

Climate change and the marine environment in Corsica

Report Card 2018

Sensitivity of benthic habitats to the impacts of climate change. Conducted on 33 biocenoses and associations present from supralittoral to circalittoral zones, this report focuses on potential impacts caused by the rising sea level, the rise in water temperature, acidification and extreme events.

Maximum

Minimum



Sources :
Equipe Ecosystèmes Littoraux (UCPP)
DEM : STRM 90 NASA
Système de coordonnées :
Lambert 93 / RGF 93

Islands are at the forefront of climate change and the challenges it poses for the ocean.

While its consequences are being measured all over the oceans and in all coastal areas, it is urgent to work with island territories to strengthen their capacities in terms of resilience and to develop strategies integrating ecological solidarity and preserving the quality of life for their populations.

- In the light of effects of climate change that are already visible, such as extreme events, particularly in coastal areas, it is advisable to incorporate strategies for adaptation to these changes into territorial management, and this, right from the conception phase for responses.
- The insular coastline is a zone with high stakes where ecological solidarity takes on all its meaning. In fact, maintaining ecological and economic balance depends on contributions of fresh water from the mountains.
- Climate change will favour the settlement of new foreign species in the Mediterranean, of which monitoring must be maintained, as is currently the case with the Corsica Alien Species Network, to try to limit both ecological and economic impacts.
- Corsica already disposes of a significant network of marine protected areas (MPAs) which has demonstrated its effectiveness in maintaining biodiversity and fishery resources. Extension of this network, envisaged within the context of the Regional Strategic Analysis, could incorporate spaces specifically devoted to the conservation of blue carbon sinks and alleviation of the impacts of climate change.
- The extensiveness of natural insular areas and the reduced level of anthropogenic pressure suggest that Corsica could be a region with a positive carbon footprint: an evaluation of this footprint throughout the territory deserves to be undertaken.

Due to its geographical position, Corsica is on the front line facing challenges posed by climate change. It is, in fact, in one of the sectors where evolution forecasts for both rising air temperatures and evapotranspiration, as well as declines in precipitation and moisture in the soil, are the most pronounced (Rhone, Mediterranean and Corsica Water Agency). The forecasts available indicate a decline i) in annual flow (10 to 40 % lower by 2070) and ii) in groundwater recharge from precipitation, which will result in increasing scarcity of water resources, especially in summer.

These modifications will have repercussions on the state of the environment and economic development, but also on the quality of living conditions. It is clear that climate change already exerts additional pressure on the functioning of the island's socio-ecosystem, and it is on the basis of this observation that the Collectivity of Corsica participates in the Conference of the Peripheral Maritime Regions (CPMR), notably via the presidency of the CPMR's Commission on Islands, in which aspects of climate change are regularly addressed and incorporated into reflections at European level. The Collectivity of Corsica also undertakes initiatives related to this issue. Several programmes can thus be mentioned, already aiming to:

- understand the environmental functioning of the west Mediterranean basin under the pressure of global change in order to predict future evolution (Regional Observation Centre for the Monitoring of the Climate and the Atmospheric and Oceanographic Environment in the Western Mediterranean, which works to improve characterization and comprehension of the water cycle in the Mediterranean basin – HyMeX, and to compile a present and future assessment of the chemical atmospheric environment of the Mediterranean basin, and its regional impacts on climate, air quality, and marine biogeochemistry – ChArMEX);
- follow the evolution of environmental conditions (measurement of seawater temperatures – TMedNet & TCorseNet);
- study the evolution of the coastline (Observation Network of the Corsican Shoreline), gain a clearer understanding of the risks of marine submersion in order to develop a common strategy and identify solutions to be acted upon (MAREGOT) or propose innovative solutions to adapt to these inevitable changes (Adapto);
- improve understanding of the functioning of the different coastal marine ecosystems that exist in the Mediterranean and describe the influence of human pressure on them (STARECAPMED);
- encourage monitoring and conservation of key ecosystems (Posidonia Monitoring Network, Padduc-Change project);

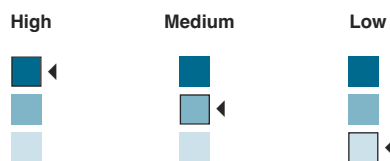
- detect as early as possible the arrival and installation of potentially dangerous exotic species (Corsica Alien Species Network), define strategies (INVALIDIS) and limit their circulation (ALIEM);
- incite MPA managers to reinforce their resilience and adaptation to climate change (MPA-Adapt).

In the face of present and future challenges, the territory's resilience will depend on the introduction of governance, concerted and pooled management, but also shared knowledge of what is in the process of happening and what could happen over the medium term, to allow for better preparation and try to provide responses adapted to the risks being faced.

The purpose of this Report Card is to offer Corsica's decision-makers and authorities a forward-looking tool to provide information on adaptation and resilience by establishing a link between the best scientific information available on climate change within its territory and priorities in adaptive management. It thus presents a survey of the knowledge available on the impact of climate change in marine and coastal environments.

On the basis of this knowledge, it identifies the most likely evolutions, which are given probability ratings. Finally, it suggests leads aimed at supporting the development, improvement and implementation of adaptation and resilience strategies, together with a reflection on the strategic role played by MPAs within this context.

Taking inspiration from work accomplished by the International Union for Conservation of Nature (IUCN) with support from the French Agency for Biodiversity (AFB), this Report Card is a Mediterranean offshoot of annual Report Cards produced by the Marine Climate Change Impacts Partnership (MCCIP). The report is the result of a joint reflection undertaken by a group of experts concerned by climate change in Corsica, working with experts from the IUCN and its World Commission on Protected Areas. Focusing on a particular theme, each team drafted a document analyzing current information. Experts then met at several workshops to draft the syntheses that are presented here. For each one, the experts identified gaps in knowledge, and offered probability ratings : high for elements which are certain, medium for elements for which doubts persist, and low for elements which remain within the realm of hypothesis.



 The backing papers of this work are available on the website of the coastal ecosystems team (Equipe Ecosystèmes Littoraux) <https://eql.universita.corsica>

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The MCCIP
<http://www.mccip.org.uk>

The MCCIP is a partnership of scientists, government agencies and NGOs. Its goal is to develop a long-term, multi-disciplinary approach in order to provide information on the implications of climate change in British waters.

