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ASIAN FISHERIES SOCIETY

e-Newsletter

MESSAGE FROM EDITOR

Our hopes of coming back to normalcy during 2021 were defeated by the second wave of Corona virus and now we are gaping at the possibility of a third wave. While the industry has learned some lessons to cope with the impacts of the pandemic, still both fisheries and aquaculture activities have not come back to normal, impacting on the livelihoods and economies. On the positive side the sector is receiving more attention in food and nutritional security discussions in recent times as evident from the just concluded events at the UN Food Systems Summit.

Due to lockdowns and travel restrictions, conferences/training programs are being held online, which will be the case with some of AFS planned activities.

Stay safe, stay healthy.

M. V. Gupta
Editor

Inside this issue:

AFS PRESIDENT MESSAGE

Dear AFS Colleagues,

This is the 15-month since the COVID-19 pandemic was declared. The response to the pandemic and the current situation varies from country to country. But we remain hopeful for better months for the rest of the year and beyond.

There are three major things that I would like to share with you. One is the major decision recently made by the AFS Council in its June 2021 Special Meeting for the 13th Asian Fisheries and Aquaculture Forum to push through virtually in May 2022. This will be hosted by the National Cheng Kung University. The objective is to provide a venue for AFS members to meet, share, and discuss their latest work and of the issues in fisheries and aquaculture. This was foremost in the decision made. We will adjust on the way we deliver AFAF but we will not miss on the schedule. Please watch out for more information that will be shared in days to come and also note this in your calendar next year.

Second is a similar decision made by the officers of the Asian Fisheries Social Science Research Network (AFSSRN), a section of AFS, to have a forum in November 2021. It will be the first forum of the AFSSRN. The aim is to provide a venue for social science researchers and scientists in fisheries and aquaculture in the region to interact and foster cooperation to advance knowledge and promote the proper use of fisheries and aquaculture social sciences research practices and results in the Asia-Pacific region.

Meanwhile, the Asian Fisheries Science, journal of AFS continuously improves in terms of citation, downloads, and quality of papers published. We are grateful to the editorial team headed by Prof. Dr. Mohamed Shariff for the passion and dedication to improving the journal. I would like to take this opportunity to encourage AFS members to submit manuscripts for consideration in the Asian Fisheries Science.

We have an increased number of active members with membership renewal and more approved applications of membership. But we further encourage more application of membership and active membership in AFS.

Keep safe and well.

ALICE JOAN DE LA GENTE FERRER
President 13th AFS Council

NEWS FROM THE GENDER IN AQUACULTURE AND FISHERIES SECTION

Since the last AFS Newsletter, while coping with the severe disruptions from the pandemic, GAFS has been finalizing a major project and progressing a number of others, including the online GAF8 events. In addition, we are engaged with partners in preparing additional projects to build on the base established by the Section and continue to maintain out outreach via our website and social media.

Finalizing the AFS-GAFS-SwedBio Project "*Dialogues in Gender and Coastal Aquaculture: Gender and the Seaweed Farming Value Chain*"

The project was funded from 1 October 2019 to 31 December 2020 and all funds, except for audit funds, had to be expended by the end of 2020. Throughout 2020, the project partners coordinating the work on behalf of GAFS and AFS (ICAR-CIFT) and carrying out the field work (ICAR-CMFRI in India and KMFRI in Kenya) worked hard under very challenging conditions due to COVID-19 to complete the field work dialogues and verification conference. These were all held with a mix of in-person, small group events designed to keep participants safe and remote electronic communications supported by training of women and men in use of smartphones for voice, video and text communication. In early 2021, the field results were reviewed and the findings synthesised through several video conferences among the partners and the donor (SwedBio/Stockholm Resilience Institute). A short narrative synthesis report has been provided to the donor and the full report, including financial and external audit results will be submitted by 31 May 2021.

The audit requirements of the donor have been particularly challenging for AFS, GAFS and the other partners. GAFS executives have been working closely with the AFS Treasurer and Executive Officer on these processes.

The project has achieved excellent results and all the partners have performed exceptionally, more so given the difficult year. The results will be uploaded on our website under a new Projects section.

The following points are highlighted from the synthesis findings.

Gender Issues:

1) Women farmers did not speak out before (or their voices were not heard) so that their needs were not visible. The dialogues started to help redress this.
2) Seaweed farming and farmers can be stigmatised in some communities until it is proven viable and profitable.
3) Women need access to new markets and new technologies in both the dialogue sites (Tamil Nadu in India, and in Kenya) as the technical production issues are holding back progress.
4) Women need assistance in negotiating with large companies in the value chain.

The approach revealed the power of dialogue in drawing out issues and helping resolve some of them, building the self-confidence of participants, and demonstrating to all partners the potential of the industry and the open consultation process. Some agencies involved in Africa intend to replicate the processed more widely.

By virtue of being forced by COVID-19 to do much more using ICT, and having to train people in its use, a real transformation is occurring, especially for the women. Women are using ICT to communicate issues, such as the occupational health impacts of some farming tasks, reporting cyclone-damaged rafts to insurance companies, for marketing products and for rapid group decision making.

Even in an apparently egalitarian process such as the dialogues, care must be taken to ensure that marginalized people do not drop out. All present must be encouraged to talk. Small dialogues were found to be better for encouraging all to speak.

Concern was expressed as to how the Blue Economy policies will affect women seaweed farmers in both sites. Are women likely to be replaced if the scale of the sector grows? Or marginalized? Or does it give them opportunities? The project has shown that through capacity building, women have the opportunity to express themselves and gain and express skills in leadership. When women can express themselves, they can participate in different situations.

Planning GAF8 Webinars

A series of webinars for 2021-2022 is being planned, several in collaboration with partners. The following topics will be covered: (a) gender and seaweed farming; (b) labour in fisheries and aquaculture ; (c) GAF in the COVID-19 era (with ICSF); and (d) gender and Small-scale fisheries (with COBI). The programme is running behind its original schedule due to major disruptions from the pandemic in several countries. AFS members will be notified when a firm schedule is established.

Developing online training course on "Integrating Gender into Fisheries Economics" with IIFET

Through the leadership of IIFET (International Institute for Fisheries Economics and Trade), GAFS is co-supporting a group of experts developing the course. Last December, GAFS was given a planning grant by the CGIAR-FISH program to help course development. The team will be presenting the full program to the IIFET board at the end of April and then commencing fund raising, with a view to running the course in June and July 2022. The course will have two parts: the first will have three instructional sessions; and the second part will be a practical workshop based on participants own research work. The course will be open to others, but will be focused on the needs of economists to build their capacity in conceptualising the gender dimension in their research.

Gender and Fisheries Journal articles

In December 2020, GAFS received a grant from CGIAR-FISH and CGIAR Gender Platform through WorldFish to offer 4 awards to emerging researchers to support publishing gender and fisheries articles in high quality journal. The awards were announced in December and selections were made in March (https://www.genderaquafish.org/2021/03/19/announcing-the-winners-of-the-gaf-journal-article-support-awards/).

Two teams and two individuals won the awards:

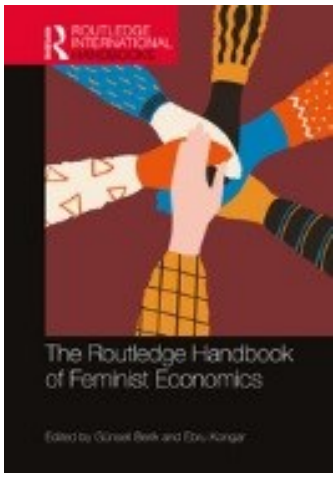
- **Ayodele Oloko** (University of Bremen, Germany) "*Multidimensional Perspectives of Taboos on Gender Roles of Fisher Folk in sub-Saharan Africa*"
- **Richard A. Nyiawung** (University of Guelph, Canada) and **Raymond K. Ayilu** (University of Technology, Sydney, Australia) "*Illuminating the hidden informal cross-border trade and women participation for small-scale fisheries in West Africa*"
- **Esther Ngwira** (Lilongwe University of Natural Resources [LUANAR], Malawi) "*Comparative gender analysis of roles and responsibilities along the aquaculture value chain in households owning their own fish ponds and in fish ponds owned collectively by belonging in clubs (Malawi)*"
- **Piyashi Debroy, B K Das, and Chayna Jana** (ICAR – Central Inland Fisheries Research Institute, Barrackpore, Kolkata, India) "*Shift in Gender Equity – A Model Study from Reservoirs, Wetlands and Rivers in India*"

The authors are also being supported by mentorships and submission of the articles to reputable journals is occurring as this goes to press.

GAFS COMMUNICATIONS

GAFS continues to be very active in its outreach, through its website, annual e-Newsletter 93rd Newsletter now in preparation), its GAFS members e-mail group, Genderaquafish e-mail group and social media outlets (Twitter and Facebook). GAFS members are receiving a monthly premium news service on GAF news items, and GAFS will release its third annual e-Newsletter later in the year. GAFS contributes reports to each of the biannual AFS e-Newsletters.

Here are the latest stories from our website https://www.genderaquafish.org/stories/

	Feminist economics: New book gives comprehensive and up to date overview, by *Meryl J Williams* Released in May 2021, The Routledge Handbook of Feminist Economics is an essential text on feminist economics. It will be of interest to those researchers working on gender in aquaculture and fisheries who have noted with frustration the almost total lack of gender in fisheries and aquaculture economics and, more specifically, feminist fisheries (and aquaculture) economics.
	In fishing industry, women face hidden hardships: study, By *Kiley Price* Women are the unseen backbone of seafood supply chains, supporting local food security and ensuring that fish are processed and packaged for sale at regional and national markets. A recent paper by authors from Conservation International highlights how systemic discrimination and a lack of representation and recognition in the seafood industry worldwide makes women more vulnerable to abuse.
	Announcing the winners of the GAF Journal Article Support Awards In preparation for GAF8 the Gender in Aquaculture and Fisheries Section of the Asian Fisheries Society (GAFS) joined with the CGIAR Research Program on Fish Agri-Food Systems (FISH) led by WorldFish and the CGIAR GENDER Platform to make 4 awards to support the preparation and publication of quality, open access, research articles. We are proud to announce the winners.

Bringing to light women's participation in the seaweed industry, By *Ms Jee Grace B. Suyo, Virginie Le Masson, Louise Shaxson, Maria Rovilla J. Luhan, Anicia Q. Hurtado.*

Seaweed farming is an important livelihood source for tens of thousands of families in the Southeast Asia. Using a gendered analysis in the Philippines, this story reveals essential gender aspects of production and risk mitigation strategies.

Roles of women in the purchasing node of the value chain of tuna in Vietnam: Case study of Binh Dinh province, By *Rachel Sundar Raj*

Vietnam has seen its economy undergo many drastic changes during the past 40 years, going from a centrally planned economy to a market-driven one. Since the transition to a market-driven economy, many studies on the economics of commodities have been conducted but this story reports on the first study of women in the purchasing node of tuna.

