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Sub-Regional Report on Vulnerability and Impacts of Climate Change on Marine and Coastal Biological Diversity in the Mediterranean Arab Countries

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EXECUTIVE SUMMARY

The present document summarises the national reviews of the Arabic countries of North Africa and the Middle East that border on the Mediterranean on vulnerability and the impacts of climate change on marine and coastal biodiversity. It is implemented as part of the SAP BIO activities selected in the context of the MAP biennium for the years 2008 and 2009. This action aims at making a contribution to the aims of the Almeria Declaration by assessing the state of knowledge and those activities related to the impacts of climate change on biodiversity that have so far been carried out. The other contribution agreed on is to define future activities relating to the “climate change/biodiversity in the context of SAP BIO, RAC/SPA and the MAP” stakes.

1. North African and Middle eastern Arabic Mediterranean riparian countries: the context

The shores of the Mediterranean are listed as hotspots by the most recent report of the IPCC. The models associated with the A1B scenario predict an average rise in annual temperatures that could reach 2.2 to 5.1°C by the end of the century. Heat waves would then be more numerous, longer and more intense, with frequent days of scorching heat.

The projections also announce a drop of 4 to 27% in annual rainfall. North Africa would be particularly affected by droughts that would be more frequent, more intense and longer-lasting. Torrential rain will be more frequent.

The water deficit, that represents a major stake for the six countries concerned, will be worsened by increased evaporation, the fact that resources will become scarcer and will be over-exploited, and that coastal aquifers will become more salty.

The sea level could rise by 23-47 cm. by the end of the 21st century, according to the IPCC. Many Mediterranean regions would then run a major risk of being submerged and eroded; among these we can cite the extreme cases of the Kerkennah archipelago in Tunisia, and Alexandria and the Nile delta in Egypt.

The societies of the southern and eastern Mediterranean and their environment are extremely vulnerable to climate change, for natural reasons, life styles and the development concentrated on the coastal area. These emerging countries are all the more vulnerable in that they lack sufficient technical and financial tools.

The impacts of climate change are extremely varied. Their effects back up and amplify one another, and also amplify the impacts of coastal development and activities. We shall mainly note i) the accelerated rise in sea level, ii) the rising water temperature and iii) the drop in rainfall.

2. Available information and level of current knowledge

RAC/SPA has put at the disposal of the national experts a set of documents that have been supplemented by other international and national sources. The documents and publications consulted concern climate change, its effects and the already noticed and potential impacts on species and habitats.

The information available in the documents constitutes a pertinent base of information and reflection at international and Mediterranean level. But it only very superficially reflects the problem at sub-regional level or at national level. The prerequisites, i.e. inventories of

biodiversity, are still incomplete and insufficient for articulating a pertinent monitoring of the effects of CC on MCBBD due, mainly, to the absence or insufficiency of skills related to biodiversity and the effects of CC on MCBBD and the absence of national or regional strategies for dealing with the effects of CC/MCBBD.

3. National activities related to climate change and biodiversity

All the countries have ratified the CBD, the UNFCCC, and the Kyoto protocol. The national UNFCCC communications and the national CBD reports are regularly transmitted or are being passed on. However, there are no policies, programmes or action plans specifically directed to assessing the effects of CC on MCBBD.

On this precise issue, related to the effects of CC on MCBBD, we shall also notice many weaknesses linked to the low awareness of the populations, of civil society and of the national authorities, hence legislation that is still unsuitable and transversal organisation that is not yet functional. The countries are not yet prepared and do not have the sufficient scientific and technical skills. They should first of all fill in their lack of basic knowledge and then craft pertinent methodologies to assess vulnerability and the adaptation capacities of the coasts, the ecosystems, and certain groups of species and species.

Many countries have crafted or are preparing reports on the assessing of coastal vulnerability compared to the accelerating rise in sea level, but it is necessary to enhance expertise in defining adaptation scenarios as well as the technical capacities needed to implement these.

4. Vulnerability and impacts

The shores and marine areas of the countries of North Africa and the Middle East that border on the Mediterranean contain a rich and extremely diversified biodiversity. This heritage is already subjected to great pressure, arising mainly from the human activities that help erode it. But the inventories are sketchy, incomplete and/or obsolete for many countries, and thus do not enable us to envisage a systematic, exhaustive monitoring of the effects of CC on MCBBD. Thus, an appraisal of the vulnerability of the marine and coastal area, the activities and infrastructures it contains, and of biodiversity is fairly unequal from one country to another.

Many analogies have been noticed when setting out the eloquent stakes, stressing their pertinence at national, sub-regional, Mediterranean and world level. They concern more particularly:

- the rise in sea level and the expected repercussions on the integrity of the coastline, wetlands generally and more particularly lagoons, *sebkhas*, and estuaries and the ecological and economic values thereof
- the effects of CC on water resources and the risk to agriculture
- the rising risk of forest fires
- the impacts on halieutic resources
- the amplifying of the effects of CC by human activities
- the thermophilous non-native species, especially Lessepsian
- the multiplying of "suspect" blooms
- the expected amplifying of the effect of CC by existing human-origin pressure.

The diagnoses made that appear in the national documents form a basis for planning actions that supplement those provided for in the first phase of SAP BIO. The similarities noted enable us to envisage enhancing cooperation at both local and international levels with a view to implementing common research and monitoring actions.

5. Needs and urgent action

The countries' considerations differ according to their own contexts: organisation, legislation, scientific and technical capacities, variability of their vulnerability, size and diversity of the stakes, etc. However, many suggestions emerge both concerning the needs expressed and as regards recommendations of urgent action:

- To various degrees, but for all the countries, pursuing and structuring the acquisition of basic knowledge constitutes an urgent precondition in order to get a better knowledge of the specific nature of the protection stakes
- Awareness by actors (politicians, scientists, users) is needed for an appropriation of this crucial stake, hence in-depth work must be done to better individualise the problems, solutions and the why and the wherefore of solutions: knowing why one must protect – protect what – and how? in order to better define strategies and priorities at every level
- Organising institutions and setting up a system to take charge of the upstream and downstream assessment of the effects of CC on MCB, and then identifying and implementing adaptation measures is necessary
- Updating legal texts
- Enhancing scientific and technical skills and capacities as well as equipment
- Updating national reference documents that take into account the effects of CC/MCB with a view to ending up with a clear action strategy (research and monitoring and adaptation)
- Mutualizing information internally and at regional and international level; cross-border and regional scientific networks
- Involvement in transnational and regional programmes
- Harmonising methods of data acquisition and monitoring
- Fitting out experimental stations for monitoring the effects of CC/MCB per kind of vulnerable environment
- Need to identify and implement priority adaptation methods.

6. Financial support and cooperation

Long lists of funding sources were enumerated and set out in the national documents:

- The first thing to notice is the weak financial level of countries that have to face up to very ambitious potential programmes
- One country only mentioned the Kyoto protocol's adaptation fund, which is fully adapted to mobilise funds
- International private donors exist, funding possibilities are possible unilaterally and via sub-regional or regional projects
- The national funding procedures remain rigid in many countries, hampering the advance of various initiatives
- The procedure for crafting requests to international donors does not seem to have been mastered.

7. Conclusions and recommendations

a) Conclusions

- This study enabled some tracks to be identified on the CC/MCB problem, which should be detailed and in-depth. However, the disturbances affecting the marine and coastal ecosystems have already been ascertained, allowing us to predict serious

consequences in the light of the forecasted evolution of factors considered as major that describe CC

- The problems are common to the countries as a whole and concern water resources, halieutic resources, risks to forests and especially risks of the submersion of the coasts and the consequences that would follow regarding development, infrastructure and economic activity, mainly resort tourism, which makes a big contribution to these countries' economic resources. These similarities justify treating these countries as a homogeneous sub-regional area
- The biological inventories are incomplete and the ecological watch system is unsuitable. However, existing information shows the great value of the marine and coastal ecosystems as a whole and the need to protect them
- The countries lack the necessary expertise, equipment and financial means to show the impacts of CC/BD and monitor the main descriptors and indicators of climate change and of its effects
- The size of the economic loss linked to the impacts of CC on the coastal and marine ecosystems has been underestimated. So the financial resources that are needed for mitigation and adaptation etc. are either insufficient, unsuitable or difficult to access
- The impact of CC on marine and coastal biodiversity and that caused by human-origin activity are still badly understood. The effects of the joining of these factors still remains unclear
- The Nile delta/Suez Canal complex constitutes the hub *par excellence* of the effects of CC and CC/BD. It is therefore necessary for special attention to be paid to it.
- The CC/MCBD problem and stakes are not sufficiently integrated in the national and regional legal and institutional systems
- There is a big deficit as regards awareness/communication about the stakes linked to CC/MCBD. This deficit concerns all the parts of society (decision-makers, managers, scientific community, economic actors, the wider public, etc.)

b) Recommendations

- As a first precondition, it is necessary to complete the inventories (biodiversity, habitats etc.) so as to possess a zero state that will permit the quantitative monitoring of the effects of CC on the M CBD, and then set up an ecological watch system at national level that will be coordinated at sub-regional and/or regional level
- It is necessary to identify standardised pertinent monitoring indicators that will allow an assessment of the changes in state, pressures and responses (at country level and at regional level) and to define their implementation
- It is necessary to prioritize issues, sites, habitats and species in order to establish pertinent handling priorities, mainly making sensitivity and vulnerability charts, drawing inspiration from similar approaches
- Networks of experts (scientists, managers of marine and coastal nature areas and NGOs etc.) must be set up at national, cross-border and regional level
- Given the relative shortcomings regarding skills in the subject, adopting simplified, cheap methodologies could be a way of getting more information
- For efficient implementation, it is absolutely necessary to mutualize human, technical and financial resources and to have a system that can permit the fluid circulation of data and information in the appropriate form for each target group at national and regional level. RAC/SPA is the appropriate body for taking responsibility for and facilitating such an approach at regional level
- Enhancing national CC/MCBD skills is necessary, particularly as regards taxonomy
- It is recommended that the existing and necessary (human, material and infrastructure) means be assessed to face up to the needs expressed
- Set up an awareness strategy and specific awareness programmes for the wider public and for decision-makers

- Enhance the institutional framework by setting up a structure in charge of climate change at national level (like the Algerian National Agency for Climate Change) with sub-regional and regional coordination
- Search for and mobilise national funds and/or constitute the equivalents necessary for international co-funding, in particular exploring the Kyoto Convention's compensation mechanisms
- The different actors should be organised according to the ICZM system with a view to better circulation of information and collective decision-making about the CC/MCBD issue
- With a view to organising activities, it will be necessary to update national strategies and national action plans, taking into consideration the effects of climate change on marine and coastal biodiversity.