Climate change and the physical environment

TEMPERATURE AND PRECIPITATION

What is happening now

- ◀ The average annual air temperature in Corsica has risen since 1970 by about 1 °C on the coast, and by over 2 °C at altitudes above 500 meters.
- ◀ There is no clear overall trend in the evolution of annual precipitation linked to climate change, though the frequency of dry years since the 1990s has risen from one year in five to one year in two.
(A year is called "dry" when it experiences a prolonged period of drought, largely exceeding the usual dry season).
- ◀ There is an increase in extreme precipitation with rainfall attaining over 200 mm in 24 hours in autumn. 38 extreme events were recorded from 1958 to 2017, versus 4 in the previous 120 years.
- ◀ Evapotranspiration is the quantity of water which evaporates through the soil, sheets of water and plant transpiration.
In Corsica, its annual level is rising: previously lower than 1,000 mm, it has exceeded this level over the past 10 years. The gap between precipitation and evapotranspiration is thus widening, accentuating the deficit.
- ◀ In Ajaccio, average annual rainfall has declined : 600 mm per year over the past 30 years, 440 mm per year over the past 3 years.
In Bastia, average rainfall was 800 mm per year in the period from 1981 to 2010, whereas it is now 690 mm per year (ie. a decline of 13.5 %).

↓ A1-Température et précipitations
A. Orsini, C. Mori & P. Rébillout

What may occur in the future

- ◀ According to studies by the Intergovernmental Panel on Climate Change (IPCC 16), a substantial rise in temperatures is to be foreseen: around 2 °C depending on seasons and scenarios from now until 2050, 2 to 6 °C by 2100.
In all events, the rise in temperatures in the Mediterranean will be higher than the rise of temperatures worldwide.
- ◀ The rise in temperature in mountainous regions of Corsica will be even more substantial.
In 2050, the coastal zone of Corsica will experience the current climate of Tunis.
- ◀ There is no clear trend in the evolution of extreme precipitation based on the modelling.
- ◀ Models show that there is an on-going trend towards increased dryness, especially on the west side of Corsica, due to the change in the direction of prevailing winds combined with modifications of the ocean-atmosphere regime of the North Atlantic (North Atlantic Oscillation).
- ◀ The coastal area will be increasingly dependent on environmental conditions in the mountain ranges.

GAPS IN KNOWLEDGE:

More meteorological data needs to be acquired on the island's interior.

STRATEGY :

Introduce an integrated management policy between watersheds and the coastal area.



Agnello Tower, Cap Corse. Photo : Christine Pergent-Martini.

SEA TEMPERATURE

What is happening now

Since the 80s, even though measurements show hotter periods followed by colder periods, the average temperature of surface water is rising.

Over the past five years, the temperature of surface water rose by 2 °C during winter periods, and 0.5 °C in summer periods.

The warming of the water favours deeper thermoclines. These past five years, the depth of the thermocline has tended to drop by over 40 m.

(The thermocline is the thermal transition zone between warmer surface waters and deep, colder waters).

A2-Température de la mer
S. Gobert, P. Lejeune & J.C. Romano

What may occur in the future

The trend towards a rise in the temperature of surface waters (0 – 100 m) will continue, specifically in the winter period.

The wind will affect the formation and disappearance dynamics of thermoclines.

Evolution in sea water temperature will affect marine habitats and encourage the naturalization of exotic species.

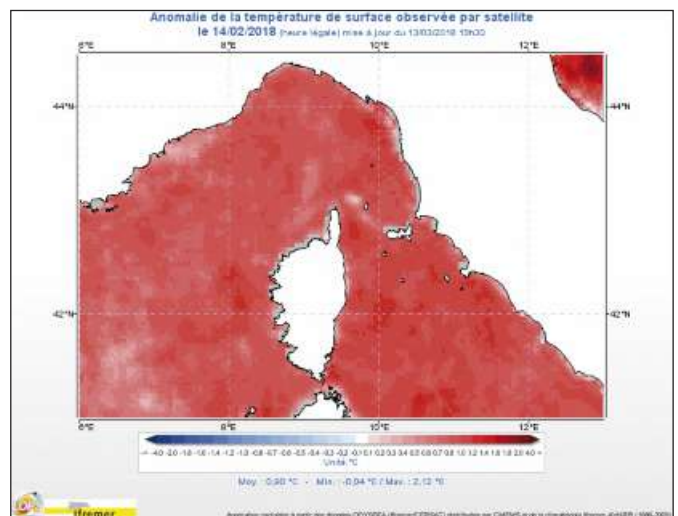
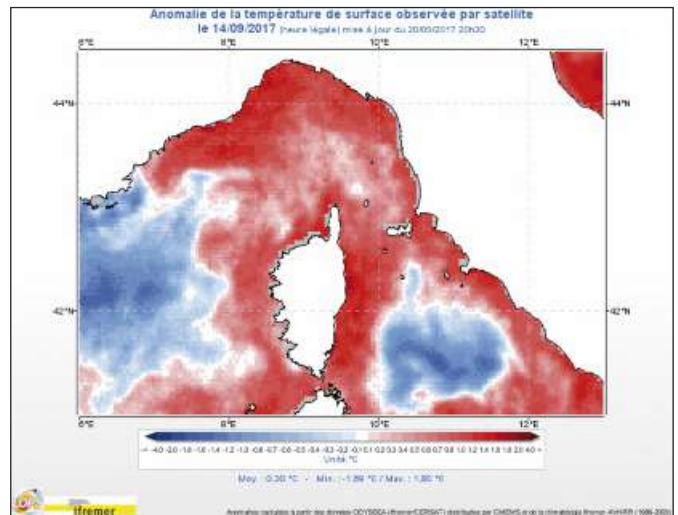
STRATEGY:

Share data and increase the number of measuring stations to cover Corsica's entire coastal area (networks, protocols) in order to dispose of statistically validated time series.



Above : Wall of Gorgonians. Photo : Sandrine Ruitton.

Right page: Tower of L'Osse, Cap Corse. Photo : Gérard Pergent.



Rise in surface water temperature : anomalies observed in 2017/18 as compared to averages in the months of September and February, 1986-2009.

[http://marc.ifremer.fr/resultats/temperature_et_salinite/images_satellite_mediterranee/\(variable\)/chla_sat/\(typevisu\)/map/\(zoneid\)/figure/\(date\)/20180414_000000/#appTop](http://marc.ifremer.fr/resultats/temperature_et_salinite/images_satellite_mediterranee/(variable)/chla_sat/(typevisu)/map/(zoneid)/figure/(date)/20180414_000000/#appTop)

CURRENTS AND WINDS

What is happening now

- Climate changes being witnessed (winds : force and direction) are already significant enough to modify the general structure of the water column:
 - Diminished intensity of winds in winter significantly reduces wintertime ventilation and the upwelling of nutrients associated with it. This leads to a considerable reduction in phytoplanktonic blooms and modification of the trophic succession which depends on it (zooplankton, larvae of crustaceans, molluscs and fish).
 - The higher number of wind-related events in summer favours mixing to such an extent that it results in perturbation of the thermocline (presence, depth).
- There is no regular measurement of evolution in water acidification due to CO₂ emissions.

