"Happy Bee, Happy Environment"

Dr. Antonello Bonfante

ACTIONS

«pollinAtors eCosystem healTh indicator Of aNtropic pressure»

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INTRODUCTION

The **ACTIONS project** (Pollinators Ecosystem Health Indicator of Anthropic Pressure)aims to assess ecosystem health through pollinator well-being.

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THE PROBLEM

Why Pollinators Matter: The Interplay of Ecosystem Health and Human Pressure

Ecosystem health directly impacts its services, and vice versa.

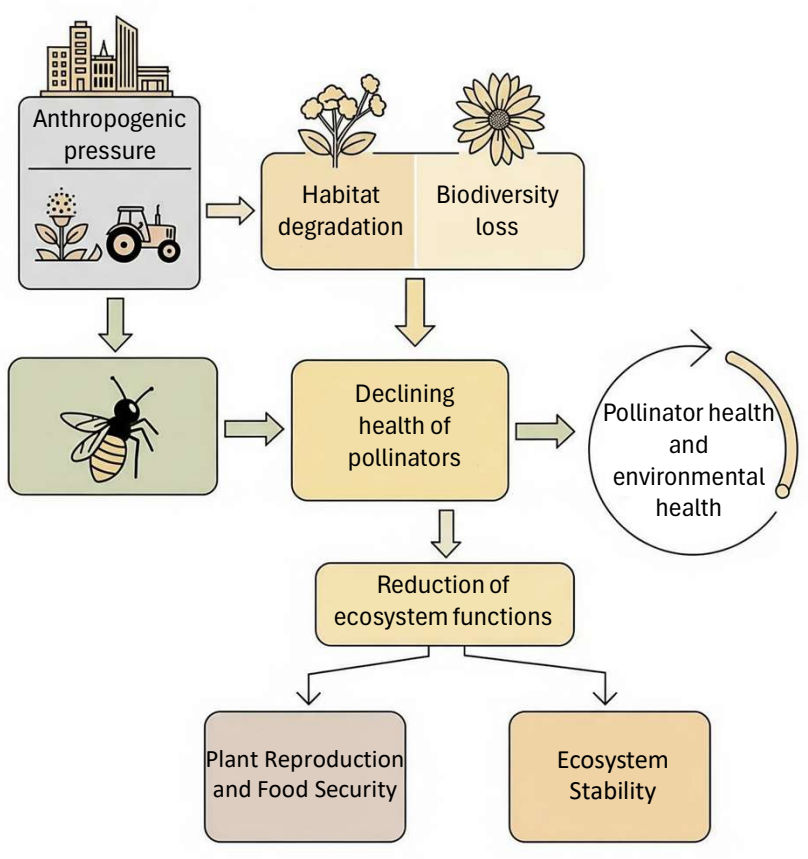
Anthropic pressure (human-induced pressure), stemming from urbanization, agriculture, deforestation, pollution, and climate change, **significantly impacts ecosystem services, particularly affecting pollinators and biodiversity**

Pollinators like bees ensure the reproduction of many plant species;

In Europe, about **80% of 264 cultivated species depend on pollinating insects**

When **ecosystem health is compromised**, **pollinator well-being is reduced**, **diminishing their ability to support ecosystem services.**

If we are able to assess the well-being of pollinators, we can evaluate the health of the environment.



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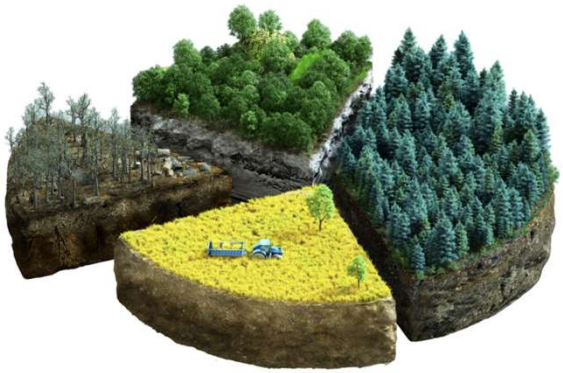
THE SOLUTION

