Global Change

Master in Interdisciplinary Studies in Environmental, Economic and Social Sustainability

Global Change

Institut de Ciència i Tecnologia Ambientals (ICTA)

Universitat Autònoma de Barcelona (UAB)

2021-2022

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Global Change

Global Change and ornithofauna

Under the current global change scenario, there is an urgent need to understand better how organisms are affected by climate and other factors within the global change framework.

This step is essential to predict accurately the biological consequences of the ongoing alterations of climate or other issues, and thus take the necessary decisions to ensure conservation of wild populations, communities and ecosystems.

Sometimes some results emerge from the interannual climate variability but not is related with climate change

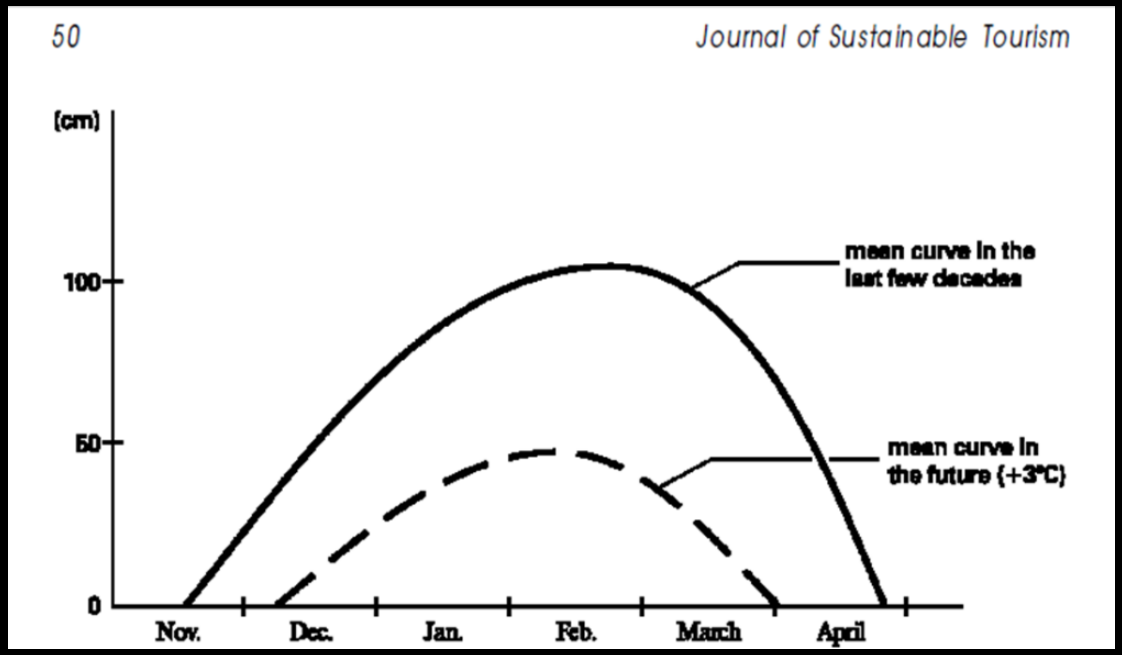
Scientists should we aware in order to attribute some interannual changes to climate change:

Two examples: snow amount and birds arrival from winter territories to Europe

Sometimes some results emerge from the interanual climate variability but not is related with climate change

Scientists should we aware in order to attribute some interanual changes to climate change:

Two examples: snow depth on ski resorts and nordic birds arriving for wintering in southern territories

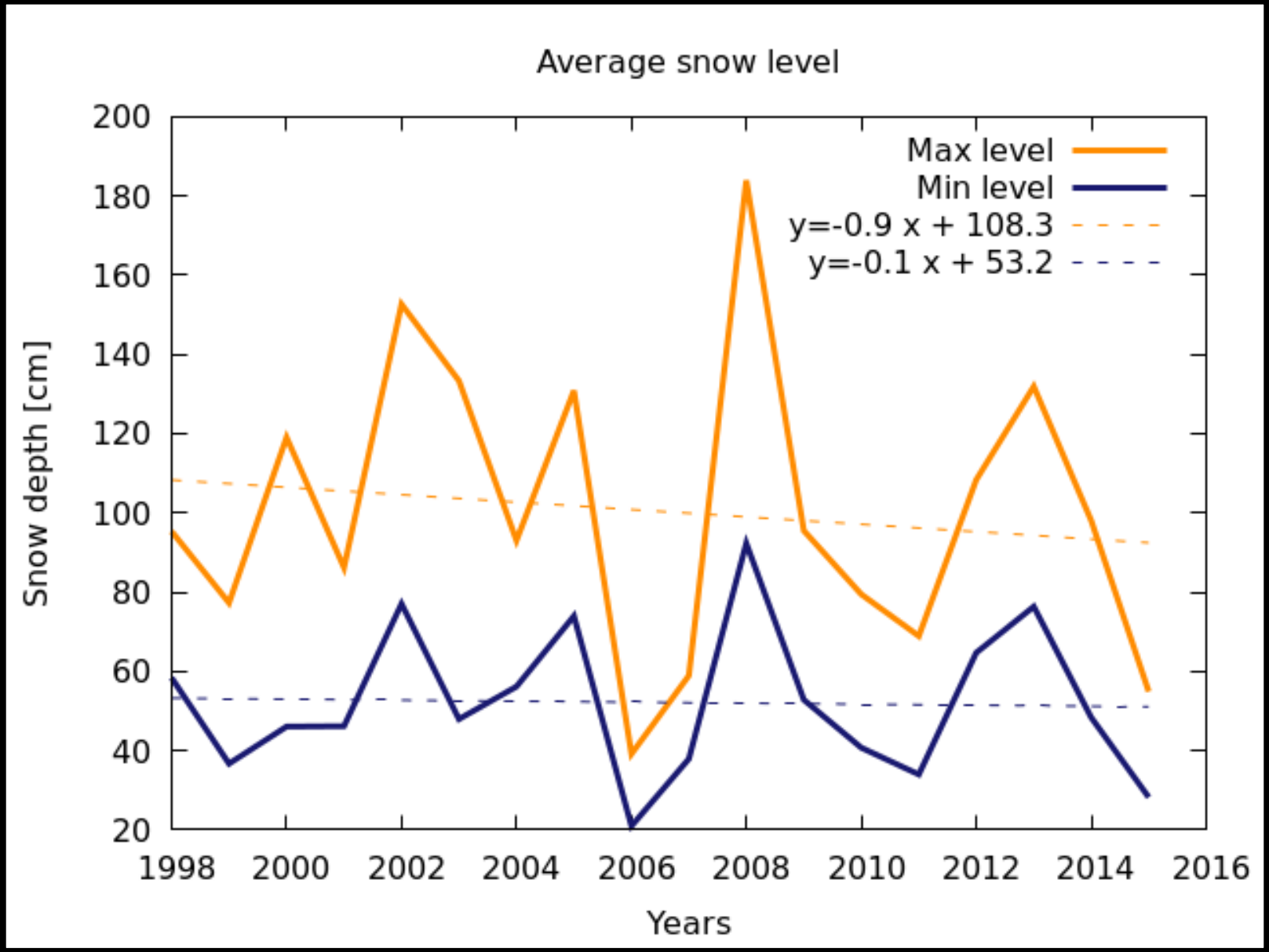


Ski tourism areas are especially affected by climate change.

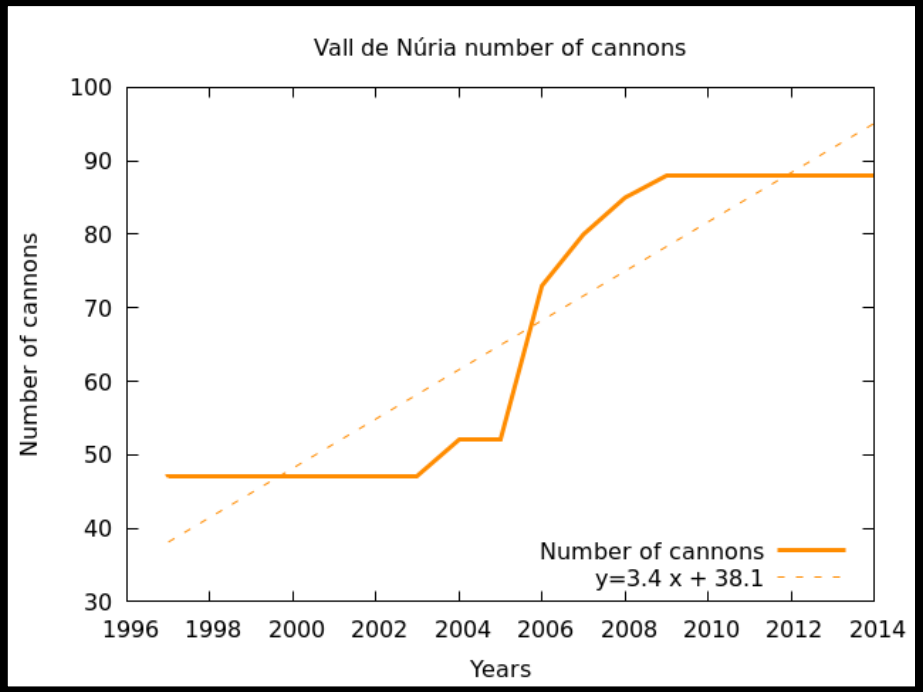
Low ranges are the most exposed.

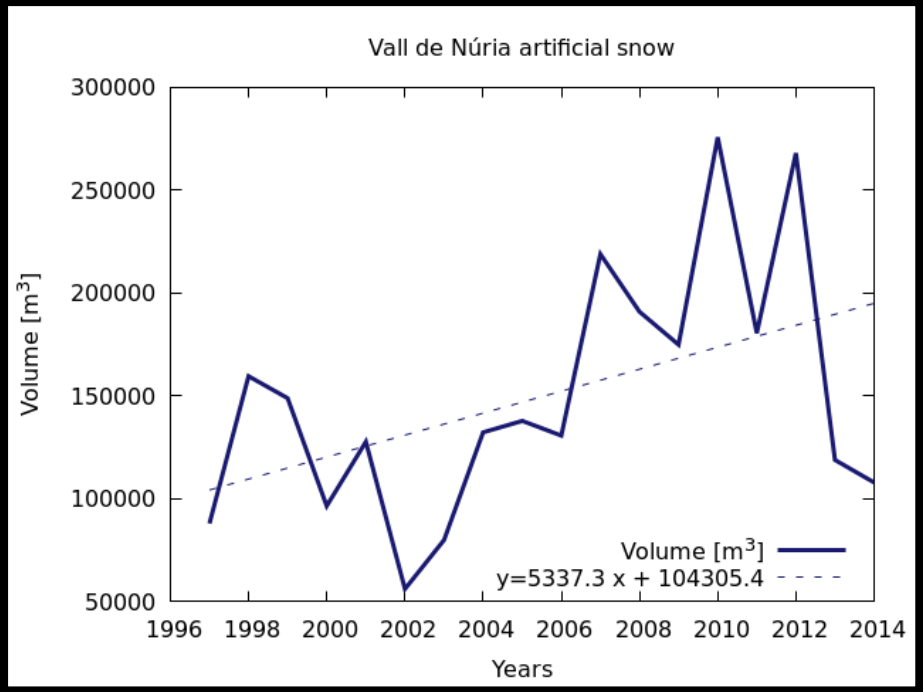
Catalan Pyrenees are highly influenced by Mediterranean climate.
Maximum heights of 3000 m.

Snow depth evolution



Both artificial snow production and specially snow cannons have greatly increased throughout the analysed years.





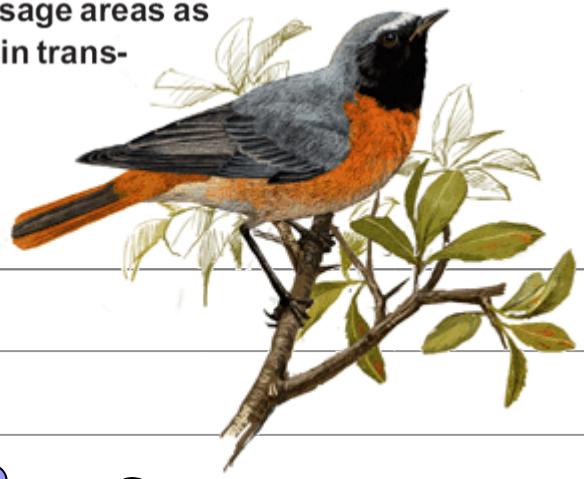
Journal of Animal Ecology

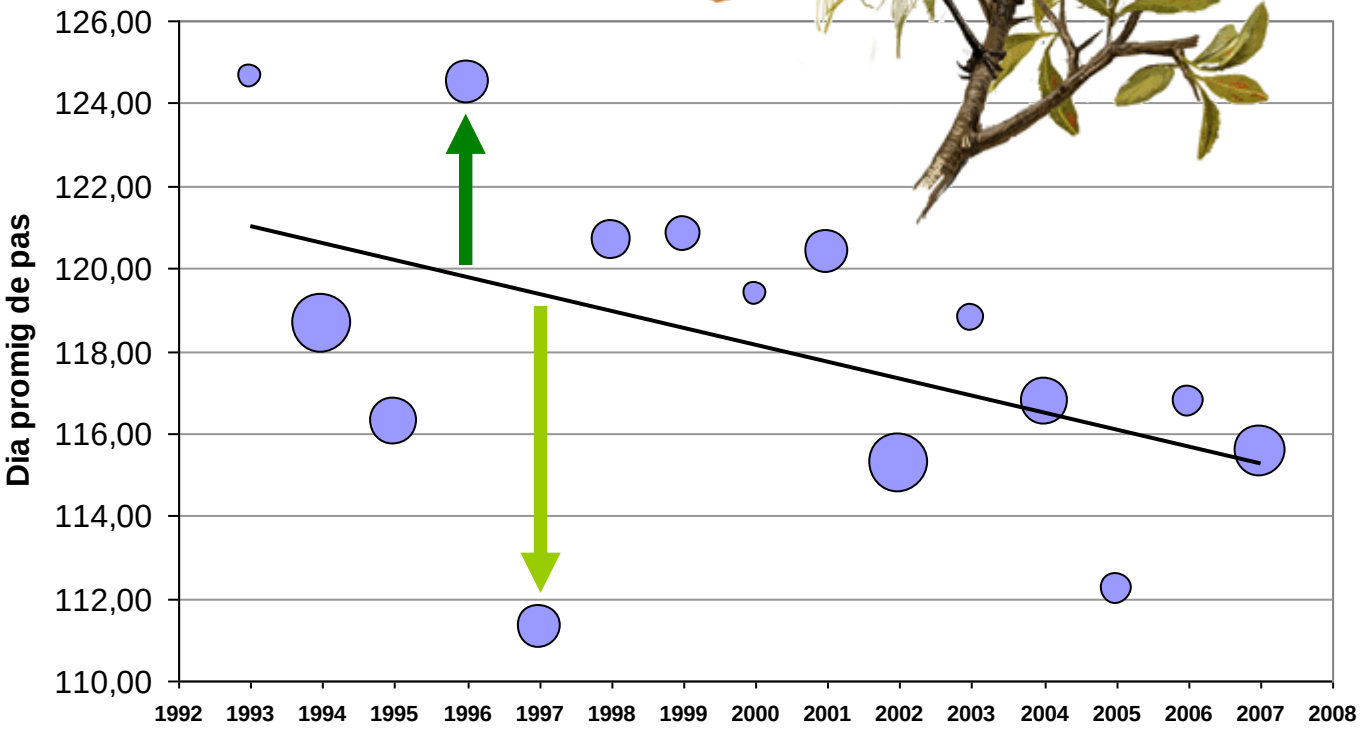
British Ecological Society

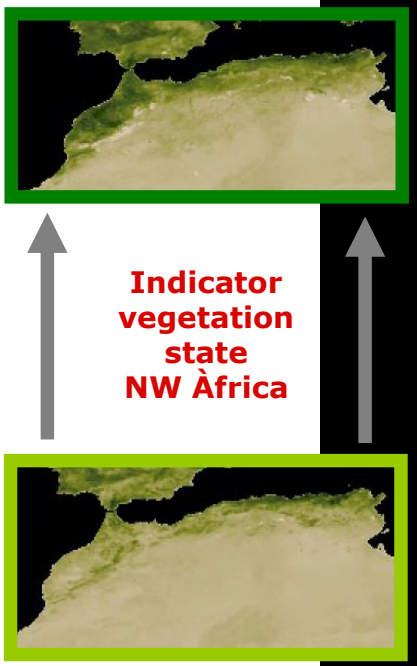
Journal of Animal Ecology 2011, **80**, 320–331 doi: 10.1111/j.1365-2656.2010.01772.x

Ecological conditions in wintering and passage areas as determinants of timing of spring migration in trans-Saharan migratory birds

David Robson[1]* and Carles Barriocanal[2,1]

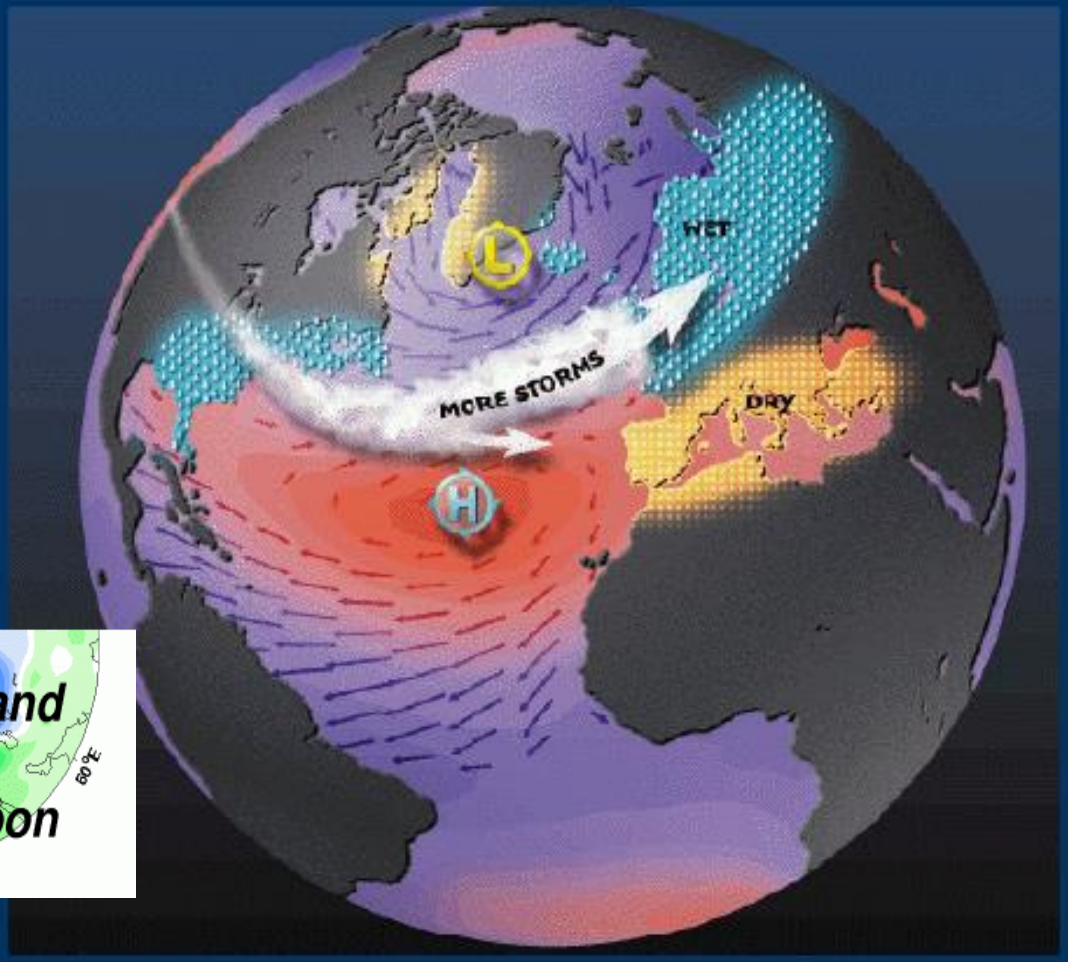


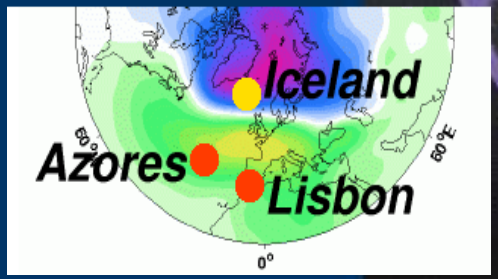




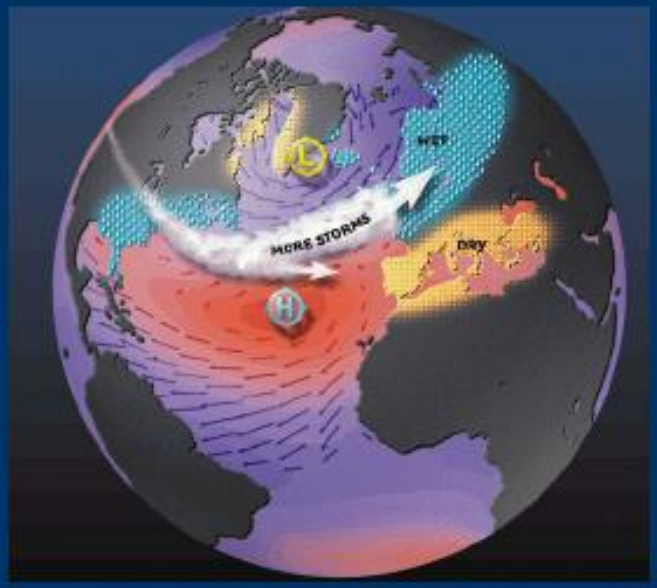
Something is similar when analyzing some teleconnexion such as NAO, el NIÑO, la NIÑA

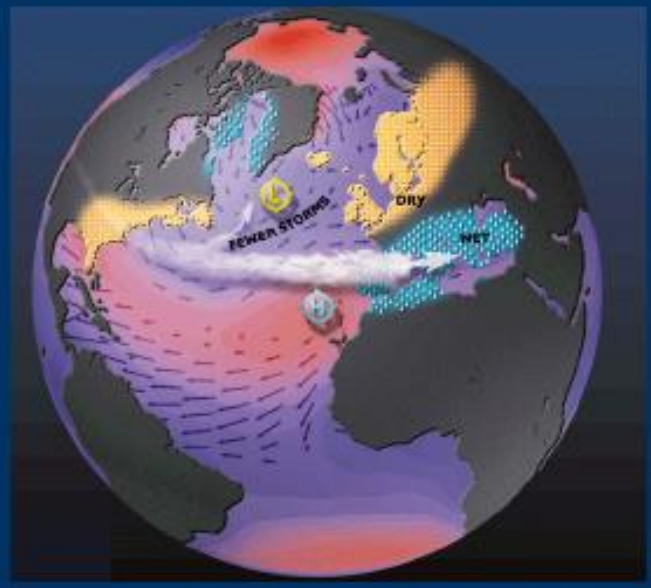
The North Atlantic Oscillation

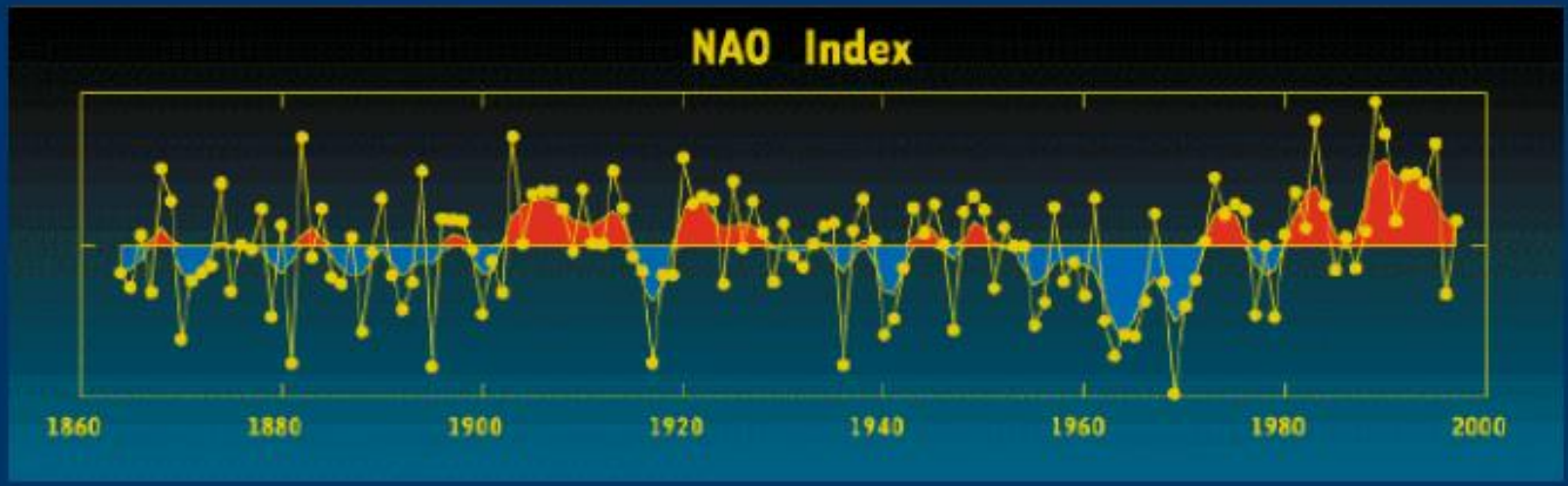




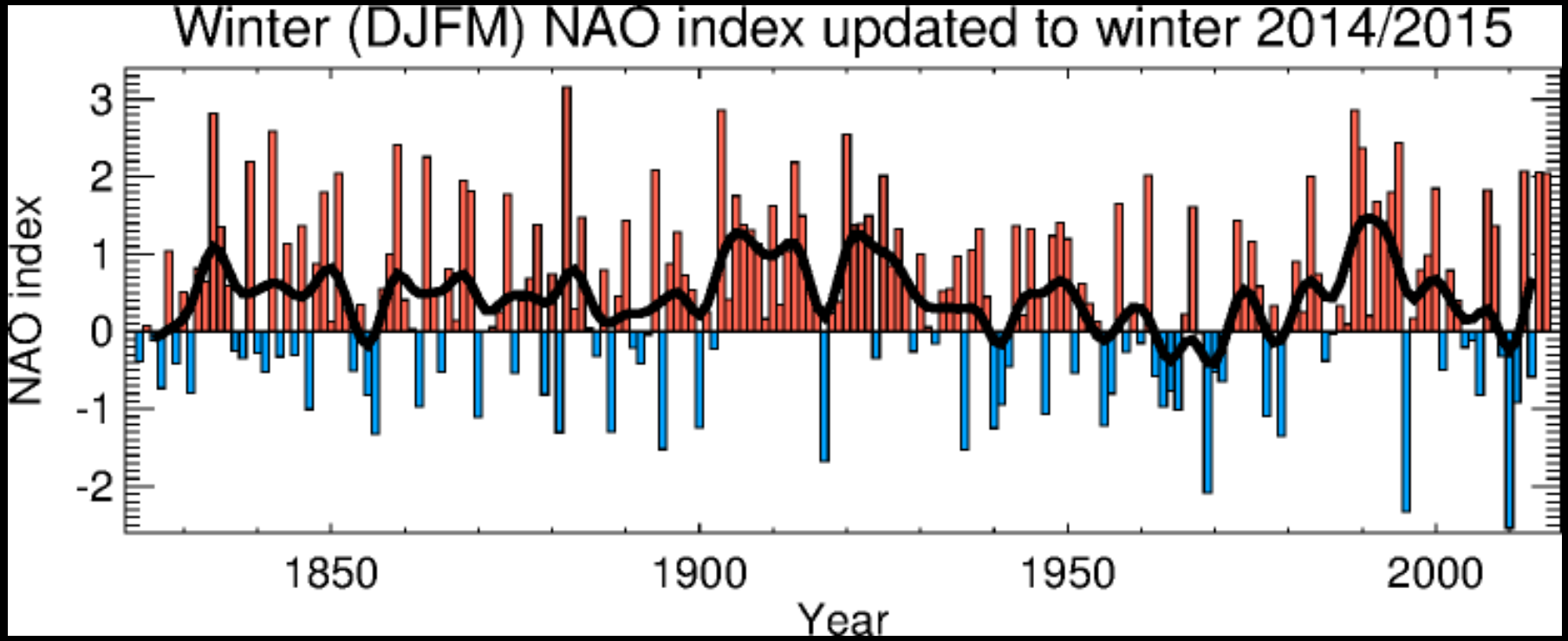
The NAO is the dominant mode of winter climate variability in the North Atlantic region ranging from central North America to Europe and much into Northern Asia. The NAO is a large scale seesaw in atmospheric mass between the subtropical high and the polar low. The corresponding index varies from year to year, but also exhibits a tendency to remain in one phase for intervals lasting several years.



