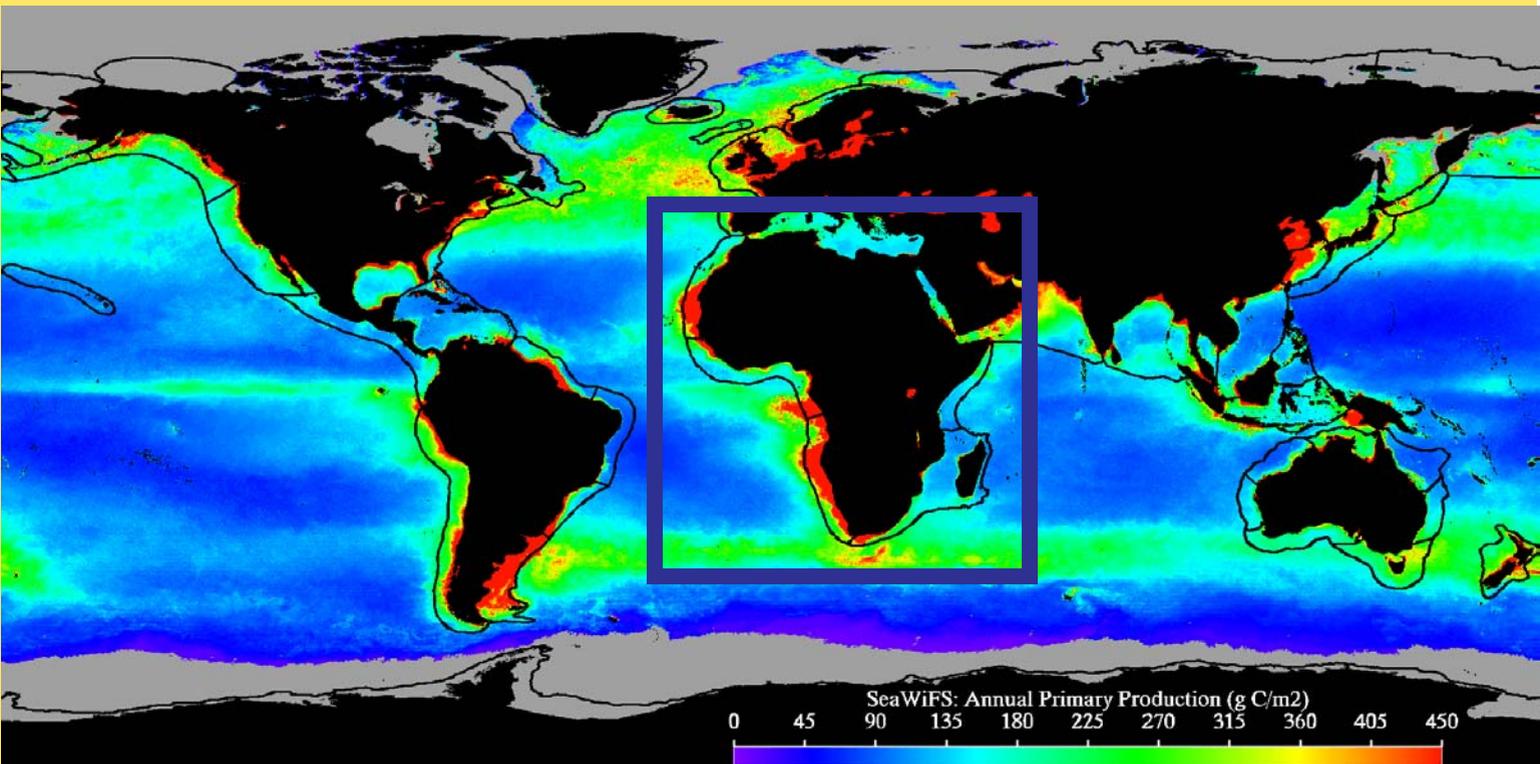


Oceans

and the

World Summit on Sustainable Development

The Restoration of The Guinea Current Large Marine Ecosystem



A GLOBAL EFFORT is underway by the United Nations Industrial Development Organization (UNIDO), World Conservation Union (IUCN), the Intergovernmental Oceanographic Commission of UNESCO (IOC), other United Nations agencies, and the US National Oceanic and Atmospheric Administration (NOAA) to improve the long-term sustainability of resources and environments of the world's Large Marine Ecosystems (LMEs) and linked watersheds.