Keep in touch with GAF

Website: https://www.genderaquafish.org/; https://www.genderequality.genderaquafish.org/

Facebook Page: https://www.facebook.com/AFS-Gender-in-Aquaculture-and-Fisheries-181176555231544/

Twitter: @Genderaquafish https://twitter.com/Genderaquafish

Contributed by: Meryl Williams, Nikita Gopal and Kafayat Fakoya on behalf of GAFS ExeComm

AFS BRANCHES & SECTIONS

Asian Fisheries Social Science Research Network (AFSSRN)

The AFSSRN will have a forum to be offered virtually on November 24-26, 2021. It will be a joint conference with the International Conference on Fisheries and Aquatic Sciences (ICFAS) to be hosted by the College of Arts and Sciences of the University of the Philippines Visayas. The AFSSRN will also have an election of officers and a general assembly during the Forum. More details will be shared soon in the AFS website.

Fish Health Section (FHS)

Announcement

Postponement of the 11th Symposium on Diseases in Asian Aquaculture (DAA11)

The Government of Malaysia and DAA11 Organizing Committee have agreed to postpone the 11th Symposium on Diseases in Asian Aquaculture until 2022 due to the global uncertainties and travel restrictions caused by COVID-19 pandemic. The symposium was initially planned to take place on 23rd – 26th August 2021 in Kuching, Sarawak.

Therefore, we are pleased to inform that DAA11 has been rescheduled to 23rd – 26thAugust 2022 and the venue remains the same. In view of this decision, all accepted abstracts are being kept and automatically selected for DAA11 in 2022. Whereas, the keynote speakers, sponsors and exhibitors will be communicated individually to discuss your future involvement.

On behalf of the Committee, we apologize for any inconveniences caused by this and rest assured that we will ensure smooth transition. We are taking all the best possible steps to ensure all participants are protected from Covid-19 by postponing this event.

We will stay in touch with you and keep you informed of the latest developments. Please check the website regularly and kindly contact the DAA11 secretariat at daa11@dof.gov.my if you have any enquiries about the postponement.

We would like to thank you for your patience and understanding as we continue to navigate this historic public health crisis. We hope that you and yours remain safe and healthy in this trying time. We hope this outbreak will be resolved soon and looking forward to see you in Kuching, 2022!

With deep appreciation,

DAA11 Secretariat
On behalf of the DAA11 Organizing Committee and the Government of Malaysia

Prohibition of great white sharks, elephant sharks and megamouth sharks fishing in Taiwan to protect marine biodiversity

In order to maintain the sustainability of species resources, the Council of Agricultural of Taiwan has announced the new regulation of *"Shark catch control measures of great white sharks and megamouth sharks"*. The new regulation totally prohibit the fishing of great white sharks, elephant sharks and megamouth shark species. When accidentally caught, regardless of whether they are still alive or dead, they should be immediately returned to the sea and proactively notified of the catch information when they return to harbor.

Taiwan government had implemented a catch notification and scientific sampling system. It revealed that a total of 32 great white sharks, 0 elephant sharks and 138 megamouth sharks have been caught since 2013. In the new regulation, government can send observers to carry out scientific observation on board for of fishing vessels that had caught megamouth sharks. The fishing methods used by fishing boats which had caught megamouth sharks and the living conditions of sharks before they have been moved to deck will be studied by researchers.

After the new regulation announced, a fishing boat had accidently caught a megamouth shark outside Haulien, Taiwan on June 3, 2021. The fishermen released it from fishnet and reported this event immediately. Luckily, this megamouth shark returned to the ocean alive. This shows that Taiwanese fishermen have made great progress in their concept of environmental protection.

Video can be seen here https://youtu.be/JH5joW42in4

The Taiwan government promotes the protection of the rights of foreign fishermen

Taiwan's direct and indirect investment in offshore fisheries heavily relied on fishermen from various countries. In the past, there were frequent unfortunate reports about the human rights violation of foreign crew members. Since 2017, the Taiwanese government has formulated the "Regulation of Licensing and Management for Overseas Employment of Foreign Seafarers", which regulates rest time, stereotyped contracts to guarantee wages, and insurance for seafarers to meet the standards of International Labour Organization Convention ILO-C188. The Fisheries Agency of Taiwan pointed out that starting from this year, the frequency of inspections will be increased four times, strengthened to ban and punish companies which violates the regulation. The government will work hard to improve the working environment of international offshore fisheries.

4th International Symposium on Aquaculture and Fisheries Education (ISAFE4)

The 4th International Symposium on Aquaculture and Fisheries Education (ISAFE4) will be organized by Asian Fisheries Society, Taiwan Branch (AFS-TB) and National Pingtung University of Science and Technology (NPUST), Taiwan. The theme of the conference will be " SMART Aquaculture and Fisheries Education". The original conference venue will be held at NPUST (Neipu Campus). However, due to the COVID-19 epidemic, ISAEF4 has been decided to postpone from May, 2021 to May, 2022 in the AFS Council meeting. The current epidemic is still severe, our local committee prefers to hold the conference as virtual meeting on May or June, 2022, but we still keep the conference hall for on-site meeting (if possible). The conference website is preparing, and will open as soon. Any updated information will be announced through AFS news.

ARTICLES

ICAR-CMFRI Develops Hatchery Technology for Picnic seabream

India's mariculture sector is on a path of transformation thanks to a slew of initiatives for the diversification of the candidate species. This has been largely influenced by the country's fishery researchers who heavily emphasised on helping the fishermen community reap a good profit through the culture of commercially important marine food fish. Realising the fact that quality seeds of diversified high-value marine fishes are required for a profitable mariculture venture, they gradually came up with economically feasible hatchery technologies for these fishes.

Mariculture is believed to be the hope of future generation to meet the growing demand in food industry. In view of the present stagnation of capture fisheries production globally, the area could be profitably used for mariculture, adopting sustainable and socially acceptable methodologies. Mariculture can be considered as one of the best alternate livelihood options for the coastal fishermen community. At a time when capture fisheries production is undergoing through a stagnation period, the mariculture can be considered as the only option to meet the ever increasing demand for the marine food products.

Recently, the ICAR- Central Marine Fisheries Research Institute (ICAR-CMFRI), Kochi, India developed hatchery technology for picnic seabream (*Acanthopagrus berda*), a commercially important marine food fish. This is the seventh marine food fish of which breeding technology has been developed by the ICAR-CMFRI. Earlier, the institute had succeeded in brood stock development of fishes like cobia, silver pompano, Indian pompano, orange-spotted grouper, pink ear emperor and John's snapper.

Also known as black seabream and goldsilk seabream, the fish is known for its excellent meat quality and high economic value. It has high demand in domestic market with a price of around Rs. 450 to 500 per kg. Locally called as *karutha yeri*, the fish is an excellent species for mariculture owing to its faster growth rate, strong resistance to diseases and ability to cope up with wide variations in environmental parameters such as salinity and temperature. The breeding technology was developed by the Karwar Regional Station of ICAR-CMFRI. It took around three years for the CMFRI scientists to develop the seed production technology for this fish.

Seabreams are commercially important food fishes for mariculture having potential for both capture based aquaculture and other commercial aquaculture practices. Commercial farming of few seabreams like Yellow tail, Red seabream, Sobaity seabream, Blackhead seabream and Yellowfin seabream have been standardized in different parts of the world. Of late, ICAR-CMFRI has focused on detailed studies on the molecular taxonomy, reproductive biology and feeding habits of Picnic seabream and other important seabreams available in India.

Broodstock development of *A. berda* was carried out in 6 m diameter galvanised iron framed floating net cages using commercial pellet feed (40 % protein) supplemented with vitamins and minerals. The fishes were collected from its natural habitat during southwest monsoon season using cast nets and transported live to the marine cage farm of the Station for broodstock development. Matured female fish having an oocyte diameter above 400 µm and male fish with running milt were shifted to the marine hatchery complex of the station. The fishes could be successfully induced to breed using GnRH analogue (two doses of 0.25 ml / kg for female at 6 h time gap and one dose of 0.25 ml/ kg for male). Fishes spawned after 42 h of inducement and 0.25 million eggs were obtained with 88 % fertilisation. Fertilised eggs hatched out (80%) after 18 hours. Planktonic larvae (total length [TL] 1.7 ± 0.14 mm) started active exogenous feeding from 3rd day post hatch (dph) when the mouth size was 180 ± 2.8 µm (TL 2.7 ± 0.48 mm). Experimental feeding with rotifer *Brachionus rotundiformis* at a density (5 / ml) with co-feeding of copepod (*Parvocalanus crassirostris*) nauplii reveled better initial larval survival. Metamorphosis of the larvae initiated at 25 dph and juveniles appeared from 35 dph onwards. The fishes achieved stockable juvenile size on 45 to 50 dph. Farming trial of the juveniles produced is progressing in the marine cage farm of the station using commercial pellet feed. Research towards the scaling up of the seed production of the species is planned by altering larval feeding and other larval rearing protocols.

The achievement is expected to open up enormous scope for the country's mariculture ventures in near future through species diversification. With the development of hatchery technology for picnic seabream, Indian mariculture is poised for a new surge with exponential increase in marine finfish production.

Globally, marine fin fish seed production and farming is expanding very fast in recent years. India is far behind not only on a global level but also in the Asia-Pacific region.

Realizing the need to increase fish production and to tap the huge potential of marine farming, the ICAR-CMFRI, which is the largest fisheries research institute in the country, has stressed on standardizing seed production and farming techniques for at least two dozen high value marine finfish within the next 10 years.

***Contributed by:** Media Cell, Central Marine Fisheries Research Institute (CMFRI)*
Cochin-682 018, India.

Super Seaweed Improves Fish Immunity

New ACIAR-supported fisheries research uncovered potentially ground-breaking alternatives to veterinary drugs to combat aquaculture diseases. Disease outbreaks pose persistent threats to aquaculture development and cost the global industry more than AU$8 billion every year.

Led by the University of the Sunshine Coast (USC) Ph.D candidate Valentin Thepot, the research discovered several seaweed species that could boost the immunity of farmed fish—as high as four times in some cases—when added to fish diets as a powdered additive.

The new research could also mean an end to the dependency on veterinary drugs that can sometimes be detrimental to the environment, to animals and consumers. The research findings were recently published in a scientific journal and indicated that small amounts of red seaweed called *Asparagopsis* resulted in significant improvement in fish's innate immune responses.

The same seaweed has been found to reduce methane emissions in cows and other ruminants when supplemented in their diets, which may prove to have significant application globally in reducing greenhouse gas emissions in the agriculture sector. Of the 11 seaweeds that the team tested, two others showed promising immunostimulatory potential: the brown seaweed *Dictyota* doubled one of the fishes' innate immune response and the green seaweed *Ulva* almost did the same.

Mottled rabbitfish *Siganus fuscescens* was chosen as a model species for the work as it is abundant on the Sunshine Coast and an excellent candidate for a range of reasons including their low-trophic level (opportunistic omnivore), so they do not require wild-caught fish as part of their diet.

