



Les programmes de recherche en écologie : implication pour la décision publique

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Module « Pluralité des sciences et interdisciplinarité.
Enjeux pour la recherche et la décision publique « Mai 2010 »



Qu'est-ce que l'écologie ?

Les relations entre les êtres vivants et leur environnement



Les questions de la décision publique : la gestion des différentes formes de biodiversité

Protéger les espèces et les habitats

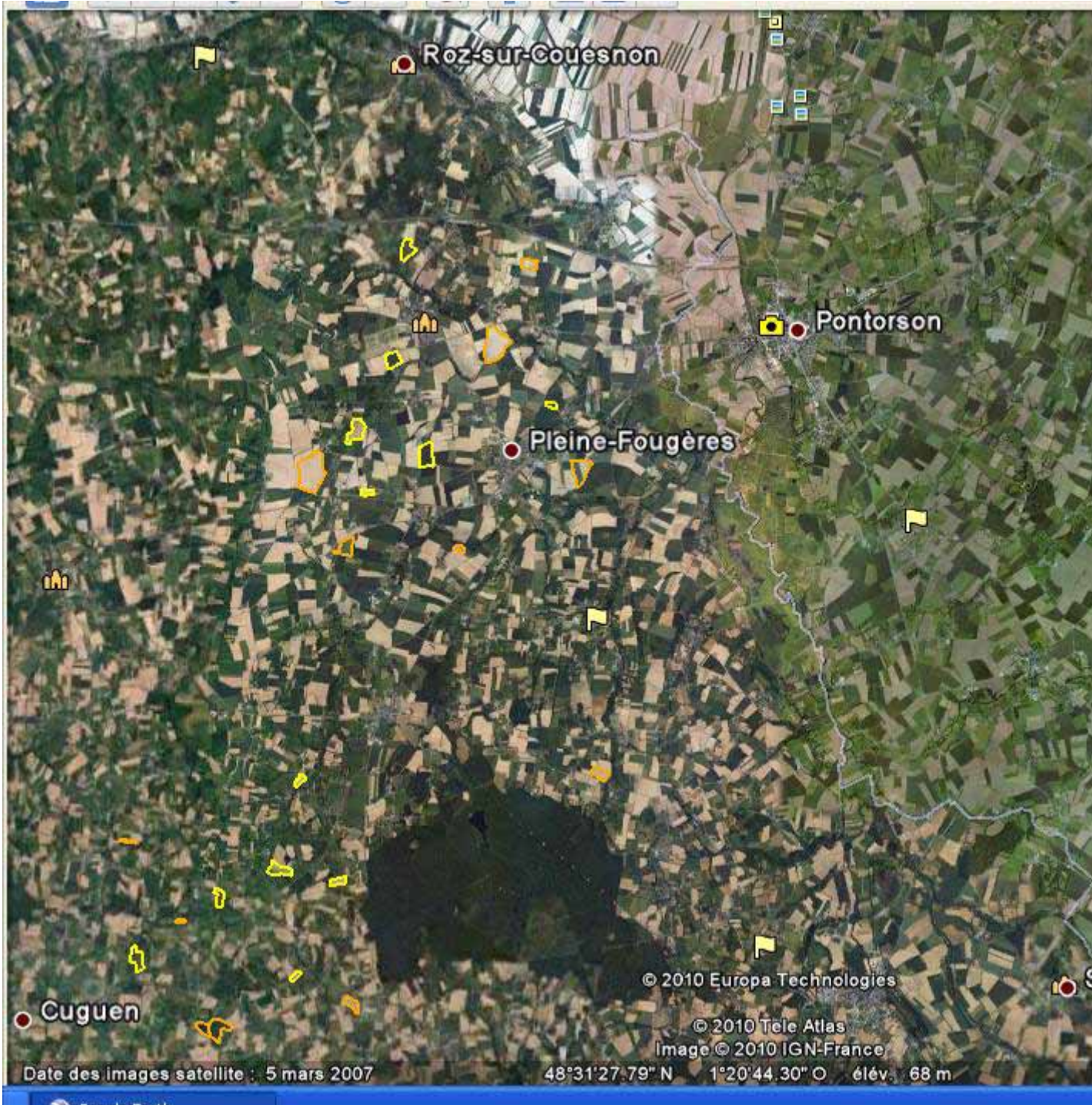
Maintenir les services écosystémiques

Ecology: The discipline of biology that concentrates on

- the relationships between organisms and their environments:
- The patterns of distribution
- The patterns of abundance
- The factors that determine the range of environments that organisms occupy and that determine how abundant organisms are within those ranges
- The functional interactions between co-occurring organisms.

Ecology is both a synthetic and an integrative science since it often draws upon information and concepts in other sciences, ranging from life sciences to social sciences, to explain the complex organization of nature.

adapted from the american heritage dictionaries (2005)



