maristas 2017
un nuevo comienzo

UM 20 años
Universidad Marista
MÉRIDA

CIBNOR - U. Marista - CICIMAR International Symposium on Bioeconomícs of Fisheries and Aquaculture

21-24 November, 2016
Mérida, México

Program / Abstracts

International Symposium on Bioeconomícs of Fisheries and Aquaculture

Hosted by

Universidad Marista de Mérida

International Symposium on Bioeconomícs of Fisheries and Aquaculture
Mérida, México, November 21-24, 2016

CONTENTS

Organizing Committee

Dr. Juan Carlos Seijo (Co-Chair)
Professor of Fisheries Bioeconomics
Universidad Marista de Mérida

Dra. Elisa Serviere Zaragoza (Co-Chair)
Professor
Centro de Investigaciones Biológicas del Noroeste

Dr. Germán Ponce Díaz (Co-Chair)
Professor
Centro Interdisciplinario de Ciencias Marinas - IPN

Dr. Alvaro Hernández
Professor of Fisheries
School of Natural Resources
Universidad Marista de Mérida

Ms. Margarita Soberanis
Director General of Administration
Universidad Marista de Mérida

Mr. Raul Villanueva
School of Natural Resources
Universidad Marista de Mérida

Mr. José Diaz
Coordinator of Computer Centers
Universidad Marista de Mérida

Mr.Manuel Estrella
Assistant, Computer Centers
Universidad Marista de Mérida

Ms. Karla Barrera
Secretary
Experimental Unit
Universidad Marista de Mérida

Monday November 21	
8:00	Registration
8:30	Welcome ceremony
9:00	**Peder Andersen**, Professor, University of Copenhagen, Denmark The economics of landing obligations and discard banThe economics of landing obligations and discard ban.
10:00	**Lee G. Anderson**, Professor Emeritus, University of Delaware, USA Ecosystem based fisheries management: An economics perspective.
11:00	Coffee break
11:10	**Anthony Charles**, Professor, St. Mary´s University, Canada Fisheries bio-socio-economics.
12:10	**Fernando Aranceta Garza,** Centro Interdisciplinario de Ciencias Marinas-Instituto Politecnico Nacional Bioeconomics of seasonality in a sequential fishery targeting short-lived species.
12:30	**Raúl R. Villanueva Poot**, Universidad Marista de Mérida Distributional performance of a rights-based co-managed and eco-certified small-scale fishery targeting a metapopulation.
12:50	**Maren Dee Headley**, Universidad Marista de Mérida Spatiotemporal bioeconomic performance of artificial shelters in a small scale rights-based managed Caribbean spiny lobster (Panulirus argus) fishery.
13:10	**Sarahi von Borstel Juarez,** Centro de Investigaciones Biológicas del Noroeste Bioeconomic analysis of recreational striped marlin fishery in Cabo San Lucas, México.
13:30	Poster sesión

Tuesday November 22	
9:00	**John F. Caddy**, International Fisheries Consultant, Italy Conserving spawners and harvesting juveniles: is this a feasible alternative to postponing capture until sexual maturity?.
10:00	**Kevern Cochrane**, Professor, Rhodes University, South Africa Eco-labelling and eco-certification of fisheries: benefits, challenges and the future.
11:00	Coffee break
11:10	**Marcelo Araneda**, AQUAINNOVO, Puerto Mont, Chile Aquaculture bioeconomics: An approach for managing fish genetic improvement programs.
12:10	**Miguel Angel Vela Magaña**, Universidad Marista de Mérida Growth and survival of juvenile red drum, Sciaenops ocellatus, acclimated to fresh water, under three different culture densities in a recirculating aquaculture system.
12:30	**Amao Lavinia Nuñez**, Centro de Investigaciones Biológicas del Noroeste Stochastic analysis of production dynamics of male and female redclaw crayfish (Cherax quadricarinatus) reared under commercial intensive cultivation.
12:50	**Patricia Borrego Kim**, Universidad Marista de Mérida Bioeconomic effect of size-heterogeneity on optimum harvest time.
13:10	**Francisco Vergara Solana**, Centro Interdisciplinario de Ciencias Marinas, Instituto Politecnico Nacional Technological interdependencies of tuna sea ranching and blue fin tuna fisheries in the Pacific: A bioeconomic approach.
13:30	Poster session

Wednesday November 23	
9:00	**Rognvaldur Hannesson**, Professor, University of Bergen, Norway The numbers of players in a fisheries game: curse or blessing?.
10:00	**Rashid Sumaila**, Professor, University of British Columbia, Canada A simple applications of bioeconomics to fisheries subsidies
11:00	Coffee break
11:10	**Eduardo Pérez Espinoza,** Professor, Universidad Católica del Norte, Chile Biological factors, production functions and bioeconomics analysis.
12:10	**Leopoldo Palomo Cortes,** Universidad Marista de Mérida Spatial economic valuation of recreational fishing in Punta Allen, Quintana Roo, México.
12:30	**Mónica Ruiz Barreiro,** Centro Interdisciplinario de Ciencias Marinas- Instituto Politecnico Nacional Is it viable to reactivate the totoaba fisheries (Totoaba macdonaldi. Gilbert, 1890) in the Upper Gulf of California?
12:50	**Juan C. Hernández Padilla,** Centro Interdisciplinario de Ciencias Marinas-Instituto Politecnico Nacional Bioeconomic variability on industrial shrimp fishing and artisanal fisheries in the southeastern Gulf of California, Mexico.
13:10	Poster session

Thursday November 24	
9:00	**Jon G. Sutinen**, Professor Emeritus, University of Rhode Island, USA Finance mechanisms for governing the commons: Paying for research, enforcement, decisión-making and administration costs.
10:00	**Juan Carlos Seijo**, Professor Universidad Marista de Mérida, México Bioeconomics of ocean acidification and climate change.
11:00	Coffee break
11:10	**Enrique Alfonso González Duran,** Universidad Marista de Mérida Biological response of the sea cucumber Isostichopus badionotus to a decrease in the ocean pH: economic consequences and adaptative fishery management of Yucatán peninsula.
11:30	**Oswaldo Rodríguez García,** Centro de Investigaciones Biológicas del Noroeste Reference points for vulnerable species based on bioeconomic age-structured models: an approach to Totoaba macdonaldi.
11:50	**José Antonio Duarte Canul,** Universidad Marista de Mérida Is it sustainable to fish during the reproductive period an endemic octopus fishery caught with a bait-based technology?
12:10	Poster session
12:30	Closing ceremony

Date: Monday, November 21, 2016 Time: 9:00 AM - 13:30 PM

The Economics of Landing Obligations

Peder Andersen*
Department of Food and Resource Economics, University of Copenhagen

By 2015 The European Common Fisheries Policy Reform includes a landing obligation (discard ban) in some fisheries and over the next few years all EU fisheries will be facing the landing obligation restriction. This is one of the most significant changes of the Common Fishery Policy (CFP) since 1983, the year EU established a formal fishery policy. Before 1983 the fisheries policy was limited and part of the Common Agricultural Policy (CAP), which came in 1957 with the Treaty of Rome.
In spite of this significant change in the governance of EU fisheries, there is a lack of theoretical as well as empirical analyses of the consequences of a landing obligation policy. This paper includes the microeconomic foundation for analysing the impact of a landing obligation and empirical analyses of the economic impacts of the EU discard ban primarily related to the Danish fishery. In the first part of the paper, we survey the fisheries economics literature for theoretical findings regarding behavioural aspects of discarding fish and relate this to a landing obligation restriction. Furthermore, we explore gaps in the current state of knowledge.
A simple model for analysing fleet behaviour under a landing obligation regime is presented and subsequently applied in an empirical analysis of the short-term economic implications for the Danish fleet. Results are presented under differing assumptions regarding quotas uplift and selectivity. Finally, considering the long-term aspect of fisheries management, some preliminary findings regarding the impact of stock dynamics are included in the paper, too.
Keywords: Fisheries economics, fisheries management, landing obligation, discard ban policy

* pean@ifro.ku.dk (Denmark)

Ecosystem Based Fisheries Management: An economic Perspective

Lee G. Anderson*
University of Delaware

At its core, the primary function of fisheries management in the single stock case is the determination of the annual allowable harvest, and most often it is based on the selection of a target stock size and a control rule that will specify a harvest path that that will cause the target stock size to be achieved or maintained. The selection of the target stock and the control rule are policy decisions. In principle, target stock and control rule are selected so as to maximize the benefits to current and future users from the production of goods and services from the fish stock. In most cases however the metric for measuring success is biomass yield which means that that target stock size is Xmsy. So, single species fisheries management is focused on the answer to two questions. Where do we want to go? (What is the target stock size?). How do we want to get there? (What is the control rule for determining the time path of harvests?)

In an analogous manner, the basics of Ecosystem-based Fisheries Management can be understood as a process of answering an analogous but expanded set of questions. It will be necessary to come with the EBFM equivalent or analogous concepts of the target stock size and the harvest control rule. But to complete the analogy it will also be necessary to answer the question of why do we want to go there. The normal presumption to use Xmsy as the target stock in single species management has pushed that question aside. Given the non-comparability of the benefits from the use of the outputs of multiple stocks, it will be necessary to go beyond the concept of the maximization of sustainable biomass yield as a measure of benefits in order to design an Ecosystem-based Fisheries Management system that will allow for the answer to the expanded set of question in an internally consistent manner. The paper will describe procedure for Ecosystem-based Fisheries Management management based on setting a multi-dimensional target space and a control rule for a multi-dimensional harvest path to that will lead to a vector of stock sizes within the target stock space. Economic principles will be used to describe the nature of the target stock space based on a broadly defined metric for measuring the value of the bundle of sustainable production from the set of stock sizes taking full consideration of the value of output tradeoffs from different harvest production bundles. The necessity of devising a transparent and inclusive process for determining the target stock space and control rule that allows for the comparison of what people are willing to trade for what

the ecosystem will allow them to trade as they change production bundles will be necessary.

