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Inside...

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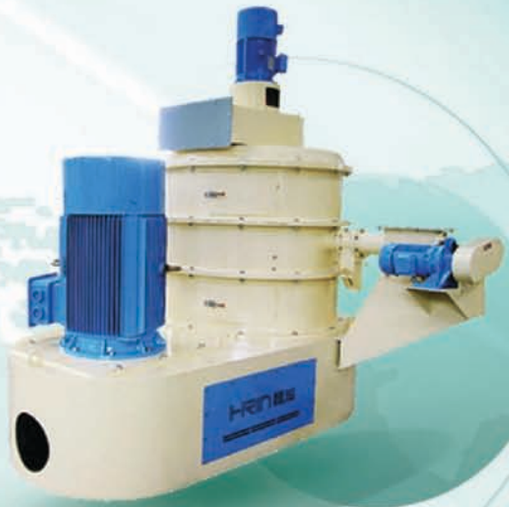

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M. A. Nazeer

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Create Awareness among Members in Parliament on the Nutrition Value of Shrimp & Fish

Dear Readers,

The June 2019 issue of *Aqua International* is in your hands.

I got surprised seeing the results of Assembly and Parliament / Lok Sabha Elections 2019. The kind of majority seats the people of Andhra Pradesh gave to YSRCP and the people of the country to BJP was beyond to the expectations of experts on the subject. The nation appreciated CBI Joint Director Mr Lakshiminarayana when he arrested Mr Y.S. Jaganmohan Reddy and others who involved in multi scams involving huge money, but the same CBI top officer-turned- politician was defeated in the present elections from Visakhapatnam constituency.

When will we change and become matured citizens and voters like America and Europe where the people carefully think and elect correct people to rule the government and the country without corruption, and with regional and religious harmony.

I am happy to congratulate our "Shahrukh Khan" from Indian poultry industry Dr G. Ranjith Reddy, President, Poultry Breeders Association of Telangana, CMD of S R Group and the one among the top 10 companies in Indian poultry industry got elected as the Member of Parliament from Chevella Constituency, near Hyderabad.

We also congratulate other stakeholders of Aquaculture industry who got elected in the recent elections. I am sure, Dr Ranjith will create awareness to the Members in the Parliament on the nutrition value of Shrimp and Fish products for human health and get government support for the promotion of Aquaculture sector in the country.

In the News section, you may find news about shrimp production in the country, after showing a consistent growth in the last decade, is likely to drop by 10 to 15% this year as low prices and fear of spread of diseases among shrimps have forced aquaculture farmers to cut production in the farms.

The stocking in the farms in south Andhra Pradesh is down by half while in north and central parts of the state, the situation is better with 80% of the farms well stocked, as per Mr D. Ramraj, President of All India Shrimp Hatcheries Association.

Tilapia is the world's second most farmed fish, mainly due to its resistance to disease, but stocks are threatened by a lethal virus. Most production is in Asia, and experts warn of social and economic catastrophe if virus wipes species out; China, the biggest producer, is not infected so far.

A small African fish called the tilapia may be vital for meeting the future food needs of humanity, according to scientists, but they are also concerned that a killer disease discovered in recent years could wipe out the species. That, they warn, would have devastating social and economic consequences for China and the rest of the Asia-Pacific region.

A special feature is given about ISHI MARINE TECHNOLOGIES, the company promoted by Contractor family of Surat, Gujarat, launched Shrimp Feed Plant with four brands such as INGESTA and NANSHE as Vannamei feeds, HAMUN and TIMEE as Tiger shrimp feed at a well attended ceremony held in Surat on May 8. The Plant has production capacity of 30,000 tonnes of shrimp feed annually.

Contractor's family are also working to set up Black tiger shrimp Broodstock Multiplication Centre in Gujarat in collaboration with Moana Technologies, USA, which is likely to come into operations in 2020. Mr Walter Coppens, CEO of Moana Technologies LLC, Belgium, confirmed it during a brief interaction with Aqua International editor on May 8 at Surat. Contractor's Family are also planning to come up with a shrimp processing plant soon.

Another special feature may also be seen on Grobest Feeds, one of the senior most aquaculture feed manufactures in the country. Its newly joined General Manager Mr S. Chandrasekher spoke to Aqua International editor about their future plans and targets to become one of the leading players in aquaculture feed market in India.

M.A.Nazeer
Editor & Publisher
Aqua International

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Aqua International

Our Mission

Aqua International will strive to be the reliable source of information to aquaculture industry in India.

AI will give its opinion and suggest the industry what is needed in the interest of the stakeholders of the industry.

AI will strive to be The Forum to the Stakeholders of the industry for development and self-regulation.

AI will recognize the efforts and contribution of individuals, institutions and organizations for the development of aquaculture industry in the country through annual Awards presentation.

AI will strive to maintain quality and standards at all times.

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Seafood industry stress on sustainable farming as shrimp output set to fall

The seafood industry feels the need for sustainable aquaculture to counter setbacks and increase production

Kochi: Shrimp production in the country, after showing a consistent growth in the last decade, is likely to drop by 10 to 15% this year as low prices and fear of spread of diseases among shrimps have forced aquaculture farmers to cut production in the farms.

The stocking in the farms in south Andhra Pradesh is down by half while in north and central parts of the state, the situation is better with 80% of the farms well stocked, said D Ramraj, president of All India Shrimp Hatcheries Association.

Ramraj reckons that farms in Gujarat and West Bengal too will have lower production. "The hatcheries will suffer heavy loss as we could not sell much seeds to the farmers," he said. Last year, the shrimp production in the country went over 6 lakh tonnes.

The seafood industry feels the need for sustainable aquaculture to counter setbacks and increase production. The aquaculture farmers lost money last year when white spot and EHP diseases reduced the shrimp output. This year, the fear of diseases has led many to stock less in farms, Ramraj said. "Little improvement in global shrimp prices and lack of funding support to farmers are the other reasons for the reluctance of farmers to go for full output."

"The need of the hour is technology upgradation fund for sustainable aquaculture development," said Shaji Baby John, chairman and managing director Kings group of companies. The recent creation of separate department for fisheries and a 2% interest subvention on loans to farmers by the Centre will go a long way in accelerating this, he said.

The group recently launched sustainable, traceable, quality certified aquaculture hub model at Tuticorin. "We are expanding this to larger areas by transferring technology developed by us to farmers covering the entire gamut of value chain, right from broodstock availability," John said.

Shrimps account for around 70% of the total seafood export from the country valued at Rs 45,000 crore.

The industry also sought more focus on the domestic market which currently accounts for low consumption of shrimps. "Shrimps fetch better price of about Rs 800-900 per kg in Delhi compared with half of it in China or other south east Asian countries," John said. According to Ramraj, if the domestic consumption can reach 20 to 30%, then it will be good for the seafood industry.

Ornamental Fish Entrepreneur for Promotion of Brackish Water

The Central Institute of Brackish Water Aquaculture (CIBA), Chennai signed a MOU with Mr Joshy Paul, 'Ornamental Fish Entrepreneur', a progressive ornamental fish breeder and trader from Thrissur, Kerala.

With this Memorandum of Understanding, the CIBA identified the brackish water ornamental aquaculture as a sector with the greater growth prospects in the country.

This is a maiden MOU by the CIBA for the promotion of brackish water ornamental aquaculture with a farmer in a partnership mode, first time in the country.

Dr K.K. Vijayan, Director, CIBA, highlighted the need to develop the brackish water ornamental fish sector on the principles of sustainability, through the development of a value chain from breeding and rearing using the formulated feeds, rather than relying on the unsustainable means, such as, capture from the wild. He underlined the need for adopting a holistic approach inclusive of nutrition, health management, genetics and novel marketing strategies in the country and overseas.

During the event, Dr K.K. Vijayan along with the Fisheries Division Scientists, handed-over the first batch of hatchery produced Monodactylus argenteus, Silver Moony Seeds to Mr Joshy Paul.

Mr Joshy Paul underlined the uniqueness and trade aspects of brackishwater ornamental fish species and expressed his optimism about the success of this new partnership with the Institute.

Dr M. Kailasam, Principal Scientist & Head-in-Charge, Fish Culture Division, CIBA outlined the technological advances made by the Institute to develop the seed production technologies for the selected ornamental species, now with the complete technology packages for Silver Moony, Spotted Scat, Silver Fish (Milkfish) and Etroplus spp.

UK releases new report on cetacean bycatch

The UK government has launched a new report on reducing the accidental capture of whales, dolphins, and porpoises (cetaceans).

Accidental capture in fishing gear, known as bycatch, is one of the greatest threats facing the three species, said the UK's Centre for Environment, Fisheries and Aquaculture Science (Cefas).

The Hauling Up Solutions report is an outcome of a joint workshop between Cefas, the Department for Environment, Food and Rural Affairs (Defra) and the Zoological Society of London, to assess how to reduce the accidental capture of cetaceans in UK fisheries.

The workshop brought together a wide range of over 60 stakeholders including fishermen, scientists, and conservationists from around the world to consider ways to better record and reduce the bycatch of whales, dolphins, and porpoises in UK fishing gear.

"I know there is no easy solution to tackling this issue, but I also know that we all have the same goal – nobody wants to see dolphins and porpoises being killed in our fisheries," said minister of state for agriculture, fisheries and food, Mr Robert Goodwill.

Finfish and shellfish fishermen from England and Scotland directly affected by the issue were at the heart of the discussion. Mr David Bond, a fisherman from Cornwall, added that he saw cetaceans every day, and "there has to be an acceptable level of bycatch, as accidents happen".

"However, anything that can bring bycatch down that's cost-effective has to be good."

The workshop report outlines clear recommendations and key next steps on how cetacean bycatch will be tackled in UK waters. These include to collaborate with the fishing industry at a regional level to collect more detailed information on cetacean bycatch and abundance; and using the latest technology to bring together all of what is known about cetacean bycatch, strandings, and bycatch mitigation into one, easily accessible, place.

Workshop co-organiser Mr Stuart Hetherington, a marine biologist from Cefas, added the information in the report will be used to prioritize where action is most needed in the UK, with scientifically robust bycatch mitigation trials, alongside monitoring, beginning in the fall.

Defra will take forward the specific recommendations from this workshop to develop more comprehensive monitoring techniques and effective mitigation measures.

Deep sea fishing nets them a bountiful catch

Madurai: Three fishermen have made an earning of more than ₹2.50 lakh each per voyage.

The first batch of Rameswaram fishermen who made a maiden venture into deep sea fishing, ending decades-long bottom trawling, were elated with a sense of hope and success as the first two fortnight-long voyages in the Arabian Sea turned out to be lucrative.

Rameswaram fishermen who ventured into deep sea fishing with their catch at Thoppumpady fishing harbour in Cochin.

After Chief Minister Mr Edappadi K.Palaniswami formally launched the project , 33 fishermen had set out for deep sea fishing in three vessels – 'Tuna long liners cum gill netter' – from Cochin and completed two voyages, each lasting for 16 days with the hope of scripting success stories.

After tackling some practical difficulties in the first voyage, the fishermen made good the second voyage with an average catch of 7.9 tonnes per vessel. "We are happy with the new venture and confident of making it successful," MrAnand Baiva, the Rameswaram fisherman, who owns one of the vessels, said.

He and two other beneficiaries of the Centre-State sponsored project made an earning of more than ₹2.50 lakh each per voyage after meeting all expenses, he said and exuded confidence of emerging successful. More than making money, they were free from stress and anxiety - synonymous with bottom trawling in the Palk Bay, he said.

Rameswaram fishermen used to spend sleepless nights due to fear of getting arrested by the Sri Lankan

navy while fishing in the Palk Bay and those who have switched over to deep sea fishing feel liberated now, he said and hoped others would follow suit. The beneficiaries have started repaying their bank loans after the second voyage, he added.

