NOAA Technical Memorandum NMFS-NE-233

Proceedings of the 2014 NOAA Economics of Protected Resources Workshop

September 9-11, 2014**,** La Jolla, California

US DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Fisheries Science Center
Woods Hole, Massachusetts
September 2015

NOAA Technical Memorandum NMFS-NE-233

This series represents a secondary level of scientific publishing. All issues employ thorough internal scientific review; some issues employ external scientific review. Reviews are transparent collegial reviews, not anonymous peer reviews. All issues may be cited in formal scientific communications.

Proceedings of the 2014 NOAA Economics of Protected Resources Workshop

September 9-11, 2014**,** La Jolla, California

Kathryn D. Bisack[1], Dale E. Squires[2], Douglas W. Lipton[3], James R. Hilger[2], Daniel S. Holland[4], Denise H. Johnson[5], Min-Yang Lee[1], Rebecca Lent[6], Daniel K. Lew[7], Gisele Magnusson[8], Minling Pan[9], Lew E. Queirolo[10], Stephen Stohs[2], Cameron L. Speir[2], and Kristy A. Wallmo[3],
with contributions from Lisa Ballance[2] and Sarah Mesnick[2]

[1]National Marine Fisheries Service (NMFS), Northeast Fisheries Science Center, 166 Water St, Woods Hole, MA 02543
[2]NMFS Southwest Fisheries Science Center, 8901 La Jolla Shores Drive, La Jolla CA 92037
[3]NMFS Office of Science and Technology, 1315 East-West Highway, Silver Spring MD 20910
[4] NMFS Northwest Fisheries Science Center, 2725 Montlake Blvd. East, Seattle WA 98112
[5]NMFS Southeast Regional Office, 263 13th Avenue South, Saint Petersburg FL 33701
[6]Marine Mammal Commission, 4340 East-West Highway, Suite 700, Bethesda, Maryland 20814
[7]NMFS Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle WA 98115
[8]Fisheries and Oceans Canada, 200–401 Burrard St, Vancouver, BC V6C 3S4
[9] NMFS Pacific Island Fisheries Science Center, 1845 Wasp Boulevard, Building 176, Honolulu HI 96818
[10] NMFS Alaska Regional Office, PO Box 21767, Juneau AK 99802

US DEPARTMENT OF COMMERCE
Penny Pritzker, Secretary
National Oceanic and Atmospheric Administration
Dr. Kathryn Sullivan, Administrator
National Marine Fisheries Service
Eileen Sobeck, Assistant Administrator for Fisheries
Northeast Fisheries Science Center
Woods Hole, Massachusetts

September 2015

Editorial Notes

Information Quality Act Compliance: In accordance with section 515 of Public Law 106-554, the Northeast Fisheries Science Center completed both technical and policy reviews for this report. These predissemination reviews are on file at the NEFSC Editorial Office.

Species Names: The NEFSC Editorial Office's policy on the use of species names in all technical communications is generally to follow the American Fisheries Society's lists of scientific and common names for fishes, mollusks, and decapod crustaceans and to follow the Society for Marine Mammalogy's guidance on scientific and common names for marine mammals. Exceptions to this policy occur when there are subsequent compelling revisions in the classifications of species, resulting in changes in the names of species.

Statistical Terms: The NEFSC Editorial Office's policy on the use of statistical terms in all technical communications is generally to follow the International Standards Organization's handbook of statistical methods.

Internet Availability: This issue of the NOAA Technical Memorandum NMFS-NE series can be accessed at: http://www.nefsc.noaa.gov/publications/.

Editorial Treatment: Issues of in the *NOAA Technical Memorandum NMFS-NE* series are typically subjected to rigorous technical and copy editing prior to publication. This issue received only minimal editing, in order to meet a required distribution deadline.

CONTENTS

EXECUTIVE SUMMARY

During a three day workshop held September 9-11, 2014, economists from the National Marine Fisheries Service (NMFS) discussed economic issues related to protected resources (PR). This was the first NMFS workshop focused exclusively on the economics of PR. The primary goal was to *initiate the process* of identifying national PR social science research needs and best practices. Attendance included economists from NMFS headquarters, the NMFS regional offices and science centers in the Northeast, Southeast, Northwest, Alaska, Southwest, and Pacific Island regions, the Marine Mammal Commission, and Fisheries and Oceans Canada. A special presentation was made by the chair of the Protected Resources Science Investment Planning Process (PRSIPP) steering committee, while a member of the PR staff at the Southwest Fisheries Science Center presented concerns with the Mexican Vaquita porpoise.

The group identified future research priorities based on NMFS's 25 years of protected resource regulatory history (1990 to 2014); current and future PR social science needs articulated by Division Chiefs from NMFS's PR Regional Office and Office of Protected Resources prior to the workshop; and a review of current research in PR economics by NMFS economists. Workshop participants created a common understanding of past and current work. We anticipate the proceedings from this workshop will bridge the communication gap between economists and non-economists who collect PR-related data and who conduct PR-related research; and initiate the development of a "PR economics roadmap" in support of PR economics becoming an integral and appropriately valued part of PR science (i.e., data and research to support conservation and management of protected species).

Summary observations about the economic analyses conducted to support PR regulatory actions include the following (Tables 1 and 2):

1. Of the 72 identified PR regulatory actions, approximately one-third of economic analyses were done in support of critical habitat designation, and were, in whole or in part, outsourced to external economic consultants; two-thirds were completed by NMFS economists.
2. Each region has provided economic regulatory support for 4 to 5 taxa, although the majority of support has been dedicated to large whales (25%), turtles (24%) and fish (19%).
3. Approximately 50% of the PR regulatory actions mitigated commercial fishery interactions deemed a threat to PR. The remaining actions addressed a broad range of threats such as tourism, offshore energy development, subsistence harvesting, and dam removals and mining.

In terms of research activities, efforts have been highly correlated with the threats addressed though regulatory actions, with the majority addressing commercial fisheries. Research presentations focused on:

- The benefits of holistic management along with unintended consequences of unilateral management for transboundary species;
- Risk pools as an alternative approach to rare-event bycatch management;
- Counterfactual studies to understand our policy instrument choices;
- Economic value of scientific information;
- Compliance behavior; and,
- Economic valuation studies of protected resources.

Workshop Recommendations

Following a review of past analyses and research, along with future regulatory and information priorities identified by regional PR managers, participants developed a set of recommendations. The recommendations were not prioritized and are not considered comprehensive, but are topics discussed at the workshop concerning issues that PR economics can address in the near to medium term. Each recommendation incorporates several potential PR economic projects, and the potential benefits or contribution these analyses can make to PR science, research and management. At the end of the document, Workshop Recommendations, examples of research and management presented, are listed with specific recommendations, in order to navigate the reader to other portions of this document. The recommendations, not in any prioritized order, are as follows:

1. **Conduct a comprehensive, high level strategic assessment.** (a) Identify, inventory, and assess all threats, by species and stock; and conduct a gap analysis on information needs; (b) conduct a similar assessment on regulatory and economic instruments used to reduce threats to PR locally, nationally, and internationally. *Benefit:* This will help identify research needs and relevant policy problems; determine what we can do now with current data/methods and categorize future needs to look holistically at protection and recovery from an economic perspective.
2. **Improve Benefit-Cost-Analysis (BCA) guidance and expand usage.** (a) Develop additional guidance on the use and application of BCA to ensure national consistency of economic analyses in support of PR actions; (b) include all relevant threats, national and international in BCA; (c) consider adopting the Millennium Ecosystem Assessment (MEA) framework (2005) within a BCA framework as NMFS moves towards ecosystem based management (EBM). *Benefits:* A more comprehensive BCA improves the likelihood of choosing an efficient outcome, avoiding unintended consequences, and identifying an alternative with a greater likelihood of success. Consistent and proper application of this more comprehensive BCA in PR-related analyses would enhance the defensibility of results.
3. **Conduct value of scientific information studies.** Quantify or describe the economic benefits of reducing uncertainty in various aspects of protected resources management (e.g., species population assessments, impacts of human activities on protected species,

predicted economic impacts of management actions). *Benefit:* This type of analysis can help to inform decisions on research, funding, and priorities.

4. **Improve and invest in ecosystem services valuation.** (a) Link PR valuation efforts with the needs of PR policy in support of legal mandates; (b) invest in expanding benefit-transfer methods for use when valuation studies are absent for the particular species; (c) conduct additional valuation studies, which are needed to improve decisions involving PR species (e.g., quantify subsistence cultural values, and ecosystem level valuations versus individual species); and (d) identify biological research needs to support economic benefit valuations to demonstrate the effects of regulations, conservation and other management actions. *Benefits*: Improved non-market value estimates allow for better decisions based on comparisons of the full scope of benefits and costs. They allow decision makers to assess options under an economic efficiency criterion and select the option that increases social welfare. In the absence of economic benefit estimates, the option that generates the greatest total net benefit to the nation may not be identified.
5. **Inventory and assess legal and institutional barriers to regulatory change** (a) Identify what is mandated and what could be modified; consider regional versus cross-regional policies, management, and governance; and (b) develop cost-recovery methodologies and participate in recovery plan development in support of lawsuit settlements or insurance design. *Benefit:* Identifying the institutional barriers that may be limiting current PR conservation efforts has the potential to provide immediate research returns, but longer term research is needed to address legal barriers.
6. **Assess current modeling/analytical methods** (a) Assess and inventory analytical methods (e.g., discuss assumptions, robustness checks, uncertainty of estimates, identification problems); and (b) identify data and methodological gaps. *Benefit*: Supports the need for "state-of-the-art" data, modeling techniques, analysis, and results to improve information necessary to assess and design recovery options.
7. **Conduct post-implementation regulatory policy analysis.** (a) Conduct a high level post implementation economic evaluation of previously adopted PR and non-PR (e.g., fisheries) regulations to identify regulatory instrument strengths and weaknesses, inconsistencies, and inefficiencies across regions; (b) identify current and potential compliance problems and metrics to measure behavioral changes; and (c) identify and prioritize PR regulatory policy for relevant evaluation analyses (e.g. back-casting counter-factual studies. *Benefit*: Evaluation of previous actions with back-casting and counterfactual analyses improves our understanding of policy instrument choices to support better forecasting, which is needed for regulatory policy analysis and recovery planning.
8. **Improve two-way communication of PR economic research and management** (a) Communicate our ideas to a broader audience, identifying opportunities for economists and other social scientists to learn about the biology of protected species and management needs; (b) find a common language to explain the importance of what we

do, what it means and why it matters to non-economists at various levels; and (c) demonstrate the advantage of involving economists early in the development of policies and regulations. *Benefits*: Earlier involvement by economists can result in stronger analyses and the development of more robust alternatives. Broader understanding of economics within the agency, particularly in PR, can help non-economists understand the role economics can play in the policy process, resulting in earlier involvement in the process and new multi-disciplinary approaches.

9. **Integrate economics into the PR Science Investment Planning Process (PRSIPP)**. A NMFS PR Economic Working Group has been established to support the needs of the PRSIPP and to continue the work identified in these proceedings. *Benefits*: A formalized Working Group will build on the momentum of the workshop and move the recommendations forward. Being part of the PRSIPP will ensure PR economics funding needs are considered in the planning process.

Workshop participants agreed that an ad hoc approach has been the typical route taken in determining what is, and is not being done in relation to economic analyses and research related to PR at NMFS. An alternative would be to follow a more formal process, similar to the PRSIPP approach presented by Lisa Ballance, PRSIPP Chair (Southwest Fisheries Science Center), with the development of a research portfolio. The group agreed a more formal prioritization process with senior management support would be helpful. These proceedings represent only what was discussed at the workshop. Future efforts that may contribute to moving these recommendations further along include a special session on PR Economics ("Key Challenges with Ecosystem-Based-Management") at the North American Association of Fisheries Economics biennial forum in May 2015, and a special issue of *Frontiers in Marine Science: Marine Affairs and Policy*, entitled "The Economics of Protected Marine Species: Concepts in Research and Management." A NMFS PR Economic Working Group has been established to support the needs of the PRSIPP and to continue the work identified in these proceedings.

1.0 INTRODUCTION

1.1 Background: A historical look

An ad hoc PR[1] economics working group, consisting of economists from each region (Northeast, Southeast, Northwest, Alaska, Southwest, Pacific Islands) and Science & Technology (NHQ), chaired by Kathryn Bisack and Dale Squires, was initiated at the 2010 NMFS Social Sciences meeting in Orlando, Florida. The purpose of the group was to share PR and PR-related economic work. In 2011, NMFS's Chief Scientist, Richard Merrick, elevated the need for PR economics; he recommended economics be assimilated into the PR strategic planning process and economist Kathryn Bisack, was appointed to the PRSIPP Steering Committee. At the 2012 PRSIPP Workshop (Simpkins and Srinivasan 2013), members of the PR economic ad hoc working group were invited to present their work and discuss their roles by region. Five case studies were presented to demonstrate the contribution economics can have on PR science, which provides data and research to support conservation and management of protected species. The presentations were well received and the PRSIPP committee accepted PR economics as an element of PR Science. However, at the 2013 PRSIPP workshop, securing funds for mandated PR abundance surveys continued to be the primary concern, resulting in unfunded PR economic data and research (Ballance et al. 2014). The PRSIPP steering committee members seemed to recognize the usefulness of PR economic data and research and requested the creation of a "PR Economic Fact Sheet[2]". However, lack of institutionalized communication channels continues to block integration of economics. In March 2014, NMFS's Chief Scientist, Richard Merrick, provided travel funds for the September 2014 PR economics workshop, which included representatives from NMFS headquarters (2), Regions (10), the Marine Mammal Commission (1) and Fisheries and Oceans Canada (1). We anticipate that workshop outcomes will assist in bridging the communications gap between economists and non-economists who collect PR and PR-related data and conduct research, as well as initiate the development of a PR economics roadmap that will demonstrate why PR economics must be an integral part of PR science.

1.2 Workshop Goals and Objectives

The primary goal of the workshop was to initiate the process of identifying national PR social science research needs and best practices. With more than 15 years of economist experience providing mandated economic benefit/cost and impact analyses for PR Divisions, there was enough knowledge and skill to begin collectively assessing the legal, scientific, and technical issues specifically pertaining to the Endangered Species Act (ESA) and Marine Mammal Protection Act (MMPA).

[1] Protected resources include marine mammals, sea turtles, fish, corals and sea birds, among others.
[2] https://www.st.nmfs.noaa.gov/economics/protected-species/

There was also an opportunity to inventory past and current PR economics data and research, identify practical and analytical problems, share analytical frameworks and state of the art methods and tools, and list potential roadblocks. By providing the forum for these discussions, the workshop's economists had the opportunity to develop a common understanding of PR economics data and research needs across regions and consider the longer term goal of developing a roadmap that will fully integrate economics into PR science.

1.3 Meeting Organization

To support the immediate and longer term goals of the workshop, the first day of discussions focused on PR economic policy and management needs. NMFS's regulatory responsibilities were reviewed. Economists presented an overview of the economic analyses conducted in support of PR actions in their regions, including externally contracted analyses. Prior to the workshop, PR Division Chiefs residing at NMFS Regional Offices and the Office of PR identified a list of current and future PR economic needs. On the second day, research conducted by NMFS economists focused on protected resources. The case of the Mexican Vaquita porpoise was presented for discussion of potential economic solutions to reverse the fate of this animal that is about to become extinct. On the third day, the group talked about improving internal communication of PR economics and developed a set of recommendations. The full workshop agenda can be found in Appendix A1. Appendices A.2 and A.3 list the goals and top research themes, and questions participants identified in anticipation of the workshop.

2.0 MANAGEMENT AND POLICY (DAY 1)

2.1 Opening

2.1.1 Chief Economist, NMFS

Doug Lipton, NMFS Chief Economist, opened the meeting. Participants were reminded to take into account PR management's analytical needs as economists consider PR research. By providing this forum for discussions, it is intended that economists will be able to develop a common understanding of PR economic data and research needs across regions. This will help NMFS in the long run, as we go forward with implementing recommendations. We want to cast a wide net, and then narrow down ideas to feasible PR economics data and research projects, and determine our priorities. These will be adjusted, over time, depending on opportunities, funding, and demands (e.g., Federal Court mandates).

2.1.2 Marine Mammal Commission

Marine Mammal Commission (MMC) Executive Director and economist Rebecca Lentexplained that the MMC is an independent government agency that oversees all the other federal agencies (Department of Commerce [NOAA], Department of Defense [US Navy] and

Department of the Interior Bureau of Ocean Energy Management [BOEM] and Fish and Wildlife Service [FWS]), to make sure they are following the MMPA and conducting the required analyses and research. The MMC is completely independent of NOAA and is a very small organization with only 12 staffers. The MMC has no regulatory role, but if agencies do not follow its recommendations, they are required under the MMPA to provide an explanation. Lent is the sole economist on staff and has been working with the Commission leadership and staff to integrate economic considerations into its oversight and review. The MMC also follows the work of the Fishery Management councils, regional fishery management organizations, and looks beyond federal waters to comment on rule-making in relation to US trade issues.

2.1.3 Protected Resource Scientific Investment Planning Process (PRSIPP)

PRSIPP Chair Lisa Ballance explained that the PRSIPP is a NMFS committee that has representatives from science centers and headquarters, including one economist (Appendix C1). The PRSIPP operates under MMPA and ESA mandates and has almost no budget available for research. With declining trends in federal budgets, abundance surveys are not being completed as mandated, so the PRSIPP steering committee members are reaching out to other federal partners and have developed a strategy to secure an investment in PR science with partnerships external to NMFS, such as BOEM and the US Navy. The PRSIPP annual process is to identify information needs from users of PR science, assess current and potential funding and infrastructure, and decide what can, and will, be done. One of its accomplishments is a list of PR science needs and priorities, along with common information needs with partners; however, the list does not include any economic-related data and research needs at this time. An example of a common information need is long term data on marine mammal distribution and abundance in an ecosystem context. There is a 6-year cycle (306-534 sea days per area) proposal to assess 6 areas for a comprehensive marine mammal survey.

> *Questions and Answers*: Economists asked if the PRSIPP experienced conflicts of interest, because it had to partner with other agencies to fund abundance surveys. Ballance stated that although PRSIPP has to partner with outside agencies to fund surveys, it is careful in maintaining its purpose and goals. Another question asked was whether survey data users (e.g., oil companies, shipping organizations, and fisheries) have a cost recovery program in place. Although the answer is no, the industry is stepping up and putting some money forward. In response to whether PRSIPP does forward-looking research to anticipate threats and identify lost causes, since multiple threats may block the recovery of a species, Balance said that some proactive and emerging threat issues are being identified by NMFS science centers. Chief Economist Lipton asked about incorporating linkages to ecosystem based fisheries management (EBFM), habitat, etc. in the PRSIPP process to which she indicated that the PRSIPP committee is trying to do so.

2.1.4 NMFS Regulatory Mandates for Economic Analysis

Lew Queirolo, Alaska Regional Economist presented the primary regulatory and administrative procedures governing preparation of economic analyses in support of PR actions. The statutory authority for PR's regulations derive from the MMPA, ESA, Magnuson Stevens Act (MSA), National Environmental Policy Act (NEPA), and Administrative Procedure Act (APA) while mandates for specific economic analyses fall under Executive Order (EO)12866 and 13563, NEPA, the Regulatory Flexibility Act (RFA), and ESA Section 4 (Appendix C2). Economic considerations are precluded by law in the listing decision of a species, but thereafter, they are fundamental. In general, when a Notice of Proposed Rulemaking is published in the Federal Register it is accompanied by economic analyses consistent with NEPA, EO 12866, and the RFA. Moreover, if a proposed rule concerns designation of critical habitat under the ESA, an economic analysis in support of the designation, in the form of a 4(b)(2) report, is also required.

EO 12866 compels preparation of a comprehensive Regulatory Impact Review (RIR), and has a mandatory requirement that a cost-benefit-analysis (BCA) framework be used to assess all attributable beneficial and adverse economic impacts of each action alternative. The impacts of each action alternative must be contrasted again the baseline, normally the "no action" alternative. Furthermore, the EO prescribes use of a national accounting stance, wherein the net benefit to the Nation shall be maximized, unless another course of action is required by law. To this end, market and non-market, consumptive, non-consumptive, direct, and passive uses yielding- economic impacts must be quantified to the extent practical; or addressed qualitatively when meaningful quantification is not feasible. These analytical requirements apply generally to any regulatory action, whether taken under ESA or not. In addition, and more specific to ESA analyses, economic impacts of critical habitat designation or other protections of a species beyond ESA listing depend upon pre-specified physical parameters. Moreover, the additional analysis required under ESA's section 4(b)(2) requires estimating benefits of inclusion and exclusion of any particular area within the critical habitat designation, and when feasible, benefits must be quantified.[3]

> *Questions:* Economists were asked why incidental harassment authorizations have no economic analysis requirements. The response was nobody knows why, other than the nature of the costs of harassment of ESA species being "non-market" values. Rebecca

[3] When listing a species, the ESA presupposes benefits of avoiding extinction exceed costs, thus the prohibition on taking account of economic effects in the listing decision. Post-listing, proposed regulatory actions under ESA require an evaluation of a set of alternative regulatory approaches that may achieve the specified environmental goal.

Those alternative approaches do not necessarily translate into identical economic benefit streams; thus, the mandate to select the alternative that maximizes net benefits to the Nation.

A Cost Effectiveness Analysis (CEA) assumes benefits are 'strictly homogeneous' and exceed costs. CEA results cannot, therefore, be used to assess 'net benefit' results across alternative actions.

Conservation actions may also be carried out by Federal agencies as part of their obligations under Section 7(a)(1) of the ESA, or as a means to minimize activities that adversely affect a species as part of an interagency consultation. States, Tribes, local agencies, and private entities may conduct conservation actions as a means to minimize or mitigate "incidental take" of species as part of a Conservation Plan under Section 10 of the ESA.

Lent (MMC) is trying, with limited success thus far, to get non-market value information introduced into such analyses. Economist Robert Hicks, of the College of William and Mary, was invited to speak at the MMC's annual 2014 meeting on "Economic Valuation for Marine Mammals." Recent BOEM analyses of possible offshore energy development in the Atlantic noted that non-market valuation studies were time-consuming, complex, and expensive, and therefore not included in the net social value calculations.

Dan Holland (NWFSC) asked whether the valuation studies really provide estimates of values of individual takes. Older studies seemed to, but more recent studies are focused on population level values, though you can potentially calculate marginal animal value in some cases. Denise Johnson (SERO) noted that the focus on existence value devalues impacts on individual animals that are not endangered. Dan Lew (AFSC) responded that more recent studies are measuring use and non-use values, in addition to existence value. Some separate those values explicitly, but most do not, though they can sometimes be teased out.

Discussion: PR-related (non-market) benefit valuation, its significance, and its role in PR and PR-related decisions are common concerns across regions. The significance of these benefits in the decision-making process needs to be more fully and clearly explained. While EO 12866 and EO 13563 identify what constitutes a sufficient analysis, and conveys the need to quantify both benefits and costs when feasible (and when not, at least a qualitative description); participants agreed that benefits have been marginalized relative to costs, but should require equal consideration. There was much discussion and eventual agreement that a cost-effectiveness-analysis (CEA) is inappropriate when it presumes equivalent benefits across alternatives (such as the benefit of one less individual taken regardless of alternative), because the same environmental goal or biological outcome does not necessarily translate to equivalent economic benefits when there are heterogeneous benefits/preferences. The goal is to determine whether net benefit of the proposed action is positive. Lew Queirolo (Alaska Regional Office [AKRO]) added that OMB guidance directs us to conduct CBA; not CEA, because of the latter's incorrect underlying assumption that benefits are homogeneous. Holland expressed the concern that a comprehensive assessment of all benefits, especially to quantify them, would require a considerable budget; which would be an unnecessary expense given that OMB guidance does not require benefits to be quantified.

2.2 NMFS's Regulatory History for Protected Resources (2000 to 2014)

The economic regulatory history discussed in this section spans 15 years. Prior to the meeting, economists provided a detailed list of the PR economic analyses conducted within their region. Across NMFS, summary observations about the economic analyses conducted to support PR regulatory actions include:[4]

- Economic support was provided for 72 PR regulatory actions according to regional economists, of which 31% of these (22 actions) were outsourced, in whole or in part, by

[4] Data supporting Table 1 and Table 2 can be found in Appendices B1-B5.

PR directly to external economic consultants including ENTRIX, Industrial Economics and Northern Economics. NMFS economists supported 69% of the actions (50 in total) identified. (Labor costs are not assessed here.)

- The majority of the economic support has been dedicated to large whales (25%) and turtles (24%) followed by fish (19%), small cetaceans (15%), and pinnipeds (11%). Roughly 6% of the actions addressed protection for abalone, corals, and sea birds. Of the 9 taxa identified, each region provided regulatory support for 4 to5 different taxa.
- Approximately 31% of the economic analyses supported critical habitat actions with the majority of these actions outsourced to consultants.
- Approximately 50% of the PR regulatory actions mitigated commercial fishery interactions.
- Other mitigated threats to marine mammals include subsistence harvesting and lethal and non-lethal interactions with vessels, such as whale watching, commercial ship strikes, and small boat tours.
- Threats to fish (primarily salmon) include agricultural interactions, hydropower, development in general (habitat, water quality runoff, fish passage) while the major mitigated threat to corals was substrate disturbances.

2.3 Summary of Economic Presentations by U.S. Region and Canada

Economists gave presentations highlighting analyses performed in their region (Appendix B1). This gave the working group an opportunity to view the range of members' involvement in specific PR projects we have been asked to address. Each region has a unique set of taxa (turtles, whales, dolphins, pinnipeds, fish, corals), threats (commercial, recreational, climate change, offshore energy, etc.), and policy instruments that have been evaluated in terms of the protection provided and economic impacts. Below are highlights and unique features of regional presentations.

2.3.1 Alaska

Alaska's Regional Economist Lew Queirolo stated the majority of analyses in Alaska were in support of establishing critical habitat (Appendix C2). Highlights include:

- Steller sea lions received an allocation of the pollock quota, pollock being the primary constituent element (PCE) within the Critical Habitat Designation (CHD) for this species, based on assertion of prey competition with commercial fisheries.
- CHD was defined by the concentration of copepods for the North Pacific Right Whale, similar to the North Atlantic Right Whale (NARW). CH areas will likely shift with climate change. There were no fishery interactions; however, offshore energy (oil impacts on copepods and euphausiids PCE) was identified as a primary threat to the NPRW CH.

- The concept of “passive use” or “non-use” values was introduced as a benefit for establishing CH for the Cook Inlet Beluga Whale.
- Bearded and ribbon seals at or near carrying capacity listed and designated CH based on threats of future disturbance from climate change caused by lost ice cover (PCE), fishing, and potential tourism.
- Native subsistence harvesting of fur seals requires a regulatory analysis exercise.
- Benefits of CH are to focus on benefits of habitat and not on the animals, but economists demonstrated the connection, using a study of the Giant Panda bear CH as an example.

2.3.2 Pacific Islands

Dr. Minling Pan, economist from the Pacific Island Fisheries Science Center (PIFSC), stated that their economic research focused primarily on protected species interactions with fisheries and tourists (Appendix C3). Pan provided a brief summary of the studies conducted in support of the decision-making process behind CHD conservation actions/regulations related to protected species, and listed studies that are still needed.

- Studies and findings include the tradeoffs between sea turtle (Loggerhead, Leatherback, Olive Ridley, Hawksbill, and Green) conservation goals vs. economic returns to the Hawaii longline fishery, which harvested highly migratory species such as bigeye tuna and swordfish. A spatial temporal model was built to examine policy options in order to balance these goals and returns.
- An evaluation of spillover effects resulting from domestic regulatory changes imposed on the Hawaii longline swordfish fishery in order to protect endangered sea turtles concluded that a lower Hawaii swordfish production limit (due to restricted sea turtle caps) may actually increase sea turtle bycatch stock-wide.
- The proposed CHD for Hawaiian monk seals has created fear among fishermen. Further research is needed to understand economic impacts of losing access to fishing grounds and potential loss in food chain; we also need to understand the scope and scale of interactions (direct and indirect) with fisheries and the impacts on those fisheries and the continued recovery of the Main Hawaiian Islands (MHI) population.
- The Hawaiian False Killer Whales (FKW) interaction with recreational and commercial fisheries, mostly longline tuna. The FKW complex is classified into three stocks; each of which holds different status. As MHI- insular FKW declined during the 1990s and 2000s, gear modifications and bycatch take cap that triggered a closure of Hawaii longline tuna fishery are the primary tools with which to reduce interactions with insular FKW.
- Tour activities associated with spinner dolphins present a general threat to the marine mammals in this region. Non-strategic animals are disturbed because the 50-yard-distance-from-animimal regulations are being violated by swim tours with spinner dolphins. Questions of interest relate to industry scale, economic impacts (such as tours, medical healing related activities) and non-market values of swimming with dolphins

(including non-tour participants). How can human behavior change to reduce the disturbance?

- Market and non-market values are needed for endangered (but recovering) green sea turtles, as tour activities, such as viewing and swimming with green sea turtles, is increasing in Hawaii.
- Global scale processes are a major threat to coral listings (15 species of the 22 were found in the PI). Need cost-benefit ratio of small scale management along with market and non-market values of resources.

2.3.3 Southwest

Stephen Stohs, Southwest Fisheries Science Center (Appendix C4):

- The focus is on highly migratory species: leatherback and loggerhead sea turtles are interacting with a drift gillnet swordfish fishery. Management tools include time-area measures, gear restrictions and CHD; proposed future management includes hard caps for a list of protected species.
- Non-Government Organizations (NGOs) petitioned for passage of CHD for leatherbacks off the West Coast, and questioned whether the small boats could block passage. The CHD review team decided to exclude the drift gillnet fishery as a primary constituent element, based on the observation that a small fleet could not obstruct migratory corridors. CHD was based on areas with high densities of brown sea nettle jellyfish; distribution of jellyfish may shift with climate change.
- There are interactions with large charismatic megafauna, primarily sea turtles and marine mammals. Despite periods of years between observed interactions, rare event bycatch rises to a regulatory priority due to population status concerns (e.g., anthropogenic mortality approaching PBR for sperm whales) and protection laws.
- Endangered leatherback and loggerhead sea turtle bycatch in commercial swordfish fisheries has been a high priority. Since 2001, the primary swordfish fishing grounds for the drift gillnet fishery close each year during the peak season. The shallow-set longline (SSLL) swordfish fishery shut down in 2004 and though RIR work was initiated for the return of SSLL permits with gear improvements (circle hooks, mackerel bait that would not attract turtles), the permits were eliminated in the regulatory approval process.

2.3.4 Northwest

Dan Holland, Northwest Fisheries Science Center, shared the following (Appendix C5)

- Species of interest are west coast salmon and steelhead, southern resident killer whales, Puget Sound rockfish (3 species), green sturgeon, eulachon and black abalone.
- Primary management tools are habitat conservation and restoration, fish passage, bycatch, prey availability, and rules to limit disturbance.
- There is little focus on benefit side of CHD. The focus is on the cost, with the benefits of exclusion identical to costs of exclusion. CHD has been created for salmon/steelhead,

killer whales, eulachon and black abalone, though the interest lies in cost-effectiveness analysis. Types of activities affected by CHD for economic analysis of salmon are dams, federal lands management, transportation, utility lines.

- RFA and RIR for whale watching are similar to the dolphin situation in Hawaii. Insufficient information on benefits of whale watching industry may impact analysis.
- Conservation Banking and Mitigation Banking - Habitat (riparian) that affect salmon and steelhead. No economic research.
- Cost-Effective Recovery Actions for Endangered Spring Chinook in the Wenatchee River Basin; biggest bang for buck analysis. Combines biological models/data with economic data to assess cost-effectiveness of alternative recovery actions (Anderson et al. 2013a). Non-market valuation to estimate changes in economic value from a set of closures to conserve Puget Sound rockfish.
- Anderson et al. (2013b) use non-market values to estimate economic value of recreational fishing to anglers in WA and OR.
- Potential needs include:
  - Welfare estimates for whale watching;
  - Cost estimates and economic impacts from evaluation of prior studies;
  - More cost-effectiveness to prioritize actions to promote salmon recovery; and
  - Valuation work to prioritize trade-offs in salmon recovery.

2.3.5 Southwest Fisheries Science Center, Santa Cruz

Cameron Speir, SWFSC (Appendix C6):

- Primary focus is on freshwater habitat issues for salmon: Central Valley CA Chinook and steelhead, and Southern OR/ Northern CA coast coho salmon
  - Dam removals on Klamath River: an agreement among stakeholders was reached to remove four dams at taxpayer and ratepayer expense. Federal government restores habitat and gives some compensation to commercial users
  - The Department of Interior and NMFS conducted a joint analysis, composed of a 3-year study where recommendations were based on using a non-market valuation and cost-benefit analysis framework.
    - Project on hold due to need for Congressional authorization and funding source from State of California.
- Recreational Use Survey in Sacramento Valley:
  - Several dozen dams ranging in size;
  - Analysis of change in recreational use in reservoirs versus change in river-based fishing;
  - What is value of recreational fishery if the dams are removed, or if they allowed fish to pass around dams?

2.3.6 Southeast

Denise Johnson, Southeast Regional Office (SERO)

- Limited analytical capacity for PR due to SERO economists leaving and not being replaced until fiscal years 2014 and 2015 and the region's organizational structure. In the SERO, all socioeconomic expertise lies within the Sustainable Fisheries Division (SFD) and SFD staff do not have a standing mandate nor program in place to address PR issues or meet the needs of PR regulatory issuance. Socioeconomic assistance is provided to the PR Division on an infrequent and ad hoc basis, if time permits around SFD responsibilities. In the SEFSC, the Social Science Research Group is also primarily focused on the needs of SFD and does not develop tools, conduct research or collect information to address PRD issues other than the effects of PR regulations on managed fisheries.
- Primary, but often limited, analyses related to gear interactions with right whales (gillnets), bottlenose dolphins (gear modifications and closures), turtles (TEDs, gear restrictions), Gulf Sturgeon (CH), smalltooth sawfish (CH) and corals (CH).
- Coral preservation issues include offshore dredging of sands to replenish beaches, offshore cables; black markets for coral are not considered. Analysis could have more fully assessed benefits. Questions on the value of corals are raised because corals are considered both species and habitat. No primary data to assess coral benefits were collected; everything used was secondary.

2.3.7 Northeast

Kathryn Bisack, Northeast Fisheries Science Center (Appendix C7):

- Historical Context: Consistent sampling of fisheries to estimate protected species bycatch and abundance surveys began in the Northeast when the Protected Species Branch was founded in 1991.
- Threats analyzed in the Northeast are primarily related to commercial fisheries except for large whale interactions with ship strikes. Regulatory work has used cost-effectiveness analysis framework.
- Policy instruments include gear modifications (VA poundnet, scallop dredge, sink gillnet, lobster and pot fisheries). Some modifications have been implemented as a result of PR take-rate reductions observed in commercial fishery experiments, while other gear modifications (e.g. Mid-Atlantic sink gillnet fishery) were based on counter-factual-analysis using NEFOP observer data. Alternative policy instruments used in the Northeast include year-round, seasonal and dynamic closures. A dynamic closure is triggered if the density of animals observed on an aerial survey exceeds a benchmark value.
- Single-species management is prevalent with gear types, such as gillnet, which take multiple PR species such as harbor porpoise, bottlenose dolphins, white-sided and common dolphins, loggerhead sea turtles, large whales and sturgeon. Further, equity and cost issues may exist with single species management which restricts the Virginia (VA)

poundnet fishery to 1 loggerhead turtle take, for example, while scallop dredgers fishing outside the bay are allowed 161 loggerhead turtle takes according to the NMFS 2014 Incidental Take Statement.

- To improve compliance, a gear inspection program was implemented in the VA poundnet fishery. The sink gillnet fishery was given an incentive to comply in the form of a "threat;" consequential closures, if non-compliance rates were exceeded. (Compliance rates are only measured in the sink gillnet fishery in relation to harbor porpoise gear regulations.)
- We rely on biological assessments to determine whether implemented policy instruments are working.

Potential analyses:

- Consider turtle CEA of alternative conservation strategies and conservation banking, for loggerhead and leatherbacks, similar to west coast (Gjertsen et. al. 2014).
- Economic feasibility analysis of whether the sink gillnet fishery can reach a zero rate mortality goal (ZMRG) for harbor porpoise. In addition, New England sectors showed an interest in learning about a potential allocation of the harbor porpoise potential biological removal (PBR) rate among sector and non-sector groups similar to groundfish catch shares. For example, if the sector did not exceed its take of porpoise, it would be exempt and not suffer from closure threats. Consequential closures were included in the 2010 harbor porpoise Take Reduction Plan if non-compliance rates exceeded a benchmark rate.

2.3.8 Fisheries and Oceans Canada

Gisele Magnusson, Fisheries and Oceans Canada (Appendix C8):

- Canada's federal regulatory framework for aquatic/marine protected species is quite young. Key regulations include the Species at Risk Act (SARA, 2002) and Marine Mammal Regulations (1993). These are very different from the MMPA proposed 2015 amendments that will include minimum approach distance). The Fisheries Act (amended 2012) provides more general protection to individuals and habitat.

In support of protected resources (i.e. SARA), regulatory CBA is done:

- To list or not list a species under SARA and provide CH protection which must be enacted 1-3 years after listing (which is required but cannot be considered before protection occurs)
- Most analyses are very straightforward, and qualitative (quantitative cost estimates required if annual cost >$1/year).

  The SARA also requires economic analysis of action plans to assess: (1) direct costs of implementation and benefits if fully implemented; and (2) a 5-year review of socio-economic impacts.
- Most quantitative CBAs have been for commercial species (e.g. Porbeagle shark, rockfish, salmon etc.) and most have resulted in a decision not to list the species.

- Very limited experience with CBAs for CH; it just started in 2013.

Key challenges include:

- Identifying benefits (sciences cannot link potential management changes for data poor species; lack of support for willingness-to-pay (WTP) studies and results, and dealing with cultural values for Aboriginal/First Nations).
- Data access (funding, industry pays, non-traditional industries e.g. forestry)

Opportunities: There are research and recovery requirements that need to be addressed for many transboundary species (e.g. killer whales, salmon) that could prove beneficial.

2.4 A Conversation with PR Division Chiefs about Future PR Economic Needs

Workshop objectives included looking forward to near-future economic data collection, and research and analyses needs based on PR management needs. To support these objectives a conference call was held with PR Divisions Chiefs before the workshop. Prior to the call, PR Division Chiefs were provided a short description on how economics, as a discipline, can be an asset in developing mitigating conservation strategies for protection of ESA and MMPA species.

Doug Lipton, NMFS Chief Economist, opened the call by asking, besides what threats—other than those that are fishery-related—should we consider? What followed was a discussion about the threats PR managers now face and their regional priorities for the next 5 years; the tradeoffs are and the types of analysis that can be undertaken. The remaining text within this section captures the discussions on the August 11th call (Appendix C9).

2.4.1 Alaska

Jon Kurland, Director PR division of the Alaska Regional Office, stated this list is a non-exhaustive overview of current needs and concerns:

- There is a need to improve market value estimates in relationship to wildlife viewing and non-market (subsistence/cultural, habitat service flows, and tourism) values which may be unique to Alaska.
- Offshore energy development is huge and growing.
- Cruise and whale watching ships interactions can result in lethal interactions along with harassment in feeding and resting areas.
- Climate change has effects on resources; what are the economic impacts? An ice seal exercise was presented as an example; consider ice cover changes in coming years and the relative distributional changes, the foundation required for an economic analysis.

2.4.2 West Coast

Lynne Barre, Marine Species Branch Chief, West Coast Regional Office

- The Orca's main threat is prey reduction or lessened availability due to commercial and recreational fishery competition for salmon. In the recreational fishery there may be a conflict between orcas and abalone.
- Large whale fishing gear entanglements are a concern.
- Non-fishery threats include ship strikes, noise, and offshore energy.
- Similar to Alaska, benefits (market and non-market, use and non-use) are needed.
- Need to learn more about recovery techniques, conservation banking for sea turtles, and how the tradeoffs work since nesting beaches are outside US for some species.
- Invertebrates/abalone may eventually open to the recreational fishery.
- Post-analysis of PR policy instruments was requested to learn what does and does not work in order to design more successful future instruments.

This region ranked the primary and secondary threats for each taxon:

- Large Whales (commercial fisheries, ship strikes; noise and offshore energy);
- Small cetaceans (commercial fisheries, ship strikes, whale watching and contaminants; noise and offshore energy);
- Pinnipeds (intentional killings; commercial fishing interactions);
- Turtles (commercial and recreational fisheries; intentional killing, subsistence harvesting, climate change, habitat destruction); and,
- Fish primarily salmon (habitat destruction; commercial and recreational fisheries, subsistence harvesting, climate change).

2.4.3 Pacific Islands

Jean Higgins, Endangered Species Biologist, Pacific Islands Regional Office

- Local needs in Hawaii are often about gaining trust with local fishing communities to gain access to information necessary to better address threats to various PR species. Perception issues can hinder our ability to get quality information and participation in regulatory efforts. Post-regulation analyses may assist in alleviating public fear in relation to a recent CHD proposal. For example, are perceived and actual impacts similar across communities?
- The pelagic population of False Killer Whales is under a take reduction plan (TRP) for commercial fishery interactions; the Main Hawaiian Islands Insular (MHII) population interacts with a fishery that lacks recreational fishery information. An understanding of non-market values associated with fishery activities in the islands may improve our ability to move beyond these barriers.
- Multiple groups (tours, tourists, local residents and spiritually driven individuals) contribute to the disturbance of spinner dolphins near shore areas; swimming with the dolphins is in high demand, as are killer whale watch tours. Understanding non-market

values associated with local community use of an area that has a large influx of tourists because marine resources are present in their local bay is important.

- It is essential to realize the costs and benefits of implementing smaller local scale management actions in relation to recovery of many listed coral species and the health of reef systems as a whole. This should include market and non-market costs.
- International threats are largest for leatherback, loggerhead and olive ridley sea turtles. Disease outranks recreational fishing interactions with Hawaiian green turtles, and there are poaching issues in the territories. Hawaiian Hawksbill turtles face habitat loss along with recreational fishery interactions. A major concern similar to other PR species is that recreational fisheries are not well reported.

2.4.4 Southeast

David Bernhart, Assistant Regional Administrator, Southeast Regional Office

- Corals are a priority. The discussion focused on whether corals should be valued as an individual species or as part of an entire reef, as an ecosystem service.
- Other PR species have the traditional commercial fishing interactions; however, recreational fishing is growing rapidly and there are concerns with vessel strikes and harassment.
- Regulatory priorities will force the Southeast to look at valuation associated with threats such as oil/gas/wind development in the Gulf, as well as coastal development.
- Commercial dolphin tours, different than whale watching in the northeast, also have harassment issues.
- Valuation work is needed for these iconic species.
- There is a concern that our models lack the ability to assess threats related to climate change, which is specifically identified as a threat to corals and sea level rise is a looming issue.

2.4.5 Northeast

David Gouveia, Marine Mammal and Sea Turtle Conservation Coordinator, Greater Atlantic Regional Fisheries Office

- The formation and styles of sector management along with changing multispecies fish regulations have affected the gillnet fishing industry and therefore harbor porpoise bycatch in the Northeast. Perhaps a comparison of vessel behavior pre- and post-sectors may assist. How will fishing effort shift with new closures for the large whale plan – the MA Restricted Area Closure.
- Non-compliance with pinger regulations is a concern; sectors want individualized pinger compliance accountability measures. Their willingness-to-pay (WTP) for additional gear modifications versus a closure to protect PR species needs to be addressed, and the cost tipping point established.

- Whale watching guidelines are weak; understanding how the public's WTP would vary by different viewing distances may be helpful by audience (commercial whale watch, recreational boaters and fishermen). Should outreach vary by group to improve compliance and public perceptions?
- Increasing pinniped populations may be responsible for losses in fishermen's catch and an increase in shark sightings that have resulted in closed beach days in summer months. Public perceptions and outreach remains an issue.
- An understanding of PR interactions with the recreational fishery and its contribution to the economy is needed.
- Harassment issues associated with drones being used to improve whale viewing and causing seals to evacuate their haul-out sites is a new and rising threat.
- Aquaculture is an emerging issue.
- Improved understanding of public perceptions is necessary to advance our communication and management ability.