INTRODUCTION

The present assignment summarises the national reviews of the Arabic countries of North Africa and the Middle East that border on the Mediterranean about the vulnerability to climate change and the impacts of climate change on marine and coastal biodiversity. It is being done as part of the SAP BIO activities selected in the context of MAP's biennium for the years 2008 and 2009.

This action aims at making a contribution to the aims of the Almeria Declaration by assessing the state of knowledge and those activities related to the impacts of climate change on biodiversity that have so far been carried out. The other contribution agreed on is to define future activities relating to the "climate change/biodiversity in the context of SAP BIO, RAC/SPA and the MAP" stakes.

In compliance with the mandate of the Mediterranean Action Plan (MAP), the national reviews and the present summary are related to the national marine and coastal areas as defined by the revised Barcelona Convention and therefore do not include the entirety of the continental national territories.

The present document summarizes, and extrapolates to the countries of North Africa and the Middle East that border on the Mediterranean, the ideas presented in the national reviews.

- Algeria's, prepared by Samir Grimès
- Egypt's, prepared by Youssef Halim
- Lebanon's, prepared by Ghazi Bitar
- Morocco's, prepared by Hocein Bazaïri
- Syria's, prepared by Amir Ibrahim
- Tunisia's, prepared by Mohamed Salah Romdhane

When crafting the national reviews, the authors informed and consulted the various national leaders (SPA Focal Points, national correspondents for SAP BIO, national UNFCCC and CBD heads and ministries) plus many national experts. However, the thoughts and suggestions included in the national reviews remain the opinions of experts.

The author, Sami Ben Haj, RAC/SPA's International Consultant on "climate change and biodiversity" for the Arabic countries of North Africa and the Middle East that border on the Mediterranean, was guided in his approach by Daniel Cebrian Menchero, PhD, Expert in Marine Biology, Head of the SAP BIO programme at RAC/SPA, also in consultation with Atef Limam, Expert in Marine Biology, RAC/SPA's International Consultant for SAP BIO.

To examine and analyse the stakes and problems, the author used documents provided by RAC/SPA, among which were the regional and national SAP BIO reports (document of the SAP BIO project, final document of the SAP BIO project adopted by the Contracting Parties, national SAP BIO reports and national SAP BIO priority actions).

The report was finalised after reflections and discussion had taken place in Tunis by RAC/SPA and the national experts, and after amendments of the national reports.

LIST OF ACRONYMS

EA: European Agency

SPA/BD: Specially Protected Areas and Biological Diversity

SPAMI: Specially Protected Area of Mediterranean Importance

ALECSO: Arab League Educational, Cultural and Scientific Organisation

BD: Biodiversity

MCBD: Marine and Coastal Biodiversity

RAC/SPA: Regional Activity Centre for Specially Protected Areas

CC: Climate change

UNFCCC: United Nations Framework Convention for Climate Change

CBD: Convention on Biological Diversity

EC: European Community

IRDC: International Research and Development Centre (Canada)

UNCCD: United Nations Convention to Combat Desertification

ARSL: Accelerated Rise in Sea Level

GEF: Global Environment Fund

FGEF: French Global Environment Fund

GHG: Greenhouse gas

IPCC: Intergovernmental Panel on Climate Change

ICZM: Integrated Coastal Zone Management

ICRAM: Istituto Centrale per la Ricerca scientifica e tecnologica Applicata al Mare

MoE: Ministry of the Environment

NGO: Non-governmental Organisation

MAP: Mediterranean Action Plan

SAP BIO: Strategic Action Programme for the Conservation of Biological Diversity

UNDP: United Nations Development Programme

UNEP: United Nations Environment Programme

REMPEC: Regional Mediterranean Pollution Emergency Centre

SMAP: Short and Medium-term priority environmental Action Programme

IUCN: International Union for the Conservation of Nature

USAID: United States Agency for International Development

1. NORTH AFRICAN AND MIDDLE EASTERN ARAB COUNTRIES BORDERING ON THE MEDITERRANEAN: THE CONTEXT

Climate change and its effects on the marine and coastal domain are already perceptible. The shores of the Mediterranean are listed as hotspots by the most recent report of the IPCC. The models associated with the A1B scenario predict an average rise in annual temperatures that could reach 2.2 to 5.1°C by the end of the century, higher than the average expected for the planet. The rise should be greater in the interior than on the coasts, at sea or in islands, and more noticeable in the summer (2.7 to 6.5°C) than in winter (1.7 to 4.6°C). Heatwaves would then be more numerous, longer and more intense, with frequent days of scorching heat, with all the repercussions that these events could have on human health and the risk of fires.

The projections also announce a drop of 4 to 27% in annual rainfall. Drought would be more marked in summer than in winter. North Africa would be particularly affected by this hazard that has already been noted in many Mediterranean countries. Droughts will be more frequent, more intense and longer-lasting. Torrential rain will also be more frequent.

The water deficit, that represents a major stake for the six countries concerned by the sub-group that is the subject of this summary, will be worsened by increased evaporation, the fact that resources will become scarcer and will be over-exploited, and that coastal aquifers will become more salty.

The rise in the sea level is still hard to predict at world level, and more particularly in the Mediterranean basin. According to 2007 projections (IPCC), which are considered to be optimistic, it could rise by 23-47 cm. by the end of the 21st century. Many Mediterranean regions would then run a major risk of being submerged and eroded; among these we can cite the extreme cases of the Kerkennah and Kneiss archipelagos in Tunisia, and Alexandria and the Nile delta in Egypt.

The societies of the southern and eastern Mediterranean and their environment are extremely vulnerable to climate change, for natural reasons (especially water deficit), and life styles and the development concentrated on the coastal area. These emerging countries are all the more vulnerable in that they lack sufficient technical and financial tools to face up to the requirements in improved knowledge and in implementing adaptation responses to prevent or mitigate the effects of CC.

Climate change thus represents a big threat where two major, intimately and regularly linked, issues emerge:

- pressure on ecosystems that have already been weakened by pollution, destruction and break-up of habitats or over-exploitation of natural resources
- challenging of past development strategies by the expected effects of CC on the entire coastal territory.

The impacts of climate change are extremely varied. Their effects back up and amplify one another, and also amplify the impacts of coastal development and activities. This CC-linked change (temperatures, rainfall, winds, rise in sea level) and human-origin change (pollution, coastal development, over-exploitation of natural resources, introduction of species) impact and will increasingly impact both the socio-economic sectors and the natural systems. We note i) the accelerated rise in sea level, ii) a rise in water temperature, and iii) a drop in rainfall. The example of the rise in sea level is central to reflection on the integrated

management of coastal areas. This phenomenon, already perceptible but which will speed up, would affect:

- the coastal ecosystems in the strict sense of the word, and mainly the wetlands, constitute the only or favourite habitat for many animal and plant species, and will be affected by accelerated erosion. For example, one can notice that the ecological functioning of the lagoons depends closely on their depth and their salinity, which will certainly evolve. The Mediterranean wetlands as a whole, already hard hit by the development of human activity, are vulnerable to the rising water
- human facilities: since the coastal areas are a favoured area for development, the loss of infrastructure, building or farmland by marine submersion (temporary flooding) and the destruction that this could give rise to, seems to be a real threat. The gradual recession of the coastline will also increasingly subject the development near the shore to the action of the waves. A general recession of the beaches has already been noted; this regression will be speeded up, endangering the resort tourism of large parts of the coast with the risk of depriving many economically weak countries of the tourist manna. The effects will also be felt at the level of capture of underground water which will be "spoilt" by salt and hard hit by over-pumping.

The thermal effect will be felt on land and at sea; it will affect ecosystems, habitats and biodiversity and economic activity.

The same holds good for the dwindling rainfall.

The institutional framework in the wider sense of the word which handles CC-MCBD issues is the MAP, with RAC/SPA as executive agency. The legal framework is borne by the Barcelona Convention (the Convention to protect the Mediterranean Sea against pollution) and its protocols that are appropriate to this framework: the SPA/BD protocol, and the recently-adopted ICZM. Still in the MAP context we can cite the 2008 Almeria Declaration, which includes important decisions on the impacts of climate change on Mediterranean biodiversity. Other international conventions on climate change and/or biodiversity (UNFCCC and CBD) have been ratified by the states that border on the Mediterranean.