* lgafish@udel.edu (USA)

Fishery Bio-Socio-Economics

Anthony Charles*
School of Business and School of the Environment Saint Mary's University

For many decades, there have been calls for better human-related fishery information and analysis, and for more human dimensions in the advice provided to managers. To this end, there has been a strong push for integrated 'fishery system' analysis; now, any analysis of a fishery that does not take an integrated perspective is seen to be falling short of the potential. The wide acceptance of a more integrated and interdisciplinary approach to fisheries is exemplified in the rapid acceptance of the Ecosystem Approach to Fisheries globally. To make this need a reality, however, and thereby to meet the worldwide goals of the four pillars of sustainable development, there is a need to expand on bio-economic analysis to incorporate the social and institutional ingredients that have typically been missing. A "bio-socio-economic" analysis can help in this direction. Some initial efforts at fishery bio-socio-economics emerged in the 1980s and these have been refined over the past several decades, to the extent that a fundamental theoretical framework is now available. The challenge is to put bio-socio-economics into practice, to meet the need for an expanded focus in modern fishery management, to better assess management initiatives, and to have a better chance of meeting the new UN Sustainable Development Goals. The key elements of bio-socio-economics include (1) assessing multiple fishery objectives held both by society and by individual resource users, and (2) building human considerations into fishery management analyses by better predicting fisher behaviour, fleet dynamics, and response to fishery regulations. Incorporating this knowledge into fishery advice may improve the feasibility and likelihood of success in fishery management initiatives. This presentation reviews and discusses experiences with fishery bio-socio-economics, notably its past performance and future potential to be incorporated into integrated fishery analysis and provision of management advice. Recommendations are provided that take into account the benefits and the challenges involved in these efforts.

* Tony.Charles@smu.ca (Canada)

Bioeconomics of seasonality in a sequential fishery targeting short-lived species

Fernando Aranceta Garza*[1]., Francisco Arreguín Sánchez[1], Juan Carlos Seijo[2]
[1]Instituto Politécnico Nacional, Centro Interdisciplinario de Ciencias Marinas
[2]Universidad Marista de Mérida

The Mexican Pacific shrimp fishery is the most important fishery in México by means of production volume, exportation income, number of ports and fleet sizes and direct/indirect jobs among others. It targets mainly three species: brown shrimp (*Farfantepenaeus californiensis*), blue shrimp (*Litopenaues stylirostris*) and white shrimp (*L. vannamei*). It is a sequential fishery where an inshore small scale fleet target juvenile and preadult shrimps where fishermen uses throwing nets from land or from canoes. The offshore industrial fleet targets adults and it's composed of vessels equipped with two trawling nets. The sequential nature of this fishery imposes technological interdependencies between the fleets capturing the same stock at different life stages. These peneid shrimps are short lived species (1-2 years of life) and this biological attribute makes them very sensitive to environmental factors mainly to temperature variations which are associated to other external factors such as precipitation, salinity, winds velocity and primary productivity. Furthermore, this highly intrinsic adaptive plasticity to abrupt environment changes modifies the onset of the reproductive period, modifying the recruitment pattern of the shrimp with economic consequences to the shrimp fishery. The objective of the study is to analyze the lag in 1-2 months of the shrimp's recruitment into the inshore grounds and its bioeconomic effect over the shrimp fishery in the south of the Gulf of California. To assess the technological externalities between fleets, a multi-species and multi-fleet age-structured bioeconomic model was developed with M-at-age (natural mortality-at-age), fleet specific catchability-at-age and a gamma recruitment function to represent recruitment seasonality for each species.

* fer_aranceta@yahoo.com (México)

Distributional performance of a rights-based co-managed and eco-certified small-scale fishery targeting a metapopulation

Raul Villanueva*
Universidad Marista de Mérida

This work reports on how benefits are distributed among the owners of fishing grounds in the spiny lobster (*Panulirus argus*) fishery of Punta Allen, Mexico. This MSC certified small-scale fishery is co-managed through Territorial User Rights. Members of the local fishing cooperative, have exclusive access to individual fishing grounds within Ascension Bay. The fishery is based on the use of artificial shelters. These bottom devices provide refuges for lobsters, reduce predation mortality, and facilitate harvesting by free diving and the use of hand nets. In order to assess the distributive performance of this fishery, data from the fishing cooperative logbooks were complemented with a survey applied to campo owners to calculate the fishing incomes achieved in seven lobster fishing seasons (2007-2014). The calculated fishing incomes included the revenues, quasi-profits, profits and the resource rent. Distributions statistics (shape parameters and log transformations) and inequality metrics (Lorenz Curve and Gini index) were applied to those calculated incomes data. The analysis was complemented with a perceptions survey about the satisfaction and effectiveness of government and cooperative regulations. The results showed ambiguity by the inequality measures used in ranking the analyzed lobster seasons. The Gini index presented relatively low values (0.372 to 0.486) and there were high levels of satisfaction between the fishing right holders in the regulations. The results showed that in the lobster fishery of Punta Allen, the fishing incomes spread more equally than other fisheries. These results suggest that the high success of this small-scale lobster fishery could be explained in part by the equal distribution of fishing benefits.

* rvillanueva@marista.edu.mx (México)

Spatiotemporal bioeconomic performance of artificial shelters in a small scale rights-based managed Caribbean spiny lobster (*Panulirus argus*) fishery

Maren Headley*
Universidad Marista de Mérida

The study presents a bioeconomic analysis of artificial shelter performance in a fishery targeting a spiny lobster meta-population, with spatially allocated, individual exclusive benthic property rights for shelter introduction and harvest of species. Insights into fishers' short-run decisions and fishing strategies are also provided. Spatiotemporal bioeconomic performance of shelters located in ten (10) fishing areas during four seasons was compared using two-way ANOVAs and Pearson correlations. Results show that there was spatiotemporal heterogeneity in bioeconomic variables among fishing areas, with mean CPUEs (kg/shelter) ranging from 0.42 kg to 1.3 kg per trip, mean quasi-profits of variable costs per shelter harvested ranging from $6.00 to $19.57 USD per trip, and mean quasi-profits of variable costs ranging from $338 to $1069 USD per trip. Positive moderate correlations between shelter density and CPUE (kg/shelter) per km2 were found. Bioeconomic performance of the shelters was influenced by: spatiotemporal resource abundance and distribution, fishing area location in relation to the port, shelter density, heterogeneous fishing strategies and the management system. The results provide empirical information on the spatiotemporal performance of shelters and fishing strategies and can contribute to management at the local-scale of a meta-population distributed throughout the Caribbean Sea and Gulf of Mexico.

* marendheadley@gmail.com (México)

Bioeconomic analysis of striped marlin (*Kajikia audax*) sports fishing in Cabo San Lucas, México.

Obsidiana Sarahi Von Borstel J.*[1], Luis Felipe Beltrán Morales[1], Germán Ponce Díaz [2]
[1] Centro de Investigaciones Biológicas del Noroeste (CIBNOR)
[2] Centro Interdisciplinario de Ciencias Marinas (CICIMAR)

Sports fishing is an important economic activity, particularly in Cabo San Lucas, México whose economic benefit was calculated in 633 million dollars in 2008. In the past years a decrease was detected in the size of striped marlin and the number of licenses to practice sports fishing. Considering these aspects, we suppose that the number of licenses required by anglers is affected by their satisfaction level. The objective of this study is to estimate the correct level of effort to maximize the total economic benefits of the activity and identify the anglers' satisfaction level with a bioeconomic model. With this analysis we could estimate the bioeconomic reference points, as maximum sustainable yield (MSY), maximum economic yield (MEY) and bioequilibrium point (Ebe). The first phase of the project consists on going to the study area to apply face to face angler surveys, which is currently, this phase is covered 33%. It's; purpose is to identify the level of effort applied to the activity obtaining the necessary information to feed the model to identify the anglers' satisfaction level. During the May-August period, 74 fish specimens of striped marlin were caught, and 16% were released; the 90% of the anglers´ interviewed were from the U.S.A., 52% expressed excellent overall satisfaction, and 84% mentioned they will continue visiting Los Cabos to practice sports fishing if the government only permits to practice catch and release (C&R). While the practice of C&R has been regarded as a good strategy for managing resources, the side effects that this management measure can bring needs to be considered. The destination of the capture generated by sports fishing benefits different users; assuming they could not retain food and income from captures, it would impact the users, and the economic benefit deriving from this activity would be diminished.

* sarahivbj@hotmail.com (México)

Date: Tuesday, November 22, 2016 Time: 9:00 AM - 13:30 PM

Conserving spawners and harvesting juveniles: is this a feasible alternative to postponing capture until sexual maturity?

John F. Caddy*
International Fisheries Consultant

The entire life history of an exploited marine fish is simulated from the best information available. Existing models mainly assume that adult fish should be targeted by a fishery. For example, the Beverton and Holt yield model was released after the Second World War had allowed North Atlantic stocks 5 years to recover from intensive fishing, and harvests were again dominated by mature fish. Adopting a constant natural mortality rate at age when mature fish are common, is a reasonable assumption. It should not be used now for most demersal fisheries, where mature fish have been depleted by over-harvesting, fishers take a high proportion of immature animals, and incidental mortalities from trawling and discarding are often high. Recall that high individual fecundities were selected for in evolution by the high predation rates experienced by eggs, larvae, and juveniles. Models corresponding to higher juvenile M's-at-age are emerging in assessments of the many fisheries where juveniles are subject to high direct or indirect fishing mortalities.

This Chapter focuses on the use of models for M-at-age proposed by the author, each stemming from different basic assumptions. They provide similar vectors for M-at-age that can be used to incorporate juvenile fish catches into preliminary assessments, and also use information on fecundity at age, and tentative estimates of larval fish mortality in the plankton. A vector of M's-at-age from the reciprocal model helped formulate a reference point for fishing mortality corresponding to intergenerational replacement of female recruits following a criterion based on Charnov. Yield calculations using estimates of M-at-age parameters, led to suggestions that delaying exploitation until age at maturity is unlikely to greatly increase the overall yield and corresponding resource rent. It may adversely affect population fecundity if the spawning stock offshore is heavily targeted: a conclusion investigated by this Chapter.

* jfcaddy1@yahoo.co.uk (Italy)

Eco-labelling and eco-certification of fisheries: benefits, challenges and the future

Kevern Cochrane*
University of Rhodes

Environmental concerns about the sustainability of fisheries and aquaculture globally have fuelled a demand, especially in developed countries, for seafood products that are certified as having come from sustainable sources. This in turn has driven growth in the number of schemes offering certification and labelling services. The success of these schemes, at least in terms of access to markets, can be measured by the growing number of fisheries that are certified or are seeking certification. The Marine Stewardship Council (MSC), one of the biggest fishery eco-certification schemes, reported in April 2016 that 287 fisheries from more than 30 countries had been certified to the MSC standard and an additional 94 fisheries were undergoing assessment. The fisheries certified by MSC represent nearly 10% of the global annual catch. Reliable certification schemes provide an incentive to fisheries to comply with globally recognized sustainability standards but, at the same time, the concepts and practice have generated conflict and confusion amongst scientists, consumers and retailers. This presentation will examine some of the biggest challenges being faced, which include accusations that developing countries and small-scale fisheries are disadvantaged, criticism of the sustainability standards that are applied, and confusion in the market place because of the proliferation of schemes and a lack of transparency on performance. It will also address the attempts being made by the Global Sustainable Seafood Initiative (GSSI) to develop and apply a benchmarking standard to facilitate effective choices amongst eco-certification schemes.

