Extractive Industries & sustainable development:

A best practice guide
for offshore oil and gas development
in the West African Marine Ecoregion

KLOFF Sandra, WICKS Clive, SIEGEL Paul

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West African marine ecoregion

Some of the world's most valuable coastal and marine ecosystems are found in the West African Marine Ecoregion and these are being threatened by a range of factors – notably fishing, land-based pollution, coastal development, dam building in river basins, tourism, climate change and, more recently, by a renewed interest on the part of the oil and gas industry. Virtually the whole coastal and marine zones – including hotspots of biodiversity, key fishing grounds and important tourism areas – have been divided into blocks open for oil and gas exploration. Many companies are looking for oil and gas and one consortium is already producing.

WWF, the global environmental organisation, in partnership with key stakeholders in West Africa, has developed and is currently implementing the West African Marine Ecoregion (WAMER) Conservation Strategy. This seeks to ensure the sustainable management of marine resources throughout the ecoregion.

WAMER's objective is to have a healthy marine and coastal environment that provides sustainable benefits for present and future generations. Capacity building, of which this book is a part, forms an important component of the programme.

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The material and the geographical designations in this report do not imply the expression of any opinion whatever on the part of the authors concerning the legal status of any country, territory or area, or concerning the delimitation of its frontiers or boundaries.

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However, responsibility for the contents and for the opinions expressed in this book rests entirely with the authors.

The authors would be pleased to receive any comments and suggestions about how future editions could be improved. Please send these to Sandra Kloff (srkloff@hotmail.com), Clive Wicks (clivewicks@talktalk.net) and Paul Siegel (psiegel@wwfsenegal.org).

The Gulf of Mexico Deepwater Horizon disaster – an overview

On 20 April 2010 – just days after President Barack Obama announced an expansion of offshore oil drilling in US waters saying that "oil rigs today generally don't cause spills" – the Deepwater Horizon drilling rig exploded and sank in the Gulf of Mexico. It killed 11 workers and injured others, and caused the largest accidental oil spill in world history. The rig, operated by BP, was drilling an exploratory well in 1,700 meters of water, and had just discovered a major oil and gas reservoir 4,000 meters beneath the seabed.

Like most industrial disasters, the Deepwater Horizon catastrophe was caused by a series of human errors and mechanical malfunctions. The rig had experienced several gas kicks in the days before the explosion, where managers should have known there was increased risk of a blowout. Yet in their rush to seal and disconnect the exploratory well and move on to other drilling locations, rig managers made several decisions to save time and money that increased the risk of a blowout. The cement job in the well casing may not have set correctly, and there were fewer installed barriers to natural gas kicks. And when gas kicked up the well on 20 April, the last line of defence – the blowout preventer at the seabed wellhead – failed, and a catastrophic blowout of gas and oil began.

For months, oil spewed into the Gulf of Mexico from the deep-sea wellhead at an estimated 35,000-60,000 barrels a day (1-2 million gallons a day). Before being controlled, the blowout released an estimated 100-200 million gallons of oil. Coming out at 1,700 meters deep and 70km offshore, the spill was very different from surface spills caused by tankers or shallow water blowouts. Much of the oil that reached the surface was heavily emulsified with water, making it difficult to contain or recover. Extensive underwater plumes of diluted oil and gas spread across the Gulf. Several failed attempts were made to kill the blowout at the seabed wellhead, culminating in a "top kill" attempt where thousands of tons of heavy drilling mud and "junk shots" of synthetic material were pumped down against the force of the blowout through the blowout preventer. But the force of the blowout was too great to overcome from above, and the top kill was suspended.

The blowout was eventually stopped by a relief well which was drilled to intersect the failed well bore. This was done by pumping mud and cement into the failed well at the bottom of the bore where it intersects the reservoir 3,600 meters beneath the seabed wellhead.

The environmental, economic and social damage from the spill were enormous. Oil spread over 20,000 sq km of the northern Gulf of Mexico, and oiled more than 1,000 km of shoreline in a wide arc from Florida in the east to Texas in the west. Much of the environmental damage occurred in the offshore pelagic ecosystem, where bluefin tunas and other large fish species were spawning floating eggs at the time, but this was out of sight of coastal observers and television cameras.

The millions of gallons of oil that washed ashore attracted more public attention. Shoreline oiling occurred on sand beaches, sensitive wetlands and marshes, including small low-lying islands where tens of thousands of seabirds were nesting. Many birds, dolphins, sea turtles and juvenile fish were killed in the first few months, and many more suffered sub-lethal injury.

There was concern also for deepwater corals and deep-sea cold seep ecosystems. Some permanent loss of inshore habitat occurred as a result of vegetation loss due to direct oiling, thus accelerating erosion of coastal islands. The spill is expected to cause some long-term environmental injury. Fishing may be shut down for the year in about a third of federal waters in the Gulf, and tourism has slowed dramatically, causing significant disruption in the local economic and social systems.

The multi-billion dollar spill response was the largest in history – 7,000 vessels, 500 skimmers, 800 km of booms, and more than 2 million gallons of chemical dispersants were applied at the deep-sea blowout and on the sea surface, and several hundred in-situ burns were conducted. Yet despite all this, less than 5% of the spilled oil was ultimately recovered from the water. In an unprecedented gesture, BP agreed to establish a US$20 billion claims fund to compensate people for economic losses outside the judicial process. This will save years of legal wrangling over claims, and has expedited compensation to claimants – but BP resisted establishing a similar fund for environmental restoration.

Many efforts were launched in the US Congress in 2010 to increase the safety of offshore drilling and improve government oversight, including establishing Citizens Advisory Councils, eliminating liability limits, better drilling technology (e.g. improved blowout preventers and companion relief wells), and a restructured government oversight process.

The Deepwater Horizon disaster brought into sharp public focus not just the risks of offshore oil development and failed government oversight, but more broadly the "hidden" costs of our continued global dependence on oil – important biological and cultural areas damaged by oil development and transportation, wars fought to secure oil supplies, health costs from breathing emissions, climate change and frequent oil spills. As oil companies have already developed much of the easily accessible reservoirs onshore and in shallow water, they are now moving into the more extreme environments, such as the deep ocean high-pressure reservoirs in the Gulf of Mexico, Brazil and West Africa, as well as the Arctic Ocean. The risks of drilling in extreme environments are now apparent. Not only that, but other regions that have suffered from chronic oil spills, such as the Niger Delta, are now receiving more public attention as a result of the Gulf spill.

As this book goes to press, the political and social consequences of the Deepwater Horizon disaster are far from over, and are likely to reverberate for years. It is to be hoped that the disaster will hasten the urgent transition to low-carbon, clean, efficient, sustainable energy economies worldwide.

Richard Steiner
Anchorage, Alaska

Foreword

This publication, produced in the context of the Regional Programme for West African Marine and Coastal Conservation (PRCM), is a successor to a 2005 volume entitled Environmental management of offshore oil exploitation and maritime oil transport. The book – as well as a series of capacity-building workshops I personally attended, and a fact-finding mission to Nigeria – helped us to better understand the environmental and socio-economic issues and options created by the emerging offshore oil and gas industry.

This new edition takes things a step further, by making positive propositions as to how the offshore oil and gas industry could contribute to sustainable development in our region.

It must be accepted though that our ecosystems are facing increasing avoidable pressures from human activity. Some fishing methods are transforming life in our seas towards simpler and less productive ecosystems and the coastline is becoming more and more fragile because of a growing population, urban sprawl and the conversion of vast tracts of coastline for tourism and other industrial uses. Today, we also need to prepare for a changing global climate which will have profound and difficult to predict impacts. The development of offshore oil and gas will inevitably put even more pressure on already weakened marine and coastal environments. The latest oil spill disaster in the Gulf of Mexico underlines the fact that developing this sector is never without risk – something which needs to be taken into account at all levels of decision-making.

The authors show that our economic and food security are intimately intertwined with marine and coastal ecosystems. We must therefore strengthen their carrying capacity so we can continue reaping the benefits. We often take the services that nature so generously provides- the food, protection from storms, jobs etc.- for granted and forget we also need to take care by reinvesting in its protection and restoration.

This book gives best practise guidance for oil and gas development by showing how other countries have found ways to reduce negative impacts and to better manage contracts and revenues for sustainable development. The book illustrates how oil and gas development presents an opportunity to rethink current use of our seas and coasts. This would be possible thanks to an increase in oil and gas revenues but also because the exploration for hydrocarbons helps to fill knowledge gaps in our understanding of the marine environment. Already in Mauritania, research has helped to localise intense upwelling (front zones) along the continental shelf which create true hotspots of marine life. Even hitherto unknown ecosystems such as cold-water coral reefs in the deep sea have been revealed by oil and gas companies. These new insights will enable us to take better care of sensitive sea areas and to plan oil and gas activities and fishing in better harmony with each other, national development plans, and nature.

While the challenges lying ahead are complex, we can make a blessing out of oil and gas if we as a society have the political courage to formulate the right policies, to provide our enforcement agencies the means to carry out their work, when we coordinate efforts within and among States, and when information is readily shared and all stakeholders encouraged to actively participate. Our generation may be the last with the ability to preserve the West African Marine Ecoregion before it's too late. We owe this to ourselves, but most of all to our children and grandchildren.

Honourable Jato S. Sillah
Minister of Forestry and the Environment,
The Gambia

Table of Contents

Boxes

Figures

Maps

Tables

Preface – by the Authors

This book provides an overview of what has gone right and wrong with oil and gas development worldwide, with particular emphasis on the West African regional situation and national energy and sustainable development plans. It is designed to help governments and civil societies of the WAMER to reconcile issues associated with oil and gas development with national development priorities.

The book is divided into three sections:

The first part gives an overview of the West African Marine Ecoregion, its biological and socio-economic significance and key challenges related to issues such as fishing, coastal development, maritime traffic, climate change and the emerging oil and gas sector. It is argued that although oil and gas development is an additional threat to the environment, under the right conditions this sector could also become an opportunity for sustainable development.

The second section reflects the governance and economic impediments towards sustainable development. The importance of good governance, civil society participation and transparency are presented as key factors to avoid the so-called 'curse of oil' or 'paradox of plenty' observed in so many African countries. This section concludes with guidance to remove the barriers to make way for the countries' desire to use oil and gas revenues for sustainable development.

The reader will be able to find answers here to questions such as:
How to maximise financial benefits?
How to negotiate with oil and gas companies?
How to best spend oil and gas revenues?
How to avoid 'the curse of oil' or 'paradox of plenty'?
What are the socio-economic impacts?
How to involve civil society?

The third part of the book gives an overview of how oil and gas development impacts on the environment. Strategic Environmental Assessments are put forward as a best practice tool to guide sound management decisions for the emerging sector. This is followed by an overview of the impacts of each single development phase. Best practice guidance for oil spill prevention and contingency planning are given at the end of this section.

This part will help to address questions such as:
What are the most important environmental impacts?
How to mitigate these?
How to avoid conflict with the fishing industry?
When, where and how to develop oil and gas?
Where to establish no-go zones?
What are best practices for offshore oil and gas development?
How to reduce oil spill risks?

Parts of the main text refer to annexes that explain a certain subject more closely. A more detailed overview of extractive industries and oil and gas development in each individual WAMER country can be found here, together with a list outlining relevant convention texts signed (or not) by the countries of the ecoregion. Details on oil spill contingency planning are given in these annexes. The organisational structure of citizens' advisory councils – a best practice model for informed citizens' involvement – is explained more closely, and a list with guidelines and other documents useful for developing a sound policy framework for oil and gas development is also included in the annexes. Full references indicated in the main text body, with the authors' names and year of publication or website name can be found at the end of the book, in alphabetical order.

List of Acronyms and Initials

AGC	Agence de Gestion et de Coopération entre la Guinée-Bissau et le Sénégal
AIS	Automatic Identification Systems
ALAP	As Low As Possible
ALARP	As Low As Reasonably Practicable
ATBA	Area to Be Avoided (IMO)
BAT	Best Available Technology
CAC	Citizens Advisory Council
CAIA	Celula de Avaliçao de Impacte Ambiental, Guinea-Bissau
CBD	Convention on Biological Diversity,
CLC	Civil Liability Convention (IMO)
CMS	Convention on the Conservation of Migratory Species
CO_2	Carbon dioxide
DECC	Department of Energy & Climate Change, United Kingdom
DENRAP	Ministry of Energy and Natural Resources and Petrol, Guinea–Bissau
ECOWAS	Economic Community of West African States
EIR	Extractive Industry Review
EITI	Extractive Industry Transparency Initiative
EMS	Environmental Management Systems
ESAF	Enhanced Structural Adjustment Facility
ESIA	Environmental and Social Impact Assessment
ESRI	Environmental Systems Research Institute
EU	European Union
FAO	Food and Agricultural Organisation (UN)
FIBA	Fondation Internationale pour le Banc d'Arguin
FOIA	Freedom of Information Act
FPIC	Free, Prior and Informed Consent
FPSO	Floating Production Storage and Offloading facility
GDP	Gross Domestic Product
GEBCO	General Bathymetric Chart of the Oceans
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
HELCOM	Helsinki Commission, Regional Seas Convention for the Baltic Sea
HSE	Health, Safety and Environment
IAOGP	International Association of Oil and Gas Producers
ICES	International Council for the Exploration of the Sea
IEA	International Energy Agency
IMROP	Institut Mauritanien de Recherches Océanographiques et des Pêches
IFC	International Finance Corporation
IFREMER	Institut Français de Recherche pour l'Exploitation de la Mer
IHS	Information Handling Service
IMO	International Maritime Organisation
ISME	International Society for Mangrove Ecosystems
ITOPF	International Tanker Owners Pollution Federation
ISLP	International Senior Lawyers Project
IUCN	International Union for the Conservation of Nature
CEESP	Commission for Environmental, Economic and Social Policy (IUCN)
JV	Joint Venture
LNG	Liquefied Natural Gas
MAB	Man and Biosphere

MADR	Ministry of the Environment and Sustainable Development (Guinea-Bissau)
MARPOL	Marine Pollution Convention (IMO)
MPA	Marine Protected Area
MSY	Maximum Sustainable Yield
NGO	Non Governmental Organisation
NORSA	Nigerian Oil Spill Response Agency
NESERA	National Standards Regulations Enforcement Agency
NIOZ	Nederlands Instituut voor Onderzoek der Zee
NNPC	Nigerian National Petroleum Corporation
NOCS	National Oceanography Centre Southampton
OPOL	Offshore Pollution Liability Association
OPRC	Convention on Oil Pollution Preparedness, Response and Co-operation (IMO)
OPRC/HNS	OPRC Protocol on Hazardous and Noxious Substances (IMO)
OSPAR	The Convention for the Protection of the Marine Environment of the North-East Atlantic
PAH	Polycyclic Aromatic Hydrocarbons
PDALM	Plan Directeur de l'Aménagement du Littoral Mauritanien
PPL	Petroleum Production Licence
PNGE	Plan National de Gestion Environnemental
PRCM	West African Marine and Coastal Conservation Programme.
PSC	Production Sharing Contract
PSSA	Particularly Sensitive Sea Area
PWYP	Publish What You Pay Coalition
SAUP	Sea Around Us Project
SEA	Strategic Environmental Assessment
SEAPRISE	Theme on the Social and Environmental Accountability of the Private Sector (IUCN-CEESP)
SNEPG	Société Nationale d'Exploitation Pétrolière de Guinée, Republic of Guinea
SOLAS	International Convention for the Safety of Life at Sea (IMO)
SPDC	Shell Petroleum and Development Corporation
STCW	International Convention on Standards of Training, Certification and Watch Keeping for Seafarers (IMO)
TCA	Technical Cooperation Agreement
TRAFFIC	The wildlife trade monitoring network
UKOOA	United Kingdom Offshore Operators Association
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
UNCW	University of North Carolina Wilmington
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNEP-WCMC	UNEP-World Conservation Monitoring Centre
UNESCO	United Nations Educational Scientific and Cultural Organisation
UNFCCC	United Nations Framework Convention on Climate Change
UNHRC	United Nations Human Rights Council
WAMER	West African Marine Ecoregion
WB	World Bank
WDCS	Whale and Dolphin Conservation Society
WEO	World Energy Outlook
WWF	World Wide Fund For Nature

Executive Summary

Countries of the West African Marine Ecoregion (WAMER) are actively engaged in identifying and developing oil and gas reserves. Virtually the entire coastal and marine zone, including important tourism areas, key fishing grounds and hotspots for biodiversity, have been divided into blocks open for oil and gas exploration. In 2006, one consortium began extracting oil off the Mauritanian coast and many test wells have been drilled throughout the region. Exploration wells are planned in the sensitive border area between Senegal and Guinea-Bissau in 2010.

This book provides an overview of what has gone right and wrong with oil and gas development worldwide, with particular emphasis on the West African regional situation and national energy and sustainable development plans. It is designed to help governments and civil societies of the ecoregion to reconcile issues associated with oil and gas development with national development priorities.

The oil and gas sector emerges at a time when WAMER finds itself at a crossroads. The coastal region could provide most of the food and all the renewable energy needed by its people – but the last 50 years have witnessed the destruction of marine and coastal resources. Difficult decisions involving short and longer term costs need to be made in order to guarantee the future of renewable sectors such as tourism and fisheries, the backbone of the regional economy. Oil, which is a non-renewable asset, can provide vital income, but it can also damage marine resources. Moreover, as has been repeatedly demonstrated around the world, the sector creates few jobs and, rather than promoting sustainable development, often destabilises the socio-economic and the political climates in the region. This can lead to conflict and increased poverty – the paradox of plenty, also referred to as 'the resource curse'.

This book is divided into three parts. Part I provides an overview of the region's biological (and related economic and social) significance, its threats and challenges and it examines questions of how oil and gas could contribute to sustainable development. Part II discusses governance, socio-economic and political impediments towards sustainable development. Part III examines environmental impacts and how these can be avoided and mitigated, and provides recommendations regarding the development of norms and standards for offshore oil and gas development adapted to regional and local conditions.

Part I The West African Marine Ecoregion – socio-economic and biological significance and threats

Socio-economic and biological significance

The West African Marine Ecoregion is extremely productive, supporting one of the world's most important fisheries. The fact that so many species pass different phases of their life cycles in different countries and habitats underscores the need to understand and manage the ecoregion as a whole.

The national economies of the seven WAMER countries – Cape Verde, Guinea, Guinea-Bissau, Mauritania, Senegal, Sierra Leone and The Gambia – depend on the marine and coastal zone for food, shelter and jobs for millions of people. Governments derive much of their foreign exchange from marine resources by selling fishing rights to Asian and European countries. The marine ecosystems also inhibit coastal erosion, protect the hinterland from rising sea-water level and sequester important amounts of carbon dioxide (a greenhouse gas) while at the same time presenting beautiful land and seascapes which attract tens of thousands of tourists annually.

Threats

WAMER's marine ecosystems and the services they provide are under pressure from a range of factors

including fishing (both foreign and domestic), coastal development, maritime traffic, climate change and now also oil and gas development. More effective efforts are needed to curb environmental degradation observed today. The Convention on Biological Diversity (CBD), which has been ratified by all WAMER countries, suggests:

- extending the total surface of Marine Protected Areas to 10% of the ecoregion's EEZs by 2012 (today, less than 3% of the WAMER is protected);
- designating protected areas/periods in a representative selection of habitats (today's Marine Protected Areas are only found along the coast, while rich benthic ecosystems – deep sea coral reefs and shellfish beds – and intense upwelling zones with abundant pelagic life situated more offshore remain unprotected); and
- filling knowledge gaps in our understanding of the marine ecosystem to ensure ecosystem-based management of human use.

Emerging oil and gas sector

Oil and gas development has an impact on marine resources through seismic surveys, oil spills, drilling, installation of facilities and waste discharges. It can also conflict with other economic sectors such as fishing and tourism. However, if carefully managed, **threats and conflicts can be avoided or significantly reduced**.

But the reserves discovered so far are relatively modest, which means that in order to make exploitation profitable, oil and gas companies are under pressure to cut costs and therefore risks for casualty and pollution may increase – hence the need for **strict government regulation** and careful oversight by civil society.

While exploration for oil and gas also helps to better understand the functioning of marine ecosystems (companies look for oil and gas in areas with difficult access and have already discovered deep sea coral reefs), tight budget constraints make it less likely that companies will finance further and more fundamental research voluntarily. In-depth knowledge is necessary if we wish to protect valuable but ill studied ecosystems overlapping with potential hydrocarbon reserves. This book reveals that the first commercially exploited oil well is situated in **the middle of a pelagic hotspot** for marine biodiversity – a distinct zone along the continental slope where upwelling is intense and marine life particularly abundant.

In addition, the discovery of oil can bring a whole range of socio-economic and political problems. The World Bank's Extractive Industry Review states:

"Countries which rely primarily on extractive industries tend to have higher levels of poverty, child morbidity and mortality, civil war, corruption and totalitarianism than those with more diversified economies. The development of extractive industries only positively contributes to the socio-economy of a country where the fundamental building blocks for good governance are put in place, e.g. a free press, a functioning judiciary, respect for human rights, free and fair elections and so on."

A particularly sensitive issue relates to unresolved maritime boundaries between neighbouring countries, which can lead to serious political tension in the event of offshore oil and gas discoveries in border areas. **It is recommended that these international borders be agreed as soon as possible**.

Finding answers to key questions

WAMER countries face an important public policy challenge: **finding strategic use for oil and gas revenues while ensuring that marine and coastal ecosystems are protected** against pollution and other damaging impacts which would undermine the jobs and food security of millions of people. Although nature can absorb a certain level of pollution, pressures from other sources (for example coastal development and especially fishing) are accumulating. This means there is little resilience left in WAMER's ecosystems to absorb the negative impacts of the oil and gas industry.

To increase ecosystem resilience, marine scientists propose:

- reducing fishing below the Maximum Sustainable Yields and restricting non-selective and habitat damaging fishing gear;
- expanding the network of Marine Protected Areas not only along the coast but also to sensitive sea areas more offshore;
- integrating marine resource issues in coastal zone planning and watershed management of dams in river basins;

- applying area-specific tools of the International Maritime Organisation (IMO) to reduce threats from international maritime traffic;
- investing in climate change adaptation through renewable energy, restoration and protection of critical habitat known as bio-sinks for CO_2 (coastal wetlands, pelagic hotspots and forests);
- adopting a 'Clean Seas and Clean Fish' policy to protect the marine and coastal environment and the marketability of local fish products; and
- establishing, monitoring and enforcing nationally and regionally agreed pollution standards.

These measures involve costs which could be paid for by oil and gas revenues. However, the following parts of the book will explain that this comes with a number of conditions that need to be fulfilled first.

Part II Socio-economic and political impacts of oil and gas: the importance of good governance and public participation

Hydrocarbons are finite resources and can never be sustainable – but if managed correctly, they can contribute to sustainable development. Revenues should be reinvested in sectors that generate the best economic return for the country while protecting the environment and human rights. It is expected that the price of oil will rise to US$150-200 a barrel by 2020 – which underscores the importance not only of using oil resources to meet national energy needs, but also to invest the revenues in renewable energy in order to minimise the impact of having to import expensive fuel later.

Experience has shown that good governance – decision-making based on transparency and the participation of a broad spectrum of stakeholders from government and civil society – is essential to maximising benefits. Examples of citizen involvement include the use of Strategic Environmental Assessments (as recommended by the Abidjan Convention), the creation of citizens' advisory councils and ensuring civil society oversight of extractive industries' operations. The Extractive Industries Transparency Initiative, a coalition of governments, extractive industry companies, civil society groups, investors and international organisations, provides an internationally recognised standard for transparency.

The advantages and disadvantages of several contracting options are compared (production sharing, joint ventures, etc.) and examples are provided of how countries can benefit from international expertise (for example through expert advisory panels) to negotiate more effectively with oil companies for increased profitability. Percentages of revenues which accrue to African producer nations from oil contracts vary from 11% in Cameroon to 83% in Nigeria.

It is recommended that countries:

- strengthen the building blocks of good governance, such as a free press, democratic elections, sound judiciary, respect for human rights and education;
- sign the Extractive Industries Transparency Initiative;
- establish an inter-ministerial extractive industry committee to deal with planning, contracting, enforcement of laws and spending of oil and gas revenues;
- invest in sustainable economic sectors such as fishing and agriculture and in renewable energy sources;
- seek international assistance to get the best possible financial and environmental benefits when negotiating contracts with oil, gas and fishing companies;
- ensure that part of oil and gas revenues is saved in special hard currency funds abroad and injected slowly into the economy to reduce inflation and the risk of exceeding the economy's absorptive capacity; and
- establish and pre-finance project closure protocols.

Part III Environmental impacts, policies and best practice

The exact environmental impacts of offshore oil and gas development are difficult to predict, which is why ecosystems providing valuable services – coastal wetlands, rich benthic communities and pelagic hotspots at front zones – are best declared

no-go zones until enough information is available to guide sound management decisions.
While there are some good examples of the oil industry in the North-East Atlantic, (Norway and North Sea countries) and – in spite of the 2010 disaster – the US-administered Gulf of Mexico, **there is no comprehensive international legal framework** regarding minimum environmental standards. This means that the ecoregion should elaborate its own norms and standards. As marine pollution easily crosses borders, this is best done at the regional level either within the framework of the Abidjan Convention or in another convention, yet to be established, among WAMER countries.

Strategic Environmental Assessments (SEA)
Formulating uniform standards and norms for individual operations (drilling fluids, seismic surveys, waste discharges) is not enough, as this approach does not take **cumulative impacts** into account. Small amounts of pollution and stress caused by the construction of platform facilities, platform operations and oil transportation can add up significantly – especially when combined with existing impacts created by other economic sectors and climate change.

SEAs are high-level decision-making procedures used to promote sustainable development. These assessments take place before decisions about individual oil and gas developments are taken; they are also important for further studies such as Environmental and Social Impact Assessments as they establish standards for hydrocarbons at the local and regional levels. Stakeholders reach consensus over when, how and where best to develop oil and gas. Needs for further research and no-go zones are identified, together with relatively sensitive areas where the oil and gas industry should obey special norms and standards. Maps are powerful tools to facilitate these assessments.

The maps in this book reveal that areas with the biggest oil and gas potential (the continental slope) overlap with the most important fishing grounds for foreign and artisanal fleets and poorly studied biodiversity hotspots such as deep sea coral reefs and intense upwelling zones with abundant pelagic marine life and seabirds.

SEAs are formally recommended by the Abidjan Convention – the regional seas convention for West Africa – as a critical tool for countries wishing to develop the hydrocarbon sector.

Environmental impacts step by step
Oil and gas development pass through different stages such as seismic surveys, drilling and production. Each has specific impacts on the marine environment.

Seismic surveys, which use very high-intensity sound to map sub-surface geology, have the potential to cause significant impacts on cetaceans, fish and other marine life forms – but for the most part, these impacts can be mitigated if the industry **avoids critical habitats, refrains from surveying during migration of key fish species and cetaceans, and uses 'soft-start' techniques**, which give animals time to leave an exploration zone.

Drilling operations take place during exploration and production. The most direct impacts are the smothering of benthic communities in the immediate vicinity of the drilling operations. Drilling in vulnerable areas such as mangrove areas, seagrasses, deep sea coral reefs and pelagic hotspots at intense upwelling zones should therefore be avoided. Different kinds of drilling fluids (water, synthetic and oil-based) are used. **The mixture of oil-based fluids and cuttings (together called mud) should be re-injected into the seafloor or shipped to shore rather than discharged in the sea.**

Gas associated with oil fields is sometimes flared off (burnt and released into the atmosphere), thereby aggravating the problem of climate change. **This gas is best re-injected into the reservoir or commercialised.**

Produced water, the most important form of production-related pollution, contains toxic and persistent pollutants such as polycyclic aromatic hydrocarbons. These can accumulate in the food chain and affect people and other species. **Production water is best re-injected into the sub-sea floor and not dumped into the sea.**

Platform and vessel waste streams
All oil and gas production platforms create waste products that are also generated by maritime traffic. These include domestic waste, grey water, oil in deck and reservoir cleaning water, and sludge oil from machine rooms. These waste products are strictly regulated by the IMO and **countries are urged to ratify relevant conventions and protocols.**

It is recommended that countries:

- stablish a comprehensive regional convention for offshore oil development and agree to minimum standards for the oil and gas industry;
- carry out Strategic Environmental Assessments (SEAs);
- identify no-go zones for the industry as well as standards and norms fitting local conditions;
- demand from oil companies to share data on the marine environment and seek their contribution (voluntarily or via a tax system) towards further research, especially into ill studied biodiversity along the hydrocarbon rich continental slope; and
- require independent environmental impact studies for all development stages, from seismic surveys to production and decommissioning;

Maritime traffic
As international law limits the ability of coastal states to impose their own environmental and navigation regulations on foreign vessels passing through their territorial waters, the IMO has developed area-specific tools. There are two designations for sensitive marine ecosystems: Special Areas, large and often enclosed sea areas, and Particularly Sensitive Sea Areas (PSSAs), generally smaller than the first. Countries can apply for stricter measures for waste discharge within these areas, or for a deviation of shipping routes.

Especially relevant for oil and gas development are the IMO-approved Areas To Be Avoided (ATBAs) and precautionary areas under the maritime safety convention SOLAS which could be used around oil and gas installations in and near international shipping lanes. Vessels transiting a newly developed oil and gas zone would be alerted to use extra care and, if necessary, follow a mandatory shipping route.

Oil spills
Large oil spills can be caused by accidents involving oil tankers or by offshore oil operations, but most spills are small and generated when oil is loaded and offloaded. For spill prevention, it is necessary for governments to systematically identify waterways and environments that are particularly vulnerable to pollution as part of a comprehensive assessment of risks and options. **Along with a comprehensive Risk Assessment, governments should consider requiring the implementation of risk reduction and mitigation measures**.

Large spills may arise from maritime traffic after collisions, the grounding of an oil tanker, or when it ruptures due to metal fatigue. All aspects related to oil spills caused by tankers and risk mitigation (such as the double hull requirement for oil tankers or a range of safety measures) are regulated via the IMO, which also operates the 1971 International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (known as the Fund Convention).

Drilling operations and oil platform accidents can cause large oil spills too – as has dramatically been seen in the Gulf of Mexico. This can happen during drilling if the operator loses control over the reservoir – a blow out – or if a floating production and storage platform (FPSO) is perforated by another ship as the result of an accident, or simply if an FPSO ruptures due to metal fatigue.

Even if FPSOs look like ships and may actually be made out of former oil tankers, IMO conventions only apply partly to these platforms. While double hulls have become mandatory for large oil tankers, these are not required for FPSOs. The first FPSO active in the WAMER is made from a former single-hulled oil tanker. Bureau Veritas, the globally respected classification company, advises against such installations because of metal fatigue problems.

Costs involved with clean-up or the compensation of third parties (for example fishermen or coastal tourism operators) for oil spills caused by platforms or drilling operations are not covered by any international convention. **Companies should be required to carry sufficient insurance coverage to protect producer states and their citizens**. As an example it would cost more than US$1 billion to restore (with very uncertain success rates) the sub-tidal seagrass beds of the Banc d'Arguin National Park in Mauritania.

All governments should develop a national oil spill contingency plan, and require all petroleum facilities and ship owners to have their own plan approved by the government.

It is recommended that countries:

- explore and ratify all relevant IMO conventions;
- identify economically, ecologically and culturally sensitive sea areas and have these designated as Particularly Sensitive Sea Areas (PSSAs);
  - make oil spill risk assessment for maritime traffic and oil production operations and establish an oil spill contingency plan;
  - allow only purpose-built, double hulled floating platforms (FPSOs);
- establish 500m exclusion zones around offshore oil and gas operations and have them recognised by the IMO as Areas To Be Avoided;
- arrange for an adequate liability scheme of at least US$1 billion for oil pollution caused by offshore oil operations; and
- establish an oil spill emergency fund.

Conclusion

Oil and gas development must overcome many hurdles before it can contribute to sustainable development. Valuable ecosystems which provide diverse, critical and renewable services for millions of people need to be protected. Hydrocarbons are non-renewable resources, but if managed correctly, they can contribute vital income for sustainable development initiatives, improve the use of the marine environment, and decrease countries' dependence on increasingly expensive imported energy.

Investment in oil and gas resources should generate the best possible economic return for the ecoregion over the long term. However, a mistake in contracts, liability and environmental risk assessment can cost governments billions of dollars in lost revenues.

Even though the challenges are complex, proven solutions exist. It is up to the governments and civil societies of the sub-region to take advantage of them to change the 'resource curse' into a resource blessing.

Part I:

The West African Marine Ecoregion: Values and Threats

Chapter 1

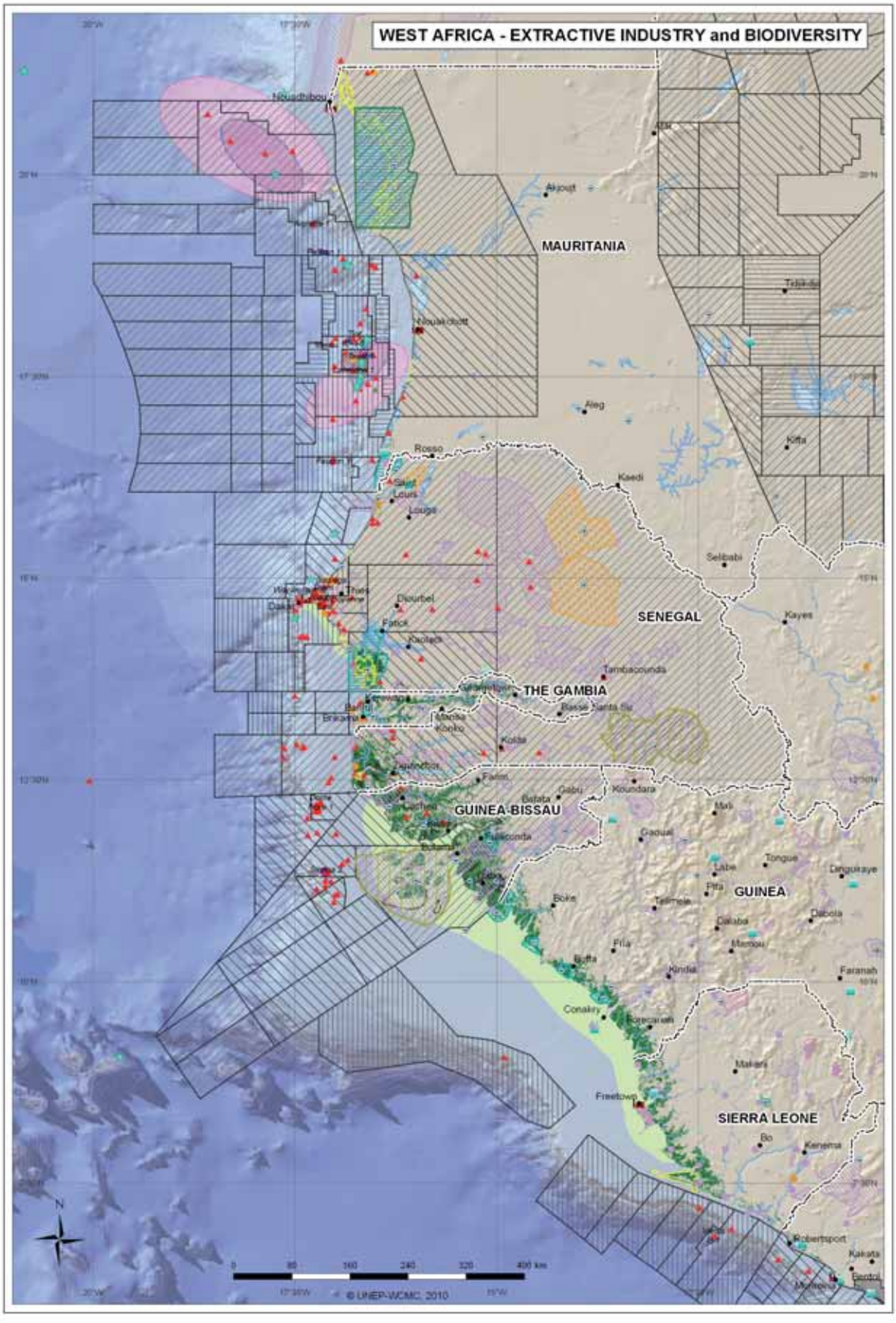
Socio-economic and biological significance and threats

The economies of the seven countries comprising the West African Marine Ecoregion depend on the marine and coastal zone. This provides food, shelter and jobs to millions of people and much of the countries' foreign exchange (fishing rights sold to European and Asian countries and coastal tourism). Dune systems protect the hinterland from rising sea-water level and high tides. Wetlands such as mangrove forests and seagrass beds prevent erosion of the coastline, and every year they not only store and sequester important amounts of the greenhouse gas carbon dioxide, but also present beautiful land and seascapes which attract tens of thousands of tourists.

