DIPARTIMENTO DI
SCIENZE
DELL'AMBIENTE E
DEL TERRITORIO
Milano - Italy

UNIVERSITA' DEGLI STUDI DI MILANO
AUDENTES FORTUNA IUVAT
BICOCCA

ALARM

ECM (Environmental Chemical Module)

Assessing and validating ecotoxicological risk on biodiversity

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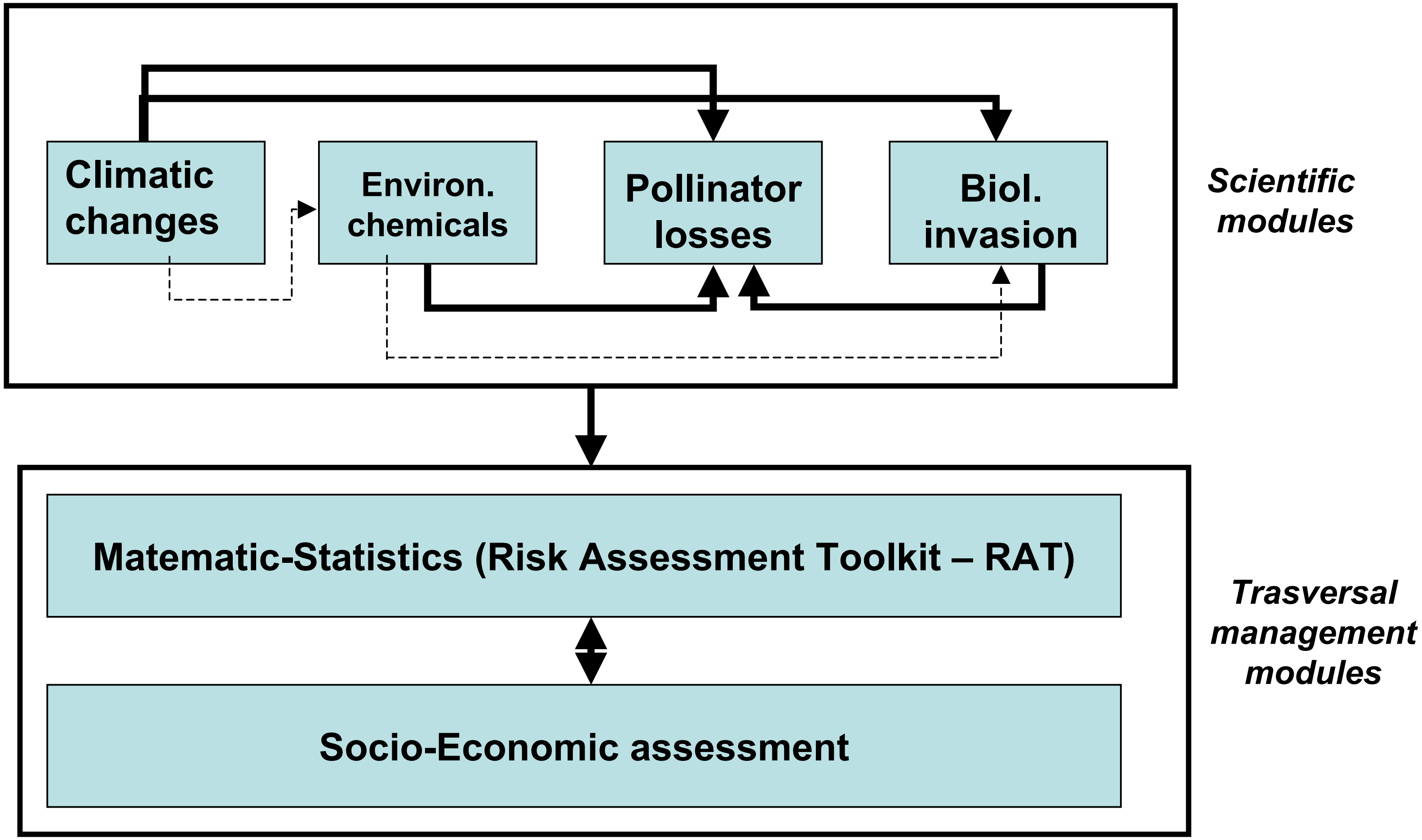
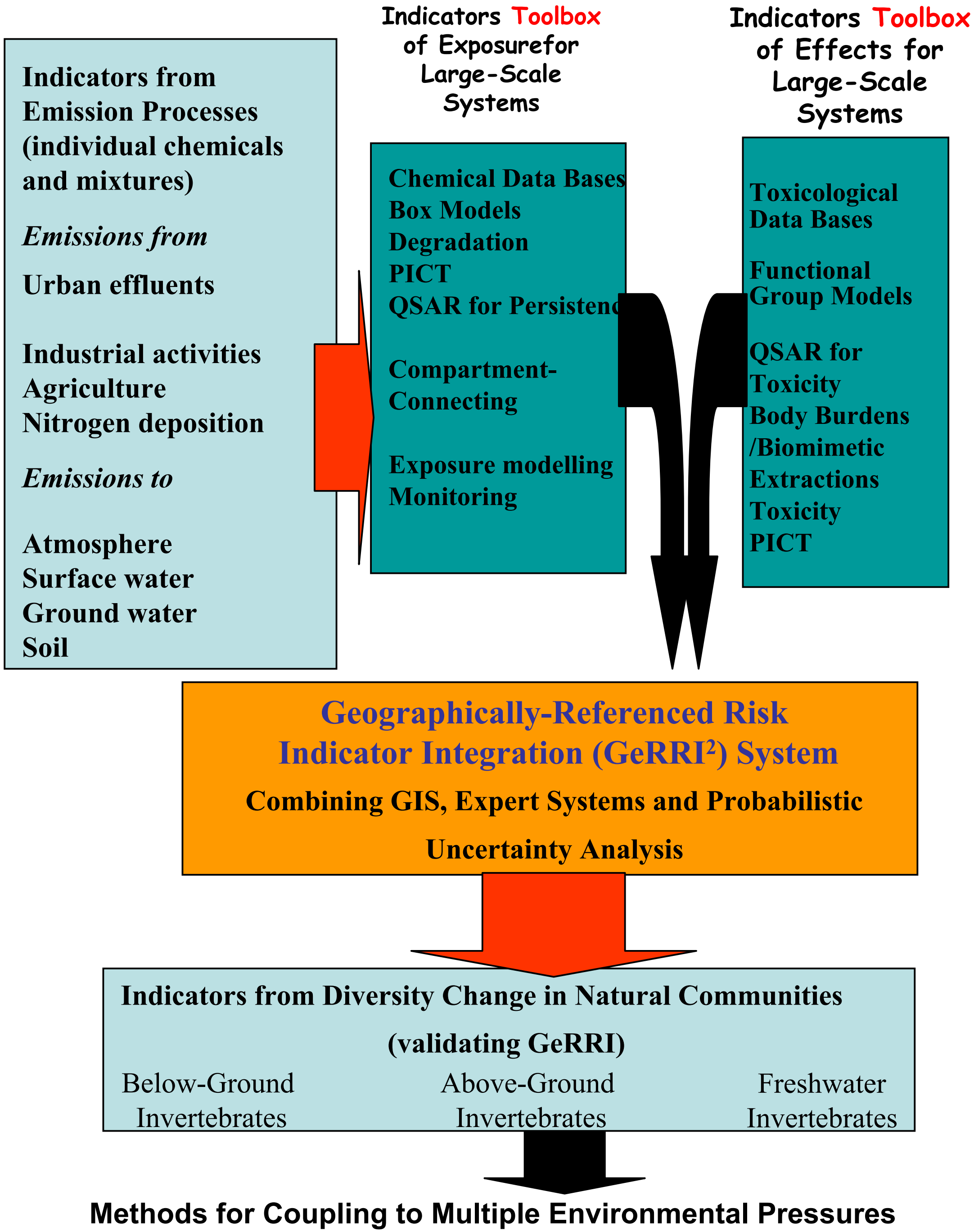
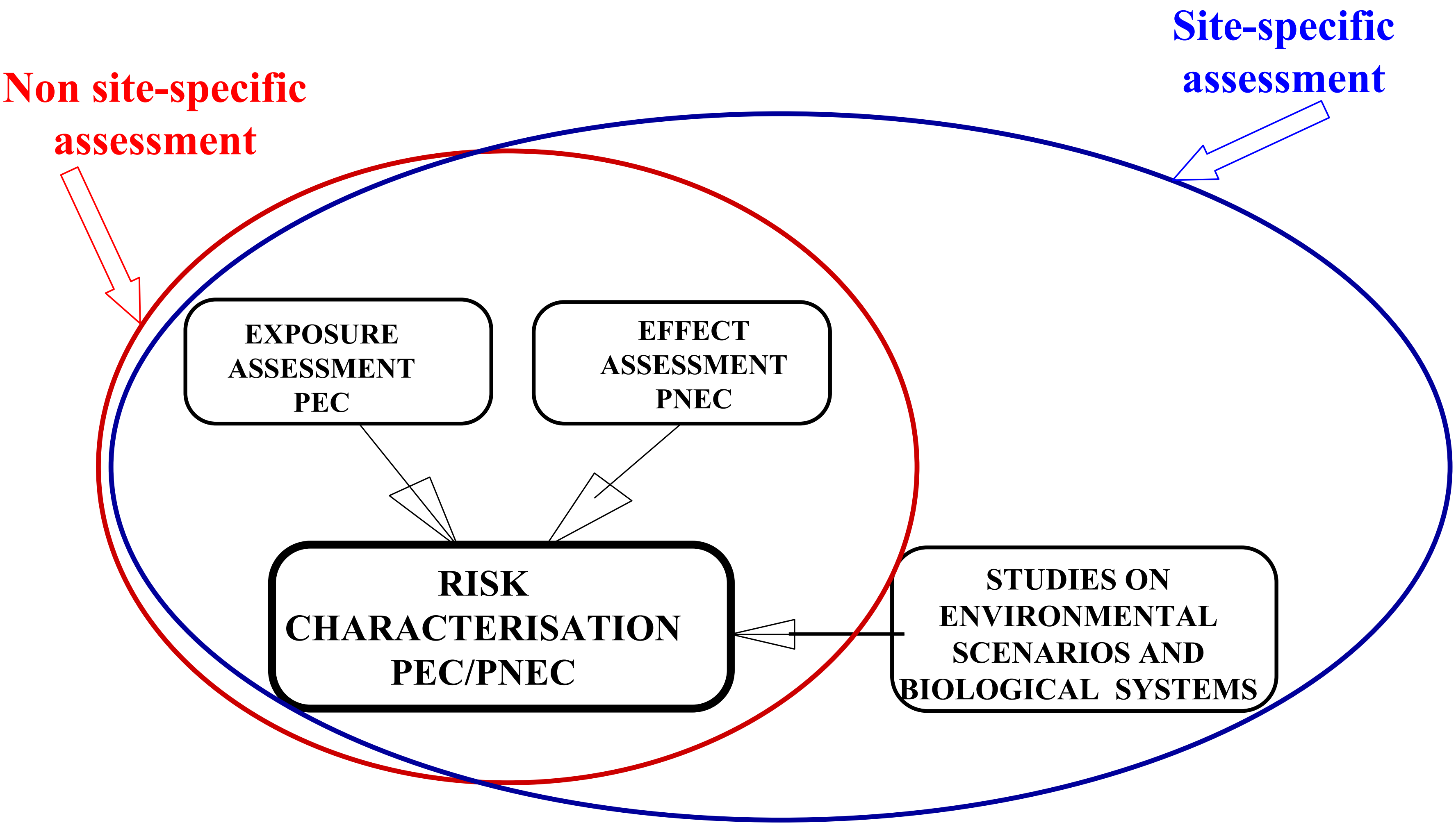
Connections among ALARM modules



