



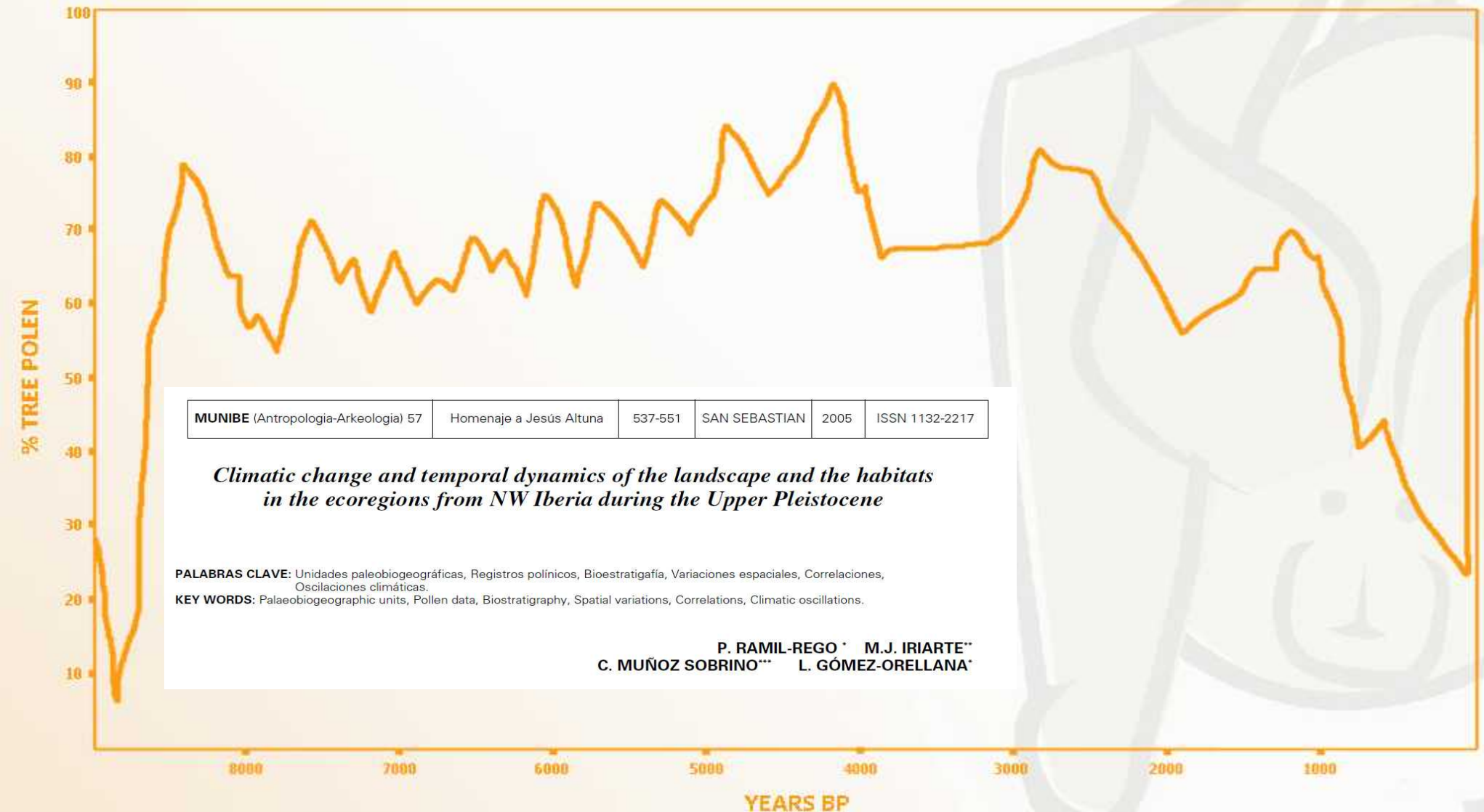
The abandonment of rural areas contributes to population growth of the lesser horseshoe bat (*Rhinolophus hipposideros*, Bechstein, 1800) in Galicia (NW Spain).

Ramón Seage, Laura Cardador, Javier Juste, Martina Carrete and Elisabeth Kalko.



THE ABANDONMENT OF RURAL AREAS CONTRIBUTES TO POPULATION GROWTH OF *R. hipposideros* IN GALICIA.