Officials said in the first voyage from April 1-16, fishermen in the three vessels returned with an average catch of 6.5 tonnes but made bigger catch to 7.9 tonnes in the second voyage from April 21 to May 6. In the second voyage, fishermen in each boat sold the catch for ₹8.5 lakh and after meeting the expenses of ₹2.23 lakh, they shared the earnings with the vessel owners.

While the owner got a share of ₹3.76 lakh, the 12 workers in a vessel shared ₹2.51 lakh, officials said. The catch comprised bullet tuna, black marlin, istiophorusplatypterus (sail fish), skipjack tuna, yellowfin tuna and albacore tuna – the species catering to the export market, officials said. The Marine Products Exports Development Authority (MPEDA) certified the quality of the catch before sale.

The fishermen, who were presently operating from Thoppumpady harbour near Cochin fishing harbour with special permission from Kerala government, would set up their bases at Mookaiyur fishing harbour and Kunthukal fish landing centre in the district once the facilities were made ready.

Presently, 39 vessels were in different stages of construction at different ship building companies, officials said adding at least eight vessels, including four from Cochin Shipyard Limited, would be ready for launch by the month-end. More fishermen have evinced interest in placing orders after seeing the success stories of their colleagues, they said.

After cyclonic storm Fani, comes bonanza for fishermen

Visakhapatnam:Landing of tuna in large numbers near shores of Visakhapatnam, Kakinada surprises them.

Tuna, coming in shoal towards North Andhra Coast for the past few days after the extremely severe cyclone Fani battered parts of Odisha, West Bengal and Bangladesh, has come as a big surprise for traditional fishermen.

Experts say turbulence in the sea in the Fani-affected areas, submergence of fresh water from brackish water lagoon Chilka and lull in fishing by mechanised boats during the breeding season lasting 61 days from April 15 could be the reason for large-scale landing of tuna near the shore areas of Visakhapatnam and Kakinada.

'In search of food'

State coordinator for MPEDA NetFish Mr P. HanumanthaRao told that with mechanised boats abstaining from venturing into the sea during the conservation period and fall in sea temperature following rain triggered by the recent system in the Bay of Bengal, tuna fish in large numbers were coming in search of food like jelly fish, squid, cattle fish, shrimp, crab, algae and photosynthetic organisms.

The traditional fishermen, who go on sailing in catamaran and other non-motorised beach landing crafts and some fishermen by fitting their boats with motors illegally are hitting jackpot. They are able to catch yellowfin tuna, which is in high demand in export market, skipjack and dogtooth tuna, which are being bought by agents from Kerala and Tamil Nadu.

Yellow fin are caught in 10 to 15 kg size.

Skipjack are captured with a weight of three to four kg and dogtooth weighing up to 2 kg. Most of the tuna netted by them are juveniles.

Confirming this, National Fisherfolk Forum general secretary Mr ArjiliDasu said the tuna depending on their size was fetching ₹120 to ₹130 as against normal price of ₹60 to ₹70 per kg.

They are sold for a premium due to short-supply during the annual ban period, which is being enforced in the entire East Coast.

Migratory species:

Tuna, a highly migratory species, fetches better price if it is transported abroad alive or processed and sent in a hygienic way.

However, this is a big casualty in Andhra coast as, for want of processing and storage units, they are cut with blunt weapons and packed in ice boxes for sale to middlemen engaged in supply in consignments to the exporters.

When contacted, Joint Director of Fisheries Mr P. KoteswaraRao said due to climatic change, tuna landing in shoal were sighted frequently. During winter months of November to February, due to lowering of temperature, they are seen in large numbers near Visakhapatnam and Pudimadaka and Uppada near Kakinada during May.

In high demand

Tilapia, a fish to feed the world, and the deadly virus that may destroy it

The seafood industry feels the need for sustainable aquaculture to counter setbacks and increase production.

The tilapia is a key source of protein for people in the developing world, but global stocks are under threat from a deadly virus.

Tilapia is the world's second most farmed fish, mainly due to its resistance to disease, but stocks are threatened by a lethal virus

Most production is in Asia, and experts warn of social and economic catastrophe if virus wipes species out; China, the biggest producer, is not infected so far

A small African fish called the tilapia may be vital for meeting the future food needs of humanity, according to scientists, but they are also concerned that a killer disease discovered in recent years could wipe out the species. That, they warn, would have devastating social and economic consequences for China and the rest of the Asia-Pacific region.

Although its name may not be widely known, the freshwater tilapia is second only to carp as the world's most widely farmed fish, and China is the largest producer. With global production of farmed tilapia reaching 6.3 million tonnes in 2018 and an estimated market value of US$9.8 billion, the little fish is big business. That's because it is an essential source of protein, revenue and employment in the developing world.

An advantage of farming tilapia was once its resistance to disease, which is a constant problem in intensive fish farming. But a new virus has caught the industry off guard. Tilapia lake virus, or *Tilapia tilapinevirus*, was identified in 2014.

Mohan Chadag is Principal Scientist (Aquaculture) for World Fish, an international non-profit organisation that supports fishing and aquaculture research.

Scientists know little more about it, except that it has a morbidity rate of up to 90 per cent, depending on the strain, and is highly contagious. The first indication of the virus on a fish farm is lots of dead tilapia.

"It's definitely alarming," says Mohan Chadag, principal scientist (aquaculture) for World Fish, an international non-profit organisation that supports fishing and aquaculture research, and is headquartered in Penang, Malaysia.

The tilapia lake virus was discovered in Israel and Ecuador. It has since been reported in 12 other nations and regions, including many in Asia: Thailand (2015), Indonesia and India (2016), the Philippines, Malaysia and Taiwan (2017). Mexico reported its first cases in 2018.

After setback in floods, farmers reap bumper harvest of mussels this time

Kochi : After a major setback in the last year's flood, farmers in Moothakunnam in Ernakulam district have had a bumper harvest of mussels under the guidance of Central Marine Fisheries Research Institute (CMFRI). Five self-help groups in the region reaped a total yield of 6.5 tonnes of mussels in as many as five farming units. The farmers—most of them are women—started the farming in January using a structure made of bamboo with a size of five metre each width and length.

Women farmers engaging in the harvest of mussel in Moothakunnam, Ernakulam

The farmers, who turned into bivalve farming as an additional livelihood option, had suffered a severe loss owing to last year's devastating flood. Their oyster farming units were completely destroyed due to the calamity. They were also worried that post-flood changes in the aquatic ecosystem may affect the mussel farming. But, farmers are now relieved with a good harvest this time and are hopeful of compensating the loss last time.

The farming that lasted 5 months was carried out under the guidance of the Molluscan Fisheries Division of the CMFRI. After the harvest, the produce was undergone depuration, a scientific process of expelling contaminants from gills and guts of mussels by providing them with good purified seawater before they are used for consumption which was also developed by the CMFRI.

As there is no need for feeding, the bivalve farming is less expensive compared to fish farming. However, the initial capital to set up the farming units is the major expense of the farming.

Available in CMFRI

Depurated mussel meat from the farms are available for sale in the CMFRI. It can be had from the Agriculture Technology Information Centre (ATIC) from 10 am to 4 pm on all working days till the stock ends. (Price: Rs.175 for a 250-g packet.) Mussels are rich in protein, lipids, carbohydrates, minerals (calcium, iron, copper, zinc, phosphorus) and vitamins.

India's shrimp exports to US set to rise after Trump's China tariffs

Huge opportunity opens up in value-added seafood products segment

India's seafood products are likely to have a competitive edge in the US markets, thanks to the imposition of an additional tariff of 25 per cent on Chinese imports. "The new decision will definitely be problematic for China. Initially, they could absorb the 10 per cent duty. But the recent tariff hike will not be very pleasant," a leading seafood exporter in Kochi.

"We have a dominant position in the shrimp market in the US and this advantage can be fully exploited to garner a significant share in value-added seafood products, where China is very strong due to factors such as cost competitiveness, larger volumes, low labour cost etc," the exporter said.

"India, at the moment, has not made any inroads in this segment, especially in ready-to-fry, ready-to-eat, heat & serve products. Right now, very few domestic companies are involved in the export of value-added seafood products. The emerging situation has given firms here an opportunity to enter the US market in a big way. But it will take time. We have the raw material to meet the demand," he said.

Marine Products Export Development Authority (Mpeda) figures reveal that India exported 35,000 tonnes of valued-added products, worth $350 million, to the US market in FY18, registering a 40 per cent growth over the previous year. The products include prepared and preserved food, cooked shrimp, pasteurised crab etc. Overall seafood exports to the US market during the period were to the tune of $2.3 billion with frozen shrimp as the flagship item of exports.

Currently Chinese companies are sourcing headless raw material from countries such as India, Bangladesh and reprocessing it in special consumer packs before catering to the US markets. With the additional tariffs, China would lose this advantage and US buyers would prefer to buy such products from India, said Shaji Baby John, CMD, Kings Group of Companies.

They are not seasonal buyers and they need the product throughout the year. To meet the emerging opportunity, seafood processing units here should upgrade with more storage space, hygiene plants etc on par with Chinese units, he said. To take on China, the global leader in aquaculture production, India should focus more on sustainable aquaculture, embracing newer technologies for which government support is a must, he said. The global market is up for grabs for those who farmed fish in a sustainable environment, he added.

Seed stocks fall

Meanwhile, the decline in seed stocks by 20-25 per cent is likely to affect shrimp production from India in 2019. There is a likely drop of 10-15 per cent against last year's production of over six lakh tonnes. Stocking has been sluggish due to the fear of losses in the minds of farmers on account of widespread diseases and the low market price at the time of harvest, said D Ramraj, President, All India Shrimp Hatcheries Association.

February to April is the peak stocking period for shrimp farming. Unlike in recent years, seed sales from hatcheries have been poor this year. The poor offtake and excess capacity has forced hatcheries to incur losses, he added

ICAR Director General along with DDG visits CIFT, Cochin

Inauguration of ICAR-CIFT Sun Boat II

Dr Trilochan Mohapatra, Secretary (DARE) & DG (ICAR)along with Dr J.K. Jena, DDG (Fisheries Science), ICAR and Dr P. Pravin, ADG (Fisheries Science), ICAR visited Central Institute of Fisheries Technology, Cochin on 25 May, 2019. The Hon'ble DG inaugurated the newly established National Referral Laboratory at CIFT. The Director General also inaugurated the Fish Behaviour Laboratory and CIFT Solar Boat II developed at CIFT.

In his address, the Director General applauded the great work done by CIFT and emphasized on perfection in work. He could appreciate that CIFT is an Institute which takes highest level of initiative and technologies from CIFT have provided great visibility to ICAR. He called for better communication of salient achievement to stakeholders and asked for preparation of brief flyers on all available technologies.

He opined that CIFT has sufficient inputs to create huge impact among stakeholders and called for exploring possibilities of automation, sensor systems, artificial intelligence and block chain technology to create value. He also suggested preparation of

Inaugurating the Fish Behaviour Lab

document on standards developed by CIFT. He wished all success for future endeavors of CIFT.

Later the Director General released six new technologies developed by CIFT namely; Squalene powder, Fish Soup Powder, ChitoPro, Tunnel Dryer, Table Top Fish Descaling Machine and Fish Freshness Sensor. The DG officially released three new mobile apps developed by CIFT namely CIFT FISHPRO, CIFT LABTEST and CIFTraining during the function.

