EXPLORING TOOLS FOR MANAGING DATA-POOR STOCKS CFMC WORKSHOP

February 23-24, 2011

SUMMARY REPORT

Hosted by the
Caribbean Fishery Management Council
and the
Fisheries Leadership & Sustainability Forum

Preface

On February 23-24, 2011 in San Juan, Puerto Rico, the Caribbean Fishery Management Council (CFMC) and the Fisheries Leadership & Sustainability Forum (Fisheries Forum) hosted an educational workshop on data collection and management for data-poor stocks. Participants included CFMC members, CFMC staff, CFMC Advisory Panel members, National Marine Fishery Service (NMFS) representatives, Southeast Fishery Science Center (SEFSC) representatives, Puerto Rico and US Virgin Islands government representatives, and stakeholders. This workshop was not a decision-making meeting and therefore no management decisions were made. The agenda and speaker biographies are provided as an appendix to this summary report. Additional materials related to the workshop, including briefing materials, PowerPoint presentations and video recordings of presentations, are available on the on the Fisheries Forum website, http://www.fisheriesforum.org.

Glossary of Acronyms

ACL	Annual Catch Limit
ABC	Acceptable Biological Catch
CCR	Commercial Catch Report
CFMC	Caribbean Fishery Management Council
CFSP	Commercial Fisheries Statistics Program
CPUE	Catch Per Unit Effort
CSIRO	Commonwealth Scientific and Industrial Research Organization
DFW	Division of Fish and Wildlife (US Virgin Islands)
DNER	Department of Natural and Environmental Resources (Puerto Rico)
DPNR	Division of Planning and Natural Resources (US Virgin Islands)
DRCR	Density Ratio Control Rule
EFH	Essential Fish Habitat
ERAEF	Ecological Risk Assessment for the Effects of Fishing
FAD	Fish Aggregation Device
FMP	Fishery Management Plan
MARFIN	Marine Fisheries Initiative
MLMA	Marine Life Management Act
MPA	Marine Protected Area
MRAG	Marine Resources Assessment Group
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSE	Management Strategy Evaluation
MSY	Maximum Sustainable Yield
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
OFL	Overfishing Limit
OY	Optimum Yield
PSA	Productivity-Susceptibility Analysis
RFMC	Regional Fishery Management Council
SEAMAP-C	Southeast Area Monitoring and Assessment Program – Caribbean
SEDAR	Southeast Data Assessment and Review
SEFSC	Southeast Fisheries Science Center
SICA	Scale Intensity Consequence Analysis
SPR	Spawning Potential Ratio
SSC	Scientific and Statistical Committee
TAC	Total Allowable Catch
TIP	Trip Interview Program
USVI	United States Virgin Islands

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Workshop Overview & Development

At the request of the Caribbean Fishery Management Council (CFMC), the Fisheries Leadership & Sustainability Forum (Fisheries Forum) organized an educational workshop in February 2011 to provide an opportunity for managers and stakeholders in the US Caribbean to explore pathways for advancing the management of data-poor stocks. The purpose of this summary is to capture the themes of the workshop discussions and serve as an educational resource for participants and other stakeholders to support CFMC's goal of continuing dialogue and identifying next steps forward.

With the reauthorization of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) in 2006, all Regional Fishery Management Councils (RFMCs) are taking steps to comply with the legal requirement to set annual catch limits (ACLs). In the US Caribbean, these requirements highlight the ongoing challenge of managing data-poor stocks and the importance of collecting reliable catch data. Building on the momentum of current data collection improvement efforts in the US Caribbean, this workshop provided exposure to innovative approaches to managing data-poor stocks and created a forum for forward-looking discussion.

The Fisheries Forum worked with the CFMC to develop the workshop agenda through a collaborative process by consulting with Council leadership, Council members, government agencies and stakeholders to accurately characterize current data collection efforts, identify informational needs and select relevant content for the workshop. Through a balance of background information, case study examples and introductions to creative methods for assessing and managing data-poor stocks, the curriculum provided a range of content relevant to this diverse audience of managers and stakeholders. The format of the two-day workshop was intended to strike a balance of substantive curriculum and opportunities for discussion.

To achieve the goal of providing decision-makers in the US Caribbean with an opportunity to explore some of the tools available for addressing data-poor stocks and to consider how the region can best move forward, the CFMC and the Fisheries Forum identified the following specific objectives:

1. Provide a common educational foundation for participants on the role of data in fisheries science, managing uncertainty, and complying with federal fishery management laws;
2. Illustrate the struggles and successes in other data-poor fisheries by highlighting both the processes and outcomes;
3. Provide a common understanding of the current work and progress in improving data collection for US Caribbean stocks;
4. Explore alternative approaches for data collection and management of data-poor stocks and evaluate their potential application for the US Caribbean; and
5. Encourage discussion of the current efforts and new approaches for improving the data collection and management of data-poor stocks,

culminating in the identification of discrete actions the US Caribbean can take in moving forward.

Agenda Overview

Opening Remarks
The workshop began with opening remarks from CFMC and Fisheries Forum leadership. Miguel Rolón, CFMC Executive Director, welcomed participants and outlined the need and purpose of the workshop. John Henderschedt, Fisheries Forum Executive Director, introduced the mission and philosophy of Fisheries Forum and educational premise of this workshop. Kim Gordon, Fisheries Forum Policy Analyst, discussed the development process for the curriculum and framed the agenda for the workshop. Dr. Donna Christiansen, US Delegate to Congress for the US Virgin Islands addressed the audience, emphasizing the need to balance preserving fisheries and the livelihood of fishers in the US Caribbean.

Background on Fisheries Science and Policy
The first two presentations focused on the statutory framework for fisheries management in the United States, the role of data and fisheries science, and the need to account for uncertainty.

Background of US Caribbean Fisheries
Representatives from Puerto Rico and the US Virgin Islands reviewed the regulatory framework, characteristics, participation and current data collection programs for fisheries in the US Caribbean.

Current Effort in Improving Data Collection
Presentations on the current efforts to improve commercial catch data and expand fishery independent data provided participants with an update on the steps already underway to increase fisheries data in the US Caribbean.

Case Study Panel
Workshop participants explored case studies from around the world to showcase examples and lessons learned from successful management of data-poor fisheries.

Data-Poor Approach Spotlight Sessions
Participants rotated through two breakout groups where they learned about four innovative approaches to managing data-poor stocks and considered the applicability of these approaches to the US Caribbean.

Looking Forward Discussion
Participants reflected on the ideas presented and brainstormed pathways forward in small and large group settings. These discussions culminated in the identification of a number of goals and recommendation for improving data collection and management in the US Caribbean.

Public Comment
The agenda also provided time for a brief public comment period where several individuals shared their thoughts with workshop participants. (Appendix 2)

Background On Fisheries Science And Policy

In order to provide a common foundation for all participants, the first segment of the agenda provided background on fisheries science and management. Dr. Rod Fujita discussed the legal framework for managing federal fisheries in the United States, and described how identifying risk and managing for uncertainty are essential for successful fisheries management. Dr. Luiz Barbieri discussed the role of fisheries science in supporting this framework by providing a primer on fisheries data, biological reference points and the assessment process in place for the southeastern US.

Managing Uncertainty: the Law, the Data, the Science, and the Incentives

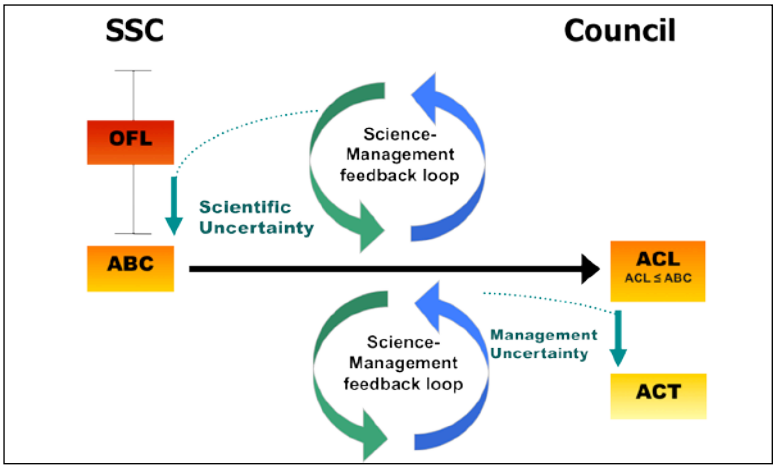
Dr. Rod Fujita, Senior Scientist and Director of Ocean Innovations, Environmental Defense Fund

Video Slide Presentation

Dr. Rod Fujita opened the workshop with a presentation on managing uncertainty in fisheries. The reauthorized Magnuson-Stevens Fishery Conservation and Management Act (MSA) mandates that councils must set annual catch limits (ACLs) for all managed stocks and that ACLs must be buffered to account for uncertainty. The National Standard 1 Guidelines identify two distinct types of uncertainty in fisheries: scientific uncertainty and management uncertainty.

- Scientific uncertainty refers to the quantity and quality of data and the appropriateness of the model employed; both the model and the data need to be accurate and precise to predict certain outcomes.
- Management uncertainty refers to how well management measures translate into the desired outcomes. Some management measures have higher certainty than others depending on how effective the regulation is at controlling human behavior and hence fishing mortality.

The National Standard 1 Guidelines outline a framework of reference points for incorporating both types of uncertainty into ACL determinations. For a given stock, a scientifically determined overfishing limit (OFL) is adjusted to account for scientific uncertainty yielding an acceptable biological catch (ABC) limit. The ABC is to be further reduced to account for management uncertainty when determining the appropriate ACL.