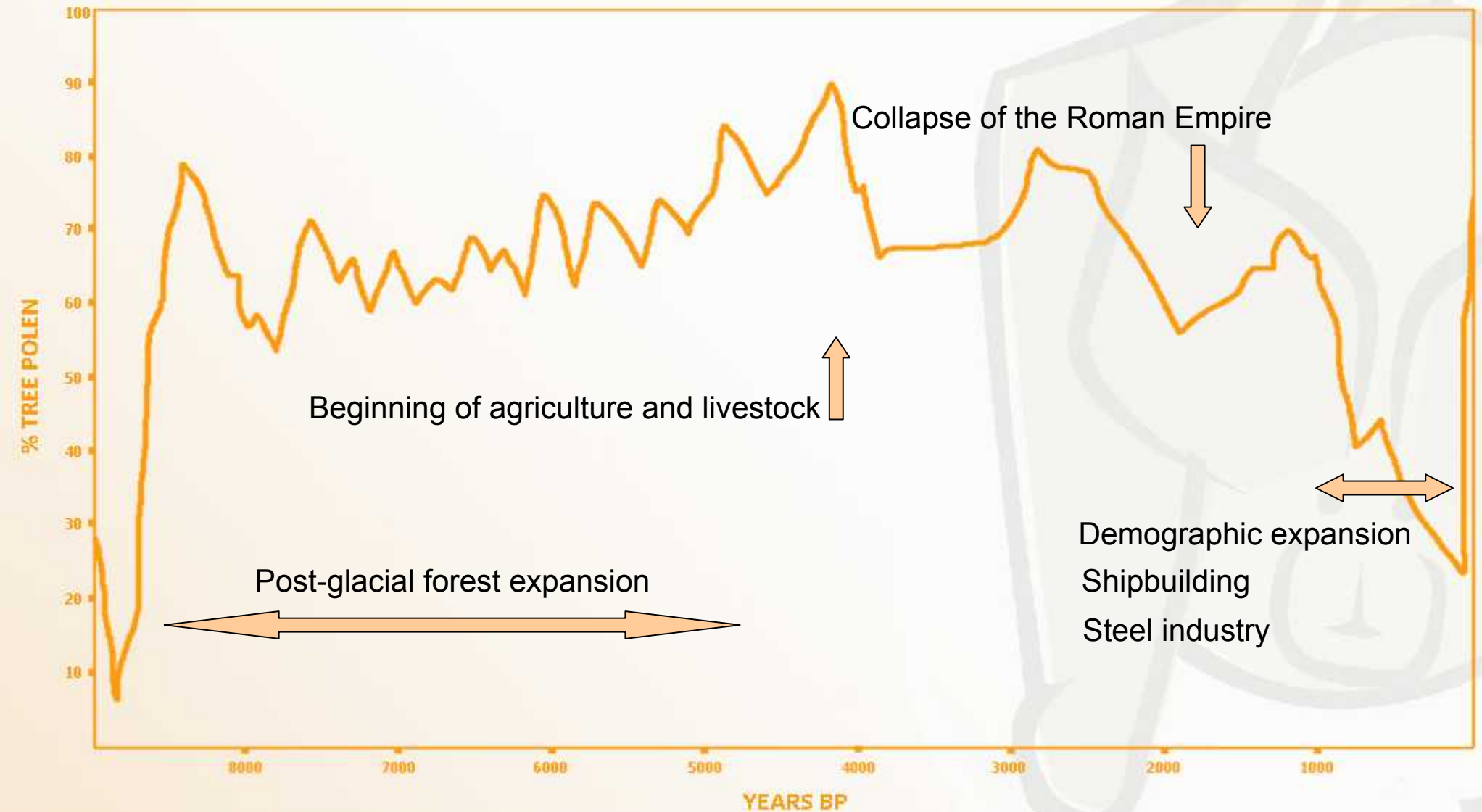
EVOLUTION OF FOREST COVER IN THE HOLOCENE





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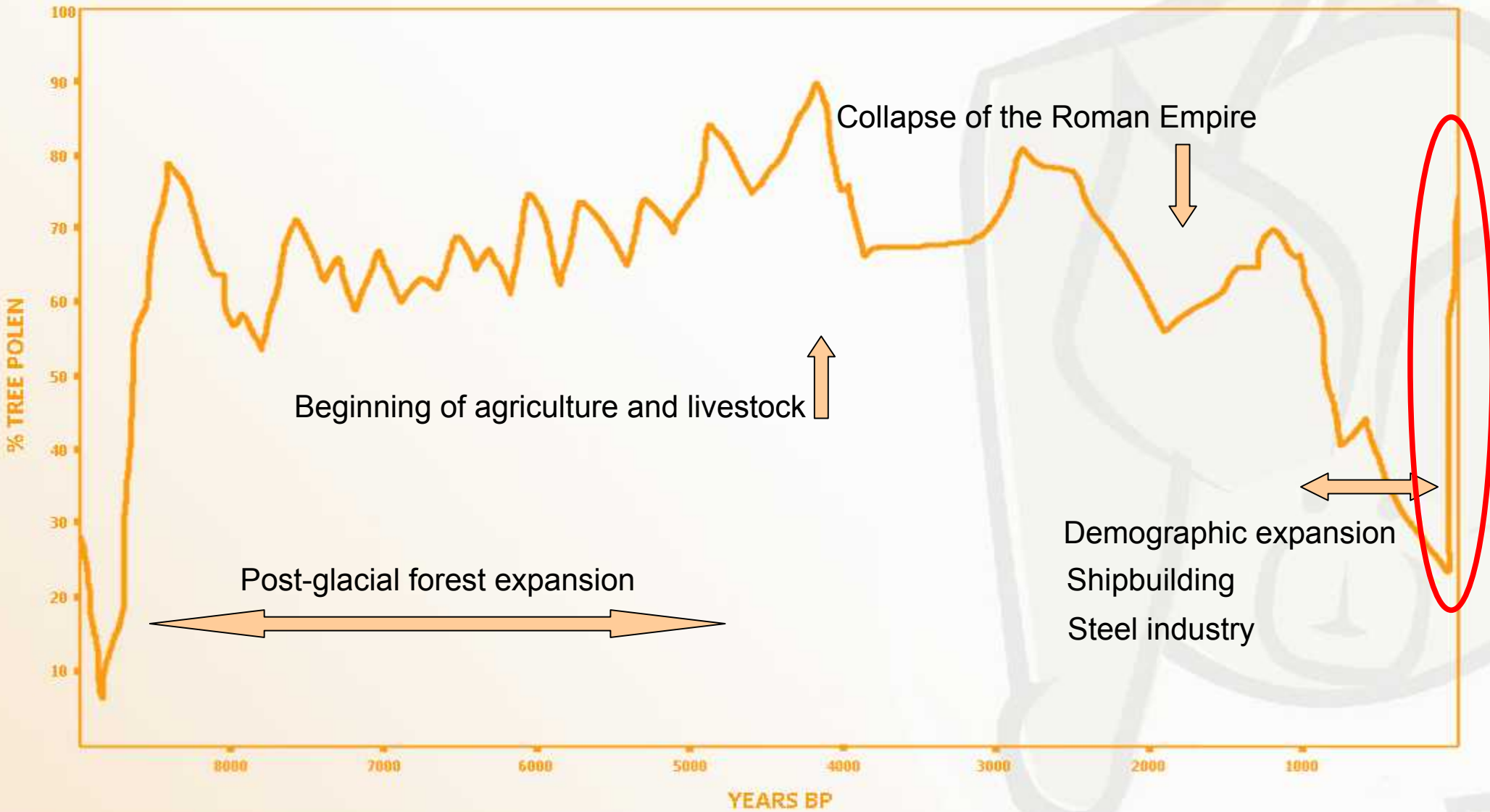
EVOLUTION OF FOREST COVER IN THE HOLOCENE





THE ABANDONMENT OF RURAL AREAS CONTRIBUTES TO POPULATION GROWTH OF *R. hipposideros* IN GALICIA.

EVOLUTION OF FOREST COVER IN THE HOLOCENE





THE ABANDONMENT OF RURAL AREAS CONTRIBUTES TO POPULATION GROWTH OF *R. hipposideros* IN GALICIA.