The event also witnessed release of CIFT training calendar and eight other publications. The DG also launched products developed by Incubates at ABI of CIFT namely Cashew Oats Cookies by Smile and Take, Ready to Cook Mussel (Retort) by Foo Foods, Dry fish products by Emma Foods, Dry fish products by Chef n Kitchen, Dried fish andDry fish products by Mr Fish.

Dr J.K. Jena, DDG (Fisheries Science) and Dr P. Pravin, ADG (Fisheries Science) also marked their presence during the occasion and felicitated the good work done by CIFT and offered suggestions for further research. DDG (Fisheries Science) lauded the contributions of CIFT and called for more focus on blue economy and increased collaborative work between fisheries Institutes.

Earlier, Dr Ravishankar C.N., Director, CIFT welcomed the dignitaries and highlighted the prominent contributions of CIFT in the past year. He thanked the DG and DDG for all the guidance and support provided for research and development activities of CIFT.

Later he visited the Agricultural Technology Information Centre at ICAE-CIFT renovated with latest digital display boards, interactive presentation system and backlit posters for enhanced technology communication. He also visited the different divisions and laboratories and offered suggestions for future research.

Directors of CMFRI, Cochin; CTCRI, Thiruvananthapuram; IISR, Calicut; Head of Station, CPCRI, Kayamkulam and HoDs of CMFRI and CIFT, several fisheries incubates and other stakeholders also graced the event.

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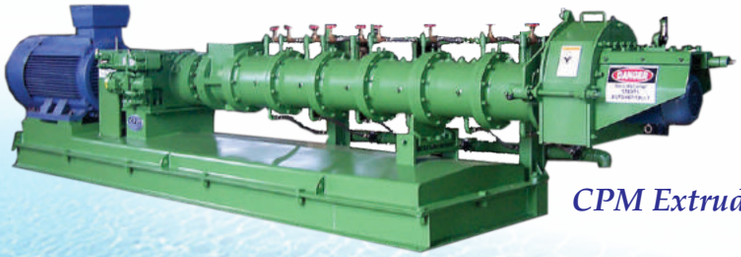

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US offshore wind developer plans whale protections

Vineyard Wind, which plans to construct an 800-megawatt offshore wind farm off the coast of the US state of Massachusetts, has announced it is seeking proposals from suppliers of acoustic monitoring systems to detect and protect endangered North Atlantic right whales.

According to Renewable Energy Magazine, the energy producer has asked universities, tech companies and others for their proposals to supply such systems along transit routes to the proposed development site some 15 miles south of Martha's Vineyard.

"Vineyard Wind has two goals with this initiative: First, to ensure best protections for the Right Whale as we go to build and operate the nation's first commercial-scale offshore wind farm," Erich Stephens, the company's chief development officer, said in a statement. "Our second goal, which is equally important, is to help place the emerging US offshore wind industry on track to deliver the substantial volume of clean, competitive cost energy that our nation needs while expanding protections for this highly endangered whale."

Snow crab and lobster harvesters in the US and Canada have been under heightened scrutiny from the public and regulators in recent years to reduce their impact on endangered whale populations.

China, world's largest aquatic exporter for 17 years, reports making positive changes

China exported more than $20 billion worth of aquatic products in 2018, making it the world's largest exporter of such goods for the 17th straight year, Han Changfu, minister of agriculture and rural affairs, said at a symposium in Beijing.

The country's fishing industry has maintained rapid growth, with the output of aquatic products remaining the world's largest for 30 straight years and accounting for more than 40% of the world's total, Han said, according to Xinhua, China's news agency.

Han reportedly urged more efforts to promote conservation and crack down on illegal fishing, while strengthening aquaculture monitoring to ensure the safety of products. He noted how various measures have been launched by fishing regulators at all levels to accelerate the industry's transformation.

China plans to optimize its fishing ban system, covering all types of water bodies, and continue to battle pollution in the Bohai Sea area, he said.

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ISHI Marine Technologies Launches 4 brands of Shrimp Feed in technical collaboration with Zeigler Bros, USA

Moana Technologies tie up with Contractor family to set up Black Tiger Shrimp Broodstock Multiplication Centre in Gujarat

To start 4 hatcheries in East and West Coast in 2020

Surat: ISHI MARINE TECHNOLOGIES, the company promoted by Contractor family of Surat, Gujarat, launched Shrimp Feed Plant with four brands of feed at a grand ceremony held in Surat on 8 May 2019. ISHI MARINE TECHNOLOGIES has the production capacity of 30,000 tonnes of shrimp feed annually.

It produces INGESTA and NANSHE as Vannamei feeds, HAMUN and TIMEE as Tiger shrimp feed. It also produces premium feed with Vpak in all above mentioned brands.

The state-of-the-art new shrimp feed plant is located at Plot No 432, Sakhya GIDC, Vaagra Taluka in Bharuch district, Gujarat spread across 26,181 square meters area.

Mr Jignesh U. Contractor from ISHI MARINE TECHNOLOGIES talking to Aqua International Editor Mr M.A.Nazeer said, "Basically we were thinking of producing high quality shrimp feed and seed for our own farms to avoid dependency and risk of diseases in culture.

Contractor Brothers - From left: Jignesh, Vaibhav and Dhaval

To achieve growth and long term success, ISHI MARINE TECHNOLOGIES has tied up with Zeigler Bros Inc., USA as their technology transfer partner. We use premium grade ingredients to produce high quality feeds, he told. We want to set up new standards in the market on production of good quality feeds for aquaculture, he added.

Contractor's family has started Shree Saikrupa Aquaculture Pvt Ltd in 2003 with 3 hectares of shrimp farming at village Parujan in Navsari district. In 2006, Mr Jignesh Contractor has established a trading firm VAISHNAVI AQUATECH as a dealer and distributor for aqua feeds, probiotics and healthcare products of different companies and became an active and leading farmer-cum-business man in aquaculture sector in Gujarat state. They are also distributors of INVE Aquaculture farming inputs in West Coast.

In 2015, Mr Jignesh along with his brothers Mr Vaibhav and Mr Dhaval started working on setting up ISHI MARINE TECHNOLOGIES, the state-of-the-art new shrimp feed plant near Bharuch. They started feed plant construction work in February 2018 and within one year time they completed plant construction and began feed production in May 2019.

Mathew Zeigler, President, Zeigler Bros, USA, addressing Ishi Marine Technologies feed launch function in Surat, Gujarat on May 8.

Walter Coppens, CEO, Moana Technologies

Mr Umakant Contractor, the father and his sons Mr Vaibhav Contractor, Mr Jignesh Contractor and Mr Dhaval Contractor received well attended large gathering of guests in the Grand Ceremony of Feed Launch held on 08th May 2019 at Surat.

In future, they want to come up with 4 hatcheries producing SPF black tiger shrimp seed from Moana project in Gujarat, Andhra Pradesh and Tamil Nadu. The company has targeted to produce 500 Million Moana tiger shrimp seed in the first year of operations, Jignesh informed.

VAISHNAVI AQUATECH is presently producing 2,000 tonnes of prawns and selling 8000 tonnes of Vannamei shrimp feed besides supplying farming inputs to 25 per cent of farmers in the Gujarat state.

Head quartered at Surat, our team of brothers, father and the employees of the company are behind the success and growth of the company in aquaculture sector, said Mr Jignesh.

Mr Mathew Zeigler, President, Zeigler Brothers Inc, USA, addressing the inaugural function of ISHI MARINE TECHNOLOGIES shrimp feed plant said, "Today is a big day for Zeigler Brothers. We signed the agreement for Technology Transfer Programme with ISHI MARINE TECHNOLOGIES in March 2015 to produce grow out shrimp feed in Gujarat state, India. The plant designing was done by ESE, Kansas, USA. Zeigler and ESE developed the plant for ISHI MARINE TECHNOLOGIES. Cremach of Gujarat has erected the equipment and the machinery. A lot of equipment came from USA and I am happy to say that the feed plant has come up very nicely. For Zeigler it is third generation business.

A view of Ishi Marine Technologies Feed Plant set up near Bharuch in Gujarat

Ishi Marine Feed Bags of different varieties of feeds

Zeigler has set up six feed plants across the world and we are happy to have tie up with Contractor's family, who are working very hard in Indian Aquaculture sector with different activities, he stated. Zeigler established two plants in Mexico, one plant each in Ecuador, Egypt and India in collaboration with local partners.

Zeigler works with the principle of Nutrition through Innovation, he stated. Zeigler has animal research centre at Florida and feed processing research

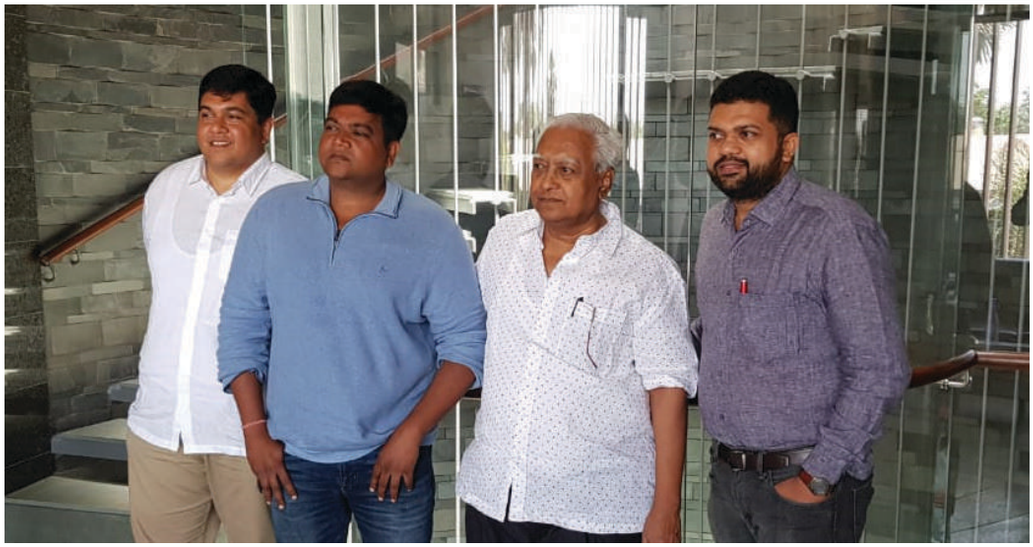
Contractor Family and their team during an occasion in Surat

centre at Pennsylvania. Ziegler will also help ISHI MARINE TECHNOLOGIES to procure quality inputs and ingredients for the feed. We, Zeigler and ISHI MARINE TECHNOLOGIES will work together and change the Indian Aquaculture industry with high quality feeds and services said, Mr Mathew Zeigler.

About Zeigler

Zeigler originated in 1935 as a local producer of poultry and livestock feeds. Till date the company had been continuously developing new and innovative technologies for specialty markets. Utilizing core competencies in R&D, nutritional formulation, and process engineering, Zeigler currently manufactures over 300 products and exports to over 50 countries around the world.

Though Zeigler manufactured first aquatic feeds in 1955, the company continuously focused on research and development of aquatic feeds under leadership of Dr Thomas Zeigler. It was only in the 80's where they became the pioneer in developing technology to achieve desired water stability for shrimp feeds. With focused journey of identifying and pursuing solutions to aquaculture industry, the company took leap in playing key role of the paradigm shift in this industry. Since then the company has achieved many mile stones in development and also received various awards in aquaculture industry. The company continues to lead its ways in technological advancement to increase sustainability, safety and productivity of shrimp feeds to make its way to the top of the industry.



Contractor's Family - Father Umakant Contractor with sons Vaibhav, Jignesh and Dhaval.

Tie up with Moana Technologies

Contractor's family are also working to set up black tiger shrimp Broodstock Multiplication Centre in Gujarat in collaboration with Moana Technologies, USA, which is likely to come into operations in 2020. Mr Walter Coppens, CEO of Moana Technologies LLC, Belgium, confirmed it during a brief interaction with Aqua International Editor here on May 8.