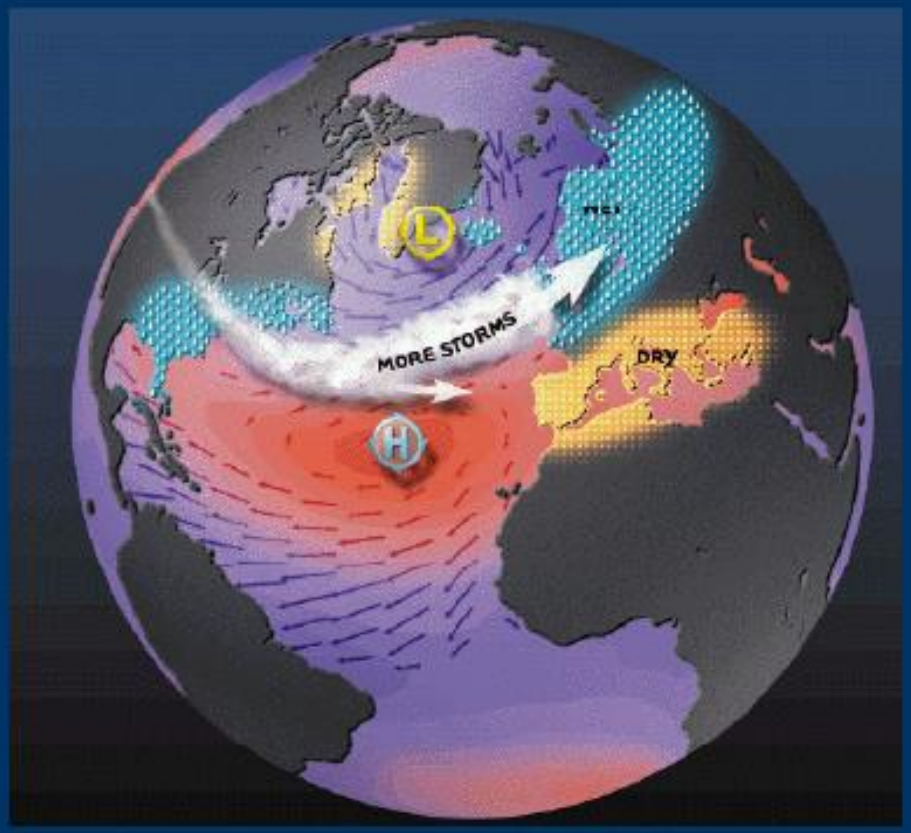




The NAO index is defined as the anomalous difference between the polar low and the subtropical high during the winter season (December through March)


Winter (DJFM) NAO index updated to winter 2014/2015
NAO index
3
2
1
0
-1
-2
1850
1900
1950
2000
Year

Positive NAO Index



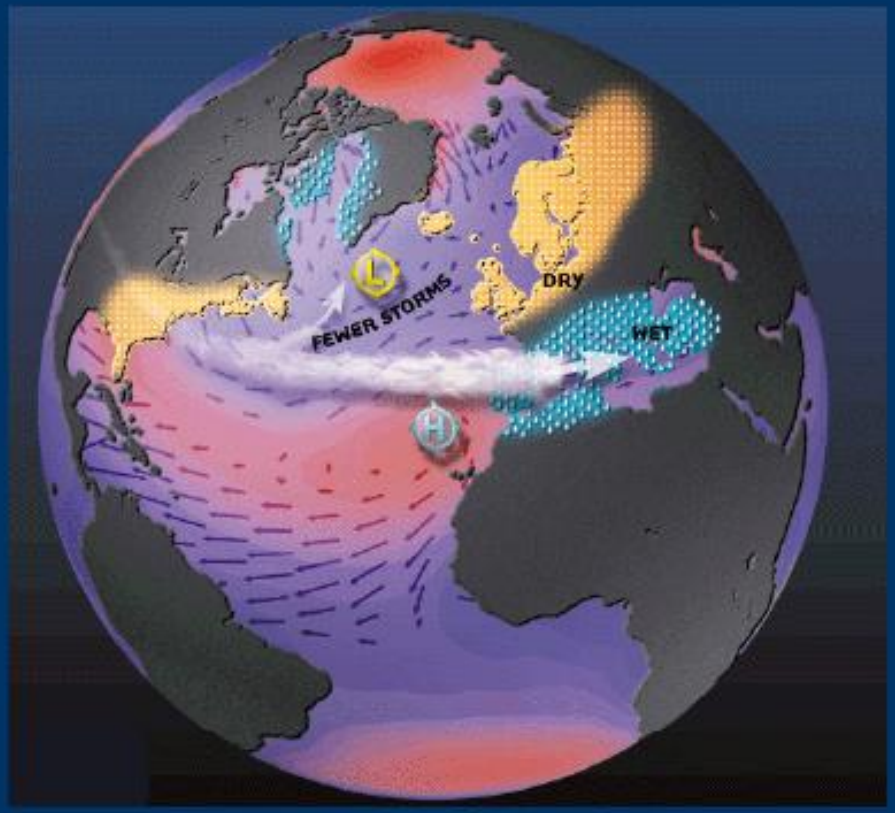
The Positive NAO index phase shows a stronger than usual subtropical high pressure center and a deeper than normal Icelandic low.

The increased pressure difference results in more and stronger winter storms crossing the Atlantic Ocean on a more northerly track.

This results in warm and wet winters in Europe and in cold and dry winters in northern Canada and Greenland

The eastern US experiences mild and wet winter conditions

Negative NAO Index



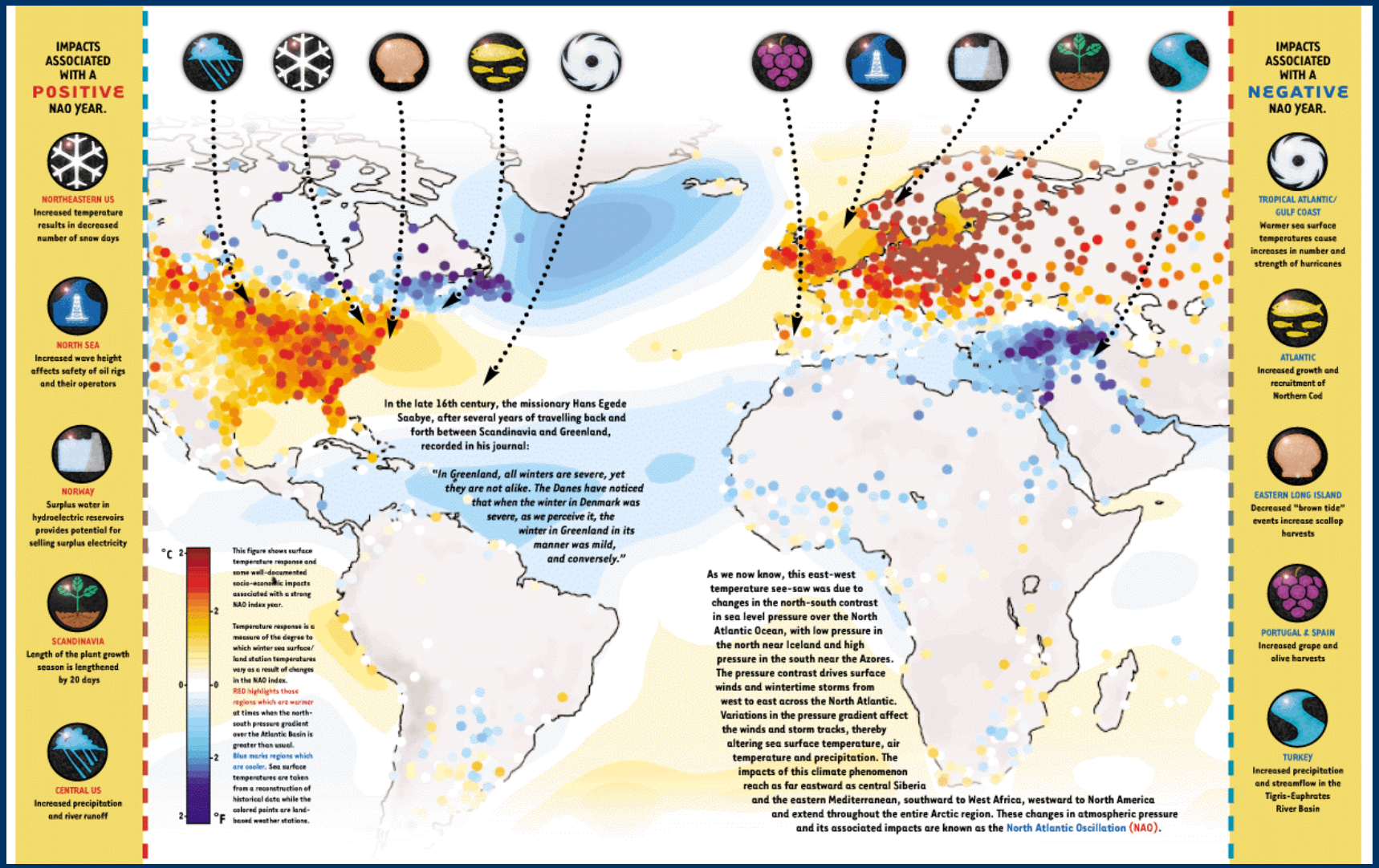
The Negative NAO index phase shows a weak subtropical high and a weak Icelandic low.

The reduced pressure gradient results in fewer and weaker winter storms crossing on a more west-east pathway.

They bring moist air into the Mediterranean and cold air to northern Europe

The US east coast experiences more cold air outbreaks and hence snowy weather conditions.

Impacts of the NAO



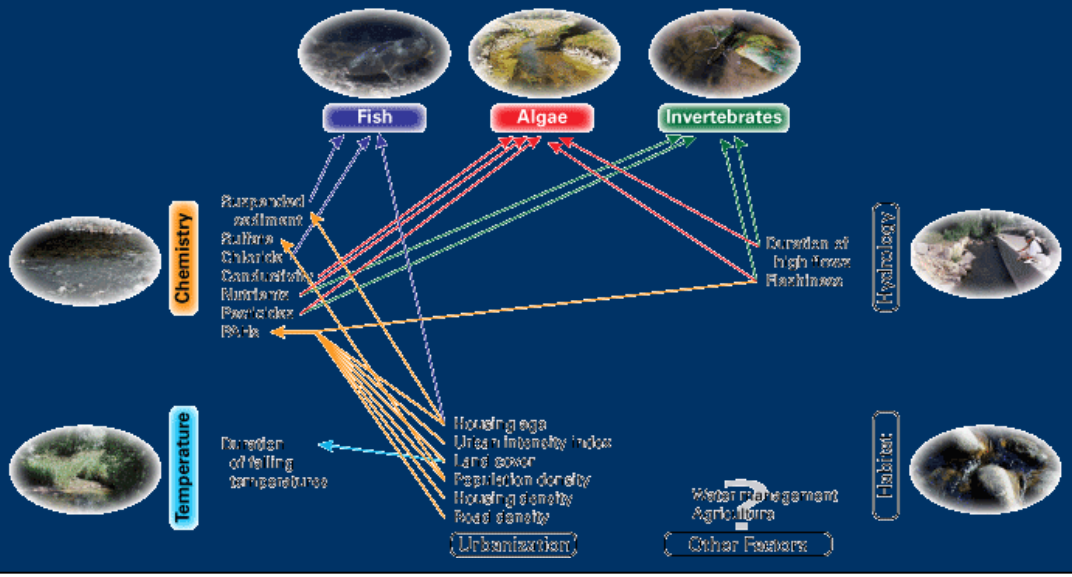
Impacts of the NAO

Effects on processes and patterns of terrestrial ecosystems

↓

plants and animals

The NAO index correlates with several biological variables.



Taxonomic group Species	Location	Time period or length	Biological variable	Relationship with NAO	Suggested mechanism	Reference
Plants						
Anemone hepatica, A. nemorosa, Convallaria majalis, Linnaea borealis, Epilobium angustifolium,Tussilago farfara, Caltha palustris, Oxalis acetosella, Primula officinalis, Trientalis europaea	Helle, Norway (and other locations)	1928-1977	Dates of flowering; flowering season lenght	- (lin), except two last species; + (lin) in 4 cases	Temperature	*Post and Stenseth*, 1999; *Post et al.*, 2001a; *Post et al.*, 2001b
Calluna vulgaris and *Vaccinium myrtillus*	Several locations, Norway	1928-1977	Dates of flowering	- (lin) on 50% of locations	Temperature	*Post and Stenseth*, 1999
Betula pubescens	Several locations, Norway	1928-1977	Date of leaf emergence	- (lin) on 50% of locations	Temperature	*Post and Stenseth*, 1999
European beech (*Fagus sylvatica*)			Diameter of tree rings	- (lin) in parts of time series	availability of water in soil in spring	*Piovesan and Schirone*, 2000
Several species (not given)	eastern North America and western Europe	1700-1979	Diameter of tree rings	sign. relationship	temperature/ precipitation depending on region	*Cook et al.*, 1998
Fir (*Abies balsamea*)	Isle Royale, USA		Diameter of tree rings	- (lin)		*Post et al.*, 1999d
Scots pine (*Pinus silvestris*); white spruce (*Picea glauca*)	Fennoscandia and Labrador		Diameter of tree rings			*D'Arrigo et al.*, 1993
Norway spruce (*Picea abies*)	Flatanger, central Norway	1898-1997 1920-1940	Diameter of tree rings	0 - (lin)	Temperature	*Solberg et al.*, 2002
Wheat	U.K.	1972-1996	3 quality indices	+ (lin) with 2 indices; no relationship with 3rd	precipitation in August	*Kettlewell et al.*, 1999
Wine	Spain	1964-1994	quality	0		*Rodó and Comín*, 2000
Wine	Portugal	33 yrs	quality	- (lin)	Precipitation	*Esteves and Orgaz*, 2001
Amphibians						

Mysterud et al. (2003) Geophysical Monograph 134

Impacts of the NAO on fauna

No study has yet been published of the effects of the NAO on invertebrate populations.

The effect of temperature on butterfly populations is well documented.

Pararge aegiria

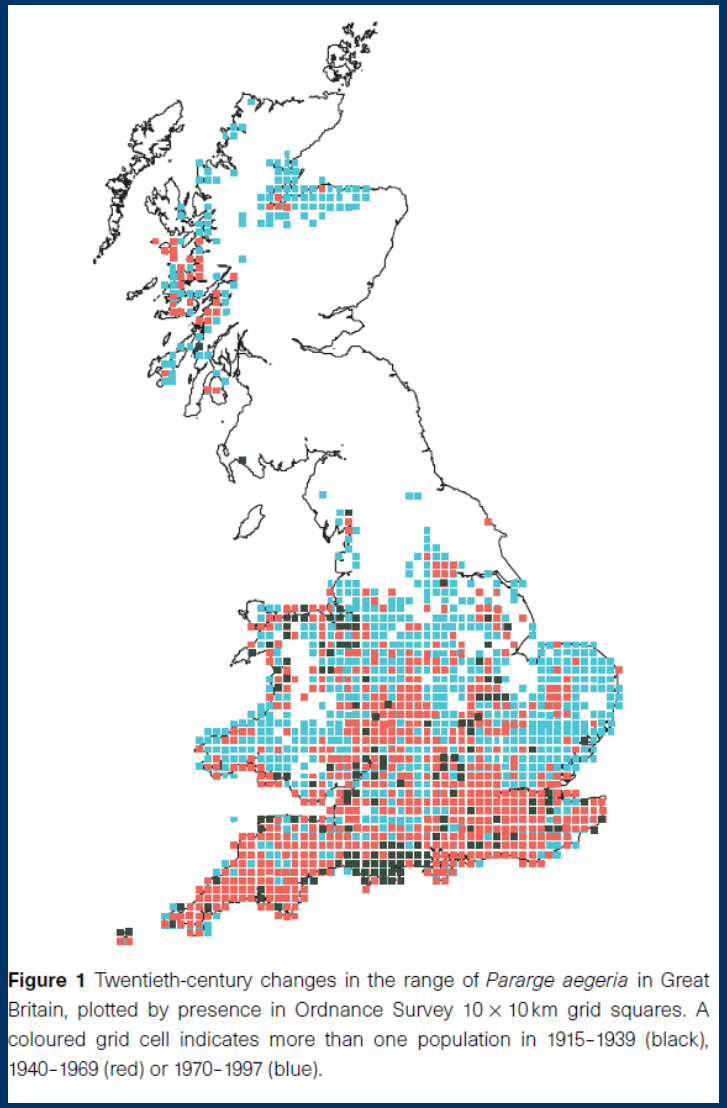


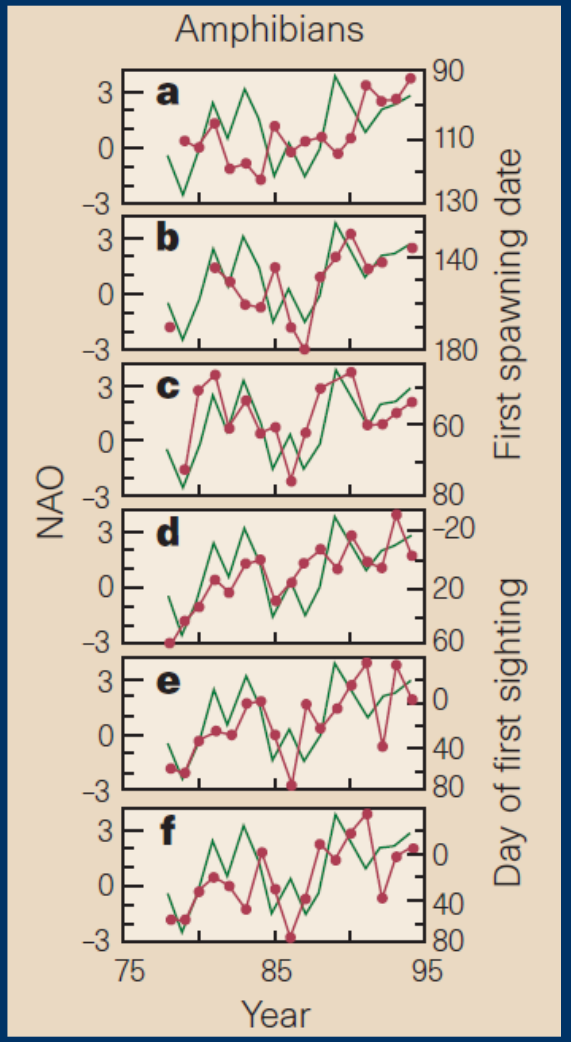
Figure 1 Twentieth-century changes in the range of *Pararge aegeria* in Great Britain, plotted by presence in Ordnance Survey 10 × 10 km grid squares. A coloured grid cell indicates more than one population in 1915–1939 (black), 1940–1969 (red) or 1970–1997 (blue).

Parmesan et al. (1999) Nature

Impacts of the NAO on fauna

In the case of the amphibians, NAO index correlates with first sighting and first spawning date.

Bufo calamita



Forchhammer et al. (1998) Nature

Impacts of the NAO on fauna

Most studies on the effect of the NAO on mammals have been conducted on ungulates.

In fact, large animals have the capacity to switch habitat several times a day in response to variation in microclimate…..

…. and may also migrate over long distances due to seasonal changes in climete

Impacts of the NAO on fauna

Red deer in Norway

* Winter at low elevations

*Altitude is a key factor: precipitation comes as rain or snow

THERE IS AN ECOLOGICAL IMPACT OF NAO

* Negative correlation between NAO and snow depth at low altitude (< 400 m.)

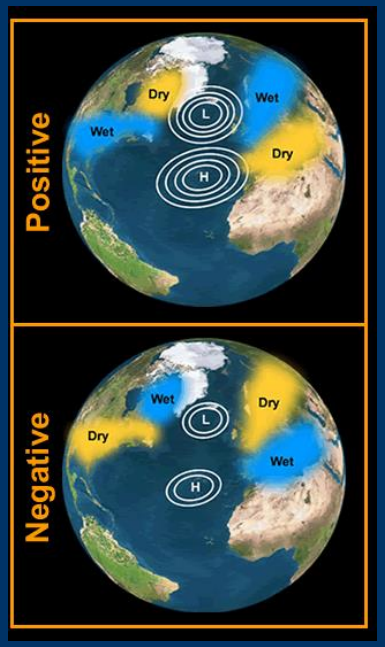
* Positive correlation between NAO and snow depth at high altitude

*Red deer forage in lowland during winters with a high NAO index due the field layer is easily available

*Higher temperatures represent less cold stress to the animals

Impacts of the NAO on fauna

Years with high NAO index values (warm and wet winters) favor large herbivorous ungulates:



* Less snow in the low-elevation wintering areas, decrease energetic costs of thermoregulation and movement, and increasing access to forage in the field layer during winter

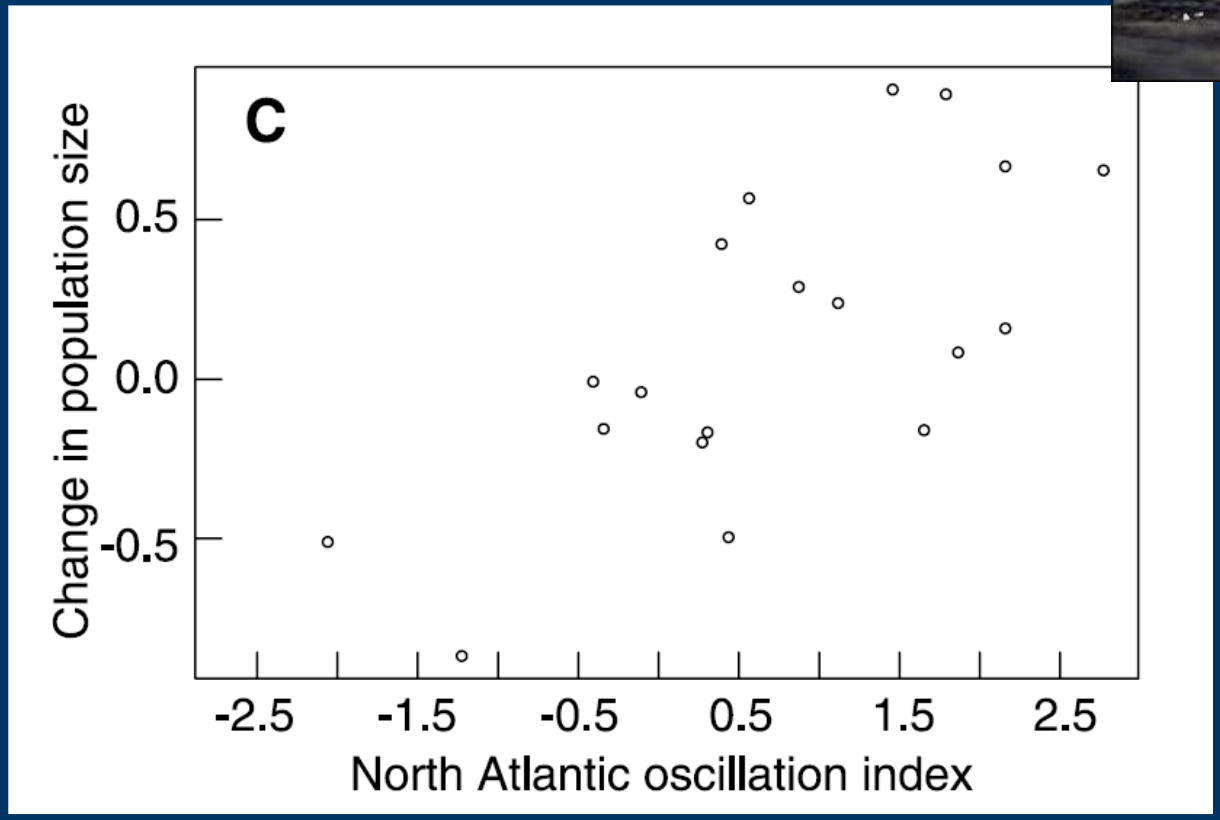
* More snow in the high elevation summer areas, will lead to a prolonged period of access to high quality forage during summer.