Our Solution: Diagnostic Bio-indicators for Ecosystem Health

The **ACTIONS project aims to develop new diagnostic bio-indicators to recognize the relationships between different levels of anthropic pressure and ecosystem health**, **defined by pollinators' well-being and ability to carry out their ecosystem services**

Multidisciplinary Approach: Combining expertise from different CNR institutes (IRPI, ISAFOM, IPSP, ISPAAM) to define an indicator/relationship between anthropic pressure and pollinator ecosystem functions/services, and to develop a geospatial ecosystem health index (EHI)

Molecular Biomarkers: Measurable sequences of DNA can evaluate the well-being of pollinators, indicating normal biological processes, pathological conditions, or responses to environmental stressors. They are non-invasive, sensitive, easily measurable, cost-effective, and deliver quick results.



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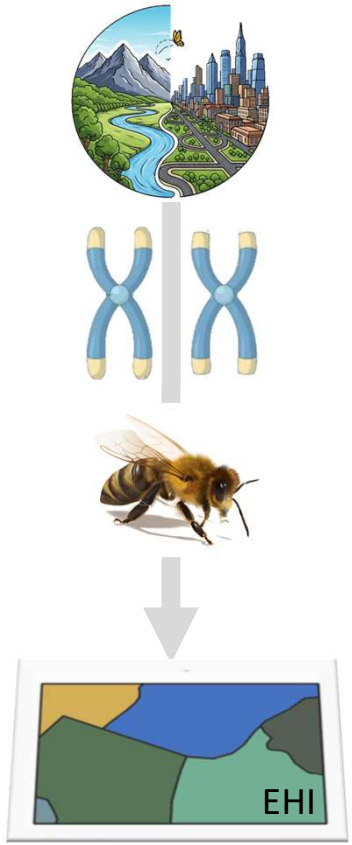
ACTIONS: KEY OBJECTIVES

Specific Objectives:

- **Characterization of the environment**al geo-biodiversity and **anthropic pressure** of the selected study areas.
- **Set up a protocol of smart low-cost molecular biomarker based on telomere length (TL)** able to evaluate the pollinators' well-being to support the assessment of ecosystem health status.
- **Evaluate the impact of anthropic pressure on pollinators' ecosystem services**.
- **Definition of an ecosystem health index (EHI)**.



We will use honey bees (Apis mellifera, L.) for colony and individual impact, and wild pollinators abundance (mainly Apoidea superfamily) as a score of pollinators' biodiversity

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HOW WILL WE DO IT?

Our Approach: A Multi-faceted Strategy

Field Experiments: Exposure to anthropic pressure will be used to evaluate the honey bee health at the colony level and wild pollinator abundance.

