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SUSTAINABLE FISHERIES MANAGEMENT PROJECT (SFMP)

Evaluation Of Fisheries Stock Assessment And Management Of Small Pelagics In Ghana Stock Assessment Peer Review

JUNE 2016

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ACRONYMS

ABNJ	Areas Beyond National Jurisdiction
AIMS	African Institute of Mathematics
CECAF	Fishery Committee for the Eastern Central Atlantic
GEF	Global Environmental Facility
ICCAT	International Commission for Atlantic Tuna
MESA	Monitoring for Environment and Security
MoFAD	Ministry of Fisheries and Aquaculture Development of Ghana
NOAA	National Oceanic & Atmospheric Administration
NPFMC	North Pacific Fishery Management Council
NSF	US National Science Foundation
SFMP	Sustainable Fisheries Management Project
STWG	Scientific and Technical Working group
UN FAO	United Nations Food Agronomic Organization
URI- GSO	University of Rhode Island Graduate School of Oceanography
URI-CRC	Coastal Resources Center of the University of Rhode Island
USAID	United States Agency for International Development

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INTRODUCTION

The Sustainable Fisheries Management Project (SFMP) is funded by the United States Agency for International Development (USAID) and implemented by the Coastal Resources Center of the University of Rhode Island (URI-CRC). The project was setup in 2014 to support the Ministry of Fisheries and Aquaculture Development of Ghana (MoFAD) to implement its national fisheries management plan (2015-2019). The project's specific goal is to assist the MoFAD and other fisheries stakeholders to end overfishing and begin the rebuilding process of the depleted small pelagic stocks. The reviewers participated in the Scientific and Technical Working Group for which there is a separate document based on notes taken during the meeting. We also broadly looked at areas related to fisheries management in Ghana and this report presents our observations.

Figure 1 Participants at the fish stock assessment peer review workshop

SCIENTIFIC AND TECHNICAL WORKING GROUP

The meeting of the Scientific and Technical Working group (STWG) focusing on the management of the small pelagic fisheries in Ghana was well run and participation excellent. The composition of the body wisely included both scientific and technical expertise from multiple sources including government and universities.as well as independent observers. Most critically it included representation from the fishing community, both fishers and processers. That latter were particularly important in areas such as what was happening in the fishery since the last available official data and in in discussing impacts of various management options on the communities as well as candid discussions of fishing practices useful in understanding the data from the fishery.

The use of bodies like the Scientific and Technical Working Group has become a gold standard in fisheries management structures. It has been the experience in the United States where we have worked, that such procedures are extremely valuable. Having the assessment and the data used in that assessment, reviewed by an independent body which of course needs government representation on it as well as having persons who did any analysis present them, brings fresh eyes and insights that can improve the analysis. Representatives of the fisheries industry provide information from their observations that the analysts need to be able to explain the meaning of in their analyses. When the question turns to management measures the involvement is particularly critical. This is true both for the evaluations of their effects and impacts for the same reason as reviewing the stock assessment. However it is extremely critical to understand both the impacts on the industry and the acceptance by the

industry. The review gives the status of the stock and possible management options additional creditability with decision makers.

Despite the outstanding job done by the STWG; there are some areas of concern. Such working groups need to work by consensus in order to have real impact. This requires that very nearly the full body be present at the meetings. Several key persons were unable to attend this meeting. Given workloads and the number of efforts each person is involved with this is understandable. However everyone needs to have near perfect attendance as a consensus recommendation can fall apart if a member who was not there strongly objects. Alternates might be considered as one option to address this particularly for sector representatives.

The presence of only one person from the fishers and one from the processors places a large burden on them to speak for such a large group. It also may result in them being targets of criticism from their peers when management recommendations are made. We would suggest trying to get two persons from each of these sectors.

We commend the group for including students as participants. All too often students learn about the science underlying the marine environment and about the response of fish populations to fishing and effective management measures from the standpoint of the fish populations but have little understanding of the milieu within which fisheries science and management operates and what better education could there be than participating in such a body as the STWG, In addition their comments and questions can bring fresh insights possibly not available without them.

