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Regional Activity Center for Specially Protected Areas



Updating the Strategic Action Programme for the Conservation of Biological Diversity in the Mediterranean Region (SAP BIO) on Climate Change Issues

Synthesis of National Overviews on Vulnerability and Impacts of Climate Change on Marine and Coastal Biological Diversity in the Mediterranean Region



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EXECUTIVE SUMMARY

The present document synthesizes the results of the RAC/SPA/MAP-UNEP action „Updating the Strategic Action Programme for the Conservation of Biodiversity in the Mediterranean Region (SAP/BIO) on Climate Change issues”. The document is based on findings presented by: (i) National Overviews prepared as part of the action; (ii) Sub-regional (Cluster) Synthesis Reports; and (iii) Working meetings organized at Clusters and regional level. In addition, a large number of reference documents were consulted. The action started in March 2008, and was concluded by the end of February 2009.

I. Objectives, methodology, activities

The objectives of the action were: (i) to update SAP/BIO on issues related to CC/Bd m/c; (ii) to contribute to objectives of the Almeria Declaration (2008); (iii) to provide the basis for follow-up within SAP BIO; and (iv) to prepare a final Synthesis Document and an Appendix to SAP/BIO.

The activities implemented were: (i) Preliminary RAC/SPA activities; (ii) Inception meeting; (iii) Preparation of National Overviews; (iv) Sub-regional (Cluster) meetings; (v) Regional Meeting to discuss Overviews and Cluster Syntheses; and (vi) preparation of final documents - the Regional Synthesis and the Appendix to SAP BIO.

Participation. Eighteen riparian countries participated in the action: Albania, Algeria, Bosnia & Herzegovina, Croatia, Cyprus, Egypt, Greece, Israel, Italy, Lebanon, Malta, Montenegro, Morocco, Slovenia, Syria, Spain, Tunisia and Turkey. Out of them, Cyprus did not prepare the Overview, but contributed by an informative document and experts' participation at the respective Cluster meeting; for the needs of the action Cyprus related documents were consulted, the one on biodiversity concerns in particular, prepared within the MAP CAMP “Cyprus” project (UNEP-MAP RAC/SPA 2007).

Clusters. The countries were grouped in 3 Clusters: (i) Cluster A: Adriatic, including the Italian Adriatic coast, Slovenia, Croatia, Bosnia & Herzegovina, Montenegro, Albania; (ii) Cluster B: North Mediterranean non-Adriatic countries and Israel, including: Spain, Italy (except the Adriatic coast), Malta, Greece, Turkey, Cyprus, Israel; (iii) Cluster C: North African and Middle-East Arab Mediterranean countries, including: Morocco, Algeria, Tunisia, Egypt, Lebanon and Syria.

Methodology. A bottom-up interactive participative approach was applied. National consultants/experts were nominated by NFPs for SPAs. RAC/SPA and the commissioned International consultants provided the authors with in-depth information and guidance. The national authors consulted a large number of national experts and responsible in relevant national bodies; drafted Overviews were reviewed by responsible national bodies. In 16 national documents a total of 190 consulted scientists/experts were consulted (f. ex. the two Italian documents were prepared with co-authorship of 23 national scientists/experts and 14 others listed, in case of Morocco 26 experts, Greece 15, etc.). All authors participated at Cluster meetings, providing additional contribution. The majority of Overviews were so far confirmed by responsible national bodies, the fact not excluding the need for further proof-checking and updating as part of follow-up.

Key events: (i) Inception meeting, Tunis, April 11-12, 2008; (ii) Working Meeting of Adriatic experts, Split, Croatia, 23-24 October 2008; (iii) Working Meeting of experts of North Mediterranean non-Adriatic countries, Israel and Turkey; Santa Pola and Tabarca, Alicante, Spain, November 10-11, 2008; (iv) Working Meeting of experts of North African and Middle-East Arab Mediterranean countries, Tunis, 28-29 October 2008; and (v) Regional Working Meeting, Vibo Valentia, Italy, 11-12 December 2008.

Outputs: (i) reference documents collected, some commissioned by RAC/SPA; (ii) Meetings' Notes and Conclusions; (iii) three Cluster Synthesis documents; and (iv) the present Regional Synthesis and Addendum to SAP/BIO.

2. The Context

The Mediterranean region – differences and inequalities. The widely different national characteristics of the 21 riparian states were of essential importance when approaching the present action. The region is characterized by

high geo-political and socio-economic heterogeneity and differences related to institutional, scientific and technical potential, capacities and expertise, such as a 10-fold difference in GDP between most developed countries and those less developed, and the 3-fold up to 6-fold difference of GNP per capita between W European countries and the other ones (WWF, 2005). Also, different demographic trends and population growth rates strongly influence the respective development outlooks and national policies.

Climate change and impacts on regional m/c Bd. The Mediterranean region is recognized as one of the most sensitive to CC, with occurring impacts close to environmental limits. The resilience of the ecosystems and biodiversity facing occurring and future CC impacts is reduced due to ever-increasing anthropogenic pressures. The present knowledge provides for figures on primary CC impacts (TR, SLR and Annual Precipitation), but with mostly qualitative descriptions only on consequences: droughts, heat waves, wildfires, changes of water regimes, inundation / flooding, storm surge, erosion, salt water intrusion, change of circulation pattern, earlier spring events, N-ward shifts in ranges of plant and animal species, invasion of NIS, all seriously affecting habitats, populations and species. Out of 75 studies on occurring CC impacts, 89% are consistent with changes expected as response to global warming (IPCC 4th Report, 2007). The key impacts envisaged by relevant scenarios are:

Year	MTR	SLR	Ann. Prec.
2025	+1,0 up to +1,4°C	up to +20 cm	up to – 4%
2050	+1,8 up to +2,0°C	+20 up to +24 cm	up to – 6%
2100	+2,2 up to 4,9°C	+23 up to +100 cm	up to – 27%*

* (higher reduction of Ann. Prec. for North African coastal areas and summers)

References consider the TR of +2,0°C as threshold towards irreversible catastrophe for Bd, with heavy impacts on economies, development and on socio-cultural context. Between 60-80% of current species may not persist in the Mediterranean under global MTR of 1.8°C (Berry, 2008). Evidence confirms the CC as already occurring, with part of impacts occurred being irreversible.

3. Available information and scientific knowledge

Reference documents. A large number (not yet exhaustive) of relevant documents was identified and analyzed. Gaps in knowledge are large; uncertainties are still many. The problems of consistency, reliability and homogeneity of data are relevant in particular at lower levels. A part of relevant information were not so far been adequately exploited. As causes of such a situation absence of monitoring and research, the level of institutional and scientific capacities and expertise and limited funding capacity were reported. Despite the above, the actual level of knowledge was evaluated as a sufficient back-up for the formulation of a consistent follow up. The establishment of updated and user-friendly CHM and/or Database(s) was recommended.

The available knowledge is predominantly focused at general aspects of CC and GHG issues, limited on CC/Bd, and very limited on CC/Bd in m/c areas. In a number of participating countries the actual knowledge on country specific CC/Bd and CC/Bd in m/c areas is very low or not-existent; the same is valid for the relevant monitoring and research. There is a consensus that the CC will result with most serious consequences for the region, even would the needed reduction of GHGs be timely realized.

The key expected impacts relate to: loss of lowlands and beaches; coastal erosion; increased salinity of estuaries, wetlands and aquifers; loss of habitats; increased risk for a number of already endangered species; changes of migration patterns, increased incidence of NIS with uncertain impacts on Bd; N-ward shifting of thermophilous species; increased vulnerability of endemic plants and vertebrates; affected avifauna; decreased distribution of a number of typical tree species; intensification of extreme events; loss of large coastal areas (e.g. Nile delta) - all affecting infrastructures, resident population, economies and development.

Comments by national authors: (i) general and region related knowledge being relevant and useful, but not comprehensive, often repetitive; (ii) regional data and scenarios do not reflect local conditions, downscaling is needed; (iii) knowledge at sub-regional and national levels: with varying degrees of achievements, comprehensiveness, consistency and reliability, being focused mostly at CC in general, GHGs, sectoral impacts, limited concerning biodiversity, very limited on CC/Bd and still more on CC/Bd in m/c areas; (iv) international projects being important for reducing gaps in knowledge; and (v) the urgent actions needed: downscaling, Bd Inventories, establishment of respective monitoring and comprehensive targeted research.

4. The relevant national activities

Signatories, reporting to International Conventions. All participating countries are signatories to the CBD, the UNFCCC and the Kyoto Protocol, the UNCCD and to a number of other relevant Conventions. EU member states are also committed to respective EU Directives and Policies (f. ex. CCCPMs). In addition to reporting to CBD and other Conventions, the majority of countries presented so far the National Communications to UNFCCC (some the 1st, most the 3rd or 4th ones). The Communications presented deal with CC/Bd at a declaratory level or not at all; when considering impacts on c/m areas deal with general impacts of SLR, but not with biodiversity. National Strategies and NAPs of interest for CC/Bd in m/c areas. All participating countries adopted and act in accordance with some National Strategies, NAPs or other specific documents related to: environment protection, biodiversity conservation, desertification, resource management and planning (ICZM included), in few countries on CC issues in general. Also, several GHGs Inventories or APs were prepared, but so far there are no specific national documents dealing with CC/Bd nor CC/Bd in m/c areas.

Other national activities. Among a large number of other activities reported some might be mentioned: national CC scenarios (Albania, Turkey); GHG Inventories (Albania, Montenegro, Syria); GHGs monitoring (Italy); research on CC, CC/coastal erosion, on CC scenarios (Greece, Israel, Italy, Malta, Slovenia, Spain, Turkey, Tunisia, ...); national/international activities on PAs / MPAs (Algeria, Croatia, Italy, Lebanon, Montenegro, Spain, Syria); karstic biodiversity, Bd as development resource in m/c areas (Croatia); institutional and human capacity building (a number of countries); specific studies on SLR and adaptation (Egypt, Italy, Morocco, Slovenia, Tunisia); wetlands, NIS (all countries); Bd monitoring of ecosystems / habitats / species (almost all countries, but limited in many of them); desertification (Algeria, Tunisia); ICZM / resource management projects (countries having implemented MAP CAMP projects: Albania, Croatia, Cyprus, Egypt, Greece, Lebanon, Malta, Morocco, Slovenia, Syria, Tunisia).

Conclusions: The majority of CC related national activities deal with general issues only and are mostly targeted at inventories and reduction of GHG emissions. When and if addressing CC, National Strategies and actions deal with CC/Bd in a declaratory way only, or not at all. Actions related to m/c areas address predominantly the impacts of SLR. Research (more intensive in countries with higher potentials) is mainly focused on CC; very limited and/or sporadic on CC/Bd, still more limited on CC/Bd in c/m areas. In several countries there is no such research at all. The lack of data/knowledge on CC, in particular on CC/Bd, of long-term data series, on inventories, and lack of targeted monitoring is strongly emphasized. In only one/two countries there are some monitoring activities on CC/Bd. Studies on mitigation/adaptation measures were so far implemented in few countries only. Capacity building and training is limited to issues dealing with obligations to UNFCCC. Public awareness on CC/Bd, despite actions reported in majority of countries is still low, for CC/Bd issues in m/c areas very low. Participation in international projects was reported as needed and beneficial for all countries, for a number of countries as the major opportunity to participate in and provide funding for the CC/Bd actions.

5. Vulnerability, impacts and critical m/c areas and sites

Vulnerability and impacts. Vulnerability on CC/Bd and resulting impact were identified and briefly commented by all national documents. Due to limitations mentioned in preceding chapters, the authors recommended to be treated as predictions and hypotheses, needing further in-depth studies. As the most vulnerable areas and habitats the following ones were considered: lowland coastal areas, beeches, coastal strips; wetlands, lagoons, estuaries;

karst – terrestrial and submarine; Mediterranean forests, shrubs and relict areas; the marine environment: fragile and important marine areas, hatchery and nursery areas, benthos / Posidonia beds, coralligena; watersheds and freshwater systems; birds sanctuaries; habitats of endangered species, also areas with endemic and autochthonous plants/species. Also, as particularly vulnerable the sectoral activities: fisheries and aquaculture, Mediterranean agriculture, tourism, WRM. Finally, health and other impacts on resident population were reported and commented. The key consequences of SLR, MTR and reduced precipitation were identified: flooding; coastal and riverbed erosion; increased incidence of extreme events, droughts and wildfires included; increase of NIS and resulting impacts; changes of marine mass movements and stratification; impacts on ecosystem functioning, N-ward shifting of ecosystems and species, migration and population distribution; impacts on endemism, populations and endangered species; finally, simultaneous effects of CC and anthropogenic stressors. The sub-regional aspects and the TB nature of many issues were emphasized. Due to the complexity of relevant issues, further proof-checking and in-depth analyses were recommended, also harmonized / consistent actions and co-operation at all levels.

Critical areas, sites, habitats. The majority of Overviews presented extensive lists of critical m/c areas, sites and spots, based on vulnerability assessments previously made (See Annex IV). Three Overviews presented information without geographical references. Two documents presented Hot-spot maps. In most cases brief justification was provided spot by spot (more extensive in few cases), in few ones critical spots were mentioned only within vulnerability analyses. In most cases the number of hot-spots correlates more or less with the length of national coastline, but in one or two documents the lists most probably were not exhaustive. No information was reported about existence of systematized Hot-spots Inventories. Therefore, the recommendations for proof-checking and further in-depth actions were repeated.

Comments. Future activities should focus on: (i) proof-checking and completing the lists; (ii) preparation of in-depth vulnerability analyses; (iii) systematized Hot-spots Inventories, including site by site justification; and (iv) identification of adaptation and mitigation measures for priority / most urgent cases. Co-ordinated regional actions are needed, to provide for common approaches, harmonized/compatible procedures, training, assistance, pilot actions.

6. Priority national needs and urgent actions

The needs identified reflect national potentials and achievements relevant for CC/Bd in m/c areas and m/c specific conditions. The needs common for all or for the majority of countries are: (i) upgrading the priority level of CC/Bd in national policies; (ii) upgrading/ updating legislation; (iii) provision of stable, regular and adequate funding; (iv) adoption and implementation of NS and NAPs on CC/Bd, also for m/c areas; (v) reducing gaps in knowledge through targeted monitoring and research; (vi) provision of compatible methodologies/ tools for research and monitoring; (vii) upgrading of institutional/professional capacities; establishment of monitoring stations, strengthening research capacities, improving co-ordination/interaction between ministries and research bodies; (viii) preparation of compatible Data bases and in-depth Hot-spot Inventories; (ix) strengthening international co-operation; establishment of regional/sub-regional networks of scientist and institutions; (x) intensified training and capacity building, assistance where requested; and (xi) establishment of new PAs and MPAs.

Monitoring and research, due to the complexity of respective problems, a number of proposals for consistent programmes were provided: (i) studies to include primarily all critical habitats, communities and phenomena (wetlands, deltas, estuaries, lagoons, submerged/ semisubmerged caves, islands and islets, Posidonia beds, coralligenous, endemic and autochthonous species, endangered species, karst, forestry, etc.); (ii) monitoring of and research on hydrographic / hydrodynamic / climatic measurements to validate existing and forthcoming models; (iii) coastline monitoring and assessment of erosion/desertification vulnerability and risks; (iv) monitoring of selected benthic / nektonic / planktonic species / habitats; (v) monitoring, research on spread/impacts of NIS; (vi) basic research on the biology of CC vulnerable species; (vii) monitoring/studies on ecosystems resilience, adaptive capacity and critical factors, including simultaneous impacts of all stressors; (viii) studies on non-linear responses of littoral ecosystems to CC, and population-to-ecosystem links (functional approach); and (ix) development of predictive modelling tools, under different scenarios, including down-scaling.

Urgent actions. A number of actions proposed is country specific, the majority refers to needs identified, for same

type of actions with country dependent differing levels and details. The regional or wider international involvement was requested, also for prerequisites to be met (reference documents, guidelines, methodology, capacity building, training, assistance, equipment). The findings presented might be considered as a very good base for further national actions – preparation of NS and NAPS, sensibilizing DMs, upgrading priority level, funding, integration into national planning, and prioritizing and design of urgent actions concerning critical areas, habitats, species, etc. As part of follow-up programme, proof-checking and in-depth elaboration (justification in particular), were recommended.

Comments. The analysis indicates that some lists might be not exhaustive. Further actions should provide for proof-checking and for assertion of status and problems perhaps not adequately emphasized, such as: (i) policy issues, level of priority of CC/Bd in m/c areas in national policies, sensibilization of high level DMs; (ii) integration of needed measures into national planning systems and practices, ICZM included; (iii) impacts on Bd in karstic areas; (iv) sectoral aspects: Mediterranean forestry, agriculture, water resources; (v) socio-economic impacts, economic valuation of Bd and ecosystem services; and (vi) phenomena related to consequences of reduced precipitation. At regional level, needs for harmonization, co-operation, joint actions, capacity building and training, assistance, should be considered.

As top priorities, the following should be considered by all countries and at regional level: (i) all actions concerning upgrading CC/Bd issues as national priority, sensibilizing DMs, provision of adequate, stable and regular national funding; (ii) setting base for monitoring and research programmes; (iii) preparation of Databases and Hot-spots Inventories; (iv) elaboration and implementation of adaptation / mitigation measures; (v) pilot actions on issues of common interest, (vi) capacity building and training; (vii) integration in national planning, ICZM as framework; and (viii) actions for most critical areas (Nile delta, others...).

7. Funding sources and constraints

Detailed information was provided on actual and potential funding sources, levels, limitations and problems. Wide differences were reported on sources, level of funding vs. needs, due to different national potentials, status and present initiatives.

The national funding sources for CC/Bd, common for all countries, are: (i) national budgets (Ministries, State Agencies, ...); (ii) National (Environment of similar) Funds; (iii) national research funds; (iv) national counterpart contribution for international projects; and (v) funds provided by local authorities.

The private funding is not realistic for all but two or three countries.

The external sources utilized so far by almost all or some countries (pending eligibility and membership) are: (i) UN Agencies' projects (WB, GEF, UNDP, UNEP/MAP, UNDESA,...); (ii) donor countries and/or respective funds for international development: Austria, Canada, Netherlands, France, Italy, Monaco, Norway, Spain, Sweden, UK, USA); (iii) EU programmes and funds (LIFE, PHARE, INTERREG, CARDS, IPA, FP 7, SMAP, EEA); and (iv) regional or other specific bodies, associations or funds: ALESCO, ISESCO, development banks (EBRD, ADB, IDB), international organizations (WWF, IUCN, MedWet, MEDMARAVIS, MED COAST, others); (v) sources allocated through bi-lateral agreements.

Other reference documents on funding sources. In addition to information provided by national Overviews, other documents on funding sources, procedures and practices are also available, such as: the RAC/SPA document (UNEP(DEPI)/MED WG.292/Inf.5, 2006); information on EU funding sources for targeted research (Eu 6th FP on Climate impacts – Co-ordinated research for a larger Europe; EF7-ENV-2009-; Programme Adaptation to CC, 2007; also on IPA, SAPARD, INTERREG ...); others.

Comments. All documents concur about: (i) the funding level being far below needs, and below actual research capacities of the predominant part of countries; (ii) the situation being consequence of the actual low level of priority of CC/Bd m/c and of quality of information and sensibilization of DMs; (iii) the international/external funding being the major or in some cases the only realistic opportunity; and (iv) the role of international projects as funding source and capacity building.

Among many country specific funding sources, a number of them might be of interest for and/or replicative in other countries or at regional level. Differences between sub-regions / Clusters on funding aspects (present levels

of funding, accessibility to EU funds, or other specific sources, needs, capacities, others), and similarity of conditions within each of them (similar or identical needs, level and type of support needed, assistance, eligibility) should be kept in mind when defining approaches for follow up. Several documents emphasized the need for regional action, improved information on funding opportunities, assistance, and upgrading experts' capacity for formulation of international projects.

8. Conclusions and Recommendations

8.1 Conclusions

General assessments. Despite gaps in knowledge and problems of monitoring and research, there is a general consensus on: (i) the CC as an occurring phenomenon, with little or no evidence about reducing or control of drivers; (ii) seriousness of impacts, some already irreversible, other dependant on timely reduction of GHG emissions and implementation of adaptive measures; (iii) need for implementation of urgent actions based on existing knowledge.

Concerning the Mediterranean, the key facts are: (i) the region is among the richest in Bd of global importance, rich with endemism and autochthonous species; (ii) Bd is rapidly declining, due to land-use change and other anthropogenic impacts, climate change, invasive species, overexploitation and pollution; (iii) a great number of globally important habitats, populations, species is already endangered, many species under risk of extinction; (iv) the nature, value and level of actual ecosystem services rendered by regional biodiversity is of paramount importance for the resident population and respective national economies; (v) the expected CC/Bd impacts, those in m/c areas in particular, if not timely and appropriately dealt with, will result with negative effects to intensify with rates and amounts of change, with further reduction of resilience to changes, and an increasing and intensifying loss of Bd, resulting with a high reduction of the value of rendered ecosystem services; and (vi) improved co-ordination across sectors and integrated management across scales are urgently needed.

The national needs identified and urgent actions proposed are of differing nature, at various levels, most mutually interdependent, many in fact prerequisites for the subsequent key ones. Also, the regional, international and national contexts (for monitoring and research in particular) have to be kept in mind.

Key findings of primary interest for DMs are as follows: (i) the CC is occurring, with most serious consequences, some impacts are already irreversible, others impacts dependent on timely reduction of GHGs and implementation of adaptation measures; (ii) the consequences at regional and national levels, in particular in case of no action, will be very serious, in cases catastrophic for biodiversity, the local, national and regional environment, economy and development, and for the resident population; (iii) the present situation related to CC/Bd in m/c areas is critical and absolutely inadequate with regard to the extent and gravity of incoming consequences and impacts; (iv) urgent actions, consistent, harmonized, comprehensive and adequately funded are needed, at all levels; (v) sub-regional and multi- bilateral co-operation, international projects; for a number of countries assistance, and external funding are needed; and (vi) despite the actual limitations, findings and recommendations provided by the present action are a good basis for defining and start of the follow-up within SAP/BIO.

Needs of regional importance. Among a large number of needs identified at national level, the following require particular attention due to their wider and/or regional aspects:

- i. wider international co-operation, also regional, multi-lateral and/or bi-lateral ones; countries with higher economic and institutional potential primarily aiming at strengthened, concerted, comprehensive and efficient actions; for other countries such co-operation is a must, due to the need for assistance and capacity building, also as the predominant funding source;
- ii. integration of CC/Bd in m/c areas into national planning and management practices with ICZM as a broader framework and tool, has been emphasized by the Overviews of all 11 countries having implemented so far the MAP CAMP projects;
- iii. the need for further MAP RAC/SPA involvement, guidance and assistance, looking for regional or sub-regional initiatives, strengthening Center's capacities if needed and as appropriate, were emphasized by all national documents.

Prerequisites to be met. A number of prerequisites for the formulation and start of a comprehensive, concerted,

and efficient programme of actions are still not met or are met partially only. This is valid in particular to: status of CC/Bd in c/m areas in national policy agendas; sound stable funding; information available; targeted research; monitoring; institutional and technical capacity and expertise; inventory of hot-spots; ranking priorities; raising public awareness and influencing decision makers. Actions needed to meet these prerequisites are listed below (being understood that their implementation should not postpone the most urgent short term actions based on actual knowledge):

- i. Public awareness, influencing DMs, putting CC/Bd at higher national priority level.
- ii. Provision of arguments to upgrade policy ranking: well justified documents on: (a) the social, cultural and economic benefits of Bd and ecosystem conservation; (b) valuation of rendered ecosystem services; (c) socio-economic analyses, including importance and role of biodiversity as development resource; (d) selected CBAs; and (e) representative and replicable pilot actions.
- iii. Adequate funding of CC/Bd related activities.
- iv. Data and scientific information. A systematized and user friendly information exchange system (CHM), updateable and with free public access; also, practical actions on exchange of information, harmonized national database systems; assistance as requested.
- v. Provision of technical means and equipment needed for studies on CC/Bd
- vi. Filling gaps in knowledge, reducing uncertainties: formulation, planning creating conditions for targeted research, to develop adequate research lines addressing gaps in knowledge.
- vii. Monitoring: training and capacity building; provision of technical equipment; development of broader monitoring schemes at spatial and temporal levels, focused on CC/Bd; concerted actions at regional level, implementation of multi-lateral programmes.
- viii. Improving evidence and systematizing actual knowledge on vulnerability and hot-spots: proof-checking, Hot-spots Inventories including justification, systematizing and priority ranking.
- ix. Comprehensive, harmonized and prioritized planning: a. adaptation planning of CC impacts in general, CC/BD in particular; integrated into national and local planning systems and practices; b. cross-sectoral interlinkages; c. for m/c areas, interlinkages with ICZM processes and planning, the action to benefit from MAP, notably RAC\SPA and PAPI\ RAC experience; d. representative and replicable pilot actions.
- x. In-depth awareness and training of specialists on CC\Bd, targeted primarily at biologists in ministries and national /local bodies for environment protection and nature conservation and management.

8.2. Recommendations

Taking into account the findings presented, the following actions are recommended, primarily for regional level:

- To provide for the best use of National Overviews and Regional Synthesis: dissemination, proof-checking, feedback.
- Public awareness, influencing decision makers, upgrading CC/Bd as high priority in national agendas: a concerted action.
- Scientific knowledge: regional database, national databases on CC, CC/Bd also in m/c areas: framework design, establishment, replicable pilot actions.
- Justification for adequate national funding of CC/Bd activities: (a) valuation of costs for actions compared with damage in case of non-action; (b) valuation of ecosystem services rendered; (c) assessment of significance and role of biodiversity as development resource; (d) representative CBAs; and (e) pilot actions for selected critical areas.
- National Inventories of Hot-spots in coastal and marine areas: framework design; training at regional level; creation of prerequisites at national levels; Hot-spot Inventories; pilot actions.
- Monitoring: an Inception document; initial meeting of regional experts; enlargement and adaptation of existing monitoring initiatives by including the CC and CC/Bd component, looking for synergies with relevant EU programmes.
- Research: establishment of a regional group of experts on CC/Bd research; a reference document for Inception meeting; Inception meeting, to set up the bases for research programme.
- Incorporating CC/Bd c/m issues in planning practices: reference document (framework criteria, good practices,

methodologies and examples); regional meeting to discuss problems and set basis for further actions; training at appropriate levels; pilot actions.

- Strengthening ecosystems resilience: increasing MPAs connectivity; reinforcing legislation on coastal land use (adapting to predictions of CC impacts); actions to reduce pollution and other anthropogenic pressures on most critical areas.
- Reinforcement of legal / institutional frameworks: regional, national actions as appropriate.
- Capacity building and training: implement regional training / capacity building programmes.
- Co-operation: regional document (good practices and problems); training document(s); training at appropriate levels; assistance where requested.
- Funding: supporting documents and a general informative document: prepared and disseminated to target groups; CC/Bd topics included in the programme of the envisaged SAP/BIO Donors Conference.
- RAC/SPA capacity for CC/Bd in m/c areas: analysis of the present RAC/SPA capacity to implement the recommended actions; strengthening of Center's capacities as appropriate, including provision of the needed funds.
- Planning, design and implementation of research, monitoring, recommended programmes and of concrete mitigation / adaptation measures:
 - a. National CC and CC/Bd Strategies and Action Plans (m/c areas included) to be prepared (revised or updated where existent), and adopted;
 - b. practical actions planned, designed and implemented: the urgent actions, based on actual knowledge; short-term actions, urgent and those aiming at achievement of tangible results within a short time span, pilot actions included; medium-term projects, programmes and actions;
 - c. permanent systems of national progress monitoring of, reporting on, and updating the CC/Bd strategies and plans – to be established and made operational.

A more detailed description of recommended actions is given in the main body of the document.

INTRODUCTORY NOTE

The present document has been produced as part of the RAC/SPA action to update the „Strategic Action Programme for the Conservation of Biological Diversity in the Mediterranean Region” (SAP BIO), with reference to expected impacts of climate change to biodiversity (hereafter CC/Bd).

The action was implemented in accordance with the “Outline for the SAP BIO Operational Plan for the 2008-09 biennium” as presented to the 8th meeting of National Focal Points for Specially Protected Areas, held in Palermo on 6-9 June 2007 (UNEP(DEPI)MED WG.308/14, Annex V). The action also aims to contribute to the objectives of the Almería Declaration by providing an insight on state of knowledge and actions concerning impacts of Climate Change on marine and coastal biodiversity, as well as to serve as input when defining future activities on CC with regard to the protection of biodiversity within the framework of SAP BIO, RAC/SPA and MAP.

The approach and methodology applied for the action were defined at the Inception meeting held in Tunis, on April 11-12, 2008. A short description presented in the subsequent chapter.

Details of activities implemented, experts involved and outputs produced are provided in respective Annexes to the present document.

The present document synthesizes the findings presented by National Overviews prepared for the participating countries, and those presented by the three Cluster (Sub-regional) Syntheses Reports, as well as of findings of respective Cluster (Sub-regional) Working Meetings and of the concluding Regional Working Meeting. In addition, a large number of reference documents (some commissioned by RAC/SPA for the purpose of the action), were consulted.

