ABSTRACTS

North American Association of Fisheries Economists

NAAFE Forum 2017

- March 22-24, 2017-

La Paz, Southern Baja California, Mexico

In collaboration with: CONACYT CIB Universidad Marista IPN CICIMAR-IPN UABCS

North American Association of Fisheries Economists

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The North American Association of Fisheries Economists (NAAFE)

NAAFE is an international group of industry, government, academic and other practitioners of fisheries economics. The purposes of NAAFE are to facilitate communication among North American fisheries and aquaculture economists in industry, academia, government and other areas, to promote dialogue between economists and others interested in fisheries and aquaculture, and to advance fisheries and aquaculture economics and its useful applications.

Origins and Activities

The North American Association of Fisheries Economists is a volunteer effort of fisheries economists from across North America to strengthen communication across our profession. Through this network, we develop strong collegial relationships, and learn about the work that others are doing and planning, in order to improve the effectiveness of our research, teaching, and fishery management strategies.

Many NAAFE members are also active members of our sister organization, the International Institute of Fisheries Economics and Trade (IIFET), and participate in the biennial IIFET conferences. IIFET and its conferences have similar goals to NAAFE's but are global in scope. The idea for a North American Association of Fisheries Economists (NAAFE) arose out of a desire to make these valuable professional interactions more accessible to those in North America who are unable to travel to the international conferences. NAAFE extends the focused opportunity to meet with people who share our specific interests and who are engaged in similar kinds of work, to those in this region.

NAAFE is officially affiliated with both IIFET and the journal Marine Resource Economics (MRE). NAAFE collaborates with both organizations fully and collegially.

Governance

The formal establishment of NAAFE took place at the first North American Fisheries Economics Forum in 2001. Ratification of the bylaws and election of a Board of Directors followed.

NAAFE is governed by a Board of Directors consisting of a President, a President-elect, a Treasurer, and two additional board members. We ensure membership on the Board from Canada, Mexico, and the United States; members serve four year terms and are elected every two years in overlapping groups of 3 and 2. Current Board membership is indicated in the list on the left side of this page. On March 24, 2017, Cathy Roheim will join the Board as President Elect, and Silvia Salas as Board member, following the completion of terms of service of current President Gil Sylvia, and Alvaro Hernandez-Flores

NAAFE is registered as a charitable corporation in the State of Oregon. Governance documents are available on the Bylaws and Policies pages of our website, http://naafe.org.
The NAAFE Business Office is co-located with the IIFET Secretariat, hosted by the Department of Applied Economics at Oregon State University. The Executive Director of NAAFE is Ann Shriver, and the NAAFE Assistant is Kara Keenan.

Membership

Complimentary 2-year membership is included in Forum registration. Individuals who did not attend the Forum are also welcome to join by visiting http://naafe.org. Click on "Join NAAFE" and follow instructions there to complete your membership application form. Please contact Ann.L.Shriver@oregonstate.edu or naafe@oregonstate.edu for further information.

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Welcome from Organizers

Rector Welcome Letter

Ladies, Gentlemen,

On behalf of the Universidad Autonoma de Baja California Sur (UABCS), I would like to warmly welcome you all to this 9th Forum of the North American Association of Fisheries Economists.

These are challenging times amid nationwide and global political and economic uncertainties. But the world of science and professional education is a privileged area to work in; from here, new approaches and alternatives can be offered. the theme of this conference is even more important in a context of growing environmental and global food security concerns.

For Mexico, in particular, the topics that the conference covers are paramount. Our country is one of the 25 major marine harvesting nations of the world and, with an annual average of 1.5 million tons; it is also part of the 10 main fisheries producers in the american continent.

Baja California Sur belongs to one of the five fishery regions that greatly contributes to mexican production: the northwest region's waters provide nearly 75% of national captures, including high volume species such as sardine, and high value species like abalone, lobster, clams and seashells. Baja California Sur, alone, is ranked 3rd in captures and 4th in terms of fisheries value, thus representing, respectively, 9 and 7% of Mexico's total.

Faculty at UABCS, and at our partners CICIMAR and CIBNOR, are committed to furthering knowledge for a better use and management of those resources. We are proud of where we are today and excited about where we are headed.

Around 160 participants will be speaking on nine different topics related to the economics of aquaculture, fisheries and seafood trade for managing the socio-ecology of sustainable marine resource use. This conference gives us an opportunity to exchange approaches and ideas; to step up our combined efforts and develop academic networks. We are delighted to have you here in La Paz and share your experiences.

I have no doubt that your commitment to the economics of aquaculture, fisheries and seafood trade will be key to developing better ways to manage the socio-ecology of sustainable marine resource use in our countries. I wish you every success in your deliberations and a very pleasant stay in La Paz. Thank you very much for coming.

Dr. Gustavo Rodolfo Cruz Chávez
RECTOR
UABCS

Welcome from the conference Chairs

I am happy to welcome you here, to the 9th Forum of the North American Association of Fisheries Economists (NAAFE). The people who attend this event represent the more qualified and recognized researches on fishery economics of the world's population. The centerpiece of an academic conference is its program. For NAAFE 2017, we had three talented, dedicated, and hard-working people to thank for a program that is innovative, thought-provoking, and representative of our academic community. Germán Ponce, Juan Antonio de Anda, Alvaro Hernández Flores, Luis Almendarez and myself served as conference co-chairs. As you go from session to session, you will see what a great job they did, and I am eternally thankful for their efforts. I would also like to thank all of the track chairs, associate editors and reviewers they were able to recruit. I'd also like to thank Smit Vázquez, for their enormous support through this process.

I hope that you as a NAAFE attendee will be able to take advantage of what all of this hard work has produced. Experience and be inspired by the excellent program; reconnect with old friends and meet new ones; enjoy field trips and tours we prepare for your enjoyment. Have a great conference experience and

happy holidays too.

Víctor Hernández-Trejo
Conference Co-chair
Universidad Autonoma de Baja California Sur
Mexico

¡Bienvenidos a La Paz!

The members of the committee composed by the Interdisciplinary Center of Marine Sciences (CICIMAR), the Northwest Center of Biological Research (CIBNOR), and the Marista University of Merida (UMM), warmly welcome the 163 participants from 104 institutions and 12 countries to the NAAFE Forum 2017 at La Paz, Baja California Sur, Mexico. The participation of these three institutions is within the framework of the Interinstitutional Doctoral Program in Science of Fisheries and Aquaculture Bioeconomics. We consider this Forum as an opportunity to promote the participation of students in academic meetings with specialists of international recognition, we also think of it as an opportunity to promote the development of their vocations as well as their scientific and technological knowledge, and innovation capabilities. We are hoping that this contributes to the formation of high-level human capital in our country. Our wish is that this event also serves as a conductive space to get to know the work that other scientists are doing or planning to do, and to strengthen communications among North American fisheries and aquaculture economists in the industry, academia, government and all other areas involved.

Dr. Germán Ponce Díaz
Centro Interdisciplinario de Ciencias Marinas del IPN
Conference Co-Chair

Student Awards

Best Student Paper

The North American Association of Fisheries Economists (NAAFE) offers a "Best Student Paper" prize to be given in conjunction with the NAAFE Forum. The purpose of this award is to recognize the most outstanding paper presented by a graduate student at the biennial Forum. The review committee selects the best paper using criteria for refereeing papers in academic journals. Selection of the winning paper is based on creativity, originality and contribution to theory, methods and/or application. Papers may be on any aspect of the economics of fisheries or aquaculture, fisheries resource management, seafood trade and markets, fisheries or aquaculture sector development, or related topics. The 2017 contest is sponsored by the National Oceanic and Atmospheric Administration (NOAA).

To compete in the NAAFE Forum Best Student Paper Contest, students (defined as those currently enrolled in a graduate program or within one year after completion) with abstracts accepted for presentation at the Forum submit a fully developed paper to a selection committee two months prior to the conference. Participants must be students (defined as currently enrolled in a graduate program, or up to a year post graduation) and have an abstract accepted for presentation at the Forum. The prize is $500, plus a travel stipend of up to $1500.

The NAAFE Forum 2017 Best Student Paper is:
Harvesters' Dynamic Decision on Fishing Trip Length, by Keita Abe, University of Washington

The following paper will receive Honorable Mention:
Common Property Resources, Property Rights and Natural Disasters, by Renato Molina, University of California Santa Barbara.

Best Student Presentation

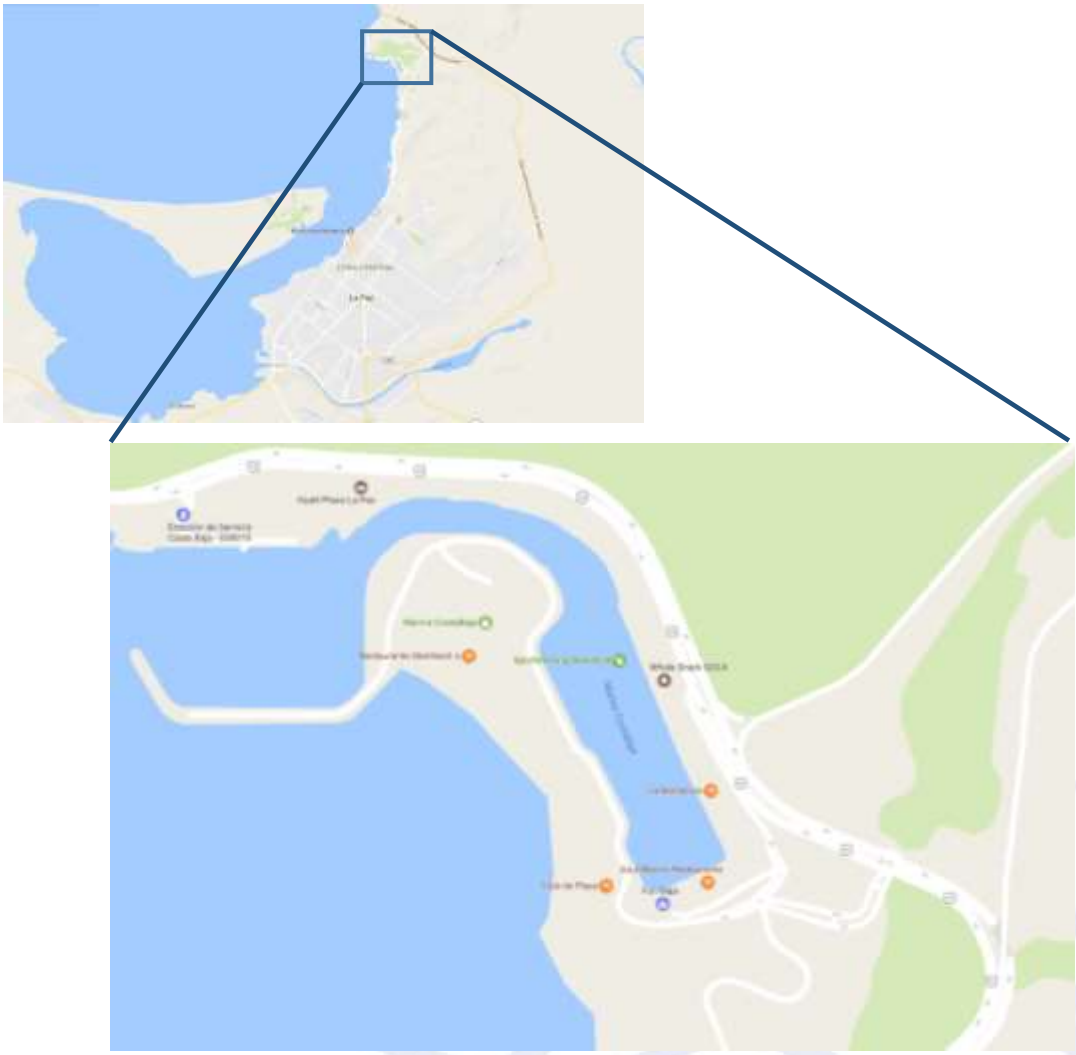
The North American Association of Fisheries Economists (NAAFE), in collaboration with our affiliated journal Marine Resource Economics (MRE), is pleased to be able to offer an award for Best Student Presentation. The winner of this award, which was first introduced at the NAAFE Forum 2013, will receive a $250 prize sponsored by the Marine Resource Economics Foundation. By supporting this award, the Marine Resource Economics Foundation recognizes the importance of effective oral presentation of economic analysis and policy implications in professional and public settings.

The Best Student Presentation Award competition is open to all individuals currently enrolled in a graduate program (i.e., have not yet completed all requirements for degree completion). The student does not need to be first author but must be the sole presenter. Students wishing to be considered for the award were asked to register prior to the conference to allow scheduling of judges to attend. The contest is being organized by NAAFE Board Representative Barbara Best and Dan Lew.

Presentations will be judged on the following criteria:

1. Quality of visual aids
2. Presentation style
3. Time management
4. Content (in that study is well-motivated and results are well interpreted)

Area Maps



Program at a Glance

Wednesday, March 22

8:30 a.m. - 10:00 a.m.	**Plenary Session 1, Room: Las Islas Keynote Address: Escaping the Fisheries Subsidies Trap: The Role of Cooperative Fisheries Management. Dr. Gordon Munro**							
10:00 a.m. - 10:30 a.m.	**Break**							
	Room 1 - Isla Navidad		**Room 2 - Isla Coronado**		**Room 3 - Isla San Jose**		**Room 4- Steinbecks**	
10:30 a.m. - 12:00 p.m	**Seafood trade & Markets**		**Economic Indicators**		**SS02 - Coastal and marine spatial planning in North America: case studies and data needs**		**SS03 - Evaluation and Analysis of Catch Share Performance and Cost–Earnings Data Collection Effort**	
	SP049	Erlendur Jonsson	SP039	Ragnar Arnason	SS164	Rosemary Kosaka	SS096	Erin Steiner
	SP091	Megan Bailey	SP120	Silvia Salas-Márquez	SS156	Kristy Wallmo	SS147	Barbara Rountree
	SP158	Gordon Munro	SP134	Robby Fonner	SS135	Smit Vasquez Caballero	SS022	Mauricio Ramirez-Rodriguez
	SP132	Benjamin Fissel	SP044	Keita Abe	SS051	Vanessa Labrada Martagón	SS071	Tammy Murphy
			SP152	Antonio Alvarez	SS169	Corey Niles		
12:00 p.m. - 1:00 p.m.	**Lunch**							
1:00 p.m. - 2:50 p.m.	**Seafood trade & Markets**		**SS04 -The Fishery Performance Indicators – Value for Fisheries Management, Impact Investing and Recreational Fisheries**		**SS01 - Ecosystem Services Valuation for Ecosystem Based Management in the U.S.: Current Practices, Opportunities, and Challenges**		**SS03 - Evaluation and Analysis of Catch Share Performance and Cost–Earnings Data Collection Effort**	
	SP053	Marie Guldin	SS160	James Anderson	SS155	Kristy Wallmo	SS093	Christopher Liese
	SP082	Gakushi Ishimura	SS161	Frank Asche	SS153	Douglas Lipton	SS013	Akbar Marvasti
	SP103	Martin Smith	SS162	James Anderson	SS154	Dan Lew	SS122	Chad Demarest
	SP037	Hiro Uchida	SS166	Chris Anderson	SS157	Leif Anderson	SS058	Hing Ling Chan
	SP100	Monica Galligan			SS159	Luke Fitzpatrick		
					SS170	Rosemary Kosaka		
3:00 p.m. - 3:30 p.m.	**Break**							
3:30 p.m. – 5:20 p.m.	**Seafood trade & Markets**		**Ecosystem-Based Management**		**Subsidies and their (un)intended consequences**			
	SP009	Kwamena Quagrainie	SP036	Peder Andersen	SP023	Andrés Cisneros-Montemayor		
	SP116	Daniel Gordon	SP080	James Sanchirico	SP027	Enrique Sanjurjo		
	SP034	Michael Weir	SP081	Barbara Hutniczak	SP104	Dale Squires		
	SP047	Chao Zou	SP126	Cameron Speir	SP109	Scott Miller		
	SP042	Oriana Poindexter	SP029	Kate Richerson	SP127	U. Rashid Sumaila		
	SP040	Frank Asche	SP140	Francisco Arreguín-Sánchez				
5:00 p.m. – 7:00 p.m.	**POSTER SESION, Room - Foyer**							

Thursday, March 23

8:30 a.m. - 9:30 a.m.	**Plenary Session 2, Room: Las Islas Keynote Address: Catch Shares: Potential for Optimal Use of Marine Resources Dr. Ragnar Arnason**							
9:30 a.m. - 10:00 a.m.	**Break**							
	Room 1 - Isla Navidad		**Room 2 - Isla Coronado**		**Room 3 - Isla San Jose**		**Room 4- Steinbecks**	
10:50 a.m. - 11:50 a.m.	**Bioeconomics Modeles and Applications**		**Rights-Based Management**		**Governance and Compliance**		**SS08 - Economics of Protected Marine Species**	
	SP129	Gakushi Ishimura	SP050	Dan Holland	SP006	Andrés Cisneros-Montemayor	SS149	Dale Squires
	SP018	Kanae Tokunaga	SP112	Andrew Ropicki	SP035	Peder Andersen	SS043	Oriana Poindexter
	SP075	Renato Molina	SP055	Aaron Mamula	SP063	Angela Munch	SS083	Oswaldo Uriel Rodríguez-García
	SP048	Luis Almanderez hernandez		Alejandro Robles	SP069	Linda Nøstbakken	SS067	Kathryn Bisack
	SP057	Fernando Aranceta-Garza			SP094	Jose Alberto Zepeda Domínguez	SS133	Robby Fonner
	SP121	Keith Criddle			SP095	Jose Alberto Zepeda Domínguez		
12:00 p.m. - 1:00 p.m.	**Lunch**							
1:00 p.m. - 2:30 p.m.	**SS06 - Distribution and ITQs**		**Rights-Based Management**		**Small-Scale Fisheries**		**SS07- Applying Economic Analysis within the Council Process**	
	SS168	Sara Sutherland	SP078	Anna Birkenbach	SP064	Oswaldo Huchim		
	SS163	Corbett Grainger	SP089	Andrew Scheld	SP068	Gina Shamshak		
	SS165	Christopher Costello	SP033	Maren Headley	SP105	Raul Villanueva		
	SS143	Eric Edwards	SP070	Erendira Aceves-Bueno	SP131	Andrés Cisneros-Montemayor		
2:30 p.m. - 3:00 p.m.	**Break**							
3:00 p.m. – 4:50 p.m.	**Bioeconomics Modeles and Applications**		**Aquaculture Model and Applications**		**Small-Scale Fisheries**			
	SP021	Barbara Hutniczak	SP012	Jorge Dresdner Cid	SP010	Xiaozi Liu		
	SP125	Chris Anderson	SP014	Diego Valderrama	SP026	Victor Hernandez Trejo		
	SP005	Jorge Holzer	SP062	Linda Nøstbakken	SP114	Alvaro Hernández-Flores		
	SP038	Ragnar Arnason	SP076	Félix Morency-Lavoie	SP124	Liliana Alencastro		
	SP110	Molly Stevens						
	SP007	Andrés Cisneros-Montemayor						
6:00 p.m. – 8:00 p.m.	**BANQUET**							

In collaboration with:

		Room 1 - Isla Navidad		Room 2 - Isla Coronado		Room 3 - Isla San Jose		Room 4- Steinbecks	
Friday, March 24	8:30 a.m. - 10:30 a.m.	SS09 - Designing rights-based management systems to achieve social objectives in fisheries		SS10 - How climate change is shaping fisheries and fishing communities in the Polar region		SS12 - The Three M's of Recreational Fishing Demand: Measurement, Modeling, and Management		SS13 - Saving the world's most endangered marine mammal: role of economic incentives for affected communities	
		SS011	Jorge Dresdner Cid	SS086	Nils-Arne Ekerhovd	SS145	Josh Nowlis	SS107	Dale Squires
		SS019	Stephanie Stefanski	SS117	Jennifer Bailey	SS146	Scott Steinback		
		SS136	Jennifer Meredith	SS118	Alan Haynie	SS150	Andrew Carr-Harris		
		SS097	Jose A. Fraire-Cervantes	SS085	Yajie Liu	SS151	Dan Lew		
		SS102	Merrick Burden						
	10:30 p.m. - 11:00 a.m.	Lunch							
	11:00 a.m. - 12:30 p.m.	SS09 - Designing rights-based management systems to achieve social objectives in fisheries		SS11 - Investing in fisheries recoveries		Recreational Fisheries		SS13 - Saving the world's most endangered marine mammal: role of economic incentives for affected communities	
		SS106	Jordan Williams	SS077	Phoebe Higgins	SP087	William Goldsmith		
		SS128	Abigail Bennett	SS174	Pablo Obregon	SP108	Joshua Abbott		
		SS130	Rafael Ortiz-Rodríguez	SS175	Brad Gentner	SP113	Leopoldo Palomo		
				SS176	Rajdeep Mukherjee				
				SS177	Rodrigo Oyanedel				
				SS178	Peter Cusack				
				SS179	Vishwanie Maharaj				
	12:30 p.m.-	CLOSING PLENARY, Room - Las Islas							

Keynote Address

Keynote Address: Escaping the Fisheries Subsidies Trap: The Role of Cooperative Fisheries Management.

Dr. Gordon Munro

Professor Emeritus of the University of British Columbia

Plenary Session I: Wednesday, May 22 (8:30 – 10:00), Room Las Islas

The evidence of the destructive economic and biological consequences of "bad" fisheries subsidies is now all but overwhelming. Yet still these subsidies persist, in spite of the evidence. This paper looks at ways of escaping the fisheries subsidies trap, by pursuing and developing a theme, which this author first put forward in a WWF sponsored forum on fisheries subsidies in La Paz. We commence by asking what the prime motivation politically is for fisheries subsidies. It is maintained that the prime motivation is income support, as in the case of agricultural subsidies. If so, then the first step towards escaping the trap is one provided for us by those involved with agricultural subsidies, namely the de-coupling of income maintenance from exploitation of the resource. This, however, is only a first step and is indeed very much a second best solution to the problem. The first best solution is one that is obvious upon being stated, namely improved fisheries management. Such management will raise the incomes of fishers, thereby removing the rationale for subsides. In support of this argument, the paper will provide a case study of a major fishery, with clear evidence in the past of severe economic distress. The resource managers responded, not with "bad" subsidies for the distressed fishery, but rather by introducing radical resource management reforms. The consequence has been a fishery that is now prosperous, free of government "bad" subsidies, and one that is actually experiencing *negative* subsidies self-imposed by the industry.

Keynote Address: Catch Shares: Potential for Optimal Use of Marine Resources

Dr. Ragnar Arnason

Professor, University of Iceland, Department of Economics

Plenary Session II: Thursday, March 23 (8:30 – 9:30), Room Las Islas

The application of catch shares as an instrument to enhance economic efficiency in marine fisheries has become widespread around the world. This paper examines the capability of high quality catch shares to generate full economic efficiency in single species and ecosystem fisheries and to optimally resolve conflicting uses of marine resources such as commercial fishing, recreational fishing, conservation, mining, transportation and waste disposal. It is found that a system of catch shares while helpful is generally insufficient for these purposes. To attain full economic efficiency, the holders of catch shares need a degree of collective decision making and to collectively bargain with other users of marine resources.

Selected Papers Summary

Seafood trade & Markets		
Wednesday, March 22 (10:30 a.m. to 12:00 p.m) - Room 1: Isla Navidad		
SP049	Erlendur Jonsson	Trends in fish price volatility: Icelandic whitefish
SP091	Megan Bailey	Current attitudes and perceptions of drivers, benefits, and costs related to seafood traceability
SP158	Gordon Munro	Trade in Fishing Services
SP132	Benjamin Fissel	The transmission of price changes between wholesale and ex-vessel markets in the Alaska shoreside pollock fishery
Wednesday, March 22 (1:00 p.m. to 2:50 p.m) - Room 1: Isla Navidad		
SP053	Marie Guldin	Timing is everything: consistency of shoreside fish deliveries and impacts to the supply chain in the West Coast groundfish trawl fishery
SP082	Gakushi Ishimura	Challenges of the "Sixth Sector Industrialization" policy in Japanese fishery Obstacles and adverse effects of the vertical sector integration led by fishers
SP103	Martin Smith	Induced Innovation in Fisheries and Aquaculture
SP037	Hiro Uchida	A New Theory of Change for the Sustainable Seafood Movement
SP100	Monica Galligan	How integrated analysis of ex-vessel price data can contribute to understanding of a commercial marine fishery
Wednesday, March 22 (3:00 p.m. to 5:20 p.m) - Room 1: Isla Navidad		
SP009	Kwamena Quagrainie	A Double Hurdle Application of Fishermen's Catch Sales Through Fish Mothers in Ghana
SP116	Daniel Gordon	The Price of Lobster, Forecasts and Simulation in a ARDL- Bounds Testing Framework
SP034	Michael Weir	Explaining Consumer Heterogeneity in Responses to Seafood Information Campaigns
SP047	Chao Zou	Assessing the impact of product information from online retailers on Chinese consumer preference of farmed seafood
SP042	Oriana Poindexter	Revealed Consumer Preferences in Seafood: San Diego County
SP040	Frank Asche	Where are the fish landed? an analysis of landing plants in norway
Ecosystem-Based Management		
Wednesday, March 22 (3:00 p.m. to 5:20 p.m) - Room 2: Isla Coronado		

SP036	Peder Andersen	The Economics of a Landing Obligation Policy: Theoretical and Empirical Aspects of Implementing the EU Landing Obligation
SP080	James Sanchirico	Multispecies fisheries, tipping points, and overfishing regulations
SP081	Barbara Hutniczak	The impact of forage fish regulations on recreational fishermen's catch
SP126	Cameron Speir	Commercial fishing behavior under changing ocean conditions: Spatial analysis of the west coast salmon fishery during "the Blob"
SP029	Kate Richerson	Quantifying and predicting responses to a West Coast salmon fishery closure
SP140	Francisco Arreguín-Sánchez	An Ecosystem Holistic Approach for Limit and Target Harvest Rates

Rights-Based Management

Thursday, March 23 (10:00 a.m. to 11:50 a.m.) - Room 2: Isla Coronado

SP050	Dan Holland	Evolving Bycatch Risk in the Pacific Groundfish Trawl IFQ
SP112	Andrew Ropicki	Evaluating Proposed Modifications to the Gulf of Mexico Red Snapper IFQ Program
SP055	Aaron Mamula	Fishing Community Sustainability Cooperatives on California's Central Coast
	Alejandro Robles	We need to restore ourselves first: the story of el manglito

Thursday, March 23 (1:00 p.m. to 2:30 p.m.) - Room 2: Isla Coronado

SP078	Anna Birkenbach	Empirical Structural Analysis of Value Generation in the Northeast Multispecies Sector Program
SP089	Andrew Scheld	Do catch shares lead to selectivity improvements in multispecies fisheries? Evidence from Georges Bank and Gulf of Maine bottom trawlers
SP033	Maren Headley	Spatiotemporal bioeconomic performance of artificial shelters in a small scale rights-based managed Caribbean spiny lobster (Panulirus argus) fishery.
SP070	Erendira Aceves-Bueno	Larval spillover does not affect profits in spatially managed fisheries

Economic Indicators

Wednesday, March 22 (10:30 a.m. to 12:00 p.m) - Room 2: Isla Coronado

SP039	Ragnar Arnason	Profits, rents and resource rents
SP120	Silvia Salas-Márquez	Influence of skipper effect in fishing efficiency of a mixed fishing fleet: a mexican case study
SP134	Robby Fonner	Targeting Ability and Behavior in the US West Coast Groundfishery
SP044	Keita Abe	Harvesters' Dynamic Decision on Fishing Trip Length
SP152	Antonio Alvarez	Assessing the technology and technical efficiency of artisan fishing boats

Bioeconomics Modeles an Applications

Thursday, March 23 (10:00 a.m. to 11:50 a.m.) - Room 1: Isla Navidad

SP129	Gakushi Ishimura	Exploring optimum economic efficiency of fishing:Shall we move from the tradition in the post-tsunami fishery?
SP018	Kanae Tokunaga	Cooperative Management of Trans-boundary Fish Stocks: Implications for Tropical Tuna Management in the Pacific Island Region
SP075	Renato Molina	Transboundary Marine Protected Areas
SP048	Luis Almanderez Hernández	The shrimp trawl fishery in the Gulf of California: risk and uncertainty factors
SP057	Fernando Aranceta-Garza	Economic and biological consequences of applying a constant natural mortality and catchability coefficients in a sequential fishery
SP121	Keith Criddle	Alaska's sablefish fishery after Individual Fishing Quota Program implementation—a bioeconomic analysis

Thursday, March 23 (3:00 p.m. to 4:50 p.m.) - Room 1: Isla Navidad

SP021	Barbara Hutniczak	Fishermen's location choice under spatio-temporal update of expectations
SP125	Chris Anderson	Dynamic choice of target species: Estimation and Policy Simulation Alaskan Pollock Catcher-Processors
SP005	Jorge Holzer	Confidence of the Trembling Hand
SP038	Ragnar Arnason	Optimal harvesting paths: Appropriate discount rates
SP110	Molly Stevens	Economic Assessment of the Biological Dynamics of Florida's Commercial Snapper-Grouper Fishery
SP007	Andrés Cisneros-Montemayor	Bioeconomic analyses can anticipate pitfalls of marine conservation policy

Subsidies and their (un)intended consequences

Wednesday, March 22 (3:00 p.m. to 5:20 p.m) - Room 3: Isla San José

SP023	Andrés Cisneros-Montemayor	Strategies and rationale for fishery subsidy reform
SP027	Enrique Sanjurjo	Redirection of fishing subsidies in Mexico
SP104	Dale Squires	Fisheries Subsidies
SP109	Scott Miller	Implications of Subsidized Fishing Access to Western and Central Pacific Tuna: The Case of the South Pacific Tuna Treaty of 2016
SP127	U. Rashid Sumaila	Fisheries Subsidies: Why should you care about them?