Obviously if there is to be permanency this group needs to evolve as an advisor to the Fisheries Commission and be appointed through a process established by them. However in the present state, it might be helpful for a brief written report of every meeting including recommendations, if any, be submitted to the Fisheries Commission.

Permanency does not come without costs. The meetings have to be funded and expenses paid. Members will need training to enable them to address the assessments. Staff will need to work with the group to ensure effective functioning. The SFMP will need to work to see that funding is available for such a committee past the end of the project. Over time we would expect that the value of such groups would be shown and governmental funds found to support them. This however can be expected to take some time and thus require support for a significant period time after the project concludes.

CONDITION OF THE STOCK

African regional scientists (UN FAO/CECAF-2012) have long raised their concerns about the overfishing of the sardinella stocks in this area. The assessment presented at the workshop supports their conclusions. Just looking at interviews with fishers and processors indicate their observations are that the stocks are down. Although the catch statistics for 2015 are not yet available, comments during the meeting indicated that 2015 was poor year for the fishery. A visit to a fishing beach found that the fish being smoked were imported in frozen blocks from Japan and South Korea.

The review of small pelagics presented in a previous section clearly indicates that these resources are subject to collapse. While the environment may be responsible for a decline in recruitment of young fish, the presence of heavy fishing accelerates the decline and drives stocks to collapsed levels that can take a long time to recover. The standard fishing guidelines are to fish small pelagics at low fishing mortality when abundance is high to maintain abundance as long as possible while stopping fishing entirely when stocks reach a

collapsed state. It is hoped that the current condition of the stocks is large enough to allow some recovery if fishing is reduced. If fishing is increased experience around the world with small pelagics, would lead one to expect a collapse sooner or later, This, is not new for as mentioned earlier this has been the advice of scientists in this region for some time. (UN FAO/CECAF-2012)

The strong reliance on the environment for the strength of year classes is discussed in a previous section as well as the implication from climate change to result in poorer conditions for sardinella production and their occurring in concentrations that provide for large catches. The prudent policy against worsening environmental conditions is to keep the stocks as large as possible.

The initial report of the results of the Nansen survey cruise is supportive of the conclusion of low sardinella stock status. The estimates of sardinella were very low even though it is not a time of concentration for spawning during the major upwelling season and some of the population maybe outside of the survey area. The delay in the start-up of the next phase in the Gulf of Guinea Large Marine Ecosystem Project precluded a repeat of the 2007 regional Nansen Survey which might have answered this question. The abundance of anchovy is instructive, as in other areas the anchovy stock has expanded when the clupeid stocks are very low. However the anchovy stocks typically do not reach the same high volume as the clupeids.

MANAGEMENT

Ghana is to be recognized and commended for developing an overall Fisheries Management Plan. This plan realizes the need to reduce excessive fishing pressure and to manage stocks within biological limits. It commits to ensuring effective legislation, participatory decision making and meeting regional and international obligations. It is a model plan.

SFMP focuses on the most difficult challenge facing fisheries management in Ghana, the small pelagic fishery. The program is to be commended for its efforts with the fishing community to gain support for management action, for conducting an assessment after putting the data together and for developing a scientific and technical working group STWG with both scientists and industry and producing solid management recommendations. The difficulty in developing effective management in a fishery with so many participants dependent on it for their livelihood is extremely challenging.

Fisheries management is managing people. The stock would benefit from reduction in fishing mortality no matter how accomplished. The question is what management of people would be most likely to be accepted and adhered to. Management is never easy and the history of the United States which is now being looked at as a success story was achieved only after decades of effort with numerous stocks being fished to very low levels during the process of developing effective management. Five years is a very short time in the world of fisheries management. Therefore while every step needs to be taken to try to get significant management in place it is important that the building blocks for management be established so that through adaptive management the goal of avoiding a collapse and establishing sustainable management of these fluctuating stocks may be attained by a process that will outlive the project. An example of one such building block being established is the registration of all the canoes. Without solid support even the best management plans will likely fail and not be continued.