* k.cochrane@ru.ac.za (South Africa)

Aquaculture bioeconomics: An approach for managing fish genetic improvement programs

Marcelo Araneda*
AquaInnovo Biotechnology Company, Bioeconomic & Statistics Department

The main objective of this conference is to present the importance of Bioeconomics as a *"Strategic Tool"* for decision-making in Genetic Improvement Programs (GIP), applied to aquaculture. This presentation starts with the definition of GIP, highlighting the elements of a GIP, operation and description of the traits that are selected in the salmon and tilapia industry. The use of bio-economics in GIP can be assessed highlighting the following points: *i) Benchmarking and evaluation of strain profiles, ii) Breeding objectives and selection index (Multitrait)* and *iii) Economic impact of genetic gains for different traits*. In addition, three case studies related to benchmarking and breeding objectives are presented. The first study belongs to a company with a GIP applied to the production of tilapia in Costa Rica. Two strains are compared through a benchmarking study, and a bioeconomic analysis is used to assess the potential for growth (fattening) and fillet yield (post-harvest phase). For each genetic strain the contribution margin and the unit cost of production is estimated. Finally, a risk analysis is applied with the objective of estimating the probability of reaching a unitary margin contribution higher than 0.52 US$ kg^{-1}. This reference point was previously defined by the company. A second case study describes the results of a benchmarking study for Atlantic salmon industry in Chile. Through historical data (2010-2016) the potential for growth and survival of different genetic lines was compared. In addition, technical and economic results are projected through a software for bioeconomical decisions, which was built as a decision-making and planning tool for the different used genetic lines in the Atlantic salmon industry. An example is projected under different geographic areas and farming seasons to depict results in bioeconomic indicators such as growth rate, survival, productivity and unit cost of production. A third study describes the objectives of genetic improvement in the production of Atlantic salmon in Chile. The process to estimate marginal economic values and the relative importance of traits such as harvest weight, mortality associated to *Rickettsial Syndrome* (SRS), and sea lice loads per fish is described. Finally, we conclude that bioeconomics is a tool not only to establish the basis of a GIP, but also to commercially manage, adequately plan the use of genetic lines and the transfer of genetic results in a commercial scale for aquaculture.

* marcelo.araneda@aquainnovo.com (Chile)

Growth and survival of juvenile red drum, Sciaenops ocellatus, acclimated to fresh water, under three different culture densities in a recirculating aquaculture system.

Miguel Vela Magaña*
Universidad Marista de Mérida

This study presents biological (growth and survival) and technical performance (biologic FCRB and economic feed factors FCRB) indicators of red drum (*S. ocellatus*) growth in a freshwater recirculation aquaculture system at three stock densities (D_1=83, D_2=167 and D_3=250 fish m^{-3}) . In this experimental culture freshwater acclimated organisms were reared during 575 days. Culture systems consisted in nine tanks each one of 1.2 m^{-3} connected by central drainage at clarifier tank. The water then flows to a reservoir where is pumped to a biolfiter and a U.V. sterilizer systems to finally return to the culture tanks. Each stock density had three replicates. The fish initial mean weight was 7.11 ± 0.02. and final weight 745.99 ± 28.2. Gravimetric data samples were taken in a monthly base. Mortality and feeding data were daily registered . The individual growth was analyzed by repeated means test. Survival, biologic and economic feed conversion factor rate between densities were analyzed by one way Anovas. von Bertalanffy growth model parameters were adjusted. There were not statistical differences between survival rates of D_2 (13% ± 0.013) and D3 (8% ±0.010), but it were with D_1 (28 % ± 0.051). There were not statistical differences between FCRB of D_1 (1.47 ± 0.13) and D_2 (1.15 ±0.03), but it were with D_3 (0.98 ± 0.03). FCRE didn't show signifficative differences between densities (3.41 ± 0.7).). Specific growth rate (% day -1) didn't show signifficative differences between densities (0.80 ± 0.005). von Bertalanffy presented isometric value (b=3.05, R^2=0.958). This study presents the preliminary base line for the technical feasibility of *S. ocellatus* freshwater culture.

* mvela@marista.edu.mx (México)

Stochastic analysis of production dynamics of male and female redclaw crayfish (*Cherax quadricarinatus*) reared under commercial intensive cultivation

***Lavinia Nuñez Amao* ***
Centro de Investigaciones Biológicas del Noroeste (CIBNOR)

We used a stochastic model to simulate, over time, total biomass production of male and female Australian redclaw crayfish (*Cherax quadricarinatus*), so as production of commercial-sized crayfish (40–60 g and 61–90 g). The model was calibrated with a database from an intensive commercial farm. Results showed that uncertainty in obtaining production of the 61–90 g grade diminished with time. In the case of 40-60 g grade and total biomass, uncertainty was minimal at 69 days (males 40-60 g grade), 84 days (females 40-60 g grade), 92 days (males total biomass) and 94 days (females total biomass). The model predicted that, at harvesting time, there is 95% confidence that males produce 2.96–3.29 t ha^{-1}, (mean = 3.13 t ha^{-1}) and females produce 2.49–2.72 t ha^{-1}, (mean = 2.60 t ha^{-1}), of biomass, closely approximating biomass production registered in the database.

* lnunez@pg.cibnor.mx (México)

Bioeconomic effect of size-heterogeneity on optimum harvest time

Patricia Borrego Kim*, Juan Carlos Seijo, Mariel Gullian-Klanian
Universidad Marista de Mérida

The effect on optimum harvest time in tilapia, as a result of size-heterogeneity is the principal subject of this study. A dispersion trial of 330 days was conducted in aquaculture tanks with juvenile Spring tilapia (*Oreochromis niloticus*). Six tanks 1500-L were stocked with 60 juveniles: **Hm** (homogeneity 100.17 ± 5.91g) per tank and **Ht** (heterogeneity 96.55 ± 24.58 g), three replicates were randomly assigned to each of the two treatments. Fish were fed three times a day.

There were no significant differences in absolute growth rate (AGR) and length-weight condition (L-W). The analysis of variance identifies significant differences between Hm & Ht, at the range of t_{-1} to t_{-90} and t_{195} to t_{330}. Fish survival was equal in both treatments. The analysis of optimum harvest time (OHT) reveals that when market objective-size (MOS) of

400 g was considered, same results were obtained for both treatments (180 days). The differences in profits are 38% in Hm system, which were higher than traditional Ht system. This reveals a dynamic behavior respect the MOS, and the information could be used to enhance the profitability in aquaculture business.

Keywords: Optimum harvest time, tilapia, heterogeneity, market objective-size (MOS).

* patriciabkim@gmail.com (México)

Bioeconomic Modelling of the Capture Based Aquaculture of The Northern Bluefin Tuna in Mexico

Francisco Javier Vergara Solana*[1], Marelo Araneda[2], German Ponce Díaz[1] Juan Carlos Seijo[3], Ramos Sáenz Pardo[4], Sofía Ortega García[1]
[1]Instituto Politécnico Nacional- Centro Interdisciplinario de Ciencias Marinas (IPN-CICIMAR)
[2]Aquainnovo
[3]Universidad Marista de Mérida
[4]Instituto Politécnico Nacional- Escuela Superior de Turismo (IPN-EST)

To achieve a production that exceeds 90 million tons, the aquaculture industry employs various strategies to get their inputs, such as obtaining juvenile organisms from wild populations for on-growing in controlled conditions. This type of aquaculture is known as capture based aquaculture (CBA). The most iconic –and polemical –species which are produced under this scheme are the bluefin tunas. The Mexican aquaculture tuna production is based exclusively on the northern bluefin tuna (NBT), which represents 1.8% of the volume of domestic tuna production but 14% of its value. In order to understand this production strategy and to assist the decision making related to the activity (on farm and in the design of public policies) a bio-economic model of the NBT production in Mexico was parameterized. The model also considers the uncertainty inherent of the CBA (seed weight, initial number of organisms and fish stocking schedule). The model was parameterized using the production records of 49 pens located in Bajo Soledad and Puerto Escondido, Baja California during three production cycles (2008-2009; 2009-2010; 2012-2013), as well from interviews with people associated with the industry. The results show that the profitability of the operation is related to changes in the SST, as this affects

mainly on mortality and efficiency in food consumption. Bajo Soledad presents the best indicators of performance. The adverse effects of SST can be mitigated when stocking the pens early in the season and trying to capture bigger NBT wild juveniles. Finally it is noted that this model would be subsequently integrated to a bioecomic model of the fishery, in order to evaluate the interdependencies between the two activities.

* vs_fj@yahoo.com (México)

Date: Wednesday, November 23, 2016 Time: 9:00 AM - 13:10 PM

The number of players in a fisheries game: curse or blessing?

Rognvaldur Hannesson*
University of Bergen

In a non-cooperative fishing game of two players, one single player must be sufficiently dominant in order to have an incentive to conserve the stock in its own interest. It seems likely that the maximum growth rate of fish stocks could often be too low in order to provide a conservation incentive even for a highly dominant player. Furthermore, the fish catch left for the dominant player could be much less than that taken by the free rider and so be considered unfair. As the number of players increases it becomes less likely that the any single one will be sufficiently dominant to have an incentive to conserve the fish stock in its own interest. But would this necessarily mean that fish stocks are increasingly likely to be exploited to extinction as the number of players increases? Would not players prefer to avoid annihilation of their fisheries even if no single one of them is dominant enough to conserve the stock in its own interest? This, at any rate, seems to have happened in the Northeast Atlantic mackerel fishery where no single player is dominant enough for this purpose. Despite no comprehensive formal cooperation and much rhetoric the parties have set themselves rather cautious fish quotas. An otherwise assured mutual destruction could prompt the parties sharing a fish stock to cooperate, at least informally, even if no single party in dominant enough to conserve the stock in its own interest. This could even produce a better situation than when one of two parties is able to free ride on the dominant party, leaving perhaps a grossly small catch to be taken by the dominant party.

* rognvaldur.hannesson@nhh.no (Norway)

A simple Application of Bioeconomics to Fisheries Subsidies

Rashid U. Sumaila*
University of Brittish Columbia

First, I briefly review key bioeconomic insights on fisheries subsidies reported in the literature. Second, I present new analysis of global fisheries subsidies data to determine how much of these subsidies are provided to small scale fisheries compared to their large scale counterparts. Third, I discuss the implications of our findings on the ability of small scale fishers to be economically viable.

