

# WHAT SHOULD WE KNOW ABOUT CLIMATE CHANGE



**BRIJUNI**  
Nacionalni park  
National Park

Earth's temperature depends on the balance between energy entering and leaving the planet's system. Many factors, both natural and human, can cause changes in Earth's balance. Climate changes prior to the Industrial Revolution can be explained by natural causes, while recent researches indicate that since the mid-20th century human activities have been the dominant cause.

## NATURAL CAUSES

Natural factors can have large impact on the Earth's overall temperature, as seen in pre-historic times. Variations in solar radiation are recognized as one of the natural causes of climate change. There are also volcanic eruptions and natural forest fires, which discharge greenhouse gases that trap solar energy and warm the atmosphere. At the same time, volcanic eruptions discharge aerosol which scatter incoming solar



# CAUSES OF CLIMATE CHANGE

radiation causing a cooling effect. The movement of tectonic plates affect global circulation patterns of air, ocean water and the climate of the continents.

## HUMAN CAUSES

The human impact on climate changes are more and more visible. Human activities related to agriculture, food provisioning, deforestation, farming and fertilizing increase greenhouse gases. The atmospheric abundance of these particles in the atmosphere changes the climate of the Earth and leads to warming or cooling. Burning fossil fuel for transportation, electricity and industry will destroy the ozone.



The average temperature around the world and in the oceans, is increasing.



Droughts have become longer.



# SIGNS OF CLIMATE CHANGE

The concentration of carbon dioxide on Earth and in oceans is increasing.



Wild weather conditions are more often.



The sea ice has been decreasing.



Some animal and plant species are disappearing.



The sea level is rising.



# CLIMATE CHANGE IN BRIJUNI NATIONAL PARK

Brijuni National Park is not immune to climate change occurring around the world, but the protection of the marine and terrestrial areas is one of the most important tools to preserve biodiversity and to fight the new changes. Marine protected areas are more resilient to climate change and are responding much better to them than other unprotected areas. It is very important to invest in their conservation because this has a positive effect on the surrounding areas as well.

## MORE FREQUENT AND LONGER DROUGHTS



Droughts on Brijuni are more and more common, and besides their ecological consequences they also affect the visual identity and the visitor's perception of the island. In addition to being more frequent, droughts are also longer, so it is quite common to see meadows with yellowed grass by the end of September.

## OCCURRENCE OF MULTIPLE FLOWERING SEASONS IN PLANTS



Longer periods of high temperatures cause the appearance of multiple flowering periods in plants, which is an additional stress for them and makes them more vulnerable in defense from pests and parasites which are also spreading easier in warmer weather conditions. In recent years at Brijuni, there are several flowering periods of the holm oak tree, Aleppo pine and cedar trees.

## INCREASED RISK OF FIRES



During summer, the number of fires in Croatia is increasing from north to south and from the interior to the coastal zone and the islands, while in winter and early spring the situation is reversed. Because of their specificity, the most endangered areas of forest fires are the islands. Forest fires are natural disasters that are increasingly occurring due to climate change, leading to other natural disasters, such as droughts, modifications in soil composition and biodiversity changes.



### FREQUENT OCCURRENCES OF EXTREME WEATHER CONDITIONS



Over the last few years, extreme weather conditions on Brijuni are more frequent, as the record high temperatures in the summer months that last longer and longer. There are also more frequent and powerful storms that, combined with other climate changes, cause damage to the coastal area.

### SEA LEVEL RISE



In addition to the global sea level rise caused by melting of glaciers, sea levels rise in Brijuni is caused by more frequent occurrence of extreme weather conditions. On Veliki Brijun island there is a particularly sensitive area named Saline, which is close to Javorika bay, and which is one of the few Brijuni's freshwater habitats, especially important for birds.

### INCREASED SALINITY OF FRESHWATER HABITATS



Due to aforementioned episodes of more frequent extreme weather conditions, Brijuni's freshwater habitat Saline is growingly under risk of increased salinity. As the stormy weather causes sea level rise, and seawater enters the small lakes in Saline, there is an increased danger of losing this freshwater habitat, and the species that survive there because of water such as numerous birds, turtles, insects and plants.

## THE APPEARANCE OF INVASIVE SPECIES AND CHANGES IN SPECIES DISTRIBUTION

As a result of climate change and rising sea temperature, the invasive species spread and changes in species distribution increased. Invasive species are those that easily and successfully adapt to new ecological conditions and suppress the local population. Most often these are warm sea species that do not survive winters in our region, but the rise in temperature enhances their survival throughout the year and further spread of the population. The changes observed in Brijuni are related to these species:

### *Mnemiopsis leidy*

is an invasive comb jelly which is easily mistaken for a jellyfish, but it cannot sting. Its native habitat is in temperate to subtropical areas along the Atlantic coast of North and South America. *M. leidy* tolerates salinity and temperature changes and different water quality conditions. Since its unintentional introduction to the Black Sea, *Mnemiopsis* has spread to adjacent bodies of water and it is present even in Brijuni. It is a carnivorous predator of zooplankton, crustaceans, mollusk larvae, eggs, and young fish larvae which causes negative impacts throughout the whole food chain.