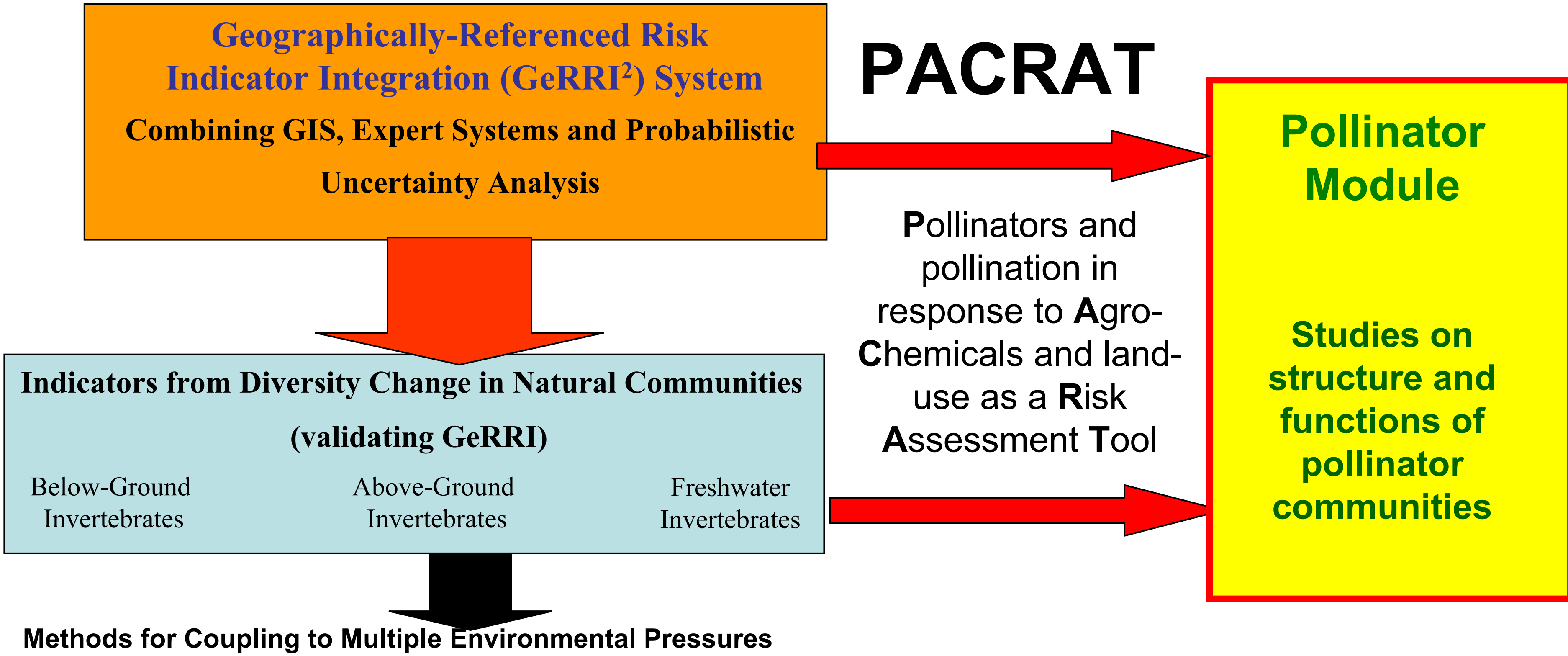


Most of the work performed within the ECM is developed according to the Risk Indicator Diagram (RID) agreed in the first ECM meeting (Milano, March 2004).

