGNNV, BFNNV, TPNNV, and SJNNV. However, a new reassortant strain has recently been identified in the Mediterranean region, raising concerns about its potential spread and impact (Kim et al., 2021). This reassortant strain was first reported in Malaysia in 2019, but its status and effects on the country's marine fish culture remain uncertain (Ariff et al., 2019). If confirmed, this new strain could pose a serious threat to the marine fish industry, particularly due to its association with different risk factors and its potentially higher virulence compared to the endemic strains of NNV currently present in the region. The introduction of such a strain exacerbates challenges in fish farming, leading to increased mortality rates, economic losses, and the need for enhanced biosecurity measures to prevent further outbreaks.

(iii) Economic and Ecological Consequences

NNV is highly contagious, posing significant challenges for farmed fish, particularly sea bass and groupers. Outbreaks can cause severe revenue losses, with total virus elimination in cage culture systems requiring extensive resources and high costs. Beyond the economic impact, outbreaks threaten food security, especially in regions reliant on fish as a primary protein source (Rowley et al., 2024). The economic burden is further aggravated by costs tied to biosecurity measures, disease monitoring, and stock compensation, straining both small-scale farmers and large enterprises (Subasinghe et al., 2023). The complexity of managing outbreaks highlights the urgent need for robust preventive strategies and industry-wide support systems. Proactive measures can help sustain economic stability and safeguard future fish production.

(iv) Impact on Marine Wild Fish Populations

NNV threatens both farmed and wild fish, spreading rapidly under environmental stress and causing mass fry mortalities (Okon et al., 2023). This impacts recruitment rates, disrupts predator-prey dynamics, and weakens biodiversity. Infected farmed fish can act as viral reservoirs, spreading the disease through escapees or poor waste management, emphasising the need for strict aquaculture biosecurity. Beyond ecological effects, outbreaks pose socio-economic risks. Coastal communities reliant on wild fish for livelihoods and food security face reduced catches and income, while recreational fishing economies also suffer. Repeated outbreaks further diminish genetic diversity, weakening wild populations' resilience to future diseases and environmental changes.

MANAGEMENT STRATEGIES AND FUTURE DIRECTIONS

Managing NNV infections in marine fish necessitates a multi-faceted approach that integrates current strategies with innovative solutions such as:

- Enhanced biosecurity, including quarantine and regular disinfection, is vital to prevent virus introduction and spread (Yue & Guo, 2025).
- Surveillance and early detection systems enable swift response, helping avoid widespread outbreaks.
- Vaccines exist for some species, like European sea bass, but broader coverage remains limited.
- Selective breeding of resistant strains offers a sustainable control strategy, while climate-resilient practices are essential amid shifting environmental conditions (Abisha et al., 2022; Padrós et al., 2022).
- Cross-border collaboration, combined with strong public awareness, promotes responsible aquaculture and coordinated action.

By integrating these strategies and investing in research, the industry can effectively mitigate the impact of NNV and ensure the long-term sustainability of marine fish populations. This comprehensive approach not only addresses immediate concerns but also builds resilience against future threats, safeguarding both economic interests and ecological balance.

CONCLUSION

Though endemic, NNV remains a growing, underreported threat to wild and farmed marine fish. Its wide host range and complex transmission present serious ecological and economic risks, often masked by its routine presence in aquaculture. Existing measures like biosecurity and vaccines offer partial protection, but more targeted research and innovative solutions are urgently needed. Strengthening surveillance, improving biosecurity, and investing in novel therapeutics will be key to curbing the virus's impact. Long-term sustainability of marine fish populations—and the stability of the aquaculture sector—depends on proactive, science-driven efforts.

References

1. Abisha et al. (2022). Sustainable development of climate-resilient aquaculture and culture-based fisheries through adaptation of abiotic stresses: A review. *Journal of Water and Climate Change*, 13(7): 2671–2689.
2. Antonovics et al. (2017). The evolution of transmission mode. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 372(1719): 20160083.
3. Ariff et al. (2019). Risk factors associated with viral nervous necrosis in hybrid groupers in Malaysia and the high similarity of its causative agent nervous necrosis virus to reassortant red-spotted grouper nervous necrosis virus/striped jack nervous necrosis virus strains. *Veterinary World*, 12(8): 1273-1284.
4. Atirah et al. (2019). Prevalence, risk factors and transmission of nervous necrosis virus in a hatchery producing hybrid grouper (*Epinephelus lanceolatus* × *E. fuscoguttatus*) fry. *Journal of Tropical Agricultural Sciences*, 42(1): 125-138.
5. Bandín & Souto (2020). Betanodavirus and VER disease: A 30-year research review. *Pathogens*, 9(2): 106.
6. Kang et al. (2023). A case report of interspecies transmission of nervous necrosis virus (NNV) between red seabream brood (Pagrus major) and juvenile pacific cod *(Gadus macrocephalus)*. *Aquaculture*, 562: 738798.
7. Kim et al. (2021). Emergence of reassortment between a new and reported types of betanodavirus in shellfish. *Pathogens*, 10(10): 1232.
8. Krishnan et al. (2021). Infection dynamics and shedding kinetics of nervous necrosis virus in juvenile seven band grouper using an intraperitoneal infection-cohabitation model. *Aquaculture*, 530: 735957.
9. Muhammad-Safwan et al. (2024). Pathogenicity of betanodavirus strains in Asian seabass (*Lates calcarifer*) under temperature fluctuation stress. *Malaysian Fisheries Journal*, 24(2): 45-53.
10. Okon et al. (2023). Dynamics of co-infection in fish: A review of pathogen-host interaction and clinical outcome. *Fish and Shellfish Immunology Reports*, 4: 100096.
11. Padrós et al. (2022). Integrated management strategies for Viral Nervous Necrosis (VNN) disease control in marine fish farming in the Mediterranean. *Pathogens*. 11(3): 330.
12. Rowley et al. (2024). Diseases of marine fish and shellfish in an age of rapid climate change, *iScience*, 27(9): 110838.
13. Subasinghe et al. (2023). Biosecurity: Reducing the burden of disease. *Journal of the World Aquaculture Society*, 54(2): 397-426.
14. Yue & Guo (2025). Strategies for managing major diseases in Asian seabass aquaculture. *Animal Diseases*, 5(6).

Scleractinian Corals of Pulau Mertang, Johor

MD. NIZAM I*, ZAIDNUDDIN I & ISMAIL MS

National Marine Park Research Centre, Fisheries Research Institute,
11960 Batu Maung, Pulau Pinang

*mdnizam@dof.gov.my

Coral reefs are vital marine ecosystems, renowned for their extensive biodiversity. Often called the "*rainforests of the sea*," these underwater environments teem with life and colour, playing a crucial role in maintaining the planet's health. Scleractinian corals, commonly known as hard corals, are the principal architects of these reefs (Vuleta et al., 2024). Their intricate structures provide habitats for a myriad of marine species, contributing to a complex and interconnected web of life. Coral reefs support approximately 25% of all marine species, making them essential for the overall biodiversity and ecological balance of our oceans (Hoek & Bayoumi, 2017).

Regions like the Mersing Archipelago, including Pulau Mertang, are recognised for harbouring a rich diversity of scleractinian corals (Lee et al., 2022; Ismail & Khoo, 2019; Reef Check, 2023). These islands are home to 261 species of corals, along with ten new records for the east coast of Peninsular Malaysia (Lee et al., 2022). Healthy coral reefs are essential as they offer shelter, breeding grounds, and feeding areas for numerous fish species, which in turn support the larger food web of the oceans. Furthermore, coral reefs provide invaluable services such as coastal protection from storms and erosion, supporting fisheries, and driving tourism, which significantly contributes to local economies (Beck et al., 2018). Therefore, understanding and conserving the coral reefs of regions like the Mersing Islands is of paramount importance for both ecological and economic reasons.

This study was conducted in Pulau Mertang, which consists of three small isles i.e., Pulau Mertang Barat, Pulau Mertang Timur, and Pulau Mertang Tengah, in the state of Johor. These islands are adjacent to Pulau Seri Buat and Pulau Sembilang, which are in Pahang waters.

Acropora grandis

Acropora muricata

Galaxea fuscicularis

Platygyra sp.

Figure 1: Among the scleractinian coral found in the waters of Pulau Mertang, Johor.

The method used for this study was the Point Intercept Transect (PIT), adapted and modified from Hill and Wilkinson (2004). A 50-metre transect was laid parallel to the shore at a depth of 3 to 10 metres. All benthic organisms intercepting the transect at 1-metre intervals were recorded using an underwater camera for the inventory listing, Live Coral Cover (LCC), and diversity index analysis.

A total of 96 species from 14 families of scleractinian corals were recorded in this study. Several of them are shown in **Figure 1**. The highest number of coral species were recorded at P. Mertang Timur with 61, followed by P. Mertang Barat (58) and P. Mertang Tengah (53). The most dominant species found include *Acropora muricata* and *Acropora grandis*. A previous study by Lee et al. (2022) recorded 261 coral species from 16 families in the Mersing waters (across 24 reef areas excluding P. Mertang), and Ismail and Khoo (2019) revealed 25 genera from 12 families from their study in P. Mertang. Even though the species were quite distinctive, the number of coral families was comparable.

The overall reef health at Pulau Mertang was in fair condition, with an average LCC of 47.25%, which was similar to Malaysia's average LCC of 47.83% (Reef Check, 2023) but slightly lower than the study by Ismail & Khoo (2019), which reported a good condition (51.0% of LCC). In this study, the Shannon-Wiener Diversity Index (*H'*) was highest at Pulau Mertang Barat (6.38), followed by P. Mertang Timur (6.23) and P. Mertang Tengah (4.66).

These findings, alongside the dominance of *Acropora* corals, contribute valuable insights into the coral community structure and health of Pulau Mertang. The data also serve as a basis for continued monitoring and conservation efforts in this ecologically significant region, particularly in light of the discrepancies observed when compared to earlier studies. Future research should focus on identifying the factors contributing to these differences and implementing strategies to enhance reef resilience in the face of ongoing environmental challenges.

References

1. Beck et al. (2018). The global flood protection savings provided by coral reefs. *Nature Communications*, 9(1): 1-9.
2. Hill & Wilkinson (2004). Methods for Ecological Monitoring of Coral Reefs (Townsville, Australia: Australian Institute of Marine Science).
3. Hoek & Bayoumi (2017). Importance, destruction, and recovery of coral reefs. *IOSR Journal of Pharmacy and Biological Sciences*. 12: 59-63.
4. Ismail & Khoo (2019). Community structure of coral reefs in Pulau Mertang, Johor, Malaysia. *Sains Malaysiana*. 48: 2335-2342.
5. Lee et al. (2022). Scleractinian coral (Cnidaria, Hexacorallia, Scleractinia) diversity of the Mersing Islands, Peninsular Malaysia. *ZooKeys*. 1102.
6. Reef Check Malaysia (2023). Status of Coral Reefs in Malaysia, 2022.
7. Vuleta et al. (2024). The global significance of Scleractinian corals without photoendosymbiosis. *Scientific Reports*, 14(1): 1-22.

Recent Shellfish Poisoning in Port Dickson, Negeri Sembilan: A Closer Look

[1]Fisheries Research Institute, 11960 Batu Maung, Pulau Pinang
[2]Kuala Lumpur Fisheries Biosecurity Centre, Jalan Carruthers, 50480 Kuala Lumpur

MOHD NOR AZMAN A[1]*,
ROZIAWATI MR[1] & ZULIFAH R[2]
*nor_azman@dof.gov.my

Shellfish poisoning cases were reported in Port Dickson and Melaka in April 2024. According to *Harian Metro*, 2nd April 2024, eight individuals were hospitalised (two in the Intensive Care Unit) after consuming shellfish bought from two markets in Port Dickson. All victims experienced symptoms such as headaches, numbness in their hands and feet, and muscle weakness. The two patients in the ICU exhibited more serious symptoms, including paralysis.

Following this, the Department of Fisheries Malaysia immediately issued a notice prohibiting the public from collecting and selling shellfish from the affected areas. Subsequently, the Fisheries Research Institute (FRI) Batu Maung received mussel and seawater samples from Kampung Telok and Kampung Sekawang for toxin analysis using High-Performance Liquid Chromatography (HPLC) and plankton identification. The Paralytic Shellfish Poisoning (PSP) analysis came out positive, with toxin levels exceeding the permissible limit (80 µg/100 g sample (800 ppb)) for both sampling locations. The mussels from Kampung Telok showed higher PSP toxin content (7934.19 - 8539.79 µg/100 g) compared to Kampung Sekawang (659.00 to 1133.82 µg/100 g) (**Figure 1**). HPLC analysis showed the highest detected PSP toxin belonged to the GTX1&4 group, followed by the GTX2&3 group, GTX5, and STX. **Figure 1** illustrates the PSP toxin content in mussels from these two locations.

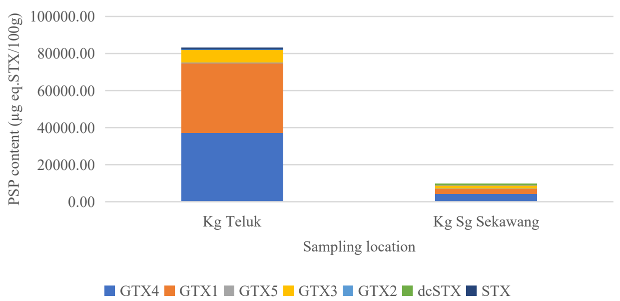


Figure 1: PSP content (µg/100g) in mussels from two locations.

Seawater samples from Kampung Telok revealed the presence of potentially toxic microalgae *Pseudo-nitzschia* spp., ranging from 550-3875 cells/L, similar to water samples from Kampung Sekawang (1,350-11,175 cells/L).

The FRI also received another batch of mussel and seawater samples for analysis from the Kuala Lumpur Fisheries Biosecurity Centre the following week, to verify the initial results. A total of five mussel samples were received from Kampung Telok, Sungai Sebang, Port Dickson market, Kampung Telok market, and the hospital. Again, shellfish samples contained PSP toxins, as illustrated in **Figure 2**. Similarly, the highest detected PSP toxin was found in the GTX1&4 group, followed by the GTX2&3 and GTX5 groups.

Seawater samples from the two sampling locations showed the presence of potentially toxic microalgae *Alexandrium* sp. and *Pseudo-nitzschia* spp., albeit at low cell densities; however, some exceeded 1,000 cells/L. The density of toxic microalgae at PNK was higher than at Sungai Sekawang. *Alexandrium* sp. ranging from 600 to 1,550 cells/L and *Pseudo-nitzschia* spp. from 150 to 400 cells/L were recorded at PNK. In Sungai Sekawang, *Alexandrium* sp. was recorded from 400 to 1,000 cells/L and *Pseudo-nitzschia* spp. between 200 and 250 cells/L. *Alexandrium* sp. is one of the microalgal species capable of causing PSP poisoning in humans who consume contaminated shellfish.

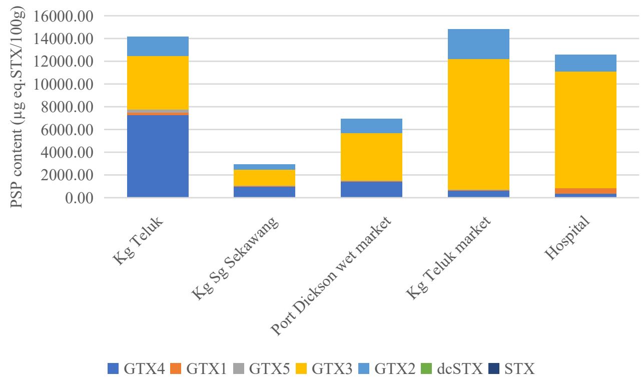


Figure 2: PSP content (µg/100g) in mussels from five locations.

Continuous sampling was conducted over eight consecutive weeks by the Kuala Lumpur Fisheries Biosecurity Centre. The cell counts of *Alexandrium* sp. were observed to gradually decline at all sampling stations. The PSP toxin contents were also reduced to approximately 233-300 ppb, below the permissible level. However, the consumers should remain cautious because in Kuala Penyu, Sabah, for example, high level of toxins (490 µg/100 g) were still detected in shellfish samples even six months after the incident.

Although potentially toxic species like *Pseudo-nitzschia* spp. and *Alexandrium* sp. have been found at low cell densities at sampling sites, there remains a risk if harmful algal blooms occur. Therefore, monitoring should be continued to ensure the shellfish harvested are safe for consumption.

Dugong Sanctuary in East Johor: From the POV of Fishers and Local Communities

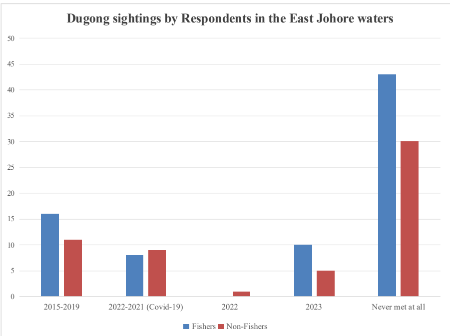
NORHANIDA D*, MASAZURAH AR,
NURASHIQIN SU & MUHAMMAD IRFAN AH

Fisheries Research Institute, 11960 Batu Maung, Pulau Pinang

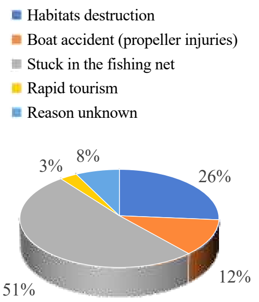
*nida@dof.gov.my

The Dugong (*Dugong dugon*) was first recorded in Johor waters in 1924, with no further sightings reported until Dugong hunting practices by the Indigenous community of Kampung Pendas, Gelang Patah, were documented. Official records of stranded Dugongs along Johor's coast began in the early 1990s. Interest in this species surged after a Dugong calf, *Si Tenang*, was accidentally caught in a fishing net on February 25, 1999, and cared for by the late Pak Atan. This event sparked research efforts to better understand the Dugong's ecological significance in Johor (**Table 1**).

A perception survey of stakeholders and local communities was carried out with 133 respondents on the mainland of Mersing, which included Teluk Buih (11.6%), Tanjung Leman (17.1%), Tanjung Genting (20.2%), Endau (8.5%), Penyabong (1.6%) and Mersing District Fisheries Office (7.0%); as well as Pulau Tinggi (21.7%) and Pulau Sibu (12.4%).



Unit: Number of Respondents.



Respondents' perception on major threats to Dugong in the East Johor waters.

