

# Sixty Years of Fisheries Management in the Gulf and Caribbean: A Retrospective on Needs, Attitudes and Role of the GCFI

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## ABSTRACT

Fisheries management has undergone substantial changes since 1948, the first year of the Gulf and Caribbean Fisheries Institute. As reflected in the Proceedings of the GCFI, these changes are driven by a variety of factors, including the extent of fishing, the techniques and approaches available, changes in global/regional fisheries governance, attitudes concerning science and the external impacts to fisheries, as well as the make up of the GCFI itself. Among the more obvious changes are a shift in concern from fisheries development to regulation and then more to conservation, with concern shifting from individual fisheries to ecosystem scales, a shift to more quantitative approaches coupled with a subsequent return to less data-hungry approaches, and the rise of the social sciences and the role of NGO's in fisheries management. Some of these changes are as much a reflection of the change in GCFI leadership over time, from an organization dominated by industry, fishers and managers with a strong US bias to one dominated by government and academic scientists, and NGO representatives with significant participation by non-US and small island nations. One constant has been that the increased application of science toward management has always been problem driven and therefore always reactive and unable to keep pace with increasing stressors on fisheries and fishery resources. This suggests that role of science in management, and therefore management itself will continue to evolve until issues and response times are commensurate with management needs and capabilities.

KEY WORDS: Fisheries management, Gulf and Caribbean, fisheries science, history

## Sesenta Años de Manejo de Pesquerías en el Golfo y el Caribe: Una Retrospectiva de Necesidades, Actitudes y el Rol del GCFI

El manejo de las pesquerías ha cambiado sustancialmente desde el 1948, el primer año del GCFI. Como se refleja de las memorias del GCFI estos cambios se deben a varios factores, entre ellos el alcance de la pesca, las técnicas y métodos disponibles, cambios en la gobernanza a nivel global y regional, las actitudes hacia la ciencia, los impactos externos a las pesquerías, al igual que la composición de la membresía del Instituto en sí. Entre los cambios más obvios están: la mudanza del enfoque del desarrollo pesquero hacia su regulación y finalmente conservación; cambios en el enfoque de pesquerías individuales hacia escalas de ecosistemas; mudanzas hacia acercamientos más cuantitativos y un retorno a métodos menos data-intensos; y el surgimiento de las ciencias sociales y el rol de las ONG en el manejo de pesquerías. Algunos de estos cambios reflejan las mudanzas en el liderazgo del GCFI a través del tiempo, de una organización dominada por la industria, pescadores y manejadores con un fuerte componente Estadounidense hacia uno dominado por científicos académicos y de gobierno, y representantes de ONGs con participación significativa de otros países e islas naciones. Una constante ha sido la mayor aplicación de la ciencia hacia el manejo que era generada para atender problemas, por lo tanto reaccionaria e incapaz de mantenerse al tanto de las crecientes amenazas y tensiones de las pesquerías y los recursos pesqueros. Esto sugiere que el rol de la ciencia en el manejo y por lo tanto el manejo como tal continuará evolucionando hasta que los asuntos y el tiempo de respuesta estén a la par con las necesidades y capacidades del manejo.

PALABRAS CLAVES: Manejo de pesquerías, Golfo y el Caribe, ciencia de pesquerías, historia

## INTRODUCTION

Fisheries management is concerned with a broad array of activities, which have expanded and evolved over time. Principle areas of concern are the status of the fisheries from a biological and socio-economic perspective, and based on these whether emphasis should be placed on further development when resources are underutilized, or when resources are fully exploited on either instituting practices and regulations to limit fishing and conserve the productive capacity of the resource and/or identify new resources to which effort can be shifted. Within this broad mandate are a variety of technical problems that must be addressed, such as stock identification on the one hand and the legal framework for management on the other.

The Gulf of Mexico and Caribbean region is a complex area both biologically and politically. Nations range from large countries with an expanse of shelf area, to small island nation states with narrow shelves, from

affluent/industrial countries to the poorest in the hemisphere. The biota is very diverse, with the region encompassing three biogeographic provinces and 12 ecoregions (Spalding *et al.* 2007), and resources range from coral reef fishes and invertebrates to highly migratory tunas and billfishes. Culturally, the region is equally complex, with a strong mix of English, Spanish, and French colonial backgrounds (and some Portuguese), Catholic and Protestant religions, and American, European, African, and indigenous influences. Such diversity in history, attitude, capacity and interest represents a challenge to fisheries management in the region as a whole. Yet, many of the problems faced are common regardless of the particular location or species. In the same way, the region offers a rich variety of different approaches to similar problems that can be invaluable for developing and testing management strategies generally applicable throughout the region.