2.4.6 Office of Protected Resources

Nicole Le Beouf (Chief, Marine Mammal and Sea Turtle Conservation Division), Angela Somma (Director, Endangered Species Division), and Cathryn Tortoric (Acting Deputy Director)

- Harassment of marine mammals includes swim-with, feeding and recreational interactions;
- Recreational fishing takes of PR species, such as sea turtles and dolphins;
- Economic and social issues are driving the rapid decline of the Vaquita in Mexico. There is also a need for social science information regarding the potential buying out of gillnet fisheries in the upper Gulf of California, among a myriad of other issues related to the Vaquita.
- Economic analysis is needed for upcoming critical habitat designations and listings associated with imports.

2.5 End of Day 1: Wrap-Up Discussion

At the end of the first day, participants had a general discussion on valuation, benefit needs, and regulatory analysis. The main points are summarized below.

1. Estimation of Benefits

- Missing information includes: non-market values associated with harassment to PR species; species not listed as endangered, cultural values, and individual species.
- Need to address Ecosystem Based Management needs: Corals have value as an individual species and as habitat.
- Heterogeneity in benefits needs to be considered, since preferences can vary by region.

2. Regulatory Analysis

- Economic analysis is not needed at ESA listing, because it presupposes benefits exceed costs to avoid extinction; but thereafter, economic considerations are fundamental.
- Market and non-market values should be quantified if possible and qualitatively explained (at a minimum) according to OMB guidance.
- Need guidance on CBA for PR to ensure consistency across regions
- Data will dictate how far we can actually go in terms of quantitative economic assessments of alternatives.
- Different goals can have different benefits and the alternative ways to achieve a single goal can have different adverse and beneficial impacts. The principal approach is to choose the alternative that both satisfies the goal and achieves the highest net benefits to the Nation. Using a CBA framework requires benefit valuation of PR species.
- More comprehensive analyses are needed rather than a spot analysis. One approach could categorize each species by threats (locally, nationally, and internationally) and compare costs and benefits by threat. This information could be useful for managers to prioritize which threats to address, and in which order.

3. U.S. Caribbean Council is moving from species-specific FMPs to island-specific FMPs. The new geographical focusshould allow for greater discussion of economic and social benefits at the island level.
4. Regional managers too infrequently seek economic advice about new regulatory alternatives.
5. We operate in a second or third best world; does it make sense to point out problems when not using first-best instruments? Participants agreed it is preferred to fully explore the economic impacts of all regulatory alternatives, even if an action or alternative is controversial. If we have a timeline for future PR regulatory actions, we may be able to collect data and conduct PR economic research that improves the regulatory decision-making process.
6. We need to look holistically at protection and recovery from an economic perspective and to identify research needs.
7. Post Regulation: There is a lack of follow-up on the effectiveness of implemented regulatory alternatives in satisfying the desired goals, especially the impacts on human behavior. Although biological indicators, such as annual PR bycatch estimates, are used to assess effectiveness of implemented regulatory alternatives, there are no similar periodic assessments of regulated human behaviors with impacts on PR species. PR managers asked for these analyses and want to know how effective their regulations will be at meeting goals. The interesting follow-up question is whether particular regulations had the intended consequences on human and biological behavior. The pre- and post-implementation evaluations will help us assess the current quality of our pre-implementation cost and benefit analyses and could

improve our future ability to estimate the economic costs and benefits of proposed rules.

The topics discussed will be assimilated into the workshop recommendations found at the end of the document. There was more material presented than time allowed for discussion.

3.0 RESEARCH: PR ECONOMIC RESEARCH BY NMFS ECONOMISTS

During the second day of the workshop, economists presented their research. This gave the group an understanding of the various research questions economists pursued independently while conducting mandatory economic analyses in support of PR regulatory actions. The day ended with a special presentation arranged by Rebecca Lent on the Vaquita, the most critically endangered cetacean in the world (Section 3.11). We had an opportunity to discuss this case collectively and brainstorm some potential (human behavioral) paths forward to assist in the recovery of this animal.

The format for this session was open-ended in the sense that some economists presented one research project, while others presented the highlights of several projects. The chosen presentation format may link to the amount of time an individual has been working with protected species. The paragraphs that follow for each presentation are based on notes taken during the meeting with the actual Microsoft PowerPoint presentations included in the Appendices.

3.1 Spill-over Effect of Sea Turtle Regulations in Hawaii Longling Fisheries

Dr. Minling Pan, Economist with the Pacific Island Fisheries Science Center (Appendix D1).

- Following the 2001-2004 closure of the domestic swordfish fishery, gear regulations and sea turtle interaction caps (17 loggerheads and 16 leatherbacks) were established upon its reopening. In general, tight caps can lead to an unstable fishery and sudden closures create bad market conditions for swordfish. At first, trade-offs were examined by modeling predicted net revenues and loggerhead interactions for different closure options. Proposed seasonal area closures were not adopted, probably because the area to be closed would vary and be difficult to monitor year to year due to the inter-annual variability of turtle migrations. Instead, information on hotspot areas (based on temperature) was published and a voluntary avoidance was requested. However, it did not work well since the turtle shares the hotspot with fish. Science Center economists were then asked to look at spillover effects of the US swordfish closure, including whether the turtle conservation goal was achieved, and if foreign fisheries displaced domestic catch, resulting in an import increase and more turtle interactions overall.
- Prior to closure, Hawaii production supplied a large percentage of swordfish domestically consumed in the US. In this study, we provide a quantified estimate of the possible spillover effects resulting from the aforementioned regulations based on two

perspectives. First, this study estimates the spillover effect resulting from market replacement as U.S. swordfish consumption shifts from domestic production to foreign imports as a result of the domestic fishery closure. Subsequently, we estimated the spillover effects of the production displacement by the competitors in the specific ocean area where the Hawaii shallow-set longline swordfish fishery operates. Results indicate foreign production does respond to changes in domestic production, so reducing Hawaii swordfish production might not actually result in lower level of sea turtle bycatch overall in the Pacific Ocean. 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. In other words, higher Hawaii swordfish production reduced sea turtle bycatch. Additionally, a much larger drop in turtle interactions could occur if the Hawaiian gear method was adopted by other countries. The new BiOP (incorporated results from this study) led to turtle cap increase (leatherback from 16 to 26 and loggerhead from 17 to 34). See Chan and Pan (2012) for details.

3.2 Risk Pools for Managing Bycatch

Dan Holland, NWFSC Economist (Appendix D2)

Individual bycatch quotas may be a much more effective and efficient way to control bycatch in fisheries than imposing technological prescriptions, area closures or aggregate catch caps. However, when bycatch events are rare and highly uncertain individual quotas may be problematic. Two potential problems with an Individual Transferable Quota (ITQ) for rare bycatch are that the market may not work because people are risk averse and prudent which may cause them to hoard quota, and secondly, even if the market does work efficiently, it may subject fishermen to substantial financial risk. A natural solution is to spread the risk across a pool of fishermen. Risk pools, in which self-selecting groups of fishermen pool their bycatch quota and cooperate to manage bycatch can substantially reduce financial risk, but if not well designed can undermine incentives to avoid bycatch. For example, people in a low risk area will not want to pool with those in a high risk area; therefore, smaller regional risk pools might make sense. Risk pools are essentially insurance products and need to address moral hazard and adverse selection issues that are common to insurance products. Three risk pools operated in 2011 for the West Coast Groundfish ITQ. Monetizing bycatch quota was avoided by not charging a price for withdrawals. There was a set of defined best practices for minimizing bycatch risk (e.g., require short test tows, delineate areas). Quota pounds for bycatch species were all transferred to a holding vessel and access to that quota for large bycatch events was contingent on whether the vessel was compliant with risk pool rules. Carryover rules for quota could reduce individual and pooled risk. Multi-year TACs would also reduce risk but are not allowed under current US law. If it makes sense, it enables a risk pool to control free-riders by threats of exclusion and contingent access to quota rules. See Holland (2010) and Holland and Jannot (2012) for details.

3.3 Unilateral Conservation of Transboundary Resources: West Coast Swordfish & Pacific Sea Turtles

Dale Squire, SWFSC Economist (Appendix D3).

This study shows that areas off the US California coast closed to the driftnet fishery led to displacement of US domestic catch by foreign catch and also increased sea turtle bycatch. There was a loss in net benefits to the U.S.; a loss to consumer welfare ($15M) as well as lower producer surplus ($10M). As much as a $75M loss in consumer surplus was associated with WTP to avoid increased turtle catch that resulted from displacement.

The trick is modeling the counterfactual, so we used an inverse demand model with substitution. We observed the fishery under the ESA action (a closure) and needed a counterfactual model which represents the fishery if the ESA action (i.e., no closures) was not in place. Equilibrium functions in the inverse demand model allow adjustments to declines in local production of swordfish (CA driftnet) and shocks through (1) increased foreign and Hawaiian imports; (2) substitution to domestic west coast longline and harpoon-caught swordfish; and (3) substitution to west coast albacore tuna. Using a vector auto-regression we predict changes in imports resulting from increases in prices as a result of lower domestic production. Harpoon caught swordfish was not a substitute for driftnet as it cannot fill consumption gap, and it was also unprofitable, with longline profits negative for 2008-2010. There is a longline counterfactual being done as well and is in progress.

Counterfactual estimates for sea turtle bycatch showed an annual leatherback bycatch rate of 1.51 turtles where closure reduced drift gillnet rate by 3.78 turtles per year as a result of reduced *effort (number of sets).* Not all sea turtle bycatch is created equal. A lot of imports come out of the Eastern Pacific and the population of leatherbacks in that region is in very bad shape, while the Western Pacific is stronger. See Gjertsen et al. (2014) for details.

3.4 Counterfactual Estimates of ESA Regulations on U.S. West Coast Swordfish Fisheries on Pacific Sea Turtle Bycatch

Stephen Stohs, SWFSC Economist (Appendix D4)

The research objective is to use a counterfactual approach to estimate net sea turtle bycatch impacts of unilateral domestic regulation of west coast US swordfish fisheries. There was a large driftnet swordfish fishery closure in the EEZ off much of the California coast since 2001, and a longline closure occurred off the US West coast after 2004. Bycatch rates for swordfish fisheries from foreign fleets are all much higher than pre-closure US rates, particularly in the Eastern Pacific, which had the biggest increase share of swordfish imports. Substitution for decreased west coast production with swordfish imports from foreign fisheries with higher bycatch rates is estimated to result in a net increase in leatherback sea turtle bycatch.

3.5 Regulatory Impacts on Exit from the California Drift Gillnet Swordfish Fishery: A Treatment-Control Duration Model Based Approach

James Hilger, SWFSC Economist (Appendix D5)

Regulatory measures imposed on firms to protect natural resources may lead to firm attrition. This research utilizes a difference-in-differences hazard rate methodology to provide an empirical estimate of the impact of regulatory changes on firm attrition and the number of industry participants. This methodology is applied to fishery regulation implemented on vessels engaged in the CA DGN fishery. The analyses provide a counterfactual fleet size estimate for the counterfactual state of non-regulatory implementation. The duration of initial participation tenure in the fishery, from entrance to exit, is modeled using a duration model approach. The impact of the regulation on tenure duration is estimated by means of a treatment-control approach. Qualitative results are robust across multiple distributional specifications of the duration model and covariate specifications. In a second stage, counterfactual fleet-size estimates are recovered via simulation. Empirical results suggest that the regulation had a significant impact on exit rates and led to a reduction in DGN fleet participant vessels during the period from 2001 to 2010. These findings are consistent with the hypothesis that increased regulatory policies impact fleet participation rates and led to larger exit rates and smaller fleet size.

3.6 Welfare Analysis of the Transition to Catch Share Management

Dr. Min-Yang Lee, NEFSC Economist (Appendix D6).

The analysis examined how much better or worse off the country would have been if the New England groundfish fishery had stayed fishing on the Days-at-Sea (DAS) system instead of moving to the catch share system. We simulated counterfactual catch and value under the DAS system and used an inverse demand model to compute lost consumer surplus. The results indicate we would have been $33 million worse off with DAS ($25 million in CS and $7.5 million in producer surplus). This approach was applied ***ex-post*** but an *ex-ante* analysis would not have been possible. See Lee and Thunberg (2013) for detail.

3.7 Economic Research in Support of Protected Species

Cameron Speir, Economist, SWFSC Santa Cruz (Appendix D7).

The SWFSC Fisheries Ecology Division (Santa Cruz) economics group currently has several distinct projects involving habitat issues for protected salmon and steelhead species. Some examples include: (1) A theoretical model of groundwater management and in-stream flow that uses a farm-profit optimization approach, subject to instream flow requirements, to examine different spatial and temporal policy options. The non-intuitive result is that under certain drought conditions, water should be allocated to withdrawals closer to the stream because the impact on stream flow is shorter in duration and more controllable. (2) An analysis of a Klamath

Irrigation Project water buyback program showed the price paid to farmers for more in stream flow is much higher than estimated use value of irrigation water. (3) The effect of unconventional oil production (hydraulic fracturing) on water quality is an important and emerging issue in coastal rivers in southern California that contain ESA-listed steelhead trout. (4) The effect of water exports from the San Francisco Bay Delta on the regional agricultural economy. Water management in the Delta is a major focus of NMFS action to protect endangered fish species. We use two methods to estimate agricultural employment impacts from historical water supply reductions: a synthetic control set-up and a structural model of agricultural production. Preliminary results indicate that impacts are smaller than some previous estimates but locally important. See Speir and Stradly (*in review*) and Speir *et. al.* (2015).

3.8 Economic value of precision sampling for marine mammal abundance and bycatch estimates; Compliance and Policy Instruments

Kathryn Bisack, NEFSC Economist (Appendix D8) presented an overview of six economic research studies on protected species:

1. The CEA of gear research relative to a closure, Virginia Chesapeake Bay poundnets and sea turtles, demonstrated the cumulative cost of a gear modification, including gear research costs, was lower than a closure. Gear modifications in the Virginia poundnet fishery were cost-effective relative to the closure (Magnusson et al. 2012).
2. A behavioral model to evaluate closed areas uses a positive math programming (optimization) model. Desirable features of the model are that it focuses on 30 minute squares, estimates changes in harvest by species and area, and can incorporate several policy instruments (days-at-sea, trip limit changes, area closures, gear modifications) simultaneously. Additional research is necessary to incorporate uncertainty and other behavioral responses such as compliance behavior.
3. An investigation of the implication of using ITQs for reducing harbor porpoise bycatch in a multi-species fishery used a numerical bio-economic model incorporating spatial and temporal patterns of abundance and harvest rates of 6 commercial fish species and harbor porpoise. Results indicate that porpoise ITQs, when compared to closures, are more profitable than closures, and distribute effort and profit reductions more evenly across seasons and areas (Bisack and Sutinen 2006).
4. Expanded upon Bisack and Sutinen (2006) to evaluate how a single policy instrument can be used to manage both porpoise and cod. Several programs for porpoise protection can achieve the same conservation outcomes with a modest difference in industry profits. At the industry level, the program selection may then rest on the goal

of cod management. Significant differences in vessel profits, however, may make consensus on the appropriate program difficult (Bisack 2008).

5. Economic value of scientific information was researched in relation to estimating the cost-benefit tradeoffs of improving the precision of the harbor porpoise stock assessments and their impact on the sink gillnet fleet. Results indicated that an increase of $217,000 in marine mammal data collection resulted in an increase of $850,000 in fleet profits (Bisack and Magnusson 2014).
6. Factors influencing the pinger compliance decision of a vessel operator/owner (e.g. economic, moral, social and legitimacy factors) are being researched. Bisack and Das (in review) using a probit framework incorporate economic and normative factors to examine compliance behavior of fishermen with regard to pinger regulations. Results indicate a fisherman who had a *history of violations*, a *low detection rate* the previous year, were characterized as a high revenue earners fishing multiple gears were more likely to be non-compliant with pinger regulations (Bisack and Das, in review). There are 4 phases to this compliance study: 2 formal compliance models and 2 years of ground-truthing focus group research.

   See Bisack and Sutinen (2006), Bisack (2008), Magnusson et al. (2012), Bisack and Magnusson (2014), and Bisack and Das (in review).

3.9 Using Non-Market Valuation to Value Protected Marine Species: A Review of the Literature

Dan Lew, Economist, Alaska Fisheries Science Center (AFSC) (Appendix D9)

WTP estimates for preservation, enhancements (e.g., population increases and extinction risk reductions), or conservation programs are often ill-defined. The focus of PR species valuation studies is typically on measuring the total economic value of protected species using state preference methods. Criticisms of stated preference methods are generally associated with hypothetical bias. A comprehensive review by Kling, Phaneuf, and Zhang (2012) indicated problems remain with these methods but there has been considerable progress to address them over the decades. The types of species valuations were divided into aggregate and disaggregate valuation studies, with the latter producing individual species values. There are 30 or so disaggregate species valuation studies (5 valuing cetaceans, 11 valuing pinnipeds, and 4 valuing fish). There are several meta-analyses of this literature, including a 1996 Loomis and White review and a 2009 update of that study by Richardson and Loomis. There were only 7 marine T&E studies in the 1996 study and an additional 5 in the 2009 study, which are mostly contingent valuation. The Martin-Lopez et al. (2008) review found 20 marine species valuation studies but there is over-counting. Some recent studies use choice experiments, but there is still contingent valuation work being done. There is a trend toward using web-enabled surveys among recent choice experiment studies. Most studies are in developed countries (many in the US)

where values range from -$120 to $350 per household in 2013 dollars. There is a need for more WTP estimates that are policy relevant. A note on coral studies is that they have been primarily done to measure "use values" instead of valuing individual species or total economic value. There is good progress but we need more studies on lesser known species, such as MMPA species, that are not ESA. There are still big questions on valuation; for example, is there a cap on WTP for all species? We need more benefit transfer work and more research on the relationship between conservation, management measures, and regulations. In response to a question about whether preferences really are stable, there is a best practice for information provision.

A discussion centered on pushback from NOAA General Council associated with individual WTP versus WTA, in relation to cultural values. One participant felt that WTP has been accepted but consideration of those cultural aspects would take things out of the realm of individual preferences, with another adding that only in the last ten years has valuing extinction risk been accepted by respondents. It used to be argued that people could not understand and value extinction risk. OMB says that we really need to value critical habitat, not just the species, which can be difficult to do because there is not a tight connection between the critical habitat and recovery probability or extinction risk.

3.10 Economic value of PR

Kristy Wallmo, Economist with NMFS's Office of Science and Technology (Appendix D10)

This presentation was an overview of NMFS-sponsored protected species non-market valuation studies. Choice experiments were used in all. Issues examined in these studies included: scope sensitivity, warm-glow, hypothetical bias, heterogeneity in WTP, questionnaire design, information effects, and anchoring effects. The Cook Inlet beluga whale study is looking at differences between rural and urban households. In a study of economic values for Steller sea lion, preference and value sensitivity to baseline conditions of the species was examined. The Klamath River study looked at ordering of uses and length of survey. The Protected Species Valuation Study, which valued 16 species over two phases, is being used to examine issues related to scope, differences in preferences and values between species, temporal stability of preferences, influence of cost vectors, and geographic variability of preferences. Multiple focus groups found they could not expect people to value changes to more than 3 species, and only ESA status improvements (not directly on population estimates). Some people wanted to do a little for all the species, but they did find significant differences between species in the survey. Respondents want to know how extinction will impact the ecosystem. The sentiment is OMB is still not keen on valuation work. We need a new blue ribbon panel on choice experiments, as the last one was on contingent valuation.

A discussion arose around the issue of adding up values beyond three species. We can say what a given three species are worth and then as we add on more species there is probably an

increase in WTP, but we can't quantify it with their data models even though they did look at more species than those in the study.The reason we don't include policy instrument in the valuation is that you may get an embedding issue where respondents may value the instrument in addition to the species, though separation may not be possible. In short, respondents are valuing more than the species. Research reported in Lew and Wallmo (2011) provides strong evidence of scope sensitivity--i.e., preferences are sensitive to the amount of the improvement in the species being valued. This means that there is an increase in value for more species than just one, but since the scope test was only done to examine scope effects for up to three species, we cannot determine whether there is a decreasing marginal WTP as you add more species beyond three, although that is what would be expected. See also Mansfield et al. (2012), Wallmo and Lew (2011, 2012), and Lew et al. (2010).

3.11 The Vaquita Case: Potential Buyouts

Sarah Mesnick with the SWFSC (Appendix D11)

The Vaquita may be extinct within three years, as it is down to the last 100 with 30 breeding females. The primary issue is bycatch in a gillnet fishery, which is the legal fishery for blue shrimp and illegal fishery for totoaba. A Vaquita-free shrimp net has been developed specifically for the small vessels they use in the drift gillnet fishery but are not yet in use. We need an immediate and complete closure of the top of the Gulf of California, which will soon be announced. We also need ideas for an incentive package to deal with the problem in the long run, (options include buyouts, market incentive for non-entangling gear, and alternative economic livelihoods). The fishery consists of approx. 900 registered vessels and 2000 people. The blue shrimp are worth $30 per pound in US. One cooperative to date has adopted the new nets.

A discussion opened around whether captive breeding was an option, but the answer is no. One participant suggested using economic incentives for the community to improve recovery. One option might be a cooperative with exclusive control of fishing in the area. We could also address the consumer demand side of the problem by pressuring US buyers not to buy the shrimp unless caught in the new trawl. The previous gillnet buyout was not well structured. People were bought out and then they got new nets. If a closure is imposed, get the message out to the fishery that it is not permanent, and other options or compensation are coming, otherwise people may end up actively trying to kill the Vaquita to get rid of the problem.

4.0 WORKSHOP RECOMMENDATIONS

The primary objective of the workshop was to provide an opportunity for NMFS economists to discuss PR exclusively and to network on research and issues facing PR. The group agreed this objective was met fully. While recognized as a good start, it was generally agreed that there is more work to be done. An ad-hoc approach has been the typical route taken to determine what is, and is not, being done in relation to economics analyses and research related to PR at NMFS. An alternative would be to follow a more formal process, similar to the

PRSIPP approach presented by Lisa Balance, with the development of a research portfolio. The focus of the final day was to review what had been discussed, and to develop recommendations. The following is not a comprehensive list of recommendations, but rather a first cut at some of the issues PR economics can address. A summary of the discussion and recommendations follow.

Recommendations (not prioritized)

1. Conduct a comprehensive (high level) strategic assessment
2. Improve BCA guidance and expand usage
3. Conduct value of scientific information studies
4. Improve and invest in ecosystem services valuation
5. Inventory and assess legal and institutional barriers to regulatory change
6. Assess current modeling/analytical methods
7. Conduct post implementation regulatory policy analysis
8. Improve two-way communication of PR economic research and management
9. Integrate economics into the PR Science Investment Planning Process (PRSIPP)

For each recommendation below, several components are identified along with the benefits or contribution these analyses can make to PR science, research and management. More specifically, the listings under each recommendation are potential PR economic projects. Examples of research and management discussions within the proceedings are identified to navigate the reader to other portions of this document for more information on that specific recommendation.

1. Recommendation: Conduct a comprehensive (high level) strategic assessment.

(a) Identify, inventory and assess, at a high level, *all threats by species and stock;* conduct a gap analysis on information needs. Include species that have future regulatory protection needs. Identify transboundary aspects of species and threats.

(b) Identify *regulatory and economic instruments currently*, at a high level, used to reduce threats to PR (locally, nationally, and internationally), and any analysis of economic benefits and costs associated with the implementation of the instruments. These data can be used to analyze how regulatory economic policy instruments are used differently, in different US regions. For example, how are caps used in Pacific Islands compared to the Northeast?

Benefit: This will help identify research needs and identify relevant policy problems (e.g. what can we do now with current data/methods and what are future needs), to look holistically at protection and recovery, from an economic perspective.

2. Recommendation: Improve Benefit Cost Analysis (BCA) guidance and expand usage

(a) i. Develop additional guidance on the use and application of BCA to ensure national consistency of economic analyses in support of PR and PR-related actions. Economic considerations are precluded in the Endangered Species Act (ESA) listing decision of a species, but thereafter in the ESA process, economic considerations are fundamental. In cases where EO 12866 applies, a BCA is mandatory. If EO 12866 does not apply, a CEA is a common option. CEA implicitly assumes benefits exceed costs, and benefits are perfectly homogeneous (since it generally ignores benefits altogether). Consideration of heterogeneous benefits/preferences is necessary even when the environmental goal or biological outcome is the same, since it does not necessarily translate to equivalent economic benefits.

ii. Develop a best practices guide on when, and for what purposes, CEA should be used. After the listing decision, CEA can be a very useful tool to help prioritize use of funds oriented toward promoting recovery. For example, in the cases of salmon, CEA can assist in decisions about where and what type of habitat restoration to undertake, whether to concentrate on riparian habitat or removing culverts, etc. This was discussed in the workshop a bit, but was overshadowed by the critical habitat discussion.

(b) Include all threats, national and international, in BCA. We need to look beyond a single species/FMP rather than conducting a spot analysis (one narrowly focused on a single species and single threat). That is, all human behaviors that threaten a particular species should be included, not just the single behavior that is being regulated to reduce a particular threat in order to protect a particular species. This expanded view is especially important for trans-boundary species (e.g., North Atlantic right whale, leatherback sea turtles) and emerging threats (e.g., future climate change impacts on ice cover for Alaska ice seals). We need to expand beyond the boilerplate description of costs and benefits to position ourselves in an EBM framework.

(c) Consider adopting the Millennium Ecosystem Assessment (MEA) framework (2005) within a BCA framework in order to incorporate economic impacts more broadly as NMFS moves towards EBM.

Examples: See PR Division Chief Discussion in Section 2.3, and Sanchirico et al. (2013).

Benefit: A more comprehensive BCA improves the likelihood of choosing an efficient outcome, avoiding unintended consequences, and perhaps identifying an alternative with a greater likelihood of success. Consistent and proper application of this more comprehensive BCA would enhance the defensibility of results.

3. Recommendation: Conduct 'Value of Scientific Information' studies.

There is potentially an important role for economists in assessing the value of scientific information. Specifically, this refers to studies that quantify or otherwise describe the benefits of reducing uncertainty in various aspects of protected resources management (e.g., species population assessments, impacts of human activities on protected species, predicted economic impacts of management actions).

Examples: See Section 3.1.6, and Bisack and Magnusson (2014).

Benefit: This type of analysis can help to inform decisions on research funding and priorities.

4. Recommendation: Improve and invest in ecosystem services valuation

(a) PR valuation efforts need to link with the needs of PRD management policy in support of legal mandates. Though policy relevant WTP estimates are increasing in number and quality, more are needed. In general, economic benefits for PR have been marginalized and need equal consideration to economic costs. The lack of benefit valuation studies and their significance and role in decisions is a common concern across regions.

(b) Invest in expanding benefit-transfer methods. Build expertise and develop formal guidance for drawing economic value information from existing valuation studies. This may be an effective, less costly approach, particularly in cases where time and resources preclude collection and analysis of new data.

(c) More valuation studies are needed to improve decision making, which could forestall lawsuits from NGOs that allege we are not adequately considering benefits. Needs include: (i) Ecosystem level valuations versus individual species (e.g. value of the corals within a reef system or as individual corals as species and habitat). (ii) Valuations of lesser known species (biological, ecological, and economic information), such as invertebrates (corals) and non-ESA species in general. (iii) Measurement of missing or underrepresented economic benefits such as non-market driven values (cultural, habitat service flows, ancillary benefits/costs related to CHD). Subsistence values are also needed.

(d) Additional biological research is needed to provide information necessary to measure economic benefits. Specifically, research to demonstrate effects due to regulations, conservation and other management actions. For example, scientists have difficulty articulating the link between habitat and species, but policy analysts are asked in regulatory analyses of CH designation to demonstrate that the cost of the designation is offset by benefits that accrue. Existing valuation studies have focused on the value of the organism and not the value of its habitat, which is needed for these analyses. To be able to construct valuation scenarios in stated preference surveys, we need to

improve knowledge of the biological linkages between the species and habitat since habitat value is a "derived demand" for species.

(e) Additional methodological work involves addressing issues related to: risk/vulnerability of extinction; uncertainty; validity; aggregation approaches; and whether there is a maximum cap on WTP for all T&E species.

Examples: See Sections 3.1.7 and 3.1.8, and Lew and Wallmo (2011); Lew *et al.* (2010); Lew (*in review*); and Wallmo and Lew (2012).

Benefit: Improved non-market value estimates allow for better decisions based on comparisons of the full scope of benefits and costs. They enable decision makers to assess options under an economic efficiency criterion and select the option that maximizes or improves social welfare. In the absence of benefit estimates, the option that generates the greatest total net benefit to the nation may not be identified.

5. Recommendation: Inventory and assess legal and institutional barriers to regulatory change

(a) Identify what is mandated and what could be modified, and consider regional versus cross-regional policies, management and governance. An understanding of legal and institutional barriers during the development and selection of regulatory alternatives (e.g. turtles and FMPs) can inform the economic efficiency analysis, which can lead to more cost- and ecologically-effective mitigation measures. For example:

i. Marine Mammals: The Potential Biological Rule is a point estimate that determines the allowable take of marine mammals. However, managing rare-event takes (e.g., 1 take every 5 years) as outlined by the MMPA can be costly. At-sea bycatch reduction mitigation for rare-event takes can run the risk of a decrease in bycatch reduction at an increasingly larger cost (ie. marginal costs) to the point that there is a net loss in economic benefits. Are there alternative mitigation measures that are more cost and ecologically effective?

ii. Turtles: Incidental Takes Statements (ITSs) are a legal requirement under ESA. However, is the allocation of turtle takes across threats as stated in the ITS consistent with National Standard 4? (National Standard 4 states: Do not discriminate between residents of different state; any allocation of privileges must be fair and equitable). Recommendation (1) would support this work.

iii. Markets: Explore the legal and institutional approaches that exist in order to incorporate international trade restrictions and market access into PR protection. Take inventory of how consumer market approaches, such as dolphin-safe tuna regulations, are carried out across regions. Investigate opportunities to increase species-a- risk protection in international waters by way of the Presidential Task Force Plan to Combat Illegal, Unreported and Unregulated Fishing and Seafood

Fraud, which specifically addresses the stopping or restraining bycatch of protected species.[5]

(b) Develop cost-recovery methodologies and participate in recovery plan development options. For example, ESA reauthorization discussions can lead to more effective protection and recovery efforts by including options to recover the costs of management actions. For example, user fees can be set before (insurance) or after (damages) an event is incurred (e.g., oil companies, shipping, and fisheries). Currently there are no cost recovery plans in place.

Examples: See spill-over effects discussions in Sections 3.1.1 and 3.1.1.1, and specifically, Chan and Pan (2012) and Gjertsen et al (2014). These empirical analyses demonstrate potential conservation losses, gains, and tradeoffs under the current legal environment.

Benefit: Identification of institutional barriers that may be limiting current PR conservation efforts, especially those that restrict assessments of all anthropogenic impacts, have the potential to provide immediate research returns, but longer term research is needed to address legal barriers.

6. Recommendation: Assess current modeling/analytical methods

(a) Assess and inventory analytical methods (e.g., discuss assumptions, robustness checks, uncertainty of estimates, identification problems)

(b) Identify data and methodological gaps.

Benefit: Supports the need for "state-of-the-art" data, modeling techniques, analysis, and results for improving information necessary to assess and design recovery options.

7. Recommendation: Conduct post implementation regulatory policy instrument analysis

(a) Conduct a high level post implementation economic evaluation of previously adopted PR and non-PR (e.g., fisheries) regulations to identify policy instrument strengths and weaknesses, inconsistencies and inefficiencies across regions, and potential causes or sources of the inefficiencies.

An in depth regulatory instrument exercise showed that, for example, tight turtle caps have led to an unstable swordfish fishery due to sudden closures (e.g., inefficiency) and resulted in negative spillover effects internationally from US actions (e.g., legal barrier within the ESA). This ESA action resulted in increased turtle takes/bycatch due to an increase in foreign swordfish landings. Another question raised was whether the ship strike sunset rule under Atlantic Large Whale Take Reduction Plan in the northeast should become mandatory versus remaining voluntary; the answer

[5] http://www.nmfs.noaa.gov/ia/iuu/taskforce.html

likely depends on whether the voluntary regulatory policy instrument was successful in achieving protection and recovery goals.

(b) Identify current and potential compliance problems. An important component to understanding what regulatory policy instruments work well requires us to determine how human (economic) behavior changes (not just costs). We need to consider metrics to measure behavioral changes.

(c) Identify and prioritize PR regulatory policy relevant analyses. Identify metrics to prioritize the case studies of PR species and regulations to be potentially analyzed. Available data and analytical techniques may determine which analyses are feasible; however, the contribution of the answer and the amount of time along with the cost of conducting the analyses should be taken into account in the prioritization decision.

i. Back Casting, Conduct Counter-Factual Case Studies: Counter-factual analyses can determine the economic outcomes if status quo had continued rather than adopting new regulatory policy instruments. Would the fleet be better off and the takes/bycatch higher if the fishery had continued operating under status quo? Counterfactuals are important, but difficult (e.g., the identification problem), and there are a number of different ways to develop counterfactuals.

ii. Forecast: Support the development of expanded and more comprehensive PR recovery and protection planning. Components to consider are: economic incentives; risk of extinction and uncertainty in economic analyses; and single policy instruments that can regulate several species simultaneously (e.g., moving toward EBM) to simplify management, improve compliance and reach recovery goals. Vary policy instrument types by area (or circumstance) to the specific problem/threat rather than implementing broad based restrictions. A comprehensive and more complete set of alternatives, comparing implemented alternatives (2^{nd} best) to optimal will illustrate the consequences of various choices in terms of net National benefits.

Examples: See Sec 3.1.2 (Holland); Sec 3.1.3.3 (Hilger); Sec 3.1.4 (Lee); Sec 3.1.5 (Speir); and Sec 3.1.6 (Bisack). Specific papers include Holland (2010); Hilger (2015); Lee and Thunberg (2013); Speir and Stradley (*in press*); Speir et al (*in press*); Bisack (2008); Bisack and Sutinen (2006); and Bisack and Das (*in review*).

Benefit: Evaluation of previous actions with back-casting and counterfactual analyses improves our understanding of policy instrument choices to better support forecasting needed for regulatory policy analysis.

8. Recommendation: Improve two-way communication of PR economic research and management

(a) Communicate our ideas to that broader audience. Identify opportunities for economists and other social scientists to learn about the biology of protected species

and management needs. Consider the following: (i) identify potential projects to communicate our contribution to PR Science; (ii) do outreach for economic research and PR management identifying the strengths and weakness of benefit valuation and other economic methods; (iii) create a sustainable two-way communication channel between economists and PR Division Chiefs at regional offices and the Office of PR; (iv) partner with other social science disciplines, such as anthropologists and sociologists as needed.

(b) Find common language to explain what we do, what it means and why it matters to non-economists at various levels (i.e. from analyst to manager). Effective two-way communication is critical for non-economists and economists to understand each other. This is especially important to PR managers as they learn when to bring economists into the process and reap the benefits of their inclusion during the planning phase. Compare how other countries communicate multidisciplinary results.

(c) Demonstrate the advantage of involving economists early in the development of policies and regulations. Include economists upfront in regional and national PR management and research meetings to allow an exchange of ideas. The Vaquita case illustrated the late involvement of economists and potential benefits that may have been realized with earlier involvement.

Benefit: Earlier involvement by economists can result in stronger analysis of anthropogenic impacts, and the development of more robust alternatives. Broader understanding of economics within the agency, particularly in PR, can help non-economists understand the role economics can play in the policy process.

9. Recommendation: Integrate economics into the PR Science Investment Planning Process (PRSIPP)

(a) A NMFS PR Economic Working Group has been established to support the needs of the PRSIPP [6] and to continue the work identified in these proceedings. Senior management agreed to the WG formation and a draft Term of Reference document is being circulated among working group members.

Benefit: A formalized Working Group will build on the momentum of the workshop and move the recommendations of the workshop forward.. Being part of the PRSIPP will ensure that the funding needs of PR Economics are considered in the planning process.

[6] The PR Board decided at the May 2015 meeting, PRSIPP responsibilities would transfer to the PR Board. However, the Science and Technology (S&T) group would continue to collect and maintain house the database that collects PR Science needs.

5.0 NEXT STEPS

Participants identified some upcoming events that will help gain traction on several recommendations provided above. They include:

- At the upcoming North American Association of Fisheries Economists biennial forum in Ketchikan, Alaska (21-23 May 2015), a special session will be held, entitled "Protected Resource Economics: Key Challenges for Incorporation in an Ecosystem Based Management Approach," by NOAA economists Kathryn Bisack and Kristy Wallmo, and Oceans and Fisheries Canada economist Gisele Magnusson.

  See: http://seagrant.uaf.edu/conferences/2015/naafe/special-sessions.php–

- A special issue is being prepared for the open-access journal *Frontiers in Marine Science* entitled "The Economics of Protected Marine Species: Concepts in Research and Management" (Editors: NOAA economists Kristy Wallmo, Dale Squires, Kathryn Bisack and Dan Lew). Submissions are due 10 June 2015.

  See http://www.frontiersin.org/Marine_Affairs_and_Policy/researchtopics

- A NMFS PR Economic Working Group has been established to support the needs of the PRSIPP and to continue the work identified in these proceedings.

ACKNOWLEDGMENTS

We thank Matt McPherson and in particular Susan Brown for their assistance with travel arrangements for the workshop participants. We greatly appreciate the assistance of the dedicated support staff at the Scripps Institution of Oceanography responsible for the equipment at the Robert Paine Scripps Forum for Science. Finally, we thank Dr. Richard Merrick for his leadership, guidance and financial support to make this workshop possible.

DEDICATION

Dr. Mark Plummer had an instrumental role in the ad hoc PR economic working group for several years. Mark had a keen understanding of natural resource economics and protected resources. His attitude, perspective, and ability to reframe a problem to present PR economics to non-economists was instrumental at the November 2012 PRSIPP workshop. It was an honor to have worked with Dr. Plummer, and he will be sorely missed.

6.0 REFERENCES CITED

Anderson LE, Lee ST, Levin PS. 2013a. Costs of delaying conservation: Regulations and the recreational values of rockfish and co-occurring species. Land Econ. 89(2):371-385.

Anderson LE, Lee ST. 2013b. Untangling the recreational value of wild and hatchery salmon. Mar Resour Econ. 28(2):175-197.

Ballance LT, Barre L, Bengtson J, Bettridge S, Bisack K, Brown S, Fahy C, Ford M, Garrison L, LeBoeuf N, LeRoux R, Parrish F, Seney E, Simpkins M, Srinivasan M, VanAtta L, Vardi T. 2014. NOAA's National Marine Fisheries Service Protected Resources Science Investment and Planning Process (PRSIPP): highlights and significant outcomes of the September 2013 steering committee meeting. NOAA Tech Memo NMFS-F/SPO-140.

Bisack K, Das C. In review. U.S. Protected species regulations: Understanding non-compliance in the Northeast. Front Mar Sci., in review.

Bisack KD, Magnusson G. 2014. Measuring the economic value of increased precision in scientific estimates of marine mammal abundance and bycatch: Harbor porpoise *Phocoena phocoena* in the Northeast US gill-net fishery. N Am J Fish Manage. 34: 311-321.

Bisack KD. 2008. Integrating porpoise and cod management: A comparison of days-at-sea, ITQs and closures. Mar Resour Econ. 23(4):361-3782.

Bisack KD, Sutinen J. 2006. Harbor porpoise bycatch: ITQs or time/area closures in the New England gillnet fishery. Land Econ. 82(1):85-102.

Chan HL, Pan M. 2012. Spillover effects of environmental regulation for sea turtle protection: the case of the Hawaii shallow-set longline fishery. US Dep Commer, NOAA Tech Memo NMFS-PIFSC-30, 38 p. + Appendices. Online at: http://www.pifsc.noaa.gov/library/pubs/tech/NOAA_Tech_Memo_PIFSC_30.pdf

Gjertsen H, Squires D, Dutton P, Eguchi T. 2014. Cost-effectiveness of alternative leatherback turtle conservation strategies. Conserv Biol. 28(1): 140-149.

Hilger J. 2015. Regulatory impacts to fleet size of the California drift gill net fishery: A treatment-control hazard rate approach. NOAA Southwest Fisheries Science Center: Working Paper. March 2015.

Holland DS. 2010. Markets, pooling and insurance for managing bycatch in fisheries. Ecol Econ. 70(1):121-133.

Holland DS, Jannot JE. 2012. Bycatch risk pools for the US west coast groundfish fishery. Ecol Econ. 78:132-47.

Lee MY, Thunberg E. 2013. An inverse demand system for New England groundfish: Welfare analysis of the transition to catch share management. Am J Agric Econ. 95(5):1178-1195.

Online at: http://ajae.oxfordjournals.org/content/95/5/1178.full.pdf?keytype=ref&ijkey=ZvwOcvtceNwT3Mw

Lew DK, Wallmo K. 2011. External tests of scope and embedding in stated preference choice experiments: an application to endangered species valuation. Environ Resour Econ. 48(1): 1-23.

Lew DK, Layton D, Rowe R. 2010. Valuing enhancements to endangered species protection under alternative baseline futures: The case of the steller sea lion. Mar Resour Econ. 25: 133-154.

Lew DK. Willingness to pay for threatened and endangered marine species: A review of the species valuation literature. Working paper.

Magnusson GM, Bisack KD, Milliken HO. 2012. The cost-effectiveness of gear research relative to a closure: Pound nets and sea turtles as an example. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 12-01; 25 p. Online at http://nefsc.noaa.gov/publications/

Mansfield C, Van Houtven G, Hendershott A, Chen P, Porter J, Nourani V, Kilambi V. 2012. Klamath River Basin restoration: Nonuse value survey. Final report: Prepared for the US Bureau of Reclamation. Research Triangle Park, NC: RTI International. Online at: http://www.rti.org/publications/abstract.cfm?pubid=19774

Sanchirico J, Lew DK, Haynie A, Kling A, Layton DF. 2013. Conservation values in marine ecosystem-based management. Mar Pol. 38: 523-530.

Simpkins M, Srinivasan M, editors. 2013. Report of the Protected Resources Science Investment Plan Workshop. US Dept Commer, NOAA Tech Memo NMFS-F/SPO-130; 34 p.

Speir C, Stradley E. (in revision) Estimating economic impacts of irrigation water supply policy using synthetic control regions: A comparative case study. (in revision, Ecol Econ.)

Speir C, Mamula A, Ladd D. (in press) Effects of water supply on labor demand and agricultural production in California's San Joaquin Valley." Accepted, Water Econ Pol.

Wallmo K, Lew DK. 2012. The value of recovering threatened and endangered marine species: a choice experiment approach. Conserv Biol. 26(5): 830-39.