Impacts of the NAO on fauna

The effect of the NAO on birds

* Population dynamics

Cinclus cinclus



Parmesan et al. (2000) Science

Impacts of the NAO on fauna

The effect of the NAO on birds

* Breeding phenology

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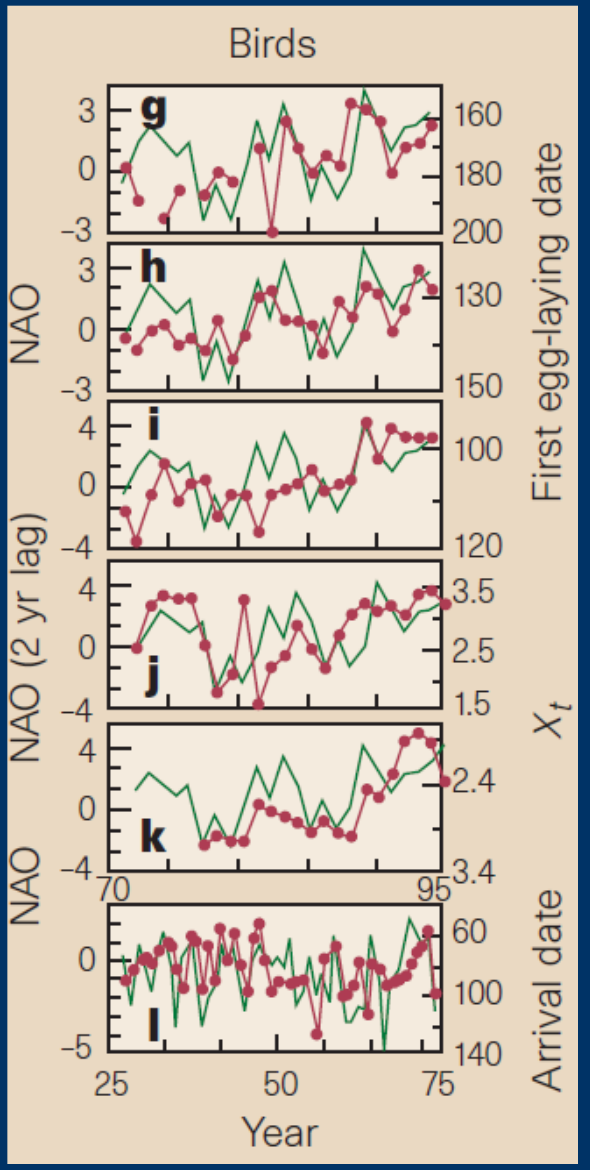


Forchhammer et al. (1998) Nature

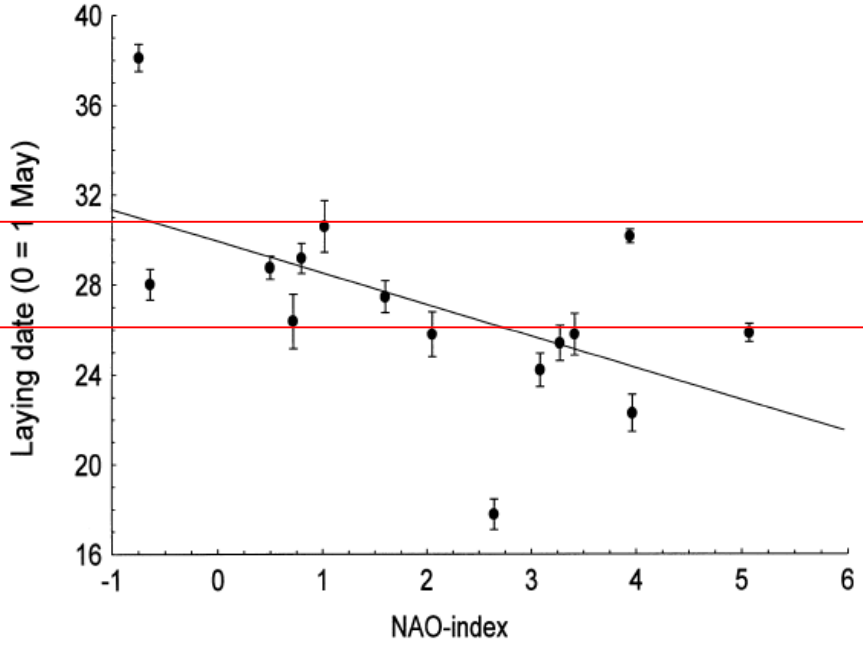
Impacts of the NAO on fauna

The effect of the NAO on birds

* Breeding phenology

Variable	E	*N*
Clutch size	± 0·015	844
Laying date	± 0·56	845
Fledging success	± 0·030	834
Male wing length	± 0·059	1080
Female wing length	± 0·051	1309

†$P < 0{\cdot}06$; * $P < 0{\cdot}05$;



Przbylo et al. (2000) Journal of Animal Ecology

Impacts of the NAO on fauna

The effect of the NAO on birds

* Migration phenology

One of the most prominent phenological events is the spring migration of birds.

The NAO is the most prominent pattern of atmospheric variability over the Northern Hemisphere that has a marked effect on the European weather especially during winter months and early spring.

Migratory behaviour is regulated by conditions in the wintering region and throught the migratory route.

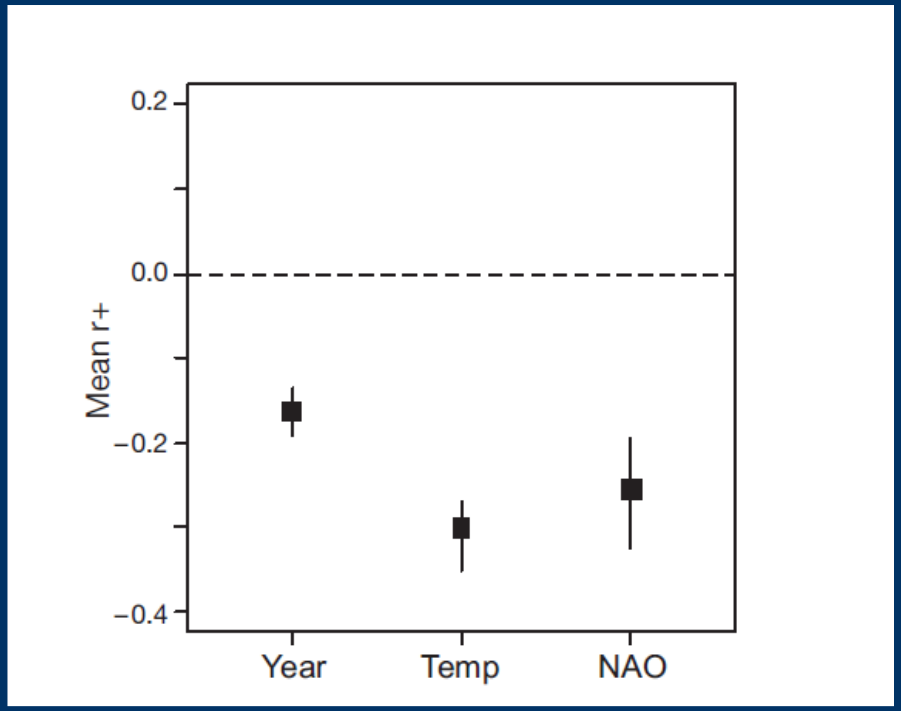
So, NAO estimate these conditions and could explain the phenology of migratory birds.

Impacts of the NAO on fauna

The effect of the NAO on birds

* Migration phenology

In northern latitudes, temperature and NAO are the most important explanatory factors of migration dates



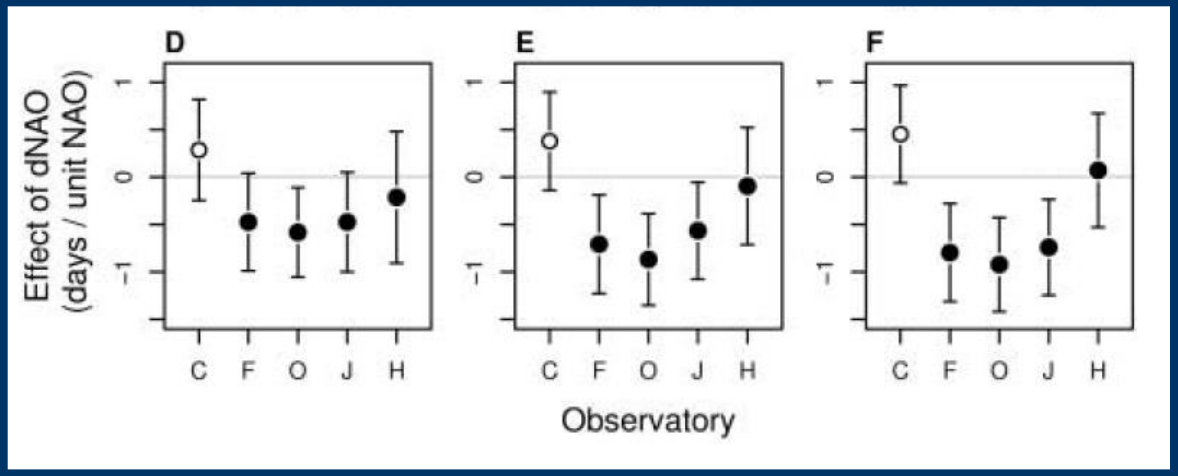
Impacts of the NAO on fauna

The effect of the NAO on birds

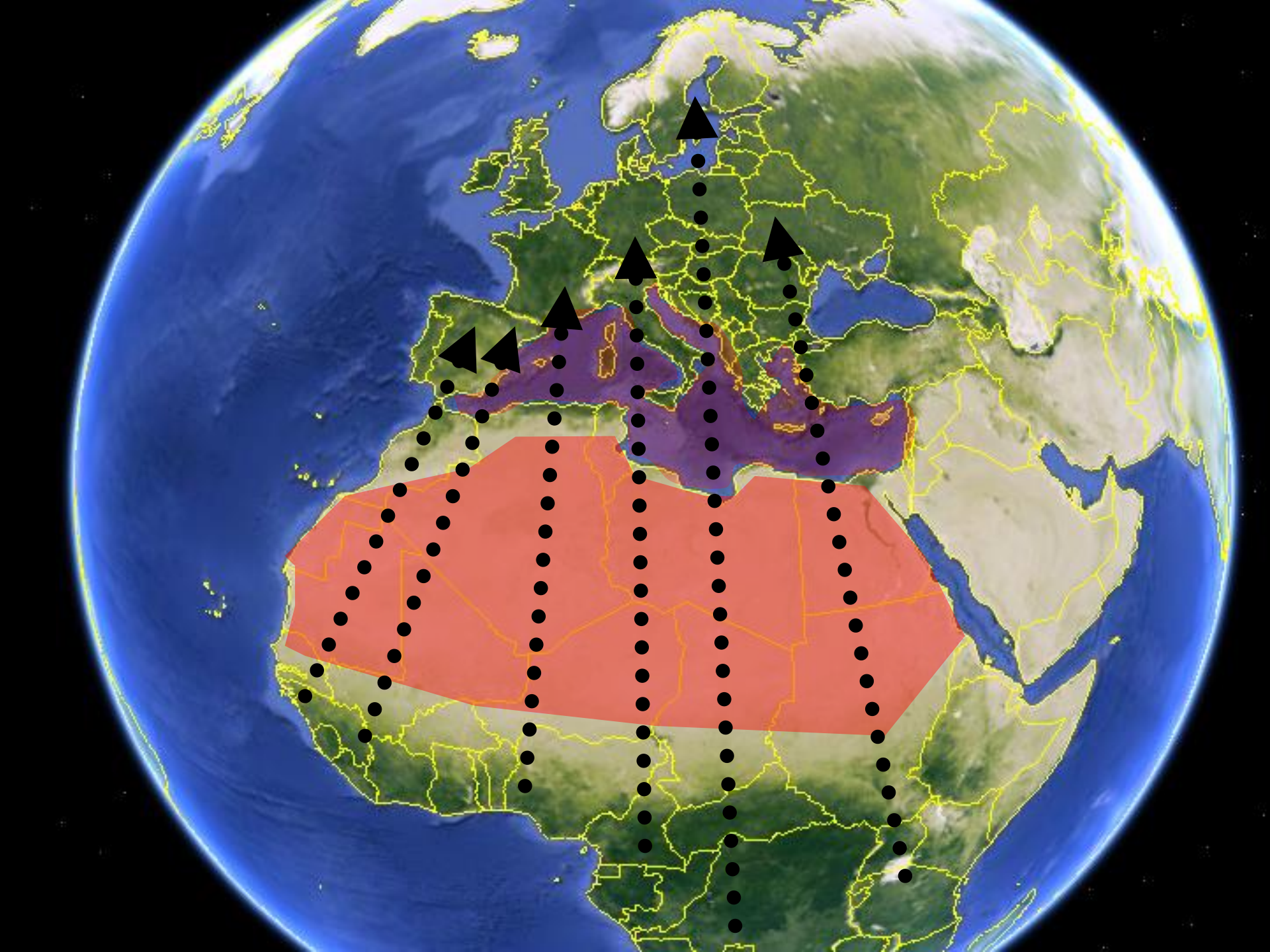
* Migration phenology

The peculiarities of atmospheric circulation in some zones of the Mediterranean basin make it difficult to generalise the effect of NAO index.

In the Iberian Peninsula and in Italy, high NAO values significantly delays the mean migration date.



Jonzen et al. (2006) Science



Impacts of the NAO on fauna

The effect of the NAO on birds

* Migration phenology

To what extend do the different environmental variables contribute to the variation in arrival time at western Mediterranean ?

Predictors of the timing of passage for the birds:

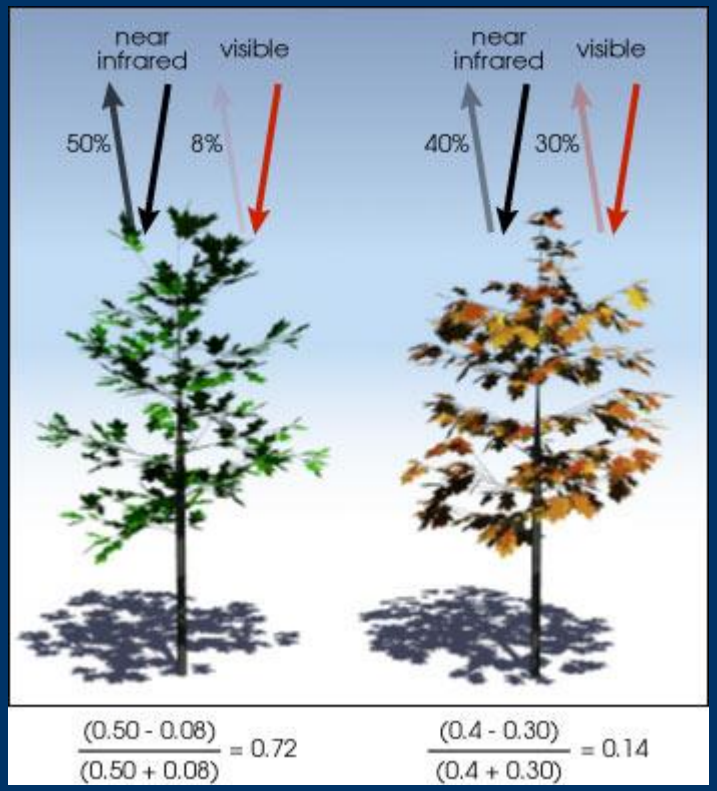
Temperature
NAO
NDVI
ENSO

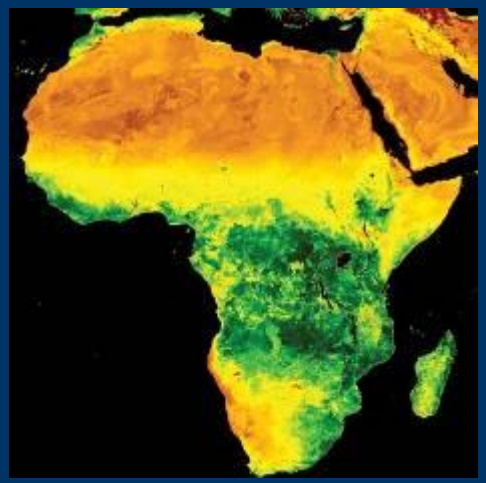
Impacts of the NAO on fauna

The effect of the NAO on birds

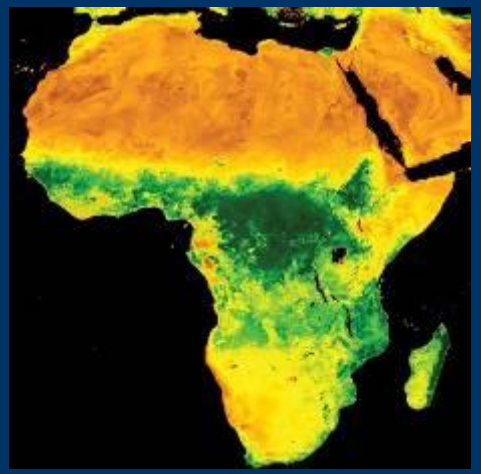
* Migration phenology

NDVI (normalised difference vegetation index)





January



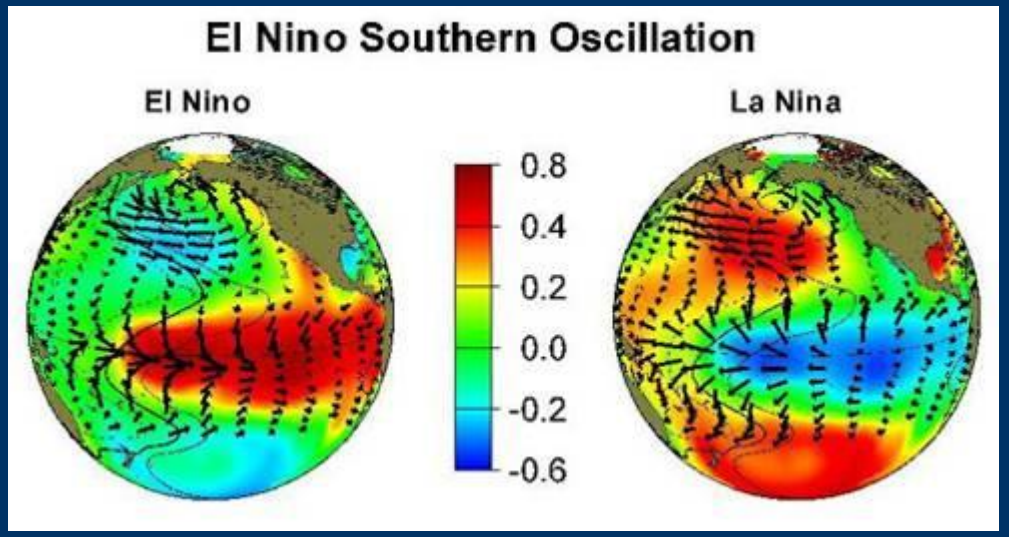
June

Impacts of the NAO on fauna

The effect of the NAO on birds

* Migration phenology

ENSO (el niño-southern oscillation)

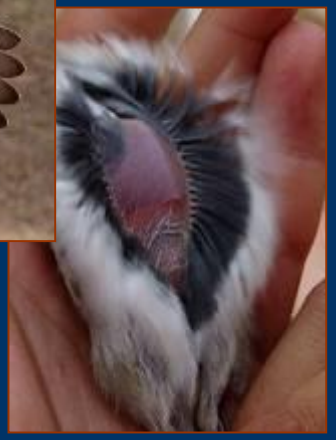


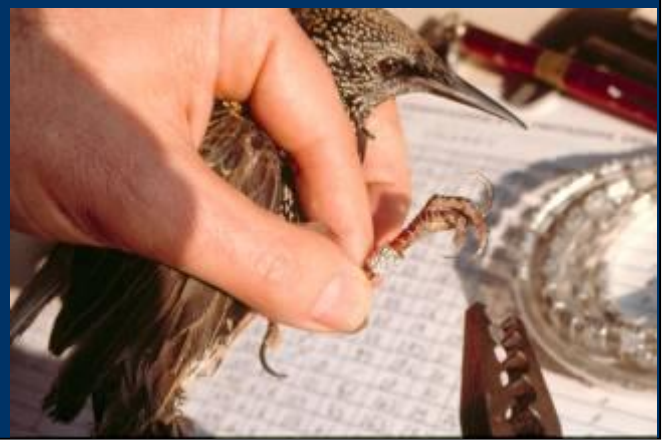
Positive anomalies correspond to drier conditions in the Gulf of Guinea and reduced rainfall in the Sahel.

Impacts of the NAO on fauna

The effect of the NAO on birds

* Migration phenology





Impacts of the NAO on fauna

The effect of the NAO on birds

* Migration phenology

Scientific name	Common name	N	Mean	SD	Allowed range for prior	Total
Acrocephalus scirpaceus	Reed Warbler	43	133	7	90 - 150	936
Ficedula hypoleuca	Pied Flycatcher	44	120	6	95 - 145	3831
Hippolais polyglotta	Melodious Warbler	38	128	7	105 - 150	1197
Lanius senator	Woodchat Shrike	44	115	8	85 - 140	1442
Luscinia megarhynchos	Nightingale	43	111	7	90 - 140	3225
Muscicapa striata	Spotted flycatcher	44	127	4	105 - 150	3041
Phoenicurus phoenicurus	Redstart	44	118	5	80 - 140	6279
Phylloscopus bonelli	Western Bonelli's Warbler	34	118	8	95 - 135	550
Phylloscopus trochilus	Willow Warbler	44	116	6	85 - 135	29967
Phylloscopus sibilatrix	Wood Warbler	33	122	8	90 - 145	569
Saxicola rubetra	Whinchat	41	120	5	95 - 145	1597
Sylvia borin	Garden Warbler	44	128	9	100 - 150	5470
Sylvia communis	Whitethroat	44	120	6	90 - 150	6187

Impacts of the NAO on fauna

The effect of the NAO on birds

* Migration phenology

Temperature and NDVI:

*March and April for the region of North africa

*February and March for the sub-Saharan region

ENSO:

*Data for December-March

NAO (winter):

*Data for December-March

Impacts of the NAO on fauna

The effect of the NAO on birds

* Migration phenology

Parameter estimates (including 95% CI and unconditional SE) for a model averaged over the nine competing models with ΔAICc < 2 for mean passage date in 13 trans-Saharan passerines through the Mediterranean. All predictors were centered around their overall mean before the test. Only variables with 95%CI not overlapping zero are shown.

			95% CI	
	Estimate	**SE**	**Lower.**	**Upper**
NDVIN	63.6	0.895	61.8	65.3
NDVIS	164,0	7.650	149	179
YEAR	-0,515	0.023	-0.560	-0.469
TIMING	0.106	0.006	0.094	0.117
POPSIZE	0.0527	0.007	0.038	0.066
WING	-0.011	0.004	-0.019	-0.003
TIMING x NDVIN	-5,940	0.172	-6.280	-5.600

Symbols are: NDVIN = NDVI northern Africa, NDVIS = NDVI Sahel, YEAR = Year, TIMING = Mean migration schedule, WING = Annual mean wing length, POPSIZE = Annual population size change.

Phenological responses to climate warming

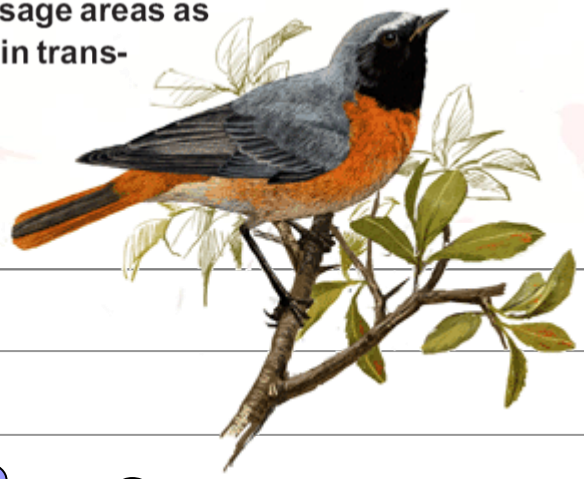
Journal of Animal Ecology

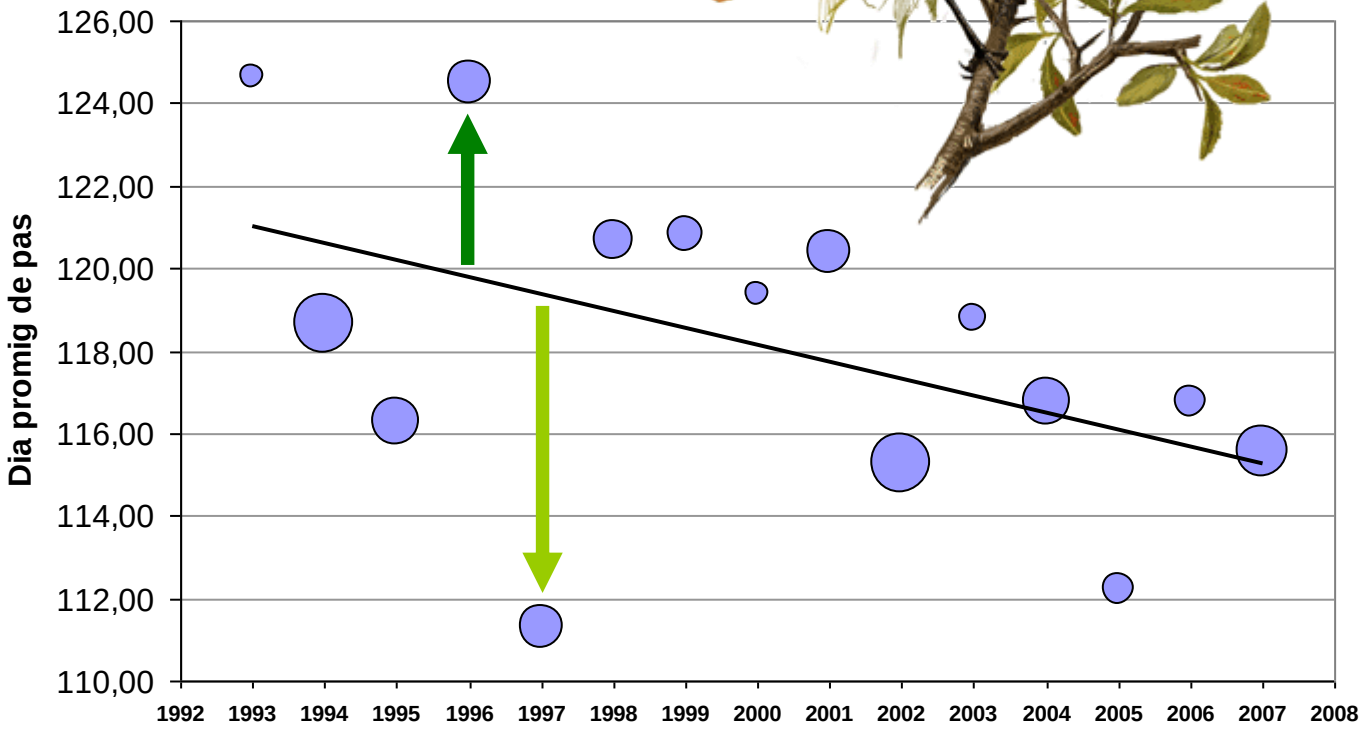
British Ecological Society

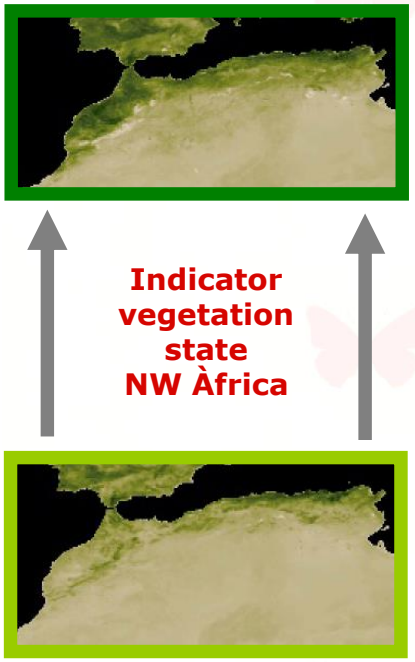
Journal of Animal Ecology 2011, **80**, 320–331 doi: 10.1111/j.1365-2656.2010.01772.x

Ecological conditions in wintering and passage areas as determinants of timing of spring migration in trans-Saharan migratory birds

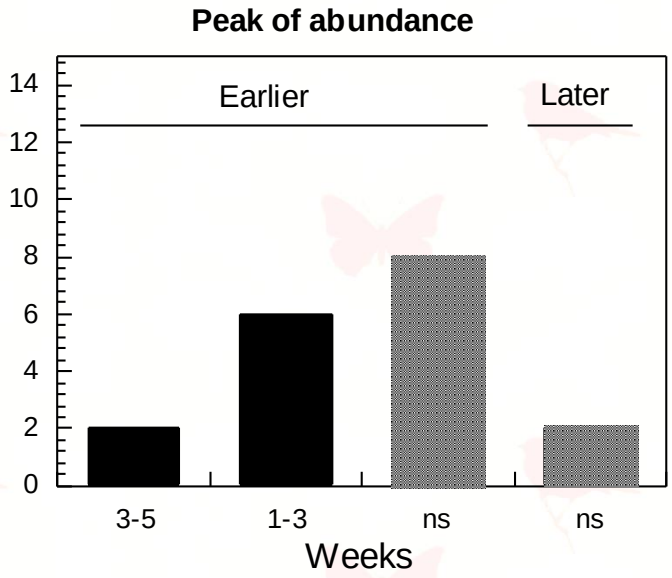
David Robson[1]* and Carles Barriocanal[2,1]







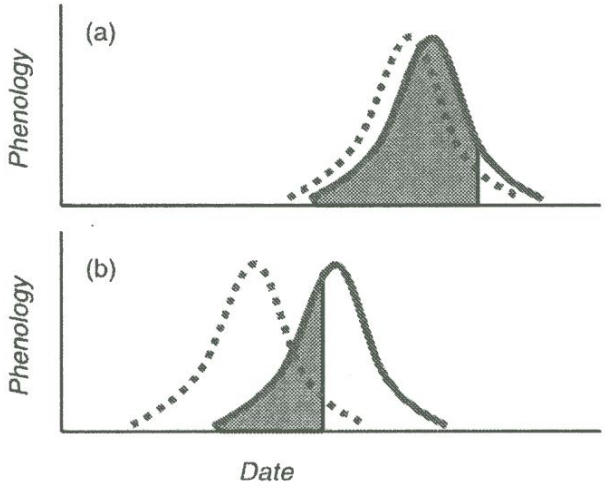
Phenological responses to climate warming



Phenological changes in butterflies at El Cortalet from 1988 to 2002. Frequency distribution of the species with advancing and delaying trends in phenophases. Significant trends ($P < 0.05$) are shown in black for advances; non-significant in grey.