SCIENTIFIC AND TECHNICAL ASSISTANCE is provided to developing countries committed to advancing new policies and actions for eliminating causes of transboundary environmental and resource-use practices leading to serious degradation of coastal environments, linked watersheds, and losses in biodiversity and food security from overexploitation. The Guinea Current Large Marine Ecosystem (GCLME) is highly productive and is ranked among the 5 most productive LMEs in the world today in terms of biomass yields. Its coastal and marine environment are vital to the socioeconomic development of the 16 countries bordering the LME. It is critical to restore this marine environment to a state capable of supporting its enormous productivity for present and future generations.

WSSD, UNIDO and LMEs

WSSD

As a new century dawns and we move forward from the September 2002 World Summit on Sustainable Development (WSSD) toward the future, a new imperative is emerging that calls for a radical shift in thinking about how marine ecosystems are to be managed. Coastal ecosystems throughout the world are under serious threats from pollution and over-exploitation. The continued destruction of coastal habitats, and the new threat of fluctuating climatic regimes are significantly affecting the socioeconomic prospects of those living in the world's coastal regions. 75 countries, including many in Africa, have made commitments to sustainable development and an ecosystem-based management of their marine areas.

A New Momentum Created in Developing Countries

In Africa, Asia and the Pacific, Latin America and the Caribbean, country officials have been implementing, with assistance from the Global Environmental Facility (GEF) and from industrialized countries of the North, strategies to reverse the decline of their marine ecosystems, and to restore the depleted biomass of food fish in order to sustain growing coastal populations for future generations. Since the early 1990s, developing coastal nations have approached the GEF, the United Nations Industrial

Development Organization (UNIDO) and other U.N. implementing agencies for technical and scientific assistance in restoring and protecting their coastal and marine ecosystems. The GEF provides guidance on addressing these issues within the framework of sustainable development. It recommends the use of Large Marine Ecosystems (LMEs) and their contributing freshwater basins as the geographic focus for integrating change.

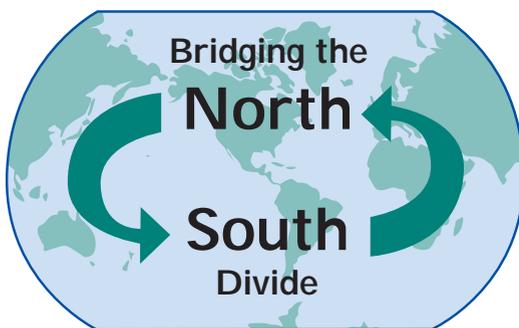
Phase 1: The Gulf of Guinea Large Marine Ecosystem Project

Six countries bordering the Guinea Current LME (Ivory Coast, Ghana, Togo, Benin, Nigeria and Cameroon) initiated the Gulf of Guinea Large Marine Ecosystem Project (GOGLME). The LME is subjected to stress from oceanographic change, overexploitation of marine resources, increased population pressure on the coastal areas, pollution and global warming. In a context of fast population growth in the region, the Project aimed to increase fish harvests to meet human nutritional needs and earn foreign exchange, to control the encroachment of

coastal erosion and to restore mangroves and seagrass beds. These were considered the issues of greatest concern. To accomplish these goals, the countries determined it was necessary to establish an assessment program to track the key environmental and biological parameters in order to achieve sustainable development. They also strengthened their regional institutional capacities and developed an integrated decision-making system. In 1998, the environmental ministers of the 6 countries signed the Accra Declaration, which expressed their commitment to the Project.



"Management plans and strategies should balance economic development with environmental protection and conservation concerns" (Accra Declaration, 1998)



In order to best establish both national and regional priorities, each of the 6 countries first published a country coastal profile, then addressed transboundary issues from an ecosystem-based approach in a Transboundary Diagnostic Analysis (TDA). This was followed by the preparation and implementation of a Strategic Action Program (SAP). The program put forward the first African plan, ever, to improve the well-being of coastal communities, and to address issues of food security and socio-cultural life within an ecosystem-based approach. In 1998, the first Symposium on the Gulf of Guinea Large Marine Ecosystem resulted in a book on "Integrated Environmental and Living Resources Management in the Gulf of Guinea", by Ibe et al. (1998), published by UNIDO. In this book, scientists and managers from the 6 countries highlighted the results of monitoring efforts, and offered opinions on management options.

