INRAE Farming system experiments : Orchard redesign towards pesticide free fruit production - Designing an experimental agroecological mixed crop livestock farm in marshland

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Designing an experimental agroecological mixed crop-livestock farm in marshland

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Présentation MScBOOST, Université de Côte d'Azur, 17 octobre 2024

Short introduction

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An INRAE experimental unit

A team of 25 people including 6 engineers covering the disciplines of ecology, animal , agronomy and water science, naturalist and information systems, a “farm" team and a research technicians
= THE COLLECTIVE

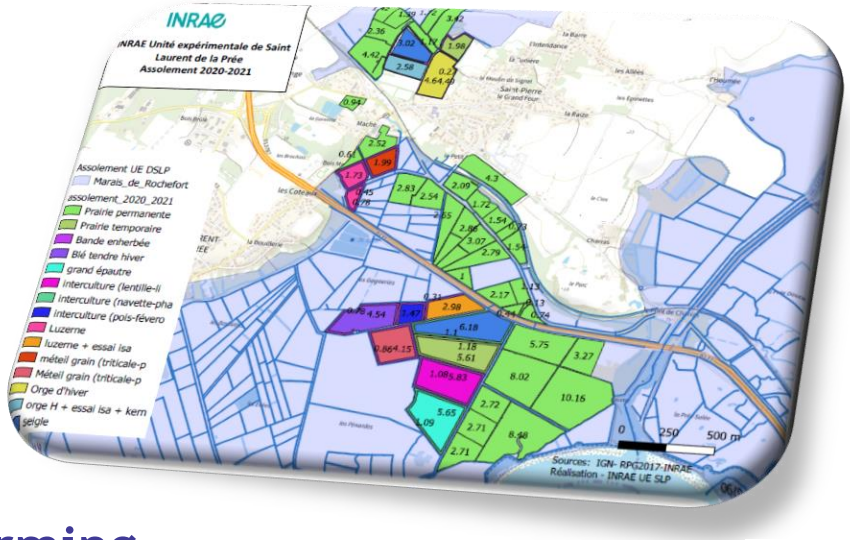
An experimental farm of 156 ha in marshland with 52 ha of arable land and 104 ha of wet grasslands

and a herd of about 100 cows of the local Maraichine breed

An experimental farm in a marsh with a system experiment: TRANSI'MARSH

Agroecological infrastructures

4 ponds, 5 hectares of grass strips, 1 reed bed, 100 hectares of natural meadows with water drops, 9 km of hedgerows



Open Innovation

Visits for citizens and farmers

Training for students and schoolchildren

100% organic farming

- **100 hectares of permanent meadows**
- **60 hectares of drained arable land**: 3 long crop rotations, soil cover in winter
- Plant species and variety diversity
- Small parcels

- **50 local Maraîchine cows**
- Two calving periods
- Herd adjusted to 100 hectares of natural meadows
- Stocking density: 0.6 LU/ha
- Feeding with hay and pasture
- **Production of rose veal and adults fattened with farm-grown cereals**

Dense hydraulic network

- 90% of land in marshland
- 3 hydraulic management units
- **25 km of ditches and collectors**, 2 sluice gates
- 3 pumps, 50 crossings
- 5 devices to retain water on meadows,
- **170 drains on crops**

Aim of our project : to support and tool the agroecological transition in marslands

3. Support multi-actor projects in marshes

2. Produce scientific knolewdege and tools for agroecology in marshes

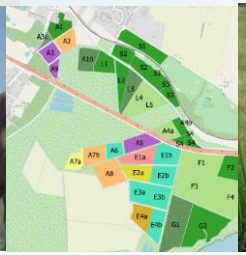
1. Implement and test an agrocological system on our farm : TRANSI'MARSH