Zeigler Generations

Contractor's Family are also planning to come up with a shrimp processing plant soon.

Ms Zankhana Patel, MLA, Dumas, Surat, Mr Maruthi Yeligar, Deputy Director, MPEDA, Valsad, Mr Pradip Navik, Mr Narendra Tandel, Dr Manoj Sharma, Mr Shanthi Bhai, Mr Yellanki Ravi Kumar, Mr G.G Srinivas, Mr Nakul Bhai and others spoke on the occasion.

While Mr Dhaval Contractor welcomed, Mr Vaibhav Contractor proposed vote of thanks.

Ishi Marine family with friends and partners during the feed launch function held at Surat, Gujarat on May 8.

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Grobest Feeds working to become a Leading Player in Aquaculture Feed Market in India

In 2018, Grobest Group sold over 680,000 tons of Aqua Feed worldwide

Grobest Feeds Corporation (India) Pvt Ltd is working to expand its Sales and Technical services team in India to make best of their efforts in providing better performing feeds for sustaining success to shrimp farmers. The company would like to be one of the leading players in Aquaculture feed market in India. *Aqua International* editor M. A. Nazeer had an interview with Mr Chandrasekar Sankaranarayanan, General Manager and Head of the Indian operations of Grobest Feeds. Excerpts:

Chandrasekar Sankaranarayanan, GM, Grobest India

Aqua International: *Who are the promoters / owners of Grobest Feeds globally?*

S. Chandrasekar: Grobest Group Limited was established by two founders from Taiwan (The Ko and Chen families) with more than 45 years of history of aquatic related researches and businesses with a London based Private Equity firm – Permira, who has extensive investments in aquaculture industry globally.

Establishment of Grobest Feeds in India and globally?

Grobest Feeds was founded in 1974 in Taiwan. With our professional and specialized knowledge in shrimp feed from Taiwan, we started exporting our High-Quality Shrimp Feeds into India from our Taiwan and other overseas subsidiaries from 1993. In 1999, we committed to serve Indian farmers by providing them the same quality of shrimp feeds with the state-of-the-art facility in Chennai. Since then, Indian farmers can get timely and freshly made products locally in India with Grobest original technologies.

While the global head quarters of Grobest is Taiwan, its Indian operations head quarter is located in Chennai.

Samson Li, the CEO, Global Operations

Mr Samson Li is the CEO of global operations. Samson, graduated from the Chinese University of Hong Kong with a Bachelor of Science degree in Chemistry and an M.B.A. He started his career in Mitsui Hong Kong and Japan Fine Chemical industry mainly in human pharmaceuticals, agrochemicals in Europe, Asia and China. Thereafter, he spent more than 20 years in key management and executive roles in different segments of the agriculture values chain including feed additives (Novus), premixes, animal and aquaculture feed (Nutreco). Before joining Grobest, he was the President of Animal Nutrition Division for ADM, responsible for the overall global strategies and businesses of the division. Samson lived and worked in China, Japan and U.S.A.

Mr Chandrasekar Sankaranarayanan was previously the Area Manager for India and South Asia for INVE Aquaculture. He has been working in Aquaculture industry for more than 27 years.

> ***"Establishing a Professional team for Sales and Technical Support is my first priority"***

Feed mills in India and globally

In India, our feed mill is located in the outskirts of Chennai in the state of Tamil Nadu and we are aggressively reviewing our business plans to grow organically as well as inorganically. We have 16 feed mills in Asia today and are dedicated to become a global player with our expansion plans to help shrimp and fish farmers with our high-quality standard feed and scientific based Functional Feeds, said Mr Chandrasekar Sankaranarayanan.

> ***"Nutrition and genetics are the two main areas where big companies invest a lot considering the market potential. Nutrition is our forte and we would like to continue our work in Shrimp and Fish nutrition in the days to come"***

Category of feeds available in India

Though we produce freshwater fishes feed, our focus remains in our professional and high-quality shrimp feeds. With our proven successes of introducing different Functional Feeds in Vietnam and Thailand since the outbreaks of many new shrimp diseases like EMS, EHP, WSSV, WFS dedicate to help shrimp species to boost their immunities, resistant to diseases challenges and expedite the weight gain. We have introduced Grobest Aqua Supreme feed and plan to introduce Grobest Aqua Prime feed and Grobest Aqua Care feed to tackle the commonly experienced shrimp diseases in India like EHP, White Faeces, White Gut, WSSV etc., he told.

Samson Li, Global CEO, Grobest Group

R&D facilities

Our global research facility is located at Yangmei, Taiwan. Housed with dedicated and renowned scientists to work in the areas of Immunology, Nutrition, Aquaculture technology, Physiology and Pathology to develop our products by utilizing technologies of Biomolecular Engineering and Biochemical Fermentation Engineering. The same research facility

***R&D Institute:** A view Grobest Feeds R & D Facilities*

also develops feed additives to address the needs of aquaculture industry and produce the products with our own feed additives plants in both Taiwan and China.

Sales & Technical Services network

All our sales and technical staff have an educational background from Aquaculture and related biological studies. They also have hands on experience in the field of Shrimp Aquaculture. Graduated from aquaculture related department, the team undergoes routine training by our inhouse team.
We also conduct regular orientation programme to our staff both on the products and on the recent developments in the field of Aquaculture. Our team visits shrimp farms and help farmers in detecting the overall health condition of the shrimps and offer environmentally friendly solutions to our customers, said the Indian operations head.

Area of operations

Grobest has operations in Taiwan, Vietnam, Thailand, China, India, Indonesia, Philippines, and Malaysia.

90 dealers network

Grobest India sells feeds through its well-established dealer network. We have around 90 dealers in India.

How is the acceptance and satisfaction level of your feed products from the customers?

Grobest Feeds being an established player has good acceptance in the market and our performance speaks for the same. We are the first one introduces

S. Chandrasekar

functional feeds in the Asian market. We have expanded the range of functional feeds and launched a couple of speciality diets commercially in the Indian market.

> ***"We have 16 feed mills in Asia today and are dedicated to become a global player with our expansion plans to help shrimp and fish farmers with our high-quality standard feed and scientific based Functional Feeds"***

We focus mainly on quality. It starts with sourcing of raw materials and quality control plays an important role in the final produce. Formulation is our strength and we never compromise on the same. Constant monitoring and assistance by our HQ add more value to our products and services. Our experts visit shrimp farms in India on constant intervals and obtain feed back on the performance of our diets. We work closely with the markets in all possible ways.

When and how did you start your career and achieved remarkable growth in career?

Mr Chandrasekar joined Grobest Feeds India on 8 April 2019 as its GM heading the Indian operations. During his career in commercial Aquaculture operations in 1993, Grobest was the largest importer of Grobest Feeds from Thailand and his association with GB has a long history. The assignment I have taken now in Grobest India provides me a lot of growth opportunities with more challenges. I am certain of my success, Mr Chandrasekar stated.

What are your priorities to establish Grobest Feeds in India?

Nutrition plays an important role in maintaining the health of the shrimps.
We aim to provide better solutions to the ongoing culture related problems through our feeds. Our functional feed Grobest Aqua Supreme feed helps the farmers to mitigate the impact of White faeces during shrimp culture. Feeding shrimps with Aqua Supreme Feed ensures better health and well being through immune stimulation. Healthy shrimps can overcome disease and stress conditions more effectively. Grobest Aqua Prime Feed helps the farmers to get better growth esp prior to harvest as well during disease recovery stages. We are also launching Grobest Aqua Care feed that can make the shrimps stronger to overcome the impact of White Spot Diseases, he said.

Prospects for Feed & Nutrition segment in Aquaculture

There is a huge prospect available to the feed industry in any livestock business and Aquaculture is not an exception to this. Nutrition and genetics are

> ***"We have introduced Grobest Aqua Supreme feed and plan to introduce Grobest Aqua Prime feed and Grobest Aqua Care feed to tackle the commonly experienced shrimp diseases in India like EHP, White Faeces, White Gut, WSSV etc"***

the two main areas where big companies invest a lot considering the market potential. Nutrition is our forte and we would like to continue our work in Shrimp and Fish nutrition in the days to come.

Size of feed business Internationally

In 2018, Grobest Group sold over 680,000 tons of aqua feed worldwide.

Best practices being implemented

By providing the best product, we support the Shrimp Aquaculture industry in India. Our commitment to quality and product development is well received by our Indian customers.

We strongly believe in after sales service and our technical team does that job professionally. We are expanding our team to cater to all our markets in India.

What changes you have planned after you took over as Grobest Feeds, India operations head?

Establishing a Professional team for Sales and Technical Support is my first priority. We shall continue our investments on people for providing timely services to our customers. Market Support Programme (MSP) through our experts from the global team and intensive field visits will be given more importance. We have also conceived a Knowledge Transfer Programme (KTP) to our customers to keep them abreast of the recent developments worldwide, said Mr Chandrasekar.

Although, Grobest Feeds is one of the senior most feed millers in India, it has not got appropriate share in Indian aquaculture feed market. What could be the reasons you attribute for it ?

Grobest has been doing pretty well in most of the Asian countries. Our strategies had been focusing very much in the major historical shrimp exporting countries like Vietnam and Thailand, where we are today the leading shrimp feed providers. We realized that opportunity in India has been growing, hence with our proven successes in the Vietnam and Thailand, especially with the help of our Functional Feeds that help farmers in tackling challenges of EHP, White Faeces, White Gut, WSSV etc., we strongly believe that we can also grow fast in India, he told.

> ***"Our global research facility is located at Yangmei, Taiwan. Housed with dedicated and renowned scientists to work in the areas of Immunology, Nutrition, Aquaculture technology, Physiology and Pathology to develop our products by utilizing technologies of Biomolecular Engineering and Biochemical Fermentation Engineering"***

S. Chandrasekar

On feed millers using harmful chemicals and antibiotics in feed

We strongly differ with these comments and observations. There is no need for the feed millers to go for using unwanted chemicals or any other banned substances. The market is matured and most of the feed manufacturing companies have GMPs and other certification programmes. Grobest continues its efforts to bring the best to the market through its products and services. This is exactly the reasons why Grobest has been dedicated to use a different approach, a nutritional approach to develop Functional Feeds such as **Grobest Aqua Supreme Feed, Grobest Aqua Prime Feed and Grobest Aqua Care Feed** to help culturing more healthier shrimps and fishes.

What are your future plans and targets?

Quality will be the key factor in market penetration. We will expand our sales and technical services team to make all our best efforts in providing the shrimp farmers better performing feeds for sustaining success. We also commit to bring our most advanced technologies and Functional Feed from Vietnam, Thailand and Taiwan into India. We would like to be one of the leading players in the Aquaculture feed market in India.

