

Impact of climate change on northern bird populations

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How to response to climate change?

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- Move:

  in time - phenology

  in space - range shifts

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- Adapt (evolution):

  physiology, morphology etc.

How to response to climate change?

- Move:

  in time - phenology

  in space - range shifts
- Adapt (evolution):

  physiology, morphology etc.
- Perish ☹ (Tropical amphibians: Pounds et al. 2006 Nature)

Monitoring schemes

http://www.luomus.fi/fi/linnustonseuranta

- Winter bird censuses
- Winter feeding monitoring
- Archipelago bird censuses (SYKE, MH)
- Breeding waterbird counts (together with LUKE)
- Landbird point counts
- Line transects (standardized 2006->)
- Breeding bird atlases (latest 2006-2010)
- Nest card scheme
- Raptor grid monitoring
- Ringing schemes
- Migration counts

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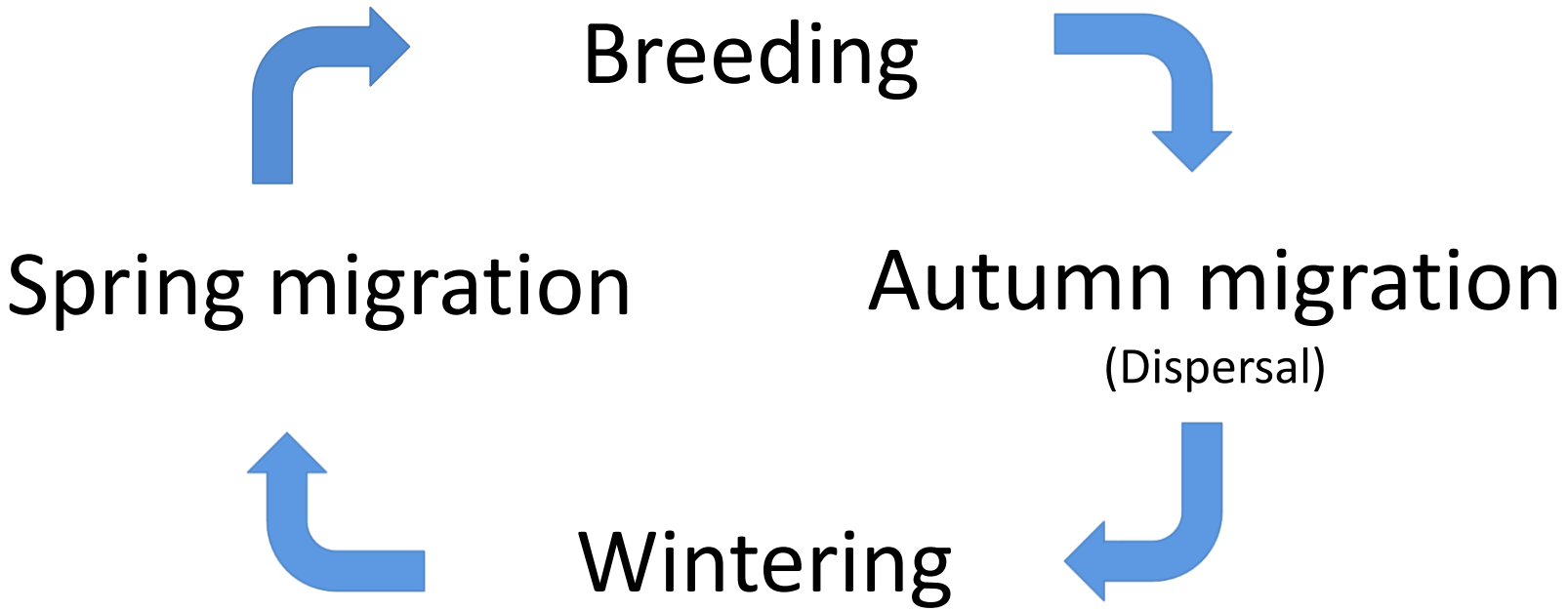
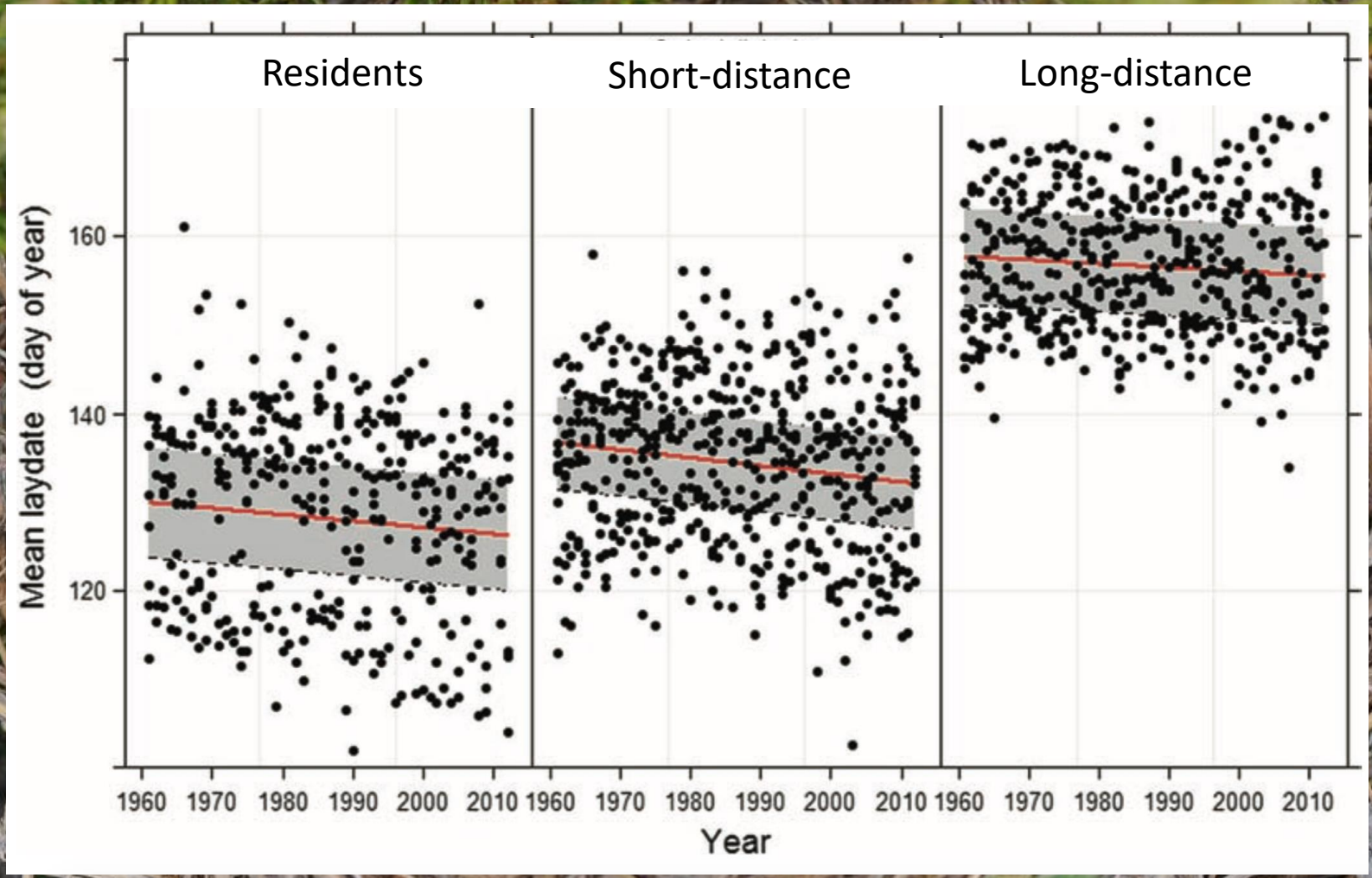
1) Move in time: climate and phenology