MORCEGOS
DE GALICIA

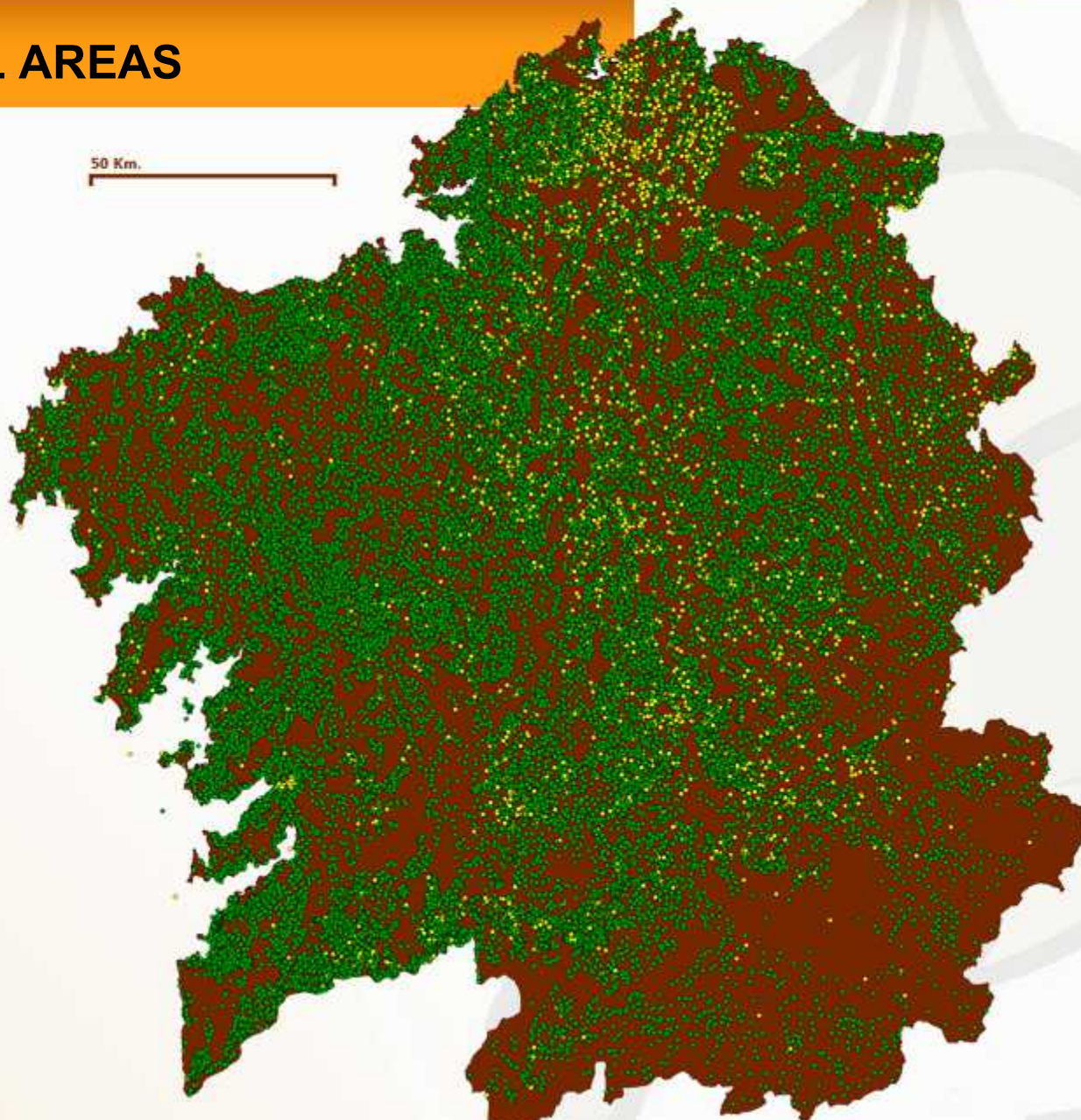


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THE ABANDONMENT OF RURAL AREAS

29 648 population entities
3 460 abandonned

50 Km.





THE ABANDONMENT OF RURAL AREAS CONTRIBUTES TO POPULATION GROWTH OF *R. hipposideros* IN GALICIA.