For example, the recently-adopted ICZM protocol reveals in its preamble the anxiety of the Mediterranean states as to the inherent risks that hang over the coastal areas and recommends the adoption of measures of prevention, mitigation and adaptation to face up to the effects of climate change. These measures must permit the maintaining and restoring of the coast's natural capacity to adapt to change, including change caused by the rise in sea level.

SAP BIO is a strategic action plan to protect biodiversity in the Mediterranean coastal and marine regions. This action plan was adopted by the Contracting Parties in 2004. The impacts of CC on BD are considered as priority activities.

However, the national reports and documents implemented as part of the National Action Plans do not integrate this stake at all.

The present assignment, undertaken by RAC/SPA, should help fill this gap and take the effect of CC on BD into consideration as a pregnant stake. The work is broken up into three parts: the first at national level; the second a summary of work for three sub-regions including that which is the subject of this document, which includes Algeria, Egypt, Morocco, Lebanon, Syria and Tunisia; the third will be devoted to producing a regional document.

2. EXISTING DATA AND INFORMATION, RESEARCH AND CURRENT STATE OF KNOWLEDGE

RAC/SPA and the international consultants made available to the national experts a set of documents which were supplemented by other international and national sources. The documents were in general read and annotated in a chapter devoted to this, or for some countries loosely in the document as a whole. The documents and publications consulted concern climate change, its effects and the noted and potential impacts on species and habitats.

2.1. International sources

The international literature of the national experts gives an appraisal of the knowledge about CC/MCBD at international or Mediterranean level; few pertinent elements that are specific to the sub-region emerge from these documents.

The documents used by the experts were for most of the countries cited in the chapter about them, rarely annotated doubtless because of the absence of information specific to the sub-region or country.

A summary of these documents appears below.

Proof of the direct influence of human activity on the climate was stressed (IPCC, 2007).

The pregnant facts linked to climate change are as follows:

- increase in the concentration of greenhouse gases, especially CO₂, CH₄, N₂O, O₃
- expected rise in temperature (1.8 to 3.4°C)
- increase in the frequency of extreme climate events.

The outstanding effects of CC on the marine environment are the rise in sea level, already perceptible and that could be 30-50 cm in mid-century, then 1 metre by 2100, with as its main impacts: coastal erosion, and a rise in salinity in estuaries, wetlands and underground water.

The rise in sea level will give rise to partial or total submersion of low-lying coastal land, certain islands and wetlands; serious repercussions would happen in the more populous areas such as the delta areas.

The effects of climate change will also be felt on land and sea economic activities and on coastal infrastructure.

Knowledge about the effects on habitats and marine and coastal biodiversity is fairly uneven and remains sketchy as regards marine fauna and flora.

A change in coastal habitats is predictable. Among the marine and coastal ecosystems that are the most vulnerable to climate change are the coral reefs, mangrove swamps and meadows (Berry, 2008; IPCC, 2007). As the coastal wetlands become more salty this will bring about a host of major habitat losses, especially for waders avifauna and seabirds. The same holds good for all the species that depend on seashore environments that will undergo major disturbances, while awaiting the stabilisation of new coastal wetlands encroaching on the continent and that they will colonise in the long term. The loss of coastal habitats will be

critical for vulnerable emblem species like the monk seal or the marine turtles, and disturbances are expected for the marine phanerogames.

The rise in water temperature is worrying for ecosystems, habitats and species.

The less tolerant species will be affected in their genes and their physiology.

Among the effects on species can be mentioned:

- mass mortalities, even extinctions
- changes affecting migration
- reduction or extension of distribution areas
- introduction of thermophilous species to the detriment of native species.

Exceptional mass deaths have already been witnessed. These events will worsen with the rise in temperatures, as predicted by the end of the century (2 to 3.4°C). Extinctions are probable, particularly for sessile and endogenous stenotherm species.

2.2. National sources

The experts also consulted a great number of national documents. Their comments appear below:

Algeria

- At national level, there are hardly any documents that are specific to the CC-MCBD issue. The available elements on MCBD basically address the aspects of inventories or those related to human activities (marine pollution). The absence of sensitivity/vulnerability charts for the coastal area (habitats and species) is another constraint for assessing the effects of CC on MCBD
- The lack of specific documentation on the CC-MCBD issue constitutes a handicap for making a diagnosis of the situation
- However, many environmental events and phenomena have been recorded for the coastal area over the last ten years, especially those directly or indirectly linked to the rise in water temperature or the rise in sea level. Other phenomena related to the variations of stocks of exploited species or the sighting of invasive species and the recurrence of coloured water have also been mentioned.

Egypt

Documents explicitly cited as source of information and analysis but not commented on.

Lebanon

- The documents related to the effects of CC on MCBD are described by the author as less rigorous than those related to other domains (land BD, GHG emissions, etc.)
- The documents are often descriptive and work on the database and statistics is outdated
- Many pertinent scientific works reproduce information on marine BD, mentioning original observations of invasive exotic species
- Close link between the lack of scientific rigour noted in certain documents and the scarcity of skills, especially in taxonomy.

Morocco

- The available knowledge is not sufficient to characterise the effects of CC on MCBD. Such ignorance is a result of the weak knowledge on the state of marine and coastal biodiversity, which is still sketchy for many elements. It is linked to the well-known lack of national MCBD skills, on the one hand, and of skills for assessing the effects of CC on MCBD on the other
- Absence of regular and structured monitoring of marine and coastal biodiversity and of the evolution of physicochemical parameters related to CC.

Syria

- Big gaps persist as regards the impacts of climate change on species, habitats and ecosystems and on resilience and adaptation capacities. CC is considered as something imponderable, about which nothing can be done about.

Tunisia

- Those of the documents consulted which show the relation of climate change and evolution and biodiversity do not present quantitative data
- Interference with fishing stakes and introduced species make it hard to establish cause-effect relations
- Gaps in quantitative data call for the establishing of databases on a chronological, spatial base

2.3. Comments on the state of knowledge and know-how

1. The information available in the documents dealing with CC/MCBD constitutes a pertinent base of information and reflection at international and Mediterranean level, but only very superficially reflects the issue at sub-regional or national level
2. The prerequisites, here the inventories of biodiversity, are still incomplete and not sufficient for articulating a pertinent monitoring of the effects of CC on MCBD. The existing data is either outdated or qualitative and in any case insufficiently structured to set up pertinent planning of research, monitoring and adaptation activities
3. The pertinence of the contents of the documents is sometimes deemed approximate (related to the absence or insufficiency of skills on biodiversity and the effects of CC on MCBD)
4. There is no reference document that relates to any strategy or planning whatever related to the effects of CC/MCBD
5. There is not much know-how as regards assessing the effects of CC on MCBD, faced with an absence of planning and research and monitoring strategies.

3. NATIONAL ACTIVITIES RELATED TO CLIMATE CHANGE AND BIODIVERSITY

All the countries have ratified the CBD and UNFCCC Conventions and the Kyoto protocol. The national UNFCCC communications and the national CBD reports are regularly transmitted or are being sent.

The other pertinent national activities related to CC and BD appear below:

3.1. Pertinent national activities

Algeria

- Setting up a National Climate Change Agency (ANCC) and a National Commissariat for the Littoral (CNL): both instruments necessary for managing the climate change/marine and coastal biodiversity risk in Algeria
- From the institutional angle, various bodies have been created to be responsible for the biological diversity issue (policy, planning, valorization). Some are also intended to be responsible for issues related to climate change or to CC interaction with the coastal area or to CC interaction with marine biodiversity: the environment and sustainable development watchdog, the National Centre for Developing Biological Resources (CNDRB), the National Centre for Environmental Training (CNFE)
- Passing the Coastal Law
- Implementing the recommendations in the national strategy for Conservation and Sustainable Use of Biological Diversity, especially the part on coastal ecosystems and marine biodiversity
- Taking into consideration the coastal vulnerability/CC in the 2nd Algerian UNFCCC communication
- Crafting a database and a national information system on marine and coastal biodiversity in Algeria (SIGBIOMARAL) as a tool for decision-making
- Crafting the ICZM operational strategy for Algeria
- Listing and setting up other protected areas, for example listing the Habibas Islands (Oran) as a marine nature reserve and Rachgoun Island (Ain Témouchent). A similar process is being undertaken for three coastal national parks (the El Kala National Park, the Taza National Park and the Gouraya National Park)
- Listing new Specially Protected Areas of Mediterranean Interest (SPAMIs)
- Making a national land register of the coast
- Carrying out coastal development plans for the Algiers region, with the support of the MAP, and in particular RAC/SPA, to protect sensitive marine natural environments, with a special part set aside for marine biodiversity and areas of ecological interest. A similar process is engaged for the coastal areas of Annaba and Oran.

Egypt

- Setting up a national clean development mechanism
- Crafting a climate change action plan
- Joining the RAMSAR Convention, establishing a national council for wetlands and crafting a Wetlands Strategy and Action Plan

- Setting up an authority in charge of wetlands, protection of biological diversity, integrated management of coastal areas and climate change
- Carrying out studies on assessment of measures of adaptation to CC in the farming sector, vulnerability and adaptation of the Nile delta (socio-economic aspects) which dealt mainly with scenarios of adaptation-protection of coasts and population transfers
- Crafting a national action plan on climate change (reducing greenhouse gas emissions, energy efficiency, clean industries, renewable energies and sustainable management of crops). Responses-adaptation to the effects of CC are scarcely dealt with. There is a need to create and feed a information and data base on the CC issue
- Strengthening the National Unity for Biodiversity with a view to coordinating monitoring and research activities regarding biodiversity, inventories and monographs on coastal lagoons; but the database on marine biodiversity remains sketchy and is still not very satisfactory
- Areas made into reserves are extensive but their effective management remains insufficient, particularly as regards monitoring and research
- A project associating the Egyptian Environmental Authority and the *Governorats* for setting up awareness programmes on approaches to the integrated management of the coastal area, projects to craft integrated management plans.