Breeding phenogy

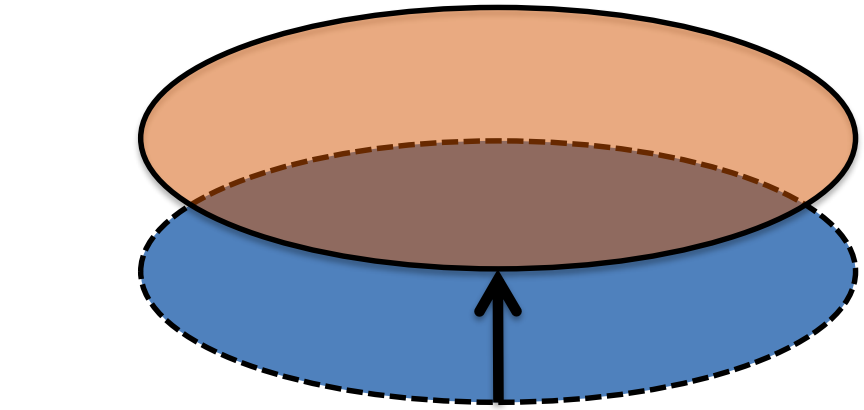
A nest card scheme

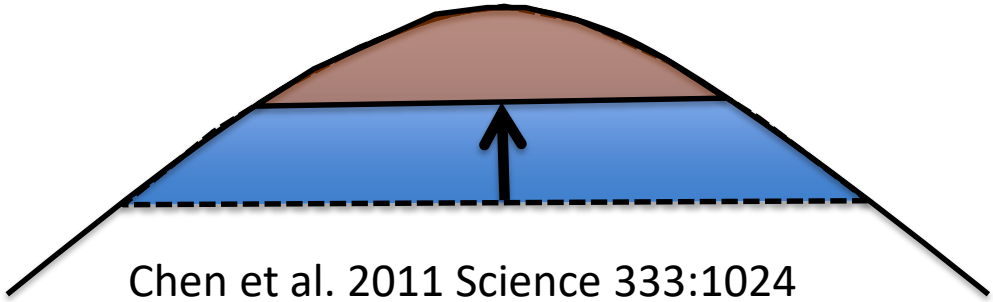
Breeding phenogy



2) Move in space: climate change and distribution changes

- Climate change shifts distribution areas towards poles and mountain tops

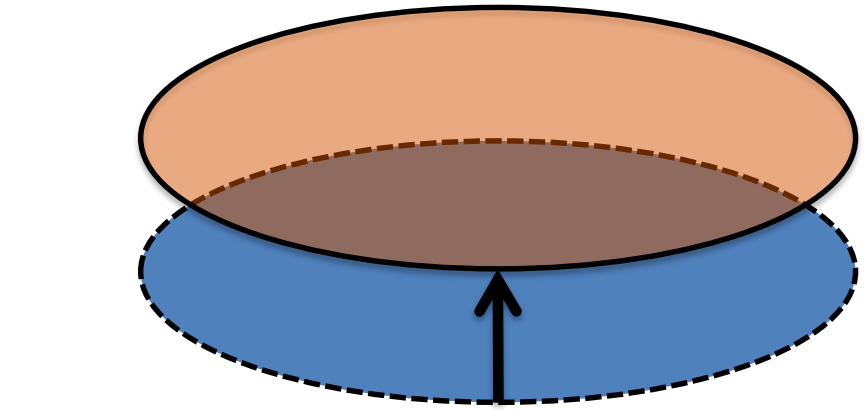


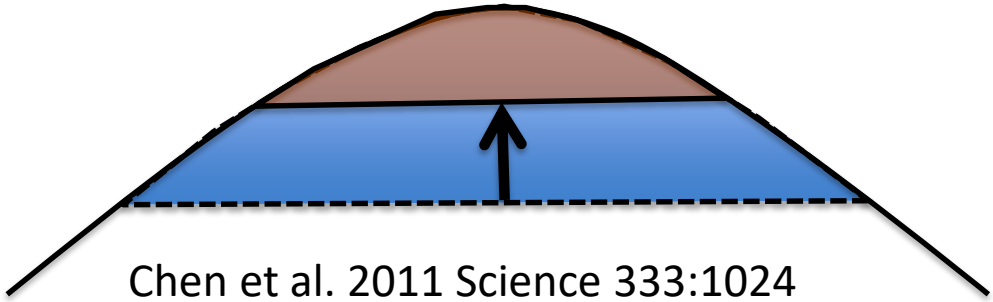


Chen et al. 2011 Science 333:1024

2) Move in space: climate change and distribution changes

- Climate change shifts distribution areas towards poles and mountain tops
- Abundance changes





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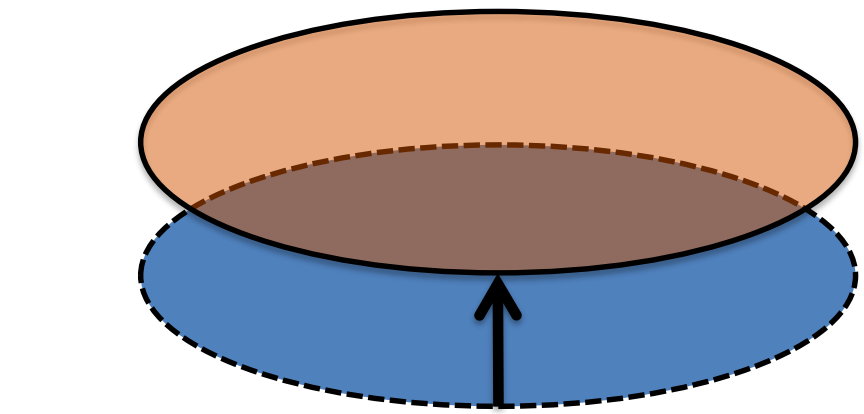
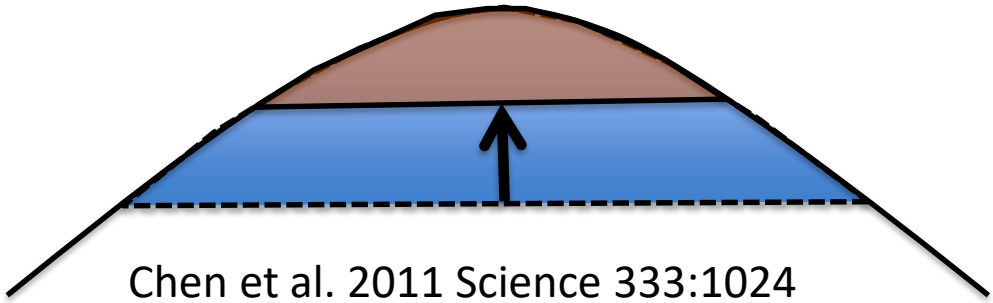
2) Move in space: climate change and distribution changes

- Climate change shifts distribution areas towards poles and mountain tops
- Abundance changes
- Non-breeding season

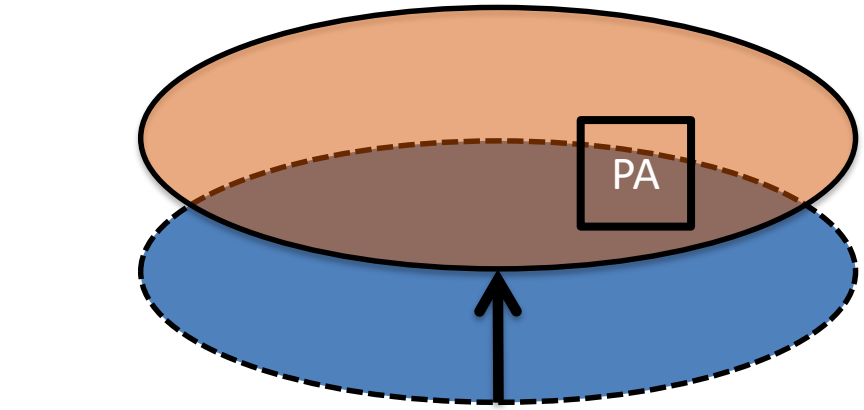


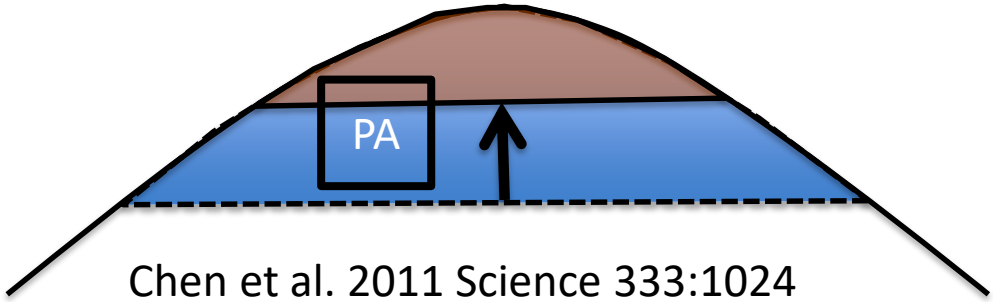


Chen et al. 2011 Science 333:1024

2) Move in space: climate change and distribution changes

- Climate change shifts distribution areas towards poles and mountain tops
- Abundance changes
- Non-breeding season
- Protected areas





Chen et al. 2011 Science 333:1024

Winter Bird Counts in Finland

http://www.luomus.fi/fi/talvilintulaskennat

- Early winter 1.-14.11. (1976=>)
- Mid-winter 25.12.-7.1. (1957=>)
- Late winter 21.2.-6.3. (1966=>)

