CIRFE
Cumul d'Infrastructures linéaires de transport terrestre et Relations Fonctionnelles Ecologiques
(12/2014 – 12/2017)

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Colloque • ITTECOP
Infrastructures de transports terrestres, écosystèmes et paysages

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MINISTÈRE DE LA TRANSITION ÉCOLOGIQUE ET SOLIDAIRE

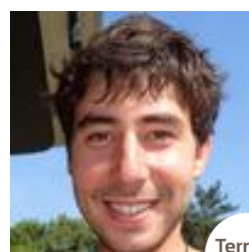ADEME — Agence de l'Environnement et de la Maîtrise de l'Energie

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Project's webpage: http://www.terroiko.fr/CIRFE.php
Grant : **MTES / CILδB / ANRt / FRB / ADEME**
Partnership: **SETE CNRS, SETEC INTERNATIONALE**

The CIRFE project

The CIRFE project, aims at determining whether different meta-population models are able to mimic the actual species meta-population dynamic (demography, dispersal and genetics).

In this respect, the project has been split in 3 work packages (WP):

CIRFE project's data flow
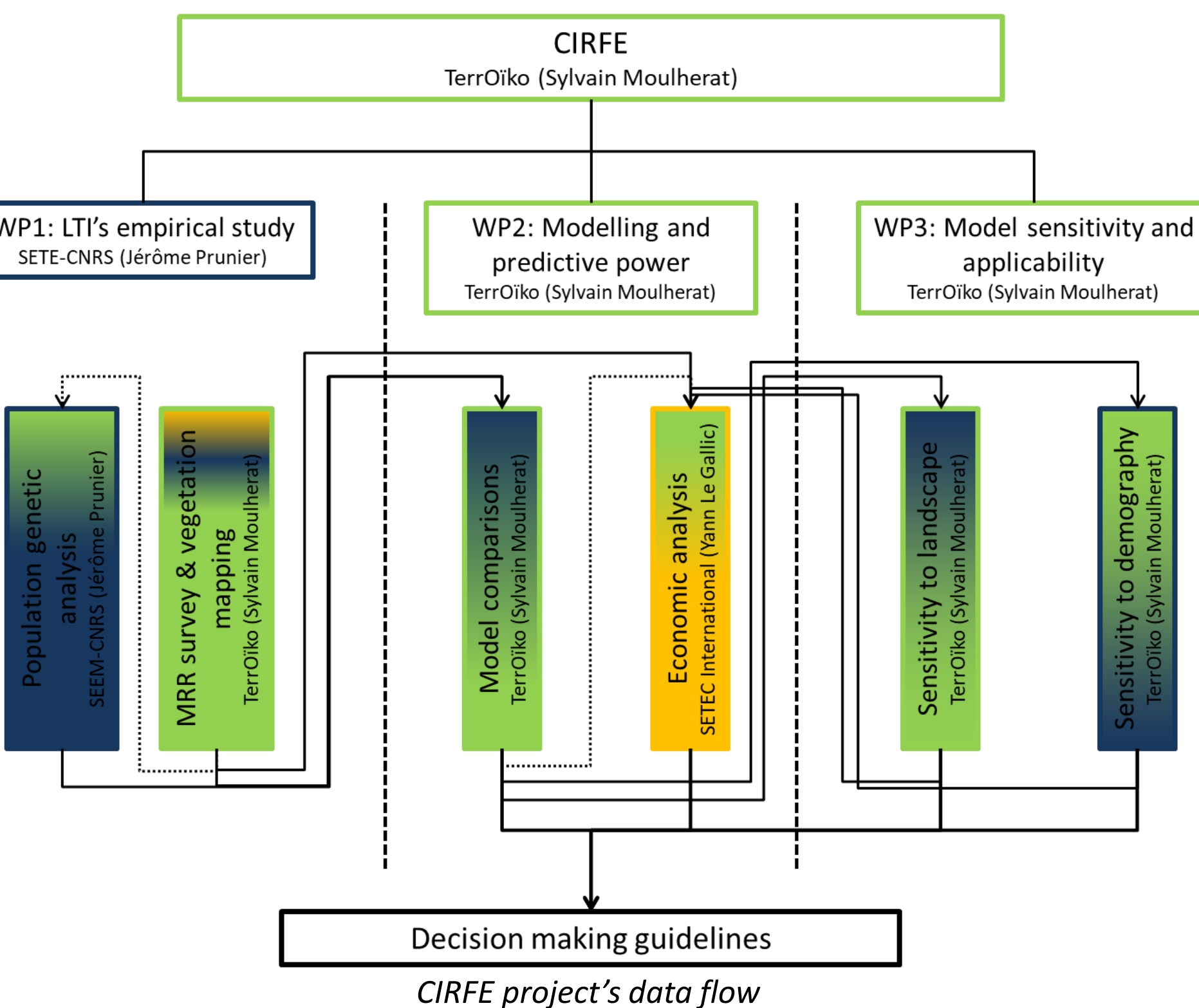
WP1 (field work) consisted in 1) mapping the study area at high spatial resolution and 2) building a robust data set concerning the meta-population functioning of *Maniola jurtina* (butterfly), *Abax parallelepipedus* (ground beetle), *Alytes obstetricans* (frog) and *Natrix natrix* (snake) within a landscape presenting a cumulative of large transportation infrastructures (LTI). For these species, landscape genetics and Mark Release Recapture (MRR) surveys, were performed to estimate population size, individual flow, population genetic clustering, etc.Thus, in addition to empirical evidence of the effects of LTIs on the surveyed species, the project benefits from an actual meta-population functioning *sensu* Calabrese & Fagan (2004) data set to be compared with model's outputs (WP2).