7.0 WORKSHOP PARTICIPANT LIST AND AFFILIATIONS

Dr. Kathryn D. Bisack, Economist/Operations Research Analyst
Social Sciences Branch
Northeast Fisheries Science Center
Woods Hole, MA 02543
Kathryn.Bisack@noaa.gov

Dr. Dale E. Squires, Senior/Supervisory Economist
Fisheries Resource Division
Southwest Fisheries Science Center
La Jolla, CA 92037-1508
Dale.Squires@noaa.gov

Dr. Douglas W. Lipton, Chief NMFS Economist
Office of Science and Technology
Silver Spring, MD
Douglas.Lipton@noaa.gov

Dr. James R. Hilger, Economist
Fisheries Resource Division
Southwest Fisheries Science Center
La Jolla, CA 92037-1508
James.Hilger@noaa.gov

Dr. Daniel S. Holland, Supervisory Economist
Conservation Biology Division
Northwest Fisheries Science Center
Seattle, WA
Dan.Holland@noaa.gov

Dr. Denise H. Johnson, Industry Economist
Economics Branch
Southeast Regional Office
Saint Petersburg, Florida 33701
Denise.Johnson@noaa.gov

Dr. Min-Yang Lee, Economist
Social Science Branch
Northeast Fisheries Science Center
Woods Hole, MA 02543
Min-yang.Lee@noaa.gov

Dr. Rebecca Lent, Economist and Director
Marine Mammal Commission
4340 East-West Highway, Suite 700
Bethesda, Maryland 20814
rlent@mmc.gov

Dr. Daniel K. Lew, Economist
Resource Ecology and Fisheries Management Division
Alaska Fisheries Science Center
Davis, CA
Dan.Lew@noaa.gov

Dr. Gisele Magnusson, PhD, Senior Economist
Economic Analysis, Policy Branch, Pacific Region
Fisheries and Oceans Canada
200 – 401 Burrard St
Vancouver, BC V6C 3S4
Gisele.Magnusson@dfo-mpo.gc.ca

Dr. Minling Pan, Economist
Ecosystem Science Division, Socioeconomic Program
Pacific Island Fisheries Science Center
Honolulu, HI 96818
Minling.Pan@noaa.gov

Dr. Lewis E. Queirolo, Senior Regional Economist
Alaska Regional Office
Juneau, AK
Lew.Queirolo@noaa.gov

Dr. Stephen Stohs, Economist
Fisheries Resource Division
Southwest Fisheries Science Center
La Jolla, CA 92037-1508
Stephen.Stohs@noaa.gov

Dr. Cameron L. Speir, Economist
Fisheries Ecology Division
Southwest Fisheries Science Center
Santa Cruz, CA 95060
Cameron.Speir@noaa.gov

Dr. Kristy A. Wallmo, Economist
Economics and Social Analysis Division
Office of Science and Techonology
Silver Spring, MD
Kristy.Wallmo@noaa.gov

Dr. Lisa T. Ballance, Director
Protected Resources Division
Southwest Fisheries Science Center
La Jolla, CA
Lisa.Ballance@noaa.gov

Dr. Sarah Mesnick, Ecologist
Protected Resources Division
Southwest Fisheries Science Center
La Jolla, CA
Sarah.Mesnick@noaa.gov

Table 1. Number of MMPA and ESA regulatory actions requiring economic support from 2000 to 2014 by taxa and region, along with actions contracted to outside economists.

Taxa	NE	SE	AK	NW	SW	PI	Total	Percent
Large Whales	7	3	2	4	1	1	18	25.0%
Small Cetaceans	4	3	2			2	11	15.3%
Pinnipeds			6			2	8	11.1%
Turtles	5	6			2	4	17	23.6%
Fish	2	2		10			14	19.4%
Abalone				1			1	1.4%
Coral		2					2	2.8%
Sea Birds			1				1	1.4%
Total	18	16	11	15	3	9	72	
Outside Contract	5	2	3	12	0	0	22	30.6%
NMFS Economists	13	14	8	3	3	9	50	

Table 2. MMPA and ESA regulatory actions by type from 2000 to 2014

Regulatory Action	NE	SE	AK	NW	SW	PI	Total	Percent
Critical Habitat (4b2)	3	4	5	9		1	22	30.6%
Recovery Action Costs (4f)				3			3	4.2%
Inspection Program	1						1	1.4%
Threats								
Commercial Fisheries	13	11	3		3	6	36	50.0%
Oil Spill			1				1	1.4%
Subsistence Harvesting			1	1			2	2.8%
Tourism: Charter Boats, Whale Watching			1	1		2	4	5.6%
Dams, Mining, etc.				1			1	1.4%
Commercial Ship Strikes	1						1	1.4%
Substrate Disturbances		1					1	1.4%
Total	18	16	11	15	3	9	72	

APPENDIX A1: AGENDA

Economics of Protected Resources (PR) Workshop

9-11 September 2014, La Jolla, CA

8:30 AM – 5:15 PM (Tues, Wed), Adjourn 12:30PM (Thurs)

Day 1 (Policy and Management Needs)

(90 minutes, 8:30 – 10:00AM)

1. Opening & Goals of the Workshop (Doug Lipton 10 min)
2. Logistics & Other (Kathryn & Dale 10 min)
3. MMC (Rebecca Lent 10 min)
4. Protected Resource Scientific Investment Planning Process (PRSIPP) (Lisa Balance 20 min)
5. PR Econ presentation given at the PRSIPP workshop: What is the role of a NMFS PR Economist? (Bisack 10 min)
6. What is NMFS's regulatory responsibilities (MMPA, ESA, EO12866, RFA, MSA) w.r.t. PR? (Lew Queirolo 15 min)

Break (10:00 – 10:15)

7. Regulatory Support: Regional
    a. What PR Regulatory work, including external contracts, has been conducted in your region? (20 min each)
        i. Alaska (Lew Quierolo)
        ii. Pacific Islands (Minling Pan)
        iii. West Coast (Dale, Dan H, Cameron)
        iv. Southeast (Denise Johnson)
        v. Northeast (Kathryn Bisack)
        vi. Canada (Gisele Magnusson)

Lunch (12:00- 1:15)

8. Regulatory Support: Regional Office Management Input from Regional Office PR Division Chiefs Continued (1:15 – 2:00)

9. Breakout Groups (2:00 – 5:15)
    a. Discuss Breakout Questions (2:00-2:30)
        i. What are the general issues facing PR managers? What do regions have in common?
        ii. What policy instruments are we currently using, what is working, and what needs more investigation and evaluation?

iii. What can we address now with the data, tools, and personnel we currently have? What can we address with additional tools, data etc.?
iv. Which PR management issues should be prioritized in terms of PR Economics?
v. Note: PRSIPP requested PR Metrics (Seek guidance from Lisa Balance)

b. Break (2:30 – 2:45)
c. Break-out Groups Meet: Same Assignment (2:45 – 3:45)
d. Plenary (3:45– 4:45)
e. Wrap up with brief discussion about tomorrow's plan (4:45 -5:15)

Adjourn Day 1: Group Dinner (6:30) at Piatti (http://www.piatti.com/lajolla/) – order off menu with 20 folks or less and separate checks!

Day 2 (Research)

(8:30 – 10:15)

10. PR Problems and social science regulatory and research integration: What PR Research has been done (in NMFS)? What questions did this research seek to address?
    a. Enhance PR Management (90 min, 20 each)
        i. Spill-over effects when managing sea turtles under dual mgt goals (PI, Minling Pan)
        ii. Risk Pools for Managing Bycatch (NW, Dan Holland)
        iii. CA Drift Gillnet Swordfish Fishery & Sea Turtles
            i. Demand and Transfer Function Analysis for Imports (SW, Squires)
            ii. Counterfactual
                a. Estimates of ESA regulations (SW, Stephen Stohs)
                b. Vessel exit rates and fleet size (SW, James Hilger)

Break (10:15 – 10:30 AM)

        iv. Welfare Analysis of the Transition to Catch Share Management. (NE, Min-Yang Lee)
        v. Salmon Analysis (SW Santa Cruz, Cameron Speir)
    b. Value of Information
        i. Economic value of precision sampling for marine mammal abundance and bycatch estimates; Compliance and Policy Instruments (NE, Kathryn Bisack)
    c. Valuation
        i. Using Non-Market Valuation to Value Protected Marine Species: A Review of the Literature". (AK, Dan Lew)
        ii. Economic value of PR (S/T, Kristy Wallmo)

Lunch (12:15- 1:15)

11. The Vaquita Case: Potential Buyouts (R. Lent) (1:15 – 2:15)
12. Breakout Groups (2:15 – 5:15)
    a. Discuss Assignments: What PR economic research should NMFS be doing (part deux) (2:15-2:45)?
        i. What are PR science and management research questions? Are there changes or additions to Day 1?
        ii. What areas of research should be <u>prioritized to aid in management</u>?
        iii. What areas of research should be <u>prioritized to improve methods</u> (e.g., validation)?
    b. Break (2:45 – 3:00)
    c. Break-out Groups Meet: Same Assignment (3:00 – 4:00)
    d. Plenary (4:00 – 5:00)
    e. Wrap up with brief discussion about tomorrow's plan (5:00 -5:15)

Adjourn Day 2 – 5:15 PM

Free night – Downtown La Jolla

<u>Day 3 (Communication and PR Economics)</u>

(8:30 – 12:30PM)

13. How do we improve communication of products to decision makers (both at the project and program level)?

14. How do we communicate funding needs to NOAA leadership?
    i. Budget Initiative
    ii. RFPs
    iii. PRSIPP

15. How do we better communicate our products to non-economists (PR Econ Glossy an example)?
16. Report Writing

Adjourn 12:30

APPENDIX A2: EXACTLY WHAT WOULD YOU LIKE TO ACHIEVE AT THIS WORKSHOP?

Inventory:

1. Understand the scope and depth of protected species economic research that has **been done and is currently** being conducted by fellow NMFS economists. (Dan Lew)
2. Learn about cases where protected resource issues were addressed **successfully** (in the context of efficient markets or cost-benefit analyses; ideally within the US). (James Hilger)

Problems:

3. Understand the **needs/questions** of protect marine resources (PR) (Minling Pan)
4. Understand the **motivations** for the research (Kristy Wallmo)
5. Share information about the **Commission's mandate and how economic research** can contribute to that mission. (Rebecca Lent)

Problem Framework:

6. I would be interested in learning about the basic features of protected resource **within an economic framework**. (James Hilger)

Tools:

7. An overview of **available tools** for pr economics analysis. (Stephen Stohs)
8. A broad overview of the management **tools/policy instruments** available for protected species management and recovery. (Kristy Wallmo)

Data: Need to take into account

Potential Road Blocks:

9. Sort out the **legal, scientific, and technical issues** pertaining to ESA mandatory economic analyses in support of CHD actions. (Lew Quierolo)
10. An understanding of what the **largest challenges** are to conducting PR economic research from a logistics, financial, methodological, etc. perspective. (Kristy Wallmo)

PR Econ Road Map

11. **Can we put together some kind of a <u>"road map,"</u> for lack of a better term, on how** this could occur? (Kristy Wallmo)
12. Learn how the research will **inform *future* regulatory** matters involving gear interactions with species that have been given protected status. (James Hilger)

Messaging/Communicating our work:

13. A good discussion on how we as economists can **integrate our work** with biological and ecological research. Have participants been successful at this? Do biologists *want* an economic perspective? Is interdisciplinary collaboration something we should be striving for and if so, **can we put together some kind of a <u>"road map,"</u> for lack of a better term, on how** this could occur? (Kristy Wallmo)
14. Explore ways to **share the research of NMFS's economists** with the marine mammal community and increase the level of awareness as well as "comfort" with this type of research. (Rebecca Lent)

APPENDIX A3: RESEARCH THEMES AND QUESTIONS

PR Economic Workshop (8-11 Sept 2014)

4 June 2014

What are your top research themes/questions?

Responses received by:

Dan Lew (AK), Lew Queirolo (AK), Dan Holland (NW), James Hilger (SW), Steven Stohs (SW), Minlin Pan (PI), MinYang Lee (NE), Kristy Wallmo (S&T), Rebecca Lent (MMC)

Dan Lew (AK)

Research Themes

1. Measuring economic values of protected species
2. Incorporating economic values in protected species policy analyses
3. Issues in communicating protected species economic study results
4. The economic effects of climate change on protected resources

Research Questions

1. How do we bridge the gap between the species values being measured in non-market valuation studies and the values needed in policy analyses?
2. What are the key issues in non-market valuation that are important to answer to improve estimates of public willingness to pay for protected species protection?
3. How can we improve communicating economic information about protected species to stakeholders, analysts, and the public?

Lew Queirolo (AK)

How might we "encourage" treatment of global climate change in Agency CHD assessment? It would appear to be precisely analogous to the mandatory "Energy Supply Impact" requirement we currently must provide. (ii) How may we encourage biologists to more effectively articulate ecosystem benefit flows, so their "uses" and "users" can be identified in an economic context? (3) When literal irreparable harm to an ESA-listed species' critical habitat is threatened by an action, is 'discounting' at ANY positive rate appropriate? Inter-generational transfer arguments, circa 1970s, asserted use of negative discount rates could be justified in certain (extreme) circumstances. Any merit?

Dan Holland (NW)

1. Managing highly uncertain bycatch (role of risk pools, cooperatives, etc.)
2. Bycatch offsets (can higher takes of protected species be allowed in some cases in return for offsets such as habitat protection or remediation)
3. How do we deal with species that are almost certainly going to go extinct regardless of what we do.

James Hilger (SW)

1. Program Evaluation Literature (treatment–control, difference-in-differences, etc).
2. Impact of Information on Consumer Behavior
3. Heterogeneity in Random Utility Models
4. Development of Economics Impact (Contribution) Multipliers and Estimates.

Steven Stohs (SW)

1. Statistical inference for rare event bycatch data, including economic applications
2. Transfer effects due to unilateral regulatory approaches in fisheries with transboundary target and bycatch species
3. Metrics for comparing bycatch impacts across fishing methods (e.g. indexes of bycatch impacts)
4. Measuring regulatory impacts of pr bycatch reduction measures
5. Economic costs and benefits of alternative bycatch reduction regulatory regimes

Minling Pan

1. Top research themes/topics
    - Measure trade-off between conflicting management objectives
    - Measure trade-off under different policy choices
    - Assess the spill-over effect of an area limited regulation to un-regulated areas

2. Top research questions
    - How to measure the conflict management objectives between sea turtle protection vs maximum net return to fishery;
    - How to measure the ecosystem services of the 82 coral species (potential listing) and the trade-off between conflicting servicesHow to measure absolute and relative value between different PR species, such different marine protected resources, and marine vs. land-base PR;

Kristy Wallmo (S&T)

1. Aggregation: How should we we think about aggregating willingness-to-pay estimates for policy purposes? How do we incorporate heterogeneity (spatial, taste parameter, other?) in aggregation?

2. Hypothetical Bias: What is the extent of hypothetical bias in stated preference surveys? To what extent can we validate WTP estimates with RP or other data?

3. PR Management:How does economic research facilitate protected species recovery and what type of research has (the most?) utility toward this end?

Rebecca Lent (MMC)

I am not conducting any research, however, I do have some favorite research questions:

- Estimating the value of marine mammals
- Including marine mammals in NEPA analyses
- Economics of climate change impacts on marine mammals

Denise Johnson (SE) Suggested Workshop Topics and Questions

In preparing the following topics and questions, PRD and SSRG were asked to identify specific PR socioeconomic information or research needs they would like addressed. These needs are included in the list of topics below.

A. Topics:

1. Exploring alternative reminders of alternative expenditures (substitute goods) to improve contingent valuation (willingness to pay) studies of PR. The 1993 NOAA Panel on Contingent Valuation recommended that respondents must be reminded of alternative expenditures (substitute goods) when responding to willingness to pay (WTP) questions. This topic is motivated by a recent doctoral dissertation (Myers 2013) that uses an alternative reminder in assessing the willingness to pay for the Atlantic red knot and also includes additional recommendations to improve CV studies of PR.

2. Potentials for and pitfalls of using ecological footprint accounting in estimating socioeconomic benefits of PR. The Ecological Footprint (EF) has been used as an accounting tool to estimate for a given year, how much of the Earth's biologically productive land and sea area is required to provide for a given human population's (biological) resource consumption and waste assimilation(Ewing et al. 2009, Wikipedia, Hagglund 2013). EF accounting is the comparison of a population's demand for resources (EF) to its available biologically productive land and sea area (biocapacity).

3. Including a food security approach in the estimation of MPA socioeconomic benefits to the surrounding community(ies). Malleret King (2000) uses such an approach to estimate the

impacts of MPAs on surrounding fishing communities in Kenya. It may be particularly useful in estimating benefits of MPAs in the U.S. Caribbean and other island areas.

4. Developing a behavioral model that incorporates costly targeting (i.e. cost of avoiding endangered sea turtles). This is motivated by the cost to the Gulf longline fleet of decreasing their interactions with endangered sea turtles.

5. Developing a mixed methods approach to estimating the combined economic values of corals as species and habitat. This is motivated by the listing of elkhorn and staghorn corals, which have value in and of themselves and as coral-reef habitat for other species.

B. Questions:

1. What is PR economics doing:

- right?
- wrong?
- could do better?

2. Would PRD be better served by PR socioeconomics, rather than PR economics?

3. What can we learn from other federal and state agencies that do PR economics?

Sources:

Ewing B, Goldfinger S, Oursler A, Reed A, Moore D, Wackernagel M. 2009. The Ecological Footprint Atlas 2009. Oakland: Global Footprint Network.

Hagglund L. 2013. A Systems-Based Approach to Ecological Footprint Accounting. Masters Thesis. Geography. Indiana University.

Mallert King D. 2000. A food security approach to marine protected area impacts on surrounding fishing communities: the case of Kisite Marine National Park in Kenya. Doctoral Dissertation. Economics. University of Warwick.

Myers KH. 2013. The Effect of Substitutes on Willingness to Pay for Endangered Species: The Case of the Atlantic Red Knot. Doctoral Dissertation. Marine Studies. University of Delaware.

Appendix B1. Alaska Regulatory History

Act	Species	Action(s)	Date	Labor		Threats		
				NMFS	Contract	Commercial Fishery	Ship Strikes	Other
ESA	**Various Marine Mammals**	EXXON Valdez Damage Assessment	1989	Lew Queirolo				Oil Spill
	Steller Sea Lions	NOAA Deposition Fed. Court Injunction on CH	2000	Lew Queirolo		Federal Court closure of all SSL CH		
	North Pacific Right Whales	(EIS) Critical Habitat Designation	2008	Lew Queirolo				
	Cook Inlet Beluga Whales	(EIS) Critical Habitat Designation	2010	Lew Queirolo	ENTRIX			
	Steller Sea Lions	(EIS) Critical Habitat Designation	2000	Lew Queirolo				
	(Western DPS)	Reconsultation	2010	Ben Muse/L.Queirolo				
	Sea Birds	Various FMP related actions		Lew Queirolo				
	Marine Mammal Viewing	Various FMP related actions		Lew Queirolo				Whale Watching
	Pacific walrus	Various FMP related actions	2013	Lew Queirolo				Transiting CH
	Northern Fur Seals	PRD actions pertaining to subsistence harvesting	2013	Lew Queirolo				Subsistence Harvesting
	Ringed Seals and Beringian Bearded Seals	(EIS) Critical Habitat Designation	2014	Lew Queirolo	CARDINO ENTRIX			
	Steller Sea Lion WDPS	Critical Habitat Revisions	2014	Scott Miller/L. Queirolo	CASCADE			

Appendix B2: Pacific Islands Regulatory History

Act	Species	Action(s)	Date	Labor		Threats	
				NMFS	Contract	Commercial Fishery	Ship Strikes
MMPA	**False Killer Whales**	(EA) HI Longline Fishery Take Reduction Measures	2011	Sarah Malloy		Longline	
	Hawaiian Monk Seal	(EA) Critical habitat	2009	Malloy, Pan, Justin Hospital		Inshore hook & line, gillnet	
		(EIS) HI Incidental Take Permit for Inshore Fisheries	~2006	Malloy, Pan, Justin Hospital		Inshore hook & line, gillnet	
	Spinner Dolphins	(EA) Human Interaction Mitigation (swim-with-dolphin tours)	2010	Michelle McGregor (on detail to PIRO)			
ESA	**Sea Turtles (Green, Loggerhead, Leatherback, Olive Ridley, Hawksbill)**	(EIS) HI Longline Gear Modifications	2000-05	Minling Pan		Longline	
		(EIS) HI Incidental Take Permit for Inshore Fisheries	~2006			Inshore hook & line, gillnet	

Appendix B3. Northwest Regulatory History

Act	Species	Action(s)	Date	Labor		Threats
				NMFS	Contract	
MMPA	Southern Resident Killer Whales	(DEA) Vessel Traffic Regulations to Protect Killer Whales in Puget Sound Final Regulatory Impact Review	2010		Industrial Economics	Whale watching
		(DEIS) EA with Critical Habitat Designation	2006		Industrial Economics	
		(4b2 analysis) Final Economic Analysis of Critical Habitat Designation for Southern Resident Killer Whales	2006	Mark Plummer	Industrial Economics	Pollution, prey competition from commercial and recreational salmon fishery
		(DEIS) Makah Whale-Hunting Request	2008		Northern Economics	Whale hunting
	Gray Whales					
ESA	West Coast Salmon and Steelhead	(4b2 analysis) Economic Analysis of Critical Habitat Designation for 12 West Coast Salmon and Steelhead ESUs	2005	Mark Plummer	Industrial Economics	Non-Hydropower Dams and Water Supply Structures; Federal Land Management; Livestock Grazing on Federal Land; Transportation; Utility Line Projects; Instream activities (excluding dredging); Dredging; NPDES-permitted Activities; Sand and Gravel Mining; Residential and Commercial; Agricultural Pesticide Applications
	West Coast Salmon and Steelhead	(4b2 analysis) Economic Analysis of Critical Habitat Designation for 12 West Coast Salmon and Steelhead ESUs	2005	Mark Plummer	Industrial Economics	Non-Hydropower Dams and Water Supply Structures; Federal Land Management; Livestock Grazing on Federal Land; Transportation; Utility Line Projects; Instream activities (excluding dredging); Dredging; NPDES-permitted Activities; Sand and Gravel Mining; Residential and Commercial; Agricultural Pesticide Applications

Appendix B3 cont'd.

Act	Species	Action(s)	Date	Labor		Threats
				NMFS	Contract	
ESA (cont'd)	**West Coast Salmon and Steelhead**	(4b2 analysis) Economic Analysis of Critical Habitat Designation for 12 West Coast Salmon and Steelhead ESUs	2005	Mark Plummer	Industrial Economics	Non-Hydropower Dams and Water Supply Structures; Federal Land Management; Livestock Grazing on Federal Land; Transportation; Utility Line Projects; Instream activities (excluding dredging); Dredging; NPDES-permitted Activities; Sand and Gravel Mining; Residential and Commercial; Agricultural Pesticide Applications
	West Coast Salmon and Steelhead	Final Regulatory Flexibility Analysis	2005		Northern Economics	Non-Hydropower Dams and Water Supply Structures; Federal Land Management; Livestock Grazing on Federal Land;Transportation; Utility Line Projects; Instream activities (excluding dredging); Dredging; NPDES-permitted Activities; Sand and Gravel Mining; Residential and Commercial; Agricultural Pesticide Applications
	Middle Columbia River Steelhead	(4f Recovery Planning) Recovery Action Costs	2006	Mark Plummer		
	Ozette Lake Sockeye	(4f Recovery Planning) Recovery Action Costs	2007	Mark Plummer		
	Lower Columbia River Salmon and Steelhead	(4f Recovery Planning) Recovery Action Costs	2009	Mark Plummer		
	Eulachon	(4b2 analysis) EA of Critical Habitat Designation	2011		Industrial Economics	Dredge disposal, dam removal (ELWHA), dam operation (MAYFIELD)
	Puget Sound Steelhead	(4b2 analysis) EA of Critical Habitat Designation for the Puget Sound Steelhead ESU	Ongoing		Industrial Economics	Hydropower, water pollution, development, forestry, ranching, mining, oil and gas, marinas
	Lower Columbia River Coho	(4b2 analysis) EA of Critical Habitat Designation (DRAFT)	2012		Industrial Economics	Hydropower, water pollution, development, forestry, ranching, mining, oil and gas, marinas

Appendix B3 cont'd.

Act	Species	Action(s)	Date	Labor		Threats
				NMFS	Contract	
ESA (cont'd)	**Puget Sound Rock Fish**	EA of Critical Habitat Designation (DRAFT)	2013		Industrial Economics	Commercial and recreation fishing, hydropower, water pollution, development, transportation, utilities, mining
	Abalone	EA with the Critical Habitat Designation	2011		Ocean Associates	Kelp harvesting, dredging in-water, construction or alterations, point source pollution, agricultural pesticide application, bottom trawl fisheries, dams, water diversions; nonnative species, restoration, commercial shipping, power plant, desalination plant, tidal energy projects, aquaculture, LNG projects
	Sturgeon	EA of the Impacts of Designating Critical Habitat	2009		Industrial Economics	Dredging in-water, construction or alterations, point source pollution, agricultural pesticide application, bottom trawl fisheries, dams, water diversions; nonnative species, restoration, commercial shipping, power plant, desalination plant, tidal energy projects, aquaculture, LNG projects

Appendix B4. Southeast Regulatory History

Act	Species	Action(s)	Date	Labor		Gear
				NMFS	Contract	
MMPA	Right Whales	(EA) Gillnet Prohibition	2002	John Vondruska		Sink Gillnet
		(EIS) Critical Habitat Designation	2004		Tetra Teck	
		(EA) Seasonal Gillnet Prohibition	2006	Denise Johnson		Sink Gillnet
	Bottlenose Dolphins	(EIS) Gear Modification & Closures	2005	Stephen Holiman		Sink Gillnet
		(EIS) Gear Modification & Closures	2008	Stephen Holiman		Sink Gillnet
		(EIS) Gear Modification & Closures	2014	SEFSC/Stephen Holiman		Sink Gillnet
ESA	Turtles	(EIS) TEDs	2003	Mike Travis		Shrimp Trawls
		(EA) TEDs	2004	Bob Hoffman/Stephen Holiman		Shrimp Trawls
		(EA) TEDs	2010	Michael Barnette/Stephen Holiman		Shrimp Trawls
		(EA) Interim Gear Restriction	2009	Stephen Holiman		Bottom Longlines
		(EA) Emergency Gear Restriction	2009	Stephen Holiman		Bottom Longlines
		(EIS) Gear Restriction	2009	Stephen Holiman		Bottom Longlines
	Gulf Sturgeon	(EIS) Critical Habitat	2000	Fish & Wildlife Service		
	Smalltooth Sawfish	(EIS) Critical Habitat	2009		Tetra Teck	
	Coral	(EIS) Critical Habitat	2007	Denise Johnson		
		(EA) Acropora	2007	Denise Johnson		

Appendix B5. Northeast Regulatory History

Act	Species	Action(s)	Date	Labor		Threats	
				NMFS	Contract	Commercial Fishery	Ship Strikes
MMPA	Right Whales	(EA) Gear Modifications & Closures	1997	Eric Thunberg		Sink Gillnet, Lobster & all Pots	
		(EA) Gear Modifications	2000	Kathryn Bisack		Sink Gillnet, Lobster & all Pots	
		(EA) Gear Modifications and Seasonal Area Management (SAM) Closures	2001	Kathryn Bisack		Sink Gillnet, Lobster & all Pots	
		(EA) Gear Mod & Dynamic Area Management (DAM) Closures	2002	Kathryn Bisack		Sink Gillnet, Lobster & all Pots	
		(EIS) Broad Based Gear Mod (Horizontal Lines)	2006		Industrial Economics	Sink Gillnet, Lobster & all Pots	
		(EIS) Ship Strike Rule	2009		Nathan Associates		Ships
		4(b)(2) Critical Habitat Designation	2012	Tammy Murphy			
		(EIS) Gear Modification (Vertical Lines)	2014		Industrial Economics	Sink Gillnet, Lobster & all Pots	
	Harbor Porpoise	(EA) Final Draft GOM TRP Closures and Pingers	1996-1998	John Walden		Sink Gillnet	
		(EA) Gear Mod & Closures	2000	John Walden		Sink Gillnet	
		(EA) Gear Mod & Closures	2008	Kathryn Bisack/Gisele Magnusson		Sink Gillnet	
		Consequential Closure Removal	2014	Kathryn Bisack		Sink Gillnet	
ESA	Loggerhead Turtles	(EA) Leader Prohibitions/Restrictions Closures	2004	Kathryn Bisack		VA Chesapeake Bay Poundnet	
		(EA) Modified Leader Requirements	2006		Gisele Magnusson	VA Chesapeake Bay Poundnet	
		Modified Leader Inspection Program	2008		Gisele Magnusson	VA Chesapeake Bay Poundnet	
		(EA) Chain Mat Gear Modifications	2008	Kathryn Bisack		Scallop Dredge	
		TEDs (Economic Analysis completed - no rule)	2010	Kathryn Bisack		Bottom Trawl	
	Atlantic Salmon	(EIS) Critical Habitat	2009		Industrial Economics		
	Atlantic Sturgeon	(EIS) Critical Habitat	TBD		Industrial Economics		

Appendix C1: NOAA Fisheries' Protected Resources Science Investment & Planning Process (PRSIPP)

NOAA Fisheries' Protected Resources Science Investment & Planning Process (PRSIPP): Overview, Accomplishments, Future

Lisa T. Ballance
Director, Mammal & Turtle Research Division
NOAA Fisheries, Southwest Fisheries Science Center

Economics of Protected Resources Workshop
9 September 2014

on behalf of M. Srinivasan, L. Barre, J. Bengtson, S. Bettridge, K. Bisack. S. Brown, C. Fahy, M. Ford, L. Garrison, N. LeBoeuf, R. LeRoux, F. Parrish, E. Seney, M. Simpkins, T. Vardi
NOAA Fisheries Science Centers, Regional Offices, HQ Offices of Science & Technology and Protected Resources

Some Context

Our Primary Mandates and Associated Information Needs

Marine Mammal Protection Act – Maintain populations at "Optimum Sustainable Levels" and as functioning elements of their ecosystem

- Stock structure
- Population size
- Human-caused mortality

Endangered Species Act – Prevent extinction and recover species

- Distinct Population Segments
- Population size
- Trends in abundance
- Threats

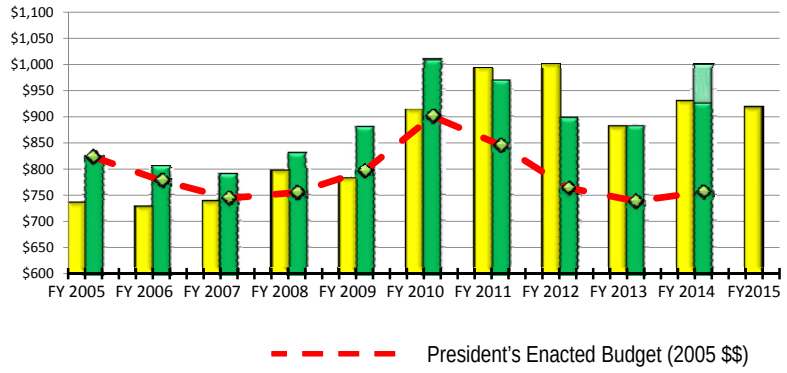
Our Science Mission

1. **Assess** species relative to management objectives
2. Mitigate threats
3. Support users of our data
4. Educate and build capacity
5. Advance the science of management and conservation

Five components of assessment:

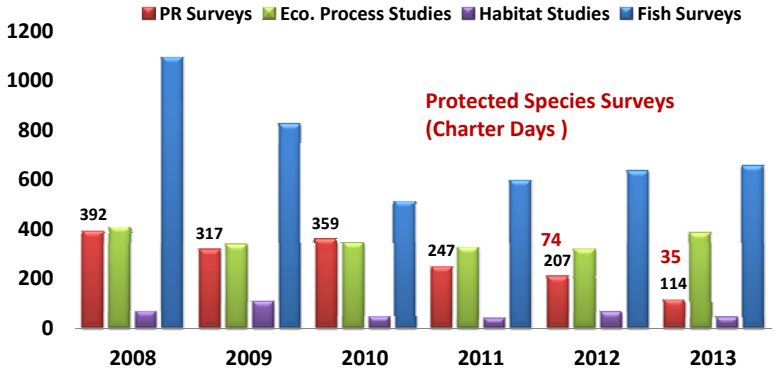
- Estimate abundance
- Monitor status and trends
- Clarify population structure
- Assess condition and health
- Place the above in an ecosystem context

NOAA Fisheries' budget is trending up, but accounting for inflation, we are currently operating below 2005 levels.



Among the many consequences of this is that our base allocation can now barely cover our permanent labor costs (leaving little to nothing left for implementation of field and laboratory science).

For example, we have experienced a decreased number of days for NOAA ships to conduct marine mammal research (although this trend too is up for 2014).



At the same time, demands for protected species science and management actions are increasing.

93 Endangered or Threatened species (80 more proposed)

Annually
- 1200-1500 ESA Section 7 Consultations
- 500+ permit requests
- 100 marine mammal incidental take evaluations

In FY13, 80% of 400 protected species stocks lacked current and comprehensive information to inform management.

Of 243 marine mammal stocks, sustainable take estimates exist for only 152.

NOAA is an Environmental Intelligence Agency. (Dr. Kathryn Sullivan)

- We need steady investment in research infrastructure and data collection for development of strategic data products in support of resilient communities.

Challenges
= Opportunities

NMFS science provides a baseline for assessing risk to protected species, especially from activities associated with energy and defense.

Uncertain science leads to reduced ability to deal with complex ecological problems, uncertain management and stewardship decisions, and often, greater expense.

The Protected Resources Science Investment & Planning Process*

CORE MESSAGE: The increased demand for protected species science to address urgent management and regulatory needs requires a "growth industry"-type investment, to ensure that the country's priority defense and economic goals are achieved, while sustaining viable wild populations.

*PRSIPP – an improved business model

Goal

➢ Secure investment in science by identifying common needs and addressing them through enhanced partnerships (NMFS, NOAA, Federal Partners, & beyond)

Achieved through a simple and adaptive *process-oriented* approach

Audience

- Ourselves
  - NMFS Science Centers, Regional Offices, Offices of S&T and PR
- NMFS Leadership Council
- Other NOAA Line Offices
- External Federal Partners (esp. energy and defense)

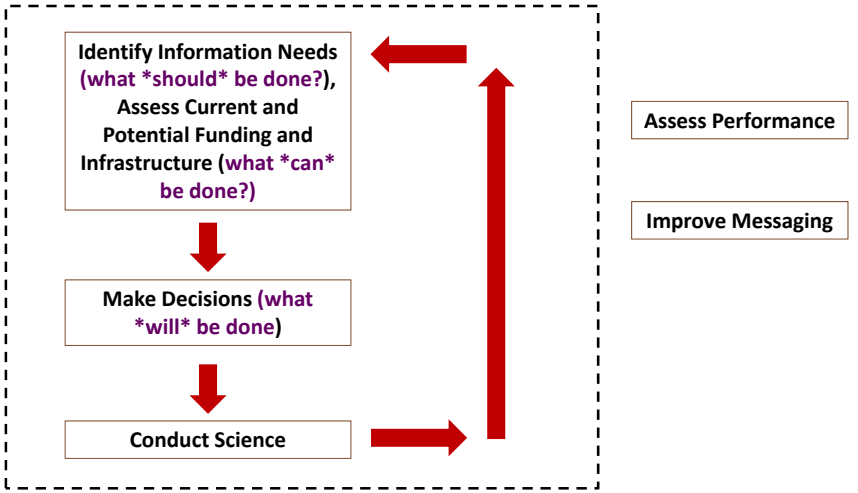
Scalability

- Focal Taxa
  - Initial development mammal/turtle-centric
  - Deliberately scalable to other protected species
- Process designed to occur at multiple scales in space and time
  - Regional, National, Across multiple Federal Agencies
  - Annual and greater (corresponding to information need and budget cycle timelines of NMFS and other external partners)

Benefits

- Improved communication and match between science needs and science conducted
  - Regional level (Science Centers, Regional Offices, HQ)
  - Agency level (Science Board and Leadership Council)
  - External partners and constituents
- Increased transparency
  - w/r/t what science is conducted and why
- Enhanced collaboration, complementarity, and investment in science

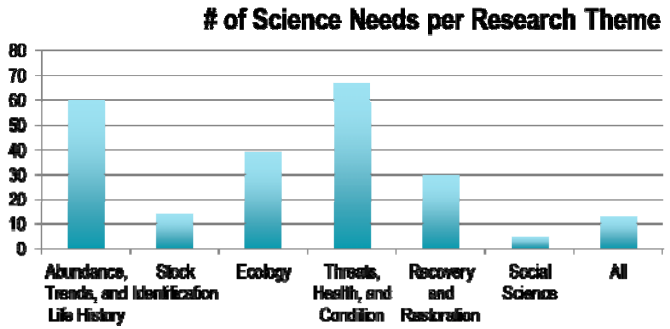
The "Process"



Accomplishments*:

*Since PRSIPP inception ~2012

- Tighter linkages between science & management within NMFS
- Incorporation of management needs into science planning, prioritization, and implementation



Accomplishments:

- Tighter linkages between science & management within NMFS
- Incorporation of management needs into science planning, prioritization, and implementation

- Tighter linkages within NOAA, across Federal Agencies

Accomplishments:

- Tighter linkages

- Identification of "common information needs" – the basis for partnerships and leveraging of expertise, funding, infrastructure

An example from "the process" in 2013

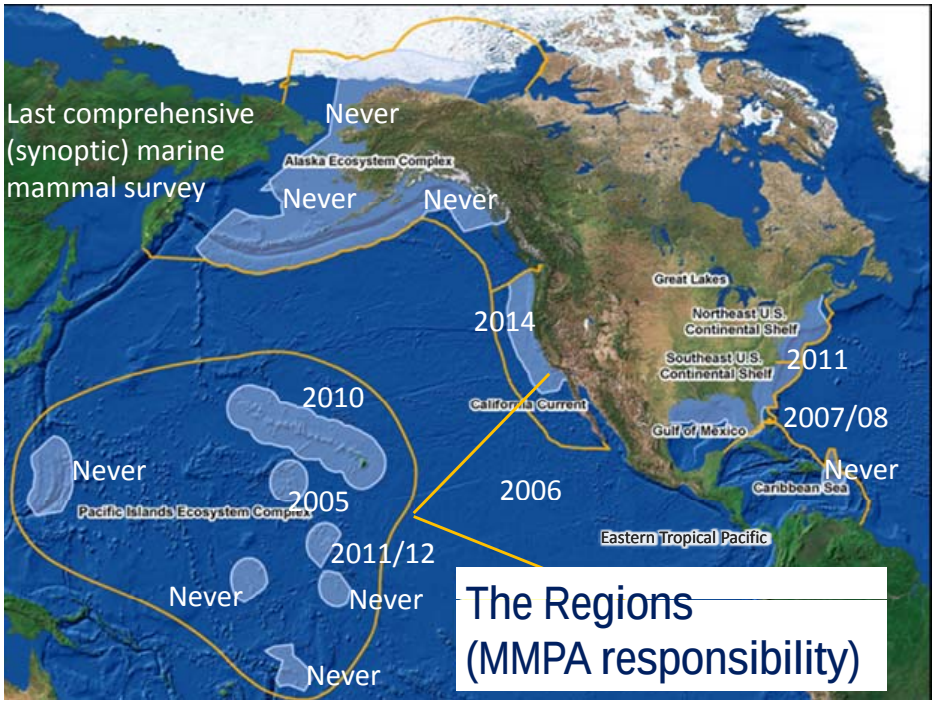
- A Common Information Need: NOAA Fisheries managers & scientists, other Federal agencies (energy & defense)

➢ Long-term data on marine mammal* distribution and abundance, and an ecosystem context

* Protected Species

Addressing a Common Need

- A proposal to conduct multispecies marine mammal & ecosystem assessment surveys



The Survey Model

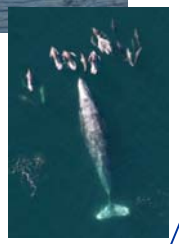
- A multispecies, multidisciplinary approach

Abundance & Trends

Biology

Population Structure

Health, Condition

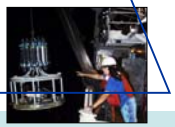


Ecosystem Assessment

Apex Predators

Low- and Mid-Trophic Fishes and Invertebrates

Physical and Biological Habitat



A Proposed Survey Cycle

- Accomplished with NOAA ships, leveraged funding from Federal partners
- ➢ A successful model in the Atlantic and California Current (NOAA, energy, defense)

Year	Regions to be Surveyed	Days Required
1	E Coast, W Coast, Bering Sea, Chukchi Sea, Palmyra & Kingman, Jarvis	488
2	E Coast, W Coast, Bering Sea, Chukchi Sea, Commonwealth of N Mariana Islands	534
3	Gulf of Mexico, Gulf of Alaska, Howland & Baker	328
4	Gulf of Mexico, Gulf of Alaska, Johnston	322
5	Caribbean, ETP, American Samoa, Wake	443
6	Caribbean, Hawaiian Archipelago	306

Accomplishments:

- Tighter linkages
- Identification of “common information needs”

- Internal funding initiative

Accomplishments:

- Tighter linkages
- Identification of “common information needs”
- Internal funding initiative

- Elevated awareness and interest
  - Key presentations & meetings

Marine Mammal Science & Management Priorities: a way forward through identification of common needs

Lisa T. Ballance Ph.D.
Director, Mammal & Turtle Research Division
NOAA Fisheries, Southwest Fisheries Science Center

Annual Meeting of the U.S. Marine Mammal Commission
Washington D.C., 6-8 May 2014

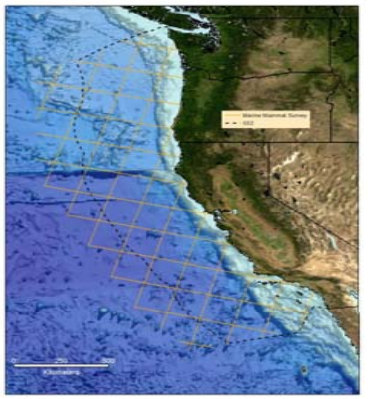
on behalf of M. Srinivasan, L. Barre, J. Bengtson, S. Bettridge, K. Bisack. S. Brown, C. Fahy, M. Ford, L. Garrison, N. LeBoeuf, R. LeRoux, F. Parrish, E. Seney, M. Simpkins, T. Vardi, L. VanAtta
NOAA Fisheries Science Centers, Regional Offices, HQ Offices of Science & Technology and Protected Resources

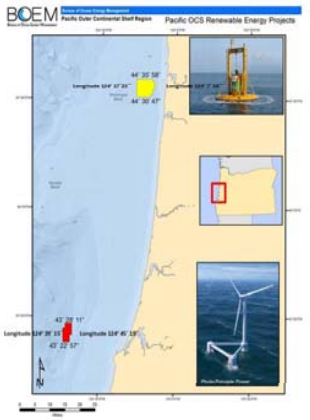
Accomplishments:

- Tighter linkages
- Identification of “common information needs”
- Internal funding initiative
- Elevated awareness and interest

- Strengthened existing partnerships, creation of new ones

Navy, BOEM, NOS partner with SWFSC to conduct a multispecies cetacean & ecosystem assessment survey in the California Current Ecosystem, fall 2014

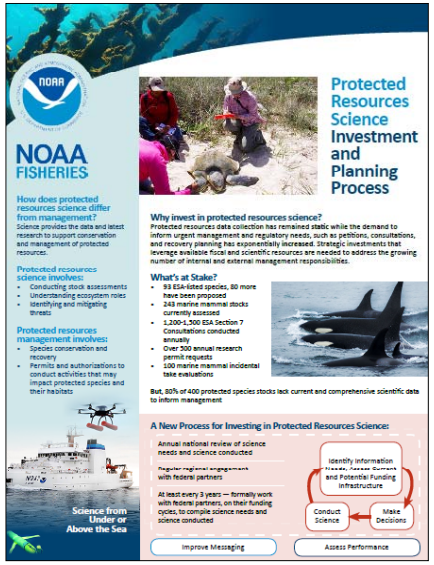


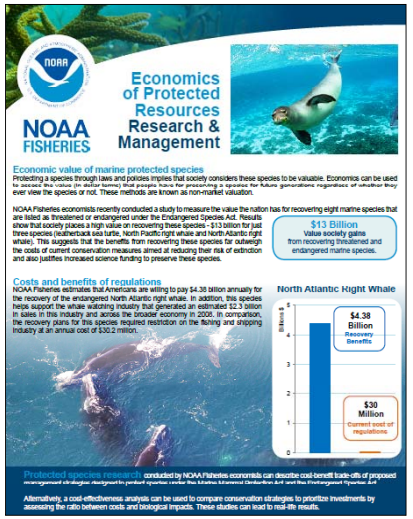


Accomplishments:

- Tighter linkages
- Identification of “common information needs”
- Internal funding initiative
- Elevated awareness and interest
- Strengthened/new partnerships

- Improved messaging





NOAA Fisheries PRSIPP: Benefits of our approach

- Consistent science planning and implementation agency-wide
- Move from ‘Triage’ to ‘Proactive’
- Increased transparency on what science is conducted and why
- Improved communication and synergy between NOAA Fisheries science & management, and across Federal agencies
- Diversified support for science

Appendix C2: Economic Analysis of Protected Resources Regulation

Economic Analysis of Protected Resources Regulation

NOAA FISHERIES
Alaska Region

Lewis E. Queirolo, Ph.D.
Senior Regional Economist

Economics of Protected Resources (PR) Workshop
September 9, 2014
La Jolla, California

A 'VERY' BRIEF OVERVIEW ... AUTHORIZING LAW

Sources of regulatory authority:

- MMPA
- ESA
- MSA
- NEPA
- APA

The Principal Mandates for Economic Documentation in Support of Rulemaking

- Executive Order 12866
  (Guidance from OMB Circular A-4)
- The Regulatory Flexibility Act
  (Guidance from Small Business Admin.)
- ESA Section 4 §4(b)(2)

In 'Rule-making', NMFS typically prepares an '*Integrated Analytic Package*'
[e.g., EIS/RIR/IRFA; RIR/Preparatory 4(b)(2)/RFAA].

