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Conference Abstracts

Listed by abstract ID number.
Presenting author names appear in **bold**.

ID: 5

SPILLOVER EFFECTS OF MARINE ENVIRONMENTAL REGULATION FOR SEA TURTLE PROTECTION IN THE HAWAII LONGLINE SWORDFISH FISHERY

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Session 2B - Wednesday, 1:30pm-3:00pm, Banyan/Citrus

This study examines the spillover effects resulting from U.S. fishing regulation instituted to protect endangered sea turtles. The globalized/international occurrence of swordfish and sea turtles allows for “spillover effects”: when one fishery reduces activity to reduce pressure on the resource, foreign fleet activity changes in ways that ultimately have adverse effects on the very species intended for protection, and vice versa. This study establishes an empirical model which estimates the spillover effects in terms of the change in sea turtle bycatch associated with production displacement between U.S. and non-U.S. fleets in the same ocean area where the Hawaii shallow-set longline fishery operates. The study finds that U.S. production displaces non-U.S. production in the North and central Pacific nearly one-for-one. Given the Hawaii shallow-set longline swordfish fishery has one of the lowest sea turtle bycatch rates among the fleets fishing in the North and central Pacific, this implies that reducing Hawaii shallow-set longline swordfish production through regulatory changes (closures and gear changes) did not cause an overall lower level of sea turtle bycatch in the North and central Pacific. On the other hand, if certain regulations are removed, the production of the Hawaii-based swordfish fishery may increase to a higher level and produce positive spillover effects in terms of less turtle bycatch. The study demonstrates strong spillover effects, resulting in fewer sea turtle interactions as Hawaii swordfish production increases.

ID: 8

MULTIPLE METHODS AND THE CHALLENGES OF RESEARCHING SMALL-SCALE FISHERIES

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Session 8C - Friday, 8:00am-9:00am, Glades/Jasmine

Economic and social research of small scale fisheries poses significantly different challenges compared to similar research of large scale fisheries. These challenges include the need to gather census-level data rather than stratified or weighted samples, and the need to produce publishable analysis that still protects the anonymity of individual fishermen. We discuss lessons learned during our recent experiences investigating attempts to convert management of Florida’s golden crab fishery into an ITQ system, and how we are applying those lessons to an analysis of ITQ performance in the even smaller wreckfish fishery of the South Atlantic coast.

ID: 9

PUTTING A PRICE ON LICE: QUANTIFYING THE BIOLOGICAL AND ECONOMIC IMPACTS OF SEA LICE ON FARMED SALMONIDS

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Session 9B - Friday, 9:30am-11:00am, Banyan/Citrus

Sea lice are a common native marine ectoparasitic copepod of salmonids (e.g., salmon and trout) that graze and feed on host mucus, skin, underlying tissue and blood. Primary host responses including increased stress, external wounds and a heightened susceptibility to secondary infections and disease have been shown to reduce fish appetite and growth – the two most important factors in the economic profitability of salmonid farming. Using an extensive panel dataset of all producing salmonid farms along the Norwegian coast, we investigate the impacts of infective sea lice on the biological growth of fish stocks. We then measure the economic impact of a variety of lice infestation scenarios on farm profits

over typical production cycles. Results suggest that the magnitude of economic damages from a particular lice infestation is sensitive to a farm's spatial location, the level of lice pressure, and the timing and duration of said infestation. For example, a 3 lice per-fish infestation occurring in the final 8 months of a typical growout cycle for a farm located in the Southern region will cost approximately \$1,010,185 or \$0.74 per kg of harvested biomass. This "Price of Lice" represents an estimate of the value to a typical farm of completely avoiding a particular infestation scenario or, in other words, of delousing their entire fish stock.

ID: 10

MAKING CENTS OUT OF BARTER AND PACKAGE TRANSFER DATA FROM MULTISPECIES ITQ MARKETS

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Session 6A - Thursday, 1:30pm-3:00pm, Tarpon Key & Sawyer Ballroom

Quota prices in fisheries managed with individual transferable quotas (ITQs) can reveal information about the fishery that can be useful to participants and to fishery managers. However, there has been relatively little study of quota markets and no published analysis of market transactions that involve sales of multispecies packages of quota or barter (quota for quota) transactions which are frequently observed in multispecies ITQ systems. A high proportion of quota market activity in the British Columbia groundfish ITQ is comprised of package sales and barter transactions. A high proportion of priced quota transfers in the newly implemented US Pacific groundfish ITQ provide only one price for multispecies packages of quota, and barter trades common in this fishery as well. In both fisheries, barter and package trades represent the great majority or only market activity for many ITQ species which are not primary target species. An issue of key interest in multispecies fisheries is how quota markets work for species that are mainly bycatch and may be constraining catch of jointly caught target species. Do these prices properly reflect scarcity and provide price signals to fishermen that incentivize sufficient but not excess efforts at bycatch avoidance. This question has yet to be investigated in a fishery with hard constraints on bycatch. I propose a modified hedonic method for estimating implicit prices from these transactions. I conduct a Monte Carlo analysis to compare and evaluate precision and potential bias associated with alternative statistical estimation methods that accommodate the peculiar error structure of this data before applying it to empirical data. While the methods appears to provide good results in the Monte Carlo experiments, applying it to empirical data is problematic when there are a large number of species traded in a relatively thin market. In some cases this may create a tradeoff between bias and accuracy of implicit price estimates. The results of the empirical analysis provide some interesting insights. They appear to confirm anecdotal evidence that quota prices in the BC groundfish ITQ do not reflect shadow values of bycatch stocks and are often priced on simple rules of thumb related to ex-vessel value. In contrast, for the US Pacific groundfish fishery quota prices have exceeded ex-vessel prices for some bycatch species and have been quite high for many species with substantial excess supply (e.g. where 70-95% of quota remained unused at the end of the year). Overall the analysis suggests quota markets are not efficient in either fishery. This may be due in part to the thinness of markets which makes price discovery (for fishermen as well as analysts) difficult and can create high transactions costs.

ID: 14

AN ECONOMETRIC APPROACH TO ASSESSING RESILIENCY IN COASTAL FISHING COMMUNITIES

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Session 9B - Friday, 9:30am-11:00am, Banyan/Citrus

We estimate an econometric model to test the degree to which fishing ports are resilient to shocks and whether ports' fishing activity exhibits significant trends over time. Coastal communities that depend on commercial fishing for a significant portion of their economic base and cultural identity are subject to many highly variable influences (e.g. stochastic and cyclical fish stocks, extreme weather events, fluctuating input and output prices). Resilience is a broad concept that can be used to characterize a community's ability to maintain desirable characteristics or identity over time and have the ability to respond to changes in the biophysical, economic, and social environment. A related definition is the ability of a community "to absorb changes of state variables, driving variables, and parameters, and still persist" (Holling 1973); these changes can be contextualized as 'shocks' to the system. However, the concept of resilience has proven to be somewhat difficult to define and operationalize, specifically in the context of coastal community economies. In this paper, we apply unit root tests to time series data of commercial fishing landings at the port level to develop measures of port resiliency.

We estimate an econometric model and test the degree to which fishing ports are resilient to shocks and whether ports' fishing activity exhibits significant trends over time. We use unit root tests to assess whether trends over time are stationary and if shocks tend to be permanent or temporary. Stationary time series fluctuate but tend to return to a constant mean, which suggests that any shocks to a system will have only temporary effects and the system will eventually return to its long-term behavior. By contrast, in non-stationary time series, shocks have permanent effects. Testing for the permanence of shocks to regional or national income time series is often employed in the literatures on regional science and economic development. If a time series exhibits a unit root, then random shocks (e.g., natural disasters, stock collapse, or sudden change in prices) have a persistent, long-term effect on the share of fishing activity in a port. If, by contrast, we are able to reject the existence of a unit root process, then shocks have temporary effects and share of fishing activity in a port will tend to return to its long term trend over time.

Using landings receipts data from 11 ports in northern and central California from 1981 to 2007, we use methods proposed by Bai and Perron (1998) to 1) identify potential structural breaks in the time series (i.e., points in time that may mark important events) and 2) determine whether the share of overall fishing activity in each port has been resilient to shocks over time. Our preliminary results show that most ports appear to revert to a deterministic mean following disturbances, i.e., most ports' shares of fishing activity are resilient to shocks. These results indicate that changes in the share of fishing activity over time are thus likely due to long term trends.

ID: 15

SUBSIDIES IN THE JUMBO SQUID FISHERY IN THE GULF OF CALIFORNIA, MEXICO

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Session 5C - Thursday, 10:30am-12:00pm, Glades/Jasmine

This paper investigates the effects of fuel subsidies and value added tax refunds on the operation of two types of firms associated with the jumbo squid (*Dosidicus gigas*) fishery in Mexico: a) firms with ships that catch shrimp and squid in different periods of the year and b) firms that deploy outboard-motor boats to catch squid year-round. The cost-benefit ratios of the policies are analysed for 2008-2015, both with and without subsidy-related income. Additionally, the net cash surplus is calculated. The elimination of subsidies may affect jobs related to vessel operations in the squid fishery and may also encourage the voluntary retirement of shrimp ships. This effect is less evident in the case of the smaller boats. Strategies aimed at improving the landed squid prices are nonetheless suggested.

ID: 17

MARINE ANGLER EXPENDITURES AND ECONOMIC IMPACTS IN THE GULF OF MEXICO IN 2011

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Session 3B - Wednesday, 3:30pm-5:30pm, Banyan/Citrus

Marine recreational fishing is a popular pastime across the United States that generates significant economic impacts to both local economies and to the nation. In 2011, marine recreational anglers took over 70 million fishing trips. As specified in the Magnuson-Stevenson Fishery Conservation and Management Act of 1996 (and reauthorized in 2006), NOAA's National Marine Fisheries Service is required to enumerate the economic impacts of the policies it implements on fishing participants and coastal communities. In order to fulfill this mandate on a regular basis and in recognition of the economic importance of recreational fisheries, NOAA Fisheries recently conducted the 2011 National Marine Recreational Fishing Expenditure Survey in all coastal states. The 2011 survey is the second nationwide survey conducted on marine recreational expenditures by NOAA Fisheries; the first nationwide survey was conducted in 2006. The data from the 2006 survey has been widely used by NOAA Fisheries, other government agencies, academic institutions and fishing-related organizations. The 2011 data and survey results will provide updated information on the economic importance of recreational fishing. The primary objectives of the national expenditure surveys are to collect trip expenditures for the most recent marine recreational fishing trip and to collect annual expenditures on durable goods used for marine recreational fishing. The estimates of expenditures are necessary for estimating the economic impacts of marine recreational fishing. Additional objectives included obtaining a profile of the most recent marine recreational fishing trip and to collect demographic information on marine recreational anglers. Because no single nationwide list of marine recreational anglers is currently available, a combination of survey methods were used to gather data from anglers. In states where NOAA Fisheries or its partners conduct established on-site catch and effort surveys, anglers were interviewed in the field and asked for their trip expenditures and asked to participate in a follow up mail survey on durable expenditures. In other states, marine anglers were identified using state fishing license databases. Data was collected on trips that occurred throughout the calendar year in 2011. Surveys were completed by over 87,000 anglers. Results were stratified by state, mode of fishing (for-hire vessels, private boats, and shore), and whether or not the angler was a resident of the state where the most recent trip took place. This presentation will provide a brief overview of the challenges faced with such a large survey effort, the survey methods and sampling strategies, the types of data collected, and the procedures used to calculate expenditures and the resulting economic impacts. US level expenditure and impact results and highlights from selected states will also be presented.

ID: 18

FISHERY DISCARDS UNDER HARVEST UNCERTAINTY AND TRADING FRICTIONS

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Session 7C - Thursday, 3:30pm-5:30pm, Glades/Jasmine

Growing evidence finds that property rights-based management approaches, such as individual fishing quotas, can address stock conservation goals and improve economic efficiency in marine fisheries. A major concern among resource managers is that fishermen operating under a harvest quota constraint will have difficulty matching random harvests with quotas. Faced with an overage, i.e., a harvest in excess of the quota, fishermen may be forced to discard fish at sea to avoid regulatory penalty. Harvest randomness and quota constraints may further aggravate the problem of wasteful at-sea discards, which recent estimates put at 7.3 million metric tons of fish per year worldwide, or 8% of the global catch (Kelleher, 2005).

A common element of most quota-based program is restricting and in some cases imposing strict limits on quota transferability. These regulations raise the cost of post-harvest quota trades which, as we show in this paper, can remedy the discard problem.

With this background, our paper has three main objectives. First, we study harvest plans under harvest uncertainty in the absence of quota trade. We explore how ex ante harvest plans and ex post harvest distributions evolve endogenously in response to management quota allocations and exogenous harvest shocks. Second, we show that harvest plans are efficient when quotas can be traded at all stages of fishing operations. Finally, we study policies that can implement efficient plans in the absence of post-harvest quota markets.

Our model considers harvest uncertainty which is idiosyncratic as well as correlated across fishermen. With only idiosyncratic harvest uncertainty, we show that frictionless post-harvest quota trade can eliminate at-sea discards completely. In the absence of such trade, we deduce an ad-valorem tax/subsidy that eliminates discards while delivering a desired harvest target. Alternatively, we identify a hybrid policy, i.e., a combined quota and landings fee, which can implement a manager's target harvest level without discards. When harvest shocks, in addition, have a fishery-wide component, post-harvest quota trading per se cannot eliminate discards; policy intervention in the form of either landing taxes or a hybrid scheme is needed. Given the prevalence of restrictions on quota trade in quota-managed fisheries worldwide, our paper offers important policy advice.

ID: 19

SEA-TURTLE BYCATCH MANAGEMENT IN RIGHTS-BASED FISHERIES UNDER STOCK UNCERTAINTY

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Session 2B - Wednesday, 1:30pm-3:00pm, Banyan/Citrus

National standard 9 of the Magnuson-Stevens Fisheries Management and Conservation Act requires that U.S. Fisheries Management Plans minimize, to the extent practicable, bycatch and bycatch mortality. Examination of U.S. fisheries suggest, however, that significant bycatch problems remain. A recent U.S. National Bycatch Report estimates that 1,887 marine mammals, 11,772 endangered sea turtles and 7,769 sea birds were intercepted by fishing gear in 2005, the base year of the study. Unintended bycatch and discard of non-target fish species in 2005 was 1.22 billion pounds, or 17% of the total U.S. catch. One often used management approach for reducing the bycatch of non-marketed but socially valuable bycatch species is to curtail fishing. Alternatives that allow benefits from commercial and recreational fishing to continue, while minimizing unintended bycatch, are clearly preferred.

We develop a stochastic general equilibrium framework that facilitates performance evaluation of quota- and non-quota-based management plans in fisheries exposed to socially costly bycatch of non-market species. We examine harvesting behavior, bycatch, and bio-economic performance in a stochastic

production environment with and without observability of bycatch, and with and without trade in harvest quotas and bycatch caps.

Our results suggest that a precise implementation of a socially optimal plan is only possible if bycatch is observable and a market for trade in fish quotas and bycatch cap functions costlessly. Non-quota-based regulations, which can be implemented without observability, do not achieve first-best bycatch avoidance and therefore raise fishing costs. The Gulf of Mexico longline reef fish fishery is examined to demonstrate key policy insights from our model.

ID: 20

COMMERCIAL SCALE AQUAPONICS: PROFITABILITY AND SUSTAINABILITY

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Session 2C - Wednesday, 1:30pm-3:00pm, Glades/Jasmine

Aquaponics, the symbiotic integration of aquaculture and hydroponics, has been touted as a sustainable farming technology that has a minimal environmental impact. Although existing literature and reports suggest economic feasibility of small-scale or backyard aquaponic system, it is not clear whether commercial scale aquaponics is a viable option. In this project, we assess the economic feasibility of commercial scale aquaponic enterprises based on a survey of several existing aquaponic enterprises in Hawaii. We compare their investment behavior and operational efficacy to the traditional aquaculture and hydroponic system. While previous studies indicate vegetable production as driving force of aquaponics enterprises, our research so far suggest that fish production may play a larger economic role depending on the design of the system. The study also investigates water, energy, and chemical use in the system to assess the environmental impacts of the operation. First we compute life cycle water and energy used in aquaponics system. By comparing the life cycle resource use with aquaculture and hydroponics, we show whether aquaponics save water and energy. Finally, we combine these results and the economic analysis to show the economic benefits from future resource savings.

ID: 21

INSTITUTIONAL DEPENDENCE OF THE FISHERY PRODUCTION FUNCTION

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Session 6C - Thursday, 1:30pm-3:00pm, Glades/Jasmine

The dominant approach to modeling the fishing production process has been to adapt conventional production models used in other industries to a fisheries setting. For example, as agricultural economists hypothesize agricultural yield to be a function of water, soil type, fertilizer, labor hours, etc., fisheries economists hypothesize catch to be a function of inputs such as vessel length, gear type, crew size, and fishing time. The production process of fishing, however, is not easily represented by a simple modification of conventional production models. Fishing production is rather unique because the firm must accommodate its activities to the spatiotemporal dynamics of a fugitive resource. The production process of fishing thus involves the strategic use of inputs over time and space as primary decision variables. As a result, many of the traditionally included inputs in conventional production models of fishing are not direct choice variables for fishermen; rather, they are indirect outcomes of deep structural decisions over the temporal and spatial deployment of fishing gear.

The implications of this idea are important for predicting the outcome of a fishery policy intervention. Conventional models of the fishing production process identify reduced form technical interactions between inputs and outputs that are functions of structural decisions over time and space. If the combination of these structural variables is ultimately shaped by the incentives inherent in management institutions, then there is no reason to expect that the observed a priori relationship between traditional

inputs and final outputs should be stable to interventions in management. Thus, conventional fishing production models do not identify policy invariant parameters. It is therefore naïve to predict the effects of a change in economic policy entirely on the basis of a relationship whose structure alters systematically with a change in policy.

In this paper, we conduct a simulation exercise to investigate the extent to which conventional fishery production models that ignore the primary decision variables of fishermen are institution-dependent. We construct a stylized spatial biological system that captures the complements-in-production relationship between a target and bycatch species that is often seen in capture fisheries. We generate multiple samples of location choices for a representative fisherman, with each sample assembled to represent the location choices that would emerge under different regulatory settings. Using the output production bundles that result from such location choices, we show that fishermen select considerably different portfolios of location choices under different institutions, and this results in output production bundles with vastly different species compositions. We show that estimates of fishery technology using conventional methods are highly dependent on the regulatory setting that generated the production data. Thus, the relationship between traditional inputs and final outputs is not policy invariant, and therefore, conventional models of fishing production are limited in their ability to inform policy makers of fishery policy intervention outcomes. Our findings suggest that accurate assessment of the impacts of a policy intervention requires a description of the production process that is sufficiently structural so as to be invariant to changes in management institutions.

ID: 22

TECHNOLOGY OR INCENTIVES? BYCATCH AVOIDANCE IN THE BSAI GROUND FISH FISHERY

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Session 7C - Thursday, 3:30pm-5:30pm, Glades/Jasmine

Multispecies fisheries add additional complexity for rights-based management implementation. Fundamental to rights-based management in a multispecies fishery is composing a portfolio of total allowable catches (TACs) for both target and non-target species. However, due to imperfectly selective fishing gear, it is difficult to know *ex ante* a fisherman's catch composition, and thus, fishermen may find it difficult or impossible to conform their catch to match their *ex ante* portfolio of quota allocations. Possible consequences include extremely high prices for binding species quota, a collapse in the markets for "slack" species, rampant illegal discarding, data fouling, and subverted quota markets.

The appropriateness of rights-based management for multispecies fisheries ultimately depends on a fisherman's ability to "target" their catch. If a fisherman can target accurately, the problem of matching catches and quota allocations declines in importance. In theory, modifying the way in which gear is employed can enhance targeting potential. For instance, modifying the speed, depth, and/or area of tow can potentially enhance the targeting ability of bottom trawlers. Previous *ex ante* examinations of targeting ability suggest that rights-based systems may face serious challenges due to weak substitution potential between species. In contrast, *ex post* evidence from multispecies ITQ fisheries suggests that far greater flexibility in outputs is possible than previously thought. These disparate findings suggest that the production technology revealed through empirical work may be heavily dependent on current management policies.

We examine this possibility through an analysis of a fishery undergoing the transition to rights-based management: the Bering Sea/Aleutian Island (BSAI) groundfish fishery. Historically, the BSAI groundfish fishery managed the incidental bycatch of Pacific halibut through a fleet-wide common-pool TAC. Due to the complementary role halibut plays in the catch of targeted species, a binding TAC for halibut often resulted in the premature closure of target fisheries, leaving millions of dollars of unharvested target species quota on the table. In 2008, the North Pacific Fisheries Management Council rationalized the BSAI groundfish fishery under Amendment 80 (A80). Under A80, shares of the TACs for several target and bycatch species are allocated to individual fishermen that are vested in either a cooperative formed by participating members or in a limited access common pool fishery.

We combine an unusually rich panel dataset of vessels with econometric production models to characterize the multi-output production technologies of vessels before and after the policy change. We use multiple measures of substitutability between outputs to investigate the extent to which the incentives prior to rationalization affected targeting ability. In general, we find that fishermen in the BSAI groundfish fishery are remarkably capable of adjusting their behavior to match their desired catch compositions. Furthermore, an investigation of targeting ability using only ex ante data arrives at grossly misleading conclusions—namely that fishermen were limited in their ability to avoid halibut bycatch—indicating that targeting behavior prior to the introduction of A80 was primarily determined by the incentives inherent in the pre-A80 management system.

ID: 25

ESTIMATING THE INDIRECT ECONOMIC COSTS TO U.S. SHRIMP CONSUMERS FROM THE 2010 DEEPWATER HORIZON GULF COAST OIL SPILL

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Session 6B - Thursday, 1:30pm-3:00pm, Banyan/Citrus

We estimate the losses to U.S. shrimp producers and consumers as a result of the 2010 Deepwater Horizon oil spill in the Gulf of Mexico. To obtain precise estimates of the loss in producer surplus, we use National Marine Fisheries Service (NMFS) data and an approach similar to Cohen (1995) in which we predict what the price would have been in each production region if the oil spill had not occurred. Using a combination of national fisheries market data, Nielsen household scanner data and the results of an experimental auction, we identify three sources of economic damages to U.S. shrimp consumers: (1) higher prices for shrimp in 2010, (2) a loss of utility from substituting consumption of preferred wild-caught Gulf shrimp with less-preferred substitutes, and (3) a loss in utility in the form of stigma attached to wild-caught Gulf shrimp.

First, data from the NMFS show evidence of a supply constraint for wild-caught shrimp following the oil spill. American shrimp producers caught 42.1 million less pounds in 2010, but the value of the catch increased \$43.7 million (NMFS 2011). The ex-vessel price of shrimp increased 30 percent, from \$1.23/lb in 2009 to \$1.60/lb. Thus, the decreased catch led to higher consumer prices.

Second, the supply constraints on Gulf shrimp caused some consumers to purchase less preferable substitutes. As predicted by classical economic theory, all of the other U.S. shrimp-producing regions increased production in 2010 (NMFS 2011). However, evaluation of shrimp attributes during a Becker-DeGroot-Marschack (BDM) (1964) experimental auction conducted at Clemson University in the fall of 2010 indicates that consumers consider shrimp from other regions of the country to be less desirable than shrimp from the Gulf. Auction participants consisting of faculty, staff, community members and graduates students rated Gulf shrimp highest in size, appearance, smell, and taste. To obtain estimates of the loss in consumer surplus associated with consumption of imperfect substitutes following the oil spill, we use Nielsen household scanner data to determine changes in purchasing habits.

Lastly, despite assurances from local experts that Gulf seafood was safe for consumption, media attention regarding the potential health risks induced a stigma effect that created avoidance behavior on the part of consumers. The estimates of WTP from the experimental auction provide evidence of a stigma effect. Gulf Coast wild-caught shrimp were rated highest in each of the attribute categories, but bids (WTP) for the Gulf shrimp were significantly lower than the bids for other types of shrimp. Tobit regressions reveal the Gulf Coast attribute negatively and significantly influenced willingness to pay. Depending on specification, participants bid \$1.10-\$1.31/ half-pound less on Gulf Coast shrimp when holding other characteristics constant.

Collectively, the results indicate that consumers suffered indirect economic losses in the form of lower consumer surplus as a result of the Gulf Coast oil spill in 2010. The lower consumer surplus resulted not only from higher prices paid for shrimp products but also from consumption of imperfect substitutes and stigma associated with the consumption of Gulf Coast products.

NAAFE Forum 2013: Marine Resource Management under Increasing Complexities and Uncertainties

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ID: 26

CONSUMER ATTITUDE IN JAPAN ON SEAFOOD PRODUCTS AFTER THE ACCIDENT AT FUKUSHIMA

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Session 6B - Thursday, 1:30pm-3:00pm, Banyan/Citrus

A conjoint analysis was conducted to estimate the consumer's attitude toward fishery products originated from Tsunami affected areas in northern Japan. A particular focus was placed on their risk averseness against possible contamination of radio-active substances in fishery products after the accident at Fukushima nuclear power plant in March 2011. Total number of 840 Japanese consumers was researched through an internet survey during the period of 21-23 August 2012. Based on the reactions of the surveyed consumers, MWTPs (marginal willingness to pay) were calculated under various scenarios. It was found that MWTP was reduced if the fish (salmon) is harvested in Miyagi prefecture. Miyagi is located next to Fukushima (commercial fishing in coastal Fukushima waters was suspended as of August 2012), and Japanese consumers widely have prior knowledge that checking on radio-active substances for fishery products is non-mandatory (i.e., selected number of fish samples, rather than all fish, were examined). Consumer showed certain avoidance against fisheries product from Miyagi under this condition. It was also found that the reduction of MWTP can be nullified if a new policy is to be introduced which imposes mandatory checking on radio-active contaminants for all fishery products. MWTP of the consumer becomes lower if the checking is to be conducted by the retailers while it is higher if the checking is to be carried out by fisheries cooperatives (compared with government checking). Policy implications to establish a cost efficient checking scheme for marketed fish in Japan are discussed using these results. This is one of the first analyses which attempt to comprehend consumers' behavior after the Fukushima accident.