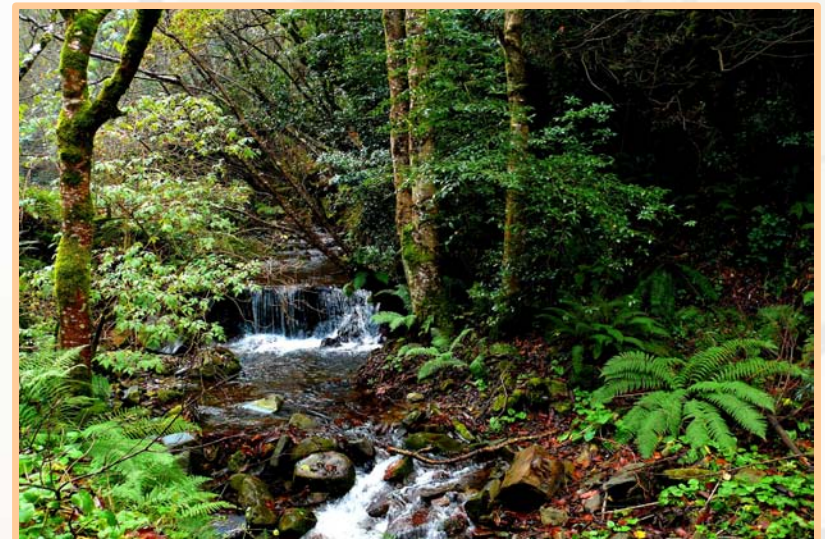
CONSEQUENCES OF THE ABANDONMENT



Empty buildings



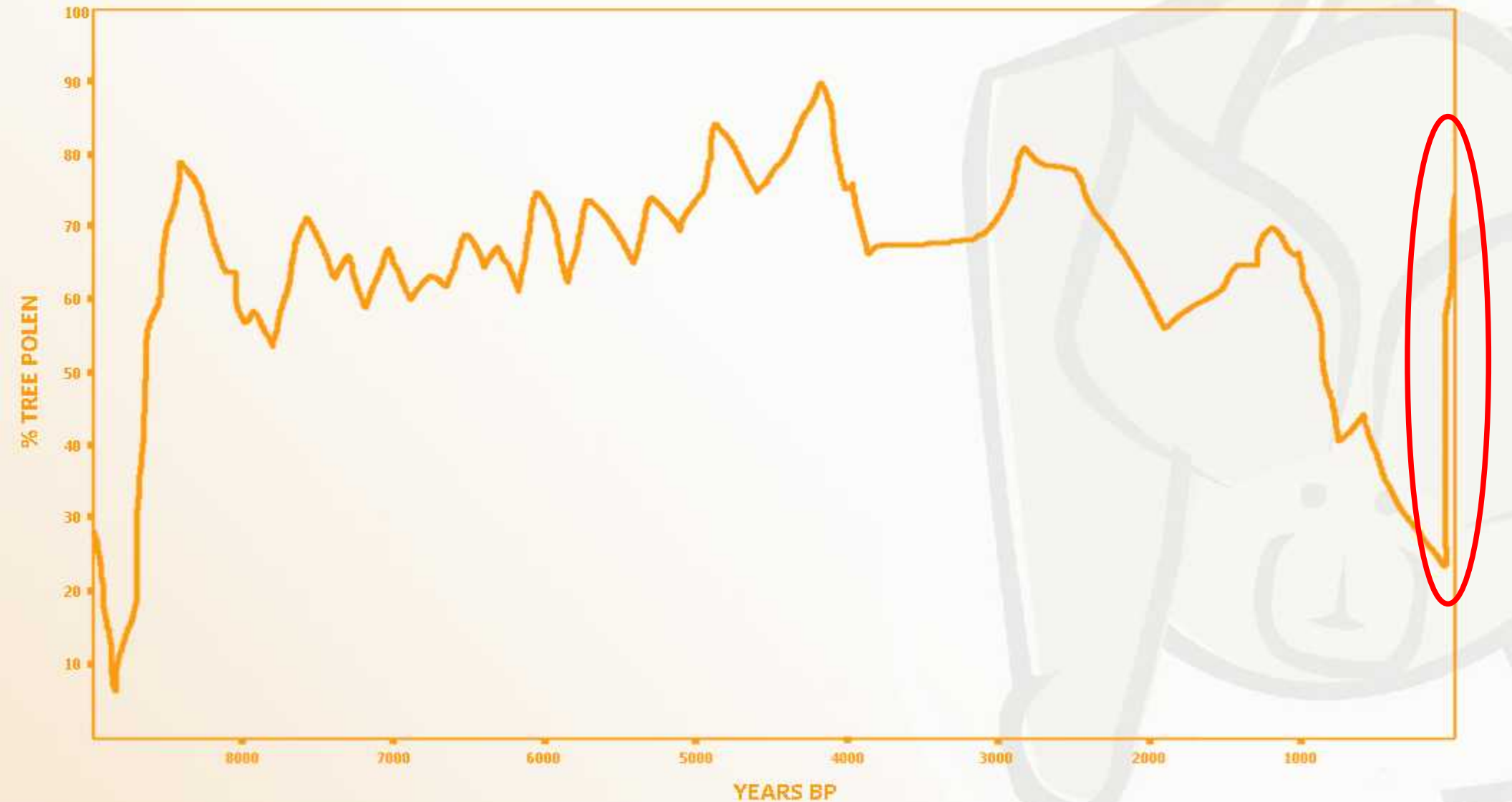
Landscape
transformation





THE ABANDONMENT OF RURAL AREAS CONTRIBUTES TO POPULATION GROWTH OF *R. hipposideros* IN GALICIA.

LANDSCAPE TRANSFORMATIONS

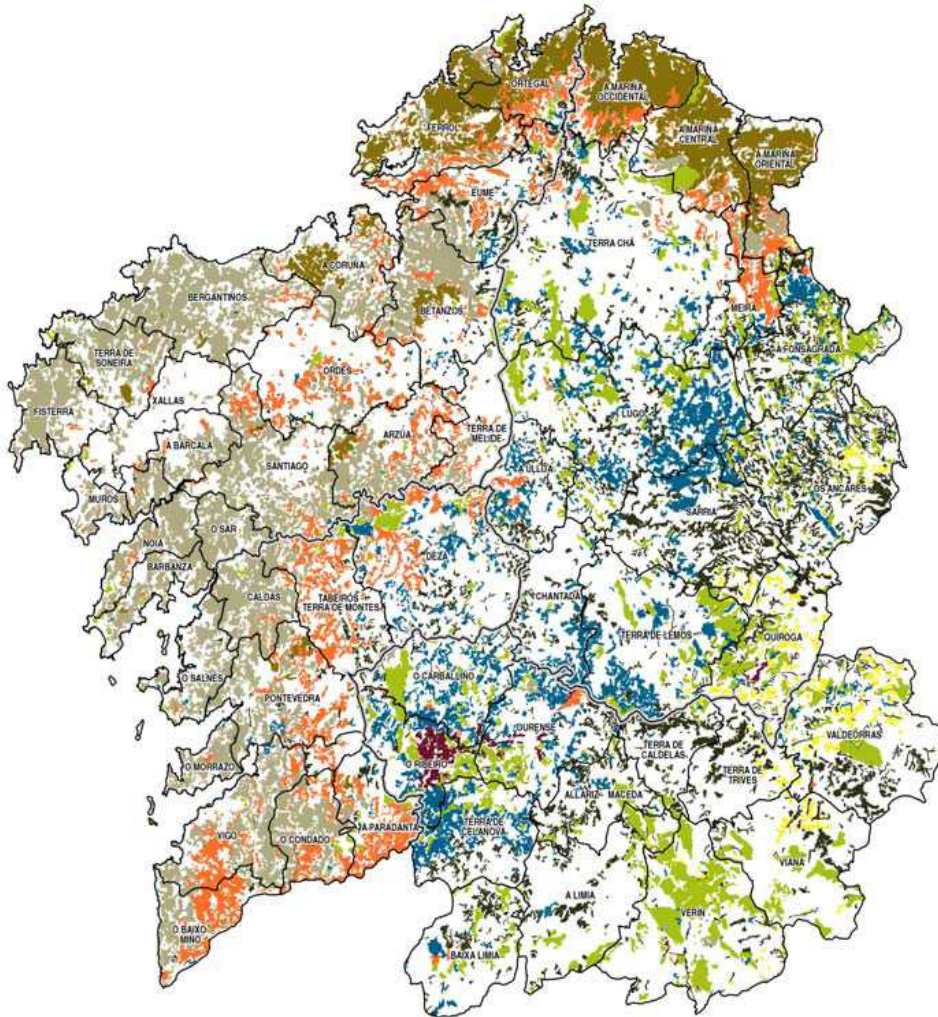




THE ABANDONMENT OF RURAL AREAS CONTRIBUTES TO POPULATION GROWTH OF *R. hipposideros* IN GALICIA.

LANDSCAPE TRANSFORMATIONS

Forested Areas



...SOME DATA (3rd. Forestal Inventory. 1998)

- * 58,56% of the territory cover is forested.
- * Between 1987 and 1998 the forest areas increased by 36%
- * In the same period deciduous forests increased by 66,4%
- * Eucalyptus crops increased by 453% (!!!)



THE ABANDONMENT OF RURAL AREAS CONTRIBUTES TO POPULATION GROWTH OF *R. hipposideros* IN GALICIA.



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THE QUESTION

Did the changes induced by human abandonment of rural areas have an effect on *R. hipposideros* population size?





THE ABANDONMENT OF RURAL AREAS CONTRIBUTES TO POPULATION GROWTH OF *R. hipposideros* IN GALICIA.

