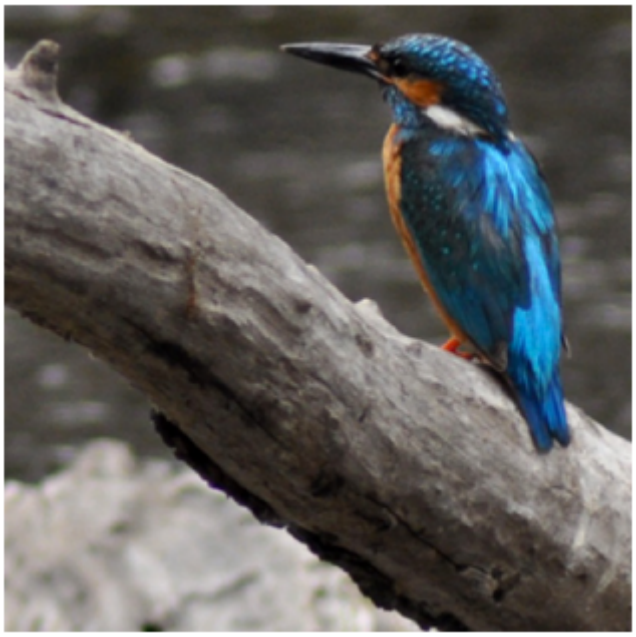
DEMETRA Project

Development of a quick monitoring index as a tool to assess environmental impacts of transgenic crops

Habitat Directive | water habitats | improving biodiversity | management tools

PROJECT DESCRIPTION



In 2008, through the implementation of projects designed to develop specific monitoring systems, the EU program LIFE+ promoted the assessment of environmental risk potentially deriving from the cultivation of Genetically Modified Organisms (GMOs). At that time, Italy was outlining a legislative framework that suggested the need to define the rules of coexistence between transgenic, biologic and traditional cultivation, in order to fulfill its obligations under EU law and comply with the national legislation in force (Law n.5/2005). In this regulatory framework, the Tuscany Region promoted initiatives aimed at filling the gap related to the lack of standardized tools to carry out environmental monitoring of GMOs and, at the same time, responding to the need to protect its territory from risks determined by transgenic crops. The **DEMETRA** project has contributed to build a European-level shared basis for the monitoring of GMOs in the environment, cultivated both for commercial and for research purposes.

OBJECTIVES

The main objective of the **DEMETRA** project was to implement an innovative method for the assessment of environmental risk related to the presence of genetically modified (GM) crops and to define a synthetic monitoring index (*Quick Monitor Index* **- QMI**) capable of determining in advance the potential impact of transgenic crops on the ecosystems and, therefore, giving indications on the operational mode of the environmental monitoring. Points of arrival of the project was the development of an innovative tool to quickly address monitoring that public bodies should implement in their territories where transgenic plants could be cropped. The activities of the project have not involved the use of transgenic organisms and the methodology adopted was based on a detailed analysis of the ecosystems allowing the study of a risk matrix related to transgenic plants, derived from bibliographic data and ecological/biological data collected in the frame of the project. The analyzed ecosystems included forests, wetlands, agricultural and uncultivated areas located within the Regional Park of Migliarino **-** San Rossore **-** Massaciuccoli, in the Province of Pisa (Central Italy). The project focused on three study areas characterized by different ecosystems: the Lake of “Padule di Massaciuccoli” (SCI IT5120021), the “Serchio” River and the “Arno” River (SCI “Selva Pisana” **-** SCI IT5170002). The Massaciuccoli Lake represents one of the most important wetlands in Italy; includes the habitats of European interest 3140, 7150 and the priority habitat 7210. The study areas of the Serchio and Arno Rivers fall within the SCI “Selva Pisana” (SCI IT5170002), entirely included in the Regional Park of Migliarino - San Rossore - Massaciuccoli. Among the numerous habitats of European interest of this area there are the 91E0, 91F0, 92 A0, 9340, 2270, 1150, 1410, 1420, 1510, 6420. Within the list of plant species present in the study areas and considered critical, a limited number of target species (maize, oil-seed rape, sunflower and poplar) were selected. The evaluation of the possibility of hybridizing cultivated varieties with wild species present in the areas of study has focused on oil-seed rape and poplar. The potential effects of GMOs on animal biodiversity were also analyzed. The study focused on invertebrates since they are directly connected with the habitat and constitute a very substantial group of consumers in the food web.

