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Regional fishery management organizations and large marine ecosystems

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ABSTRACT

Regional fisheries management organizations (RFMOs) addressing the management of living marine resources have a long history, beginning in 1811 with the North Pacific Fur Seal Convention followed by the International Pacific Halibut Convention in 1924. Following the expansion of fisheries after WWII RFMOs proliferated and after the general acceptance of a 200 mile extended jurisdiction in the mid-1970s many more nations became involved. There are approximately 17 RFMOs, (depending on the definition of "management") of the over 40 marine Regional Fisheries Bodies(RFBs) identified by FAO. The Large Marine Ecosystem (LME) approach has roots in the experience of the International Commission for the Conservation of Northwest Atlantic Fisheries (now defunct and replaced by the Northwest Atlantic Fisheries Organization (NAFO)) which pioneered ecosystem based fisheries management. The LME approach was fleshed out in the 1980s and initiated as both the Global Environment Facility (GEF) and country projects, beginning in the mid-1990s. LMEs have fisheries as a major component to be addressed under the LME five-module concept. As LME Programs enter the stage where they need to move to develop their governance responsibilities, the relationship with existing RFMOs is critical. This paper examines possibilities for this interaction with special attention to, but not exclusively, the Western coast of Africa. Possible inferences from the US east coast experience are also addressed, considering the Atlantic States Marine Fisheries Commission as a pseudo RFMO with the states assuming a role similar to countries.

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1. Introduction

Large Marine Ecosystems have been designated throughout the world as effective units for assessing, managing recovering and sustaining the resources of the continental shelf and coastal ocean areas (Sherman and Alexander, 1986; Wang, 2004; Hennessey and Sutinen, 2005; McLeod et al., 2005; Duda, 2009; Lubchenco, 2013; Ishii, 2013; Watson-Wright, 2013) (Fig. 1). They have become the "gold standard" for such efforts, and have been adopted by the United Nations for their Transboundary Waters Assessment Program (TWAP) of the status of the ocean as part of their efforts to meet General Assembly instructions. (http://www.unesco.org/new/en/natural-sciences/ioc-oceans/high-level-objectives/ecosystem-health/transboundary-waters-assessment-programme/) (2014). The Global Environment Facility (GEF) adopted LMEs beginning in 1995 with the Gulf of Guinea (GOG LME pilot project,) as the core of their coastal ocean international waters programs. They are supporting projects in 19 of the world's 64 currently designated LMEs (Hume and Duda, 2012). Unlike many development projects, the success of

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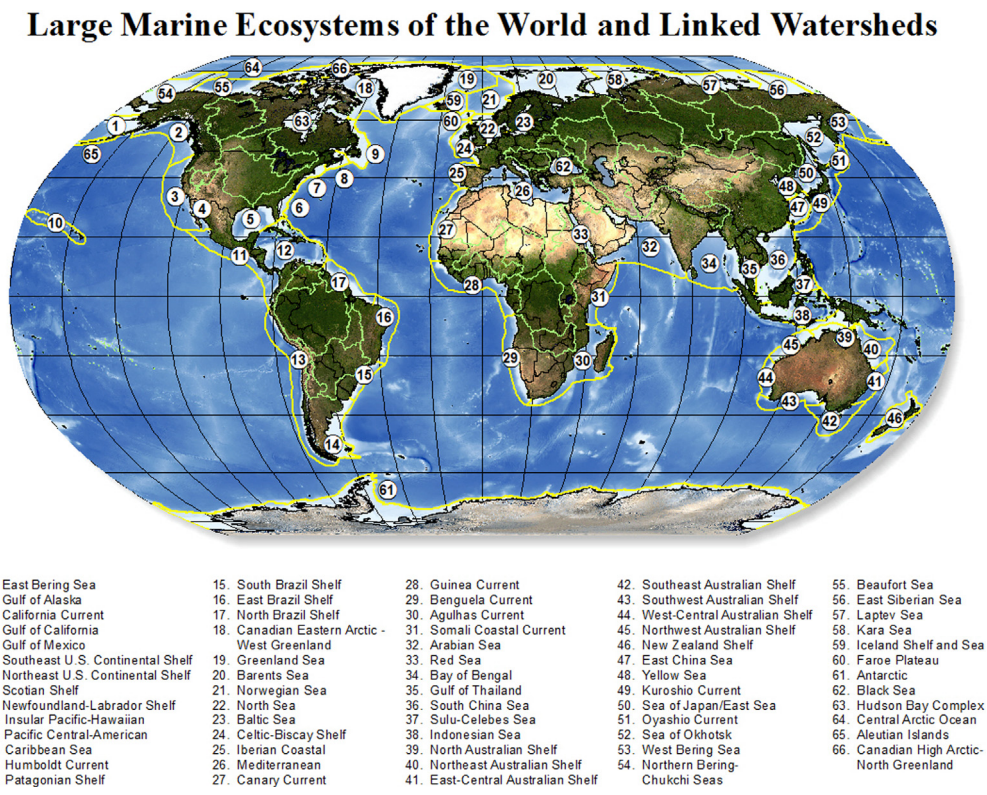