The research showed that the fish treated with seaweed had strong innate immune responses, often surpassing that of the fish fed one of the four commercial immunostimulant ingredients also tested in this study. Mr Thépot said fish had a similar innate immune system to poultry, pigs, cattle, and other farmed animals, meaning that seaweed could also benefit different livestock industries globally. Professor Nick Paul, who is part of the USC Seaweed Research Group, added that the research is fundamental for aquaculture globally.

'While there is an abundant supply of *Asparagopsis* in the wild in Australia, the Pacific Islands and parts of Europe (which has helped kickstart research and development), the wild harvest of seaweed for commercial purposes has its limitations', he said.

The USC has patented the process for commercial use, confident in the enormous market potential for natural seaweed additives in Australia and across the world. ACIAR Research Program Manager for Fisheries, Professor Ann Fleming commented that 'ACIAR is proud to have supported this research. Our fisheries program aims to strengthen the seaweed-based livelihoods of women and men in our partner countries —providing sustainable economic and social benefits.

This research was part of a PhD programme supported by the USC and ACIAR under the project: *Accelerating the development of finfish mariculture in Cambodia through south-south research cooperation with Indonesia.*

Contributed by: Prof Ann Fleming, ACIAR, Australia

Restorative aquaculture can improve marine habitats, biodiversity

Growing body of scientific evidence indicates that the commercial cultivation of bivalve shellfish and seaweed can deliver valuable ecosystem goods and services, including provision of new habitats for fish and mobile invertebrate species.

Seth J. Theuerkauf, Luke T. Barrett, Heidi K. Alleway, Barry A. Costa-Pierce, Adam St. Gelais, Robert C. Jones completed a systematic literature review of studies focused on understanding habitat-related interactions associated with bivalve and seaweed aquaculture, and a brief meta-analysis of 65 studies to evaluate fish and mobile macroinvertebrate populations at farms and reference sites. Bivalve and seaweed aquaculture were associated with higher abundance (n = 59, range: 0.05× to 473×, median $lnRR$ = 0.67) and species richness (n = 29, range: 0.68× to 4.3×, median $lnRR$ = 0.13) of wild, mobile macrofauna. Suspended or elevated mussel and oyster culture yielded the largest increases in wild macrofaunal abundance and species richness. The authors describe the major mechanisms and pathways by which bivalve and seaweed aquaculture may positively influence the structure and function of faunal communities—including provision of structured habitat, provision of food resources and enhanced reproduction and recruitment—and identify the role of the species cultivated and cultivation gear in affecting habitat value. Given the continued deterioration of coastal habitats and increasing investments into their restoration, understanding how industry activities such as aquaculture can be designed to deliver food within ecological limits and have positive influences on ecosystem goods and services is essential in ensuring ecological, social and economic objectives can be achieved.

The full paper can be downloaded from: https://onlinelibrary.wiley.com/doi/10.1111/raq.12584

Potential Replacements for Fishmeal

Directorate of Incubation and Vocational training in Aquaculture (DIVA) of Tamil Nadu Dr. J. Jayalalithaa Fisheries University, Chennai, India, has been involved in studies on feed for *Penaeus vannamei* which contributes almost 81% of the total shrimp production in India. The studies are being conducted in collaboration with two commercial industries, String Bio – Bengaluru, India and Natural Remedies – Bengaluru, India.

Replacing fish meal in the aquafeeds is the worldwide challenge in order to produce cost-efficient feeds and to reduce the pressure on the usage of marine resources. Methanotrophs are bacteria that utilize methane as a sole carbon and energy source finds a significant potential in feed industries as a single cell protein. In this line, String Bio, a Bengaluru based Indian company has produced two Single Cell Protein products (PROfit & PROtyde) with high crude protein content that can be used in the aquaculture feed as an alternative to fishmeal in shrimp feeds. Based on the results of 90-day feeding trial on *P. vannamei*, it was found that the string protein products, PROfit and PROtyde were able to replace more than 50% fishmeal in the formulations without negatively affecting the growth performances, feed utilization and physiological responses of *P. vannamei*. The digestibility of these two products were also higher.

Another study based on synthetic choline replacement in shrimp feeds was conducted in collaboration with an industry, Natural Remedies – Bengaluru, India. Due to the increasing demand for environment-friendly shrimp aquaculture, herbal feed additives are gaining attention in the aquafeeds. In corroboration with this, an herbal product was tested against commercial synthetic choline and satisfactory results were obtained at the end of 90-day growth trial.

This Directorate has been involved in various species-specific feed production for fishes and shrimps with the objectives to develop and upgrade aquaculture technologies with innovative interventions for the benefit of farming community, to provide business incubation services for the growth of farmers, start-ups and other stakeholders with lower lease rates and technical support. This Directorate has also been involved in research collaborations with industries for conducting problem solving research for the benefit of the farmers and entrepreneurs and also produce vocational graduates in Industrial Aquaculture by imparting three year B.Voc Industrial Aquaculture programme.

Read more: https://www.tnjfu.ac.in/directorates/diva/

Contributed by: Dr. N. Felix, Directorate of Incubation and Vocational training in Aquaculture (DIVA), Tamil Nadu Dr Jayalalitha Fisheries University (TNJFU), India.

A trivial step towards the conservation of two endangered fishes of India.

Amblyceps mangois (Hamilton-Buchanan, 1822) (Actinopterygii, Siluriformes, Amblycipidae) or the "Indian torrent catfish" and *Badis badis* (Hamilton-Buchanan, 1822) (Actinopterygii, Perciformes, Badidae) or "Dwarf chameleon fish" are tropical, freshwater, hill-stream species that have ornamental as well as commercial value and are found in major river systems of North-Eastern region of India. These species have been designated as "Endangered" as per the list of threatened freshwater fishes of India published by the National Bureau of Fish Genetic Resources, India in 2010. However, there hasn't been enough research undertaken on these fish species' genetic diversity and demographic structure, particularly in India. As the region is part of the Eastern Himalayan biodiversity hotspot, the findings of research reported here will be of crucial importance in validating the species' endangered status and wild population conservation/sustainability.

Molecular markers are used extensively to assess the genetic architecture of any species. We have taken the help of DNA fingerprinting technology with two nuclear markers viz., RAPD (Randomly Amplified Polymorphic DNA) and ISSR (Inter Simple Sequence Repeat) techniques for our preliminary study as they are easy, cost-effective, and fast methods. We have performed DNA fingerprinting on DNA extracted from fin clips and scales. . Intra and inter-population genetic diversity was analysed with the help of sophisticated computer software. Several biodiversity, population genetic, and statistical indices (viz., number of polymorphic loci, allelic richness, Nei's gene diversity, Shannon's Information index, measure of evenness, Heip's evenness index, *SHE* analyses, AMOVA, etc.) were calculated to get a clearer conception about the genetic architecture. Moreover, in an interesting study, we have analyzed the population genetic hierarchical model which is based on gene flow and genetic divergence along the river stream flows downstream. Our data revealed that as the river streams converged from higher to lower altitude, there was a fluctuation in the diversity patterns which is obvious for a riverine organism but the substantial decline of genetic variability within *A. mangois* and *B. badis* populations of the sub-Himalayan region is a local and global issue to concern. The very low level of gene flow and high level of genetic divergence between adjacent populations is nullifying the notion of metapopulation.

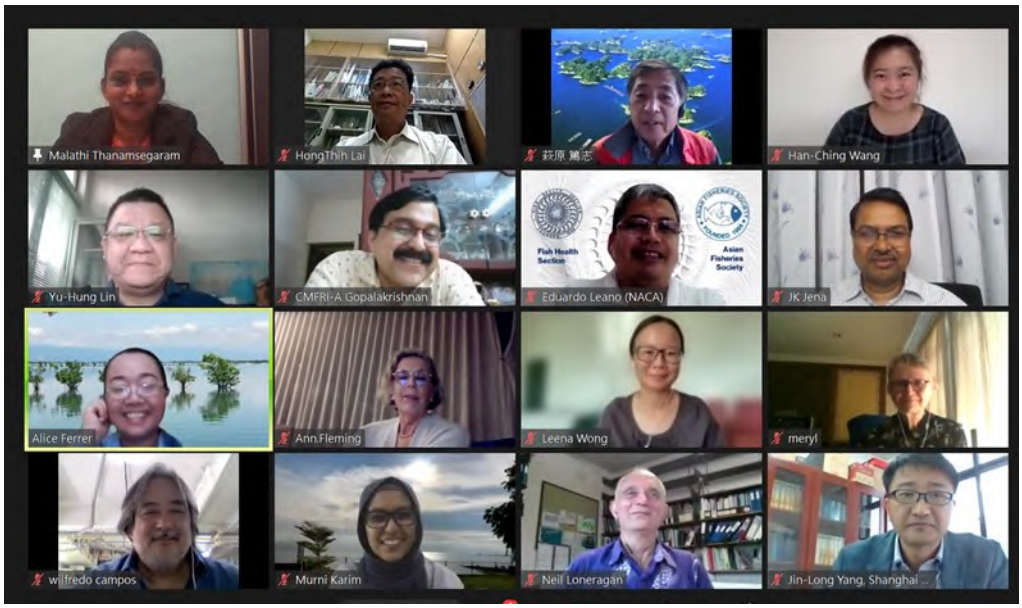
This initial finding strives our focus on more robust analyses with mitochondrial gene Cyctochrome oxidase subunit I (COI) based barcoding analyses. Because of its high mutation rate, maternal inheritance mitochondrial DNA is variable in natural populations, providing information on population history over short periods. Here we have also analyzed several indices (number of haplotypes, haplotype diversity, nucleotide diversity, gene flow, genetic divergence, etc.) to estimate the genetic diversity in a more precise way. It was revealed that mitochondrial barcoding-based study was also in accordance with the fingerprinting-based analyses. Moreover, a coalescent-based stimulating study (neutrality test statistics, nucleotide mismatch distribution, and haplotype network) established on a neutral evolutionary model at mutation-drift equilibrium discovered rapid demographic expansion from a small effective population size, which signal to recent population expansion after common bottlenecking effect and a positive selective pressure acting on the population. The majority of haplotypes are unique to each region which might reveal the presence of many founder populations.