The input from SFMP‘s work with the fishing communities indicated that the of efforts for new regulations for reducing fishing, the most acceptable were closed seasons and closed areas. Of the two, it is likely more difficult to obtain effective reductions in fishing mortality

for pelagics by closed areas as the fish move and the areas need to be sufficiently large to have an impact. The issue of fairness is involved also because those living near a closed area are impacted more than those further away.

The closed season has the element of equal sharing of the costs of the closure. It is easier to enforce than closed areas which can result in such intense fishing on fish entering and leaving that it negates the positive impact of reducing fishing pressure inside the area.

The length of time needed to be closed depends on the reduction of fishing mortality achieved. Thus in seasons when fish are concentrated the closure will be shorter than if it were in a time when the fish were more scattered, to achieve the same benefit. A closure during spawning aggregations has an additional benefit of preventing any disruption of spawning and allowing a higher proportion of the females to spawn i.e. if a fish is not caught in the spawning season it is more likely to survive predation and spawn than a female not caught, say six months before spawning.

The discussion of the length of the closure was between one and three months with the former being the choice because of its lesser immediate negative impact on fishers. There is not the detail data available to effectively calculate response under the different lengths of closure. However it must be kept in mind that if the reduction in fishing mortality is too low there is small likelihood of recovery and the sacrifices would have been in vain. The answer is in adaptive management. In adaptive management the best prediction possible is made of what is expected in response to management. Monitoring is done and if the managing is not achieving its goals than it needs to be adjusted in a timely manner.

The committee recommended that in addition to the closure that the current regulations such as mesh size and use of explosives et al be enforced. It may take a combination of several measures to accomplish needed reductions in fishing mortality. What is needed is to develop a management plan with a number of measures and a schedule for monitoring. Some actions that on their own would not suffice might be useful in concert with others for example, establishing a marine protected area in an estuary to stop beach seining there from taking very young fish. Alone it would not be enough but as part of a package it could be helpful. The ultimate goal should be a management plan for the area with the interactions between fisheries taken into account.

Listening to the report of the recent Nansen survey could lead listeners to conclude groundfish stocks might even be higher than 2007, that there is an abundance of anchovy and a large number of carangids waiting to be caught. Pressure to not stop fishing can be expected. We would urge examination of a closed spawning area during peak spawning be examined to have ready if objections to a total seasonal closure proved insurmountable. This would need to have a buffer zone to reduce boundary fishing. It is also critical to have a sound enforcement plan. The project's work with fishing communities can hopefully gain enough local support for management so community pressure can play a role in keeping the area unfished. Cooperative work with fishermen could help define the area and the start and finish of closure on a real time basis. This could be combined with satellite oceanography to determine the usefulness of that tool to set a closed spawning season in real time. The ECOWAS Coastal and Marine Resources Management Center at the University of Ghana Legon, directed by Dr. George Wiafe has the capability to address this issue through its MESA (Monitoring for Environment and Security) Project.

Objections to management can be strong enough to stop it from happening. Every effort possible should be used to anticipate objections and look for facts to counter then. For example the Project will look at the genetics of stock determinations. If this is pursued with a

purely basic science perspective the question of whether or not other fisheries will catch the fish that Ghana fishers sacrificed to save will take significant time to answer. The other big fisheries are in Angola and in Senegal to Morocco. Thus we urge the initial work be to determine the differences between fish in the three peak areas and latter look at the complexity of fish along the west coast of Africa as at the present time only in those areas is fishing harvest large enough to impact the prevention of collapse and the likelihood of recovery should the sardinella recovering off Ghana reach those fisheries. Environment is always held up as a reason not to manage arguing that the environmental conditions drove the stock to low levels and when the environment is favorable the stocks will rebound. We suggest that the information on the current trends in environment such as possible decreases in productivity and the impacts of continuing climate change be examined and would expect that the conclusion would be that it is getting poorer. The larger the stock size is when environment turns poorer the greater the likelihood that the stocks are able to withstand these changes. This information needs to be combined with the advice to keep stocks as high as possible when the environment is favorable.