Fig. 1. Large Marine Ecosystems and linked Watersheds.

an LME Project cannot be judged by a final project report on how well the project followed its project plan or even on the scientific results from a successful research cruise. This is because the ultimate goal of LME projects is to have, at the end of the day, a management structure capable of making LME decisions which has an ongoing stream of information from all of the five LME modules -Productivity, Fish and Fisheries, Pollution and Ecosystem Health, Socioeconomics and Governance) (http://lme.edc.uri.edu/, 2014) (2014) upon which to base those decisions.

One of the major driving forces in an LME is its fisheries. The LME approach emphasizes that fisheries be assessed and managed holistically taking into consideration not only the ecosystem approach to fisheries (http://www.fao.org/fishery/topic/16034/en) (2014) but all of the services of the ecosystem. Fisheries has a long history of establishing bodies to address transboundary fisheries issues going back to the first half of the 20th century. Thus, as LMEs move to address fisheries management issues the existing fisheries organizations need to be addressed.

This paper will look the intersection of LME management's future efforts and regional fisheries management organizations. It will focus primarily but not exclusively on West Africa. It will also look at the US experience particularly with the Atlantic States Marine Fisheries Commission (ASMFC) for possible inferences where the ASMFC as a pseudo-RFMO, with the states which are responsible for fisheries management within three miles of shore assuming the role of countries.

2. RFBs and RFMOs

RFMOs have a long history, as the nature of living marine resources drives sound management to transboundary agreements. The first RFMO for a living marine resource was the fur seal convention of in 1911 signed by the US, Great Britain (for Canada) Japan and Russia http://pribilof.noaa.gov/documents/ THE_FUR_SEAL_TREATY_OF_1911.pdfm) (2014). The Governments of Canada, Japan and the Union of Soviet Socialist in 1976 updated it in the CONVENTION ON CONSERVATION OF NORTH PACIFIC FUR SEALS (sedac.ciesin.columbia.edu/entri/texts/acrc/fur.seals) (2014). The second RFMO was the International Pacific Halibut Commission established in 1923 by a convention signed by the US and Great Britain (for Canada)(http://www.iphc.int/) (2014) There were some efforts in the 1930s but they failed to come to complete fruition because of WWII. Post WWII, fisheries commissions began to expand in response to rapidly expanding fisheries. Prior to the extension of coastal jurisdiction these conventions covered what now are both international waters and those now within country jurisdiction. One of them, the International Convention for the Northwest Atlantic Fisheries (ICNAF) for the investigation, protection and conservation of the fisheries, came into being in 1950 (http://www.nafo.int/about/frames/hist-early.html) (2014) and became a laboratory for the early developments of the LME approach.

In the mid-1970s (the United States in 1976) countries rapidly extended their fisheries jurisdictions to 200 miles resulting in most of the continental shelf areas coming under national management (Burke, 1983). This led to further development of RFBs and RFMOs.

