



THE 8TH INTERNATIONAL CONFERENCE ON
**FISHERIES AND
AQUACULTURE**

" Managing Fisheries and Aquaculture
under New Normal Environment:
Issues, Challenges and Opportunities "

19TH – 20TH AUGUST 2021

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Aquaculture 2021
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(ICFA 2021)

Edited by Dr. Krishna R. Salin, Dr. Ravi Fotedar, Dr. Rohana Subasinghe & Dr. Albert G.J. Tacon

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MESSAGE FROM THE CO-CHAIR ICFA 2021



I'm glad to see the ICFA Conference gaining traction as a significant global event dedicated to promoting sustainable fisheries and aquaculture. Feeding the world has become increasingly complex as we see more and more disruptions to global food systems, including resource scarcity, degradation, and climate change impacts, particularly in the post-pandemic era. This emphasizes the importance of fisheries and aquaculture as viable choices for feeding and nourishing the world's growing population. Asia accounts for about 90% of the global aquaculture production, with smallholder farmers accounting for most of this. With possibilities for increasing capture fishery outputs being limited, there is a growing need to boost aquaculture productivity through innovative farming technologies. However, the pace and scale of aquaculture intensification also result in several problems that need attention. Therefore, sharing knowledge on technological advancements and emerging modern approaches to sustainable fisheries and aquaculture is essential, and this conference is a good step in this direction. Since the 1980s, AIT has been at the forefront of promoting sustainable aquaculture. We will continue to take on this role with greater passion and enthusiasm, advocating for the Asia Pacific region's research and capacity development needs. The focus of research has recently switched to new areas. Today, AIT's Aquaculture Program is as relevant as ever, focusing on the sustainable intensification of aquaculture practices for improved product quality and food safety. The theme of the Conference, *MANAGING FISHERIES AND AQUACULTURE UNDER NEW NORMAL ENVIRONMENT: ISSUES, CHALLENGES AND OPPORTUNITIES*, aligns with this priority. I'm delighted to be working with TIIKM again for ICFA 2021, and I hope that the conference's conclusions will help stakeholders in the fisheries and aquaculture industries sustainably boost food production. As a Co-Chair of ICFA 2021, I am delighted to welcome all attendees to this important conference in the hopes of achieving the best possible outcomes for the global fisheries and aquaculture industry.

Salin Krishna

Krishna R. Salin, PhD.
Chair,
Aquaculture and Aquatic Resources Management Program,
Asian Institute of Technology,
Thailand

MESSAGE FROM THE CO-CHAIR ICFA 2021



“As Co-Chair I wish to extend to all participants a very warm welcome to this 8th International Conference on Fisheries and Aquaculture 2021. During these difficult times due to the COVID-19 pandemic it is important that we do not lose hope and stay focused on our work, research and passion’s - whether they be in fisheries, aquaculture or in both. Toward this end, I hope that this meeting bring you new insights and experiences from around the world, and will brighten your hopes for a better tomorrow and future for all”

**Dr. Albert G.J. Tacon,
Technical Director,
Aquahana LLC,
USA**

MESSAGE FROM THE CO-CHAIR ICFA 2021



During this critical time of wading through the COVID-19 pandemic, addressing the importance of fisheries and aquaculture for food, nutrition, income and wellbeing of millions of people worldwide, I congratulate TIIKM for organizing the 8th International Conference on Fisheries and Aquaculture (ICFA 2021), in collaboration with many agencies and individuals. I wish fruitful webinar with tangible and productive outcomes.

**Dr. Rohana Subasinghe,
Honorary Life Member of the World Aquaculture Society,
Former President of the World Aquaculture Society – Asia Pacific Chapter (WAS-
APC)**

MESSAGE FROM THE ACADEMIC PARTNER ICFA 2021



Indonesia is an archipelago state with more than 17,000 islands. Of approximately 5.19 million Km² of its territory, around two-thirds are categorized as an aquatic region, especially marine (consisting of sea and ocean). However, in the terrestrial zone, there are also being covered by large water bodies (e.g. rivers, lakes, swampy areas).

East Kalimantan, with a total administrative area of 127 thousand Km² of which 25.6 thousand Km² are oceans, belongs to provinces with potential marine and fishery productions. However, from the estimated 341 thousand tons production, so far only 30% of it has been exploited and treated. The strategic position of East Kalimantan is being supported by the fact that the Makassar Strait and Sulawesi Sea in the western part of the province are classified as an international sea trade/transportation line. To manage those very rich resources optimally, adequate professional human resources, as well as sufficient proper technologies, are necessary.

The above background was the main consideration for the establishment of the Faculty of Marine and Fisheries, Mulawarman University (*FPIK UNMUL*) in 2001. Today, although the *FPIK UNMUL* has been recognized to be one of the most progressive development faculties within the university, spirits and efforts to increase its capacity as well as the competitiveness of the lectures and students, are still further carried out.

Therefore, it is an honor for UNMUL to be one of the partners of the International Institute of Knowledge Management, and to be invited to the 8th International Conference of Fisheries and Aquaculture 2021 (ICFA 2021). It is hoped that this conference will be able not only to strengthen scientific networks and to produce international scientific articles but also to encourage experts and their expertise to find out smart strategies and new ideas for sustainably managing the marine ecosystem.

Thank you and have a nice conference.

Prof. Dr. Mustofa Agung Sardjono
Vice Rector for Academic Affairs,
Mulawarman University, Indonesia

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ORAL PRESENTATIONS

[01]

**COMPARISON OF LIVELIHOOD VULNERABILITY RISKS AND PERCEPTIONS
TOWARDS CONSERVATION REGIME BETWEEN MARICULTURE, FISHERY,
ECOTOURISM IN MULTI-USE MPA, INDONESIA**

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ABSTRACT

Vulnerability risks of different livelihoods within marine protected areas (MPAs) and their support to MPA regimes have not been thoroughly studied. This research aimed to compare the seasonal, trend and shock vulnerability indicators (LVIs) of fish farmers, fishers and ecotourism operators and the LVIs' influence on the groups' livelihood toward supporting conservation efforts in an MPA. The Anambas Archipelago MPA was selected as the study site. A total of 65 respondents, consisting of 43 fishers, 18 fish farmers, and five ecotourism operators, were selected using stratified random sampling and interviewed using a questionnaire containing 14 LVIs. Collected LVIs data in the form of Likert-scale type responses were aggregated and standardized using functional relationships. The groups' perceptions toward the MPA were analyzed using frequency distribution and thematic analysis using NVIVO 10. The average LVI composite index values of the three groups show that the fisher group is most vulnerable (0.65), followed by the fish farmer (0.62) and ecotourism operators as the least (0.47). Fishers and fish farmers expressed high vulnerability risk related to their dependency on coastal resources. Low vulnerability risk experienced by ecotourism households was attributed to less dependence on natural resources, high political support, and less affected by seasonal weather and conflicts over resource use. The household groups have similar general views that the MPA has improved fish stocks and prevented illegal fishing. Mariculture sits between fishery and ecotourism in terms of vulnerability, and all the groups support the MPA conservation objectives. The findings of this study provide alternatives on how MPA authority or national government addresses vulnerability risks and increases conservation support in small island MPAs using the right management tools and strategies.

Keywords: vulnerability risk, small-island MPA, livelihood, mariculture, perception

[02]

**MULTIPLE VALUE CREATION OF SMALL-SCALE FISHING COOPERATIVES
GRADUATE SCHOOL OF BUSINESS, FACULTY OF COMMERCE, UNIVERSITY
OF CAPE TOWN – SOUTH AFRICA**

Ngxiza S*

*Parliament of the Republic of South Africa, Office of the Speaker, Republic of South Africa
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ABSTRACT

Small-scale fishing cooperatives are directly productive of value. In fact, cooperatives produce various forms of value, however the dominant neo-classical economics orthodoxy use uni-dimensional economic measurements and thus declare them structurally inefficient. This orthodoxy provides a scaffolding for state and market logics that perpetuate marginalisation of small-scale fishing cooperatives from economic activity. The persistent neglect of fishing cooperatives obscures their significance and deprives them of proper recognition of their innovative capabilities and concomitantly the required support and transformation in the broader market system. The purpose of this paper is to illuminate, demystify and amplify the multiple value contribution of small-scale fishing cooperatives in fish dependent coastal communities. therefore their multiple value contribution needs to be demystified and further amplified. To this end the study employed a qualitative inductive multicase study using group discussions and in-depth interviews focusing on primary and secondary fishing cooperatives in South Africa's Western Cape coastline. Accordingly, emerging empirical evidence confirms that latent fishing cooperatives generate a cross-section of benefits in terms of sustainable livelihoods, curbing intergenerational poverty, and enacting principles of equity, solidarity and reciprocity which are critically important for social stability and resource sustainability. This study reveals the profound content and quality of value contribution categorised into transgenerational, existential and emancipatory dimensions of value. Further, the value generation capacity of small scale fishing cooperatives can be intensified through provision of material support for processing, marketing and promotion; integration into the upstream and downstream value chains; altering of power asymmetries in the market, improving technological innovation and sedimentation of networks; and harnessing alternative modes of legitimacy to recognise the totality of value for upscaling and diffusion.

Keywords: fishing cooperatives, multiple value contribution, institutional logics perspective

[03]

**THE EFFECT OF CLIMATE CHANGE ON SMALL SCALE FISHERY ACTIVITIES
IN THE SWAMP AREA OF OGAN ILIR, SOUTH SUMATERA, INDONESIA**

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ABSTRACT

Climate change is a major environmental problem and has been the subject of debate and controversy. The impacts caused by changes in weather, seasons, and humidity have undeniably made various sectors, including fisheries, vulnerable. This study aims to identify the impact of climate change on small scale fishery activities in the swamp area in Ogan Ilir Regency, South Sumatra, Indonesia. Fisheries activities that are generally carried out by the community include catching, processing products, and cultivating fish, both in earthen ponds, concrete/tarpaulin ponds, and cages. Data on capture fisheries production, aquaculture, and processing of fishery products were obtained through questionnaires and interviews with 50 respondents. The collected land and water quality samples were analyzed in the water quality laboratory, Faculty of Agriculture, Sriwijaya University. The study results describe the current situation of the community in the study location affected by climate change, including the decline in catches. The number and types of fish caught have decreased in the last 5-10 years. Likewise, with the production of aquaculture, especially cages, due to the declining quality and quantity of river and swamp water. Processing of products still relies on raw materials from natural catches, thus affecting processing production and community income. Information on adaptation patterns carried out by fishers, fish farmers, and fishery product processors is an essential consideration in determining appropriate and sustainable fisheries development models in the swampy swamp area related to climate change.

Keywords: climate change, small scale fishery, swamp area, aquaculture, sustainable fisheries

[04]

**BALANCING THE ACTS: THE ISSUES IN THAI LABOUR LAWS AND THAI
FISHERY SUPPLY CHAIN**

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ABSTRACT

Ethical treatments of labour in Thai fishery have been important issues for both Thai fishery industry and Thai government for decades. Since the IUU issued in 2010, Thai government has issued 5 laws to curve the labor practice. The latest law was the Labour Protection Act (No. 7), B.E. 2019. Through in-depth interviews with many stakeholders in Thai seafood supply chain (e.g., fish farmers, fishermen, re-processor, traders, fish market, local supermarkets, seafood processors), the impacts of human right accusations and the laws on their livelihoods and businesses was assessed. The laws issued since 2008 until 2019 were targeted the labour issues addressed by the International Labour Organisation mainly unethical treatments of the labour; however, there were impacts throughout out the supply chain beyond the fish farmers and fishermen. Many players disagreed with many clauses in the laws especially the latest law that protects only the labours but not the employers. There were many risks to business when the employers followed the laws and resulted in loosing competitive edges and, eventually, going out of business. The study revealed how businesses that survived, adapted to the laws and identified issues that needed to be addressed to help small businesses survive.

Keywords: Labour Law, seafood supply chain, fishery, Thailand

[05]

THE RELATIONSHIP BETWEEN THE DOMAIN OF BEHAVIOR OCCUPATIONAL HEALTH AND SAFETY IN FISHERS TO THE INCIDENCE OF WORK ACCIDENTS IN PAPUMA BEACH AREA, JEMBER REGENCY, EAST JAVA, INDONESIA

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ABSTRACT

Behavior applied by workers will affect the incidence of workplace accidents. This study aimed to determine the relationship between the behavior of fishers on workplace accidents in the Papuma Coast area, Jember Regency. Based on the data collection, this study was observational and used a cross-sectional design. Data obtained by conducting interviews and distributing questionnaires to 81 fishers in Papuma Beach, Jember Regency. The results indicate that there is a relationship between knowledge and work accident events (p -value: 0.003), there is a relationship between attitude and work accident events (p -value: 0.001), and there is a relationship between actions and work accident events (p -value: 0, 001). The conclusion of this study shows a relationship between knowledge, attitudes and behavior of workers in workplace accidents. Insufficient knowledge, attitudes, and behavior of workers have a higher risk of experiencing workplace accidents than workers who have adequate knowledge, attitude, and behavior. The advice that can be given from this research is that fishermen workers always use personal protective equipment to reduce the risk of work accidents. Furthermore, advice the government should be more concerned with the safety of fishers who can be sought by providing personal protective equipment.