The purpose of this paper is to review the history of fisheries management within the Gulf and Caribbean over the past 60 years, using the Proceedings of the Gulf and Caribbean Fisheries Institute as an historical record. Within the Gulf of Mexico and Caribbean, fisheries management has undergone substantial changes over the past 60 years. The objectives of this retrospective are to identify the large-scale trends within the region, to evaluate these changes within the context of changes in fisheries management in general, to evaluate where the region's strengths and weaknesses lie, and to identify directions that should either be supported if beneficial or altered if non-productive.

### METHODS

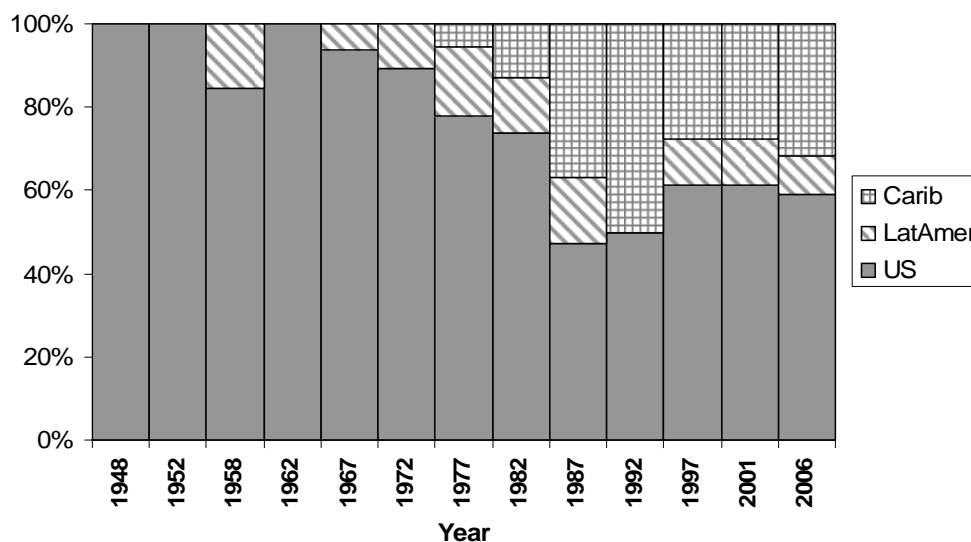
Given the extent of the historical record represented by the GCFI Proceedings, the principal approach used here was to reduce the task by using thin-slicing. This was accomplished by surveying in detail the Proceedings at approximate five year intervals. Deviations from this occurred when access to a specific volume was not possible, or when this would bias the results. The latter case arose due to a period where meetings were held in Mexico at five year intervals, and these meetings were generally exceptionally large and dominated by the host nation. In this case, only one of the meetings was used and the time line then offset by one year. For each volume, notes were taken on all articles generally related to management concerns. Additionally, records were kept on the make-up of the GCFI Board of Governors in terms of geographic and occupational representation.

Resulting notes were used to develop time lines reflecting changes and trends in areas of management concern. These time lines were graphically displayed and

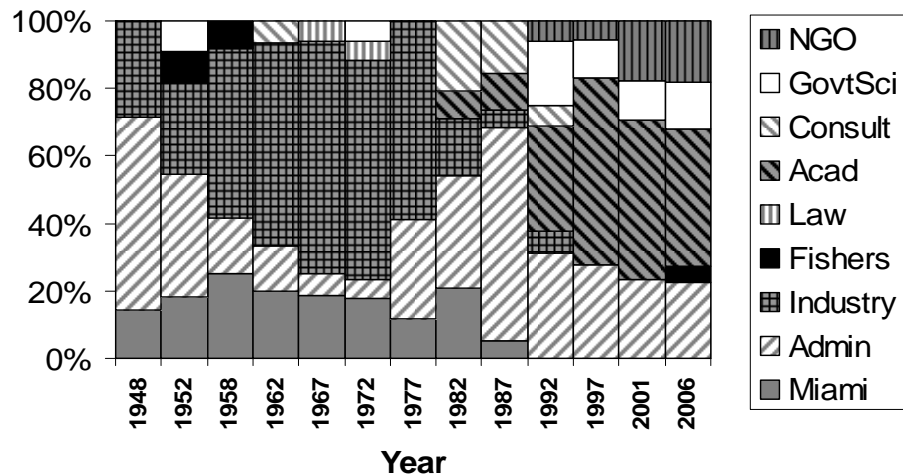
related to larger historical events. Five series of time lines were developed. While their focus is different, they are overlapping and not mutually exclusive. Overall, the process must be viewed as subjective and influenced by the biases and interests of the author.