Collaborative research

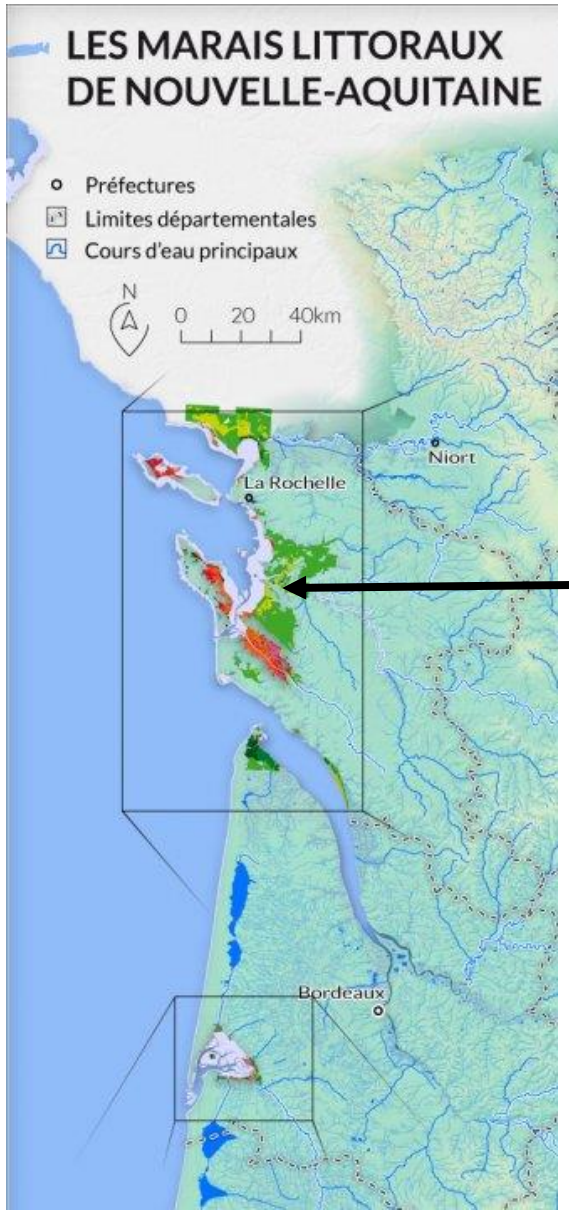
Factorial experimentations

The experimental farm as a laboratory of the agroecological transition

Systemic approach



Marshes of French atlantic coast



Experimental farm

- Cover an area of 200,000 ha of wetlands from Morbihan to Gironde

- Marshes are devoted to agriculture, with many conventional farms that are crops farming systems, mixed crop-livestock farming systems or grassland-based suckling farms.

  Few crops farms are organic which poses major water quality problems and a miultiplication of children cancers

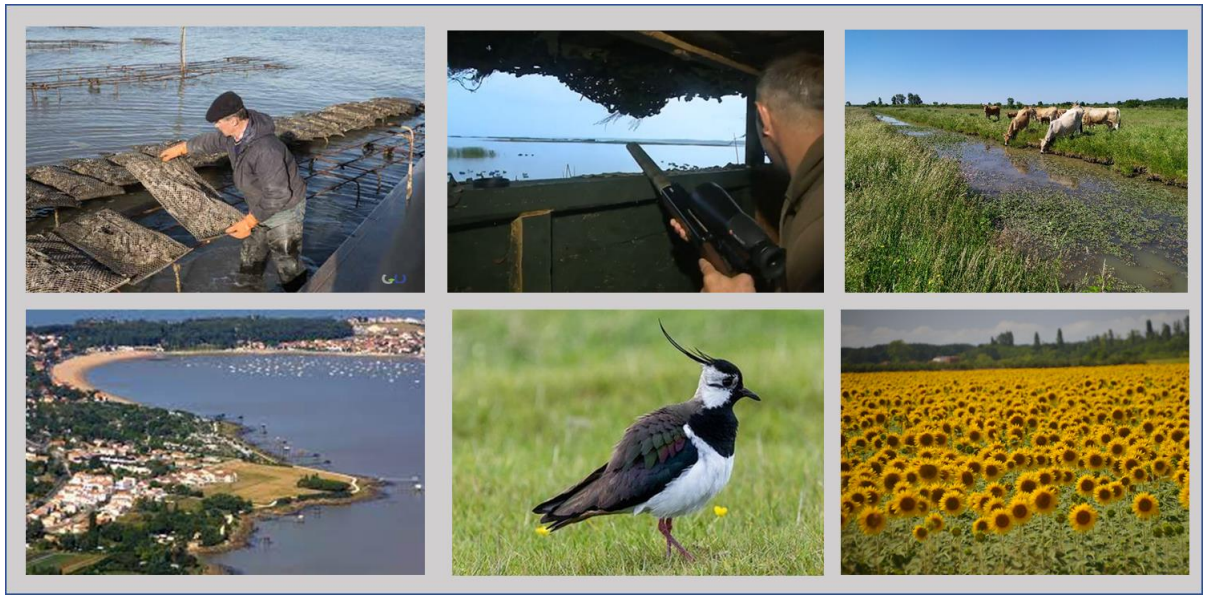
- The environmental services they provide are essential for natural and territorial balance

→ Our researches are deeply rooted in this territory

https://www6.nouvelle-aquitaine-poitiers.inrae.fr/dslp/

A few words on the specificities and constraints for agriculture in marshes

- **Remarkable biodiversity and landscape recognised** as being of national and European interest in the framework of various regulatory measures (bird migratory road)



- **Many actors and skateholders linked by water**

The design of our system experiment and the first feedbacks

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Our scientific project

Support multi-actor project

Produce scientific knolewdege and tools for agroécology in marshes

Implement and test an agrocological system TRANSI'MARSH

= Proof of concept

Collaborative research

Factorial experimentations

The experimental farm as a laboratory of the agroecological transition

→ All our farm is involved in the farming system experimentation Transi'marsh

Farming system experimentation specificities

Set up a farming system experiment is:

- Experimenting consistent and innovative systems rather than just techniques or new varieties
- Designing new ways of farming to valorise natural ressources while being economically sustainable
- Changing scale, space and times by no longer working at plot or animal scale on one year
- Evaluating the sustainability and providing data on the long term
- Understanding the processus of transition

What theorical frameword do we use?

