

# ECOSYSTEM SERVICES RESTORATION IN THE ERA OF CLIMATE CHANGE: SAND DUNE SERVICES

Peña L., Amaia-Orozco A., Fernández de Manuel B., Onaindia M. & Ametzaga-Arregi I.

UNESCO Chair of Environmental Education and Sustainability. University of the Basque Country (UPV/EHU), Leioa (Biscay, Basque Country)

Presenting author: [lorena.pena@ehu.es](mailto:lorena.pena@ehu.es)

This work was financed by the Departments of Environment and Education, Universities and Research (General Grants to Research Groups (IT 1113-16)) of the Basque Government and by the Department of Environment of the County Council of Biscay (Project: Assessment of the Ecosystem Services of Euskadi).

## INTRODUCTION

Nowadays, human societies have to tackle severe environmental threats, mainly due to the effect of their own activities such as land use change, pollution, introduction of alien species, atmospheric CO<sub>2</sub> increment and loss of biodiversity; however, ecosystem restoration, like the sand-dune restoration project on the Bay of Plentzia (Biscay, Basque Country, northern Spain) has a high potential in order to mitigate and adapt to these threats and to recover ecosystem services lost (Onaindia et al. 2015).

## RESTORATION

The Bay of Plentzia was highly transformed at the beginning of the XX century reclaiming land to the bay. This led to a reduction of beach area and continues works in order to rebuild storm damage: broken walls and road and sand movements (Figure 1).

The restoration project started in 2009 knocking down a car park and a road (Figure 1 zone A), taking away all the debris, putting barriers to settle the sand and planting some species such as of *Ammophila arenaria*, *Elymus farctus*, *Festuca juncifolia* and *Pancreatium maritimum*. In 2015 in zone B (Figure 1) a building and the pavement were removed and the same methodology of restoration was applied. Subsequently, the restoration process was left to develop on its own and a wooden walking path for pedestrians was built (Figure 2).

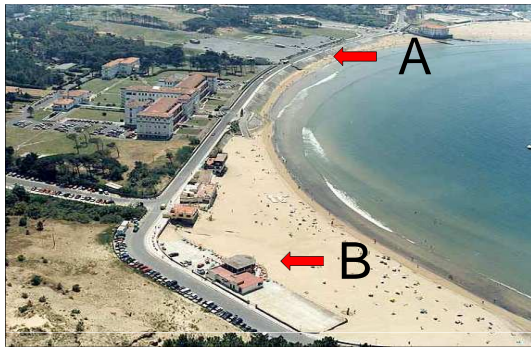


Figure 1. The sites before the restoration in 2008



Figure 2. The sites after the restoration started

## OBJETIVE and METHODOLOGY

The aim of the study was to analyze the supply of ecosystems services after the sand-dune restoration project.

In 2015 and 2016, we interviewed users and managers about the benefits that the restoration was providing to them. Moreover, in 2016, a sampling was carried out with 18 transects located perpendicular to the sea and following the dune profile. In each transect 2x1m quadrants were sampled every three metres. Plant cover was visually estimated, and one sand sample (2.5 cm diameter and 6 cm depth) was taken in order to measure the pH and the organic matter content of the sand.

## RESULTS

**SAND-DUNE SPECIES HABITAT MAINTENANCE:** results showed that after 6 years since restoration started 17 dune plants species had already colonized the area, and 11 species after a year such as *Tortura ruralis* (Hedw.) Gaertn, *Aetheorhiza bulbosa* subsp. *bulbosa* (L.) Cass., *Eryngium maritimum* L. and *Malcomia littorea* (L.) R. Br. (Figures 3). Moreover, plant species diversity and soil organic matter increased significantly from front to the back of the dune (Figure 4 and 5) and soil pH decreased following the dune profile (Figure 5), which indicated an ecosystem structure similar to other nearby sand-dunes.



Figure 3. Plant dune species colonization and establishment at the front (left) and back (right) of the sand dunes.

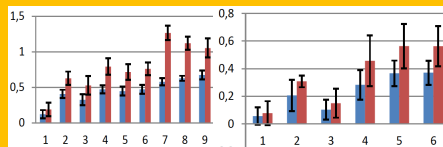


Figure 4. Mean plant species diversity (Shannon= red & Simpson= blue) for the two studied zones (zone A left & B right) from the front (1) to the back of the sand-dune (6 & 9).



Figure 5. Mean organic matter (M.O) and soil pH from the front (1) to the back of the sand-dune (9). D1= Zone A and D2 = Zone B.

**SOIL FERTILITY:** sand-dunes accumulated soil organic matter (Figure 5) improving soil fertility.

**COASTAL PROTECTION:** managers have indicated that since 2016 there has been no annual costs derived from storm events.

**RECREATION:** more recreational areas are available for the public, such as beach and walking pleasant sites. In fact, according to the respondents, the recreation service was one of the most important service in the area.

**ENVIROMENTAL EDUCATION:** surveys also indicated an improvement of this service.

## CONCLUSIONS

"Nature based Solutions" are showing to be the best methodology and long-term inversions in order to achieve long term solutions and recover ecosystem services.

## References

Onaindia, M., Madariaga, I., Palacios, I. & Arana, X. (coord.) 2015. Nature and human well-being in Biscay. Ecosystem services assessment; research applied to management. Universidad del País vasco (UPV/EHU). Leioa, España. 130 pp. ISBN: 978-84-9082-507-5.