FAO lists over forty regional fisheries bodies (RFBs) (http://www.fao.org/fishery/rfb/en) (2014) of which around 17–18 of them are considered regional fisheries management organizations (RFMOs) depending on how one defines management. In any case less than half of the RFBs have any regulatory authority, so do not reach the status of RFMOs. Some could possibly assume such authority in the future. Some are creatures of FAO and these would likely have to change to an independent body before assuming management authority. Nevertheless, such bodies e.g. CECAF, the Fishery Committee for Eastern Central Atlantic which covers three LMEs, in addition to providing an interchange between managers does provide assessments of the stocks and has the potential to look at LME wide assessments. The Canary Current LME project has chosen to use CECAF as its Fisheries Committee for addressing stock assessment issues. The Ministerial Conference on Fisheries Cooperation Among African States Bordering the Atlantic (ATLAFCO; better known by its French acronym, COMHAFAT, has the geographic coverage to address LME management (particularly if South Africa joined). It would be inclusive of three LMEs along the West Coast of Africa—Canary Current LME, Guinea Current LME, and Benguela Current LME—but does not have the management authority. In Southeast Asia there is the Partnerships in the Environmental Management for the Seas of East Asia (PEMSEA) which includes living marine resources but has a broad environmental mandate and is not listed by FAO as an RFB. While countries form the intergovernmental policy body, at the technical level there are partners with many other entities.

With the need for management of coastal transboundary fisheries, various RFMOs have come into being. Some have limited authority and their areas are not always optimal. In addition to coastal RFMOs there are the commissions for management of highly migratory tuna and tuna like fisheries. These species move in and out of LMEs and can be very important in the fisheries within LMEs particularly those of coastal states and they are also in the energy flow relationships within LMEs. LMEs are the logical body to interact with the five large tuna commissions for management for sustainability and particularly for the socio-economic interests of the coastal states.

In 2010, the effectiveness of the world's 18 RFMOs was quantitatively assessed, based on a two-tiered approach, concentrating “first on their performance ‘on paper’ and secondly, in practice”(Cullis-Suzuki and Pauly, 2010). Cullis-Suzuki and Pauly concluded that RFMOs performed poorly for both assessments. They also found no connection between the two sets of scores, indicating that there was disconnect between intentions and actual implementation of effective management. The Global Oceans Commission in Nov. 2013 in a Policy Options Paper reviewed RFMOs in high seas fisheries and concluded that there was a general lack of effectiveness (http://www.globaloceancommission.org/wp-content/uploads/POP-9_Reform-of-Fisheries-Management_FINAL-1.pdf) (2014). There have been a few successes such as Atlantic swordfish management by ICCAT, and these show that there is hope that if the right conditions exist, RFMOs can manage for sustainability. Unfortunately these successes are few and far between. Is it possible that the LME movement might play a significant role in seeing that evaluation changed?

3. The large marine ecosystem movement and fisheries

The genesis of the LME approach has one of its roots in the work of NOAA's Northeast Fisheries Center (and its predecessors) within the International Commission for the Northwest Atlantic Fisheries (ICNAF) which had come into existence in 1950 as an RFMO. By the mid-1960s it had become evident that the single species approach was inadequate in face of large trawlers with high opening nets which fished all of the continental shelf off the coast of Northeastern United States. The Northeast Fisheries Center where both the author and Dr. Kenneth Sherman, the father of the LMEs, were scientists, responded by developing a multipurpose bottom trawl survey that piggy backed other ecosystem sampling (initially ichthyoplankton) in what was then known as ICNAF Sub-Areas 5 and 6, a close match to the Northeast US Continental Shelf LME. The area survey was carried out two to three times a year. Other countries e.g. the USSR, Poland, Federal Republic of Germany and the German Democratic Republic joined in cooperative surveys. By 1977 primary productivity was being monitored under Dr. Sherman's direction. Multispecies analyses were undertaken and several papers published e.g.(Brown et al., 1976; Clark and Brown, 1977) On the management front ICNAF rose to the occasion and established an overall catch limit less than the sum of individual species allowable catch known as the “second tier” quota (Anderson, 1998) This recognized that Maximum Sustainable Yield (MSY) is always a conditional estimate as well as the existence of fishing interactions through the existence of bycatch. When looking at the record of ICNAF and fisheries management it is important to recognize that without extended jurisdiction enforcement and compliance was always a contentious issue. However, the record does show that at one time it was possible for a RFMO to set fishery regulations on an LME basis using an ecosystem approach. Despite the fact that some progress in controlling fishing was being made in ICNAF the political winds were strong in favor of extending national jurisdiction. The importance of fishers seeing visible effective enforcement on everyone was and still is, critical to achieving more effective regulation.