### RESULTS

Figures 1 and 2 depict changes in the make-up of the GCFI Board of Governors over the past 60 years with respect to geographic representation and professional occupation. The GCFI was initially incorporated in the US and centered at the University of Miami. From the onset, the Board has been dominated by members from the US (including the US Caribbean). Participation by representatives from mainland Latin America began in the late 1950s, and has held fairly steady since the late 1960s. Starting in the late 1970s, a notable increase has occurred in the representation of Caribbean islands. Significant shifts have occurred within the professional ranks of the GCFI Board. A solid core from the University of Miami was consistently present until the University gave up sponsorship of the GCFI in the mid-1980s. At its inception, one goal of the GCFI was to bring all players within fisheries to the forum, including industry, administrators, fishers, and scientists. This philosophy can be seen by the strong, and at times dominate, presence that the industry had on the Board. This participation arose from a close association between the driving group at the University of Miami and the fishing industry, and when the University withdrew from the GCFI, industry participation similarly plummeted. This led to a fundamental changeover in the Board, with members from academia, government scientists (as opposed to administrators), and NGO's markedly increasing their presence.



**Figure 1.** Geographic representation within the GCFI Board of Governors over time. Caribbean includes all islands except Puerto Rico, which is included under US.



**Figure 2.** Professional representation with the GCFI Board of Governors over time, with the exception of members from the University of Miami, where the GCFI was initially based.

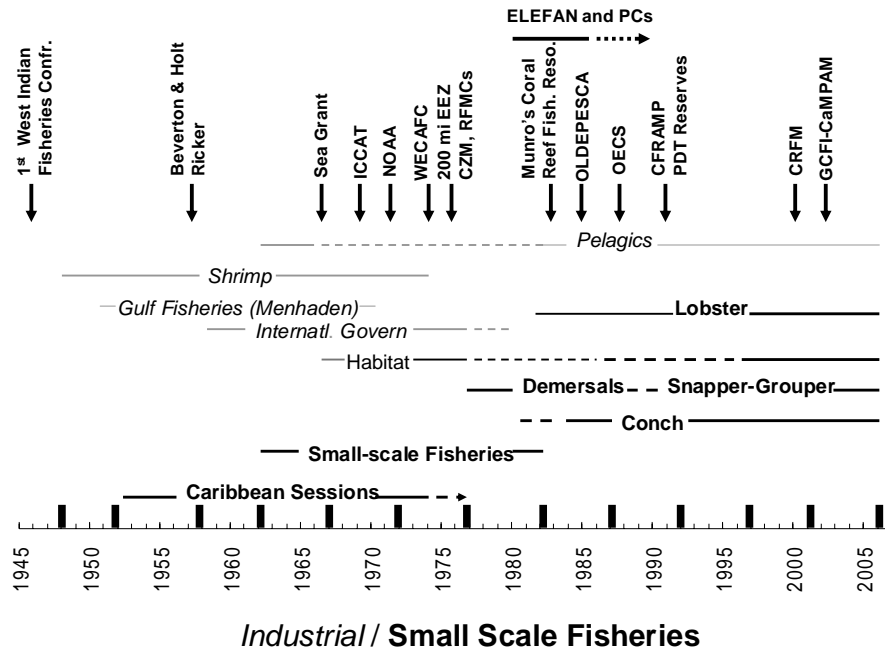
The changing interests of management concern relative to industrial and small-scale fisheries over the past 60 years are shown in Figure 3. Early on, the focus of GCFI was clearly oriented to industrial fisheries, with most attention given to the US based shrimp and menhaden fisheries. The former was also a driver on concerns over international governance as US companies sought access to new shrimping grounds, most of which were located along the mainland Latin American coast. This interest ended with the UN Law of the Sea and the extension of the 200 mile Exclusive Economic Zones (EEZs). Debate on these issues ended, with access then dependent on developing bilateral treaties. More recent attention in industrial fisheries has focused on the coastal and highly migratory pelagic fishes, particularly as small island states attempted to control and benefit from activities within their respective EEZs, and scientists and managers struggled to understand more about a fishery that extends over a range of national jurisdictions as stocks as a whole declined.

While concerns of Caribbean islands were represented from the beginning within isolated sessions on Caribbean or small-scale fisheries, by the mid-1980s these became more dominant, particularly as dedicated sessions to more coral reef ecosystem-based resources, such as conch, lobster, and the snapper-grouper fisheries, became staple features. These trends also reflect the increasing role of Caribbean islands in the GCFI Board (Figure 1).