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- 8 habitat categories since 1986
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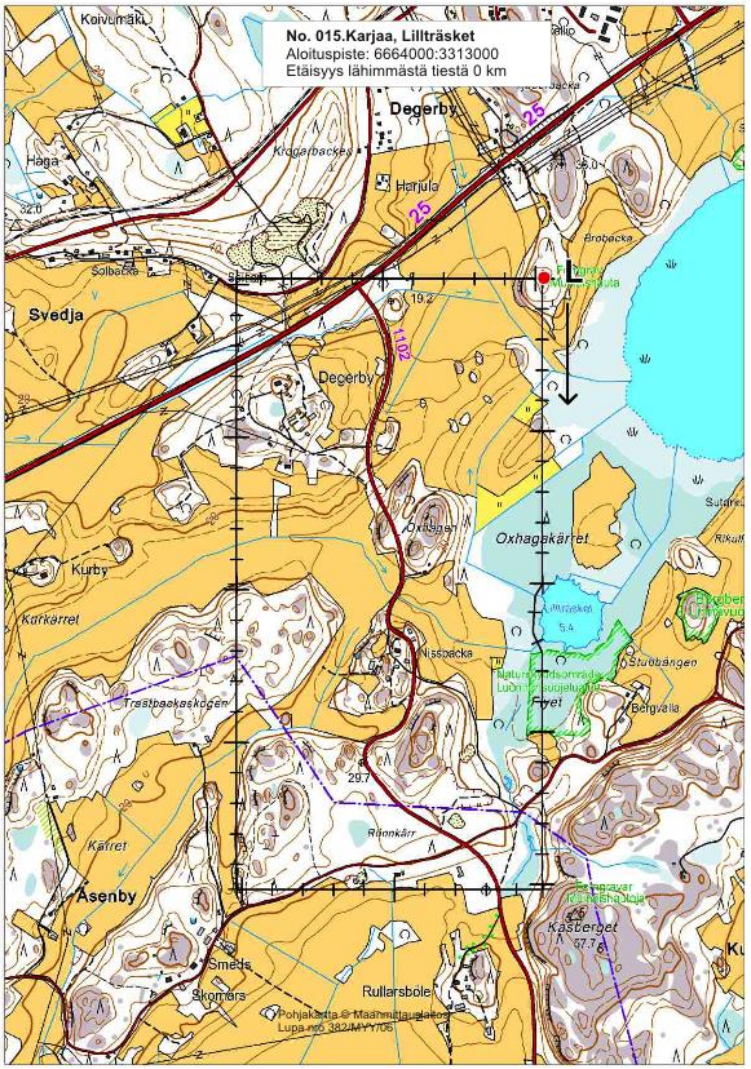
- N. 10 km long route
- All birds are counted
- 8 habitat categories since 1986
- Sex ratios since 2010
- Mammals 2014->
- C.550 routes/a, c. 1000 volunteers

International winter counts

- Finnish winter bird counts are part of the International Waterbird Counts
- Wetlands INTERNATIONAL

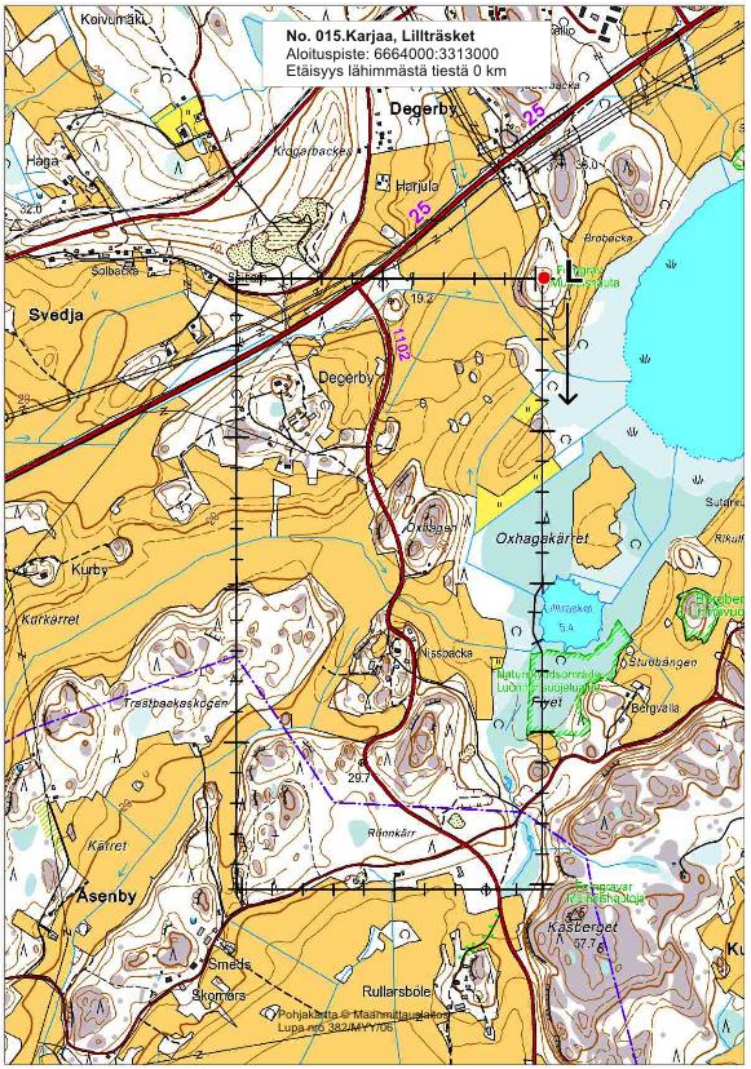
Line transect counts

- Breeding season
- One visit in June



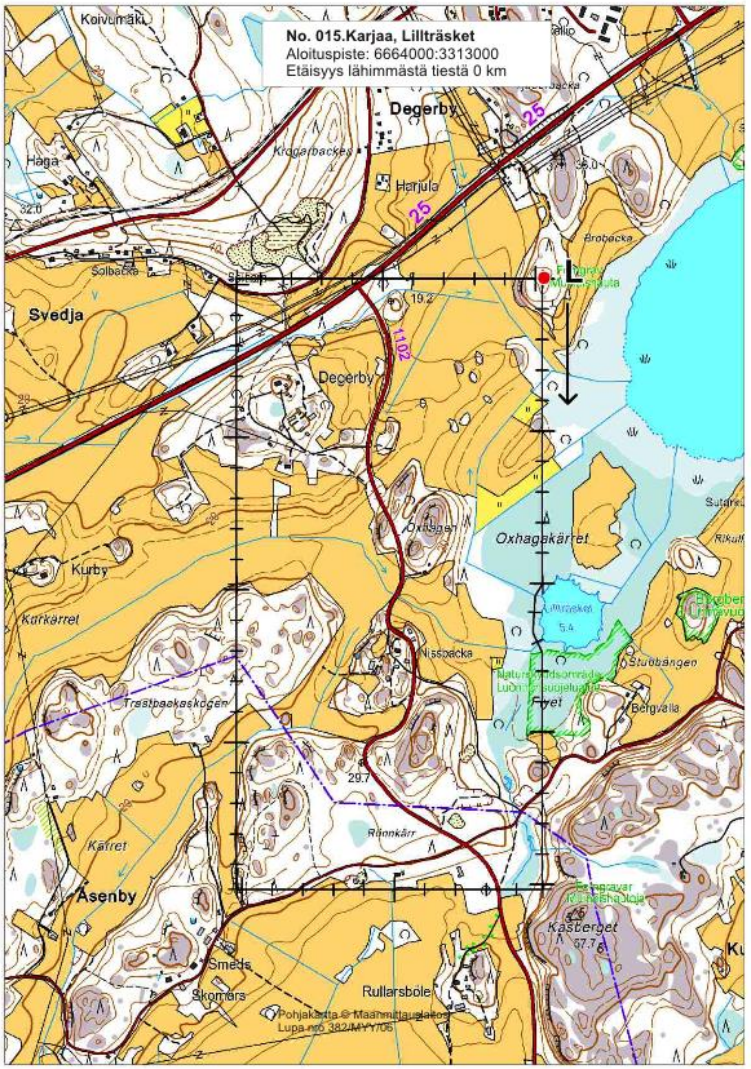
Line transect counts

- Breeding season
- One visit in June
- Walking along the line



Line transect counts

- Breeding season
- One visit in June
- Walking along the line
- 50 metres main belt, supplementary belt



