



2015

**North American Association of Fisheries Economists
8th Biennial Forum:**
*Economic Sustainability, Fishing Communities,
and Working Waterfronts*

**Ketchikan, Alaska
May 20-22, 2015**

**Organized by:
University of Alaska Fairbanks,
School of Fisheries and Ocean Sciences**



Contents

Welcome from Forum Organizers	4
Sponsors	4
Internet Access	4
Tours.....	4
Student Awards.....	5
Best Student Paper Competition.....	5
Best Student Presentation Award.....	5
Conference schedule	6
Area Maps.....	7
Program at a Glance.....	8
Information	10
Instructions for Presenters	10
Instructions for Moderators	10
Keynote Address: A Preliminary Approach to Formalization of Ecosystem Based Fisheries Management using the NS1 Paradigm.....	11
Selected Paper Session Summary	12
Aquaculture	12
Bioeconomics	12
Bycatch and Discards	12
Climate Change	12
Ecosystem-Based Management.....	12
Ecosystem Services	13
Fishing and Communities.....	13
Lagniappe	13
Markets and Trade.....	14
Modeling	14
Recreational Fisheries	14
Rights-Based Management.....	15
Small-Scale Fisheries	15
Special Sessions Summary	16
The Impact of Catch Shares on Fishing Income Diversification and Fleet Diversity	16
The Economics of Recreational Fishing Sectors in U.S. Fisheries: Allocation, Demand, Supply, and Impacts	16
Fisheries' Shoreside Support - the Forgotten Sector	17

MSC, FPIs, and Everything in Between: Assessment of the Evolving Markets for Certification and Sustainable Seafood	17
Re-Thinking Niche Markets for Seafood: Challenges and Opportunities for “Local” Seafood	17
Protected Resource Economics: Key Challenges for Incorporation in an Ecosystem Based Management Approach	17
Emerging Technologies in Fisheries Economic Data Collection	18
Selected Papers Abstracts	19
Special Sessions Abstracts	65
The Impact of Catch Shares on Fishing Income Diversification and Fleet Diversity	65
The Economics of Recreational Fishing Sectors in U.S. Fisheries: Allocation, Demand, Supply, and Impacts	67
Fisheries’ Shoreside Support - the Forgotten Sector	72
MSC, FPIs, and Everything in Between: Assessment of the Evolving Markets for Certification and Sustainable Seafood	74
Re-Thinking Niche Markets for Seafood: Challenges and Opportunities for “Local” Seafood	76
Protected Resource Economics: Key Challenges for Incorporation in an Ecosystem Based Management Approach	78
Emerging Technologies in Fisheries Economic Data Collection	80
Workshops	83
Student and Early Career Workshop	83
Creating Fisheries Value by Reforming Management Institutions across Small Scale Billfish Fisheries in the Caribbean.....	83
Index of Authors	84

Organizers

Keith Criddle
UAF Fisheries Division

Quentin Fong
UAF Fisheries Division and Marine Advisory
Program

Gary Freitag
UAF Marine Advisory Program

Eric Thunberg,
NOAA Fisheries

Program Committee

Chuck Adams, University of Florida
Chris Anderson, University of Washington
Juan Agar, NOAA Fisheries
Chang Seung, NOAA Fisheries
Keith Evans, University of Maine
Ron Felthoven, NOAA Fisheries
Joshua Greenberg, University of Alaska Fairbanks
Alan Haynie, NOAA Fisheries
Porter Hoagland, WHOI Marine Policy Center
Rob Johnston, Clark University
Stephen Kasperski, NOAA Fisheries
Walter Keithly, Louisiana State University
Jonathan King, Northern Economics
Douglas W. Lipton, NOAA Fisheries
Sabrina Lovell, NOAA Fisheries
Tom Murray, Virginia Institute of Marine Science
Bob Pomeroy, University of Connecticut
Matt Reimer, University of Alaska Anchorage

Jenny Sun, Gulf of Maine Research Institute
Gil Sylvia, Oregon State University
Eric Thunberg, NOAA Fisheries
Hirotsugu Uchida, University of Rhode Island
Quinn Weninger, Iowa State University
Frank Asche, IAAEM
Chris Wright, Holmes Institute
Tony Charles, St Mary's University, Halifax
Daniel Gordon, University of Calgary
Dan Lane, University of Ottawa
Gisele Magnusson, DFO
Dale Marsden, DFO
Rashid Sumaila, University of British Columbia
James Wilson, University of Quebec Rimouski
Mauricio Ramirez Rodriguez, CIBNOR
Silvia Salas, CINVESTAV-IPN, Universidad
Merida
Juan Carlos Seijo, Maris University of Merida

Welcome from Forum Organizers

Welcome to the 8th Biennial NAAFE Forum—*Economic Sustainability, Fishing Communities, and Working Waterfronts*. It is our pleasure to host you in Ketchikan, Alaska's gateway community. Ketchikan has a rich and diverse maritime economy. It serves as homeport for commercial fishing fleets that participate in state and federal fisheries. It is a destination and a jump-off point for sportfishing and sightseeing adventures. It is the center of Alaska's shellfish aquaculture industry and operations base for the Southern Southeast Regional Aquaculture Association, a major contributor to salmon restoration and enhancement programs. In addition, Ketchikan is home to Alaska's largest shipbuilding and repair facilities.

Sponsors

We are very grateful for the generous financial and in-kind contributions of our sponsors:

- [Alaska Sea Grant](#)
- [North Pacific Fishery Management Council](#)
- [North Pacific Research Board](#)
- [Northern Economics](#)
- [Pollock Conservation Cooperative Research Center](#)
- [Rasmuson Foundation](#)
- [University of Alaska Fairbanks, School of Fisheries and Ocean Sciences](#)
- [University of Alaska Southeast, Ketchikan](#)

Internet Access

A dedicated Wi-Fi link has been created and will be available throughout the UAS Robertson Building.

ID = NAAFE2015

Passcode = NAAFE2015

Tours

We have arranged for opportunities to tour the Trident Seafood processing Plant, the Southern Southeast Aquaculture Association Whitman Lake Hatchery, the OceansAlaska Shellfish Hatchery, and a Walk-the-Dock look at Ketchikan-based fishing vessels. Sign-up sheets will be on the registration desk. Tours will be at noon on Wednesday and Thursday and during the early afternoon on Friday. Contact Quentin Fong qsfong@alaska.edu for details.

Student Awards

Best Student Paper Competition

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 will select 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 2015 contest was 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 three 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 winner of the 2015 NAAFE Best Student Paper contest is:

[Yutaro Sakai—Subsidies, Fisheries Management, and Stock Depletion.](#)

Yutaro is a graduate student at the University of Calgary; his major professor is Dan Gordon.

Best Student Presentation Award

The NAAFE Forum 2015 is pleased to be able to offer a 2015 Best Student Presentation Award. 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 submit a nomination by May 15 to allow scheduling of two judges to attend. The contest is being organized by NAAFE President Eric Thunberg (Eric.Thunberg@NOAA.GOV) and Chris Anderson (cmand@uw.edu.)

Presentations will be judged on the following criteria:

1. Quality of visual aids.
2. Presentation style.
3. Time management (i.e., success at covering all aspects of outline).
4. Study is well-motivated and results were well interpreted.

Conference schedule

Tuesday, May 19, 2015

1:00–5:00 p.m.	Registration	UAS Robertson Building 600 Steadman Street
6:30–8:00 p.m.	Reception/cruise	Allen Marine Tours 5 Salmon Landing 215

Wednesday, May 20, 2015

8:30–10:00 a.m.	Plenary	Lumberjack Arena 420 Spruce Mill Way
10:00–10:30 a.m.	Registration and coffee	UAS Robertson Building
10:30 a.m.–12:00 p.m.	Session 1	UAS Robertson Building
12:00–1:30 p.m.	Lunch	UAS Robertson Building
12:15–1:15 p.m.	Student and Early Career Workshop	UAS Robertson Building
1:30–3:00 p.m.	Session 2	UAS Robertson Building
3:00–3:30 p.m.	Coffee	UAS Robertson Building
3:30–5:00 p.m.	Session 3	UAS Robertson Building

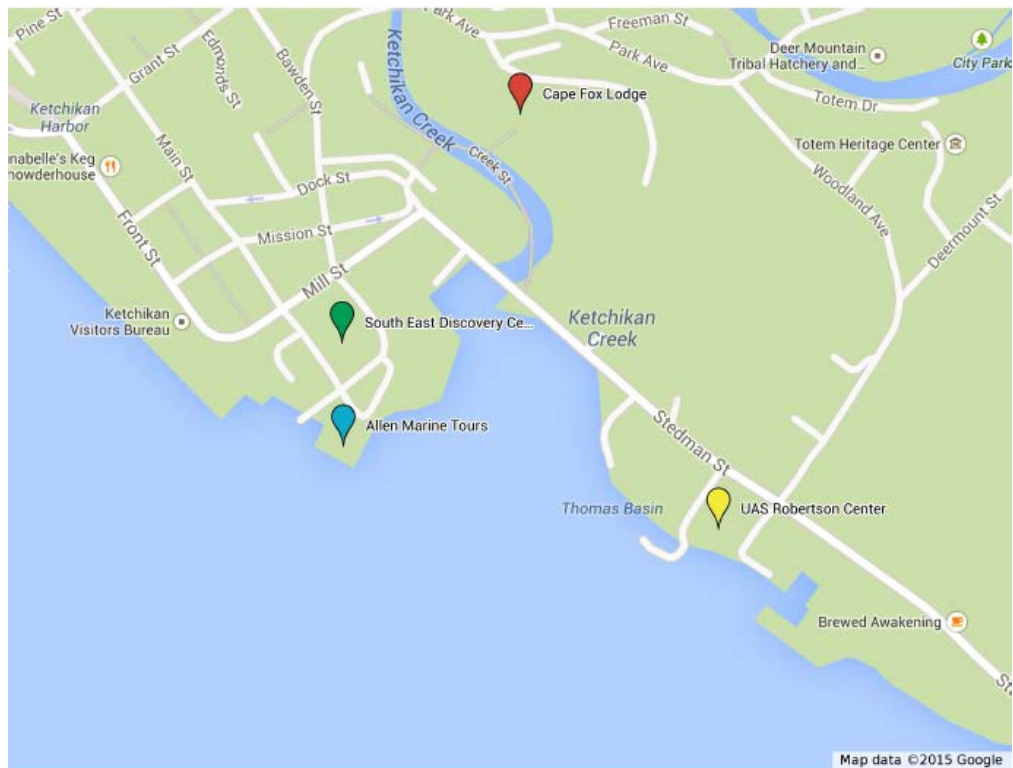
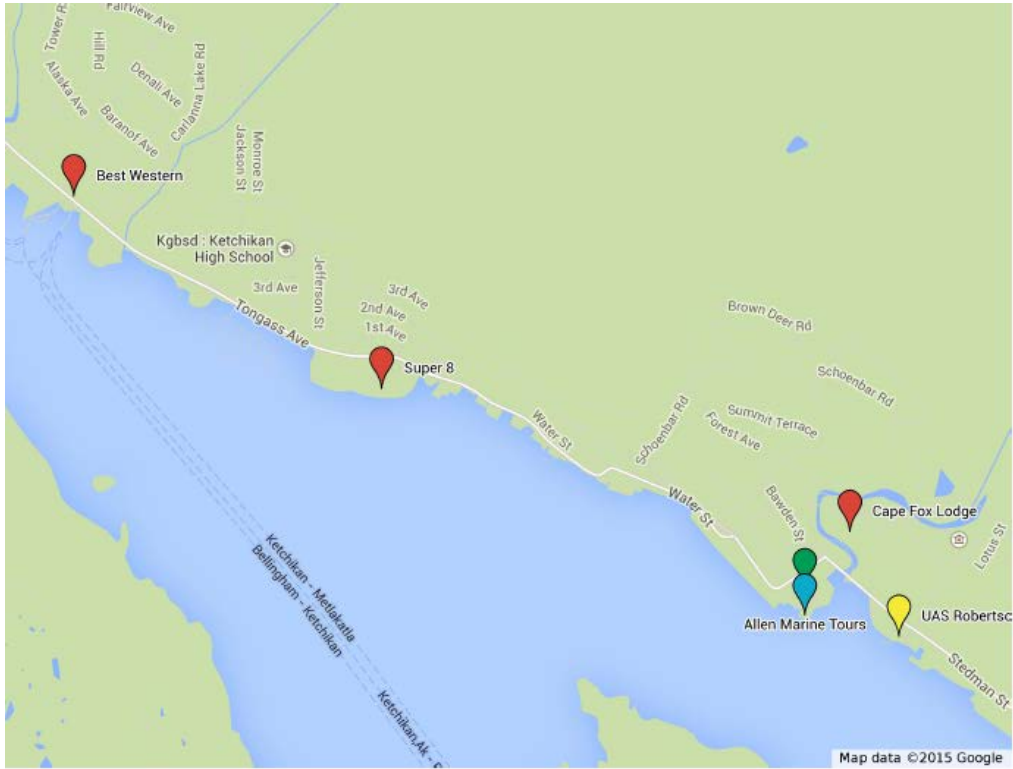
Thursday, May 21, 2015

7:30–8:30 a.m.	Registration	UAS Robertson Building
8:30–10:00 a.m.	Session 4	UAS Robertson Building
10:00–10:30 a.m.	Coffee	UAS Robertson Building
10:30 a.m.–12:00 p.m.	Session 5	UAS Robertson Building
12:00–1:30 p.m.	Lunch	UAS Robertson Building
12:15–1:15 p.m.	Caribbean Billfish Workshop	UAS Robertson Building
1:30–3:00 p.m.	Session 6	UAS Robertson Building
3:00–3:30 p.m.	Coffee	UAS Robertson Building
3:30–5:00 p.m.	Session 7	UAS Robertson Building
6:30–8:00 p.m.	Banquet	Sunny Point Conference Center, Best Western Landing Hotel 3434 Tongass Avenue

Friday, May 22, 2015

7:30–8:30 a.m.	Registration	UAS Robertson Building
8:30–10:00 a.m.	Session 8	UAS Robertson Building
10:00–10:30 a.m.	Coffee	UAS Robertson Building
10:30 a.m.–12:00 p.m.	Session 9	UAS Robertson Building
12:15–12:45 p.m.	Closing Session	UAS Robertson Building

Area Maps



Program at a Glance

19-May	1:00-5:00PM	Registration @ Robertson Building		
	6:30-8:00PM	Reception/Cruise @ Allen Marine		

20-May	8:30-8:40	Welcome and Orientation: Local Organizing Committee					
	8:40-8:45	Introduction of Keynote Speaker: Eric Thunberg, NAAFE President					
	8:45-9:45	Keynote Address: Lee Anderson					
	9:45-9:55	Announcement of Best Student Paper Award to Yutarō Sakai: Hiro Uchida					
	9:55-10:00	Report by MRE Editor					
	10:00-10:30	Coffee and Registration @ Robertson Building					
	10:30-10:45	(1a) Shoreside Support	Erin Steiner, Ayeisha Brinson et al.	(1b) Recreation: Allocation, Demand, and Supply	Daniel K. Lew, Sabrina Lovell, Clifford Hutt et al.	(1c) Catch Shares	Dan Holland et al.
	10:45-11:00						
	11:00-11:15						
	11:15-11:30						
	11:30-11:45						
	11:45-12:00						
	12:00-1:30	Lunch @ Robertson Building		Student and Early Career Workshop (12:15-1:15)	Tours: Trident Seafoods, Whitman Lake Hatchery, Dock Walk		
	1:30-1:45	(2a) Fishing and Communities	042 Hekia Bodwitch 044 Devlin Fernandez 045 Sam Cunningham 046 Stephen Kasperski 047 Anna Birkenbach 048 Matthew Freeman	(2b) Recreation: Economic Impacts	Daniel K. Lew, Sabrina Lovell, Clifford Hutt et al.	(2c) Rights-based management	125 Gordon Munro 080 David Kaczan 128 Timothy J. Emery 129 Timothy J. Emery 084 Jenny Sun 086 Andrew Ropicki
	1:45-2:00						
	2:00-2:15						
	2:15-2:30						
	2:30-2:45						
	2:45-3:00						
	3:00-3:30	Coffee					
	3:30-3:45	(3a) Fishing and Communities	049 Tammy Murphy 065 Quentin S.W. Fong 040 Mike Downs 079 Mihoko Tegawa 118 Matt Reimer 062 Monica Galligan	(3b) Recreational Fisheries	075 Joshua K. Abbott 076 Daniel Willard 077 Jorge Holzer 078 Håkan Eggert	(3c) Rights-based management	093 Manuel Bellanger 088 Jim McIsaac 089 Kailin Krotz 090 Eric Edwards 085 Stephen Kasperski 099 Jennifer Meredith
	3:45-4:00						
	4:00-4:15						
	4:15-4:30						
	4:30-4:45						
	4:45-5:00						

21-May	7:30-8:30	Registration @ Robertson Building					
	8:30-8:45	(4a) Small-Scale Fisheries	111 Samantha Hettihewa 117 Gabriel S. Sampson 113 Miguel Jara-Iturra 114 Alvaro Hernández-Flores 115 José A. Duarte 121 Raul Villanueva-Poot	(4b) Fisheries Certification	Hirotosugu Uchida et al.	(4c) Rights-based management	081 Daniel S. Holland 091 Marysia Szymkowiak 094 Lisa Pfeiffer 096 Erin Steiner 097 Marcus Gho 087 Andrew Ropicki
	8:45-9:00						
	9:00-9:15						
	9:15-9:30						
	9:30-9:45						
	9:45-10:00						
	10:00-10:30	Coffee					
	10:30-10:45	(5a) Climate Change	023 Brooks A. Kaiser 074 Alexa M. Dayton 027 Andrew M. Scheld 024 Olanrewaju Badmus 028 Babagana Abubakar	(5b) Re-thinking Niche Markets	Tracy Yandle et al.	(5c) Rights-based management	051 Rajesh Singh 095 Chad Demarest 092 Sara A. Sutherland 071 Angela Münch 072 Ling Huang
	10:45-11:00						
	11:00-11:15						
	11:15-11:30						
	11:30-11:45						
	11:45-12:00						
	12:00-1:30	Lunch @ Robertson Building		Small Scale Billfish Fisheries in the Caribbean Workshop (12:15-1:15)	Tours: Whitman Lake Hatchery, Dock Walk, OceansAlaska		
	1:30-1:45	(6a) Ecosystem- Based Management	036 Claire W. Armstrong 010 Amanda Faig 032 Joshua K. Abbott 033 Barbara Hutniczak 035 Lars Ravn-Jonsen 037 Sunny L. Jardine	(6b) Markets and Trade	102 Frank Asche 083 Stephanie Warpinski 101 Taro Oishi 103 Pratheesh Sudhakaran 105 Kelly A. Davidson 041 Benjamin E. Fissel	(6c) Modeling	058 Quinn Weninger 056 Min-Yang Lee 066 Chang Seung 053 Aneesh Hariharan 014 Alan Haynie 131 Jane Sullivan
	1:45-2:00						
	2:00-2:15						
	2:15-2:30						
	2:30-2:45						
	2:45-3:00						
	3:00-3:30	Coffee					
	3:30-3:45	(7a) Ecosystem Services	039 Chris Anderson 030 Ying Wang 031 Shiyu Li 038 Geret Sean DePiper 124 Michael Carroll 127 Melissa Errend	(7b) Markets and Trade	110 Gil Sylvia 106 Jonathan King 107 Benjamin Fissel 108 Adam Stemle 109 Nobuyuki Yagi 082 Barbara Hutniczak	(7c) Bioeconomics	016 Sunny L. Jardine 009 Diwakar Poudel 011 David Kling 013 Daniel Georgianna 015 Y. Allen Chen 126 Alice Thomas-Smyth
	3:45-4:00						
	4:00-4:15						
	4:15-4:30						
	4:30-4:45						
	4:45-5:00						

6:30-8:00	Banquet @ The Landing
-----------	------------------------------

22-May	7:30-8:30	Registration @ Robertson Building					
	8:30-8:45	(8a) <u>Protected Resources</u>	Kathryn Bisack, Kristy Wallmo, Gisele Magnusson et al.	(8b) <u>Aquaculture</u>	001 Frank Asche	(8c) <u>Economic Data Collection</u>	Barbara Rountree et al.
	8:45-9:00			002 Julie Decker			
	9:00-9:15			003 Pratheesh Sudhakaran			
	9:15-9:30			005 Jorge Dresdner			
	9:30-9:45			008 Jessie Chen			
	9:45-10:00			130 Gary Eaton			
	10:00-10:30	Coffee					
	10:30-10:45	(9a) <u>Bycatch and Discards</u>	067 Tracy Yandle 020 Alan C. Haynie 018 Marcus Hartley _____ _____	(9b) <u>Lagniappe</u>	063 Andrew M. Scheld		
	10:45-11:00			064 Diego Valderrama			
	11:00-11:15			070 Yutaro Sakai			
	11:15-11:30			054 Akbar Marvasti			
	11:30-11:45			055 Scott Crosson			
	11:45-12:00			122 Gunnar Knapp			
	12:15-12:20	Best Student Presentation Award: Chris Anderson					
	12:20-12:30	Closing Remarks: Eric Thunberg, Outgoing NAAFE President					
	12:30-12:40	Introduction of Incoming and Continuing NAAFE Board Members, Gil Sylvia, incoming President					
	12:40-12:45	Invitation to IIFET 2016 Scotland , Ann Shriver, Executive Director					
	1:30-3:00	Post-Conference Tours: Whitman Lake Hatchery, Dock Walk, OceansAlaska					

Information

Instructions for Presenters

Each session will be facilitated by a moderator who is responsible for keeping speakers on time. Plan to arrive at the session 5 minutes prior to the published start time and introduce yourself to the moderator. They will review the speaker timing method with you. Be sure they know how to pronounce your name. It is best to sit in the front row for convenient access to the podium.

The amount of time allotted for each presentation is 15 minutes, including Q&A.

Please prepare a PowerPoint (pptx) or Adobe Acrobat (pdf) presentation to accompany your talk. A student volunteer will be available to assist with equipment operation during the session. Each room will have:

- PC laptop with Microsoft PowerPoint and Adobe Reader
- Computer projector with 15-pin VGA connector

Recommendations

- Please limit file size to 25 MB or less. Photos can be compressed and saved in a lower resolution.
- Embed graphs or figures into the document as independent objects; do not dynamically link content to other files or programs.
- Disable any automatic advance timer on your file.
- When saving your file, use the name of the person who is presenting, e.g., Jane_Smith_(Wed_AM).ppt.
- We can accept presentations as email attachments or on USB drives.
- Your presentation will be pre-loaded to facilitate a smooth transition from one speaker to the next.
- We encourage you to use the laptop provided. If you prefer to use your own laptop, plan to have your laptop setup before the beginning of your session. Do not forget to bring your power cord and an adapter cable if your computer does not have a 15-pin VGA port.

Presentations must be loaded at least 15 minutes before the start of your session. We prefer that you load your presentation or email it to us the evening before your presentation.

Instructions for Moderators

Moderators are responsible for keeping speakers in order and on time.

- Please introduce each speaker; state their name, current title, and current position; keep introductions brief to keep sessions on time.
- Let speakers know what your signal is to cut them off (Example: Moderator will raise their hand and wave when the speaker has three minutes left. – Timer cards will be provided)
- If you allow time for Q&A after speaker presentations and no one from the audience has questions, please pose questions to stimulate discussion.
- In the event of speaker 'No Shows', we recommend that you do not ask the next speaker to begin early or the program agenda will be off schedule the remainder of the session. You may choose to give each speaker additional time to speak, or conduct a Q&A at the end of the session to use the additional time.

If you are moderating a session before a mid-day or afternoon refreshment break or before lunch, BEFORE the audience departs:

- Remind them how long the break time is and when to be back and ask them to return promptly on time so as not to interrupt the first speaker after the break.

Keynote Address: A Preliminary Approach to Formalization of Ecosystem Based Fisheries Management using the NS1 Paradigm

Lee G. Anderson

Maxwell P. and Mildred H. Harrington Professor Emeritus, School of Marine Science and Policy, College of Earth, Ocean, and the Environment, University of Delaware, Newark, DE

Wednesday, May 20 (8:45-9:45) Lumberjack Arena (420 Spruce Mill Way)

National Standard 1 states that a primary function of fisheries management in the single stock case is the determination of the annual allowable harvest, and it is based on the selection of a target stock size and a control rule that will specify a harvest path that that will cause the target stock size to be achieved or maintained. The selection of the target stock and the control rule are conceptually policy decisions. In principle, target stock and control rule are selected so as to maximize the benefits to current and future users. In summary, NS1 guidelines are focused on the answer to two questions. Where do we want to go? (What is the target stock size?). How do we want to get there? (What is the control rule for determining the time path of harvests?) In an analogous manner, the basics of EBFM can be understood as a process of answering an analogous but expanded set of questions. It will be necessary to come with the EBFM equivalents or analogous concepts of the target stock size and the harvest control rule. But to complete the analogy it will also be necessary to answer the question of why do we want to go there. The legislative mandate to use X_{msy} as the target stock in single species management has pushed that question aside. Given the non-comparability of the benefits from the use of the outputs of multiple stocks, it will be necessary to go beyond the concept of the maximization of sustainable biomass yield as a measure of benefits in order to design an EBFM system that will allow for the answer to the expanded set of question in an internally consistent manner. The presentation will describe a preliminary approach to the design of an EBFM program using the NS1 paradigm giving special emphasis to required changes in the statute and the guidelines.

Selected Paper Session Summary

Aquaculture

Friday, May 22 (8:30 to 10:00)

- 001 Frank Asche [The economics of escaped farmed salmon](#)
002 Julie Decker [Alaska mariculture initiative—why not Alaska? Six economic case studies of successful mariculture industries and their potential relationship to a statewide strategic plan to develop Alaska’s industry](#)
003 Pratheesh Sudhakaran [The effect of oyster farm on the neighboring housing value in Rhode Island](#)
005 Jorge Dresdner-Cid [Biosecurity vs. profits: a multi-objective model for the aquaculture industry](#)
008 Jessie Chen [Economic feasibility of producing oysters using a small-scale Hawaiian fishpond model](#)
130 Gary Eaton [The economic impact of ocean acidification on Pacific oysters](#)

Bioeconomics

Thursday, May 21 (3:30 to 5:00)

- 016 Sunny L. Jardine [Parameter estimation for bioeconomic systems](#)
009 Diwakar Poudel [Determining optimal catch in age-structural multispecies fisheries](#)
011 David Kling [Bayesian fishery management under multiple uncertainties](#)
013 Daniel Georgianna [Combining fishermen’s knowledge with economic models to locate and evaluate gray meat outbreaks in Atlantic sea scallops](#)
015 Y. Allen Chen [An empirical model of in-season size selection](#)
126 Alice Thomas-Smyth [Assessing the accuracy of high spatial resolution effort data: comparing VMS and logbook data in the California groundfish trawl fishery](#)

Bycatch and Discards

Friday, May 22 (10:30 to 12:00)

- 067 Tracy Yandle [What drives regulatory effort? An analysis of the U.S. federal fisheries regulation at the national and regional levels](#)
020 Alan C. Haynie [The impacts of chinook bycatch reduction incentives in the Bering Sea pollock fishery](#)
018 Marcus Hartley [An iterated multiyear simulation model to assess impacts of Halibut bycatch limits](#)

Climate Change

Thursday, May 21 (10:30 to 12:00)

- 023 Brooks A. Kaiser [Walking a tight line: management of Arctic fisheries in the presence of spatially differentiated ecological-economic externalities](#)
074 Alexa M. Dayton [Technical inefficiency of the American Lobster fishery and implications for the industry under climate change](#)
027 Andrew M. Scheld [Competitive markets in stochastic environments: will climate change drive industry consolidation of global fisheries?](#)
024 Olanrewaju Badmus [Climate change and food security scenario: state of Nigeria’s fishing industry](#)
028 Babagana Abubakar [Climate change, fishing and land disputes in Africa: case study of the Lake Chad area](#)

Ecosystem-Based Management

Thursday, May 21 (1:30 to 3:00)

- 036 Claire W. Armstrong [Non-use values in natural resource management – a bioeconomic model of fisheries and habitat](#)
010 Amanda D. Faig [The economic cost of ignoring fishery induced evolution](#)
032 Joshua K. Abbott [Comprehensive fishery wealth: a bioeconomic, ecosystem-based approach to measuring fisheries sustainability](#)
033 Barbara Hutniczak [Modeling heterogeneous fishing fleet in an ecosystem based management context](#)
035 Lars Ravn-Jonsen [Indicators for ecosystem externalities in fishing](#)
037 Sunny L. Jardine [Fishermen, markets, and population diversity](#)

Ecosystem Services

Thursday, May 21 (3:30 to 5:00)

- 039 Chris Anderson [Identifying effective fishery development strategies: evidence from the fishery performance indicators](#)
- 030 Ying Wang [An integrated approach for evaluating the societal impacts of fisheries activities in the Pearl River Delta](#)
- 031 Shiyu Li [Simulating the effect of seasonal fishing moratorium in the Pearl River estuary coastal ecosystem](#)
- 038 Geret S. DePiper [Valuing ecosystem services: oysters, denitrification, and nutrient trading programs](#)
- 124 Michael Carroll [An analysis of the impacts of the Deepwater Horizon on the seafood industry](#)
- 127 Melissa Errend [Applying benefit transfer to improve the transfer of ecological estimates in ecosystem services research and policy](#)

Fishing and Communities

Wednesday, May 20 (1:30 to 3:00)

- 042 Hekia Bodwitch [Social class differentiations and the regulation of coastal resources in New Zealand](#)
- 044 Devlin Fernandes [Understanding values in Canada's North Pacific: capturing values from commercial fisheries](#)
- 045 Sam Cunningham [The privilege to process Aleutian Islands Pacific Cod: community protection vs. economic efficiency in the national standards](#)
- 046 Stephen Kasperski [Using socio-economic and fisheries involvement indices to understand Alaska fishing community well-being](#)
- 047 Anna Birkenbach [Discrete choice modeling of landings locations](#)
- 048 Matthew Freeman [A mixed methods approach to analyzing Vietnamese American fishing communities on the Gulf of Mexico](#)

Wednesday, May 20 (3:30 to 5:00)

- 049 Tammy Murphy [New England commercial ground-fishermen: adaptation and transition](#)
- 065 Quentin S.W. Fong [Maintaining the viability of seafood processing and harvesting industries in coastal Alaska: role of marine extension](#)
- 040 Mike Downs [Measuring the effects of catch shares: identifying indicators and establishing baselines along the West and Northeast coasts](#)
- 079 Mihoko Tegawa [How can community-based management improve an outcome? The effects of revenue sharing and social capital in a fishery](#)
- 118 Matt Reimer [Unintended consequences of a ban on illegal fishing gear: evidence from a field experiment in Tanzania](#)
- 062 Monica Galligan [Data management and analysis challenges in describing social and economic aspects of a small-scale commercial marine fishery](#)

Lagniappe

Friday, May 22 (10:30 to 12:00)

- 063 Andrew M. Scheld [The effects of derelict gear on blue crab production in the Chesapeake Bay](#)
- 064 Diego Valderrama [Testing the cost effectiveness of manual removal strategies for the containment of invasive lionfish stocks in a Caribbean reef](#)
- 070 Yutaro Sakai [Subsidies, fisheries management and stock depletion](#)
- 054 Akbar Marvasti [Occupational injuries in the shrimp harvesting in the Gulf of Mexico and the value of statistical life](#)
- 055 Scott Crosson [Health insurance coverage and commercial fishing in North Carolina](#)
- 122 Gunnar Knapp [Does the Alaska's fishing industry pay its way?](#)