Aquaculture Model and Applications

Thursday, March 23 (3:00 p.m. to 4:50 p.m.) - Room 2: Isla Coronado

SP012	Jorge Dresdner Cid	The Impact of Sea Lice Treatments on the Unit Production Costs of Salmon Growth Centers: Evidence from Chilean Aquaculture
SP014	Diego Valderrama	The economic impact of emerging diseases in shrimp aquaculture: Insights from a multi-year, global survey of the industry

SP062	Linda Nøstbakken	The bigger, the better? Concentration and economies of scale in the Norwegian salmon farming industry
SP076	Félix Morency-Lavoie	A Small Sea Parasite Making Big Waves: Industry Consolidation and Collaboration under Spatial-Dynamic Externalities

Governance and Compliance

Thursday, March 23 (10:00 a.m. to 11:50 a.m.) - Room 3: Isla San José

SP006	Andrés Cisneros-Montemayor	Economically-optimal management investment given unreported fisheries catch: a value of information approach for Mexico
SP035	Peder Andersen	Consequences of Recovering Enforcement Costs in Fisheries
SP063	Angela Munch	How to assess the spatial representation of fishery's revenues? A method comparison
SP069	Linda Nøstbakken	Why do fishermen comply with regulations? The role of preferences
SP094	Jose Alberto Zepeda Domínguez	Exploration of non-monetary benefits of the Marine Stewardship Council (MSC) certification, lessons from the developing world
SP095	Jose Alberto Zepeda Domínguez	The Round table of Mexican fisheries: Fisheries governance examples from Northwestern Mexico

Recreational Fisheries

Friday, March 24 (11:00 a.m. to 12:30 p.m) - Room 3: Isla San José

SP087	William Goldsmith	Modeling angler choices, preferences, and values in the U.S. east coast recreational Atlantic bluefin tuna fishery
SP108	Joshua Abbott	The Benefits of Escaping Recreational Derbies: Evidence from a Kuhn-Tucker Model of For-Hire Fishing in the US Gulf of Mexico
SP113	Leopoldo Palomo	Co-management of a recreational fishery with a socio-ecological approach

Small-Scale Fisheries

Thursday, March 23 (1:00 p.m. to 2:30 p.m.) - Room 3: Isla San José

SP064	Oswaldo Huchim	A qualitative risk assessment of hookah diving as fishing technology in small-scale fisheries
SP068	Gina Shamshak	Evaluating the Economic Viability of Inland Seafood Markets in Georgia: A Two Pronged Approach
SP105	Raul Villanueva	Distributional performance in a rights based small-scale fishery using artificial habitats
SP131	Andrés Cisneros-Montemayor	Economic viability of small- compared to large-scale fisheries using Mexico as an example

Thursday, March 23 (3:00 p.m. to 4:30 p.m.) - Room 3: Isla San José

SP010	Xiaozi Liu	At the Mercy of the Sea or Rational Profit-speculators: Offshore Fishermen in Taiwan
SP026	Victor Hernandez Trejo	Economic Assessment of Small Scale Longline Fisheries in Oaxaca, Mexico. A cross section data approach

SP114	Alvaro Hernández-Flores	Modelling a small-scale sea cucumber fishery in Yucatan
SP124	Liliana Alencastro	Managing for fishermen exit and alternative livelihoods in small scale fisheries: the role of fishermen interrelations and relevant socioeconomic factors

Special Sessions Summary

SS 01 - Ecosystem Services Valuation for Ecosystem Based Management in the U.S.: Current Practices, Opportunities, and Challenges		
Wednesday, March 22 (1:00 p.m. to 2:50 p.m.) - Room 3: Isla San José		
SS155	Kristy Wallmo	Ecosystem Service Valuation: A U.S. Policy Context
SS153	Douglas Lipton	The NOAA Science Board Report on Ecosystem Services Valuation and Its Implications
SS154	Dan Lew	Ecosystem Service Valuation: An Overview of Methods, Values, and Applications
SS157	Leif Anderson	Recreational Demand for Shellfish Harvest in Puget Sound Under Future Climate Scenarios
SS159	Luke Fitzpatrick	Transfer Reliability for Meta-Regression Models: Accounting for Uncertainty
SS170	Rosemary Kosaka	Ecosystem Service Values and the Proposed Klamath River Dam Removal
SS02 - Coastal and marine spatial planning in North America: case studies and data needs		
Wednesday, March 22 (10:30 a.m. to 12:00 p.m.) - Room 3: Isla San José		
SS164	Rosemary Kosaka	Coastal and Marine Spatial Planning efforts in the United States and beyond: an introduction to this special session
SS156	Kristy Wallmo	Using choice models to inform marine spatial planning: A case study of marine protected area design off the U.S. west coast
SS135	Smit Vasquez Caballero	Model of Fishery Participation and Location Choice for the West Coast Salmon Fishery
SS051	Vanessa Labrada Martagón	How biological data has contributing to management plans in the bay of La Paz: Los Islotes sea lion rookery as case of study
SS169	Corey Niles	Data and information needs for effective coastal and marine spatial planning: a Washington State case study
SS03 - Evaluation and Analysis of Catch Share Performance and Cost–Earnings Data Collection Effort		
Wednesday, March 22 (10:30 a.m. to 12:00 p.m.) - Room 4: Steinbecks		
SS096	Erin Steiner	Quota Net Revenue in the West Coast Groundfish Trawl Catch Share Program
SS147	Barbara Rountree	Data collection and measurement in the Northeast US
SS022	Mauricio Ramirez-Rodriguez	Catch Quotas for the Pacific Hake Fishery in the Gulf of California
SS071	Tammy Murphy	Commercial Fishing Business Cost Data Collection in the Northeastern US Region: Changes and Challenges
Wednesday, March 22 (1:00 p.m. to 2:50 p.m.) - Room 4: Steinbecks		

SS093	Christopher Liese	Evaluating the Economic Benefits of Catch Share Management in the Northern Gulf of Mexico Reef Fish Fishery: Preliminary Results
SS013	Akbar Marvasti	The Markets for Quota Share Allocations for the Gulf of Mexico IFQ Programs and Their Implications for Fishing Effort and Entry-Exit Decisions
SS122	Chad Demarest	Triangulation: A Tale of Three Quota Price Signals in the Northeast US Groundfish Fishery
SS058	Hing Ling Chan	Cost-Earnings Survey of Hawaii Small Boat Fishery

SS04 -The Fishery Performance Indicators – Value for Fisheries Management, Impact Investing and Recreational Fisheries

Wednesday, March 22 (1:00 p.m. to 2:50 p.m.) - Room 2: Isla Coronado

SS160	James Anderson	Developing Performance Indicators for Recreational Fisheries
SS161	Frank Asche	Impact Evaluation of a Fisheries Development Project
SS162	James Anderson	The Fishery Performance Indicators: Evaluating Fishery Management Systems
SS166	Chris Anderson	Fishery Performance Indicators for Global Tuna Fisheries

SS06 - Distribution and ITQs

Thursday, March 23 (1:00 p.m. to 2:30 p.m) - Room 1: Isla Navidad

SS168	Sara Sutherland	Empirical Evidence on the Role of Distribution in Determining Level of Policy Support
SS163	Corbett Grainger	Price Discovery in Newly Created Markets
SS165	Christopher Costello	Fishery Federalism under Climate Change
SS143	Eric Edwards	Consolidation in Alaskan Ports after the Introduction of Fishing Property Rights

SS07- Applying Economic Analysis within the Council Process

Thursday, March 23 (1:00 p.m. to 2:30 p.m.) - Room 4: Steinbecks

SS08 - Economics of Protected Marine Species

Thursday, March 23 (10:00 a.m. to 11:50 a.m.) - Room 4: Steinbecks

SS149	Dale Squires	Least-Cost Bycatch Reduction Through the Biodiversity Mitigation Hierarchy
SS043	Oriana Poindexter	The value of eco-labels: Revealed consumer preferences for seafood in San Diego County
SS083	Oswaldo Uriel Rodríguez-García	Reference points for vulnerable fish species based on bioeconomic age-structured models: an approach for Totoaba macdonaldi
SS067	Kathryn Bisack	Assessing effectiveness of management measures to protect North Atlantic Right Whales
SS133	Robby Fonner	Emerging Issues in Marine Protected Resources Management: A role for economics

SS09 - Designing rights-based management systems to achieve social objectives in fisheries

Friday, March 24 (8:30 a.m. to 10:30 a.m.) - Room 1: Isla Navidad

SS011	Jorge Dresdner Cid	Some distributional consequences of collective rights in artisanal fisheries.
SS019	Stephanie Stefanski	The New Fisheries Catch Shares Program in Argentina: Balancing Efficiency and Equity Objectives in Rights-Based Management Systems
SS136	Jennifer Meredith	Fish or Flight: Household Survey Evidence of the Impact of Transferable Permits on the Migration Decisions of Rural Alaskan Salmon Harvesters
SS097	Jose A. Fraire-Cervantes	Reducing Illegal Fishing Using Behavior Change Interventions: A case study in the Upper Gulf of California
SS102	Merrick Burden	Achieving social objectives through a community co-management entity

Friday, March 24 (11:00 a.m. to 12:30 p.m.) - Room 1: Isla Navidad

SS106	Jordan Williams	Securing women's rights and livelihoods through gender-responsive rights-based management
SS128	Abigail Bennett	Strengthening small-scale fishing cooperatives through rights-based fisheries management: A case study from Yucatán, Mexico
SS130	Rafael Ortiz-Rodríguez	Socio-economic analysis of the results of implementing a rights-based management system in a small-scale fishery in the Gulf of California: the gulf curvina

SS10 - How climate change is shaping fisheries and fishing communities in the Polar region

Friday, March 24 (8:30 a.m. to 10:30 a.m.) - Room 2: Isla Coronado

SS086	Nils-Arne Ekerhovd	Marine food webs, environmental variability, and coastal state conflicts: A game theoretic analysis.
SS117	Jennifer Bailey	Climate change and conflicts of interests in marine areas in Northern Norway: Comparative methodologies and Research Results
SS118	Alan Haynie	Heterogeneity in vessel resiliency to climate variability in the Bering Sea pollock fishery
SS085	Yajie Liu	Economic impacts of climate change on marine fisheries in the Arctic

SS11 - Investing in fisheries recoveries

Friday, March 24 (11:00 a.m. to 12:30 p.m.) - Room 2: Isla Coronado

SS077	Phoebe Higgins	Case Study: California Fisheries Fund
SS174	Pablo Obregon	OPP – Project Overview and rationale for Fisheries Business Case Development
SS175	Brad Gentner	OPP – Fisheries Business Case Development Progress in the Caribbean
SS176	Rajdeep Mukherjee	OPP – Fisheries Business Case Development Progress in the Bay of Bengal
SS177	Rodrigo Oyanedel	Walton Family Foundation's Chile Oceans Initiative - channeling private/public investment for management improvements
SS178	Peter Cusack	OPP – Fisheries Business Case Development Progress in the Western Central Pacific

SS179	Vishwanie Maharaj	WWF World Bank OPP – Executing Agency in Eastern Pacific

SS12 - The Three M's of Recreational Fishing Demand: Measurement, Modeling, and Management

Friday, March 24 (8:30 a.m. to 10:30 a.m.) - Room 2: Isla San José

SS145	Josh Nowlis	Predicting the effects of angler regulations off Washington and Oregon using discrete choice surveys and stock assessments
SS146	Scott Steinback	Applying a bioeconomic model to recreational fisheries management in the Northeast U.S.: the good, the bad, and the just plain ugly
SS150	Andrew Carr-Harris	Heterogenous Valuation for Keeping and Releasing Fish: A Shore Thing or a Boat-load of Baloney?
SS151	Dan Lew	Estimating recreation benefits through joint estimation of revealed and stated preference discrete choice data

SS13 - Saving the world's most endangered marine mammal: role of economic incentives for affected communities

Friday, March 24 (8:30 a.m. to 10:30 a.m.) - Room 2: Steinbecks

SS107	Dale Squires	Economic Incentives and Vaquita Bycatch

Poster Session Summary

Poster Session		
Wednesday March, 22 (5:30 p.m. to 7:00 p.m.) - Room: Foyer		
PS015	Juan Agar	Seasonal Closures in Puerto Rico: Are they effective?
PS017	Christina Wiegand	The Impact of the Affordable Care Act in North Carolina's Commercial Fisheries
PS045	Ruth Pincinato	The brazilian sardines market: domestic landings and imports
PS046	Marcus Hartley	An elusive consensus: Heterogeneity across fishery stakeholder engagement, dependence, and social objectives makes catch shares a hard sell in the Gulf of Alaska
PS061	Angela Munch	Observer effects in the Northeast- US multi-species sector
PS074	Renato Molina	Common Property Resources, Property Rights and Natural Disasters
PS119	Alice Thomas-Smyth	VMS Tools: Developing tools in ArcGIS for improved access and analysis of fine-scale spatial data
PS137	Brandon Rus	Investigating the economic viability of macroalgae production in the fishing community of Las Pacas, Baja California Sur
PS141	Francisco Arreguín-Sánchez	Management consequences of climate change in some Mexican fisheries
PS090	Juan Carlos Murillo Posada	Can the effect of distance to port and fishers' behavior explain relative abundance of lobsters? : The case of Galapagos Islands
PS172	Andrew Kitts	History of Collecting Information about the Cost of Fishing in U.S. Commercial Fisheries

Selected Papers Abstracts

Seafood trade & Markets Room 1: Isla Navidad

Wednesday, March 22 (10:30 a.m. to 12:00 p.m)

SP049
Trends in fish price volatility: Icelandic whitefish
Erlendur Jonsson (erlendur.jonsson@uis.no)
Univeristy of Stavanger, Norway

For centuries, the Icelandic people has relied on its abundance of natural resources and fisheries in particular. In today's volatile and homogenous economy of Iceland, fisheries is one of its main export industries, together with power-intensive manufacturing and tourism. Consequently, movements in fish prices have a significant effect on the economy as a whole, making the small nation of Iceland vulnerable to fish price volatility. In this study, we investigate market price uncertainty of exported whitefish in Iceland. Among whitefish, cod is the most important fish species for the Icelandic fisheres, with haddock and pollack following. We model the price volatility for a set of whitefish speiees and establish empirically that price volatility is stable or in a downward trend. Contributing factors such as the food price trends and trends in world whitefish markets are discussed. In addition, we account for other contributing factors to volatility such as the financial crisis, exchange rates, quota restriction and policy implications.

SP091
Current attitudes and perceptions of drivers, benefits, and costs related to seafood traceability
Megan Bailey (megan.bailey@dal.ca)
Dalhousie University, Canada

Traceability for globally traded seafood already exists due to concerns over health and safety, and some businesses have embraced innovative traceability technologies as a way to improve business efficiencies. But traceability is also being heavily pushed as a potential approach to promote sustainable seafood, specifically as a way to combat illegal, unreported and unregulated (IUU) fishing, to address issues over seafood mislabelling and fraud, and to promote social justice at sea Governments and trading blocs, like the US and the EU, have prioritized traceability in various documents. However, the development of and requirements for traceability are generally progressing more quickly than the questions about implementation process, cost, equity, and benefits can be answered. In this paper we surveyed seafood value chain actors and actors peripheral to seafood value chains to elucidate current opinion and perceptions related to the demand for and costs and benefits of seafood traceability. Notable differences exist between value chain and non value chain actors, illustrating a disconnect between those who are often regulating and promoting traceability, and those who will actually be required to implement it. Understanding these perceptions can help traceability technology providers, government regulators, and seafood supply chain actors better navigate the dynamic traceability landscape and help position traceability and traceability technologies as tools capable of contributing to sustainable global seafood.

SP158
Trade in Fishing Services
Gordon Munro (gmunro@mail.ubc.ca)
University of British Columbia, Canada

While the importance of international trade in fish products has long been recognized, international trade in fishing services (TIFS), involving harvesting, processing, transportation and marketing has received but little attention. Yet, one half of the world's EEZs involve foreign fishing arrangements, resulting in such trade. The World Bank report, Trade in Fishing Services (2014), represents a first step towards building the understanding of TIFS and its potential impacts. This paper discusses the key economic findings of the report, which point to the potential enhancement of resource rent through time that TIFS offers. The economics of TIFS is seen to rest upon a blend of standard fisheries economics, international economics and Principal-Agent analysis. The paper discusses as well an attempt to apply some of the key economic findings of the report to coastal states of West Africa, and the potential opportunities opened up by such an application for south-south cooperation. The paper concludes by arguing that TIFS open up a major avenue for future research by fisheries economists.

SP132
The transmission of price changes between wholesale and ex-vessel markets in the Alaska shoreside pollock fishery
Benjamin Fissel (ben.fissel@noaa.gov)
NMFS - Alaska Fisheries Science Center, United States

This paper tests the existence of asymmetric price transmission between first-wholesale and ex-vessel markets in the Alaska shoreside pollock fishery. The theory of derived demand implies that price changes should be transmitted through different levels of the supply chain. This suggests a cointegrating relationship between prices at the first-wholesale (the first sale after processing onto the global market) and ex-vessel (the sale from harvesters to shoreside processors) market levels. Asymmetries in the transmission of prices arise when price changes do not fully pass through or are delayed. A threshold error-corrections model is used to test for price asymmetries in the timing, direction and magnitude price changes between the two markets. Results indicate that price shocks flow downstream through the supply chain (i.e., from the first-wholesale to the ex-vessel market). Furthermore, moderate negative deviations in the first-wholesale price are transmitted to the ex-vessel price more quickly.

Wednesday, March 22 (1:00 p.m. to 2:50 p.m)

SP053

Timing is everything: consistency of shoreside fish deliveries and impacts to the supply chain in the West Coast groundfish trawl fishery

Marie Guldin (mguldin@uw.edu)
University of Washington/NOAA NWFSC, United States

After implementation of an IFQ program in the West Coast groundfish trawl fishery in 2011, members of the shoreside processing sector noted an increased unevenness in catcher vessel deliveries of groundfish, resulting in difficulty maintaining employment of production workers and supplying end markets that require product consistency. Prior fishery regulations included bi-monthly cumulative landings limits which guaranteed a steadier flow of groundfish landings throughout the year-long season. This study utilizes fish ticket data to assess the stability of industry-wide and processor-level groundfish landings pre- and post-rationalization of this fishery, as well as processor-level production information from the Economic Data Collection Program to investigate shifts in product form decisions during this period.

SP082

Challenges of the “Sixth Sector Industrialization” policy in Japanese fishery Obstacles and adverse effects of the vertical sector integration led by fishers

Gakushi Ishimura (gakugaku@iwate-u.ac.jp)
Iwate University, Japan

Since the implementation of "The Basic Policy and Action Plan for the Revitalization of Japan’s Food, Agriculture, Forestry, and Fisheries" in 2011, Japan has comprehensively promoted the strategy of "sixth-sector industrialization" for primary sectors, aiming to increase primary producers' income, competitiveness, and rural economic vitality. Sixth-sector industrialization, which means additive or multiplicative effects of three sectors (i.e., 1+2+3 or 1×2×3), aims to create high value added by combining the primary (e.g., fishery), secondly (e.g., processing, middlemen), and tertiary (e.g. retails) sectors led by primary producers. Despite many successful projects in agriculture, the number of success projects in the fishery is limited. Besides, few studies have considered issues on how the vertical integration of fishery sectors in sixth-sector industrialization affects and modifies the current fishery systems in the Japanese coastal community. This study reviews key obstacles and adverse effects caused by conflicts between fishers and middlemen/processors in the Japanese seafood distribution system. Then this study argues possible ways to develop a new market for diversifications for Japanese coastal fisheries landings by the sixth-sector industrialization strategy, namely, small lots and non-standard landings.

SP103

Induced Innovation in Fisheries and Aquaculture

Martin Smith (marsmith@duke.edu)
Duke University, United States

Many poignant claims from marine ecologists about threats to ocean resources echo debates among the classical economists about scarcity. These claims take both Malthusian forms (e.g. we are running out of fish) and Ricardian forms (e.g. we are fishing down food webs). Such neo-malthusian and neo-ricardian writings are fundamentally pessimistic in that they claim that humans are mining renewable resources to the detriment of society. Like Malthus and Ricardo, both views ignore innovation and its resulting effects on scarcity. A third classical economist, John Stuart Mill, was more optimistic about the ways in which humans respond to scarcity. Mill acknowledged absolute physical limits but highlighted innovation as a likely response to anticipated scarcity. In fisheries and aquaculture, there is a proliferation of innovations in response to growing demand for seafood and what might otherwise be stagnating supplies. As Mill suggested, innovations include both technology and policy responses to scarcity. But there are also market innovations that generate new products. Some seafood market changes combine technological, policy, and market innovations. Ultimately, tensions between the path of innovation and potential for absolute physical limits paint a picture of what is likely to govern seafood market development in the coming decades. Here we provide an analysis of these tensions. We examine a series of case studies in fisheries and aquaculture in which seafood scarcity plausibly has induced technological, policy, or market innovation, and we use these cases to illustrate how seafood production and consumption is likely to change in the coming decades.

SP037

A New Theory of Change for the Sustainable Seafood Movement

Hiro Uchida (huchida@uri.edu)
University of Rhode Island, United States

This paper is the result of a project that began with NAAFE 2015 special session on Fisheries Certification, which asked what forces are driving the market for sustainable seafood. Many previous studies looked at consumers' demand, but in this paper we looked at the entire supply chain (from producers to retailers) to examine the mechanism creating the market for sustainable seafood. Using a retrospective case study approach to draw out and understand how the sustainable seafood movement's 'theory of change' has evolved over a series of inductively-defined time periods, we trace the coordination failures inherent in these iterations of the theory of change, and propose an improved theory of change in which new forms of value chain partnerships better align the incentives of retailers, producers, and NGO-led sustainability programs to drive environmental improvements. Specifically, we propose a novel new actor embedded within the supply chain to initiate value chain partnerships creating brand (financial) risk of all firms. This new actor, labeled a 'sustainable seafood aggregator', can more efficiently align incentives and reduce transaction costs associated with the delivery to the global market of credible sustainability attributes of seafood, in turn delivering greater and more lasting environmental improvements in fisheries and aquaculture production.

SSP100

How integrated analysis of ex-vessel price data can contribute to understanding of a commercial marine fishery

Monica Galligan[1] (mgalligan@csumb.edu), Caroline Pomeroy[2], Carolynn Culver[3]

California State University[1], California Sea Grant Extension[2], California Sea Grant Extension[3], United States.

As part of an effort to characterize the dynamics of the small-scale commercial fishery for California halibut, we were provided access to a large, multi-faceted data set. The landings data included price per pound, along with multiple factors that could influence that price. We combined fishery participants' knowledge with statistical analyses to identify those factors that have the greatest influence on price and value. We will integrate these results into guidance for systematically building socioeconomic information to inform fishery management by the State of California. This presentation will describe our price data analysis and explain insights gained, along with ways that the results could be used by fishery managers and those analyzing the economic value of a fishery.

Wednesday, March 22 (3:00 p.m. to 5:20 p.m)

SP009

A Double Hurdle Application of Fishermen's Catch Sales Through Fish Mothers in Ghana

Kwamena Quagrainie (kquagrai@purdue.edu)
Purdue University, United States

A significant proportion of catch by artisanal fishers in Ghana is sold through wealthy middle-women, known as "fish mothers," who often pre-finance fishing trips. This study examined the determinants of catch sales through fish mothers. Data used came from artisanal fishermen at major coastal fishing communities in Ghana. The effects of select variables were examined with a Double Hurdle model assuming the fisherman's marketing decision first relates to whether or not to sell to fish mothers, and secondly, what percentage of fish catch is sold to them. Self-financing of fishing trips was found to negatively impact fish sold to fish mothers. Artisanal fishermen were 19% less likely to sell to fish mothers if they self-finance, and that self-financing will result in a 10% downward change in the unconditional percentage fish sold to fish mothers. The impact of price, percentage of high value fish landed, boat size, number of fishing trips per year as well as fishing experience were found to positively impact the fishermen's decision. The estimated average partial effects suggested that boat size had the strongest effect on fish sold through the fish mothers, with about 146% and 91% change, respectively on conditional and unconditional sale of fish catch, which is likely caused by higher catches. Fishermen used a range of canoe (boat) sizes from 8m to 27m, with an average of 16.4m. Price, percentage of high value fish landed, the number of fishing trips per year and fishing experience had relatively smaller positive effects.