Line transect counts

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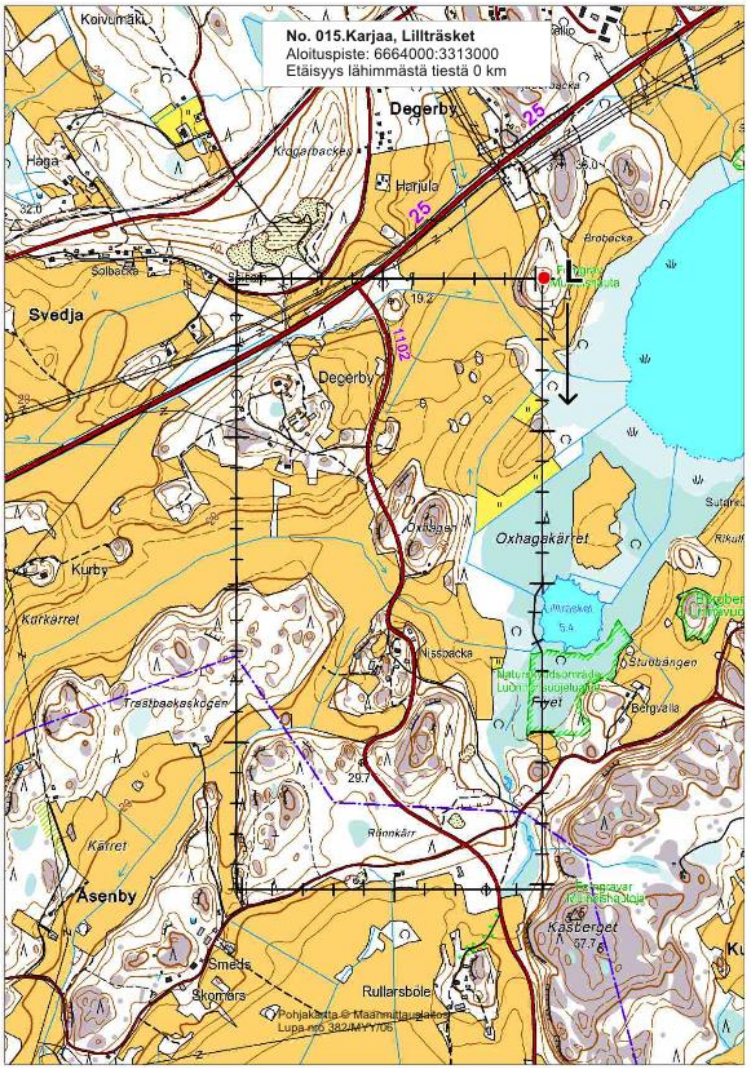
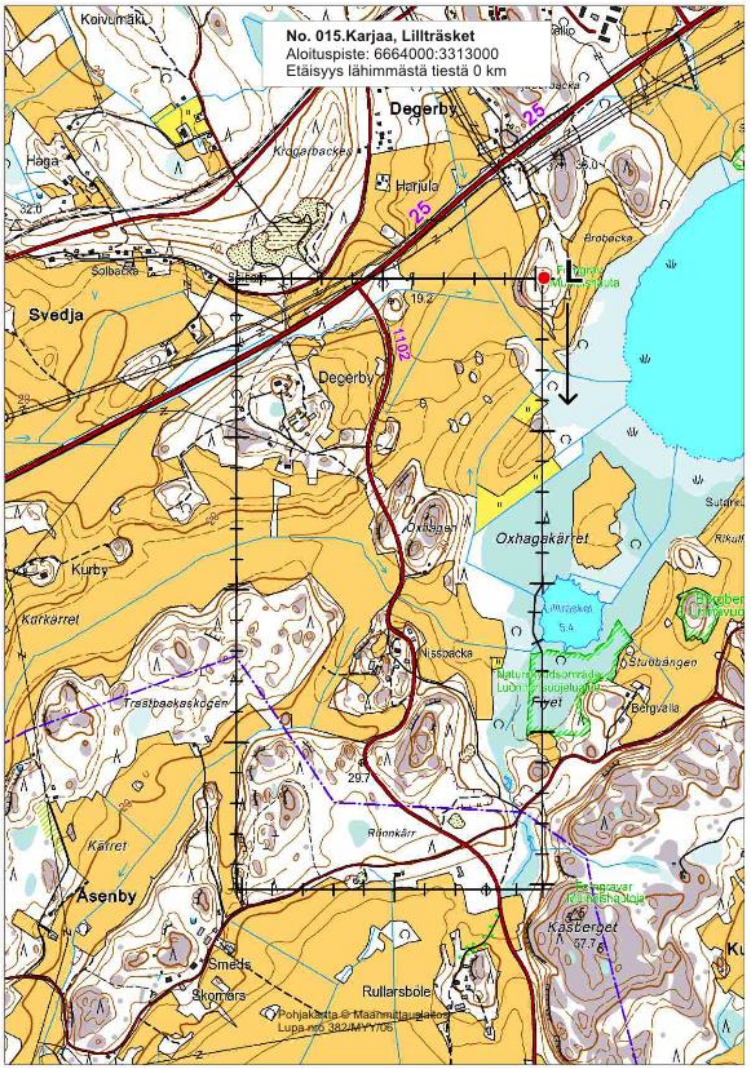
- 50 metres main belt, supplementary belt
- 50 metres habitat blocks



Line transect counts

- Breeding season
- One visit in June
- Walking along the line
- 50 metres main belt, supplementary belt
- 50 metres habitat blocks
- Type of observation: singing calling, seen etc



Standardized line transects

http://www.luomus.fi/fi/pesimalintujen-linja-pistelaskenta

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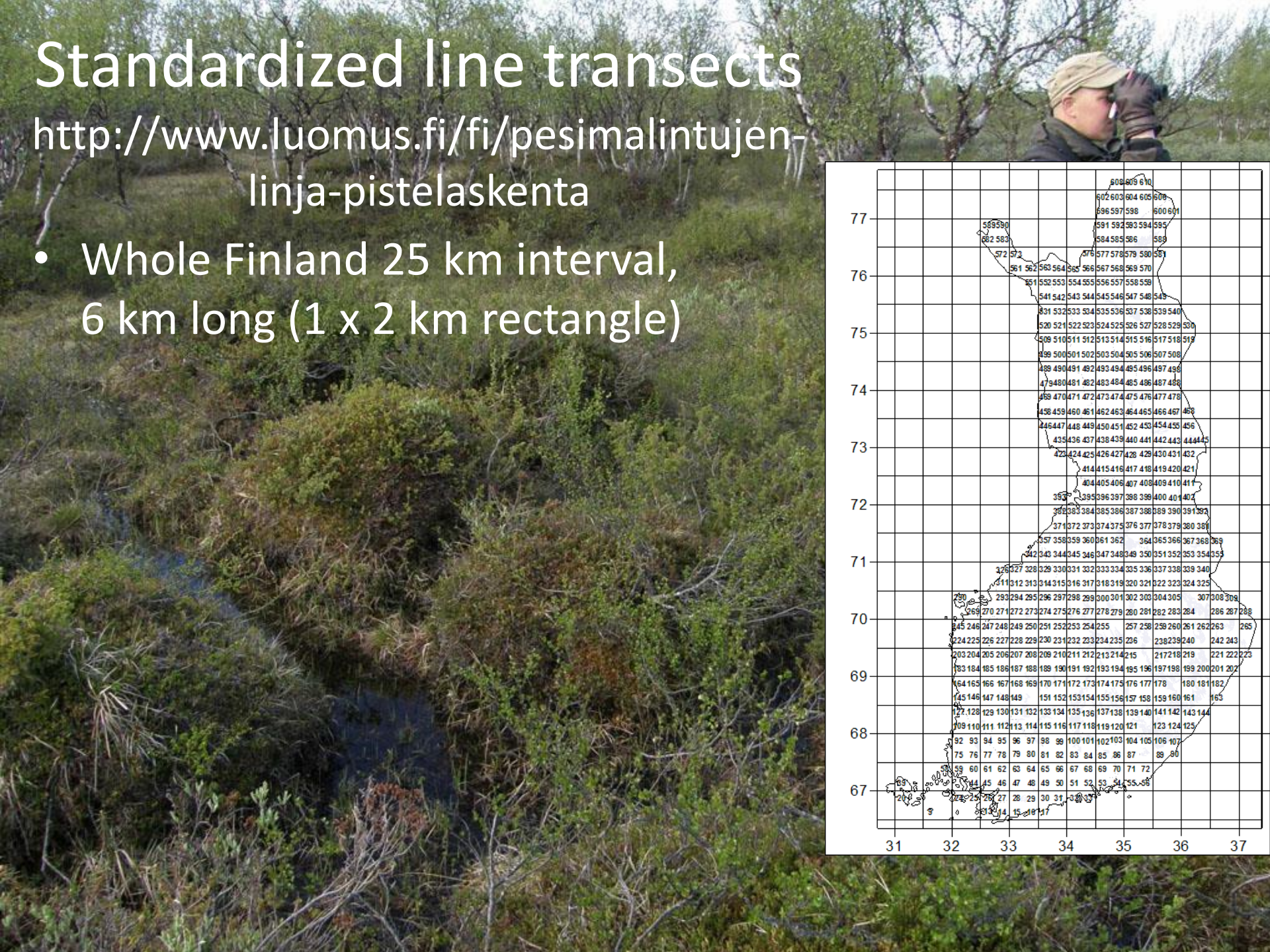
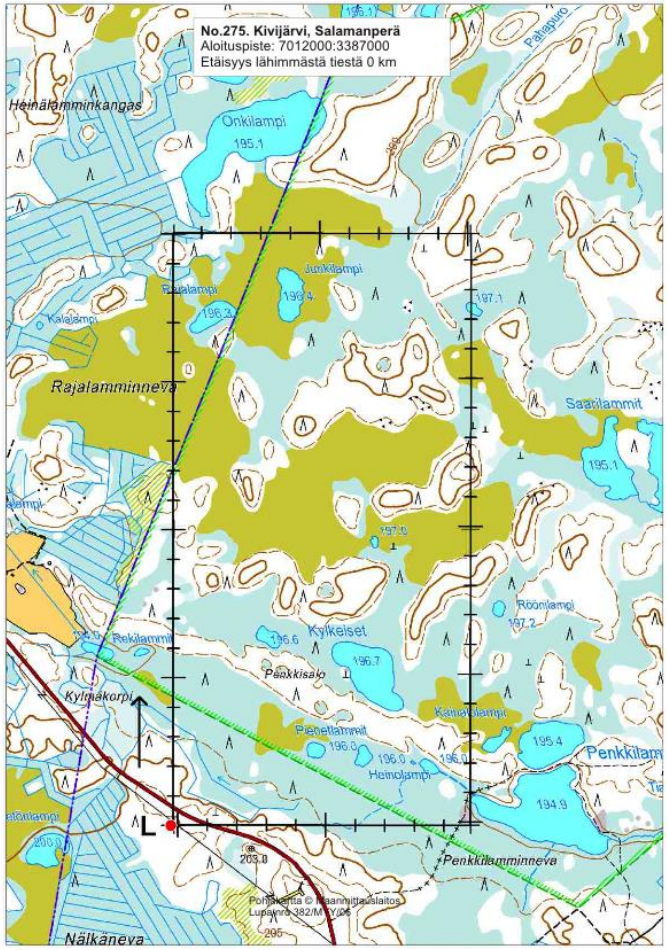
- Whole Finland 25 km interval, 6 km long (1 x 2 km rectangle)

