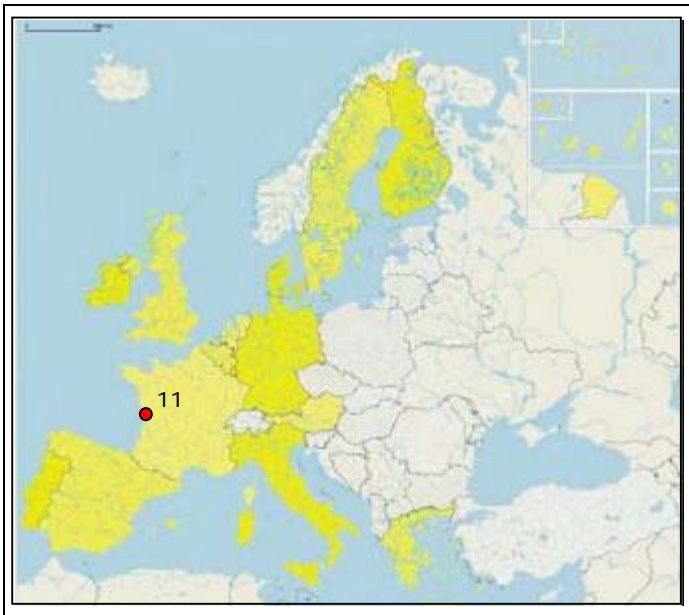


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## CHATELAILLON (FRANCE)



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## 1. GENERAL DESCRIPTION OF THE AREA

The area of interest is the beach of Châtelailillon a 2400 meters long part of a 4 km long coastal section in the bay of Châtelailillon on the Atlantic French coast, close to La Rochelle, between Ré Island and Oléron Island. T

### 1.1 Physical process level

#### 1.1.1 Classification

The bay of Châtelailillon is open on the “Pertuis d’Antioche”, a little sea located between the northern Ré Island, the southern Oleron Island, and French coast in the east. The bay of Châtelailillon is enclosed by the headland of Chay (north) and by the submersible rocks of the Châtelailillon’s headland (south). The beach studied in this case is 2400 meters long. A seawall is built on the upper beach, and protects the city of Châtelailillon against flooding.



Fig. 1: Map of the study site in the “Pertuis d’Antioche”

### 1.1.2 Geology

The bay is part of the Aquitaine basin with secondary layers from the Jurassic with limestone and marl materials. The littoral has evolved during the quaternary and influenced by sea level variations. The marshlands were filled up with fine sand and mud. The beach sand has a  $D_{50}$  between  $200\mu\text{m} < D_{50} < 260\mu\text{m}$  (fine sands)