Meadow brown, *Maniola jurtina*

Grass snake, *Natrix natrix*

*Abax parallelepipedus*

Midwife toad, *Alytes obstetricans*

In the WP2 (modelling) we ran 7 models of meta-population functioning along a complexity gradient. The selected models are currently used to perform regulatory studies (EIA and/or SEA) in France. Model outputs were then compared with measured metrics of meta-population functioning coming from WP1 results.

Complexity gradient of the selected models adapted from Calabrese & Fagan (2004) classification
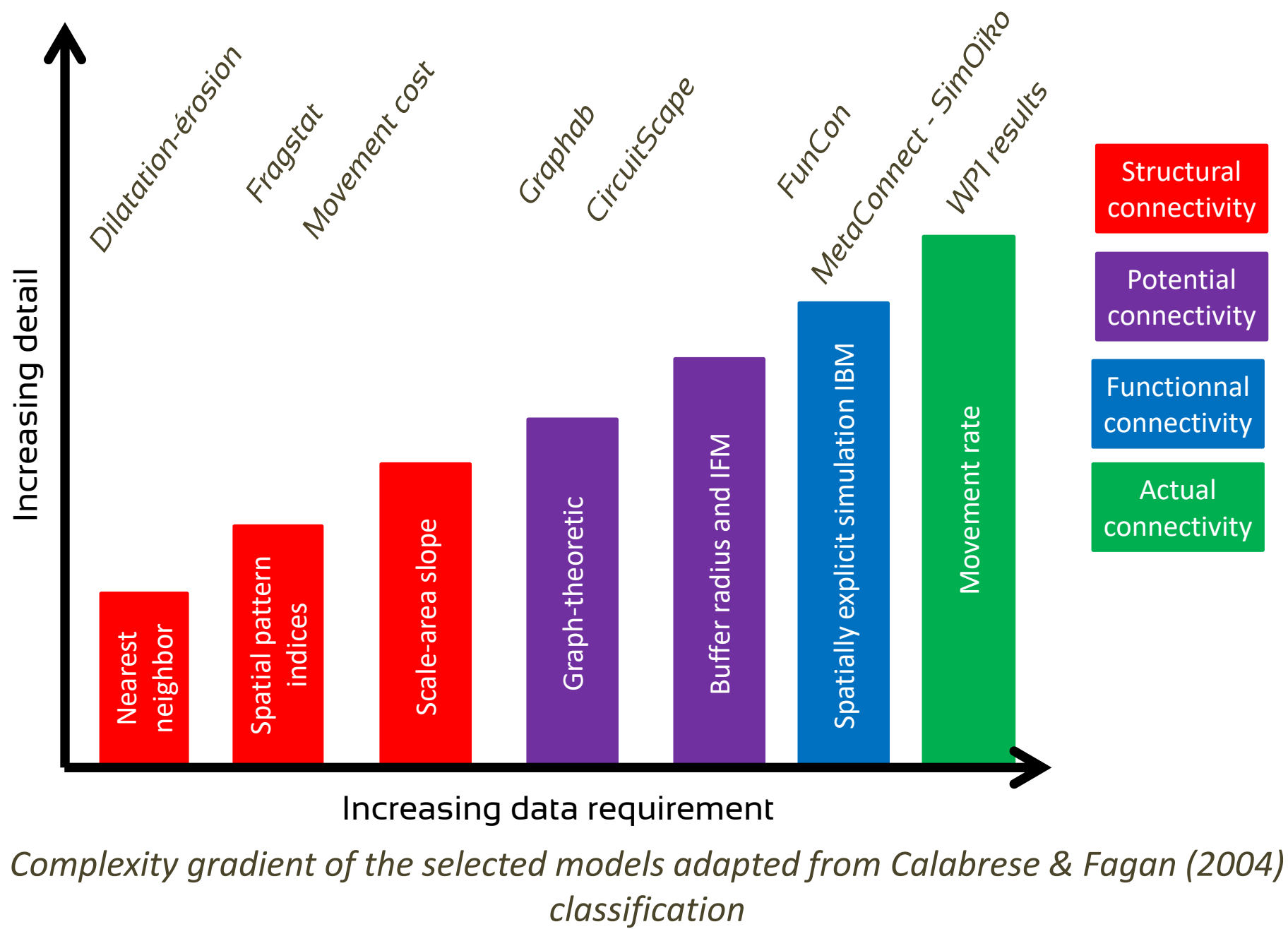
WP3 studied the sensitivity of the 6 models to input data quality in predicting actual meta-population functioning. We focused on parameters as the spatial resolution of input maps, land cover accuracy or pixel size.