The results of the survey indicated that:

- 91.7% of respondents recognised the importance of Dugong conservation.
- 82.0% supported the proposal to gazette a Dugong Sanctuary, believing it would increase their numbers and expand their distribution.
- 60.9% agreed that the sanctuary would boost fishers' income.
- 74.4% were confident that its establishment would stimulate tourism in East Johor.
- 91.0% fully supported the DOF's proposal for a Dugong Sanctuary in East Johor waters.

Due to the presence of fishers who reside on the islands within the sanctuary area, as well as their total dependence on the availability of fisheries resources, co-management of fisheries is the most recommended approach to successfully establishing a Dugong Sanctuary.

Table 1: Dugong Research Chronology in Malaysia.

2000	Dugong and Seaweed Ecosystem in Johor waters (Department of Fisheries, DOF and Universiti Putra Malaysia, UPM).
2014	Studies to improve understanding and knowledge regarding Dugong ecology and distribution, seagrass habitats, and stakeholders' perceptions of Dugong's conservation at Pulau Tinggi and Pulau Sibu waters (Marine Mammal Research and Conservation (MareCet), local and international scientists).
2015	World Dugong and Seaweed Conservation Project (government agencies, universities, and NGOs from the Global Environment Facility (GEF) allocated funds).
2016	Declaration and establishment of the Mersing Archipelago for the protection of the Dugongs' population and seaweed habitat by the Johor State Government.
	Feasibility studies on the Dugong Sanctuary in the waters of Pulau Tinggi, Pulau Sibu, and Pulau Besar. The Johor State Government allocated RM1 million through the Johor Five-Year Plan (RJ5T).
2023	Survey of public and fishers' perception on the proposal of gazetting the Dugong Sanctuary in East Johor waters (DOF).

Recommendations for Fisheries Co-Management

Incentives to fishers (on islands) in implementing monitoring and surveillance	Reporting of vessel encroachment incidents in real-time using fisheries applications	Exclusive usage of fishing communities in Zone 2 Management Area*
Aid to fishers for monitoring and enforcing special permit regulations and to eliminate ghost-fishing activities.	Fishers (on islands) are trained to use apps to be developed by DOF to report illegal fishing and vessels encroachment.	Artificial reefs will be deployed in specific areas in Zone 2.
Fishers are given special authorisation to confiscate illegally operated fishing gears in Dugong Sanctuary waters.	Immediate actions are taken against offenders when enforcement officers are present at the scene of the reported incidents.	The coordinates of artificial reefs deployment locations will be distributed to the fishers of Pulau Tinggi and Pulau Sibu.
Establish a repayment scheme for fuel subsidies and allowances to specially trained fishers.	If there are no enforcement officers at the time of the incident, then a fine(s) shall be imposed on the offender(s).	Fishers are empowered to self-regulate their fishing grounds to protect their own income and livelihood.
Provide incentives to fishers who safely release Dugongs into the sea after being caught in fish nets.	Repeated offenders will have their fishing licenses suspended, with the possibility of being unable to renew their licenses.	

*Waters that are 2 to 3 nautical miles from Pulau Sibu and Pulau Tinggi, not including waters overlapping Pulau Lima

Sharks and Rays Vulnerable to Extinction in Sarawak

PERCEVAL C*, NURRIDAN AH, QHAIRIL SHYAMRI R, FATIN NABILAH Y & JAMIL M
Fisheries Research Institute Bintawa, 93450 Kuching, Sarawak
*perceval@dof.gov.my

Sarawak recorded the highest landings of sharks and rays in Malaysia, totalling 2,640 tonnes and 2,352 tonnes, respectively, in 2021 (DOF Statistical Records). A previous study conducted by researchers indicated that 48 species of fish are vulnerable to extinction in Sarawak's water bodies, according to Ahmad et al. (2008). This drives the critical need for future monitoring and conservation by the local government. Out of all 48 vulnerable species, 33 species (68.8%) consist of sharks and rays. Among the 33 species, sharks identified were *Carcharhinus galapagensis, Carcharhinus leucas, Carcharhinus plumbeus, Chaenogaleus macrostoma, Eusphryra blochii, Hemipristis elongata, Hemigaleus microstoma, Lemiopsis temminckii, Heterodontus zebra, Sphyrna lewini, Sphyrna mokarran, Stegostoma fasciatum, Squantina tergocellatoides,* and *Triaenodon obesus.* Meanwhile, rays species listed include *Dasyatis thetidis, Glaucostegus typus, Glaucostegus thouin, Gymnura zonura, Brevitrygon walga, Maculabatis gerrardi, Pateobatis uarnacoides, Himantura uarnak, Himantura undulata, Pastinachus solocirostris, Pastinachus sephen, Plesiobatis daviesi, Pristis zijsron, Rhinobatos formosensis, Rhynchobatus laevis, Telatrygon zugei, Urogymnus lobistoma,* and *Aetomylaeus nichofii.*

Conservation Priority

Based on previous studies conducted by Ahmad et al. (2018), nine species of hammerhead sharks are considered for conservation, including the winghead shark, scalloped bonnethead, whitefin hammerhead, and scoophead. Four species: *Sphyrna mokarran* (great hammerhead), *Sphyrna zygaena* (smooth hammerhead), *Eusphyra blochii* (winghead shark), and *Carcharhinus longimanus* (whitefin shark), are listed as endangered. In Sarawak, based on Hamizah & Roba'a (2019), two commonly caught ray species are *Manta birostris* and *Manta alfredi*. Rays, which are closely related to sharks, belong to three orders: Pristiformes, Myliobatiformes, and Torpediniformes. With around 630 species across 18 families, they include stingrays, electric rays, butterfly rays, manta rays, guitarfish, and sawfish. These rays are harmless to humans, feeding primarily on plankton and small fish.

References

1. Ahmad et al. (2008). Panduan Mengenali Spesies Ikan Yu di Malaysia, Brunei Darussalam, Indonesia dan Thailand. Kuala Terengganu: DPPSPM/DOF.
2. Ahmad et al. (2018). A study of fisher's dependency on sharks and rays in Sabah, Malaysia. Southeast Asian Fisheries Development Centre.NPOA-MALAYSIA-National Plan of Action for the Conservation and Management of Shark (NPOA Shark) 2006.
3. Hamizah & Roba'a (2019). Domestics marketing of sharks and rays in Perak and Pahang, Malaysia. Department of Fisheries Malaysia.
4. Annual Fisheries Statistics. Department of Fisheries website.

Carcharhinus borneensis

Carcharhinus galapagensis

Chaenogeus macrostoma

Hemipristis elongata

Common sharks captured in Sarawak.

Dasyatis thetidis

Gymnura zonura

Maculabatis gerrardi

Urogymnus lobistoma

Common rays captured in Sarawak.

Insights of *In Silico* and Bioinformatics Approach in R&D of Aquatic Animal Health

NOOR HANIS AH
National Fish Health Research Centre (NaFisH), 11960 Batu Maung, Pulau Pinang
noorhanis@dof.gov.my

Disease remains a major challenge in aquaculture, reducing growth rates and survival while causing significant financial losses. Traditional methods for diagnosis, treatment, and vaccine development are often costly and time-intensive. However, advancements in *in silico* and bioinformatics approaches have revolutionised aquatic animal health research, offering computational tools to analyse biological data, model disease processes, and accelerate the identification of effective treatments in a faster, cost-efficient manner. Key contributions of *in silico* and bioinformatics in aquaculture include:

a. Disease surveillance and diagnosis

Early disease detection is key to minimising economic losses in aquaculture. Whole genome sequencing (WGS) and metagenomics enable rapid identification of bacteria, viruses, and parasites affecting aquatic species. Bioinformatics tools analyse genetic variations, mutations, and virulence factors, allowing swift detection of emerging or highly pathogenic strains. Phylogenetic analysis further traces pathogen evolution and transmission routes, as seen in betanodavirus reassortant strains (Arif et al., 2019). *In silico* methods also help identify molecular markers linked to aquatic diseases—for instance, WGS has been used to assess *Vibrio* species diversity and detect antimicrobial resistance elements in shrimp-associated strains (Teixeira et al., 2022).

b. Vaccine development

Conventional vaccine development—using heat, chemically killed, or attenuated pathogens—is both costly and time-consuming. *In silico* approaches, such as antigenic epitope prediction via immunoinformatics, accelerate the process by identifying immune-responsive epitopes for safer, more effective vaccines (Rawat et al., 2023). Multi-epitope vaccines targeting bacterial and viral diseases benefit from computational techniques, enhancing specificity and immune response (Suleman et al., 2023). Protein-ligand simulations further assess immune efficacy, guiding vaccine selection before lab testing (Joshi et al., 2020). For example, computational docking has successfully designed multi-epitope vaccines against Cyprinid herpesvirus (Rani et al., 2024). These advancements optimise vaccine structures and drive innovation in aquatic animal immunisation.

c. Antimicrobial drug discovery

New antiviral and antimicrobial compounds affecting aquatic species can be identified through molecular docking, virtual screening, and pharmacophore modelling. Ligand-Based Drug Design (LBDD) and Structure-Based Drug Design (SBDD) are two methods for identifying novel drugs that can be used to screen and optimise the best possible drug. Interestingly, the safety and pharmacokinetics of a potential drug can be predicted before *in vitro* (cell culture assay) and *in vivo* assays by using computational modelling of drug absorption, distribution, metabolism, and excretion (ADME), as well as toxicity prediction. This prediction ensures safe and efficient drug formulations by reducing the need for animal testing (*in vivo* assay). To combat the White Spot Syndrome Virus (WSSV) in shrimp, for instance, *in silico* screening has found putative self-inhibitory peptides from the hydrophobic membrane regions of the VP28 protein (Panchalingam & Kasivelu, 2024). Another study has identified potential antiviral drugs against Tilapia Lake Virus (TiLV) from two different tropical mangrove plants from tropical regions: *Heritiera fomes* and *Ceriops candolleana* (Sumon et al., 2023).

Challenges

- **Data integration** is crucial, as large-scale biological datasets require efficient storage and computational tools to manage their growing complexity (Cremin et al., 2022).
- **Validation of *in silico* findings** is essential—while computational predictions provide valuable insights, experimental confirmation is needed to ensure real-world applicability (Viceconti et al., 2021).
- **Limited computational resources** pose challenges, especially for smaller research institutions. High-performance computing and advanced bioinformatics tools demand significant investment and expertise, limiting accessibility. Addressing these barriers is key to unlocking bioinformatics' full potential in scientific and medical advancements.

In summary, the aquatic animal health R&D is being revolutionised by *in silico* and bioinformatics approaches, which offer efficient, cost-effective, and scalable methods for disease detection, prevention, and treatment. Integration between *in silico* and bioinformatics approaches with traditional experimental methods enhances the sustainability of aquaculture, supports biodiversity conservation, and contributes to global food security.

References

1. Ariff et al. (2019). Risk factors associated with viral nervous necrosis in hybrid groupers in Malaysia and the high similarity of its causative agent nervous necrosis virus to reassortant red-spotted grouper nervous necrosis virus/ striped jack nervous necrosis virus strains. *Veterinary World*, 12(8): 1273.
2. Cremin et al. (2022). Big data: Historic advances and emerging trends in biomedical research. *Current Research in Biotechnology*, 4: 138-151.
3. Joshi et al. (2021). In-silico designing of epitope-based vaccine against the seven banded grouper Nervous Necrosis Virus affecting fish species. *Network Modeling Analysis in Health Informatics and Bioinformatics*, 10(1): 37.
4. Panchalingam & Kasivelu (2024). A computational approach to identifying peptide inhibitors against White Spot Syndrome Virus: Targeting the virus envelope protein. *Microbial Pathogenesis*, 195.
5. Rani et al. (2024). Development of multi epitope subunit vaccines against emerging carp viruses Cyprinid herpesvirus 1 and 3 using immunoinformatic approach. *Scientific Reports*, 14(1): 11783.
6. Rawat et al. (2023). Immunoinformatic approaches for vaccine design: A fast and secure strategy for successful vaccine development. *Vaccines*, 11(2): 221.
7. Suleman et al. (2023). Designing a multi-epitopes subunit vaccine against human herpes virus 6A based on molecular dynamics and immune stimulation. International journal of biological macromolecules, 244, 125068.
8. Sumon et al. (2023). Identification of natural antiviral drug candidates against Tilapia Lake Virus: Computational drug design approaches. *Plos One*, 18(11): e0287944.
9. Teixeira et al. (2022). Whole-genome sequences of *Vibrio* species from warm-water shrimps imported into Canada: Detection of genetic elements associated with antimicrobial resistance and potential mobilizing capacities. *Microbiology Resource Announcements*, 11(2): e01014-21.
10. Viceconti et al. (2021). In silico trials: Verification, validation and uncertainty quantification of predictive models used in the regulatory evaluation of biomedical products. *Methods*, 185: 120-127.

Exploring Tuna Fisheries in the Indian Ocean: Malaysia's Perspective

MOHD HARIZ AH*, EFFARINA MFA, NUR ATHIRAH MA, MOHD FATHUL A'DNIN Z, SHARIFAH NUR SHUHAILLY SN, WASILAH MR & MOHD LUKMAN MUAZZIM R
Fisheries Research Institute Kg. Acheh, 32000 Sitiawan, Perak
*hariz@dof.gov.my

The Indian Ocean is one of the world's most productive fishing grounds, contributing approximately 20% of global tuna catches (Satlink, 2025). This region supports diverse tuna species essential to both global food security and regional economies. Malaysia, strategically located along key migratory routes of commercially important tuna species such as *Thunnus albacares* (yellowfin tuna) and *Katsuwonus pelamis* (skipjack tuna), plays a crucial role in the region's tuna fisheries. Recent research on tuna population dynamics, including length-weight relationships and environmental influences, is essential for developing sustainable management practices that ensure the long-term viability of tuna resources (FAO, 2020).

REGULATION AND COMPLIANCE

Malaysia's tuna fisheries are regulated in line with IOTC conservation and management measures (CMMs), including Resolutions 15/02 and 19/04 (DOF, 2024). The Department of Fisheries (DOF), Malaysia, monitors deep-sea and tuna vessels using the National Vessel Monitoring System (VMS) and has installed CCTV on tuna vessels as part of an Electronic Monitoring System (EMS) (DOF, 2024). Additionally, Malaysia has updated its national logbook to include species-specific reporting, as required by IOTC Resolution 19/04 (DOF, 2024). Fishing vessels submit weekly reports via email to DOF for verification, and port inspectors monitor tuna landings at designated ports (DOF, 2024).

FISHING METHODS

Fishing vessels predominantly utilise longline and purse seine methods. Longline vessels operate in both the East Indian Ocean (EIO) and West Indian Ocean (WIO), with vessels in the EIO targeting yellowfin and bigeye tuna and landing their catches monthly at Penang Port. In contrast, vessels in the WIO target albacore tuna, with catches unloaded at Port Louis, Mauritius (DOF, 2024).

FISHING EFFORT MEASUREMENT

Fishing effort is measured using indicators such as the number of vessels berthing at fishing ports and the number of hooks used during fishing operations (DOF, 2024). Each longline vessel typically uses 1,800 to 3,000 hooks per fishing operation, as recorded in logbooks (DOF, 2024). Scientific data collected from commercial landings are essential for estimating biomass and stock productivity, which contribute to more accurate stock assessments and the determination of sustainable catch limits (FAO, 2020).

CHALLENGES AND FUTURE RESEARCH

Several challenges threaten the sustainability of tuna fisheries in the Indian Ocean. Climate change is altering oceanographic conditions, including rising sea surface temperatures (SST) and shifting ocean currents, which influence tuna distribution and migratory patterns (Intergovernmental Panel on Climate Change, 2019). This temperature rise affects the vertical distribution of tuna, forcing them to inhabit deeper waters with optimal thermal conditions, which may reduce their availability to surface fishing gear. Additionally, changes in ocean currents can alter migratory routes, potentially shifting tuna stocks away from traditional Malaysia's fishing zones and affecting catch rates. Furthermore, illegal, unreported, and unregulated (IUU) fishing remains a significant concern, resulting in an estimated economic loss of USD 1.3 billion annually across the Indian Ocean (Agnew et al., 2009). Addressing these challenges requires enhanced monitoring, control, and surveillance (MCS) measures, such as vessel tracking systems, electronic logbooks, and catch documentation schemes, as well as increased regional cooperation among IOTC member states.

Fisheries inspectors measuring and documenting frozen tuna during port unloading operations.

Future research in Malaysia's tuna fisheries should focus on refining species-specific length-weight relationships using larger datasets and improving population models to enhance stock assessments. Additionally, advancements in satellite tracking, electronic monitoring, and artificial intelligence (AI) for data analysis can improve real-time tracking of fishing effort and tuna behaviours (FAO, 2020). By combining robust scientific research with adaptive management practices and regional collaboration, Malaysia aims to secure the long-term sustainability and economic viability of its tuna fisheries in the Indian Ocean.

Frozen tuna being lifted from a fishing vessel during unloading operations at the port.

References

1. Agnew et al. (2009). Estimating the worldwide extent of illegal fishing. *PLoS ONE*, 4(2): e4570.
2. DOF (2024). Malaysia national report to the Scientific Committee of the Indian Ocean Tuna Commission, 2024 (IOTC–2024–SC27–NR15). 1-2.
3. DOF (2024). Malaysia national report to the Scientific Committee of the Indian Ocean Tuna Commission, 2024 (IOTC–2024–SC27–NR15). 3.
4. DOF (2024). Malaysia national report to the Scientific Committee of the Indian Ocean Tuna Commission, 2024 (IOTC–2024–SC27–NR15). 26-27.
5. Food and Agriculture Organization of the United Nations. (2020). The state of world fisheries and aquaculture 2020: Sustainability in action. FAO. https://doi.org/10.4060/ca9229en.
6. Intergovernmental Panel on Climate Change. (2019). IPCC special report on the ocean and cryosphere in a changing climate. IPCC.
7. Satlink. (2025). Fisheries management works: Indian Ocean yellowfin tuna considered healthy in latest stock assessment.

The Potential of White Shrimp, *Penaeus vannamei* and Giant Freshwater Prawn, *Macrobrachium rosenbergii* Polyculture in Brackish Water Ponds

MOHD LAZIM MS*, AZMI R, FADZILAH Y, NUR AMALINA MR, MOHD FARAZI J, AZLINA A & QAWIEMAH AR

Fisheries Research Institute Gelang Patah, 81550 Gelang Patah, Johor

*lazim_saif@dof.gov.my

Polyculture has been developed and practiced in China for the past 2,000 years. It is a sustainable farming practice involving the combination of two or more species with different feeding habitats, which effectively utilises nutrients, resulting in higher production compared to monoculture (Aubin et al., 2015; Milstein, 2005). In other words, each species farmed should provide benefits to the other and should not compete with one another in terms of nutrition or space. Polyculture farming is one of the best strategies for sustainable aquaculture production, with limited and more efficient land use.