Roz-sur-Couesnon

Pontorson

Pleine-Fougères

Cuguen

© 2010 Europa Technologies

© 2010 Tele Atlas
Image © 2010 IGN-France

Date des images satellite : 5 mars 2007

48°31'27.79" N 1°20'44.30" O élév. 68 m



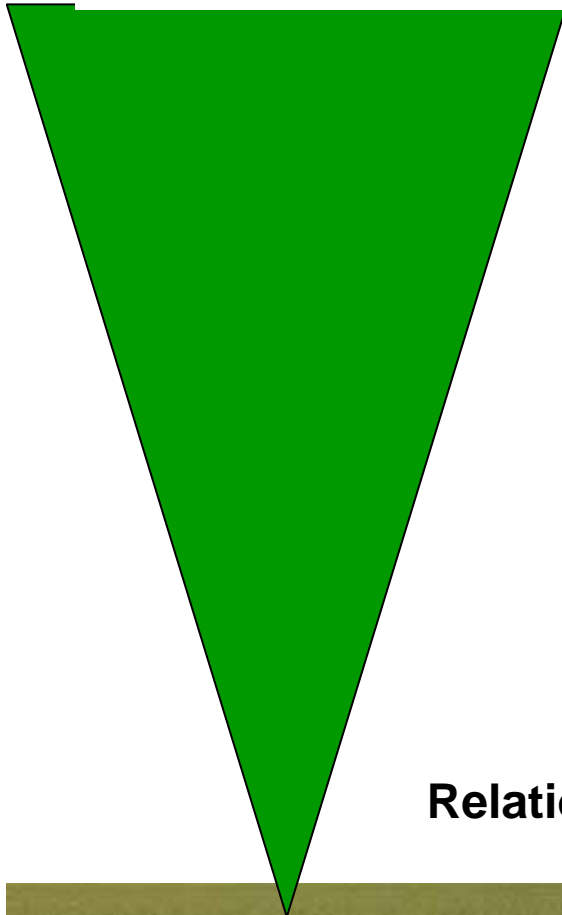
Un point de vue longtemps dominant

Équilibres naturels

Activités humaines = perturbations

Niagara escarpment, Manitoulin Island, Ontario, Canada, 2004

Un changement de point de vue



Inclus dans un paysage



Relations avec le champ voisin



Bois

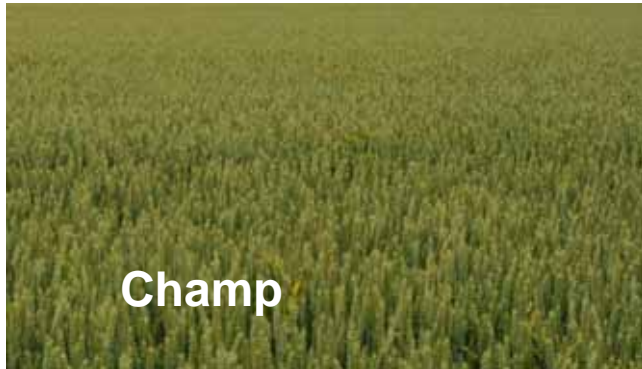


Champ



Prairie

Programme de recherche 1: les systèmes écologiques sont clos, a-spatiaux et a-historiques



Champ



«Système autonome»



Prairie



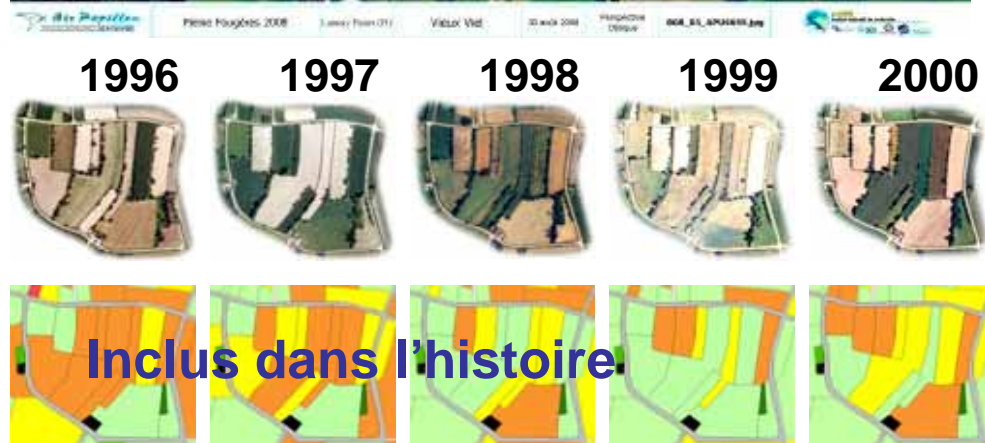
Bois

Programme de recherche 2: les systèmes écologiques sont contingents et ont des dimensions spatiales et historiques

Systeme contingent



Relations avec le champ voisin



Main concepts related to these programmes (core)

Systeme autonome

Homogeneity, equilibrium

plots or fields



Systeme contingent

heterogeneity, complexity, history

landscape



4 m²

Systeme autonome

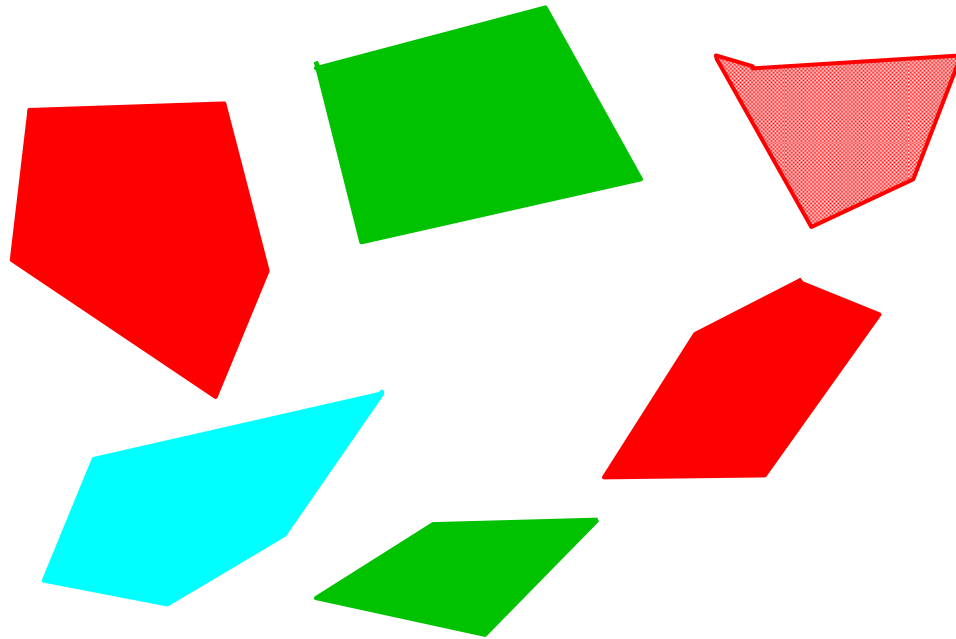
the classic paradigm in ecology is the assumption that ecosystems follow a linear path of development toward a particular, biologically diverse, and stable “climax” state (Fiedler et al. 1997). Disturbance (fire, insects, disease) is considered to be a rare, external event, rather than an intrinsic property of the community and is, therefore, something managers should eliminate (Hobbs and Huenneke 1992). Because it is assumed that nature is governed by mechanistic natural laws that people can know (Langston 1998), the endpoint of ecosystem development is both inherently predictable, and the assumed goal of management

Wallington, Hobbs, and Moore, 2005 Ecology and Society

Systeme contingent

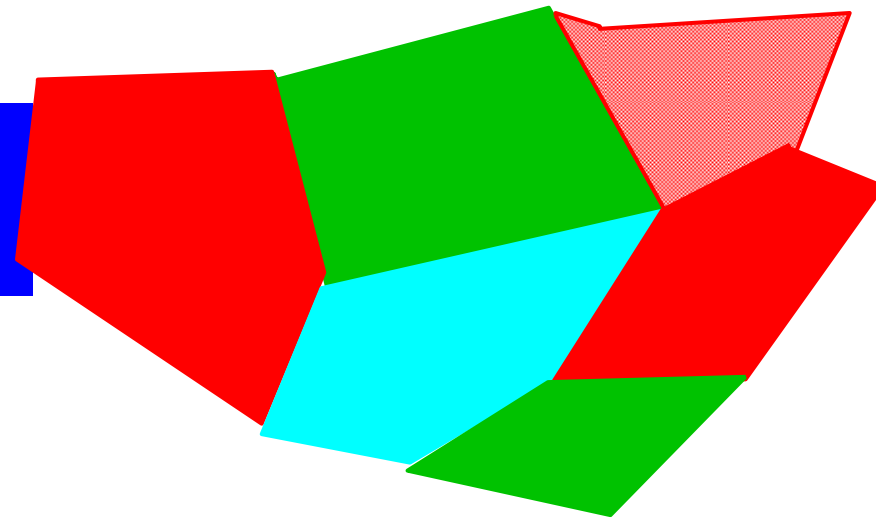
emphasis is directed to the dynamic, complex, nonequilibrium nature of ecological systems (Pickett et al. 1992). According to this view, successional processes are much less deterministic. The view is of a much more open system that exists in a constant state of flux, usually without long-term stability

Éléments isolés du paysage



L'écologie du paysage, c'est le passage de compréhension du fonctionnement d'éléments supposés homogènes à l'analyse de mosaïques spatialement explicite donc hétérogènes.