Keywords: knowledge, attitude, work accidents

[06]

**THE CHARACTERISTICS ONE DAY ANCHOVY FISHERIES IN PULO LAMPES,
NORTH COAST OF CENTRAL JAVA, INDONESIA**

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ABSTRACT

One-day anchovy fisheries based in Pulo Lampes is one of the fishing activities in the western part of the North Coast of Central Java. The fisheries significantly developed since 2010 by using a ring net with a platform of the small-scale fishing craft of 10.0 + 2.48 GT. This study aimed to describe the characteristics of coastal small-scale anchovy fisheries, emphasizing the annual catch and effort dynamics. The fleet operated on a daily daylight basis. Daily landing from 2011 to 2020 was observed. The result indicated that the fishing trips ranged from 2371 (2013) to 4532 trips (2016) a year with annual landing from 379 to 1926 tons. The monthly landing tends to increase by the year, with catch rates are relatively stable at around 400 to 450 kg/trips. The fish mainly belong to *Stolephorus commersonii*, with size distribution ranging between 4.0 and 8.0 cmTL. The catch was fresh landing and traditionally drying in the open air using the sun's energy. They applied this reasonable post-harvest to produce a medium-high quality marketable product.

Keywords: small-scale fisheries, ring net, anchovy, Java Sea

[07]

**CONSTRAINTS OF FISHERWOMEN'S PARTICIPATION IN FISHERIES
COOPERATIVE SOCIETIES: A CASE STUDY OF BARGI RESERVOIR, MADHYA
PRADESH (INDIA)**

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ABSTRACT

The study was conducted in 6 fishing villages of the Bargi reservoir of Madhya Pradesh state, India. Key Informant Interviews of 6 chairpersons of Fisheries Cooperative Societies (FCSs), Personal interviews of 180 fisherwomen, a daily routine chart of 18 fisherwomen members and non-members of FCSs through Participatory Rural Appraisal technique, and Focus Group Discussions with 180 fisherwomen were carried out for data collection. To explore the participation status of fisherwomen, in the beginning, membership participation in FCSs were gathered through Key Informant Interviews. Thereafter, primary data of fisherwomen's participation in FCS and fisheries activities were collected. The constraints in fisherwomen's participation were collected using Focus Group Discussions. Rank Based Quotient method was used to analyze and rank various constraints. The results showed that only 8.88percent of the fisherwomen possessed the membership of FCS. Though 80.54percent of the fisherwomen were engaged in fisheries activities such as fish smoking (33.33percent), fish trading (12.22percent), fish harvesting (11.11percent), and net making/repairing operations (23.88percent). Daily routine chart showed that fisherwomen were engaged for 8 hours/day in productive work and 9 hours/day in reproductive and community work. The constraint analysis revealed that poor social status, poor social acceptance and lack of ownership of assets were the major social constraints. The economic constraints of poor participation observed were; poor income, lack of working capital, and lack of alternative livelihood opportunities in the fishing close season. It was also observed that gender biases in getting membership of FCSs, limited access to training & extension services and the lack of access to saving schemes were the main institutional constraints. The production constraints were; the lack of skills in the operation of craft and gear, a decline in stocked and native fish species, and the operation of destructive fishing gears.

Keywords: fisherwomen, fisheries activities, participation, constraints and Fisheries Cooperative Societies (FCS)

[08]

ROLE AND CONTRIBUTION OF SMALL SCALE FISHERY IN FMA 713, 714 AND 715 TO THE NATIONAL LEVEL OF FISHERY

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ABSTRACT

Indonesia can be divided into 11 Fisheries Management Area of fishing. As commonly stated, fishery in Indonesia is considered tropical fishery characterized by multi fishing fleets, multi fishing gears and multi species caught. FMA 713, FMA 714 and 715 are ecologically considered the most important FMA in Indonesia. In terms of fishing fleet and fishing gears being used, the fishery can be categorized into 5 different groups of fishing fleets and seven fishing gears, respectively. However, contribution of central and local management as well as small scale versus commercial fishing were unknown. This study intends to describe fishery in terms of the above mentioned and illustrate contribution of the fishery to Indonesia fishery. Data of PIPP produced by Fishing Port authority was used in this study. A cross tabulated method was used in this study. Results of the study indicated that in terms of fish caught and value of fish caught local government management dominated in FMA 713 and FMA 715; they were 66.57% (weight) and 67.55% (value) and 78.12% (weight) and 79.86 (value), respectively. Meanwhile center government management dominated only in the FMA 714 illustrated by 45.14% (fish weight) and 43.52% (fish value). Small scale fishery contributes a relatively low to the fishery in all selected FMA. Total contribution of the FMA 713, FMA 714 and FMA 715 to the national fishery were only 4.18% (weight) and 3.51% (value). Similarly, income generated from fishery of that particular FMA was not significant.

Keywords: role and contribution of fishery, FMA 713, FMA 714 and FMA 715, small scale fisheries, PIPP National Data Set

[09]

**CONSUMERS' CONSCIOUSNESS AND WILLINGNESS TO PAY FOR FISHERY
ECOLABELS. RESULTS OF AN ITALIAN EMPIRICAL STUDY**

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ABSTRACT

This research concerns ecolabels in the fishery sector and its main objectives are to verify: 1) whether they are recognized and their meaning is known by culturally qualified young consumers and 2) whether it is possible to quantify these consumers' "willingness to pay" (WTP) for fish products bearing ecolabels. Literature review has shown that even though over the years many researches on Corporate Social Responsibility (CSR) labelling were carried out, only few focused exclusively on the fishery sector, analysing the young consumers' point of view. Following literature review, a questionnaire was designed. The measurement scale used in this study was adapted from scales validated in previous researches and double checked against field literature. The final part of this research investigates the sentiment of 411 students of the University of Turin (Italy), employing multivariate statistical methods. The results of this analysis point out four clusters characterised by distinctive attitudes and WTP: one of the clusters (29.44% of the sample) has a greater WTP than the others (more than 15%) and is very interested in ocean protection. Familiarity with ecolabels may improve consumers' sustainability awareness, enabling purchasers to make informed choices. Ecolabels can also support the sea environment avoiding overfishing and the risk of depletion of certain fish stock.

Keywords: consumer attitude, Willingness to Pay (WTP), Ecolabels, fishery products, purchase intention, multivariate analysis

[10]

ASSESSMENT OF TILAPIA-FRESHWATER PRAWN CO-CULTURE SCHEMES IN TANKS AND LAKE-BASED CAGES FOR INCREASED FARM PRODUCTION

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Multi-species aquaculture presents fish farmers a chance to produce more fish and earn additional income in spite of limited facilities and resources. This study assessed the viability of growing i-EXCEL Nile and/or red hybrid tilapias (1) singly or in co-culture with giant freshwater prawns (GFP), in cages within tanks, and (2) in co-culture with GFP in lake-based cages using different feeding regimes. The first experiment evaluated growth and survival of i-EXCEL Nile or red tilapias reared singly for five months in 1x1x1m³ cages set within 2x2x1m³ tanks. This was compared to tilapias reared in cages, in co-culture with similarly sized prawns stocked directly in tanks. The second experiment was conducted in a shallow eutrophic lake for five months, where i-EXCEL Nile and red tilapias held in 2x2x1m³ cages were grown with prawns stocked in larger (5x5x1.5m³) net cages. Here, three feeding treatments were used, namely, A - feeding Nile and red tilapias only; B- feeding GFP only; and C - feeding all species. Both experiments were done twice, that is, during the wet and dry seasons. In the first experiment, all the tilapia species generally grew faster during the dry season with the red tilapia-GFP co-culture system giving the best results (red tilapia: SGR = 2.52 gBW/day, 83.3% survival; prawns: 1.17gBW/day, 72.85). For the second experiment, tilapias in treatments A (tilapias fed) and C (all species fed) had comparable growth rates although the prawns in treatment A grew slightly slower. It has been shown in this study that the co-culture schemes where good growth and survival have been demonstrated, are technically viable options for the traditional fish farmer to consider to increase his farm output.

Keywords: Nile tilapia, red tilapia, giant freshwater prawn, co-culture

[11]

COMPARATIVE EFFECTIVENESS OF LOCALLY DEVELOPED PACKAGING MATERIALS WITH IMPORTED PRODUCTS FOR MARKETING OF PROCESSED FISH

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ABSTRACT

The impact of COVID-19 pandemic on the world has brought the issue of health and safety in fish processing to the limelight. Consumers are now more concerned about the characteristics of packaging used for dried fish. Composite packaging materials of different thicknesses developed from locally sourced materials of polyethylene and paper were compared with the imported products of vacuum bag and aluminum foil in packaging of smoke-dried catfish. The weight of the composite packaging materials (single, double and triple laminated packaging) ranged from 10 to 17 g with corresponding thicknesses of 0.1 to 0.19 mm. The weights of the vacuum and aluminum foil were 9 and 10 g with thicknesses of 0.08 and 0.10 mm respectively. Fish samples from the five different packaging were subjected to monthly analysis for four (4) months and this covered proximate, microbial, entomological and sensory analyses. The data collected were subjected to analysis of variance (ANOVA) using SPSS statistical tool, and cost of production for the packaging was also evaluated for cost effectiveness. Packaged catfish dried to moisture content of 7.3 % stored in these packaging materials were able to maintain the proximate, microbial limits and sensory attributes for four months with no sign of insect infestation. There was no significant difference in all the quality parameters considered in the study ($p \leq 0.05$). The production costs for the composite packaging materials ranged from ₦30.55 to ₦63.15 while that of aluminum foil and vacuum bags were ₦80:00 and ₦115:00 respectively. The composite packaging developed from the local compatible materials compared favorably with the imported ones. It was also observed that the triple laminated packaging offered the best barrier to contaminants among the three composite considered as local materials but at a higher cost of production. Even though the imported materials have slight advantage in curtailing the microbial loads, their scarcity and high cost might negate their acceptance as packaging materials in a developing economy.

Keywords: fish, packaging, composite, paper, polyethylene, packaging materials, shelf life, quality

[12]

UTILIZATION OF THE POST-PRODUCTION OIL AND GAS PLATFORM SITES FOR OFFSHORE AQUACULTURE IN THE JAVA SEA: THE HYDRODYNAMIC SUITABILITY ASSESSMENT

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ABSTRACT

Indonesia plans to increase aquaculture production by 19.47 million tons in 2021, and keeps on growing in the future. Offshore aquaculture may contribute to the increasing productivity and help mitigate some of the negative consequences of near-shore and land-based farms. Offshore aquaculture requires a significant investment and complex operations. Taking advantage of structures of oil and gas post-production platforms (POP), could accelerate offshore aquaculture development. More than 75% of the POP located in the Java Sea and have the potential to be converted into cages support structures. This study aims to assess the hydrodynamic suitability of the POP structure for offshore aquaculture in the Java Sea. We conducted a hydrodynamic model to obtain a high-resolution current data. The model was run for five years using global oceanic and atmospheric data as a forcing input. Wave analysis is based on 40-years global wave simulation. Model results and observations agree very well on sea surface temperature, tides, sea surface height, and current velocity. Flow transport from the South China Sea has the impact on the Java Sea's hydrodynamics. Seasonality and climate, on the other hand, have the impact on temperature and salinity. Our suitability assessment found that POPs located deeper than 30 meters are suitable for offshore aquaculture. The extreme wave period must be considered when calculating POPs mooring and floating structure. Furthermore, the oceanographic model's results can be used to help determine the suitability of future offshore fish farm sites in the Java Sea.

Keywords: Offshore Aquaculture, Numerical Model, Hydrodynamic, Java Sea

[13]

DIGITALIZATION OF SEAFOOD FIRST SALES MARKETS AS A RESPONSE TO COVID-19

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ABSTRACT

The current COVID-19 pandemic challenged the fisheries and aquaculture sectors, with lockdowns and containment measures breaking important supply chains. For the small-scale fisheries around the world, the closure of local seafood markets and the HORECA channel, among others, compelled fishers to resort to direct sales in order to stay afloat. Within this context, we reviewed the worldwide emergence of digital initiatives to sell and deliver seafood directly to consumers in 48 countries. Solutions ranged from online auctions to direct sales via websites, mobile apps, and predominantly, social networks, phone/WhatsApp, and e-mail. Furthermore, several countries launched national campaigns through social media to encourage local products consumption. Portugal, with a deeply rooted artisanal fishery tradition and one of the highest seafood consumption rates per capita in the world, was taken as a case study. Here, we found more heterogeneous first sale markets in the Northern region, with 46% of the fishing associations classifying the use of technologies as an asset during the outbreak, and some fishers resorting to unregulated direct sales. On the other hand, in the center/south regions, where a stricter sales structure is in place, that percentage dropped to 21%. We also verified an increase of costumers and sales volume in different online alternatives already existing in Portugal, with the official online national auction following the same trend. It seems evident that virtual seafood market played an important role in overcoming some of the challenges triggered by the pandemic, particularly at the small-scale fisheries, highlighting the need to globally enhance such channels as part of more functionally diversified supply chains.

Keywords: COVID-19, fisheries, seafood markets, sales, digital, Portugal

Acknowledgements: Docapesca, Fishers' Associations, Fishers and Online fishmongers. Study developed under the project e-FishMarket (MAR-01.03.01-FEAMP-0031).

