Fishery-Dependent Data Collection and the Evolving Needs of Fisheries Management

Recopilación de Datos Dependen de la Pesca y la Evolución de las Necesidades de la Gestión Pesquera

Collecte de Données Dépendant de la Pêche et de l'Évolution des Besoins de Gestion des Pêches

R. RYAN RINDONE
Gulf of Mexico Fishery Management Council, 2203 North Lois Avenue, Tampa. Florida 33607 USA.
ryan.rindone@gulfcouncil.org.

ABSTRACT

Resource managers in the United States rely primarily on outputs from stock assessments to inform fishery management decisions. Reliable stock assessments depend on the availability of both quality and sufficient data collection systems. In the U. S. Exclusive Economic Zone, management actions are governed by the Magnuson-Stevens Fishery Conservation and Management Act ("Magnuson Act"). As mandated by the Magnuson Act, the National Marine Fisheries Service has developed ten *National Standards*, or principles, to be followed in all fishery management plans to ensure sustainable and responsible fishery management. National Standard Two requires resource managers to employ the *best scientific information available* when establishing annual catch limits and regulating fishery resources. In the Gulf of Mexico, species are qualitatively categorized as *data-rich* or *data-poor* by managers; these designations are defined based on the quantity and quality of data available for a species. These designations indirectly determine if a relatively sophisticated stock assessment model (e.g., catch-at-age) may be used to assess the species, or if a less data-intensive modeling approach (e.g., landings-only) is more appropriate. Ideally, any improvements to data collection efforts would produce benefits for both data quality categorizations and both stock assessment rigor and management advice. The most pressing data needs in the Gulf of Mexico are: characterizing discard mortality; defining the universe of recreational fishing effort; and determining the ecosystem function and value of submerged artificial structures. Enhancements in fishery-dependent monitoring and data collection efforts could benefit the stock assessments of multiple species. Such efforts may lead to improved satisfaction of National Standard Two and also contribute to more robust stock assessments of previously *data-poor* species.

KEY WORDS: Fishery management, data collection, stock assessment

INTRODUCTION

Resource managers depend on data from stock assessments to inform fishery management decisions. These data are derived from a variety of sources which are often aggregated into one of two categories: fishery-independent and fishery-dependent data. Fishery-independent data are collected directly from the resource in question and can include sampling efforts conducted by governmental entities and academic institutions which are independent of stakeholder exploitation activities. Fishery-dependent data are largely collected from fishermen and include such surveys as the Marine Recreational Information Program (MRIP) used by the National Oceanic and Atmospheric Administration in the United States. Since fishery-dependent data are collected directly from resource users, largely by word of mouth and/or submitted responses (e.g., logbooks, questionnaires), it is vital to validate the data collected. Data validation may be both costly and time-consuming and is often logistically arduous.

In the United States exclusive economic zone (EEZ), fishery management decisions are governed by the Magnuson-Stevens Fishery Conservation and Management Act (hereafter: "Magnuson Act") which was most recently reauthorized in 2006 (109th U.S.C.). The original Magnuson Act (94th U.S.C. 1976) created eight regional fishery management councils (RFMCs), composed of an appointed membership including state governmental and governor-appointed representatives, to serve as regional rule-proposing bodies which develop fishery management actions with direct input from resource stakeholders. As mandated by the Magnuson Act, the National Marine Fisheries Service (NMFS) has developed ten *National Standards*, or principles, that must be followed in any fishery management plan (FMP) to ensure sustainable and responsible fishery management. According to National Standard Two, these fishery management decisions must be made using the best scientific information available (NMFS 2015). The RMFCs rely on scientific advisory bodies known as Scientific and Statistical Committees (SSCs) to determine if a stock assessment, and the data used to inform the assessment, represents the best scientific information available. Upon making this determination, the SSC makes recommendations about overfishing limits (OFL) and acceptable biological catch (ABC) levels for that species.