### *Caulerpa cylindracea*

is a species of green alga that is one of the most invasive species recorded in our area. It is native to southwest Australia, but is now found worldwide in shallow coastal waters of both temperate and tropical seas. It began spreading through the Mediterranean as an invasive species in the 1990's and is present in Brijuni.



### *Pomatomus saltatrix*

is a marine, highly-migratory fish. It is usually present in southern Adriatic but is expanding its range northwards in response to recent warming. It is a voracious feeder, strictly carnivorous, renowned for its appetite which is a problem for the local fish communities. Brijuni's species biodiversity could be affected because this species does not have many predators in our area.



## IMPACT ON TOURISM

Increases in seawater temperatures, CO<sub>2</sub> emissions and consequent ocean acidity are altering the ecosystem and causing outbreaks of jellyfish, algal blooms and mucilage events, which is a risk for our coastal tourism. While tourists might expect certain climatic conditions when they travel to a place, they will experience the actual weather, which might deviate quite substantially from the average conditions. It is estimated that the average temperature between 27°C and 32°C is optimal for summer tourism, and any increase in temperature and more frequent periods of extreme weather can result in negative consequences. In addition, increased temperatures during summer can lead to changes in the influx of visitors and the peak tourist season could shift to spring and fall.

# WHAT IS BRIJUNI NATIONAL PARK DOING IN FIGHTING CLIMATE CHANGE?

## EDUCATION

One of the tools in fighting climate change in the Park is education and raising awareness about the protection of nature and the environment. Educational programs are aimed at school and kindergarten children and park visitors. Education focuses on nature conservation and man's influence on it. Important dates are also marked in co-operation with the local community (Biodiversity Day, World Forest and Water Day, Earth Hour Day). Education is one of the most effective tools in reaching the goal because people as individuals can make a big difference in preventing negative changes and contribute to better adaptation to new changes.

## ADAPTABLE PARK MANAGEMENT

It is very important to identify on time changes that may be negative for biodiversity and habitats, and that is why park management cannot be considered a static process that is not subject to change. It is necessary to regularly review and, if necessary, adapt management activities in order to protect the park and its living world as effectively as possible. We are trying to reduce CO2 emissions by encouraging the use of electric and hybrid vehicles and

the use of bicycles as the main means of transport for our visitors.

## MONITORING OF SPECIES AND HABITATS

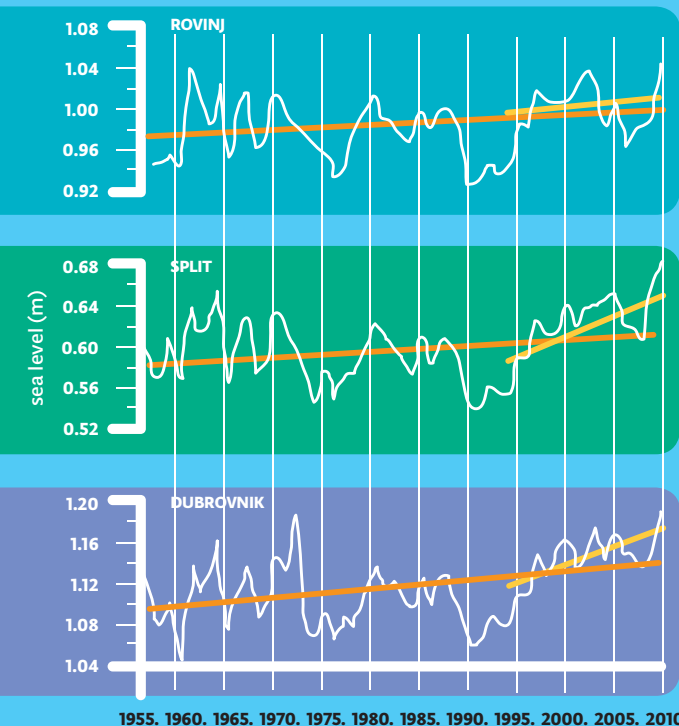
It is very important to monitor species and habitats that are sensitive to climate change in order to respond in time if there is a risk that could endanger them. If a certain habitat is under increased influence of erosion, it is necessary to take measures which would prevent further habitat destruction. The salinity of the freshwater habitat Saline is monitored on Brijuni, where due to more frequent occurrences of stormy weather, seawater is entering the lakes. Also, temperature sensors on Cape Kamik have been set up for a long-term monitoring of sea temperature within the T-MedNet Mediterranean Sea Observation System.