GAPS IN KNOWLEDGE:

More knowledge is required about currents, mainly at coastal level, and extreme events affecting the shoreline area.

STRATEGY:

Optimize good management of anthropogenic inputs to limit imbalances and cumulative effects.

RISING SEA LEVEL

What is happening now

- The overall rise in the sea level is estimated at 3 mm per year.
- Values calculated in Ajaccio : on average 4 mm per year between 2004 and 2017.
- Le niveau de la mer élevé, allié à des événements climatiques (vent, pression), conduit à des phénomènes extrêmes (submersions marines et inondations).

GAPS IN KNOWLEDGE:

The lack of historic data on Corsica does not allow for precise forecasts.

STRATEGY:

Extend and sustain the network of tide gauges around Corsica.

Take forecasts of a rising sea level into account in coastal development (cf coastal erosion).

A3-Courants et vents P. Lejeune & S. Gobert

What may occur in the future

- Any rise in the temperature of surface water in winter will encourage further stratification of the water column, leading to reduced mixing and lower inputs of nutrients.
- Higher wind intensity in summer which destroys, either partly or fully, the stratification of water masses will modify the oligotrophic character (low levels of nutrients) that is naturally found in summer, and encourage the development of non-native, or even invasive and/or toxic planktonic species.
- Reduced availability of nutrients in winter will restrict phytoplanktonic production and could lead to modifications of the populations comprising this first level in the food chain. Such changes in the quantity and quality of nourishment will have repercussions on all marine organisms living on the seabed and in the water column.
- Wind will affect thermocline dynamics (formation and disappearance), while acidification of the water will have an impact on calcification.

A4-Élévation du niveau de la mer JC. Romano, S. Gobert & P. Lejeune

What may occur in the future

- Over the next 20 to 30 years, the sea level will continue to rise, though its amplitude over the longer term is difficult to estimate.



Changement climatique et milieu vivant

WATERSHEDS AND RIVERS

What is happening now

- Due to the cumulated effects of rising temperatures, reduced precipitation in summer and the increasing scarcity of snow in winter, the flow of stream water has dropped by 20 to 30% since the mid 1980s.
- During a hydrological cycle, extreme events (high and low water levels) are more frequent and more widespread.
- The distribution area of Corsica's endemic aquatic species is becoming smaller as they move upstream in response to rising water temperatures.
- The biodiversity of fresh water ecosystems is threatened by climate change and the proliferation of non-native species.
- Human health is threatened by emerging or re-emerging infectious and vector-borne diseases (malaria, chikungunya, dengue, zika, etc.) fostered by higher temperatures.
- The increased proliferation of toxic cyanobacteria in reservoirs constitutes a danger for users of this water resource.
- There is an impact on the energy sector when water levels in reservoirs are low, which undermines multi-annual energy programming.

↓ B1-Bassins versants et rivières
C. Mori & A. Orsini

What may occur in the future

- The impact on water resources will be greater, mainly due to rising temperatures and evapotranspiration.
- Rising temperatures in fresh water ecosystems will result in a higher risk of extinction of endemic species.
- There will be a higher risk of the development of infectious and vector-borne diseases having an impact on human health.
- More frequent proliferation of cyanobacteria in reservoirs will constitute additional risks for users of water not only for recreational activities but also for domestic consumption (drinking water) or agricultural use (irrigation, watering of livestock).
- Rarity of water resources will lead to price increases with economic consequences and an impact on tourist activity.

Valley of La Restonica.

Photo : Antoine Orsini.



COASTAL LAGOONS

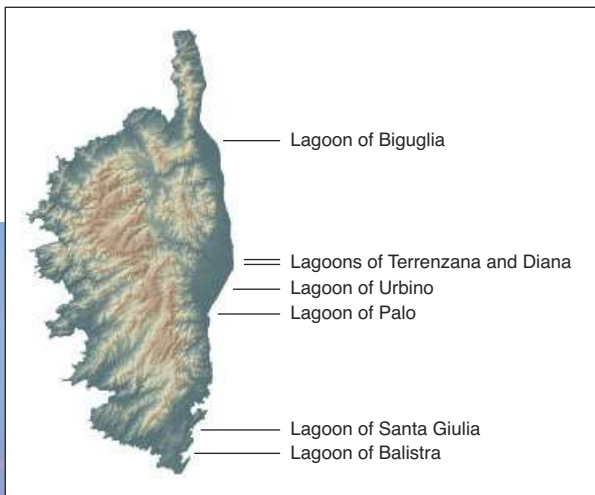
What is happening now

- ◀ These systems are particularly vulnerable to climate changes, especially with the increase in extreme weather phenomena such as torrential rain.

- ◀ Rising water temperatures and the intensity of fresh water inputs lead to the emergence of potentially toxic species of phytoplankton. This reaction varies from one zone to another because of their different situations.

- ◀ Over the past 30 years, the intensity and frequency of proliferations of phytoplankton, including its harmful species, have increased in humid coastal areas.

- ◀ There are about a dozen toxic phytoplanktonic species that are known to appear and proliferate in these environments. These proliferations have repercussions on the food chain, associated fisheries and shellfish aquaculture.



B2-Lagunes côtières
 M. Garrido & V. Pasqualini

What may occur in the future

- ◀ Humid coastal areas will experience greater variations in both frequency and intensity (temperature, water levels and precipitations).

- ◀ Proliferations of phytoplankton and algae will continue and intensify, which will perturb the food chain and shellfish aquaculture, and could affect seaside activities on the adjacent coast.

STRATEGY:

Maintain, and even better, reinforce existing observation networks.

Manage ecological continuum (marine environment and watersheds) and improve the quality of water in liaison with watershed management entities.

Lagoon of Urbino,
 Photo : Bilan PDRC 2007/2013 sur les bassins versants
 des quatre principales lagunes de Corse OEC – janvier 2016.



COASTAL HABITATS

What is happening now

- ◀ Coastal marine habitats which are iconic of Corsica (seagrass, coralligenous beds) are beginning to be affected by climate change.