Markets and Trade

Thursday, May 21 (1:30 to 3:00)

- 102 Frank Asche [Demand for fresh and frozen seafood in Norway: species, product form and demographics](#)
- 083 Stephanie Warpinski [An econometric market model for Alaska sablefish](#)
- 101 Taro Oishi [Japanese consumers' environmental and health consciousness revealed by choice behavior at conveyor belt sushi restaurants](#)
- 103 Pratheesh Sudhakaran [Nonlinear inverse almost ideal demand system for shellfish in Rhode Island: a market study](#)
- 105 Kelly A. Davidson [Are catfish inspections an administrative trade barrier to imported fish?](#)
- 041 Benjamin E. Fissel [Fisheries market sub-indices](#)

Thursday, May 21 (3:30 to 5:00)

- 110 Gil Sylvia [Assessing the value and role of seafood traceability from an entire value-chain perspective](#)
- 106 Jonathan King [China squeeze: what happens when your biggest customer says no?](#)
- 107 Benjamin E. Fissel [A unified framework for estimating aggregate fisheries prices](#)
- 108 Adam Stemle [Do fishermen benefit from MSC certification? Analysis of exvessel prices in multiple fisheries](#)
- 109 Nobuyuki Yagi [Consumer heterogeneities on their attitudes toward conservation on ocean environment](#)
- 082 Barbara Hutniczak [The role of expectations in modeling fishing fleet capacity changes](#)

Modeling

Thursday, May 21 (1:30 to 3:00)

- 058 Quinn Weninger [Search and learning on the sea](#)
- 056 Min-Yang Lee [Geographic concentration in the Northeast U.S. sea scallop fishery](#)
- 066 Chang Seung [Measuring the multiregional economic contribution of an Alaska Fishing fleet with linkages to international markets](#)
- 053 Aneesh Hariharan [A stochastic optimal control methodology for managing the trans-boundary Pacific sardine fisheries](#)
- 014 Alan C. Haynie [FishSET: new tools for modeling the economic impacts of fisheries management and environmental change](#)
- 131 Jane Sullivan [Implications of bycatch, wastage, and discards on declines in size-at-age and biological reference points in the Pacific halibut fishery](#)

Recreational Fisheries

Wednesday, May 20 (3:30 to 5:00)

- 075 Joshua K. Abbott [Evaluating an experimental catch shares program for Gulf of Mexico headboats: Year One](#)
- 076 Daniel Willard [Prospects for management reform in Gulf of Mexico recreational fisheries](#)
- 077 Jorge Holzer [Recreational fishing, risk preferences and welfare](#)
- 078 Håkan Eggert [Homo economicus meets H. politicus: a comparison between preferences of EPA bureaucrats, recreational anglers, and the public](#)

Rights-Based Management

Wednesday, May 20 (1:30-3:00)

- 125 Gordon Munro [Trade in fishing services and coastal state rights](#)
080 David Kaczan [Do catch shares increase ex-vessel prices in U.S. fisheries?](#)
128 Timothy J. Emery [Experimental analysis of coordination of fishing effort to reduce dissipation of economic rent in stock enhancement](#)
129 Timothy J. Emery [An experimental analysis of assignment problems and economic rent dissipation in quota managed fisheries](#)
084 Jenny Sun [Groundfish sectors business viability assessment in New England: analyzing the date-dependent ACE leasing price and constraints of ACE utilization](#)
086 Andrew Ropicki [Evaluating the impact of the Deepwater horizon oil spill on red snapper IFQ trading](#)

Wednesday, May 20 (3:30 to 5:00)

- 093 Manuel Bellanger [Distributional effects of quota self-governance by French producer cooperatives: the case of the Bay of Biscay sole fishery](#)
088 Jim McIsaac [Caught up in catch shares: regulations matter](#)
089 Kailin Kroetz [Dynamic efficiency costs of non-efficiency objectives in tradable permit programs](#)
090 Eric Edwards [Bigger pie, smaller piece: how fishery rights-based management affects seafood processors](#)
085 Stephen Kasperski [Diversification or specialization: the impact of U.S. West Coast trawl rationalization on multiregional fishery participation and effort](#)
099 Jennifer Meredith [Fish or flight: modeling the migration decisions of fish harvesters in rural Alaska](#)

Thursday, May 21 (8:30-10:00)

- 081 Daniel S. Holland [The anatomy of a multispecies individual fishing quota \(IFQ\) market in development](#)
091 Marysia Szymkowiak [Understanding the determinants of hired skipper use in the Alaska halibut IFQ fishery](#)
094 Lisa Pfeiffer [Adaptation to climate variation in a multispecies fishery: the West Coast groundfish trawl fishery](#)
096 Erin Steiner [Varying profitability across gear types in a multi-gear, multispecies IFQ fishery](#)
097 Marcus Gho [Changes in the distribution of Alaska's commercial fisheries entry permits](#)
087 Andrew Ropicki [Can fisher social networks be used to explain IFQ trading?](#)

Thursday, May 21 (10:30 to 12:00)

- 051 Rajesh Singh [A global game of capital divestment in a quota-managed fishery](#)
095 Chad Demarest [A model for predicting catch and revenues in a multispecies fishery with inter-annually unstable quotas](#)
092 Sara A. Sutherland [Empirical evidence on the economics of stakeholder opposition to fishery rationalization](#)
071 Angela Münch [On the efficiency of Polish fishing fleets](#)
072 Ling Huang [Evaluating the impact of rights-based fisheries management: evidence from the New England groundfish fishery](#)

Small-Scale Fisheries

Thursday, May 21 (8:30-10:00)

- 111 Samantha Hettihewa [Empowering domestic artisanal fishers as environmentally and financially sound alternatives to distant-water fishing vessels](#)
117 Gabriel S. Sampson [Cooperation, externalities, and spatial property rights: implications for small scale fisheries management](#)
113 Miguel Jara-Iturra [Collective rights in artisanal fisheries and the trade-offs in fisheries policies: an analysis of distributive policies](#)
114 Alvaro Hernández-Flores [The cost of avoiding sea cucumber stock depletion](#)
115 José A. Duarte [Fishing season in reproductive period: a sustainable management strategy for the *Octopus maya* fishery of Yucatan Shelf?](#)
121 Raúl Villanueva-Poot [Environmental variables and fishery performance: the effect of temperature, rainfall, wind and waves in the operation of a spiny lobster fishery](#)

Special Sessions Summary

The Impact of Catch Shares on Fishing Income Diversification and Fleet Diversity

Wednesday, May 20 (10:30-12:00)

Daniel S. Holland

[Introduction to the Special Session on the Impact of Catch Shares on Fishing Income Diversification and Fleet Diversity](#)

Daniel S. Holland

[Impact of West Coast Catch Share Programs on Vessel Diversification](#)

Cameron Speir

[Patterns of Port-Level Geographic Concentration in West Coast Groundfish Fisheries](#)

Stephen Kasperski

[Patterns of Port-Level Geographic Concentration in West Coast Groundfish Fisheries](#)

Juan Agar, Larry Perruso

[Impact of Gulf of Mexico Catch Shares Programs on Diversification and Spatial Concentration of Revenues](#)

Scott Crosson

[Diversification of South Atlantic Wreckfish ITQ Fishermen](#)

Andrew Kitts

[Assessing Diversity Trends in the Northeast U.S. Groundfish Fishery](#)

Geret S. DePiper, Andrew Kitts

[Golden Tilefish and Scallop ITQs in the Northeast: Assessing Trends Beyond Groundfish](#)

The Economics of Recreational Fishing Sectors in U.S. Fisheries: Allocation, Demand, Supply, and Impacts

Wednesday, May 20 (10:30-12:00 and 1:30-3:00)

Allocation, Demand, and Supply

Joshua K. Abbott

[Fighting over a red herring: the role of economics in recreational-commercial allocation disputes](#)

Brad Gentner

[Fisheries allocation in the United States: letting the perfect be the enemy of the good](#)

Daniel K. Lew, Gabriel S. Sampson, Amber Himes-Cornell, Jean Lee

[Cost and earnings in the Alaska saltwater sport fishing charter sector](#)

Christopher Liese, David Carter, Sabrina Lovell

[Do charter anglers value changes in regulations differently than private boat anglers and what does this mean for recreational sector separation?](#)

Min-Yang Lee, Scott Steinback, Kristy Wallmo

[Using a coupled bioeconomic model for recreational fisheries management in the Northeast United States](#)

Economic Impacts

Jerry Leonard [Characteristics, expectations, and challenges for the marine charter fishing industry in Washington and Oregon](#)

George Silva, Clifford Hutt

[The economics of Atlantic highly migratory species for-hire fishing trips](#)

Sabrina Lovell, James Hilger, Scott Steinback

[Angler spending on fishing-related durable goods: results from the 2014 Durable Good Expenditure Survey](#)

Rosemary Kosaka, Scott Steinback, Cindy Thomson, Rita Curtis

[Fishing and other ocean recreation impacts on coastal regions: The National Ocean Recreation Expenditures Survey](#)

Chang K. Seung, Daniel K. Lew

[Accounting for variation in exogenous shocks in economic impact modeling](#)

Fisheries' Shoreside Support - the Forgotten Sector

Wednesday, May 20 (10:30-12:00)

Ayeisha Brinson

[Cost and earnings profile of U.S. seafood processors](#)

Marie Guldin, Christopher M. Anderson

[Impacts of catch share management on shorebased processors: evidence from the Northwest trawl groundfish fishery](#)

Daniel Georgianna, Min-Yang Lee

[U.S. Atlantic fresh groundfish and scallop processing and marketing: a tale of two fisheries](#)

Jocelyn Wang, Christopher M. Anderson

[The value of alternative escapement goal policies: how much can be captured?](#)

Panel Discussion

MSC, FPIs, and Everything in Between: Assessment of the Evolving Markets for Certification and Sustainable Seafood

Thursday, May 21 (8:30-10:00)

Re-Thinking Niche Markets for Seafood: Challenges and Opportunities for "Local" Seafood

Thursday, May 21 (10:30-12:00)

Gina Louise Shamshak

[Assessing the willingness to pay for local seafood in Georgia's farmers' markets and CSAs](#)

Quentin S. W. Fong

[Putting local seafood into the Alaska school system: seafood processor's perspectives](#)

Kari MacLauchlin

[Foodies, fish, and the fed: fisheries regulations and the development of local seafood markets and culinary tourism in coastal communities](#)

Charles Adams

[Florida Market Maker: buying and selling local seafood](#)

Tracy Yandle, Jennifer Sweeney Tookes

[What is "local" seafood? An analysis of consumer perceptions, opportunities, and barriers to market development](#)

Panel Discussion

Protected Resource Economics: Key Challenges for Incorporation in an Ecosystem Based Management Approach

Friday, May 22 (8:30-10:00)

Kathryn Bisack, Kristy Wallmo, Gisele Magnusson

[Introduction](#)

David Kling

[The structure of conservation values and ecosystem-based management dynamics](#)

Dale Squires

[A biodiversity conservation mitigation approach to bycatch reduction](#)

Kathryn Bisack, Gisele Magnusson

[A review of policy instruments used to manage protected resources](#)

Kristy Wallmo, Daniel K. Lew

[Public preferences for endangered species recovery: an examination of geospatial scale and non-market values](#)

Panel Discussion

Emerging Technologies in Fisheries Economic Data Collection

Friday, May 22 (8:30-10:00)

Barbara Rountree

[Electronic technology in Northeast fisheries](#)

Minling Pan

[Methods and challenges to collecting real-time data in the Pacific Islands Region](#)

Jessica Joyce, Amanda Barney

[Operationalizing open-source electronic monitoring in New England groundfish sectors: is the future of monitoring more cost effective than the past?](#)

Catherine E. O'Keefe, Greg DeCelles, Steven X. Cadrin, Daniel Georgianna

[Real-time bycatch avoidance in the US Atlantic scallop fishery](#)

Selected Papers Abstracts

SP001

The Economics of Escaped Farmed Salmon

Frank Asche¹, Atle Guttormsen², Kristin Roll¹

¹ Department of Industrial Economics, University of Stavanger, Stavanger, NO

² NMBU Business School, Norwegian University of Life Sciences, Ås, NO

Friday, May 22 (8:30-8:45)—Aquaculture

Escaped salmon is a “bad output” which is produced concurrent with the good output, i.e., farmed salmon. The bad output is undesirable, both from the farmers’ and the environment’s point of view, as there are private and social costs related to it. Private costs stems from loss of production or insurance costs. Social costs are related to the farmers’ use of the environment as a free resource. Escapes of farmed salmon, along with high levels of sea lice are considered as the industry’s main environmental challenge. This study examines the interaction between the production of farmed salmon and the occurrences of escapes recognizing that the salmon industry is consisting of multioutput firms which are producing both a good and a bad output concurrently. We estimate a translog cost function. The effects of the bad output are investigated using measures of shadow values as well as test of jointness and separability, allowing us to quantify overall costs linked to efforts aimed at reducing the escapes.

SP002

Alaska Mariculture Initiative – Why not Alaska? Six Economic Case Studies of Successful Mariculture Industries and Their Potential Relationship to a Statewide Strategic Plan to Develop Alaska’s Industry

Julie Decker¹, Katherine Wellman²

¹ Alaska Fisheries Development Foundation, Wrangell AK, USA

² Northern Economics, Seattle WA, USA

Friday, May 22 (8:45-9:00)—Aquaculture

The potential economic impact of a fully developed mariculture industry in Alaska is not well understood by industry or policy makers. It is also not entirely clear what is needed to move from Alaska’s current micro industry (approximately \$500,000 in annual sales) to a fully developed industry. In general, the existing seafood industry (harvesters and processors) does not consider itself to be potential beneficiaries of mariculture development. Since the Aquatic Farm Act was passed in 1988, allowing for aquatic farming of shellfish and marine plants in Alaska, the stakeholders and agencies have not been acting in coordination to expedite the development of the industry, pointing to the necessity for a statewide strategic plan. The Alaska Fisheries Development Foundation (AFDF) is spearheading the Alaska Mariculture Initiative (Initiative), which will develop a clear and comprehensive statewide strategic plan. An important part of the Initiative is an economic analysis to inform the decisions to be made in the creation of the strategic plan. Phase I of the economic analysis will be six comparative case studies which outline examples of successful mariculture industries in different regions of the world with similar or relevant environmental and/or economic conditions to Alaska, including native species and potential stakeholders. The results of these case studies will be presented as well as their potential relationship to Alaska’s statewide strategic plan.

SP003

The Effect of Oyster Farm on the Neighboring Housing Value in Rhode Island

Pratheesh Sudhakaran¹, Gavino Puggioni², Hirotsugu Uchida¹, Jim Opaluch¹

¹ Department of Environment and Natural Resource Economics, University of Rhode Island, Kingston RI, USA

² Department of Computer Science and Statistics, University of Rhode Island, Kingston RI, USA

Friday, May 22 (9:00-9:15)—Aquaculture

From 2000 onwards, the United States saw an increasing trend for the shellfish aquaculture practices especially along the Northeast coast. Despite the supporting majority of public regarding the shellfish aquaculture operations, these operations are sometimes opposed by local communities claiming the devaluation of housing property due to the construction of oyster farm. Since the uproars against the devaluing of housing property is directly affecting the lives of public, it is critically important to study the effect of construction of oyster farm on its value. A difference-in-difference (DoD) model within hedonic price model (HPM) was used to evaluate the effect of oyster farm on property value. We collected the details of the oyster farms operated in Rhode Island from the Coastal Resource Management Council (CRMC). Our housing sales data lists all the housing transactions in Rhode Island between 2000 and 2013. We used a linear mixed model with lot size as unit level fixed effect and city as random effect. The result showed that the DoD coefficient associated with interaction of distance bands and the construction of oyster farm, was statistically insignificant. The statistical insignificance of the coefficients suggests that there is not much change in housing value due to the construction of oyster farm. The analysis shows that houses further away from coastline will reduce the value of the property. One of the caveats of this study is lesser housing transactions since the construction of oyster farm happened in recent years.

SP005

Biosecurity vs. Profits: A Multi-Objective Model for the Aquaculture Industry

Jorge Dresdner-Cid^{1,2,3}, Manuel Estay-Montecinos^{1,2}

¹ Department of Economics, Universidad de Concepción, Concepción, CL

² Research Nucleus on Environmental and Natural Resource Economics, Universidad de Concepción, CL

³ Interdisciplinary Center for Aquaculture Research (INCAR), Concepción, CL

Friday, May 22 (9:15-9:30)—Aquaculture

In this paper we measure the value of sanitary restrictions in terms of forgone profits. For this we model the trade-off between biosecurity and profits in the salmon aquaculture industry. We introduce the concept of “sanitary desirable volume” of the salmon industry, as a goal in a bi-objective model. We are able to optimize this model, using base information relevant for the Los Lagos Region in Chile, and identify a Pareto Frontier. Within this setting we analyze the shadow price of one objective in terms of the other, the effect of changes in the administrative regulations that limit fish density in the farms, and of prices on the Pareto frontier. We find that the effect of sanitary restrictions in terms of forgone profits is quantitatively important and that this effect is dependent on the level of sanitary restrictions and on the relative product prices. This has important implications for the design of sanitary restrictions. The level of the sanitary desirable volume should be determined carefully to avoid costly excessive regulation. Moreover, market conditions can also affect the optimal level of regulation.

SP008

Economic Feasibility of Producing Oysters Using a Small-Scale Hawaiian Fishpond Model

Jessie Chen¹, Maria Haws², Quentin S. W. Fong³, PingSun Leung¹

¹ Department of Natural Resources and Environmental Management, University of Hawai'i at Mānoa HI, USA

² Pacific Aquaculture and Coastal Resources Center (PACRC), University of Hawai'i at Hilo HI, USA

³ Marine Advisory Program, University of Alaska Fairbanks, Kodiak AK, USA

Friday, May 22 (9:30-9:45)—Aquaculture

While studies have long examined the economic viability of oyster industries along the Pacific and Atlantic coasts of the mainland United States, Hawai'i has had no industry to speak of in modern times. This may soon change due to the recent establishment of a long-absent water quality monitoring program required to classify shellfish growing areas. The first oyster farms have been established in traditional Hawaiian fishponds and in one case, clams are being produced in polyculture with shrimp. This potential for a new bivalve market, combined with the twenty-five-year absence of the industry and dearth of literature on the novel use of fishponds for the purpose of oyster farming, provide opportunity for an assessment of economic feasibility of raw oyster production in the state. The State Shellfish Sanitation Plan also differs from those in other

states in ways that entail economic costs. For example, in most cases depuration utilizing artificial seawater will be required. In order to address the return to risk, capital, and management, a cost-benefit analysis was conducted with data collected from Hawai'i's only certified oyster farm. Results show that net return is near the breakeven point, and is highly dependent on the optimal levels of three key variables: oyster mortality rate, market price, and quantity of seed planted. The proposed three-fold expansion has costs reflected primarily in materials and supply expenses. Total costs did not increase three-fold, as a linear relationship would imply, thereby suggesting some economy of scale is present.

SP009

Determining Optimal Catch in Age-Structural Multispecies Fisheries

Diwakar Poudel, Stein Ivar Steinshamn

Department of Business and Management Science, NHH Norwegian School of Economics, Bergen, NO

Thursday, May 21 (3:45-4:00)—Bioeconomics

This study investigates optimal catch of Barents Sea stocks, namely Northeast Arctic Cod and Capelin in multispecies ecosystem. We solve a multispecies age structured bioeconomic model for predator-prey interaction. Barents Sea stock data from ICES are employed for model application. Among others, we also include sustainability constraint in the model that contributes towards ecosystem based management of fishery. Our preliminary result suggests that a conservative harvest is optimal for capelin compared to the single species model and a higher harvest is possible in cod in multispecies model. Furthermore, we found that a pulse fishing yields higher value in cod (predator) compared to the uniform (current) fishing policy.

SP010

The Economic Cost of Ignoring Fishery Induced Evolution

Amanda D. Faig

Department of Agricultural and Resource Economics, University of California, Davis CA, USA

Thursday, May 21 (1:45-2:00)—Ecosystem-Based Management

Ecologists warn that the rapid evolution occurring as a result of high-intensity commercial fishing could have potentially disastrous economic and ecological effects. The evolution of economically relevant life-history traits in fish, which can occur due to the harvesting pressure from commercial fisheries, can irreversibly diminish fisheries yields and ecological services. I model the interactions between the genetics, population structure, and economics of the fishery in order to determine whether the economic implications of this rapid evolution (called fisheries-induced evolution or FIE) are as potentially consequential as ecologists predict. My model is based on North-East Arctic Cod, which are long lived and for which an abundance of information exists, including proof of FIE. I compare the steady state reached by a 'myopic' fishery manager who sets effort and mesh size policy while ignoring evolution, to one who dynamically optimizes his strategy with the knowledge of how evolution will respond. This paper shows that ignoring evolution may lead to some profit loss, but not likely the 'catastrophic' amount of loss predicted by biologists. While the value of the fishery is somewhat improved when evolution is accounted for, an important auxiliary benefit of accounting for evolution is that the fish stock is healthier, with a larger biomass and a more balanced age-structure. Thus while, in a narrow sense, accounting for the evolutionary effects of fishing may yield only modest gains in the present value of returns, there may be broader reasons for fisheries managers to adopt policies that incorporate knowledge of FIE.

SP011

Bayesian Fishery Management under Multiple Uncertainties

David Kling

Department of Applied Economics, Oregon State University, Corvallis OR, USA

Thursday, May 21 (4:00-4:15)—Bioeconomics

A challenge in fisheries management is to set harvest limits under multiple forms of uncertainty, including biological uncertainty, imperfect policy implementation, and measurement error. In a seminal paper, Sethi et al. (2005) introduce a dynamic model that incorporates each of these types of uncertainty, and find that the solution can diverge from the classical constant-escapement rule. Measurement error, which induces state uncertainty, is particularly important. The authors point out that they assume decisions are based solely on the current stock measurement. This restriction is strong given measurement error and the widespread use of historical data in fisheries management practice. I extend Sethi et al. by modeling the problem of a fishery manager who acts based on a dynamic belief state that incorporates the full history of actions and stock measurements. The manager updates the belief state based on new information using Bayes' rule. I implement the model numerically as a continuous-state partially observable Markov decision process (POMDP). This approach allows me to evaluate the sensitivity of the harvest rule to different channels of uncertainty. I am also able to assess the impact of initial conditions—both in terms of the underlying stock and the initial information available to the manager—on management dynamics. This paper contributes to the resource economic literature by characterizing the dynamics of Bayesian resource exploitation under multiple uncertainties. I add to interdisciplinary research on fisheries management by characterizing how efficient harvest rules adapt to economic and biological uncertainty of varying textures when managers make use of past information.

SP013

Combining Fishermen's Knowledge with Economic Models to Locate and Evaluate Gray Meat Outbreaks in Atlantic Sea Scallops

Daniel Georgianna¹, Susan Inglis¹, Kevin Stokesbury¹, Kevin St. Martin², Min-Yang Lee³

¹ University of Massachusetts Dartmouth, Fairhaven MA, USA

² Rutgers University, Piscataway NJ, USA

³ NOAA Fisheries, Northeast Fisheries Science Center., Woods Hole MA, USA

Thursday, May 21 (4:15-4:30)—Bioeconomics

Atlantic sea scallop fisheries in Iceland and the United States have been subject to outbreaks of 'gray meat', a disease caused by infestation by a new species of apicomplexan parasite that causes progressive myodegeneration of scallop meats that kills scallops and reduces recruitment. Due to reduced exvessel value, fishermen discard gray meats, and if possible, move to different fishing areas. Scallop biomass in Iceland dropped from 80% in 1999 to 10% in 2005 due to discards, natural mortality and recruitment failure attributed to gray meat infestation. Initial interviews with U.S. fishermen on the locations of gray meat outbreaks and daily monitoring of the scallop auction reveal that the condition persists in Georges Bank and the range of the infection appears to be large and increasing. This paper reports the spatial and temporal location of gray meats, and oceanographic conditions associated with gray meat infestations in the U.S. We also report the effects of gray meats on scallop exvessel price at the Whaling City Seafood Display Auction. We also examine the loss of biomass of scallops in the 2012 access fishery in Closed Area 1 due to gray meat infestation and discards of gray meat scallops, which led to the early closing of the access fishery after only about one half of allowed scallop trips had been taken. During this access fishery, the scallop biomass declined from 28 million pounds according to the SMAST video survey in 2011 to less than 10 million pounds in 2013.

SP014

FishSET: New Tools for Modeling the Economic Impacts of Fisheries Management and Environmental Change

Alan C. Haynie

NOAA Fisheries, Alaska Fisheries Science Center, Seattle WA, USA

Thursday, May 21 (2:30-2:45)—Modeling

NOAA Fisheries and partners have developed the Spatial Economics Toolbox for Fisheries (FishSET) to provide better information to managers and the public about the economic tradeoffs among different uses of

our marine resources. An enhanced understanding of how stakeholders utilize resources and adapt to regulations and environmental change will improve management and provide greater economic benefits to fishing communities and the Nation. Here we present a brief demonstration of FishSET software, discuss the variety of models included in FishSET, and compare sample model results. We also discuss pilot projects related to climate change and closed areas in the Bering Sea and turtle protection in the Gulf of Mexico.

SP015

An Empirical Model of In-Season Size Selection

Y. Allen Chen^{1,2}, Alan C. Haynie³, James N. Ianelli³

¹ Department of Economics, University of Washington, Seattle WA, USA

² Pacific States Marine Fisheries Commission, Seattle WA, USA

³ NOAA Fisheries, Alaska Fisheries Science Center, Seattle WA, USA

Thursday, May 21 (4:30-4:45)—Bioeconomics

While modern fisheries stock assessments are typically based on age (and size) structured population models, the application of age-specific fish population dynamics in the economics literature is relatively rare. Fish population traits such as size-at-age affect economic modeling, since larger fish may produce better yields and/or be more valuable. Biologically, population age structure also affects viability since reproductive output is a function of age. In this study, we provide an overview of how size-selective processes have been applied in the fisheries economics literature. We then contrast these with our approach that involved developing a model for evaluating alternative in-season management measures related to size-specific fishing practices. Using simulations, we show the impacts on fishery profitability when such measures are considered. By evaluating real data from NOAA Fisheries observers and production and revenue reports, we characterize how harvesters decide to target fish based on location-specific attributes in the pollock catcher-processor fishery. We estimate the implications to the age structure of the population over time and the potential for implementing incentives to target alternative sites with more optimally sized fish.

SP016

Parameter Estimation for Bioeconomic Systems

Sunny L. Jardine¹, James N. Sanchirico^{2,3}

¹ School of Marine Science and Policy, University of Delaware, Newark DE, USA

² Department of Environmental Science and Policy, University of California Davis, Davis CA, USA

³ Resources for the Future, Washington DC, USA

Thursday, May 21 (3:30-3:45)—Bioeconomics

Traditional econometric methods used to estimate parameters in bioeconomic systems, i.e. ordinary least squares (OLS), do not make use of the structural information in the data. Unfortunately, because small changes in parameters can imply qualitative differences in the system dynamics, only slight imprecision in these parameter estimates may lead to a failure to accurately characterize the system. Here we show how collocation-based parameter estimation methods, used in the fields of physics, engineering, and biology, can be used to estimate parameters in bioeconomic models and the resulting parameter estimates perform better at capturing the true qualitative dynamics of the system. We demonstrate the improved performance of the collocation-based parameter estimation methods over OLS estimates using a Monte Carlo analysis with simulated data and provide an empirical example to illustrate the application of these methods in practice.

SP018

An Iterated Multiyear Simulation Model to Assess Impacts of Halibut Bycatch Limits

Marcus L. Hartley

Northern Economics, Anchorage AK, USA

Friday, May 22 (11:00-11:15)—Bycatch and Discards

Bering Sea/Aleutian Islands (BSAI) groundfish fisheries are hugely productive with 2008 – 2014 harvests averaging 1.6 million tons and generating \$1.95 billion annually. The BSAI also hosts a commercial halibut fishery with 2013 landings of 3,500 tons and revenues of \$41.5 million. Downward trends in halibut biomass combined with continued bycatch mortality in the groundfish fishery pushed the commercial harvests down to 2,000 tons in 2014, with lower harvest limits expected in 2015. Halibut bycatch mortality in the groundfish fisheries have exceeded commercial halibut harvests since 2012, and barring significant changes, bycatch will continue to exceed commercial harvests. An Iterated Multi-year Simulation (IMS) model was developed to assess future impacts to both the groundfish and commercial halibut fisheries of proposed reductions of up to 35 percent from current NMFS limits on bycatch mortality, established in the groundfish management plan. The IMS-model randomly selects from the basis years (2008 – 2013) to generate a simulated future from 2014 – 2023, in which the exploitable halibut biomass is held at 2014 estimates. Each randomly drawn year brings with it the halibut bycatch from that year, along with the groundfish harvests and revenue generated. Allowable future halibut harvests are estimated using the International Pacific Halibut Commission’s harvest policy algorithm, which nets out predicted bycatch mortality from exploitable biomass levels. After 10,000 iterations, the IMS-model yields distributions of expected bycatch and harvest levels, along with estimates of changes in the net present value of revenue over the 10-year future period for both the halibut and groundfish fisheries.

SP020

The Impacts of Chinook Bycatch Reduction Incentives in the Bering Sea Pollock Fishery

Alan C. Haynie

NOAA Fisheries, Alaska Fisheries Science Center, Seattle WA, USA

Friday, May 22 (10:45-11:00)—Bycatch and Discards

Chinook and chum salmon are prohibited species catch (PSC) which are taken as bycatch in the Bering Sea pollock fishery, the largest fishery in the United States. While salmon cannot be completely avoided when catching pollock, salmon PSC must be discarded or donated to food banks. In 2011, a new Chinook bycatch management program, Amendment 91 to the Bering Sea Aleutian Islands Fishery Management Plan, was implemented. This program consists of two elements: a hard cap on the total Chinook PSC that is sub-allocated to individual vessels and industry-developed Incentive Plan Agreements (IPAs) that provide additional incentives for bycatch reduction at levels below the hard cap. In 2015, due to historically low in-river Chinook returns, the North Pacific Fishery Management Council is considering other measures that would further strengthen protective measures. We explore a range of behavioral changes to determine if there have been changes in fishing strategy that have led to additional Chinook bycatch avoidance since 2011. We examine behaviors and bycatch outcomes to determine if measurable changes in behavior in the fishery are evident. The Chinook bycatch rate for the first four years since Amendment 91 was implemented has been extremely low. However, because there is large variation in salmon encounters among years, this is not conclusive evidence for the effectiveness of the program. We also examine the current IPA mechanisms, assess the strength of the incentives in those programs, and discuss how measures currently under consideration are likely to impact future bycatch rates.

SP023

Walking a Tight Line: Management of Arctic Fisheries In the Presence of Spatially Differentiated Ecological-Economic Externalities

Brooks A. Kaiser¹, Linda M. Fernandez², Jan H. Sundet³, Melina Kourantidou¹

¹ Department of Environmental and Business Economics, University of Southern Denmark, Esbjerg, DK

² Department of Economics and Department of Environmental Studies, Virginia Commonwealth University, Richmond VA, USA

³ Institute for Marine Research, Tromsø, NO

Thursday, May 21 (10:30-10:45)—Climate Change

The rapid pace of climate change and increased human disturbance of ecosystems in the Arctic is bringing urgency to concern over non-native species introductions and their potential threats to the marine

environment and its economic productivity, where before environmental conditions served as a barrier to their establishment. The same characteristics that have previously made the Arctic less open to the establishment and spread of invasive species are ones that make the potential problem so expansive. At stake are unique species and co-evolved systems that have taken millennia to develop. Small perturbations in the fragile Arctic ecosystems are likely to have outsized impacts both ecologically and economically. This work discusses the optimal management of international invasive species threats in order to minimize overall damages and costs. The related cases of the purposeful introduction of the Red King Crab (RKC) and the accidental introduction of the Snow Crab in the Barents Sea, and the Red King Crab's recent identification in Icelandic waters, are used to develop the discussion of the tradeoffs, local, regional and international governance opportunities and failures, and intervention possibilities. These species present particularly interesting challenges due to their dual nature as invasive species and market commodities. Part of the balancing act needed for a solution to the spread of the RKC has been directed at spatial containment, where the containment procedure depends on economic incentives of open access fisheries. We examine this history and discuss whether such a solution would be feasible for the newer but more rapidly expanding Snow Crab invasion.