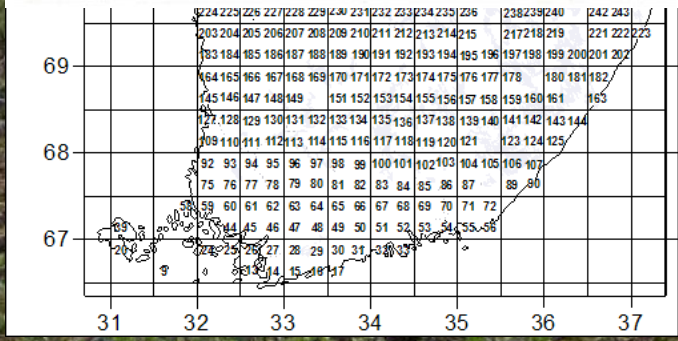


Standardized line transects

http://www.luomus.fi/fi/pesimalintujen-linja-pistelaskenta

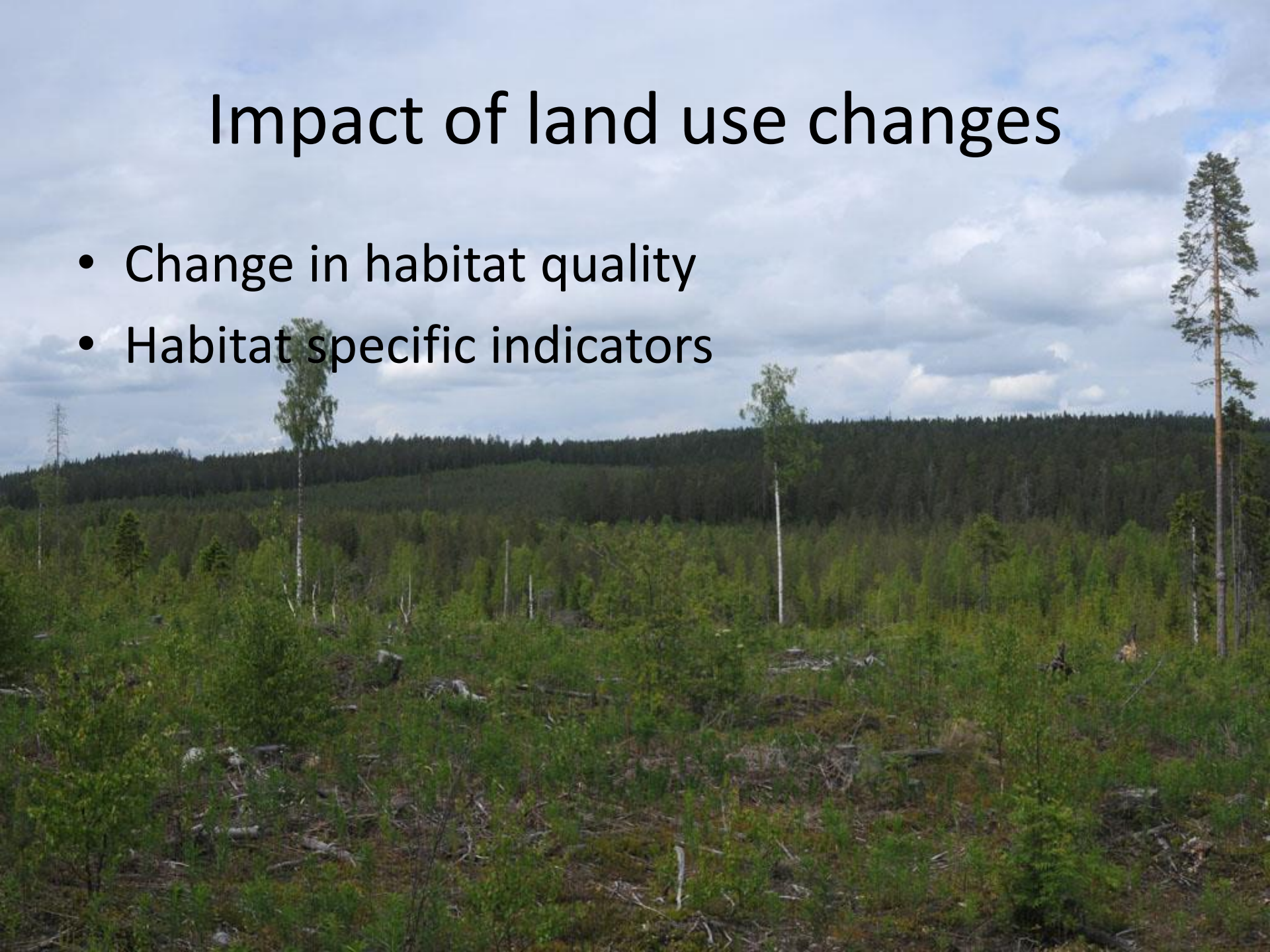
- Whole Finland 25 km interval, 6 km long (1 x 2 km rectangle)
- 566 transects, year 2006=>
- 200+ repeated annually, 100+ volunteers