[14]

**EFFECT OF DIFFERENT DOSES OF RECOMBINANT GROWTH HORMONE
AND FISH SIZE ON GROWTH PERFORMANCE AND GONADAL
DEVELOPMENT OF SNAKEHEAD (*Channa striata*) AT JUVENILE STAGE**

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ABSTRACT

Decreasing growth rate and unclear gonadal sexual differentiation in juvenile currently are the challenges in aquaculture production of snakehead. This report describes a study of growth performance, gonad morphology and gonadal development in juvenile of snakehead belonging to different doses of recombinant growth hormone (rGH) and fish size. The experimental design used was a randomized block design with 5 different doses of rGH (mg / kg of feed): 0 (K +), 2 (P1), 3 (P2), 4 (P3) and only commercial feed (K-). Meanwhile, fishes were divided into three groups according to their length: 4-5.5 cm (Group 1), 5.5-6.5 cm (Group 2) and 6.5-7 cm (Group 3). The treatments were given to 2 month-old juvenile for 6 weeks and it continued until fish were 5 months old. The results showed that the different doses of rGH did not significantly affect on all growth performance parameters; however, the fish size had significant effect on the specific growth rate and absolute body weight. Moreover, both doses of rGH and fish size had significant effect on gonad morphology. Meanwhile, the gonad morphology were successfully divided into 4 characteristics, namely gonad type 1, which contained perinucleolar oocytes (PnO) and ovarian cavity (OC), gonad type 2 was dominant with primary oocyte (PO), few somatic cells (SC), gonad type 3 had primary oocyte (PO) and dominant somatic cells (SC), and gonad type 4 dominant somatic cells (SC) and blood vessel (BV). Interestingly, the time of female differentiation occurred early at 2 months of age, whereas male gonads were 4-5 months old.

Keywords: gonadal sex differentiation, juvenile ovary, snakehead, sizes, gonochorist undifferentiated

[15]

SQUID (*Loligo sp.*) INK POWDER IMPACT IN REDUCING POLYMORPHISM AND MUSCLE BREAKDOWN OF WHITELEG SHRIMP (*Litopenaeus vannamei*) INFECTED BY INFECTIOUS MYO NECROSIS VIRUS (IMNV)

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ABSTRACT

Infectious Myonecrosis Virus (IMNV) has retarded the growth rate, morphologically change in color of the body's muscle tissue, resulted in reduction in yield with economic losses and mass mortality in cultured White leg shrimp (*Litopenaeus vannamei*). The purpose of this study was to determine factors reducing of polymorphism in growth gene (Cyclopiline A (CypA) and Molting Inhibiting Hormone (MIH)), and tissue damage in IMNV infected shrimp. Experimental methods using squid ink powder (*Loligo sp.*) treatment of 400, 500, and 600 mg squid ink powder/kg feed, with control positive (K⁺) and negative (K⁻). RdRp gene was checked for IMNV infection, while CypA and MIH gene sequences was investigated for polymorphism using qualitative and quantitative test. Histology was done for white leg shrimp tissue breakdown investigating through scoring of fat generation, necrosis, and vacuola. Statistical analysis was done using ANOVA. This research can be concluded that 500 mg squid ink powder/kg feed was the best remedy for infected IMNV white leg shrimp, because it gave the lowest fat degeneration (2.2), necrosis (1.87), vacuola (2) in shrimp muscle. Either in CypA and MIH genes with the lowest polymorphism.

Keywords: growth, IMNV, fat degeneration, necrosis, vacuola

[16]

**UTILIZATION OF AQUATIC PLANTS TO IMPROVE THE WATER QUALITY
AND THE GROWTH OF TILAPIA (*Oreochromis niloticus*) IN THE POST-COAL
MINING VOID**

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ABSTRACT

Water quality improvement is very essential for aquatic biota. Water quality problem may lead to the mortality of fish cultivated in ponds. One of method to handle the water quality problem is using aquatic plants. Some of aquatic plants have capability in removing or destroying contaminants from the water, the objective of this study was to examine the effect of aquatic plants on water quality and fish growth. The experiment was conducted in post mining void in Loa Bahu, Samarinda, East Kalimantan. Using randomized block design with 4 treatments (including control) and 5 repetitions. Three (3) aquatic plants species, namely *Salvinia molesta*, *Pistia stratiotes*, and *Eichhornia crassipes*, placed individually in fish cages. Every cage of 2 x 2 m were supplied with 80 (Eighty) Tilapia (*Oreochromis niloticus*) and cultivated for 3 months. The results showed the aquatic plants increased DO concentrations as well as maintained water temperatures and pH levels. These plants were also able to decrease NO₂, NH₃, and H₂S. The growth of Tilapia that reared in cages with aquatic plants were significantly higher than the control (without plants).

Keywords: phytoremediation, aquaculture, eutrophication, waste, growth

[17]

**IN VITRO AND IN VIVO ASSAY OF SILVER NANOPARTICLE USING
ETHANOLIC *Myrmecodia* sp EXTRACT AGAINST *Aeromonas hydrophila* IN *Clarias
gariepinus***

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ABSTRACT

Biosynthesis of nanoparticle using silver (Ag⁺) along with plant extract such as *Myrmecodia* sp bulb as bioreductor and capping agent has a great potential to be as an antibacterial agent. Present research aimed to investigate in vitro and in vivo antibacterial assay of silver nanoparticle (AgNPs) using *Myrmecodia* sp bulb extract against *Aeromonas hydrophila*. The AgNPs was synthesized using *Myrmecodia* sp bulb ethanolic extract. Scanning Electron Microscope (SEM) and Transmission Electron Microscopy (TEM) nanoparticle characterization showed a cubic form which had a size less than 100 nm. In vitro assay of antibacterial activity of the AgNPs was performed by agar well diffusion method and found that a 40% AgNPs had the optimum inhibition index (7.7 ± 0.45 g mm). Meanwhile, in the in vivo assay, an injection of *A. hydrophila* was applied to some groups of *Clarias gariepinus*. During this assay, a group of fish was also injected with the AgNPs and compared to groups of fish with antibiotic injection, placebo, and control. The survival rate was observed during 96 h. The results found that infected fish without AgNPs injection showed significantly reduced erythrocyte ($20.89 \pm 0.03 \times 10^6 \mu\text{L}^{-1}$), hemoglobin (1.20 ± 0.10 g dL⁻¹) and neutrophile, while Leukocyte ($11.73 \pm 0.09 \times 10^3 \mu\text{L}^{-1}$), platelet ($29.67 \pm 2.91 \times 10^3 \mu\text{L}^{-1}$) and lymphocyte were found significantly increased. The infected fish that was injected with either AgNPs or *Myrmecodia* sp ethanolic bulb extract groups had also better survival rate compared to control group. The AgNPs biogenerated using ethanolic bulb extract of *Myrmecodia* sp, demonstrated potent antimicrobial activity either in vitro or in vivo and might be beneficial in fish cultured.

Keywords: Nanoparticle, antibacteria, survival, *Clarias gariepinus*

[18]

BREEDING PROGRAM IMPROVEMENT FOR GROWTH PERFORMANCE OF TILAPIA IN BRACKISH WATER POND IN INDONESIA

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ABSTRACT

Salinity tolerant tilapia has been developed for years in Indonesia. However, genetic parameters have not been estimated. As a result, selection has been hampered by large differences in productivity between ponds. An accurate breeding strategy is needed that is based on either pedigree or genomic relationships allowing estimation of genetic parameters and selection on a range of salinities with greater accuracy. The objectives of this study were to investigate the genetic parameter and the effect of genotype by environment interaction for growth performance of tilapia in brackish water and freshwater. We produced 91 fish families from 1:3 mating design combination of male and females. For each family, 20 fingerlings were randomly chosen and communally reared for grow-out in a brackish water and freshwater pond. We harvested and recorded harvest weight (HW) after the grow-out period of 120-147 days. To calculate the genetic parameter of heritability and correlation, we developed bivariate model including age, sex and pond as the fixed effects. The animal model was fitted in ASReml V4.1. The following bivariate model was used: $y_{ijkl} = \mu + \text{POND}_i + \text{SEX}_j + \text{AGE}_k + a_l + e_{ijkl}$. Our results showed that harvest weight in brackish water is 324.7±61.43 g for males and 255.0±53,85 g for females. Whereas in fresh water is 261.5±49.72 g and 201.7±46.6 g for males and females, respectively. Heritability for growth performance is moderate between 0.35-0.38. Genetic correlation between BW and FW for growth performance was moderate at 0.66. Based on the moderate magnitude of GxE for harvest weight, we should include the information from two environments in broodstock selection. The genetic parameter and GxE information will allow us to increase accuracy and sustainability on tilapia breeding program in Indonesia.

Keywords: Tilapia, genetic parameter, breeding program, brackish water

[19]

**EMPOWERING FISH FARMERS TO COPE WITH THE CHALLENGES OF
COVID-19 PANDEMIC: THE ROLE OF NSPRI**

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ABSTRACT

COVID-19 pandemic has impacted the whole world in several dimensions leaving the fishing communities in the rural areas more vulnerable. A huge proportion of this fishing communities derive their income from the sales of fish that are caught and processed using local smoking equipment. The lockdown occasioned by the pandemic has really made life difficult for these people. In responding to these challenges, Nigerian Stored Products Research Institute (NSPRI), only postharvest research agency of the federal government of Nigeria built fish processing facilities for fish farmers and processors in six (6) different locations spread across Niger and Kwara States. The processing centres were constructed as a facility where all the unit operations from fresh fish reception to packaging of dried fish could be carried out under hygienic condition. The centres were equipped with NSPRI's improved smoking kilns, handling and processing utensils as well as packaging materials for marketing of the dried fish. Fish famers and processors in the various locations were trained on proper handling, processing, packaging and marketing of their products. This intervention has alleviated the sufferings of the concerned communities and bring about a turnaround in their social economic status. The initiative has also improved community engagement among the fish farmers which has increased their output. They can produce better quality products and sell them to buyers in neighbouring communities. The residents of the six affected communities and their respective neighbours could now access safe fish products. This study demonstrated the key role of government in providing succor for rural communities especially in times of pandemic such as COVID-19 that the world is just recovering from.

Keywords: fish processing, pandemic, social intervention, empowerment

[20]

QUALITY CHARACTERISTICS OF CATFISH DRIED IN NSPRI'S CHARCOAL POWERED SMOKING KILN

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ABSTRACT

Handling and processing techniques adopted in value addition of fish greatly contributes to the quality of smoked fish product available for public consumption. COVID-19 pandemic has raised awareness on the need to take more action in ensuring that safety measures employed in fish processing is of high standard. This study assessed the proximate composition, microbial quality and Polycyclic aromatic hydrocarbons (PAHs) of catfish (*Clarias gariepinus*) dried with Nigerian Stored Products Research Institute's (NSPRI) charcoal powered smoking kiln after 20 hours of drying. The proximate, microbial and PAHs analyses were carried out using standard laboratory procedures. The initial quality conditions were compared with final conditions using T-test statistical tool. The result from this study revealed that the smoked catfish had moisture content of 10.4 %, ash content 4.23 %, fat of 24.51 % and protein of 60.1 % after 20 hours of drying. The microbial analysis showed that the initial bacterial load and fungal count were statistically higher than the initial as the drying operation reduced the bacteria from 6.8×10^2 CFU/g to 5.4×10^2 CFU/g and the fungus from 3.6×10^5 CFU/g to 2.9×10^5 CFU/g. The bacteria isolated were *Staphylococcus aureus*, *Escherichia coli*, *Bacillus cerus*, *Bacillus subtilis*, *Pseudomonas aeruginos* while the fungus isolated were *Aspergillus niger*, *Fusarium oxysporium*, *Rhizopus stolonifer*, *Saccharomyces cerevisiae*, *Mucor* spp, *Aspergillus flavus*, *Penicillium chrysogenum*. The Benzo(a)pyrene and other 4PAHs detected were below the maximum acceptable risk limits of 5 µg/kg and 30 µg/kg respectively. Levels of contaminants in the dried fish obtained from this study were generally below the maximum permissible limits hence one may conclude that the fish samples may not be harmful to health.

Keywords: smoked catfish, quality, PAHs, proximate composition

[21]

**EVALUATION OF GROWTH PERFORMANCE AND HETEROSIS OF THE
SRIKANDI TILAPIA AND BLUE TILAPIA CROSSBRED IN THE
BRACKISHWATER POND**

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ABSTRACT

Hybridization is one of the breeding program that can be carried out to increase growth and produce high hybrid vigor. This study aimed to evaluate the heterosis and growth performance of the crossbred of Srikandi tilapia and third-generation blue tilapia (G3) after family selection. Communal spawning and nursery activities were carried out at freshwater in the 25 m² concrete pond. Before being stocked in the brackishwater pond, fish fry were acclimatized by adding sea water to increase the salinity of 5 gL⁻¹day⁻¹. The grow-out activity was carried out in ponds with salinity of 25 to 40 gL⁻¹ using 3x5x1 m³ sized net for 120 days. During rearing period, fish were fed with commercial feed containing 30% crude protein twice daily with a feeding rate of 5-10% of biomass day⁻¹. The results showed that the crossbreeding of blue tilapia (G3) female x Srikandi tilapia male revealed the best growth performance with a weight gain of 244.35 ± 5.45 g, specific growth rate (SGR) of 3.40 ± 0.06% day⁻¹, daily growth rate (DGR) of 2 g day⁻¹, biomass gain of 434,155 ± 760 g and survival rate of 90%. The heterosis in this study showed a positive value. In the crossbred population of blue tilapia (G3) female x Srikandi tilapia male showed mid-parent heterosis of weight, SGR, survival and biomass of 17.07%, 6.52%, 4.5%, and 22.93%, respectively. Meanwhile, the population of Srikandi tilapia female x blue tilapia (G3) male had heterosis of weight, SGR, survival and biomass of 3.19%, 3.85%, 6.09%, and 9.75%, respectively. These results indicated that the hybridization program was successful in improving growth and survival performance in cross-bred populations compared to their parent populations.