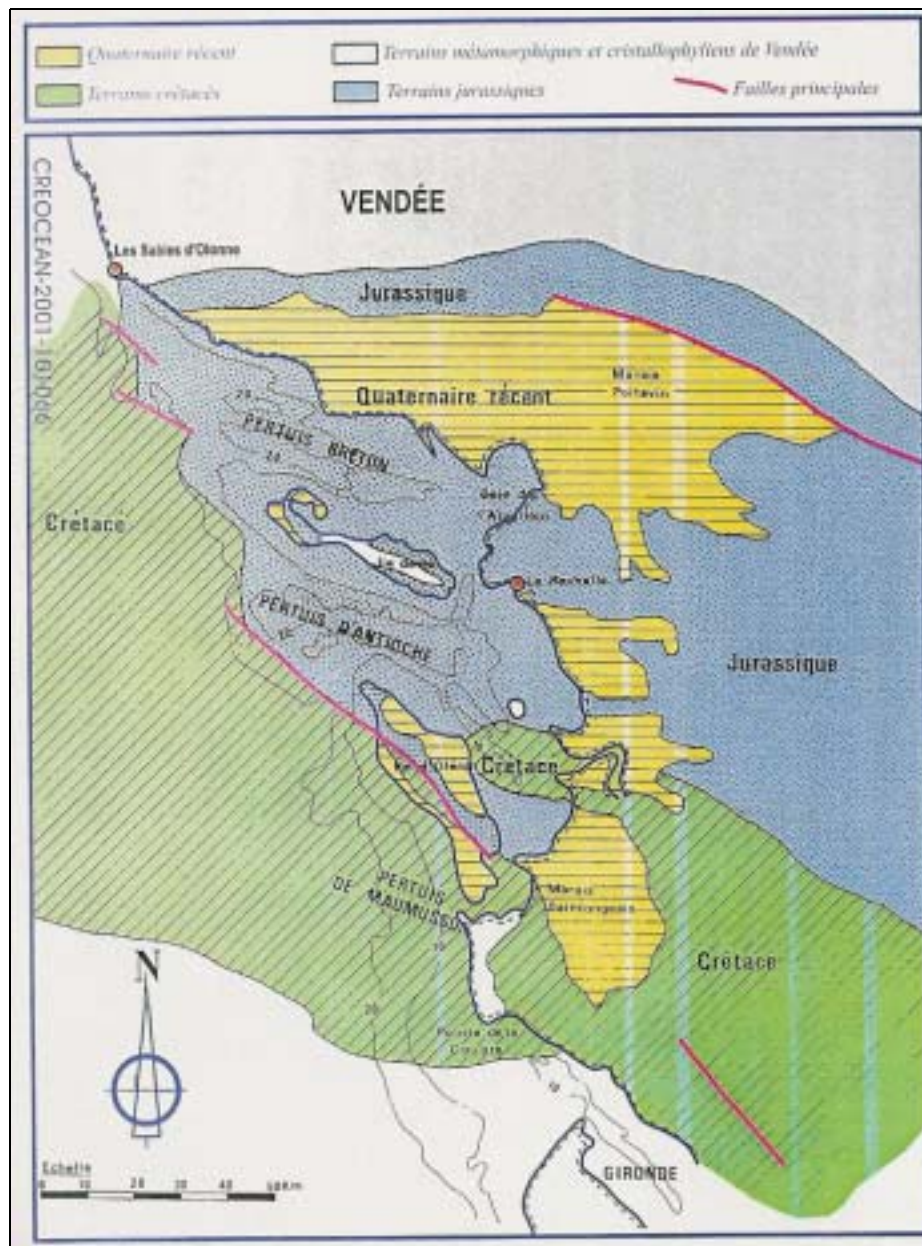


Fig. 2: Geologic map of the area

### 1.1.3 Morphology

The bottom of the bay of Châtelailillon in the “Pertuis d’Antioche” has a low angled slope (level –5 meters at 4,5 Km from the foreshore). The bay could be separated in three components:

- The sandy foreshore close to the seawall
- The rocky shore (lower foreshore)
- The rocky and sandy submarine shore changes into muddy bottom



Fig. 3: Bathymetric map of the studied beach in Châtelailillon.





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### 1.1.4 Physical processes

- The dominant winds are from the south-west to north-west (50%). The wind speed is more than 8 m/s representing 18%, resulting in a significant wind erosion and sand transport from north to south.
- The spring tidal range is about 6 meters
- The dominant current is the tidal current. The flood current is directed to the south with a velocity of around 0,6 m/s and the ebb current is directed to the west-north-west with a velocity of around 0,45 m/s.
- Only swells from south-west to north-west penetrate into the "Pertuis d'Antioche" Around 45% of the swells have a height less than 2 meter, and 6% more than 6 meters. The frequency of the swells is around 6 to 10 s.

### 1.1.5 Erosion

Long shore transport is directed from north to south. The transport induced by the waves, the current and the wind can vary between 1000 to 3000 m<sup>3</sup>/yr (CREOCEAN 2001). After the first seawall has been built in 1925, against the wind erosion of the dune, the beach profiles have began to erode. The reflection of the waves on the seawall, and the cross-shore transport due to the action of the waves have increased the erosion. In the 60's the beach submerged at high tide. The foot of the seawall had to be protected by rocks in order to protect the city of Châtelailon against flooding (in 1962, and in 1972). The erosion, was mainly chronic, with peaks during storm events. The beach would eventually disappear if the erosion in the 80's was not counteracted. The consequences for the city would be twofold: the seaside resort would disappear and the economic costs due to severe damages on the seawall and flooding would be high.

## 1.2 Socio-economic aspects

### 1.2.1 Population rate

The population density of the city of Châtelailon is around 300 inhabitants per square kilometre, with a concentration close to the seaside. The city of La Rochelle, 15 kilometres in the north has 120.000 inhabitants.