PROJECT PHASES

The data collected in the study areas were related to: i) weather conditions that affect the pollen transport; ii) plant and animal biodiversity; and iii) pollen flow of the plant species studied with pollen samples collected by pollen traps or insect pollinators, and consequently analyzed in the laboratory. The project activities lasted three and a half years (2010-2013) and were articulated in 20 actions. Among these, the most important were:

- collection, analysis and selection of parameters to represent the environments considered in relation to local weather conditions, soil functions, trophic chains, land use, as well as animal and plant biodiversity;
- assessment of the collected data and selection of the most significant ones to develop the QMI index;
- installation of a meteorological station in each study area to collect information on air temperature and humidity, rainfall, wind speed and direction, diffused and global radiation, sunshine duration. The soil humidity and temperature were also considered in some plots, and ozone measurements were also recorded from June 2013
- installation of pollen traps around the crops to study the pollen dispersion of the cultivated species. This data is necessary for estimating the maximum distance at which transgenic pollen can reach, and thus identifying in the surroundings the cultivated fields that could be affected by the phenomena of gene flow;
- assessment of the local biodiversity through the quantification of the present species of microbes, plants and animals;
- **definition of the *Quick Monitor Index* (QMI)** on the basis of the effects of genetically modified plants on target / non-target species, biodiversity, gene flow;
- identification of specific study sites to test the application of QMI;
- creation of a Geographic Information System (GIS) to develop geographic patterns of QMI. **Through the GIS, the index can be used to monitor and map the level of risk** generated by transgenic plants in a given area, whether these GM plants are really cultivated, or their presence is only simulated.
- **development of Guidelines** for the definition of the monitoring areas and for the selection of the relevant parameters.

The project activity has foreseen actions of communication and dissemination of the achieved results including workshops, seminars, regional conferences, public events and video.

PROJECT RESULTS

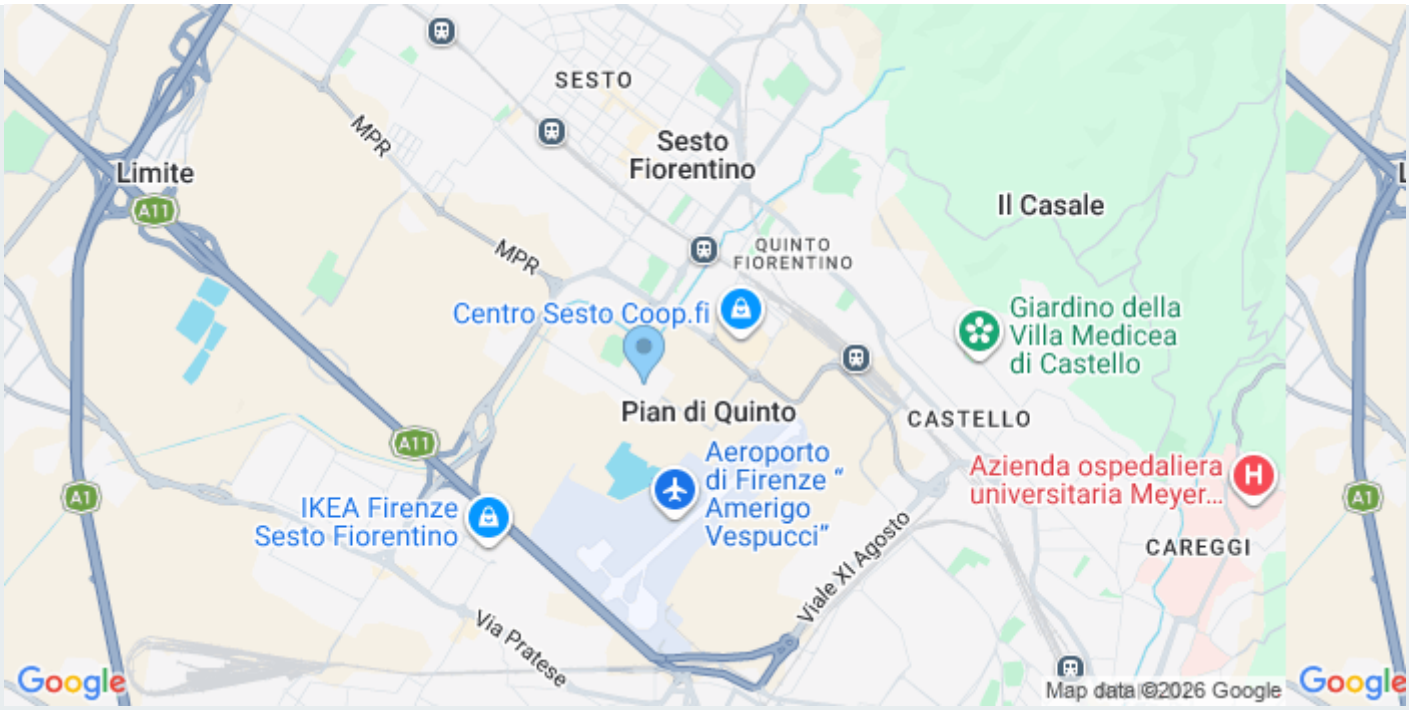
The project, while not including conservation actions, has provided important information on the state of biodiversity in the study sites that resulted very useful as basis for development of action plans by the Park Authority. DEMETRA was a unique initiative in the Italian and European scene. At EU level, in fact, currently there is no shared standard methodology for monitoring the environmental effects of GMOs. This gap was filled by DEMETRA providing an analytical tool, able to anticipatorily determine the potential impact of transgenic crops on ecosystem components. The intense investigation of the target ecosystems of the project has produced indirect positive effects too. In the SCI Regional Park of Migliarino - San Rossore - Massaciuccoli, in particular in the forests of natural poplars, an herbaceous perennial, *Veronica montana (Wood Speedwell)*, and other nemoral species normally not present at sea level were found, which can be considered as potential bio-indicators of the conservation status of the related habitat. New data on the distribution of rare species or other species at risk was also collected.