Due to conditions and methodology determining their preparation, the National Overviews should be considered as respective authors' expert opinions, unless and until confirmed by national responsible, i.e. NFPs for RAC/SPA. The Conclusions and Recommendations presented in Chapter 7. are based on results of all action's activities, in particular taking into account the outputs of the Regional Working meeting, held in Vibo Valentia (Italy) on October 11-12, 2008 (see Annexes I. and II.).

The present document was drafted by Arsen Pavasovic, RAC/SPA international consultant. The draft was revised by participating authors: Daniel Cebrian, Atef Limam, Sami Ben Hadj and Jose Garcia Charton, providing comments and proposals for amendments. The final version was prepared by Arsen Pavasovic and the editing made by RAC/SPA.

Mr Daniel Cebrian, the RAC/SPA Programme Officer, was the overall responsible for the action, also providing guidance, co-ordination and harmonisation of activities and actors, assisted by Mr. Atef Limam, RAC/SPA international consultant.

Preparatory activities. The objectives, approaches and methodological framework of the present action were defined by RAC/SPA, and discussed and finalized at the Inception meeting, held in Tunis on April 11-12, 2008.

Approaches. A number of considerations were taken into account, in particular:

- the complex, multidisciplinary and multi-sectoral nature of the action, issues related to: climate change, biodiversity, marine and coastal areas; integrated coastal zone management; monitoring, research, planning, socio-economic and cultural aspects, etc.;
- the Mediterranean context, including: sub-regional differences; multi-level aspects (regional, sub-regional, national, sub-national); available knowledge; problems of and interlinkages among on-going and needed monitoring activities, same for research; hitherto implemented and on-going CC related activities; international Conventions and commitments (CBD, Basel Convention, UNFCCC, EU directives, etc.); harmonization with and interlinkages among key international actors; national aspects (economic potentials, institutional and human capacities); information and awareness of scientists, professionals, of national responsible, of general public; level of national priority; legislation; planning and management practices);
- the UNEP/MAP, RAC/SPA and SAP/BIO context, actions and experiences, actions on-going and in preparation by other UN Agencies and international bodies;
- the need for an interactive participatory approach; and
- the need for a realistic approach when defining the methodology and plan of action.

The objectives of the action were defined as follows:

- to update SAP/BIO on issues related to impacts of climate change on biodiversity in Mediterranean marine and coastal areas;
- to contribute to objectives set up by the Almeria Declaration as adopted by the 15th OMCPs (UNEP(DEPI) MED IG.17/10, 2008);
- to set up the basis for respective activities of SAP/BIO, in accordance with the Outline for the SAP/BIO Operational Plan for the 2008-09 biennium (UNEP(DEPI)MED WG.308/14, Annex V); and
- a final Synthesis Document and an respective Appendix to SAP/BIO to be prepared, to present the outcomes of the action.

The key outputs. As key deliverable outputs the following ones were envisaged: (i) documents on available relevant international scientific and technical knowledge, to be committed by RAC/SPA and distributed to all involved; (ii) National Overviews; (iii) Cluster (Sub-regional) Syntheses of National Overviews; (iv) Cluster Working Meetings' Reports and Regional Working Meeting Report; and (v) The Regional Synthesis and the resulting Appendix to SAP/BIO.

Defining Overviews. Taking into account the technical and programmatic limitations, the National Overviews are considered as authors' expert opinions, requiring implementation of an interactive participatory approach (see below), with proof-checking and updating during follow up. In order to provide for harmonization of Overviews, and facilitate their synthesizing, Annotated Contents for National Overviews were prepared (RAC/SPA Ann. Conts. Overviews, 2008). The key issues requested to be elaborated at national level were: (i) analysis of available scientific information presented by RAC/SPA, identification of additional ones, national primarily, and critical analysis; (ii) survey of national activities; (iii) vulnerability, impacts, and hot-spots; (iv) priority needs and actions; (v) funding issues, and (vi) conclusions and recommendations.

The General plan of activities was defined as presented in **Box I**.

Box I: General plan of activities

- i. Preliminary RAC/SPA activities: to prepare inputs for the Inception Meeting, identify international consultants, provide for key available reference documents.
- ii. Inception meeting, to define: approaches; objectives; action design; participants and their role; interactions/linkages; the participatory component; implementation scheme – Clusters; plan and time table of activities; Annotated Contents for National Overviews.
- iii. Preparation of National Overviews: national experts – identification, nomination by NFPs; drafting of National Overviews, assistance provided by RAC/SPA and international consultants; presentation of finalized documents.
- iv. Drafting of Cluster (sub-regional) Syntheses by respective international consultants.
- v. Cluster (sub-regional) meetings, to present/discuss draft Overviews, to formulate Cluster Conclusions and Recommendations.
- vi. Preparation of final versions of Overviews and Syntheses.
- vii. Regional meeting to discuss Overviews and Syntheses, and draft Conclusions and Recommendations for the Regional Synthesis and for the Appendix to SAPBIO.
- viii. Preparation of a Regional Synthesis document and of the Appendix to SAP BIO.

Time table. A provisional time table was discussed, with the aim of concluding all activities by the end of 2008, to be updated during implementation, if needed and as appropriate.

Participation. All Mediterranean riparian countries in their role of Contracting Parties to the Barcelona Convention were invited to participate. Out of 21 Contracting Parties, 18 of them actively participated: Albania, Algeria, Bosnia & Herzegovina, Croatia, Cyprus, Egypt, Greece, Israel, Italy, Lebanon, Malta, Montenegro, Morocco, Slovenia, Syria, Spain, Tunisia and Turkey. For reasons out of competence of RAC/SPA, France, Monaco and Libya were not participating. Out of 18 participating countries, for Cyprus an informative document was prepared (UNEP/MAP RAC/SPA, 2008a), instead of the Overview, with national experts' contributions during the respective Cluster meeting. It should be noted that Cyprus recently prepared a document on national biodiversity concerns as part of the implemented Cyprus MAP CAMP project (UNEP – MAP RAC/SPA, 2007), the document having been also consulted.

Defining Clusters. The action was implemented in 3 Clusters:

- Cluster A: the Adriatic, where a full sub-regional approach could be applied, including: the Italian Adriatic coast, Slovenia, Croatia, Bosnia & Herzegovina, Montenegro and Albania;
- Cluster B: North and East non-Adriatic countries, Israel and Turkey, including: Spain, Italy (except the Adriatic coast), Malta, Greece, Turkey, Cyprus, and Israel;
- Cluster C: North African and Middle-East Mediterranean countries, including: Morocco, Algeria, Tunisia, Egypt, Lebanon and Syria.

Each Cluster group was assisted by one international consultant, providing information, consultation and guidance concerning harmonization and comprehensiveness of outputs.

The interactive participatory approach. A bottom-up interactive approach was applied. National consultants/experts were recruited after consultations with national responsible and nominated by NFPs for SPAs. RAC/SPA and one international consultant responsible per each Cluster assisted the national authors by providing guidance and harmonization, as well as in-depth information on the action, and on their expected role and contribution. To assure a more comprehensive coverage of key issues, authors were invited to contact, inform and consult: (i) national experts reputed in issues/sectors others than those mastered by themselves; (ii) the responsible national

bodies and NFPs; and (iii) to ask responsible national bodies for comments on and approval of the prepared documents.

Such an approach resulted with involvement of and contributions by a considerable number of scientists, experts and responsible, providing thus for as comprehensive as possible information, identification of problems and needs, and formulation of recommendations and proposals. All authors participated at Cluster meetings, exchanging information and experiences, and providing additional contribution and advice. The majority of Overviews were so far confirmed by responsible national bodies, the fact not excluding the need for their further proof-checking and updating as part of follow-up (see also Annexes I, II, and III.).



Figure 1: An interactive participatory approach involving the authors of the national, subregional and synthesis overviews, who participated to three sub-regional meetings and a regional working meeting. A) the Cluster A meeting (Adriatic Sub-region): Split, Croatia, 23-24 October 2008), B) the Cluster C meeting (Middle East and North Africa): Tunis, Tunisia, 28-29 October 2008), C) the Cluster B (Mediterranean European countries and Israel): Santa Pola - Nueva Tabarca Island - Spain, 9-13 Novembre 2008, D) the regional working meeting was held at the Cooperativa Nautilus premises (Vibo Valentia, Italy) on 11 and 12 December 2008. Photos by A. Limam.

LIST OF ACRONYMS AND ABBREVIATIONS

ALECSO	The Arab League Economic, Cultural and Scientific Organization
Ann. Conts.	Annotated Contents
Ann. Prec.	Annual Precipitation
AP(s)	Action Plan(s)
APAL	National Agency for Coastal Management (Tun.)
APD	Public Development Agency (Tun.)
approx.	approximation, approximately
Bd	Biodiversity
BD NSAP	Biodiversity National Strategic Action Plan
B&H	Bosnia and Herzegovina
CAMP	MAP Coastal Areas Management Programme
CARDS	Community Assistance for Reconstruction, Development and Stabilization, EU programme
CBA	Cost-Benefit Analysis
CBD	Convention on Biological Diversity
CC	Climate Change
CC/Bd	Impacts of Climate Change on Biodiversity
CC/Bd m/c	Impacts of Climate Change on Biodiversity in marine and coastal areas
CCCPMs	EU Climate Change Co-ordinated Policies and Measures
CDM	Clean Development Mechanisms
CFEEE	Croatian fund for Environment and Energy Efficiency
CHM	Clearing House Mechanisms
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
COAST	GEF/UNDP - Croatian Project „Conservation and Sustainable Use of Biodiversity in the Dalmatian Coast through Greening Coastal Development”
COST/ESF	One of funding programmes of the European Science Federation
DB	Database
DFID UK	The UK Government Department for International Development.
DMs	Decision Makers
DMS	Dimethyl Sulphide
ECNC	European Center for Nature Conservation
EEA	European Environment Agency
EMERALD	Bern Convention Ecological Network of Areas of Special Conservation Interest (ASCI), for EU identical as NATURA 2000
ENDA Maghreb	International NGO, Environment / Development, Morocco
ENEA	National Agency for New Technologies, Energy and Environment, Italy
ENI	Ente Nazionale Idrocarburi, Italian Agency for Hydrocarbon Resources
EPA	Environment Protection Agency (Montenegro, Slovenia)
EPBRS	European Platform for Biodiversity Research Strategy
ESF	European Science Federation
EU	European Union
EU MS	European Union Member State
FFEM	The French Fund for Global Environment
FIRB	Fund for Investments for Basic Research, It.
FISR	Special Integrative Research Fund, Italy
FP 6, 7	EC Framework Programme 6, 7
GDP	Gross Domestic Product

GEF	Global Environment Facility
GHGs	Green-house Gasses
GNP	Gross National Product
HA(s)	Humid Area(s)
HAB(s)	Harmful Algae Bloom(s)
HDR	UNDP Human Development Report 2007/2008 - „Fighting CC”
ICM	Integrated Coastal Management
ICRD	International Center for Research and Development, Canada
ICZM	Integrated Coastal Zone Management
IFAW	International Fund for Animal Welfare
IG	Inter-governmental
INAT	The Tunisian National Agronomic Institute
INSTM	National Institute of Marine Sciences and Technologies, Tunisia
INTERREG (III C)	Programme on Co-operation among Eu Regions, part of EU Co-operation objective
IPA	Instrument for Pre-accession Assistance, EU
IPCC	Intergovernmental Panel on Climate Change
ISESCO	Islamic Socio-economic, Scientific and Cultural Organization
IUCN	International Union for the Conservation of Nature
IWRM	Integrated Water Resource Management
LBSP	Land-Based Sources of Pollution
LME	Large Marine Ecosystems
MAP	Mediterranean Action Plan
MATTM	Ministry for Environment and Protection of Territory and Sea, Italy
M&B	Man and Biosphere Programme, UNESCO
m/c	marine and coastal (areas)
MEA	Millennium Ecosystem Assessment
Med.	Mediterranean
MEDU	The Co-ordinating Unit of MAP, Athens
MED POL	The Programme for the Assessment and Control of Marine Pollution in the Mediterranean sea, MAP-UNEP
MedWet	UNDP Regional Programme for Conservation of Wetlands Biodiversity
MEN	Marine Ecological Network
MEPPPC	Ministry for Environment Protection, Physical Planning and Construction, Cro.
MESP	Ministry for Environment and Spatial Planning, Slovenia
MHS	Meteorological and Hydrological Service of the Republic of Croatia
Mn.	Montenegro
MOE	Ministry of Environment
MoEFWA	Ministry for Environment, Forests and Water Administration, Albania
MPA(s)	Marine Protected Area(s)
MTR	Mean Temperature Rise
N	North
NAP(s)	National Action Plan(s)
Nat. Comm.	National Communication
NBLSAP	National Biodiversity and Landscape Strategic Action Plan, Croatia
NComm(s)	National Communication(s)
NCCAP	National Action Plan on CC
NCSA	National Capacity Self-Assessment UNDP/GEF/Mn. Project

NDA	National Diagnostic Analysis
NEAP	National Environment Action Plan
NEN	National Ecological Network, sites
NFP(s)	National Focal Point(s)
NIS	Non-Indigenous Species
NR(s)	National Report(s)
NS	National Strategy
NSGHG	National Strategy for Reduction of GHG Emissions, Slo.
NW	North – West
OMCPs	Ordinary Meeting of the Contracting Parties to the Barcelona Convention and its Related Protocols
PA(s)	Protected Area(s)
PHARE	Poland/Hungary Assistance for Restructuring Economic Programme
POP(s)	Permanent Organic Pollutant(s)
PRIN	Projects of Relevant National Interest, It.
RAC/SPA	MAP Regional Activity Centre for Specially Protected Areas
RAMSAR	International Convention on Wetlands, adopted in Ramsar (Iran) in 1975
RES	Renewable Energy Sources
SAP	Strategic Action Programme / Plan
SAPARD	The EU Special Programme of Pre-accession for Agriculture and Rural Development
SAP BIO	Strategic Action Programme for the Conservation of Biological Diversity in the Mediterranean Region
SCSR	Supreme Commission for Scientific Research
SEA	Strategic Environmental Assessment
SFRY	the ex Socialist Federative Republic of Yugoslavia
SINP	State Institute for Nature Protection, Croatia
SLR	Sea Level Rise
SMAP	The EU Short- and Medium-term Assistance Programme
SPA(s)	Specially Protected Area(s)
SPA/Bd Prot.	The Protocol on Specially Protected Areas and Biodiversity
STR	Sea Temperature Rise
TB	Transboundary
TBDA	Transboundary Diagnostic Analysis
TPBs	Poly-phenyl borates (Tri- phenyl-, Tetra phenyl-)
TR	Temperature rise
UN	United Nations
UNCCD	United Nations Convention on Combating Desertification
UNDP	United Nations Development Programme
UNDESA	United Nations Department for Socio Economic Affairs
UNEP	United Nations Environment Programme
UNESCO	The United Nations Economic, Social and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
WB	The World Bank
WCMC	World Conservation Monitoring Centre (UNEP)
WG	Working Group
WFD	Water Frame Directive
WRM	Water Resource Management
WWF	Wildlife World Fund

I. THE CONTEXT

Key topics. As introduction, few citations on key topics relevant for this action and for the present document are given in **Box 2**.

Box 2: Biodiversity, vulnerability, hot-spots, climate change, awareness ...

UNEPWCMC, 2003:

„The Biodiversity of ecosystems is important in its own right, in its contribution to the services we expect of ecosystems, and for the spiritual needs of people.”

„Vulnerability, or the potential for harm can be assessed as a function of exposure to change, ecosystem sensitivity and the adaptive capacity of both people and biodiversity ... Vulnerability information ... to guide stakeholder approaches to understanding future for ecosystem services, coping mechanism and interactions and facilitate sustainable management.”

„Hotspots occupy less than 2% of land area, but hold 44% of plant and 35% of vertebrate species potential for species loss is high ... with narrow habitat breadth and low migration, the rate of species loss in the models approach those seen with tropical deforestation...”

„ ... most conservation biologists not aware of the impacts of climate change” (Conference Synthesis and Outlook).

Millennium Ecosystem Assessment, 2005:

„Climate change is likely to become the dominant direct driver of biodiversity loss by the end of the century. Climate change exercises already strong negative impacts, by shifting habitats, changing natural conditions and life cycles, developing new physical traits and inducing species die-offs and extinction. ...” harm will grow with increasing rates in change and absolute amounts of change... some ecosystem services in some regions may initially benefit ... but there will be a significant net harmful impact if the global mean surface temperature increase more than 2 deg C above pre-industrial level ...” ...Urgent and consistent actions at all levels are needed on or allow for protection, mitigation and adaptation of species, habitats, populations and ecosystems within changing conditions.”

The Mediterranean region hosts 21 riparian states, with widely different national characteristics, all Contracting parties to the Barcelona Convention. The region is characterized by high geo-political and socio-economic heterogeneity and differences related to institutional, scientific and technical potential, capacities and expertise. As illustration, it might be mentioned the 10-fold difference in GDP between most developed countries and those less developed, and the 3-6-fold difference of GNP per capita between W European countries and the other ones (WWF, 2005). In addition, different demographic trends and growth rate strongly influence development outlook and policy approaches. Some data on riparian states, of interest for this action are given in **Box 3**.

Country	Population (mln)	GNP, (nom. \$/capita)	Coastline length (km)	Some specific features of interest for the project
Albania	3.6	2.130	476	Rich in Bd and endemism; wetlands; karst; a number of endangered habitats, high losses occurring, 247 lakes – 94 karstic; 1 small island, ...
Algeria	33.8	3.900	1.557	Rich in Bd- 3.900 species. An extensive list of sensible m/c areas, Reghaia wetlands, Habibas and Aguel islands, Rachgoun island, ...
Bosnia & Herzegovina	4 (approx.)	1.800 (approx.)	21	Large inland coastal area, karst, Med. forest few reefs (**)
Croatia	4.7	7.600	5.840	Jabuka pit, E Adriatic pit, karst, Velebit, high endemism, 79 islands, 525 islets, 642 reefs, third per c. length, ...
Cyprus (EU MS)	0.8	27.000	782	Island state. Long beach areas, rocky c. areas; m. areas very rich in Bd, nursery, shelter areas; Paphos, S. Larnaka areas; forests, endemics ...
Egypt	75.5	1.740	900	Nile delta, humid areas and lagoons; SLR – Nile delta flooding; ! population at high risk !
France(*)	64.5	42.300	1.703	
Greece (EU MS)	11.2	28.150	16.500	Rhodes, Crete, more than 1.000 islands, bays, estuaries, first per coastline length, ...
Italy (EU MS)	59.7	37.750	7.375	Po watershed and estuary, lagoons, wetlands, long low-laying coastal strips, karst; Sicily, Sardinia, several archipelagos, second per coastline length, ...
Israel	7.3	27.100	188	Sandstone cliffs 70 km, coastal aquifer, turtles nesting sites, flat sandy shores, Eilat fringes reef, ...
Lebanon	4,2	11.300	210	Coastal areas rich in Bd, small islands: Tripoli, Palmas islands, ...
Libya (*)	6.2	11.500	1.570	
Malta (EU MS)	0.4	20.750	253	Island state, Gozo, Comino, sand dunes, coastal wetlands, karst, high population density, aquifer lens, endemism, insularity, ...
Monaco (*)	0.3	70.670	4	
Montenegro	0.7	2.200	274	Kotor bay, Bojana estuary, Tivat salina, Med. forests, 3 islets, ...
Morocco	33.7		540	Lagoons: Nador, Smir; Mouloya inlet; Tetouan-Smi, Al Hoceima, Bou Aref, Saidia bays; Mdig, Reslinga Smir, Al Hoceima, other beaches, NPs, ...
Slovenia (EU MS)	2.0	16.000	46 (**)	Unique steep flysch cliffs, Secovje salina and NP, coastal wetlands, Skocjan inlet, birds' nesting sites, ...
Spain (EU MS)	45.3	30.100	2.580	Ebro, Llobregat Deltas; Manga del Mar Menor; Baleari islands with MPAs along their coasts; long beach areas, sand dunes; karst, ...
Syria	19.4	2.000	183	Bd rich coastal lowlands, small islands: Arwad, Al-Hbas, Al-Namil, Abo Ali, ...
Tunisia	10.1	4.000	1.400	Gulf of Gabes, Sfax, coastal areas rich in Bd, Kerkennah archipelagos, Kuria, Kneiss and Jerba islands; Mediterranean agriculture, olives, grape sorts..
Turkey	71.9	11.500	1.595	Karst, 30% of species are endemic, a rich coast, bays, wetlands, a great number of islands, islets, ...

The Mediterranean sea with a surface of 2.51 mil km² and a coastline length of 46.000 km – out of it 19.000 km (42%) on islands – has been recognized as one of the global biodiversity hot spots. While covering 1,5% of global surface, it hosts 7% of global marine fauna, 18% of marine flora (out of it 28% endemic), about 12.000 marine species, 600 fish species (out of it 81 cartilaginous ones), 3 turtle species, 12 whale species, 19 cetaceans/seals listed in Annex II. of the SPA Protocol as endangered, birds – 33 breeding wintering species (out of them 9 endangered), 13.000 marine endemic plants... It includes also a great number of globally important habitats: 150 wetlands registered as Ramsar sites, 81 coastal large/larger lagoons, dunes, thousands of islands, islets, reefs, long flat coastal stretches and sandy beaches, a very indented coastline... The marine areas are rich with beds of *Posidonia Oceanica*, calcareous algal rims, submarine caves. The species distribution is not homogenous, the Western area being richer than other ones (UNEP/MAP MEDPOL 2005).

From the hydrological point of view, the Mediterranean sea is divided in two deep basins, the western and the eastern one, separated by the threshold from Tunisia to Sicily; with water deficit compensated by the major marine influx through Gibraltar and Black Sea; connected through the Suez channel with the Red Sea. A number of marine subsystems/seas should be mentioned: Ligurian, Tyrrhenian, Ionian, Adriatic, Aegean, Levantine, large Southern marine areas – hydrologically it counts for a total of 11 sub-basins. Finally, the importance of the four big rivers Rhone, Ebro, Po, Nile, deltas, and of a number of smaller and small rivers should be taken kept into consideration.

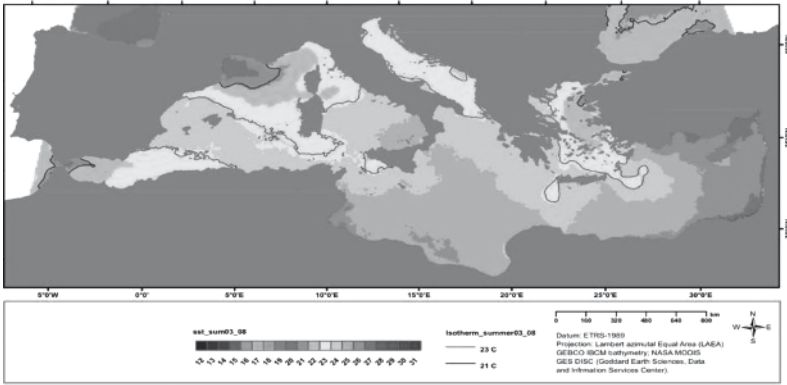
The coastal areas are also rich in diversity, with specific subsystems/areas: Adriatic as a semi-enclosed sea bordered by Apennines and Dinarides; the North Mediterranean Alpine Arc; the South Mediterranean mountain coastal areas of Morocco and Tunis; the flat coastal strips of Libya and Egypt, with immediate influence of deserts semi-arid and arid zones; the Aegean archipelago; the Middle Eastern Mediterranean coasts, etc.

Karst. A particular feature of Mediterranean coasts are the karst areas, their importance for and richness of Bd often underestimated and neglected, and particularly susceptible to expected decrease of annual precipitation, increased incidence of extreme events, unsustainable changes of land-use and pollution (see **Box 4.**)

The region's climate is the typical “Mediterranean”, sub-tropical and temperate one, with significant differences between the Northern and Southern coasts, with micro climates at down scale orders; also with large differences in precipitation and patterns and the resulting consequences. The climate is already under strong influence of CC, often presently defined as „climate variability”.* (see **Maps 1 and 2**).

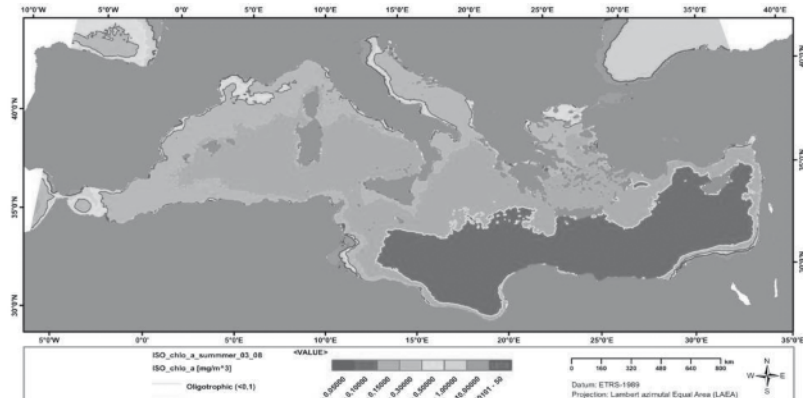
The Mediterranean ecosystem should be understood as a complex system composed by specific (sub-)systems: seas; islands and archipelagos; wetlands and lagoons, deltas, dunes; the Mediterranean forests, scrubs / maquis, relict forest micro areas; karst; high plains, long flat/low-land coastal strips, terraces with rubble walls, ... The regional ecosystem is characterized by limited resources not supporting over-exploitation. Here it should be kept in mind that in 2001 an ecological deficit was recorded in all riparian countries – the environmental capital being spent faster than it is renewed (MAP UNEP BP, Earthscan 2005)

* Unfortunately, since the CC phenomena and impacts are already registered and in fact occurring, „climate variability“ might not be accepted as a synonym for climate change.



Map 1: Sea Surface Temperature (SST) of the Mediterranean region (© RAC/SPA, by Requena Moreno, S., 2009)

Map 2: Sea Productivity in terms of Chlorophyll-*a* (Chlo-*a*) concentration of the Mediterranean region (© RAC/SPA, by Requena Moreno, S., 2009)



Box 4: Mediterranean karst, fragile, of global importance for biodiversity

Karst is characterized by presence of limestone or other soluble rocks, with drainage largely into subterranean. The karst ecosystems are fragile, interconnected and highly dependent on balance among relief, hydrology, vegetation, fauna and flora. Karst is characterized by two inorganic and two organic components: (i) the inorganic ones: soluble rock, and double layer stretches in hydrosphere, atmosphere and biosphere of the sub-terranean space; and (ii) organic: karst vegetation, and underground fauna and flora (Episodes, Vol.23, No.4. Dec 2000).

The Mediterranean karst is recognized as one of globally important types, due primarily to its specific phenomena and richness in biodiversity, endemism in particular. Karst is dominating along the Mediterranean coastal areas, with hilly stretches and coastal mountain chains.

Karst areas are abundant or occur in: Spain, southern France, Italy, Malta (Gozo as typical example), the Dinarides karst mountain chain along the coasts of Slovenia -Croatia – Bosnia & Herzegovina – and partly Montenegro, Albania (karst covering 23% of national surface, Ionian coastal area as example ...), Greece, Turkey, Lebanon, Israel, Tunisia, Morocco. (Ref. various scientific papers)...

The Dinarides chain might be considered as the most representative Mediterranean karst area, with some of the cave systems included in UNESCO M&B Programme, its forest system classified among 10 most important regional ones and included in the WWF Forests Hot-spot Initiative.

The richness of karst biodiversity might be illustrated f. ex. by the Croatian karst ecosystem registering 3.500 flora (283 endemic) species, 200 resident bird species, 36 reptile species, 79 mammal species, 69 freshwater (11 endemic) species, relict – troglodyte species ... (UNEP-MAP RAC/SPA,2008f).

Pollution of marine areas, still heavy in many hot-spots, is in particular due to industrial pollution; TPBs; urban waste and discharge of nutrients; heavy metals, POPs; maritime traffic pollution, etc. As consequence the region is „rich” with 101 pollution hot-spots registered by MED POL; with recorded eutrophication phenomena in 104 marine areas and lagoons, 27 out of them in 7 countries, registered as highly threatened; with 89 marine and freshwater species considered as endangered, included in Annex II. of the SPA Protocol.

Climate change – a grim prospective. The Mediterranean is recognized as one of regions most sensitive to CC. In addition, pollution, the increasing pressure of other human activities and unsustainable development further reduces the resilience and adaptability of ecosystems, habitats and biota related to occurring and future CC impacts.

The available reference documents, either at global or regional scale, some at national levels, provide figures on CC impacts for essential phenomena (temperature rise / TR, sea level rise / SLR, and change of annual precipitation), also more or less descriptive indications on a number of secondary impacts: droughts, heat waves, changes of water regimes, inundation / flooding, storm surge, erosion, wildfires, salt water intrusion, change of circulation pattern, earlier spring events, N-ward shifts in ranges in plant and animal species, invasion of alien species, all with further impacts on habitats, populations, species. Out of 75 studies on occurring impacts of CC analyzed by the IPCC Fourth Assessment Report, 89% are consistent with changes expected as response to global warming. (IPCC Fourth Report. 2007).

Unfortunately, even for the key figures, uncertainties are still many; the problem of consistency, reliability and homogeneity of data is visible in particular at lower levels; where impacts are subject to specific local phenomena and conditions.

The figures presented at the regional level by Brochier-Ramieri (2001), consistent with those of IPCC (2007) might be taken as basis for actual considerations. With the above accepted, the key impacts expected in the Mediterranean are presented in Box 5.