* r.sumaila@oceans.ubc.ca (Canada)

Biological factors, production functions and bioeconomics analysis

Eduardo Pérez Espinoza*
Universidad Marista de Mérida

Although it is recognized that a model is a simplification of reality that must represent the main features of the system under study, it is not always easy to recognize what such main characteristics are.
An example of this is represented through a hypothetical fishery using the dynamic version of the Gordon-Schaeffer's model. In this case, we will see how, starting from the general model, by relaxing some simple assumptions, the behavior of the output variables suffer important modifications. Assuming a catchability coefficient subject to long-term cycles, one calculate the effects on the model production function by altering over time biomass availability of the resource being exploited. Something similar happens when price of the resource and the cost of the effort are not constant. Likewise, the access mode to the resource modifies temporal and spatial availability of the resource affecting the production function underlying to the model and by extension the bioeconomic valuation of the fishery.
We can see that in the modeling of aquaculture systems something similar occurs. In aquatic production harvestable biomass over time is an essential variable, but more so the quality of this biomass. The gain in individual growth in weight does not necessarily mean

higher performance in fillet value on the market. An allometric growth implies a greater gain in weight of the head or of the fins. It can also indicate a gain in fat. Thus, a fish can be heavier because the fat contribution of organs that are not valued at the market. In this case it is urgent to find a production function that relates directly the growth of the fish with the performance in fillet with greater price in the market. Heavier fillets, but fat will be counterproductive for the firm.

Partial harvests strategy is another example from aquaculture. The biological variability within the same cohort has not all individuals simultaneously with a caliber desired by consumers. Thus, over the production cycle, there will be individuals that meet the conditions desired in the market and others will not. Therefore, individuals with delayed growth will affect the costs structure and the corresponding economic performance of the different production batches. Finding the balance between waiting time between harvests, determination of optimal harvest time, among other variables can mean success or economic failure of fish culture.

* eduardo.p.perez.e@gmail.com (Chile)

Economic value of the recreational fishing and abundance of permit (*Trachinotus falcatus*) in Ascension Bay, Quintana Roo

Leopoldo Palomo Cortés*
Universidad Marista de Mérida

This research is carried out in the fishing community of Punta Allen, Quintana Roo. This community is located in the Biosphere Reserve of Sian Ka'an, where recreational fishing in the Ascension Bay is very important to the livelihoods and lifestyles of the community. Fly fishing in Punta Allen has attracted investments in lodges and fishing clubs administrated mostly by foreign anglers or in associations with local fishermen. These clubs have agreements with the local touristic cooperatives, to provide boats and local guides for their anglers. The game fishes species in Ascension Bay, are bonefish (*Albula vulpes*), permit (*Trachinotus falcatus*), tarpon (*Megalops atlanticus*) and snook (*Centropomus undecimalis*), but the high presence of permit, promotes that most of the anglers come to seek this species. However, the resources have never been accurately assessed to determine the population size or their spatial distribution, besides information about the economic impact on the community and the ecosystem are insufficient. Specific objectives included are: (1) an economic valuation of the recreational fishery in Ascension bay, using a travel cost method; (2) carry out a population census of permit (*T. falcatus*) to estimate

abundance and its spatial distribution, using a standard line transect visual estimate inside the bay and, (3) estimate the economic impact of population size of permit (*T. falcatus*) for the community of Punta Allen. The community could use this information as an indicator of population and ecosystem health to promote management policies that consider recreational fishing species and encourage their protection and sustainable management.

* polo_palomo@hotmail.com (México)

Viability of the reactivation of the totoaba fisheries (Totoaba macdonaldi Gilbert, 1890) in the Northern Gulf of California

Mónica Ruiz Barreiro*, *, Francisco Arreguín Sánchez
Instituto Politécnico Nacional, Centro Interdisciplinario de Ciencias Marinas

One of the most important fisheries in Mexico during 1920-1970 in the Northern Gulf of California (NGC) was the totoaba, and it was also one of the first species that shows evidence of overfishing. In 1975 it was declared a permanently fishing closure, and nowadays is rated as "endangered species" on the Red List. Recent studies suggested population recovers; however illegal fishing is increasing. The ultimate objective of the research initiative is to assess the bioeconomic viability to reactivate the totoaba fishery as a form to control the state of the stock. Due to permanent closure, there is no information about the totoaba abundance since 1980, being the objective of this contribution the estimation of the stock for the last decades, through an ecosystem time-dynamic simulation trophic model. The trophic model was calibrated with time-series of catch per unit effort data (CPUE), as a measure of relative abundance of several fished stocks, and environmental forcing. Based on generalized additive models significant correlations between CPUE and environmental time-series data was performed, and incorporate to the dynamic trophic model. Results indicate the Colorado River's streamflow is highly correlated with totoaba, corvina and chano abundances; and the sea surface temperature with shrimp, rays, serranids and sharks abundances. Once trophic model was calibrated, an estimates of recent abundance of totoaba was estimated. Further research will be carrier to investigate potential reactivation of the totoaba fishery accounting biological and economic reference points.

* monika.cicimar@gmail.com (México)

Bioeconomic viability on industrial shrimp fishing and artisanal fisheries in the southeastern Gulf of California, Mexico

Juan Carlos Hernández Padilla[1], Silvia Salas[2], Andres Cisneros Montemayor[3], Manuel Jesús Zetina Rejón[1], Francisco Arreguín Sánchez[1]

[1] Centro Interdisciplinario de Ciencias Marinas – Instituto Politécnico Nacional
[2] CINVESTV-IPN
[3] University of British Columbia

Studies that integrate both social and economical aspects of resource exploitation in fisheries can provide critical information in the modelling of more sustainable and efficient management schemes. Due to the poor administration of both industrial and artisanal fisheries in the southeastern Gulf of California, Mexico, the aim of this study was to describe the temporal behavior of the resource rent derived from the industrial shrimp fishery, and the shark, shrimp, lobster, red snapper, sawfish, robalo fish and scallop artisanal fisheries. This behavior was monitored by boat and by fleet, using 2013 as a reference year. The bioeconomic parameters of the industrial fishery were obtained from interviews to a boat owner and those of the artisanal fisheries from surveys performed in the area of study. For both fleets, the highest expenditure throughout the fishing season was on operation costs, followed by the opportunity cost of capital and finally, the fixed cost. In the particular case of the industrial shrimp fishery, and despite having a negative development in the first four years, the overall resource rent for the whole fleet exhibited a positive trend during the 2006-2014 period, totalling US $ 121, 875, 063.53. Regarding the artisanal fisheries, only the sawfish and scallop ones retained a positive resource rent during the entire 2006-2011 period. Additionally, and as a consequence of high catches in 2008, resource rent for all artisanal fisheries was highest during this year. In conclusion, the behavior of resource rent for both types of fisheries proves current unsustainable practices in the southeastern Gulf of California.
Keywords: southeastern Gulf of California, resource rent, industrial shrimp fishery, artisanal fisheries.

* jchpadilla@gmail.com (México)

Date: Thursday, November 24, 2016 Time: 9:00 AM - 12:10 PM

Finance Mechanisms for Governing the Commons: Paying for research, enforcement, decision-making and administration costs

***Peder Andersen*[*], *John G. Sutinen*[2]**
[1] Director, Danish Economic Council, Copenhagen
[2] Professor Emeritus, University of Rhode Island

This paper evaluates the efficiency of user fees and other mechanisms for recovering the costs of publicly provided services for the management of the commons. Services such as research, enforcement, decision-making and administration services are essential ingredients of regulatory programs directed at the management of common pool resources. These services range from private goods, to club and public goods; and government often provides most of them. Government expenditures on these regulatory services tend to be large, imposing significant burdens on both taxpayers and the regulated community. To pay for these services, countries such as Australia, Canada and New Zealand have applied cost-recovery mechanisms to several economic sectors, including agriculture, food quality, transportation, telecommunications, etc. The U.S. also has a long history of user fees, although at a lesser scale.
In this paper we derive a set of pricing rules for publicly provided research, enforcement, decision-making and administration services in the context of governing the commons. Our models are based on the following assumptions: that research adds to the stock of information, which depreciates over time; that added information increases the expected returns to firms and reduces the costs of regulatory decision-making; and that enforcement of regulations reduces external costs, such as congestion or pollution. The demands by regulated firms (agents) for information, enforcement, decision-making and administration services are derived to determine the use of these services under various cost-recovery mechanisms. The mechanisms range from no recovery of costs to user fees on the amounts of the services provided. Allocative outcomes of the cost-recovery mechanisms are compared to the social optimum. The analysis demonstrates that the efficiency and effectiveness of regulatory services depends critically on the structure of the cost-recovery mechanism and on the technology of production (joint and non-joint). For example, a user fee as a percent of gross sales is not a fully efficient mechanism and can produce other inefficiencies and problems in the provision and use of regulatory services.

Bioeconomics of ocean acidification and climate change

Juan Carlos Seijo [*]***, Raul Villanueva***
School of Natural Resources, Marist University of Merida

Organisms in benthic and neritic environments are susceptible to changes in saturation of carbonates, and even small changes in concentrations of CO2 in oceanic waters can cause negative impacts in calcifier organisms, like mollusks, echinoderms and crustaceans, as well as ecologically valuable critical habitats such as corals. Also associated to CO2 emissions, there are changes in ocean temperature and salinity affecting marine species and their population dynamics in variety of ways. Changes temperature and salinity affecting habitats of marine species can influence significantly their metabolism, individual growth rates, seasonal reproduction and the distribution of many species over space and time. To deal with the possible effects of ocean acidification (OA) and climate change, this Chapter presents equilibrium and dynamic bioeconomic frameworks and trajectories to account for the OA and climate change stressors affecting marine species and the likely performance of their fisheries over time. Alternative management strategies are considered to mitigate the bio-ecological and economic effects of these environmental stressors. A stochastic analysis is included to assess associated risks of falling below biological and economic limit reference points with alternative explotation rates. Questions addresed in this chapter to be answered with the above mentioned approach include: How can the ef fects of OA be incorporated into the bioeconomics of fisheries management and decision-making?, How should we deal with the new uncertainties inherent in the effects of ocean acidification and climate change in the absence of probabilities of occurrence of possible future states of OA, water temperature and salinity?, and What is the effect of OA on calcifier species having different life cycles and resilience capacity?