As a project, transversal analysis, we aimed at determining the best compromise between a project phase development objectives, the required realism to fulfill these objectives and the cost of running the most adapted model.
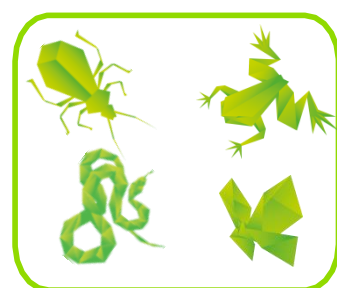
Main contributions of the CIRFE project

Large Transportation Infrastructure's empirical study.

Comparison between population-based and individual-based population genetic analysis methods: For the first time, a direct comparison between both the methods on 2 species (*Maniola jurtina* and *Abax parallelepipedus*) has been implemented within the same landscape.

LTI's effects on species meta-population functioning: The CIRFE project shew that most LTIs (in a single or cumulative context) have limited effects on the focal species' meta-population functioning. However, individual movements may change depending on the species landscape interaction.

Estimating LTI's effect on animal movements: Within the CIRFE project, we developed a simple field work method to easily estimate the effect of existing LTIs on animal movements.

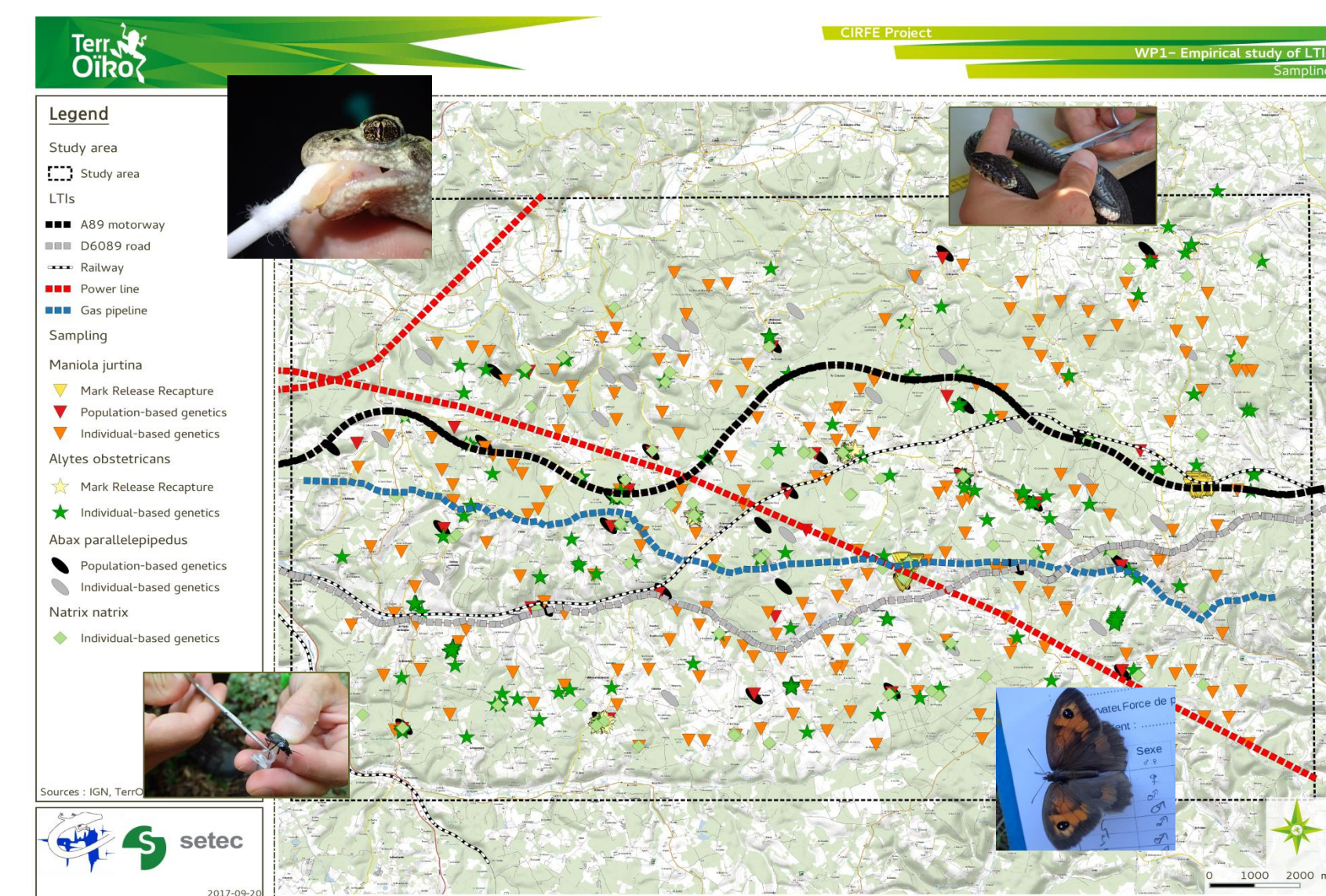### Modelling meta-population functioning.
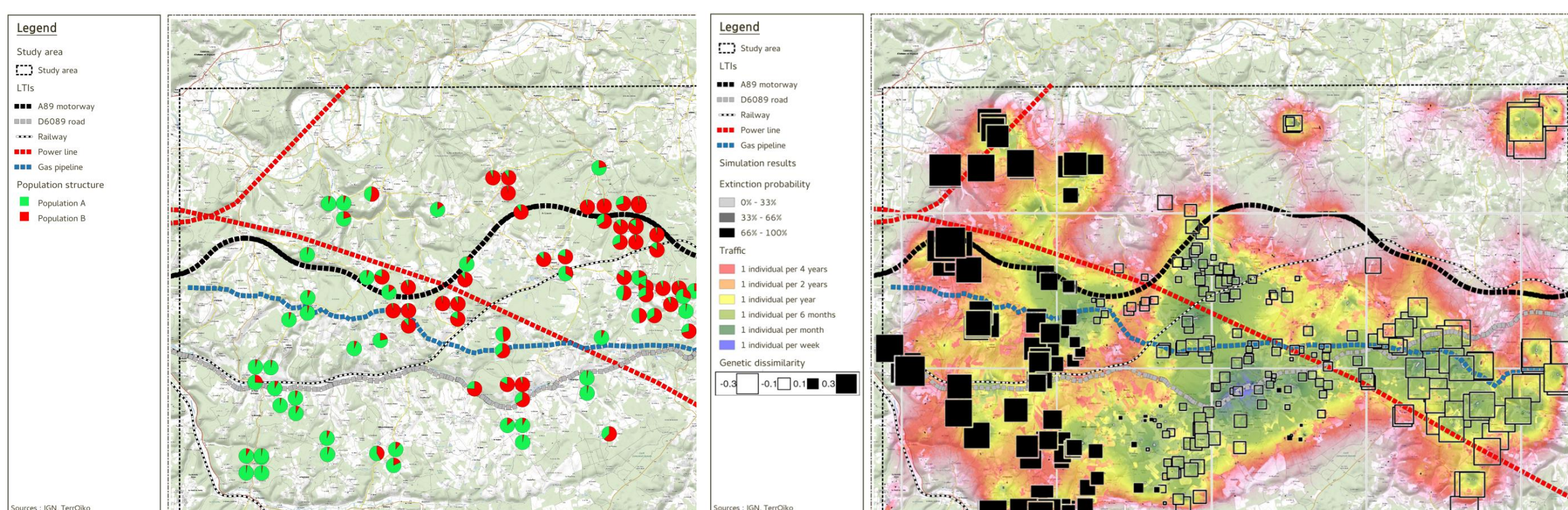
Meta-population functioning simulation of Alytes obstetricans *(right map) leads to population genetic structure congruent with the actual population genetic structure (left map)*