Main results to be reported:

- collection of all technical, scientific and legal documents. The database is accessible from the project's website;
- cultivation of different types of maize, sunflower and oil-seed rape in the Culatta area (study area n.3);
- definition of **108 sub-areas** for biodiversity sampling;
- definition of a list of **1462 animal and 457 plant species** for monitoring purposes;
- census of **307 plant and 443 animal species**;
- installation of **114 pollen traps** around the cultivated fields. Pollen of maize was found at a distance of 160 m, pollen of oil-seed rape at 34 m, pollen of sunflower up to 19 m while in the case of poplar pollen also the distance of 540 m was reached. Moreover the pollen concentration remains constant till 540 m in case of poplars; in case of the oil-seed rape it starts to decrease after 5 m, then continues to be constant till 30 m, to be decreased again over this distance, while the maize pollen tends to zero at different distances and it does not reach distances over 300 m (Method for pollen flux study);
- installation of **8 beehives** at increasing distances from the test area of sunflower (0 Km, 1 km, 2 km, 3 km). Analysis of 80 pollen samples collected by the pollinating insect *Apis mellifera*. From the investigations it was found that the maximum distance at which the pollen has been transported is equal to 1 km;
- installation of **3 meteorological stations** (**agro-meteorological data detection network**) **and monthly and annual weather reports**;
- realization of the QMI, method for the assessment of risk related to the presence of genetically modified plants in the environment;
- definition of **Guidelines for applying the monitoring schemes in high risk areas**;

- production of a **GIS** application allowing to have the topographic maps and the themes needed to characterize the different environments of the Park. The resulting maps show which areas of the Park should be monitored because subject to eventual environmental risk deriving from GM crops. The results obtained indicate that natural and man-made barriers are useful to mitigate the adverse effects of GM crops.

DEMETRA has succeeded in its objective to provide guidance to protect lands in case of use of genetically modified crops. The methodology developed in Tuscany can be replicated in all regions. All results are published in the book DEMETRA.



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Acronym
DEMETRA

Number of reference
LIFE08 NAT/IT/000342

Reference Programme
LIFE

Beneficiary Coordinator
Agenzia Regionale per lo Sviluppo e l'innovazione in agricoltura (ARSIA Toscana). Dal 2011: Istituto di Genetica Vegetale del CNR (IGV-CNR), confluito nel novembre 2013 nell'Istituto di Bioscienze e Biorisorse (IBBR)

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EU contribution
897.834,00

Call Year
2008

Start Year
2010

End Year
2013

Beneficiary headquarters

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Region
Toscana

Description

Regione Toscana, Parco Regionale di Migliarino-San Rossore-Massaciuccoli, SIC IT5120021, SIC IT5170002, habitat 3140, habitat 7150, habitat 7210, habitat 91E0, habitat 91F0, habitat 92 A0, habitat 9340, habitat 2270, habitat 1150, habitat 1410, habitat 1420, habitat 1510, habitat 6420.