Concerning MTR, the rise will be higher in coastal hinterland areas than on coastal strips, more pronounced in summers, with heat waves as extremes. The SLR, will be critical for many flat or low laying coastal strips, wetlands, lagoons, deltas and estuaries, marshes and saltponds, islands, islets and reefs, submarine caves with fresh water influx; wetlands and areas with recorded land subsidence will be particularly affected. The reduced annual precipitation will result with hydrological deficit and affect firstly the actual hydrological regimes, also river watersheds and outlets, all karst areas, also submarine caves with freshwater influx, drying of soils in summers, ... Drought periods will be more frequent, more intensive and longer, but also diluvial rains. Combined with effects of SLR, reduced precipitation will induce salinization of coastal aquifers and wetlands, most of them with no retreat opportunities. Intensified droughts will induce more frequent forest fires. Desertification processes, occurring in arid/dry Mediterranean areas will be intensified.

The above should be taken into consideration within the context of different economic and human potential of riparian countries, as well as with overexploitation of resources, pollution and unsustainable coastal management; all to result with reduced resilience of ecosystems, habitats and species, and increased risks for a large number of already endangered species.

In addition to available information at regional scale, important data are available at sub-regional (W Mediterranean, Adriatic), and in most cases national scale – for details see f. ex. (METEO-FRANCE, CNRM/GMGEC); (UNDP: Human Development Report 2007/2008); (MAP RAC/SPA-Alb. 2008); (MAP RAC/SPA-It.a. and It.b. 2008), and practically each national Overview, (ECNC, Conf. Belgrade, 2008), etc. Nevertheless, all Overviews and Sub-regional Syntheses emphasized the lack of knowledge at sub-regional and national levels as one of critical problems.

The institutional framework of the present action is provided in **Box 6**.

Box 5: The Mediterranean – key impacts of Climate Change

For year 2025: MTR +1,0 up to +1,4 deg. C; SLR up to + 20 cm; Ann. Prec. – 4%

For year 2050: MTR +1,8 up to +2,0 deg. C; SLR +20 up to +24 cm; Ann. Prec. – 6%

For year 2100: MTR + 2,2 up to 4,9 °C; SLR +23 up to +70 (?100) cm;

Ann. Prec. – 4 up to -27% (with higher figures in N.African area and summers).

The temperature increase of +2,0 deg. C might be considered as threshold towards irreversible catastrophe; with 450 ppm CO₂ equiv. concentration of GHG there will be a 50% probability to limit the temperature increase to 2 deg. C; with 550 ppm CO₂ equiv. – 80% probability to break the threshold.

MTR – mean temperature rise; SLR – sea level rise; Ann. Prec. – Annual precipitation

Box 6: The institutional framework

The broader institutional framework for the implementation of this action, concerning impacts of climate change on biodiversity in Mediterranean marine and coastal areas, is the Mediterranean Action Plan (MAP), in this case with RAC/SPA as the responsible and implementing institution.

The legal international framework of MAP is the revised (1995) Convention for the Protection of the Mediterranean Sea against Pollution and its related Protocols, in this case the Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean and the Protocol on ICZM, adopted in 2008. Within the MAP context, the 2008 Almeria Declaration, adopted at the 15th OMCPs, includes important decisions concerning impacts of climate change on Mediterranean biodiversity (see Box 7). Other international Conventions concerning climate change and/or biodiversity (primarily the UNFCCC and CBD, some others too), are also relevant and of primary importance (see Box 9.).

Finally, the present action is implemented as part of the RAC/SPA SAP/BIO programme.

The SAP BIO Context. SAP/BIO, the Strategic Action Plan for the Conservation and Protection of Biodiversity in Mediterranean Coastal and Marine Areas was adopted by the Contracting Parties in 2004. The SAP/BIO document identifies impacts of climate change on biodiversity as one of key regional issues. The list of priority activities at regional level includes inter alia: (i) integrated inventory of sensitive habitats; (ii) monitoring of key impacts on biodiversity and marine and coastal PAs; (iii) effects of climate change on biodiversity.

It should be noted that most of the SAP/BIO National Reports and NAPs prepared during the 2002/2004 period at that time have not identified CC/Bd among national priorities, although some of NAPs included issues relevant for CC/Bd.

The Almeria Declaration. The issue of climate change impacts on biodiversity has been upgraded as a regional priority by the Almeria Declaration (2008), adopted by the 15th OMCPs in Almeria, Spain, see **Box 7**. (UNEP(DEPI) MED IG.17/10)

Box 7: Almeria Declaration, excerpts*Preamble:*

- environmental priorities changed over the decades ...
- environmental awareness not sufficiently translated into practical action ...
- environmental protection/preservation not sufficiently integrated into other policies ...
- the adaptation effort ... all countries requested, in order to reduce the impact of CC ...
- importance of capacity building, technology transfer, mobilization of financial resources ...
- need to strengthen regional, international co-operation within spirit/provisions of UNFCCC
- rapid rates of loss of biodiversity, continuing degeneration of m/c environment ...

Conclusions:

- problem of CC to be seriously addressed to reduce effects on Med. m/c environment ...
- early measures needed to mitigate effects ...
- strategies to include ecosystem approach, risk management, SEA and m/c ICZM ...

Decisions:

- to identify by 2011: the c/m species and habitats most sensitive to CC, and measures for the Med Network of MPAs ...
- to estimate values of products from services by marine and coastal ecosystems and the impacts by climate change ...
- CPs to present regular reports on progress made concerning climate change and effects on biodiversity for each OMCPs and to CBD ... ,,

National Overviews. As mentioned in the Introductory part - Methodology, in order to provide for an updated and as much as possible comprehensive insight and information, the national Overviews were prepared after authors' consultations with and informing of relevant national responsible and experts, and upon further identification of additional national and international reference documents. In fact, all national authors informed and consulted the responsible national Ministries, Agencies and officers (names of responsible officers listed in each Overview).

In addition, a large number of other national experts and professionals were consulted, in 16 documents a total of 190 consulted scientists/experts was listed. F. ex. the two Italian documents were prepared with co-authorship of 23 national scientists/experts plus 14 others listed, in case of Morocco 26 experts, Greece 15, etc.

A list of National Overviews prepared is presented in Annex II. So far, the predominant part of them was approved by respective NFPs.

Cluster (sub-regional) Syntheses and the Regional Synthesis. The three Cluster (sub-regional) Syntheses were prepared by the respective international consultants, on the basis of National Overviews and outcomes of Cluster Working Meetings (MAP RAC/SPA -CI. A Synth. 2008.; MAP RAC/SPA -CI. B Synth. 2008; MAP RAC/SPA -CI. C Synth. 2008). The regional Synthesis was prepared on the basis of National Overviews, Cluster Syntheses and the Outcomes of the Regional Working meeting

2. AVAILABLE INFORMATION AND SCIENTIFIC KNOWLEDGE

2.1. Reference documents and information available

For the needs of the action, RAC/SPA made available a number of relevant international documents and commissioned two reviews, to assist and update the authors of national Overviews. In addition, a large number of references were identified and consulted by national experts. Within 17 National Overviews prepared, more than 660 such references were listed, out of it about 15% international. All international documents and most of national ones were commented by authors.

The international documents provided a large amount of information at all levels. Among them, the IV-th IPCC Assessment Report should be considered as one of key ones, presenting the global perspective of CC impacts, emphasising general problems of low laying areas, islands and small islands, etc. These documents provided also additional extensive lists of references. Figures on impacts of CC on mean/sea temperature rise, sea level rise and annual precipitation (Brochier-Ramieri, 2001; Giannacopoulos et. al. 2005) and the results of global, regional and some lower level scenarios (f. ex. the Albanian National Scenario prepared within a GEF/Albanian project) were commented and used. High praise was expressed for the documents provided by RAC/SPA, in particular the commissioned ones (Perez 2008, Le Ravallec 2008).

The key references emphasized the problems of consistency, reliability and homogeneity of data, in particular at lower levels, where impacts are subject to local phenomena and conditions. While figures related to years 2025 and 2050 could be accepted as realistic (due to the fact the hitherto and present emissions of GHGs might be considered as irreversible), those for year 2100 will depend on rate and dynamics of future emissions. Figures for annual precipitation were reported to be considered as less reliable / homogenous than those for temperature rise, with some inconsistencies / contradictions at lower levels (Brochier et al. 2001). Finally, large variations of changes at lower levels and in particular at small horizontal scale might be expected

The impacts of CC and the resulting consequences expected in the Mediterranean region are presented in Ch. **I. Box 5**, using the data available and interpretations provided by Overviews and Cluster Syntheses.

National sources. The National Overviews identified and commented altogether a large number of national reference documents, reports and communications, among them National Reports to CBD, Communications to UNFCCC, regular national reports on state of environment, actual results of sectoral and thematic monitoring and research, studies concerning areas or species of high environmental and/or biodiversity importance, etc. As expected, the number of identified national documents and topics dealt with varied greatly from country to country, not only due to respective national capacities and potentials, but also due to authors' sectoral thematic profile. The second cause was remedied by consultations with other reputed national experts (as reported in all Overviews) and/or through involvement of a multi-disciplinary group of co-authors (f. ex. in the case of the two Italian Overviews).

Comments provided by national authors. All Overviews presented quite extensive and elaborated comments concerning available information and knowledge, included in a synthesised way in two subsequent subchapters. Although being presented from national points of view, the comments are by great majority relevant either for entire sub-regions or for a number of countries, and in many cases for all of them.

Need for further actions on identification of existing information and knowledge. Despite efforts made to identify relevant references, almost all Overviews emphasized the need for further systematic efforts to provide for establishing more exhaustive and comprehensive, updated and user-friendly information systems at national and lower levels. In such a case, the large number of national documents identified and commented so far will be a fair input for Information Databases, either at regional or national levels.

2.2. Actual knowledge and gaps in knowledge

Looking at global level and at the level of large marine ecosystems there is an extensive amount of information on climate change in general and in particular on issues related to GHGs (on GHGs in some cases also at national levels), most of them updated, consistent and with an acceptable level of reliability. Important references relate to general impacts of SRL, MTR, STR and precipitation. When looking for specific impacts of CC on biodiversity, information at general or regional levels are more limited, mostly documents within actions of CBD, UNEP, UNFCCC, MEA, EU. Still more limited are information concerning impacts of CC on biodiversity in marine and coastal areas. The same refers for issues related to vulnerability and adaptation/mitigation measures. Within a large number of important thematic reference documents related to PAs/MPAs, wetlands, habitats, the marine environment, etc., only a limited number refers to transversal issues (monitoring, targeted research, integration into planning and development, management, biodiversity valuation, ecosystem services...), still more limited on issues dealing directly with CC impacts on biodiversity in such environments. As exemption, a large number of sources dealing within the CC/Bd context on NIS, avifauna in some cases should be mentioned. It was noted that in several documents the Mediterranean region was identified as a hot spot for CC/Bd. Few sources only refer to wider framework of CC change impacts in biodiversity, such as priority level, integration into ICZM and national planning, funding aspects.

Finally an objection was raised a large number of papers being accessible after subscribing only.

At the Mediterranean level, a number of findings are similar to those valid for the global level, despite a number of region specific information, in particular through references provided / commissioned by RAC/SPA. The amount and in-depth level of information at sub-regional scale varies, the NW area being better and more deeply covered than the other ones. The general impacts of CC are presented in a number of documents; but the effects and impacts of CC on biodiversity in a limited number only. Biodiversity inventory at regional level is limited. References on regional aspects of CC/Bd in c/m areas are still more limited, often vague and scant; information on marine ecosystems limited in comparison with those on terrestrial systems. Biodiversity is usually treated in terms of species, less in terms of ecosystem functioning, valuation and services approach, with the risk of oversimplifying CC/Bd issues. A number of sources at regional level are focused at issues of transversal interest for CC/Bd in m/c areas, in particular those related to ICZM, maritime spatial planning, protected areas (PAP/RAC, RAC/SPA, BP/RAC, RAMSAR, CBD, EU INTERREG, etc. documents) – issues to be elaborated in subsequent chapters. Concerning the regional aspects of available knowledge, most Overviews agree that:

- despite the existing evidence of climate change impacts on biodiversity, the magnitude of Mediterranean marine biodiversity responses to climate change remain largely unknown; this due to (i) the lack of consistent long-term monitoring of Mediterranean marine biota and ecosystem processes; and (ii) the scarce information available on climate change impacts on marine organism physiology, population demography, reproduction, species distribution and ecosystem function;
- regional projections and scenarios might be used as approximations only when dealing at lower levels, downscaling is needed;
- nevertheless, as for the global level, the existing knowledge at regional level provides sufficient background for further actions within the SAP/BIO context.

References and knowledge at national level indicate an unevenly distribution of efforts and resulting achievements between countries:

- In most countries the level of scientific knowledge of CC impacts on marine and coastal biodiversity is reported to be low or very low, due mainly to the lack of monitoring, targeted research, institutional scientific capacities, technical expertise, national policies and priorities, and funding opportunities. The issue of climate change impact on biodiversity was not addressed at all in documents previous to year 2002 and is still poorly addressed in recent ones.
- Large gaps in knowledge at national levels are reported, concerning country specific impacts, critical areas,

habitats, populations; absence of systematized surveys on knowledge, of pertinent monitoring, of comprehensive Bd inventories.

- Absence of or insufficient national strategies or planning for research, monitoring and adaptation/mitigation measures.
- The documents available deal predominantly with issues related to GHG inventories and emissions, as obligations to UNFCCC.
- In a predominant number of countries there are no national documents dealing with CC/Bd issues and impacts, or only few of them at general level only; still less on CC/BD issues in m/c areas.
- Among reported problems: spatial and temporal limitations, scarcity/absence of long-term data series, uncertainties about cumulative effects of CC and other negative impacts, magnitude of impacts and response largely unknown,....
- In all countries the knowledge on CC/Bd vulnerability and measures is very limited.
- Part of available information is at level of approximation or outdated. Several documents refer about more information on terrestrial, less on c/m areas.
- There is a consensual conclusion that CC/Bd issues, in m/c areas in particular; are nor yet considered as priority in national agendas.

Despite the above, a more favourable situation is reported for several countries:

- Few Overviews refer about considerable but not exhaustive information on Bd in national c/m areas, with information on research (sectoral or species related predominantly) and monitoring (climate predominantly) only indirectly relevant for CC/Bd issues.
- For several developed and/or highly developed countries and EU member states the scientific knowledge, information and the technical 'know-how' to deal with CC research and issues is reported as of a high quality, as exemplified by the number of high-quality research papers published so far in scientific journals indexed in ISI (RAC/SPA, Synthesis, Cluster B, 2008). Nevertheless, for these countries as well, some Overviews reported: (i) the scarcity of long-term data series preventing design and implementation of effective management tools; (ii) uncertainty on cumulative effects of CC and other mostly anthropogenic impacts; need for further in-depth research on specific topics; (iii) research on CC/Bd limited to international projects; and (iv) national funds for CC/Bd research being far below actual needs.
- In a number of less developed countries important studies and projects were implemented with the assistance of or within projects implemented by international agencies, institutions or bodies, concerning either transversal or targeted issues (the UNDP project on National Scenario on impacts of CC for Albania, the Turkish UNDP CC scenario, models for two Gediz and Buyuk Menderes river basins, the Maltese studies on coastal erosion, f. ex.), reducing thus gaps in knowledge on important CC/Bd related issues.
- MAP implemented a number of studies on impacts of CC on selected m/c areas:
 - studies implemented by MEDU (deltas of Ebro, Rhone, Po and Nile; areas of Ichkeuil – Bizerte lakes, Thermaikos Gulf, Cres-Losinj islands; (Jeftic L. et al. 1992, Jeftic L. et al. 1996);
 - studies implemented within MAP CAMP Projects (CAMP Albanian coast, CAMP Kastela bay – Croatia, CAMP Rhodes Island – Greece, CAMP Syrian coast, CAMP Malta, CAMP Sfax – Tunisia, CAMP Alger – Algeria, CAMP Israel, CAMP Lebanon, CAMP Cyprus, and CAMP Slovenian Coast (references at <http://pap-thecoastcenter.org/>); and
 - as issues of transversal character: PAP/RAC documents on ICZM, coastal erosion, IWRM, maritime spatial planning; BP/RAC documents on prospective studies and futures; a large number of site / topic specific documents of RAC/SPA, on SPAs, MPAs, habitats, biota, ...

Here it might be noted that Overviews of almost all countries having implemented CAMP projects stressed the importance of ICZM as a wider management framework for CC/Bd in m/c areas.

International documents of importance for all levels. A number of documents important for all levels, dealing with wider aspects or of transversal interest for CC/Bd issues might be mentioned:

- among MAP documents: the Protocol on Mediterranean SPAs, and the ICZM Protocol; PAP/RAC documents on

ICZM, coastal erosion, IWRM, maritime spatial planning; BP/RAC documents on prospective studies and futures; a large number of site / topic specific documents of RAC/SPA: on SPAs, MPAs, Habitats, biota, Action Plans ...; MED POLTBDA for the Mediterranean sea 2005.; etc.....

- documents on integration of biodiversity issues into ICZM and national planning systems and practices, f. ex.: Principles and Guidelines to Incorporate Marine Protected Areas into Integrated Coastal and Ocean Management (CBD 2003); Principles and Guidelines for incorporating wetland issues into Integrated Coastal Zone Management (RAMSAR, 2004); and Handbook on Integrated Maritime Spatial Planning, from the INTERREG III. B PlanCoast Project (PlanCoast, 2008).

- large reference lists include a number of references generated within the framework of other international agencies and bodies: GEF, UNDP, CBD, Ramsar, MEA, EU and EEA documents and projects (as part of FP6, FP7, others), and international and national level web-sites.

2.3. Comments

The national Overviews and the respective Cluster syntheses identified, analyzed, and consulted a large number of scientific and technical documents, including those provided by RAC/SPA. The analyses made by all authors are concordant about the available knowledge being predominantly focused at general aspects of CC, are limited concerning CC/Bd, and very limited on CC/Bd in m/c areas, in particular at lower levels. In a number of participating countries the knowledge on CC/Bd and CC/Bd in national m/c areas is almost or at all non-existent. The same is valid for targeted monitoring and actual research as prerequisites. The comments are concordant that the available knowledge confirm the most serious consequences to be expected in the region, even assuming an effective future reduction of GHGs. The key expected impacts of CC have been already mentioned in Ch. 1; some additional information as emphasized by Cluster Syntheses and national documents are presented in **Box 8**.

Box 8: CC impacts, the grim prospective, more...

MAP RAC/SPA – Cluster C, Synth. 2008.:

Impacts expected in the region:

TR by 2100 – 1,8 up to 3,4°C, SLR by 2050 – 0,3 – 0,5m, by 2100 more than 1 m.

Consequences:

Loss of lowlands and beaches; coastal erosion; increased salinity of estuaries, wetlands and aquifers; intensification of extreme events; birds avifauna affected, dramatic loss of habitats of some endangered species; increased risk for monk seal and turtles, also marine meadows and phanerogames; changes of migration patterns, increased incidence of NIS and uncertain impacts on Bd; infrastructures affected; Among gaps of knowledge: uncertainties on impacts on habitats and m/c areas; absence on knowledge and expertise on vulnerability and mitigation, etc ...

Berry, 2008:

The Mediterranean ecosystems among the most vulnerable to CC in Europe, close to environmental limits (droughts, extreme events, wildfires, inundation,), ... the eastern Adriatic seaboard among the most affected, ... expansion of arid and semi-arid systems..., many ecosystems with low adapting capacity to be limited still more by land-use pressures and habitat fragmentation.

Between 60 and 80% of current species may not persist in Mediterranean under global MTR 1.8 °C. ... Endemic plants and vertebrate particularly vulnerable, distribution of a number of typical tree species to decrease...

Many ephemeral aquatic ecosystems projected to disappear and permanent ones to shrink and increase in salinity...

A number of marine mammals to be affected; temperature increase to trigger large scale disease-related mortality events of dolphins in Mediterranean, and seals across European marine areas, etc.

Among causes of the actual situation and actions needed to reduce identified gaps in knowledge, those most relevant presented by national documents were:

- international/regional information: relevant, useful, at general level, often repetitive;
- sub-regional and national specific information and knowledge: unevenly distributed, the best situation in EU MS; predominantly dealing with general impacts of CC and GHGs; large gaps in knowledge on CC/Bd, still larger on CC/Bd in m/c areas;
- CC/Bd m/c specific monitoring non-existent; scientific research sporadic and limited or very limited, on CC/Bd in m/c areas non-existent in majority of countries;
- international projects and programmes: for all of countries very important, reducing gaps, increasing expertise, for most of them also indispensable as a funding source;
- a number of important information were produced within activities of MAP, CBD, Ramsar, UNFCCC, MEA, EU programmes, but in many cases still not adequately exploited
- monitoring and research: sporadic, not targeted at CC/Bd, still less on m/c areas; existing research opportunities (national, EU – EF7, ESF, others) often not exploited;
- prerequisites for reducing gaps: monitoring, targeted research, institutional and human potentials, funding potential; all still to be properly addressed and met;
- urgent actions needed on (i) systematized, updated and user-friendly Data Bases on information sources and available knowledge; and (ii) inventories on Bd and on critical areas.

3. NATIONAL ACTIVITIES RELATED TO VULNERABILITY AND IMPACTS OF CLIMATE CHANGE ON BIODIVERSITY IN MARINE AND COASTAL AREAS

3.1. International Conventions, Strategies and NAPs

3.1.1. The international legal framework

The international legal framework for biodiversity and/or CC issues consists of a number of international Conventions, agreements and legal acts; the most relevant ones are listed in Box 9. Among them, as those providing directly for the broader CC/Bd framework the following might be considered: the CBD, UNFCCC and the Kyoto Protocol, RAMSAR, Bern (Wildlife and Habitats), CITES Conventions, and the Barcelona Convention protocols - PAs/Bd and the newly adopted one on ICZM. While implementing obligations deriving and activities pertaining to these international acts, countries at the same time contribute meeting some objectives of SAPBIO and some prerequisites for actions related to CC/Bd in m/c areas.

Box 9: International legal acts, relevant for Climate Change and Biodiversity

- Convention on Biological Diversity (CBD), signed in Rio in 1992, with the Cartagena Protocol on Biosafety to protect biodiversity from potential risks from modern biotechnology
- United Nations Framework Convention on Climate Change (UNFCCC), entered in force in 1994
- The Kyoto Protocol to reduce GHG emissions world-wide, entered in force in 2005
- The United Nations Convention to Combat Desertification (UNCCD), adopted in Paris in 1994, entered in force in 1996
- The Ramsar Convention on Wetlands, adopted in Ramsar (Iran) in 1975, came in force in 1975
- The Convention on Migratory Species (CMS), also a UN Framework Convention, adopted in 1979
- The UNESCO World Heritage Convention, on world cultural and natural heritage (1972)
- The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), adopted in 1973, entered in force in 1975
- The Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (Barcelona Convention, revised in 1995) and its Protocols, in particular the Protocol on Specially Protected Areas and Biodiversity (SPA/Bd Protocol), and the Protocol on Integrated Coastal Zone Management (ICZM Protocol). (the above adapted from: MEA, 2005). Also, relevant documents:
- The Convention on the Conservation of European Wildlife and Natural Habitats (Bern, 1979)
- The EU „Birds” Directive – Council Directive 79/409/EEC of 2 April 1979, entered in force in 1979, on the conservation of wild birds.
- The EU „Habitat” Directive – Council Directive 92/43/EEC, 21 May 1992, on the conservation of natural habitats and wild fauna and flora, with its Annexes
- EC REC 2002/413 on ICZM, and EC COM (2006) 216 on halting loss of Bd
- EU Co-ordinated Policies and Measures on Climate Change (CCCPMs)

3.1.2. Signatories to International Conventions

All participating countries are signatories to the CBD, the UNFCCC and the Kyoto Protocol. In addition, EU member states are acting in accordance with obligations arising from EU legislation, Directives, Policies and Recommendations.

3.1.3. Reports to UNFCCC

In addition to regular reporting to CBS and other Conventions, the National Communications to UNFCCC were so far presented as follows:

- Cluster A. Albania the 1st, Croatia the 1st-4th, Slovenia the 1st-3rd, Bosnia & Herzegovina and Montenegro in preparation the 1st Communication.
- Cluster B. Greece, Italy and Spain presented the 1st-4th Nat. Comms.; Israel the 1st, Malta and Turkey presented the 1st, in preparation the 2nd. Cyprus: no information.
- Cluster C. Algeria – 1st Nat Comm.; Egypt, Lebanon and Morocco – 1st presented, the 2nd in preparation; Syria 1st presented; Tunisia no information.

It should be noted that the Communications presented so far deal with CC/Bd either at a declaratory level only or not at all; and when considering impacts on c/m areas deal with impacts of SLR, but not with biodiversity.

3.1.4. National Strategies and NAPs of interest for CC/Bd in m/c areas

Generally speaking all the countries adopted and act in accordance with some national strategies, APs or other specific documents relevant for CC/Bd issues:

- **Cluster A.** Albania – NCCAP, an inventory of GHGs on-going; Bosnia & Herzegovina – a Bd inventory on-going within Natura 2000, the preparation of an AP on CC/Bd envisaged; Croatia – NBD/L SAP, NEnv. Strategy and NEAP, draft NS for implementing UNFCCC; Montenegro – Directive for Development of Montenegro as Ecological State (2003), Framework SAP in GHG emissions, several NAPs of indirect interest for CC/Bd; Slovenia – Bd Conservation Strategy (2002), Strategy for reduction of GHGs emissions, EU CCCPMs.
- **Cluster B.** Greece – a NS on Bd is in preparation, Strategy and measures for Harmful Algae Blooms; Israel – an Inter-ministerial Plan on CC impacts, a NAP for Bd adopted but practically not dealing with marine Bd; Italy – sectoral and cross-sectoral policies on GHG emissions, Green Certificate System, NP on CO₂ emissions; Malta – proposal for NCCS prepared, the BdNSAP currently being drafted; Spain – NAP on CC adaptation, a number of national plans and programmes on CC, but limited with regard to CC/Bd in m/c areas; Turkey – a BdNSAP in preparation (Workshop held in 2007), a Biodiversity SAP and a NAP on Desertification adopted, a National CC Research programme, operational.
- **Cluster C.** Algeria – a national GHGs Inventory, the 2007 Survey on CC, NS/ICZM in preparation; Egypt – a CC AP in 2002, a GHGs Inventory in 2007, preparation of a NDA and of a NAP on CC, preparation of a NS for Humid Areas; Lebanon – a national GHGs inventory and emission reduction strategy; Morocco – NSAP on Conservation and Sustainable Development of Biodiversity (2003), National Programme to Combat Desertification, several sectoral NPs, but not on CC; Syria – NS for adaptation in /coastal region in preparation; Tunisia: NS, NAPs not reported.

To summarize: a number of NS and NAPs adopted, some concerning GHGs, few on CC strategies, all others of indirect relevance for CC/Bd; so far no country has prepared CC/Bd specific strategies and/or NAPs, still less for c/m areas.

3.2. Other relevant national activities

The national documents presented a number of other activities of interest for CC/Bd. Some most relevant or characteristic ones are listed below:

Cluster A

- **Albania:** The Albanian National Scenario on CC prepared within a joint GEF / UNDP / Albanian project, NCCAP, on-going inventory of GHGs, a CC unit established within MOE.
- **Bosnia & Herzegovina:** Limited activities on CC, none on CC/Bd, the legislation not addressing CC nor CC/Bd, a Bd inventory on-going within Natura 2000, the Neretva/Trebinjica TB Cro/B&H project envisaged within the GEF/ UNEP LME Med. Project.
- **Croatia: International projects:** GEF/WB Karst, GEF/UNDP COAST (Bd as development resource in c/m areas); a detailed sectoral CC related project (UNDP/Croatia HDR 2007/08). Approximation of legislation with EU norms.

- **Montenegro:** No national programmes on CC/Bd, but a number of international projects being indirectly relevant: a draft GHG inventory, GEF/UNDP NCSA project – capacity building for UNFCCC, EMERALD Network on Bd hot-spots, several international projects in preparation. Slovenia: Research on CC impacts on agro/Bd, on forests, on CC scenaria, on Alpine Area; also activities in conformity with EU programmes.

- **Slovenia:** Research on: CC impacts on Bd in agriculture and forestry, and in the Alpine area; on CC scenarios; defence measures planned for Secovje salina, against impacts of SLR; also activities in conformity with EU programmes. TCs on impacts of CC for 3 coastal municipalities

Cluster B

- **Cyprus:** A NAP to combat desertification, and a study on Bd concerns within MAP CAMP Cyprus ICZM (UNEP-MAP RAC/SPA, 2008a MAP .), were reported.

- **Greece:** Actions within the EU network of observation and research infrastructures and development of CC forecasting models; a number of implemented or on-going research programmes on: CC, water quality, fisheries/Bd, plankton, marine Bd; a number of PhD and MSc theses; awareness actions. The scientific capacity is satisfactory but CC relevant activities scarce and mostly funded through international programmes.

- **Israel:** Relevant legal activities scarce. Nationally funded research studies on CC issues, dealing with coastal erosion and CC scenarios. A MOE Report on CC presented in 2008.