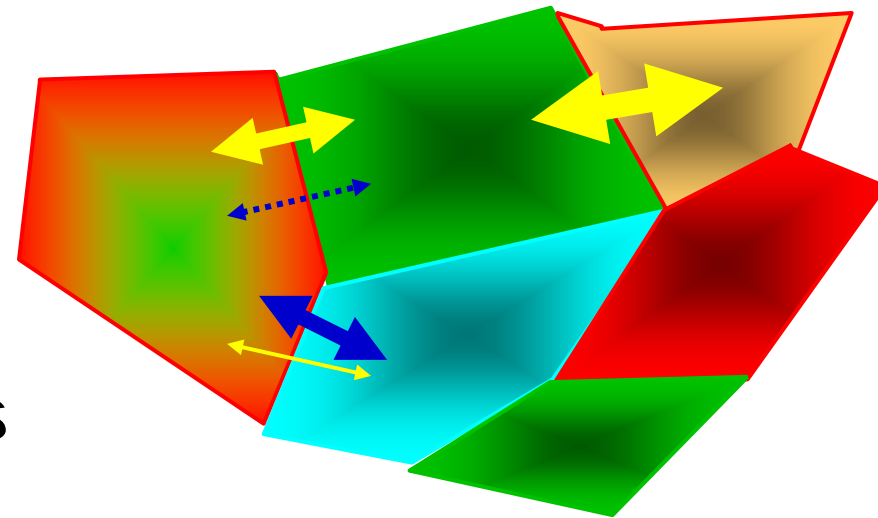
Mosaïque
paysagère



Principe d'hétérogénéité

Principe d'hétérogénéité

L'hétérogénéité implique des interactions, des flux, des **connexions**.
Ceci conduit à prendre en compte l'hétérogénéité interne due aux interactions.

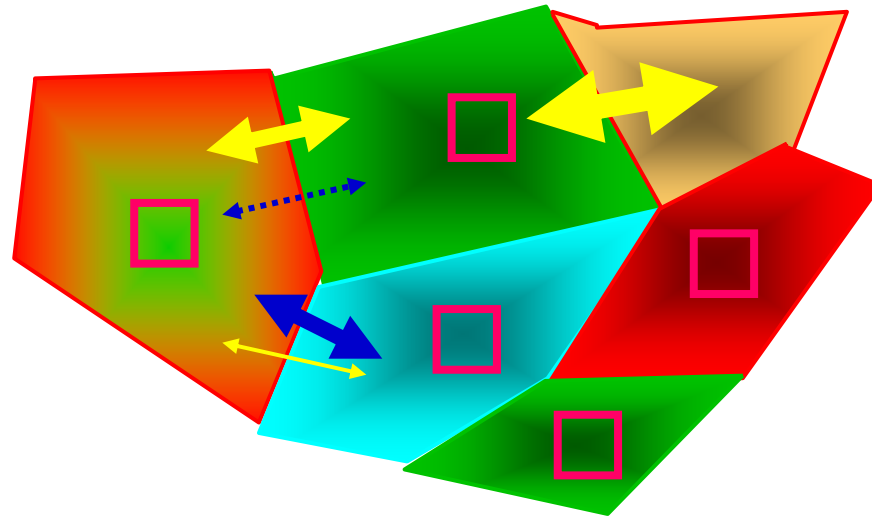


+ interactions

Principe de connectivité

Systeme autonome

Reconnaissance des « effets lisières » : il faut échantillonner loin de ces effets



Système contingent : un point de vue très dominant chez les chercheurs

A fundamental tenet of science is that results must be reproducible by other scientists before they are accepted as factual. However, **because ecological phenomena are context dependent, and because that context changes through time and space**, it is virtually impossible to reproduce precisely or quantitatively any single experimental or observational field study in ecology.

Aaron M. Ellison

Repeatability and transparency in ecological research

Ecology (in press)

Ecological studied systems

Systeme autonome

Biological organisms:
plants, animals, microorganisms
Individuals, populations, communities

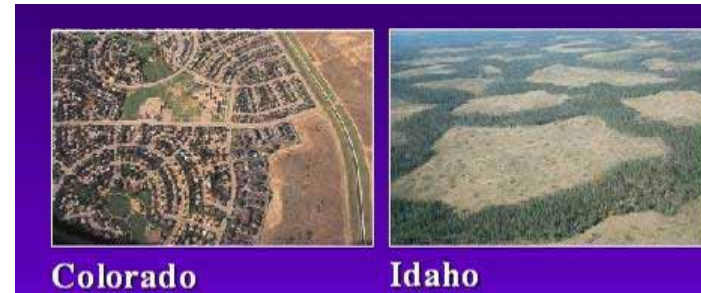


Ecological interactions
Prey/predator; parasitism; ...

Ecological services/processes
Productivity
Pollination
Decomposition
....

Systeme contingent

Ecological systems have an explicit spatial dimension



There is an infinity of systems as studied scale varies



0.0004 km²

1 km²

10 km²

Main concepts related to these programmes (core)

Systeme autonome

stability,
determinism,
equilibrium with an « optimal value »

Climax

a biological community of plants and animals which has reached a steady state. This equilibrium occurs because the climax community is composed of species best adapted to average conditions in that area.

The idea of a single **climatic climax**, which is defined in relation to regional climate.



Primitive, climax forest in Slovenia

Systeme contingent

dynamic, trade-off, non linearity, thresholds;
discontinuities permit to identify hierarchical levels;
no « optimal value », importance of the context.



In Yellowstone National Park USA, spatial and temporal discontinuities depend on different disturbances operating at their own scales

Two main research programmes

Système autonome

Studied ecological systems are autonomous, closed; all theories and results can be drawn from them.