Grobest Feeds India team

We feed millions

Skretting is the global leader in providing innovative and sustainable nutritional solutions and services that best support the performance of fish and shrimp

Our mission

feeding the future

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3	Skretting France	12	Skretting Canada
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5	Skretting Italy	14	Skretting Ecuador
6	Skretting Turkey	15	Skretting Chile
7	Skretting Egypt	16	Skretting Nigeria
8	Skretting Vietnam	17	Skretting Zambia
9	Skretting China	18	Skretting India

Skretting has production facilities in 18 countries on five continents, and manufactures and delivers high quality feeds from hatching to harvest for more than 60 species. The total annual production volume of feed is more than 2 million tonnes. The head office is located in Stavanger, Norway.

www.skretting.com

Environmental stressors on fish and it's adaptation physiology

Ramjanul Haque*, Krishnapada Singha, Sutanu Karmakar
Central Institute of Fisheries Education, Mumbai - 400061

Introduction

Stress in fish is an undesirable aspect of production. Stress results from biotic and/or abiotic factors that act in changing or modifying the animal's natural or homeostatic state. Aqua-husbandry practices can potentially cause different types and degree of stress and can harm the welfare of the cultured stock. The negative factors that influence the welfare of farmed fishes are genetic, environmental factors, stocking density during growth, malnutrition, starvation, cataracts, deformities, transport, handling, selection, overcrowding etc. (Conte, 2004). The magnitude and the type of behavioral and physiological response to stress can vary among fish species, strain, and individual levels. Stress can break the ordinary physiological balance of fish by making reallocation of vitality inside its framework. The inducers of stress i.e., stressors are ecological factors which incorporate biotic factors like food availability, the presence of predators, infection with pathogens or interactions with conspecifics; and abiotic factors like temperature, water availability, toxicants etc.

Highlight Points

- **The general physiological response of fish to adverse situations (stressors), as with all vertebrates, is referred to as stress.**
- **The stress response leads to the production of corticosteroids (mainly cortisol) and catecholamines (such as adrenaline and noradrenaline and their precursor dopamine).**
- **Consideration and minimization of stress in the aquaculture management practice is crucial for better production, disease prevention and better economic profit**

Stress In Wild Vs Captivity

When fish is cultured in wild condition, the stress response is beneficial as it increases the ability of a fish to overcome adverse conditions. Once out of danger, the fish would then be able to recoup rapidly. But in captive condition, the fish won't be able to escape, and in this way, the reaction will be drawn out. Eventually what started as an adaptive response, soon becomes a detrimental one as the fish cannot keep up its elevated physiological state. That's why fish face more risk from stress in captive condition than in wild condition.

Stressors

There are diversified group of stressors that can potentially influence the fish stock. However, stressors are commonly classified as follows (Fig. 1)

Chemicals Stressors

- Poor water quality
- Pollution: intentional pollution like chemical treatments and accidental pollution like insect spray, spills etc.
- The improper composition of feed i.e., the improper ratio of protein, lipid, carbohydrate, vitamins, minerals and other feed additives
- Nitrogenous and other metabolic wastes: accumulation of ammonia or nitrite

Thermal Stressors

- Thermal discharges from Nuclear and Power plants
- Global Warming

Biological Stressors

- Population density: Over-stocking density
- Other species of fish: aggression, territoriality, lateral swimming space requirements
- Microorganisms: pathogenic and non-pathogenic
- Macroorganisms: internal and external parasites

Physical Stressors

- Temperature: This is one of the most important influences on the immune system of fish
- Light
- Sounds

Fish are in constant interaction with their environment through the gills and skin, therefore water quality (Dissolved oxygen, salinity, ammonia, nitrites, pH, temperature, pollutants levels etc.) is crucial for their welfare (Bianca, 2009).

Procedural Stressors

- Handling
- Shipping
- Disease Treatments

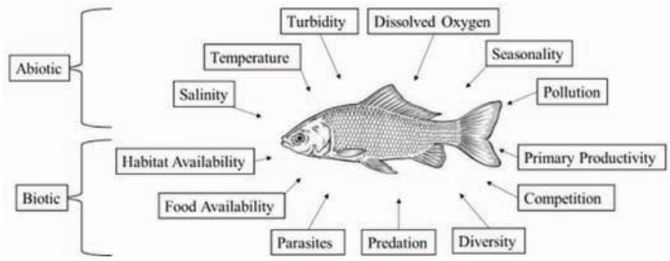


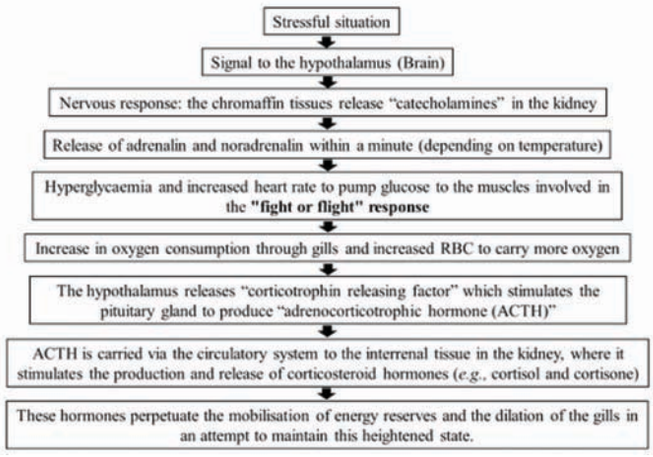
Fig 1. Biotic and abiotic factors influencing fish species

Causes And Symptoms Of Stress In Fish

Causes of stress	Symptoms of stress
Rapid change in temperature; below and beyond the optimum range	Poor appetite
pH outside of the range, or rapid changes (> 0.3/day)	Unusual swimming behavior, resting at the surface or bottom
High level of ammonia, nitrite or other toxins	Rubbing or scraping the sides of the tank, piping at the surface, red blotches, and streaks
Very low dissolved oxygen	Piping at surface
Malnourishment and/ or overcrowding	Clamped fins close to their body, physical injuries
Poor water quality	Fast breathing
Poor fish handling, noise or light disturbance	Erratic behavior
Bullying companions	Physical injuries

The Stress Response

When a fish is exposed to a stressor, a set of physiological responses are put into place that occurs in response to the release of two sets of hormones. The following diagram illustrates a generalized stress response, but it is important to be aware that different species of fish respond in slightly different ways:



N.B.- Whilst it takes longer for corticosteroid hormones to be released, their effects can last much longer than those of adrenalin

Type of stress responses:

- Primary response
- Secondary response
- Tertiary response

► **The Primary response:**

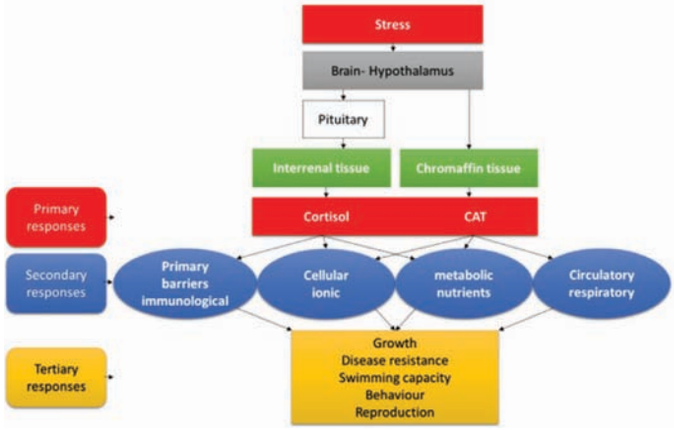
The brain-sympathetic-chromaffin cell (BPC) axis produces catecholamines (adrenaline and noradrenaline) from the chromaffin cells. The other (second) axis is the Brain-pituitary-interrenal tissue (BPI) axis, with the production of cortisol, from the interrenal tissue. Catecholamines (CA) is released in the "Fight or Flight" response during acute stressors. Corticosteroids, predominately cortisol, is the primary hormone released in response to chronic stressors. The catecholamine hormones epinephrine (adrenalin) and norepinephrine (noradrenalin) are associated with immediate reactions to stress and are released when situations requiring a fight or flight response occur. The release of catecholamine hormones into the bloodstream causes increases in cardiac output, blood sugar, respiration, oxygen uptake, and blood flow to the gills.

► **The secondary response:**

The response is a physiological and behavioral adjustment to the stress conditions. Secondary responses made changes in level of plasma and tissue ion and metabolite levels, haematological conditions, and heat-shock proteins (HSPs), all of which relate to physiological adjustments such as in metabolism, respiration, acid-base status, hydro-mineral balance, immune function and cellular responses (Pickering, 1981; Iwama et al., 1997, 1998; Mommsen, 1999).

► **The tertiary response:**

It refers to changes in the whole organism and has to do with chronic stress. Its inhibitory effects on fish reproduction, immunity, and growth, mortality/adaptation. The two major activities of cortisol in angle are control of hydro-mineral or osmotic adjust and vitality digestion. Some consider the role of corticosteroids to be protecting the body from overdoing with its own defense mechanisms (Munck et al., 1984).



Stress On Osmoregulation

During stress, the dilation of the gills allows an influx of water and a loss of body salts in freshwater fish (the reverse happening in marine water). Whilst the fish may be able to cope with this in the short term by using up extra energy, in the long run, it will be unable to maintain an optimum concentration of salts in its body fluids and will in stress condition. Including this, the corticosteroid hormones released during the response have a direct effect on the immunity, suppressing its effectiveness in fighting off infection. An endeavor is made to characterize those zones of osmotic and ionic control which are probably going to be impacted by stress.

Role Of Stress In Fish Disease

Resistance:

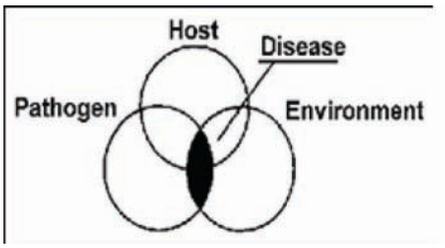
An animal can adapt to stress for a finite period. During this era, the animal might look and act traditionally however

is depleting energy reserves as a result of the additional necessities placed upon it.

Exhaustion:

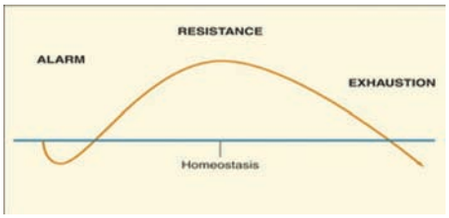
The animal's reserves are depleted, and adaptation fails as a result of the stress was too severe or lasted too long.

Disease:



Disease is associate in nursing status characterized by a gradual degeneration of a fish's ability to keep up traditional physiological functions. The fish isn't "in balance" with itself or its environment. Several factors affect how an individual respond to a potential pathogen. The infective agent (bacteria, parasite, or virus) must be virulent enough of causing disease and the fish must be in a susceptible state, and certain environmental conditions must be present for a disease outbreak to occur.

General Adaptation Syndrome (Gas)



The components of the stress response are collectively known as the General Adaptation Syndrome (GAS) which can be divided on a temporal basis into stages of alarm, stages of resistance and stage of exhaustion. It has also been demonstrated by Schreck who presents evidence to show that the domination of "awareness" reduces the magnitudes of the physiological stress response.

Stage of alarm: Sympathetic NS of ANS has activated the adrenal gland secretes the stress hormone cortisol, along with adrenaline.

Stage of resistance: Parasympathetic NS of ANS is activated-the results of the hormonal changes which occurred in the previous stage are still take place (metabolic changes).

Stage of exhaustion: If the stressor is removed, the body will start to recover. Otherwise, due to the depletion of resources, the animal may die/adapt.

Responses to GAS

Stress and immunity:

There is a close relationship between the immune system and the stress response. Glucocorticoids having a strong anti-inflammatory effect and inducing relevant changes in immune cells. Cytokines having the power to stimulate the cortisol production.

Adaptation: Morphology, physiology, and behavior of associate animal are very well matched to survive in the environment.

Acclimatization: Physiological amendment at intervals an individual animal ensuing from new environmental conditions.

Homeostasis: It's the tendency of organisms to keep up relative internal stability.

Thermoregulation:

Hypothalamus play a major role in thermoregulation. Gamma-Aminobutyric Acid (GABA) is the most important inhibitory neurotransmitter involved in thermoregulation and choline, dopamine, serotonin is also involved.

- Heat shock response: Short and sudden adaptation to extreme lethal temperature. This will help in the adaptation to sublethal temperature.