Keywords: Srikandi tilapia, hybridization, growth, heterosis

[22]

ISOLATION, IDENTIFICATION AND MOLECULAR TYPING OF *Vibrio vulnificus* FROM SHRIMP FARMING SYSTEM

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ABSTRACT

Vibrio vulnificus; an opportunistic human as well as shrimp pathogen is inhabitant of marine and brackish water ecosystems where shrimp farming is practiced. The pathogenicity and virulence in Vibrios are highly variable. Hence, the present study was conducted to isolate, identify and molecular typing of the selected *V. vulnificus* strains to analyse the strain variability subjected to Polymerase Chain Reaction (PCR) using insertion sequence (IS) targeted primers. The samples were collected from shrimp hatchery water, shrimp larvae and shrimp farm water from Tamil Nadu and Andhra Pradesh states of India and brought to Bacteriology unit, FCRI, Thoothukudi for further analysis following standard protocols. To find out the variability within the 11 selected strains of *V. vulnificus* using IS primers, all the *V. vulnificus* strains fingerprinted were analyzed by UPGMA cluster analysis by one Dice Coefficient using UVI bandmap gel analysis software. A threshold limit of 80% homogeneity coefficient was taken for the fingerprinting cluster analysis. The fingerprint pattern showed a common band of about 0.55 kbp size in all 11 strains indicating certain degree of similarity of insertion sequence associated genetic material of the *V. vulnificus* strains analysed. These strains formed two groups and two unique fingerprint profiles forming a total of four different genogroups. Among these, one group comprised seven strains, of which six came from the single source. However, another strain isolated from the same source formed an independent genogroup. The virulence characteristics had no characteristic association with the fingerprint profile, as all the strains were able to produce all the three enzymes viz. gelatinase, amylase and lipase tested. The present study revealed that the primers were capable of identifying the strain specific variability at varying level of discriminating potential. The differentiation was less distinct in *V. vulnificus*. *V. vulnificus* strains exhibited limited variability in the IS PCR leading to only four genotypes among the 11 strains analysed. The current PCR analysis also showed source independent variation among *V. vulnificus* strains.

Keywords: *Vibrio vulnificus*, virulence, molecular typing, insertion – sequence, dendrograme analysis, shrimp

[23]

**THE EFFECT OF SKIM MILK ON VIABILITY, AND ABNORMALITY OF GOD'S
FISH, TOR SORO MILT AFTER FREEZING**

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ABSTRACT

God's fish, T. soro is one of the local endemic fish in Indonesia, which has high economic value and therefore has high demand in the market. However, the production of this species is low. One of the problem is asynchronised of gonad maturation among male and female. Accordingly, one way to solve this problem is by cryopreservation. The purpose of study was to evaluate the effect of skim milk as a natural cryoprotectant combined with methanol as permeating agent on the motility, viability, and abnormality of fish milt, 48 h after freezing in -34 °C. Fish milt (1 part) was collected by hand stripping method, and then was diluted by 9 part of soluble liquid (fish Ringer + 10 Methanol + skim milk). Skim milk concentration used in this study were 0%, 5%, 10%, 15%, 20%, and 25%, respectively. Before frozen, milt were equilibrated at 5 °C for 10 min. Thawing was conducted at 40 °C for 1 min. Based on the one-way ANOVA test that there were a significant ($p < 0.05$) effect of skim milk on the milt viability, and abnormality compared to the control (without skim milk or 0% of skim milk). According to the posthoc, Tukey test, 10% of skim milk showed the highest milt viability ($79 \pm 2.16\%$), but the lowest milt abnormality ($27.75 \pm 1.26\%$). In conclusion, that 10% of skim milk combined with 10% methanol is the optimum concentration to protect milt viability, and abnormality for 48 h at -34 °C.

Keywords: abnormality, motility, viability, skim milk, Tor soro

[24]

**ASSOCIATION OF BIOCHEMICAL PROFILE OF SERUM OF ASIAN CATFISH,
CLARIAS BATRACHUS WITH PHYSICO-CHEMICAL PARAMETERS OF
WATER IN ITS BREEDING HABITATS UNDER NATURAL CONDITION**

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ABSTRACT

Asian catfish or magur, *Clarias batrachus* (Linnaeus, 1758) is well noted for their inability to spawn spontaneously in captivity. To understand the reproductive failures in captivity, the serum profile of ionic and biochemical parameters namely Osmolality, Ca²⁺, Mg²⁺, total protein (TP), albumin (ALB), phospholipid (PL) and triglycerides (TG) of male and female catfish were examined during pre-spawning (PRS), spawning (SP) and post-spawning phases (POS) of reproductive cycle of *C. batrachus* under natural environmental condition and induced spawning (IS) with Ovaprim injection. All the natural breeding habitats studied had certain common topographical features which often serve as a shallow piece of water during pre-monsoon and provide a bundh like environment during monsoon season. The physico-chemical parameters (Water temp., pH, bicarbonate alkalinity, hardness, Ca²⁺, Mg²⁺, Cl⁻¹, NO₃, PO₄, and NH₄) of bundh water showed significant attenuations in the concentration of all the parameters except dissolved oxygen content during monsoon season. The osmolality and blood ion dynamics clearly exhibited that most of the ion concentration get altered during active reproductive phases. In females, serum Ca²⁺, and Mg²⁺ levels were attenuated during IS suggesting their involvement in final oocyte maturation and hydration processes. In males, decrease in serum concentration of Mg²⁺ concentration during 16 h at the spawning phase on IS may be attributed to their participation in active spermatogenesis phase. General decrease in serum TP and AL levels clearly indicated the protein utilization towards gonadal growth in both the sexes. The decrease in serum phospholipid during SP and IS indicating its utilization for gonadal maturation while triglycerides decreased during PRS indicated its utilization for gonadal development. Consequently, present study concluded that serum biochemical parameters in relation to changes in chemical properties of water during natural spawning season indicates role of osmolality, ions and other biomolecules in final maturation and spawning in magur.

Keywords: annual reproductive cycle, *Clarias batrachus*, biochemical profile, physico-chemical parameters, serum profile, natural habitat.

[25]

**EFFECT OF VARIOUS DOSES OF FERMENTED HERBAL EXTRACTS ON
GROWTH, MOLTING, AND FEED EFFICIENCY OF MUD CRABS (*Scylla olivacea*)
CULTIVATED IN PONDS**

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ABSTRACT

The purpose of this study was to analyze the effect of various dosages of fermented herbal extracts on growth, molting, and feed efficiency of orange mud crabs (*Scylla olivacea*) cultivated in ponds. The herbal extract used is a combination of *Morus alba*, *Curcuma xanthorrhiza*, and *Boesenbergia rotunda* fermented with *Lactobacillus casei*. There were 240 crabs used in this study for four dosages of herbal extract, namely 0, 200, 400, 600 mg kg⁻¹ of feed. Each dosages treatment consisted of 60 crabs. Crab is kept individually in a crab box which is placed on a floating bamboo raft, so that it floats on the surface of the pond water which has a depth of ±80 cm. The feed given during study is formulated feed at a dose of 5% body weight daily. Descriptively, the results of this study indicate that the dose of fermented extract affects the growth and feed efficiency of the mud crabs. A higher dose of fermented herbal extract in the feed (600 mg kg⁻¹ of feed) provides higher growth and feed efficiency. Significant growth occurred after molting. Crabs with the control (without fermented herbal) treatment just received an average weight gain of ±43%, while the treatment of 600 mg kg⁻¹ of herbal extract got an average weight gain of ±59% from the initial weight. The results of this study provide information that molting is very important to manage in crab cultivation. Herbal extracts can be used to stimulate molting, improve growth, and increase feed efficiency in crab cultivation.

Keywords: crab, growth, feed efficiency, herbal extracts, molting

[26]

**SCREENING AND IDENTIFICATION OF POTENTIAL PROBIOTICS FROM
Penaeus SHRIMP GUT AND HEPATOPANCREAS: TOWARDS MITIGATING THE
PATHOGENICITY OF *Vibrio parahaemolyticus***

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ABSTRACT

Acute hepatopancreatic necrosis disease (AHPND) has caused a tremendous economic loss on the shrimp industry worldwide for the last decade. The disease is primarily caused by the pathogenic strains of *Vibrio parahaemolyticus* and other closely related *Vibrio* bacteria. This study was conducted to investigate the inhibitory effect of isolated bacteria on the growth of *Vibrio parahaemolyticus* and *Vibrio damsela* as a preliminary study to identify potential probiotics. A total of 26 bacteria strains were isolated from the gut and hepatopancreas of Pacific white shrimp, *Litopenaeus vannamei*. The morphologically distinct bacteria were cultured to obtain pure culture and subsequently screened for their antagonistic ability against the *Vibrio* bacteria. Isolate M18 demonstrated an outstanding inhibitory zone (11.50 ± 0.71 mm) against *V. damsela*. The result from the disk diffusion test was also revealed that the other 3 isolates also showed a moderate antagonistic effect against *V. damsela* strain, evidenced by the diameter of the inhibitory zone ranging from 9.0 to 10.00 mm. The present findings merit future studies to investigate the antagonistic activity of bacteria in mitigating the pathogenicity of AHPND-causing bacteria.

Keywords: *Vibrio parahaemolyticus*, Probiotics, White-leg shrimp, AHPND

[27]

GROWTH PERFORMANCE AND NUTRIENT CONTENT KOBIA FISH (R.CANADUM) LARVAE FED FED DIFFERENT COMBINATION OF ARTEMIA SP. AND OITHONA SP.

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ABSTRACT

The kobia fish (*R.canadum*) has a fast growth rate and high quality meat. The purpose of this study was to find of growth performance and nutrient content of kobia fish (*R.canadum*) fed different combination of *Artemia* sp. and *Oithona* sp. Kobia fish larvae (*R.canadum*) used at age of 8-20 days, with an average length and weight of 0.5cm and 0.023g. The culture medium used in this study was sea water with a stocking density of 50 larvae/hafa and culture period were 14 days. This study used an experimental method with a completely randomized design (CRD) consisting of 5 treatments and 3 replications. The treatments consisted of treatment A (*Artemia* sp. 100%), treatment B (*Artemia* sp. 75% and *Oithona* sp. 25%), treatment C (*Artemia* sp. 50% and 50% *Oithona* sp.), D (*Artemia* sp. 25% and *Oithona* sp. 75%) and E (*Oithona* sp. 100%). Feeding was carried out 3 times a day, namely at 07.30; 14.30 and 17.00. The parameters observed were the growth in length and absolute weight, grazing rate, protein, fat, fatty acid and amino acid profile, survival rate and water quality. The results showed that the highest value in absolute length, absolute weight, Grazing rate and survival rate of tested kobia fish (*R. canadum*) were obtained in treatment D (*Artemia* sp. 25% and *Oithona* sp. 75%). The value were of 3.43cm; 0.21g; 507.07 ind /day; 55% protein; 7.23% fat; 19.23% lisen; 6.80% EPA and 80.00% respectively. The water quality in the rearing media during the rearing period was within the proper range for cultivating kobia fish larvae (*R.canadum*).

Keywords: *R. canadum*, *Artemia* sp., *Oithona* sp., growth, nutrient

[28]

EFFICACY OF B-1,3-GLUCAN AND VITAMIN C SUPPLEMENTATION IN PULSE FEEDING PROGRAM ON GROWTH PERFORMANCE DURING NURSERY JUVENILE RED TILAPIA (*Oreochromis Spp.*)

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ABSTRACT

Juvenile stage of red Tilapia is the critical of immune developing. During nursing, farmer has to keep feed their fish with immune modulator products. This may result in over stimulate and show adverse effect on tilapia defense system. To study on the application of immune stimulant, β -1,3-glucan and vitamin C, during nursery fingerling red tilapia on growth performance and controlling of enteric bacteria. The research was assigned in CRD with 3 different diets, Control without any supplementation, 35% Ascorbryl Phosphate supplementation (VC35) and Combination of Coated Vitamin C 19% and β -1,3-Glucan 9% from algae (BGVC). Both supplementary products were applied by on top coating of commercial feed at inclusion rate of 0.5%. Supplementary feed was applied as a pulse feeding program, once every 3 days. Initial fish size was 1.26 ± 0.11 g and stocked at 500 individuals in 2X1X0.4 m net cage. Feeding rate was recorded at 75 g per cage per day and increase 15 g per cage per day every week. The average survival rate both treatments were significantly improved from control, improvement range between 7.95 – 9.25% ($p < 0.05$). Average body weight and feed conversion ratio was improved significantly only in BGVC with 45 ± 4.5 b individual per kg and 0.72b ($p < 0.05$). The total Aeromonas count from intestine was reducing significantly different in VC35, with range between 0.37 – 7.29 $\times 10^5$ CFU \cdot g⁻¹. In contrast, there is not significanty different in liver. Lysozyme activities and Total glutathione was also improve significant in BGVC and VC35 ($p > 0.05$). Economic analysis show increase in revenue at 134.55 and 305.73 THB cage. In conclusion, pulse application of Vitamin C and β -1,3-Glucan can enhance immunity, improve survivability and increase economic advantage of tilapia nursery farm.