A polyculture trial of white shrimp (*Penaeus vannamei*) and giant freshwater prawns (*Macrobrachium rosenbergii*) was conducted at FRI Gelang Patah. The species were selected based on their distinct pond habits, where white shrimp occupy the entire water column, while giant prawns primarily inhabit the bottom. Despite their coexistence potential, polyculture farming of these species is still underdeveloped in Malaysia, with limited available information. This study assesses their compatibility in polyculture systems with varying stocking densities.

The experiment was conducted in 0.25-ha earthen ponds, with white shrimp stocked at 150,000 individuals for 90 days and giant freshwater prawns at 40,000 individuals for 150 days. Pond management followed standard procedures for white shrimp monoculture. In monoculture systems, white shrimp at 80 individuals/m² reached an average weight of 22.59 ± 4.36 g in 120 days, achieving a survival rate of 86.8% and a production yield of 20 mt/ha/cycle. Meanwhile, giant freshwater prawns in intensive monoculture attained a final average weight of 35.00 g in 150 days, with a survival rate of 40.0% and a production yield of 1.5 mt/ha/cycle.

The polyculture study successfully produced white shrimp with an average final weight of 33.35 ± 4.20 g, a survival rate of 88%, and a production yield of 22 mt/ha/cycle. Meanwhile, giant freshwater prawns reached an average final weight of 42.00 ± 21.57 g, with a survival rate of 41% and a production yield of 2.0 mt/ha/cycle. Water quality parameters showed no significant difference between culture systems ($p > 0.05$). These findings confirm the compatibility of white shrimp and giant freshwater prawn in polyculture, demonstrating increased production and profitability within a single cycle, without compromising water quality. Thus, polyculture systems are recommended as a viable strategy for achieving higher yields compared to monoculture farming.

Table 1: Results of the 150 days polyculture study.

	White shrimp	Giant Freshwater Prawn
Final average weight (gm)	33.35±4.20	42.00±21.57
Survival rate (%)	88	41
Production (mt/ha/cycle)	22	2.0

References

1. Aubin et al. (2015). Environmental performance of brackish water polyculture system from a life cycle perspective: A Filipino case study. *Aquaculture*, 435: 217-227.
2. Milstein (2005). Polyculture in aquaculture. *Animal Breeding Abstracts*, 73(12): 15-41.

Biofloc for Sustainable Aquaculture: Optimisation for Tilapia Fish Farming

[1]Fisheries Research Institute Glami Lemi, 71660 Jelebu, Negeri Sembilan
[2]Fisheries Reserach Institute, 11960, Batu Maung, Penang

NOOR FAIZAH I[1]*, SITI NORITA M[1] & AZHAR H[2]
*nfaizah@dof.gov.my

Limited land and water resources challenge conventional aquaculture, but biofloc technology offers a sustainable solution through minimal or zero water exchange. This method fosters beneficial microorganisms (bacteria, algae, and protozoa) that form nutrient-rich flocs containing proteins, lipids, and vitamins, which act as an additional feed for fish while microbial activity recycles nutrients and maintains water quality. Thus, biofloc is an efficient and eco-friendly approach to intensive fish farming. Several factors need to be taken into consideration when using biofloc in fish farming.

Biofloc requires a higher ratio of carbon to nitrogen (C:N), typically between 15:1 and 20:1. Besides the C:N ratio, the source of carbon also plays a significant role in obtaining efficient and effective biofloc. The addition of carbon in biofloc is important to promote the growth of the bacteria. Various sources of carbon have been utilised, such as starch, wheat flour, ground breadcrumbs, glycerol, and cornmeal. The main criterion for choosing the carbon source is abundant availability and cost-effectiveness. Depending on the carbon source, it could affect the microbial community of the biofloc, water quality, growth performance of the cultured fish, and their health status.

A comparison study was performed to investigate the effect of molasses and rice bran on the water quality and growth performance of red tilapia (*Oreochromis* spp.), starting at an initial size of 32 g. A commercial microorganism (Aquaenzyms) consists of several *Bacillus* species, and enzymes were applied to the red tilapia culture in fiberglass tanks. After 98 days of culture, the final body weight of red tilapia using rice bran as a carbon source was significantly higher (179.6 ± 5.9 g) than molasses (157.5 ± 6.3 g). Rice bran treatment revealed a lower FCR value of 1.6 ± 0.1 compared to molasses (1.9 ± 0.2), although it was insignificant. The lower FCR could be due to the higher protein content found in floc from the rice bran treatment compared to molasses biofloc. Proximate analysis conducted by Becerril-Cortés et al. (2018) showed that 48% protein was found in biofloc from the rice bran treatment compared to molasses (42%). Overall, the total production of red tilapia from the rice bran treatment was significantly higher (9.8 ± 0.5 kg/m^3) than the molasses treatment (8.7 ± 0.8 kg/m^3).

Monitoring floc levels is important when using the biofloc application because excessive aggregates will contribute to suspended solids that may clog up the fish gills. The highest level of floc was detected in rice bran treatment, followed by molasses at 26.7 ± 2.9 ml/L and 25.7 ± 4.0 ml/L, respectively ($p > 0.05$). According to Emerenciano et al. (2017), 20-50 ml/L of settling solids from the Imhoff cone is applicable for rearing juvenile and adult tilapia. Dissolved oxygen, temperature, pH, and unionised ammonia were within the optimal range throughout the experiment for both treatments.

In summary, biofloc technology holds great promise for optimising tilapia farming and advancing sustainable aquaculture practices. Biofloc systems offer a viable solution for meeting the growing demand for tilapia while minimising the environmental footprint by improving water quality, reducing feed costs, and enhancing fish health. However, successful implementation requires careful management of water quality, aeration, and feeding strategies to optimise the growth of both tilapia and the microbial community.

References

1. Becerril-Cortés et al. (2018). Effect on the nutritional composition of produced bioflocs with different carbon sources (Molasses, coffee waste, and rice bran) in the biofloc system. *International Journal of Fisheries and Aquatic Studies*, 6(2): 541-547.
2. Emerenciano et al. (2017). Biofloc technology (BFT): A tool for water quality management in aquaculture. *InTech.* https://doi.org/10.5772/66416

From Hatch to Harvest: The Milkfish Breeding Success at FRI Tanjung Demong

MOHD KHAIRUDIN M*, SUFIAN M & AHMAD DAUD O
Fisheries Research Institute Tg. Demong, 22200 Besut, Terengganu
*mohdkhairudin@dof.gov.my

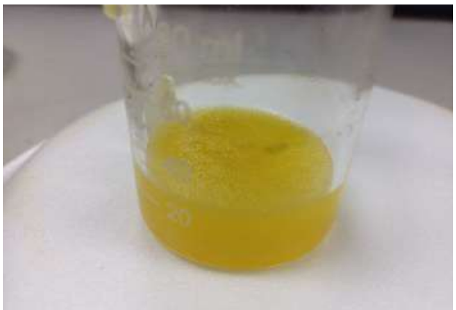
Milkfish (*Chanos chanos*) is a widely distributed finfish across the Indo-Pacific and Southeast Asia. As an omnivorous feeder, it takes three to five years to mature, with females capable of spawning multiple times a year, producing up to six million eggs per cycle. Nutritionally, milkfish is rich in protein (24.18%) and monounsaturated fatty acids, particularly oleic acid (32.11%). It contains essential macro minerals like calcium, magnesium, sodium, and potassium, as well as microminerals such as iron, zinc, copper, and manganese, along with vitamins A, B1, and B2. Indonesia and the Philippines are the top milkfish producers, exceeding 400 metric tons annually. Malaysia's production is growing, reaching 9,276 metric tons (MT) in 2022, up from 2,819 MT in 2021. However, the industry relies entirely on imported fry due to the lack of local breeding. To enhance sustainability, FRI Tanjung Demong is researching broodstock development to improve fry quality and ensure a stable supply for aquaculture.

On July 4, 2023, FRI Tanjung Demong imported 11 broodstock from Bali, Indonesia, to initiate the milkfish breeding process. By August 3, 2023, the milkfish had successfully produced 100,000 eggs after being kept for a month in a 150-tonne water tank at the facility. Milkfish eggs are slightly yellowish, with a diameter between 1.1 mm and 1.3 mm. High-quality eggs float on the water's surface at a salinity of 30 ppt, while damaged eggs sink to the bottom of the tank.

The feeding process begins with *Nannochloropsis* (phytoplankton) and rotifers (zooplankton) sized 150–200 microns from the first day until the 12th day post-hatching. On the 6th day, copepods measuring 250 microns are introduced, followed by *Artemia*, and formulated powdered feed from the 12th day onwards. The larval rearing period lasts between 20 and 40 days in the tank before the fry are transferred to grow-out ponds.

In 2024 alone, FRI Tanjung Demong successfully produced 105,000 fry measuring 2–6 inches, which were distributed to 15 aquaculture farmers across Malaysia. In conclusion, the successful production of milkfish fry by FRI Tanjung Demong highlights the high potential for commercialising milkfish farming in Malaysia. This initiative offers a promising opportunity for aquaculture farmers to boost the country's marine fish production and enhance the industry's growth and sustainability.

Broodstock milkfish *Chanos chanos* from Bali Indonesia.



Milkfish eggs are slightly yellowish with a diameter between 1.1 - 1.3 mm.

Seagrass Haven at Telaga Simpul, Kemaman and its Ecological Wealth

SITI NABILA MS*, MUHAFFIZ H
Fisheries Research Institute Rantau Abang, 23000 Dungun, Terengganu
*nabila@dof.gov.my

Nestled in the vibrant, busy waters of Kemaman Port, the seagrass habitat of Telaga Simpul stands as a testament to the remarkable ecological diversity and resilience found within these underwater meadows. The site is home to several seagrass species, including *Halodule pinifolia* and *Halophila beccari*. Over the years, the seagrass meadows have experienced changes in species composition and areal coverage, primarily influenced by anthropogenic activities such as sand mining, nearby shipping operations, and recreational fishing in the area.

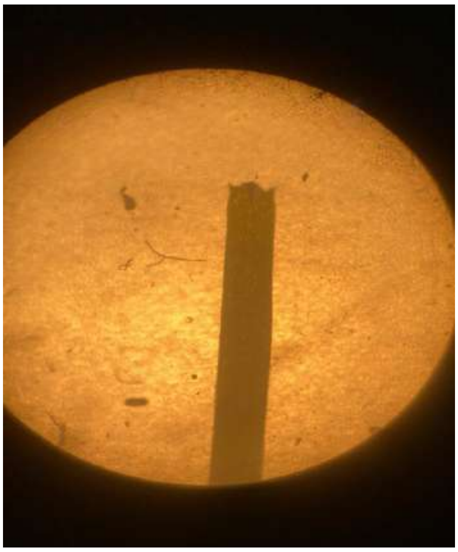
Previously, the area had recorded the presence of *Halophila beccari* (Bujang et al., 2006), a prominent species in the seagrass and mangrove-associated sections, while also maintaining *H. pinifolia* up until the present. The coverage area of these seagrass beds has fluctuated, with some periods of apparent lush growth and other times, low growth when the meadows were relatively impacted by the grazing of sea turtles. Last year, the seagrass meadow covered an area ranging from 10.5 to 23.2 hectares, which appeared to be a decline from its previously recorded extent of 28 hectares (DOF-MNSC, 2007).

On the seaward edge, the seagrass meadow is dominated by *H. pinifolia* with coverage of 60-100% whilst on the mangrove-associated area, its sparse coverage is of 15-30%. This condition is believed to be driven by the prevailing hydrological conditions and sediment characteristics that favour the growth of these species in their respective zones (Karlina & Idris, 2019). The difference in coverage composition of the existing and previously recorded (Bujang et al., 2006) is potentially shaped by the varying tolerance of seagrass taxa to the environmental factors such as light, nutrients, and substrate types (Lee et al., 2024).

This is true, as the water has been observed to experience turbidity as high as 50 NTU, which may be contributed by the nearby port activities and a suspected sand mining operation. Although the seagrass meadow appears to be resilient to some level of environmental disturbances, the current conditions at Telaga Simpul suggest the urgent need for management interventions to safeguard this valuable coastal ecosystem (Lavery et al., 2023; Lee et al., 2024).

The seagrass ecosystem in Telaga Simpul plays a crucial role in supporting the livelihoods of local fishers, as it serves as a vital nursery and feeding ground for a diverse array of marine life (Arkham et al., 2016). This includes species that are protected under conservation efforts, such as the iconic green turtle, *Chelonia mydas*, that grazed upon the lush green meadows. During low tide, artisanal fishers will take advantage of the richness of the seagrass and mangrove-associated habitat for their fishing activities, harvesting a handful of catches that include highly valued target species like *Portunus pelagicus* and *Epinephelus* spp. as observed during landing. The mangrove also serves as a nursery for juvenile fish since its pneumatophores and stilt roots provide shelter and refuge (Karlina & Idris, 2019; Lavery et al., 2023). Mangrove species such as *Avicennia* spp. and *Rhizophora* spp. are also known to thrive in the vicinity, intertwining with the seagrass meadows and enhancing the overall habitat diversity (Karlina & Idris, 2019; Syukur et al., 2021).

Seagrass meadows, mangrove forests, and salt marshes possess the ability to sequester carbon from the atmosphere and store it in their soils, a process known as blue carbon. In Southeast Asia, the average carbon storage within seagrass meadows is estimated to be 121.95 ± 76.11 Mg ha^{-1}, with the Philippines having the highest carbon stock in the region (Stankovic et al., 2021). Considering the substantial coverage of seagrass habitat in Telaga Simpul, the site holds immense value as a natural carbon sink, contributing to climate change mitigation efforts.



The main species recorded at Telaga Simpul, *Halodule pinifolia*.

The ecological wealth of Telaga Simpul's seagrass habitat is undeniable, as it supports a diverse array of marine life, provides essential services to local communities, and offers significant potential for climate change mitigation through blue carbon storage. However, the ongoing anthropogenic pressures and environmental changes underscore the urgent need for comprehensive conservation and management strategies to safeguard this invaluable coastal ecosystem.

Seagrass surveyed at the mangrove associated area.

The leftover of seagrass after being grazed by sea turtle.

Seagrass coverage of approximately 85%, dominated by *H. pinifolia*.

References

1. Arkham et al. (2016). Social-ecological system of seagrass and small-scale fisheries connectivity in Malang Rapat and Berakit Villages, Bintan District, Riau Islands. *Jurnal Ilmu dan Teknologi Kelautan Tropis*, 7(2).
2. Bujang et al. (2006). Distribution and significance of seagrass ecosystems in Malaysia. *Aquatic Ecosystem Health & Management*, 9(2): 203–214.
3. Department of Fisheries Malaysia-Malaysia National Seagrass Committee. (2007). *Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand: National Seagrass Report of Malaysia.*
4. Karlina & Idris (2019). Habitat function of seagrass ecosystem for megabentos diversity in Teluk Bakau, North Bintan, Indonesia. *IOP Conference Series Earth and Environmental Science.* 241: 12020.
5. Lavery et al. (2023). Blue carbon opportunities: Seagrass carbon storage and accumulation rates at Johor and Penang, Malaysia.
6. Lee et al. (2024). Blue carbon ecosystems in Malaysia: Status, threats, and the way forward for research and policy. *The Journal of Environment & Development.*
7. Stankovic et al. (2021). Quantification of blue carbon in seagrass ecosystems of Southeast Asia and their potential for climate change mitigation. *Science of The Total Environmen*t, 783: 146858.
8. Syukur et a. (2021). Seagrass-associated fish species' richness: Evidence to support conservation along the South Coast of Lombok Island, Indonesia. *Biodiversitas Journal of Biological Diversity*, 22(2).

Native Betta Fish as a Natural Solution for Mosquito Control

Fisheries Research Institute Glami Lemi,
71650 Jelebu, Negeri Sembilan

CHEW PC*, AMIRAH FATIHAH MN & SITI NORITA M
*chew@dof.gov.my

Biological control of mosquito larvae using larvivorous fish is an effective and eco-friendly strategy to combat mosquito-borne diseases such as dengue and malaria. These fish consume mosquito larvae, preventing them from developing into adults. Suitable mosquito species for control include *Culex, Anopheles, Aedes,* and *Ochlerotatus* (Jafari et al., 2019). Their larvae remain near the water surface, making them prime prey for fish that feed in the upper water layers.

Several fish species have proven effective in mosquito control, including *Poecilia reticulata* (guppy), *Gambusia affinis* (western mosquitofish), *Carassius auratus* (goldfish), and *Oreochromis niloticus* (tilapia). *G. affinis* has been widely introduced in Malaysia for this purpose (Gerberich, 1985), while guppies have been used in local studies (Saleeza et al., 2014). However, non-native species pose ecological risks if their populations destabilise. In contrast, native species like *Betta* from the Osphronemidae family offer a sustainable alternative for mosquito control.

Betta can be an effective mean of controlling mosquito larvae, especially those that inhabit small, shallow, calm, and stagnant waters such as ponds and slow-flowing streams. However, as far as the author is aware, biocontrol efficacy studies have only been conducted on *Betta splendens* (commonly known as the Siamese fighting fish) (de Oliveira-Lima et al., 2010). There are currently 29 known *Betta* species in Malaysia, most of which are kept as ornamental fish, and their potential for mosquito control is still largely unexplored.