### 1.2.2 Major functions of the coastal zone

- **Industry, transport and energy:** Châtelailon is a small city without industry. The major railway of the west of the France (between Nantes and Bordeaux) is located in the east of the territory of the city, less than 200 meters from the sea. The altitude of this railway is just above the sea middle level (+2,0 m NGF). Flooding of this area would hinder railway traffic severely.
- **Tourism and recreation:** the major function of this coastal zone is the tourism and recreation. Châtelailon has 5750 inhabitants, which increases to more than 25000 in summer. The number of tourist-day was around 590.000 in 1984 and more than 870.000 in 2000. The capacity is around 10100 beds. (Sources: Tourist



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Office). Châtelailon is one of the attractions of the town of La Rochelle (more than 120.000 inhabitants). Research shows that more than 50% of the tourists are visiting Châtelailon for the beach. The presence of the Casino, the hippodrome, the marine hydrotherapy centre, the cruise harbour, and the hotels make Châtelailon an attractive seaside resort for the tourists.

- **Urbanisation (safety of people and investments):** the urbanisation is concentrated close to the seaside. The risk of flooding is important due to the fragility of the seawall, the low level of the upper-beach and the neither level of the constructions behind the seawall. The urbanisation is located on top of some filled-up marshes. Currently, a plan for the future urbanisations and a plan for preventing the risks (PPR) are made taking these risks of flooding into account.
- **Fisheries and aquaculture (exploitation of renewable natural resources):** Aquaculture plays an important economic role. There are seventy exploitations of mussels (9000 T/year) and several exploitations of oysters. The basin "Marennes-Oleron" in the Pertuis d'Antioche represents 40% of the national production.
- **Nature conservation:** the site is well urbanised, without special natural area. Some marshes particularly in the south are classified as protected, for example the "Marais d'Angout" which is a ZICO (Community Interest Area for the Birds). The sea between the land and the different islands (Ré, Oléron...) is classified as "Natura 2000" due to the quality of the sea environment.
- **Agriculture and forestry:** agriculture and forestry are not important functions for the country.

### 1.2.3 Assessment of capital at risk

At the moment the value of the endangered property is not established. The fact that more than 300 houses were flooded in December 1999, on the north of the bay, may give an indication

## 2. PROBLEM DESCRIPTION

### 2.1 Eroding sites

At the moment, after the two beach nourishments, actual erosion is mainly located in the north, which is never been nourished. The erosion results in a low and narrow foreshore, with a low angled slope (around 3%). The longshore current due to waves, wind and current transports the sand from north to south. Here the beach is high with embryonic duneforms and wide.

