EMERGING OPPORTUNITIES FOR CULTURE OF MARINE FISHES IN MEXICO

Advances in lipid nutrition of cool- and warmwater finfishes relevant to mariculture in the Americas

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Although terms such as “lipid requirement” and “fish oil requirement” are part of the common vernacular of aquaculture nutrition, fish don’t require lipid or any feedstuff, per se. Rather, fish require essential fatty acids to support growth and maintain physiological competence. Unfortunately, fatty acid ‘requirements’ are often defined collectively (e.g., n-3 fatty acids) or in terms of feedstuff inclusion rates (e.g., fish oil), leading to confusion, inaccuracies in formulation, and potentially undesired outcomes in cultured fishes. So-called requirements—based on variable feedstuffs or groupings of related, but distinct nutrients—do little to illuminate our understanding of fatty acids and their functions in fishes. These issues are compounded by the continued use of inaccurate axioms, such as the ‘rules of thumb’ regarding the essentiality of long-chain polyunsaturated fatty acids for warmwater vs. coldwater fishes or freshwater vs. saltwater fishes. Conditional essentiality, influenced by lifestage, environmental conditions, or other dietary constituents adds further complexity. In this presentation, recent experiments with White Seabass Atractoscion nobilis, California Yellowtail Seriola lalandi, Cobia Rachyretron canadum, and Florida Pompano Trachinotus carolinus will be reviewed to highlight advances in our understanding of fatty acid requirements, factors that influence essentiality, and optimal feeds for these emerging mariculture species.

Fish drug approvals and use in the United States – Sharing what we know with our counter-parts in Mexico

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The absence of harmonized, enabling regulation that appear to become increasingly stringent constrains the expansion of aquaculture programs in the U.S. This issue is exemplified by the U.S. Food and Drug Administration regulatory framework for the development and use of aquaculture drugs. The approval process requires substantial investments of time, money, and other resources, which are not readily recouped once a drug is approved and can be legally marketed. Consequently, there are few drugs available to aquaculturists or fisheries managers in the U.S. Fish disease management strategies have been developed to use the limited number of drugs available for use in the U.S. most effectively, often as a short-term solution while efforts are underway to manage around problems through changes in culture system design, husbandry methods, or use of licensed vaccines. To encourage judicious use of aquaculture drugs throughout the Americas, this presentation will cover what drugs are available for use on fish in the U.S. and how effective they’ve been when used legally and judiciously in the context of broader disease management strategies.

Modeling intraspecific interactions for management of aquaculture programs

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Rapid worldwide development of marine finfish farming has raised awareness over possible genetic and ecological effects of escaped fish on wild populations. The Off-shore Mariculture Escapes Genetics/Ecological Assessment (OMEGA) model was developed by ICF and NOAA as a tool for use by scientists, managers, and industry to evaluate potential negative impact of escapees on wild populations, providing insights useful for planning and licensing aquaculture operations. OMEGA characterizes the aquaculture program by brood source, size and growth of cultured fish, and frequency and magnitude of escape events. Genetic and ecological interactions are calculated from assumptions regarding survival of escapees in nature, their likelihood of encountering conspecifics, breeding success, and the consequence of interbreeding on the fitness and abundance of wild conspecifics. This talk will address the evaluation of OMEGA using a sablefish (Anoplopoma fimbria) hypothetical culture program. Effects of
escapees on fitness and abundance were generally negative and dependent on the frequency of escape events and abundance of escapees relative to the natural population. Use of natural origin brood stock reduced the effects of escapees. Next steps are to identify partners interested in applying the model to species of interest and evaluate model applicability for proposed or existing marine aquaculture operations.

A review of water re-use and conservation technologies for hatchery and fish culture applications in the Americas

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Several attempts have been undertaken to conserve and/or re-use water for fish culture and production programs. These include complex recirculation system technologies to efforts to collect and use rainwater to save operating expenses. This paper reviews the various approaches and technologies that have been deployed for fish culture-related water conservation. Results encompass both reviews of available literature on water conservation for culture facilities to interviews with facilities that routinely employ or research new water conservation strategies (e.g. U.S. Fish and Wildlife Service Fish Technology Centers, National Fish Hatcheries, state fish hatcheries, and private aquaculture facilities). Water is becoming a scarce commodity in the U.S. desert Southwest and in many parts of South America. Also, water conservation has become a global priority in light of human population growth and climate change. The goal of this paper is to provide review results and technical information on water conservation and reuse technologies for fish culture partners in Mexico and other parts of South America, where aquaculture practices are still being refined and developed.

Fish health challenges, proactive ways to prevent major disease problems

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As new aquaculture opportunities are developed in Mexico there will undoubtedly be a variety of challenges to overcome for these to be successful. Such challenges can range from larval weaning and juvenile rearing problems to grow out and harvest feasibility issues. In new ventures, disease outbreaks often occur and can devastate an entire year class resulting in lost revenue and often putting operators out of business. Many such problems can be avoided if early preventative measures are put into place and aimed at combating anticipated disease problems. These can include utilization of nutritionally complete or enhanced feeds, administration of dietary immunostimulants (or possibly probiotics) during early periods of susceptibility, or development of vaccination programs and/or strategies that target specific disease problems. The cost of implementing such measures can typically be outweighed by the benefits of improved performance, growth, and the avoidance of catastrophic losses. A general overview of such products and how they may be effectively incorporated for an operation will be presented.

