

What is a population?

Combining demographic and genetic data to describe (meta)population functioning

Case study: Common frog in human-dominated landscape



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What is a population?

population = one (several) set(s) of individuals of the same species living together at one time during their developmental cycle, thus interacting on reproductive mechanisms
D. Debouzie & J-M. Legay (1985).

1) **Systematic criteria** : «of the same species.... »

2) **Biological criteria** : « ... living together at one time during their developmental cycle, thus interacting on reproductive mechanisms » = individuals of the same population share genetic identity.

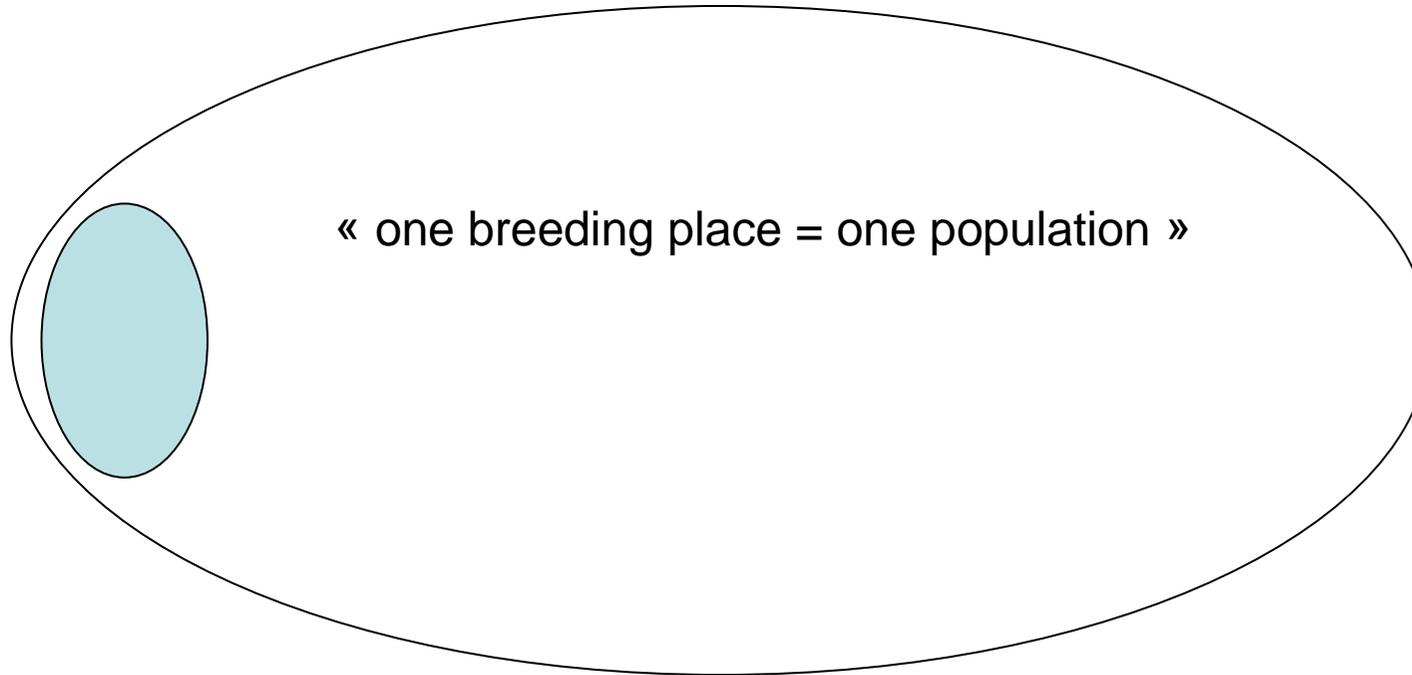
What is an amphibian population ?

1) «living together... »

2) «interacting on reproductive mechanisms... »



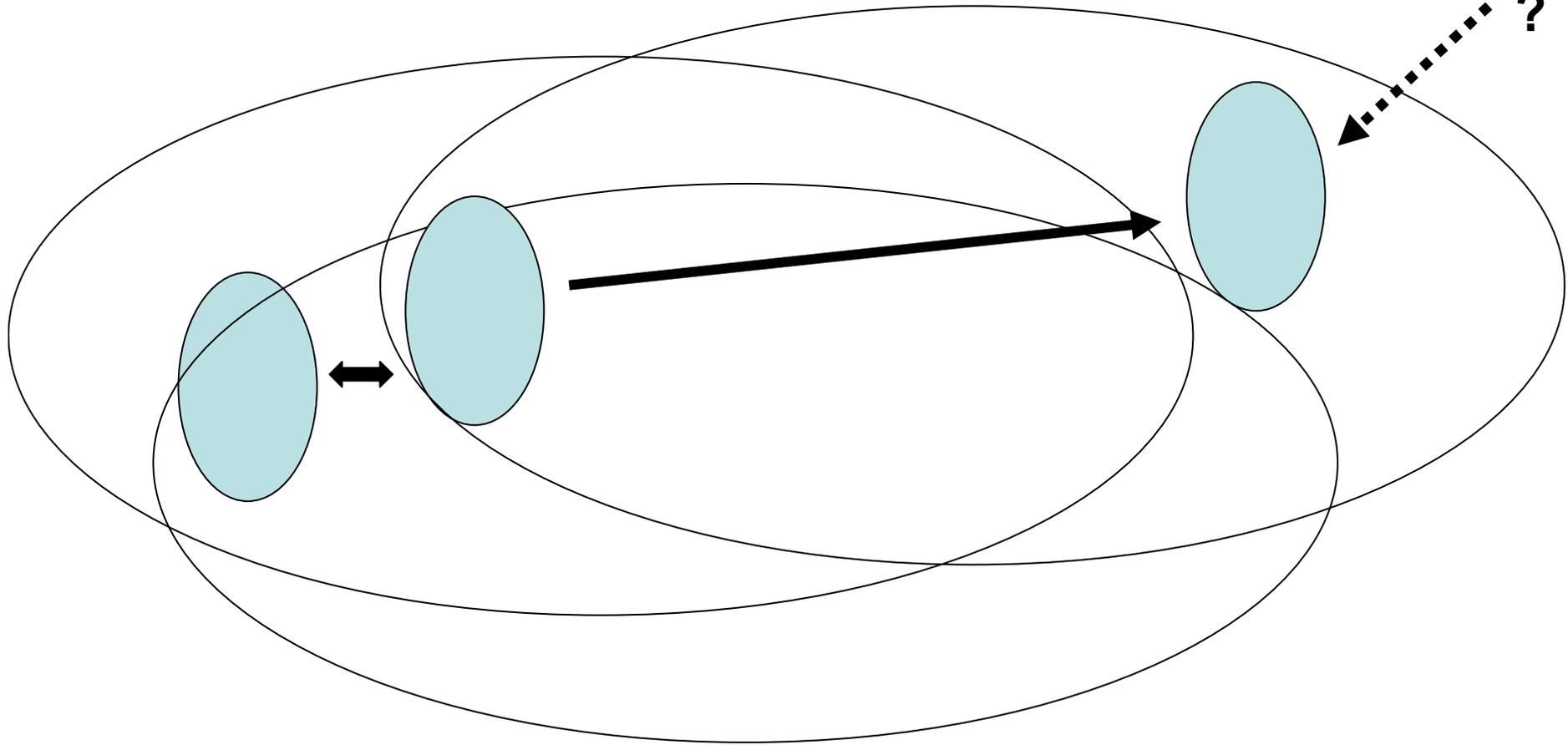
What is an amphibian population ?