A study was conducted at the FRI Glami Lemi to investigate the effectiveness of native *Betta* species in consuming mosquito larvae. The study was conducted in aquariums (L 15 cm x W 15 cm x H 25.5 cm) with three species, namely *B. imbellis*, *B. pugnax,* and *B. ocellata*, and *P. reticulata* (control) of comparable size and weight (0.20-0.30 g). One fish was placed in each aquarium, in triplicate setups for each species. Each aquarium was fed 100 mosquito larvae daily for two weeks. Uneaten mosquito larvae were

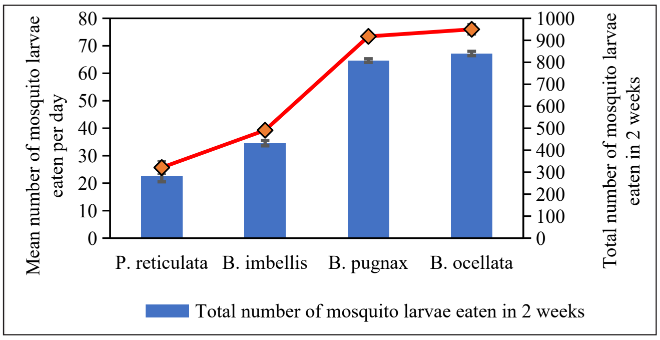


Figure 1: Efficacy of three native *Betta* species in consuming mosquito larvae compared to guppies.

counted and removed from each tank after six hours. The number of mosquito larvae eaten per day was recorded. The results showed that all three *Betta* species were effective predators of mosquito larvae in stagnant water and significantly outperformed the guppies in their larval consumption ($p < 0.05$) (**Figure 1**). The study also showed that the mouthbrooding *Betta* species (*B. pugnax* and *B. ocellata*) were more effective in consuming mosquito larvae ($p < 0.05$) than the blubber-nester (*B. imbellis*). However, their efficacy has not yet been evaluated in the field and therefore needs further investigation.

The use of native *Betta* for mosquito control has many benefits. As a native species, *Betta* can thrive and reproduce continuously, creating a stable population in the water source that contributes to long-term mosquito larvae control. This method is environmentally friendly, reduces reliance on costly chemical insecticides, and is non-toxic as the *Betta* do not harm the environment and pose no threat to other non-target organisms. Furthermore, as a native species, *Betta* can selectively feed on mosquito larvae without significantly disturbing the surrounding ecosystem, so the impact on other aquatic life is minimal.

While *Betta* fish are effective in controlling mosquito larvae, their effectiveness is limited to calm or slow-moving waters where larvae breed. They struggle in fast-flowing rivers, deep waters, shaded areas, or confined spaces like tree holes and bamboo pools (Warfe & Barmuta, 2004). Some mosquito species have adapted to avoid predation by hiding in vegetation or tolerating polluted waters, making them less susceptible. *Anopheles* larvae, for example, conceal themselves in plant roots (Rufalco-Moutinho et al., 2016). Additionally, while mosquito larvae can survive in pH levels ranging from 4 to 11, native *Betta* thrive within a range of 3.5 to 7.5 (Tan & Ng, 2005). Due to these limitations, *Betta* fish are best suited for localised, small-scale mosquito control efforts, particularly in rural areas where larvae are abundant and access to chemical pesticides is limited.

Overall, native *Betta* can be an effective and sustainable method of controlling mosquito populations, but their effectiveness depends on the environment of the water body and the targeted species of mosquitoes.

References

1. de Oliveira-Lima et al. (2010). Survival of *Betta splendens* fish (Regan, 1910) in domestic water containers and its effectiveness in controlling *Aedes aegypti* larvae (Linnaeus, 1762) in Northeast Brazil. *Tropical Medicine & International Health*, 15(12): 1525-1532.
2. Gerberich (1985). Update of annotated bibliography of papers relating to the control of mosquitos by the use of fish for the years 1965-1981. Geneva: World Health Organization.
3. Jafari et al. (2019). A narrative review of the control of mosquitoes by larvivorous fish in Iran and the world. *Iranian Journal of Health Sciences*. 7(2): 49-60.
4. Rufalco-Moutinho et al. (2016). Larval habitats of *Anopheles* species in a rural settlement on the malaria frontier of Southwest Amazon, Brazil. *Acta Tropica*, 164: 243–258.
5. Saleeza et al. (2014). Guppies as predators of common mosquito larvae in Malaysia. *Southeast Asian J Trop Med Public Health*. 45(2): 299-308.
6. Tan & Ng (2005). The fighting fishes (Telesotei: Osphronemidae: Genus *Betta*) of Singapore, Malaysia and Brunei. *The Raffles Bulletin of Zooology*. *Supplement* (13): 43-99.
7. Warfe & Barmuta. (2004). Habitat structural complexity mediates the foraging success of multiple predator species. *Oecologia* 141(1): 171-178.

Vision to Venture: Intellectual Property Highlights in 12th Malaysia Plan

Fisheries Research Institute,
11960 Batu Maung, Pulau Pinang

LIYANA R
liyana@dof.gov.my

The 12th Malaysia Plan (MP) establishes a framework for a dynamic innovation ecosystem, emphasising strategic partnerships, market-driven research, and effective commercialisation. Recognising intellectual property (IP) as a catalyst for economic growth, the 12th MP prioritises enhanced IP awareness and more efficient commercialisation pathways.

In accordance with this vision, the Department of Fisheries Malaysia (DOF), through the Fisheries Research Institute (FRI), is aligning efforts to strengthen the IP landscape in the fisheries sector. Key initiatives focus on optimising IP management, accelerating fisheries R&D, and fostering high-impact IP collaboration. By promoting technology transfer and private sector partnerships, the FRI aims to bridge the gap between research and practical applications, ensuring that innovative fishery solutions reach the market and contribute to national economic development.

FRI has successfully secured various intellectual properties to support fisheries innovation. Copyrights lead the registrations with 25 granted, ensuring strong protection for research publications and digital assets. Patents follow with 4 granted and 1 pending, reflecting novel technological advancements. Utility innovations (UIs) stand at 2 granted and 2 pending, supporting incremental innovations. Trademarks, essential for product identity, have 3 granted and 2 pending, while industrial designs (IDs), protecting product aesthetics, have 1 granted and 1 pending. These achievements reinforce FRI's commitment to innovation and commercialisation under the 12th MP.

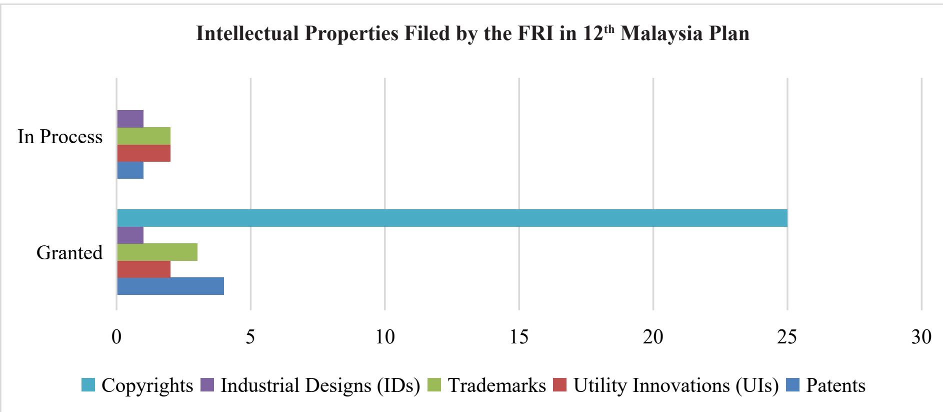
12th MP has already delivered tangible results in technology commercialisation, with notable projects such as M-SPEX, ConnectAqua2U, Solar Cockle Sorter, and SirehMAX:

1. **M-SPEX**: A major step in aquaculture innovation, this project is progressing through a partnership between FRI and IM Bio Tech Aquaculture Sdn. Bhd. This collaboration aims to improve aquaculture efficiency and scalability.

2. **ConnectAqua2U & Solar Cockle Sorter**: These innovations enhance sustainability and efficiency in fisheries and aquaculture, paving the way for wider industry adoption.

3. **SirehMAX**: The scale-up of SirehMAX production is advancing through a partnership between FRI and Absolute Base Sdn. Bhd. The agreement marks a key milestone in its commercialisation, showcasing the effectiveness of public-private collaborations in fish disease innovation.

SirehMAX®

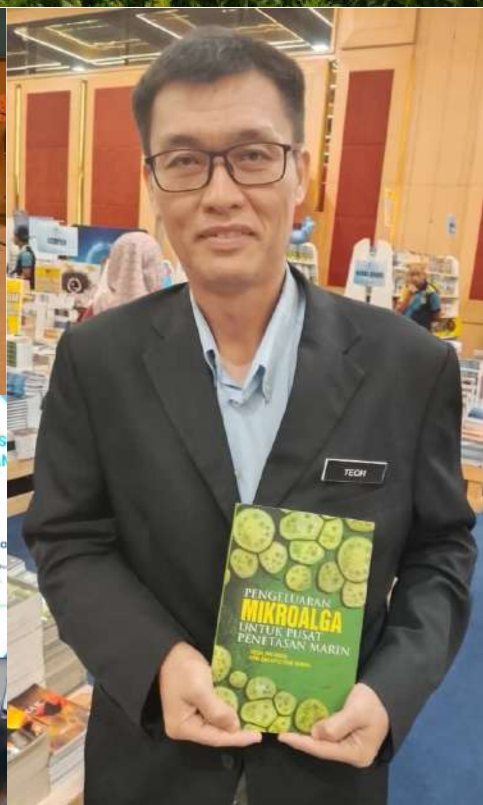


These successes demonstrate the 12th MP's impact on driving innovation and highlight the importance of collaboration between industry and government. Strong IP strategies will continue to transform fisheries innovations into commercial ventures and strengthen Malaysia's competitiveness in the sector. The achievements under the 12th MP also set the stage for further innovation expansion in the 13th MP.

FISH PUNS/JOKES

1. What was the fish that stomped all over Japan? -Codzilla
2. Who is the most underrated member in the fish band? -Their bass player
3. What is the staple of a healthy fish's diet? -Plenty of vitamin sea
4. What happens when you mix a fish and a banker? -You get a loan shark
5. Where do fish keep their money? -In the river bank
6. Who makes sure the ocean is clean and tidy? -Mermaids

FACES & FIELDWORK: LIFE AT FISHERIES RESEARCH INSTITUTE



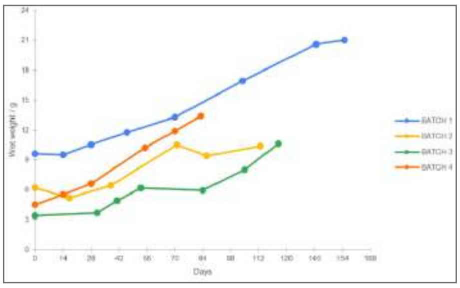

ITEX'25
Concurrent Exhibition:
WYIE WORLD YOUNG INVENTORS EXHIBITION
Incorporating:
AYIE
WYIE

In Vitro Propagation of the Economically Valuable Seaweed *Kappaphycus alvarezii*

NAJIHAH MN
Langkawi Research Centre, 07000 Langkawi, Kedah
najihahnasir@dof.gov.my

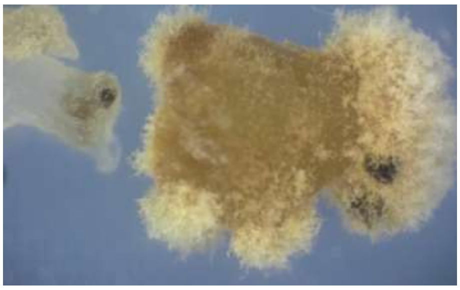
Kappaphycus alvarezii is a commercially cultured seaweed in tropical regions, including Malaysia, where it is exclusively farmed in Sabah due to its protected coastlines (Aroyehun et al., 2019). Seaweed aquaculture contributes 45% of Malaysia's total aquaculture production, amounting to 225,077 metric tons worth around RM 100 million in 2023 (DOF, 2024). However, seaweed production fluctuates due to the scarcity of high-quality seedlings. Since seaweed farming began in 1978, overexploitation of wild populations has led farmers to reuse harvested seaweed as seedlings, resulting in lower yields, poor carrageenan quality, and susceptibility to ice-ice disease and epiphytes (Ali et al., 2020; Yong et al., 2014). Without intervention, Malaysia's seaweed production will continue to decline.

To overcome this, under the 12th Malaysia Plan, seaweed research in Langkawi Research Centre focuses on seaweed breeding research using the tissue culture method to produce high-quality *K. alvarezii* seedlings. Seaweed tissue culture is a method of growing seaweed using artificial growth media in controlled, axenic, and sterile conditions, hence capable of producing mass number of disease-free and epiphyte-free seaweed seedlings. Fresh *K. alvarezii* seaweed was obtained from Semporna, Sabah. After acclimatisation, the seaweed was cut into small pieces called explants and grown throughout four laboratory-based experimental stages: (i) callus induction, (ii) embed culture, (iii) shaking culture, and (iv) aerated culture. The produced seedlings were then used for tank-based nursery culture.



Increase in the wet weight of K. alvarezii over time in tank-based nursery.

The growth of *Kappaphycus alvarezii* relies on Provasoli's Enriched Seawater (PES) medium for essential nutrients during laboratory stages. Each explant undergoes either indirect organogenesis or indirect somatic embryogenesis, with filamentous callus forming first before developing into a young thallus. In embed culture, the callus transitions into a brownish young thallus resembling mature seaweed. Shaking and aerated cultures further promote thallus development into propagules. Once seedlings reach 2 cm, they are transferred to tank-based nursery culture, where their wet weight increases over time, reaching 10–20 g, suitable for out-planting in the sea. This study highlights seaweed tissue culture as a viable solution for producing high-quality seedlings, emphasising the need to scale up production for sustainable commercial aquaculture.



Explant with callus formation at callus induction stage.

References

1. Ali et al. (2020). Micropropagation and sea-based nursery growth of selected commercial *Kappaphycus* species in Penang, Malaysia. *Journal of Applied Phycology*, 32(2): 1301-1309.
2. Aroyehun et al. (2019). Effects of seasonal variability on the physicochemical, biochemical, and nutritional composition of Western Peninsular Malaysia *Gracilaria manilaensis*. *Molecules*, 24(18): 3298.
3. DOF (2024). *Perangkaan Tahunan Perikanan 2023: Jilid 1.*
4. Yong et al. (2014). Chemical composition of farmed and micropropagated *Kappaphycus alvarezii* (Rhodophyta, Gigartinales), a commercially important seaweed in Malaysia. *Journal of Applied Phycology*, 27(3): 1271-1275.

Banana Shrimp (*Fenneropenaeus merguiensis*): A Promising Species for Malaysia's Marine Shrimp Aquaculture Industry

CHE ZULKIFLI CI
Fisheries Research Institute Pulau Sayak,
08500 Kota Kuala Muda, Kedah
che.zulkilfli@dof.gov.my

Marine shrimp aquaculture is a vital sector in Malaysia, with Tiger Prawn (*Penaeus monodon*) and Pacific White Shrimp (*Penaeus vannamei*) dominating commercial production. To diversify and strengthen the industry, introducing new candidate species is crucial—one such species is the Banana Shrimp (*Fenneropenaeus merguiensis*), a native shrimp widely found across the western Indo-Pacific and a primary catch for Malaysia's coastal fishers.

Though *F. merguiensis* is farmed in Southeast Asia and Australia, its production remains low compared to the Tiger Prawn and Pacific White Shrimp. Historically, Malaysia cultivated Banana Shrimp, but records show limited production in the 1990s and early 2000s, with small-scale farming reported in India, Australia, and Indonesia. Banana Shrimp has strong aquaculture potential due to its ability to breed in captivity, tolerate varied environments, and require lower dietary protein. It is also easily sourced as wild broodstock and has straightforward larval rearing (Khanjani et al., 2022). In 2006, global production peaked at 96,633 tonnes, but the dominance of Pacific White Shrimp led to a decline, with production dropping to 24,681 tonnes by 2016 (Aziz et al., 2020).

Since 2021, the FRI Pulau Sayak has been conducting a study to revive Banana Shrimp cultivation in Malaysia, focusing on breeding techniques and pond farming performance. Gravid female broodstock, sourced from Kampung Pulau Sayak fishers, were housed in 100-litre fiberglass tanks and spawned within a day. Eggs hatched in 24 hours, and nauplii were transferred to larval rearing tanks. Larvae progressed through nauplius, zoea, mysis, and post-larval (PL) stages, fed with *Chaetoceros* sp., *Artemia*, and formulated feeds, with survival rates from nauplius to PL10 ranging between 5-38%. Post-larvae were transferred to earthen ponds prepared through liming, fertilisation, and EM application, with cultivation trials conducted in Kuala Muda District and FRI Gelang Patah. Farming methods mirrored those of Tiger Prawns, with shrimp fed four times daily (up to 4% body weight) and monitored biweekly. Grow-out trials ranged from 80–150 days, with stocking densities of 28, 40, and 68 PLs per m².

Growth was slower and size variation was higher compared to the Pacific White Shrimp. Harvesting occurred at 3-4 months, mainly for live bait and local market supply. Despite lower farming performance, Banana Shrimp remains a viable alternative due to its native status and ease of broodstock collection. Further research is needed to improve survival rates and reduce feed conversion ratios (FCR) for enhanced commercial viability.

References

1. Aziz et al. (2020). Genetic diversity of banana prawns *Fenneropenaeus merguiensis* in Malaysian waters using microsatellite markers. *Journal of Environmental Biology*, 35(November): 1013–1020.
2. Khanjani et al. (2022). The effects of different stocking densities on nursery performance of banana shrimp (*Fenneropenaeus merguiensis*) reared under biofloc condition. *Annals of Animal Science*, 22(4): 1291-1299.




FISH PUNS/JOKES

1. Why do lawyers hate having a fish as a client? -They're always gill-ty
2. Stay safe online—you don't want to get catfished
3. We should dolphin-ately hang out sometime
4. What did the sea lion say to the flying fish? -You sure are making a splash around here
5. Why did the fisherman stop playing the violin? -Because it was out of tuna
6. When is it time for a fish to go to an eye doctor? -When it's having trouble sea-ing
7. How do you say "seize the day" in fish language? -"Carp-e diem."
8. Who is the most famous fish spy? -James Pond

RESEARCH UPDATES

Milkfish (*Chanos chanos*) Growth in Tank Culture with Reduced Fish Meal Diets

MOHD FIRDAUS A*, MOHAMMED SUHAIMEE AM, ROSNANI, Y & NOR AIDA SUZANA AR

Fisheries Research Institute Pulau Sayak,
08500 Kota Kuala Muda, Kedah

*firdausazmi@dof.gov.my

Milkfish (*Chanos chanos*) aquaculture heavily depends on fish meal as a primary protein source, but rising costs and sustainability concerns have prompted exploration of alternatives. Plant-based feeds and microalgae are being studied to reduce reliance on wild fish stocks while maintaining production efficiency (Tacon & Metian, 2008). To assess these alternatives, a study was conducted at FRI Pulau Sayak under the 12th Malaysia Plan to evaluate the impact of reduced fish meal diets on milkfish growth in tank culture.