Source: NOAA Fisheries Service, Office of Sustainable Fisheries. (2010). MSA and NS1 Guidelines Presentation to RFMCs

Dr. Fujita explained the importance of managing for uncertainty and the impact of uncertainty relative to risk. The consequences of scientific and management uncertainty depend on the probability of negative consequences, or risk, associated with having uncertain outcomes. For example, a highly productive fishery with low effort may have relatively low risk in the presence of high uncertainty because the range of potential outcomes resulting from uncertainty may not pose significant risk to the fishery. Discussion about risk factors such as fishing effort, stock vulnerability, uncertainty, governance and social capital prompted workshop participants to think about how these factors contribute to risk in the US Caribbean. Dr. Fujita highlighted the story of the US west coast rockfish fishery, in which high scientific uncertainty led to unintentional overfishing and subsequent economic collapse due to the strict regulations required for rebuilding the stocks.

Dr. Fujita stressed the importance of identifying management goals for a fishery, using those goals to determine the appropriate model to assess the stock, and then optimizing the data collection strategy to fit the model. Dr. Fujita noted that there are methods available for assessing stocks on a smaller scale that demand fewer resources and less time, and perform almost as well as a more resource intensive stock assessment. In closing, Dr. Fujita noted that if steps are taken to reduce management and scientific uncertainty, the buffers councils are required to establish to account for uncertainty will shrink. As these buffers shrink, ACLs will increase toward OFLs and management will be based upon science and knowledge rather than uncertainty and risk.

Discussion

Participants commented on two possible ways of reducing scientific uncertainty for the US Caribbean: (a) through acquiring regionally specific data; and (b) by considering market driven selectivity when using landings data to infer stock status. There was also discussion around how obtaining data about fish stocks within marine protected areas (MPAs) could influence ACLs.

The Role of Data and Uncertainty in Fisheries Science

Dr. Luiz Barbieri, Marine Fisheries Research Section Leader, Florida Fish and Wildlife Conservation Commission and Member of Gulf and South Atlantic SSCs

Video Slide Presentation

Dr. Barbieri discussed the process by which stock assessments synthesize data to inform management decisions. For the US Caribbean, Gulf of Mexico and South Atlantic regions, stock assessments are conducted within the Southeast Data Assessment and Review (SEDAR) process. SEDAR involves a series of three consecutive workshops focusing on data, assessment and review. Data workshops gather scientists and stakeholders to identify and evaluate all available data sources that may be used in assessments. Assessment workshops convene stock assessment scientists and analysts to review the data and select appropriate models to evaluate the fishery. After a stock assessment report is produced, review workshops employ independent experts to review the assessment process and outcomes. The assessment is incorporated into the management process as scientific input to the council through the Scientific and Statistical Committee (SSC).[1]

Dr. Barbieri distinguished between fishery-dependent and fishery-independent data, both of which can be used to inform stock assessment models.

- Fishery-dependent data are collected from commercial or recreational fisheries such as catch and landings statistics.
- Fishery-independent data are collected by scientists and represent an independent source of data to provide information about the biological characteristics of populations as a whole.

The purpose of stock assessments is to understand the population dynamics of a stock by accounting for additions (growth and recruitment) and removals (fishing and natural mortality) of stock biomass. Dr. Barbieri discussed the relationship between the complexity of stock assessment models and the respective data requirements, by explaining age-structured and surplus production models. For data-poor situations when stock assessment models cannot be employed, assessing the vulnerability of a stock through methods such as Productivity-Susceptibility Analysis (PSA) can help guide catch level recommendations through informing the size of buffers required to account for risk and uncertainty.

Dr. Barbieri then discussed biological reference points, which are benchmarks for gauging the status of a stock or fishery. Target reference points identify the desired level of exploitation, such as at optimum yield (OY). Limit reference points, such as maximum sustainable yield (MSY), indicate a limit for the maximum amount of safe exploitation.

[1] A more detailed description of the SEDAR process is available in the Fisheries Forum 2010 Innovations Report available on the Fisheries Forum website: http://www.fisheriesforum.org/resources.

Building on Dr. Fujita's explanation of uncertainty and reference points, Dr. Barbieri discussed how estimates of scientific uncertainty within stock assessments are used to inform buffers when determining ABC levels.

Discussion
Several participants commented on the need for fishers to be involved in the SEDAR process, particularly in data-poor situations where managers rely heavily on landings data. It was also noted that processes are needed to ensure the accuracy of self-reported catch data. Stakeholders expressed concern about the lack of SEDAR assessments in the US Caribbean and the perceived unwillingness of managers to perform the alternative analyses that have been suggested by stakeholders. As the SEDAR process provides a structured framework for industry and stakeholders to provide input, Dr. Barbieri suggested that stakeholders could make recommendations to scientists through this process.

Another main point of discussion was how SEDAR addresses non-fishing related impacts on stocks such as episodic events and invasive species. Dr. Barbieri explained how ecosystem models could incorporate environmental contributions to mortality; however, given the complexity and data requirements for those models, they may not be feasible with the current data availability in the US Caribbean. Models can be modified to incorporate variation or better represent the fishery, though uncertainty may be greater.

Background Of Caribbean Fisheries

Representatives of Puerto Rico and the US Virgin Islands' natural resources management agencies gave presentations on the fishery characteristics, current data collection programs and government resources in their regions. These presentations provided participants with a baseline for considering changes to the data collection programs and a framework for considering the applicability of new approaches.

Puerto Rico

Daniel Matos-Caraballo, Principal Investigator, Fisheries Research Laboratory, Department of Natural and Environmental Resources, Puerto Rico

Video *Slide Presentation*

Mr. Matos-Caraballo presented on the process and operation of the Puerto Rico Department of Natural and Environmental Resources (DNER) Commercial Fisheries Statistics Program (CFSP). As Puerto Rico's fisheries have undergone change, new challenges have arisen, particularly with funding the CFSP. After 2010 fiscal problems resulted in the loss of two CFSP employees, the National Oceanic and Atmospheric Administration (NOAA) provided funding in 2011 to support three part-time port samplers to join CFSP. The program now employs five port samplers and a principal investigator to visit fishing centers and collect biostatistics data (species, length, weight, sex and tissue sampling).

In Puerto Rico, fishers are required by law to submit monthly landings reports. A new trip ticket form created with input from commercial fishers has been in use since May 2010. The new trip ticket consists of administrative fields such as fishing center, fisher name, license number, and catch information grouped by fishery (pelagic, sharks, shellfish, snappers, etc.). Commercial fishers have been receptive to and are utilizing the new trip ticket. Once trip tickets are submitted to CFSP, port samplers check the forms for errors and statistical clerks enter the data into the computer system. After data entry, the CFSP runs a validation program to eliminate duplicates and correct errors, and then data is submitted to NOAA's Southeast Fishery Science Center (SEFSC) in Miami, FL. The process of data entry and validation takes approximately 5 to 15 days from the time the trip ticket is submitted.

Discussion
Following Mr. Matos's presentation, participants asked questions about the challenges with non-reporting and timeliness of data in Puerto Rico. Mr. Matos clarified that fishers who do not submit trip tickets may not be able to renew their licenses. A correction factor is applied to fisheries data to adjust for those who do not report. DNER is also considering ways to improve timeliness of data to support ACLs and AMs. Participants discussed the challenges of collecting representative data for multi-species fishing trips where catch may not be an indication of effort. Mr. Matos noted that DNER understands how Puerto Rico's fisheries are prosecuted and takes this into account. Lastly, Mr. Matos and other participants expressed the important role that fishers played in helping to develop the new trip ticket form.

US Virgin Islands

Dr. Jed Brown, Acting Director and Chief of Fisheries, Division of Fish and Wildlife, US Virgin Islands

Video Slide Presentation

Dr. Brown presented on the process and operation of the Bureau of Fisheries, a branch of the Division of Fish and Wildlife (DFW) within the USVI Department of Planning and Natural Resources (DPNR). With an annual budget of around $3.6 million, the division currently employs 13 staff, 6 of whom are fisheries staff. The bulk of its funding comes from the US Fish & Wildlife Service through the Wildlife & Sport Fish Restoration Program, a program whose "user pays – user benefits" system stipulates that these funds cannot be used for commercial fishing projects. The remaining funding comes from NOAA and CFMC, which support fishery dependent and independent data collection as well as CFMC activities.

Fisheries in the USVI are artisanal, small boat fisheries with 181 registered fishers in St. Croix and 114 registered fishers in St. Thomas. Both island regions employ multiple fishing methods (traps, hook and line, nets and spearfishing), though predominate methods and target species differ between regions. In the US Virgin Islands, fishers report catch on a monthly basis using commercial catch report forms (CCRs). Fishers are also required to participate in DFW port sampling four times per year where biostatistics data are collected (species, length and weight). CCR and port sampling data are entered

into database programs and submitted to NOAA SEFSC. Lack of compliance with submitting CCR forms and lack of species resolution on the report forms pose challenges for the utility of catch data. The USVI also participates in the Southeast Area Monitoring and Assessment Program – Caribbean (SEAMAP-C) fishery independent sampling program and three fishery dependent programs: the State/Federal Cooperative Statistics Program, Inter-Jurisdictional Fisheries Program and Marine Fisheries Initiative (MARFIN).

Dr. Brown summarized a number challenges and data needs regarding fisheries management in the USVI:

- Need for accurate, timely and verifiable data that reflects the fishery;
- Lack of funding and ability to hire and attract key personnel; and
- Lack of enforcement and evaluation for existing regulations.

Discussion
Discussion following Dr. Brown's presentation focused on the use of fish aggregation devices (FADs) to redirect effort from nearshore to offshore fisheries. Commercial and recreational fishers in the US Virgin Islands believe that the program has been successful and would like to have additional FADs installed. The desire for FADs in Puerto Rico's offshore waters was also suggested as a way to shift effort and make monitoring easier. Participants also discussed the development of a new catch report form for the US Virgin Islands, and fishers expressed their desire to be involved in that process.

Current Efforts In Improving Data Collection

Building on the discussions of the data collection programs currently in place in Puerto Rico and the US Virgin Islands, this segment of the workshop explored the current efforts underway to improve data collection for commercial fisheries and expand fisheries independent data collection.