Theoretical Population « closed » =

- no genes exchanges with other populations
- population turn over depend only of its internal dynamics

Real situation...



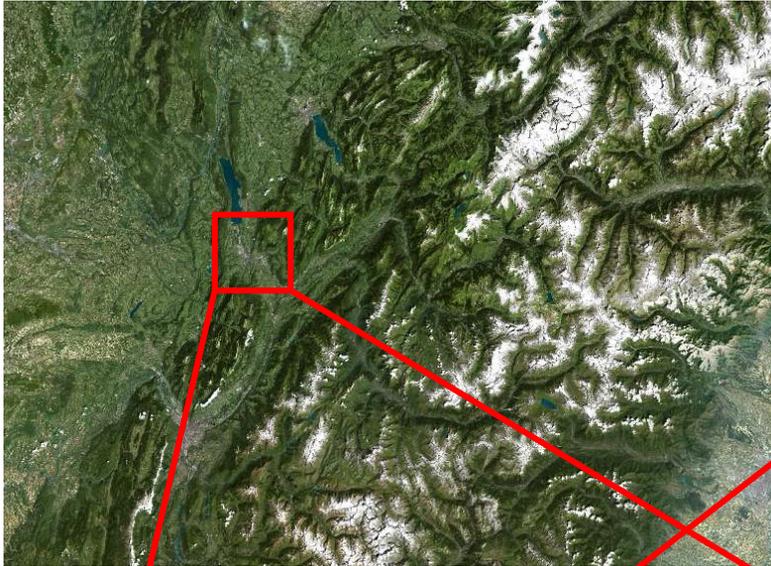
- Open populations: emigration & immigration (= global gene pool)
- Set of open population = metapopulation

Métapopulation : set of local populations spatially defined, and connected by some level of migration
Levins (1969)

Concept A – Space is discrete and there is a distinction between favourable patches and the remaining landscape (matrix)

Concept B – Migration can affect local population dynamics (e.g. reestablishment of extinct population)

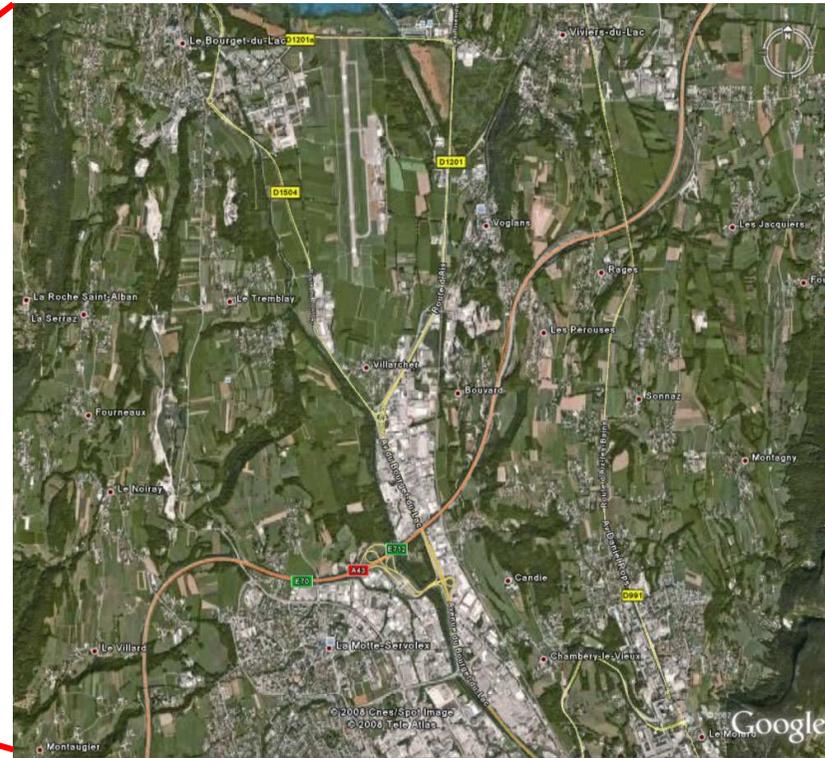
= structural and functional connectivity....



Case study

Cluse de Chambéry, 135 km²

Well structured landscape (lake, city, mountains)