## PROTECTION OF FISH STOCKS

Brijuni are one of the well managed marine protected areas, especially with regard to fish stocks, which is also proven by scientific research. The fact that Brijuni's underwater has 9 times larger fish stock biomass compared to the unprotected areas, speaks of the importance and effectiveness of the protection. In addition, conservation of fish stock has its effect on the unprotected area as well because of the so-called spillover effect. This has a positive impact on the marine ecosystem, which is becoming more resilient to external negative impacts such as climate change.

# SITUATION IN CROATIA

## ANNUAL MEAN SEA LEVEL FOR ROVINJ, SPLIT AND DUBROVNIK

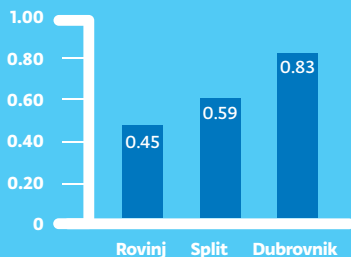


In Croatia, sea level measurements have been measured for many years at tide gauge stations located in Dubrovnik, Split, Zadar, Bakar and Rovinj. Tide gauge is a device used to record sea tides, and long-term measurements allow us to calculate absolute sea level changes. These data are globally important for assessing the rise of the median sea level, which is becoming more and more important as one of the major consequences of climate change.

The average annual sea level values, continuously measured since 1955, indicate an upward trend of sea level of 0.5 to 0.8 mm per year. After 1993 it is noticeable that this trend is accelerating and the average sea level rise is more than 4 mm per year. If this trend continues in the mid and southern Adriatic region over the next 100 years, we could expect a sea level rise of around 40 cm.

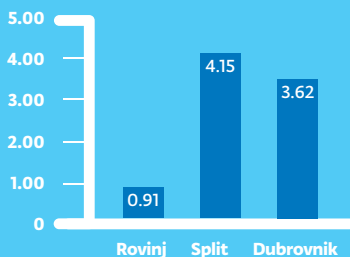
### TREND OF SEA LEVEL RISE FROM 1955 TO 2009

mm/year






### TREND OF SEA LEVEL RISE FROM 1993 TO 2009

mm/year



#### Legend for the upper graph:

-  sea levels
-  trend of sea level rise from 1993 to 2009
-  trend of sea level rise from 1955 to 2009



# MARINE PROTECTED AREAS AS NATURAL RESILIENCE

Marine protected areas play an important role in mitigating climate change. They can be pilot sites for climate change monitoring and serve as a link to the scientific community to anticipate steps for a more effective adaptation to change.

## CLIMATE CHANGE AND THE LIVING WORLD

Due to differences in temperature species are shifted to higher altitudes. Diseases and parasites are spreading more successfully, while invasive species are suppressing native species. Certain species which depend on water cannot reproduce, and their possibility for to survive is reduced. In plants, changes in the flowering periods occur. Climate change threatens human health, their psychological wellbeing, access to clean air, safe drinking water and nutritious food. Sea levels rise erodes livelihood and force communities to migrate. The spread of pests and diseases affects the vegetation and the agriculture.

## HOW TO ADAPT

We can and we must plan today to preserve our planet. It is important to protect endangered and rare species and enforce ecosystem and wildlife monitoring programs. Increase of protected areas can be a good solution. We have to adapt laws and regulations related to nature and the environment and efficiently enforce them.

### SALT MARCHES

Salt marshes vegetation is responsible for mitigating over 90% of the wave energy that can be detrimental to the coastal area. The sheltered estuary area controls sea level rise.

