

TuristiCO₂: a carrying capacity assessment for sustainable tourism in a park island

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Abstract — Carrying capacity has been a long-standing issue in management of parks, outdoor recreation and tourism. This paper describes the first analysis concerning a project on touristic carrying capacity assessment on Pianosa, an island of the Parco Nazionale of Arcipelago Toscano, using an Eddy-Covariance tower for CO₂ fluxes measurement. The preliminary results show that Pianosa represents a sink of carbon, thus actively contribute to reduce the amount of CO₂ in the atmosphere.

Index Terms — Carrying Capacity, Carbon Sequestration, Greenhouse effect, Park Islands.

1 INTRODUCTION

Natural areas play an important role in promoting the tourist product [1], and they can be added to other considerable efforts and funding to enhance the tourist image and attractiveness of certain destinations [2]. Indeed, much has been written, in both the scientific literature and popular press, about the carrying capacity of parks and related tourist attractions [3]. The underlying concept of carrying capacity has a rich history in the natural resource professions. Indicators of carrying capacity usually take in account the available resources, the management

and experiential evaluation. This paper describes the preliminary results of the TuristiCO₂ project, that aims to using data on Pianosa's potentiality in CO₂ sequestration, and comparing them with the CO₂ caused by tourists' trip to Pianosa itself, to work out an assessment of tourism sustainability.

Pianosa is a 10 square km island of the Arcipelago Toscano, located at about 13 km from Elba island, and characterized by flat terrain. The first historical record of Pianosa island dates back to the Roman age, when the Emperor Ottaviano, in the 6-7 A.C., forced the grandson Agrippa Postumo to live on Pianosa island. Following the decadence of the Roman Empire, during the periods of Barbarians invasions, the island was abandoned.

The name of Pianosa island newly appeared in some documents of the Repubbliche Marinare of Pisa and Genova (XII and XIII Century) that reported the remarkable strategic position of the island. The original vegetation of Pianosa island was presumably represented by a Mediterra-

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nean macchia, dominated by a mixture of sclerophyllous and deciduous trees, bushes and grassland.

This has fostered, throughout centuries, the development of agriculture, yet, in spite of many attempts, the island has seldom housed through centuries a permanent human population, also in consequence of the difficulty in defending it from war attacks, common in the area until all the eighteenth century. For many decades, the presence of a jail has severely limited the access of tourists, helping to preserve an unexploited marine environment; yet, the agricultural overexploitation of soils has led to environmental problems, including the nitrate pollution of deep freshwater, while other problems, related to the maintenance of infrastructures, arose ten years ago, when the jail was closed.

The island passed quickly from being an overexploited but very well monitored area, to being an outpost of a national park in an area characterized by heavy tourism pressure in summer months. At the same time, the abandonment of agriculture and breeding started to foster changes in biodiversity, in consequence of the renaturalization of most cropland. At the moment, the island can be visited by a limited number of tourists per day in summer season on one day excursion from Elba, as overnighting on Pianosa is in general forbidden. A large debate is open, involving the park administration, local policy makers and tour operators, about the carrying capacity of the island [4], and the number of tourists it could accept daily. On this basis, aiming mainly to assess the number of visitors on the only beach where bathing is allowed, the maximum number of visitors per day has been defined in 250. Yet, the largest part of the island can be described as abandoned farmland, rather than an endangered natural ecosystem, and the possibility to use other parameters, more strictly based on the available resources, to assess its carrying capacity, cannot be ruled out.

2 THE TURISTI CO_2 PROJECT

1.1 The carbon balance of Pianosa Island (Pianosa_Lab)

The Pianosa_LAB is a research network established in the 2000, aiming at the long-term monitoring of the actual exchange of carbon, water and energy among the biosphere and atmosphere of the island. Key objective of the Pianosa_Lab project is the determination of the C balance of the Pianosa island, thus, it significantly contributes to the understanding of the role of Mediterranean ecosystems as sinks or sources of atmospheric CO_2 . Additionally, the project aims at monitoring on the long term the vegetation dynamics on the island also in view of the future conservation management plans proposed for the island. The above objectives are pursued through the quantification of C stores in soils and vegetation and through the quantification of biosphere-atmosphere carbon, water and energy fluxes, for the entire island [5].

2.2 The aim of the project

The concept of sustainable tourism is strictly related to the concept of carrying capacity: it has been defined as the maximum number of people visiting a site without compromising its environmental, economic and socio-cultural conditions. Yet, the impact of Green-Houses Gases (GHG) emissions on the global environment, first of all their role in the ongoing climate change, imposes to take in account, in evaluating the sustainability of tourism, also the GHG strictly related to tourists' movement. Transport represents one of the major sources of GHG, and has been proved to be the most difficult to reduce. Turisti CO_2 aims to use the compare the data on carbon sequestration of Pianosa with the footprint of tourists reaching the island (the surface of forest land needed to absorb the CO_2 emitted by their travel), using as reference term the carbon sequestration activity of the island itself.

The work will be carried out by submitting questionnaires and by interviews to the tour-

ists arriving on Pianosa, in order to assess the typology of their travels to the Elba island, and to calculate the corresponding greenhouse gases emissions. In addition to them, the CO₂ emissions caused by boat transport and by tourists' stay on Pianosa, will also be calculated. The data will be compared with CO₂ assimilation of the island, to assess its ability to compensate for tourism emissions.

The project will have an additional educational value, by involving tourists in the evaluation of the environmental effects of their trip, and in a deeper knowledge and appreciation of the environment they are visiting.

2.3 Results

The Island of Pianosa represents a typical example of a MTE (Mediterranean Ecosystem) as its surface is a mosaic of different ecosystems that include both natural patches and areas where anthropogenic disturbances have been predominating. Considerations on the specific land use history of the island, together with a comparison of the total amount of carbon contained in the soils of the disturbed and undisturbed part of the island, suggests that Pianosa's ecosystems soils did lose a significant fraction of their organic Carbon during the period in which the island was subjected to highly intensive cultivation. The subsequent land abandonment has turned the island from a carbon source into a sink.

Data collected by Eddy Covariance tower (Fig. 1) showed that the Island of Pianosa is a substantial sink for atmospheric Carbon.

Net Ecosystem Exchange (NEE) was measured by integrating C flux measurements that were made using the eddy covariance system. In fact in the twelve-months period considered here, a net sink for atmospheric CO₂.

Island's NEE was, during this period, equivalent to 2.64 t C ha⁻¹. Sink activity was the highest during the spring and the autumn months while the island became a net source of C in the central part of the summer period (0.41 t C ha⁻¹ for July-August).



Fig. 1 Eddy Covariance tower

This trend will continue until the macchia vegetation will have recolonized the former farmland [6]. The island will continue to be a C sink for several years, if the annual NEE that was observed during our study period will be sustained in the future, Pianosa is a very good analogue of a large portion of the Mediterranean Region, where intensive agriculture activity has been abandoned and it is currently unmanaged. Since 1990, 10 to 20% of the agricultural land in Mediterranean countries was abandoned [7] and this suggests, by simple analogy, that the current carbon sink that can be provided by such land in the Mediterranean could be much larger than previously expected.

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