Offshore aquaculture in Mexico: from potential to reality

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Several assessments coincide in that Mexico holds great potential for offshore farming of marine fish, but whereas these conclusions are often based on geographical and meteorological characteristics, translating that potential into viable enterprises presents significant challenges and carries serious economic risk. Among the many things that are required to translate potential into reality the following have been, in our experience, the most limiting to date: a) access to fingerlings, the country still lacks commercial hatchery capability; b) viable feeds, with domestic feed mills still lacking experience at manufacturing extruded feeds for marine fish; c) commercial veterinary services, with limited capacity at research institutions; d) general infrastructure constraining marine operations, processing, and transportation; and e) expertise at all levels of farm and hatchery employees. Mexico is fortunate to have indigenous
species that are suitable for offshore aquaculture and the development of an industry is one of the priorities of the current administration, which has translated into efficient and reasonable permitting processes.

**Aquatic fauna exclusion device in shrimp farms of Sinaloa State, Mexico: a sustainability proposal**

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In Sinaloa, Mexico 608 farms operated during the shrimp farming season in 2011. Throughout the season farms depend largely of adjacent natural body water for function. This water contains a lot of planktonic species that are suctioned by pumping activity. A constant preoccupation of Sinaloa’s farmers is to avoid the entrance of wild organisms into their farms, farmers filter the pumped water before it enters into the ponds. Filter devices are capable to retain organisms but are not capable to exclude them, then those organisms die by asphyxia or compression, water pressure destroys organisms and organic material must go through a filter mesh. In Sinaloa, a small group of shrimp farmers have been developing different systems that allow wild organisms return to the natural body water. In the present work we analyze the characteristics and function of the different kinds of Exclusion Device of Aquatic Fauna (SEFA for its Spanish initials). A SEFA is efficient if it excludes in good conditions the aquatic fauna and then put them back to a similar natural system from where they were extracted. This simple practice allows: 1) reduce conflicts among different sectors that use the same resources, for example lost of wild larvae of shrimp, crabs and fishes of commercial importance; 2) return wild organisms to the natural environment; 3) avoid or minimize entrance of non desired organisms into the ponds. The Mexican government is interested to establish norms for the use of new technologies that avoid make more sustainable the aquaculture activity, for this reason the implementation of an Official Norm to regulate the obligatory use of SEFA in the Sinaloa state has been promoted in 2012. Because the implementation of any SEFA implies a cost, it is necessary to impulse and regulate a sustainable tag to add value to the product.

**Marine Fish Culture in Mexico: Current Status and Future Trends**

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Aquaculture in Mexico has grown steadily in the recent years with yearly growth rates of more than 4.5%. While our main production system is centered on shrimp and tilapia culture, several marine fish species are now being produced. The opportunity for expansion is quite significant since Mexico has over 11,500 km of coastal areas with tropical to temperate climates. Although there are many species with successful spawning and larval culture techniques, only redrum, totoaba, Pacific yellowtail, spotted rose snapper, and cobia are currently cultured under commercial conditions. Most hatcheries utilize green water culture techniques with enriched rotifers and Artemia and mid to late weaning strategies. Survival to the juvenile stage is species specific with an average of 10 to 20%. The most common production system for juveniles grow-out is net pen based. There is a lack locally produce grow-out diets. Yearly production rates have fluctuated around 5,000 MT valued at $40 million USD, primarily from bluefin tuna. With so much opportunity for growth, it is not easy to understand why the industry has not developed into its full potential. The reasons for the lack of development (i.e., poor development policies, lack of locally produce grow-out feeds, few hatcheries with low seedling supply and a complicated legislation among others) will be reviewed and discussed.

**Global Aquaculture**

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As a rapidly emerging agriculture production sector, global aquaculture production is expanding from traditionally strong production regions such as Asia and Europe, to most every populated corner of the world. Globally, aquaculture now produces greater than 50% of the total seafood production from wild fisheries, with growth in production trends expected to continue if not accelerate. Not only does aquaculture contribute a high-quality protein source for a growing global population, but it does so while enhancing geopolitical stability; this benefit coming from improvements to domestic food safety and security, public health, export (GDP), employment, and other ancillary socioeconomic benefits. One of the reasons for this global expansion is the myriad of production types, methods, and systems available for aquaculture production. These types include, but are not limited to near shore and offshore systems, and land-based ponds and recirculating aquaculture production systems in tanks. There are also integrated multi-trophic systems, hydroponics, aquaponics, and a whole range of hybridized integrated systems. This presentation will review the present global status of aquaculture, and review ongoing and emerging aquaculture production technologies.

Aquaculture could bring back Totoaba to the Sea of Cortes, state of development.

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The totoaba is a giant, endangered sciaenid from the Sea of Cortes that once constituted one of the most important fisheries in the upper gulf regain. The value of this resource was given mainly due to the high value of its swimbladder for the oriental fish market. Currently after ~20 years of research we have developed a captive breeding technology that could startup both a restocking and commercial aquaculture for this species. An overview of the state of the art will be presented discussing major technical advances and drawbacks to its development. This species although a physoclist prone to barotrauma during capture, readily adapts to captivity, undergoes gonadal growth and exhibits courtship under simulated natural environmental conditions but doesn’t spawn volitionally in captivity and are hormonally induced to spawn. Development through metamorphosis during intensive rearing (26°C, 35 gL-1 salinity) takes 35-50 days, after which growth of juveniles fed practical diets is rapid and comparable to that in other cultured sciaenids. Major difficulties with early husbandry involve swim bladder overinflating during weaning from rotifers to artemia, and size disparity leading to cannibalism during the transition pelleted diets. Efforts to establish commercial aquaculture and fishery enhancement enterprises are presently underway in Mexico, which is particularly important due to the increase of illegal poaching and the social need for development in the region.