Executive Order 12866

- Requires 'Comprehensive' Regulatory Impact Review

"Costs and benefits shall be understood to include both quantifiable measures (to the fullest extent that these can be usefully estimated) and qualitative measures of costs and benefits that are difficult to quantify, but nevertheless essential to consider …"

- Include economic, environment, public health and safety, and any other relevant benefits or costs; distributive impacts; and equity.

RIR is 'inclusive' and 'exhaustive'. '**Identify**' winners, losers, timing and size of expected impacts; however, '***equity***' criteria are exogenously determined by policy-makers.

- Mandatory use of *Benefit Cost Analysis* (BCA) Framework

OMB Circular A-4 expressly and repeatedly discourages use of CEA, noting, in relevant part, *that one typically will not have a single, unique, homogeneous benefits function, making meaningful 'benefit' comparisons problematic.*

Executive Order 12866
(cont.)

- Conduct BCA of alternatives *vis-à-vis* No Action

The analytic 'baseline' is No Action. Evaluate comparative strengths and weaknesses of each competing action alternative in achieving regulatory objectives, contrasted with not regulating. Identify critical assumptions, data limitations, caveats, and uncertainties.

- Requires National Accounting Stance

Maximize '*net benefit to the Nation*'. An RIR may *supplement* the BCA – but must separate benefits & costs from economic *impacts*. Limit RIR to residents of the United States.

- Impact analyses are sequentially dependent

Defining the Objectives, Purpose & Need, and Action Alternatives are *strictly reserved* for the decision-maker, never the purview or responsibility of the analyst. Biological, temporal, and physical dimensions; policy, institutional, and political parameters are precursory to economic analyses.

Executive Order 12866
(cont.)

- CHD economic analysis depends on '*pre-specified*' physical parameters

Those proposing regulation must identify the '*essential features*' (PCEs) that define critical habitat; then precisely demarcate the physical boundaries thereof, special management needs, mechanisms of 'adverse mod' ... *before* the RIR can be conducted.

- Seek unique '*attribution*' of benefits and costs to each action alternative

Adverse modification of CH is defined through changes to the specific PCEs. Thus, PCEs must be "quantifiable" and "measurable" ➔ *attributable impacts* (to some level of probability).

- Summarize RIR findings: relative performance; net benefit conclusion(s); impact attribution

Section 4 ESA 4(b)(2) Analysis

- Substantially Narrower Economic Question

For any *particular area,* within the proposed CHD, upon a determination that the benefits of exclusion outweigh the benefits of designation, the SOC has the *discretion* to exclude.

- Confine geographic dimensions of BCA to each '*particular area*' considered for exclusion

Estimate benefit of 'inclusion' and benefit of 'exclusion' *comprehensively*, treat in the same manner as prescribed under EO12866 (i.e., monetize, quantify, measure qualitatively, leaving none out).

- § 4(b)(2) also provides for non-economic exclusions and exemptions

Section 4 ESA 4(b)(2) Analysis
(cont. - CHD)

- Benefits w/ and Benefits w/o

To fully comply with the mandates of E.O.12866 and RFA, as well as communicating strictly '*comparable economic measures*', the 4(b)(2) 'benefits' analysis must extend beyond arbitrary '*conservation rankings*' or '*annualized average revenues*' for each *particular area* being considered for exclusion.

- Bottom line – What Does 4(b)(2) mean?

Under the ESA, the *only direct consequence* of CHD is to require Federal agencies to ensure, through Section 7 consultation, that any action they fund, authorize, or carry out does not *destroy or adversely modify* designated critical habitat.

Regulatory Flexibility Act

- When contemplating Federal regulations, seriously consider *adverse economic impacts on 'small' entities.*

"Small entities" may be small businesses, small non-profits, small government jurisdictions. SBA establishes definitional thresholds for each category (e.g., total annual gross receipts, numbers of employees, population size, affiliations). Only directly regulated small entities are relevant to RFAA.

Ask: "*Does the proposed action have the potential to impose significant adverse economic impacts on a substantial number of small entities*?"

No … *Certify*, companied by the supporting 'factual basis'. -- We have met RFA obligation

Yes … Prepare a Regulatory Flexibility Act Analysis (RFAA)

"*Significant …*" and "*substantial …*" are only relevant to the Certification stage. They do not carry forward into the RFAA.

What must the RFAA contain?

- The Initial Reg. Flex. Analysis (IRFA) must provide

(1) A description of the reasons why action by the agency is being considered;

(2) A succinct statement of the objectives of, and legal basis for, the proposed rule;

(3) A description and, where feasible, an estimate of the number of small entities to which the rule will apply (i.e., directly regulate);

(4) A description of the projected reporting, recordkeeping and other compliance requirements of the proposed rule, including the type of professional skills necessary for preparation of the report or record;

(5) An identification of all relevant Federal rules, which may duplicate, overlap, or conflict with the proposed action;

(6) A description of any 'significant alternatives' to the proposed rule (i.e., the selected action) that accomplish the stated objectives of the proposed action and that would minimize any significant adverse economic impact of the proposed rule on small entities.

What must the RFAA contain? (cont.)

- At the end of the public comment period, NMFS must prepare a Final Reg. Flex. Analysis (FRFA) containing:

(1) A succinct statement of the objectives … ;

(2) A summary of the significant issues raised by the public comments in response to the IRFA, a summary of the assessment of the Agency of such issues, and a statement of any changes made in the proposed rule as a result of such comments;

(3) A description and estimate of the number of small entities … ;

(4) A description of the projected reporting, recordkeeping and other compliance requirements … ;

(5) A description of the steps the Agency has taken to minimize the significant adverse economic impact on small entities, consistent with the stated objectives of applicable statutes, including a statement of the factual, policy, and legal reasons for selecting the alternative adopted in the final rule, and the reason that each one of the other *significant alternatives* to the rule considered by the Agency which affect small entities was rejected.

That's it …

QUESTIONS ?

Thank you

Appendix C3: Economic Supports of Protected Resources in Pacific Islands Region

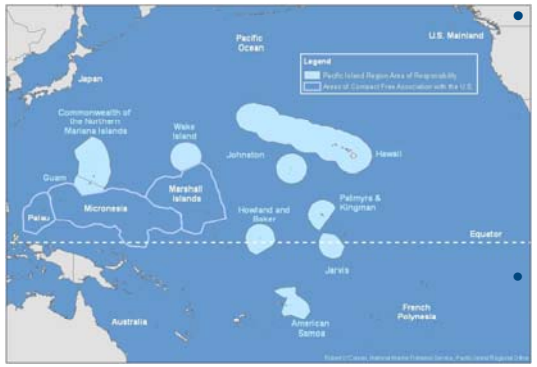
Economic Supports of PR in Pacific Islands Region

NOAA FISHERIES
PIFSC

Dr. Minling Pan

September 9, 2014
Economics of Protected Resources Workshop 2014
La Jolla, CA

Pacific Islands Region Areas



- Areas of responsibility
  - Hawaii
  - Guam
  - CNMI
  - PRIAs (Pacific remote island areas)
- 48% of total U.S. EEZ

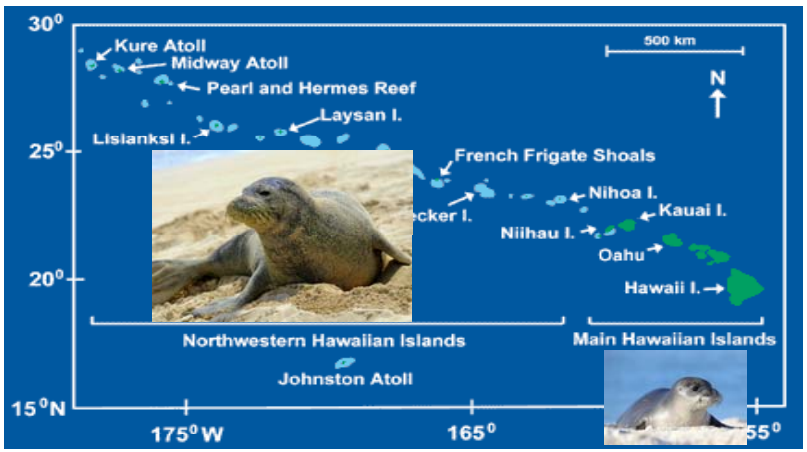
Pacific Islands Region PR

- Species in concerns: monk seal, cetaceans, turtles, & corals

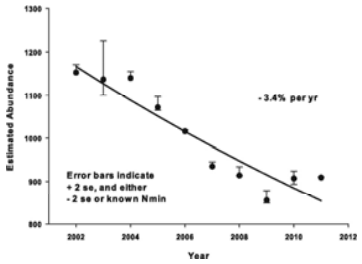
1	P	Marine Mammals	Central Pacific EEZ regions	Various	Various	Problems
2	P	Marine Mammals	Hawaii EEZ	Hawaiian monk seal (Monachus scha	Endangered	Failure of NOAA to achieve monk seal recc
3	P	Marine Mammals	Hawaii EEZ	Hawaiian monk seals (Monachus sch	Endangered	Takes of ESA listed species occuring in Fede
4	P	Marine Mammals	Hawaii EEZ	Hawaiian monk seal (Monachus schu	Endangered	Potential for catastrophic disease event: sh
5	P	Marine Mammals	Hawaii EEZ	Hawaiian Monk Seal (Monachus sche	Endangered	Loss of demographic resolution will impair
6	P	Marine Mammals	Hawaii EEZ, Guam EEZ, CNMI EEZ	All cetaceans	Endangered	lawsuit:
7	P	Marine Mammals	Hawaii EEZ, Guam EEZ, CNMI EEZ,	All cetaceans	Endangered	continued high cost of ship-based surveys
8	P	Marine Mammals	Hawaii EEZ, Guam EEZ, CNMI EEZ, Americ	False killer whales (Pseudorca crassic	Endangered	fishery closure, lawsuit:
9	P	Marine Mammals	Hawaii EEZ, Guam EEZ, CNMI EEZ, Americ	Endangered large whales (Balaenopt	Endangered	Insufficient data for recovery plans
10	P	Marine Mammals	Hawaii EEZ, Guam EEZ, CNMI EEZ, Americ	Non-listed cetaceans (Balaenoptera edeni, Balaenopte		eventual lawsuit:
11	P	Marine Mammals	Hawaii EEZ, Main Hawaiian Islands, high-s	Hawaii False killer whales stock com	Endangered	lawsuits, fishery closure
12	P	Marine Mammals	Hawaii EEZ, Palmyra EEZ, high-seas (range	False killer whales (Pseudorca crassidens)		fishery closure, lawsuits
13	P	Marine Mammals	Main Hawaiian Islands	Main Hawaiian Islands Insular false k	Endangered	delay in ESA Critical Habitat and Recovery P
14	P	Marine Mammals	Main Hawaiian Islands	Hawaii spinner dolphin stock complex (Stenella longiro		population decline
15	P	Marine Mammals	Main Hawaiian Islands, American Samoa	Island-associated stocks- Hawaii spinner dolphin stock		lawsuits, ESA-listing actions
16	P	Sea Turtles	Central Pacific - Hawaii	hawksbill sea turtle	Endangered	extinction of the population in the near 25
17	P	Sea Turtles	Main Hawaiian Islands	green turtle	Threatened	lawsuit: from not dealing with disease risks
18	P	Sea Turtles	North Pacific	loggerhead sea turtle	Endangered	Inaccurate final rule, possible lawsuits from
19	P	Sea Turtles	North Pacific	leatherback sea turtle	Endangered	potential severe fishery regulations
20	P	Sea Turtles	North Pacific	leatherback sea turtle	Endangered	Improper assessments of population status
21	P	Sea Turtles	Northwestern Hawaiian Islands	green turtle	Threatened	lawsuit: due to inadequacy of dealing with c
22	P	Sea Turtles	Pacific Ocean (not ETP)	green turtle	Threatened	Region is split into different DPSs, recover
23	P	Sea Turtles	Pacific Ocean (not ETP)	hawksbill sea turtle	Endangered	Improper management strategies for recov
24	P	Sea Turtles	Pacific Ocean (not ETP)	hawksbill sea turtle	Endangered	Inadequate and Insufficient information on
25	P	Sea Turtles	South Pacific	green turtle	Threatened	Inaccurate assessments due to insufficient
26	P	Coral (15/20)	Guam	4 species	Threatened	What is Hot Now
27	P	Coral (15/20)	N. Marianas	2 species	Threatened	What is Hot Now
28	P	Coral (15/20)	A. Samoa	8 species	Threatened	What is Hot Now
29	P	Coral (15/20)	The Pacific Remote Island Areas	3 species	Threatened	What is Hot Now

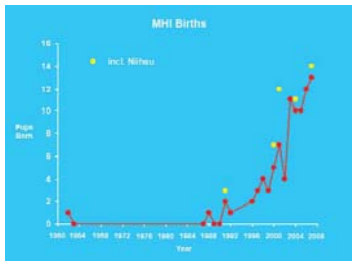
Concerns about Monk Seal (www.fpir.noaa.gov)

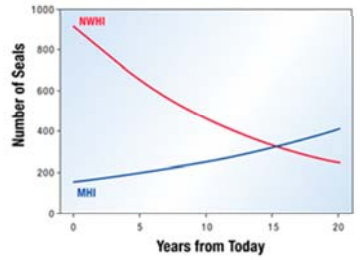
- Endangered marine mammal



Concerns about Monk Seal (www.fpir.noaa.gov)





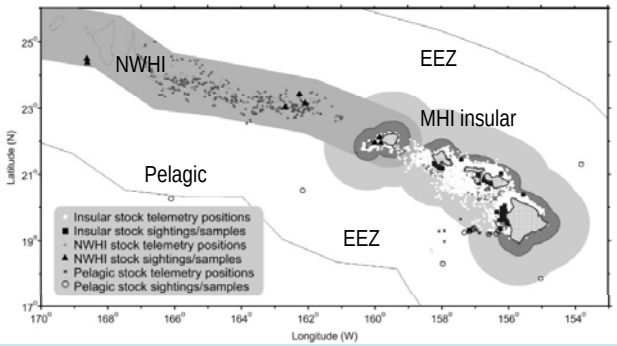


Why Monk Seal Is Coming to MHI?

- This is a question from biologists
  - ✓ Not coming, but newly born
- This is a question from fishermen
  - ✓ Are fishermen and monk seal are competitor for fish?
  - ✓ If yes, how many fish a monk seal eat in a day?
- Need to establish critical habitat
  - ✓ NWHI established in 1988
  - ✓ MHI in progress/proposed - Created a lot of fear
- Need for economic study
  - ✓ Post-regulation economic impacts (access to fishing ground and loss in food chain)

Concerns about False Killer Whale

- Three stocks (stock assessment report in 6/4/2014)
  - ✓ Main Hawaiian Islands (MHI) Insular – endangered ;
  - ✓ Northwestern Hawaiian Islands (NWHI) – not endangered;
  - ✓ Hawaii Pelagic – not endangered

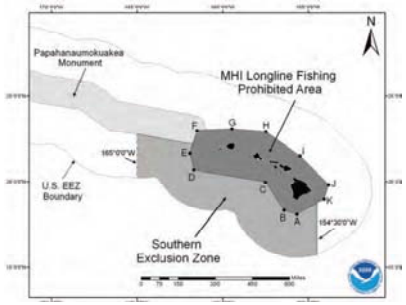


Interactions with Fisheries

	Potential Biological Removal (PBR)	Hawaii longline (Tuna set)	Hawaii longline (Swordfish set)
MHI insular	0.3	0.5*	0
NWHI	2.6	0	0
Hawaii Pelagic	9.1	24.8*	0.3

* MHI insular & Hawaii Pelagic are "Strategic" stocks: Take > PBR

Take Reduce Plan



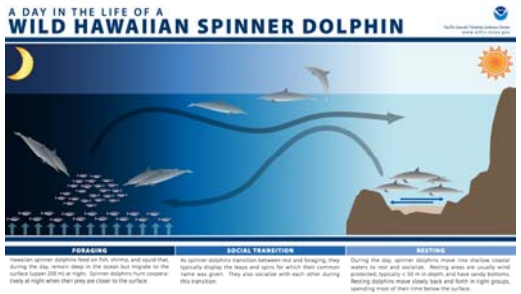
- The False Killer Whale TRT is the first TRT in the Pacific Islands;
- "Strategic" stocks: MHI insular & Hawaii false killer whale
- Regulations – different from the stocks
  - ✓ Types of hook and line;
  - ✓ No LL fishing zone in MHI insular;
  - ✓ Southern Exclusion Zone (will be closed after certain bycatch is observed)
- Need for Economic Study
  - ✓ Unknown recreational interactions
  - ✓ Non-market value of fishing activities

Spinner Dolphin

- Not listed as "threatened" or "endangered"
- Human disturbance on dolphins due to increasing tours (Swimming with dolphins)

Current Regulations

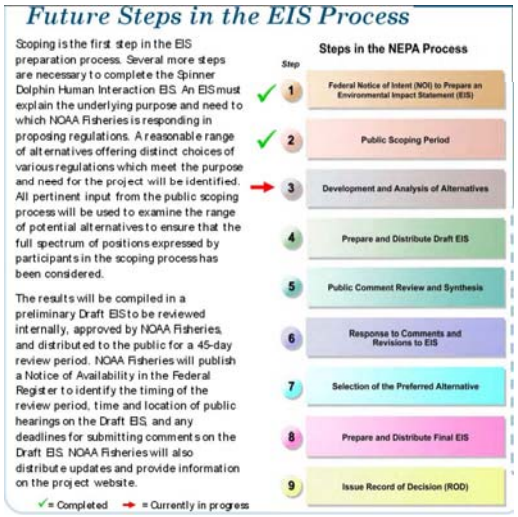
- Spinner dolphin rest at daytime near shore
  - ➢ Swimming with wild dolphins is getting popular
- PI Regional Guideline
  - ➢ DON'T feed, swim with, or harass wild dolphins.
  - ➢ We encourage you to observe them from a distance of at least 50 yards



To Change Regulations?

- Current viewing guideline (50 yards)
  - ✓ Not effective
  - ✓ Not enforceable
- Proposed rulemaking in December 2005
  - ✓ Encouraging viewing, not swimming
  - ✓ Restricting certain activities (in developing alternatives)

Regulatory in Progress

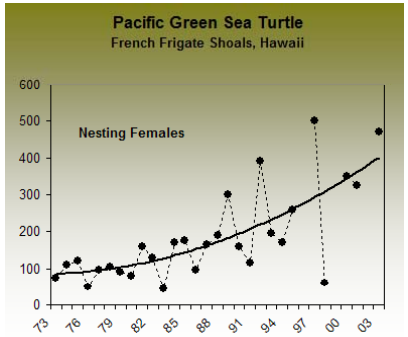


To Change Regulations?

- Current viewing guideline (50 yards)
  - ✓ Not effective
  - ✓ Not enforceable
- Proposed rulemaking in December 2005
  - ✓ Encouraging viewing, not swimming
  - ✓ Restricting certain activities (in progress)
- Questions of interests?
  - ✓ Industry scale and economic impacts (tours, medical healing related activities) https://www.youtube.com/watch?v=jnCQEmvvDlg
  - ✓ Non-market value of swimming with wild dolphins (non-tour participants)

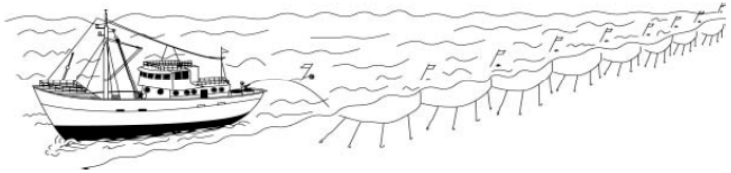
Sea Turtles

- Hawaii Green Sea Turtle
  - ✓ Endangered Species but recovered
  - ✓ Increased 53% over the last 25 years
- Rec. Fishing and Tourist interactions
  - ✓ Market value
  - ✓ Non-market value of human activities



Leatherback & Loggerhead Interactions with Longline

- Hawaii longline is the largest fishery with $100 millions revenue;
- Lawsuits started in 1999 led of swordfish longline close;
- Re-open with new regulations in 2004;
- Unstable fisheries and sea turtle catches.



Coral (15 of 20 species)

- Newly listed (all 15 species in territory areas)
  - ✓ Guam (4); North Mariana (2); American Samoa (8); Pacific remote island areas (3 species)
- Primary threats are related to larger global scale processes
  - ✓ Cost-benefit of small scale management actions
  - ✓ Market and non-market value of the resources

Economic Works Contracted by Regional Office

- Economic analyses for the **Hawaiian monk seal** (~critical habitat);
- Economic analyses for the insular **false killer whale** (~critical habitat) ;
- The Regulatory Impact Review (RIR) was done for the take reduction for **false killer whales**;
- The **monk seal** Programmatic Environmental Impact Statement (PEIS RIR) was done under NEPA.

Economic Works Related to Turtle Funded by the Council

- A study on the spillover effect of turtle regulation in Hawaii longine
  - ➢ Import increase
- A study for cost-effectiveness of alternative conservation strategies
  - ➢ Reduce bycatch in coastal areas and nesting beaches
- Social economic study and conservation education
  - ➢ Looking at improving social and economic condition of the communities in the nesting beaches

PR Economic Supports from PIFSC

	Interaction	Data Support	Analysis /Studies
Marine Mammals			
False Killer Whales	Hawaii Longline	√	
Hawaiian Monk Seal	Hawaii small boats	√	
Spinner Dolphins	Hawaii tourists	√	√
Sea Turtles			
Loggerhead & Leatherback	Hawaii	√	√

Any Questions?

Appendix C4

Steve Stohs
Southwest Fisheries Science – La Jolla

Steve Stohs presented for the SWFSC. The PR focus is on Highly Migratory Species (HMS) and more specifically swordfish fishery issues. The commercial swordfish and HMS shark fishery has used three gear types over recent decades: harpoon, drift gillnet (DGN) and shallow-set longline (SSL); only drift gillnet catches HMS shark at commercial volume. There are fishery interactions with large charismatic megafauna, both sea turtles and marine mammals. Management tools include time-area measures, gear restrictions, and critical habitat designation. Analyses include cost-benefit analysis to support critical habitat designation, regulatory impact reviews under alternative regulations

Critical Habitat Designation for leatherback sea turtles established in response to an NGO petition. Primary Constituent Elements in the initial proposal included obstruction of passage and forage areas; obstruction of passage was subsequently dropped, while areas where forage species (brown sea nettle jellyfish) are found were deemed worthy of protection. The initial economic analysis only considered cost effectiveness of protection, but this was extended to a benefit-cost approach for the final version. Protected habitat includes the area around Monterey Bay and some of northern coast.

The DGN and SSL fisheries profitably land swordfish at commercial volumes. There is a history of rare event ESA and MMPA bycatch and though there are years between interactions, it rises to a priority due to protection laws. In 2001, time-and-area closure regulations for leatherback and loggerhead sea turtles closed the primary swordfish fishing grounds to the north of Pt. Conception during the peak season (August 15-November). Other PR management tools to reduce DGN interactions include mandatory gear restrictions (e.g. 36’ net extenders, pingers and minimum 14” mesh size to exclusively target large pelagics).

The shallow-set longline swordfish fishery ramped up in the 1990s and peaked over the 1998-2004 fishing seasons, after which the West Coast based fishery effectively was shut down; the gear type was not included as a legal alternatives when the HMS FMP was adopted in 2004. After 2004, one exempted fishing permit application was submitted to the Pacific Fishery Management Council for a limited return of DGN effort to the area closed to protect leatherback turtles, and a second was proposed to establish a West Coast based limited entry longline fishery outside the 200 nmi EEZ limit which would utilize circle hooks and mackerel type bait to reduce sea turtle interactions. RIR work was initiated for the environmental assessments to support these measures, but they failed in the regulatory approval process before implementation, at which point the analysis to support them became moot.

Appendix C5: Protected Resource Economics in the Northwest Region

Science, Service, Stewardship

Protected Resources Economics in the Northwest Region

Dan Holland Northwest Fisheries Science Center

NOAA FISHERIES SERVICE

Holland, D.S. and J.E. Jannot 2012. Bycatch Risk Pools for the US West Coast Groundfish Fishery. *Ecological Economics* 78:132-47.

Species of Interest

- West Coast Salmon and Steelhead (multiple species and ESUs)
- Southern Resident Killer Whales
- Puget Sound Rockfish (three species)
- Green Sturgeon
- Eulachon
- Black Abalone

Primary Management Tools

- Habitat Conservation and Restoration
- Fish Passage
- Bycatch
- Prey Availability
- Rules to limit disturbance

Analyses

- Critical Habitat Designations - evaluation of costs or economic impacts of designations
- Regulatory Flexibility Act – economic impacts on small entities
- Regulatory Impact Review – costs of regulations such as vessel speed and approach distance
- Cost-effectiveness analysis of different methods of promoting salmon recovery in Wenatchee River watershed
- Non-market valuation of a set of closures to help conserve Puget Sound rockfish species
- Recreational Value of Wild and Hatchery Salmon.

Cost and Benefits of Critical Habitat Designations

- Section 4(b)(2) of the ESA -consider the economic, national security, and other impacts of designating a particular area as critical habitat
- Conceptually, the "benefits of exclusion," which is essentially the language used in section 4(b)(2) of the ESA, are identical to the "costs of inclusion,"
  - Define the geographic study area and identify the units of analysis.
  - Estimate the economic impacts associated with this change in management – both administrative and use modification.
  - Contracted out to Consulting Firms
  - Done for Salmon/steelhead, Killer Whales, Euchalon, Abalone, Sturgeon, Puget Sound rockfish

Activity types affected by critical habitat designation for the economic analysis for salmon:

- Hydropower dams
- Non-hydropower dams and other water supply structures
- Federal lands management, including grazing (considered separately)
- Transportation projects
- Utility line projects
- Instream activities, including dredging (considered separately)
- EPA NPDES-permitted activities

Regulatory Flexibility Act (RFA)

- Determine the number of small entities affected by critical habitat designations and estimate the economic impacts on these entities.
- Done for several protected species

Regulatory Impact Review (RIR)

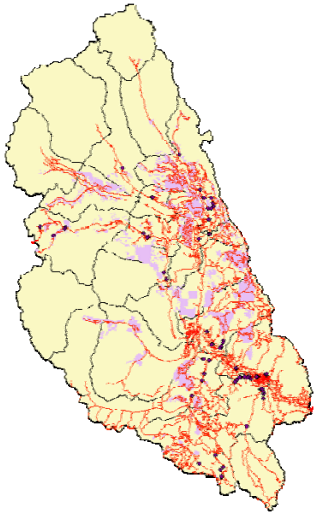
- RIR on vessel traffic regulations for Killer Whale rules
- Key focus on economic impacts on the Whale Watching Industry Found insufficient data to quantify costs of proposed rules

Conservation Banking and Mitigation Banking

- Conservation banking programs and mitigation banks that offset wetland conversion exit.
- No economic research on these programs

Cost-Effective Recovery Actions for Endangered Spring Chinook in the Wenatchee River Basin

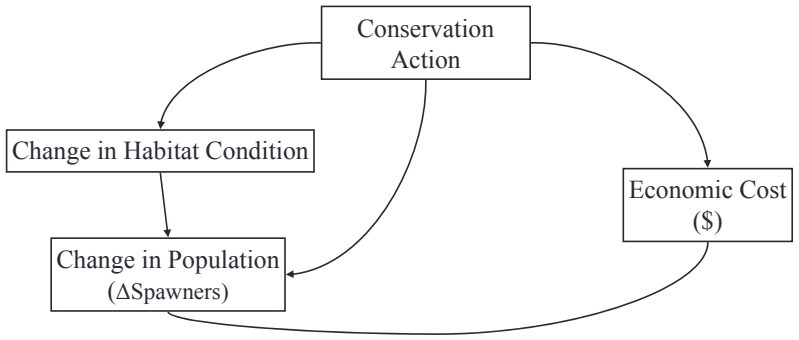
- "Biggest Bang for the Buck" analysis – Mark Plummer, Jeff Jorgensen, Jon Honea
- Combines biological models/data with economic data to assess cost-effectiveness of a suite of possible recovery actions for spring Chinook in the Wenatchee river basin



Honea *et al*. model: Habitat and other conditions to population response

System characteristics		Population response
Habitat condition in watershed Prespawn temperature Incubation temperature Summer temperature Fine Cobble Embeddedness Capacity in watershed Fry and spawner System condition Wild harvest Hatchery harvest Hatchery releases	→	Wild spawners Hatchery spawners

Cost-Effectiveness Analysis: Wenatchee river spring Chinook



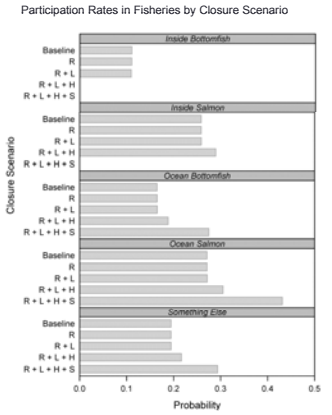
ΔSpawners/$ = Cost-effectiveness of action

Anderson, L. E., S. T. Lee, P. S. Levin. 2013. Costs of Delaying Conservation: Regulations and the Recreational Values of Rockfish and Co-occurring Species. Land Economics, 89(2):371-385.

Researchers used non-market valuation to estimate the changes in economic value from a set of closures that may be implemented in order to help conserve Puget Sound rockfish species

Four closures were examined incrementally: a rockfish closure; a rockfish and lingcod closure; a rockfish, lingcod, and halibut closure; and a rockfish, lingcod, halibut, and salmon closure

In addition to economic values, the study examined the amount of substitution that would occur to related fisheries



WTP for a Fishing Day by Closure Scenario

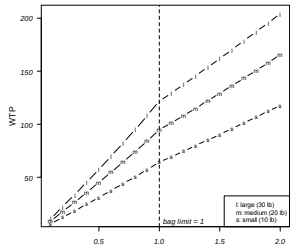
Closure Scenario	Mean	5th Percentile	Median	95th Percentile
R	$0.17	$0.08	$0.17	$0.30
R + L	$0.78	$0.36	$0.75	$1.34
R + L+ H	$48.47	$29.34	$46.93	$69.89
R + L + H + S	$215.80	$141.60	$214.20	$284.50

Anderson, L. E., S. T. Lee. 2013.
Untangling the Recreational Value of Wild and Hatchery Salmon. Marine Resource Economics, 28(2):175-197.

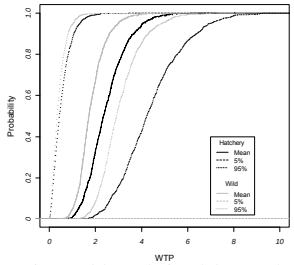
The researchers used a non-market value method to estimate the economic value of recreational fishing to anglers in WA and OR marine waters.

In particular, the study measured the economic value of catching coho and Chinook salmon, and tried to determine whether a fish's origin, "hatchery" or "wild", affects the value anglers place on either retained or released catch.

Significant differences in value are found between hatchery and wild salmon catch, especially for fish that must be released because of a bag limit. The effects of changes in bag limits and catch rates are examined.



Wild King WTP by Size and Catch Under a Bag Limit of 1



CDFs of WTP per Choice Occasion for Equivalent Increase in Catch

13

Potential Needs

- Welfare estimates for whale watching
- Evaluations to see whether cost estimates and economic impacts from prior studies (critical habitat cost, RIR, RFA) were accurate
- More cost-effectiveness work to prioritize actions to promote salmon recovery
- Valuation work to prioritize trade-offs in activities to promote salmon recovery (e.g. fast recovery vs. resilience)

14

Appendix C6: Economics Research and Regulatory Support: Protected Resources

Southwest Fisheries Science Center,
Fisheries Ecology Division - Santa Cruz

Economics Research and Regulatory Support: Protected Resources

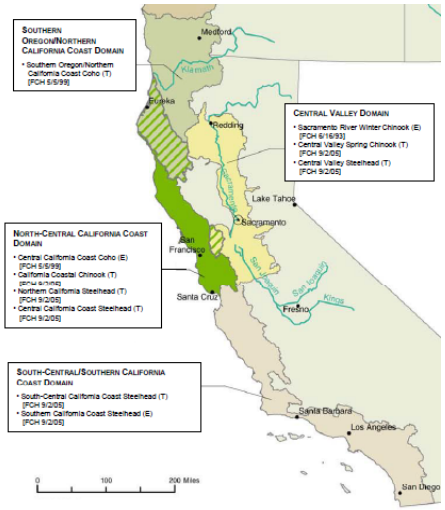
Southwest Fisheries Science Center
Fisheries Ecology Division
Santa Cruz

Cameron Speir
(along with Cindy Thomson and Aaron Mamula)

SWFSC - Santa Cruz (Fisheries Ecology Division)

Listed Salmonid Species – 9 ESUs

Species and ESU	*ESA Status*	Listed Updated
Sacramento R. Winter-run Chinook salmon	*Endangered*	1994 2014
Central Valley Spring-run Chinook salmon	*Threatened*	1999 2014
California Central Valley Steelhead	*Threatened*	2006 2014
Southern OR/Northern CA Coast Coho salmon	*Threatened*	2005 2014
Central California Coast Coho salmon	*Endangered*	2012 2014
California Coastal Chinook salmon	*Threatened*	1999 2014
California Coast Steelhead (3 ESUs)	*Threatened*	2006 2014



SWFSC – Santa Cruz PR Activities

Regulatory Support

- Klamath Dam removal
- Litigation Support: Biological Opinion, SF Bay Delta pumping operations
- Review of economic analysis: Bay Delta Conservation Plan, San Joaquin River restoration agreement

Research

- Effects of water supply changes on regional agriculture
- Groundwater management and instream flow
- Effect of energy development (hydraulic fracturing) on water quality, habitat, and regional economy

Economic Benefits/Costs and Economic Impacts of Removing Four Dams on the Klamath River

3-year DOI/NMFS collaboration

Copco 1 Dam

- **Management issue:** whether removal of four Klamath dams is in 'public interest'

Economic Benefits/Costs and Economic Impacts of Removing Four Dams on the Klamath River

3-year DOI/NMFS collaboration

Method: integrated models linking dam removal to

a) river hydrology

b) Chinook life cycle and population abundance

c) ocean troll, ocean sport, inriver sport and tribal fisheries – based on PFMC harvest control rule

Economic Benefits/Costs and Economic Impacts of Removing Four Dams on the Klamath River

Employment Impacts

Activity	Change	Duration
Dam removal	+1423	2020
Mitigation	+218	2018-25
KBRA Programs:		
Fisheries	+261	2012-26
Water Resources	+16	2012-26
Regulatory Assur	+10	2012-26
County	+?	2012-26
Tribal	+26	2012-26
Irrig agriculture	+29	2012-61
Refuge recreation	+5	2012-61
Dam O&MR	-49	2020-61
Reservoir rec	-4	2020-61
Whitewater rec	-14	2020-61

Activity	Change	Duration
Troll Chinook fishery:		
San Francisco	+218	2012-61
Fort Bragg	+69	2012-61
KMZ-CA	+19	2012-61
KMZ-OR	+11	2012-61
Central OR	+136	2012-61
Ocean rec Chinook fishery:		
KMZ-CA	+13	2012-61
KMZ-OR	+3	2012-61
Inriver rec fisheries:		
Chinook	+3	2012-61
Steelhead	+?	2012-61
Redband trout	+?	2012-61

Discounted Benefits and costs of Action Alternative 1 Relative to No Action
(discounted at 4.125% over 2012-2061, base year=2012)

Benefit Category	Benefit Million $		Cost Category	Cost Million $
Dam O&MR (cost savings)	188.9		Dam removal/mitigation	166.8
Irrigated agriculture	29.9		KBRA	472.1
Refuge recreation	4.3		Foregone hydropower	1,320.1
Troll Chinook fishery	134.5		Foregone reservoir rec	35.4
Ocean rec Chinook fishery	50.5		Foregone whitewtr rec	6.0
Inriver Chinook fishery	1.8			
Non-use value	15,645.0			
Total quantified benefits	16,054.9		Total quantified costs	2,000.4
Non-quantifiable benefits: Tribal fisheries/culture rec steelhead fishery rec redband trout fishery Reservoir bird watching Conflict resolution (KBRA)			Non-quantifiable costs: CO2 emissions	

Water Use and Impacts to Agriculture: San Francisco Bay Delta

Delta is the "hub" of the water supply system in California

Chinook, steelhead ESUs and Delta smelt affect the quantity and timing of water exports

There are real and perceived economic impacts

Water Use and Impacts to Agriculture: San Francisco Bay Delta

Inspiration: 2009 drought and Biological Opinions

Jobs vs. Fish

Author	Date	Agriculture	Non-agriculture
Howitt et al.	Jan 2009	*60,000 – 80,000*	
Howitt et al.	May 2009	*35,000*	
Michael	Aug 2009	5,000 – 6,500	5,000 – 6,500
Howitt et al.	Sep 2009	12,000	9,000
Michael	Dec 2009	4,400 – 6,300	2,500 – 3,500
Michael, Howitt	Dec 2010	3,500 – 4,725	2,000 – 3,000
Sunding et al.	May 2011	5,000	--
Howitt et al.	Jul 2011	9,800	--
Foreman	May 2013	6,900 – 9,000	--
Speir & Stradley	Jan 2014	5,500	0
Speir, Mamula & Ladd	Apr 2014	5,300	--

Water Use and Impacts to Agriculture: San Francisco Bay Delta

Estimating Economic Impacts of Irrigation Water Supply Policy Using Synthetic Control Regions: A Comparative Case Study

Cameron Speir and Eric Stradley

- Estimate job losses by comparing employment in affected counties to other counties
- Natural Experiment
  - Synthetic control group: Abadie et al. 2010
  - Concept similar to difference-in-differences

Effects of Water Supply on Labor Demand and Agricultural Production in California's San Joaquin Valley

Cameron Speir, Aaron Mamula, Daniel Ladd

Estimate structural model: labor demand and crop production as a function of water supply

- Production system: 1 variable input (labor), 1 quasi-fixed input (water), 7 crop categories
- Theoretically consistent (properties)
- Cross equation constraints: symmetry and allows calculation of crop substitution effects

Potential Economic Benefits of Fish Passage Above Dams for Central Valley Recreational Fisheries

What is probability that salmon anglers will fish in newly accessible areas?

Management issue: whether fish passage (ladders, dam removal) likely to yield recreational benefits

Method: Central Valley angler survey to collect data for recreational demand and location choice models

- effort and trip expenditures by waterbody type (rivers/creeks, lakes/reservoirs, Delta waterways), target species, and mode (bank, private boat, hired guide)
- non-trip expenditures
- angler demographics
- factors other than salmon CPUE that affect fishing location decisions (site accessibility, boat ramp, etc.)

Groundwater Management and Instream Flow
Spatial-Dynamic Problem

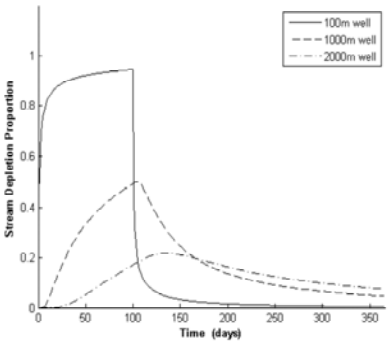
Optimization model: maximize farm profits subject to instream flow requirements

- Allocate ***daily*** water pumping to wells located at different distances from the stream
- Hydrologic model: stream-aquifer system where stream depletion effects vary across space and time (Glover-Balmer)

Groundwater Management and Instream Flow
Spatial-Dynamic Problem

1) Tradeoff between magnitude and duration of stream depletion effect. Optimal allocation of water across wells is differentiated over space and time.

2) In some cases in drought years, wells located closer to the stream should be allocated more water. Duration of the stream depletion effect is more important than the magnitude.

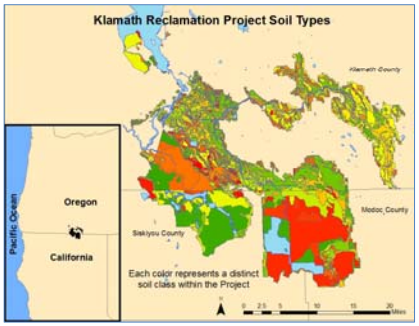


Economic Evaluation of Water Buyback Programs: A Study of the Klamath Water Bank

Objectives: evaluate the efficacy/economic efficiency of water buybacks as a strategy for freshwater salmonid habitat provision

Study Area: Klamath Irrigation Project in Northern California/Southern Oregon where land idling programs have been used since 2002 to reduce agricultural water diversion from the Klamath River

Methods:
- GIS modeling used to generate spatially explicit data on soil productivity
- Linear profit maximization model is constructed using agronomic production functions with decreasing marginal physical products
- Project level derived demand for surface water is generated using positive math programming to solve the profit maximization problem with relevant acreage and crop rotation constraints



Economic Evaluation of Water Buyback Programs: A Study of the Klamath Water Bank

Results:
- Results show that value of accepted land idling bids exceeded value of the water by 10%, 40% and 75% in low, medium and high baseline diversion scenarios, respectively.

Implications: A key finding of our study is that a portion of the wedge between observed payment and derived value can be attributed to the program's insistence on paying for land rather than water…a situation necessitated by the fact that water use is not monitored/measured/metered in the KIP.

Oil & Gas Development: Water Supply, Habitat, and Regional Impacts

Dissertation project – Duran Fiack, UCSC, Environmental Studies

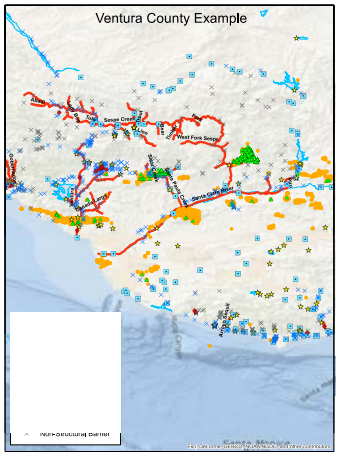
1. What are the impacts and risks to critical habitat, the agricultural sector, and regional economies from hydraulic fracturing in California?
2. Do impacts differ across space?
   - Inter-regional (macro): three regions with distinct water and ecological characteristics, different local institutions
   - Small scale (micro): siting issues, habitat connectivity, aquifer properties, population diversity, local geology
3. What polices and institutions will be (or should be) used to help mitigate these impacts?