During 1976 the US extended fisheries jurisdiction. Shortly after that ICNAF ended and was replaced by the Northwest Atlantic Fisheries Organization (NAFO) which covered areas outside of the 200 mile jurisdiction. US Jurisdiction encompassed the entire shelf area of the Northeast US Continental Shelf LME except for a small piece assigned to Canada. A Regional Fishery Management Council system was established to address management in this LME. While the U.S. continued

to monitor the area on an ecosystem basis management, the analyses directly necessary for Council management focused initially on single species and removing foreign effort. The latter goal was achieved and efforts focused on trying to rebuild stocks, a goal which has been partially successful in this LME.

The Swedish Agency for Marine and Freshwater Management, in 2012 produced a survey review entitled Large Marine Ecosystems: Study of the Concept of Large Marine Ecosystems and its Institutional Relevance for Ecosystem-based Management and Development (Anna Tengberg & Arne Andreasson, 2012, unpublished document available at http://iwlearn.net/publications/ll/study-of-the-concept-of-large-marine-ecosystems-and-its-institutional-relevance-for-ecosystem-based-management-and-development)(2014) to provide guidance for the Swedish International Development Agency (SIDA). Their methodology was a questionnaire and did not involve on the ground efforts. Tengberg and Andreasson looked at the relationships between LME projects and the regional based organizations (RBOs), the Regional Economic Communities and Regional Seas Programs (RSPs). Their final recommendation was: "Further efforts are needed to strengthen coordination and collaboration among LME programmes, RSPs, RFBs and other regional bodies with a mandate in coastal and marine management, to improve communication and information flows, harmonization of approaches and interventions, and donor coordination. Before establishing institutions for joint ecosystem-based management to implement agreed LME SAPs, such as new LME Commission, an institutional assessment should be conducted that examines different options in terms of opportunities for embedding the LME approach into existing regional institutional and policy frameworks of e.g. regional economic communities."

In East Asia, PEMSEA includes six LMEs including the Yellow Sea LME. They are looking towards ways to help strengthen LME governance according to Chua Thia-Eng, their Regional Program Director (http://www.un.org/depts/los/consultative_process/documents/7abstract_chua.pdf, 2014). Tengberg and Andreasson op. cit., state the "the Yellow Sea LME is planning to capitalize on the policy and institutional framework established by PEMSEA, to establish a Commission for the YSLME based on a legally nonbinding agreement." In South Asia, the Bay of Bengal LME Project (BOBLME) has been active in developing fisheries management plans and working with a Regional Fisheries Management Advisory Committee (RFMAC) to "interpret the information and deliver ecosystem based fisheries management advice"(http://www.boblme.org/eventDocs/03%20%20Prospectus%20and%20draft%20agenda%20BOBLME%20Regional%20Fisheries%20Management%20Advisory%20Committee%20Meeting.pdf). For the East Asian Seas, Tengberg and Andreasson (op cit.) specifically recommended the strengthening of coordination and collaboration between the LMEs and the plethora of organizations addressing components of the Large Marine Ecosystems.

Tengberg and Andreasson also looked at the West Coast of Africa with its three LMEs (Fig. 2). They noted the close relationship of the CCLME to the Sub-Regional Fisheries Commission (CSRP) as a positive. The GCLME was noted for its tenacity in supporting an Interim Guinea Current Commission (IGCC) and its cooperative efforts with regional RFBs including developing MOUs with them. The Benguela Current Commission stands out as a singular achievement. It is now working on transboundary fishery management plans and its formal relationships with related entities were noted.