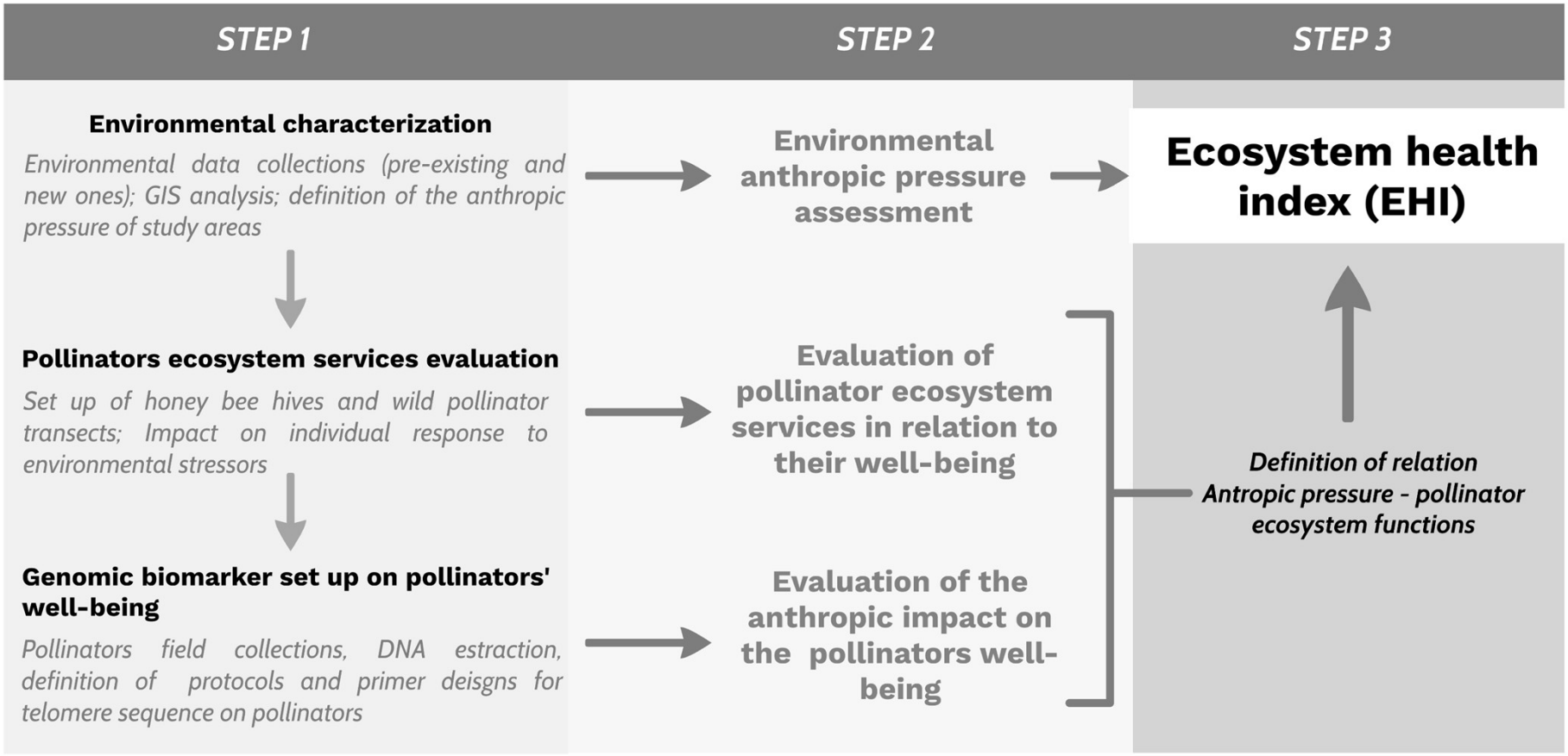
Laboratory Experiments: Fine-tuning experiments can be performed by rearing honey bees and wild bees in incubators, flight chambers, and wind tunnels at environmentally controlled conditions to assess the ability to perform ecosystem functions at different levels of well-being induced by different environmental conditions.

GIS Analysis (Geographic Information Systems): Effective tools for assessing ecosystem health by integrating and analyzing various environmental information layers, including land use, biodiversity indices, habitat quality indices, and climate indicators. This provides a comprehensive assessment of human impact.

Genomic Biomarkers: Set up a standardized amplification protocol and design specific primer pairs for telomere and single-copy gene (scg) sequences in honey bees, validated using qPCR. Telomere length (TL) analysis will be performed using a PCR-based method, focusing on relative telomere length (RTL) measured as the ratio of telomere repeats to an scg (T/S ratio)

ACTIONS PROJECT

Step-by-Step



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ACTIONS PROJECT

Structure

WP1

Management, coordination, and dissemination

(Lead CNR -ISAFOM, co-lead CNR-IRPI. Involved all partners)

T1.1 Governance of the project progress incl. checking milestones and compliance
T1.2 Coordination of research and joint activities
T1.3 Active dissemination of project outcomes

(Lead CNR-IPSP)

WP3 Pollinators ecosystem services evaluation

- T3.1 Set up of honey bee hives and wild pollinator transects.
- T3.2 Effects on colony health and wild bees abundance.
- T3.3 Impact on individual response to environmental stressors.