The first ever African-planned and implemented joint **bottom trawl surveys** of demersal fish populations were successfully conducted by African scientists in the Gulf of Guinea. The purpose of the surveys was to evaluate stocks of living resources and assess pollution levels in LME waters. A French-speaking scientist and an English-speaking scientist were the co-leaders of each survey.



Surveying the fish from trawl surveys in the Guinea Current LME

A **Mangrove Restoration Project** was initiated to help restore fish stocks and reduce pollution. Mangroves are critical habitats of exceptional biodiversity. They are nursery and breeding grounds for various species of fish.

The Role of UNIDO and NOAA

In recognition of the interest expressed by the coastal countries of the Guinea Current to halt and reverse the deteriorating condition of their coastal areas, UNIDO and NOAA joined in the first phase of the program to assist these countries in the **restoration** of the degraded conditions in the LME. They helped bridge the North/South divide by organizing training workshops for the African scientists who were to conduct the bottom trawl surveys. Other workshops addressed the issue of marine debris and indices of pollution. They assisted the countries in planning and implementing an ecosystem-based strategy. The countries in preparing a Transboundary Diagnostic Analysis (TDA) for the region prioritized the following issues in their restoration activities: (1) food security, and (2) addressing the negative impact on the traditional artisanal fisheries sector of foreign industrial fishing vessels. These foreign vessels have already removed a significant biomass of key commercially-important fish species through unregulated fishing. *It is an industrialized form of fisheries that involves the use of new technologies and sees fish as an economic commodity on a global scale.* In this context of emerging globalization, UNIDO, whose mission is to improve the living conditions of people in developing countries and to help them pursue sustainable development, is in a position to support the sustainability of artisanal fisheries in the Guinea Current LME. This is a priority issue for the LME if local food security is put at risk from northern industrialized fishing activities.

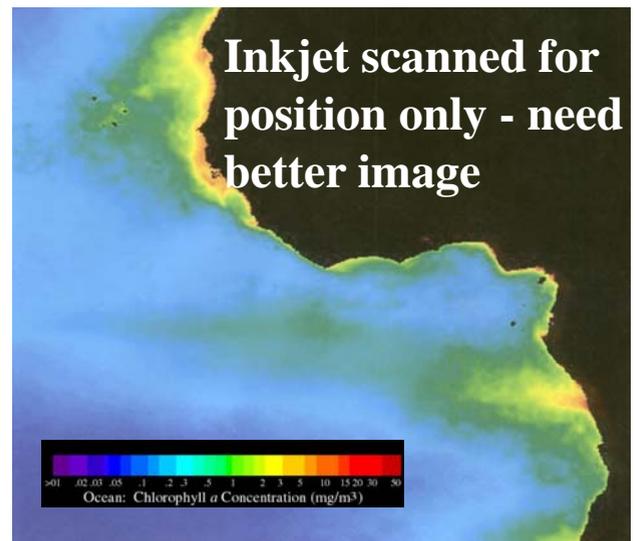
The Large Marine Ecosystem Concept

The LME approach requires a paradigm shift from a small spatial scale to a larger one, and from a short-term to a long-term perspective. At a time of changing political allegiances in a much-altered world, the 6 participating countries of the Gulf of Guinea LME project in signing the Accra Declaration put forward a new concept of political progress, one that addressed transboundary issues and helped advance an ecosystem approach to shared resources. Coastal and marine resource management had

been fragmented so far, due to the legacy of the colonial past and its policies of “divide and rule”, varying political cultures and the use in the region of different languages. In forging cooperative institutions, these countries transcended the colonial legacy and its artificial political borders. By opting for an integrated and sustainable approach to the management of their marine and coastal countries, they helped restructure the old world order.