GAPS IN KNOWLEDGE

By using stock assessment models, fisheries managers can forecast future landings trends which account for both known and unknown variables which may affect fisheries populations, thereby increasing the efficacy of management decisions (Stergiou and Christou 1996, Makridakis et al. 2008). These models can be data- and time-intensive and taxing on available resources, especially when applied to the many species for which fisheries managers are responsible (Ward et al. 2014). A variety of gaps in knowledge often exist within these assessments, creating uncertainty in the condition of a managed species (i.e., overfished or undergoing overfishing). These gaps must be characterized in the stock assessments and also must be considered when developing future management alternatives. Such gaps in knowledge may be the result of insufficient spatial or temporal sampling coverage, inadequate sampling intensity, or other identified concerns. Qualitative distinctions can then be made about a particular species with said species being identified as either *data-rich* or *data-poor*." *Data-rich* refers to those species which can be assessed through statistically robust catch-at-age models (e.g., Stock

Synthesis- see Gulf of Mexico Red Snapper: SEDAR 31 2013), and *data poor* species have assessments that tend to use modeling or analytical evaluation environments that have less intensive data requirements. Additionally, management concerns can evolve to require changes in what and/or how data are collected. These concerns can be addressed through additional analyses of existing data; however, it may more often be the case that unique data need to be collected to assist resource managers in making decisions about proposed management options. Fishery-dependent data collection programs have an advantage over fishery-independent programs in that fishery-dependent data collection can often be implemented rather quickly (comparatively) in response to a perceived management concern and, validation notwithstanding, can be conducted in a more affordable manner through methods such as web-based surveys and dockside intercepts. Exploration of fishery-dependent data collection options is crucial for those resource management entities which may be resource limited (e.g., personnel, monetary funding, infrastructure, equipment), making the implementation of statistically robust models which rely on a variety of complex data implausible (Carruthers et al. 2014, Berkson and Thorson 2015).

One of the most pressing concerns facing resource managers today is managing a resource ideally present at a constant level (in the case of marine fisheries, possibly characterized by spawning stock biomass) while continuing to allow access for an ever-growing user base. In the southeastern United States, this user base is increasingly comprised of private recreational anglers (Coleman et al. 2004) for which fishery-independent sampling is not feasible. As such, fishery-dependent data collection methods are necessary to develop estimates of landed catch, discarded catch, fishing effort, catchability, gear selectivity, and other metrics. Over time, the suite of data collection methods available has evolved to include more technologically engaging alternatives, allowing for flexibility and adaptability in sample designs and reactive sampling of participating stakeholders. Examples of these new alternatives include smartphone applications tablet-based programs (see *iSnapper*: Stunz et al. 2013), as well as other internet-based data entry and electronic reporting methods. Such advancements also provide a mechanism for fostering improvements in stakeholder-resource manager relationships by contributing to a collaborative effort of data collection. This level of collaboration between stakeholders and resource managers can increase communication, thereby contributing to a mutual comprehension of their individual perspectives.

Resource managers must prioritize fiscal and logistical resources to address pressing gaps in knowledge to improve management advice and reduce uncertainty of stock status. As recently as 2014, in the southeastern United States, resource managers and stock assessment scientists alike voiced concerns over common data needs such as comprehensive landings histories, spatially explicit and sector-specific catch and effort data, and characterization of artificial habitat use for prominent species at RFMC meetings. Presently, with many of the aforementioned data needs addressed for frequently-assessed species (i.e., species assessed every three to five years), new and additional gaps in knowledge have been identified as a result of a continued need to improve accuracy and precision in landings and effort reporting. Resource managers have expressed a desire for near-real-time landings and effort data and absolute estimates of landings and effort by fishing sector and species/species grouping. Concurrently, the desire to reduce biases in landings and effort profiles has become another pressing objective amongst stakeholders and fishery managers. These desires are in addition to more comprehensive evaluations of ecosystem components and anthropogenic effects. Some examples of anthropogenic influences on fishery resources include oil spills and subsequent clean-up efforts, oil rig removals, loss of wetlands, estuarine habitat degradation, and deployment of artificial structures intended to serve as finfish habitat.