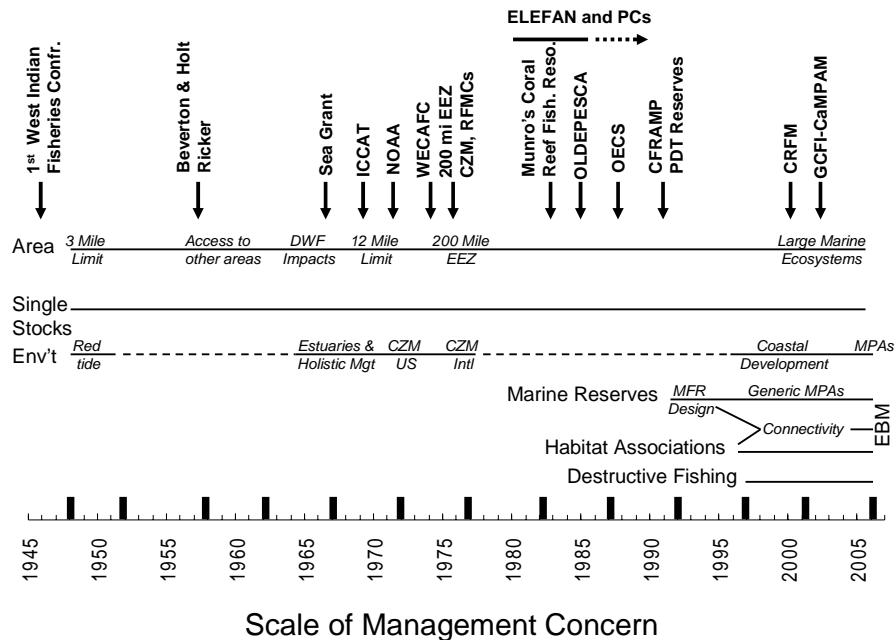
Habitat was not an initial concern of management, but this changed in the late 1960s and early 1970s as it became apparent that nearshore and estuarine waters were rapidly declining in quality, and coastal wetlands were being destroyed by anthropogenic activities, particularly due to coastal development. This effort was led by US members and reflected the general greater concern in this area that eventually led to the establishment of formal Coastal Zone

Management (CZM) programs within the federal and state governments. Habitat issues then returned to a low level until they once again came to the fore in the mid to late 1990s, particularly in response to noticeable declines in coral reef habitats, the rise of large-scale tourism-driven coastal development throughout the region, and increased interest in designing marine protected areas.

Figure 4 depicts how the scale of management interests has changed in spatial extent and how this relates to biological and environmental concerns. Generally, the spatial scale of concern has shown a steady increase over time. While biological focus has remained centered on single stocks, fisheries have expanded. This led first to questions of exploration of new stocks, and subsequently, to concerns of either sustained access to foreign areas, or conversely, the impacts of foreign fishing to local resources. These were all connected with governance issues as government control expanded from 3 miles to 12 miles to eventually 200 miles. More recently, the realization of the large-scale ecological impact of fishing and other anthropogenic stressors, and the need to maintain functional ecosystems has led to a management focus on large marine ecosystems, in this case encompassing the whole of the Gulf and Caribbean. Management efforts are now giving greater attention to the full complexity of factors affecting fisheries and looking at interactions at multiple scales among fisheries' biological, socio-economic, and governance components. While the overall scale of concern has increased, there has been renewed focus on local scales, particularly with respect to developing Marine Reserves (MRs) and other Marine Protected Areas (MPAs), but this reduction in local geographic scale retains the larger complexity of issues that has grown with time.



**Figure 3.** Timeline of interest areas within the GCFI related to industrial (thin lines and italics) and small-scale fisheries (bold). Markers along the time axis (bottom) show years included in the analysis. For context, along the top are listed some key events in fisheries and within the region relevant to fisheries management (see Table 1). Solid lines indicate periods of sustained interest; dashed lines indicate periods of scattered interest. Arrows indicate activities that continued but under different thematic areas.



**Figure 4.** Timeline of interest areas within the GCFI related to the scale of management concern. Items in italics reflect specific issues, within larger thematic areas. DWF- Distant Water Fleet, MFR – Marine Fishery Reserve, EBM – Ecosystem-Based Management; see text for other terms. See Figure 3 and Table 1 for further explanation.

**Table 1.** Summary of selected contextual events in fisheries management in the Gulf and Caribbean region over the past 60 years used in Figures 3-7.