Lebanon

- The ministry in charge of the environment implemented various activities related to biodiversity conservation. This basically involved reports on exotic species, on the management of protected areas and on the conservation of wetlands (MedWetCoast project). Reports concerning the administration and management of protected areas, legislation on biodiversity conservation and capacity-building were also crafted
- Activities undertaken to reduce pollution
- In the context of research, oceanographic studies were done, inventories made etc., with pertinent results related to the effects of CC on the physicochemical and biological features of the marine environment
- A thesis on the retrospective evolution of the geo-morphodynamics of the Lebanese coast
- University research work on exotic/invasive species, published work.

Morocco

- The initial national communication made as part of the UNFCCC was devoted to assessing vulnerability to CC: an inventory of greenhouse gases and vulnerability of the agricultural and water sectors. The document did not mention the effects of CC on MCB, but gave rise to the following programmes: programme to fight against the encroaching desert, programme to develop hillside lakes, national forestry programme and national reforestation plan, programme for savings in the drinking water sector, programme for savings in the irrigated sector, programme to fight against pollution, programme to fight against flooding, programmes to fight against the effects of drought and a master management plan for conservation management of *Bour* farmland
- The second national communication is being prepared. Its aims are to further pursue the studies done in 2001 in the initial communication, and the projects crafted in this context, including assessing the vulnerability (erosion, flooding and their socio-economic effects) of the Moroccan coast, both Atlantic and Mediterranean, in the face of CC, essentially ARSL
- There is an ongoing project co-funded by Canada's International Centre for Research and Development (CRDI) and the British Department for International Development

(DFID) addressing Adaptation to Climate Change in Morocco (2007-2010). In this context an assignment to assess 'the vulnerability of the ecosystems of the eastern Mediterranean coast to the rise in sea level' was carried out, but did not report on the impacts of CC on biodiversity in this sector

- Awareness and capacity-building programmes dealing with CC but not with MCBBD aspects.

Syria

- Activities related to greenhouse gas emissions, the ozone problem
- Adaptation strategy for the coastal regions now being prepared
- Involvement of all the ministries in the CC issue, but the CC/MCBD stake remains very secondary
- Existence of a legislative and institutional framework related to biodiversity
- Setting up new protected areas
- Strong involvement of the university in research on marine and coastal biodiversity
- Participation in international programmes and projects
- Sector-based studies on erosion and water resources integrating CC-linked aspects.

Tunisia

- The main activities related to the CC stake are those identified via the national study on the effects and consequences of climate change on the farming ecosystems and the Second National Communication on the Accelerated Rise in Sea Level: a study on the environmental and socio-economic vulnerability of the Tunisian coast faced with an accelerated rise in sea level due to climate change, and the identifying of an adaptation strategy
- Climate change is also integrated in synergy with the UNFCCC, the UNCCD and the CBD in a project now under way.

3.2. Problems and constraints

Although all the governments are committed to honouring their obligations under the international conventions and the Kyoto protocol, most of what has been done has been devoted to assessing and mitigating greenhouse gas emissions, and to a lesser extent to the effects of CC on socio-economic stakes, mainly linked to agriculture and water, and rather less to the consequences of the accelerated rise in sea level and finally almost nothing on the effects of CC on MCBBD; what little is being done is still at the stage of intentions or declarations.

The main constraints and difficulties that have been identified are:

1. The absence of policies, programmes or action plans specifically directed to assessing the effects of CC on MCBBD
2. Low awareness of people, civil society and the national authorities about the CC/MCBD stakes
3. Inter-sector transversal organisation for the integrated management of coastal areas has not yet started working as desired, or else does not take the CC/MCBD stake into consideration in its prerogatives
4. Legislation is to be updated
5. Absence of a strategy to meet the needs required for acquiring knowledge about the effects of CC/MCBBD, risks linked to insufficient organisation of research institutions
6. Weak scientific and institutional capacities

7. Scattered databases that do not allow the initial situation to be defined
8. Difficulties linked to the absence of pertinent methodologies for assessing the vulnerability of the coast, and the vulnerability and adaptation capacities of the ecosystems, some groups of species and species
9. Many countries have made or are making reports on assessing the vulnerability of the coast in relation to the accelerated rise in sea level, but it is necessary to enhance expertise as regards defining adaptation scenarios as well as the technical capacities necessary for these to be implemented
10. Variability of data and information concerning the sighting of exotic species.

4. VULNERABILITY AND IMPACTS

4.1. Identifying vulnerability and impacts

State of the art, taken by country is set out below:

Algeria

- Marked erosion of sandy coast, amplified by removal of sand. This risk is greater in naturally vulnerable low-lying areas, especially coastal and littoral wetlands
- Impacts on the composition and structuring of the benthic macrofauna and macroflora related to changes in the sedimentary dynamics
- Effects of the increased water temperature on the physiology of marine organisms; this phenomenon encourages thermophilous species to become established. These effects are especially perceptible on the reproductive habits of some species
- Effects of the rise in water temperature on the ecology of certain sensitive populations, particularly in terms of distribution, resistance to changes in the original environment's physiochemical processes
- Changes in the distribution area of stenothermic species (lower and upper edges)
- Mass appearances with increasingly notably frequency of jellyfish in the summer period, especially in the central part of the Algerian coast
- Anticipated effects on the formations of the backwash areas (vermetids), with implications for the associated fauna and flora
- Vulnerability of the coastal wetlands, their habitats and the dependent species
- Increasingly frequent appearances of coloured water and toxic bloom phenomena
- Effects that are anticipated but should be pursued on fishing activity; among the perceptible effects: growing catch of barracuda, considered to be a thermophilous species
- Marine intrusion (increased salinity).

The most exposed sites: The sandy coast of Reghaia-Kadous (to the east of Algiers), Zeralda-Sedi Fredj (to the west of Algiers), Mostaganem, and El Kala, the low-lying beaches of Jijel and Skikda, the coast with low-lying rocky platforms (vermetid platforms) of Kouali (Tipaza) and Mars El Hadjadj (Arzew), the sandy beach of Chenoua (Tipaza), the coast east of Bejaia, the coastal wetlands of El Kala, Skikda and la Macta, and the low-lying beaches of Ghazaouet.

Egypt

- Vulnerability of coastal wetlands and risks of profound change in the way they function as they become more salty, if the fragile ridges that cut them off from the sea break up, the expected spoiling of habitats and impacts on economic activities (fishing and fish-farming)
- Great complexity in the way the coastal lagoons function; these basins and the conflicting ecological and economic stakes, currently balanced
- The impacts of human activity (pollution, best use of land, illegal fishing and break-up of the habitat) on these systems could be worsened by the effects of CC
- Great vulnerability to submersion of low-lying land, especially farmland, located in the northern part of the Delta; this submersion could happen quickly under the joint effect

of CC and subsidence, added to the rise in temperature and the reduction of sediment, blocked by the Aswan Dam, being carried down

- Risks of low-lying land being changed into *sebkhas* in other physiographic scenarios
- Increased deterioration of the aquifers under the effect of CC and of their over-exploitation
- General risks to all low-lying land (infrastructure, tourism, mass movements of the population, etc.)
- Expected effects on the stratification and productivity of water in the Levantine sub-basin
- Multiplication of harmful bloom
- Increase in sources of aquatic weed pollution under the joint effect of protective infrastructure and the rise in water temperature
- Multiplication and proliferation of Lessepsian species at the expense of Mediterranean species, positive impacts on fishing
- Predictable harmful impacts on the fishing sector due to disturbances in how the Nile-Mediterranean system functions, worsened by the land drainage policy
- Dwindling water resources, worsening of this process by CC and over-exploitation, and projected solutions with the recycling and treatment of farm waste water will reduce the fertilisation of the lagoons and have a severe impact on the lagoon fishing sector

The most exposed sites: The lagoons of Maryut, Edku, Borullus and Manzala and Bardaweel. The northern part of the Nile Delta.

Lebanon

- Joint effects of CC and human activity on the coastline and on marine biodiversity, which undergoes disturbance that is worsened by pollution
- Cyclical changes in the coastline, with a regressive trend
- Regular proliferation of massive, sometimes toxic, plankton bloom, due to heatwaves and the presence of quantities of nutrients with high concentrations, with perceptible effects on halieutic products
- The Levantine ecosystems are precursors for the Mediterranean as a whole as regards vulnerability to climate change, mainly as regards marine biodiversity: mass mortalities, exogenous invasive species, disappearance of species at the edge of their distribution area (*Posidonia*, *Mytilus galloprovincialis*, *Sarpa salpa*, etc.) replaced by more eurybiontal species and thermophilous Lessepsian species. The effects are felt even on species that were introduced long ago and have adapted well to the environmental conditions (*Oculina patagonica*)
- Many similarities between the Syrian context and the Lebanese context as regards the effects of CC on MCBDD.

The most exposed sites: Akkar bay and the Tyr coastal area.