R. hipposideros DEMOGRAPHY

479 individuals sequenced (d-loop HVII)
61 summer clusters

Neutrality Test: Fu's F_s

$F_s = -5,588$ $p = 0,06$ (*)

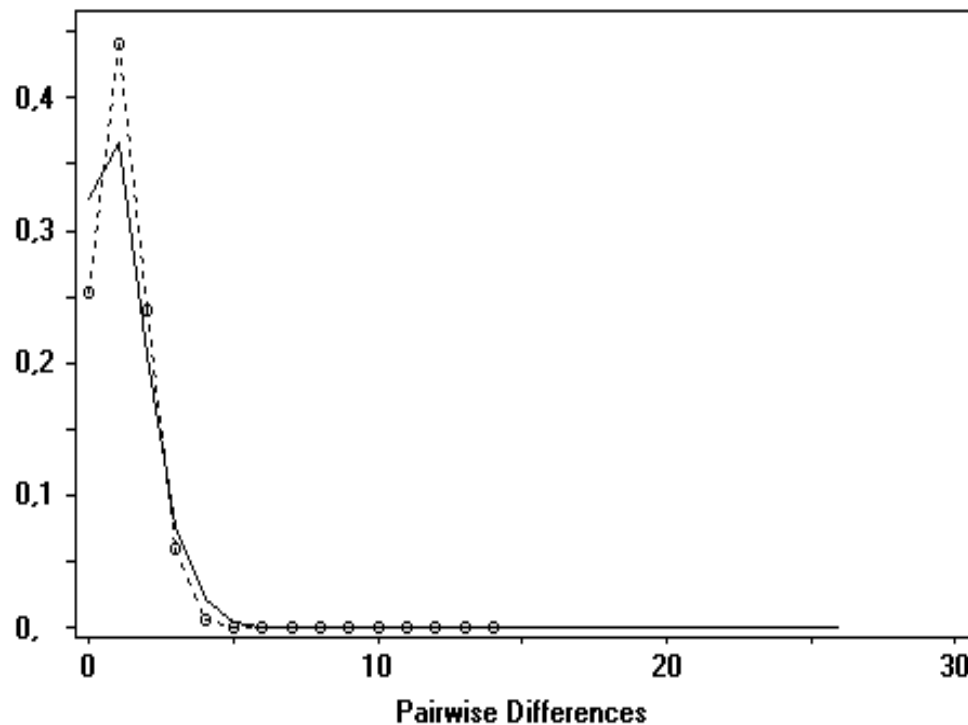




THE ABANDONMENT OF RURAL AREAS CONTRIBUTES TO POPULATION GROWTH OF *R. hipposideros* IN GALICIA.

R. hipposideros DEMOGRAPHY

Mismatch Distribution. Model for expected values of Population growth-decline



Parameters estimated under the sudden expansion model:

— Exp

---○--- Obs

Mismatch observed mean	:	1.564
Mismatch observed variance	:	1.059
Tau	:	1.746
Theta0	:	0.000
Theta1	:	99999

Test of goodness-of-fit:

Sum of Squared deviation: 0.00887532
P(Sim. Ssd \geq Obs. Ssd): 0.00180000
Harpending's Raggedness index: 0.07108743
P(Sim. Rag. \geq Obs. Rag.): 0.00030000



THE ABANDONMENT OF RURAL AREAS CONTRIBUTES TO POPULATION GROWTH OF *R. hipposideros* IN GALICIA.

R. hipposideros DEMOGRAPHY

POPULATION STRUCTURE: Sequential SAMOVA





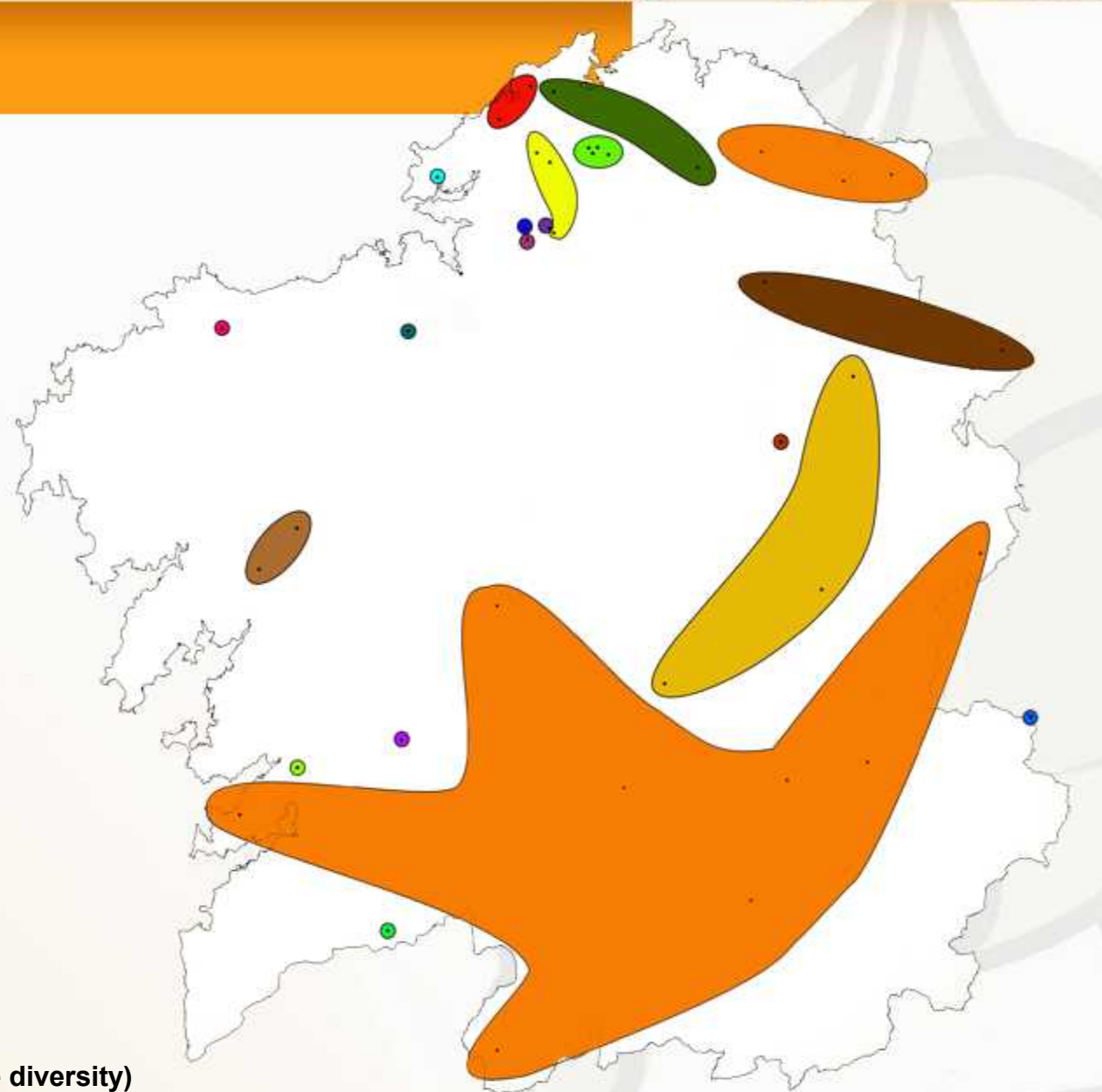
THE ABANDONMENT OF RURAL AREAS CONTRIBUTES TO POPULATION GROWTH OF *R. hipposideros* IN GALICIA.