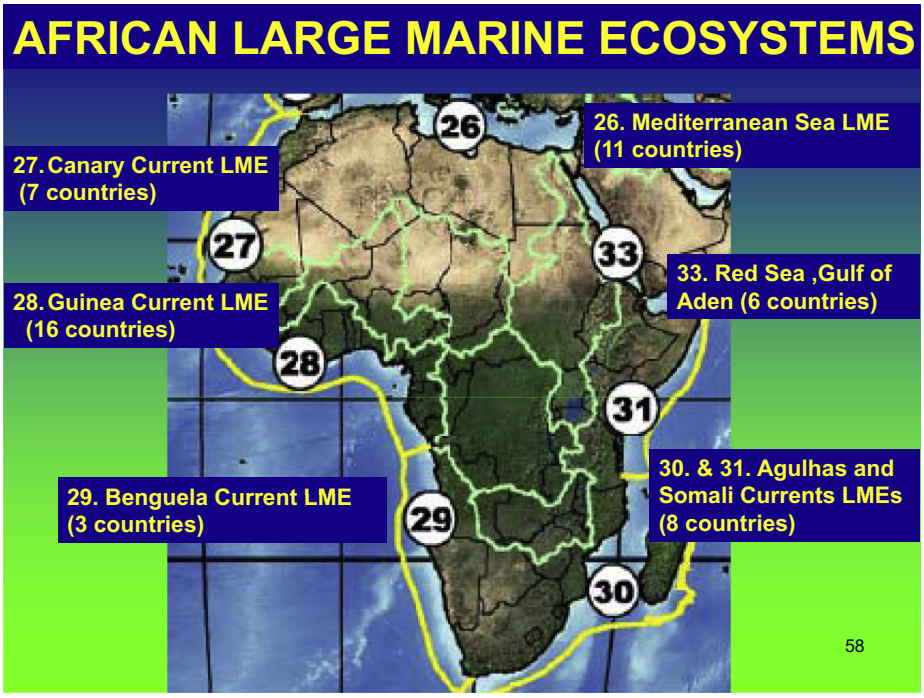

Fig. 2. African Large Marine Ecosystms.

Although not mentioned in the Swedish document, the BCC has a strong working relationship with the adjacent offshore Regional Fisheries Management Organization (RFMO), the Southeast Atlantic Fisheries Organization (SEAFO) with which it is co-located.

On the Indian Ocean side of Africa the Agulhas Current and Somali Current LMEs ran into considerable political concern about establishing an LME Commission, as there were a number of bodies addressing various components already in existence. "A Western Indian Ocean Alliance of Partners for Implementation of a Strategic Action Programme for LME Management" is proposed in their Strategic Action Plan and has the potential for future growth into a body whose actions will result in management (http://www.asclme.org/SAP/Final%20SAP%20English%20131007.pdf.2014)

Fisheries are extremely important components of an LME's goods and services and if the LME effort is to be successful they must be managed on the basis of sustainability. Thus there is peril in ignoring RFBs. Strong support of Fisheries Ministries is critical to the success of the LME effort. This is a result of the importance of fisheries for food security, livelihoods and foreign exchange which results in fisheries also being a strong political issue. Thus Fisheries Ministers are often a stronger force than Environmental Ministers throughout the world and their coordination, not competition, is needed for the LME approach. Fisheries Ministers are invested in RFBs and they have potential to become RFMOs. Thus they are a force to be reckoned with in achieving the goal of ecosystem based management of LMEs.

4. The Guinea Current Large Marine Ecosystem (GCLME)

Having painted with a broad brush the LME governance status, it is worth examining in more detail the situation facing the GCLME. There are a number of RFBs and RFMOs that impinge on the LME. They are ICCAT, SEAFO, CSRP, COMAFAT, CEACAF, Fishery Committee for the West Central Gulf of Guinea (FCWC) and Regional Fisheries Committee for the Gulf of Guinea (COREP). Only the first two are RFMOs. There are also Regional Economic Bodies (REBs) that have fisheries involvement beginning with the African Union (AU) with its New Partnership for African Development (NEPAD). On the regional level there are the West African Economic and Monetary Union (UMOEA), the Economic Community of West African States (ECOWAS) and the Economic Community of Central African States (ECCAS) all of which have a fisheries concern. ECOWAS even has established a Coastal and Marine Resources Monitoring Center at the University of Ghana, Legon (http://www.ug.edu.gh/news/ecowas-coastal-and-marine-resources-management-centre-commissioned, 2014). In 2012 NEPAD held a "Think Tank Event" with FAO to address the issue of coordination between RFBs and REBs. ("REPORT OF THE THINK TANK EVENT held from 18th to19th September 2012, at the South African Breweries Conference Centre, Newtown, Johannesburg, South Africa" edited by Jonathan Ocran, (DREA) and Sloans Chimatiro,(NPCA), NEPAD Unpublished document 21 p.). This was an important step in moving towards implementation of fisheries management. It is disappointing to note that in the report there was no reference to the LME projects. However, earlier in the history of LMEs there were strong linkages between both the Gulf of Guinea (GOG) pilot LME project and the GCLME with REBs. Undoubtedly, the number of times the entire effort was in hiatus is a significant part of the reason for this disconnect and renewed efforts on the part of the Interim Guinea Current Commission (IGCC) when it begins its next phase of the GCLME project should be able to bring this situation back to where it was quickly and then move forward. On the positive side, the MOUs signed between the IGCC and the RFBs are a strong sign of the desire on the part of the GCLME region to move forward. The question to be addressed is whether or not there are other areas that have faced not too different problems and succeeded in getting their fisheries under control and turning them around. I would suggest there are two areas where this has been done. The first is the Baltic Sea LME (Thulin, 2009) (European Commission Press Release (http://europa.eu/rapid/ press-release_IP-13, 2014)-787_en.htm?locale=en, 2014), and the second is the United States (Statement of Dr. Steve Murawski, 2011, (http://www.newsmax.com/US/EndofOverfishing -2011/ 01/08/id/382234/, 2014). While I encourage someone intimately involved in the Baltic Sea efforts to write up involvement in fisheries management of the LME effort, this paper will focus on the US case and its relevance for other areas, particularly West and Central Africa.