Stefanescu et al., 2003. ***Global Change Biol.,*** 9: 1494-1506

Phenological mismatches



Both et al., 2006. *Nature*, 441: 81-83

Other examples:

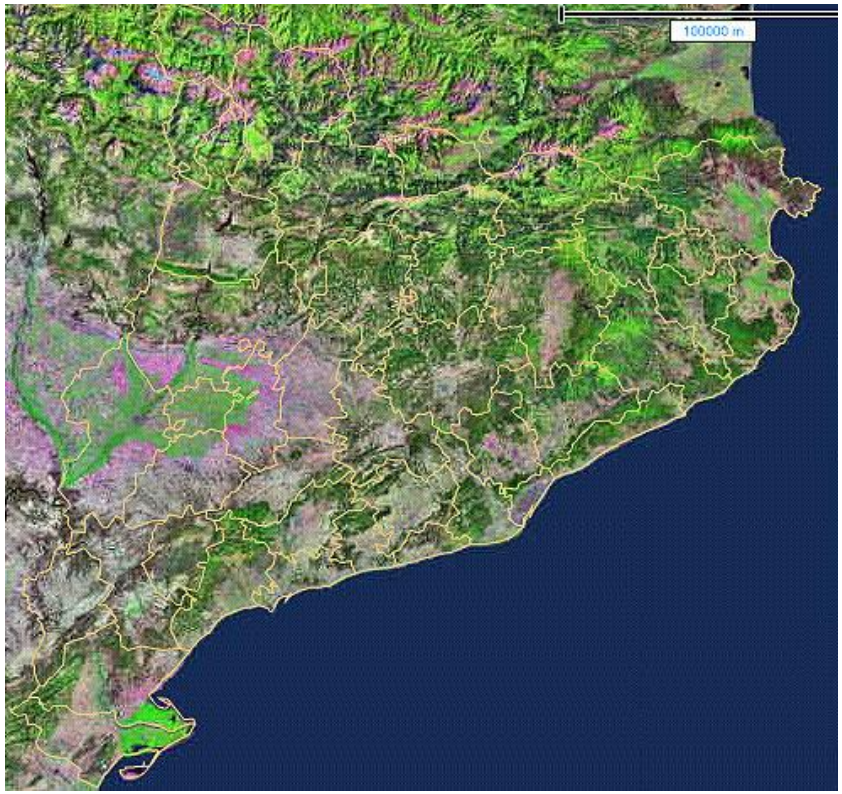
- Saino et al., 2011. *Proc. R. Soc. B.*, 278: 835-842

Bird Monitoring and Bird as a methodology to study the global change in birds

The Catalan Breeding Bird Atlas

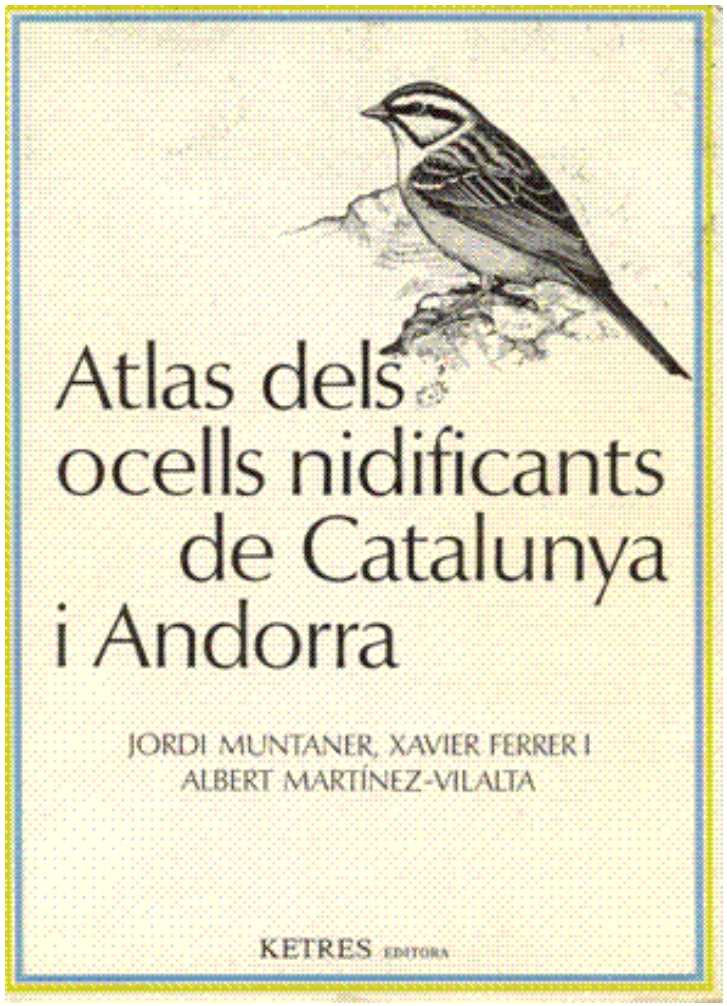
Institut Català d'Ornitologia

Catalonia: a small part of Spain

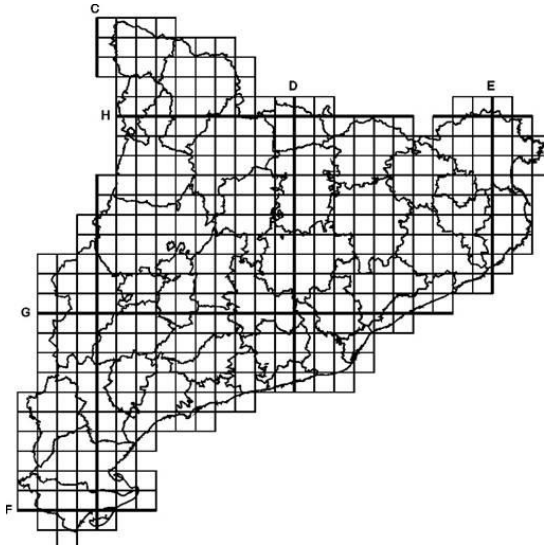


- 32.000 km^2 (6,3 % of Spain)

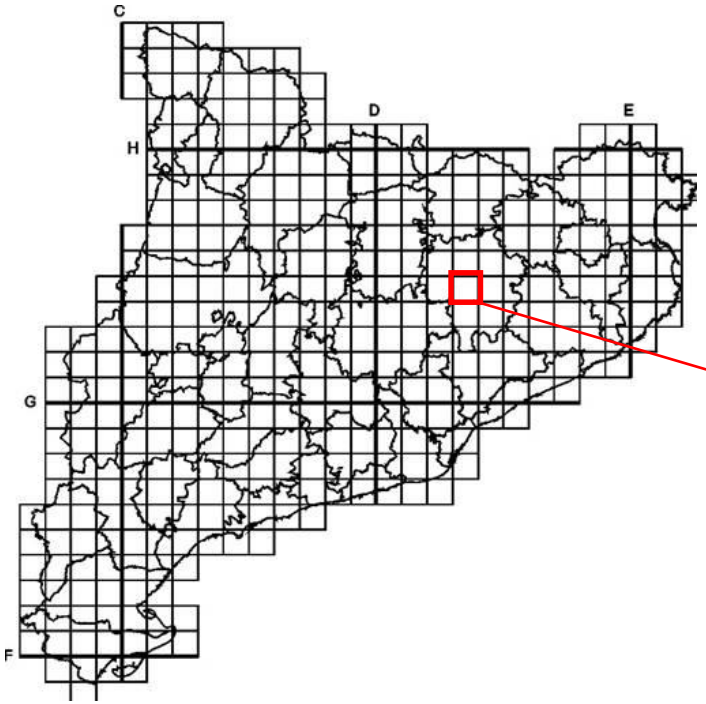
First Catalan Breeding Bird Atlas

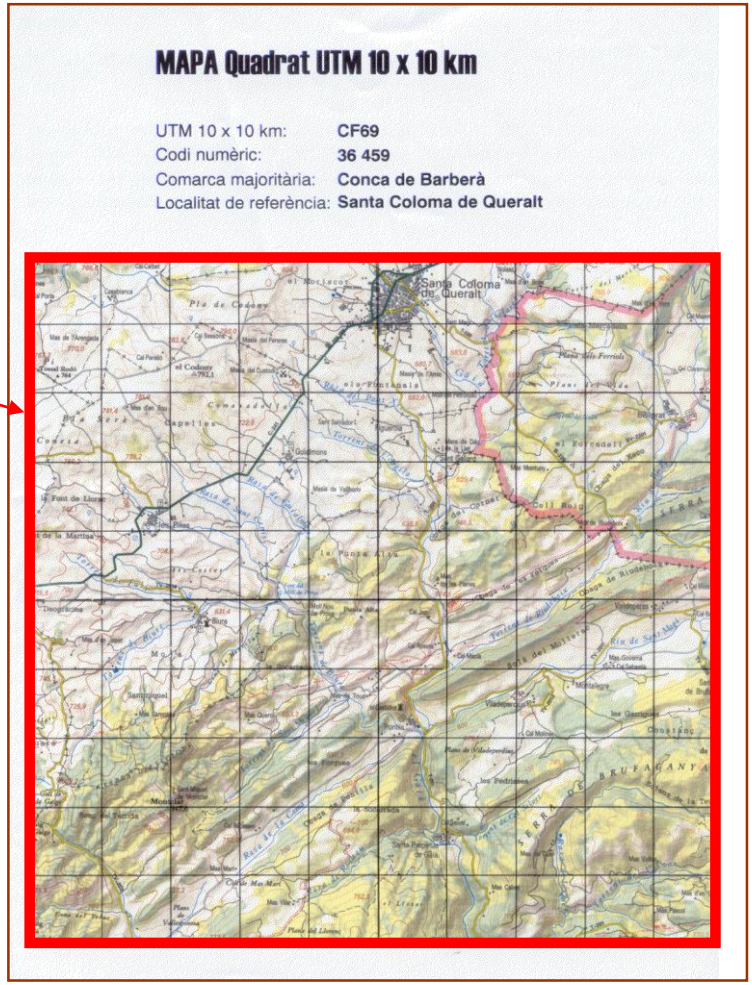


- Published in 1984
- Field work: 1975-1982
- Based on a 10x10 km survey
- 214 breeding species detected



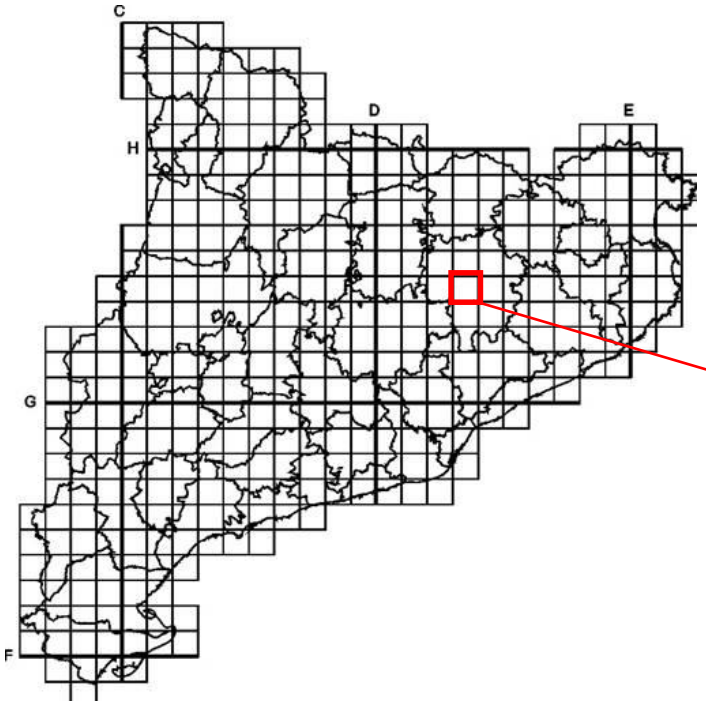
UTM 10x10 square surveys

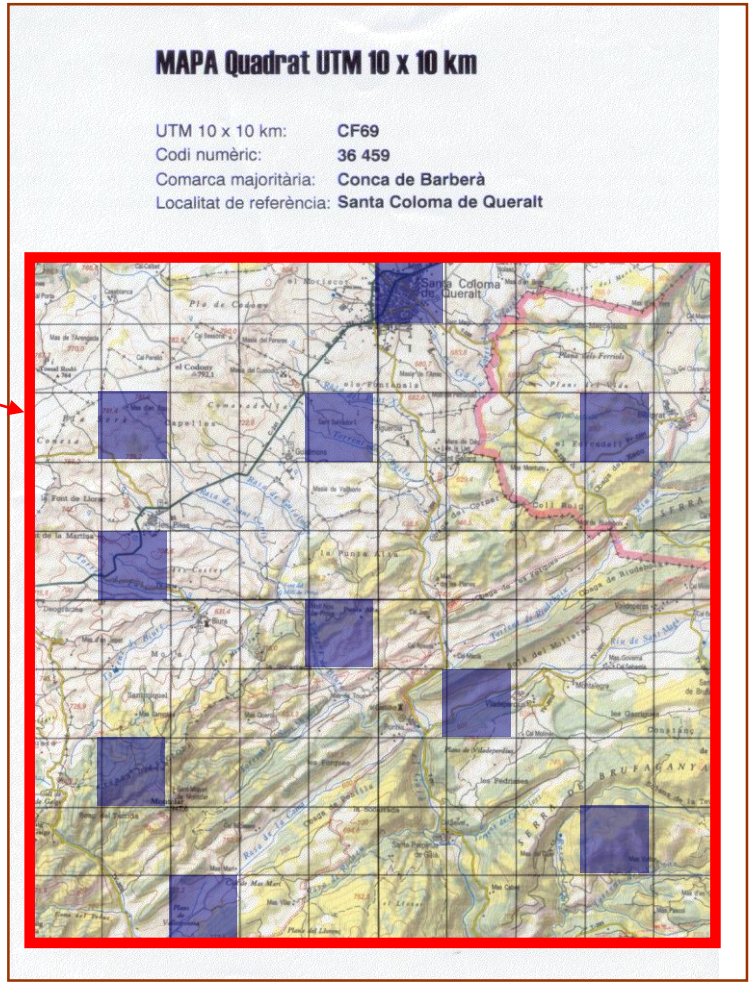




- Total: 385 10x10 km squares
- No time-limited
- Presence/absence data & evidence of breeding
- Field work: 1999-2002

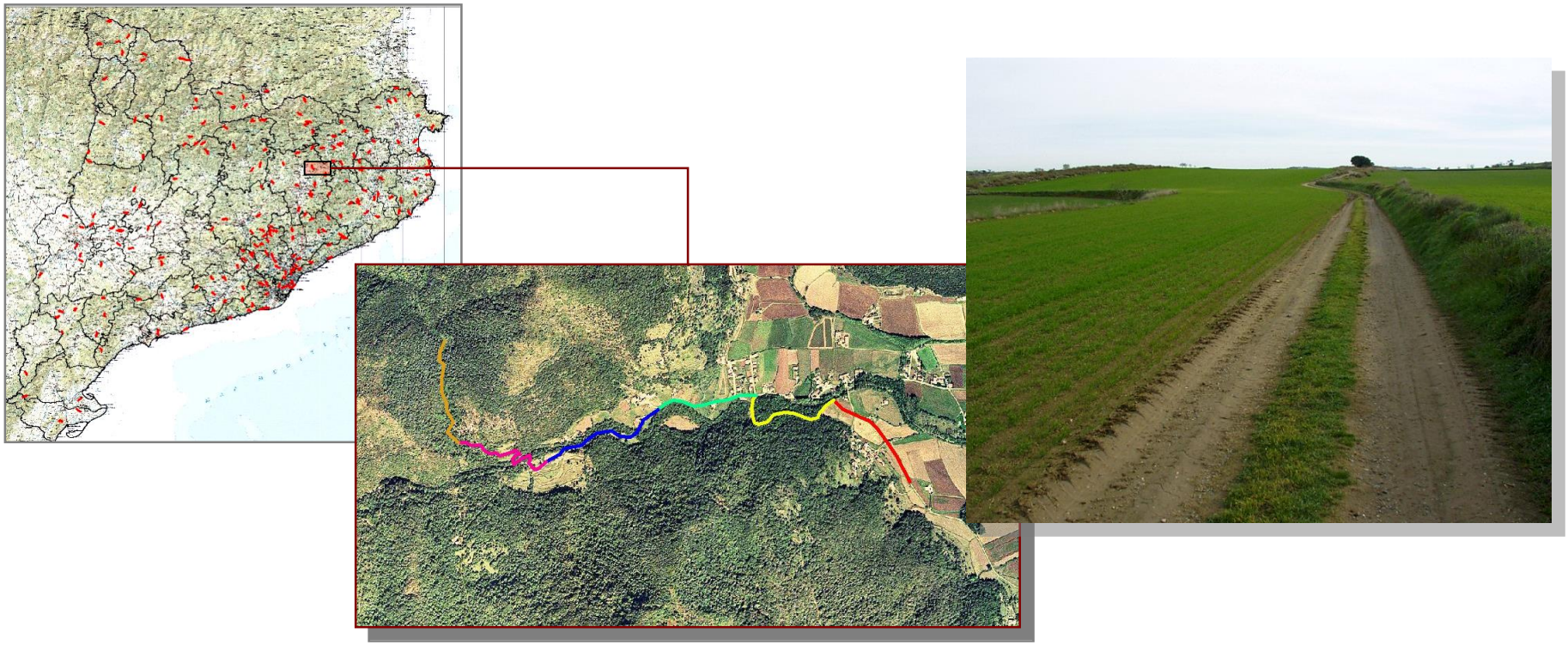
UTM 1x1 square surveys





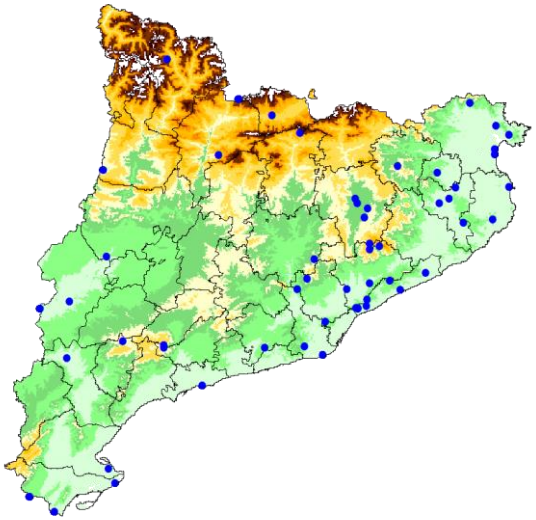
- c. 10 1x1 squares surveys for each 10x10 square
- 1 hour long census (for each 1x1 square)
- Two census periods: March/April & May/June
- Presence/absence data
- Field work: 1999-2002

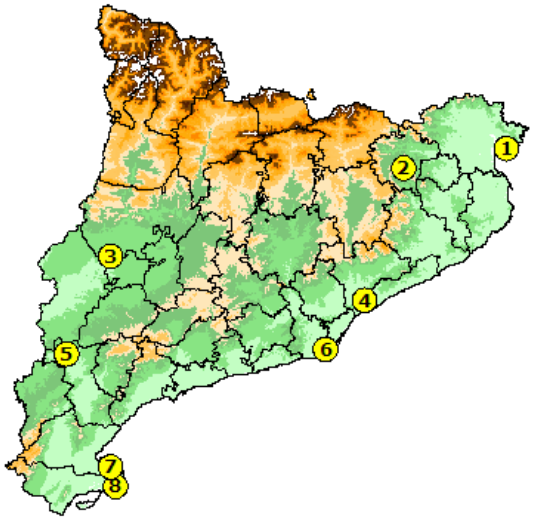
Catalan Common Bird Survey (BBS)

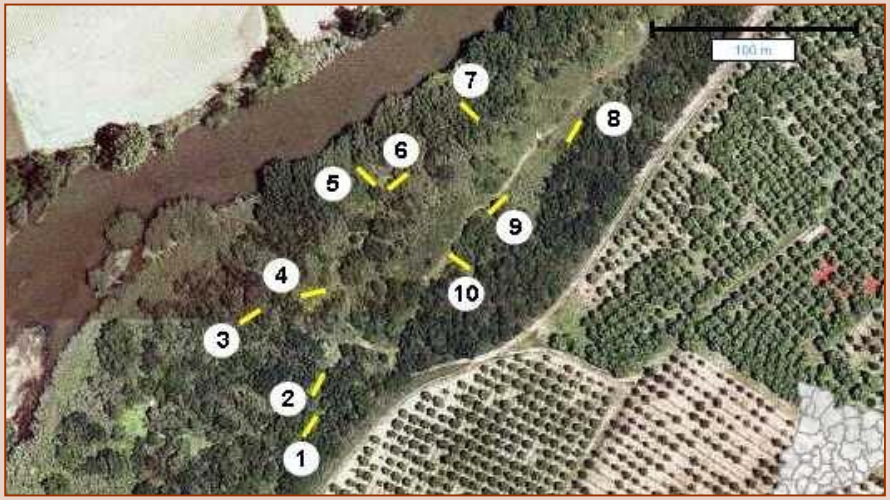


- 3 km long timed transects with 6 half km long sections
- 174 transects (50 of them using distance-bands and male separation)
- Two census periods: March 15th-April 15th & May 15th-June 15th
- Density data
- Field work from 2002