Impact of land use changes

- Change in habitat quality
- Habitat specific indicators



Impact of land use changes

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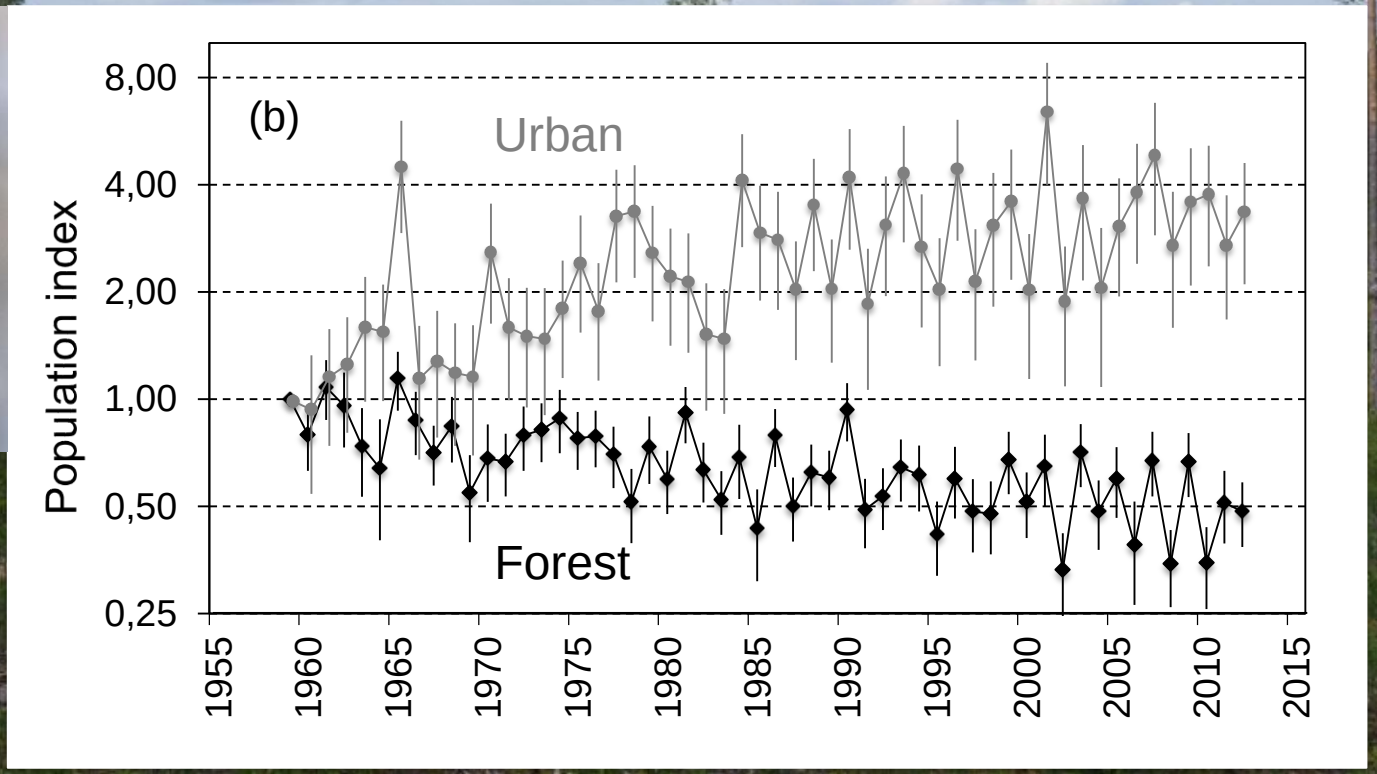
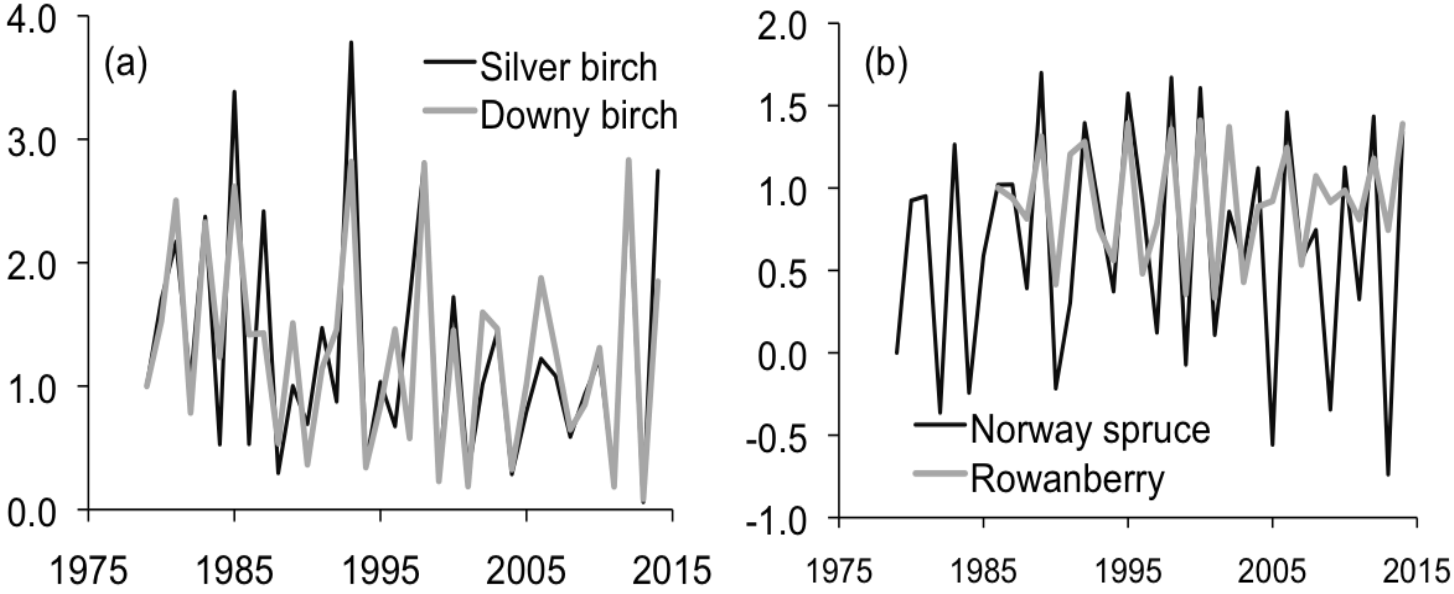
- Habitat specific indicators