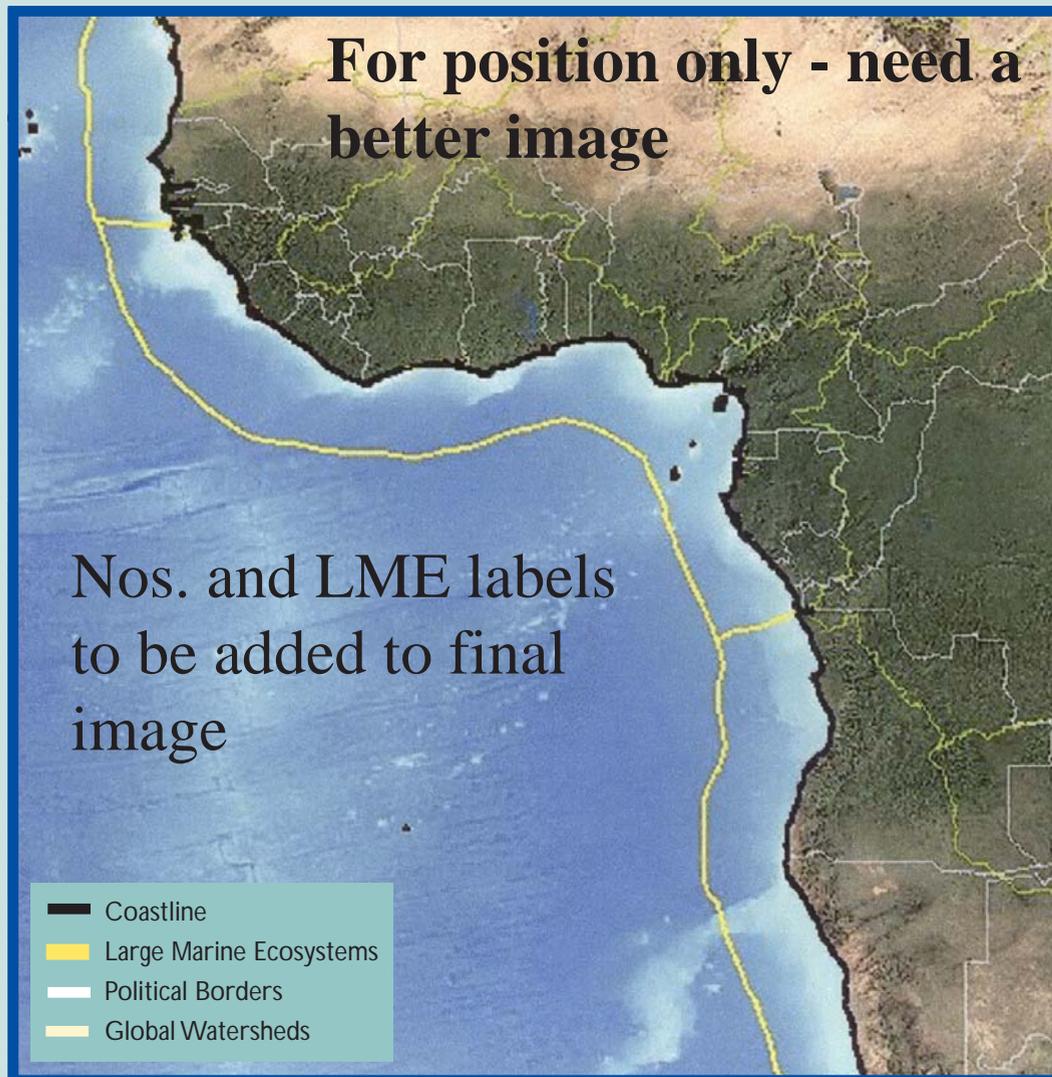
Phase 2: The Guinea Current Large Marine Ecosystem Project

The Guinea Current Large Marine Ecosystem Project (GCLME) brought 10 neighboring countries (Guinea-Bissau, Guinea, Sierra Leone, Liberia, Sao Tome & Principe, Equatorial Guinea, Gabon, Congo-Brazzaville, Congo-Kinshasa and Angola) into the fold. This addition to the original 6 countries of the Gulf of Guinea Project now meant that the countries bordered the full extent of the Guinea Current LME. They were collectively ready to address the transboundary issues of fisheries, pollution, coastal erosion and habitat protection that pertained to the entire LME region. The expanded group included the Portuguese-speaking countries of Angola, Sao Tome & Principe, and Guinea-Bissau, who added to the French and English-speaking countries of the GCLME. The 10 countries are making contributions to a Transboundary Diagnostic Analysis (TDA) and a Strategic Action Program (SAP) for the GCLME Project. UNIDO continues as Executing Agency for Phase 2 of the Project. The United States Department of Commerce through its National Oceanic and Atmospheric Administration (NOAA) will continue to provide scientific and technical support and capacity-building initiatives. In Phase 2, one of the demonstration activities is to implement actions to regain control over the marine resources and to find the appropriate balance between artisanal and industrial fisheries.