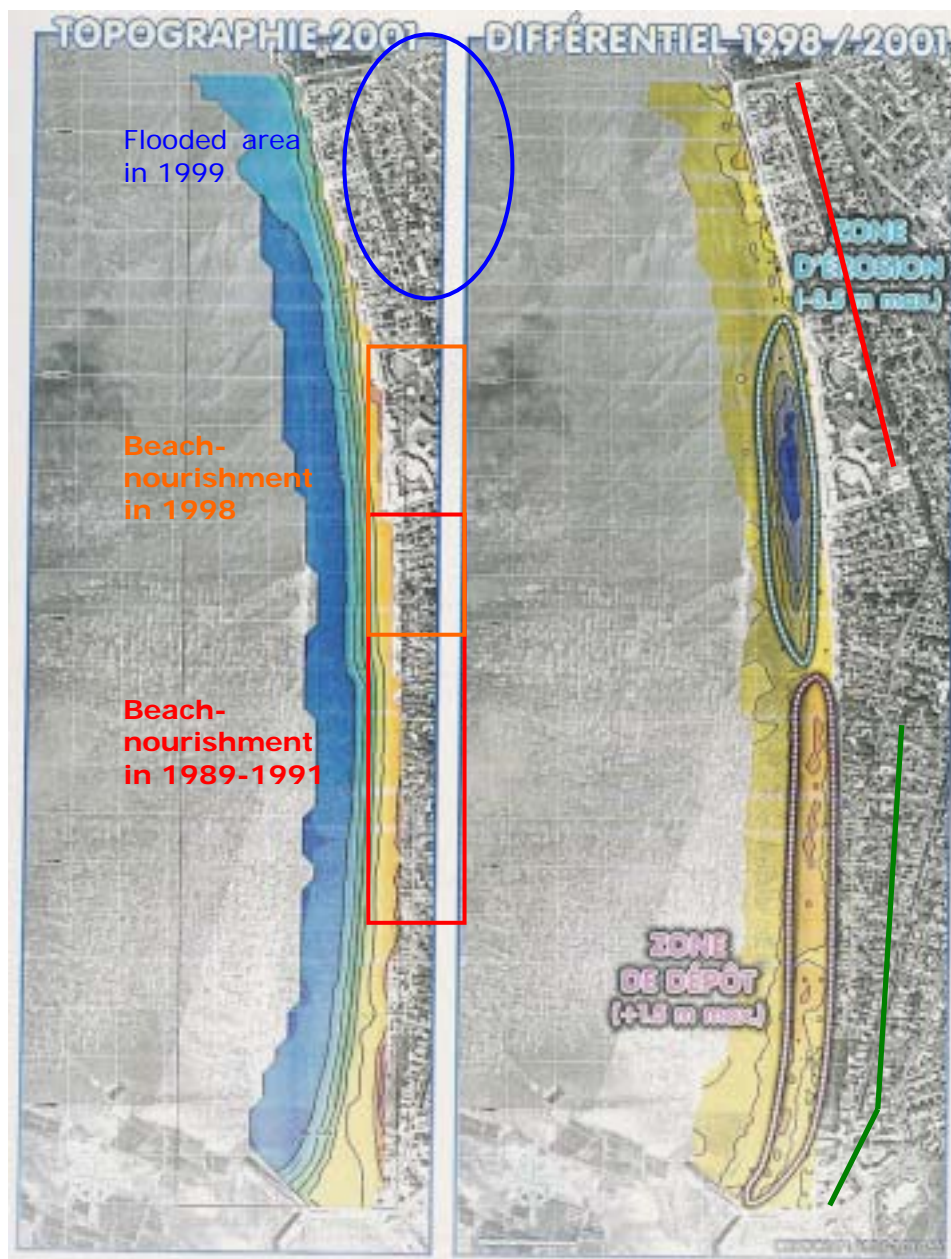


Fig. 4: Beach of Châtelailon, in 2001, location of the actual erosion In the right map blue colors indicate erosion and red colors sedimentation.



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## 2.2 Impacts

The erosion of the north part of the beach causes a higher risk for flooding. The narrow and flat beach does not protect the seawall from the highest waves from south-west and flooding of the urbanised area behind it is not unlikely as was the case in 1999 when 300 houses were flooded. The beach-nourishment of the north side is schemed for 2003. The wide and high southern beach is a protection against flooding and favours tourism.





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## 3. SOLUTIONS/MEASURES

### 3.1 Policy options

Till the end of the 80's, the policy was to "hold the line" using different measures (groins, breakwater, etc.), but without success. In 1989, the authority of the city changed policy into: "moving the line seaward" by carrying out the most important nourishment in France using more than 330.000 cubic meters of sand.

### 3.2 Strategy

#### 3.2.1 Approach related to the problem

Previously, in the 60's, hard measures were taken because it was the policy to preserve the littoral. Later, (1989) the *mayor* of the city chooses, although all public authorities disagreed, to perform a beach-nourishment, after having seen the results of the American beach-nourishments. The nourishment was, with 330.000 cubic meters on the south and middle of the site, one of the first large nourishments in France. The aim of this "soft" measure was to create a large beach for the tourists even at high tide, and to protect the city against flooding. The origin of the nourished sand in it is an offshore sand bank (North of Oleron Island). The success of this "soft" measure led to a second nourishment, which has been carried out in 1998, at the centre of the beach. A third one is schemed for 2003, to protect the north of the site against the flooding and offer a wider and higher beach for tourism.

#### 3.2.2 Issues concerning threat to life and property

Currently a Plan de Prevention des Risques: a map of the prevention of the risks is applied to all the littoral of the department.

### 3.3 Technical measures

#### 3.3.1 Historic measures

##### Hard solutions: 1888 –1987

- 1888: building of different walls to protect the houses which were covered by the dunes.
- 1925: building of the first seawall. The beach profiles began to lower
- 1932, 1947 and 1953, building of five small groins along the beach and a larger one on the south of the bay (trapping sand from littoral drift)
- 1962, protection of the seawall by rocks, boulders
- 1968: test without success of emerged breakwater in the centre of the beach
- 1972 to 1983 program for the protection of the seawall by rocks and boulders
- 1987 building of three "Y" groins.

Replacing the dune with the first seawall has been the first cause of the severe erosion of the beach. Other measures taken to catch sand from littoral drift (groins) or to prevent erosion using wavebreakers were tests.