This study evaluates the use of 2% fish meal in three experimental diets with crude protein levels of 32%, 30%, and 28%, compared to a commercial diet with 28% crude protein as a control. The experimental diets maintain a consistent lipid content of 8.4% to ensure controlled dietary conditions and accurate results (Martino et al., 2022). Ingredients for both experimental and commercial feeds were sourced locally in Kedah, Malaysia, with the experimental feed formulated at Bengkel Makanan, FRI Pulau Sayak, using a single-phase extruder.

The study involved 12 units of 5-ton tanks, with three replicates for each diet. Each tank was fully aerated and underwent a 30% water exchange every three days. Milkfish juveniles were stocked at a density of 30 fish per tank, with average initial weights of 22.67±1.12g for Diet 1, 21.67±1.24g for Diet 2, 22.97±0.94g for Diet 3, and 21.82±1.05g for the commercial diet. The fish were cultured for three months, with weight measurements taken monthly. A one-way ANOVA analysis indicated that the final weights of the fish fed different diets were as follows: Diet 1: 214.01±11.01g, Diet 2: 209.49±12.88g, Diet 3: 200.50±13.00g, and Commercial Diet: 203.12±11.15g. There were no significant differences ($p > 0.05$) between the diets (**Figure 1**). The specific growth rate and feed conversion ratio also showed no significant differences ($p > 0.05$) across all diets. Regarding survival rates, Diets 1, 2, and 3 did not show significant differences ($p > 0.05$) compared to the Commercial Diet; however, Diet 1 was found to be significantly different ($p < 0.05$) when compared to Diets 2 and 3. In the trial, no statistically significant differences ($p > 0.05$) concerning feed conversion ratios were observed among the various diets. The results were as follows: Diet 1 exhibited a feed conversion ratio of 1.66±0.11, Diet 2 displayed a ratio of 1.69±0.13, Diet 3 showed a ratio of 1.77±0.06, and the commercial diet presented a ratio of 1.75±0.13 (**Table 1**).

Diet 3 (28% crude protein) emerged as the best alternative to the commercial diet, delivering comparable growth, feed efficiency, and survival rates despite containing only 2% fish meal. Its matching protein level offers a sustainable, cost-effective solution for milkfish aquaculture, making it a viable replacement for traditional fish meal-based feeds.

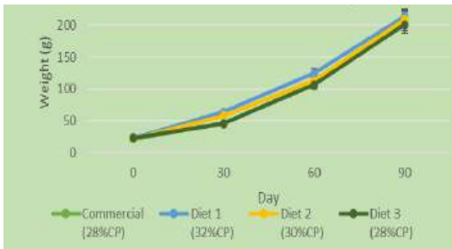


Figure 1: Performance of milkfish rearing in a tank culture system over a 90-day period.

Fiberglass tank used for culturing milkfish in a closed system.

Table 1: Performance of Milkfish with commercial and experimental diet after 90 days of feeding trial in tank culture.

Diet	Initial Weight (g)	Final Weight (g)	Weight Gain (%)	Specific Growth Rate (% day $^{-1}$)	Feed Conversion Ration (FCR)	Survival Rate (%)	Cost/kg (RM)
Comm 28%CP	21.82±1.05g^{a}	203.12±11.15g^{a}	831.1±12.61^{ab}	2.48±0.06^{a}	1.75±0.13^{a}	29±0.13^{ab}	4.75
Diet 1 32%CP	22.67±1.12g^{a}	214.01±11.01g^{a}	844.15±11.96^{ab}	2.49±0.04^{a}	1.66±0.11^{a}	29±0.13^{a}	4.53
Diet 2 30%CP	21.67±1.24g^{a}	209.49±12.88g^{a}	869.63±15.13^{b}	2.52±0.09^{a}	1.69±0.13^{a}	30±0.13^{b}	4.46
Diet 3 28%CP	22.97±0.94g^{a}	200.50±13.00g^{a}	773.90±5.72^{a}	2.41±0.04^{a}	1.77±0.06^{a}	28±0.13^{b}	4.33

* The same superscript indicates no significant differences ($p>0.05$) between the values.

References

1. Martino et al. (2002). Performance and fatty acid composition of surubim (*Pseudoplatystoma coruscans*) fed diets with animal and plant lipids. *Aquaculture*, 209(1-4): 233-246.
2. Tacon & Metian (2008). Global overview on the use of fish meal and fish oil in industrially compounded aquafeeds: Trends and future prospects. *Aquaculture*, 285(1-4): 146-158.

Torpedo Scad in Focus: Growth Patterns and Length Based Spawning Potential Ratio Analysis

EFFARINA MFA*, SHARIFAH NUR SHUHAILLY SN, WASILAH MR & NUR ATHIRAH MA
Fisheries Research Institute Kg. Acheh,
32000 Sitiawan, Perak
*effarina@dof.gov.my

Torpedo scad (*Megalaspis cordyla*) is an important pelagic species in Malaysia's waters, particularly in the Fisheries Management Area (FMA01). Understanding its growth dynamics and reproductive potential is crucial for effective fisheries management. This study aims to analyse the growth patterns and length-based spawning potential ratio (LBSPR) of torpedo scad, providing insights into the sustainability of its stock under different fishing gears.

Sampling was conducted at three sites: Kuala Perlis, Kuala Kedah, and Hutan Melintang. A total of 8,108 samples were collected randomly from purse seine and trawl catches between January and December. Data collection was facilitated by enumerators, who measured the fork length of the fish using a measurement board with 1 mm accuracy and weight using a digital scale with an accuracy of 0.01 g. The length-weight relationship of torpedo scad was determined as $W = 0.00003L^{2.87888}$ ($R^2 = 0.978$), indicating a strong correlation between length and weight. The exponent value ($b = 2.87888$) suggests that the growth pattern of torpedo scad follows negative allometric growth, meaning that the fish scad grows more in length than in weight, which is common for pelagic fish species.

The length frequency distribution for torpedo scad varied between fishing gears. Fish caught by purse seine ranged from 91 mm to 520 mm, with a mean length of 259.93 mm (SD = 55.9) (**Figure 1**). In contrast, trawl-caught individuals ranged from 71 mm to 440 mm, with a mean length of 219.29 mm (SD = 67.7). A t-test analysis revealed a significant difference in the mean fork length between fish caught using trawl and purse seine across the three locations. At a significance level of $\alpha = 0.05$, the t-value was -28.701 ($p = 0.000$), suggesting that gear type has a substantial effect on fish size distribution. Purse seine catches tend to include larger individuals compared to trawl, indicating differences in selectivity between the two fishing gears.

The asymptotic length (L_∞) was estimated at 541.28 mm for purse seine catches and 509.78 mm for trawl catches. This indicates that torpedo scad in purse seine fisheries have a higher potential maximum length compared to those in trawl fisheries. The growth coefficient (K) values were 0.29 and 0.25 for purse seine and trawl, respectively, suggesting that the species grows at a moderate rate, with purse seine-caught individuals growing slightly faster than trawl-caught individuals.

The estimated length at maturity (L_m) was 234.3 mm, which serves as a critical reference for assessing fishing impacts. Logistic regression analysis showed that the L_{25}, L_{50}, and L_{75} values for purse seine catches were 217.34 mm, 237.77 mm, and 258.20 mm, respectively, while for trawl catches, these values were 142.40 mm, 154.22 mm, and 163.24 mm, respectively. The lower size at maturity observed in trawl catches suggests that smaller fish are being harvested before reaching reproductive size, which could have negative implications for stock sustainability.

The size at 50% selectivity (SL_{50}) was 185.47 mm for purse seine and 175.12 mm for trawl, while SL_{95} was 231.23 mm and 215.7 mm, respectively. The fishing mortality to natural mortality ratio (F/M) was estimated at 2.09 for purse seine and 3.84 for trawl. The spawning potential ratio (SPR) was found to be critically low at 12% for purse seine and 7% for trawl, far below the threshold of 20-40% necessary to maintain a sustainable fishery (**Figure 2**). This suggests that the current level of fishing pressure is unsustainable and poses a risk of recruitment overfishing. The high F/M ratios further emphasise the excessive fishing pressure, particularly in trawl fisheries.

The findings indicate that torpedo scad in FMA01 are experiencing high fishing pressure, particularly from trawl fisheries. The low SPR values suggest an elevated risk of recruitment overfishing, which could jeopardise the sustainability of the stock. Management measures such as increasing mesh sizes, implementing size limits, or reducing fishing effort may be necessary to ensure a sustainable fishery for torpedo scad in Malaysia's waters. A reduction in fishing mortality, particularly in trawl fisheries, could help increase SPR and improve the long-term viability of the stock.

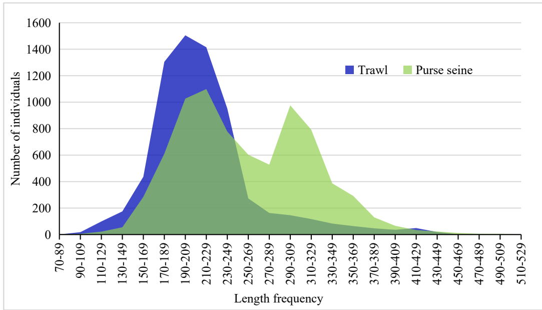


Figure 1: Length frequency distribution of torpedo scad from trawl and purse seine catches.

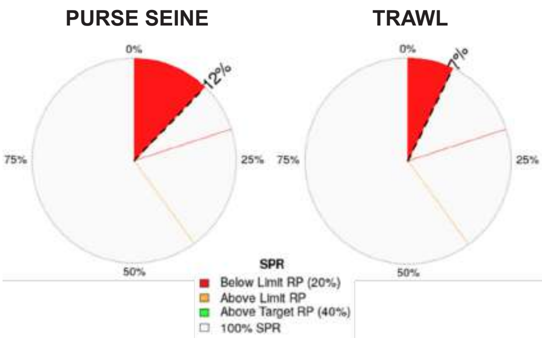


Figure 2: Spawning potential ratio (SPR) analysis of torpedo scad.

Assessment of Growth Performance in F_2 Generation Asian Seabass (*Lates calcarifer*)

Fisheries Research Institute Tg. Demong,
22200 Besut, Terengganu

NUR FATIN AFIFAH OM* & SHAHARAH MI
*fatinafifah@dof.gov.my

The Asian seabass F_2 generation growth experiment was conducted under the 12^{th} Malaysia Plan. Fish averaging approximately 40 g were stocked in 5-ton tanks (200 individuals/tank) with two replicates and fed pelleted feed twice daily at 3% of body weight. Monthly, 30 fish were sampled to assess growth parameters, including body weight (BW), total length (TL), standard length (SL), and body depth (BD). Growth rate and length-weight relationships were analysed, with the experiment concluding when the average BW reached 200 g.

Growth, monthly percentage weight gain, weight gain per day, specific growth rate (SGR), feed conversion rate (FCR), and yields for tank-reared Asian seabass are summarised in **Table 1**. Fingerlings from four cohorts, with an average initial weight of ~42 g, were stocked at 200 fish per tank. After 60-120 days, their body weights (BW) ranged from 206.65 g to 241.62 g, with survival rates of 90-100%. The SPFRITD0822/F_2/C6-C7 cohort demonstrated superior SGR within two months. Past study showed that seabass juveniles stocked at densities of 100-300 m^3 in cages reached final body weights of 505-573 g in seven months (Sakaras, 1987). Growth rate closely correlated with fish weight, supporting Jobling's (1995) findings.

The final average size of seabass at harvest (about 3 months) in this programme was above 200 g. This agrees with the growth of seabass weighing over 400 g in 6 months timeframe (Schipp et al., 2007) and the growth of 45-day old fish (mean length of 50 mm) to 300 mm (390 g) in 4 months (Mackinnon, 1989). However, the results of F_1 growth performance (**Table 2**) were significantly better compared to F_2 growth performance (**Table 1**). The differences observed in fish growth performance could be attributed to poor water quality (Pickering,1993), culture conditions, feed used, and respective aquaculture systems (Shubhadeep et al., 2016).

Table 1: Growth performance of second generation (F_2) Asian sea bass (40–200 g) in tanks.

	SPFRITD0822/F^2/ C6-C7	SPFRITD0822/F^2/ C4-C8	SPFRITD0722/ F^2/C8-C6	SPFRITD01122/F^2/ C4-C5
Rearing period (days)	60	120	90	90
Initial numbers (tails)	200	200	200	200
Final numbers (tails)	200	200	200	200
Initial body weight (g)	42.55 ± 0.39	41.18 ± 0.79	41.87 ± 0.36	42.10 ± 0.38
Final body weight (g)	206.65 ± 1.70	217.45 ± 1.47	214.68 ± 0.36	241.62 ± 5.14
Weight gain (g/day)	2.65	1.47	1.88	2.38
SGR (%/day)	2.55	1.39	1.78	2.08
Survival rate (%)	100.00	90.00	100.00	100.00
FCR	1.3	1.3	1.2	1.4

Values are means ± SD.
BW = Body weight, SGR = Specific growth rate, FCR = Feed conversion ratio.
Comparison between means ± SD along the same column.

Table 2: Growth performance of first generation (F_1) Asian sea bass (40–200) g in tanks.

	Cohort 4	Cohort 5	Cohort 6	Cohort 7	Cohort 8
Rearing period (days)	60	60	60	90	60
Initial numbers (tails)	200	200	200	200	200
Final numbers (tails)	200	199	200	199	200
Initial BW (g)	42.28 ± 0.31^{ab}	72.08 ± 0.17^{a}	39.50 ± 0.00^{b}	43.12 ± 0.02^{ab}	40.82 ± 0.31^{b}
Final BW (g)	217.75 ± 5.54^{a}	209.80 ± 9.00^{a}	205.67 ± 7.31^{a}	215.48 ± 7.85^{a}	201.07 ± 0.14^{a}
Weight gain (g/day)	2.92 ± 0.10^{a}	2.30 ± 0.15^{bc}	2.77 ± 0.12^{a}	1.92 ± 0.09^{cd}	2.67 ± 0.003^{ab}
SGR (%/day)	2.73 ± 0.05^{a}	1.78 ± 0.08^{bc}	2.75 ± 0.06^{a}	1.79 ± 0.04^{bc}	2.66 ± 0.01^{a}
Survival rate (%)	100.00 ± 0.00^{a}	99.25 ± 0.71^{a}	100.00 ± 0.00^{a}	99.25 ± 1.06^{a}	100.00 ± 0.00^{a}
FCR	1.24 ± 0.01^{b}	1.53 ± 0.04^{a}	1.24 ± 0.01^{b}	1.25 ± 0.01^{b}	1.25 ± 0.002^{b}

Values are means ± SD.
BW = Body weight, SGR = Specific growth rate, FCR = Feed conversion ratio.
Comparison between means ± SD along the same column. Values with different superscript letters are significantly different at $P < 0.05$.

References

1. Sakaras (1987). Optimum stocking density of sea bass (*Lates calcarifer*) cultured in cages. In: ACIAR proceedings of an international workshop (eds. Copland, J.W., Grey, D.L.), 172–178. Darwin, N.T. Australia.
2. Jobling (1995). Fish bioenergetics. *Oceanographic Literature Review*. 785.
3. Schipp et al. (2007). Barramundi farming handbook. Department of Primary Industry, Fisheries and Mines, Darwin Aquaculture Centre, Darwin NT. 80.
4. Mackinnon (1989). Status and potential of Australian *Lates calcarifer* culture. *Advances in Tropical Aquaculture*, 65: 713–727
5. Pickering (1993). Growth and stress in fish production. *Genetics in Aquaculture*: 51–63.
6. Shubhadeep et al. (2016). Growth performance of Asian sea bass (*Lates calcarifer*) (Bloch 1790) stocked at varying densities in floating cages in Godavary Estuary, Andhra Pradesh, India. *Indian Journal of Fisheries*, 63: 146–149.

Survival Rate of Giant Freshwater Prawn, *Macrobrachium rosenbergii* (De Man, 1879) Intensively Culture in Concrete, HDPE, and Earthen Pond System

AHMAD BAIHAQI O*, MUHAMMAD ZUDAIDY J & SITI NORITA M

Fisheries Research Institute Glami Lemi,
71660 Jelebu, Negeri Sembilan

*baihaqi@dof.gov.my

The giant freshwater prawn (*Macrobrachium rosenbergii*) is commercially significant in tropical and subtropical aquaculture. Pond system selection plays a crucial role in productivity, influencing temperature control, water quality, and maintenance. This study compares the survival rates of *M. rosenbergii* in earthen, HDPE, and concrete ponds under controlled conditions, providing insights to enhance aquaculture management and efficiency.

The experiment was conducted at FRI Glami Lemi, Negeri Sembilan, over 150 days using three pond systems: earthen (400 m²), HDPE (400 m²), and concrete (256 m²). Each pond was aerated and supplied with fresh water to maintain optimal conditions. Juvenile prawns averaging 0.5 ± 0.1 g were sourced from a certified hatchery, acclimatised for 7 days, and stocked uniformly at 25 individuals per m². A commercial prawn feed was administered at 5% of the total biomass daily. Dissolved oxygen and pH were assessed weekly, while temperature was recorded daily at 11:00 a.m. using a LogTag® reader. Survival rate was determined by counting live prawns at the end of the experiment.

Earthen ponds showed the highest survival rates, followed by HDPE and concrete ponds (**Table 1**), likely due to differences in water quality, particularly temperature and dissolved oxygen (DO). The stability of temperature and DO in earthen ponds may be influenced by natural soil conditions, which also support microorganisms and natural feed that enhance prawn immunity and growth. In contrast, concrete ponds had lower survival rates, possibly due to high temperature fluctuations and reduced DO levels. Concrete structures absorb and retain temperature, leading to drastic variations that stress prawns. Additionally, the absence of microorganisms in concrete and HDPE ponds may contribute to organic matter accumulation, increasing the risk of ammonia toxicity, a known stressor in prawn culture.

Table 1: Survival (%) of giant prawn in different pond types after 150 days of culture.

Pond type	Survival (%)
Earthen	82.22 ± 0.09[a]
HDPE	71.07 ± 6.52[b]
Concrete	36.30 ± 5.66[c]

As a conclusion, earthen ponds, with their natural microorganism, live feed, and temperature consistency, offer the most favourable conditions for prawn survival. Future research should investigate cost-effective strategies to enhance the environmental factors in earthen and HDPE pond systems to improve the survival and growth of *M. rosembergii*.

Giant freshwater prawns from the research pond.

Harvesting of giant freshwater prawn.