The Guinea Current Large Marine Ecosystem is among the 5 most productive LMEs in the world today in terms of biomass yields. The color-enhanced image produced from satellite data shows a zone of major upwelling located off the coasts of Gabon and Congo.

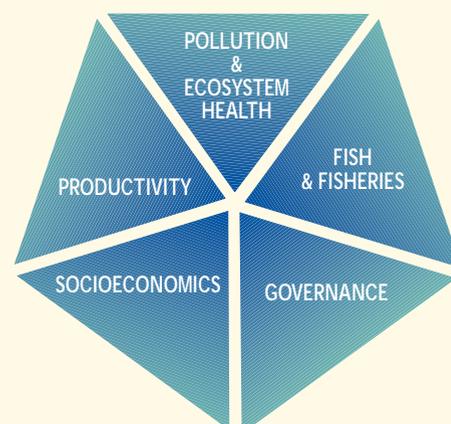
The Guinea Current Large Marine Ecosystem



1. Angola
2. Benin
3. Cameroon
4. Congo-Brazzaville
5. Congo-Kinshasa
6. Equatorial Guinea
7. Gabon
8. Ghana
9. Guinea
10. Guinea-Bissau
11. Ivory Coast
12. Liberia
13. Nigeria
14. Sao Tome & Principe
15. Sierra Leone
16. Togo

Modular Assessments for Sustainable Development

The 5 module approach to LMEs has been developed to provide science-based information for the monitoring, assessment, and management of LMEs. The modules are focused on LME: (1) productivity, (2) fish and fisheries, (3) pollution and ecosystem health, (4) socioeconomics, and (5) governance. The modular approach is critical for integrating science information into management actions, for addressing issues of transboundary concern and for determining the role and responsibilities of each participating country. The accomplishments and concrete actions taken by the 16 participating countries of the Guinea Current LME are positive signs that the LME is moving in the direction of restoration and better livelihood for its communities.



THE PRODUCTIVITY MODULE

The Guinea Current Large Marine Ecosystem is a region of marine coastal space characterized by the Guinea Current, an eastward flow that is fed by the North Equatorial Counter Current off the Liberian coast. Projections on the future availability of living marine resources for economic and food security purposes will depend on knowledge of the productivity patterns of the LME. Surveys are cooperatively carried out, using Ships of Opportunity towing Continuous Plankton Recorders (CPR), to assess the LME's physical characteristics and carrying capacity. In the Project's Phase 1, new areas of upwelling were discovered off of Benin and Nigeria, which led to an upward revision of potentially available fish stocks. However, the increasing occurrence of harmful algal blooms indicated intense eutrophication and excessive nutrient loading from anthropogenic sources.



landings by foreign trawlers in the offshore areas.

The 16 participating countries have determined that it is best to jointly manage the region's fisheries, and especially its transboundary, straddling and migratory fish stocks. They are in the process of evaluating the state of the demersal and pelagic fishery resources, and of examining the role of overfishing, pollution, as well as other factors, whether natural or anthropogenic, that might be impacting the situation. They are also improving forecasts of environmental events affecting fish and fisheries. Obtaining this information will help them determine the steps they need to take in managing their fisheries. The trawl surveys of 1996 and 1999 already led to regulatory actions for the region, such as restrictions in the licensing of fishing boats (except for tuna vessels, the tuna resource being under-exploited), the strict application of mesh sizes, turtle exclusion devices in trawl nets and more enforcement patrols in LME waters.

Environmental Factors Influencing LME Dynamics

There are teleconnections in the marine environment that affect the internal dynamics of the ecosystem. The Project's 2nd phase will focus on assessing oceanographic processes influencing the dynamics of fishery resources, affecting their growth, distribution and abundance. Hardman-Mountford and McGlade (2002)* have studied the variability of the central West African upwelling system. Its cold, nutrient rich water drives the biology of the area extending from Liberia to Benin, and can be subject to strong seasonal, inter-annual and annual change, linked to the migration of the Intertropical Convergence Zone (ITCZ), the equatorial area at which the trade winds converge. The variability of upwelling strengths leads to variability in productivity. Koranteng and McGlade (2002)* have studied physico-chemical changes in the Gulf of Guinea over several decades. They identified three "environmental time blocks": before 1972, from 1972 to 1982, and from 1982 to the early 1990s, in which they observed changes in sea surface and bottom temperatures, salinity and dissolved oxygen. The first time block showed relatively high temperatures, low salinity and a thermocline below its long-term average depth. The second block was colder, both in the coastal area and offshore, with a shallower thermocline and relatively high salinities. The third block had high temperature and a low and erratic salinity. The authors suggest that the changes observed showed interconnections between the eastern and western parts of the Atlantic Ocean, with warm climatic events being possibly linked with the El Nino Southern Oscillation (ENSO).