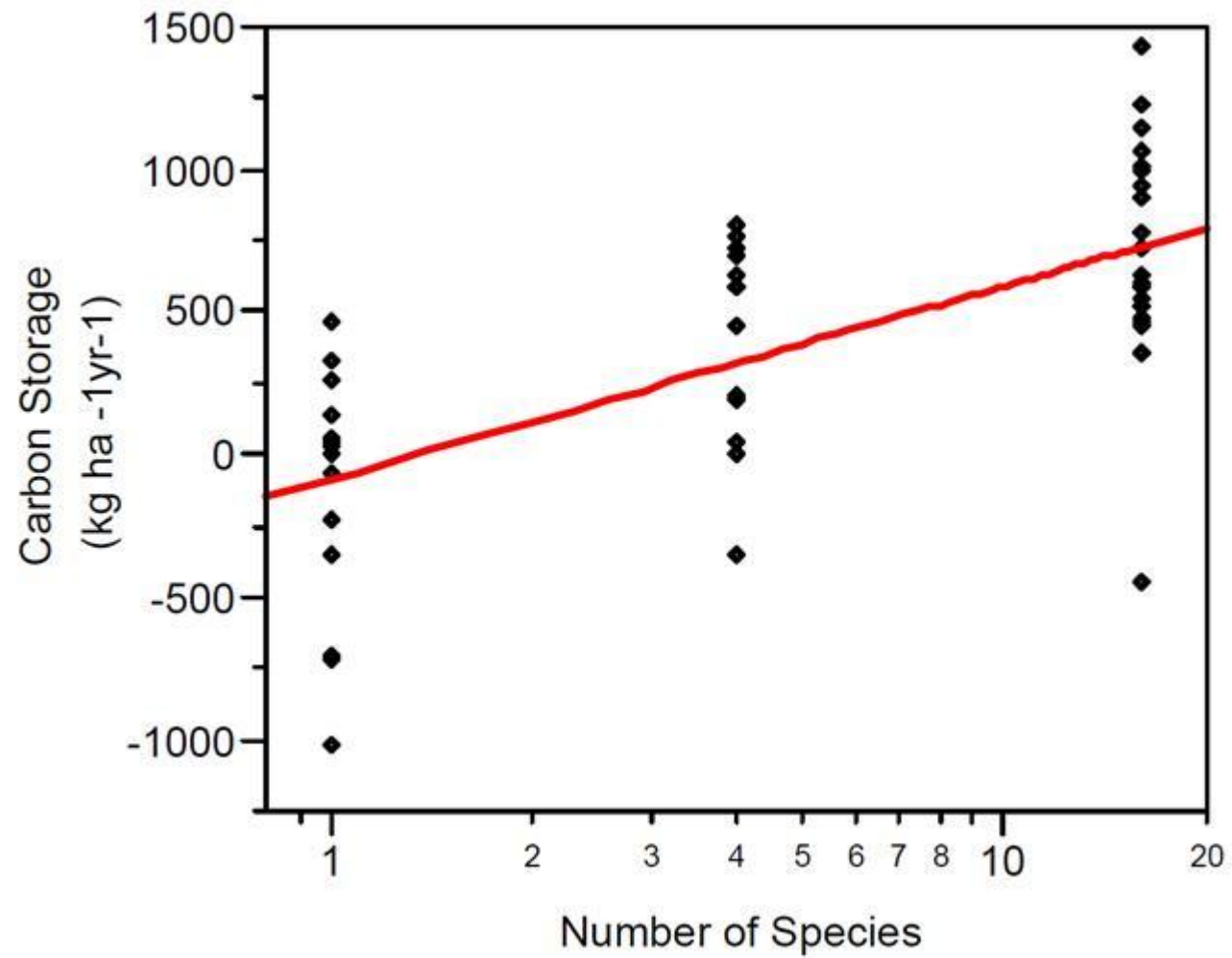


Biodiversity experiment, a greater number of plant species leads to greater community productivity. In the experiment shown, 245 plots, each 9 m x 9 m, were assigned randomly to have from 1 to 16 prairie plant species, with the species composition of each plot being separately chosen at random. Species composition and plant diversity were both strong determinants of ecosystem functioning.

Experiment 120 Cedar Creek, Minnesota

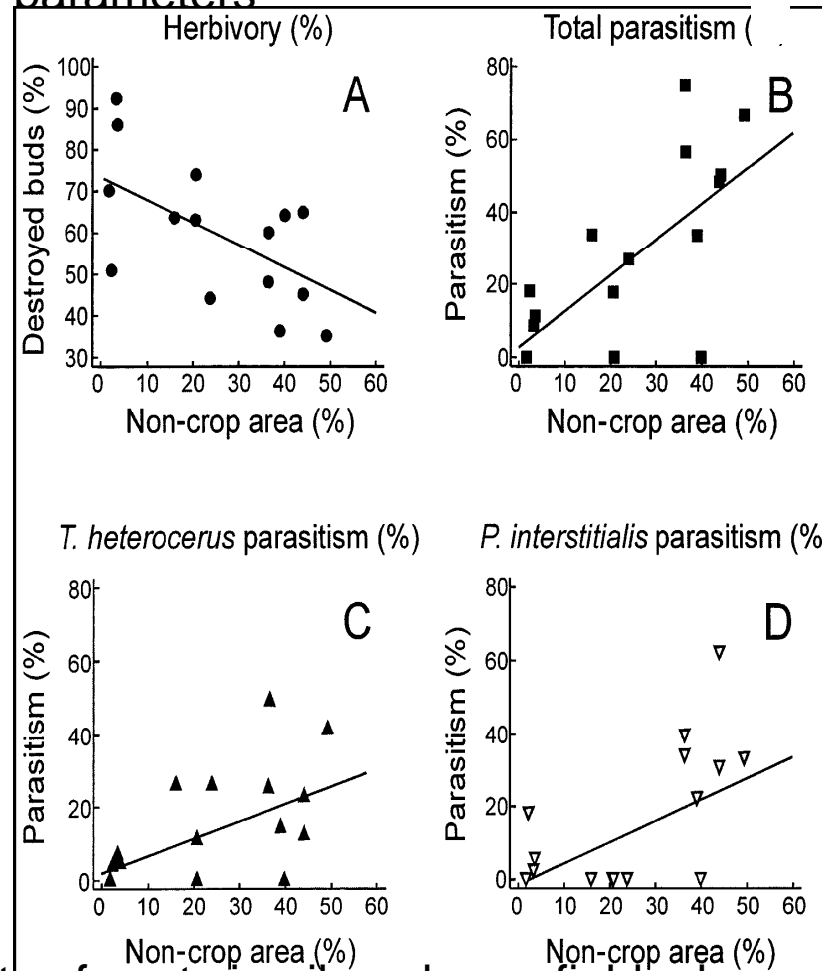


Systeme autonome



2- **Système contingent**

Studied ecological systems are embedded within a context that influences processes, systems are connected and depend on external parameters