- ◀ While Posidonia is regressing in many areas in the Mediterranean, it is here relatively stable, even though the rising sea level is causing seagrass at deep levels to die.

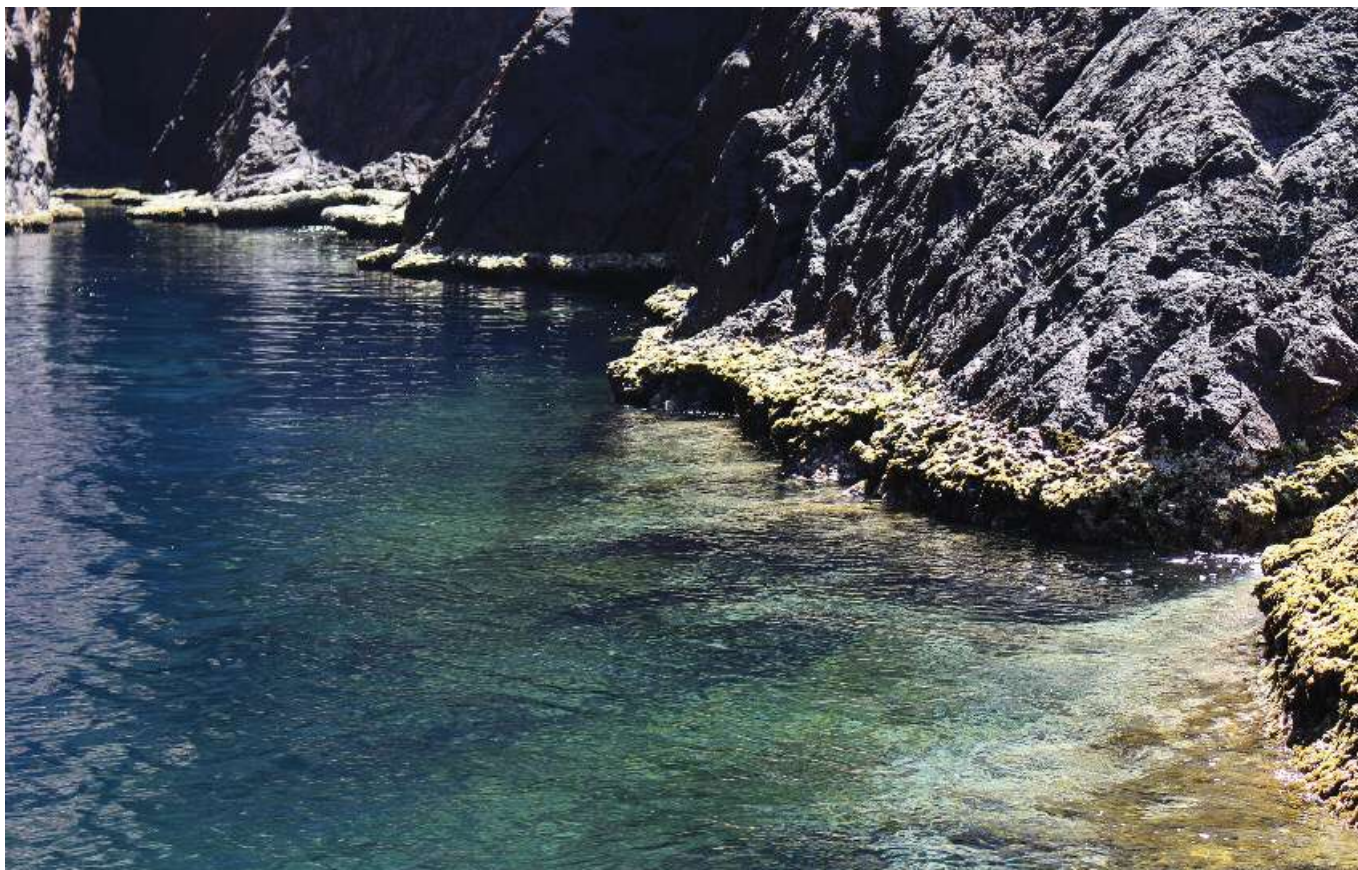
- ◀ Abnormal rises in the sea water temperature (heat stress) explain massive mortality, especially in species characteristic of coralligenous populations (gorgonians, sponges).

- ◀ The regular rise in the sea level is causing lower vitality in the Lithophyllum pavement, but also a reduction in the amount of light, which has an impact on deep Posidonia meadows.

GAPS IN KNOWLEDGE:

Evaluation of modifications engendered by acidification in organisms and habitats.

Lithophyllum pavement, La Scandola.
Photo : Gérard Pergent.



↓
B3-Habitats côtiers
C. Pergent-Martini, MC. Buia & Gérard Pergent

What may occur in the future

- ◀ Simplification of ecosystems and modifications of food chains caused by climate change will have an effect on ecosystem services (eg. fisheries resources, protection against erosion).

- ◀ Increasing heat anomalies will lead to more frequent phenomena of massive mortalities.

- ◀ Acidification of the water will lead to regression of bioconstruction formations.

- ◀ The consequences of climate change will result in the disappearance of Corsica's main "natural landmarks" (Posidonia platform reef, Lithophyllum pavement, coralligenous atolls).

STRATEGY:

Enable better conservation of the natural landmarks and habitats that are most sensitive to climate change by incorporating them into efficient, representative Marine Protected Areas (cf. AMP).

Ensure maintenance of ecosystem services for habitats that are the most sensitive to climate change (conservation, restauration).

PLANKTON

What is happening now

- ◀ Anomalies observed in the composition and dynamics of zooplankton result from variations in phytoplankton related to climate change.

- ◀ Wider proliferations of jellyfish are being seen in coastal waters, though no direct connection with climate change has yet been proven.

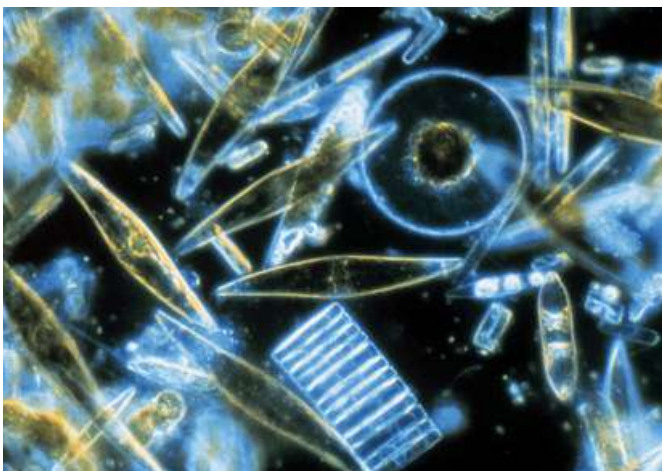
- ◀ Since the 1970s, on the west coast, a decline in the production of phytoplankton has been regularly recorded and linked to climatic variations.