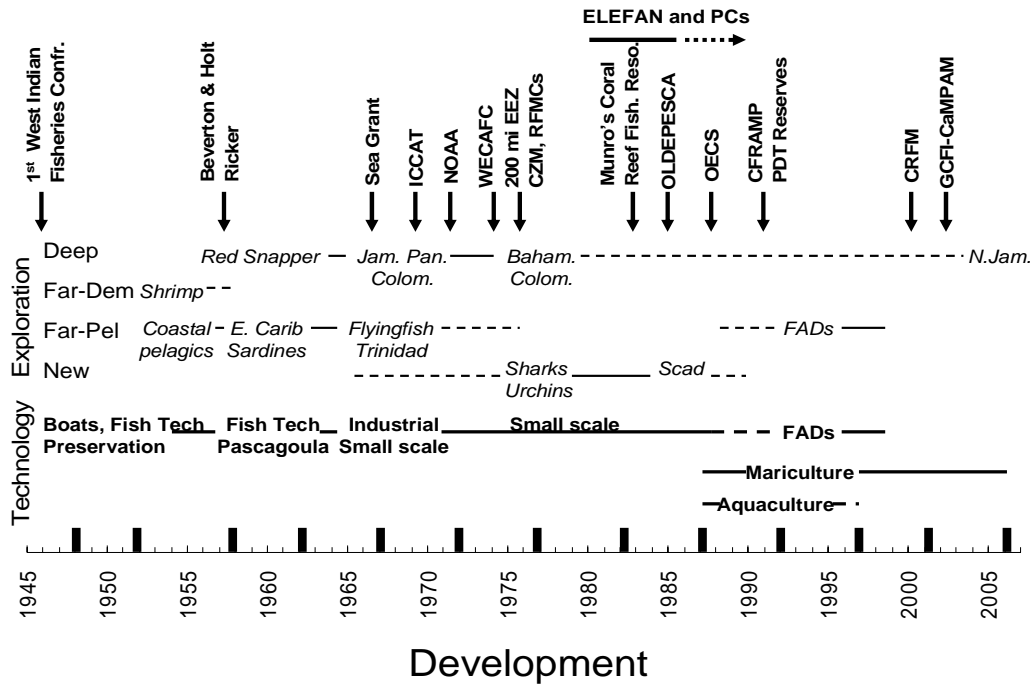
Event	Description
1st West Indian Fisheries Conference	Convening of the First West Indian Fisheries Conference
Beverton & Holt; Ricker	Publication of general stock assessment methods by Beverton and Holt (1957) and Ricker (1958)
Sea Grant	Creation of the Sea Grant Program in the US, a government-university partnership for research and outreach
ICCAT	Establishment of the International Commission for the Conservation of Atlantic Tunas
NOAA	Establishment of the US National Oceanic and Atmospheric Administration
WECAFC	Establishment of the Western Central Atlantic Fisheries Commission under the UN Food and Agriculture Organization
200 mi EEZ	Establishment of 200 mile Exclusive Economic Zones under the UN Law of the Sea
CZM	Establishment of the US Coastal Zone Management program
RFMCs	Establishment of the US Regional Fishery Management Councils including those for the South Atlantic, Gulf of Mexico and Caribbean
ELEFAN and PCs	The development of PC-based assessment techniques, most typified by the ELEFAN suite of programs using length-frequency data
Munro's Coral Reef Fisheries Resources	Publication of Munro's (1983) "Caribbean Coral Reef Fishery Resources", which tabulated life-history parameters and made previous stock assessment studies more readily available
OLDEPESCA	Establishment of the Latin American Organization for Fisheries Development
OECS	Establishment of the Natural Resources Management Unit (now the Environment and Sustainable Development Unit) of the Organisation of Eastern Caribbean States
CFRAMP	Establishment of the CARICOM Fisheries Resource Assessment and Management Program
PDT Reserves	Publication of PDT (1990), which first synthesized the general arguments and approaches for using Marine Reserves for fisheries management and made them more widely available.
CRFM	Establishment of the Caribbean Regional Fisheries Mechanism, a follow-up to CFRAMP expanded to 19 countries
GCFI-CaMPAM	Formation of the partnership between the GCFI and the CaMPAM (Caribbean MPA Managers)

Management concerns relative to fisheries development usually focus on either locating new resources or more efficiently capturing and utilizing existing resources. Activities within the GCFI reflect both of these (Figure 5). Early explorations targeted new resources by searching further a field, deeper or turning to underutilized species. However, the bulk of these activities ended by the mid 1970s indicating most resources were fully exploited. Large-scale technological development as a management focus also declined in the early 1970s, being replaced by a focus on small-scale technology, with Fish Attracting Devices (FADs) getting particular attention in island states with narrow shelves. Since the late 1980s, there has been a sustained interest in turning to mariculture to either maintain production or restore wild stocks.