The ecoregion includes the territorial seas and Exclusive Economic Zones of Cape Verde, Guinea-Bissau, Guinea, Mauritania, Senegal, Sierra Leone and The Gambia. These seas are very productive, supporting one of the world's most important fisheries. During much of the year, the trade winds and ocean currents push surface water away from the coast and draw cold, nutrient-rich, water from deep in the ocean up to the surface – a phenomenon called upwelling. Intense tropical sun, together with this almost constant flow of nutrients, provides perfect conditions for massive growth of plankton – the foundation of extremely productive food webs. In the summer, when the wind changes direction and when much of the upwelling stops, the region is also influenced by warm tropical surface water from the South. The alternation between cold upwelling water and warm surface water is one of the reasons why the area hosts a wide variety of species and ecosystems. More than 1,000 species of fish have been identified in the ecoregion, as have nearly 20 species of cetaceans, five species of endangered marine turtles, and a colony of 100 Mediterranean monk seals in northern Mauritania – the largest breeding colony on Earth. Guinea-Bissau holds the largest breeding colony of green turtles in Africa, and Cape Verde is the third most important loggerhead nesting site in the world (WWF WAMER website).

The 3,500km coastline bordering this large marine ecosystem presents a multitude of habitats, from rocky cliffs, broad sandy beaches and extensive sea grass prairies in the north to dense mangrove forests and well-developed estuaries in the south. The coral reefs of Cape Verde are both a centre of endemism and a 'Top Ten global hotspot' for coral communities (WWF website; also see Map 1).

Further offshore, rich benthic communities lie scattered in distinct patches on the seabed of the continental shelf. Shellfish beds form the basis of rich ecosystems on which many fishery resources rely for their survival, notably octopus (Diop, 1988; Duineveld et al., 1993; Kloff et al., 2007). At particular locations along the shelf-break, where cold upwelling water meets warm surface water, temporary or permanent front zones are formed, creating true hotspots for biodiversity. Seabirds join predatory fish here, such as tuna, swordfish, and sharks, to feast upon dense schools of pelagic fish swarming around clouds of relatively high plankton concentrations (Camphuysen, 2004; Wynn & Knefelkamp, 2004; Camphuysen & van der Meer, 2006). These intense upwelling zones are probably most pronounced in the northern part of the ecoregion and strongest in front of capes such as Cap Blanc in Mauritania and Cap Vert in Senegal (Helmke, 2003). The bottom of the continental shelf-break harbours extraordinary deep sea life, about which little is known. Cold-water coral reef systems have been discovered at the Mauritanian and Senegalese shelf-breaks and there are indications that these ecosystems play an important role in the replenishment of many fishery resources (Rogers, 1999; Colman et al., 2005; Krastel et al., 2006; see also Map 1 for the location of these sea habitats).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Nouakchott
Aleg
Rosso
Kaedi
Selibabi
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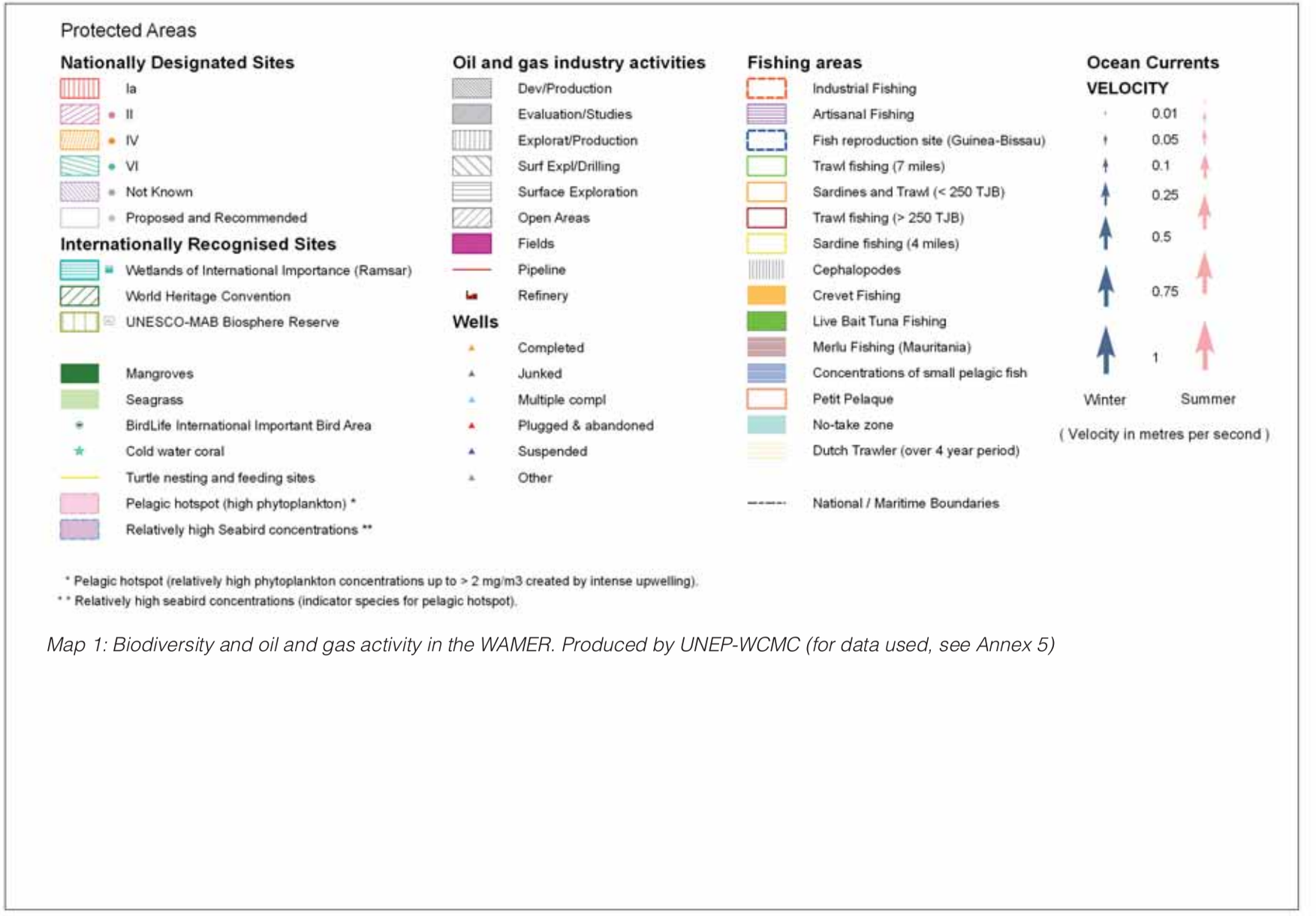


Map 1: Biodiversity and oil and gas activity in the WAMER. Produced by UNEP-WCMC (for data used, see Annex 5)

The area is one ecological unit. Fish that spawn in northern nurseries seasonally migrate southwards and provide food for human fishing communities along the way. Recent satellite tracking has confirmed that green turtles lay eggs along the remote beaches of Guinea-Bissau and travel northwards through Senegalese and Gambian waters to graze on the seagrass prairies of the Banc d´Arguin National Park in Mauritania.

The ecoregion's importance also extends from Africa to other continents. More than 6 million migrating birds from Europe and the Arctic feed in the rich coastal waters in the winter.

The fact that many marine species pass different phases of their life cycle in the waters of the WAMER countries underscores the need to understand and manage the ecoregion as a whole.

Chapter 2

Threats

Governments of the ecoregion countries have made considerable efforts to safeguard their marine and coastal resources. An impressive network of Marine Protected Areas (MPAs) has been created, most of the countries adopted the FAO code of conduct for responsible fisheries and all WAMER countries are party to the Convention on Biological Diversity (CBD). Both policy texts promote ecosystem-based management for human use of natural resources.

The regions coastal and marine zones could provide much of the food and all the renewable energy needed by its people – but in spite of reasonably good policies, the last 50 years have witnessed a decline in marine and coastal resources. Most are either fully or over-exploited, some species such as the saw fish, guitar ray and large groupers have disappeared from habitats, while others face regional extinction. These include white groupers, marine turtles, bill fish (marlins and swordfish), and several cetacean and shark species, notably hammer-heads and manta rays (Alder & Sumaila, 2004; Christensen, et al., 2005; Zeeberg et al., 2006; Gascuel et al, 2007).

Some of the world's largest Marine Protected Areas have been created in WAMER – the Banc d'Arguin World Heritage Site in Mauritania, the Sine Saloum/ Nuimi Man and Biosphere Reserve in Senegal and The Gambia, the Bolama Bijjagos Biosphere Reserve in Guinea-Bissau and the Tristao and Alcatraz Natural Reserves in Guinea (see Map 1). Even so, less than 3% of the countries' Territorial and Exclusive Economic Zones is protected. This is above the world average of 1%, but far below the 10% target set for 2012 by the Convention on Biological Diversity (Wells, 2008).

The ecoregion countries' commitment under the CBD to protect a representative selection of habitats and to ensure connectivity is not yet fully implemented. Today's Marine Protected Areas (MPAs) are almost exclusively situated along the coast and comprise habitats such as seagrasses, river deltas and mangroves (see Map 1). Other important habitats with high levels of biodiversity situated more offshore remain unprotected. These include intense upwelling zones (front zones) along the continental shelf-break, rich benthic ecosystems such as deep-sea coral reefs at the bottom of the continental slope, and shellfish beds on the continental shelf.

The countries' commitment to the CBD to manage human use based on the ecosystem approach is furthermore seriously hampered by a lack of knowledge about how the marine ecosystem functions and the cumulated impacts of different economic sectors. To guarantee the future of the WAMER, the precautionary approach is therefore the best way forward. But unfortunately – given the serious economic constraints facing these developing countries and a lack of alternatives – many countries find themselves caught between the short-term development needs of their people and the need to manage their natural resources for the long term.

2.1 Fishing

Fishery resources in the WAMER region include small pelagic fish such as sardine, sardinella, anchovy, chub mackerel and horse mackerel, which together constitute more than 60% of catches. Other species caught include tuna, coastal migratory pelagic finfish and bottom-dwelling species, notably octopus and shrimp. Most of these species are transboundary or migratory, with the distribution of tunas often extending beyond the bordering countries' EEZs into international waters (Heileman and Tandstad, 2008).

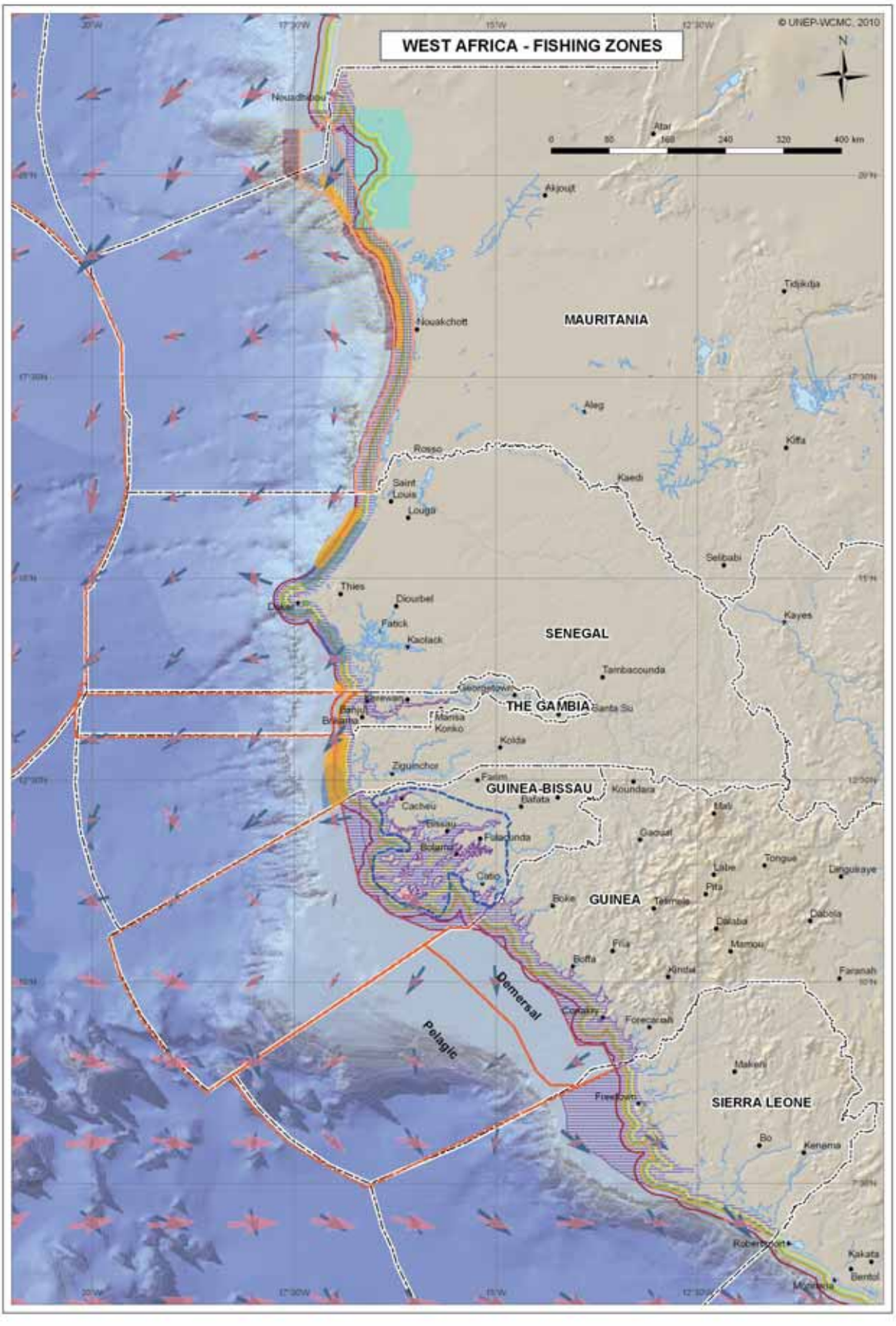
Since the 1960s, European and Asian countries have signed agreements with the governments of the WAMER to exploit fishery resources, while a local fishery sector expanded rapidly at the same

time. Payments made by foreign fleets in exchange for the right to fish contribute significantly to the gross domestic product (GDP). While this figure may fluctuate from year to year, the European Union pays around € 130 million annually to the ecoregion, notably to Mauritania (Walmsley, et al., 2007; personal communication with Khady Sane Diouf, director of the Senegalese NGO Envipêche). However, the value of the fish is worth at least three times that amount (IFREMER, 1999).

Revenues derived from fishery agreements signed with Asian countries are more difficult to evaluate in monetary terms as they are less transparent and compensation is often paid in the form of development projects and the construction of large-scale infrastructures (Walmsley, et al., 2007). Costs coupled to the degradation of ecosystem services are not enough taken into account in any of the fishery agreements (Alder and Sumaila, 2004). For example, newly discovered deep-sea coral reef systems believed to play an important nursery function for fishery resources have been seriously damaged by bottom-trawling of foreign fleets targeting spiny lobsters, hake and red crabs (Colman, et al., 2005).

The local fishery sector is an important pillar in the economy too. Nearly 11 million people live along the WAMER coast, and in Senegal alone – a country of 12 million – the jobs of more than 600,000 men and women depend directly on fishing and fisheries-related industries. Furthermore, it is one of the few economic sectors with potential to generate work for 'unemployed' people living in the slums of the mushrooming urban centres on the coastline. For example in Mauritania, the foreign industrial fishing fleet catches about 80% of the fish while the local artisanal sector catches around 20%. The opposite holds true in Senegal, where artisanal fishermen land 80% of that country's total catches (Walmsley et al., 2007).

Map 2 indicates the locations of different fishing zones, although this is not an exhaustive picture. Some of the datasets used cover particular countries, so the absence of data doesn't necessarily mean that such fishing does not occur in other areas. For more information about the datasets, see Annex 5.


WEST AFRICA - FISHING ZONES
© UNEP-WCMC, 2010
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Atar
Akjoujt
Tidjikdja
Nouakchott
MAURITANIA
Aleg
Kiffa
Rosso
Kaedi
Saint Louis
Louga
Selibabi
Thies
Diourbel
Dakar
Fatick
Kaolack
SENEGAL
Kayes
Tambacounda
Georgetown
Barra
Brikama
Farafenni
THE GAMBIA
Santa Su
Mansa Konko
Kolda
Ziguinchor
Farim
GUINEA-BISSAU
Koundara
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Cacheu
Bissau
Mali
Gaoual
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Demersal
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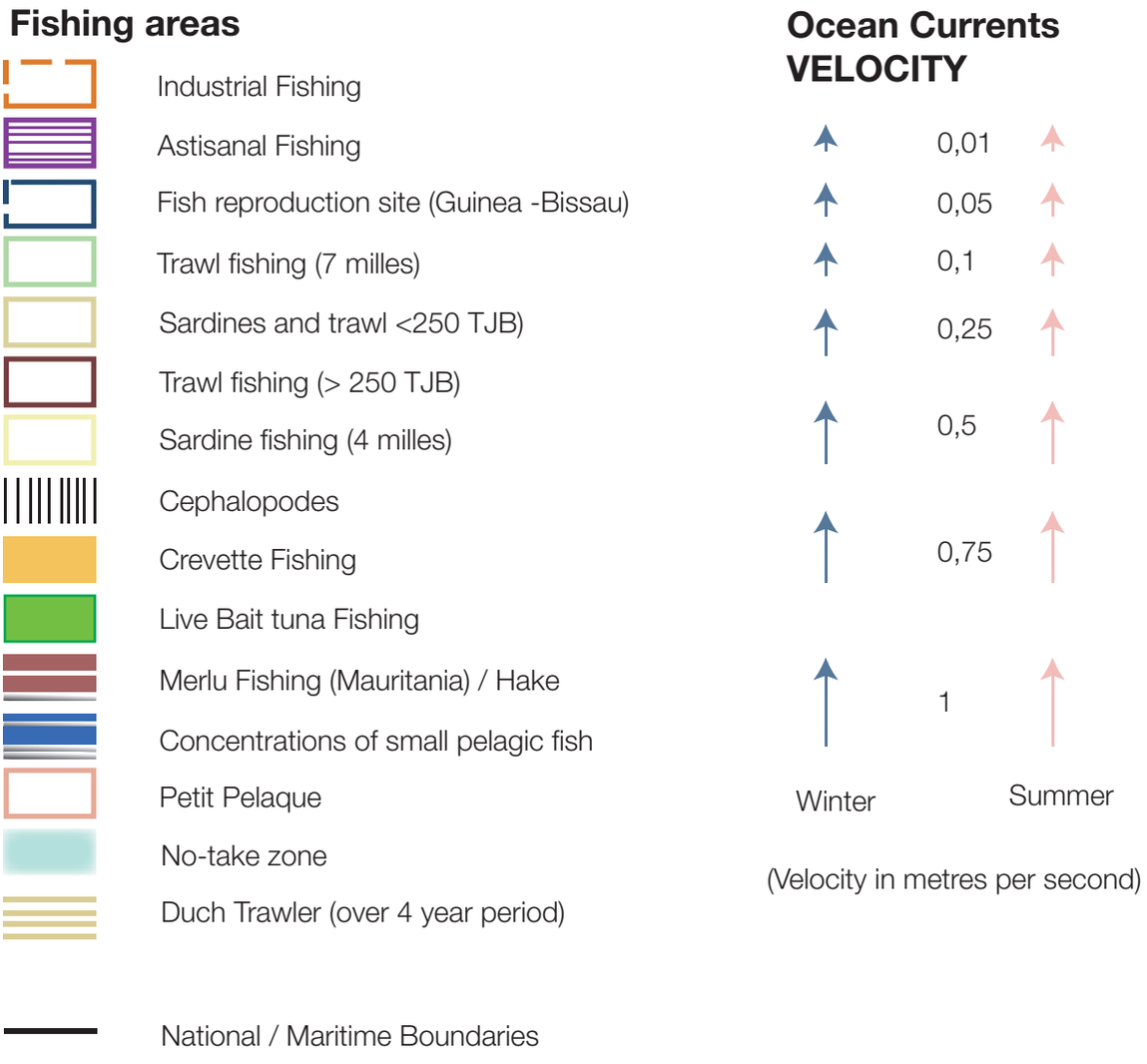
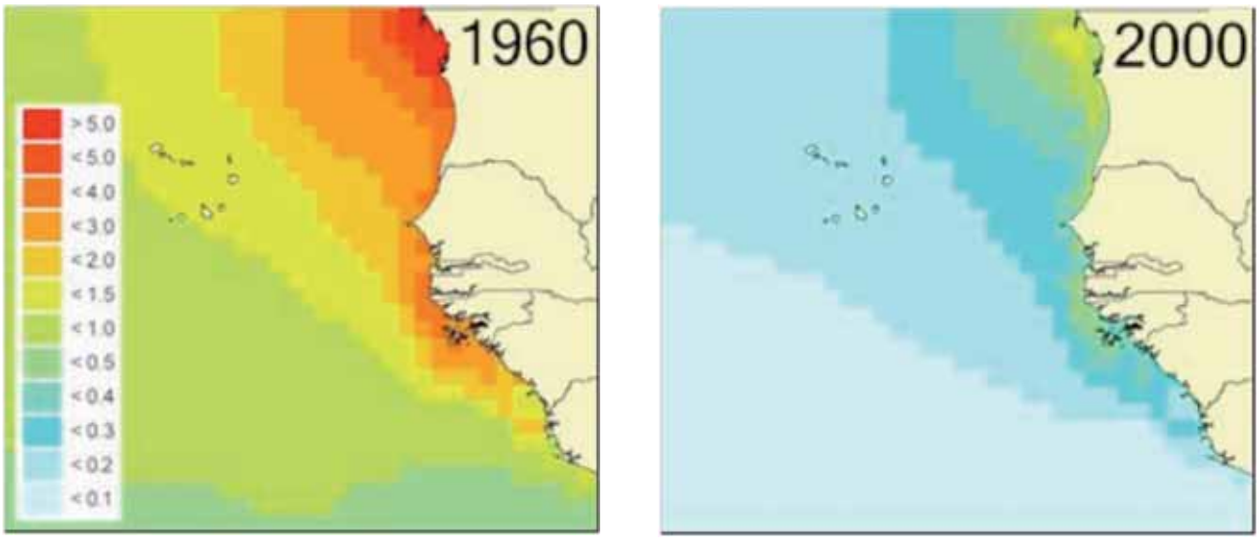


Map 2: Fishing zones in the WAMER. Map UNEP-WCMC (for data used see Annex 5)

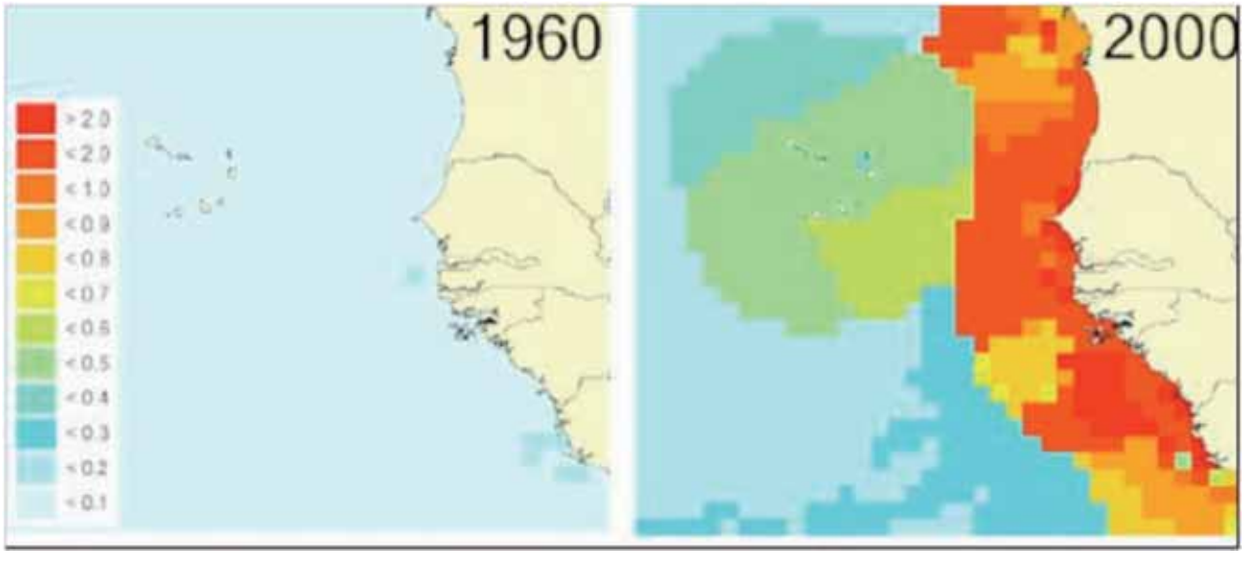
Box 1: Need for a detailed ocean use plan

It is interesting to note that while the foreign fleet has the right to exploit a large area of the EEZ, in reality it fishes almost exclusively along the continental shelf-break right at the border with the artisanal fishing zone. This is well illustrated by the recorded GPS positioning of a Dutch pelagic trawler fishing off the Mauritanian coast (Zeeberg, et al., 2006). The continental shelf-break is also the zone where most drilling for hydrocarbons takes place (see also Map 1). The previous chapter highlighted the importance of this area for biodiversity – deep-sea coral reefs are found here as well as pelagic hotspots for biodiversity at the front zones. The biodiversity significance, as well as the various economic uses – industrial fishing fleets, artisanal fishers and now also the offshore oil and gas sector – along this relatively narrow stretch of sea, calls for a more detailed ocean use plan.

Biomass of fishery resources has been reduced significantly since the 1960s, coupled to an increase in fishing intensity (see Maps 3 and 4). Over-fishing is already jeopardising the survival of this important economic sector. Some scientists have shown that the exploitation of marine resources caught in the wild may cease to exist within 40 years if we continue to fish as we do today (Worm et al., 2006).



Map 3: Biomass distributions for fish (excluding small pelagics and mesopelagics) off West Africa in 1960 and 2000. The units in the legend are tons per sq km.



Map 4: Fishing intensity (= catch/biomass ratio) for fish (excluding small pelagics and mesopelagics) off West Africa in 1960 and 2000. Catch is measured in tons per sq km per year and biomass in tons per sq km. Maps 3 and 4 from Christensen et al. (2005)

The reduction in fishery biomass is also felt in reported landings of fish in the ecoregion. The local fishery sector in particular suffers greatly from declining catches. Experimental trawl data show that high-value bottom-dwelling species, important target species for local fishermen, have been reduced by a factor of 3 to 4 since the 1980s. The abundance of top predators has been reduced by 8 to 10-fold, and for some species even up to 20-fold (Gascuel, et al., 2007). This confirms the ecoregion's global trend of 'fishing down the marine food webs' as illustrated in Figure 1 (SAUP).

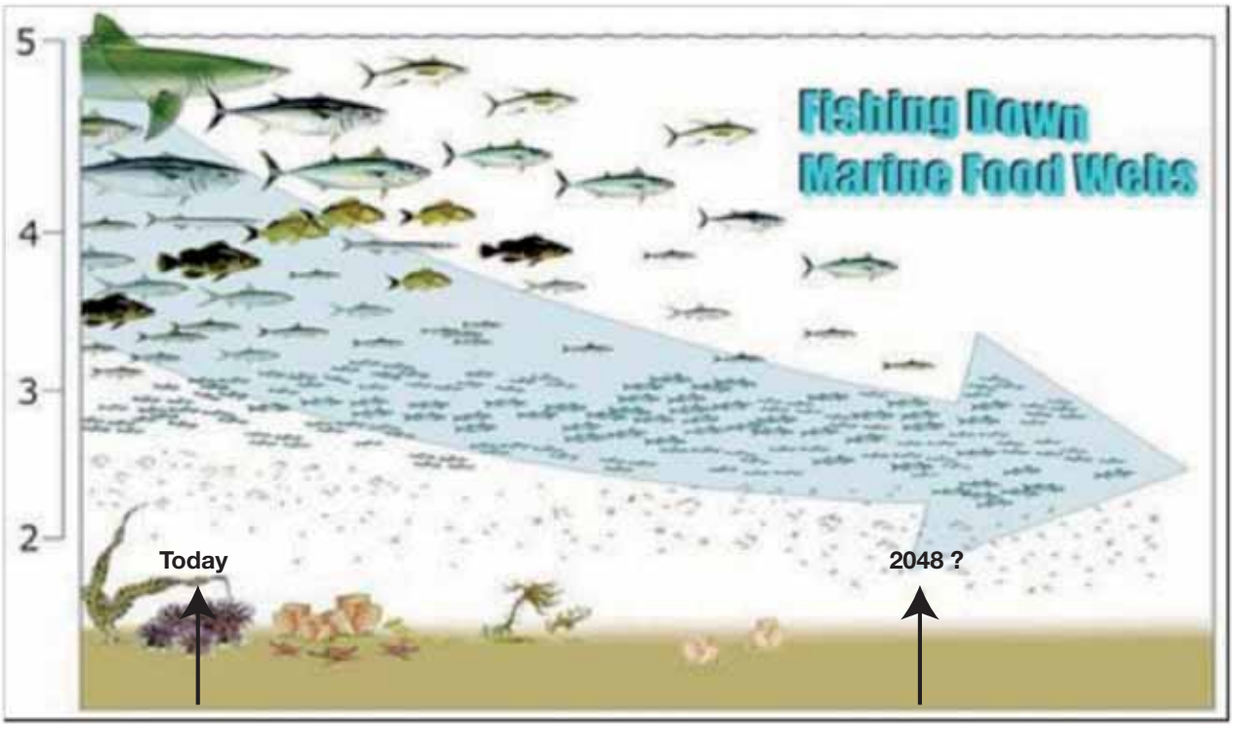


Figure 1: Fishing down marine food webs (Pauly, et al., 1998) The y-axis represents trophic levels in the food chain and the x-axis time.

Today, many young men risk their lives by travelling to the Canary Islands in wooden pirogues (traditional fishing canoes) in the hope of finding work as illegal immigrants in Europe. The emerging oil and gas sector will not be able to make up for declining availability of jobs in the fishery sector – oil and gas companies operate with few people and most of the personnel are highly skilled and hired abroad. The potential to create employment for local people is one of the reasons why the protection of the artisanal fishery sector should remain a top priority, coming before the interests of the oil and gas sector.

Some regions such as the Barents Sea, Iceland and the United States (New England and California) have shown that it is not too late to save collapsing fisheries. Policy-makers in these regions have accrued conservation efforts in the struggle against marine ecosystem degradation and have halted and even reversed the trend of 'fishing down the marine food webs'. A number of management tools were used simultaneously – for example, reducing fishing effort below the traditional Maximum Sustainable Yields (MSY), restricting habitat-damaging fishing gear, promoting more selective gear, involving communities in the management of fishery resources and expanding the network of Marine Protected Areas. Obviously this will only work if governments are willing and able to bear the costs involved with putting such management options into practice (Worm et al., 2009). Oil and gas may provide income to cover these expenses.

2.2 Coastal development and tourism

Development of the coastal zone is accelerating. Urban centres on the coast attract mass migration from rural areas emptied by the droughts of the 1970s and 80s, as well as by the increasing

impacts of climate change. Today, more than 60% of the ecoregion's population lives along the narrow coastal fringe. The mushrooming urbanisations on the coastal zone provide clear examples of how cumulative impacts from habitation, industrial development and tourism can add up.

While most countries insist on Environmental Impact Assessments for each significant construction activity, there are not enough comprehensive standards or mechanisms in place to track and adapt to the overall degradation of the zone. Mangrove forests are being cut (particularly in Senegal, The Gambia, Guinea–Bissau and Guinea) destroying key nursery areas for fisheries and rendering coastlines more vulnerable to coastal erosion and climate change. Building along the coast is often poorly controlled. Mandatory setbacks and other regulatory mechanisms, where they exist, are often disregarded with impunity, leading to serious threats such as 'mining' the dune systems that protect Nouakchott, the Mauritanian capital, from rising sea-water level and high tides (part of the city lies below sea level). Sand mining is also a critical issue in Cape Verde.

Rivers are dammed for hydropower (for example the Manatali dam in Mali) and for the prevention of seawater intrusion to allow for large-scale rice agriculture upstream (the Diama dam on the Senegal River). All too often insufficient regard is paid to the impact on the estuarine systems downstream that nourish the region's fisheries and its globally important biodiversity. Impacts are somewhat mitigated, however, by the ecosystem restoration efforts of Diawling National Park in Mauritania and the Djoudj National Park in Senegal – but more promising results could be achieved if the Senegal River delta's importance for marine and estuarine biodiversity were taken into account in watershed management scenarios (Hamerlynck and Duvail, 2003).

Many countries of the ecoregion are actively promoting the expansion of tourism. Already, this represents about 16% of national income and more than 30% of all export earnings for The Gambia (Mitchell and Faal, 2008). In Senegal, tourism is the country's second most important source of foreign exchange (euro monitor website). The World Travel and Tourism Council predicted that in 2009, tourism would account for 7% (US$1,045 million) of gross domestic product (GDP), 5.8% (155,000 jobs) of total employment and 15.1% (US$440.8 million) of Senegal's total export earnings (World Tourism Directory Website). Similarly, the sector represents more than 12% of Cape Verde's GDP (WWF Cape Verde website). Efforts to develop tourism, especially mass tourism along the coast, are seen as a potentially important economic driver, but are often promoted without adequate regard to either environmental or social costs.

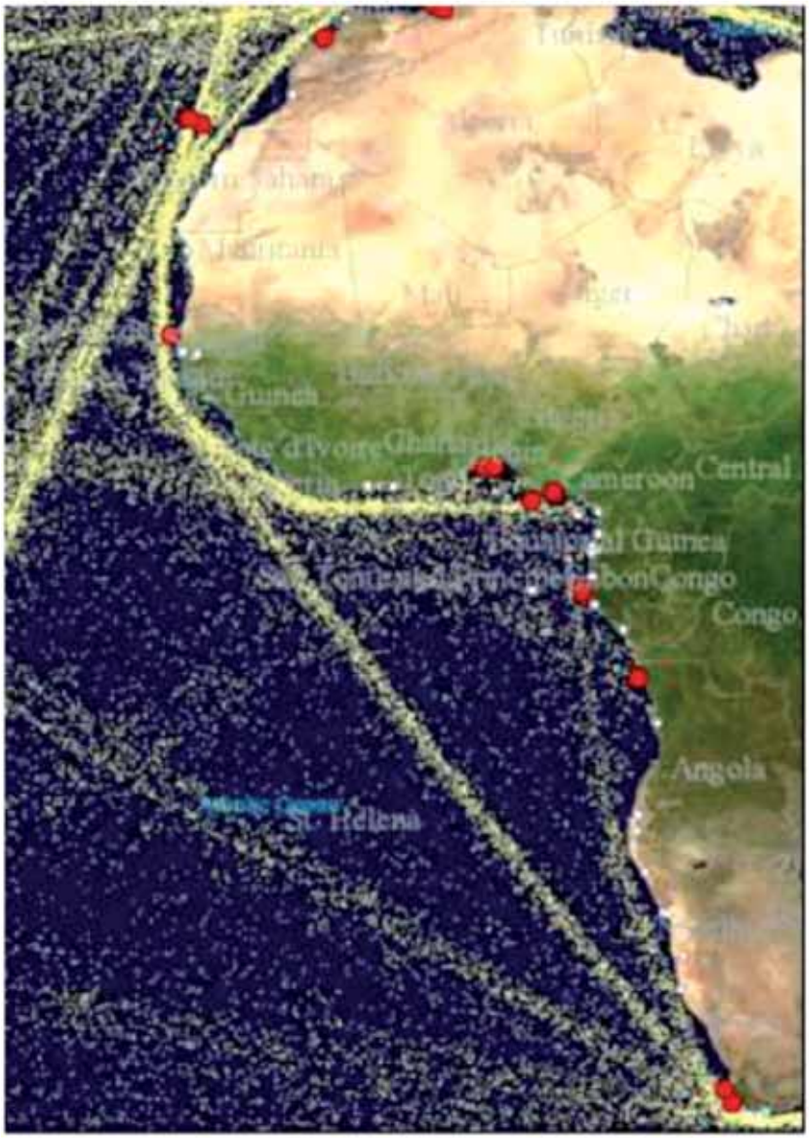
Coastal wetlands play an important role in the tourism industry. Day trips to nature parks and reserves are part of the holiday package of most tourists staying in luxury beach resorts. Demand for longer stays in coastal wetlands is increasing and companies specialising in ecotourism also see potential in marine habitats situated more offshore. The first seagoing expedition will take place in 2011, when birdwatchers and whale watchers will visit the rich front zones along the edge of the continental shelf (Wildwings Tours website).