Keywords: algae betaglucan, immunomodulator, vitamin C

[29]

UTILIZATION OF CABBAGE AS AN ARTIFICIAL FEED FOR GROWTH OF CATFISH (*Clarias gariepinus*)

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ABSTRACT

Catfish (*Clarias gariepinus*) has main benefit of its rapid growth. To optimize the growth of catfish, the feed must be considered. The use of commercial feeding for catfish has already been a common practice. Therefore, using existing feed raw materials or homemade food for the catfish is necessary. Vegetable waste such as cabbage and tofu dregs can be used as such food, which is processed into pellets. This is because cabbage waste, tofu dregs, rebon and mixed bran contain protein and carbohydrates that can be used for the fish growth. This study consisted of two steps: step1, analyzing the comparison between commercial feeding and the homemade feeding, and step 2, analyzing dosage difference of homemade catfish food and its effect on the growth of the catfish, and also its usage efficiency. Data were analyzed using unpaired t-test ANOVA test for two sample groups. The results showed that commercial feed and homemade feed had no significant effect on the length, weight and feed efficiency of catfish seeds. Catfish can be given homemade feed with ingredients from fermented cabbage waste, tofu dregs flour, rebon flour, bran flour, plus vitamins and minerals. The results of the analysis of various treatments for different feed dosages (4%, 5%, 6%, 7%, and 10% per body weight of fish, respectively) had a significant effect on length and weight growth of catfish, and no significant effect on feed efficiency. The study also found that the higher the dose is given for the maintenance of 30 days of catfish, the better effect is obtained, with the best dose of 10% per fish body weight.

Keywords: Cabbage, artificial feed, Catfish, growth

[30]

**EFFECT OF ORGANIC MINERAL COCKTAIL ON GROWTH PERFORMANCE
OF HYBRID CATFISH (*Clarias gariepinus* × *Clarias macrocephalus*) FED WITH
PLANT-BASED DIET**

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ABSTRACT

An experiment on hybrid catfish (*Clarias gariepinus* × *Clarias macrocephalus*) diet supplemental organic mineral cocktail was conducted to compare the effects of chromium-L-methionine, zinc-amino acid complex and selenomethionine between supplementation in planted-base diet and poultry meal-based diet on growth performance. The study was designed as Factorial 2x2 in CRD. Two factors were factor A an organic cocktail mineral supplementation: zinc amino acid complex 45 mg/kg, selenomethionine 0.4 mg/kg diet, chromium-L-methionine 0.5 mg/kg diet compared to non-supplement organic cocktail mineral. The factor B was plant-based diet compared to poultry meal-based diet. Factor A and B were applied to 4 treatments and 5 replicates, T1: poultry meal-based with no mineral cocktail, T2: poultry meal-based diet added mineral cocktail on top, T3: plant base diet with no mineral cocktail. T4: plant base diet added mineral cocktail on top. A 6-week trial were conducted in net cage installed in earthen pond. The catfish with average of 52 g/individual were stock at 34 fish per cage (17 individual/m²). The result showed that organic mineral factor has no significant effect on growth parameter in term of Yield, WG, FCR, ADG, Survival and SGR (p>0.05). However, the plant-base diet shows significantly improved on growth in term of FCR, ADG, survival and SGR (p<0.05). Furthermore, The growth parameter of fish fed the plant-base diet with mineral cocktail added on (T4) had significant better growth performance in term of FCR, WG, ADG and survival (p<0.05). In conclusion, planted-based diet has significant effect on improving growth performance compared to the poultry meal-based diet. Hybrid catfish diet was recommended to add on mineral cocktail for improving growth performance and survival in fish fed with plant-base diet.

Keywords: zinc amino acid complex, selenomethionine, chromium-L-methionine, organic mineral, hybrid catfish

[31]

IN SILICO STUDY OF *Haematococcus pluvialis* BIOMARKER COMPOUND AS SUPPLEMENT TO FISH BONE REMODELLING

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ABSTRACT

This study aims to determine the docking predictions for RAR, RXR, and ROR in the bone remodeling pathway using *Haematococcus*, which is the highest carotenoid-producing microalgae. Furthermore, it determines the projection of using this carotenoid-producing alga in bone regulation. Carotenoids include provitamin A and non-provitamin A, which are predicted to replace vitamin A in bone control. It is also required in silico proof of carotenoids' function of bone remodeling control. Furthermore, molecular and visualization docking validation was conducted using PyRx and Discovery Studio Visualizer software respectively. According to binding affinity and RMSD value, each biomarker compound had particular binding sites on RAR α , RAR β , ROR β , and ROR γ . Astaxanthin was the only compound with binding sites on all four receptors. Through enzymatic action, provitamin a carotenoids can serve as a precursor to retinol, allowing them to act as a native RXR ligand. Therefore, the biomarker compound used in *Haematococcus pluvialis* can replace the role of vitamin A in the regulation of fish bones. The prediction of bone regulation in biomarker compounds through the RAR-RXR pathways inhibited osteoblast and osteoclast. Otherwise, VDR-RXR pathways regulated osteoclast maturation and osteoblast mineralization

Keywords: Carotenoid, bone malformation, *Haematococcus pluvialis*, in silico, remodeling bone

[32]

IN VITRO DIGESTIBILITY OF SHRIMP DIET IN COMBINATION WITH YEAST PRODUCT SUPPLEMENTATION BY PACIFIC WHITE SHRIMP (*Litopenaeus vannamei*) DIGESTIVE ENZYME

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ABSTRACT

The in vitro digestibility of shrimp diet in combination with yeast product supplementation by using Pacific white shrimp (*Litopenaeus vannamei*) digestive enzyme was conducted and assigned in Factorial 2x4 in Complete Randomized Design (Factorial 2x4 in CRD). Factor A was yeast product supplementation of control without yeast product supplementation, *Saccharomyces cerevisiae* fermentation product from USA, dried yeast product from Korea and yeast nucleotide 500 ppm product from China. Factor B was added shrimp enzyme and without adding shrimp enzyme. The trial was conducted on 8 treatments and 3 replicates. Shrimp diet of 36% crude protein and 7% crude lipid was grinded to fine ground and then supplemented each of 0.25% yeast product on top. The diet samples were weighed and added phosphate buffer with pH 8.0 then incubated at room temperature (25°C) for 16 hr. The solution after incubation was collected for determined the protein digestibility products of amino acid by ninhydrin reaction and soluble protein by biuret test. The carbohydrate digestibility of starch and sugar was focusing on maltose liberation by using 3,5-dinitrosalicylic acid (DNS). The non-starch poly saccharide of mannan digestion which liberated mannose sugar was determined by 3,5-dinitrosalicylic acid (DNS) which is the technique for determined the reducing sugar. The results showed the high ability ($p < 0.05$) of shrimp enzyme on amino acid, protein, maltose, and mannose digestibility. The three types of yeast products showed no significant difference ($p > 0.05$) on improving amino acid digestibility. Furthermore, all yeast product supplementation showed significantly different ($p < 0.05$) on improving protein digestibility both with and without shrimp enzyme. In addition, there was significant difference ($p < 0.05$) on maltose digestibility based on yeast product supplementation. The fermentation yeast product and yeast nucleotide 500 ppm product showed significantly higher ($p < 0.05$) ability on improving carbohydrate digestibility especially starch and sugar to liberate more maltose when adding shrimp enzyme than dried yeast product. On the other hand, all three types of yeast products themselves had no ability ($p > 0.05$) to digest non starch poly saccharide of mannan to be mannose sugar but significantly promoted ($p < 0.05$) the activity of shrimp digestive enzyme to liberate mannose sugar from mannan in shrimp diet. Therefore, fermented yeast product, dried yeast product and yeast nucleotide 500 ppm product supplementation at 0.25% in shrimp diet can enhance the shrimp digestive enzyme activity on protein, carbohydrate in term of starch and sugar including non-starch poly saccharide of mannan to liberate more soluble protein, maltose, and mannose to fulfill shrimp requirement.

Keywords: in vitro digestibility, fermentation yeast, dried yeast, yeast nucleotide, yeast product, shrimp digestive enzyme

[33]

EFFECTS OF DIFFERENT LEVELS OF CRAB SHELL INCLUSION ON THE GROWTH AND SURVIVAL PERFORMANCE OF MANGROVE CRAB *Scylla serrata* (FORSKAL, 1775)

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At present, a competition in trash fish utilization between the aquaculture industry and humans is experienced. Also, waste management problem on crab shell disposal in crab industry is another major concern faced today. With that, the study investigated the viability of crab shell as an inclusion for formulated crab feed in order to address the scarcity of trash fish and contribute to crab shell waste management. Three (3) experimental formulated diets were used with 10% (T2), 20% (T3) and 30% (T4) crab shell inclusion and compared with a positive (chopped *Sardinella* sp., (T5) and negative (formulated without crab shell, T1) control and were fed to early adult giant mangrove crabs, *Scylla serrata*. Results revealed that highest weight gain, specific growth rate, survival rate, protein efficiency ratio and better feed conversion ratio and lowest feed intake was observed in T5. Results of the proximate composition of the diets showed that T4 significantly had the highest crude ash, carbohydrate and crude fiber, and lowest protein content. T5 had the highest moisture and crude protein content but lowest in carbohydrate, crude fat and crude fiber content. Carcass analysis of mangrove crabs showed that T2 and T6 (wild mangrove crabs) were statistically similar in crude protein content and T2 had the highest moisture content among the treatments. T4 had the highest carbohydrate content. However, results showed no significant differences in growth and survival performance but significantly different on the body composition of mangrove crabs and proximate analysis of feeds among treatments. Thus, formulated feeds with crab shell inclusions could be feasible to promote growth as observed during the experiment and could be an alternative substitute of fishmeal.

Keywords: *Scylla serrata*, crab shell, growth, inclusion, proximate composition, carcass

[34]

EFFECTS OF POTENTIAL PROBIOTIC BACTERIA ON THE IMMUNE RESPONSE AND DISEASE RESISTANCE OF KELABAU FISH (*Osteochilus melanopleurus*) AGAINST *Pseudomonas* SP. INFECTION

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ABSTRACT

Pseudomonas sp. as a facultative bacterium found to play a role in causing disease in cultured fish. The Kelabau fish (*Osteochilus melanopleurus*) is a herbivorous fish that has the potential to be cultivated, so it is necessary to control bacterial infection including those caused by *Pseudomonas* sp. The study evaluated the ability of three bacterial isolates originating from the Kelabau fish gut on the immune response and disease resistance against *Pseudomonas* sp. PS-1 infection as potential probiotics. The bacterial isolates were *Staphylococcus edaphicus* MT269536 (BPs2), *Bacillus paramycooides* MT269537 (BP3) and *B. albus* MT269538 (BeP1) were added to fingerling Kelabau fish with a concentration of 10⁶ CFU mL⁻¹ as much as 0,05 mL g⁻¹ by spraying on the feed and Phosphate Buffer Saline solution used as control with the same dose. Fish were fed two times a day by at satiation and the addition of bacteria in the feed was done once in the morning. Feeding according to the treatment was carried out for 13 days of maintenance, on the 14th day the fish were challenged with *Pseudomonas* sp. PS-1 which is injected intramuscularly with a concentration of 10⁶ CFU mL⁻¹ at a dose of 0.1 mL fish⁻¹. Observations on the ability of probiotic candidates bacteria against *Pseudomonas* sp. infection were carried out until the 21st day. The results showed that *S. edaphicus* MT269536 bacteria had the ability to increase disease resistance in Kelabau fish better than other bacteria after challenged with *Pseudomonas* sp. PS-1 with survival rates of 86.67%. The number of bacteria at the end of the observation was 1.15x10⁵ CFU mL⁻¹, the hematological and immune response parameters were better than other treatments.

Keywords: *Osteochilus melanopleurus*, *Staphylococcus edaphicus*, probiotic, survival rate, immune response

[35]

**THE OPTIMAL DOSAGE OF FERMENTED HERBAL EXTRACT ON GROWTH
AND FEED EFFICIENCY OF *Tilapia niloticus***

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ABSTRACT

The objectives of this research were to determine the optimal dosage of fermented herbal extracts that provide the higher growth and feed efficiency of *Tilapia niloticus*. The herbal extract used is a combination of *Morus alba*, *Curcuma xanthorrhiza*, and *Boesenbergia rotunda* fermented with *Lactobacillus casei*. There were four doses of herbal extracts treatments, namely 0, 100, 300, 500 mg kg⁻¹ of feed, each with three replications. A total of 420 fish were used for this study. Fish were kept in 12 conical tanks with a volume of 250 L and density were 35 fish for each tank. During 30 days of rearing, the fish were fed commercial feed of 3% body weight daily. The ANOVA results showed that the herbal extract dosage had an effect on weight gain, specific growth rate (SGR), and feed efficiency (FE) of *Tilapia*. Weight gain, SGR, and FE significantly higher than those of control (0 mg kg⁻¹). The best dose that gives the best growth and feed efficiency was 300 mg kg⁻¹ of feed (Tukey's tests; P<0.05). Based on polynomial model analysis, it was estimation that the optimal dose was about 250 mg kg⁻¹ of feed. These results indicate that the fermented herbal extract can be used as a feed additive to stimulate growth and improve feed efficiency in tilapia fish farming.