### Soft solutions: 1989 – 2003

- 1989 to 1991: beach nourishment with 330.000 cubic meters within three years
- 1998: beach nourishment with 150.000 cubic meters
- 2003: a new beach nourishment is schemed for the northern part of the beach

### 3.3.2 Type of the last measures

In the first operation, carried out in three years (1989-1990-1991), 330.000 cubic meters of marine sand, from the Chassiron sand bank (north of Oleron island) was used. The aim of the nourishment was to cover the rocks on the foot of the seawall and to elevate the top of the beach with 3.5 meters (from 4.5 m CM to 8.0 m CM) The width of the beach was increased from 15 meters to 100 meters. The costs were about 15 millions of francs in 1991. Subsidies were from the FEDER, the department of "Charente maritime" and the SIVOM of La Rochelle (association of the cities).

In the second operation 150.000 cubic meters of sand from an area close to a channel in the harbour, was dumped in the centre and north of the first beach nourishment to increase the width and to elevate the upper beach. The costs were about 7 millions of francs. The subsidies were allowed by the FEDER and the department of "Charente maritime".

Every year between 10.000 to 30.000 cubic meters sand are removed from the south of the beach and are transported to the north with power shovels and dumper-trucks.



*Fig.5: The beach prior to the beach-nourishment (1988). The foreshore is narrow, the groins and the rocks on the foot of the seawall are not efficient measures against erosion.*



*Fig.6: After the beach-nourishment (1992), the top level of the beach has been elevated with about 3,5 m. The potential for tourism and the protection against flooding are improved.*



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## 4. EFFECTS AND LESSONS LEARNT

### 4.1 Effects related to erosion

After the first beach-nourishment of 1991, a study of the public authorities (Service maritime DDE17) has shown:

- A decrease of the width of the nourished upper-beach at the northern part
- An increase of the slope in the northern part and a decrease at the southern part of the beach
- An one meter higher beach level on the upstream side of the central groin in contrast to downstream side.

This shows that the southward directed long shore current continues to erode the beach. The with power shovels and dumper trucks transport of sand, between 10.000 and 30.000 cubic meters has minimized the loss of sand and hold the sand in the same coastal cell.

Between the second operation (1998) and 2001, the results of the survey are:

- The erosion at the northern part of the beach amounts to 4.000 cubic meters
- The erosion at the central part of the beach: 74.000 cubic meters
- The accumulation of sand in the southern part of the beach of around 70.000 cubic meters.

The long shore current is proofed and the erosion is counteracted by transporting sand artificially.

In 1999, the most severe storm of the last decade caused a flooding in the north of the city. The weakest point of the sea defence was the northern part of the beach: the only part of the beach which was not protected by a beach-nourishment. More than 300 houses were flooded. The beach-nourishment schemed for 2003 has to protect this northern area of the city.

### 4.2 Effects related to socio-economic aspects

Before the first beach-nourishment, the economy of the seaside resort declined, and the amount of inhabitants decreased (the number of inhabitants had decreased to less than 5.000 inhabitants in 1990 but was raised to 5753 in 2000).

After the beach nourishment, a policy to develop the seaside resort and to improve the tourist potential has been developed, using the allure of a wide beach:

- The building of properties
- The building of a marine hydrotherapy
- The rehabilitation of the casino
- The building of hotels

The number of tourists-days has increased from about 600.000 in 1984 and 1990 to 870.000 in 2000.

The chosen strategy for the protection of the beach works. The erosion seems to be controlled and the seaside resort is expanding.





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### **4.3 Effects in neighbouring regions**

Due to the southward directed long shore current the north of the nourishment area continues to erode and has to be protected. The southern part of the studied site holds a part of the littoral drift, due to the presence of the groin and the pier of the harbour. A part of this sand could cover the mussel banks.

### **4.4 Relation with ICZM**

The safety of the inhabitants of the seaside resort still has the highest priority. A minimum safety against flooding must be guaranteed by studying the maximum set-up during the most severe storms. It is the aim of the PPR to map the prevention of the risks. Other functions as regarded as well. The survey and the coastal maintenance are carried out by the public authorities (Service maritime DDE 17). Prior to the beach-nourishments, the impacts of dredging, the quality of the sand, of the water and the impacts on the neighbouring areas are studied in an "Impacts study". A few public meetings were organised to debate and to explain the different effects of the operation in the region.

### **4.5 Conclusions**

#### **Effectiveness**

Nourishments have shown to be effective to protect against flooding and to create a beach, resulting in a recreational area as an essential element of the development and expansion of a seaside resort like Châtelailon. Transporting sand artificially each year prevent a loss of sand out of the coastal zone which results thus in a balanced sedimentary budget.

#### **Possible undesirable effects**

The studied impacts of the beach nourishments and dredging.

#### **Gaps in information**

Beach nourishments have to be evaluated over a longer period.



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