Molecular Insights into the Hidden Marine Fish Diversity of West Coast Peninsular Malaysia: Findings from the 2024 Demersal Survey

NOORUL AZLIANA J*, JAMSARI AMIRUL FIRDAUS J, MOHD HANS AFIFI H, HASHIM S & RYON S

Fisheries Research Institute Kg. Acheh,
32000 Sitiawan, Perak

*azliana@dof.gov.my

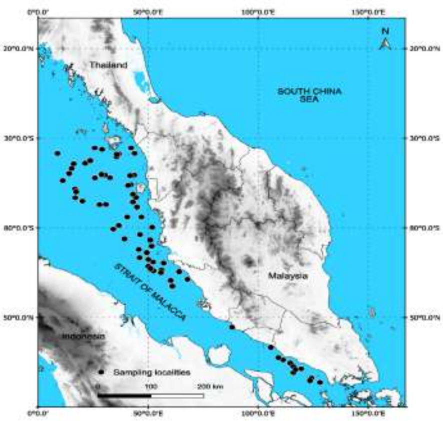


Figure 1: Sampling localities of marine fish specimens collected along the West Coast of Peninsular Malaysia.

The West Coast of Peninsular Malaysia's waters are rich in marine biodiversity. The comprehensive survey, namely the Survey of Demersal Species in the West Coast Peninsular Malaysia 2024, was conducted across seven states - Johor, Kedah, Perak, Selangor, Penang, Negeri Sembilan, and Melaka (**Figure 1**). This survey sheds light on some remarkable findings through DNA barcoding technology (Hajibabaei et al., 2007; Trivedi et al., 2018) and unveiled new insights into the region's fish diversity, marking a significant step forward in our understanding of Malaysia's marine ecosystems.

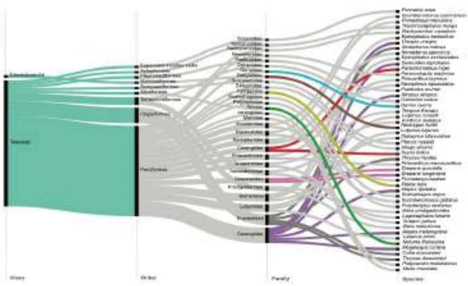


Figure 2: Taxonomic hierarchy of marine fish diversity from the west coast of Peninsular Malaysia showing the relationships between Class, Order, Family, and Species levels.

The amplification of both F1R1 and F2R2 primers (Ward et al., 2005) using mitochondrial DNA (mtDNA) Cytochrome Oxidase Subunit I (COI) revealed 50 distinct species representing 29 families (**Figure 2** and **Figure 3**) of marine fish.

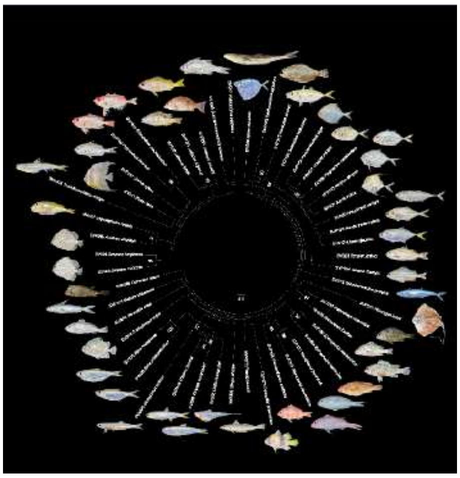


Figure 3: Molecular phylogenetic relationships of marine fish from the west coast of Peninsular Malaysia with morphological representations.

This investigation captured diversity from two major fish classes: Teleostei (bony fish) and Elasmobranchii (cartilaginous fish), with bony species dominating the samples. Among these, the Perciformes order represented 74% of specimens **(Figure 4),** comprising various families such as Carangidae, Lutjanidae, and Serranidae. A significant discovery was the presence of *Neotrygon orientalis* (blue-spotted stingray), representing the only cartilaginous fish encountered throughout the survey. However, this does not mean other cartilaginous fish do not occur in the west coast of Peninsular Malaysia, but they may not be commonly caught by the demersal trawl net used in this survey.

This also demonstrated the power of molecular tools in modern taxonomic research, where BLAST analysis uncovered remarkable accuracy, with most species showing 99.84-100% matches to reference sequences. The circular dendrogram **(Figure 3)** illustrated distinct clustering of related species within families, particularly evident in groups such as Carangidae (represented by species like *Alepes djedaba* (pelata keledek), *Megalaspis cordyla* (cencaru), and *Uraspis uraspis* (sagai lidah putih)) and Lutjanidae (including *Lutjanus russelli* (merah tanda) and *L. lutjanus* (kunyit-kunyit)), which are considered economically important fish species in Malaysia.

This molecular tool has also played a part in validating traditional morphological identification methods, in addition to resolving taxonomic ambiguities among closely related species and revealed cryptic organisms that share similar physical characteristics but differ genetically. Molecular analysis has proved invaluable in clarifying taxonomic uncertainties, particularly regarding species with historical nomenclature changes (such as *Alectis indica* originally named as *Scyris indicus*) (World Register of Marine Species, 2025). DNA sequencing confirmed identifications through high genetic similarity to reference sequences, showing 99.84-100% matches (Jeanette et al., 2023).

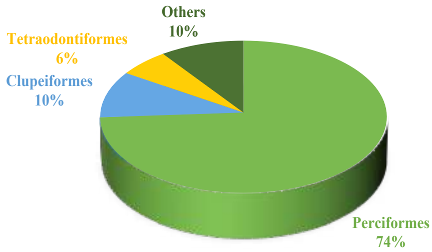


Figure 4: Taxonomic composition of demersal fish orders from the West Coast of Peninsular Malaysia based on molecular identification, showing the predominance of Perciformes.

FUTURE STUDY RECOMMENDATIONS

To enhance fishery management in Malaysia, regular genetic monitoring programs are essential for tracking population health and preventing species misidentification. Establishing a comprehensive genetic database would support research and management efforts. Conservation strategies should prioritise areas with high genetic diversity and monitor population connectivity for marine protected area planning. Genetic data can refine stock boundaries, improve quota systems, and guide breeding programs for aquaculture species. Future research should expand molecular sampling to deeper waters and different seasons, assess genetic connectivity in the Strait of Malacca, and monitor temporal changes in genetic diversity.

CONCLUSION

This comprehensive study demonstrates the power of integrating molecular and morphological data in taxonomic studies and provides a valuable baseline for future monitoring of marine biodiversity in the region. This detailed phylogenetic analysis has important implications for conservation and fisheries management, enabling the identification of unique evolutionary lineages, recognition of cryptic species that might have been previously overlooked, and documentation of biodiversity patterns along Malaysia's coast.

References

1. Hajibabaei et al. (2007). DNA barcoding: how it complements taxonomy, molecular phylogenetics and population genetics. *Trends in Genetics*, 23(4): 167–172.
2. Jeanette et al. (2023). DNA barcoding and morphological characters of two trevally fish species (*Caranx* spp.) collected from Youtefa Bay, Papua, Indonesia. *Ilmu Kelautan: Indonesian Journal of Marine Sciences*, 28(1): 97–105.
3. Trivedi et al. (2018). DNA barcoding and molecular phylogeny. *Springer Nature*. https://doi.org/10.1007/978-3-319-90680-5.
4. Ward et al. (2005). DNA barcoding Australia's fish species. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 360(1462): 1847–1857.
5. WoRMS Editorial Board (2025). World Register of Marine Species.

Growth Performance and Health of Pacific White Shrimp (*Litopenaeus vannamei*) Fed with Combined Plant Extracts

Fisheries Research Institute Gelang Patah,
81550 Gelang Patah, Johor

FADZILAH Y*, AZLINA A, AZMI R, M. LAZIM MS & M. FARAZI J
*fadzilah@dof.gov.my

The present study reviewed the effects of a combined crude extract consisting of lemongrass (*Cymbopogon citratus*), which is established, patented, and trademarked as SitroPro™, along with crude extracts of turmeric (*Curcuma longa*) and galangal (*Alpinia galanga*). This combined herbal extract is hereafter referred to as SitroPro™ Plus.

The proportions of the herbal extracts were determined through preliminary experiments, which included antibacterial zone inhibition tests and trials with Pacific white shrimp (*Litopenaeus vannamei*) cultured in 1-ton tanks using various combinations of herbal extracts in their feed. The optimal combination was selected and applied in this experiment to assess its impact on the growth performance, survival, and health of the shrimp in a super-intensive culture environment.

Juvenile shrimps were randomly assigned to two experimental groups, each with three replicates: a control group (receiving a basal diet) and a herbal extract group (receiving the basal diet supplemented with 200 ppm v/w of SitroPro™ Plus). The herbal extract was prepared by mixing the appropriate proportions of lemongrass, turmeric, and galangal extracts, which were then sprayed onto the feed at a concentration of 200 ppm v/w. The treated feed was subsequently air-dried in the shade. The shrimp were fed their respective diets over a 120-day culture period, during which growth parameters, survival rates, and water quality metrics were evaluated.

Shrimp fed with the herbal extract-supplemented diet demonstrated a higher growth rate compared to the control group by day 60 of the culture period (**Figure 1**).

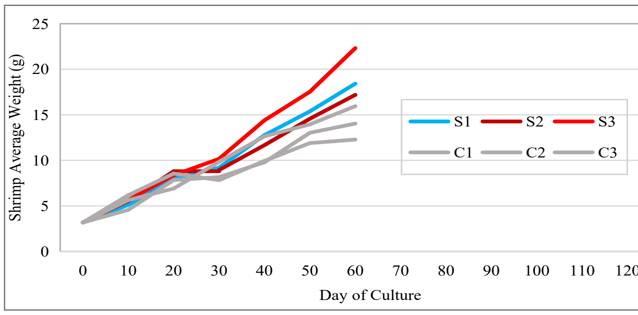


Figure 1: Average shrimp weight throughout day of culture.

Additionally, the survival rate was significantly improved in the herbal extract group. The combined supplementation of lemongrass, turmeric, and galangal extracts, referred to as SitroPro™ Plus at a concentration of 200 ppm v/w, effectively enhanced the growth performance of cultured Pacific white shrimp.

This natural, multi-herb approach represents a promising strategy for improving productivity and sustainability in shrimp aquaculture systems. By integrating herbal supplements into shrimp diets, aquaculture operations can potentially reduce reliance on synthetic additives and antibiotics, leading to healthier shrimp and a more environmentally friendly farming practice. This strategy aligns with the growing demand for sustainable aquaculture solutions that prioritise animal welfare and ecosystem health.

Rescuing Giants: Lessons from the Arapaima Rescue

[1]Fisheries Research Institute Glami Lemi, 71350 Jelebu, Negeri Sembilan
[2]Marine Fishery Resources Development & Management Development, Taman Perikanan Chendering, 21080 Kuala Terengganu, Terengganu
[3]Zoology Department, Zoo Negara Malaysia, 68000 Ampang, Selangor

HASLAWATI B[1]*, MOHAMAD SUFIYAN S[1], MOHD TAMIMI AA[2], NORFAIZAL AZLI MN[2], SUHAILIZA HANIE S[3] & MOHD SAFUAN N[3]
*haslawati@dof.gov.my

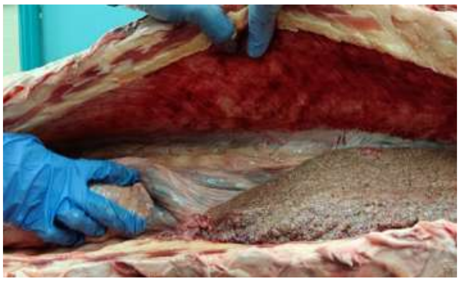
On October 11, 2024, the Melaka State Fisheries captured three Arapaima (measuring about 80–200 kg and 1.2–2.5 metres) following a voluntary surrender by a restaurant owner. The Arapaima (*Arapaima gigas*), one of the world's largest freshwater fish, is native to the Amazon Basin and can grow up to 3 metres long, weighing over 200 kg. As air-breathing carnivores, they prey on fish, crustaceans, and small terrestrial animals.

The fish, reared for a decade in a rain-fed pond beneath an abandoned chalet near Masjid Tanah, were kept alongside a one-metre-long African Catfish (*Clarias gariepinus*) and two albino shark catfish (*Pangasius* spp.) as customer attractions. Their proximity to Sungai Baharu, a tributary of Sungai Melaka, raised concerns about potential escapes as they pose ecological risks, including predation on native species, food chain disruption, competition with local predators, uncontrolled breeding, and disease transmission. Hence, Malaysia strictly regulates Arapaima ownership and prohibits their release into natural water bodies as stated in the Fisheries Act 1985 and Fisheries Regulations (Prohibition of Import for Fish) (Amendment 2024). While special permits may be granted under strict conditions, unauthorised possession can result in fines, confiscation, or imprisonment.

The restaurant owner voluntarily surrendered the Arapaima to the Department of Fisheries (DOF). The operation was conducted together with the Selangor State Fisheries Department and successfully secured the fish after a challenging seven-hour battle due to the fish's aggressive behaviour. Unfortunately, one specimen died during transportation to Zoo Negara. The other two managed to arrive at the Zoo and were kept in separate tanks each. Upon arrival, the animals looked less aggressive, with bruises all over their bodies, and one of them vomited food items before being found dead after 18 hours. The death was confirmed by a veterinary officer. The autopsy was conducted with the help of a Zoo Negara veterinarian, and the cause of death was attributed to stress and internal injuries during capture and transportation. The incident also resulted in injuries to five officers, as reported by *The Malay Mail* on 13th October 2024.

The failed rescue mission, resulting in fish deaths and injured personnel, has sparked online debate. The incident highlights the need for better training, standardised procedures, and stricter animal welfare compliance for the DOF. This article outlines the event chronology, rescue mission, challenges, and recommendations for these endeavours, which are divided into three phases: before, during, and after the rescue mission (**Table**).

The first step in examining the external morphology and detection of the Passive Integrated Responder (PIT) tag



Checking the internal organs to investigate the cause of death

Time phase	Challenges	Recommendations/suggestions
Before (2nd & 4th October 2024) - *In situ* inspection and discussion on capture strategies	• Untrained personnel. • No SOP.	• Site visit and thorough site examinations. • Establish capture SOP, strategies, and translocation plan. • Selection of a proper sedative agent, dose, and method, taking into consideration the fish size and safety to handlers. • Materials preparation and listings. • Personnel training. • Discuss and select transportation procedure, for example, concentrations of sedative agent or amount of ice needed (temperature-controlled environment).
During (11th October 2024)	• Gigantic fish with aggressive behaviour. • Small working space (regarding pond facility). • Early on-site observation did not reveal the actual size of the fish. It was unexpectedly huge. The size of the fish (nearly 200 kg).	• A better capture method, with suitable gear. • Use of canvas wrap is more efficient for big-sized and scaly fish, not gill-net. • Try to reduce fish movement, which will increase the fish pressure and increase cortisol hormone, a sign of a high stress level. • Stabilise fish in holding tanks before being translocated/transported.
After	• No SOP. • Finding suitable fish transportation means aims to reduce stress to the fish. • Ensuring proper receiving facilities.	• Training in handling large animals, for example, attachment with PERHILITAN or Zoo, to get experience in their operation with wildlife capture activities. • Sought the service of veterinary/wildlife experts to support.

Multiplex Real-Time PCR Assay for Simultaneous Detection of *Vibrio* spp.

[1]National Fish Health Research Centre (NaFisH), 11960 Batu Maung, Pulau Pinang
[2]Centre for Chemical Biology, Universiti Sains Malaysia, Pulau Pinang

MUHAMMAD SYAFIQ IZZUDDIN AH[1]*, AZILA A[1] & NOORIZAN MISWAN[2]
*syafiqizzuddin@dof.gov.my

The marine aquaculture sector faces significant challenges due to bacterial infections, particularly *Vibrio* sp. This group of bacteria is commonly found in marine environments, causing diseases such as vibriosis that affect both wild and farmed fish (Sanches-Fernandes et al., 2022). Disease outbreaks due to *Vibrio* sp. can cause mortality of more than 50%. *Vibrio* spp. is also the source of Acute Hepatopancreatic Necrosis Disease (AHPND), which can cause severe mortality in shrimp aquaculture up to 100% within a few days (Kumar et al., 2021).

Currently at the NaFisH, *Vibrio* sp. was detected using a conventional method for fish and a molecular method for shrimp. Both methods require sacrificing the specimen and take 3–7 days to complete.

NaFisH, in collaboration with Universiti Sains Malaysia (USM), is developing a multiplex real-time PCR (qPCR) technique for detecting *Vibrio* sp. This project aims to develop a qPCR assay for simultaneous identification of *Vibrio parahaemolyticus* and *Vibrio alginolyticus* using species-specific primers and probes. The assay targets the *tlh* gene for *V. alginolyticus* and the *toxR* gene for *V. parahaemolyticus*, with optimisation for eDNA extracted from water samples.

At the initial stage, species-specific primers were designed using the Geneious software, based on multiple sequence alignments of the *tlh* gene from *Vibrio parahaemolyticus* and the *toxR* gene from *Vibrio alginolyticus*. The multiplex qPCR assay was then optimised for sensitivity and specificity by testing against pure cultures of *V. parahaemolyticus*, *V.*

alginolyticus, and other non-target bacterial strains, including *E. coli*, *Bacillus* sp., and *S. aureus*. To ensure the reliability of the assay, a 16S rRNA primer set was incorporated as an internal amplification control (IAC).

Finally, water samples spiked with *V. alginolyticus* and *V. parahaemolyticus* were used to test the primer that had been designed. The results are shown in **Figure 1**. The developed assay demonstrated high sensitivity, detecting as little as 10 femtograms (fg) of DNA per reaction, equivalent to approximately three copies of *V. parahaemolyticus* or *V. alginolyticus* DNA. The assay stably detected bacterial concentrations as low as 1 × 10^5 CFU/mL for both species. No cross-amplification with other organisms was observed, confirming its specificity.

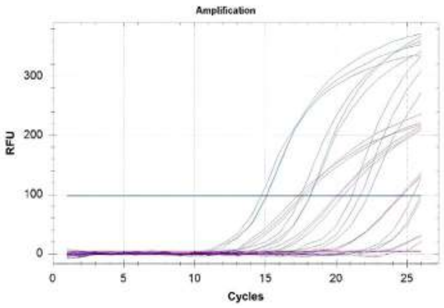


Figure 1: Multiplex amplification by real-time PCR of serially diluted, spiked seawater DNA samples for the detection of *V. parahaemolyticus* and *V. alginolyticus*.