The Ecotoxicological Risk Assessment Procedure



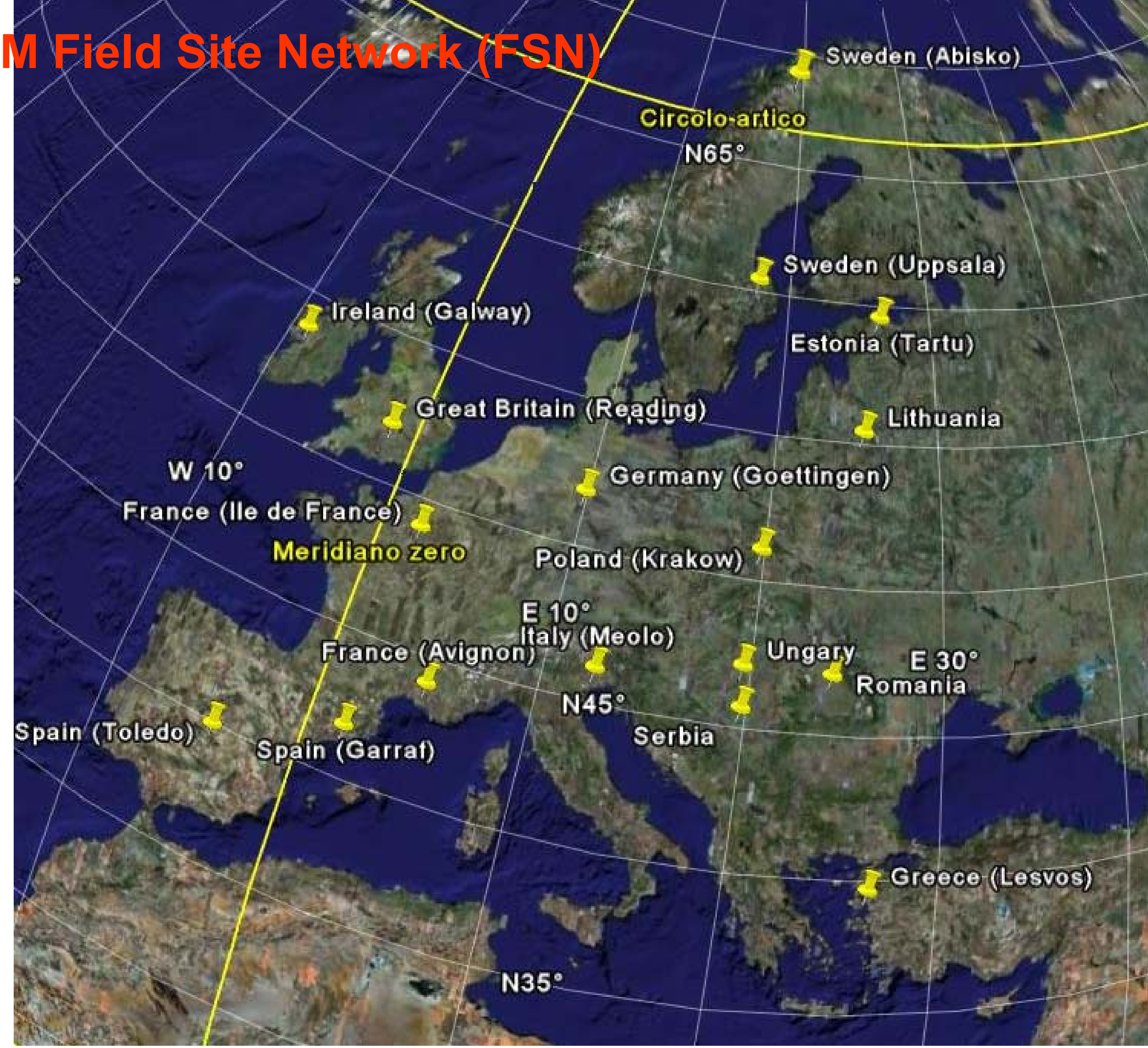
The PAC-RAT programme was established in the last ALARM general meeting (Athens, January 2007)



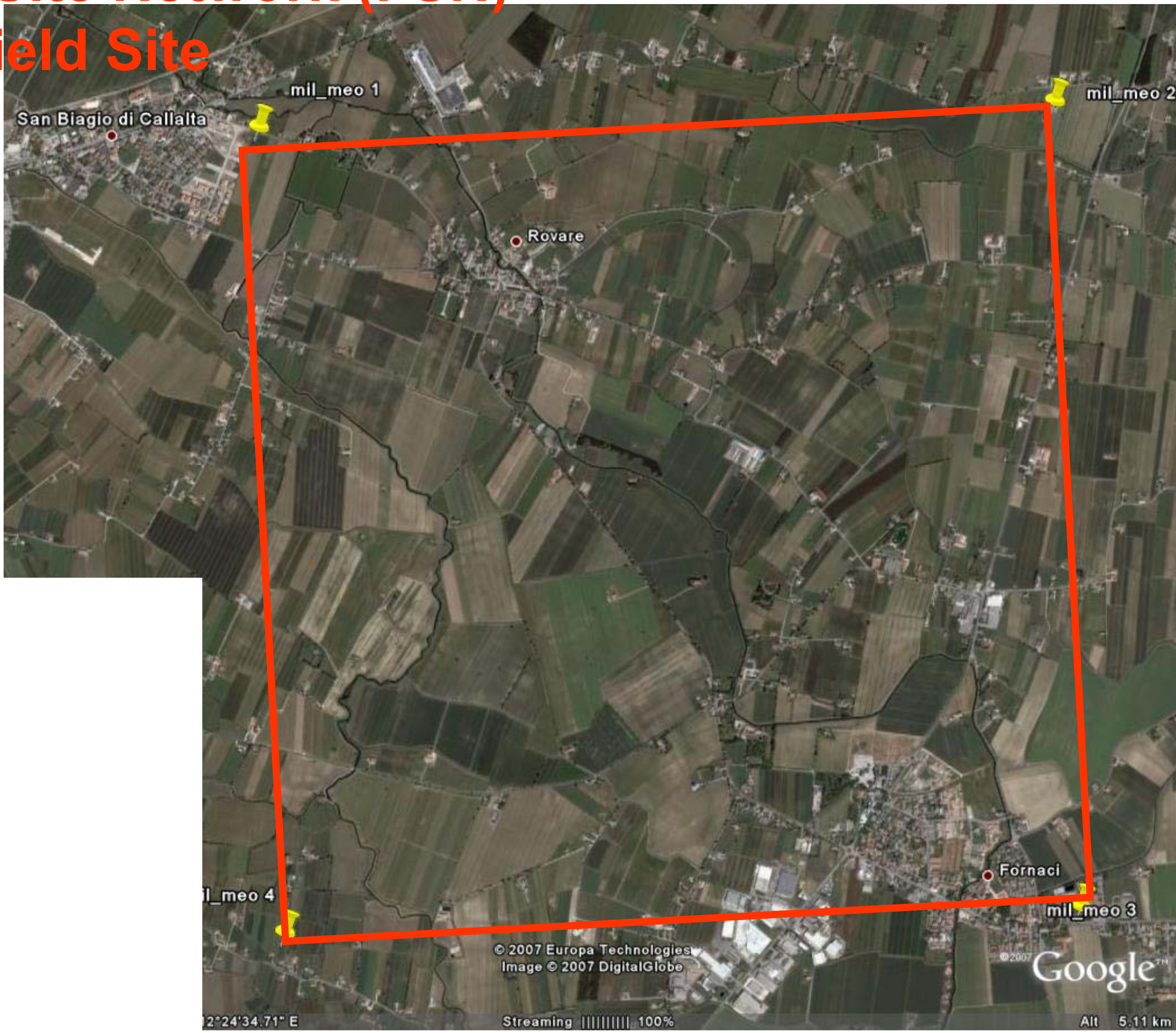
The ALARM Field Site Network (FSN)