SP024

Climate Change and Food Security Scenario: State of Nigeria's Fishing Industry

Olanrewaju Badmus¹, Filibus Vwarji Obadiah¹, Yacim Sunday¹, Laniyi Lawrence¹, Yakubu Isah², Oyewale Wale²

¹ Department of Fisheries, Federal College of Animal Health and Production Technology, Vom, Plateau State, NG

² Yaks Integrated and Fishing Nigeria Limited, Lagos State, NG

Thursday, May 21 (11:15-11:30)—Climate Change

Climate change poses a serious threat to sustained economic growth of aquaculture, poverty reduction and food security. The fisheries sector provides jobs and income for Nigerian families with an estimated population of 10 million people actively engaged in primary and secondary fishing operations. The small scale fishery sector provides job opportunities for Nigerians, with a total estimate of 12 million artisanal fishermen of which 705,000 are employed full time. The sector is rated the highest revenue-earning department in Nigeria's Federal Ministry of Agriculture and Rural Development. However, the significant contribution of fisheries to the Nigerian economy is being seriously threatened by the effect of climate change. The fish farmers have lost their investments through washing away of their ponds, and fish escaping into the wild while fishermen are experiencing a dwindling catch.

SP027

Competitive Markets in Stochastic Environments: Will Climate Change Drive Industry Consolidation of Global Fisheries?

Andrew M. Scheld

Virginia Institute of Marine Science, College of William & Mary, Gloucester Point VA, USA

Thursday, May 21 (11:00-11:15)—Climate Change

Climate change and continued fishing pressure threaten to increase recruitment variability for many stocks globally. Shifts in the inter-annual stability of an exploitable renewable resource may have dramatic consequences for the industries and communities which depend upon them. In this talk, the link between resource volatility and industry structure is explored using two models. First, an agent-based simulation model is presented to illustrate the effects of increasing resource variation on the number of participants in an extractive industry. Model output depicts a causal relationship between resource stability and industry structure, showing few industry participants when the resource is highly variable. Several other structural components of the model are additionally explored and suggest policy prescriptions that may mitigate environmentally driven industry effects. A second model is also presented which empirically investigates the relationship between resource volatility and industry consolidation. Here we apply tools from portfolio theory to global fisheries production and employment data, finding countries which exhibit higher portfolio volatility

in production across different species groups tend to employ fewer people in their fishing industries. Both models suggest a strong link between environmental stability and the structure of resource dependent industries, indicating a need for proactive policies to address anticipated effects of climate change.

SP028

Climate Change, Fishing and Land Disputes in Africa: Case Study of the Lake Chad Area

Babagana Abubakar

Thursday, May 21 (11:30-11:45)—Climate Change

The drying of this lake occasionally due to the impacts of the ongoing climate change the region records fluctuating flooding due to excess rain water which mostly empties into the lake as a result the Lake banks or shores were some indigenous fishing and farming communities share borders is experiencing fluctuating land disputes between the fishing and farming communities along this areas ,hence leading to incessant crisis leading to even loss of lives and properties among both the fishing and the farming communities. This trend is caused by the fact that some part of the shores or bank of the lake will be under water for two to three years when a high level of flooding is experienced/recorded in a given year (s) thereby creating fishing opportunities to the fishermen to be fishing within this jurisdiction or areas of the lake while the area is under water or submerged and occasionally due to low annual rainfall in some years the same area were the fishing communities are fishing dries up and the area is then taken over by farmers farming on the shores of the lake for also another two to three years. However due to the negative impacts of the ongoing climate change in this region many of the farmers discovered that the best option for farming in the region under this scenario is to always farm along the shores of the lake this resulted in to a situation whereby the farmers legalized their occupancies of these shores of the lake which they call their lands through purchase under customary laws that are not recognized by the fishing communities as a result the farmers are preventing the fishermen permanently from fishing within what they call their legally acquired territories regardless of the position of the lake water and these keeps leading to the ongoing Land disputes in this region of Africa.

SP030

An Integrated Approach for Evaluating the Societal Impacts of Fisheries Activities in the Pearl River Delta

Ying Wang^{1,2}, Haoran Pan³, Shiyu Li², Pierre Failler⁴

¹ Centre for Ecological Civilization, School of Economics and Management, Zhejiang Sci-tech University, Hangzhou, CN

² Guangdong Provincial Key Laboratory of Environmental Pollution Control and Remediation Technology, School of Environmental Science and Engineering, Sun Yat-sen University, Guangzhou, CN

³ School of Economics and Business Administration, Beijing Normal University, Beijing, CN

⁴ Centre for the Economics and Management of Aquatic Resources (CEMARE), University of Portsmouth, Portsmouth, UK

Thursday, May 21 (3:45-4:00)—Ecosystem Services

The paper puts forward a model of the Pearl River Delta (PRD) fishery in the South China Sea that integrates the ecological, social and economic costs and benefits of fisheries activities in a multidisciplinary framework. In particular, In particular, we developed integrated model by linking a regional Social Accounting Matrix (SAM) to an ecological model constructed by Ecopath with Ecosim (EwE) software. Then based on the ECOST model, the costs and benefits of five fishing métier are compared from economic, ecological and social dimensions in monetary terms. Finally, a series of dynamic simulations for a 10-year period are examined according five scenarios to explore the impact of fishing effort reduction on fishing communication. Key results from prediction (2005-2015) and policy simulations illustrate that fisheries of PRE are geared toward short-term economic profits at the expense of ecological gains and the whole group of societal benefits associated with fishing. However, the status quo can be improved to better levels by reducing fishing effort.

SP031

Simulating the Effect of Seasonal Fishing Moratorium in the Pearl River Estuary Coastal Ecosystem

Shiyu Li¹, Ying Wang^{1,2}, Lijie Duan³, Pierre Failler⁴

¹ Guangdong Provincial Key Laboratory of Environmental Pollution Control and Remediation Technology, School of Environmental Science and Engineering, Sun Yat-sen University, Guangzhou, CN

² Centre for Ecological Civilization, School of Economics and Management, Zhejiang Sci-tech University, Hangzhou, CN

³ Department of Teaching and Research, Haizhu District Committee Party School of Guangzhou of CCP, Tong Fu Xi road, Guangzhou, CN

⁴ Centre for the Economics and Management of Aquatic Resources (CEMARE), University of Portsmouth, Portsmouth, UK

Thursday, May 21 (4:00-4:15)—Ecosystem Services

The coastal ecosystem of the Pearl River Estuary (PRE) has been overfished and received a high level of combined pollution in the past decades. The fisheries stock assessments have shown a declining population and have led to a number of management measures, including fishing moratorium. This study evaluated the effect of the fishing moratorium on the sustainability of the PRE fisheries through an ecosystem approach. Two Ecopath models of the PRE coastal ecosystem in 1998 and 2008 were applied to get snapshot pictures of the ecosystem in different periods. Then a dynamic simulation from 1998 to 2008 using Ecosim was developed on the assumption that the seasonal moratorium was never applied to the PRE fisheries since 1999, which resulted in a predicted ecosystem of 2008* (the so-called 2008* ecosystem). Then, the attributes indices of the 2008* ecosystem were compared with that in the actual 2008 ecosystem to investigate the effect of the fishing moratorium. Finally, a series of 100 years dynamics simulations were examined in light of five scenarios on the basis of the 1998 Ecopath model to explore better strategies on the fishing moratorium. S0: The present fishing moratorium continuation, S1: No fishing moratorium executed, S2: Extending the duration of the moratorium (i.e., 1 June to 1 September), S3: Banning all fishing operations in the moratorium season, S4: No fishing moratorium executed but reducing the fishing effort of all fishing gears by 50%. The results show that the 2008* ecosystem which is supposed to be without seasonal moratorium since 1999 is more deteriorated, immature and fragile than the actual ecosystem in 2008. The seasonal fishing moratorium did benefit the ecosystem protection, although its effect on ecosystem recovery is limited. Comparative analysis among different scenarios indicates that the largest increase (28.0%) in the fish stocks could be obtained in S4. Moreover, it incurred an increase (43%) in total landings.

SP032

Comprehensive Fishery Wealth: A Bioeconomic, Ecosystem-Based Approach to Measuring Fisheries Sustainability

Joshua K. Abbott¹, Eli P. Fenichel²

¹ School of Sustainability, Arizona State University, Tempe AZ, USA

² Yale School of Forestry and Environmental Studies, New Haven CT, USA

Thursday, May 21 (2:00-2:15)—Ecosystem-Based Management

Fisheries sustainability is a much sought-after goal. Yet, “sustainability” is often too ambiguously defined to be of much practical guidance to policymakers. Furthermore, fisheries managers are increasingly expected to assess and manage fisheries in an “ecosystem-based” manner – accounting for the ecological interdependencies of species and their coupling with the physical environment. We build upon the green accounting and sustainable development literatures to downscale indices often used to measure sustainability at the nation-state scale to measure the current and projected future sustainability of exploited fishery ecosystems. We argue that the sustainability of a fishery ecosystem can be assessed by whether the properly measured value of the natural, physical and human capital stocks embodied within the fishery (i.e., the comprehensive fishery wealth) is non-decreasing over time. We extend our published work (Fenichel and Abbott 2014) to show how ecosystem models of fisheries can be integrated with bioeconomic models of human “predators” responses to changes in multispecies fish stocks and policy to provide rigorous “shadow prices” for all species within the system and fishing capital. These prices can then be multiplied by their associated capital stocks to provide an index of inclusive fishery wealth. Changes in this index (i.e., comprehensive investment) allow managers to assess the ability of past and current fishery management

regimes to maintain wealth within the fishery for future generations. Finally, we show how our wealth accounting approach – when coupled with ecosystem-based bioeconomic models – can be leveraged to prospectively evaluate the sustainability and efficiency of alternative management approaches.

SP033

Modeling Heterogeneous Fishing Fleet in an Ecosystem Based Management Context

Barbara Hutniczak^{1,2}

¹ Department of Environmental and Business Economics, University of Southern Denmark, Esbjerg, DK

² Chesapeake Biological Laboratory, University of Maryland, Solomons MD, USA

Thursday, May 21 (2:15-2:30)—Ecosystem-Based Management

Multispecies fisheries pose a considerable management difficulty with respect to quota allocation between species. Externalities of direct control over the harvest may include, among others, creation of unbalanced predator-prey relationships in the environment. That, in turn, may affect the individual economic incentives of fishing vessels. Combining economic and ecological factors in one model has multiple advantages, whereas there have been little attempts to coordinate setting the total allowable catches in multispecies fisheries, particularly in the context of individual decision-making process. The objective of this article is to develop a methodological framework for multispecies modeling with integrated ecological and economic realism suitable to evaluate the long term implications of the imposed regulations that can be used for better policy guidance. An empirical application is provided for the central Baltic Sea with its interacting fish community dominated by three species: cod, herring and sprat. The developed model includes three separate, dynamically updating, age-structured submodels for each species, which are linked through predation. The harvest component is associated with the fishing vessels that optimize individual behavior subject to regulations, owned capital and individual technical efficiency derived with the use of a multiproduct distance function. The findings present a clear picture of asymmetries between vessels with respect to harvest process and reveal the rational harvest strategy that is accommodated in the multispecies simulation model.

SP035

Indicators for Ecosystem Externalities in Fishing

Lars Ravn-Jonsen¹, Ken H. Andersen², Niels Vestergaard¹

¹ Department of Environmental and Business Economics, University of Southern Denmark, Esbjerg, DK

² Center for Ocean Life, Natl. Inst. of Aquatic Resources, Technical University of Denmark, Charlottenlund, DK

Thursday, May 21 (2:30-2:45)—Ecosystem-Based Management

Ecosystem externalities arise when one use of an ecosystem affects its other uses through the production functions of the ecosystem. We use simulations from a size-spectrum ecosystem model to investigate the ecosystem externality created by fishing of multiple species. The model is based upon general ecological principles and is calibrated to the North Sea. Two fleets are considered: a 'forage fish' fleet targeting species that mature at small sizes and a 'large fish' fleet targeting large piscivorous species. Based on the marginal analysis of the present value of the rent, we develop a benefit indicator that explicitly divides the consequences of fishing into internal and external benefits. This analysis demonstrates that the forage fish fleet has a notable economic impact on the large fish fleet, but the reverse is not true. The impact can be either negative or positive, which entails that for optimal economic exploitation, the forage fishery has to be adjusted according to the large fish fishery. With the present large fish fishery in the North Sea, the two fisheries are well adjusted; however, the present combined exploration level is too high to achieve optimal economic rents.

SP036

Non-use Values in Natural Resource Management – A Bioeconomic Model of Fisheries and Habitat

Claire W. Armstrong¹, Viktoria Kahui², Godwin Kofi Vondolia¹, Margrethe Aanesen¹, Mikolaj Czajkowski³

¹ University of Tromsø, NO

² University of Otago, NZ

³ University of Warsaw, PL

Thursday, May 21 (1:30-1:45)—Ecosystem-Based Management

The paper develops a dynamic bioeconomic model of fishing on a valuable habitat. The value connected to the habitat is assumed to be due to fishing cost reductions resulting from congregating effects, and due to non-use values of the habitat. Two types of fishing technology are applied; habitat destructive and non-destructive, and the habitat is assumed to be non-renewable. The model is applied to the Norwegian North East Arctic cod fishery, using bottom trawl and coastal non-destructive gear. Cold water coral is the habitat studied. A discrete choice model survey is carried out to determine non-use values of cold water corals in Norway. Applying these and fisheries data, the results show how the non-use value impacts upon the optimal fishing practices, and halts the bottom trawling earlier than otherwise.

SP037

Fishermen, Markets, and Population Diversity

Sunny L. Jardine¹, James N. Sanchirico^{2,3}

¹ School of Marine Science and Policy, University of Delaware, Newark DE, USA

² Department of Environmental Science and Policy, University of California Davis, Davis CA, USA

³ Resources for the Future, Washington DC, USA

Thursday, May 21 (2:45-3:00)—Ecosystem-Based Management

Fishing impacts biodiversity on multiple levels, potentially resulting in unintended feedbacks to economic performance of the fishery over time. For example, targeting observable traits within a population can impact genetic diversity, targeting populations within a species can impact population diversity, and targeting valuable species can impact biodiversity at the ecosystem level. The natural science and economics literatures, however, have given little attention to the impact of fishing on population diversity, even though population diversity is directly linked ecosystem services and estimates of population extinction rates are three orders of magnitude higher than species extinction rates. Here we develop a stochastic bioeconomic model that links the harvest of multiple salmon populations by a single commercial fishery to the trajectory of population diversity in a salmon stock complex. We parameterize our model with biological and economic data from the Copper River Chinook salmon fishery. We show that markets can incentivize the degradation of population diversity, reducing infra-marginal fishery rents and increase the variability in financial returns to the fishery. Factors impacting the magnitude of our results include the level and distribution of harvesting efficiency and market conditions. We also show that second-best management can conserve population diversity and improve welfare. Furthermore, depending fishermen's time preferences, this management strategy is potentially self-financing.

SP038

Valuing Ecosystem Services: Oysters, Denitrification, and Nutrient Trading Programs

Geret S. DePiper¹, Douglas W. Lipton², Romuald N. Lipcius³

¹ NOAA Fisheries, Northeast Fisheries Science Center, Woods Hole MA, USA

² NOAA Fisheries, Office of Science and Technology, Silver Spring MD, USA

³ Virginia Institute of Marine Science, Gloucester Point VA, USA

Thursday, May 21 (4:15-4:30)—Ecosystem Services

Maryland, Pennsylvania, Virginia, and West Virginia have all developed nutrient trading programs to defray the cost of achieving mandated nitrogen load reductions in Chesapeake Bay, and there is increasing interest in the role oysters can play in generating credits. A number of bioeconomic models highlight the impact these credits have in optimizing oyster harvest rates, but all overlook a major limiting factor in oyster population

dynamics: oyster shell is an oyster's preferred settling medium. Harvest thus impacts oyster productivity through the removal of both extant oysters and the future shell habitat. This is extremely important given that the removal of shell and oyster meat is a major channel by which nutrient credits could be generated. Further, recent research suggests that multiple oyster reef equilibria exist, and reef height determines the trajectory of oyster population change. In this research we couple a biological model of an oyster population, including shell dynamics, to a value function and analyze optimal oyster harvest regimes. The value function incorporates both the oyster harvesting profits and the value of an oyster reefs' nutrient sequestration and denitrification. We then maximize the net present value of the oyster reef, using numerical dynamic programming and simulation techniques for a reasonable range of biological and economic parameters, to provide policy guidance on the trade-off between harvest, sequestration and denitrification services. Results indicate that optimal harvest rates are more sensitive to variability in the biological rather than economic parameters, although some level of harvest is almost always optimal.

SP039

Identifying Effective Fishery Development Strategies: Evidence from the Fishery Performance Indicators

Christopher M. Anderson¹, Jennifer Meredith², James L. Anderson³, Jingjie Chu⁴, Martin D. Smith⁵

¹ School of Fisheries and Aquatic Science, University of Washington, Seattle WA, USA

² Department of Economics, University of Washington, Seattle WA, USA

³ Department of Food and Resource Economics, University of Florida, Gainesville FL, USA

⁴ The World Bank

⁵ Nicholas School of the Environment, Duke University, Durham NC, USA

Thursday, May 21 (3:30-3:45)—Ecosystem Services

We apply a dataset of more than 60 case studies scored with the Fishery Performance Indicators — a rapid assessment instrument for measuring the ecological, economic and community performance of fisheries — to explore which management systems are associated with comprehensive notions of success. Our analysis shows relationships among rights-based management and ecological and socioeconomic outcomes are more nuanced than has been argued in the literature. Positive correlations between rights-based systems and ecological and economic outcomes appear only when there are supporting investments in the post-harvest sector. The policy message is clear: aid agencies and foundations should seek to invest in infrastructure in conjunction with the formation of access and harvest rights. On its own, infrastructure can exacerbate existing conditions that promote unsustainable harvest by providing market access and facilitating a labor influx. But rights alone are unable to generate better value in the post-harvest sector and may thus have a limited role in supporting desirable ecological, economic, and social outcomes for communities. Together, the infrastructure converts rights to incentives to protect the resource and generate profits that support the community.

SP040

Measuring the Effects of Catch Shares: Identifying Indicators and Establishing Baselines along the West and Northeast Coasts

Michael A. Downs¹, Marcus L. Hartley², Stev Weidlich¹, Don Schug²

¹ AECOM, San Diego CA, USA

² Northern Economics, Anchorage AK, USA

Wednesday, May 20 (4:00-4:15)—Fishing and Communities

The Measuring the Effects of Catch Shares Project is a webportal-based effort that continues to compile and analyze data on ecological, economic, social, and administrative changes in groundfish catch share fisheries on the West Coast and in the Northeast. The purpose of the five-year project is to make the best available data and accompanying analyses readily accessible to the general public as well as to those with specific interests the fisheries, including fishery managers, fishermen, policymakers, legislators, and service business owners. Among other data, the project presents information on six key economic and social indicators across both

fisheries. This presentation describes the overall project, its goals, and initial findings. Specifically described are methodological considerations used in determining how and why a much larger number of potential indicators considered during project planning and initial baseline data gathering processes were winnowed down to the final key economic and social indicators. These considerations included the public availability of data, data accuracy, confidentiality, geographic coverage, and replicability, among others. Specifically underlined by the project findings is the importance of extended baseline time series data in placing potentially catch share-related changes in the context of longer-term fishery fluctuations and trends of change. Another preliminary conclusion is related to the challenges of confidentiality that severely restrict the analysis of changes at the sub-regional and/or port level, which is requiring implementation of additional methodologies in later stages of the project to address data gaps.

SP041

Fisheries Market Sub-indices

Benjamin E. Fissel, Daniel K. Lew

Alaska Fisheries Science Center, Seattle WA, USA

Thursday, May 21 (2:45-3:00)—Markets and Trade

Fishery managers typically have responsibility for the management of fisheries covering many species and seafood product types. While a fishery manager's barometer for successful management may involve monitoring and responding to aggregate trends in a region, effective policy requires, in part, understanding trends of individual species and product types. To this end, we describe a framework for relating price, quantity, and value sub-indices to the aggregate. The data and plots are designed to be accessible to a wide audience and useful in a policy framework where managers come from many different backgrounds. Using detailed data for Alaska groundfish fisheries between 2003 and 2012, we construct indices for price, quantity, and value for specific fisheries and product types and in the aggregate. Principal component analysis is used to quantify the additional information conveyed through product type and fishery specific sub-indices. Our results suggest sub-indices capture distinct variation in fisheries markets, that is not reflected in the aggregate index, which may be important metrics for fishery managers to follow. This framework is currently being used to assess economic trends for the management of the U.S. Alaskan groundfish fisheries and is a tool that can be easily applied in other regions.

SP042

Social Class Differentiations and the Regulation of Coastal Resources in New Zealand

Hekia Bodwitch

Department of Environmental Science, Policy, and Management, University of California, Berkeley, Berkeley CA, USA

Wednesday, May 20 (1:30-1:45)—Fishing and Communities

Indigenous fishing rights are partially recognized via allocation of commercial quota rights to tribes. Concern exists, however, that the allocation of commercial quota rights to indigenous groups without restrictions on how the benefits from quota holdings can be allocated and exchanged will lead to class segregation within indigenous groups. Scholars writing about indigenous fishing rights in New Zealand, where tribal quota ownership and exchange is less regulated than in North America, have expressed concern that a "tribal capitalism" is emerging, whereby tribal elites accumulate wealth at the expense of local fishers, ostensibly the intended beneficiaries of tribal quota holdings. This paper examines the extent to which exchange of quota and coastal resources influences social class differentiation in New Zealand's South Island, home to some of the nation's most economically productive Maori fishing enterprises. Drawing on ethnographic data, it becomes clear that tribal quota holdings are not the driver effecting how benefits from resources are distributed. Rather, differential regulation between upstream and downstream coastal resources effects how wealth is accumulated in the watershed, patterns that largely fall along racial lines. Those who own private property, primarily non-Maori, are less regulated in their wealth accumulation than Maori who historically were pushed to the coasts, historic injustices indigenous fishing rights are designed to address. This analysis

refocuses responsibility away from indigenous communities and onto the government's regulatory practices, indicating that upstream regulation, as opposed to additional restrictions on tribal resource rights, will likely lead to more equitable distribution of coastal resource benefits.

SP044

Understanding Values in Canada's North Pacific: Capturing Values from Commercial Fisheries

Kerrie O'Donnell¹, Taylor Hesselgrave², Eliana Macdonald¹, Jim McIsaac³, Des Nobles⁴, Tasha Sutcliffe¹, **Devlin Fernandes**⁵, Brenda Reid-Kuecks¹

¹ Ecotrust Canada, Vancouver BC, CA

² Ecotrust, Portland, OR

³ T. Buck Suzuki Environmental Foundation, Victoria BC, CA

⁴ T. Buck Suzuki Environmental Foundation, Prince Rupert BC, CA

⁵ Ecotrust Canada, Prince Rupert BC, CA

Wednesday, May 20 (1:45-2:00)—Fishing and Communities

Commercial fishing is a strong thread in the social fabric that has held British Columbia's coastal communities together for generations. The industry's impact is typically boiled down to dollars and cents, leaving the wider societal impacts poorly documented and largely underrepresented in fisheries policy and marine planning. Yet these values are no less important to the people who make their livings on the sea. In partnership with the T. Buck Suzuki Environmental Foundation, Ecotrust Canada set out to address this gap in knowledge by documenting the full suite of values, from economic to intangible, that wild-capture commercial fishing brings to communities in Canada's Pacific North Coast Integrated Management Area (PNCIMA). Our findings show that the role commercial fisheries play in the formal economy is just the tip of the iceberg.

SP045

The Privilege to Process Aleutian Islands Pacific Cod: Community Protection vs. Economic Efficiency in the National Standards

Sam Cunningham, Sarah Marrinan, Jon McCracken

North Pacific Fishery Management Council, Anchorage AK, USA

Wednesday, May 20 (2:00-2:15)—Fishing and Communities

When making policy recommendations, the North Pacific Fishery Management Council balances community stability with efficiency in resource utilization. The Council is considering an action that, for part of the year, would effectively limit the harvest of Aleutian Islands Pacific cod to vessels that deliver to a shore plant in the remote community of Adak, Alaska. Until 1997, Adak was a military community of over 6,000 residents, but is now inhabited by fewer than 350 people. To bolster the local fishing industry, the community purchased a shuttered processing facility and is seeking a *de facto* allocation that will attract deliveries. Vessels that currently fish Aleutian Islands cod deliver to at-sea mothership processors, which benefit the community by their port calls. At-sea processing capacity has flowed into the open access Aleutian Islands cod fishery as it was freed by a string of rationalization programs implemented in Alaska since 1999. Onshore processing in Adak could boost local employment and fish tax revenue, but might also reduce the harvest fleet's production efficiency. The processor would have to offer competitive exvessel cod prices, as harvesters could focus effort in the Bering Sea rather than make the long trip to Adak. This case represents a ubiquitous challenge for Councils: promoting stability in fishery-dependent communities while considering trade-offs and national net benefits. This presentation describes staff economists' contribution to the decision process, as well as challenges including the short timeline for regulatory impact analysis, data confidentiality, and limited information about future cod prices, business cost structures, and private business decisions.

SP046**Using Socio-Economic and Fisheries Involvement Indices to Understand Alaska Fishing Community Well-Being**Amber Himes-Cornell, **Stephen Kasperski**

NOAA Fisheries, Alaska Fisheries Science Center, Seattle WA, USA

Wednesday, May 20 (2:15-2:30)—Fishing and Communities

Over recent years, fisheries managers have been going through a paradigm shift to prioritize ecosystem-based management. With this comes an increasing need to better understand the impacts of fisheries management decisions on the social well-being and sustainability of fishing communities. This paper summarizes research aimed at using secondary data to develop socio-economic and fisheries-dependence indices to measure fishing community well-being in Alaska. Data from more than 300 communities in Alaska were used to create a database of socio-economic and fisheries dependence indices of well-being and adaptability for Alaskan communities dependent on marine resources. Each index was developed using a principal components analysis to assess the relative position of each community compared to all other communities in Alaska. We find that creating performance measures, such as the indices presented here, in fisheries provides a useful way to track the status of important fisheries and social variables over time.

SP047**Discrete Choice Modeling of Landings Locations**Anna Birkenbach¹, Frank Asche², Martin D. Smith¹¹ Nicholas School of the Environment, Duke University, Durham NC, USA² Department of Industrial Economics, University of Stavanger, NO**Wednesday, May 20 (2:30-2:45)—Fishing and Communities**

Interest in sustainable fishing communities suggests the need to understand fishermen's decisions about where to land fish. In this paper, we apply techniques used extensively to analyze fishing location choices to study landings location choices. We analyze detailed microdata from Norwegian groundfish vessels that land fish in fourteen different ports in Norway's northernmost region of Finmark. We find that insights from the fishing location choice literature are relevant but do not translate perfectly to the landing location. As in fishing location choice, vessels are responsive to travel distance. However, fish stocks in the water are far more dynamic than changes in market opportunities on land. As a result, we find little evidence that measures of expected revenues drive behavior. The discrete choice models appear to parallel the fishing location choice models when run naively with simple backward looking averages of port-level revenues. But when state dependence (the tendency to return to the same location) is accounted for, the significance on expected revenue evaporates. A high percentage of vessels in our sample always land in the same port, and many of these always deliver to the same processor. We are currently in the process of splitting the sample and treating port switchers as arbitrageurs. This analysis will allow us to see if port switchers are responsive to changing economic opportunities over space.

SP048**A Mixed Methods Approach to Analyzing Vietnamese American Fishing Communities on the Gulf of Mexico**

Matthew Alan Freeman¹, David Michael Hoffman², Rebecca Lynn Schewe³, Brian Dale Shoup⁴, Joseph Dylan Witt⁵

¹ Department of Agricultural Economics, Mississippi State University, Starkville MS, USA

² Department of Anthropology & Middle Eastern Cultures, Mississippi State University, Starkville MS, USA

³ Department of Sociology, Syracuse University, Syracuse NY, USA

⁴ Department of Political Science & Public Administration, Mississippi State University, Starkville MS, USA

⁵ Department of Philosophy & Religion, Mississippi State University, Starkville MS, USA

Wednesday, May 20 (2:45-3:00)—Fishing and Communities

As fisheries management becomes more collaborative by seeking input and involvement from stakeholders, it is important to understand and address the diversity of those stakeholders. Gulf Coast fisheries communities include diverse racial and ethnic groups, particularly a large number of Vietnamese Americans involved in all aspects of the seafood industry. Recent disasters, including hurricanes and the BP Macondo oil spill, have exposed a number of communication barriers between state and federal agencies and the Vietnamese American fishing community on the Gulf Coast as well as a lack of reliable socioeconomic data on Vietnamese American fishers and their management and governance priorities. This research focuses on a mixed methods approach to create a database of key baseline socioeconomic data on the Vietnamese American communities affected by fishery management in Mississippi and Alabama and as well as to identify avenues and barriers for communication between Vietnamese American fishers and state and federal fisheries-related agencies in the region. In doing so, we discuss using a combination of 1) face-to-face surveys with Vietnamese Americans in the fishing industry, 2) interviews with representatives of relevant state and federal agencies, 3) interviews with community organizations and key informants, and 4) focus groups with Vietnamese Americans in different aspects of the fishing industry. Collection of this type of data will be used in identifying potential strategies to improve engagement of Vietnamese American stakeholders in the region and be crucial to understand the current and future consequences of management choices for diverse stakeholders.

SP049**New England Commercial Ground-fishermen: Adaptation and Transition**

Tammy Murphy, Anna Henry

NOAA Fisheries, Northeast Fisheries Science Center, Woods Hole MA, USA

Wednesday, May 20 (3:30-3:45)—Fishing and Communities

Fishing years 2012 -2013 brought declines in socio-economic performance for the Northeast groundfish fishery. Severe reductions in catch limits for key species such as Atlantic cod have constrained fishing behavior and declining groundfish revenues cannot be offset by non-groundfish revenues earned by the fleet. Little is known about the way groundfish fishermen are making decisions in response to changes in the fishery. We present results from approximately 60 ethnographic interviews with previously active groundfish fishermen who exited the fishery and current active participants who are considering transitioning out of the fishery. Interviews focused on level of participation in the groundfish fishery, changes since the implementation of catch shares and factors that have influenced decision-making around continued participation or exiting the groundfish fishery. The information collected suggests that adaptation strategies and impacts vary considerably with factors such as the fisherman's age, initial quota allocation, level of debt, and presence of a second earner in the household. We develop a descriptive theory that characterizes actual choices being made currently by New England fishermen, with the goal of improving the ability to predict responses to future regulatory changes. Decision-making processes appear to differ from typical economic models used to analyze proposed regulatory actions. A richer understanding of these decision-making processes will lead to improved analysis of regulatory impacts.