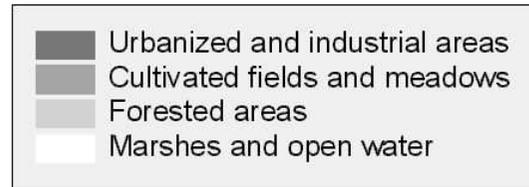
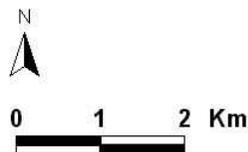
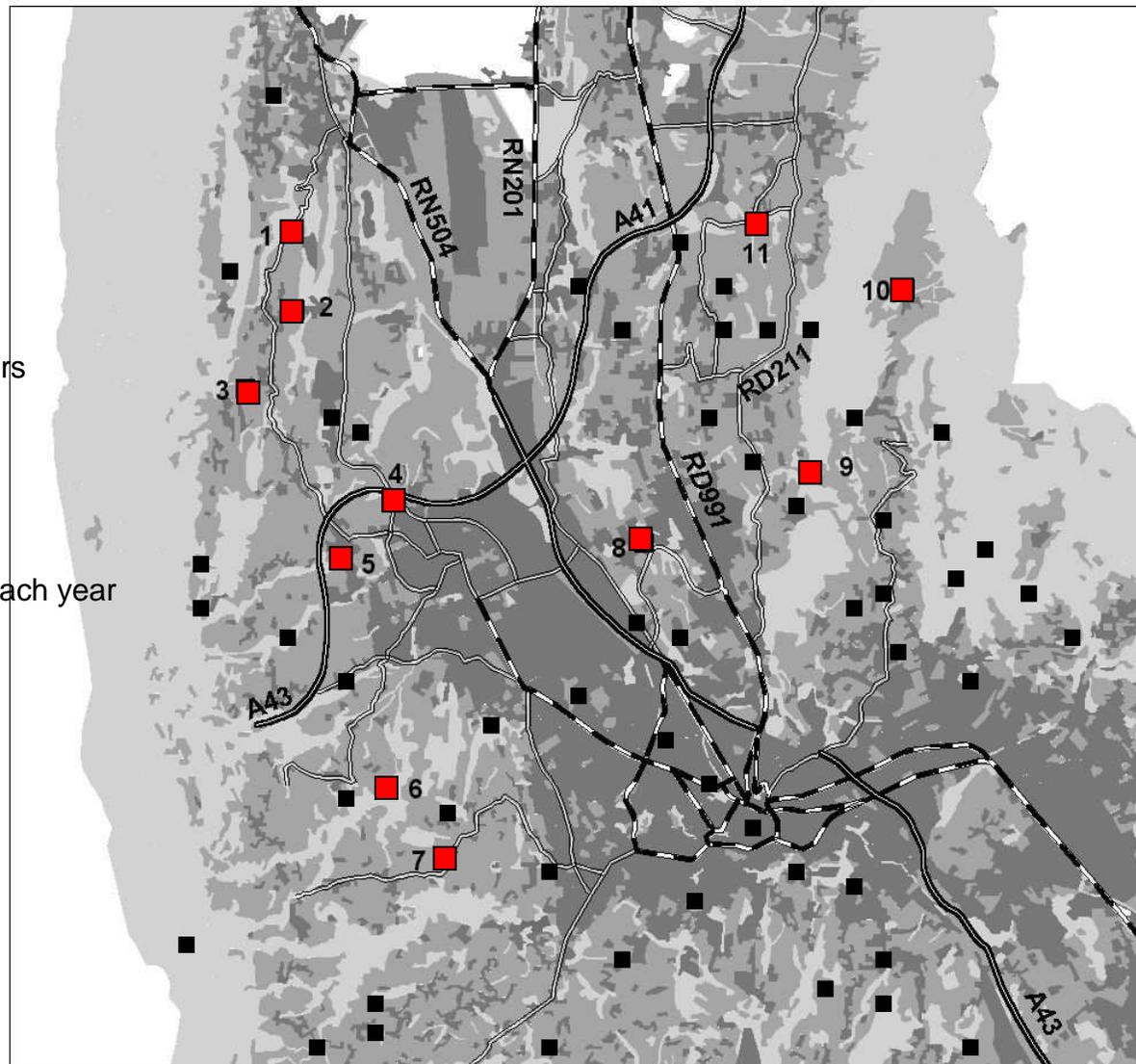


Concept A – landscape with favourable and unfavourable patches

≠ 78 aquatic places sampled during 5 years
= habitat patches

20 sites with Common frog presence
= occupied habitat patches

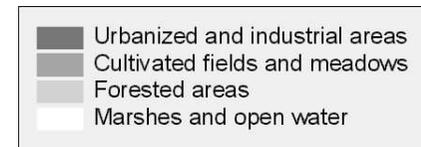
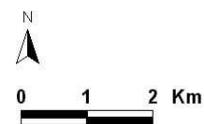
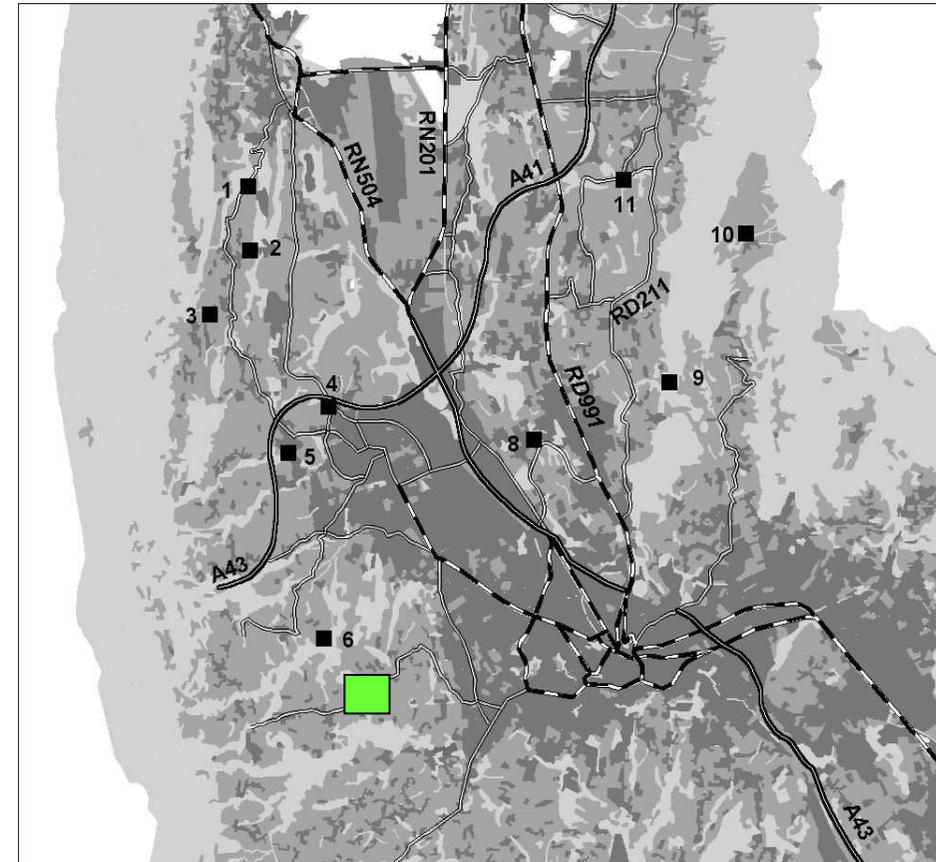
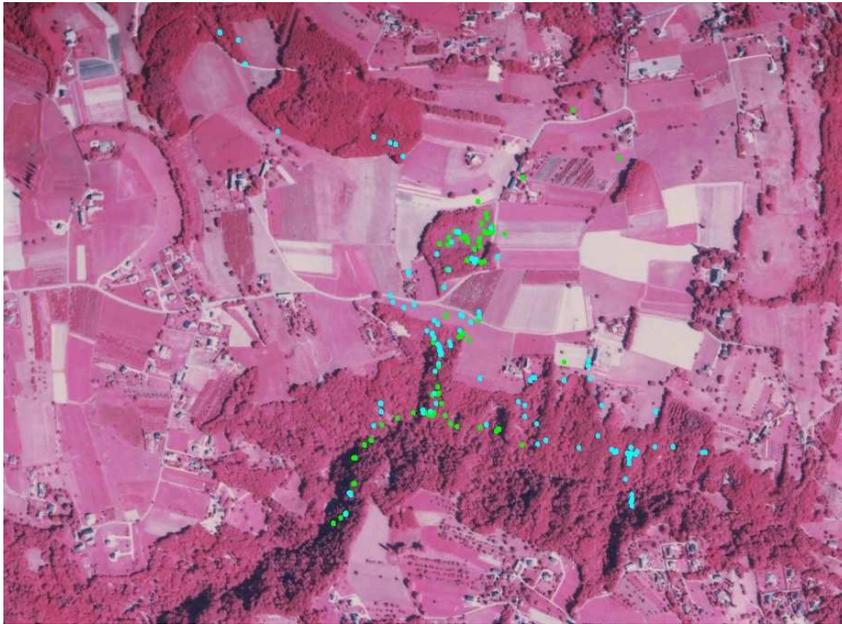
with 11 sites where reproduction occurs each year
= breeding patches