In addition to exploring and preparing responses for expected objections there is also the rule of unexpected consequences. Considerable thought needs to be paid to addressing these possibilities. If 13,000 canoes cannot fish what do they do? If the closure is complete do they migrate? If so would the numbers be so much more than usual that they would cause social problems? Would the increased effort be harmful to other resources? If the closure is only on part of the Ghanaian shelf these questions still are valid but they also apply to in country areas. What would happen to the trawlers? The original proposal would have them stop fishing everywhere as well but what if this does not happen? Can their bycatch be reduced? If there is less than a full area closure would there be increased conflict within the canoe fleet? Unintended consequences are common in fisheries management. A classic was the initial quotas in the US surf clam fishery which resulted in greater risk to life as fishers went out in worst weather than they did before management.

The information needed to classify a stock as overfished and risking collapse does need to extremely precise to be obvious. But while a stock is recovering and still having some fishing the issue of adequate information for monitoring and adaptive management is crucial. The relationships between effort and catch and abundance used to follow stocks, change with the implementation of management. It is critical to develop a monitoring plan that can account for such changes. The details about the fishing behavior and catch need precise tracking to develop new indices. The fundamental design of catch sampling in Ghana is good but it will need grater supervision to ensure the details are collected in a way to allow the stock to be followed under management conditions. Obviously a research vessel is a high priority. When Ghana had a research vessel, its monitoring and research on fisheries stocks was outstanding. Cooperative research with fishers should also be explored. Such research now only increases the information available but builds cooperative relationships that can help support management.

Although this project is a national one not regional, eventually to be successful regional efforts will be required. A classic example was given in the report of the Nansen cruise which caught very few Sardinella but that fact was dismissed in the reporting as it was said the bulk of the populations could have been in areas outside of the boundaries of a survey limited to the Ghana shelf. A seasonal closure that did not cover the range of the stocks creates a sense of unfairness if fishing continued on the fish just across a country boundary, Just because historically 80 percent of the catch is within Ghana does not mean that will always be the case. So while given the current low level of the stock and the present center of the fishery, management limited to Ghanaian waters would be expected to be adequate to

prevent a collapse and maintain a significant fishery, looking to future requires encouraging regional bodies to take the first steps towards research, monitoring and management on an entire stock basis.

CLIMATE AND ECOSYSTEM CONSIDERATIONS

The preliminary results from environmental data analysis presented at the workshop (sea surface temperature (SST) trends, upwelling relative index and zooplankton productivity) shows that environmental conditions in the waters of Ghana are changing. SST along the coast has increased with inter-annual variability, and upwelling intensity of the major and minor upwelling is decreasing. The variability in sea surface temperatures as well as changes in the strength and duration of coastal upwelling are weakening major production of phytoplankton and zooplankton (MESA program, Bio. Bull., 2016) and affecting the recruitment of pelagic fish stocks. These changes in the environment are consistent with numerous observations in all ocean basins. Global-scale changes including large-scale distribution shifts of species and altered ecosystem composition on multi-decadal time scales are tracking climate trends. The distribution and abundance of many fishes and invertebrates have shifted poleward and/or to deeper, cooler waters (Weatherdon et al. 2015).

For example, in the Northeast U.S. region, multiple studies conducted by NOAA scientists and elsewhere have found that many species of fish are shifting their distribution as the climate changes. They are moving North and East. They are also changing their migration schedules as the timing of fall and spring changes (Nye et al. 2009, Pinsky, 2013). However, each species responds somewhat differently to climate changes. So as temperatures change, some species move out while others move in. Some are moving fast and some are moving more slowly. These changes are creating a number of challenges both for fishermen and for managers in U.S.

Many recreational and state-water commercial fisheries are managed spatially. In the case of black sea bass, just to name one, the total catch is divided among the states, with some states allocated more catch and some states allocated less. These allocations, however, are based on where the fish were in the late 80's and early 90's. But since then, the fish have moved north, and now New England fishermen are catching black sea bass in the Gulf of Maine. Those fishermen bump up against their catch limits very quickly, while fishermen from the Mid-Atlantic have to work much harder to catch their limit. That mismatch between the regulations and the distribution of the stock creates a lot of inefficiencies in the fishery.