Morocco

- Low-lying coastal plains, beaches, coastal wetlands and estuaries are among the environments that are most vulnerable to CC
- The multiplication of risks of fire the Mediterranean forest runs
- Erosion and easy flooding of the low-lying coast related to the rise in sea level

- Dwindling water resources caused by the water deficit and the increased saltiness of underground water and impacts on coastal agriculture: farmland also faced with the effects of the rise in sea level, shortages of drinking water
- Dwindling catch and socio-economic impacts in the fishing sector
- Vulnerability of the fish-farming facilities related to the multiplication of extreme events, rise in temperature, proliferation of seaweed, drop in dissolved oxygen, and multiplication of epizootics
- Risks encountered by the coastal infrastructure generally and the towns and seaside resorts in particular
- Extreme vulnerability of the supralittoral habitats and consequences for the biodiversity they contain (monk seal, etc.)
- Major risks for certain sessile organisms (red coral, date-shells, etc.)
- Vulnerability of meadows related to the reduction of their distribution area
- Multiplication of plankton bloom, toxicity of certain species
- Expected vulnerability of the fauna and flora of the backwash area
- Expected effects on avifauna, changes in phenological status, disturbance related to the destruction of or change in habitats, mainly coastal wetlands.

The most exposed sites: The mouth of Oued Moulouya, the marshes and tidal areas between Fnideq and Martil, the Nador and Smir lagoons, the Tangiers and Al-Hoceima bays, Cap des Trois Fourches; the forest areas in the regions of Tangiers, Tétouan, Chefchouan and Nador; the coastal shelf of the bays of Tétouan-Smir, Al Hoceima, Bou Areg and Saidia.

Syria

- The vulnerability of the Syrian coast to the accelerated rise in sea level arises from its flat physiography. The great pressure of development and human activity are worsening factors
- Expected changes in temperature, wind system etc. will also contribute to the change in the characteristics of the sea water column
- Coastal erosion mainly threatens the loose coast that makes up 20% of the coastline. This phenomenon and the risks of submersion that it gives rise to will affect the resort beaches and archaeological sites located on low-lying land. Latent threats for all infrastructure, facilities, housing, industrial establishments... located in the low-lying parts of the coast
- Erosion of the coast will be worsened by the increasingly rough sea and by the rise in sea level that will gradually destroy the shallows that run alongside the coast and that will increase the exposure of sheltered mode habitats and species that have established themselves there. The surface currents will also become more rapid and will help worsen these effects
- Perceptible effects on coastal marches and the biodiversity they contain; certain marshes shrink and could disappear
- Expected effects on estuary habitats and the species that live there. These effects are a result of the increased saltiness of the estuary water, the erosion of the banks and the change in substrata
- The effects of development and human activity could markedly reduce the adaptation capacities to climate change of habitats and species
- Threats of submersion of caves that contain or could shelter monk seals
- Risks also concerning the Mediterranean coastal forest that contains many endemic and threatened species. The vegetation will be faced with a rise in temperature that will bring about heat stress, even an increased risk of fire. The most coastal fringe of these forests may disappear due to a big rise in sea level

- The chemistry and structure of the soil may undergo changes that will affect the associated biodiversity; the irrigated crops grown on the coastal plain will be affected by the effects of CC (rise in sea level, violent winds and storms)
- Sea-farming projects set up on the coast will have to bear CC stakes in mind in their investment and setting up plans
- Changes in the salinity of the coastal water, particularly in estuaries, will influence the practice of fishing for young fish, and collection areas will be smaller
- Probable risks arising from the increasing frequency and violence of storms undergone by fishing ports that have run-down infrastructure and by the fishing fleet, essentially made up of traditional, small, coastal boats
- Marked vulnerability of the Syrian islands that will be faced with risks of partial or total submersion; the sponge that constitutes the main halieutic resource may well be affected by CC
- Less rainfall and water that can be mobilised (surface water and underground sheets); the quality of underground water will be affected by the seeping in of seawater. Several springs may well be submerged
- Vulnerability to CC of many marine and coastal habitats and species
- Vulnerability of species living in small niches that may well become smaller or disappear, risk of biodiversity loss
- Migration and reproduction of certain species may well be changed; expected responses at physiological and ethological level/CC
- Vulnerability of the monk seal, a Mediterranean emblem species, and of marine turtles
- Major risk run by the facies of backwash areas (vermetids, etc.) and indirect impacts on the associated organisms
- Multiplication and proliferation of thermophilous, mainly Lessepsian, species at the expense of native species
- Impacts on the distribution and size of stocks of fishes, their migration, etc., worsening of epizootics and parasitism
- Changes in the distribution areas, mainly of benthic organisms, in response to the expected changes in water temperature; possibilities of extinction
- Indirect impacts on the avifauna related to the changes in coastal habitats
- Impacts on pelagic fauna and flora inherent to changes in pH and temperature
- The joint effects of pollution and CC worsen the impacts on organisms and habitats; multiplication of dystrophy and suspect bloom
- Expected impacts on farming speculation and agrobiodiversity.

The most exposed sites: Ras Al-Bassit, Oum Al-Tiur, Wadi Kandil, Joun Jablah and Al-Hamidiah, Ibn Hani, Al-Azhari, the Al-Kabir Al-Shimali estuary, the Jablah beach and that of Banias, the Al-Housen estuary, the Tartous and Al-Nawras beaches, the Al-Kabir Al-Janobi estuary and the coastal valley of Al-Ghamka. The Al-Bassit, Blue Coast, and Al-Rimal al-Zahabih beaches. 15 archaeological sites located near the shore, including Ras Shamra, Amrit and Arwad. The islands of Arwad, Al-Hbas, Al-Namil and Abo Ali. Seepage of seawater into the underground water in the coastal plain of Al-Hamidiah near Banias, in Al-Bassa and north of Lattakia (Dimsarko area, and the area north of Wadi Kandil). 18 freshwater springs, mainly in the Banias area.

Tunisia

- The effects of climate change are felt at planet level as regards the rise in sea level and at a more local level for the rise in water temperature

- The main risks are erosion, increased salinity and submersion; the whole Tunisian coast is exposed to these risks. The rocky coast and cliffs are the least vulnerable
- Developed parts of the coast will experience situations that are more complicated to manage
- Spatial extension and increased salinity of wetlands
- Marked erosion of all the sandy coast
- Erosion and/or submersion of the islands
- Major impacts on coastal development generally and on seaside resort activity
- Changes in the spatial distribution of marine and coastal organisms, particularly halieutic resources; a direct effect on stenothermic organisms
- Increase, proliferation and spatial extension of thermophilous non-native species
- Effects on the metabolism and physiology of organisms that can give rise to extinction, adaptation, phenological change, even the beginnings of a speciation process
- Impacts on slow-growing sessile biogenous formations in the backwash areas (vermetids)
- The risks for biodiversity will be worsened in the most polluted areas
- Changes will be noticed in the productivity of fisheries and fishing areas, with an increase in exotic species in sea catch and an increase in the productivity of the lagoon areas and *sebkhas*.

The most exposed sites: the Bizerta lagoon, Garaet Ichkeul, the Ghar el Melh lagoon, the Kalaat el Andalous *sebkhas*, the wetlands and lagoons in the Gulf of Gabès, the archipelagos and islands of Kuriat, Kneiss, Kerkennah and Jerba and all the sandy beaches.

4.2. Comments

1. The shores and marine areas of the Arabic countries of North Africa and the Middle East that border on the Mediterranean contain a rich and extremely diversified biodiversity. This heritage is already subjected to great pressure deriving mainly from the human activities that contribute to its erosion.
2. The inventories are sketchy, incomplete and/or outdated for many countries and thus do not permit systematic, exhaustive monitoring of the effects of CC on MCB to be envisaged.
3. An appraisal of the vulnerability of the marine and coastal area, the activities and the infrastructure it contains and the biodiversity were unevenly presented according to the national documents; aspects linked to the effects of CC or MCB to be envisaged were particularly documented in detail for the documents as a whole.
4. Potential or expected vulnerability was dealt with and formulated according to the countries and to the existing mass of material, either through observations that really had been done, or, in contrast, simply through an expert's prospective analysis.
5. Many analogies were noticed when setting out the pregnant stakes, and these stakes can be considered as pertinent at national, sub-regional, Mediterranean and world level.
6. Major anxieties often recur in the national documents, particularly concerning:
 - the rise in sea level and the expected repercussions on the integrity of the coastline, wetlands generally and more particularly lagoons, *sebkhas*, estuaries as well as the ecological and economic values they contain
 - the effects of CC on water resources and the risks to agriculture
 - the increased risk of forest fires
 - impacts on halieutic resources
 - the worsening of the effects of CC by human activity
 - thermophilous non-native species, particularly Lessepsian

- the multiplication of 'suspect' bloom
 - expected worsening of the effects of CC by existing human-origin pressures
7. The diagnoses made and set out in the national documents constitute a base for planning supplementary actions to those anticipated in the first phase of SAP BIO. Updating the appraisal, both in terms of climate, physical and biological parameters, remains a priority for many countries to optimise the implementation of an action plan specific to the effects of CC on MCBD.
 8. These similarities enable us to envisage enhanced cooperation at levels that range from the local to the international with a view to implementing common research and monitoring actions.