US Caribbean Commercial Data Improvement Project

Dr. Robert Trumble, Vice President, MRAG Americas

Video Slide Presentation

Dr. Trumble provided an overview of the process and outcomes from the US Caribbean Commercial Data Improvement Project – a joint project between Puerto Rico Department of Environmental and Natural Resources (DNER), US Virgin Island Division of Fish and Wildlife (DFW), Caribbean Fishery Management Council (CFMC), National Marine Fisheries Service (NMFS) Southeast Regional Office and the NMFS Southeast Fishery Science Center (SEFSC). Contracted through the Marine Resource Assessment Group (MRAG Americas), the goal of the project was to propose a data collection system that would support the use of catch data in scientific assessments.

The project identified both short-term and long-term priorities that need to be addressed.

- Short-term priorities included providing management advice for selected species within 2-7 years, enhancing industry understanding and engagement, reporting

landings by species, increasing bio-sampling, validating landings reports and enhancing enforcement.
- Long-term priorities included life history sampling, statistical model applications, periodic evaluation of program design, and ongoing program monitoring and reporting.

The project involved a series of three meetings.
1. The first meeting identified challenges with the current data collection system in Puerto Rico and the US Virgin Islands then formulated an approach to address them. The challenges included: unreported catch, lack of landings validation, insufficient biological sampling, lack of species resolution in landings data, timeliness and catch per unit effort (CPUE) data.
2. The second meeting involved a series of technical workshops to design a new data collection system. Workshop attendees concluded that distribution of trips by gear, distribution of species caught by gear, and distribution of pounds by species by gear is needed to determine estimates of catch independent of catch reports. Species specific information on catch reports and more detailed catch location data will also help the scale of analysis to fit the scale of the fishery. Additionally, spatially and temporally specific length data was identified as a key data collection item that could be used to support the Gedamke-Hoening assessment method as a long-term strategy.
3. The final meeting evaluated the costs associated with the required data collection and developed a budged for implementing the project.

The next step will be to adjust the scope of work according to the budget appropriated by the responsible governing agencies. To ensure that the program is effective, the development of regional and sub-regional steering committees is recommended to plan, execute and review the overall performance of the projects.

In summary, the US Caribbean Commercial Data Improvement Project outlines a broad program that utilizes catch and biological data, with continual monitoring and assessment. Dr. Trumble noted the importance of engagement and participation from fishers to ensure accurate data collection to support the most efficient program.

Discussion
Workshop participants from St. Thomas noted that they would have liked to participate in the project and expressed their frustration with the new data collection forms for the USVI. Participants also discussed the importance of gathering data by sub-region and the need to address the near term management needs and alternative methods not addressed by the project. There was also discussion about the relationship between assessment models and data collection programs; if data should be collected to fit the model or if the model should be crafted around the data fishers are willing to supply.

Developing a Commercial Fishery Independent Survey in St. Croix: A Pilot Project

Dr. Todd Gedamke, Branch Chief of Gulf and Caribbean Fisheries, NOAA/NMFS Southeast Fishery Science Center

Dr. Gedamke presented the methods and preliminary results for a recent cooperative research project for reef fish off the coast of St. Croix. The project utilized a fishery independent survey to produce spatially comprehensive data. The objectives for the St. Croix survey were to incorporate existing habitat data, oversample given the small shelf area, transfer the model to other locations, and provide guidance to the council as quickly as possible. The design for the survey was a classic stratified design between hard and soft bottom, and open and closed areas. Fishers designed and built 40 identical traps that were set with identical bait at 638 stations to yield greater than 6 traps per square mile.

The project spanned one month from October to November 2010. Preliminary data indicate a total catch of 2860 fish representing 67 different species. All fish were photographed, identified, and measured and spatial distribution was recorded. Data from this study should provide enough information for equilibrium mean lengths for at least 10 species. For 5 species in particular (white grunts, queen triggerfish, blue tang, banded butterflyfish and yellowtail snapper), the high volume of length data collected could serve as a starting point for determining abundance and CPUE trends. Dr. Gedamke explained the limitations in sample design for this study such as temporal differences in catchability and the impacts of using a single bait type.

The most immediate management guidance will likely come from estimations of total mortality informed by length measurements taken during the survey. The process behind mean length mortality estimates is as individuals grown older mortality increases, resulting in exponential decline. As a population is fished, the decline becomes steeper and the value of mean length declines, thus the mean length reflects the mortality that is occurring on the population. With the simplicity of mean length models there are some strong assumptions, particularly with age-growth parameters and variability. These assumptions can be minimized through executing additional studies to accurately define these characteristics.

This pilot study was a successful proof of concept in cooperative research and sets the stage for future studies to expand knowledge about the fishery such as sampling at different times of the year and targeting specific species such as parrotfish. Dr. Gedamke stressed that the involvement of fishers is the key to successfully conducting meaningful assessments, and expressed his gratitude to the fishers in St. Croix who participated in the study.

Discussion

Participants discussed potential explanations for why fish counts from sampling stations in Buck Island were not as high as expected, such as a different sampling method inside the closed area and water temperature during the months when the survey was conducted.

Another point of discussion was the use of mean length data in relation to port sampling to discern the impacts of fishing on age structure, the limitations of needing representative, spatially explicit samples and the need to consider market influences on catch lengths. Dr. Gedamke suggested three questions for participants to keep in mind during the workshop: (1) what information can be derived from existing data?, (2) what short term, inexpensive studies can be conducted to increase the utility of data?, and (3) what data could be collected now to support management decisions in the future?

Case Study Panel

Examining case studies of fisheries that are similarly challenged with managing data-poor species can help managers in the US Caribbean gain insight into the lessons learned from other regions. Three panelists representing domestic and international fisheries shared their experience with the struggles and successes of managing and improving data collection for data-poor fisheries.

Managing Data-Poor Fisheries: Solutions from around the world

Dr. Jeremy Prince, Director, Biospherics L/P and Associate Professor, Murdoch University

Video Slide Presentation

Dr. Prince shared his experience with the Australian abalone fishery and his work synthesizing lessons learned from data-poor fisheries around the world. As a doctoral student, Dr. Prince explored the spatial complexity of managing the abalone fishery in Australia. The abalone fishery was managed as a single limited access quota fishery and assessed through one stock assessment for the entire state. Studying two populations within the same bay revealed that the size limit employed statewide for the abalone fishery had disparate impacts on the two populations given the differences in growth rate and size at reproductive maturity. With the management of the fishery on the scale of hundreds of kilometers and the dynamics of abalone on the scale of meters, the data for the fishery did not reflect the true spatial impacts of fishing. Dr. Prince refers to this mismatch of management and the localized spatial complexity of populations as the "tyranny of scale" and suggests that most of the stocks we manage are in fact very complex and comprised of multiple spatially explicit communities.

Dr. Prince presented his work on synthesizing solutions employed around the world for managing data-poor fisheries. Examining studies of fisheries in Japan, Oceania, Southeast Asia and Chile, Dr. Prince identified four commonalities among successfully managed small-scale, data-poor fisheries:

- Governance and the right incentives
    - Aligning management with incentives for human behavior that provide rewards for long-term stewardship. Limited entry is an important component to sound fisheries management.
- A simple assessment toolbox

    - Simple rules of thumb such as protecting habitat and protecting breeding stocks, rapid assessment and simple data driven feedback decision rules.
- Fishing for knowledge
    - Combining fishery independent and fishery dependent data, utilizing fishers in scientific studies, collecting spatially explicit data, and linking fishing privileges with the responsibility to provide data.
- Extension officers
    - Practical integration of managers, scientists and communities, encouraging self-monitoring systems, and utilizing fisher knowledge.

Returning to the abalone fishery, Dr. Prince explained his work with a group of abalone fishers to develop a qualitative harvest strategy. Despite differences in size at reproductive maturity across local populations, mature abalone can be distinguished from juvenile abalone by the shape and appearance of their shells. Therefore to ensure the fishery harvests only mature individuals, the group developed a qualitative guide to determining the age of abalone shells and a qualitative decision tree to guide management. The engagement of fishery participants in developing this new management system resulted in ownership of the process and innovative data collection tools, which have transitioned the fishery from data-poor to data-rich.

Discussion
Participants asked Dr. Prince about the attributes of the abalone fishery and if those attributes influence the fishery. The fishery has varied capacity in terms of numbers of divers and boat size depending on remoteness of the abalone beds, and can have default no-take zones in areas where abalone breed in deep waters inaccessible to divers.

New England Scallop Fishery: A success story in cooperative research and management

Dr. Todd Gedamke, Branch Chief of Gulf and Caribbean Fisheries, NOAA/NMFS Southeast Fisheries Science Center

Dr. Gedamke provided an overview of his graduate work with the New England scallop fishery, sharing the success story of cooperative research and stakeholder ownership. Cooperative research studies in Georges Bank provided information and insight to allow limited entry fishing in one of the closed areas, refine estimates of gear efficiency and catch targets, and set the stage for future collaborative studies to reduce bycatch in the scallop fishery.

In the mid 1990s, scallop landings were declining and the fleet was facing significant reductions in days-at-sea and the closure of Georges Bank, which closed about half of the scallop grounds to fishing. A study performed by the National Oceanic and Atmospheric Administration (NOAA) in Georges Bank indicated high densities of scallops in the closed areas, and prompted fishers to advocate for collecting more data. A cooperative survey mapped the resource in fine detail and came up with a population estimate corroborating the NOAA survey. As a result, the quota was set for the area based upon an

intermediate gear efficiency estimate and Georges Bank was opened to restricted fishing in 1999.

Dr. Gedamke conducted research with scallop fishers in Georges Bank to refine gear efficiency estimates, and quantify changes in length and catch rates with detailed spatial distribution. Collecting data with fishers provided Dr. Gedamke with additional insight into the data such as the impacts of market shift on length-frequency data, and production constraints of the vessels. Post-season surveying indicated that the quota was set too high, and provided information to refine quota levels. The closed areas off Georges Bank are now managed for scallop harvest in a rotational area strategy, which allows scallop populations to recover between open seasons. The New England scallop fishery now benefits from higher landings and is a more profitable fishery.