Fraixedas et al. 2015 J Avian Biology 46: 63

Winter bird trends



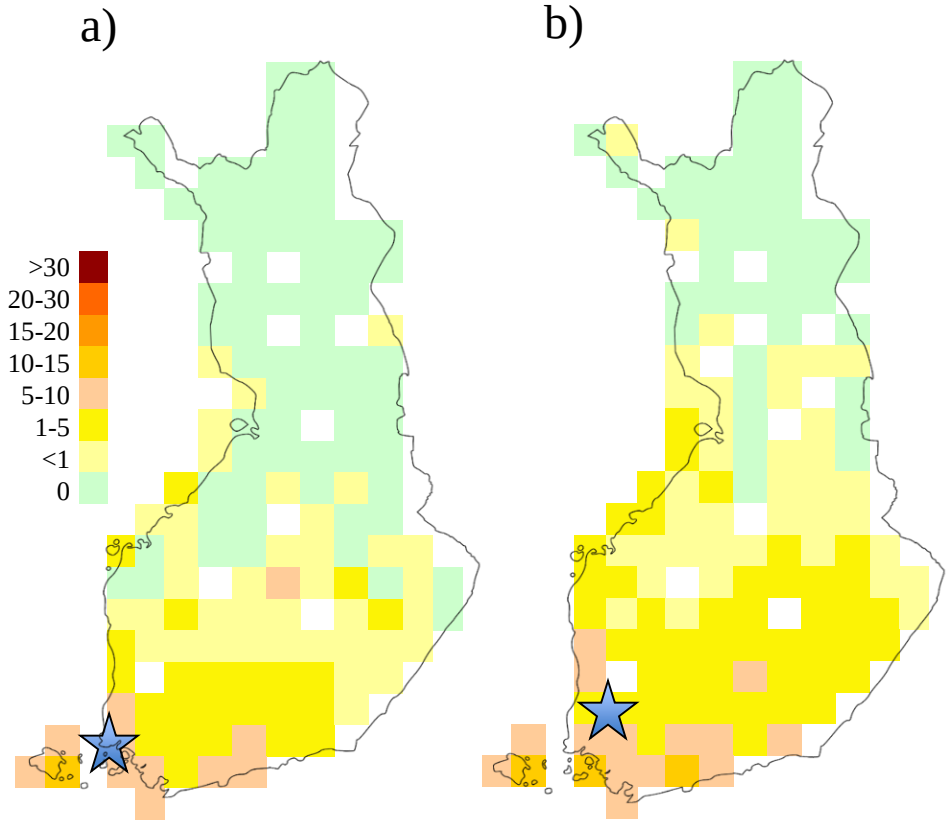
Correlated crop sizes



Meller et al. 2016: J Animal Ecol, Gallego Zamorano et al. 2017 J Plant Ecol

I) Density shifts of breeding Finnish land birds

Change in the central gravity of breeding landbirds



Blackbird

Lehikoinen & Virkkala 2016: Global Change Biol 22: 1121–1129

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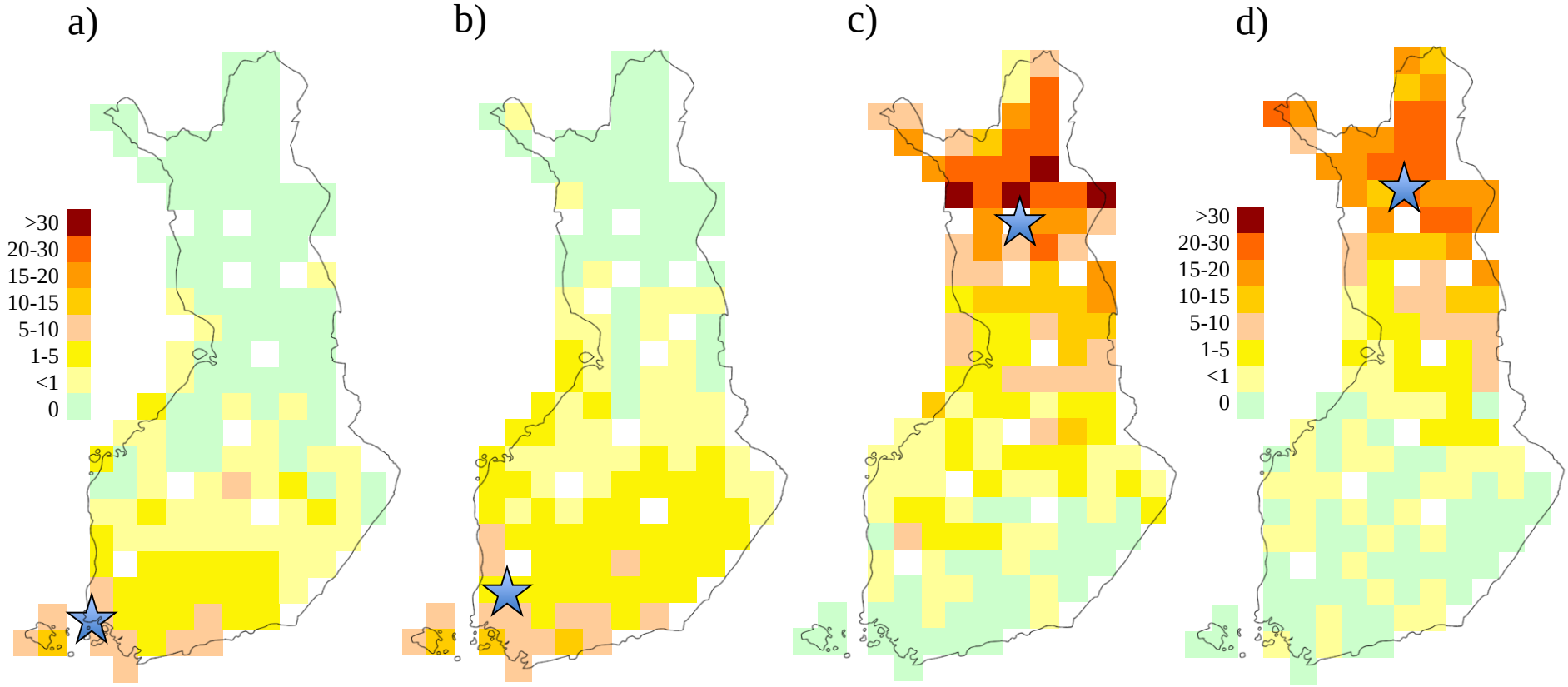


Lehikoinen & Virkkala 2016: Global Change Biol 22: 1121–1129

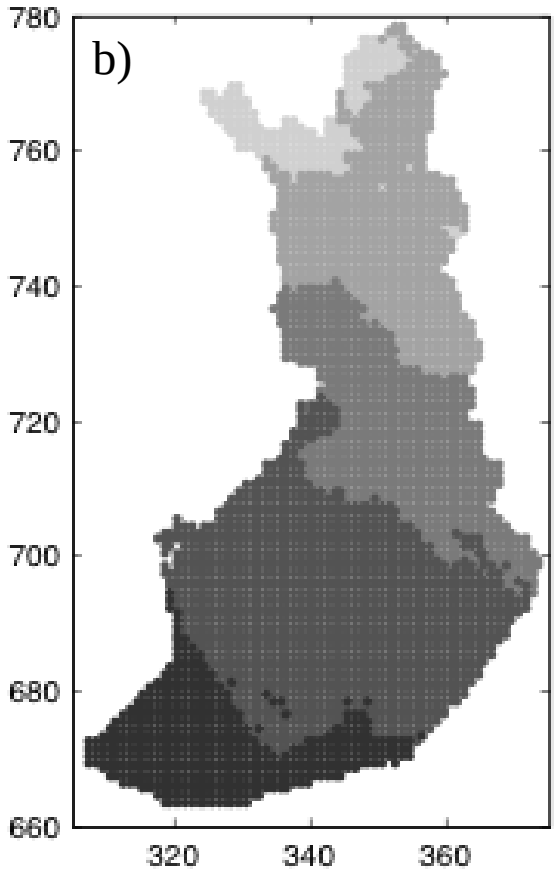
Change in the central gravity of landbirds

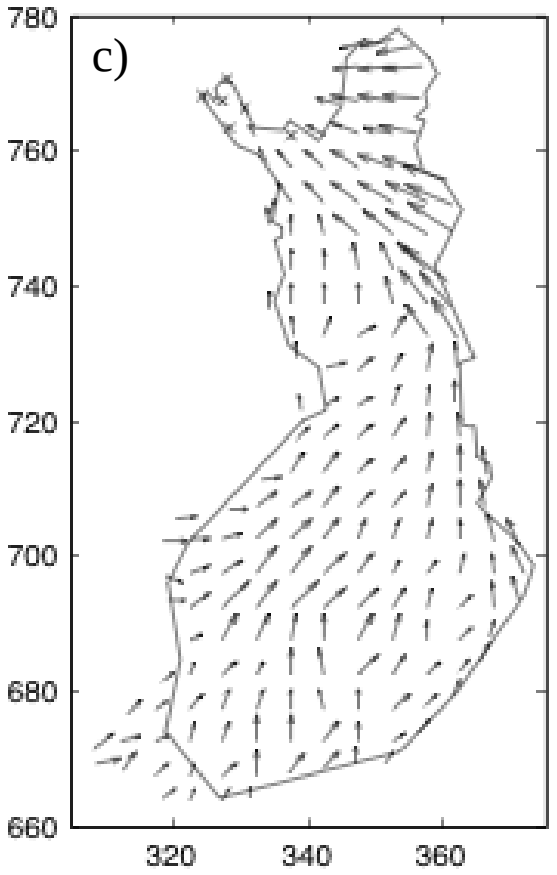
- Direction of density shifts
- Birds 15 km/decade NNE

Lehikoinen & Virkkala 2016: Global Change Biol

Change in the central gravity of landbirds

- Direction of density shifts
- Birds 15 km/decade NNE
- Direction of temperature shifts

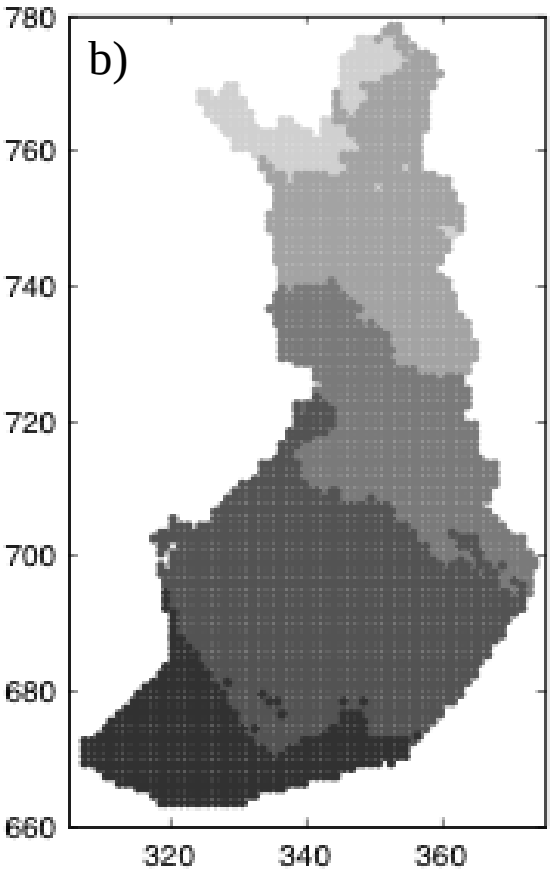


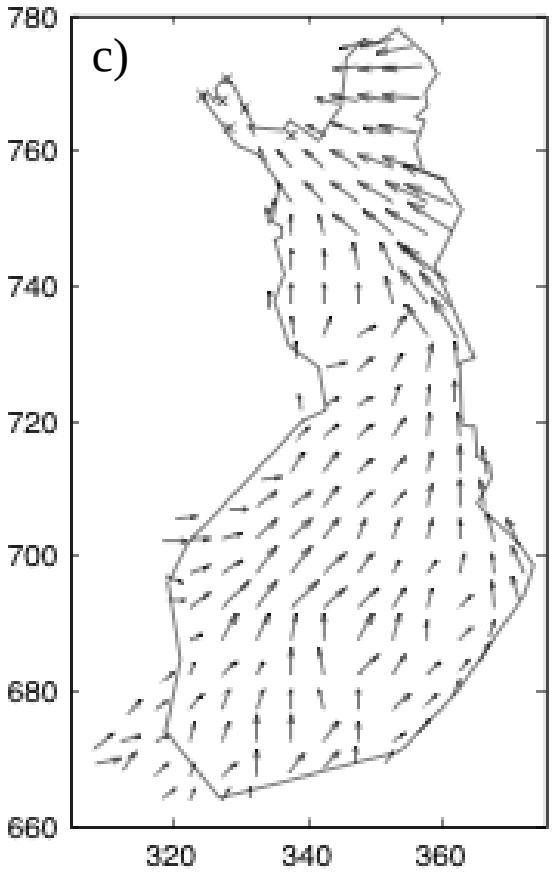


Lehikoinen & Virkkala 2016: Global Change Biol

Change in the central gravity of landbirds

- Direction of density shifts
- Birds 15 km/decade NNE
- Direction of temperature shifts
- Temp 74 km/decade NNE

