BIODIVERSITY AND CLIMATE CHANGES IN THE CARRIBEAN AREA

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Abstract*. Climate change is a major threat to global biodiversity. From the tropics to the poles, all ecosystems seem to be affected. A study published in the journal Nature indicates that 15-37% of animal and plant species may be at risk of extinction due to anthropogenic climate change. Ecosystems provide goods and services that are crucial to people's well-being. This is more true for overseas collectivities, whose populations are predominantly rural and depend largely on natural resources for their livelihoods. The ecosystem services provided to people are of several types, covering several areas of the active society. Island ecosystems are fragile balances and are particularly vulnerable to anthropogenic aggression. About 75% of animal species extinctions and 90% of bird species extinctions recorded over the past 400 years have occurred on islands. Island ecosystems have evolved in an isolated and relatively protected way, so they are particularly fragile in the face of changes in the environment, and especially to some species introduced by man, against which they developed no resistance. Historically, the natural ecosystems of overseas communities have been largely degraded following the first colonization to make room for crops or human settlements. For example, several natural forests were almost entirely converted to sugar cane plantations in the 19th century; this culture has also had a strong impact on ecosystems throughout the Caribbean. More recently, the direct destruction of habitats has intensified due to the significant population expansion that characterizes the majority of overseas communities, and the intense development of tourism.*

Keywords*: climate change, biodiversity, Caribbean, ecosystems*

INTRODUCTION

The Caribbean is a region of the Americas that includes several island states such as the Dominican Republic, Haiti, Guadeloupe and Jamaica. Caribbean countries are part of a category of states called Small Island Developing States (SIDS). This type of country is currently the one most threatened by the impacts of climate change SIDS are low-lying countries, i.e. they are not much higher than sea level. This means that the melting of the ice sheet is a reality that is increasingly felt for them, as rising sea levels threaten their territories that could eventually disappear. For several years, SIDS have used the as a slogan "small islands, big problems" to illustrate the damage they face (CALLICOTT et all., 2001). The dual vulnerability of the Caribbean According to the World Health Organization. This can, in part, be explained by the phenomenon of dual vulnerability. Indeed, in the face of climate change, the Caribbean region is experiencing a double vulnerability, that is to say, it is the victim of as many direct factors than indirect (ȘMULEAC et all., 2013). On the one hand, direct factors represent all changes that are directly related to climate change. For example, the geographical location of the Caribbean is a direct factor, as by itself it makes the region more vulnerable to the impact of climate change (PAȘCALĂU et all., 2020). Because of this geographic location, the Caribbean is among the places most affected by the increase in extreme weather events. On the other hand, indirect factors are those that are created by humans. Deforestation, for example, is a human activity that influences the impacts of climate change on the region. Indeed, it leads to soil erosion and monopolizes a large part of the region's water resources (ȘMULEAC et all., 2020). The adverse effects of the tourism industry Caribbean countries are economically dependent on tourism, resulting in a complex relationship with this industry. The

region's tourism industry employs 2.4 million people and contributes more than $62 billion. This amount corresponds to more than 15 % of the gross domestic product of the sector. It is therefore clear that tourism is an important economic activity for these States. However, the tourism industry is responsible for much of the emissions and direct damage to the region. In 2018, taking into account the displacements it causes, regional tourism would have contributed 62 billion kg of CO 2. In addition, it is tourists who are directly responsible for a large number of environmental damages in host countries. Along with resort activities, which accompany this kind of trip, such as scuba diving, hiking trails and water skiing, come several harmful effects. Reef damage, soil degradation and biodiversity loss are just a few (LOTZ-SISITKA, 2010). In order to attract tourists to their regions, accommodation in travel destinations is becoming more and more spectacular. On the other hand, this type of installation requires staggering amounts of energy to use all kind of facilities for the comfort of tourists. Caribbean countries are therefore faced with a dilemma between economic activity and environmental protection (PAȘCALĂU et all., 2020).

MATERIAL AND METHODS

Concerted actions Caribbean countries have established several local and joint measures to address the impacts of climate change in their region. In particular, they asked the Intergovernmental Panel on Climate Change (IPCC) to produce a special report on the impacts of global warming of 1.5 degrees Celsius compared to impacts at higher temperatures, in order to anticipate results. All Caribbean States have submitted to the Nationally Determined Contributions (NDCs). The NDC is a document of the Paris Agreement that commits States to establish, communicate and update the contributions they have identified at the national level and plan to make. They also organized the establishment of the Caribbean Disaster Emergency Management Agency (CDEMA). CDEMA is a regional intergovernmental agency for disaster management in the Caribbean Community.

The aim of the creation of this agency is to unite the forces of the Caribbean countries, in order to act better when a disaster occurs (BENAYAS, 2009). At the national level, several countries in the region, such as Barbados, Grenada, Haiti and the Dominican Republic, have passed bills to adaptation to climate change. Also, they have set up verification systems that track carbon emissions.