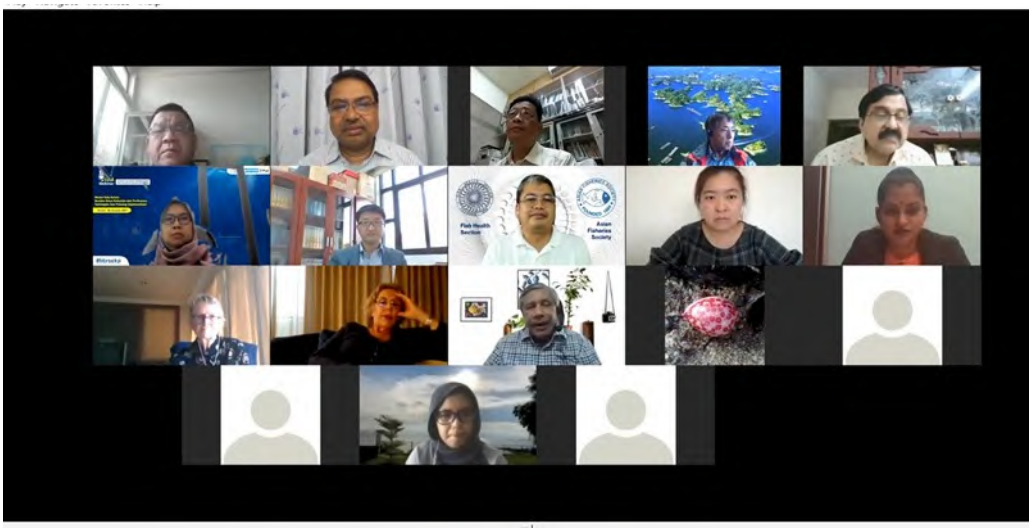
This information is crucial for the long-term survival of a population since it enables the implementation of appropriate conservation and management strategies. Additional studies need to be undertaken with larger sample sizes and temporal replicates, samples collected from different geographical locations, sequencing data from other mtDNA genes, and information based on nuclear DNA. This research provides data that will be useful in large-scale biogeographical and taxonomic studies of this species in the future.

Contributed by: Dr. Tanmay Mukhopadhyay, North Bengal St. Xavier's College, Rajganj, West Bengal, India.

AFS SECRETARIAT NEWS

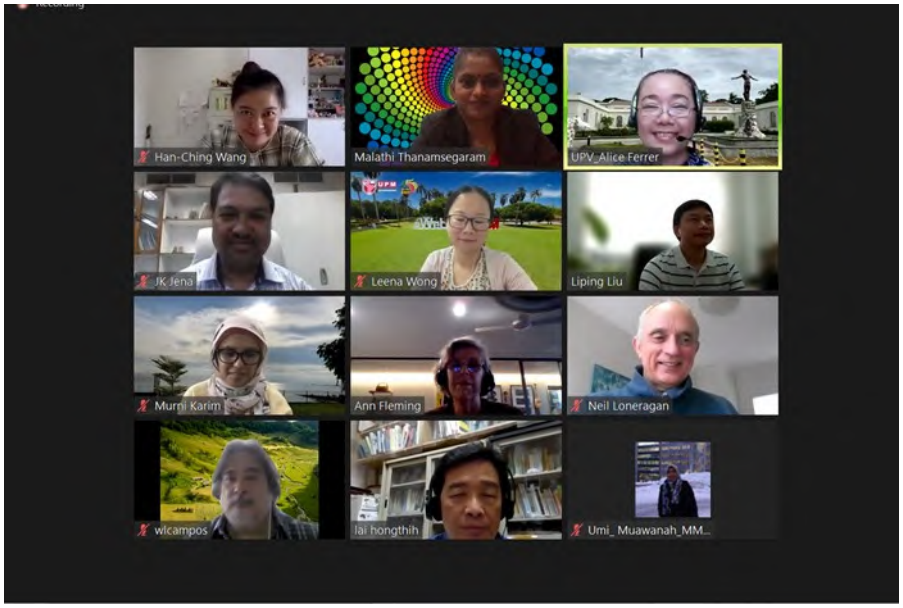
The Asian Fisheries Society 57th Council meeting was held on Tuesday, 20th April 2021 using online platform. During the meeting, 15 councillors from respective countries, Chair of Gender in Aquaculture & Fisheries Section, Secretary/Treasurer of Fish Health Section (FHS) and an Editor of Asian Fisheries Science Journal were participated.

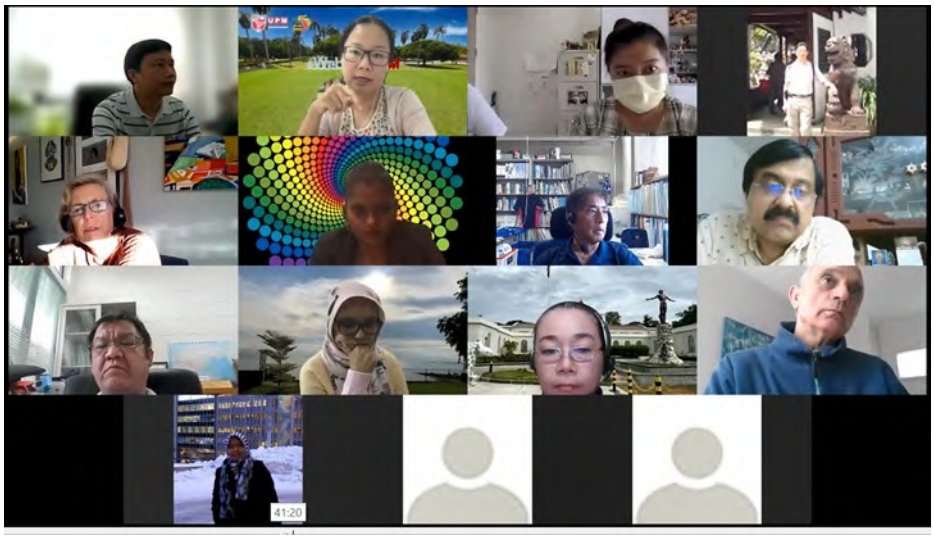




AFS SECRETARIAT NEWS

The Asian Fisheries Society 58th Council meeting (Special Meeting) was held on Tuesday, 8th June 2021 using online platform. During the meeting, 13 councillors from respective countries, President of AFS-Taiwan Branch, and Chairman of Department of Biotechnology and Bio industry Sciences National Cheng Kung University were participated.





Membership Account

Letter for renewal of membership and Permanent Active Member were issued using email to AFS members who haven't renewed their membership fees. All the members were advised to make the payment using PayPal or Telegraphic Transfer (TT).

The username and password were remained as below:
Username: ID Number password: afs@123

2022 Year of International Artisanal Fisheries

The United Nations General Assembly has declared 2022 as the International Year of Artisanal Fisheries and Aquaculture (IYAFA 2022). FAO is the agency leading the advocacy activities for the Year, in collaboration with other UN entities. Celebrating IYAFA 2022 gives important recognition to the millions of small-scale fishers, fish farmers and fish workers who provide healthy and nutritious food to billions of people and contribute to achieving Zero Hunger. The objective of celebrating IYAFA 2022 is twofold: the Year aims to focus world attention on the role that small-scale fishers, fish farmers and fish workers play in food security and nutrition, poverty eradication and sustainable use of natural resources – thereby increasing global understanding and action to support them. The celebration is also an opportunity to enhance dialogue between different actors, and not least to strengthen small-scale producers to partner up with one another and make their voices heard so they can influence the decisions and policies that shape their everyday lives – all the way from local community level to international and global fora. WHAT IS 'ARTISANAL' AND 'SMALL-SCALE'? There is no universal definition for what type of fisheries or aquaculture count as 'artisanal' or 'small-scale'.

Commonly, these terms are used for describing fisheries and aquaculture that use relatively small production units with low input and output, and low levels of technology or capital investment. Fishing for sport or recreation are excluded. IYAFA 2022 will be an opportunity to showcase the potential of small-scale fisheries and aquaculture, and point to the benefits which can be gained from strengthening these small-scale sectors. FAO aims to engage with policymakers, development partners, academia, the private sector, small-scale fisheries and aquaculture organizations, and the general public. To make the most of this opportunity, it is time to think creatively, join hands and start making plans now for how to make IYAFA 2022 a memorable year. Let us give small-scale fishers, fish farmers and fish workers the attention they deserve!

The document can be downloaded at: **http://www.fao.org/3/ca6973en/CA6973EN.pdf**

Fishermen and supporters oppose MPAs favoured by environmental NGOs

On 8 June 2021 -- World Ocean Day -- organizations of fishermen and their supporters, including the Collectif Pêche & Développement in Lorient, France, rallied to declare their opposition to the unilateral and exclusionary policies that favour the establishment of marine protected areas (MPAs) designed to declare 30 per cent of the world's oceans as complete reserves closed to so-called "industrial" fishing.

Pointing to the disregard for fishermen's experiences, knowledge and commitments, the Collectif Pêche & Développement asserts that to embark on a path of authoritarian and technocratic ocean management is to call into question the culture, knowledge and life of fishermen without taking into account the reality of their practices and commitments.

According to the indigenous peoples' organization, Survival International:"Major conservation NGOs claim that (MPAs) will mitigate climate change, reduce wildlife loss, enhance biodiversity and so save our environment. They are wrong. Protected areas will not save our planet. On the contrary, they will increase human suffering and so accelerate the destruction of the spaces they claim to protect, because local opposition to then will grow. They have no effect on climate change and have been shown to be generally poor to prevent wildlife loss. The idea of 'conservation-fortress' -- that local people should be removed from their land in order to protect nature -- is colonial. "

In a paper published in World Development (Volume 146, October 2021), Marco J.Haenssgen et al analyzed the socioeconomic development impact of marine resource management and conservation in Southeast Asia. They concluded: “Qualitative research – based on 22 interviews in Koh Sdach Archipelago, Cambodia – demonstrates how the local community experienced improving relationships with the state and a slowing deterioration of marine resources, but also social division, heightened livelihood anxiety, and potentially a false sense of economic security. We hypothesise on this basis that marine conservation could impede socio-economic development, for which we find support in our quantitative analysis across Cambodia, the Philippines, and Timor-Leste: MPAs materialised in better-off communities but were associated with slower and partly regressive socio-economic development, in particular decreasing wealth and increasing child mortality.”

They added: “These findings suggest that the rapid global expansion of MPA coverage in its current, environmental-conservation-focused form is problematic as it disregards local social realities. Livelihood adaptation support should complement the implementation of marine resource governance mechanisms to mitigate unintended negative consequences.”

Source: **https://outlook.live.com/mail/0/deeplink?popoutv2=1&version=20210607004.05**

Thailand—Rehabilitation of Fishermen Livelihoods and Migrants Work Permits

The national committee on fisheries policy has approved the 2020-2022 fisheries management plan, which is designed to ensure the development of a more sustainable and fishery sector, and the second national plan of action on IUU (NPOA-IUU). The committee also endorsed measures that will ensure the fair, transparent and swift processing of IUU and related cases of forced labour and human trafficking, acknowledged the granting of 2.82- billion baht of funding, to rehabilitate the livelihoods of 188,134 fishermen, and the extension of work permits for migrant workers in the sector during the COVID-19 pandemic.

Meanwhile, Deputy Prime Minister Prawit Wongsuwan urged all authorities to maintain their efforts in curbing illegal, unreported and unregulated (IUU) fishing and to enforce the laws strictly, to tackle forced labour and human trafficking in the sector.

Source: https://www.pattayamail.com/thailandnews/thailand-new-plan-focuses-on-rehabilitation-of-fishermen-livelihoods-and-migrants-work-permits-358715

WTO fishing subsidies negotiations resume, with exemptions for developing nations a key issue

World Trade Organization members have restarted negotiations on ending harmful fisheries subsidies, with the key issue of exemptions for artisanal fisheries and developing nations under debate.