Models' ecological relevancy: In line with the work of Calabrese & Fagan (2004), most of the studied models produce metrics of limited biological meaning and non recordable on the field.

Models and realism: Only the most complex models studied in the CIRFE project are able to predict the actual/future meta-population functioning.

Models' sensitivity to input data: The large majority of the models studied in the CIRFE project are sensitive to input data. The more realistic the model, the more sensitive to input data quality especially concerning the spatial resolution of vegetation mapping.

Current Environmental Impact Assessment (EIA) practices and modelling

Under exploitation of modelling opportunities: Most of the studies provided by CILδB members shew that models are sometimes used to assess the conservation state of animal population or ecological network functioning. However, previous research identified the complementary between modelling and traditional field studies. In addition, when used, very low performances (non realistic) models are run.
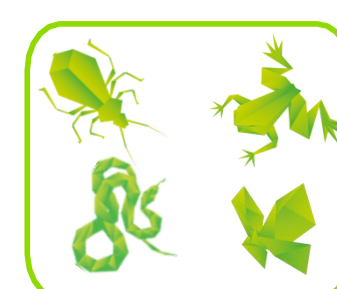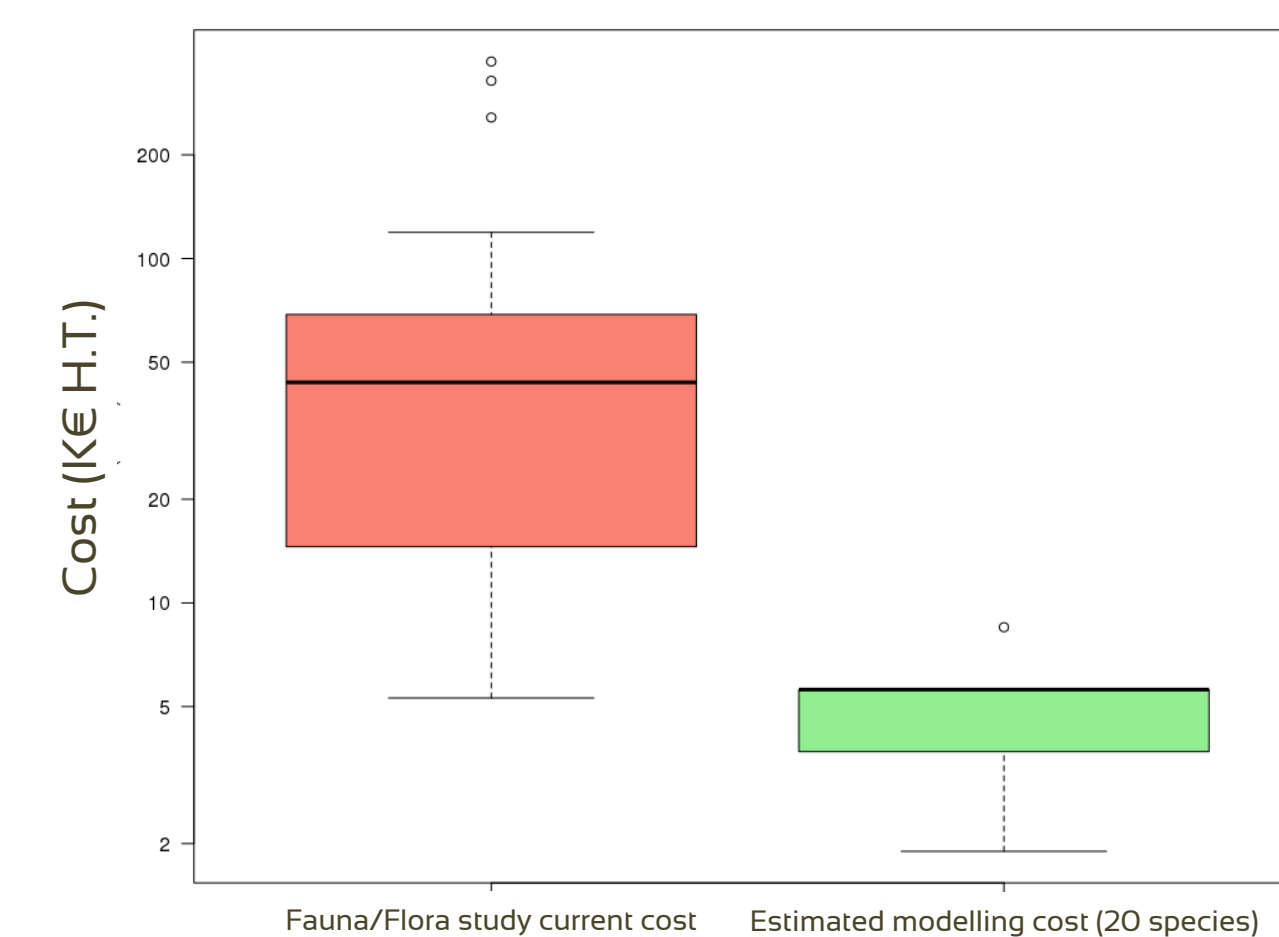
Evolution of EIA practices with regulatory context: The empirical study of French EIA performed in the CIRFE project, pointed out that EIA have changed over time and with regulation evolution. Nowadays, practices tend to homogenize regardless on the project phase.