ID: 27

THE EFFECTS OF IMPROVED WATER QUALITY ON AN OPEN ACCESS FISHERY: EVIDENCE FROM THE CHESAPEAKE BAY BLUE CRAB FISHERY

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Session 3C - Wednesday, 3:30pm-5:30pm, Glades/Jasmine

In 2010, the U.S. Environmental Protection Agency (EPA) established the Chesapeake Bay Total Maximum Daily Load (TMDL), a comprehensive pollution diet to restore clean water in the Chesapeake Bay and its tributaries by 2025. Implementing the TMDL will be costly to states and local jurisdictions. This paper examines one area of potential benefits, the health of the Bay blue crab fishery. The fishery is one of the most productive in the Bay, accounting for over 65% of landings revenues.

There are concerns that improvements to water quality may not yield long-term benefits in open access fisheries. As the water quality improves, fish stocks will initially improve. However, as the potential gains

from fishing increase, new fishermen may enter and current fishermen may increase their efforts. Both effects ultimately depress fish stocks and profits from harvesting. McConnell and Strand (1989) were among the first to examine this effect theoretically and found that social returns to the fishery are positive under optimal management, but potentially negative under open access.

Mistiaen et al. (2003) developed two harvest production models to estimate the potential effect of dissolved oxygen on blue crab harvests by the trotline fishery. The first model assumes that water quality influences the availability of crabs to gear and the second assumes that water quality influences crab mortality. Their results support the availability model. However, their study does not take into account the behavioral response of the fishermen, such as changing fishery, location, or gear.

This paper empirically examines the effect of water quality on the Maryland blue crab commercial fishery including its effect on the behavioral response of fishermen. It uses trip level data from 2000-2010 to model the effects of increased dissolved oxygen levels on blue crab stocks and fishermen profits. First, the effects of water quality on stock levels and harvests are modeled using three stage least squares. Then, hypotheses on the role of water quality, migration, and the flow of benefits (e.g., timing and location) from water quality improvements are tested. Finally, fishermen entry and location decisions are modeled using a repeated nested logit model. Preliminary results indicate that a 10% increase in water quality during all months will increase stock density by 19% and profits by 11-13%.

ID: 29

RESOURCE PRICES AND ECOLOGICAL REGIME SHIFTS

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Session 3C - Wednesday, 3:30pm-5:30pm, Glades/Jasmine

Ecological shocks can threaten renewable resource extraction and flows of non-extractive ecosystem services. We show that resource prices can provide a signal of the existence and the nature of an ecological regime shift. Because ecological shocks can affect different sizes of organisms differently, they could induce relative price changes in resource products that are priced by size. Here, we analyze the Gulf of Mexico shrimp fishery and a potential regime shift triggered by the Gulf Dead Zone, a large seasonal area of hypoxia (low dissolved oxygen) that coincides with the height of the shrimp season. Because hypoxia may alter the size structure of stocks and corresponding catches, periods with worse hypoxia will see relatively large catches of small shrimp and smaller catches of large shrimp. In contrast, recruitment shocks would tend to increase or decrease all size classes. Thus, we expect hypoxia to alter relative prices, but relative prices to remain unchanged in the presence of recruitment variability attributable to other sources.

In this paper, we first conduct a series of spatial-dynamic bioeconomic simulations. The motivation is twofold: 1) to understand the ways in which known channels for hypoxic effects on the shrimp fishery will translate into biological and economic outcomes, and 2) to produce predictions about aggregate-level data that shed light on why scientists have had difficulty attributing fishery losses to hypoxia. We find that hypoxic effects are obscured in aggregate-level data that do not contain a clear indication of the counterfactual. Most aggregate-level predictions are only mildly suggestive of hypoxia's effects. Empirical data from the Gulf of Mexico brown shrimp fishery appear consistent with these somewhat ambiguous predictions. The simulations and aggregate-level empirical analysis motivate our main empirical strategy of using time series analysis of prices as an alternative to understanding the impacts of hypoxia.

For the time series analysis, we use monthly brown shrimp prices from January 1983 to December 2008. We find strong evidence of a regime shift in which the relative price of small shrimp decreases in hypoxic years. However, the effect weakens after 2000 when domestic shrimp prices are more influenced by import prices. The findings are robust to changes in fuel prices that may have altered the spatial distribution of fishing effort. For ecological, technological, or natural disasters, price compensation can be an important element of damages; losses in quantity produced may be partly offset by higher prices. Our analysis suggests that in early years, to the extent that the net effect of hypoxia is harmful to the fishery,

the industry was likely compensated partially through higher prices. In later years, this price compensation dissipated.

ID: 30

PRICING OF ECO-LABELS FOR SALMON IN UK SUPERMARKETS

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Session 1B - Wednesday, 10:30am-12:00pm, Banyan/Citrus

Eco-labels have become an increasingly important product attribute in many natural resource and food markets. Eco-labels certifies that the product or the production process have some intrinsic quality. Depending on the market and product, consumers have the option to buy products that are certified as being sustainably produced, organically produced, having a specific origin, etc.

In general, it is costly to provide the intrinsic value associated with the eco-label. Theoretically, an eco-label will only be supplied if the higher willingness-to-pay translates into a positive price premium (Gudmundsson and Wessells, 2001; Sedjo and Swallow, 2002). Somewhat surprising, there are comparatively few studies showing that eco-labels actually result in a price premium. Among the exceptions are Teisl, Roe and Hicks (2002), who show that a dolphin-safe tuna label increases demand for eco-labeled product in a demand system and Roheim, Asche and Insignares (2012) and Gruntvåg, Larsen and Young (2013), who show that the eco-label of the Marine Stewardship Council (MSC) creates a price premium in respectively the London area and in Glasgow.

Despite all the existing labels, an issue that has received little attention is the case when goods with different labels are available, so that consumers have to choose between products with different intrinsic values. The only exception we are aware of is Onazaka and Thilmany McFadden (2012), who investigate the willingness-to-pay for respectively organic, fair trade, carbon footprint and production location using survey data. They show that there are different preferences for the different eco-labels, and that eco-labels may enhance as well as discount each other.

In this study, we will investigate whether actual prices vary with different eco-labels for salmon, and whether the eco-label premium varies with retailer. To test these hypotheses, we have access to a unique data set of store data from Glasgow, UK, which contain weekly observations of product attributes for salmon products from eight retail chains, including two eco-labels (organic, MSC) and one origin label (Scottish). These data allow us to access all attributes of each product, in contrast to scanner data which typically do not include information on eco-labels. For instance, Roheim, Asche and Insignaris (2012) had to augment their scanner data with store observations to be able to find which products carried the MSC label.

Our methodological approach will be the estimation of hedonic price models. In common with most hedonic price models, these studies estimate a single parameter for each product attribute. To capture potential differences in pricing strategies for the different eco-labels for the various retailers, we will introduce a set of interaction variables in our model specification.

ID: 33

IMPLICATIONS OF CLIMATE CHANGE FOR FISHERIES IN VIETNAM

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Session 5B - Thursday, 10:30am-12:00pm, Banyan/Citrus

Vietnam ranks the 6th in the global rankings of Climate Risk Index (CRI) for the period 1991 to 2010. The damage caused by extreme weather events such as storms, floods is significant for Vietnam each year. Fisheries play an important role in Vietnam's economy, the value of seafood exports have tripled for the last 10 years and reached 6.1 billion in 2011. The fisheries sector is greatly impacted by extreme weather

events. Hurricane Linda in 1997 alone has sunk and damaged nearly 2,000 fishing vessels, causing damage of about 136,000 ha of aquaculture and more than 34,000 tons of seafood. In addition, with millions of people directly and indirectly involved in fisheries, mainly living in the coastal areas, the Vietnamese fisheries sector is very vulnerable to the natural disasters and sea level rise caused by climate change. This paper presents an estimation of climate change impacts for fisheries in Vietnam. An augmented production function is used in the present study to model the effects of climate change on fisheries outputs, in order to determine the impact of climate change on the fisheries sector in Vietnam. The analysis controls for price effects and typical fisheries inputs. Three scenarios are employed to forecast the impact of climate change up to 2050: a business-as-usual (BAU) scenario and the Intergovernmental Panel on Climate Change (IPCC) A2 and B2 climate scenarios. The loss/gain in production under climate change is then computed by comparing the production under the BAU scenario with the production levels under the A2 and B2 climate change scenarios.

ID: 34

ANTICIPATING ADAPTATION: A MECHANISTIC APPROACH FOR LINKING POLICY AND STOCK STATUS TO RECREATIONAL ANGLER BEHAVIOR

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Session 3B - Wednesday, 3:30pm-5:30pm, Banyan/Citrus

While recreation demand models have been used extensively to provide estimates of the value of a marginal fish or fishing day for recreational fisheries (or to value complementary aspects of the natural environment), they have seen comparatively little use as predictive models of angler behavior to changes in stock conditions or management policies. We argue that the emphasis on the normative/valuation aspects of recreation demand models at the expense of their positive/predictive functions has limited economists' voice and impact in the recreational fisheries management process.

We use techniques from economic recreation demand modeling to develop a structural model of individual recreational fishing behavior – a Kuhn-Tucker demand model – and estimate it using license-frame survey data. By consistently integrating individuals' seasonal decisions of where, whether and how much to fish, the model generates predictions of aggregate indicators such as angler-days and fishing mortality as emergent phenomena arising from individual behavior. We use the model to simulate alternative future scenarios by altering policy variables or measures of fishing quality, such as catch rates. The structural nature of the model incorporates anglers' adaptive behavior to these stimuli, generating scenarios that are likely more robust to shifts in the policy or ecological context than many commonly-used reduced-form models. We utilize the model to examine the sensitivity of total catch and CPUE to changes in fish stocks, providing a rigorous economic motivation for hyperstability. We also simulate total fishing trips, participation, CPUE, and total catch for a seasonal fishing permit versus a per-trip fee, finding dramatic differences across the two policies that call into question the wisdom of permit fees as management tools.

ID: 36

RUNNING TO STAND STILL? COMMON PROPERTY INDUCED INERTIA IN THE SPATIAL COMMONS

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Session 4C - Thursday, 8:30am-10:00am, Glades/Jasmine

The metaphor of the "race to fish" is powerful, conveying effectively the overinvestments in harvesting inputs in fisheries for which seasonal harvesting rights are insecure and subject to claim by first possession. While empirical and theoretical work has expanded economists' and managers' understanding of the nature of the distortions wrought by common-pool allocation of harvest rights in regulated open access or limited access systems, the findings of this literature have been consistent with the "race to fish" metaphor – with harvest-augmenting inputs seeing greater intensity of use under common-pool management than under systems with more secure harvesting rights. We contribute an additional insight to understanding the linkage between management institutions and fisher behavior by

proposing and empirically demonstrating a hitherto unobserved effect of common-pool management that contrasts with the usual “race to fish” metaphor. We propose that fishermen in a common-pool fishery will be less mobile than in an otherwise equivalent system with secure access to catch rights. For example, in a trawl fishery, vessels will tend to change fishing grounds less frequently under common pool institutions and also move smaller distances between trawls. We build an analytical model to demonstrate how fishing under a common-pool quota can induce fishermen to delay the decision to move to a new fishing ground and, upon moving, move a shorter distance. This occurs because fishing under the shared quota increases the opportunity cost of non-fishing time since one’s competitors are depleting the stock of quota even as one moves to better fishing grounds. Paradoxically, the “race to fish” manifests itself in an intense yet relatively stationary fishery. The implications of this perverse incentive may include reductions in average productivity of fishing, reduced incentives to engage in prospective searching, or greater localized depletion and habitat damage. This phenomenon may also help explain the large shadow values of distance and significant “habit persistence” often noted in fishing location choice models. We demonstrate the empirical relevance of the analytical predictions by analyzing fishing behavior before and after a major policy change in the Eastern Bering Sea mixed species groundfish trawl fishery. Under the policy change, quota for a portfolio of target and prohibited species that were once held in common by the fleet were allocated to cooperatives in a way that effectively gave fishermen secure rights to their seasonal quota allocations. Detailed observer data at the individual trawl level from before and after the policy change enables us to examine the prevalence of movements and the distance between these movements as well as link these decisions to contextual variables such as catch and bycatch rates. We demonstrate that the propensity to move to new fishing grounds increased in statistically and economically significant ways after the policy change. We also use quantile regression techniques to demonstrate that the entire distribution of distance of movement experienced an upward shift. These findings validate the predictions of our theoretical model, thereby deepening our knowledge of the connections between management institutions and fisher behavior.

ID: 38

TIMING OF HARVEST: A NUMERICAL BIOECONOMIC MODEL OF MULTISPECIES FISHERIES

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Session 7C - Thursday, 3:30pm-5:30pm, Glades/Jasmine

In recent years, there has been increasing focus on fishers’ behavior. Topics that have been addressed include the multi-output structure of the fishery, what (mix of) species to target, where to fish and with what gear. Separate strands of the literature have also noted that for some species there exist small high-valued marked segments that can only be served with long harvesting seasons, and also that the quality of many species vary over time.

With the introduction of individual fishing quotas, fishers have the opportunity to orient the time profile of their landings to economic conditions for quota species. Timing the harvest will in many cases lead to a trade-off between costs and revenues. Costs may be lowest by concentrating harvest to follow seasonal biological aggregations or at the beginning of the season when stock effects are less pronounced. Revenues, in contrast, may be highest by spreading harvest throughout the season to take advantage of inelasticity of demand. Timing decisions are further complicated by the possibility of participating in other fisheries without individual quotas.

In this paper we develop a numerical bioeconomic model that allows us to investigate the time-profile of a fisher’s landings throughout the year in a multispecies context. We find harvest patterns that are consistent with patterns in the Norwegian whitefish fisheries that target cod, haddock, and saithe. The model parsimoniously explains dramatic differences in harvest patterns across the stocks that are consistent with independent information about market conditions and biological factors. The results highlight the importance of understanding the market context in bioeconomic models, the biological context in studies of seafood markets, and the complex interplay amongst species targets and fisheries regulations.

ID: 39

SUBSIDIES AND OVERFISHING: A CAUSAL INTERPRETATION

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Session 5C - Thursday, 10:30am-12:00pm, Glades/Jasmine

Fisheries subsidies are a common management tool. Some theoretical studies link subsidies to excess fishing effort and capacity resulting in overfishing. Other studies argue that subsidies can improve the marine environment by supporting fishermen to employ new environmentally friendly equipment and can actually lead to a reduction in capacity. A major report by the United Nations identifies eight different subsidies used in the fishery and concludes that a positive or negative impact on the fishery depends on the type of subsidy implemented and ultimately it is an empirical question. The fisheries economics literature is surprisingly scant on empirical attempts to address this issue and what is more, there have been no attempts at causal modeling of subsidies in the fishery. The purpose of this research is two-fold: First, to report theoretical results on the impact and consequence of subsidies on the fishery. This will address the ambiguity in the outcome of subsidies and lead the specification and interpretation of the empirical model. Second, is to rigorously/econometrically identify the equation model leading to the causal interpretation of subsidies on overfishing.

To set the empirical research an ideal experiment would be to randomly pick a number of fisheries with different target fish species and that are independent of each other. Then, randomly assign different levels of subsidies to each species and measure the degree of overfishing. Theoretically, the random design of the experiment would allow a regression of the value of subsidy on overfishing, controlling for size of the fishery, to measure the causal relationship between subsidies and overfishing. The empirical challenge is to measure the causal relationship with observational data. The empirical model attempts to mimic a natural experiment for identification based on instrumental variables. Econometric problems that have been recognized include: (i) Reverse causality from overfishing to subsidy. An overexploited resource may trigger subsidy to support fishermen. (ii) Persistency in overfishing status. Overfishing status must persist for more than one period due to the dynamic nature of the fishery resource. (iii) Measurement error and missing observations. Even the richest database for OECD countries contains missing observations and measurement error due to the nature of self-reporting. (iv) The timing of the effect of subsidy. The effect of subsidy may continue for more than one period.

Data for 24 OECD countries from 1996 to 2006 are used to form the main database and this is supplemented with additional data from the 'Sea Around Us' project at UBC. Three candidates for the outcome variable are defined and represent either a measure of Fish Stocks Overexploited or Collapsed (the fraction of species fished that are overexploited or collapsed), Mean Trophic Level (the mean of the position of a species in the food web), and Mean Max Length (the mean of the max length of each species in landings). All three indicators represent alternative proxies for the outcome variable and will be used in empirical work.

ID: 40

EFFICIENCY COSTS OF NON-EFFICIENCY OBJECTIVES IN TRADABLE PERMIT PROGRAMS

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Session 1C - Wednesday, 10:30am-12:00pm, Glades/Jasmine

Tradable permit programs are a broadly used management tool applied to pollution and natural resources. Designing a tradable permit program requires setting a cap on total pollution or resource extraction, allocating permits to participants, and setting guidelines to allow participants to trade permits. Restrictions on trade are often implemented to address social, cultural, and other non-economic, non-efficiency goals. These restrictions can create regulatory transaction costs that can negatively impact the ability of a program to achieve the cost-effective allocation of permits.

In this paper we conduct an ex post evaluation of the costs of design restrictions in the commercial Alaskan federal halibut and sablefish individual tradable quota (ITQ) program. The ITQ program was implemented in 1995 with the purpose of managing the Alaskan halibut and sablefish fisheries (58 FR

215: 59375-59413). The rationale for including the restrictions was to preserve the small-scale, owner-operated character of the fishery and to further engineer the potential distributional outcomes associated with capacity reduction in ITQ systems. The result is that quota is linked to vessel size classes and areas, limits exist on corporate ownership and consolidation, and there are provisions requiring quota owners to be on-board the vessel during fishing operations.

We take a structural econometric approach to examining the costs of restrictions in tradable permit programs. The use of a structural model allows for a broad examination of the costs of restrictions. First, we are able to examine the transition period. A transition period arises when there are significant transaction costs associated with matching buyers and sellers and/or when transaction costs exist in vessel capital and labor markets that slow the transition to equilibrium. Second, we can examine the interactive costs of restrictions. Published work to-date has focused almost exclusively on the cost of one restriction. In reality, many restrictions are implemented at once, and therefore single-restriction analysis is limited in its applicability to management when multiple restrictions may simultaneously bind.

We use 15 years of lease and sale data as well as data on ex-vessel prices, landings, permit holders characteristics, and capital and labor characteristics (including vessel horsepower, length, tonnage, crew size, and days fished) to develop the model of the ITQ fishery. We use a stochastic dynamic programming approach to estimate the model. We then use the model to investigate the impacts of restrictions on the transition dynamics from the initial allocation of permits to the equilibrium allocation of permits and identify the key mechanisms that impact the transition period. Furthermore, by using the initial model to develop counterfactual scenarios we quantify the magnitude of the economic efficiency loss, including losses during the transition period and in the long-run, due to the existence of the set of trading restrictions and determine the relative impact of each restriction type, and interactions between restrictions, on the economic efficiency losses.

ID: 41

SPILLOVERS IN REGIONAL FISHERIES MANAGEMENT: DO CATCH SHARES CAUSE LEAKAGE?

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Session 1C - Wednesday, 10:30am-12:00pm, Glades/Jasmine

United States commercial fisheries are managed by regional councils that have jurisdictions circumscribed by political boundaries. Species ranges often span management borders and link fishermen together who are home ported in multiple regions. The result is that individual fishermen can prosecute multiple fisheries managed by different councils. This institutional arrangement raises the question of whether a policy change for a fishery in one region will affect outcomes for fisheries in other regions that were not directly involved in the policy process. Most policy evaluation focuses on the intended effect on the target fishery and neglects ancillary effects on other fisheries. In this paper, we test for the existence of policy-induced transboundary impacts on fishery outcomes and explore the implications for regional fisheries management. In fisheries, as in carbon leakage, a policy in one location frees up capital to move to another location or creates incentives for the regulated activity to expand into un-regulated areas.

Our empirical application examines leakage by exploring the effects of the 2010 New England Groundfish Sector Program (Sector Program hereafter) on adjacent fisheries in the Mid-Atlantic Region. Recent work using quasi-experimental methods finds evidence of economic benefits from Sectors on the Sector fisheries but leaves open the potential impacts on other fisheries (Scheld et al. 2012). We hypothesize that regulation in one region (New England) frees up fishing capital to exploit less regulated fisheries in another region (the Mid-Atlantic). Similar to how individual transferable quotas (ITQs) operate, the Sector Program allocates shares of groundfish total allowable catches to cooperative entities called sectors. The economic logic is that these sectors will rationalize the deployment of fishing effort, lower costs, increase revenues through market timing, and profit share. In the adjacent Mid-Atlantic Region, regulatory structures vary from regulated open access to ITQs. In practical terms, many New England Groundfish vessels had permits and established catch records for Mid-Atlantic species before the Sector Program. This regulatory history coupled with species ranges that in some cases span both regions suggest that

there low barriers to entry. As groundfish sector management altered the deployment of fishing effort in New England, did newly idled groundfish fishermen increase their participation in the Mid-Atlantic?

We view the creation of the Sector Program as a natural experiment. The control group includes Mid-Atlantic fishermen who did not fish for groundfish (sector) species before the program. We use their fishing outcomes (catches and revenues) before and after the Sector Program to estimate our counterfactual. We define the treatment group three different ways: 1) all fishermen reporting landings of sector species, 2) all fishermen officially enrolled in the Sector Program, and 3) all fishermen listed as “inactive” in the sector program. We use a difference-in-differences (DID) estimator to isolate the treatment effect. We estimate models with both pooled and disaggregated Mid-Atlantic species as well as individual sectors. We find strong evidence of spillovers, but the effects are heterogeneous across fisheries and across sectors.

ID: 42

OPTIMUM FISHERIES MANAGEMENT UNDER CLIMATE VARIABILITY: EVIDENCE FROM ARTISANAL MARINE FISHING IN GHANA

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Session 5B - Thursday, 10:30am-12:00pm, Banyan/Citrus

In most developing coastal countries, including Ghana, the artisanal fisheries sector is managed as a Common Pool Resource (CPR). As a result, such fisheries are overcapitalized leading to biological overfishing. In Ghana, in addition to anthropogenic factors, there is evidence of rising coastal temperature and its annual variance which could potentially impact the environmental carrying capacity of the artisanal fish stock. In this study the surplus production function of Schnute (1977) was extended to include the effect of climate variation on yield and the biophysical parameters necessary to estimate the tax were estimated using the Generalized Maximum Entropy (GME) Estimator implemented in General Algebraic Modeling System (GAMS). We found that the rising temperature is decreasing the carrying capacity necessitating increasing the tax rate to protect the artisanal fish stock. In addition, a univariate analysis of the annual coastal temperature indicates it will continue to rise at least in the near future. Consequently the optimum tax on cost of harvest must internalize the crowding externality as well as accounts for the impact of the climate variables.

ID: 44

INSTITUTIONAL ADAPTATION TO ENVIRONMENTAL RISKS AND ECONOMIC VULNERABILITY ON FISHERIES AND AQUA FARMING: LAND USE AND WATERSHED MANAGEMENT IN THE DAY ESTUARY OF VIETNAM

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Session 5B - Thursday, 10:30am-12:00pm, Banyan/Citrus

Institutional Adaptation to Environmental Risks and Economic Vulnerability on Fisheries and Aqua Farming: Land Use and Watershed Management in the Day Estuary of Vietnam

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Abstract: This paper outlines a framework for analyzing institutional adaptation to environmental risks and economic vulnerability on fisheries and aqua farming in Vietnam. It argues that institutions under the form of collective actions to mediate vulnerability to environmental problems can be observed through the process of decision-making made by state authorities as well as local people. The paper using field based study on the land use and the economic values from livelihoods and watershed management in the area with different natural environment conditions in the Day Estuary, one of the main estuaries of the Red River system in the North of Vietnam. The case study shows that with the changes of salinity of the land and water areas, the local authorities and residents in the Day Estuary have found their effective ways to solve the problems of overexploitation and the increasing pollution from upstream for earnings and restorations of natural fishery resources. The fresh water area, with the fertile alluvial from the Red River,

is covered with rice at high quality and productivity. The mild brackish area is covered with the mixture of rice at a lower productivity, vegetables and aqua farming. The moderate brackish area is mainly used for aqua farming. In the heavy brackish area, the mangrove forests grow well, bringing good total economic value. With the natural land expansion to the sea at 80-100 m annually due to the alluvial from the Red River system, local people use the flora wisely to expand their land: rice encroaches rush, rush encroaches mangrove, and mangrove encroaches sea. The development of the sea dyke system and the irrigation water channel system also help the farmers to actively change the natural environmental conditions for their livelihoods. On the other side, there are more concerns on the vulnerability of natural coastal ecosystem as results of the development of the aqua farming, as well as the construction of sea dykes and water channels, is threatening the development of the mangrove forest. These raising issues are putting the local people in a challenge for more institution and management adaptation. Keywords: institution adaptation, fisheries and aqua farming, environmental risk management, Vietnam JEL classification: A13, D70, H41, O13, Q22, Q24

ID: 45

UNCOVERING CLUB AND CONGESTION EFFECTS

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Session 4C - Thursday, 8:30am-10:00am, Glades/Jasmine

Fishermen may consider information and other signals from their peers (especially close peers) when making their spatial site choices. However, the presence of other vessels in a spatial location may generate congestion or agglomeration effects. Disentangling the potential peer effects with issues of congestion is difficult since it is hard to ascertain whether the observed congestion effects are a result of observing others behavior or the influence of peer effects within the same network encouraging a fisherman to visit a site even in the presence of congestion. The research develops an empirical framework to decompose both motivations in a spatial discrete choice model in an effort to synthesize the congestion/agglomeration literature with the peer effects literature. Using Monte Carlo analysis we investigate the robustness of our proposed estimation routine to the conventional random utility model (RUM) that ignores both peer and congestion/agglomeration effects as well as the spatial sorting equilibrium model that ignore peer effects. Our results indicate that both the RUM and sorting equilibrium models can be used to successfully investigate the presence of a peer effect, they do not adequately address the full specification of the empirical framework. Using a data set on fishermen operating within the Alaskan groundfish fleet we apply our model directly and observe non-linear congestion effects as well as the presence of strong peer group formation.