Concept B - migration between patches

1. Individus : radiotracking

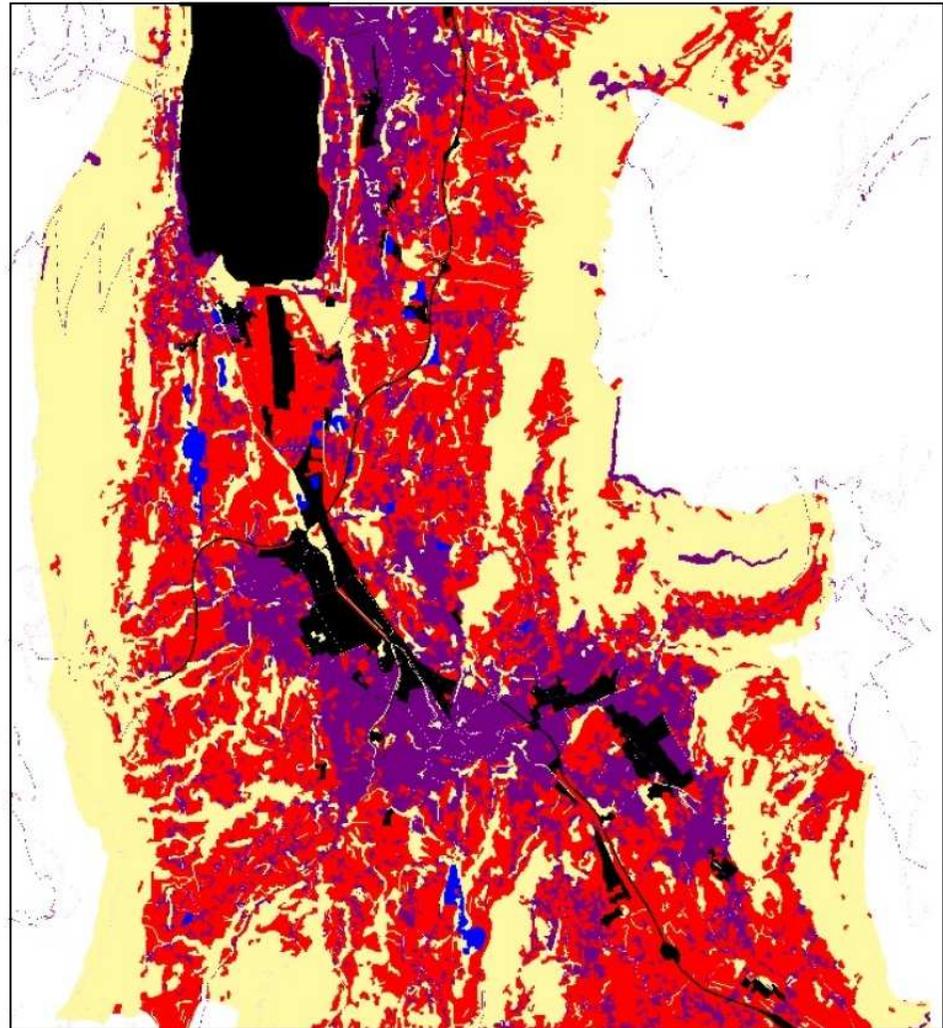
- 24 adults
- 2 successive years
- Migration from breeding patch 7
(distance max = 1,5 km)



2. Friction map

- Habitat preference analysis (compositionnel analysis)
- Estimation of friction coefficient (= cost of moving in each habitat)

Coût par mètre :