Oil & Gas Development: Water Supply, Habitat, and Regional Impacts

Oil production occurs in watersheds with protected steelhead – Southern California Coast ESU

- Water quality
- Water quantity – instream flow
- Cumulative impacts analysis

Water reallocation in the southern San Joaquin Valley may affect the demand for Delta water



California Current Integrated Ecosystem Assessment (CCIEA) Pacific Salmon Component

Joint NWFSC/SWFSC Effort

- **Management context:** CCIEA is part of NOAA Integrated Ecosystem Assessment Program, goal being to facilitate more comprehensive and holistic management
- **CCIEA Pacific Salmon component:** ESA listings of 9 Chinook, 2 chum, 4 coho, 2 sockeye, 11 steelhead stocks
- **2014 CCIEA Pacific Salmon report:** status and trends of salmon abundance, environmental pressures (ocean/freshwater conditions, climate change), and human dimensions
  - ✓ Human dimensions: historical context – including legacy effects of fishing, farming, logging, mining, etc. on salmonids and their habitat – and recent trends in these industries
- **Next step:** management scenario analysis

Costs of Implementing Sacramento River Winter-Run Chinook Recovery Plan

- **Management issue:** address ESA requirement that Recovery Plan include "estimates of the time required and the cost to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal " (ESA Section 4(f)].
- **Approach taken by SWR:** estimate agency costs only (no NMFS-wide guidance)
- **Challenges:**
  - ✓ diversity of recovery actions and number of agencies involved (State and Regional Water Quality Control Boards, CA Fish & Game, Fish & Wildlife Service, Environmental Protection Agency, Bureau of Reclamation, Army Corps of Engineers, etc.)
  - ✓ high uncertainty in some cost estimates due to vagueness of some recovery actions (economist brought in at end)
  - ✓ isolating costs of Recovery Plan from salmon conservation costs associated with other laws/regulations/programs

Effects of Changes in Environmental Conditions and Hatchery Practices on Klamath River Chinook Population and Chinook Fisheries in California

SWFSC Santa Cruz, Humboldt State, UC Davis

Management issues:

- trade-off hatchery reform versus fisheries (which depend heavily on hatchery fish)
- distinguishing variability in abundance due to ocean conditions versus management actions that affect hatchery practices and river flows

Method: enviro-bio-economic simulation model for Klamath Chinook

- 100-year simulations of ocean conditions (upwelling, curl, sea surface temperature, sea level height) and river flow in monthly time steps
- Age-structured stock recruitment model linked to environmental simulations
- Stock abundance linked to commercial and tribal harvest and ocean and inriver recreational effort via PFMC harvest control rule
- Scenario analysis – how changes in hatchery practices and river flows affect stock structure/abundance and fisheries

Appendix C7: Northeast Protected Resources Regulatory History

Science, Service, Stewardship

NE Protected Resources (PR) Regulatory History

Kathryn Bisack

NOAA FISHERIES SERVICE

NOAA FISHERIES SERVICE

Outline

- Historical Context
- Regulatory Support & Staffing Snapshot
- Large Whales, Harbor Porpoise, and Sea Turtles
  - Questions:
    - What policy instruments are we using?
    - What needs more investigation: future direction?
- Final Comments

NOAA FISHERIES SERVICE

NE Historical Context

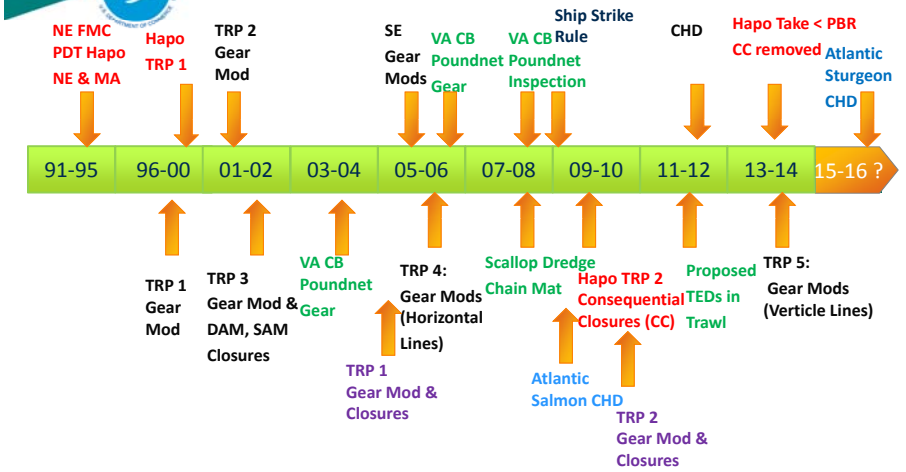
- 1991 – 2000
  - PSB forms (1991)
  - First Bycatch Estimates in 1992 (too high)
    - Recommend sampling at 10%
    - PDT form under FMC to reduce bycatch
  - 1994 Marine Mammal SARs
  - TRTs form (Lrg Whales, Hapo, Bottlenose)
  - PR economist (2000)
- 2000-Present
  - Turtle Team forms
  - Gear Researcher joins PSB
  - PSB responsibilities only to marine mammals and turtles
  - GARFO contracts out Large Whale economic regulatory work (Industrial Economics, Nathan Associates) as well as CHD for fish

NOAA FISHERIES SERVICE

Regulatory Support

Fishery Related Threats to

Large Whales, Harbor Porpoise, **Bottlenose**, Loggerheads, Fish



NOAA FISHERIES SERVICE

NE PR Dedicated Staffing
GARFO (42) > PSB (32) > SSB (1)

PSB **(18 FTE, 14 Contract)**	• Commercial Fishery Bycatch Analysts (3 FTE, 2 Contract • Large Whales & Small Cetaceans (8 FTE, 5 Contract • Turtles (1 FTE, 1 Contract) • Pinnipeds (1 FTE, 1 Contract) • Gear Speacilists (1 FTE, 1 Contract) • Acoustics (1 FTE, 4 Contract)
SSB **(16 FTE, 4 Contract)**	• Commercial (6 FTE, 3 Contract) • Recreational (1 FTE) • Eco-system (1 FTE) • **PR (1 FTE)** • BOEM (1 Contract) • Anthropologists (4 FTE)
GARFO PR Division **(42 Staff)**	• Marine Mammal & Sea Turtle Conservation (15 Staff) • Section 7 (9 Staff) • Endangered Species Coordinator (12 Staff)

5

NOAA FISHERIES SERVICE

Threats

- Fishery Related
  - Commercial
  - Recreational
- Non-Fishery
  - Offshore wind energy
  - Noise
  - Climate Change
  - Etc.

6

NOAA FISHERIES SERVICE

BCA for Fishery Related Threats

- Benefit
  - Reduction in PR bycatch
- Cost
  - Gear experiments to estimate how modifications impact direct catch (revenue losses)
  - Behavioral fishing effort shifts

7

NOAA FISHERIES SERVICE

Sea Turtles
Threats: Commercial, Recreational & Non-Fishery (See ITS)

- Regulatory Support: Loggerheads (5 Actions NMFS)

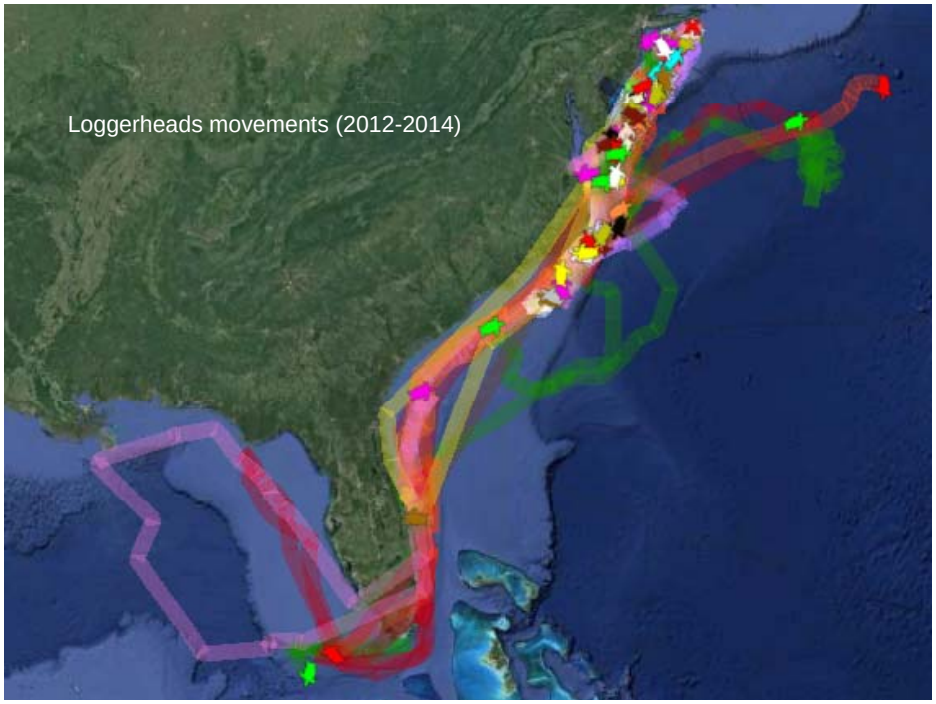
  VA Poundnet (3), Scallop Dredge (1), Bottom Trawl (1), Gillnet

  - Economic analysis for Trawl Rule to implement TEDS dropped by GARFO
  - 41 to 1 Cost ratio of saving a sea turtle in the flounder fishery in the Mid-Atlantic compared to Southern New England
- Policy Instruments

  Gear Modifications, Closures, Inspection Program

  Gear modification based on experimental work

8



NOAA FISHERIES SERVICE

Sea Turtles (2012)
ITS Total Takes (Not Lethal)
Atlantic: EEZ, GOM & Caribbean

		Loggerhead	Leatherback	No. FMPs
NER	Trawl	458	16	10
	Gillnet	199	12	6
	Dredge	161	1	1
	Poundnet	1		
SER	HMS Long Line	636	588	1
	Atlantic Shark	226	25	1
	Snapper Grouper	67	8	1
	Reef Fish	157	4	1
	Dolphin Wahoo	16	16	1
		1921	670	

10

NOAA FISHERIES SERVICE

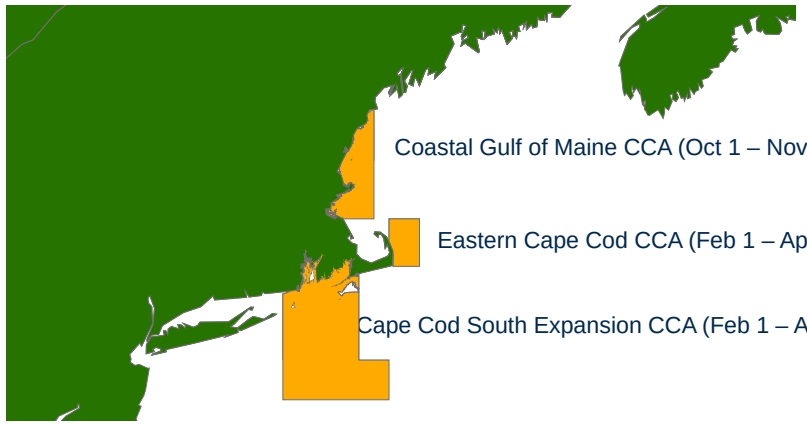
Harbor Porpoise
Threats: Fishery Related (Gillnet)

- Regulatory Support (2 Actions NMFS)
- Policy Instruments
  - Seasonal and Year-Round Fishery Closures
  - Gear modifications
    - Pingers in NE, experimental work in mid-90's
    - Physical alterations in Mid-Atlantic gear based on PSB bycatch analysis using NEFOP data
  - Pinger Compliance Deterrent: Consequential Closures

11

NOAA FISHERIES SERVICE

Consequential Closures
If non-compliance too high!



12

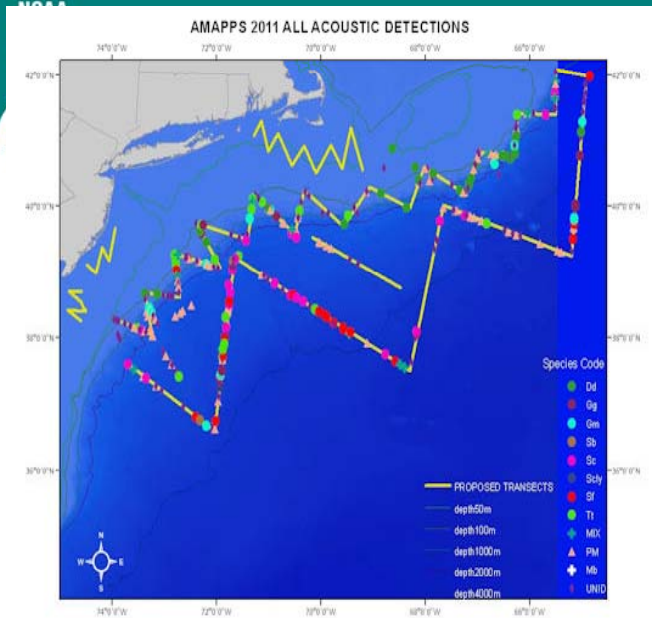
13

NOAA FISHERIES SERVICE

Large Whales (Right Whales) Threats: Fishery Entanglements, Ship Strikes, Other

- Opportunistic mortality data
- Regulatory Support (8 Actions)
  - Gillnet, Pots, Lobster Pots (5 NMFS, 2 Contract)
  - Ship Traffic Regulations (1 Contract)
- Policy Instruments
  - FMP: Gear Modifications, Seasonal & Dynamic Closures, Subsidies (to replace sinking line)
  - Shipping Rerouting (Voluntary), Speed Reductions

14



15

NOAA FISHERIES SERVICE

Other Regulatory Work Completed

- Bottlenose Dolphin (contract, SE)
- Atlantic Salmon CHD (contract)
- Atlantic Sturgeon CHD (forthcoming, contract)

16

NOAA FISHERIES SERVICE

GAPs we can address

- Turtles
  - CEA of Alternative Conservation Strategies for North Atlantic Loggerhead and Leatherbacks.
    Expand upon (Gjertsen, Squires and Dutton. 2014 Conserv. Biol) SW analysis
- Harbor Porpoise
  - Is it economically feasible to reach ZMRG?
  - PBR sector allocation scheme requested (ITQs)
    - Address how a move to catch shares has impacted fleet bycatch.
  - Recommendations forthcoming via compliance research completion
- Large Whales
  - CEA of Alternative Migratory Pathways &Conservation Strategies.
  - Resuscitate, revise & incorporate the NARW WTP valuation work

NOAA FISHERIES SERVICE

Other Programs going on but uninformed

- **Industry Funded Scallop Observer Program** (IFS)
- NE Dolphin-safe tuna certifications via observer program

NOAA FISHERIES SERVICE

Final Comments

- Move PR Economics to the front line of management. Benefits equal across alternative designs. Incorporate valuation (consumer benefits) into econ analyses
- Did not address what is working. We rely on biological assessments for answer, however, this does not explain whether the policy instrument was successful
- Move toward an ecosystems management approach. Integration has declined since onset of TRTs.
- Consider incentives versus deterrents to improve compliance. Understanding compliance behavior is an important component to designing successful policy instrument.

NOAA FISHERIES SERVICE

Final Final Comments

- Work Smarter
  - Coordinate and piggy back efforts with PSB/GARFO and other centers.
  - If contract out include NMFS economist
  - Bigger bang for the same buck!
    - Stop outsourcing PR economic analysis. Hire contractors to work in-house with NMFS economists.

NOAA FISHERIES SERVICE

Thank-you

http://www.nefsc.noaa.gov/psb/surveys/index.html

Questions?

Appendix C8: Protected Resource Economics - The Canadian Experience

Fisheries and Oceans Canada | Pêches et Océans Canada

Protected Resource Economics: The Canadian Experience

NOAA Economics of Protected Resources Workshop
September 9-11, 2014
La Jolla, California
Gisele Magnusson, Fisheries and Oceans Canada

Canada

Outline

- Key regulatory responsibilities for species at risk (SAR)
- Economic analysis in support of SAR
  - Regulatory
  - Non-regulatory
  - Policy instruments examined
- Challenges

Canada

Fisheries and Oceans Canada Regions

Canada

Regulatory Responsibilities

- Cabinet Directive on Regulatory Management (CDRM 2012)
  - Government-wide for all regulatory actions
  - Regulatory Impact Analysis Statement (RIAS) must include an assessment of costs and benefits
  - Cost Benefit Analysis triaged on preliminary costs estimates:
    - <$1 million per year → qualitative analyses
    - > $1 million per year → quantitative analysis
  - New in 2012:
    - Small Business Lens – RFA for medium/high cost proposals
    - One-for-one Rule – remove regulations to offset increases in administrative burden

Canada

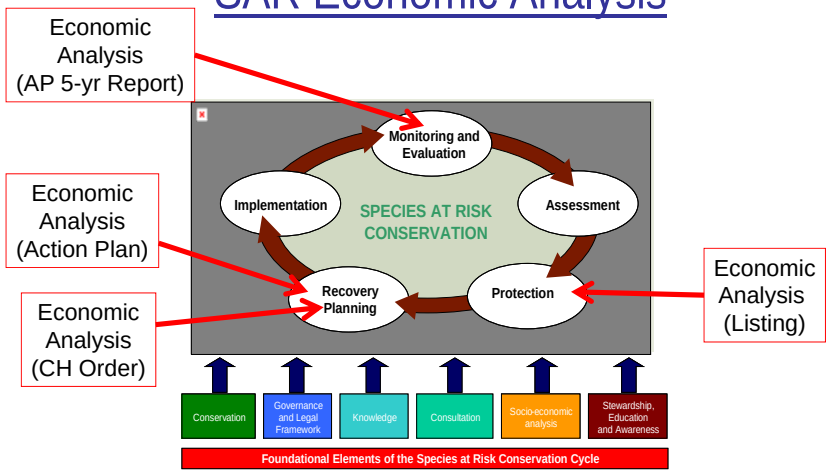
Regulatory Responsibilities

- *Fisheries Act (1985)*
  - Fish includes shellfish, crustaceans and marine animals, including marine mammals
  - Amendments in 2012 and 2013
  - "No person shall carry on any work, undertaking or activity that results in serious harm to fish that are part of a commercial, recreational or Aboriginal fishery, or to fish that support such a fishery." (section 35(1))
    - "Serious harm to fish is the death of fish or any permanent alteration to, or destruction of, fish habitat." (Section 2(2))
  - Marine Mammal Regulations (1993)
    - "No person shall disturb a marine mammal …" (Section 7).

Regulatory Responsibilities

- *Species at Risk Act* (SARA 2002)
  - Passed 2002, fully into force June 1, 2004
  - Scientific assessment of risk classification with 10 year review
  - Senior government officials (i.e. Cabinet) determine whether to add a species to the list of wildlife species at risk (Schedule I)
  - Protections for extirpated, endangered and threatened species:
    - Automatic prohibitions :
      - No person shall kill, harm, harass, capture or take an individual
      - No person shall possess, collect, buy, sell or trade an individual or any part or derivative
      - No person shall damage or destroy the residence of one or more individuals
    - Protection of critical habitat from destruction
  - For all species legal timelines for production of recovery documents (recovery strategies, management plans)

SAR Economic Analysis



SAR Economic Analysis - Regulatory

- Listing:
  - Government is not obligated to list a species
  - Adding a species to SARA Schedule I (i.e. extirpated, endangered, threatened or special concern) is a regulatory change
  - Regulatory Impact Analysis Statement (RIAS) is required and must include information on costs and benefits
  - Many analyses are low impact and qualitative, but species interacting with commercial fisheries are more quantitative

SAR Economic Analysis - Regulatory

- Listing (examples)

Marine & Anadromous	Freshwater
Quillback Rockfish (2013) – consultations	Lake Sturgeon (2013, 6DUs) – consultations
Yellowmouth Rockfish (2012) – consultations	Misty Lake Sticklebacks (2009, 2DUs) – listed
Bocaccio Rockfish (2009) – not listed	White Sturgeon (6 DUs, 2005) – 4 listed, 2 not (consultant)
Canary Rockfish (2009) – not listed (consultant)	
Cultus Lake Sockeye (2009) – not listed (consultant)	
Sakinew Sockeye (2009) – not listed (consultant)	
Okanagan Chinook (2009) – not listed (consultant)	
Winter Skate (2008, 3 DUs) – not listed	
Porbeagle Shark (2006) – not listed	
Interior Fraser Coho (2005) – not listed (consultant)	
Atlantic Cod (2005, 3 DUs) – not listed	

DU = Designatable Unit; EN = Endangered; TH = Threatened

SAR Economic Analysis - Regulatory

- Critical Habitat Protection:
  - Critical habitat is identified at recovery planning, then have 180 days to ensure protection from destruction
  - May use a regulatory Order to provide legal protection, or issue a Statement indicating how it is legally protected
  - Use of Protection Order is a regulatory process (i.e. RIAS)
  - One Order to date (Resident Killer Whales, 2009) with qualitative statement of costs and benefits

SAR Economic Analysis – Non-Regulatory

- Action Plans
  - Act requires an evaluation of costs of the Plan and benefits from its implementation
  - Act calls for 5-year report on the Plan to include assessment of socio-economic impacts
  - As well, recovery team could request assistance to assess cost-effectiveness of actions during development of Action Plan

SAR Economic Analysis – Non-Regulatory

- Action Plans

Final	In Various Stages of Public Consultation
Northern Abalone (2012)	Large Whales (Blue, Fin, Sei, North Pacific Right)
	Resident Killer Whales (Northern & Southern)
	Cultus Pygmy Sculpin (freshwater)
	Nooksack Dace & Salish Sucker (freshwater)
	Paxton Lake & Vananda Creek Stickback Pairs (freshwater)

SAR Economic Analysis – Non-Regulatory

- Critical Habitat identification
  - Option exists to use economic analysis prior to identification to develop cost-effective configurations (if there is more habitat than required to meet the survival/recovery objectives)

SAR Economic Analysis – Policy Instruments

- Listing analysis is primarily focused on prohibitions (harm; buy/sell), Action Plans often focus on research, monitoring and stewardship
- Primarily fishery related changes examined; examples include:
  - No buy/sell (all commercial species - Rockfish, Salmon, Atlantic Cod)
  - Fishery closures (Atlantic Cod, Rockfish)
  - Changes to fishery open times and areas (Salmon, Atlantic Cod)
  - Bycatch ITQs (Rockfish)
  - Recreational changes
    - catch/release only (Salmon)
    - species specific permit (White Sturgeon)
- Some habitat measures examined; examples include:
  - Expand ecological reserve (Misty Lake Stickleback)
  - Hydroelectric flow modifications (White Sturgeon)

Challenges

- Data.
- Linking with Science
  - How to ensure output is appropriate for economic analysis (e.g. projections beyond 10 years for rockfish)
- Listing analysis - management scenarios
  - Providing support to development without being the lead
  - Getting the necessary detail for analysis
  - Describing expected changes in recreational and Aboriginal (FSC) fisheries
- Characterizing cultural values and possible changes (non-food)
- Identifying benefits (i.e. linking management to changes; WTP acceptance)
- Accounting costs verses economic costs

Questions?

Photo credit: Jared Towers

Appendices

- DFO Past SAR Economic Research
- SARA Schedule I Species (EX, EN)
- SARA Schedule I Species (TH)
- SARA Schedule I Species (SC)

DFO Past SAR Economic Research

- Non-market valuation surveys
  - Marine Mammals in St. Lawrence (2009)
  - Survey of Southern Ontario residents (2010, C&A)
    - Single species (3), guilds (2), ecosystems and species (2)
  - 2011 National Survey (2011, NHQ)
    - Single species (2, one matching regional survey)
- Methods to assess impacts to Aboriginal Food, Social and Ceremonial fishing (2011, Gulf)
- (Freshwater) Habitat restoration cost guide (2011, Pacific)

SARA Schedule I Species (EX, EN) - Marine

Common name	Population (DU)	SARA Status
Striped Bass	St. Lawrence River population	Extirpated
Atlantic Walrus	Northwest Atlantic population	Extirpated
Grey Whale	Atlantic population	Extirpated
Atlantic Salmon	Inner Bay of Fundy population	Endangered
Basking Shark	Pacific population	Endangered
White Shark	Atlantic population	Endangered
Blue Whale	Atlantic population	Endangered
Blue Whale	Pacific population	Endangered
Killer Whale	Northeast Pacific southern resident population	Endangered
North Atlantic Right Whale		Endangered
North Pacific Right Whale		Endangered
Northern Bottlenose Whale	Scotian Shelf population	Endangered
Sei Whale	Pacific population	Endangered
Northern Abalone		Endangered
Leatherback Sea Turtle		Endangered

SARA Schedule I Species (TH) - Marine

Common name	Population (DU)	SARA Status
Northern Wolffish		Threatened
Spotted Wolffish		Threatened
Beluga Whale	St. Lawrence Estuary population	Threatened
Fin Whale	Pacific population	Threatened
Humpback Whale	North Pacific population	Threatened
Killer Whale	Northeast Pacific transient population	Threatened
Killer Whale	Northeast Pacific northern resident population	Threatened
Killer Whale	Northeast Pacific offshore population	Threatened

SARA Schedule I Species (SC) - Marine

Common name	Population (DU)	SARA Status
Atlantic Wolffish		Special Concern
Bluntnose Sixgill Shark		Special Concern
Green Sturgeon		Special Concern
Longspine Thornyhead		Special Concern
Rougheye Rockfish type I		Special Concern
Rougheye Rockfish type II		Special Concern
Tope		Special Concern
Yelloweye Rockfish	Pacific Ocean outside waters population	Special Concern
Yelloweye Rockfish	Pacific Ocean inside waters population	Special Concern
Bowhead Whale	Bering-Chukchi-Beaufort population	Special Concern
Fin Whale	Atlantic population	Special Concern
Grey Whale	Eastern North Pacific population	Special Concern
Harbour Porpoise	Pacific Ocean population	Special Concern
Sea Otter		Special Concern
Sowerby's Beaked Whale		Special Concern
Steller Sea Lion		Special Concern
Olympia Oyster		Special Concern

Appendix C9: What are NMFS' Social Science Needs Identified by Protected Resources' Regional Management?

Science, Service, Stewardship

What are NMFS's Social Science Needs Identified by PR Regional Management?

NOAA FISHERIES SERVICE

NOAA FISHERIES SERVICE

Input Data

1. Draft Economic Data Gap Report (2007)
2. Annual PR Reports
   - ITS for turtles (2012)
   - SARs for marine mammals
3. PRSIPP – PR Science Needs Request
   - Presented at:
     - 3-day PRSIPP workshop (Sept 2013)
       - BOEM, Navy, FWS, and others included in Day 1 then NMFS
     - Annual PR ARA meeting (May 2014)
   - Products: Spreadsheet and presentations of PR Science needs
4. National Call with RO and OPR Division Chiefs on PR Social Science needs (Aug 2014)

NOAA FISHERIES SERVICE

Economic Data Gaps Report
Three (3) broad categories of data used to protect and recover protected species

- Cost of Fishery Management Actions
  - Commercial: Lack of precision in PR bycatch estimates does not allow management at FMP, thus at gear type.
  - Non-commercial: Recreational & Subsistence even less known
  - State managed areas
- Cost of Non-Fishery Regulatory Action
  - Critical Habitat 4(b)2
  - Recovery Plans
- Benefits of
  - Fishery and Non-Fishery Management Actions
    - Too few species evaluated at national level

NOAA FISHERIES SERVICE

Call with RO and OPR Division Chief Social Science Needs Request

- Call Set up
  - Sept 2014 PR Science Needs Request
  - PR Science Needs categorized by:
    - Region, Taxon, Species, Themes, Priority Rating
  - Social Science can be an asset in
    - Mitigating Threats
    - Recovery & Restoration
  - PR Economic Fact Sheet
  - Identified Potential Mitigating Threats
    - Fishery Related
    - Non-Fishery Related Interactions
  - Provided a matrix (taxon by threats) – Please rank (1 high to 5 low) before the call

NOAA FISHERIES SERVICE

Attendees on the Call

Economists: Doug Lipton, Dale Squires, Rita Curtis, Kathryn Bisack, Dan Holland, James Hilger and Lew Queirolo

Regional Office PR and OPR (Division Chiefs): Dave Gouveia (NE), David Bernhart (SE), Jon Kurland (AK), Lynne Barre (NW/SW for Chris Yates), Jean Higgins (PI), Nicole Le Beouf (OPR), Angela Somma (OPR), Cathryn Tortorici (OPR)

NOAA FISHERIES SERVICE

Alaska Region
Non-exhaustive Overview of Current Needs!

- Cost of Fishery Management Actions
  - Prominent Commercial Interaction: Aleutian Island Groundfish and Steller sea lions
- Cost of Non-Fishery Management Actions
  - Offshore energy development - huge and growing
  - Climate change and associated loss of sea ice: Case of ice seals
  - Cruise and whale watching ships - value wildlife viewing but threats include:
    - lethal interactions, harassment in feeding and resting areas
- Benefits of
  - Non-consumptive use value for marine mammals
  - Subsistence use of marine mammals unique in AK

NOAA FISHERIES SERVICE

West Coast Region

- Cost of Fishery Management Actions
  - Commercial: Orcas
  - Large Whale entanglements (recreational?)
- Cost of Non-Fishery Management Actions
  - Ship Strikes
  - Recreational: Orcas and abalone in future
  - Noise: Large whales and small cetaceans
  - Offshore Energy
  - Orca prey reduction due to salmon consumption
  - Sea turtle conservation banking since international threat
- Benefits of …same need as AK
- Need post analysis of PR policy instruments

West Coast Region	Lrg Wh	Sm Cet	Seals	Turtles	Fish Salmon	Fish Other	Coral	Invert
Commercial	1	2&1 ~~SRKW~~ prey	2	1	2	2		
Recreational	5	4	3	1	2	1		3
Whale Watch	3	1	5	5				
Inten Kill		3	1	2 International	4			
Subs Harv	4			2	2			4
Ship Strikes	1	1	3	5				
Noise	2	2	3	5	5	4		
Offshore Energy	2	2	3	3	4	4		
Tourism	3	3	3	5	5			
Climate Change	4	4	4	2 International	2	3		2
Disease	5	3	4		3			1
Contaminants	5	1	3		3			2
Habitat				2	1			

NOAA FISHERIES SERVICE

Pacific Island Region

- Cost of Fishery Management Actions
  - Commercial interaction: False Killer Whale
- Cost of Non-Fishery Management Actions
  - International Threats: Leatherback, Loggerhead, Olive Ridley
  - Disease & Poaching: Green sea turtles
  - Habitat Loss: Hawksbill turtle
  - Recreational impacts: Main island seals, false killer whale, green sea turtles
  - Food limitations : Northern Island seals
  - Beach threats (e.g. harassment, intentional killings, other negative interactions): Main Island seals
  - Near shore disturbances (tourism etc.): Spinner dolphins
  - CHD: Hawaiian Monk Seal, Hawaiian False Killer Whale & Corals
- Benefits of …same need as AK
- Fear of regulatory actions hinder our ability to get data

NOAA FISHERIES SERVICE

Pacific Island Region Questions to address

- Monk Seals:
  - Fear associated with the recent CHD proposal.
    - Are perceived impacts and actual impacts similar across communities for future regulations?
  - Understanding values associated with marine resources and monk seals across communities to maximize the impacts of outreach strategies for this species.
- False Killer Whales
  - TRP: How did actual costs to the fishing industry compare to perceived or projected costs?
  - Lack of information available on recreational fisheries interactions. Would a -better understanding of non-market values associated with fishery activities in the Islands provide a better understanding of how to approach some of these barriers?

NOAA FISHERIES SERVICE

Pacific Island Region, continued

- Sea Turtles
  - Interactions with recreational fisheries: Not well reported; Would understanding the obstacle to reporting support recovery for some of these species?
- Spinner Dolphins
  - Non-market value of local communities targeted for dolphin-directed behavior.
  - Non-market value to those that participate in dolphin-directed activities (non-tour participants).
  - Use value: Demand for swimming with the dolphins is high (2009), but how close do they need to be?
- Corals
  - Primary threat is climate change. Market and non-market costs of implementing smaller local scale management actions in relation to the health of reef systems as a whole.

NOAA FISHERIES SERVICE

Southeast Region

- Cost of Fishery Related Actions :
  - Usual suspects (commercial & Recreational)
- Cost of Non-Fishery Related Actions
  - CHD Corals
  - Tourism, commercial dolphin tours: harassment
    - Bottlenose dolphins have negative behavioral changes
  - Recreational fishery growing rapidly:
    - incidental capture, boat operation strikes, harassment.
  - Offshore energy development
  - Coastal Development
  - Climate change & rising sea level is a looming big issue for corals
- Benefits of….Valuation:
  - Protect individual corals or whole reef?
  - Value to overall ecosystem
  - How does "iconic" species like turtles & dolphins affect tour trip values?

NOAA FISHERIES SERVICE

Northeast Region

- Cost of Fishery Related Actions :
  - Better understand sector management: How does it affect bycatch?
  - Pinger Compliance: accountability in sectors?
  - WTP for gear modifications versus closures. What is the tipping point? Or allow them to fish until a cap it met?
  - Fisher's behavioral response to closures? Specifically interested in MA restricted area closure for large whale plan. What do they do?
  - Competing mandates: MSA vs MMPA/ESA
  - Recreational Fishery: How much out there and how is it contributing to different parts of the economy?

NOAA FISHERIES SERVICE

Northeast Region

- Cost of Non-Fishery Related Actions
  - Aquaculture an emerging issue (salmon?)
  - Technology advancement with drones: harassment
  - Seal haul outs
  - Whale watching trips to improve viewing
    - Whale watching guidelines weak. How does WTP value change with different encroachment guidelines? How does that vary across the country? What factors motivate compliance?
  - What makes people care about PR species? Should outreach be different for different groups of animals? How do we improve our regulatory outreach?
  - Public versus fishermen's perception of regulations: Is there a difference? Need more transparent understanding of regulations.
  - Dolphin safe tuna - NEFOP certification ?

NOAA FISHERIES SERVICE

Office of PR

- Harassment of marine mammals, including swim-with, feeding and the recreational us
- Recreational fishing takes such as sea turtles and dolphins
- Intersections between above items
- Recreational use of drones: National proposed rule – working with Park Service
- Recreational Fishery: Need to know more about perceptions of PR issues (intentional dolphin killings, fear based killings, entanglement issues)
- Commercial Industry lawsuit in North Carolina about rec fishery not being regulated for PR takes
- Economic/Social issues are driving down the vaquita in Mexico. Need a buyout in gillnet fisheries in upper Gulf of California

NOAA FISHERIES SERVICE

OPR

- Upcoming CHD
- Listings associated with imports?
- Need more than traditional data. What do fisherment think verus us? Eco-trust organization hired to collect data in Oregon

NOAA FISHERIES SERVICE

Questions for us to address

- What does our end-of-the-day product look like?
- What are the common themes across past and future needs?
- How should we discuss the common past and future needs; by region, threat, taxon, types of analyses (CEA, Valuation, CBA)?
- What criteria can we use to prioritize?
- What should we discuss before, in and after we break out in groups?
- Should we break out in more than 2 groups to get a product today?

17

Appendix D1: Spillover Effect of Sea Turtle Regulation in Hawai'i Longline Fisheries

Spillover Effect of Sea Turtle Regulation in Hawaii Longline Fisheries

1. Domestic issue --Trade-off between fishery and turtle protection

2. International issue -- Spillover effect of turtle protection

Pacific Islands Fisheries Science Center

PR Economic Supports from PIFSC

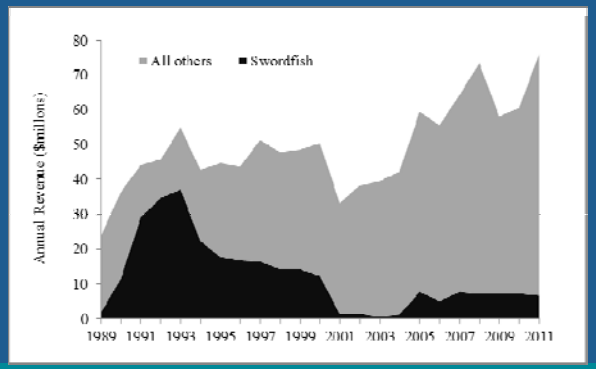
	Interaction	Data Support	Analysis /Studies
Marine Mammals			
False Killer Whales	Hawaii Longline	√	
Hawaiian Monk Seal	Hawaii small boats	√	
Spinner Dolphins	Hawaii tourists	√	√
Sea Turtles			
Loggerhead & Leatherback	Hawaii	√	√

Leatherback & Loggerhead Interactions with Longline

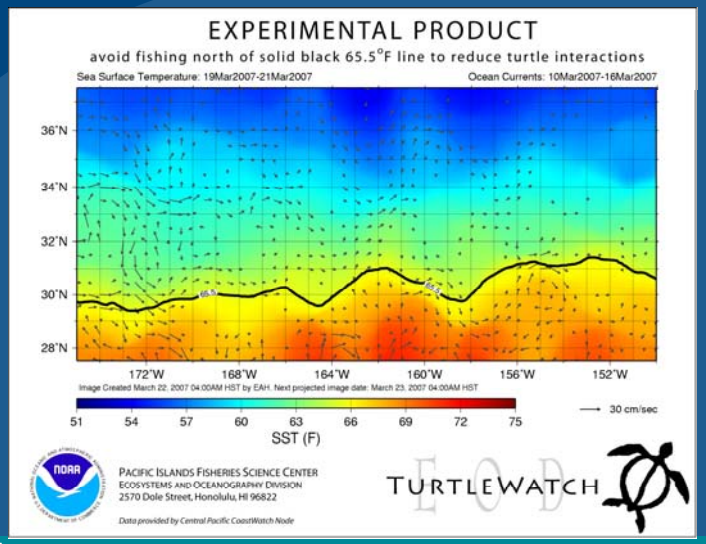
- Lawsuit in 1999 led to complete closure of the swordfish in 2001
- Re-open with new regulations in 2004
  - Use circle hooks (not J hooks)
  - Use fish as bait (not squid)
  - 2120 sets effort limits (< 50% historical level)
  - 17 loggerhead or 16 leatherback limit 2004 – 2012
- Unstable fisheries
  - 2006 & 2011 fisheries was closed b/c turtle interactions reached the caps
  - 17 loggerheads in March 17; 16 leatherbacks in Nov. 15

Economic Impacts under Current Policy

- Economic loss – Foregone fishing opportunity
  - Lower production
  - The sudden closure resulted in bad market conditions



Turtle Watch Analysis - SST 65.5 °F



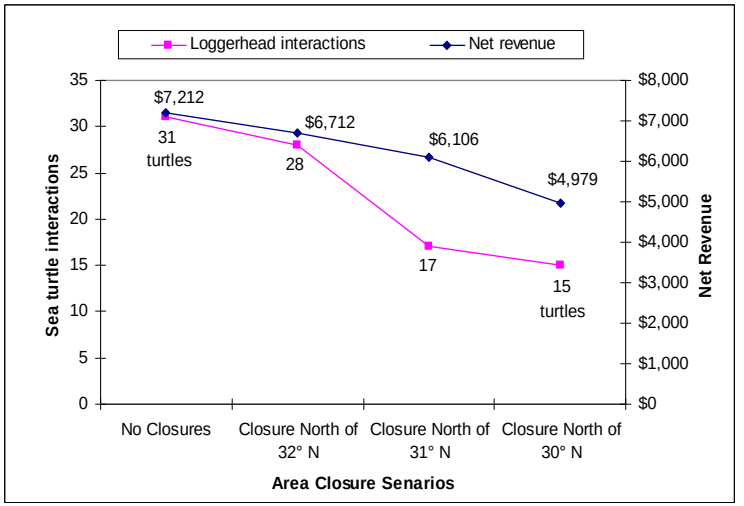
The Spatial & Temporal Economic Model to Exam the impacts of alternative policy Options

- To understand the trade-offs
  - ✓ Sea turtle interaction reduction vs. economic returns
- Predicted sea turtle interactions associated with fishing efforts
  - ✓ A few observations (5-100% observation rates) on sea turtles interactions
  - ✓ Need to build a model to estimate turtle bycatch rate associated with fishing effort
  - ✓ Model was built by the scientists in PIFSC using GAMs model
  - ✓ Modified to predict sea turtle interactions associated with SST, location, moon face, & season
- To build a net revenue function
  - Built a cost-function to related fishing activities
  - Historical average CPUE by season and location & recent fish price

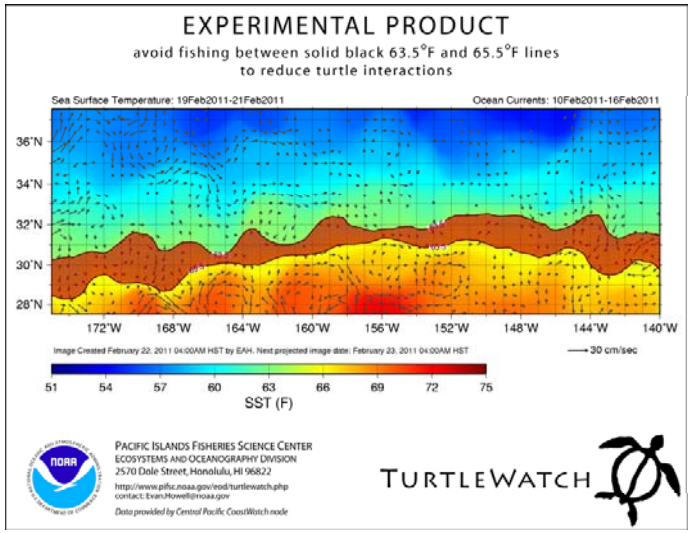
Model Applications – Analyzing Tradeoffs Through Scenario Simulations

- Control Policy for Fisheries Management
  - ✓Seasonal closure
  - ✓ Area closure
- Trade-off under different polices
  - ✓Net revenue from fishing
  - ✓ Sea turtle interactions

Trade-offs under Different Options of Closure



Turtle Watch in the Science Center Website

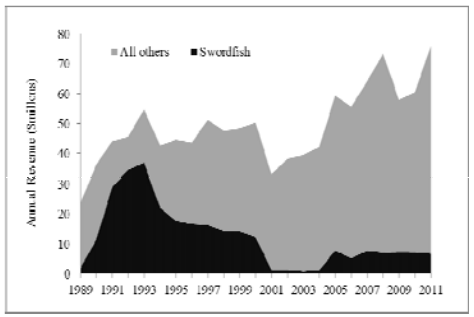


Spillover Effects of Sea Turtle Protection: The Case of the Hawaii Swordfish Longline Fishery

Hing Ling Chan and Minling Pan

Economic Impacts under Current Policy

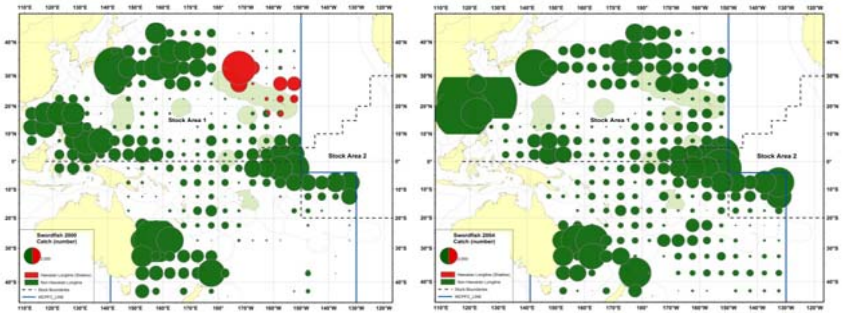
- U.S. consumed more swordfish that it produced
  - ✓ Foreign imports increases
  - ✓ Spillover effect, more imports, more turtle were caught (Rausser 2008)
- Foreign productions
  - ✓ Production displacement



Shared Stock with Other Countries

Before the closure

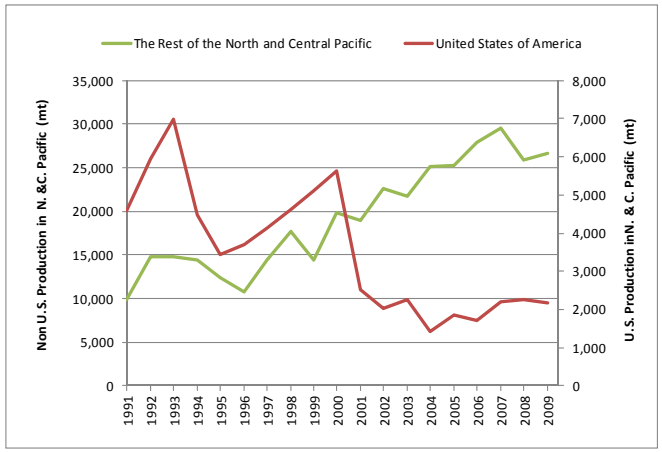
Four years later



Swordfish catch distribution in 2000
- ✓Red represents Hawaii catch
- ✓ Green catch by other countries

Swordfish catch distribution in 2004
- ✓Same catch but caught by other countries

Swordfish Production – U.S. vs. Non-U.S



Models for the Estimation the Spillover Effect (Displacement in Production)

1. Test the correlation between non-U.S. and U.S. production from 1991 to 2009

X_j *U.S. production*

Yj non-U.S. production

2. The trend for non-U.S. production without any regulatory impact by U.S. production 1991 to 2000, then predicted Y after 2001

$$Y_j = a + bT$$

3. How did non-U.S. swordfish production indeed respond to the changes of U.S. production from 2001 to 2012

$$Y_t - \hat{Y}_t = c + d\,X_t$$

4. 1 to 1 production replacement was found

SPILLOVER EFFECTS in the HI Longline Fishery

	All Countries Turtle Interactions	Reduction in Turtle Interactions from Current (Value)	Reduction in Turtle Interactions from Current (Percent)
Current sea turtle interactions	1866	-	-
Scenario 1: Hawaii shallow-set longline swordfish fishery production increases to 5500 sets with one-for-one replacement of foreign production	1645	221	12%
Scenario 2: Production by all countries if all had the same bycatch rate as the Hawaii shallow-set longline swordfish fishery	333	1533	82%

Happy Ending?