The expansion of the offshore oil and gas industry presents both a threat to, and an opportunity for, the fragile coastal zone. If poorly managed large-scale industrial infrastructures needed for the extraction of oil and gas are built close to tourist resorts, valuable ecosystems which are barely supporting current coastal development may be weakened further. If they are well-managed, however, environmental impacts can be minimised and a proportion of oil-derived revenues invested in enhancing protection of coastal and marine ecosystems that provide critical services to the people of the region.

Communication and coordination (both between ministries and between government and civil society) and the establishment of no-go zones and enforcement of clear standards and construction guidelines are key to maximising the long-term productivity and stability of the coast. Strategic Environmental Assessment can help countries develop just such a framework and help promote the smooth integration of the various and often conflicting needs for limited coastal goods and services (see also Part III).

2.3 Maritime traffic

Tankers filled with oil (some 400 to 500 million tonnes every year) on their way to the refineries in Europe and North America from Angola and Nigeria in particular pass through WAMER waters (Kloff and Wicks, 2004). An accident involving one of these tankers could have devastating consequences for marine resources and the people who depend on them for food and jobs. The countries of the region have no oil spill contingency plans and very limited capacity to deal with medium to large oil spills (see also Part III).



Map 5. Ship routes from observed reporting positions (yellow dots). Courtesy of Global Ballast Water Management Programme

Small oil spills caused by either accidental or deliberate discharges (such as waste water from tank washing or unburned sludge oil from vessels' engine rooms) have been identified in spite of the fact that international maritime traffic is tightly regulated. The cumulative effect of small spills is not negligible. With oil and gas activities off and onshore, this traffic will increase.

Dangerous or risky manoeuvres during oil transfer from production platforms to tankers may increase spill risks. However, oil and gas development in the region may also help countries to put in place an adequate oil spill contingency plan. This would help further reduce the impacts of a spill involving one of the numerous tankers passing through the ecoregion.

2.4 Climate change

Global warming will have far-reaching consequences on WAMER's biodiversity, not least its marine resources. Species unable to adapt will either move away to colder parts or become extinct, causing unpredictable cascading effects in the marine food webs. Even though climate change has not yet been a major cause of biodiversity loss, effects are already measurable in the ecoregion. The Mauritanian Research Institute, IMROP, showed a significant rise in temperatures since 1970 and correlated this with a reduction in upwelling intensity, the motor behind the WAMER's productivity (IMROP, 2007). Climate change is expected to become a growing threat: despite a number of global and local efforts, the continued need of industrialised nations for fossil fuels, and the increasing demand for energy from emerging economies such as Brazil, China, India, Russia and South Africa predominates.

In addition to global warming, ocean acidification – climate change's evil twin – will threaten marine ecosystems in particular. As the oceans absorb approximately a quarter of the CO_2 derived from burning fossil fuels, carbonic acid is formed (UNESCO website), which decreases the ability of marine organisms to build shells or other skeletal structures. Field studies suggest that impacts of ocean acidification on some major marine calcifiers such as coral reefs and shellfish may already be detectable

Even if the oil and gas potential of the WAMER is relatively small compared with other more conventional hydrocarbon-producing countries such as Nigeria and Angola, the choice to exploit hydrocarbon resources will aggravate the problem of climate change – more CO_2 will be added to the atmosphere from the consumption of WAMER oil and gas.

In order to mitigate or offset the effects, WAMER countries should consider re-investing some of the financial benefits derived from oil and gas in renewable energy, and in conserving and restoring CO_2 bio-sinks such as forests, as well as coastal and marine habitats – in the latter case not least because seagrasses, mangroves, coral reefs and shellfish beds store and sequester large amounts of CO_2 (Laffoley & Grimsditch, 2009). Intense upwelling areas at the front zones also export significant amounts of atmospheric CO_2 in the form of organic carbon to the deep sea (Helmke et al., 2003).

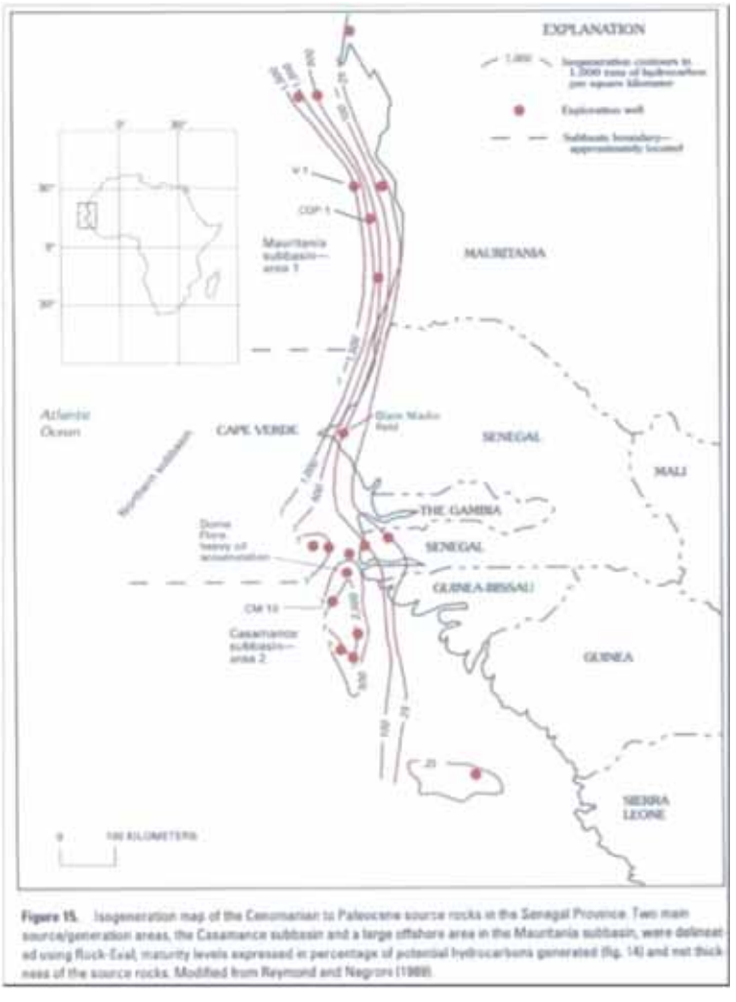
Making part of the oil and gas revenues available for conserving critical marine and coastal habitats as a means to adapt to climate change joins the management recommendations of marine scientists to preserve the fishing sector. Moreover, financing the protection of CO_2 bio-sinks will help prepare the institutional infrastructures needed to acquire funding from offsetting and greenhouse gas reduction schemes. More than 50 bilateral and multilateral funding sources, and over 60 different markets for carbon cap and trade instruments, are available from large consumers of fossil fuels (UNDP, 2009).

Chapter 3

The emerging oil and gas sector

Because the WAMER has fairly good potential, there is growing interest in exploiting oil and gas. New deep-water technology now makes it possible to exploit reserves that were previously considered inaccessible. Prognoses shown below are from a US study, Assessment of the Undiscovered Oil and Gas of the Senegal Province, Mauritania, Senegal, The Gambia, and Guinea-Bissau, Northwest Africa (Brownfield and Charpentier, 2003).

Map 6 shows that oil and gas fields are most likely to be found on the continental shelf and especially along the shelf-break, which is not only a critical area for marine biodiversity (deep-sea coral reefs and pelagic hotspots for biodiversity can be found here – see Map 1) but also an important fishing zone for the foreign fleet in particular (see Map 2).



Map 6. Potential for hydrocarbon per square kilometer. Red dots are exploration wells drilled in the region.

One consortium is already producing off the Mauritanian coast and further oil and gas discoveries have been made in the country's EEZ. With the exception of Cape Verde, all WAMER countries hold potentially interesting hydrocarbon reserves (see country reports in Annex 1).

As efforts to develop the sector accelerate, noise from seismic surveys, drilling and routine waste discharges will affect the environment directly. Oil exploitation will increase risks of spills. But if well managed, potential and direct threats could be reduced significantly. Many examples exist from across the world, notably from the North-East Atlantic (Norway and North Sea countries) where governments have developed their offshore hydrocarbons in reasonably good harmony with nature and other economic uses. WAMER countries can take advantage of their experiences.

But there are many challenges to safely developing the sector. The 2010 oil spill caused by the Deepwater Horizon operation in the Gulf of Mexico underlines the fact that the risk of major catastrophes occurring when developing the sector is always present. Governments of the ecoregion have limited means to protect the marine environment and to control the industry. Patrolling at sea is difficult and expensive. No regional pollution standards exist. There is also not enough knowledge about the marine environment, and especially sensitive ecosystems offshore (where most development is expected to take place) are ill studied such as deep sea coral reefs and pelagic hotspots at front zones of intense upwelling. This makes it difficult to carefully plan offshore oil and gas development and to monitor impacts. Moreover, monitoring is often carried out with high-tech equipment needing highly specialised personnel. Some of this may already be available, but if not, it must be acquired.

The reserves discovered in the ecoregion so far are relatively modest, which means that in order to make exploitation profitable, oil and gas companies are under pressure to save costs – the ecoregion may therefore become exposed to increased risks of casualty and pollution, hence the need for strict government regulation and careful oversight by civil society.

While exploration for oil and gas also helps to better understand the functioning of marine ecosystems (companies look for oil and gas in areas with difficult access and have already discovered deep-sea coral reefs in the WAMER), tight budget constraints make it less likely that companies will finance further and more fundamental research voluntarily. In-depth knowledge is necessary if we wish to protect these valuable but ill studied ecosystems sometimes overlapping with potential hydrocarbon reserves. The first oil well exploited by Malaysian oil major Petronas off the Mauritanian coast is situated in the middle of a pelagic hotspot created by strong upwelling (see Map 1 and Map 14 for a more detailed overview in Annex 1). Pressures are building up in these sensitive sea areas, not least because fishing by the industrial fleet is particularly intense here as well.

Next to environmental impacts and potential conflict with other economic sectors such as fisheries and tourism, the discovery of oil and gas can create a whole range of socio-political problems. Emil Salim, who led the World Bank Extractive Industries Review, summarises these problems:

"Not only have the oil, gas and mining industries not helped the poorest people in developing countries, they have often made them worse off. Countries which rely primarily on extractive industries tend to have higher levels of poverty, child morbidity and mortality, civil war, corruption and totalitarianism than those with more diversified economies. The development of extractive industries only positively contributes to the socio-economy of a country where the fundamental building blocks for good governance are put in place, e.g. a free press, a functioning judiciary, respect for human rights, free and fair elections and so on" (Dr Emil Salim, Chairman of Extractive Industries Review (EIR) quoted in the UK Financial Times, 16 June 2004).

Many WAMER countries already know the downside of the extractive industries. Mauritania relies largely on iron ore, Guinea has an important gold industry, bauxite exploitation is planned in Guinea-Bissau, and diamond exploitation in Sierra Leone has already fuelled violent conflict. In addition, the selling of fishing rights and forestry concessions often creates similar symptoms as those created by the extractive industries.

Today, civil society and the governments of the ecoregion are determined to find the right cure against this resource curse. The need for more transparency is strongly advocated. Governments of Mauritania, Guinea and Sierra Leone signed the Extractive Industries Transparency Initiative (EITI). Sierra Leone's Minister of Information recently stated:

"If oil becomes a flourishing industry, all Sierra Leoneans will benefit, particularly the younger generation. We are going to put in place the structures for accountability and transparency. We will never again make the mistakes we made when we squandered the wealth that should have accrued from diamonds in this country" (also see Annex 1).

Civil society organisations from Guinea, Guinea-Bissau, Mauritania, Senegal and Sierra Leone have joined the worldwide network 'Publish What You Pay' – a global coalition that helps citizens of resource-rich developing countries hold their governments accountable for the management of revenues from the oil, gas and mining industries. The Mauritanian coalition also watches over government earnings from fishery agreements.

An additional barrier associated with developing offshore oil and gas is the fact that some maritime boundaries are poorly defined, which can lead to serious political tension between countries, especially in the event of oil and gas discoveries at the fringes of the EEZs. This is also the case for the WAMER (see Map 7). The UN has already mediated in a number of conflicts concerning such offshore fields – between Nigeria and Cameroon, for example.

The challenge – finding answers to key questions

In deciding to develop their oil and gas resources, the countries of the ecoregion face an important public policy challenge: to make the best possible use of oil and gas revenues while ensuring that the marine environment, and the people and industries that depend on it for their livelihoods, are protected against pollution and other damaging social and environmental impacts.

In light of offshore oil and gas development, it's important to realise that the marine and coastal ecosystems are already under considerable stress from other economic activities, notably fishing, coastal development and maritime traffic, as well as the (increasing) effects of climate change. The previous section discussed how these factors have affected ecosystem integrity and that urgent policy intervention is needed to rebuild marine and coastal resources.

How to rebuild marine and coastal resources?

There is growing consensus among marine scientists that the following measures must be taken to safeguard fisheries:

- reduce catch quotas of fishery resources (below the traditional one-species approach of maximum sustainable yields);
- promote the use of more selective fishing gear;
- involve communities in management;
- make a zoning plan of the ocean with local and temporary fishing closures and no-go zones for habitat-disturbing bottom-trawl fishing (seagrass, coldwater corals and shellfish beds);
- expand the network of Marine Protected Areas;
- Adopting a 'Clean Seas and Clean Fish' policy to protect the marine and coastal environment and the marketability of local fish products; and
- establish, monitor and enforce nationally and regionally agreed pollution standards.

For more information see Boris Worm., 2009. Rebuilding Global Fisheries. Science 325 : 578–584. Also on www.youtube.com. Also contact WWF and its partner organisations.

In terms of coastal zone protection, countries should:

- take the impacts of dam building on marine ecosystems into account;
- integrate the needs of marine resources in water management policies;
- limit land-based pollution;
- limit coastal erosion;
- make a zoning plan of the coast; and
- expand the network of coastal protected areas.

For more information see World Commission on Dams www.unep.org/DAMS/WCD/; and the Coastal Zone Plan of Mauritania (PDALM) and contact WWF and their partner organisations.

To address threats from maritime traffic, countries should:

- sign all relevant IMO conventions;
- apply area-specific IMO tools to better protect sensitive sea areas; and
- set up an oil spill contingency plan.

For more information see Part III.

To increase the likelihood of successfully adapting to climate change, countries should:

- protect terrestrial, freshwater and marine ecosystems that sequester and store CO_2, (also called carbon bio-sinks) such as primary forests, wetlands, floodplains, but also 'blue carbon bio-sinks' such as marine organisms, mangroves, coral reefs, sea grasses and coastal wetlands;
- effectively manage a network of Protected Areas and assure their connectivity;
- increase bio-sequestration of CO_2 by reforestation and restoring degraded wetlands (for example the Diawling National Park in Mauritania and the Djoudj National Park in Senegal);
- introduce cleaner production methods for industry, housing and transport;
- stimulate the use of renewable energy sources such as wind and solar (but not necessarily hydro energy as this may upset natural river flows and degrade important carbon bio-sink habitats such as wetlands and floodplain ecosystems); and

- protect coastal habitats that shelter inland areas from rising sea level, storms and high tides.

For more information see UNFCCC and The management of natural coastal carbon sinks by Laffoley & Grimsditch (IUCN, 2009).

Oil and gas – a window of opportunity?

The challenge is to put these measures into practice. This will inevitably involve costs. Oil and gas could provide vital income to help governments bear these expenses, but this comes with a number of conditions that need to be fulfilled first. If not well managed, oil and gas could accelerate environmental degradation loss rather than support sustainable development. Moreover, a sudden increase in revenues could become a curse, as these transform the socio-economy and political climate, as has been observed in some oil-producing African countries.

The next parts will show how to create the right conditions so that oil and gas can contribute towards more sustainable development in the ecoregion.

Part II

Socio-economic and political impacts of oil and gas: the importance of good governance and public participation

Chapter 4

Good governance and the extractive industries: managing non–renewable resources for sustainable benefits

At present, the world depends on finite oil and gas resources to power its transport, homes and industries. But the use of these fossil fuels results in a range of environmental and social costs which need to be balanced against the benefits that oil can bring.

Hydrocarbons are finite resources and can never be sustainable, but if managed correctly, they can contribute to sustainable development. The development of renewable energy, for example, will reduce the cost of importing expensive fuels in future. Such investment could also be considered as an effort to offset climate change caused by the exploitation and commercialisation of WAMER oil and gas. Investment in the hydrocarbon sector should generate the best economic return for the country while protecting the environment and human rights.

Key to maximising benefits is good governance: decision-making based on transparency and the participation of a broad spectrum of stakeholders from government and civil society.

Without good governance, the oil and gas industry impacts on people and the environment through:

- impacts on the economy which can have adverse social effects such as corruption, wars, and the over-dependence on oil and gas for revenue to the detriment of other economic sectors (the 'Dutch disease') and the resource curse, also known as the 'paradox of plenty';
- climate change; and
- operations on land and at sea.

4.1 Energy revolution

"We cannot let the financial and economic crisis delay the policy action that is urgently needed to ensure secure energy supplies and to curtail rising emissions of greenhouse gases," asserted Nobuo Tanaka, Executive Director of the International Energy Agency (IEA). Speaking at the launch of World Energy Outlook 2008 – the annual IEA flagship publication – he added, "We must usher in a global energy revolution by improving energy efficiency and increasing the deployment of low-carbon energy".

The energy agency stressed that although oil prices had fallen in recent months, the era of cheap oil was over. It predicted that once the economy recovered in about 2010/2011, demand from India and China could cause the price of oil to soar as high as US$200 a barrel by 2030 (Energy Institute website).

The world currently uses more than 70 million barrels of oil a day – a figure that may double by 2025. Even if the rate of use doesn't increase, we would need new resources four times those of Saudi Arabia's to replace fields that are drying up. The impact of a rapid rise in oil prices was clear in 2008 when the price of a barrel jumped to US$150, creating wide fluctuations among world economies.

Developing countries will find the cost of imported oil and gas painfully (if not prohibitively) high – this, too, will affect their development plans unless they use their own reserves carefully, reduce their consumption levels, increase their energy efficiency and invest in renewable energy resources. These decisions will have far-reaching consequences on how a country's energy is generated, who has access to it and who benefits from it. Therefore, transparent decision-making is essential if public support is to be maintained and assured – and conflict avoided.

It is essential to get the best possible financial, economic, environmental and social benefits possible if a decision is made to allow oil exploitation.

4.2 Oil is becoming scarcer and prices higher

As the world's oil supplies become scarcer, prices will inevitably rise – and the poor will suffer most. If this is not addressed, serious social, environmental and political problems will result. That's why the process of contracting needs to be informed, open and transparent.

Although hydrocarbons are finite resources, they can contribute to sustainable development if managed correctly. Investment in these resources should generate the best economic return for the country over the long term.

Oil and gas development projects require large capital investment in geological surveys and identifying hydrocarbon resources before any commercial exploitation begins. Because investment risks are so high and acquiring capital and expertise so difficult, most developing countries grant development rights to foreign companies with very mixed results.

The difference between a good and a bad contract can be measured in billions of US$.

Cameroon	11%	Nigeria (offshore)	65%
Mauritania	22%	Nigeria (onshore)	84%
Mexico	31%	Gabon (onshore)	73%
Canada	35-50%	Sudan	77%
Ivory Coast	55%	Norway	84%
Equatorial Guinea	60%	Iran	93%

Source: US General Accounting Office, May 2007, PRCM website.

4.3 David and Goliath

Many international extractive industries are more experienced and economically powerful than the developing countries with which they are negotiating, and the two often have conflicting objectives.

The objectives of international oil companies are to build equity and maximise wealth by finding and producing oil and gas reserves at the lowest possible cost and highest possible profit margin.

Some state-owned oil and gas companies are more interested in obtaining long-term supplies than in obtaining the highest profit margin. Their deals appear to be better and are linked to international development assistance programmes. Some, however, have created major social and environmental problems, notably in the Congo basin.

The host country's objectives may include public interest goals, economic growth, quality of life, optimal use of mineral resources, earning foreign exchange, satisfying domestic fuel demand and minimising adverse effects of mineral exploitation on the environment. It also includes fostering both direct and indirect employment, accumulating expertise and establishing a solid foundation for future generations.

Because the exploitation of offshore oil and gas can impact upon several other sectors, notably fishing and tourism, it is important to establish a national inter-ministry extractive industry committee. This must have clear Terms of Reference and a chairperson appointed by the government to deal with planning, environmental management, interaction between sectors, contracting, transparency and law enforcement. Some of the biggest problems have occurred when all the responsibility for developing oil, gas and mining is left in the hands of just one ministry.

4.4 A model for citizen participation: citizens' advisory councils

Public participation in planning oil and gas development is critical. All involved need to have access to information and the means to participate in lengthily decision-making procedures.
In Alaska, citizens have found ways to engage fully and effectively in a constructive and equitable

dialogue with government and the industry. After the Exxon Valdez oil spill of 1989, people lost all faith in the self-regulating capabilities of the oil industry and the ability of their government to exercise control. The citizens organised the Prince William Sound Regional Citizens Advisory Council (PWSRCAC) to provide a voice for communities. It is an independent non-profit corporation guided by its mission: citizens promoting environmentally safe operation of the oil pipelines, marine terminal and the oil tankers that use them.

The citizens' council in Alaska is an organisation with money, staff, authority, broad representation and, most of all, independence. Councils such as this provide support for the transparent process required by the Extractive Industry Transparency Initiative and similar schemes.

A complete overview of how the Alaska Citizens' Council is organised can be found in Annex 4. For more information, see also www.pwsrcac.org

In the aftermath of the Deepwater Horizon oil spill, legislation was introduced into the US Senate on 30 June 2010 to establish a Gulf of Mexico Regional Citizens Advisory Council (RCAC), funded to the tune of US$18 million a year.

4.5 Integration of hydrocarbon investments in National Plans

Extractive industries should be developed in the context of national sustainable development, poverty reduction and environmental plans, national and international laws, treaties and conventions. It is important to establish a national extractive industry committee, with its chairperson appointed by the president or prime minister. It can include the minister for the environment (who is often the chair), the ministers responsible for extractive industries, agriculture, fisheries, health, planning, and foreign affairs.

Foreign assistance can be sought during the contracting process. External support can come from aid donors and from international lawyers, who can support government negotiating and contract review teams. Examples include:

Liberia: A civil war fought mainly over natural resources devastated Liberia between 1989 and 2003. In 2006, the new President set about renegotiating contracts and enlisted the International Senior Lawyers Project (ISLP), which offers pro bono help to developing and deserving nations. A review team was appointed which included ministers or agency heads from a number of government departments, all of whom were directly accountable to the President, the National Legislature and the public before whom they had to defend the contracts. They were supported by four international lawyers and a Liberian lawyer (Revenue Watch website).

Of the 102 contracts reviewed, 52 were accepted, 36 were cancelled and 14 were recommended for renegotiation, including five oil contracts, a mining contract and a rubber contract. The renegotiated contracts produced significant gains for the state and the affected communities.

Nigeria: To control corruption associated with the extractive industries, Nigeria introduced a law in 2004 recognising the country's Extractive Industry Transparency Initiative (EITI). In 2009 the initiative's executive secretary reported that as a result, $US5 billion had been saved through fraud prevention in the first five years (Vanguard newspaper, 2009).

This was one of the actions that a former oil minister promised a delegation from West Africa in 2006. He said, "learn by the mistakes that Nigeria has made. We relied too much on the oil companies to follow international standards. The result was pollution, corruption, a distorted economy and a destabilised society". Nigeria also failed to develop its renewable resources.

Nigeria recruited senior staff from the World Bank and other international Institutions. It also clamped down on pollution and corruption, and many changes occurred including the establishment of a Nigerian Oil Spill Response Agency (NORSA) and a National Standards Regulations Enforcement Agency (NESERA) within the Ministry of the Environment. Unfortunately the oil industry was exempted from inspection by NESERA, which defeated one of the principal objectives of forming NESERA.

Mauritania: A transitional government put in place after a military coup in 2005 sought advice from several experts with regard to amendments that were allegedly illegally added to the production sharing agreement for the development phase of the first oil well (Goodland, 2006; Trebaol et al., 2006). This resulted in a settlement with the oil company; the amendments were annulled and a project bonus of US$100 million was paid.

The conflict with the oil company also raised awareness in government circles that it should play a more dominant role in regulating the sector and to promote transparency. Several development organisations are now helping the government to build a sound regulatory framework and to strengthen institutions (see also Annex 1).

4.6 Contractual arrangements

Contracts can be divided into two basic types: concession licences and contractual arrangements. The differences arise in varying attitudes towards compensation, reward-sharing schemes (including levels of government involvement) and the levels of control granted to companies.

Under concession licences, the state owns all mineral resources (including oil and gas), but the rights to produce the minerals are granted in exchange for royalty and tax payments (Bindemann, 1999; Johnston, 1994).

Joint Ventures

Two or more parties form a joint venture (JV) to develop oil and gas and agree to create a new company. Both contribute equity and share the revenues, expenses and control of the enterprise. JVs are often established between local and foreign companies (about 75% are international) but failure rates are 30-61% (Osborn, 2003).

A typical example of a JV company is the Shell Petroleum and Development Corporation (SPDC) in Nigeria. This operates a JV agreement involving the Nigerian National Petroleum Corporation (NNPC) which holds 55%, Shell 30%, EPNL 10% and Agip 5%.

Problems arose when the company tried to recover operating costs from the state partner. Replacement of old pipes and installations was delayed for years. Corroded and leaking 40-year-old pipelines were left in the ground, creating serious environmental, social and human rights abuses. When the JV company was found guilty of breaking gas flaring and oil pollution laws, the state had to pay 55% of the fines imposed.

Production-sharing contracts

Under a production-sharing contract (PSC), mineral/hydrocarbon resources are owned by the state, which brings in a foreign company as a contractor to provide technical and financial services for exploration and development operations.

The main objectives of a PSC are to encourage foreign investors and to ensure equity between the revenue of the state and the profit of the company, while strengthening the state's management of operations. The PSC is attractive to foreign firms because they can book the reserves in their balance sheets even though they don't own them. The attraction to producer countries is that they can share the profits without the risks and they can still insist on laws being respected without having to contribute to fines if the exploitation company breaks the law.

A typical PSC model showing how revenue can be allocated to all parties

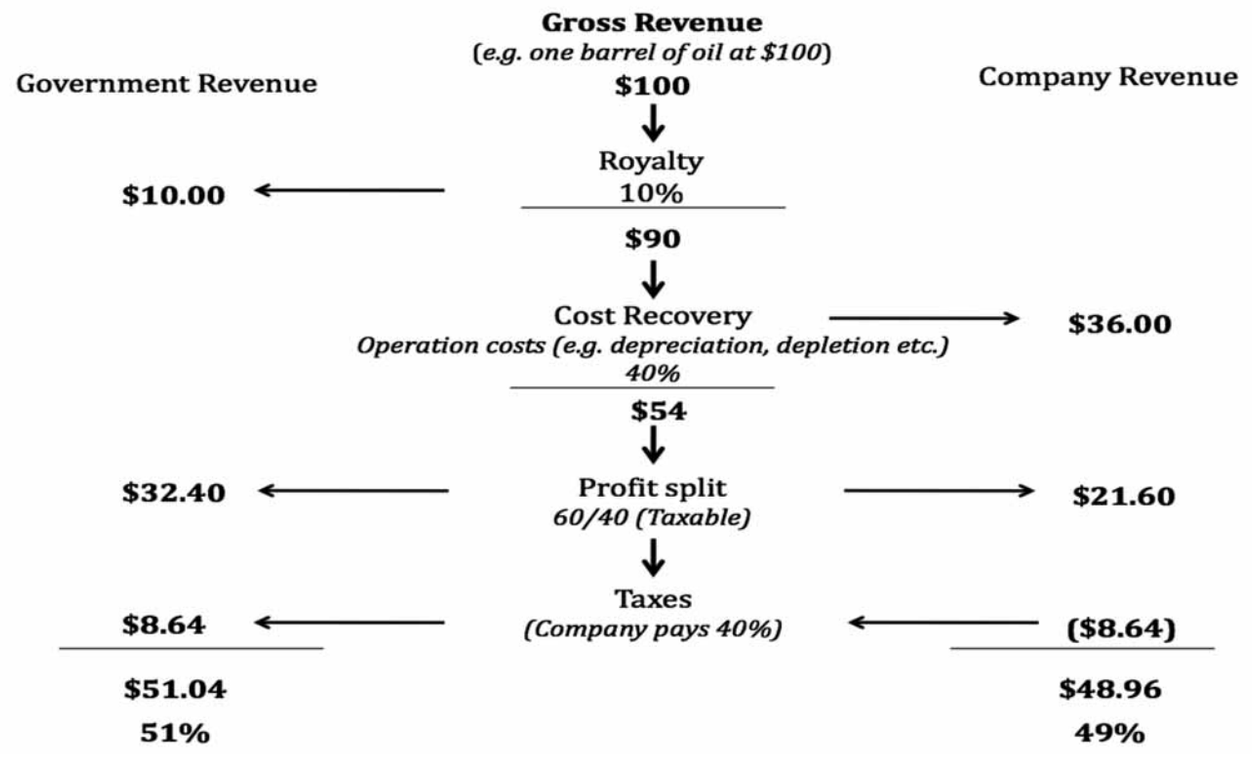


Figure 2: A single barrel of oil at $100 is tracked through a Production Sharing Contract, based on a model first developed by Johnston, 1994.
A 10% royalty is applied. Operation costs, in which the company is allowed to recover costs out of net revenues, are limited at 40% of gross revenue less the 10% royalty. The remaining revenue is shared 60/40 in favour of the government. The company pays a 40% tax rate. After taxes, the company's financial entitlement comes to 49%.

Other methods allow the government to take an increasing share as the price rises, which explains why Nigeria gets such high returns.

Contract problems
Conflicts of interest between public and private partners have arisen over a range of issues, including failure to follow national and best practice standards, human rights abuses, allowable expenses, taxation, fines, corruption and repatriation of profits. Tendering was supposed to reduce corruption, but it is often the principal entry point for imposing 'crony' contracts.

Chapter 5

Oil and gas operations worldwide

Under the right conditions and with the right controls, the development of oil and gas can contribute to national development. However, the World Bank-funded Extractive Industry Review (EIR) concluded that this often fails to happen in developing countries. The so-called 'Dutch disease' (the over-dependence on oil and gas for revenue to the detriment of other economic sectors), the resource curse (the paradox of plenty) and pollution are affecting large numbers of people, especially the poor.

5.1 World Bank-funded Extractive Industry Review (EIR)

The Extractive Industry Review headed by Dr Emil Salim, a distinguished scientist and former Environment Minister in Indonesia, concluded that the development of extractive industries only positively contributes to the socio-economy of a country where the fundamental building blocks for good governance are put in place – for example, a free press, a functioning judiciary, respect for human rights, free and fair elections and so on. Many African countries that rely primarily on extractive industries generally score low on the Human Development Index and tend to have high levels of poverty, child morbidity and mortality, civil war, corruption, totalitarianism and environmental degradation (EIR, 2004).

Unfortunately the oil and gas industry does not always practise adequate environmental standards in Africa. Oil pollution is common. The engineering standards and equipment used are not always of the same standard as those used in industrialised countries and the capacity of governments and civil society to monitor the sector is low. For example, floating production and storage units (FPSOs) in the North Sea and the US are all newly-built with double hulls, whereas most FPSOs in African and some Asian seas are made from cheaper single-hulled oil tankers built in the 1970s and no longer legal for transporting oil. The first oil field in the WAMER is likewise developed with such a single-hulled converted oil tanker (see Annex 1, Mauritania). Discharge of production water in estuaries and other sensitive ecosystems is forbidden in the US, whereas this is common practice in Africa and Asia.

An infamous example of environmental degradation caused by the oil and gas industry in Africa is the Niger Delta in Nigeria. Over the past 50 years, more than 6,800 oil spills have occurred in Africa's largest mangrove forest and the third largest wetland in the world (Nigeria's Federal Ministry of the Environment). The delta was one of the most important fish breeding grounds in Africa, but is now severely damaged. Today, 60% of fish consumed in the delta is imported (Personal communication with Fisheries Department River State Government, 2006).

Countries wishing to develop their hydrocarbons need to realise early in the development stage what the risks are, and to be especially aware that oil and gas are finite resources and can be depleted very quickly. Production lifetime in Mauritania has been estimated at 20 years (see Annex 1).

Countries need to ensure that oil and gas revenues are maximised for producer countries. Some companies are boasting that they can get up to twice as much per acre for exploration in Africa than they can get in Asia for the same money. Revenue needs to be used to develop sustainable activities, including agriculture, fisheries and renewable energy.

5.2 Oil extraction in Africa

Africa now has 50 years experience of oil exploitation and many lessons have been learnt. As part of its capacity-building component, WWF and its PRCM partners arranged for many senior government officers and NGO staff from the West African Ecoregion to visit Nigeria, see for themselves and hear directly from the authorities and affected

people groups what lessons had been learnt.

It is worth noting that:

- in the 1960s, Africa produced 10 million tonnes of oil per year while today, it produces 376.4 million tonnes of oil per year – 10.6 % of world oil production;
- between 2003 and 2012, production is predicted to exceed 20 billion barrels, worth at least $1,000 billion. As much as 80% is expected to come from Nigeria and Angola;
- the US plans to obtain 25% of its hydrocarbons from Africa by 2015;
- China has become a big competitor for African oil, is dealing directly with African governments, and is already involved in oil extraction in Sudan, Kenya and Nigeria;
- the rush for oil is causing or contributing to conflicts in many parts of West Africa;
- oil is being stolen from Nigeria on a massive scale. Mafia and terrorist groups are believed to be involved;
- disaffected rebels challenge governments and use money from stolen oil to purchase arms;
- corruption is a major issue: easily earned money invites 'rent seekers' behaviour, including kidnapping;
- fraud and corruption spread from oil and gas to other sectors; and
- companies are moving from Asia to Africa because they can get a better deal from African governments. The cost of licences and share of profits with governments is much more favourable for the companies in Africa than in Asia.

5.3 UN concerns about oil and gas development in West Africa

The UN Secretary-General was so concerned about governance problems surrounding oil development in West Africa that he appointed a Special Representative, who presented some of the critical issues associated with oil and gas development in 2004.