The Triggerfish vs. the Sardinella

The information on natural variability in the marine environment appears to agree with observations made in the last two decades regarding major fluctuations in the fishery of Triggerfish and Sardinella, two commercially-valuable fish in this LME. Based on trawl surveys conducted in Ghana, it was found that significant changes were occurring in the demersal fish biomass in terms of distribution, abundance and reproductive strategy. One fishery resource,



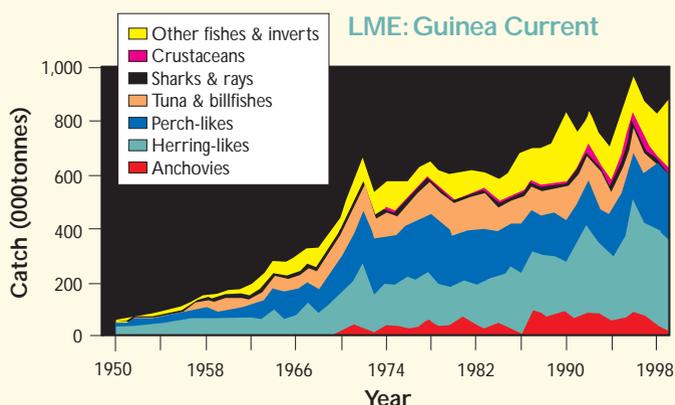
Dr. George Wiafe is a scientist and a professor at the University of Ghana. His PhD research analyzed CPR samples collected from Ivory Coast to Cameroon under the Gulf of Guinea LME Project. Dr. Wiafe attended training workshops for plankton analysis, some of which took place at the Sir Alister Hardy Foundation for Ocean Science in Plymouth, England. He contributed to the first assessment of variability in plankton productivity across the LME and has prepared a manual on the identification of zooplankton in the Gulf of Guinea.

THE FISH AND FISHERIES MODULE

The Guinea Current LME is very rich in living marine resources and commercially valuable fish, both marine and coastal. One of the principal objectives of the Guinea Current LME Project is to increase fish harvests to meet the growing nutritional and protein needs of the 300 million people living in the region. The goal is to increase local and regional consumption as well as to earn much-needed foreign exchange from fisheries exports. However, the Guinea Current LME shows evidence of ecosystem stress. There are major fluctuations of commercially valuable species. Significant changes in species composition have occurred over time. Several demersal and pelagic fish species are over-exploited. There was a significant increase in



the grunt, maintained for a time its position at the top of the list of demersal fish, but gave way to the triggerfish, which dominated and drove the ecosystem from the early 1970s to the late 1980s, after which time the triggerfish dramatically decreased in abundance. Koranteng and McGlade (2002)* attribute the almost complete disappearance of the Triggerfish after the late 1980s to observed environmental changes, an upwelling intensification in the LME's central part, off of Ghana and Ivory Coast. There was a subsequent increase of the *Sardinella*. The *Sardinella* industry had collapsed in 1973, but subsequently recovered to unprecedented levels during the 1980s. Such changes in fishery patterns appear to be related to overfishing, as evidenced by a decline of Catch-Per-Unit-Effort and the taking of young immature fish by artisanal fishermen. They also appear to be related to a new geographical distribution of pelagic stocks and environmental factors, as outlined above. The east and west flows and position of the Guinea Current may play a role in these population fluctuations. Shifts in biomass appear to be connected to a shift in the boundary of the Guinea Current. These alterations have been linked to oceanographic change including the southward displacement of the Intertropical Convergence Zone (ICTZ) during Atlantic El Ninos. The Project's 2nd phase will focus on assessing these oceanographic processes in order to improve fisheries forecasting.