- New BiOp was published with higher sea turtle caps and won over the court case (hearing in July 25 2013)
- Turtle caps increase

✓Leatherback turtle cap 16 to 26

✓Loggerhead turtle cap 17 to 34

Appendix D2: Bycatch Risk Pools

Science, Service, Stewardship

Bycatch Risk Pools

Dan Holland Northwest Fisheries Science Center

NOAA FISHERIES SERVICE

Individual Bycatch Quotas and Risk Pools

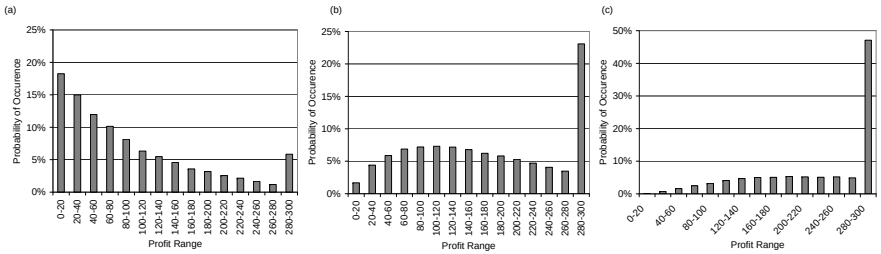
- Individual bycatch quotas can be more efficient and effective at reducing bycatch than regulations
- When bycatch is highly uncertain and rare individual quotas markets may may fail to allocate quota efficiently and result in financial risk (Holland 2010).
- I'll discuss how pooling approaches can be used to reduce financial risk for fishermen in these cases

(Holland, D.S.2010. Markets, Pooling and Insurance for Managing Bycatch in Fisheries. *Ecological Economics*. 70(1):121-133)

A Simple Model of Rare Bycatch

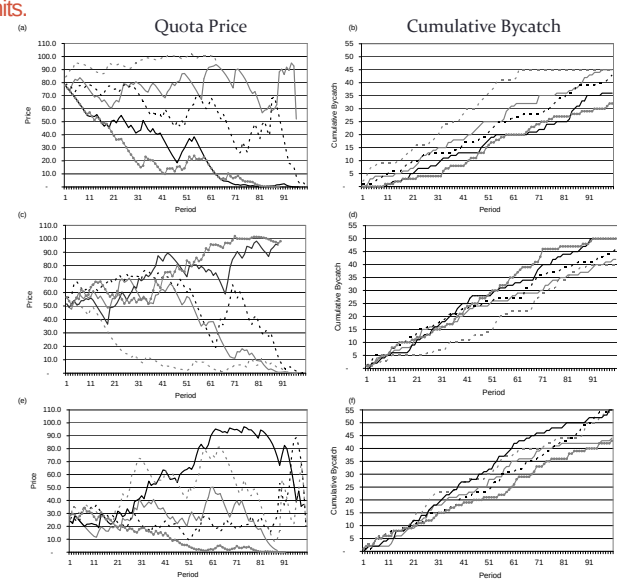
- Fishing events and bycatch are discrete homogeneous events.
- Each fishing event yields one unit of target catch with certainty and has a constant probability of catching one unit of bycatch.
- For simplicity, the bycatch is assumed to have no value and the target catch has a unit net value after harvest costs.
- Bycatch is purely random modeled as a Bernoulli process where bycatch events are independent over time and across fishermen
- With this specification the expected value of an individual bycatch quota allocation is equal to the sum of negative binomial probabilities of exactly reaching period *k* before exhausting IBQ holdings, *j*, summed over periods (ITQ use) *k<=t* and IBQ holdings *j<q* plus the probability of reaching the final period without exhausting IBQ times the profit associated with harvesting in all possible periods.

The distribution of ITQ units used (with a maximum of 300) before for (a) one, (b) two, (c) three units of IBQ is exhausted with p=0.01.



- With only one unit of IBQ the distribution of possible outcomes is skewed to the right but with three units it is skewed to the left
- Thus trading away a unit of quota always increases downside risk, in terms of increased right skew of the new distribution of outcomes, and may either increase or decrease standard risk as measured by the standard deviation of expected revenue.
- Sufficient standard risk aversion and or "prudence" (downside risk aversion) could inhibit trading even where it would lead to increases in total expected value.

Simulated price paths for IBQ from simulations with p=0.01 and 50 fisher each with allocations of 100 units (aggregate ITQ=5000) and aggregate IBQ of (a) 45 units, (b) 50 units and (c) 55 units.



- Even prices, assuming an efficient market with not risk aversion vary widely during the year as actual bycatch departs from the expected level
- Think of these as values of highly leveraged investments

Pooling

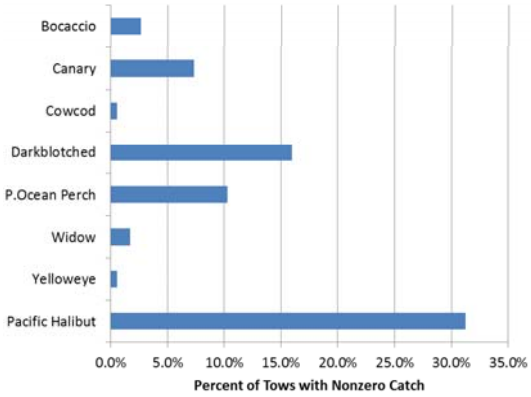
- Pooling bycatch quota can protect pool members from variability in profit due to individual variability in bycatch and exposure to price variability in the IBQ market
- While larger pools decrease price variability they may also increase problems associated with moral hazard and adverse selection – so limited pool sizes may be preferable

Key Problems in Risk Pool Design and Operation

- **Basic pool design:**
  - What is the appropriate species scope of pools?
  - What is the appropriate pool size and geographic scope?
- **Adverse selection:**
  - Who should you let in or keep out of your pool?
  - Should pool members be expected to contribute to the pool in-kind or monetarily?
- **Moral hazard (reduced incentives to avoid bycatch):**
  - Can/should risk pools specify observable “best fishing practices” that reduce expected bycatch rates and mitigate moral hazard?
  - Should the pools consider other mechanisms such as coinsurance or deductibles to reduce moral hazard?
  - Could the risk pool actually aggravate a race for fish and if so how can this be mitigated?

Percent of Observed Tows with Overfished Rockfish and Halibut Between 2002-2009 (pre IFQ)

- Several species were caught in less than 5% of tows and some on less than 1% of tows
- Distributions of positive tows are roughly lognormal
- Some species can have very large “disaster” tows



Methods – Nonparametric Analysis

- Data: West Coast Groundfish Observer Program data from over 26,000 observed tows between 2002-2009 segregated by latitudinal strata
- Draw 100 tows with replacement 1000 times to construct distributions of potential QP requirements for individual vessels
- Evaluate risk and risk reduction from pools of different sizes using tail conditional expectation (TCE)
- Caveat: Bycatch risk reflects historical behavior under different incentives

Nonparametric Monte Carlo Analysis of Risk Reduction from Pooling

- Which species should be included in risk pools?
- How big should risk pools be?
- What is the appropriate geographic scope of risk pools?

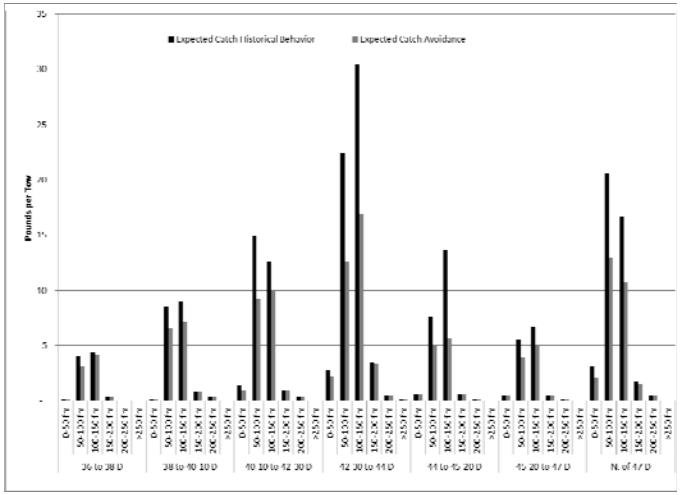
95th Percentile Tail Conditional Expectation (TCE) vs. Median QP holdings for Canary Rockfish by Latitudinal Strata

Species	Risk Measure	North of 47'	45'20" to 47'	44' to 45'20"	42'30" to 44'	40'10" to 42'30"
	95th Perc TCE	3,627	1,148	1,413	2,502	7,504
	TCE (Pool=10)	1,842	489	844	1,111	2,239
Canary	TCE (Pool=50)	1,524	336	723	862	1,345
	TCE/Median QP	10.7	3.4	4.2	7.4	22.1
	TCE Pool=10/Median QP	5.4	1.4	2.5	3.3	6.6
	TCE Pool=50/Median QP	4.5	1.0	2.1	2.5	4.0
	95th Perc TCE	22,574	3,575	14,841	5,254	3,566
	Pool=10	15,406	2,531	11,099	3,154	2,471
Pacific Halibut	Pool=50	14,149	2,298	10,178	2,787	2,232
	TCE/Median QP	24.0	3.8	15.8	5.6	3.8
	Pool=10/Median QP	16.4	2.7	11.8	3.4	2.6
	Pool=50/Median QP	15.1	2.4	10.8	3.0	2.4

Estimating Expected Catch Per Tow

- Probability of encounter bycatch for species j is (binary logit):
- (1) $$P(Catch_j > 0) = \frac{\exp(\beta_j x_j)}{1+\exp(\beta_j x_j)}$$
- Catch per tow for positive tows (assume lognormally distributed):
- (2) $$\ln(Catch_j \mid Catch_j > 0) = \alpha_j x_j + \varepsilon_j$$
- An unbiased estimate of expected conditional catch is:
- (3) $$E(Catch_j \mid Catch_j > 0) = \exp(\alpha_j x_j) * \exp(\sigma^2 / 2)$$
- The unconditional expected bycatch for a given fishing tow:
- (4) $$E(Catch_j) = P(Catch_j > 0) * E(Catch_j \mid Catch_j > 0)$$

Expected Catch Per Tow for Canary Rockfish by Latitude and Depth



Holland, D.S.2010. Markets, Pooling and Insurance for Managing Bycatch in Fisheries. Ecological Economics. 70(1):121-133.
Holland, D.S. and J.E. Jannot 2012. Bycatch Risk Pools for the US West Coast Groundfish Fishery. Ecological Economics 78:132-47.

Consistent Elements Across Existing Risk Pools in West Coast Groundfish Fishery

- At least three risk pools operated in 2011 (the initial year of the West Coast Groundfish ITQ).
- Avoided monetizing bycatch quota – didn't charge a price for withdrawls to cover bycatch events
- Created system to share real-time information to avoid bycatch
- Defined best practices for minimizing bycatch risk (e.g. require short test tows, delineate areas
- Quota pounds for bycatch species all transferred to a holding vessel and access to that quota for large bycatch events is contingent on whether vessel was compliant with risk pool rules fishing).

Risk Management and Fishery Management

- Sources of risk faced by risk pools are due in part to a lack of flexibility in the regulatory structure.
- Individual and pooled risk could be reduced by allowing greater carryover of QP (10% allowed now but British Columbia ITQ allows 30%).
- Multi-year TACs would also reduce risk but are not allowed under current US law
- Market insurance could address residual risk for the risk pool but practicality (and supplier) is uncertain.

Risk Pools Vs. Group Allocation

- If pooling makes sense, why allocate to individuals in the first place?
- Enables risk pool to control free- riders
  - Threat of exclusion
  - Contingent access to quota

Related Publications

- Holland, D.S.2010. Markets, Pooling and Insurance for Managing Bycatch in Fisheries. Ecological Economics. 70(1):121-133.
- Holland, D.S. and J.E. Jannot 2012. Bycatch Risk Pools for the US West Coast Groundfish Fishery. Ecological Economics 78:132-47.

Appendix D3: Unilteral Conservation of Transboundary Resources: West Coast Swordfish and Pacific Sea Turtles

Unilateral Conservation of Transboundary Resources: West Coast Swordfish & Pacific Sea Turtles

Outline

- 1. Introduction
- 2. Background
- 3. Changes in Net Benefits: Cost-Benefit Analysis
- 4. Components of the Analysis
- 5. Empirical Results
- 6. Concluding Remarks

1

A Tale of Good Intentions…

- Unilateral conservation of transboundary resources
- Application of ESA
- Close fishing area to lower bycatch of Pacific leatherback & loggerhead sea turtles
- Drift gillnet fishery off west coast USA.

3

…with an Unanticipated Ending…(1)

- Induced:
- (1) reduced domestic production of fresh, locally caught swordfish
- (2) transfer of swordfish production abroad – "production leakage"
- (3) imports back into U.S. – "trade leakage"
- (4) increased foreign sea turtle mortality
  - "Transfer effect" / "conservation leakage"

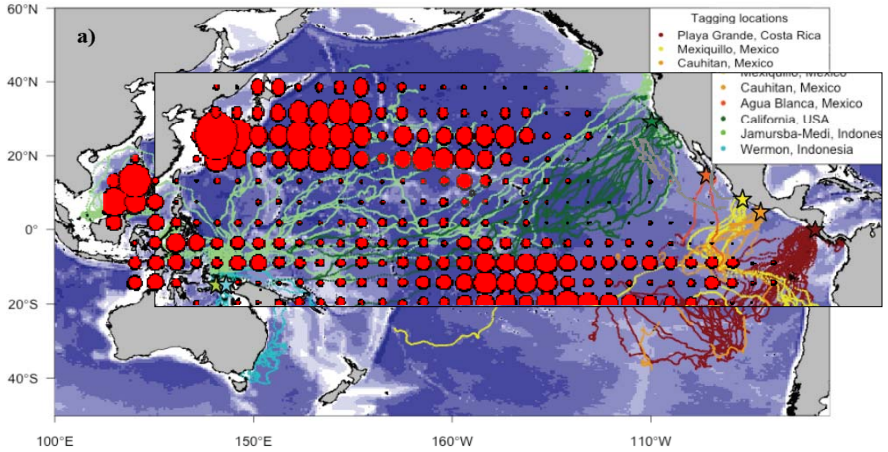
…with an Unanticipated Ending…(2)

- Lead to decrease in net economic benefits for west coast U.S. vessels, firms in supply chain, and consumers
- Plus….
- Net increase in sea turtle bycatch that further reduces U.S. west coast net economic benefits.
- *Ex-post* cost-benefit analysis to measure change in net benefits.

Transboundary Resource & Imports

- U.S. west coast consumer demand for swordfish filled by both U.S. west coast production and Hawaiian and foreign production & imports.

Leatherback Turtles Running the Gauntlet



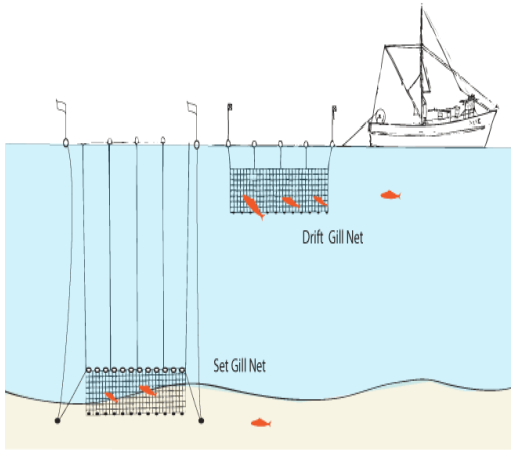
Red circles = swordfish catch Green squiggles = turtle migration

Federal Leatherback Conservation Closed Area

3. Changes in Net Benefits: Cost-Benefit Analysis

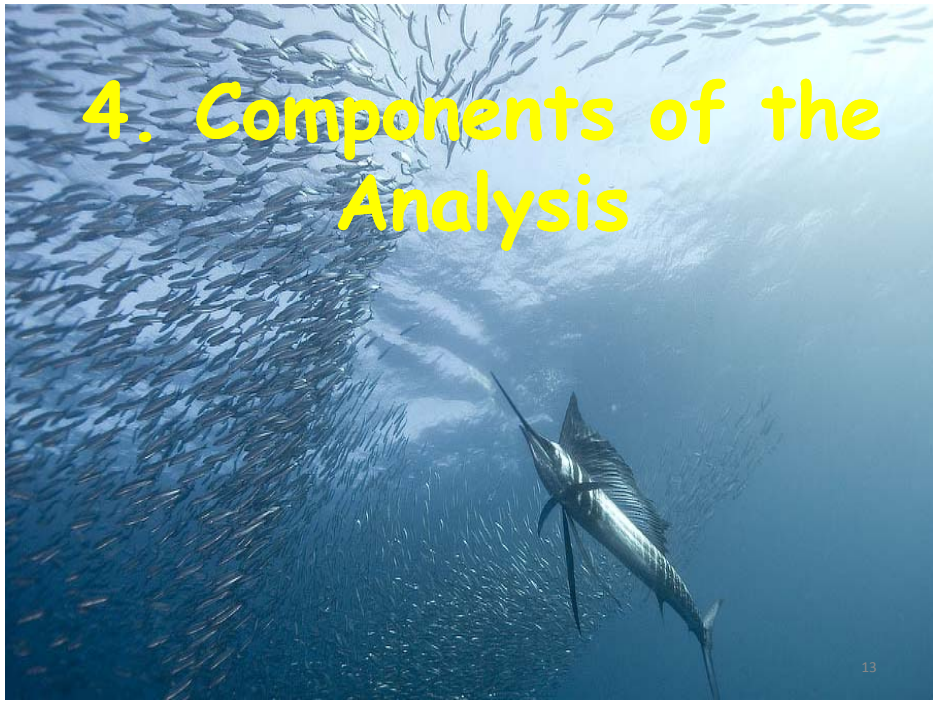
With and Without

- With = with ESA action
  - Observed
- Without = without ESA action
  - Need counter-factuals



Changes in Net Benefits From:

- (1) Loss in producer surplus west coast DGN vessels
- (2) Loss in consumer and producer welfare in supply chain from reduced DGN production
- (3) Gain in producer and consumer welfare in supply chain from HI & foreign imports
- (4) Gain in producer and consumer welfare from potential increase in longline catches
- (5) Gain in consumer welfare from reduced domestic DGN sea turtle mortality but potential increase in domestic LL sea turtle mortality
- (6) Loss in consumer welfare from increased foreign sea turtle mortality



4.1. Counterfactual Drift Gillnet Swordfish Production & Fleet Size

- Hazard (duration) model
- Estimate California DGN swordfish landings
- Estimate California DGN fleet hazard rate
  - Rate of vessel exit

4.2. Inverse Demand Model…(1)

- Econometric estimation of system of equations
- Monthly data from January 1997 to December 2008
- Calculate compensating variation losses for consumers and firms in supply chain

4.3. Inverse Demand Model…(2)

- Equilibrium functions allow adjustments to declines in local production of swordfish and sharks through:
- (1) increased foreign imports & Hawaiian imports,
- (2) substitution to domestic west coast longline and harpoon-caught swordfish,
- (3) substitution to west coast albacore tuna

16

4.4. Estimate Increased Imports

- Vector autoregression model / transfer function
- Translates price increase for swordfish imports due to lower domestic swordfish landings into increase in imports

17

4.5. Counterfactual Estimate of Sea Turtle Bycatch

- Kalman-filter based estimate of leatherback interaction rates inside and outside of time-area closure.
- Produced counterfactual prediction of additional drift gillnet fishery leatherback turtle interactions that would have occurred for years since 2001 had closure not been implemented.

18

4.6. Counterfactual for Foreign Fleets

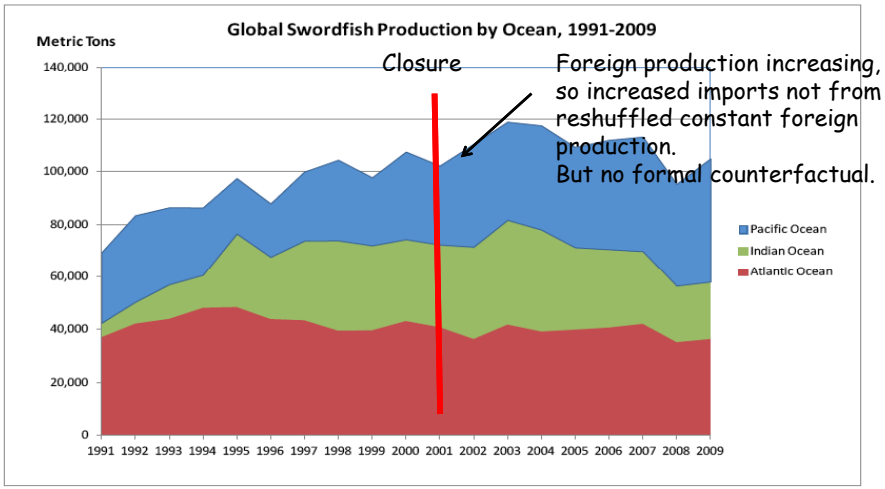


Figure 1.--Global Swordfish Production by Ocean, 1991-2009. Source: FAO Fisheries Global Information System.
http://www.fao.org/figis/servlet/TabLandArea?tb_ds=Capture&tb_mode=TABLE&tb_act=SELECT&tb_grp=COUNTRY

19

Pacific Swordfish Production Increasing

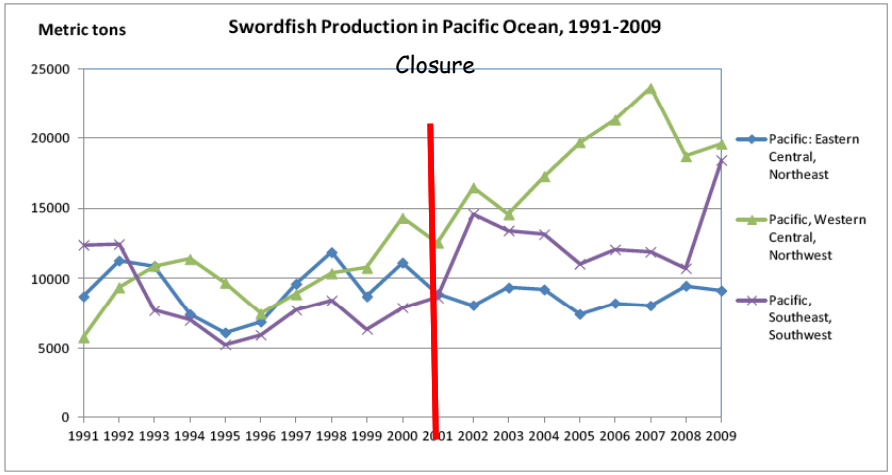
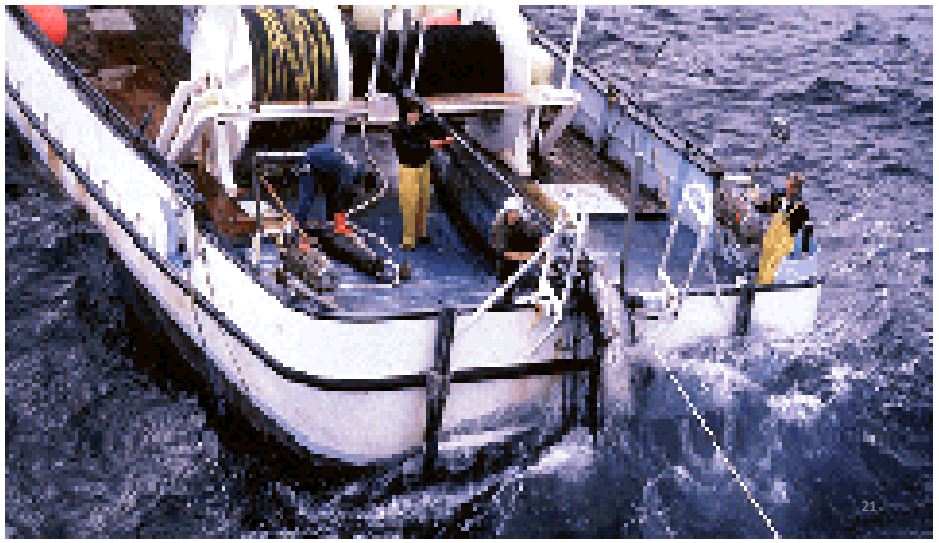


Figure 5.— Global swordfish production in Pacific Ocean by area, 1991-2009. Source: FAO Fisheries Global Information System.

5. Empirical Results



US Domestic Swordfish vs. Imports

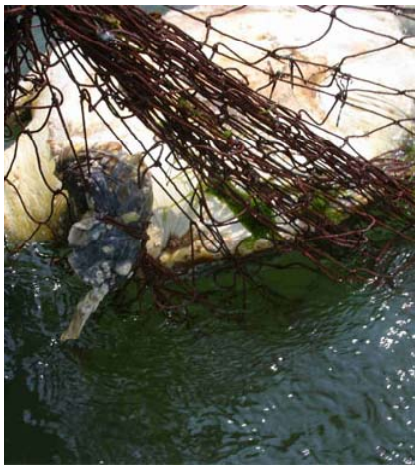
- West coast consumers value west coast-caught swordfish (fresh) from all gears more than imported swordfish (largely frozen)
- Consumers place lower value on imports.
- (Source: Demand analysis)

Harpoon-caught enter into different market

- Harpoons do not have sea turtle bycatch.
- Harpoon-caught swordfish are luxury good
- It does not substitute in consumption for drift gillnet-caught swordfish.
  - Cannot fill consumption gap.
- (Source: demand analysis and cost-and-earnings survey)

Harpooning for swordfish is unprofitable

- Profits negative for 2008-2010.
- (Source: cost-and-earnings survey for 2008-2010)



Small volume of swordfish landings from "clean" gear will not compensate for reduced drift gillnet landings

- Landings from buoys, hook-and-line, and harpoons very small proportion of total landings on west coast.
- Harpoon landings remain largely unchanged after 2001 closure.

Closure induced DGN vessel numbers from vessel exit.

- About 11 fewer DGN vessels over 2001-2010 compared to what would have occurred without closure.
- Lower producer surplus
- Work-in-progress: producer surplus gained from alternative fishing for exiting DGN vessels

- (Source: Hazard-attrition model)

Closure induced smaller DGN swordfish landings than otherwise would have occurred.

- Reduced drift gillnet swordfish landings

Closure induced lower annual DGN leatherback bycatch rate than otherwise would have occurred.

- Closure reduced drift gillnet leatherback bycatch rate by 3.78 turtles per year due to reduced effort (number of sets).
- Counterfactual annual leatherback bycatch rate: 1.51 turtles.
- (Source: Kalman filter model counterfactual and observer data.)

Longline Counterfactual

- Work in progress to determine with and without impacts upon LL swordfish landings, producer surplus, sea turtle bycatch
- Cross-price flexibility for increase in LL swordfish price with lower DGN landings
  - From inverse demand model for
- Multiply by own-price swordfish supply elasticity for LL
  - From simple supply response model

Not all sea turtle bycatch is created equal.

- Transfer effect has a greater bycatch impact for EPO imports than WCPO imports
- EPO leatherback populations are less healthy

Mean willingness to pay for recovery of leatherbacks and loggerheads

- US estimates of mean annual willingness to pay for the recovery of:
- Leatherbacks: $67.97
- Loggerheads sea: $42.72.

- (US$2011 per household every year for ten years.)
- (Source: Wallmo and Lew, *Conservation Biology* 2012)

Total Loss Over 10 Years

- 2001-2010 (present value, US$2012):
- (1) DGN vessel producer surplus loss: $10,765,793
- (2) Consumer and supply chain compensating variation loss: $15,030,957
- (3) Upper bound welfare loss (WTP) from higher net bycatch: $75,339
- Need calculate longline fleet incremental (with and without) producer surplus & bycatch
- (OMB 10-year real discount rate of 1.00%)

32

Economic Impact Multipliers: Economic Impacts upon Income and Employment

- In 2001 and measured in US$2012:
- (1) revenue foregone: $1,554,476
- (2) income foregone: $761,585
- (3)number of jobs lost excluding vessels: 15.
- (4) with 11 vessels lost, number of crew-captain jobs lost: 37.

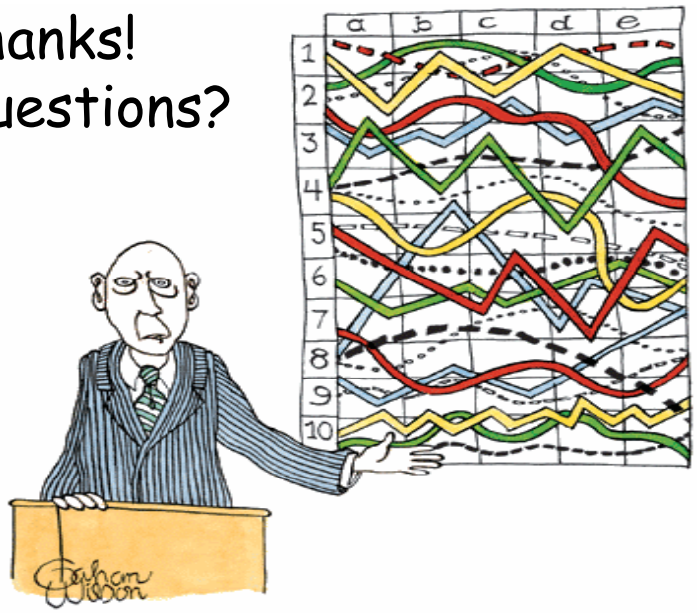
33

6. Concluding Remarks

Two Externalities Require Two Policy Instruments

- Two externalities
- Each one requires a policy instrument
- Transnational requirement of multilateral cooperation is a second externality

Thanks!
Questions?



"I'll pause for a moment so you can let this information sink in."

36

Appendix D4: Counterfactual Estimate of the Impacts of ESA Regulation of US West Coast Swordfish Fisheries on Pacific Sea Turtle Bycatch

Science, Service, Stewardship

Counterfactual Estimates of the Impacts of ESA Regulation of U.S. West Coast Swordfish Fisheries on Pacific Sea Turtle Bycatch

NMFS Economics of Protected Species Workshop
September 9-11, 2014

Stephen M. Stohs, Southwest Fisheries Science Center

NOAA FISHERIES SERVICE

NOAA FISHERIES SERVICE

PR Economics Research Interests (1)

- Estimating rare event bycatch rates and predicting counts from incomplete observer samples (Kvamsdal and Stohs, AJAE 2013; Martin, Stohs and Moore, EA 2014)
- Metrics to compare protected species bycatch impacts across U.S. commercial fisheries (with Heidi Gjertsen and Heidi Dewar)
- Economic impacts of rare event bycatch management under hard caps

NOAA FISHERIES SERVICE

PR Economics Research Interests (2)

- PR Regulatory Effectiveness
- Unintended consequences of unilateral domestic conservation regulation on transboundary protected species stocks
- Bren School project to consider alternatives for revitalizing the west coast commercial swordfish fishery

NOAA FISHERIES SERVICE

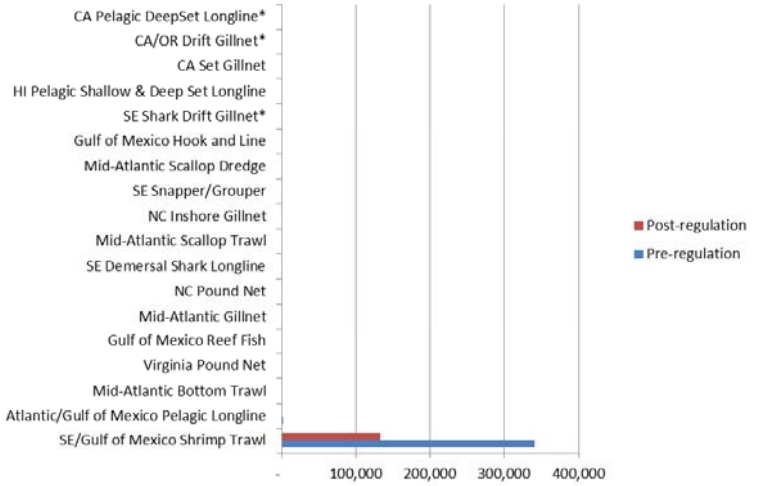
Bycatch Comparisons

- How do protected species bycatch impacts compare across U.S. commercial fisheries?
- Possible equity issue (NS4: Do not discriminate between residents of different states; any allocation of privileges must be fair and equitable)
- CEA Consideration: Given scarce resources, where should bycatch conservation efforts be focused to best address known concerns?

ESTIMATED ATLANTIC AND PACIFIC MEAN ANNUAL SEA TURTLE BYCATCH

Fishery	Pre-regulation	Post-regulation
SE/Gulf of Mexico Shrimp Trawl	340,500	133,400
Atlantic/Gulf of Mexico Pelagic Longline	1,600	1,400
Mid-Atlantic Bottom Trawl	1,100	600
Virginia Pound Net	600	600
Gulf of Mexico Reef Fish	600	600
Mid-Atlantic Gillnet	400	300
NC Pound Net	200	200
SE Demersal Shark Longline	200	200
Mid-Atlantic Scallop Trawl	100	100
NC Inshore Gillnet	100	100
SE Snapper/Grouper	100	100
Mid-Atlantic Scallop Dredge	300	90
Gulf of Mexico Hook and Line	10	10
SE Shark Drift Gillnet*	10	10
HI Pelagic Shallow & Deep Set Longline	700	100
CA Set Gillnet	10	10
CA/OR Drift Gillnet*	**30**	**10**
CA Pelagic DeepSet Longline*	10	10
*Figures of 10 on these lines are estimated upper bounds		
Source: Table 4, Finkbeiner, E.M. et al., Biol. Conserv. (2011)		

ESTIMATED ATLANTIC AND PACIFIC MEAN ANNUAL SEA TURTLE BYCATCH

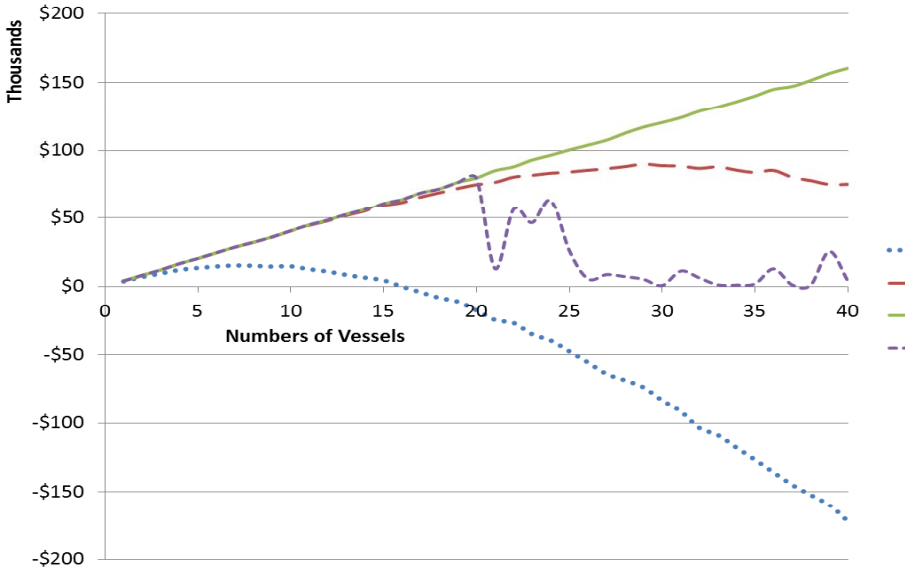


NOAA FISHERIES SERVICE

DGN Hard Cap Scenarios

1. Fixed number of 20 DGN vessels fishing, no caps
2. 1-year caps for ESA-listed species (leatherback, loggerhead, olive ridley and green sea turtles plus fin, humpback and sperm whales) with 100% observer coverage
3. 5-year rolling caps at 5X 1-year cap levels with 100% observer coverage
4. Conservation banking with upper limits of 2X 5-year cap levels and reversion to 1-year caps if bank balance is exhausted for a species; assumes 100% observer coverage
5. 5-year rolling caps with 30% observer coverage (estimate unobserved set takes at average rates observed since 2001)

Means of Simulated Potential Fleet Profits on Numbers of Vessels under Alternative Cap Polici



NOAA FISHERIES SERVICE

Counterfactual: Background

- A 2001 ESA regulatory closure of the HI SSLL fishery led to numerous research efforts regarding the transfer effect on sea turtle bycatch
- ESA regulations in the west coast drift gillnet (2001) and shallow-set longline (2004) fisheries may have similarly generated sea turtle bycatch transfer effects

NOAA FISHERIES SERVICE

Research Objective

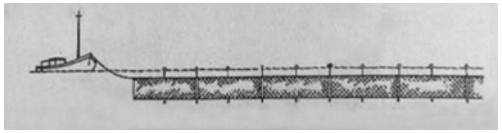
- Use a counterfactual approach to estimate net sea turtle bycatch impacts of unilateral domestic regulation of west coast U.S. swordfish fisheries
- A counterfactual approach is necessary to estimate what would have occurred in the absence of regulation

NOAA FISHERIES SERVICE

Harpoon

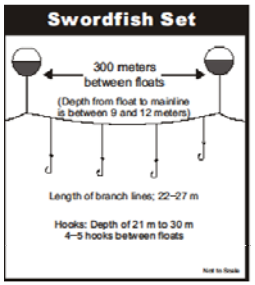
NOAA FISHERIES SERVICE

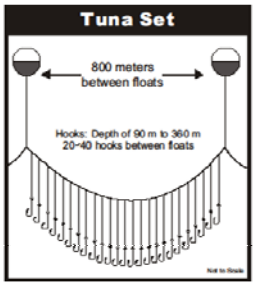
Drift Gillnet



NOAA FISHERIES SERVICE

Longline





NOAA FISHERIES SERVICE

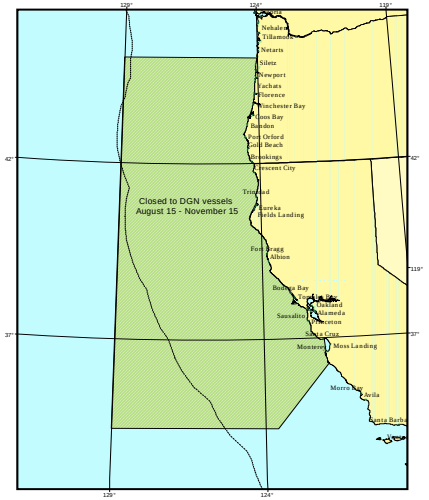
ESA Regulation

- HI SSLL Closure 2001-2004; fishery reopened subject to gear standards
- DGN Time-Area Closure 2001-
- West Coast SSLL Closure 2004-

NOAA FISHERIES SERVICE

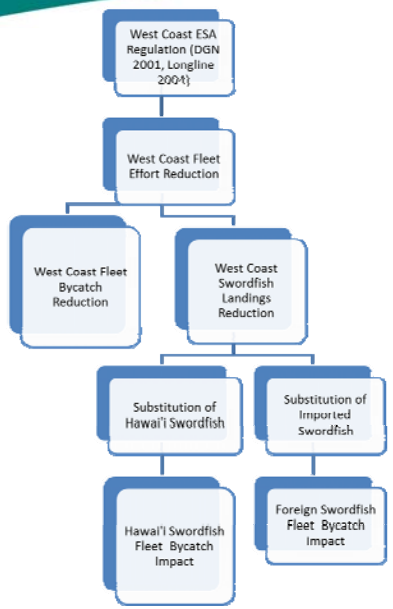
Leatherback Closure

- Established in 2001
- Annual closure 8/15-11/15
- No leatherback mortalities observed in fishery since the closure



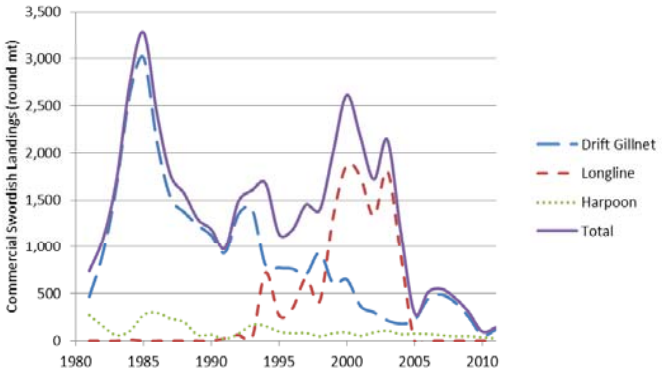
NOAA FISHERIES SERVICE

West Coast Impacts of U.S. Pacific Commercial Swordfish Regulation Changes



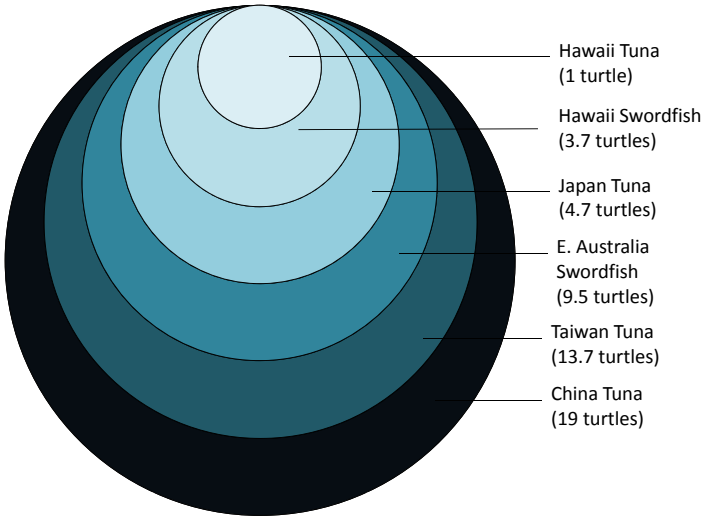
NOAA FISHERIES SERVICE

Commercial Swordfish Landings by HMS FMP Fishery (round mt), 1981-2011



Estimate of Longline Fisheries B/C Ratio

(sea turtle interactions per 190,000 kg of target fish)



Source: Bartram, P, J Kaneko and K Nakamura. 2010. Sea Turtle Bycatch to Catch ratios for differentiating longline –caught seafood products. *Marine Policy.* 34: 145-149.