ID: 46

COOPERATIVE FORMATION AND PEER EFFECTS IN FISHERIES

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Session 6A - Thursday, 1:30pm-3:00pm, Tarpon Key & Sawyer Ballroom

The economic benefits that arise following the transition to a rights-based fishery management regime accrue on both the extensive and intensive margins. On the extensive margins the fishery is consolidated and on the intensive margin fisherman may utilize their inputs of production more efficiently. This research explores the benefits that accrued following the Bering Sea Crab Rationalization program in the federally managed crab fisheries within Alaska. On the extensive margin we investigate the arbitrage opportunities that existed within these fisheries as fishermen formed cooperatives to manage their respective quota allocations. On the intensive margin we investigate the role of peer effects in facilitating the flow of information within the cooperative and the reduction in the cooperative's utilization of variable inputs. Our results support the hypothesis that cooperatives were formed to take advantage of inter-cooperative arbitrage opportunities and our econometric analysis supports the presence of peer effects in both the red king crab and snow crab fisheries.

ID: 47

BYCATCH AVOIDANCE IN THE PACIFIC GROUND FISH ITQ FISHERY

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Session 4C - Thursday, 8:30am-10:00am, Glades/Jasmine

Following the implementation of a new individual transferable quota (ITQ) system in the Pacific groundfish fishery in 2011, fishermen are required to cover their catches of several bycatch species with quota, and observers on all vessels ensure that all catch is accounted for whether retained or discarded. In order to meet this requirement fisherman must maintain quota balanced portfolio of quota for target and bycatch species or acquire more quota to cover catches that exceed their quotas. This internalizes the incentives for bycatch avoidance into their daily operating decisions. This research investigates the bycatch avoidance behavior of fishermen operating within this fishery during the first year of the ITQ program using a suite of RUM models. We estimate separate models for different subsets of the fishing fleet based on their principal landing ports. We also explore a number of alternative ways of defining choice sets including traditional methods using discrete areas as choices as well as choices sets based on specific fishing locations sampled either from actual observed fishing locations or from a uniform grid of points. A basic conclusion that follows from comparison of our results across models is that the definition of choice sets and the spatial scale of information used to estimate the expected utility for those choices can dramatically change what each model suggests about bycatch avoidance for specific species. This has important ramifications for estimating the cost of bycatch avoidance and how changes in quota availability and quota prices might affect behavior and catch rates in the future.

ID: 48

THE ECONOMICS OF ESCAPED FARMED SALMON

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Session 9B - Friday, 9:30am-11:00am, Banyan/Citrus

According to FAO, farmed fish production will surpass captive fisheries as a source for human protein within this decade. A growing number of species are farmed, and farming technology becomes more and more advanced as the industry become more like other food producing industries.

In the forefront of industrialized aquaculture is salmon aquaculture. In 2012 global production was more than 2 million tonnes, and the industry is characterized by frequent innovations and high productivity growth. However, as is the case for all food production, the substantial increases in production come with a potential environmental cost. One important concern for both farmers and environmental NGOs are escaped salmon. Salmon are farmed in pens immersed in open water, so small accidents will typically lead to escapes. This can cause pollution as escaped salmon can interact with wild salmon. The effect of escaped salmon on wild salmon stocks debated in the biological literature, and results indicate several potential negative consequences from salmon escapes, e.g. genetic contamination from breeding with wild stock and resource competition. On the other hand, effort focusing on reducing the extent of escapes can lead to increased operating costs. In this paper we study the relationship between escapes and productivity by estimating a translog cost function with multiple outputs. We utilize a regional panel data set from Norway. This approach allows us to study implied cost of induced reduction in salmon escapes by estimating and evaluating shadow values for the negative externality, as well as multi-output characteristics of the escapees in terms of jointness and separability. This will also allow us to assess the incentives of farmers to restrict escapees, or to what extent regulations are necessary.

ID: 50

ITQ PRICES: WHAT DO THEY REVEAL?

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Session 6A - Thursday, 1:30pm-3:00pm, Tarpon Key & Sawyer Ballroom

ITQ systems generate ITQ prices. For any given ITQ-managed species there are typically two prices. One is for the annual (or seasonal) quota, the other is for the longer lasting ITQ-share. In well-functioning ITQ markets, these prices reveal important information about the fishery. In the single species framework, prices of annual quotas measure the current profitability of fishing and prices for ITQ-shares reflect the expected future profitability of fishing under the ITQ system. Trading arbitrage leads to a determinate functional relationship between the prices of annual quantity quotas and that of TAC-shares. In the multi-species framework, if the ability to select the species composition of the harvest is less than perfect, the information content of the ITQ-prices is much less straight-forward. For instance the price of annual quotas for a given species may, under not uncommon circumstances, far exceed its landings price or, alternatively, be approximately zero.

This paper explores these issues. It derives explicit expressions ITQ prices under various circumstances including the multi-species context with imperfect selectivity, discarding possibilities and ITQ-noncompliance. To illustrate the issues, empirical data on ITQ prices in Iceland are presented.

Keywords: ITQ prices, ITQs, TAC-shares, informational content of ITQ prices

ID: 52

EXPERIMENTAL ANALYSIS OF WILLINGNESS-TO-PAY FOR VALUE-ADDED PRAWNS

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Session 1B - Wednesday, 10:30am-12:00pm, Banyan/Citrus

In order to reach new consumers, food industries and food science departments continue to test new products (or variations of existing products) for acceptability. While acceptability and product differentiability are important marketing concerns, firms will only supply those products which are profitable. New or differentiated product development typically comes at an additional cost. Therefore, consumers must be willing to pay an adequate premium for the firm to respond to consumer demand. With this research project, we examine the consumers' willingness-to-pay for value-added variations to freshwater prawns. Working with the Department of Food Science, Nutrition, and Health Promotion, our research examines the separate effects of (1) salt-acclimation and (2) marination of freshwater prawns on consumers' willingness-to-pay, as compared to the standard untreated freshwater prawns. First, a sensory analysis is conducted to determine the acceptability of the prawn samples, with participants utilizing a hedonic scale. Descriptive analysis attributes included are flavor, odor, texture, and appearance. Following the sensory analysis, subjects will participate in standard nth-price auctions to determine their individual willingness-to-pay for said products. This particular auction mechanism has shown to be advantageous in eliciting consumer demand in laboratory settings (Shogren et al., 2001; List, 2003; Lusk et al., 2004; Umberger and Feuz, 2004). In the auction, subjects are given a monetary allowance from which their willingness to pay is deducted, if their auction bid is at or above a randomly drawn market price for that good. Analysis of the data will determine the impacts of the descriptive analysis attributes on consumers' willingness-to-pay. This applied research will assist prawn producers in identifying value-added products and from which they can determine the profitability of these products (i.e. if the price premium exceeds their added cost).

ID: 53**TESTING FOR ENDOGENEITY BIAS IN THE SNAKE RIVER RESERVOIRS SPORTFISHING DEMAND MODEL**

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Session 7A - Thursday, 3:30pm-5:30pm, Tarpon Key & Sawyer Ballroom

The travel cost method (TCM) assumes that recreationists ignore the distance to a desired recreation site when choosing the location for their residence. Thus, in the TCM, a single equation demand model relates annual visits (quantity demanded) to travel cost (price), where travel cost is based mainly on the round trip distance traveled. The model assumes that travel cost is exogenous. If recreationists do consider distance to the desired recreation site when choosing the location of their residence then the single-equation model is not appropriate and the slope of demand and the consumer surplus (CS) estimate may be biased and inconsistent (Parsons 1991). Evidence that access to recreation opportunities and/or water resources is important in selecting a residence location is found by Lansford and Jones (1995), Earnhart (2001), Kim, Horner, and Marans (2005), and Poudyal et al. (2009). Omitted variables also can create endogeneity bias. "Whenever an explanatory variable has been omitted its influence is encompassed by the error term. But often the omitted explanatory variable is correlated with included explanatory variables. This makes these included explanatory variables correlated with the error term." (Kennedy 2008) A very serious error in the estimated benefits created by a recreation site can occur if there is endogeneity, whether caused by omitted variables or if both trips per year and travel distance are endogenous variables.¹ The conventional TCM model ignores the voluminous theoretical and empirical literature resulting from the Tiebout model (1956) where he argues that a consumer's residence location is based on their preferred combination of government services (such as outdoor recreation facilities) and taxes. The Tiebout model implies that both residence location and travel distance to a preferred recreation site are endogenous in the recreation demand specification (Guo and Bhat undated, Lankford and Wycholl 2000, Bayoh, Irwin, and Haab 2006, Phaneuf, Smith, Palmquist, and Pope 2008, Morrow-Jones and Moon 2009, Ebertz 2009). Although the conventional single equation travel cost method is widely used, few studies test the critical assumption that residence location is exogenous. Loomis, Englin, and Gonzalez-Caban (1999) remove observations on individuals "... who traveled less than one mile to the site on the presumption that they either live adjacent to the site (which violates another assumption of the travel cost method; Parsons 1991) " ... or ... were staying at a resort or location nearby the site ..." Murdock (2006) and Petrin and Train (2010) consider the endogeneity problem in consumer choice (site selection) demand models.

Several tests for endogeneity are conducted on a travel cost model for sportfishing on the Snake River reservoirs in eastern Washington. A test based on angler years of site experience indicates simultaneity and a test based on reduced constraints on residential location for retirees also indicates simultaneity. A test that estimates the travel cost model using two radically different simultaneous equation estimation techniques found that consumer surplus is likely to be greatly overstated and the associated Hausman test also indicates endogeneity bias.

ID: 56**CAN SPECIES DIVERSITY IMPROVE THE RESILIENCY OF FISHING COMMUNITIES?**

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Session 9B - Friday, 9:30am-11:00am, Banyan/Citrus

There is a need to create quantitative measures of social well-being of fishing communities to assess the sustainability and resiliency of coastal communities. Improving community resilience is important for individuals and communities but also taxpayers who end up funding disaster assistance and vessel and permit buybacks. We have created a set of social indicators to assess the vulnerability and resiliency of the US West Coast and Alaskan fishing communities along a variety of different dimensions including socioeconomic status, labor force characteristics, demographics such as the number of dependents, as

well as commercial, recreational, and subsistence fishing activities in the community. These social indicators can assist policymakers in determining which communities may be impacted by a specific type of regulation or regulations on specific fisheries.

As the implementation of IFQs or catch share programs can have dramatic impacts on the distribution of landings across ports, these programs may leave some communities less resilient to shocks that affect particular fisheries. A recent study has found that the income of the current fleet of vessels on the US West Coast and in Alaska is less diverse than at any point in the past 30 years and vessels that participate in multiple fisheries over the course of a year are likely to experience smaller deviations in their income from year to year (Kasperski and Holland, 2013). This study addresses whether species diversification of commercial landings in a community can reduce income variability and improve community resiliency.

ID: 57

INFERRING STOCK MIGRATION PATTERNS FROM LANDINGS DATA AND PROFIT MAXIMIZATION

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Session 4C - Thursday, 8:30am-10:00am, Glades/Jasmine

Spatial modeling of fishing area choice typically includes a spatially-explicit characterization of the fish stock. This can be problematic when there is no fishery independent spatially explicit stock estimate. This study integrates fishery-independent data, reported commercial harvest at the NOAA statistical area level for 2000-2011, and assumptions about profit maximization by harvesters in the Maryland blue crab fishery, to infer patterns of migration of crabs between statistical areas over the season. Using data on blue crab spatial distribution from a winter dredge survey and landings at the beginning of each season, the authors estimate the harvest technology to determine the dependence of harvest on stock abundance and discretionary inputs. The paper then uses landings in each NOAA statistical area and period combined with the estimated technology, to determine the range of crab abundance implied by landings in the corresponding area and period. Finally, assuming profit maximizing behavior by fishermen and optimality of their observed spatial choices, the authors choose the spatial distribution that results in the largest profits for the industry each season. The study uses logbook data for 2012 as an out of sample test to determine whether fishermen are using the derived spatial distribution as beliefs on the location of crabs in future periods.

ID: 58

RECOVERY 'UP THE FOOD-CHAIN'

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Session 7C - Thursday, 3:30pm-5:00pm, Glades/Jasmine

The classic optimal-control model of fishery management recommends zero harvest when biomass falls below the optimal level. Though rarely seen in practice, this implies that fisheries at or near open-access equilibrium should be managed as no-take areas until optimal biomass accumulates. In this research we investigate the potential returns to temporary closures of artisanal in-shore fisheries in the Gulf of California. Using a panel dataset containing SCUBA-transect estimates of biomass for over two-dozen species in numerous reefs across the Gulf of California, we calibrate growth models for trophic groups throughout these reefs. Combining our growth projections with ex-vessel revenues for current stocks, we estimate the return to various scenarios of temporary closures. We find dramatic economic returns to closures, particularly for high productivity reefs. The greatest returns are seen for reefs with the potential to house high abundances of predatory fish. We show that these closures could be self-financing in that re-payment for loans to replace foregone revenues during closure can take as little as one-fifth the closure time for repayment after fishing resumes. We perform sensitivity analyses and find that for almost all reasonable parameterizations, temporary closures easily pass a Benefit-Cost criterion. We discuss implications for management of these fisheries given political constraints and the potential for multiple uses of reef-fish stocks.

ID: 59

WHO IS EATING WHAT AND WHY? A LATENT VARIABLE APPROACH OF SEAFOOD CONSUMER SEGMENTATION

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Session 7B - Thursday, 3:30pm-5:30pm, Banyan/Citrus

Previous literature shows that consumers have different priorities in how to select food, perceptions about seafood, and the patterns of seafood consumptions. Such heterogeneity is evident not only at the individual level, but can be observed at the higher level, such as country. Reflecting on the different market conditions, food culture, and socioeconomic standings, each country develops its own food environment. Thus, reasons for and against seafood consumptions may differ among countries.

In this research, we aim to identify the different consumer segments and compare factors that are contributing to the level of seafood consumptions, as well as looking into factors that are preventing them from eating seafood. We will do so by using the consumer survey administered to various European countries (UK, Germany, France, Sweden, Russia, and Poland) during spring and summer of 2012. The responses contain rich variables in consumer behaviour, knowledge, and perceptions, as well as socioeconomic status. Moreover, the survey was done in three different fish species (salmon, cod, and herring) which allows us to draw comparisons among fish species. Our preliminary analysis shows that consumers in these countries have different priorities in terms of food related lifestyles, perceptions about fish, and image about the origin country (in this case, Norway). The current paper will extend these results and analyze various market segments in each of the country and species.

It is important to note that many of the variables mentioned above are not directly observable (e.g., country image, food related lifestyles, product perceptions). Instead, indicators of these variables can be observed and be used to construct the unobserved (latent) variables in interest. However, indicators are not perfect measurements, i.e., they are measured with errors. For that reason, we employ LISREL (Linear Structural Relationships) model, in which the measurement errors are integrated and the structural relationship among latent and observed variables can be estimated. Further advantage of the LISREL model is that the differences in the structure (structural parameters, as well as the error structures) can be statistically tested for different groups.

For seafood industry wishing to further penetrate into these heterogeneous markets, cultivating the market opportunities means two things; encouraging further consumption of seafood among the current seafood users, and developing new market among those who are currently not eating seafood. The challenge lies in identifying the barriers to higher seafood consumption among these heterogeneous consumer segments in different markets, and develop a strategy customized to each segment. The results from this paper will provide useful insights of consumer behaviour in seafood consumptions by comparing the size and the characteristics of different consumer segments in different countries.

ID: 60

DEVELOPING A BIOECONOMIC, SPATIAL, MULTI-SPECIES FISHERY SIMULATOR.

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Session 6C - Thursday, 1:30pm-3:00pm, Glades/Jasmine

Ecosystem-based fishery management (EBFM) will require explicit recognition of the spatial aspects of fishery dynamics. Neither the fish nor the fishermen are uniformly distributed in the seas. Just as the habitats where the fish reside are a complex mosaic of different substrate types and patches of prey and predator organisms, all influenced by changing ocean conditions, so too the home ports from which fishing vessels operate have distinct capabilities for providing supplies, support services and access to fishing grounds. The standard models used for assessing stock status and projecting future harvests almost always ignore spatial complexity. Instead they treat fishing and other factors as spatially homogeneous. Further, the standard models normally focus only on biological aspects of fisheries and

represent fishers as an external driving variable that generates fishing mortality but is unaffected by the state of the system. Another tenet of EBFM is that fish stocks generally are harvested in combination with other non-target fish stocks. Fishing operations almost always harvest more than just the target species. The evident ineffectiveness of the single-species approach at preventing fish stocks from becoming overfished was a major impetus leading to calls for EBFM. Appropriate modeling tools, which consider multiple species and their spatial relationships, are needed to understand the complex interactions between fisheries resulting from fishers' responses to management and regulations. The presentation will describe an on-going project that is refining a generalized bioeconomic simulator that can mimic multiple stocks occupying multiple spatial regions with harvesting by multiple fishing fleets. When complete, the simulator will be a flexible tool for exploring the effectiveness of EBFM policies in the face of uncertainty. By including human dimensions as well as fish resources, the simulator will allow users to evaluate trade-offs between human and environmental needs. The presentation will discuss design aspects of the simulator and planned applications in management strategy evaluations of two current West Coast fishery issues.

ID: 61

FISHING FOR ORANGE ROUGHY ON SEAMOUNTS: A BIOECONOMIC ANALYSIS OF FISHERIES-HABITAT INTERACTIONS

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Session 7C - Thursday, 3:30pm-5:30pm, Glades/Jasmine

This paper develops a bioeconomic model that captures the interactions between a harvested renewable resource and a non-renewable resource without commercial value that is negatively affected by the harvesting activity. Bottom trawling for deepwater species such as orange roughy in New Zealand waters is a prime example of the destructive impacts of fishing on habitat. The fish form dense aggregations on restricted topographic features such as seamounts, which are associated with large colonies of cold water corals (CWCs). These have become an important focal point for fishing and bottom trawling destroys the extremely slow growing CWCs irreversibly. Little is known about the role of CWCs in the life history of orange roughy, but studies show rapid declines on seamount catch rates over time, where fishing moves progressively from fished to un-fished seamounts. We develop a bioeconomic model where CWCs affect the cost of orange roughy harvest, i.e. CWCs attract larger concentrations of fish thereby reducing harvesting costs. Deepwater interests in New Zealand are combined in a single management company and the problem can be described as the optimization problem of a sole owner fishery. Harvest for orange roughy can either occur on pristine seamounts (leading to the associated destruction of CWCs) or along known tracks of destroyed (non-pristine) seamounts/flat bottom. The results are shown in a state space diagram depicting the optimal trajectories for fish and habitat stock levels. We find that the optimal fish stock is no longer independent of the level of habitat, i.e. successively lower levels of CWCs require increasing levels of optimal fish stock levels to compensate for rising unit harvest costs. A steady-state (where no further bottom trawling on pristine seamounts occurs) is achieved where the optimal trajectories of the fish and habitat stock intersect. We obtain an extensive data set from the Ministry of Fisheries on catch, effort (number of bottom trawl tows) and location (latitude/longitude) of orange roughy catch between 1990 and 2012 on the Chatham Rise, New Zealand's largest orange roughy fishery. We solve the bioeconomic model for optimal harvest and regress catch levels on price of orange roughy, interest rate and catch-per-unit of effort (to approximate unit harvest costs) accordingly. The regression analysis allows us to test the hypothesis that commercial fishing for orange roughy in New Zealand has, in fact, followed the optimal stock trajectories predicted by the bioeconomic model when the assumption of a constant habitat quality for a destructive fishing method does not hold.

ID: 63

MARGINAL DAMAGE COST OF NUTRIENT ENRICHMENT: THE CASE OF THE BALTIC SEA

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Session 3C - Wednesday, 3:30pm-5:30pm, Glades/Jasmine

The purpose of the article is to investigate the link between pollution and marine renewable resources. A bio-economic model of a fishery is developed to derive a marginal damage function for nutrient enrichment using the dynamic production function approach. This function can be compared with the marginal abatement cost and hence it provides the basis for policies that balance the use of nutrients in land-based industries (for example agriculture) with the external cost in the marine environment. The model is empirically applied to the case of the Baltic Sea, where Eastern Baltic cod fisheries are affected by nutrient enrichment. The results indicate that nitrogen loadings are too high and that they need to be reduced in order to get the optimal cod stock level.

ID: 64

UNDERSTANDING DIFFERENCES IN REGULATORY EFFORT ACROSS STOCKS

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Session 9C - Friday, 9:30am-11:00am, Glades/Jasmine

Regulators decide how intensively to regulate different stocks in an environment of limited resources and expanded management expectations. The US 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? This question has implications for understanding regulatory decision-making and how management resources are prioritized. We use a dataset comprised of over 130 species in US Federal waters (and encompassing all regional councils) to explore the influence of a number of variables, including commercial and recreational economic value, overfishing and overfished status, biological productivity, and media attention.

ID: 67

REFLECTIONS ON SMALL-SCALE FISHERMEN'S RETICENCE TO PARTICIPATE IN THE PUERTO RICAN DEEP-WATER SNAPPER GROUPER CATCH SHARE PROGRAM

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Session 8C - Friday, 8:00am-9:00am, Glades/Jasmine

The paper describes the experience of the first attempt to establish a catch share program in the U.S. Caribbean. It also investigates the reasons behind Puerto Rican, small-scale fishermen's reluctance to participate in the deep-water snapper grouper catch share program. Our analysis shows that catch share programs may not be a suitable management tool for the U.S. Caribbean given high transaction costs. High decision-making and operational costs were the main impediments for the establishment of the program. However, the process may have been a positive experience because it encouraged fishermen and managers to work together to find solutions suited for their local circumstances.

ID: 68

AND NOW, SOMETHING COMPLETELY DIFFERENT: A RADICAL SOLUTION TO MANAGEMENT OF PACIFIC HALIBUT RESOURCE APPORTIONMENT IN AND OFF ALASKA

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Session 8B - Friday, 8:00am-09:00am, Banyan/Citrus

Commercial Pacific halibut Quota Share (QS) holders believe their economic survival is slipping away, siphoned off by what seems to be an insatiable growth in halibut harvested by charter fishing operations in and off Southeast (SE) and Southcentral Alaska. At the same time, removals of halibut as Prohibited Species Catch (PSC) in commercial groundfish fisheries, as well as halibut mortality incurred in non-groundfish commercial fisheries in the same region, have accounted for halibut removals exceeding the total charter catch off Alaska. Halibut PSC has been regarded as distinctly separate from allocation fights between commercial and charter sectors, and, as such, sacrosanct in North Pacific fishery management. Only recently has there been systemic acknowledgement of the scope of the halibut allocation dilemma; economic incentives forcing movement towards a comprehensive solution; and recognition that the “public process” may be usurped by the courts, if resolution cannot be achieved. The sources of conflict are not unfamiliar ... lack of “quasi-property interest”; too many users chasing too few fish; non-selective fishing gear/fishing practices imposing waste; conflicts between market and non-market “users”; U.S. treaty obligations that supersede fishery management regulatory provisions; and sustainability concerns for the Pacific halibut species, itself. In a thought experiment, I ask, “How could the demand for Pacific halibut, within these disparate commercial sectors, be integrated in such a way as to produce a Pareto improvement for society, when compared to the status quo management approach?” I begin by examining “commercial” sources of halibut removal, which have been the recent focus of contention. If one accepts the widely held premise that “each pound of halibut landed by a charter client, fishing SE or Southcentral Alaska, is a pound of halibut removed, without compensation, from commercial halibut IFQ sector’s harvest”; and that halibut mortality resulting from groundfish PSC, especially non-pelagic trawling, (but also from halibut discards in non-groundfish fisheries) in and off Alaska reduces the combined catch limit (CCL) available to halibut IFQ and charter operations; and discarding intercepted halibut “wastes” an economically valuable public resource, without compensation; then identifying a cohesive, comprehensive strategy, abandoning convention, may be necessary to realizing a Pareto superior outcome. In this paper, a radical, but technically feasible, approach to facilitating an integrated management and operational solution to the aforementioned allocation problem is explored. If realized, the solution would enhance inter-sectorial cooperation; reduce PSC waste and diminish the stigma associated with discards; increase high-grade halibut product available to consumers; facilitate stewardship, conservation, and ecological awareness; sustain economically viable commercial fisheries in SE and Southcentral Alaska (and the communities they depend upon and support); and improve the availability and value derived by clientele utilizing Pacific halibut charter fishing purveyors in these areas.

Ancillary benefits may accrue to subsistence, personal-use, unguided sport, and passive-use populations that derive utility from a healthy, sustainably managed, and abundant Pacific halibut resource. Finally, the solution relies upon market-based incentives and internally generated revenues to operate and sustain the program.

ID: 71

SUSTAINABLE BIOECONOMIC MODELING OF THE CHESAPEAKE BAY BLUE CRAB FISHERY

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Session 7C - Thursday, 3:30pm-5:30pm, Glades/Jasmine

This paper develops a framework conducting sustainable bioeconomic analysis of fisheries by integrating biological, economic and policy modeling. The resulting model will allow us to map from policy space to sustainable economic outcomes. In this paper, we will model the blue crab fishery in Chesapeake Bay using such an integrated framework. Blue crab in Chesapeake Bay is not only a crucial component of the ecosystem, but also the largest source of crabs in the US.