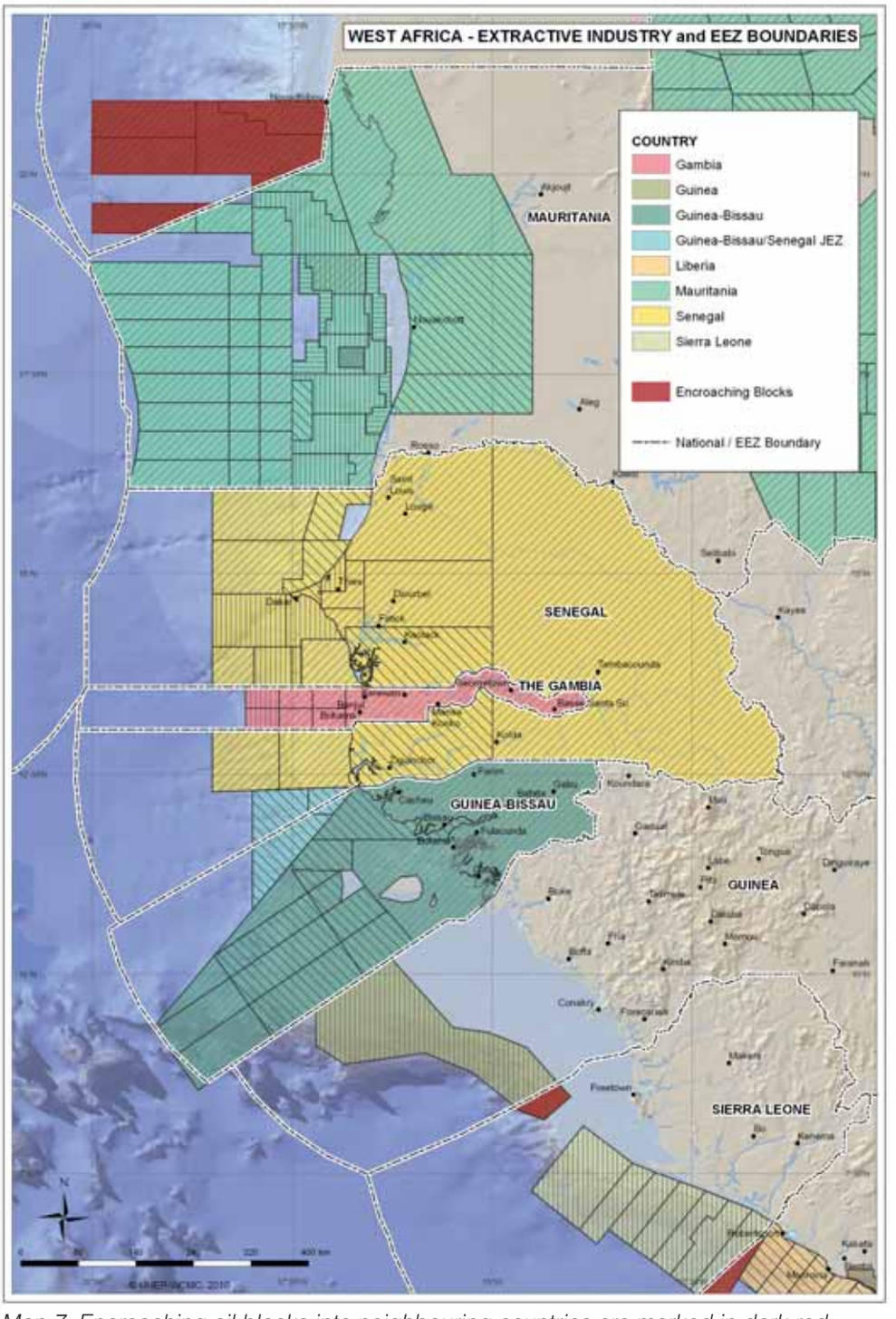
Tensions are caused by:

- a scramble for highly-priced oil in the region;
- delimitation and demarcation of inherited boundaries, particularly marine boundaries;
- corrupt practices and lack of transparency; and
- states weakened by over-dependence on oil (Dutch disease/paradox of plenty).

Disputes occur at many levels:

- between states on delimitations of maritime boundaries (See Map 7);
- between governments and oil companies on contracts and revenues;
- between governments and their populations on revenue sharing;
- between oil companies; and
- between local authorities and ethnic groups over rights.

In addition, confusion exists in WAMER about maritime boundaries. There are concessions belonging to a particular country encroaching on the EEZs of adjoining countries – for example, the northern blocks in Mauritania and the most southern blocks of Guinea and Sierra Leone. In the event of oil and gas discoveries in these areas, it's likely that this will cause serious political tension, as has happened between Nigeria and Cameroon. The encroaching parts of the offshore blocks are marked in dark red on Map 7. The trans-border blocks in between Senegal and Guinea Bissau marked in light blue are jointly managed by both countries through the intergovernmental agency AGC (see Annex 1).



Map 7. Encroaching oil blocks into neighbouring countries are marked in dark red

5.4 Good governance

The UN is trying to resolve disputes by promoting 'good governance' – for example, by:

- supporting democratic reforms in producer countries to minimise the risks of wars and increase stability in oil producing regions;
- arbitration and negotiation;
- sharing oil revenue – such as Nigeria splitting revenues from a disputed marine oil field with Equatorial Guinea or Senegal sharing with Guinea-Bissau;
- transparency (EITI – see below) in dealings with the oil industry to help reduce tensions and benefit countries;

- companies publishing details of what they pay;
- national and local government informing the public on how oil revenue is used; and
- transparency to favour development projects which benefit all.

Good governance recommendations made during a PRCM visit to Nigeria in 2006 are as follows:

- protect the natural resource base, human rights and sustainable development plans;
- establish an Inter-Ministerial Committee to oversee the extractive industries;
- improve governments' ability to negotiate with and manage oil companies;
- obtain international assistance in negotiations and management;
- carry out SEAs, as recommended by the Abidjan Convention and the Paris Declaration;
- reinforce environment ministries to strengthen environmental monitoring;
- ensure adequate legal infrastructure for controlling offshore oil operations;
- enforce all laws, conventions and treaties and cancel contracts when companies break laws;
- refuse the use of converted old single-hulled tankers as floating, production, storage and offloading platforms (FPSOs); and
- join the EITI (see below).

The EITI (Extractive Industries Transparency Initiative) is a coalition of governments, companies, civil society groups, investors and international organisations which:

- promotes equitable benefit sharing from the extractive industries;
- aims to improve transparency and accountability in the extractives sector by setting standards to verify and publish company payments and government revenues from oil, gas and mining; and
- has a robust yet flexible methodology that ensures a global standard is maintained by the implementing countries.

This Initiative aims for full public disclosure of earnings and spending derived from oil and gas revenues. It includes a coalition of governments, companies, civil society groups and investors. EITI has established criteria for full publication and verification of company payments and government revenues from oil, gas and mining. It has a robust yet flexible methodology for monitoring and reconciling company payments and government revenues at the country level. The process is overseen by participants from government, companies and national civil society. The EITI board and the international secretariat are the guardians of EITI methodology internationally.

The quality assurance mechanism of EITI is done through a process serving two critical functions: to promote dialogue and learning at the country level; and to safeguard the EITI brand by holding all EITI implementing countries to the same global standard. Validation has broad objectives: it evaluates EITI implementation in consultation with stakeholders, it verifies achievements with reference to the EITI global standard, and it identifies opportunities to strengthen the EITI process going forward. The process includes two phases. The first includes compliance with sign-up indicators if it is to become a 'Candidate Country'. The second phase includes indicators to prepare, disclose and disseminate information on the initiative if it is to become a 'Compliant Country'. So far Liberia is the only African country that has obtained the 'compliant country status' (EITI website).

Civil society groups have set up a global Publish What You Pay coalition which aims at overseeing and advocating a serious implementation of the principles laid out in the EITI Agreement (www.publishwhatyoupay.org).

5.5 Rush for the last drops

Many industry experts believe that we have reached the maximum rate of global petroleum extraction. The peak-oil movement, a group of independent scientists and NGOs, estimated that by 2008 we had extracted half of the Earth's oil (peak oil websites) – which means we're using oil faster than we can find it. This explains the free trade policies that have been aggressively promoted over the last decade; these are supporting new exploration by encouraging oil companies to freely invest in developing economies where the West African region is seen as an important frontier. New deep-water technology and

increasing oil prices make the search for offshore oil and gas profitable, even in non-conventional areas where no oil or gas was found in the past century and about which experts say that only relatively small reserves may be encountered.

If new-found reserves are relatively small, oil and gas companies will face significant budget constraints to make extraction profitable. As a result, the marine ecoregion and socio-economic sectors depending on a healthy marine environment run the risk of becoming exposed to cost-saving and substandard practices. To prevent this, it's vital that countries do not overly rely on the self-regulating capacity of oil companies, but instead dictate very precise rules on how and with what techniques they want their oil and gas reserves to be developed in order reduce risks.

5.6 Dutch disease

It's important that national economies stay diversified and don't become dependant upon oil revenues alone. Without the right precautions, oil and gas extraction may distort the macro-economy, a phenomenon also known as the 'Dutch disease' (the term originated in the Netherlands after the discovery of North Sea gas). Its basic symptoms are that the economic sectors such as agriculture, fisheries and locally made goods decline and, in the worst cases, may even disappear.

The root cause of this so-called 'de-agriculturalisation' or 'de-industrialisation' is that boom revenues derived from extracting mineral or hydrocarbon resources raise the value of a nation's currency to such a degree that non-extractive industry goods become less competitive with other nations, resulting in increased imports and decreased exports (Investor words website). This would be catastrophic for the WAMER countries, as labour-intensive agricultural and local fishery sectors provide work for large numbers of people, whereas the oil and gas sector will create very few local jobs. The risks of 'Dutch disease' can be reduced by investing in activities such as sustainable fisheries, forestry, agriculture, renewable energy, tourism and local manufacture.

Saving some of the funds abroad in hard currency special funds, and bringing them into the economy slowly, avoids the negative impacts of flooding all the revenues into the economy at once. Examples of special funds include the Government Pension Fund in Norway, the Stabilisation Fund of the Russian Federation, the State Oil Fund of Azerbaijan and the Future Generations Fund of Kuwait. However, freezing the spending of boom revenues in developing countries can be politically difficult as there is ample pressure to use the funds immediately, rather than strategically, on poverty alleviation projects while ignoring the broader and longer-term macroeconomic implications (Wikipedia, 2007).

5.7 Best practice

In the absence of international rules and regulations governing the oil and gas industry's operations, a series of best practice guidelines has been drawn up as being a positive way forward. They include the following:

Legal and institutional reforms
Undertake reforms in the legal, policy and institutional framework for oil and gas development to respond to the emerging challenges associated with the sector. It is useful to ensure the separation of roles among the various organs, including development, regulation and enforcement, with a view to increasing efficiency, transparency and accountability in the industry. The reforms should consider the adoption of international instruments, best practices and regulations. Particular attention should focus on a comprehensive review of the Petroleum Act and Petroleum Production Sharing Agreement (PSA) to conform to present realities and emerging developments in the sector.

Extractive Industrial Review
Establish governance structures, sustainable financing and revenue sharing mechanisms following the extractive industry transparency initiatives (EITI) principles.

Capacity building and technical assistance
Enhance skills and build institutional capacity to deal with challenges associated with the development of the oil and gas industry. More efforts should be directed towards regulatory and enforcement agencies, revenue management and mitigation of impacts as well as the civil society groups engaging in the sector.

World Bank safeguard policies
Countries are encouraged to apply national environmental policies and World Bank safeguard policies and environmental, health and safety guidelines.

Community development plans
Governments and prospecting/producing oil and gas companies should draw up community development plans in a participatory manner. This is to ensure that the interests of local communities are considered and that they derive benefits from the petroleum investments. The community development plan – paid for by oil and gas revenues – can include provision of education and health facilities, water and power supplies and employment and training opportunities for local people.

Corporate social responsibility
Oil and gas companies are encouraged to embrace corporate social responsibility.

Communication strategy
An effective communication strategy is essential. Misconceptions about the project often spread in the absence of a good strategy. This should be tailored to various audiences.

Regional collaboration
Pursue regional efforts to address oil and gas development. The Abidjan Convention and the Economic Community of West African States (ECOWAS) could provide a framework for addressing regional issues. The Abidjan Convention in November 2007 recommended the use of SEAs and other environmental assessments to identify threats and opportunities presented by oil and gas development.

International instruments, treaties and protocols
Countries are encouraged to ratify international conventions and protocols relevant to oil and gas development. WAMER governments should consider preparing comprehensive standards for guiding oil and gas operations. These should be based on international best practices, and utilising model oil and gas development guidelines from OSPAR countries (including the Netherlands, Norway and the UK) and the World Bank/IFC.

We also recommend that WAMER governments and stakeholders establish regional and local citizens advisory councils based on the model in Alaska to facilitate an open and informed dialogue between all stakeholders.

In order to reduce the risks of developing the 'Dutch disease', governments should:

- not allow oil and gas revenues to distort the economy;
- encourage investment in other (preferably renewable) economic sectors; and
- save some of the revenues in hard currency special funds, bringing them into circulation slowly and strategically.

When drawing up hydrocarbon contracts, the following should be considered:

- protect the natural resource base for present and future generations;
- establish an inter-ministerial extractive industry committee with clear terms of reference and a chair appointed by the government, to deal with planning, environmental management, interaction between sectors, contracting, transparency and enforcement of laws;
- do not allow oil and gas investment to distort the economy or destabilise population;
- address the country's energy needs before allowing exports; and
- demand the best available techniques and standards, and refuse the use of converted single-hulled tankers as floating production and storage platforms (FPSOs).

To protect food resources and the health of the population:

- protect all rights of the population – particularly the right to food, water clean air and employment;
- reinforce the powers of the Environment Ministry to strengthen environmental monitoring;
- allow other ministries such as Agriculture, Fisheries, Health, and Planning to be involved in enforcing laws and monitoring oil and gas activities, and those of any other polluting industries;

- obtain prior informed consent of local/indigenous people and ensure they benefit;
- produce guidelines for security forces; and
- reinforce public engagement through citizens advisory councils.

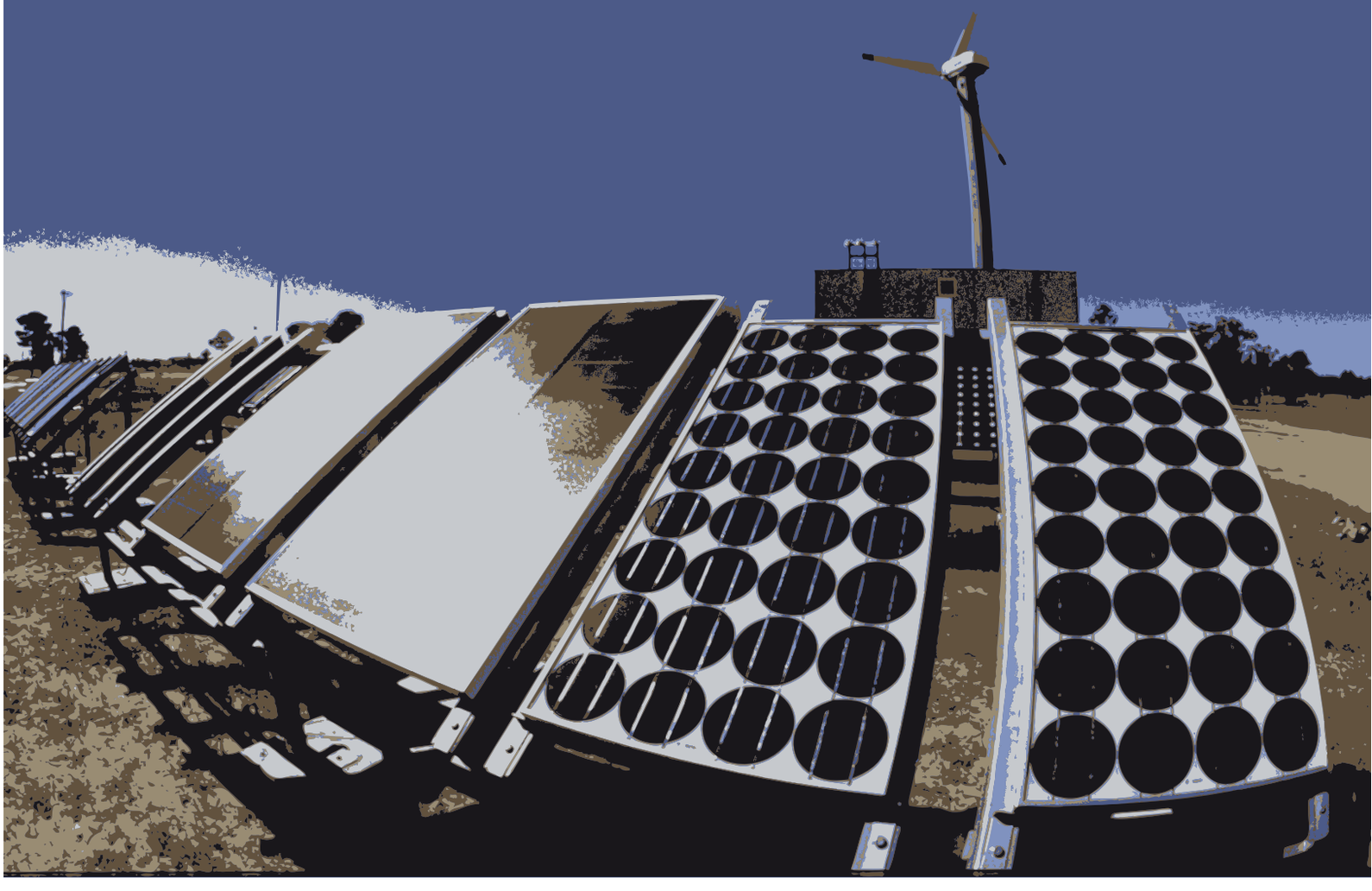
In terms of financial and legal controls, governments should:

- maximise the positive and minimise the negative long-term impacts of investment in the hydrocarbon sector;
- consider obtaining international assistance to develop best possible contracts;
- share profits without compromising the ability to manage or enforce laws;
- ensure adequate legal infrastructure for controlling offshore oil operations;
- enforce all laws, conventions and treaties and cancel contracts when companies break laws;
- legalise government/industry transparency (FOIA, PWYP, EITI);
- ensure that public revenue is fairly and transparently managed (maximise take + spend strategically + savings fund);
- maximise the benefits to the local economy – jobs, revenue sharing, etc;
- ensure companies have sufficient financial liability insurance (unlimited for gross negligence);
- insist that companies restore all damage possible after closure;
- establish and pre-finance project closure protocols; and
- invest funds from oil and gas in sustainable energy.

Many of these best practices were recommended not only by the Nigerian minister responsible for petroleum, but also by senior government officials during a visit to Nigeria in 2006.

Part III

Environmental impacts, policies and best practice



Chapter 6

Combined impacts on the marine environment

Offshore oil and gas development can affect the marine environment in many different ways. The combined impacts of exploration and exploitation phases include noise and vibration, solid and liquid production wastes, increased water column turbidity from dredging, disturbance of the seabed, increased maritime traffic, invasion of non-indigenous species carried in ballast water of support vessels and oil tankers, and avoidance of the area by marine wildlife such as fish and marine mammals due to construction noise and the presence of facilities such as oil platforms (Patin, 1999; Wills, 2002; Steiner, 2003).

Environmental stress generated by offshore oil and gas development can cause different biological responses. The flow-chart in Figure 3 illustrates how.

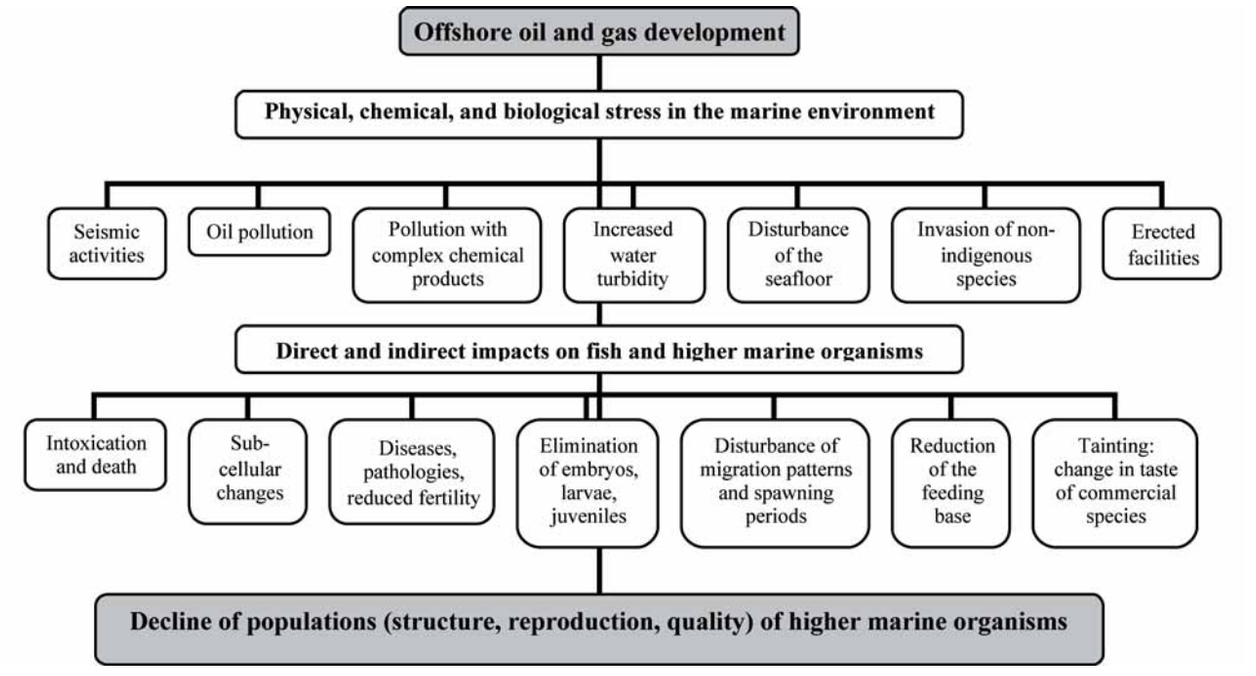


Figure 3: Flow-chart showing impacts of offshore oil and gas development on the marine ecosystem (based on a flow-chart from Patin, 1999)

The severity of the impacts depends on a combination of many natural and human-induced factors: different ecosystems, habitats and organisms react differently to oil and gas development. As it is almost impossible to predict with precision how the offshore oil and gas industry will affect certain areas, the precautionary approach is the best way forward – which means that sensitive ecosystems such as coastal wetlands, deep sea corals or shellfish beds and rich front zones should be protected totally and declared no-go zones. In addition, sensitive time periods such as the migration of birds and important fish species associated with a variety of predatory species (bill fish, sharks and cetaceans) should be taken into account when planning oil and gas operations.

It should also be remembered at all times that just a small amount of oil pollution can change the taste of fish, and that this in turn affects its marketability.

6.1 No international legal framework

Although offshore oil and gas development adversely affects the marine environment and can pollute vast sea areas that cross borders, no comprehensive legal framework outlining minimum environmental standards has been elaborated at the international level. This means that there is no legally binding international guidance for the elaboration of minimum norms and standards.

In spite of the absence of a universal legal framework, many general principles contained in international conventions intended to protect the marine environment also apply to offshore oil and gas development. Examples include the Convention on Wetlands of International Importance (Ramsar), the Convention on Biological Diversity (CBD) and the Convention on the Conservation of Migratory Species (CMS). But none of these conventions dictates precise norms and standards for offshore oil and gas development and therefore leave room for different interpretations.

The United Nations Convention on the Law of the Sea (UNCLOS) specifically refers to offshore oil and gas development and calls on countries to set up their own domestic or regional legal frameworks and to make sure sufficient financial resources are available in case of accident. But this convention has adopted no norms for waste discharges, so countries must set the standards themselves. For a list of guidelines that can help countries to formulate a domestic or regional legal framework, see Annex 2. Annex 3 gives an overview of relevant conventions that have been signed by the WAMER countries.

Many countries involved in oil and gas development have already formulated detailed minimum environmental standards. Because marine pollution easily crosses borders, this is often done on a regional level in line with the principles outlined in UNCLOS. Examples of such regional agreements are the OSPAR Convention for the North-East Atlantic (with which the Abidjan Convention is twinned), the Barcelona Convention for the Mediterranean Sea and the Helcom Convention for the Baltic Sea. For the West African Ecoregion, the Abidjan Convention represents the appropriate legal framework to introduce similar minimum standards for offshore oil and gas development. But WAMER countries could introduce a regional hydrocarbon convention among themselves.

6.2 The need for a strategic approach

Discussion about the need to minimise environmental impacts of the oil and gas industry was one of the most significant changes of the 1980s – which means that environmental regulation of the sector is a relatively recent phenomenon. In the past, there was an assumption that wastes discharged into the ocean from offshore oil and gas installations were rapidly diluted to safe levels by the hydrological processes of mixing and dispersing. But today, it's evident that persistent background contamination occurs in seawater, sediment and marine ecosystems.

Although there is a need to set minimum standards for offshore oil and gas operations, just formulating uniform norms for the discharge of waste products is not enough. Setting minimum standards for isolated development steps does not take into account the cumulative impacts when different development stages occur at the same time in the same place.

Such an approach also fails to recognise the environmental stress induced by other human uses of the sea such as fishing or land-based pollution; nor does it recognise the vulnerability of different ecosystems. Sensitive ecosystems such as mangroves and nursery areas for fish may not be able to sustain oil or gas development at all. It's also possible that in some cases certain economic activities are unable to coexist with offshore oil or gas development – for example, the tourist industry in Florida is convinced that offshore oil development would do unacceptable harm to its business. This has been an important argument in maintaining a moratorium on all offshore oil and gas developments in that state.

According to UNEP, the concept of sound management for the offshore oil and gas industry calls for a different approach. Strategies must provide sustainable multiple use solutions to solve many of the conflicts surrounding conservation and resource use in the marine environment (UNEP website).

Box 2: Sensitive ecosystems

Most coastal wetland areas of the West African Marine Ecoregion – mangroves, estuaries, corals, seagrasses and tidal flats – are particularly vulnerable to disturbance. Oil and gas development within or near such areas can greatly damage these ecosystems. Routine or accidental discharges of waste products are likely to accumulate in these critical habitats. Pollutants stick to suspended material and are deposited on the shoreline or the seabed and are eventually taken up in the ecosystems via the root systems of (for example) mangroves or seagrasses.

In deep and turbulent water further offshore, waste products may dilute more quickly over vast areas (NRC, 2002). However, this does not mean that offshore oil development further at sea will not affect vulnerable ecosystems. Front zones with abundant marine life and seabirds, and rich benthic ecosystems such as deep sea coral reefs and shellfish beds can be found here. Small oil spills frequently created during offloading operations mostly disintegrate before hitting the coast, but at sea these may affect large numbers of seabirds found at front zones of intense upwelling. Rich benthic ecosystems such as shellfish beds on the continental shelf and coral reefs in the deep sea can become smothered by drilling operations. Some pollutants contained in waste products routinely discharged at sea, such as PAHs in production water which are persistent in time and can travel long distances without losing toxicity. These may therefore still end up in the vulnerable coastal wetlands. The Banc d'Arguin Park in Mauritania is particularly at risk due to its geological formation, which means that it draws in water from far away with great force.

Seismic surveys preceding oil and gas development can do great harm in habitats known as nursery areas for marine species. Fish eggs and larvae cannot swim away and may suffer lethal or sub-lethal damage when they are in close vicinity to airguns used in surveys.

Mangrove forests in The Gambia

Sea grass of the Banc d´Arguin, Mauritania

Pelagic hotspot with dense seabird concentrations at the Mauritanian shelf break off Cap Blanc (photo: Erwin Meesters)

6.3 Strategic Environmental Assessment (SEA) – when, where and how?

The strategic Environmental Assessment (SEA) is a high-level decision-making tool used to promote sustainable development.

The maps of the ecoregion have shown that fishing along the continental shelf-break is intense and that most oil and gas development is expected to take place here – an area extremely rich in biodiversity with deep sea coral reefs and pelagic hotspots for biodiversity created by intense upwelling. To avoid conflict between industrial and artisanal fishermen and the emerging oil and gas sector, while at the same time guaranteeing the sustainability of marine resources, more detailed ocean use planning may be necessary. The SEA is an excellent tool to establish spatial and/or temporal separation of oil and gas activities and fishing.

Strategic Environmental Assessments were formally recommended by the Abidjan and Nairobi Conventions as a critical tool for countries wishing to develop the hydrocarbon sector. This was because oil and gas had been found in many countries and oil development in one country could seriously impact on others. Many fishers in West Africa are already affected by more than 6,000 oil spills which have damaged the Niger Delta mangroves – once one of the most important fish breeding grounds in the region.

SEAs help decision-makers broaden high-level planning from single-sectoral approaches (for example individually assessing sectors such as oil and gas, mining, fisheries, tourism, etc.) to a broader, more coherent and participatory approach across multiple sectors – for example identifying how offshore oil and gas development, coastal tourism, agriculture and fisheries together impact upon each other and marine ecosystems. SEAs look particularly at combined/cumulative impacts on people and the environment. The process also bridges disciplinary divisions between fisheries scientists and conservation biologists, and make these groups share best available knowledge.

A SEA is undertaken much earlier than a project-level Environmental and Social Impact Assessment (ESIA). It provides for inter-sectoral and extensive public participation in decision-making and sets the standards for the ESIAs which follow.

SEAs can also ensure that development of the oil or mining sector is aligned with the principles in national strategies for poverty reduction and sustainable development.

Benefits of SEA

Strategic Environmental Assessments complement and facilitate subsequent project-level ESIAs. They are undertaken by governments to assist in participatory decision-making and are best coordinated by an inter-ministerial committee. They can also be undertaken at a district or provincial level if several extractive activities are envisaged in the same region.

A SEA identifies the main groups of governmental, civil society and private sector stakeholders and provides a platform for dialogue and learning to find their common interests. For example, in WAMER countries hundreds of thousands of artisanal fishers, as well as commercial fishing companies and an expanding tourism market, all depend upon maintaining the health of their marine and coastal resources. A SEA also helps forge consensus on the most relevant issues – for example protecting key fishing and fish breeding zones and essential habitats such as mangroves, sea grass beds, rich benthic communities (shellfish beds, deep sea coral reefs) and pelagic hotspots for biodiversity.

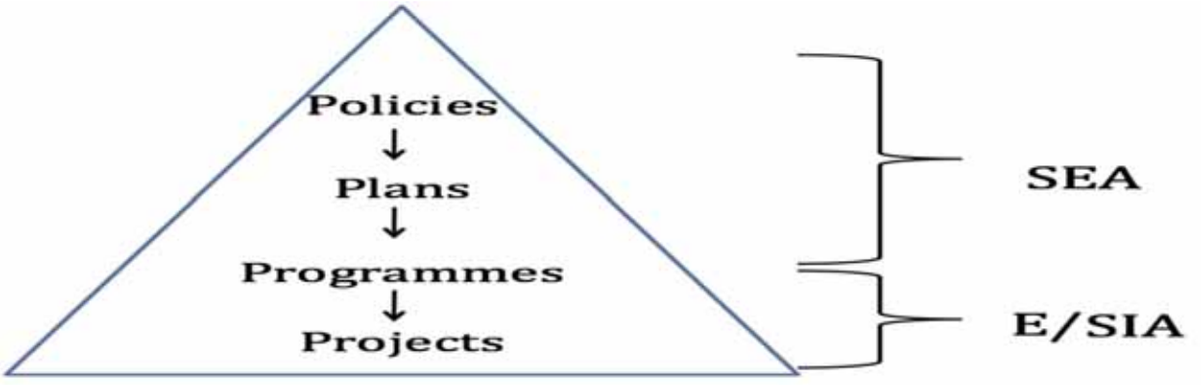
Definition of SEA

The Strategic Environmental Assessment is a flexible process: proactive, participative and systematic.

The SEA focuses on three main classes of work:

1. **Policies, legislation** and other rules governing actions;
2. **Plans and strategies**, including regional, watershed and sectoral plans such as new or revised national water, mining or hydrocarbon codes, a new poverty reduction or national sustainable development strategy; and
3. **Programmes**, or sets of coordinated projects, rather than specific individual projects

themselves, partly because specific projects are identified at the conclusion of the SEA. If a number of projects – for example oil and gas or mining – are proposed for a region, the SEA tackles the region as a whole, and draws from lessons learned from similar projects.



A SEA should be scheduled as early as possible, preferably as soon as the decision is taken to draft a policy, plan or programme, and well before individual projects have been identified. This is to ensure the participation of different ministries and civil society stakeholders.

The SEA is designed to identify, predict, report, prevent, compensate or otherwise mitigate the economic, social, health and environmental implications of the policy, plan or programme being assessed. It enhances the benefits of the policy, plan or programme, and is particularly effective in preventing expensive and damaging errors.

The SEA is a decision-making tool designed to promote better projects, postpone questionable projects, and help cancel the worst projects in a programme or sector. It also helps decision-makers to select alternatives.
Effective SEAs rank alternatives in a sector in one or more orders of quality (for example, more rather than less sustainable; lower negative social impacts rather than higher).

Box 3: Making strategic trade-offs: lessons from the Dutch Wadden Sea

Trade-offs between sectors may be considered in a SEA. In areas where human use reached or even surpassed the carrying capacity of the ecosystem, strategic choices between eliminating one sector for allowing another one could yield in some cases positive results for biodiversity. As an example: in the Dutch Wadden Sea, high-impact bottom-trawl fishing of shellfish was traded for the exploitation of gas which has less impact on the ecosystem. Gas revenues allowed the government to buy out shellfish dredge companies and to reserve a significant sum for ecosystem restoration and developing sustainable economic activities such as ecotourism.

A similar approach could be considered for the Chinguetti oil field, off the Mauritanian coast. When exploitation was allowed, reports issued by the oil company failed to show that the area was a pelagic hotspot for biodiversity. Very careful management is now necessary to preserve the rich food chains associated with this zone of intense upwelling. As fishing by the foreign fleet is particularly intense in this area as well, the government may wish to consider declaring the area a no-fishing zone as a way to correct the decision to allow exploitation in this vulnerable sea area. Such a trade-off would be beneficial to the ecosystem in the water column and would also relieve the nearby deep sea coral reefs identified by Woodside Energy, the oil company that first operated the field (see Box 4 and Annex 1).

However, it should be noted that in a best practice scenario, sensitive sea areas of high biodiversity are entirely protected against any large-scale economic development, whether hydrocarbon exploitation or industrial fishing.

The SEA is totally transparent and fully participatory, as mandated by the UN Aarhus Convention. Free, prior and informed consent (FPIC) is the goal.

The SEA sets standards for conventional ESIAs and Environmental Management Systems (EMS) of individual projects. A project-level ESIA takes a proposed project and assesses the environmental implications. ESIAs that follow SEAs will be faster and cost less because only better projects will have been taken up.

Table1. Differences between a SEA and an ESIA

ESIA	SEA
Is reactive to a specific development proposal.	Can be proactive in a way that informs development proposals and can address geographic regions or technical sectors
Focuses on project-specific impacts.	Enables the creation of a framework against which impacts and benefits can be measured.
Has a well-defined beginning and end, and informs a particular development decision.	Can ensure that the right information is available to inform multiple decisions over a period of time.
Assesses the direct positive and negative impacts of a single proposed activity.	Enables cumulative impacts to be assessed and identifies implications and issues for sustainable development.
Focuses on the mitigation of impacts.	Enables a focus on achieving and maintaining a chosen level of environmental quality.
Emphasises the reporting of impacts in a document for decision-making purposes.	Is seen more as a 'process' than a 'product'. A written report and a mechanism for continued collaboration are produced.

Based on DEAT (2007)

In short, the SEA:

- is a sustainable development tool;
- helps maximise the benefits and beneficiaries of development activities;
- ensures coherence and coordination between all related and overlapping activities related to a sector or region;
- is based on transparency, stakeholder participation and dialogue;
- ensures that stakeholders are part of overall decision-making; and
- provides a mechanism for conflict avoidance and resolution.

WAMER can learn lessons about how to conduct SEAs from various sources such as the UK Department of Energy and Climate Change (www.offshore-sea.org.uk).

The Dutch Commission for Environmental Impact Assessment has written the terms of reference for a SEA in Mauritania and is an excellent source of information (www.eia.nl).

Chapter 7

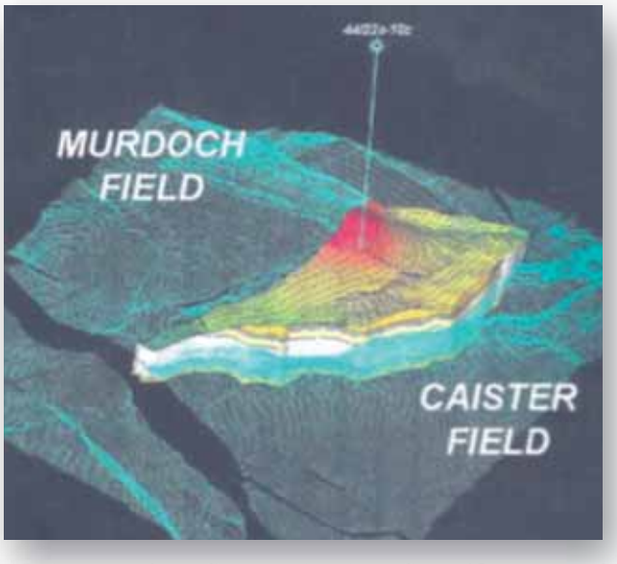
Environmental impacts step by step

Oil and gas development passes through different stages – seismic surveys, drilling, production, etc. – that each has specific impacts on the marine environment.

7.1 Seismic surveys

When oil companies look for oil and gas they carry out seismic surveys. This involves firing pulses of sound energy down to the layers of rock beneath the Earth and recording the energy that is bounced back (UKOOA website). In a typical survey area of 100sq km, some 25,000 shots are fired (personal communication with Woodside Energy). The recording of reflected pulses provides images of the subseafloor strata and gives geologists an idea of whether the area has oil or gas potential. If it does, a company may decide to go ahead with exploratory drilling.