However, when it comes to small pelagic fish or so called "forage" fish, careful examination of traditional assumptions is needed. Fishery managers should manage these species differently than other commercial fish species and be precautionary about setting management measures or limits for these species (e.g. Overholtz et al. 2008; Moustahfid et al. 2009 a,b; Essignton *et al*. 2015).

Forage fish such as Sardinellas in the upwelling region of the Gulf of Guinea that extends from the coast of Cote d'Ivoire to Benin play an important role. They form an essential link between primary and secondary producers (e.g., phytoplankton and zooplankton) and top predators (e.g., large fishes such as tunas and billfishes).

They're the base of the food web, and are extremely important. When they start to disappear, then simple logic the Tuna and other large pelagic fish will move away from Ghana to other feeding grounds. In other words, without the strong presence of forage fish in Ghana and in Gulf of Guinea in general, the entire food chain is weakened. On the other hand, when forage fish populations are strong and vibrant, the same food chain can better withstand pressure from factors like climate change.

These are the critical forage species that provide the basis and foundation for the coastal economy in Gulf of Guinea countries. Given the huge demand for these fish, it's only a matter of time before these fish become overexploited. There is strong evidence that fisheries managers in Ghana and in the Gulf of Guinea have not looked closely enough at how many forage fish need to be left in the ocean to ensure a healthy ecosystem in the Gulf. Recent research done in US and elsewhere suggests that keeping one-third of the forage fish biomass in the water is necessary to sustain healthy ecosystem.

History has taught us over and over again that fisheries for forage species tend to be more prone to collapse than are those for other types of marine fishes. Large fisheries for sardines off Japan and California collapsed during the 1940's. After a long decline, the Hokkaido herring fishery finally collapsed in the mid 1950's, shortly followed by a much more sudden collapse of Norwegian herring. In the mid-1960's yet another sardine fishery collapsed, this time off South Africa. And more recently again the pacific sardine fishery collapsed. All of these stocks appeared to withstand intense exploitation for an extended length of time, but suddenly failed to exhibit the vigorous productivity that characterized their pre-collapse fisheries. In 50s and 60s there was intense debate whether these collapses were due to the effects of fishing, or whether they were unavoidable consequences of environmental fluctuations. But most of the fishery dynamics models provided convincing evidence that marine fish stocks can be depleted by intense fishing even in the absence of environmental perturbations. Recent work by Essington et al. (2015) provided yet more evidence that the forage fish stock collapses are caused when high fishing rates are maintained when stock productivity is in rapid decline. As a consequence, the magnitude and frequency but not duration of stock collapses are far greater than expected from natural fluctuations.

As stated above the consequences of collapse of forage species can have a serious impact on other species and on the ecosystem as a whole. The recent sardine collapse in California has rippled up the food chain and has been linked to deaths of sea lions and brown pelicans across the U.S. West Coast. Sea lion pups, emaciated and starving, have washed up on California beaches.

A good example of effective forage fish management that we can learn from is the one done in the North Pacific (West Coast of U.S.). In March 2015 the North Pacific Fishery Management Council (NPFMC) voted to prohibit development of new commercial fisheries for seven groups (representing hundreds of species) of forage fish along the U.S. West Coast, including smelts, pelagic squids. This measure was necessary to conserve and manage the forage fish resource off Alaska a critical food source for many marine mammal, seabird and fish species.

There are certainly other similar actions in other part of the world to protect forage species. But the most important is that these examples of precautionary forage policy do not create winners and losers, nor do they have significant negative impacts on existing fisheries. In fact, proactive and precautionary management of the forage base can help increase both the productivity and sustainability of all fisheries.

This approach should be undertaken by the Ghana's fishery management bodies and by the Gulf of Guinea regional fisheries committees. Because of the vital role forage fish play in marine ecosystems and the reliance of predators on healthy forage fish populations, a precautionary management strategy for small pelagic in Ghana is advised.