- **Italy:** A number of national activities and those within or in conformity with EU programmes; a number of on-going international programmes; actions related to obligations towards Conventions, active involvement in international CC-linked projects; a GHG monitoring programme, extensive research on CC, a large international co-operation programme. Needs expressed for consistent actions on CC/Bd in c/m on national level and with other Med. countries, Adriatic in particular.

- **Malta:** The University preparing involvement in regional climate modelling, also undertaking research on coastal meteorology, hydrography and physical oceanography. Several EU funded projects are on-going; actual monitoring not CC addressed but CC relevant and useful; few limited training programmes. Public awareness actions implemented, but on GHGs solely.

- **Spain:** Numerous activities reported, on: legislation; CC related ones; participation in international committees; monitoring and research, but limited related to CC/Bd in m/c areas. Out of more than 400 publications on global CC registered in 2005 only few dealing with marine Bd. On-going monitoring of Posidonia, phytoplankton, meiofauna and macroalgae and on NIS, within WFD. Several monitoring networks on marine ecosystems established. Training activities on CC/Bd in terrestrial environments. Public awareness rapidly growing.

- **Turkey:** A Conference on CC held in 2004; a NR published in 2006. An Expert Group Report on Fisheries in 2007. Several scientific / technical meetings on CC. A CC nat. scenario. No legal activities, no monitoring. Several public awareness actions implemented on CC issues, but so far the level of awareness is still low.

Cluster C

- **Algeria:** Institutions established – ANCC (National Agency for CC) and CNL (National Agency for Coastal Areas), OEDD (National Observatory on Environment/SD), CNDRB (National for Development of Bd resources), CNFE (National Center for Environmental Education), the Law on Coasts; DB/info-system on m/cBd (SIGBIONARAL), new PAs, MPAs established (Habibas, Rachgoun islands), 3 new NPs, new SPAMIs, cadaster of coastline.

- **Egypt:** Establishment of an Agency for Humid Areas, Bd conservation and CC; studies on adaptation on CC; on vulnerability and adaptation in Nile delta; establishment of a National Commission on Humid Areas. Needs reported: for a data base on CC, to strengthen NBd Agency, for Public Awareness Projects on Bd and on needs for ICZN, for preparation of ICZM Plans.

- **Lebanon:** on-going actions on NIS, Bd conservation and legislation, management of PAs; the MEDWetCoast project, actions on pollution reduction, oceanographic studies and inventories of interest for CC impacts on Bd in m/c areas, studies published on NIS and tropicalization. So far no specific actions on CC/Bd in m/c areas.

- Morocco: On-going projects with Canadian ICRD (adaptation to CC but not dealing with CC/Bd). Actions on CC related capacity building and awareness, but not including CC/Bd in m/c areas.
- Syria: actions on GHGs and ozone layer; all relevant ministries involved in CC issues but not on CC/Bd in m/c areas; CC related legislation and structures existing; establishment of new PAs; University involved in research on m/c Bd; several international programmes; several studies on erosion and WR liased with CC issues.
- Tunisia: studies on CC impacts on agriculture, on SLR in m/c areas (vulnerability, socio-economics, adaptation); a number of actions within UNFCCC, CBD, UNCCD.

3.3. Problems and constraints

Same as for information available and relevant knowledge, the national activities reflect the differences in national economic and scientific potentials, institutional and human capacities and expertise. The highly developed countries and other EU member states are more advanced concerning CC/Bd issues and CC/Bd in m/c areas; other countries' achievements are more limited and mostly as results of international projects.

The major problems and constraints reported are:

- Absence of relevant national policies, programmes and NAPs on CC/Bd and in particular in m/c areas.
- National legislations on CC/Bd issues and on the needed ICZM framework are still weak or non existent.
- Research and monitoring actions are unequally distributed, most numerous and intensive in the NW Mediterranean countries. Activities related to climate and hydrology are being implemented in all countries, varying in comprehensiveness, in-depth level and intensity. Most national actions relate to: SLR, coastal erosion and desertification; response of marine organisms and populations to STR, migration and distribution shifts of native and alien species, spatio-temporal changes in community structures; model development and forecasting projections; and sectoral / socio / economic aspects of CC impacts. Several countries have the GHGs Inventory prepared or in preparation and monitor GHG emissions. Monitoring of biodiversity is intensive in few countries only, in others scarce, mostly limited to selected areas or species. But research and monitoring directly related to CC/Bd and in particular in m/c areas are rare, limited, in majority of countries not existent.
- More or less sporadic actions on vulnerability and adaptation to SLR were dealt with by all countries. Other issues were not tackled yet by the majority of countries. if any than at general level only (with few exemptions mentioned above);
- Large gaps in knowledge exist on the effects of CC on biodiversity and their consequences for human populations, only few countries being more advanced.
- The limited available information and data are dispersed, not systematized, partly hardly available, sometimes inconsistent and/or unreliable.
- For a number of countries: weak institutional and human capacity; lack of scientists oceanographers and those specialized for CC issues; absence of and need for training and capacity building (training needs being at differing levels).
- Lack of reliable technical documentation, guidelines and methodologies.
- Low level of public awareness; in all countries decision makers not yet sensibilized on CC/Bd issues; NGOs in only few cases involved in activities on CC/Bd. F. ex., the actual level of public awareness on CC in Mediterranean EU member states and candidate countries is presented in **Box 10**. The awareness level on CC/Bd and in particular on CC/Bd in m/c areas might be expected to be still much lower.

Box 10: On public awareness and influencing decision makers

On level of public awareness on CC in EU countries/candidates:

EU country / candidate	% badly informed on causes CC	% badly informed on consequences	% badly informed on ways of fighting
Croatia	48	45	52
Cyprus	44	39	50
Greece	54	47	50
Italy	51	50	57
Malta	52	47	52
Slovenia	35	30	37
Spain	45	46	47
Turkey	61	63	63
EU 27	41	41	45

Source: EU Parliament, EU Commission (2008): Special Eurobarometer 300: „Europeans' attitude towards Climate Change, Report”

II. On costs of action and non-action:

- Funds for action, needed till 2030: 1,6% GDP at global level
- If no action: 5-20% GDP losses at global level.

Source: UNDP Cro HDR Rept 2007/08

Conclusion

The majority of on-going CC related national activities still deal with issues at general level and are mostly targeted at GHG emission inventories and reduction.

National strategies and activities when addressing CC deal with CC/Bd in a declaratory way, or not at all. Activities related to m/c areas, address predominantly impacts of SLR.

Research is more intensive in countries with higher potentials, is mainly focused on CC and GHGs; research on CC/Bd is very limited and/or sporadic, still more limited on CC/Bd in c/m areas; in several countries there is no such research at all.

The lack of data/knowledge on CC, in particular on CC/Bd, of long-term data series, of inventories, and absence targeted monitoring is strongly emphasized. In only two countries there are some CC/Bd specific monitoring activities.

Studies on mitigation/adaptation measures were implemented in few countries only.

Capacity building and training is limited to issues dealing with obligations to UNFCCC.

Public awareness on CC/Bd, despite actions reported in majority of countries, is still low, for CC/Bd issues in m/c areas probably very low.

Participation in international projects was evaluated as needed and beneficial for all countries, for a number of countries it is the major opportunity to participate in and provide funding for the CC/Bd actions.

4. VULNERABILITY, IMPACTS AND CRITICAL NATIONAL MARINE AND COASTAL AREAS

4.1. Vulnerability and impacts

All National Overviews identified and analyzed the vulnerability and expected impacts of a large number of areas, sites, habitats, population and species in m/c environments, taking also in account problems related to available knowledge, uncertainties, and hitherto level of relevant national activities, as presented in preceding Chapters. Almost all authors recommended the findings presented in this Chapter to be understood as predictions to be used for qualitative discussion and as hypotheses for design of follow up activities. Even within such conditions, the picture presented might be considered as quite reliable and realistic, but subject to further in-depth analysis and proof-checking.

In many cases the assessments made and impacts identified are similar or identical for typical areas and/or habitats, the most critical ones related to: low-laying coastal areas, beaches and coastal strips; wetlands, lagoons, estuaries; karst – terrestrial and submarine; Mediterranean forests, shrubs and relict areas; the marine environment: fragile and important marine areas, hatchery and nursery areas, Posidonia beds, NIS...; watersheds and freshwater systems. The critical phenomena most frequently reported were: flooding, inundation, coastal erosion, extreme events, droughts, change of marine mass movements, affected ecosystem functioning, N-ward shifting of ecosystems, populations migration and distribution; impacts on endemism and rare / endangered species. A number of phenomena being of a TB nature, of common regional or sub-regional interest, or for a number of countries, calling for harmonized and consistent regional, sub-regional, and/or multi- or bi-lateral actions.

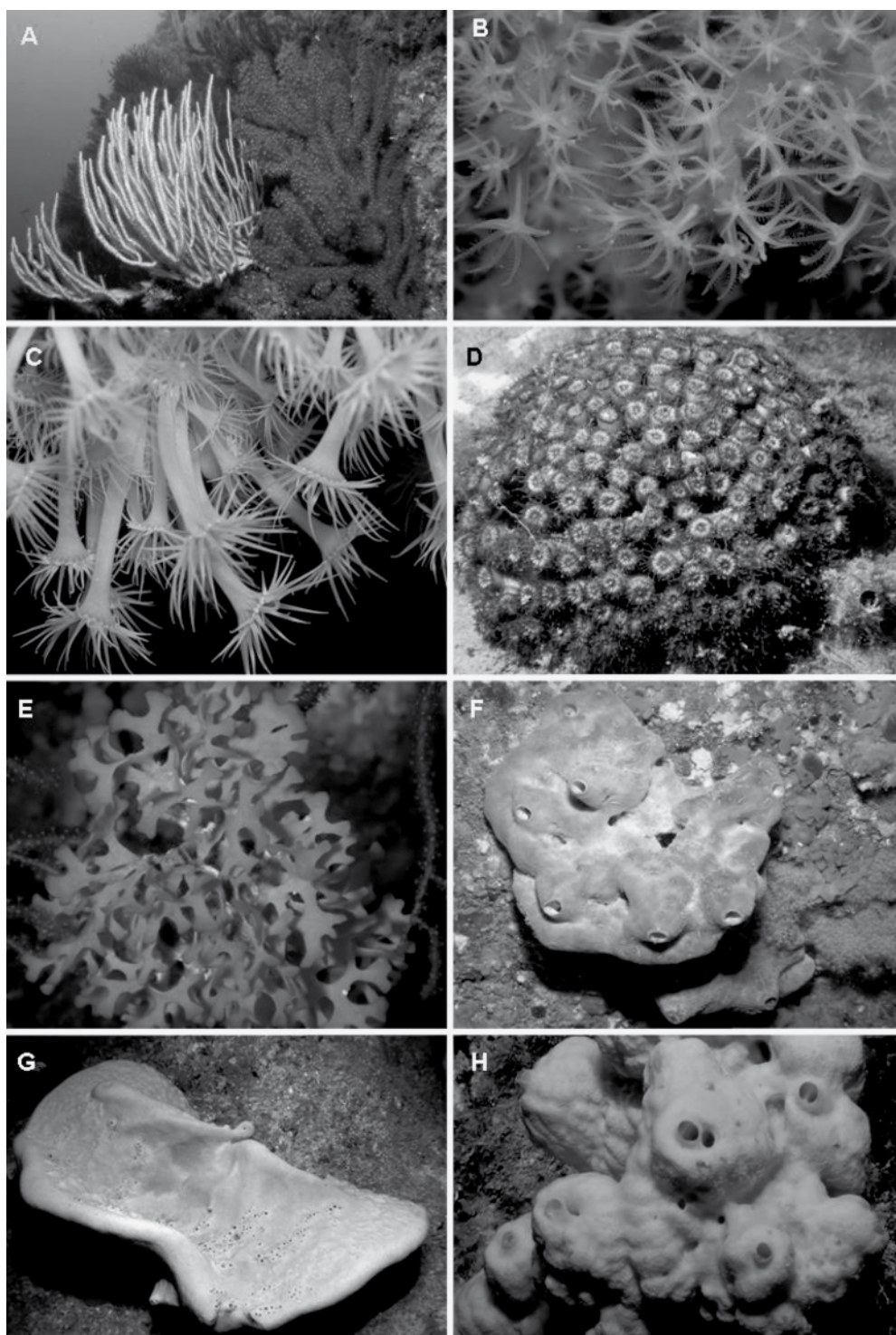


Figure 2 : Benthic invertebrates affected by repeated climate anomalies in the Mediterranean. A) The gorgonians *Eunicella singularis* (left) and *Paramuricea clavata* (right); B) the red coral *Corallium rubrum*; C) the zoantharian *Parazoanthus axinellae*; D) the scleractinia *Cladocora caespitosa*; E) the bryozoa *Pentapora fascialis*; F and G) the commercial sponges *Spongia officinalis* and *S. agaricina*; H) *Agelas oroides*. Photos by T. Pérez.

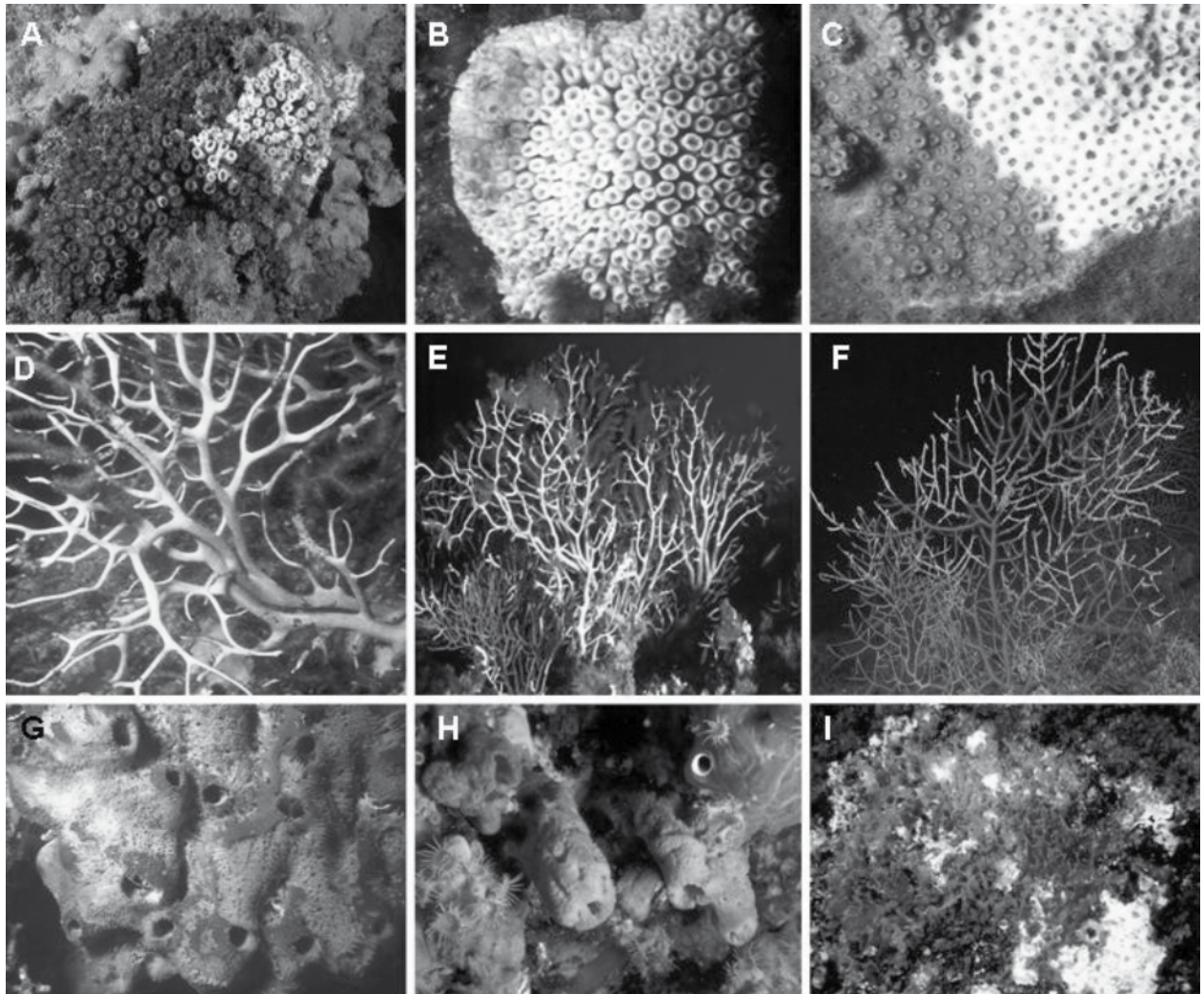


Figure 3: Signs of disease and mortality. Partial (A, C) and total (B) whitening of the scleractinian *Cladocora caespitosa* (A, B) and *Oculina patagonica*; necrosis of *Paramuricea clavata* gorgonias in the first hours (D) and some weeks after the start of the disease (E), *Leptogorgia sarmentosa* (F); necrosis of the bathing sponge *Spongia officinalis* (G), skeletons of the sponges *Agelas oroides* (H) and *Crambe crambe* (I). Photos by R. Graille (A,F), J. Harmelin (B, D, E, G, I), and T. Pérez (C, H).

Some documents do not include all types of national areas and/or habitats, or do not provide for an equal level of elaboration of coastal/terrestrial vs. marine issues (f.ex. avifauna, forestry, karst, watersheds, endemic and autochthonous sorts: grapes, olives, others, etc.), the fact calling for proof-checking during follow-up activities.

Among a very large set of respective information, those most nationally relevant and/or of interest for a major number of countries, and/or of regional interest, are presented below, per Clusters and countries.

Cluster A

- **Albania:** Flooding of coastal areas and beaches (land subsidence also present). In all lagoons increase of pathogens with impacts on aquaculture, in non-protected ones accretion and increased salinity. Also: riverbed erosion; impacts on evergreen forests with changes in species structure. In the marine environment: increase of thermophilous species and changes of plankton productivity with flow-effects on ecosystems.
- **Bosnia & Herzegovina** (due to absence of data, assumptions): Wetlands and low laying areas: inundation, flooding, salinization. MTR, reduced precipitation and drought: impact on river watersheds and karst areas/lakes inducing habitat degradation, endangering migrating/wintering birds, endemic fish in river basins, reptiles and amphibians. In marine areas: changes in structure of biota, habitat degradation, coral bleaching.
- **Croatia:** CC impacts already registered: extreme events. Areas/habitats of high Bd importance to be highly affected, in particular: species distribution and geographical range, habitats fragmentation, non-adaptable species under risk of disappearance. Coastal wetlands considered as the most threatened, also estuaries, lagoons, mudflats. Karst Bd and endemism under risk of extinction. Beech and fir forest shrinking, risk of extinction of wet oak penduculate forest. Also: NIS, impacts on coralligenous habitats, changes of pelagic plankton.
- **Montenegro:** Wetlands, karst – amphibians and reptiles: highly affected. Skadar lake: impacts on ecosystem functioning, on bird populations. Also: NIS, eutrophication, phenology.
- **Slovenia:** SLR – flooding, salt water intrusion, habitat degradation; impacts on coastal wetlands, salinas, river inlet, erosion of coastal flysch cliffs. In marine areas: changes in mass movements, “boreal” species under risk. N-ward shifting of thermophilous species, coral bleaching, NIS.

Cluster B

- **Greece:** A detailed analysis is presented (scientific references included) of occurring phenomena of CC and resulting impacts recorded so far for the marine environment: the recent changes in termohaline circulation, climatic shift, long-scale salinity increase, modifications in hydrology and dynamics, inputs of atmospheric dust containing nitrates and trace elements, DMS, ... Changes were registered, impacts commented and references provided: tropicalization due to TR and salinity increase, expansion of thermophilous fish, increase of zooplankton, changes of biology and of molecular pattern, of circulation pattern, all without geographic reference to individual critical areas.
- **Israel:** Also a detailed analysis with references. Critical issues in m/c areas: (i) changes in precipitation volume, predictability and spread, to affect crops and natural biota, replacing Mediterranean communities with desert ecosystems; (ii) SLR to accelerate coastal erosion, 1 m rise to result with: doubling the present erosion rate, loss of 50-100 m wide coastal strip along sandy beaches (more than 50% of the Mediterranean coastline of Israel), and accelerated erosion of the Eolianite sandstone cliffs (70 kms of Israeli Mediterranean coastline); (iii) sea-water intrusion into the coastal aquifer to advance the „seawater interface” an additional 500 m with a permanent reserve loss estimated at 12.5 MCM/km of shoreline; and (iv) TR to induce: increase in infections by waterborne pathogens; increase of the potential transmission of vector-borne diseases carried by mosquitoes (malaria, dengue fever). Critical issues for m/c biodiversity: (i) TR to result with temporal impacts between elements in the marine food web, driving community-level changes in nearshore assemblages, biological zonation patterns to shift with environment changes; not adaptable species to become restricted to deeper water or disappear; (ii) SLR to cause extinction of slow-growing, long-lived species such as the unique, Mediterranean-endemic vermetid reefs, or impact low-lying off-shore islets serving as nesting sites for water fowl, and the area of sandy shore available for nesting of marine turtles; and

(iii) CC to induce biogeographical range shifts (latitudinal range shifts of native species, and establishment/spread of NIS), with implications on ecosystem functioning (productivity, invasion resilience).

- **Italy:** Detailed analysis with references. SLR to incite sea intrusion and flooding, with risks of partial or total loss of coastal wetlands, marshes, lagoons, long strips of coastal flat areas; subsidence speeding up (a large number of areas, Venice). Also: change of sea mass circulation pattern, to endanger „boreal” species, to induce N-ward spreading of thermophilous species, to impact coralligenous platforms and crustaceans. SLR and reduced precipitation to induce coastal erosion of rocky karstic areas. MTR and reduced precipitation to result with: N- and up-ward shift of terrestrial plant communities; decrease of productivity and distribution of Med agro-systems and forests; impacts on amphibians, on migratory / wintering / breeding bird species; changes in Po basin to affect seriously watershed and marine areas. Habitats situated at the level of the summer thermocline (e.g. coralligenous), and also in the shallower infralittoral zone (e.g. vermetid platforms), with gorgonians, sponges and octocorals will be among the most threatened species. NIS – establishment and spreading. Special focus is recommended on the numerical and evolutionary responses of meiofaunal species to CC, as well as on the eco-physiological response of seagrasses (namely *Posidonia oceanica*). Socio-economic repercussions of CC effects on marine and coastal biodiversity are expected for fisheries and aquaculture, tourism, public health, and agriculture.

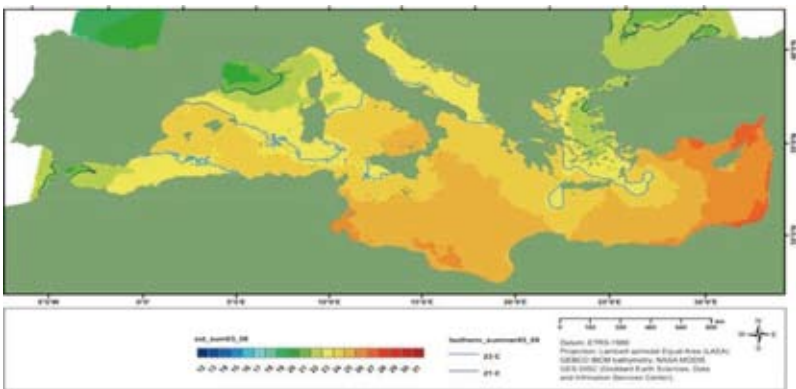
- **Malta:** Detailed analysis with references. Impacts already registered: MTR in 77 years - 0,5 °C, MSSTR since 1978 - 1,25°C; also mass mortality of benthic invertebrates. Predictions for year 2100: TR 3°C with 50% probability, Ann. prec. reduced by 17% mostly in autumns, but less reliable. Reduced precipitation to induce water deficit and all resulting negative impacts. SLR to affect the NE low-laying areas, Simar and Salini wetlands in particular. About wetlands: out of 25 identified in 1989: 6 already obliterated, 13 heavily degraded, 6 only in good state. Areas to be critically affected: coastal wetlands and dunes, both resting and breeding grounds for avifauna; hard oligo-mesothropic waters with benthic vegetation, supporting rare, endemic species; all terrestrial ecosystems to be affected by droughts. In the marine environment: changes in species distribution, N-ward shifting of species, consequences of rise in thermocline depth. Maps presented on: Conservation and SP areas, impacts on NE coasts, location/status of coastal wetlands, locations/extent of sand dunes.

- **Spain:** Detailed analysis with references. The atmospheric TR in the XXth century larger than that recorded globally, with a concomitant STR. The actual ATR increasing even faster than forecasted by the most unfavourable scenario. Other general effects of CC are decline in precipitation, increased frequency of extreme events, and SLR (of about 50 cm, and perhaps up to 1 m by year 2100). Occurred impacts in the marine environment, so far recorded: increased mortality of some species, changes in species reproductive biology, increased NIS. Expected impacts of CC on m/c areas: (i) threats to low-lying coasts (deltas, coastal lagoons and other wetlands, beaches) and the habitats and species living on them (e.g. seagrass meadows); (ii) changes in marine productivity due to eco-physiological response of marine phytoplankton to increasing CO₂ and STR, strengthened by other anthropogenic effects (e.g. increased nutrient availability); (iii) mass mortality events of sessile (e.g. gorgonians, scleractinians, sponges) and benthic mobile (e.g. crustaceans) species, increased mortality rate of seagrass species (e.g. *Posidonia oceanica*); shift in geographical distribution range of marine species; (iv) NIS settlement and spread; (v) increased risk of hypoxic events; and (vi) increased seawater pH. In addition, impacts on fish species and plankton and spread of mariculture parasites will affect fisheries and aquaculture.

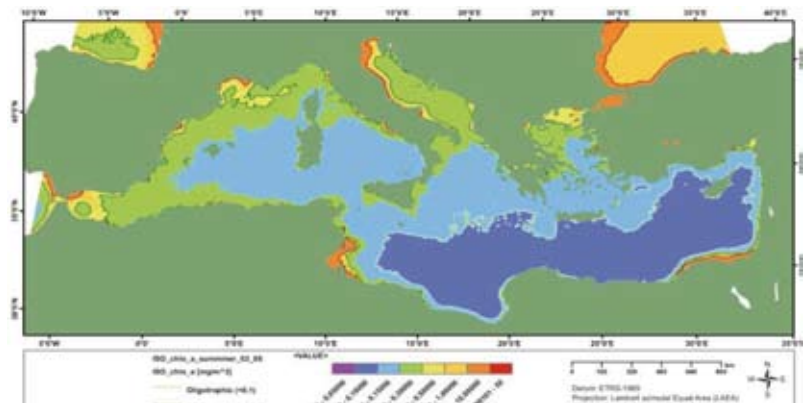
- **Turkey:** Detailed analysis with references: (i) SLR and oscillations: all coastal wetlands and lagoons (see Map in Overview); sea turtle nesting areas and beaches; impacts on low-lying offshore or near the shore isolated islets (the stepping stones for birds and some fish species); (ii) STR and oscillation to cause: mass mortality or bleaching of gorgons; fishes to change distribution and migration patterns, changing fishing areas and periods; (iii) irregular terrestrial flooding near coastline to decrease water transparency, inducing mass mortality of sessile species (sponges, gastropods, others); (iv) siltation to cause hypoxia and loss of habitats for molluscs living in sediments; (v) impacts of NIS on native fauna and flora; some NIS to become commercial target, changing catch composition; (vi) phytoplankton blooms; and (vii) impacts of CC on marine mammals and consequences of acidification - need for further monitoring and studies.



Figure 1: An interactive participatory approach involving the authors of the national, subregional and synthesis overviews, who participated to three sub-regional meetings and a regional working meeting. A) the Cluster A meeting (Adriatic Sub-region): Split, Croatia, 23-24 October 2008), B) the Cluster C meeting (Middle East and North Africa): Tunis, Tunisia, 28-29 October 2008), C) the Cluster B (Mediterranean European countries and Israel): Santa Pola - Nueva Tabarca Island - Spain, 9-13 Novembre 2008, D) the regional working meeting was held at the Cooperativa Nautilus premises (Vibo Valentia, Italy) on 11 and 12 December 2008. Photos by A. Limam.



Map 1: Sea Surface Temperature (SST) of the Mediterranean region (© RACISPA, by Requena Moreno, S., 2009)



Map 2: Sea Productivity in terms of Chlorophyll-a (Chlo-a) concentration of the Mediterranean region (© RACISPA, by Requena Moreno, S., 2009)



Figure 2 : Benthic invertebrates affected by repeated climate anomalies in the Mediterranean. A) The gorgonians *Eunicella singularis* (left) and *Paramuricea clavata* (right); B) the red coral *Corallium rubrum*; C) the zoantharian *Parazoanthus axinellae*; D) the scleractinia *Cladocora caespitosa*; E) the bryozoa *Pentapora fascialis*; F and G) the commercial sponges *Spongia officinalis* and *S. agaricina*; H) *Agelas oroides*. Photos by T. Pérez.