- ◀ On the east coast, since 2009, changes in species comprising phytoplankton have been brought to light, linked to climate changes, but also human activities around the lagoons.

GAPS IN KNOWLEDGE:

Lack of knowledge about the origins of phytoplankton proliferations in Corsica's lagoons.

Phyto- and zooplankton.
Photos : G. T. Taylor, Marie Garrido.



What may occur in the future

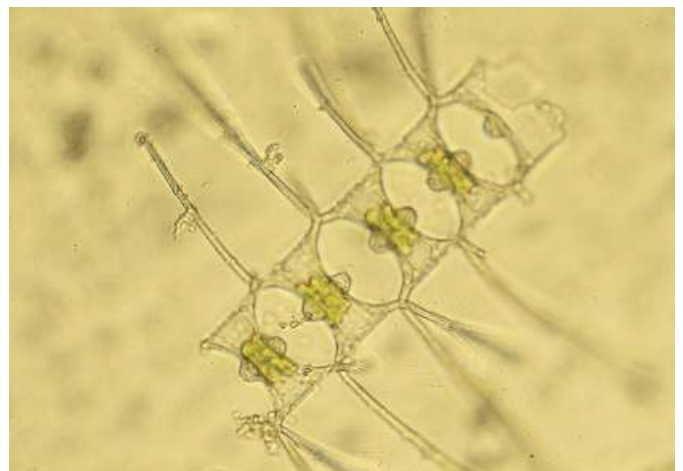
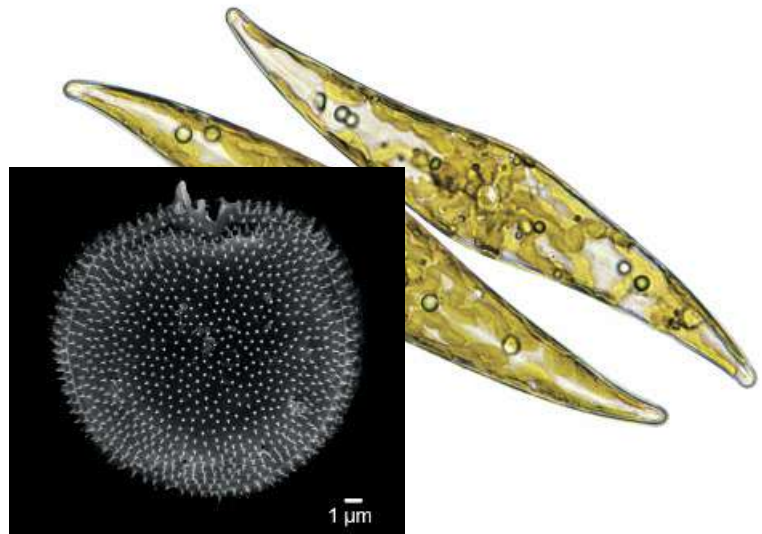
- ◀ As Corsica's coastal plankton ecosystem depends on natural climate forcings (seasons), all modifications in the climate will lead to changes in the dynamics of coastal water masses and thus the plankton ecosystem.

- ◀ Persistent modifications in the climate in winter will reduce the abundance of phytoplankton, with direct consequences on all coastal ecosystems.

- ◀ Modifications in the quality and quantity of plankton will lead to replacement of key species, with possible ecological and economic consequences (notably on fishing).

STRATEGY:

Coordinate with fisheries (cf. fishing).



FISH

What is happening now

- Climate change is a very serious additional threat facing fish populations, already weakened by human activities (coastal development, pollution, recreational fishing, etc.).
- Increasingly frequent observations are being made of species benefiting from climate change, such as pipefish, white grouper, barracuda, Mediterranean parrotfish.
- Several thermophile species (eg. barracuda, peacock wrasse) now reproduce in Corsica.
- Several species with an affinity for cold water have been observed less and less frequently over the past few decades, such as the angel shark, brown scorpionfish and cuckoo wrasse.