R. hipposideros DEMOGRAPHY

POPULATION STRUCTURE: Sequential SAMOVA

POP1	0,00123
POP2	0,00202
POP3	0,00147
POP4	0,00246
POP5	0,00197
POP6	0,00029
POP7	0,00235
POP8	0,00001
POP9	0,00080
POP10	0,00133
POP11	0,00189
POP12	0,00155
POP13	0,00133
POP14	0,00240
POP15	0,00001
POP16	0,00076
POP17	0,00290
POP18	0,00130
POP19	0,00039
POP20	0,00278

Genetic diversity values (nucleotide diversity)





THE ABANDONMENT OF RURAL AREAS CONTRIBUTES TO POPULATION GROWTH OF *R. hipposideros* IN GALICIA.

R. hipposideros DEMOGRAPHY

Population expansions (bottlenecks, invasions) → Reduced genetic diversity
(Nei et al. 1975)





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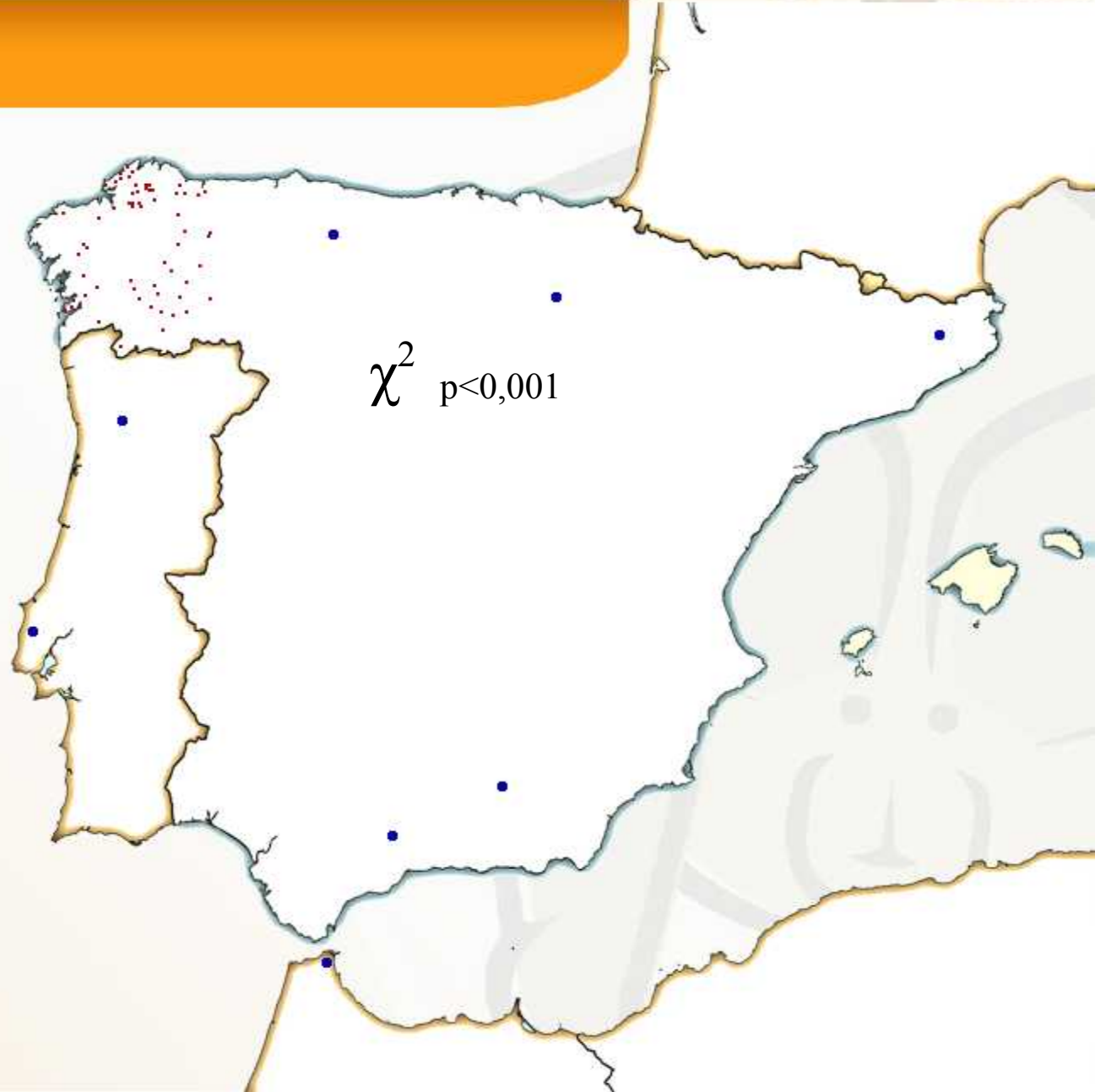
R. hipposideros DEMOGRAPHY

GALICIAN POPULATIONS

POP1	0,00123 (**)
POP2	0,00202 (**)
POP3	0,00147 (**)
POP4	0,00246 (**)
POP5	0,00197 (**)
POP6	0,00029 (**)
POP7	0,00235 (**)
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POP20	0,00278 (**)

IBERIAN & N AFRICA POPULATIONS

CE001	0,01125
GI124	0,01185
GR001	0,01019
LE116	0,00417
LR001	0,00244
MA001	0,01035
PT120	0,00169
PT121	0,00164



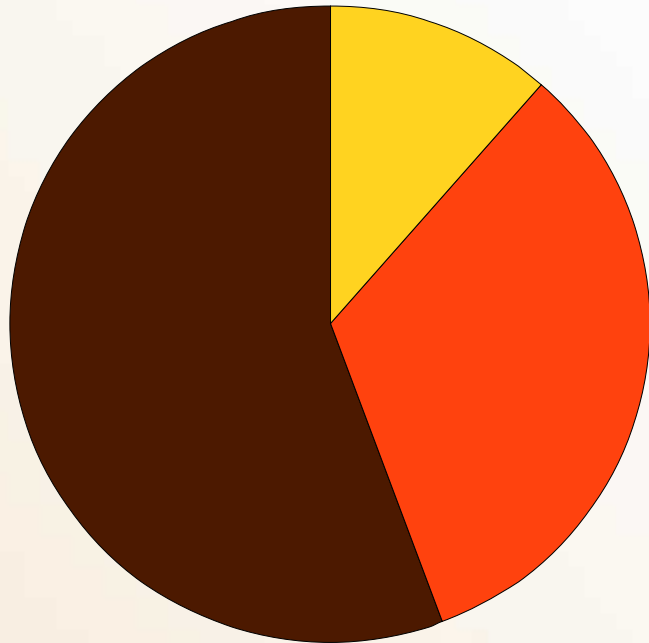
Genetic diversity values (nucleotide diversity)



THE ABANDONMENT OF RURAL AREAS CONTRIBUTES TO POPULATION GROWTH OF *R. hipposideros* IN GALICIA.