5. NEEDS AND PROPOSALS FOR URGENT ACTIONS

The pertinent needs expressed in the national documents, and the urgent actions, appear below:

5.1. Needs

Algeria

- Define and implement a true National Research Programme on climate change and its impact on development and on the different physical and biological aspects, particularly marine and coastal
- Have the legal, institutional (including participative) and financial systems accord with needs related to the CC-MCBD issue; identify and strengthen the institution in charge of running and coordinating the system
- Set up a permanent inter-institutional consultation approach on the CC-MCBD issue
- Back up the operational ability of the institutions in charge of natural resource protection
- Make funding mechanisms and procedures more flexible
- Honour Algeria's commitments in the context of the CCC and the CBD
- Set up a network and a system for monitoring pertinent CC-linked parameters and its effects on the most sensitive and the most vulnerable areas. Information from this network will be used in the context of aid mechanisms for national, cross-border, regional and world decision-making
- Enhance CC-MCBD skills and know-how
- Assess and monitor the evolution of halieutic production and set up a CC-MCBD watch mechanism for the exploiting of halieutic resources; define and carry out this sector's adaptation strategies
- Rethink coastal development with a view to anticipating and reducing the impacts of the rise in sea level on marine and coastal natural habitats, infrastructure and human activities
- Enhance communication about CC-MCBD stakes, and set up environmental education and awareness programmes
- Craft and put into effect cross-border research programmes that are common to Morocco, Algeria, Tunisia and Libya.

Egypt

- Assess the share of climate pressure and that of other pressures and the effects of their interaction on the health of the environment
- Organise watch and decision-making as regards CC-MCBD, involving institutions and NGOs
- Develop an information base that can be used by decision-makers
- Set up monitoring of climate parameters, physical parameters, coastal erosion (checking the contribution made by subsidence) and the quality of underground water. Assess the socio-economic impacts
- Strengthen the legal measures related to conservation of coastal and marine areas, threatened species and the use of the resources contained by these environments
- Designate new marine protected areas

Lebanon

- Update knowledge of marine and coastal biodiversity and enhance skills in the field of taxonomy
- Set up programmes to monitor pertinent climate change parameters that affect marine and coastal biodiversity as well as long-term studies enabling its effects to be assessed, mainly as regards ecosystems, habitats and species
- Enhance the technical capacities needed for investigations, rehabilitate and strengthen the existing oceanographic stations and integrate them within regional and international networks
- Back up active research structures in the field of adaptation to climate change
- Strengthen the skills and capacities of actors and users of coastal and marine areas in the field of natural resource conservation
- Strengthen the budgets set aside for research
- Revise the legal texts and approve bills related to nature conservation and the effects of climate change
- Set up a collective institutional administration for watch, adaptation, mitigation and conservation
- Craft cross-border research programmes with Syria
- Implement urgent and priority national action plans.

Morocco

- First improve knowledge on marine and coastal biodiversity in Mediterranean Morocco
- Plan sets of continuous recordings of physicochemical parameters in Mediterranean Morocco
- Get the pertinent (air and sea) climate data that will permit decision-making
- Enhance national taxonomic capacities and skills in marine and coastal biodiversity via strengthening international cooperation
- Strengthen the legislative and institutional framework related to climate change and biodiversity
- Strengthen international cooperation, especially with neighbouring countries bordering on the Mediterranean, to improve and exchange knowledge, skills and scientific experience about CC impacts on Mediterranean marine and coastal biodiversity

- Involve all actively involved parties and assimilate CC and its impacts on biodiversity in all sector-based policies
- Strengthen awareness programmes for volunteers, amateurs, people working for free, naturalists, students, government agents, scientists, NGOs etc. for a participatory approach as part of the observation of marked changes in biological diversity faced with CC
- Have Moroccan experts take part in all events dealing with CC and its effects on marine and coastal biodiversity
- Establish synergy between the various conventions on CC and biodiversity.

Syria

- Develop a digital model of the rise in sea level to identify the areas faced with this risk
- Plan, bearing in mind the changing trends of the coast, with regards to CC, in order to prevent and reduce the risks brought about by development and activities on the coast
- Identify funding sources to cover the needs inherent in CC impacts on marine and coastal areas
- Fill in gaps in the legislation in order to respond to specific CC-MCBD issue needs as regards mitigation measures and adaptation measures, five-year updating of the texts and intermediary reviews if necessary
- Consider CC in the sector-based development plans as a whole, as was done in the energy sector
- Craft a database that can be consulted, putting in the results of CC-related research programmes
- Create an institution that specialises in research and education
- Enhance and diversify existing research skills and technical capacities
- Have research and monitoring methodologies that can be replicated for the Mediterranean as a whole
- Enhance communication, information, awareness and education
- Every year produce reports on the state of the environment in which analyses and assessments regarding environment protection will be transcribed
- Set up an effective network of actors involved in CC issues and people responsible for CC in the different ministries involved.

Tunisia

- Set up programmes of inventories and monitoring prior to setting up specific strategies of adaptation to CC with the acquisition and processing of climate, physical and biological data
- Continuously monitor CC parameters that affect MCBD
- Craft a model of water heating in the Mediterranean and the effects on the thermal structure of habitats
- Craft a geo-referenced database on the distribution of species that are sensitive to climate change. Perfect methods of monitoring the edges of distribution and models to predict the risks of extinction in the Mediterranean
- Develop research programmes on the life cycles, reproduction and dynamics and genetics of sensitive populations. Acquire this basic data in various geographic areas and assess the effects of a change in the thermal system on phenology

- Develop phenological information systems for managing and studying climate change in the Mediterranean and assess the capacities of adaptation of species threatened by climate change
- Back up studies on the effects of climate change on the way the ecosystems function
- Craft specific adaptation strategies on i) watch and monitoring of the sea level, ii) the low-lying areas and coasts that are sensitive to erosion, iii) the coastal water resources, iv) the ecological and halieutic resources and v) the coastal infrastructure.

5.2. Urgent actions

Algeria

Urgent actions summarised in the previous chapter. A detailed action plan has been proposed by the consultant.

Egypt

- Craft long-term scenarios for the northern part of the delta that take into consideration possible interaction between CC and economic development
- Prevent and reduce the effects of CC on water and soil quality and on wetlands
- Take the effects of CC on the coastal protection infrastructure into consideration, and strengthen them as a result
- Study the possibilities of relieving the northern fringe of the delta of the demographic and socio-economic pressures, and identify sites where these populations can be moved to.

Lebanon

- Effectively implement actions on the sustainable management of land, the fight against the encroaching desert and the mitigation of the effects of climate change, as well as the sustainable valorization and conservation of biodiversity, as advocated in the national reports relating to the UNCCD, UNFCCC and CBD conventions
- Update the SAP BIO National Action Plans 1, 4 and 5, taking into consideration the effects of CC on MCB, and implement the priority action plans
- Create and update oceanographic observation networks integrated within regional and international networks
- Complete and update biological inventories, and therefore strengthen the numbers and capacities of young taxonomic researchers
- Update cartographic information/MCB: ecosystems, biocenoses, associations and facies
- Consider the benthic communities of the Lebanese coast, and more widely those of the Levantine coast, as having regional priority (The habitats action plan is set out in detail in the Lebanese document).

Morocco

- Urgent actions summarised in the previous chapter.

Syria

- Urgent need to have a bigger mass of information and data to better guide research and monitoring programmes; set up long-term planning for research on the vulnerability of species and their capacity to adapt to changes in climate and anthropic conditions
- Centralise the existing data and acquire supplementary data related to monitoring the effects of CC on MCBD
- Rationalise research methodologies for better valorization at Mediterranean and international level
- Set up pilot monitoring stations per kind of vulnerable environment
- Establish ecological corridors as an adaptation response to the effect of CC
- Long-term studies of halieutic potential with a view to adapting the activity
- Inventory threatened species in the marine and coastal ecosystems with a view to protecting them against additional threats inherent in CC
- Update the legislative framework and make political decision-makers aware of the CC/MCBD stakes
- Establish partnership ties between politicians and scientists in order to facilitate the circulation of information necessary to decision-making.

Tunisia

- Urgent need to implement actions to permit predictions and to have tools to help decision-making
- Set up a system that can centralise, acquire, and check information related to the CC/MCBD stake and give it the necessary means, especially means of processing and calculating, and to connect it to a data valorization and circulation system
- Set up a network of permanent fitted-out stations
- Promote suitable research programmes
- Set up stations to monitor the coastline.

5.3. Comments

The countries' considerations differ according to their special contexts: organisation, legislation, scientific and technical capacities, variability of vulnerability, size and diversity of the stakes, etc. However, many proposals recur both as concern the needs expressed and the recommendations for urgent actions. The proposals formulated are as follows:

1. To various degrees, but for all the countries, pursuing and structuring the acquisition of basic knowledge constitutes an urgent precondition in order to get a better grasp of the specific features of the protection stakes
2. Making actors (politicians, scientists, users etc.) aware is necessary for appropriation of this crucial stake; here, in-depth work has to be done to better individualise the problems, solutions and the why and the wherefore of the solutions: knowing why we protect? what we should protect? how we should protect it? in order to better define the strategies and priorities at every level
3. Organising the institutions and setting up a system that is responsible for upstream and downstream assessment of the effects of CC on MCBD, then identifying and implementing the adaptation measures is necessary

4. Updating legal texts
5. Enhancing skills and scientific and technical capacities as well as facilities
6. Updating national reference documents that take the effects of CC/MCBD into account in order to end up with a clear action strategy (research and monitoring and adaptation)
7. Mutualization of information inside the country, regionally and internationally; cross-border and regional scientific networks
8. Involvement in transnational and regional programmes
9. Harmonising methods of data acquisition and monitoring
10. Developing experimental stations to monitor the effects of CC/MCBD per kind of vulnerable environment
11. Need to identify and implement priority measures of adaptation.