NOAA FISHERIES SERVICE

Table 1. Observed Sea Turtle Bycatch per 100 Metric Tons of West Coast Swordfish Landings

Fishery	Period	Leatherback	Loggerhead	All Turtle Species
Drift Gillnet	Pre-regulation[1]	2.32	1.71	4.23
	Post-regulation[2]	0.52	0.52	1.04
Shallow-set Longline	Pre-regulation[3]	0.57	14.00	14.85
	Post-regulation[4]	1.10	0.46	1.56

[1]Pre-2001 seasons

[2]Post-2000 seasons

[3]Pre-2005 seasons

[4]Post-2004 seasons

NOAA FISHERIES SERVICE

Table 2. Leading California Import Sources by Pre- and Post-regulation Weight Share

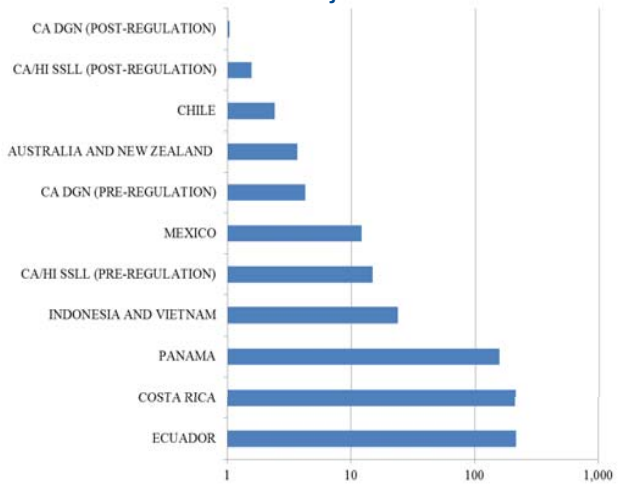
	1997-2004	2005-2012	Change
MEXICO	11.9%	18.0%	6.1%
PANAMA	0.2%	4.4%	4.2%
NEW ZEALAND	3.5%	6.8%	3.3%
CHILE	2.2%	4.9%	2.7%
INDONESIA	1.6%	4.2%	2.6%
ECUADOR	0.9%	2.8%	1.9%
COSTA RICA	0.9%	2.2%	1.3%
VIETNAM	1.0%	1.9%	0.9%
AUSTRALIA	5.4%	3.7%	-1.7%
JAPAN	2.4%	0.4%	-2.0%
CHINA - TAIPEI	5.4%	1.0%	-4.3%
SINGAPORE	63.2%	46.7%	-16.5%
SHARE OF TOTAL	98.4%	97.1%	

Top Ten 1997-2004, Not 2005-2012

Top Ten 2005-2012, Not 1997-2004

NOAA FISHERIES SERVICE

Sea Turtle Bycatch per 100 mts of Swordfish for Major Sources of CA Supply



NOAA FISHERIES SERVICE

Table 3. Weighted Average Turtle Bycatch Rate due to Import Transfer Effect

Source Country	Post-regulation CA Import Share	BPUE	CPUE	All Turtle Species B/C Ratio
MEXICO	18.0%	0.125	1.04	12.02
AUSTRALIA AND NEW ZEALAND	10.6%	0.0175	0.48	3.65
INDONESIA AND VIETNAM	6.1%	0.1904	0.80	24
CHILE	4.9%	0.025	1.04	2.40
PANAMA	4.4%	1.250	0.80	156
ECUADOR	2.8%	1.725	0.80	216
COSTA RICA	2.2%	1.700	0.80	213
	49.0%		Average	44.1

NOAA FISHERIES SERVICE

Summary

- Commercial swordfish effort on the West Coast has been heavily regulated since the 1990s to reduce protected species bycatch impacts
- Available data shows far higher sea turtle bycatch rates per unit of SWO production than for west coast fleets, post-regulation
- A SIDS estimate of west coast SWO demand indicates substitution of imports for west coast DGN and SSLL SWO landings
- Preliminary results suggest a net increase in sea turtle bycatch due to ESA regulation

Appendix D5: Regulatory Impacts on Exit from the California Drift Gillnet Swordfish Fishery: A Treatment-Control Duration Model-Based Approach

Regulatory Impacts on Exit from the California Drift Gillnet Swordfish Fishery:

A Treatment-Control Duration Model Based Approach

NOAA FISHERIES
South West Fisheries Science Center

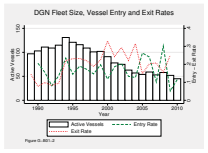
Fisheries Resource Division

James Hilger, Dale Squires, Stephen Stohs

Protected Resources Workshop
Scripps Institute of Oceanography
September 10th, 2014

Background

- Drift gill net gear - sea turtle interactions
  - Leatherback Turtle Conservation Area (LTCA)
    - DGN prohibition in N. CA swordfish grounds: 8/15-11/15, 2001-present

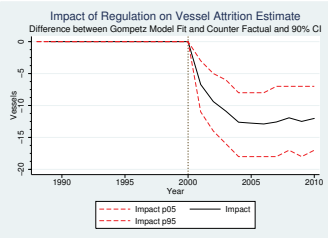


Motivation

- In Regulatory Analysis, including Cost / Benefit, we need to know the counter factual, the with or without
- What is the impact of the regulation?
  - Vessels
  - Landings

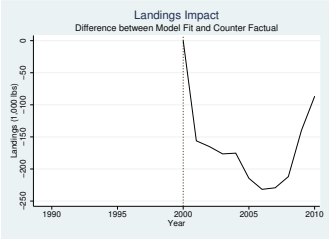
DGN Regulation Fleet Size Reduction Impact

- 11.4 fewer vessels annually



DGN Regulation Fleet Landings Reduction Impact

- Reduction of 179,000 lbs landings annually (28% from predicted)

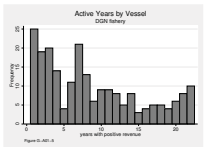


Application

- **Impact of regulation on DGN fleet size**
  - Duration analysis
  - Counter-factual estimated via treatment-control framework
  - Simulating participation decisions
- **Impact of regulation of fleet swordfish landings**
  - Reduced form analysis

Data

- Mandatory reporting CA DGN participants, 1989-2010
  - Vessel ID, port, fishing block, gear, & landings & revenue by species.
    - Pacific Fisheries Information Network: http://pacfin.psmfc.org/



Difference-in-Differences Framework

- Identify impact while controlling for confounding variables
  - Compare changes in variable of interest (hazard rates, landings) between pre- and post-treatment of treatment group to that of control group

$$Y_{itg} = \beta_1 T_{ig} + \beta_2 t_{it} + \beta_3 \mathbf{T_{ig}} \mathbf{t_{it}} + \lambda X_{itg} + \varepsilon igt \qquad (1)$$

  - Coefficient interpretation:
    - T_{ig}: treatment group specific effect
    - t_{it}: common time trend effect
    - $\mathbf{T_{ig}} * \mathbf{t_{it}}$: average treatment effect (ATE)
    - X_{itg}: additional controls and intercept

Identification Strategy

What is the treatment and treatment / control group?

- Regulation
  - Prohibits DGN gear in LTCA during peak season
  - Introduced prior to 2001 season (August)
  - No impact expected in 2000 and prior seasons
- Treatment Period
  - **2001 and following seasons**
- Treatment Group
  - Identification of vessel impacted is latent
  - Proxies:
    - **% revenue associated with fishing in LTCA (pre-closure)**
    - % landings associated with fishing in LTCA (pre-closure)
    - Homeport
    - Primary Landing Port

Model Estimation

Parametric Transition Rate Models

Direct estimation of the survival function as a known distribution

- Exponential, Gompertz, Weibull, Log Normal, and Log Logistic
  - Easily parameterized: continuous and/or multiple covariates
    - (vs. Kaplan-Meier - also modeled)
  - Shape parameter easily parameterized
  - Transition rate can vary over time,
  - Constant, increasing or decreasing monotonically, or U or $\bigcap$
  - Relaxes proportionality assumption (vs. Cox - also modeled)

Covariate Specifications

- Treatment, treatment group, ATE
- Additional vessel and time specific covariates
  - Vessel length, skipper age
- Improves model fit
  - LR test, chi2(5) test statistic
- ATE covariate statistically significant
  - 1% level for the Exponential, Gompertz and Weibull
  - 10% level for the Log Normal
  - N.S. at the 10% level: Log Logistic

Empirical Results

- 1994 Coast-wide Reg. = + : -> shorter participation spells
- % LTCA Rev. = - : -> longer participation spells
- Post-2000 treatment period is not statistically significant
- Gompertz shape coefficient = - : HR is monotonically decreasing w/ time
  - Entrants are more likely to exit than incumbents
- **ATE = + : Post LTCA Reg & High LTCA Rev % vessels -> shorter participation spells**
  - Average effect nearly doubles hazard rate

Placebo Check

- 1994 coast-wide regulation
  - Expected to impact all vessels in the fleet
    - Not differentially impact vessels most likely impacted by future LTCA
  - Interact Coast-wide Regulation Period (post-1994) with Treatment Group Proxies
    - Fail to reject $\neq 0$ at all standard significant levels for all models

Model Selection

- Model selection is important as it directly impacts the resulting parameterization of the fleet size counterfactual simulation
- Statistical methods.
  - Gompertz outperforms Exponential and Weibull models - AIC and BIC
  - LogNormal and Log-logistic outperform the Exponential family
    - LogNormal outperforming Log-logistic - AIC and BIC

Model Selection: Graphical

- Inspection of pseudo residuals
  - Predicted hazard rates & cumulative hazard rate
  - Corollary of an inspection of residuals of standard OLS models

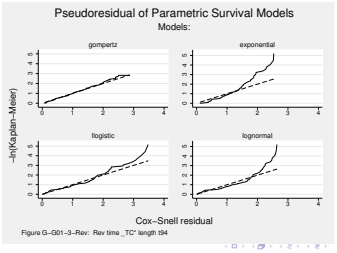


Figure G–G01–3–Rev: Rev time _TC" length t94

Fleet Population

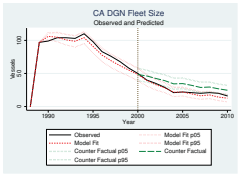
- Generation of a fleet size estimate
  - Under historic and non-regulation counter-factual conditions
  - Assumptions:
    - fleet entry is assumed exogenous
    - Hazard rate is not conditional on fleet size
    - Single episode of participation

Fleet Size Algorithm (2)

1. Define analysis-time at entry as $t_i = 1$ for each vessel i;
2. Calculate fitted hazard rate, $\hat{H}$ for each vessel & analysis time pair;
3. Draw $l * max(t_i)$ vector of uniform [0,1) distributed r.v., $\mathbf{U}$;
   1. Assign participation state:
      - If $u_{it} > \hat{H}_{it}$, vessel stays;
      - If $u_{it} \leq \hat{H}_{it}$, vessel exits (all remaining years);
   2. Count participating vessels by year;
4. Repeat Step (3)
5. Calculate mean, median, 5%, and 95% of sample for fleet size estimate

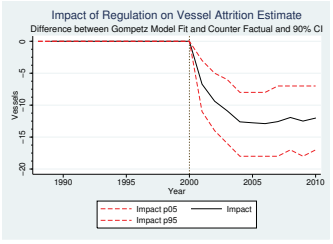
Fleet Size Estimate

Gompertz Based Parameters

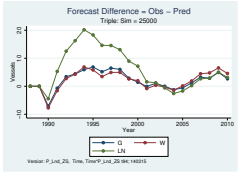


Regulation treatment effect reduced fleet size by roughly 11.4 vessels.

Impact of Regulation Estimate



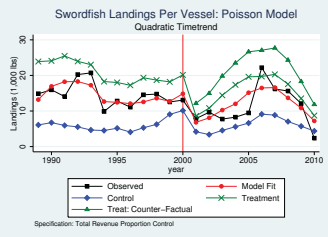
Specification Test Continued



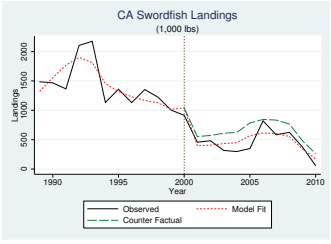
- Fitted fleet size robust to model specification post regulation
- Gompertz based fit outperforms alternative models
- Recall pseudo residuals

Landings Model

DGN Regulation Fleet Landings Reduction Impact



DGN Regulation Fleet Landings Reduction Impact



Summary

- Counter Factual Analysis is an important part of Cost Benefit Analysis
- Differential behavior by firms directly constrained by the regulation
- Supports H_0s that regulation increases hazard rate of exit
  - Counter-factual fleet size impact: 11.4 vessels
- Supports H_0s that regulation decreased landings
  - Counter-factual swordfish landings impact: 1.8 million lbs (10 years)
- Future Research
  - Model fishery/gear type entry decision

Important Note

Estimating the cost of regulation is only part of the analysis
Proper analysis also considers benefits

- WTP measures for recovery of turtle populations
  - Wallmo & Lew (Conservation Biology, 2012)

Thank you and Questions

- Many thanks to those that have commented or otherwise contributed to this research
- Questions?

Regression Results: w Covariates

Parametric Transition Rate Models

	Exp PH	Gompertz PH	Weibull AFT	LogNormal AFT	Loglogistic AFT
Length	-0.019***	-0.013*	0.019***	0.017**	0.015**
Coastwide Regulation	0.690***	1.012***	-0.901***	-0.994***	-1.129***
Rev	-0.475**	-0.410*	0.477*	0.338	0.372
treatment period	-0.716***	-0.342	0.721***	0.543*	0.450
Treatment	2.318***	1.991***	-2.450***	-1.721*	-0.876
Constant	-1.313***	-1.367***	1.387***	0.951***	1.002***
Shape		-0.084***	-0.113*	0.120**	-0.442***
Observations	1295	1295	1295	1295	1295
AIC	652.9	632.8	651.5	614.6	621.8
BIC	683.9	669.0	687.6	650.8	658.0
ll	-320.4	-309.4	-318.7	-300.3	-303.9

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

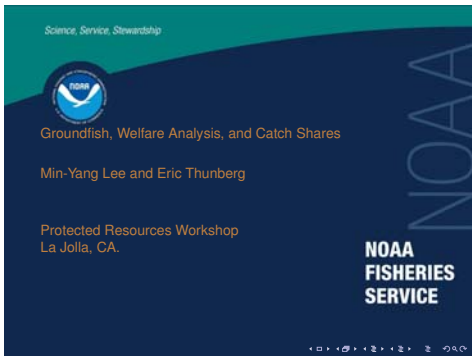
Period	Obs.	Pred-G	CF-G	Diff-G	Pred-LN	CF-LN	Diff-LN
Pre-Reg.	80.8	78.1	78.1	0	72.1	72.1	0
Post-Reg.	24.5	22.4	33.9	-11.4	16.9	31.9	-15.0

Hazard Model

Observed, Fitted, Counter-factual

Season	Obs	Pred-G	CF-G	Diff-G	Pred-LN	CF-LN	Diff-LN
1989	97	97	97	0	97	97	0
1990	99	106	106	0	103	103	0
1991	104	105	105	0	99	99	0
1992	104	101	101	0	92	92	0
1993	103	99	99	0	87	87	0
1994	110	104	104	0	91	91	0
1995	98	91	91	0	81	81	0
1996	83	78	78	0	70	70	0
1997	76	70	70	0	64	64	0
1998	68	62	62	0	57	57	0
1999	58	55	55	0	51	51	0
2000	50	49	49	0	45	45	0
2001	40	39	46	-7	33	43	-10
2002	35	33	42	-9	27	40	-13
2003	29	28	39	-11	22	37	-15
2004	21	22	34	-13	16	33	-17
2005	22	22	35	-13	16	33	-17
2006	21	20	32	-13	14	30	-17
2007	20	16	29	-13	11	27	-16
2008	21	18	30	-12	123	28	-15
2009	20	14	26	-13	10	25	-15
2010	16	13	25	-12	8	23	-14

Appendix D6: Groundfish, Welfare Analysis, and Catch Shares



Outline

Research Question and Motivation

New England Groundfish switched from Days-at-Sea to catch shares and saw big reductions in catch limits in 2010.

Question: How much better/worse would the nation have been with a modified DAS system instead?

Motivation 1:Catch shares are a bit controversial. We wanted to provide some with-/without- analysis instead of a pre-/post-comparison.

Motivation 2:Include consumers.

This talk in 1 slide

- Figure out which fishing trips would have occurred under the input control
  - Gives us Q_s
  - Gives us costs $C(Q_S)$
- Plug the Q_s into a demand model to compute consumer welfare measures
- Incorporate uncertainty in Q_s, C, and demand parameters to get a distribution of welfare measures

Recalibrated DAS would have been about $33M worse than the catch-share system, 80% of that cost falls on consumers.

Northeast Groundfish

- 13 species, 20 stocks, 2 broad areas
- Catch is minimally processed before first sale to processors, wholesalers, middlemen
- Lots of fish in this form is imported into the US
- Final products include fillets, chunks, sticks, and steaks

	2010 Catch	2010 Value	YoY Δ Catch	YoY Δ in Value
Cod	12.6 M lbs	$26.9M	-32.6%	-1.6%
Haddock	16.7	20.5	15.4%	28.2%
Pollock	10.6	9.9	-19.7%	-3.3%

Things we know:

- Price & Quantity in 2009 (DAS; high output)
- Price & Quantity in 2010 (Catch Shares; low output)

Things we would like to know:

- Price & Quantity under a counterfactual policy with (DAS; low output)

Counterfactual Regulations & Quantities:

"common pool" regs applied to the entire fleet

Trips:

- Distribute fishing time within the year based on an optimization model.
- Randomly select trips for the first month from the pool of trips which occurred in the first month in 2008 & 2009.
- Adjust the trips by the management changes. Draw trip costs based on survey data from 2010.

"Welfare" for Producers

- Compute output prices from uncompensated flexibilities.
- Make some assumptions about the owner/labor split.
- ... "Net operating revenues"

Generalized Inverse Demand System

- Aggregate our 13 species into 3 groups
- Monthly time-step: 1994-2011
- Include Imports & Monkfish
- Use a GMM estimator instead of the commonly used SUR, 3SLS, or GLS (autocorrelation) system estimators

Consumer Welfare

- No closed form distance function corresponding to the GDIDS estimating equations
- Approximate the demand curves using the definition of flexiblities
- Numerically integrate under the inverse demand curve
- Simulate over the Q_S's and GDIDS parameters ~$N(\beta, \Omega)$.

Some Results

Relative to catch shares with low output, DAS with low output is:

- $25M (std. dev 0.6M) worse for consumers (CV)
- $7.5M(std. dev 2.1M) worse for producers ("Net operating returns")

Some Problems:

- A "real" model of supply would have been far more realistic
- No changes to Import quantities
- No closed form for the demand model – yuck
- *ex-post* analysis can be done, but we couldn't do this *ex-ante*.

This talk in 1 slide

- Figure out which fishing trips would have occurred under the input control
  - Gives us Q_s
  - Gives us costs $C(Q_S)$
- Plug the Q_s into a demand model to compute consumer welfare measures
- Incorporate uncertainty in Q_s, C, and demand parameters to get a distribution of welfare measures

Recalibrated DAS would have been about $33M worse than the catch-share system, 80% of that cost falls on consumers.

Estimating equation

$$\bar{w}_{it}\Delta\ln\frac{p_{it}}{M} = \sum_j \pi_{ij}\Delta\ln q_{jt} + \pi_i\Delta\ln Q_t - \theta_1\bar{w}_{it}\Delta\ln Q_t - \theta_2\bar{w}_{it}\Delta\ln\frac{q_{it}}{Q_t} + \varepsilon_{it}$$

- Nests 4 popular inverse demands models using 2 extra parameters
- Estimate using seasonal differences
- Moment conditions based on no correlation between ε and instruments
- Try a few "sets" of instruments

Appendix D7: Economic Research and Regulatory Support: Protected Resources

Southwest Fisheries Science Center, Fisheries Ecology Division, Santa Cruz

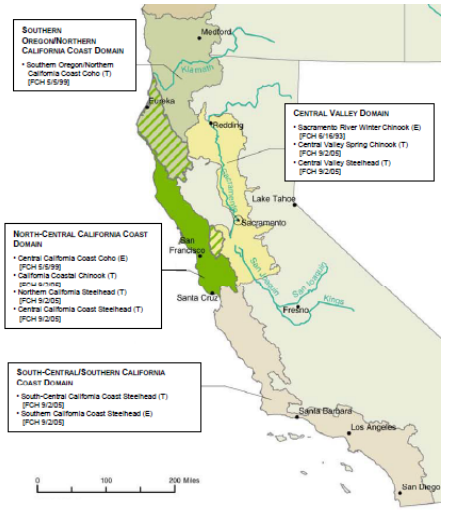
Economics Research and Regulatory Support: Protected Resources

Southwest Fisheries Science Center
Fisheries Ecology Division
Santa Cruz

Cameron Speir
(along with Cindy Thomson and Aaron Mamula)

Listed Salmonid Species – 9 ESUs

Species and ESU	*ESA Status*	Listed Updated
Sacramento R. Winter-run Chinook salmon	*Endangered*	1994 2014
Central Valley Spring-run Chinook salmon	*Threatened*	1999 2014
California Central Valley Steelhead	*Threatened*	2006 2014
Southern OR/Northern CA Coast Coho salmon	*Threatened*	2005 2014
Central California Coast Coho salmon	*Endangered*	2012 2014
California Coastal Chinook salmon	*Threatened*	1999 2014
California Coast Steelhead (3 ESUs)	*Threatened*	2006 2014



SWFSC – Santa Cruz PR Research
3 Examples

1. Groundwater management and instream flow
2. Effect of energy development (hydraulic fracturing) on water quality, habitat, and regional economy
3. Effects of water supply changes on regional agriculture

1a. Groundwater Management and Instream Flow
Spatial-Dynamic Problem

Optimization model: maximize farm profits subject to instream flow requirements

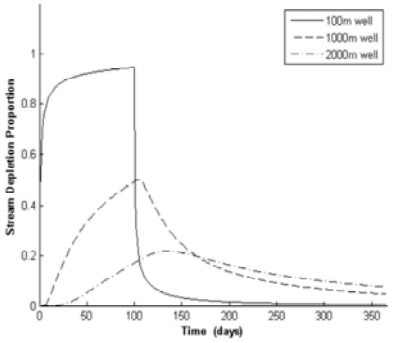
- Allocate ***daily*** water pumping to wells located at different distances from the stream
- Hydrologic model: stream-aquifer system where stream depletion effects vary across space and time (Glover-Balmer)

1a. Groundwater Management and Instream Flow

Spatial-Dynamic Problem

1) Tradeoff between magnitude and duration of stream depletion effect. Optimal allocation of water across wells is differentiated over space and time.

2) In some cases in drought years, wells located closer to the stream should be allocated more water. Duration of the stream depletion effect is more important than the magnitude.



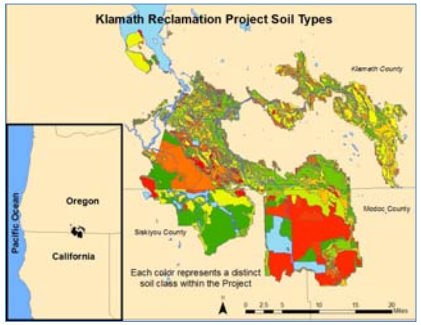
1b. Economic Evaluation of Water Buyback Programs: A Study of the Klamath Water Bank

Objectives: evaluate the efficacy/economic efficiency of water buybacks as a strategy for freshwater salmonid habitat provision

Study Area: Klamath Irrigation Project in Northern California/Southern Oregon where land idling programs have been used since 2002 to reduce agricultural water diversion from the Klamath River

Methods:

- GIS modeling used to generate spatially explicit data on soil productivity
- Linear profit maximization model is constructed using agronomic production functions with decreasing marginal physical products
- Project level derived demand for surface water is generated using positive math programming to solve the profit maximization problem with relevant acreage and crop rotation constraints



1b. Economic Evaluation of Water Buyback Programs: A Study of the Klamath Water Bank

Results:

- Results show that value of accepted land idling bids exceeded value of the water by 10%, 40% and 75% in low, medium and high baseline diversion scenarios, respectively.

Implications: A key finding of our study is that a portion of the wedge between observed payment and derived value can be attributed to the program's insistence on paying for land rather than water…a situation necessitated by the fact that water use is not monitored/measured/metered in the KIP.

2.Oil & Gas Development: Water Supply, Habitat, and Regional Impacts

Dissertation project – Duran Fiack, UCSC, Environmental Studies

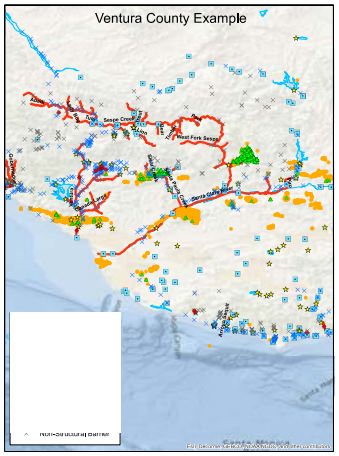
1. What are the impacts and risks to critical habitat, the agricultural sector, and regional economies from hydraulic fracturing in California?
2. Do impacts differ across space?
   - Inter-regional (macro): three regions with distinct water and ecological characteristics, different local institutions
   - Small scale (micro): siting issues, habitat connectivity, aquifer properties, population diversity, local geology
3. What polices and institutions will be (or should be) used to help mitigate these impacts?

2. Oil & Gas Development: Water Supply, Habitat, and Regional Impacts

Oil production occurs in watersheds with protected steelhead – Southern California Coast ESU

- Water quality
- Water quantity – instream flow
- Cumulative impacts analysis

Water reallocation in the southern San Joaquin Valley may affect the demand for Delta water



3. Water Use and Impacts to Agriculture: San Francisco Bay Delta

Delta is the "hub" of the water supply system in California

Chinook, steelhead ESUs and Delta smelt affect the quantity and timing of water exports

There are real and perceived economic impacts

3. Water Use and Impacts to Agriculture: San Francisco Bay Delta

Inspiration: 2009 drought and Biological Opinions

Jobs vs. Fish

Author	Date	Agriculture	Non-agriculture
Howitt et al.	Jan 2009	*60,000 – 80,000*	
Howitt et al.	May 2009	*35,000*	
Michael	Aug 2009	5,000 – 6,500	5,000 – 6,500
Howitt et al.	Sep 2009	12,000	9,000
Michael	Dec 2009	4,400 – 6,300	2,500 – 3,500
Michael, Howitt	Dec 2010	3,500 – 4,725	2,000 – 3,000
Sunding et al.	May 2011	5,000	--
Howitt et al.	Jul 2011	9,800	--
Foreman	May 2013	6,900 – 9,000	--
Speir & Stradley	Jan 2014	5,500	0
Speir, Mamula & Ladd	Apr 2014	5,300	--

3. Water Use and Impacts to Agriculture: San Francisco Bay Delta

Estimating Economic Impacts of Irrigation Water Supply Policy Using Synthetic Control Regions: A Comparative Case Study

Cameron Speir and Eric Stradley

- Estimate job losses by comparing employment in affected counties to other counties
- Natural Experiment
  - Synthetic control group: Abadie et al. 2010
  - Concept similar to difference-in-differences

Effects of Water Supply on Labor Demand and Agricultural Production in California's San Joaquin Valley

Cameron Speir, Aaron Mamula, Daniel Ladd

Estimate structural model: labor demand and crop production as a function of water supply

- Production system: 1 variable input (labor), 1 quasi-fixed input (water), 7 crop categories
- Theoretically consistent (properties)
- Cross equation constraints: symmetry and allows calculation of crop substitution effects

Natural experiment: *synthetic control counties*

Create a single *synthetic* control county from a pool of *donor* counties

Synthetic control employment = weighted average of a group of un-affected counties

Create a "credible counter-factual"

4 ***treatment*** counties
- Fresno
- Kings
- Tulare
- Kern

25 ***donor*** counties

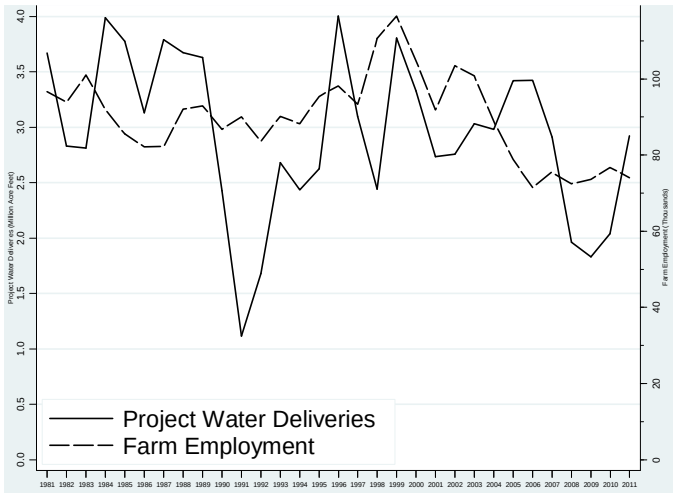
Synthetic control method

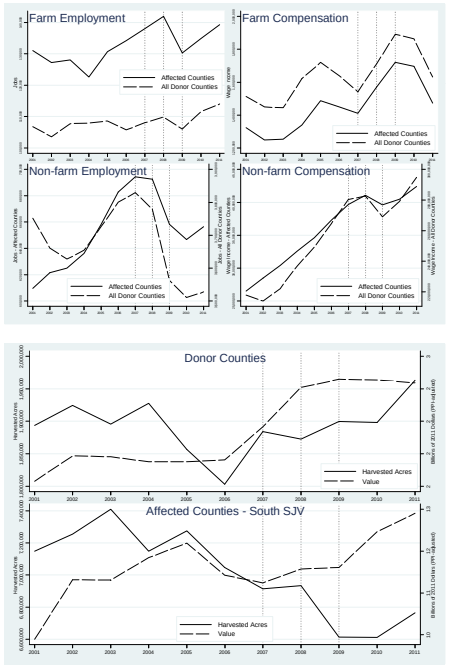
Reduced form experiment vs. structural models
- Few observations → low power for structural model of labor demand
- Reduced form does not require county-level data on wages, input prices, water deliveries
- Reduced form does not assume a particular functional form
- Labor market disequilibrium (Michael 2009, Hertz and Zahniser 2013)

Synthetic control method vs. other natural experiments (e.g, D-i-D)
- Choosing any one (or several) control units as a counterfactual is difficult (crop mix, climate, lots of other things). So we make our own counterfactual that looks like the treatment county

- Better addresses uncertainty and inference
  - Observe *aggregate* outcomes, so sampling variability is not present (vs. regression-based standard errors)
  - Our main source of uncertainty: how well does the control mimic the treatment?
  - Permutation (or placebo) tests: Abadie et al. 2010, Bertrand et al. 2004

Natural experiment: water supply shock





Synthetic control method

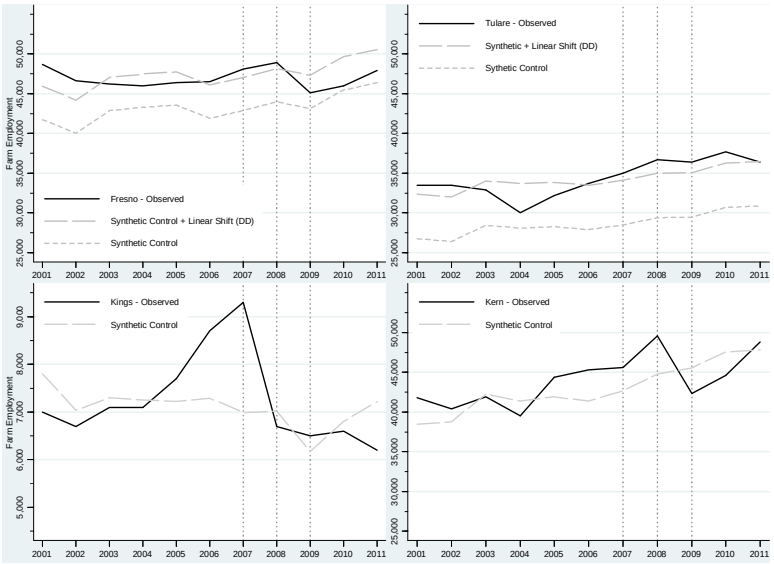
Donor County Weights
Farm Employment

Donor County	Fresno	Tulare	Kings	Kern
Sacramento	0.145	-	0.078	0.006
Yolo	-	-	-	0.174
Sutter	0.219	-	0.24	-
Glenn	-	-	0.12	-
Monterey	0.443	-	-	-
Imperial	0.096	0.115	0.272	0.075
Santa Clara	-	0.138	-	-
San Benito	-	-	0.012	-
Tehama	-	-	-	-
Butte	-	0.028	-	-
Lake	-	0.240	-	0.156
Lassen	-	-	0.056	-
San Bernardino	-	-	0.149	0.121
San Luis Obispo	-	-	0.073	-
Santa Barbara	0.096	0.480	-	0.468

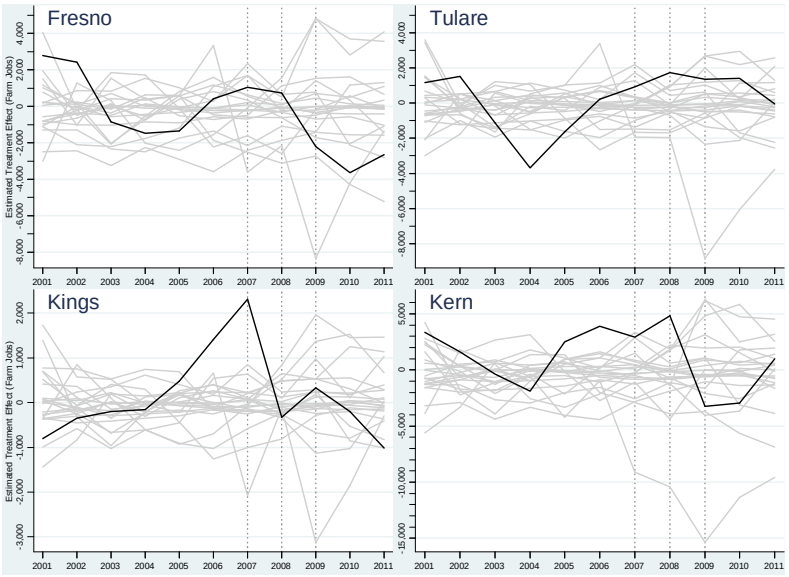
Predictor Variables
Fresno County Farm Employment

Variable	Observed	Synthetic
Population density	134.1	283.3
ln(Population)	13.6	12.6
Precipitation	77.8	191.1
Cooling Degree Days	1,928.3	995.6
Heating Degree Days	2,326.1	2,247.3
Field Crop %	15.0	5.9
Grains %	4.0	5.4
Orchard %	9.6	4.5
Rice %	0.3	7.4
Truck Crop %	12.7	13.9
Vegetable %	10.2	3.1
Pasture %	48.3	58.5
Value per acre	$ 1,538.9	$ 1,525.1

Synthetic control method: Results Farm Employment



Synthetic control method: Results Farm Employment



Uneven Impacts

5,500 agricultural jobs

- Fresno = 2,000
- Kern = 2,500
- Anecdotal evidence of highly concentrated impacts

No evidence of impacts to other sectors

Appendix D8: Protected Resources Research in the Northeast

Science, Service, Stewardship

PR Research in the Northeast
What has been done?
What was the point of the research?

Kathryn Bisack

NOAA FISHERIES SERVICE

NOAA FISHERIES SERVICE

Outline

- Regulatory Support
  - CEA of Gear Research in VA Poundnet Fishery (Magnusson & Bisack)
  - Behavioral Model: Positive Math Programming Approach: CAM (Bisack & Magnusson)
- Value of Scientific Information (Bisack and Magnusson, 2014)
- Enhance PR Management
  - Policy Instruments
    - Closures and ITQs to Manage Porpoise(Bisack and Sutinen, 2006)
    - ITQs and DAS to Manage Porpoise & Cod (Bisack 2008)
  - Pinger Compliance (in review and in analysis) (Bisack, Das & Clay)

NOAA FISHERIES SERVICE

1. CEA of Gear Research Relative to a Closure: Pound Nets and Sea Turtles

- Magnusson GM, Bisack KD, Milliken HO. 2012. The Cost-effectiveness of Gear Research Relative to a Closure: Pound Nets and Sea Turtles as an Example. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 12-01; 25 p
  - Demonstrates the cumulative present value of costs for a gear modification, including gear research costs, was lower than for a closure; than is, the gear modification was cost-effective relative to the closure

NOAA FISHERIES SERVICE

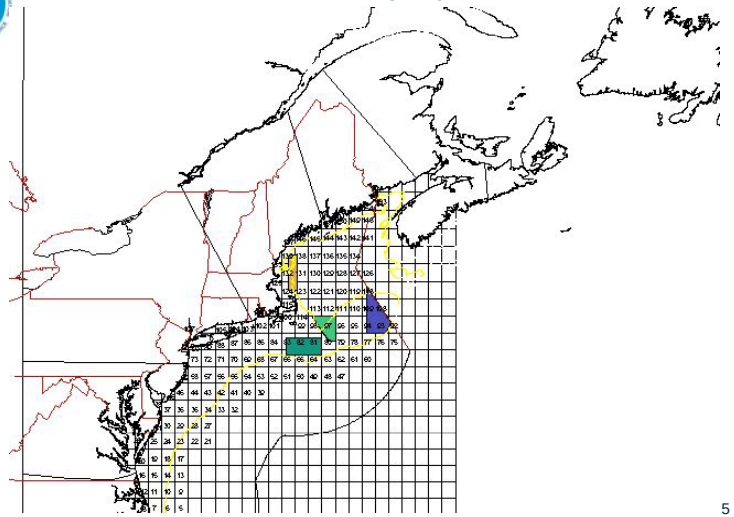
2. Behavioral Model to Evaluate Area Closures (CAI

- Large amount of work over last several years looking at welfare losses associated with closed areas:
  - (Dupont, 1993; Hicks 1997, Curtis 1999, 2000 Holland and Sutinen, 1999 Hicks, Kirkley and Strand, 2004…
- Most used Random Utility models
- Work in the Northeast has used Math Programming (Optimization) Models.
  - Developed by John Walden to assess groundfish regulations
  - Closures was one of the policy instruments analyzed, thus the name CAM
  - Expanded to include non-groundfish vessels (Maine to North Carolina)
    - Bisack & Magnusson. 2010. Harbor Porpoise EA.
- Estimating changes in Harvest under each Management Option: Desirable features
  - A focus on 30 minute square blocks, and monthly time periods.
  - Estimate changes in harvest by species and area
  - Incorporate several policy instruments (days at sea limits, trip limit changes and area closures, gear modifications) simultaneously.
  - Focus on the individual vessel level, and profit changes.

tbm1

NOAA FISHERIES SERVICE

Northeast Region Grid Numbering System



5

Slide 5

tbm1 I am assuming these are the 30 minute blocks, correct?
Tammy B. Murphy, 11/16/2012

NOAA FISHERIES SERVICE

2. Modeling Approach, Results and Future

- Originally Published in AJAE (1995)
- Approach uses a model, calibrated to observed conditions in a base year, to examine policy changes
- Models are widely used in Agriculture, particularly by the USDA.
- We use three stages –
  - Stage 1 uses a linear program to obtain dual values based on observed activity in a base year
  - Stage 2 uses the dual values along with average values to obtain yield function parameters.
  - Stage 3 uses base year data to construct the model.

6

NOAA FISHERIES SERVICE

2. Model Result Process & Future Direction

- Model Result Process
  - Run Model with the status quo and proposed options
  - Changes in profits, landings and distributional impacts provided.
  - Model results should be interpreted as an ordinal ranking of alternatives. Information from the model helps managers choose alternative.
- Future Directions: Need to develop
  - Fleet models that evaluate alternative policy instruments (Bisack and Sutinen 2006)
  - Models that incorporate uncertainty, other behavioral responses such as decision choice models, compliance behavior
  - Models that assess commercial fishery and PR targets simultaneously (Bisack 2008).

7

NOAA FISHERIES SERVICE

4. Policy Instruments

Bisack and Sutinen. 2006. Harbor Porpoise Bycatch: ITQs or Time/Area Closures in the New England Gillnet Fishery. Land Economics

- We investigate the implications of individual transferable quotas (ITQs) for reducing harbor porpoise bycatch in a multi-species fishery.
- Develop a numerical bio-economic model incorporating spatial and temporal patterns of abundance and harvest rates of 6 commercial fish species and harbor porpoise.
- Results indicate that porpoise ITQs, when compared to closures, are more profitable than closures, and distribute effort and profit reductions more evenly across seasons and areas.
- Price estimates for a unit of porpoise quota ranges from $1,395 to $5,782, for total allowable catches ranging from 951 to 209 porpoise, respectively.
- Total annual willingness to pay for porpoise quota is approximately $1.25 million.

NOAA FISHERIES SERVICE

4. Policy Instruments

Bisack 2008. Integrating Porpoise and Cod Management: A Comparison of Days-at-Sea, ITQs and Closures. MRE

- The purpose is to determine if management measures based on effort reductions, in particular DAS controls, can approach a porpoise ITQ program in terms of efficiency.
- Expand upon Bisack and Sutinen (2006) to include additional policy instruments.
- Include year-round DAS charges and surcharges. Use a single policy instrument to manage both porpoise and cod.
- Results indicate
  - Several programs for porpoise protection can achieve the same conservation outcomes with modest difference in industry profits.
  - At the industry level, the program selection may then rest on the goal of cod management since reduction in cod landings are much greater under the DAS year-round (59-63%) versus seasonal (39-46%) programs.
  - Significant differences in vessel profits, however, may make consensus on the appropriate program difficult.

NOAA FISHERIES SERVICE

3. Measuring the economic value of precision sampling for MM abundance and bycatch estimates: Case study of harbor porpoise and NE gillnet fishery

- Inconsistent government funding results in disruption of abundance survey frequency, survey length and levels of observer coverage; key inputs into PBR calculation.
- Higher funding results in higher precision ("better" information) and a higher PBR (management decision).
- Fishery responds to changes in PBR by changing amount and location of effort ("state of the world")
- These changes are accompanied by changes in the value (profitability) of fishing, which therefore determines (in part) the value of the higher precision of surveys.

NOAA FISHERIES SERVICE

3. Value of scientific information

Protected Resource Economics

Economic value of scientific information

Because the risk of being wrong could result in extinction, protected species management must be risk averse. Thus, scientific information with a high degree of uncertainty results in stricter management measures.

All survey information includes some amount of statistical error and uncertainty. We know that the more data we collect, the more precise our estimate will be, and the more confident we can be in setting regulations that balance fishing activity and species protection.

A recent NOAA Fisheries study found that a modest annual increase of $217,000 for data collection could improve the precision of the Northwest Atlantic harbor porpoise stock assessment such that profits to commercial fishermen would increase by $850,000 per year.

	Column A Fleet Economic Profits	Column B Cost to improve precision	Net Benefits Column A less Column B
Option 1: Low Precision	$1,914,000	$221,000	$1,693,000
Option 2: High Precision	$2,764,000	$438,000	$2,326,000
Difference between options	$850,000	$217,000	$633,000

(Bisack and Magnusson. 2014)

NOAA FISHERIES SERVICE

5. SSB Compliance Project

- Phase 1 – Empirical Compliance Model under 1998 TRT plan (2007-2010) (Bisack and Das)
- Phase 2 – Focus group ground-truthing & survey (2012) (Bisack & Clay)
- Phase 3 – Empirical Compliance Model under threat of Consequential Closures (2010-2012) (Bisack)
- Phase 4 – Focus group ground-truthing & survey (2013) (Bisack and Clay)

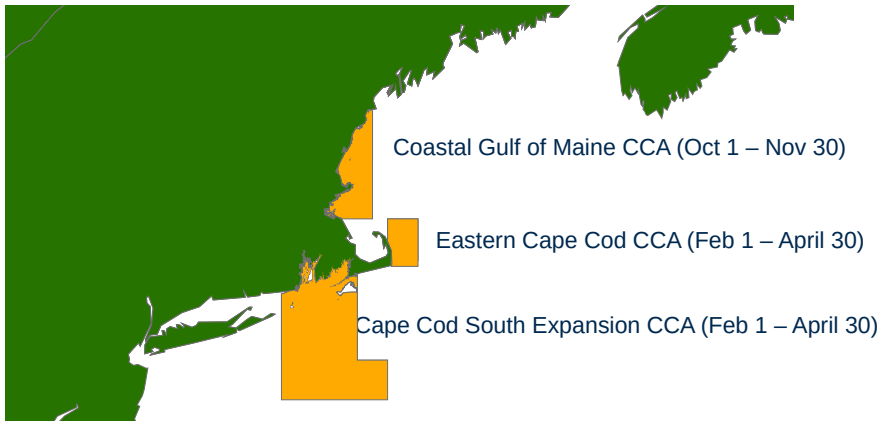
NOAA FISHERIES SERVICE

5. Empirical Compliance Model Harbor Porpoise and the Gillnet Fishery

- Objective is to identify factors that may influence a vessel's compliance decision.
- Policy Instruments used to control porpoise bycatch
  - Performance Standard (Area Closures)
  - Technology Standard (Gear Modifications)
    - Pingers
- Problem: Pinger Non-Compliance too high
- Compliance measured via at-sea-observer program (~5% of fishing effort)
- Natural Experiment (Pre-CC and Post-CC)

NOAA FISHERIES SERVICE

Consequential Closures If non-compliance too high!