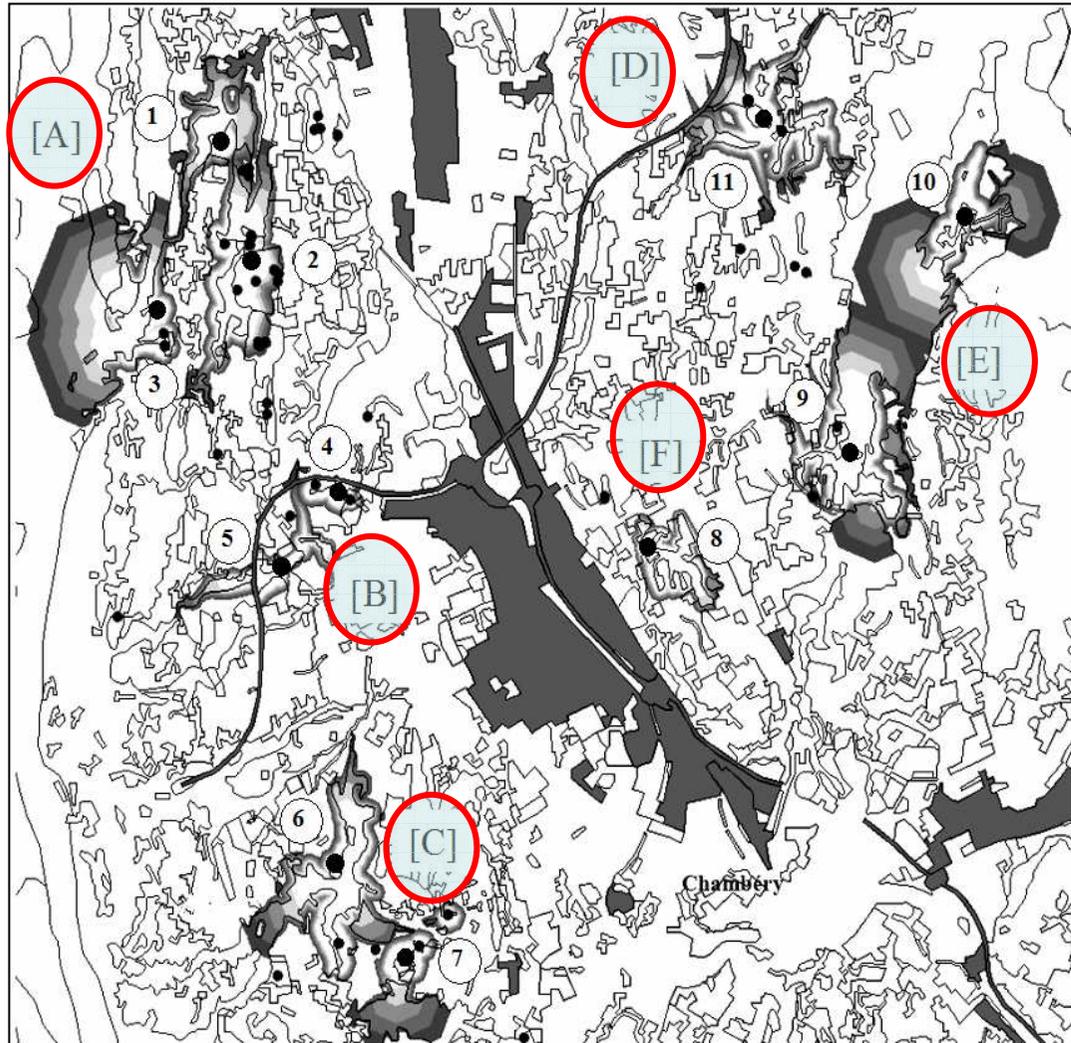


3. Simulation of dispersal areas

- Dispersion model based on additive moving costs in the landscape (stop in case of impassable habitat or distance > 1500 m : Fonction « Costdistance » of ArcGIS)

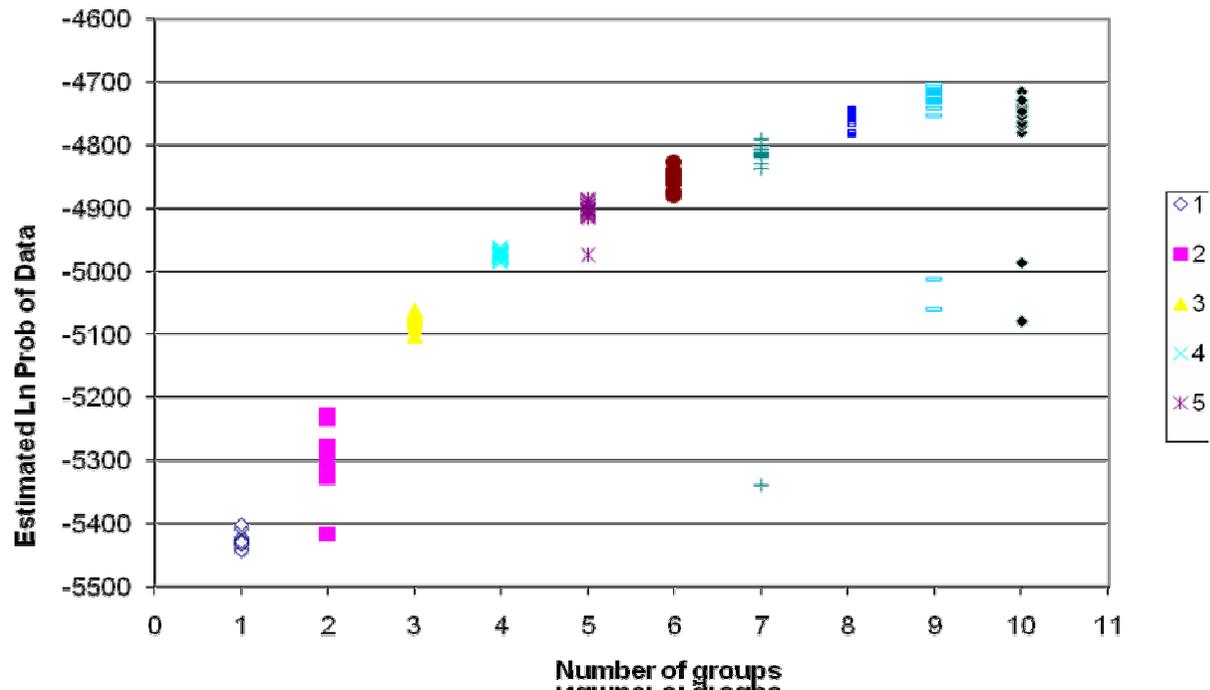
Result :

- 6 habitat patches identified



4. Genes = genetic structure

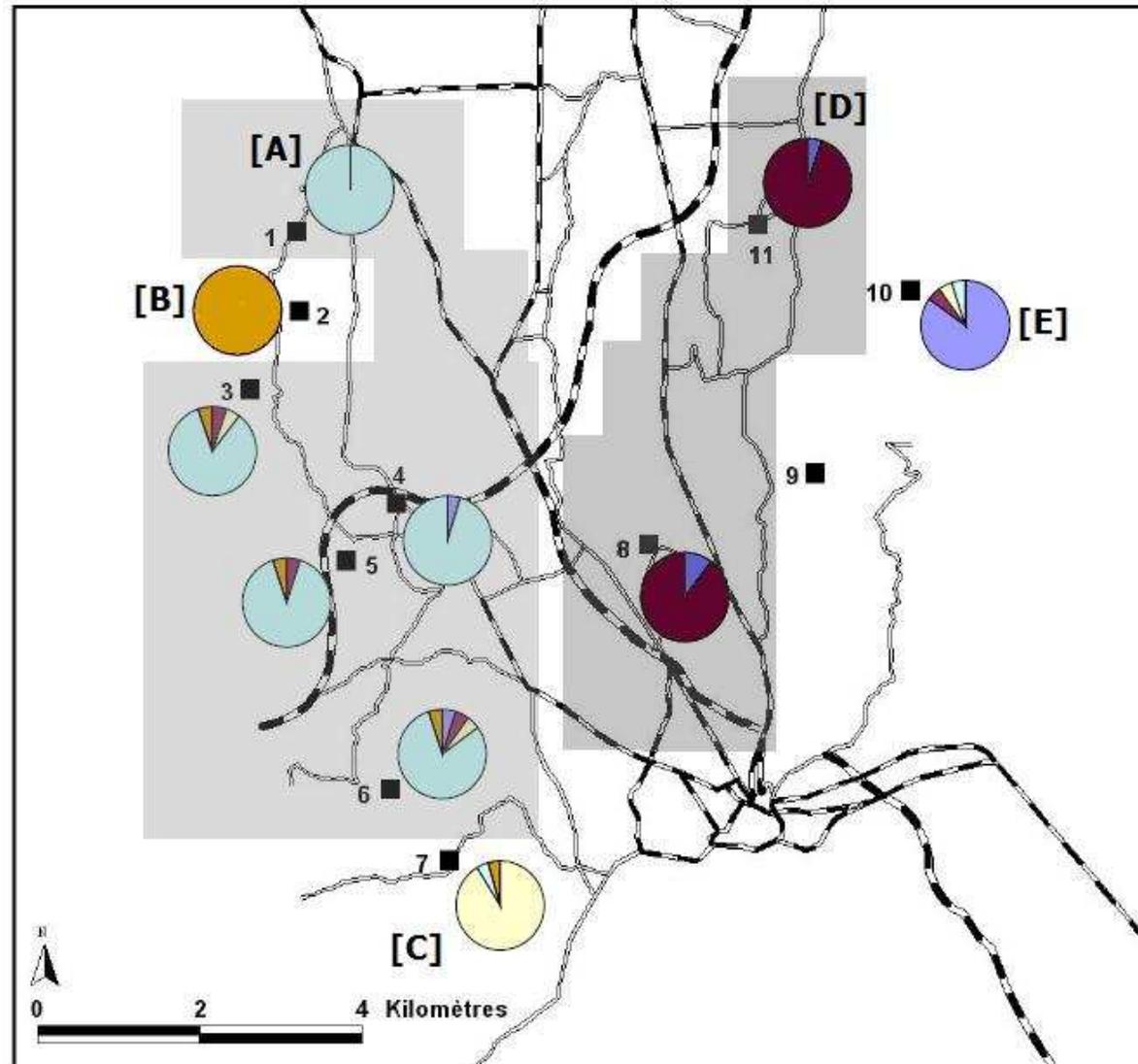
- 9 microsatellites, 20-25 individuals per breeding patch
- *without a priori* on individual location in breeding patches with STRUCTURE (Pritchard et al. 2000).