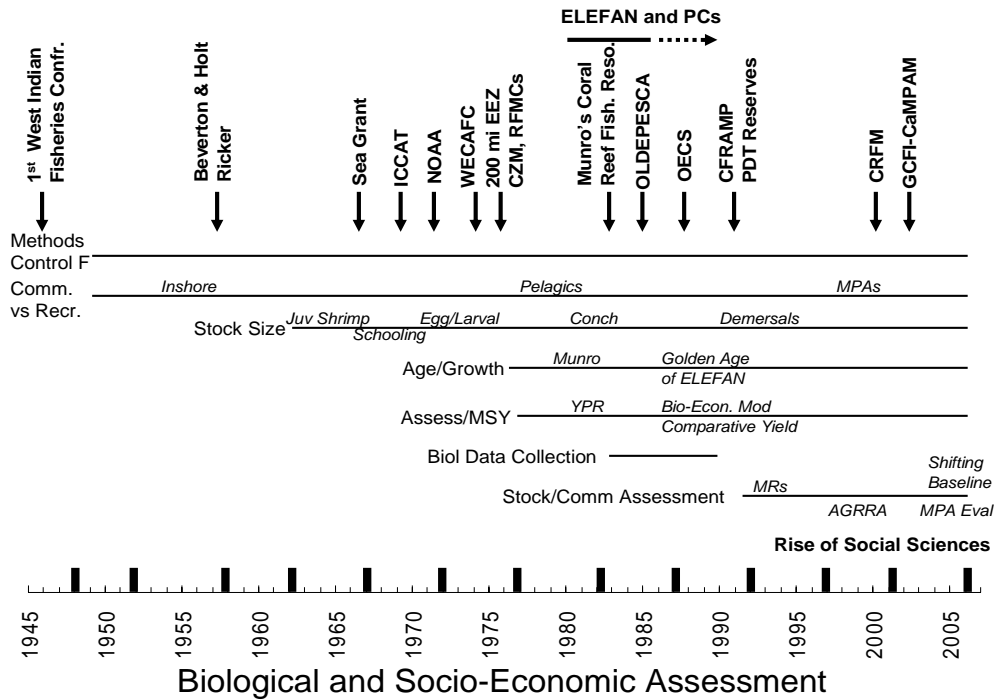
Assessment of the status of fisheries stocks is a core component of fisheries management, which in recent times has been complemented by equally important socio-economic assessments of the human component. Figure 6 shows how emphasis within these areas has changed. From the very beginning of GCFI, the full range of practical methods for controlling fishing mortality were known, the problems facing managers have always been

terms of when and how to implement them, especially in the face of competing demands. Commercial and recreational fishing conflicts have also always confronted managers; the nature of these conflicts has changed and their extent has spread throughout the region.

The earliest quantitative assessments were aimed at determining stock size, with various methods used and resources targeted. These activities have increased over time. Quantitative age and growth studies, another critical component of biological assessments did not take off until the mid 1970s. Leading this effort was John Munro and his team working in Jamaica. Efforts here accelerated during the late 1980s and early 1990s as length-based methods were developed and incorporated into simple PC-based assessment packages. More formal assessments that include calculation of reference points such as Maximum Sustainable Yield (MSY) first appeared in the late 1970s, some 20 years after publication of the seminal assessment works by Beverton and Holt (1957) and Ricker (1958). The enhanced quantitative capabilities offered by desktop computers led to the realization that sustained data collection efforts must be designed and implemented, which became a focus within the GCFI during the 1980s.



**Figure 5.** Timeline of interest areas within the GCFI related to fisheries development as management goals. Items in italics reflect specific issues, within larger thematic areas. Dem – Demersal, Pel – Pelagic. See Figure 3 and Table 1 for further explanation.