The paper consists of two lines of work that together form an integrated biological and economic model that can be used to conduct optimal management of the blue crab fishery. First, we will extend the sustainable yield to obtain sustainable profit by introducing economic components. Second, fishery policies will be incorporated into the integrated model. Fishery policy here is comprised of the length of fishing season, fish size limitations, etc.

The bioeconomic model developed in this paper is built on two different models. The first one is the stock assessment (SA) model for blue crab developed by Miller et al. (2011) that calculates sustainable yield. While the SA model is able to estimate sustainable yield, it lacks economic indicators of the fishery and does not incorporate realistic policy options. In order to build those elements into the model, we make use of a second model, an individual-based (IB) simulation model developed by Bunnell, Lipton, & Miller (2010) that can be used to calculate revenue for blue crab in Chesapeake Bay associated with specific policies.

We have carried out the intermediate step of mapping from fishery policy to sustainable yield. The sustainable yield for 15 realistic fishery policies in Bunnell, Lipton, & Miller (2010) are calculated. It is shown that most policies are within reasonable regions except for three outliers with exceptionally high sustainable yield. The reason is that the policies lead to abundant parenting females left in the stock.

The next step is to calculate sustainable revenue and sustainable profit. The preliminary results show that the three outliers mentioned above generate lower sustainable revenue, although they have higher sustainable yield. This is because their large harvest levels drive the prices down to zeros. The cost estimation for the fishery will be incorporated using survey data by collected by Environmental Defense Fund (EDF).

We believe that this paper makes contributions to bioeconomic modeling of fishery management. Our integrated model offers an example that might be applicable in other fishery problems. Also, the paper will provide policy makers useful information.

We believe that this paper will be of interest to participants of the NAAFE meeting, and provoke thoughts and discussions. The modeling framework can provide insights of how to link two different models to form one that generates outputs we want. In addition, the fishery economists will be interested in the integration of biological modeling, economic modeling and policy modeling. The specific analysis applied to the blue crab fishery will be of interest to those concerned with the economics of the Chesapeake Bay.

ID: 72

CONSUMER DEMAND FOR FROZEN SEAFOOD PRODUCTS IN THE UNITED STATES: AN ANALYSIS USING MARKET-LEVEL RETAIL SCANNER PANEL DATA

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Session 7B - Thursday, 3:30pm-5:30pm, Banyan/Citrus

Frozen seafood retailing in grocery stores of the United States (U.S.) has undergone a transformation as a result of the introduction of value-added convenience products. However, it is not yet clear whether consumers perceive these value-added seafood products to be substitutes for traditional unprepared or unbreaded products. To examine this, we model retail demand for frozen seafood in the U.S. within the extended linear approximate almost ideal demand system (LA-AIDS) framework using monthly market-level retail scanner panel data. Results show that unbreaded products, as compared to value-added categories of breaded and entrée seafood, would gain market share if expenditure on seafood increases. We also find that unbreaded products are stronger substitutes for value-added products than the reverse. Unbreaded shellfish can be expected to gain market share if expenditure on frozen seafood were to increase. Hence, the overall growth in the seafood market could be expected to be driven by unbreaded products, with unbreaded shellfish products being the main drivers of growth.

ID: 73

AN ECONOMIC MODEL OF SCALLOP AQUACULTURE PRODUCTION IN THE COLOMBIAN CARIBBEAN

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Session 2C - Wednesday, 1:30pm-3:00pm, Glades/Jasmine

Mollusk aquaculture is of great importance worldwide with production increasing at a very rapid pace over the last 30 years. Although not much development has taken place thus far in the Western Caribbean, *Argopecten nucleus* and *Nodipecten nodosus* have been identified as two scallop species with potential for commercial aquaculture production. Fisheries for these two species failed to develop in the region given the low densities of natural populations; however, captures of wild juveniles in artificial collectors and seed production by public hatcheries have led to the establishment of farmed stocks in the Colombian Caribbean. Nevertheless, factors such as the inconsistent availability of seed, inadequate planning and the lack of information on financial and marketing aspects have prevented the development of an aquaculture industry in Colombia. Preliminary financial analysis suggest that scallop aquaculture is commercially viable due to the high selling price of scallops. In order to assess the true potential of scallop aquaculture in the region, this study developed an economic model for the hatchery and growout phases of an aquaculture operation based on the results of experimental trials conducted by scientists at the Shellfish and Microalgae Lab of the University of Magdalena in Taganga, Colombia. The study examined the economic performance of the proposed operation under a number of assumptions on key production and economic parameters. The study also examined the conditions under which scallop aquaculture could be successfully undertaken by local communities of fishermen affected by declining catches from traditional fisheries. Some policy recommendations were also formulated to promote the development of this form of aquaculture in the country and in the wider Caribbean region.

ID: 75

REVISITING COMMERCIAL - RECREATIONAL SECTOR QUOTA ALLOCATIONS

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Session 8B - Friday, 8:00am-09:00am, Banyan/Citrus

In many settings, resources are allocated without property rights and hence without the attendant price schedules or market exchange. In such instances the aggregate value of the resource cannot be determined by the demand or marginal value schedules without additional information about the access to the resource. Alternative management scenarios induce different sorting of marginal values and different probabilities of access for each valuation. As a consequence, the expected marginal value function differs from the standard demand. The authors run simulations to illustrate this result in the context of allocation of harvest quota between commercial and recreational fishing sectors using marginal value schedules from real case studies in the United States. They conclude with the need to revisit the criterion currently used in fisheries management to arrive at the optimal allocation of harvest quota.

ID: 76

THE BIGGER, THE BETTER? ECONOMIES OF SCALE AND CONCENTRATION IN THE NORWEGIAN FISH FARMING INDUSTRY

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Session 9B - Friday, 9:30am-11:00am, Banyan/Citrus

Prior to the deregulation of the Norwegian fish farming industry in 1991, regulations required local ownership and one owner could not be the majority owner of more than one fish farm. These constraints were abandoned in the 1991 deregulation, following a crisis in the industry around the turn of the decade. Studies of economies of scale have shown that the ownership limitations in the late 1980s imposed large

costs on the firms. Consequently, a number of mergers and acquisitions occurred during the following decade. Up until today, industry ownership has continued to become more and more concentrated. Nonetheless, although industry ownership has become quite concentrated, there are still a number of smaller and medium sized firms left in the industry.

In this paper, we use firm-level data for the period 2001-2010 to investigate what has been driving mergers and acquisitions in the Norwegian fish farming industry. Are there still economies of scale or other gains from higher concentration that can be taken advantage of? Or could it be the case that some firms have overinvested and become too large?

Our analysis of ownership structure reveals that most fish farming firms operate within specific regions and tend to expand within their home regions. Preliminary econometric results of economies of scale and optimal firm size suggest that some firms have in fact become too large. Further investigation of firm level cost and revenue data shows that the average small and medium sized firm generates more value relative to size than the average large firm. While the large firms tend to obtain better conditions both when purchasing fish feed and selling its farmed salmon, the smaller firms tend to be more efficient and are able to produce significantly more fish from the same amount of inputs. This effect more than makes up for their disadvantage in input and output markets.

In addition to economies of scale, there are other potential gains from higher concentration. In particular, higher concentration may yield better incentives to tackle disease and parasite problems, which is a growing concern in the industry. Disease and parasite (fish lice) issues have become increasingly costly, and current estimates of the cost of the fish lice problem alone are in the range 0.5-2 billion NOK (90-350 mill USD) per year for the industry as a whole. The parasite and disease problems can be seen as production externalities, since disease and fish lice are transmitted from farm to farm, while outbreaks to some extent are affected by a farm's operating procedures. If a firm owns many farms in an area, it should be able to internalize some of these effects. We therefore try to measure and account for the possible advantage of owning many farms in an area, in addition to the standard economies of scale.

ID: 78

INSTITUTIONAL EVOLUTION IN FISHERIES MANAGEMENT: SCARCITY AND THE INTENSITY OF GOVERNANCE

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Session 9C - Friday, 9:30am-11:00am, Glades/Jasmine

This study embeds governance costs into a model of optimal harvesting to explore how efficient fisheries governance changes as stocks are depleted. Existing literature (e.g. Roumasset and Tarui 2010) shows that a switch from open access to a single institution (either common or private property) may be warranted by depletion of resource stocks. But the institutional evolution of fisheries management has witnessed multiple stages. Many fisheries have first adopted a limited licensing regime before switching to total allowable catch (TAC) and/or to the more sophisticated catch share regime. Our objective is to provide and illustrate a theory that allows for multiple institutions corresponding to different stock levels and other factors influencing scarcity and governance costs. We provide a model of optimal harvesting with endogenous governance costs and derive the paths of harvest, stock, and governance costs. In the model, governance cost is defined by the sum of fixed switching cost and the variable cost of resource conservation, defined as the reduction of harvest from the open access solution. Under plausible conditions, governance costs increase (at least up to a point) with resource scarcity, i.e. scarcity induces institutional change that moves equilibrium harvest closer to the first-best efficient quantity. Next, we replace the continuous model of harvest and governance with multi-stage regime switching model (based on Makris 2001) to characterize three key fishery management regimes: limited licensing, total allowable catch, and catch share, where the order of institutional adoption is given by the continuous model. This allows the characterization of conditions for optimal switching from one form of governance to another. The stages of evolution involve some subset of the possible institutions, for example open access to total allowable catch, to catch share (i.e. skipping the stage of limited licensing). We find that higher relative resource prices expedite the adoption of more intensive resource management regimes. This provides a theoretical explanation of the pattern documented by Sethi et al. (2010) that high valued species tend to be initially exploited faster but also experience faster evolution to more intensive forms of management.

NAAFE Forum 2013: Marine Resource Management under Increasing Complexities and Uncertainties

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ID: 79

IMPLICIT VALUES OF SEAFOOD PRODUCTS IN THE UNITED STATES: HEDONIC ANALYSIS OF RETAIL SCANNER DATA

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Session 1B - Wednesday, 10:30am-12:00pm, Banyan/Citrus

The U.S. seafood markets offer a variety of seafood products with different combination of product value function attributes, such as product form, processing form, packaging size and material, convenient/preparation and brands, to name a few. Product entry and exit in the seafood markets and the changes in sales denote the changing consumer preference. Often, retailers practice non-price and price promotional tools to attract shoppers. Hence, a buyer's choice may be influenced by product attributes as well as promotional tools. This paper follows hedonic pricing approach, and analyzes the effects of both product attributes and relevant promotional tools in consumer's preference for various seafood products in the U.S.

We have used store-level aggregated at four week scanner data on frozen and chilled seafood products procured from A.C. Nielsen Inc. for the period September 2009 to August 2012. The data includes market specific information on all major seafood items, as identified through product-specific Universal Product Code (UPC), from 10 metro cities, namely, Atlanta, Boston, Chicago, Detroit, Los Angeles, New York, Philadelphia, Pittsburgh, San Francisco and Washington D.C. This dataset covers major food/grocery, drug, mass channels, and retail chains, including Wal-Mart, Kroger, Food Lion, Walgreens, Target, to name a few.

The paper reports market-specific hedonic models and preliminary results for major seafood product categories. The basic structure of the hedonic pricing model followed in the paper is that the price of a seafood product (e.g., species, brand) is a function of a set of characteristics of the seafood product, a set of promotional tools (e.g. price promotion) and other external factors (e.g., seasonality). We have estimated the hedonic models for each of the structurally different seafood markets. As branding tends to add instinct value to seafood products, we have tested the significance of brand using fixed effect model. In addition, we have tested the significance of other attributes using fixed effect models. The results reported in the paper are expected to help seafood marketers in the U.S. to develop location and commodity specific marketing strategies.

Keywords: seafood products, U.S., consumer preference, marketing tool, hedonic pricing analysis.

ID: 80

A FIRST LOOK AT CREW IN THE WEST COAST TRAWL RATIONALIZATION PROGRAM

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Session 8A - Friday, 8:00am-9:00am, Tarpon Key & Sawyer Ballroom

West Coast Trawl Rationalization, the most complex rights-based management system in the United States was implemented in the West Coast Limited Entry Trawl fishery in 2011. Crew is an important component of coastal communities, therefore it is important to understand how they have been affected by the catch share program and how they could be affected as the program matures. Crew participating in the fishery is typically compensated through a crew share system where the wage is calculated as a set percentage of the gross revenue minus certain expenses. Information about the crew share system,

including the percentage of net wages paid to the crew and the types of expenses deducted before calculating the share provide context for understanding the drivers of wage changes. These drivers potentially include changes in the fishery such as the introduction of expenses related to acquiring quota, and changes in participation over time, number of participating vessels, and gear types. Data about vessel characteristics, costs, earnings, and crew were collected from all vessel owners and operators in the fishery in 2009 and 2010 (pre-implementation of Trawl Rationalization) and 2011 (post-implementation). This unique census data set was combined for the first time with state fish ticket data to examine the effects on crew. Measures include annual wages, average daily wages, and number of days spent executing the fishery, which determines whether there was potential to earn additional wages outside of fishing. Owing to the diversity of the fishery, these measures are analyzed in terms of vessel length, port, target species, and whether the vessel is owner operated. These analyses will be used to develop a framework for understanding how crew will continue to be affected by the new management system. As more information becomes available about how vessel participation changes over time, the relationship between vessel characteristics and crew will be essential for estimating future effects on crew.

ID: 81

THE ROLE OF ECONOMICS IN ECOSYSTEM BASED FISHERIES MANAGEMENT

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Session 3C - Wednesday, 3:30pm-5:30pm, Glades/Jasmine

The aim of the paper is twofold: 1) to address the EU fisheries management from an economic viewpoint since the adoption of the Common Fisheries Policy (CFP) in 1983, and to assess the impact of economic research on EU fishery management and 2) to outline and discuss the role of economics in future ecosystem management that is inaugurated in the revised CFP in 2012. The Common Fisheries Policy (CFP) has now been effective for 30 years and during this period it has been heavily criticized by economists in particular for the lack of focus on resource rent and for ignoring the objective of maximizing the resource rent by use of pertinent measures such as individual transferable quotas. The question is whether this is correct. In the literature, open access, subject to the assumption that fishermen disregard the resource restriction and hence dissipate resource rent, is often used for comparison in economic analyses of fisheries management. Open access has not been the case for any of the current fishermen, who have been subject to both resource and effort restrictions since 1983. Recent research indicates that the CFP has been more successful than often argued. Furthermore, in the latest revision of the CFP in 2012 it was proposed by the European Commission to take the final step, namely to make individual transferable quotas compulsory. The proposal was rejected by the member states and therefore not included in the formal regulation. However, it is interesting to note that a number of member states already have introduced this kind of management. The fisheries management of the EU has already moved forward in the sense that the UN Summit on Sustainable Development in Johannesburg in 2002 recommended that MSY should be accomplished and in the Council regulation it is stated that the goals is to restore and maintain populations of harvested species at least at levels which can produce the maximum sustainable yield in 2015 or 2020 at the latest. Further, it is now stated in the objectives that the CFP shall implement an ecosystem-based approach to fisheries management to ensure that negative impacts of fishing activities on the marine ecosystem are minimised. Does economics play a role here? And if it does, which role? In the paper ideas and models to take up these challenges are presented.

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ID: 82

CORPORATE APOLOGY AND COMPENSATION DEMANDED FOR ENVIRONMENTAL DAMAGE

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Session 6B - Thursday, 1:30pm-3:00pm, Banyan/Citrus

High profile apologies often follow high profile environmental disasters; for example, the Exxon Valdez and BP Deepwater Horizon oil spills were both followed by corporate apologies and aggressive public relations campaigns. What is the impact of these expressions of organizational remorse on demand for compensation and punishment? How does the size of these impacts depend on the sincerity of the apology and the reputation of the transgressor? We answer these questions using a survey tool with randomly-assigned information treatments. We present all respondents with a uniform oil spill scenario and vary information about the polluting firm's previous pollution record, reputation, and apology from the polluting firm's CEO. Respondents were not told the scenario was fictional until after the survey was complete.

We find that in information-poor environments – when respondents do not have objective information about the polluting firm – respondents are more likely to take CEOs at their word and the minimum willingness to accept (WTA) compensation from a firm is lower when the firm claims a third party was at fault than when the firm admits fault and sincerely apologizes. When objective information about the firms' previous track record on pollution is presented, however, respondents had lower WTA from firms with good reputations who sincerely apologized and greater WTA from firms with bad reputations who insincerely apologized. These effects are interactive (i.e., increased WTA from “bad” firms becomes even larger when the “bad” firm offers an insincere apology). These results apply to multiple channels of punishment, including the respondents' preferred size of federal fine, likelihood of boycotting the firm's products, opposing a project by the firm in the respondent's community, or petitioning regulators to prosecute the firm. Elements from the sociology, anthropology, and legal literature on remorse were used in constructing “sincere” versus “insincere” apologies.

The potential for social context to affect WTA compensation for damage has been shown recently in the laboratory and in the legal case study literature, primarily in the context of bilateral transgressions. This study will be the first to systematically investigate the impact of corporate apologies for environmental accidents on the compensation demanded by the public. This paper contributes to the literatures on the effectiveness of cheap talk in practice, social psychology in preference elicitation, and valuation of nonmarket public goods.

ID: 83

THE BIOECONOMICS AND POLICY IMPLICATIONS OF CONSPICUOUS CONSUMPTION OF CHARISMATIC SPECIES

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Session 2B - Wednesday, 1:30pm-3:00pm, Banyan/Citrus

Consumption of animal parts from charismatic species often serves as a signal of wealth or cultural ideals rather than a direct source of utility, but the harvest of these parts is also associated with unsustainable practices. Shark fins, Maori wrasse lips, and bluefin tuna meat are just a few examples of seafoods whose demand functions may include status appeal or rarity value in addition to nutritional value or consumption utility. This paper investigates the effectiveness of demand side conservation policies when (1) animal parts are conspicuous goods with conformist, snobbish, and/or Veblen effects, and (2) stock dynamics exhibit a backward-bending supply curve. Conspicuous goods may exhibit upward sloping demand which causes unstable market and bionomic equilibria. More importantly, the reason for upward sloping demand depends on what the consumer wants to signal to her peers, in particular whether she is signalling a superiority to her peers (a snob) or a similarity to her peers (a conformist). Not all types of signalling may respond to policy prescriptions in the same way. International attempts to deal with excessive depletion of charismatic species are often focused on inducing taboo effects (as in educational or publicity campaigns, social norms, or moral suasion), or output restrictions (as in international or unilateral bans), as compared to the canonical approach of raising the price through taxes. These policies

can have perverse impacts or Pareto-improving effects depending on whether consumers are signaling income rank or cultural ideals, and whether they have snobbish or conformist preferences.

ID: 84

PERCEIVED OCCUPATIONAL IMMOBILITY AMONG MALAYSIAN FISHERS

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Session 8A - Friday, 8:00am-9:00am, Tarpon Key & Sawyer Ballroom

With depleted stocks and improved harvesting technology, reducing fishing participation is one way to preserve the health of some fisheries. In Malaysia, the economy experienced significant growth during the last decade yet employment in fishing, particularly on the east coast of peninsular Malaysia, remained steady. Despite a frequently stated desire to exit the fishery and to encourage their children to choose another occupation, many fishers did not transition to more attractive and growing industries. We study the results from a survey of 350 fishers on the east coast of peninsular Malaysia to understand the perceptions about mobility underlying these choices.

Fishers were asked whether they would change occupations if given the chance, and if so which occupation they would choose. Only half of respondents said they would like to switch jobs, but very few among those not interested in switching indicated happiness with the profession. Most said they were too old or unable to acquire needed skills to pursue new opportunities.

This paper attempts to explain these responses. Amount of income and diversity of income sources in the household significantly explain the stated desire to exit the fishery, as do the size of capital stocks like boat and net and the captain's years of experience. However, the relationships depend on which type of fishery the respondent participated in. Artisanal gill net fishers were more likely to want to switch jobs if they had higher total income and fishing was their primary occupation. The opposite relationship holds for commercial purse seine and trawl fishers. Older captains were less likely to want to switch in all groups.

ID: 85

LONG-TERM HEALTH EFFECTS, RISK PERCEPTIONS, AND CONSUMPTION PATTERNS FOR AQUACULTURED SEAFOOD

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Session 1B - Wednesday, 10:30am-12:00pm, Banyan/Citrus

Challenges to the competitiveness of US food industry in both domestic and international markets occur regularly as producers are confronted with consumer concerns over health risks. In the context of US aquaculture, primary factors influencing the competitiveness of the industry are consumers' perceptions of long-term health risks related to domestic farmed seafood consumption. The public is often particularly sensitive to food risk scares, and can often dominate other considerations in food choice and lead to large impacts on consumption and the viability of aquaculture industry. While recent labeling requirements have aided consumers in determining the seafood production process and the country of origin, it remains difficult for consumers to address health risk in purchasing decisions as there is widespread confusion with respect to riskiness of various species, whether farmed or wild.

This paper analyzes the influences of health risk trade-offs, perceptions, information and attitudes on farmed seafood consumption. Main questions being asked include: (1) How do consumers perceive, process and respond to information regarding mixed, or offsetting, long-term health effects in aquaculture products, and how does this influence purchase behavior relative to competing food products? (2) Does the source and type of risk information matter and how (or why)? (3) Do the answers to the prior two questions vary systematically across population segments? (4) How can policy (including public and/or private actions) encourage more informed consideration of health risks and benefits associated with farmed seafood and promote consumption that reflects informed risk trade-offs? To answer these questions, this paper combines information collected through the usual consumer surveys coupled with

experimental auction sessions. Average of 10 participants attended the experimental auction, where they went through six rounds of bidding for each of the three seafood products: one pound of fillet of wild salmon, farmed salmon, and swordfish. Wild versus farmed salmon products are intended to capture the perception towards farmed seafood when the health risk/benefit trade-offs are similar. Swordfish was included because of its relatively high content of mercury compared to salmon, so as to capture whether proper information on mercury risk will have an impact on salmon demand. We chose four publicly available advisories on seafood health benefits and risks with varying sources, and included them as information treatments during the experimental auction. Bids were made without any information ("cold feet"), with the content of information being provided, and then being notified of the source of that information. Collected bidding data will be analyzed econometrically to identify any changes in bidding prices before and after each information treatment, and analyze if and how these observed changes in bid are associated with participant characteristics that we have collected via surveys.

ID: 86

CAPACITY AND QUOTA COMPLIANCE IN ITQ REGULATED FISHERIES

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Session 1C - Wednesday, 10:30am-12:00pm, Glades/Jasmine

Production quotas can restore efficiency in industries characterized by production externalities, such as fisheries and other natural resource industries. However, with imperfect quota enforcement, firms may have incentives to build up excess capacity relative to their quotas. Firms with excess capacity may also have stronger incentives to violate quotas. In this paper, we investigate the relationship between enforcement, compliance, and capital investment in the short and long run. Although both compliance and excess-capacity problems have been studied extensively, previous work treats the two issues separately despite the close linkages between them. In this paper, we look at the issues jointly.

We develop a model of fishing firms with quota regulations and we analyze the relationship between enforcement, compliance, and firm-level capacity. In the short run, when the firm's level of physical capacity is fixed, the decisions of whether to exceed quotas and by how much depend on the firm's current capacity levels: the larger the capital stock (physical capacity), the lower the variable harvesting costs, and the stronger the firm's incentives to violate the quota. Furthermore, we show how the firm's optimal level of physical capacity depends on the cost of violating quotas (the expected punishment). The cheaper it is to violate quotas, the stronger the incentive to build up more capacity. Our results show how tradability and well-functioning quota markets improve both the allocative efficiency in production and reduce the aggregate non-compliance problem. However, additional management instruments are necessary to ensure efficiency.

Both non-compliance and excess capacity are serious problems in many fisheries. According to a report published by the United Nations Environmental Program in 2010, the level of capacity in world fisheries is 1.8 to 2.8 times the desired level. Quotas are commonly used to limit total extraction in fisheries, and individual rights to quotas (or catch shares) eliminate the need to race-to-fish. However, if excess capacity exists at the time quotas are introduced, firms have few incentives to reduce capacity levels in the short run because of the irreversibility of capital that often characterizes this industry. The investment cost is sunk and disinvestment only occurs gradually as the capital approaches the end of its economic lifespan. As a consequence, it may take many years from individual harvest rights are introduced until the capacity level reaches its long-run level. Our analysis shows how the presence of excess capacity upon the introduction of individual quotas has critical implications for the firm's incentives to violate quotas, and hence, illegal extraction. The more excess capacity exists in an industry, the stronger the incentives to fish over quotas. On the positive side, this complementarity implies a double dividend as a response to a stricter enforcement. When we increase enforcement efforts, illegal extraction reduces directly today and firms build-up less capacity, which implies lower incentives to exceed quotas in the future.

ID: 87

SEAFOOD CONSUMPTION OF HOUSEHOLDS WITH CHILDREN AND PRODUCT INNOVATION

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Session 7B - Thursday, 3:30pm-5:30pm, Banyan/Citrus

In this paper we study the relationships between seafood consumptions of households in Norway during the years 2000-2011, a period with several seafood product innovations. Among the most important innovations were pre-packed frozen and fresh fillet products which have increased their share of households' seafood budgets. We depart from previous studies (e.g. Pieniak et al, 2008) by focusing particularly on households with children and characteristics of the mother.

Food consumption choices in households are often determined by both parents and their kids, and the social interaction between them. Children may influence households' seafood consumption through parents' nutritional concerns and childrens' own preferences on taste etc. Furthermore, parents' and in particular mothers' may differ in their preferences and choices due to age cohort effects, education, income, work participation and other socioeconomic and demographic characteristics.

We estimate AIDS models with separate equations for different seafood products, including fresh and frozen fillet products. Using a rich household data set we examine the effects of different combinations of age of mother and age of children - younger and older mothers and younger and older children - on consumption of different seafood products. We also control for demographic and socioeconomic characteristics of the mother and household.