SP116

The Price of Lobster, Forecasts and Simulation in a ARDL- Bounds Testing Framework

Daniel Gordon (dgordon@ucalgary.ca)
University of Calgary, Canada

Economists have long been interested in empirically modelling/forecasting the price of staple commodities using both structural and reduced form models. The purpose of this paper is to apply

Pesaran's Autoregressive Distributed Lag/ Error-Correction Bounds model for forecasting the ex-vessel price of lobster on the east coast of Canada using monthly data for the period 1990(1)-2013(12). Since the collapse of the groundfish fishery in the early nineties, crustaceans (particularly lobster) have developed into the most important fisheries in Canada. The advantage of the Pesaran Bounds model is that it is valid regardless of the stationary/probability properties of the variables in question (i.e., ~I(1), ~I(0), or fractionally integrated) and allows the model to capture both short- and long-run price adjustments in the fishery, and importantly, the speed of adjustment to a new equilibrium. Empirically, the base model is an inverse demand equation specified for the ex-vessel price of lobster, lobster landings in Canada and U.S., the U.S. GDP, Canadian/U.S. exchange rate and a Canadian producer price index of finfish. Using four alternative stationarity tests we show a serious lack of consistency in determining the rank of each variable and this supports the Pesaran modelling approach. What is more, using a Boswijk and Urbain test Canadian landings are shown to be endogenous in the model. Econometric procedures are used to address these issues. The interest here is to generate accurate forecasts and predict turning points in ex-vessel prices that will support planning, management and predicting income and welfare effects of Canadian lobster fishermen.

SP034

Explaining Consumer Heterogeneity in Responses to Seafood Information Campaigns

Michael Weir (michaeljweir@uri.edu)
University of Rhode Island, United States

Recently, the U.S. Departments of Agriculture (USDA) and Health and Human Services (HHS) recommended that pregnant and nursing women consume at least 8 to 12 ounces of seafood per week as part of a well-balanced diet. Thus, the seafood market has been flooded with health benefit/risk information targeted at women to aid in achieving this policy goal. However, the economics literature is still unclear on whether additional information helps consumers make more informed choices regarding seafood. Using data from a seafood auction experiment, we use a finite mixture model to explore potential sources of heterogeneity among participants and their responses to health benefit/risk information. We identify three distinct groups of consumers: "Cautious Target Group," "Intended Response Target Group," and "Rational Consumers". The majority of our sample exhibited the "intended response" given the tone of a particular information treatment i.e. decreased (increased) WTP for information discouraging (promoting) consumption of a fish species. The "Cautious Target Group" decreased their bids on average while exhibiting the largest variance of change in WTP, which we interpret as general uncertainty. The "Rational Consumers" exhibited the smallest variance of change in WTP and tended to increase bids on seafood products deemed beneficial to one's health while decreasing bids on products considered potentially risky to one's health. We conclude that information campaigns should be adapted to address the cautious consumers, which would likely lead to more successful achievement of the goals and recommendations of the USDA and HHS.

SP047

Assessing the impact of product information from online retailers on Chinese consumer preference of farmed seafood

Chao Zou (zorrozouchao@gmail.com)
University of Rhode Island, United States

Sustainable farmed seafood has been introduced into Chinese market for about three years and it is mainly distributed through online retailers. Since most of the certified products are imported during early stage of this movement, it is not sure whether the consumers are paying premium for the eco-label or country of origin. In addition, with multiple standards on seafood quality, safety and sustainability, if the aquaculture eco-label does generate a significant price premium, what attribute/attributes do consumers actually pay the premium for? This research aims to answer these questions using the white-leg shrimp (Penaeus vannamei) weekly price data and the associated product information from 13 Chinese online retailers' website from June 2015 to August 2016. A log-linear hedonic price model shows that Chinese consumers are willing to pay a 23% premium for imported products when no eco-label, safety or sustainability information provided. When sustainability information is provided Chinese consumers are willing to pay a higher premium for domestic certified shrimp than imported, but they tend to pay less for the domestic when safety information is provided. It is concluded that Chinese consumers trust more on imported seafood for their safety and they reward more to domestic aquaculture in terms of sustainability. Since it is not sure about consumers' understanding of seafood eco-label standards, future research can test this conclusion with different information treatments using controlled experiment.

SP042
Revealed Consumer Preferences in Seafood: San Diego County
Oriana Poindexter (oriana.poindexter@noaa.gov)
NOAA, Southwest Fisheries Science Center, United States

Seafood markets are the inflection point in the fish-to-food transformation, and act as windows into revealed consumer preferences for seafood selection. These preferences have far-reaching implications for fisheries management, food security, and marine conservation. This study reveals consumer preferences for seafood in San Diego County by quantifying the relationship between the prices of seafood products, trophic level, and eco-labeling using data collected from a random selection of markets over the course of a year across San Diego County. The prices of seafood products reflect supply and consumer preferences in demand. Hedonic analysis shows price per unit weight increases with trophic level of the seafood species. The economic effect of third-party eco-labeling (Marine Stewardship Council, Monterey Bay Aquarium Seafood Watch, Best Aquaculture Practices, etc.), and keyword labeling (the use of keywords such as 'local', 'sustainable', and 'responsible') are also analyzed. We discuss the implications of revealed consumer preference for high trophic level seafood species, externalities inherent in seafood production, and opportunities for harnessing consumers as assets in the shift towards a more holistic approach to seafood consumption.

SP040
Where are the fish landed? an analysis of landing plants in norway
Frank Asche (Frank.Asche@ufl.edu)
University of Florida, United States

There is a vast literature focusing on what happens on the water, and on drivers of fishermen behavior. However, the question of what happens once the fish reach the docks has been limited to pricing quality attributes. When landing their catch, fishermen can choose between different landing plants. This may give rise to competition in the harbor, based on the type of species landed, quality of the landed product, and possibly fishermen's reputation. It becomes important to look for

characteristics associated with a receiving plant's existence, as the link between the fishermen and the distributors. In this study, we have access to all transactions at each landing port in mid- and northern-Norway, where approximately 90% of the landings take place. We use a discrete choice model to investigate behavioral patterns in interaction between fishers and 400 different landing locations over 14 years. A key trend, not solely for the number of fishers but also for the number of landings, is a noticeable reduction over time. Results indicate that factors such as total value of landings and community population levels have a negative impact on a receiving plant's probability of failure. At the same time, harvesting rights and the geographical dispersion of the homeport for vessels landing at the same location also affect the odds of exit. Perhaps most interesting is a clustering tendency of landing plants to some geographical locations. This is an indication that an industry cluster provides additional services that enhance productivity.

Ecosystem-Based Management, Room 2: Isla Coronado

Wednesday, March 22 (3:00 p.m. to 5:20 p.m)

SP036
The Economics of a Landing Obligation Policy: Theoretical and Empirical Aspects of Implementing the EU Landing Obligation
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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 fleet dynamics are included in the paper, too.

SP080
Multispecies fisheries, tipping points, and overfishing regulations
James Sanchirico (james.sanchirico@gmail.com)
UC Davis, United States

Calls to account for ecological interactions and tradeoffs in fishery management have grown over time. For example, some groups are asking to reduce global forage fish catch by 10-20% to ensure food supplies for other species. These efforts follow advances in ecology and the development of

large food web models, such as Ecosim and Atlantis. To help inform ecosystem-based management, we examine the implications of ecological interactions for management when a tipping point potentially exists. We utilize a flexible delay-differential bioeconomic model based on cod and herring fisheries that includes non-linear predation on cod eggs by herring that produces depensation. This case has been hypothesized to result in a regime switch whereby cod might not be able to rebuild even in the absence of fishing. We use pseudospectral collocation to solve for the optimal dynamic solution under numerous fishing histories with and without the constraint imposed by the Magnuson-Stevens Act with regards to overfishing on single stocks. We highlight how the optimal management and recovery of the system is impacted by the overfishing constraint and measure the loss in net present value. Our results highlight the potential costs from one size fits all single species regulations being imposed in a world of ecosystem based fisheries management.

SP081

The impact of forage fish regulations on recreational fishermen's catch

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NOAA NMFS, United States

Fisheries management has been traditionally single-species oriented. Only recently more pressure has been put on developing a holistic, science-based approach that considers the ecosystem as a whole. This approach is widely known as ecosystem-based fisheries management (EBFM). One of the most often highlighted aspects of EBFM is the relevance of predator-prey interactions in the aquatic ecosystems. The motivation is that there are considerable trade-offs between the supporting role of forage species as energy conveyors in food webs and provisioning service as target species to fisheries. We study this aspect by looking at the Chesapeake Bay. The motivation is a recent debate on the potential impact of excessive forage base fishing. In particular, we are interested in the propagation of forage overfishing through the food web and its influence on more valuable, higher trophic species fisheries. We develop a Bayesian model of recreational harvest of striped bass where benefits are derived from stock size as well as age structure. The age structure drives the probability of catching a fish of a particular size what is of considerable importance to the fishery highly constrained by minimum catch size regulations. Then, using a dynamic multispecies framework (Ecosim) and modified random utility model, we analyze multiple scenarios varying by menhaden regulations and derive benefits changes imposed on the striped bass recreational fishery. We focus on the recreational sector as recent research indicates that the recreational fishing is becoming increasingly important and new management strategies may be necessary to address this shifting trend.

SP126

Commercial fishing behavior under changing ocean conditions: Spatial analysis of the west coast salmon fishery during “the Blob”

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NOAA Fisheries, United States

In this paper we characterize changes in the level and spatial distribution of fishing effort during the extreme ocean temperature event known by oceanographers, climate scientists, and the public as “the Blob.” The Blob was an unprecedented marine heatwave that occurred off of the Pacific Coast of North America from 2013 through 2016 and may have resulted in a variety of effects including changes in species range shifts, low chlorophyll levels, and harmful algal blooms. Such extreme

biophysical conditions may affect abundance or commercial catch of important pelagic species, including Pacific salmon. We construct historical landings and effort from 1981-2015 in the west coast salmon troll fishery to evaluate coastwide and regional effort changes. We use Vessel Monitoring System data from 2008-2015 to map and characterize the spatial distribution of commercial salmon fishing effort and qualitatively identify changes in distribution over time and across regions. Preliminary results suggest that there are changes in level and distribution of salmon fishery effort coincident with "the Blob" and other extreme oceanographic events (e.g. El Nino events in 1992 and 1997). Additional work will formally test these preliminary results. Unusual climate events will become increasingly common as climate change continues to occur. Case studies such as this one will increase our understanding of the effects of climate change on commercial fishing operations and help develop methods for identifying impacts.

SP029

Quantifying and predicting responses to a West Coast salmon fishery closure

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Northwest Fisheries Science Center, United States

As anthropogenic changes interact with natural climate cycles, the variability of marine ecosystems is likely to increase. This variability influences the behaviour of fishers, which can affect the profitability and sustainability of stocks and may have wider economic and ecological effects. We use data from the US West Coast salmon troll fishery before, during, and after a large-scale closure to illustrate how altered resource availability influences the behaviour of fishing vessels in heterogeneous ways. We find that vessels were less likely to participate in fishing during the closure, with >40% of vessels ceasing fishing temporarily and 17% exiting permanently. Vessels that were more dependent on salmon were more likely to cease fishing, and more diversified vessels were more likely to continue. In spite of a high level of cross-participation, we find limited evidence that vessels increased their participation in other fisheries. Ports that obtained more of their revenue from salmon troll vessels saw larger decreases in their revenue during the closure. Overall, the closure was associated with a loss of ~$43 million in fishery revenue relative to the five year period before the closure. Based on our models and the composition of the current fleet, we predict that a closure in the near future would cause another economic disaster and lead to a large fraction of vessels exiting fishing. However, our results suggest that effects on fisheries linked by cross-participation are likely to be low.

SP140

An Ecosystem Holistic Approach for Limit and Target Harvest Rates

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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.

Rights-Based Management, Room 2: Isla Coronado

Thursday, March 23 (10:00 a.m. to 11:50 a.m.)

SP050
Evolving Bycatch Risk in the Pacific Groundfish Trawl IFQ
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Northwest Fisheries Science Center, United States

Catches of several potential choke species in the Pacific groundfish IFQ are highly uncertain and tend to be concentrated while quota is broadly distributed. An analysis prior to implementation of the IFQ suggested substantial risk of individual vessels accidentally exceeding quota allocations for several rockfish species and Pacific halibut. Many fishermen lacked confidence that they would be able to acquire quota on the market to cover incidental catch and consequently joined risk pools to mitigate this risk. I update the analysis of bycatch risk using tow level catch data since implementation of the IFQ. The analysis indicates that expected catch rates of most choke species have declined suggesting more effective bycatch avoidance behavior. However, there remains a significant risk that vessels' catch of some choke species can be several times median quota allocations, in part because many vessels have increased catch and effort by leasing quota pounds, but quota share ownership has remained distributed. The results underscore the importance of an efficient quota market to redistribute quota to match realized catches, but a recent analysis suggests that the quota market is not distributing quota effectively and is subject to high transactions costs. This provides and explanation for the persistence of risk pools despite the fact that aggregate catches of overfished rockfish species and Pacific halibut have remained well below total quotas.

SP112
Evaluating Proposed Modifications to the Gulf of Mexico Red Snapper IFQ Program
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Texas A&M University - Department of Agricultural Economics, United States

The Gulf of Mexico Red Snapper IFQ Program (Program) was the first catch share management program implemented in the Gulf of Mexico. IFQ management was implemented to reduce overcapacity and eliminate the problems associated with derby style fishing. The Program was successful, the number of vessels harvesting red snapper decreased and the fishing season became year-around with higher dockside prices. Although IFQ management ended derby style fishing and decreased overcapacity, issues have been raised over the Program's impacts on fishers and fishing communities. One issue often cited is the development and growth of lease dependent fishers and non-harvester quota owners and how the rise in these groups impact the sustainability and resiliency of Gulf of Mexico fishing communities. After a 5-year review of the Program and input from participants and other stakeholder groups, the Gulf of Mexico Fishery Management Council

developed a scoping document that outlined several potential modifications to the Program. Our analysis examines some of the proposed changes to the Program and potential implications for Program participants. The proposals discussed included: changing program eligibility requirements, imposing caps on the use and/or possession of quota, the possible implementation of use-it or lose-it provisions with regards to quota, and adopting a roll-over provision for unused quota. The proposed changes are evaluated using a mix of publicly available data from, and research on, the Program and other IFQ fisheries.

SP055

Fishing Community Sustainability Cooperatives on California's Central Coast

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NOAA, United States

Our study examines the organization and operation of two Fishing Community Sustainability Cooperatives: The Morro Bay Community Quota Fund and the Monterey Bay Fisheries Trust. These organizations address fishing community sustainability primarily through the acquisition and leasing of quota in the Pacific Groundfish Fishery. From May 2016 to September 2016 we conducted interviews with fishing community stakeholders in Santa Barbara, Morro Bay, Monterey/Moss Landing, San Francisco, Half Moon Bay, and Fort Bragg, CA. The interviews yielded considerable insight into specific strategies being actively employed by fishing community stakeholders to preserve and grow local fishing activity. Our paper focuses on lessons learned from the interviews regarding organization and operation that may be of interest to fishing communities considering the formation of a Community Sustainability Cooperative or Quota Fund. Three key results are explored here in detail: i) success of the cooperative depends on clear understanding of the extent to which profitable out-of-region vessels will be allowed to participate, ii) financial solvency can be heavily dependent on receiving a 'community sustainability discount' on quota acquisition, and iii) communicating success to stakeholders requires a clear and honest definition of success metrics and clear delineation of strategies to meet those metrics.

We need to restore ourselves first: the story of el manglito

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Noroeste Sustentable, Mexico

El Manglito is a fishing community of six hundred people that borders the Ensenada de la Paz, a five-thousand-hectare coastal lagoon. For decades, El Manglito harvested the Ensenada. Over time, resources diminished, and El Manglito fished further away, their costs increased. Catch volumes increased, triggering a downward spiral that made fishers go even further away, to fish even harder, as well as illegally. Resources became scarce. Poverty and desperation deepened. In 2008, a few community members and NOS began working together, despite an environment of drug abuse, crime, distrust, and fear. The effort of NGOs and Government to protect marine biodiversity contributed to tension. In El Manglito, simple actions started changing this reality, building social capital. In 2011, the desire of two fishermen to restore the Ensenada unleashed an unstoppable movement. In November 2015, after four years of working together, 109 community members joined to form a cooperative to restore and harvest the Ensenada. The value of the penshells in the Ensenada has increased from $11,000 dollars in 2012, to over US $850,000 today. In three months a commercial fishing concession will be granted to OPRE for 13 species of bivalves in the Ensenada.

Once the Ensenada is fully restored, its commercial value will exceed 15 million dollars. Without building social capital, this new reality would have been only a dream. The concession is essential, as is the commercial entity to process and distribute product. But without a strong community, no sustainable ecology or commercial activity is possible.

Thursday, March 23 (1:00 p.m. to 2:30 p.m.)

SP078

Empirical Structural Analysis of Value Generation in the Northeast Multispecies Sector Program

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Duke University, United States

Much of the emerging work to evaluate the impact of catch share programs relies on treatment effects models, which identify the causal net effects of the policy change but fail to identify the mechanisms driving those changes and thus have limited relevance for proposed new (out-of-sample) policies. To shed new light on mechanisms, I develop and estimate a structural dynamic discrete choice model of individual vessel behavior in order to learn more about how catch shares influence micro-level decision-making on the water. These decisions include species targets, timing of catch, and sector participation. The structural model builds on emerging methodological advances in industrial organization and labor economics. This work seeks to improve our understanding of how catch shares—or other proposed policies—influence the overall efficiency of extraction patterns and value generated from the resource. To allow study of inter-species substitutions in pre- versus post-rationalization exploitation patterns and to maximize external validity, I implement this model using fine-scale commercial fishing data from before and after the start of the Northeast Multispecies Sector Program. The economic effects I seek to understand are particularly salient now, as the Magnuson-Stevens Fishery Conservation and Management Act faces reauthorization and Congress debates the role of quota programs as fishery management tools going forward.

SP089

Do catch shares lead to selectivity improvements in multispecies fisheries? Evidence from Georges Bank and Gulf of Maine bottom trawlers

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Virginia Institute of Marine Science, College of William & amp; Mary United States

Management of individual stocks in multispecies fisheries is complicated as a result of bycatch and imperfectly selective gear. Output controls can lead to quota underutilization when allowable harvest levels do not reflect relative rates of encounter and the ability to target or avoid stocks is limited. Using eight years of tow-level catch data collected through the Northeast Fisheries Observer Program, we evaluate fishing selectivity for bottom trawlers catching federally regulated groundfish in the Gulf of Maine and Georges Bank. Directional distance functions are used to measure output distances to efficient production frontiers satisfying conditions of strong and weak output disposability. A measure of fishing selectivity is constructed by differencing output distances for a particular catch observation; a non-zero difference indicates separation between strong and weak output disposal efficient frontiers and thus a multi-output technology characterized by imperfect selectivity and costly disposal. Separate measures consider targeting of haddock

(Melanogrammus aeglefinus) and avoidance of cod (Gadus morhua). Preliminary results indicate selectivity differs by region and over time. Additionally, the 2010 introduction of catch shares in the management of New England multispecies groundfish is found to correspond with significant selectivity improvements. Our findings suggest that fishing selectivity may respond to management incentives, however this ability is imperfect as multispecies production technologies are largely found to exhibit weak output disposability both before and after the implementation of multispecies catch shares. Retrospective catch-quota balancing mechanisms may therefore be necessary to increase quota utilization rates.

SP033

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

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Universidad Marista de Mérida, Mexico

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.

SP070

Larval spillover does not affect profits in spatially managed fisheries

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Bren School of Environmental Science and Management, UCSB, United States

Territorial Use Rights in Fisheries (TURFs) are increasingly used as a tool to promote sustainable and profitable fisheries. Their success depends on shifting incentives to longer time horizons by securing the future benefits of fisheries reforms for TURF owners. One challenge to this security is the spillover of fish across the border of the TURF. If the size of the TURF is small relative to the scale of fish movement, most benefits of actions go to neighboring fishing areas, and the motivation for reforms by TURF owners is reduced or eliminated. Past studies of TURFs support this conclusion. These theoretical and empirical analyses, however, have focused on the effects of adult fish movement. However, in many TURF systems, larval dispersal greatly exceeds TURF size, yet they can still be quite successful. We propose that including the effect of the market conditions (fishermen discount rates and price premiums for size) and the targeted species' life history into

TURF models could greatly increase our understanding of why existent TURF systems seem unaffected by high levels of larval spillover. In this paper we explore this hypothesis by building age-structured models to assess how fishermen behavior is likely to change when including these drivers into current models. Our results show that maximum economic gains can be achieved in systems with high levels of larval spillover if 1) access rights over the adults are clearly defined where fishing activities are performed and 2) there's a price premium for larger fish.

Economic Indicators; Room 2: Isla Coronado

Wednesday, March 22 (10:30 a.m. to 12:00 p.m)

SSP039
Profits, rents and resource rents
Ragnar Arnason (ragnara@hi.is)
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The concept of rents has a venerable history in economic theory. In his fundamental work on the Wealth of Nations, Adam Smith defined the concept making it clear that rents were distinct from profits. Ricardo, building on the foundation laid by Adam Smith, similarly distinguished between profits and rents in his theory about land rents. In spite of this, in fisheries economics the word rents is often carelessly used as synonymous with profits. To further confound the issue, some authors refer to this concept of rents as resource rents apparently suggested that the fisheries profits are somehow generated by the resource. This paper attempts to clarify these issues. It provides a definition of rents which makes theoretical sense and is in accordance with the traditional use of the term in economic theory. It then shows that there is no particular quantitative relation between rents and profits; rents may be larger, smaller or equal to profits. It further argues that while the resource has an impact on the size of rents, many other factors also affect rents and there is no theoretical or quantitative basis for attributing part or the whole of rents to the resource.

SSP120
Influence of skipper effect in fishing efficiency of mixed fishing fleet: a Mexican case study
Quijano Daniel[1], Salas Silvia[1] (marquezs.silvia@gmail.com), Monroy-García Carmen[2]
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Understanding the factors that define technical efficiency in a fleet is a requirement to define strategies to regulate the fishing pressure. In industrial and semi-industrial fleets more weight has been given to the technological effect, while in small-scale fisheries the skipper effect has been more widely discussed. This study aimed to understand the human and technological factors that define the fishing efficiency of a semi-industrial fleet operating at the Campeche Bank, Mexico. A stochastic ray frontier was used to evaluate such efficiency. Nine variables were included: days at sea, crew size, vessel length, power-engine, skippers' experience, skippers' education, year-season, fishing area and fishing gear. The data from two fishing seasons (2012 and 2014) used in the

analysis comes from logbooks of skippers and interviews undertaken in the Yucatan coast. A total of 1,095 fishing trips were analyzed, the efficiency of the fleet for both year was medium (0.72 and 0.62). Fishing gear, days at sea, crew size, fishing zone and skipper experience were significant variables. The skipper experience (given their background), associated to other variables seemed more relevant for fishing efficiency than the technological effect. Catch composition associated to the type of gear used and fishing zone were also significant factors, which becomes relevant when one analyze the performance of a mixed fishery.

SSP134
Targeting Ability and Behavior in the US West Coast Groundfishery
Robby Fonner (robby.fonner@noaa.gov)
NOAA Fisheries, United States

Multispecies fisheries are typically characterized by imperfect targeting and joint production of multiple species. As such, participants in these fisheries have only limited control of the species composition of their catch. When harvest constraints on a valuable or protected species become binding, fishermen may be forced to stop fishing all together to avoid surpassing the allowed catch of these so called “choke species”. The US West Coast groundfish fishery is a multispecies fishery where valuable stocks are underutilized, presumably due to choke species. This study empirically models vessel-level production in West Coast groundfish fishery with vessel characteristic and species-specific catch data. The model is specified after testing for non-joint production and separability of outputs from inputs. The ability of fishers to modify the species composition of their catch (targeting) is tested and heterogeneity in targeting ability is compared across port locations and vessel characteristics. Finally, observed shifts in vessel catch composition are compared to those expected based on model estimates and the relative ex-vessel prices of target species. The results can inform strategies to facilitate utilization while maintaining other management objectives.

SSP044
Harvesters’ Dynamic Decision on Fishing Trip Length
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University of Washington, United States

This study investigates harvesters’ effort in terms of days at using dynamic discrete choice model. Fishing effort as a form of time has been analyzed with trip level data, in which only averaged daily catch is available. On the other hand, daily level data enables us to have the variation of daily catch within a trip. Such variation provides more information than averaged daily catch in two ways. Firstly, it can capture how the harvesters update the expectation of future catch. Secondly, it also captures the daily change in the state variables such as total weight and freshness of caught fish. This study incorporates these factors in a dynamic discrete choice model of a fishing trip. We suggest freshness as a critical factor in determining fishing trip duration. Using daily logbook data from a Japanese-based longline fishery, we find the effect of freshness on trip length. The result shows that the catch older than 15 days significantly decreases the probability of a trip continuation. Our use of daily data resolves the endogeneity present in this related work and identifies the tradeoff between freshness and increased catch, capturing the intra-trip variation that drives the marginal decision to remain at sea or return to port.

SSP152

Assessing the technology and technical efficiency of artesian fishing boats

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Many policies have been proposed in order to alleviate the problem of declining stocks. However, the policies that intended to limit fishing effort need a better understanding of the fishing technology. In particular, these policies should be based on the marginal productivity of the different inputs which vary greatly across time and boats. Additionally, the efficiency with which fishermen operate the technology is an important variable to take into account. For these reasons, in recent years, there has been an increasing interest in studying the performance of fishing fleets. This paper uses a stochastic frontier approach to estimate the technology and the technical efficiency of the artisanal fleet in the island of Gran Canaria. Since we are interested in finding which variables explain the differences in technical efficiency across boats, we estimate the Hadri (1999) that allows technical inefficiency to be a function of some explanatory variables. To the best of our knowledge, this is the first attempt to apply this model to fisheries data. One of the main interests of our research is to analyze the effect on catch landings of the variables that can be easily modified by the fishermen. In particular, we are interested in analyzing the role of days spent fishing. In Gran Canaria there is a great variability in the number of fishing trips per month across boats and we would like to assess the possible effect of regulating days at sea in order to reduce fishing effort.

Bioeconomics Modeles and Applications, Room 1: Isla Navidad

Thursday, March 23 (10:00 a.m. to 11:50 a.m.)

SP129

Exploring optimum economic efficiency of fishing:Shall we move from the tradition in the post-tsunami fishery?

Gakushi Ishimura (gakugaku@iwate-u.ac.jp)
Iwate University, Japan

An empirically-estimated production function for a Japanese off-shore longline fishing vessel for swordfish fishery is integrated with a demand model and operating costs. This integrated model is used to explore optimal fishing efforts, a combination of days for (a) searching fishing grounds and (b) actual longline fishing operations. The results demonstrate explicit differences between the optimizing combination of two fishing efforts to maximize economic efficiency and fishing efforts resulted from a traditional revenue share scheme under limited- open access situation. Our result suggests that this group of vessels operates close to the open access equilibrium which is not optimal for the economic maximization, and encourage them to move new revenue share scheme to induce optimal fishing efforts to rationalize their operation.