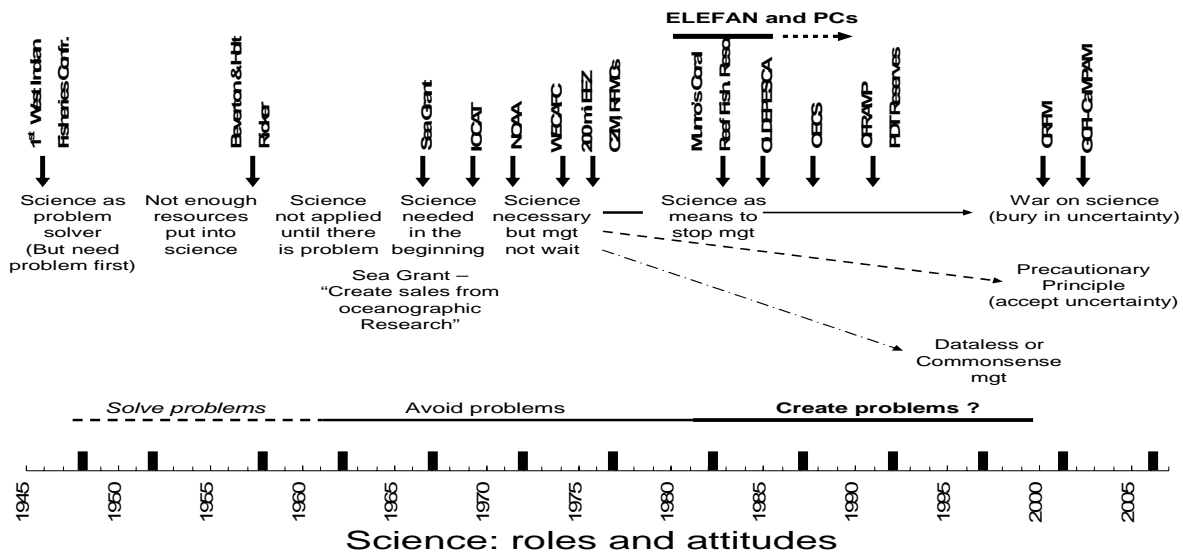


**Figure 6.** Timeline of interest areas within the GCFI related to biological and socio-economic assessments. Items in italics reflect specific issues, within larger thematic areas. YPR – Yield per recruit; see text for other terms. See Figure 3 and Table 1 for further explanation.

Beginning in the early 1990s, alternative and community-based methods for biological assessment have increased. First of these was the use of marine reserves to compare the abundances and size structures of exploited and unexploited species, as well as to detect differences in species composition at the community level. At the other end, is the examination of shifting baselines and the reconstruction of what populations and communities looked like prior to fishing. Also gaining prominence, is the use of whole reef surveys, as found in reef monitoring programs such as those conducted within MPAs or at a regional level by the Atlantic and Gulf Rapid Reef Assessment (AGRRA) program. These surveys are more concerned with overall reef health, rather than the abundance of commercially important species. Lastly, the past decade has seen a marked increase in socio-economic studies, many associated with MPA development and implementation. These studies are providing valuable insight into the status of resources, the ecosystem that supports them and the human component that exploits and manages them.

The final time-line (Figure 7) attempts to capture changes in the attitudes of how science has been used in fisheries. It is clear that science was initially viewed as a means to solve problems. The following quote typifies the prevalent attitude: "In the fisheries division .... there is a *modus operandi* based on the noble premise that if a proposal is just, reasonable, *scientifically sound* (emphasize added), and does the least harm to the most people, that proposal should be advance on its merits, that we are appealing to the higher civilized instincts of mankind in an enlightened world" Neblet (1958). But, while support for science remained strong, the process was recognized as

being reactive, *i.e.*, the application of science awaited until a problem already existed. The short-sightedness of this approach became evident, and by the 1970s, the view had changed that science needed to be applied before hand to avoid problems. This was a unique period when science was viewed as having almost mythical powers. In the US, one of the premises for establishing the Sea Grant program was that the application of science could be to make money. Yet, even with the growth of Sea Grant and other research programs, it was soon recognized that the resources available were not sufficient to the task. Thus, perceptions changed again to the recognition that science was necessary, but that management could not necessarily wait for a science-based solution. There seemed to be three responses to this situation. One was developed particularly in small island areas and was based on recognition that there would never be sufficient scientific resources available, but that general principles and fishery-based knowledge could be used to guide fishery management. These were termed "data-less" or "common sense" management. A second, more formal response recognized that uncertainty would always be present in fisheries analyses and that management must incorporate this uncertainty into management strategies by developing risk adverse policies. This was eventually codified in the FAO Code of Conduct of Responsible Fisheries as the "precautionary approach". The third response was found mostly in the US, where the use of science had been ingrained into the regulatory process. In this response, lack of a scientific certainty was used to delay management action that would limit fishing activity. The burden of proof was maintained on science to demonstrate a problem, and uncertainty used to mask scientific consensus.



**Figure 7.** Timeline of attitudes toward the role science in fisheries management as expressed within the GCFI. Arrows represent a split in recent years into three different end points. See Figure 3 and Table 1 for further explanation.