Seafood is beneficial for human health in general, and childrens' health in particular, as it is an important source of a number of nutrients including the essential long-chain polyunsaturated fatty acids (Pieniak et al, 2008). Dietary guidelines from national governments give recommendations on minimum intakes of seafood, e.g. Dietary Guidelines for Americans (2010). It is also useful for the seafood industry to understand the determinants of seafood product consumption, including responses to new product innovations.

ID: 88

MEY IN CANADIAN FISHERIES? POLICY ISSUES AND POTENTIAL CASE STUDIES

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Session 9C - Friday, 9:30am-11:00am, Glades/Jasmine

In recent years, Fisheries and Oceans Canada has placed increasing emphasis on economic prosperity as an objective of Canadian fisheries, raising the question of what role economic analysis should play in the development and implementation of fisheries policy and management. In this paper we explore one area in which economic analysis might support economic prosperity: in the setting of fisheries management targets, with specific reference to the concept of maximum economic yield (MEY). We review a set of cases from the literature where the implications of managing for MEY have been analyzed. We then examine some of the challenges in implementing MEY in general terms, and review the specific experiences of Australia, where MEY is enshrined in law as the primary objective of fisheries management and has been implemented in one fishery, and the United States, where legislation allows for pursuit of MEY but implementation is still under development. We consider whether and how MEY might be implemented in Canada, what challenges might be encountered and how these challenges might be addressed within the existing legislative and policy framework. Then, based on this review, we develop a set of criteria for the selection of case studies to examine in more detail the possibility of pursuing MEY in Canadian fisheries. Finally, we present and discuss a number of potential case studies that meet these criteria.

ID: 89

A NASH EQUILIBRIUM APPROACH FOR PREDICTING THE SPATIAL DISTRIBUTION OF FISHING EFFORT IN A MULTI-FLEET, MULTI-AREA GENERALIZED EQUILIBRIUM MODEL

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Session 4C - Thursday, 8:30am-10:00am, Glades/Jasmine

Many fisheries are characterized by a heterogeneous spatial distribution of fish species. The age-, size-, and sex- distributions of these fish species may also vary spatially. This provides both an opportunity and a problem for fishery managers. On one hand, area-specific catch or effort limits may help to foster desirable stock characteristics, such as an age-structure that makes the stock more resistant to environmental perturbations. On the other hand, the decision made by fishing vessels on the level and spatial distribution of fishing effort can be difficult to predict, and the impact of management regulations uncertain. It is this interaction between size-selective fishing gear and a heterogeneous stock distribution that results in fishing mortality for the area in question. Most bio-economic models of fisheries assume that both fish stocks and fishing effort are distributed homogeneously within the fishery, and that fishermen's decisions on effort level and distribution is determined independently of other participants in the fishery. We propose a model that explicitly takes the actions of other fishermen into account in that the marginal revenue function of one vessel depends on the actions of all other vessels in the fishery. We outline a generalized equilibrium model based on this assumption that can accommodate multiple stocks, fleets, and areas. We discuss the conditions under which a Nash Equilibrium solution to the level and spatial distribution of fishing effort exists. We then introduce constraints on effort and catch and discuss the continued existence of a Nash Equilibrium solution to fishing effort. The solution algorithm that is used to solve for equilibrium effort levels is discussed. Finally, we apply the model to existing fisheries data to illustrate both the shortcomings of such an approach to determining fishing location choice, and the potential that the model has to be used as a tool for examining alternative spatial management strategies.

ID: 90

TRADE-OFFS BETWEEN FINANCIAL AND CONSERVATION OBJECTIVES IN FRASER RIVER SOCKEYE SALMON FISHERIES

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Session 6C - Thursday, 1:30pm-3:00pm, Glades/Jasmine

Sockeye salmon (*Oncorhynchus nerka*) in the Fraser River are immensely important to British Columbia's culture and economy. Despite centuries of exploitation and decades of intensive study there remain several key uncertainties about the biological system, including those around dramatic four-year cycles of abundance and pre-season projections of how many fish will return in a given year. Recent years have seen declines in the productivity of some stocks as well as broader conservation concerns, leading to closure of some commercial fisheries, and it appears that greater financial benefits may only be obtained if greater conservation risks are incurred. However, the existing literature contains no analysis focused on bioeconomic analysis of trade-offs between financial and conservation objectives in such complex multi-stock, multi-fleet fisheries. This paper develops a bioeconomic simulation model to examine these trade-offs. The model is applied to the Fraser River sockeye salmon fishery and parameterized using historical biological, fishery and economic data. The fishery is simulated 24 years into the future, assuming either that the long-term average biological productivity regime is still valid, or that recently observed changes in productivity are permanent. Given the outcomes of these simulations the trade-offs between financial benefits and conservation risk are described. The analysis under the long-term average productivity regime found that there is a policy region that would yield significantly greater financial benefits than the currently applied policy while only minimally increasing conservation risk. Under the modified productivity regime, however, conservation risk is uniformly and unavoidably higher, and the trade-offs become more difficult in the sense that relatively more conservation risk must be incurred to obtain greater financial benefit.

ID: 92

A FRAMEWORK FOR ESTIMATING THE ECONOMIC IMPACTS OF RED TIDE CLOSURES ON YIELDS OF MOLLUSCAN (BIVALVE) SHELLFISH IN COASTAL MAINE

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Session 3C - Wednesday, 3:30pm-5:30pm, Glades/Jasmine

Following on the work of Athearn (2008) and Jin et al. (2008), we develop a GIS-based empirical framework for estimating the economic impacts of bivalve shellfish closures due to blooms of the dinoflagellate *Alexandrium fundyense* (“harmful algal blooms [HABs]” or “red tides”) in coastal Maine. Red tides along the coast of New England, particularly in Maine, are a natural hazard. *A. fundyense* produces a toxin known as paralytic shellfish poisoning or “PSP.” When *A. fundyense* blooms are dense enough, shellfish toxicity can reach levels that can cause human morbidities or mortalities due to PSP. The most common way of mitigating the potentially adverse public health effects is to monitor the level of toxins in the exposed shellfish and to close shellfish beds to commercial digging and growing when toxin levels exceed a certain threshold. These closures can result in economic impacts felt by the shellfish industry. In 2005 and 2008, federal commercial fishery disaster relief funds were allocated to compensate Maine shellfishermen for occurrences of red tides and subsequent fishery closures, and federal and state managers are particularly interested in improving methods of estimating the scale of economic impacts.

We interview a cross-section of industry participants to gain insights into the behavior of Maine molluscan (bivalve) shellfish diggers and growers when faced with fishery closures due to red tide. Taking this behavior into account, we employ the framework to develop estimates of the economic impacts of red tide events on the Maine bivalve shellfish industry, including the wild harvest (digging or dredging) and aquaculture (growing) of soft-shell clams, mussels, quahogs, mahogany clams, and oysters, at local and regional scales. We present preliminary results of economic impact estimates for Maine red tides, and we discuss reasons why these estimates might differ from earlier ones, including the availability of higher resolution data on fishing areas, fishing closures, yields, and values; the likely beneficial effects of small-scale closures on yields and sales values; and recent declines in Downeast production of softshell clams and blue mussels that may be unrelated to red tides.

ID: 95

THE EVOLUTION OF MANAGEMENT: DO INDIVIDUAL RIGHTS EMERGE FROM COLLECTIVE RIGHTS SYSTEMS?

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Session 6A - Thursday, 1:30pm-3:00pm, Tarpon Key & Sawyer Ballroom

A trend in fishery management allocates to self-identifying subgroups of harvesters in a fishery, or “sectors,” their collective total share of the harvest of each species as a group right that they may manage in any way they wish. This means a single fishery with a single set of overall total allowable catches can be managed by multiple management systems concurrently. We ask whether common pool or individual quota type management systems are more likely to emerge as groups gain experience with their collective rights. In a novel quasi-continuous time experimental environment with a contemporaneous price externality, harvesters can choose to affiliate with a common pool managed group, or an individual quota managed group. We find that the common pool group engages in a fishing derby and receives lower prices, whereas the individual quota group achieves stable harvest levels throughout each season to minimize the price externality. Through successive fishing seasons, the frequency of subjects’ choosing individual quota rises from about half to over 85% of subjects. This suggests that the efficiencies associated with strong individual fishing rights may emerge endogenously from the sectorization process, even without imposing them through regulation. We use three supplemental instruments to measure individual preferences to explain which subjects remain in common pool management, and find enjoyment of competition is significant, but risk attitudes and other-regarding preferences are not.

ID: 96

THE FISHERIES PERFORMANCE INDICATORS: RESULTS FROM GLOBAL CASE STUDIES

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Session 9C - Friday, 9:30am-11:00am, Glades/Jasmine

The Fisheries Performance Indicators (FPIs) are a rapid assessment instrument for benchmarking and tracking wealth generation from fisheries resources. Applied once to a single fishery, the FPIs provide a snapshot of where fishery-based wealth is accumulating (e.g., with capital owners, with crew or with processors) and of levels of factors thought to affect wealth accumulation. We present results from a cross section of nearly 40 case studies, encompassing artisanal and industrialized fisheries from developing and developed countries around the world, conducted by more than 20 cooperating fisheries economists. The data capture a range of management methods and outcomes, demonstrating that that biological sustainability does not necessarily lead to good economic performance, as represented by wealth accumulation in harvest, post-harvest or fishing community sectors.

ID: 97

A SOURCE DIFFERENTIATED MIXED DEMAND MODEL FOR SHRIMP: AN ANALYSIS OF THE INFLUENCE OF U.S. IMPORTS BY SOURCE ON THE GULF OF MEXICO DOCKSIDE PRICE

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Session 6B - Thursday, 1:30pm-3:00pm, Banyan/Citrus

With a 2009 dockside value of \$314 million, the shrimp fishery is the largest contributor to the \$615 million (2009) Gulf of Mexico commercial fishing sector. The annual production of shrimp from the Gulf of Mexico has, in the long-run, remained relatively stable though year-to-year variations can be significant due to changes in environmental conditions that influence the reproduction, survival, and growth. While the long-run production of Gulf shrimp, in pounds, has remained stable over time, the same cannot be said about the value of landed product; especially when the influence of inflation is removed. The long-run dockside value of the Gulf shrimp harvest has, overall, been declining whether considered on a current or deflated basis. This decline has been particularly pronounced since 2001. On a current dollar basis, the value of Gulf production fell from an average of just over \$400 million annually during 1990-94 to about \$350 million annually during 2005-09. After adjusting for inflation, the decline was approximately 40%; from \$617 million to \$367 million (expressed in 2009 dollars). Relatively constant production in association with a declining value implies, of course, a falling price. While there are several reasons for the sharp decline in the Gulf dockside shrimp price beginning in 2001, the overriding one is that of increasing imports. Overall, imports (heads-on equivalent weight) advanced from an average of 850 million pounds annually during 1990-94 to 2.3 billion pounds annually in 2005-09 with much of the increase occurring post-2000. By comparison, Gulf production since 1990 has averaged less than 250 million pounds (heads-on weight) and imports currently account for in excess of 90% of the shrimp consumed in the United States. The source of these imports is from more than forty countries throughout the world with Asian countries accounting for a large proportion of the increase. Thailand dominated exports to the U.S. in 2009; accounting for almost one-half of the Asian exports and more than a third of total exports. Other countries of significance include Indonesia (17% of Asian exports and 13% of total exports to the United States), Ecuador (70% of South American exports and 11% of total exports to the United States), China and Vietnam (each accounting for approximately 10% of Asian exports to the U.S. and 8% of total exports to the United States), and Mexico. The primary objective of this paper is to examine the impact of imports, by country of origin, on the Gulf of Mexico dockside price with a secondary objective of determining whether the Deepwater Horizon Spill influenced consumer perceptions and, hence, the Gulf dockside price. To accomplish this objective, a system of mixed Rotterdam demand equations was estimated based on quarterly data from 1995(1) through 2011(4). Countries considered in the analysis include Thailand, Vietnam, China, India, Indonesia, Ecuador, and Mexico. Demand for Gulf shrimp was specified by size of shrimp with three sizes (large, medium, and small) being considered. U.

ID: 98**THE RETAIL DEMAND AND QUALITY FOR SEAFOOD PRODUCTS IN THE UNITED STATES: A BIVARIATE MODEL**

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Session 7B - Thursday, 3:30pm-5:30pm, Banyan/Citrus

U.S. consumption of commercial fish and shellfish increased from 12.5 pounds (edible meat weight) per capita in 1980 to 16.6 pounds in 2004 and thereafter declined in successive years to 15.8 pounds in 2010. While seemingly moderate in nature, the increase from 1980 to 2004, when adjusted for population change, represents an additional source requirement of 2.1 billion pounds annually. Though per capita consumption has fallen since 2004, the increase in population since 2004 has resulted in virtually no change in source requirements. As the socioeconomic characteristics of the “average” U.S. household changes, one can expect changes in seafood consumption. An analysis of household seafood demand can be used to forecast changes in product species and composition that will likely be forthcoming over time. From February 2005 through January 2006, a NOAA Fisheries Seafood Consumption Survey was conducted to gather information about seafood purchases and consumption behavior. The sampling design, which included both cross-sectional samples and longitudinal cohorts, consisted of 10,798 completed interviews, 5,311 of which were fresh cross-sectional interviews. The objective of the study is to estimate expenditure-based household demand functions for seafood consumed at home in aggregate and by primary species. Emphasis will be given to the influence of socioeconomic factors and opportunity costs on the demand for quality. As an outcome of this objective, and based on the hypothesis that demand for quality is proportional to the level of aggregation (i.e., as one moves from a commodity to a good), the study examines whether the demand for quality diminishes in relation to the level of disaggregation. Completion of this objective will build upon the analysis originally proposed by Dong et al. (1998). The bivariate model estimated by Dong et al. (1998) utilized the maximum likelihood method to successfully deal with a truncation problem as well as difficulties of unobserved unit price values. As such, the quality variation and consumer preference could be simultaneously investigated by this bivariate analysis. The quality effect will be analyzed via the quality elasticity which is the distinction between the income elasticity and expenditure elasticity (Cramer, 1973) when the seafood categories were characterized by heterogeneity. Such an analysis will provide relevant information to forecast changes in product species, composition, and demand for quality that are likely to be forthcoming as the U.S. demographics change over time. Cramer J. S., (1973) Interaction of Income and Price in Consumer Demand, *International Economic Review*, Vol.14, No.2 , pp.351-363 Dong, D., J .S. Shonkwiler And O. Capps, Jr. (1998) Estimation of Demand Functions Using Cross-Sectional Household Data: The Problem Revisited, *American Journal of Agriculture Economics*. 80(August 1998):466-473

ID: 99**ESTIMATED IMPACTS OF CATCH SHARE MANAGEMENT ON NEW ENGLAND MULTISPECIES GROUND FISH HARVESTER REVENUES**

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Session 1C - Wednesday, 10:30am-12:00pm, Glades/Jasmine

To comply with catch limit and stock rebuilding requirements specified in the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006, Amendment 16 to the Northeast Multispecies Fishery Management Plan encouraged groundfishermen to transition from Days-at-Sea (DAS) to sector, or catch share, management. In May of 2010 seventeen self-selecting harvesting sectors representing 432 active vessels and 98% of historical Multispecies landings were issued Allowable Catch Entitlements (ACE), a form of hard TAC, for fourteen stocks of nine groundfish species. This significant change in management coupled with a variety of non-Multispecies targeting options presented incentives for sector vessels to alter harvesting strategies and landings' timing. Prior to Amendment 16 tradable DAS management created a reservation level for expected profitability from a Multispecies trip; landing Multispecies as bycatch in small quantities when targeting low value species (e.g. spiny dogfish and skate) would squander the commodity's value. Amendment 16 provided flexibility in Multispecies landings

NAAFE Forum 2013: Marine Resource Management under Increasing Complexities and Uncertainties

and led to an increase in the race-to-fish for spiny dogfish while jointly landing Multispecies, skate, whiting, and monkfish. Using fixed effects models of inverse demand at the ex-vessel level and two hypothetical, or counterfactual, individual landing environments for twenty-five commercially important species, gains of over \$30,000,000 in fleet revenues are estimated as a result of Amendment 16.

ID: 100

THE U.S. GULF OF MEXICO SEAFOOD PROCESSING SECTOR: ECONOMIC STATUS AND PERFORMANCE

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Session 7B - Thursday, 3:30pm-05:30pm, Banyan/Citrus

Though commercial seafood processors in the U.S. Gulf of Mexico form an essential link in the supply chain by connecting seafood harvesters in the region and consumers nationwide, there is relatively limited economic information about this multi-million dollar sector of the regional economy. Access to current data regarding the revenues, expenditures, and economic returns of the seafood processing sector in the U.S. Gulf of Mexico has the potential to assist managers, harvesters, processors and other stakeholders to understand the performance and contributions of processors to the regional economy as well as the challenges facing the industry. This research presents the results of in-person surveys of businesses identified as seafood processors in the five states in the U.S. Gulf of Mexico region for the year 2009. Data were obtained from interviews with seafood processors conducted by local state agencies and universities in Florida, Alabama, Mississippi, Louisiana, and Texas with the support and direction of the Gulf States Marine Fisheries Commission. Variables included revenues, expenditures, the value of processing facilities, labor usage, seafood species handled, sources of seafood purchased, and types of businesses and consumers to whom products were sold. This research examines the economic performance of these processors and generates estimates of asset value, outstanding debt, net worth, net cash flow, and net income.

ID: 101

ANALYSIS OF ECONOMIC IMPACT OF CLIMATE CHANGE ADAPTATION STRATEGIES: METHODOLOGY AND ITS APPLICATION IN FIJI AND SOLOMON ISLANDS

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Session 5B - Thursday, 10:30am-12:00pm, Banyan/Citrus

There are two broad approaches to analyze the impact of climate change in fisheries and aquaculture, namely, bio-economic modeling approach and market supply-demand approach. A merit of bio-economic modeling approach is that climate change scenarios can be incorporated by altering an appropriate set of ecosystem or population parameters. But, many of the required information on resource and ecosystem interactions are not available in most developing countries, including the Pacific island countries. The market supply-demand approach represents climate change in terms of supply shocks, and works out its economic consequence using the microeconomic tools of supply and demand.

This paper outlines a simplified version of market fish supply model and applies it to Fiji and Solomon Islands. The model was applied to assess development strategies for Fiji and Solomon Islands in response to future and projected impacts of climate change on the key coastal and marine resources. The paper followed a three-step procedure to measure the size and distribution of the potential impact of various climate change adaptation strategies: a) development of a baseline model of the fish sector for each country; b) collection/construction of data set on model parameters, exogenous variables, and ex-ante impact indicators of various climate change adaptation strategies; and c) analysis of overall impact of climate change adaptation strategies at national and household levels, by incorporating the ex-ante impact indicators (step b above) into the fish sector model (step a above).

The fish sector model developed for evaluating the impact of climate change adaptation strategies is based on the Modified Balance-of-trade Function approach. We have constructed ex ante indicators of the direct impact of climate change adaptation strategies using data collected through focus group discussions and expert opinion surveys. The fish sector models were solved using the solver option in EXCEL. The paper reports the results on the economic impacts of climate change adaptation strategies on households dependent on coastal and marine resources, and identify alternative development strategies for coastal communities in Fiji and Solomon Islands using the results of the economic analysis.

ID: 104

ESTIMATING POTENTIAL EFFECTS OF SEAFOOD SAFETY AND MERCURY ON THE DEMAND FOR DOMESTIC AND IMPORTED WHITE AND LIGHT MEAT TUNA

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Session 7B - Thursday, 3:30pm-5:30pm, Banyan/Citrus

In March 2004, the U.S. Food and Drug Administration (FDA) released a warning about methylmercury accumulation in larger seafood species and the potential for harmful effects, particularly on the health of pregnant women and young children. The notice suggested limiting the consumption of canned white meat tuna, and also notes that this type of tuna contains greater amounts of mercury than light meat tuna. Yellowfin and skipjack tuna are typically sold as "light meat," while albacore tuna is the only species of fish in the U.S. that can be sold as "white meat." Though the majority of tuna consumed in the U.S. is imported, the FDA remains concerned about the safety of imported seafood. Given the FDA's warning and concerns about seafood safety, this study estimated potential effects on the demand for domestic and imported white and light meat tuna using a non-linear almost ideal demand system (AIDS) model. Quarterly domestic landings and imports data from 1996 to 2011 were obtained from the National Marine Fisheries Service.

Four share equations were estimated for the following categories of tuna: domestic white meat, imported white meat, domestic light meat, and imported light meat. Prices between estimated products tend to be correlated, and therefore, the Stone price index was used to account for collinearity. A time trend variable was incorporated into the time series model, and the seasonality of dockside demand was accounted for through the use of dummy variables by quarter. A dummy variable was also used to estimate any permanent shifts in demand for each category of tuna beginning in March 2004. The symmetry, homogeneity, and adding-up restrictions were imposed, and the AIDS model was analyzed in SAS 9.3 using PROC MODEL.

Seasonality in dockside demand was clearly a significant factor for each category of tuna examined. Perhaps more interesting, the parameter for the mercury dummy variable was negative and statistically significant ($p=0.081$) for imported white meat tuna. This result suggests that there was a statistically significant decrease in demand for imported white meat tuna beginning in March 2004, a change which is not accounted for by any other variable included in the model. Parameter estimates, as well as own- and cross-price elasticities, are presented and discussed.

ID: 106

POTENTIAL FOR SELF-RULE AND WILLINGNESS TO PAY FOR MONITORING AND ENFORCEMENT: A SMALL ISLAND STATE CASE

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Session 8C - Friday, 8:00am-9:00am, Glades/Jasmine

Many small island developing states experience fisheries with limited management systems in place as a result of poor governance structures and limited financial resources. This study will assess the potential for fishers to form groups and initiate forms of self-rule, as an option to limited intervention by the State. It will also determine the willingness of fishers to pay for insurance, as well as elements of security, such as

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monitoring and enforcement, especially in situations where piracy and illegal fishing practices are deemed to occur. Surveys of fishers will be carried out in Trinidad to determine their socio-economic status, as well as fishing practices, their willingness to participate in self-rule, and their willingness to pay for improved access to the fish stock, as well as improved access to security while at sea. The analysis will employ non-linear regression techniques. This will then be developed to determine the value of the willingness to pay for the local population of fishers. These issues are seldom reported in the literature and provides an important case for obtaining significant primary data on fishers' attitudes and perceptions, which will help fishers directly, as well as the municipal fisheries management authorities.

ID: 110

REGULATORY RIGHTS VS. PROPERTY RIGHTS

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Session 9C - Friday, 9:30am-11:00am, Glades/Jasmine

This paper argues that economic analysis of fisheries management institutions would be improved if economists conceptualized individual transferable quotas (ITQs) as "regulatory rights" and not as "property rights". ITQs are a form of cap-and-trade regulation, which creates regulatory rights and thereby introduces market incentives to achieve efficient regulatory outcomes. ITQs create incentives to maximize the value of the traded quota, usually through reduced harvest costs and increases in landed value. This is exactly analogous to the incentives under cap-and-traded pollution rights to minimize the cost of achieving the pollution reduction target. Under regulatory rights, a government defines a specific and narrow set of uses of some resource. Any changes in that narrow set of uses can only be made by the regulator. Under property rights, the owner of the property has the right to claim the economic value that may come from new uses of the property. So the owner has an incentive to look for new uses that generate higher economic value from the property. Moving from regulatory rights to property rights would vest with the rights owner the opportunity to increase value from the resource. Going from "regulatory rights" to "property rights" is not possible for air pollution, because it is not possible to create a closed set of owners who can capture all the benefits of using the air. But in fisheries, it is possible to define a set of owners of a fish stock who can claim all the benefits of use of the landed fish. If fisheries economists do not see the difference between regulatory rights and property rights, then they will also not see the opportunities for institutional evolution that gives ITQ rights holders broader decision making. Such property rights can reduce the losses associated with government failure in fisheries regulation.

ID: 111

RECREATIONAL & COMMERCIAL FISHERIES REALLOCATION: CHALLENGES FOR PACIFIC HALIBUT IN CANADA

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Session 8B - Friday, 8:00am-09:00am, Banyan/Citrus

In 2004 Canada implemented a formal 88% commercial: 12% recreational allocation policy for Pacific halibut. The intent was to develop a market transfer mechanism to allow adjustments to this initial formula over time. This paper outlines the evolution & challenges to meeting this goal. Many of the challenges relate to the diverse nature of the recreational sector which has no legal entity and cannot raise funds directly, and also relates to government policy which does not allow surcharges or earmarking of fisheries licence fees. Progress on market transfer development has been slow. In 2012 the government adjusted the allocation formula to 85% commercial; 15% recreational without compensation to the commercial sector for their loss in allocation. The commercial sector took the federal government to court on the matter - the participants are awaiting the trial judge's decision. The Canadian experience provides lessons learned to Alaska, which is facing similar allocation issues for halibut, and to other North American jurisdictions which are embarking on more formal commercial: recreational allocation policies.