Discussion
Participants expressed concern and distrust about the use of closed areas in the US Caribbean and the lack of protection that closed areas provide against lionfish. Participants also expressed their support for protecting species by preventing possession during spawning months and spatial spawning aggregation closures. Dr. Gedamke noted that in New England, the rotational closure of scallop grounds worked because the fishers saw the utility of the management measure. In the US Caribbean, the engagement of fishers in proposing and providing input on new management and data collection strategies is critical.

California Nearshore Finfish Fishery

Dr. Rod Fujita, Senior Scientist and Director, Ocean Innovations, Environmental Defense Fund

Video Slide Presentation

Dr. Fujita described the California reef fish fishery and its transition to improved data collection and management, catalyzed by precautionary harvest control rules. The reef fish fishery is a cold water, productive fishery comprised of about 125 species. In the 1990s, a strong market developed for live pan-sized reef fish that led to heavy selective fishing pressure, which contributed to a reduction in the diversity, productivity and resiliency of the rocky reef ecosystem.

Without historical catch records to estimate unfished biomass, fish populations inside and outside marine reserves were compared to determine the impacts of fishing and environmental factors on the reef fish populations. Fish populations outside of marine reserves were smaller, less abundant and less diverse than inside marine reserves indicating that fishing pressure was the driver of change in the ecosystem. The overexploitation of this fishery led to dramatic reductions in landings and associated declines in employment and wages from the fishery.

The collapse of the reef fish fishery prompted the development of California's Marine Life Management Act (MLMA) in 1999, which mandates the development of fishery management plans (FMPs) and harvest control rules for fisheries in California state

waters. Harvest control rules in the MLMA created strong incentives for data collection as a result of precautionary management. For data-poor stocks, total allowable catch (TAC) levels were set at 50% of the mean catch, whereas data moderate and data rich stocks required smaller buffers. The incentives for data collection prompted investment by the government and industry to perform collaborative research and stock assessments.

Dr. Fujita discussed the role of incentives and limited entry permits in the California reef fish fishery, which encouraged fishers to engage in data collection for the fishery. Stock assessments have now been conducted for 17 species, and TAC levels have been revised in light of increased scientific information. The reduction in uncertainty gained by the addition of data allowed some catch limits to be increased above the initial precautionary levels.

Discussion
Participants inquired about how a new fishery could be developed under the data driven harvest control rules of the MLMA. Dr. Fujita explained that with basic life history characteristics, an experimental fishery could be established which would allow data to be collected to support the evaluation of a new fishery. There was also discussion about the use of incentives in fisheries management and how enforcement is related to effective management. Dr. Fujita highlighted that the goal should be to provide incentives that result in high compliance, which alleviates the need for high enforcement.

Full Panel Discussion
After the presentations, participants had the opportunity to ask questions of all three speakers. One of the central discussion points was the need to integrate fishers into the process of data collection and incorporate local knowledge to identify the characteristics of each fishery. The distinction was also made between cooperative research (hiring fishers to collect data) and collaborative research (working with fishers to develop and execute data collection), and that collaborative research can yield incredibly valuable data. Participants expressed an interest in Dr. Prince's idea that fishers can produce a combination of fishery dependent and fishery independent data by consistently fishing a small percentage of their effort in the same location over time.

Participants expressed concern about setting annual catch levels (ACLs) without region specific data for each island's unique fisheries and that setting limits for such small fisheries will put fishers out of work. There was also discussion about the need to assess closed areas and consider ecosystem factors such as invasive species when setting ACLs. In addressing these concerns, participants from National Marine Fisheries Service (NMFS) noted that the 2010 and 2011 amendments that establish ACLs based upon adjusted average catch are a starting point and can be adjusted as more data become available.

Another topic of discussion was the frustration commercial fishers feel about the impacts on fish populations by recreational users and coastal development, and the lack of management measures to restrict those impacts. Invited speakers commented on the validity of those concerns and noted that many other places are struggling with

developing the data and tools necessary to manage recreational fisheries. Dr. Fujita noted that the Magnuson Stevens Act (MSA) provides councils with the ability to initiate consultation with any user group which impacts a fishery through the designation of Essential Fish Habitat (EFH) and suggested that creating fishing privileges can help balance the power inherent with land based property rights in coastal development.

Data-Poor Approaches Spotlight Sessions

With the implementation of annual catch limits (ACLs) as required under the Magnuson Stevens Act (MSA), fisheries scientists have been developing methods to inform the establishment of ACLs in the absence of stock assessments. In the US Caribbean where catch history, catch per unit effort (CPUE) and life history data are lacking, the data required for most data-poor methods do not exist, which necessitates an even more innovative approach.

In this session, workshop participants rotated through two small groups where they had the opportunity to learn about four creative data-poor approaches. These approaches represent only some of the innovative approaches for data collection and management of data-poor stocks that may hold potential for application in the US Caribbean.

Data-Poor Solutions for Assessing and Managing Spawning Potential Ratio

Dr. Jeremy Prince, Director, Biospherics L/P and Associate Professor, Murdoch University

Video Slide Presentation

Fisheries are traditionally conceived as unit stocks that are uniform in characteristics (fishing pressure, natural mortality, spawning etc.); however, units are often a collection of smaller populations with unique characteristics. Dr. Prince likened fisheries to carpets: over time, carpets display high wear patterns in characteristic places. A similar phenomenon occurs in fisheries where a unit stock is differentially impacted by fishing pressure, leading to localized rather than uniform depletion. Dr. Prince proposed that the answer to localized depletion is to manage local levels of fishing pressure and local levels of spawning potential. Dr. Prince shared his recent work on managing local levels of fishing pressure to maintain target levels of spawning potential ratio (SPR) using a simple and inexpensive decision tree method. Decision trees are iterative decision making frameworks that can guide management decisions in response to predetermined criteria. This work reflects the philosophy of addressing fisheries issues through entire human systems - integrating fishers, scientists and managers.

When combined with catch and abundance data, SPR is a very powerful tool for assessing the condition of fish stocks. SPR represents the proportion of spawning potential in a population relative to its unfished state. An unfished stock represents 100% of its spawning potential; any level of fishing will reduce the percentage of spawning potential still available. SPR is a well-established reference point, which indicates how

fishing pressure is impacting a stock. SPR can also provide insight into the status of a stock relative to maximum sustainable yield (MSY); generally, an SPR of approximately 30% is consistent with population levels that support MSY.

Dr. Prince introduced the SPR Decision Tree approach, a two-step decision making process that utilizes catch rates and size structure to make incremental adjustments in allowable catch. The iterative process with decision tree management will stabilize catch per unit effort (CPUE) and size composition at SPR targets over time.

Given the importance of the proportion and catch rate of old fish, uncertainty in the data results in a more conservative catch limit. The SPR decision tree approach is robust, scale-less system for conserving local SPR and avoiding localized depletion with minimal data requirements and minimal assumptions. Unlike other methods that require an estimate of MSY, the decision tree will stabilize at MSY when target levels of SPR are achieved. This data-poor approach does not require full assessment but still requires significant resources and knowledge of growth, reproduction and mortality rates.

Taking the SPR decision tree one step further, Dr. Prince discussed his recent work developing an inexpensive, simple and almost data-less decision tree. Using species for which data are available in the literature, models of spawning per recruit were assembled and analyzed related to their growth patterns. The Beverton-Holt Life History Invariance model provides estimates of correlation between life history parameters and has been used extensively to set up stock assessment models. Using these correlation values, Dr. Prince discovered that with size and maturity data, SPR targets could be determined, bypassing the need for complex stock assessment models. Dr. Prince explained that through a single survey of length and reproductive potential, targets could be determined and imported into decision tress to produce catch targets for almost any species. Simple studies that involve fishers, such as devoting a small percentage of fishing effort to research, monitoring total catch, and using simple decision trees with incremental adjustments, can support cost effective harvest strategies.

Discussion

Several participants raised questions regarding the data inputs required for this method and how the lack of biological data and selective fishing practices would impact the performance of the SPR decision tree method. Dr. Prince explained that the method could be performed with limited biological data and that selectivity could be accounted for through measuring total catch instead of just landings, or through utilizing different survey techniques to characterize the whole stock. Participants were very interested in Dr. Prince's ideas to have industry involved in data collection, but wondered how credible the data would be without monitoring. Dr. Prince recommended that some form of verification would be needed, but that as industry becomes more engaged, trust increases and the level of verification needed would decrease.

Participants also discussed the outcomes of the method in terms of determining management reference points, managing multiple sectors and effort controls. Dr. Prince explained that the SPR decision tree method provides recurring catch adjustments rather

than determining a target catch level or overfishing limit (OFL). The method could be used to manage both commercial and recreational sectors for a fishery. There was also discussion about how effort controls, such as size limits could be used as another management dimension to attain target SPR levels.

Marine Reserve-Based Management Strategies for Data-Poor Species

Jono Wilson, Doctoral Candidate, Bren School of Environmental Science and Management, University of California at Santa Barbara

Video Slide Presentation

Mr. Wilson presented his work in expanding the decision tree framework for use in the California nearshore live fish fishery by utilizing data from marine reserves to serve as a proxy for unfished conditions. Inside and outside comparisons of marine reserves can inform managers by generating estimates of natural mortality and fishing mortality. More recently, marine reserves are being explored as a metric to directly guide harvest strategies for commercial and recreational fisheries.

The marine-reserve based decision tree calculates recommended catch levels through an iterative process that responds to new information by refining catch levels. Data inputs include sampling inside and outside of reserves, length and density measurements as well as biological data, which are used to parameterize SPR. Identification of a target SPR is translated into the theoretical size structure at the level of fishing mortality associated with the target SPR.