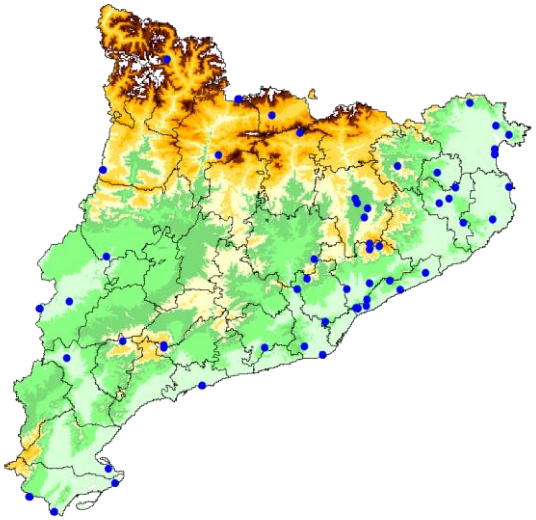
Bird Banding Monitoring Programs



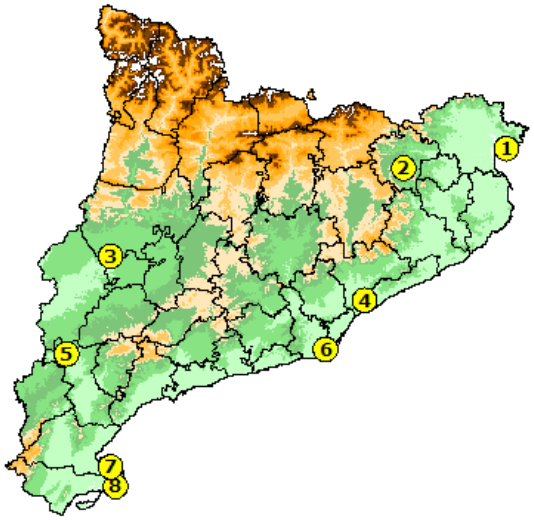




Bird Banding Monitoring Programs

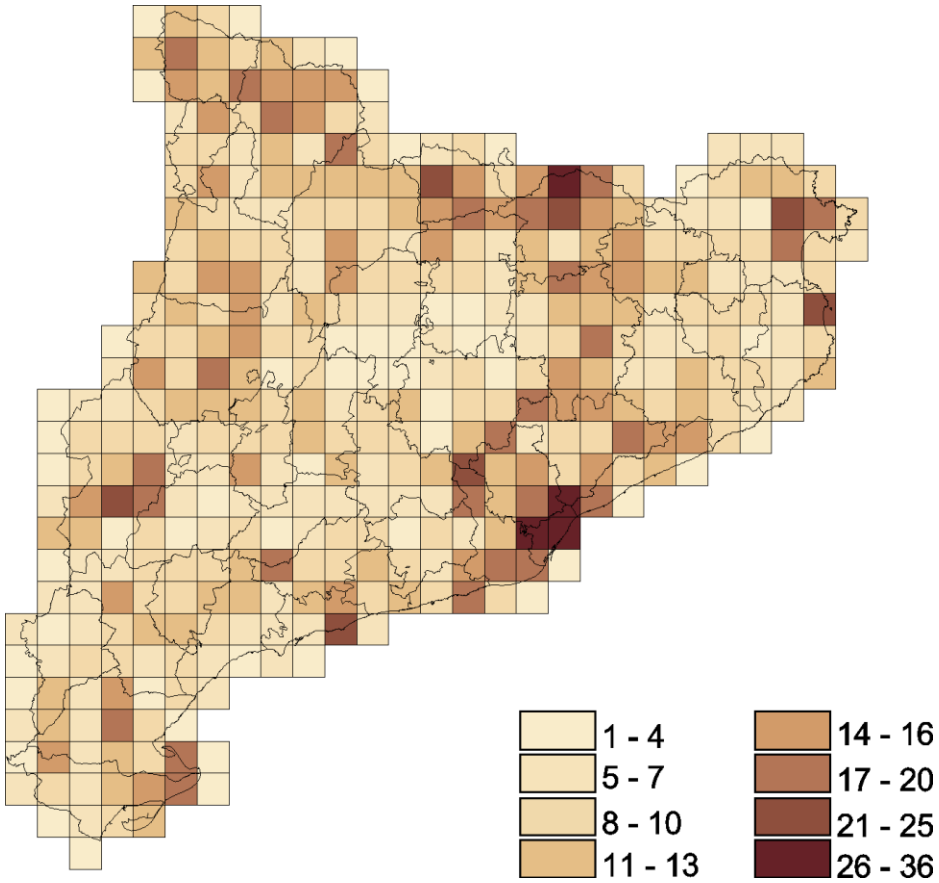


- 40 banding stations
- 1st May – 8th August
- 10 visits at 10-day periods
- Field work from 1991
- Data on productivity, abundance and sex-ratios



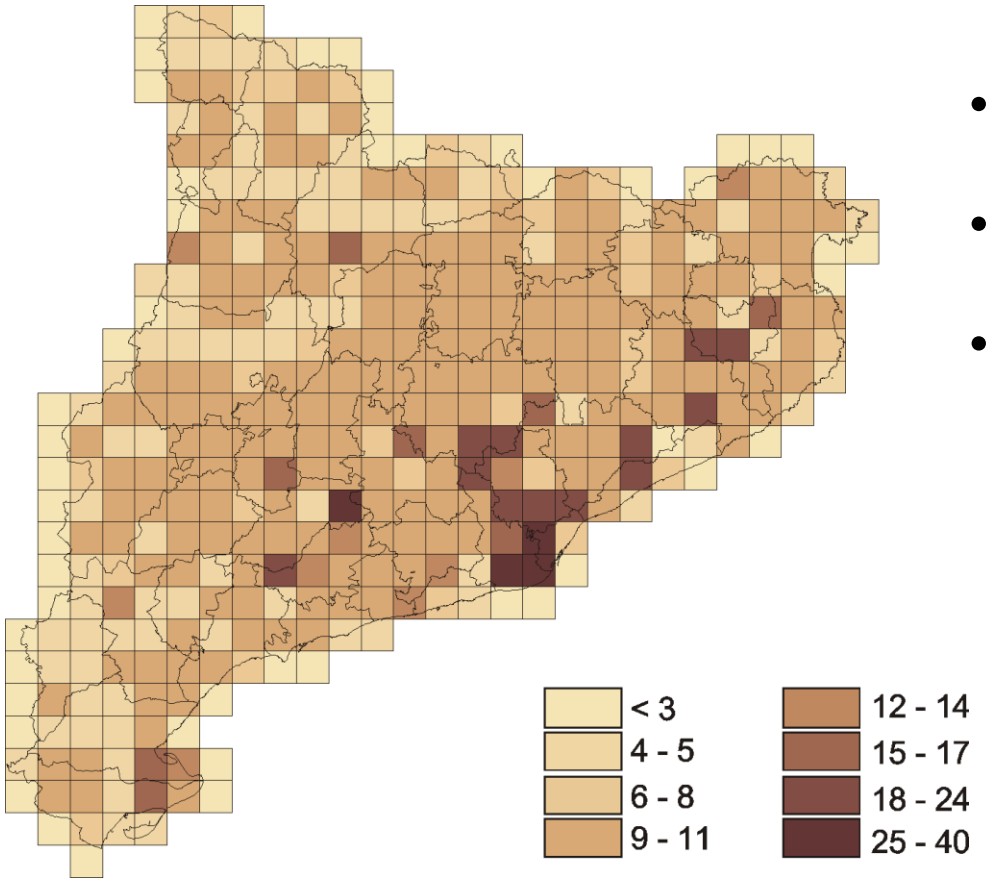
- 8 banding stations
- 1st March – 30th May
- Daily visits
- Field work from 1991
- Data on migratory phenology

Contributors



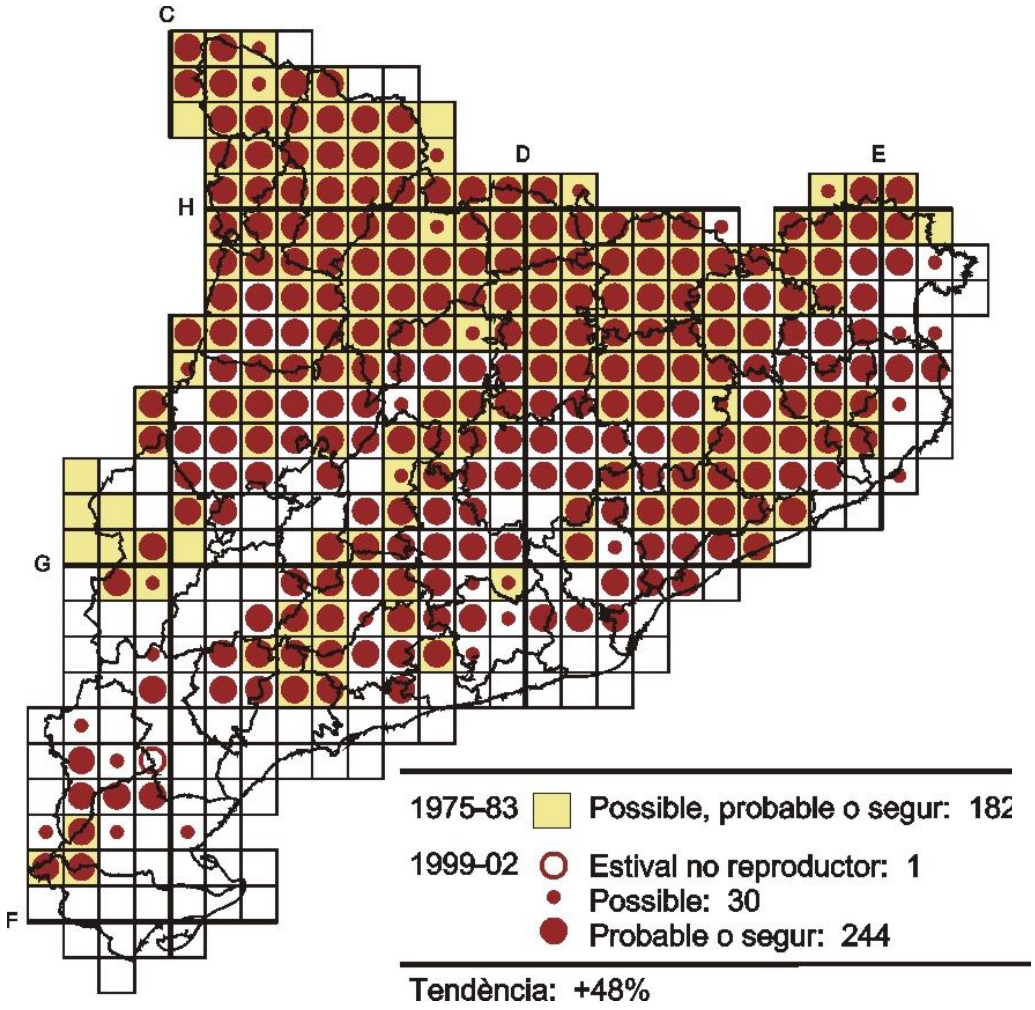
- 518 during field wotk
- 250 through BBS/Bird banding
- 190 writing texts

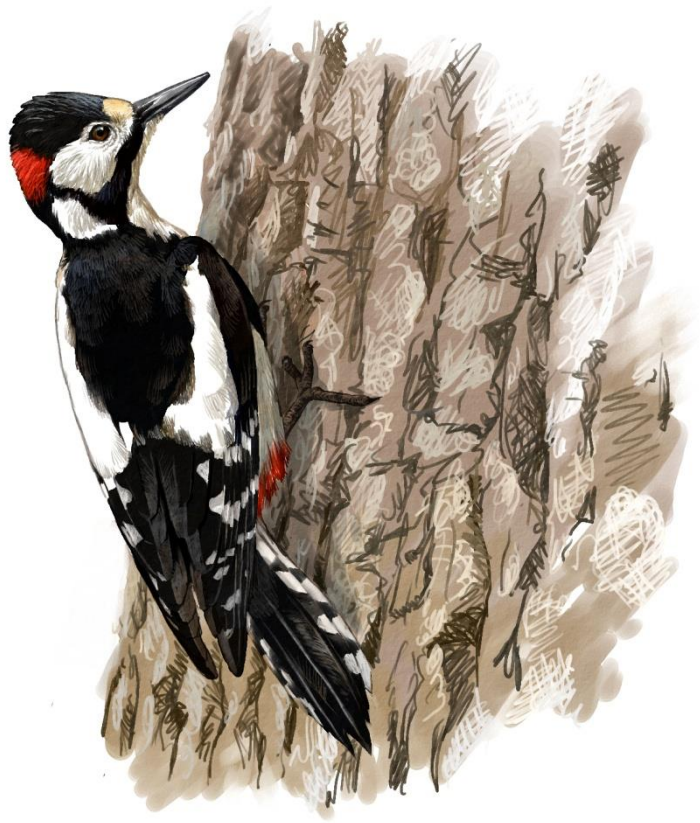
Data available



- 3.077 1x1 km diurnal surveys
- 1.204 1x1 km nocturnal surveys
- 174 BBS transects
- 48 Banding stations

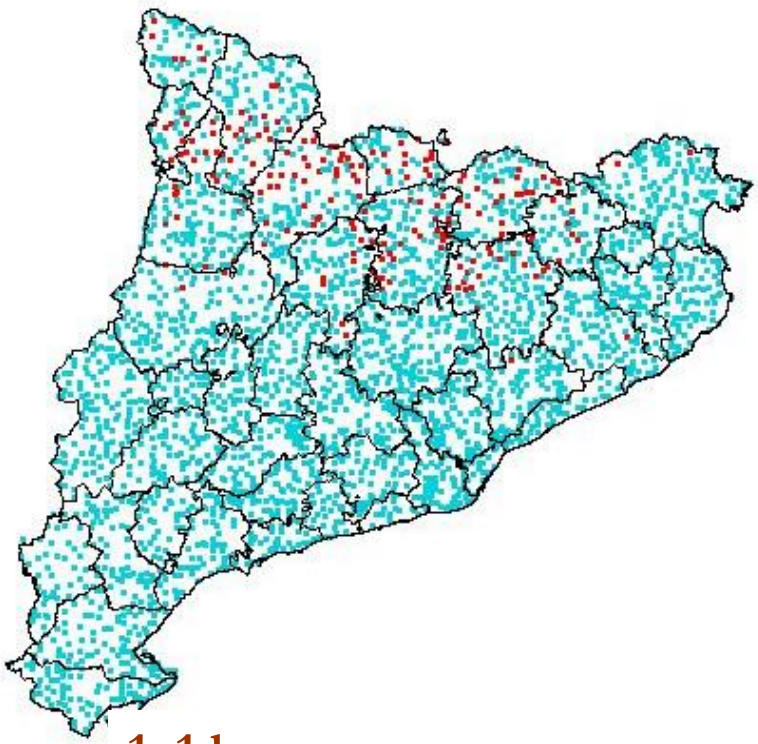
Distribution maps with breeding evidence





Dendrocopos major

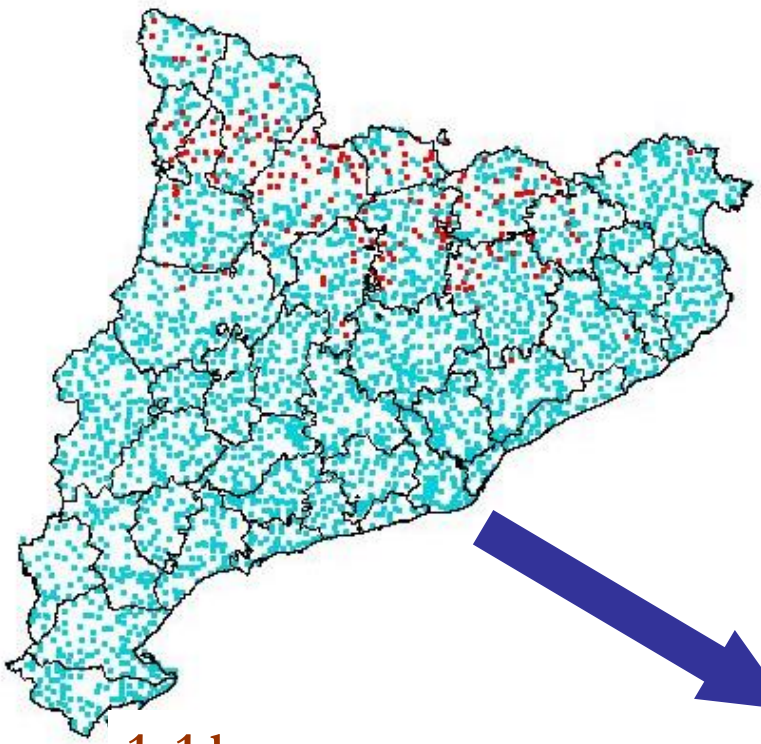
Abundance index maps



1x1 km square surveys
(c. 10 % of the territory)

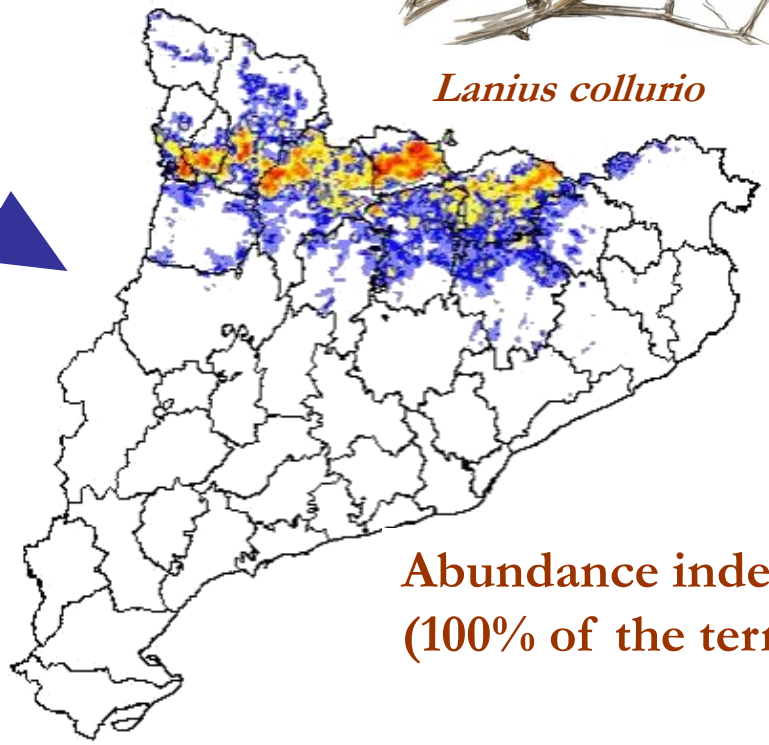
Lanius collurio

Abundance index maps: modeling habitat quality



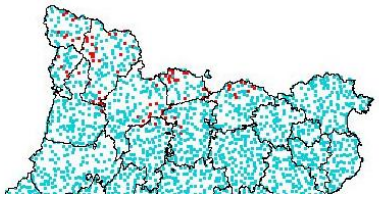
1x1 km square surveys
(c. 10 % of the territory)

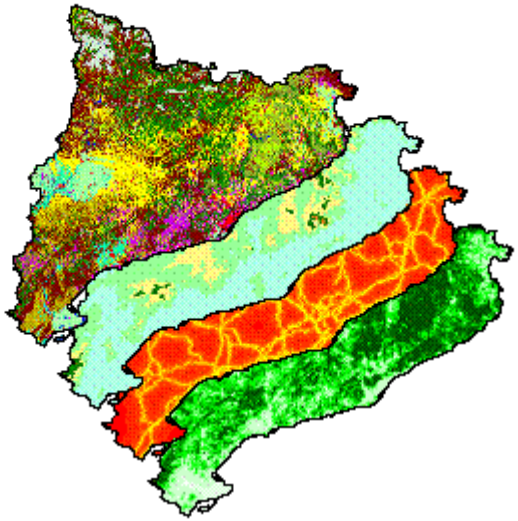
Lanius collurio



Abundance index maps
(100% of the territory)

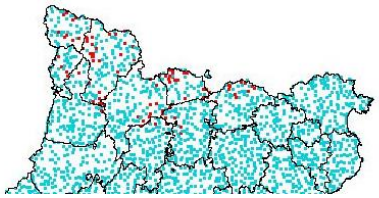
Abundance index maps: modeling habitat quality

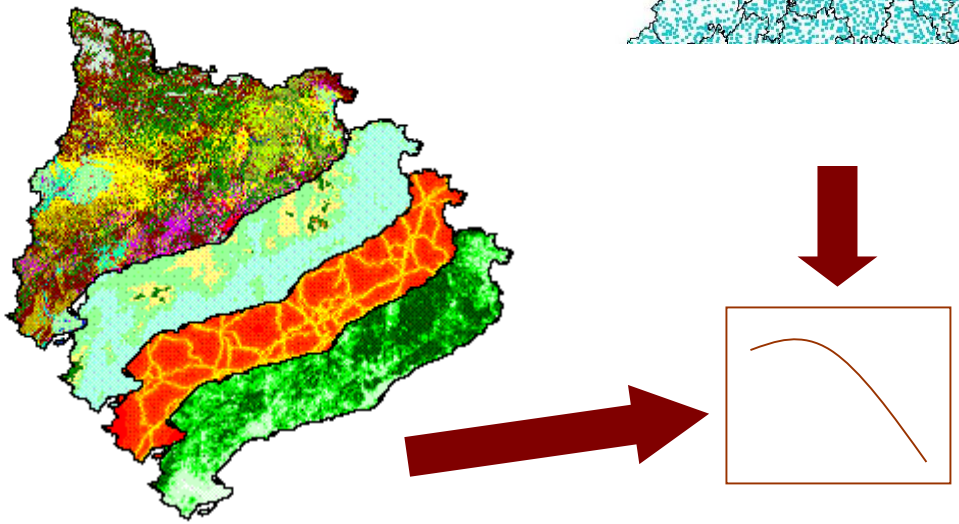




Turdus torquatus

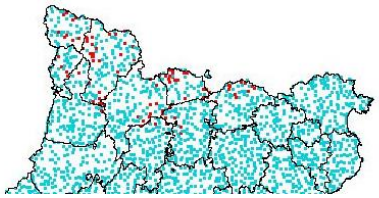
Abundance index maps: modeling habitat quality

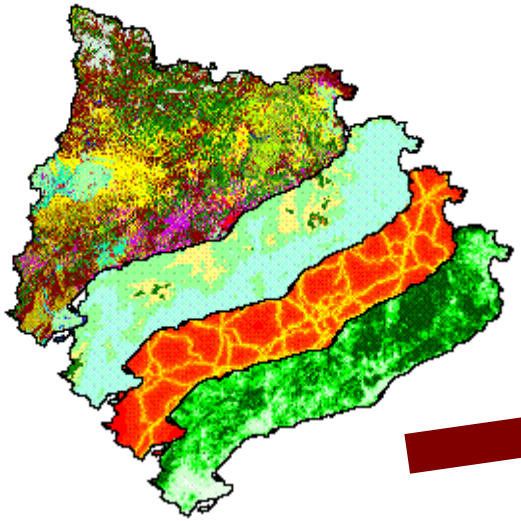


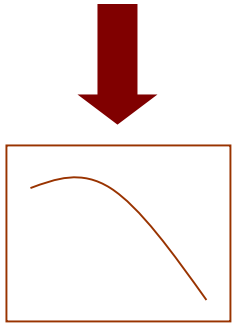


Turdus torquatus

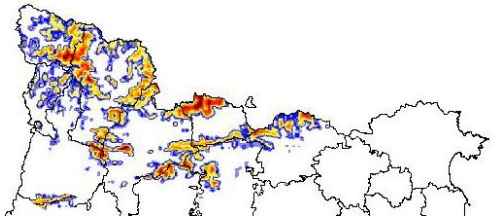
Abundance index maps: modeling habitat quality