Keywords: feed efficiency, fermentation, growth, herbal extracts, tilapia

[36]

**KEY MECHANISMS OF GUT HEALTH PROMOTION BY PHYTOBIOTIC-BASED
ADDITIVE IN MARINE FISH (PART 1)**

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ABSTRACT

Establishing a healthy gut is a key approach for successful and profitable fish production. Functional feed additives can be effective in stimulating gut integrity and health and supporting fish in dealing with production conditions. The aim of the present study was to combine different approaches to evaluate the gut health promoting effect of a commercially available functional feed additive (Sanacore®GM). Gilthead seabream of 100g were fed a low fish meal feed and supplemented with the additive during 5 weeks. Anterior intestine was dissected out and three methodologies were used to assess gut health: 1) tissue electrical resistance (TER) to evaluate intestinal integrity, 2) morphometry and histopathology to assess villi development and intestinal damage, and 3) shotgun proteomics to better understand the mechanisms underlying gut health improvement. Results showed that Sanacore®GM improves gut barrier integrity by 30% in relation to the non-supplemented group. This observation was corroborated by better villi development and lower damage score, while proteomics identified important metabolic pathways associated to cytoskeletal integrity and immunity. In conclusion, the different approaches validate each other and point towards an enhancement of gut health by the additive supplementation. These observations support experimental and field data collected in marine fish and that shows benefits in growth performance and resistance to endoparasite infections (part 2 by M. Guerin).

Keywords: gut health, marine fish, functional additive

[37]

**EXPERIMENTAL AND FIELD VALIDATION OF HEALTH PROMOTION BY
PHYOTBIOTIC-BASED ADDITIVE IN MARINE FISH (PART 2)**

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ABSTRACT

Functional nutrition can be effective in supporting fish to deal with challenging production conditions such as parasite infestations. Sanacore® GM is a commercially available health-promoting feed additive with proven benefits as preventive strategy against parasite infestations. The aim of this presentation is to summarize the main findings from the research conducted on the use of this additive in marine fish under both controlled laboratory conditions and field conditions during the last ten years. In gilthead seabream under controlled infection with *Enteromyxum leei*, the dietary inclusion of the additive can refrain most of the diseases signs and mitigate the reduction in growth caused by the infection. Quantitative parasitological data on prevalence, intensity, and abundance, as well as histopathological analysis on the extension of infection confirmed the effect of additive supplementation on reducing the severity of infection. Reduced mortality under parasite coinfections has been reported in different marine species in field conditions. In conclusion, the experimental data on the efficacy of Sanacore®GM to reduce the severity of parasitic infestation in marine fish is confirmed by numerous field trials. The benefits of supplementation are attributed to the enhancement of the intestinal barrier integrity and to the positive regulation of intestinal immunity (part 1 by W. G. Nuez-Ortín).

Keywords: parasites, marine fish, functional additive

[38]

**EVALUATION OF GREEN MUSSEL PERNA VIRIDIS MEAL AS A FEED
INGREDIENT WITH HUMIC ACID SUPPLEMENTATION IN FEED FOR ASIAN
SEABASS LATES CALCALIFER AQUACULTURE**

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ABSTRACT

The green mussel *Perna Viridis* meal contains high nutrients but is constrained by heavy metals content. Therefore, humic acid has been supplemented in feed formulation to increase the absorption of feed nutrients and reduce heavy metals' toxicity effects. This study evaluated green mussel as a feed ingredient with humic acid supplementation in Asian seabass *Lates calcalifer* aquaculture feed. The experiment was designed with five treatments and three replication. The treatments were different dosages of natural humic acid (NHA) and synthetic humic acid (SHA) supplementation (0, 1600 mg kg⁻¹ (SHA) and 1600, 10.000 and 20.000 mg kg⁻¹ (NHA) in feed test. The fish cultivation for 70 days of culture. Based on the results, green mussels meal can be used as feed ingredients through humic acid supplementation in feed for Asian seabass. The supplementation of natural and synthetic humic acid with a dose of 1600 mg kg⁻¹ in feed played a role in reducing Cd accumulation, increasing health intestine status and digestibility, and fish growth performance. The supplementation of high-dose humic acid could cause a negative response so that the health status and fish growth performance decreases. It concludes that green mussel meal as a feed ingredient with humic acid supplementation can reduce fish meal composition in fish feed aquaculture.

Keywords: green mussel meal, humic acid, and fish feed

[39]

**IN VITRO PROTEIN DIGESTIBILITY, SAPONIN, AND TRYPSIN INHIBITOR
CONTAINED IN WHITE SHRIMP FEED SUPPLEMENT WITH CONCENTRATED
BROMELAIN EXTRACTED FROM PINEAPPLE**

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ABSTRACT

This study was to investigate the action of concentrate bromelain crude extracted from crown and peel of pineapple to digest the protein, saponin, and trypsin inhibitor in white shrimp feed. The bromelain was extracted from the crown and peel of pineapple (Bhattavia strain) at a one-third rip of fruit. The trial divided into two experiments was the optimal condition for in vitro protein digestibility of white shrimp feed contained 38% protein which digested by concentrate bromelain crude extract at different pH (6 – 9), time (5, 10, and 30 min), and temperature (25 and 30°C) and the second experiment detected the saponin and trypsin inhibitor (TI) in white shrimp feed which digested with concentrate bromelain crude extract at 0, 90, 170, and 250 ppt for 5, 10 and 30 min at 30°C. The results presented that the optimal condition for protein digestion with bromelain was pH 6 at 25°C for 5 and 30 min by the percentage of protein digestion was 63.15 and 70.66% (P<0.05). Otherwise, saponin contained in white shrimp feed was varied according to the levels of bromelain and time by the highest level of saponin was found in feed digested with bromelain at 170 and 250 ppt for 30 min (1.84 and 1.88 mg/g feed) and lowest at 90 and 170 ppt for 5 min. (0.94 and 0.99 mg/g feed) (P<0.05). While TI contained in feed was varied inversely with the levels of bromelain concentrate at 5 min by the lowest level of TI showed in feed digested with bromelain at 250 ppt (0.008%/g feed) (P<0.05) whereas TI was varied with bromelain concentrate at 10 and 30 min by the lowest level presented at 0 ppt (0.0031 and 0.007%/g feed) (P<0.05). Consequently, the optimal condition for protein digestion with concentrated bromelain was pH 6 at 25°C for 5 and 30 min, and the suitable level of bromelain and time to control the saponin and trypsin TI level in feed were 250 ppt at 5 min.

Keywords: bromelain, in vitro digestibility, saponin, trypsin inhibitor, white shrimp

[40]

**THE EFFECTIVENESS OF *Carica papaya*, *Ipomoea aquatica*, *Alpinia galanga* IN
PROTECTING CATFISH JUVENILE FROM PATHOGENS**

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ABSTRACT

Carica papaya, *Ipomoea aquatica*, *Alpinia galanga* are plants that often used by local community as a culinary and traditional medicine. The causes of catfish juvenile's disease are *Aeromonas hydrophila* and *Pseudomonas* sp, sometimes *Saprolegnia* Ssp. This study aims at assessing the effectiveness of plants as antimicrobial, immunostimulatory agent and as an agent to enhance the durability of catfish juveniles against pathogens. These plant's leaves were dried, chopped, macerated and extracted with ethanol 80% and distilled water, respectively. Each extract at a concentration of 800 and 1000 was tested on juveniles of cat fish aged 7 days by immersion method. Then challenged with *A. hydrophila*, *Pseudomonas* sp., and *Saprolegnia* Spp., respectively. As the results, the extract of plants possess activities of inhibiting the growth of pathogens on juveniles (total plate count= 194-323x10³CFU/mL), reducing the prevalence of pathogen attacks (11.21±1.89-26.97±0.17%) and improving survival of juveniles (65.45±2.29-80.30±1.39%). The based on these parameters as well as clinical symptoms and pathological anatomy, ethanol extract of *C. papaya* leaf has the best protection against pathogens followed by *A. galanga* and *I. aquatica* leaf extracts.

Keywords: *A. galanga*, *C. papaya*, *I. aquatica*, juvenile, antimicrobial, immunostimulant

[41]

**GONAD DEVELOPMENT AND INITIAL SPAWNING OF SELECTED THIRD
GENERATION CORAL TROUT (*Plectropomus leopardus*)**

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ABSTRACT

Coral trout (*Plectropomus leopardus*) is one of the grouper species with high economic value. The demand for coral trout fingerlings has been increasing considerably in recent years. Dependence on the wild broodstock must be reduced gradually and replaced with domesticated broodstock from hatchery production. Institute for Mariculture Research and Fishes Extension (IMRAFE) has succeeded in coral trout culture and select domesticated broodstock using a fast-growth marker and now have a third-generation (F3) of coral trout. Observation of gonad development and initial spawning of third-generation (F3) coral trout was carried out. The aim of the study was to understand gonadal development and initial spawning of coral trout F3 as an alternative for wild broodstock used in grouper hatchery activities. The study used 100 fishes of 3 years old coral trout F3. The research includes analysis of coral trout F3 gonad development; cultured and initial spawned of coral trout F3. The result shown in the population of coral trout F3 was a male, transition, and female. Stage of female gonad maturation was III, IV, and V. The fecundity range 175.478 - 1.777.988 eggs, and coral trout F3 was spawned with quality still low. Increasing spawning quality can be done by improving feed management and hormonal stimulation.

Keywords: Gonad development, initial spawning, coral trout, third-generation (F3)

[42]

PHAGOCYTTIC PROCESS OF THE HEAD KIDNEY LEUKOCYTES AMONG FOUR EUROPEAN PERCH, *Perca fluviatilis*, POPULATIONSGebauer T^{1,2*}, Rebl A², Verleih M², Stejskal V² and Korytář T¹¹*Institute of Aquaculture and Protection of Waters in Ceske Budejovice, Czech Republic*²*Leibniz Institute for Farm Animal Biology in Dummerstorf, Germany**gebauer@fhn-dummerstorf.de**ABSTRACT**

Fish disease resistance is one of the most desirable traits for aquaculture production. It is known that up to 90% of immune response relies on the innate immunity. Fish innate immunity could be potentially heritable since it is determined by fish local adaptation based on genetic differentiation or population-specific environment. Therefore, using fishes from populations with higher/faster innate immunity responses could significantly improve fish nursery and fish farming selective-breeding programs. Here, we evaluated the phagocytosis process, as the front-line component of innate immunity, among four different European perch, *Perca fluviatilis*, populations (Denmark, 41.4 ± 6.7 g; Hungary, 36.0 ± 7.4 g; France I and II, 43.0 ± 7.3 g and 85.9 ± 20.4 g, respectively) to set the baselines of promising candidate (s) for the future selective-breeding processes. The head kidney leukocytes (HKL) were isolated using density-gradient centrifugation and incubated with fluorescent latex beads (0.25 μ g/50 000 cells) for two hours at 26°C. Following the incubation, the cells were washed twice with RPMI 1640 and measured on the BD FACSCanto II, where only FITC-positive cells were considered as phagocytic cells. The results showed a higher percentage of phagocytotic cells of the total number HKL in the population from Denmark compared to the populations from France and Hungary. The phagocytic capacity showed the highest percentage of one bead ingested by the population from Denmark, while a non-statistical difference was found for two, three/more beads ingestion between populations. The higher phagocytic activity seen in European perch from Denmark could be population-specific and modulated by its past environmental circumstance. The study was financially supported by the Ministry of Education, Youth and Sports of the Czech Republic, 622 Mobility ZV FROV.

Keywords: aquaculture, innate immune response, head kidney leukocytes, latex beads, *Perca fluviatilis*

[43]

CONTROL OF *Ectoparasites Octolasmis* SP IN YOUNG LOBSTERS (*Panulirus Horamus*) USING KMNO₄ AND HERBAL LIQUID CONTAINING TAMARIND EGGPLANT

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ABSTRACT

Ectoparasites are disturbing organisms that particularly live outside the host body. In juvenile sand lobsters (*Panulirus humarus*.) one of them is *Octolasmis* sp. which attacks the gills and mouth organs of lobsters, therefore this ectoparasites must be addressed immediately. A chemical that can be used to treat this is KMnO₄ and as a comparison, herbal ingredients derived from tamarind eggplant were also used. This study aims to determine the appropriate dose of KMnO₄ and herbal solutions for juvenile lobsters infected with *Octolasmis* sp. The experimental design used in this study was a completely randomized design (CRD) with five treatments and three replications. The treatment in this study was the provision of a dose of KMnO₄, A = 1 ppm, B = 2 ppm, C = 3 ppm, D = 3 ppm and E = herbal. The container used is a 60 liters volume acrylic tub, filled with 30 liters of fresh seawater and water equipped with aeration. The variable measured was the length of time *Octolasmis* sp died due to immersion of KMnO₄ solution or herbs and survival rate after six hours treatment. The results showed that D treatment at a dose of 4 ppm resulted in ectoparasite death within 30 minutes. Whereas for treatment A, B and C the results showed 120 minutes, 90 minutes and 45 minutes, respectively. In comparison, the herbal solution only showed the result after 12 hours of observation. Six hours-survival rate of lobster in every treatment were up to 100%. In conclusion, the use of KMnO₄ showed a better performance compared to herbal solution, thus potentially used as treatment approach for ectoparasites in sand lobsters.