The marine-reserve decision tree involves four levels, incrementally adjusting catch through each level. In level 1 an initial ACL is determined through comparing the CPUE of prime sized fish in the fished population relative to a target level as informed by the CPUE levels in the unfished population; for example 50% of reserve CPUE. Level 2 evaluates the CPUE of prime sized fish over time to identify trends. Level 3 involves the comparison on CPUE of old fish relative to theoretical levels at SPR of 40%, and level 4 compares the CPUE of young fish against the same SPR target and over time.

Mr. Wilson collaborated with commercial fishers to monitor the Channel Islands Marine Reserves off the coast of California. Over the course of two years, the study generated significant data on CPUE and length structure inside and outside of the reserves. To test this new management strategy, Mr. Wilson ran a Management Strategy Evaluation (MSE) which simulates how a population will function using the decision tree approach for the fishery. Through running the simulation over time, the decision tree adjusts to approach the target SPR level, providing an estimate for recommended catch levels. Simulating the marine reserve based decision tree method for the California grass rockfish fishery under 8 different scenarios revealed that catch rates could increase while staying near the target of 40% SPR. The decision tree model performs conservatively in response to uncertainty, which promotes collaborative data collection to increase data inputs and quality. The next steps in California are to define the objectives of the fishery, expand length, CPUE and SPR data, and perform additional MSE simulations to support

implementation of marine reserve based decision tree management for the California nearshore fishery.

Discussion
The effectiveness of marine reserves was a common theme of discussion. Mr. Wilson noted that marine reserves are not going to be effective in every case and that the benefits derived from reserves may not always be uniform. Participants also discussed the potential for modifying the marine reserve-based decision tree for spawning aggregation closures. In regards to data requirements, Mr. Wilson estimated that a time series of 3 years of CPUE data should be sufficient to support the method. Participants discussed how, as with the SPR decision tree method, the iterative nature of the method is used to determine desired catch levels rather than to directly generate a value for OFL.

The Use of Monitoring Data from Marine Reserves for Fishery Management: The Density Ratio Control Rule

Dr. Elizabeth Babcock, Assistant Professor, Rosenstiel School of Marine & Atmospheric Science, University of Miami

Video Slide Presentation

Dr. Babcock presented her work in California exploring levels of fish density inside and outside of marine reserves as a potential management metric for the impact of fishing on fish populations. The premise behind this method is that over time, marine reserves can be used as a proxy for unfished conditions. Comparing fished populations to those in reserves can be used directly as a metric for management as an alternative to traditional stock assessments.

The density ratio control rule (DRCR) utilizes the concept of a density ratio, a measure of the density of fish populations in a fishable area relative to the density of fish populations in a marine reserve. As demonstrated by looking at the Channel Islands Marine Reserve in California, the density of biomass for targeted fish species was significantly higher with the reserves than in the fishable area after a period of only five years. By tracking the relative densities inside and outside of marine reserves over time, both density measurements will shift as a response to environmental factors, but the difference between the densities, or density ratio, will isolate the impact of fishing on the fished population. This concept can be translated into management actions by establishing DRCR target ranges and regulating fishing to maintain the desired density ratio. This method provides incremental regulatory responses comparable to control rules used in traditional stock assessment based management.

Dr. Babcock and her colleague, Dr. Alec MacCall, performed simulation testing of DRCR for 5 species in the California nearshore fishery. Using species for which stock assessments are available, the performance of DRCR was evaluated in comparison to traditional stock assessment management. A variety of density ratio targets and assumptions about migration between reserves and fished areas were explored. Dr. Babcock reviewed the simulation results, which demonstrated that the low data DRCR

method could perform nearly as well as a data-intensive stock assessment, and that DRCR works equally well regardless of species' stock status.

Despite the very positive results of the simulation testing, Dr. Babcock explained that there are several caveats and limitations to the use of DRCR.

- Increases in effort during the first years after a reserve is established may lead to overfishing until the reserve builds up biomass to serve as a metric for unfished populations.
- DRCR is most likely to work well for species that become more abundant in marine reserves. Research has demonstrated that as a result of trophic interactions, piscivores (fish that eat fish) tend to become more abundant in marine reserves while herbivors (fish that eat plants) tend to become less abundant in marine reserves.
- Species with limited movement in their adult phase are better suited for marine reserve based management. Species that do not migrate can better build up biomass in reserves and ensure populations inside marine reserves are not exposed to the fishery.
- Fish biology and life history characteristics can influence how well DRCR works for a particular species. For example, density and recruitment of a fish population in a marine reserve may be limited by density dependent responses.

In summary, Dr. Babcock noted that for species that fit the assumptions of the method, DRCR can perform nearly as well as assessment based management.

Discussion

There was much discussion about if the DRCR approach would work in the US Caribbean given spawning aggregations, migration, life history characteristics of stocks and the ecological capacity of marine reserves compared to fished areas. Dr. Babcock verified the limitations of these characteristics but noted that it is possible to design the monitoring program to account for these variables. Involving fishers in designing the monitoring program is important for capturing these details. Participants also discussed the need to pair fishing grounds with marine reserves that have similar ecology and productivity to serve as a good metric for comparison. As a result of the time required for marine reserves to build enough biomass to reach a level characteristic of unfished biomass levels, individuals noted that the DRCR method may not be an appropriate method given the US Caribbean's need for timely data.

Participants expressed concern over the impact of lionfish on the ability of marine reserves and closed areas to provide the intended protection. The impact on parrotfish of increasing piscivore populations in reserves was also mentioned. Dr. Babcock noted that even without utilizing the management target aspect of DRCR, comparing populations inside and outside of marine reserves could help clarify the impacts of fishing versus the impacts of environmental factors.

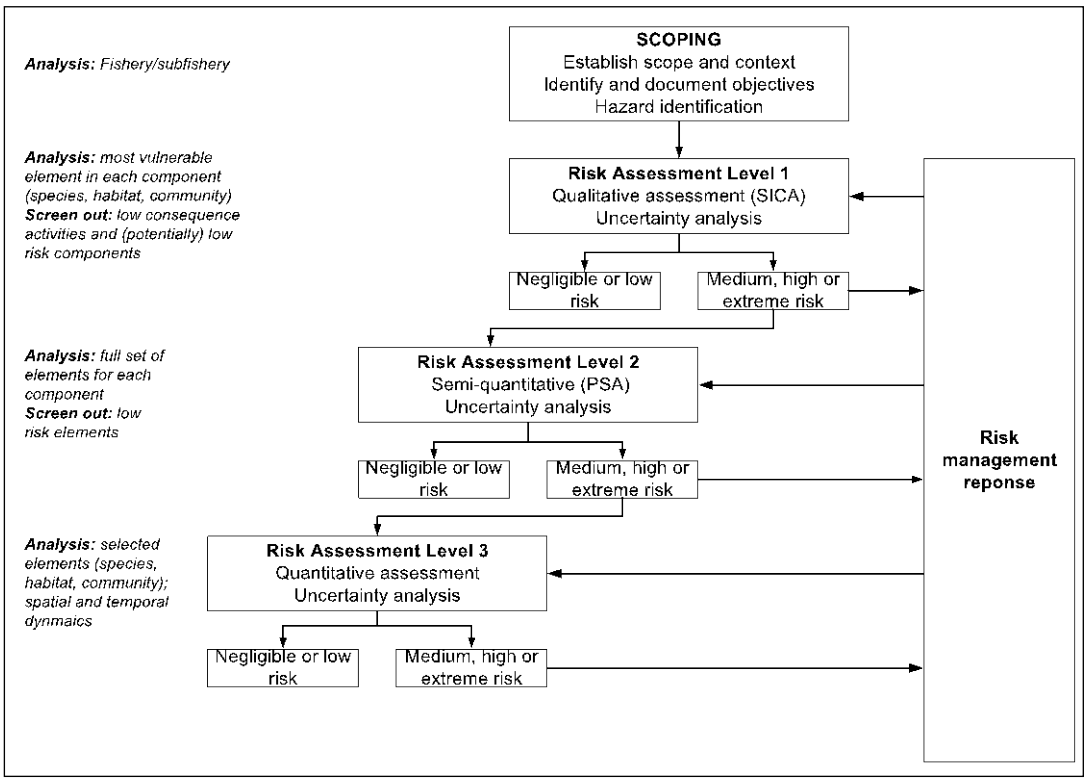
Ecological Risk Assessment for the Effects of Fishing (ERAEF)

Ross Daley, Marine and Atmospheric Research, Commonwealth Scientific and Industrial Research Organization (CSIRO)

Video Slide Presentation

Mr. Daley presented the Ecological Risk Assessment for the Effects of Fishing (ERAEF) approach developed by CSIRO in Australia. ERAEF provides a hierarchical framework to identify risk and inform managers on how best they can focus their limited resources. The ERAEF method has been widely applied in Australia, Canada, Galapagos Islands and Sub-Antarctic fisheries. The method also supports the certification process of the Marine Stewardship Council.

ERAEF is a three-step approach that assesses the level of risk to fisheries, screening out low risk stocks and informing management of higher risk stocks. Prior to the start of any ERAEF assessment, scoping is performed on each sub-fishery (gear type, location) to summarize fishery characteristics, identify activities, define units of analysis (species), group units into fishery components (target, bycatch, other) and to carefully define objectives for each component in the fishery. The information gathered during scoping provides a foundation for all levels of analysis and provides an opportunity to engage stakeholders early in the process through utilizing fishers' knowledge of stock characteristics and fishery operations.



Source: Hobday et al. (2011). Ecological risk assessment for the effects of fishing. Fisheries Research, 108, 372-384

The first level of assessment in ERAEF utilizes Scale Intensity Consequence Analysis (SICA), which assesses the spatial scale, temporal intensity, and consequence of fishing effort on each component. Individual sub-fisheries are evaluated for the impact of an identified activity on a particular fishery component relative to the objective established during the scoping process. The SICA process is performed through gathering stakeholders, scientists and managers together and talking trough the assessment of each scenario. The analysis results in a numerical scoring of risk, which is used to screen out low risk components and activities, encourage further evaluation of medium and high-risk scenarios and inform potential management responses.