↓ B5-Poissons
JM. Culioli

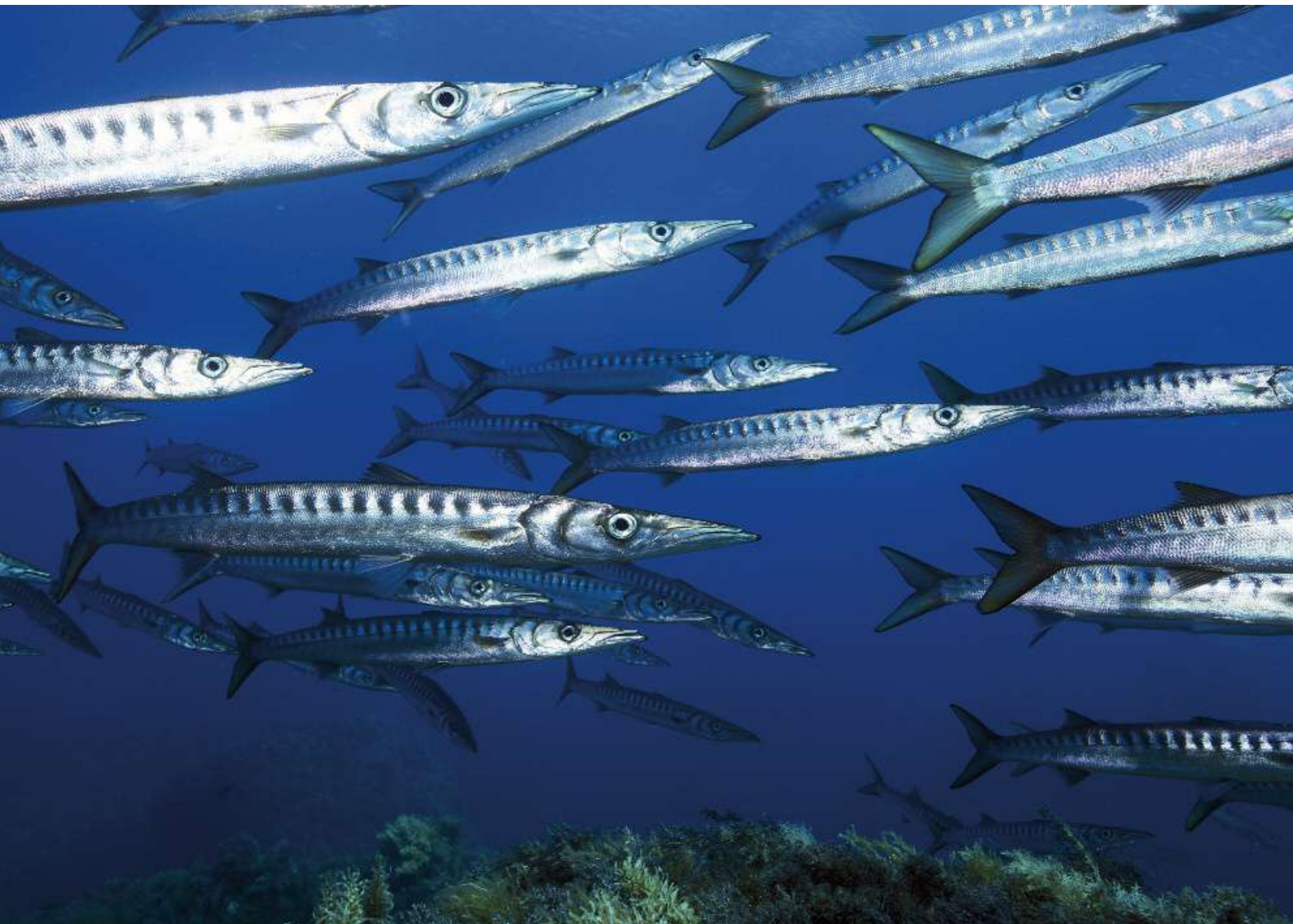
What may occur in the future

- Climate change will exacerbate the decline of marine fish populations already affected by the exploitation of living resources and degradation of the environment.
- Species of fish already favoured by climate change will continue to extend their distribution areas and their abundance.

STRATEGY:

Take the evolution of fish populations into consideration in fisheries management (cf fishing).

Conduct more observation of thermophile and thermophobic species in order to follow more closely the consequences of climate change in this compartment (cf. temperature measurement).



Above : shoal of barracudas, Lavezzi.

Right page : loggerhead sea turtle, striped dolphins, and aythya diving ducks. Photos : Gérard Pergent, Artescienza, Andreas Trepte/www.photo-natur.net.

MARINE MAMMALS AND SEA TURTLES

What is happening now

█ The ten or so species of cetaceans found in the waters around Corsica suffer no impact from climate change.

█ The loggerhead sea turtle, the main species in Corsica, is not directly affected by climate change.

GAPS IN KNOWLEDGE:

Data is lacking on migrations and the diet of sea turtles and cetaceans.

STRATEGY:

Ensure conservation of egg-laying sites and conduct surveys of sea turtles' nests.



BIRDS

What is happening now

█ Certain seabirds such as puffins return earlier and earlier in the year.

█ Wintering of pink flamingos in Corsica, as well as that of other large waders such as herons, is encouraged by milder winters in the Mediterranean and reduced availability of water in North Africa.

█ The number of seabirds and aythya ducks that come to hibernate in Corsica is falling due to milder winters.

GAPS IN KNOWLEDGE:

Lack of regular observation of sea and coastal birds in Corsica.

STRATEGY:

Adapt opening and closing dates of the hunting season to preserve migratory and breeding birds as much as possible.

↓ B6-Mammifères marins et tortues
C. Cesarini

What may occur in the future

█ Modifications in the food chain linked to climate change may have indirect consequences on the distribution of some cetacean species.

█ In the case of sea turtles, rising temperatures will have an impact on food resources, favour nesting and modify the sex-ratio of newborn turtles.

█ The rising sea level will have an effect on potential egg-laying sites.



↓ B7-Oiseaux
JM. Culioli, B. Recorbet & A. Leoncini

What may occur in the future

█ Cumulative effects of climate change and human activities will exacerbate threats faced by birds.

█ The rising sea level will lead to alteration of coastal areas and the small islands thus formed will encourage nesting among certain species of colonial birds.





SEAGRASS AND CARBON CAPTURE

What is happening now

- ◀ Coastal vegetation plays a major role in attenuating climate change (carbon fixation and sequestration) ; Posidonia, the most effective species in this respect, covers over 60 % of the sea at depths between 0 and 40 m in Corsica.
- ◀ There are other habitats around the island likely to play a part in carbon fixation and sequestration (eg. maerl, coralligenous, seagrass).



B8-Herbiers et capture du carbone
G. Pergent, C. Pergent-Martini & B. Monnier

What may occur in the future

- ◀ The rising sea level will accentuate regression of deep seagrass meadows (lower limits) due to less light on the seabed.
- ◀ Regression of Posidonia seagrass will reduce its capacity for carbon sequestration as well as other ecosystem services it provides.
- ◀ Deterioration of the Posidonia bed caused by human activities (anchoring, trawling) will release part of the sequestered carbon and worsen the effects of climate change.
- ◀ The rise in water temperature will affect the carbon footprint of coastal vegetation and give rise to higher emissions of carbon dioxide.

STRATEGY:

Preserve the carbon sink by taking appropriate measures (eg. anchorage management, reinforcement of bans on trawling).

Create Marine Protected Areas dedicated to the conservation of carbon sinks.



Climate change and human activities

COASTAL EROSION

What is happening now

- ◀ Complex natural mechanisms causing coastal erosion are affected by anthropogenic pressures (eg. dredging, sand replenishment, urban development of the coast), but also by climate change (eg. rising sea level, extreme events).

- ▶ The average annual speed of the rise in the sea level has increased over the past decades.

- ▶ The impact of climate change on coastal areas is not established from a statistical viewpoint, despite the presence of habitats that are vulnerable to erosion (eg. sandy beaches, low-lying land).



C1-Érosion côtière
T. Pelte, A. Honorez, N. Frissant & J. Mugica

What may occur in the future

- ▶ Forecasts for rising sea levels (last IPCC report) show that by the year 2100 the rise will be from 0.3 to 0.5 m in the Mediterranean.

- ▶ The rising sea level will increase coastal risks (erosion and flooding) with marked disparities at local level.

- ▶ Increasing frequency and intensity of storms (extreme events) will have an impact on coastal erosion.

STRATEGY:

Shoreline management must anticipate and address increasing risks of marine submersions and coastal erosion.