It is recognized that no "cookie cutter" solutions exist for developing LME governance structures, but there is value in examining other areas for lessons learned. Those looking at transboundary issues often do not look at the United States because much of its fisheries management does not involve other countries. However, the fact that the states are legally such strong entities with regard to fisheries makes the US relevant even though management is within US boundaries. The state tradition is strongest on the East Coast as they are the original states and it took a bloody Civil War for the language to change from the United States are to the United States is. The coast of West Africa and the East Coast of the United States have a number of obvious dissimilarities as well as similarities and one might be pessimistic about progress in Africa. However things have been changing in Africa, the degree of cooperation between countries is much greater than it was 30 years ago, Even the forms of government are not as different from each other. The effects of colonialism with its different varieties are still with us but their strength is less. The economic growth rates are significant (http://www.mckinsey.com/insights/africa/lions_on_the_move) (2015). Former President of South Africa Thabo Mbecki's call for an African Renaissance resonates (www.dfa.gov.za/docs/speeches/1998/mbek0813.htm) (2015) and in Senegal, President Abdoulaye Wade build a monument to the African, not Senegalese Renaissance, (http://daghettotymz.com/current/armvssol/armvssol.html) (2015) Africa may still be a long distance from the united Africa vision of the first President of Ghana Kwame Nkrumah (http://newafricanmagazine.com/we-must-unite-now-or-perish) (2015) but it is also an even longer distance from where it was when he stated his vision. The COMESA-EAC-SADC Tripartite FTA comprising of 26 countries coming to fruition in 2015 will be the largest economic bloc on the continent and the launching pad for the establishment of the Continental Free Trade Are

Fig. 3. States of the U.S. East Coast (http://www.greenway.org/pdf/map_mefl.pdf, 2014).

(CFTA) in 2017 (http://www.comesaria.org,June, 2015) is proof of that. It will be up to African marine experts to develop the appropriate governance for their LMEs drawing on insights gained from examining other areas and the US case should be an important one to examine.

5. The United States' experience

At first glance the United States would not seem to have much to offer in lessons learned to a trans-national boundaries situation. However the United States was formed by a union of separate colonies of varying sizes, shapes and resources and

the union only succeeded through making many compromises. One of them was that the Constitution of the United States reserved all powers not specified for the Federal Government to the states. That is why it is so difficult for much of the world to comprehend the US electoral process where there is no national election only an oddly weighted sum of results from individual states. The fisheries in the waters off each state are constitutionally the responsibility of the States out to territorial limits. Thus, on the East Coast of the US, the states control waters out to three miles and the Federal Government from 3 to 200 miles (and also the responsibility for representing US interests in international waters), so that LME fisheries management within the US has to face many of the issues that international LME management is required to address. Fig. 3 shows the US east coast with its 16 states varying in size and coastline much as the countries on the west coast of Africa. The Northeast US Continental Shelf Large Marine Ecosystem provides an example of such multijurisdictional management within an LME framework. This is described not as a model to copy but as indicative of the complexities needed to address LME management in the US to achieve the holistic ecosystem approach and the importance of having the LME boundaries in place.