### DUNES

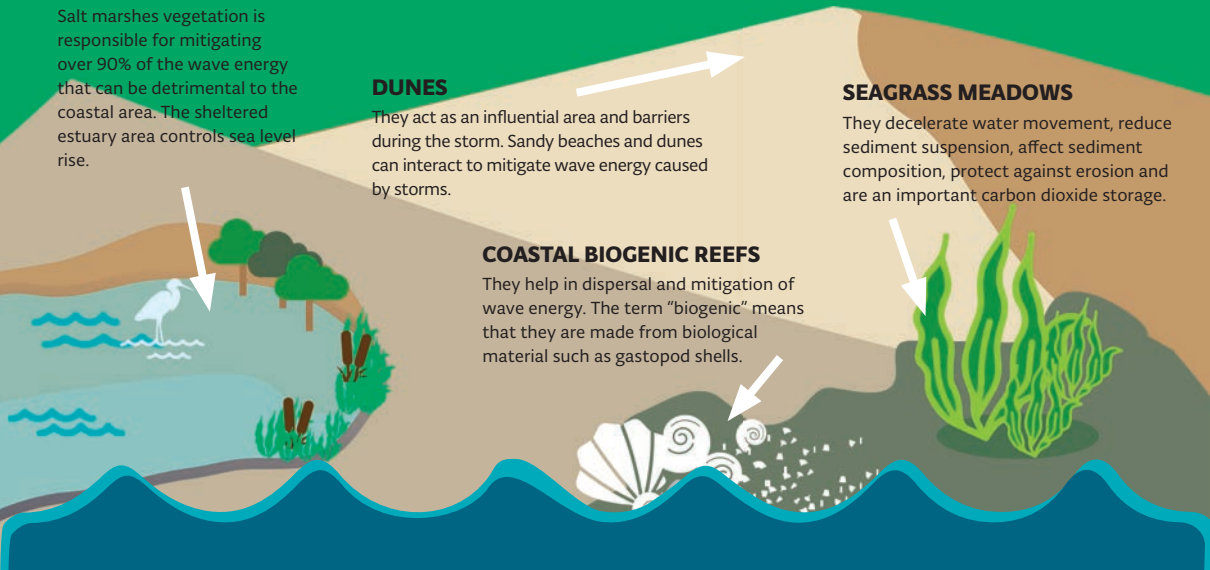
They act as an influential area and barriers during the storm. Sandy beaches and dunes can interact to mitigate wave energy caused by storms.

### SEAGRASS MEADOWS

They decelerate water movement, reduce sediment suspension, affect sediment composition, protect against erosion and are an important carbon dioxide storage.

### COASTAL BIOGENIC REEFS

They help in dispersal and mitigation of wave energy. The term "biogenic" means that they are made from biological material such as gastropod shells.



# SMALL STEPS, BIG IMPACTS

## WHAT CAN YOU DO TO CONTRIBUTE TO THE FIGHT AGAINST CLIMATE CHANGE?

While we can't undo the damage caused to the environment, we can help decelerate the rate of change together. What we have to do as individuals is start making little changes, educate other people and provide information on how to do it.

### **RENEWABLE ENERGY**

Use renewable energy sources when possible. By using wind and sun energy, through windmills and solar panels, carbon dioxide emissions that are a product of using fossil fuels such as coal, oil or natural gas are avoided.

### **EAT LOCAL**

Consider purchasing locally-grown foods as this also reduces greenhouse gas emissions. The further the food that we buy daily travels, means that more greenhouse gases are produced during transportation from the cultivating site to your plate.

### **REDUCE, REUSE, RECYCLE**

Reduce the amount of waste you produce daily, buy fewer new things whose

production and disposal leads to additional greenhouse gas emissions. If possible reuse products and recycle materials that can be reused in the production of new products.

### **WATER CONSUMPTION**

It takes a lot of energy to process water to be delivered to your home and to be safe to drink and safe for everyday use. Save water because you also save energy.

### **CONSUMPTION OF ELECTRIC ENERGY**

Reduce power consumption, unplug the appliances you do not use, because some devices consume power even if they are off. Use energy-efficient devices of higher energy class (A or even A+++).

### **TRANSPORTATION**

Cars, trucks, aircrafts and other motor vehicles are responsible for one third of greenhouse gas emissions, so smart choice of means of transportation is crucial in preventing climate change. Whenever you can choose to walk, ride a bicycle or use public transportation.



# IMPRESUM

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# About the project „Guiding Mediterranean MPAs through the climate change era: Building resilience and adaptation – MPA-ADAPT“

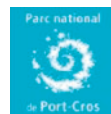
The Mediterranean Sea climate will undergo rapid changes over the next decades. Direct evidence of climate change is already being observed in the Mediterranean coast and also in Marine Protected Areas (MPAs). The need to understand and work towards building resilience for both coastal communities and marine biodiversity, through adaptive management, have become an essential element for mitigation against and adaptation to the rapid changes to maintain and protect healthy ecosystems in the MPAs.

Mainstreaming climate change adaptation into Mediterranean MPAs contributes to the efforts being made across the region to improve adaption to change in the coastal zones.

Brijuni National Park's role as a Mediterranean MPA is to develop a climate change adapted management plan which will be incorporated in its management plan in order to plan future mitigation and adaptation measures. Brijuni will be one of the five sites where pilot projects will be implemented, which will be a tool to test adaptations to climate change, monitoring strategies and asses socio-economic and biodiversity vulnerability.

Marine protected areas: tools to contribute to the adaptation and mitigation of climate change impacts

## PROJECT PARTNERS



**BRIJUNI**  
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National Park



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[www.interreg-med.eu](http://www.interreg-med.eu)