WTO members reopened formal negotiations on fisheries subsidies as the heads of delegations met on 22 January 2021 in Geneva, Switzerland. The organization had hoped for a deal in 2020, but talks repeatedly stalled over the issue of special treatment for developing countries. Some developing countries involved in the negotiations have called for an exemption from any ban on harmful subsidies, after China's claim to be classed as a developing nation created tension in earlier phases of the talks. Members are using a second revision of a text circulated on 18 December by Colombian Ambassador to the WTO Santiago Wills, who is chairing the talks, as the basis of their negotiations. But divisions have arisen over disagreement as to whether the final document should be comprised of a list of prohibited subsidies, or whether it should be centered around effects-based approach that considers the actual impact of a subsidy. Some of the key issues being discussed include wording for which reference points should be used to determine whether a certain fish stock is being maintained at a "biologically sustainable level" and therefore be exempted from the prohibition on capacity-building subsidies. A reference point commonly used in fishery quota-setting is maximum sustainable yield (MSY).

According to press briefing notes issued by the WTO, some members are wary of potential loopholes in any agreement that would allow the use of unreliable stock assessment methods. Others have reiterated they won't accept a fisheries subsidies agreement that is watered down by exceptions that rely on fisheries management and stock assessments. Ecuador, meanwhile, has proposed the talks define what qualifies as "artisanal fishing" so as to exempt that sector from a prohibition on subsidies related to overfished stocks and fleet overcapacity.

Wills has called for a second cluster of in-person meetings between 15 and 19 February. In the meantime, negotiators will continue their discussions remotely due to COVID-19 health precautions.

Source: https://www.seafoodsource.com/news/supply-trade/wto-fishing-subsidies-negotiations-resume-with-exemptions-for-developing-nations-a-key-issue

India to WTO: Exemption of Low-income Fishers from Subsidy Cuts

India's proposal of exempting low-income fishers from developing countries operating in territorial waters from a subsidy ban is gaining weight with several WTO members supporting its inclusion in the draft agreement floated by the chair of the negotiating committee. "What is, however, worrying for India is the indication that the exemption may come with a timeline and may be withdrawn after the initial years," an official source told. As per the draft text being circulated, the prohibition on fisheries subsidies shall not apply to subsidies granted or maintained by developing country members, including least-developed countries, for low income, resource-poor or livelihood fishing or fishing related activities within 12 nautical miles measured from the baselines for a period of about 2 years from the date of entry into force of this instrument. "The text is full of brackets including a bracket on the suggested two years of exemption meaning that these are to be negotiated. However, it will be difficult for India to accept any timeline to the exemption as resource-poor farmers will need support for a long time to come," the source said.

The on-going negotiations around a draft text is important as an agreement on curbing fisheries subsidies is being projected as one of the key achievable at the next WTO Ministerial meeting scheduled in Geneva on November 30 this year. The prohibition targets subsidies in all categories such as fuel subsidy and subsidies for nets, fishing boats and other equipment. An agreement on prohibiting 'harmful' fisheries subsidies could lead to elimination of an estimated $14-20.5 billion of subsidies annually that lead to overfishing and depletion of fish stocks worldwide, but many countries like India have sought exemption for artisanal fishers who fish in territorial waters.

Source: https://www.thehindubusinessline.com/economy/policy/indias-proposal-for-exempting-low-income-fishers-from-subsidy-cuts-at-wto-gaining-weight/article34667091.ece

Singapore deploys drones to monitor reservoir water quality

Singapore's national water agency PUB is deploying autonomous drones at six reservoirs to monitor water quality and other activities to improve operational efficiency. The Beyond Visual Line of Sight (BVLOS) drones, which can be monitored remotely, are fitted with remote sensing systems and cameras that can analyse water for turbidity and algae concentration – indicators of water quality – as well as look out for signs of aquatic plant overgrowth.

The drones are expected to improve the agency's operational efficiency. At present, PUB officers spend 7,200 man-hours each year on daily patrols to look out for excessive growth of aquatic plants and algal blooms. During these patrols, data is also collected on water activities in and along the reservoirs' edge, to ensure they are conducted safely.

By using unmanned drones to carry out monitoring operations, PUB expects to save about 5,000 man-hours, which can be redirected to other works. The drones are capable of surveying large areas of the reservoir, collecting comprehensive data, and triggering alerts when it detects activities such as illegal fishing.

Source: https://www.computerweekly.com/news/252501476/Singapore-deploys-drones-to-monitor-reservoir-water-quality

Enzootic Genetics & Innovation and NRGene to launch all-female *M. rosenbergii*

Freshwater shrimp farmers will soon have the option of purchasing all-female post-larvae (PL), juveniles and broodstock with a genomic sequence that gives them greater disease resistance, better food conversion rates and faster growth rates.

Enzootic Genetics & Innovation, a Singapore-based company, recently built a hatchery in Thailand where it hopes to produce 460 million PLs each year. This year the company is growing freshwater shrimp (*Macrobrachium rosenbergii*) in demonstration ponds to help farmers understand the differences between their current practices and the results they can expect with all-female populations supplied by Enzootic. But by 2022 the company plans to be selling directly to farmers, at prices equal to what they're paying now.

In 2018 Enzootic approached Israel-based NRGene, which provides tools to optimize and accelerate the breeding programs for global agriculture, seed and food companies. Its goal was to have NRGene tap into the sexual plasticity of freshwater shrimp and to find the gender switch whereby shrimp can switch from being male to female. Within three months of that first meeting, NRGene delivered on the request.

"Enzootic now has a patented technology for all-female shrimp and there is no one else in the world that can do this," said Enzootic's executive chairman. "In Israel, at our research and development center, we are producing super-females that can only produce other female shrimp. With this population we can build hatcheries and produce larvae and juveniles for shrimp farmers."

"The real value of what we do here is deliver to farmers a genomic sequence that reduces your research and development and your time to market," said Dr. Gil Ronen, CEO. "NRGene helps its clients do more efficient breeding to reach their goals, and much faster than they could using classical breeding. This is common practice in agriculture and farm animal breeding, but it's only just beginning in aquaculture."

Enzootic believes its patented technology and the genetic improvements coming down the line with this new collaboration with NRGene constitute nothing short of a revolution for the shrimp industry.

"Thailand has a large interior and the ability to grow this shrimp, but in the future Vietnam, Indonesia, India, China and Bangladesh are countries we hope to expand into," Illing said. Over the next five years the company plans to establish 10 hatcheries across Southeast Asia, at a cost of $1.5 million each. "Most countries in Southeast Asia want to expand this industry and their governments are promoting that expansion," he noted. "We hope to bring profitability to the industry by increasing stocking densities of ponds and improving the animals' performance, so farmers will have a much more efficient animal to work with."

Source: https://www.aquaculturealliance.org/advocate/genomics-and-feed-teams-take-aim-at-improving-freshwater-prawn-aquaculture/?utm_source=Informz&utm_medium=email&utm_campaign=Informz%20email&_zs=eAbVe1&_zl=4bXf7

Oceanic Shark and Ray populations collapsed by 70%

On the high seas, far from any continent, sharks and rays were once abundant. Shortfin makos, the fastest sharks on the planet, chased after their prey at speeds of over 20 miles an hour. Scalloped hammerheads plied the waters, scanning the ocean expanse for food with their wide-set eyes and other specialised sensory organs.

"A decade ago," recalls Nicholas Dulvy, co-chair of the International Union for Conservation of Nature's Shark Specialist Group, "we would have extremely heated debates about listing an oceanic shark as threatened." A sweeping analysis of current and historic population numbers have created a clearer—and sobering—picture. Dulvy and co-author Nathan Pacoureau, both at Simon Fraser University in Canada, found that populations of 18 shark and ray species have declined by 70% since 1970, according to the study, published in the journal *Nature*. At this rate, many of the species might disappear entirely in a decade or two, the authors caution.

When the research team crunched the numbers for the oceanic whitetip shark, a species that was common back in 1970, it had declined by 98% in the last 60 years. That pattern was consistent across all three oceans." The International Union for Conservation of Nature now lists the species as critically endangered. Scalloped and great hammerhead sharks have met a similar fate. Though fisheries rarely target oceanic sharks, if they're caught, their meat, fins, gill plates, and liver oil is often sold. This is troubling news both for the sharks and ocean health, as these top predators play a crucial role in the food web, in part by keeping smaller predators in check, experts say.

For the study, Dulvy and Pacoureau collected all the data on those 18 species they could find across the globe, much of it buried in government reports or collecting dust on old hard drives. A growing public awareness of shark conservation has prompted fisheries management agencies to start collecting shark data, providing the team with an influx of brand-new information.

The scientists ended up with 900 datasets spanning 1905 to 2018, each representing a species' population changes over time within a particular region. With the help of international experts and computer modelling, the team extrapolated these data into best estimate of the global change in abundance. They also took into account the development of open-ocean fishing techniques. Long lines studded with hundreds of hooks or enormous purse seine nets often accidentally ensnare sharks, and their use has doubled in the last half century, while the number of oceanic sharks caught in them has approximately tripled.

"Combined with the increasing rarity of sharks, this means that the chance for an individual shark to get caught is now 18 times higher than it was in 1970," says Dulvy. Dulvy adds that uncertainty is inevitable in his analysis, and that the authors have likely underestimated some of the species' declines, particularly in areas where overfishing has occurred for many decades.

The impact of overfishing, accidental or otherwise, on sharks should motivate governments to impose more regulations, with the goal of making fisheries sustainable. A proposed ban on fishing of endangered shortfin makos in the North Atlantic was recently blocked by the European Union and the United States, in part because the bulk of the catch is by Spain.

Source: **https://www.nationalgeographic.co.uk/environment-and-conservation/2021/01/bringing-back-the-most-endangered-bird-in-the-us**

Experimental cultivation of Whiteleg shrimp underway in Bangladesh

Bangladesh has finally started to farm *P.vannamei* shrimp on pilot basis following pleas from exporters as locally grown black tiger shrimp and freshwater prawn are unable to compete with cheaper varieties in western markets.

Purchased from Thailand, the first 1million batch of vannamei was released in four ponds of Bangladesh Fisheries Research Institute (BFRI) in Paikgachha upazila of Khulna. The project will test whether whiteleg shrimp can cope with the local environment. If successful, the initiative is expected to breathe life back into the ailing industry.

The Department of Fisheries (DoF) gave the go-ahead to culture whiteleg shrimp in the southwestern division of Khulna, a major farming region for export-oriented shrimp, after years of concerns that foreign species may have a negative impact on their native counterparts such as black tiger shrimp. The project, set to begin last year, had been delayed by early rainfall and the ongoing coronavirus pandemic. The move comes after repeated pleas from shrimp processors and exporters to allow vannamei cultivation as export earnings from local varieties have fallen consistently since fiscal 2014-15.

Source: https://www.thedailystar.net/business/news/experimental-vannamei-shrimp-cultivation-underway-2072853

Shark Fishing Could Soon be Legal in the Maldives

After an 11-year ban on shark fishing in the Maldives, the country has announced plans to discuss legalising the practice again.