SP051**A Global Game of Capital Divestment in a Quota-Managed Fishery**Keith Evans¹, Sunanda Roy², Rajesh Singh², Quinn Weninger²¹ Department of Economics, St. Lawrence University, Canton NY, USA² Department of Economics, Iowa State University, Ames IA, USA**Thursday, May 21 (10:30-10:45)—Rights-Based Management**

We develop a model where individual fishermen must decide whether to remain active in an ITQ-managed fishery or exit and allocate their capital endowment to an alternative use. Fishermen have private information about their own productivity, which determines the profit potential of their vessel/fishing operation. They however do not observe the productivity of other fishermen. In a game of imperfect information, fishermen choose to remain active or exit based on their own productivity and their beliefs about the distribution of productivity in the fishing population. We prove the existence and uniqueness of this global game equilibrium for a range of parameters. In a unique equilibrium, fishermen follow a threshold strategy: remain active if own productivity exceeds a given threshold; otherwise exit. If the cost of capital remains below an upper bound, a unique threshold equilibrium as described above always exists. Furthermore, the lower the cost of capital, the higher is this threshold productivity. We find that equilibria under imperfect information substantially deviate from that under perfect information because under the former fishermen cannot accurately forecast quota market outcomes. Under imperfect information, they learn about the average productivity only over time, and the fleet's transition to its efficient level only occurs gradually, as observed in practice. Using data from the pacific ground fish trawl fishery which switched to ITQ management in 2012, we calibrate our model by using stochastic frontier econometric methods. We then simulate our model to evaluate of the efficiency and distributional impacts of alternative quota allocations.

SP053**A Stochastic Optimal Control Methodology for Managing the Trans-Boundary Pacific Sardine Fisheries**Aneesh Hariharan¹, Vincent Gallucci¹, Christopher M. Anderson¹, Sandy McFarlane², David Fluharty¹¹ University of Washington, Seattle WA, USA² Pacific Biological Station, Department of Fisheries and Oceans Canada, Nanaimo BC, CA**Thursday, May 21 (2:15-2:30)—Modeling**

The Pacific sardine fishery is shared but independently managed by three nations: Canada, USA and Mexico. As a result, potential conflict scenarios may arise. A stochastic optimal control methodology is presented to analyze potential conflict scenarios by first considering a deterministic logistic stock growth function and adding a stochastic term, specified by a Wiener process. We identify Feedback Nash Equilibriums (FNE) in a 2 player scenario in the presence and absence of cooperative resource extraction with uncertainty. Players participating in the fishery can revise their strategy contingent upon the current stock size and current time. We suggest an instantaneous payment transfer mechanism when extractors cooperatively harvest the sardine stock under principles of group optimality and individual rationality. We compare the cooperative game theoretic outcome to the non-cooperative outcome. Finally, we present simulation results comparing the feedback approach to standard open loop strategies, where agents commit to a harvest plan at the initial time. This work is compared to a previous approach where a deterministic optimal control framework was developed and the merits of introducing stochasticity in the stock's growth function are highlighted.

SP054**Occupational Injuries in the Shrimp Harvesting in the Gulf of Mexico and the Value of Statistical Life****Akbar Marvasti**

NOAA Fisheries, Southeast Fisheries Science Center, Miami FL, USA

Friday, May 22 (11:15-11:30)—Lagniappe

This paper investigates determinants of fatal accidents in the shrimp industry in the Gulf of Mexico. Shrimp harvesting is one of the most dangerous occupations in the U.S. with an occupational fatality rate significantly above the average, because of dangerous working conditions, long hours, laborious work, and harsh weather. While occupational accidents have been the subject of numerous studies, commercial fishery accidents have received limited attention by economists. We construct the number of full-time equivalent (FTE) employers to be used as a scale variable. Our control variables include landing revenues, vessel characteristics, geographic location, wind speed, and the shrimp observer program. The instrumental variables method will be employed for estimation. Estimates of the value of a statistical life (VSL), using the revealed preferences method, provide useful information for public policy.

SP055**Health Insurance Coverage and Commercial Fishing in North Carolina****Scott Crosson**

NOAA Fisheries, Southeast Fisheries Sciences Center, Miami FL, USA

Friday, May 22 (11:30-11:45)—Lagniappe

Commercial fishing is generally hazardous, but some types of commercial fishing are more dangerous than other types. Since much of the fishing industry is composed of small family-owned businesses, commercial fishermen have to rely on the private health insurance markets, health insurance offered through a landside job, spouses' plans, social insurance, or forgo coverage altogether. If health insurance coverage impacts workplace choices, then fishermen working in more dangerous environs and using more dangerous gear should be more likely to make sure they are covered. What does the presence and source of health coverage tell us about commercial fishermen and fishing activity? I review landings and survey data from North Carolina in the years immediately preceding the passage of the 2010 Affordable Health Care Act (ACA). If health care coverage affects fishing activity, then the recent increase in health coverage via the ACA may lead to changes in fishing behavior as well as increase the productivity of the commercial fleets.

SP056**Geographic Concentration in the Northeast U.S. Sea Scallop Fishery****Min-Yang Lee¹, Cameron Speir², Andrew Carr-Harris³**¹ National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole MA, USA² National Marine Fisheries Service, Southwest Fisheries Science Center, Santa Cruz CA, USA³ Department of Environmental and Natural Resource Economics, University of Rhode Island, Kingston RI, USA**Thursday, May 21 (1:45-2:00)—Modeling**

New Bedford's share of Atlantic sea scallops landings and revenues increased from 44% in 1996 to 67% in 2013. Explanations for industrial agglomerations often focus on the relative importance of natural advantage and economies of scale or scope. We use the absolute and relative Theil indices of disproportionality to examine changes in geographic concentration of landings in this fishery from 1996-2013. During this time, the scallop stock was rebuilt from an overfished condition, large areas of the ocean were closed to fishing, portions of those areas were re-opened to scallop fishing, and a formal rotational management program was put into place. The relative Theil index shows that the geographic distribution of sea scallop landings has grown increasingly similar to the geographic distribution of other federally managed fisheries during this time period, although there were 3 brief reversals of this trend. The absolute Theil indicates that the geographic distribution of landings was characterized by a relatively stable period through 1999, a period of accelerating

divergence from the 1996 baseline, abrupt reversion to a new steady state from 2007-2012, and another abrupt change in 2013. Because the Theil disproportionality measures are aspatial, we conduct Exploratory Spatial Data Analysis (ESDA) to examine global and local indicators of spatial association such as hot spots, cold spots, and negative spatial autocorrelation.

SP058

Search and Learning on the Sea

Quinn Weninger

Department of Economics, Iowa State University, Ames IA, USA

Thursday, May 21 (1:30-1:45)—Modeling

This paper develops a model of (infinite horizon) sequential location choice facing the captain of a commercial vessel fishing operation. The captain chooses, simply, the next location for the vessel operation. Feasible locations include at sea sites and land-based port locations. Following Marcoul and (2008) the model assumes that the vessel captain faces uncertainty about the true, unobservable spatial distribution of the fish stock. The captain holds prior beliefs about stock conditions and learns as fishing proceeds and catch signals reveal real-time, but noisy, information about stock conditions and payoff possibilities. Upon receiving a catch signal, the captain rationally updates beliefs about stock conditions following Bayes rule, before choosing the next preferred location. The solution to the dynamic stochastic search and learning problem is obtained using numerical collocation methods supplemented by techniques to reduce computational demands in high-dimension state space optimization problems (Smolyak, 1963). The optimal spatial-search policy, derived numerically, shows how location choices are impacted by key state variables, including the quantity of fuel and supplies on board, the quantity of fish that is onboard, and importantly the current beliefs of the captain regarding the spatial distribution of the fish stock. Optimal movements between at-sea fishing locations are derived as is the decision of when and under what conditions to return to port. Simulated search patterns derived under the optimal dynamic spatial fishing policy differ significantly from patterns predicted by the static random utility model. First and foremost, the model shows how spatial movements are determined by the captains' objective beliefs about stock conditions at available fishing sites. Beliefs, which are key state variable in the decision problem, evolve depending on particular harvest realizations at the sites that have been fished during a trip. A decision to abandon a site currently being fished in favor of another site is driven by the difference in expected catch, as perceived by the skipper, at competing sites, as well as on other model state variables, e.g., the supplies on board and the quantity of fish currently in the vessel hold. Switching incurs an irreversible steaming cost. The decision to move the vessel operation is akin to an optimal stopping problem under uncertainty. Only if the expected catch difference exceeds a particular threshold (which varies with other state variables), will the spatial move be made. The model also characterizes the decision to stop fishing and return to port. As with the site switching decision, factors such as the remaining fuel on board, the quantity of fish on board and the captain's belief about current stock conditions all play a role. The results provide several new insights and important policy guidance for empirical evaluation of spatial fishing behavior.

SP062

Data Management and Analysis Challenges in Describing Social and Economic Aspects of a Small-Scale Commercial Marine Fishery

Caroline Pomeroy¹, **Monica Galligan**², Paul Reilly³,Carolynn Culver¹

¹ California Sea Grant Extension

² California State University, Monterey Bay, Seaside CA, USA

³ California Department of Fish and Wildlife

Wednesday, May 20 (4:45-5:00)—Fishing and Communities

As part of an effort to describe the recent history and socioeconomics of a small commercial fishery, we were provided access to a large, multi-faceted data set. In using those data, we faced a number of challenges related to data management, data protection and confidentiality, and needed to develop effective methods for

identifying and communicating fishery trends with collaborators from a wide range of backgrounds and perspectives. This presentation will address lessons learned and techniques developed for effectively managing and integrating quantitative and qualitative data from diverse sources, determining the most relevant aspects of a fishery to depict, and generating outputs to inform audiences in fishing communities, fishery management and the general public.

SP063

The Effects of Derelict Gear on Blue Crab Production in the Chesapeake Bay

Andrew M. Scheld, Donna M. Bilkovic, Kirk J. Havens

Virginia Institute of Marine Science, College of William & Mary, Gloucester Point VA, USA

Friday, May 22 (10:30-10:45)—Lagniappe

Several factors currently threaten blue crab (*Callinectes sapidus*) in the Chesapeake Bay. In addition to poor water quality, degraded habitat, and shifting environmental conditions, derelict gear has recently been recognized as a significant source of mortality for this economically and culturally significant species. From 2008 through 2014, commercial watermen in Virginia were hired during their winter off season to locate, document, and remove derelict gear as part of a larger research effort to determine the biological impacts of marine debris in the Chesapeake Bay. Data on derelict gear removal generated by this research was subsequently paired with spatially resolved catch and effort data and entered into a translog production model used to estimate the economic effects of derelict gear on commercial blue crab production. Model results indicate removal significantly improved pot production and economic profits, a finding which had been previously confounded by concurrent blue crab management action. Our research builds on previous work through explicit acknowledgment of important spatial production differences and incorporation of derelict gear removal.

SP064

Testing the Cost Effectiveness of Manual Removal Strategies for the Containment of Invasive Lionfish Stocks in a Caribbean Reef

Kathryn Ann H. Fields, **Diego Valderrama**

Food and Resource Economics Department, University of Florida, Gainesville FL, USA

Friday, May 22 (10:45-11:00)—Lagniappe

Two species of the Indo-Pacific lionfish (*Pterois miles* and *P. volitans*) have rapidly expanded throughout the Gulf of Mexico, mid- and south Atlantic and the Caribbean following their introduction to Florida coastal waters during the mid-1980s through releases from marine aquaria. There is overwhelming scientific agreement on the threats that this invasion poses to a wide range of native species, including grunts, snappers, and groupers. Because eradication of lionfish is unfeasible, scientists and conservationists are urging the implementation of lionfish management plans in order to reduce the environmental and economic impacts of the invasion to a manageable scale. Recent studies indicate that persistent removal of lionfish by spearheading does help control lionfish populations and help native fishing rebound. Through mathematical modeling and field tests, researchers have found that reducing lionfish stocks by about 75 to 90 percent leads to the rapid recovery of native fish numbers (Green et al. 2014). Data on prey fish and lionfish densities as well as spearheading catch rates were collected from lionfish derbies held at the Bacalar Chico Marine Reserve, Belize, in 2014. These data were used to estimate reef-specific target lionfish densities leading to the recovery of native prey species in the marine reserve as predicted by the Green et al. (2014) model. The fishing costs involved in reaching the target densities were also estimated to evaluate the overall effectiveness of manual removal techniques as a management strategy for invasive lionfish stocks.

SP065

Maintaining the Viability of Seafood Processing and Harvesting Industries in Coastal Alaska: Role of Marine Extension

Quentin S. W. Fong

Alaska Sea Grant Marine Advisory Program, Kodiak Seafood and Marine Science Center, University of Alaska Fairbanks, Kodiak AK, USA

Wednesday, May 20 (3:45-4:00)—Fishing and Communities

Alaska is the largest seafood producing state in the US. In 2013, Alaska landed 1.88 billion USD worth of seafood, with a volume of 2.63 million MT. This consists of 34% of the total value and 60% of the total volume landed in the US. Of the top 20 fishing port landing by value, 11 are from Alaska. Alaska's seafood industry directly employs more workers than any other industry sector with more than 60,000. The success of the seafood industry is vital to our coastal communities. In response to employers and stakeholders concern of the graying or increasing age of the workforce, the Alaska Maritime Workforce Development Plan was developed by representatives of the fisheries, seafood, and marine industry sectors, state agencies and the university in Alaska. Aside from workforce development, stakeholders and policy makers also recognize the need for business and entrepreneurship development, including seafood to sustain the economic viability of our fisheries/seafood dependent coastal communities. This presentation illustrates how marine extension, specifically the Alaska Sea Grant Marine Advisory Program and the Kodiak Seafood and Marine Science Center assist Alaska's seafood harvesting and processing sectors to maintain their viability in the global seafood marketplace. Training programs such as the Alaska Seafood Processor Institute, Seafood Processor Quality Control to address the graying of the workforce, research programs such as co-product development to increase the total value of the catch, and service programs such as one-on-one business and market development consultations will be presented and discussed.

SP066

Measuring the Multiregional Economic Contribution of an Alaska Fishing Fleet with Linkages to International Markets

Edward C. Waters¹, **Chang K. Seung**², Marcus L. Hartley³, Michael G. Dalton²

¹ Beaverton OR

² NOAA Fisheries, Alaska Fisheries Science Center, Seattle WA, USA

³ Northern Economics, Inc., Anchorage AK, USA

Thursday, May 21 (2:00-2:15)—Modeling

The Alaska head and gut (H&G) fishing fleet, a major component of the Bering Sea Aleutian Islands region (BSAI) groundfish fisheries, was recently rationalized under Amendment 80 (A80) to the BSAI groundfish fishery management plan. Economic impacts from H&G sector activities occur not only in Alaska but also extend to other U.S. regions via economic linkages with economic agents in those regions. Using a multiregional social accounting matrix (MRSAM) model of three U.S. regions (Alaska, West Coast, and rest of USA), the multiregional contribution of the H&G industry is estimated, and multiregional impacts of selected shifts in H&G sector production are evaluated in terms of changes in output, employment and income. Results indicate that the A80 H&G fleet vessels are important participants in Alaska fisheries, that more than half of the impacts from the H&G fleet on total output and about 80% of the impacts on household income accrue outside Alaska, and that the H&G fleet is relatively insensitive to variations in world prices of its primary products.

SP067**What Drives Regulatory Effort? An Analysis of the U.S. Federal Fisheries Regulation at the National and Regional Levels****Tracy Yandle**¹, Michael Melnychuk², Scott Crosson, Ray Hilborn²¹ Department of Environmental Sciences, Emory University, Atlanta GA, USA² School of Aquatic and Fishery Sciences, University of Washington, Seattle WA, USA³ NOAA Fisheries, Southeast Fisheries Sciences Center, Miami FL, USA**Friday, May 22 (10:30-10:45)—Bycatch and Discards**

In an environment of limited resources and expanded management expectations, fisheries regulators face hard decisions about how intensively to regulate different stocks. The Fishery Management Councils are required to regulate harvest of all stocks in a sustainable manner, but have discretion on how much regulatory effort to invest in individual species or species complexes. What drives regulators to invest management resources in one species over another? Is this dynamic the same nation-wide or does it vary by region? These questions have implications for understanding regulatory decision-making and how management resources are prioritized. Regulatory activity for a stock is represented by the number of citations in the Federal Register (notices, proposed rules, and rules) over a recent 5-year period for each species in each management council region. Predictor variable data for the same stocks are from the FSA management attributes database consisting of current and historical management, biological, and economic characteristics of each fishery.

SP070**Subsidies, Fisheries Management and Stock Depletion****Yutaro Sakai**

University of Calgary, Calgary, Alberta, CA

Friday, May 22 (11:00-11:15)—Lagniappe

This paper investigates the impact of fishery subsidies on resource stocks in 23 OECD countries for the period 1996-2011. Country level subsidy data is matched with a resource stock index prepared by the Sea Around Us Project. Since the impact of subsidies is likely to vary by type, subsidies are grouped into three categories: Direct Payments, Cost Reducing Transfers, and subsidies to management and infrastructure investments that represent General Services. As the impact of subsidies is likely a function of existing fisheries management, two different management regimes are evaluated: quota-based and traditional input/output management. Findings show that the effect of subsidies depends on both the type of subsidy and the management regime in place. Cost reducing subsidies have no effect on stocks if management is quota-based but have negative effects if management uses traditional input/output restrictions. Subsidies for improving fishery management and infrastructure produce small beneficial effects on stocks under traditional management, but no effect with quota-based management. To examine the robustness of the results, the model is re-estimated using the share of green parties in parliament as an instrument for fishery subsidies. Green parties prefer fewer fishery subsidies following a widely shared notion that the subsidies are harmful. The share of green parties is, however, unlikely to affect resource stocks other than through subsidies because fishing industries are small. The result is in accordance with the main results. These results suggest that global efforts to reform fishery subsidies should be carried out in a selective manner.

SP071

On the Efficiency of Polish Fishing Fleets

Barbara Hutniczak^{1,2}, Angela Münch³

¹ Department of Environmental and Business Economics, University of Southern Denmark, Esbjerg, DK

² Chesapeake Biological Laboratory, University of Maryland, Solomons, MD, USA

³ NOAA Northeast Fisheries Science Center, Social Sciences Branch, Falmouth MA, USA

Thursday, May 21 (11:15-11:30)—Rights-Based Management

The Baltic fishery is managed under the European Union Common Fisheries Policy (CFP) which defines procedures for setting annual total allowable catches (TAC) for major commercially harvested species. TACs are given as fixed shares to each member state by applying the principal of relative stability. Poland uses non-tradable individual vessel quotas (IVQ) in order to allocate their TACs within their fishery fleet. The lack of tradability of the IVQs as well as the long-term tradition in fishery slowed down an adaptation of the Polish fleets towards changing fish stocks in the Baltic. The resulting overcapacity motivated the Polish government to implement time-limited scrapping program (2009-2011) to create exit incentives. This paper analyzes the remaining post-buyback inefficiencies of the Polish fishing fleet looking at the production structure of major fleet segments. Logbook data of 2012 is used to estimate multi-output and multi-input distance function. Calculated (Morishima) elasticities of substitution are used to determine the flexibility of the fleet in terms of targetability and substitutability between inputs defined as on-site effective effort (E), capital (K) and the travel distance (R). Policy recommendations are derived to increase fleet efficiency besides the first-best solution of tradable quotas.

SP072

Evaluating the Impact of Rights-Based Fisheries Management: Evidence from the New England Groundfish Fishery

Ling Huang¹, Subhash Ray¹, Kathleen Segerson¹, John Walden²

¹ Department of Economics, University of Connecticut, Storrs CT, USA

² NOAA Fisheries Service, Northeast Fisheries Science Center, Woods Hole MA, USA

Thursday, May 21 (11:30-11:45)—Rights-Based Management

Cooperatives in the Rights-based Fisheries Management have the potential to overcome some of the limitations of Individual Transferrable Quotas. The New England groundfish sector management, a new regime under which fishermen can voluntarily form sectors with each sector constrained by a total allowable catch or Annual Catch Entitlement (ACE), is a good example to examine the effectiveness of decentralized collectives. We conduct a comprehensive analysis of the impact of the sector program on Technical Efficiency (TE), using detailed data at the vessel level. Combining Battese and Coelli (1995) and Caudill et al. (1995) to allow for maximum flexibility in modeling efficiency using a stochastic production frontier (SPF) method for the panel data, we compare TE before and after the program implementation. The results show that TE of New England groundfish fishery has improved 10.4% after sector management in 2010. The gains can be partially explained by restructuring of vessel composition since less efficient vessels exit and more efficient vessels stay. We also find that the average TE for the vessels that always stay across all years does increase by 9.8%, which cannot be simply explained by vessel structuring. Given the information, we explore other two mechanisms and find that after 2010, fishermen significantly specialize more in location choices, and vessels cooperate in choosing fishing locations in some sectors, but not in all of them. It turns out the impact of location specialization on TE is quite small.

SP074

Technical Inefficiency of the American Lobster Fishery and Implications for the Industry under Climate Change

Alexa M. Dayton^{1,2}, Jenny Sun¹

¹ Gulf of Maine Research Institute, Portland ME, USA

² School of Marine Sciences and Economics Department, University of Maine, Orono ME, USA

Thursday, May 21 (10:45-11:00)—Climate Change

Since 1990, landings of American Lobster (*Homarus americanus*) have increased fivefold, and the fishery now dominates Maine's seafood economy. But, there is uncertainty about the future robustness of the stock due to underlying ecological and climate factors. Despite the volume increases, the economic value and profitability of the fishery has suffered at an individual and State level, a trend which has been exacerbated during the extreme warming in the Northwest Atlantic and Gulf of Maine in 2012. Fleet characteristics were evaluated by industry-wide survey (Dayton and Sun, 2012) and reveal a prioritization of societal benefits associated with employment levels over firm-level efficiency, and excessive fishing effort has led to production inefficiency. This study provides a quantitative assessment of the production inefficiency through application of a stochastic frontier production model (Battese and Coelli, 1995) for fishing year 2010, where confidential firm-level data and survey responses for 1,001 fishermen are used. The Cobb-Douglas and Translog functional forms of the stochastic frontier production model were estimated using the maximum likelihood method. Empirical results show that productivity varies by vessel class, indicating competition among the fleet. Further investigations reveal inshore fishing inefficiencies associated with larger vessels and suggest the fleet might be overcapitalized. Under changing spatial and temporal harvest patterns associated with increased water temperatures, which favor earlier lobster inshore migration in summer and delayed offshore migration in winter, our study suggests that profitability and efficiency will decline further and intensify the competition among vessel classes during peak harvest in summer months.

SP075

Evaluating an Experimental Catch Shares Program for Gulf of Mexico Headboats: Year One

Joshua K. Abbott¹, Daniel Willard²

¹ School of Sustainability, Arizona State University, Tempe AZ, USA

² Environmental Defense Fund, Gulf and Southeast Oceans Program, Austin TX, USA

Wednesday, May 20 (3:30-3:45)—Recreational Fisheries

Recreational fishing for popular species like red snapper and grouper in the Gulf of Mexico has followed a familiar pattern to that observed in many commercial fisheries: fishing under regulated open access has promoted a “race to the fish” with cascades of shorter seasons, shrinking bag limits, and significant fishery discards. These restrictions may have significant effects on angler welfare – misallocating fish from those with high valuations to those able to fish during the “derby” – and have also made it difficult for vessel owners in the for-hire recreational fishery (e.g., charter and headboats) to sustain viable, year-round businesses. In this atmosphere, Environmental Defense Fund has worked with an affiliation of headboat operators, the Gulf Headboat Collaborative (GHC), to obtain an experimental fishing permit (EFP) from NOAA Fisheries to pilot a headboat catch share (effectively a cooperative) program. Operating under strict catch limits and electronic data reporting requirements, this EFP authorizes up to 20 headboat operators to fish for a limited allocation of red snapper and gag grouper when it is best for their businesses and safest for their customers, instead of being constrained by short and unpredictable season openings. This talk synthesizes data from headboat logbooks (for both GHC and non-GHC vessels) and surveys of headboat owners and passengers to examine the performance of this policy experiment after its first year. Wherever possible we draw upon program evaluation methods to rigorously analyze the effects of the program on number and distribution of fishing trips, revenues and profits of GHC participants.

SP076**Prospects for Management Reform in Gulf of Mexico Recreational Fisheries****Daniel Willard**¹, Joshua K. Abbott²¹ Environmental Defense Fund, Gulf and Southeast Oceans Program, Austin TX, USA² School of Sustainability, Arizona State University, Tempe AZ, USA**Wednesday, May 20 (3:45-4:00)—Recreational Fisheries**

Recreational fishing for popular species like red snapper and grouper in the Gulf of Mexico follows a pattern that is well known in commercial fisheries: fishing under regulated open access promotes short, unpredictable seasons, shrinking bag limits, and large and persistent overharvests. With federal fishing seasons at all-time lows and conflicts increasing between state and federal regulators, anglers are losing fishing opportunities and many in the Gulf's for-hire industry struggle to operate viable businesses. Red snapper is in the spotlight, but many overfished species are on the same path. Gulf of Mexico commercial fisheries rationalization has promoted economic benefits and accountability to annual catch limits, but most recreational fisheries are managed under regulated open access with relatively poor catch accounting. For many reef fish species, recreational fishing represents over half of total fishing mortality. Yet innovation in recreational management reform is lagging, in part because regulators' attention is diverted to contentious policy issues such as sector allocations. This talk reviews policy challenges in mixed-use fisheries, such as sector and sub-sector allocation disputes, the state of for-hire and private recreational fisheries management, and prospects for rights-based management reform in mixed use fisheries. We also introduce the Gulf Headboat Collaborative, an affiliation of headboat operators who are testing rights-based management in Gulf of Mexico recreational fisheries through an experimental fishing permit (EFP). This two-year pilot program represents cooperation between industry, government, academia, and the NGO community, providing a unique opportunity for empirical evaluation and an innovative model for adaptive fisheries management.

SP077**Recreational Fishing, Risk Preferences and Welfare****Jorge Holzer**, Kenneth McConnell

Department of Agricultural and Resource Economics, University of Maryland, College Park MD, USA

Wednesday, May 20 (4:00-4:15)—Recreational Fisheries

This study focuses on the impact of recreational anglers' risk preferences on trip choices. To this end, we develop a model that introduces uncertainty into a random utility model where the index for each alternative is expected utility. Some work has been conducted on this topic in fisheries economics. Bockstael and Opaluch introduced uncertainty in the commercial fisheries choices in the first application of random utility models. But in the context of choice experiments, which provide useful information for recreational fisheries preferences, there has been very little work on risk preferences. Attitudes towards risk may shed additional light on anglers' decision making. We use data from a 2010 choice experiment survey designed to provide preference information necessary to measure the economic effects of regulation changes on recreational anglers fishing for summer flounder, scup, and black sea bass. The survey, administered in conjunction with NMFS' Marine Recreational Fisheries Statistics Survey along the coastal states in the Northeast Region, asked anglers to choose between trips in which the number of fish caught is certain, and trips described by ranges of fish caught rather than an exact number. The survey is therefore well-suited to study anglers' trade-offs in the face of uncertainty on catch.

SP078

***Homo economicus* meets *H. politicus*: A Comparison Between Preferences of EPA Bureaucrats, Recreational Anglers, and the Public**

Håkan Eggert, Mitesh Kataria, Elina Lampi

Department of Economics, University of Gothenburg, Gothenburg, SE

Wednesday, May 20 (4:15-4:30)—Recreational Fisheries

In this paper we study whether environmental bureaucrats share preferences for environmental policy with the general public. We use the choice experiment method to elicit preferences for improvements in coastal cod abundance along the Swedish West coast. This is done for the general public, Swedish EPA (SEPA) bureaucrats, and for recreational anglers. Half of the respondents in each population were asked to choose the alternatives that best corresponded with their opinion, *Homo economicus*, and the other half was asked to make policy recommendations that they should be decisive for Swedish fisheries policy, *H. politicus*. Our approach facilitates a comparison between the preferences of the different groups given the same preference orderings, and an empirical test concerning the multiple preference hypothesis. Preferences of the general public do differ from preferences of both SEPA bureaucrats and recreational anglers. Moreover, the different roles also matters. For example, the recreational anglers are less self-oriented as *H. politicus*, reducing the difference in MWTP of general public and recreational anglers for the fish stop policy. Moreover, the differences in the average MWTPs are smaller between SEPA bureaucrats and the general public as *H. economicus* compared to when they answer as *H. politicus*.

SP079

How can Community-Based Management Improve an Outcome? The Effects of Revenue Sharing and Social Capital in a Fishery

Mihoko Tegawa¹, Hirotsugu Uchida¹, Christopher M. Anderson²

¹ Department of Environmental and Natural Resource Economics, University of Rhode Island, Kingston RI, USA

² School of Aquatic and Fishery Sciences, University of Washington, Seattle WA, USA

Wednesday, May 20 (4:15-4:30)—Fishing and Communities

We empirically disentangle the efficiency mechanism of revenue sharing, in which a group of harvesters shares catch and/or revenue among members of a fishery cooperative, by incorporating the influence of social capital. In addition to each of revenue sharing and social capital influencing a fishery independently we hypothesize social capital potentially affecting the efficiency that revenue sharing brings through strengthening collective fishing efforts performed as a group. This paper provides the first rigorous analysis to measure the effect of revenue sharing and social capital in a co-managed fishery and to identify the mechanism through which revenue sharing and social capital affect the outcome of a fishery. We quantified social capital using controlled economic experiments with fisherman subjects. Using a panel dataset containing 10 fishery groups and random-effects model with wild cluster bootstrap for small sample inference, we find evidence of the long-run positive effect of trust in a community on an economic outcome. The results also show that the fisheries with fishers having similar information network size achieve better stock conditions over time. However, we find no robust evidence of the effect of revenue sharing directly improving an outcome in a fishery or the effect of both revenue sharing and social capital interacting to affect the fishery or its management outcomes.

SP080

Do Catch Shares Increase Ex-vessel Prices in U.S. Fisheries?

Anna Birkenbach, David Kaczan, Martin D. Smith

Nicholas School of the Environment, Duke University, Durham NC, USA

Wednesday, May 20 (1:45-2:00)—Rights-Based Management

Catch shares appear to lower fishing costs by eliminating redundant capacity. Theory suggests that catch shares may also increase fishing revenue by enabling improved market timing, changes in the mix across fresh

and frozen products, and/or changes in quality. Anecdotally, ex-vessel price increases have been documented for a number of catch share fisheries, including the noteworthy Pacific halibut case. Do ex-vessel prices consistently increase when new catch shares are formed? If so, can these price changes be tied causally to the formation of the catch share? Despite compelling theory and anecdotal evidence, there is little systematic support for the hypothesis that catch shares increase ex-vessel prices. We test this hypothesis using a treatment effects approach for all U.S. catch share fisheries. We use difference-in-differences to identify ex-vessel price treatment effects. This method compares the price change in the treated fishery to the price change in the control fishery. Examples of our results from the South Atlantic and Gulf of Mexico include: a 30% ex-vessel price premium for wreckfish, a 15% premium for red snapper, premiums of roughly 15% for tilefish that are not statistically significant, and negative premiums for shallow water grouper, deep water grouper, gag, and red grouper that are sometimes statistically significant. In sharp contrast, our preliminary results for Alaskan halibut (using U.S. Pacific Northwest as a control) suggest a statistically significant 60% premium for halibut under ITQs (much larger than any of our South Atlantic and Gulf examples).