* jseijo@marista.edu.mx (México)

Biological response of the sea cucumber Isostichopus badionotus to a decrease in the ocean pH: economic consequences and adaptative fishery management of Yucatán península

Enrique González Durán [*]***, Alvaro Hernández Flores***
Universidad Marista de Merida

Commercial fisheries activities for the sea cucumber *Isostichopus badionotus* in Yucatan became important in early 2000s; since then, growing concerns with regard to its management have been arising. It has been proven that this holothurian may display a patchy distribution on the seabed, between 10 and 30 m depth. The effects that environmental conditions have on the spatial distribution of this species need to be included in fisheries modeling to anticipate the fisheries collapse risk. Since temperature has proven to have a strong effect on other echinoderm spawning, larvae development and juveniles' settlement, we assessed the effect that decadal variation of seawater temperature (rate of 0.2°C decade^{-1}) could have on the recruitment (*R*) and natural mortality (*m*) of early life stages of *I. badionotus*. Age-specific spatial models of the stock were generated by a Beverton-Holt model that incorporates the effect of temperature. Dynamic of the stock structure over space were simulated with a time unit of four months, and survival was considered as function of natural and fishing mortality. Patches were open to the fishery after meeting the compliance of regulations ($L_{50\%}$ = 23 cm, a minimum density of 0.10 ind m^{-2}, and minimum biomass per patch of 3,000 tons). Once the stock meets these conditions, the patches were opened for fishing. Fishing mortality was calculated using a depensatory catchability function. Once the stock was subject to fishing, the effects of both mortalities were included on the stock assessment. The economic consequence of targeting this species with a spatial-dynamic pattern (patches), continuously exposed to natural variations, were addressed over time. Steaming and effectiveness cost related with the election of different alternative grounds were calculated with four management strategies: reduction of TAC (s_1), reduction of maximum allowable effort (s_2), increase of the period of closed seasons (s_3), and reduction of minimal size catch (s_4). Results indicate that the increase of temperature significantly reduced recruitment, and affects the growth of patches, enhancing the vulnerability of the species to overexploitation. Therefore adaptive fishery management oriented to maintain the economic benefits through the time, the stock and to compensate the negative effects of climate variability are studied.

* enriqduran@hotmail.com (México)

Reference points for vulnerable species based on bioeconomic age-structured models: an approach for Totoaba macdonaldi

Oswaldo Rodríguez García [1], Juan A. De Anda Montañez[1], José María Da Rocha[2,3], Fausto Valenzuela Quiñonez[1,4], Juan Carlos Seijo[5], Alvaro Hernandez F.[5], Silvia Salas Marquez [6]

[1] Centro de Investigaciones Biológicas del Noroeste
[2] Centro de Investigación Económica, Instituto Tecnológico Autónomo de México
[3] Facultad de Ciencias Económicas y Empresariales, Universidad de Vigo
[4] Consejo Nacional de Ciencia y Teconología Centro de Investigaciones Biológicas del Noroeste
[5] Universidad Marista de Mérida
[6] Centro de Investigaciones y Estudios Avanzados, Unidad Mérida

Management objectives of vulnerable fish species must focus on maintaining healthy population status. Hence, reference points should be constrained to ensure recruitment. We assessed bioeconomic reference points for the totoaba (*Totoaba macdonaldi*), an endemic fish to the Gulf of California, reaching lengths of 2 m and 25 years. Totoaba fishing was banned by the Mexican government in 1975 after a drastic decline of catches in the upper Gulf of California. Although totoaba is protected by several international organizations, the demand by the Asian black market for the totoaba swim bladder has intensified illegal fishing in the past few years. Social pressure for authorities to reopen the fishery has also increased. Totoaba reference points were estimated as the steady state solution of a dynamic optimal management problem, taking into account: (1) fishing hook and gillnet technology with different selectivity shapes, (2) a discount factor associated with the reference points to discount future economic profits, and (3) effort levels (*f*) are subject to maintaining optimal spawning-stock biomass (*SSB*). With the selection of the fishing mortality path that maximises the present value of future utilities considering the stock dynamics implied by the age-structured population, we analyzed *f*, yields (*Y*), and *SSB* trajectories under four scenarios, where the initial *f* begins at different years when totoaba fishery regulation decision is taken (from 2013 through 2016). Each scenario was modeled under three totoaba population states: recovered, mid-recovery, and depleted. Gillnet reached higher *Y* and *SSB* at lower *f*; however, this gear is not recommended because it is highly predatory for totoaba, marine mammals, and sea turtles. Different scenario modelling showed that regulation delay has a negative impact on *SSB* and, if the totoaba population is still depleted, the *SSB* will be low since the regulations have not been formalized

* rodriguezg.osw@gmail.com (México)

Is it sustainable to fish during the reproductive period an endemic octopus fishery caught with a bait-based technology?

José Duarte Canul*
Universidad Marista de Merida

This study explores the sustainable harvest of the octopus fishery of Yucatán continental shelf, which has a fishing season occurring during species reproductive period. The spawning and post-spawning egg care by females induces them to stop eating once they have spawned until their dead occurs. There is no planctonic larval occurrence, avoiding predation and adverse oceanographic conditions mortality. The fishing method used in the Yucatan shelf to fish for octopus consists of a rod with lines having crabs as bait and weights with no hooks that is called jimba. Two fleet have an impact over this resource: a small scale and a semindustrial fleet. Male/female percentages by ages indicate that during reproduction period the occurrence of females in the harvest decreases as spawning progresses during the fishing season. A Virtual Population Analysis was built to obtain the recruitment pattern which was used as an input of an age structured bio-economic model with seasonality was built to explore the effect of changes in the fishing season of this short-lived (12-18 months) semelparous cephalopod. The number of spawners was calculated by th Beverton-Holt function whose results were distributed in time using the distributed delay function which uses the Gamma distribution. The scenario of the regular fishing season or Status Quo was compared with other four alternative scenarios related to the beginning of the fishing season were studied using the model: two scenarios that start before the regular fishing season (2 an 1 month) and two scenarios that start after them (1 and 2 month).
Results indicate that the regular season have a better performance in the sustainable management of the resource linked to fishing gear mechanism (fishing with bait, i.e. crabs) which protect spawners from being harvested and therefore allows for sustainable generations of recruits. Fishery management based on considerations of reproductive behavior and fishing method used may determine the sustainable performance of fisheries targeting post-spawning egg care species.

* jduarte@marista.edu.mx (México)

Holistic reference points for exploited ecosystems with explicit harvest rates

Francisco Arreguín Sánchez*[1]; Pablo del Monte Luna[1]; Manuel J. Zetina Rejón[1]; Luis Orlando Duarte[2]; Diego Lercari[3,4]; Martha Albañez Lucero[1]; Danilo Calliari[4]; Mónica Ruiz Barreiro[1]; Rodolfo Vógler[3].

[1] Instituto Politécnico Nacional, Centro Interdisciplinario de Ciencias Marinas
[2] Laboratorio de Investigaciones Pesqueras Tropicales, Universidad del Magdalena
[3] Universidad de la República, Centro Universitario Regional Este
[4] Universidad de la República, Facultad de Ciencias,

The need to include ecosystem dynamics theory in fisheries management currently is recognized. However, even when valuable indicators on ecosystem resilience and sustainability are provided, no specific advice on harvest rates applied to individual fish resources exists. We present explicit allowable harvest rates for individual stocks estimated from ecosystem reference points (ERPs). This contribution proposes, through simulation experiments, ERPs derived from holistic properties. Simulation experiments were based on Ecosim model and consisted in estimate the effect of a systematically increasing harvest rate on individual functional groups in the ecosystem; and measures such effect through variables like catch, biomass, resilience, production, and entropy, among others. The ERP are based on concepts that make them potential management objectives such as maximizing catch per unit of biomass, ecosystem resilience maintenance, balanced harvesting and, a new concept, the noxicline, that identifies the critical level of ecosystem deterioration due to the loss of biomass. We illustrate these ERPs with the application to four ecosystems, the Northern and Central Gulf of California, Mexico; the estuary of Río de La Plata, Uruguay-Argentina; and the Gulf of Salamanca, Colombia; and discuss ERPs in terms of their potential use and implementation for management purposes including the challenges of climate change and, using the case of Mexico as example, how to insert this strategic scheme within the institutional arrangements for taken decision process.

[a] farregui@ipn.mx (México)

¿Is lobster fishing a profitable activity?:contribution of supplementary fishing in the income of fishermen

Miguel Cabrera*, Silvia Salas, Iván Velázquez

Lobster fishery (*Panulirus argus*) has been considered as an important source of income and foreign exchange in Yucatan. Annual yield of this resource however has been variable due to climatological events and red tide among others. These factors have had an impact in lobster abundance and availability of the resource for fishing with the implicit effect on the revenues. While lobster is the target specie, fishers also capture other resources in the same trip, hence it can be said that this is not a single species fishery. Among the species captured in a journey species like red grouper, black grouper, and hogfish stand up. Based on data from all the species captured, prices, and information on travel costs per trip, the quasi-rent was estimated (revenues minus cost per trip). The analysis was undertaken in four fishing ports of Yucatan where lobster is targeted. The analysis of quasi-rent along the fishing season, showed that the lobster fishery including only lobster as a target can generate red numbers, in all ports fishermen lost between 16 to 57 % of the trip investment. When other species captured in the trip where included, fishermen obtained positive revenues, at least in two ports, fishermen earn up to 50% of the money invested per trip. Results show that the fishery based exclusively on lobster is far from been profitable, hence the contribution of other species in a fishing trip make the balance in the fishers' income, and hence in the profitability of the fishery.

* miguel.cabrera@cinvestav.mx

Optimal feeding in tilapia culture

Roger Domínguez May*,
Centro de Investigación y de Estudios Avanzados del Instituto Politécnico Nacional, Unidad Mérida

One the problems that facing the producers in aquaculture are the feeding high costs, which represents between 40 and 60% the operation costs. In this work, it is studied optimal feeding in tilapia, using a bioeconomic model and optimal control theory. It is found the optimal feeding according for market prices of Monterrey, Mexico City, Cancun.

The best scenery that maximize the present value of benefits using the optimal ration-size, was according market price Monterrey, respect other cities, with benefits of $3,811.50/tank. The time and size (for unit) optimal of harvesting, were 307 days and 485.58g. The optimal feeding in aquaculture, can contribute to the economy to producers principally in the reducing the operation costs.