Moving from qualitative analysis to semi-quantitative methods, the second level of ERAEF utilizes the Productivity Susceptibility Analysis (PSA) approach. This approach looks at each species within a component separately and assumes that risk depends on two characteristics of the species: productivity and susceptibility. Productivity refers to the intrinsic and biological ability of a species to recover from fishing pressure such as age at maturity, annual fecundity, maximum size and trophic level. Susceptibility refers to the exposure of a species to fishing effort and is evaluated through examining four attributes: availability, encounterability, selectivity and post capture mortality. As with level 1, the attributes used to examine productivity and susceptibility are given a numerical scoring and used to calculate overall values. The values for productivity and susceptibility are plotted in relation to each other on a graph, which places each species in a category of high, medium or low risk. As with the first ERAEF level, low risk species are screened out in level 2 and the highest risk species are identified. In the third level of ERAEF, managers can move forward with more quantitative assessments for high-risk species.

In summary Mr. Daley recounted the highlights of the ERAEF method. The hierarchical, cost effective approach of the assessment is efficient in screening and prioritizing species for strategic use of fishery assessment resources. ERAEF is also precautionary in the absence of data meaning that risk is assumed to be high in the absence of data. The ERAEF framework fits within a range of level three methods and can contribute the data collected through the first two levels of the process.

Discussion
Participants discussed how the ERAEF method could be used to help managers in meeting the MSA's ACL requirement. Though the method does not provide ACL recommendations, the risk-based rankings can be used to develop graduated buffers that can be applied to ACLs relative to each species associated risk. The results of the ERAEF assessment can also be utilized to inform data collection to provide more detailed information for the most critical species.

There was also significant discussion about the importance of stakeholder engagement in the ERAEF process. Mr. Daley explained that during the scoping phase of the method, fishers are key to describing the characteristics of the stocks and how the fishery operates. In levels 1 and 2 of the assessment, fishers are instrumental in articulating the level of risk and in defining how the fishery interacts with the stock. Many participants

expressed their interest in exploring the implementation of the ERAEF method as a good starting point for refining catch limits and targeting data collection efforts.

Full Group Discussion

When the two breakout groups reconvened, speakers recapped the methods, and outlined the inputs and outcomes of their respective approaches. Participants also had the opportunity to continue the discussion with the larger group and solicit feedback from all four speakers. Four main topics emerged through this discussion.

- Method Compatibility: Participants asked the panelists if the four methods presented could be combined or used together to set and adjust ACLs. Speakers noted that the ERAEF method is the only approach that does not result in a catch level recommendation, but that all of the methods are complementary and could be combined or adjusted to work together depending on data inputs and the desired outcomes. When asked for their recommendations on the next steps for the Caribbean Council, speakers suggested that performing ERAEF would be beneficial.
- SEDAR: There was much discussion surrounding the SEDAR process and the need to find a more efficient way for making annual adjustments to ACLs. Participants suggested seeking approval from SEDAR for the ERAEF process and working to develop a more timely and tailored SEDAR process for the US Caribbean.
- MSA Requirements: Participants discussed the immediate challenge of the MSA mandate for using OFL and ACL reference points. Some of the methods presented at the workshop have been reviewed by SEDAR and determined to pose challenges for working within the MSA mandate. Participants suggested exploring amendments to the MSA that would allow the Council to utilize a new set of tools for stocks where ACL management is not the best option.
- Ecosystem-Based Fisheries Management: Participants discussed the mandate for Councils to perform ecosystem based management and the need to look down the line beyond ACLs. The ERAEF method, through incorporating information about target catch, bycatch, habitat and communities, is an effective way to collect information and incorporate ecosystem considerations in management.

Looking-Forward Discussions

The final substantive session of the workshop included breakout and large group discussions to consider how the region can best move forward. Participants broke into two small groups for concurrent 90-minute discussions, facilitated by Fisheries Forum staff. When the two groups reconvened, they shared their discussions and recommendations. The participants agreed that the next step was for the Fisheries Forum to compile the outcomes from the breakout groups. Fisheries Forum staff organized the discussion points and recommendations into “general goals” and seven specific categories with goals and recommendations within each category.

The following list of ideas is the outcome from that work as presented to the Council at their March 2011 meeting. The goals and recommendations are presented in no particular

order; items marked with an asterisk (*) indicate ideas that were identified as priorities by workshop participants.

General Goals:

- Don't want to end up going in the wrong direction (Want to make smart decisions)*
- Sustainable, viable fisheries
- End overfishing
- More effective control of fisheries
- Reduce uncertainty

1. Fisheries Data

Goals:

- Collect both fishery dependent and independent data*
- Protect and utilize fishers' knowledge
- Increase research capacity
- Use each region's data for management decisions

Recommendations:

- Collection of fishery independent data:
    - Perform studies that can be representative of the fishery (i.e., size- and length-based studies)
    - Utilize existing Marine Protected Areas (MPAs) for data
        - Use historical data from MPAs
        - Coordinate with government agencies to conduct research in MPAs and parks
        - Council meet with National Park Service to determine protocol to get reports and acquire required permits for monitoring studies (USVI Congressional delegate willing to facilitate)*
    - Incorporate cooperative research
        - Build fisher sampling into fishery independent data (i.e., consistent area and gear)*
        - Continue trap study
    - Evaluate the effectiveness of current management actions
        - Seasonal closures*
        - Spawning aggregation closures and MPAs
- Collection of fishery dependent data:
    - Develop island and region-specific catch reporting forms*
        - Disentangle the multispecies fishery catch on forms (identify gear, place, effort, etc.)
    - Acquire good catch and effort data
    - Examine port sampling data in addition to commercial catch reports (CCRs) to have more accurate landings estimates

2. Explore new approaches for data collection and management

***Goals**:*

- Maximize utility of existing data
- Use realistic and simple methods
- Determine a method to assess annual catch limits (ACLs) over time*

***Recommendations**:*

- Explore local examples of the spawning potential ratio (SPR) approach*
- Create a decision tree to determine sustainable yields*
- Try surplus production model in certain island regions*
- Use Ecological Risk Assessment for the Effects of Fishing (ERAEF) to determine appropriate harvest control and sustainability targets*
    - Conduct level 1 ERAEF with fishers input
    - Use ERAEF level 2 to buffer uncertainty (science and management)

3. Communication & Improving Relationships

***Goals**:*

- Rebuild trust between fishers and managers*
- Increase co-management opportunities with stakeholders, managers, scientists, etc.*
- Actively work to improve communication and strengthen relationships*

***Recommendations**:*

- Use small meetings to increase awareness, understanding and support
- Create pathways for feedback between managers and fishers
- Gather commitment from managers and fishers to actively and productively engage to build trust in both directions
- Develop rules of engagement – what's needed from each side (managers, fishers, scientists)
- Share data with fishers

4. Outreach and Education

Goals:

- Increase outreach and education activities
- Inform fishers and encourage participation

Recommendations:

- Develop an acronym list for stakeholders
- Use a language all groups can understand
- Conduct "101 level" meetings and workshops with fishers*
- Articulate a list of all the data required to do a stock assessment with whatever model the council decides*
- Conduct outreach regarding accuracy and uncertainty*

- Perform outreach on a person to person basis
- Perform geographically specific outreach with fishers

5. Structural Alternatives for Management

***Goals**:*

- Simple and fisher-friendly management process*
- Improve rights, incentives and engagement of fishers*
- Have regulations that match how the fishery is prosecuted

***Recommendations**:*

- Develop different management approaches for different parts of the US Caribbean
    - Discuss short and long term priorities, models, funding, timelines and action items for each region (St. Thomas/St. John, St. Croix, and Puerto Rico)*
- Separate ACLs for commercial and recreational sectors
- Update USVI fishing regulations
- Revise licensing program (including recreational licenses)
- Explore limited entry and perhaps catch shares*
- Move toward ecosystem-based management where fishers are considered part of the ecosystem

6. Management and Data Collection Capacity

***Goals**:*

- Increase capacity to adequate levels
- Use existing resources to increase capacity
- Get the industry involved in science and data collection

Recommendations:

- Work with National Park Service
- Use students from universities, fishers and territorial government to gather and analyze data*
- Get more staff for territorial government and fill all funded vacancies*
- Appoint a permanent director for USVI Department of Fish & Wildlife (DFW)
- Use local knowledge for fishery independent research
- Fishers and scientists work together to design surveys

7. Other Items to Address

- Outreach to politicians
- Enforcement of fishing regulations (at marketplace)
- Consider amending the Magnuson Stevens Act (MSA)

Appendix 1: Workshop Agenda

Exploring Tools for Improving Management of Data-Poor Stocks
February 23-24, 2011

PREFACE:
At the request of the Caribbean Fishery Management Council (CFMC), the Fisheries Leadership and Sustainability Forum (Fisheries Forum) organized this educational workshop to provide an opportunity for managers and stakeholders in the US Caribbean to explore pathways for advancing the management of data-poor stocks. All Councils are taking steps to comply with the legal requirement to set annual catch limits (ACLs) under the Magnuson-Stevens Act (MSA). In the Caribbean, these requirements highlight the ongoing challenge of managing data-poor stocks and the importance of collecting reliable catch data.

This workshop balances informational presentations with opportunities for open discussion among all participants. The invited speakers will provide expertise in data-poor fisheries science and management, and perspectives from fisheries around the world. The CFMC hopes to foster constructive, forward-looking dialogue among participants and invited experts to inform its next steps forward. Active participation from all workshop attendees is crucial to the success of the workshop. As the workshop is educational in nature, there will be no management decisions made.

GOAL & OBJECTIVES:
The goal of this workshop is to provide decision-makers in the US Caribbean with an opportunity to explore the tools available for addressing data-poor stocks and to consider how the region can best move forward.