## DISCUSSION

In viewing the above trends, the first question to be addressed is to what degree the GCFI Proceedings reflect the actual reality of fisheries management in the Gulf and Caribbean over the past 60 years. Clearly, much of the agenda at the GCFI is driven by the interests of its Board Members and the locations of meetings relative to local issues and ability to attend. If so, the make up of the Board would be expected to affect the nature of the meetings and hence content of the Proceedings, and the significant change in the structure of the Board starting in the mid-1980s could be seen as causing bias in the Proceedings. However, two perspectives argue against this top down view. First, it can equally be argued that this cause and effect works in both ways, *i.e.*, that the change in the Board of Governors reflects fundamental changes within Gulf and Caribbean fisheries. Under this bottom-up view, industry dropped out because their benefits to membership declined as resources became fully exploited and the regulatory atmosphere matured with the passage of the UN Law of the Sea. Similarly, increased presence of scientists may truly reflect the increased role of science in the fisheries and the expansion of concerns beyond the stocks themselves toward integration with coastal zone management and the development of a sustained effort to understand the socio-economic forces and impacts within fisheries. Secondly, some regional trends in the record track similar trends in fisheries as a whole. Thus, the increase in representation of Caribbean islands reflects the global integration of fisheries, through distant water fishing, expanded regional tourism and trade, enhanced communications and increasing ecological impact. Additionally, the growth of NGO's within the Board reflects the increased role of these organizations in fisheries on a global basis. They have become a force in modern fisheries management by representing the role of the general public as equal stakeholders to break impasse between vested interests within government and industry, by challenging ineffective management practices in and out of court, and by providing new approaches and resources, particularly with respect to implementing MPAs, which in turn has driven much socio-economic research.

The trends clearly show that the exploration phase for new sources of traditional resources has come to an end. Instead, efforts are now turning toward more fully and efficiently utilizing existing resources and dealing with conflicts among stakeholders. This requires development of more formal management structures and must account for both the biological and human components of fisheries. Mariculture is another growth area for the region, again a consequence of the full exploitation of traditional resources.

For the most part, the region has been slow to adopt methods to assist the process of biological assessment. This is no doubt due to a combination of factors, rather than lack of management oversight. Fundamental param-

eters such as age and growth were not even developed for many tropical species until the 1970s with the onset of programs in Jamaica and Cuba, with the results of the latter not readily available until recently (Claro *et al.* 2001). The co-evolution of length-based methods and personal computers in the 1980s resulted in a marked increase in our knowledge of basic biology. More recent technological advances are refining our knowledge even more, showing longevities to be greater than previously determined (thus reducing productivity estimates) and allowing complex interactions to be assessed (*e.g.*, use of ECOPATH with ECOSIM and ECOSPACE). Greater access to data and computing programs points to a clear need for more extensive and detailed training in assessment methodologies; misuse of the technologies has not been uncommon. Given this, equally important will then be the recruitment and retention of these highly trained individuals.

In contrast to assessment capabilities, the region seems to be at the forefront in several management issues. Three of these are the development of alternative assessment methodologies (some community based), the integration of MPAs into fisheries management and the application of the social sciences. Much of these efforts have yet to be incorporated into direct management of fisheries on a day-to-day basis, but they are forming a background for this development. As a consequence of these developments, much of the region seems primed to make the transition to ecosystem-based management, where alternative assessment methodologies, use of *no-take* marine reserves, and inputs from the human component will be important structural components. This transition is a logical step the stems from the large scale trends reflecting the increase in scales, complexities, and anthropogenic stresses that fisheries management has had to address.

The shift in attitudes and expected role of science in management suggests that scientists need to reassess on a formal basis how science can best serve fisheries management. Fisheries are highly dynamic relative to both the resource and human components, and fisheries management needs to confront the fact that there are limits on the nature, amount, and availability of data that can be collected and analyzed for fisheries purposes and adjust their studies accordingly. One obvious path would be to split studies into those that address real-time needs (*e.g.*, annual assessments of the biological and socio-economic components) with those aimed at providing scientific support for the contextual approach taken by management at a larger scale.

Lastly, scientists need to incorporate outreach as a fundamental component of their responsibilities if science is to remain relevant to the management process. The following quote illustrates the problem:

*“What is more serious is that in drawing up legislation for the control and conservation of these resources, the*



*legislature is dependent upon those engaged in the industry for advice. As a result, the legislations finally enacted may sometimes fail to accomplish its purpose and may even be adverse in effect. This implies not fault on the parts of the legislature or of the industry, but rather a failure on the part of scientists to make the results of their investigations known in a suitable form and in such a way that the material is readily available to those most concerned."*

The development of science advocacy, particularly through NGOs, is a recent development and one made necessary by the twin facts that (1) academic scientists have traditionally lived within a "publish or perish" environment, while (2) state or federal scientists are banned from being advocates at their respective levels. While the above quote is a wake-up call to change the way we do business, the need has been recognized from the beginning. The quote is from Walton Smith (1948) from the inaugural meeting of the GCFI.

#### ACKNOWLEDGEMENTS

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