SP018

Cooperative Management of Trans-boundary Fish Stocks: Implications for Tropical Tuna Management in the Pacific Island Region

Kanae Tokunaga (katokunaga@oa.u-tokyo.ac.jp)
The University of Tokyo, Japan

The trans-boundary migration of fish stocks creates spatial externalities, and hence, makes international cooperation beneficial. This study provides a model for the management of straddling and highly migratory fish stocks and examines the relationship between fish migrations and the benefits from cooperation. Previous studies on trans-boundary fish stock management have focused on seasonal migrations of fish stocks. Instead, this study focuses on non-seasonal movements of fish. In addition, the model presented in this paper takes stock leakages from exclusive economic zones to international waters into consideration. These two model features are applicable to the tuna fisheries in the Pacific island region, where the countries' exclusive economic zones are surrounded by international waters. The study confirms that cooperation is beneficial when fish migrate. The study finds that leakages of stocks to international waters reduce the surplus gained from cooperative management. For a given stock leakage level, the surplus gain from cooperation increases with an increase in the gap between the two countries' fish migration rates. Under the Nash-bargaining rule, the surplus is gained equally between the two cooperating countries. In contrast, under the rule based on stock distribution, the country with higher migration rates gains more from cooperation. The study suggests a positive relationship between the optimal price of a fishing license and stocks. This implies possible large income loss for some Pacific island countries from predicted climate change impacts on tuna distribution in the Western and Central Pacific.

SP075

Transboundary Marine Protected Areas

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Countries exploiting transboundary fisheries face strong incentives for over- exploitation. This basic economic insight has been validated empirically; transboundary fisheries tend to be in worse condition than fisheries in sin- gle nations. Thus, transboundary fisheries pose a significant, and globally ubiquitous, management challenge. Attempts to solve this challenge through cross-country cooperation have been largely unsuccessful because defection is often more attractive than adhering to cooperative agreements. We ex- plore the economics of an alternative solution, a transboundary marine pro- tected area (TMPA), and derive the conditions under which it can improve profits and stock biomass, even in the presence of individually-rational non- cooperation across countries. We find that well-designed TMPAs have the po- tential to overcome non-cooperation across countries; this result is strength- ened when stocks have relatively low growth rates. A well-designed TMPA can earn higher profit for both countries, increase stocks in both countries, and reproduce the fully cooperative outcome.

SP048

The shrimp trawl fishery in the Gulf of California: risk and uncertainty factors

Luis Almanderez Hernandez (lach1406@gmail.com)
CICIMAR-IPN, Mexico

The shrimp fishery off the Mexican Pacific coast is the country's most important fishery from the economic standpoint. However, it faces serious problems, including the fleet's overcapitalization and age, in addition to the environmental variability that affects the size of catches. Thus, this activity depends on a variety of factors that add uncertainty to the profitability of fishing vessels. This study aims to estimate the probability of success and economic risk of "type vessels" under two different environmental variability scenarios in the Gulf of California. The results from the economic simulation pointed to the vessel type used in Guaymas (Sonora) as the most efficient one under a neutral climate change scenario, showing a homogeneous behaviour in physical characteristics and mode of operation. By contrast, under a scenario of a monotonic rise in sea surface temperature, the shrimp fishery faces a greater risk of incurring economic losses. The simulated climate behaviour scenarios revealed that the activity involves a moderate economic profitability under the neutral scenario; however, under the warming scenario, profitability may be low or even nil due to the risks and uncertainty resulting from the influence of environmental phenomena.

SP057

Economic and biological consequences of applying a constant natural mortality and catchability coefficients in a sequential fishery

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The Mexican shrimp fishery comprises a sequential fishery: an inshore fleet (IF) using cast nets and targeting juvenile shrimps; and the offshore fleet (OF) using trawler boats targeting adult shrimps. The main target species are brown, blue and white shrimps. Conventional aged-structured models are used to advice management of this fishery assuming constant M (natural mortality) and q (catchability) which do not accord with the dynamics of a sequential fishery. In our analysis we compare both, conventional and M and q constant aged-structured models, for the shrimp fishery (2014-15) in southern Gulf of California using as state variables fleet profits, recruitment (R) and spawning stock (SSB); finally we apply a management criteria of Maximum Economic Yield (MEY) to the OF. The constant M scenario showed a high economic and biological variables (R&SSB) overestimation because low M values for earlier stages. The constant q scenario showed a global underestimation mainly in IF profits and biological variables. Using both constant coefficients resulted in a higher overestimation of OF profits and biological variables, with an underestimation in inshore fleet profits. The MEY criteria over the conventional model showed -60% trawler effort and a biological and economical fishery gain. In contrast, the model using constant M and q showed overestimated OF profits and biological variables. On the other hand, it tends to underestimate IF profits. In conclusion assumption of constant M and q values used in sequential fishery resulted in effort, economic and biological biased estimates which may have undesired consequences for fishery management.

SP121
Alaska's sablefish fishery after Individual Fishing Quota Program implementation—a bioeconomic analysis
Keith Criddle (kcriddle@alaska.edu)
Juneau Center for Fisheries and Ocean Sciences, United States

Alaska is the world's principal supplier of Sablefish Anoplopoma fimbria a buttery-flavored whitefish greatly prized in Japan. Sablefish are distributed from Baja California to western Japan but the majority of commercial catches are from the Gulf of Alaska and the Aleutian Islands off Alaska. Landings volume and value of this long-lived demersal fish are comparable to those of the better-known Pacific Halibut Hippoglossus stenolepis. Like Pacific Halibut, Alaska region catches of Sablefish are managed under an Individual Fishing Quota (IFQ) program implemented in 1995. We present a simultaneous equation market model for Sablefish and use the model to examine linkages between landings volume and exvessel prices and revenues including the sensitivity of Alaska exvessel price and revenue to changes in landings, to changes resulting from the implementation of IFQs and to changes in the Japanese economy. Model simulations indicate that markets could absorb substantially more Sablefish than can be sustainably harvested from the current stock of Alaska region Sablefish. However, sluggishness in the Japanese economy has resulted in overall downward pressure on Alaska region Sablefish exvessel prices. Model simulations indicate that IFQ implementation in this fishery significantly increased exvessel revenues, beyond what they would have increased, as a consequence of longer seasons that resulted from an end of the race-for-fish. In addition, we find that IFQ implementation has helped buffer the fishery against revenue losses associated with reduced catch limits triggered by the decline of Sablefish biomass in the Alaska region.

Thursday, March 23 (3:00 p.m. to 4:50 p.m.)

SP021
Fishermen's location choice under spatio-temporal update of expectations
Barbara Hutniczak (bashiaa@gmail.com)
NOAA NMFS, United States

Information acquired by fishermen while fishing play a crucial role in their decision-making process. Those are used to form the basis for update of beliefs on productivity of a range of available fishing grounds while acting in an uncertain environment. In this paper, we focus on the formation of fishermen's beliefs about the productivity of fishing grounds based on signals obtained through harvest activity. We task ourselves with better understanding of the impact of prior experience on the at-sea day-to-day decision with respect to location choice. We investigate how obtained signals are propagated over time and space considering knowledge decay with increasing spatial and temporal separation, hence, incorporating intertemporal and spatial correlation between gained experience and future expectations. The parameters of the updating process are derived by fitting a dynamic Bayesian model to available data of location choices. The signal propagation parameters are derived by fitting the multinomial logit model to simulated expectations data paired with observed discrete location choices. Our motivation is that successful fisheries management must be able to accurately predict the response of fishermen to fishery regulations with particular attention paid to flexible technologies where individuals can adjust effort and alter fishing behavior. Good understanding of fishermen location choice and location adjustment flexibility can contribute

substantially to a design of management practices with spatial components. We apply our model to the Polish bottom trawler fleet in the Baltic Sea.

SP125
Dynamic choice of target species: Estimation and Policy Simulation Alaskan Pollock Catcher-Processors
Chris Anderson (cmand@uw.edu)
University of Washington, United States

"This study estimates the harvesters' dynamic target fishery choice by building an empirical model incorporating dynamic quota use with the insight from a theoretical model. The harvesters' behavior, which purposes to maximize seasonal profit under constraints of the regulations, are theoretically modeled and solved using a dynamic optimization method. The solution motivates us to incorporate the dynamic quota use in a simple discrete choice model to estimate the harvesters' choice. Choice behavior of fisheries has been analyzed using a discrete choice models. The application of this model is implemented with an offshore fleet in Alaskan groundfish fishery, which has appropriate feature to apply the model such as multiple target choices and individual quota. The result indicates that the dynamic variable, quota use, adjusts the incentive to catch pollock for revenue, and it largely lessened the avoidance behavior. We run a simulation of a policy alternative that opens fishing season earlier using the parameter estimates and evaluate the potential effect of the policy on bycatch reduction induced by the change in harvesters' fishery choice behavior. "

SP005
Confidence of the Trembling Hand
Jorge Holzer (jholzer@umd.edu)
University of Maryland, United States

Management of data-poor fisheries typically relies on setting an annual catch limit (ACL) using catch-based methods that are concerned with estimating a sustainable harvest and hinge on the logic that historic catches reflect a level of exploitation the stock can sustain. The resulting harvest control rules routinely set ACLs at the median (or mean) landings over a reference period, with or without a scalar downward adjustment according to the assumed level of depletion. Thus, the only way for the ACL to increase in the future is for the fishery to routinely exceed the ACL, which may be highly unlikely with strong enforcement. We propose an alternative approach: perturbations in the form of small, temporary and intermittent increases to ACLs between stock assessments (combined with a safety valve) can increase the permanent value of the stock. On one hand, these perturbations translate into a more accurate estimation of the population model in the next assessment, which leads to ACLs closer to the true maximum sustainable yield thereafter. On the other hand, increases in ACLs imply a higher management risk in the form of overfishing. To characterize this tradeoff, we first build a dynamic stochastic model that summarizes the interaction among the stock, the industry and the regulator. Then we perform several Monte Carlo experiments. We find that under reasonable parameterization, a wide range of perturbations give rise to a net present value of the stock that not only in expectation is higher than, but oftentimes first-order stochastically dominates that without perturbation.

SP038

Optimal harvesting paths: Appropriate discount rates

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University of Iceland, Iceland

Discount rates, it is well-known, play an important role in the determining optimal extraction paths for natural resources. In fisheries analysis, as well as other natural resource use, constant discount rates are customarily assumed. In practical applications, the constant discount rate is often taken to be the social rate of discount which is usually assumed to be quite low. Incorporating the fishery in a two-sector economic growth model, it is easy to show that this customary approach is inappropriate. The appropriate discount rate to use in the fishery is at all times the marginal production of capital in the other sector and vice versa. It immediately follows that the appropriate discount rate varies with the state of capital accumulation as well as over the business cycle. A further consequence is that in developing countries where the marginal product of capital is typically high, high fish stock exploitation levels may be perfectly compatible with what is socially social optimal.
JEL classification: Q2,Q3,O41

SP110

Economic Assessment of the Biological Dynamics of Florida's Commercial Snapper-Grouper Fishery

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University of Miami RSMAS, United States

The goal of this research was to characterize the trade-offs between profitability and sustainability when managing a valuable commercial fishery. The Florida finfish fishery generates over $75 million in annual dockside value; the snapper-grouper complex constitutes over half of that total. Currently, federal stock assessment procedures focus on stock size and effort constraints, but lack any economic specificity associated with proposed regulatory actions. To evaluate management strategies for snappers and groupers, an age-structured bioeconomic model was created for half a dozen snappers and groupers that dominate the commercial catch vector. Prices per pound of these snappers and groupers were estimated using domestic landings and imports, then linked to dynamic biological-economic production models. Management scenarios including eumetric fishing, which optimizes yield per recruit by adjusting minimum size limits and fishing mortalities, were simulated to examine the sensitivity of tradeoffs between economic returns and long-term fishery sustainability. An increase in minimum size limits causes a temporary decrease in domestic landings to allow for spawning stock biomass to rebuild. Since grouper production is primarily domestic, the price per pound would increase during the rebuilding phase; however, since snapper production is primarily imported, the decrease in domestic catches would have no influence on price per pound. These results imply that market elasticity surrounding grouper production will buffer the economic hardship of decreased catch, while snappers' inelastic market may require more intricate management intervention.

SP007
Bioeconomic analyses can anticipate pitfalls of marine conservation policy
Andrés Cisneros-Montemayor (a.cisneros@oceans.ubc.ca)
The University of British Columbia, Canada

The Gulf of California is undoubtedly the Mexican marine region with the most research and conservation efforts. In addition to overfishing issues, it harbors endemic and Critically Endangered populations of totoaba (Totoaba macdonaldi) and vaquita (Phocoena sinus). Conservation strategies have varied, but there is a wide recognition of their historic failure to effectively curtail negative human impacts on local ecosystems. A main reason has been a lack of explicit consideration of the economic dynamics and behavior of artisanal fishers. We develop a bioeconomic model that represents a series of past conservation and fisheries management policies, analyzing their empirical results from a simple economic theoretical framework. Results show how counteracting policies, and basic changes to fishing behavior, negate potential benefits to various objectives. Even with wide ecological knowledge and possibly legitimate commitment to sustainable actions from key stakeholders, integrating bioeconomic analyses is essential to understand the outcomes of past policies and generate more effective ones in the future.

Subsidies and their (un)intended consequences Room 3: Isla San José

Wednesday, March 22 (3:00 p.m. to 5:20 p.m)

SP023
Strategies and rationale for fishery subsidy reform
Andrés Cisneros-Montemayor (a.cisneros@oceans.ubc.ca)
The University of British Columbia, Canada

Subsidies can directly support unsustainable fishing practices that harm both ecosystems and long-term social and economic benefits. Globally, fishery subsidies total around US$27 billion, yet their impacts on fishing dynamics are specific to given regions or particular fisheries and fishery subsidies within a nation have markedly different effects when applied to artisanal versus industrial, or managed versus open-access conditions. A range of subsidy reform strategies are critically assessed, drawing on a review of over 30 case studies worldwide to determine patterns in their usefulness and necessary conditions for implementation. Strategies with best overall results are explicitly reorienting subsidies away from capacity-enhancement, and/or conditioning them on specific sustainability performance metrics. Decoupling subsidies from fishing (e.g. providing direct aid to fishers) has unpredictable and unclear results, whereas buyback programs have mostly, and sometimes significantly, poor outcomes. Eliminating subsidies is perhaps the simplest strategy, but is also the most difficult to implement from a social and political perspective. There are clear patterns in effective and beneficial subsidy reform strategies, though key factors for any policy to succeed are clear short- and long-term goals; creative design; transparent implementation; and strong socio-political will.

SP027
Redirection of fishing subsidies in Mexico
Enrique Sanjurjo (esanjurjo@wwfmex.org)
WWF-Mexico

Fisheries subsidies have been roughly estimated to be as high as $35 billion worldwide, of which about $20 billion have been categorized as capacity-enhancing subsidies that directly contribute to overfishing. Since 2001, the necessity for reforming fishing subsidies has been part of the discussions in the World Trade Organization (WTO). Several emerging economies including Mexico are claiming for special and differential treatment, arguing that subsidies actually help countries to develop their own fishing sectors. This paper shows that, at least for the case of Mexico, there are not real domestic benefits for subsidizing fisheries; in contrast, there could be important benefits if redirecting fishing subsidies to investments in fishing management.

SP104
Fisheries Subsidies
Dale Squires (dale.squires@noaa.gov)
NOAA, Southwest Fisheries Science Center

"The fisheries subsidy discussion remains contentious and ongoing. This discussion has rightfully focused upon “harmful” subsidies that can reduce society’s welfare and place unnecessary pressures upon resources stocks and the ecosystem. Nonetheless, this discussion has largely overlooked the increased welfare for society from Pigouvian subsidies that increase the supply of and investment in public goods when there are external benefits and free riding. Important fisheries public goods and external benefits include knowledge associated with new technology for “target” species and “bycatch” reduction, research and development for new technology, and ecosystem services and biodiversity. Careful definition of harmful subsidies also requires consideration of the counter-factual or what would have happened without the action to which the fishery subsidy is attributed. Moreover, conclusions depend upon which parties have standing and whether all or part of an individual State’s society or global society are given standing. In isolation, a transfer payment may appear as a subsidy, but within the context of an environmental agreement may be a side payment to insure that all parties gain and multilateral cooperation is attained. When measuring subsidies, economic – as opposed to financial – costs must be defined according to economic principles from welfare and public economics. This submission contributes to harmful subsidies in Mexican fisheries by adding to the classification and potential uses and removals of both “bad” or welfare-decreasing and “good” or welfare-increasing subsidies."

SP109
Implications of Subsidized Fishing Access to Western and Central Pacific Tuna: The Case of the South Pacific Tuna Treaty of 2016
Scott Miller (scott.miller@noaa.gov)
National Marine Fisheries Service, Alaska Region

The South Pacific Tuna Treaty has existed as a model of international fishery cooperation since 1988. However, in 2016, changing economic conditions led to an impasse between United States purse seine interests and the Forum Fisheries Agency (FFA) over payment of vessel day fees. The impasse resulted in the United States State Department giving notice that it would withdraw from the treaty, and the stand down of the United States’ fleet. The possibility of permanent expiration

of the treaty placed at risk $128 million in vessel day fee payments and $21 million in annual United States investment subsidy payments to FFA members. Many of the members of the FFA depend heavily on these sources of income and the announcement effectively put the FFA in the position of attempting to sell the remaining vessel days to other distant water fishing nations. The United States' announcement indicated a willingness to hold talks to restructure the treaty and such talks culminated in a new treaty agreement, with substantially fewer United States vessel days, that was signed in December of 2016. This paper examines the economic conditions that led to the treaty impasse, the elements of the newly signed treaty, and the implications of the new agreement on future United States purse seine access. This paper evaluates whether the revised treaty has provided an opportunity for other distant water fishing nations to expand purse seine fleets in the area via subsidies and whether subsidized access payments are sustainable into the future.

SP127
Fisheries Subsidies: Why should you care about them?
U. Rashid Sumaila (r.sumaila@oceans.ubc.ca)
The University of British Columbia

The objective of this paper is to provide an analysis of the current state of fisheries subsidies worldwide, and how they are likely to affect the sustainability of fisheries. More specifically, I will review previous investigations of global subsidies issues, and give a brief overview of the impact of subsidies on key economic, social and environmental aspects of the fisheries sector; present and discuss the different types of subsidies proposed in the literature and how they are likely to affect our ability to manage fisheries sustainability through time; discuss and present the magnitude of fisheries subsidies worldwide, and analyse the most recent estimates at regional and global scale, by categories of subsidies. I conclude my talk by suggesting policy options for restructuring fisheries subsidies, drawing from the work of the E15 Expert Group on Fisheries and Oceans convened by the World Economic Forum and the International Centre for Trade and Sustainable Development.

Aquaculture Model and Applications; Room 2: Isla Coronado

Thursday, March 23 (3:00 p.m. to 4:50 p.m.)

SP012
The Impact of Sea Lice Treatments on the Unit Production Costs of Salmon Growth Centers: Evidence from Chilean Aquaculture
Jorge Dresdner Cid (jdresdne@udec.cl)
Universidad de Concepción, Chile

We measured the impact that sanitary treatments aiming to reduce the abundance of sea lice Caligus rogercresseyi have on the unit production costs of Atlantic salmon fattening centers in southern Chile. We make use of a unique data set that allows us to follow complete production cycles for a sample of centers between 2009 and 2015. We estimate a salmon biomass growth and a sea lice determination model, which later are complemented with outside cost information on treatments, such as bath treatment costs, medication costs, and operational costs associated with the treatments. In this setting, we control for endogeneity bias and truncation in the sea lice data. The statistical analysis determines the effect of different treatments on the salmon growth profile. The model also allows identifying the effect that factors such as center location, environmental conditions, sea lice abundance in the area, have on salmon growth. We simulate how unit

production costs vary with different treatments and center characteristics, and estimate the impact of treatments costs on unit production costs. Our results indicate that lice generate an important increase in unit costs, basically because its negative impact on the salmon production cycle and that sea lice treatments in the form of chemical baths, although expensive, do reduce unit production costs. However, the cost effect of treatments is positive and significant as compared with a scenario without sea lice.

SP014

The economic impact of emerging diseases in shrimp aquaculture: Insights from a multi-year, global survey of the industry

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University of los Andes, Colombia

Acute hepatopancreatic necrosis disease (AHPND), initially referred to as early mortality syndrome (EMS), is an emergent bacterial disease that has resulted in substantial economic losses for the global shrimp farming industry. Its occurrence was first reported in China in 2009, rapidly spreading to Vietnam, Malaysia, Thailand, and eventually Mexico in early 2013. AHPND outbreaks typically occur within the first 30 days after stocking a newly prepared shrimp pond, with mortality exceeding 70% in some cases. The emergence of AHPND substantially altered patterns in the international trade of shrimp as declining exports from affected countries such as Thailand and China were partially compensated by increased production in Indonesia, India and Ecuador. This study combines actual production and exports data with production forecasts from an annual, global survey of the industry conducted by the Global Aquaculture Alliance in order to arrive at informed estimates of the global economic impact of AHPND. Information from the GAA survey on production expectations in major farming nations prior to the onset of the disease was used to develop estimates of foregone production and economic losses borne by these countries following the AHPND outbreaks. This study provides a benchmark for the assessment of investments in shrimp health prevention and management programs currently undertaken by farming nations in their efforts to reduce the frequency and magnitude of disease outbreaks that have historically plagued the industry.

SP062

The bigger, the better? Concentration and economies of scale in the Norwegian salmon farming industry

Linda Nøstbakken (linda.nostbakken@nhh.no)
Norwegian School of Economics, Norway

Early studies of economies of scale show that ownership limitations imposed large costs on salmon farming firms prior to the deregulation of the industry in 1991. Since then a number of mergers and acquisitions have taken place and the industry has become far more concentrated. Despite this, a number of smaller firms remain in the industry, and in recent years, industry concentration has stagnated. From 1996 to 2012, the ten largest companies increased their production share from 18.9% to 69.1%. Since then, it has remained stable at this level (68.9% in 2015). According to survey data from the Norwegian Directorate of Fisheries, medium-sized firms currently have lower variable costs per kilo fish produced than larger firms. We use firm-level data for the period 2001-2014 to investigate what has been driving mergers and acquisitions in the Norwegian fish farming industry. Can the presence of economies of scale justify the mergers and acquisitions that have taken place since 2001? Could it be the case that some firms have grown too large? Combining data on mergers

and acquisition and inter-firm collaboration (joint production) with annual survey data on firm-level production, costs and revenues, we empirically investigate drivers of mergers and acquisitions in the industry. Our analysis confirms that some firms have become too large relative to what minimizes production costs. In recent years, we find evidence of increasing collaboration between firms, particularly between small and medium sized firms operating in the same regions. Meanwhile, mergers and acquisitions came to a near halt.

SP076

A Small Sea Parasite Making Big Waves: Industry Consolidation and Collaboration under Spatial-Dynamic Externalities

Félix Morency-Lavoie
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Norwegian School of Economics, Norway

Parasites and diseases represent major challenges in aquaculture. In the Norwegian salmon farming industry, costs associated with treatment of sea lice are surging and reached 5bn NOK or 10% of the industry's total export value in 2015. In addition to the direct impact on production, sea lice affect the industry indirectly through stricter regulations and monitoring requirements. Another feature of the Norwegian salmon farming industry is increasing consolidation ever since the deregulation in the early 1990s. In this paper, we investigate whether and to which extent consolidation is driven by a desire to internalize the spatial disease and parasite externality. Theory suggests that such intra-industry spatial externalities create incentives both for mergers and acquisitions, or spatial cooperation, to increase coordination in pest management. Using spatial techniques to capture the geographical spread and density of sea lice, we estimate the spatial dependencies between neighboring farms. The analysis rests on a novel and unique dataset regrouping high frequency biological and financial information at the farm and company level, with industry-wide history of mergers and acquisition as well as of collaboration in the form of joint production. Using this dataset, we are able to identify the impact of sea lice and other pathogens on the structure and behavior of the industry.

Governance and Compliance, Room 3: Isla San José

Thursday, March 23 (10:00 a.m. to 11:50 a.m.)

SP006

Economically-optimal management investment given unreported fisheries catch: a value of information approach for Mexico

Andrés Cisneros-Montemayor (a.cisneros@oceans.ubc.ca)
The University of British Columbia, Canada

Informal fisheries (including unreported legal, illegal and discarded catch) have significant benefits for communities that official statistics often ignore, yet there is an associated loss in potential economic impacts compared to catch that is processed and marketed formally. This represents a significant global issue, as recent estimates suggest that about half of global fisheries catch is informal. We develop a value of information framework to evaluate monitoring investment policies given uncertainty regarding the size of the informal sector, associated economic losses, and the effectiveness of management, and apply it to an example dataset for Mexico. Results provide advice

on optimal investment in fisheries catch formalization to maximize economic impacts. This analysis complements improvements in fisheries policies themselves, also necessary to achieve ecologically and economically sustainable fisheries. Providing estimates of foregone economic benefits due to poor governance can help elicit positive actions, while revealing the costs of inaction.

SP035
Consequences of Recovering Enforcement Costs in Fisheries
Peder Andersen (pean@ifro.ku.dk)
University of Copenhagen, Denmark

The recovery of fishery management costs from the fishing industry is becoming increasingly common among the fishing nations of the world. Countries such as Australia, Canada, and New Zealand have led the way in applying user charges and other cost recovery mechanisms in their commercial fisheries. The United States and other countries have increased their use of cost recovery for fisheries management in recent years. Although some aspects of cost recovery mechanisms are well studied and documented, there remain some important consequences for fisheries policy that have not been adequately studied. To partially address this gap in knowledge, this paper investigates how cost recovery in the form of a user charge influences producers' behavior and optimal policy for managing a fishery. This is done by extending our earlier economic analysis of fisheries law enforcement to examine the economic and policy consequences of using a royalty on production to recover the costs of enforcement services for fisheries management. We find that who pays and how they pay for governance services influences economic performance of a fishery, as well as the nature and extent of governance expenditures.