Methodologies to measure thermal tolerance limits:

1. Critical thermal methodology
2. Critical lethal methodology
3. Incipient lethal methodology (incipient lethal temperature-ILT)

Reducing Stress

1. To keep up a far healthier assortment of fish
2. To keep the fish in the correct social grouping is also important, e.g., large numbers for shoaling species and avoid mixing in aggressive fish with placid ones
3. Where stressful events are unavoidable like, throughout water changes, it's vital to perform the task quickly and to permit the fish time to recover later on
4. It's particularly prudent to avoid performing multiple stressful tasks all right away (e.g. performing arts a water amendment straight when introducing a replacement fish)
5. Try leaving the lights off for a while and not feeding them for a day afterward
6. If possible, increase oxygen levels with an air pump
7. Adding a stress-relieving product, such as AquaSafe to the tank which will also help to protect the fish
8. Use of Antioxidant (like vit-C, vit-D, BHT, BHA, etc.) as a stress reducer. Different spp of carotenoid (such as Astaxanthin, Canthaxanthin, etc.) are also use to reduce stress caused by changing of pH, hardness etc.
9. The keys to minimizing disease outbreaks on your fish farm are the maintenance of good water quality, proper nutrition, and sanitationAny management deficiencies in water quality management, nutritional management, or sanitation should be corrected
10. Prevention of disease outbreaks is more rewarding and cost-effective than treatment of dying fish
11. Fish that don't answer a properly administered treatment ought to be re-evaluated by a fish health care provider

Conclusion

Stresses create a physiological load on the fish, thereby reducing its capacity to response on subsequent stresses. The appropriate recovery time depends upon the severity and duration of the initial stress and on habitat conditions of the sock. Therefore, the consideration and minimization of stress in the aquaculture management practice is crucial for better production, disease prevention and better economic profit.

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More Reference can be provided on request.

Seed production of Magur at farm level at Patharpratima Block, WB

Subrato Ghosh

Introduction

Next to major carps, catfishes are considered to be potential cultivable species in India. According to a published article of fishery scientist Dr S. D. Tripathi, techniques of seed production have been standardized in Clarius batrachus, Heteropneustes fossilis, Wallago attu and other catfishes, which can be spawned even repeatedly at intervals of 30-40 days. The technology for breeding and seed production of Ompak pabda has been developed by scientists of CIFA Kalyani RC. Among catfishes, indigenous magur C. batrachus is a highly preferred air-breathing fish, possesses medicinal value and fetches a higher market price than major carps. It can be grown in semi-clean small ponds of low water depth after necessary pre-stocking management measures, which involves low cost.

For culture purposes, the potential to obtain C. batrachus seed from natural sources has become low due to increasing use of pesticides in the paddy fields which are its main breeding ground. Induced breeding is the only way to obtain quality seeds of economically-important catfishes throughout the year for pond culture. Culture practice of C. batrachus will flourish more and will have wider acceptance in rural sector of WB and other states if problems like inadequate supply of seed and proper feed are overcome. Office of the Joint Director of Fisheries (ME & MS Wing), Government of WB has furnished a list/database of 58 indigenous magur hatcheries in WB under private ownership (ten in South 24 Pgs district) which have obtained accreditation and seed certification from Department of Fisheries, GoWB. Recently Sri Dipankar Bera and Sri Animesh Das, Proprietors of Maa Durga Fishery and Hatchery have applied to Office of the ADF, South 24 Pgs on 16/11/2018 for seed certification.

Magur breeder Sri D. Bera

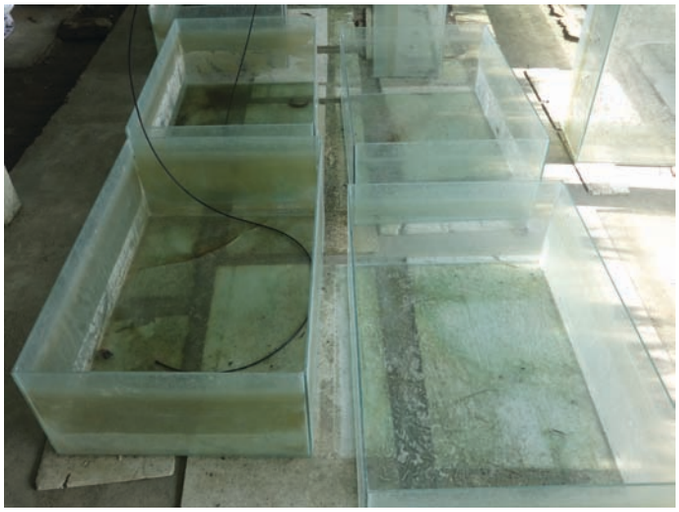
Sri Dipankar Bera, aged 40 is Proprietor of Maa Durga Fishery and Hatchery located at Vill. Debichak, P.O. Shibgobindapur, Ramganga GP under Patharpratima Block, Dist. South 24 Pgs, WB. Activities like grow-out culture of Jayanti Rohu, monosex Tilapia, culture of milkfish Chanos chanos and fattening of mud crab Scylla serrata in boxes (both on experimental basis), seed production and culture of bagrid catfish Mystus gulio have started here recently, but Sri Bera is doing seed production of C. batrachus on a mass scale in captivity since 2007.

Sri Bera applying feed in fish pond

He obtained basic knowledge on C. batrachus seed production while working under Sri Milan Sinha, a renowned magur breeder and Proprietor of Bluetech Dynamics fish farm at Vill. Dakshin Bijaynagar, Joynagar-II Block, South 24 Pgs, WB for three consecutive years. In 2007, Sri Bera obtained 45-days training on fish breeding and culture from Vivekananda Institute of Biotechnology, South 24 Pgs. He also obtained one-week training from Freshwater Fisheries Research and Training Centre, Kalyani under Go WB in 2009 and four-days Block-level training on

Highlight Points

Semi-derelict and seasonal village ponds of small size, unsuitable for major carp culture, can be utilized for farming of indigenous magur Clarius batrachus, a high-priced fish. Availability of good quality seed (fry/advanced fry) is the basic component and requisite of every successful magur culture programme. In this context, amongst few others, Sri Dipankar Bera at Ramganga GP under Patharpratima Block, South 24 Pgs, West Bengal has taken initiative seriously since 2007. Conversation was made with professional magur breeder Sri Bera on 21st and 22nd October, 2018 at his hatchery site to note his set-up and method of magur seed production.



Magur larval rearing tanks

fisheries at Patharpratima Block in 2008. In the initial period, he visited C. batrachus hatcheries at Moyna Block in Purba Medinipur, at Budge Budge-II Block, at two places in North 24 Parganas district and at CIFA Bhubaneswar (in 2017) to gain more theoretical and practical knowledge and skill on the subject.

Magur hatchery set-up

Total area of Maa Durga Fishery and Hatchery including ponds is 10 bigha (330 decimal). For magur, Sri Bera has three broodstock ponds of size 40 feet x 20 feet each; 10-15kg brooders of size 150-225gm (8-9 inches) are stocked and maintained in each pond, males and females kept separately. To prepare 1kg brooders' feed, he is using either soyabean dust or fish meal 300gm, mustard oil cake 200gm, wheat flour 200gm and a mixture of pulverized paddy grains and rice bran 300gm, fed @ 3-4% of body weight daily. Here C. batrachus breeding season continues from May to mid-September. He has constructed 5 indoor rectangular cement cisterns of size 10 feet x 3 feet x 2.5 feet, where magur brooders are temporarily stocked prior to induced breeding operation. Sri Bera uses Ova-FH or Ovaprim as inducing agent, stripping is done after 16-18 hours of injection. About 4000nos eggs obtained from a single female. Circular concrete cemented structures of 3 feet diameter with 6 inches water level are used as egg incubation-cum-hatching chambers. Sri Bera has four such structures, each costs Rs 500/-. He has observed hatching out of larvae from 24th-25th hour of egg fertilization. Fine meshed net with net frame is placed in the upper water column in egg incubation chambers so that sufficient water column exists between the net and the bottom of chamber. Fertilized eggs are placed over net. Hatchlings are kept here for 72 hours till yolk sac is observed.

Hand pelletizer and sample pelleted feed

Sri Bera has 25nos of rectangular glass aquaria of size 3 feet x 2 feet x 1 foot; each costs Rs 1500/-. For the first 22-26 days after absorption of yolk sac, C. batrachus larvae are reared in glass aquaria, 500-700 pieces in each aquarium. Boiled egg yolk, zooplankton Daphnia sp and Moina sp are fed to growing larvae in aquaria, chopped tubifex worm is used (15gm / glass tank) from 7th day in addition to zooplankton.

Magur egg incubation cum hatching chambers

It attains 24mm from an initial size of 5mm in aquaria. Faecal/ waste matter is siphoned out and water exchange is done twice daily in every glass tank. After 26 days, the one-inch stage are stocked in outdoor earthen cisterns/ponds of size 40 feet x 20 feet (water level 1.5-2.0 feet), 5000 pieces in each and Sri Bera has constructed six such cisterns. Growing C. batrachus fry are fed a mixture of fish meal or soyabean meal, wheat flour, Vit-Mineral mixture, mustard oil cake and seven-seas cod liver oil in dough ball form during late evening @ 10% of body weight daily, 200gm each time in each earthen cistern in earthen bowls. These are reared for 35-40 days and attain 2.5-3.0 inches (6-8gm) advanced fry stage, which are sold by Sri Bera @ Rs 6/- / piece.

His opinion

Sri Bera has opined that if farm-made supplementary fish feed (with 22% protein) is prepared either in pellet or dough ball form using wheat flour that costs Rs 8-10/- / kg, the feed will cost Rs 20/- / kg. Similar kind of commercial pelleted

Author with Sri Dipankar Bera

feed will cost Rs 30/- / kg. About 1.5-1.8kg feed is required to produce 1kg table-sized fish; Rs 10/- may be saved in per kg produce. Hand pelletizer can be used to produce farm-made pelleted feed using meat meal (Rs 40/- / kg), wheat flour (Rs 8-10/- / kg), soyabean dust (Rs 40/- / kg), fish meal (Rs 30/- / kg) and pulverized paddy grains (Rs 10/- / kg). Mustard oil cake cannot be pulverized properly during rainy season, so it must be stored in pulverized form. During winter, its price is lessened as production becomes more. Sri Bera is using Pasupati Brand pelleted fish feed (22% protein); each 25kg sack costs Rs 700/-.

He stated that Patharpratima and Kakdwip Blocks are such places in WB where freshwater, brackishwater and marine resources are available, fish farmers can have provision of those. Different kinds of commercially-important inland fishes can be cultured in freshwater and brackishwater ponds. Many people from these regions go to distant places like Kolkata and Sealdah, stay for weeklong for a job of only Rs 6000/- / month, but they can gain more income from fish farming (Indian major carps, brackishwater finfishes, catfishes, crabs, giant prawn) in proper manner in 33 decimal water area, utilizing the resources. Sri Bera is planning for fattening of S. serrata in submerged-type boxes in shallow region near bank of local tidal river namely Borchura-Gobodia. Sri Bera has received technical guidance from scientists of CIBA Kakdwip RC in breeding and seed production of M. gulio on a commercial scale. He has started it from 2016. Kakdwip Research Centre of CIBA has developed a complete package comprising of homestead/backyard hatchery technique and grow-out culture of Mystus gulio in brackishwater system (Source: www.uniindia.com). Dr P. K. Mukhopadhyay, Retd. Principal Scientist, CIFA and scientists of CIBA, Kakdwip have visited Maa Durga Fishery and Hatchery.