* roger.dominguez@cinvestav.mx (México)

Evaluation of growth and survival capacity of Litopenaeus vannamei through an oxytetracycline bioavailability bioassay

S. Gámez Bayado*, A. Espinosa Plascencia, M. Bermúdez Alamada.
Research Center for Food and Development

Introduction
Shrimp farming is a large development area for the end of last century. However, due the high densities of organisms on sowing, poor quality in water and deficient food administration, there is disease related problems which it translates in collapse of the industry. This study aimed to evaluate the growth and survival capacity of *Litopenaeus vannamei* through an oxytetracycline bioavailability bioassay with controlled conditions.
Materials and Methods
A bioassay was conducted in Maricultura del Pacífico farm, located at Bahía de Kino, Sonora. A total of 360 juvenile shrimp *L. vannamei* were used for this study, housed in 20 organisms per fishbowl that were handled with to two different treatments and one diet without oxytetracycline added which corresponds the control group. The treatments were repeated three times. During 46 days, all organisms were fed with two oxytetracycline added diets. Samples were collected every third day taking one organism per fishbowl. Biometry was performed. It was evaluated Feed Conversion Rate (FCR), Growth Rate (GR), Cumulative Growth (CG) and Weight Gain (WG). Additionally, Physico-Chemical parameters (PC) were measured daily and water quality were analyzed by Total Ammonia Nitrogen (TAN), NO_2 and $CaCO_3$
Results and Discussion
It was found FCR of 1.23±0.84, GR of 0.32±0.60 g, CG of 0.07±0.01 y WP of 0.60±0.53 g. Also, in PC was obtained a pH 7.83±0.07, temperature 31.70±2.25 °C, salinity 37.97±0.53

‰, dissolved oxygen 4.75±0.02 mg/L, TAN 3.17±0.81 mg/L, NO_2 3.85±1.35 mg/L, y $CaCO_3$ 100.05±9.63 mg/L. The survival percentage was 99.72 %.
Conclusions
L. vannamei on controlled conditions had appropriate growth and survival capacity. However, we suggest the evaluation of hemolymph, internal injuries and the presence of microorganisms to ear

* sergio.gamez@estudiantes.ciad.mx (México)

Economics and Management of Aquaculture of Tilapia and White Shrimp

Eucario Gasca Leyva*, Roger Dominguez May
Centro de Investigación y de Estudios Avanzados del Instituto Politécnico Nacional, Unidad Mérida

Centro de Investigación y de Estudios Avanzados del Instituto Politécnico Nacional
Shrimp farming and tilapia are the most widespread and occurring with greater volume worldwide. However, economic studies are relatively few and recent, particularly in rural semi-intensive systems. These organisms have been studied by the CINVESTAV Merida since the 80 and more recently the economy of production is studied by the laboratory of Aquaculture Economics and Management of CINVESTAV. In this analysis the work more relevant and more recent that have developed in this area of research are described. An example of intensive tilapia aquaculture is shown, and how economic studies can help industry to develop efficient and sustainable manner.

* eucario.gasca@cinvestav.mx (México)

Factors affecting the relative abundance of low mobility species: Spiny Lobster in the Galapagos Islands

Juan Carlos Murillo Posada*,
CINVESTAV

One approach to estimate relative abundance has been the use of standardization methods, especially in cases where resources have not a homogeneous spatial distribution, such as lobster. The aim of this study was to standardize catch per unit of effort (CPUE) and analyze the factors involved in the variability of this index of relative abundance. Based on data collected in the Galapagos Islands, Ecuador, this study assessed how factors such as sea surface temperature (SST), distance to port, region, origin of fishermen, daily timing and the season fishing, affects CPUE of lobsters *Panulirus penicillatus* and *P. gracilis*. Generalized linear and generalized additive models were tested to standardize CPUE and identify significant variables that can contribute to relative abundance. The results show that the variables have different effect on the two species. SST, distance to the port and fishing region are the factors that most affect the variation in CPUE of both species. In both species, SST is inversely related to the CPUE. CPUE was higher near the ports up to 110 km, coinciding with a high allocation of fishing effort within this spatial range. On the other hand, CPUE was higher at night than during the day for *P. penicillatus*, the opposite was evident for *P. gracilis*, these differences would be related to the behavior of the animal associated to the fishing method. *P. penicillatus* showed sustained catch rates in the first three months of fishing, declining in last month e.g. December; conversely, CPUE in *P. gracilis* increased in December. Finally, the relative abundance between the two species was also different, both between regions and between the ports of origin of fisherman. Along with the spatial, temporal components, and those related to species behavior and dynamics of fisherman, other variables that contribute to variations in CPUE are discussed; all these factors largely determine the accuracy in the assessment of the stocks.

* juanmurilloposada123@hotmail.com (México)

The use of probiotics in shrimp aquaculture, a bioeconomic analysis

Daniel Peñalosa*
CICIMAR

In 1986, Kozasa documented the first use of probiotics as a growth promoter in aquaculture. Subsequent work pointed out probiotics as an alternative to the use of some chemicals and drugs. Currently, there are commercial formulations of probiotics aimed to improve the performance of some crops.
The role of probiotics in shrimp farming has mainly two effects that directly affect economic performance **(1) to promote the growth of organisms in culture, and (2) to protect the crop against pathogens, reducing mortality**.
The use of probiotics in shrimp farming has proven beneficial, however, the actual application can be sub-optimal. Following this, the need to address the issue arises. The goal: to quantify and evaluate through a bio-economic study, the technical and economic benefits of implementing this technology. The main research questions to answer are:
For the production of *Penaeus vannamei* cultivated with different concentrations of probiotic in a super-intensive system in a pilot-commercial scale.
1. What is the effect on biological technical indicators?
2. On which month is the net present value maximized?
3. Which probiotic concentration minimizes the bio-economic risk in long-term production?
An experiment will be executed in 50m^3 tanks with 1000 shrimps per m^3, in which the concentration of probiotics applied will vary, including two control groups: one without probiotics and another one with a commercial probiotic. The rest of the factors will remain constant.
Results will be integrated into a bio-economic model composed by different sub-models: (1) biological sub-model (2) technological sub-model (3) economic sub-model
Deterministic simulations will be conducted to find the concentration of probiotic to optimize economic performance. After this analysis, a risk assessment (stochastic analysis) will be performed. The purpose is to design bio-economic risk indicators to help and make a better investment decision and crop management under the implementation of this technology.

* dpmartinell@hotmail.com (México)

Technical efficiency determinants in a Semi Industrial Fishing Fleet: A Mexican case study

Daniel Quijano Quiñones*[1], Silvia Salas[1], Carmen Monroy-García[2].
[1]Research Center of Advance Studios (CINVESTAV, Merida)
[2]National Fisheries Institute (INP).

Introduction-
Understanding the factors that define technical efficiency in a fleet is a requirement to define strategies to regulate fishing pressure of fishing resources. This study aimed to understand the factor that define the technical efficiency of the semi-industrial fleet of Yucatan, Mexico and identify if there were differences in the boats that comprise this fleet. This fleet operates at the Bank of Campeche and some technical differences in the boats suggest differences in their efficiency. A stochastic ray frontier was used to evaluate such efficiency. Seven variables were included in the analysis: days at sea, crew, vessel length, power-engine, year season, fishing area and fishing gear. The data from three fishing seasons used in the analysis comes from logbooks of skippers and interviews.
Results- A total of 7,095 fishing trips were analyzed, the estimated efficiency in each fishing season respectively was 0.77, 0.72 and 0.62; the range of efficiency per trip was wide. The significant variables were: gear, days at sea, crew and fishing zone (East coast).
Discussion- The days at sea and crew were important inputs in the performance of the fleet, and the effect of the area was associated with the occurrence of upwelling in the East coast of Yucatan peninsula. Although the gear "dinghie and jimbas" showed better efficiencies in the general model, further analysis separated by gear determined that the segment of the fleet using bicycle, though small, showed higher average efficiency.
Conclusions- The efficiency analysis performed resulted appropriate, but other analysis cold also apply to evaluate efficiency of mixed fisheries accounting for differences of fishing gear, or using production functions oriented to output.

* mgs781@gmail.com (México)

Representative production units data and Economic Assessment of Multispecies Fisheries in the Gulf of California

Mauricio Ramírez Rodríguez*
Centro Interdisciplinario de Ciencias Marinas, Instituto Politécnico Nacional

The information needed to assess the profitability of fishing firms is scarce and difficult to obtain through surveys or reviews of account books. For analyzing small-scale multispecies fisheries operating at the central Gulf of California, basic data were collected for Representative Production Units (RPUs) which are depictions of the actual firms operating. The features of the RPUs are estimated by panels of producers from actual firms that are similar in terms of infrastructure, production scale and operation modality. Profitability estimates for and the behaviour of each RPU were based on cost-benefit analyses. Total income considers disembarked weight and prices of different finfish species by fishing season and gears. The analysis of operating costs was adjusted by differentiating between costs directly related to fishing trips and those required for vessels to sail at all. Financial balance shows that the firm works at levels near the economic equilibrium, with scarce revenues, affecting the owner's income at the catch level, but providing him the opportunity to gain in the commercialization process.

* mramirr@ipn.mx (México)

Bioeconomic analysis of an unregulated and unreported fishery in the southeastern Gulf of California, Mexico.

Shelley Salcedo*
Centro Interdisciplinario de Ciencas Marinas IPN

Fishing pressure on species devoted to recreational fishing has been poorly documented in developing countries. Generally, these species are frequent bycatch of commercial artisanal fleets, and illegal or unregulated fishing. According to the NOM-017-PESC-1994 law the resource exploitation of the dolphinfish *Coryphaena hippurus* in the Mexican Pacific coast is exclusively licensed for sports fishing. Management strategies based on bioeconomic studies can lead to a more sustainable exploitation of the resources. In the present studie, the resource rent derived from the unregulated fishery of dolphinfish in

the port of Mazatlan, Sinaloa 2013 was calculated both by vessel and by fleet. All bioeconomic parameters were obtained through interviews to vessels owners. These results showed that the 96% of total cost represented operating cost followed by the opportunity cost of capital (4.2%); finally, due to lack of regulation, this fishery does not generate a fixed cost. The resource rent by vessel per year derived from this fishery was US$ 599,192.4. In addition, that of the whole fleet was approximately US$ 17,975,772.9. These results suggest that this activity is economically viable despite the low price of the resource. However, this situation leads to unsustainable catch rates and therefore the addition of a commercial exploitation of this resource should be considered for decision makers.

Keywords: Dolphinfish, unregulated and unreported fishery, southeastern Gulf of California.

* shelleysal@gmail.com (México)

Bio-economic analysis of the jumbo squid Dosidicus gigas (D' Orbigny, 1835) fishery in the northwest of Mexico.

Ricardo Urías Sotomayor*[1], Guillermo Rodríguez Domínguez[1], Nicolás Castañeda Lomas**[1], Raúl Pérez González[1], Gabriel Iván Rivera Parra[2].