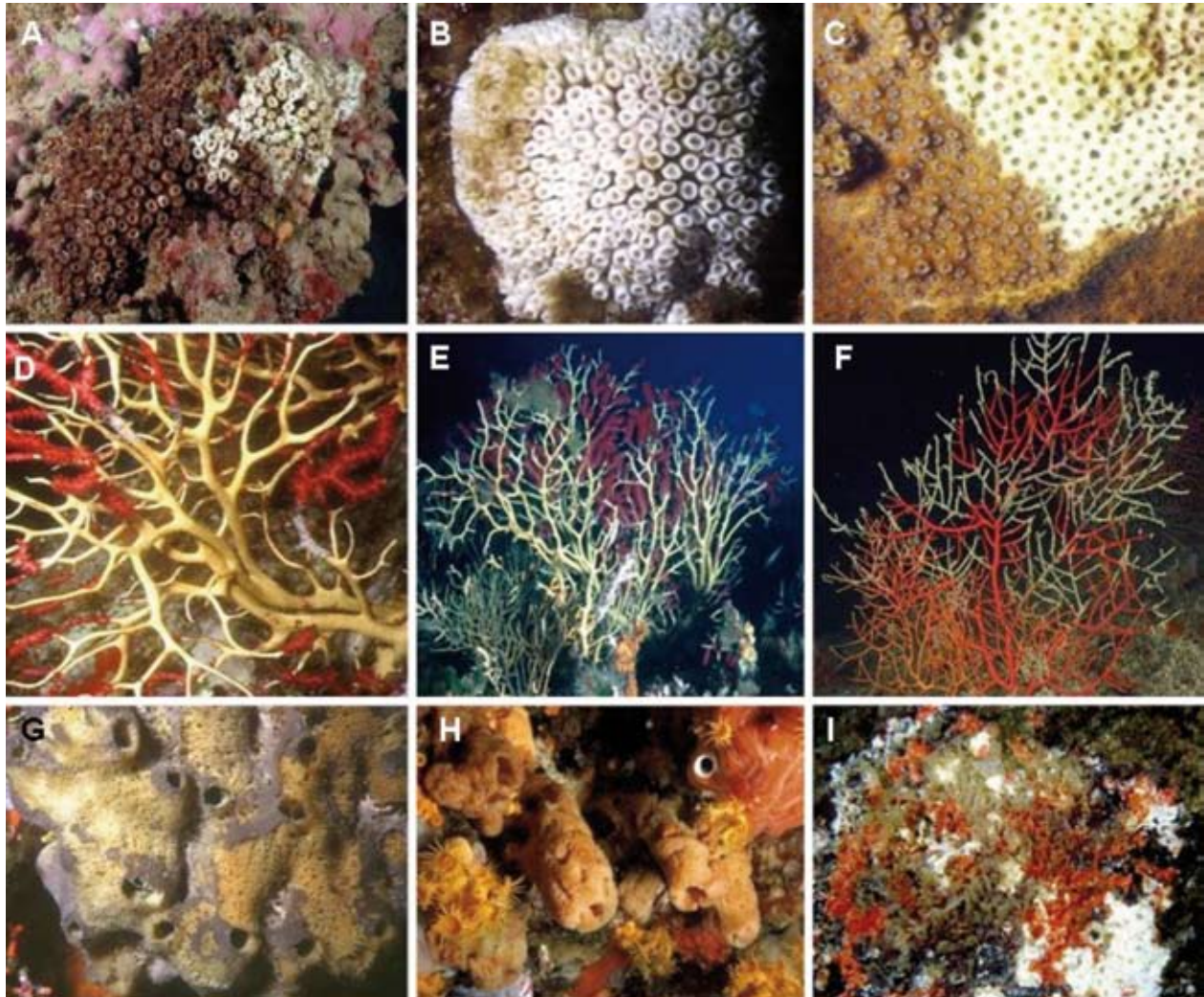


Figure 3: Signs of disease and mortality. Partial (A, C) and total (B) whitening of the scleractinian *Cladocora caespitosa* (A, B) and *Oculina patagonica*; necrosis of *Paramuricea clavata* gorgonias in the first hours (D) and some weeks after the start of the disease (E), *Leptogorgia sarmentosa* (F); necrosis of the bathing sponge *Spongia officinalis* (G), skeletons of the sponges *Agelas oroides* (H) and *Crambe crambe* (I). Photos by R. Graille (A,F), J. Harmelin (B, D, E, G, I), and T. Pérez (C, H).

- **Algeria:** Coastal erosion of low-laying humid coastal areas and sandy beaches, intensified due to sand extraction. Sea water intrusion and salinization. Change of sediment deposition – impacts on composition and structure of macrofauna and macroflora. STR impacts on marine biota: on reproduction in particular, favouring thermophilous species; changes in distribution and reduced resilience of sensible populations; modification of distribution areas of stenothermic species (upper and lower limits); increased incidence of jellyfish; impacts on vermetus zones affecting associated flora and fauna. Combined impacts of CC on coastal humid areas / habitats and an increased incidence of eutrophication and toxic blooms. Need for further monitoring of and studies on fisheries.
- **Egypt:** The Nile delta considered as one of the most critical area in the region, SAP impacts with expected dramatic socio-economic and environmental consequences. The humid coastal areas and lagoons under risk of deep changes in case of rupture of fragile protecting strips, changes of habitats structure, impacts on fisheries and aquaculture, on infrastructures, population. Flooding/inundation of low-laying agricultural lands located at N of delta, exacerbated also by human activities, land subsidence and reduced sediment inputs due to impact of Assuan dam. In other areas, degradation in sebkhas. Degradation of aquifers, impacts on water resources and balance with consequences on biota, exacerbated due to overexploitation. Stratification and reduced productivity of the Levantine sub-basin. Intensified algal blooms, red tide, mucilage. Impacts of increased incidence and abundance of NIS. Finally, impacts on marine and lagoon fisheries (impacts of recycling of waste waters, reducing inputs of nutrients, to be added).
- **Morocco:** Low-laying coastal areas and productive land, humid areas and estuaries – among the most vulnerable environments. Risks from SLR: coastal erosion and flooding of low laying coastal areas; coastal infrastructures, resorts, settlements – flooding, impacts on supralittoral habitats important for Bd (monk seal, ...); Mediterranean forests: increased risk of wildfires. Reduced water resources, water scarcity, salinization of aquifers – impacts on coastal agriculture and associated biota. Increased incidence of extreme events and other CC impacts – vulnerability of humid areas and adjacent marine habitats, algal blooms, reduced dissolved oxygen, increased incidence of epizoots. Endangered sessile marine species (red corals, date-shells, ...), Posidonia beds, flora and fauna in ressac/turbulent zones; plankton (some toxic) blooms, impacts on avifauna: change of phenology status, effects of habitat modification/ degradation / loss of wetlands and humid areas. Fisheries – reduced fish landings.
- **Lebanon:** Combined CC and anthropogenic impacts on c/m Bd, intensified by pollution. Coastline regression. Increased incidence of toxic plankton blooms. Levantine ecosystems affected by increased mass mortality events, NIS, reduced distribution areas and species loss (Posidonia, Mytilus galloprovincialis... Sarpa salpa...) replaced by thermophilous species. Similarity of impacts among Lebanese and Syrian m/c areas.
- **Syria:** Impacts of SLR on low-laying coastal areas, exacerbated by anthropogenic impacts: coastal erosion, flooding of resort areas and archaeological sites, risks for infrastructures, settlements, industries ...; estuaries – salinization, riparian erosion, modification of substrata -impacts on Bd; coastal erosion exacerbated by intensified storms and currents, to affect habitats and biota; retreat and/or loss of marshes to affect the pertinent Bd. Cumulative impacts – to reduce resilience of habitats, populations and species. Caves potential habitats of monk seal – to be submerged. TR and reduced precipitation: coastal forests, endemic/relict areas, and areas nearest to coastline in particular – endangered, risking disappearance. Cumulative impacts to modify soil chemistry and structure with impacts on associated Bd and irrigated areas. Fisheries and mariculture to be affected by salinity modifications in estuaries, increased incidence of extreme events, impacts on infrastructures and equipment, also reducing stocks, changes of migration pattern, increase of epizooties and parasitism. Islands under risk of partial or total submergence. Water resources reduced, aquifers under risk of marine intrusion, some of them under risk of submergence. Migration and reproduction patterns of a number of species under risk of modification. Monk seal and marine turtles under high risks and under threat of extinction. Increased risk for ressac / vermetus zones and associated Bd. Multiplication and proliferation of thermophilous species. Benthic communities – distribution changes, risks of extinction. Pelagic flora and fauna affected by TR and Ph decrease. Avifauna largely affected due to changes of coastal habitats. Multiplication of dystrophies and suspect blooms due to cumulative impacts.
- **Tunisia:** Major risks relate to SLR in coastal areas, leading to coastal erosion (sandy coasts in particular), salinization

and submersion; islands affected by coastal erosion and under risk of submersion; the rocky coasts and cliffs less vulnerable. Humid coastal areas subject to regression and salinization. Impacts on coastal/marine management practices, and recreation activities. Changes and spatial redistribution of m/c resources, fisheries in particular, direct impacts on stenothermic organisms. Proliferation and spatial expansion of thermophilous, NIS species. Impacts on metabolism, physiology and phenology of species, potentially inducing extinction. Increased vulnerability of sessile bioformations in resac / vermet zones. Impacts on fisheries productivity, increased ratio of NIS in catch landing.

4.2. Areas, sites, habitats, identified so far as critical

Based on vulnerability assessments, the national Overviews presented extensive lists of critical m/c areas, sites and spots. In most cases brief justification was provided spot by spot, in several ones critical spots were listed only, in few cases critical areas were listed within vulnerability analyses. The Italian, Maltese and Turkish documents were provided with maps of Hot-spots (see Map 2, below, and Maps in Maltese and Turkish Overviews). Again, the aspect of comprehensiveness mentioned previously should be taken into consideration. The Greek, Israeli and Turkish Overviews have not presented geographically identified information on critical sites.

The lists of identified national critical areas and sites are presented in Annex IV., per Clusters and countries.



Map 3. List of marine and coastal sites considered to be especially at risk (or endangered) in the short-term by the effects of climate change in Italy. Squares refer to Areas at risk from SLR and circles refer to areas at risk of impact on biodiversity. By F. Badalamenti and P. Guidetti.

4.3. Comments

Assessments of vulnerability to CC/Bd in national m/c areas, and lists of hot-spots (critical areas, sites, habitats, communities and species) were presented by all national documents. While some assessments were based on research made and reliable information and accompanied with detailed justification, others were presented at the level of expert opinion based on predictive analyses with brief annotations, in few cases at general level only.

Despite the mentioned limitations, the information provided might be considered as an acceptable basis for preliminary conclusions and design of follow up. The findings presented confirm that the expected consequences of CC for globally and nationally important biodiversity in the region, and for national economies and human development must be the cause of a most serious concern.

Analyzing the presented information, the following should be noted:

- The vulnerability assessment deals predominantly with identical or similar types of areas, sites, habitats, with the majority of impacts common for almost all countries.
- The most frequent areas and phenomena identified as critical are: (i) low-laying coastal areas, strips, beaches; (ii) wetlands, lagoons, estuaries and/or river inlets, salt-pans, muds, humid areas; (iii) terrestrial karst and submerged karst/caves; (iv) marine areas – nurseries and hatcheries, Posidonia beds, coralligena; (v) Mediterranean forests, shrubs and forest relict areas; (vi) the endemic and autohtonuos species and sorts of traditional Mediterranean agriculture; (vii) biodiversity associated with freshwater resources; (viii) biodiversity associated with supralitoral zones, benthos, coralligena, pelagic areas; (ix) impacts of induced marine mass movements and stratification; (x) areas / habitats functioning as birds sanctuaries and breeding areas; (xi) all centers of endemism; etc.
- A number of assessments and critical areas, relevant for one or few countries only, deserve regional attention, being related to Bd of global or regional importance.
- So far, national inventories of critical areas do not exist; in many cases data and information are fragmented and not systematized.
- Therefore, future activities should include further actions aiming at: an improved comprehensiveness, an in-depth elaboration and justification, and systematizing, within the preparation of compatible National Hot-spots Inventories. This also taking into account that such Inventories are indispensable for further activities.
- The present level of knowledge on vulnerability and critical areas reconfirms the need for: (i) design and implementation of: targeted research at regional and national levels; (ii) design and implementation of respective monitoring activities; and (iii) elaboration of prioritized and reliable adaptation and mitigation measures for critical areas and habitats – Hot-spots. For these actions a regional approach is needed to provide for harmonized co-operation and consistent joint actions at respective levels.
- Finally, it should be noted that several documents reported on the need for direct assistance by RAC/SPA concerning national actions on vulnerability assessment, identification of hot-spots and Cc adaptation measures.

5. PRIORITY NATIONAL NEEDS AND URGENT ACTIONS

Based on findings presented in preceding chapters, all Overviews identified the priority national needs and proposed urgent actions to meet them. Justifications and comments were provided in all cases, in some documents detailed ones. Several Overviews included the urgent actions in the sub-chapter on Needs.

The findings presented were analyzed and commented by respective Cluster (sub-regional) Syntheses and meetings (see Annexes II. and III.).

Complete lists of national needs to be met and of urgent actions proposed are given in Annex V., presented per Clusters and countries.

5.1. National needs expressed

The needs identified by Overviews reflect specific national and m/c conditions and features, also national potentials and achievements relevant for CC/Bd in m/c areas.

The following needs might be considered as common or similar for all or almost all the countries:

- upgrading level of CC/Bd in national policies;
- reducing gaps in knowledge through targeted monitoring and research: programmes design, meeting of needed prerequisites, implementation of programmes, dissemination of results;
- provision of methodologies and tools for national research and monitoring, compatible with regional and/or international ones;
- preparation of national Data bases and Inventories: (i) Data bases on knowledge and references available; and (ii) Hot-spot Inventories;
- strengthening and updating legislation and institutional arrangements;
- identification of funding sources and their increase for CC/Bd issues;
- updating and strengthening institutional and professional capacities and expertise for research and monitoring; establishment of monitoring stations and research capacities;
- need for an interactive stakeholders involvement, improved information and awareness;
- intensified training and capacity building, assistance to a number of countries;
- strengthened international co-operation; establishment on national and higher levels networks of scientist and institutions, participation at relevant international events and active involvement of national experts;
- improved interaction and co-operation between key responsible institutions, and between decision makers, national responsible and scientists;
- establishment of new MPAs;
- preparation, adoption and implementation of NSs, priority actions and NAPs.

Concerning monitoring and research, from an extensive list of topics, a number of them should be mentioned as of interest design of future programmes:

- in principle, monitoring and targeted research / studies, related to all critical habitats, communities and phenomena (wetlands, deltas, estuaries, lagoons, submerged caves, islands and islets, Posidonia beds, coralligena, endemic and autochthonous species, endangered species, etc.);
- hydrographic / hydrodynamic / climatic measurements to validate existing and forthcoming models;
- coastline monitoring and assessment of erosion/desertification vulnerability and risks;
- monitoring of selected benthic / nektonic / planktonic species / habitats;
- monitoring and research on spread and impacts of NIS;

- basic research on the biology of species vulnerable to CC;
- monitoring of occurring impacts; studies on ecosystems resilience, adaptive capacity and critical factors, including simultaneous impacts of all active stressors;
- studies on non-linear responses of littoral ecosystems to CC, and population-to-ecosystem links (functional approach);
- development of predictive modelling tools, under different mitigation, adaptation and population growth scenarios, including downscaling of regional scenarios.

In addition, lines of research to be pursued at regional level, as T. Perez suggested in the document commissioned by RAC/SPA (UNEP-MAP RAC/SPA, 2008b.) are summarized in **Box II**.

Box II: UNEP-MAP RAC/SPA, 2008b.: Lines of research to be pursued. excerpts•

- Acquiring Mediterranean related sets of T records and other physico chemical parameters.
- Establishment of a geo-referenced Database on distribution of species sensible to CC.
- Modelling to predict STR and modifications of general mass movement
- Improving methods of monitoring distribution boundaries and extinction risk predictive models.
- Research programmes on life and reproductive cycles of sensible populations.
- Acquiring data and assessing STR impacts on phenology; develop a relevant information system all aiming at assessment of adaptive capacities of endangered species
- Studies on different adaptive responses by organisms and populations on impacts of Cc, anthropogenic pressures and NIS.
- Development of macrophysiological approaches, identification of physiological markers for stress resilience; improving biological stress indicators to explain mechanisms of Bd changes.
- Intensified studies on impacts of CC on ecosystem functioning.

The survey of national needs indicates that in a number of Overviews some needs were not mentioned, although identified by other reference documents as potentially relevant. Further analysis should establish whether these needs were omitted because not relevant, or for other reasons, and whether they should be added. Topics to be checked further on refer primarily to: (i) policy issues, level of priority of CC/Bd in m/c areas in national policies, sensibilization of high level DMs, (ii) integration of protection, mitigation and adaptation measures into national planning systems and practices, (iii) Bd and impacts in karst areas, (iv) sectoral aspects: Mediterranean forestry, agriculture, water resources, (v) socio-economic impacts, economic valuation of Bd and ecosystem services, (vi) phenomena related to consequences of reduced annual precipitation; etc.

These questions were discussed at Cluster meetings and taken into account when finalizing Cluster (Sub-regional) Syntheses and the present document.

The expressed needs by a great majority deal with the same topics or relate to phenomena common for almost all countries, differing by country to country in levels, details, urgency and priority. This fact once again calls for harmonization, co-operation and joint actions.

5.2. Urgent actions

Urgent actions as proposed by national documents derive from identified needs. As requested, actions were predominantly defined by title and briefly annotated. Comments presented in Ch. 5.1. concerning Needs, related to comprehensiveness, prerequisites, topics not dealt with, and other considerations are valid also for urgent actions. While the needs identified in most cases are identical or related to same type of problems, most of the proposed

actions are country specific and differ in objectives, targets, temporal aspects and implementation level. While the majority of actions call for national level, a great number requires regional involvement: provision of reference documents, guidelines, methodology, capacity building, assistance (in training, provision of opportunities for external funding, equipment), pilot actions, etc. In a number of cases the nature of actions provides opportunity for sub-regional, multi- or bi-lateral co-operation. Targeted monitoring and research, other actions too, require international co-operation and involvement of international actors / partners.

Among a large set of urgent actions proposed by national documents, those most relevant for the present SAP/BIO action and reflecting proposals of a predominant number of countries are as follows:

- Upgrading the priority level of CC/Bd issues in national policy agendas.
- Influencing and sensibilizing DMs on CC/Bd issues in national m/c areas.
- Actions to improve, update, adapt the national legal framework and institutional arrangements with regard to CC/Bd m/c concerns.
- Actions to provide for permanent, stable and adequate funding sources for CC/Bd m/c activities and programmes.
- Formulation of CC/Bd related national strategies, NAPs and topic specific APs, all to include m/c areas.
- Integration on CC/Bd m/c concerns into national sectoral strategies.
- Formulation of NAPs or National Programmes for CC/Bd monitoring and research.
- Adoption and implementation of focused research programmes (a large list of proposed topics).
- Urgent detailed studies on vulnerability and impacts for highly critical areas, such as the N part of Nile Delta, the most critical one in the region.
- Establishment of monitoring systems, provision of new facilities, methodology, common indicators, training, in some cases of equipment, too.
- Preparation of Databases and Hot-spots Inventories.
- Design and implementation of urgent actions for conservation of endangered areas and habitats and applying of remedial measures.
- Actions towards improved management of natural resources, primarily PAs, MPAs, MEN, wetlands, of all critically affected areas and habitats, communities, species.
- Actions on integration of CC/Bd m/c protection, mitigation and adaptation measures in national planning systems and practices, including ICZM.
- Provision for and implementation of capacity building and training programmes.
- Actions to intensify international co-operation, increase the number of relevant international programmes for CC/Bd in m/c national areas, and measures for a wide participation of national scientists and experts in relevant international events.
- Establishment of expert groups and/or Networks at regional, sub-regional, multi- and bi-lateral levels.
- Establishment of national bodies and/or expert groups for CC/Bd in m/c areas within existing national institutions.
- Targeted actions on information, public awareness and interactive involvement of stakeholders.

5.3. Comments

The national documents presented country specific needs and urgent actions, many of them of the same or similar nature. While needs identified by one country might in many cases be considered as relevant for a number of other ones, the respective actions are predominantly country specific. All documents emphasized firstly the need for focused monitoring and research programmes and actions, secondly concerning vulnerability and measures,

while those related to policies, management, institutional arrangements, were often overlooked, as well as the prerequisites for implementation of some actions.

The level of elaboration of presented needs and actions calls for: (i) further in-depth elaboration of needs and careful design of actions, with provision of regional guidance and assistance; (ii) multi-level co-operation and joint actions; and (iii) identification and implementation of pilot actions on topics of interest for all or for the majority of countries.

For a number of urgent actions, prerequisites for their implementation have still to be met, concerning primarily: (i) upgrading the priority level of CC and CC/Bd c/m issues in national policy agendas; public awareness; influencing / sensibilizing DMs (including provision of documents on economic valuation of Bd as justification); (ii) targeted research and monitoring; (iii) provision of regular and adequate funding; and (iv) training and institutional capacity building; in some cases expertise for formulation and implementation of international projects.

Among needs not identified by some national Overviews, the valuation of national c/m biodiversity for respective economies and socio-cultural development should be underlined. This because DMs have to decide on priority and allocation of funds taking into account a wide array of needs and respective costs/benefits analyses, in particular having in mind the actual global development outlook. Therefore, valuation of ecosystem services and biodiversity are needed, also assessments of economic consequences of „no action” and mitigation / adaptation measures, to include pilot CBAs for representative cases. With that regard, relevant references are available, f. ex. (CBD 2007), references provided in (CBD 2008), also (UNEP 2000), etc.

Targeted monitoring and research, identified by all documents as urgent, are key prerequisites for consistent and concerted programmes. Both issues need a specific approach, due to: (i) the complexity of problems; (ii) interlinkages and harmonization with relevant on-going programmes, implemented by a number of international bodies, institutions and Agencies; and (iii) need for establishment of partnership and/or joint actions at regional and international levels. Multilevel approaches will be needed, as well as regional assistance and funding support to a number of countries.

As top priorities, the following urgent actions should be considered:

- upgrading CC/Bd issues as national priority, provision of justification included;
- setting base for consistent monitoring and research programmes;
- preparation of compatible national Data bases and Hot-spots Inventories;
- identification and implementation of adaptation and mitigation measures;
- pilot actions dealing with topics/areas of common / multiple interest;
- capacity building and training;
- integration of Cc/Bd in m/c areas in national planning, ICZM as framework;
- actions for the most critical areas (Nile Delta f. ex.).

6. FUNDING SOURCES AND CONSTRAINTS

6.1. Funds provided and future opportunities

A detailed insight was presented on funding sources and funds for research in general, and those for CC and CC/Bd in particular. Details were provided on actual and potential sources, their nature, hitherto and prospective levels, limitations, problems and opportunities. Interdependence was emphasized between: the actual priority level of CC/Bd, the present level and quality of information and sensibilization of DMs and the level of funds allocated for CC/Bd activities.

All national documents concur on three key issues: (i) needs being far above actual funding levels; (ii) opportunities for private funding sources being limited; and (iii) the role of international co-operation as funding source.

From a sub-regional/Clusters' point of view, some differences among Clusters (present levels of funding, accessibility to EU funds, or other specific sources), and similarity of conditions within each of them should be kept in mind when defining the follow up.

Many individual solutions and specific sources and opportunities reported might be of interest for / replicative in other countries or at regional level.

Finally, in addition to information provided by national Overviews, important reference documents on funding sources, procedures and practices are also available, such as the RAC/SPA document (UNEP(DEPI)/MED WG.292/Inf.5, 2006) on funding sources and networking partners for c/m PAs, as well as information about EU funding sources for targeted research (Eu 6th FP on Climate impacts – Co-ordinated research for a larger Europe; EF7-ENV-2009-1 with and indicative budget of 193.5 mill EUR; Programme Adaptation to CC, 2007; also on IPA, SAPARD, INTERREG ...).

The most relevant national findings are briefly presented below:

Cluster A

- Albania: regular national funds are very limited, mostly as counterpart contribution to international projects; establishment of an Environment fund is on-going; other national sources are not realistic; the international sources are presently the only realistic opportunity; a number of international projects has been externally funded so far by: GEF, WB, UNDP, UNEP; the potential donors/partners are Austrian, Spanish, Dutch, EU-IPA.
- Bosnia & Herzegovina: Environment Funds were established in both state entities, with very limited funds; no opportunity for private funding. Funds for research activities: the national ones are very limited, the international ones through EU FP7, also limited. The international funds are the predominant funding source, but limited: GEF, WB, UNDP, UNEP, EU Funds (LifeTC, INTERREG, CARDS, IPA), also through bi-lateral agreements.
- Croatia: National funds are predominantly secured by the State budget, through Ministries: for Environment (MEPPPC), Culture (SINP included), Science (research); also through the Government Bureau for NGOs (NGOs capacity building and Public Awareness). Hydrology monitoring (MHS) is also funded by the State Budget. A number of actions is funded by the Croatian Fund for Environment and Energy Efficiency (CFEEE). Counties fund/co-fund environmental projects of local interest. Presently, funding from other (private) sources is not realistic. The country benefits also from international funds, such as: GEF, UNDP, UNEP, WB (loans), EU funds/programmes (INTERREG, PHARE, CARDS, IPA). Once EU member state, the country will be eligible for EU Regional Policy funds, Structural Funds and Cohesion Funds; for research through EU F7.
- Montenegro: Funding for CC and CC/Bd related activities is provided by the Government and local administrations budgets, all very limited. Presently the funds are provided for: (i) the National Environmental Monitoring programme; (ii) activities of environmental institutions and bodies; and (iii) public services. Private sources are not available. The country is eligible for GEF and UNDP funding, also for some EU funds. The only realistic funding opportunities are through the implementation of international programmes and support by donor countries. So far some activities

were funded by Italy, one project co-funded by Norway; a number of projects is in preparation. Training of experts on formulation of international projects is requested.

- Slovenia: National research funds are provided by the Slovenian Research Agency, within NRDP. Basic projects are funded 100%, the applied ones up to 75% of costs. MESP is funding some NGOs projects, few of them CC related. Another source is the Slovenian Science Foundation, of a limited funding potential. Private funding sources are not available. International funds are available through: EC FC7 – Environment, INTERREG (one CC project on Alpine area is on-going), GEF. Few CC and/or Bd projects were supported by the Principality of Monaco and RAC/SPA.

Cluster B

- Greece: The national funds presently being allocated for CC related activities are insufficient. Due to specific national needs, more funds in particular for marine CC issues should be allocated within budgets if relevant Ministries. Presently there are no CC/Bd related projects funded by national sources. Other possible sources might be: (i) available funds for EIAs, if allocated for CC monitoring; (ii) private sources to co-fund LIFE + projects; and (iii) other EU CC related funds. The establishment of regular, stable system and adequate national funding for CC/Bd is the first priority.

- Israel: So far no national funds are available for activities in CC/Bd in m/c areas. Information on possible external funds were not provided by the document.

- Italy: National research programmes and actions related to environment protection are funded by a great number of organizations. The funds allocated so far are far below needs. The national funding system for CC and CC/Bd research is: (i) not regular; (ii) not stable; (iii) limited for c/m Bd issues. One of the problems is a difficult access to information on funding sources. The main national source for CC and CC/Bd research is FISR – Special Integrated Research Fund. Funding is also provided by: five relevant Ministries, several agencies, a number of institutes and universities, private sources included. Specific funding sources, also for research on CC, are: FIRB (Fund for Investments on Basic Research), PRIN (Projects of Relevant National Interest), and through bi-lateral projects. Private national funding sources are available but limited, the international ones including also: EU FP7, INTERREG IV, COST/ESF, etc.

- Malta: presently, no regular national sources are available for CC issues. Private partnerships in future not to be discounted. A number of international sources are potentially available, pending eligibility and respective criteria: the EU Structural and Cohesion Funds, EU LIFE +, the EU 7th FP through specific programmes, GEF (Malta being eligible for CC area).

- Spain: Funding sources for research projects include: (i) national budgets, Ministries: for Science and Innovation, for Environment, for Agriculture and Fisheries; (ii) Autonomous Governments and Provinces' budgets of public administrations; (iii) private funds (f. ex. Biodiversity Foundation, AXA foundation); and (iv) EU research calls (FP7, LIFE, INTERREG, etc.). All these funds include programmes for research on CC issues; but amounts allocated to marine Bd are small. The need was expressed for increased funds for research within the N-S Mediterranean co-operation. Finally, the current maximum project time span of 5 years is not sufficient to support long-term monitoring programmes.

- Turkey: There are no regular national sources for CC research. Presently, the Turkish National Research Council has allocated some funds for research on topics concerning natural hazards. Funds for research on sea level oscillation, acidification, sea current monitoring and global ocean observation systems were allocated by the Middle East Technical University, Institute of Marine Science, and Istanbul University. Some international funds were allocated by GEF. The MOE is involved in initiatives for new international projects, to include CC/Bd in c/m areas.

Cluster C

- Algeria: Since CC/Bd m/c issues are not yet identified as national priority, the access to funding sources is difficult. The central national funds, the National Scientific Research Council and relevant governmental agencies should

recognize them as priorities. Other potential sources are: the Environment fund and the National Funds for: (i) protection of coastal and marine areas; (ii) land-use planning and SD; and (iii) development of fisheries and aquaculture. All these funds are operational, the need is to sensitize respective DMs by providing justification and C/B analyses. International funds available / the country being eligible for / are: GEF, the French Fund for Global Environment (FFEM), the WB, EU SMAP, regional programmes, and those of NGOs involved in international co-operation.