Reducing the fishing on forage fish not only benefit predators (e.g. Tuna) but also reduce the risk of collapsing forage fish populations.

Implementing management plans that take into account the unique role that key forage species play in the marine ecosystem is a common sense, first step along the path to ecosystem based fisheries management. Fisheries management has failed in many places because it has not recognized the ecosystem and has not been sufficiently precautionary. Precautionary management of forage fisheries, and protections for these key species is crucial to the future of a healthy Ghana's fishing industry.

OTHER ITEMS

It is obvious that Ghanaian Fisheries officials are stretched with responsibilities that are very broad and a staff that is relatively small. The tuna responsibilities alone could consume more individuals than are available. We met with a scientist with new Global Environmental Facility (GEF) Areas Beyond National Jurisdiction Project (ABNJ) who is addressing tuna issues in Ghana and also with senior people in the Ghana Fisheries Commission. There is a desire for synergy between Projects. While the ABNJ project is primarily concerned in Ghana with issues of monitoring and enforcement and catch enumeration and sampling, Ghana itself wants to develop the capability of participating as an equal in the International Commission for Atlantic Tuna (ICCAT). They would like to send two scientists with their data to the NOAA Miami Fisheries Laboratory and have them work with NOAA assessment scientists for several months prior to the annual ICCAT meeting. Dr. Brown will be exploring the feasibility of this with the ABNJ Project. If it comes to fruition it would valuable for The SFMP to find money for travel within the US by these scientists to NOAA centers of expertise in small pelagic and multispecies assessments. When stocks are put under management sophisticated data collection and analyses are necessary to follow the recovery and keep harvests from reversing the recovery process and having Ghanaian staff with increased quantitative assessment experience would be invaluable.

Persons with quantitative skills working in fisheries are in short supply everywhere but especially so in Africa. However there is a program of the African Institute of Mathematics (AIMS) that might help. This Institute has Pan African centers of excellence and one of them is in Ghana near Cape Coast. Students spend a year in an institute and receive a Master's Degree, Many than go on to PhDs. There are instructors in residence and regular short term lecturers throughout the year who are world recognized mathematicians. We met in Accra with the President of the Ghana Institute and also the Education Director for the Next Einstein Project of the Institute, We also stopped by the Ghanaian Institute and were briefed by Ms. Sarah Osei the Career Development Manager. This is a tremendous opportunity to interest young mathematicians in fisheries modeling and to have them do master's projects in this area. We would encourage the SFMP and the Fisheries Department to jointly lecture on the importance of fisheries modeling and the need to develop appropriate models for West African conditions. Since URI is partnering with the University of Cape Coast which has a partnership with AIMS it should be possible to tap expertise whose visit could involve both institutions. Looking at the total amount being spent in fisheries related projects in Ghana it would seem feasible they together they could come together and support the expenses of visiting scholars in fisheries modeling and set the stage that in the future such donor efforts could rely on in country world class modelers. Everyone talked to within AIMS was enthusiastic about this possibility.

As stated before under recovery management the demands for analyses increase. Ghana has a sophisticated tracking system for its trawlers and other vessels licensed by them. International tracking processes provide additional information. This information could allow regulations for that shifted some of the trawler catch to canoes which would have the

advantage of reducing the pressure on small pelagics from trawler bycatch. These and other options will need to be evaluated if a recovery program is instituted.

We did not examine in detail the support in the project for the University of Cape Coast in detail but we did interact with some students and faculty and visited their facility. We were very encouraged by the enthusiasm of the students and with those we interacted more closely the quality of their involvement in fisheries. This is truly a situation where capacity empowerment not just capacity building needs to be considered. Five years is a very short time in academia. We have seen equipment obtained during a project's years go unused afterwards for lack of funds for maintenance and operations and students unable to conduct the research they were educated for because of a lack of opportunity. The promise of President Dooley of a party at his house when the students selected to attend URI arrive is welcomed as isolation can become an issue and I would encourage have the students introduced to the Multicultural Center at URI to provide some contacts in addition to their professional ones. Hopefully the longer term relationship President Dooley stressed in his lecture can be maintained.