NOAA FISHERIES SERVICE

Questions

Q1: What factors influence the pinger compliance decision of a vessel operator/owner?

Economic, moral, social and legitimacy factors

Q2: Did compliance improve under the revised porpoise TRT plan (Post CC)?

NOAA FISHERIES SERVICE

Model Variables

Dependent: V = 1 if violation observed at-sea between
- June 2009-May 2010 (Pre CC)
- June 2012-May 2013 (Post CC)

Independent
- Vessel Characteristics
  - Gross Tons, Horsepower/Vess Length, Captain Years, Revenues, Gillnet Gear Exclusively
- Deterrent Factor
  - Vessels perception of detection = 1 if sampled 2 consecutive years
- Normative Factors (Proxy)
  - Moral: Previous violations
  - Social: Port Behavior
  - Legitimacy: TRT member in vessel's port

Model Results
Q1: Influential Factors
(Parameter Estimates)

	Pre CC (2009-10)	Post CC (2012-13)	Pre & Post CC
Intercept	**0.61**	-1.66	**1.36**
Gross Tons	**0.09**	0.01	0.02
Horsepower/Foot	**-1.31**	0.04	**-0.24**
Gillnet Exclusive	**-5.14**	0.69	-0.42
Capt Years Gill	**0.09**	-0.02	<0.01
Revenues	**0.01**	<0.01	**0.39**
Detection	**-2.55**	**-1.64**	**-0.87**
Violation History	**3.11**	0.75	0.47
Port Behavior	1.41	**1.09**	0.47
TRT	-0.61	-0.25	
Post CC	Significant at 1% , 5% and 10%=*		**-0.95**

NOAA FISHERIES SERVICE

Model Results Summary
Pre & Post CC Model

Q1: Vessels/Operators more likely to violate the pinger regulations
- High revenues
- Lower detection rate
- Lower horsepower per foot of vessel
- Pre-Consequential Closure Period

Q2: Compliance improved under Revised TRT
- The onset of sectors seems to have improved compliance.
- CC more of a "real" threat to sector vessels
  - Detection rate higher (NEFOP & ASM)
  - High Penalty if caught

NOAA FISHERIES SERVICE

Focus Group Interview Findings (2012)

- Over and under sampling by observers influences compliance decisions
- They are aware of and know the "Repeat Violators"
- Perceive that punishments are non-existent
- Do not discuss pinger regulations in a group/sector setting as they do general fishery regulations
- Pinger compliance of other members not transparent
- Some sector members have a financial advantage over common pool and non-groundfish individuals.
- TRT – venue, membership, frequency was an issue

NOAA FISHERIES SERVICE

2012 & 2013 Focus Group Compliance Research What we talked about: Next meeting

NOAA FISHERIES SERVICE

Future Direction

- Need more research on policy instruments in order to move toward EBM.
- While Portfolio Theory, FISHSET, CAM and other RUM models have been used, more research is necessary to understand the pros & cons of the various modeling approaches.
- More holistic types of analyses are needed:
  - Gjertson, Squires, Dutton and Eguchi. 2014. CEA of Alternative Conservation Strategies with Application to the Pacific Leatherback Turtle. Conservation Biology.

21

Appendix D9: Using Non-Market Valuation to Value Protected Marine Species: A Review of the Literature

Science, Service, Stewardship

Using Non-Market Valuation to Value Protected Marine Species: A Review of the Literature*

Daniel K. Lew
Alaska Fisheries Science Center
NOAA Fisheries and
University of California, Davis

2014 NMFS Protected Resources Economics Workshop
September 9-11, 2014
La Jolla, California

NOAA FISHERIES SERVICE

*Opinions expressed are those of the authors and do not reflect those of NMFS, NOAA, or the U.S. Department of Commerce.

NOAA FISHERIES SERVICE

What Economic Values Are Measured?

- Willingness to pay (WTP)
  - For preservation of the species
  - For enhancement of the species (population increases, status improvements, reductions in extinction risk, etc.)
  - For conservation programs
    - Often with ill-defined or ambiguous effects on species
- Most commonly, the measured WTP is an estimate of the Total economic value (TEV)
  - TEV = use + nonuse value
  - For most T&E species, TEV is primarily or exclusively non-consumptive value (includes nonuse and non-consumptive use values)

NOAA FISHERIES SERVICE

Stated Preference (SP) Valuation Methods

- Use carefully constructed survey questions to elicit information about preferences
  - Hypothetical market situations
  - Contingent valuation (e.g., open-ended, payment card, referendum)
  - Choice experiments (focus on attributes)
- SP is capable of measuring nonuse or "passive use" values (i.e., value separate from use values, like existence value)
- General problem: In most cases, there is no corroborative evidence

NOAA FISHERIES SERVICE

Stated Preference-Related Controversies

- Hypothetical bias, "warm glow" and scope effects
- Critics argue that people do not answer CVM questions consistently with their actual behavior (e.g., Hausman [1993, 2012])
- Recent evaluation by Kling, Phaneuf, and Zhao (2012)

4 types of validity
- Criterion validity (stated value = actual value?)
- Convergent validity (other values the same? RP/SP)
- Construct validity (theoretically consistent? Scope, WTP/WTA)
- Content validity (best practices used?)

Table 2
Summary of Authors' Assessment

Validity concept	*Assessment*	*Comments*
Criterion	Some Yes, Some No	• Persistence of hypothetical bias in homegrown value experiments implies invalidity. • Emerging consequentiality paradigm suggests potential for validity. • Difficult to conclude purely in favor of validity, but also difficult to outright reject validity.
Convergent	Likely Yes	• Formal tests often accept revealed and stated preference equality. Even when statistically different estimates occur, they appear to illustrate common economic phenomena. • Practice has migrated towards using revealed and stated preference data as complements rather than substitutes.
Construct	Strongly Yes	• Further development of standard theory suggests a wider range of outcomes can still be considered neoclassically rational. • New behavioral theories suggest alternative paradigms might be needed to assess validity. • Definitive construct validity tests are now more difficult to formulate.
Content	Variable	• Content validity is a study-specific concept, but the stock of accumulated wisdom suggests adherence to best practice is now a stronger validity concept than in the past.

NOAA FISHERIES SERVICE

Types of Species Valuation Studies

- Aggregate species valuation studies
  - Value one or more *groups* of species that include threatened and endangered (T&E) species
  - Species-specific values cannot be estimated
- Disaggregate species valuation studies
  - Enable estimation of species-specific values

NOAA FISHERIES SERVICE

Aggregate Species Valuation Studies

- Studies
  - Berrens et al. (2000) – 11 T&E fish species
  - Farr et al. (2014) – broad groups of species in GBR in Australia
  - Jin et al. (2010) – general "marine turtle conservation" in Asia
  - Lyssenko and Martinez-Espineira (2006) – 17 species of whale in Canada
  - Ressurreicao et al. (2011, 2012) – programs to avoid reducing marine species richness in Europe (in terms of numbers of species in large taxa)
- Limited ability to use in benefits transfer (no individual species values)

NOAA FISHERIES SERVICE

Disaggregate Species Valuation Studies

- Over 30 T&E marine species valuation studies to date
  - Many valuing charismatic megafauna
    - Cetaceans (5 studies)
    - Pinnipeds (11 studies)
  - Some valuing lesser known species
    - Striped shiner (Boyle and Bishop 1987)
    - Silvery minnow (Berrens et al. 2000)
    - Riverside fairy shrimp (Stanley 2005)
    - Short-nosed sturgeon (Aldrich et al. 2007)
- Many of these studies are included in one of three **meta-analyses** (Loomis and White 1996; Richardson and Loomis 2009; Martin-Lopez et al. 2008)

NOAA FISHERIES SERVICE

Meta-Analyses of U.S. T&E Species Values

Loomis and White (1996)

- 20 CV studies conducted between 1983 and 1994
- Annual WTP ranged between $11 and $153 (2013 dollars)
- 7 studies valuing T&E marine species
- Marine species valued: whales, salmon, steelhead, sea otters, loggerhead sea turtles

Richardson and Loomis (2009)

- 11 additional studies conducted through 2005 (all CV except 1 CE unpublished study)
- Annual WTP ranged from $12 to $404 (2013 dollars)
- An additional 5 studies valuing T&E marine species
- Additional marine species valued were other migratory fish, fairy shrimp, and Steller sea lions

NOAA FISHERIES SERVICE

Martin-Lopez et al. (2008)

- Not just U.S. studies
- 60 studies total, but only 20 value aquatic species
- Of the 20, there are 4 non-U.S. studies, several gray literature papers, a non-primary study, and a duplicate study

Table 1. Threatened, endangered, and rare marine species values reported in meta-analyses

Martin-Lopez, Montes, and Benayas (2008, Conservation Biology)

Marine Species	Source Study	Country
Gray seals	Boseti and Pearce (2003)	U.K.
Hawaiian monk seal	Samples and Hollyer (1990), Brown et al. (1994)	United States
Mediterranean monk seal	Langford et al. (1998)	Greece
Northern elephant seal	Hageman (1986)	U.S.
Steller sea lion	Giraud et al. (2002)	U.S.
Beluga whale	Tkac (1998)	U.S.
Blue whale	Hageman (1985, 1986), Bulte and Kooten (1999)	U.S., Canada
Bottlenose dolphin	Hageman (1986)	U.S.
Gray whale	Hageman (1985, 1986), Loomis and Larson (1994)	U.S.
Humpback whale	Samples et al. (1986), Samples and Hollyer (1992), Brown et al. (1994), Wilson and Tisdell (2003)	U.S., Australia
Loggerhead sea turtle	Whitehead (1992), Wilson and Tisdell (2003)	U.S., Australia
Atlantic salmon	Stevens et al. (1991), Bulte and Kooten (1999)	U.S., Canada
Arctic grayling	Duffield and Patterson (1992)	U.S.
Chinook salmon	Hanemann et al. (1991), Olsen et al. (1991)	U.S.
Cutthroat trout	Duffield and Patterson (1992)	U.S.
Steelhead	Olsen et al. (1991)	U.S.
Shortnose sturgeon	Kotchen and Reiling (1998)	U.S.
Kelp bass	Carson et al. (1994)	U.S.
White croaker	Carson et al. (1994)	U.S.
Riverside fairy shrimp	Stanley (2005)	U.S.

NOAA FISHERIES SERVICE

Recent Disaggregate Studies: SPCE Studies

- Rudd (2009) – Canada
  - **5 species**: Atlantic salmon, Atlantic whitefish, N. Atlantic right whale, porbeagle shark, and white sturgeon
  - Valued Canadian households' WTP for increasing populations
  - *SPCE design only allowed estimation of relative species values*
- Lew et al. (2010) – U.S.
  - **1 species**: Eastern and western stocks of Steller sea lion
  - Valued U.S. and Alaska households' WTP for increasing population sizes and improving ESA status
- Lew and Wallmo (2011), Wallmo and Lew (2011, 2012) – U.S.
  - **8 species**: N. Atlantic right whale, N. Pacific right whale, Puget Sound Chinook salmon, Upper Willamette River Chinook salmon, smalltooth sawfish, leatherback sea turtle, loggerhead sea turtle, and Hawaiian monk seal
  - Valued U.S. households' WTP for improving ESA status

NOAA FISHERIES SERVICE

Recent Disaggregate Studies: CV Studies

- New data
  - Solomon et al. (2004): WTP for protection program for manatees from a survey of a Florida county's residents
  - Ojea and Loureiro (2010): WTP for preservation and for increase in population above MVP for European hake and Norwegian lobster (Galician households in Spain)
  - Stithou and Scarpa (2012): WTP for programs involving setting up MPAs which contribute to protection of Mediterranean monk seal and loggerhead sea turtle (very small sample of tourists of Greek island)
- Old data, new models
  - Giraud and Valcic (2004), Larson et al. (2004), Aldrich et al. (2007), and Kontogianni et al. (2012)
- Hybrid CV/CE: Boxall et al. (2012)

NOAA FISHERIES SERVICE

Recent Disaggregate Studies by T&E Marine Species

Table 2. Recent Disaggregate Threatened, Endangered, and Rare Marine Species Valuation Studies

Species	Reference	Valuation Method	Mean/Median WTP Range	Frequency of payment	Units	Survey Year	Good Valued	Country
Short-nosed sturgeon	Aldrich et al. (2007)	CV	-$6.46–40.57	One-time	I	1997	Recovery program	U.S.
Harbor seal	Boxall et al. (2012)	Hybrid CV/CE	$77.37 – 197.85	Annual	H	2006	Improved status	Canada
Beluga whale	Boxall et al. (2012)	Hybrid CV/CE	$111.46 – 349.10	Annual	H	2006	Improved status	Canada
Steller sea lion	Giraud and Valcic (2004)	CV	-$88.43 – 88.18	Annual	H	2000	Recovery program	U.S.
	Lew et al. (2010)	CE	$34.94 – 204.24	Annual	H	2007	Improved status and population increase	U.S.
Mediterranean monk seal	Kontogianni et al. (2012)	CV	50 – 87.1 euros	Unknown[a]	H	2009	Protection program	Greece
	Stithou and Scarpa (2012)	CV	15.20 – 20.94 euros	One-time	I	2003	Protection program	Greece
			12.40 – 14.27	Per visit	I	2003	Protection program	Greece
Gray whales	Larson et al. (2004)	CV	$22.51 – 33.94[b]	Annual	I	1991 – 1992	Population increases	U.S.
Hawaiian monk seal	Lew and Wallmo (2011),	CE	$43.72 – 85.66	Annual	H	2008	Improved status	U.S
	Wallmo and Lew (2011)	CE	$43.72 – 68.12	Annual	H	2008	Improved status	U.S.
	Wallmo and Lew (2012)	CE	$36.26 – 66.31	Annual	H	2009	Improved status	U.S.
Puget Sound Chinook salmon	Wallmo and Lew (2011)	CE	$46.95	Annual	H	2008	Improved status	U.S.
	Wallmo and Lew (2012)	CE	$40.49	Annual	H	2009	Improved status	U.S.
Smalltooth sawfish	Lew and Wallmo (2011)	CE	$33.96 – 64.50	Annual	H	2008	Improved status	U.S
	Wallmo and Lew (2011)	CE	$33.96 – 53.39	Annual	H	2008	Improved status	U.S.
	Wallmo and Lew (2012)	CE	$32.45 – 51.89	Annual	H	2009	Improved status	U.S.
Norwegian lobster	Ojea and Loureiro (2010)	CV	15.83 euros	One-time	H	2006	Protection program	Spain
Hake	Ojea and Loureiro (2010)	CV	24.57 euros	One-time	H	2006	Protection program	Spain
Manatee	Solomon et al. (2004)	CV	10.25 – 21.44	Annual	H	2001	Protection program	U.S.
Loggerhead sea turtle	Stithou and Scarpa (2012)	CV	15.70 – 22.52 euros	One-time	I	2003	Protection program	Greece
			12.04 – 13.64 euros	Per visit	I	2003	Protection program	Greece
	Wallmo and Lew (2012)	CE	$43.72	Annual	H	2009	Improved status	U.S.
Upper Willamette River Chinook salmon	Wallmo and Lew (2012)	CE	$40.65	Annual	H	2009	Improved status	U.S.
North Pacific right whale	Wallmo and Lew (2012)	CE	$41.72 – 73.16	Annual	H	2009	Improved status	U.S.
North Atlantic right whale	Wallmo and Lew (2012)	CE	$38.79 – 71.62	Annual	H	2009	Improved status	U.S.
Leatherback sea turtle	Wallmo and Lew (2012)	CE	$37.96 – 67.97	Annual	H	2009	Improved status	U.S.

Units refer to the value's unit measurement in terms of household (H) or individual (I)
[a]The payment vehicle was a contribution made on the water bill, but the frequency of billing was not mentioned.
[b]Also presents estimated WTP in non-monetary terms (hours donated).

NOAA FISHERIES SERVICE

Recent Disaggregate Studies: Some Observations

- WTP values range from -$120 to $438 (2013 dollars)
  - Negative values for SSL recovery program (Giraud and Valcic 2004) and shortnose sturgeon protection program (Aldrich et al. 2007) in CV studies
  - Largest values were from Boxall et al. (2012) for valuing beluga whales in St. Lawrence estuary
- Survey methodologies: numerous web-based surveys (primarily SPCE studies)
- Expansion of species covered, but still many holes
- Geographic coverage worldwide remains concentrated (U.S., Canada, Australia, Europe)
- Increasing number of WTP estimates that are "policy flexible"
  - Value of increasing population, reducing risk, or improving status
  - Mainly due to switch to SPCE methods

13

NOAA FISHERIES SERVICE

Discussion: Some Observations

- Gray literature contains additional studies, but have not been peer reviewed
- Many earlier studies and some newer ones use less than state-of-the-art methods, are based on small sample sizes, use simple estimation models, or survey limited populations
- Embedding remains a problem
  - E.g., valuing a broad program instead of specific policy instruments, or effects on species
- A note about corals
  - Numerous recreation-based valuation studies in coral reef ecosystems (Londoño and Johnston 2007); not tied to individual species generally

14

NOAA FISHERIES SERVICE

Discussion: Are We There Yet?

- Answer: No, but progress is being made
- Policy relevant WTP estimates are increasing in number and quality, but more are needed
- Need more studies on lesser-known species (biological, ecological, and economic information)
- Need values for MMPA species that are not ESA-listed
- More research on relationship between regulations, conservation, and other management measures on species
- Big questions still remain in valuation generally (e.g., Is there a cap on WTP for all T&E species?)
- Benefits transfer methods are advancing but many challenges remain given limitations in the set of available estimates
- Integrating economic values into policy analyses and related models (e.g., bioeconomic models)

15

Appendix D10: To Market, To (Hypothetical) Market: Protected Species Valuation Research at NMFS

Science, Service, Stewardship

To market, to (hypothetical) market: Protected Species Valuation Research at NMFS

Kristy Wallmo
Office of Science and Technology
NOAA Fisheries

Dan Lew
Alaska Fisheries Science Center
NOAA Fisheries

NOAA FISHERIES SERVICE

Presented at 2014 NMFS Protected Resources Economics Workshop
September 9-11, 2014
La Jolla, California

NOAA FISHERIES SERVICE

An overview of NMFS-sponsored protected species non-market studies

Species	Date fielded	Scale	Initiating region
Cook Inlet beluga whale	2013	Alaska households	Alaska (AFSC)
Klamath river species: coho salmon wild chinook salmon & steelhead trout shortnose & Lost River suckers	2011	National, with oversampling in Klamath river area and oversampling in the rest of Oregon and California	Southwest (SWFSC)
Multi-species (16)	2010 Phase 1 2011 Phase 2	National	HQ
Steller sea lion	2007	Two samples: (1) Non-Alaska U.S. households (2) Alaska households	Alaska (AFSC)
North Atlantic right whale	Instrument developed; not yet fielded	National	Northeast (NEFSC)

NOAA FISHERIES SERVICE

An overview of NMFS-sponsored protected species non-market studies

Species	Date fielded	Method	Mode
Cook Inlet beluga whale	2013	Stated Preference Choice Experiment	Mail
Klamath river species: coho salmon wild chinook salmon & steelhead trout shortnose & Lost River suckers	2011		Mail with option to take online
Multi-species (16)	2010 Phase 1 2011 Phase 2		Online using a standing RDD-recruited web panel
Steller sea lion	2007		Mail
North Atlantic right whale	Instrument developed; not yet fielded		Mail

NOAA FISHERIES SERVICE

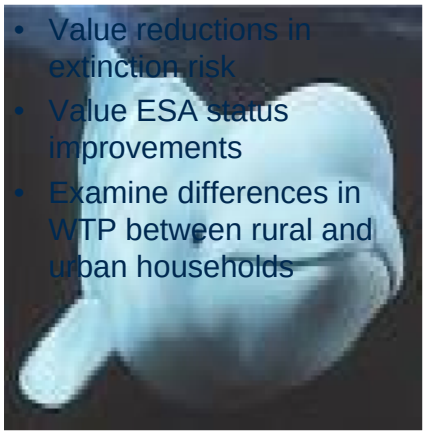
Stated Preference/Valuation Issues to Examine

- Scope sensitivity
- Warm-glow
- Hypothetical bias
- Heterogeneity in WTP
- Questionnaire design
- Information effects
- Anchoring effect (prices)

NOAA FISHERIES SERVICE

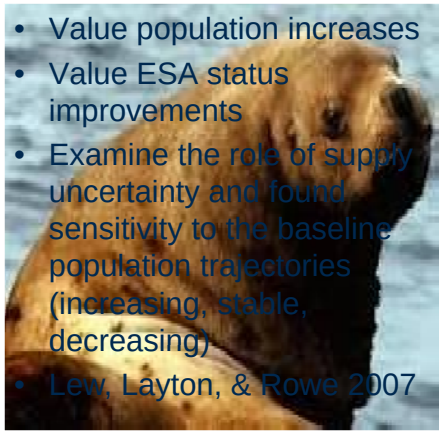
Survey-specific Theoretical and/or Methodological Issues

Cook Inlet beluga whale



- Value reductions in extinction risk
- Value ESA status improvements
- Examine differences in WTP between rural and urban households

Steller sea lion

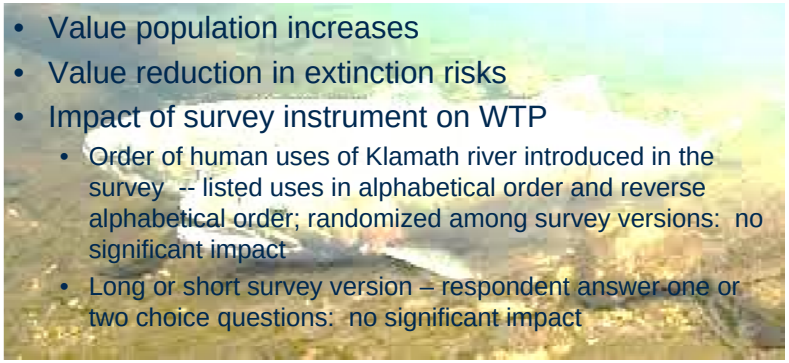


- Value population increases
- Value ESA status improvements
- Examine the role of supply uncertainty and found sensitivity to the baseline population trajectories (increasing, stable, decreasing)
- Lew, Layton, & Rowe 2007

NOAA FISHERIES SERVICE

Survey-specific Theoretical and/or Methodological Issues

Klamath river fish species

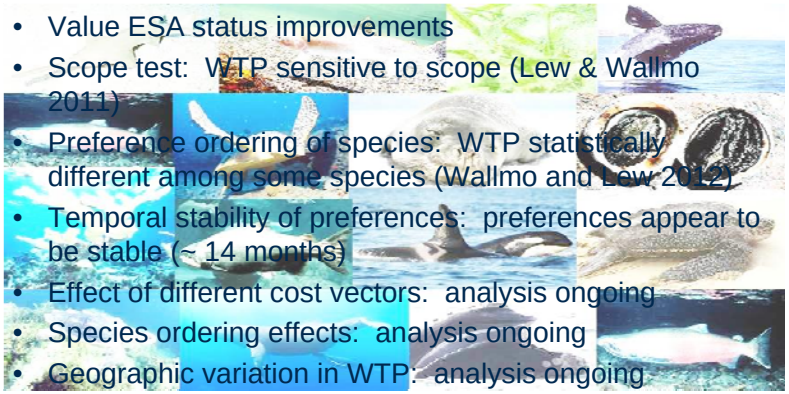


- Value population increases
- Value reduction in extinction risks
- Impact of survey instrument on WTP
  - Order of human uses of Klamath river introduced in the survey -- listed uses in alphabetical order and reverse alphabetical order; randomized among survey versions: no significant impact
  - Long or short survey version – respondent answer one or two choice questions: no significant impact

NOAA FISHERIES SERVICE

Survey-specific Theoretical and/or Methodological Issues

Multi-species Valuation Survey



- Value ESA status improvements
- Scope test: WTP sensitive to scope (Lew & Wallmo 2011)
- Preference ordering of species: WTP statistically different among some species (Wallmo and Lew 2012)
- Temporal stability of preferences: preferences appear to be stable (~ 14 months)
- Effect of different cost vectors: analysis ongoing
- Species ordering effects: analysis ongoing
- Geographic variation in WTP: analysis ongoing

NOAA FISHERIES SERVICE

SEA TURTLE VALUES

Species	Mean WTP* to Improve to Threatened	Mean WTP * to Recover
Hawksbill sea turtle	$51.17 (47.04-55.29)	$85.95 (81.27-90.20)
Leatherback sea turtle	$36.04 (33.13-38.84)	$64.53 (60.64-68.49)
Loggerhead sea turtle	NA	$41.52 (39.05-44.08)

NOAA FISHERIES SERVICE

MARINE MAMMAL VALUES

Species	Mean WTP* to Improve to Threatened	Mean WTP * to Recover
Southern Resident Killer whale	$48.30 (44.38-52.41)	$84.38 (79.15-89.69)
North Pacific right whale	$39.61 (36.36-42.95)	$69.46 (65.07-73.85)
North Atlantic right whale	$36.83 (33.65-40.13)	$68.00 (63.96-71.88)
Humpback whale	NA	$60.98 (57.47-64.52)
Hawaiian monk seal	$34.43 (31.55-37.68)	$62.96 (59.29-66.81)

NOAA FISHERIES SERVICE

FISH VALUES

Species	Mean WTP* to Improve to Threatened	Mean WTP * to Recover
Southern California steelhead	$45.71 (41.76-49.83)	$71.06 (66.29-75.96)
CCC coho salmon	NA	$51.96 (47.59-54.67)
Smalltooth sawfish	$30.81 (26.70-35.08)	$49.28 (44.40-54.47)
Upper Willamette River Chinook Salmon	NA	$38.59 (36.07-41.01)
Puget Sound Chinook Salmon	NA	$38.44 (35.99-40.70)

10

NOAA FISHERIES SERVICE

INVERTEBRATES, PLANTS & CORAL VALUES

Species	Mean WTP* to Improve to Threatened	Mean WTP * to Recover
Black abalone	$39.56 (35.62-43.59)	$70.50 (66.19-74.58)
Johnson's seagrass	NA	$43.83 (40.67-46.87)
Elkhorn coral	$38.00 (33.93-42.15)	$71.78 (67.30-76.23)

11

NOAA FISHERIES SERVICE

Welfare Estimates from other NMFS studies

Species	Type of Improvement	WTP
Klamath species		
Wild chinook and steelhead	150% increase in fish returning to river	$10.59
Shortnose and Lost River suckers	Reduce extinction rate to moderate	$17.37
Coho salmon	Reduce extinction rate to low	$48.21
Cook Inlet beluga whale	Reduce extinction rate to zero (urban or rural households)	$109.97 $113.23
Steller sea lion	Increase the western stock population to a recovered status (varying assumptions about population of eastern stock)	$83.80 $111.53

12

NOAA FISHERIES SERVICE

Issues from the Multi-species Study

- 3 species per respondent, respondents asked to assume all other threatened/endangered species remain at current status
- Variation in types of species (desirable) limited the types of improvements we could use in choice experiment – only ESA status improvements were plausible

NOAA FISHERIES SERVICE

Issues from the Multi-species Study

From focus groups:

- some respondents focus on doing something for all species vs more (or less) for preferred (less preferred) species
- respondents want to know what are the ecosystem impacts of a species decreasing or going extinct

NOAA FISHERIES SERVICE

Challenges and Future Work

- OMB & conducting non-market valuation (particularly for non-use)
  - Sample and implementation issues
  - Using non-market results
- Second “Blue Ribbon Panel” (last one was 1993, focused on contingent valuation)

NOAA FISHERIES SERVICE

Challenges and Future Work

- Climate impacts/protected species values
- Ecosystem level valuations vs. species level
- Uncertainty
- Validity
- Aggregation approaches
- Improve fit for policy needs
- Special issue Frontiers in Marine Science: The Economics of Protected Marine Species: Concepts in Research and Management
  - http://journal.frontiersin.org/ResearchTopic/3306#overview
  - Wide range of topics
  - Call for abstracts upcoming

NOAA FISHERIES SERVICE

Citations Slide

- Mansfield, C., Van Houtven, G., Hendershott, A., Chen, P., Porter, J., Nourani, V., & Kilambi , V. 2012. Klamath River Basin restoration: Nonuse value survey. Final report: Prepared for the U.S. Bureau of Reclamation. Research Triangle Park, NC: RTI International. http://www.rti.org/publications/abstract.cfm?pubid=19774
- Wallmo, K., and Lew, D. 2012. The value of recovering threatened and endangered marine species: a choice experiment approach. Conservation Biology, 26(5): 830-39.
- Lew, D., and Wallmo, K. 2011. External tests of scope and embedding in stated preference choice experiments: an application to endangered species valuation. Environmental and Resource Economics, 48(1): 1 – 23.
- Lew, D., Layton, D., Rowe, R., 2010. Valuing Enhancements to Endangered Species Protection under Alternative Baseline Futures: The Case of the Steller Sea Lion. Marine Resource Economics, 25: 133 – 154.

NOAA FISHERIES SERVICE

Welfare Estimates

Common Group	Species	Mean WTP to Recover
Whales	North Atlantic right whale	$68.00 (63.96-71.88)
	North Pacific right whale	$69.46 (65.07-73.85)
	Humpback whale	$60.98 (57.47-64.52)
	Southern resident killer whale	$84.38 (79.15-89.69)
Marine sea turtles	Loggerhead sea turtle	$41.52 (39.05-44.08)
	Leatherback sea turtle	$64.53 (60.64-68.49)
	Hawksbill sea turtle	$85.95 (81.27-90.20)
Corals	Elkhorn coral	$71.78 (67.30-76.23)

NOAA FISHERIES SERVICE

Welfare Estimates

Common Group	Species	Mean WTP to Recover
Fish	Upper Willamette River Chinook Salmon	$38.59 (36.07-41.01)
	Puget Sound Chinook Salmon	$38.44 (35.99-40.70)
	Smalltooth sawfish	$49.28 (44.40-54.47)
	Central California Coast Chinook salmon	$51.96 (47.59-54.67)
	Southern California steelhead	$71.06 (66.29-75.96)
Invertebrates	Black abalone	$70.50 (66.19-74.58)
Plants	Johnsons seagrass	$43.83 (40.67-46.87)
Seals/sea otters	Hawaiian monk seal	$62.96 (59.29-66.81)

NOAA FISHERIES SERVICE

Non-market Values for Threatened and Endangered species

What's been done?

- Estimates for over 40 T&E species exist in literature, from bald eagles to striped shiners
- NMFS species: Atlantic and Pacific salmon species, Hawaiian monk seal, whale species, bottlenose dolphins, sea otters, Steller sea lion, coral reefs, abalone, seagrass
- Traditional method is Contingent Valuation; recent applications of Stated Preference Choice Experiment

Why do more?

- More flexible instrument designs can fit better with policy or regulatory needs
- Difficult to compare values among studies due to methodological/survey design differences
- Different sampling scales
- Many gaps, still mostly mammals or charismatic species

Appendix D11: The Vaquita and the Upper Gulf of California

Conservation: Vaquita and the upper Gulf of California

- Arid
- Productive
- Second highest tidal range in the world in the northern end of the basin

The vaquita is the most critically endangered cetacean in the world ….
…. will the species become the second cetacean to go extinct "under our watch"?

Taylor, Barlow, Gerrodette - Southwest Fisheries Science Center, NOAA Fisheries Service
Rojas-Bracho, Jaramillo-Legoretta - Instituto Nacional de Ecologia, SEMARNAT
and many more

NOAA NMFS SWFSC PRD photo by Tom Jefferson

2

Family: Phocoenidae

Scientific name: *Phocoena sinus*

Common name: Vaquita

Described as a new species in 1958

Natural History

One of the smallest cetaceans in the world:
adult female: 135 - 150cm; adult male: 128 – 145cm

Smallest geographic distribution of any cetacean; naturally rare

Foraging: ~26 different species; main prey: mollusks (squid) and crustaceans

Vaquita are difficult to see in the wild

- Small size (triangular fin about the height of a milk carton visible about 3 seconds at a time)
- Spends most of its time under water
- When surfacing vaquita rarely splash or jump
- Small group size (average 2)
- Avoid boats

http://vaquita.tv/blog/2008/10/23/meet-vaquita-marina/

Fisheries by-catch

Study by D'Agrosa et al. in 1993-1995:

Vaquitas were killed in a variety of artisanal gill net fisheries

By-catches occurred year-round

By-catches occurred throughout the upper Gulf of California

About 78/year estimated killed

(D'Agrosa et al. 2000)

What are the threats?

(Taylor et al. 1999)

- Pollutants (no threat …clean blubber)
- Inbreeding depression (no threat (yet)…many calves, naturally rare)
- Lack of Colorado River flow (no threat now)
  - Dead vaquita fat
  - Many calves
  - Many fewer vaquita than normal levels
- Bycatch (accidental death in fishing nets)
  - Estimated 78/year…is that too many?

How many vaquita are there?

Joint Mexican/U.S. abundance surveys in 1997 and 2008

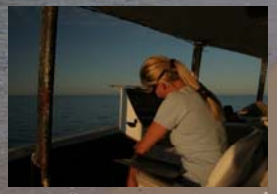
Biosphere Reserve Boundary

Area de la Refugio de Vaquita

2008

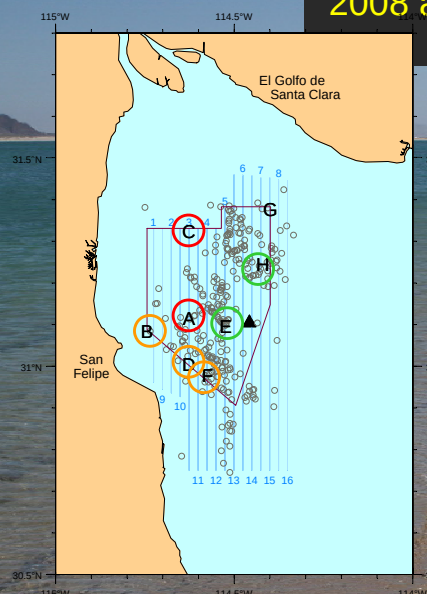
1997 abundance = 567 vaquitas
95% C.I. 177 – 1073

(Jaramillo *et al*., 1999)


2008 abundance = 245 vaquitas
95% C.I. 68-884

(Gerrodette et al., 2011)



The 2008 estimate was 57% lower than the 1997 estimate

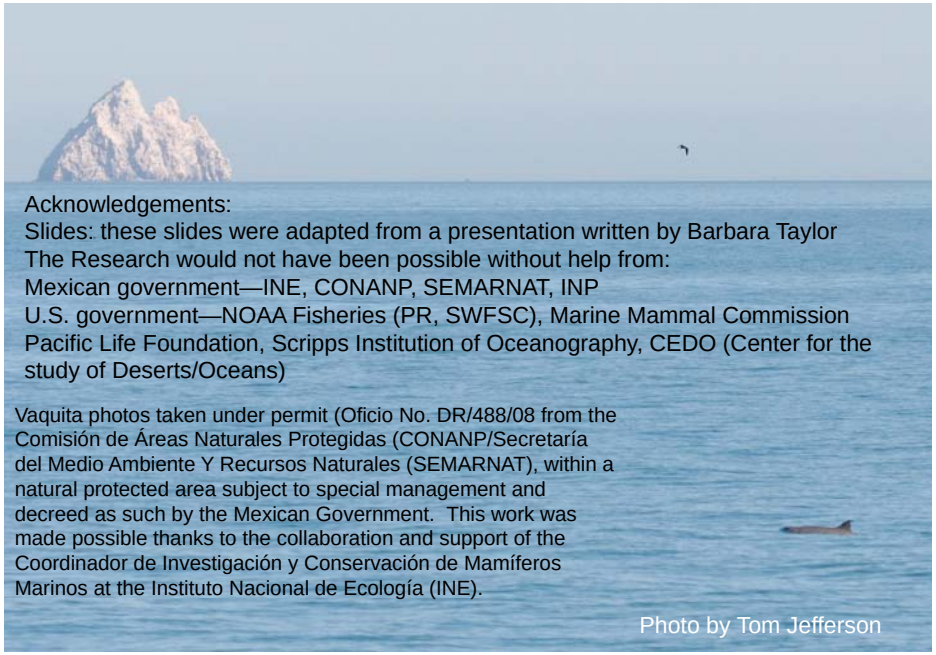

Science is clear: nets must go

However, a net ban is likely to have a significant socioeconomic impact on the local fishing communities.

Funds will be needed to:

- -- compensate fishermen for the economic loss
- -- support the transition to alternative livelihoods
- -- enforce the removal of fishing nets
- -- find alternative fishing methods
- -- engage markets

Mexico has invested
>$18 Million US
into vaquita efforts
(buyout + enforcement)



Acknowledgements:
Slides: these slides were adapted from a presentation written by Barbara Taylor
The Research would not have been possible without help from:
Mexican government—INE, CONANP, SEMARNAT, INP
U.S. government—NOAA Fisheries (PR, SWFSC), Marine Mammal Commission
Pacific Life Foundation, Scripps Institution of Oceanography, CEDO (Center for the study of Deserts/Oceans)

Vaquita photos taken under permit (Oficio No. DR/488/08 from the Comisión de Áreas Naturales Protegidas (CONANP/Secretaría del Medio Ambiente Y Recursos Naturales (SEMARNAT), within a natural protected area subject to special management and decreed as such by the Mexican Government. This work was made possible thanks to the collaboration and support of the Coordinador de Investigación y Conservación de Mamíferos Marinos at the Instituto Nacional de Ecología (INE).

Photo by Tom Jefferson

13

Publishing in *NOAA Technical Memorandum NMFS-NE*

Manuscript Qualification

This series represents a secondary level of scientific publishing in the National Marine Fisheries Service (NMFS). For all issues, the series employs thorough internal scientific review, but not necessarily external scientific review. For most issues, the series employs rigorous technical and copy editing. Manuscripts that may warrant a primary level of scientific publishing should be initially submitted to one of NMFS's primary series (*i.e., Fishery Bulletin, NOAA Professional Paper NMFS,* or *Marine Fisheries Review*).

Identical, or fundamentally identical, manuscripts should not be concurrently submitted to this and any other publication series. Manuscripts which have been rejected by any primary series strictly because of geographic or temporal limitations may be submitted to this series.

Manuscripts by Northeast Fisheries Science Center (NEFSC) authors will be published in this series upon approval by the NEFSC's Deputy Science & Research Director. Manuscripts by non-NEFSC authors may be published in this series if: 1) the manuscript serves the NEFSC's mission; 2) the manuscript meets the Deputy Science & Research Director's approval; and 3) the author arranges for the printing and binding funds to be transferred to the NEFSC's Research Communications Branch account from another federal account. For all manuscripts submitted by non-NEFSC authors and published in this series, the NEFSC will disavow all responsibility for the manuscripts' contents; authors must accept such responsibility.

The ethics of scientific research and scientific publishing are a serious matter. All manuscripts submitted to this series are expected to adhere -- at a minimum -- to the ethical guidelines contained in Chapter 2 ("Publication Policies and Practices") of the *Scientific Style and Format: the CSE Manual for Authors, Editors, and Publishers*, seventh edition (Reston VA: Council of Science Editors). Copies of the manual are available at virtually all scientific libraries.

Manuscript Preparation

Organization: Manuscripts must have an abstract, table of contents, and -- if applicable -- lists of tables, figures, and acronyms. As much as possible, use traditional scientific manuscript organization for sections: "Introduction," "Study Area," "Methods & Materials," "Results," "Discussion" and/or "Conclusions," "Acknowledgments," and "References Cited."

Style: All NEFSC publication and report series are obligated to conform to the style contained in the most recent edition of the *United States Government Printing Office Style Manual*. That style manual is silent on many aspects of scientific manuscripts. NEFSC publication and report series rely more on the *CSE Style Manual,* seventh edition.

For in-text citations, use the name-date system. A special effort should be made to ensure that the list of cited works contains all necessary bibliographic information. For abbreviating serial titles in such lists, use the guidance of the International Standards Organization; such guidance is easily accessed through the various Cambridge Scientific Abstracts' serials source lists (see *http://www.public.iastate.edu/~CYBERSTACKS/JAS.htm*). Personal communications must include date of contact and full name and mailing address of source.

For spelling of scientific and common names of fishes, mollusks, and decapod crustaceans from the United States and Canada, use *Special Publications* No. 29 (fishes), 26 (mollusks), and 17 (decapod crustaceans) of the American Fisheries Society (Bethesda MD). For spelling of scientific and common names of marine mammals, use *Special Publication* No. 4 of the Society for Marine Mammalogy (Lawrence KS). For spelling in general, use the most recent edition of *Webster's Third New International Dictionary of the English Language Unabridged* (Springfield MA: G. & C. Merriam).

Typing text, tables, and figure captions: Text, tables, and figure captions should be converted to Word. In general, keep text simple (*e.g.*, do not switch fonts and type sizes, do not use hard returns within paragraphs, do not indent except to begin paragraphs). Also, do not use an automatic footnoting function; all notes should be indicated in the text by simple numerical superscripts, and listed together in an "Endnotes" section prior to the "References Cited" section. Especially, do not use a graphics function for embedding tables and figures in text.

Tables should be prepared with a table formatting function. Each figure should be supplied in digital format (preferably GIF or JPG), unless there is no digital file of a given figure. Except under extraordinary circumstances, color will not be used in illustrations.

Manuscript Submission

Authors must submit separate digital files of the manuscript text, tables, and figures. The manuscript must have cleared NEFSC's online internal review system. Non-NEFSC authors who are not federal employees will be required to sign a "Release of Copyright" form.

Send all materials and address all correspondence to: Jarita A. Davis (Editor), Editorial Office, NMFS Northeast Fisheries Science Center, 166 Water Street, Woods Hole, MA 02543-1026.

Northeast Fisheries Science Center
Operations, Management & Information Division
Research Communications Branch
Editorial Office

National Marine Fisheries Service, NOAA
166 Water St.
Woods Hole, MA 02543-1026

MEDIA MAIL

Publications and Reports of the Northeast Fisheries Science Center

The mission of NOAA's National Marine Fisheries Service (NMFS) is "stewardship of living marine resources for the benefit of the nation through their science-based conservation and management and promotion of the health of their environment." As the research arm of the NMFS's Northeast Region, the Northeast Fisheries Science Center (NEFSC) supports the NMFS mission by "conducting ecosystem-based research and assessments of living marine resources, with a focus on the Northeast Shelf, to promote the recovery and long-term sustainability of these resources and to generate social and economic opportunities and benefits from their use." Results of NEFSC research are largely reported in primary scientific media (*e.g.*, anonymously-peer-reviewed scientific journals). However, to assist itself in providing data, information, and advice to its constituents, the NEFSC occasionally releases its results in its own media. Currently, there are three such media:

NOAA Technical Memorandum NMFS-NE -- This series is issued irregularly. The series typically includes: data reports of long-term field or lab studies of important species or habitats; synthesis reports for important species or habitats; annual reports of overall assessment or monitoring programs; manuals describing program-wide surveying or experimental techniques; literature surveys of important species or habitat topics; proceedings and collected papers of scientific meetings; and indexed and/or annotated bibliographies. All issues receive internal scientific review and most issues receive technical and copy editing.

Northeast Fisheries Science Center Reference Document -- This series is issued irregularly. The series typically includes: data reports on field and lab studies; progress reports on experiments, monitoring, and assessments; background papers for, collected abstracts of, and/or summary reports of scientific meetings; and simple bibliographies. Issues receive internal scientific review, but no technical or copy editing.

Resource Survey Report (formerly *Fishermen's Report*) -- This information report is a quick-turnaround report on the distribution and relative abundance of selected living marine resources as derived from each of the NEFSC's periodic research vessel surveys of the Northeast's continental shelf. There is no scientific review, nor any technical or copy editing, of this report.

OBTAINING A COPY: To obtain a copy of a *NOAA Technical Memorandum NMFS-NE* or a *Northeast Fisheries Science Center Reference Document*, or to subscribe to the *Resource Survey Report*, either contact the NEFSC Editorial Office (166 Water St., Woods Hole, MA 02543-1026; 508-495-2228) or consult the NEFSC webpage on "Reports and Publications" (*http://www.nefsc.noaa.gov/nefsc/publications/*).