Specifically, the workshop aims to:

1. Provide a common educational foundation for participants on the role of data in fisheries science, managing uncertainty, and complying with federal fishery management laws;
2. Illustrate the struggles and successes in other data-poor fisheries by highlighting both the process and outcomes;
3. Provide a common understanding of the current work and progress in improving data collection for US Caribbean stocks;
4. Explore alternative approaches for data collection and management of data-poor stocks and evaluate their potential application for the US Caribbean; and
5. Encourage discussion of the current efforts and new approaches for improving the data collection and management of data-poor stocks, culminating in the identification of discrete actions the US Caribbean can take in moving forward.

Exploring Tools for Improving Management of Data-Poor Stocks
Workshop Agenda

IMPORTANT CONTACT INFORMATION:

Location: La Concha Resort
1077 Ashford Avenue
San Juan, Puerto Rico

CFMC Staff: Diana Martino: (787) 766-5926
FLSF Staff: Kim Gordon: (858) 204-6175
John Henderschedt: (206) 390-0273
Meghan Jeans: (415) 215-4981
Whitney Tome: (240) 606-4625
Katie Latanich: (919) 451-6591

TUESDAY, FEBRUARY 22, 2011

5:00 – 8:00 pm **Workshop Registration**
Location: Indigo Salon Foyer

WEDNESDAY, FEBRUARY 23, 2011

9:00 – 9:45 am **Meeting Overview and Introductions**
Location: Indigo Salon
- Miguel Rolón, Executive Director, Caribbean Fishery Management Council
- John Henderschedt, Executive Director and Kimberly Gordon, Policy Analyst, Fisheries Leadership & Sustainability Forum
- Participant introductions

9:45 – 10:15 am **Managing Uncertainty: the Law, the Data, the Science, and the Incentives**
- Dr. Rod Fujita, Senior Scientist and Director, Ocean Innovations, Environmental Defense Fund

10:15 – 10:30 am **BREAK**

10:30 – 11:15 am **The Role of Data and Uncertainty in Fisheries Science**
- Dr. Luiz Barbieri, Marine Fisheries Research Section Leader, Florida Fish and Wildlife Conservation Commission

11:15 – 11:45 am **Public Comment**

11:45 – 12:45 pm **BREAK** (lunch on your own)

12:45 – 2:30 pm **Case Study Panel**
Moderator: Fisheries Forum Staff

- Managing Data-Poor Fisheries: Solutions from around the world
  - Dr. Jeremy Prince, Director, Biospherics L/P and Associate Professor, Murdoch University
- New England Scallop Fishery: A success story in cooperative research and management
  - Dr. Todd Gedamke, Branch Chief of Gulf and Caribbean Fisheries, NOAA/NMFS Southeast Fisheries Science Center
- California Nearshore Finfish Fishery
  - Dr. Rod Fujita, Senior Scientist and Director, Ocean Innovations, Environmental Defense Fund

2:30 – 2:45 pm **BREAK**

2:45 – 3:15 pm **Background of Caribbean Fisheries**

- Daniel Matos-Caraballo, Fisheries Research Laboratory, Department of Natural and Environmental Resources, Puerto Rico
- Dr. Jed Brown, Acting Director and Chief of Fisheries, Division of Fish and Wildlife, US Virgin Islands

3:15 – 4:00 pm **US Caribbean Commercial Data Improvement Project**

- Dr. Robert Trumble, Vice President, MRAG Americas

4:00 – 4:45 pm **Developing a Commercial Fishery Independent Survey in St. Croix:**
A Pilot Project

- Dr. Todd Gedamke, Branch Chief of Gulf and Caribbean Fisheries, NOAA/NMFS Southeast Fisheries Science Center

4:45 – 5:00 pm **Day One Summary**

5:00 – 7:00 pm **RECEPTION**
Light snacks, cash bar
Location: Solera Upper Deck

THURSDAY, FEBRUARY 24, 2011

9:00 – 9:15 am **Introduction to Data-Poor Approaches Spotlight Sessions**

Location: Indigo Salon

9:15 – 10:45 am **Data-Poor Approaches Spotlight Breakout Rotation***
Moderators: Fisheries Forum Staff

*Workshop participants will be broken into two groups and will rotate through two breakout sessions. Each breakout session will include presentations from invited experts, followed by Q&A and discussion. Each rotation will run 90 minutes.

Breakout #1

- Data-Poor Solutions for Assessing and Managing Spawning Potential Ratio
    - Dr. Jeremy Prince, Director, Biospherics L/P and Associate Professor, Murdoch University
- Marine Reserve-Based Management Strategies for Data-Poor Species
    - Jono Wilson, Doctoral Candidate, University of California at Santa Barbara

Breakout #2

- The Use of Monitoring Data from Marine Reserves for Fishery Management: The Density Ratio Control Rule
    - Dr. Elizabeth Babcock, Assistant Professor, Rosenstiel School of Marine & Atmospheric Science, University of Miami
- Ecological Risk Assessment for the Effects of Fishing (ERAEF)
    - Ross Daley, Marine and Atmospheric Research, Commonwealth Scientific and Industrial Research Organization (CSIRO)

10:45 – 11:00 am **BREAK**

11:00 – 12:30 pm **Data-Poor Approaches Spotlight Breakout Rotation***
Moderators: Fisheries Forum Staff

12:30 – 1:30 pm **BREAK** (lunch on your own)

1:30 – 2:15 pm **Data-Poor Approaches Spotlight Wrap-up: Discussion and Questions**
Moderator: Fisheries Forum Staff

2:15 – 2:30 pm **Introduction to Looking Forward Breakout Group Discussions**

2:30 – 2:45 pm **BREAK**

2:45 – 4:15 pm **Concurrent Looking Forward Breakout Group Discussions**
Moderators: Fisheries Forum Staff

4:15 – 5:00 pm **General Session: Next Steps**

- Eugenio Piñeiro-Soler, Chair, Caribbean Fishery Management Council

5:00 – 5:15 pm **Day Two Summary and Workshop Closing**
- Miguel Rolón, Executive Director, Caribbean Fishery Management Council
- Fisheries Forum Staff

Appendix 2: Public Comment

In addition to the opportunities for discussion throughout the workshop, a short public comment period was included in the agenda. The following concerns and suggestions were presented during the public comment session:

- SEDAR – Individuals expressed frustration with the SEDAR process, noting that it does not work in the US Caribbean due to the uniqueness of the region. Participants suggested increasing fisher input into the SEDAR process and developing alternative approaches that work in the context of the US Caribbean fisheries. The exploration of Surplus Production model and Productivity Susceptibility Analysis (PSA) was recommended specifically.
- Environmental factors – The need to account for environmental uncertainty and seasonal changes when developing and evaluating ACLs was stressed.
- Fisher involvement – Several public comments expressed the desire among fishers to engage with managers and scientists and work toward solutions that support healthy fisheries. The importance of integrating fisher input into scientific and management processes was also stressed.
- Next steps – The desire for this workshop to identify concrete steps and desired outcomes was echoed in public comment. Individuals offered the following specific suggestions: convene a fishers workshop to communicate the importance of accurate reporting, encourage agencies to utilize electronic databases, and perform pilot studies for region-specific data collection.
- Spatial scale – Several comments recommended breaking down data collection and management to an island specific spatial scale to address the unique fisheries within the US Caribbean.
- Dr. David Olsen of the St. Thomas Fishermen's Association gave a presentation on a 15 participant survey that reflected fishers' opinions about the proposed data form. The survey found the new form too time consuming and recommended working with the scientists to develop a new form that would include accurate information on total landings, fishing methods, fishing effort, and fishing locations with the species detail derived from port sampling and applied to the total landing value recorded on the catch forms. Dr. Olsen also presented data from a trap study performed with MRAG Americas, which indicated that species-specific data in the form of percentage of total catch could be derived from approximately 15-20 port samples and applied to total landings data to provide species specific data needed to support more refined ACLs.

Appendix 3: Speaker Biographies

Exploring Tools For Managing Data-Poor Stocks
Workshop Speakers
February 23-24, 2011

Dr. Beth Babcock
Assistant Professor, Division of Marine Biology and Fisheries
Rosenstiel School of Marine and Atmospheric Science
University of Miami
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Beth Babcock is a fisheries biologist with a Ph.D. from the University of Washington, School of Fisheries. She has worked as a fishery observer onboard commercial fishing boats in Alaska and her dissertation research focused on the Oregon trawl fishery. She spent five years at the Wildlife Conservation Society in New York, conducting scientific analyses in support of conservation efforts for tuna, swordfish, marlins and sharks. For the last six years, she has been on the faculty of the University of Miami's Rosenstiel School. Most of her research focuses on analyzing fisheries data to determine how to make fisheries more sustainable, particularly fisheries for vulnerable species like sharks. She uses Bayesian statistical methods for fisheries stock assessment and decision analysis. She focuses on species and fisheries for which conventional fisheries data are lacking, and has developed methods to determine what levels of fishing are sustainable with limited data, for example by using monitoring data from in and around marine protected areas to determine whether fish populations are overexploited. She is also a collaborator on an 11-year field research project studying abundance, and movement behavior of sharks at Glover's Reef atoll, Belize. She is a co-editor of the book "Sharks of the Open Ocean", edited by M. Camhi, E. K. Pikitch and E. A. Babcock.

Dr. Luiz Barbieri
Marine Fisheries Research Section Leader
Florida Fish and Wildlife Research Institute
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Luiz Barbieri received a B.S. in Biology and a M.Sc. in Biological Oceanography in his native country of Brazil. He came to the US in 1986 to continue his graduate education and in 1993 earned a Ph.D. in Marine Science from the College of William and Mary, Virginia Institute of Marine Science. Dr. Barbieri's research background is in the life history and population dynamics of fishes and its application to the assessment and management of marine fisheries. After a 10-year research career he currently heads the Marine Fisheries Research Program at the Florida Fish and Wildlife Research Institute. In this capacity he oversees a multidisciplinary research and monitoring program of 300 staff distributed in eight locations statewide. Dr. Barbieri also serves on several scientific advisory panels and committees including the Atlantic States Marine Fisheries Commission, and the Scientific and Statistical Committee for both the Gulf of Mexico and South Atlantic Fishery Management Councils.