R. hipposideros AND ABANDONED BUILDINGS

61 SUMMER CLUSTERS



Abandoned buildings	55,74%
Buildings in use	32,78%
Others	11,48%





THE ABANDONMENT OF RURAL AREAS CONTRIBUTES TO POPULATION GROWTH OF *R. hipposideros* IN GALICIA.

R. hipposideros AND LANDSCAPE

MAXENT: Maximum Entropy modelling → “Only presence” method

Explaining *R. hipposideros* distribution in Galicia

Climatic

RAN: Mean annual precipitations

TAN: Mean annual temperature

TMAX: Mean of maximal temperatures in hottest month.

TMIN: Mean of minimum temperatures in coldest month.

Relief

ALT: Altitude

SLO: Mean of slopes

ORIENT: Orientation

RUG: Rugosity

Landscape

WOOD: Deciduous forests (%)

REFOR: Timber crops (%)

RURAL: Rural landscapes (%)

SHRUB: Bushes (%)

URBAN: Urban areas (%)

OTHER: Other uses (%)

RIVER: Rivers length

BUILD: Number of buildings

Local scale (1x1 Km. cell)

Regional scale (5x5 Km. cell)



THE ABANDONMENT OF RURAL AREAS CONTRIBUTES TO POPULATION GROWTH OF *R. hipposideros* IN GALICIA.

R. hipposideros AND LANDSCAPE

BEST MODEL:

Relief + Landscape. AUC value= $0,80 \pm 0,05$

ALTITUDE

RUGOSITY

URBAN

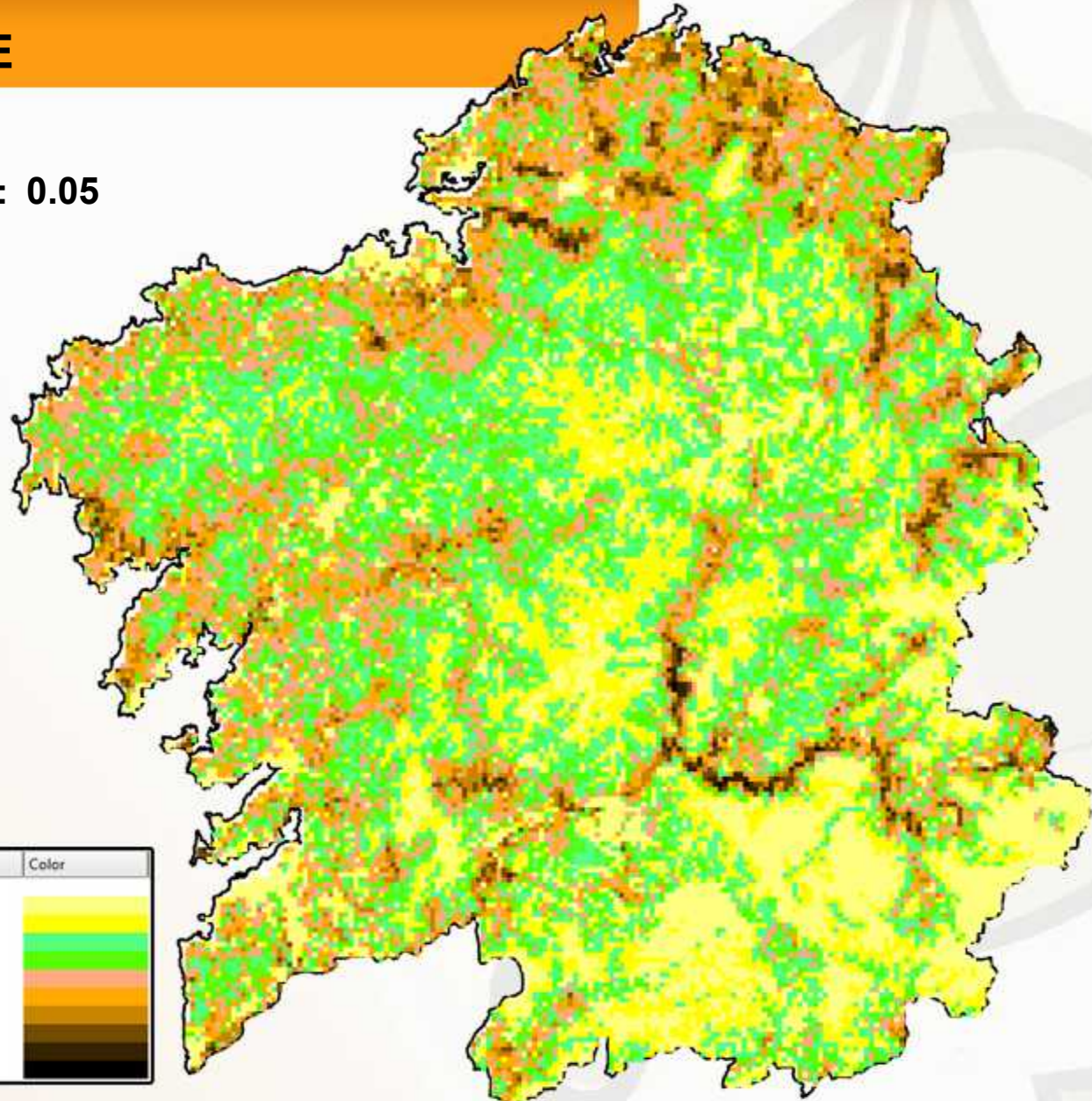
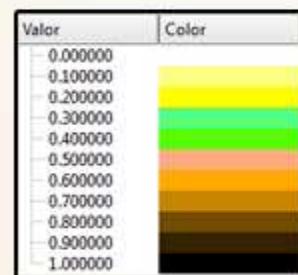
BUILD