[1]Facultad de Ciencias del Mar, Universidad Autónoma de Sinaloa
[2]Instituto Nacional de Pesca, Centro Regional de Investigación Pesquera

Introduction

The fishery of *Dosidicus gigas* in the Gulf of California started in 1974 and reached a maximum catch of 121,016 tons in 1997. Small boats and ships compete for catches of jumbo squid. These two fleets generate differentiated impacts in jobs, profits and product quality. A bioeconomic approach, the *Two fleets competing for a stock Model* (Seijo et al., 1997), was used to analyze the fishery. The biological parameters *of Schaefer's Model* (1954) were estimated using Catch-Maximum Sustainable Yield method (Martell and Froese, 2012) for 1974 - 2012 series of jumbo squid catches.

Results, Discussion and Main Conclusions

From 1974 to 1996 the jumbo squid biomass was over the biomass with which Maximum Sustainable Yield is obtained (B_{MSY}), indicating a healthy fishery. But in the following years a decrease in biomass was observed, and after 2003 biomass was below B_{MYS}, suggesting a deteriorated fishery. In a survey carried out in November 2015, scattered patches of low abundance and small size jumbo squid were observed. In 2012 effort of both fleets (548 small boats and 56 ships) operated below estimated fMEY (557 and 118, respectively). As effort increases, competition for the resource becomes greater, causing a decrease in bio-economic equilibrium fEBE and fMEY. In 2012 the capture of 23,179 tons was below the sustainable annual yield, estimated in 39,338 tons for that year.

* ricardo_urias@yahoo.com.mx ** nicocast10@hotmail.com

Mr. Victor Alcantar Cardenas
INAPESCA
Boulevard del Pescador Esquina Antigua Carretera a Chelem, Yucalpetén
Progeso, Yucatán C.P.97320
Mexico

Dra. Liliana Alencastro
Escuela Superior Politécnica del Litoral
Facultad de Ciencias Sociales y Humanísticas Guayaquil
Guayaquil, Guayas 090150
Ecuador
lalencas@espol.edu.ec

Dr. Luis C. Almendarez Hernández
CICIMAR
Av. IPN S/N, Colonia Playa Palo de Santa Rita
La Paz, B.C.S. 23096
Mexico
lach1406@gmail.com

Ms. Nancy Fabiola Alvarez Velazquez
Calle 22 no. 413 departamento 1
Fraccionamiento Bugambilias
Mérida, Yucatán 97205
Mexico
nancyfav@hotmail.com

Dr. Peder Andersen
University of Copenhagen
Department of Food and Resource Economics
Rolighedsvej 25, DK-1958
Frederiksberg C
Denmark

Dr. Lee G Anderson
University of Delaware
Newark, Delaware 19716
USA
lgafish@udel.edu

Mr. Luis Enrique Angeles Gonzalez
CINVESTAV
Calle 26 b numero 195 colonia villas de chuburna
Mérida, Yucatán 97700
Mexico
luis.angeles0612@gmail.com

Mr. Fernando Aranceta Garza
CICIMAR
Tlaloc 544
La Paz, B.C.S. 23090
Mexico
fer_aranceta@yahoo.com

Dra. Minerva Arce Ibarra
El Colegio de la Frontera Sur
Av. Centenario Km 5.5 s/n. Col. Pacto Obrero Campesino
Chetumal, Quintana Roo 77014
Mexico
aibarra@dal.ca

Dr. Francisco Arreguin Sanchez
IPN-CICIMAR
Instituto Politécnico Nacional S/N Colonia Palo de Santa Rita
La Paz, B.C.S. 23096
Mexico
farregui@ipn.mx

Mr. Otilio Avendaño
CINVESTAV Mérida
Antigua carretera a progreso km. 6 S/N, col. Cordemex
Mérida, Yucatán 97310
Mexico
ottoavend@gmail.com

Dr. Eduardo Balart
CIBNOR
Av. IPN # 195, Col. Playa Palo de Santa Rita Sur
La Paz, B.C.S. 23096
Mexico
ebalart04@cibnor.mx

Ms. Karla Barrera
Universidad Marista de Mérida
Periférico Norte Tablaje Catastral 13941 Carretera Mérida - Progreso
Mérida, Yucatán 97300
Mexico
kbarrera@marista.edu.mx

Ms. Patricia Borrego
Universidad Marista de Mérida
Norte Tablaje Catastral 13941 Carretera Mérida- Progreso, Post Office Box 97300
Mérida, Yucatán 97300
Mexico
patriciabkim@gmail.com

Mr. Alfonso Briceño Avila
Universidad Marista de Mérida
Calle 19B #573 x68B Col. Gran Santa Fe
Mérida, Yucatán 97314
Mexico
larnbriceno@gmail.com

Mr. Miguel Angel Cabrera
CINVESTAV Mérida
Carretera Antigua a Progreso Km 6
Mérida, Yucatán 97310
Mexico
miguel.cabrera@cinvestav.mx

Dr. John F. Caddy
International Fisheries Consultant
Rome
Italy
jfcaddy1@yahoo.co.uk

Dr. Castañeda Lomas
Universidad Autónoma de Sinaloa
Paseo Claussen Co. Centro S/N
Mazatlán, Sinaloa 82000
Mexico
nicocast10@hotmail.com

Dr. Anthony Charles
Saint Mary's University
School of Business and School of the Environment
923 Robie St, Halifax
Canada
Tony.Charles@smu.ca

Dr. Kevern Cochrane
University of Rhodes
Drosty Rd, Grahamstown 6139
South Africa
k.cochrane@ru.ac.za

Dr. Alfonso Cuevas
Universidad Marista de Mérida
Periférico Norte Tablaje Catastral 13941 Carretera Mérida - Progreso
Mérida, Yucatán 97300
Mexico
acuevas@marista.edu.mx

Dr. Juan Antonio De Anda Montañez
CIBNOR
Calle Instituto Politécnico Nacional # 195, Col. Playa palo de Santa Rita Sur
La Paz, B.C.S. 23096
Mexico
jdeanda@cibnor.mx

Ms. Ana Diaz
INAPESCA
Heroes del 21 de Abril S/N Av. Playa Norte
Ciudad del Carmen, Campeche 24115
Mexico
ana.diaz@inapesca.gob.mx

Mr. José Díaz Barrera
Universidad Marista de Mérida
Periférico Norte Tablaje Catastral 13941 Carretera Mérida - Progreso
Mérida, Yucatán 97300
Mexico
jdiazb@marista.edu.mx

Mr. Roger Domínguez May
CINVESTAV Mérida
Antigua carretera a Progreso Km 6,
Cordemex, 97310 Mérida, Yuc.
Mérida, Yucatán 97310
Mexico
roger.dominguez@cinvestav.mx

Mr. Miguel Angel Dorantes González
CINVESTAV Mérida
Antigua carretara a Progreso km. 6 S/N
Mérida, Yucatán 97310
United States
miguel.dorantes@cinvestav.mx

Mr. Jose Duarte
Universidad Marista de Mérida
Periferico Norte Tablaje Catastral 13941
Mérida, Yucatán 97300
Mexico
jduarte@marista.edu.mx

Mr. Roman Espinal
CINVESTAV Mérida
Calle 37 531 Garcia gineres
Mérida, Yucatán 97009
Mexico
Roman.espinal@cinvestav.mx

Dr. Francisco Espinosa
Universidad Marista de Mérida
Periférico Norte Tablaje 13941
Mérida, Yucatán 97300
Mexico
fjespinosa@marista.edu.mx

Mr. Sergio Gámez Bayardo
Centro de Investigación en Alimentación y Desarrollo
Acanto #39 Cerrada Córdoba, California Residencial.
Hermosillo, Sonora 83249
Mexico
sergio.gamez@estudiantes.ciad.mx

Dra. María Cristina Garza
Universidad Nacional Autónoma de México
Puerto de abrigo s/n
Sisal, Yucatán 97356
Mexico
mcristina.garza@gmail.com

Dr. Eucario Gasca Leyva
CINVESTAV Mérida
Km. 6 Carretera Progreso
Mérida, Yucatán 97208
Mexico
eucario.gasca@cinvestav.mx

Mr. Enrique González Durán
Universidad Marista de Mérida
Periférico Norte Tablaje Catastral
Carretera Mérida-Progreso, México
Mérida, Yucatán 13941
Mexico
enriqduran@hotmail.com

Dra. Mariel Gullian Klanian
Universidad Marista de Mérida
Periferico Nte. Tablaje Catastral 13941
Mérida, Yucatán 97300
Mexico
mgullian@marista.edu.mx

Dr. Rognvaldur Hannesson
University of Bergen
Norwegian School of Economics
Helleveien 30, 5045 Bergen
Norway
rognvaldur.hannesson@nhh.no

Ms. Maren Headley
Universidad Marista de Mérida
Univ. Marista, Periferico Norte, Tablaje Catastral, 13941 Carretera Merida-Progreso
Mérida, Yucatán 97300
Mexico
marendheadley@gmail.com

Dr. Alvaro Hernández
Universidad Marista de Mérida
Tablaje Catastral 13941 Carretera Merida - Progreso
Mérida, Yucatán 97205
Mexico
ahernandez@marista.edu.mx

Ms. María José Hernández Dueñas
CINVESTAV Mérida
Calle 7 # 103 entre la 22 Y 24 A. Col. Chuburná Inn II
Mérida, Yucatán 97205
Mexico
majos.h.due@gmail.com

Mr. Juan Carlos Hrnández Padilla
CICIMAR-IPN
Av. Instituto Politécnico Nacional.
Col. Playa Palo de Sta. Rita S/N.
La Paz, B.C.S. 23096
Mexico
jchpadilla@gmail.com

Dr. Robert Oswaldo Huchim Lara
Universidad Marista de Mérida
Periferico Norte Tablaje Catastral 13941
Carretera Mérida - Progreso
Mérida, Yucatán 97300
Mexico
rhuchim@marista.edu.mx

Dr. Daniel Bernardo Lluch Cota
CIBNOR
Instituto Politécnico Nacional 195
Playa Palo de Santa Rita Sur
La Paz, B.C.S. 23096
Mexico
dblluch@cibnor.mx

Mr. Rodrigo López
UNAM
Calle 59 # 263, Col. Fco de Montejo
Mérida, Yucatán 97203
Mexico
Rodrigols27@gmail.com

Dr. Jorge A. López Rocha
UMDI Sisal UNAM
Puerto de Abrigo s/n
Sisal, Yucatán 97356
Mexico
jorgelopezrocha@ciencias.unam.mx

Mr. Ernesto Martinez Ordaz
CONAPESCA
Calle 2a x 1 Col Diaz Ordaz
Mérida, Yucatán 97130
Mexico
ernesto.martinez@conapesca.gob.mx