ID: 112

A CHARACTERIZATION OF RECREATIONAL FISHERIES FROM BELIZE: INSIGHTS FOR FISHERY MANAGERS

44

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Session 3B - Wednesday, 3:30pm-5:30pm, Banyan/Citrus

This paper addresses a data-sparse fishery and particularly reports on the first characterisation of the recreational fishing of Belize in terms of i) its natural resource base, ii) gears used, iii) resource users, and iv) management and its level of compliance. It used a mixed methods approach including (a) interviews, (b) independent fishing, (c) standard and molecular identification of fish species, (d) ethnographic field notes and local knowledge, and (e) community workshops. Our results indicated (1) that there is a mismatch in the very definition of recreational fisheries between the fishery managers and the resource users, (2) according to the users, the fishery is best defined based on the end-point of the catch, which includes either catch and release or catch and consumption, (3) a resource base of multi-specific nature with a total of 26 bony fish species in the study area, (4) the gears used vary from fly fishing rods, spinning rods, trolling rods to bait casting rods, with innovative ways of using and combining them, (5) a mainly male oriented fishery, but with some women and children involved in reef fishing, with a total of four nationalities recorded, (6) the direct users (fishers) are mainly non-residents and the indirect users (service providers) are residents, and (7) current centralized regulations do not respond to the local needs and require of the development of coordinated and collaborative participation amongst the public sector (resource managers) and the private sector (fishers and service providers) to develop and implement a management plan. Our results are meant to identify opportunities to improve the current fishery management in place.

ID: 113

WILLINGNESS TO PAY FOR STRIPED BASS, A SALINE FISH SPECIES GROWN IN THE US MIDWEST: EVIDENCE FROM AN ONLINE SURVEY

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Session 1B - Wednesday, 10:30am-12:00pm, Banyan/Citrus

The US Midwest region has no marine or saltwater resources therefore seafood products produced from saline sources need to be shipped over long distances from the coasts making them relatively expensive. There are plans by some Midwest fish farmers to begin farming striped bass, a marine species. To assist the development of an effective marketing strategy for striped bass products from the Midwest, the study examined the potential market using willingness to pay information from consumers in the Midwest. We found that males relative to females, and consumers who are 29 years of age and younger relative older consumers, are more likely to pay higher amounts for Midwest striped bass. Other variables found to increase the probability of paying higher amounts for Midwest striped bass include preference for farmed seafood; preference for fresh seafood; seafood purchase frequency of 1 to 3 times per month for home consumption; seafood purchase frequency of once per week for home consumption; eating out 1 to 3 times per month; eating seafood 26 – 50% of the time when eating out; and eating mostly shrimp when eating out. Simulated results from selected variables show that frequent seafood consumers have a higher likelihood to pay more for Midwest striped bass with the magnitude of predicted probability increasing from lower to larger categories of WTP for striped bass. This includes consumers who buy seafood 1 to 3 times per month for home consumption, consumers who buy seafood once per month for home consumption, and consumers who eat seafood 26 - 50% of the time when they eat out. We then took the highest WTP category, i.e., WTP at least \$6.00/lb for Midwest striped bass group and simulated for each level of consumers' willing to pay more for Midwest saltwater seafood, (2%, 4%, 6%, 8% and 10% more) against whether or not a consumer buys seafood 1 to 3 times per month for home consumption and whether or not a consumer eats seafood 26 – 50% of the time when eating out. The results show that predicted probabilities increase significantly as the level of willingness to pay more for Midwest saltwater seafood increases.

ID: 114

SELECTING STOCKING DENSITY IN DIFFERENT CLIMATIC SEASONS: A DECISION THEORY APPROACH TO INTENSIVE AQUACULTURE.

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Session 2C - Wednesday, 1:30pm-3:00pm, Glades/Jasmine

A decision theory approach was used to select the most appropriate stocking density in the annual climatic seasons. This approach used the decision table framework and criteria with and without probabilities. This framework used a bioeconomic model, which was calibrated with experimental data from a freshwater recirculating aquaculture system (with three stocking densities: D1=230, D2=280 and D3=330 shrimps m⁻²), literature research and local market conditions. In order to incorporate thermal uncertainty, three possible states of nature were defined using historical records of environmental temperature in the study area. Since the study area is a tropical location, the thermal variability between climatic seasons and between states of nature was low (around 4°C). Nevertheless, this small thermal variability was enough to produce differences in the profits up to 30 %, depending on the climatic season, stocking density selected and the state of nature. Decision criteria with and without probabilities chose the highest density (D3), as the best selection in dry and rainy seasons (both warm seasons) and D1 was the best option in cold front season. These results emphasize how important is taking into account seasonal variations in the selection of production management strategies. This work also underlined the pertinence of using decision criteria without probabilities in situations with a shortage of historical data, and when the historical behaviour is not a reliable indicator of future patterns, like the current climate change situation. This kind of analysis is even more important in locations with greater thermal oscillation, like middle and higher latitudes sites.

ID: 117

FEASIBILITY STUDY OF CLOSED-CONTAINMENT OPTIONS FOR THE BRITISH COLUMBIA AQUACULTURE INDUSTRY

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Session 2C - Wednesday, 1:30pm-3:00pm, Glades/Jasmine

Closed-containment can include a range of technologies and operating environments—from ocean- to land-based production systems—with varying degrees of isolation from the environment. Typically, the more “closed” a system is, the more complex its management becomes, since its energy requirements are greater and waste can be more of an issue. In 2008, the Canadian Science Advisory Secretariat (CSAS) published a report entitled Potential Technologies for Closed-containment Saltwater Salmon Aquaculture. That report identified a need to analyze closed-containment technologies, and included economic recommendations. The goal of the current study is to use financial analysis tools to respond to the CSAS report. This study is therefore limited to financial considerations. All scenarios described in this report were developed and analysed in the context of the current operating environment of the British Columbia industry. Further analysis and adaptation would be necessary to reflect a different operating environment accurately. To begin the study, DFO conducted a preliminary financial assessment of all technology types identified by CSAS. The results indicated that only two of them—net pen and recirculating aquaculture systems (RAS)—were likely to show positive returns. Based on this preliminary assessment, DFO conducted more in-depth financial analyses, including sensitivity analyses, on net pens and RAS. The results demonstrate a positive net income for both technologies. However, with capital expenses of \$5.0 million and \$22.6 million respectively for net pens and RAS, the analysis found a significant advantage for net pens in terms of pre-tax income. Although RAS production showed efficiencies in biological feed conversion ratio (FCR), temperature stability, and improved environmental control, the presence of higher capital costs, energy costs and labour requirements significantly affected its overall profitability. The study results also showed that while both technologies are profitable on a pro-forma basis, with returns significantly higher for net pens, RAS technologies are likely to be considerably more sensitive to market forces that are beyond an operator’s control (such as exchange rate and market price), and may prove non-profitable within a range of variability that has been experienced by the Canadian salmon aquaculture industry in the past. These sensitivities are due largely to the high initial

capital investment and subsequent associated costs. As with most emerging technologies, once wider uptake within the sector is achieved, capital and operating costs may go down. If closed-containment technologies achieve a critical mass of production, operators may benefit from economies of scale in the acquisition of capital items, and their increasing expertise could help reduce operating costs. To conduct this analysis, DFO used costs for net pens that are the result of several decades of expertise and an industry that has achieved the advantages of critical mass. It is possible that RAS-based production systems could experience similar gains, but the scope and time frame of those gains are beyond the current analysis. It is also possible that certain intangible costs could affect the operations' profitability.

ID: 119

COST-BENEFIT ANALYSIS OF GOOD ENVIRONMENTAL STATUS IN THE BALTIC PROPER – A BAYESIAN BELIEF NETWORK APPROACH

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Session 3C - Wednesday, 3:30pm-5:30pm, Glades/Jasmine

The aim of this paper is to assess the economic consequence for society of achieving a good environmental status in the Baltic Sea. Given that policies already are in place our task is to evaluate whether the agreed upon policies that focus on Good Environmental Status (GENS), is a good idea for societies then calculating the costs and benefits of this policy and potentially indicating whether more or less regulation or changes in the design of the regulation are appropriate. In our analysis we apply Bayesian state-space modeling to evaluating policy options under uncertainty. By using the BBN (Bayesian belief networks), the focus is not to avoid / ignore the prevailing uncertainty, but to quantify it by discretizing, that is, derive discrete probabilities for possible outcomes for each of the stochastic processes or other uncertainties. In order to include both the economic and environmental dimension of the problem and the attached uncertainties, on equal terms we apply a BBN approach. Given the amount of uncertainty, the analysis is done in probabilistic terms by including the prevailing inherent uncertainties into analysis evaluation using BBN.

Our initial model run predicts that compared to a reference situation, the BSAP gives a positive benefit to society. The costs of implementing the necessary policy measures are valued lower than the benefits these policies generate in utility terms. The result is only a first attempt to use the BBN and assess its applicability for this case. The analysis shows that it is extremely fruitful to have the BBN structure to integrate the interdisciplinary nature of the problem and the researchers involved.

ID: 121

LIMITS OF INDUSTRY-FINANCED BUYBACK AUCTIONS

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Session 5C - Thursday, 10:30am-12:00pm, Glades/Jasmine

Buyback programs to reduce excess capacity in national fisheries have been oft-used but seldom successful. Where they have successfully reduced excess capacity, the programs have come at a high cost, almost always in the form of governmental subsidies to buy out the excess capacity. These subsidies may even exceed the full gain in social surplus from the fishery that is, after all, the main purpose of the programs. While, in principle, the presence of excess capacity implies there are Pareto-improving allocations of fishing rights, which involve the removal of the highest cost or least efficient vessel capacity from the industry, the difficulty is in identifying the least efficient vessels and providing the incentives for their owners to be voluntarily bought out by the owners of vessels remaining in the fishery.

Our paper explores, from a mechanism-design approach, the possibilities for and limits of buyback programs - specifically auctions - that are entirely self-financed. Our main result delimits conditions on the fishery (in terms of how quickly aggregate profits in the fishery increase as excess-capacity is removed) that allows an efficient, revenue-neutral (i.e. requiring no outside subsidies) auction design that will also satisfy voluntary participation (i.e. all a priori identified vessel owners will choose to participate in the auction.) We also provide empirical support for our theoretical results from controlled laboratory

experiments. Finally we compare our efficient auction design with some proposed real-world buyback auction schemes.

ID: 122

INCORPORATING INDEPENDENT PEER REVIEW IN FISHERIES SCIENCE: THE PERFORMANCE OF THE CENTER FOR INDEPENDENT EXPERTS, 1999-2012

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Session 9C - Friday, 9:30am-11:00am, Glades/Jasmine

The Center for Independent Experts (CIE), an independent program that organizes independent peer reviews of National Marine Fisheries Science (NMFS) assessments, has conducted over 200 reviews over its 14 year history in the fields of fishery stock assessment, fishery assessment methodology, protected species, anadromous stocks and habitats, ecosystem science, econometrics, social impact assessment, and socioeconomics. The reviews have considered a range of issues, from periodic stock assessment cycles, protected species status reviews, and the efficacy of research methods, among others.

The presentation will consider the performance of the CIE over its history, in terms of the program's output in an increasing array of peer review products, and it will evaluate the importance of dedicated, independent peer review in improving fishery science and management.

ID: 123

INCORPORATING CONTEXT INTO THE SELECTION OF RECREATIONAL FISHING SITES : THE CASE OF BRITISH COLUMBIA RAINBOW AND KOKANEE ANGLERS

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Session 3B - Wednesday, 3:30pm-5:30pm, Banyan/Citrus

The goals of many of today's fisheries management organizations require sustaining fish stocks while simultaneously providing for maximum angler satisfaction. Achieving such goals requires not only knowledge regarding the behavior of fish stocks, but also regarding the behavior of anglers—how they fish and where they fish. However, much of the research regarding the preferences and behavioral intentions of recreational anglers has overlooked the impact of contextual factors on identifying what aspects of the fishing experience may draw anglers to any particular location. Our research focused on identifying and describing the preferences of and heterogeneity among Rainbow trout (*Oncorhynchus mykiss*) and Kokanee salmon (*Oncorhynchus nerka*) anglers residing in British Columbia in light of contextual factors such as trip duration, species preferences, and availability of choices. Anglers from across the province were invited to participate in a survey (administered both online and via mail) containing a discrete choice experiment addressing choice of fishing location. Since an angler's choice of fishing site is the result of an evaluation of many factors, the alternatives in the choice experiment were described with 11 attributes that addressed resource quality, the lake environment, travel to the site, and lake accessibility. The choice task addressed both single day and multi day trips. Preliminary results indicate that resource quality (but not necessarily the availability of a particular species), the duration of the trip and geographic accessibility may significantly mediate angler's preferences for the resource related attributes of the fishing experience. Furthermore some anglers that fish for Rainbow trout and Kokanee salmon exhibit species preferences that are quite broad and differentiated which may considerably mediate their preferences for other aspects of the fishing experience.

ID: 124

NOT ALL FISHERY CO-MANAGEMENT ARE EQUAL: ESTIMATING THE IMPACT OF SELF-IMPOSED RULES CHOICE ON THE PERFORMANCE OF COASTAL SMALL SCALE FISHERY CO-MANAGEMENT

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Session 8C - Friday, 8:00am-9:00am, Glades/Jasmine

This paper investigates deeper into the performance of fishery co-management, defined as collective resource management by a group of harvesters, with particular focus on the self-imposed rules that these groups employ. Fishery co-management is garnering attention as potential alternative to command-and-control or individual quota system, and as such a number of studies have been conducted on the topic. However, most of these studies looked at the existence of co-management scheme, often coded as dichotomous variable that enters the regression models. Others focused on a particular rule—such as the so-called sharing rule—and examined its effect on outcome measures. The reality, however, is that there are many other rules that these groups can employ and each group has its own combination of rules. As such, it is of much interest to know how these rules affect the outcome of fishery co-management. The challenge is the sheer number of such rules and combinations of rules that exists, which makes the identification almost impossible if one is to treat each rule and attempts to measure its impact individually. In this paper, we collect the data from coastal small scale fishing groups, both who are and are not engaged in co-management, in South Korea through phone surveys that includes detailed description on the self-imposed rules employed. We then processed this data with factor analysis method to reduce the data dimension, from 25 different rules to 11 factors that are characterized with rules' attributes. The results were then included in the regression models to estimate the effect of these rules (factors) on the total fishing revenue, both in terms of the actual level and the change in total revenue before and after the implementation of co-management scheme. Preliminary results show that “weak” stock rebuilding effort measures and information sharing had positive effect on the outcome, while other factors are still inconclusive.

ID: 125

MEASURING BENEFITS FROM A MARKETING COOPERATIVE IN THE COPPER RIVER FISHERY

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Session 7B - Thursday, 3:30pm-5:30pm, Banyan/Citrus

Rent dissipation from incomplete property rights in fisheries manifests itself in many ways. Excess inputs into the resource and degradation of product quality are two well-documented sources of economic waste in fisheries. Industry structure can also lead to additional market failures and economic waste through underinvestment in product quality. In this research I examine how collective action, through formation of a marketing cooperative, can mitigate several market failures that lead to the production of inferior product quality in fisheries. Fishermen can potentially use collective action to reduce the intensity to which they compete in the race to fish in order to realize gains in product quality. As vertically integrated firms, marketing cooperatives have the potential to address information asymmetries that emerge in the traditional industry structure.

I first develop a simple theoretical model that describes the impact of moving from a homogeneous-goods world to a world with heterogeneous product quality in a limited-entry fishery. The model demonstrates the conditions under which fishermen will benefit from product quality development.

I then estimate the impact that the Copper River Fisherman's Cooperative, an Alaskan salmon marketing cooperative, had on ex-vessel salmon prices and salmon quality measures through difference-in-difference analyses. To create a counterfactual, I select Upper Cook Inlet as a control fishery. I demonstrate that Upper Cook Inlet is similar to the Copper River fishery along several dimensions. I find evidence of significant impacts on both salmon prices and measures of salmon quality. I estimate a 22-24% increase in ex-vessel sockeye salmon prices and a 39%-46% increase in ex-vessel Chinook prices. Additionally, I estimate that the cooperative led to a 23% increase in the number of delivery trips for a given volume of sockeye salmon, thereby shortening the time between harvest and delivery and increasing salmon freshness.

NAAFE Forum 2013: Marine Resource Management under Increasing Complexities and Uncertainties

I subject all of my results to “placebo years” and “placebo species” tests and find my results robust to both tests. The “placebo years” test provides information over concerns that either pre-existing trends or serial correlation may be driving the results. The “placebo species” test provides information over concerns that either a confounding factor or serial correlation drives the results.

This research is important because in the last decade there has been growing demand for high-quality food products. Understanding the challenges the fishing industry faces in improving product quality is critical first step in understanding how the industry can move forward to take advantage of changing markets.

ID: 126

NETWORK ANALYSIS OF THE GULF OF MEXICO RED SNAPPER IFQ PROGRAM

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Session 3A - Wednesday, 3:30pm-5:30pm, Tarpon Key & Sawyer Ballroom

Individual Fishing Quota (IFQ) programs have become a popular tool for fishery managers trying to stop overfishing, overcapitalization, and derby style fishing. Although IFQs, and other tradable rights programs, provide market based management tools for fishery managers, the effectiveness of such programs requires the quota trading markets function effectively. In short, this means that buyers and sellers must be able to find each other with relative ease (i.e., low transaction costs) and market participants must have relatively uniform knowledge of prices. This research uses network analysis to examine trading in the quota lease market for the first five years (2007-2011) of the Gulf of Mexico Commercial Red Snapper IFQ Program. Network analysis is a technique commonly used in other social science fields that analyzes some aspect of a groups' interaction to provide insight into social processes and the characteristics and roles of the group and its members. For this research, the group analyzed is the participants in the IFQ program and the interaction is the trading of quota. Network analysis is used in this research to examine the following issues regarding the Gulf of Mexico Red Snapper Fishery: 1) the efficiency of the quota lease market, 2) what type of trading network exists and how it has changed over the first five years of the IFQ program, and 3) how IFQ management has changed participation in the red snapper fishery. This analysis is designed to provide insights on both the efficiency and competitiveness of the red snapper IFQ lease market.

The shift in fisheries management toward rights-based management, including IFQ programs, requires a thorough analysis of such systems post-implementation. The ability of rights-based management to decrease overcapacity and overfishing is tied to the efficiency and competitiveness of the quota trading in the fishery; and although basic measurement of the effectiveness of these systems with regards to decreasing overcapacity and overfishing have occurred, IFQs have not been thoroughly studied with regards to the efficiency and competitiveness of quota trading markets and the effect these markets have on the subsequent composition of the fishery. This research will provide insights into how IFQ programs affect the participants in these fisheries and could provide methods to improve not only quota trading but the ability of IFQs to alleviate overfishing and overcapacity in fisheries.

ID: 127

FISHING PORTFOLIOS OF COMMERCIAL FISHERMEN IN THE U.S. SOUTH ATLANTIC REGION: A TWO-MODE NETWORK APPROACH

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Session 3A - Wednesday, 3:30pm-5:30pm, Tarpon Key & Sawyer Ballroom

In the South Atlantic region it is common for commercial fishermen to hold several different types of permits and harvest various species throughout the year or in different years. For the commercial sector of the snapper grouper fishery, some species have more economic value than others and that value can fluctuate throughout the year. The risk of reduced or complete lack of access to a stock varies among the numerous managed species in the fishery. The multi-species nature of the South Atlantic snapper grouper fishery presents many challenges to management, but the diversity of the available species can be examined in the context of assets in a commercial fishing portfolio. This paper presents the results of

the initial analysis of the commercial snapper grouper fishery in North Carolina in which logbook data are analyzed as a two-mode network to identify which species are most frequently caught together (as targeted or as bycatch). This information will be used as 'assets' in a further economic analysis of the fishing portfolios. Two-mode network analysis is used because the results reveals connections between similar catch combinations in addition to connections and shared attributes among fishing trips with the similar combinations, allowing us to also examine the time of year and location that is most common to a catch combination. The results of the analysis demonstrate the utility of network analysis in identification of fishing portfolios and how two-mode analysis can also be used to incorporate spatial and seasonal components of a fishery.

ID: 128

THE NATURE OF INHERENT SOCIOECONOMIC AND CONSERVATION TRADE-OFFS IN RECREATIONAL FISHERIES: IMPLICATIONS FOR MANAGEMENT STRATEGIES AND UNDERSTANDING STAKEHOLDERS

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Session 3B - Wednesday, 3:30pm-5:30pm, Banyan/Citrus

Management of nearly all natural resources can be characterized primarily by two objectives—the conservation of a resource for intrinsic, aesthetic, or long term purposes, and use of the same resource for some socioeconomic benefit. These objectives often conflict in the short term, resulting in a trade-off. A trade-off is commonly realized in recreational fisheries between conservation goals of sustaining healthy wild fish populations and socioeconomic goals of supporting high effort and/or catch rates. Understanding the nature or “shape” of this trade-off, and how it may be affected by alternative management strategies or public opinion is critical for predicting what fisheries system outcomes are possible. Using Florida’s recreational red drum (*Sciaenops ocellatus*) fishery as a case study, we examined how a proposed management strategy, stock enhancement, might optimize or altogether circumvent the potential trade-off between conservation and socioeconomic goals. We evaluated this using a simple simulation model that represented both conservation and socioeconomic values, and was informed from estimated fish and angler dynamics of Tampa Bay, Florida. Our results suggest that stock enhancement is unlikely to alleviate the conservation-socioeconomic trade-off in recreational fisheries. Instead, the trade-off shape resulting from enhancement is particularly un-advantageous, since achieving a small socioeconomic gain was associated with a large conservation loss. This is because fishing effort must generally increase for enhancement to achieve socioeconomic goals, but this in turn increases fishing mortality exerted on wild fish and threatens conservation goals. Our work also shows how the conservation-socioeconomic trade-off shape itself may change with stakeholder opinions, and how the trade-off frontier associated with stock enhancement may be entirely eclipsed by alternative management strategies (e.g., habitat restoration, catch and release regulations), if they were acceptable to stakeholders. These findings emphasize the need to directly consider public/stakeholder opinion as a component of recreational fisheries systems and other natural resource systems, and illustrate how natural resource trade-offs and their outcomes may better understood using even simple quantitative models.

ID: 130

CATCH SHARE SCHEMES, THE THEORY OF DYNAMIC COALITION GAMES AND THE GROUND FISH TRAWL FISHERY OF BRITISH COLUMBIA

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Session 6A - Thursday, 1:30pm-3:00pm, Tarpon Key & Sawyer Ballroom

NAAFE Forum 2013: Marine Resource Management under Increasing Complexities and Uncertainties

This paper is a follow up to a paper that was presented at IIFET 2012, and as such is a progress report. In the 2012 paper, it was argued that catch share schemes should be analyzed through the lens of game theory to a far greater extent than had hitherto been the case in the past. The basic framework was seen to be derived from a 2006 article by Kronbak and Lindroos, in which the resource managers play a Stackelberg game with the relevant fishers and in which the fishers play either a competitive or cooperative game among themselves.

A real world example, which provided a focus for the paper, is the ITQed groundfish trawl fishery of British Columbia. The number of players in the fishery is large, certainly not fewer than 30. The players were seen to be playing a stable cooperative game among themselves, and as a coalition, had played a cooperative game with a second coalition consisting of a consortium of conservation NGOs. The two coalition cooperative game, resulting in the B.C. Groundfish Trawl Habitat Conservation Agreement, has as its objective the minimizing of bycatches of threatened sponge and coral species.

The IIFET 2012 paper pointed to many game theoretic issues, which needed to be addressed. Furthermore, the Agreement was at an early stage, with its success being by no means assured. The paper will report on progress that has been made in addressing the aforementioned theoretical issues. In addition, the Agreement has now completed its first full year of operation. It will be argued that the Agreement has to date been remarkably successful. The paper will discuss the implementation of the Agreement in detail and will attempt to explain what has gone right.

ID: 135

BIO-ECONOMIC ANALYSIS OF MULTI-SPECIES, MULTI-FLEET FISHERIES IN YUCATAN, MEXICO.

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Session 6C - Thursday, 1:30pm-3:00pm, Glades/Jasmine

Fisheries in Yucatan, Mexico do not contribute greatly to the GDP, however they generate almost 15,000 direct jobs and around 5,000 indirect jobs. Almost 95% of the fleet is small-scale. A variety of species are caught in the region, but three main species contribute with large catches: grouper, lobster and octopus, all of them targeted by three fleets. Management of these fisheries has followed single species approaches, focusing on understanding the resource dynamics and has generally ignored changes in catch composition related with the dynamics of the fleet. Moreover, depending the fishing season, fishermen may change the target species and gear in the short-term. For these fisheries, it is essential to identify the factors defining catch variability given the shifting of different fishing gears and several fleets. Under this context we posed several questions: Is there an overlap on the areas where each fleet operates given the target species? Are there significant differences in catch rate and quasi-rent generated by each fleet? And what are the factors that define catch variability in each fleet? Different sampling campaigns undertaken from 2005 to 2010, have contributed to integrate information to answer these questions. Production functions by fleet were generated through Generalized Linear Models using the quasi-rent as response variable, by target species and fleet. In addition, differences in species composition associated to the target species were evaluated by means of a dissimilarity-based test for homogeneity of multivariate dispersions. Results confirm the effects of sequential interactions among fleets that operate the three main fisheries in Yucatan. Medium-scale fleet also showed overlap with the small-scale and semi-industrial fleets, the first one showed to be the most efficient fleet in economic terms. It is discussed the need of a change of vision in the way fisheries in Yucatan have been assessed and managed to improve management schemas. Emphasis is made in to evaluate the extent of the identified interactions among fleets and species deeply.

