Building a Collaborative Strategy for the Assessment of Data Deficient Fisheries in the Caribbean Region

Construcción de una Estrategia para la Evaluación de Pesquerias con Defiecienca en Datos en la Region del Caribe

La Construction d'une Stratégie Collaborative sur L'évaluacion de Pêcheries Déficientes en Data aux Région des Caraïbe

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ABSTRACT

Increasing needs by fisheries managers to establish harvest controls to sustain fishery resources have shifted priorities to meet the minimum stock assessment requirements for each fishery. To achieve an optimal data collection system of managed resources, managers acknowledge the need to address data deficiencies that exist for many fisheries. This is particularly true for the Caribbean region where essentially all of the stock assessments are considered as data limited. In addition to the challenges of limited survey capabilities, managers and assessment scientists must address sampling and modeling uncertainties in an environment with complexity in species diversity, life history parameters, and habitats that are difficult to sample. The Caribbean is further complicated by the diversity of fisheries, lack of technical capacity, and political complexity. Furthermore, the biological and technical challenges of assessing artisanal fisheries are not small-scale issues because of the connectivity of stocks across the Caribbean jurisdictions. For these reasons, scientists and resource managers must work collaboratively on improving the science to safeguard the health and sustainability of fishery resources and their habitats in the Caribbean region. A collaborative capacity building strategy for enhanced survey capabilities is the ultimate goal, yet the most immediate benefits can be obtained by evaluating and developing the analytic tools to conduct assessments of data deficient fisheries. The political will for capability building is not only driven by mandates to achieve sustainable fishery resources, but also requires partnership and consensus on how best to improve the science for policy decisions.

KEY WORDS: Data-limited, stock assessment, fishery management, scientific capacity, Caribbean

INTRODUCTION

The Gulf and Caribbean Fisheries Institute (GCFI) for more than five decades has served as an international forum among scientists, managers, and stakeholders who strive to improve the ecological health and socioeconomic sustainability of living marine resources in the larger Caribbean region. Last year's GCFI conference emphasized that the small-scale fisheries are actually large-scale issues for the Caribbean community because of the connectivity of the commercially and recreationally important fish stocks and their essential habitats across the jurisdictional boundaries. Furthermore, the ability to collect scientific information in the larger Caribbean region is challenged by the size and diversity of the resource area, costs of conducting survey operations, biases associated with a diverse array of sampling gear, complexities in life history patterns of marine organisms, and difficulties in sampling reef habitats. Managing marine resources in the larger Caribbean is further complicated by the environmental effects on the marine ecosystem, diversity of fisheries, and jurisdictional geopolitics of the 15 Caribbean nations and dependencies. For these reason, nearly all of the stock assessments in this region are considered data-limited and inadequate for the efficient conservation and management of the Caribbean's marine resources. GCFI provides an international forum of expertise to foster international cooperation in the evaluation of the priorities and data collection gaps to provide recommendations on building the technical capacity to develop long-term monitoring programs to improve scientific information for understanding the impacts of environmental and anthropogenic perturbations on coastal and marine habitats, and sustaining living marine resources in the Caribbean.

METHOD

A collaborative effort in the large Caribbean is needed to improve the availability, quality, and timeliness of scientific information and analytical tools for stock assessments. Developing a strategy to improve scientific information must first begin with an evaluation of the analytical methods used in both population dynamic forecasting and guidance on the data requirements. Stock assessment models most often rely on fisheries-dependent information from sampling catch data, while fisheries-independent data collected from standardized resource surveys provides the best abundance trend information that

is less biased by market changes (Figure 1). Length and age data are also needed for age-based population models to best understand stock status and optimum yield.

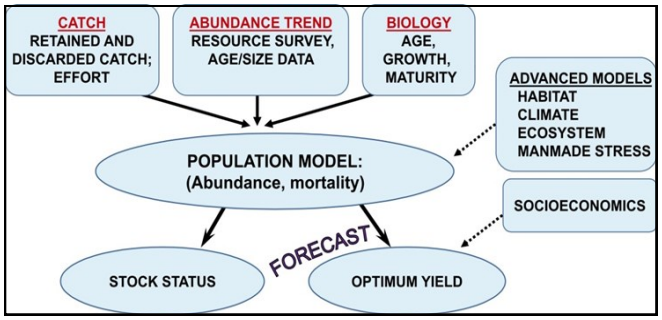

Figure 1. Stock assessment models use fisheries-dependent data (from catch) and fisheries-independent data (from resource surveys) to provide population estimates, and these estimates with life history parameters are used along with other ecological and socioeconomic information for fisheries management.

