

Draft list of research priorities identified by participants during the e-conference

Session I:

An overarching theme throughout the e-conference was that integrated monitoring with a long-term perspective operating on a European scale would lead to a better understanding of the effects of climate change on marine biodiversity. In summarising the research priorities suggested by contributors we have tried to organise them into categories (some priorities obviously could have been placed in multiple categories, but have been placed in a single category to reduce duplication). In order to better understand the effects of climate change on marine biodiversity, the e-conference participants suggested the need to carry out research to:

Global drivers

- Understand the interdependence between climatic phenomena such as the North Atlantic Oscillation, the Atlantic Multidecadal Oscillation and global warming and their individual as well as combined impacts on marine ecosystems.
- Quantify the effects of ocean acidification in relation to future scenarios of anthropogenic CO₂ emissions and ocean warming
- Develop models to map the results of small-scale studies to larger spatial and temporal scales (especially needed to predict the outcomes of management decisions such as the designs of MPAs).
- Widen spatial and temporal scales of monitoring programmes to better link known biodiversity dynamics with global-scale studies of atmospheric and oceanic processes
- Develop reliable global climate models stemming from various social and economic scenarios as well as numerical models of ecosystems that could be coupled to these climate models

Systematics and taxonomy

- Revise taxa
- Compile comprehensive catalogues of faunas and floras
- Analyse the genetic and morphological diversity in multiple marine communities and combine these with the analysis of long-term data to assess global change phenomena

Baselines, monitoring and indicator species

- Explore understudied marine geographical regions
- Determine baselines in order to better understand the impacts of ongoing and future changes
- Long-term monitoring of intra-specific genetic biodiversity and genetic expression to improve the knowledge base of studies on the impacts of global change and human activity
- Carry out quantitative monitoring to record the effects of acute and chronic disturbances to intertidal ecosystems
- Increase funding to long-term monitoring networks (to derive 'evidence-based' policies)

Mechanisms by which species respond to climate change

- Determine the thermal and pH tolerances of marine organisms
- Better understand sensitivities and adaptation capabilities of key species in the marine environment

- Determine the effects of climate on recruitment pathways and phenology of coastal habitat biodiversity
- Understand the mechanisms by which a warming climate affects marine organisms
- Understand the mechanisms by which ocean acidification affects marine organisms
- Understand the ecological mechanisms by which climate change alters the marine environment

Variability in climatic and biodiversity responses

- Better understand the interactions between natural climate variability and anthropogenically driven change

Invasive species

- Research on the impact of marine species invasion on native biodiversity Better understand the role of climate change in invasion success

Ecosystems consequences

- Understand the effects of climate change on ecosystem functioning in benthic communities
- Understand and assess pelagic diversity and heterogeneity (e.g. by using top predators as potential indicators of pelagic biodiversity and oceanographic processes)
- Determine the effects of "low-dissolved-oxygen" events such as hypoxia and anoxia on function and status of the marine environments

Validation and prediction

- Develop systems that can track, forecast and control uncertainties regarding biodiversity loss
- Develop tools to validate predictions

Historical ecology, data acquisition and data access

- Expand on the current status of data access and dissemination
- Retrieve environmental data from historical sources, reports and other grey literature and to make this data available and compatible with future scientific analyses
- Create more detailed fisheries data sets

Restoration and mitigation

- Assess the responses of different biodiversity indicators to restoration measures
- Determine the impact of global change on planktonic communities and the sequestering of carbon in ocean sediments.

Policy relevant priorities

- Develop guidelines to summarize and effectively disseminate scientific results to end-users
- Develop mechanisms by which science could inform policy and practice more rapidly
- Promote the training of intermediaries between scientists and policy-makers, who could interpret the scientific data, and put an "economical" value on or, at least, clearly identify the "risk" factors involved.
- Develop better communication systems between scientists, policy and stakeholders

- Promote the development of multidisciplinary studies in the field of marine resource management
- Create representative marine protected areas which factor climate change into their design

Session II:

In order to better understand the effectiveness of mitigation and adaptation measures with respect to the impacts of climate change on marine biodiversity, and the role of marine and coastal ecosystems in the mitigation of climate change effects, participants to the e-conference suggested the need to carry out research to:

- Determine the consequences of coastal defences on ecosystem function and services
- Conduct sound monitoring before and after construction of coastal defences in order to assess their effectiveness at meeting management goals.
- Determine the effects of coastal defences on non-target systems and species, including promotion of range extensions on non-natural habitat
- Establish the environmental benefits and costs of wind farms, especially the long-term effects on ecosystem processes and function
- Determine the impacts of tidal and wave projects on marine biodiversity
- Determine the effectiveness of iron fertilization and the long-term impacts of such fertilisation on the marine food web.
- Carry out molecular and biochemical research to enhance the physiological properties of algal strains, as well as optimisation of algal production and harvesting systems.

Session III:

Current status and trends:

- Map, list and rank coastal habitats types in terms of vulnerability to human impact, species richness, relevance for ecosystem functioning and uniqueness
- Understand the cause-effect relationships between impacts and biotic response in estuarine habitats
- Develop knowledge of deep-sea specific diversity and distribution of main macro-habitats
- Develop current knowledge on the ecology and functioning of biodiversity in the high seas

Drivers of biodiversity change in marine environments:

- Assess the main drivers of change by addressing impact and environmental quality at the relevant scale
- Develop consistent methods for monitoring environmental parameters (e.g. water and sediment nutrient concentrations, light attenuation) to better interpret community variability
- Determine the impact of new chemicals and synthetic materials and compounds on the structure and functioning of marine ecosystems
- Understand the links between increased marine traffic and the spread of alien species
- Determine the impacts of industry, commercial fishing, and pollution on deep-sea environments

- Develop new functional indicators (rather than species) as a more predictive approach to detecting ecosystem changes

Biodiversity management:

- Develop a framework that allows MPAs to be treated as designed experiments at the appropriate spatial and temporal scales, allowing for the re-design of MPAs following proper assessment and critique.
- Analyse fine scale spatio-temporal data and information (e.g. on fisheries) in the creation of MPAs
- Determine current and predicted future state of benthic communities in Natura 2000 areas and how fishing activities could impact on these communities
- Determine the actual effects of marine reserves on the genetic structure of populations, the spatial scales involved, and the suitability of islands as reserves in terms of connectivity
- Promote the creation of large deep-sea and high sea MPAs to protect habitats such as deep corals and other natural reefs, seamounts, cold-seep and hydrothermal vent communities.
- Promote the development of an EU sustainable fishery certification mechanism

Linking research with policy:

- Develop a balanced dialogue between scientists and policy makers to ensure that research priorities are correctly identified and supported
- Develop mechanisms to better incorporate key actors and publics in the discussions about marine biodiversity conservation to gain their active support for conservation measures
- Develop mechanisms to integrate effective, detailed and long-term knowledge with precautionary policy-making flexible enough to be able to incorporate new knowledge
- Carry out research on the adaptation of existing legislative instruments
- Carry out research on integration within nature conservation instruments and integration with other sectors