SP081

The Anatomy of a Multispecies Individual Fishing Quota (IFQ) Market in Development

Daniel S. Holland

NOAA Fisheries, Northwest Fisheries Science Center, Seattle WA, USA

Thursday, May 21 (8:30-8:45)—Rights-Based Management

In 2011 an individual fishing quota (IFQ) system was implemented for the limited entry trawl component of the Pacific groundfish fishery in the US. The IFQ system allocates quota shares (QS) for 29 IFQ stocks and individual bycatch quota (IBQ) shares for Pacific halibut. Each year quota shareholders are issued quota pounds (QP) which can be used to balance their own catches of IFQ species or can be traded. The complex multispecies nature of this fishery and the requirement to balance all catch with QP makes QP transferability a critical part of this IFQ system since fishermen have limited ability to control the species composition of their catch and may need to acquire QP to cover unplanned catch. Although a web-based system was created to enable QP transfers, this did not create a functional QP market automatically. Rather the market (and a variety of other mechanisms for distributing QP) is developing organically as quota holders, fishermen, and intermediaries develop trading and contractual relationships, and QP values are determined and evolve. I describe the structure of the QP market, how it has developed, and how it is performing. The analysis suggests that the market to date is thin and inefficient, and that this may be inhibiting utilization of fishery resources and profitability. I discuss the impediments to QP market efficiency and make recommendations on how more efficient multispecies markets might be facilitated in this and other multispecies IFQ fisheries.

SP082

The Role of Expectations in Modeling Fishing Fleet Capacity Changes

Barbara Hutniczak^{1,2}, Niels Vestergaard¹

¹ Department of Environmental and Business Economics, University of Southern Denmark, Esbjerg, DK

² Chesapeake Biological Laboratory, University of Maryland, Solomons MD, USA

Thursday, May 21 (4:45-5:00)—Markets and Trade

The paper analyzes a situation in which the fishing fleet is subject to restrictive regulation regarding the harvest of its primal target species due to biological overfishing that in turn reveals a high level of overcapacity. The goal is to model fishermen's expectations and likely responses to the government initiated transition to a sustainable fishery. The question the paper aims to answer is: to what degree anticipation of policy change may be delaying the fleet restructuring process. The investigated setting includes direct intervention in the form of a time-limited buyback program and two scenarios regarding future regulations. In the first, the fishery continues under Individual Vessel Quotas (IVQs). In the second scenario, introduction of Individual Transferable Quotas (ITQs) is expected in the near future. Under a rationality assumption, the exit decision depends on the expected sum of discounted profits in comparison with the

single buyback payment. The profits in turn depend on expectations regarding the form of the quota that may become a valuable asset in the future. The paper uses a restricted profit function approach. The advantage of the developed model is its flexibility with respect to the multispecies and multigear character of the fishing industry. An application is provided for the Polish trawler fleet targeting primarily cod.

SP083

Econometric Market Model for Alaska Sablefish

Stephanie Warpinski¹, Mark Herrmann¹, Keith R. Criddle², Joshua Greenberg³

¹ Department of Economics, University of Alaska Fairbanks, Fairbanks AK, USA

² Fisheries Division, University of Alaska Fairbanks, Juneau AK, USA

³ School of School of Natural Resources and Extension, University of Alaska Fairbanks, Fairbanks AK, USA

Thursday, May 21 (1:45-2:00)—Markets and Trade

Sablefish (*Anoplopoma fimbria*) are distributed from Japan to Baja California. Alaska is the world's principal supplier of sablefish with the majority of commercial landings occurring in the Gulf of Alaska and the Aleutian Islands. This demersal, long-lived fish is in one of Alaska's highest value commercial fisheries. In terms of both export and ex-vessel prices; the total value of the sablefish fishery is comparable to that of the Pacific halibut fishery. Although sablefish came to be managed under IFQs at the same time as halibut, the outcomes of IFQ implementation in this fishery have not received as much as attention as in the halibut fishery. We have developed a simultaneous equation market model for sablefish and used simulations to examine linkages between harvests, prices and revenues.

SP084

Groundfish Sectors Business Viability Assessment in New England: Analyzing the Date-Dependent ACE Leasing Price and Constraints of ACE Utilization

Jenny Sun¹, Andrew Kitts²

¹ Gulf of Maine Research Institute, Portland ME, USA

² NOAA Fisheries, Northeast Fisheries Science Center, Woods Hole MA, USA

Wednesday, May 20 (2:30-2:45)—Rights-Based Management

The New England groundfish fishery faced a major transition in 2010 when it moved from a days-at-sea effort control system to output controls with allocations to sectors. From this sector management system, 17 sectors were formed, with membership often grouped according to community affiliation, gear, relationships, and geography. A three-phase sector business viability assessment was conducted to gain an understanding of sector viability through business profiles, a simulation of the Annual Catch Entitlement (ACE) leasing prices by stock, and an analysis of the constraints that preclude sectors from fully utilizing their allocated ACE. By using Fishing Year 2010 to 2012 ACE trading information, a hedonic price model was estimated to discover the equilibrium leasing prices at various points of time and a principal component analysis (PCA) was used to identify the correlation of landings of stocks by broad fishing area. With this understanding of the date-dependent ACE leasing price that shows time preference of ACE trading and a better sense of which species need to be bought or sold to gain a target mix of ACE given some harvest objective, groundfish sectors will be provided a business management tool for making harvest and trading decisions. Results show that ACE leasing prices are primarily determined by the amount of ACE traded and the timing of the trades. Since no two sectors are alike, the sector-specific characteristics of gear type and vessel size are used to refine the model to calculate the overall weighted utilization measurement (based on the PCA major component that identifies the best combination of different stocks in each fishing area).

SP085**Diversification or Specialization: The Impact of U.S. West Coast Trawl Rationalization on Multiregional Fishery Participation and Effort**Lily Hsueh¹, Stephen Kasperski²¹ School of Public Affairs, Arizona State University, Phoenix AZ, USA² NOAA Fisheries, Alaska Fisheries Science Center, Seattle WA, USA**Wednesday, May 20 (4:30-4:45)—Rights-Based Management**

“Rationalization” or the change to catch share management in fisheries has been shown to lead to the slowing of fishing activity, input and effort consolidation, cost savings, as well as new market and product development. The effects of rationalization on fishermen’s behavior become more complex when one accounts for the spillover effects that catch share programs can create in other fisheries and other regions. The possession of secure harvesting privileges in one catch share fishery allows quota shareholders to expand operations in other fisheries since their share of the catch share fishery is protected (a “diversification” effect). However, there is an opportunity cost related to the slowing of the rate of fishing, given that more time spent fishing in the catch share fishery means there will be less time available for fishing elsewhere. Therefore, it is possible that more efficient vessels may expand their operations and specialize in the catch share fishery leaving the selling/lessor vessels to specialize in another fishery and/or region (a “specialization” effect). Which outcome is more likely is an empirical question, which we address by examining the recently implemented U.S. West Coast Groundfish Trawl Catch Share Program. Newly available cost and earnings data, product revenues and prices, and biological stock data allow us to calculate the average marginal effect of changes in West Coast species total allowable catches, prices, and vessel costs on the expected number of days spent fishing in Alaska to quantify the spillover effects of West Coast trawl rationalization on fisheries in Alaska.

SP086**Evaluating the impact of the Deepwater Horizon Oil Spill on Red Snapper IFQ Trading**Andrew Ropicki¹, Sherry Larkin²¹ Department of Agricultural Economics, A&M University, Corpus Christi TX, USA² Food and Resource Economics Department, University of Florida, Gainesville FL, USA**Wednesday, May 20 (2:45-3:00)—Rights-Based Management**

During the first three years (2007-2009) of the Gulf of Mexico red snapper IFQ program most quota lease trades were local, involving fishers that lived in the same communities. In 2010, the red snapper quota lease market changed as more IFQ participants began trading quota with fishers from different regions of the Gulf. One possible cause of the change in trading was the Deepwater Horizon Oil Spill in April 2010, which led to widespread fishing closures in the northern Gulf of Mexico that lasted for much of the remainder of the year. Fishing closures led to some affected fishers looking to lease out their 2010 quota before it became worthless (non-harvested quota does not carry forward to future years); however, unlike in previous years where they would trade the quota locally they were forced to lease their quota to different areas of the Gulf since their neighbors were subject to the same fishery closures. This research compares IFQ trading data in the years prior to the spill (2007-2009) to 2010 trading data to determine how the oil spill impacted quota trading. Specifically, this analysis compares 2010 quota trading before and after the spill to the same periods in previous years to see if the spill changed the nature of quota trading. In addition, the analysis examines if new trading relationships created in the wake of the oil spill continued into future years.

SP087

Can Fisher Social Networks be used to Explain IFQ Trading?

Andrew Ropicki¹, Sherry Larkin²

¹ Department of Agricultural Economics, A&M University, Corpus Christi TX, USA

² Food and Resource Economics Department, University of Florida, Gainesville FL, USA

Thursday, May 21 (9:45-10:00)—Rights-Based Management

Many of the tangible benefits of catch share programs (e.g., reducing overcapacity) are dependent on the trading of shares. Additional trading-related questions (such as whether landings will change port or be concentrated geographically) are also important to the overall evaluation of a fishery, but are often asked only during post-implementation program reviews. Using both quota trading data and survey data on information sharing among Gulf of Mexico IFQ fishers, this research analyzes the overlap between fisher information sharing networks and quota trading networks to measure the extent to which quota trading is accomplished through social networks. Comparing these two networks will provide information on the role of acquaintanceships in quota trading markets and the value of using fisher survey data on information sharing to gain a better understanding of trading behavior. The insights of this analysis could provide policy makers with a means of estimating how quota will flow through a fishery prior to implementation of a catch share program by surveying potential participants (commercial, for-hire, and/or recreational) about their information sharing networks. These insights would allow policy makers to predict possible issues related to catch share management in a fishery prior to implementation and design the management program in response to these potential issues.

SP088

Caught up in Catch Shares: Regulations Matter

Andrea Robertson¹, Tasha Sutcliffe¹, Brenda Reid-Kuecks¹, Devlin Fernandes¹, **Jim McIsaac**², Des Nobles², Kegan Pepper-Smith³

¹ Ecotrust Canada, Vancouver, BC, CA

² T Buck Suzuki Foundation, New Westminster, BC, CA

³ Faculty of Law, University of British Columbia, Vancouver, BC, CA

Wednesday, May 20 (3:45-4:00)—Rights-Based Management

Individual transferable quotas (ITQs) have been used in British Columbian fisheries management for more than 25 years. When they were implemented, few restrictions were placed on who could own or lease quota. As a result, many retiring fishermen retain quotas to lease or sell to processors and corporations rather than new entrants. Because new entrants are unable to compete with processor financing and have no mechanism to secure access to the resource, recruitment is near zero. Fishermen have become price takers, with related effects on the safety and stability of the industry. Most economic research has focused on the impacts of ITQs at a fleet wide scale. Our research dives deeper, exploring the effects on individual fishermen, particularly those in small boat fleets. Drawing on harvest, income, and socioeconomic data from the Government of Canada, interviews with fishermen, and published literature, our research demonstrates that ITQs have had a detrimental effect on many fishing enterprises, particularly new entrants. This deeper analysis of the system proves that despite producing more economically efficient fleets, there have been serious implications for BC's remote coastal communities. Interactive data visualizations offer new perspectives on the issue, illustrating the rapid rise of consolidation in BC's fishing fleets and the rapid loss of viable employment for many participants. By closely examining boat-level economics in tandem with on-the-ground interviews, this project humanizes the fishermen at the heart of the ITQ debate, giving voice to their perspectives, data to their circumstances, and highlighting opportunities for positive change in fisheries management.

SP089

Dynamic Efficiency Costs of Non-efficiency Objectives in Tradable Permit Programs

Kailin Kroetz¹, James N. Sanchirico², Daniel K. Lew³

¹ Resources for the Future, Washington DC, USA

² Department of Environmental Science and Policy, University of California Davis, Davis CA, USA

³ National Marine Fisheries Service, Alaska Fisheries Science Center, Seattle WA, USA

Wednesday, May 20 (4:00-4:15)—Rights-Based Management

Economic efficiency is not the sole objective in many tradable permit programs. Other objectives may include community, cultural, and other non-economic goals. In response to the presence of these non-efficiency goals, restrictions on trade are often implemented. However, if these restrictions on trade are binding, they likely decrease economic efficiency. We develop a dynamic discrete choice model to investigate the impacts of restrictions on the evolution of a fishery managed with an individual transferrable quota program. Using data from the Alaskan Halibut and Sablefish IFQ program, we model the transition dynamics from the initial allocation of permits and identify the key mechanisms that impact the transition period. Then, we use the model to develop counterfactual scenarios without one or more of the restrictions in place. This allows us to quantify the magnitude of the economic efficiency loss due to restrictions as well as the success of restrictions in meeting non-efficiency goals. Our results suggest that restrictions can significantly alter the evolution of the transferrable quota program, suggesting that costs and benefits should be quantified and considered during the program design phase. We show that adjustment in the fishery is not instantaneous, and that dynamic decision-making plays a role in observed profitability and exit. We find evidence of economic costs associated with restrictions, but also changes in anticipated benefits such as the number of active fishermen and vessels in the fishery, the characteristics (e.g., length) of vessels in the fishery, and the geographic distribution of participating fishermen and vessels.

SP090

Bigger Pie, Smaller Piece: How Fishery Rights-Based Management Affects Seafood Processors

Eric Edwards¹, Sara A. Sutherland²

¹ Dept. of Applied Economics, Utah State University, Logan UT, USA

² Bren School of Environmental Science and Management, University of California, Santa Barbara CA, USA

Wednesday, May 20 (4:15-4:30)—Rights-Based Management

The regulation of a natural resource affects downstream firms through the timing and amount of extraction and the organization of the extracting sector, as well as its impact on the intermediate market and the potential to coordinate production. In this paper we examine the effect of the introduction of rights based management (RBM) in fisheries on downstream seafood processors. While the literature has focused on both modeling the effect theoretically and examining it empirically, it has not compared the drivers of these changes across different fisheries. Similarly, the empirical literature on other industries has typically focused on single market. In this paper we utilize variation across four economically significant Alaskan fisheries to statistically test the effect of the introduction of RBM on processor organization. We first construct a general model of the bilateral bargaining problem between harvesters and processors that allows us to reconcile the results of much prior theoretical work. We use this model to formalize a general hypothesis that processor organization depends critically on several factors idiosyncratic to each fishery: the pre-RBM structure of the processing sector, RBM design, fish and fisher characteristics, and the final product market. We then examine pre- and post-RBM data in halibut, sablefish, Pollock, and cod fisheries using Commercial Operator's Annual Reports (COAR) from 1990-2013. We track individual processors in each fishery in terms of their input volume, ex-vessel price, entry/exit, market power, and final product forms and prices. Results inform IFQ policymaking and anti-trust regulation.

SP091

Understanding the Determinants of Hired Skipper use in the Alaska Halibut IFQ fishery

Marysia Szymkowiak¹, Ron Felthoven²

¹ Marine Policy, College of Earth, Ocean and Environment, University of Delaware, Newark DE, USA

² NOAA Fisheries, Alaska Fisheries Science Center, Seattle WA, USA

Thursday, May 21 (8:45-9:00)—Rights-Based Management

There is a growing body of literature evidencing the distributional impacts of leasing in catch share fisheries, but little research on the determinants of the leasing decision itself. This study addresses this critical gap by using a discrete choice model to examine the determinants of the decision of quota shareholders to use hired skippers in the Alaska halibut IFQ fishery. Since the implementation of the Alaska halibut IFQ program there has been an increasing reliance on hired skippers by initial quota share recipients in relationships that are often functionally equivalent to leasing. This has frustrated the North Pacific Fishery Management Council's efforts to ultimately transition the IFQ catcher vessel fleet to a group of owner-operators. This study shows that the probability of hiring a skipper is statistically significantly related to the residency and shareholdings of shareholders and identifies potential attributes of shareholdings, including quantity and diversity. This information may allow fishery managers to both predict the degree of such practices and customize regulations to lead to their preferred outcomes in program design or modification.

SP092

Empirical Evidence on the Economics of Stakeholder Opposition to Fishery Rationalization

Sara A. Sutherland

Bren School of Environmental Science and Management, University of California, Santa Barbara CA, USA

Thursday, May 21 (11:00-11:15)—Rights-Based Management

In a common-pool resource setting, policies that are best for the health of the resource and economically beneficial to those directly involved in management are not necessarily welfare enhancing to all stakeholders. The implementation of rights based management (RBM) in fisheries has been met with a great deal of resistance despite its well-documented benefits of increased harvesting profitability and resource health. In the United States, industry members, small-scale fishermen and fishing community members can influence policy design and timing of implementation. This paper examines the opposition to RBM in the context of the Alaskan Halibut and Sablefish fisheries. The Alaskan Halibut and Sablefish Individual fishing quota program was first introduced as a potential management regime in 1988. Due to disputes over allocation, concerns for small fishing communities, and other program characteristics, the IFQ program was not implemented until 1995. Based on the expected distribution of rents under IFQs, I predict three groups will display a higher degree of opposition: residents of remote communities, small vessel owners, and fishermen skilled in a derby setting. I create a novel dataset by coding available public comments between 1988 and 1992 from North Pacific Fishery Management council meetings, public hearings, and letters. I show that parties located in remote locations and those with small vessels are significantly more likely to oppose IFQs. These findings suggest that considering small communities and industry members when designing RBM may reduce opposition and shorten the time between initiation and implementation, and thus improve efficiency.

SP093

Distributional Effects of Quota Self-Governance by French Producer Cooperatives: The Case of the Bay of Biscay Sole Fishery

Manuel Bellanger, Claire Macher, Olivier Guyader

Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER), UMR AMURE, Département RBE, Unité d'Economie Maritime, Plouzané, FR

Wednesday, May 20 (3:30-3:45)—Rights-Based Management

Quota allocation mechanisms have distributional effects with important issues concerning the economic organization of the fishery and acceptability. Yet, these distributional effects are rarely studied. In France,

where fishing rights are not transferable, the quotas are shared between producer cooperatives based on the historical landings of their members. Each cooperative is then responsible for distributing its quotas to its members (i.e. pooling and redistribution). What are the distributional effects of the different quota management systems adopted by cooperatives on quotas and productions? The Bay of Biscay sole fishery is a good case study for investigating this question in the context of the EU Common Fishery Policy reform and the individualization of quota management by cooperatives as quotas become more constraining. This paper presents comparisons between (i) theoretical allocations by vessel based on historical landings; (ii) theoretical allocations according to cooperative quota management systems; (iii) actual landings observed. Concentration and inequality indicators were used to quantify and qualify distributional effects. Results showed that the various quota management systems among cooperatives have contrasting effects on vessels' productions including benefits to the most sole-dependent vessels in some cooperatives and benefits to the small scale fisheries in other cooperatives.

SP094

Adaptation to Climate Variation in a Multispecies Fishery: The West Coast Groundfish Trawl Fishery

Lisa Pfeiffer

NOAA Fisheries, Northwest Fisheries Science Center, Seattle WA, USA

Thursday, May 21 (9:00-9:15)—Rights-Based Management

The West Coast groundfish trawl fishery lands 26 percent of all fish, including shellfish, landed on the West Coast of the United States. However, the average West Coast groundfish trawl fishery participant receives only about 50 percent of their annual revenue from groundfish. The other three fisheries that make up the majority of extra revenue are the Dungeness crab, pink shrimp, and Alaska pollock fisheries. The abundance and timing of maturity of these target species are each highly driven by climatic cycles. In this paper we explore the drivers of participation in and allocation of time between fisheries when harvesters participate in multiple fisheries. Prior to the transition to a catch share management system in 2011, the groundfish fishery was primarily driven by management. Season openings and trip limits restricted landings, and participation in other fisheries potentially involved a trade-off of lost groundfish landings. After the transition to catch shares, we observe shifts in timing and participation more closely related to the climate-driven biological cycles of crab, shrimp, and pollock. Going forward, we expect fishermen allocate time between fisheries by maximizing net revenue from participation in the entire portfolio of fisheries available to them. The expected revenue and costs of each will at least partially depend on climate factors. Climate projection models can be used to predict how the patterns of participation and revenue will change in the future.

SP095

A Model for Predicting Catch and Revenues in a Multispecies Fishery with Inter-Annually Unstable Quotas

Chad Demarest

NOAA Fisheries, Northeast Fisheries Science Center, Woods Hole MA, USA

Thursday, May 21 (10:45-11:00)—Rights-Based Management

Quota-managed commercial multispecies fisheries face binding catch constraints that may vary based on stock-level individual catch allocations, fishing technology, quota market liquidity, final product market conditions and environmental factors. Predicting the impacts of non-marginal quota allocation changes in a multispecies fishery requires understanding and predicting how fisherman will adjust their fishing practices to accommodate anticipated constraints. A constrained optimization simulation model of the multispecies Northeast (US) groundfish fishery has been used for the past three years to predict fishery catch, revenues, stock-level constraints and fleet-level distributional impacts. The model is predicated on the simple notion that fisherman seek to maximize the value of their aggregate catch with respect to their most binding quota constraints. Predictive accuracy and implications for management are discussed. The results provide vital

insights into many critical factors affecting quota-based multispecies fishery management such as inter- and intra-annual catch and catchability variation, changing market conditions and fishing technologies, quota market liquidity and transparency, production frontiers and inefficiency, and stock-level shadow values.

SP096

Varying Profitability across Gear Types in a Multi-Gear, Multispecies IFQ Fishery

Erin Steiner, Daniel S. Holland

NOAA Fisheries, Northwest Fisheries Science Center, Seattle WA, USA

Thursday, May 21 (9:15-9:30)—Rights-Based Management

Individual fishing quota (IFQ) systems are typically expected to increase the profitability of a fishery and improve sustainability by ensuring catches remain within quotas. They can also have important distributional and ecological implications that result from shifts in catch and effort between different gears, regions, and habitats. In multispecies fisheries these changes may be hard to predict since the value of quota and the amount and distribution of catch of primary target species may be dependent on prices, abundance, distribution, and quota availability of other jointly caught species. We analyze how the implementation of IFQs in the West Coast Groundfish Trawl Catch Share Program has, and may in the future shift the distribution of catches, effort and revenue in the fishery. We focus on the most valuable component of the groundfish fishery that targets sablefish, either independently using fixed gear, or jointly with Dover sole and thornyhead rockfish using trawl gear. We simulate the effects of changes in prices of sablefish, Dover sole and fuel on trip level profitability. Our analysis suggests significant differences in the value of sablefish quota by gear and regionally that could lead to shifts in where and how sablefish quota is used. These shifts can have important ecological as well as distributional consequences. Our analysis also shows that relative profitability is quite sensitive to changes in fish and fuel prices with the range of changes seen in recent years. Thus movement of sablefish spatially and between gears is likely to be dynamic going forward.

SP097

Changes in the Distribution of Alaska's Commercial Fisheries Entry Permits

Marcus Gho, Craig Farrington, Kurt Iverson

Commercial Fisheries Entry Commission, Alaska Department of Fish and Game, Juneau AK, USA

Thursday, May 21 (9:30-9:45)—Rights-Based Management

A brief overview of changes in the distribution of permanent entry permits in Alaska's limited fisheries is provided in this presentation. From 1975 to 2014, 79 permit types have been issued in 65 fisheries. This presentation provides an overview of Alaska's limited entry program, gives statewide data and some fishery-specific data on the number of permit transfers, geographic distribution of permit holders, changes due to permit transfers, changes due to the relocation of permit holders, and the 2014 year-end geographic distribution of permit holders.

SP099

Fish or Flight: Modeling the Migration Decisions of Fish Harvesters in Rural Alaska

Jennifer Meredith¹, Christopher M. Anderson²

¹ Department of Economics, University of Washington, Seattle WA, USA

² School of Aquatic and Fishery Sciences, University of Washington, Seattle WA, USA

Wednesday, May 20 (4:45-5:00)—Rights-Based Management

This research incorporates the dynamics of the fishery and discrete changes in fisheries management into a model of migration in order to analyze the drivers of outmigration in 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. The

implementation of a limited entry permit system in the Alaska salmon fishery and individual quotas in the Alaska commercial halibut and crab fisheries 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 interregional migration that integrates fluctuations in the value of these fisheries and transactions within the quota and permit markets is tested using regional data on rural Alaskan migration flows. Although the early impact of the transition to rights-based management appears to be negligible, there is evidence that the long run effect is an increase in rural outmigration, particularly from regions where the initial endowment of permits or quota was relatively high.

SP101

Japanese Consumers' Environmental and Health Consciousness Revealed by Choice Behavior at Conveyor Belt Sushi Restaurants

Taro Oishi

Fukuoka Institute of Technology, Fukuoka, JP

Thursday, May 21 (2:00-2:15)—Markets and Trade

An online survey in September 2014 targeting 1,200 Japanese consumers segmented by age asked respondents about their environmental and health consciousness, and their consumption patterns at conveyor belt sushi restaurants. Empirical analysis of the data collected through the survey showed that approximately 90% of respondents have been to a conveyor belt sushi restaurant at least once in their lifetime, and analyzing purchasing behavior at the restaurant was a suitable method to gain a comprehensive understanding of consumers' fish preferences. This study used an ordered probit analysis to examine the relationship between consumers' environmental and health consciousness and the sushi items consumed. The results show that respondents concerned about ingesting mercury from natural fish preferred salmon over tuna, while people concerned about ingesting antibiotics from cultivated fish preferred the opposite. Moreover, people with anxieties over eating food potentially contaminated by radiation tended to eat yellowtail, which is mainly produced in western Japan, far away from the power plant struck by the 2011 Tohoku earthquake and tsunami. However, consumers with a sense of the potential crisis over declining fish resources tended not to refrain from eating tuna and eel, whose stock levels are decreasing. These results suggest that Japanese consumers will take actions with regard to their own health, though will not modify their behaviors when it comes to fish resource conservation, and demonstrates a need to create mechanisms to encourage more responsible consumption.

SP102

Demand for Fresh and Frozen Seafood in Norway: Species, Product Form and Demographics

Frank Asche¹, Kristin Lien², Pei C. Liu¹

¹ Department of Industrial Economics, University of Stavanger, Stavanger, NO

² Norwegian Seafood Export Council, Tromsø, NO

Thursday, May 21 (1:30-1:45)—Markets and Trade

The demand for seafood has in recent years received increased attention as it is regarded as healthy and per capita consumption and trade is increasing. In recent years, a number of new data sets with detailed household information on seafood consumption have been made available, allowing researcher to obtain more information with respect to consumption patterns. In this paper we investigate seafood consumption for three species (cod, saithe and salmon) and two product forms (fresh and frozen) in Norway containing some new demographic measures in addition to the common ones. One of them is associated with a very interesting result; households owning a cat have a significantly higher expenditure on frozen saithe. We also find that seafood expenditures vary by retail chain, and that substitution is strong between the species in a frozen product form but weak for fresh. Zero-observations is a substantial challenge when using household data, particularly at a disaggregated level. Most approaches dealing with this issue does not account for the adding-up property of demand systems, and are accordingly not invariant to which equation is deleted. We

address this issue by accounting for the missing observations in all equations, and are thereby able to ensure that adding-up holds.

SP103

Nonlinear Inverse Almost Ideal Demand System for Shellfish in Rhode Island: A Market Study

Pratheesh Sudhakaran, Hirotsugu Uchida

Department of Environment and Natural Resource Economics, University of Rhode Island, Kingston RI, USA

Thursday, May 21 (2:15-2:30)—Markets and Trade

The opening and closing of the shellfish harvest area inevitably influences the market, particularly the exvessel prices that harvesters receive. Without a better understanding of shellfish market and its behaviors, it is impractical to determine the impact of management policies on the market as well as the fishery resources. Using Rhode Island data, this study aims to understand and quantify the market interactions of wild harvested shellfish products in Rhode Island. Specifically, we estimated how sensitive are the exvessel prices of shellfish products (three market categories for quahog, scallop, and whelk) with respect to the quantity landed, both of its own and other products. The data were obtained from Statistical Atlantic Fisheries Information System (SAFIS) and analyzed using Nonlinear Inverse Almost Ideal Demand System (NL-IAIDS) to estimate the price sensitivity of shellfish. We found that exvessel prices were inflexible to the variation in quantity landed, however the magnitude of sensitivity varied across products: most sensitive was necks and least sensitive was cherrystone. The study also found that shellfish products included in this study were all substitutes to each other which have a policy implication. The substitutive relationship between the shellfish species would help fishermen to maintain their profit by switching to catch other species/products if catch of one of the species/products is predominant. However, the magnitude of the relation varies with products. Our result showed that the relationship was stronger between necks and cherrystone quahog and least affected between cherrystone and scallops.

SP105

Are Catfish Inspections an Administrative Trade Barrier to Imported Fish?

Kelly A. Davidson, Jaclyn D. Kropp

Department of Food and Resource Economics, University of Florida, Gainesville FL, USA

Thursday, May 21 (2:30-2:45)—Markets and Trade

The Agricultural Act of 2014 (Public Law 113-79) amended legislation regarding the U.S. catfish inspection program to include “all fish of the order Siluriformes,” encompassing imported species: basa, tra, and pangasius. Furthermore, the amendment finalized the transition of catfish and catfish-like product inspection responsibilities to the USDA Food Safety and Inspection Service (FSIS), leaving all other fish species under FDA inspection. The shift in responsibility produces tighter food safety mandates for domestically produced and imported catfish, which some argue acts as an administrative trade barrier protecting the U.S. catfish industry. Since domestic producers were likely subject to similar standards under FDA inspection, the cost of compliance is likely higher for international fish farmers who mostly operate in low-income countries. We analyze the potential trade distortions of the regulation change on domestic catfish production and imported products. Furthermore, we analyze the impact of the new regulation on the market share of imported fish products relative to domestic production. The reformed legislation will likely decrease market competition from imported catfish-like products. Additionally, the competition from tilapia imports might increase since tilapia inspection remains under FDA regulation and there is evidence that consumers view catfish and tilapia as substitutes. Using data from the USDA Economic Research Service and NOAA National Marine Fisheries Service, we estimate the potential effects of the new regulation under various assumptions regarding the cost of compliance. The impact of the new regulation depends on assumptions pertaining to the differences in compliance costs across industries and markets (domestic versus foreign).

SP106

China Squeeze: What Happens When Your Biggest Customer Says No?

Jonathan King

Northern Economics, Anchorage AK, USA

Thursday, May 21 (3:45-4:00)—Markets and Trade

Over the last decade direct exports to China and Hong Kong of Pacific Geoduck have grown to encompass more than 80 percent of U.S. geoduck production. In December 2013 China shut its doors to U.S. geoduck over possible arsenic contamination and imports from the U.S. fell from over 250 MT per month to less than one MT per month. What are producers to do when they lose the biggest customer for a \$250 million dollar industry? Do prices crater? Did producers find new markets? Are geoducks left in the ground to grow another year? Did regulators in Washington's wild fishery delay planned auctions or accept lower auction values as the price for keeping revenues flowing. This presentation explores how fishermen, growers, and managers adapted to China's ban on geoduck imports and the fact that overnight their largest customer could no longer legally accept their product.

SP107

A Unified Pricing Framework for Estimating Aggregate Fisheries Prices

Benjamin E. Fissel, Michael G. Dalton

NOAA Fisheries, Alaska Fisheries Science Center, Seattle WA, USA

Thursday, May 21 (4:00-4:15)—Markets and Trade

Primary economic data for fisheries consists of revenues and quantities from a census dataset (e.g., fish tickets or processor reports). These data are used for a variety of purposes including the calculation of "standard" exvessel (or wholesale) prices. Different linear aggregation method can be used to estimate aggregate prices such as the standard ratio-based calculations (e.g., ratio-of-means, mean-of-ratios), or regression (e.g., ordinary least-squares). We show these aggregation methods can be expressed in a unified framework highlights the trade-offs between the different methods. There are non-trivial difference in the in the prices calculated depending on the procedure. Estimators are also considered within a statistical framework where tools are available to encompass real-world market features and evaluate uncertainty in price estimates. For example, the notion that the actual price paid in the market is random with a distribution is more consistent with Bayesian framework, in contrast to classical regression where quantity is related to value through a constant but unknown price (i.e., assuming the law of one price). The methods discussed are compared empirically in an application to estimating the annual exvessel prices of the Alaskan crab fisheries.