- Egypt: The implementation of very large CC adaptation projects is needed, implying provision of funds far above possibilities of the major part of developing countries. Since the emission of GHGs in Egypt is negligible, it is justified to expect adequate international support for CC projects, including those on Bd. Technical and financial support should be provided by the EU, and international agencies, such as GEF and UNDP, already involved in national environment projects.

- Lebanon: The part of national budget allocated for research is very limited, far below needs and potential of the national scientific institutions. Opportunities for private funding sources are very limited. In principle, all scientific projects are implemented within international co-operation and support (GEF, other Agencies), with national co-funding in kind. Opportunities exist also for: (i) TB co-operation with Syria or at regional level; (ii) funding of CC/Bd m/c projects by GEF, FFEM, UNDP, UNEP-MAP RAC/SPA; and (iii) funding and technical support by: ALESCO, Bern Convention, EEA, WWF, IUCN, MedWet, MEDCOAST, MIO-ESDE, Birdlife Int., MEDMARAVIS, and various Mediterranean Oceanographic Stations and Universities. SAP BIO provides also opportunities for international co-operation and support. Significant contributions were allocated on the occasion of great oil pollution in July 2006, by United Arab Emirates, France, Italy, Switzerland, Spain and Canada, also UNEP, UNDP, EU, MAP-REMPEC, IUCN, Euronature, USAID, ICRAM, Mercy corps, IRS.

- Morocco: Regular national funding sources are: state budget through public institutions (High Commissariat for forests and desertification, State Secretariat for WR and Environment, Ministry of National Education and Scientific Research). Other national sources are: University Hassan II, some NGOs (ENDA Maghreb f. ex.). The potential international funds are: (i) FFEM, GEF – both requiring co-funding; (ii) through bi-lateral co-operation with France, Germany, Portugal and Spain; (iii) WB, African Development Bank, UNDP; (iv) donor countries: USA, Canada, Germany, Japan, others; (v) EU SMAP; and (vi) international organizations: WWF, Birdlife Int., Wetlands Int., Ciconia, IFAW, ICRD Canada, UK DFID, EEA, Islamic Development Bank, ISESCO.

- Syria: The Environment Fund was established in 2002 as part of the state budget, but the allocations for monitoring and research on CC/Bd in m/c areas are limited. Presently, a number of environment related projects has been proposed by respective Ministries, including impacts of CC/Bd in m/c areas, in particular for data collection, monitoring and research, and capacity building – all needing co-funding. Other sources, public and private, are weak and of limited extent. So far, the risks of CC impacts are still considered as limited and therefore not a priority. The potential international sources are: GEF, UNDP, UNEP/MAP, UNDESA, the Japanese Government, ALESCO, TEMPUS, also Arab and other international organizations.

- Tunisia: adequate funding of proposed plans and actions on CC and CC/Bd is the major constraint for their implementation; the international support being the major funding source, with the needed national contribution / co-funding. Funding of urgent actions is provided by Ministries responsible for environment, agriculture, tourism, the latter for actions dealing with vulnerability on SLR and socio-economic impacts on coastal areas. Additional funding might be obtained through research budgets of national scientific institutes (INSTM, INAT units), and bi-lateral agreements involving national institutions such as APAL. The potential international funding sources are: those liased with UNFCCC (related to: adaptation mechanisms and extreme events; and from the Kyoto Protocol out of the voluntary contributions by industrialized countries), also adaptation projects through WB, EU, EBRD, etc.

6.2. Comments on funding sources

Information given by national authors provides grounds for comments valid for the majority of countries, in most cases for all of them:

- a. There is a consensus about national funds presently available and allocated being far below the needs of and urgency for CC/Bd m/c related activities.
- b. Root causes for such a situation are: (i) the present level of priority of CC/Bd issues in national policy agendas is low and not adequate to CC/Bd impacts to be faced; (ii) the actual low level of priority is due to absence of facts presented and of an adequate public awareness, in particular due to poor sensibilization and influencing of the DMs; and (iii) to provide for influencing DMs, declaratory initiatives are superfluous, arguments and proven justification are needed, primarily by comparing costs for action and damage in case of no-action and by providing CBAs for selected national critical areas/cases.
- c. Funds for most urgent actions should be sought as top priority.
- d. The funds presently available and those listed as opportunities are country specific and dependent. Countries with a higher economic and institutional research capacity benefit from more or less considerable national funding sources, more or less regular and stable, but not enough or not at all yet addressed at CC/Bd issues. Other countries dispose with limited regular national sources, in practice very limited for CC/Bd and CC/Bd in c/m areas.
- e. The EU member countries, and in some cases also the actual candidates for membership, benefit from EU funding sources and programmes – candidate states from IPA pre-accession funds. Also, all non-member countries benefit from some EU specific funds/programmes (SMAP, f. ex.).
- f. Opportunities for private national funding are not realistic, except in case of the most developed countries.
- g. International funding, predominantly within international co-operation on CC/Bd issues has been sought as needed, beneficial, in most cases indispensable, with differing accents dependant on national specificities and potentials.
- h. Pending eligibility, funding by UN agencies (GEF, WB, UNDP, UNEP) within respective programmes and funds is still the major funding source and opportunity for almost all countries. France, Italy and Spain in a number of cases act as contributors.
- i. A number of donor sources were obtained so far, and should be considered as important opportunity. The hitherto and potential donors, in addition to the Mediterranean ones mentioned above, are: Austria, Canada, the Netherlands, Norway, Sweden, UK, US; also several international organizations and bodies, and few (private) funds.
- j. Due to the limited capacity of national institutions and experts to formulate, apply for and implement international projects, regional assistance and training was requested by several countries.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1. General assessments

Due to the nature of CC and CC/Bd phenomena and the actual state of relevant arrangements and actions, a number of wider considerations should be kept in mind when formulating conclusions and recommendations.

As an external framework, CC issues and actions of a general nature, in particular those on GHGs reduction and CC monitoring and research have to be taken into account, defining conditions, approaches and limits for CC/Bd m/c actions in general and within the SAP BIO context. The CC relevant Conventions define the role, responsibilities and obligations for all signatories. Therefore, harmonisation and co-ordination is needed with a number of the actors involved, and at appropriate levels.

Despite still serious gaps in knowledge and limitations concerning monitoring and research, there is a general consensus about:

- i. CC as already an occurring phenomenon; with little or no evidence at global or large ecosystems scale about any reducing or control of drivers;
- ii. the seriousness of expected impacts, some of them already irreversible, others dependant on timely reduction of GHG emissions and implementation of appropriate adaptation measures;
- iii. needs for immediate formulation and implementation of urgent actions in critical areas, based on existing knowledge, applying the precautionary principle; and
- iv. the need for a permanent reconsideration and updating of plans and activities once adopted and started.

With regard to the Mediterranean region the key facts are:

- i. the region is among the richest in biodiversity of global importance, with very high level of endemism and autochthonous species;
- ii. due to the present pressures, predominantly anthropogenic, a great number of globally important habitats, populations, species is already endangered, some of them under risk of extinction; presently Bd is declining rapidly due to land-use changes, climate change, invasive species, overexploitation and pollution.
- iii. the nature, value and level of actual ecosystem services rendered by regional biodiversity are of paramount importance for the resident population and respective national economies;
- iv. the expected CC/Bd impacts, those in m/c areas in particular; if not timely and appropriately dealt with, will result with: negative effects to intensify with rates and amounts of change; further reduction of ecosystems' resilience; and an increasing and intensifying loss of Bd - all to result with a high reduction of the value of rendered ecosystem services and serious consequences for resident population;
- v. due to the nature of phenomena and impacts, co-ordination across sectors and integrated management across scales will be needed.

The present action has provided through the preparation of national Overviews and sub-regional / Cluster and regional meetings, has provided for identification of: actual knowledge and references; relevant national activities implemented or in preparation; vulnerability assessment and identification of critical areas; identification of national needs and urgent actions; and actual and future funding sources.

The needs identified and urgent activities proposed are of differing nature, at various levels, most being interdependent. A number of activities identified as urgent are in fact prerequisites for the implementation of the subsequent key ones. Monitoring and research as one of key prerequisites need wider approaches. Finally, the regional and national contexts will have to be kept in mind.

When formulating conclusions and recommending provisions for follow up at regional level, a systematic and

logical approach was needed. Accordingly, synthesized conclusions are structured as follows: (i) main/key findings, (ii) priority needs, (iii) identification and defining of the key prerequisites; and (iv) formulation of a consistent set of annotated recommendations for follow up. In addition, key conclusions and recommendations presented by individual national Overviews are given briefly per countries in Annex VI.

7.2. Conclusions

The findings, needs and prerequisites presented below reflect the national ones, taking into account those formulated by (i) Sub-regional / Cluster syntheses, (ii) the Sub-regional / Cluster meetings, and (iii) the Regional meeting in Vibo Valentia.

7.2.1. Main findings

a. Facts and data provided by national Overviews differ in level and abundance of country specific information due to different national capacities, conditions and practices. Nevertheless, the Overviews are considered as a good base for further actions, their inputs to be further systematized, made user friendly and updateable.

b. Evidence is provided on key starting points, namely: (i) the very rich Mediterranean biodiversity being highly sensible to impacts of climate change; (ii) the climate change as an already occurring phenomenon; (iii) some impacts observed or occurring being probably irreversible; and (iv) the main concrete actions to limit consequences of CC relying on other anthropogenic causes reducing resilience and therefore increasing impacts on marine and coastal species and habitat. These facts call for urgent, harmonized and comprehensive actions.

c. National experts agree (in line with the international scientific consensus) on the importance and extent of risks of marine and coastal biodiversity in their countries due to CC, as a result of (and simultaneous complex interactions between):

i. changes in precipitation patterns and the resulting freshwater scarcity, increasing air and sea water temperature, enhancing UV radiation;

ii. sea level rise, likely to accelerate coastal erosion, marine intrusion into coastal aquifers and wetlands, and other effects;

iii. acidification (decreasing pH);

iv. change of hydrodynamic and hydrological parameters (e.g. local and regional currents, upwelling, thermal stratification, frequency of storms and extreme events, salinity, turbidity, nutrient supply...).

d. Expected effects of CC-driven stressors will affect marine / coastal biodiversity by producing shifts in the short-, medium- and long-term:

i. Short-term (ongoing and next decade): spatio-temporal patterns of biodiversity; migratory paths; abundance of species; eco-physiological processes (reproduction; immunological response affecting the individual performance of sensible species at various stages of their life history and possible adaptive selection pressure on species traits);

ii. Medium-term (decades): larval dispersal and recruitment; resource availability (food, habitat, etc.); primary and secondary production; complex (non-linear, non-independent) responses at the community / ecosystem level, likely leading to regime shifts and local extirpation of species and habitat losses; simultaneous effects of other human-driven stressors (e.g. over-fishing, pollution, habitat degradation, alien species), and land-sea links (e.g. soil erosion and desertification, agricultural runoff, river regulation, etc.);

iii. The long-term effects forecasted by current scenaria might be mitigated by the reduction of GHG emissions and other appropriate measures, while the above short and medium term effects are already expected to occur anyway;

iv. These biodiversity changes are likely to have profound direct socio-economical effects, and affect public health. Such effects are so far strongly underestimated in long-term planning of national economies.

e. National Overviews provided extensive surveys concerning vulnerability and critical sites (hot-spots) in national m/c areas, based on actual knowledge and predicted impacts of CC on biodiversity. Among the large number of critical areas, some of them require a particular and urgent attention due to tremendous socio-economical consequences, such as the Nile Delta and other most critical areas.

f. Different national conditions, political status, socio-economic status and potential, institutional inequality, attained level of relevant knowledge, etc. call for country and area specific approaches when developing CC/Bd related (sub) regional strategies and programmes.

g. So far, there is almost no CC/Bd targeted research at regional/national levels. Most implemented or on-going research refers to GHG emissions, less on other general CC phenomena, still less on CC/Bd phenomena and impacts. Presently, research attention is focused predominantly on terrestrial areas and sectoral (forestry and agriculture/fisheries, WR) issues, much less on m/c areas.

h. CC/Bd related monitoring programmes are still rare and mostly within short term international projects. In the majority of the countries some actions on biodiversity monitoring, species related mostly, are being implemented on regular or case by case basis. All countries have regular hydro and meteo monitoring, of indirect interest for CC/Bd. In several countries a regular monitoring on GHGs is on-going or in preparation. Presently there is no regular monitoring on CC/Bd in general, nor in m/c areas (with few countries as exceptions). Indicators, parameters and methodologies are not standardized.

i. All national documents refer to large gaps in knowledge and high uncertainty level.

j. All riparian countries are active (i) with respect to the UNFCCC, CBD, (ii) as Contracting Parties to the Barcelona Convention, its related Protocols, and the Almeria Declaration. The commitments related to UNFCCC and the Kyoto Protocol, mainly those on GHG emissions are at a high or relatively high level of national priorities. Other CC and the CC/Bd related issues are at a low level of national priorities, or not identified as priority at all. So far there is no Mediterranean nor national strategies on CC/Bd. CC issues and CC/Bd in particular are not part of national planning systems, the coastal and marine issues are not properly addressed within national/local land-use planning and ICZM. There is a consensus on the need to strengthen or update national legislations with regard to CC issues.

k. Levels: Some key problems and issues cannot be addressed at levels lower than the sub-regional or regional one. Problems concerning wetlands, lagoons, small islands, estuaries, freshwater habitats; other wider spread habitats such as: Mediterranean forests and maquis – shrubs; sand dunes; low-land areas; are shared by all or by the majority of countries. A number of phenomena concerns few countries only (f. ex. karst, islands, individual species). Problems related to open sea areas (NIS, impacts on thermophyluos and or „boreal” species, fisheries, Posidonia meadows...) concern all Mediterranean countries. Research and monitoring issues need regional and higher level approaches. Finally, for a number of issues such as capacity building and training, public awareness, methodologies and guidelines, funding strategies and opportunities, a regional approach and/or international co-operation and support are a must.

l. In most countries regular national sources are limited, in majority of countries very limited; private funds are available only in few countries. For many countries funding through multilateral co-operation is indispensable. The number of international projects is scarce, access to information often difficult. Very limited national and regional funds are allocated for research of CC in the marine realm, since most of on-going CC initiatives are focused on terrestrial and inland aquatic environments.

7.2.2. Needs of wider / regional importance

Among a large number of needs identified at national level, the following require particular attention due to their wider and/or regional aspects:

i. International co-operation. There is a consensus on needs for and benefits of CC/Bd related international co-operation, also for multi-lateral and/or bi-lateral one. The related implemented or on-going projects considered

as needed, successful and beneficial from a number of aspects. Countries with higher economic and institutional potential are looking at international co-operation primarily through needs for strengthened and more efficient actions. For other countries such co-operation is a must, firstly due to the need for scientific and technical assistance and capacity building; secondly, but not less important, as the predominant funding source.

ii. Integration of CC/Bd in m/c areas into national planning and management practices with ICZM as a broader framework. The need for linking the CC/Bd problems and actions in c/m areas with the coastal and marine areas management, has been emphasized by almost all Overviews, indicating ICZM as the indispensable broader conceptual framework and planning tool.

iii. Finally, further MAP RAC/SPA involvement, guidance and assistance, looking for initiatives at either Mediterranean or sub-regional levels, were unanimously requested.

7.2.3. Prerequisites to be met

The analysis of findings presented indicates that a number of prerequisites for comprehensive, concerted, efficient and timely actions are still not met or are met partially only, such as: status of CC/Bd in c/m areas in national policy agendas; sound stable funding; information and knowledge available; targeted research; monitoring; institutional and technical capacity and expertise; inventory of hot-spots; ranking priorities; raising public awareness and influencing decision makers.

Actions needed to meet these prerequisites are listed below, following their logical order. It is understood that their implementation should not postpone the most urgent short term actions based on the actual knowledge, to be implemented applying the precautionary principle.

a. Public awareness and information, influencing decision makers, putting CC/Bd issues at higher level of national priorities. All Overviews indicate a relatively low or low level of public awareness on risks from and impacts of climate change on national/local coastal and marine biodiversity, including proposals for respective socio-economic analyses. Increased awareness of general public, fluent tailored information addressed at scientific, industrial and technical communities should induce political pressure which, combined with a targeted approach to national decision-makers should result with putting CC/Bd issues at an adequate level of national priorities.

b. Provision of arguments for upgrading policy ranking. Well documented and justified documents should be prepared on: (i) the social, cultural and economic benefits of Bd and ecosystem conservation, (ii) valuation of rendered ecosystem services, (iii) socio-economic analyses, including importance and role of biodiversity as development resource. Also, selected CBAs and representative and replicable pilot actions should be implemented as reference and examples of good practices.

c. Funding of CC/Bd related activities. The need for consistent funding strategies was emphasized, assistance with that regard requested, by several Overviews, also, a regional action by RAC/SPA concerning funding strategies and opportunities.

d. Data and scientific information. Despite the impressive set of information and data collected, still a number of these (many at national level and in national language) are not registered and made available (grey literature), to: (i) scientists, (ii) local technical, planning and CZM responsible and bodies, (iii) NGOs and the general public. A comprehensive and user friendly information exchange system (CHM), comprising international scientific literature, capable for periodic updating and with a free public access, would prevent or minimize risks of redundancy, overlapping, and implementation of inappropriate or unsustainable actions. Also, practical solutions for exchange of information and harmonization across the region (including assistance to be provided) are needed.

e. Provision of necessary means and equipment to monitor and study the main impacts of CC on biodiversity and the resulting consequences of CC/Bd.

f. Filling gaps in knowledge, reducing uncertainties, targeted research. Short- and medium-term expected impacts can be dealt with in a comprehensive and sustainable way only after developing the adequate research lines

addressing the gaps in knowledge (see also Box 11.).

g. Monitoring. The need for long-term monitoring is obvious as prerequisite. Needs for strengthening of institutional and human capacities for such monitoring, and for related training and capacity building were emphasized by all documents. Support and provision of technical equipment is needed for several countries. The lack of comprehensive and systematic CC/Bd inventory and of ecosystems and species monitoring prevents a reliable assessment of nature and magnitude of CC impacts on biodiversity. The ongoing Bd monitoring initiatives at sub-national, national and transboundary levels might facilitate starting initiatives for broader monitoring schemes at spatial and temporal levels, focused on CC/Bd. Proposals were formulated for concerted actions at regional level, also for implementation of multi-lateral monitoring programmes.

h. Improving evidence and systematizing actual knowledge on vulnerability and hot-spots. A very large number of critical sites and areas were identified (see Annex IV), but the present list should not be considered as comprehensive. Further in-depth analyses are needed, including checking, justification, systematizing and ranking.

i. Comprehensive, harmonized and prioritized planning. Presently in no country exists a systematized planning approach concerning CC and CC/Bd issues. With that regard, the following is needed: (i) adaptation planning of CC impacts in general, CC/Bd in particular; to be integrated into national and local planning systems and practices, (ii) cross-sectoral interlinkages to be established, (iii) in case of m/c areas, interlinkages with ICZM processes and planning, the action to benefit from knowledge, methodology and experience of MAP, notably RAC/SPA and PAPI/RAC, (iv) representative and replicable pilot actions.

j. Awareness and training of specialists on fields related to the CC/Bd. Here, reference should be made at: „... most conservation biologists not aware of the impacts of climate change” (UNEP WCMC, 2003). This statement was implicitly confirmed in several national Overviews, by defining this activity as priority. Actions have to be targeted at scientists and professionals in ministries, agencies and bodies for environment protection and nature conservation / management.

7.3. Recommendations

Recommendations provided by national Overviews are presented in Annex VII.

Taking into account: (i) the main conclusions, needs and prerequisites to be met, presented above; (ii) findings by national Overviews; and (iii) findings of sub-regional meetings and of the regional one, the following actions are recommended:

a. Actions to provide for the best use of national Overviews and Regional Synthesis. Finalized documents should be distributed in order to (i) incite discussion and proof-checking; (ii) provide for feed-back; (iii) be used at respective levels, as appropriate.

b. Public awareness, influencing decision makers, setting CC/Bd as high priority in national agendas. A regional awareness raising programme to be implemented: (i) a regional document on expected critical impacts and a set of promotional leaflets to be prepared; also sub-regional and country specific documents; (ii) national awareness raising actions to be implemented, for some countries assisted; (iii) national actions aiming at setting up CC/Bd m/c issues as national priority, to be implemented and assisted; and (iv) pilot actions to be implemented.

c. Establishment and management of an open-access, regional database (including scientific literature, GIS-based thematic maps, etc.) promoted within the framework of UNEP/MAP, preferably at RAC/SPA, to feed on CC the existing Clearing House Mechanisms. This database should be usable for target groups (scientists, managers, operational responsible and the general public). At national levels, establishment of compatible national databases should to be promoted and assisted, including implementation of selected replicable pilot actions.

d. Provision of justification for more adequate national funding of CC/Bd activities, by: (i) preparing valuation of costs for actions vs. damage in case of non-action; (ii) valuation of rendered ecosystem services; (iii) assessment of importance and role of biodiversity as development resource; (iv) preparation of selected representative CBAs;

and (v) implementation of representative and replicable pilot actions.

e. National Inventories of Hot-spots in coastal and marine areas: (i) framework Inventory design to be prepared at regional level, to standardise the process; (ii) training at regional level; (iii) creation of prerequisites at national levels to be incited and supported; (iv) National Hot-spot Inventories to be prepared, offering assistance where needed; and (v) representative pilot actions to be implemented.

f. Monitoring. The complexity of problems calls for hitherto experiences from on-going separate CC and Bd monitoring activities, also experiences of early stages of MED POL. The monitoring indicators have to be identified and agreed on. The key problems (interrelation with on-going monitoring activities, system design, parameters, indicators, methodologies, institutional framework, capacity building, etc.) are of regional level firstly, to be dealt with at national levels secondly, involving also other relevant Agencies and bodies. The recommendation is: (i) to prepare a comprehensive Inception document; (ii) to organize an initial meeting of Mediterranean experts to set up the basis for further actions; and (iii) to encourage enlargement and adaptation of existing monitoring initiatives by including the CC component. Alternative: an international (?GEF?), regional project.

g. Research. Problems concerning targeted research on CC/Bd issues are of a multidisciplinary and multilevel nature, complex and in many cases country specific. The key problems are similar to those listed for monitoring, above. A number of priority research topics were listed in Overviews: refinement of modelling tools, response of species vulnerable to CC, non-linear response of ecosystems, and populations-to-ecosystem links. An in-depth further elaboration is needed to define lines of action, priorities, addressees, funding, co-operation and support, as prerequisites for a harmonized and comprehensive research. The recommendations are: (i) to establish a Mediterranean group of experts on CC/Bd research, (ii) to prepare a regional document for an Inception meeting, and (iii) to organize the meeting to set up the bases for a consistent CC and CC/Bd research programme.

h. Incorporating CC/Bd c/m issues in national planning practices. Here, the following should be taken into account: (i) that all development and land-use planning issues are strongly dependent on country specific legislation and practices; (ii) the need for a step-by-step approach: firstly at planning related to CC in general, secondly targeted at c/m areas, thirdly included in or properly addressed at ICZM; and (iii) the urgency of such initiatives being emphasized by a number of national documents. The recommendations are: (i) to prepare a comprehensive reference document, to present framework criteria, good practices, methodologies and examples; (ii) to organize a regional meeting to set up the basis for further actions; (iii) to implement training at appropriate level; and (iv) to implement pilot actions.

i. Actions aiming at strengthening ecosystems resilience, such as (i) increasing MPAs connectivity; (ii) adapting legislation on coastal land use to predictions of CC impacts; and (iii) reducing pollution and other anthropogenic pressures, all to be implemented as collateral measures to mitigate CC/Bd impacts.

j. Reinforcement of legal and institutional frameworks through adapting/updating legislation on CC issues and establishment of national bodies in charge of CC issues, providing for a regional co-ordination. Furthermore, CC/Bd planning should be co-ordinated with other sectors under pressure of CC effects, such as water resources, agriculture, fisheries, tourism, infrastructures, and land use.

k. Capacity building and training. All Overviews reported the need for capacity building and/or training, at differing levels and on various topics. The developed countries might be considered as having training implementing capacities, others as potential beneficiaries. The reported requests include training and/or capacity building on: monitoring, planning, co-operation, project formulation, training of specialists. The recommendation is to prepare and implement a regional programme of training and capacity building; such a programme to be liased with respective key actions.

l. Co-operation. Taking into account the opportunities identified, eligibility and funding problems, and examples of successful co-operation: (i) a regional document on good practices and problems should be prepared and disseminated; (ii) a training document should be prepared, related to the formulation and implementation of

international projects; (iii) training to be implemented at appropriate level(s); and (iv) assistance to be provided, where requested.

m. Funding. Recommendations: (i) to disseminate to target groups the supporting documents defined in point 4. above; (ii) to prepare and disseminate an informative document on the needs for stable and permanent funding and good practices and opportunities; and (iii) to include CC/Bd related topics in the programme of the planned SAP/BIO Donors Conference, as appropriate.

n. The Overviews expressed a high praise for the efforts and activities of RAC/SPA within the preparation and implementation of the present action. Nevertheless, it was recommended to (i) analyze the capacity of RAC/SPA to implement the enlarged future CC/Bd m/c programme; and (ii) to provide for further strengthening of respective Center's human capacities to be involved.

o. Planning, design and implementation of concrete actions:

- National CC and CC/Bd Strategies and Action Plans (coastal and marine areas included) must be prepared / revised and adopted;
- practical actions should be planned, designed and implemented: firstly, the urgent actions, based on actual knowledge; secondly, short-term actions, urgent and those aiming at achievement of tangible results within a short time span, pilot actions included; and thirdly medium-term projects, programmes and actions; all based on a long-term Operational Programme
- permanent national systems of progress monitoring, reporting, and updating of CC/Bd strategies and plans to be established and made operational.

ANNEX I.

INSTITUTIONAL ARRANGEMENTS

1. Implementing agency:

The Regional Activity Centre for Specially Protected Areas (RAC/SPA), Mediterranean Action Plan (MAP), UNEP

2. Programme:

The Strategic Action Programme for the Conservation of Biological Diversity in the Mediterranean Region (SAP BIO)

3. Action:

Updating on Climate Change issues of SAP BIO

4. Participating countries, per Clusters:

- Cluster A, Adriatic countries: Albania, Bosnia & Herzegovina, Croatia, Montenegro, Italy (Adriatic areas), Slovenia;
- Cluster B, North Mediterranean non-Adriatic countries, Israel and Turkey: Cyprus, Greece, Israel, Italy (non-Adriatic areas), Malta, Spain, Turkey;
- Cluster C, North African and Middle-East Arab Mediterranean countries: Algeria, Egypt, Lebanon, Morocco, Syria and Tunisia.

5. Consulting institution:

Nautilus, Societa Cooperativa, Vibo Valentia, Italy

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ANNEX II.

LISTS OF EVENTS AND OUTPUTS

I. LIST OF EVENTS

1. Inception meeting, RAC/SPA and the inner Working Group, Tunis. April, 11-12, 2008
2. Working Meeting of Adriatic national experts for the updating on Climate Change issues of the Strategic Action Programme for the Conservation of Biological Diversity (SAP BIO) in the Mediterranean Region, Split, Croatia. 23-24 October 2008
3. Working Meeting of national experts of North Mediterranean non-Adriatic countries and Israel for the updating on Climate Change issues of the Strategic Action Programme for the Conservation of Biological Diversity (SAP BIO), Santa Pola and Tabarca, Alicante, Spain. 10-11 November 2008
4. Working Meeting of national experts of North African and Middle-East Arab Mediterranean countries for the updating on Climate Change issues of the Strategic Action Programme for the Conservation of Biological Diversity (SAP BIO) in the Mediterranean Region, Tunis. 28-29 October 2008
5. SAP BIO-Working Group Meeting on Climate Change and Biodiversity in the Mediterranean Region, Vibo Valentia, Italy. 11-12 December 2008

2. LIST OF OUTPUTS

2.1. Regional outputs

- UNEP-MAP RAC/SPA. 2008b. Impact of Climate Change on Biodiversity in the Mediterranean Sea, By Perez, T. Ed. RAC/SPA, Tunis 61 pp.
- Le Ravallec C. 2008: Impacts des changements climatiques sur la biodiversité de Méditerranée, Constitution d'une base de données bibliographiques, PNUE / PAM / CAR-ASP.
- Informal Note on Inception meeting of the RAC/SPA Inner Working Group, Tunis. April, 11-12, 2008, prepared by J.A. Garcia Charton.
- Conclusions and recommendations of the SAP BIO-Working Group Meeting on Climate Change and Biodiversity in the Mediterranean Region, Vibo Valentia, Italy. 11-12 December 2008.
- The present document.
- The Addendum to SAP BIO.

2.2. Sub-regional / Clusters' outputs

- UNEP-MAP RAC/SPA, 2009a. Synthesis of National Overviews on Vulnerability and Impacts of Climate Change on Marine and Coastal Biodiversity in the Adriatic Countries, by Pavasovic A, Ed. RAC/SPA, Tunis.
- UNEP-MAP RAC/SPA, 2009b. Synthesis of National Overviews on Vulnerability and Impacts of Climate Change on Marine and Coastal Biodiversity in the North Mediterranean countries (Adriatic coast excluded), and Israel. by Garcia-Charton, J.A. Ed. RAC/SPA, Tunis.
- UNEP-MAP RAC/SPA, 2009c. Synthèse des Revues Nationales sur la vulnérabilité et les impacts de changement climatique sur la biodiversité marine et côtière dans les pays arabes méditerranéens, par Ben Hadj, S. Ed. RAC/SPA, Tunis.