Managers must make policy decisions even for data deficient fisheries situations. GCFI brings together international experts to conduct collaborative evaluations, exchange expertise, and give recommendations on improving scientific data collections and data-limited assessments. This strategy using a study group approach should initially evaluation the current assessment methods that can be applied to data-limited situations most often found in the Caribbean, and this provides the basis for developing a series of steps for building scientific capacity in the larger Caribbean region:

i) *Data-limited assessment methods* — The first step is access the status of the current data-limited stock assessment methods, evaluate model performance in regard to their assumptions and minimum data requirements, and provide recommendations on analytical improvements to better characterized sources of uncertainty in these methods.

ii) *Fisheries-dependent data* — The next step would be to identify the fisheries-dependent catch and landings data primarily utilized for stock assessments, determine what are the main data or sampling gaps causing uncertainty in the assessments, and provide recommendations for more efficient fisheries-dependent sampling programs, including use of electronic monitoring technologies.

iii) *Fisheries-independent data* — Based on the previous steps, determine the optimal strategy for balancing fisheries-dependent and fisheries-independent data collections, and provide recommendations on the appropriate fisheries-independent survey sampling improvements, including implementation of innovative technologies, that best addresses the requirements of scientific sampling at various spatial scales in support of fisheries management.

These steps provide the framework to identify more focused topics for future study groups, such as the need to develop guidance for long-term monitoring programs to monitor spawning aggregations and their essential habitats, or to evaluate the cost-benefits of marine protected areas on the socioeconomic likelihood of coastal communities.

RESULTS

Evaluation of the analytical tools and the minimum data sampling requirements bring into consideration the various temporal and spatial scales of the scientific information needed for fisheries management (Figure 2). Spatial-temporal uncertainties in population dynamics can be mainly attributed to:

i) Sampling design limitations,
ii) Localized depletion,
iii) Habitat and spawning aggregations,
iv) Distributional shifts from environmental fluctuations, and
v) Mismatch in sampling and management.

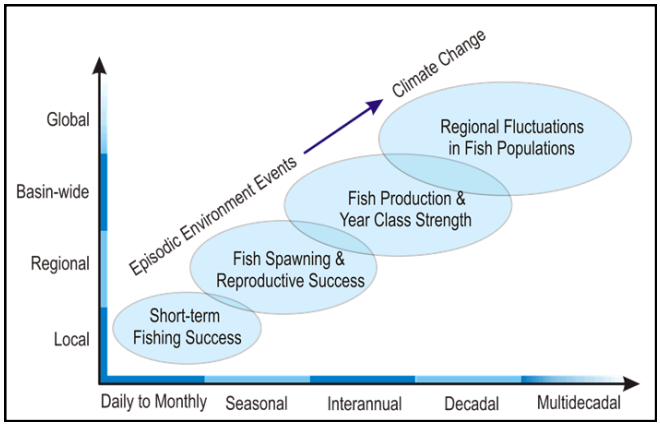

Figure 2. The best scientific information available for fisheries management is relevant and inclusive to the population estimates and biological parameters that are affected by anthropogenic and environmental perturbations at various temporal and spatial scales.

The optimal balance between fisheries-dependent and fisheries-independent sampling designs should take into consideration the minimum data requirements for stock assessment, as well as the spatial uncertainties pertinent to the population estimates. This requires that scientists conduct the appropriate model comparisons and model simulations to evaluate the assumptions, performance and uncertainties of the model, and to determine which model and data requirements should most appropriately be used for each data-poor situation. The selected model and data sampling objectives should also match the questions of the stakeholders and managers. This is particularly true when optimizing a sampling strategy at various spatial scales to address ecosystem-based management. Generally, accurate catch and effort data, life history information, and length-frequency data over the range of the stock are con-

sidered to be the minimum data requirements, but are more often lacking in the Caribbean. Regardless of the data deficient situations, there are increasing demands that fishery managers understand the uncertainties in establishing harvest controls to achieve sustainable fishery resources. There is varying degrees of scientific uncertainty associated with the estimation of harvest control rules for a stock (Figure 3), and most of this uncertainty can most often be attributed to the constraints of the sampling design, data collections, and life history biology of the stock at various regional levels. This has shifted priorities from building scientific capability for only economically high valued fisheries to the recent priority to obtain the minimum data requirements of stock assessment for each fishery.

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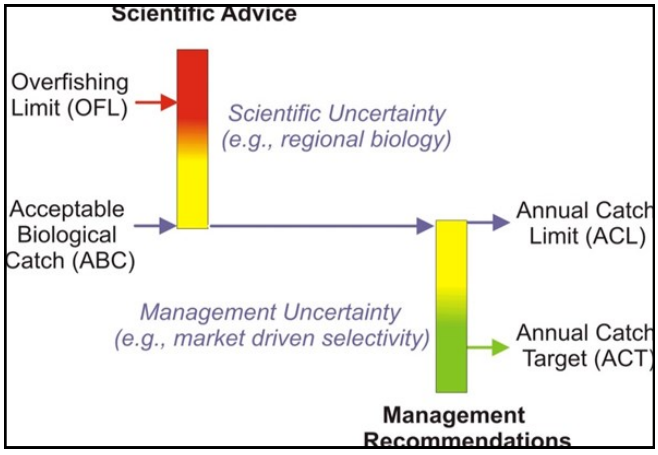

Figure 3. Scientific advice must account for the sources of uncertainty in population and catch estimates, while managers must take into consideration the uncertainties and risks with management recommendations.