Mrs. Marianne Moreno
CICESE
Carretera Ensenada-Tijuana 3918,
Zona Playitas
Ensenada, Baja California 22860
Mexico
mmoreno@cicese.edu.mx

Mr. Juan Carlos Murillo Posada
CINVESTAV
Calle 15A 22B Felipe Carrillo Puerto,
Merida Yucatán
Mérida, Yucatán 97310
Ecuador
juanmurilloposada123@hotmail.com

Mr. Adrian Nuñez
CINVESTAV
calle 37 591 bis Garcia gineres
Mérida, Yucatán 97000
Mexico
adrianenunez92@gmail.com

Mrs. Lavinia Nuñez Amao
CIBNOR
Carretera a San Juan de La Costa
La Paz, B.C.S. 23096
Mexico
lnunez@pg.cibnor.mx

Dr. Rafael Ortiz Rodríguez
Environmental Defense Fund
Revolución 345 Col. Centro
La Paz, B.C.S. 23000
Mexico
rortiz@edf.org

Mrs. Vanessa Oviedo
UNAM
Sisal
Hunucmá, Yucatán 97356
Mexico
vanecookie_12@hotmail.com

Mr. Javier Pacheco Vazquez
Grupo Agua Marina Golfo de Mexico
Calle 62 no. 268 Col. Alcala Martin
Calle 20A No. 423 Col. Nueva
Aleman CP 97460
Mérida, Yucatán 97500
Mexico
javpachel@hotmail.com

Mr. Leopoldo Palomo
Universidad Marista de Mérida
Mérida, Col. Cd Caucel
Mérida, Yucatán 97314
Mexico
polo_palomo@hotmail.com

Mr. Daniel Peñalosa
CICIMAR
Playa el conchalito, S.N.
La Paz, B.C.S. 23094
Mexico
dpmartinell@hotmail.com

Mr. Alejandro Perera
Universidad Marista de Mérida
Calle 36 número 415 x19 y 21 jesus carranza
Mérida, Yucatán 97109
Mexico
Alejandromtzctrxv@gmail.com

Dr. Raúl Pérez González
Universidad Autónoma de Sinaloa
Paseo Claussen s/n
Mazatlán, Sinaloa 82000
Mexico
raulp@uas.edu.mx

Dr. German Ponce Díaz
CICIMAR-IPN
Av. Instituto Politécnico Nacional s/n Col. Playa Palo de Santa Rita Apdo. Postal 592. Código Postal 23096 La Paz, B.C.S. México
La Paz, B.C.S. 23096
Mexico

Dra. Alicia Poot Salazar
INAPESCA
Boulevard del Pescador, Esquina Antigua Carretera a Chelem, Puerto de Abrigo, Yucalpetén
Progeso, Yucatán 97320
Mexico
alipootsalazar@gmail.com

Mr. Daniel Quijano
CINVESTAV
C. 20 # 133 x 25 y 27 Fco. I. Madero
Mérida, Yucatán 97240
Mexico
mgs781@gmail.com

Mrs. Susana Ralirez
Grupo Agua Marina Golfo de Mexico
Calle 57b entre 56 y 54 no. 358
Mérida, Yucatán 97205
Mexico
Mvzsusana@hotmail.com

Dr. Mauricio Ramírez Rodríguez
CICIMAR-IPN
Av. IPN s/n, Col. Playa Palo de Santa Rita
La Paz, B.C.S. 23096
Mexico
mramirr@ipn.mx

Mr. Baltazar Ramos Torres
Acuacultores de Eldorado
Natividad Alvarez Castro # 1:
Colonia Fidel Velázquez Sánchez
Eldorado, Sinaloa 73953
Mexico
balta.1968@hotmail.com

Mr. Javier Robles
CINVESTAV
Km. 6 Antigua Carretera a Progreso, A.P. 73 Cordemex
Mérida, Yucatán 97310
Mexico
javier.rc606@gmail.com

Dr. Guillermo Rodriguez Dominguez
Universidad Autónoma de Sinaloa
Facultad de Ciencias del Mar Paseo Claussen S/N Col. Centro.
Mazatlán, Sinaloa 82000
Mexico
guirodom@uas.edu.mx

Mr. Oswaldo Uriel Rodríguez García
CIBNOR
Villa Daniela 354
La Paz, B.C.S. 23085
Mexico
rodriguezg.osw@gmail.com

Mr. Salvador Romero Gallardo
CINVESTAV
Calle 57 #389 Fco. de Montejo II
Mérida, Yucatán 97203
Mexico
salvador_gallardo_14@hotmail.com

Ms. Alejandra Romero Yam
Universidad Marista de Mérida
Periferico Norte Tablaje Catastral 13941
Mérida, Yucatán 97300
Mexico
ale.romero02@hotmail.com

Mrs. Thelma Monica Ruiz Barreiro
CICIMAR
Av. IPN s/n, Col. Playa
Palo de Sta. Rita
La Paz, B.C.S. 23075
Mexico
monika.cicimar@gmail.com

Mr. Diego Ruiz Orta
UNAM
Av. Tetiz #493 Col. Pedregal de San
Nicolás 4ª secc. Del. Tlalpan
Ciudad de México, Ciudad de México
14100
Mexico
druizorta@ciencias.unam.mx

Dra. Silvia Salas Márquez
CINVESTAV Mérida
Km 6 antigua carretera a Progreso
Mérida, Yucatán 97310
Mexico
ssalas@cinvestav.mx

Ms. Shelley Salcedo
CICIMAR-IPN
Av. Insituto Politecnico Nacional s/n , Col.
Playa Palo de Santa Rita
La Paz, B.C.S. 23000
Mexico
shelleysal@gmail.com

Ms. Alicia Saldaña Millan
CINVESTAV-IPN
Antigua carretera a Progreso km6
Mérida, Yucatán 97310
Mexico
isla_aly@hotmail.com

Dr. Juan Carlos Seijo Gutierrez
Universidad Marista de Mérida
Periférico Norte Tablaje Catastral 13941
Carretera Mérida - Progreso
Mérida, Yucatán 97300
Mexico
jseijo@marista.edu.mx

Dra. Elisa Serviere Zaragoza
CIBNOR
Calle IPN 195 Playa Palo de Santa Rita Sur
La Paz, B.C.S. 23096
Mexico
serviere04@cibnor.mx

Ms. Margarita Soberanis Villa
Universidad Marista de Mérida
Periférico Norte Tablaje Catastral 13941
Carretera Mérida - Progreso
Mérida, Yucatán 97300
Mexico
msoberanis@marista.edu.mx

Mr. Jesus Soto
CINVESTAV
Carretera antigua a progreso km 6
Mérida, Yucatán 97310
Mexico
soto.017@hotmail.com

Mr. Aristoteles Stavrinaky
Environmental Defense Fund
Revolucion 345, col. Centro
La Paz, B.C.S. 23000
Mexico
astavrinaky@edf.org

Mrs. Berenice Suarez
Kin Yuc Agroacuacultura del Sureste
C.19 #331 POR 20A Y 22 FRACC. MONTEBELLO
Mérida, Yucatán 97113
Mexico
berenicesuarez86@gmail.com

Dr. Rashid U. Sumaila
University of Brittish Columbia
Fisheries Economics Research Unit
Vancouver Campus
Vancouver, 2202 Main Mall V6T 1Z4
Canada
r.sumaila@oceans.ubc.ca

Dr. John G Sutinen
Professor Emeritus, University of Rhode Island
Environmental & Natural Resource Economics
USA
jgsutinen@gmail.com

Mrs. Mitzy Torres
INAPESCA
Niño Martires
Ciudad del Carmen, Campeche 24115
Mexico
mitzyblanco@gmail.com

Ms. Nayelli Torres

Calle 80 no.536 x 64 y 66 Paseos de Pensiones
Mérida, Yucatán 97217
Mexico
nayelli.s.t@gmail.com

Dr. Edgar Torres Irineo
UNAM
Carretera Sierra Papacal Chuburna Puerto Km 5
Sierra Papacal,, Yucatán 97302
Mexico
edgar.torres82@gmail.com

Dr. Ricardo Torres Lara
Universidad de Quintana Roo
Boulevard Bahía s/n Esq. Ignacio Comonfort, Col. del Bosque
Chetumal, Quintana Roo 77019
Mexico
rtorres@uqroo.edu.mx

Mr. Joe Alonso Trinidad Robles
Universidad de Guadalajara
Cuca Hernandez 5108 Int 102
Zapopan, Jalisco 45079
Mexico
mariajose.hernandez@cinvestav.mx

Mr. Ricardo Urías Sotomayor
Universidad Autónoma de Sinaloa
Paeseo Claussen col.centro S/N
Mazatlán, Sinaloa 82000
Mexico
ricardo_urias@yahoo.com.mx

Mr. Miguel Angel Vela Magaña
Universidad Marista de Mérida
Periferico norte tablaje catastral 13941 carretera Mérida-Progreso.
Mérida, Yucatán 97314
Mexico
mvela@marista.edu.mx

Dr. Iván Velázquez Abunader
CINVESTAV Mérida
Km. 6, Antigua Carretera a Progreso, Apdo. Postal 73-CORDEMEX
Mérida, Yucatán 97310
Mexico
jvelazquez@cinvestav.mx

Mr. Francisco Javier Vergara Solana
CICIMAR-IPN
Av. Instituto Politécnico Nacional s/n Col. Playa Palo de Santa Rita
La Paz, B.C.S. 23096
Mexico
vs_fj@yahoo.com

Mr. Raul Villanueva
Universidad Marista de Mérida
Periférico Norte Tablaje Catastral
13941 Carretera Mérida - Progreso
Mérida, Yucatán 97300
Mexico
rvillanueva@marista.edu.mx

Mrs. Obsidiana Sarahi Von Borstel Juarez
CIBNOR
Instituto politécnico nacional 195 Col.
Playa palo de santa rita sur
La Paz, B.C.S. 23096
Mexico
sarahivbj@hotmail.com

Mr. José Alberto Zepeda Domínguez
CICIMAR
Av. Instituto Politécnico Nacional S/N
Col. Playa Palo de Santa Rita
La Paz, B.C.S. 23096
Mexico
joalzedo@hotmail.com

Dr. Manuel J. Zetina Rejón
CICIMAR
Av. Instituto Politécnico Nacional S/N
Playa Palo Sta. Rita
La Paz, B.C.S. 23094
Mexico
mjzetina@gmail.com

CIBNOR - U. Marista - CICIMAR International Symposium on Bioeconomics of Fisheries and Aquaculture

www.marista.edu.mx