Survey vessel with airguns towed behind (Courtesy of UKOOA)



3D image of seafloor and subseafloor (Courtesy of UKOOA)

Impacts

Seismic surveys in the marine environment are neither completely without consequences, nor are they certain to result in serious and irreversible harm to the environment. However, in the huge range of effects between those extremes, there are many potentially detrimental consequences. In general, the risks attached to these consequences are poorly quantified – indeed, they are often unknown – and are likely to be variable in terms of the environment and of the organisms exposed to the sounds. This is why so many industrialised countries have developed regulatory legislation (McCauly et al., 2000; Tolstoy et al., 2004; Michaud & Chenelière, 2005).

Laboratory studies on fish, turtles and marine mammals indicate that if they are close to the airguns, the sounds produced by seismic surveys can cause haemorrhages, and brain and hearing damage (Mc Cauly et al., 2003; Gausland, 2003; Popper, 2003).

In a field situation, most species can swim away from the sound source, but even so, studies have revealed significant effects on fishery resources (see Table 2 below). Scaring effects in fish have been monitored, leading to a change in swimming patterns.

Table 2. Short-term effects of seismic surveys on fisheries

Species	Gear type	Noise level	Catch reduction
Atlantic cod *(Gadus morhua)*	Trawl	250 dB	46-49% lasting at least 5 days (Engas et al., 1996)
Atlantic cod *(Gadus morhua)*	Longline	250 dB	17-45% lasting at least 5 days (Engas et al., 1996)
Atlantic cod *(Gadus morhua)*	Longline	Undetermined	55-79% lasting at least 24 hours (Lokkeborg and Soldal, 1993)
Haddock *(Melanogrammus aeglefinus)*	Trawl	250 dB	70-72% lasting at least 5 days (Engas et al., 1996)
Haddock *(Melanogrammus aeglefinus)*	Longline	250 dB	49-73% lasting at least 5 days (Engas et al., 1996)
Rockfish *(Sebastes spp)*	Longline	223 dB	52% – effect period undetermined Skalski 1992)

While these catch reductions last just a few days, we have limited knowledge of the long-term consequences, which may be more profound if seismic surveys are carried out when fish migrate. Experts have argued that during such periods, shoals may become dispersed and lose track of their migratory path (Patin, 1999). Moreover, when dispersed, the distinct advantage of swimming in a shoal is lost, and smaller groups or individuals can become easier prey for predators. As a precautionary measure some countries prohibit, and responsible companies refrain from, seismic surveying during migration periods.

It is widely recognised that marine mammals are particularly sensitive to seismic surveys, which can result in a permanent shift in their hearing threshold – in other words, they could become deaf to certain sound frequencies. (Michaud and Chenelière, 2005). Several studies have shown that whales and dolphins not only stop feeding and interacting, but also change their diving patterns (McCauley, et al., 2003). Sperm whales in the Gulf of Mexico appeared to move more than 50km away when surveys began. Similarly, sperm whales in the Indian Ocean stopped vocalising in response to seismic pulses that were fired more than 300km away (Whale and Dolphin Conservation Society website).

Shallow areas such as estuaries, mangroves and seagrass ecosystems are particularly vulnerable zones and may need protection from seismic testing. These critical habitats harbour many species – epifauna on seagrass leaves, fish eggs and larvae, for example – that cannot swim away to escape the sound source (Dalen and Knutsen, 1987). These organisms may well become exposed at close range to the airguns, leading to possible developmental arrest or abnormalities. However, this has been observed only in a small proportion of exposed eggs or larvae. While more research is needed on the impacts of seismic surveys in such habitats, many scientists have argued the case for a moratorium in nursery areas.

In short, seismic surveys have the potential to cause significant impacts on cetaceans, fish and other marine life forms – but for the most part, these impacts can be avoided if the industry applies responsible management measures such as spatial/temporal avoidance of critical habitats, refraining from surveying when cetaceans are spotted, and

employing a 'soft start' technique, whereby the noise volume is slowly built up to give any marine life the chance to move away (IAOGP website, Shell, 1999).

Regulations

Many companies looking for oil and gas in the West African Marine Ecoregion are relatively small, and have unclear corporate policies for responsible management measures. It is therefore important that countries introduce laws governing seismic surveys in order to prevent any detrimental effects that could be easily avoided. Relevant legislation from other countries can be consulted and adapted to local needs.

At the international level there are no specific regulations for seismic surveys, although the general principles outlined in UNCLOS do apply. Unlike other international treaties that apply only to chemical or biological substances, UNCLOS includes forms of energy in its definition of pollution. Because sound is a form of energy, the general duties described in UNCLOS have to be considered for seismic surveys (Dotinga and Oude Elferink, 2000).

Therefore, all member countries of the convention need to:

- protect the marine environment from any sort of pollution;
- prevent pollution from occurring;
- act with precaution; and
- carry out Environmental Impact Assessments (EIAs) before allowing any polluting activity to take place.

Examples of national legal restrictions

A number of countries already restrict survey activities in their territorial waters. For example:

Australia

- Prohibition of seismic surveys in sensitive habitats with a Marine Protected Area status.

Canada and the United States

- EIA for seismic surveys;
- keeping a certain distance between the survey ship and marine mammals; and
- prohibition of seismic surveys during times of the year when marine mammals are particularly abundant.

Norway (Dotinga and Oude Elferink, 2000)

- Prohibition of seismic surveys in fishing zones, observing a buffer zone of 50km around the outer edges of the fishing areas (surveys within these zones are only allowed when no fishing takes place);
- prohibition of seismic surveys during fish migration periods; and
- prohibition of seismic surveys in shallow areas known to be nurseries for fish.

United Kingdom (UKOOA; Shell, 1999)

- EIA for seismic surveys;
- prohibition of seismic surveys during the spawning and migration periods of commercial fish species such as herring;
- prohibition of seismic surveys if cetaceans are seen within 500m (surveys may therefore only be carried out in daytime and only when there is reasonable visibility); and
- survey vessels are required to wait for 20 minutes after the last sighting of cetaceans before proceeding.

Box 4: Localising deep-water Marine Protected Areas

Because oil and gas companies often look for hydrocarbons in environments that remain largely unexplored – for example the deep sea – important discoveries of ecological significance are sometimes made. In Mauritania, scientists working for Woodside Energy in 2005 discovered at about 800m deep underwater 'mountain ranges' composed of carbonate mud with deep sea coral reefs on top of them (Colman, et al., 2005)

Deep water coral ecosystems are now recognised as critical habitats for commercially important fish and crustaceans (Lophelia website). It's argued that they need protection from all human activity – offshore drilling activities but most of all bottom-trawling, as this heavy fishing gear may destroy these ecosystems completely.
Picture of Lophelia deep sea coral reef (Photo courtesy of S. Ross UNCW)

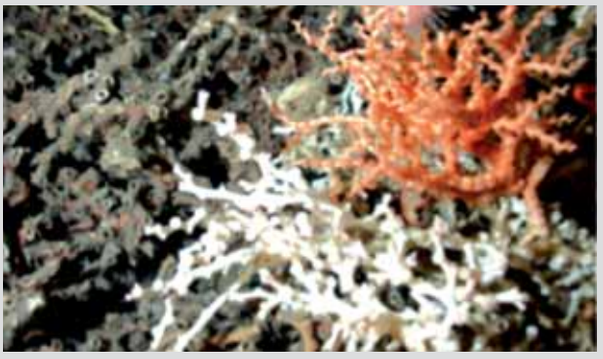
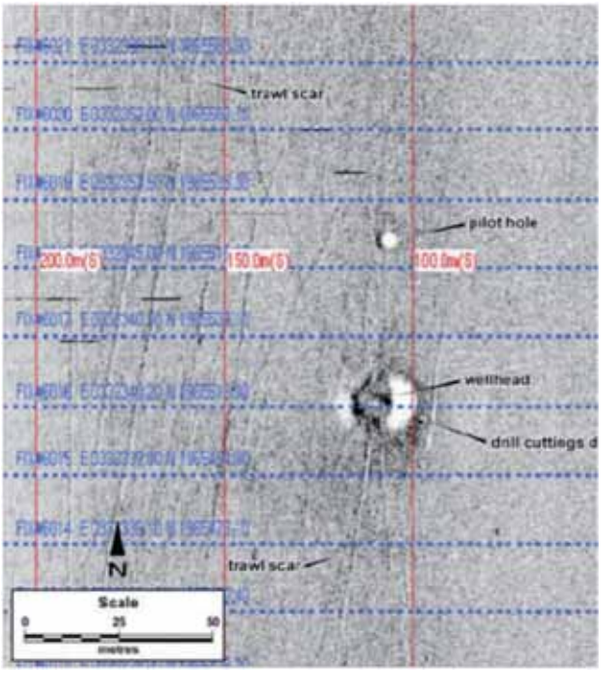


Image d'un récif corallien d'eau profonde de Lophelia (Photographie reproduite avec l'aimable autorisation de S. Ross UNCW)

Oil exploration data showed that the newly discovered habitats in Mauritania were already significantly damaged by the foreign fleet targeting hake, red crabs and spiny lobsters. Declaring these areas deep sea Marine Protected Areas may help rehabilitate deep-sea corals and save them from further destruction.

Map 8. Carbonate mud mounds and deep-sea corals. Courtesy of Woodside Energy



Map 9. Trawl scars on deep-sea coral reefs. Courtesy of Woodside Energy.

7.2 Drilling and production

Hydrocarbon reserves are trapped underground in permeable reservoir rocks such as porous sandstone and fractured limestone. Seepage towards the surface is stopped or slowed down by impermeable rocks such as clay, cemented sandstone and salt deposits, which act as seals. A large natural water reservoir is situated underneath the oil and gas. As soon as seismic surveys reveal that such rock structures are likely to contain hydrocarbon reserves, exploratory drilling starts. Drilling operations also take place to create production. In the case of a large oil field, more than 50 production wells may be drilled (Patin, 1999).

Pendant le forage, un burin minier se trouvant au bout d'un système de tube pénètre les différentes couches de roche. Des fluides sont injectés dans le tube pour lubrifier, contrôler la pression et la température ainsi que pour retirer les déblais de forage. Ces fluides sont composés soit de pétrole, de composés synthétiques, soit d'eau. Le choix du fluide dépend du type de roche rencontré pendant le forage, ce qui signifie que différents types de fluides sont utilisés pendant un simple forage. Le mélange de fluides et de déblais (que l'on appelle également boue de forage) est pompé jusqu'à la surface. Une partie de la boue est réutilisée et réinjectée dans le tube. L'autre partie est soit transportée à terre, soit prétraitée sur la plateforme et rejetée à la mer, tout dépend du type de boue (Patin, 1999).

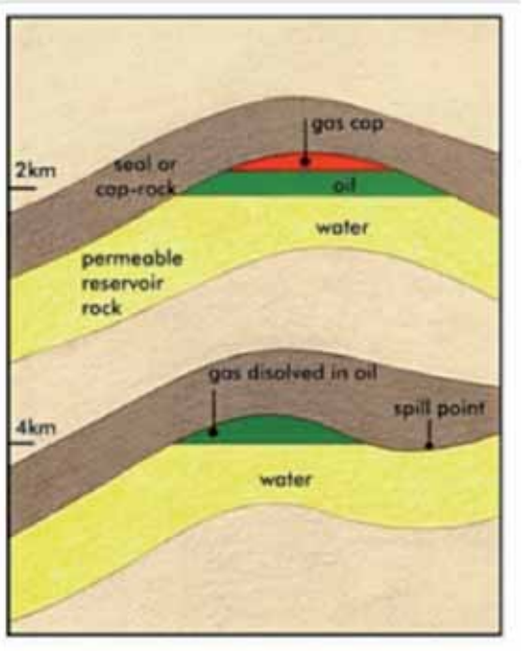
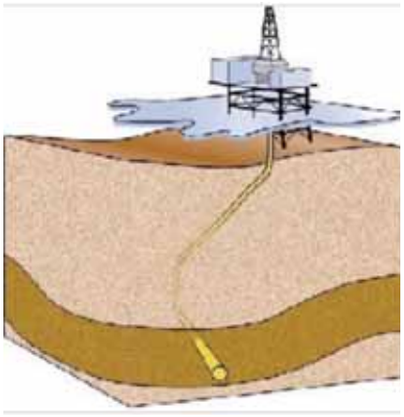


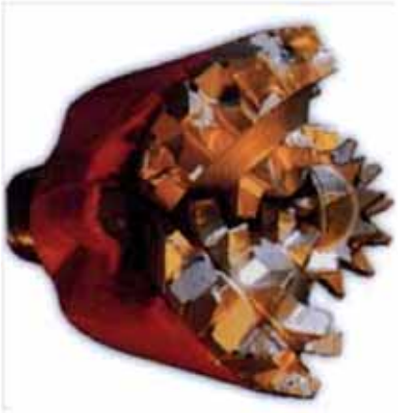
Figure 4: Cross-section of an oil and gas field (courtesy of UKOAA)

During drilling, a drill head at the end of a tube system penetrates the different rock layers. Fluids are injected into this tube system for lubrication, pressure and temperature control, and for the removal of sediments (cuttings). These fluids can either be based on oil, synthetic compounds or water. Choice of fluids depends on the type of rock encountered during drilling, which means that during one single drilling different types of fluids are used. The mixture of fluids and cuttings (also called drilling mud) is pumped back to the surface. Part of the mud is reused and re-injected into the tube (Patin, 1999).



Offshore platform with tube system

Drilling in action



Drill head

(illustrations courtesy of UKOOA)

Figure 5: Drilling operations

Most significant sources of pollution generated during drilling and production stages are:

- drilling mud;
- geological formation water (also called produced water) pumped up with the hydrocarbons; and
- gas.

Drilling mud

Drilling mud is composed of a large range of different and complex chemical compounds. They consist of gelling and deflocculating agents (bentonite clays), filtration control agents, pH and ion-control substances, barites, biocides, corrosion inhibitors, lubricants, defoaming agents and trace elements of heavy metals such as arsenic, barium, chromium, cadmium, lead and mercury. A production platform may discharge about 60,000 cubic meters of drilling fluids and 15,000 cubic meters of cuttings (Patin, 1999).

The most common impacts observed during drilling activities are the smothering of bottom-dwelling organisms living in the direct vicinity of the drilling operations. Most research on the impacts consists of classic toxicity tests measuring direct and short-term effects on a limited number of seafloor organisms. This research concludes that water-based drilling fluids are the safest for the marine environment, whereas oil-based drilling fluids are the most toxic and most persistent in time; after 150 days only 5% is biodegraded (Patin, 1999).

Production water

Geological formation water (also called produced water) is by far the largest-volume by-product or waste stream associated with oil and gas production. All hydrocarbon reserves have varying volumes of water, which is pumped to the surface during exploitation. In the first production year no production water may be extracted, but at the end production volumes may reach 40,000 cubic meters per day. Production water consists primarily of relatively warm water from the oil reservoir, containing dissolved and dispersed oils, high salt concentrations, heavy metals, polycyclic aromatic hydrocarbons (PAHs) and, on occasion, naturally occurring radioactive material. This reservoir water contains no oxygen.

Produced water can lead to serious pollution and cause unpredictable cascading effects on vulnerable marine ecosystems such as nursery areas (estuaries, seagrasses and mangroves). Of special concern are hydrocarbons that occur naturally in produced water, such as organic acids, PAHs, phenols and volatiles. These soluble organics are not easily removed from produced water during treatment on the platform. This means that these

more or less dissolved compounds end up in the ocean if the waste stream is discharged to sea.

Research on the ecological impacts of PAH content in production water has shown that it can affect fertility of male fish and delay spawning periods by several weeks (Meier, et al., 2002). PAHs are carcinogenic and persistent in time, and moreover accumulate in the food chain. PAH content in produced water from gas fields is on average much larger (up to 11 times) than PAH content in produced water from oil fields (Patin, 1999).

Gas

Gas associated with oil fields is sometimes flared off (burnt and released into the atmosphere). Nigeria and Russia have long been two of the world's largest sources of flaring, which has contributed significantly to climate change and local pollution. It is best practice either to market gas or to re-inject it into the oil reservoir – a process that is increasingly becoming the norm for oil production. Currently, about 40% of gas is flared off in Nigeria, compared with 80% in 1993 – this is an obvious improvement, but there is still a long way to go.

International regulations

At the international level no specific regulations exist for waste products generated by drilling activities or production. Similarly, the Abidjan Convention does not stipulate any precise norms for drilling and production waste, but it does recommend that member states carry out Strategic Environmental Assessments when developing their hydrocarbon sector.

Also, the general principles of the UN Convention on the Law of the Sea – of which all the sub-region's countries are members – apply to waste products generated by offshore oil and gas development. Therefore governments should not only protect the marine environment from pollution, but also prevent it from occurring in the first place, act with precaution, and oblige companies to carry out independent environmental impact studies at all development stages.

Offshore oil and gas-producing countries have created their own regulations nationally and/or regionally.

Table 3: Examples of national and regional regulatory frameworks for drilling and production wastes

	OSPAR Convention (North-East Atlantic)	Helcom Convention (Baltic Sea)	United States (NRC, 2002)
Drilling mud	- oil-based mud shipped to shore. - water-based and synthetic-based mud is tested for toxicity prior to discharge. - prohibition on discharging mud containing more than 1% of oil.	- oil-based mud shipped to shore. - water-based and synthetic-based mud is tested for toxicity prior to discharge. - prohibition on discharging mud containing more than 1% of oil. - prohibition on discharging mud with more than 1 mg of cadmium and mercury per kilo.	- oil-based mud shipped to shore. - water-based and synthetic-based mud is tested for toxicity prior to discharge.
Produced water	- re-injecting into the geological formation in vulnerable areas such as estuaries and coastal areas. - when discharged to sea oil content is lowered to 30 mg/L.	- re-injecting into the geological formation in vulnerable areas such as estuaries and coastal areas. - when discharged to sea oil content is lowered to 30 mg/L.	- re-injecting into the geological formation in vulnerable areas such as estuaries and coastal areas. - when discharged to sea oil content is lowered to 15 mg/L in Alaska, 18 mg/L in California, 29 mg/L in Gulf of Mexico.
Gas	- either exploited or re-injected.	- either exploited or re-injected.	- either exploited or re-injected.

7.3 Platform and vessel waste streams

Aside from typical drilling and production wastes, all platforms produce the same kind of waste products as conventional vessels. These include garbage, sewage water (grey water) and deck and reservoir cleaning water

These waste streams are less severe than those from drilling and production waste. As these waste products are also produced by ordinary vessels, they are tightly regulated at the international level by the IMO. The following chapter on maritime traffic will show how.

Chapter 8

Maritime traffic

As much as 400 to 500 million tons of oil is transported through the ecoregion by tankers every year. Oil and gas development will increase maritime traffic in the WAMER – for example, seismic survey ships and vessels carrying support material for platform construction. And when oil is produced, tankers will enter the area to load their cargo from production platforms. This additional maritime traffic will increase pollution caused by ships.

The same waste products from oil tankers are also generated on oil and gas platforms and are therefore regulated in the same way. Next to increasing waste products from maritime traffic and platforms, oil and gas development will considerably increase the risk of casualties. Terminal operations at platforms involve dangerous or risky manoeuvres; and oil and gas may well be found near and even within traffic lanes – so ships passing through need to be warned and detoured around oil and gas installations.

8.1 Waste products

Waste products generated by maritime traffic and oil and gas platforms include oil, noxious liquid substances, sewage, garbage, anti-fouling paints and foreign organisms.

Routine oil pollution
Routine oil pollution is usually associated with tank cleaning of large oil carriers. Oily residues in reservoirs are cleaned and may then be discharged into the sea, after treatment such as separation onboard.

Apart from cargo tank cleaning, oil pollution is also caused by sludge oil and oil used to lubricate the ship's engines (Lentz and Felleman, 2003). Sludge oil is a by-product from ships that use heavy fuel. World use of heavy fuel for maritime traffic is estimated to be 130 million tonnes per year. These fuel oils contain between 1% and 5% sludge and waste oil, which is not burnt (NCR, 2002).

Noxious liquid substances
Noxious liquid substances are chemicals other than oil which, if introduced into the marine environment, have the potential to create hazards to human health and to harm living resources and marine life. Drilling and producing oil involves the use of a wide variety of chemical substances. Because they need to be shipped to the development areas, the risk of an accident involving these chemicals is increased.

Sewage
The discharge of raw sewage into the sea can create a health hazard. In coastal areas sewage can also lead to oxygen depletion and obvious visual pollution. However, the main sources of human-produced sewage, such as municipal sewers or treatment plants, are land based.

Garbage
Garbage from ships can be just as deadly to marine life as oil or chemicals. The greatest danger comes from plastic, which can float for years. Fish and marine mammals can in some cases mistake plastic for food and they can also become trapped in plastic ropes, nets, bags and rings used to hold cans of drinks together.

Anti-fouling paints
Antifouling paint on ships is a less visible source of chronic pollution that arises from maritime traffic. This paint often contains potent biocides such as Tributyltin (TBT). Biocides reduce the encroachment of marine organisms on offshore production installations or ships' hulls. But these substances also leach into the marine environment and may adversely affect several non-target species. One infamous effect of TBT contamination is the masculinisation of female marine snails, resulting in reproductive failure and decline of populations. Female snails with abnormal development of male reproductive organs (also called 'imposex') have been found in the North Sea along important

shipping lanes. Tributyltin is also found in relatively high concentrations in harbour sediments (Mensink, et al., 1997).

Exotic organisms
Less obvious sources of pollution associated with maritime traffic in general are animals and plants that accidentally hitchhike, often in the vessel's ballast water, from one part of the world to another. When these 'non-indigenous' or exotic organisms are discharged, they may reproduce rapidly under the new environmental conditions and become ecological pests (ICES, 1994).

8.2 Environmental regulation of maritime traffic

Almost all aspects related to routine pollution of the sea coming from ships are regulated by the conventions of the International Maritime Organisation. IMO instruments to protect the marine environment from threats and routine pollution created by shipping are:

MARPOL 73/78;
SOLAS 1974;
Anti-fouling Convention; and
Ballast Water Management Conventions

MARPOL
The MARPOL Convention is the main international accord covering prevention of pollution of the marine environment by ships from operational or accidental causes. It is a combination of two treaties adopted in 1973 and 1978 and updated by amendments through the years. The convention includes regulations aimed at preventing and minimising pollution from ships – both accidental pollution and that from routine operations – and it currently includes six technical Annexes:

Annex I	Regulations for the Prevention of Pollution by Oil
Annex II	Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk
Annex III	Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form
Annex IV	Prevention of Pollution by Sewage from Ships
Annex V	Prevention of Pollution by Garbage from Ships
Annex VI	Prevention of Air Pollution from Ships (entry into force 19 May 2005)

As for oil pollution, the content of oily residues in cleaning water is regulated by MARPOL. Regulation 9 limits the oil content of discharged effluent to 15 ppm (1 mg/L is approximately 1 ppm). Discharge of oily wastewater within 50 nautical miles of the shore is prohibited (IMO website; NCR, 2002).

Discharge of fuel oil sludge from machinery room is strictly forbidden anywhere in the world by MARPOL (IMO website). This sludge oil should be discharged at reception facilities in ports.

SOLAS
The International Convention for the Safety of Life at Sea (SOLAS) is designed to improve vessel safety and can also be seen as a convention to improve environmental protection. Its main objective is to specify minimum standards for constructing, equipping and operating ships, compatible with their safety. To reduce accidents at sea the convention provides tools to set up special routing and reporting systems and vessel traffic services.

Anti-fouling Convention
The International Convention on the Control of Harmful Anti-fouling Systems on Ships prohibits the use of harmful organic tins in anti-fouling paints used on ships and establishes a mechanism to prevent use of other harmful substances in anti-fouling systems. However, the new convention exempts offshore platforms, so these are still allowed to use paint containing hazardous potent biocides such as TBT if the issue is not addressed in regional or domestic law.

Ballast Water Convention
The International Convention for the Control and Management of Ships' Ballast water and Sediments outlines obligations on signatories to prevent, minimise and ultimately eliminate the transfer of harmful aquatic organisms and pathogens through the control and management of ships' ballast water and sediments.

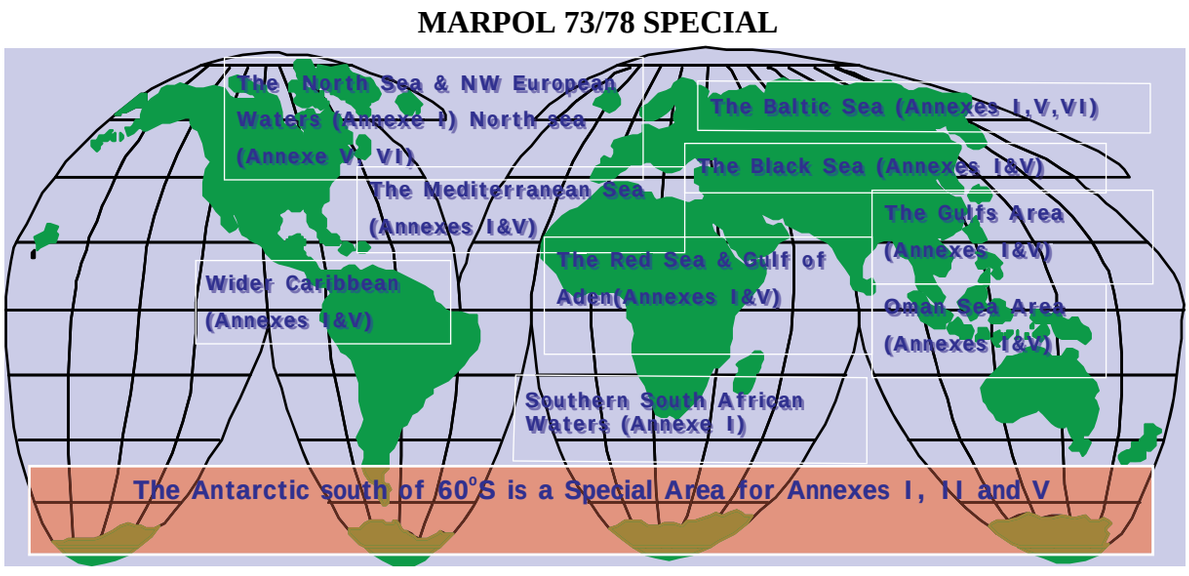
8.3 Area-specific IMO rules

International law limits the ability of coastal states to impose their own environmental and navigation regulations on foreign vessels passing through their territorial waters. Within their Exclusive Economic Zone (EEZ) which extends up to 200 nautical miles offshore, countries may not 'impair' a foreign ship's right of 'innocent passage'. But because international regulations generally apply to all ships wherever they go, it can be difficult to protect relatively vulnerable areas. The IMO developed two types of designations – Special Areas and Particularly Sensitive Sea Areas – to impose stricter rules for international maritime traffic in specific locations.

Special Areas

Under the MARPOL Convention, these Special Areas are provided with a higher level of protection against routine oil pollution (Annex I), pollution by noxious liquid substances (Annex II), garbage (Annex V) and air pollution (Annex VI) generated by international maritime traffic.

ZONES SPÉCIALES DE LA MARPOL 73/78



Map 10: Sea areas designated as Special Areas by IMO. (Courtesy of IMO).

Particularly Sensitive Sea Areas

PSSAs are generally smaller than Special Areas and can be designated within or outside Special Areas.

Marine areas of particular importance for tourism, recreation, traditional subsistence, science or education can benefit from PSSAs – which can also help preserve fishery resources by providing extra protection to coastal wetlands, estuaries, mangrove forests and other important habitats. Where these areas are threatened by maritime traffic, it is possible to obtain a PSSA designation with special protection measures laid down by the IMO (IMO website; WWF-UK, 2002).

PSSAs can help prevent accidents, avoid habitat damage and stop intentional pollution by regulating the passage of ships through, or guiding them away from, the areas to which they apply. The marking of PSSAs on nautical charts also serves to inform mariners of the need to take special care when approaching a sensitive area (IMO website; WWF-UK, 2002).

Identifying PSSAs

The criteria for PSSA designation are:

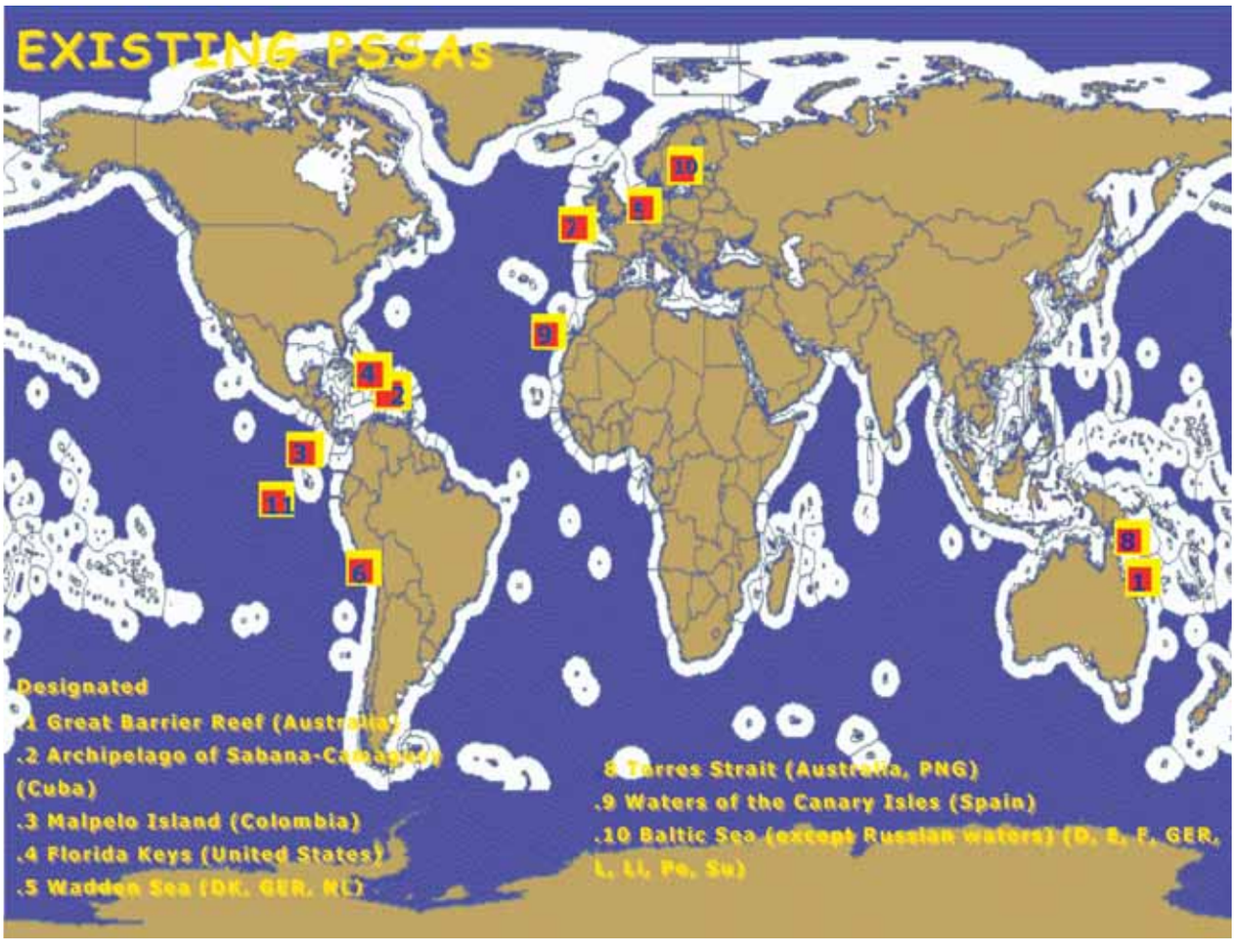
Ecological: Uniqueness, dependency, representativeness, diversity, productivity, naturalness, integrity, vulnerability.

Social, Cultural and Economic: Economic benefit, recreation, human dependency.

Scientific and Educational: Research, baselines and monitoring studies, education, historical value.
A proposal for a PSSA may only be submitted by a member government of the IMO. The petition should include an assessment of the area's vulnerability to damage by shipping activities, identify proposed measures to protect the area, and explain how those measures would work. It should further describe the oceanographic and ecological conditions that make the area sensitive to shipping impacts, and it should indicate any other sources of environmental pressure – the development of offshore oil and gas, for example.

Identifying PSSAs can be valuable when preparing a Strategic Environmental Assessment that should precede offshore oil and gas development. Such PSSAs could, under domestic or regional law, benefit from special protection from the oil and gas industry, and they may be designated as no-go zones or as zones where the industry should obey stricter rules.

A PSSA can be anywhere in the Exclusive Economic Zone or even beyond.



Map 11: World map of PSSAs.(Courtesy of IMO).

Through the IMO, various measures are available to better protect PSSAs from transiting maritime traffic. They include:

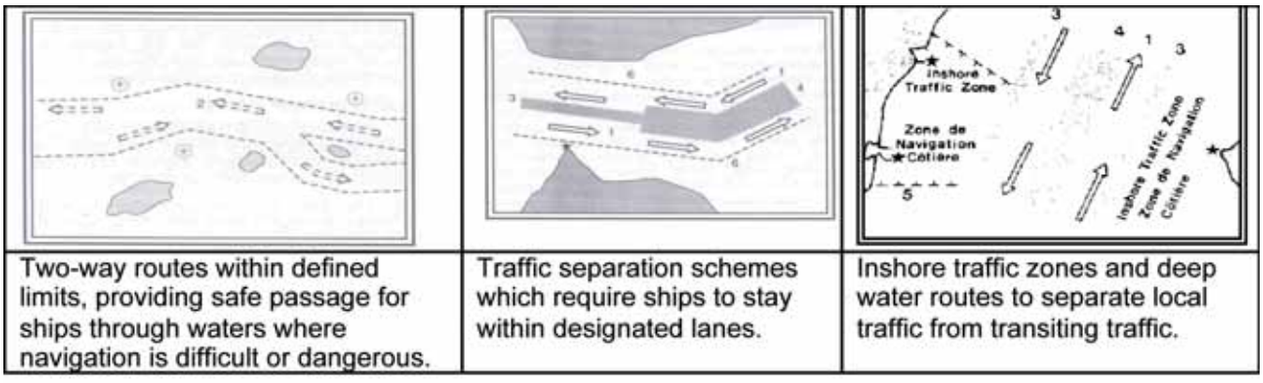


Figure 6: Area-specific IMO tools. (Illustrations courtesy of Edward Kleverlaan, IMO).

In addition, it is possible to impose alternative routes on passing maritime traffic. For example:

- **Recommended track:** A specially examined route that is as free from danger as possible, and along which ships are advised to navigate.
- **Area to be Avoided:** A routing measure involving an area within defined limits in which navigation is particularly hazardous and where it should be avoided by certain classes of ships, or indeed, all ships.

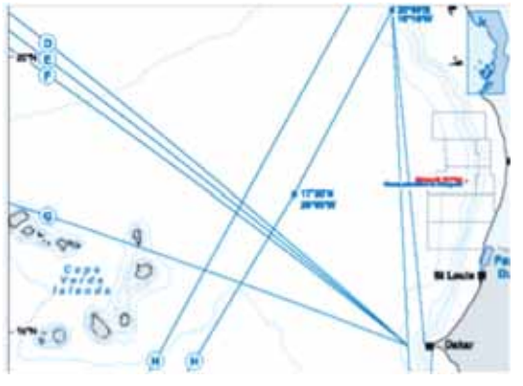
Examples of other types of IMO measures are:

No anchoring area: A routing measure covering an area within defined limits where anchoring is hazardous or could result in unacceptable damage to the marine environment.

- **Ballast water management area:** The establishment of an area for ballast water exchange. The purpose is to prevent invading organisms from infesting local ecosystems and causing irreversible damage.
- **SOX Emission Control Area:** Measures to reduce air pollution.
- Special liquid discharge restrictions: These may cover oily waste, garbage or sewage water.

PSSAs for WAMER

The great density of maritime traffic in WAMER constitutes an immediate threat to valuable marine ecosystems in the region. An accident involving an oil tanker would have devastating and long-term impacts and would jeopardise the well-being of millions of coastal people who depend upon fishery resources for their livelihoods. The tourism sector would also suffer if any oil spill were to reach resort beaches, particularly in Senegal, The Gambia and Cape Verde. Designating PSSAs in these areas would reduce the risks and lead to safer shipping.