The role of developed countries

Despite all the measures put in place by Caribbean countries and other SIDS, some of the work must be done by developed countries, to see real change. At the Copenhagen conference, which was the 15th Conference of the Parties to the United Nations Framework Convention on Climate Change, the Alliance of Small Island States (AOSIS) made important demands. It has requested, inter alia, that the target of a maximum increase in average temperature be reduced from 2°C to 1,5°C, without success. For the past decade, SIDS have been trying to put their issues on the international agenda, to no avail.

Caribbean countries are going beyond their financial means to avoid further damage caused by climate change. This region of the world contributes only 1% of global CO2 emissions. Although they are trying to reduce this 1%, there is still a 99% that need to be improved, so that SIDS see the changes needed to reverse their plight.

The Barbados Summit in 1994 and the Mauritius Summit in 2005 were two international conferences devoted by the United Nations to island issues specificities of these States and their vulnerability to climate change. These conferences have demonstrated that the threats facing these islands are part of a global problem and that this should also affect the continents.

The IPCC anticipates a large increase in climate refugees from island states. This issue, which is increasingly being talked about, is likely to become more concrete among SIDS in the coming years. Since these waves of migrants are likely to move to developed countries, the issue will certainly capture their attention.

RESULTS AND DISCUSSIONS

Invasive alien species

Invasive alien species are currently the most important cause of species extinction for island ecosystems (GISP 2008). The animal and plant populations of the islands are largely affected by the introduction of new predators or competitors against which they have not developed specific resistance. Chemical or organic pollution of air, water and soil affects most of the natural ecosystems of the European overseas territories. Chlordecone, an insecticide widely used in banana crops in the Caribbean until 1993, caused serious pollution of waterways and permanently contaminated the soils of the French West Indies Terrigenous sedimentation, caused by soil erosion, seriously affects the lagoon of Mayotte. In addition, 80-90% of the water discharged into the ocean in the Caribbean and Pacific is not treated, and the resulting pollution directly affects marine ecosystems.

Changes in precipitation patterns

Since the 1970s, across the globe, in all areas, important changes have been registered. This increased drying is due to higher temperatures and lower precipitation. This trend has been confirmed in the Caribbean region and New Caledonia, with a significant decrease in rainfall in recent years while in the rest of the European overseas communities, the general trend observed was rather an increase in the volume of precipitation (HAMILTON, 2010).

Intensification of cyclones

Observations show an increase in the intensity of tropical cyclones in the North Atlantic since 1970, correlated with the increase in sea temperatures.

Based on a set of advanced models, the IPCC projects an intensification of cyclones throughout tropical regions, with stronger maximum winds and heavier point rainfall. This intensification is linked to the increase in the surface temperature of tropical seas.

Sea level rise, observed globally for several years, is directly linked to global warming. It is mainly due to the thermal expansion of increasingly warm oceans, but also to the melting of glaciers, ice sheets and polar ice caps Global Sea level has risen by about 20 centimeters since 1900.

Change in wind patterns

Climate change could also alter the dynamic balance of atmospheric circulation (global movement of the air layer surrounding the Earth) (PAȘCALĂU et all., 2021).

In particular, in recent decades, an eastward shift of the Azores anticyclone has been observed corresponding to a positive phase of the Oscillation North Atlantic (NAO+). This phenomenon leads to a significant change in wind patterns for the entire North Atlantic. In Macaronesia, this variation induces a reduction in fresh trade winds from the northwest, and on the contrary, an increase in easterly winds from Africa.

Ocean acidification

The increase in the concentration of carbon produced by human activities since 1750 has led to a general acidification of the oceans. A global mean pH decrease of 0.1 units was measured. IPCC simulations project a further reduction in the surface pH of the world's oceans of between 0.14 and 0.35 units on average.

Impacts of climate change on biodiversity

Climate change will have irreversible impacts on biodiversity. According to the IPCC, about 20 to 30% of species assessed to date are likely to be at increased risk of extinction if global average warming exceeds 1.5 to 2.5°C (compared to 1980-1999). If the increase in global average temperature exceeds 3.5°C, modelling suggests a large number of extinctions (40 to 70% of species assessed) across the globe (IPCC 2007). The biodiversity of the overseas communities of the European Union is particularly vulnerable.

Climate-sensitive forests

Climate and forests are intimately linked. Forest biomass traps and stores C02, playing an essential role in the carbon cycle. It was previously recalled that deforestation was responsible for about 22% of global CO2 emissions and was a major contributor to climate change. Forests are also the first victims. They are generally greatly affected by rising temperatures, altered precipitation patterns and extreme weather events (ROMM, 2007) Widespread degradation of forest ecosystems is likely to increase CO2 emissions and further accelerate climate change through positive feedback.