Location of the 18 sites.

For each site a "disturbed" and an "undisturbed" area, with comparable climatic and environmental conditions (as far as possible) were selected.



The ALARM Field Site Network (FSN)
An example of a Field Site



A Field Site is a 4x4 km area where all chacteristics (geographical, climatic, land use, etc.) are described in GIS

The Italian "disturbed" site: The River Meolo basin (TV) is an intensive agricultural area.

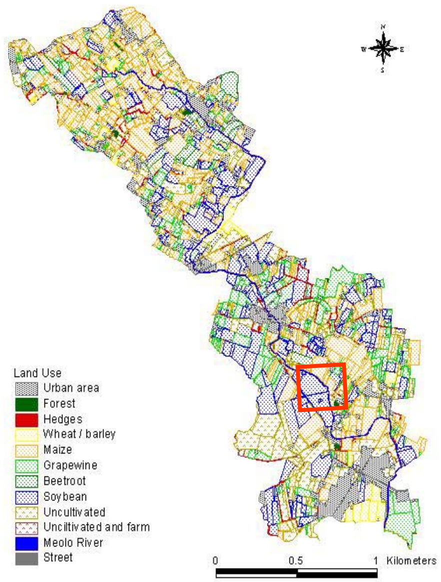
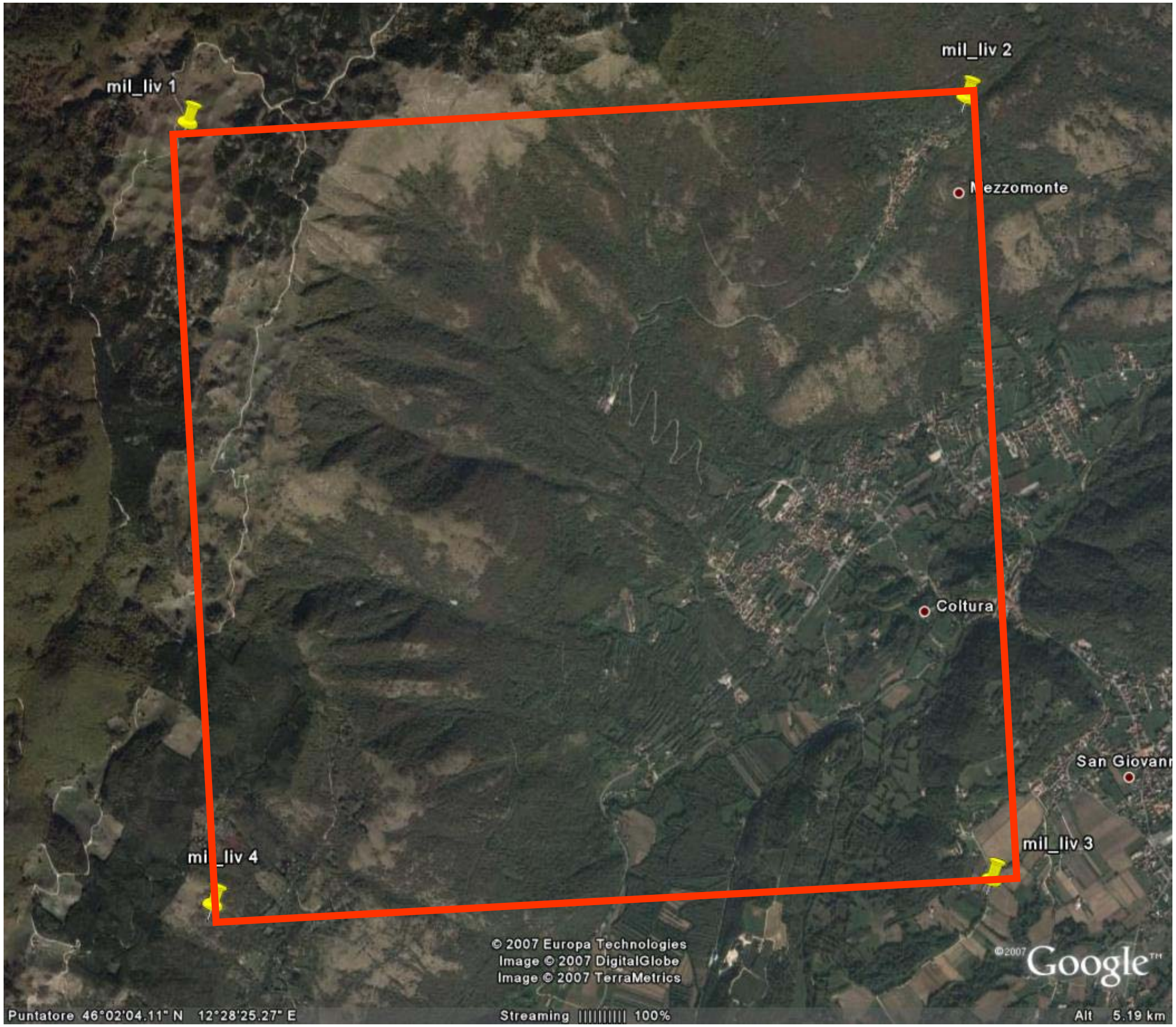


Figure 2 - crop distribution in Meolo catchment basins

Field sites are often part of wider study areas, where other ALARM activities are performed

The ALARM Field Site Network (FSN)
An example of a Field Site

The Italian "undisturbed" site: The Upper Livenza basin (PD) is a protected, almost natural area.