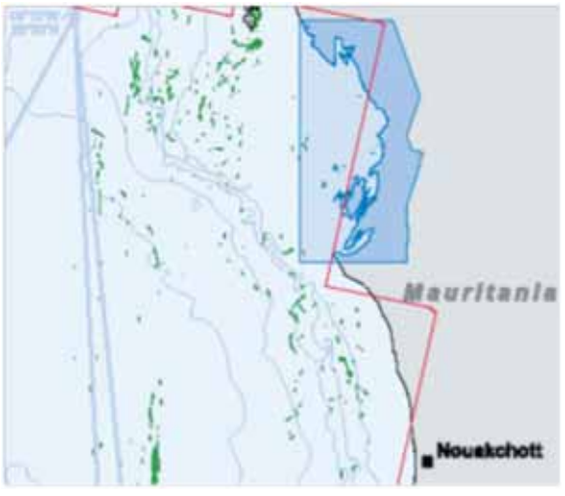


Major commercial shipping routes off Mauritania, Senegal and the Cape Verde islands (dark blue lines).

The G route leads to the North East Providence Channel in the US and passes very close to the Cape Verde islands, in particular the island of Sal, an important tourist destination, and Murdeira, a protected area south of Sal. This would probably benefit from an alternative shipping route.

Map 12: Major shipping routes in the WAMER. (Courtesy of Woodside Energy).

Special discharge restrictions could be imposed on passing vessels in and near critical habitats. Oil in waste water from cleaning the ships' decks and tanks can affect important habitats such as the Bijagos archipelagos in Guinea-Bissau, the Banc d´Arguin in Mauritania and the Sine Saloum Delta in Senegal. Currents may take dissolved and persistent carcinogenic polycyclic aromatic hydrocarbons to these critical habitats and the heavier oil substances may cover the aerial roots of mangroves.



Map of northern Mauritania showing the Banc d´Arguin National Park (dark blue) and surface oil slicks (green spots) related to shipping routes (light blue lines).

Map 13: Surface oil slicks off Mauritania. (Courtesy of Woodside Energy).

Areas to be Avoided

Oil and gas could be found in and near international shipping lanes. Platforms or FPSOs should therefore have safety zones established around them. FPSOs in the North-East Atlantic and the North Sea, and offshore platforms in the Gulf of Mexico, have such zones with a radius of at least 500 meters to keep all maritime traffic at a distance.

In addition to excluding navigation near platforms, governments of the West African Ecoregion may under national law also consider having these exclusion zones recognised as Areas to be Avoided (ATBAs) or as 'precautionary areas' under the SOLAS convention. In this way, transiting vessels will be alerted to use extra care and, if necessary, follow a mandatory shipping route.

Governments can make a strong case for international recognition with the IMO because the West African Marine Ecoregion is not well known as an offshore oil and gas development area. Seafarers need to be alerted to take extra care when transiting the areas. This kind of international recognition has been approved for offshore wind energy parks in the North Sea and several offshore oil and gas installations such as the FPSO located on the Grand Banks of Newfoundland in Canada.

Chapter 9

Oil spills and large-scale accidents

Large oil spills can be caused by accidents involving tankers or offshore oil installations. It is important for governments to identify risks for major spills, minimise those risks as much as possible, and sufficiently prepare for the eventuality of a major spill.

History has shown that once a major spill has occurred, it is difficult to contain, clean the coast, rehabilitate oiled wildlife, restore spill-injured ecosystems, and adequately compensate spill-injured economies and social systems. Although governments must of course prepare to respond to spills, their most important responsibility is to prevent such events to the maximum possible extent.

9.1 Oil spill risk assessments

For spill prevention measures, governments must systematically identify waterways and environments that are at significant risk from a major pollution event. A comprehensive Oil Spill Risk Assessment should identify all potential causes, sources, locations, size and types of hazardous substances that may be spilled, as well as potential flow characteristics and trajectories. The risk assessment should include a systematic analysis of ship (tanker and freighter) traffic patterns and types of vessels and cargoes, and identify traffic convergences and navigational characteristics that may increase the risk of large spill events. In addition, all petroleum facilities – terminals, offshore platforms, floating production, storage, offloading FPSOs, on-shore and offshore pipelines, etc. – should be thoroughly analysed in the assessment.

Box 5: Single-hulled FPSO conversions: low cost – high risk

An FPSO is a floating oil platform that can either be purpose-built or made from a former oil tanker.
The hull of an FPSO may be punctured after a collision with another vessel in the same way as an ordinary oil tanker. The industry argues that FPSOs are nevertheless a safe development option. Part of their reasoning is based on the fact that no major accidents have occurred during the past 30 years. However, drawing conclusions from statistical data is difficult because the vast majority of FPSOs have only been put into service recently. It was not until the second half of the 1990s that the number of FPSOs began to grow significantly (Kloff and Wicks, 2004).

Several studies have been undertaken to assess the risks involved in the use of FPSOs. Bureau Veritas, the respected classification group, has surveyed half the FPSOs in service. Its conclusions: FPSOs made from former oil transporting tankers are unsuitable to serve as oil production and storage platforms. Structural and metal fatigue problems arise over time, even in the calmest of conditions. The study also concluded that oil tankers are built to meet ship specifications not matching those of platforms – these structures have more extreme and frequent loading and offloading sequences (Bureau Veritas, 2005).

An expert panel for oil and gas issues advised the Mauritanian government to allow only purpose-built and double-hulled FPSOs (Expert Panel website).

High-risk areas may include approaches to oil ports and terminals, high-traffic areas offshore, and traffic crossings (areas at risk of groundings and collisions). The Risk Assessment should also identify cross-border environments that may be affected in neighbouring countries, and it should include a chemical analysis of cargoes/pollutants most likely to be spilled – specific types of crude oil, petroleum products, LNG, chemicals, etc. These analyses should include physical properties such as specific gravity, viscosity/pour point, solubility and volatility, a complete chemical characterisation, and toxicity analyses (with local organisms). Finally, the Risk Assessment should include a detailed analysis of all environments, species and human communities at risk from such major spills.

9.2 Oil spill risk reduction and mitigation

Once they have the results of the spill Risk Assessment, governments should require the implementation of cost-effective risk reduction and mitigation measures as identified. For oil and gas tanker traffic, these may include the following:

- ship traffic management / monitoring systems;
- real-time ship tracking (with coastal radar, automatic identification systems (AIS), satellite tracking);
- establishing ship traffic lanes (for example, inbound and outbound lanes to and from ports and in transit zones offshore);
- weather restrictions for entering/leaving port or loading/unloading; additional navigational aids (buoys, lights, channel markers, etc.);
- ship vetting standards (double hulls, redundant steering and engine systems, bow thrusters, etc.);
- enhanced piloting requirements for hazardous waterways (with local mariners on the bridge);
- rescue and/or escort tugs on standby for tanker transits (tugs with sufficient power to render assistance to a disabled tanker in severe weather conditions);
- enhanced inspection protocols while tankers are in port; and
- placing spill booms around tankers during loading/offloading.

Similar spill risk reduction protocols should be instituted for all other potential spill sources, including terminals, pipelines, on-shore and offshore platforms and FPSOs. These include independent engineering audits commissioned by the government for all petroleum facilities; regular inspection and maintenance of all facilities; and requirement for Best Available Technology (BAT) for all petroleum facilities.

9.3 Oil tanker accidents

Large spills may arise from maritime traffic after the grounding of an oil tanker, collisions with other vessels, and/or due to cargo fires and explosions. Technical failure and human errors are the most usual causes. Under a combination of certain extreme conditions such as bad weather, bad maintenance, old age and metal fatigue, some oil tankers may simply break up. The accident involving the Prestige, a single-hulled oil tanker built in the 1970s, is the most recent sad example of such a complex of circumstances (New Scientist, 2003).

Regulations

Virtually all aspects of oil spills caused by international maritime traffic are regulated via the International Maritime Organisation. Many provisions to reduce maritime accidents and oil spills are contained in the Convention for the Safety of Life at Sea (SOLAS). Its main objective is to specify minimum standards for the construction, equipment and operation of ships, compatible with their safety. The convention also provides tools to set up special routing and reporting systems, and vessel traffic services. Fire is a major cause of maritime accidents and SOLAS contains strict fire safety provisions. It also contains rules to replace inflammable oil fumes with inert gas (non-explosive gas). An inert gas system is required on all new tankers and most existing tankers of 20,000 tonnes deadweight and above (IMO website).

In addition to SOLAS regulations governing construction, the MARPOL Convention states that all new tankers need to have a double hull. This measure was introduced to reduce the likelihood of an oil spill after collision. Regulation 13G requires mandatory retirement for single-hull tankers at 25 years of age. A revision to the regulation 13G required

phase-out of all single-hull tankers above 20,000 tonnes deadweight by 1 January 2007 (IMO website; NCR, 2002). However, flag states are allowed to operate smaller single-hull tankers up to 2015 or to their 25th anniversary of construction, whichever comes first. These tankers are subject to a newly strengthened condition assessment scheme (CAS). Any tanker of 15 years or more must now undergo CAS at its next survey (WWF, 2003).

Human failure is probably the most important factor causing maritime accidents – indeed the cause rate is estimated at about 80% (Häseli, 2003). Collisions, technical failure and shipboard fires and explosions are all factors that could be caused by human error. It is therefore important that a ship's crew have a thorough technical knowledge and possess the necessary qualifications. The IMO's International Convention on Standards of Training, Certification and Watch-keeping for Seafarers (STCW), 1978, is the first internationally agreed convention to address the issue of minimum standards of competence for seafarers. The STCW was revised and updated in 1995 to clarify the standards of competence required and provide effective mechanisms to enforce its provisions (IMO website).

The IMO's Intervention Convention affirms the right of a coastal state to take measures on the high seas to prevent, mitigate or eliminate danger to its coastline from a maritime casualty.

The International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC), 1990, provides a global framework for international cooperation in combating major incidents or threats of marine pollution. This convention applies to oil spills caused by maritime traffic as well as spills for spills caused by offshore oil installations.

Compensation

The IMO has rules for compensating oil spill victims and for the availability of funds to finance clean-up costs if a spill is caused by a tanker. The Civil Liability Convention (CLC) of 1969 puts the onus of paying compensation on the ship owner. The 1971 Fund Convention extends additional liability to cargo owners (the oil companies and importers), who pay into a central fund. Increased levels of compensation are now available for victims of pollution from oil tanker accidents, following the adoption by a diplomatic conference in 2003 of a protocol establishing an international oil pollution compensation supplementary fund.

- Under the Civil Liability Convention (1992 protocol, amended in 2003), those affected by pollution are able to claim damages from the ship owner of up to US$132 million for ships of 140,000 Gross Register Tonnage and above.
- When the damage exceeds the limit of the ship owner, the Fund Convention of 1971 (1992 protocol, amended in 2003) provides additional compensation to a maximum of US$299 million.
- The Oil Pollution Supplementary Fund (2003) increased the compensation available under the 1992 Civil Liability and Fund Conventions with an additional third tier of compensation. The protocol is optional and participation is open to all parties to the 1992 Fund Convention. The total amount of compensation payable for any one incident would be limited to a combined total of just over US$1.1 billion, including the amount of compensation paid under the existing CLC/Fund Convention.

9.4 Oil platform and drilling accidents

Drilling operations and oil platforms can of course cause oil spills, and small spills happen regularly during offloading. The amount spilled during these so-called terminal operations is in the order of three times greater than the total amount of oil spilled after accidents with oil tankers (ITOPF website).

Large spills rarely occur – but when they do, they are usually as a result of accidents during drilling, when the operator loses control over the reservoir, a blow-out, if an FPSO is perforated by another ship, or simply when an FPSO ruptures due to metal fatigue. Blow-outs are relatively rare, and accidents involving large oil spills with an FPSO have so far never occurred. However, it should be noted that most FPSOs have only recently been put in service, so it's too early to base a proper risk assessment on statistical data. This is one reason for the in-depth study by Bureau Veritas (see Box 4).

Box 6: Oil spill sensitive ecosystems

Coastal wetlands, notably seagrass ecosystems and mangrove forests, are very sensitive to oil spills. These habitats need special attention in oil spill contingency planning as they have a nursery function in renewing many commercial fish stocks at sea.

A large oil spill hitting mangrove ecosystems on the coastline will cover the aerial roots and disrupt gas exchange and damage root membranes, causing lethal concentrations of salt to accumulate in mangrove tissue. Dying trees will ultimately lead to unstable habitats and erosion. An oil spill in Panama caused the mangrove forest system to erode at several centimetres a day (NRC, 2002).

When seagrasses are found on subtidal flats, oil will smother leaves and root systems when the water subsides during low tide, causing mass mortality. When seagrasses are destroyed or damaged, restoration is expensive. Many lost ecological services are not adequately restored (Fonseca et al., 2000). Replanting techniques have been used to a limited extent for a small number of species, but recent cost evaluations to restore tropical seagrasses in the United States have been estimated at US$100,000 per acre (US$25 million per square km) (Larkum, 2006). This means that the restoration of 412 sq km of subtidal seagrass beds in Mauritania's Banc d'Arguin National Park would cost US$10.3 billion. If we estimate that a Mauritanian earns about 10 times less than a US citizen for manually replanting seagrass, it would probably still cost more than US$1 billion to restore the seagrass beds of the Banc d'Arguin, with uncertain success.

Pelagic hotspots for marine biodiversity created at front zones along the continental shelf are also quite sensitive to small spills. While such spills disintegrate before hitting the coast, they can smear large numbers of seabirds found at pelagic hotspots.

Lack of international regulation for platforms – and a need for local solutions

Even if FPSOs look like ships and may actually be made from former oil tankers, their status as a 'ship' in international shipping law is unclear. How IMO conventions apply to them is under debate – which is just as well, because loopholes in international legal frameworks need to be filled at national and regional levels.

FPSO 'ship' safety

The IMO has developed several guidelines and codes to maintain FPSO compatibility with international law for maritime safety. The code for the construction and equipment of mobile offshore drilling units (the MODU code) was developed to adapt the application of the SOLAS Convention on offshore oil and gas installations (IMO MODU guidelines). And because an important provision in Annex 1 of the MARPOL Convention (the double hull requirement) is only applicable to oil tankers, the IMO formulated a non-binding recommendation extending this to mean double-hulled floating platforms (FPSOs) as well (IMO, 2003).

States that wish to have the same safety standards for oil and gas operations that also apply at the international level to conventional vessels should incorporate these IMO guidelines and recommendations into their own binding national or regional legislation. They should also establish safety zones with a radius of at least 500 meters around FPSOs to keep maritime traffic at a reasonable distance, and they should have these zones recognised by the SOLAS Convention as Areas to be Avoided.

Best domestic and regional law

All FPSOs used in the North-East Atlantic are purpose-built and double-hulled, although this is not specifically mentioned in the regional OSPAR convention. The US government issued studies leading to a policy to only allow newly-built and double-hulled FPSOs in the Gulf of Mexico.

Platform oil spill compensation

Costs involved with clean-up or the compensation of third parties affected by oil spills caused by platforms or drilling operations are not covered by any international convention. The Civil Liability Convention and the Fund Conventions are written

for oil spills caused only by oil tankers, and thus exclude all platforms. The UN Law of the Sea (UNCLOS) stipulates the need for states to ensure that offshore oil and gas operators have sufficient insurance coverage against such casualties.

Box 7: International convention for oil spill liability caused by offshore oil development

The international convention specifically addressing liability for offshore exploration and exploitation is the 1976 Convention on Civil Liability for Oil Pollution Damage Resulting from Exploration and Exploitation of Sea Bed Mineral Resources (the CLEE Convention), which has never come into force. Negotiators were unable to place the convention within the jurisdiction of any competent international organisation. Furthermore, CLEE also failed to attract industry support because it breached the uniformity principle by allowing signatory states to opt for limited or unlimited liability (Canadian Maritime Law Association, 1996).

Examples of national legal frameworks

The United States has put in place an unlimited liability for gross (or wilful) negligence for oil spills caused by oil tankers or offshore oil and gas operations. All tankers trading in US waters and all oil and gas platform operators are required to demonstrate to local authorities that they carry adequate insurance to cover maximum financial risk. They can do this by means of Certificates of Financial Responsibility.

In the absence of international law, a number of offshore unit operators in Europe agreed to the Offshore Pollution Liability Association (OPOL-1974), a voluntary pollution liability compensation scheme. Participating companies accept strict liability towards affected people for pollution damage, and to government authorities for cleanup costs, up to a maximum of US$120 million per incident (Canadian Maritime Law Association, 1996; OPOL website).

The UK government obliges oil and gas companies wishing to exploit its continental shelf to become a member of the Offshore Pollution Liability Association (OPOL) – a clause to this effect is included in the licence agreement (personal communication from R. Segal, director of OPOL, to S. Kloff). Considering the costs involved in cleaning up an oil spill, this liability limit seems highly inadequate. The clean-up of the Prestige oil spill in Spain and the Erika in France exceeded € 1 billion. Ecosystem restoration costs are often not considered and surpass clean-up costs and short-term compensation of third parties such as fishermen. Box 4 has shown that the restoration of the subtidal seagrass flats in the Banc d'Arguin National Park would cost more than US$1 billion. BP agreed to establish a US$20 billion claims fund to compensate people for economic losses outside the judicial process. However, this figure excludes ecosystem restoration costs (see also "The Gulf of Mexico Deepwater Horizon disaster – an overview" at the beginning of this book).

9.5 Oil spill response and contingency plan

In addition to mitigating and reducing spill risk as much as possible, governments must sufficiently prepare for a major spill. All governments should develop a national oil spill contingency plan, and all petroleum facilities and ship owners should be required to have their own contingency plans approved by the government.

Contingency plans should be detailed and structured in a three-tier system based on size of spill:

Tier I – response just with local assets;
Tier II – requiring additional assets from in-country organisations; and
Tier III – requiring assistance of international oil spill response consortia.

A best practice example is given in Annex 6.

The International Convention on Oil Pollution Preparedness, Response and Cooperation (OPRC), 1990, provides a global framework for international cooperation in combating major incidents or threats of marine pollution. This convention applies to oil spills caused by maritime traffic as well as those caused by offshore oil installations.

9.6 Best practice

Countries should:

- apply Strategic Environmental Assessments (SEAs) as recommended by the Abidjan Convention in November 2007. (The use of SEAs should be provided for in environmental legislation of the respective countries. All stakeholders should be involved, including coastal managers, fishery biologists, marine scientists, the fishery sector, coastal communities and the tourism industry, in order to reach consensus over when, where and how to develop hydrocarbons);
- make a more detailed plan of ocean use, especially along the continental shelf-break. (The maps in these pages show that the area with the biggest oil and gas potential is situated along the continental shelf-break, which coincides with the most important fishing grounds for foreign and artisanal fleets and ill-studied biodiversity hotspots such as deep sea coral reefs and abundant pelagic life at zones with intense upwelling);
- formulate minimum standards for the region's oil and gas industry with other WAMER states or within the framework of the Abidjan Convention;
- manage all social, environmental, health and safety aspects of the oil and gas projects according to their Environmental Management Plan (EMP). (Key elements of the plan should include, among others, waste management, stack emissions, air quality, safety, employment and training opportunities. A transparent monitoring and audit system should be put in place for this purpose);
- set up an observatory with appropriate environmental indicators to monitor impacts and adjust policies whenever necessary;
- require oil companies to share their exploration data to gain better insights into the locations of sensitive ecosystems such as deep sea coral reefs and frontal zones; and
- seek a contribution from oil companies (voluntarily or via a tax system) towards research needed to fill knowledge gaps of the marine environment so that hydrocarbon development can be planned with better care for nature and other users of the sea.

For the exploration phase, countries should:

- demand an Environmental Impact Statement for all seismic survey campaigns;
- prohibit all seismic surveys in Marine Protected Areas and sensitive sea areas such as mangroves, seagrass and estuaries known to play a role as a nursery for marine resources;
- prohibit surveying during migration periods of important fish species, and near cetaceans and sea turtles;

For the drilling phase, countries should:

- demand an Environmental Impact Statement;
- prohibit production and drilling in or adjacent to vulnerable areas such as mangrove areas, deep sea coral reefs, seagrasses, shellfish banks, estuaries and pelagic hotspots;
- require similar discharge norms already applied in other relatively well managed oil and gas areas such as the North-East Atlantic;
- prohibit discharge of oil based drilling mud;
- require a zero discharge regime in areas that are likely to impact vulnerable ecosystems; and
- require environmental impact studies before allowing any drilling and production operation (in line with UNCLOS).

For the production phase, countries should:

- require Environmental Impact Statements and Environmental Management Plans; and
- encourage the re-injection of production water.

In terms of maritime traffic, countries should:

- sign all relevant IMO conventions;
- identify sensitive sea areas and have these designated as Particularly Sensitive Sea Areas and apply appropriate IMO tools; and
- sign IMO fund conventions for the compensation of oil spills caused by maritime traffic.

To reduce impacts and likelihood of oil spills, countries should:

- make oil spill risk assessments for maritime traffic and for drilling and oil production operations;
- allow the use of only purpose built and double-hulled floating platforms;
- establish navigation exclusion zones of 500 meters around offshore oil and gas operations;

- oblige oil companies to protect this zone with a surveillance vessel;
- have these zones recognised by the IMO as Areas to be Avoided under the SOLAS Convention, in order warn off international maritime traffic when necessary;
- transpose the MODU guidelines into domestic and regional law;
- arrange an adequate liability scheme of at least US$20 billion for oil pollution caused by offshore oil platforms, along the lines of the amount set aside by BP to compensate oil spill victims after the Deepwater Horizon blowout;
- establish an oil spill emergency fund; and
- draw up a detailed oil spill contingency plan.

10. Conclusion and recommendations

Oil and gas development must overcome many hurdles before it can contribute to sustainable development. Valuable ecosystems providing diverse critical and renewable services for millions of people need to be protected. But oil and gas can provide vital income for sustainable development initiatives such as improving the use of the marine environment involving management measures. For example:

- reducing fishing below the traditional Maximum Sustainable Yields;
- expanding Marine Protected Areas towards a more significant part (at least 10%) of the EEZ and a representative network of habitats which should include deep sea coral reefs and distinct zones along the continental shelf-break where pelagic life is particularly abundant;
- investing in more research to ensure improved ecosystem-based management of human activities and use in the future; and
- implementing climate change adaptation measures.

Another way of guaranteeing important economic returns is to re-invest oil and gas revenues in renewable energy sources which will decrease a country's dependence on importing increasingly expensive energy.

Implementing such policies involves short-term costs; oil and gas could provide vital income. However, this comes with a number of conditions, and questions which need to be addressed first.

- *How to make sure that oil and gas revenues are used strategically?*
- *How to mitigate environmental impacts?*
- *How to avoid conflict with other users of the sea, notably fishermen?*

To address governance and socio-economic impediments, it is recommended that countries:

- strengthen good governance, such as freedom of speech, respect for human rights, transparency in government earnings and spending, a functioning judiciary and free and fair elections;
- invest oil and gas revenues in sustainable sectors with best economic returns: renewable energy, fisheries, agriculture and tourism;
- save part of their oil and gas revenues in special hard currency funds abroad and introduce them slowly into the economy;
- base decision-making on transparency and the participation of a broad spectrum of people;
- strengthen civil society's capacity to engage in decision-making through the establishment of citizens advisory councils;
- seek assistance in order to obtain the best possible financial benefits when negotiating contracts with oil and gas companies;
- establish an inter-ministerial extractive industry committee to deal with planning, contracting and enforcement of laws;
- resolve maritime boundary issues with neighbouring countries; and
- sign the Extractive Industries Transparency Initiative.

To mitigate environmental impacts and avoid conflict with other users, countries should:

- adopt a 'Clean Seas and Clean Fish' policy to protect the marine and coastal environment and the marketability of local fish products;
- establish, monitor and enforce nationally and regionally agreed pollution standards;
- carry out Strategic Environmental Assessments (SEAs) as recommended by the Abidjan Convention;

- identify no-go zones and areas where special operational standards should be applied;
- demand that oil companies share data on the marine environment and seek their contribution (voluntarily or via a tax system) towards further research;
- set standards for environmental impact studies during different development stages and make a detailed sea-use plan; and
- formulate minimum standards for the oil and gas industry at the national and regional levels, similar to those stipulated in the OSPAR Convention for the North-East Atlantic.

For the exploration stage, countries should:

- prohibit as a precautionary measure all seismic surveying in Marine Protected Areas and sensitive sea areas such as mangroves, seagrasses and certain estuaries such as nursery areas for marine resources; and
- prohibit surveying during the migration of important fish species, and near cetaceans and sea turtles.

For the drilling and production stage, countries should:

- prohibit production and drilling in vulnerable areas such as in or adjacent to Marine Protected Areas, mangrove areas, seagrasses, rich benthic communities such as deep sea corals or shellfish beds, estuaries and pelagic hotspots;
- prohibit discharge of oil-based drilling mud;
- require a zero discharge regime in areas that are likely to impact upon vulnerable ecosystems; and
- encourage the re-injection of production water.

In terms of maritime traffic, countries should:

- sign all IMO conventions;
- identify sensitive sea areas and have them designated as Particularly Sensitive Sea Areas and apply appropriate IMO tools; and
- sign Fund conventions for the compensation of oil spills caused by maritime traffic.

To reduce the risk of oil spills to a minimum, countries should:

- make oil spill risk assessments for maritime traffic and for drilling and oil production operations;
- allow only purpose-built and double-hulled floating platforms to operate;
- establish 500m navigation exclusion zones around oil and gas operations;
- have these exclusion zones recognised by IMO as Areas to be Avoided under the SOLAS Convention in order to warn international Maritime traffic whenever necessary;
- arrange for an adequate liability scheme of at least US$20 billion for oil pollution caused by offshore oil platforms (in line with the amount set aside by BP to compensate oil spill victims after the Deepwater Horizon blowout);
- establish an oil spill emergency fund; and
- draw up a detailed oil spill contingency plan.

Although the challenges are complex, proven solutions exist. It is up to the governments and civil societies of the subregion to take advantage of them, and to change the ‘resource curse’ into a resource blessing.

Annex 1: Oil and gas in different WAMER countries

Mauritania

Mauritania has significant mineral deposits, in particular iron ore. Mineral products account for more than half of total export earnings. Copper and gold are extracted from the Guelb Moghrein mine near Akjoujt in Inchiri, 260km north-east of the capital, Nouakchott and iron ore extraction takes place in the north of the country.

Mauritania is the first country in the ecoregion to exploit hydrocarbon resources. Exploitable quantities of oil were discovered in 2001 at the Chinguetti field about 80km from Nouakchott. Production started in 2006 with relatively good expectations – 75,000 barrels were to be produced per day during the next 20 years. In reality, average production started with 30,600 barrels per day in 2006 and plummeted within a few months to some 11,000 barrels. Today, in 2010, the field has a daily production rate of 10,000 barrels (BBC News, 2004, and personal communication with a former environment adviser to Woodside Energy).

The Chinguetti field was first operated by the Australian oil major Woodside Energy, which invested US$600 million during the first development phase. A Floating, Production, Storage and Offloading (FPSO) platform built from a 1976 single-hulled oil tanker was brought into position in early 2006, with a storage capacity of 1.6 million barrels – enough to stock production from the Chinguetti field and to connect to nearby smaller fields later in the development phase. These fields included the Banda gas structure, which was estimated to hold 3 trillion cubic feet of natural gas plus 300 million barrels of liquids, and the Tiof field holding 350 million barrels of oil (Offshore technology website).

Disappointing production rates, less favourable reserve estimates, tensions with the government and a new corporate policy to concentrate on its Australian liquefied natural gas (LNG) led to Woodside's decision in 2007 to sell all its Mauritanian assets.
The Malaysian-based company Petronas bought a 47.4% stake in the Chinguetti project from Woodside. This is part of a US$418m package that also gives it the role of operator on the Banda, Banda Tevet and Tiof fields (Asean Energy news service website).

The discovery of oil in 2001, and especially the release of the draft environmental impact statement of Woodside for the development phase of the first oil well, led to intense public debate. Environmental impacts were discussed and questions asked about how oil exploitation and fisheries could co-exist. Much of the discussion focused on the need for transparency in order to protect Mauritania against the so-called 'resource curse', the paradox of plenty.

In March 2005, WWF and its partner organisations IUCN and FIBA, organised a workshop and a lesson-learning trip for key stakeholders to Nigeria (PRCM website, activities in 2005) These capacity-building activities contributed to the government's acknowledging the need for transparency, which was sealed by the signing of the Extractive Industry Transparency Initiative. A year later, in 2006, a Publish What You Pay coalition of Mauritanian NGOs was set up to watch over the implementation of the principles laid down by EITI. The government also asked several international organisations to assist in reconciling the emerging sector with fisheries and marine and coastal biodiversity.

Mauritania was admitted as an EITI Candidate country on 27 September 2007. On 13 January 2006 the government adopted Decree No 2006-001 establishing a National Committee responsible for the EITI in Mauritania. Members of the National Committee include representatives of all the relevant stakeholders. On 9 May 2006, the National Committee organised an EITI workshop in Nouakchott, aimed at engaging all stakeholders involved in the EITI process. It also discussed the work of the future National Committee.

Mauritania released its first EITI report in March 2007 and its second report in July 2007. Due to the political situation the validation process in Mauritania met challenges from early 2008 to summer 2009, and was relaunched in October 2009. Work on the third report was due to start in March 2010. Validation started in January 2010. Mauritania has requested an extension to the validation deadline.

Oil blocks and biodiversity

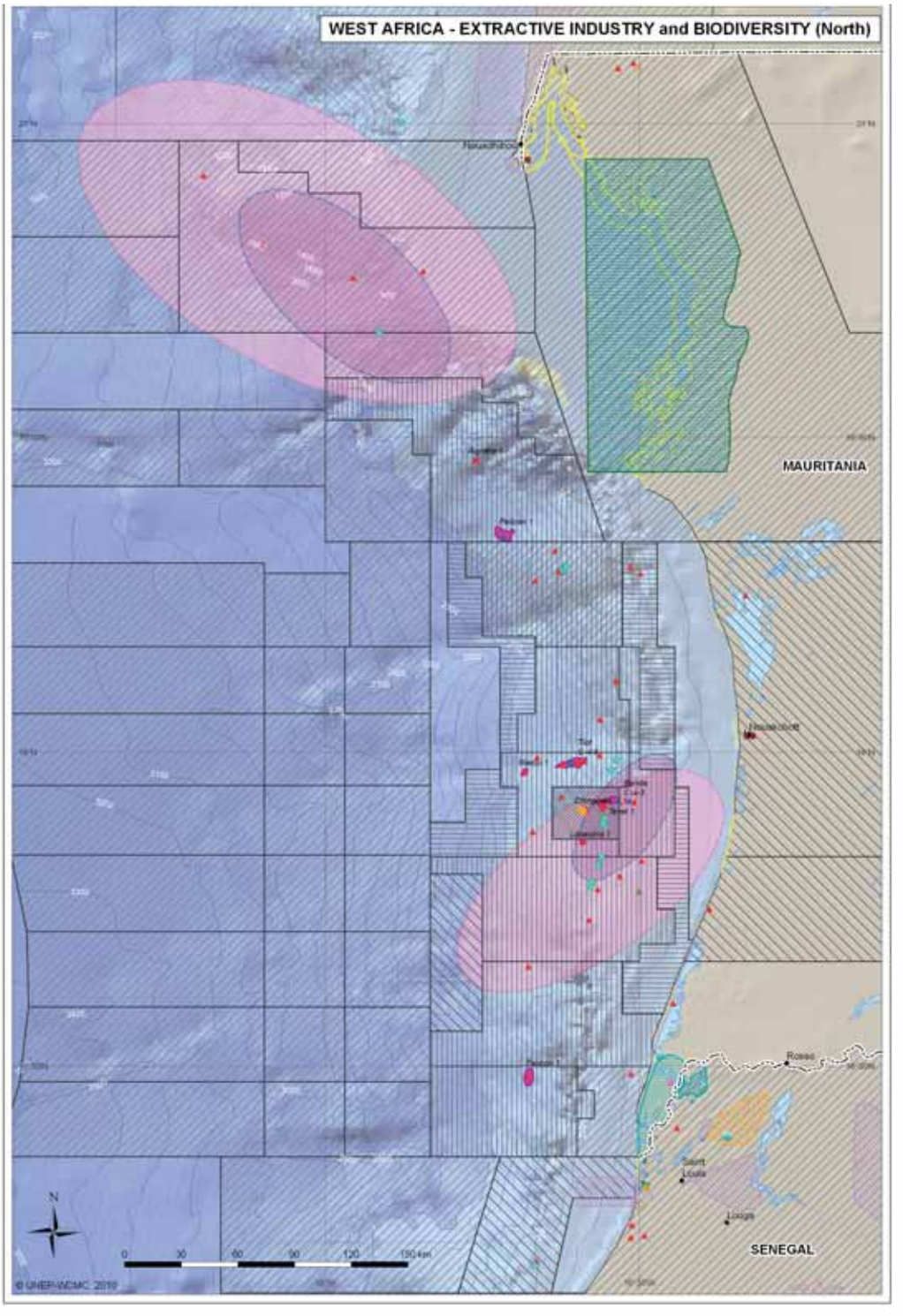
Fourteen oil and gas companies are registered in Mauritania. The country's territory and EEZ is subdivided into 104 oil blocks. Six offshore blocks were awarded to five companies, while 46 blocks are still classified as 'open' (not allotted), including blocks 9 and 10, where the Banc d'Arguin-Cap Blanc Complex of Protected Areas – a World Heritage Site – is located. The managing authority of the Banc d'Arguin has already requested government to protect the area against oil and gas exploration.

Blocks 48 and 20 coincide with another complex of protected areas, the Diawling-Chat T'boul-Djoudj, and is part of a trans-border UNESCO Man and Biosphere reserve. An exploratory well has been drilled in this area close to the only recorded breeding site in West Africa for the lesser flamingo, a species notoriously sensitive to any large-scale development. However, no commercial quantities of oil and gas have been encountered, the well is closed and further drilling abandoned.

Map 1 and the zoomed-in version (Map 14) reveals that the Chinguetti oil well is found within a pelagic hotspot for biodiversity, an ecosystem created by intense upwelling. Phytoplankton concentrations have been measured here at more than four times those in surrounding waters. The associated high number of seabirds is most likely related to the presence of dense shoals of pelagic fish feeding off the abundant plankton (Wynn and Knefelkamp, 2004). Except for pointing out the existence of deep sea coral reefs in the vicinity of the Chinguetti field, reports from the oil company (Woodside Energy) had not indicated the biological significance of the water column. This is a clear example of more research on sensitive sea areas offshore being necessary to guide sound management decisions before allowing oil and gas development.

To correct the introduction of offshore oil and gas in such a sensitive ecosystem, the government may wish to consider prohibiting all industrial fishing in the area. This will not only have beneficial effects on the ecosystem in the intense upwelling area but will also stop further destruction of the deep sea coral reefs by fishing gear. Woodside Energy argues in peer-published scientific reviews that these ecosystems have been partly destroyed by fishing for deep sea crustaceans and hake (Colman, 2005). The instauration of a large no-fishing zone in this oil exploitation area may in the long term have a beneficial impact on fisheries as a result of the spill-over effect. Moreover, it will reduce risks of fishing vessels colliding with the oil platform (FPSO). A temporary loss in fishing revenues may be compensated with oil and gas earnings. A UNDP project aimed at mainstreaming biodiversity into the oil and gas policy framework plans to make inter-generational cost benefit analysis of such trade offs between fishing and oil and gas exploitation. Another area of intense upwelling in northern Mauritania off Cap Blanc is also divided into exploration blocks which are licensed to the Scottish oil company Dana Petroleum. No-go zone management scenarios for this area should be considered in the SEA for oil and gas development.

Since the discovery of the Chinguetti field, six more offshore oil fields have been discovered, with total known oil reserves estimated at 290 million barrels. It is expected that production of the Tiof and Tevet fields will start in the near future. Additionally, it is estimated that more than 70 billion cubic meters of natural gas is contained in the Labedna and Banda fields that will fuel a power station in the capital, Nouakchott (UNDP, 2009).