Tersilochus heteroceris



Phradis interstitialis



Meligethes aeneus



Oilseed rape

Impacts of pests in oilseed rape fields depend on the presence on non crop areas in the surrounding landscape

ad hoc hypotheses

Spatial and temporal scales

Système autonome

Small spatio-temporal scales
plots, fields
days, season



Forest species

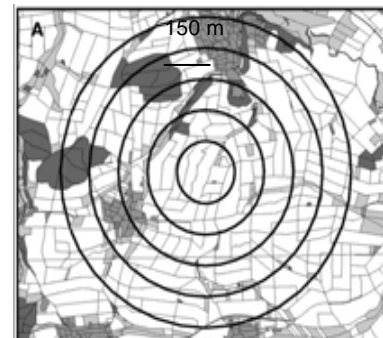


Cropland species

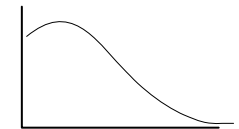
this system is not-scale
dependant

Système contingent

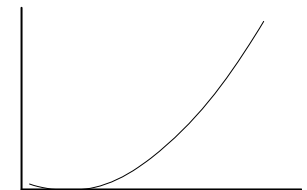
A large range of scales, from severals fields
to a region in space, includes long term
monitoring (decades) in time and long term
processes (regional or landscape dispersion)



Chaetocarabus intricatus



Trechus quadristriatus



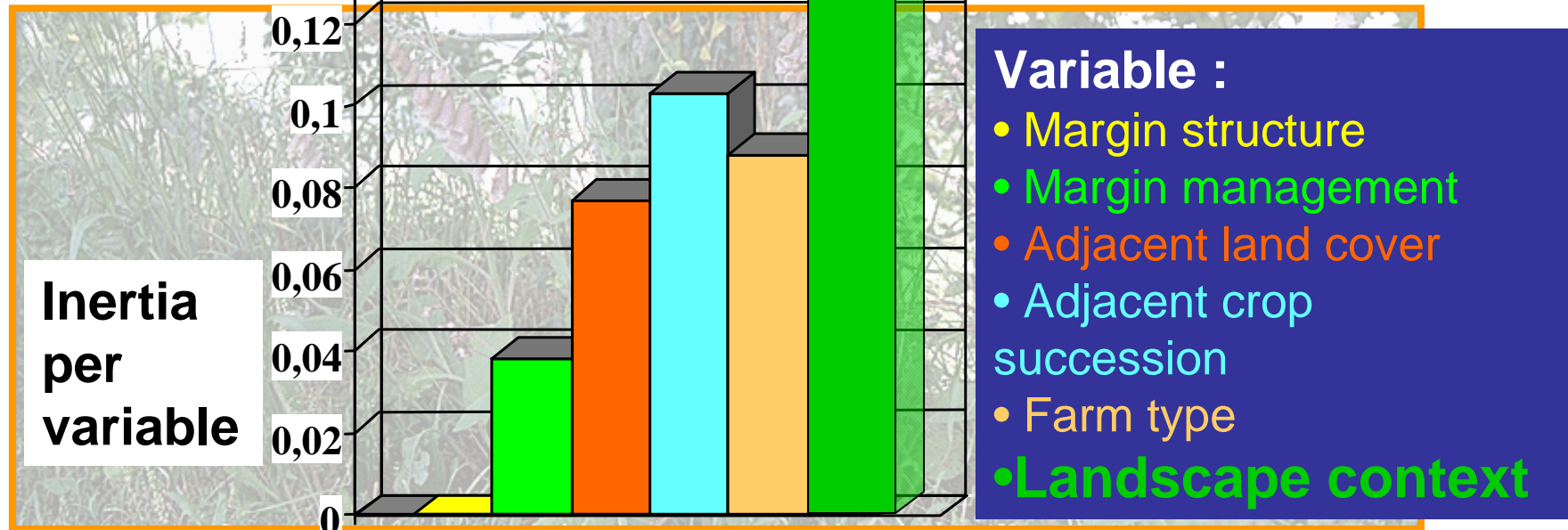
this system does not consider density
of organisms localement

Plant species composition: Brittany

Systeme contingent

A multiple scale approach

Presence of species in field margins depend upon factors from field boundary to farming system and landscape



Abax p.

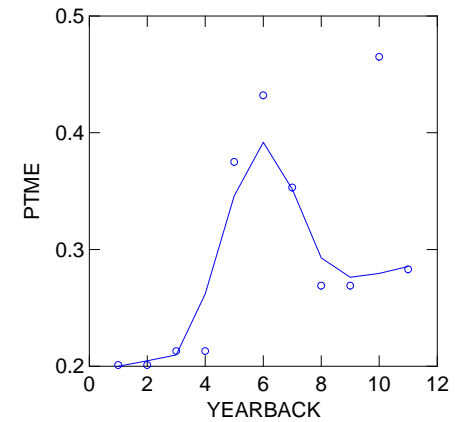
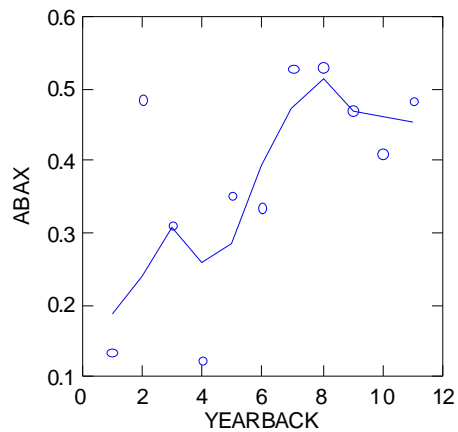


Système contingent

P. melanarius



Variance expliquée par les pratiques dans les haies



Temps (années) pris en compte

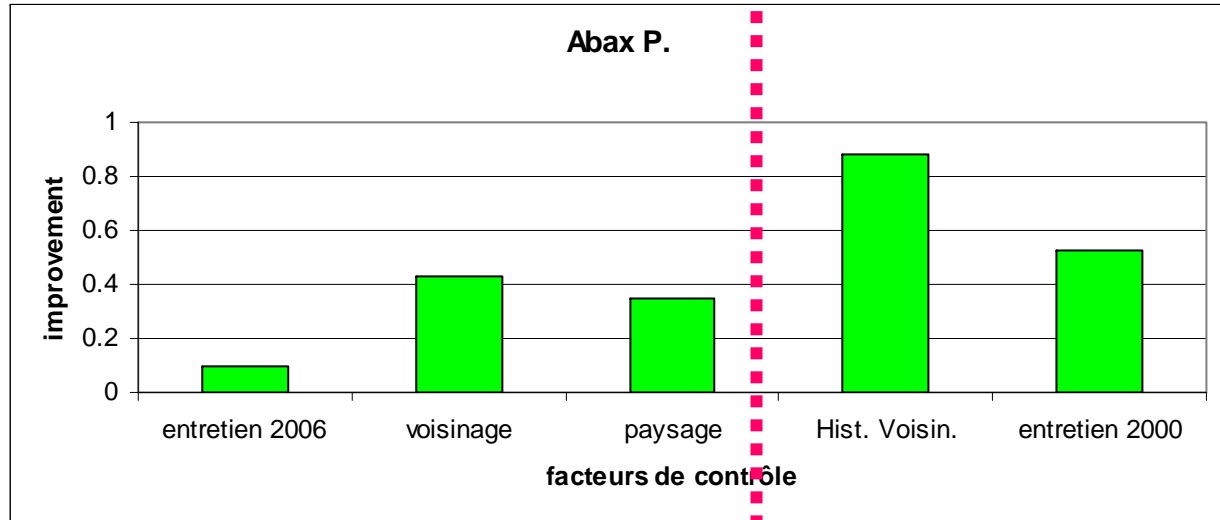
L'abondance des espèces dépend de l'histoire des pratiques