Recommendations for action

Training and education.

Modelling tools allowed for providing relevant information facing the current regulatory requirement. The CIRFE project has shown that some models are now able to mimic species' meta-population functioning and thus establish a realistic and objective evaluation of species conservation state and movements. However, EIA/SEA stakeholders must be informed of models' data requirement, capabilities and limitations.

Co-evolution of technologies and practices.

Current methods of population genetics and modelling could be used in combination with traditional practices to improve EIA/SEA comprehensiveness of species current actual meta-population functioning (population genetics) and expected changes (modelling) with project development/upgrade.
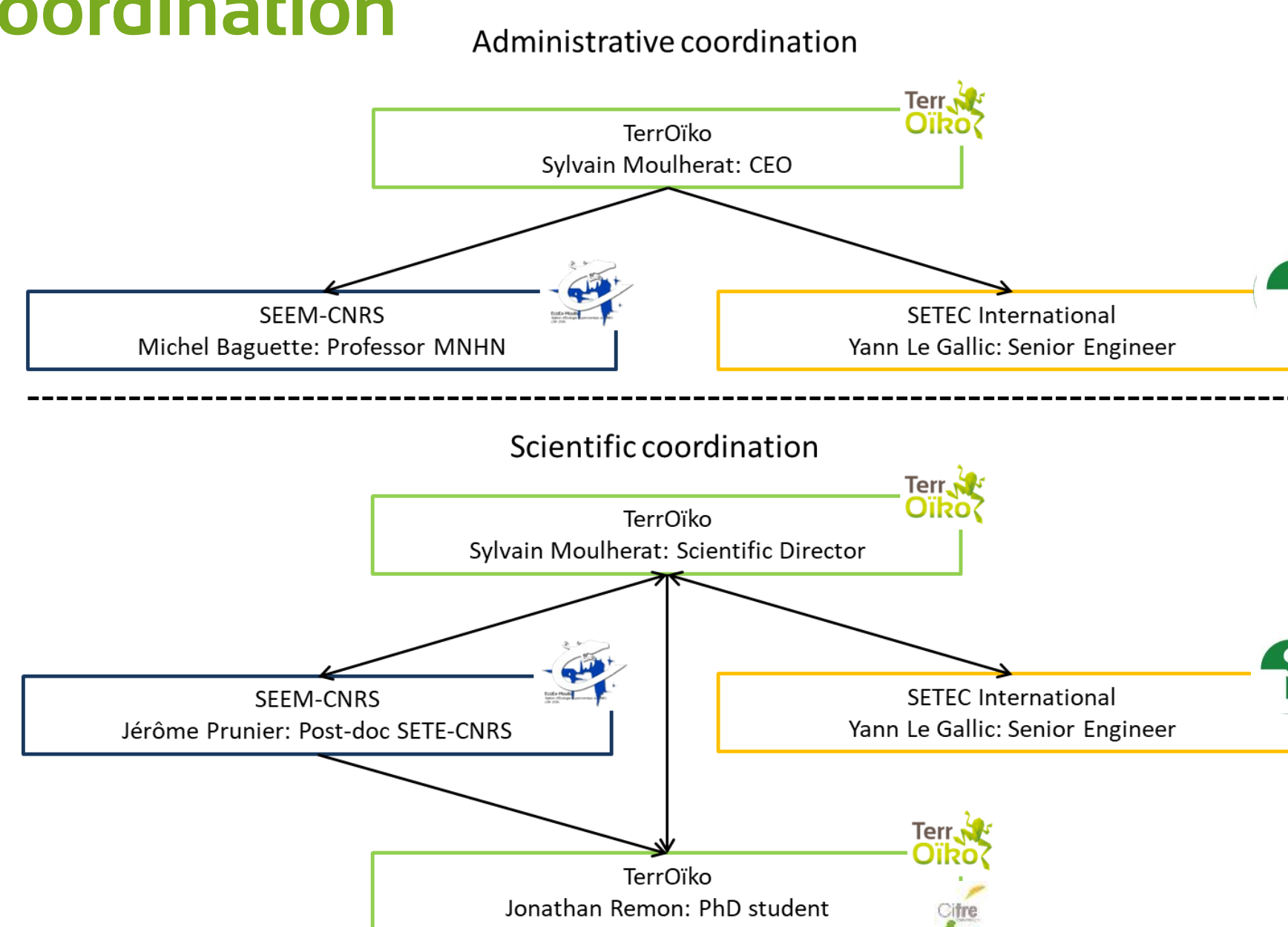
Research and technology transfer.

The CIRFE project shew that some research technologies are now sufficiently developed and widespread to enhance EIA/SEA contents (population genetics and modelling). However, technology transfer should be sustained to make these technics easily and commonly used in an operational context.

Going further with the CIRFE results.

The CIRFE project focused on 4 species. Further similar work using birds, mammals or fishes as model species would greatly improve the scope of the CIRFE project results.