In 2005, an increase in temperature above 29°C for more than 6 months in the Caribbean region caused significant bleaching in Guadeloupe, causing the death of about 40% of corals. Satellite images have shown that ocean warming has led to a 30% decline in phytoplankton biomass in parts of the South Pacific over the past 10 years.

Beach erosion degrades turtle nesting sites and rising sand temperatures could unbalance the male/female ratio. The sex of turtles is determined by the incubation temperature of the eggs

An increase in invasive species

Due to the development of international trade, increased travel and trade, invasions of invasive alien species are increasing considerably and exerting pressure on growing on natural ecosystems. Climate change could greatly exacerbate this problem (LOPEZ, 1998) A change in climatic conditions would make certain ecosystems more suitable for the establishment or proliferation of alien animal or plant species. For example, the warming of Kerguelen since the 1970s has favored the proliferation of a blue fly (Calliphora vicina) and two species of plants, a dandelion (Taraxacum erythrospermum) and a stellar (Stellaria alsine), which represent an important pressure for the local fauna and flora.

On the other hand, climate change could also remove some of the physical barriers that prevent the spread of invasive species. For example, melting glaciers in polar regions would allow invasive species to colonize new spaces that were previously inaccessible to them. This is the case for rats in South Georgia which affect seabird populations.

Birds as indicators of climate change

Highly sensitive to climate and weather, birds are excellent indicators of global climate change Many studies report a recent change in the seasonality of migratory birds around the world The period of laying and migration of birds is closely linked to the alternation of seasons, and a change in global climatic conditions leads to a significant change in life cycles of these species, often impairing their reproductive and survival capacities. Of the 119 migratory bird species studied in Europe, 54% have already shown sustained or sometimes very severe decline between 1970 and 2000. Climate change is presented as one of the factors responsible for this decline (KAGAWA et all., 2010). Migratory birds are also largely disturbed by tropical storms and cyclones that slow them down during their migration or divert their paths.

This is the case for migratory birds from the Caribbean islands Cyclones also affect land birds, through the temporary destruction of their refuges and the reduction of their food resources. In the Cayman Islands, for example, Cyclone Ivan had a major impact on local bird populations. In Antarctica, a decrease in phytoplankton abundance linked to climate change is severely affecting populations of seabirds such as King Penguins depend.

Finally, changing climatic conditions can alter the range of some bird species and have indirect consequences on all Ecosystems (LÆSSØE, 2009).

Beach erosion

Rising sea levels have already caused significant erosion of beaches around the world. Global sea level has risen by about 20 centimeters since 1900, and the consequences for beaches are not fully understood globally but have been extremely severe. for certain regions. A study of 200 beaches in nine Caribbean islands between 1985 and 1995 shows that 70% of the beaches studied have eroded. Similarly, in the Pacific region, beach erosion is a common and significant pressure, and continued sea level rise could increase this pressure.

CONCLUSIONS

The impacts of tourism on biodiversity are major, in particular through the clearing of natural areas, mangroves, the filling of wetlands to build reception infrastructures, but also by increasing the number of pollution and overexploitation of resources. About 80 per cent of the mangroves in the British Isles have been destroyed, mainly for the construction of tourism infrastructure.

Climate change is a more recent threat to biodiversity and according to some scientists, this phenomenon is becoming the most important pressure for global ecosystems. (DESCOLA, 2013). Island ecosystems are particularly vulnerable to climate change, as the biological populations of island species are generally sparse, highly localized and highly specialized and can be easily driven to extinction. But also, because island ecosystems, such as coral reefs, are often fragile balances very sensitive to a change in their environment. Major impacts have already been noted, such as coral bleaching or erosion of certain coastlines, and projections of the future effects of change.

The so-called "greenhouse gases" trap some of the infrared radiation emitted by the Earth to the Earth's atmosphere and thus increase the temperature of the lower atmosphere (troposphere) (FRASER, 2001).

Islands are particularly threatened by climate change, yet in general their liability is relatively limited. The Pacific Islands, for example, constitute 0.12% of the world's population and are responsible for only 0.003% of CO2 releases. Significant warming is expected in all overseas communities of the European Union, but with significant variations between the different geographical areas. In the Caribbean, the Indian Ocean, the South Pacific and Macaronesia, the projected temperature increase, of the order of + 2°C on average for all communities, is slightly below the global trend. In French Guiana, the projected increase is higher, with an estimate of + 3.3 °C [+ 2.6 to + 3.7 ° C]. This is due to the fact that continents are warming faster than oceans, due in part to their lower thermal inertia. Finally, Arctic temperatures could rise dramatically, and at a much faster rate than in the rest of the world. The models predict a likely rise in temperatures of 4.9°C [+4 to +5.6°C] in this region.

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