We operate with a ‘step-by-step’ approach, well adapted to manage the agroecological transition

ELSEVIER

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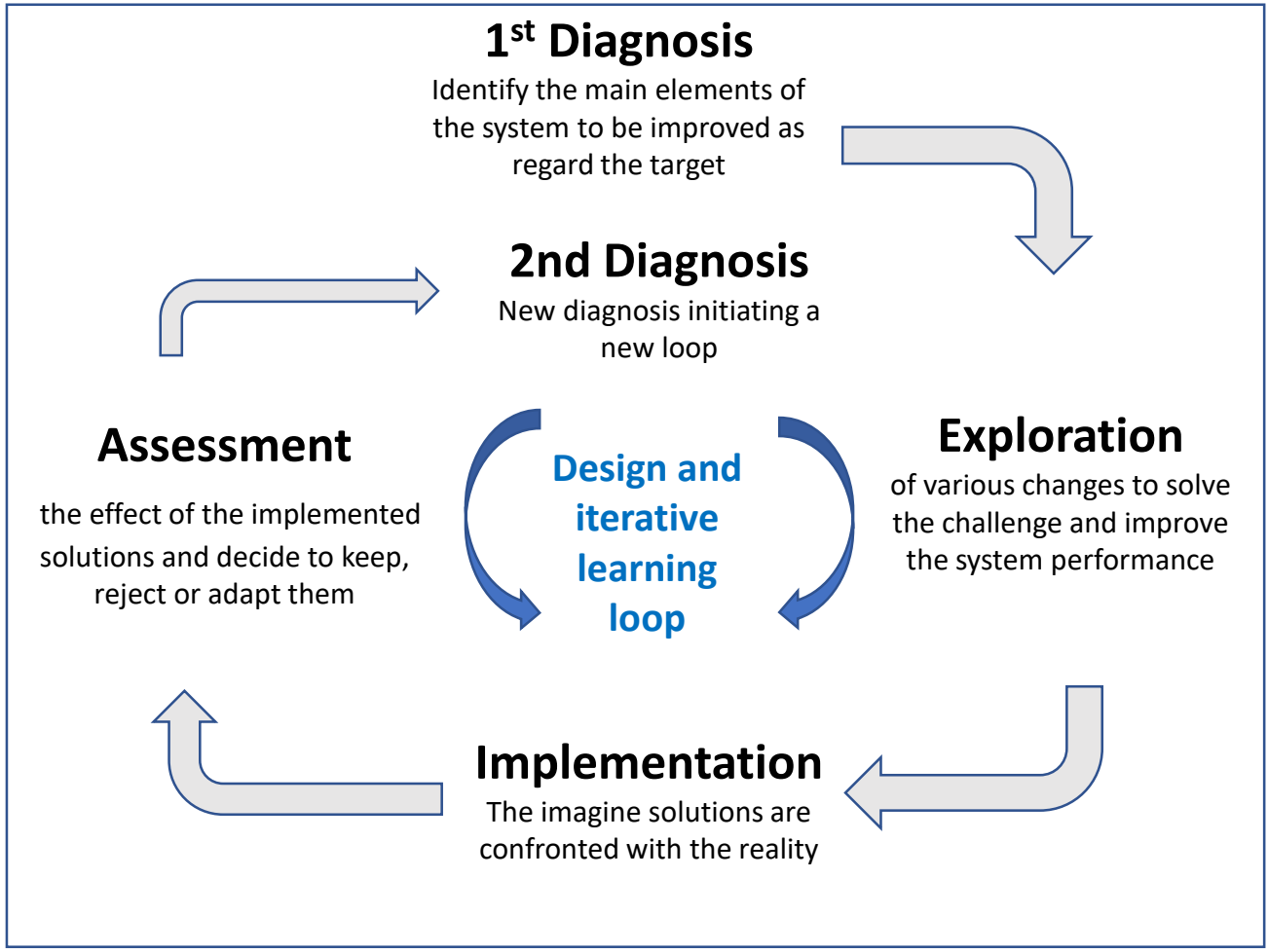
Unravelling the step-by-step process for farming system design to support agroecological transition

Jean-Marc Meynard [a], Marianne Cerf [a], Xavier Coquil [b c], Daphné Durant [d], Marianne Le Bail [a], Amélie Lefèvre [e], Mireille Navarrete [f], Jérome Pernel [g], Anne Périnelle [h], Benjamin Perrin [e], Lorène Prost [a], Raymond Reau [i], Chloé Salembier [a e], Eric Scopel [h], Quentin Toffolini [i], Marie-Hélène Jeuffroy [i]



How do we proceed to design Transi'marsch?

TRANSI'MARCH 1

Diagnosis

Exploration

Implementation

Assessment

1. Autonomy for animal feed
2. Synergy between production and biodiversity

TRANSI'MARCH 2

Diagnostic

Exploration

Implementation

Assessment

Cessation of inputs - transition to AB system

TRANSI'MARCH 3

Diagnosis

Exploration

Implementation

Assessment

1. Rehabilitating biodiversity
2. Producing local food for human consumption
3. Helping to reduce the impact of climatic change

2009

2017

2019

2024

D'après Meynard et al., 2023

Step by step design of Transi'marsch

2009

TRANSI'MARCH 1

Diagnosis

1. Autonomy for animal feed
2. Synergy between production and biodiversity

Assessment

Exploration

Implementation

2017

TRANSI'MARCH 2

Diagnostic

Cessation of inputs - transition to AB system

Assessment

Exploration

Implementation

2019

TRANSI'MARCH 3

Diagnosis

1. Rehabilitating biodiversity
2. Producing local food for human consumption
3. Helping to reduce the impact of climatic change

Assessment

Exploration

Implementation

2024

IMPLEMENT AND TEST THE PRINCIPLES OF AGROECOLOGY AND THE RESULTS OF SCIENTIFIC LITERATURE

PRODUCTION SYSTEM
"Improving the agro-ecosystem"

SCALE

SCALE

AGRI-FOOD SYSTEM
"Acting on the transformation of the food system".