As off Africa, coastal migrant species are very important off the US east coast and states realized early that they could not be effective alone. To address this issue the states in 1942 formed an interstate compact, the Atlantic States Marine Fisheries Commission,(http://www.asmfc.org/about-us/program-overview, 2014). “The purpose of this compact is to promote the better utilization of the fisheries, marine, shell and anadromous, of the Atlantic seaboard by the development of a joint program for the promotion and protection of such fisheries” (http://delcode.delaware.gov/title7/c015/index.shtml, 2014). It is important to note that this language did not deal directly with management, similar to the goals of many existing RFBs which focus on harmonization. It was not until the mid-1980s over 40 years after its founding and almost 10 years after extended jurisdiction that the ASMFC become heavily involved in fisheries management. This was not an easy task. The states had different socio-economic conditions in their fisheries; some had large commercial boats while others have primarily small boat recreational fisheries. Some had large well-staffed, fisheries departments while others had minimal capacity. One impact of establishing management plans has been the increase in technical capacity in all of the states. There are now 24 management plans. The goals are adopted to manage for sustainability of the resource and each state issues its own regulations which, when summed together, achieve the biological targets while allowing for different socioeconomic choices by the different states. The Commission supports ecosystem based management and in its goals document states: The Commission remains committed to seeking ecological sustainability over the long-term through continuing its work on multispecies assessment modeling and the development of ecosystem-based reference points in its fisheries (http://www.asmfc.org, 2014). The east coast of the US consists of two LMEs the US Northeast Continental Shelf and the US Southeast Continental shelf. The dividing line is at the northern third of the state of North Carolina. Thus like COHAFAT or CEACAF the ASFMC covers more than one LME. Most of the management plans fall within one or the other LME but some, particularly seasonal migrants cross LME borders. The inclusion of all the states in ASFMC facilitates addressing those issues.

With the Fisheries Conservation and Management Act in 1976 the US Congress established Fisheries Management Councils to manage fisheries in the waters between 3 and 200 miles (http://www.nmfs. noaa.gov/msa2005/) (2014). Three were established for the US Atlantic East Coast. Two of these cover the Northeast Continental Shelf LME dividing it into two subunits. The two councils coordinate very closely to ensure that there is a holistic LME consideration. The third covers the Southeast US Continental Shelf LME. One state belongs to both LMEs and thus sits on two councils. Again the management of the two is very closely linked in order to maintain a holistic approach. For stocks primarily taken inshore, the Councils establish complementary management to re-enforce the state plans. The composition of the Management Councils is designed to ensure that the plans are developed with consideration of the states. The chief Regional Federal Fisheries Official is a voting member, as are the Chief Fisheries Officers of each state. The Council's remaining voting members are appointed by the Federal Government from persons nominated by State Governors from the community of stakeholders. The language of all of the operational bases for both the Councils and the Commission pushes for the ecosystem approach to fisheries within a large marine ecosystem context. Community based fisheries management has been advocated by many because of the realization that without local community support management is not effective. However all too often the movement of fish and fishing fleets can negate the benefits desired by local communities. To address this, the management plans developed by the Fisheries Management Councils are capable of, and in a number of cases do, assign specific components of a management plan to be developed and managed by a community of fishers. They are able to do this successfully because the overall plan protects them from being negatively impacted by other components of the same fisheries. The Councils are also involved in the development of the US positions at the International Commission for Conservation of Atlantic Tunas so that impacts of those decisions can be considered from the standpoint of their impact on the LME.

Recently with the establishment of a US National Ocean's Policy (http://www.boem.gov/National-Ocean-Policy/, 2014) under the administration of President Obama, Regional Ocean Councils are in place on the East Coast (http://www.cmsp.noaa.gov/activities/index.html) (2014), aimed at protecting shared coastal waters and ocean resources, and addressing regional issues of concern to the coastal and ocean waters of the Northeast Shelf LME. The Councils seek to develop an ecosystem-based management approach to face present and future threats to the ocean and coastal areas. These provide the ability to address larger issues such as siting of wind farms within the contest of ecosystem management.