SP108

Do Fishermen Benefit from MSC Certification? Analysis of Exvessel Prices in Multiple Fisheries

Adam Stemle¹, Hirotsugu Uchida¹, Cathy Roheim²

¹ Department of Environment and Natural Resource Economics, University of Rhode Island, Kingston RI, USA

² Department of Agricultural Economics, University of Idaho, Moscow ID, USA

Thursday, May 21 (4:15-4:30)—Markets and Trade

Fisheries certification programs utilize an ecolabel to create market-based incentives for better management and ecological improvements in ocean fisheries. The Marine Stewardship Council (MSC) ecolabel has the longest and broadest presence in the market relative to other fisheries ecolabels, and represents 10% of seafood the global market, having certified 224 fisheries. A number of studies have investigated whether consumers are willing to pay a premium for ecolabeled seafood, such as the MSC ecolabel, relative to non-ecolabeled seafood and found evidence that consumers indicate a preference for ecolabeled seafood. However, relatively little literature exists on the economic benefits of ecolabeling programs on fishermen, such as to dockside prices. The focus of this paper is to examine the effect of MSC certification on exvessel prices of three different certified fisheries (e.g., the treatment) relative to exvessel prices from fisheries that are similar yet not certified (e.g., the control). Fisheries included as certified fisheries are Alaskan salmon,

Alaskan halibut, and the Kyoto Danish Seine Fishery Federation (KDSFF) flat-head flounder in Japan. The contribution of this paper is thus in providing an analysis of the effect of MSC certification on relative prices between certified and non-certified fisheries for several fisheries. Our models produced results that indicate that different fisheries (and different species for salmon) have experienced different economic effects from certification.

SP109

Consumer Heterogeneities on their Attitudes Toward Conservation on Ocean Environment

Nobuyuki Yagi

Graduate School of Agricultural and Life Sciences, University of Tokyo, JP

Thursday, May 21 (4:30-4:45)—Markets and Trade

Consumers tend to have stronger preferences for consuming fish that occupy higher trophic levels in the ocean ecosystem. For instance, tuna is one of the ocean's top predators and the carrying capacity of tuna in the ocean ecosystems is smaller than for other fish species (such as sardines) that occupy lower trophic levels. An online survey was conducted in March 2014 by the author's team. It collected responses from 3,332 residents in Japan, and the survey results indicate that 75% prefer tuna, while 52% prefer sardine. Another online survey to assess people's attitude toward the conservation on the ocean environment was conducted in August 2013 by the author's team and collected responses from 1,042 residents in Japan. One of the questions asks "when you purchase food in the market, to what extent do you pay attention to the environment impacts potentially caused by your purchasing behavior"? Factor analyses were conducted on the responses, and it was identified that "persons with leadership role" and "persons with long-term perspective" relatively paid higher attentions to the environment when purchasing food. Taken as a whole, it can be argued that heterogeneities exist among consumers on their attitudes toward the environmental impacts potentially caused by own purchasing behaviors and that certain information dissemination strategies which precisely target certain group of people can be developed using the study results.

SP110

Assessing the Value and Role of Seafood Traceability from an Entire Value-Chain Perspective

Brian Sterling¹, Martin Gooch², Benjamin Dent³, Nicole Marenick², Alex Miller⁴, Gil Sylvia⁵

¹ Institute of Food Technologists, Global Food Traceability Center, Washington DC, USA

² Value Chain Management International, Oakville, CA

³ Value Chain Management International, Tonbridge, UK

⁴ Gulf States Marine Fisheries Commission, Biloxi, MS

⁵ Hatfield Marine Science Center, Oregon State University, Newport OR, USA

Thursday, May 21 (3:30-3:45)—Markets and Trade

The traceability practices of 48 seafood businesses were assessed as part of an evaluation of nine global seafood value chains (from harvest to retail). The research was conducted through direct interviews and written surveys in order to assess the reasons why traceability systems were used to strengthen business performance. The study was designed to determine which industry, product, or chain characteristics enhanced a seafood business' ability to generate benefits from traceability practices. This included understanding the impacts that traceability information has on commercial performance and the relationships that exist between individual businesses. Using a value chain classification scheme, none of the nine chains were found to be "fragmented", two were classified as "cooperative", five were "coordinated", and two were "collaborative". Based on twenty seven benefit categories, collaborative chains generated significantly greater traceability related benefits than other chains. Most benefits were more important to upstream as compared to downstream members of a seafood chain. Benefits included enhanced product quality, reduced costs, and improved risk management. Successful firms exhibited greater willingness to share information and considered traceability research to be of value to their future success. Evidence also suggests that traceability information system costs may be scale dependent and relatively higher for smaller firms. Based on these

findings, the research concludes with policy and research recommendations for businesses, governments, and NGOs.

SP111

Empowering Domestic Artisanal Fishers as Environmentally and Financially Sound Alternatives to Distant-water Fishing Vessels

Christopher S. Wright¹, K.D.M. Gamage², **Samanthala Hettihewa**³

¹ Holmes Institute, Melbourne, AU

² (retired engineer), kasyapachandra@yahoo.com

³ Federation University of Australia, Ballarat, AU

Thursday, May 21 (8:30-8:45)—Small-Scale Fisheries

In recent decades, distant-water fishing vessels (DWFVs) have drawn increasing criticism for exacerbating misery in developing nations. As part of a resolution to this issue, a coalition of academics, fishers, processors and others developing nations are field-testing new technologies to extend the fishing power and reach of local small-to-medium-boat artisanal fishers to empower them to displace DWFVs. In the preliminary field trials, the technology raised the fishing power of small-vessels by over seven-fold and quadrupled their maximum-effective-fishing depth to 400 meters. The second testing round will occur in Spring 2016 and will seek to increase the number of tests (and parallel controls) from ten-fold and expand the maximum effective fishing depth to 1,600 meters. Such capabilities will strengthen the ability of the governments of coastal developing countries to either exclude DWFVs from their exclusive economic zones (EEZs) or negotiate and enforce better agreements. Recognizing that new technology outcomes are often a mixed blessing, a vital part of this endeavor is to establish the best approach to release and use the innovations. Thus, at this point, the coalition is unwilling to release details on the new technologies. Instead, this paper documents the project's intent, its field-test design/methodology, results and a vision for how its innovations might best be introduced to developing-nation fishers. This article should interest fisheries policy makers, processors, academics, artisanal fishers and diplomats.

SP113

Collective Rights in Artisanal Fisheries and the Trade-Offs in Fisheries Policies: An Analysis of Distributive Policies

Miguel Jara-Iturra¹, Jorge Dresdner-Cid^{1,2,3}, Walter Gómez^{2,4}

¹ Department of Economics, Universidad de Concepción, Concepción, CL

² Research Nucleus on Environmental and Natural Resource Economics, Universidad de Concepción, CL

³ Interdisciplinary Center for Aquaculture Research (INCAR), Concepción, CL.

⁴ Department of Mathematical Engineering, Universidad de la Frontera, Temuco, CL

Thursday, May 21 (9:00-9:15)—Small-Scale Fisheries

This research analyzes the effects that a redistributive fishing quota policy, within a collective rights quota assignment system, might have on the profits and employment of artisanal fisher organizations. The Chilean authorities have been pursuing a deliberate quota redistributive policy between ship-owners of different vessel categories. This policy has affected income distribution between organizations. We use this experience to study the impact of distributive policies in artisanal fisheries. We use a multi-objective programming model and apply it to the common sardine and anchovies fisheries in the Biobío Region in Chile. The results indicate the presence of trade-offs between the equity–profits and equity–employment objectives. However, the scope for effective redistributive policies seems limited if the artisanal organizations consume their assigned quotas entirely. Moreover, the results suggest the existence of widespread inefficiencies in the effort allocation within the organizations, independently of the weight given to the different objectives.

SP114

The Cost of Avoiding Sea Cucumber Stock Depletion

Alvaro Hernández-Flores, Alfonso Cuevas-Jiménez, Javier Aranda-Nah
Escuela de Recursos Naturales – UNEXMAR, Universidad Marista de Mérida, Yucatán, MX

Thursday, May 21 (9:15-9:30)—Small-Scale Fisheries

In 2013 a stock of sea cucumber (*Isostichopus badionotus*) was discovered in northern shelf of Yucatan. A survey calculated a biomass of 17,600 tons. The species has an attractive price for local fishers, therefore, in order to avoid the “race for sea cucumbers” and the collapse of the stock, authorities established a total quota of 1,278 tones, issued a limited number of permits and restricted the fishing season to six weeks. Because of fishers’ dynamic behavior and the installed local fishing capacity, the applied effort was higher than the authorized (750 boats per day). Regulations were not enough to avoid excess fishing and entry of non-authorized boats, driving the stock to a low level. We developed a spatial and density dependent bioeconomic model which calculates an optimum pathway to maximize the profits without putting the stock in peril. The model operates seasonally in the short-run. Because of catchability and cost depend on the sea cucumbers densities, both were modeled with asymptotic functions. In order to avoid the Allee effect, the species requires a minimum density of 0.1 individuals per square meter. Our results indicate that the maximum quota could be 5,700 tons, which is about 32% of the vulnerable biomass. This quota would produce profits of US\$2,300,000. If minimum density were neglected, the system would lead the biomass to 8,400 tons, instead 11,000 tons, with extra profits of US\$76,000; however, in such level the density would be 0.08 individual per square meter, reaching the Allee effect and impeding the stock recovery.

SP115

Fishing Season in Reproductive Period: a Sustainable Management Strategy for the *Octopus maya* Fishery of Yucatan Shelf?

José A. Duarte, Juan Carlos Seijo, Alvaro Hernández-Flores
Universidad Marista de Mérida, Mérida, Yucatán, MX

Thursday, May 21 (9:30-9:45)—Small-Scale Fisheries

This paper analyzes the sustainable harvest of the small-scale octopus fishery of Yucatán continental shelf, which has a fishing season occurring during species reproductive period. The spawning and post-spawning egg care by females induces them to stop eating once they have spawned. Its only behavioral activity is to protect progeny. In addition, *O. maya* larval stages occur within the egg protected by spawner. There is no planktonic larval occurrence, avoiding predation and adverse oceanographic conditions mortality. Females die of starvation about 50 days after spawning, about a week after eggs hatch. An age structured bioeconomic model with seasonality was built to explore the effect of changes in the fishing season of this short-lived (12-18 months) semelparous cephalopod. Spawning, hatching and recruitment seasonality was modeled using the distributed delay function. The fishing method used in the Yucatan shelf to fish for octopus consists of a rod with lines having crabs as bait and weights with no hooks. Male/female ratios indicate that during reproduction period the occurrence of females in the harvest decreases as spawning progresses during the fishing season. Results indicate that the effect of using a fishing method providing food (fishing with bait, i.e., crabs) instead of habitat (fishing with pots or traps) protect spawners from being harvested and therefore allows for sustainable generations of recruits, given the relatively strong stock-recruitment relations calculated. Fishery management based on considerations of reproductive behavior and fishing method used may determine the sustainable performance of fisheries targeting post-spawning egg care species. The effect of changes in the fishing season is also explored in the paper to identify the bioeconomic optimum fishing season.

SP117

Cooperation, Externalities, and Spatial Property Rights: Implications for Small Scale Fisheries Management

Gabriel S. Sampson¹, James N. Sanchirico², James E. Wilen¹

¹ Department of Agricultural and Resource Economics, University of California, Davis CA, USA

² Department of Environmental Science and Policy, University of California, Davis CA, USA

Thursday, May 21 (8:45-9:00)—Small-Scale Fisheries

Data scarcity and weak institutional governance make the implementation of top-down, quota-based fisheries management in much of the developing world's fisheries difficult. An alternative to quota-based management is the use of space-based rights such as territorial use rights fisheries (TURFs). In spite of wide spread use of TURFs as a management tool, the efficient design of spatial property rights remains poorly understood. When resource populations are distributed across discrete patches of space and connected via mobility, then it is likely that local harvest behavior will impose external costs in neighboring spaces. If rights are held communally, the spatial extent of the property right partly determines the incentives to act noncooperatively which, in turn, determines the resulting externalities. In this paper, we present a spatially explicit model of a renewable resource in the context of a small scale developing country fishery. The model incorporates spatial movement of the resource between patches and the interactions of agents both within and between patches. We characterize the incentives for TURF members to act noncooperatively in terms of TURF size and biophysical features of the fishery. In addition, we characterize how the losses accruing from dynamic harvest externalities within the TURF and spatial externalities outside the TURF depend on patch size and spatial configuration. We find that biological dispersal patterns and patch size are critical in determining both the likelihood for internal cooperation and, when cooperation fails, the relative magnitude and distribution of spatial externalities.

SP118

Unintended Consequences of a Ban on Illegal Fishing Gear: Evidence from a Field Experiment in Tanzania

Spencer MacColl¹, Yaniv Stopnitzky¹, **Matt Reimer**²

¹ University of San Francisco, San Francisco CA, USA

² Institute of Social and Economic Research, University of Alaska Anchorage, Anchorage AK, USA

Wednesday, May 20 (4:30-4:45)—Fishing and Communities

Overfishing and the destruction of small-scale fisheries in developing countries — particularly through the use of illegal fishing gear — is a pressing issue. Policymakers and local community leaders often suggest fines and enforcement mechanisms to reduce the use of illegal fishing; however, the response of fishery participants to “bans” on illegal fishing are not well understood, particularly in small-scale fisheries where fishing commons are often governed by local and informal institutions. We use a unique field experiment conducted with local fishers throughout several fishing communities in Tanzania to determine the effect of a hypothetical ban on illegal fishing gear on cooperative fishing behavior. In our experiment, players participate in a dynamic common-pool resource game whereby a group of players “harvest” from a communal bucket of beans. Players have the option of secretly choosing to use illegal harvesting gear, thereby doubling their harvest in a round. In the treatment arm, illegal gear use may be detected and punished by the group; in contrast, there is no threat of being caught or punished in the control arm. We show that the enforcement mechanism actually hurts cooperative fishing behavior as players shift from cooperative harvest strategies to more destructive ones, causing the commons to be depleted faster. One possible explanation is that the ban and subsequent enforcement mechanism crowded out fishers attitudes to sustain the resource for future rounds in the game. The fishers may have been more focused on not using illegal fishing gear than they were with sustaining the resource.

SP121**Environmental Variables and Fishery Performance: The Effect of Temperature, Rainfall, Wind and Waves in the Operation of a Spiny Lobster Fishery****Raúl Villanueva-Poot**, Juan Carlos Seijo, Alfonso Cuevas-Jiménez, Maren Headley

Universidad Marista de Mérida, Mérida, Yucatán, MX

Thursday, May 21 (9:45-10:00)—Small-Scale Fisheries

This paper reports on the relative effects of local environmental conditions on the bioeconomic performance in the spiny lobster (*Panulirus argus*) small-scale fishery of Punta Allen, Mexico. This MSC certified small-scale fishery is co-managed through Territorial User Rights. Members of the fishing cooperative, have exclusive access to individual fishing grounds within Ascension Bay. Fishers are currently concerned with perceived changes in environmental conditions possibly due to climate change. Lobster harvest is performed through the use of artificial shelters. These bottom devices provide refuges for lobsters, reduce predation mortality, and facilitate harvesting. Sheltering lobsters are caught with hand nets, allowing juveniles and berried females to be returned to their natural environment. Using cooperative logbooks, fisher interviews and a geographic information system, it was possible to obtain times series of total catches, fishing days, CPUE values (kg/shelter), variable costs and revenues, and quasi-profits of the variable costs within Ascension Bay. This data set was correlated with historical records from satellite images, weather stations and oceanographic buoys. A time series multivariate analysis was performed between fishing performance indicators (i.e. spiny lobster catch and quasi-profits of the variable costs) and environmental variables such as: sea surface temperature, rainfall, wind and waves in the Ascension Bay area. Results indicate statistically significant environmental factors were affecting performance of this small-scale fishery.

SP122**Does the Alaska's Fishing Industry Pay Its Way?****Gunnar Knapp**

Institute of Social and Economic Research, University of Alaska Anchorage, Anchorage AK, USA

Friday, May 22 (11:45-12:00)—Lagniappe

The State of Alaska is facing a severe budget crisis—the combined result of a drastic fall in oil prices, the state's 90% dependence on oil revenues, and rising expenditures over the past decade. State agencies are facing significant budget cuts, and political pressures are building to increase revenues from other Alaska resource industries, particularly fishing and mining. This has opened a debate about how much the fishing industry does, could and should contribute to the state and local governments. This paper examines these questions. Assessing what the industry does pay is complicated by many factors such as (a) the “fishing industry” is extremely diverse: it includes not only commercial fisheries but also industries dependent in various ways on sports fisheries, personal use and subsistence fisheries; (b) commercial fisheries occur for a very wide range of species and gear types, producing widely varying products of widely varying value; (c) fishermen and processors pay a wide range of taxes, permit fees, and service fees to local and state governments, as well as indirect taxes such as marine fuel taxes. Assessing what the industry could or should pay raises significant political issues. The industry is managed to varying degrees for social goals, such as maximizing employment, which tend to reduce economic rents and the potential for public rent capture. Management changes could significantly increase rents and rent capture—but with potentially far-reaching social and economic consequences.

SP124

An Analysis of the Impacts of the Deepwater Horizon on the Seafood Industry

Michael T. Carroll, Brad Gentner², Sherry Larkin³

¹ VERTEX, Weymouth MA

² Gentner Group Consulting, LLC, Tucson AZ

³ Food and Resource Economics Department, University of Florida, Gainesville FL, USA

Thursday, May 21 (4:30-4:45)—Ecosystem Services

This research was carried out for the Bureau of Ocean and Energy Management to assist them in understanding the economic impacts the Deepwater Horizon Oil spill had on the Gulf of Mexico seafood industry. In addition to an extensive research effort compiling all research pertinent to the Gulf seafood industry structure from vessel to market we have reviewed and compiled available economic impact publications pertinent to the commercial fishing industry. In context to this information and various other economic data and model sources we have developed an input/output impact model that calculates these impacts as they occur down the seafood supply chain. Impacts have been broken down by each Gulf State and key species category, with estimates of direct, induced and indirect impacts on Sales, Value Added, Employment and Income. The primary contribution of this research was laying out the supply chain relationships and market structure to allow for a better understanding how economic impacts occurred during the post spill period.

SP125

Trade in Fishing Services and Coastal State Rights

Gordon Munro¹, Steve Cunningham²

¹ Department of Economics, University of British Columbia, Vancouver, CA

² IDDRA Ltd, Montpellier, FR

Wednesday, May 20 (1:30-1:45)—Rights-Based Management

Almost one half of the EEZs of the world are subject to so-called foreign fishing arrangements (FFAs), in which foreign fishing states (distant water fishing states in particular) gain access to EEZs under access arrangements with the relevant coastal states. The FFAs may take the form of “fee fishing” arrangements, joint ventures or charter arrangements. The World Bank undertook a project on FFAs, with particular reference to developing coastal states and launched the resultant project report in December 2014. The report includes a set of case studies, an important one of which is focused on the Bering Sea Pollock fishery. This paper presents an overview of the key findings of the report, including the legal obligations of coastal states concerning FFAs, and the conditions under which the rational coastal state will, or will not, welcome such arrangements. It is argued that coastal states entering into FFAs are properly to be seen as importing harvesting and/or processing and/or marketing services – hence the title of the report: Trade in Fishing Services. Trade in these services, it is argued, constitutes an important, but hitherto largely ignored, component of fisheries international trade. The economics required for the study of FFAs is thus a blend of fisheries economics, international economics, along with principal-agent analysis.

SP126

Assessing the Accuracy of High Spatial Resolution Effort Data: Comparing VMS and Logbook Data in the California Groundfish Trawl Fishery

Alice Thomas-Smyth, Aaron Mamula, Cameron Speir

NOAA Fisheries, Southwest Fisheries Science Center, Santa Cruz CA, USA

Thursday, May 21 (4:45-5:00)—Bioeconomics

Fisheries management is increasingly being conducted at finer scales of spatial resolution. The spatial distribution of fish stocks is recognized as being an important aspect of stock abundance and spatial management tools, such as marine reserves, have become common. Information on the spatial distribution of fishing effort is critical to conducting this type of spatially-oriented management for at least two reasons.

First, harvest information from individual vessels can generate data used in higher spatial resolution stock assessment. Second, understanding the location choice behavior of fishermen is important in understanding the effects of policy on both fish stocks and the fishermen themselves. In this paper, we compare for consistency two sources of two high-resolution data sets on fishing location: self-reported logbook data and vessel monitoring system data.

SP127

Applying Benefit Transfer to Improve the Transfer of Ecological Estimates in Ecosystem Services Research and Policy

Melissa Errend

Marine Resource Management Program, Oregon State University, Newport OR, USA

Thursday, May 21 (4:45-5:00)—Ecosystem Services

Ecosystem services (ES) represent a way to represent and quantify multiple uses, values as well as connectivity between ecosystem processes and human well-being. Ecosystem-based fisheries management approaches may seek to quantify expected trade-offs in ecosystem services due to actions such as restoration and gear restrictions, or due to changes such as climate change and ocean acidification. However, lack of adequate data, time or budget constraints needed to model these scenarios in part creates a demand to directly apply (i.e., transfer) existing models and estimates of ecological production across different geographic, temporal, or spatial scales. Inconsistency and a lack of transparency in how knowledge gaps are filled by transfers can create sources of uncertainty and error that can propagate through and between ecosystem service values and assessments. While production estimate transfer represents a useful tool for research, policy and management to gain ES information when primary research is not available, transparency concerning these values is needed for assessing assumptions, trade-offs, and the need for primary research. While methodologies exist to facilitate and analyze the transfer of economic ES values (e.g., benefit transfer), there is no analogous formalized process to transfer ecological data underlying ES production. Drawing from the benefit transfer literature, we present a framework to similarly improve the transparency and accuracy of transferred ecological and biophysical ES production estimates in coastal ecosystem services assessments, specifically for habitat-fishery linkages.

SP128

Experimental Analysis of Coordination of Fishing Effort to Reduce Dissipation of Economic Rent in Stock Enhancement

Rafael León¹, John Tisdell², Caleb Gardner¹, Klaas Hartmann¹, Ingrid van Putten³, **Timothy J. Emery¹**

¹ Institute for Marine & Antarctic Studies (IMAS) University of Tasmania, Hobart, Tasmania, AU.

² Tasmanian School of Business and Economics, University of Tasmania, Hobart, Tasmania, AU.

³ CSIRO Marine and Atmospheric Research, CMAR, Hobart, Tasmania, AU.

Wednesday, May 20 (2:00-2:15)—Rights-Based Management

Individual Transferable Quota (ITQ) systems have been used to control harvests and increase fisheries' economic efficiency; however, they do not eliminate competitive fishing which can result in stock and congestion externalities that are especially apparent when resources are spatially heterogeneous within the controlled region of the ITQ system. These externalities arise because ITQ systems do not control the spatial distribution of effort leaving fishers to concentrate their effort in more profitable patches. We explored the potential for cooperative behavior to reduce this congestion using an experimental economics approach in the context of management of a stock enhancement program (SEP). Four treatments were applied involving different systems which were: compulsory, voluntary and by-use payment for the SEP, with either open or exclusive access to the enhanced zone (EZ). Income is either directly to individuals or split between participants through income-sharing (as occurs in cooperatives). Voluntary payment to fund the SEP enabled individuals to opt out of cooperation, which reduced the enhancement activity and led to a significantly lower cooperation than the optimal level and also lower relative to the compulsory payment system. Treatments that included a by-use payment combined with exclusive access to the EZ were most effective in preventing

dissipation of economic rent. The different rule settings were affected by participants' expectations of reciprocity, with greater involvement and thus production from the SEP amongst cooperative participants. Perceptions of vulnerability were also important, as more self-interested participants were more likely to exclude themselves from the SEP. The structure of rules may enable individuals who are more intrinsically cooperative to drive the fishery towards a state with low rent dissipation.

SP129

An Experimental Analysis of Assignment Problems and Economic Rent Dissipation in Quota Managed Fisheries

Timothy J. Emery¹, John Tisdell², Bridget S. Green¹, Klaas Hartmann¹, Caleb Gardner¹, Rafael León¹

¹ Institute for Marine and Antarctic Studies, University of Tasmania, Hobart, Tasmania, AU

² School of Economics and Finance, University of Tasmania, Hobart, Tasmania, AU

Wednesday, May 20 (2:15-2:30)—Rights-Based Management

Assignment problems may remain in quota managed fisheries due to variation in the productivity of the stock across space and time. Unless fishers can agree to coordinate their fishing effort, they will compete amongst themselves and over-exploit the stock where or when the quota unit value is highest, leading to economic rent dissipation. Coordination may be made more difficult in a dynamic marine environment when groups are heterogeneous and cannot communicate amongst themselves. To investigate this supposition, a series of economic experiments were conducted using university students. Participants took on the role of either a quota owner or lease quota fisher and in the presence or absence of communication were asked to make individual harvesting decisions, which allowed researchers to assess the relative influence of these factors on group coordination. This study found that participants were more likely to make socially optimal decisions to prevent rent dissipation when they could communicate and were in an experimental group containing solely quota owners. Participants who were lease quota fishers were less likely to make socially optimal decisions due to: (i) inequality in wealth; (ii) insecurity of tenure; and (iii) asymmetric information exchange. As participants were aware of these disparities, it negatively affected the ability of heterogeneous groups to establish trust and a sense of identity, despite being able to communicate. While requiring further exposition in the field, these results provide a theoretical insight into the difficulties heterogeneous fishers may have in solving assignment problems in a dynamic environment.

SP130

The Economic Impact of Ocean Acidification on Pacific Oysters

Gary A. Eaton

Department of Economics, University of Alaska Fairbanks, Fairbanks AK, USA

Friday, May 22 (9:45-10:00)—Aquaculture

Since the start of the Industrial Revolution, our atmosphere has continued to experience increased levels of CO₂ concentrations and with them, changes in seawater carbonate chemistry. These changes in the carbonate chemistry of seawater, a process known as ocean acidification (OA), threatens some species upon which some economies are largely dependent for economic activity. This thesis uses the best available data to summarize the Washington State shellfish economy and estimate potential impacts of OA on Pacific oyster demand. The analysis evaluates the economic impact of OA on demand using an autoregressive distributed lag (ARDL) model approach to estimate short-run and long-run impacts. Although initial research attempted to assess the impacts of OA on Pacific oyster supply, findings from this study suggest that long-run decreases in carbonate chemistry may negatively impact the demand for Pacific oysters. As the waters used to grow Pacific oysters in Washington State continue to degrade as a result of OA, substantial losses in economic activity from Pacific oysters may be lost. On the west coast, oysters appear to be a luxury good with demand highly responsive to changes in income. Pacific oysters are moderately sensitive to price, indicating demand for oysters is elastic.

SP131

Implications of Bycatch, Wastage, and Discards on Declines in Size-At-Age and Biological Reference Points in the Pacific Halibut Fishery

Jane Sullivan¹, Stephen Martell², Ian Stewart², Gordon Kruse¹

¹ Fisheries Division, University of Alaska Fairbanks, Juneau AK, USA

² International Pacific Halibut Commission, Seattle WA, USA

Thursday, May 21 (2:45-3:00)—Modeling

Recent declines in size-at-age of Pacific halibut have led to large reductions in harvest and triggered an investigation into the potential role of size-selective fishing on size-at-age and biological reference points in the halibut fishery. Current harvest policy uses a 32-inch minimum size limit in the directed commercial halibut fishery and assumes that 84% of discarded sub-legal halibut survive annually regardless of size. Retention of halibut in non-directed fisheries (e.g. trawl fishery bycatch) is prohibited; however, post-release survival rates are gear dependent and partially based on onboard observations of halibut release condition. We examined the sensitivity of maximum sustainable yield and spawning biomass-per-recruit-based reference points to assumptions about post-release survival and the cumulative effects of size-selective fishing. Trade-offs between discard mortality, size limits, bycatch, and fishing intensity were examined from a long-term equilibrium perspective using isopleths that describe per-recruit changes in spawning biomass, yield, discards, and mean weight-at-age of the landed catch. Resultant potential losses in landed value to the directed fishery associated with discarding sub-legal fish are approximately \$10 to \$24 million per year, while total losses associated with bycatch mortality are about \$70 to \$120 million per year.

Special Sessions Abstracts

The Impact of Catch Shares on Fishing Income Diversification and Fleet Diversity

Daniel S. Holland

NOAA Fisheries, Northwest Fisheries Science Center, Seattle, WA

Fishermen face high financial risk as a result of high year-to-year variation in their fishing income caused by variation in catches, input and output prices, and changes in regulations that impact their ability to participate in various fisheries. One strategy to reduce variability in income is to diversify fishing activity across several fisheries. If catch rates, total allowable catch, prices or costs in these different fisheries are uncorrelated or inversely correlated, diversification will reduce variability in income much like having a diverse stock portfolio. Kasperski and Holland (Income Diversification and Risk for Fishermen. Proceedings of the National Academy of Science. 100(6):2076-2081) showed that for vessels fishing off the West Coast of the US and Alaska over the last three decades greater diversification did in fact significantly decrease year-to-year variability of fishing revenue. However, diversification had generally declined on the West Coast and Alaska and the same may be true in other regions. Fishing ports and associated communities may also be affected negatively by variation in landings and associated revenue, and that variation may depend in part on how diversified the port or community is in terms of the species landed there.

A growing number of fisheries in the US are managed with catch shares and concerns have been expressed that these types of management systems may lead to a decline in fishery diversification and fleet diversity, primarily as a result of consolidation. There are also concerns that consolidation of landings in fewer ports could reduce the amount or diversity of fishing income in some coastal communities. While catch share programs are generally expected to increase profitability of fisheries by increasing quality and value of catches and reducing costs, they may also lead to a reduction in the number of participants which could reduce the diversity of the fleet, lead to vessel specialization for the catch share fishery which may limit participation in other fisheries, and may change the distribution of landings across communities. On the other hand, catch shares could enable fishermen to become more diversified by allowing them to buy into fisheries in which they have not historically participated. Some catch share systems offer the possibility for fishing communities to acquire quota and potentially create a more diversified and stable stream of fishing revenue for the community.

There is a need to document the actual impact that catch shares have had on diversification and fleet diversity and to understand what has driven the outcomes and whether undesired (desired) outcomes can be avoided (promoted) through policy interventions. Economists at several NMFS Science Centers are calculating a common set of metrics to evaluate changes in diversification and fleet diversity in US fisheries that have implemented catch shares. The results of these studies will be presented and discussed. We will also seek out additional presenters who have been doing work on this theme to present or participate in the panel discussion.

Introduction to the Special Session on the Impact of Catch Shares on Fishing Income Diversification and Fleet Diversity

Daniel S. Holland

NOAA Fisheries, Northwest Fisheries Science Center

A growing number of fisheries in the US are managed with catch shares and concerns have been expressed that these types of management systems may lead to consolidation of landings in fewer ports by fewer fishing, a decline in diversification of individual fishermen, and a reduction in diversity of fishing income in some coastal communities. Since diversification of fishing revenues has been shown to be inversely correlated with the variability of annual revenues, both for individual and ports, reductions in diversification could lead to increased financial risk. This presentation provides an introduction to a special session that presents several case studies of how catch share programs around the US have impacted diversification of fishermen and

fishing ports and spatial consolidation of revenues. I briefly discuss the motivation for these studies, the methodologies used to measure changes in diversification and spatial concentration, and the fisheries and regions included in the study.