The learning loop: examples of Transi'marsh 3

DIAGNOSIS

1. **Animals use too much arable land for human food**
2. Feed for our hardy cows too expensive (wrapping)
3. **Poor economic valuation of our animals**
4. **Animals sent abroad by lorry (wellfare)**
5. **Production for export**
6. **Biodiversity issues are not clearly explained**
7. **Our attention for biodiversity only linked to permanent grassland**

ASSESSMENT/LEARNING

- An effective reduction in the herd and an increase in the amount of arable land used for human consumption
- All our meat is sold locally to a wide range of buyers (0 exported animals abroad) with increasing economic margins → Requires a great deal of interactions with stakeholders
- 11 target species identified with 11 dashboards → positive results for some species
- All the large plots of arable land were cut, 4 types of strips were set up and 1 hibernaculum was planted.

TRANSI'MARCH 3
3 TARGETS

Rehabilitate biodiversity

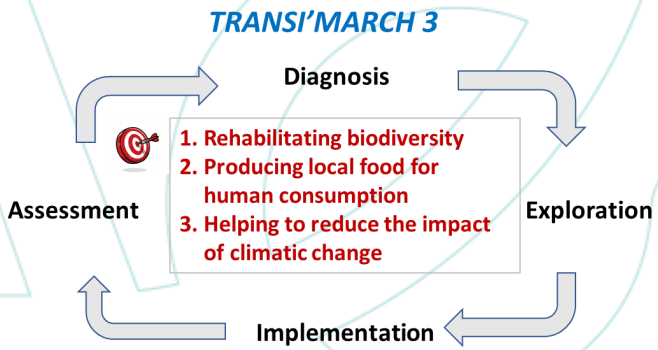
Produce local food for human consumption

Contribute to reduce the impact of climatic change

EXPLORATION

1. **Reduce the number of animals to fit the ha of natural grassland**
2. Stop wrapping and produce alfalfa hay to replace it
3. **Sell our products locally to a wide range of buyers and invest in selective catering**
4. Diversify our crops for human consumption in 3 fixed rotations
5. **On a plot-by-plot basis, set targets for results on target wild species using an adaptive management approach**
6. **On the scale of our arable land, create a mosaic and increase the number of semi-natural habitats for wildlife**

A focus on our approach on biodiversity



…. EXPLORATION of the two paths to improve biodiversity

1. On a plot-by-plot basis, set targets for results on target wild species using an adaptive management approach

2. On the scale of our arable land, create a mosaic and increase the number of semi-natural habitats for wildlife

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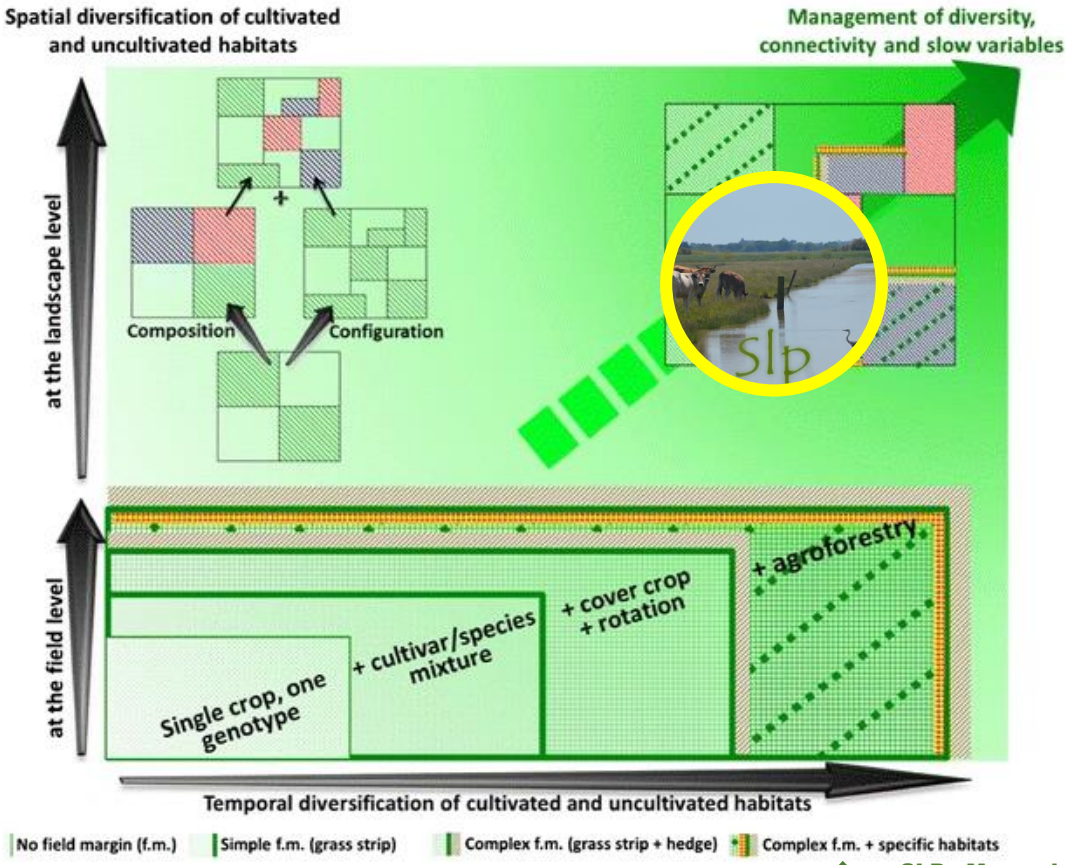
How to implement biodiversity-based agriculture to enhance ecosystem services: a review