SP063
How to assess the spatial representation of fishery's revenues? A method comparison
Angela Munch (angela.muench@noaa.gov)
NOAA NEFSC, United States

Maps of fishing locations are important in assessing fishery exposure to management alternatives and facilitates stakeholder outreach (e.g. the New England Fishery Management Council's Omnibus Habitat Amendment 2 http://www.nefmc.org/library/omnibus-habitat-amendment-2 and the Mid-Atlantic Fishery Management Council's Amendment 16 to the Atlantic Mackerel, Squid, and Butterfish Fishery Management Plan https://www.greateratlantic.fisheries.noaa.gov/regs/2016/September/16msbamend16ea.pdf). Fishing location data is also a primary input into behavioral location choice models. Issues of fishing location accuracy and precision thus affect both a manager's ability to govern effectively and a researcher's ability to model welfare changes. Using data from the limited access scallop fishery in the Northeastern US, this study compares revenue maps created by different approaches for the fishing years 2000-2015. Besides the commonly used aggregation approach of logbook data into statistical areas and ten-minutes-square grids, two probability models will be employed. One of the probability models is based on the work of DePiper (2014) and employs statistical representations of logbook point data, while the second approach follows the approach of Münch/DePiper/Demarest (2017) and incorporates a kernel smoother on Vessel Monitoring System track data. This works aims to highlight the differences in the spatial distribution of revenue between the method applied and to discuss the drawbacks of simply aggregating logbook data into standardized grids, which serves as the most common approach to its spatial representation. This

research indicates that statistical models can substantially improve the ability to define fishing locations when compared to traditional point aggregation methods.

SP069
Why do fishermen comply with regulations? The role of preferences
Linda Nøstbakken (linda.nostbakken@nhh.no)
Norwegian School of Economics, Norway

We investigate how individual preferences affect noncompliance in fisheries. We use data from a combined web-based experiment and survey of Norwegian fishermen conducted in the spring of 2014 to analyze this empirically. In the economic experiment, the participants won real money in a set of lotteries based on their answers and lottery outcomes. Based on the participants' lottery choices, we derive measures of various individual preferences, including time, risk, and social preferences. We combine these preference measures with the fishermen's survey responses related to violations of formal and informal rules, to empirically test and quantify theoretical predictions. Fishermen comply with formal rules primarily because they believe one should obey the law. In addition, and contrary to the standard assumption of self-interested agents made in many studies, respondents comply with regulations out of concern for future stock development. Furthermore, we find that individual preferences matter both for fishermen's attitudes to noncompliance and for whether they see themselves as more or less compliant than the average. For example, and in line with theoretical predictions, more risk averse fishermen identify as relatively compliant.

SP094
Exploration of non-monetary benefits of the Marine Stewardship Council (MSC) certification, lessons from the developing world
Jose Alberto Zepeda Domínguez (joalzedo@hotmail.com)
Independent Consultant, Mexico

Eco-labels have been developed to face the difficulties faced by States in managing fisheries. They promote the voluntary adoption of sustainable practices, through market differentiation of sustainably produced items. In fisheries, the Marine Stewardship Council (MSC) is the most commonly used eco-label. The label is presumed to increase the social and political capitals of the certified fisheries. Mexico has the largest and longest experience in MSC within the developing countries. Mexico has had five certified fisheries including the first small-scale certified fishery. In this work we will focus on four of those five, also exploring the reasons that made 2 of these to withdrawn. The objective of this work is to explore non-financial economic benefits, associated to the certification of these fisheries. To this end, we did an stakeholder map to identify the key players of each certification process based on interviews and on-line MSC data. 40 interviews to those key players were done to recognize benefits associated with the certification. Despite the fact that half of the respondents acknowledge that there has been no improvement in the price of the product, two thirds stated that certification has allowed them to achieve better social or political agreements; around 80% would recommend certification. It is recognized that MSC's certification has not generated the financial returns expected, but it seems that it has resulted in other economical benefit, such as the validation of high social capital an the increasing of political capital.

SP095
The Round table of Mexican fisheries: Fisheries governance examples from Northwestern Mexico

Jose Alberto Zepeda Domínguez (joalzedo@hotmail.com)
Independent Consultant, Mexico

Fisheries management currently claims for fisheries governance (FG), a more balanced scheme that proposes to share the power among government, civil society and economics. In Mexico and other developing countries, the lack of operational regulations has delayed its implementation. Several authors state that topological analysis is useful to identify key stakeholders and their relations, thus it can be used to identify the generalized model of participation needed to achieve the FG. The aim of this study was to identify how the FG social structure is currently performing in sardine, blue crab, abalone and red lobster fisheries in NW Mexico. Based on interviews a topological stakeholder map was elaborated for each fishery; centrality measure was calculated and interpreted as power indicator. Social Network Analysis (SNA) showed that all stakeholders recognized by law are present (government, civil society, fishermen and researchers), although they play different social roles in each fishery. Structural and regular equivalences were identified for each fishery; the four systems showed that federal management agencies, and producer associations can be grouped in a main cluster with different companions according the fishery. Federal Agencies and producer associations were the key players in all the four fisheries state agencies, NGOs and research institutions were present with different weight in each system. The round table contains all the guests but some of them can play a more important role. We found this method is useful to identify key players and their interactions, key aspect to achieve FG as generalized scheme.

Recreational Fisheries, Room 3: Isla San José

Friday, March 24 (11:00 a.m. to 12:30 p.m)

SP087
Modeling angler choices, preferences, and values in the U.S. east coast recreational Atlantic bluefin tuna fishery

William Goldsmith (wmgoldsmith@vims.edu)
Virginia Institute of Marine Science, College of William & Mary, United States

The recreational fishery for Atlantic bluefin tuna (Thunnus thynnus) along the U.S. east coast is thought to be of considerable economic value. The National Marine Fisheries Service (NMFS) uses a combination of permitting, harvest regulations, and monitoring to maintain landings within domestically and internationally prescribed limits. Despite these strategies, recreational landings have in some years exceeded the allowable catch due to changes in fish availability, limited predictability of angler effort, and difficulties in monitoring catch. Understanding the drivers of angler behavior is critical for predicting how effort and harvest may vary as a function of changing fish availability, regulations, or costs. To investigate angler decision-making, preferences, and values, we surveyed private anglers from Maine to North Carolina who possess the permit necessary to target Atlantic bluefin tuna. We present an overview of the survey and preliminary modeling results. The survey collected information on angler demographics, fishing behavior, and attitudes, and employed discrete choice experiments (DCEs) to determine how regulatory and non-regulatory trip-specific variables influence trip-taking behavior. A response rate of 46.4% (n=1154) was achieved. A latent class ranked logit model was applied to DCE responses, with a two-class model best fitting the data. Model estimates will be used to calculate angler willingness-to-pay for various aspects of the fishing experience (e.g., harvest, catch-and-release); to examine heterogeneity in preferences by region, consumptive orientation, and other relevant factors; and to

estimate overall consumer surplus. Findings will be used to inform domestic management that maximizes angler benefits while keeping landings within acceptable limits.

SP108

The Benefits of Escaping Recreational Derbies: Evidence from a Kuhn-Tucker Model of For-Hire Fishing in the US Gulf of Mexico

Joshua Abbott (joshua.k.abbott@asu.edu)
Arizona State University, United States

Many recreational fisheries are managed under regulated open access governed by seasonal closures and bag limits. This approach has often promoted a "race to the fish" with cascades of shorter seasons and shrinking bag limits. These restrictions may have significant effects on angler welfare by inefficiently allocating fish across anglers, worsening congestion, and constraining fishermen's intertemporal choice set. These effects have been particularly conspicuous in the Gulf of Mexico (GOM) red snapper fishery, where season lengths have fallen to weeks or even days per year.

To quantify the losses from recreational open access we analyze data obtained from a two-wave Internet survey of GOM headboat anglers fishing in 2014 and 2015. The sample was derived from respondents to an onboard survey deployed on 19 vessels that participated in a pilot catch share program. We gathered recall data on fishing activities in the previous year. However, we also asked several stated preference questions. These included a choice experiment between alternative policies: one status-quo policy in which fishermen are limited to retaining red snapper during a short summer season and another in which red snapper can be retained year-round but with higher trip costs or lower bag limits. This question is paired with contingent behavior questions that elicited anglers' anticipated behavior under either policy. We combine these data to estimate the implications for angler demand and welfare of transitioning from the current derby system toward a more efficient and flexible approach – such as a catch share system for the for-hire sector.

SP113

Co-management of a recreational fishery with a socio-ecological approach

Leopoldo Palomo (polo_palomo@hotmail.com)
Universidad Marista de Mérida, Mexico

Most regulations for recreational fishing in Mexico focus primarily on offshore boat fishing. However, regulations for inshore recreational fishing in Mexico are insufficient. Every year hundreds of European and American fishermen visit Punta Allen, Mexico to practice fly-fishing. Punta Allen is a coastal village located in the Sian Ka'an Biosphere Reserve, Quintana Roo. For many years, locals have been organized for a sustainable management of lobster fishing. This experience let them to organize and develop internal regulations to manage the newly created fly-fishing activity. The objective of this study is to assess the economic spill from fly-fishing in the community. With data from semi-structured questionnaires to fishing guides and records of cooperatives, the contribution of this activity to the sustainability is explained by describing the internal organization. We observed that in order to increase profits, villagers organized themselves into cooperatives and established alliances with private firms, some of these from the United States. These companies make contact with anglers abroad and offer them all-inclusive packages per day and/or week, including ground transportation, accommodation, meals, and hire local guides with their own boats to take fishermen to fly fishing sites. Local guides have organized five cooperatives to avoid unfair competition by establishing agreements, maximum number of boats, and schedules. Despite few

private external firms acquired licenses to provide fly-fishing guiding services, most licenses belong to local cooperatives, which has empowered them in the alliances to co-manage the activity.

Small-Scale Fisheries, Room 3: Isla San José

Thursday, March 23 (1:00 p.m. to 2:30 p.m.)

SP064
A qualitative risk assessment of hookah diving as fishing technology in small-scale fisheries
Oswaldo Huchim (rhuchim@marista.edu.mx)
Universidad Marista de Merida, Mexico

In many small-scale fisheries around the world, hookah diving is the main fishing method and gear to catch high-value species like sea urchin, sea cucumber, queen conch and spiny lobster. Decompression sickness (DCS) and carbon monoxide poisoning (COP) are diseases related to hookah diving and are the cause of non-fatal and fatal injuries in small-scale fishers with the social and economic effects over households and coastal communities. A misunderstanding about diving risks still prevails among small-scale fishers. This study reports on a qualitative risk analysis method developed to obtain fishers perception, the likelihood of undesired health threatening events occurring as a result of hookah diving, and the corresponding perceptions of impacts or consequences of such accidents. These risk perceptions are contrasted with hyperbaric physicians' perceptions and the actual diving accidents occurring in the spiny lobster (P. argus) and sea cucumber (I. badionotus) small-scale fisheries in a Yucatan northeastern coastal community. Fishers identified the DCS as a major problem in the diving activity; however, their impact value perceived was lower than the one perceived by the physicians. Fishers diving behavior exceeded the recommended standards for a safety diving practice. The method allows for identification of priority decisions relevant to the need for appropriate fishing technologies, for fishers capacity building associated with health-related precautionary measures, and increased community awareness of possible consequences of current fishing technology.

SP068
Evaluating the Economic Viability of Inland Seafood Markets in Georgia: A Two Pronged Approach
Gina Shamshak (gina.shamshak@goucher.edu)
Goucher College, United States

In 2012, over five million pounds of seafood was landed in Georgia, at a value of over $7 million (DNR 2013). While little quantitative data is available, conversations with local experts suggest that most seafood is transported out of Georgia, where it enters the broader national and international markets. This leaves the large inland markets of Atlanta and Athens with relatively few local seafood varieties, thereby creating a potential opportunity for Georgia seafood producers to market their product to these inland markets.
The goal of this research project was to develop a better understanding of the potential benefits and costs associated with participating in inland markets, especially given a presumed market premium for local, wild caught seafood. To that end, the first part of this project estimated the willingness to pay (WTP) for locally caught Georgia seafood (clams, oysters, shrimp, and grouper) sold in either farmers markets or through Community Supported Agriculture (CSA) outlets in the Atlanta-Athens area. Both parametric and non-parametric methods were used to provide estimates of WTP. The second part of this project involved estimating the costs associated with transporting

the product to inland markets. An enterprise budget framework was used to estimate of the cost per pound per species for three potential market outlets (farmers markets, CSAs, and local restaurants). This cost data combined with the WTP data allows producers to estimate the potential profitability associated with selling four locally caught species in three inland markets.

SP105

Distributional performance in a rights based small-scale fishery using artificial habitats

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Universidad Marista de Merida, Mexico

This work reports on how resource rent is distributed among owners of exclusive 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. The fishery is based on the use of artificial shelters, bottom devices that by providing refuge attract and aggregate lobsters facilitating their harvest by free diving and hand nets. In order to assess the distributive performance of this fishery, data from the fishing cooperative logbooks were used to calculate the fishing resource rent achieved spatially by the owners of fishing grounds and corresponding artificial shelters invested in them. Inequality metrics (Lorenz Curve and Gini index) were applied to the calculated fishery distributional performance indicators. The individual resource rent analysis was spatially undertaken considering the transfer cost of steaming from port to alternative exclusive fishing grounds, the corresponding cost of fishing and the opportunity cost of the investments in site specific artificial shelters and fishing assets (i.e. boat, engine and gears). The Gin index presented relatively low values [0.372, 0.429]. Results showed that in this lobster fishery, fishing revenues spread more equally than other fisheries where their distributional performances have been assessed. These results suggest that the relative success of this MSC certified small-scale lobster fishery could be explained in part by the relatively low inequality in the distribution of the benefits among fishers of this rights based fishery.

SP131

Economic viability of small- compared to large-scale fisheries using Mexico as an example

Andrés Cisneros-Montemayor (a.cisneros@oceans.ubc.ca)
The University of British Columbia, Canada

Achieving economic viability is an important goal when it comes to developing policies for sustainable fisheries management, especially for small-scale fisheries (SSF). SSF are vital for many coastal communities, however, often economically and politically marginalized. Here, we develop and estimate what we denote as 'basic economic viability' of SSF, using Mexican fisheries as an example. Results from 2000 to 2012 show increasing economic viability of SSF, mainly driven by decreasing fishing effort and increasing total revenue. Despite receiving 75% of total fisheries subsidies, the economic viability of large-scale fisheries (LSF) declined over the study period and more recently has fallen below zero, indicating a negative contribution to society. Recommendations for improvement in economic viability of fisheries include improved fisheries monitoring, especially in small coastal communities that is backed by increased access to data (social and economic). This can be done by re-directing capacity-enhancing subsidies towards strengthening fisheries management and broadening the livelihood possibilities available to fishers. We hope that results from assessments such as this help bridge the current knowledge gap in SSF

research essential for policy making and management, that would not only improve economic viability but also the sustainability of the fish stocks upon which they rely.

Thursday, March 23 (3:00 p.m. to 4:30 p.m.)

SP010
At the Mercy of the Sea or Rational Profit-speculators: Offshore Fishermen in Taiwan
Xiaozi Liu (xzliu@econ.sinica.edu.tw)
Taiwan

We investigated the own- and cross-price elasticity of supply (PES) of 20 fish and shellfish species, caught in mixed fisheries off southwestern Taiwan and serving the local fresh seafood market. Because the licensed fishermen face little regulation constraining their behavior, we hypothesize that they adjust their catch profiles so as to maximize the expected value of their catch, instead of fishing indiscriminately at the mercy of the elements. However, because catches are auctioned after the landing, fishermen face uncertain price. Using daily data from 2001--2015, we found that price-taking fishermen are capable to respond to price changes of 17 of the 20 species by shifting the catch profile. The species with the highest PES are those corresponding to the highest revenues, and the fishermen are the most price elastic during the season when the catches are highest. Input substitution effect and by-catch effect offset each other, leading to weak and mostly insignificant cross-PES for most of the species. Weather conditions such as wave height, wind speed and wind direction do not appear to affect fishermen's targeting decisions for most of the 20 species, but they do affect fishermen's exit decision, i.e., going fishing or not.

SP026
Economic Assessment of Small Scale Longline Fisheries in Oaxaca, Mexico. A cross section data approach
Victor Hernandez Trejo (victorhtrejo@gmail.com)
Universidad Autónoma de Baja California Sur, Mexico

During last decade, the excluding efficiency of circle hooks for sea turtle has given positive and successful outcomes in Oaxaca, Mexico. The research seeks: 1) determine if the change of fishing gear provides positive benefits to local small scale longline fishermen, 2) estimate the benefit and cost functions, 3) determine the parameters variates and its influence in both models, and 4) estimate a Cobb-Douglas production function. Using unrestricted sampling with proportional assignment, 540 surveys were conducted through May to September 2015. Two benefit models were estimated (EE1-R1 and EE1-NR), the first one is restricted to boats using Selar rumenophthalmus, Ophioscion vermiculatus and Caranx caballus as bait, and the second model is unrestricted. Two models were also estimated for catch, the first (EC1-R1) includes boats using only longline, and the second (EC2-R2) restricted to boats using the bait species mentioned. For model EE1-R1 cost and income are statistically significant at 0.01%, showing elastic and inelastic elasticities respectively. For benefit model EE1-NR, significant variates at 0.01% are price, catch and coast distance. For EC1-R1 significant parameters are coast distance, catch weight and time (hours longline left in water). Significant parameters for model EC2-R2 are coast distance and number of caught fish. Finally, a Cobb-Douglas production function was also estimated, using fishermen as labor and hooks in longline as capital, the factor elasticities are inelastic and, lastly, the small scale longline fishery has decreasing returns to scale. Models highlights the importance of the use of bait species in Oaxaca´s small scale longline fishery.

SP114 Modelling a small-scale sea cucumber fishery in Yucatan

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Universidad Marista de Mérida, Mexico

The status of many sea cucumber fisheries in the world is overexploited. Some of the reasons are: an increase in demand from China, the distance of these fisheries to China, and the high rate of fisheries development. Most sea cucumber fisheries are small-scale with a simple management system. To overcome overexploitation, it is important to know the fisheries management systems. The research questions of this study are: What are the biological and economic factors that accelerate the development of these fisheries? What factors threaten the sustainability of these stocks? And what possible strategies could be implemented? With biological information of the species, fishermen behavior, and the economics, we developed a spatial dynamic bioeconomic model. The model explained the interactions between fishing effort allocation, quasi-profits and population depletion. Our results showed that the main factors that could lead the fishery to the collapse are: a) the spatial pattern, b) excess fishing capacity, c) high quasi-profits in the short term, d) density dependent catchability, and e) heavy density dependence of reproduction. Given the high prices, production, and low opportunity cost of fishers in tropical countries, they often prefer to maximize their short-term gains, regardless of long-term losses due to collapse. Ensuring sustainability requires community agreements and regulations like: minimum legal size, quotas, catch limit per trip, season closed to fishing and rotation of participants.

SP124
Managing for fishermen exit and alternative livelihoods in small scale fisheries: the role of fishermen interrelations and relevant socioeconomic factors

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Escuela Superior Politécnica del Litoral, Ecuador

Despite the success of co-management policies and territorial use rights in achieving the sustainability of some small scale fisheries, a considerable part of them still operate under open access, with very limited management and monitoring (if any), and even facing the risk of overexploitation. As a result, fleet reduction and fishermen exit programs have been adopted as management and conservation policy options. Small scale fisheries are defined by multiple social, economical and ecological factors, have highly interactive harvesting systems, and formal and informal linkages might be relevant to the decision making process of members of interrelated social or production groups. Hence, it is important to understand relevant factors and potential interdependencies in fishermen´s exiting decisions and their preferences for alternative livelihoods before designing and investing in such programs. Using the case of a fleet and fishermen reduction program in the Galápagos Marine Reserve, the objective of this paper is examine the role of socioeconomic factors and fishermen interrelations, as measured by their participation in multivessel harvesting goups, on their decisions to permanently exit the sector and change occupations. We applied random utility theory and multinomial logit models using survey data collected from a sample of registered active fishermen in the three main fishing ports of the reserve. Preliminary results support the relevance of accounting for harvesting interdependence among fishermen to explain exit choices, and identify key demographic and harvest-related factors. Further steps in the analysis are also mentioned.

NAAFE

Special Sessions Abstracts

Ecosystem Services Valuation for Ecosystem Based Management in the U.S.: Current Practices, Opportunities, and Challenges (SS01) Room 3: Isla San José

Wednesday, March 22 (1:00 p.m. to 2:50 p.m.) - Room 3: Isla San José

Primary Contact: Kristy Wallmo, NOAA Fisheries Service, kristy.wallmo@noaa.gov

Session Description:

Ecosystem services are generally thought to be the outcomes of ecosystem functions that provide value to people. Identifying and valuing these services through ecosystem service valuation (ESV) is an important component of ecosystem-based management (EBM), an approach increasingly adopted by marine management agencies. EBM, regarded as an integrated, system-level approach, emphasizes the consideration of multiple objectives and their associated trade-offs as a key element of management. Often these trade-offs involve changes in the provision of ecosystem services, some of which lack a quantitative measure of value for use in evaluation and policy analyses. Despite a number of state, federal, and global ESV-related initiatives, challenges in identifying, measuring and using ecosystem services values in marine management still exist. This session will address some of these challenges through five presentations and discussions on ESV methods, applications, and policy in the U.S. The session will begin with a brief overview of U.S. policies that provide the context for including ecosystem service values in coastal and marine management. A presentation on the use, implications, and challenges for ESV at the National Oceanic and Atmospheric Administration (NOAA) will follow. The third presentation will provide an overview of ESV methods, existing values, and policy applications at NOAA. The final two presentations will present case studies of ecosystem service value estimation and application on the U.S. west coast. We expect the session to generate discussion of the use and challenges of ESV both in the U.S. and abroad, and consider it an initial step in advancing ESV at NOAA.

SS155
Ecosystem Service Valuation: A U.S. Policy Context

Kristy Wallmo (kristy.wallmo@noaa.gov)
NOAA Fisheries Service, United States

In the last several years a number of U.S. policies and directives have laid the foundation for Ecosystem Service Valuation (ESV) to be incorporated into ecosystem-based management (EBM), the current management paradigm for U.S. oceans and coasts. In 2010 the Final Recommendations of the Interagency Ocean Policy Task Force instructed federal agencies to adopt EBM "as a foundational principle for the comprehensive management of the ocean, our coasts, and the Great Lakes." While the Task Force did not explicitly direct the use of ESV, the need for EBM to "consider all the elements that are integral to ecosystem functions and account for [their] economic and

social benefits…" implies that ecosystem service values are a vital component for fully implementing EBM. Since then several national directives, including the National Ocean Policy Implementation Plan, the President's Council of Advisors on Science and Technology, the Federal Resource Management and Ecosystem Services Guidebook, and the Executive Memorandum on Incorporating Ecosystem Services into Federal Decision Making, have all recognized the need for ESV. The U.S. National Oceanic and Atmospheric Administration (NOAA) has made progress in broadening traditional views of marine management to include ESV; challenges remain, however, concerning standardized approaches, systematic, and comprehensive use of values in decision-making. This presentation will provide a brief overview of the policy context for ESV in the U.S. and highlight potential applications as well as challenges associated with establishing and utilizing ESV in NOAA research, management, and policy.

SS153

The NOAA Science Board Report on Ecosystem Services Valuation and Its Implications

Douglas Lipton (douglas.lipton@noaa.gov)
NMFS, United States

In May 2016, the NOAA Science Advisory Board, Ecosystem Services and Management Working Group, submitted a report to the NOAA Administrator entitled, An Assessment of the Use and Potential Use of Ecosystem Service Valuation (ESV) within NOAA: A Report from the NOAA Science Advisory Board". While the report covers all ecosystem service valuation, its primary emphasis is on non-market valuation, and particularly non-use value. We present our interpretation of the major findings of the report and the potential NOAA response. The report finds that the demand for ecosystem services valuation is evolving at NOAA and is likely to increase, but the capacity of the organization to assimilate findings needs to be further developed. On the supply side, the capacity to deliver ecosystem services valuation is limited to a few "hot spots" within the agency. We explore the challenges to expanding this capacity by leveraging with other federal agencies and the academic community. Other recommendations related to the use of benefits transfer and "off-the-shelf" valuation approaches that have not been fully vetted.

SS154

Ecosystem Service Valuation: An Overview of Methods, Values, and Applications

Dan Lew (Dan.Lew@noaa.gov)
NOAA Fisheries, United States

The literature on ecosystem service valuation has grown considerably in the past decade as nations around the world have moved towards adopting more holistic, systems-level frameworks to managing both marine and terrestrial resources, ones recognizing and accounting for the interconnectedness of all parts of the ecosystem. In these frameworks, economic values are often desired to fully understand trade-offs involving human uses and policy interventions on the ecosystem. In this presentation, I provide an overview of the methods used to estimate the economic value of marine ecosystem services with an emphasis on non-market valuation methods. Additionally, I describe and assess the literature in terms of the types of ecosystem services for which economic values are or could be estimated, the methods used, and examples of studies that

illustrate the methods. In addition, I discuss benefit transfer methods used for transferring ecosystem service values for use in policy applications.

SS157
Recreational Demand for Shellfish Harvest in Puget Sound Under Future Climate Scenarios

Leif Anderson (leif.anderson@noaa.gov)
Northwest Fisheries Science Center, United States

Future predictions of environmental conditions in Puget Sound exhibit an increased frequency and temporal extent of paralytic shellfish toxin closures. These predictions, generated using experimentally-derived growth responses of the common toxin-producing Alexandrium together with simulations of climate and local hydrology, depict a scenario in which the number of days favorable to bloom development is increased by 30 by the year 2050. We quantify the lost consumer surplus that would result from this reduced recreational opportunity, as impacted by future climate change. Our economic model is estimated using a recent contingent behavior survey of recreational shellfish harvesters in Puget Sound. Specifically, we estimate an incomplete count model demand system for recreational shellfish harvest trips along with the demand for close substitute trips.

SS159
Transfer Reliability for Meta-Regression Models: Accounting for Uncertainty

Luke Fitzpatrick (fitzpatl@Ohio.edu)
Ohio University, United States

"Meta-analysis is one of the most common tools in benefit transfer. The typical way to gauge the reliability of a meta-analytic benefit transfer is to use convergent validity, which consists of cross-validation exercises. The analyst estimates a meta regression model while omitting one or more observations from a meta dataset, then uses the estimated transfer model to predict the value of the omitted observation(s). These two objects (the true value and the predicted value) are then compared, producing a prediction error. The mean of the distribution of absolute percentage prediction errors is the standard measure of reliability of the benefit transfer, but discards useful information generated by the cross-validation exercise. In particular, using point estimates to conduct benefit transfer ignores that the estimated value carries substantial uncertainty. Further, only using the mean of the transfer error distribution when assessing reliability ignores information that could potentially be useful to decision makers. The present paper proposes interval transfers as opposed to point estimate transfer for conducting benefit transfers. Interval-based estimates contain more information regarding the true value of an environmental amenity. Further, a new approach to policy making under uncertainty is proposed that can be used within the framework of meta regression models. We showcase these methods in the context of benefit transfer of the recreational value of coral reef ecosystems, an area of growing international interest that has thus far received little attention. "

SS170

Ecosystem Service Values and the Proposed Klamath River Dam Removal

Rosemary Kosaka (rosemary.kosaka@noaa.gov)

NOAA Fisheries Service, United States

In February 2010, two agreements were finalized by Federal, State, and Tribal governments and PacifiCorp, a utility company that owns dams on the Klamath River: the Klamath Basin Restoration Agreement (KBRA) and the Klamath Hydroelectric Settlement Agreement (Settlement Agreement). These agreements included provisions that would affect the Klamath River Basin such as removing four dams on the Klamath River, habitat restoration projects, and water allocation schedules for water users. To determine whether implementing these agreements would provide environmental benefits that outweighed the costs, an extensive benefit-cost analysis was undertaken, a collaboration between agencies within the Department of Interior and the Department of Commerce's National Oceanic and Atmospheric Administration. Ecosystem service benefits such as the restoration of salmonid fisheries, improvements to irrigated agriculture, and increased recreational opportunities were evaluated against ecosystem service costs such as dam removal, forgone hydropower, and habitat restoration activities. When considering these and other use values, the net benefit of implementing the KBRA and Settlement Agreement was negative (-US$1.6 billion). When including non-use values such as public willingness-to-pay to reduce the extinction risk of Coho salmon, the net benefit of implementing these Agreements was positive (+US$14.1 billion). The addition of these non-use ecosystem service values tipped the scales in favor of the preferred outcome: removing the four Klamath Dams and implementing the other provisions of the Agreements. This talk will discuss the range of ecosystem service values that were evaluated, the controversial nature of the benefit-cost analysis, and the underlying politics and historical context surrounding the Agreements.