- STRUCTURE did not give a reliable estimation of the number of clusters (K = group of breeding patches).
- There was no clear correspondence between the breeding patches and the clusters identified by STRUCTURE

4. Genes = genetic structure

- with predefined groups of individuals i.e. individuals belonged to breeding patches with BAPS5 (Corander et al., 2008)

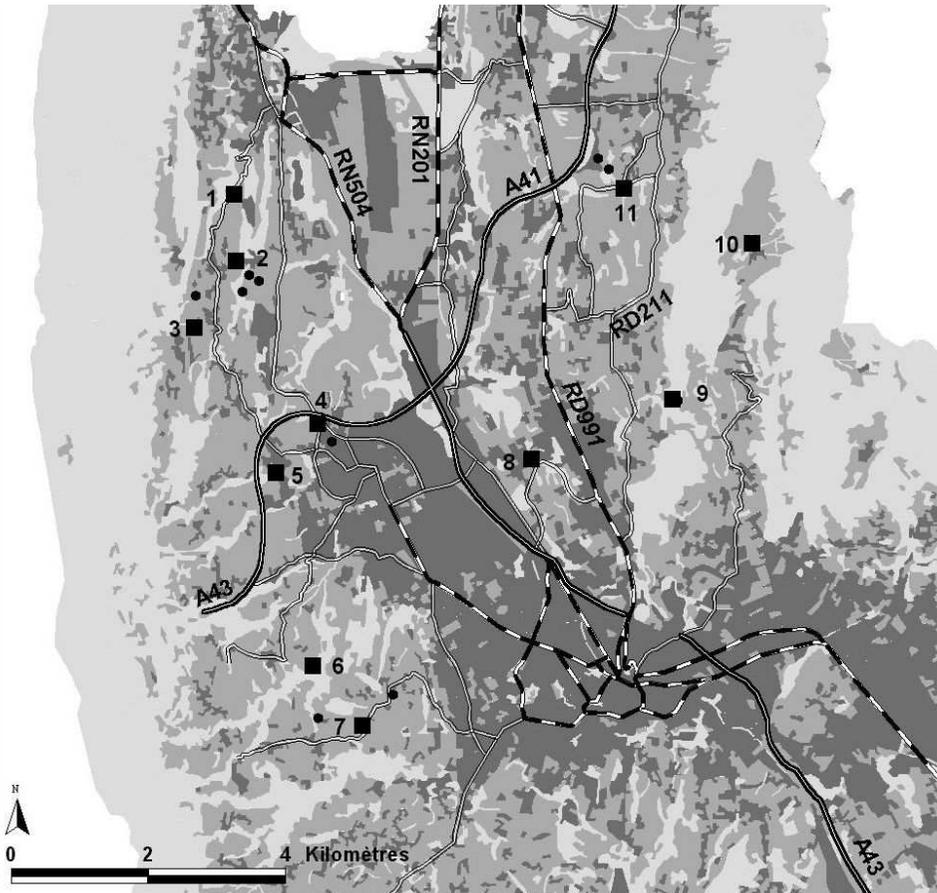


-BAPS5 detected a clear genetic structure with 5 clusters of breeding patches

B - migration can affect local population dynamics (e.g. following extinction)

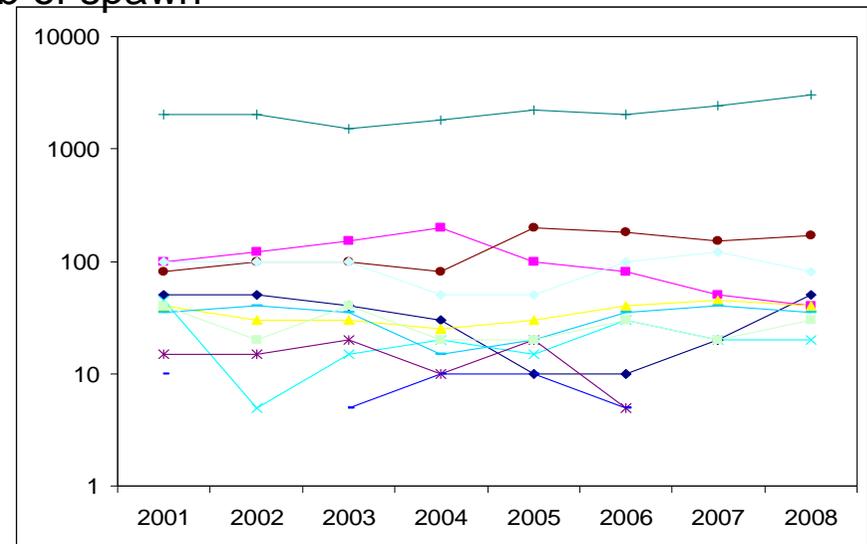
Condition C2 : local population have independent dynamics (no synchronism)