Michel Duru[1,3] · Olivier Therond[1,3] · Guillaume Martin[1,3] · Roger Martin-Clouaire[2,3] · Marie-Angélina Magne[1,4] · Eric Justes[1,3] · Etienne-Pascal Journet[1,3,5] · Jean-Noël Aubertot[1,3] · Serge Savary[1,3] · Jacques-Eric Bergez[1,3] · Jean Pierre Sarthou[1,3]

FARM SCALE

PLOT SCALE

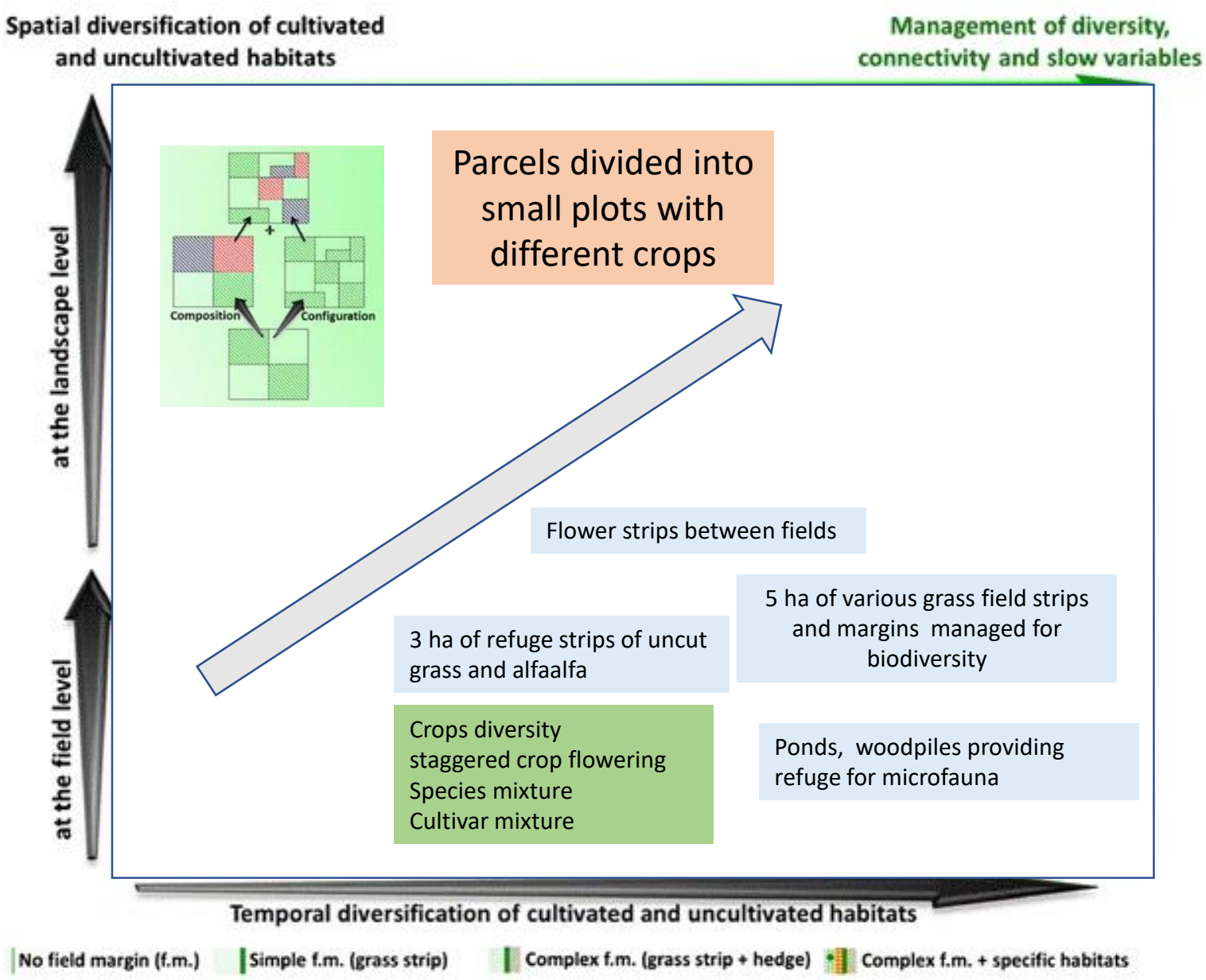
Creating a mosaic and heterogeneity of habitats across the farm