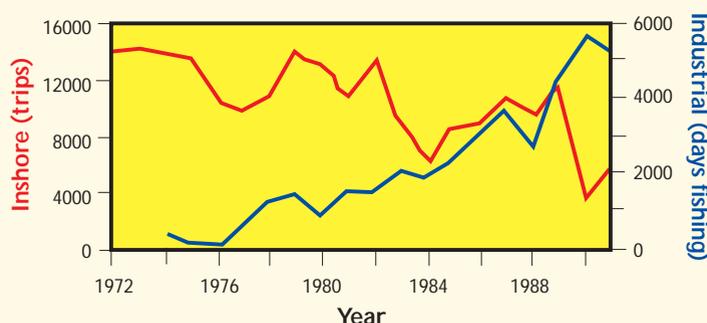


Fisheries resources in the Guinea Current Large Marine Ecosystem (source: the University of British Columbia, at <http://data.fisheries.ubc.ca>). The GCLME Project will be addressing the increasing effort of foreign industrial fleets fishing for the large pelagic resources of the Guinea Current LME, including sardines and tuna.

Artisanal vs. Industrial Fishing Vessels

A large artisanal fisheries sector with strong traditional roots in the region has used bottom set nets, hook and line and beach seines to catch demersal fish for the populations of Sierra Leone, Ghana and Togo. After the 1960s, the Guinea Current LME's transboundary straddling and migratory stocks attracted large commercial offshore fishing fleets. Their fishing efforts exerted extreme pressure on the fishing resources, placing them at risk of collapse. This was exacerbated after 1982 by the return of local industrial fleets that had previously fished other EEZ waters but were barred from them according to the new UNCLOS provisions pertaining to the Exclusive Economic Zone. This resulted in

a significant increase in trawling effort and landings. There was a steady rise in landed catches of demersal fisheries. Koranteng (2002) did a time series analysis of Catch-Per-Unit-Effort (CPUE) for both small sized inshore trawlers and industrial trawlers in Ghana, and found an increasing trend from 1972 to 1977, followed by a general downward trend after 1977. There was a consistent rise in industrial trawling effort and a decline in that of inshore trawlers operated by artisanal fishermen. The Catch-Per-Unit-Effort exceeded sustainable yields in some of the countries bordering the LME and led to a decline in both demersal and pelagic species diversity and average body lengths of the most important fish species. *There are serious concerns regarding excessive or unregulated fishing and insufficiency of information on coastal and ocean biological diversity and the stocks of commercially exploitable species. Transboundary actions are being developed that seek to achieve the sustainable management of the fisheries resource for future generations while maximizing socioeconomic benefits for the people in the region.*



Evolution of trawling effort in the Ghanaian demersal fisheries, by K.A. Koranteng, 2002. Status of Demersal Fishery Resources on the Inner Continental Shelf off Ghana. In: J. McGlade, K. Koranteng and P. Cury, "Gulf of Guinea Fishery Resources: Ecosystem Forcing and Sustainable Development". Elsevier.

*These reports are all published in: J. McGlade, K. Koranteng and P. Cury (2002), "Gulf of Guinea Fishery Resources: Ecosystem Forcing and Sustainable Management", Elsevier.

THE POLLUTION AND HABITAT RESTORATION MODULE



There is strong evidence of serious degradation in the Guinea Current coastal environment. The main pollution problems are water pollution, harmful algal blooms, the loss or degradation of critical habitats for migratory and non-migratory species, major changes in rivers flowing into the LME, the risk of offshore spills, marine debris and beach pollution, industrial waste and solid waste. Almost all these forms of pollution have negative transboundary effects. Pollution projects such as the **Mangrove Restoration Project** have aimed at the restoration of critical habitats. Other projects have provided a detailed survey of industries and recommendations for the

reduction of industrial pollution. A **Recycling of Waste Project** in Ghana cleaned up a lagoon near Accra that was clogged with municipal waste, then launched a successful campaign for the reduction, recovery, recycling and re use of industrial wastes. The Ghanaian Waste Stock Exchange Management System was later extended to other countries. Progress was also achieved in building regional water quality, and defining regional effluent standards.

Phase 2, country-identified projects that have regional, transboundary implications continue their focus on combating coastal habitat degradation and addressing pollution. Benin is establishing **coastal and marine protected areas**. In Togo, the phosphate mines are considered a major contributor of nutrients to the waters of the Guinea Current LME. The excessive nutrient loading is resulting in eutrophication and algal blooms. Weeds are threatening to clog up shallow waterways and are impeding both transportation and fishing. They are also affecting the fresh water supply. The Project aims at **controlling leachate pollution** from the phosphate mines and **restoring the lagoons** where the leachates were freely discharged.