WEST AFRICA - EXTRACTIVE INDUSTRY and BIODIVERSITY (North)
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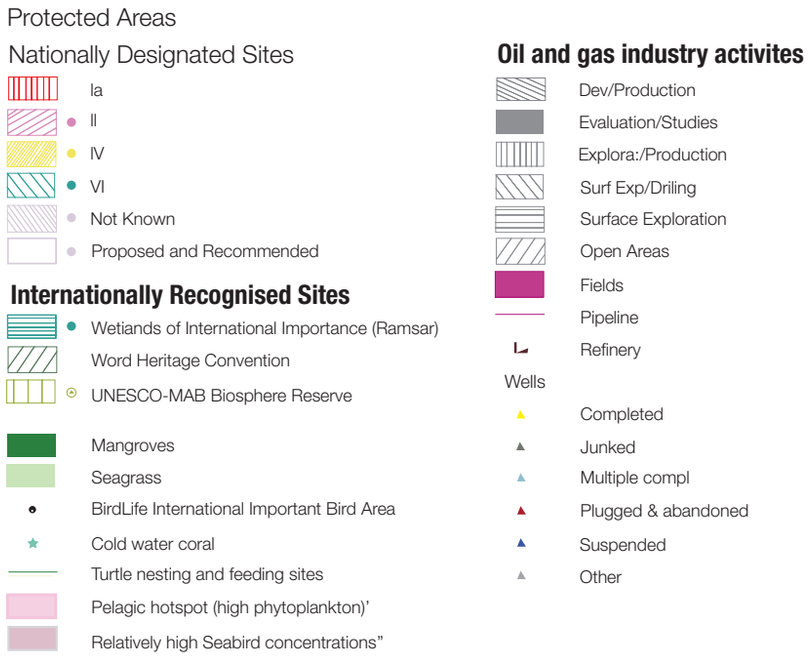


' Pelagic hotspot (relatively high phytoplankton concentrations up to > 2 mg/m3 created by intense upwelling
" Relatively high seabird concentrations (indicator species for pelagic hotspot).

Map 14. Offshore oil and gas activity in Mauritania. Map by UNEP-WCMC (for data used see Annex 5)

Governance frameworks

As the first oil producing country in the WAMER, Mauritania has started to develop a comprehensive hydrocarbon policy framework.

Several multilateral and bilateral initiatives have been set up to assist the government with the work in progress for a sound policy framework.

Expert panel

Because of earlier contracting problems and a lack of local expertise, an expert panel was set up and financed by the governments of Mauritania, France and the Netherlands and by MAVA and FIBA, international NGOs. No payments were made by the oil companies. The approach has been to develop dialogue on oil and gas activities with Mauritanian NGOs, oil and gas companies, the University of Nouakchott, the media and other bilateral (GTZ) and multilateral (WB) donors.

The panel identified a series of basic questions regarding an effective development of the oil and gas sector:

- What are the major technological risks and the response capacities?
- What are the existing or needed norms and standards concerning the management of technological risks? How can their enforcement be increased in the Mauritanian context?
- How are the oil and gas activities coordinated by government? With what results? How can the capacities for relevant coordination be consolidated?
- How is the rent redistributed, sector-wise and in social and spatial terms? What risks are associated with this distribution? And what are the means to follow and/or influence this distribution?

According to the panel, present laws and decrees do not sufficiently address the basic questions: who, where and how to operate; and present organisations and coordination of the state do not meet the demands for public intervention on oil and gas matters. Based on its assessment, the panel proposed to the government how to address these barriers through a series of recommendations such as defining no-go zones, implementing the principle of adopting best

worldwide standards and practices, strengthening coordination and improving the instruments for monitoring the distribution of oil and gas royalties (expert panel website).

Strategic environmental assessment
In the framework of the World Bank's Program de Renforcement Institutionnel du Secteur Minier, the Bank is helping the government to:

- build up and consolidate its long-term institutional and technical capacity to manage the country's mineral resources, including social and environmental management;
- promote private investment in the mineral sector; and
- improve the mineral sector's contribution to national and regional socio-economic development.

The project supports the development of a new hydrocarbon code, a registry for oil reserves and an environmental management and information system. It has also introduced a social component by providing financial support to local communities for capacity development and activities to generate revenues.

The World Bank supports the implementation of a Strategic Environmental Assessment (SEA) for the offshore and onshore hydrocarbon sector.

In 2005, at the request of the Prime Minister, the Dutch Committee for Impact Assessment wrote a Terms of Reference concerning how to carry out an SEA for the offshore oil and gas industry.

Integrating biodiversity into oil and gas policies
The UNDP was asked to help mainstream marine and coastal biodiversity in the policy frameworks through a partnership involving the oil and gas industry, government and civil society stakeholders. A proposal for a medium-sized project was submitted to the Global Environment Facility in 2009 and approved in February 2010.

The project's objective is to strengthen policy, legislative and financial instruments as well as the capacity of government and civil society stakeholders in partnership with the oil and gas industry to protect and conserve marine and coastal biodiversity. WWF, in the framework of its West African Marine and Coastal Conservation Programme (PRCM), is a partner. In collaboration with the University of British Columbia, this project will elaborate intergenerational cost benefit analysis of making trade offs between the emerging oil and gas industry and the existing fishing sector (UNDP, 2009).

Senegal

Petroleum exploration in Senegal began in 1952 with a surface geology survey, and the first exploration well was drilled in 1953. Since then nearly 150 wells have been drilled in the search for economically viable hydrocarbons. A number of small fields were discovered, but most were designated uneconomical. In the late 1970s, offshore exploration started again and a field of 1 billion barrels was discovered.

In 2007 and 2008, Senegal felt the full force of the global oil crisis which pushed the cost of crude to nearly US$150 a barrel. This forced the government to reconsider its entire energy strategy in light of the reality that the era of cheap oil was over and that increasing fuel costs would have significant socio-economic impacts.

Its new energy policy is focused on:

- improving the efficiency of electricity production;
- diversifying the sources of electricity generation;
- exploiting new sources of energy;
- promoting renewable energy with specific emphasis on biofuels;
- accelerating the rural electrification target of reaching 50% of all households by 2012;
- accelerating exploration ;
- strengthening refining and storage capacity;
- promoting energy efficiency; and
- improving energy management and building links with the private sector.

Senegal has both oil and gas reserves, the most important of which is Astride, an offshore reservoir at the southern border with Guinea-Bissau which is estimated to hold nearly 1 billion barrels. The large offshore block that straddles the Senegal

and Guinea-Bissau border has water depths extending from 50m to 3,500m. It is managed by the Agence de Gestion et de Coopération entre le Guinée-Bissau et le Sénégal (AGC), a joint commission established to administer the maritime zone between the two countries. However, the oil is very heavy and will be expensive to produce profitably until prices rise significantly. The field lies in waters claimed by both countries, but an agreement has been made to share production in an 80/20 split favouring Senegal. In 2006 natural gas extracted from onshore facilities contributed 0.3% of Senegal's energy needs.

Currently, eight petroleum companies are actively engaged in Senegal. Recent studies have indicated several potential sites in deeper waters some 100km offshore, which could hold up to 3,500 million barrels.

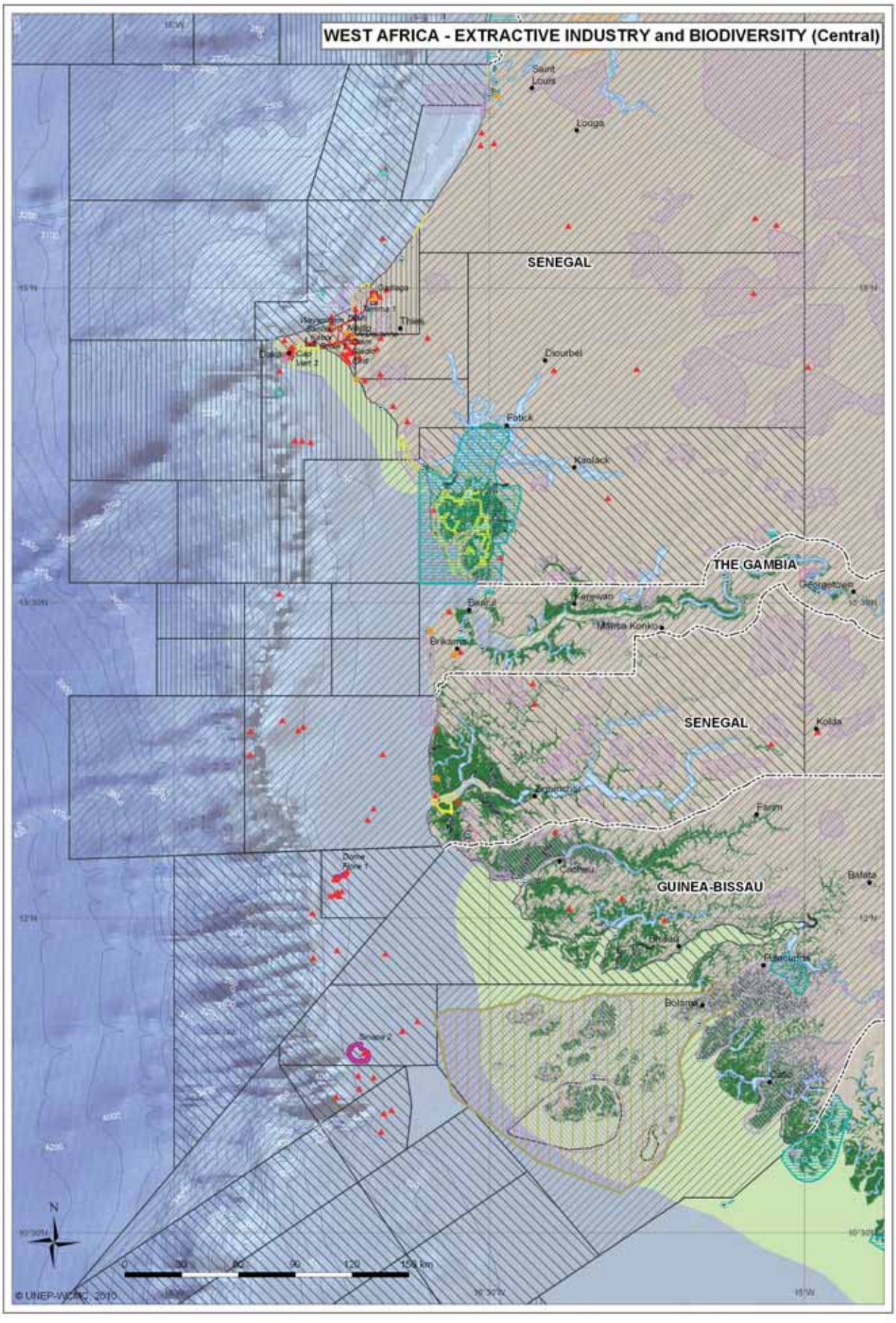
These cover an area of 8,187sq km. Roc oil currently holds a 92.5% interest in the production sharing contract, but is assigning part of this interest to a third party. Petrosen holds the remaining 7.5 % interest.

Governance
In accordance with economic structural reforms mandated by the Enhanced Structural Adjustment Facility (ESAF) and to increase the interest in hydrocarbon exploration in the country, Senegal issued a revised hydrocarbon law in 1998. The new code amended the terms of exploration permits, including the length that a permit can be held and extensions of permit licences.
At the time of writing, Senegal has not yet signed a commitment to the Extractive Industries Transparency Initiative.

There is interest in carrying out an SEA to better manage and plan current exploration and future exploitation activities.

Biodiversity
Extensive seagrass beds and mangrove forests are found along the coast. Offshore shellfish beds can be found on the continental shelf and at several points along the continental slope where deep sea coral reefs have been monitored. It is very likely that pelagic hotspots at distinct zones of intense upwelling exist off the Senegalese coast. There are anecdotal observations of dense concentrations of seabirds off Cap Vert (Dakar) (personal communication with Kees Camphuysen), concurring with Helmke's observation that zones of intense upwelling along the north-west African coast are most likely to be found off capes (Helmke, 2004).

Valuable sea areas along the coast, and more offshore, need to be considered when planning oil and gas development.


WEST AFRICA - EXTRACTIVE INDUSTRY and BIODIVERSITY (Central)
Saint Louis
Louga
SENEGAL
Thiès
Dakar
Cap Vert 2
Diourbel
Fatick
Kaolack
THE GAMBIA
Georgetown
Kerewan
Basse
Brikama
Mansa Konko
SENEGAL
Kolda
Ziguinchor
Farim
Dome Flore 1
Cacheu
GUINEA-BISSAU
Bafata
Bissau
Buruntuma
Bolama
Cabo
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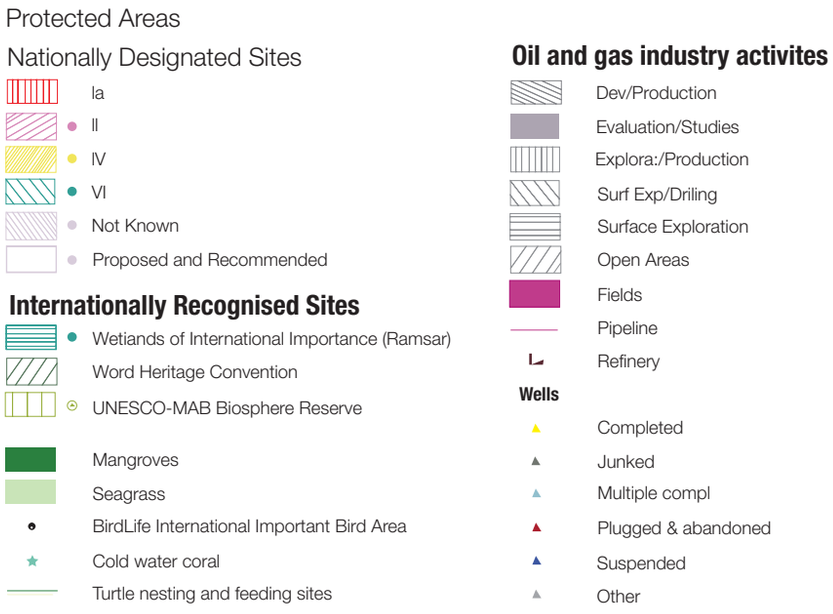
60
90
120
150 km
© UNEP-WCMC, 2010



Map 15 Offshore oil and gas activity off Senegal, The Gambia and Guinea-Bissau. Map by UNEP-WCMC (for data used see Annex 5)

The Gambia

Exploration for hydrocarbons is taking place offshore. In 1998, West Oil held an offshore block under a Technical Cooperation Agreement (TCA) and Planet Energy held the rights to two blocks, one offshore and one onshore. In October 1999, Fusion Oil and Gas NL, with 90% and The Gambia 10%, signed a petroleum production licence (PPL) for the deepwater offshore block off Banjul, previously held by West Oil. Fusion carried out an in-depth study of the data available for the deepwater areas offshore.

According to Fusion's managing director, Alan Stein, the study revealed significant, previously unrecognised deepwater exploration potential, enabling the company to embark upon a fast-track exploration programme.

Lamin Kaba Jawara, The Gambia's Commissioner for Petroleum, declared that his government "looks forward with confidence to continuing our work with Fusion to fully evaluate the prospectivity of our deepwater acreage".

Banjul recently signed a PPL with Britain's Planet Oil in conjunction with Balmain Resources over offshore acreage. While Planet Oil is the operator, Balmain Resources has a 10% interest in the acreage that has four potentially viable prospects, with probable oil reserves exceeding 100 million barrels. The largest prospect, G-8, has estimated reserves of up to 1.4 billion barrels.

Governance

With the overall objective of effective development of the hydrocarbon resources – crude oil and natural gas and the judicious utilisation of the revenues to be derived – The Gambian government outlined the following policies for developing the hydrocarbon sub-sector:

- encourage oil exploration activities through the creation of a policy environment that is friendly to investors;
- encourage more private sector participation in oil and gas exploration and prospecting;
- continuousgovernmentsupportforhydrocarbon exploration and exploitation through incentive schemes and as well as initiation of new studies complementary to the work of the oil companies;
- cooperation with neighbouring countries (Guinea-Bissau, Guinea, Mauritania and Senegal). They will be encouraged to share experiences and information on hydrocarbon exploration;

- licensing terms, regulations and fiscal regimes on hydrocarbon to be harmonised between sub-regional countries (Guinea-Bissau, Guinea, Mauritania, Senegal and The Gambia) for efficient implementation of the programmes;
- the sub-regional oil and gas conference will be promoted as an annual and semi-annual conference; and
- encourage collaboration with countries such as Canada and Norway, which have excellent credentials and considerable expertise in modern oil technology, in order to gain assistance for human resources development leading to efficient management of sub-regional petroleum resources.

The government has so far made no commitment to sign the Extractive Industries Transparency Initiative.

The Ministry of the Environment has expressed interest in an SEA, but plans have not yet become definite.

Guinea-Bissau

There has been active exploration of Guinea-Bissau's offshore resources since the late 1960s, when Esso drilled six wells. In 1974, Guinea-Bissau gained independence from Portugal and since then exploration has been frequently affected by civil unrest. Offshore exploration has been hampered by a boundary dispute with Senegal, which was not resolved until 1993.

Under an agreement signed in 1995, the area of the border dispute with Senegal, which contains the Dome Flore and Dome Gea discoveries, is now jointly managed by both Senegal and Guinea-Bissau through the Agence de Gestion et de Cooperation entre la Guinée-Bissau et le Sénégal (AGC). Under the terms of this agreement, proceeds from activity in the joint exploration area were divided between Senegal and Guinea-Bissau in an 85:15 ratio, but in 2000 this was revised to 80:20.

There have been intermittent drives to promote offshore exploration, and a number of international companies have been involved over the last 40 years – among them Esso, Elf, Pecten, Lasmo, Sipetrol of Chile, West Oil, Sterling Energy, Benton Oil and Gas and Petrobank Energy and Resources.

The Guinea-Bissau permits are situated in shallow waters of the Casamance-Bissau sub-basin. Live oil recoveries from several wells, and their proximity to the heavy oil accumulations at Dome Flore and Gea, support the oil potential of the Sinapa and Esperanca permits. The Sinapa (Block 2) and the Esperanca (Blocks 4A and 5A) permits cover a combined area of 5,840 sq km and are located offshore Guinea-Bissau in water depths ranging from 10m to 2,000m. However, an oil spill in these blocks could seriously damage some of the region's most important biodiversity, particularly fish breeding grounds in the Bijagos archipelagos.

Governance

A National Plan for Environmental Management defines national policies on the management of natural resources, but no sustainable development or poverty reduction plans exist at present.

Currently, Guinea-Bissau has no specific policy or plan for extractives in general and hydrocarbon resources in particular. As the national authorities envisage the exploitation of hydrocarbon resources, ministries and NGOs responsible for environmental protection should prepare to help the country develop negotiation tools to promote the use of the income from these resources for sustainable development. It is also vital to have transparency in the receipt and use of funds and to enable public access to information. An informal IUCN working group comprises government bodies, NGOs including the Guinean environmental group Tiniguena, the Swiss Development Cooperation and other civil society organisations.

On 21 May, a national Publish What You Pay coalition was launched, following a three-day workshop on revenue and licensing transparency and good governance, organised by Movimento da Sociedad Civil.

The workshop was attended by representatives of government, civil society, UN agencies, international NGOs and academia. Its key recommendations

include ensuring that Guinea-Bissau quickly endorses the EITI, making civil society and the media aware of the need to promote the initiative, and more general revenue transparency.

In spite of the Nairobi and Abidjan Conventions' recommendation in 2007, there has been no Strategic Environmental Assessment (SEA) – although there are plans to approve an environmental code and laws which will cover SEAs and protect not only the environment but also human rights.

The government has not yet signed the Extractive Industries Transparency Initiative (EITI) nor engaged in an SEA. But these themes were expected to be addressed in March 2010 at an extractive industries and sustainable development conference organised at the initiative of the Cabinet in collaboration with the Department of Development and Environmental impact studies (CAIA).

Approvals of plans and contracts
The Ministry of Energy and Natural Resources and Petrol (DENRAP) is primarily responsible for oil and gas. A number of other ministries and departments are responsible for protecting the environment, including the Ministry of the Environment and Sustainable Development (MADR), and the state agency on environmental impact assessments (CAIA).

At present there is no inter-ministerial extractive industries committee or transparency department.

Guinea

Guinea has abundant natural resources, including 50% of the world's known bauxite reserves, along with diamonds, gold, and other metals. Until 1990 mining accounted for more than 20% of GDP, supplied over 90% of exports and provided 70% of fiscal revenues. Financial problems, however, hindered the bauxite/alumina sector since the late 1980s. In 2002, mining activities accounted for an estimated 17% of GDP, while mineral exports represented nearly 90% of total export earnings and 20% of domestic government income.

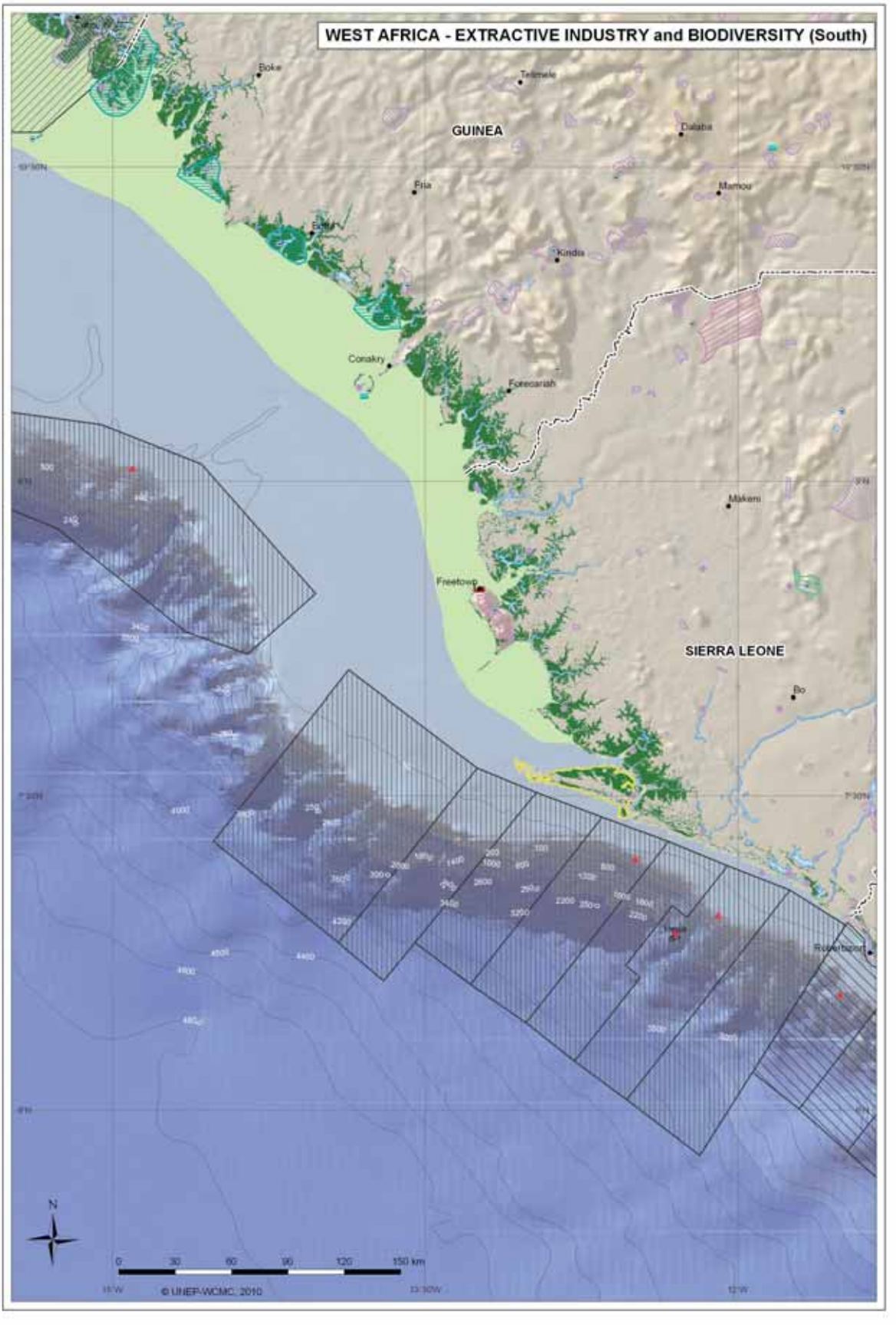
Research for oil and gas in Guinea goes back more than 30 years. Shell carried out a 2,900 sq km seismic study between 1967 and 1970 without finding commercial quantities of hydrocarbons exploitable with the then available technology. Other companies carried on the research during the 1970s and '80s.

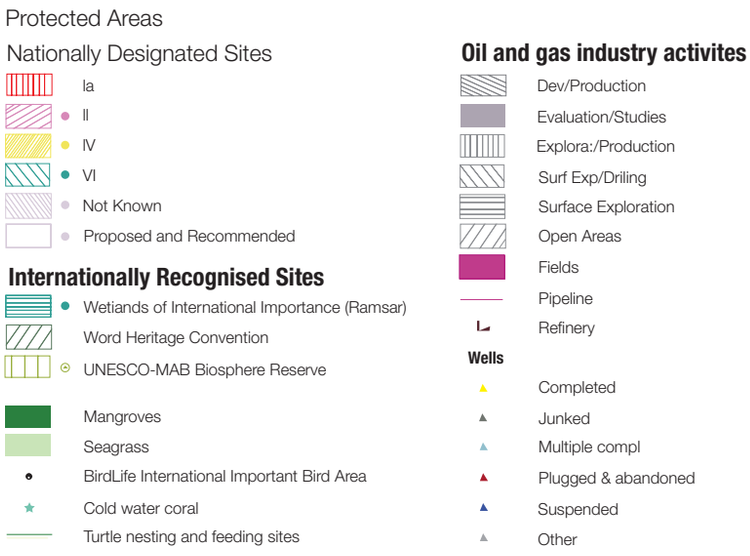
In 2003, a Hydrocarbon Research and Promotion Bureau was set up by the Ministry of Mines and Geology to facilitate investments by international companies. This was replaced in 2008 by SNEPG (Société Nationale d'Exploitation Pétrolière de Guinée) to represent the government in managing contracts, participating in hydrocarbon operations and marketing the country's share of the oil and gas produced.

More than 22,000 sq km of seismic studies have been carried out in offshore shallow and deep waters. In 2006, Hyperdynamics Corporation (Sugarland, TX), an American oil company, signed a production-sharing agreement to develop Guinea's offshore Senegal Basin oil deposits in an 80,300 sq km concession; it is pursuing seismic exploration. A collaboration with Aberdeen-based Dana Petroleum has been set up (Afronews, 2009).

"With a strong record of successful exploration and production activities in the North Sea and ongoing exploration in Mauritania and Senegal, Dana is the kind of partner Hyperdynamics has been seeking to supply additional technical expertise and help us accelerate exploration of our offshore Guinea concession," said Ray Leonard, Hyperdynamics' president and chief executive.

Also in October, Guinean Mines Minister Mahmoud Thiam announced that the China International Fund, a finance and engineering company, would invest more than US$7bn in infrastructure. In return, he said the company would be a 'strategic partner' in all mining projects in the mineral-rich country. It would help build ports, railway lines, power plants, low-cost housing and even a new administrative centre in the capital, Conakry. However, analysts say that the timing of the deal is likely to stir controversy. Oil and gas operations are controlled by legislation, including Law 119/ PRG/ 86 of 23 September 1986.


WEST AFRICA - EXTRACTIVE INDUSTRY and BIODIVERSITY (South)
Boke
Telimele
GUINEA
Dalaba
Pita
Mamou
Kindia
Conakry
Forecariah
Makeni
Freetown
SIERRA LEONE
Bo
Rokerbiport
N
0 30 60 90 120 150 km
© UNEP-WCMC, 2010



Map 16. Offshore oil and gas activity off Guinea and Sierra Leone. Map by UNEP-WCMC (for data used see Annex 5)

Guinea initially signed the EITI agreements but has voluntarily suspended its EITI Candidate status starting from 19 December 2009. The government and the EITI Guinea Steering Committee had made this request in view of the difficult political situation. Meanwhile, they informed the Board of their intention to continue unilateral EITI implementation during suspension. Guinea's Candidate status will be suspended for up to one year. During this time, Guinea will be listed as 'EITI Candidate country – Suspended'.

A national Publish What You Pay Coalition was launched in May 2006.

The government has shown an interest in Strategic Environmental Assessments (SEAs) to guide oil and gas development and other extractive industries.

Extensive seagrass beds and mangrove forests are found along the coast. Offshore oil and gas exploration is concentrated around the continental shelf, but as oil spills can destroy a large part of the coastal ecosystems, it is important that countries carry out thorough risk assessments and weigh the benefits against the risks involved – restoring these vast sea-grass beds and mangrove forests might not be an option as costs involved will be prohibitively high.

Cape Verde

The small island republic of Cape Verde has no known oil or gas reserves, either onshore or offshore, and has no upstream oil industry. The downstream industry is wholly dependent on refined petroleum products imported from Portugal and mainland African countries.

The islands are vulnerable to oil spills, particularly from passing vessels washing their tanks and by spills from other countries in the region. These could damage the country's natural resource base and its plans to expand ecotourism. And because much of Cape Verde's drinking water comes from desalinised seawater, oil pollution at sea could threaten this supply.

The Cape Verde oil industry is regulated by Direcção Geral de Energia (General Directorate of Energy).

Sierra Leone

Sierra Leone is rich in mineral resources. Diamonds, gold, bauxite, rutile and iron ore are known to exist in large quantities, although geological studies have not yet mapped all the country's terrain, and may reveal additional mineral deposits. The rise of mineral prices in recent years has led to strong interest by international mining companies in Sierra Leone, resulting in a surge of new mining

licences and exploration. The mining sector now contributes about 30% of the country's GDP, though the vast majority of this is artisanal, and is still illegal.

In 2008, Anadarko Petroleum Corporation announced a deepwater discovery at the Venus exploration well in block SL 6/07 in the offshore waters of Sierra Leone. It is one of more than 30 identified prospects across 10 blocks offshore of Sierra Leone, Liberia, Ivory Coast and Ghana. Anadarko also discovered oil in Ghana's Jubilee field. It's claimed that the first offshore site alone could generate US$20 billion by 2030.

IHS Global Insight states that together with recent discoveries in Ghana's Jubilee field, the potential exists for a new oil province stretching 1,200 km from Sierra Leone across Liberia and the Ivory Coast to Ghana. This might open up the potential for cross-border pipelines and a regional refinery.

President John Atta Mills of Ghana has publicly stated his determination to make sure that wealth does not lead to the corruption and environmental damage that is troubling Nigeria, the region's oil giant.

This has been repeated by Sierra Leone's Information Minister, I.B. Kargbo, who says that if oil becomes a flourishing industry, "all Sierra Leoneans will benefit, particularly the younger generation. We are going to put in place the structures for accountability and transparency. We will never again make the mistakes we made when we squandered the wealth that should have accrued from diamonds in this country." (Money website).

Sierra Leone's oil industry is regulated by the Department of Trade, Industry and State Enterprises. The government has also ratified most of the relevant international conventions (see Annex 2).

Sierra Leone was accepted as an EITI Candidate country on 22 February 2008. A steering committee was established including industry, government and civil society and an official launch was held in June 2007.

A national Publish What You Pay coalition was launched in 2007.
The government has expressed interest in carrying out a Strategic Environmental Assessment to better manage and plan current exploration and future extractive industry exploitation activities.

Extensive seagrass beds and mangrove forests are found along the coast. Offshore oil and gas exploration concentrates around the continental shelf, but as oil spills can destroy a large part of the coastal ecosystems, it is important that countries carry out thorough risk assessments and weigh the benefits against the risks involved – restoring vast sea grass and mangrove forests might not be an option as costs involved will be prohibitively high.

Annex 2: Basic documents and guidelines concerning environmental practices in offshore oil and gas activities

(from UNEP website: www.oilandgasforum.net)

E&P Forum/UNEP	Document	Topic Env. Impact Assessment	Env. Management	Env. Technologies	Env Reporting
E&P Forum/PNUE	Environmental Management in Oil and Gas Exploration and Production (1997)	X	X		X
IUCN/E&P Forum	Oil and Gas Exploration and Production in Mangrove Areas (1993)		X	X	
ARPEL	A Guideline for the Disposal and Treatment of Produced Water			X	
ARPEL	A Guideline for the Treatment and Disposal of Exploration and Production Drilling Wastes			X	
ARPEL	Guidelines for an Environmental Impact Assessment (EIA) Process			X	
AEPS (Arctic Council)	Arctic Offshore Oil & Gas Guidelines (1997)		X	X	
E&P Forum	Exploration and Production Waste Management Guidelines (1993)			X	
E&P Forum	Guidelines for the Development and Application of Health, Safety and Environmental Management Systems (1994)		X		
E&P Forum	E&P Forum Guidelines for the Planning of Downhole Injection Programmes for Oil-Based Muds Wastes and Associated Cuttings from Offshore Wells (1993)			X	
E&P Forum	Quantitative Risk Assessment Data Directory (1996)			X	
E&P Forum	The Physiological Effects of Processed Oily Drill Cuttings (1996)			X	
E&P Forum	Technologies for Handling Produced Water in the Offshore Environment (1996)			X	
E&P Forum	Production Water: Current and Emerging Technologies (1994)			X	
E&P Forum	North Sea Produced Water: Fate and Effects in the Marine Environment (1994)	X		X	
Petro-Maritime Consultants	Operational Discharges from Offshore Oil and Gas Exploration and Exploitation Activities: Regulatory Requirements and Enforcement Practices (1997)		X	X	
World Bank	Environmental Guidelines 1988, 1995		X	X	

World Bank	Offshore Hydrocarbon Resource Drilling Operations – Effluent Guidelines 1983			X	
API	Chemical Treatments and Usage in Offshore Oil and Gas Production Systems, Offshore Effluent Guidelines (1989)			X	
API	Safety and Environmental Management Programme (Semp) (1993)		X		
IAGC	Environmental Guidelines for World-wide Geophysical Operations (1992)	X	X	X	
The Joint Links Oil and Gas Consortium	Polluting the Offshore Environment (1996)	X		X	
WWF	The Application of Strategic Environmental Assessment in Relation to Offshore Oil & Gas Resource Exploration (1998)	X		X	
WWF	The Application of EIA in Relation to Offshore Oil and Gas Exploitation (1998)	X		X	
APPEA	Environmental Implications of Offshore Oil and Gas Development in Australia- The Findings an Independent Scientific Review (1994)	X	X	X	
E&P Forum	View of environmental impact assessment	X	X		
WWF	Environmental Best Practice and the Move Toward Zero Discharge in the offshore oil and gas industry			X	
OGP	Implementation of HSE Management Systems Workshop Proceedings (1999)		X		
OGP	HSE Management – Guidelines for working together in a contract environment (1999)		X		
SustainAbilty' and UNEP	Engaging Stakeholders 1998:The Non-Reporting Report (1998)				X
SustainAbilty' and UNEP	The Oil Sector Report (1999)				

Annex 3: List of relevant conventions signed by WAMER states

X = ratified; d = denunciation; * = singed but not ratified; ** = not a member state, but signatory of MoU on migration on sea turtles and African elephant

	Cape Verde	Gambia	Guinea	Guinea-Bissau	Mauritania	Senegal	Sierra Leone
IMO Convention 48	X	X	X	X	X	X	X
IMO amendments 91		X	X			X	X
IMO amendments 93	X	X					X
SOLAS Convention 74	X	X	X		X	X	X
SOLAS Protocol 88							X
SOLAS Protocol 88							X
STCW Convention 78	X	X	X		X	X	X
MARPOL 73/78 (Annex I/II)	X	X	X		X	X	X
MARPOL 73/78 (Annex III)	X	X	X		X	X	X
MARPOL 73/78 (Annex IV)	X	X	X		X	X	X
MARPOL 73/78 (Annex V)							X
MARPOL Protocol 97 (Annex VI)	X						X
London Convention 72							X
London Convention Protocol 96					X	X	
INTERVENTION Convention 69				X			
INTERVENTION Protocol 73		X			X	X	D
CLC Convention 69					X		
CLC Protocol 76	X		X				X
CLC Protocol 92		X			X		D
FUND Convention 71							
FUND Protocol 76	X		X				X
FUND Protocol 92							
FUND Protocol 2003	X		X		X	X	X
OPRC Convention 90							
OPRC/HNS 2000							X
ANTI FOULING 01							X
BALLASTWATER 2004							
Other relevant conventions	X	X	X		*	X	X
Abidjan Convention	X	X	X	X	X	X	X
UN Convention against Corruption	X					X	
Rio Declaration 1992	X	X	X	X	X	X	X
Stockholm Declaration	X	X	X	X	X	X	X
Ramsar	X	X	X	X	X	X	X
EITI			X		X		X
CBD	X	X	X	X	X	X	X
CMS	X	X	X	X	X	X	**

Annex 4: Organisational structure and functioning of Citizens Advisory Councils (CACs)

- Establishment of a CAC should be required by the government in order for the project to be in legal compliance.
- The CAC should exist for the lifetime of the project or projects.
- Sufficient funding is essential.
- With proper safeguards, a citizens group can be independent with industry funding.
- Funding should come with no strings attached.
- The CAC should represent all stakeholder groups that are potentially affected by the project.
- Board members should be appointed by, and serve solely at the pleasure of, stakeholder groups; they should not be controlled by industry or government.
- Board members do not have to be experts.
- Cooperation works better than confrontation.
- Conflict is inherent, but common ground is possible.
- Agreeing on how to disagree reduces conflict.
- Logic makes passion persuasive – using science, etc.
- A clear mission and identity should be established early on.