SLP : Mares, bandes refuges, hibernaculum, ITK BE spécifiques

A target-based approach for biodiversity management at plots scale

Towards a biodiversity-based farm



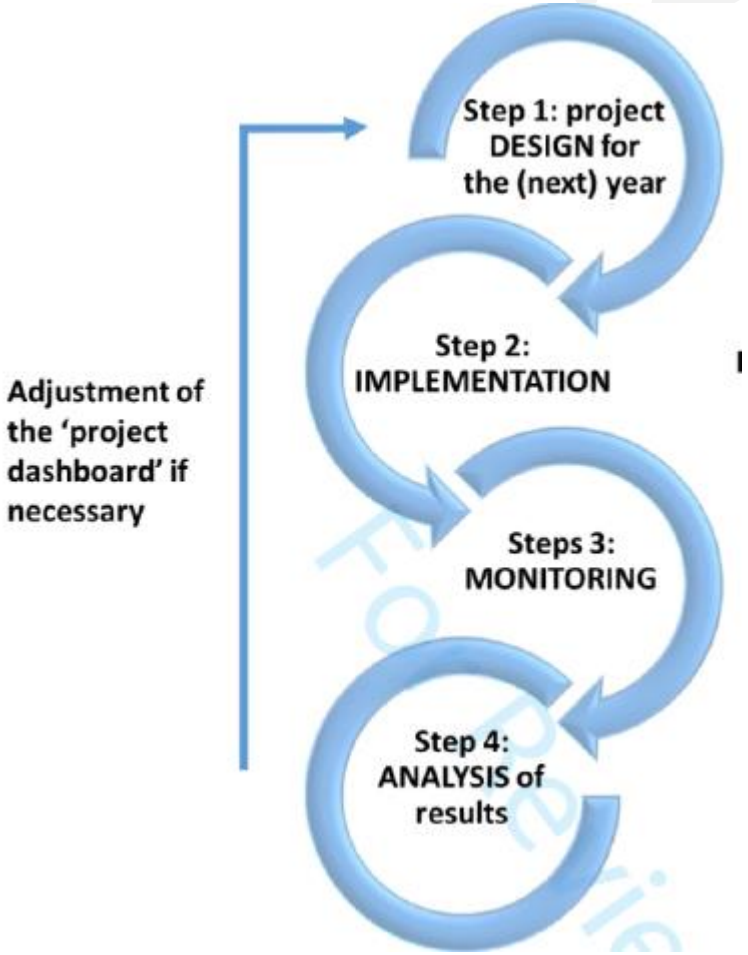
Towards a target-based approach for biodiversity management at plots scale

STEP 1 : the collective of the farm highlights of **target species** and the identification of their habitats and the agricultural practices favourable to these species
This phase is based on **the construction of dashboards**

STEP 2 : the implementation of the “roadmaps” of practices on the plots

STEP 3 : monitoring : observation and measurements

STEP 4 : The collective examines **each year** the results and explained the gaps between obtained and expected results and between realized and intended practices



11 target species

● species at various conservation stake ● species from several taxa (to cover the food chain) ● covering the various environments existing on the farm

‘Open’ marshland / bocage marshland

Crops / grasslands

Aquatic / terrestrial environments

Patrimonial and functional biodiversity (biological regulations)