End note

Sri Bera explained the concept of preparation of 'organic juice', which enhances zooplankton production in C. batrachus broodstock ponds and culture ponds. A mixture comprising pulverized paddy grains 7kg, yeast 500gm and date palm molasses 4kg is required for every single use in 33 decimal pond. About 4-5lit water is added to the mixture in a large earthen bowl and kept undisturbed for 72 hours in a covered state. The semi-thick liquid produced is applied in ponds once in every 15-20 days, that leads to zooplankton growth within 3 days.

Expert magur breeder Sri Milan Sinha, who is also influential teacher of Sri Bera, has installed a flow-through system coupled with bio-filter, which helps to lower ammonia and nitrite concentration in larval rearing tanks below optimum level and maintain dissolved oxygen near to saturation. It resulted in better survivability along with optimum growth of *C. batrachus* larvae. In *C. batrachus* brood fish management, Sri Sinha has developed a modified practice of farm-made supplementary feed, which comprise soyabean whole 35%, fish meal 40%, soyabean oil cake 10%, groundnut oil cake 10%, rice polish 2%, fish oil 2%, Vitamin and minerals 1% fortified with trace elements like cobalt and phosphorus and used @ 3% of body weight three months prior from the breeding season. As larval feed, zooplankton *Brachionus sp.* and *Moina sp.*, chopped tubifex filtered through nylon net, adequately washed in freshwater and disinfected with Dimethyldidecylammonium chloride, was used {Ref: Sinha, M., Mahapatra, B. K., Saha, D. and Maitra, N. J. (2014). Mass scale seed production of Magur, Clarias batrachus at farm level through improvised modifications. Int. Jour. of Fisheries and Aquatic Studies, 2(2): 210-214}.

Attempt has been made to produce C. batrachus seeds using a low-cost village-level hatchery technique {Ref: Das, S. K. (2002). Seed production of magur using a rural model portable hatchery in Assam – a farmer proven technology. Aquaculture Asia, VII(2): 19-21}. Participatory magur breeding technology (low-cost) developed by Dakshin Dinajpur Krishi Vigyan Kendra, WB is expected to open the vistas of income generation of rural youth as well as it may help to provide magur seed to the fish farmers to enable them to take magur culture as an alternative means of self employment (Source: http://www.ddkvk.in). Skilled and technologically-sound entrepreneurs like Sri Sinha, Sri Bera and others in India have come up with new ideas in seed production of C. batrachus, that has high consumer preference, with modifications and improvement made over conventional method. It has led to production of healthy and high quality fry/advanced fry on a large scale in village conditions. This practice will definitely encourage economically-viable C. batrachus grow-out culture and production systems for livelihood and nutritional security. Government of India has suggested that emerging areas like catfish culture be given the emphasis for diversification of culture practices including identifying catfish farming as a National priority.

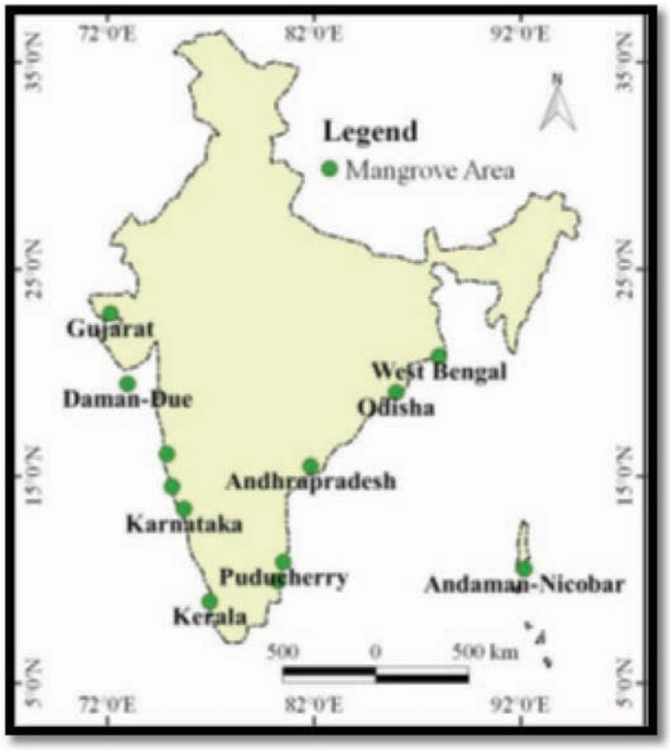
Ecological notions and Status of Mangroves in India

Lovedeep Sharma*
Kerala University of Fisheries and Ocean Studies, Kochi, Kerala

Introduction:

Mangroves are halophyte plants that grow in tidal areas. The word mangrove can describe a single plant or it can refer to a whole community of plants. In India, these are also known as 'Mangal'. These are located between the land and sea so they represent the best example of an ecotone. India contributes nearly 3.3% in world's mangrove and it covers approximately 4921 sq. km.Sundarbans (West Bengal) is the largest and most important mangrove of country.

Mangroves distribution in India



(Source: Samanta, 2017)

Habitat:

Mangroves grow only in the tropics and sub-tropic regions between 24N- 38S. They do not tolerate cold temperatures well, and freezing temperatures will kill them. Mangroves grow best in sheltered areas with low wave energies. High wave energies destroy the shallow root systems of Mangroves. They also prevent seedling establishment and the build-up of fine sediments needed for growth. There are about 100 types of mangrove plant around the world. The Indian mangroves comprise approximately 59 species in 41 genera and 29 families. Of these, 34 species belonging to 25 genera and 21 families are present along west coast of country. There are about 25 mangrove species which have restricted distribution along the east coast and are not found on the west coast.

Special Adaptations of Mangroves:

Major mangroves are red, black and white mangroves.They have different kinds of adaptive mechanisms to tolerate the environmental conditions. The Red mangroveshave tall arching roots called prop roots. These props supply air to the underlying roots and provide stability. These mangal are found closest to the water as they have the highest salt tolerance. They have dark green elliptical leaves, which are paler underneath. Black mangroves are different from red as they are having numerous breathing tubes called pneumatophores project from the soil beneath. These generally grow on high tide shores. White mangroves are usually found upland of the red and black mangroves. The bark is pale and they do not have prop roots or pneumatophores.

All mangrove plants have special adaptations that allow them to survive in their salty environment. Their unusual root systems give them support and stability in the loose soil. There is little oxygen present in these soils and prop roots and pneumatophores allow them to get oxygen from the air. Mangrove plants are unique in that they have live young (viviparous). The seed remains attached to the parents plant until it germinates. It then falls from the tree and drifts on the water until it finds somewhere to take root. Mangroves do not have to live in salt water. They

Highlight Points

- **Mangroves are salt tolerant plants also known as Mangal.**
- **Approximately 59 species of Mangroves are present along both coasts of India.**
- **To combat with its salty environment these vegetation have special adaptations.**
- **Loss of Mangroves is an alarming sign of loss of economy of country based on fisheries and tourism.**

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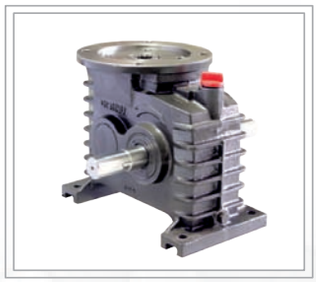

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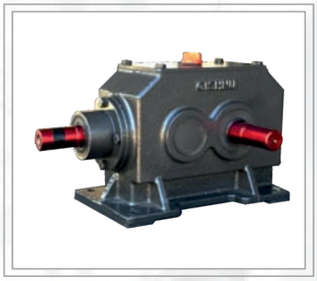

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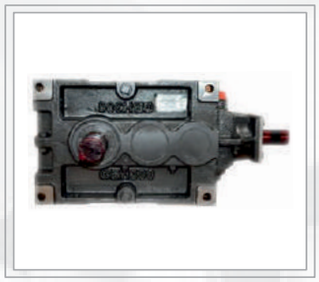

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tolerate the salt water and so out-compete other plants. They excrete salt through pores in their roots and leaves.

Mangroves are considered as the most productive ecosystems on earth. The fauna include resident and migrant, aquatic and semi aquatic species as well as terrestrial. Mammals like dolphins can also be observed in these ecosystems. Mangrove wetlands provide habitat, feeding, breeding and nursery areas for a wide variety of plants and animals, including endangered species. Algae, Barnacles, Oysters, Sponges, and Mud lobsters, Mangrove crab, Fishes (Mullets, Snapper, Tarpon, Eels) etc.

Importance of Mangroves:

Mangrove plants form a very unique ecosystem. An ecosystem consists of living organisms and non-living factors such as soil and water.

1. Mangroves are essential to the first link in the food chain. When their leaves fall into the water and are decomposed by bacteria many valuable nutrients are released that are essential to the growth of plankton. Plankton are the producers in this and oceanic ecosystems. Leaf detritus provides food for animals such as oysters, snails, clams, conch living in these Mangals.
2. Interestingly these are not just important for animals but also act as a buffer against the high winds and eroding waves of storms. The mangroves trap sediments and prevent them from building up further out to sea, which is damaging to other ecosystems like coral reefs and sea grasses.
3. Mangroves contribute to our economy; they have a big influence on our fisheries, because so many commercially important species breed or develop there. The mangroves also provide important sources of food for local human population.

Degradation of Mangroves- Reasons:

The sad part is human race is not grateful to these 'Mangals' and so due to continuous anthropogenic involvement, world has lost 20% of its mangrove forests since 1980. This could have an alarming effect on biodiversity, due to loss of habitat. It could also result in the silting of coral reefs, shipping lanes and ports. Loss of mangroves could also severely impact economies that rely on tourism and fisheries. Without a barrier of mangroves low lying countries such as Bangladesh, are more susceptible to flooding and devastation by cyclones.

But in present era the coastal areas are thickly populated and hence encroachments into the mangroves results in degradation of these ecosystems, besides overexploitation of forest and aquatic resources. Mangroves need protections from natural disasters in which coastal zone is a dynamically unstable region where one or the other kind like sea intrusions, cyclones, tsunami, etc., strike year after year. Last few decades have experienced gradual increase and unusual accumulation of CO_2 in the atmosphere mainly due to industrial activities, global warming, ice melt increase in water in oceans, tidal waves.

Protection Measures:

Proper monitoring is imperative to prevent illegal activities such as poaching of mangrove fruits, woods and also fishing activities. Proper planning is needed for aquaculture practices in these regions due to their high sensitivity. Timely surveys can also be a part of conservation. In addition to all these activities awareness programmes and campaign are very necessary because general awareness regarding these ecosystems can protect them better.

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Reference can be provided on request.

Feeding Behavior, Mechanisms and Factors Affecting Feed Intake in Fish

Gyandeep Gupta[1]*, Munish Kumar[1], Prasanta Jana[1], Mritunjoy Paul[1] and Banani Mohanta[1]

[1]Fish Nutrition, Biochemistry and Physiology Division, Central Institute of Fisheries Education, Versova, Mumbai.

Introduction

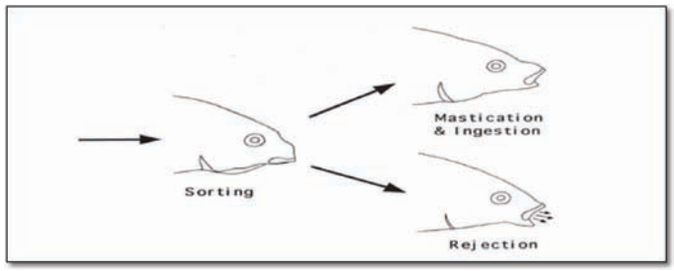
Feed represent a major cost in intensive aquaculture and efficient use of feed therefore of prime economic importance for the aquaculture industry. To achieve effective feed utilization, it is important to understand the mechanism which are the controlling feed intake. Feed intake generally controlled by different feeding behaviors. Feeding behaviors of fishes are categorized into three sequential phase arousal phase (alerting), appetitive phase (Potential food items are identified and located) and consummatory phase (consisting of food intake and either ingestion or rejection).