In conclusion, the multiplex real-time PCR assay is a reliable and sensitive tool for the simultaneous detection of V. *alginolyticus* and *V. parahaemolyticus* in marine aquaculture, which saves time for the detection process. This initial project will be further optimised and used widely to detect pathogen samples from the environment, mainly culture waters, for better disease prediction.

References

1. Sanches-Fernandes et al. (2022). Vibriosis outbreaks in aquaculture: Addressing environmental and public health concerns and preventive therapies using gilthead seabream farming as a model system. *Frontiers in Microbiology*, 13.
2. Kumar et al. (2021). Acute Hepatopancreatic Necrosis Disease (AHPND): Virulence, pathogenesis, and mitigation strategies in shrimp aquaculture. *Toxins*, 13(8): 524.

Assessing Coral Reef and Sea Cucumber Populations: Next Steps in Habitat Conservation of Pulau Pangkor and Pulau Sembilan

ZAIDNUDDIN I*, MOHAMAD SAUPI I & MD NIZAM I

National Marine Park Research Centre,
Fisheries Research Institute, 11960 Batu Maung, Pulau Pinang

*zainuddin01@dof.gov.my

This study was conducted to determine the status of sea cucumber and coral reefs in Pulau Pangkor and Pulau Sembilan, Perak, based on two parameters: (i) coral cover and (ii) sea cucumber biomass. The sampling activities for ecosystem parameters (benthic and sea cucumber) were carried out from June to September 2023, involving all 25 stations. The benthic community is grouped into six categories: hard corals (HC), soft corals, dead corals, crustose coralline algae, other biota (such as filamentous algae, macroalgae, and sponges), and other non-living components (such as sand/silt and rocks). Dead corals are defined as recently dead corals and coral rubble.

The percentage of live coral cover (LCC) (hard corals and soft corals) in the Pangkor and Sembilan Islands ranges from 0.0% to 40.3%, with an average value of 8.4 ± 1.9%. The correlation with live corals is low for *Stichopus horrens,* SH (-0.193), but it shows a high positive correlation (0.505) with dead corals (**Figure 1; Figure 2**). The deterioration of coral reefs is associated with continuous sedimentation, especially on the west coast of Peninsular Malaysia (Lee & Mohamed, 2011; Praveena et al., 2014; Rudra, 2018). The coral reefs in this area struggle to survive due to high rates of sedimentation and turbidity (Kimura et al., 2014; Safuan et al., 2016). However, the high percentage of dead corals suggests the existence of healthy corals in the past (Ismail & Khoo, 2019). Therefore, appropriate management measures are crucial to reduce the deterioration of reefs in the waters of the Pangkor and Sembilan Islands.

Most locations where sea cucumbers are found have a higher cover of dead corals compared to live corals. The visible coral skeletons are those of staghorn corals that have died within the period of 2-5 years. Coral reef conservation measures are crucial and require immediate action. Delays in implementing these measures will have negative impacts on the coral reefs and reduce the sea cucumber resources that rely on the reefs for survival. Innovations that can address both coral and sea cucumber extinction issues need to be sought.

S. horrens using dead corals as a refuge

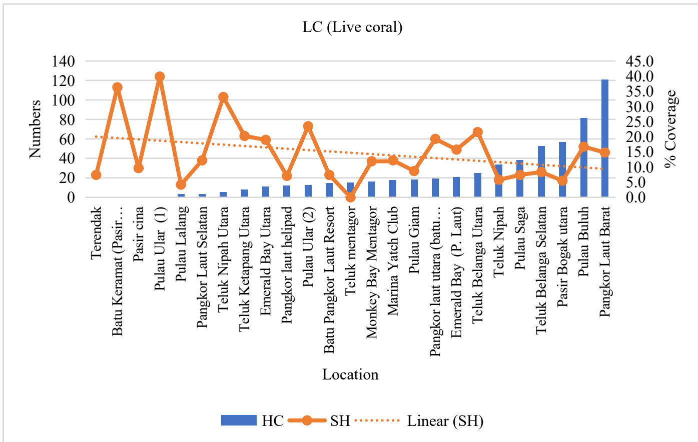


Figure 1: Population of sea cucumbers and live corals

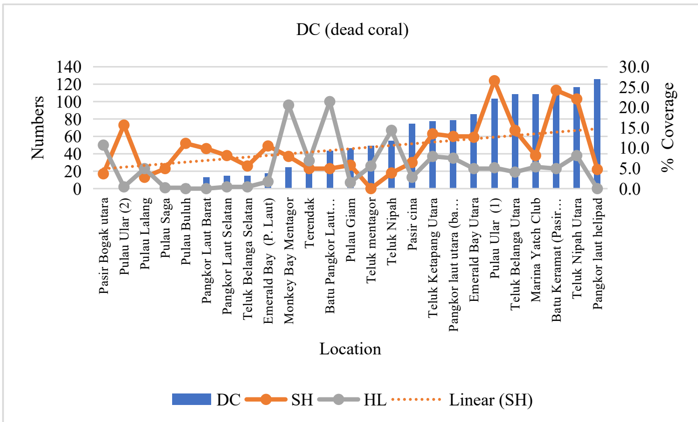


Figure 2: Population of sea cucumbers and dead corals

References

1. Kimura et al. (2014). Status of coral reefs in East Asian Seas Region: 2014. Ministry of the Environment, Japan.
2. Lee & Mohamed (2011). Accumulation of settling particles in some coral reef areas of Peninsular Malaysia. *Sains Malaysiana*, 40(6): 549–554.
3. Mohamad Saupi et al. (2021). Laporan Kajian Penentuan Kawasan Baharu yang Berpotensi Dijadikan Kawasan Perlindungan Sumber (MPA) Di Perairan Perak, September 2021, Department of Fisheries, Malaysia ISBN: 978-967-2840-24-4.
4. Praveena et al. (2012). Coral reefs studies and threats in Malaysia: A mini review. *Rev. Environ. Sci. Biotechnol.,* 11: 27-39.
5. Rudra (2018). Coral lives of Malaysian Peninsula: A multifaceted review. *Eco. Env. and Cons.*, 24(3): 1435-1441.
6. Safuan et al. (2016). Current status on community structure of coral reefs around West Coast of Peninsular Malaysia using coral video transects technique. *Journal of Sustainability Science and Management*, 1: 107-117.

Sungai Belanga Pechah, Langkawi: Water Quality and Its Impact on Marine Nurseries

MUHAMMAD ASYRAF AL[1]*, MUHAMMAD SYAFIQ IZZUDDIN AH[2], SYED MOHAMAD AZIM SM[1], KHAIRUDIN G[1], MOHD SYAFIQ MR[2] & AZILA A[2]
*asyraflatip@dof.gov.my

[1]Langkawi Research Centre, 07000 Langkawi, Kedah
[2]National Fish Health Research Centre (NaFisH), 11960 Batu Maung, Pulau Pinang

Sungai (Sg.) Belanga Pechah, Langkawi, holds economic significance due to its role in aquaculture. One of the marine fish nurseries in Langkawi relies on this river as its primary water source. However, in recent years, the nursery's production has significantly declined, likely due to human activities along this river. A team was formed to investigate the water quality parameters of Sg. Belanga Pechah in relation to marine nursery health management. This study was conducted under the 12th Malaysia Plan as part of the Research and Development in Aquaculture Fish Health Program (P21300040170502).

Water samples were collected monthly during the full moon and high tide, as the river becomes inaccessible at lower tides due to its shallow depth and the appearance of an undulating seabed. The study categorised the river into three sections: the control area, the problematic area, and the victimised area. Each section had three sampling checkpoints to ensure triplicate measurements. In-situ water quality parameters recorded included temperature, dissolved oxygen (DO), total dissolved solids (TDS), salinity, pH, and river depth. *Ex situ* analyses measured concentrations of ammonia, nitrate, nitrite, phosphate, and iron. During high tide, seawater flows from the Peluru Strait into the Sg. Kilim and the Sg. Belanga Pechah and recedes into the Peluru Strait through Sg. Kisap.

Based on **Table 1**, the water quality deteriorates as pollution from the problematic area flows into the victimised and nursery zones. Dissolved oxygen (DO) drops by 18% in the victimised area but partially recovers in the nursery due to aeration. DO should be ≥ 5.0 ppm for optimal fish health, though some species can tolerate 3–4 ppm temporarily (Boyd, 1998; FAO, 2006). The pH levels show slight acidity in the victimised area but recover in the nursery, which is not an immediate concern but should remain stable to avoid fish stress. The ideal range for marine fish is 7.5–8.5 (FAO, 2006). Salinity, however, declines from the problematic area to the nursery, which may not be ideal for marine fish, as they require a stable range (25–35 ppt) for proper osmoregulation. Maintaining consistent salinity and pH levels is crucial to ensure a healthy environment for fish farming. Marine fish thrive in 25–35 ppt (NOAA, 2020). TDS increases in the victimised zone due to pollution, but decreases in the nursery, likely due to sand filtration treatment.

The ammonia levels increase sharply, exceeding safe limits for marine fish. Ammonia levels above 0.1 ppm are toxic, causing gill damage (Boyd & Tucker, 1998; EPA, 1999). Meanwhile, nitrite, nitrate, phosphate, and iron concentrations remain within acceptable ranges. Nitrite should not exceed 0.2 ppm to prevent methemoglobinemia (Colt, 2006), while nitrate is considered safe below 50 ppm (EPA, 2002). Phosphate exceeding 0.5 ppm may cause eutrophication (Boyd, 1998), and iron levels above 0.1 ppm can cause oxidative stress in fish (WHO, 2011). Maintaining these parameters is crucial for a sustainable marine fish farming operation. Mitigation efforts are needed to improve water quality before use in marine fish farming.

As a conclusion, to improve water quality in the nursery by increasing water exchange and implementing biofilters can help lower the ammonia concentrations, while aeration and oxidising agents can mitigate the toxicity build-up. Enhancing oxygenation with aerators will support fish health, and optimising feeding practices will minimise organic waste. Regular water quality monitoring is essential to track changes and adjust management strategies accordingly.

Table 1: Mean (± SD) water parameters of the Sg. Belanga Pechah, Langkawi, throughout the year 2024

Zone	Control	Nursery	Problematic	Victimised
Temperature (°C)	31.0 ± 0.9	30.1 ± 0.9	30.4 ± 1.0	30.2 ±0.9
Dissolved Oxygen (ppm)	4.23 ± 0.61	3.96 ± 0.78	3.55 ± 0.59	2.91 ± 0.40
pH	8.22 ± 0.65	7.96 ± 0.66	7.94 ± 0.75	7.57 ± 0.22
Salinity (ppt)	30.42 ± 1.17	27.06 ± 1.96	30.03 ± 1.41	27.92 ± 2.20
Total Dissolved Solid (ppm)	30509 ± 1142	27268 ± 1389	30187 ± 1270	28683 ± 4172
Ammonia (ppm)	0.02 ± 0.03	0.28 ± 0.32	0.06 ± 0.16	0.09 ± 0.12
Nitrite (ppm)	0.003 ± 0.002	0.009 ± 0.012	0.004 ± 0.002	0.004 ± 0.002
Nitrate (ppm)	1.557 ± 0.936	1.558 ± 0.919	1.547 ± 0.821	1.595 ± 0.798
Phosphate (ppm)	0.15 ± 0.107	0.444 ± 0.438	0.251 ± 0.232	0.273 ± 0.470
Iron (ppm)	0.054 ± 0.048	0.095 ± 0.279	0.061 ± 0.049	0.066 ± 0.055

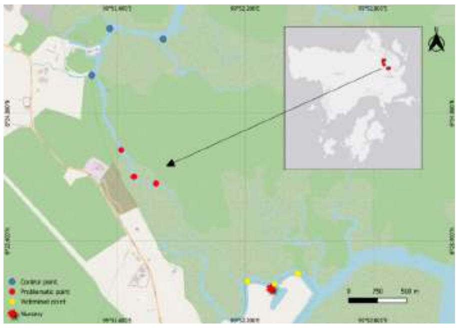


Figure 1: Water sampling points along the Sungai Belanga Pechah, Langkawi

References

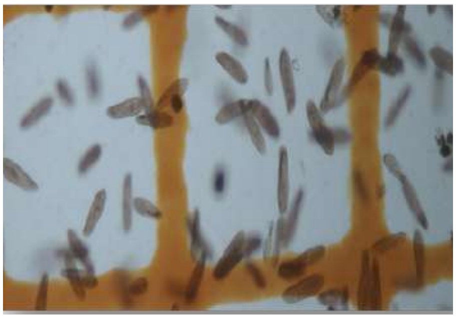
1. Boyd (1998). Water quality for pond aquaculture. Auburn University, Alabama Agricultural Experiment Station.
2. Boyd & Tucker (1998). Pond aquaculture water quality management. *Springer Science & Business Media.*
3. Colt (2006). Water quality requirements for fish. J. Colt & L. Armstrong (Eds.), *Aquaculture Engineering*: 1-24.
4. Environmental Protection Agency (EPA) (1999). Water quality criteria for ammonia. U.S. EPA, Office of Water.
5. Environmental Protection Agency (EPA) (2002). National recommended water quality criteria. U.S. EPA, Office of Science and Technology.
6. Food and Agriculture Organization (FAO) (2006). Water quality and fish health. FAO Fisheries Technical Paper.
7. National Oceanic and Atmospheric Administration (NOAA) (2020). Marine water quality and aquaculture. NOAA Fisheries Division.
8. World Health Organization (WHO) (2011). Guidelines for drinking-water quality (4th ed.). WHO Press.

Paramecium sp. as a Potential Live Feed for Freshwater Ornamental Fish

AMATUL SAMAHAH MA*, HANAN MY, CHEW PC, TAZRI AMIL S, AZNALIZA Y, NURAMIRAH AM, AHMAD AZIZI I & MOHD SOLEHIN A
Fisheries Research Institute Glami Lemi,
Jelebu 71650, Negeri Sembilan
*amatul@dof.gov.my

High-quality live feed is essential for ornamental fish survival, especially in their early development. Newly hatched larvae, with underdeveloped digestive systems, rely on easily digestible live feed (Jadhav, 2023). While traditional options like rotifers and *Artemia* nauplii are common, they may not suit the smallest larvae. *Paramecium* sp., a unicellular ciliate, is an ideal first feed due to its microscopic size (50–300 µm), ease of culture, and high level of protein, lipid, and essential fatty acid content (Patil et al., 2024). Additionally, its soft body and continuous movement in water stimulate the natural hunting behaviour of fish larvae, promoting active feeding (Lahnsteiner & Kletzl, 2018). Their rapid reproduction, adaptability to various aquatic environments, and ease of cultivation enhance their suitability as a live feed. In hatchery settings, *Paramecium* sp. can be cultured using cheap organic media such as hay infusions, lettuce, bacterial cultures, and yeast-based substrates (Baton, 2010). Their ability to thrive in controlled conditions would allow hatchery managers to produce them in large quantities with minimal costs.

Betta splendens gape size ranges from 100-200 µm at hatching increasing gradually as they grow



Paramecium cultured at FRI Glami Lemi

In the 12th Malaysia Plan, FRI Glami Lemi is conducting a study on the suitability of *Paramecium* sp. as a live feed for *Betta* sp. larvae. *Paramecium* sp. was isolated from an infusoria culture, and an axenic culture was successfully established. The average size of *Paramecium* sp. in this study was recorded as 127.12 ± 8.91 µm in length and 40.33 ± 3.93 µm in width. The successful establishment of an axenic culture ensures a controlled and contamination-free environment, allowing for more accurate assessment of its nutritional benefits and effectiveness as a live feed.

Among the different organic media tested, the medium labelled P3A exhibited the highest cell density and was selected for upscaling. The culture was successfully scaled up to a 2-litre volume, with an average cell density of 1,270 ± 160 individuals/ml. Preliminary findings indicate that feeding *Paramecium* sp. to *Betta splendens* larvae from the first to the fifth day post-hatching resulted in a survival rate exceeding 80%. These promising results highlight the potential of *Paramecium* sp. as an effective first feed for *Betta* larvae, providing an optimal nutrient source to support early-stage growth and development.

Mass culture techniques for *Paramecium* sp. are currently being refined to ensure consistent and reliable production in aquaculture systems. Traditionally, organic matter has been used to stimulate bacterial growth, providing a natural food source for Paramecium sp. However, large-scale production may require optimisation of culture conditions — including controlled aeration, temperature regulation, and supplementation with specific bacterial strains — to enhance growth efficiency and overall productivity.

In conclusion, *Paramecium* sp. represents a promising live feed option for ornamental fish larvae, particularly for species requiring smaller prey during early development. By overcoming existing challenges and optimising their culture methods, *Paramecium* sp. could significantly enhance hatchery productivity and larval survival rates.

References

1. Baton (2010). A new laboratory cultivation of *Paramecium bursaria* using non-pathogenic bacteria strains. *Zeitschrift für Naturforschung C*, 65(7-8): 479-482.
2. Jadhav (2023). Importance of Infusoria as live feed for fish larvae and its cultivation techniques. *International Journal of Agriculture and Animal Production,* 35: 8–11.
3. Lahnsteiner & Kletzl (2018). A method for rearing perch, *Perca fluviatilis*, larvae using *Paramecium caudatum*, followed by wild zooplankton and formulated dry feed in combination with adequate tank systems. *The Journal of Agricultural Science*, 10(8): 26.
4. Patil et al. (2024). Isolation and Cultivation and Staining of Paramecium. In: Amaresan, N., Chandarana, K.A. (eds) Practical Handbook on Soil Protists. Springer Protocols Handbooks. Humana, New York, NY.

Addressing the Low Hatching Rates in Turtle Hatchery: Challenges and Solutions

MOHAMAD FATHULLAH R* & MUHAMMAD AMIRUL SIDDIQ AR
Fisheries Research Institute Rantau Abang,
23000 Dungun, Terengganu
*fathullah@dof.gov.my

Hawksbill turtles, a critically endangered species, rely on successful egg hatching for survival. Melaka's beaches serve as vital nesting sites, but declining hatching rates threaten conservation efforts. This study by FRI Rantau Abang examines key factors affecting hatching success at three primary nesting sites: Padang Kemunting, Kampung Baru, and Tanjung Serai.

Between May and August 2024, 15 nests from three locations were collected and incubated at the Pusat Penetasan dan Penerangan Penyu in Pengkalan Balak, Melaka (**Figure 1**). Egg transfer times, environmental conditions, and hatching success were monitored. Temperature data were recorded using HOBO Tidbit V2 loggers. After 60 days, nests were examined to assess hatching rates and embryo condition, analysing factors such as transfer time, incubation temperature, and hatchery conditions to determine the causes of low hatching success.