Sharks have always been a valuable tourist attraction in the small island nation, which is one of the top destinations for diving with these marine creatures. But shark fishing was prohibited in 2010 following a reported decline in populations. This ban was put in place to protect the species from dying out.

But in a recent government u-turn, Maldives Minister of Fisheries Zaha Waheed has said discussions are taking place to decide whether legalising shark fishing would provide economic benefits. There have also been concerns around overpopulation of sharks in Maldivian waters and recent shark attacks.

"Very few countries implement shark conservation. Since it is a means to generate profit we don't have to limit ourselves. [We can] open [shark fishing] as a manage fishery for a certain duration and fish without endangering the shark population," she said at the Parliamentary Committee on Economic Affairs.

The top five biggest shark fishing nations in the world are Indonesia, Spain, India, Mexico and the USA, according to the Marine Stewardship Council. Sharks are harvested primarily for their meat and fins but have also been targeted for their skin, cartilage and liver.

Source: https://www.euronews.com/living/2021/04/06/shark-fishing-for-profit-could-soon-be-legal-in-the-maldives

Aquabounty Commercial Harvest of GM Salmon

AquaBounty will initiate its first commercial harvest of fast-growing genetically modified salmon, the first GM animal approved for human consumption, from its Indiana facility. It took AquaBounty nearly three decades and cost well over $80 million.

AquaBounty claims that its sustainable land-based operations have a lower carbon footprint with reduced transportation requirements than Atlantic salmon that is imported from other suppliers.

The AquAdvantange salmon has been engineered to grow to market weight in about half the time of a typical Atlantic salmon. This reduces the amount and cost of feed that is needed to produce the fish. AquaBounty can produce up to 70% more fresh salmon annually compared to conventional Atlantic salmon grown in the same period under the same conditions. The GM salmon are also free of antibiotics and ocean contaminants.

Source: **https://allianceforscience.cornell.edu/blog/2021/05/seafood-distributors-welcome-aquabountys-sustainable-gm-salmon/**

NEW PUBLICATIONS

Matsya Setu – Virtual Learning App for Fish Farmers

ICAR-Central Institute of Freshwater Aquaculture, Bhubaneswar, India has come up with - The Virtual Learning App for Fish Farmers - ***Matsya Setu*** (Matsya means fish and Setu means bridge). It has self-learning modules on the breeding and culture technologies for different fish varieties.

The App can be download and installed from Google Play Store link:

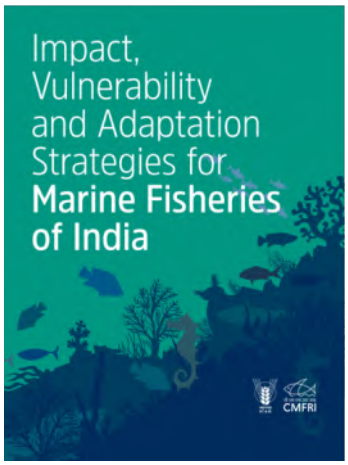
https://play.google.com/store/apps/details?id=com.fish.cifa

https://youtu.be/UA1itvkWZxw

SUPPORTING SMALL-SCALE AND ARTISANAL FISHERIES

This document summarizes achievements of FAO to support sustainable marine and inland small-scale and artisanal fisheries governance and development. It highlights the contribution of small-scale and artisanal fisheries to food system transformation in the context of the 2030 Agenda for Sustainable Development, as well as innovative efforts to improve technical capacities for data collection and analysis in small-scale fisheries. Finally, it presents preparations for the International Year of Artisanal Fisheries and Aquaculture (IYAFA) in 2022.

Document can be downloaded from: http://www.fao.org/3/ne712en/ne712en.pdf



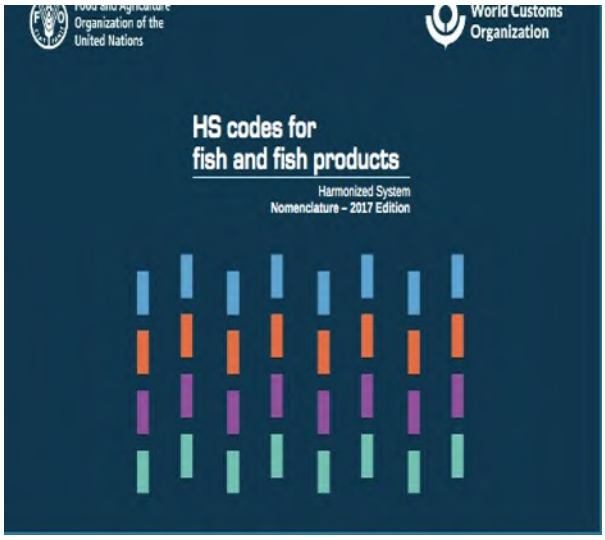
India: Study on Impact, vulnerability and adaptation strategies for marine fisheries.

This document can be downloaded from: http://eprints.cmfri.org.in/14771/

Aquafeed value chain analysis and a review of regulatory framework of striped catfish farming in Viet Nam

This document can be downloaded from: http://www.fao.org/3/ca7177en/ca7177en.pdf?fbclid=IwAR0cbKJUuhQNheSou7ubTxe4OsBuRm-LWBt-_bG7ei8Mje4zwHGFyHZf7s0

HS Codes for Fish and Fish Products



The classification of products is a key element in international trade. The Harmonized System (HS) of the World Customs Organization (WCO) provides an internationally recognised system of product classification. It is used for many purposes, including import duties, rules of origin, freight documents and statistics. This publication, developed by FAO GLOBEFISH with the active support of the World Customs Organization (WCO), builds on the Harmonized System 2017 Edition. It presents all possible classifications for fish and fish products by species with a full description of each HS code, to facilitate its use within the fisheries sector.

This document can be downloaded from: https://issuu.com/globefish/docs/fao_wco_-_hs_code

Strengthening, Empowering and Sustaining Small-scale Aquaculture Farmers Association

This document can be downloaded from: http://www.fao.org/3/ca7741en/ca7741en.pdf?fbclid=IwAR0TrclGyV8TJHA4rRvaf5vBfYz5NT9D884BDD7kFgSnDB17MjPn6Y_ELNE

COFI Declaration for Sustainable Fisheries and Aquaculture

In February 2021, FAO country members endorsed the COFI Declaration for Sustainable Fisheries and Aquaculture at the 34th Session of the Committee on Fisheries (COFI 34) in the context of the High-Level event to celebrate the 25th Anniversary of the Code of Conduct for Responsible Fisheries.

The COFI Declaration for Sustainable Fisheries and Aquaculture is the result of an extensive consultative process to acknowledge the achievements of the fisheries and aquaculture sector since the endorsement of the FAO Code of Conduct for Responsible Fisheries in 1995 and to gather collective momentum in tackling the challenges and opportunities to secure the long-term sustainability of the sector. The COFI Declaration for Sustainable Fisheries and Aquaculture is available here.

Full declaration can be downloaded from: http://www.fao.org/3/ne472en/ne472en.pdf#page=2

Samudra Report No. 85, May 2021

SAMUDRA Report No. 85, dated May 2021, published by the International Collective in Support of Fishworkers (ICSF) features a range of articles from Africa, Asia, South America and the Caribbean, specifically from Turkey, Cambodia, South Africa, Brazil, Tanzania, Sri Lanka, Indonesia, Mozambique, Antigua and Barbuda, Bangladesh, Costa Rica, India, France, the Philippines, Brazil and Thailand. The issue also carries articles that analyze the Blue Economy, destructive fishing, small-scale fisheries (SSF) and the SSF Guidelines, among other topics.

The current issue has three articles on food security (from Indonesia, Sri Lanka and Cambodia) and five articles on social development and sustainable fisheries (from Antigua and Barbuda, Bangladesh, Costa Rica, India, the Philippines and Thailand). The editorial Comment in SAMUDRA Report No. 85 discusses how the COVID-19 pandemic has exposed the global inadequacy of social-protection floors in safeguarding marginalized communities, in the process exacerbating poverty and vulnerability. The report can be accessed at: https://www.icsf.net/en/samudra/article/EN/85.html?limitstart=0

Source: https://outlook.live.com/mail/0/deeplink?popoutv2=1&version=20210614002.09

The Routledge Handbook of Feminist Economics

Edited by Gunseli Berik and Ebru Konga. Published by Routledge May 2021

Price Pound 190; e-book: Pound 35.99

AFS MEMBERSHIP RENEWAL NOTICE

Dear AFS Members:

Thank you all AFS Members for your ongoing commitment and support towards the Society!

The Secretariat has started to update the Members details in database.

Therefore, the Secretariat requests all AFS members to update their membership dues and contact information, to the Secretariat via email at **info@asianfisheriessociety.org.**

Kindly renew your membership dues using online payment system at **http://www.asianfisheriessociety.org/join.php** or

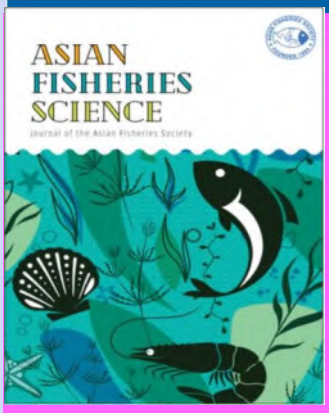
you may also request the membership form from Secretariat via **info@asianfisheriessociety.org.**

Membership is open for all!

Please apply your membership at http://www.asianfisheriessociety.org/join.php.

If you have any question, kindly email us at info@asianfisheriessociety.org

SYNOPSIS OF PAPERS VOLUME 34 (ISSUE 1) : ASIAN FISHERIES SCIENCE JOURNAL



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Status of Fish Assemblages in Four Major Reservoirs of Thailand

AMPHORN SAKSET, SUWIMON SEEHIRUNWONG, CHATCHAI PREECHA

https://doi.org/10.33997/j.afs.2021.34.1.001

Results of the fish assemblages' showed that the Pa Sak Jolasid Reservoir had the highest number of fish species (70), while the Rajjaprabha Reservoir had the lowest number (41). Eight species were identified as in danger of extinction and six species as alien. The percentage of the index of relative importance showed that the major species mainly belong to the family Cyprinidae. The forage and carnivorous fish ratio showed balanced communities in all reservoirs except the Sirikit Reservoir. The evenness index and diversity index indicated moderate diversity and distribution in all reservoirs. In the overall assessment of fish assemblage status among the reservoirs, the Pa Sak Jolasid and Rajjaprabha Reservoirs showed the most desirable condition, while the Sirikit Reservoir showed the least desirable condition. These findings suggest the need to implement various practical fishery resource management, such as banning the introduction of invasive exotic species, and establishing conservation measures for species on the list of extinction.