Coastal and marine spatial planning in North America: case studies and data needs (SS02) Room 3: Isla San José

Wednesday, March 22 (10:30 a.m. to 12:00 p.m.) - Room 3: Isla San José

Primary Contact: Rosemary Kosaka, NOAA Fisheries Service, rosemary.kosaka@noaa.gov

Session Description:

Coastal and marine spatial planning (MSP) can be used to better understand and coordinate the many activities occurring on and in the ocean environment. From data collection activities that provide information, such as public preferences related to protected areas, to acknowledging areas where activities are in conflict, MSP seeks to better understand and evaluate the diversity of ocean activities and uses. This session will provide case studies from North America that highlight information that may be useful for informing coastal and marine spatial planning processes, and analyses used to evaluate the extent and magnitude of conflicting use types. The session will begin with a brief overview of coastal and marine spatial planning policies in the U.S. with examples from regional MSP ocean plans. A talk about Washington State's experience with MSP, highlighting

challenges and data needs, will follow. A third talk will discuss large marine protected area values off of the U.S. west coast and how this information may inform a MSP process. The final one or two presentations will present case studies from Mexico and/or Canada. We anticipate this session to generate discussion about the data and analyses, particularly focused on social science data and analyses, that may best support effective marine spatial planning in the U.S. and abroad.

SS164

Coastal and Marine Spatial Planning efforts in the United States and beyond: an introduction to this special session

Rosemary Kosaka (rosemary.kosaka@noaa.gov)
NOAA Fisheries Service, United States

This talk will introduce this special session on coastal and marine spatial planning (MSP). An overview of how MSP is interpreted and implemented in the United States at different geographic scales will be discussed. An emphasis on data and research needs will be given as well as context for the five case studies in this session. These case studies vary in spatial scale from region-wide (i.e., Marine Protected Area values relative to size and use types; the effect of salmon closures on fishing behavior), to the state level (i.e., lessons learned from Washington's ongoing MSP process; evaluating species abundance in and around California's network of MPAs), and to the community level (i.e., measuring and mitigating tourism impacts on sea lions in La Paz, Mexico). One goal of this session was to assemble researchers and practitioners with a range of expertise in disciplines from resource economics, fisheries and marine mammal biology, and coastal and marine policy. These experts will share examples of their research and/or management experiences from the West Coast of the United States and Baja California Sur, Mexico towards identifying and providing MSP-relevant data and analytical products.

SS156

Using choice models to inform marine spatial planning: A case study of marine protected area design off the U.S. west coast

Kristy Wallmo (kristy.wallmo@noaa.gov)
NOAA Fisheries Service, United States

Marine spatial planning (MSP) is a process that planners can use to make decisions about different, sometimes conflicting, ocean uses. The process is intended to be participatory and to facilitate the sharing of information about multiple uses of the marine environment. In the U.S. an important component of MSP is the development of marine plans for nine coastal and marine regions, including the Northeast, Mid-Atlantic, South Atlantic, Great Lakes, Caribbean, Gulf of Mexico, West Coast, Pacific Islands, and Alaska/Arctic. Plans are developed by and for each region, and provide "information about specific issues, resources, or areas of interest to better inform existing [or future] management measures." This paper contributes to the information needs of MSP on the West Coast by examining public preferences for different marine protected area (MPA) designs sited in West Coast federal waters. Using data from over 3,000 randomly selected households in California, Oregon, and Washington we estimate choice models and calculate economic values (willingness-to-pay) for a suite of different size-use MPA configurations. Our results show that designating ~15.6% of west coast Federal waters as a mixed-use MPA yields the highest economic value. Results also underscore the significance of the use regime allowed within MPA boundaries,

demonstrating considerably different threshold sizes above which diminishing returns and negative economic values are derived from no-access, no-take, and limited use MPAs. Our results should be useful for MSP planners desiring stakeholder input on marine conservation and managing the multiple uses of the open ocean.

SS135

Model of Fishery Participation and Location Choice for the West Coast Salmon Fishery

Smit Vasquez Caballero (vasquesm@oregonstate.edu)
Oregon State University, United States

A behavioral study on fishery participation and fishing location choice for the West Coast Salmon fishermen was undertaken to determine the effect of salmon fishery closures on the distribution of fishermen across alternative fisheries and fishing locations. A dataset describing fishing trips from West Coast salmon vessels from 2005 to 2014 was used in a Random Utility Model that estimated both fishery choice and fishing location jointly. The empirical model used expected revenues for different fishing alternatives and individual vessel's past behavior to predict fishery and fishing location choices. The results support fisheries economics literature that fishery participation and location choice are associated with expected revenue, past behavior, and spatial and temporal closures. Our work suggests that caution must be exercised when modeling fishermen location choice in isolation. Ignoring the multi-species aspect of fisheries may lead to both poor characterization of fishing behavior and poor prediction of the effect of spatial management policies.

SS051

How biological data has contributing to management plans in the bay of La Paz: Los Islotes sea lion rookery as case of study

Vanessa Labrada Martagón (vlabrada@gmail.com)
Facultad de Ciencias, Universidad Autónoma de San Luis Potosí, Mexico

Los Islotes is the southernmost breeding site of the California sea lion (Zalophus californianus) in Northern Hemisphere and represents one of the most important economic activities for the city of La Paz, Mexico. The increasing tourism activity grew without any control until researchers and organizations started to be concerned about the perturbation to the reproductive and haul-out patterns of the sea lion. The International Conservation Program of The Nature Conservancy funded a research project, with the goal to determine the effect of tourism activities on the behavior of sea lions, in order to help design regulations to assure better use and conservation of the site. The nature and intensity of tourism activity and the effects to the sea lion behavior were determined based upon monthly sampling over a one-year period (May 2000-April 2001). The main result was that perturbations occurred mostly in autumn and winter coinciding with the highest frequency of tourism, large number of male sea lions, increasing suckling behavior of pups, and unfavorable environmental conditions for haul-out, such as high tide level and strong winds. Researchers, service tourism providers, and governmental personnel collaborated and participated in workshops organized by the regional office, CONANP-SEMARNAT, in order to develop a regulation plan with a buoy system and zoning specifications for tourism activities. Some of the former management strategies are in current force in conservation management plans in the area. Current needs for

conservation physiology studies relative to changes in tourism and fishing activities will also be discussed.

SS169

Data and information needs for effective coastal and marine spatial planning: a Washington State case study

Corey Niles (corey.niles@dfw.wa.gov)
Washington Department of Fish and Wildlife, United States

Washington State is currently developing a marine spatial plan for its outer coast under a mandate from its Legislature. One key mandate for the plan involves mapping areas that have "high potential for renewable energy production with minimal potential for conflicts with existing uses and sensitive environments." Fisheries are a major focus with the Legislature mandating that the plan "minimize the negative impacts" on commercial and recreational fishing. The plan will apply directly to state waters and also seek to influence the siting of projects in federal waters through the Coastal Zone Management Act and linkages to federal marine spatial planning efforts. The prospect of renewable energy projects in the ocean has been controversial. Washington's coast is not heavily populated but no area of the ocean clearly shows "minimal potential for conflict. The northern coast is home to Native American tribes who hold treaty rights to fish in the ocean, a national marine sanctuary, a national park, and hundreds of offshore rocks and reefs managed as national wildlife refuges. The southern coast is the center of the Dungeness Crab fishery, the most important commercial fishery for the coast's fishing communities. Planning has been ongoing for a number of years with the plan now scheduled for completion in 2017. This talk will reflect on the Washington Department of Fish and Wildlife's experience with the process and will discuss how the innovations sought by marine spatial planning and ecosystem-based management have played out so far.

Cost–Earnings Data Collection, Analysis, and Evaluation of Catch Share Performance (SS03) Room 4: Steinbecks

Wednesday, March 22 (10:30 a.m. to 12:00 p.m.) - Room 4: Steinbecks

Primary Contact: Minling Pan, NOAA Fisheries, Pacific Islands Fisheries Science Center, minling.pan@noaa.gov

Session Description:

In many fisheries, efforts are made to build long term and systematic economic data collection programs (including periodical and continuous programs) to provide rich, time series data for research and management. Economic data are paramount in fisheries management because they give fisheries managers the ability to accurately assess the economic health of fisheries, to estimate economic impacts of fisheries, and to evaluate economic effects of fishery management decisions including catch share programs. Both revenue and cost data are needed to measure economic

performance and track trends in performance indicators, such as profits, returns, productivity, and economic efficiency. This special session at NAAFE 2017 intends to provide a platform for fisheries economists and managers to present their latest research on these topics, share ideas, and develop collaborative projects. These exchanges will inform development of catch share program reviews mandated by the Magnuson-Stevens Fishery Conservation and Management Act.

SS096
Quota Net Revenue in the West Coast Groundfish Trawl Catch Share Program

Erin Steiner (erin.steiner@noaa.gov)
NOAA fisheries, Northwest Fisheries Science Center, United States

Estimates of net benefits are an essential metric for measuring the effects of catch share programs. Costs and earnings associated with quota transactions are excluded from these calculations because they are considered net transfers. However, from the perspective of vessel operators and fishery managers, cash flow measures, including quota earnings and costs, are important for evaluating the effects of catch share programs on individual participants. Cash-flow analysis at the individual level provides important information about distributional impacts, including geographic distributions as well as distribution of quota payments between quota owners with and without active vessels. To accurately calculate a cash flow measure, data about quota transactions, quota ownership structures, as well as the cost earnings data are required. Using five years of data from U.S. West Coast Groundfish Trawl Catch Share Program, we find that even in a data rich fishery, conducting this calculation is a complex process, requiring intricate knowledge of individual operations. We present lessons learned from designing catch share data collection programs, calculating cash flow measures, and techniques for communicating findings to fishery participants and fishery managers.

SS147
Data collection and measurement in the Northeast US

Barbara Rountree (barbara.rountree@noaa.gov)
NOAA fisheries, United States

"The Resource Evaluation and Assessment Division's Social Sciences Branch (SSB) in the NOAA Northeast region is preparing for an external review in 2017 to evaluate its programs alignment between the strategic objectives of SSB, NEFSC, NMFS, and NOAA. In previous SSB and NEFSC wide reviews, much attention has been drawn to the data and data architecture used by the Branch. It is anticipated that one major focus of the 2017 review is to examine the potential that SSB could better meet its objectives if reorganized into management, research, and data groups instead of its current undivided structure. To obtain a preliminary idea of how such an organizational change might affect SSB activities from the data perspective, we examine how data currently flows through the branch and its eventual impact upon future management decisions. Using the catch share management program as an example, we examine the data requirements necessary to monitor the economic effects through the creation of performance indicators. In addition, thought is given to the configuration and design of our long-term data collection program."

SS022
Catch Quotas for the Pacific Hake Fishery in the Gulf of California

Mauricio Ramirez-Rodriguez (mramirr@ipn.mx)
CICIMAR-IPN, Mexico

Fishing for Pacific Hake Merluccius productus in the Gulf of California is carried out by shrimp trawlers. When the shrimp fishing season ends, these boats shift to catching Pacific Hake and other finfish. The Pacific Hake fishery is relatively new and has the potential to grow as an industry. Therefore, there is interest in defining management plans to create a sustainable fishery. One option is an individual vessel quota system. This paper estimates the pervessel quota in the Pacific Hake fishery that achieves a break-even operation and estimates the number of vessels that could enter the fishery to avoid overexploitation and overcapacity. Potential per-vessel quotas were estimated based on the cash flow of a representative trawler and the estimate of total Pacific Hake biomass. The results indicate that individual catch quotas for Pacific Hake should be 90.4 or 100 tons to achieve a 30% or 45% increase, 15 respectively, in net cash. Additionally, with total allowable catch values equivalent to 25% of the available biomass, the corresponding fleet size would be 74, 82, or 103 vessels based on different scenarios. Because the Pacific Hake fishery is under development, these approximations can be used during the planning stage to meet resource conservation and right-of-use standards.

SS071
Commercial Fishing Business Cost Data Collection in the Northeastern US Region: Changes and Challenges

Tammy Murphy (Tammy.Murphy@noaa.gov)
NOAA Fisheries, United States

"Information on the total costs associated with commercial fishing is essential to quantitative estimation of fisheries performance measures that indicate the fleet's economic health over time as biological, management and cost conditions change. NOAA's Northeast Fisheries Science Center (NEFSC) collects fixed and labor costs on a periodic basis through voluntary participation in its cost survey. In the Northeastern US, there are no federal fisheries with mandatory fixed and labor cost reporting; data collection efforts must weigh the need to collect these costs routinely with the cost of the data collection and vessel owner survey fatigue. The NEFSC has implemented several rounds of cost data collection (most recently for 2011, 2012 and 2015) to estimate the total costs of commercial fishing and profitability for various segments of the Northeast fleet. The NEFSC modified its data collection methodology in its most recent survey (for 2015). Modifications include changes in the survey instrument and sampling design to address well-established cost collection and estimation challenges (e.g., cost allocation across trips, missing values for aggregate variables, and multiple vessel owners). The 2015 cost survey sampled commercial fishing businesses (rather than fishing vessels, as in prior rounds). Additional outreach and data collection efforts were undertaken in several Northeast ports to supplement the survey modes previously used (mail and Internet). While the objective of these changes was to address known cost data collection and estimation issues, we recognize and will discuss how these changes may create new challenges or twists on well-established ones.

Wednesday, March 22 (1:00 p.m. to 2:50 p.m.) - Room 4: Steinbecks

SS093

Evaluating the Economic Benefits of Catch Share Management in the Northern Gulf of Mexico Reef Fish Fishery: Preliminary Results

Christopher Liese (christopher.liese@noaa.gov)
NOAA Fisheries, Southeast Fisheries Science Center, United States

It has long been argued that the Gulf of Mexico commercial reef fish fishery would benefit economically by being managed by "a system of tradable harvest permits" (Weninger and Waters 2003; Waters 2001). Between 2007 and 2010, all the major species in this fishery were transitioned into catch share management, effectively creating tradable permits. We now have enough economic data to explicitly calculate the economic benefits created by moving to catch share management. This study uses cleaned trip- and vessel-level revenue and cost data---from before and after the introduction of catch share management for the various species---to estimate the increased profitability due to catch share management. Conceptually, the increased profitability should correspond to "resource rent."

SS013

The Markets for Quota Share Allocations for the Gulf of Mexico IFQ Programs and Their Implications for Fishing Effort and Entry-Exit Decisions

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SEFSC/NOAA, United States

We investigate the dynamics of the price adjustment process for quota shares, quota allocations, and catch price for red snapper and grouper individual fishing quota (IFQ) programs, since their introduction in 2007 (red snapper) and 2010 (grouper and tilefish). Prices affect decisions, such as what species to target, the length and number of fishing trips, as well as the decision to enter or exit a market. Basic economic logic leads us to expect that the price for allocations, which are tradable, will be bid up, bringing down operating margins. This, in turn, would reduce overcapacity, as less efficient vessels exit the industry because their owners find it more profitable to sell or lease their rights to more cost-efficient producers. The response to the new policy has not been instantaneous, however, and the aim of this research is to understand why the structural change in active fleet composition is still an on-going process eight and five years after the introduction of the IFQ programs and what potential policy implications might be.

SS122

Triangulation: A Tale of Three Quota Price Signals in the Northeast US Groundfish Fishery

Chad Demarest (chad.demarest@gmail.com)
NOAA Fisheries - Northeast Fisheries Science Center, United States

The Northeast US groundfish fishery adopted a catch share-based system in 2010 that melded aspects of cooperative-based systems with an ITQ for individual stocks in a multi-species complex. More than 15 cooperatives, called "sectors," signed up for the program, and sector-affiliated vessels have landed over 95% of the region's groundfish since program inception. Potential quota shares are assigned to individual vessel owners, but are only convertable into landed fish once an owner joins a sector. Quota from all owners is pooled within the sector and, in theory, fished collectively. Official quota transfers occur between sectors and are not traceable to individual owners or permits. Quantity and price data are recorded in real time, facilitating price analysis for the inter-sector quota market. Nearly all sectors allocate pooled quota allocations in propotion to the potential quota shares individual owners brought to their sectors. Preferences and individual utility allow a vibrant internal quota leasing market. Sectors have voluntarily agreed to provide quantity and price information for these internal leases by filing end-of-year reports with transaction-level data. These reports facilitate price analysis of the intra-sector quota market. Finally, an informal, email-based mechanism for advertising inter-sector quota trades has emerged over the years. These emails have been collected since early 2013 and, wherever possible, the data contained in the emails has been electronically scraped into a third dataset of advertised prices, allowing a comparison between bid, ask and realized prices in the inter-sector market. The combination of all three signals provides insight into this unusual market.

SS058
Cost-Earnings Survey of Hawaii Small Boat Fishery

Hing Ling Chan (hingling.chan@noaa.gov)
Pacific Islands Fisheries Science Center, United States

The Pacific Islands Fisheries Science Center (PIFSC) conducted a cost-earnings survey for the Hawaii small boat fishery in 2014. This study examines the economic and social characteristics of the Hawaii small boat fishery and presents a wide range of information to further our understanding of the fishery. A mixed mail and online methodology was used and a total of 1,796 fishermen that held a State of Hawaii commercial marine license (CML) and reported fish sales in the past 12 months were invited to participate in the survey and 824 surveys (47%) were returned. A primary goal of this study was to update our understanding on the fishing trip costs and fixed costs investment in the fishery. Results from this survey also build upon past efforts in describing the diversity of fisher motivations and how they relate to behavior in the small boat fishery. Fishermen were asked to self-identify themselves and motivations varied widely with 7% identifying as full-time commercial fishermen, 51% identified as part-time commercial fishermen, 27% as recreational expense fishermen, and 11% as purely recreational. Fish catch distribution varied as well, with significant portions of catch retained for home consumption and customary exchange, even for more commercially-motivated fishermen. These findings support past research findings that emphasize the vital social role small boat commercial fishermen play in local communities. In addition, this study provides estimations on the amount of fish sold by different fishermen types; thus, allows to compare fish sale behaviors between commercially-motivated and non-commercially-motivated fishermen.

The Fishery Performance Indicators – Value for Fisheries (SS04) Room 2: Isla Coronado

Wednesday, March 22 (1:00 p.m. to 2:50 p.m.) - Room 2: Isla Coronado

Primary Contact: James Anderson, Univ. of Florida, Inst. for Sustainable Food Systems, james.anderson@ufl.edu

All Authors: James Anderson, Univ. of Florida, Inst. for Sustainable Food Systems (Primary Presenter)

Session Description:

The Fishery Performance Indicators (FPIs) is a newly developed tool designed to assess the performance of fishery systems in achieving environmental, economic and social outcomes and for linking fishery outcomes to enabling conditions and management approaches. The evaluation tool was designed to facilitate assessment that is cost-effective, accurate and applicable in data poor and data rich fisheries systems. Research using the FPIs ranges from specific case study applications to broad analysis of management systems including both harvest and post-harvest sectors. The FPIs have been used to measure fishery system performance, evaluate the impacts of investments, and identify general trends leading to fishery management systems' success or failure.

The goal of this proposed session is to reflect on lessons learned from existing FPI studies and to understand how FPIs could better provide decision-making support for management and investment decisions.

First Part: Introduction to the FPIs and Insights for Management

Paper 1.1: Background and Status of the FPIs - J.L. Anderson, U Florida & C.M. Anderson, U Washington

Paper 1.2: Insights for Fisheries Management - J.L. Anderson, U Florida & C.M. Anderson, U Washington & Frank Asche, U Florida

Discussion: Audience

Second Section: New Applications - Impact Investing and Recreational Fisheries

Paper 2.1: Investment impact evaluation – Jingjie Chu, World Bank and Taryn Garlock, U Florida

Paper 2.2: Recreational fisheries - Taryn Garlock, JL Anderson, Frank Asche, U Florida & CM Anderson, U Washington

Discussion: Audience

SS160
Developing Performance Indicators for Recreational Fisheries

James Anderson (james.anderson@ufl.edu)
Univ. of Florida, Inst. for Sustainable Food Systems, United States

The Fishery Performance Indicators (FPIs) have been successfully applied to commercial fisheries around the globe and have uncovered key insights into fishery management success. We developed an extension of the FPIs to consider performance of recreational fisheries. The Sport FPIs were developed through multiple iterations of consulting, piloting and revision with fisheries experts. The indicators were tested on three case study fisheries: Florida tarpon, Florida bay scallops and Florida spiny lobster. These case studies and the authors' experiences led to further revision of the instrument. The structure of the Sport FPIs relies heavily on the original FPI framework due to its success in addressing the lack of standardized, precise fishery data. Some aspects of commercial fisheries are analogous to recreational fisheries and commercial indicators required only minor revision to effectively measure recreational performance. To capture other aspects of recreational fisheries required development of new indicators. Thirty-two new output indicators and 33 new input indicators were developed to capture recreational fishery success and to explain outcomes. New indicators were designed to capture the social utility and the impact of recreational fishing expenditures on the local community. New input indicators were developed including indicators characterized by angler motivations and common recreational management strategies such as fish stocking, habitat enhancement, bag limits, among others. Insights and value of this new tool will be discussed.

SS161
Impact Evaluation of a Fisheries Development Project

Frank Asche (Frank.Asche@ufl.edu)
University of Florida, United States

A number of fisheries development projects are undertaken every year in recognition of the important role fisheries play in many coastal communities. The objectives and emphasis varies, but typically goes beyond a limited focus on fisheries management and the ecosystem to include essential economic and social impacts. This makes it difficult to evaluate the impact of a project in any environment, and it is particularly challenging in the data poor circumstances in many developing countries. In this paper we will use the recently developed Fisheries Performance Indicators (FPI) to investigate the impact of a World Bank development project in Liberia, as the FPIs are designed to capture most dimensions of a fisheries system and are applicable in data poor environments. It was relatively straightforward to collect the FPI indicators when the project was started and completed. The results show improvements in most dimensions emphasized in the project, and also in many hard to measure social dimensions. Hence, one can conclude that the project was highly successful. However, there were also important indicators, particularly in relation to general governance, with a negative development.

SS162
The Fishery Performance Indicators: Evaluating Fishery Management Systems

James Anderson (james.anderson@ufl.edu)
Univ. of Florida, Inst. for Sustainable Food Systems, United States

The sustainability of fish stocks, fishery-derived income and well-being of dependent communities are interrelated and sustainable socio-ecological systems require an understanding of all three. A newly developed evaluation tool addressing these three important facets of fishery systems is the Fishery Performance Indicators (FPIs). The FPIs were designed to associate fishery outcomes relating to sustainability, economics and the fishing community to enabling conditions and management approaches. This tool provides helpful insight to policy reform while also being applicable to data poor situations including data-poor fisheries such as those in developing countries and data-poor sectors such as the post-harvest sector. One hundred twelve fishery systems from around the globe have been assessed. Preliminary results suggest ecologically successful fishery systems tend to be correlated with economic success, indicating that conservation and economic objectives reinforce one another and suggests the potential for healthy fish stocks to support high levels of economic performance if appropriately managed. Access rights and harvest rights contributed positively to ecological and economic success, and to a weaker extent, community success. Analysis on the strength of the rights including measures of transferability, durability, flexibility and exclusivity indicates a positive correlation with ecological and economic success. The exclusivity of harvest rights was incrementally more important than other measures of strength in achieving ecological success. These results provide valuable insight for effective design and reform of rights-based programs.

SS166
Fishery Performance Indicators for Global Tuna Fisheries

Chris Anderson (cmand@uw.edu)
University of Washington, United States

We apply the Fishery Performance Indicators (FPIs) to the 21 major tuna fisheries managed by the five regional tuna Regional Fishery Management Organizations (FPIs). We compare outcomes and enabling conditions by product market (canned, sashimi or local), by industrial scale of fishing, and by the managing RFMO, and compare outcomes to similar non-tuna fisheries in the FPI database. Comparisons suggest that, in the harvest sector, tuna fisheries are much like other fisheries with similar levels of capital, but tuna fleets targeting international markets outperform other fisheries in the post-harvest sector. Differences in performance by RFMO are driven primarily by the composition of species they manage, and their ability to connect their potentially highest-value products to international markets. This comparative advantage of the tuna post-harvest sector has implications for designing agreements that share the benefits of tuna fishing among harvesters, processors and the coastal states in whose waters fishing takes place.

Distribution and ITQs (SS06) Room 1: Isla Navidad

Thursday, March 23 (1:00 p.m. to 2:30 p.m) - Room 1: Isla Navidad

SS168
Empirical Evidence on the Role of Distribution in Determining Level of Policy Support

Sara Sutherland (sara.sutherland@usu.edu)
Utah State University, United States

When evaluating potential government interventions economists often consider whether a proposed policy is efficient. However, changes in policy can also result in changes in wealth. When politically influential individuals or groups see losses, efficient policies can become politically infeasible even if they increase wealth in aggregate. This paper examines political support for individual transferrable quotas (ITQs), which transition a fishery from a derby setting, where fishers race to catch a total quota, to the assignment of quota shares to each individual. The initial assignment of quota, often via grandfathering, can result in a redistribution of wealth from fishers who do well in a derby to those who receive quota. To test whether distributional concerns drive opposition, I examine over 3,000 political participation records, in the form of public testimony and written letters, from the transition of the Alaska sablefish and halibut fisheries to ITQ management. I link the stated political position of each fisher to their historic catch and then construct measures of expected catch under status quo and catch share regimes. I find that opposition is increasing in the difference between status quo and ITQ catch. For instance, a fisher who missed one of the years from which historic catch is calculated, leading to a lower quota allocation, is around 20% more likely to oppose ITQs. After nearly five years of deliberation, the ITQ policy was modified to address distributional concerns and include provisions allowing fishers to drop their lowest year of participation, leading to final approval in 1992.