The success in the US in turning overfishing around has already been noted. Although the overall management has focused on an LME approach and assured that the entire resources were addressed at an LME level the path has not been smooth. Restrictive regulations have met with controversy and political struggles. The intensity of the efforts has resulted in establish a large number of single species assessments and regulations designed to achieve species targets that end overfishing. (http://

www.digplanet.com/wiki/Magnuson%E2%80%93Stevens_Fishery_Conservation_and_Management_Act, 2014). This, to the author, looks similar to the situation in the mid-1970s when the difficulties of pursuing this path resulted in ICNAF moving to a two tier system with an overall quota. The US National Academy of Sciences conducted a review of this situation, "Evaluating the Effectiveness of Fish Stock Rebuilding Plans in the United States" (NRC, 2014). The Committee concluded that the sum of the efforts had achieved as NOAA had stated, the stopping of overfishing and the rebuilding of the stock. However when they examined the individual stock assessments and the management by biomass recovery targets, they added the following:

"The committee attributes some of the variable or mixed performance of rebuilding plans to uncertainties inherent in specifying a rebuilding threshold and in assessing stock status relative to that threshold. Estimates of both the threshold and stock status are influenced by statistical variation associated with sampling and uncertainty inherent in modeling fish populations as well as the natural variation associated with the dynamic nature of ecosystems. As a result, estimates of stock size and productivity may change dramatically between successive assessments, leading to changes in stock metrics and the biological reference points to which they are compared. Given these uncertainties, the current policy dependence on biomass thresholds often triggers abrupt changes, or discontinuities, in management. Although scientific uncertainty contributes to the variable results of rebuilding plans, this should not be interpreted as a criticism of the science. Rather, mixed performance of rebuilding plans often reflects a mismatch between policy makers' expectations for scientific precision and the inherent limits of science because of data limitations and the complex dynamics of ecosystems." They further suggested that targets of fishing mortalities might be more robust and less subject to swings than biomass targets. This is reminiscent of the numerous discussions held among assessment scientists from ICNAF counties and from FAO in the late 1960s and early 1970s. At that time many scientists felt that fishing rate (F) targets would be more efficacious. There was also support for using effort control measures as opposed to quotas both in terms of estimation and enforcement. However effort measures lost out to quotas because of equity concerns raised by countries who felt that if a measure such as days fishing were used, some fleets would be able to increase their efficiencies while others could not, resulting in a shift in proportions of the catch whereas with a quota the allocations to countries' shares would not be subject to shifts because of country actions.

6. Implications from the US east coast experience for LMEs

The most obvious conclusions from an examination of the US experience are that it takes time, it can work even when the process is "messy" and it is not without its controversies. The major element that allows for success is the commitment of all parties to consider the LME areas as a basis for holistic action and to strive for an ecosystem approach, to move closer and closer to real ecosystem based management in a coordinated manner with others addressing the same LME (with a lesser, but still very important link to neighboring LMEs and the offshore areas.) RFBs will most likely to continue to have support but to be effective will not only need increased authority to be become RFMOs but will need to become proponents of looking at the LME (s) as the unit within which management must be harmonized and thus the need to coordinate with others. The success of the Interim Guinea Current Commission (IGCC) in obtaining MOUs with RFBs is a very positive step. In the LME approach, fisheries take place within a larger socioeconomic context thus the involvement of REBs and the support for LME management is critical. The LME projects have all recognized that they need country buy-in to the LME approach but it is just as important that there be buy-in by the RMOs and REOs particularly if there is to be any success with fisheries, which by their nature are essentially transboundary issues. The success of the IGCC in obtaining MOUs with RFBs is a very positive step.

Monitoring, control and surveillance (MCS) is a critical part of fisheries management (http://www.fao.org/fishery/topic/3021/en). This in the US case has been true not only for the success of individual regulations but in creating a climate where fisheries management restrictions are more acceptable (although the specific form can be very controversial) then they were before extended jurisdiction. MCS must be LME wide to be effective and it is difficult to get acceptance in one area when resources are subject to harvest in adjacent areas of the LME. RFBs and REBs are critical to this effort.

The LME entity as an advocate can be the catalyst for action on ecosystem based management and the "glue" that pulls all this together. It could also be the place where strategic issues are dealt with such as fisheries and climate change, fisheries and ocean zoning etc., while the countries and RFPs are absorbed with tactical issues such as yearly adjustments in allocations to fishers. Without that "glue" it is unlikely the management will be any more successful than in the earlier years of management on the US East Coast. With that "glue" and everyone pulling in the direction of ecosystem based management within the LME, success is possible, as the success in the very complex and multijurisdictional process in the US has shown, in being able to address overfishing.

More detailed examination of the US. East Coast efforts would be useful for the evolving LMEs to help avoid pitfalls that have hampered the US progress, as the National Academy of Sciences report (op cit.) describes.

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