The Relationship Between Size at Maturity and Maximum Size in Cichlid Populations Corroborates the Gill-Oxygen Limitation Theory (GOLT)

UPALI S. AMARASINGHE, DANIEL PAULY

https://doi.org/10.33997/j.afs.2021.34.1.002

Fish generally mature at a smaller fraction of their maximum sizes than birds and mammals. The farmed tilapia can tolerate adverse conditions that result in stunting and which also cause the fish to spawn at small size. The present study shows that tilapia and other cichlids do not spawn 'earlier' than other 2 teleosts. Rather, they are exceptionally tolerant of stressful environmental conditions, but with elevated metabolism. By reducing their growth and the maximum size they can reach 'stunting', they also reduce the sizes at which their maturity is initiated ('early spawning'). This corroborates the gill-oxygen limitation theory (GOLT), which identifies spawning as an event rather than a determinant of fish growth.

Beyond Bycatch: The Species Diversity of Tonguesole (Pleuronectiformes: Cynoglossidae) in Coastal Fisheries of the Tanintharyi Region, Southern Myanmar

IRIS SEGURA-GARCIA, SABAI SOE, NYO-NYO TUN, STEPHEN BOX

https://doi.org/10.33997/j.afs.2021.34.1.003

This study investigated the species diversity of tonguesole landings in Myanmar. DNA barcoding was used to distinguish potentially 10 different species, of which five were identified to species level and five at the genus level. Unconfirmed genetic identifications were based on external morphology. The poor efficacy of DNA barcoding for tonguesole species identification resulted from the limited DNA barcode reference sequences available in public databases. The most common species was Cynoglossus oligolepis, a new species record for Myanmar, followed by Cynoglossus lingua. The results of the present study provide new information to characterise the tonguesole fishery as a first step in the development of management plans for the coastal fishery in Myanmar.

Bacterial Communities Associated With Penaeus vannamei Boone, 1931 Surface and Its Rearing Water in Biofloc Culture System

PALLAVI BALIGA, PUNEETH THADOORU GOOLAPPA, MALATHI SHEKAR*, S.K. GIRISHA, RAMESH K.S., VILASINI UDYAVARA, M.N. VENUGOPAL

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The microbial communities associated with the biofloc pond water and the surface of Penaeus vannamei reared in it were characterised using the Illumina Miseq sequencing technology. Analysis revealed that Proteobacteria, Bacteroidetes, Planctomycetes and Cyanobacteria formed the principal phyla. The operational taxonomic units (OTU) analyses revealed that 18.38 % OTUs were shared by the pond water samples, the shrimp surface samples shared 29.35 % at the three different time points. PICRUST analysis revealed that the bacterial communities in the biofloc rearing water, and shrimp surface, were likely involved in intensive microbial metabolism and core housekeeping functions. The information generated will help understand the bacterial community composition associated with optimal water quality and shrimp health in a biofloc culture system.

Diet of Exotic Pirapitinga Piaractus brachypomus (Cuvier, 1818) From Vembanad-Kole Wetland, India, as Inferred From Gut Content Analysis and DNA Barcoding

VINOD SREEDEVI ANUPAMA, SMRITHY RAJ, SUVARNA S. DEVI, APPUKUTTANNAIR BIJU KUMAR

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Gut contents of the exotic characid fish Piaractus brachypomus that escaped into the Vembanad-Kole Wetland, India, during the floods were examined. The qualitative analysis of gut contents showed that the fish is an omnivore with detritus (27 %) as the most dominant food item followed by, plant matter (25 %), crabs (16 %), molluscs (12 %), fish (11 %) and insects (7 %), respectively. DNA barcoding of the gut contents revealed taxa such as Puntius mahecola, Bellamaya sp., Spiralothelphusa sp. And Ictinogomphus sp. among diet contents. The most predominant food item of P. brachypomus is crabs. Piaractus brachypomus showed greater variations in diet spectrum from their frugivorous nature in the home range (Amazon basin) to a more generalist heterogeneous feeding nature in the introduced ecosystem. The study found that in a highly biodiverse ecosystem, the introduced alien fish may compete with native fish and feed on native organisms. The paper suggests a precautionary approach in flood plain aquaculture, especially with the increase in extreme climatic events and holistic studies on invasion biology to manage invasive species.

Generation of Transgenic Medaka Oryzias curvinotus (Nichols & Pope, 1927) Carrying a Cyan Fluorescent Protein Gene Driven by Alpha Actin Promoter

VY NGUYEN HOANG THUY, TRUNG MAI NGUYEN THANH, BINH NGUYEN QUOC, HOA NGUYEN THI KIEU, DU NGUYEN VAN, THAO LUU THI THACH, VU THANH NGUYEN

https://doi.org/10.33997/j.afs.2021.34.1.006

The study produced fluorescent protein transgenic medaka as a novel strain of ornamental fish. These fish were produced by transferring a plasmid consisting of a fluorescent reporter gene and a strong promoter into one-cell stage embryos. The study also evaluated the stability of the transgenic medaka germline acquiring vivid fluorescent phenotypes via the transgenesis of the cyan fluorescent protein (CFP) gene under the control of O. curvinotus skeletal alpha-actin (OCacta) promoter. The pOCacta-CFP plasmid, containing a OCacta promoter and CFP reporter gene, was transferred into the one-cell stage of O. curvinotus embryos by a microinjection technique. As a result, 36 of 1386 microinjected O. curvinotus embryos exhibited CFP signals in their trunks. Oryzias curvinotus founders showing clear CFP signals were selected and crossed with non-transgenic counterparts to produce subsequent generations. Only two of the five founders successfully pass the transgene to the F1 generation. At present, the progeny of subsequent generations is being produced and tested for the expression of CFP signals, and therefore, stable lines are ongoing.

The Extent, Dynamics, and Potential Predictors of Technical Efficiency and Capacity Utilisation in Small-Scale Fisheries in Oman

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This paper investigates the extent, dynamics, and factors influencing technical efficiency (TE) and capacity utilisation (CU) in small-scale fisheries (SSF) using a two-stage data envelopment analysis (DEA) approach covering the period 2010–2012. A considerable extent of boat-level technical inefficiency, capacity underutilisation and scale inefficiency were evident. On average, TE and CU levels under the constant returns to scale (CRS) and variable returns to scale (VRS) models declined over time. The TE and CU scores of 2010 remained unaltered with the addition of 'fishing time' as an input to the model. The proportion of boats with unitary scale efficiency (SE) decreased from 26 % in 2010 to 12 % in 2012. The underutilisation rates of the inputs 'crew' and 'fishing time' ranged from 15.5 % to 31.6 % and 15.8 % to 28.6 %, respectively. Among the species category, the extent of excess capacity was 70 % to 156 % and 47 % to 119 % under the CRS and VRS models, respectively. The second-stage DEA results indicated that the explanatory variables 'fishing location', 'catch per unit of effort' (CPUE), 'fuel costs' and 'crew share' significantly influenced CU under the CRS model. Other significant variables were found in the study under CRS and VRS models.

Red Hybrid Tilapia (Oreochromis spp.) Broodstock Development Programme in Malaysia: Status, Challenges and Prospects for Future Development

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https://doi.org/10.33997/j.afs.2021.34.1.008

This paper discusses the status of the red hybrid tilapia breeding programme in Malaysia, including issues and future perspectives. Selected founder stocks from Malaysia, Taiwan and Thailand were used to establish a base population for the programme. In this programme, the combined selection was practised which produced six generations of selection and successfully improved 12.5 % of harvest body weight per generation. The 6th generation was used as one of the founder stocks, apart from FRI Glami Lemi, Negeri Sembilan and Pahang populations to improve resistance to Streptococcus agalactiae. In 2017, the scope of the programme was expanded to include molecular tool in identifying markers for growth. Ten SNP markers associated with high growth performance traits were discovered. The provision of better breeding stocks for the aquaculture industry and the development of safe and productive operations are expected to result in more stable fish production and an improved income for farmers.

How Much Do Farmers Expect to Implement for Traceability? Evidence From a Double-Bound Choices Experiment of Vietnamese Shrimp Aquaculture

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https://doi.org/10.33997/j.afs.2021.34.1.009

Traceability is considered the most important requirement for shrimp products exported to global markets. However, implementing traceability in shrimp-exporting countries is challenging because of limited production at the local supply chain and lack of financial welfare awareness. This study investigated the expected farm-gate price for traceability implementation using a double-bound dichotomous choice experiment. The censored regression model is used to estimate the factors influencing the anticipated farm-gate price of shrimp farmers. To implement traceability, P. monodon farmers estimated the farm-gate price at 10.17 USD.kg-1, while P. vannamei farmers expected 6.18 USD.kg-1. Application of international quality assurance certifications, willingness to implement traceability, land used, culture methods, shrimp species, current farm-gate price, and variable costs affected the expected farm-gate price. The attractive anticipated farm-gate price compensated for the negative influence of applying international quality assurance certifications, indicating that the farmers were willing to implement traceability. This suggests that the application of certifications increased the ability to implement traceability in the shrimp supply chain. The attractive farm-gate price for certified shrimp products would enhance their willingness to implement the traceability of shrimp products.

Histopathology of Anilocra leptosoma Bleeker, 1857 (Isopoda, Cymothoidae) Infestation on Its New Host Nematalosa nasus (Bloch, 1795) From India

AMRUTHA SHYLA SURESH, BALAMURALI RAGHAVAN PILLAI SREEKUMARAN NAIR, ARYA UNNI, BINUMON THANKACHAN MANGALATHETTU

https://doi.org/10.33997/j.afs.2021.34.1.010

This study reported the histopathological changes caused by Cymothoid, Anilocra leptosoma in the skin of Bloch's gizzard shad, Nematalosa nasus. Histopathological examination of processed skin tissues showed changes such as hyperplasia and erosions of the epidermis associated dermal oedema and muscle degeneration. The host response also included an aggregation of subepithelial dense sheets of hemosiderin-laden macrophages within the dense mixed inflammatory cells. Anilocra leptosoma are serious parasites of marine fish that can cause severe economic loss in the commercially important fish species. The present study represents the first record of the parasite on N. nasus from India.

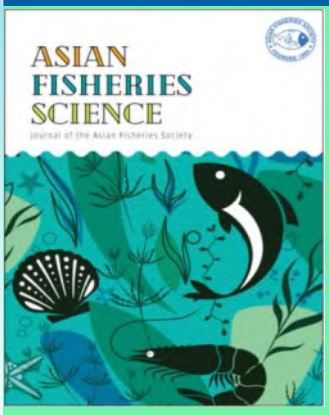
COVID-19 and Small-Scale Fisheries in Southeast Asia: Impacts and Response

ALICE JOAN G. FERRER, ROBERT POMEROY, MICHAEL J. AKESTER, UMI MUAWANAH, WATCHARAPONG CHUMCHUEN, WEN CHIAT LEE, PHUNG GIANG HAI, K. KUPERAN VISWANATHAN

https://doi.org/10.33997/j.afs.2021.34.1.011

This paper describes the impacts of and responses to COVID-19 of small-scale fisheries in six selected countries in Southeast Asia - Indonesia, Malaysia, Myanmar, Philippines, Thailand, and Vietnam. The paper used a structured case study approach to analyse the impacts and responses in each country. The paper recommends several approaches and interventions to improve household resilience and to be better prepared for similar challenges and threats in the future.