Structure and function

A CAC should be structured to give local people a direct voice in the corporate and governmental decisions that affect them and their communities. The group should become the primary conduit through which government and industry communicate to the public on industry issues. In a real sense, the CAC should become the eyes, ears and voice of the local public on industry issues.

Board of directors

A CAC should have a board of directors (either volunteer or paid), consisting of members representing the communities and major citizen constituencies potentially affected by the project – the stakeholders. These board seats might, for example, represent indigenous people, commercial fishing, aquaculture, conservation, recreation, tourism, communities, tribal entities and so on. Board members must be chosen by, and serve entirely at the pleasure of, their respective constituencies. Representatives should not be chosen by industry or government. A CAC may also have several ex-officio non-voting board members representing the relevant governmental agencies.

The board should meet regularly (quarterly, for example), and at each meeting representatives of industry and government should be asked to report on their operations and listen to citizens' concerns. This regular interchange provides a line of communication vital to the interest of each constituency, and results in a constructive climate for problem solving. The board is responsible for hiring staff, making policy recommendations and allocating the annual budget.

Staff

The day-to-day activity of the CAC is the responsibility of a paid staff. Depending on the desire of the board, staffing can include an executive director, deputy directors, public information manager, community liaison manager, finance manager, project managers and administrative assistance. The staff serves at the pleasure of the executive director.

Committees

Much of the CAC's work can be conducted by technical committees, each with dedicated staff liaison. These committees should be appointed by the board based on expertise, interest and willingness to serve. The committees should meet regularly to discuss all issues within their purview, draft and recommend policy actions to the board, and conduct research approved and financed by the board.

Responsibilities

The broad mission of a CAC is to enable citizens to ensure the highest standards of environmental and social responsibility of an industrial project. The CAC should be empowered to provide oversight on all aspects of extractive industry development in their region – permitting, exploration, production, transport, refining, public revenue collection, risk management, and environmental compliance.

The CAC should provide oversight, advice and advocacy on issues such as the following: where to allow development, rates of reserve extraction, Best Available Technology (BAT) standards, accident prevention and response preparedness, legal liability, environmental monitoring, regulatory reform, revenues and taxes, and so on. It should have a voice in the selection of export routes and transport methodologies. The CAC should review and submit written comments on all project operations. This should include government legislation, regulations and permits, industry policy and procedure, and industry financial matters – revenues, costs, taxes, royalties, etc.

At the request of its board or committees, the CAC should commission independent scientific studies and reports on issues of relevance to the public, the media, government agencies, legislative bodies and the industry. This research should form the basis of policy recommendations. Conducted jointly with government and industry, this research will foster a more cooperative spirit among these groups, minimising conflict and contention. The CAC monitors and plays an active role in all industry and government oversight for the project.

The recommendations of the CAC are advisory and non-binding, and while government regulators and industry are not required to adopt the council's advice, many recommendations are likely to be adopted if they result from thorough research and vetting by the council's process. All the CAC's work should be open to the public on whose behalf it operates, and interested citizens can attend and comment as well. A robust public outreach and communications effort should be developed by the CAC, with a website and regular newsletters.

Funding

Substantial and stable funding is critical. The budget should be commensurate with the responsibilities of the CAC, and include sufficient funds to commission independent research and technical reports as the CAC deems appropriate. One thing that distinguishes the CAC concept from other advisory structures is that the CAC has sufficient funding to conduct its work. Typically, about one third of the annual budget is devoted to staff; one third to administration (office rent, supplies, equipment, audits, etc), and one third to research and contracts.

There are several possible avenues for financial support:

- Direct funding by the extractive industry: Funding could come directly from the companies and/or their consortia (as in Alaska), but must contain sufficient safeguards against industry bias and control. Industry funding would be best in the form of an endowment from which the CAC could operate off the investment earnings.

- Financial institutions requiring the establishment of a CAC as a condition of their loan: Lacking direct support by the extractive companies, international financial institutions (IFIs) could require companies receiving loans to establish and fund such independent, credible public participation as a condition of their loan. The IFIs could stipulate what sort of audit, review protocols, representation and government and industry cooperation must be put in place for the groups.

- Government support: Governments can themselves enable civil society to establish independent CACs by providing finance from public revenues derived from extractive industry projects, thereby removing industry from any direct role in the group's budget.

- Interim, start-up support from philanthropic non-governmental organisations (NGOs): If none of the above financial instruments is attainable in the short term, the assistance of an outside philanthropic NGO can be solicited. As an interim CAC proves its worth as a

mechanism for informed public participation, its funding should be picked up directly by government or industry.

- Avoiding corruption and co-option: To prevent financial corruption, a CAC should commission annual financial audits by independent firms, and report results in its publicly available annual reports. Clear conflict of interest and disclosure policies for directors and staff should be instituted. To minimise the risk of industry co-option, CAC members should remain accountable to their respective stakeholder groups, and have high standards of transparency and openness. Ultimately, it is the citizens groups represented in a CAC that control the process – not government or industry.

Annex 5: Data used for maps produced by UNEP-WCMC

Extractive Industry and Biodiversity maps.

Petroleum exploration and production data: IHS, extracted January 2010.

Nationally Designated and Internationally Recognised Protected Areas

World Database on Protected Areas (WDPA) Annual Release 2009 (web download version), February 2009. The WDPA is a joint product of UNEP and IUCN, prepared by UNEP-WCMC, supported by IUCN WCPA and working with Governments, the Secretariats of MEAs and collaborating NGOs. For further information protectedareas@unep-wcmc.org

Mangroves

Mangroves of Western Central Africa (2006) compiled by UNEP World Conservation Monitoring Centre (UNEP-WCMC). Dataset processed from Landsat imagery circ 2000.

Seagrasses

Global distribution of seagrasses (V2.0, 2005) prepared by UNEP World Conservation Monitoring Centre (UNEP-WCMC) in collaboration with Dr. Frederick T. Short.

Important Bird Areas

BirdLife International (2009). Important Bird Area (IBA) data extracted from the World Bird Database on 15th April 2009. For further information please visit www.birdlife.org.

Cold Water Coral

Global distribution of Cold-water corals (V2.0 2005) sourced from A. Freiwald, Alex Rogers and Jason Hall-Spencer, and other contributors.

Turtle nesting and feeding sites

Global Marine Turtle feeding and nesting sites (V 1.0) 1999 compiled by UNEP World Conservation Monitoring Centre (UNEP-WCMC).

Pelagic Hotspots (high phytoplankton) and Relatively high Seabrid Concentrations

Taken from illustration on P. 6 and P. 7 (respectively) of “Seabird distribution and oceanic upwelling off Northwest Africa” by Russell B. Wynn and Britta Knefelkamp, British Birds 97, July 2004.

Pink ovals show areas with relatively high phytoplankton concentrations measured at more than 2 mg of chlorophyll a per cubic meter of ocean water. Outside these areas of intense upwelling, water was measured below 0.5 mg per cubic meter.

These zones of intense upwelling result in the proliferation of phytoplankton, the basis of a rich marine food chain and high seabird concentrations. These birds are most probably attracted by dense shoals of small pelagic fish feeding off abundant planktonic species. The blue ovals within the pink ones indicate locations where more than 100 seabirds per hour were observed, whereas in the surrounding waters fewer than 10 birds per hour were counted. This research was only conducted in a part of the Mauritanian EEZ. More pelagic hotspots, either permanent or temporary, may exist in Mauritania and other WAMER countries.

Rich benthic ecosystems on the continental slope are not indicated on the map due to a lack of knowledge about where these ecosystems can be found throughout WAMER. A large Venus shellfish bank situated off the Banc d’Arguin park is believed to play a key role in creating the right environmental conditions for seagrasses within the adjacent park and World Heritage Site. See also: Kloff, S., Trebaol, L. and E. Lacroix, 2007. Pêche aux bivalves & environnement. *Panorama mondial, études de cas, application à l´exploitation des praires en Mauritanie. Fondation Internationale du Banc d´Arguin, FIBA. La tour du Valat, Arles, France. Available on www.lafiba.org.*

Bathymetry data reproduced from the GEBCO Digital Atlas published by the British Oceanographic Data Centre.

International boundaries taken from Digital Chart of the World, Environmental Systems Research Institute Inc (ESRI), 1993.

Fishing zones

There was no single dataset available which could provide a consistent picture of fishing activities and zones. Various data available for individual countries was used and wherever possible this was displayed in a consistent way. Where no mapped information was available, descriptions of fishery limits were used and data generated accordingly.

A number of useful datasets for fishing for the different West African countries were provided by Dr Khady Sane Diouf, a fisheries expert in Senegal. Datasets used were: Guinea fishing zones, The Gambia fishing zones, cephalopods, shrimp, gambas fishing, live bait tuna fishing, hake fishing, small pelagics, and juvenile fish. Some of these species datasets appeared only to cover particular countries, so it is important to note that absence of data doesn't necessarily mean that such fishing does not occur in other areas.

Additional datasets were used as follows:

For Sierra Leone, the artisanal fishing limits were defined as operating in estuaries and inshore waters and extending from the shoreline to a depth of 20-40 meters.
Reference: www.fao.org/DOCREP/003/R9003E/R9003E03.htm

For Senegal, the artisanal fishing limit was defined as 12 miles.
Reference: http://base.d-p-h.info/es/fiches/premierdph/fiche-premierdph-4047.html

For Guinea-Bissau, data from a previous map produced at UNEP-WCMC, *Biodiversity and Perspectives on Oil*, Gas and Mining Exploitation in Guinea-Bissau, was used. Data was provided by Alfredo Simão da Silva, Director of IBAP, Instituto da Biodiversidade e Areas Protegidas (IBAP), Guinée Bissau; Nelson Dias Gomez, Head of mission, IUCN-Guinea Bissau, and Herculano Da Silva Nhaga, Gabinete de Planificação Costeira, INEP/CELUWA SIG/GPC, Guinea Bissau.
For the location of the Dutch pelagic trawler in Mauritania the following reference was used: Zeeberg, J., A. Corten, and E. de Graaf, 2006. Bycatch and release of pelagic megafauna in industrial trawler fisheries off Northwest Africa. Fisheries Research, 78:186-195.

A number of different distance limits are referred to in Zones de Peche Idéales (optimal fishing zones) for Senegal. These were generated for the whole region by buffering different distances from the coast. They are shown in various colours according to distance from the coast on the fishing maps and are intended to assist in locating any further information which may become available. These were provided by Dr Khady Sane Diouf of Senegal.

Ocean Currents from:
Mariano, A.J., E.H. Ryan, B.D. Perkins, S. Smithers. The Mariano Global Surface Velocity Analysis 1.0, US Coast Guard Technical Report, CG-D-34-95, 1995.

Annex 6: Oil spill contingency plan example

1. Securing the Spill Source: To stop further release of oil – for example, offloading, grounded/ ruptured tankers (ship salvage assets available, etc.), capping wells (platforms for relief wells available, etc), clamping pipelines (equipment and procedure), shut-down procedures for spilling facilities, etc.
2. Response Planning Standard: For example, a requirement for operators to be capable of recovering 300,000 barrels of oil from the sea surface within 72 hours, including all equipment and personnel on standby.
3. Response Organisation: Details of personnel who will respond to a spill, the incident command system, how they will be notified, their training, financial contracting authority, etc. All spill response contractors and their equipment on hand should be identified.
4. National Oil Spill Fund: All governments should establish a national fund with which to finance their oil spill prevention and response efforts, based on a nominal tax on all petroleum produced, imported or shipped through their borders (perhaps US$0.05 per barrel). The Fund should be available for all governmental efforts in spill prevention and response, including emergency responses.
5. Spill Containment: Sufficient oil booms, skimmers, storage equipment for recovered oil (barges, bladders, etc.) on standby to be inspected and tested regularly, with sufficient spare parts and trained operators and deployment boats available, personnel protections from hazardous materials, pre-staging equipment in strategic locations, etc.
6. Dispersants Protocol: Plan for where, how and under what conditions chemical dispersants (and/or coagulants, etc.) are approved for use on spills. Dispersants should be approved for use only in offshore areas with a water depth over 100m, where the oil/dispersant mix will not contact any sensitive environment (sea bed, coastal environment, mangroves, coral reefs, etc.), when winds are in the 10-20 knot range with 0.5-1m wave height, and where removing oil from the sea surface provides a clear environmental – not public relations – benefit.
7. Ignition Protocol: Plan for where and under what conditions igniting a spill is approved. This must include sufficient fire booms on hand, isolation of any burning oil from igniting additional oil (for example, oil still aboard a tanker or in tanks at a terminal), safety, etc.
8. Shoreline Cleanup: Plan for recovering oil that comes ashore, including shoreline cleanup assessment (shoreline segments identified for cleanup). Cleanup technologies to be used: high-pressure and/or hot water washing (where and when this will provide a net benefit); skimmers/ storage barges into which recovered oil will be transferred; and bioremediation (inoculating oiled beach segments with fertiliser and/or indigenous bacteria to enhance degradation of oil). Materials to be used; personnel for shoreline cleanup and how they will be housed/supported, etc. A plan for the use, training and safety of volunteers in any shoreline cleanup operation should also be included.
9. Waste Disposal: Identified locations and methodologies for disposing of recovered oil and oiled material, including re-processing recovered oil into useful products (pavement, refining, etc.).
10. Wildlife Response: Plan for how to deal with wildlife in and around the spill area, including how and when to attempt to recover injured wildlife (without scaring un-oiled wildlife into the spill), hazing un-oiled wildlife away from the path of the slick, facilities on vessels and ashore where oiled wildlife will be taken, treatment protocols for oiled animals, sanitation protocols to avoid disease transmission in holding facilities, and release protocols (zoos, into the wild, etc.).
11. Spill Drills: Governments should require all operators to respond to spill drills (announced and unannounced), including table-top exercises and full call-out exercises where equipment and personnel are deployed as if there were an actual spill. Training of all response personnel should be required, as well as pre-contracting/training local residents to assist in a spill response.

12. Damage Assessment: Plan to conduct a comprehensive environmental, social and economic assessment of spill damage, identifying the agencies to be involved, the studies and data collection to be conducted, and collection of economic impact information from businesses (fishermen, tourism, etc.) to support claims for compensation against the spillers, their insurers or the international oil spill compensation regimes to which the government is party.
13. Restoration: Plan should be established by which various environmental restoration measures will be employed to restore to their pre-spill condition any population injured by the spill, or that replaces or substitutes for the injured resources, or that provides another positive environmental offset to the damage suffered.
14. Regulatory Review: Governments should regularly review and enhance their oil spill prevention and response statutes and regulations, including their oil spill liability standards, to make certain they are consistent with highest international standards.

About the authors

Sandra Kloff is a biologist with more than 10 years experience in the field of sustainable use of marine and freshwater resources. She worked for four years in the WAMER, first as a project leader of a research programme on the proliferation of aquatic vegetation in the Lower Senegal River Basin financed by the European Union, and later she joined the IUCN in Mauritania as a programme manager on the conservation and restoration of coastal wetlands. She has worked as a consultant for DFID, WWF, FIBA, Greenpeace, UNDP, GEF and the governments of Mauritania and Guinea-Bissau, and is actively involved in the advocacy work of European and West African grass roots NGOs addressing pollution and over-exploitation of natural resources.

Clive Wicks has a background in management, engineering and agriculture and has worked in the environmental movement, mainly for WWF, for 24 years. This follows 25 years working in agriculture in Africa with an international company, latterly as a director. He is currently a conservation and development consultant working mainly on the impact of oil, gas and mining industries. He is Co-Chair of the IUCN Commission on Environmental Economic and Social Policy (CEESP) Theme on the Social and Environmental Accountability of the Private Sector. He has worked on oil, gas and mining issues in many countries and was the co-supervisor of a WWF project on criteria for oil, gas and mining companies working in areas of high biodiversity.

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References

Abidjan Convention for West and central Africa. http://www.unep.org/AbidjanConvention/

Afronews, 19 October 2009.

Alder, J. and R.U. Sumaila, 2004: Western Africa: a fish basket of Europe past and present. Journal of Environment and Development, 13, 156-178.

Asean Energy news service. Petronas to buy Woodside's oil assets in Mauritania. http://aseanenergy.org/news/?p=957

Australian Government. Department of the Environment, Water, Heritage and the Arts. www.environment.gov.au/coasts/mpa/index.html

Barcelona convention for the Mediterranean Sea. www.unep.ch/regionalseas/regions/med/t_barcel.htm

BBC News, 31May 2004. Woodside to pump Mauritania oil. http://news.bbc.co.uk/2/hi/business/3763927.stm

Bindemann, K., 1999. Production-Sharing Agreements: An Economic Analysis. Oxford Institute for Energy Studies.

Bureau Veritas, 2005. Bureau Veritas tackles FPSO cracking. www.veristar.com/content/static/veristarinfo/images/408.1.pdf

Camphuysen C.J. & J. van der Meer, 2006. Wintering seabirds in Western Africa: foraging hot-spots off Western Sahara and Mauritania driven by upwelling and fisheries. African Journal of Marine Science 27(2): 427-437.

Camphuysen C.J., 2004. Seabird distribution and oceanic upwelling off northwest Africa. Comunicaçoes orais i Congresso Internacional Aves do Atlantico, 1 November 2004, Sao Vicente, Madeira.

Canadian Maritime Law Association, 1996. Discussion Paper on the Need for an International Legal Regime for Offshore Units, Artificial Islands and Related Structures Used in the Exploration for and Exploitation of Petroleum and Seabed Resources. Available on: www.wob.nf.ca/News/1998/July98/offshore3.htm

Christensen, V., Amorim, P., Diallo, I., Diouf, T., Guénette, S., Heymans, J.J., Mendy, A.N., Taleb Sidi, M.M., Palomares, M.LD., Samb, B., Stobberup, K.A., Vakily, J.M., Vasconcellos, M., Watson, R., and D. Pauly, 2005. In Pêcheries maritimes, écosystèmes & sociétés en Afrique de l' Ouest : Un demi-siècle de changement, Dakar (Sénégal), 24-28 juin 2002. Actes du symposium international, France. pp. 377-386.

Colman, J.G., Gordon, D.M., Lane, A.P., Forde, M.J. and J.J. Fitzpatrick, 2005. Carbonate mounds off Mauritania, north-west Africa: status of deep-water corals and implications for management of fishing and oil exploration activities. In Freiwald, A. & Roberts, J.M. (Eds.), Cold-water corals and ecosystems, 417-441. Springer-Verlag, Berlin Heidelberg.

Convention on Biological Diversity www.cbd.int

Convention on Migratory Species www.cms.int

Dalen, J. and G.M. Knutsen, 1987. Scaring effects in fish and harmful effects on eggs, larvae and fry by offshore seismic explorations. In: Merklinger, H.M. ed. Progress in Underwater Acoustics. New York: Plenum Publishing Co. pp 93-102.

DEAT, 2007. Strategic Environmental Assessment Guideline, Integrated Environmental Guidelines Series 4 ISBN: 978-0-9802694-0-6. See also OECD Guidelines www.oecd.org/dataoecd/4/21/37353858.pdf.

DECC (UK Department of Energy & Climate Change) website. Strategic Environmental Assessment. www.offshore-sea.org.uk/sea/index.php

Diop, M., 1988. Ecologie et dynamique des populations de praires (Venus rosalina) à l'Ouest du Banc d'Arguin. Mauritanie. Thèse 3ème Cycle, Univ. Bretagne Occidentale, Brest : p191.

Dotinga H.M., and A.G. Oude Elferink, 2000. Acoustic Pollution in the Oceans: The Search for Legal Standards. Ocean Development & International Law, 31(1-2): pp 151-182.

Duineveld, G. C. A., Lavalaye, M. S. S., and G.J. Van Noort, 1993. The trawl fauna of the Mauritanian shelf (Northwest Africa): density, species composition, biomass. In: Ecological studies in the coastal waters of Mauritania, Leiden, The Netherlands, W.J.Wolff, J. Van Der Land, P. H. Nieuhuis, et P. A. W. J. de Wilde. Hydrobiologia, 258:165-174.

Energy Institute website : www.energyinst.org.uk/

Engas, A., Loîkkeborg, S., Ona, E. and F.V. Soldal, 1996. Effects of seismic shooting on local abundance and catch rates of cod Gadus morhua and haddock Melanogrammus aeglefinus. Canadian Journal of Fisheries and Aquatic Sciences Vol. 53, pp 2238-2249

Euromonitor website: www.euromonitor.com/Travel_And_Tourism_in_Senegal

Expert panel website: www.panelpetrole.mr

Extractive Industries Review http://www.ifc.org/eir

Extractive Industries Transparency Initiative EITI www.EITI.org

Fonseca, M.S., Kenworthy, W.J., and P.E. Whitfield, 2000. Temporal dynamics of seagrass landscapes: a preliminary comparison of chronic and extreme disturbance events. Biologia Marina Mediterranea 7: 373-376.

Gascuel, D., Labrosse, P., Meissa, B., Taleb Sidi, M.O. and S. Guénette, 2007. Decline of demersal resources in North-West Africa: an analysis of Mauritanian trawl survey data over the past 25 years. African Journal of Marine Science 29-3: 331-345.

Gausland, I., 2003. Impact of seismic surveys on marine life. In: SPE International Conference in Health, Safety and the Environment in Oil and Gas Exploration and Production. June 2000, Stavanger, Norway, Society of Petroleum Engineers. pp 26-28.

Ghana SEA. Guide to Strategic Environmental Assessment www.cea.lk/pdf/SEAGuideline.pdf

Goodland, R., 2006. Mauritania : Oil and Gas sector Environment Mission Report, April 2006 (commissioned by GTZ-Mauritania)

Hamerlynck, O. and S. Duvail, S., 2003. «The rehabilitation of the delta of the Senegal River in Mauritania». Gland, Switzerland and Cambridge, UK. IUCN.

Häseli, P., 2003. Reducing Accidental Oil Spills in the International Tanker Shipping Industry: The balance between the International Regulatory Framework and Competition. Paper written for the course Tr815 International Shipping during the spring semester at Høgskolen i Molde, Molde University College, Norway.

Heileman,S. and M. Tandstad, 2008. Canary Current Large Marine Ecosystem. Available on: www.lme.noaa.gov/LMEWeb/LME_Report/lme_27.pdf

Helmke, P., 2003. Remote sensing of the North West African upwelling and its production dynamics. Dissertation zu Erlangung des Doktorgrades der Naturwissenschaften am Fachbereich 5 – Geaowissenschaften der Universität Bremen. 169 pp.

HELCOM Helsinki Commission for the Baltic Sea www.helcom.fi

IAOGP website www.iaogp.org

ICES, 1994. International Council for the Exploration of the Sea. Report on the ICES Advisory Committee on the Marine Environment. Copenhagen: ICES, 122 pp.

Investor words. www.investorwords.com/1604/dutch_disease.html

IFREMER, 1999. Evaluation of the fisheries agreements concluded by the European Community. Summary Report.

IMO International Maritime Organisation Guidelines for application of MARPOL Annexe I Requirements to FPSOs and FSUs. Ref. T5/1.01 MEPC/Circ.406 10 November 2003 www.imo.org

IMO London convention www.londonconvention.org

IMO Modu guidelines. http://www.imo.org Mobile Offshore Drilling Units. www.imo.org

IMO. International Maritime Organisation. www.imo.org/environment/mainframe.asp?topic_id=1357

IMO. International Maritime Organisation. PowerPoint Presentation Edward Kleverlaan, Technical Officer. Marine Environment Division

IMROP, 2007. Rapport de synthèse du 6ème Groupe de Travail sur l'évaluation des ressources et l'aménagement des pêcheries de la ZEE mauritanienne

International Association of Oil and Gas Producers. www.info.ogp.org.uk/Geophysical/

Intervention Convention, IMO convention relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, 1969. www.imo.org/Conventions/mainframe.asp?topic_id=258&doc_id=680

Investor Words website: www.investorwords.com/1604/dutch_disease.html

IRIN news. humanitarian news and analysis: a project of the UN Office for the Coordination of Humanitarian Affairs. www.irinnews.org/IRIN-Africa.aspx

International Tanker Owners Pollution Federation website: www.itopf.org

Jeune Afrique, 2009. 21/09/2009 par Samir Gharbi Jackpot pétrolier au Sierra Leone.

Johnston, D., 1994. International Petroleum Fiscal Systems and Production Sharing Contracts. Tulsa, OK: PennWell Publishing.

Kloff, S. and C. Wicks, 2004. Gestion Environnementale De L'exploitation De Pétrole Offshore Et Du Transport Maritime Pétrolier. FIBA PRCM Membres de la Commission de l'UICN des Politiques Environnementales, Économiques et Sociales – CEESP. 80 pp.

Kloff, S., Trebaol, L. and E. Lacroix, 2007. Pêche aux bivalves & environnement. Panorama mondial, études de cas, application à l´exploitation des praires en Mauritanie. Fondation Internationale du Banc d´Arguin, FIBA. La tour du Valat, Arles, France. Available on: www.lafiba.org/

Kloff, S., 2009;. A preliminary baseline study of Mauritania's marine biodiversity. A background document for the United Nations Development Programme – UNDP – for the elaboration of a medium or large sized project with the interim title *"Strengthening the mainstreaming of biodiversity in Mauritania's oil and gas sectors"* to be submitted to GEF and other agencies. Internal report for UNDP country office for Mauritania.

Krastel, S., Wynn, R.B., Hanebuth, T.J.J., Henrich, R., Holz, C., Meggers, H., Kuhlmann, H. Georgiopoulou, A., and H.D. Schulz., 2006. Mapping of seabed morphology and shallow sediment structure of the Mauritania continental margin, North-West Africa: some implications for geohazard potential. Norwegian Journal of Geology 86 (1976): 163-176.

Larkum, A. W. D., Orth, R.J., and C. M. Duarte, 2006. Seagrasses: Biology, Ecology and Conservation. The Netherlands, Springer.

Laffoley, D. & G. Grimsditch, 2009. The management of natural coastal carbon sinks. IUCN, Gland, Switzerland. 53 pp.

Lentz, S.A., and F. Felleman, 2003. Oil spill prevention: a proactive approach. In: Proceedings of the 2003 International Oil Spill Conference. Vancouver Canada.

Lokkeborg, S. and A.V. Soldal, 1993. The influence of seismic exploration with airguns on cod (Gadus morhua) behavior and catch rates. ICES Marine Science Symposium. 196, pp 62-67.

Lophelia website: see references at www.lophelia.org

MacCauley, R.D., Duncan, A.J., Fewtrell, J., Jenner, C., Jenner, M., Penrose, J.D., Prince, R.I.T., Adhitya, A., Murdoch J., and K.J. MacCab, 2003. Marine Seismic Survey Analysis and Propagation of Airgun Signals; and Effects of Airgun Exposure on Humpback Whales, Sea Turtles, Fishes and Squid. In: *Environmental Implications of Offshore Oil and Gas Development in Australia; Further Research.* APPEA, pp 364-370, 381–385, 498–521.

MacCauley, R.D., Fewtrell, J., Duncan, A.J. Jenner, C., Jenner, M-N., Penrose, J.D., Prince, R.I.T., Adhitya, A., Murdoch, J. and K.J. McCabe, 2000. Marine seismic surveys: analysis and propagation of air gun signals; and effects of air gun exposure on humpback whales, sea turtles fishes and squid. Centre for Marine Science and Technology, Curtin University of Technology, Project CMST 163, Report R99-15,198.

MacCauley, R.D.; Fewtrell, J. and A.N. Popper, 2003. High intensity anthropogenic sound damages fish ears. Journal of The Acoustic Society of America, 113: 638-642

Meier, S., Andersen, E.T., Hasselberg, L., Kjesbu. O.S., Klugsøyr, J., and A. Svardal, 2002. Hormonal effects of C4-C7 Alkyphenols on cod *(Gadus morphua)*. Report to the Norwegian Oil Industry Association, Norwegian Institute of Marine Science, 68 pp. www.imr.no/

MARPOL, IMO Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL). www.imo.org/Conventions/contents.asp?doc_id=678&topic_id=258

Mensink, B.P., Van Hattum, B.G.M., ten Hallers-Tjabbes, C.C., Everart, J.M., Kralt, H., Vethaak, A.D. and J.P. Boon, 1997. Tributyltin causes imposex in the common whelk, Buccinum undatum: Mechanism and occurrence. Netherlands Institute for Sea Research, NIOZ Report 1997-6: 56 pp.

Michaud, R & V. Chenelière, 2005. Scientific Opinion on the department of Fisheries and Oceans of Canada. Mitigation of Seismic Noise in the Marine Environment Statement of Canadian Practice. Available at www.gremm.org

Mitchell, J. and J. Faal. 2008. Working Paper 289: The Gambian Tourist Value Chain and Prospects for Pro-Poor Tourism. Overseas Development Institute. ISBN 978 0 85003 858 3. 68pp.

Moneybiz website: moneybiz.co.za 18 September 2009

New Scientist, 2003. Prestige oil spill far worse than thought. NewScientist.com news service, 27 August 2003.

NRC, 2002. National Research Council of the National Academies. Oil in the Sea III. Inputs, Fates and Effects, The National Academies Press, Washington D.C. 265 pp.

Offshore technology website: www.offshore-technology.com/projects/Chinguetti/

OPOL Offshore Pollution Liability Association Limited website: www.opol.org.uk.

OPRC, IMO Convention on Oil Pollution Preparedness, Response and Co-operation, 1990. www.imo.org/Conventions/mainframe.asp?topic_id=258&doc_id=682

OSPAR Oslo Paris Convention for the North-East Atlantic Convention www.ospar.org

Patin, S., 1999. Environmental impact of the offshore oil and gas industry, EcoMonitor Publishing East Northport, N.Y. 425 pp. Also available on www.offshore-environment.com

Pauly, D., Christensen, V., Dalsgaard, J., Froese, R., and T. Jr. Francisco, 1998. Fishing down marine food webs. Science 279:860-863.

Pauly, D., J. Alder, E. Bennett, V. Christensen, P. Tyedmers, and R. Watson, 2003: The future for fisheries. Science, 302(5649), 1359-1361.

Peak oil websites: www.lifeaftertheoilcrash.net/ ; www.peakoil.net/ ; www.oilcrisis.com/ ; www.wolfatthedoor.org.uk/

Popper, A.N., 2003. Effects of anthropogenic sound on fishes. Fisheries: A bulletin of the American Fisheries Society Volume 28 Number 10: pp 24-31.

Programme régional de conservation de la zone Côtière et marine en Afrique de l'Ouest. Activity report 2005. www.prcm.org

PRCM website: www.prcm.org

Publish What You Pay website: www.publishwhatyoupay.org

Ramsar Convention website: www.ramsar.org

Revenue Watch website: www.revenuewatch.org/ "Concession Negotiations in Liberia 2006-2008"

Rogers, A.D., 1999. The biology of Lophelia pertusa (Linnaeus 1758) and other deep-water reef-forming corals and impacts from human activities. International Review of Hydrobiology 84: 315-406.

Salim, E., 2000. Extractive Industries Review: www.ifc.org/eir

Shell, 1999. Seismic Environmental Statement: Forth Approaches. Shell UK Exploration & Production, April 1999. 69 pp.

Skalski S., 1992. Effects of sound from geophysical surveys device on catch-per-unit-effort in a hook-and-line fishery for rockfish (Sebastes spp.).Canadian Journal of Fisheries and Aquatic Sciences Vol. 49, pp 1357-1365.

SOLAS, IMO Convention for the Safety of Life at Sea (SOLAS), 1974. www.imo.org/Conventions/contents.asp?topic_id=257&doc_id=647

STCW, IMO Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978. www.imo.org/

Steiner, R., 2003. Background document on offshore oil for stakeholders of the Baltic Sea region. Unpublished report available via the authors.

Steiner, R.., 2009. The Brussels Principles: A New Paradigm for Oil and Gas Development by Professor Richard Steiner, October 2009. IUCN CEESP Internal document.

SAUP. Sea Around Us Project. www.seaaroundus.org

Tolstoy, M., J.B. Diebold, S.C. Webb,D.R. Bohnenstiehl, E. Chapp, R.C. Holmes, and M. Rawson, 2004. Broadband Calibration of R/V Ewing Seismic Sources, Geophys. Res. Lett., 31, doi:10.1029/2004GL020234.

Trebaol, L., Kloff, S. and C. Wicks, 2006. Analyse et recommandations relatives au plan de Gestion Environnementale pour la phase d'exploitation du projet Chinguetti, Juin 2006. Document commissioned by the Government of the Islamic Republic of Mauritania – Prime Minister's office and Ministry of Fisheries and Maritime Economy.

UKOOA (United Kingdom Offshore Operators Association) website: www.ukooa.co.uk

UNCLOS (United Nations Law of the Sea) website: www.un.org/Depts/los/index.htm

UNDP, 2009. Charting a new low-carbon route to development. A primer on Integrated climate change planning for regional governments. United Nations Development Programme.

UNESCO website on ocean acidification: http://ioc3.unesco.org/oanet/index.html

UNFCCC website: www.unfccc.int

US General Accounting Office, May 2007. www.gao.gov/htext/d07676r.html

Vanguard newspaper, 6 October 2009.

Walmsley, S.F., Barnes, C.T., Payne, I.A. and C.A. Howard, 2007. Comparative Study of the Impact of Fisheries Partnership Agreements – Technical Report. May 2007. MRAG, CRE & NRI

Wells, S. with several associates and advisors, 2008. «National and Regional Networks of Marine Protected Areas:A Review of Progress». Master Evaluation for the UN Effort. World Conservation Monitoring Centre. pp. Chapter 1 – Introduction. www.unep wcmc.org/oneocean/pdf/MPA%20 report%20FINAL.pdf.

Whale and Dolphin Conservation Society website: www.wdcs.org

Wikipedia – Dutch disease: http://en.wikipedia.org/wiki/Dutch_disease

Wildwings Tours website: www.wildwings.co.uk/wafricanpel.html

Wills, J.W.G., 2000. Muddied Waters – A Survey of Offshore Oilfield Drilling Wastes and Disposal Techniques to Reduce the Ecological Impact of Sea Dumping. Ekologicheskaya Vahkta Sakhalina, Yuzhno-Sakhalinsk, Russia 139 pp.

Woodside Energy, 2003. Chinguetti Development Project: Draft Environmental Impact Statement, November 2003. Available on: www.woodside.com.au

World Tourism website: www.worldtourismdirectory.com

Worm, B., Barbier, E.B., Beaumont, N., Duffy, J., Folke, C. Halpern, B.S., Jackson, J.B.C., Lotze, H., Micheli, F., Palumbi, S.R., Sala, E., Selkoe, K.O., Stachowicz, J.J. and R. Watson, 2006. Impacts of biodiversity loss on ocean ecosystem services. Science 314:787-790

Worm, B., Hilborn, R., Baum, J.K., Branch, T.A., Collie, J.S., Costello, C., Fogarty, M.J., Fulton, E.A., Hutchings, J.A., Jennings, S., Jensen, O.P., Lotze, H.K.,.Mace, P.M., McClanahan, T.R., Minto, C., Palumbi,S.R., Parma, A.M., Ricard,D., Rosenberg A.A., Watson,R. and D. Zeller, 2009. Rebuilding Global Fisheries. Science 325 : 578-584

WWF, 2003. Shipping issues and actions for the WWF network – a position statement and background briefing. WWF document 2003.

WWF Cape Verde website: www.panda.org/about_our_earth/all_publications/?20955/Boa-Vista-Island-Cape-Verde-Paradise-on-the-Brink

WWF-UK brochure, 2002. PSSAs. Particularly Sensitive Sea Areas. Living seas programme. http://assets.panda.org/downloads/wwfpssabrochure.pdf

WWF WAMER website: www.panda.org/what_we_do/where_we_work/west_africa_marine/

Wynn, R.B and B. Knefelkamp, 2004. Seabird distribution and oceanic upwelling off northwest Africa, 2004. British Birds 97 323-335.

Zeeberg, J., A. Corten, and E. de Graaf, 2006. Bycatch and release of pelagic megafauna in industrial trawler fisheries off Northwest Africa. Fisheries Research, 78:1

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