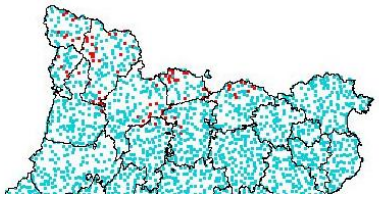


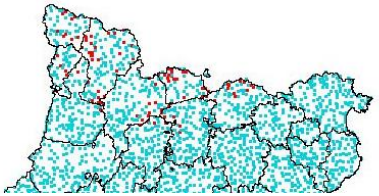
Projection to the whole area

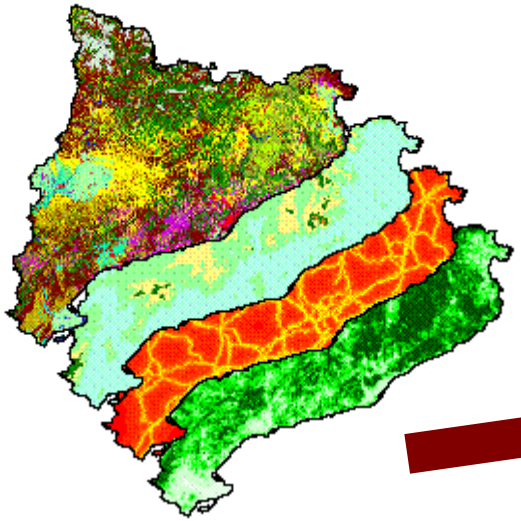


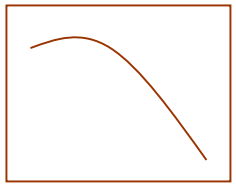
Turdus torquatus

Abundance index maps: modeling habitat quality



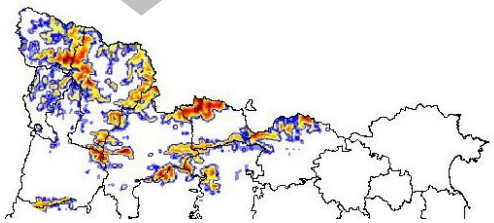






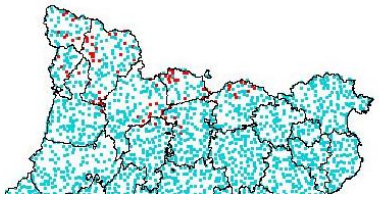
Projection to the whole area

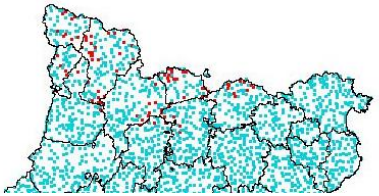
Evaluation

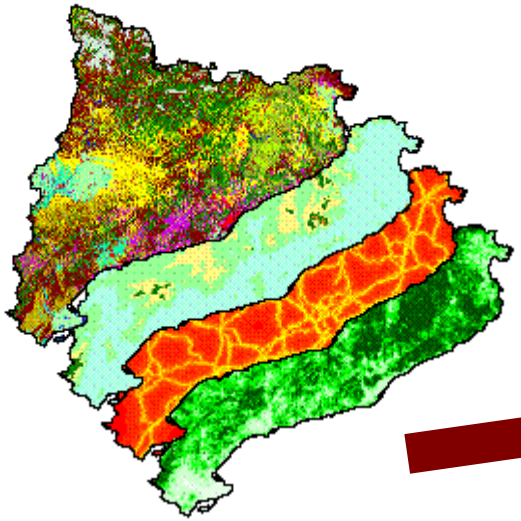


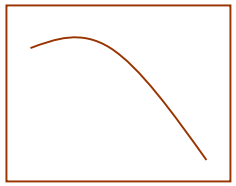
Turdus torquatus

Abundance index maps: modeling habitat quality



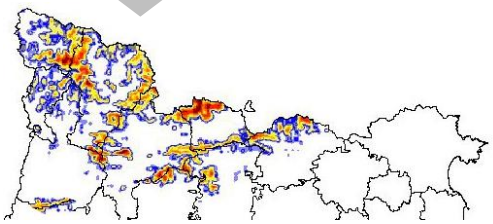






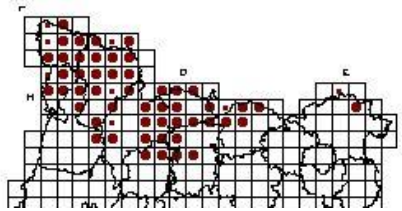
Projection to the whole area

Evaluation

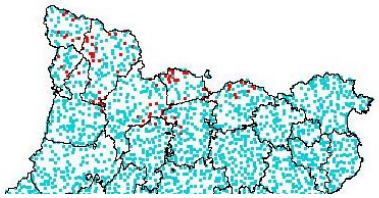


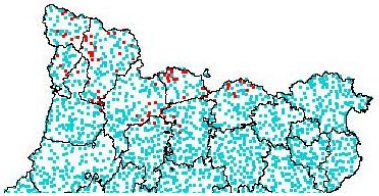
Turdus torquatus

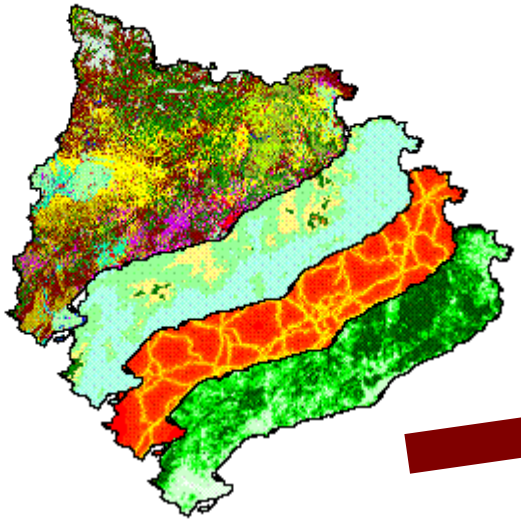
Filtering

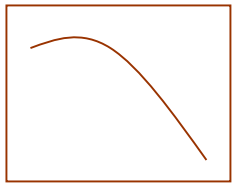


Abundance index maps: modeling habitat quality



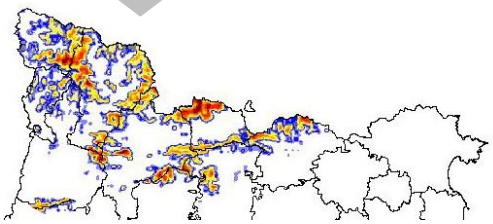




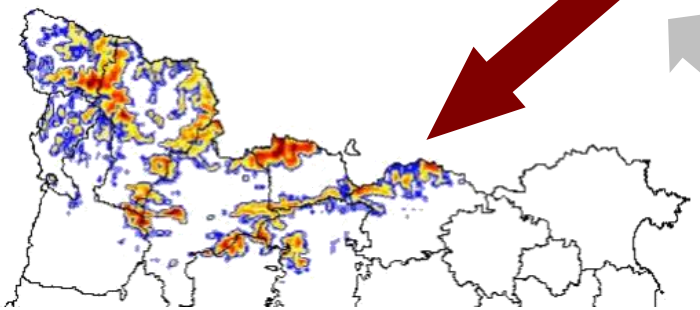


Projection to the whole area

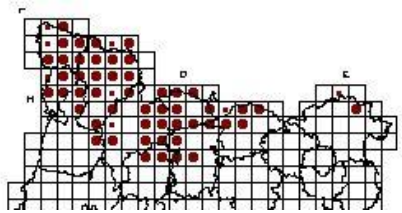
Evaluation



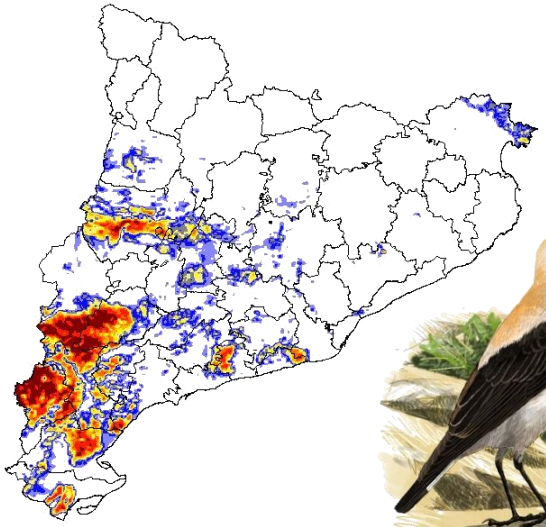
Turdus torquatus

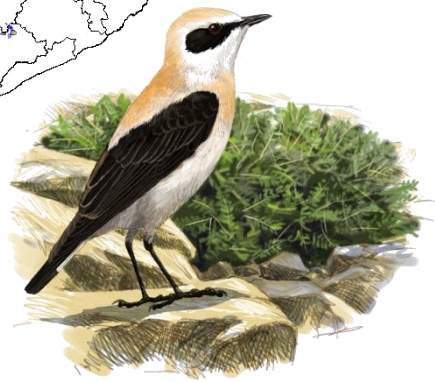


Filtering



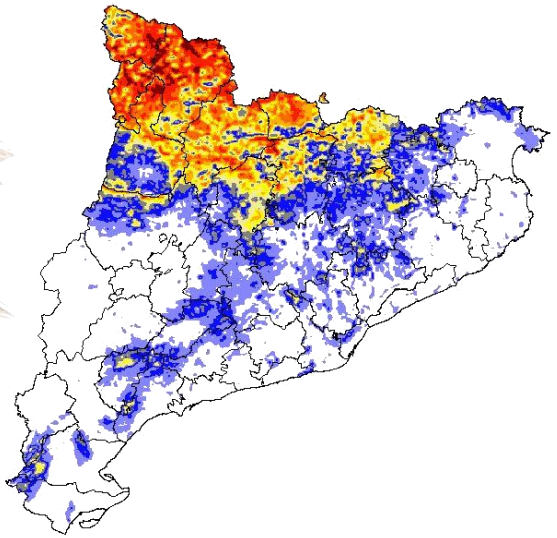
Abundance index maps: examples

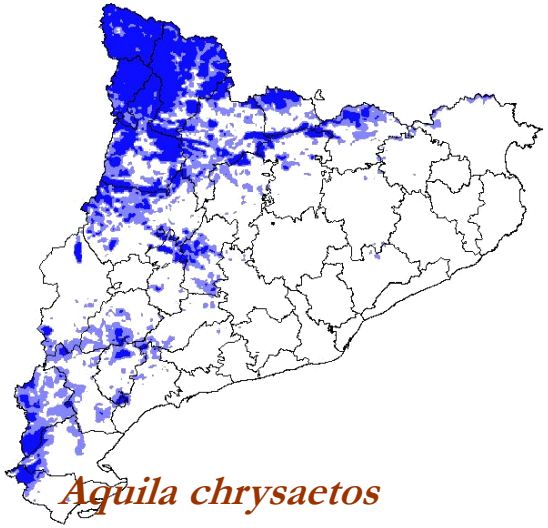




Oenanthe hispanica

Phoenicurus ochruros

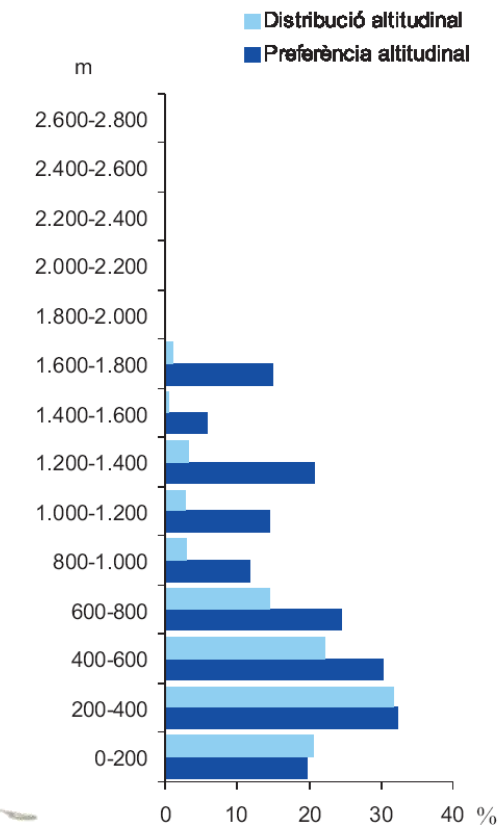


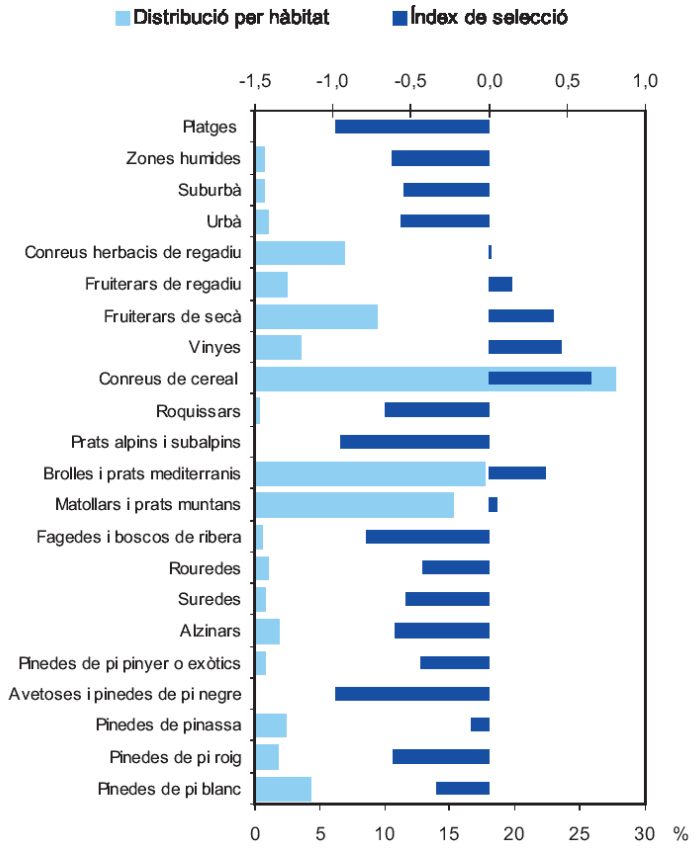


Aquila chrysaetos

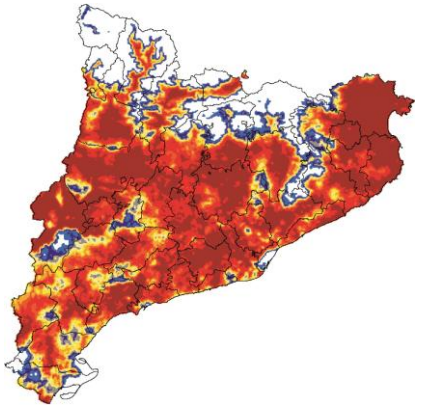
Ecological requirements

Alectoris rufa





Population estimates

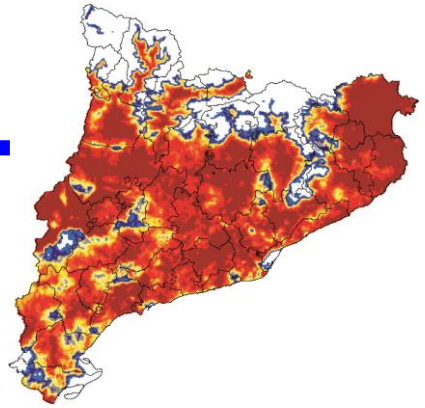


Luscinia megarhynchos

Population estimates

Density:
20 pairs/km^2

Probability of
ocurrence: 0,8

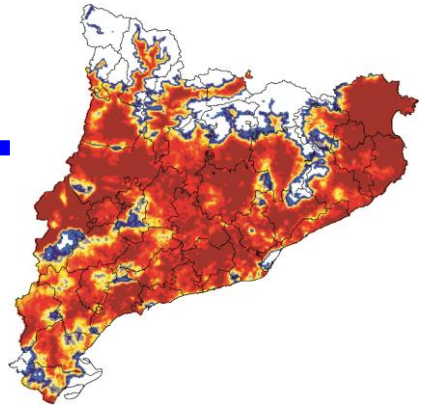


Luscinia megarhynchos

Population estimates

Density:
20 pairs/km^2

Probability of
ocurrence: 0,8



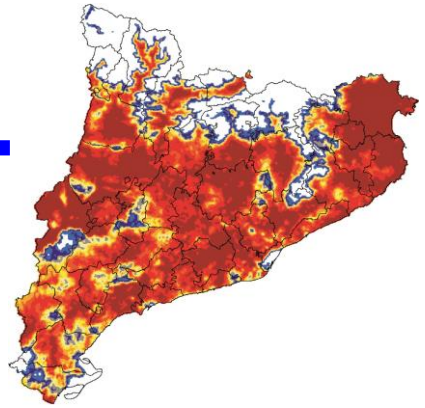
Regression model

Luscinia megarhynchos

Population estimates

Density:
20 pairs/km^2

Probability of
ocurrence: 0,8



Regression model

Estimate of density for all 1x1 km squares

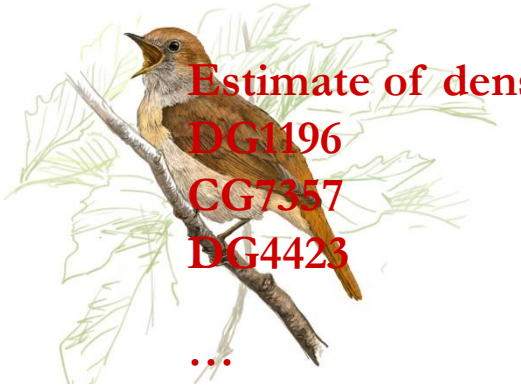
DG1196 → 30-32 parelles

CG7357 → 12-13 parelles

DG4423 → 0 parelles

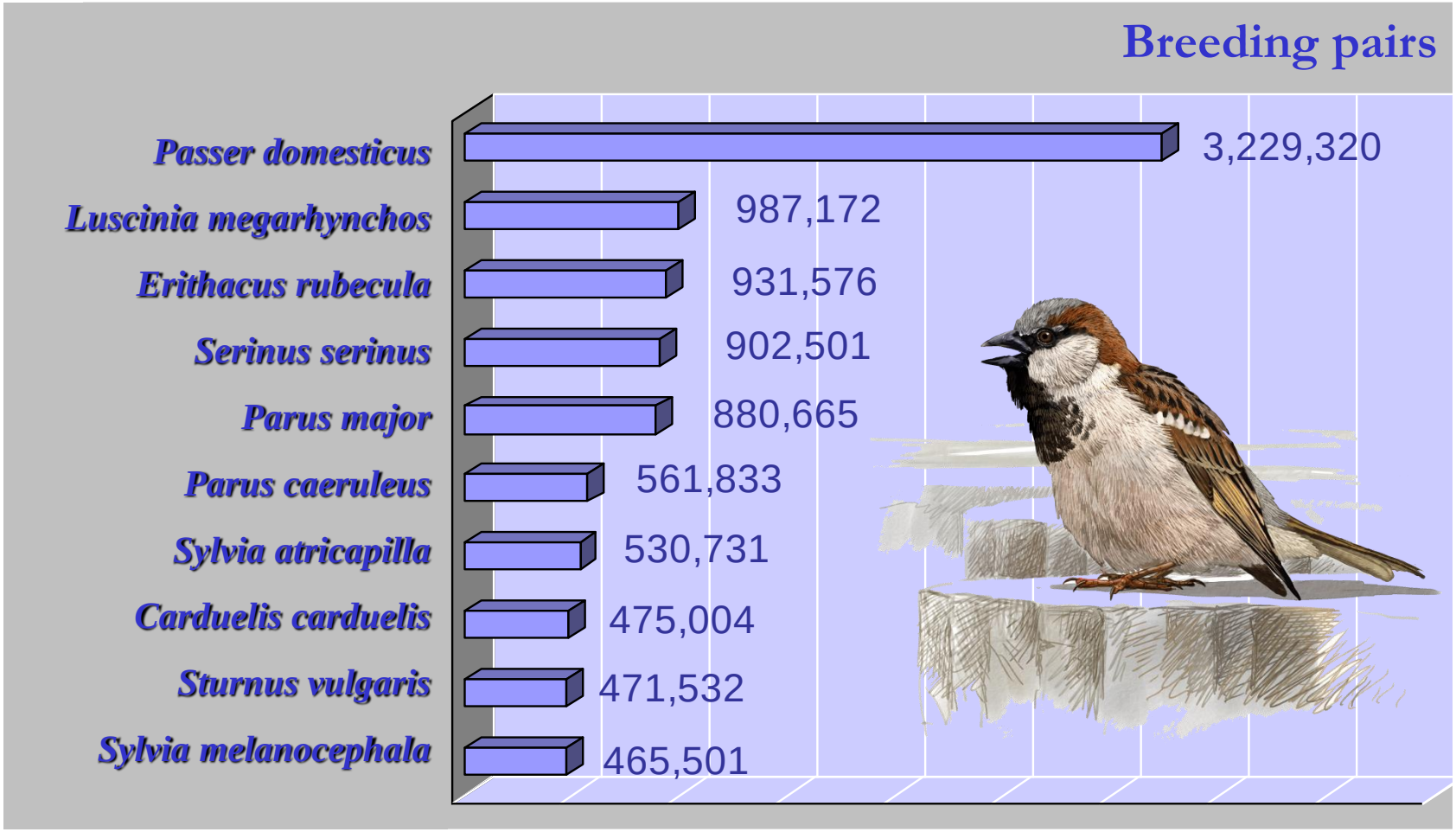
…

... rest of 1x1 squares... ....



Luscinia megarhynchos

Population estimates

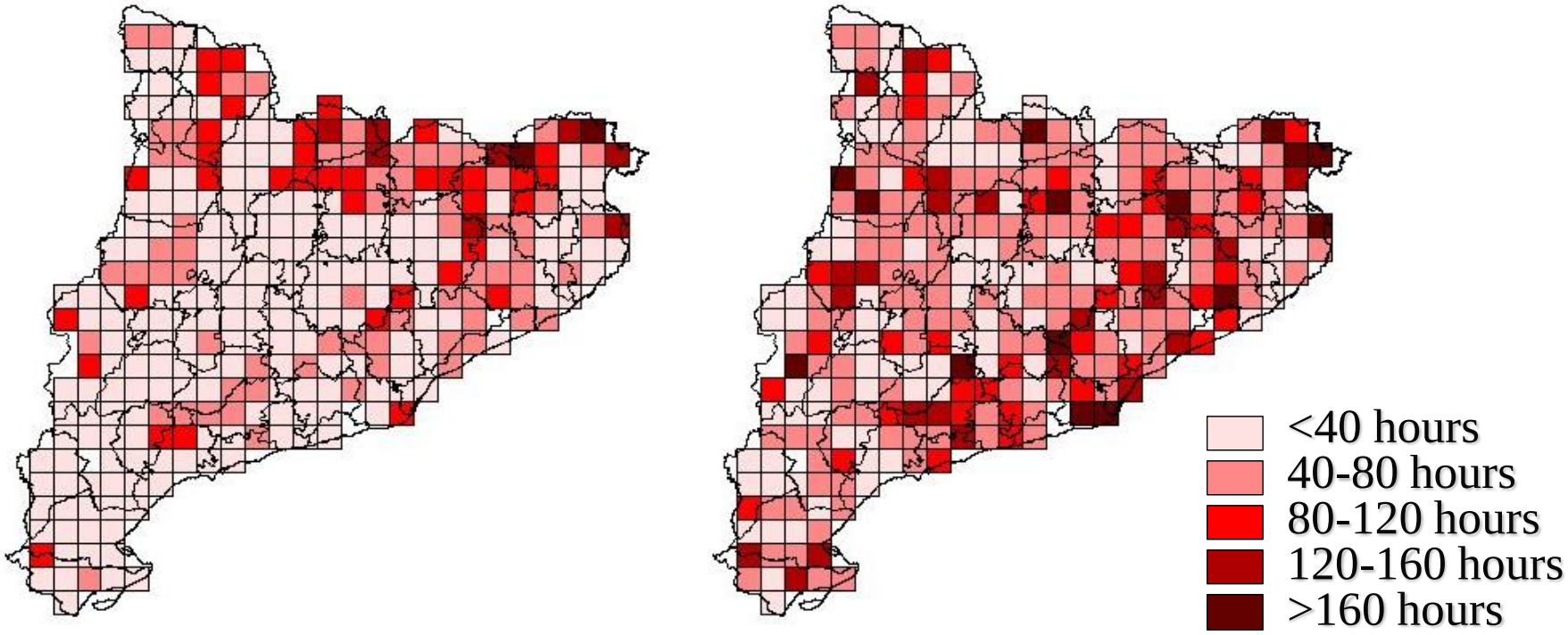


In Catalonia we have one Sparrow for each person!

Estimating tendencies: sampling effort

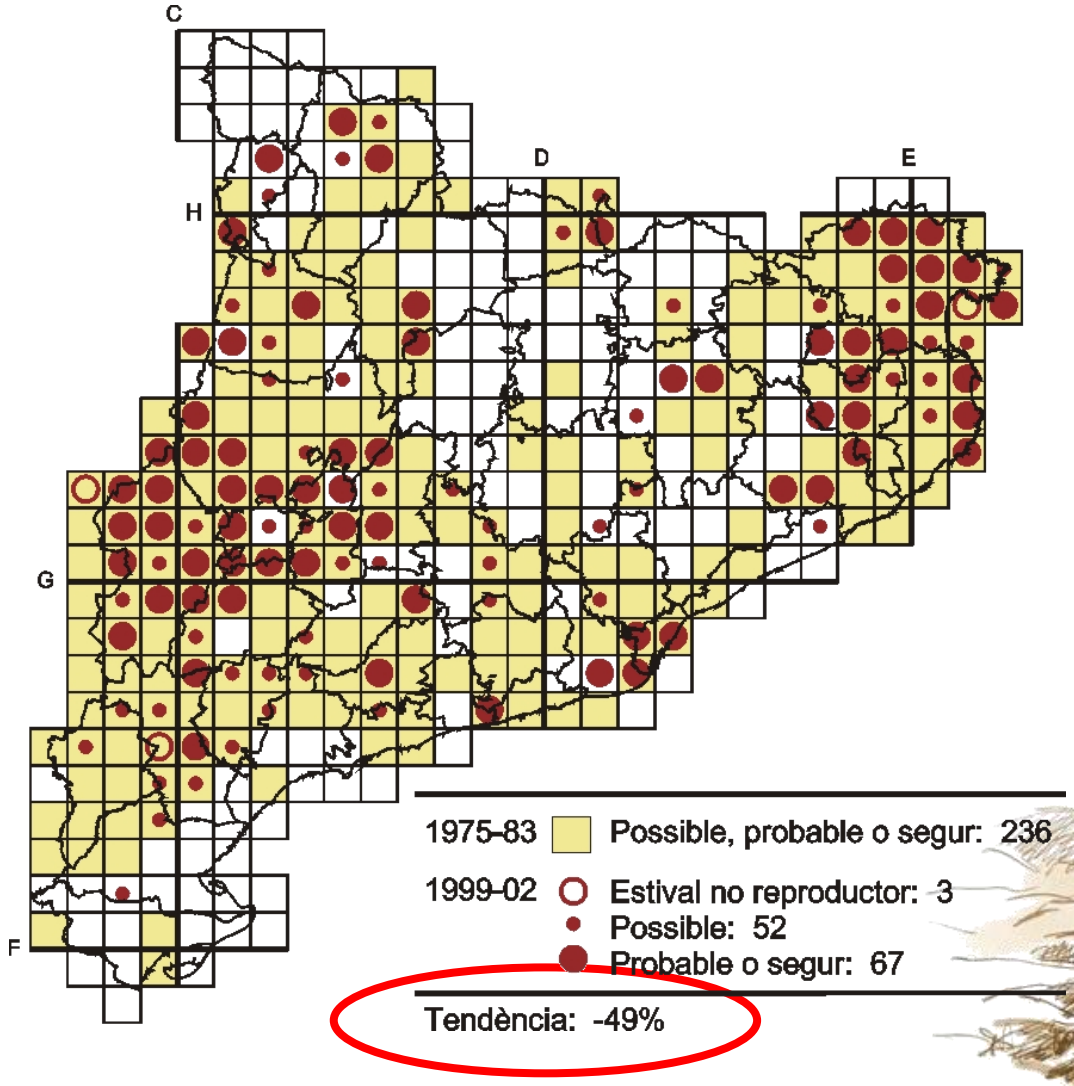
1975-1983

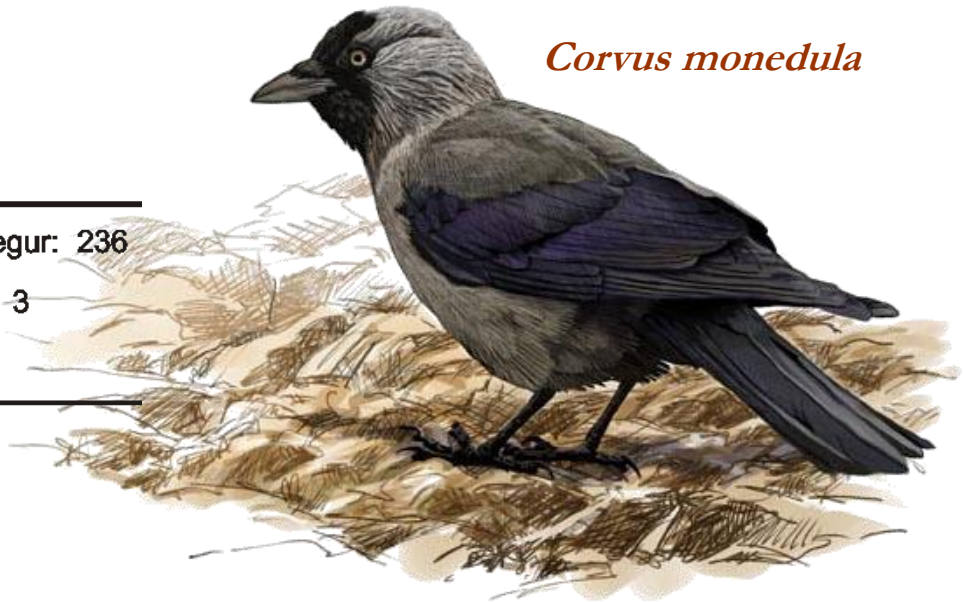
1999-2002



During the new atlas, sampling effort in each 10x10 km square increased an average of 23 hours