Condition C3 : Exchange between local populations are very low
(i.e. migration do not influence local dynamics)



2 migrants pour 3000 marqués

Nb of spawn

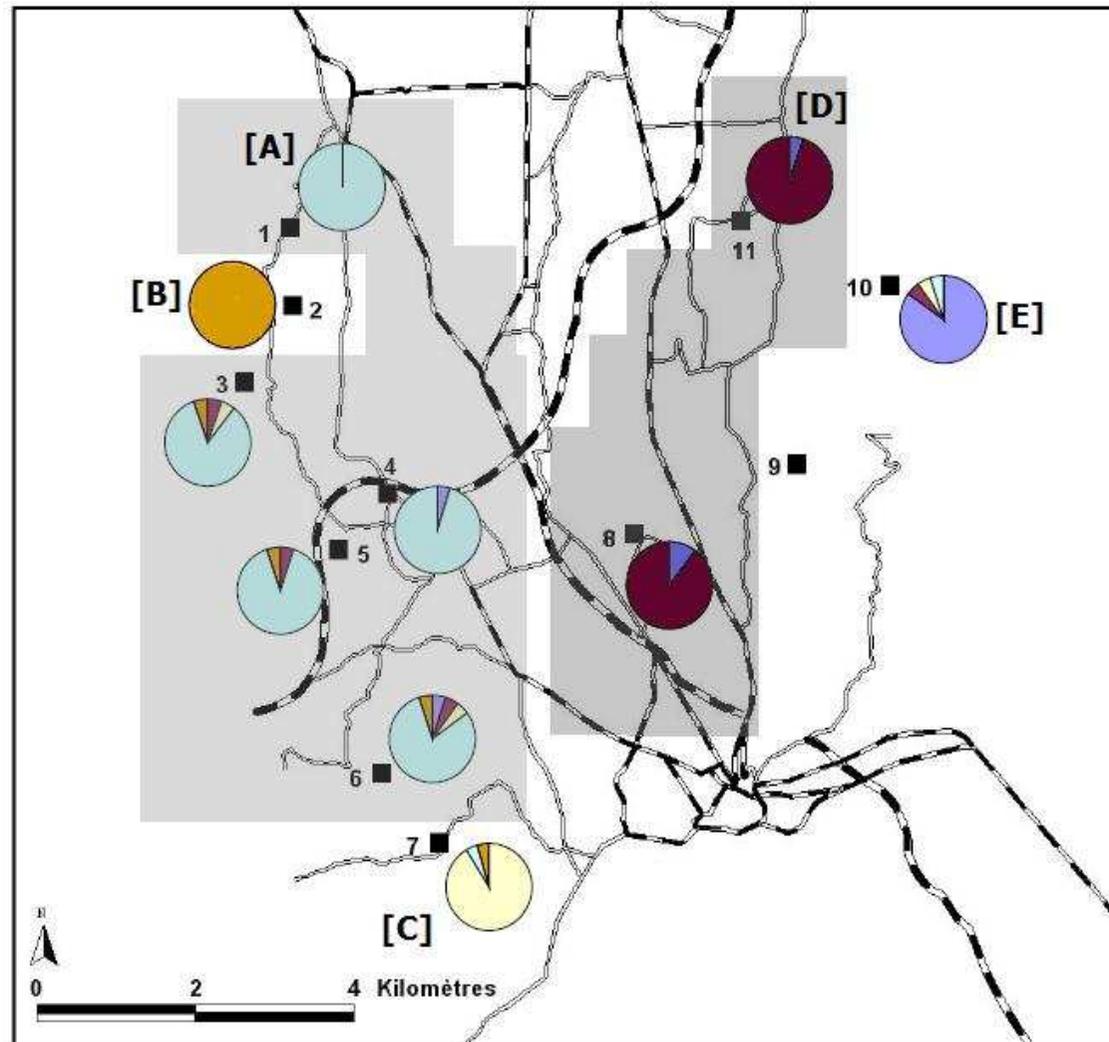


years

Conclusion:

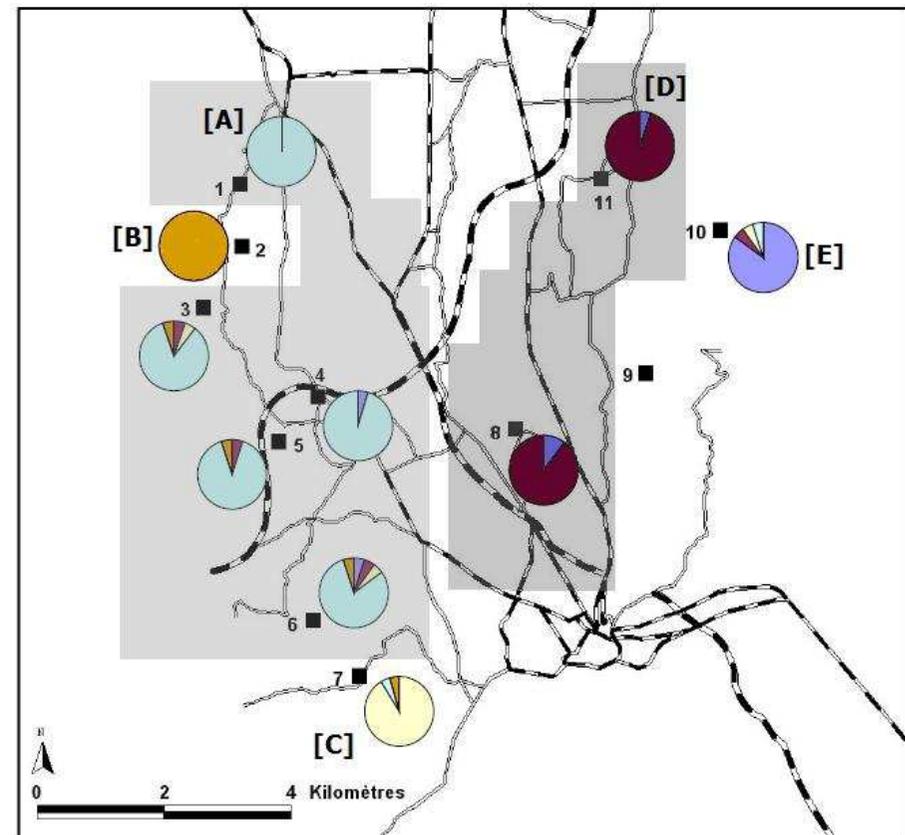
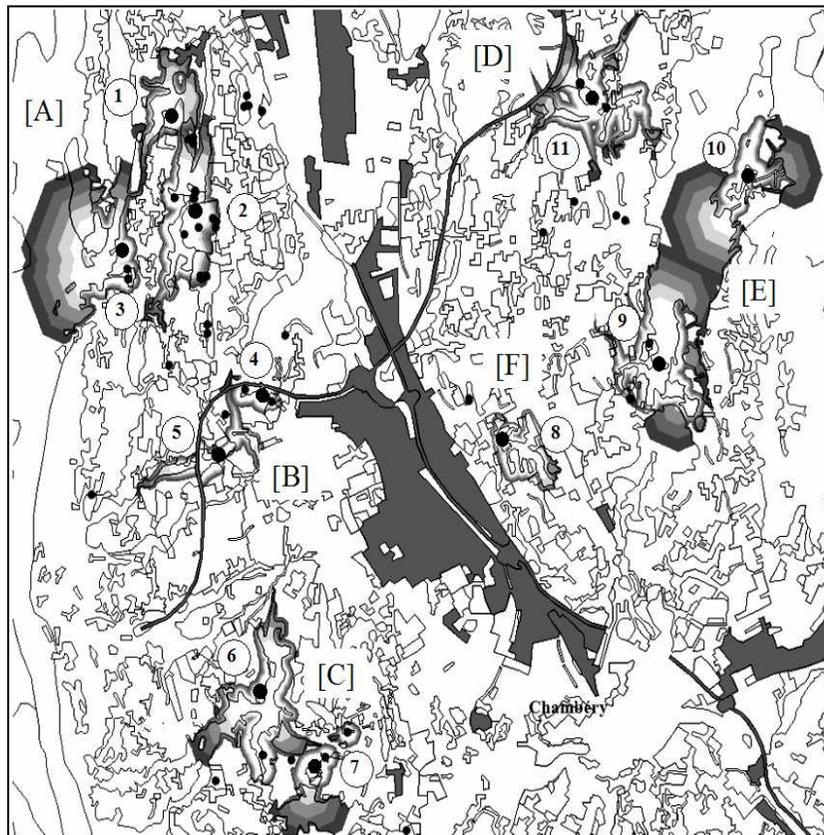
- 5 local populations connected by low exchanges
- Each local population with its own dynamics