(CNR-ISAFOM & CNR-IRPI)

WP2 Study areas environmental characterization and anthropic pressures definition

- T2.1 Collection of environmental pre-existing data and new ones.
- T2.2 Environmental characterization of selected study areas through GIS analysis
- T2.3 Definition of anthropic pressure of study areas

WP5

Data integration and Environmental Health Index (EHI) definition

- T5.1 Multisource data integration
- T5.2 Definition of the EHI index

(Lead CNR -ISAFOM, co-lead CNR-IRPI. Involved all partners)

(Lead CNR-ISPAAM)

WP4 Genomic biomarker set up on pollinators' well-being

- T4.1 Set up a standardized amplification protocol.
- T4.2 Implementation of lab analysis
- T4.3 Post analysis

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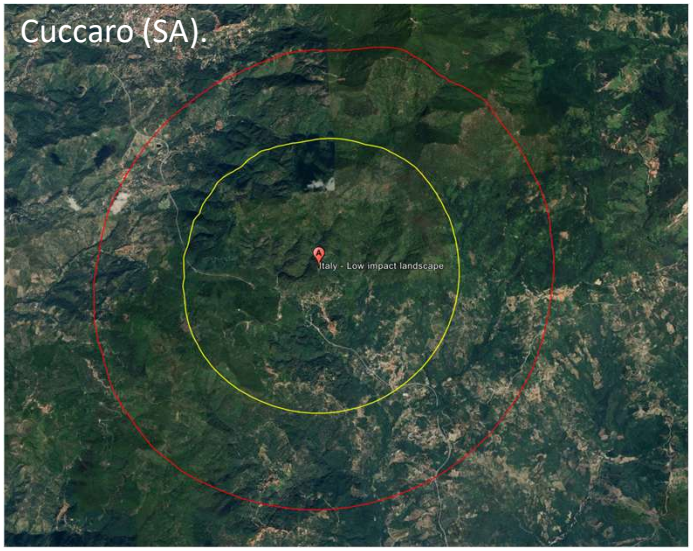
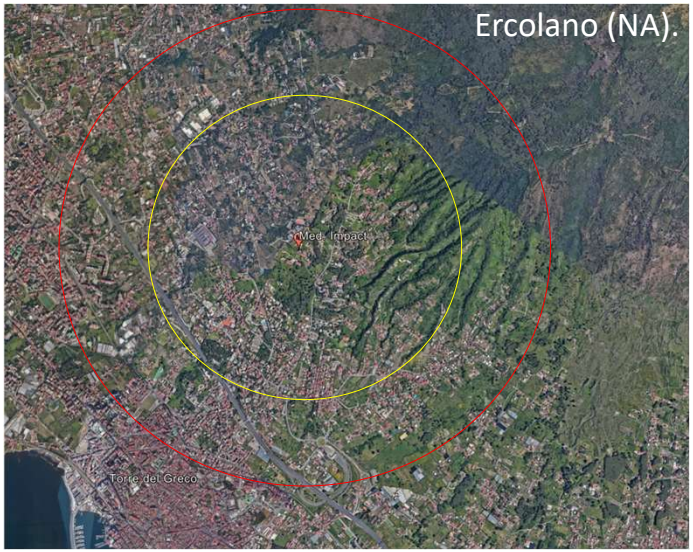
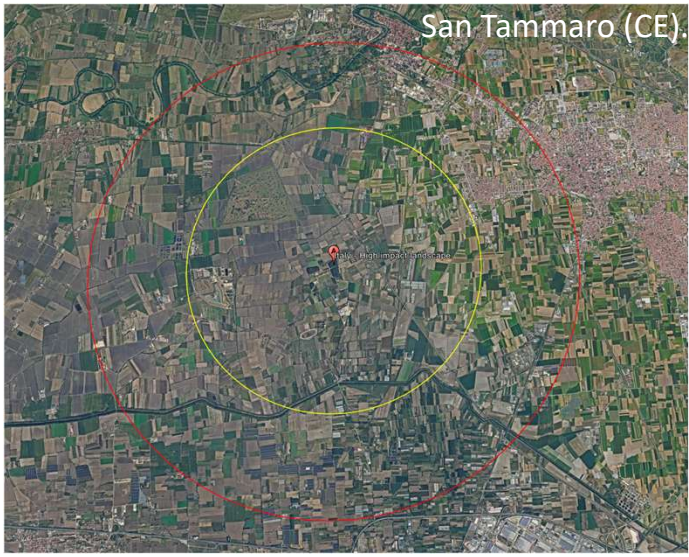
HOW WILL WE DO IT? Our approach

Three experimental sites (Campania region) at different level environmental impacts by human activities…







Low ⟶ **Anthropogenic pressure and environmental degradation** ⟶ **High**

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EXPECTED OUTPUTS, OUTCOMES, AND IMPACTS

WP1 -Management, coordination, and dissemination: Enhanced coordination and management, leading to improved efficiency and adherence to administrative/financial requirements.