Padang Kemunting recorded the highest percentage of hatching success (25%) compared to Kampung Baru (5%) and Tanjung Serai (2%). However, these rates are way below the Department of Fisheries, Malaysia, hatching target of 80%. One of the main factors could be due to the delay in egg transfer. Eggs from all three locations experienced transfer times exceeding 8 hours compared to the recommended standard (less than 3 hours). According to Eckert et al. (1999), delays beyond this critical window increase embryo mortality due to mechanical disturbance and environmental stress. Geographical distance further exacerbated this issue. Eggs collected from Padang Kemunting, located only 1-3 km from the hatchery, achieved better hatching rates compared to Kampung Baru (6 km) and Tanjung Serai (15 km). Eggs subjected to prolonged transfer times are more vulnerable to physical damage, temperature fluctuations, and environmental contamination.

Figure 1: Hatching sites at the Pusat Penetasan dan Penerangan Penyu, Pengkalan Balak, Melaka

Hatching site conditions significantly impacted outcomes (**Table 1**). At A1 (covered), rates fell from 53.4% in 2022 to 16.91% in 2024. Site B, lacking protective structures, saw an even steeper decline from 63.02% in 2021 to 10.66% in 2024 due to environmental fluctuations affecting embryo development. This suggests that a controlled environment is essential for stable incubation conditions.

Table 1: Comparison of Hatching Rates for Site A1 and Site B from 2021- 2024.

Site	Hatching rate, %			
	2021	**2022**	**2023**	**2024**
A1	51.01	53.4	50.8	16.91
B	63.02	59.81	14.96	10.66

Incubation temperature is crucial for turtle embryo development and sex determination. Recorded temperatures (29.74°C–32.56°C) were within the optimal range (Ackerman, 1997), but exceeding 32°C increased the female hatchling likelihood and embryo mortality. High moisture levels promoted fungal and bacterial growth, with *Fusarium solani* causing egg decay and reduced hatching success (Sarmiento-Ramírez et al., 2014). Mechanical disturbances within the nest environment also played a role in the declining hatching rates. Several nests exhibited root intrusion, which mechanically disrupted the eggs and reduced oxygen availability, inhibiting embryo development (Mortimer, 1990). The presence of roots within the nest can also create physical pressure on the developing embryos, leading to increased mortality. Root intrusion was more prevalent in the open hatchery area (Site B), where vegetation was not adequately managed.

Urgent conservation measures are needed to reduce egg mortality and environmental disruptions. Cutting egg transfer time to under 3 hours, with more staff for night-time collection, is crucial. Expanding hatchery facilities and using root barriers like geotextiles can prevent nest disturbances. Continuous monitoring of temperature and moisture with data loggers ensures stable incubation. Limiting artificial beach lighting and promoting coastal restoration will further support natural nesting behaviours.

Nest overgrown with creeping tree roots (left) and eggs covered with fungi and roots (right)

References

1. Ackerman (1997). The nest environment and the embryonic development of sea turtles. *The Biology of Sea Turtles*: 83-106.
2. Eckert et al. (1999). Research and management techniques for the conservation of sea turtles. *IUCN/SSC Marine Turtle Specialist Group Publication No. 4.*
3. Mortimer (1990). The influence of beach sand characteristics on the nesting behavior and hatching success of green turtles (*Chelonia mydas*). *Copeia*, 1990(3): 802-817.
4. Sarmiento-Ramírez et al. (2014). *Fusarium solani* species complex: An emerging pathogen of sea turtles. *Fungal Biology*, 118(8): 630-641.

Evaluation of Visible Implant Elastomer Tagging for Riverine Catfish Juvenile (*Hemibagrus capitulum*): for Inland Fisheries Monitoring

Fisheries Research Institute Glami Lemi,
71650 Jelebu, Negeri Sembilan

MOHAMAD SUFIYAN S*, HASLAWATI B,
SHAFARIZAN S & MUSTAFA A
*sufiyansalmi@dof.gov.my

In Malaysia, inland fisheries produced about 9.4 metric tonnes of fish worth RM 179.5 million in 2023. Hence, the Department of Fisheries has implemented several programs to enhance fish landings from inland waterways. One of them is the fish restocking program. A total of 6.5 million fish fry of different species were released in 2023, which include 3.5 million giant freshwater prawns, 1.5 million tinfoil barb, and 1.1 million riverine catfish. However, little is known about the survival of fish fry discharged into public waters. Therefore, monitoring is particularly important to assess the impact of fry releases on fish landings.

Differentiating released fish from native populations requires effective tagging techniques. The choice of tagging method must align with the selected fish seed release quantity for the program. Tag retention varies depending on species, tag type, placement, and fish size (Rude et al., 2011). Visible Implant Elastomer (VIE) tags have been recognised as suitable for fish seed size in stock enhancement efforts. This study evaluates the resistance of VIE tags in riverine catfish juveniles.

Fifty riverine catfish juveniles, each measuring two inches, were tagged using the VIE technique. Before injection, clove oil (50 mg/L) was used as a sedative based on the fish's resistance. A 0.3 cc insulin needle was used to inject VIE beneath the epidermal layer at the operculum, dorsal fin, adipose fin, and anal fin. After injection, the fish were placed in an aerated recovery tank before being transferred to the research tank for monitoring to assess tag resilience.

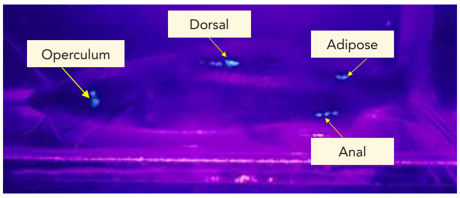


Figure 1: The part of the fish juvenile injected with VIE marker

Table 1: Monitoring the growth data of the riverine catfish.

Month	Total length (Mean±SD, cm)	Body weight (Mean±SD, g)
Initial	5.7±0.5	1.7±0.5
First	8.5±0.5	4.8±0.9
Second	10.7±0.8	10.9±2.2
Fifth	15.9±1.6	28.4±7.3

Tagged fish showed positive growth in weight and length. VIE marker retention was 100% at the injection site in the second month but declined by the fifth month, varying by location (**Table 2**). High retention was recorded in the operculum and anal fin. Significant differences were observed in marker resistance ($p < 0.05$), with some markers becoming undetectable due to tissue growth. A study by Zeller and Cairns (2010) found the operculum to be the best tagging site, maintaining 100% marker retention for 9 months. Further monitoring will assess marker durability as the fish grow.

Table 2: Percentage of VIE tag retention in different body parts (%).

Body Parts	1st Month	2nd Month	5th Month
Operculum	100	100	78.3
Dorsal fin	100	100	55.0
Adipose fin	100	100	50.0
Anal fin	100	100	81.7

In conclusion, VIE markers are effective for tagging juvenile fish, but several factors influence their success, including tagging technique, injection site, growth rate, and durability. The study highlights that marker retention varies by location, emphasising the need for further research to enhance VIE's durability and suitability for juvenile fish population studies.

References

1. Rude et al. (2011). Long-term PIT and T-bar anchor tag retention rates in adult Muskellunge. *North American Journal of Fisheries Management*, 31: 515–519.
2. Zeller & Cairns (2010). Evaluation of Visible Implant Elastomer (VIE) for marking fingerling blue catfish. *North American Journal of Fisheries Management*, 30: 254–258.

LatokWaze: The Beginning

Fisheries Research Institute Pulau Sayak,
08500 Kota Kuala Muda, Kedah

NIK NAZLI EFFENDY R
niknazli@dof.gov.my

Caulerpa, a green alga from the Caulerpaceae family, includes sea grape *Caulerpa lentillifera* (Latok), which has thallus structures forming roots, stolons, and ramuli. This alga attaches to substrates like sand, mud, and fragments. In Malaysia, Latok cultivation is still limited, with most of the market supply coming from wild collection. Due to climate change, natural availability is declining, highlighting the need for improved cultivation techniques to ensure sustainable production.

LatokWAZE (Latok Water Zero Exchange (WAZE)) is a new Latok cultivation technique developed at FRI Pulau Sayak, designed to address climate change challenges. Erratic rainfall and rising temperatures associated with monsoons affect Latok survival by lowering seawater salinity and impacting growth. The optimal temperature range for Latok culture is 27-30°C. WAZE operates as a closed system, regulating salinity, temperature, light intensity, pH, turbidity, seedling strength, and fertiliser use. Since no new water is introduced during cultivation, fertiliser selection is critical for growth. With proper light intensity and fertiliser, WAZE ensures stable water quality while supporting Latok production.

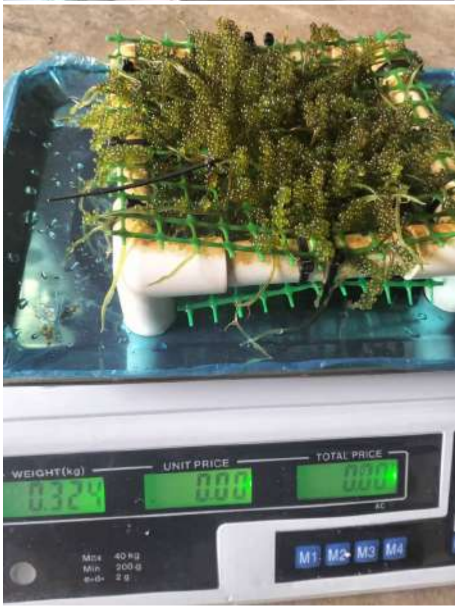
This research, conducted from August to October 2024, used Thai seedlings after a seven-day acclimation process to adapt them to local conditions. This acclimation period is an important process to familiarise plants with the environmental conditions that Latok will face (Fisma et al., 2024). Cultivation took place in a dark room at the Seaweed Hatchery, FRI Pulau Sayak, with fixed artificial lighting. Aquarium LED lights, ranging from 1000-4000 lux, were used continuously for 12 hours daily. No natural light or water changes occurred during the four-week culture period. Growth was analysed by measuring Latok weight under different fertiliser doses, with data collected every seven days.
The 28-day rearing period showed SGR values ranging from 1.63% to 3.08% per day across different fertiliser doses (**Table 1**). The highest SGR (3.08%/day) was achieved with a 0.5 ml fertiliser dose, followed by 0.75 ml (2.57%/day) and 0.25ml (2.53%/day). The lowest SGR (1.63%/day) was recorded with no fertiliser. The 3.08%/day SGR is close to the profitable benchmark of 3.59%/day (Nurfebriani et al., 2015). These findings support the need for optimised cultivation methods to enhance sustainable production of *C. lentillifera* in Malaysia.

Table 1: Specific Growth Rate SGR of Latok cultured with different fertiliser concentrations.

Fertiliser (Dose)	Specific Growth Rate
0.00 ml	1.63%/day
0.25 ml	2.53%/day
0.50 ml	3.08%/day
0.75 ml	2.57%/day

References

1. Fisma *et al.* (2024). Growth analysis of *Caulerpa lentillifera* cultivated at labarotary scale with different light intensities. *Journal Penelitian Pendidikan IPA*, 10(5): 2346-2353.
2. Nurfebriani *et al.* (2015). Pengaruh pemberian pupuk organik cair dengan lama perendaman yang berbeda terhadap pertumbuhan rumput laut (*Caulerpa lentillifera*). *Journal of Aquaculture Management and Technology*, 4 (4): 88-94.



Golden Sea Cucumber Hatchery: Early Observations and Findings

SYED MOHAMAD AZIM SM*, MUHAMMAD ASYRAF AL & KHAIRUDIN G
Langkawi Research Centre, 07000 Langkawi, Kedah
*syedazim@dof.gov.my

Sea cucumbers are vital marine invertebrates found in Malaysia waters, especially in Langkawi, Pangkor, and Sabah. These seabed dwellers thrive in sandy, muddy, coral, or seagrass-covered environments, feeding on algae and organic matter. Sea cucumbers are valued for their healing properties, containing bioactive compounds such as collagen, glycosaminoglycans, and antioxidants. Sea cucumber-based oils, creams, and capsules are widely used in health and beauty products. Langkawi stands as a hub for sea cucumber processing, supporting local economies and creating job opportunities. Wild populations of sea cucumber are declining, particularly the golden sea cucumber (*Stichopus* and *Holothuria* spp.), due to climate change, habitat loss, and overharvesting. Thus, R&D in breeding techniques is crucial to reduce pressure on natural stocks while preserving their habitats. This article describes the induced spawning research undertaken at Langkawi Research Centre.

A total of 60 healthy *Stichopus* sp. broodstock (300-1000 g, average 555.58 ± 170.26 g) were collected at night during full moon at Pulau Payar, Kedah. The collected broodstock underwent a quarantine period of 3 to 4 days before being transferred to induction tanks in the hatchery for 2 to 4 months.

Three breeding induction methods were investigated:

1. The desiccation method - sea cucumber broodstock were kept in the tank for 30 to 60 minutes without water to simulate the natural tidal cycle, particularly during the full moon and new moon phases.
2. The temperature stimulation method - water temperature in the induction tank was rapidly increased or decreased by 5°C for 30 to 60 minutes to stimulate spawning.
3. The algae stimulation method - highly concentrated algae were introduced into the induction tank for 30 to 60 minutes to stimulate spawning.

A total of 15 induction trials were conducted, but only 3 successfully produced seedlings (**Table 1**). The hatching rate ranged between 10% and 22%, while the overall induction success rate was 20% for all induction activities. In addition, an extremely low survival rate was also recorded in this study. Less than 1% (N=161) of the seedlings successfully developed into the juvenile stage compared to the total number of eggs and larvae produced. Most of the seedlings died during the settlement phase, when the doliolaria stage larvae transformed into the pentactula stage and attached to the substrate (**Figure 2**).

Studies should be continued to identify the causes of the small number of larvae produced and low survival rates and explore solutions to improve them. This is worth doing as commercial farming of sea cucumber offers a path forward in balancing ecological protection with economic opportunity while safeguarding valuable marine resources.

Fun fact

- An lowercase is known to produce electricity sufficient enough to light up to 10 electric bulbs.
- Sea sponges have no head, mouth, eyes, feelers, bones, heart, lungs, or brain, yet they are alive.
- Turtles live on every continent except Antarctica.
- Sea otters have a secret pocket of skin near their armpits.
- The giant squid has the largest eyes in the animal kingdom.

Table 1: Induction activities carried out.

No	Induction method	No of eggs produced	No of larvae produced	Hatching %
1	Desiccation, algae, thermal (full moon)	0	0	
2	Desiccation, algae, thermal (full moon)	0	0	
3	Desiccation, algae, thermal (full moon)	0	0	
4	Desiccation, algae, thermal (full moon)	0	0	
5	Desiccation, algae (live algae), thermal (new moon)	0	0	
6	Desiccation (3rd day new moon)	0	0	
7	Desiccation, algae (waxing Moon 87%)	0	0	
8	Desiccation, algae (waning gibbous Moon 87%)	0	0	
9	Desiccation, algae (waning gibbous Moon 80%)	0	0	
10	Desiccation, algae (waning crescent 25.00%)	0	0	
11	Desiccation, thermal (new moon 0%)	0	0	
12	Desiccation (third quarter moon 52%)	1,890,000	432,000	22.85
13	Desiccation (third quarter moon 52%)	0	0	
14	Natural (waxing crescent 12%)	1,050,000	352,600	33.58
15	Natural (waning gibbous Illumination: 74%)	437,500	47,600	10.88

Figure 2: The development of golden sea cucumber seed from day 1 to day 120.

Sperm release from male golden sea cucumber broodstock.

IP UPDATES

Effectiveness of Streptokit – An Update

MOHD SYAFIQ MR
syafiq@dof.gov.my

National Fish Health Research Centre (NaFisH), 11960 Batu Maung, Pulau Pinang

Streptokit – rapid detection kit of *Streptococcus agalactiae.*

The persistent occurrence of streptococcosis, particularly in tilapia aquaculture, has driven the development of Streptokit, a rapid detection tool. Developed through a collaborative effort between National Fish Health Research Centre, FRI (NaFisH) and International Islamic University Malaysia (IIUM), Streptokit utilises advanced aptamer technology to offer a cost-effective and user-friendly solution for the early detection of *Streptococcus agalactiae* directly from tilapia body mucus. Utilising the lateral flow assay principle, Streptokit delivers results in just 15 minutes, offering a streamlined one-step procedure. A previous study demonstrated an impressive laboratory-tested sensitivity of 93.3% and specificity of 100%. This technology was registered as a patent in 2023 with a certificate of filing number PI20230006263.

To further assess its practical effectiveness, a field study was conducted across three tilapia farms: Kenyir Lake (cages), Kg. Beladau Kolam (cages, river), and INOCEM (pond). The sensitivity and specificity of Streptokit were evaluated on samples from 30 tilapias at each location, spanning from February to October 2024. For comparison, conventional PCR testing was performed concurrently. The results revealed that Streptokit identified 15 positive cases of *S. agalactiae*, while PCR detected 18 positive cases at two locations—Kenyir Lake and Kg. Beladau Kolam. Notably, no positive cases were found at INOCEM using either detection method. In conclusion, Streptokit has proven to be an effective point-of-care diagnostic tool, demonstrating a field sensitivity of 83.33% and specificity of 100%.

Positive detection through (a) Streptokit – indicated by presence of reddish lines at both test and control lines (b) Conventional PCR

RIDDLES

1. I am not a plant, but I bloom in water's light. My colours are vibrant, forming homes in the blue.
2. I'm known for my size and song beneath waves, holding the title of the largest of all.
3. Beneath the waves, I silently roam, in the deep blue sea, I find my home.
4. I'm not alive but I once was, listen closely and you'll hear the ocean buzz.
5. A drifter's cloak yet rooted deep, a leafy maze where fishes sleep.
6. I'm a creature that glows in the dark of the sea, I'm often found in the depths, and I'm a mystery.
7. I'm a large sea creature with a tusk like a spear, I'm often called the unicorn of the sea, my friends hold me dear.
8. I'm known for my long, flowing fins and graceful moves, I'm often kept in tanks, and I love to groove.

Jabatan Perikanan Malaysia

INSTITUT PENYELIDIKAN PERIKANAN (FRI)
11960 Batu Maung, Pulau Pinang
Tel : (604) 626 3925 / 26 | Faks : (604) 626 2210 | Website : www.dof.gov.my
fri_helpdesk@dof.gov.my