Project	Research leader
Rose hip seed predators: hazards related to invasive seed insects	***Alain Roques, INRA***
Ornithogalum plants genetics diversity	***Ante Vujic, FSUN***
Seed collection: Climate changes and their influence on seeds germination	***Belen Luna Trenado***
Socio-economic survey	***B.R. Labajos, UAB***
CITI-RAT (Climate Interactions with Terrestrial plant Invasions: a Risk Assessment Tool): • Plant survey • Temperature survey • Ant community biodiversity in relation with microclimate • Pollinators abundance in relation to microclimate	***Bill Kunin, LEEDS*** ***Jens Dauber, LEEDS*** ***Koos Biesmeijer, LEEDS*** 

PAC-RAT

Monitor pesticides exposition for pollinators:

- Honeybee pollen
- Crops: field survey
- Crops: interviews

Potted plants:

Are pollination services and seed set affected by differences in land use intensity, different habitat types, and climatic differences across the European gradient?

Trap nest

Assessment of the abundance and diversity of trap-nesting pollinators

Transects

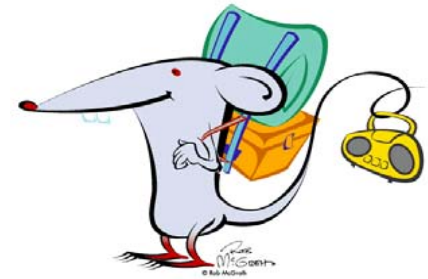
Assessment of the abundance and diversity of butterflies and bumblebees

Pan traps

Pollinators abundance in relation to land use and pesticide pressures

Bumblebees

Genetic diversity and parasite load of bumblebees across a land use intensity and climatic gradient



Marco Vighi, UNIMIB

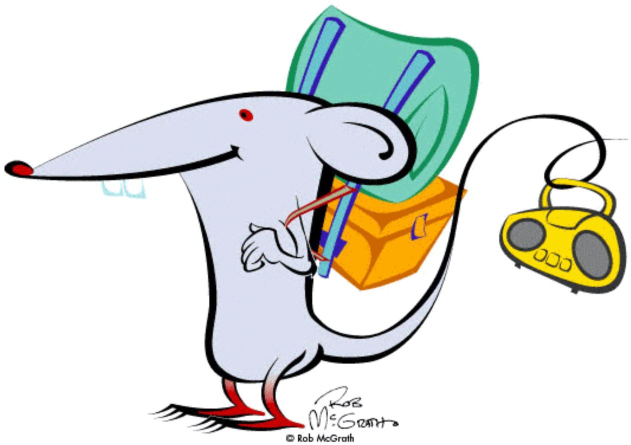
Riccardo Bommarco, SLU

Eduardas Budrys, Vilnius, Lithuania

Josef Settele, UFZ

Catrin Westphal, Bayreuth

Koos Biesmeijer, LEEDS

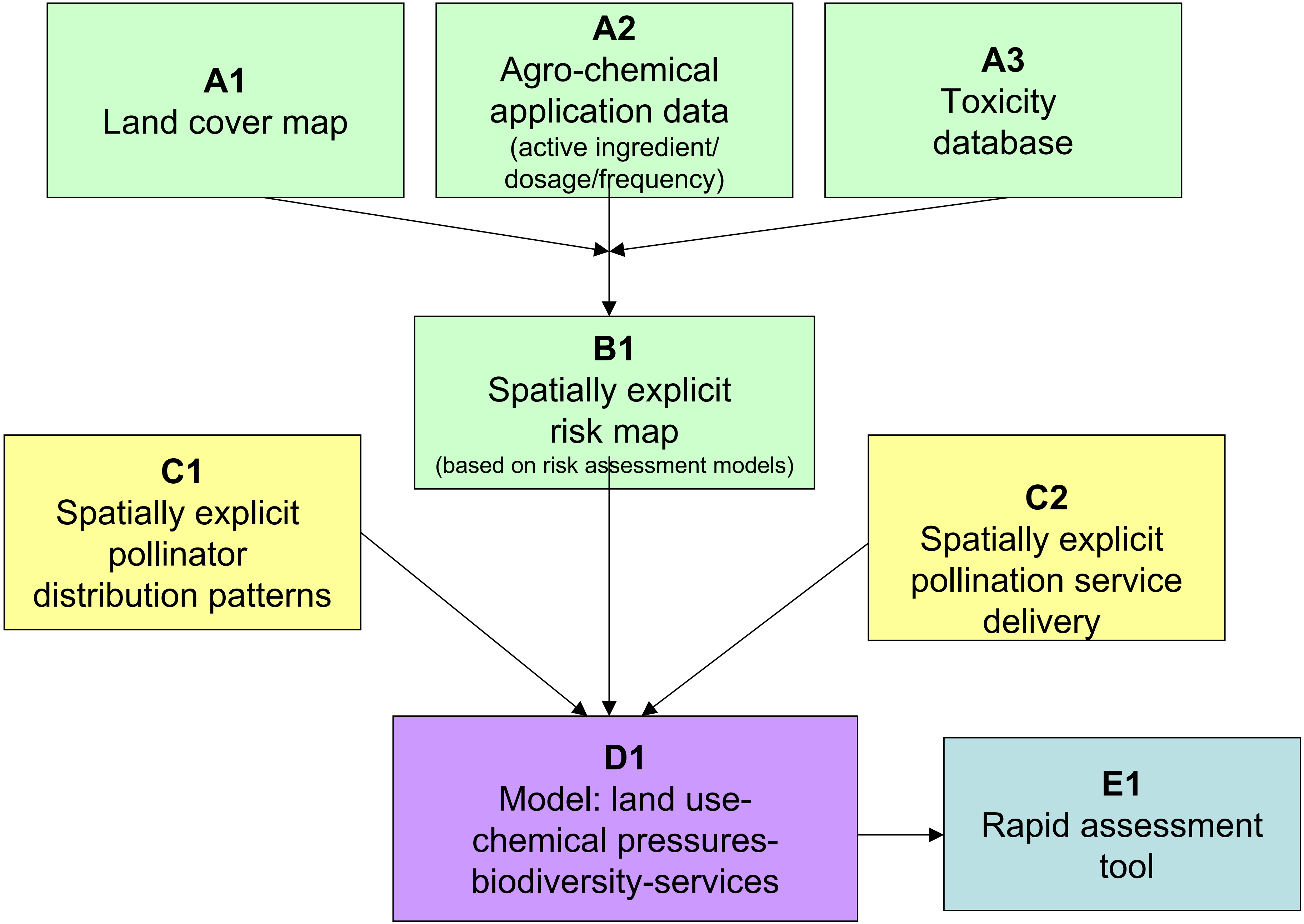


PACRAT

Pollinators and pollination in response to **A**gro-**C**hemicals and land-use as a **R**isk **A**ssessment **T**ool

- Cross-link between Envir. Chem. and Pollinator pillars, using all FSN sites

- Rationale: We aim at linking land use and agro-chemical use to pollinator diversity and pollination services at a landscape scale. We will develop a GIS model that can use agricultural information to assess risks of loss of pollination services.