Impact of West Coast Catch Share Programs on Vessel Diversification

Daniel S. Holland

NOAA Fisheries, Northwest Fisheries Science Center

This study explores the trends in diversification of fishing income for individual vessels that participated in two West Coast fisheries for which catch shares were introduced: the fixed gear sablefish fishery and the groundfish trawl fishery. We document and compare changes in diversification over time for vessels that stayed in the fishery after implementation of the catch share program as well as for vessels that left the catch share fishery but continued participating in other fisheries. The result indicated that diversification for both groups declined after catch share implementation but the decline in diversification for many of those who left the fishery began long before the catch share program following implementation of limited entry programs.

Patterns of Port-Level Geographic Concentration in West Coast Groundfish Fisheries

Cameron Speir

NOAA Fisheries, Southwest Fisheries Science Center

Explanations for industrial agglomerations tend to focus the relative importance of natural advantage and economies of scale or scope. A marine capture fishery presents a unique opportunity to examine spatial patterns of industrial location because fish stocks are highly variable and mobile, capital stock (fishing vessels) are highly mobile, and output is regulated. We use exploratory spatial data analysis methods to describe changes in the spatial pattern of fishing revenue for West Coast groundfish fisheries over time. Using an absolute reference, we examine changes in disproportionality measures of industrial concentration from 1987-2012, a period when many biological and regulatory changes occurred. We find increasing levels of the concentration of revenue among fishing ports over time. We are unable to detect evidence of spatial autocorrelation using global Moran's I tests. We find little evidence of clustering of high-value ports using Moran scatterplots.

North Pacific Catch Share Program Vessel Diversification

Stephen Kasperski

NOAA Fisheries, Alaska Fisheries Science Center

This study explores the trends in diversification of fishing income for individual vessels that participated in five catch share programs in the North Pacific (Alaska) region of the U.S.: North Pacific Halibut & Sablefish IFQ, Bering Sea American Fisheries Act (AFA) Pollock, BSAI King & Tanner Crab Rationalization, BSAI Non-pollock Groundfish Trawl Catcher/Processors (Amendment 80), and the Central Gulf of Alaska Rockfish Program. We assess trends for the fleet of vessels that are active in any given year and compare trends in species diversification for vessel that were issued catch shares and stayed in the fishery and those vessels that have left the fishery after catch share implementation.

Impact of Gulf of Mexico Catch Shares Programs on Diversification and Spatial Concentration of Revenues

Juan Agar and Larry Perruso

NOAA Fisheries, Southeast Fisheries Science Center

This study investigates the impact of the individual fishing quota (IFQ) programs implemented in the Gulf of Mexico red snapper fishery and the Gulf of Mexico Grouper-Tilefish IFQ fishery on the diversification of fishermen and on the spatial distribution of landings and revenues. The impacts of catch share programs on diversification of landings and revenues across space is an important but less studied aspect of catch share

programs. While diversification is an important livelihood strategy because it mitigates risk and stabilizes incomes, a number of studies have shown that catch share landings have become more concentrated into fewer ports. Preliminary results show that a greater share of the red snapper catches and revenues is being landed on west coast of Florida; however, this change may not be solely due to the adoption of the IFQ program.

Diversification of South Atlantic Wreckfish ITQ Fishermen

Scott Crosson

NOAA Fisheries, Southeast Fisheries Science Center

The wreckfish individual transferable quota (ITQ) program started in 1992 with 38 initial shareholders. Initially, the program appeared to be a success, bringing order to the previous years' derbies. However, participation in the fishery plummeted in the ensuing decades, to the point that by the 2001 season federal rules on confidentiality prevent the public release of fleet harvest statistics. We discuss what happened to the shareholders who left, and the diversification of the current fleet.

Assessing Diversity Trends in the Northeast U.S. Groundfish Fishery

Andrew Kitts

NOAA Fisheries, Northeast Fisheries Science Center

A catch share system based on allocations to self-organized cooperatives called "sectors" was implemented in the groundfish fishery in 2010 with allocations to several sectors. Concern has been expressed about concentration of quota and revenue from landings and loss of fishing fleet diversity. The New England Fishery Management Council has recently been discussing taking action to address these concerns. We present preliminary results measuring diversity changes pre- and post- implementation from number of perspectives.

Golden Tilefish and Scallop ITQs in the Northeast: Assessing Trends Beyond Groundfish

Geret S. DePiper, Andrew Kitts

NOAA Fisheries, Northeast Fisheries Science Center

The groundfish fishery is the most well-known catch share program in the Northeast US. However, two additional fisheries were moved to quota based management around the same time as the groundfish fishery. The scallop ITQ system was implemented the same year as the groundfish (2010), while the golden tilefish fishery was rationalized a year before (2009). We assess the diversification trends in these two additional fisheries providing a broader context from which to understand trends within the groundfish fishery, and the transition to quota based systems in the Northeast more generally.

The Economics of Recreational Fishing Sectors in U.S. Fisheries: Allocation, Demand, Supply, and Impacts

Daniel K. Lew, Sabrina Lovell, Clifford Hutt

Recreational fisheries play an important role for fishing enthusiasts directly, but also support economic activity in coastal communities across the United States. Until recently, little had been done to understand the demand for and supply of marine recreational charter (for-hire) fishing opportunities, with most research focused on understanding the economics of commercial fisheries and value of recreational sport fishing as a whole without differentiating charter and non-charter fishing. However, U.S. regional fishery councils are increasingly asked to make allocation decisions for marine fisheries in which there are active commercial and recreational sectors. In the North Pacific, for instance, a recently-implemented Catch Sharing Plan has been

implemented for Pacific halibut with explicit formulas to allocate catch between the commercial fishery, which is managed with an individual fishing quota system, and the recreational fishing sector, which is dominated by the charter industry. Discussions of economically efficient allocations have generally been precluded due to a lack of comprehensive understanding of the marginal values of fishing in each sector, particularly in the charter fishery. Moreover, understanding the economic effects of allocation decisions have on the charter sector (on employment, costs, earnings, etc.), and subsequently on fishing communities and the larger economy, has been hampered by a lack of economic information about the sector that are needed to develop economic models of behavior. Despite these challenges, data collection and modeling efforts aimed at measuring the economic contributions of U.S. marine recreational fisheries have been an active area of research in the U.S. In several regions, regularly-conducted surveys of saltwater anglers collect data necessary to quantify fishing-related expenditures on trips and durable goods, which are used to estimate the economic contributions of recreational fishing in each coastal state. Additional data collections and analyses, such as of the bait and tackle industry or charter industry, are conducted to improve on the basic model and to shed light on specific questions regarding potential changes in policy or changing environmental conditions.

The goal of these special sessions is to present current economic research on the recreational sector in the U.S. The first of the two sessions highlights several efforts to address some of the information deficiencies in recreational fishing research. The second session concentrates on additional efforts to understand the economic contribution of recreational fisheries in the U.S., as well as the economic impacts of recreational fishing management actions.

Allocation, Demand, and Supply

Fighting Over a Red Herring: The Role of Economics in Recreational-Commercial Allocation Disputes

Joshua K. Abbott
Arizona State University, Tempe, AZ

This presentation turns a critical eye on the current role of economics in informing inter-sector allocation disputes. I argue that much of this analysis relies on a notion of efficiency that is flawed on both static and dynamic grounds and fails to address the inefficiencies of existing management institutions. I propose that reallocation is rarely a first-order concern. Rather, it is a “red herring” that detracts from far more necessary fundamental reforms within the recreational sector. These reforms would significantly improve the accountability and efficiency of the sector and establish the necessary institutions to resolve allocation disputes in an adaptive, efficient manner through arms-length transactions. I propose a general framework for reform of mixed recreational-commercial fisheries and discuss realistic rights-based policies to better manage fishing mortality for private recreational anglers and facilitate transferability across sectors. I close with an appeal for more policy-relevant work on recreational fisheries by fisheries economists.

Fisheries Allocation in the United States: Letting the Perfect Be the Enemy of the Good

Brad Gentner
Gentner Consulting Group, Tucson, AZ

Allocation has become a hot issue for every fishery management council in the country. In mixed use fisheries, those with both a recreational and commercial component, recreational anglers have been seeking a higher percentage of the total quota. Hard total allowable catches and hard rebuilding timelines have increased conflicts between user groups. Because of these institutional shifts and pressures from recreational advocacy groups, the last Magnuson reauthorization included the requirement to examine economic values in making allocations. Additionally, the NMFS official Catch Share Policy requires the examination of allocation using economic metrics before the institution of a catch share program and an update of the allocation every five years. These policies have prompted several economic studies showing that recreational values are much higher than commercial values across the most important recreational fisheries. Many state managers have

already decided to manage inshore species as entirely recreational fisheries because they generate more value. However, these studies and the state experience with inshore species are being ignored in the management process. Academics have published articles, funded by catch share supporters, which state recreational fisheries need to be “rationalized” and limited entry must be instituted before allocations can be changed. “Rationalization” is completely antithetical to the creation of value and the generation of economic activity for private recreational anglers. This presentation will focus on this rusted shut policy process. The councils and NMFS are currently letting the perfect defeat the good that is possible in reallocation.

Cost and Earnings in the Alaska Saltwater Sport Fishing Charter Sector

Daniel K. Lew^{1,2}, Gabriel S. Sampson³, Amber Himes-Cornell¹, Jean Lee⁴

¹ NOAA Fisheries, Alaska Fisheries Science Center, Seattle, WA

² Department of Environmental Science and Policy, University of California, Davis, Davis, CA

³ Department of Agricultural and Resource Economics, University of California, Davis, Davis, CA

⁴ Pacific States Marine Fisheries Commission, Alaska Fisheries Science Center, Seattle, WA

The Alaska recreational charter boat sector has undergone significant change in recent years due in part to several regulatory changes in the management of the Pacific halibut sport fishery, including a limited entry program, harvest controls specific to the charter sector, and a Catch Sharing Plan (CSP) implemented during 2014. In the face of these regulatory changes, the number of active charter businesses declined from over 1,000 in the mid-2000s to less than 600 in recent years. To understand the economic conditions of this sector prior to implementation of the CSP, a survey was undertaken to collect costs, earnings, and employment information from charter businesses. Sample data for the 2011, 2012, and 2013 fishing seasons were used to generate population-level estimates of fixed and variable costs, fishing and non-fishing revenues, and offshore and onshore employment. These estimates are adjusted to reflect missing data using sample weighting and nearest neighbor data imputation approaches. The adjusted population-level results suggest that in 2011 the Alaska saltwater sport fishing charter sector as a whole operated at a loss, but in 2012 and 2013, as the population of charter businesses shrank, the sector yielded an overall profit. Overall, the 3-year period saw slight changes in employment and spending patterns by charter businesses that remained in the fishery, including a shift to using proportionately more part-time employees for on-shore work and decreasing the amount spent on charter trip expenses and cash investments in vehicles, machinery, equipment, buildings and real estate.

Do Charter Anglers Value Changes in Regulations Differently Than Private Boat Anglers and What Does This Mean For Recreational Sector Separation?

Christopher Liese¹, David Carter¹, Sabrina Lovell²

¹ NOAA Fisheries, Southeast Fisheries Science Center, Miami, FL

² NOAA Fisheries, Office of Science and Technology, Silver Spring, MD

Recreational anglers need a boat to fish for marine species that live in offshore waters. They can use a private boat or hire a charter boat. Each type of vessel entails potentially different experiences, different costs, and different catch expectations. That said, do angler preferences for catching and keeping fish depend on the mode of fishing? For example, does angler willingness to pay (WTP) for a change in a bag limit depend on whether they are fishing on a private boat or a charter boat? What about WTP for a change in actual (i.e., ex post) harvest? We conducted a choice experiment in the Gulf of Mexico in 2013 to look for differences in values held by anglers fishing from private or charter boats. Specifically, the survey evaluated anglers' WTP for changes in the bag limit for important offshore species. This WTP reflects an ex ante or option value for keeping a maximum number of fish. However, anglers' historical data suggests that anglers might expect different catch levels when fishing from a charter boat when compared with fishing from a private boat. We show the conceptual relationships between the ex-ante and ex post WTP values for fish and calculate empirical estimates based on the choice experiment data and historical catch data for anglers fishing from charter and private boats. We discuss the policy implications, especially in the context of recreational sector separation proposals, when and if ex ante and ex post WTP values differ between modes.

Using a Coupled Bioeconomic Model for Recreational Fisheries Management in the Northeast United States

Min-Yang Lee¹, Scott Steinback¹, Kristy Wallmo²

¹ NOAA Fisheries, Northeast Fisheries Science Center, Woods Hole, MA

² NOAA Fisheries, Office of Science and Technology, Silver Spring, MD

Recreational fisheries regulations frequently consist of possession limits, size limits, and seasonal closures that constrain the ability of recreational fishermen to catch or land fish. It is difficult to predict how these regulations will influence angler participation and recreational fishing mortality. This research integrates a 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. The integrated model allows for two-way feedback loops between recreational fishing trips and the age-structure of targeted stocks. The recreational cod and haddock regulations implemented in 2014 have high costs in terms of foregone angler welfare. Minimal positive impacts of the stringent recreational regulations on long-run stock conditions are found because the resultant reductions in recreational fishing mortality are quite small. Furthermore, current stock-projection models do not contain a stock-recruitment relationship. The ability of policies that generate large amounts of discarding, like high minimum size limits, to meet conservation objectives are also found to be quite sensitive to assumptions about the recreational discard mortality rate. We discuss some of the practical difficulties encountered during the fishery management process when using this model to inform policy makers as they make difficult decisions about fishing regulations.

Economic Impacts

Characteristics, Expectations, and Challenges for the Marine Charter Fishing Industry in Washington and Oregon

Jerry Leonard

NOAA Fisheries, Northwest Fisheries Science Center, Seattle, WA

In the mid-1970s the marine charter vessel industry in Washington and Oregon was at its pinnacle. The industry consisted of close to 650 vessels: 417 in Washington (Crutchfield and Schelle, 1977) and 239 in Oregon (Fraser et al, 1977). By the 2000s, the total in Washington and Oregon had dwindled to around 217 active vessels. This presentation utilizes the results of a survey of Washington and Oregon marine charter businesses active in 2012 to characterize the charter fleet and examine the economic conditions it faces. Generally, respondents are not optimistic about the future of their business. Respondents who ranked potential problems for their businesses most frequently cited fuel costs and regulations as “extremely important” for their success. Among regulations that businesses found challenging, seasonal closures and in-season regulation changes are most frequently cited as “extremely challenging.”

The Economics of Atlantic Highly Migratory Species For-Hire Fishing Trips

George Silva¹, Clifford Hutt²

¹ NOAA Fisheries, Office of Sustainable Fisheries, Silver Spring, MD

² ECS Federal, Inc., NOAA Fisheries, Office of Science and Technology, Silver Spring, MD

The for-hire sector plays a significant role in providing recreational fishing opportunities for Atlantic highly migratory species (HMS) such as tuna, billfish, swordfish, and sharks. Because of the high cost of equipment needed to pursue HMS, many saltwater anglers find chartering a for-hire vessel to be the only affordable alternative. In 2013, there were 3,968 licensed Atlantic HMS Charter/Headboat (CHB) permit holders from Maine to Texas that took an estimated 12,965 for-hire vessel trips in the Atlantic and Gulf of Mexico (not including Texas) to pursue HMS from July to December of 2013. During this time period, NOAA Fisheries conducted a log-book study of randomly selected Atlantic HMS Charter/Headboat (CHB) permit holders to collect trip cost and earnings data. Data were collected on 596 for-hire trips targeting Atlantic HMS. Approximately 68 percent of HMS for-hire trips targeted a combination of pelagic species (most commonly yellowfin tuna, swordfish, or marlin) while 32 percent targeted coastal sharks. Average charter fares for HMS

charter boat (6 anglers or fewer) trips ranged from \$1,223 in the Southeast (NC - FL) to \$2,450 in the Northeast (ME - VA). Net returns per trip ranged from a low of \$528 in the Southeast to a high of \$1,028 in the Gulf of Mexico (FL -TX). Overall, HMS for-hire charter operations were estimated to generate approximately \$21 million in total expenditures and \$34 million in economic output along the Atlantic and Gulf of Mexico coasts.

Angler Spending on Fishing-Related Durable Goods: Results from the 2014 Durable Good Expenditure Survey

Sabrina Lovell¹, James Hilger², Scott Steinback³

¹ NOAA Fisheries, Office of Science and Technology, Silver Spring, MD

² NOAA Fisheries, Southwest Fisheries Science Center, La Jolla, CA

³ NOAA Fisheries, Northeast Fisheries Science Center, Woods Hole, MA

Purchases made by marine recreational anglers are an important source of economic activity in coastal areas around the United States. In recognition of the economic contributions anglers make to coastal state economies, NOAA Fisheries conducts surveys every three to five years in order to gather data on expenditures made by anglers on annual purchases of durable fishing equipment (e.g., rods and reels, boats, vehicles, and second homes). In 2014, NOAA Fisheries surveyed anglers about their annual purchases on durable goods. The sample frame consisted of licensed anglers in every coastal state except Hawaii. The survey asked anglers about their purchases of durable goods used at least in part for saltwater fishing in the prior 12 months in the state of licensure. Across all coastal states, a total of 10,809 completed surveys were returned with an overall response rate of 11 percent. Mean expenditures for different durable good categories were estimated for both resident and non-resident fishermen in each state. Using NOAA and state level estimates of the number of resident and non-resident anglers in each state, total expenditures are calculated and used to estimate the economic impacts from purchases of fishing-related durable goods at the state and national level.

Fishing and Other Ocean Recreation Impacts on Coastal Regions: The National Ocean Recreation Expenditures Survey

Rosemary Kosaka¹, Scott Steinback², Cindy Thomson¹, Rita Curtis³

¹ NOAA Fisheries, Southwest Fisheries Science Center, Santa Cruz, CA

² NOAA Fisheries, Northeast Fisheries Science Center, Woods Hole, MA

³ NOAA Fisheries, Office of Science and Technology, Silver Spring, MD

From 2012 through 2013, NOAA Fisheries Service conducted a study to collect participation, effort, and expenditure information related to ocean recreation activities in the United States. This study collected information from all 50 states and the District of Columbia in six, two-month waves. There were eight ocean recreation categories of interest: recreational finfishing; recreational shellfishing; hunting waterfowl or other animals; viewing or photographing the ocean and wildlife; beachcombing and tidepooling; water contact sports such as swimming and surfing; boating and related activities such as wake boarding and tubing; and outdoor activities not involving water contact such as beach volleyball and camping. The survey was conducted using an online panel of U.S. households and was available in both English and Spanish. Over 31,000 respondents completed the survey, resulting in a survey completion rate of 60%. This dataset provides an abundance of information regarding numbers and types of ocean recreation trips made by respondents, details of individual trips, and respondent characteristics. The survey also included questions regarding how hypothetical changes in air temperature might influence ocean recreation preferences. This talk will provide more details about the study, the types of information collected, the questions the data are intended to answer, and our analytic efforts to date.

Accounting for Variation in Exogenous Shocks in Economic Impact Modeling

Chang K. Seung¹, Daniel K. Lew^{1,2}

¹ NOAA Fisheries, Alaska Fisheries Science Center, Seattle, WA

² Department of Environmental Science and Policy, University of California, Davis, Davis, CA

To increase confidence in results from a computable general equilibrium (CGE) model, modelers often conduct sensitivity analysis to better understand the impact of uncertainty or variations in underlying assumptions and parameter values on results. However, CGE modelers have paid little attention to variations in input (i.e., policy changes or exogenous shocks). Recently, a few input–output studies consider sources of input variations, but focus on addressing a single source of variation and, therefore, ignore the interactions (and cumulative effects) among them. In this study, we propose methods for calculating the range (confidence intervals) of impacts from input variations within a CGE framework, explicitly accounting for multiple sources of input variations. To illustrate our approach, we use, as an example, recreational fisheries in Alaska, and estimate confidence intervals of economic impacts from regulatory changes. In doing so, we consider two important sources of input variation driving the impacts: (i) sample variation in recreational fishing-related expenditures, which is estimated using bootstrapping approach and (ii) stochastic variation from the parameters in the recreation demand model, which is estimated using a simulation-based approach. Results show that confidence bounds on total economic impacts calculated while only accounting for the first type of variation (sample variation) are much narrower than the confidence bounds on the impacts when we account for both sample and stochastic variation in model inputs.

Fisheries' Shoreside Support - the Forgotten Sector

Ayeisha Brinson¹ and Erin Steiner²

¹ NOAA Fisheries, Office of Science and Technology

² NOAA Fisheries, Northwest Fisheries Science Center

The processing sector is a vital and vibrant component of most fishing communities, as well as an essential component of nearly all commercial fisheries. For these reasons, it is important that management actions consider the potential effects on the sector, both in terms of effects on the sector itself, and the effects on the commercial harvesters. This is a very complex sector, ranging from small fish markets to multinational corporations. The types of operations can range from specializing on one species caught by one gear type or generalizing into all seafood, or as far as aquaculture or other agricultural products. This session will cover current topics in fisheries management as it relates to seafood processing and marketing. One topic to be covered is the impact of catch share policies on the seafood processing sector. As more U.S. fisheries are managed under catch share programs, we should see a shift in the processing sector from optimizing location and quantity to optimizing quality and expanding into more lucrative markets. Another topic to be covered is the impact of the local foods movement on seafood processing and marketing. Consumers are increasingly demanding foods that are local and traceable back to the source. Seafood products are an interesting product that can fill this niche. Understanding this current consumer movement and how it impacts the markets is important for fisheries management and will be another topic of interest for this session.

Cost and Earnings Profile of U.S. Seafood Processors

Ayeisha Brinson

NOAA Fisheries Office of Science & Technology

NOAA Fisheries is responsible for estimating the capacity by U.S. seafood processors for federally managed fisheries. NOAA Fisheries implements an annual survey of seafood processors that collects information on production of seafood in the United States. In 2015, NOAA Fisheries used an economic add-on survey to collect annual cost and employment information annually on seafood and industrial fishery processing plants. Data from this survey will be used in economic analyses to estimate the capacity and extent to which U.S. fish

processors, on an annual basis, will process that portion of the optimum yield harvested by domestic fishing vessels. Employment data will be used in socioeconomic analyses for determining the potential impacts on processing employment, due in part to management measures. Two thousand surveys were sent to seafood processors across the United States in February – April 2015. To date, 432 surveys have been received. The survey was implemented in two phases. The first phase of the survey focused on seafood processors identified in the Federal Processed Products Survey and the second phase identified dealers and processors with state licenses. Preliminary analyses show that response rates were 32% and 12.4% for each phase, respectively. Future analyses include identifying mark-up rates for fishery species, overall revenue and costs for production of seafood species.

Impacts of Catch Share Management on Shorebased Processors: Evidence from the Northwest Trawl Groundfish Fishery

Marie Guldin, Christopher M. Anderson
University of Washington

Much of the literature in fisheries economics focuses on the harvesting sector. Due to lack of data, a less explored area is how the fish processing industry is affected by fishery management strategies. This paper utilizes unique cost-earnings data on shoreside processors from the Economic Data Collection (EDC) Program's mandatory survey for participants in the West Coast Groundfish Trawl Catch Share Program. This program was implemented in 2011 and introduced a feature, which allocates 20% of the Pacific whiting harvesting quota to eligible processors. With company-level data, we give a first look at the downstream effects of rationalization in the shoreside Pacific whiting fishery. We find that lengthening of the Pacific whiting season has altered labor decisions and led to more efficient production. We also investigate evidence of regional and industry consolidation in response to relative quota allocations.

U.S. Atlantic Fresh Groundfish and Scallop Processing and Marketing: A Tale of Two Fisheries

Daniel Georgianna¹, Min-Yang Lee²

¹ University of Massachusetts, Dartmouth

² NOAA Fisheries, Northeast Fisheries Science Center

The North Atlantic U.S. groundfish and scallop processing industries are a tale of two fisheries. The groundfish processing industry has suffered a steep, almost continual decline in landings starting in 1984 that resulted in 2014 landings that were only 16% of 1983 landings. US scallop landings increased from 5 million mt in 1998 to 30 million mt in 2004, remaining around that peak until 2012. Both processing industries had to adjust: groundfish processors had to find new sources of fresh groundfish and other products to fill customers' orders and scallop processors had to find new customers to buy its surplus product. This study used interviews with processors and data on landings, imports and exports to examine the marketing strategies of these processing industries to adjust to trends in landings and to evaluate their success within the confines of the US Magnuson-Stevens Act. After imported whole groundfish from Canada were eliminated as substitutes for local landings, groundfish processors increased diversification of products as substitute for fresh groundfish to fill their customers' orders, scouring the world for products such as Pacific cod, other groundfish, and some pelagic species. They also skipped the wholesale market to sell direct to retailers and restaurants. Not all succeeded, processing plants declined by almost half since 1990. Scallop processors successfully developed new markets for scallops, through exports and IQF packing for restaurants. The doubling of ex-vessel scallop prices, adjusted for inflation, since 2000 shows their success, which also supports processors' claims that steady increasing supply improves product sales.

The Value of Alternative Escapement Goal Policies: How Much Can Be Captured?

Jocelyn Wang, Christopher M. Anderson
University of Washington, Seattle WA

The salmon fisheries in Bristol Bay, Alaska are evaluating alternative escapement goal policies to examine how changes in escapement goals affect biological and economic outcomes. We develop an integrated bioeconomic and an in-season management simulation model to predict the distribution of revenues that will result from alternative escapement policies. The model uses historical reconstructions of daily fish abundance throughout 9 stocks of the fishery to predict the spatial distribution of harvester effort, jointly with daily opening and closure of a sub-district, to determine the daily landings. Based on daily landings and pre-season staffing decisions, the processors choose product forms, determining market production and the price received. The days on limit is used to select the appropriate long-term capital investment scenarios across alternative escapement goals. Ex-vessel price is determined as a function of total processor revenue. We find that increase in escapement goals will lead to increase in mean and variance of total run size. However, the average catch level may not necessarily increase, which is different than previous research when the daily processing capacity limit is not taken into account. We also find that the benefits arise from increase in escapement goals are not distributed equally among harvesters. Set net harvesters and driftnet harvesters who do not switch districts will decrease its average revenues due to an increase in average number of no fishing days with increase in escapement goals.

Panel Discussion:

The session organizers will compile a list of questions that emerged from the individual papers for use in the panel discussion. Depending on the exact topics presented, the panel discussion could include some of the following: How does direct marketing and traceability fit into the seafood processing model? How will innovative marketing tools be incorporated into the traditional seafood distribution network? What should be included as part of the cost/benefit analyses? Some questions to focus on in terms of the expanded cost/benefit analyses include: How or if or whether benefits from processing should be considered as part of net national benefit? This is related to the question of what is the proper estimation of MEY? Currently we think of estimating benefits as solely from the commercial harvesting sector, but there is additional producer surplus associated with processing. Therefore, should economists expand their view of benefit and cost analyses to include the processing sector? This question is of management interest and contributes to the dialogue of what is the proper method to conduct benefit/cost analyses. Finally, the analyses presented reply on data ranging from a handful of industry-wide data points, to hundreds of thousands of company level data points. Is more data better? How do studies with minimal data improve with additional data collections? How will the recent results of the national processor data collection be leveraged in the analyses presented? Depending on interest, we may ask the panel participants to submit one to two questions for the discussion session.

MSC, FPIs, and Everything in Between: Assessment of the Evolving Markets for Certification and Sustainable Seafood

Hirotsugu Uchida
University of Rhode Island

Certification labels for commercially caught fish and crustaceans are a growing trend whose premise is the creation of incentives that will encourage fishing firms to employ more sustainable practices. For the most part, this trend was fueled by the growth of the Marine Stewardship Council (MSC). Moving forward, however, there are several certification programs with varying levels of participation by the retail and producing sector that could give rise to competition to MSC and between these new labels. Another issue that established certification programs face is how to 'reward' those fisheries making progress towards

certification, but not yet not at conditions necessary to achieve the status. Fisheries Improvement Projects (FIPs) have partially filled that niche.

A critical question, however, is whether the expansion of FIPs may ultimately undermine the environmental benefits generated through certification. With fisheries certification, buyers in the market (from processors, distributors up to the retail sector) reward certified fisheries via increased market access, possible price premiums or other market benefits for the certified fishery. In contrast, FIPs create a scenario where fisheries are rewarded with market access, possibly before significant improvements in the sustainability of the fisheries have occurred. While this may provide an economic incentive for further environmental improvements, studies have shown that a preponderance of FIPs are ‘stuck’ at an early stage of the FIP process. Direct competition in the marketplace between MSC certified and FIPs products may lead to FIP fisheries explicitly not pursuing MSC certification, given the market opportunities being already presented by engaging in FIPs.

Another important question to be addressed is whether the growing number of certification programs for fisheries, in addition to the MSC, is undermining significant environmental improvements. These include the Responsible Fisheries Management program used by Alaska and others, country-specific certifications, such as those by Japan, Iceland and Norway (and proposed by NMFS for the US), and private certifications such as by the Friends of the Sea. Numerous benchmark studies have shown, for the most part, that MSC is the gold standard in terms of the environmental benefits. However, it is not clear to what extent these programs also undercut the value of MSC certification.

This special session is proposed by a group of researchers (Uchida, Roheim, Frank Asche, and James Sanchirico) working on above issues. Specifically, the group is working on the project to provide insights into the following:

- (1) The consumer, producer, and retail outlets roles in the provision of sustainable seafood;
- (2) The extent seafood products from FIP-engaged fisheries are substitutable with more formal certified sustainable seafood; and
- (3) The perceptions of agents throughout the value chain on the substitutability of seafood across the various certification programs.

Prior to the NAAFE meeting, the group will gather and compile information on these topics through extensive review of academic literature and interviews with industry and FIPs. We anticipate that the literature review will present a series of hypotheses as to what drives demand for sustainable seafood, and what might affect the relative positioning of FIPs versus certification – as well as how the various certifications substitute for one another. Then, in order to place these hypotheses in the context of current behavior and practice within the seafood sector, we will conduct a series of discussions with individuals in the seafood supply chain. Targeted industry experts include, but will not be limited to, Bill DiMento at Highliner Seafoods, Logan Kock at Santa Monica Seafoods.

The proposed special session will first involve the research group’s presentation of the preliminary findings. The presentation will be followed by a keynote speech by Jim Anderson, who formally led the fishery program in the World Bank and seafood markets expert, on the role of MSC and FIPs in the context of fisheries in developed and developing countries. After the keynote speech, panelists listed above will be invited onto the stage. Panel discussion on the topic will be moderated by Uchida (lead), Roheim, and Asche.

Thus, the proposed special session will serve two purposes: 1) to raise the profile of the issues identified to members of our disciplinary field, hopefully spurring other researchers to begin their own investigations of these complex issues; and 2) to obtain feedback from other fisheries economists in academia, regulatory agencies, and environmental NGOs, as well as non-economists from a diverse set of backgrounds.