SYNOPSIS OF PAPERS VOLUME 34 (ISSUE 2) : ASIAN FISHERIES SCIENCE JOURNAL



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Substitution of Fishmeal with Black Soldier Fly Hermetia illucens Linnaeus, 1758 Larvae in Finfish Aquaculture – A Review

Priyadarshana et al.

https://doi.org/10.33997/j.afs.2021.34.2.001

This article reviewed the use of black soldier fly Hermetia illucens larvae (BSFL) as a fishmeal replacer in aquaculture. Most studies revealed that up to 50 % of fishmeal replacement would be possible without negative effects on the fish. Notable adverse effects were found beyond 50 % of fishmeal replacement, mainly due to high chitin levels in the pupal stage and high crude fat levels. Harvesting BSFL before the pupal stage and defattening made it possible to replace 100 % of fishmeal without adverse effects on fish.

Diversity of Biological Communities Along the Major Rivers of Sundarbans in Bangladesh

Uddin et al.

https://doi.org/10.33997/j.afs.2021.34.2.002

This study assessed the abundance, diversity indices and richness of plankton and fisheries resources of the Pasur, Sela, Sibsa, and Kapotakkho rivers in Sundarbans, a biodiversity hotspot in Bangladesh. During the study, the range of pH, temperature, salinity and dissolved oxygen values were from 7.1 to 8.7, 25 °C to 32.8 °C, 1.5 ‰ to 23 ‰ and 4.3 mg.L-1 to 7.7 mg.L-1, respectively. Phytoplankton and zooplankton communities were represented by 29 and 18 species, respectively. The number of plankton per litre was highest in the Pasur River during both pre-monsoon and post-monsoon seasons. A total of 186 species of fish and crustaceans were recorded in the rivers of Sundarbans. The plankton, fish and crustacean diversity indices were as follows: Shannon-Wiener diversity (1.22 ± 0.27 to 3.48 ± 0.22), Margalef's richness (1.29 ± 0.33 to 4.56 ± 0.45) and Pielou's evenness (0.94 ± 0.04 to 1.02 ± 0.04). The results of the present study underscore new insight on riverine biological communities of the Sundarbans and emphasise the need for long-term monitoring in this ecologically fragile ecosystem.

Community-Based Cobia, Rachycentron canadum (Linnaeus, 1766) Culture in Open Sea Cages at Olaikuda, Pamban Island, India: An Economic Analysis of Technology Transfer Initiative

Rajaprabhu et al.

https://doi.org/10.33997/j.afs.2021.34.2.003

The Olaikuda Village of Pamban Island, India, was chosen to demonstrate and transfer the cobia.s open sea cage culture technologyto supplement the income of traditional fishers under the societal development initiative. With the active participation of the local fishers Rachycentron canadum fingerlings were stocked in two cages with a stocking density of 4.7 fingerlings.m-3 and reared with the locally available low-value fishes for 8 months. Cobia attained an average weight of 3.3 kg resulting in an average daily growth rate of 13.5 g with a survival rate of 75 %. The fish harvested on the 245th day of culture, yielded 7,000 kg of marketable size cobia (1st cage 3,687 kg and 2nd cage 3,313 kg with an FCR of 1:5.5). The fish were sold at the farm gate price of USD4.42 kg-1. The economic analysis revealed a profit margin of USD1.26 kg-1. The parameters such as cost of production, productivity, profitability, socio-economic impacts of native fishers were analysed during the study. The result of this farmerdriven attempt is encouraging the farmers across the coastal states to do cage culture farming in a big way. More organised massive similar programs will create new jobs, reduce fishing pressure on the natural sea stocks and be considered a viable alternative livelihood for the fishers' community affected by the declining natural fishery resources and international border issues.

Production Trends, and Challenges for Biodiversity Conservation and Sustainable Fisheries Management of Kaptai Lake, the Largest Reservoir in Bangladesh

Suman et al.

https://doi.org/10.33997/j.afs.2021.34.2.004

A study was conducted to evaluate the current fish management scenarios, fish production, relative abundance to improve the production and biodiversity of Kaptai Lake (KL), the largest artificial lake in Bangladesh. Data were collected from stakeholders through personal observation, focus group discussions, and cross-check interviews. The fish production of KL increased from 1,200 metric tons (MT) in 1965–1966 to 10,577 MT in 2018–2019. The output of the lake was dominated by small fish. A total of seventy-six fish species were observed under ten orders, including seven exotic fish species. According to the IUCN Bangladesh, 14 % of total species were identified as vulnerable, 11 % as endangered, 3 % as critically endangered, 11 % as near threatened and 51 % as least concern. The study also identified that climate change and various human-driven causes threaten this lake's fish production and biodiversity. These findings suggest that community-based fisheries management, protection of natural breeding grounds of carps, control of pollution, amendment of existing fishing laws, and collaborative research would be necessary approaches for mitigating the negative environmental impact of this lake.

The overall practical knowledge of this investigation could assist in policymaking and further research.

Length-Based Stock Assessment of Smith's Barb, Puntioplites proctozystron (Bleeker, 1865) (Cyprinidae) and Asian Redtail Catfish, Hemibagrus nemurus, (Valenciennes, 1840), (Bagridae) in a Multipurpose Reservoir in Thailand

Charernnate et al.

https://doi.org/10.33997/j.afs.2021.34.2.005

In this study, two fish stock assessment models, viz., relative yield per recruit and length-based spawning potential ratio, were used to evaluate the status of Smith's barb, Puntioplites proctozystron and Asian redtail catfish, Hemibagrus nemurus, as well as to highlight their applications to data-limited situation in Kangkrajan Reservoir, Thailand. Both species showed isometric growth. Von Bertalanffy growth parameters were estimated. Asymptotic length, curvature parameter and theoretical age at length zero were 36.2 cm TL, 0.39 yr-1 and -0.28 yr for P. proctozystron, respectively, and 63.2 cm TL, 0.37 yr-1 and -0.32 yr for H. nemurus. The exploitation rates reveal that both species are slightly overfished. Sizes at 50 % maturity and 50 % selectivities were 17.8 and 23.5 cm TL for P. proctozystron, respectively, and 15.6 and 20.8 cm TL for H. nemurus. Considering both parameters, the size at first capture to sustain the fisheries of P. proctozystron and H. nemurus should be >18 cm and >30 cm, respectively, which can be achieved by mesh-size regulations.

Bacterial Community Changes in Penaeus vannamei Boone, 1931 Surface and Rearing Water During Enterocytozoon hepatopenaei Infection

Baliga et al.

https://doi.org/10.33997/j.afs.2021.34.2.006

This study evaluated the bacterial community changes occurring on the surface of shrimp Penaeus vannamei afflicted by the white faeces syndrome and the pond water in which it was reared. The pond water and the shrimp surface shared >45 % of the operational taxonomic units (OTUs), reflecting the influence of water quality on the bacterial community composition on the shrimp surface. Among these, the Proteobacteria formed the principal phyla and remained unaltered throughout the culture period. Bacteroidetes formed the second largest group across samples, followed by Cyanobacteria, Actinobacteria, Planctomycetes, Verrucomicrobia and Chloroflexi. The relative abundance levels of health indicator bacterial families such as Thiotrichaceae, Microbacteriaceae and Chitinophagaceae showed significant fluctuations on the shrimp surface. Disease indicators such as Rickettsiaceae, Mycobacteriaceae showed an increase in numbers on the shrimp surface. PICRUSt functional predictions revealed higher abundances of genes involved in metabolism and genetic information processing. The study provides valuable findings on the bacterial communities of rearing water and shrimp surface associated with white faeces syndrome.

Genetic Diversity and Population Structure of Endangered Catfish Rita rita (Hamilton, 1822) Revealed by Heterologous DNA Microsatellite Markers

Ali et al.

https://doi.org/10.33997/j.afs.2021.34.2.007

Rita rita collected from Old Brahmaputra, Jamuna, Meghna and Kangsa rivers, Bangladesh, were analysed to evaluate the genetic diversity and population structure using five microsatellite primers. Four of the five amplified loci were found polymorphic (P95) in all the populations and 46 alleles were recorded with 9 to 14 alleles per locus. Differences were observed in the total number of alleles ranging from 41 to 44, effective number of alleles from 29.96 to 37.46, observed heterozygosity from 0.57 to 0.76, Shannon's information index from 2.09 to 2.30 and polymorphic information content from 0.84 to 0.88 among the four populations. Results exposed the highest levels of genetic diversity in the Meghna population while the lowest in the Kangsa population of R. rita. All the populations were significantly deviated from the Hardy-Weinberg equilibrium for all the loci. Nei's genetic distance between populations ranged 0.007 to 0.017 with low overall genetic difference FST = 0.011 and high gene flow Nm = 24.333, indicating that R. rita populations were not subdivided. This study revealed a high level of gene diversity with deficiency in genetic heterogeneity in all the populations of R. rita, emphasising natural management, conservation and rehabilitation measures of this species

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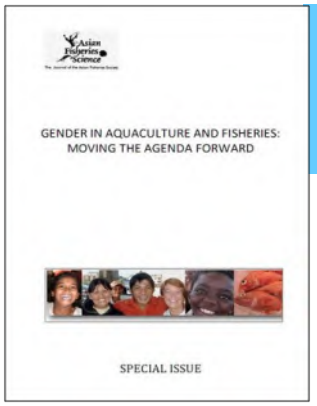

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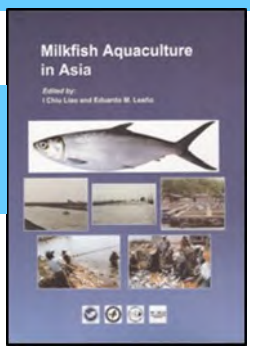

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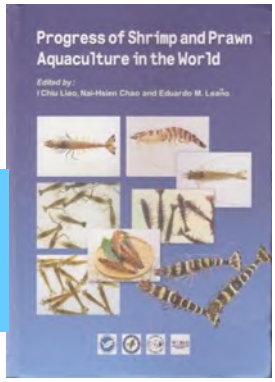

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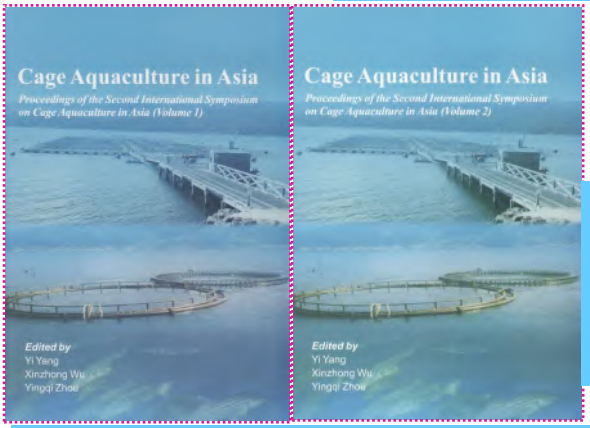

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