A1
Land cover map
A2
Agro-chemical application data
(active ingredient/ dosage/frequency)
A3
Toxicity database
B1
Spatially explicit risk map
(based on risk assessment models)
C1
Spatially explicit pollinator distribution patterns
C2
Spatially explicit pollination service delivery
D1
Model: land use-chemical pressures-biodiversity-services
E1
Rapid assessment tool

Outputs

- Models linking land use, agrochemical usage and risk, pollinator biodiversity and delivery of pollinator services. Pollinators as a surrogate of wider biodiversity?

- Rapid risk assessment tool to measure pesticide pressure on biodiversity and ecosystem function.

Multi-modal involvement:

- Environmental chemicals module:
  - Agro-chemical pressures and risks
- Pollinator module:
  - Impacts on pollinators and services
- Invasives module?:
  - Competition between natives and invasives
- RAT module:
  - Rapid assessment tool for chemical impacts on biodiversity and ecosystem function

Risk map [A1-3 and B1]:

- Use several pairs of FSN sites to provide a gradient of land use intensity (and environmental chemical pressures) within each set of sites.
- Map land cover paying particular attention to areas of crops, horticulture, orchards and managed forests [A1].
- Collect data on agro-chemical inputs for each cultivated land use type [A2]:
  - directly through farmer interview/questionnaire
  - indirectly through regional databases
- Apply and validate suitable models for assessing pesticide exposure
- Develop a pesticide toxicity database (A3)
- Construct a spatially explicit risk map based on A1-3 data [B1].

Biodiversity and ecosystem service [C1-2]

- Survey pollinators, stratifying to include major land use types [C1]. Use combination of:
  - Transects (butterflies)
  - Pantraps (bees and hoverflies).
  - Sample bumblebees for pop genetic analysis
  - Reduce taxonomic workload by using functional groups
- Match with measurements of pollination service delivery using a range of flowering (potted) plants to cover:
  - generalist to specialist species
  - native vs. non-native species?
- In addition set up a grid of trap nests across the FSN sites. Collected at the end of the season and pesticide residues measured. The correlation between measured (pollen content) and predicted (modelled on land use and chemical inputs) can then be assessed.
- Set up honeybee hives in each site and collect pollen and nectar for analysis of pesticide residues and heavy metals

Partners

- FSN partners - fieldwork: Mapping, Pollinator assessments, Service assessments
- UNIMIB – risk assessment coordination
- Reading / Leeds – pollinator coordination
- Leeds/OLANIS/UFZ- landscape structure and GIS **(A1)**
- UNIMIB – assessing and validating exposure (A2)
- NERI – pesticide pressure maps and models (B1, D1)
- UNIMIB – ecotoxicological risk maps (B1)
- UFZ/Bayreuth/Leeds/Reading/Lithuania-pollinator and services protocols **(C1-2)**
- MLU/GAUG/TCD?-population genetics Bombus **(C1)**
- BIOSS – risk assessment tool (E1)

Methods already tested

- Landscape mapping – FSN 2006 (Leeds)
- Pantrap surveys – FSN 2006 (Leeds)
- Transect surveys – pilot FSN 2006 (UFZ)
- Pollination services – FSN 2006 (GUAG)
- Risk maps – NERI / UNIMIB expertise

Risk for biodiversity in surface water

Macrobenthos communities of Meolo and Upper Livenza rivers were compared

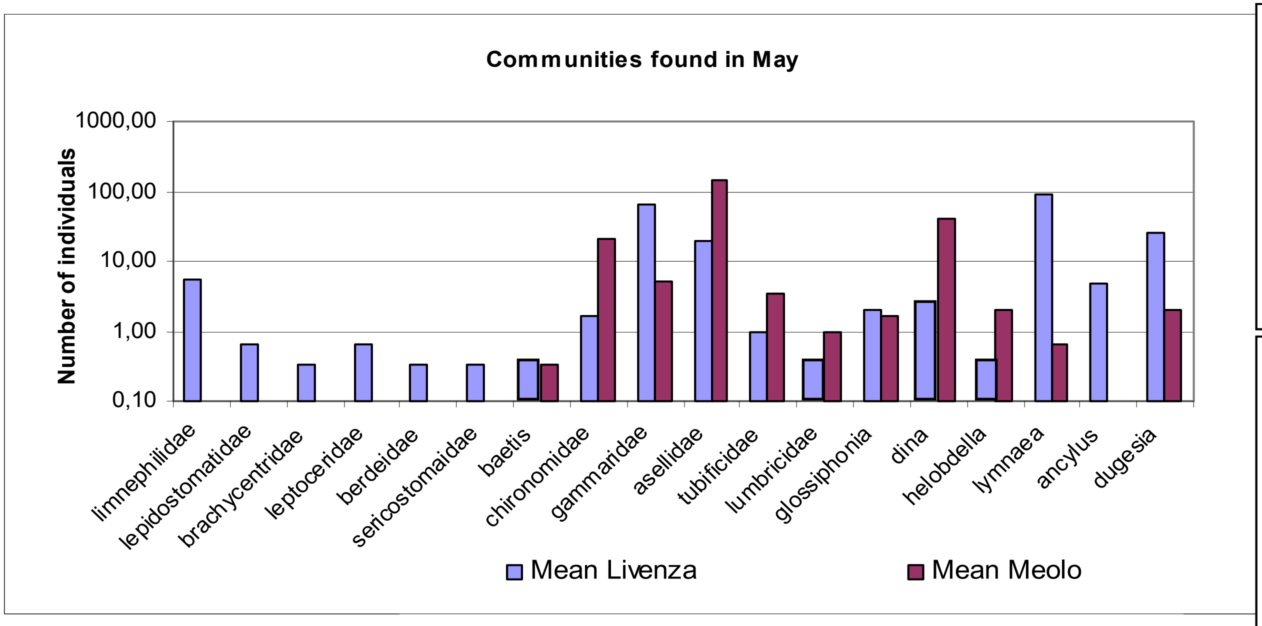
Meolo and Livenza are resurgernce rivers.
Climatic and hydrologic characteristics are comparable.

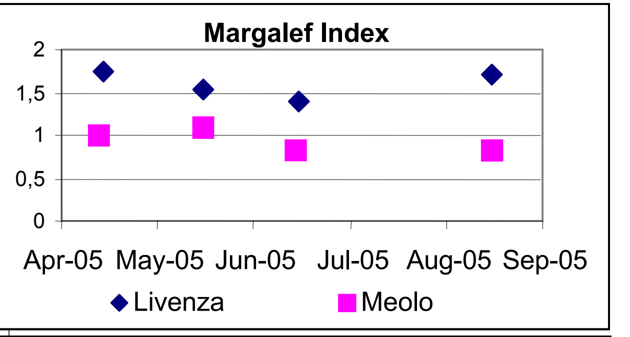
THE METHODOLOGICAL APPROACH

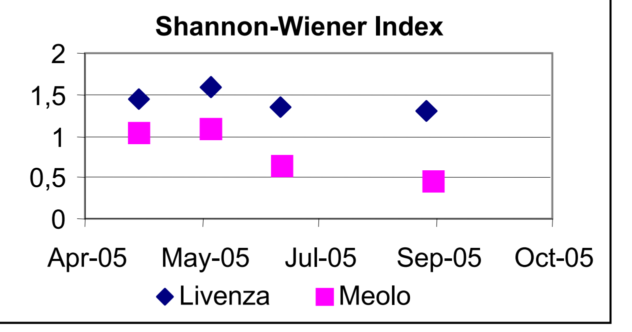
Macrobenthos communities of running waters have been studied by examining the colonisation of artificial substrates in River Livenza (reference, unpolluted site) and River Meolo (higly polluted site).