Above :
cliffs of Bonifacio.

Left page :
Posidonia seagrass meadow and *Pinna nobilis* (noble pen shell).

Photos : Gérard Pergent.

NON-NATIVE SPECIES

What is happening now

- Climate change is encouraging the arrival of new non-native thermophile species and the naturalization of a certain number of them (eg. natives of the Red Sea or South Atlantic).

- Several of these species (eg. caulerpa, ostreopsis micro-algae, comb-jelly Mnemiopsis or "American jellyfish") have an invasive character and pose problems for certain socio-economic activities (eg. fishing, tourism).

STRATÉGIE :

Fédérer les actions concernant le recensement et le suivi des espèces non-indigènes en collaboration avec l'ensemble des acteurs.

Anticiper et intégrer les modifications induites par l'arrivée des espèces non indigènes dans la gestion des activités économiques comme la pêche ou le tourisme.



Trumpet fish.. Photo : Jean Georges Harmelin.

FISHING

Ce qui se passe actuellement

- Certain species of commercial importance (spider crab, edible sea-urchin) are showing changes in behaviour (modification of the reproduction period).

- Effects of climate change on species allow new resources for fisheries to be exploited (eg. white grouper, barracuda).

GAPS IN KNOWLEDGE:

Long-term data on the species exploited should be linked to data on climate change.

C2-Espèces non indigènes P. Francour, V. Raybaud, C. Pergent-Martini & Joseph Donini

What may occur in the future

- The arrival of new species and their possible naturalization will continue with unforeseeable consequences in ecological, economic and public health terms.

- Naturalization of species already observed within the "Alien Corse" network (trumpet fish and rabbitfish) and the arrival of species which already pose problems in other Mediterranean regions (balloon fish, lionfish, stonefish) will thus have an impact on the functioning of ecosystems and economic activities, fishing in particular.



Caulerpa. Photo : Gérard Pergent.

C3-Pêches JM. Culioli & MC. Santoni

Ce qui peut arriver dans le futur

- The future of fisheries is uncertain in the context of effects of climate change.

- The arrival of new thermophile species may not only constitute new fisheries resources, but also give rise to ecological imbalances and economic impacts.

STRATEGY:

Take the effects of climate change on fisheries management into consideration.

Marine protected areas

Marine Protected Areas (MPAs) are watchdogs and laboratories. They make it possible for alerts to be raised on changes observed in the marine environment, and to understand phenomena arising within it. Corsica benefits from recognized experience in terms of management of the marine environment thanks to the creation of fishing reserves in the 1960s, then Corsica's Regional Nature Park in the 1970s and, since 1975, nature reserves which now cover almost 7.5% of Corsica's territorial waters. Corsica's MPAs comprise a real watchdog network capable of identifying the impacts of climate change.

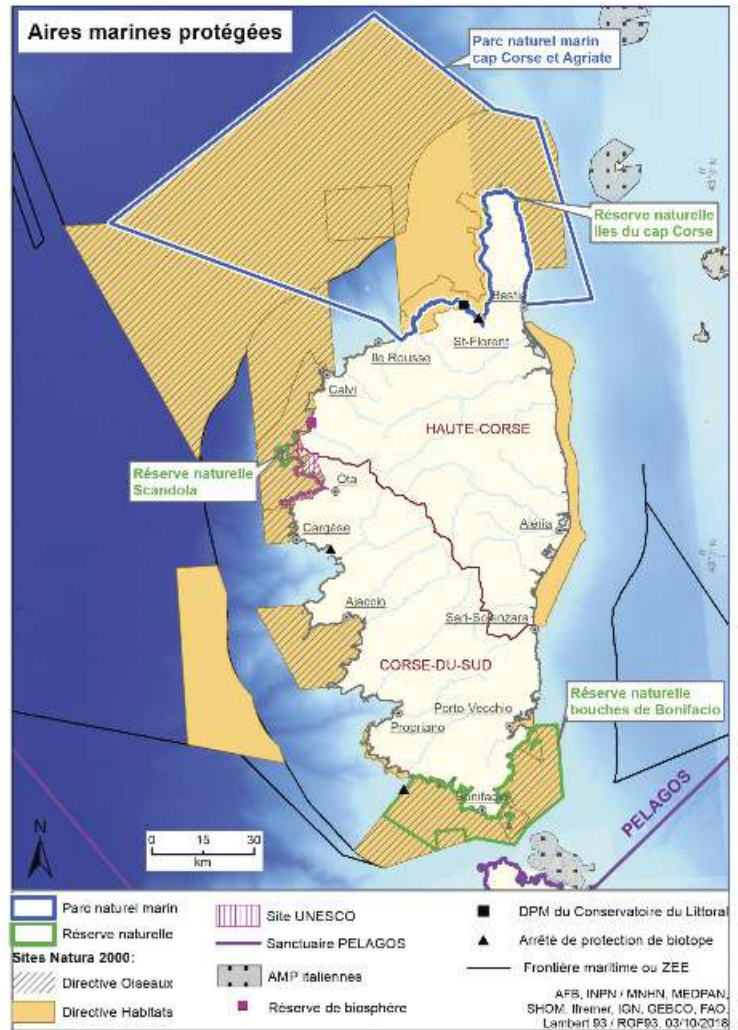
Scientific data acquired over several decades in the Nature Reserves of Les Bouches de Bonifacio (RNBB) and Scandola now provide extensive and reliable data for the study of climate change, particularly within the Mediterranean network of MPAs. In 2007, climate change was identified as having an influence on the overall functioning of the RNBB. Examples of its impact there are numerous : erosion due to the high frequency of exceptional storms, storms from the east giving rise to deposits of *Posidonia* foliage, more frequent appearance of *velella*, massive mortality among Gorgonians in periods of scorching heat. Likewise, extensive mortality in red coral has been recorded in Scandola.

In all the MPAs, multiple impacts on fish have been observed: mortality of groupers caused by nodaviruses accentuated by high temperatures, more extensive presence of non-native species, some invasive, and thermophile species in fishing nets or divers' observations.

In addition to their watchdog role, MPAs provide real sites for experimentation to define management practices with all the socio-economic players needing to take climate change into account. They contribute to communication on climate change issues, their understanding by decision-makers and citizens, and thus to the definition of adaptation strategies, thanks in particular to pilot projects. MPA managers thus need to be pro-active in incorporating problems related to climate change into the management of their areas. Management measures should not only make it possible to identify anthropogenic pressures accentuated by the effects of climate change as, for example, the prolongation of tourist seasons which heightens pressure caused by tourist activities (disturbance of avifauna, degradation of remarkable natural landmarks, anarchic anchoring which destroys coralligenous assemblages and *Posidonia* meadows), but also to guarantee the practical role of MPAs in attenuating climate change (carbon sinks) and reinforcing the resilience of protected ecosystems.