Keywords: *Octolasmis* sp, *Panulirus homarus*, life time, KMnO₄ dose, herbal dose

[44]

CAPTIVE BREEDING OF *Channa gachua* (DWARF SNAKEHEAD)**BY ENVIRONMENTAL MANIPULATION**Abeykoon HMNM¹, Chandrarathna WPR² and Mihiran BDM^{1*}

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ABSTRACT

Channa gachua (Dwarf snakehead; locally called parandal kanaya) is a native fish to Sri Lanka and has a high demand as an ornamental fish. The objective of the present study was to captive breeding of *C.gachua* by environmental manipulation and study spawning behavior, embryonic and larval development. Adult fish were collected from a stream at the Dodamgaslanda, Kurunegala district, Sri Lanka. Male has a narrower body, wider and more arched with highly colourful dorsal fins, while female has a bulkier more rounded body shape with less colorful and a narrower dorsal fin. Brooders were acclimatized to laboratory conditions for three weeks in a tank (length×width×height = 90 cm × 60 cm × 60 cm; water depth 20cm) with aquatic plants. Brooders were fed with live feeds and chopped beef liver twice a day. Eight indoor glass tanks (length×width×height = 60 cm × 30 cm ×30 cm; water depth 15cm) were used as breeding tanks with sand bottom, and aquatic plants (*Hydrilla verticillata*, *Echinodorus grisebachii*). Matured adults (length14.4cm-17.2cm, weight 29.49g-35.41g) were stocked in each tank with male: female ratio; 1:1. Brooders were fed with the same diet as in the conditioning tank and natural photoperiod was maintained. Breeding was succeeded in two tanks and spawning observed during the night. *C.gachua* didn't create a bubble nest. External fertilization was observed and the only male showed parental care. Yellow-colored fertilized eggs were hatched one day after spawning and free-swimming larvae were observed after one week. Temperature and pH were maintained at 26-28°C and 7-8 respectively. Fertilization rate, hatching rate, and survival rates were observed as 92.4%, 90%, and 90% respectively. The present study concludes that *C.gachua* can successfully bred with environmental manipulation under captivity.

Keywords: *Channa gachua*, Dwarf snakehead, Captive breeding, Native fish

[45]

IDENTIFICATION OF POTENTIAL RISKS OF DEGENERATIVE DISEASES AMONG THE COASTAL COMMUNITY IN JEMBER DISTRICT, EAST JAVA PROVINCE

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Degenerative disease is a disease caused by tissue/organ deteriorates and loses its functional ability. Coastal community mostly worked as fishermen and fishmonger, that rely heavily on physical strength because of the high workload of outdoor activities. These activities may lead to premature degenerative disease. The purpose of this cross-sectional study was to explore the potential risks of degenerative diseases among the coastal community. The survey was carried out from Jember and Banyuwangi District, Indonesia during May-June 2021 on the population of the coastal community. We used cluster random sampling as a sampling technique, resulted 194 respondents. Then it was analyzed descriptively. The results stated that the respondents were on reproductive age and most of them did not have a family history of degenerative diseases. For risk potentials: BMI of 46.9% respondents was normal (18.5-22.9). 87.3% of them had a smoking habit with 10-19 cigarette sticks/day. Majority (40.2%) started smoking at 15-18 years old. Most of them (83%) also were exposed to cigarette smoke. More than half (57.2%) routinely did strenuous activity. Most of them (60.8%) work outside with average sun exposure of >5 hours/day. Most of them consumed seafood (70.1%) and vegetable (60.3%) as daily intake. However, mostly never restricted salt intake for their food/cooking (49.4%) and sometimes still consumed fatty food (59.2%) and meat fat (88.1%). Therefore, their strenuous physical activity, excessive sun exposure, and unhealthy lifestyle can cause degenerative of the organ and tissue that could lead to premature degenerative diseases. This degenerative process if not immediately prevented can reduce productivity and have an impact on decreasing fishermen's income.

Keywords: degenerative, fishermen, coastal, health risk, community

[46]

**A STUDY ON ECONOMIC RIPPLE EFFECT AND SMALL-SCALE
MARICULTURE MICRO DATA: AN INSIGHT OF CURRENT EVIDENCE IN
PROVINCES OF BALI AND LAMPUNG, INDONESIA**

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ABSTRACT

This paper presents an investigation of the potential of the fisheries sector to the region and fish farmers, especially mariculture, via economic ripple effect analysis and microdata analysis of small-scale mariculture fish farmers. Bali and Lampung are of the essential mariculture centers in Indonesia and are targets of mariculture development in the priority programs of the Indonesian government for the 2019-2024 period. However, the study on the economic effect of the fisheries sector on the regions and fish farmers is still not comprehensive. Previous studies mainly provide an overview based on secondary statistical data. We perform the analysis using a combination of primary microdata and secondary statistical data. A field survey with 29 respondents was conducted in Bali and Lampung, Indonesia, in February 2020. Secondary data provided by The Indonesian Central Statistics Agency. The economic ripple effect of the fisheries sector and its role in this study by using three approaches, i.e., Input-Output (I-O) Analysis and Minimum Requirement Approach (MRA) and Location Quotient (LQ). The analysis results show that the fisheries sector in Bali and Lampung Province has great potential to become the leading sectors or base sectors. The fisheries sector provides a positive multiplier effect on increasing regional income and regional economic output. Small-scale mariculture has had a positive impact on livelihoods through increased income. However, the welfare of workers in mariculture facilities must be improved. Mariculture development does not only pay attention to the sustainability of its business but also must pay attention to the welfare of business actors, especially workers.

Keywords: economic ripple effect, finfish farmers, livelihood, small scale mariculture

[47]

**ISSUES AND CHALLENGES IN CONSUMER PERCEPTION, AWARENESS AND
ACCEPTANCE OF AQUACULTURE PRODUCTS IN NORTHERN PENINSULA
MALAYSIA**

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ABSTRACT

Consumer perception, awareness and acceptance of aquaculture products affect the sustainability of the aquaculture industry, which is rapidly growing in northwest Peninsular Malaysia. However, a combination of poor planning, poor regulation, poor public education and uncontrolled development has affected the environment negatively as well as the industry's sustainability. This study aims to understand consumer perception, awareness and education on the aquaculture industry and its products. The methodology includes a questionnaire survey of 281 respondents and a focus group discussion of selected consumers of aquaculture products. A stratified sample is selected followed by random sampling of respondents. Results showed that consumers' level of awareness and understanding of aquaculture products are poor with average score less than 3.0 out of 5.0. Most consumers (3/4) perceive that aquaculture products are safe, and are generally unaware of the major quality issues affecting aquaculture products. Consumption of aquaculture products are on a rising trend as the most influential variables affecting consumers' choice of aquaculture products are price, convenience and freshness. Results also show that most respondents (4/5) are unaware that aquaculture might have negative effects on human health and the environment. The majority of consumers (3/4) generally feel that the quality of aquaculture products is good. The implication of this study is that low awareness and understanding on aquaculture amongst Malaysian consumers results in lack of pressures on the aquaculture sector to move towards better environmental standards. Hence, in conclusion, it is recommended that public education for consumers is necessary to enhance consumer awareness and understanding as well informed and educated consumers can exert pressures on aquaculture producers to adopt sustainable practices and ensure quality products, paving the way towards sustainable aquaculture practices and products.

Keywords: aquaculture product, consumer perception, consumer awareness, sustainable aquaculture

[48]

THE MACRO-ECONOMIC IMPACT OF INVESTMENT IN AQUACULTURE IN SOUTH AFRICA

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ABSTRACT

The untapped potential of South Africa's extensive inland waterways and coastline, which include the increasing shortfall in fish supply, creates a significant opportunity for aquaculture to meet the rising demand for a growing rapid consumer population. The South African government and the private sector have made a considerable investment to ensure the sustainability and productivity of the ocean economy. It is in this regard; aquaculture is one of the sectors that contribute to ocean economy. Although, South Africa has a limited suitable environment conditions for aquaculture. However, this did not hamper the country's drive to develop the aquaculture sector by investing in its infrastructure. Aquaculture has been identifying as a solution for the countries triple development challenges such low GDP, high rate of unemployment and poverty. The ARDL method is used to examine the causal relationships of investment in Aquaculture on economic growth, unemployment, and entrepreneurship in South Africa from 1994 to 2019. The results show that in the short run there is negative relationship between investing in aquaculture and economic growth while in the long run there is significant positive causal relationship. This means that investing in aquaculture could lead to significant growth, and also create employment. It is recommended that more investment on aquaculture to ensure the sectors growth to its significant potential to economic activity, poverty reduction, empowerment, employment and the sustainable use of coastal and inland resources to the benefit of local communities

Keywords: aquaculture, ARDL, GDP, investment

[49]

**THE EFFECT OF FISHING REGULATIONS ON HARVEST RATES OF
FRESHWATER FISH SPECIES IN CENTRAL EUROPE**

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ABSTRACT

Freshwater fishes are among the most threatened organisms worldwide. They are significantly threatened by anthropogenic activities, among which recreational angling plays a critical role. Fishing restrictions such as bag and slot limits are often used to decrease the anthropogenic pressure on fish populations. In our studies, we analyzed the effects of fishing regulations (bag and slot limits) on fish harvest rates and fishing visit rates. The fisheries data (harvest and visit rates) were collected by the Czech Fishing Union from mandatory angling logbooks and fish restocking notes on 178 fishing sites over years 2005 to 2018 in central Bohemia, the Czech Republic (central Europe). We used GLMM (generalized linear mixed models) to assess the effect of fisheries management on fish harvest rates. We analyzed approximately 9 million fishing visits and 5 million harvested fish belonging to 25 species. We found that setting a stricter fishing regulation resulted to lower harvest rates of most targeted fish species. The harvest rate of targeted fish species decreased to 40–60 % of the initial harvest rate (varied by species). Conversely, the mean body size of harvested fish increased 1.2–1.5 times (varied by species). However, the angling visit rate did not decrease after the regulations were implemented (it actually kept increasing by 1 % per year). It means that the fishing pressure kept increasing after the restrictions were implemented. We conclude that while bag and slot limits led to decreased fish harvest rates, they were not enough to decrease the angling pressure that anglers put on fish populations. Regulations of fishing visits are further needed to fully protect freshwater fish populations.

Keywords: angling, bag limits, fisheries management, recreational fishing, slot limits

[50]

A STUDY ON TRIGGER FACTOR OF HARMFUL ALGAL BLOOMS IN LAMPUNG BAY, INDONESIASaville R^{1*}, Muawanah², Shimojima H¹, Hatanaka K¹, Puspasari R³ and Albasri H³*¹Tokyo University of Agriculture, Japan**²Lampung Marine Aquaculture Development Center, Indonesia**³Center for Fisheries Research, Indonesia***sr203424@nodai.ac.jp***ABSTRACT**

Harmful algal blooms (HABs) affect various coastal fisheries-related sectors leading to significant economic losses. Lampung Bay, Indonesia, is one of the regions regularly hit by HABs. A massive event of HABs first occurred in Lampung Bay in 2012. Afterward, HABs continue to occur and have been associated with cultured fish's mass mortalities. Fertilizer runoff from nearby farmlands was suspected as one of the trigger factors of HABs in Lampung Bay. This paper investigated the potential trigger factors of HABs in the bay by combining land cover analysis through spatial assessment and water quality measurement through in-situ water sampling. Land cover analysis was conducted using high-resolution satellite image (WorldView-3) and a digital elevation model (DEM). Results of the land cover analysis were verified via ground truth survey in February 2020. Water quality measurement was conducted at four sampling stations (two stations each in upstream and downstream near river mouths). The sampling stations were selected based on the land cover analysis results. Measured water quality parameters consisted of pH, EC, NO₂, and NH₃. The water quality measurement was repeated for 25 times from February 2020 to March 2021. A t-test statistical analysis was performed on the water quality data to examine fertilizer runoff possibility from upstream to downstream. The land cover analysis shows that most farmland areas are situated on steep hills along the Lampung Bay coastline. The measured values of EC, NO₂ and NH₃ in downstream are significantly higher than that of upstream, with the p-value of EC, NO₂, and NH₃ are 1.89×10^{-3} , 1.89×10^{-4} , and 2.25×10^{-6} , respectively. This study provides an evidence that fertilizer runoff could be one of the triggers of HABs in the bay.

Keywords: harmful algal blooms (HABs), remote sensing, GIS, land cover analysis, hydrologic characteristics analysis, fertilizer runoff

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HEAVY METAL LEVELS IN BLOOD COCKLE FROM SOUTH VIETNAMTu NPC^{1*}, Ha NN², Dong NV³ and Tri NN¹¹*Faculty of Fisheries, Nong Lam University, Vietnam*²*Research Institute of Biotechnology and Environment, Nong Lam University, Vietnam*³*Faculty of Chemistry, University of Science, National University Ho Chi Minh City, Vietnam*[*npctu@hcmuaf.edu.vn](mailto:npctu@hcmuaf.edu.vn)**ABSTRACT**

The blood cockle, *Anadara granosa*, is a favored bivalve mollusc species of Vietnamese people. Since the cockle is a filter feeder, heavy metal (HM) pollutants in the mudflat and natural food tend to accumulate in its tissues. This study was carried out to evaluate the concentrations of HMs (As, Cd, Hg, and Pb) in soft tissues of farmed cockles from five provinces in the Southern coast of Vietnam. Concentrations of Cd, Pb, Hg, and As in tissues were determined by an inductively coupled plasma-mass spectrometer, a cold vapor-atomic absorption spectrometer (AAS) and a hydride generation-AAS, respectively. Besides, levels of HMs in the cockle were used to estimate biota-sediment accumulation factor (BSAF) and human health risk. The results showed that the concentration of HMs generally did not differ significantly among provinces. Remarkably, the highest BSAF values was found for Cd in the cockle. In comparison to the permissible limits established by the Vietnamese Ministry of Health (MOH) and the European Commission (EC), about 45% and 28% of samples had Cd levels exceeding the guidelines of EC (1 $\mu\text{g g}^{-1}$ wet weight) and MOH (2 $\mu\text{g g}^{-1}$ wet weight). Moreover, approximate 10% of cockle had Pb concentrations higher than the regulation of MOH and EC (1.5 $\mu\text{g g}^{-1}$ wet weight). However, concentrations of As and Hg in the cockles were below these guidelines. The estimated target hazard quotients for HMs via consuming cockle were <1 , implying that there is no non-carcinogenic risk to the consumers. It is essential that routine monitoring programs of HM levels in cockles should be established.