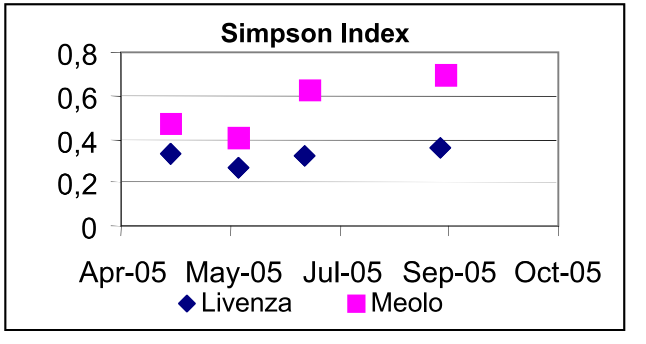
Substrate	May 15	June, 22		July, 13		September, 21		
1	**X**	X		X		X		
2	**X**	X		X		X		
3	**X**	X		X		X		
4			**X**				X	
5			**X**				X	
6			**X**				X	
7					**X**			
8					**X**			
9					**X**			X
11								**X**
12								**X**

Comparison of community structure





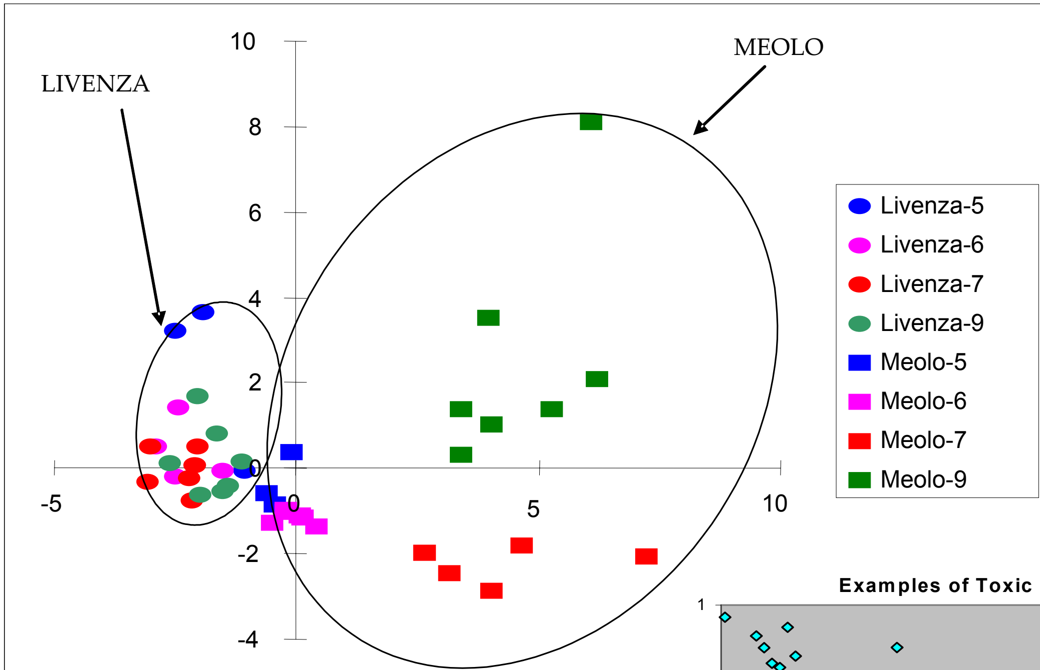




Community structure is significantly different in the two rivers.

Are differences due to pesticide toxicity or to organic pollution (BOD)?

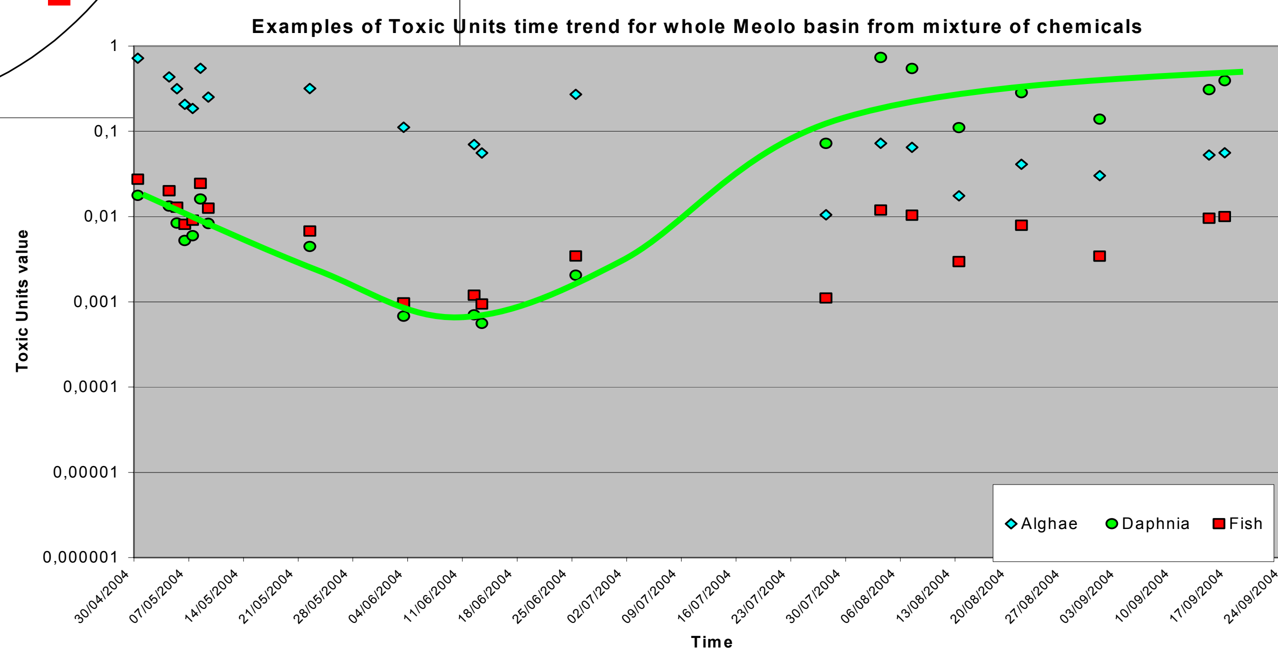
The combined effect of different stress factors



PCA indicate that differences increase in late summer (July-September).

Organic pollution is almost costant during the year.