contingence

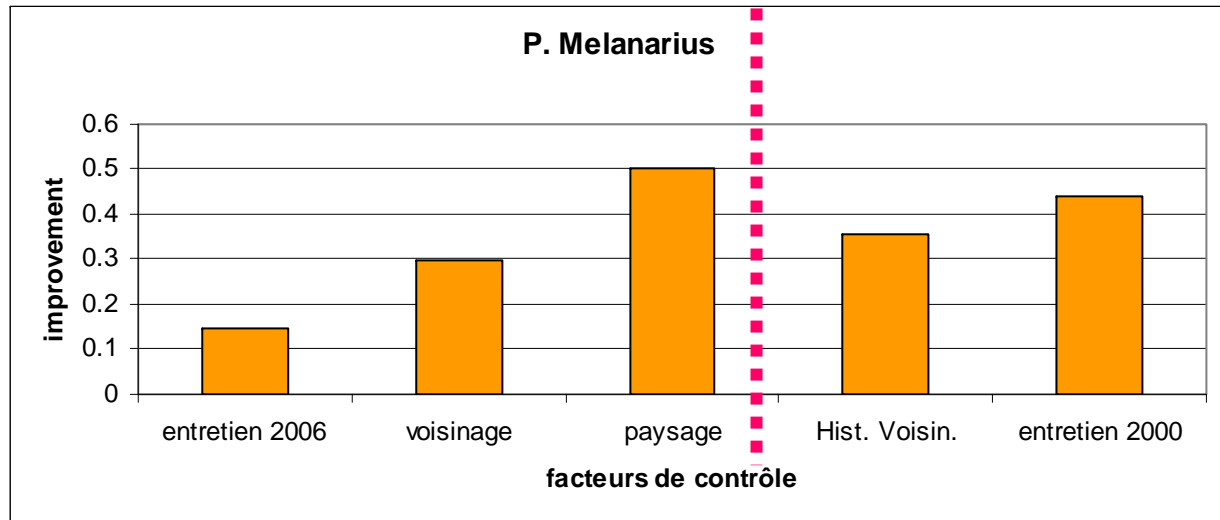
Espace

Temps

Abax p.



P. melanarius



ad hoc hypotheses

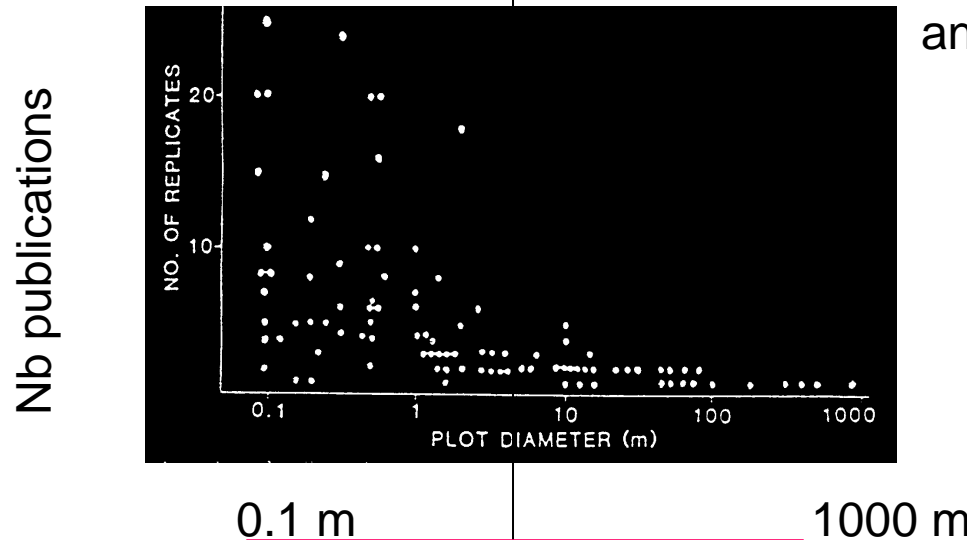
methods

Système autonome

experiments
replicates
statistical analyses

Système contingent

observation
experiments for lower
hierarchical levels
models
scenarios to test hypotheses
and predict behaviour



Kareiva et Anderson, 1988

0.1 m

1000 m

Taille de l'espace étudié

the experiment does not take
in account initial conditions

the model and scenarios do not take
in account the dynamics of
environmental conditions

***ad hoc* hypotheses**

Human activities

Système autonome

External parameters

ad hoc hypothesis:
the experiment excludes the
disturbance of human
activities

Système contingent

Part of the studied system;
Pluri- and inter-disciplinary approaches;
Role of human activities on complex
systems

ad hoc hypothesis:
the system considers and ranks
a limited number of parameters
and interactions