OPPORTUNITIES FOR IMPROVEMENT

Marine fisheries stakeholders often describe concerns which highlight previous gaps in knowledge identified by resource managers and stock assessment scientists. Stakeholder concerns largely center on decreasing bag limits and seasons, more restrictive size and/or slot limits, and the notion that stock assessment models do not reflect what anglers see on the water (see www.gulfcouncil.org for a sample of public comments on a variety of managed species). These concerns typically pair well with those of resource managers, and additional data collection efforts in some of these areas may further elucidate current conditions within popularly targeted fisheries. Improvements in discard mortality estimates, fishery sector-specific real-time data collection, and understanding the ecosystem function and value of submerged artificial structures are all pressing data needs (see Section IV: Research Recommendations of any Southeast Data, Assessment, and Review (SEDAR) stock assessment: www.sedarweb.org). There are many suggested improvements which may decrease gaps in knowledge and refine discard mortality estimates, and cautious implementation of promising proposals through pilot programs has proven to be an effective way to test new methodologies. Further, modeling of how management advice (i.e., allowable harvest levels, effort controls, and seasons) changes with improvements in previous gaps in knowledge would help resource managers demonstrate the efficacy of investing limited resources into solving specific questions about a fish stock or group of stocks.

Increased observer coverage, similar to that employed on headboats, has been proffered as a way of validating those landings collected on charter-for-hire vessels with smaller capacities. On-board observer coverage, however, requires the dedication of larger amounts of both financial and human resources in order to be effective, concurrently making it more difficult to implement. A substitute for on-board observers may be video sampling, with video footage reviewed at random against an electronic monitoring and reporting form. Whether using on-board observers or video footage, either method may assist resource managers and stock assessment scientists in collecting necessary data to refine discard mortality rate estimates. In addition, information provided by stakeholders on discards has been helpful in some small artisanal fisheries (e.g., St. Thomas, U.S. Caribbean, NOAA Cooperative Research Program project 05CRP019), further emphasizing the importance of enhancing stakeholder engagement in the data collection process.

To further refine the universe of anglers to explicitly report landings and effort, it may be helpful to look towards terrestrial harvested species management. Recreational anglers have proposed attaching stamps or other forms of delineating identification to fishing licenses to better define the universe of anglers fishing for a particular species or group of species. Such endorsements are currently used by some (but not all) state fishery management entities, and are similar to those used by those states to manage deer, turkey, and other animals. Electronic reporting would be necessary to relate landings to a specific population of anglers; however, without validation, electronic reporting may not prove useful for inclusion in stock assessments. Validation of private recreational electronic reporting data may prove arduous, especially since many anglers in the southeastern United States have the ability to land their catch at a private boat ramp or dock.

Understanding the ecosystem function and value of submerged artificial structures have historically been popular topics in fisheries management in the southeastern United States (Pickering and Whitmarsh 1997, Baine 2001, Miller 2001, Peterson et al. 2003). However, one area where electronic reporting, especially in the recreational sector, may prove valuable is artificial structures. Anglers could have the option of reporting whether they were fishing on artificial substrates such as Reef Balls®, reefed ships, tanks, train box cars, and other common reefing materials. In addition to reporting effort in these locations, anglers could report their catch in number and length, fishing gear and/or method used to land said catch, and other easily collectible metrics. Data validation would remain an issue; however, fishery-independent sampling through video surveys, traps, and others could serve to provide a level of qualitative utility to those fishery-dependent data. These data may be used to inform selectivity and catchability estimates of assessed species, thereby increasing the precision of stock assessments on those species and improving final management advice. Effort comparisons could be made between natural and artificial bottom habitats, with trends in effort through time analyzed to determine if the utility of a particular reefing material changes with time.

CONCLUSIONS

A multitude of options exist within the universe of fishery-dependent sampling to address gaps in knowledge. Creativity may be necessary, combined with coupling fishery-independent sampling efforts to satisfy the statistical rigor required for today's age-structured and other complicated stock assessment models. However, such data collection systems may constitute positive steps for some species currently described as *data-poor* and aid resource managers in addressing present management concerns. The use of comprehensive modeling techniques to address these concerns will become more crucial as fishing effort increases, particularly in the recreational sector (Farmer and Froeschke, in press). Where possible, funding should be made available to explore those fishery-dependent methods which demonstrate a reasonable probability of success as pilot studies to determine their efficacy in addressing gaps in knowledge.

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