6. FINANCIAL SUPPORT AND COOPERATION

6.1. Funding and cooperation opportunities

Algeria

- The question of the effects of CC on MCBD is not always seen as having priority, and so access to funding remains difficult. It is vital that institutions like (i) the Scientific Councils of the university research establishments, (ii) the governmental agencies and bodies that supervise scientific research activity or (ii) at central level treat it as a priority subject
- Some national funds could be requested: the fund for the environment and cleaning up, the national fund for the protection of the littoral and the coastal areas and the national land use and sustainable development fund. Other funds can be requested such as the national fund for scientific and technological research and the national fund for developing fishing and aquaculture. Most of these funds are operational, but the mobilisation procedures should be more flexible. International funding could be requested to bring additional funding: GEF, FGEF, World Bank and also the EC (SMAP) or programmes and NGOs that are involved on a regional scale.

Egypt

- Egypt will be faced with implementing large-scale and enormously expensive adaptation projects that will require the mobilising of budgets that are out of the reach of most developing countries. These projects require technical assistance and funding that cannot be borne by the state. The greenhouse gas (GHG) emissions responsible for CC are produced mainly by the rich countries, and Egypt's share is negligible. It would be unjust for Egypt to shoulder intrinsically the costs. Thus it will be necessary for major adaptation projects to find technical and financial support from the European Union; international agencies like the GEF or UNDP, which are already involved in environmental projects in the country, could also be called on.

Lebanon

- The national budget for research is very small and does not at all meet the needs and ambitions of Lebanese researchers. In this connection, the MoE has a tiny budget which only enables restricted studies to be done
- On a national scale, collaboration is possible between the public bodies (ministries) on one hand and the research institutions on the other. Collaboration also happens between public bodies (ministries and municipalities) and NGOs. But private donors have very restricted possibilities
- In general, all the research programmes and projects are carried out with international support from the GEF and several other international bodies with an equivalent in kind and/or in cash provided by ministries
- Opportunities exist and could help towards the implementing of national cross-border (with Syria) programmes, or regional programmes. Potential donors are: GEF, FGEF, UNDP and UNEP-MAP-RAC/SPA, which fund programmes linked to the CC/BD issue
- Other possible donors and technical partners are: ALECSO, the Bern Convention, AE, WWF, IUCN, MedWet, MEDCOAST, MIO-ECSDE, Birdlife International, MEDMARAVIS, and the Mediterranean universities and oceanographic research stations. Note that SAP BIO also provides great opportunities for establishing partnerships between countries and a justification for multilateral funding. It is important to mention the financial and technical aid from governments (United Arab Emirates, France, Italy, Switzerland, Spain and Canada), the international organisations and bodies and institutes (UNEP, UNDP, EC, REMPEC, IUCN, Euronature, USAID, ICRAM, Canada IRDC, Mercy Corps and IRS, which have contributed (in collaboration with the MoE) to operations of cleaning up and biodiversity assessment and to capacity-building to face up to the serious threats of the oil slick of July 2006.

Morocco

- Bilateral technical help via the Cooperation and Cultural Action Services of embassies of countries like Germany, France, Spain, Portugal etc. The actions implemented are almost exclusively human exchanges aiming at the transfer of skills and methodologies or backing up the undertaking of a contract. So far, expertise is mostly dispensed by executives from the state or from public establishments and does not appear in the cooperation budgets
- The FGEF via the AFD, and the GEF constitute potential donors but require co-funding
- Other possible partners and backers: the World Bank, the African Development Bank, the United Nations Environment Programme (UNEP), the United Nations Development Programme (UNDP), donor countries (US, Canada, Germany, Japan, etc.), the European Union through funding multilateral projects on a Mediterranean basin scale, the international NGOs: WWF, Birdlife International, Wetlands International, Ciconia Foundation etc.), the Canadian International Centre for Research and Development (CRDI), the British Department for International Development (BDID) and the European Agency for the Environment.

Syria

- A fund has existed since 2002 concerning investment for environment protection; this fund is fed by the state budget. The fund is 339 million Syrian pounds. The financial capacity and available funds for CC and biodiversity research and monitoring is weak
- As part of the 10th Five-Year Plan, a set of environment-related projects was proposed by several ministries. Additional funding is necessary to back up these projects and to integrate the impacts of CC on MCB, especially for implementing programmes of data acquisition, research and monitoring and for capacity-building
- Other contributions from the public and private sector exist, but are modest and focus on small-scale activities. The risks inherent in CC are considered to be low and therefore as not having priority
- UNEP/MAP, UNDP, GEF, UNDESA and the Japanese Government via the JICA are potential donors, traditionally contributing to funding projects related to CC stakes
- ALECSO and Tempus can fund national projects through the State Planning Commission (SCP). Loans and gifts can also be mobilised by Arab and international organisations and help fund programmes related to the impact of CC on MCB
- Gifts mobilised vary according to the requests made by the Government and the funds that can be mobilised; it is thus important to start programmes on CC gradually and realistically.

Tunisia

- Funding proposed actions represents a major constraint that makes any implementing of action plans difficult, so the main recourse is the funding opportunities offered on an international scale in this field. However, the contribution of the state and the national operators is vital to put this approach into effect. Many backers demand an equivalent
- To implement urgent actions, potential funds can be sought from the ministries in charge of the environment and agriculture; national funding possibilities can be envisaged in the context of the study on the environmental and socio-economic vulnerability of the Tunisian coast faced with an accelerated rise in sea level: Vulnerability and Adaptation
- Research laboratories, especially the INSTM's Biodiversity Laboratory and INAT's Research Unit: Aquatic Resources and Ecosystems can ensure a good contribution out of their research budgets, and those of the bilateral conventions with national institutions like APAL as part of implementing research and monitoring programmes
- At international level, two kinds of appropriate funding can be used, i.e. the fund linked to the United Nations Framework Convention for Climate Change (UNFCCC) and the traditional public development aid (PDA). For the first kind, there is a choice of funds: i) the special climate change fund that addresses adaptation mechanisms in the fields of water, land, agriculture, health, infrastructure, ecosystems, coastal areas and climate disasters (flooding/drought), and ii) the Kyoto protocol's adaptation fund fed by voluntary contributions from the industrialised countries and from a deduction of 2% on the value of certified emissions reduction units (CERUs) generated by "clean development mechanism" projects. For the second kind, many international backers offer appropriate funding for adaptation projects with interesting concession conditions (World Bank, European Union, European Investment Bank, etc.).

6.2. Funding and cooperation opportunities: comments

Long lists of funding sources were enumerated and set out in the national documents:

1. The first thing to notice is the countries' weak financial capacity to address very ambitious potential programmes
2. Only one country mentioned the Kyoto protocol's adaptation fund, which is well suited to mobilise funds
3. International private donors exist; funding possibilities are possible unilaterally or through sub-regional or regional projects
4. National funding procedures remain rigid for many countries, hampering the progress of various initiatives
5. Procedures to craft requests directed at international donors seem not to be well mastered.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1. Conclusions and recommendations expressed by the national experts

Algeria

- Resolve knowledge deficit problems, enhance and organise capacities, to assess the scope of CC impacts on the Algerian MCB and coast
- Make the climate change-marine and coastal biodiversity problem into a priority issue
- Facilitate the mobilisation of the necessary funding as well as researchers' access to these programmes
- Improve coordination between the institutional and university actors involved or interested in this subject
- Interest the economic actors, especially industries located in the coastal area, in CC-linked risks to involve them in the process of funding work, studies and mitigation measures
- Favour academic research teams with various outlooks (institutions) and profiles (specialities) in order to permit a more integrated approach to the issue
- Place this coordination within the framework of integrated management of the coastal area, as recommended in the GIZC operational strategy for Algeria
- Improve capacities of expertise at university level by involving them more closely in the existing networks, projects and programmes at Mediterranean and world level
- Implement cross-border activities with Morocco and Tunisia, especially on the issues of sensitivity of species and habitats as well as on monitoring the water temperature, the rise in sea level and coastal erosion
- Identify simplified, standardised indicators to be able to compare the results over the entire Algerian coast and favour those indicators selected at regional level (Mediterranean Sea) to be able to assess the impact at global level
- Make maps of the sensitivity of coastal areas, and fragile habitats and species
- Finally, Algeria's commitment by ratifying the Convention on Climate Change and the Convention on Biological Diversity at international level means it must find the necessary resort at national level to put the strategic objectives into effect.

Egypt

- The effects of CC constitute an imponderable that will not be solved even if Egypt commits itself to reducing GHGs
- Policies, strategies and action plans must urgently be set up to reduce the effects of CC on MCB; now Egypt, like the other southern Mediterranean countries, is the most vulnerable and simultaneously the least prepared to face up to these large-scale impacts
- Enhance the role of the NGOs as tools to put pressure on decision-makers and to inform-make aware the wider public, so that all possible responses are deployed to prevent and reduce the effect of CC
- Strengthen the acquisition, analysis, use and circulation of data, particularly to political decision-makers

- Integrate the nature protection issue in the country's policies and plans
- Strengthen the enforcement of existing legal measures and introduce new measures to protect wetlands and the biodiversity they contain
- Coastal engineering work must be done to protect the wetlands and low-lying land
- Recommend that the Salloum area become a marine specially protected area
- Plan to relieve the northern part of the Delta from demographic pressure.