‘Open’ wetlands: grasslands and crops

Lapwing
3 breeding pairs

Bocage marshland

Red-backed Shrike
4 breeding pairs

Ponds

Marbeled Newt
10 pairs

Crops

Parsley Frog

Reedbeds

Reed Warbler
4 breeding pairs

Ditches

Hairy dragonfly
2 breeding sites

Flowering areas

Bees : 50 species et 5 beehives

Grasslands and roadsides

Iris, Adder's-tongue Spearwort, orchids

‘Open’ Wetlands: crops and grasslands

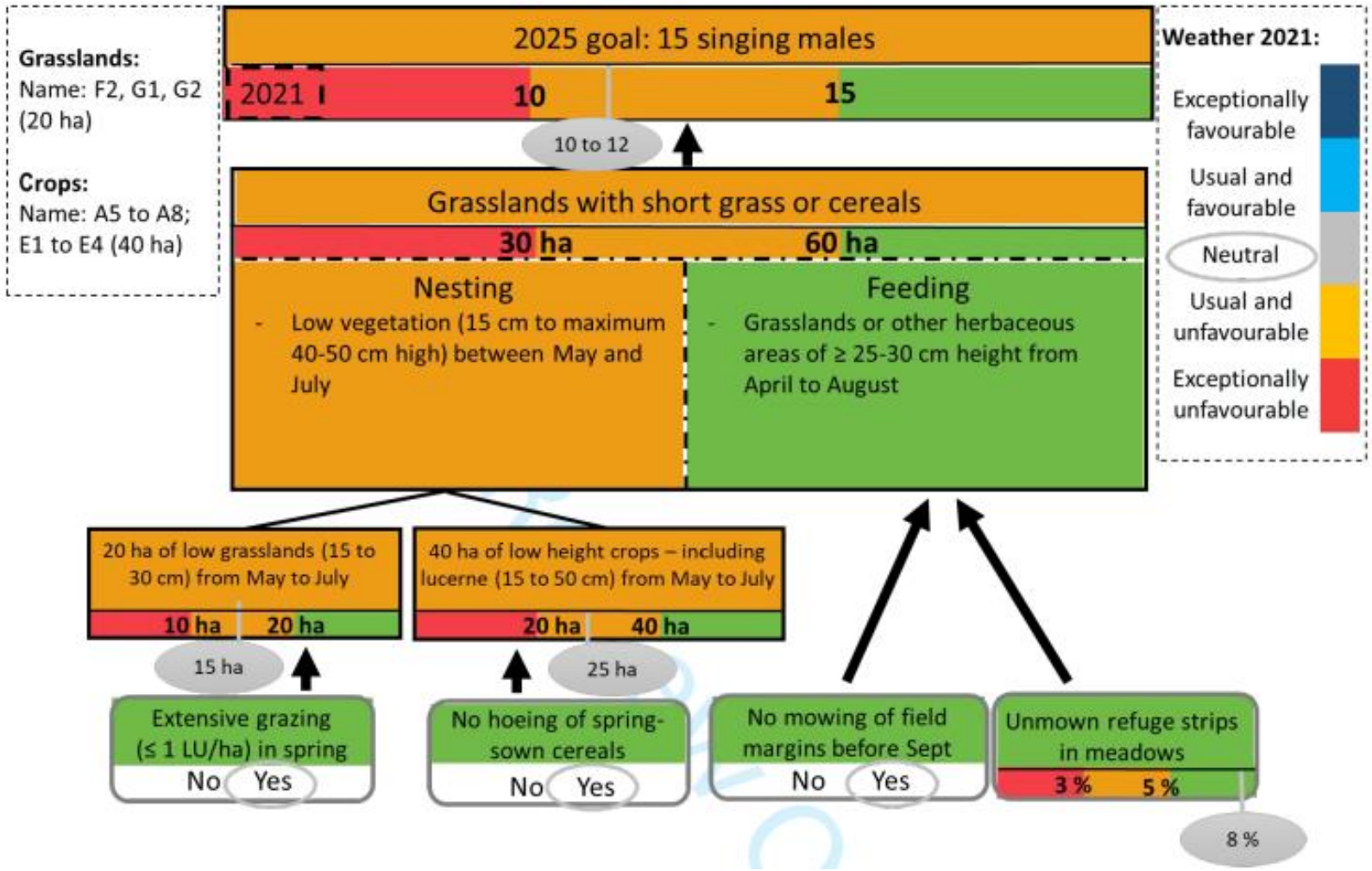
Skylark
5 breeding pairs

The example of the skylark dashboard

Goal: expected results for the species

Habitat needed and expected

Practices to create this habitat



The first feedbacks

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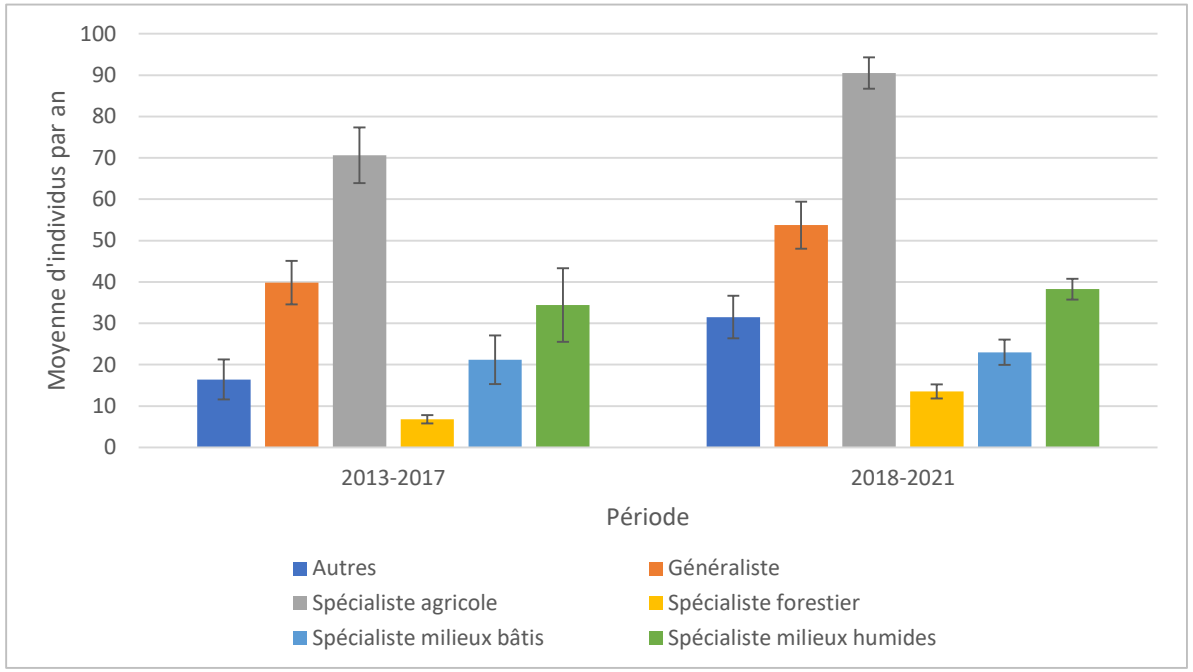
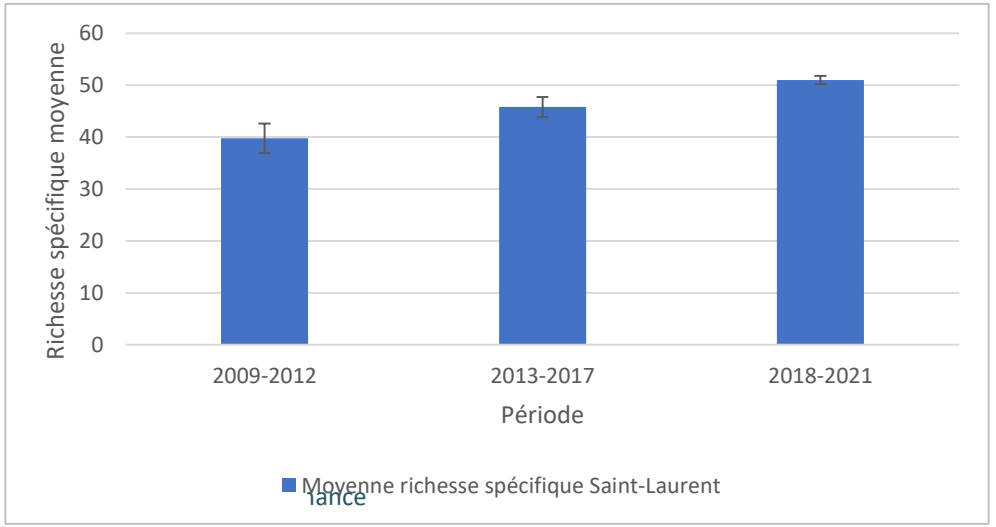
Birds example