} metapopulation



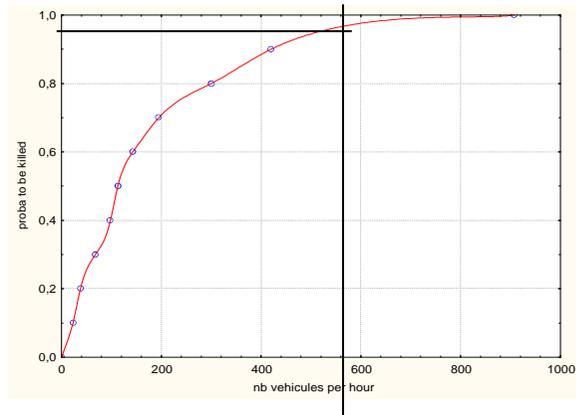
Conclusion:

- Clusters of local populations differ with the individual or gene approaches

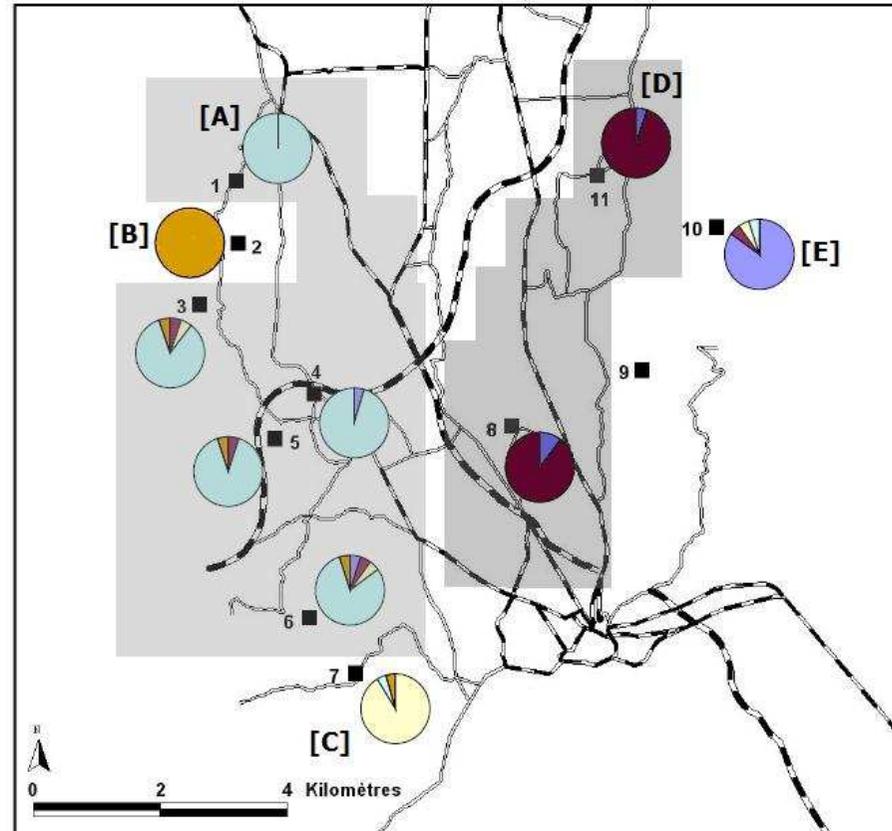
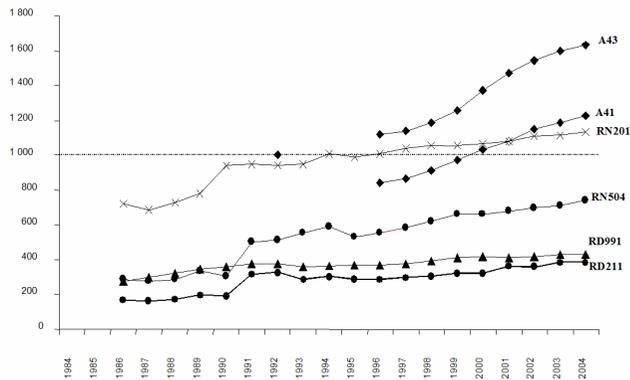


Conclusion:

- because fragmentation is a dynamic process, and in progress in this landscape.....



Hels and Buchwald (2001) The effect of road kills on amphibian populations. *Biological Conservation*, **99**, 331-340



Conclusions

Some particularities :

-Fonding effect? 

- metapopulation limit ? 

futur ?

- ↗ fragmentation ↗ isolation
↗ risque d'extinction de pop locales

Quelles actions ?

- entretenir la qualité des patches pour maintenir les pop locales
- Assurer la colonisation des patches favorables dont la population locale aurait disparu par stochasticité démographique