Lebanon

- Climate change is a planetary challenge that requires a global solution. Taking into account the impacts of climate change (rise in sea level, variations in water temperature and frequency of extreme events) and of pollution and introduced species on biodiversity, and of adaptation to and mitigation of these impacts represents a major stake for Lebanon, added, moreover, to the existing stakes inherent in non-sustainable human activity and development
- The effective implementing of the Conventions (UNCCD, UNFCCC, CBD) in order to sustainably manage land, fight against the encroaching desert, mitigate the effects of CC and conserve and sustainably exploit biodiversity
- As part of its commitment to the UNFCCC, Lebanon has crafted a national inventory of greenhouse gases, assessed the vulnerability of several sectors and ecosystems, and proposed a strategy for mitigating greenhouse gas emissions in various sectors with some adaptation measures
- There is no doubt that, in order to react to many factors, including climate change and vulnerability of species and communities, it is necessary to be able to adapt; to find solutions to the problems of adapting to the variability and change of the climate, governmental actors and all the actively involved parties must collaborate and incorporate adaptation into planning and activities
- Capacity-building and public awareness on maintaining marine and coastal biodiversity must play a very effective part
- Alongside the needs expressed and the priority actions, it is suggested that lines of research be pursued related to i) setting up long-term federative research programmes and doing modelling studies to predict the impacts of climate change and characterise the sensitive or most exposed habitats and to plan potential distribution areas of species of flora and fauna according to the IPCC's different climate scenarios; ii) feasibility studies (of impacts and threats to the coastal and marine ecology) on plans for installing or building or filling in by demolition tips and rubble; iii) impact studies on pollution, vulnerability of species and communities and introduced species related to climate change; iv) ecophysiological studies on species affected by climate change or thermal anomalies; v) macro-physiological studies that enable the metabolic functions of marine organisms to be examined and explain their state of abundance or performance in their life environment. Macro-physiology also gives information on more complex phenomena such as biological invasions and the impact of climate change. This new approach, in the field of chemodiversity, permits the acquisition of basic levels of expression of physiological markers involved in resistance to the stress caused by climate change. This is so for the ECIMAR Mediterranean programme in which the LU and CNSM are concerned.

Morocco

- Despite all the initiatives undertaken by Morocco as part of the CBD and UNFCCC, Morocco has not started on large-scale policies, programmes or actions directed towards assessing the impacts of CC on marine and coastal biodiversity

- The available information on the current state of marine and coastal biodiversity, and on the evolution of the main indices that describe climate change, does not allow any ruling to be given on the impacts of climate change on marine and coastal biodiversity
- Faced with this situation, Morocco is led to craft a national action plan on the effects on climate change on marine and coastal biodiversity. This action plan must be technically and financially supported by the international community.

Syria

- Set up an experimental station to monitor the effects of CC on MCBBD in Ras el Bassit
- Take into consideration the constraints that will be imposed by the effects of CC on the fishing and fish-farming sector
- Encourage dry-farming speculations and reduce crops that depend on excessive irrigation
- Make the newly created SCCR responsible for the coordination of planning and implementing scientific research on and monitoring of the effects of CC on MCBBD
- Update MCBBD-related inventories and extend them to the whole of the Syrian coast
- To follow up the national strategy and action plans for the conservation of biodiversity, it is necessary to develop the national system for monitoring biodiversity
- Take into consideration the effects of CC on MCBBD in the national environment strategy
- Include the “investing in the environment” approach in the five-year plans
- As a measure of adaptation to the effects of CC, extend the surface areas of the MPAs with a view to integrating buffer areas there that will also act to manage the areas and have them adapt to the effects of CC, mainly the rise in sea level
- Enhance information, communication, awareness and environment education programmes and integrate the CC/MCBBD stake in them
- Start programmes to develop structures to protect against the effect of CC on the coastline, and to add more sand to some beaches
- Pursue the preliminary work done in partnership with neighbouring countries (Lebanon, Turkey and Cyprus) and involve Egypt and Saudi Arabia in them with a view to integrating the CC/MCBBD stake
- A full regional study (run by a main regional organisation like RAC/SPA) should be done to assess the possibility of movements of species and to identify potential host sites (adaptation measure for protecting vulnerable species from the effects of climate change)
- Integrate the results from small-scale studies concerning the distribution areas of marine fauna species with a view to monitoring responses to the effects of climate change
- Making the port infrastructure adapted and safer with a view to adapting it to the effects of CC
- Greater involvement in regional projects. Increase national funding.

Tunisia

- The choice and implementing of pertinent scientific monitoring indicators:

Level 1

- Effects on the physiology of species, including photosynthesis, respiration, basic metabolism, growth etc.
- Effects on life cycle and reproduction, including fertility
- Effects on distribution towards the higher latitudes

- *In situ* adaptation

Level 2

- Monitoring changes and specific interactions, in particular competition and predator/prey relationship

Level 3

- Major changes in distribution and disappearance or extinctions of species

Level 4

- Changes in structures and make-up of communities, gradual appearance of opportunist species
- At national level, the primordial action would be to have a system for centralising, acquiring and checking data and information related to climate change and marine and coastal biodiversity.

7.2. Conclusions and recommendations of the sub-regional consultant

The conclusions that appear below derive from those formulated in the documents composed by the national experts and that are pertinent at sub-regional and regional level.

7.2.1. Conclusions

- i) This study constitutes a first phase that has enabled some paths (institutional, etc.) on the CC/BD issue to be identified, and that should be further developed in-depth
- ii) The most recurrent problems, that moreover concern all the countries, are to do with water resources, halieutic resources, risks to forests and especially of the erosion and submersion of the coast and the consequences this will have for development, infrastructure and economic activity, mainly seaside tourism, which makes a big contribution to these countries' economic resources. Highlighting the threats to the integrity of the ecosystems and that of their disintegration, with as a result the risk of mortgaging the future of the marine and coastal natural resources
- iii) The problems are also similar as regards habitats and marine and coastal biodiversity
- iv) The biological inventories are incomplete and the ecological watch system unsuitable. Some data is old and recent data is sketchy and often localised. However, the existing information shows the great value of the marine and coastal ecosystems as a whole and the need to protect them
- v) The countries do not have the necessary and suitable means and facilities to highlight the impacts of CC/BD and monitor the main descriptors and indicators of climate change and its effects.

The human resources and expertise necessary for assessing and research on adaptation to the CC/BD impacts are insufficient.

The countries underestimate the scope of economic loss linked to CC impacts on coastal and marine ecosystems. So the financial resources needed for mitigation and adaptation etc. are either insufficient, or unsuitable or difficult to access

- vi) The impact of CC on marine and coastal biodiversity and that caused by human activity are still badly understood. It is still not known how these impacts mutually reinforce one another

- vii) The Nile Delta/Suez Canal complex constitutes the hub *par excellence* of the CC and CC/BD effects. It is therefore necessary to pay particular attention to this
- viii) The CC/MCBD problem and stakes are not sufficiently integrated into the national and regional legal and institutional systems
- ix) There is very little awareness/communication on the stakes linked to CC/MCBD. This deficit concerns all parts of society (decision-makers, managers, scientific community, economic actors, NGOs, the wider public, etc.)
- x) The CC/MCBD issue and stakes are not sufficiently integrated into the national and regional legal and institutional systems.

7.2.2. Prerequisites, priorities and general recommendations

Recommendations for urgent, priority and long-term actions and programmes

- i) As a first prerequisite, it is necessary to complete the inventories (biodiversity, habitats etc.) so as to have a zero state that enables a quantitative monitoring of the effects of CC on MCBD and so that an ecological watch system can be set up at national level, that will be coordinated at sub-regional and/or regional level
- ii) It is necessary to identify standardised pertinent monitoring indicators that permit the evolution of the state, pressures and responses to be assessed (at country level as well as regional level) related to the effects of CC on MCBD, and to define how these will be implemented
- iii) A database that can be used at several levels (scientists, managers, decision-makers) must be crafted for the wider circulation of information.

It is necessary to prioritise the problems, sites, habitats and species in order to establish pertinent priorities for dealing with them, especially crafting sensitivity and vulnerability charts inspired by similar approaches

- iv) Networks of experts (scientists, managers of marine and coastal natural areas and NGOs, etc.) must be set up at national, cross-border and regional level. These will identify priority stakes and indicators, and reflect on and craft suitable methodologies for monitoring and research, and talk about the results.

Given the relative lack of skills in the subject, adopting simplified cheap methodologies could be a way of getting more information. The processing and analysis of this information will be done by qualified experts

- v) Enhancing national CC/MCBD skills is necessary, especially in taxonomy
- vi) It is recommended that the existing (human, material and infrastructure) means necessary to meet the needs expressed be assessed
- vii) Set up an awareness strategy and specific programmes for the wider public and decision-makers, emphasising the impacts of climate change, especially at socio-economic level
- viii) Strengthen the institutional framework by setting up a structure in charge of climate change at national level (like the Algerian National Agency for Climate Change), with sub-regional and regional coordination
- ix) Seek and mobilise national funds and/or constitute the necessary equivalents for international co-funding, particularly explore the Kyoto Protocol's compensation mechanisms.

Furthermore, meetings with RAC/SPA as catalyst are to be anticipated with donors to identify the funding possibilities that can be mobilised.

- x) There should be organisation of the various actors according to the GIZC system for better circulation of information and concerted decision-making on the CC/MCBD issue; this approach could be put into effect with the support of RAC/SPA and RAC/PAP

- xi) With a view to organising activities, it will be necessary to update the national strategies and action plans, bearing in mind the effects of climate change on marine and coastal biodiversity.

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