To achieve an optimal data collection system for long-term resource monitoring programs, managers must acknowledge and address data deficiencies that exist for each fishery. This is particularly true for the Caribbean region where essentially all of the stock assessments are considered as data limited. In addition to the challenges of limited survey capabilities, managers and assessment scientists must address sampling and modeling uncertainties in an environment with complexity in species diversity, life history parameters, and habitats that are difficult to sample. The Caribbean is further complicated by the diversity of fisheries, lack of technical capacity, and political complexity. Furthermore, the biological and technical challenges of assessing artisanal fisheries are not small-scale issues because of the connectivity of stocks across the Caribbean jurisdictions. For these reasons, scientists and resource managers must work collaboratively on improving the science to safeguard the health and sustainability of fishery resources and their habitats in the Caribbean region. A collaborative capacity building strategy for enhanced survey capabilities is the ultimate goal, yet the most immediate benefits can be obtained by evaluating and developing the analytical tools to conduct assessments of data deficient fisheries. The political will for capability building is not only driven by mandates to achieve sustainable fishery resources, but also requires partnership and consensus on how best to improve the science for policy decisions.

CONCLUSION

The larger Caribbean region is an interconnected ecosystem and its natural resources, including small-scale artisanal fisheries, have large scale connectivity throughout the region. The ability to conduct stock assessments in the Caribbean region is often limited by insufficient data collections, such as having only short time series of catch and length data. An evaluation of the strengths and limitations of the data-limited analytical tools provides guidance on the feasibility and utility of fisheries-dependent and fisheries-independent data collections. There are a variety of analytical approaches that can be applied to data deficient stock assessments of living marine resources in the wider Caribbean region, and other similarly under-sampled habitats. A primary concern with data collection in the Caribbean is the lack of sustained funding that often results in research projects of short duration, rather than long-term monitoring programs. Although there is agreement that the scientific priority is the need to establish annual indices and proxies for monitoring the health and ecological conditions of marine resources and their habitats, the challenge

is the political will to build the capability for long-term survey programs. It is for this reason that scientists, managers, and stakeholders must routinely be bought together to evaluate the objectives and utility of scientific sampling programs to ensure the priorities and uncertainties of management are addressed (Figure 4).

Further evaluation of the efficiency and cost-benefits of survey sampling will need to be examined to ensure the scientific requirements are addressed at various scales for management. Regardless of data deficient situations, partnership throughout this complex geopolitical region must be established to address data deficient situations and optimize long-term monitoring programs that support effective policy decisions to maintain the sustainability of the living marine resources. In conclusion, the following recommendations are provided to increase scientific capacity in the Caribbean through collaborative efforts and cooperative agreements among organizations and countries:

i) Improve mutually supportive international partnerships among governmental agencies, organizations, and stakeholders to develop survey programs that match management requirements which take into consideration the socioeconomic requirements among the Caribbean communities.
ii) Develop consensus on the assessment priorities, validation of data-limited methods, and identify the data collection gaps for providing guidance to international partnerships and policy leadership with the goal of developing long-term survey and monitoring programs.
iii) Optimize fisheries-dependent and fisheries-independent sampling programs at various spatial-temporal scales that address management concerns, and investigate the feasibility of implementing innovative and cost-effective sampling technologies, such as electronic monitoring, remote sensing, alternative platforms, and improved processing efficiencies.
iv) Foster international collaboration in training, exchange of expertise, development of sampling technologies and analytical tools, and communication between scientists, managers, and stakeholders.

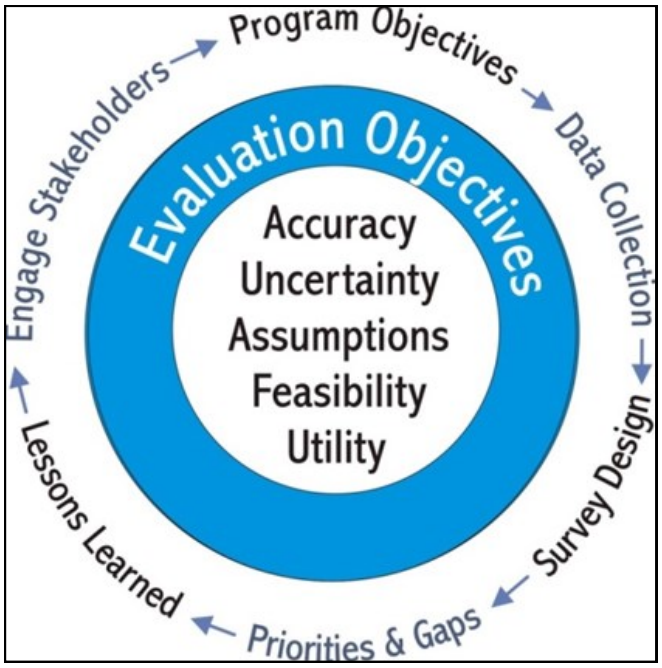

Figure 4. Scientific capacity and political will to improve scientific information in the Caribbean region are best achieved through consensus building by scientists, stakeholders, managers that matches the scientific sampling objectives with the management priorities.