SS163
Price Discovery in Newly Created Markets

Corbett Grainger (corbett.grainger@wisc.edu)
University of Wisconsin – Madison, United States

One of the main concerns surrounding the transition to individual transferable quota (ITQs) is that it could have adverse distributional consequences. Some fisheries, such as the West Coast Groundfish fishery, have implemented moratoria on permanent transfers due to a concern that large-scale firms could take advantage of smaller-scale by not paying a "fair" price for ITQ shares. We study the evolution of prices in a newly-created ITQ system. Our analytical model suggests that there could be adverse distributional consequences if small-scale fishers have less information regarding the potential decreases in marginal extraction costs for others in the fishery. Using detailed data on trades from New Zealand, we describe the evolution of prices for newly-created ITQ assets, and we test for evidence of adverse distributional consequences.

SS165
Fishery Federalism under Climate Change

Christopher Costello (costello@bren.ucsb.edu)
University of California Santa Barbara, United States

Recent scientific data suggest that climate change will have dramatic and lasting effects on the world's oceans. Perhaps the most significant effect on wild ocean fisheries is through the movement of stocks. While effects surely differ across species, the general scientific conclusion is that stocks will shift poleward, sometimes by hundreds or thousands of miles. This scientific insight interacts in an interesting way with economic institutions. As stocks cross into new jurisdictions, it raises the prospect of the "old" jurisdiction overharvesting in anticipation of the stock migration, whereas the "new" jurisdiction would like to inherit a robust stock. It also raises the possibility of designing property right institutions to address this challenge. In this paper, we examine the efficiency and distributional effects of alternative property right approaches to deal with shifting fish stocks. While the theory is motivated by climate change, a similar set of dynamics occurs for small-scale TURF fisheries, and other settings. One basic insight is that if institutions fail to extend across jurisdictions, the shifting stock problem can induce a commons problem just as severe as open access, even if property rights are perfectly secure within all jurisdictions. Alternative designs of property rights can have vastly different distributional effects, even if overall efficiency is the same.

SS143
Consolidation in Alaskan Ports after the Introduction of Fishing Property Rights

Eric Edwards (eric.edwards@usu.edu)
Utah State University, United States

ITQs increase fishery efficiency, but have been criticized for redistributing income away from small communities and increasing concentration in production. We empirically examine these effects in the 1995 adoption of ITQs in the Alaskan halibut and sablefish fisheries. Fishing ports generally do not lose harvesting or processing revenue, but both processors and vessel owners consolidate, and fewer fish are delivered to the home port of the fisher. Small coastal cities see a reduced number of vessel owners and may experience overall population declines. Written and oral testimony suggests pre-adoption opposition may be increased when community residents foresee these changes.

Applying Economic Analysis within the Council Process (SS7), Room 4: Steinbecks

Thursday, March 23 (1:00 p.m. to 2:30 p.m.) - Steinbecks

Economics of Protected Marine Species (SS8), Room 4: Steinbecks

Thursday, March 23 (10:00 a.m. to 11:50 a.m.) - Steinbecks

SS149

Least-Cost Bycatch Reduction Through the Biodiversity Mitigation Hierarchy

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NOAA, Southwest Fisheries Science Center, United States

The Biodiversity Impact Mitigation (BIM) hierarchy provides an overarching conservation framework for bycatch reduction, and more broadly for biodiversity conservation. This framework includes four steps, which are implemented sequentially to: (i) avoid and (ii) minimize impacts; (iii) rehabilitate/restore impacted biodiversity; and (iv), compensate such impacts, usually elsewhere. The first three steps are supposed to be implemented in that order to re-establish the biodiversity component to its pre-disturbance baseline or any other agreed upon "healthy state". If this is not achieved despite having exhausted all possible conservatory efforts, a residual impact remains. Strict, application of the biodiversity impact mitigation through sequentially implementing each step will not generally give the most "bang for the conservation buck" and hence not allow as much conservation for a given budget as a more economically efficient (i.e., least cost) approach to achieving the same target. An economically efficient approach could use a combination of "avoid, minimize, restore, compensate", but that combination would not necessarily (or generally) be the combination that sequentially pushes each of these approaches ("steps") to its maximum limit. It would not be based on a strategy to first "avoid as much as possible" but rather on a strategy that would "avoid up to the point where the marginal benefit of further avoidance is equal to the marginal cost of further avoidance", or, more specifically for cost-minimization, "avoid up to the point where the marginal cost of additional contributions to the stock through avoidance is equal to the marginal cost of additional contributions.

SS043

The value of eco-labels: Revealed consumer preferences for seafood in San Diego County

Oriana Poindexter (oriana.poindexter@noaa.gov)
NOAA, Southwest Fisheries Science Center, United States

Seafood markets are the inflection point in the fish-to-food transformation, and act as windows into revealed consumer preferences for seafood selection. These preferences have far-reaching implications for fisheries management, food security, and marine conservation. This study reveals consumer preferences for seafood in San Diego County by quantifying the relationship between the prices of seafood products, trophic level, and eco-labeling using data collected from a random selection of markets over the course of a year across San Diego County. The prices of seafood products reflect supply and consumer preferences in demand. Hedonic analysis shows price per unit weight increases with trophic level of the seafood species. The economic effect of third-party eco-labeling (Marine Stewardship Council, Monterey Bay Aquarium Seafood Watch, Best Aquaculture Practices, etc.), and keyword labeling (the use of keywords such as 'local', 'sustainable', and 'responsible') are also analyzed. The discussion considers the implications of revealed consumer preference for high trophic level seafood species, externalities inherent in seafood

production, and opportunities for harnessing consumers as assets in the shift towards a more holistic approach to seafood consumption.

SS083

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

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Centro de Investigaciones Biológicas del Noroeste, S.C. Mexico

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 is banned since 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. 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 introduction of economic behavior in the model, 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 at lower f; however, this gear is not recommended because it is highly predatory for other protected species. Different scenario modelling showed that regulation delay has a negative impact on net present value.

SS067

Assessing effectiveness of management measures to protect North Atlantic Right Whales

Kathryn Bisack (kathryn.bisack@noaa.gov)
NOAA, Northeast Fisheries Science Center, United States

With the goal of identifying more effective policy instruments for protected species, we identify key factors to consider when choosing an instrument. Management actions to recover the north Atlantic right whale (NARW), our case study, have been underway for several decades. Since the initial take reduction plan in 1997, bycatch reduction measures in the Atlantic gillnet and lobster fishery included a mix of technology standards (mandated gear requirements) and area based restrictions including Dynamic and Seasonal Area Management (DAM and SAM) which were implemented in 2002. In 2007 a broad-based gear modification rule replaced the DAM and the SAM and expanded the affected gillnet and trap/pot fisheries. Economic impacts of these measures are not trivial. For example, the initial analysis for the DAM and gear removal in 2001 suggested an annual cost of approximately $6.9M to the lobster and gillnet fishery (2007$). The estimated annualized replacement cost for the selected broad-based gear alternative was $13.4M (2007). Despite these measures as well as others to reduce ship strikes, recent evidence suggests the NARW population is not increasing. To complicate matters, disentangling the effectiveness of these measures from environmental changes is uncertain. Using a multiple criterion framework including biological, economic, social normative and longevity factors (Bisack and Magnusson,

2016), we develop a report card to examine key factors related to the shift to the 2007 broad based gear approach.

SS133

Emerging Issues in Marine Protected Resources Management: A role for economics

Robby Fonner (robby.fonner@noaa.gov)
NOAA Fisheries, United States

A comprehensive economics gap analysis of protected resources (PR) management is underway for the West Coast Region as recommended by NOAA's PR economics working group in 2014. The results from the ongoing gap analysis are presented and their implications for the role of economics in marine PR management and recovery are discussed. Emerging challenges and opportunities associated with PR management in NOAA's West Coast Region are identified and the capacity of economic analysis to address these issues is examined. Finally, the applicability of the West Coast gap analysis findings to other contexts is assessed to inform ongoing PR economic gap analyses in in other regions.

Designing rights-based management systems to achieve social objectives in fisheries (SS9), Room 1: Isla Navidad

Friday, March 24 (8:30 a.m. to 10:30 a.m.) - Room 1: Isla Navidad

Primary Contact: José A. Fraire-Cervantes, Environmental Defense Fund, jfraire@edf.org

Session Description:

This session will explore the alternative ways RBM can be designed to achieve social goals. Though presentation of different cases and studies the session will highlight areas of flexibility and adaptability within RBM systems to meet different contexts and fishery goals and emphasize the innovative techniques which can be implemented under an RBM system to achieve these goals. In particular, panelists will be asked to discuss how RBM approaches can simultaneously improve conservation, while meeting social goals. Particular social goals may include: preservation of traditional fishing, applications to fisheries with subsistence or food-security goals, applying RBM to small-scale fisheries, and methods for fostering new entry.

The session will provide ample opportunity for panelists to discuss strategies to meet fishery´s dual goals and lessons learned from design and implementation of RBM in the field. Session organizers will determine a set of questions for the presenters to highlight the similarities and contrasts amongst the experiences and tools presented, and then lead an open Q&A session.

SS011

Some distributional consequences of collective rights in artisanal fisheries.

Jorge Dresdner Cid (jdresdne@udec.cl)
Universidad de Concepción, Chile

This paper analyzes the distributional consequences of re-distributing quota between different artisanal fisher groups (from large vessel to small vessel owner) when management is based on a collective rights system. We develop a basic model to analyze optimal decisions with a collective fishing rights system. With this model as a conceptual framework, using a Theil index as a distributive measure, and employing optimization techniques we calculate assignment and distribution rules within the organization: centralized efficient quota assigment, decentralized quota assignment with and without transferability, individual quotas, and initial allocation based on historical assignments (with no transferability). The model is based on the common sardine and anchovies artisanal fisheries of central – southern Chile and it is used to analyze an actual experience of quota re-distribution between artisanal fishers. The analysis of the results allows discussing and comparing the equity implications of these different assignment and distributional rules.

SS019

The New Fisheries Catch Shares Program in Argentina: Balancing Efficiency and Equity Objectives in Rights-Based Management Systems

Stephanie Stefanski (stephanie.stefanski@duke.edu)
Duke University, United States

While rights-based management is generally purported enhance economic efficiency in fisheries and reduce over-capitalization, the social and economic outcomes due to this regulatory regime are less comprehensively understood. Relatively recently, industrialized and export-oriented Latin American fisheries began adopting individual transferable quota (ITQ) regimes to recover collapsed fish stocks. While these programs tend to follow standard, Western approaches to ITQ design and implementation, Argentina experimented with a new design model by interjecting social and ecological objectives into ITQ design through the creation of Artisanal and Social Quota reserves and through determining initial allocation based on historical vessel landings, employment, at-sea and on-land production, investment, historical landings across species, and record of fishery violations. In 2010, Argentina established ITQs for four commercially important and export-oriented fisheries: Argentine hake (Merluccius hubbsi), Patagonian grenadier (Macruronus magellanicus), Patagonian toothfish (Dissostichus eleginoides), and southern blue whiting (Micromesistius australis). The first part of this study, to be presented, is a comprehensive institutional analysis of the ITQ fishery management program in Argentina to preliminarily evaluate how configurations of rights-based managed influence social, economic, and ecological outcomes in regulated fisheries. This paper analyzes legislative documents and government data on program design, vessel landings, and participation in the ITQ program from 2000-2016, to evaluate how program design, specifically initial allocation and trading restrictions, potentially influences fishery outcomes. The results of this study are broadly applicable to understanding how the design of rights-based management regimes influence compliance behavior, social equity, and economic efficiency outcomes in developing country fisheries.

SS136

Fish or Flight: Household Survey Evidence of the Impact of Transferable Permits on the Migration Decisions of Rural Alaskan Salmon Harvesters

Jennifer Meredith (jenmer8@uw.edu)
University of Washington, United States

This research incorporates unique household survey data and a discrete shift in fisheries management into a model of migration in order to analyze the drivers of outmigration in rural Alaskan communities that traditionally depend on fisheries for income. Although there is evidence that a transition to rights-based management decreases the degree of local participation in fisheries as rural residents sell their allocations to outsiders with higher capital endowments, little is known about how these large lump-sum payments affect migration and assets. The implementation of a limited entry permit system in the Alaska salmon fishery allows us to examine how harvesters who reside in rural Alaskan communities respond to such allocations and to test whether these management shifts generate an outflow of migration, potentially undermining the resilience of small communities. A model of migration that integrates fluctuations in fishery returns and transactions within permit markets is tested using individual responses to a household survey conducted with randomly sampled respondents from 10 communities around Bristol Bay. Although the immediate impact of permit sales on migration appears to be negligible, there is evidence of intergenerational spillovers with descendants being less likely to reside in the region, participate in the fishery, and own durable assets.

SS097

Reducing Illegal Fishing Using Behavior Change Interventions: A case study in the Upper Gulf of California

Willow Battista (willowbe@gmail.com)
Environmental Defense Fund, United States

Illegal fishing is a serious problem that threatens the sustainability of fisheries around the world. Historically, fisheries managers have attempted to increase the costs of illegal fishing through imposition of stricter sanctions and improvements to monitoring and enforcement programs. Non-monetary factors also influence illegal fishing behaviors, and failing to address them can undermine the efficacy of an otherwise well-designed fishery management system. Furthermore, in many of the world's fisheries, strong and reliable monitoring and enforcement has proven to be an elusive goal. In such cases, interventions designed to address the social, moral, and cognitive drivers of illegal behavior can potentially supplement conventional deterrence methods. Building on insights from the behavioral sciences, we developed a process for designing interventions aimed at strengthening social incentives and psychological motivations for complying with fishery regulations. This process begins with an in-depth stakeholder characterization exercise. Potential interventions that may disrupt undesirable beliefs, norms, and modes of thinking, along with those that encourage behaviors that support the objectives of the fishery, are then developed. Experimental testing is conducted prior to piloting and, finally, scaling of the resulting intervention(s). We are currently applying this process in a catch share fishing community in the Upper Gulf of California, Mexico, where illegal fishing is a pervasive problem that jeopardizes the sustainability of the region's fisheries, as well as the wellbeing of the community members who depend on them. The results of this research can inform management design to more effectively meet the environmental and social objectives of the region.

SS102

Achieving social objectives through a community co-management entity

Merrick Burden (merrickburden@yahoo.com)
Environmental Defense Fund, United States

Catch share programs have been criticized for a variety of social impacts. These criticisms can be traced back to the manner in which certain catch share programs were designed; market-based approaches that transfer individual quota to where it is needed and most wanted. Markets tend to allocate resources to the place of highest value and this tendency is the underpinning reason for some of the social impacts that catch shares are criticized for causing. In response to these market-driven dynamics, we proposed the establishment of a new type of entity along the U.S. west coast that would be given certain market advantages if this entity was set up in a way that aimed to achieve specific social objectives. We proposed that these entities, which we called Community Fishing Associations (CFAs), would be allowed to hold quota in excess of quota accumulation limits, thus gaining certain advantages of scale. In order to receive these advantages, we envisioned a co-management relationship where these CFAs would be established to address certain social objectives for their local community, would be required to contain certain institutional factors to prevent abuse, and would be required to publicly report on activities. Along the U.S. west coast several of these entities have formed in spite of the lack of any formal policy guiding their establishment. The impact these entities are having on their local communities is mixed. To date, each entity has prioritized slightly different goals and they have used different approaches for goal attainment.

Friday, March 24 (11:00 a.m. to 12:30 p.m.) - Room 1: Isla Navidad

SS106

Securing women's rights and livelihoods through gender-responsive rights-based management

Jordan Williams (jowilliams@edf.org)
Environmental Defense Fund, United States

The UN Voluntary Guidelines for Securing Small-scale Fisheries, along with the Voluntary Guidelines for Responsible Governance of Tenure of Land, Fisheries, and Forests, recognize the role of secure tenure in ensuring the livelihoods, well-being, and basic human rights of small-scale fishing (SSF) communities. Rights-based management (RBM), which works to secure tenure rights, can therefore serve as a useful tool in upholding the rights of all SSF participants. Globally, women in SSF communities have increasingly been recognized for their contributions, not just as wives of fishermen, but as seafood processors, traders, retailers, and in some cases, fishers themselves. However, traditional societal rules and expectations have, in many cases, come to marginalize women, leaving them out of decision-making and limiting their access to resources. Recognizing and incorporating gender-specific roles and access needs can be built into the design process of RBM systems in order to secure women's tenure rights and meet social goals around food security, livelihoods, and protection of economic security and social welfare. Designing gender-responsive management strategies requires localized knowledge about the contributions and concerns of women throughout the value chain; this project identifies the role that women play in several SSF communities where the EDF is working to establish sustainable fisheries management through secure tenure. Utilizing this robust information, we can develop gender-responsive RBM strategies that not only support the economic and biological viability of fisheries, but aim to meet common

social goals within these communities and ensure equitable access to resources and representation, regardless of gender.

SS128

Strengthening small-scale fishing cooperatives through rights-based fisheries management: A case study from Yucatán, Mexico

Abigail Bennett (abby@abigailebennett.com)
Duke University, United States

Designating small-scale fishing cooperatives as key actors in rights-based fisheries management represents a viable strategy for reconciling biological conservation with social objectives. Cooperatives are democratically-controlled enterprises designed to pursue the common interests of their members. In small-scale fishing communities, cooperatives provide a way for fishers to pool resources and engage in collective action towards social objectives including obtaining higher prices for fishers, investing in infrastructure, providing loans to members, and a range of community benefits. However, many aspects of the contemporary political and economic context of small-scale fisheries present barriers to the success of fishing cooperatives, such as competition with private sector fish buyers and middlemen and fewer opportunities for government subsidies and loans. Providing fishing cooperatives with exclusive fishing rights can bolster the success of fishing cooperatives by generating a strong incentive for members to actively participate in cooperatives instead of work independently or for individual fish buyers. I present a case study of fishing cooperatives from Yucatán, Mexico that highlights multiple social benefits arising from cooperatives' participation in rights-based fisheries management. In Yucatán, exclusive 20-year fishing concessions for spiny lobster have underpinned the success of large, successful, and long-lasting fishing cooperatives. These cooperatives have, in turn, promoted important social and conservation outcomes in small-scale fishing communities. They serve as livelihood opportunities and social safety nets for fishing families and enhance the broader well-being of fishing communities. Furthermore, they have played an important role as stewards of fishery conservation for multiple species and encourage fishers' active participation in management.

SS130

Socio-economic analysis of the results of implementing a rights-based management system in a small-scale fishery in the Gulf of California: the gulf curvina

Rafael Ortiz-Rodríguez (rortiz@edf.org)
EDF, Mexico

Annual socio-economic surveys, pared with third-party landing monitoring data, have allowed a multi-year analysis of the economic impacts and perceptions of implementing an individual vessel quota rights-based management system in the gulf corvina (Cynoscion othonopterus) fishery. This fishery is targeted by four communities, including an indigenous one, in the Upper Gulf of California region shared by the states of Sonora and Baja California, and is one of the most highly regulated fisheries in Mexico, including gear and season limits, as well as a total allowable catch (TAC). In 2012, as a measure to better manage the overall TAC, action was begun by federal government, in partnership with state government, fishermen, processors, fishery scientists and NGOs to start a transition to a RBM system. Since then, significant changes have occurred. Here we present the measured economic changes in landing, ex-vessel prices, revenue, costs, profits and market share, and how they impacted fishermen, permit holders and local buyers. Surveys have also permitted

detailed analysis of community perceptions of these changes. These results are discussed in light of both fishery-specific management changes, as well as regional conservation challenges which have also impacted to fishery indirectly. This case highlights the potential of the approach followed – participation, science based decisions and partnerships - to improve the livelihood of small-scale fishermen, particularly those occurring in low governance contexts such as Mexico.

How climate change is shaping fisheries and fishing communities in the Polar region (SS10), Room 2: Isla Coronado

Friday, March 24, (8:30 a.m. to 10:30 a.m.) - Room 2: Isla Coronado

SS086
Marine food webs, environmental variability, and coastal state conflicts: A game theoretic analysis.
Nils-Arne Ekerhovd (nilsarne.ekerhovd@snf.no)
Norwegian School of Economics, Norway

The Northeast Atlantic sustains a number of pelagic fish stocks, the most important of which are Norwegian Spring Spawning (NSS) herring, Northeast Atlantic blue whiting and Northeast Atlantic mackerel. The stocks are located in Russian, Norwegian, Icelandic, Faroese and EU waters, but the large scale distribution pattern varies and is related to total stock sizes and water temperatures. All stocks are classified as straddling stocks in the sense that they not only cross boundaries between the EEZs of coastal states, but also traverse the high seas areas between those boundaries. The migratory patterns of these stocks have undoubtedly made it more difficult to attain and to uphold international agreements on catch quotas. While agreements on less migratory demersal stocks (cod and haddock, for example) between Russia and Norway have remained unchanged since the early 1980s, the agreements on the pelagic stocks have sometimes broken down or taken long time to establish. Although the literature on straddling fish stocks is extensive, with several contributions in recent years, few studies address these issues in a multispecies context. The present work will be a step toward closing this gap by developing a framework for game theoretic analysis of such systems.

SS117
Climate change and conflicts of interests in marine areas in Northern Norway: Comparative methodologies and Research Results
Jennifer Bailey (jennifer.bailey@svt.ntnu.no)
Norwegian University of Science and Technology, Norway

The farming of Atlantic salmon and other aquaculture ventures have been controversial in many areas. It has apparently been most accepted in Norway, today's largest producer of Atlantic salmon. Current research on climate, however, suggests that increasing water temperatures will lead to the migration of the industry from Southern and Mid Norway to Northern Norway, an area where skepticism to the industry is currently strongest. The current government supports the expansion of aquaculture as the oil industry declines. These factors suggest that disputes over the use of marine areas in northern Norway will become a factor that could affect the future expansion of the industry. This paper will use media mining techniques to uncover the primary conflicts of interest in the Norwegian county of Troms, with a particular focus on the fishing, aquaculture and tourism industries. It will then compare the findings of this work with findings from previous

studies, input to a recent round of hearings on the industry and workshops conducted as a part of the EU-funded project Ocean Certain, allowing for an evaluation of the use of media mining techniques as a data gathering technique. Do the various approaches (media mining, hearings, surveys and stakeholder workshops) provide commensurate understandings of the situation? Can the approaches complement each other by identifying/emphasizing different aspects of the conflicts?

SS118

Heterogeneity in vessel resiliency to climate variability in the Bering Sea pollock fishery

Alan Haynie (alan.haynie@noaa.gov)
NOAA Fisheries Alaska Fisheries Science Center, United States

Pollock recruitment and biomass in the Bering Sea has fluctuated in concert with environmental changes since the early 2000s. As pollock spatial distributions, densities, and abundances varied, fishers have adjusted their fishing behavior. Utilizing ~30,000 trips made by Bering Sea pollock catcher vessels from 2003 – 2014, we found strong correlations between the distances that vessels traveled and both pollock survey abundance and bottom temperatures. During colder years when waters drove pollock populations north (during the summer B season) and closer to the edge of the Bering Sea shelf, many vessels traveled farther, following fish and maintaining high catch per unit effort (CPUE), despite low pollock abundance. The temperature and abundance relationships remain difficult to disentangle, however, as recent warm years have all occurred in concert with abundant pollock. Without low abundance warm years for comparison, it is difficult to project the impacts of warming. However, if warm waters yield predicted poor recruitment, then pollock may require more effort, even when closer to port. This increased effort (decreased CPUE) represents an additional cost to fishers because vessels use significantly more fuel while fishing than while transiting. Longer trips offer complicated trade-offs for fishers. The far-ranging trips overall had statistically similar net earnings as the shorter trips, suggesting that the higher CPUEs offset the costs, but many vessels are unable to profitably make these longer trips. As climate changes further and variability of pollock populations is predicted to increase, understanding the ability of different vessels to adapt is critical for efficient management.

SS085

Economic impacts of climate change on marine fisheries in the Arctic

Yajie Liu (yajie.liu@ntnu.no)
Department of Economics, NTNU, Norway

This paper is to investigate how climate change affect fisheries resources and economic performance of fishing sector and coastal communities in the Arctic with a focus on Svalbard Fisheries Protection Zone. Climate change is projected to alter the productivity of our oceans, the distribution, abundance, composition, quality and quantity of marine fisheries resources. Many coastal communities in the Arctic have been intricately connected to marine fisheries economically, culturally and socially. Changes in the spatial distribution and relative abundance of commercially exploited and potentially valuable fish species are likely to change the dynamics of fishing activities and exploitation patterns. Using a Dynamic Bioclimate Envelope Model (DBEM), we project that a warming climate will likely increase overall species richness and abundance in the Arctic, resulting in increased catch potential. We then evaluate how these changes affect fishing sector and coastal communities through changes in revenues, profits, fishing cost, household income and employment

opportunities in the fisheries sector. The results highlight the disparity in climate vulnerability in fisheries related food security and livelihood between different fishing sectors and areas.

Investing in fisheries recoveries (SS11), Room 2: Isla Coronado

Friday, March 24, (10:30 a.m. to 12:30 p.m.) - Room 2: Isla Coronado

SS077
Case Study: California Fisheries Fund
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EDF, United States

The California Fisheries Fund (CFF) launched in 2008 as a public-private initiative aimed at demonstrating how to make financial investments in a growing, sustainable commercial fishing industry. Since then, CFF has operated as a nonprofit revolving loan fund, extending 34 loans totaling more than $4.2 million. CFF's initial business model proposed that loans would be made to associations of fishermen who would conduct research and planning to develop better fisheries management structures. However, such associations did not develop as quickly as anticipated, and CFF sought out alternate borrowers. CFF was the first lender to accept Pacific groundfish quota as collateral. For fishermen, using quota as collateral presents a powerful new opportunity to access capital. CFF has demonstrated that the fishing industry can be financially viable and bankable but has also uncovered challenges regarding the size of the investment opportunity and financial viability of such a fund. During this session we will address some key questions regarding how and when to deploy financial return-seeking capital to accelerate the transition to sustainable fisheries: What are the critical enabling conditions that facilitate financial investment? How do you identify or develop viable investible entities with a track record of success? How can different forms of capital be paired or blended to achieve the desired outcome? Given the lack of profitable fisheries investment fund models, what are the right models for achieving impact?

SS174
OPP – Project Overview and rationale for Fisheries Business Case Development
Pablo Obregon (pobregon@conservation.org)
Conservation International

Healthy ocean ecosystems and fisheries are vital to the food security and well-being of much of the world's population, particularly in developing coastal and island states. The increasing human impact on the underlying natural processes and ecosystems upon which these wide-ranging benefits depend, represents the single greatest threat to the sustainability of fisheries. A large proportion of the world's fisheries are currently over-exploited, and as a result are underperforming in terms of their full biological and economic potential. Ineffective fisheries management continues to perpetuate these negative outcomes. To-date, a majority of investments in fisheries management improvements have disproportionately depended on public and philanthropic sources of funding, with few cases of private-sector investment being deployed despite the potential upside to fisheries recovery. The latter is at least in part the result of a lack of project pipeline for fisheries investment. The OPP project responds directly to this challenge by providing technical assistance and analytical support to identify and design a series of fisheries investment proposals that are

attractive to return-seeking investors. The latter will in-turn catalyze pilot investment into selected transformational public-private partnerships that mainstream the sustainable management of highly migratory fish stocks spanning areas within and beyond national jurisdictions.