Arousal phase serves as a 'PRIMER' for chemosensory system that is used in the subsequent appetitive response to the presence of food. Feeding behaviors are characterized by stimulation of chemosensory system by potent stimulants and amino acids are the most potent for many teleost. Arousal phase involves increase muscular activity of the mouth, pharynx, appendages and results in twitching or exaggerated movements. Catfishes stiffen their bodies, twitch their barbells and increased respiratory movements following chemical detection of food items or amino acids. Gustatory stimulation is responsible for the arousal behaviors. Continue to arousal stimulation, it resulted in searching behaviors that signals the appetitive phase of feeding. These include swimming or other movements that are directed towards locating a chemical stimulus. Gustatory stimuli have a profound effect on appetitive behaviors, especially with highly developed extraoral taste system. Species with gustatory barbells or fin rays respond to the presence of taste stimuli with an increase in swimming activity to search the source of the stimulation. Gustation is more important as a close range chemosensory system, while olfaction is probably more effective in greater distance.

Once the food item is located and identified, it is taken into the oropharynx where its palatability is assessed through intraoral gustation. Cyprinids fishes have highly developed vagal gustatory system that determines whether to ingest or reject the food e.g. gold fish.

The consummatory phase of cyprinids consists of taking food into mouth, followed by sorting of palatable and unpalatable particles and culminating in the ingestion of food items and the expulsion of those that are unpalatable. The selection behaviors, sorting and backwashing allow goldfish to identify food through gustatory stimulation of vagal taste buds in the pharyngeal epithelium. Particles containing amino acids are selectively ingested, while particles having oxidized oils (Ketola et al., 1989), certain D-amino acids (proline), certain combination of amino acids (taurine, alanine and arginine), ANF's (Bureau et al., 1998) and aflatoxin (Black et al., 1988) are rejected.

Fig. 1. Feeding behaviour pattern of cyprinid fishes with specialised oropharyngeal taste systems



Mechanisms of Feed intake

Feeding by fish is dependent upon their sensory capacities to locate food, their ability to capture, handle and ingest food items and their physiological and biochemical capacities to digest and transform the ingested nutrient. This capacity in turn depends on different environmental factors in which animal experience in the aquatic environment. When fish experience environmental disturbances which lay outside the 'normal' range the effect may be dramatic. This will interfere with the biological and physiological system essential for the substance of life. Short term exposure to such disturbance may result in reduced feed intake and growth. The tolerance limit to environmental disturbance depends on the evolutionary history of the species and varies species to species. Thus any change in environmental condition caused by different means (seasonal or human made) caused reduced performance of cultured organism. Feed intake in fish is a process of voluntary food ingestion

Highlight Points

- **Feed intake generally controlled by different feeding behaviors like arousal phase appetitive phase and consummatory phase.**
- **This capacity of feed intake depends on different environmental factors which animal experience in the aquatic environment.**
- **Thus any change in environmental condition caused by different means (seasonal or human made) caused reduced performance of cultured organism.**
- **Exogenous factors light intensity, temperature, salinity, oxygen, CO_2, NH_3, pH and food abundance may influence food intake.**

which in terms comes into action by cumulative physiological response of sense organs to the chemical stimuli.

A. Gustation – taste in the acquisition of food

B. Olfaction - through smell

C. Solitary chemoreceptor cells – for social behaviors

D. Common chemical sense – helps in rejection of obnoxious stimuli

Gustatory pathways in the central nervous system controlling food intake

The gustatory pathways in teleost species have been examined which possess an ascending gustatory lemniscus controls the feed intake by the fish. A primary gustatory centre in the medulla oblongata with input from the facial, glossopharyngeal and vagal nerves, a secondary gustatory centre (2G) in the isthmic region, a complex tertiary gustatory centre (3G) in the diencephalon, and various forebrain gustatory centres. Fibres connecting the taste-specialist gustatory centres (Finger, 1984; Wulliman, 1997).

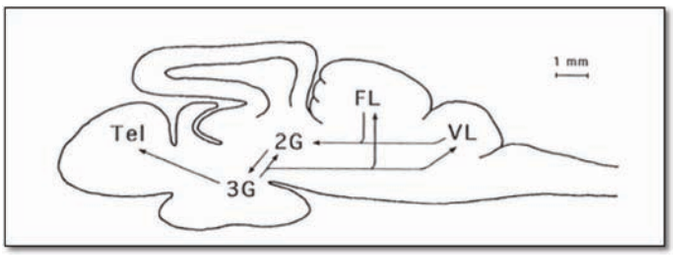


Fig. 2.Schematic diagram of gustatory pathways in brain of teleosts

Taste information from food in terms of chemoreception enters the hindbrain through termination of the facial, glossopharyngeal and vagal nerves in the facial (FL) and vagal (VL) lobes. The secondary gustatory tract projects from the FL and VL to the superior secondary gustatory nucleus (2G) in the rostral hindbrain. Cells from 2G project to the tertiary gustatory centre (3G) in the diencephalon, where there are ascending connections to the telencephalon (Tel) and descending pathways back to the FL and VL which determines the acceptance or rejection of feed in terms of feed intake by fish.

Factors affecting food intake in fish

Exogenous factors that may influence food intake include photoperiod, light intensity, temperature, water current and weather-related factors (wind, rain and pressure), salinity, oxygen, CO_2, NH_3, pH, food abundance, availability composition, and social interactions etc.

A. Abiotic factors

1. Light

In abiotic factors influence feeding behavior of fish, light has received much attention, but generalization regarding effect remain difficult, because of due to multiplicity of properties of light –light spectrum, light intensity, daily and seasonal variations of day length and interaction with other environment or physiological factor.

2. Photoperiod and feeding

Day night alteration is the most important factor because of responsible for alteration of physiological variation. Long photoperiod stimulate feeding activity, short photoperiod leads to a reduction in feeding. Therefore, salmonids display increased in food intake during spring where daylight is long despite of having low temperature. Thus, increasing photoperiod produce greater endocrine-mediated photo stimulation of growth and thus feed intake.

3. Light intensity and light spectrum

Compare to photoperiod the effect of light intensity and spectrum on feeding have less attention but both influences on behavior. Many planktivorous fish are visual feeders that seem to be restricted to feeding when illumination is sufficient for perception of the prey e.g. Asian sea bass Latescalcarifer (Davis, 1985). Threshold intensities vary between species, being as high as 1500 lux in Eurasian perch Perca (Dabrowski, 1982) or 860 lux in turbot Psetta maxima, whereas Atlanticcod Gadusmorhua are able to feed at low light intensities (0.1–1.0lux). Changes in light intensity may result in a shift to feeding on food items having different characteristics (e.g. size, motion, transparency, etc.). Mills et al. (1984) observed that young yellow perch fed on large daphnids at low light intensity and shifted to smaller prey as light intensity increased. Different combinations of light intensity and tank colour modify the feeding behaviour and efficiency of food detection by fish larvae. Larvae or juveniles that show a phototactic response may be attracted by bright light reflecting from tank walls, and this may influence feeding.

4. Temperature

According Fry (1971), temperature is the most important controlling factors (termed 'tonic effects by Blackman, 1905), governing metabolic rate and ingestion rate. Under unlimited food supply, an increase in temperature leads to increase in food intake, but there will be decline in rate of ingestion at high temperature. Food intake by fish increases with increasing temperature, reaches a peak and then falls more or less dramatically at supra-optimal temperatures (Brett, 1979), whereas metabolic rate may show a continuous increase up to the upper thermal limit for growth. Comparing optimum temperature for growth with the temperatures at which feed intake and conversion efficiency are maximised, it appears that the optimum temperature for growth is usually slightly lower than the temperature at which feed intake is highest but slightly higher than that corresponding to the best food conversion efficiency.

5. Dissolved Oxygen

Dissolved oxygen is potentially a limiting environmental factor (Fry, 1971), especially at high temperature (Jobling, 1997). Early life stages less sensitive to changes in oxygen than older fishes, as oxygen can diffuse passively through the body wall, but their feeding activity can be affected under conditions of reduced oxygen. The metabolic rate of well-fed fish is higher than those of starved fish, and the rate of oxygen consumption increase as the feeding conditions of the fish are improved. In low dissolved oxygen, food intake

suppressed and this is due to the reduced oxygen availability is unable to support the high energy demand of well-fed fish. A reduction in food intake at low level of DO would have consequences for growth and attempt is made to determine the critical level of DO at which feed intake is affected.

7. Nitrogenous compounds, pH and salinity

Depending on temperature, oxygen and pH, non-lethal concentrations of nitrogenous compounds (unionized ammonia, nitrite) may have effects on gill structure and epidermal mucus (Kamstra et al., 1996), but their effect on feeding. Tandler (1985) found that the feeding of juvenile lake trout was unaffected by ammonia concentrations less than 0.1 ppm NH_3, but depressed at 0.3ppm and the decrease in feed intake was greater when fish were given a high-protein diet. The exposure of lake trout to 0.1 ppm NH_3 only resulted in a temporary decrease of feeding.

Progressive increase to pH 9.5 in 6h was lethal to rainbow trout, whereas they showed only a temporary loss of appetite when pH was not increased beyond 9.3 during the same period (Murray and Ziebell, 1984), when the acclimation period was extended to five days, rainbow trout could acclimate to pH as high as 9.8. So it is necessary to acclimatize the animal properly to have an optimum feed intake.

Exposure of fish to an extreme salinity imposes energetic constraints which vary among species (euryhaline/ stenohaline).So for physiological adaptation, fish will be required to expand more amount of energy in order to meet the metabolic cost of ionic and osmotic regulations that reflects in terms of feed intake by fish.

B. Biotic factors

The abundance and the temporal and spatial distributions of food have major impacts on feed intake in fish, and these factors also interact with other biotic factors such as predator avoidance, social interactions and responses to human disturbances.

1. Stocking density

High stocking density is often considered to be a stressor with detrimental effects on feeding, growth and a range of physiological processes (Wedemeyer, 1997). In Nile tilapia, it has been shown that stocking at high density may lead to increased survival, better growth and reduced size heterogeneity within the population (Mélard, 1996). Increasing stocking density beyond a threshold may result in a reduction of agonistic interactions, reduction in growth, disease outbreak etc.

2. Social structure

Social environment may be influenced not only by population density, but also by factors such as size heterogeneity and sex ratio. Toguyéniet al. (1996)provided evidence that monosexgroups of male Nile tilapia fed using self-feeders grew faster and showed better feed conversion efficiency than sibling females, although food demand was similar. Social hierarchy generally results in a variable access of individual fish to food resources, and promotes growth heterogeneity. Insome species, size-based hierarchies result in feed intake and specific growth rates that are proportional to fish size and weight, resulting in increasing size.

3. Predators

In shoaling species, the reduction of foraging activity and feed intake in the presence of a predator may be inversely proportional to shoal size, probably because increased shoal size reduces individual risk of predation (Morgan and Colgan, 1987).

Conclusion

Many fishes possess highly developed gustatory, along with other chemosensory systems, providing evidence for the importance of chemoreception to feeding behaviour and feed intake by fishes in an aquatic environment. Additionally, teleosts share a common vertebrate neural organisation for processing gustatory information in the brain, along with fundamental similarities in behavioural responses to taste stimulation. Furthermore, anatomical, physiological and behavioural studies are needed in combination to provide a systematic analysis of gustation with behavioural and feed intake pattern within a fish species.

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