RECOMMENDATIONS

1. The SFMP while long in the terms of USAID Projects is short in terms of the historic time it takes to move from very limited management to programs to rebuild and sustain fisheries. The project is already a year and a half into the five year period and while they have made significant process, Ghana is not yet controlling its fisheries and is still in the process of registering its canoes. Therefore we recommend taking a view with a longer horizon and concentrate on the building blocks for fisheries management and working to establish them and work for their sustainability;
2. The work with fishing communities to gain support for fisheries management is excellent and should be pursued while working to establish structures for this to continue. There may well be a continuing role for academic institutions in this effort i.e. the University of Cape Coast and the University of Ghana-Legon.
3. In line with this effort the Scientific and Technical Working Group is a step in a good direction and we recommend efforts to make it an official part of the management process. The question of ongoing support and use of that group needs to be addressed.
4. The efforts to build relationships between the Project and the University of Cape Coast has the potential for strengthening marine and coastal management in Ghana. Close cooperation between the Ministry of Fisheries and Aquaculture and the two universities with marine science capacity, Legon and Cape Coast can strengthen the infrastructure for management.
5. Capacity development has to be done with caution. It has been going on in West Africa in donor projects since the 1960s with limited results to show for it. On our visit we heard skepticism about capacity building and were urged to shift to Enabling Capacity. This is similar to the term Empowering Capacity being used in parts of Nigeria. We urge that attention be directed to enabling capacity to effectively use the capacity being developed.
6. Focusing on small pelagics in Ghana is warranted by their importance in the fishery and in the food supply, the poor condition of the stock, the likelihood of small pelagic stocks to collapse and the dominance of Ghana in the regional fishery. In the longer term a regional and ecosystem approach will be necessary e.g, importance of the small pelagic as forage, the mixed species fisheries, and overall poor condition of much of the fisheries resources. This project should help set the stage for future

directions. Should the Guinea Current Large Marine Ecosystem Project be restarted soon enough this should be useful for moving in this direction.

7. Management for recovery of the stocks and their sustainable maintenance will required an increase in needed data for analyses and in the sophistication of the analysis. Fisheries dependent indices developed before management will no longer track the conditions of the stocks in the same way. There will be an even greater need for fisheries independent indices such as Ghana once did superbly when she had a research vessel which is greatly needed. Investments in expanded data collection (e.g., monitoring catch and effort from all fleets, representative biological sampling, and resource surveys) are expected to be more productive for improving stock assessments not only of small pelagics but for all species and providing advice for fishery management. The current fisheries statistics system needs to be fine-tuned to include greater detail and will require significant management supervision. Environmental conditions will need to be tracked and satellite tracking can be very useful. Close collaboration with MESA program at the University of Ghana can strengthen the capability to provide real-time monitoring and forecasting of environmental parameters
8. The largest gap in expertise in West Africa is in the capabilities for quantitative analysis and modeling applied to fisheries. In international fora the stock assessment modeling is generally done by scientists working in the northern hemisphere. Donor projects although relying on in country expertise generally when it comes to quantitative analysis outside expertise is usually brought in. All too often, instead of models being developed for tropical conditions ones developed for other environments have to be used. Particularly efforts need to be made to strengthen current capabilities and for the future, creative ways need to be explored to build West Africa's strength in this area such as involvement of the African Institute of Mathematics in marine and coastal issues particularly fisheries.
9. The URI –University of Cape Coast Partnership is an excellent approach to enabling capacity at Cape Coast and opening research opportunities for URI. The recent NSF-USAID partnership allowing for funding of both US and developing country investigators is a natural for such twining. However there are only three and one half years left in this project and that is a very short time. Immediate efforts need to be pursued to find ways to continue beyond the current project. The bringing students to URI are a good effort and we applaud the supporting of several students which can reduce the isolation such students often experience. Given the limited experience of URI-GSO in dealing with diversity the introduction of these students to the URI Multicultural Center is encouraged. Follow up efforts with the students after they leave URI are also encouraged to assist in their reaching their full potential.

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