SS175
OPP – Fisheries Business Case Development Progress in the Caribbean
Brad Gentner (brad@gentnergroup.com)
Gentner Consulting Group

Billfish have greater value as living targets for non-consumptive, or minimally consumptive, recreational fisheries than they do as either directed catch or by-catch species in commercial fleets. The pilot projects seek a Coasian solution to this problem through private funding mechanisms. The angler sector has a high willingness to pay for access to the billfish resource and the plan is to develop a mechanism to generate self-sustaining private investment in the sustainable management of highly migratory billfish stocks in the areas within and beyond national jurisdictions. These investments will include improved monitoring, control and surveillance as well as investments in education and gear modifications for the small scale fleets that harvest billfish. It is hoped that these investments in billfish friendly gear modifications will pay livelihood dividends through improved catch rates for billfish in the recreational fishery, improved commercial fish quality and access to high value supply chains for harvest other than billfish and reduced congestion and conflict between sectors. It is also hoped that the project will address the increase in fishing capacity brought by an explosion anchored FADs in the region and their use in a new and growing fishery that targets billfish. As the MCS and governance capacity in the region grows, it is hoped that the same types of policies can be expanded to the distant water longline fleets that have substantial billfish bycatch.

SS176
OPP – Fisheries Business Case Development Progress in the Bay of Bengal
Rajdeep Mukherjee (rmukherjee@bobpigo.org)
Bay of Bengal Programme Inter-Governmental Organisation

The Bay of Bengal Programme Inter-Governmental Organisation (BOBP-IGO) is implementing the Bay of Bengal Ocean Partnership Project (OPP-BOB). The Project region comprises the Exclusive Economic Zones of Bangladesh, India, Maldives and Sri Lanka and the ABNJ waters encircling them. The region currently contributes 6% and 26% of the global and Indian Ocean tuna (including billfishes) landings. The countries differ considerably in respect of the composition of tuna fisheries value chain, institutional framework and development experience. However, the underlying and unifying common theme in this diversity is the importance of fisheries in coastal livelihoods and the weak institutions to optimize benefits at all levels. Given this, the OPP-BOB is primarily focused on initiating institutional reforms to open up possibilities for introduction of market and non-market instruments for ensuring sustainable and optimal flow of benefits. Beginning the process with broad-based regional consultations and knowledge mapping for sectoral characterization, six business cases are proposed that also aim at complimentary institutional reforms. These six cases include: (i) development of a 'Regional Tuna Fisheries Consortium' comprising governments and private stakeholders for a bottom-up participation in the global/IOTC tuna governance process; (ii) & (iii) development of management plans for coastal and migratory tunas in Gujarat and Lakshadweep respectively in India; (iv) improving fisheries MCS in the region; (v) improving catch quality through improved on-board preservation technology; and (vi) setting up of fisheries co-

management system in Puducherry, India'. Simultaneously, capacity building activities at different levels and knowledge management is also being implemented to develop the Project synapse.

SS177

Walton Family Foundation's Chile Oceans Initiative - channeling private/public investment for management improvements

Rodrigo Oyanedel (royaned2@uc.cl)
The Walton Family Foundation

"The overall goal of the Walton Family Foundation's (WFF) Chile Oceans Initiative is to create well-managed, sustainable fisheries that contribute to healthy ocean ecosystems and provide greater social and economic security to coastal communities and industries. Chile is the eighth largest fishing nation in the world, and although Chile boasts good fishery laws and regulatory framework, implementation has been poor and its fishing industry is in decline. To secure healthy, sustainable fisheries WFF is focusing on implementing management reforms for a limited number of important industrial and small-scale fisheries. Philanthropic resources only go so far in helping to advance the implementation of fisheries management measures. Recently, Chile was a focus of a Bloomberg and Rockefeller-funded effort to develop investment blueprints for an infusion of private capital to support fisheries management reforms. Understanding that philanthropic dollars are usually not enough to recover fisheries, WFF intents to channel significant investment resources (private capital and government funding allocations) in service to management improvements. During the session, discussion will center on the barriers, challenges and opportunities in combining private and philanthropic money to enable fisheries recovery. "

SS178

OPP – Fisheries Business Case Development Progress in the Western Central Pacific

Peter Cusack (peter.cusack@ffa.int)
Pacific Islands Firum Fisheries Agency

The tuna catch from the Western and Central Pacific Ocean (WCPO) amounted to 2.86 m mt in 2014, worth USD5.8 b and accounting for about 60% of the global tuna catch. About 60% of the catch was taken in the waters of the Pacific Island Forum Fisheries Agency (FFA) member-countries and territories, about one third of the global catch by volume. The three main fish stocks of skipjack, yellowfin and albacore, accounting for 95% of the catch are 'biologically healthy'. However, bigeye tuna is overfished and albacore longline fishing, particularly by domestic fleets, is uneconomic. Although there is little scope to increase catches, the economic benefits of the fishery to resource owners have increased dramatically in recent times, through access fees, domestication of fleets, onshore processing and export revenues, but only 30% of fish caught in FFA-member waters is taken by local fleets and only 15% is landed for processing. To increase and maintain benefits, Pacific Island countries seek to raise their level of participation in the value chain, but are constrained by challenges in market access, lack of infrastructure, transport and utility costs, low labor productivity and often weak Government investment frameworks. FFA's implementation of OPP in the region is developing a pipeline of business opportunities, including scoping of a sub-regional FAD management scheme, exploring PPP models for financing the development of a dedicated tuna port in Papua New Guinea, and "investment ready" support for

establishment of a purse-seine vessel service centre at a major transhipping port. These business cases aim to

SS179
WWF World Bank OPP – Executing Agency in Eastern Pacific
Vishwanie Maharaj (vishwanie.maharaj@wwfus.org)
WWF

A hot topic for purse seine tuna fisheries in the Eastern and Western Central Pacific regions is the management of incidentally caught tuna species that are overfished or undergoing overfishing. In the Eastern Tropical Pacific managing the mortality of small bigeye and yellowfin tunas caught in the pursuit of skipjack tuna is a priority for stakeholders in the purse seine sector. This paper explores incentive based solutions for addressing these fishing mortality issues as alternatives to seasonal closures. A business case that utilizes outputs from a producer surplus type cost benefit analysis is under development. The most effective ways to scale up monitoring for quota based regimes is explored in this developing business plan. The analytical framework, key data and assumptions will be discussed under different pathways to reform that include a number of second best solutions.

The Three M's of Recreational Fishing Demand: Measurement, Modeling, and Management (SS12), Room 3: Isla San Jose

Friday, March 24, (8:30 a.m. to 10:30 a.m.) - Room 2: Isla San José

Primary Contact:	Dan Lew, NOAA Fisheries, Dan.Lew@noaa.gov
All Authors:	Dan Lew, NOAA Fisheries **(Primary Presenter)**

Session Description:

The goal of this special session is to present current research on the economics of marine recreational fishing with an emphasis on the measurement and modeling of recreational fishing demand using revealed and/or stated preference valuation techniques and the integration of this information in larger bioeconomic modeling frameworks. The presentations will include recent research to combine revealed preference and stated preference data to improve recreational fishing demand models that take advantage of the strengths of each type of data to offset the weaknesses of the other (Lew). Also included are two presentations that discuss recent efforts to develop and use Bioeconomic Length-Structured Angler Simulation Tool (BLAST) models, which is an integrated modeling approach and dynamic decision support tool that can (and has in some U.S. regions) be used to assess the economic benefits of recreational fishing management alternatives. The first of these presentations (Lee) describes the application of a BLAST model to inform fisheries management decisions in the Northeast U.S., while the second (Anderson) presents a new BLAST model being developed for U.S. West Coast marine recreational fisheries. Additional presentations of theoretical and empirical research on recreational fishing demand and its application in management models and practice will be considered to fill 2-3 additional presentation time slots.

SP145
Predicting the effects of angler regulations off Washington and Oregon using discrete choice surveys and stock assessments
Josh Nowlis (jsnowlis@gmail.com)

ECS in support of NOAA's Northwest Fisheries Science Center, United States

The effects of regulations on recreational fishers are especially difficult to predict. Data lags typically prevent in-season management, so regulations restrict aspects of individual fishing activity in the hopes of achieving collective catch limits. This study began with discrete choice surveys to elicit angler preferences among various types of fishing trips (including none at all). Trip choices varied in the species composition, number, and size of fish caught, as well as how many could be retained. The results of these surveys allowed us to provide a statistical representation of angler preferences. These preferences were then incorporated into models of fishing behavior in which catch probabilities were modeled using data from actual fishing trips, but potentially constrained by regulation. The model included additional dynamics for selected species by making the probability of catches vary with stock abundance, which in turn varied across years of a model run based on overall fishing pressure. The goal of this angler regulation assessment tool include (a) research to improve our understanding of fishing behavior and (b) operational use to guide managers in setting recreational bag, size, and seasonal limits suitable to achieve recreational catch allocations.

SP146

Applying a bioeconomic model to recreational fisheries management in the Northeast U.S.: the good, the bad, and the just plain ugly

Scott Steinback (scott.steinback@noaa.gov)
NOAA / National Marine Fisheries Service, United States

This research combines a utility-theory consistent model of demand for recreational fishing trips with an age-structured stock dynamics model to provide policy relevant advice to managers of the groundfish fishery in the Northeast United States. We provide an overview of the model and describe the challenges encountered with using this modeling approach to develop recreational fishery policies. Specifically, time lags in the availability of scientific information, uncertainties in that information, and institutional constraints of the management system can be obstacles to using this modeling approach effectively. Despite these shortcomings, we believe integration of this decision support tool into the fishery management process represents a substantial step forward in the science of fisheries management.

SP150

Heterogenous Valuation for Keeping and Releasing Fish: A Shore Thing or a Boat-load of Baloney?

Andrew Carr-Harris (acarrharris@my.uri.edu)
Department of Environmental and Natural Resource Economics, University of Rhode Island, United States

Shore and private boat anglers enjoy fishing trips that differ in many ways, including expenditures and likely in expected catch. The choice of whether to fish primarily from shore or on a private boat might also reflect distinct fishing preferences. We seek to determine if this is the case; that is, whether anglers' willingness-to-pay (WTP) for changes in catch and harvest is dependent on fishing mode. Identifying if, and by how much, these values differ is necessary to understand if changes in regulations disproportionately impact certain groups of anglers. We conducted a choice experiment survey in 2016 in the Northeast US which was distributed to Atlantic striped bass anglers. These anglers took nearly 5.5 million striped bass fishing trips in 2015, approximately 35% of which were

shore based and almost all of the rest were from privately-owned boats. Our survey evaluated shore and private boat anglers' WTP for changes in catch and harvest of small, medium, and trophy-sized striped bass—sizes which encompass the variety of prevailing regulations across the study region. We incorporate baseline catch data to calculate empirical estimates of WTP for shore and private boat anglers and discuss the practical implications of our results.

SP151

Estimating recreation benefits through joint estimation of revealed and stated preference discrete choice data

Dan Lew (Dan.Lew@noaa.gov)
NOAA Fisheries United, States

We develop econometric models to jointly estimate revealed preference (RP) and stated preference (SP) models of recreational fishing behavior and preferences using survey data from the 2007 Alaska Saltwater Sportfishing Economic Survey. The RP data are from site choice survey questions, and the SP data are from a discrete choice experiment. Models using only RP data may be more likely to estimate the effect of cost on site selection well, but catch-per-day estimates may not reflect the benefits of the trip as perceived by anglers. SP models may be more likely to estimate the effects of trip characteristics well, but less attention may be paid to the cost variable due to the hypothetical nature of SP questions. The combination and joint estimation of RP and SP data seeks to exploit the contrasting strengths of both. We find significant gains in econometric efficiency, and differences between RP and SP willingness to pay estimates are mitigated by joint estimation. We compare a number of estimation models. The nested logit "trick" model ignores the panel nature of the data and is less preferred to the mixed logit error components model that accounts for panel data and scale differences. Naïve (1) scaled, (2) mixed logit, and (3) generalized multinomial logit models produced similar results to a generalized multinomial logit model that accounts for scale differences in RP and SP data. Willingness to pay estimates do not differ across these models but are greater than those in the mixed logit error components model.

Saving the world's most endangered marine mammal: role of economic incentives for affected communities (SS13), Room 4: Steinbecks

Friday, March 24 (8:30 a.m. to 10:30 a.m.) - Room 2: Steinbecks

Primary Contact: Oriana Poindexter, NOAA, Southwest Fisheries Science Center, oriana.poindexter@noaa.gov

Session Description:

Saving the world's most endangered marine mammal: role of economic incentives for affected communitie

The world's smallest porpoise is in danger of extinction within a few years. The "vaquita", endemic to the upper Gulf of California, faces only one primary threat – fishing with gillnets. While the gillnet

fishery has been officially closed by th government of Mexico, illegal gillnet fishing continues to threaten the survival of this iconic species. Despite compensa paid to the fishery sector participants during a two-year closure, illegal fishing with gillnets continued, motivated by th very high prices paid for the swim bladders of gillnet-caught illegal totoaba. There have been few if any alternative economic livelihoods developed during the compensation period, even though financial capital was provided to communities that were not actively fishing. Alternative fishing gear faces an uphill battle due to a variety of factors including few viable alternatives, reticence among fishers and assumed higher fishing costs. Other investments have n been developed given the lack of micro and macro policies to encourage the development of alternative economic livelihoods, as well as the entrepreneurial skills needed to engage in business development. Looking to the future, the announced permanent ban (with one possible exception) will only be successful if these communities are able to make living – whether fishing with alternative "vaquita-safe" gear or working in another sector amenable to these communiti

At the most recent meeting of the International Committee for the Recovery of Vaquita (CIRVA), the participants recommended that policy, business and economic experts focus on identifying and nurturing the development of alternative economic livelihoods to ensure the viability of the communities who surround the habitat of the vaquita. Th activities can include improved fishing techniques to encourage the use of vaquita-friendly gear and enhanced market structure and incentives for the seafood products of those fisheries. Ecotourism, aquaculture and renewable energy are other possible opportunities. The ultimate goal is to organize an Economic Summit in the fall of 2017 to focus on these efforts, including public-private partnerships to fund and launch these critical investments. This NAAFE special session an excellent opportunity to lay the groundwork for the Economic Summit.

This half-day special session will be conducted in two parts: setting the scene and exploring alternative economic livelihoods. This will ensure that the participants have a common and through understanding of the socioeconomic situation in these communities, and therefore be better able to explore options for alternative economic activities. The second session brings in entrepreneurs and experts who can shed light on the options available for alternative econom development in these communities, and pathways to developing these opportunities.

The session will include discussions of intrinsic motivation, such as social norms, extrinsic motivation, notably economi incentives, and points of intervention, ranging from the vessel at-sea through the supply chain to consumer retail mark The session will also include discussions of the role of technological change to reduce vaquita bycatch, and technology policy on how to increase rates of both innovation and adoption and public-private partnerships to organize research a development.

Session I - Setting the Scene: Overview of the Communities of the Upper Gulf of California

Presentation: Review of fisheries by port: numbers of vessels, fishermen, cooperatives, volume and value (net and gro of landings

Presentation: Other economic activities currently in the coastal region: sport fishing, tourism, expat communities, aquaculture, green energy, and other possible alternative economic activities.

Presentation: Impediments, challenges to economic growth: lack of financial and human capital, lack of alternatives to fishing, etc.

Session II: Exploring Alternative Economic Livelihoods

Panel discussion: A panel of speakers composed of one representative from each of various alternative sectors (e.g., "vaquita-friendly" gear; sportfishing; aquaculture; tourism; green energy) provides an overview of the potential for establishing or expanding economic activity in each of the areas. The speakers will highlight opportunities and also be asked to raise particular challenges or impediments to this development.

Audience participation: Brief presentation of each panelist, followed by moderated audience discussion

SS107

Economic Incentives and Vaquita Bycatch

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The vaquita, a critically endangered marine mammal, is a bycatch to shrimp strawl and gillnet fisheries in the upper Gulf of California. Reducing vaquita bycatch, however, is complex. The fisheries are smaller-scale and major contributors of income and employment to coastal communities. Although tourism is increasingly important, fishing remains an important contributor to income and employment. Considerable effort toward bycatch reduction has helped slow the decline of vaquita, but the population nonetheless has declined to an alarmingly small population. Bycatch conservation and management can proceed by direct regulation, incentive-based regulation, or intrinsic motivation. Bycatch reduction can be addressed at the vessel level, at firms in the supply chain through standards and certification, and at consumer markets through eco-labels and information programs. Incentive-based approaches, recognizing that bycatch is more than a technological and biological problem, address vessel bycatch through altering fisher behavior and decision-making. Both direct and incentive-based regulation also address the insufficient and asymmetric information held by vessels, firms in the supply chain, and consumers. This submission addresses vaquita bycatch through potential application of specific incentive-based policy instruments at the vessel level -- the bycatch externality, and insufficient and asymmetric information – the information externality.

Friday, March 24 (11:00 a.m. to 12:30 p.m.) - Room 2: Steinbecks

Poster Session Abstracts

Wednesday March, 22 (5:30 p.m. to 7:00 p.m.) - Room: Foyer

PS015
Seasonal Closures in Puerto Rico: Are they effective?

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Fishery managers often use seasonal closures to protect spawning aggregations and further ecosystem-based management; however, knowledge gaps and uncertainty about their efficacy persists. This paper investigates Puerto Rican fishermen's perceptions about their performance. It examines how individual characteristics and contextual factors influence their views and also identifies impediments and opportunities to enhance the efficiency of this management tool.

PS017
The Impact of the Affordable Care Act in North Carolina's Commercial Fisheries

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East Carolina University United States

We provide an initial look at our follow up study on the impact of the Affordable Care Act (ACA) on U.S. commercial fisheries. Earlier work found that In the years immediately preceding the passage of the ACA, North Carolina's commercial fishermen were more likely to purchase health insurance coverage on the private market if they worked in a more dangerous environment or were more highly vested in fishing. Our preliminary results show that North Carolina's commercial fishermen are indeed purchasing health insurance through the ACA in significant numbers. Insurance coverage has risen overall, although some fishermen are still choosing to remain uninsured. We provide early estimates on the size of the ACA subsidies and changes in fishing behavior and investment.

PS045
The brazilian sardines market: domestic landings and imports

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Seafood imports have increased substantially in emerging economies during the last decades as these countries get stronger links to the global market. However, there has been little attention to the impact of increased imports in developing countries despite the potentially large influence on price determination process and impacts, local fishers income and fish stocks. In this paper, an empirical analysis is conducted for the Brazilian sardines market. This market consists of two main segments, fresh and canned sardines. Imports have been increasing and supply about one half of the sardines used in the canning industry, and even more when the domestic fisheries production fails. The results suggest not only a fully integrated market, but also a complete price transmission in both value chains. There is also some evidence that import prices are exogenous, indicating price leadership from the global market. Hence, imports competition with domestic fisheries may limit

increases of the domestic fishery prices and reduce fishers' income and effort. However, the processing industry, consumers and fish stock are better off.

PS046

An elusive consensus: Heterogeneity across fishery stakeholder engagement, dependence, and social objectives makes catch shares a hard sell in the Gulf of Alaska

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Northern Economics, United States

"In December 2016, the North Pacific Fishery Management Council indefinitely postponed further work on a proposed Gulf of Alaska (GOA) trawl bycatch management action. That action could have established a catch share program for the groundfish trawl fishery. This marked the third time since the early 1990s that the Council halted an action that would have altered the fundamental structure of the limited access fishery, with the proposed actions varying in their geographic and gear/sector scope. Inability to reach consensus on a GOA-wide catch share program is likely linked to the diversity of the trawl fleet, processors, and GOA communities/residents in terms of engagement and reliance on this fishery. The stakeholder landscape of the GOA is further complicated by affected communities ranging from Alaska to the Pacific Northwest and beyond, and numerous GOA trawl vessels that also participate in west coast and/or Bering Sea fisheries. Moreover, a new management regime would need to maintain the connections between interrelated Federal and State water fisheries overseen by different bodies. Differing perspectives on the use of historical catch as the basis for allocation of harvest quota among current participants and those representing future entrants have also made proposed GOA catch share programs contentious. Individuals and entities differ over social objectives – be it solidifying existing patterns of engagement in the fishery or fostering an alternate pattern of rent distribution across communities and generations. This presentation quantifies factors that have impeded consensus: fleet and community diversity, regional groundfish reliance, and crew employment, among others."

PS061

Observer effects in the Northeast- US multi-species sector

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This study examines empirically if fishing vessels of the Northeast-US multi-species sector fleet changed their effort, location and catch composition if the trip was observed by a human monitor. Since the fishing year 2010, with the introduction of a catch share program, the observer data of the multi-species sector fleet is used to estimate discard rates which are subtracted from the multi-species quotas. Based on the argumentation that the incentive to change behavior when observed varies with the level of quota utilized and gear employed, the empirical analysis is conducted gear group specific for the fishing years 2007-2015. This study extends the classical analysis of observer effect of revenues and catch composition towards spatial distribution of effort as well as controls explicitly for deployment effects in the matching. Moreover, we seek to assess if the introduction of the catch share program had an significant effect or if restraining the allowable catch is the major driver for the observer bias. Based on data from logbooks and the Vessel Monitoring System, we are able to show significant difference between observed and unobserved trips when it comes to

the harvest location. Regarding species composition and effort, results are mixed and seems to be driven by external factors hampering the offsetting of the potential costs to carry an observer.

PS074

Common Property Resources, Property Rights and Natural Disasters

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Property rights are the foundation of institutions that shape economic decisions ranging from individual transactions to the performance of a country's economy. The incentives generated by the institutions in place also translate into measures of vul- nerability and recovery in the face of natural disasters. Using the example of Chilean fisheries and the tsunami that affected the country in 2010, I measure how those in- centives translate into production decisions before and after the natural disaster un- der different property right regimes. I find significant evidence that weak property rights over the resource lead to economic inefficiencies. These results contribute to the ongoing discussion of the role of property rights in the economic performance of common property resources, and how productive sectors and countries are affected by and recover from natural disasters.

PS119

VMS Tools: Developing tools in ArcGIS for improved access and analysis of fine-scale spatial data

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"Vessel Monitoring System (VMS) data present a unique potential for extremely high resolution spatial representation of fishing effort on the West Coast of the United States, however the size, complexity, and availability of these datasets create a challenge for users. Complete understanding of the mechanisms of VMS transmission units, the database management practices of the Office of Law Enforcement (who collect and house the data), and the series of tables necessary to link VMS vessel IDs to coastguard IDs is often needed to maximize the potential of the data. In order to address these challenges, we are developing an ArcGIS Toolbox comprised of several tools that automate some of the steps necessary to utilize VMS data. These tools can be made available as a simple download for any user with the confidentiality permissions to access VMS data, and will come with a complete User Guide, set up instructions, and examples to ensure the toolbox is operating correctly. Future expansion will see a Toolbox for users without full access permissions that automates a confidentiality screen over selected data, so users may see approved maps of effort abiding by data confidentiality rules. The Toolbox assists users through the process from accessing and importing the VMS data into a familiar ArcGIS shapefile, including ability to query for specific time frames or vessels, to common data cleaning methods and on to merging VMS with other data sources such as logbooks and landings data. With this Toolbox, extensive socio-economic analysis is possible regardless of VMS knowledge."

PS137

Investigating the economic viability of macroalgae production in the fishing community of Las Pacas, Baja California Sur

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The artisanal fishing community of Las Pacas is situated on the Sea of Cortez in Baja California, Mexico. It is an area where fishing regulations are seldom enforced, and where the efforts to fish for survival have long since sapped the available supply of seafood. The fishermen of Las Pacas, now forced to reevaluate their very existence, have identified their circumstance as an opportunity for environmental reform. Their incentive now becomes one to harvest - that is, by cultivating sustainable algae and participating in conservation efforts, Las Pacas can position itself as a destination for researchers and volunteers, while calling attention to the dire state of their, and indeed our, marine environment. Las Pacas is redefining the criterion by which similar communities have typically been constrained, engaging as innovators and entrepreneurs in this new, unchartered space of eco-volunteerism. They have taken the initiative in strategizing how to create a successful, attractive ecotourism and research facility, including the development of a government funded non-profit organization that will permit aquaculture and other research related activities. Additionally, they have consulted with scientists from Centro de Investigaciones Biológicas del Noroeste (CIBNOR) and La Universidad Autónoma de Baja California Sur (UABCS) to implement well-founded research projects that will provide a foundation for future studies conducted by research groups both locally and internationally.

PS141

Management consequences of climate change in some Mexican fisheries

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Population models used in the conventional management of fishery resources assume ecosystem stability (carrying capacity) and fishing is the main driver of change in abundance. At present there is evidence of climate change effects on different resources of Mexico, in different regions. In some cases, such as the Campeche Bank, it has been shown that the warming effect has led to a significant reduction in the system's carrying capacity where the abundance of some of the most important resources has decreased sharply. In the Gulf of California, the effects of climate change are not clearly evident given the combination of environmental events of different frequencies, such as El Niño, decadal variation or climate change in frequencies near 70 years. Despite this mixture, changes in the structure of ecosystems have been identified. The effect of these changes on the management of the resources is discussed since in principle the decrease of the abundances has been attributed to overfishing. The consequences range from the state of resources, the definition of allowable catches, to economic and governance problems.

PS090

Can the effect of distance to port and fishers' behavior explain relative abundance of lobsters? : The case of Galapagos Islands

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One approach to estimate relative abundance of exploited resources has been the use of standardization methods, especially in cases where resources have not a homogeneous spatial distribution, such as lobster. Based on data collected in the Galapagos Islands, Ecuador, this study determines how factors such as distance to port (associated to distance and operating costs) and

the origin of the fishers (associated to fisher's experience) affect relative abundance of spiny lobster (Panulirus penicillatus and P. gracilis). Generalized linear and generalized additive models were used to standardize CPUE (as an index of relative abundance), and evaluate the effect fishers experience and travel distance on changes of such index. The perfomance of the models was evaluated with Regression Error Characteristics Curve (REC). The results show that the lobsters had relatively high CPUE in areas near to the base ports; above of 87% of its fishing effort was allocated to sites 74 km away from the base Port. The origin of the fisher had differential effect in both species, these differences are explained because both species have different distribution in the Galapagos Islands and fishers' experience and the distance to the lobsters fishing areas differs; for example, Villamil fishermen have higher catch rates of P. gracilis; while the fishermen of the ports Baquerizo Moreno and Ayora are more experienced and attain higher catch rates of P. penicillatus. Spatial and temporal factors among others related to fisher's behavior could be key for understanding changes in relative abundance index of fisheries of benthic resources.

PS172

History of Collecting Information about the Cost of Fishing in U.S. Commercial Fisheries

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"The U.S. National Marine Fisheries Service, and its precursor agency, has collected information about the cost of commercial fishing since the 1950's. The efforts were intermittent and geographically sporadic until 2000 when a systematic approach was developed and supported by ongoing budgetary commitments. Information about which fisheries within each region have reported both operating and fixed cost data through both mandatory and voluntary surveys since 2001 is provided. Coverage in all regions has improved with some regions increasing from 10% of fisheries reporting to 40% to 60% reporting."

North American Association of Fisheries Economists

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