WP2 - Study areas environmental characterization and anthropic pressures definition: Defined procedure for evaluating anthropic pressure, transferable to other national and international environmental contexts

WP3 - Pollinators ecosystem services evaluation: Improved understanding the impact of anthropic activity on honey bees and wild pollinators, strengthening capacity to address them. This will feed into decision-making tools for honey bee colony deployment, promoting practices that reduce potential impacts of beekeeping on ecosystem services, and supporting biodiversity by increasing resilience genes

EXPECTED OUTPUTS, OUTCOMES, AND IMPACTS

WP4 - Genomic biomarker set up on pollinators' well-being: Enhanced knowledge in using genomic biomarkers on pollinators to evaluate ecosystem health. Provides a better understanding of environmental influences on pollinator health, serving as a foundational reference for future research.

WP5 - Data integration and Environmental Health Index (EHI) definition: Definition of a new ecosystem health assessment index (EHI) based on relationships between anthropogenic pressure and pollinator well-being. This new tool will evaluate the effect of ecosystem health on primary production in relation to anthropic pressure effects on pollinator-provided ecosystem services

BUDGET OVERVIEW

Budget	Description of costs.	Budget
Personnel	Three contracts for a 1-year research grant and	78,000.00 €
Travel	Travels for: (i) new environmental data acquisition (WP2) for field characterization (3-6 field survey, 3-6 people) ; (ii) Set up of honey bee hives and wild pollinator transects (9-12 travels; 2-3 people); (iii) pollinators field collection (6-12 travels, 2-3 people).	9,000.00 €
Instrumentation and	Laboratory consumables for molecular	25,000.00 €
Services	External chemical analysis on different matrix	11,000.00 €
Communication,	Set up of project website. Participation in	23,000.00 €
Overheads		34,000.00 €
Total		**180,000.00 €**

Sustainability/Contribution from other projects:

- Activities will be carried out in accordance with established protocols of ongoing projects like BEEGUARDS (Horizon Europe, Grant Agreement No. 101082073) and MoBeeFO (PRIN2022, Prot. No. 2022YRJAAC).
- BEEGUARDS aims to enhance honey bee health and resilience, while MoBeeFO focuses on understanding wild bee populations and their ecological roles.

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OUR TEAM

Transdisciplinary Research Group: Composed of researchers from two CNR departments (DSSTTA and DISBA), proposing an innovative transdisciplinary approach to ecosystem health and anthropic pressure evaluation

ISAFOM: Specializes in integrating environmental data, land evaluation, and detailed field surveys (UAVs), crucial for understanding geo-biodiversity and anthropic pressure effects, ensuring comprehensive GIS analyses

IRPI: Leads in environmental analysis and characterization of geodiversity

IPSP: Expert in pollinator health and biodiversity, focusing on morpho-physiological and molecular impacts of stress factors. Leads the evaluation of pollinator ecosystem services

ISPAAM: Pioneer in genomic biomarker research, particularly telomere length analysis, providing innovative tools for assessing pollinator well-being


PI A.Bonfante


CoPI M.Alvioli


G. Di Prisco


A. Iannuzzi

Our project integrates field and laboratory experiments with advanced GIS techniques and molecular biomarkers for a comprehensive and accurate assessment of anthropic pressures and pollinator health

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Core Team Contacts:

PI: Antonello Bonfante, ISAFOM (antonello.bonfante@cnr.it)
CoPI: Massimiliano Alvioli, IRPI (massimiliano.alvioli@irpi.cnr.it)
Gennaro Di Prisco, IPSP (gennaro.diprisco@cnr.it)
Alessandra Iannuzzi, ISPAAM (alessandra.iannuzzi@cnr.it)

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A cura di A. Bonfante