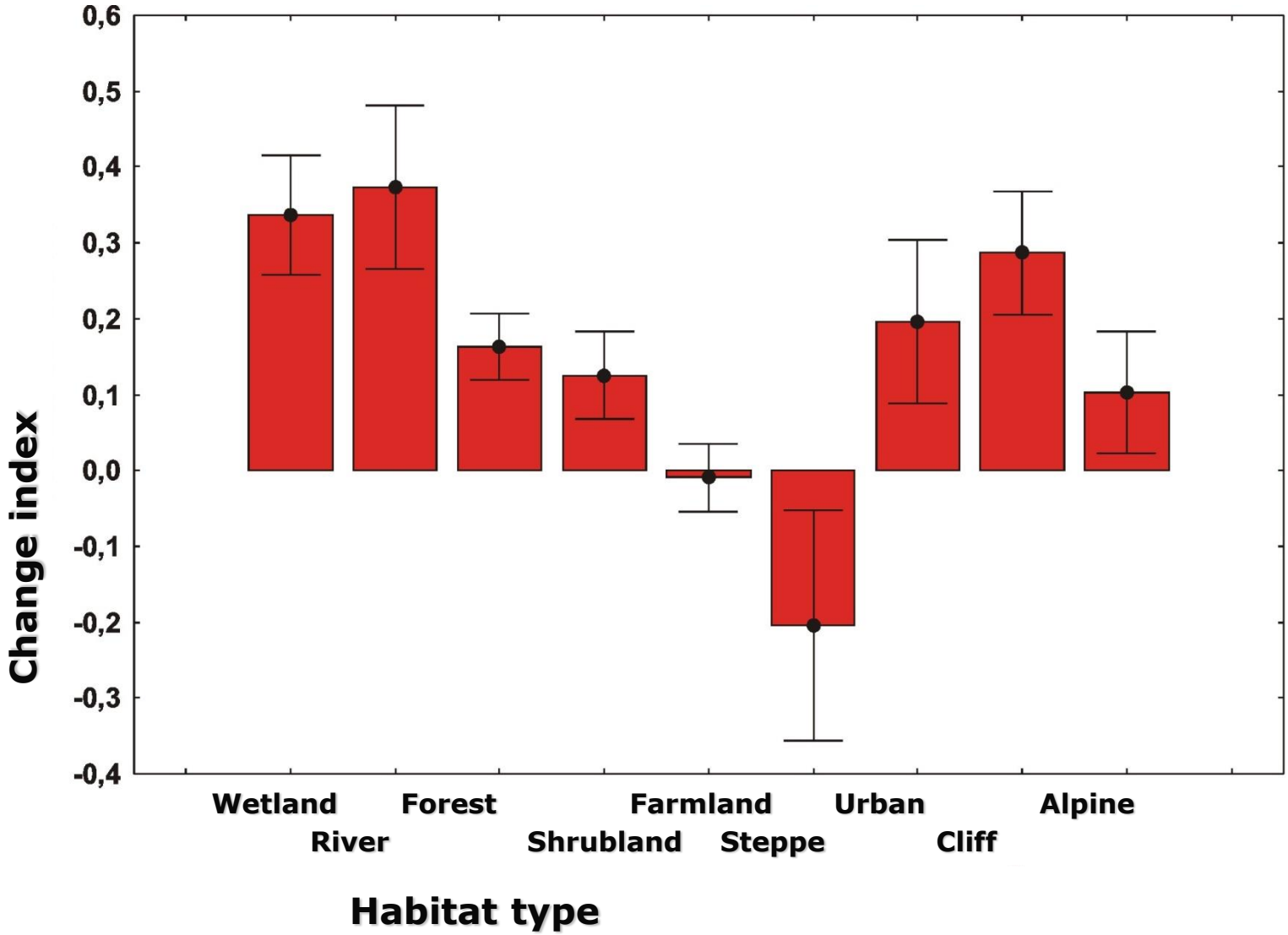
Estimating tendencies: examples



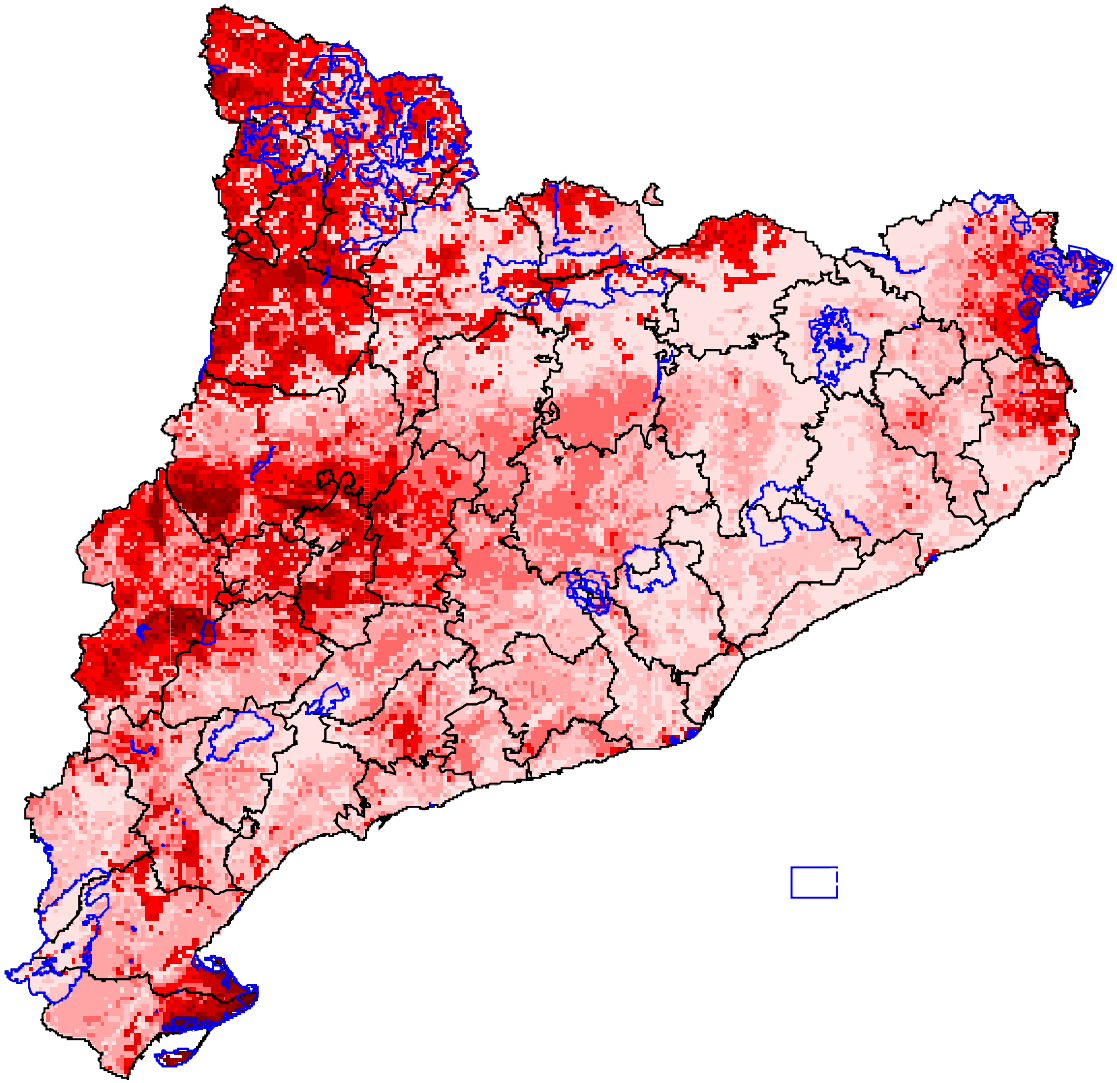


Corvus monedula

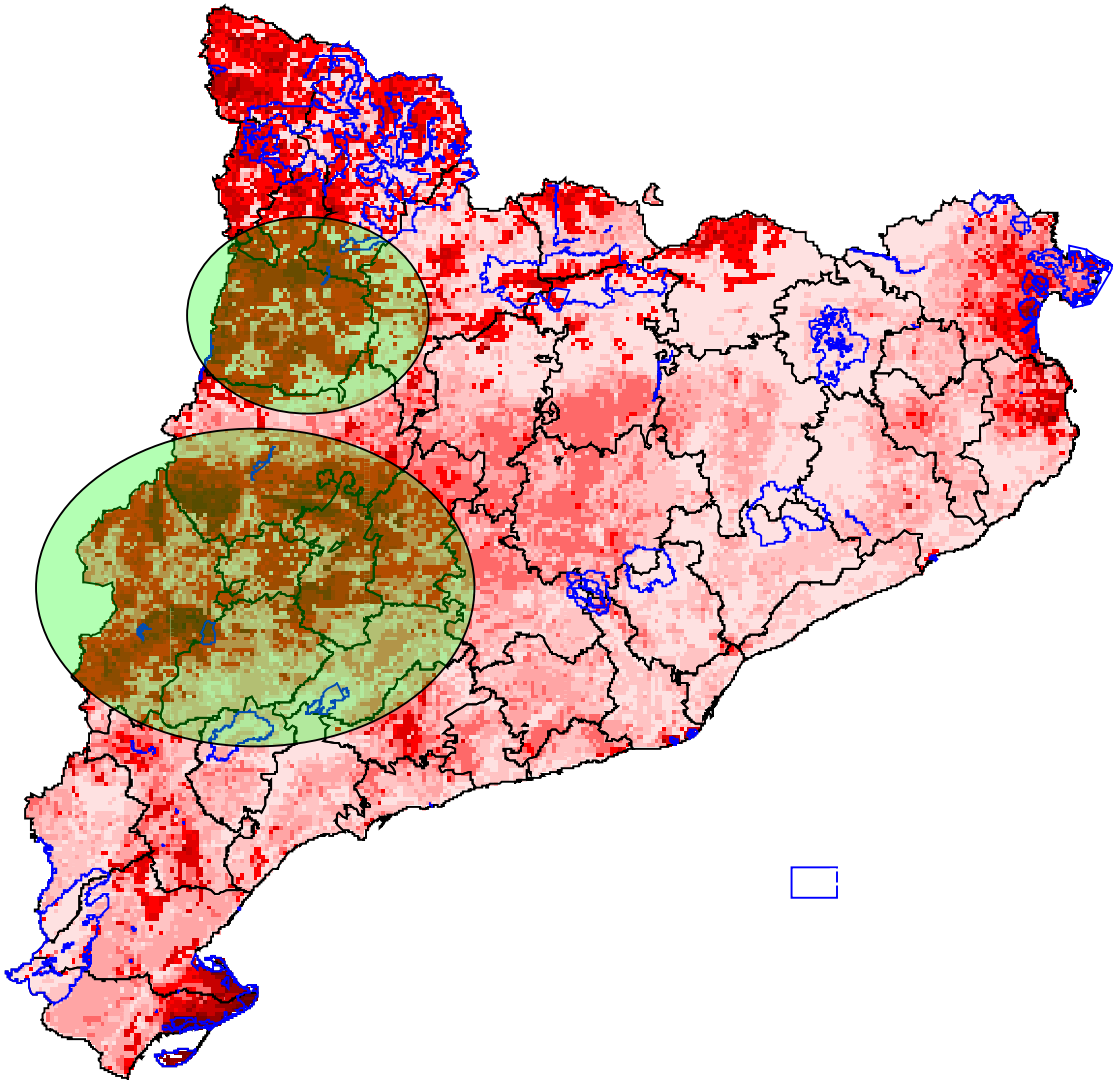
Estimating tendencies: main changes in 20 years



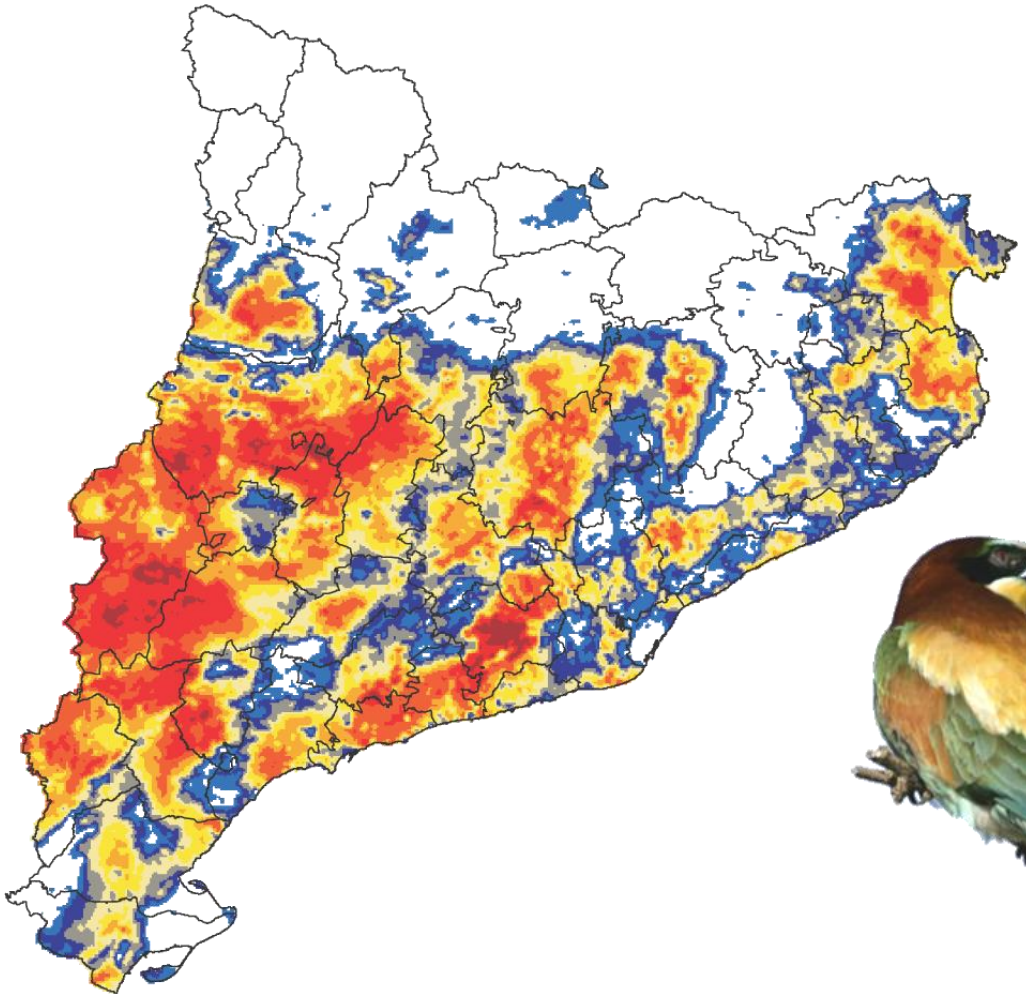
Territorial planning: European Nature 2000 network

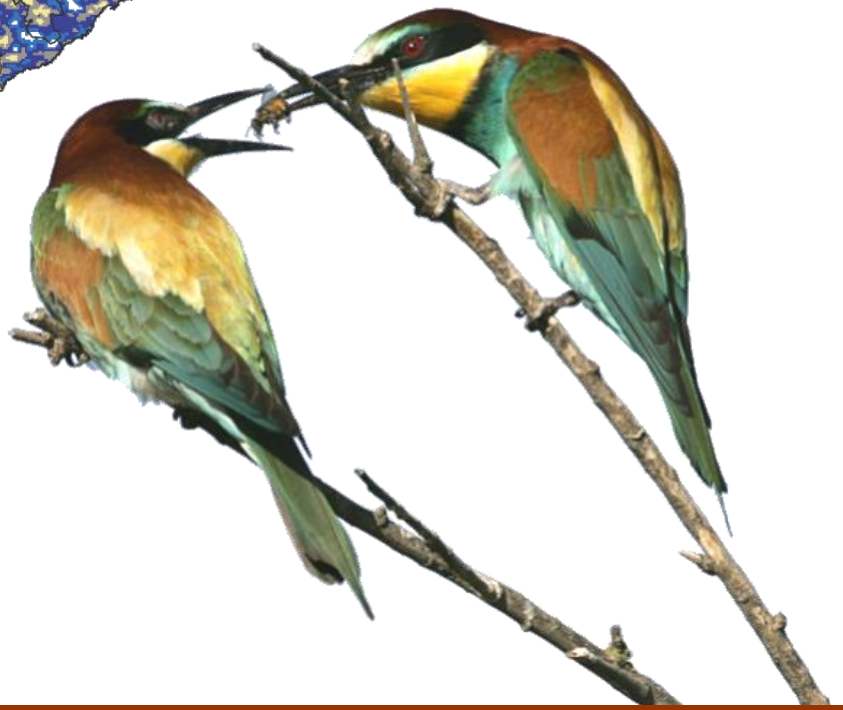


Territorial planning: European Nature 2000 network

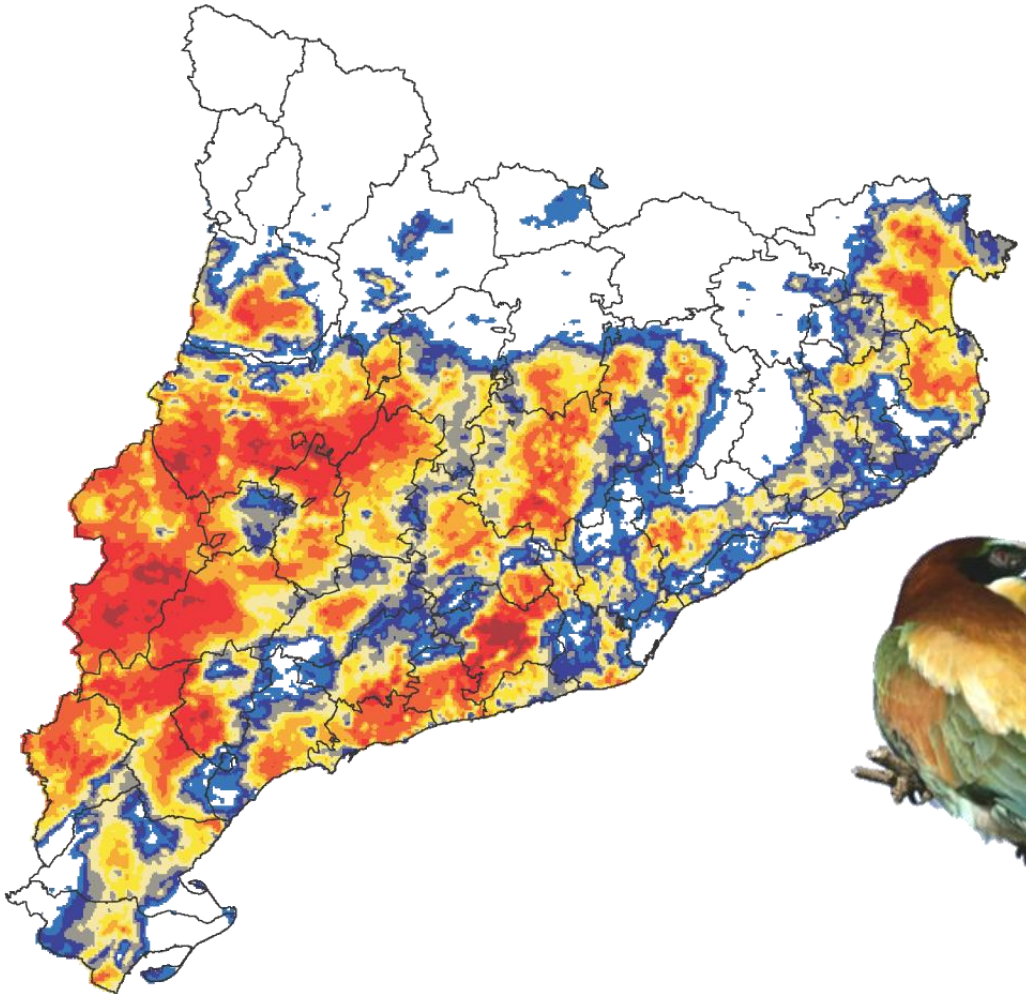


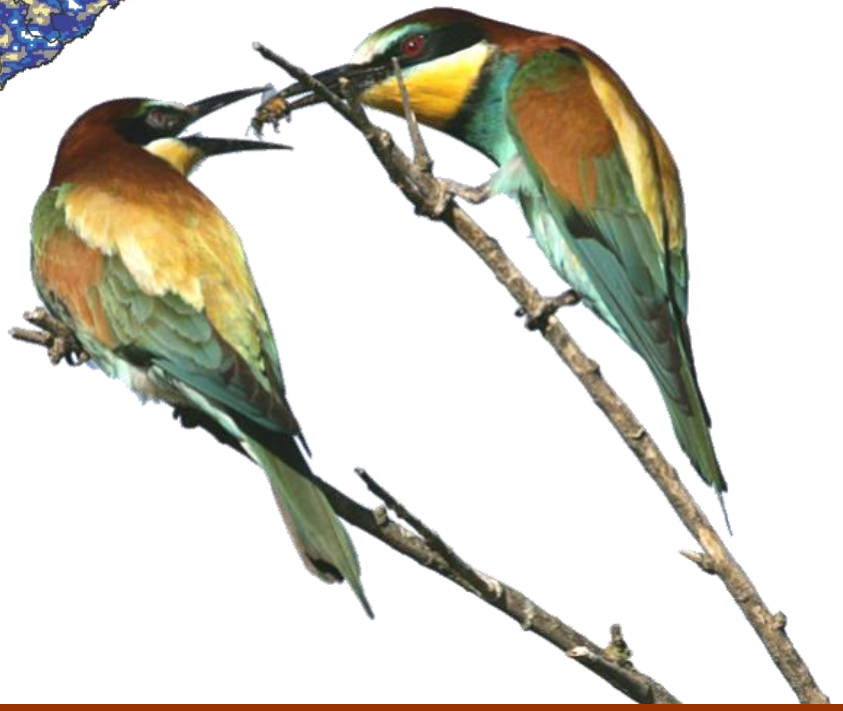
Management of natural resources: establishing subsidies



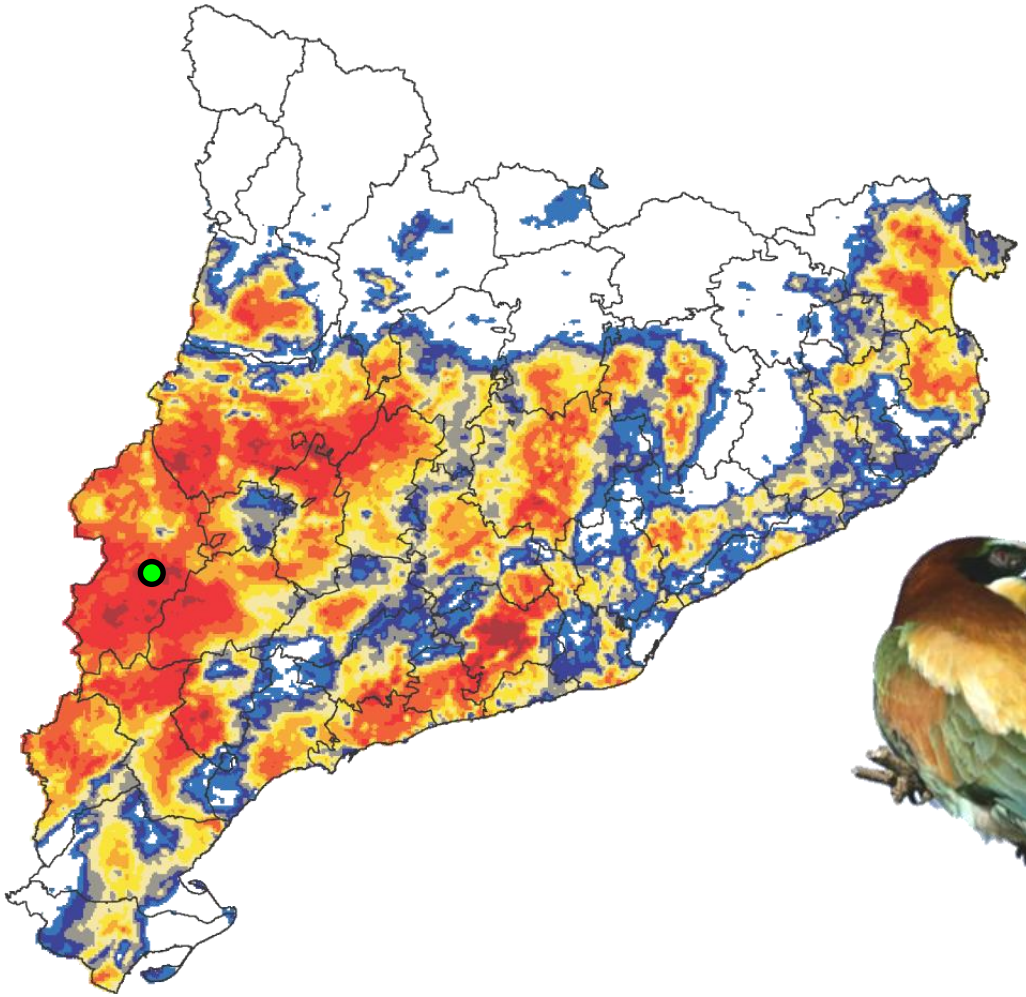


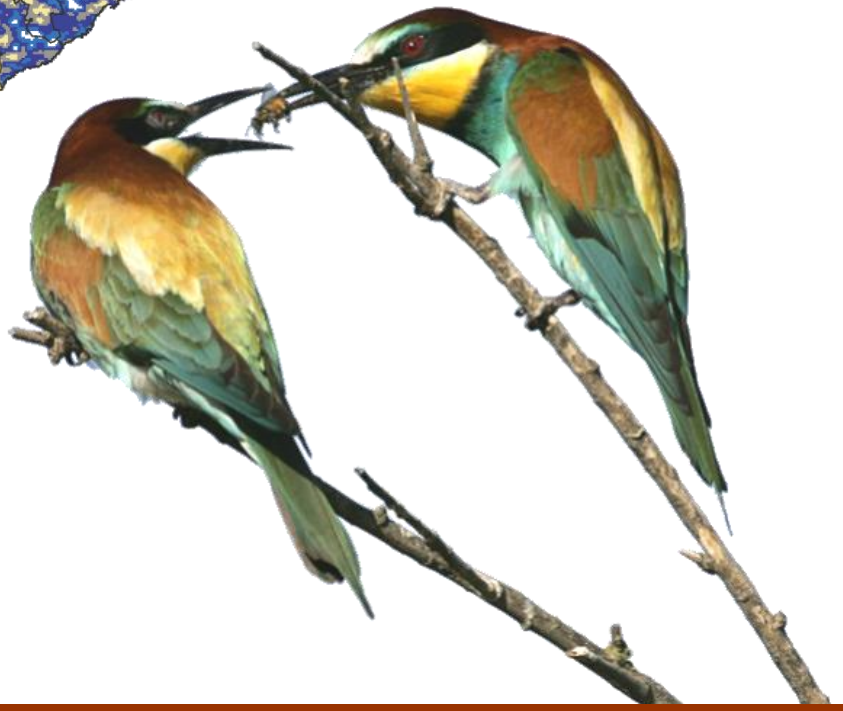
Management of natural resources: establishing subsidies