ID: 137**ANALYSIS OF ACCIDENTS REGISTERS OF FISHING VESSELS FROM THE GULF OF MEXICO**

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Session 8A - Friday, 8:00am-9:00am, Tarpon Key & Sawyer Ballroom

Commercial fishing is a risky activity, which many accidents are reported on many countries in the world. In Mexico the semi-industrial fleet is equipped with high onboard technology that facilitates the rescue in emergencies at sea. However, the small-scale fleet operates with limited technological devices that do not allow communication in case of accidents that could delay rescue or even disregard those accidents. These conditions may have a significant impact in the region considering that in the Gulf of Mexico there are around 20,000 artisanal vessels, and almost 50,000 persons depends on artisanal fishing activities. This study analyzes the types of risk situations and accidents of fishing vessels reported in the Gulf of Mexico and the Mexican Caribbean Sea from two data sources. We used historical data of accidents at sea from 20 ports, and these data are from official register of the Ministry of navy from 1999 to 2012. In addition, we obtained information through interviews from 17 ports of the southeastern Gulf of Mexico from 2011 to 2012. We analyzed official records, compared with the information from interviews, and carried out an analysis of the operating characteristics of vessels from 4 states. Our results show 20 types of emergencies or risk conditions, among them, the sinking, stranding mechanical failure, bilge and collision were the most common. We observed in most cases, fishers consider other fishers as their first choice to call in case of emergency. This agrees with official reports, where 80% of the rescues were coordinated by commercial fishing vessels. We found significant differences ($P \leq 0.05$) in the fishing time (7-10 hrs.) and distance from the coast (25-40 km) in all fishing ports. Specific risks/accidents were reported by area and type of fishery, such as collision of small boats with ships in Campeche and Tabasco, or decompression problems of divers in Yucatan and Quintana Roo. There was no evidence of an increase in the number of accidents in recent years. However not all the accidents are reported to the corresponding authorities, mainly in the artisanal fleet. We discuss around these issues and about the security strategies of fishers to face emergency conditions and propose action plans could help to define contingency plans to improve fishing operations in the region.

ID: 138**PULSE FISHING IN CONTRACTING RESERVES AS A STOCK REBUILDING OPTION FOR MARINE INVERTEBRATES**

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Session 5C - Thursday, 10:30am-12:00pm, Glades/Jasmine

“Pulse fishing”- allowing a fish stock to rebuild in an area, heavily exploiting the area, and shifting fishing to a different area- can in some instances lead to higher fishing profits than traditional management strategies based on limits to effort or catch. We studied a novel way to apply pulse fishing: a “contracting reserve” that allows pulse fishing around its core area. A contracting reserve could be a practical way to address a common complaint among fishermen of not being able to fish in protected areas where stocks have already recovered. In contrast to other forms of pulse fishing, such as rotational reserves, this type of reserve-fishery system relies heavily on self-recruitment. For their part, rotational reserves are difficult to administer due to their transient nature. We developed a demographic model of an exploited resource that included two life stages, sub-adults and adults. For Caribbean lobster (*Panulirus argus*) and queen conch (*Strombus gigas*), we used known values for natural mortality, fishing mortality, and growth rates in fished areas of Belize to estimate the fertility levels required to produce a sustainable population ($\lambda=1$). We then estimated the minimum size of a contracting reserve that would allow the levels of self-recruitment required for a sustainably-exploited population. We propose a scheme for the expansion and contraction of the reserve that could result in an economic improvement over the current system that is applied in Belize to manage lobster and conch fisheries.

ID: 140

TAMING THE LIONFISH

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Session 2B - Wednesday, 1:30pm-3:00pm, Banyan/Citrus

The Pacific red lionfish (*Pterois volitans*) invasion is a growing threat to native marine life throughout the Caribbean, Western North Atlantic, and Gulf of Mexico. Lionfish abundance is not readily observable, and monitoring the species is costly. Resource managers must plan their response based on imperfect information about the state of the invasion. In this paper, we develop a spatial-dynamic bioeconomic model of lionfish management under imperfect information. We consider the problem of a resource manager who seeks to minimize the present value of both invasion damage and management costs using two controls: lionfish removal effort and monitoring. We account for the manager's imperfect knowledge of local lionfish abundance by posing the control problem as a continuous-state partially observable Markov decision process (POMDP). Using a newly available approximate solution method, we characterize efficient lionfish management under a range of economic and biological conditions. We find that early monitoring helps the manager limit the impact of the invasion. The importance of monitoring increases with greater biological stochasticity. We provide results for a spatial system that illustrate the roles of population connectivity and spatial heterogeneity in determining the efficient targeting of lionfish removal effort across space. Our study also considers the problem of native species bycatch (unintentional capture of non-target species) arising from lionfish removal. We identify scenarios where tolerating some native species bycatch is worthwhile in order to suppress lionfish numbers.

ID: 141

"APPLIED RESEARCH AND EXTENSION TOOLS SUPPORTING SHELLFISH AQUACULTURE DEVELOPMENT IN VIRGINIA"

Tom Murray, Virginia Institute of Marine Science, tjm@vims.edu

Session 2C - Wednesday, 1:30pm-3:00pm, Glades/Jasmine

The Virginia Institute of Marine Science (VIMS) provides wide ranging applied research and advisory support for shellfish aquaculture development in Virginia. These efforts include extensive applied economic research and extension products to support the sustainable development of aquaculture in Virginia and are led by the Advisory Services component of VIMS. This presentation by the Director of VIMS Advisory Services will highlight ongoing and recently completed applied economic tools and analyses related to molluscan shellfish aquaculture in Virginia. The presentation will cover three contemporary products: 1. Summary of the "Annual Virginia Shellfish Industry Situation and Outlook Report-2012" which has just completed its 7th consecutive annual grower survey;

2. Findings of a recently completed regional economic impact assessment "Economic Impact of Shellfish Aquaculture in Virginia-2012";

3. Demonstration of a recently completed web-based oyster aquaculture enterprise budget generator tool "2012 Cultch less (Single Seed) Oyster Crop Budgets for Virginia" which is already widely used by industry as well as those interested in learning more about the micro-economics of developing oyster aquaculture business. The presentation will conclude with an assessment of the value of such applied economic tools and assessments to resource managers, growers, related trade, lenders, investors and researchers

ID: 142

TEMPORAL STABILITY OF STATED PREFERENCE VALUES FOR ENDANGERED SPECIES PROTECTION FROM CHOICE EXPERIMENTS

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Session 7A - Thursday, 3:30pm-5:30pm, Tarpon Key & Sawyer Ballroom

Policy analyses involving natural resource and environmental goods are increasingly turning to benefit transfer methods to incorporate economic benefits. Since these methods rely on past models and results, it is important to know whether economic benefit estimates are stable over time or are subject to change, either because of the reliability of the methodology or due to actual preference changes. The temporal stability of willingness to pay (WTP) has been tested extensively in the context of contingent valuation methods. However, the temporal stability of WTP estimates from stated preference choice experiments (SPCE) have only begun to be assessed. In this paper, we use data from two identical SPCE surveys on different samples from the same population that occurred 15 months apart to estimate and compare mean WTP and preference parameters associated with providing protection to threatened and endangered marine species. We find that preferences and values are not statistically different with and without controlling for differences between samples. This provides some evidence that economic values estimated using SPCE methods are stable over time.

ID: 143

THE IMPACT OF EMPOWERING SCIENTIFIC AND STATISTICAL COMMITTEES (SSCS) TO CONSTRAIN CATCH LIMITS IN U.S. FISHERIES

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Session 1A - Wednesday, 10:30am-12:00pm, Tarpon Key & Sawyer Ballroom

Following the 2006 revision to the Magnuson–Stevens Act, the eight Fishery Management Councils that manage U.S. stocks have been restricted from setting regional catch levels that exceed the recommendations of their Scientific and Statistical Committees (SSCs). I review the impact of that new requirement using principal–agent theory. After demonstrating that the SSCs are still agents of the Councils, I show that the process of managing federal fisheries stocks now requires a lengthy dialogue between the two groups revolving around issues of risk tolerance, management buffers, and data availability that has resulted in the development of explicit rules for setting biological boundaries on catch.

ID: 144

DO STAKEHOLDER ATTRIBUTES INFLUENCE SOCIAL NETWORK CAPITAL? EVIDENCE FROM AN ETHNICALLY DIVERSE PELAGIC FISHERY

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Session 3A - Wednesday, 3:30pm-5:30pm, Tarpon Key & Sawyer Ballroom

Marine fisheries are commonly characterized by a diverse set of stakeholders embedded in social networks, which can influence the flow of information among fishers. By sharing information and building relationships with various stakeholders, fishers can accrue social network capital – an asset that can provide economic and other advantages to those that are better, or strategically connected. Yet little is known concerning who decides to cooperate and share information with others, thereby achieving a greater level of social network capital. Specifically, previous research has not investigated the role of ethnic diversity and other stakeholder attributes on individual levels of social network capital in a marine resource system. In this paper, we first identify social network analysis (SNA) measures which may be appropriate indicators of social network capital. Utilizing a comprehensive social network dataset on Hawaii's longline fishery, we then employ SNA methods, general linear models and other statistical tools

to construct these measures and determine the extent to which individual stakeholder attributes can explain the variation within them. We find that ethnicity most strongly correlates with the majority of social network capital measures compared to all other stakeholder attributes, while also being a highly significant predictor of their variation. Results also show that title, or occupation, and fishing experience are also important predictors. This research furthers our understanding of stakeholder diversity and information sharing in competitive marine fisheries, and has important implications for fishery policy and management. Our results are also critically important for empirical studies of social networks in fisheries as they clearly demonstrate that individual determinants of economic behavior, many of which are difficult to observe, are highly correlated with social network characteristics; thus, any attempt to link social network analysis with economic outcomes is likely to suffer from endogenous variables bias.

ID: 145

A SOCIAL NETWORK ANALYSIS OF THE AUSTRALIAN CORAL REEF FIN-FISH FISHERY INDIVIDUAL TRANSFERABLE QUOTA MARKET

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Session 3A - Wednesday, 3:30pm-5:30pm, Tarpon Key & Sawyer Ballroom

Of central importance to the effectiveness of ITQs as fisheries management tools is the associated quota market and the efficiency with which it operates. High transaction costs, illiquidity, limited information, and situations of market power are all circumstances that can reduce market efficiency and result in both unanticipated and undesirable outcomes at the fisher level. Despite their significance, there are relatively few empirical studies of quota trade markets in the fisheries literature. This analysis uses data on individual level quota holdings and trades in conjunction with recently collected economic survey data to assess the Australian coral reef fin-fish fishery (CRFFF) quota market. We undertake a social network analysis that demonstrates how trade networks and the nature of quota ownership and trades have evolved since the fishery first took up ITQs in 2004, and discuss whether the market has performed as may have been expected. Distinct groups of market participants are classified on the basis of their trade characteristics, leading us to identify the emergence of investors and lease dependent fishers as important groups in the fishery. In 2010-11, 42% of coral trout quota was owned by participants that did not themselves fish, whilst 69% of the landings were made by fishers that owned only 11% of the quota. The data collected via a survey of operators showed a degree of variability in both expected and actual prices paid for quota units across different segments of the fleet. We examine these findings in the context of market efficiency, and discuss their implications with respect to expected profitability and the incentives faced by the different businesses involved in the fishery.

ID: 146

THE IMPACTS OF SAMPLING STRATEGY ON RECREATION SITE CHOICE MODELS: LESSONS FROM META-ANALYSIS

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Session 7A - Thursday, 3:30pm-5:30pm, Tarpon Key & Sawyer Ballroom

This study utilizes methods developed for meta-analysis to investigate the potential impacts of onsite sampling on the estimation of recreation site choice models. Resource agencies can benefit from the cost savings associated with onsite sampling routines; however, these sampling routines can lead to biased estimation in the form of endogenous stratification, size-based bias, and length-based bias. Using 2006 data of anglers targeting summer flounder from the National Marine Fishing Service's Marine Recreation Fishing Statistics Survey, we simulate 1328 random, exogenous, and endogenous sampling routines with and without the presence of size-based and/or length-based bias. We then estimate recreation site choice models with and without propensity score based weights in an effort to estimate the influence of sampling and estimation strategy on the marginal willingness-to-pay for an additional fish. We compare estimates from our simulated samples to those from our simulated population. Our results provide insight into the implications of sampling strategy on models of recreation site choice for management and policy.

ID: 147

SPATIAL HETEROGENEITY IN WILLINGNESS TO PAY FOR IMPROVEMENTS TO THREATENED AND ENDANGERED MARINE SPECIES: REGIONAL HOT SPOTS AND RELATIONSHIPS TO SPECIES DISTRIBUTION

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Session 7A - Thursday, 3:30pm-5:30pm, Tarpon Key & Sawyer Ballroom

Spatial dimensions of willingness to pay (WTP) for improvements to threatened and endangered species may depend not only on the spatial distribution of the species, but also on the spatial distributions of underlying preferences and other potentially confounding factors. Most nonmarket welfare estimation still applies rudimentary approaches to evaluate such spatial heterogeneity. These include methods that require questionable assumptions such as (1) values are spatially homogeneous, (2) values decay as a monotonic function of distance from environmental changes, or (3) values display a small number of discrete thresholds over geopolitical boundaries. There is little reason to expect that such simplifications provide valid perspectives. For example, where nonuse values predominate, there is no necessary theoretical expectation for WTP to follow the global distance decay or threshold patterns commonly assumed in the valuation literature. Similar concerns apply to a wide range of non-valuation phenomena, leading disciplines such as ecology and geography to largely discard such spatial simplifications in favor of more realistic approaches that allow for spatial patchiness and other non-continuous patterns. Although some research has begun to explore non-continuous spatial dimensions of nonmarket WTP, these models tend to focus on localized, clearly identifiable policy impacts (e.g., Johnston and Ramachandran 2012). In contrast, the types of policies for which spatial welfare distributions may be most relevant for policy analysis—and for which common treatments are least well suited—are those characterized by geographically dispersed and less easily identifiable policy impacts. An example is WTP for improvements to threatened and endangered marine species. This paper evaluates spatial heterogeneity and localized clustering (hot and cold spots) in WTP for the recovery or downlisting of three marine species with distinct spatial habitat ranges—the Hawaiian monk seal, the Puget Sound Chinook salmon, and the Upper Willamette River Chinook Salmon. Spatial welfare patterns are evaluated using approaches that are established in the geography literature but almost entirely unknown in nonmarket valuation (Johnston and Ramachandran 2012), including spatial grouping analysis and local indicators of spatial association (LISAs). Empirical analysis draws from a stated preference choice experiment implemented in 2009 over a nationwide panel of U.S. households to evaluate households' WTP for the recovery or downlisting of specific threatened or endangered marine species. Particular attention is given to relationships between species' habitat ranges and the spatial distribution of WTP. Results identify statistically significant and complex patterns of spatial heterogeneity in WTP that appear largely unrelated to habitat ranges. Rather, when viewed from a nationwide perspective, it appears that some localized areas may be characterized by atypically high and low WTP regardless of the species considered. This suggests that spatial patterns in underlying preferences may be more relevant to WTP distributions than the habitat ranges of affected species. Results demonstrate shortcomings in common treatments of spatial heterogeneity, as well as insight available through alternative methods. For example, results identify policy relevant patchiness in WTP that is invisible to traditional methods. Discussion emphasizes implications for both valuation and policy analysis.

ID: 148

SPATIAL DYNAMIC OPTIMIZATION OF GROUNDWATER USE WITH STANDARDS FOR INSTREAM FISH HABITAT

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Session 4B - Thursday, 8:30am-10:00am, Banyan/Citrus

This presentation is to be included in the special session "Landscape Ecology and Economics"

We analyze policies for managing groundwater pumping that affects fish habitat. In particular, we examine how variations in the spatial distribution and timing of policy actions, as well as the physical characteristics of a stream aquifer system, affect the regulators' ability to meet ecological goals. Adequate instream flow is crucial for the survival of fish species, particular salmonid species that depend on high-quality stream habitat for spawning and rearing, thus the use of water for irrigation can have negative effects on fish populations. This externality is clear and visible for irrigation water diverted directly from surface water bodies but is less obvious when water is pumped from groundwater aquifers that are hydrologically connected to nearby streams.

The objective of our optimization model is to distribute restrictions on groundwater pumping among a set of irrigators in a way that minimizes costs, subject to meeting instream flow requirements need to provide adequate habitat for fish. Our model is distinguished by two features. First, instream flow requirements must be met daily. This is in contrast to previous models that focus on total water use over a complete irrigation season. Our emphasis on the flow externality associated with groundwater pumping rather than the stock externality produces some notable results. Second, we incorporate a hydrologic model of stream-aquifer interaction that allows the effects of groundwater pumping on streamflow to vary across space and over time. As a case study, we apply our model to the Scott River Basin in northern California, a region where stream depletion resulting from extensive irrigation has degraded habitat for ESA-protected Coho salmon. Our analysis emphasizes three results. First, there is a tradeoff between the magnitude and duration of the stream-depletion effect. More distant wells have a smaller, but longer-lived, impact on streamflow. Incorporating this spatially variable time lag reveals that the optimal spatial and temporal distribution of groundwater pumping differs dramatically depending on the level of streamflow. In particular, we find that in drought years wells located closer to the stream should be allocated more water than wells farther from the stream. Second, the physical properties of the stream-aquifer system affect the optimal pumping allocation. This makes recommending one optimal policy for regulating groundwater difficult and highlights the need for investment in hydrologic information when designing cost-effective groundwater regulations. Third, we compare the welfare costs of uniform versus targeted pumping allocations. Our analysis suggests that in our case study area policies that are spatially and temporally targeted may lead to welfare costs that are 30% less than those under uniform pumping restrictions. The welfare gains of the targeted policy over the uniform reduction policy increase as the scarcity of the instream water supply increases.

ID: 149

STATED PREFERENCES FOR SIZE AND BAG LIMITS OF ALASKA CHARTER BOAT ANGLERS

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Session 7A - Thursday, 3:30pm-5:30pm, Tarpon Key & Sawyer Ballroom

Stated preference valuation methods can be used in recreational contexts to estimate changes in the economic value of recreational activities under counterfactual policy changes. This is important to the extent decision makers need information about the likely impacts of policies that have yet to be implemented, particularly ones that employ new regulatory tools. Thus, these approaches can be important as ex ante policy analysis tools and are often the only recourse for predictive quantitative information about changes to policies that have remained mostly, or entirely, static in the past and therefore lack sufficient behavioral information that could be used to reveal how changes would affect behavior and preferences.

In the case of Pacific halibut *Hippoglossus stenolepis* in Alaska, for instance, several of the sport fishing restrictions being considered by the North Pacific Fisheries Management Council have only been implemented recently in part of the state, but expansion of these restrictions to new areas and modifications to the existing restrictions are under consideration. These newer restrictions, particularly size limits, are only being implemented on charter boat fishing trips, most of which are taken by non-resident (non-Alaska) anglers. This paper reports the results of a stated preference study conducted in 2012 to understand the preferences and values that non-resident recreational saltwater anglers place on several potential regulations governing their charter boat saltwater fishing activities in Alaska related to Pacific halibut and other saltwater sport species (Chinook salmon *Oncorhynchus tshawytscha* and coho salmon *O. kisutch*). We analyze stated preference choice experiment data from a 2012 survey of non-resident Alaska anglers using a panel ordered logit model to estimate the economic value, or willingness to pay, anglers place on saltwater boat fishing trips in Alaska and assess their response to changes in characteristics of fishing trips, particularly the harvest restrictions related to Pacific halibut. Utility specifications are presented that account for a wide array of size and bag limit restrictions that have been recently implemented or are under consideration by fishery managers. The paper presents welfare estimates associated with several types of fishing trips that vary by the region fished, duration of the trip, species targeted, and restrictions. It also provides insights into the trade-offs between size limits and bag limits as management tools in Alaska saltwater recreational fisheries.

ID: 150

A COMPARATIVE ANALYSIS OF THE MULTI-MODE CHESAPEAKE BAY MENHADEN SURVEY

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Session 7A - Thursday, 3:30pm-5:30pm, Tarpon Key & Sawyer Ballroom

Recreational anglers and various conservation associations have long been concerned about the harvesting of menhaden in Chesapeake Bay. Their concerns include the fact that menhaden are filter feeders, whose overharvest could affect water quality, and that menhaden are forage fish for various recreationally important predators, such as striped bass, weakfish, speckled trout, bluefish, as well as various marine mammals and seabirds. Also important is the fact that the reduction fishery is believed to be vital to the social and economic well-being of Reedville, VA.

As a consequence, the Virginia Marine Resources Commission requested a study be done by the Virginia Institute of Marine Science of the social and economic importance of the fishery to Chesapeake Bay region. The emphasis of the study was to document how reallocating the Bay quota might affect the social wellbeing and economies of the region and to determine the economic value of menhaden in the region. In order to provide some answers to this question we conducted a multi-mode Chesapeake Bay menhaden survey of Virginia and Maryland residents. The Menhaden survey has 12 versions (3 scenarios and 4 tax amounts) distributed in Maryland (MD) and Virginia (VA). The multi-mode survey contains three elements: telephone, mail and internet surveys. Data collection followed the "tailored design method" where the budget allowed.

The mail survey was conducted between May and August 2010. 4319 surveys were sent to randomly chosen households in Maryland and Virginia. Using the total number of surveys delivered, the response rates were 8% for Maryland, 13% for Virginia and 10% overall. The Survey Research Laboratory at Appalachian State University conducted telephone interviews between June 1 and July 22, 2010. A list-assisted method of random digit-dialing (RDD) was used to obtain phone numbers in the sample from Maryland and Virginia. Calls were staggered over times of day and days of the week to maximize the chance of making contact with potential respondents. The Cooperation Rate was 36 percent. Zoomerang (www.zoomerang.com) is an online survey research firm that has recruited 2 million U.S. residents to complete online surveys in response to a survey incentive (Zoomerang, undated). Zoomerang invited a random subsample of Virginia and Maryland residents to take the Menhaden online survey. The survey opened on July 16, 2010 and closed on July 19, 2010 with 849 respondents completing the survey.

In this paper we examine differences across survey mode for response rates, item nonresponse rates, demographics, Chesapeake Bay recreation trips, concern about the impacts of changes in the menhaden fishery on the Virginia economy and willingness-to-pay higher taxes for changes in the menhaden fishery. We find significant differences in each of these variables across survey mode.

ID: 151

INTERRELATED OUTPUT SUPPLY AND INPUT DEMAND FOR AGRICULTURE IN CALIFORNIA'S CENTRAL VALLEY: THE IMPACT OF EXOGENOUS IRRIGATION WATER SUPPLY

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Session 4B - Thursday, 8:30am-10:00am, Banyan/Citrus

In this paper, we estimate the effect of changes in the irrigation water supply on farm employment. In particular, we describe the economic impacts of providing additional in-stream flow for threatened fish species in California's Sacramento-San Joaquin Delta. With water a crucial, but often scarce, resource in California's Central Valley its allocation involves substantial opportunity costs. Freshwater from the Sacramento-San Joaquin Delta is a component of the agricultural production function, but also serves as a critical habitat for threatened fish species, including Delta smelt and Chinook salmon. We analyze the trade-off in water allocation by estimating the relationship between water deliveries to farms and their demand for labor. A significant increase in farm unemployment can be considered an opportunity cost to society of reserving water to maintain fish habitat. Thus, drawing on existing work in agricultural production economics (Shumway 1983, Shumway and Alexander 1984, Moore and Negri 1992), we specify a multi-output production model, which treats water as a fixed, exogenous input. The model takes the form of a system of input demand (including labor demand) and output supply equations that we derive from a general restricted profit function. Letting the profit function be a normalized quadratic, we identify the system of equations by seemingly unrelated regression and infer an estimate of elasticity of labor demand with respect to water deliveries. The data include 31 years of county-level employment, water deliveries, crop prices and quantities, relevant production inputs, and weather variables for seven counties in California's Central Valley. For both farmers and policy makers, water supply is an exogenous variable, in the sense that it is determined by hydrologic conditions, not a market price. In the last decade, the two government projects that supply water, the Central Valley Project and the State Water Project, have considered the impact to in-stream flows that are important for fish (namely, Delta smelt and salmonids) in their water supply decisions. To investigate opportunity costs of these policy decisions, we use our model to simulate farms' labor demand responses to changes in water deliveries. These results serve as a tool for California's policy makers to assess trade-offs in water allocation, as they face increasing drought frequency.

ID: 152

BENEFITS AND COSTS OF WATER CONVEYANCE TUNNELS PROPOSED IN THE BAY DELTA CONSERVATION PLAN

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Session 4B - Thursday, 8:30am-10:00am, Banyan/Citrus

The Bay Delta Conservation Plan is built around a proposal to build a pair of 40 foot diameter, 38 mile long tunnels to convey water for the Central Valley Project and the California State Water Project around rather than through Sacramento-San Joaquin Delta. Moving the diversion point from the south Delta to the Sacramento River may reduce impacts on endangered and threatened fish which may allow for increased and more reliable water supplies for the water contractors who would pay for the tunnels. Construction costs of the massive tunnels are estimated at \$14 billion.

This paper presents a benefit-cost analysis of the initial tunnel proposal. The present value of costs are estimated to exceed the present value of benefits by approximately \$7 billion, a benefit-cost ratio of 0.4. Benefits include increased water supply, water quality and earthquake risk reduction benefits for water contractors, and costs include construction, operating and maintenance, and a rough estimate of some of the third party impacts to communities in and upstream of the Delta. The results will be updated when a revised plan is released in February or March 2013.

ID: 153

ECONOMICS AND THE NATIONAL STANDARD 1: INTRODUCTION AND CONTEXT

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Session 1A - Wednesday, 10:30am-12:00pm, Tarpon Key & Sawyer Ballroom

The implementation of harvest rules under the Magnuson-Stevens Reauthorization Act raises important economic and social science questions that have not been adequately addressed within US federally managed fisheries. This presentation will outline the role--in concept and in practice--of socioeconomic analysis in the development of harvest rules intended to prevent overfishing while achieving optimum yield. The presentation's aim is to provide background and context for subsequent presentations in this special session on socio-economic aspects of harvest control rules in fisheries.

ID: 154

FISHERIES HARVEST POLICIES: A CANADIAN PERSPECTIVE

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Session 1A - Wednesday, 10:30am-12:00pm, Tarpon Key & Sawyer Ballroom

The presentation will give a brief overview of Canada's experience in developing and in some cases implementing harvest control rules in our legislative and policy framework. In particular we will address the application of the precautionary approach and more generally the management of risk and uncertainty in these harvest control rules; and then how economics is used in this area, how it is not used, and how it may be used in the future. We will discuss some novel collaborative approaches that management is taking to work with industry to allow for investment in science in order to address uncertainty. We will use relevant examples to illustrate these general points. We will select and present material in a way that will allow for comparison with the US approach and should spur discussion at the session.