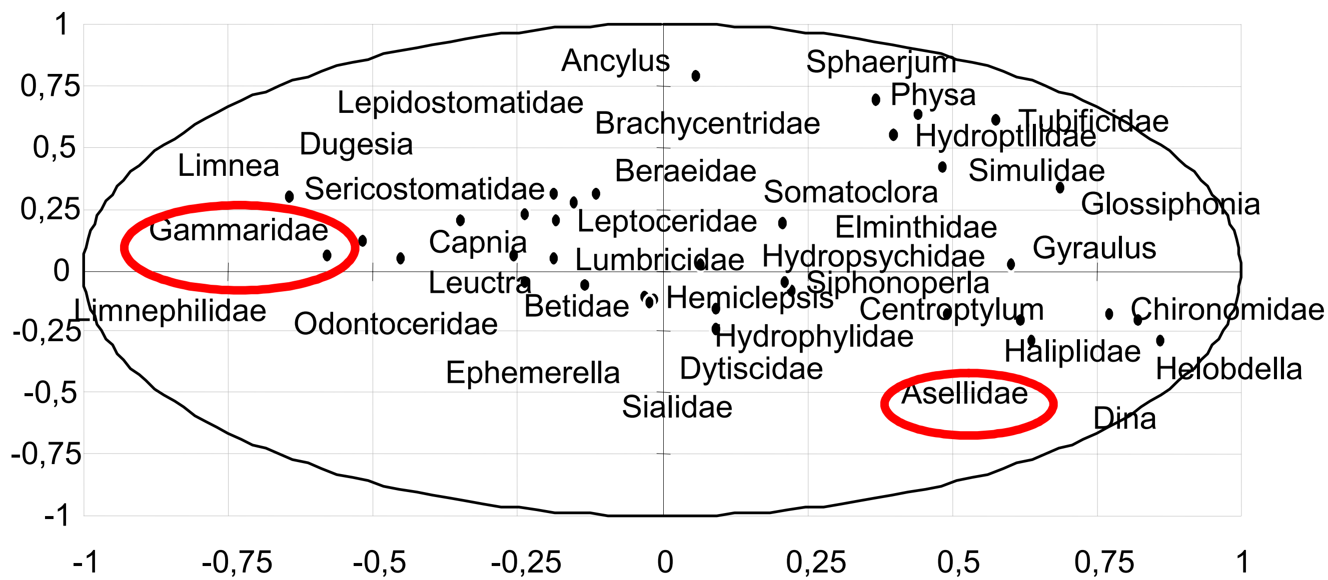
Pesticide toxicity for invertebrates strongly increases in late summer, after insecticide application



The role of different taxonomic groups

Sensitivity ranking to organophosphorus insecticides

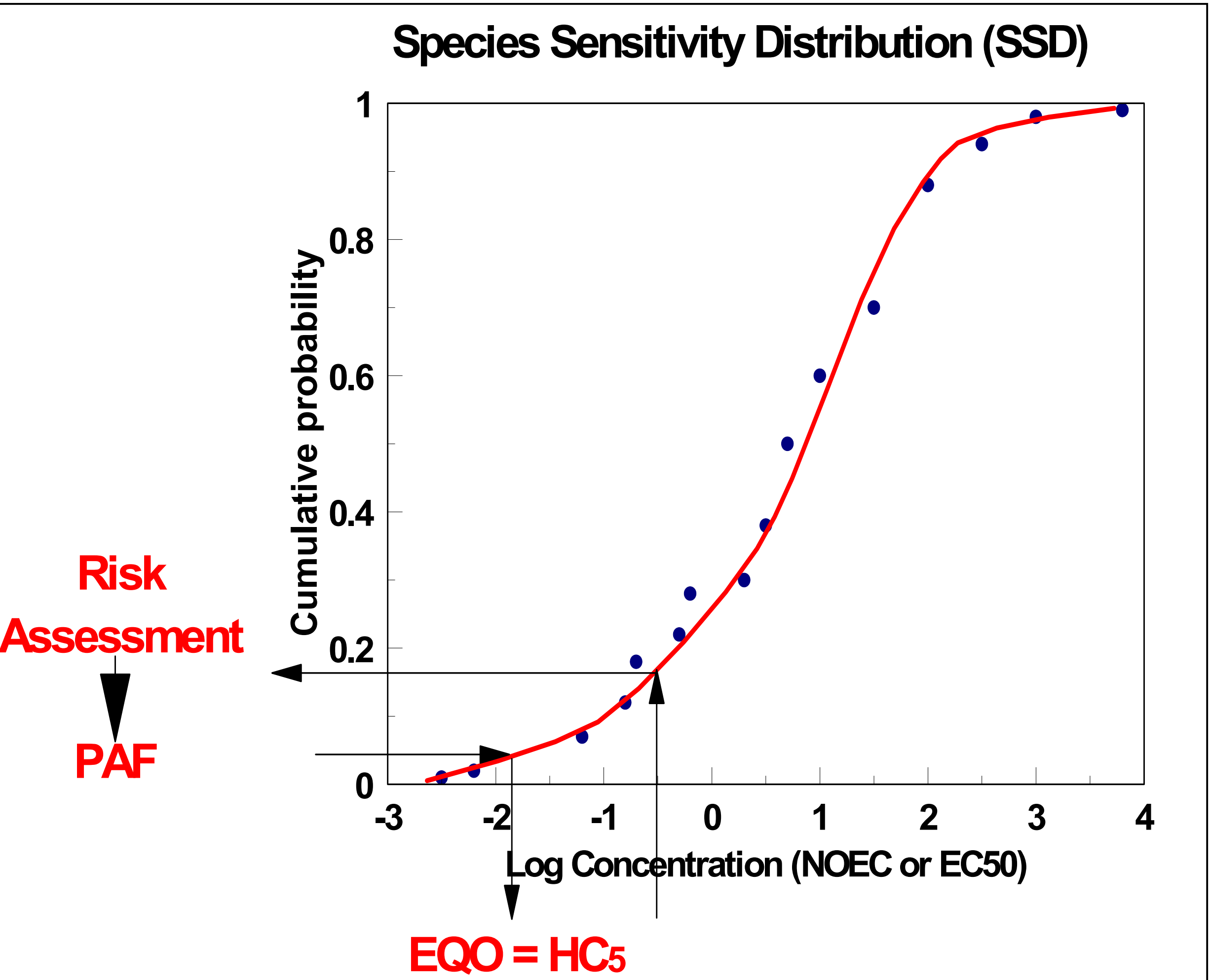
Some indicator groups with different sensitivity to pesticides are major responsible of community structure differences



High sensitivity
Gammaridae
Plecoptera
Tricoptera
Ephemenoptera (Baethidae)
Medium sensitivity
Diptera (Chironomidae)
Odonata
Ephemenoptera (excluding Baethidae)
Ostracoda
Low sensitivity
Oligocheta
Gasteropoda
Bivalva
Hirudinea
Asellidae

Some approaches under development

The SSD approach applied to Risk indicators



May allow assessing effects on biodiversity

May indicate changes in the community structure

Some approaches under development

Development of biotic indices (comparable to EBI) applicable to toxic chemicals.

On a number of organophosphorous insecticides, enough data are available for developing a preliminary sensitivity ranking of macrobenthos taxonomic groups.

High sensitivity
Amphipoda
Plecoptera
Tricoptera
Ephemeroptera (Baethidae)
Medium sensitivity
Diptera (Chironomidae)
Odonata
Ephemeroptera (excluding Baethidae)
Ostracoda
Low sensitivity
Oligocheta
Gasteropoda
Bivalvia
Hirudinea
Isopoda

Insects

Crustaceans