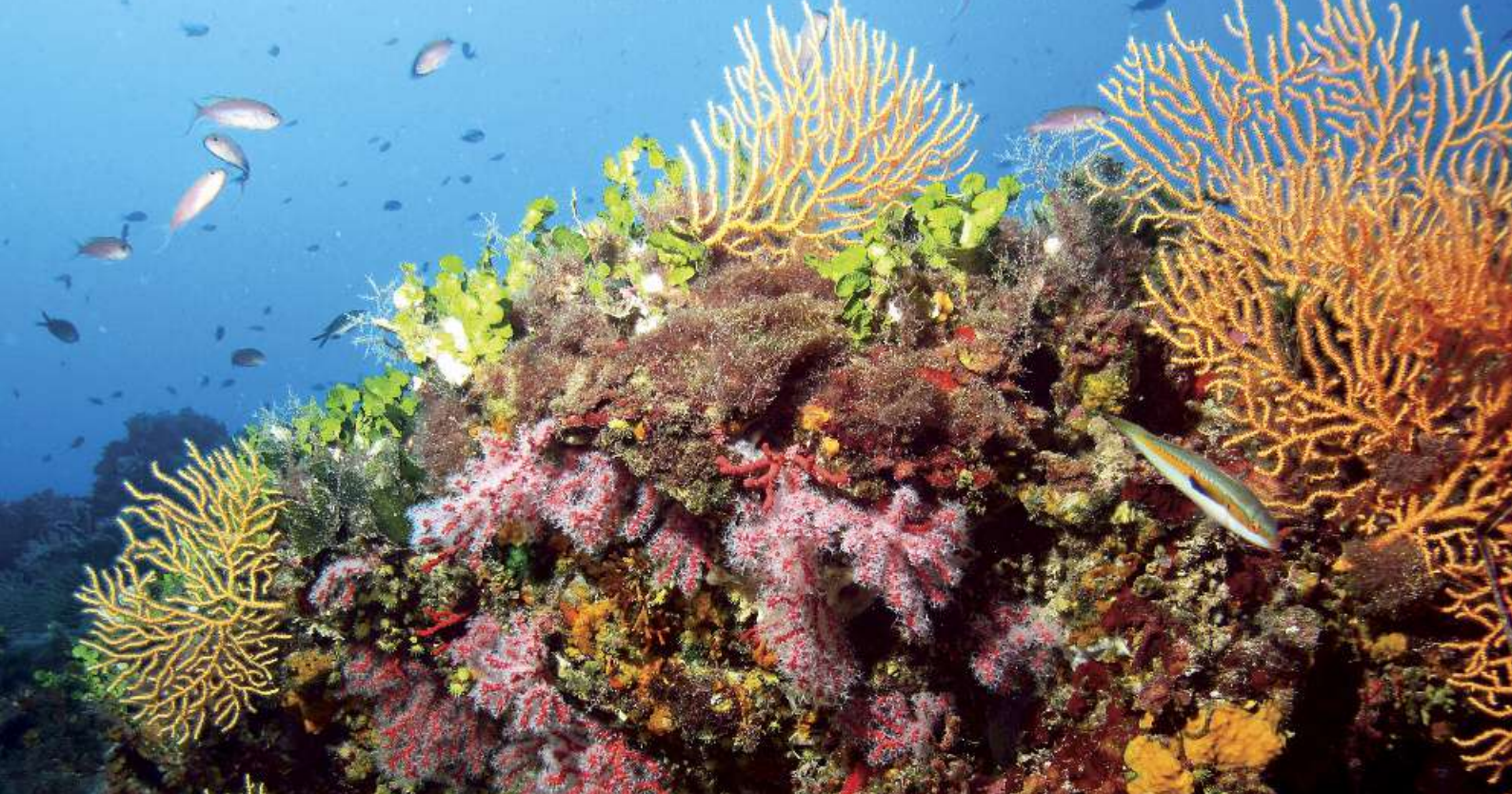
They must:

- limit accidents related to drought, such as fires on the islands, and the impact of activities involving impairment of threatened species or habitats;
- encourage good practices by making information available to the general public, promoting new species on the local market, enabling adaptation on the part of small coastal fisheries, and speeding up management activities for nautical tourism;
- communicate on the role of the reserve effect which improves the ability of ecosystems to adapt to changes without provoking major alterations.



Source : French Agency for Biodiversity.

In conclusion, preservation of the capital of Corsica's coastal and marine biodiversity is seen as an example in the Mediterranean basin, though climate change now threatens these progressive policies associating the protection of marine biodiversity with sustainable development of the shoreline and the sea. Even with their long experience of management, Corsica's marine protected areas will have to adapt to allow for optimal conservation of this biodiversity. To this end, they dispose of series of long-term scientific data, awarded credibility through scientific consultation, which can serve as a base for planned management action, attenuating the effects of climate change and encouraging adaptation on the part of MPA managers and users. Today, scientific activity must be firmly focused on understanding phenomena linked to climate change, and must offer simple, coordinated scientific follow-up within MPAs placing all the scientific data and their management experience at the disposal and service of ambitious, global projects for the Mediterranean.



Coralligenous. Photo : Sandrine Ruitton.

Conclusion

While the coast is currently a driver behind economic development in Corsica, it seems to be particularly vulnerable to modifications induced, directly or indirectly, by climate change. Its ability to respond to the pressures being applied, especially in terms of water resources, will largely depend on the smooth functioning of its watersheds. The marine environment will also be particularly affected, whether in terms of the quality of sea water or conservation of ecosystems and the species they accommodate. Taking probable and foreseeable consequences of climate change into account in development strategies for Corsica's coastal areas (erosion, submersion, management of living resources, tourism) thus seems indispensable.

In this context, any approach to land development projects, for which coastal and marine protected areas are privileged tools, should be based on a shared, dynamic and functional vision of natural and cultural heritage. Consideration of upstream-downstream relationships and the complementary nature of different areas (mountain/shoreline/sea), as well as their "common destiny", is a guarantee of success in the process of adapting to consequences of climate disturbance, making us reflect on taking climate change into account in terms of ecological solidarity.

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