Keywords: *Anadara granosa*, blood cockle, cadmium, heavy metals, Vietnam

[52]

**ECOSYSTEM APPROACH TO FISHERIES MANAGEMENT IN PALABUHANRATU
ARCHIPELAGO FISHING PORT: EVALUATION AND DEVELOPMENT STRATEGY**

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ABSTRACT

Comparison between the usage of fisheries resources and the allowable catch in Indonesia is in the fully exploited category, which means that fishing efforts are maintained with close monitoring. This study aims to analyze whether fisheries management practices, especially in Palabuhanratu Archipelago Fishing Port, have been managed sustainably or not based on indicators in the Ecosystem Approach to Fisheries Management (EAFM). Therefore, it is necessary to identify strategies for developing and strengthening fisheries management based on the results of the EAFM evaluation. The method used is a survey method using composite analysis and flag modeling visualization techniques. This method will assess the EAFM indicator as a multi-criteria system that ends in a composite index in the form of a score of values related to the level of achievement or sustainability of fisheries management based on EAFM principles. The results show that the mean value for all EAFM domains is 66.72 with a good category. The strategies for developing and strengthening the sustainability of fisheries management at PPN Palabuhanratu are through increasing the status of the port to become an Ocean Fishery Port, increasing the added value of the economy of fisheries products, monitoring and strengthening regulations with fair law enforcement, optimizing the usage of technology in fisheries management, and strengthening fishery business capital system.

Keywords: EAFM, Palabuhanratu, evaluation and development strategy

[53]

MACROPLASTIC COMPOSITION AND ABUNDANCE IN COSTAL SEDIMENT OF MUARA BADAK, EAST KALIMANTAN OF INDONESIA

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ABSTRACT

The volume of marine debris in various areas in East Kalimantan is increasing despite Covid-19 crisis. Recreational destinations, especially beaches, in Muara Badak continue to receive visitors so that the volume of plastic waste continues to increase. Lack of study on plastic waste investigation leading to a lack of strategies on marine debris management. This study was aimed to investigate macroplastic distribution and composition in coastal sediment of some recreation destinations in Muara Badak, Kutai Kartanegara district, East Kalimantan of Indonesia. The study was conducted in 2 (two) locations, namely Jingga Beach and Mutiara Beach. Sampling method and sample analyses were adapted from NOAA (2013). As many as 5 of 10 x 10 m quadrants with 5 replications were used to collect the plastic waste. The plastic samples were identified and separated based on the type of the plastic before measured and weighed individually. Film of plastic type of Film was dominantly found in Jingga beach (64%) followed by Fiber (26%). Meanwhile, types of Fiber was dominantly detected in Mutiara beach (82%). There was no Styrofoam collected in Mutiara Beach. The total of macroplastic particles were found slightly higher on from Mutiara Beach in comparison to Jingga beach.

Keywords: debris, coastal, ocean, plastic, waste

[54]

TRANSCRIPTOMIC INSIGHT INTO THE MELON MORPHOLOGY OF TOOTHED WHALES FOR AQUATIC MOLECULAR DEVELOPMENTS

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ABSTRACT

Aquatic habitats are home to large animals like marine mammals. Toothed whales have special fat deposits in their head region, the one at the forehead, called the melon that has been recognized as associated with echolocation underwater. Due to a lack of information on gene expression in the melon of toothed whales, we investigated the morphology of melon with a transcriptomic approach for the first time. Four parts of melon from three individual Risso's dolphins were used for total RNA extraction, cDNA library preparation, and sequencing by NGS technologies. After the downstream analysis of raw sequence data, we identified the outer layer of the melon, the ML4 region consisted of multifunctional roles. The differentially expressed genes included ASB5, MYH13, MYOM2, and MYOM3. These genes are associated with muscle function and energy metabolism. Gene clustering and functional enrichments also represented functional enrichments related to lipid metabolism and muscle functions. Hence, we suggest the ML4 region of the melon is a regulating part of the inner melon (ML1, ML2, and ML3) via the distribution of muscle fibers. The study will be important for muscle and fat functional-related studies in livestock animals for food purposes. Moreover, these genes are useful for molecular studies of other aquatic animals, molecular evolution, and genetic engineering.

Keywords: Melon, transcriptomics, gene expression, marine mammals

[55]

**THE RELATIONSHIP OF NUTRITIONAL STATUS OF TODDLERS BASED ON
COMMUNITY CHARACTERISTICS, KNOWLEDGE, CONSUMPTION PATTERNS, AND
INFECTIVE DISEASES IN THE GETEM BEACH AREA**

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ABSTRACT

Stunting in East Java in 2016 reached 26.1% (East Java Health Profile, 2016), while the prevalence of stunting in Jember District reached 44.1% (National Team for the Acceleration of Poverty Reduction, 2017). The high prevalence of malnutrition in children under five shows that malnutrition at the family level is still not good. The purpose of this study was to study the description of the community and nutritional status of children in the coastal areas of Getem, Puger District, Jember Regency, East Java with a type of descriptive research with quantitative research. The results of the univariate analysis showed that mothers with an elementary education background had toddlers with good nutritional status (67.3%); Mothers with a profession Housewives (77.58%) have toddlers with good nutrition status; most of the family members less than 5 people have under five with good nutrition (60.34%); Families with income below the minimum wage have a toddler who is in good nutrition (63.79%); It is estimated that 59.3% of children under five experience severe infections 1-2 times in the last three months as long as <1 week; It is estimated that 81% of children under five are in good nutrition with the right consumption patterns. It is expected that the results of this study can be a further study that can find the right solution that can reduce the stunting rate in Jember Regency, especially in the Getem Coast Region.

Keywords: stunting in infants, community characteristics

[56]

STUDY OF IMPACT OF CLIMATE CHANGE ON THE NORMALIZED DIFFERENTIAL VEGETATION INDEX IN NORTHERN SRI LANKAFernando MMSSM^{1*}, Wickramasinghe D² and Halwatura D²¹*Faculty of Graduate Studies, University of Colombo, Sri Lanka*²*Department of Zoology and Environmental Sciences, University of Colombo, Sri Lanka**milanthi11@gmail.com**ABSTRACT**

The wildlife and the nature threatening and limiting into smaller fragments confined in the planet earth by the anthropogenic activities conducted during the industrial era, had been highlighted by the 15th sustainable development goals (SDGs) ‘‘Life on Land’’ by UN in 2015. Also the changeability of the humanity is strongly pointed out with the pandemic COVID – 19, which is the strongest infected zoonotic disease are closely interlink with the health of global ecosystems in the global. To respond and recover effectively from the current pandemic, extensive research on ecosystem conditions is required so that humanity could be protected by the nature. Assessing distribution and dynamics of vegetation has become important increasingly for ecologists to predict impact of anthropological or natural activities on degradation of habitat, deforestation or reduction of biodiversity. Being an index of greenness and widely applied for monitoring regional and global vegetation dynamics, the NDVI is a dimensionless index that quantifies vegetation by measuring the difference between near-infrared (which vegetation strongly reflects) and red light (which vegetation absorbs). The NDVI variation was done in the northern part of the Sri Lanka between latitude 80.8013098 N and 79.95005763 N and longitude 8.19499577 E to 9.200437018 E using LANDSAT data obtained by the earth explore programmer conducted by the united states of geological survey (USGS). The NDVI values were extracted in 112 points of selected sampling stations representing each 1km grid by data management tools of ArcGIS 10 during 1981 to 2006. Interpolated NDVI distribution curve within the all sampling point was generated by best fitting method of math lab editing property. The long term variation of NDVI was computed as 0.01409 of total difference during 1981 to 2008 with an annual negative linear trend of 0.00054 in the study area. The monthly average variation of NDVI had exhibited seasonal fluctuation in-line with the monsoon rain pattern of Sri Lanka with higher NDVI during April, September and November while lower during June. The negative trend of NDVI shown is in accordance of 1.14 % of deforestation in the country during last 25 years as indicated by UNEP 2020. The long term trend of NDVI was fluctuated periodically approximately comparing with Oceanic Nino Index (ONI) constructed based on the historical Niño event by the National Oceanic and Atmospheric Administration (NOAA) during 1952-2018. The NDVI reduced in periodically with El Niño (warm) while increased during La Niño (cool) event in 4-6 years.

Keywords: satellite, NDVI, ecosystems, climate change, vegetation

[57]

**THE QUALITY OF MUD CLAM (*Polymesoda erosa*) FROM INDONESIAN BEACH:
STUDY OF Cd HEAVY METAL CONTENT IN TRATAS BEACH, MUNCAR DISTRICT,
BANYUWANGI REGENCY, INDONESIA**

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ABSTRACT

Tratas beach is one of the beaches that become one of the river estuary of the Tratas River. This beach is a place for people around the coasts, especially Kedungringin villagers the fishermen to look for scallops. The purpose of this study was to assess the heavy metal content of Cd in sediments and Mud Clam (*Polymesoda erosa*) and health complaints coastal communities that consume mussel shells. This study was a descriptive study. Samples was marine sediments taken at three locations in the Tratas Coastal Waters: location 1 which was around the mangrove forest, location 2 was around village and location 3 around the estuary of Pacific. Marine sediment samples at each location were taken at the time of high tide and low tide. Mud Clam samples (*Polymesoda erosa*) taken at the same point with the sampling of sediments at low tide. Based on the results of the research content of heavy metal Cd on scallops taken at location 1 of 0.329 mg / kg, location 2 of 0.109 mg / kg and at location 3 of 0.104 mg / kg. The content of heavy metals Cd in scallops meat in the three locations has exceeded the quality standard.

Keywords: mud clam, heavy metal, Cd, Tratas beach

**POSTER
PRESENTATIONS**

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**3D ULTRASTRUCTURAL INVESTIGATION ON WSSV-INFECTED NUCLEUS
REVEALED THE SEQUENCE OF VIRUS ASSEMBLING IN RED SWAMP
CRAYFISH (*Procambarus clarkii*)**

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ABSTRACT

Since the first outbreak of the white spot disease in the shrimp industry, the huge economic loss has been made through the fast spreading and high mortality within 3-10 days of infection. As the pathogen of the disease, the white spot syndrome virus (WSSV) contains a double-stranded circular DNA of about 300kb in the rod-shaped virions and belongs to the only genus (Whispovirus) in the family Nimaviridae. Currently, the infections of WSSV have been reported in a wide range of crustaceans, while only 30% of the 181 predicted protein were functionally annotated. Since the knowledge of virus assembly is still limited in literature, the current study was planned to visualize the cellular structures during virus assembling in red swamp crayfish (*Procambarus clarkii*). The purified WSSV was injected into the crayfishes, and the samples were prepared for electron microscopic observations on the 7th day post-infection. The virus particles were observed in the cell nucleus from the brain, gills, and intestine. Since the infected cell can be frequently observed in the intestine, the 3D volume of the infected nucleus was reconstructed by serial sectioning and electron tomography on the intestinal tissue. After 3D reconstructions, multiple layers of straight or curved sheets can be observed near the assembled WSSV particles while the assembling virus can be recognized by the attachments of several centers for nucleocapsid elongation on the continuous teguments. Both empty and filled elongation centers can be observed. Current observations light the order of WSSV assembling in infected crayfish, while more investigations are still necessary to connect the mechanisms and functional proteins with cellular structures.

Keywords: Crayfish, WSSV, electron tomography, ultrastructure

[59]

SMALL-SCALE FISHERIES ACTIVITY IN THE NORTH-WESTERN REGION OF PORTUGAL DURING THE COVID-19 PANDEMIC

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*ICBAS-UP – Institute of Biomedical Sciences Abel Salazar – University of Porto and
CIIMAR – Interdisciplinary Centre of Marine and Environmental Research, Portugal**afmcosta@icbas.up.pt**ABSTRACT**

The first patients infected by COVID-19 in Portugal were diagnosed in early March 2020. Shortly after the pandemic started, as declared by the World Health Organization (WHO), the Portuguese Government lockdown inflicted severe restrictions affecting key economic sectors. The present work assesses the impact of such pandemic situation on the small-scale fisheries activity in the Portuguese Northwestern Region, defined as a case study due to the socioeconomic importance of local fisheries. A methodology based in a two-pronged focus was applied; a stakeholder survey collected the perceptions from Fishing Associations (n=13, representing approximately 900 vessels), and professional fishers (N=20) about the impact of the national lockdown. In parallel, official statistical data were used to analyze the fishing activity of randomly selected small-scale vessels within fishing communities (N=82), throughout the 2018-2020 period. In overall terms, catches and revenue increased from 2018 to 2019, but decreased during the 2020 pandemic year. Nevertheless, the values were still higher than those of 2018. However, from the perspective of stakeholders, 46% of the Fishing Associations categorized COVID outbreak as a highly negative impact event in artisanal fishing activity, whereas the majority of fishers classified it as having very high negative impact. Both stakeholders highlighted a reduction of fishing effort as a consequence of demand by buyers, as well as the price for high-value species. Nevertheless, the decrease in the performance of the selected vessels, was not as drastic as pictured, possibly due to some resilience of the regional fishing activity to the pandemic situation. An extremely sensitized environment is likely not a sufficiently compelling reason to explain the divergence between the perception of fishing professionals and the official data. Therefore, further research addressing underlying causes is in dire need.

Keywords: COVID-19, small-scale fisheries, NORTE Region of Portugal, stakeholder survey, artisanal fleet

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