ID: 155

NETWORK ANALYSIS OF THE QUOTA POUNDS MARKET FOR THE WEST COAST ITQ

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Session 3A - Wednesday, 3:30pm-5:30pm, Tarpon Key & Sawyer Ballroom

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 28 IFQ stocks and individual bycatch quota (IBQS) shares for Pacific Halibut. Some IFQ stocks are single species (e.g. darkblotched rockfish) while others are species complexes (e.g. minor slope rockfish). Several species are divided into two stocks or are part of a species complex depending on whether they are caught North or South of a particular latitude. Each year quota share accounts holders are allocated quota pounds (QP) in proportion to QS holdings and catch of IFQ species, including discards, must be balanced with QP. QP is transferable amongst vessels, but transfers of QS were prohibited in the first few years of the program. (The program issued quota shares and permits to 139 account holders). There were over 150 vessel accounts active in the first year of the program but only 111 with landings against quota pounds. The complex multispecies nature of the fishery and the requirement to balance catch with QP, whether retained or not, makes the QP market a critical part of this IFQ system. This is particularly true for several overfished rockfish species for which many individuals received very small allocations. Catch for some of these species is highly variable and uncertain, and a single unlucky "disaster tow" could exceed the QP allocations for many vessels. We use network analysis software UCINET (Borgatti, S.P., Everett, M.G. and Freeman, L.C. 2002.) to analyse QP trading activity in the first two years of the IFQ program. We differentiate arms-length "market" transfers from internal company transfers and evaluate how the market has evolved between the first and second year (e.g. increased activity and thickness of the market). We evaluate whether there are noticeable geographic patterns in QP trading activity - e.g. QP moving from one state to another. We also analyse the structure and transfer activity of risk pools that were developed specifically to deal with the problem of meeting QP needs for unexpected catches of overfished rockfish species.

ID: 156

TOWARDS A BIOECONOMIC HARVEST CONTROL RULE FOR BERING SEA AND ALEUTIAN ISLAND GROUND FISH

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Session 1A - Wednesday, 10:30am-12:00pm, Tarpon Key & Sawyer Ballroom

The harvest control rules specified for groundfish and crab fisheries off Alaska are simple mathematical expressions keyed to two critical values. The Overfishing Limit (OFL) is set to zero when the current stock level is estimated to be below a critical lower bound. The OFL is set to a biologically determined maximum when biomass is above a critical upper bound. For intermediate biomass levels, the OFL is set proportionate to a ratio of current biomass and the sustainable yield maximizing biomass. The Acceptable Biological Catch (ABC) is set as a fraction of the OFL and the Total Allowable Catch (TAC) also known as the Annual Catch Limit (ACL) is set as a fraction of the ABC. At present, neither critical value reflects economic or social considerations. This paper presents a bioeconomic basis for specification of the critical values and for curvature of the harvest control rule at intermediate biomass levels.

ID: 157

ECONOMICS AND NATIONAL STANDARD #1: AN OXYMORAN NO LONGER?

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Session 1A - Wednesday, 10:30am-12:00pm, Tarpon Key & Sawyer Ballroom

My discussion will describe why I think that it may soon be possible to introduce some economic concepts into the National Standard #1 discussion. I believe this trend is a sign of greater acceptance of the economics paradigm in the fisheries management decision, but it is also because of increased demands to understand the economic efficiency and distribution effects and ABC determinations.

ID: 158

UTILIZING FISHERMEN'S KNOWLEDGE AND PERSPECTIVES IN ASSESSING ANNUAL CATCH LIMITS IN THE PACIFIC ISLANDS REGION

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Session 1A - Wednesday, 10:30am-12:00pm, Tarpon Key & Sawyer Ballroom

In the Western Pacific Region, setting annual catch limits (ACLs) for managed species was difficult for many reasons. There was little precedent for commercial catch limits in areas under the jurisdiction of the Western Pacific Regional Fishery Management Council; quotas existed only for a complex of bottomfish (Deep 7) in the main Hawaiian Islands (MHI), and for bigeye and yellowfin tuna based on management measures passed by regional fisheries management organizations. As a result, managers, scientists, and fishermen were generally unaccustomed to the idea of specific catch limits imposed on individual species or groups. In addition, the western Pacific was generally in a data-poor situation based on the lack of stock assessments or other valid, reliable information about fish populations for many species or groups. One consequence was that fishermen had very limited knowledge of the procedures used or how the final limits were set, and systematic opportunities did not exist for fishermen's involvement in the technical process. Now that the initial legal deadlines have been met and the required ACLs are in place, there is an increasing opportunity to constructively involve fishermen in the adaptive revising of ACLs.

This presentation will describe the cooperative research efforts currently being conducted by the Human Dimensions Research Program at the Pacific Islands Fisheries Science Center to seek ways for fishermen and scientists to work collaboratively in addressing this issue. One case focuses on involving fishermen in the refinement of the MHI Deep 7 bottomfish stock assessment. In the existing stock assessment, the fishermen's knowledge was sought, but they were not involved in the stock assessment process in any systematic manner. A second case focuses on the data-poor reef fish fishery of the Commonwealth of the Northern Mariana Islands. For this fishery, no stock assessments for individual species or groups exist, but some level of catch history is available. In such data-poor situations,

scientists have turned to the literature to seek rules of thumb that seem appropriate given the level of data available, a process that also does not systematically involve the fishermen.

The status of each of these efforts will be presented, including a description of the challenges associated with identifying the types of data to be collected and how to incorporate those into current stock assessment and ACL processes. Additionally, the trials experienced by social scientists while trying to engage fisheries scientists, fishermen, and managers in the cooperative projects will be described.

The results of these two activities will have implications not just to the western Pacific but to other regions, by demonstrating the benefits of integrating the knowledge of recreational and commercial fishermen into stock assessments and identification of ACLs for data-poor fisheries. Incorporating fishermen's perspectives and knowledge into these processes not only expands the information base available, but increases fishermen's awareness of and knowledge about the eventual ACL numbers, another goal of the Cooperative Research program.

ID: 159

THE OPPORTUNITY COST OF PRECAUTION IN SETTING ALLOWABLE CATCH LIMITS IN US FISHERIES

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Session 1A - Wednesday, 10:30am-12:00pm, Tarpon Key & Sawyer Ballroom

The 2006 reauthorization of the US Sustainable Fisheries Act now requires establishing control rules for setting annual catch limits. To date, control rules have typically been set based solely in biological criterion. This presentation explores the opportunity cost of precaution in establishing allowable biological catch. Economic implications for setting ABCs in multispecies fisheries as well as fisheries with size-based price premiums are also explored.

ID: 160

MODELING IMPACTS OF A REGULATORY CHANGE ON SALMON PERMIT PRICES

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Session 8B - Friday, 8:00am-09:00am, Banyan/Citrus

In February 2012, Northern Economics was asked to look at the impacts of a regulatory change in one of Alaska's salmon fisheries. The client was arguing that the regulatory change had caused an increase in permit prices, and had the effect of reducing access to the fishery to local residents. To address the question of whether the regulatory change led to an increase in permit prices, we ran a multivariate regression analysis on monthly permit prices. The dependent data comprised permit prices over a 120 month period from August 2002 – July 2012. Independent variables tested included lagged revenues in the fishery, along with forecast future returns, global supply, and a monthly counter variable. We also postulated that a 0,1 dummy variable—where 1 was assigned to months following the regulatory change. We hypothesized that if the regulatory change had the effect of increasing prices then dummy variable would be significant and positive. The regression was fairly robust with a 90% adjusted R-square. The regulatory change dummy variable was highly significant, but rather than positive as hypothesized, it was negative and relatively large. In spite of the fact that prices increased after the regulatory change, the dummy variable was clearly linked to a sharp drop in permit prices that started 8 months prior to the regulatory change. It was obvious that we needed to re-assess the model. If the impact of the regulatory change was not a one-time change in the price, and instead had the impact of increasing the underlying slope of the price trend, then our fixed-effect dummy variable, while significant, was inappropriate. To test to see if there was an underlying change in the slope of the permit price trend, we bifurcated the monthly counter variable into two separate counters—before and after the change. If the regulatory change increased the underlying slope of the price trend the coefficient on the “after-the-change” counter would be higher than the before the change counter. In fact, this was what we found. After the change the coefficient on the “after-change” counter variable nearly doubled, and tests indicated that the two coefficients on the before/after counters were significantly different from each other. Bifurcating the

NAAFE Forum 2013: Marine Resource Management under Increasing Complexities and Uncertainties

counter variable also increased the predictive power of the model. In spite of the fact that there appeared to be a one-time price decline coincidental with the regulatory change, it was also apparent that the slope of the underlying price trend increased following the change. It appears reasonable that this type of analysis might have other applications when looking at the impacts of regulatory changes in other fisheries.

ID: 161

EVALUATING THE ECONOMIC PERFORMANCE OF U.S. CATCH SHARE PROGRAMS

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Session 1C - Wednesday, 10:30am-12:00pm, Glades/Jasmine

Catch shares is a general term to describe fishery management programs that dedicate a secure share of fish to individual fishermen, cooperatives or fishing communities for their exclusive use. These programs have been in existence for more than 20 years in the United States. NOAA Fisheries recently began a systematic collection of performance indicators for U.S. Catch Share Programs. Data collected include catch and landings, revenue and effort data from 13 U.S. Catch Share fisheries. While each of the Catch Share Fisheries are unique and operate under very different management plans, there are some similarities that can be drawn. Some effort measures (active vessels, entities holding share) initially decrease, but stabilize after a few years of operation. Revenue per vessel initially increases, but then levels off. Select indicators will be discussed from various catch share programs to discuss the performance trends and implications for future fisheries management policies.

ID: 162

ECONOMIC VALUATION OF MARINE BIODIVERSITY IN THE GULF OF MEXICO: APPLICATION TO PROPOSED BOUNDARY EXPANSION OF THE FLOWER GARDEN BANKS NATIONAL MARINE SANCTUARY

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Session 2B - Wednesday, 01:30pm-03:00pm, Banyan/Citrus

Social values for preserving marine biodiversity are poorly understood. While it is relatively easy to value changes in commercial seafood products using market prices, it is much more difficult to assess changes in passive use and other nonmarket values. Optimal marine policy choices, however, require a full understanding of many benefits of marine preservation. This study explores U.S. residents' willingness to pay, a measure of overall social value, for increasing marine biodiversity protection in the Gulf of Mexico. We focus on marine preservation in the Gulf for three reasons. First, marine resources contribute a disproportionate share of economic and cultural welfare in Gulf-coast communities. Second, the Gulf is home to several threatened and endangered, and these species may have high nonmarket values. Third, the Gulf is a focal point of U.S. marine policy. Recent debate has highlighted controversial trade-offs between commercial harvesting, resource extraction, and environmental preservation. The study applies contemporary contingent valuation (CV) techniques to elicit respondents' willingness to pay for marine sanctuaries that enhance biodiversity in the Gulf of Mexico. We survey a sample of 1000 participants constructed to be representative of the U.S. population. We use double-bounded dichotomous-choice questions that assess if respondents would vote for or against a hypothetical – yet realistic – program that would designate new marine sanctuaries if the cost to their household was some fixed amount. Our survey was comprehensively pre-tested, and the final survey aimed to minimize embedding, hypothetical response bias, and other common forms of bias. We find that the average respondent perceived that threats to biodiversity in the Gulf were moderately serious to serious. Quantitative contingent valuation results indicated that the average US resident expressed a significantly positive willingness to pay for expanding marine preservation in the Gulf of Mexico. Younger residents, with higher incomes, living further away from the Gulf of Mexico were willing to pay more, all else equal. On a more cautionary note, however, our qualitative follow-up questions indicated that, despite positive willingness to pay, respondents expressed some skepticism regarding the overall effectiveness of marine preserves as a tool to protect and enhance marine biodiversity. We believe our results contribute to economics and policy in

at least two ways. First, our final willingness to pay figures provide direct estimates of social benefits from new or expanded marine preserves in the Gulf. These results are especially timely, as the policy scenario presented in our CV study is based on a current NOAA proposal to expand marine preserves in the Gulf of Mexico. Second, our sample is nationally representative. Most CV studies assessing willingness to pay for terrestrial or coastal ecosystem goods and services target specific populations, like local residents or visitors. Yet nationally policy decisions should be informed by comparing national benefits to national costs. We find that willingness to pay, perhaps driven by passive use values, is actually higher away from the Gulf coast region.

ID: 163

CATCH-QUOTA BALANCING REGULATIONS IN THE ICELANDIC MULTI-SPECIES DEMERSAL FISHERY: ARE THEY USEFUL FOR ADVANCING ECOSYSTEM-BASED MANAGEMENT?

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Session 3C - Wednesday, 3:30pm-5:30pm, Glades/Jasmine

A fisheries management system is only as good as its ability to conform to biologically appropriate catch limits that lead to sustainable exploitation of stocks. However, implementation of single-species catch limits in multi-species fisheries remains problematic when individual species quotas become limiting, and can therefore preclude advancement toward the holistic approach of ecosystem-based management. By adding flexibility to regulations controlling how quotas may be used by fishermen, the constraints of single species quotas may be alleviated, potentially yielding greater short-term profits. However, this greater flexibility may be detrimental in the long term if it simultaneously allows for greater risk in stock depletion due to persistent surpassing of catch limits. This study uses a bioeconomic model to analyze how catch-quota balancing mechanisms currently implemented in Iceland affect long-term sustainability of individual species and profitability of the fishery as a whole. We focus on the mechanism that allows species transformations of quota whereby quota for one species can be transformed into quota of another species at specified rates related to relative value, so called “cod equivalents.” This system reduces the likelihood or degree that the TAC of any particular species constrains catch of others but also allows catches of some species to exceed TACs which could lead to their depletion or collapse. A process for setting total allowable catches based on the expectation that species transformations will occur is discussed.

ID: 164

ESTIMATING ILLEGAL, UNREPORTED, AND UNREGULATED FISHING EFFORT USING ECONOMIC VARIABLES FROM COLOMBIA'S CARIBBEAN SPINY LOBSTER FISHERY

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Session 5C - Thursday, 10:30am-12:00pm, Glades/Jasmine

In assessing fisheries, effort information can often be a limiting factor. This is true of well documented legal fishing fleets, and even more so of illegal, unreported, and unregulated (IUU) fleets. We studied the Colombian Caribbean spiny lobster fishery to see if economic conditions have influenced fishing effort in the observed fleet, with aim to estimate IUU effort from these results. There is catch per unit effort from the diver- and trap-based industrial fishing fleets spanning over a period of light fishing, expansion, stock collapse, and recent signs of rebuilding. Economic data are available on the costs of fishing and expected revenues over most of this period. We performed a regression analysis of various measures of fishing

effort on expected costs of fishing and on expected revenue per unit effort. Effort measures included annual participation (a binary variable), trips per season, and days per trip. Expected costs of fishing were calculated by accounting for a wide range of factors, but fuel price drove annual variability. Expected revenues per unit effort were determined by multiplying the price of lobster by last season's fleet-specific catch per unit effort, both of which varied from year to year. Our results, which focus on the trap-based fleet where data were richer, indicate that boats are more likely to participate and take more trips per year when fishing costs are lower and expected revenue per unit effort are higher. Trips were also longer when costs were lower. Our results imply that economic conditions may be crucial in determining fishing pressure, and provide insight for better modeling of IUU fishing.

ID: 165

THE IMPORTANCE OF FISH LIFE-HISTORY AND HETEROGENOUS ANGLER BEHAVIOUR FOR THE SOCIALLY OPTIMAL MANAGEMENT OF RECREATIONAL FISHERIES

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Session 3B - Wednesday, 03:30pm-05:30pm, Banyan/Citrus

In some areas of the world, recreational fisheries are not managed sustainably. This might be related to the omission or oversimplification of angler behaviour and angler heterogeneity in fisheries-management models. To predict recreational fishing impacts on freshwater fish species it is important to understand the interplay among fish populations, anglers, and management actions. We present an integrated bioeconomic modelling approach to examine how differing assumptions about angler behaviour and angler preferences alter predictions about optimal recreational-fisheries management, where optimal regulations were determined by maximizing aggregated angler utility. Furthermore, we examined how results varied with fish life history (LHT) by describing five prototypical freshwater species – European perch (*Perca fluviatilis*), brown trout (*Salmo trutta*), pikeperch (*Sander lucioperca*), northern pike (*Esox lucius*), and bull trout (*Salvelinus confluentus*). We report four main results. First, we found that accounting for dynamic angler behaviour changed predictions about optimal input (license number) and output (minimum-size limit) regulations, and that optimal angling regulations varied substantially among different angler types (generic, consumptive, or trophy anglers). However, the welfare measure used to quantify aggregated utility altered the predicted optimal regulations, highlighting the importance of choosing welfare measures that closely reflect management objectives. Second, LHT was important for determining fish populations' vulnerability to overfishing, but angler type influenced the magnitude of declines, due to differences in fishing practices and the influence of LHT on angler-effort dynamics. Socially optimal minimum-size limits generally increased as LHT vulnerability increased, while optimal license numbers had a similar range across LHTs. However, both regulations varied among angler populations. Thus, both LHT and the composition of the angler population in terms of angler types were important for determining optimal regulations. Third, angler types were systematically attracted to particular LHTs (e.g., consumptive anglers preferred perch, and trophy anglers preferred pike and bull trout), resulting in the partial exclusion of some angler types under optimal regulations. Fourth, a final key finding of this research was that despite differences in socially optimal regulations, these regulations resulted in biological sustainability, in all but one case. Our results highlight the importance of jointly considering fish diversity, angler diversity, and management when deriving sustainable management strategies for recreational fisheries. Failure to do so could result in socially suboptimal management, fishery collapse, or both.

Author Index

Numbers refer to abstract ID numbers.
Bold numbers indicate presenting authors.

Abbott, Joshua	21, 22, 34, 36	Engle, Carole	72
Abolofia, Jay	9	Eskander, Shaik Muhammed S.U.	84
Agar, Juan.....	67	Euan-Ávila, Jorge	137
Ahrens, Rob	128	Farrow, Katherine.....	161
Ajibefun, Igbekele	24	Felthoven, Ronald	46
Ako, Harry	20	Fenichel, Eli.....	34
Akpalu, Wisdom	42	Forbes, Trisha	164
Almendárez-Hernández , Luis César	15	Freeman, Matthew	52
Alvarez Bustillo, Lucy	164	Frost, Hans.....	81
Andersen, Peder	81	Fujita, Rod.....	138
Anderson, Christopher	95, 96, 99	García-Ortega, Martha	112
Anderson, James L.	96	Gilbert, Benjamin.....	82, 83, 84
Anderson, Lee.....	157	Gislason, Gordon	111
Araneda, Marcelo.....	114	Gosh, Kamal	101
Arce-Ibarra, Ana Minerva	112	Grace-McCaskey, Cynthia	158
Arita, Shawn.....	144	Gray, Steven	144
Arlinghaus, Robert	165	Groves, Theodore	121
Armstrong, Claire	61	Guttormsen, Atle	9, 38, 48
Arnason, Ragnar.....	50	Haider, Wolfgang	123
Asche, Frank.....	9, 29, 30, 38, 48	Han, Jae.....	148
Ball, Sarah	27	Harrison, R. Wes	97
Barnes-Mauthe, Michele	144	Hartley, Marcus	160
Bennear, Lori	29, 41	Hartman, Todd	150
Bent, Heins	164	Haynie, Alan.....	22, 93
Best, Barbara	88, 154	Hicks, Robert.....	45, 47
Bhattacharjee, Arnab	45	Hilger, James	17
Boulet, David.....	117	Himes-Cornell, Amber.....	56
Brandt, Urs Steiner	119	Hindsley, Paul	146
Brinson, Ayeisha	161	Hoagland, Porter	92
Brozovic, Nicholas	148	Holland, Dan	10, 47, 56, 155, 163
Camp, Edward	128	Holzer, Jorge.....	57, 75
Castro, Erick	164	Huang, Pei	71
Chan, Hing Ling	5	Hunt, Len.....	123
Chen, Oai Li	79	Hutchinson, Sharon.....	106
Chidmi, Benaissa	72	Innes, James.....	145
Chu, Jingjie	96	Isaac, Dasmani	42
Coatney, Kalyn.....	52	Isaacs, Jack	100
Coronado-Castro, Eva	135, 137	James, Alex.....	82
Criddle, Keith	156	Jardine, Sunny	125
Crosson, Scott	8, 64, 143	Jarvis, Daniel.....	147
Cunningham, Sam	41	Jin, Di	92
Cusack, Christopher	60, 89	Johnson, Donn	53
Dabrowska, Kornelia.....	123	Johnston, Fiona.....	165
Dieckmann, Ulf.....	165	Johnston, Robert.....	85, 147
Dey, Madan Mohan.....	72, 79, 101	Jung, Ae-Rin	124
Ellis, Addison	25	Kahui, Viktoria	61

NAAFE Forum 2013: Marine Resource Management under Increasing Complexities and Uncertainties

Karr, Kendra.....	138	Oishi, Taro.....	26
Kasperski, Steve.....	56	Onozaka, Yuko.....	59
Keithly, Walter.....	67, 97, 98	Oparinde, Lawrence.....	24
Kirkely, James.....	150	Ovrum, Arnstein.....	87
Kling, David.....	140	Palomo-Cortés, Leopoldo.....	137
Kroetz, Kailin.....	40	Pan, Minling.....	5
Kronbak, Lone.....	130	Perez, Addiel.....	112
Kropp, Jaclyn.....	25	Prada, Martha.....	164
Ladd, Daniel.....	151	Punt, André.....	163
Larsen, Thomas.....	30	Quagraine, Kwamena.....	113
Larson, Douglas.....	149	Queirolo, Lewis.....	68
Lazkano, Itziar.....	86	Ramírez-Rodríguez, Mauricio.....	15
Ledyard, John.....	121	Ravensbeck, Lars.....	81
Lee, Jean.....	46	Ravn-Jensen, Lars.....	63
Lee, Todd.....	80	Reimer, Matthew.....	21, 22
Leung, PingSun.....	20, 144	Roheim, Cathy.....	85
Lew, Daniel.....	40, 142 , 147, 149	Roll, Kristin.....	48
Lien, Kristin.....	87	Rolon, Miguel.....	67
Lindroos, Marko.....	130	Rooplal, Vishram.....	106
Lipton, Douglas.....	57	Ropicki, Andrew.....	126
Little, Rich.....	145	Rosegrant, Mark.....	101
Liu, Pei Chun.....	87	Roumasset, James.....	78
Lorenzen, Kai.....	128	Sakai, Yutaro.....	39
Lovell, Sabrina.....	17	Salas, Silvia.....	135, 137
Lynham, John.....	144	Sampson, David.....	60, 89
MacLauchlin, Kari.....	127	Sanchirico, James.....	40, 140
Marsden, Dale.....	88, 90, 154	Savolainen, Michelle.....	104
Marteinsdóttir, Guðrún.....	163	Scheld, Andrew.....	99
McConnell, Kenneth.....	75, 150	Schilling, Wes.....	52
McDaniel, Tanga.....	150	Schnier, Kurt.....	45, 46, 47
McKean, John.....	53	Seijo, Juan Carlos.....	114
Michael, Jeffrey.....	152	Shivlani, Manoj.....	122
Michaels, William.....	122	Singh, Kehar.....	72
Miller, Alex.....	17 , 100	Singh, Rajesh.....	18, 19
Munro, Gordon.....	130	Slinger, Keegan.....	106
Murray, Jason.....	58	Smith, Martin.....	29, 38, 41
Murray, Tom.....	141	Sogn-Grundvåg, Geir.....	30
Nakamura, Akira.....	26	Speir, Cameron.....	14, 148
Nguyen, Ngoc Thanh.....	33	Stefanski, Stephanie.....	162
Nguyen, Quoc Viet.....	44	Steinback, Scott.....	17
Nguyen, Thanh Viet.....	33 , 63	Steiner, Erin.....	80
Nguyen, Thi Vinh Ha.....	44	Sumaila, Rashid.....	90, 130
Norman, Karma.....	155	Surathkal, Prasanna.....	72
Norman-López, Ana.....	145	Tabarestani, Maryam.....	97
Normanyo, Ametefee.....	42	Tamaru, Clyde.....	20
Norton, Michael.....	25	Taylor, R.G.....	53
Nøstbakken, Linda.....	76 , 86	Tegawa, Mihoko.....	95
Nøstbakken, Ronny.....	76	Thebaud, Olivier.....	145
Nowlis, Josh.....	164	Thomson, Cindy.....	60
Oglend, Atle.....	29	Thunberg, Eric.....	159 , 161

Tokunaga, Kanae.....	20, 78	Villanueva, Raúl	114
Tomberlin, David.....	71, 153	Wallmo, Kristy	142, 147
Tonioli, Flavia.....	67	Wang, Huabo	98
Torres-Irineo, Edgar.....	135, 137	Weninger, Quinn	18, 19
Townsend, Ralph	110	Whitehead, John	150
Turris, Bruce	130	Wielgus, Jeffrey.....	138
Tveteras, Ragnar	87	Wilberg, Michael.....	71
Uchida, Hirotsugu	85, 99, 124	Wilen, James.....	9, 21, 22
Valderrama, Diego	73	Wilson, Hugo.....	164
Valdés Pizzini, Manuel.....	67	Woods, Pamela.....	163
Valdéz-Moreno, Martha	112	Woodward, Richard.....	71
Valmonte-Santos, Rowena	101	Yagi, Nobuyuki	26
Vela, Miguel	114	Yandle, Tracy	8, 64
Velasco, Luz Adriana	73	Young, Jimmy	30
Vestergaard, Niels	63		