Coastal erosion

Ivory Coast is pioneering low cost, low technology **coastal erosion defense measures**. Coastal erosion is catastrophic in the majority of the countries. It causes serious concerns because it uproots coastal settlements and tourism infrastructures, and destroys harbors and other economic structures. Also the sediments smother benthic organisms, increase turbidity and impede light penetration. Coastal erosion, while almost always localized to specific sites, is nonetheless transboundary since sediments for the natural replenishment of the Guinea Current coast are carried by a longshore drift associated with the Guinea Current. Any interruption of the sediment flow has transboundary implications. The Project will assess the magnitude of the damage caused by coastal erosion, and will assist the countries in obtaining financial support to mitigate its effects from donor contributions or bank loans.

“It is critical to maintain the marine environment in a state capable of supporting its enormous productivity” (Chidi Ibe, CD-ROM, Gulf of Guinea Large Marine Ecosystem Project, 1999)

THE SOCIO-ECONOMIC MODULE

The over-exploitation of fish by large, industrialized offshore fishing fleets is having a detrimental effect on artisanal fishermen as well as on those coastal communities that depend on the near-shore fisheries resource for food. The absence of comprehensive, ecosystem-wide fisheries management and good forecasting systems has major economic and food security implications for the region. Local communities are literally at risk if artisanal fishing cannot proceed. This becomes particularly serious in a context of exploding demographics in the coastal areas. Making more fish available to the 300 million people living in the region's coastal



communities is a project objective. Addressing pollution problems will also have immediate positive socioeconomic effects on the livelihood of coastal communities. The restoration of lagoons, mangroves, estuaries, deltas and tidal wetlands—the Project's top priority—is a long-term means to maintain the living resources that benefit local communities. All are critical habitats rich in natural resources and they are also filters for pollution. Assessing the magnitude of coastal erosion is a first step towards obtaining financial support to mitigate its causes. This is needed in order to stabilize cities, coastal settlements and economic infrastructures, including those linked to maritime transportation. It will improve conditions for the development of tourism, which would provide local communities with an additional source of revenue.

THE GOVERNANCE MODULE

Stakeholders in the petroleum industry, the fishing industry, tourism, agriculture, transportation and mariculture all share in the renewable and non-renewable resource base of this LME. Indicators of a successful Guinea Current Project are all the interactions, created between the 16 countries and also within each country, that express a common political will for the sustainable development of marine and coastal areas and a better livelihood for the coastal communities. Governmental changes have not altered country plans or regional strategies. Other indicators of success are the greater transparency in the decision-making process, and the bridging of the gap between government leaders, policy-makers, managers, business people, scientists and academics, and grassroots communities. Project activities including mangrove restoration, coastal erosion defense measures and beach cleanups involve the active participation of local communities. The Project is introducing management practices to the region. 500 scientists and policy-makers have participated together and exchanged information in more than 40 workshops organized across the region. Their decision-making capacity has been increased through the use of Geographical Information Systems, the provision of crucial databases, and e-mail capability.

The participating countries are committed to reducing and controlling land-based sources of pollution in conformance with the principles of the Abidjan Convention. The crisis of the shared fisheries resource, and its importance to the livelihood of the region's coastal peoples and as an essential food and protein source place it among the Project's highest concerns. The Project will provide the 16 participating countries with a new mechanism for ensuring that fish and fisheries will be jointly managed under the aegis of a **compact** or commission, to ensure their long-term sustainable development in accordance with the FAO Code of Conduct for Responsible Fisheries.



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Network of United Nations organizations participating in the GEF/Guinea Current LME activity:

United Nations Industrial Development Organizations (UNIDO)

UNESCO Intergovernmental Oceanographic Commission (IOC)

National Oceanic and Atmospheric Administration (NOAA)

The World Conservation Union (IUCN)

United Nations Development Programme (UNDP)

United Nations Environmental Programme (UNEP)

Food and Agriculture Organization of the United Nations (FAO)

World Meteorological Organization of the United Nations (WMO)

International Maritime Organization of the United Nations (IMO)

Cover image

Global map of average annual productivity and the boundaries of the 64 Large Marine Ecosystems (LMEs), available at www.edc.uri.edu/LME. The annual productivity estimates are based on SeaWiFS satellite data. The color-enhanced image (provided by Rutgers University) depicts a shaded gradient of primary productivity from a high of 450gCm² in reddish tone to <45gCm² in purple.