Management of natural resources: establishing subsidies





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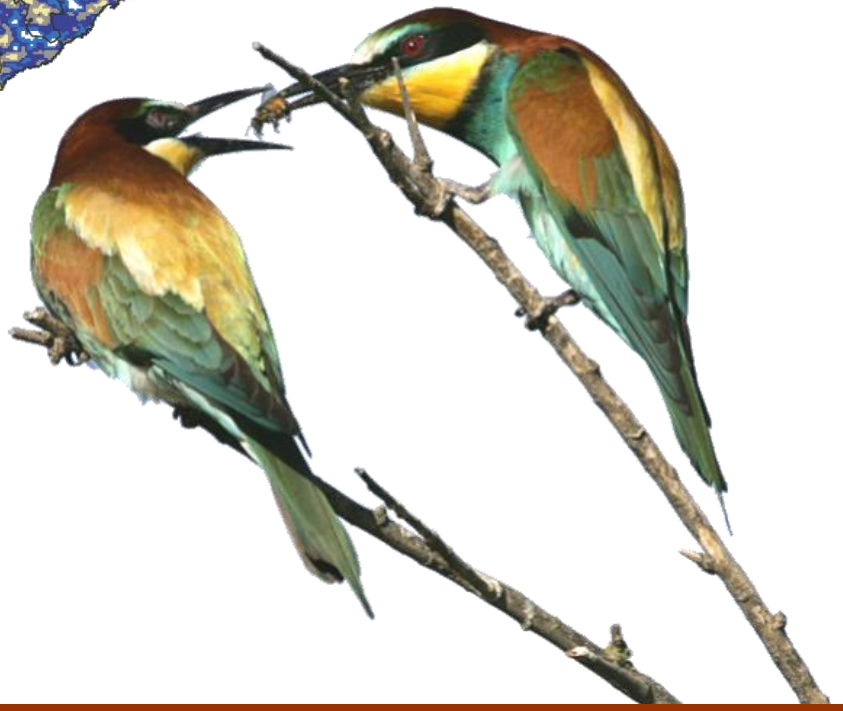
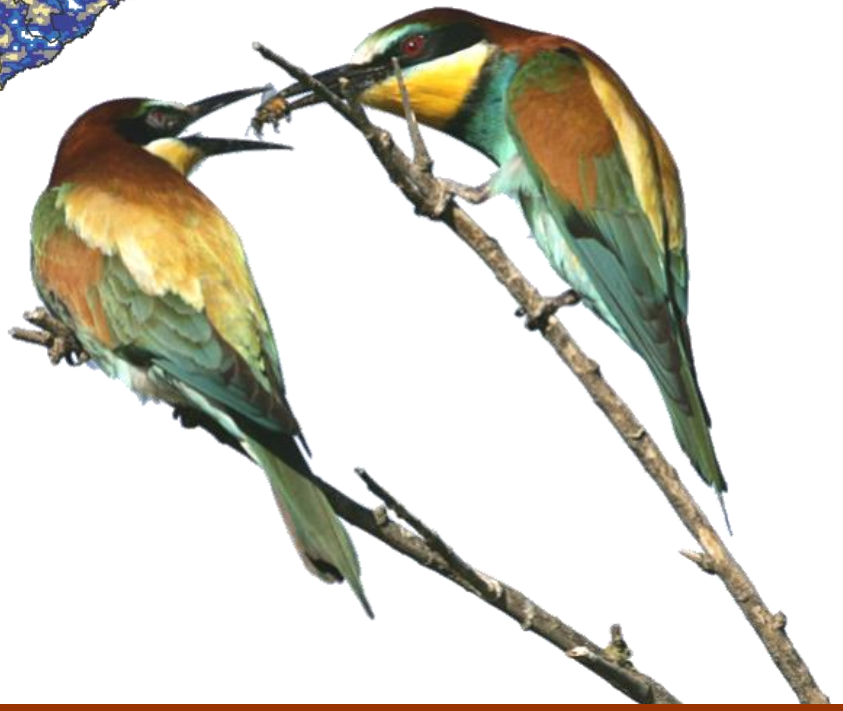
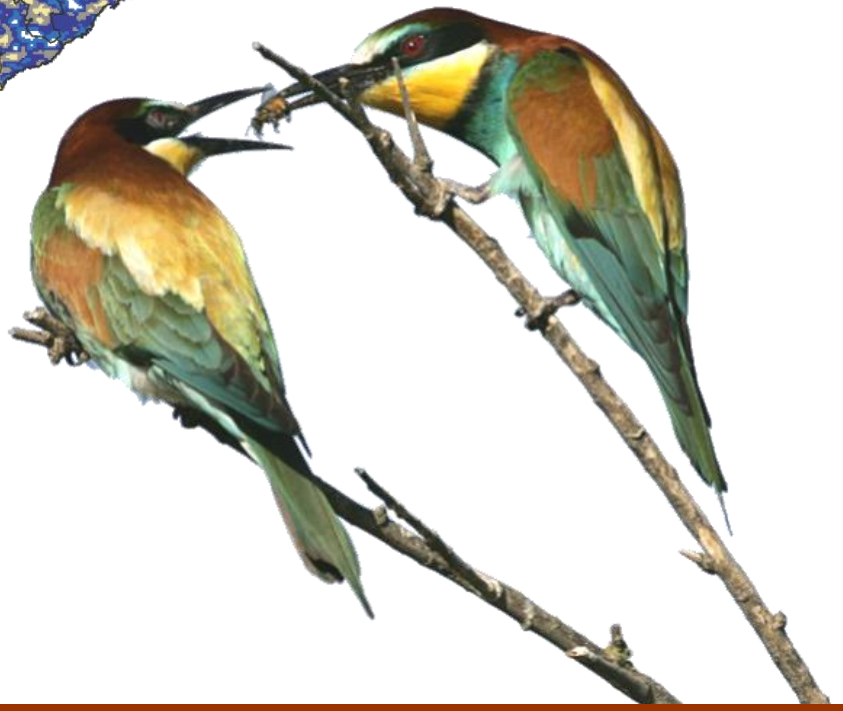


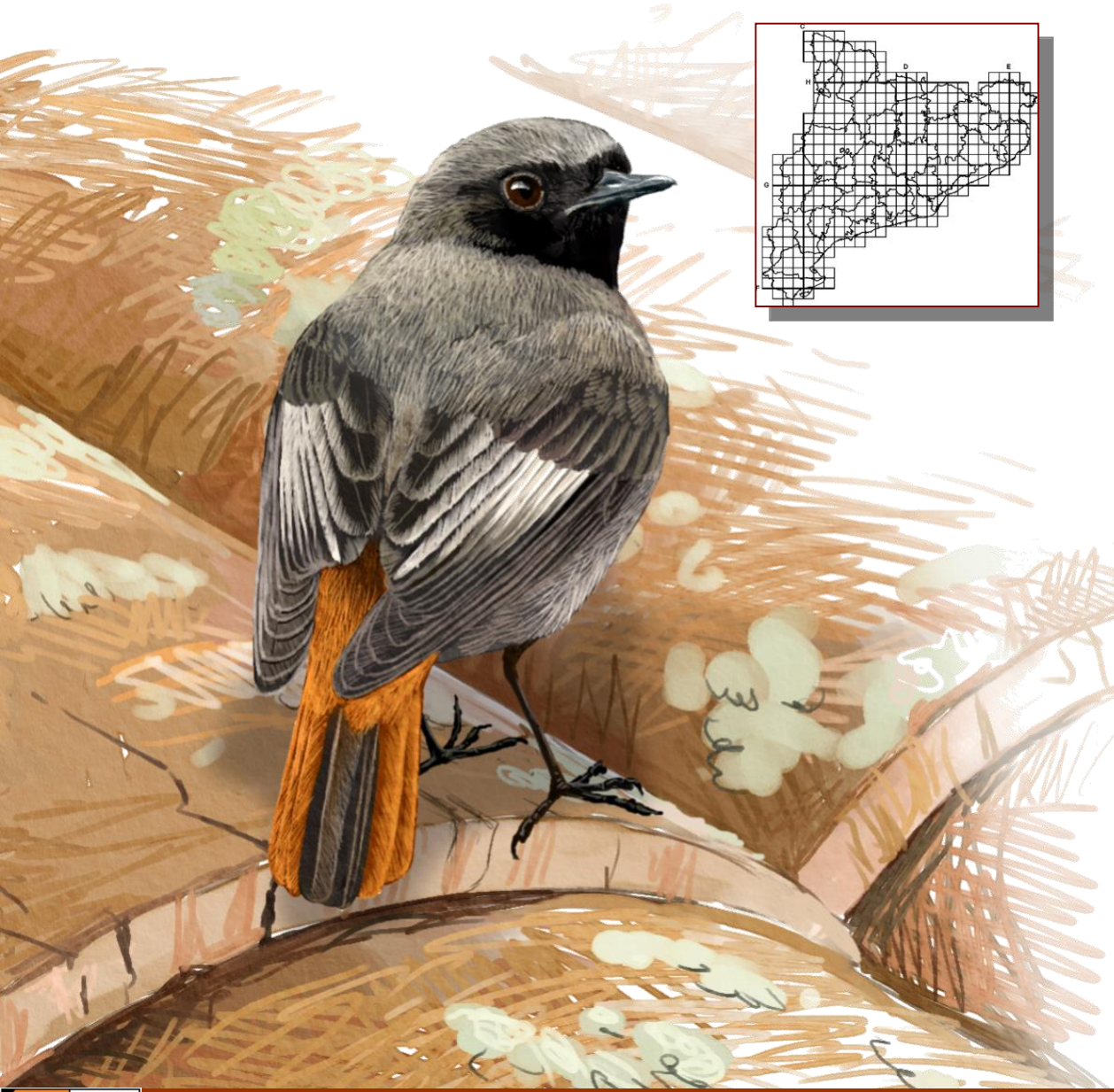
Management of natural resources: establishing subsidies

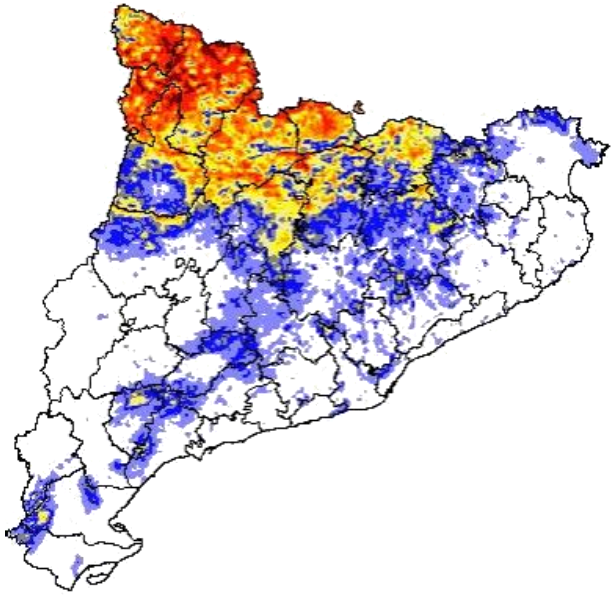


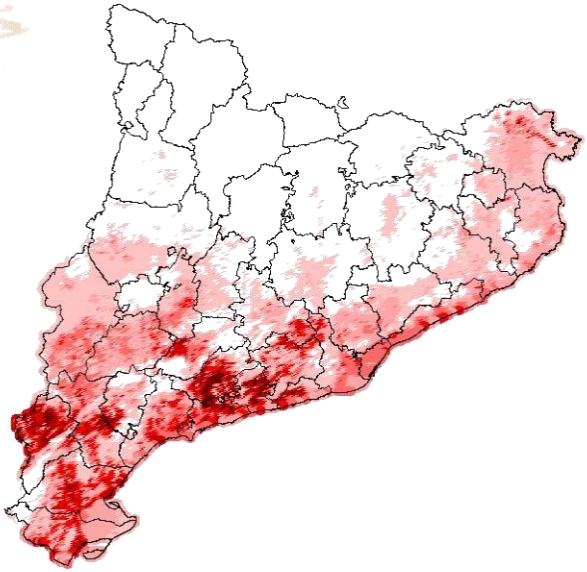
Management of natural resources: establishing subsidies



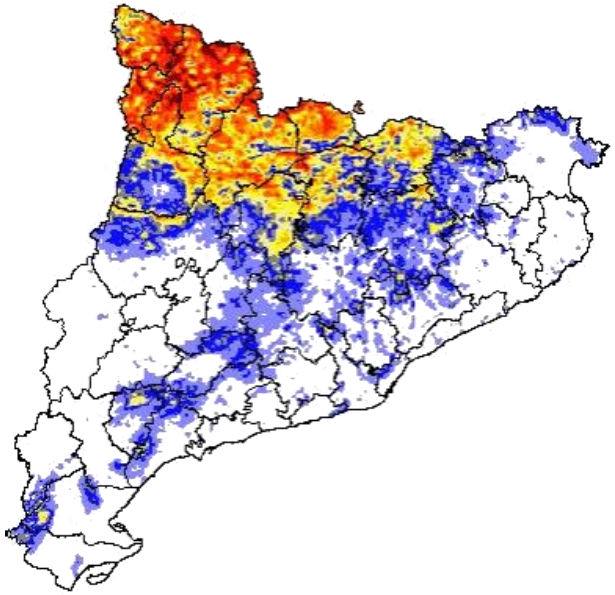
Catalan Winter Bird Atlas 2006-2009

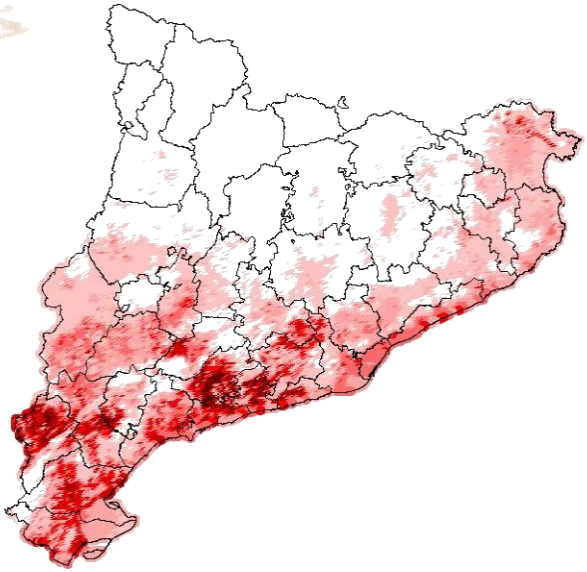




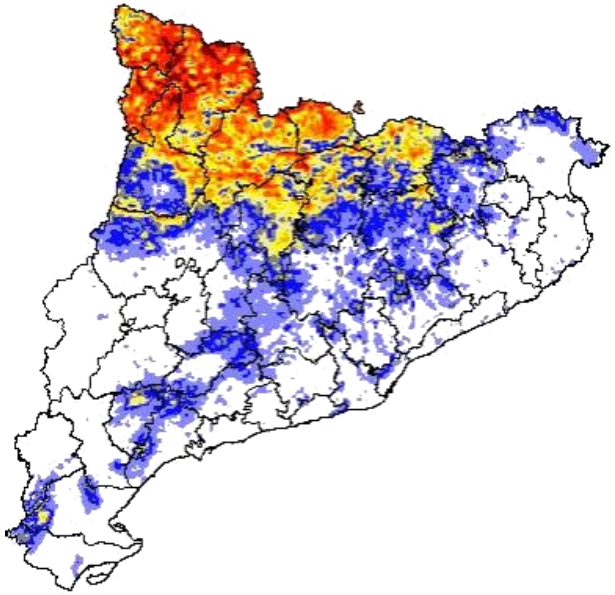


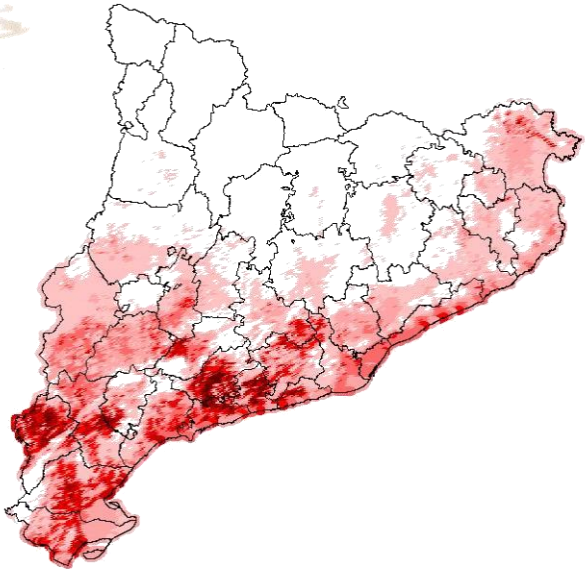
Winter Bird Survey



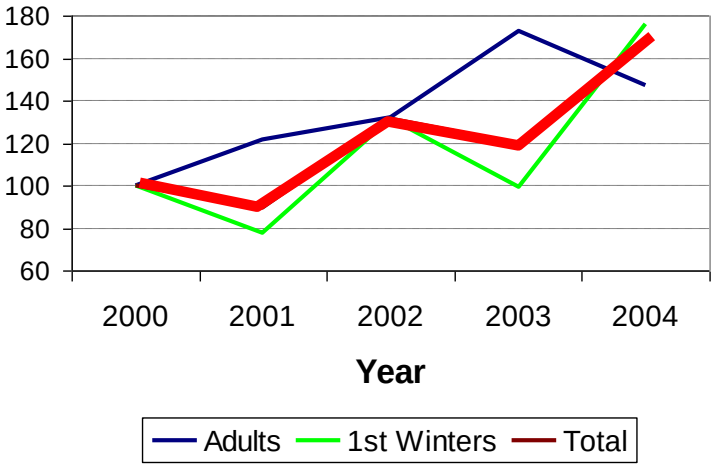


Winter Constant Effort Sites (bird banding)





The relevance of segregating age-classes



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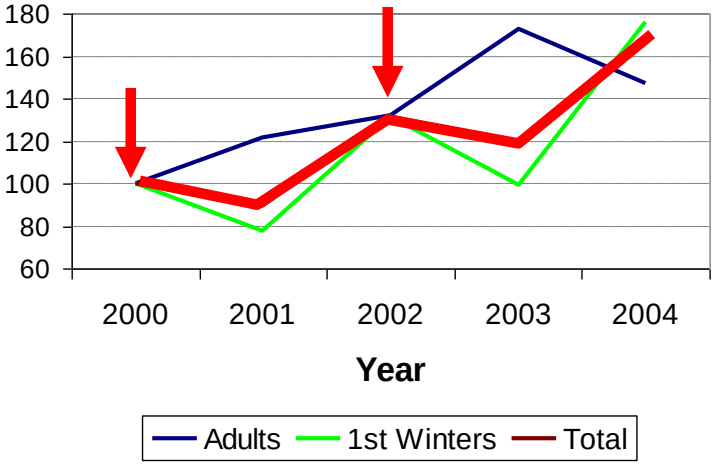

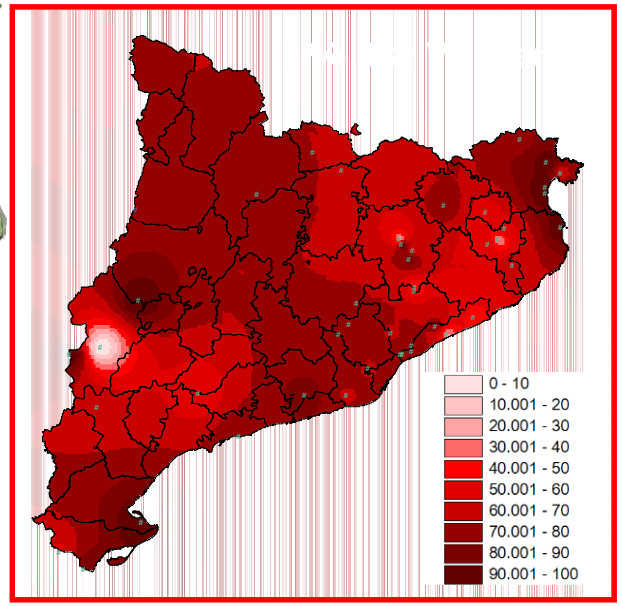

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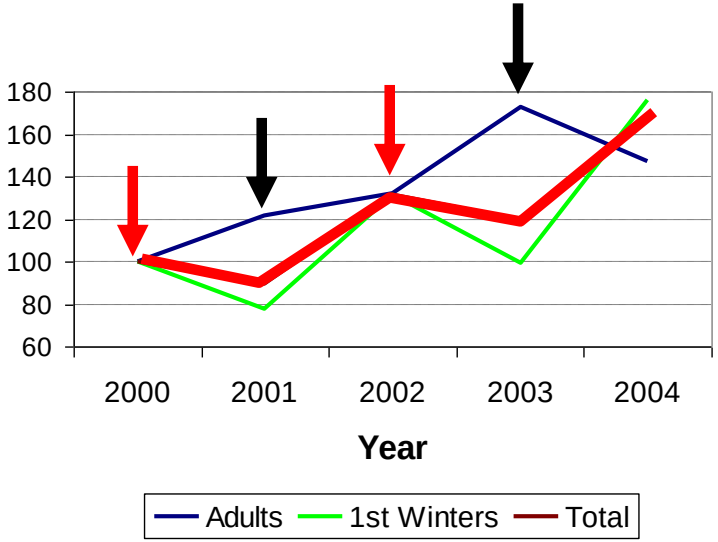

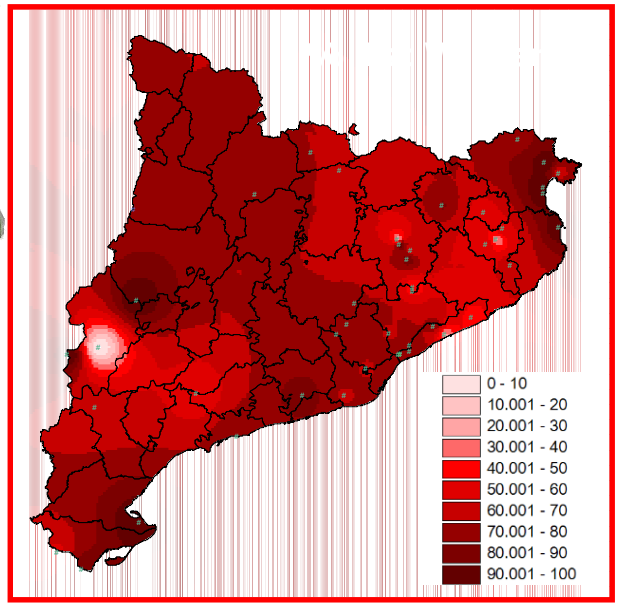

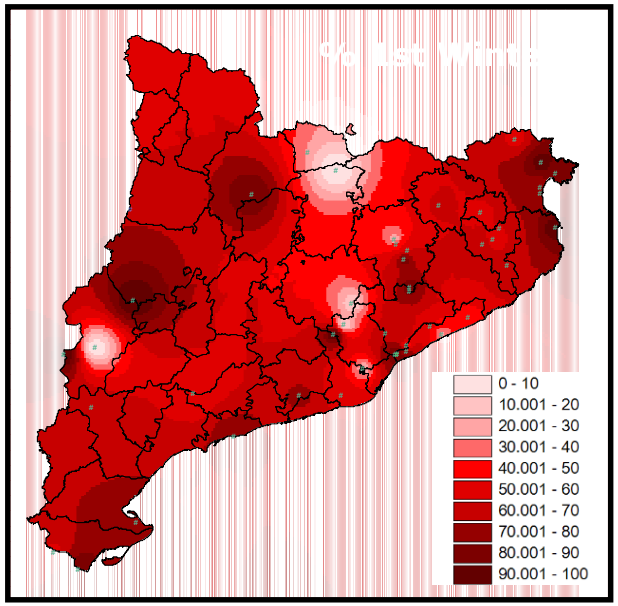

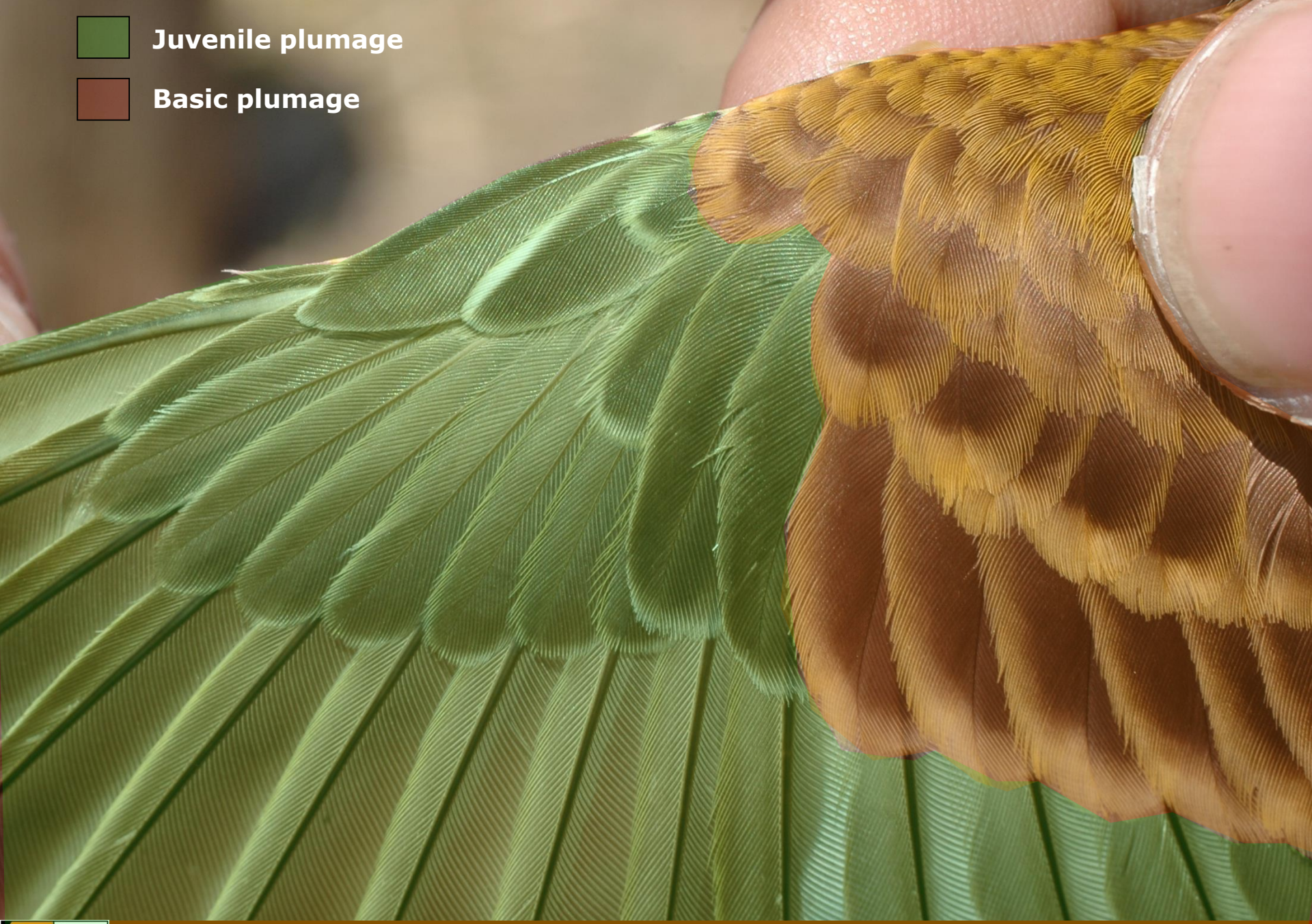

Ageing birds by molt and plumage

Why using molt?

Why using molt?




Why using molt?





Why using molt?





Thank you for your attention !!!