Dr. Jed Brown
Acting Director and Chief of Fisheries
U.S. Virgin Islands Division of Fish and Wildlife
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Dr. Jed Brown received a Ph.D. in Wildlife and Fisheries Science from the University of Arizona and an M.S. in Marine Environmental Science from SUNY Stony Brook. He has previously worked for NOAA Fisheries and the US Fish and Wildlife Service. He has worked for the USVI Division of Fish and Wildlife since 2009 as the Chief of Fisheries and the Assistant Director and is currently the Acting Director of the Division.

Ross Daley
Doctoral Candidate
Commonwealth Scientific and Industrial Research Organization (CSIRO), Marine and Atmospheric Research Division
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I completed a Bachelors Degree at University of Tasmania in 1991. In 1992 I started a postgraduate degree, which I deferred after a job offer from CSIRO. I started at CSIRO working with Dr Peter Last in the Taxonomy Group/Fish collection 1993 as an author and co-author in a series of seafood and fish identification Guides. I then had a brief foray into genetics looking at the stock structure of Pink Ling (Genypterus blacodes). This was followed by five years in the CSIRO shark group with Dr John Stevens, focusing on deep-sea shark fisheries. For about the last five years I have been working with Dr. Tony Smith and Dr. Alistair Hobday on Ecological Risk Assessment and am just about to start a PhD studying fishery management strategies for vulnerable non-target species, using deepwater sharks as case studies. In 2009 I presented on the ERAEF method in Wellington New Zealand. Prior to this I worked with the British Columbia Dogfish Hook and Line Fishery providing a pre-assessment report for the Marine Stewardship Council using the ERAEF methods.

Dr. Rod Fujita
Senior Scientist & Director of Oceans Innovations
Environmental Defense Fund
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Rod Fujita received his Ph.D. in 1985 at the Marine Biological Laboratory in Woods Hole, Massachusetts and has conducted basic research in ocean ecology at some of the nation's leading research institutions. He joined Environmental Defense Fund in 1988, and co-founded its Oceans Program. Fujita also directs EDF's new Ocean Innovations unit, a think-tank aimed at developing breakthrough solutions to environmental problems through collaboration with ocean resource users, natural scientists, economists, policy experts, and others.

Fujita has worked to combat climate change, acid rain, sewage pollution, and ocean dumping. For the last 15 years, he has been working to improve fisheries management, with a focus on the U.S. West Coast. At the state level, he worked with many partners to develop and pass California's Marine Life Management Act and served on the state's

fisheries Master Plan committee, as well as the California Ocean Protection Act, which set up the innovative Ocean Protection Council and Ocean Protection Trust Fund. Fujita helped initiate the ultimately successful transition of the West Coast groundfish trawl fishery to more sustainable harvest rates, bycatch reduction policies, habitat protection measures, and Individual Fishing Quotas. He specializes in developing novel solutions to fishery and marine conservation problems, including the California Fisheries Fund, which invests in projects to sustain fisheries, working waterfronts, and fishing communities. In partnership with The Nature Conservancy, fishermen, and community leaders, he also helped to engineer an innovative private buyback of trawlers in Morro Bay (California), resulting in the protection of 3.8 million acres (5,900 square miles) of sensitive bottom habitat from trawling and a transition to a higher value fishery. He also helped Mexico develop its Vessel Monitoring System and a gillnet buyout to protect the endangered Vaquita porpoise, and is now working to reform the Gulf of California shrimp fishery. Fujita has authored numerous scientific and popular articles, has testified before the California legislature, the U.S. House, and the U.S. Senate on several occasions, and has served on a number of state, federal, and international advisory panels on ocean conservation. In 2000, Fujita received a Pew Fellowship in Marine Conservation and wrote his book, *Heal the Ocean: Solutions for Saving the Seas*.

Dr. Todd Gedamke
Branch Chief of Gulf and Caribbean Fisheries
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Dr. Todd Gedamke received a B.A. in Biology from Colgate University in 1990. Following his undergraduate studies he worked in a number of different marine science roles including: Seagrant marine educator, assistant aquarium curator, NMFS fisheries observer Director of Loggerhead sea turtle research project, and field coordinator for a hawksbill sea turtle research project in Antigua, West Indies. Todd then obtained an M.S. from the Virginia Institute of Marine Science in 2002 focusing his research on gear efficiency and stock assessment in the commercial scallop fishery of New England. While conducting thesis research onboard commercial scallop vessels on Georges Bank, he began collecting data on a species of skate (barndoor skate; *Dipturus laevis*), which was reported to be on the brink of extinction. Due to data limitations, the barndoor skate could not be adequately assessed and Todd's dissertation work focused on developing both a stock assessment for the species and more generally in developing methodologies for use in data-limited situations. He obtained his PhD from the Virginia Institute of Marine Science in 2006 and began working as a stock assessment scientist at NMFS at the Southeast Fisheries Science Center in Miami, FL. His primary focus has been with the data-limited fisheries in the US Caribbean and in the development of data-poor methodologies. He is a member of the Caribbean Fishery

Management Council's SSC. Todd's recent work also includes: steering committee member for NMFS National Ecosystem Modeling Workshop; United States delegate for the Ecosystem working group of the International Commission for the Conservation of Atlantic Tunas; Co-chair of Deepwater Horizon/SEAMAP Fishery independent survey program evaluation meeting; and PI for a pilot study developing a cooperative fishery-independent survey in St. Croix. In 2010, Dr. Gedamke was promoted to Branch Chief of Gulf and Caribbean Fisheries and now oversees stock assessments for both regions.

Daniel Matos-Caraballo
Puerto Rico Department of Environment and Natural Resources
matos_daniel@hotmail.com

Daniel Matos-Caraballo graduated with an M.S. in Marine Sciences from the University of Puerto Rico, Mayaguez Campus, in 1988. He also has a B.S. in Biology from Antillean College in 1982. Since September 1988 he has been the Principal Investigator of Puerto Rico's Commercial Fisheries Statistics Program. Since 1990, Daniel has been active member of the Gulf and Caribbean Fisheries Institute. Daniel designed and was the principal investigator of Puerto Rico's Commercial Fishing Census since 1988-2010. He is the author of approximately 35 papers, most of them describing Puerto Rico's commercial fishery during the last 23 years. Daniel is also an active community volunteer. He serves as Chapel at Mayaguez Penitentiary and also is a Leader of the Pathfinder (boys and girls from 2-18 years old), teaching them to help the community, and love nature and camping.

Dr. Jeremy Prince
Director
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Active in Australian fisheries research, assessment and management for the last three decades, Dr Jeremy Prince currently chairs Australian Federal Government assessment groups, is a scientific member of fisheries Management Advisory Committees and active researcher, and an independent consultant for government, fishing industry associations and non-government organizations.

Dr Prince's doctoral work on abalone in the 1980s revealed that units of abalone stocks are small scale (measured in 100s – 1,000s) and highly variable (size of maturity can vary by 100% over 5-10km). This meant that instead of working with a single data-rich fishery

on the scale of a state (100kms), he was in fact working with 1,000s of data poor fisheries the size of football fields. This finding sparked a quest to develop cost-effective techniques for assessing and managing small scale, spatially complex data-poor fisheries. After 20 years following this quest Dr Prince believes the grail is in sight, and involves a combination of community-based data collection, management & enforcement, and simple harvest strategies based on generic semi-quantitative decision trees to assess size in the catch against empirically estimated sized based Spawning Potential Ratio (SPR) reference points. This makes possible a rudimentary but robust form of quantitative assessment and management utilizing just catch rates and size composition data.

Dr. Robert Trumble
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Dr. Robert Trumble, a marine scientist for 40 years, has wide-ranging experience in marine fish science and management, fishery habitat protection, and oceanography. Dr. Trumble joined MRAG Americas in 2000 as Senior Research Scientist and became Vice President in 2005. He performs project planning, assembles research teams, and conducts research, with a focus on improving management of aquatic ecosystems and the resources and fisheries they support. His projects have included oversight of observer programs, preparation and review of fishery management and habitat management plans, development bycatch management and control, preparation of environmental assessments and environmental impact statements, and conducting workshops on fishery issues. Dr. Trumble has extensive experience working with government agencies, commercial and recreational fisheries groups, Indian tribes, and national and international advisory groups. He has conducted numerous projects in the US Caribbean. He received appointments to the Scientific and Statistical Committees of the South Atlantic Fishery Management Council and the Pacific Fishery Management Council, the Groundfish Management Team of the North Pacific Fishery Management Council, the affiliate faculty of Fisheries at the University of Washington, and the Advisory Committee of the Washington Sea Grant Program. Dr. Trumble has published in peer-reviewed journals and symposium proceedings, presented invited papers at national and international meetings, and written reports for government agencies. Dr. Trumble received a B.S. degree in Oceanography from the Department of Oceanography, University of Washington, M.S. degree in Fisheries from the College of Fisheries, University of Washington, and Ph.D. in Fisheries from the College of Fisheries, University of Washington.

Jono Wilson
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Jono Wilson is a PhD candidate at UCSB who will soon be transitioning to a postdoctoral position with the Sustainable Fisheries Group, a collaboration of economists, ecologists and fisheries scientists working towards integrating market-based approaches, marine reserves and property rights to enhance fisheries management. The foundation of his current research involves developing and testing data-poor management strategies that increase stakeholder involvement, reduce costs, and match the spatial scale of biological interactions with the scale of assessment. The use of marine reserves in fisheries management is one such approach that Jono is actively evaluating. Reserves can be used as reference areas for developing decision rules to manage fisheries and can also be used to calculate natural and fishing mortality rates at local scales. Jono has worked with local fishing communities in California to increase awareness of these approaches and facilitate transition to community-based co-management arrangements.