- Conclusions and recommendations of the Working Meeting of Adriatic national experts for the updating on Climate Change issues of the Strategic Action Programme for the Conservation of Biological Diversity (SAP BIO) in the Mediterranean Region, Split, Croatia. 23-24 October 2008.
- Conclusions and recommendations of the Working Meeting of national experts for the updating on Climate Change issues of the Strategic Action Programme for the Conservation of Biological Diversity (SAP BIO) in the NorthMediterranean non-Adriatic, sub-Region and Israel , Santa Pola and Tabarca, Alicante, Spain. 10-11 November 2008.
- Conclusions and recommendations of the Working Meeting of North African and Middle East Arab Mediterranean national experts for the updating on Climate Change issues of the Strategic Action Programme for the Conservation of Biological Diversity (SAP BIO) in the Mediterranean Region, Tunis. 28-29 October 2008.

2.3. National outputs

Albania

- UNEP-MAP RAC/SPA. 2008c. "National Overview on Vulnerability and Impacts of Climate Change on Marine and Coastal Biodiversity in Albania", by Dedej Z. Ed. RAC/SPA, Tunis.

Algeria

- UNEP-MAP RAC/SPA. 2008d. "Impact des changements climatiques sur la biodiversite marine et cotiere en Algerie", par Grimes S. Ed. RAC/SPA, Tunis.

Bosnia & Herzegovina

- UNEP-MAP RAC/SPA. 2008e. UNEP-MAP RAC/SPA. 2008. "National Overview on Vulnerability and Impacts of Climate Change on Marine and Coastal Biodiversity in Bosnia and Herzegovina", by Vucijak B. Ed. RAC/SPA, Tunis.

Croatia

- UNEP-MAP RAC/SPA. 2008f. "National Overview on Vulnerability and Impacts of Climate Change on Marine and Coastal Biodiversity in the Republic of Croatia", by Radovic J. Ed. RAC/SPA, Tunis.

Cyprus

Contribution provided at the Cluster meeting (see Methodology and Annex II).

Egypt

- UNEP-MAP RAC/SPA. 2008g. "National Overview on Vulnerability and Impacts Related to Climate Change on Mediterranean Marine and Coastal Biodiversity in Egypt", by Halim Y. Ed. RAC/SPA, Tunis

Greece

- UNEP-MAP RAC/SPA. 2008h. "National Overview on Vulnerability and Impacts of Climate Change on Marine and Coastal Biodiversity in Greece" by Zenetos A. & N. Streftaris. Ed. RAC/SPA, Tunis.

Italy, (except the Adriatic coast):

- UNEP-MAP RAC/SPA. 2008i. "National Overview on Vulnerability and Impacts of Climate Change on Marine and Coastal Biodiversity in Italy (except the Adriatic coast)", by Fabio Badalamenti, Franco Andaloro, Giandomenico Ardizzone, Giorgio Bavestrello, Lisandro Benedetti-Cecchi, Carlo Nike Bianchi, Renato Chemello, Francesco Colloca, Marco Curini Galletti, Marco Milazzo, Carla Morri, Stefania Puce, Leonardo Tunesi . Ed. RAC/SPA, Tunis.

Italy, Adriatic coast

- UNEP-MAP RAC/SPA. 2008j. "National Overview for the Italian Adriatic Coast on Vulnerability and Impacts of Climate Change on Marine and Coastal Biodiversity", by: Paolo Guidetti, Laura Aioldi, Roberto Ambrosini,

Carlo Nike Bianchi, Ferdinando Boero, Roberto Danovaro, Serena Fonda-Umani, Mario Morri, Carla Morri, Anna Occhipinti-Ambrogi, Diego Rubolini, Cecilia Totti . Ed. RAC/SPA, Tunis.

Israel

- UNEP-MAP RAC/SPA. 2008k. „National Overview on Vulnerability and Impacts of Climate Change on Marine and Coastal Biodiversity in Israel“”, by Galil B. Ed. RAC/SPA, Tunis.

Lebanon

- UNEP-MAP RAC/SPA. 2008m. “Vue d'ensemble nationale sur la vulnérabilité et les impacts des changements climatiques sur la biodiversité marine et côtière en Liban”, par Bitar G. Ed. RAC/SPA, Tunis.

Malta

- UNEP-MAP RAC/SPA. 2008n. “National Overview on Vulnerability and Impacts of Climate Change on Marine and Coastal Biodiversity in Malta”, by M. Rizzo, D. Borg and S. Saliba Ed. RAC/SPA, Tunis.

Montenegro

- UNEP-MAP RAC/SPA. 2008p. “National Overview on Vulnerability and Impacts of Climate Change on Marine and Coastal Biodiversity in Montenegro”, by V. Buskovic. Ed. RAC/SPA, Tunis.

Morocco

- UNEP-MAP RAC/SPA. 2008q. “Vue d'ensemble nationale sur la vulnérabilité et les impacts des changements climatiques sur la biodiversité marine et côtière en Méditerranée marocaine”, par H. Bazairi. Ed. RAC/SPA, Tunis.

Slovenia

- UNEP-MAP RAC/SPA. 2008r. “Slovenian National Overview on Vulnerability and Impacts of Climate Change on Marine and Coastal Biodiversity”, by L. Lipej & Z. Dobrajc. Ed. RAC/SPA, Tunis.

Spain

- UNEP-MAP RAC/SPA. 2008s. “National Overview on Vulnerability and Impacts of Climate Change on Marine and Coastal Biodiversity, Spain”, by N. Marba Bordalba . Ed. RAC/SPA, Tunis.

Syria

- UNEP-MAP RAC/SPA. 2008t. “National Overview on Vulnerability and Impacts of Climate Change on Marine and Coastal Biodiversity in Syria”, by Ibrahim A., Ed. RAC/SPA, Tunis.

Tunisia

- UNEP-MAP RAC/SPA. 2008u. “Vue d'ensemble nationale sur la vulnérabilité et les impacts des changements climatiques sur la biodiversité marine et côtière en Tunisie” par Romhdane M. S., Ed. RAC/SPA, Tunis.

Turkey

- UNEP-MAP RAC/SPA. 2008v. “National Overview on Vulnerability and Impacts of Climate Change on Marine and Coastal Biodiversity in Turkey”, by Ozturk B. Ed. RAC/SPA, Tunis.

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3. Working Meeting of national experts of North Africa and Middle East Arab Mediterranean countries for the updating on Climate Change issues of the Strategic Action Programme for the Conservation of Biological Diversity (SAP BIO) in the Mediterranean Region, Tunis. 28-29 October 2008.

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4. Working Meeting of national experts of North Mediterranean non Adriatic countries, Israel and Turkey for the updating on Climate Change issues of the Strategic Action Programme for the Conservation of Biological Diversity (SAP BIO), Santa Pola and Tabarca, Alicante, Spain. 10-11 November 2008.

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5. SAP BIO Working Group Meeting on Climate Change and Biodiversity in the Mediterranean Region, Vibo Valentia, Italy. 11-12 December 2008.

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ANNEX IV.

NATIONAL OVERVIEWS: LIST OF CRITICAL AREAS

SO FAR IDENTIFIED

Albania

- Lagoons: Drini-Mati delta (Patok), N of Erzemi delta, Semani Vjosa area, S Vjosa area, Cheka lagoon – SLR, flooding, low strands destruction, in Mati new wetlands;
- Karavasta and Narta lagoon – SLR, complete change of ecosystem into a saline one;
- Wetlands, former swamps of Durres, Myzeque, Narta, Vrug – SLR, flooding, impacts on agricultural lands habitats;
- Sandy beaches in subsidence areas: Shengjin, Kune-Vain, Tale, Patok, Oshem – SLR, flooding;
- Beaches in elevated areas: Durres, Golem, Myzeque, Divjake, Hirmare, Borch – SLR, partially affected;
- In addition, Patok, Durres, Karavasta-Ndemenas coastline shifting inwards;
- Skutari (Skadar) lake;
- Forests in coastal area – individual areas not specified.

Algeria

- Sandy coasts of Reghaia-Kadous, of Zeralda-Sedi Fredj, of Mostaganem, El Kala;
- Low-lying beaches of Jijel, Skikda, Ghazaouet;
- Low-lying rocky coasts (vermets) of Kouali (Tipaza) and Mars El Hadjadj (Arzew);
- Sandy beach of Chenoua (Tipaza), the eastern coast of Bejaia;
- Humid coastal zones of El Kala, Skikda and Macta.

Bosnia & Herzegovina

- Neum coastal and marine area;
- Wetland Hutovo blato (Ramsar site and Nature Park);
- Mostarsko blato, Livanjsko polje;
- Neretva, Trebišnjica, Cetina rivers and tributaries (Trebizat river), including riparian areas;
- Lakes and reservoirs: **Boračko, Blidinjsko, Buško, Jablaničko, Ramsko, Bilečko.**

Croatia

- Critical karst areas of high Bd importance: mountains Velebit, Biokovo (MTR, Ann. Prec.);
- Endemic fish species: rivers Zrmanja, Krka, Cetina, Neretva tributaries (MTR, Ann. Pr.);
- Estuaries and lagoons: Mirna, Krka, Zrmanja, Neretva, Pantan (SLR, MTR, Ann. Pr.);
- Intertidal mudflats: Neretva estuary, N. Dalmatia (SLR, MTR);
- Salt pans, muds, mudflats: NW part of Ravni kotari, Kolensko and Velo/Malo blato (Pag), Ninsko, small wetlands/ ponds (MTR, Prec.);
- Marine habitats of particular value: Brijuni, Kornati, Telascica, Lastovo, Mljet;
- Islands' endemism and biodiversity: Krk, Cres, Vis and small off-shore islets (Palagruza, Jabuka, Sv. Andrija, Susac), cliffs on bigger islands (SLR, MTR, Ann. Prec.);

- Coastline adjacent marine areas: endemic marine fauna/flora, Posidonia beds (STR);
- Important nurseries: Velebit Channel, Neretva Delta, Jabuka Pit; marine reserves Limski Bay and Maloston Bay (STR, change of water mass movements);
- Sand/shingle beaches: Rab, Neretva, Mljet Sapljunara beach, islands, others (SLR);
- Marine lakes Zmajevsko oko, Mir, two Mljet lakes (SLR, MTR, Ann. Prec.);
- Karst habitats: underground/terrestrial aquatic habitats (Ann. Prec.), submarine karst caves/pits with underground fresh water input (SLR, Ann. Prec.);
- Freshwater lakes: Vransko- Pakostane (reedbed also), Vransko-Cres island (SLR, MTR, Ann. Precip.), marine coraligenous formations (STR), Mljet Veliko lake (SLR, STR, MTR);
- Motovun wet alluvial oak forest, the only one in the Mediterranean;
- Autochthonous sorts of Mediterranean/Adriatic agricultural species and aromatic plants.

Cyprus No data provided.

Egypt

- Lagoons: Maryut, Edku, Borullus, and Manzala and Bardaweel;
- The Northern area of Nile Delta

Greece

Impacts presented and commented in detail but critical areas not geographically identified.

Italy

(per Provinces – See also Ch. 4.2, Map 2.)

- Liguria: Coralligenous assemblages / aggregations of *Lithophyllum lichenoides* within the Marine Protected Areas of: Isola di Gallinara, Isola Bergeggi, Portofino, Cinque Terre;
- Tuscany: Areas at risk from SLR: Verisilia Riviera; Coralligenous assemblages / aggregations of *Lithophyllum lichenoides* within the MPAs of: Arcipelago Toscano, Secche della Meloria;
- Latium: Areas at risk from SLR: Fondi and Pontina plains; Coralligenous assemblages / aggregations of *Lithophyllum lichenoides* within the Marine Protected Areas of: Secche di Tor Paterno, Isole Pontine di Ponza, Palmarola and Zannone, Isole di Ventotene e Santo Stefano;
- Campania: Areas at risk from SLR: delta of Volturno (the Gulf of Gaeta), delta of Sele (the Gulf of Salerno); Coralligenous assemblages / aggregations of *Lithophyllum lichenoides* within the Marine Protected Areas of: Regno di Nettuno (Isole di Ischia, Vivara and Procida), Isola di Capri, Punta Campanella, Santa Maria di Castellabate, Costa degli Infreschi;
- Sardinia: Areas at risk from SLR: Pilo lagoon, Tortoli lagoon, Gulf of Orosei (beach and lagoon), Murtas Beach, Porto Pino and Palmas (Sardinia), Gulf of Cagliari, Gulf of Oristano; Coralligenous assemblages / aggregations of *Lithophyllum lichenoides* within the Marine Protected Areas of: Asinara, Capo Testa – Punta Falcone, Arcipelago della Maddalena, Tavolara – Punta Coda Cavallo, Golfo di Orosei – Capo Monte Sannu, Capo Carbonara, Penisola del Sinis – Isola di Mal di Ventre, Capo Caccia – Isola Piana;
- Sicily: Areas at risk from SLR: Stagnone di Marsala, Trapani and Paceco saltmarshes; Noto and the Vendicari lagoon, Pantani Cuba and Longarini; Vermetid platforms within the Marine Protected Areas of: Egadi and Capo Gallo – Isola delle Femmine; Coralligenous assemblages / aggregations of *Lithophyllum lichenoides* within the Marine Protected Areas of: Isole Egadi, Capo Gallo e Isola delle Femmine, Isola di Ustica, Isole Eolie, Isole Ciclopi, Plemmirio, Isole Pelagie, Isola di Pantelleria; Posidonia recife barrier of Capo Feto SCI (Site of Community Interest);

- Apulia: Areas at risk from SLR and/or biodiversity loss: Salento Peninsula (marine caves), Coastal dunes and Alimini coastal lakes, MPA Torre Guaceto, Apulian coastal lakes and wetlands, Lesina and Varano lagoons, Tremiti Archipelago (and local MPA);
- Marche: Areas at risk from SLR and/or biodiversity loss: Conero Promontory;
- Emilia-Romagna: Areas at risk from SLR and/or biodiversity loss: Coastal defences, Padanian Plain and Po delta system;
- Veneto and Friuli Venezia Giulia: Areas at risk from SLR and/or biodiversity loss: Venice and Grado-Marano lagoons, Miramare MPA.

Israel

Impacts presented and commented in detail, critical areas not geographically identified.

Lebanon

- The Accar bay;
- Coastal area of Tyr;
- Small islands.

Malta

- Low-lying NE coast of Maltese islands, sand dunes and sandy beaches,
- Coastal located areas with rare and endemic species;
- Freshwater rock pools,
- Coastal located Special Areas of Conservation and SPAs.

Montenegro

- Coastal lagoons, lowlands, Tivat Salinas, Buljarica marsh/bay, Velika plaza-Stoj-Knete-Ada Bojana, Bojana river estuary: SLR, change of precipitation pattern, saltwater intrusion, changes of ecosystem functioning;
- Bay of Kotor: SLR, change of mass movements, impacts on ecosystem functioning.
- MPAs: Platamuni, Katici island, Stari Ulcinj island – STR, change of mass movements, impacts on ecosystem functioning;
- Bay of Kotor, port of Bar, Ulcinj – Milena Port, Bojana river estuary: thermophilous species;
- Bojana river estuary, Knete and Port Milena, Buljarica marsh, Jaz river, Morinj bay: conversion in permanent marine, salted waters;
- Sub-Mediterranean Starocrnogorska karstic area, Kuci-Zijovo, mountains Rumija, Lovcen, Orjen: MTR, precipitation pattern change, hydrology, impacts on ecosystem functioning;
- Skadar lake (National Park and Ramsar site), Gornje Blato, Boljesestre: WTR, MTR, impacts on hydrology, on ecosystem functioning, birds ...

Morocco

- Estuary of Oued Moulouya;
- Marshes and swamps between Fnideq et Martil;
- Lagoons: Nador and Smir;
- Bays of Tanger and Al Hoceima;
- Cape Trois Fourches;

- Forest areas of Tanger, Tétouan, Chefchouan and Nador;
- Coastal stretches of bays of Tétouan-Smir, Al Hoceima, Bou Areg, and Saidia.

Slovenia

- Secovje salina NP, other salinas, coastal wetlands, Skocjan inlet – impacts: SLR, flooding, salt water intrusion, habitat degradation/loss, endangered: breeding colonies, nesting sites;
- Trieste bay – STR, change in mass movements, impact on relict / „boreal” species;
- National c/m areas – STR: coral bleaching, NIS, N-wards shifting of thermophilous species;
- Coastal flysch cliffs, SLR: increased erosion.

Spain

- Ebro Delta, Llobregat Delta, with 50 cm SLR, and presently reduced sediment transport – 50% of areas to disappear; coastal lagoons 5 km long at Cabo de Gata,
- Coastal low land areas; about 20 km along the Manga del Mar Menor, Mazarrón, Carboneras - Almeria, inland retreat likely; Albufera de Valencia, Santa Pola - Alicante,
- Beach erosion and retreat along the entire Spanish Mediterranean coast (Mazarrón, Murcia; Carboneras, Almería; Puçol and Massalfasar, Castellón; Albufera de Valencia, Valencia; Santa Pola, Alicante). The map on projected beach retreat for year 2050,;
- Posidonia oceanica meadows along the Spanish Mediterranean (losses already occurring due to anthropogenic impacts);
- All wetlands and marine ecosystems dominated by sessile organisms (red coral, gorgonians, sponges, ...).

Syria

The most critical areas, as listed:

- Ras Al-Bassit, Oum Al-Tiur, Wadi Kandil, Joun Jablah et Al-Hamidiyah, Ibn Hani, Al-Azhari;
- Estuaries: Al-Kabir Al-Shimali, Al-Housen, Al-Kabir Al-Janobi;
- Beaches: Jablah, Baniyas, Tartous, Al-Nawras, Al-Bassit, Blue Coast, Al-Rimal Al-Zahabih;
- Coastal valley: Al-Ghamka;
- 15 sites in coastal area of archaeological importance, Ras Shamra, Amrit and Arwad;
- Islands: Arwad, Al-Hbas, Al-Namil and Abo Ali;
- Sea water intrusion into aquifers in coastal plains of Al-Hamidiyah near Baniyas, at Al-Bassa and N of Lattakia (zone Dimsarko, and area located N of Wadi Kandil);
- 18 freshwater springs, primarily in the Baniyas area.

Tunisia

The most critical areas, as listed:

- Lagoons: Bizerte, Garaet Ichkeul, and Ghar el Melh;
- Salt ponds: Kalaat el Andalous;
- Humid areas: The Gulf of Gabes;
- Archipelagos and islands: Kuriat, Kneiss, Kerkennah and Jerba;
- Sandy beaches: all sandy beaches along the coastal strip.

Turkey

- SPAs: Belek, Kas-Kekova, Patara, Fethiye-Gocek, Koycegiz-Dalyan, Gokova Bay, Datca-Bozburun, Foca.
- Rivers: Gediz and Menderes.
- Wetlands: Gediz delta, Kucuk Menderes delta, Buyuk Menderes delta, Baffa lake, Koycegiz lake, Goksu delta, Tuzla lake, Yumurtalik lagoon, Akyatak lagoon
- Vermetid reefs: Datca, Gazipasa, Cevlik.

ANNEX V.

NATIONAL OVERVIEWS: NEEDS IDENTIFIED AND URGENT ACTIONS PROPOSED

CLUSTER A

Albania

Needs identified:

- Need for a national CC/Bd policy;
- Improved knowledge on: occurring impacts, ecosystems resilience, adaptive capacity and critical factors;
- Vulnerability/hot-spots inventory;
- Improved legal framework;
- Monitoring programme and facilities;
- Capacity building;
- Increased public awareness.

Urgent actions proposed:

- Formulation and implementation of a focused research programme;
- Establishment and making operational a pertinent monitoring system;
- Preparation of a vulnerability / Hot-spots Inventory;
- Improving of wetlands and lagoons management;
- Establishing the financial support mechanism;
- Implementation of preservation measures and APs;
- Capacity building and training;
- Raising public awareness.

Bosnia & Herzegovina

Needs identified:

- CC/Bd issues to be set up as national priority;
- Improved knowledge on occurring impacts;
- Vulnerability and hot-spots inventory;
- Elaboration of national strategies/programmes; training, education,
- Awareness raising;
- Capacity building for CDM projects.

Urgent actions proposed:

- Preparation of a vulnerability assessment and Hot-spots inventory;
- Preparation of national CC scenario, of NAP on CC/Bd, of APs for vulnerable species;
- Intensified international co-operation; implementation of TB B&H/Cro Neretva/Maloston project;
- Awareness programme.

Croatia

Needs identified:

- CC/Bd issues to be set up as priority in strategies and legislation;
- Hot-spots inventory;
- Revision of PAs network and MEN;
- Mapping of marine habitat types;
- Monitoring system to be funded and established;
- Targeted research and conservation programmes;
- International research and monitoring programmes;
- N strategies and APs on adaptation/conservation and on invasive species;
- Wetlands' restoration projects.

Urgent actions proposed:

- Revision of management plans for: NPs, PAs, MEN networks; completing MEN;
- Hot-spots inventory;
- Establishment of CC related monitoring;
- Development of CC/Bd targeted APs;
- Implementation of Neretva/Maloston TB project;
- Improving co-operation among national institutions, intensifying international co-operation;
- Public awareness programme.

MontenegroNeeds identified:

- National/sectoral strategies, to include CC and CC/Bd in c/m areas;
- An infobase on CC/Bd;
- Monitoring and research on CC and CC/Bd, including capacity building, training, equipment;
- A national CC scenario;
- PAs in forestry.

Urgent actions proposed:

- NAP and scenario on CC to include Bd in c/m areas;
- Actions to integrate CC and CC/Bd in sectoral strategies;
- Adapting the statistics and monitoring programmes, providing for training and equipment;
- A GHG inventory;
- Implementation of new CC/Bd related international programmes.

SloveniaNeeds identified:

- In-depth knowledge on: c/m areas, reduction of GHG emissions, increased use of RES; evidence of: CC phenomena, SLR, flooding, erosion;
- Hot-spots inventory;
- Monitoring of: eco-process modifications, impacts on all national wetlands, coral bleaching whether CC related.

Urgent actions proposed:

- Issues concerning CC in national c/m area to be set up as priority in policy agenda;
- Establishment of a working body within NCC Committee;
- Implementation of baseline research / studies on: meteo- and oceanographic parameters, bioinvasion, meridionalization, decrease of fish stocks;
- Preparation of studies within ongoing ICZM projects for 3 coastal municipalities, on SLR impacts and flooding risk; and a pilot study on wetlands restoration;
- Establishment of an Adriatic TB network of experts and of a system for exchange of information.

CLUSTER B

The Overviews of Cluster B presented together the needs and urgent actions.

Greece

Needs identified and urgent actions proposed:

- Reducing actual gaps in knowledge, in particular related to: air/sea exchanges, extremes of SL; systemic monitoring of spatial and temporal shifts in fisheries, benthic communities, NIS, plankton communities, consolidation of data, co-ordination of activities;
- Data collection and monitoring programmes on NIS, including impact studies, development of pertinent indicators, training programmes;

- Legislation needs improvement at national and international levels;
- Regular national reports to be prepared on CC/Bd.

Israel

Needs identified and urgent actions proposed:

- The need for more research on CC/Bbd in national m/c areas is defined as the fundamental one, in particular relates to: non-linear responses of littoral systems on CC, in particular on simultaneous effects of multiple stressors in CZs; linking species and populations to communities and ecosystems dynamics;
- Development of predictive modelling tools;
- Multidisciplinary studies (gathering respective specialists, training and capacity building needed);
- Actions to be coupled with international co-operation and assistance.

Italy

Needs identified and urgent actions proposed:

- To minimise effects negatively affecting ecosystem resilience, anthropogenic impacts primarily, by: building monitoring networks of scientists, improved interactions with local authorities, mitigate GHG emissions, reduce energy consumption, develop RES, improve WRM;
- Safeguard of natural communities and ecosystem functioning, by: (i) Network of MPAs, such as an expanded AdriaPAN; (ii) an inception meeting of regional / sub-regional (Adriatic) experts; (iii) research on MPAs, improved management of other marine areas; and (iv) establishment of permanent Monitoring Observatory, other countries' experts to be trained and included;
- Developing tools for implementing dialogue between politicians and researchers;
- Providing for restoration of lost habitats and polluted waters, by: (i) conservation / restoration measures; and (ii) tools/procedures to be identified for Directives on Water Framework and Nitrates;
- Funding and implementation of long term monitoring and research (both multidisciplinary and on an international scale), to understand and predict the effects of climate change on marine ecosystem structure (e.g. species composition, food web lengths, size distribution) and functioning (e.g. biomass, production and decomposition processes, predator-prey interactions). Assessment of the relative role and or synergism of fishing, eutrophication, and climate change on variation of fish stocks;
- Creation of a network of sampling sites, preferably within the system of Italian (and Euro – Mediterranean) MPAs, to measure Bd variables related to climate change;
- To limit CC impacts on Mediterranean agro-species, to implement land use management practices in accordance with adaptability of plant varieties.

Malta

Needs identified and urgent actions proposed:

- actions to put CC on top of national agenda
- to address gaps in information and knowledge on: CC impacts (by downscaling regional data); biology and ecosystems, distribution of marine habitats and rare species;
- systematized collection of relevant data and information, Database to be prepared;
- monitoring schemes to be developed on biology and current status of species and habitats;
- research on analysis and assessment of CC impacts, vulnerability assessment for key species, studies on adaptation measures;
- determination of costs of no-action and research towards valuation of ecosystem services;
- training on: CC impacts and risk assessment; adaptation options, CBAs;
- strengthen international co-operation.

Spain

Needs identified and urgent actions proposed:

- Promotion of research on CC issues and their synergies with other impacts on marine and coastal biodiversity;
- Reduction of gaps in knowledge, in particular related to: time series on climate parameters (seawater temperature,

sea level rise); distribution and conservation status of vulnerable ecosystems; impacts of CC on rainfall (increased flood/drought events); identification of climatic threshold values for shifts in coastal ecosystems; life-cycle of invertebrate populations (reproductive efforts, successful reproduction and recruitment of larvae, contribution made by asexual reproduction and regeneration in maintaining populations), gene flow between populations and dispersion of propagules, adaptive capacity to stress; ecosystem functioning; eco-physiological studies on affected species, predictive models in CC/Bd under CC scenarios. Long-term monitoring: of relevant processes, of ecosystems and habitats vulnerable to CC. Measures for a planned retreat from vulnerable coastal areas;

- Increasing the number of MPAs;
- Increasing participation of Spanish research and management institutions in international programmes;
- Strengthening dissemination of relevant information;
- Implementation of targeted training activities.

Turkey

Needs identified and urgent actions proposed:

- Strengthening the legal support to CC issues at national and international levels;
- Increasing research efforts to understand and assess CC effects on m/c Bd;
- Launching of a monitoring programme to assess CC/Bd in m/c areas;
- Support for long-term academic initiatives for studies of: fisheries shifts, risks to coastal habitats (wetlands, beaches, rivers, etc.), benthic habitats, distribution shifts of NIS, impacts on marine mammals;
- Implementation of targeted training and awareness programmes, according to stakeholders' demands and priorities.

CLUSTER C

Algeria

Needs identified

- Formulation and implementation of a national research programme on CC/Bd in m/c areas. Upgrading and adaptation of the legal, institutional and financial arrangements for needs concerning CC/Bd in m/c areas; defining of competencies and responsibilities for co-ordination and implementation of relevant activities;
- Establishment of permanent institutional arrangements for co-ordination and strengthening of institutional capacities for protection of natural resources; upgrading the capacity and expertise on CC/Bd in m/c areas and establishment of operational funding procedures and mechanisms. As decision support at all levels, establishment of a system and network of monitoring of CC impacts in most sensible and vulnerable areas;
- Assessment of productivity of marine/fishery resources, establishment of a specific monitoring of impacts of CC on fisheries, definition and implementation of an adequate sectoral strategy. Reconsideration of the actual coastal management system, aiming at mitigation and reduction of SLR impacts on m/c habitats, infrastructures and human activities;
- Strengthening of information, awareness and education activities concerning CC/Bd in m/c areas;
- Establishment and implementation of TB research programmes on issues of common interest with Morocco, Tunisia and Libya;

Urgent actions proposed:

Urgent actions were synthesized under sub-chapter on Needs. By extrapolation the following urgent actions might be listed:

- Formulation and implementation of a long-term national strategy to improve relevant knowledge, establish monitoring and provide for evaluation of national m/c Bd;
- Design and implementation of a National research programme on CC and impacts on development and physical and biological components in national m/c areas; focused at areas and systems identified as the most vulnerable ones, also at TR, precipitation, extreme events, NIS, distribution of thermophilous species (endemic and invasive ones), at impacts on benthic and necto benthic species, evaluation of socio-economic consequences, etc.;
- Provision of conditions for an intensified follow up of on-going research programmes;

- Making operational the established National Agency for CC;
- Preparation of maps, systematized databases and Inventories concerning vulnerability, critical areas, systems and occurring phenomena;

Egypt

Needs identified:

- Assessment of impacts on environment of CC and other activities, and their interactions. Establishment of a database to be used by DMs;
- Defining role, responsibilities and decision making competence on CC/Bd in m/c areas, involving institutions and NGOs;
- Monitoring of climate and physical parameters of coastal erosion (including land subsidence phenomena), also of aquifers' water quality; evaluation of the socio-economic impacts. Strengthening the legislative basis for conservation of m/c areas, for protection of endangered species and sustainable use of respective resources;
- Improving conservation of sensible areas by establishment of new MPAs.