Despite the exploratory aspect of the CIRFE project's economic analysis, EIA content evolution has been detected and many tendencies of stakeholders' behaviour highlighted. Based on these results, further study in collaboration with sociologists, lawyers and economists should result in regulation adaptation proposals.

Example of expected practice evolution

Coordination

Administrative coordination

TerrOïko — Sylvain Moulherat: CEO

SEEM-CNRS — Michel Baguette: Professor MNHN

SETEC International — Yann Le Gallic: Senior Engineer

Scientific coordination

TerrOïko — Sylvain Moulherat: Scientific Director

SEEM-CNRS — Jérôme Prunier: Post-doc SETE-CNRS

SETEC International — Yann Le Gallic: Senior Engineer

TerrOïko — Jonathan Remon: PhD student

Dissemination

Thesis: Jonathan Remon's defense planned for December 2017
Scientific papers: 1 submitted, 6 in preparation (landscape ecology, molecular ecology, herpetology, modelling, monitoring, …)
Communications / poster: 5 in international events, 5 additional in national events. A CIRFE project dedicated seminar planned for early summer 2018
Popularization: 1 technical publication (*Espace Naturel* review), 1 general public seminar
Education/Training: Result integration and specific trainings added to the TerrOïko's trainings catalog.
Other research projects collaborations: 5 national projects