Re-Thinking Niche Markets for Seafood: Challenges and Opportunities for “Local” Seafood

Tracy Yandle

Emory University, Atlanta GA

In recent decades, the seafood industry has faced remarkable changes. Aquaculture and globalization both put pressure on the fishing industry to reduce prices and compete in a global marketplace. Meanwhile, rapidly increased fuel costs and increased regulatory requirements increased the costs of fishing. In this context, the local foods movement -- Farmers Markets, CSFs (Community Supported Fisheries) and restaurants highlighting local foods -- offers an intriguing opportunity to tap into a new niche market that holds the potential for higher prices (Brinson et. al 2011) over traditional wholesale trade. But these markets also have expectations not necessarily present in the broader seafood market. These include: higher expectations for environmental sustainability (Wall, 2011), and a desire for a relationships with food providers (Martinez, 2010). Thus, it seems intuitive that niche market like local foods cannot be a panacea for seafood industry challenges. In the face of this uncertainty, there is little economic research specifically examining the local foods market for seafood, and the degree to which it may provide an opportunity to engage in a higher value market. This panel represents a first step in addressing this challenge. This session (chaired by Gil Sylvia, Oregon State University) will highlight a series of papers, each presenting research or analysis of experience on a particular challenge or opportunity for the seafood industry’s participation in the local foods marketplace. This panel presents a diversity of: geographic areas, methods, and issues facing seafood in the local foods market.

Assessing the Willingness to Pay for Local Seafood in Georgia’s Farmers’ Markets and CSAs

Gina Louise Shamshak

Department of Economics, Goucher College, Baltimore, MD

In 2012, over five million pounds of seafood were landed in Georgia, at a value of over \$7 million (DNR 2013). While little quantitative data is available, conversations with local experts suggest most seafood is transported out of Georgia. This leaves the large inland markets of Atlanta and Athens with relatively few local seafood varieties, thereby creating an opportunity for Georgia seafood producers to market their product to these inland markets. Research indicates that consumers are interested in locally produced foods (Gallons et. al 1997, Jekanowski et. al 2000). While farmers markets in Atlanta and Athens rarely include seafood, it is a growing presence in farmers markets in other communities, either for Lent (Walker 2013) or year round (Locals Seafood 2013). Using a single bound dichotomous choice contingent valuation format, the willingness to pay (WTP) for locally sourced seafood products will be estimated for both farmer’s market patrons and Community Supported Agriculture (CSA) members. This WTP analysis is part of a larger research effort to assess whether there is a market for locally sourced seafood in Georgia. Surveying consumers who are currently active in the Georgia local food movement (active CSA members and active farmer’s market participants) will allow for the estimation of WTP for locally caught Georgia seafood sold inland to that target customer base. The results of this effort will be used to assist fishermen and processors/distributors when deciding whether to pursue direct marketing approaches or to continue with established marketing routes.

Putting Local Seafood Into the Alaska School System: Seafood Processor’s Perspectives

Quentin S. W. Fong

Alaska Sea Grant Marine Advisory Program, University of Alaska Fairbanks, Kodiak AK

Hunger and food insecurity in Alaska are significant and growing problems that are exacerbated by the state’s geographic isolation and extreme climate¹⁻². Alaska Native and other rural residents are most severely impacted. In 2008, 19% of Alaska Natives and 22% of rural residents were food insecure. Per capita income is less than half of the national average in rural communities and residents suffer from high energy costs, high unemployment rates and limited local economies. These factors severely limit rural residents’ access to healthy and affordable foods. On the other hand, Alaska is the largest seafood producing state in the US. Yet,

for various reasons, almost all of Alaska's seafood are exported and does not stay and consumed in the state. In 2012, the University of Alaska Fairbanks received USDA funding to examine and possibly develop a program that connects school cafeterias with locally owned fish businesses. One piece of information needed to achieve the Fish to School program objectives is the capacity and willingness of Alaska based seafood processors to supply local seafood to the school system. The results of a survey with Alaskan seafood processors on their motivation to supply fish to local schools, availability of product forms and species of individual seafood processing plants, willingness to hold inventory and arrange logistics, pricing structure, and advice to Alaskan school food service purchasers on how to best source local seafood will be presented and discussed.

Foodies, Fish, and the Fed: Fisheries Regulations and the Development of Local Seafood Markets and Culinary Tourism in Coastal Communities

Kari MacLauchlin

South Atlantic Fisheries Management Council, North Charleston SC

The regulatory environment has a crucial role in development of local and regional markets that include a fresh local seafood component. Particularly with the expansion of the local food movement and the increase in culinary tourism in coastal communities, consistent availability of locally caught species is important to many restaurant owners and chefs, and associated staff and businesses. However, fisheries regulations designed to sustain harvest at the regional level can include restrictive measures that negatively affect the flow of product into the local supply chain. This paper presents a case study of several economically important species in the South Atlantic region and how the regulatory effects on harvesters can in turn hinder or help the local seafood market and restaurant industry. Additionally, the paper includes examples of future steps for regulatory agencies in removing obstacles and minimizing regulatory impact on new and developing local markets and culinary scenes in coastal communities.

Florida Market Maker: Buying and Selling Local Seafood

Charles Adams

University of Florida, Gainesville FL

Market Maker is a web-based tool that allows local buyers and sellers of agricultural and seafood products to acquire greater visibility within local and regional markets. Market Maker was developed at the University of Illinois, but is now available through Riverside Research, a private, not-for-profit, scientific research company. Market Maker was initially developed to provide assistance for buying and selling of more traditional agricultural products. However, NOAA funding for the Oil Spill Disaster Program of the Gulf States Marine Fisheries Commission provided an opportunity to apply Market Maker to enhancing the marketability for Gulf of Mexico seafood products following the Deepwater Horizon oil spill. All Gulf-region states, including Florida, received Market Maker funding. With programmatic support through Florida Sea Grant, Market Maker was implemented statewide, the initial application being targeted at certified retail and wholesale seafood dealers. Limited success has been realized for Market Maker as a tool for the marketing of seafood in general ... from the vessel to the consumer ... but recent interest has been generated for Market Maker to be used as a tool specifically for connecting consumers with sellers of locally sourced seafood products. However, Market Maker represents only one of several such web-based tools that can be used to enhance the ability buy and sell local seafood. This discussion will focus on the history of Market Maker within the Gulf of Mexico region, and provide insight into the opportunities and constraints associated with utilizing such web-based tools for the marketing of local seafood products.

What is "Local" Seafood? An Analysis of Consumer Perceptions, Opportunities, and Barriers to Market Development

Tracy Yandle¹ and Jennifer Sweeney Tookes

¹ Emory University, Atlanta GA

² Georgia Southern University

Across the United States, there are a growing number of consumers interested in (and willing to pay premium prices for) foods that were grown locally. How does seafood fit into the interest in local food? How do consumers define “local” seafood? How well does this definition match with the seafood sold in local markets? Using data from a national survey of farmers market managers, and a survey of Georgia farmers market patrons; this study examines consumer definitions of “local” seafood and the needs (and desires) of local foods consumers. These are then compared to the needs and desires of the fishermen and processors providing seafood in Georgia. The resulting opportunities and barriers to developing “local food” markets for seafood are explored.

Panel Discussion

Protected Resource Economics: Key Challenges for Incorporation in an Ecosystem Based Management Approach

Kathryn Bisack¹, Kristy Wallmo¹, Gisele Magnusson²

¹ NOAA Fisheries

² DFO, Canada

In the U.S. the traditional use of economics in protected resource (i.e. marine mammals, sea turtles, corals and fish addressed in specific legislation to protect) management has been through benefit-cost, cost effective, or cost minimization analyses. These analyses are typically undertaken for specific regulatory actions, including those supporting the Marine Mammal Protection Act and the Endangered Species Act (similar requirements exist in many countries including Canada). However, increasing competition for marine resources combined with threats such as climate change and habitat degradation warrant an approach to marine management that balances trade-offs among competing uses (and non-use) of the marine environment while protecting ecosystem integrity and it’s derived goods and services. Such an approach is often referred to as Ecosystem Based Management (EBM), and explicitly integrating protected resources and economics into EBM will be important for its success.

Economics can be used to help understand and quantify the inherent trade-offs of alternative marine management scenarios or designations, a key component of EBM. Though this ability underscores the significant role economics can play in EBM, in practice the use of economics in EBM has been limited conceptually and empirically. In addition, protected resources have not been fully incorporated in ecosystem models, compounding some of the special challenges for economic analysis of management for these species. The intent of this session is to illustrate the use of economics for protected species/biodiversity conservation within an EBM framework and to generate discussion on how to further integrate protected resources into EBM. After four presentations a panel discussion will be convened to identify the primary challenges associated with this task as well as specific research and/or applications that will advance EBM to a more fully integrated, interdisciplinary approach.

The goal of the session is to engage a broader audience in a discussion that has largely been internal to NOAA. We will have an opportunity to expand the capacity within our profession to tackle the research challenges of economics of protected resource problems. Topics in this session will address some of the components needed to move toward a more holistic approach of analysis for protected resources, in an EBM or other framework. The session will begin with an introduction of the purpose of the session, followed by four presentations (15 minutes). Each presentation will be followed by a short question and answer period (5 minutes). Following all presentations, session participants will be invited to engage discussion with the panel of presenters on key questions.

Presentations to address components of the EBM and PR question include:

Introduction

The session will start out with a short presentation on the goals, accomplishments and priorities discussed at the Sept 2014 NOAA PR Economic workshop. This will set the stage for the presentations.

The structure of Conservation Values and Ecosystem-Based Management Dynamics

David Kling

Department of Applied Economics, Oregon State University, Corvallis OR, USA

An ecosystem-based approach to marine resource management involves making trade-offs among consumptive and non-consumptive uses of multiple species over space and time. A large literature focuses on the spatial-dynamics of harvest. The role of conservation values in multispecies management has received less attention. This paper examines how non-consumptive benefits shape the optimal conservation of a generalist marine predator and the harvest of its prey. To illustrate how the structure of benefits can drive optimal management, the spatial-dynamic bioeconomic model developed in this paper is tailored to the case of the western Steller sea lion (*Eumetopias jubatus*) subpopulation in the Aleutian Islands.

A Biodiversity Conservation Mitigation Approach to Bycatch Reduction

Dale Squires

NOAA Fisheries, Southwest Fisheries Science Center, LaJolla, CA

Conventional bycatch reduction approaches give insufficient attention to the holistic (ecosystem-level) impacts of bycatch. Bycatch reduction simply focused on at-sea catch ignores opportunities offered by more cost- and ecologically-effective bycatch mitigation measures that may directly and more effectively increase impacted populations elsewhere in their geographic range or life cycle. A broader-based ecosystem approach to biodiversity conservation allows the incorporation of a broader range of policy instruments, applied at life stages and geographical ranges other than those of the strict harvesting process to achieve better cost- and ecological effectiveness and increased compliance and self-enforcement. While harvesting strategies, such as balanced harvesting, may form the conceptual basis for ecosystem based management, a broader-based ecosystem approach to biodiversity conservation, and especially to bycatch, may be the primary means of implementing ecosystem based management in the foreseeable future.

A Review of Policy Instruments used to manage Protected Resources

Kathryn Bisack¹, Gisele Magnusson²

¹ NOAA Fisheries

² DFO, Canada

Choosing a policy instrument is a strategic choice. In the case of fisheries interactions with marine mammals and sea turtles, the preferred policy instrument has been a command-and-control approach such as effort reductions (e.g. area closures) and/or technology standards (e.g. gear modifications), even though market based approaches are available. Since monitoring, compliance and enforcement is more challenging and costly for protected resources this can be significant in the choice of instrument. We examine a case study to identify current and alternative criteria that can be used to identify the strengths and weakness of various policy instruments designed to protect marine mammals and sea turtles.

Public Preferences for Endangered Species Recovery: An Examination of Geospatial Scale and Non-Market Values

Kristy Wallmo, Daniel K. Lew

NOAA Fisheries

Non-market valuation allows society to express their preferences for goods and services whose economic value is not reflected in traditional markets. This can be an important component of an ecosystem approach to marine management (EAM), as some marine resources, e.g. protected marine species, do not have a

market price and are thus difficult to integrate into the types of policy analyses needed to support EAM. One issue that arises in applying non-market values in policy settings is defining the extent of the economic jurisdiction – the area that includes all people who hold values – for a good or service. In this paper we estimate non-market values for recovering eight threatened and endangered marine species in the US for two geographically embedded samples: households on the west coast of the US and households throughout the nation. We statistically compare species values between the two samples to help determine the extent of and variation in the economic jurisdiction for endangered species recovery. Our findings offer support to the tenet that the summation of non-market values across the country is appropriate when evaluating alternative policies for endangered species recovery.

Panel Discussion

Douglas W. Lipton, Eric Thunberg, Kathryn Bisack, Kristy Wallmo, Gisele Magnusson, David Kling, Daniel K. Lew

Have the key gaps been identified? How do we prioritize research and application needs? What research and applications should we pursue? Is a broad based management approach a practical way forward?

Emerging Technologies in Fisheries Economic Data Collection

Barbara Rountree,

NOAA Fisheries, Northeast Fisheries Science Center

Electronic technology is changing the world. Technologies experts are busy developing new methods to collect, store, visualize, and use fisheries data. Aside from regulatory requirements, reliable and improved fisheries economic data has many research applications. As fisheries economists, we use these data for spatial analyses, ecosystem-based management, bio-economic modeling and long-term interdisciplinary research. The objective of this session is to explore the use of emerging technologies to ensure our economic fisheries data collection system will support the future management and research needs in North America's fisheries. Over the years, fisheries data collection programs and data management needs have generally been developed as needs arose, in response to management actions, and not ideal for management, monitoring, bycatch reduction or research purposes. Historically, timeliness, accuracy, and completeness have been critical issues, and are now even more so for the study of ecosystems, sustainability and property rights.

The expanding use of Smartphone's, digital tablets, digital pens, and cameras promises to increase the ease and accuracy in data collection. Rapidly improving software and hardware, geographic identifiers, sensor, and satellite technology are increasing the speed, reliability and capacity to gather and analyze information. Computer-assisted interviewing is available for both telephone and personal interviewing. New techniques are available to use and analyze archived qualitative data for research purposes. Social science research is generating new types of data files, such as video, audio and geospatial that require new handling and storage considerations. In conjunction, there has been an expanded appreciation of the benefits of socio-economic data and more funding allocated to collect this data through mail, phone and web surveys, in-person interviews, and specialized focus groups. Better data will allow improved measurements of economic effects and outcomes and help in posing new research ideas and designs.

The increasing interest and need for real-time data for management provides challenges and trade-offs in terms of timeliness, reliability, convenience, and cost. Different methods of transmission of data from vessel to shoreside (Wi-Fi, cell phone, USB thumb drive, satellite) and analysis can be provided at different levels of costs and speed. This session will focus on marine commercial fisheries social science data collection and the challenges and opportunities in developing and employing new technologies. Speakers will discuss enforcement and research applications; examine tradeoffs between human and electronic monitoring, and

data sharing agreements. We seek to offer a mix of case studies using current technology as well as thoughts on how improvements will address the current challenges associated with accurate reporting.

Electronic Technology in Northeast Fisheries

Barbara Rountree

NOAA Fisheries, Northeast Fisheries Science Center

Fishery dependent data collections (FDDC) are undergoing major changes in the Northeast and elsewhere. These changes will have broad implications for a wide audience, including the fishing industry, other stakeholders, Councils, state partners, ACCSP, academic partners, and NOAA fisheries using the data to support management and research needs. Increasingly, fishery regulations have challenged the methodological and budgetary limits of contemporary data collection methods such as on-board observers, self-reporting, dockside monitoring, and filing landing receipts. Fishery managers are striving for greater monitoring, accounting, and reduction of bycatch via increasingly more sophisticated regulatory approaches. Given governmental and industry budget constraints, the use of Electronic Technologies (ET) is emerging as a possible effective and efficient solution to meet these challenges and demands. Additionally, the potential ability for ET to provide fishery- dependent data that are spatially explicit could be beneficial. A truly regional electronic technology implementation plan needs to take into account the roles of several key partners in addition to NMFS. This presentation describes the progress and challenges involved in undertaking this large ambitious task to improve our FDDC collections. Work is ongoing on estimating costs and examining the tradeoffs between human and electronic monitoring. The knowledge and heritage of historical methods of collecting FDDC data must be preserved so that it can be properly evaluated in comparison with current and future data collections.

Methods and Challenges to Collecting Real-time data in the Pacific Islands Region

Minling Pan

NOAA Fisheries, Pacific Island Science Center

For a long period of time, economic information on the fisheries in the Pacific Islands region was limited primarily to the dockside value of landed fish. Data on fishing expenses were obtained intermittently through a one-time survey conducted once every 5 or so years. The paucity of economic data has been a significant hurdle in the evaluation of economic performance of fisheries and economic impacts associated with proposed regulatory alternatives. Starting in 2004, significant strides were made towards establishing programs to collect real-time economic data on a routine and continuous basis. This presentation describes the methods and challenges of implementing several real-time economic data collection programs established in the fisheries of the Pacific Islands region. In addition, this presentation provides examples of the integration of real-time economic data with other related fisheries-dependent data (e.g., landings and fishing location) and the implications of the integrated data in supporting management and research needs in Pacific Islands' fisheries.

Operationalizing Open-Source Electronic Monitoring in New England Groundfish Sectors: Is the Future of Monitoring More Cost Effective than the Past?

Jessica Joyce¹, Amanda Barney²

¹ Gulf of Maine Research Institute, Portland, ME

² Ecotrust Canada, Prince Rupert, British Columbia, CA

Electronic monitoring (EM) systems hold promise for the future collection of fishery-dependent data, either to supplement human at-sea observers or replace them. Several pilot studies have been conducted on EM in the New England groundfish fleet, though there are still on the water operational and shore-side protocols to further test and refine, not to mention the lack of guiding policy around an EM program for the groundfish fleet. The Gulf of Maine Research Institute and Ecotrust Canada, along with the Maine Coast Community Sector and The Nature Conservancy are entering the third year of a collaborative project to operationalize

EM systems on gillnet and trawl vessels in groundfish sectors. The focus of the systems in the first two years has been to obtain species IDs and weights (from lengths) from the video to validate captain's estimates of the same data in their haul-by-haul log. In Year 3, we are collaborating with NMFS to develop an EM project in fishing year (FY) 2015 that will continue to test proof of concept for a fully operational system in FY 2016 that would replace sector at-sea monitors (ASMs). The groundfish fleet may have to fund ASMs as early as FY2015, and there is a need for a more cost-effective alternative to human observers. This project has been designed with the industry cost-limitations in mind, and depending on the ultimate program requirements for EM, may prove some cost savings to fishermen, but what are the trade-offs?

Real-time Bycatch Avoidance in the US Atlantic Scallop Fishery

Catherine E. O'Keefe, Greg DeCelles, Steven X. Cadrin, Daniel Georgianna
University of Massachusetts Dartmouth, School for Marine Science and Technology, Fairhaven, MA

Real-time and near real-time information gathering and exchange can improve our ability to manage trip limits, track species' distributions and avoid bycatch species. Integrating new technologies and data sharing capabilities into fisheries management has enabled quick responses to mandated catch limits, including bycatch. A dynamic, real-time approach to bycatch reduction and avoidance can ensure that both management and fishery objectives are acknowledged and prioritized. While the outcomes of bycatch avoidance programs can be ecologically beneficial, specific aspects of program design can include measures that lead to socioeconomic benefits. We employed a cooperative, iterative approach to address bycatch of yellowtail flounder in the Atlantic sea scallop fishery. We developed a system that uses near real-time, spatially-specific, fishery-dependent data to a) determine high density bycatch areas and b) advise the fishing fleet to avoid these 'hot spots.' We employ a two-phase approach to bycatch avoidance. Phase one provides maps of previously collected data on target and bycatch species' distributions prior to the fishery opening, representative of traditional static fishery survey information. The second phase consists of daily transmissions from fishermen about the amount and location of bycatch, rapid identification of bycatch "hotspots", and transmission of a daily bycatch advisory to the active fleet. We addressed issues of data sharing and confidentiality by collaborating with the scallop fleet during the development of the program. This case study demonstrates use of near real-time information exchange to avoid bycatch that uses a single data stream, cost-effective, user-friendly technology, and minimal data processing.

Workshops

Student and Early Career Workshop

Wednesday, May 20 (12:15 to 1:15)

The Student and Early Career Workshop will provide opportunities for networking and workshops on sharpening your career skills. This is an opportunity for Q&A with the NAAFE and IIFET presidents, the MRE Editor, and academic department heads. Grab your lunch and join us for a free-ranging discussion on how to succeed.

Creating Fisheries Value by Reforming Management Institutions across Small Scale Billfish Fisheries in the Caribbean

Thursday, May 21 (12:15 to 1:15)

Brad Gentner

Gentner Group Consulting, LLC, Tucson, AZ

This brainstorming session is an outgrowth of a project recently funded by the World Bank (WB) under their Global Partnerships for Oceans (GPO). One issue of particular concern to the health of the oceans and GPO partners are the high seas or areas of the ocean beyond national jurisdiction (ABNJ). These areas are recognized as one of the least managed global commons on Earth – and represent a new frontier for efforts to address global environmental and sustainable livelihood challenges. Overfishing, habitat destruction, and pollution are collectively symptomatic of a wide-ranging institutional failure to address the open access commons nature of most living marine resources found within both EEZ and ABNJ and these institutional failures erode ocean wealth and cripple economic development for developing nations. It is hoped the Caribbean Billfish Project, which is being operated by the Western Central Atlantic Fishery Commission in collaboration with IGFA, will identify and propose more appropriate institutional arrangements to ensure that those who invest in fisheries are given secure claims to the benefits that accrue from this investment.

ICCAT has determined that white marlin and blue marlin are seriously overfished in the region, while sailfish appear to be overfished but a lack of adequate catch data from artisanal harvesters makes assessment difficult. In June of 2013 new conservation measures became effective, setting hard national quotas and prohibiting the entrance of recreationally caught billfish into commercial markets for all nations fishing Atlantic billfish within and beyond national jurisdictions. Innovative management strategies involving rights based approaches are desired to increase economic value and efficiency in this fishery, as well as to distribute benefits of improved management. From an economic and management perspective, billfish is a very good candidate for the use of rights-based tools to address the relationship between commercial and recreational fishers. Billfish are among the lowest priced species in local fish markets in the Caribbean, indicating a relatively low contribution to profitability for commercial fishers, and in contrast, it is among the most sought after species by recreational fisherfolk, giving them a high value in this primarily non-consumptive use. The key challenges are to demonstrate that value and create institutional mechanisms that make it beneficial for commercial fisherfolk to abstain from harvesting billfish, and to demonstrate to recreational operators and associated industries that this enhances catchability and their business.

Agenda:

1. Introductions
2. Presentation:
 - a. World Bank Global Partnership for Oceans
 - b. Caribbean billfish project
 - i. Background
 - ii. Goals
 - iii. Partners
 - c. Tools/institutions
 - i. TURFs
 - ii. Co-management
 - iii. Limited entry or effort rights
 - iv. Tradable bycatch quotas
 - v. Compensation schemes
 - vi. Community harvest rights/quotas
3. Discussion
 - a. Open brainstorming session
 - b. Recruitment of a handful of collaborators

Index of Authors

Aanesen, Margrethe.....	29	Duarte, José A.	58
Abbott, Joshua K.	27, 42, 43, 68	Eaton, Gary A.....	63
Abubakar, Babagana.....	26	Edwards, Eric	49
Adams, Charles	77	Eggert, Håkan.....	44
Agar, Juan	66	Emery, Timothy J.	62, 63
Andersen, Ken H.	28	Errend, Melissa	62
Anderson, Christopher M....	30, 35, 44, 52, 73, 74	Estay-Montecinos, Manuel.....	20
Anderson, James L.....	30	Evans, Keith	35
Anderson, Lee G.....	11	Faig, Amanda D.....	21
Aranda-Nah, Javier.....	58	Failler, Pierre.....	26, 27
Armstrong, Claire W.	29	Farrington, Craig.....	52
Asche, Frank	19, 33, 53	Felthoven, Ron	50
Badmus, Olanrewaju	25	Fenichel, Eli P.....	27
Barney, Amanda.....	81	Fernandes, Devlin.....	32, 48
Bellanger, Manuel.....	50	Fernandez, Linda M.....	24
Bilkovic, Donna M.....	38	Fields, Kathryn Ann H.....	38
Birkenbach, Anna.....	33, 44	Fissel, Benjamin E.	31, 55
Bisack, Kathryn.....	78, 79, 80	Fluharty, David.....	35
Bodwitch, Hekia.....	31	Fong, Quentin S. W.	20, 39, 76
Brinson, Ayeisha	72	Freeman, Matthew Alan.....	34
Cadrin, Steven X.	82	Galligan, Monica.....	37
Carr-Harris, Andrew	36	Gallucci, Vincent	35
Carroll, Michael T.	61	Gamage, K.D.M.	57
Carter, David	69	Gardner, Caleb	62, 63
Chen, Jessie.....	20	Gentner, Brad.....	61, 68, 83
Chen, Y. Allen.....	23	Georgianna, Daniel.....	22, 73, 82
Chu, Jingjie.....	30	Gho, Marcus.....	52
Criddle, Keith R.	46	Gómez, Walter.....	57
Crosson, Scott.....	36, 40, 67	Gooch, Martin	56
Cuevas-Jiménez, Alfonso	58, 60	Green, Bridget S.	63
Culver, Carolyn	37	Greenberg, Joshua	46
Cunningham, Sam	32	Guldin, Marie.....	73
Cunningham, Steve	61	Guttormsen, Atle.....	19
Curtis, Rita.....	71	Guyader, Olivier	50
Czajkowski, Mikolaj	29	Hariharan, Aneesh	35
Dalton, Michael G.....	39, 55	Hartley, Marcus L.	23, 30, 39
Davidson, Kelly A.....	54	Hartmann, Klaas.....	62, 63
Dayton, Alexa M.....	42	Havens, Kirk J.	38
DeCelles, Greg.....	82	Haws, Maria.....	20
Decker, Julie.....	19	Haynie, Alan C.....	22, 23, 24
Demarest, Chad	51	Headley, Maren.....	60
Dent, Benjamin	56	Henry, Anna	34
DePiper, Geret S.....	29, 67	Hernández-Flores, Alvaro.....	58
Downs, Michael A.....	30	Herrmann, Mark	46
Dresdner-Cid, Jorge	20, 57	Hesselgrave, Taylor.....	32
Duan, Lijie	27	Hettihewa, Samantha.....	57

Hilborn, Ray.....	40	Macher, Claire.....	50
Hilger, James.....	71	MacLauchlin, Kari	77
Himes-Cornell, Amber.....	33, 69	Magnusson, Gisele.....	78, 79, 80
Hoffman, David Michael.....	34	Mamula, Aaron	61
Holland, Daniel S.	45, 52, 65, 66	Marenick, Nicole.....	56
Holzer, Jorge.....	43	Marrinan, Sarah.....	32
Hsueh, Lily.....	47	Martell, Stephen.....	64
Huang, Ling	41	Marvasti, Akbar	36
Hutniczak, Barbara.....	28, 41, 45	McConnell, Kenneth.....	43
Hutt, Clifford.....	67, 70	McCracken, Jon	32
Ianelli, James N.	23	McFarlane, Sandy.....	35
Inglis, Susan	22	McIsaac, Jim	32, 48
Isah, Yakubu	25	Melnychuk, Michael.....	40
Iverson, Kurt	52	Meredith, Jennifer.....	30, 52
Jara-Iturra, Miguel	57	Miller, Alex	56
Jardine, Sunny L.....	23, 29	Münch, Angela.....	41
Joyce, Jessica	81	Munro, Gordon	61
Kaczan, David.....	44	Murphy, Tammy	34
Kahui, Viktoria.....	29	Nobles, Des.....	32, 48
Kaiser, Brooks A.....	24	O'Donnell, Kerrie.....	32
Kasperski, Stephen.....	33, 47, 66	O'Keefe, Catherine E.....	82
Kataria, Mitesh.....	44	Obadiah, Filibus Vwarji	25
King, Jonathan	55	Oishi, Taro	53
Kitts, Andrew.....	46, 67	Opaluch, Jim.....	19
Kling, David.....	21, 79, 80	Pan, Haoran.....	26
Knapp, Gunnar.....	60	Pan, Minling	81
Kosaka, Rosemary.....	71	Pepper-Smith, Kegan.....	48
Kourantidou, Melina.....	24	Perruso, Larry	66
Kroetz, Kailin	49	Pfeiffer, Lisa	51
Kropp, Jaclyn D.	54	Pomeroy, Caroline	37
Kruse, Gordon.....	64	Poudel, Diwakar	21
Lampi, Elina.....	44	Puggioni, Gavino	19
Larkin, Sherry.....	47, 48, 61	Ravn-Jonsen, Lars.....	28
Lawrence, Laniyi	25	Ray, Subhash	41
Lee, Jean	69	Reid-Kuecks, Brenda	32, 48
Lee, Min-Yang	22, 36, 70, 73	Reilly, Paul.....	37
León, Rafael.....	62, 63	Reimer, Matt.....	59
Leonard, Jerry	70	Robertson, Andrea.....	48
Leung, PingSun	20	Roheim, Cathy	55
Lew, Daniel K.....	31, 49, 67, 69, 72, 79, 80	Roll, Kristin	19
Li, Shiyu.....	26, 27	Ropicki, Andrew	47, 48
Lien, Kristin.....	53	Rountree, Barbara.....	80, 81
Liese, Christopher	69	Roy, Sunanda.....	35
Lipcius, Romuald N.	29	Sakai, Yutaro.....	40
Lipton, Douglas W.....	29, 80	Sampson, Gabriel S.....	59, 69
Liu, Pei C.	53	Sanchirico, James N.....	23, 29, 49, 59
Lovell, Sabrina	67, 69, 71	Scheld, Andrew M.....	25, 38
MacColl, Spencer	59	Schewe, Rebecca Lynn.....	34
Macdonald, Eliana.....	32	Schug, Don.....	30

Segerson, Kathleen.....	41	Tegawa, Mihoko	44
Seijo, Juan Carlos	58, 60	Thomas-Smyth, Alice.....	61
Seung, Chang K.	39, 72	Thomson, Cindy.....	71
Shamshak, Gina Louise.....	76	Thunberg, Eric	80
Shoup, Brian Dale.....	34	Tisdell, John.....	62, 63
Silva, George.....	70	Tookes, Jennifer Sweeney	77
Singh, Rajesh.....	35	Uchida, Hirotsugu.....	19, 44, 54, 55, 74
Smith, Martin D.	30, 33, 44	Valderrama, Diego.....	38
Speir, Cameron	36, 61, 66	van Putten, Ingrid.....	62
Squires, Dale	79	Vestergaard, Niels.....	28, 45
St. Martin, Kevin.....	22	Villanueva-Poot, Raúl	60
Steinback, Scott.....	70, 71	Vondolia, Godwin Kofi.....	29
Steiner, Erin.....	52, 72	Walden, John	41
Steinshamn, Stein Ivar.....	21	Wale, Oyewale	25
Stemle, Adam.....	55	Wallmo, Kristy.....	70, 78, 79, 80
Sterling, Brian.....	56	Wang, Jocelyn	74
Stewart, Ian	64	Wang, Ying.....	26, 27
Stokesbury, Kevin	22	Warpinski, Stephanie.....	46
Stopnitzky, Yaniv	59	Waters, Edward C.....	39
Sudhakaran, Pratheesh	19, 54	Weidlich, Stev	30
Sullivan, Jane.....	64	Wellman, Katherine	19
Sun, Jenny	42, 46	Weninger, Quinn	35, 37
Sunday, Yacim.....	25	Wilen, James E.....	59
Sundet, Jan H.....	24	Willard, Daniel.....	42, 43
Sutcliffe, Tasha.....	32, 48	Witt, Joseph Dylan.....	34
Sutherland, Sara A.....	49, 50	Wright, Christopher S.	57
Sylvia, Gil.....	56	Yagi, Nobuyuki.....	56
Szymkowiak, Marysia	50	Yandle, Tracy.....	40, 76, 77