Urgent actions proposed:

- The most urgent action concerns the elaboration of prospective scenarios for the N area of Nile Delta, including interactions of CC and economic development;
- Studies to explore possibility of reducing demographic and socio-economic pressure on the N area of Nile Delta, also identification of possible receptive areas in case of unavoidable need;
- Actions/studies on prevention and mitigation of CC impacts: on quality of WR and soil; and concerning humid areas;
- Measures to reduce impacts and consequences of CC on coastal protective infrastructures.

Morocco

The Overview presented needs and urgent actions together:

- Knowledge and monitoring: improve knowledge on CC/Bd in national m/c areas; design monitoring of key parameters; collect pertinent climate data (atmospheric and marine environment related), all in order to allow for sound decision making; strengthen capacities on Bd in national m/c areas and on taxonomy;
- Legislation: improve the legislative framework concerning CC and Bd;
- International co-operation to be strengthened, in particular with neighbouring countries and other Mediterranean coastal states, to improve exchange of information, upgrade capacities and improve the scientific expertise on CC/Bd in m/c areas;
- National policies: integrate the CC/Bd m/c concerns into sectoral politics and provide for involvement of sectoral responsible;
- Strengthening and diversification of programmes of public awareness for target groups, NGOs included, and interactive participative approach concerning CC/Bd;
- Securing participation of national experts in all relevant international activities and events;
- Need to look for synergies of actions implemented within the framework of relevant Conventions.

Lebanon

Needs identified:

- Updating the knowledge on CC/Bd in national c/m areas and strengthening capacities in taxonomy; supporting national research structures active in the CC/Bd domain;
- Establishment of monitoring pertinent parameters and implementation of prospective studies;
- Strengthening of technical capacities for research, upgrading existing oceanographic stations and integrating them into regional and international networks;
- TB research programmes with Syria to be established and implemented;
- Revision of legal acts and adoption of laws on CC and nature conservation.
- Increasing funds allocated for research on CC;
- Establishment of an administrative structure to monitor and implement measures for protection, adaptation and mitigation of CC impacts;

- Upgrading stakeholders' and users' role and capacities for conservation of natural resources in m/c areas;
- Adoption of and making operational the NAPs for urgent / priority actions.

Urgent actions proposed:

- Design and implementation of actions aiming at: (i) sustainable management of m/c resources; (ii) combating desertification and mitigation of CC impacts; and (iii) conservation and sustainable use of Bd resources, as envisaged by national reports to UNCCD, UNFCCC and CBD;
- Implementation of NAPs presented within SAP/BIO: No. 1. Palm Islands and Tyre coast National reserves, No. 4. Continuous monitoring of m/c biodiversity, and No. 5. Determination of physical parameters of Lebanese marine environment;
- Updating of the existing and establishment of new facilities of the oceanographic monitoring network, also their integration into regional and international networks;
- Completion and updating of the Bd Inventories, strengthening of teams and capacities of taxonomy researchers;
- Updating of cartographic information on Bd in m/c areas (ecosystems, biocenoses, communities, facies);
- Upgrading problems of benthic communities in Lebanese coasts as a regional priority;
- Implementation of the Habitats AP, presented in detail in the Overview.

Syria

Needs identified:

- Development of a numeric model for SLR, to identify areas under risk;
- Provisions for permanent control of change in m/c areas and implementation of coastal and maritime planning aiming at reduction of risks for coastal activities and management. Establishment of database on results of relevant research programmes;
- Strengthening and diversifying of actual technical capacities for research;
- Provisions for mastering of monitoring and research methodologies replicable at regional level. Establishment of an institution specialized on CC research and education;
- Improving legislation to meet needs for activities on CC/Bd in national m/c areas, for mitigation and adaptation measures in particular, five-yearly (or ad-hoc if needed) updating of APs. Inclusion of CC concerns in national sectoral development plans, as done for the energy sector. Identification of funding sources for actions on CC/Bd in national m/c areas, increasing the actual level of funding;
- Improving relevant information, public awareness and education;
- Preparation of regular yearly reports on state of environment;
- Establishment an effective network of: (i) involved institutions; and (ii) responsible in respective ministries.

Urgent actions proposed:

- Preparation and adoption of a long-term plan of monitoring and research on vulnerability and adaptive capacity to CC and anthropogenic impacts of species;
- Reducing gaps in data and information;
- Preparation of a centralized database and provision of additional information on CC/Bd in national m/c areas;
- Updating and rationalizing research methodologies in order to make them compatible with and reproducible at regional and international levels;
- Establishment of pilot monitoring facilities, per key types of vulnerable environments. Establishment of ecological corridors to mitigate impacts of CC;
- Implementation of prospective studies on adaptive potential of the marine environment. Preparation of the Inventory of endangered species in m/c ecosystems aiming at their protection from CC impacts;
- Updating the legislative framework and implementation of actions aiming at influencing DMs. Establishment of partnership between politicians and scientists to facilitate flow of information needed for decision making.

Tunisia

Needs identified:

- Implementation of a programme of inventories and monitoring of climatic, physical and biological phenomena, as

prerequisite for national strategies on CC/Bd in m/c areas;

- Provisions for a permanent control of CC/Bd in national m/c areas;
- Establishment of a model for STR and impacts on thermic structure of marine habitats. Preparation of a georeferenced database on distribution of species sensible on CC;
- Need for a regional methodology for species' distribution monitoring and models for assessment of extinction risk;
- Development of research programmes concerning sensible populations, in various geographic areas, to evaluate impacts of STR on phenology;
- Improvement of the information system on phenology and evaluation of the adaptive capacity of endangered species;
- Intensification of and support for studies on impacts of CC on ecosystem functioning.
- Definition of adaptation strategies, control and monitoring of: SLR, erosion phenomena in low-laying areas, water resources in coastal areas, natural m/c resources and coastal infrastructures.

Urgent actions proposed:

- Urgent implementation of actions aiming at prevision of CC impacts and development of tools for decision making;
- Establishment of a network of monitoring facilities, properly equipped;
- Establishment of a centralized CC/Bd m/c areas information system for data collection and retrieval, user friendly and suitable for dissemination and evaluation of data and information;
- Promotion of monitoring and research programmes on species and habitats affected;
- Implementation of actions dealing with morphology and modification of coastal areas.

ANNEX VI.

NATIONAL OVERVIEWS: CONCLUSIONS AND RECOMMENDATIONS, PER CLUSTERS AND COUNTRIES

CLUSTER A

Albania

Conclusions:

- CZs are complex, dynamic and vulnerable systems, with highly interdependent sub-systems. Most of existing problems in c/m areas are consequence of bad planning, bad practices, and overuse. C/m areas need a comprehensive and integrated management, therefore, dealing with CC and CC/Bd impacts in c/m areas may not be efficient if not integrated within national ICZM.
- The preparation of a national CZM legal act, to include CC/Bd aspects, should be considered as a needed prerequisite for future actions.
- An adequate system of monitoring CC/Bd impacts is an indispensable prerequisite.
- There is an intensive activity related to preparation of development plans and detailed land-use plans in national c/m areas; CC and CC/Bd issues should be included, buffer zones related to coastal erosion to be incorporated.
- Decisions on response to CC and CC/Bd need information on costs/benefits of mitigation and adaptation measures and respective interrelations.

Recommendations:

- Construction of dams parallel and perpendicular to coastline, to cope with erosion of low sandy coasts.
- Bench terracing.
- Creation, maintenance or restoration of wetlands, marshlands and dune systems.
- Dune protection and active management measures.
- Monitoring and warning system on abnormal phytoplankton blooms in coastal wetlands.
- Rehabilitation, post-fire management of coastal burned areas.
- Establishment of new and improved management of all PAs.
- Active, in situ management of wild species populations outside PAs.

Bosnia & Herzegovina

Conclusions and recommendations are presented together:

- CC/Bd issues so far deserved very limited attention, yet not identified as national priority.
- The institutional and administrative capacities are too weak to cope with CC related obligations and issues, a programme for capacity building is needed.
- Vulnerability assessment and management plans for threatened habitats, sites, species, as well as education and awareness programmes on CC and CC/Bd are urgently needed.
- Large gaps in knowledge call for urgent targeted research and monitoring, funding to be provided, international sources being indispensable. An Adriatic experts' network is needed.
- The on-going international co-operation needs to be intensified and expanded, the TB B&H/Cro project on Neretva -Maloston – Neum to be considered as high priority.

Croatia

Conclusions:

- Issues related to CC/Bd are not yet identified by responsible national sectors as neither important nor a priority issue.
- One of major constraints are the still large gaps in knowledge on CC/Bd issues.
- The networks and management plans do not deal, or not adequately, with CC/Bd issues.
- Regular funding for CC and CC/Bd initiatives is below the needed level.
- Monitoring CC and CC/Bd is one of key prerequisites for further actions.

Recommendations:

- The CC/BD issues to be upgraded in the national policy agenda and strategies, in particular within the National Biodiversity and Landscape Strategy, currently under revision.
- To prepare and start activities concerning: (i) analysis of available information; (ii) inventory of vulnerable species, habitats, sites; and (iii) definition of indicators and monitoring within the international framework (immediately).
- To provide for regular national funding of priority activities, international funds to be sought for joint actions and programmes.
- To develop and adopt mitigation / adaptation strategies and concrete APs.
- The PAs Networks, Eco-sites Networks to be analysed and adequately revised to include CC/Bd issues; new management plans for vulnerable sites to be prepared, those existing to be adequately revised.
- To extend and intensify public awareness and education activities/programmes.
- TB projects to be prepared and implemented, related to: (i) monitoring of CC impacts on vulnerable species and sites; (ii) common management plans with B&H TB areas (Neretva river basin/Maloston bay, Paleombla subterranean hydrological system); (iii) multilateral co-operation on: network of MPAs, of monitoring of migratory birds, and of fish stock; and (iv) to continue and expand the existing co-operation programmes.

MontenegroConclusions and recommendations are presented together:

Priorities and urgent measures need to be conceived as a cycle of inter-connected components:

- A CC related NAP to be prepared.
- Adaptation to CC issues of national planning and statistics; establishment of monitoring.
- Preparation of programmes for and start of CC related research and impact assessment.
- Implementation of actions for a regular allocation of funds, including international funds as the indispensable source.
- Strengthening the capacity of national institutions; implementation of capacity building and training, implementation of actions aiming at provision of the needed equipment.
- Implementation of public awareness and influencing decision makers programmes.
- Provision of international support for the implementation of CC/Bd related plans/projects.

SloveniaConclusions:

- The CC/Bd issues in national c/m areas deserved so far only a minor attention.
- The most serious expected impacts on coastal environment are by SLR, to result with flooding of coastal wetlands.
- The main impacts on the marine environment will be induced by STR. Increased incidence of NIS is already occurring, while a foreseeable coral bleaching was not yet observed.
- Hitherto occurring mass fish mortalities and anoxic crises: not clear whether CC related.
- Decrease of landing of commercial fish was reported: not clear whether CC related.

Recommendations:

- The research on CC, including CC/Bd topics, within competence of respective Ministries, should be set as a national priority.
- Establishment of a regular monitoring system on CC/Bd impacts.
- Establishment of an Adriatic network of experts and researchers on CC and CC/Bd, to exchange information, propose an alerting system, prepare guidelines, assist and advise responsible national bodies.
- Implementation of measures for harmonized and coherent co-operation among relevant ministries, institutions, NGOs and other bodies.

CLUSTER B

Overviews of Cluster B have conclusions and recommendations presented together.

Cyprus

- A monitoring program should be set as a priority on a national level in order to trace the link between CC and changes to coastal/marine biodiversity and ecosystem functioning.
- The increasingly water-deficit problems, which are prominent over the recent years in the Mediterranean, and particularly in the eastern region, resulted in the need of augmentation of waters sources through constructions of sea water desalination plants. Therefore, a long-term monitoring and assessment of the impact of desalination on coastal/marine biodiversity is needed to be undertaken.
- A pan-Mediterranean network of National Institutions should be established for exchange scientific information to deepen the knowledge on the impact of CC on marine biodiversity and to initiate co-operation in relevant research programs.
- Assessment the socio-economic consequences of biodiversity changes due to CC on a national and regional level including possible mitigation measures.
- Public awareness and strengthening the education aspects.

Greece

An adaptation plan in Greece should include the establishment of a Working Group / Task Force / National Committee, authorized by the Ministry for the Environment, Physical planning and Public Works, in collaboration with the competent ministries that will interactively plan the national actions concerning the impacts of CC. A clear legislation covering its spectrum of activities and authorities is considered crucial. The scheme will:

- Launch the procedures for enacting or strengthening EU or national legislation relevant to impacts of CC e.g. ratification of the IMO Convention on Ballast Water; implementation of the Action Plan on species introductions.
- Set up and co-ordinate an expert group responsible for analysing long-term biological data and correlate them with hydrographical data, and analyse risks and possible consequences, in close consultation with the other Parties and relevant International Organisations.
- Develop/promote monitoring programmes for data collection in hotspots (ports, coastal lagoons, aquaculture sites, sensitive areas, etc.). Incorporation of data collection in existing EU directives should be promoted.
- Develop programmes to raise the awareness of the general public and target groups, including decision-makers, concerning the risks associated with CC e.g. marine non-indigenous species introduction, sea level rise and, generally, natural phenomena and the economic consequences of beach management.
- Strengthen, and where necessary, set up systems to control the intentional import and export of non-indigenous marine species.
- Develop and implementing risk-assessment techniques.
- Validate the conclusions and the measures respectively and prepare on a regular basis a national report on biodiversity changes on the marine ecosystem.

Israel

The following actions should be implemented in collaboration, or at least co-ordination, with neighbouring countries:

- Survey of the infralittoral biota along the Mediterranean coast (with emphasis on the commercially valuable species), in order to identify communities spatially or physiologically vulnerable to climate change. Identification of „thermal indicator species”.
- Survey of marine and coastal thermophilous opportunistic and invasive alien species (including pathogens and disease vectors) and their impacts on the native biota.
- Estimation of the impact of sea level rise and accelerated coastal erosion on the supratidal populations (shorebirds, marine turtles, endemic fauna and flora), and the midlittoral vermetid reefs.
- Establishment and protection of coastal and marine nature reserves and establishing corridors between reserves.
- Perfection of transplantation and reintroduction techniques of species considered most endangered.

- Preparing an all-Mediterranean open-access dynamic data base of the temporal and geographical distribution of „thermal indicator species” and thermophilous opportunistic and invasive alien species.

Italy

Italy invested a lot in limiting GHGs and in funding CC research and monitoring; also many projects derived from EU support. MATTM is particularly active, also other ministries and many other actors. So far, attention was predominantly focused at terrestrial and agricultural systems. The temporal aspects of CC processes and impacts discourage initiatives and public perception of risks, in particular if compared with the level of investments needed at short terms. Therefore:

- At Mediterranean and Adriatic levels short-term actions should be looked for, to influence impacts expected at large scale or in the long term.
- A reasonable strategy would be (despite uncertainties) to implement immediate actions based at actual knowledge, at the same time to influence and persuade national governments and agencies to secure regular funding for respective research and actions.
- Political steps are needed for an efficient, consistent and comprehensive co-operation of interested countries (Adriatic, f. ex.), to cope with forthcoming risks from CC, the resulting impacts on biodiversity included, to be fostered and stimulated by the scientific community.
- In parallel, actions on information and awareness raising of politicians, of productive categories, and of the general public should be conceived and implemented.
- Improved interaction should be established among the terrestrial and marine researchers.
- Multidisciplinary monitoring and research on CC issues are urgently needed, and in particular on: (i) Monitoring and updating of distribution and abundance maps of species sensitive to variations in temperature, e.g. *Thalassoma pavo*, *Ophidiaster ophidianus*, *Astroides calycularis* and/or important for the fishing industry such as *Engraulis encrasicolus*, *Sardina pilchardus*, *Seriola dumerili*, *Thunnus thynnus*, etc.; (ii) Monitoring of habitat-former species in danger from increases in surface temperatures and from rises in sea level such as *Dendropoma petraeum* and *Posidonia oceanica* through checking density, distribution and relationships with other species; (iii) selection of specific cases for evaluating the effects of competition between native and exotic species and to understand the changes to the functioning of ecosystems with particular reference to the trophic food web; (iv) selection of variables for the study and comprehension of changes to the biology of species, to be related to changes in climate; and (v) monitoring, preparation and updating of distribution and abundance maps of species sensitive to variations in temperature.
- The creation of a network of sampling sites, preferably within the system of Italian marine protected areas, to measure biodiversity variables to relate to climate change.

Malta

Conclusions and recommendations are presented together:

- To focus limited national resources on adaptation measures for most significant impacts, therefore need for realistic indication of CC impacts
- The lack of data relates not only to CC, but also on biology and species/habitats and their conservation status; comprehensive data are needed for vulnerability assessment, to be followed by assessment of adaptation options.
- The terrestrial Bd is vulnerable to: drought, deterioration of freshwater quality and availability, inundation, coastal erosion, all due to SLR and extreme events.
- Most of PAs to be affected due to their coastal location; the NE coasts low-lying are particularly vulnerable, with habitats without retreat possibility; rare and endemic species in coastal areas highly vulnerable.
- In the marine environment the expected changes relate to distribution of species and shifts in species composition of ecosystems..
- Adaptation measures for coastal terrestrial ecosystems to be explored beyond connectivity to other natural areas.
- Co-operation with other countries is essential, in particular for impacts monitoring.
- Current policies and legislation to address non-climatic impacts reducing ecosystems resilience; spatial planning

to take into consideration CC/Bd impacts. Adaptation measures to be mainstreamed into existing policies and legislation.

- A NS on CC adaptation to be developed, to cover all sectors, also to ensure coherence

Spain

The following actions for decreasing impacts of climate and global change to vulnerable Spanish Mediterranean m/c biodiversity are recommended:

- Initiation of long-term monitoring programmes of key ecosystems, habitats and species.
- Creation of a Data Centre to compile, and make available to public, data from monitoring programmes of key ecosystems, habitats and species.
- To increase the number of MPAs, particularly along the peninsular Spanish Mediterranean.
- To increase research activities addressed to understanding and forecasting: climate dynamics; interactions between atmospheric climate and oceanography; and, marine biodiversity responses to climate (and global) change.
- To increase dissemination of information and training actions on CC impacts on and vulnerability of c/m biodiversity.
- Implementation of existing legislation aiming at reduction and mitigation of direct and diffusive anthropogenic impacts on c/m ecosystems.
- Design and implementation of a Retreat Plan for vulnerable coastal ecosystems.
- Promotion of adaptive management of coastal ecosystems and marine biodiversity, adjusting responses to the evolving impacts of CC, as opposed to static regulation and management approaches not flexible enough to accommodate the dynamic situation of the Mediterranean marine ecosystem.

These actions could be implemented by national or autonomous community governments, co-ordinated and homogeneously designed at national, and when possible, Mediterranean scale.

Turkey

The urgent actions proposed:

- Review and integrate existing information on past and current status of selected taxa in Turkish waters.
- Establish Turkish „biodiversity warning system”, based on climate-indicator species, to detect and monitor major changes in marine biodiversity mostly for the toxic Lessepsian species for human health; identify a set of „sentinel species” which can reliably represent indicators of climate change; these species may be *Lithophyllum lichenoides* an indicator of the sea level variations, *Eunicella singularis* and *Paramuricea clavata* which are likely to suffer from the mass mortality due to water turbidity and rise of water temperature.
- Identify a list of species or taxa that will be mostly threatened by increasing warming of waters and climate-related events and thus in need of special protection.
- Track geographic expansion of „warm-water” species and retreat of „cold-water” species. Monitor the relations between global warming, ballast waters and harmful aquatic organisms in Turkey. Assess tropicalization impacts on species commercially important for fisheries, for example by providing information on geographic shifts as a consequence of STR and/or of competition with fast advancing species of low economic value.
- Record mass events (invasions, blooms, mass mortalities) in Turkish marine areas.
- Correlate changes in abundance and distribution ranges of Mediterranean species with variability and trends of the hydro-climatic environment.
- Develop dynamic, web-interfaced, interactive distribution maps providing information on taxonomy, ecological traits and geographic trends of climate-indicator species.
- Actively participate GOOS (Global Ocean Observation System) in the Mediterranean Sea and deploy new buoys to the Mediterranean coasts of Turkey (presently only 6 real time sea level observation systems exist in the Turkish Mediterranean marine areas.
- Investigate global warming and acidification process.
- Increase public awareness campaigns to distribute to general public all relevant information on impacts of and basic knowledge on CC in the Turkish m/c areas. This kind of campaign is also important for the tourism and local

population, for example on cases such as venomous jellyfish species *Pelagia noctulica* and *R. nomadica* or poisonous fish like *Lagocephalus sceleratus*.

- Adapt, upgrade the related Turkish national legislation, as needed and appropriate.
- Develop new strategies in the framework of the Barcelona Convention, EU Habitat and Water Framework Directives, and help forge conservation strategies for biodiversity.

CLUSTER C

Algeria

Conclusions and recommendations are presented together:

- Reduce gaps in knowledge; strengthen, upgrade, organize institutional capacities, in order to evaluate the impacts of CC on Algerian M/c areas and on related biodiversity.
- Upgrade CC/Bd m/c issues as a priority question.
- Facilitate allocation of funds needed for related research programmes.
- Improve co-ordination between institutional and university partners, involved in CC/Bd issues.
- Inform / influence enterprises, industries in particular, located in coastal areas on risks and impacts of CC, in order to provide financial support for research, development of mitigation measures and implementation of protective / adaptation measures.
- Favorize establishment of research interdisciplinary teams scholars and specialists, in order to provide for a more integrated approach to CC/Bd m/c issues.
- Provide for co-ordination within the ICZM framework, as recommended by the Algerian Operational ICZM Strategy.
- Upgrade capacity and expertise at university level for an improved and intensified involvement in regional and global networks, projects and programmes.
- Implement B actions with Morocco and Tunisia, in particular on vulnerability of habitats and species and monitoring ST, SLR and coastal erosion.
- Identification of simplified and standardized indicators, capable to provide comparison of results along the entire national coast, favouring those compatible with regional and global level ones.
- Preparation of coastal zone vulnerability maps for fragile habitats and species.
- Finally, the involvement of Algeria at international level through ratification of the UNFCCC and CBD should provide for allocation of national funds to meet the strategic objectives.

Egypt

Conclusions:

- In accordance with IPCC (2002) scenarios, by the end of 21st century, the MST increase will range from 1.4 deg. C to 5.8 deg. and SLR from 0.09m to 0.88 m. CC is occurring and will affect the country whether effective measures are taken or not. Hitherto and future measures implemented by Egypt are of intrinsic value but irrelevant regarding impending impacts. Therefore, adaptation policies, strategies and measures have to be designed
- The S and SE Mediterranean countries are the most vulnerable in the region to CC impacts, BD included, and at the same time the last well equipped to adapt to CC, due to: (i) socio-political-cultural factors, including poor awareness and mismanagement'; (ii) magnitude of pressures on the socio-economic system due to increasing population density and other non-climatic factors; (iii) insufficient technological and financial resources; and (iv) insufficient scientific support.
- The role of public and NGOs' opinion is essential for sensibilizing and influencing decision makers to overcome minimizing or ignoring the incoming threats. A professional multimedia campaign should be launched to include: (i) sensibilization on socio-economic implications of impending impacts on ecosystems and biodiversity; and (ii) change of consumption pattern, to rationalize use of water and energy resources and minimize wasteful practices.

Recommendations:

- Capacitate the scientific institutions and experts to monitor biological and physical indicators of CC as well as the socio-economic implications, in accordance with a pre-established programme; systematize data and information

and made available through a data bank; provide DMs with the scientific back-up for decision making.

- Integrate nature conservation into national policies and plans.
- Enforce existing relevant legislation, adopt new measures to protect wetlands and biodiversity.
- In order to protect lowlands and wetlands from sea water flooding, protect the weaker segments with coastal engineering works, taking into account the hydrodynamic aspects.
- Establish a MPA for the bay of Sallum, West of Alexandria.
- The most urgent recommendation: to start a long-term programme to relieve the demographic and development pressure on the northern Nile delta, possible by developing new centers in the W desert and at the periphery of the delta.

Morocco

Conclusions and recommendations are presented together:

- Despite initiatives undertaken by Morocco within the framework of UNFCCC and CBD, no policies, programmes or actions related to CC/Bd m/c areas were defined / implemented.
- Available information on actual state of m/c biodiversity and on evolution of CC phenomena do not allow for an assessment of impacts CC/Bd in m/c areas.
- Facing such a situation, a NAP on impacts of CC/Bd in m/c areas should be prepared. Such NAP should be technically and financially supported by the international community.

Lebanon

Conclusions and recommendations are presented together:

- CC is a planetary issue calling for solution at global level. Taking into account the impacts of CC (SLR, TR and frequency of extreme events), impacts of pollution and NIS on biodiversity, as well as the respective adaptation and mitigation measures – is a great concern for Lebanon in addition to actual problems of mismanagement and unsustainable human activities.
- Efficient implementation of provisions of UNCCD, UNFCCC and CBD is needed, in order to provide for sustainable land management, combating desertification, reducing impacts of CC, and sustainable exploitation of biodiversity resources.
- Within the involvement in UNFCCC, Lebanon has established a National Inventory of GHGs, evaluated the vulnerability of several sectors and ecosystems and proposed a Strategy for reduction of GHG emissions by several sectors, including adaptive measures.
- In order to face multiple factors relevant for CC, species' and communities' vulnerability, to provide for adaptation measures, the governmental responsible and all involved parties should co-operate and include CC/Bd issues in respective workplans and activities.
- A very efficient capacity building and public awareness programmes on protection of m/c biodiversity is of primary importance.
- While meeting the needs identified and implementing the proposed urgent actions, at the same time key lines of research should be implemented related to: (i) establishment of long-term research programmes on modelling aiming at prediction of: CC impacts and identification of critical habitats, also potential distribution of species according to various CC scenarios prepared by IGPPC; (ii) feasibility studies, concerning impacts on and threats for m/c ecosystems, infrastructure protection projects; (iii) studies on pollution impacts, vulnerability of communities and species, and impacts of NIS introduced as consequence of CC; (iv) eco-physiological studies on species affected by CC or thermic anomalies; and (v) macro-physiological studies of metabolic functions of marine organisms to understand their abundance and behaviour in the respective environments. Macro-physiology allows for a better insight on more complex phenomena, such as bioinvasions and impacts of CC. These new approaches belonging to chimio-diversity allow for identification of physiological markers on resilience to CC impacts (f. ex the case of the Mediterranean ECIMAR programme, with Lebanese University and CNSM as involved institutions).

Syria

Conclusions and recommendations are presented together:

- To establish a pilot monitoring station for CC/Bd in m/c areas at Ras el Bassit.
- To keep into account the CC impacts to affect fisheries and aquaculture.
- To support agricultural practices not requiring irrigation, and reduce those needing excessive water consumption.
- To entrust the newly established SCCR with the co-ordination of planning, implementation and progress monitoring of CC/Bd m/c related research.
- To update the inventories relevant for CC/Bd m/c and to extend them on the entire Syrian coastal zone.
- Following the NS and NAPs for biodiversity conservation, it is necessary to establish a national system of biodiversity monitoring.
- The issues related to CC/Bd m/c impacts should be included in the NS for the environment.
- The approach „investments in the environment” to be included in national 5-yearly plans.
- As adaptation measure on CC/Bd m/c impacts, to extend the perimeters of MPAs in order to integrate buffer areas, to function also for adaptive management in view of CC impacts, primarily of SLR.
- To integrate the CC/Bd m/c issues in programmes of information, communication, public awareness and environmental education; programmes to be strengthened and intensified.
- To launch programmes for management of structures to protect the coastline against impacts of CC, and for sand replenishment of affected beaches.
- To continue the initial activities related to partnership with neighbouring countries (Lebanon, Turkey and Cyprus), to involve also Egypt and Saudi Arabia, aiming at integration of activities on CC/Bd m/c issues.
- To implement a comprehensive regional study (guided by a key regional organization, such as RAC/SPA), to identify possibilities for displacement of species under risk and potential receptive areas (as adaptation measure on CC impacts).
- To integrate results of studies implemented at small scale concerning distribution areas of marine faunal species, aiming at mitigation of CC impacts.
- Adaptation of port infrastructures on CC impacts.
- To provide for an increased and more intensive involvement in international projects.
- To provide for an increased allocation of the national funds for CC/Bd m/c activities.

Tunisia

The following recommendations are presented only:

- Selection of scientifically pertinent indicators and implementation of monitoring, as follows:
- Level 1: (i) Impacts on species physiology: photosynthesis, respiration, basic metabolism, growth, etc; (ii) impact on life cycle, reproduction and fecundity; (iii) N-ward shifting; and (iv) adaptation in situ.
- Level 2: Monitoring modifications, competitiveness interactions; and predators / preys interactions.
- Level 3: Changes in species; distribution, disappearance and/or extinction.
- Level 4: Modification of structure and composition of communities, rate of progression of opportunistic species.
- At national level, priority to be given to the establishment of a central database for data collection, retrieval and valuation of data and information on CC and Bd in m/c areas.

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