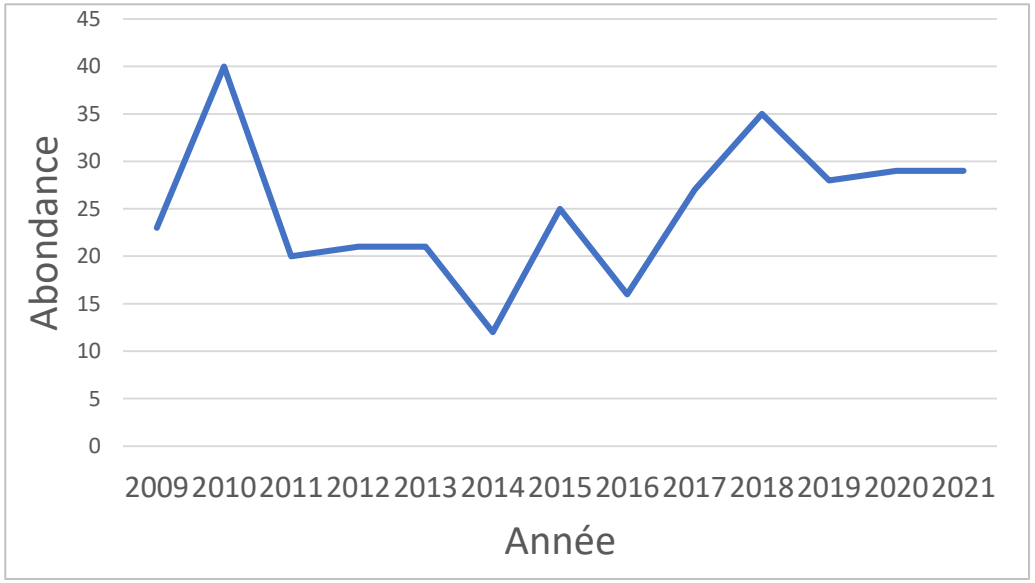




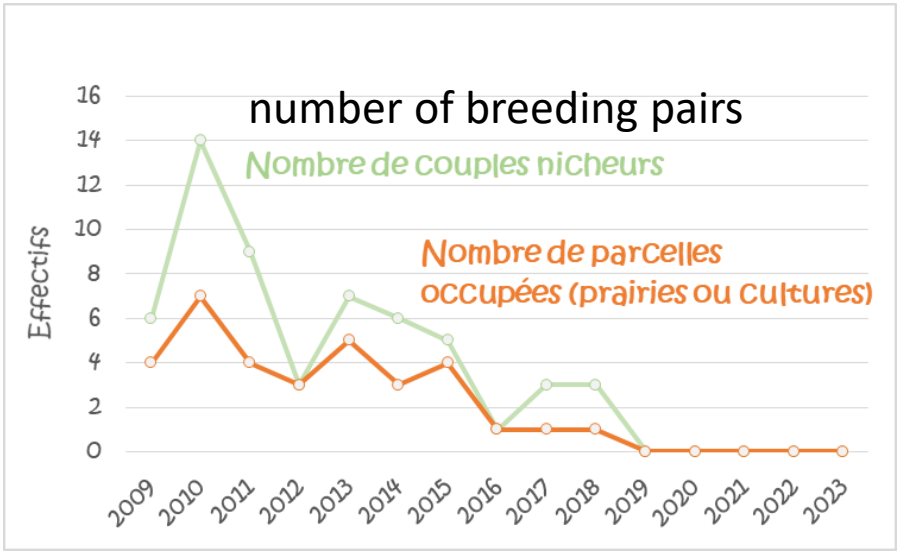
→ Increase in the abundance and number of bird species.

Birds example

Some species are doing well..



... and others not at all...



What are the mid-term results? 4 main types

① " A winning strategy "

Iris maritime

Orchidées

Alouette des champs

② " Habitat successful but abundance not achieved "

Pélodyte ponctué

Pie grièche écorcheur

Pollinisa-teurs

Vanneau huppé

③ " Failure to carry out planned actions "

Aechne printa-nière

Triton marbré

Renoncule à feuilles d'Ophioglo-sse

④ " Compliance with planned actions but unsatisfactory habitat "

Rousserolle effarvatte

To conclude

- ✓ We are also committed to an open innovation approach
- ✓ We produce a lot of knowledge transfer documents
- ✓ we are involved in a lot of participative projects with a wide range of non-academic partners

- ✓ we have a different posture as researchers from our colleagues: we're between doing and science
- ✓ it is often more difficult to publish the results of this type of approach than of analytical experiments

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