ad hoc hypotheses présence/ absence d'une espèce

Système autonome

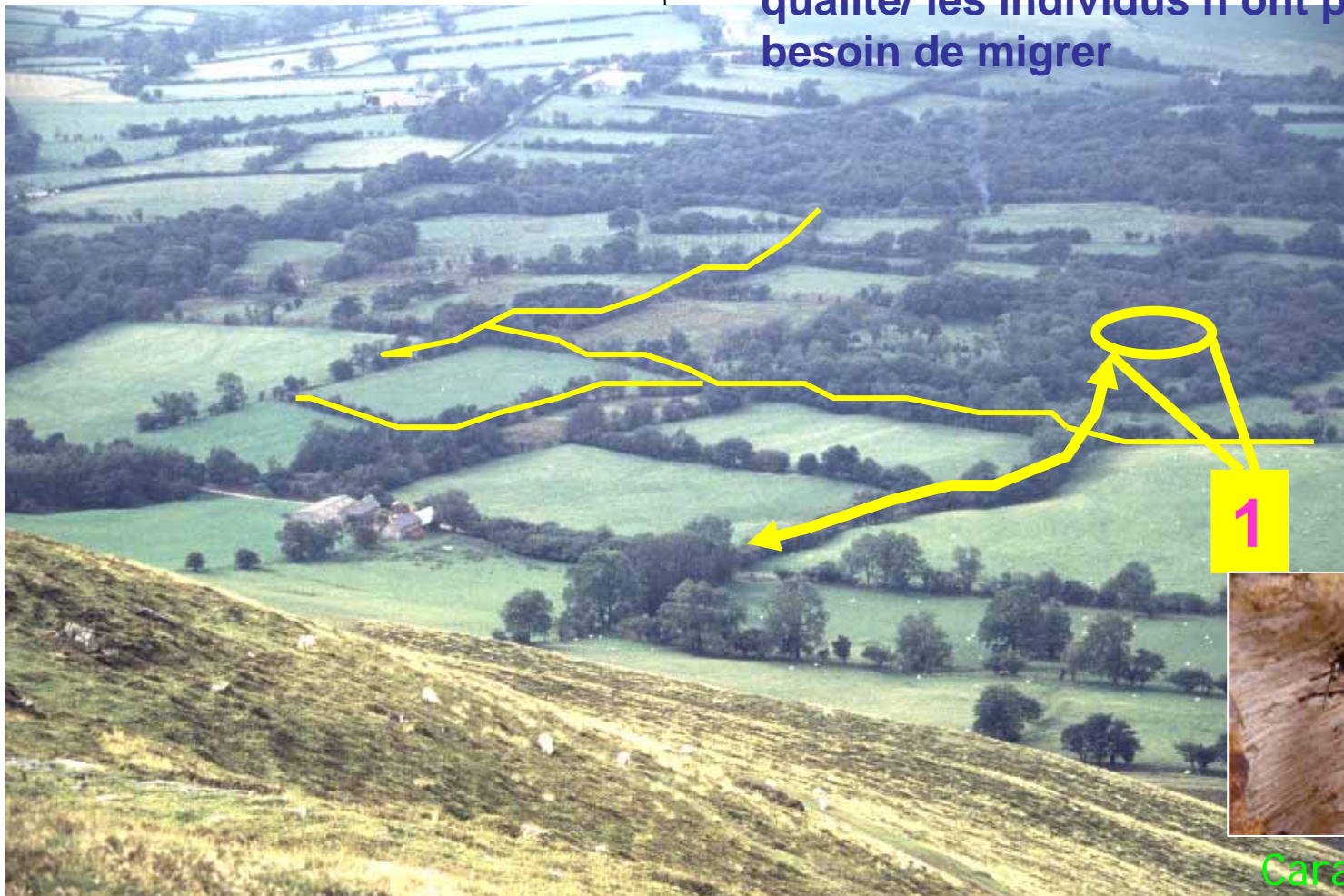
Les peuplements sont déterminés

Espèce absente: le système n'est pas à maturité

Système contingent

Les peuplements dépendent de la structure et histoire du paysage

Espèce absente: habitat de moindre qualité/ les individus n'ont pas eu besoin de migrer



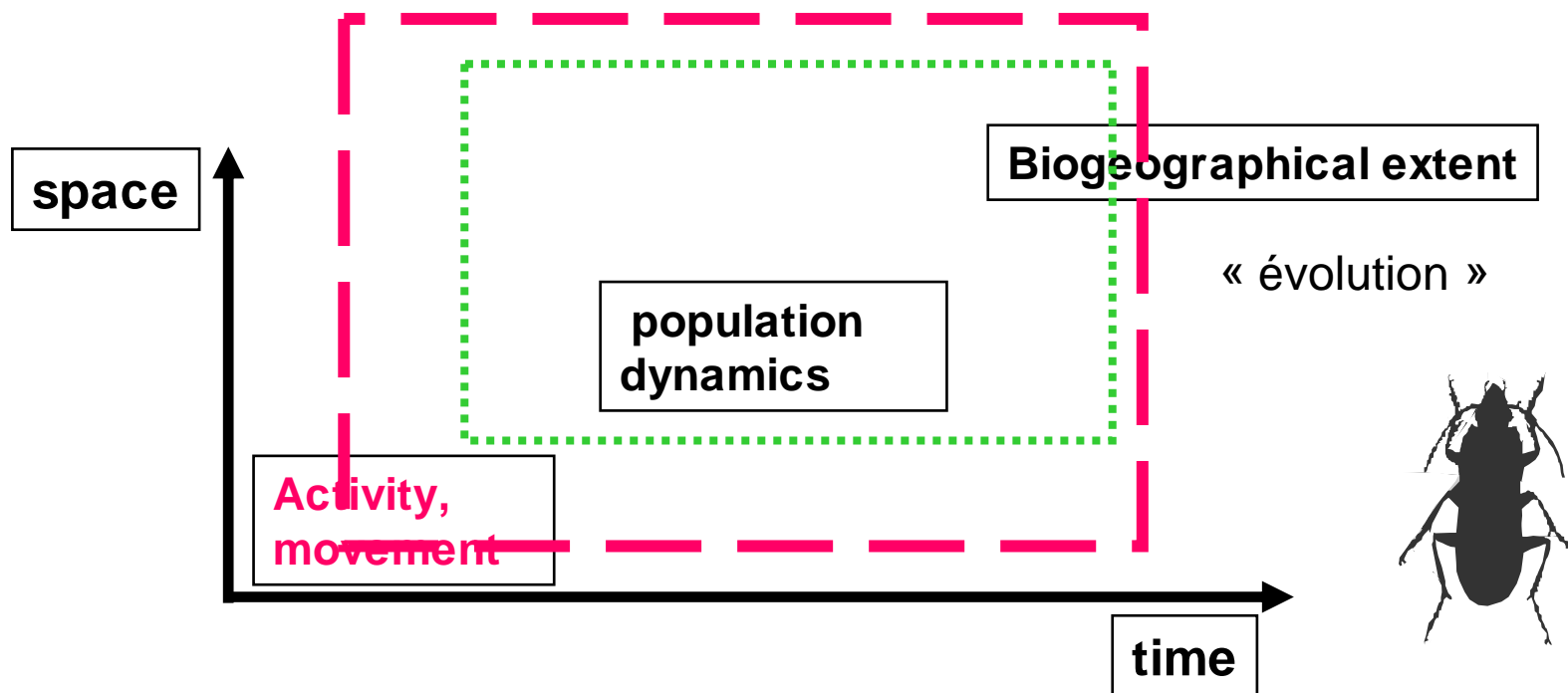
Carabe

Système contingent

These systems are organised within an ecological hierarchy

Theory predicts that levels of hierarchy form discontinuities in space and time

At each level, processes are studied at different scales to identify ecological response scales