WOOD 5X5

REFOR 5X5

OTHER 5X5

RIVER





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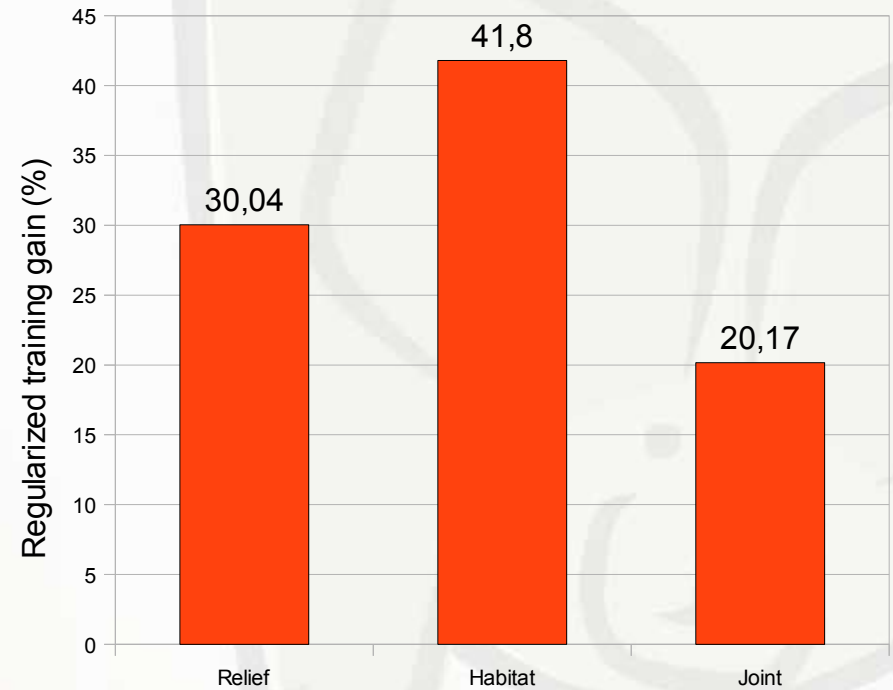
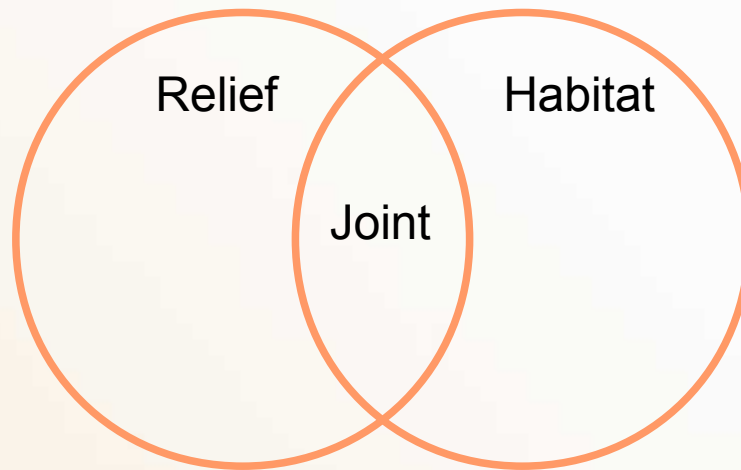
R. hipposideros AND LANDSCAPE

BEST MODEL:

Relief + Landscape. AUC value= $0,80 \pm 0.05$

- ALTITUDE
- RUGOSITY
- URBAN
- BUILD
- WOOD 5X5
- REFOR 5X5
- OTHER 5X5
- RIVER

Variation Partitioning Analysis

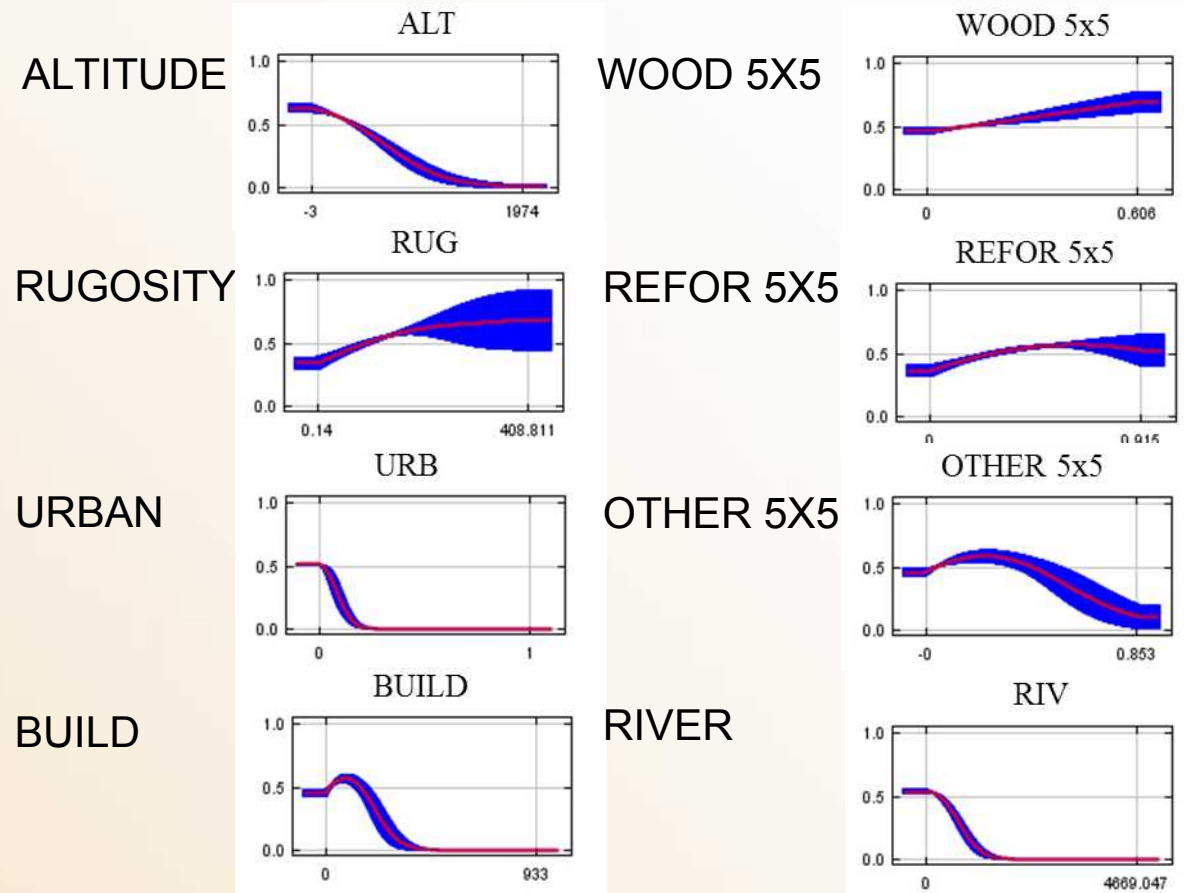




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R. hipposideros AND LANDSCAPE

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THE ABANDONMENT OF RURAL AREAS CONTRIBUTES TO POPULATION GROWTH OF *R. hipposideros* IN GALICIA.

RECAPITULATION

More than 10% of the nucleus of population in Galicia are abandoned

Consequences of the abandonment → Empty buildings
→ Increasing of forested areas

Demographic evolution → Neutrality test Fu's F_s (*)
→ Genetic diversity **

55,74% of the clusters roost in abandoned buildings

MAXENT Model Relief + Landscape. AUC value= $0,80 \pm 0.05$

→ Habitat pure effect 41,8%
→ Among habitat variables Deciduous forests and timber crops