Système autonome

Classifications des
objets de la nature

États de références

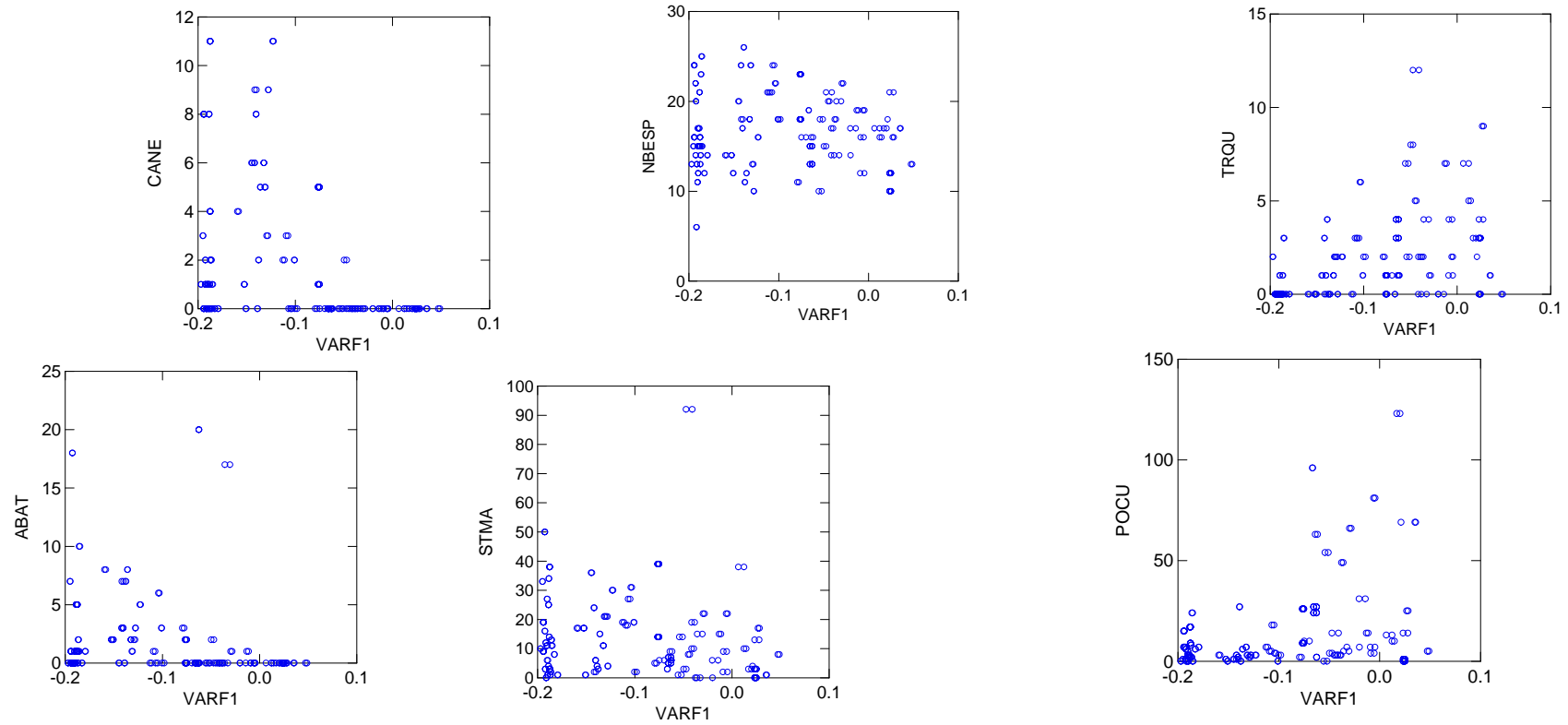
Système contingent

Construction de modèles
fonctionnels de la nature
en interactions avec les
sociétés humaines

Systemes dynamiques,
du fait de l'évolution des
relations nature/ société

The CORINE Biotopes Project: a database for conservation of nature and wildlife in the European Community

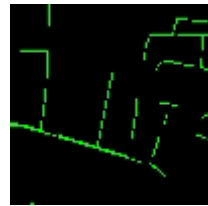
D Moss, BK **Wyatt** - Applied Geography, 1994 - Elsevier



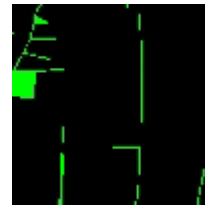
G1



G2



G3



G4



G5



Gradient d'ouverture du paysage

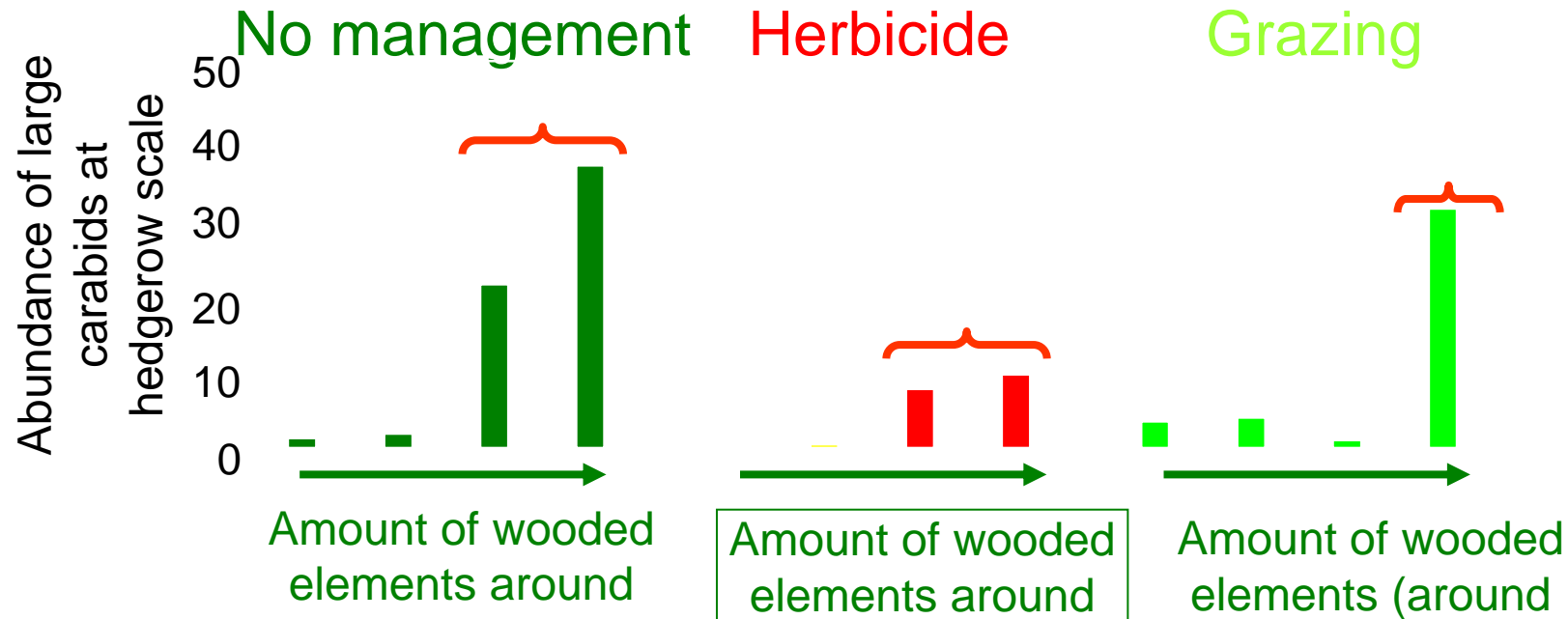


Abondance d'espèces de carabes



Effect of landscape context and management on carabids

And of the surrounding landscape



Plant species composition: Jutland

More semi-natural species in organic hedges

Hedge margin most affected by land use

No stat. difference in center