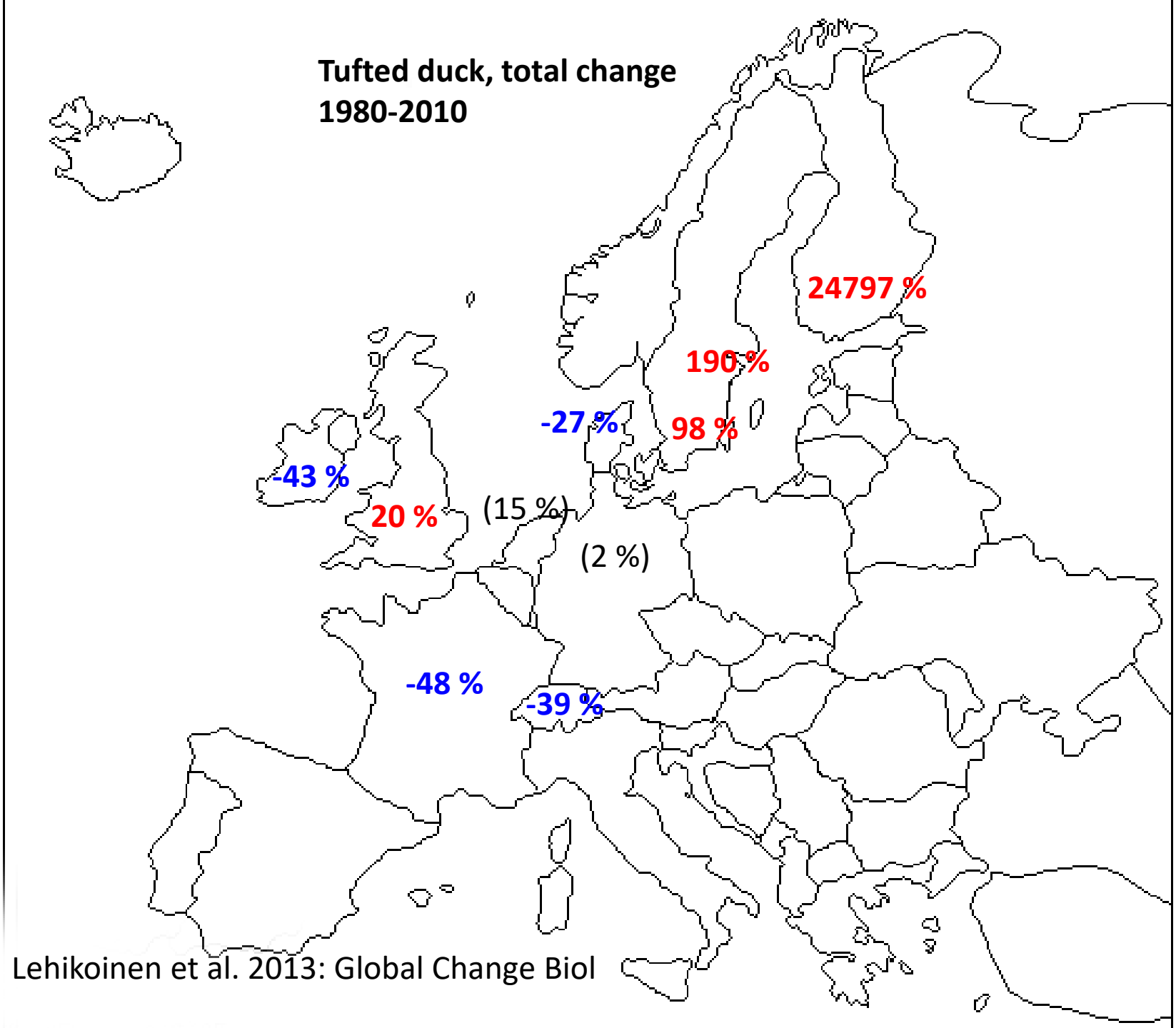




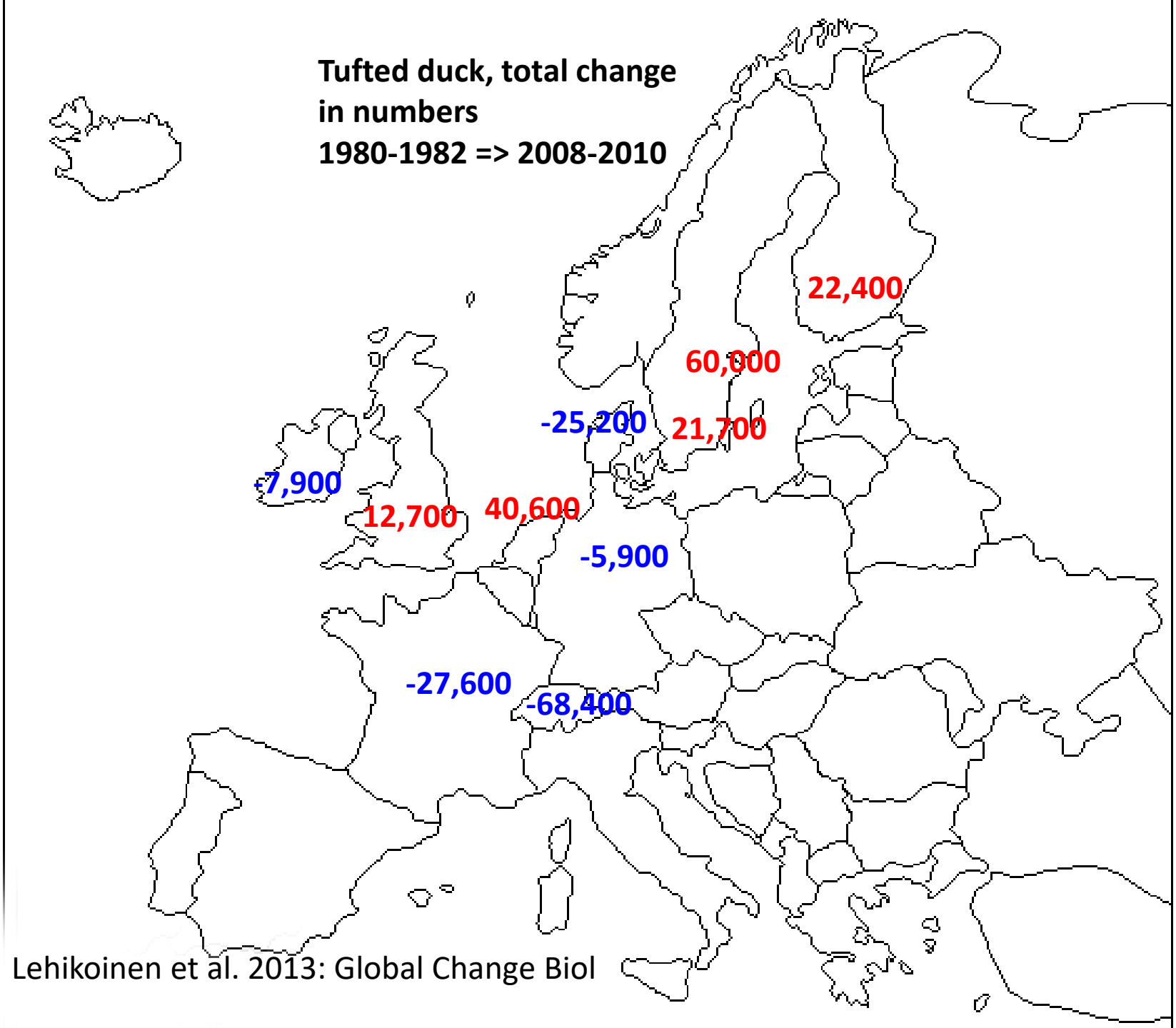
Lehikoinen & Virkkala 2016: Global Change Biol


LAPLAND
#CLIMATESTRIKEONLINE

II) Changes in abundance of wintering waterbirds



Lehikoinen et al. 2013: Global Change Biol



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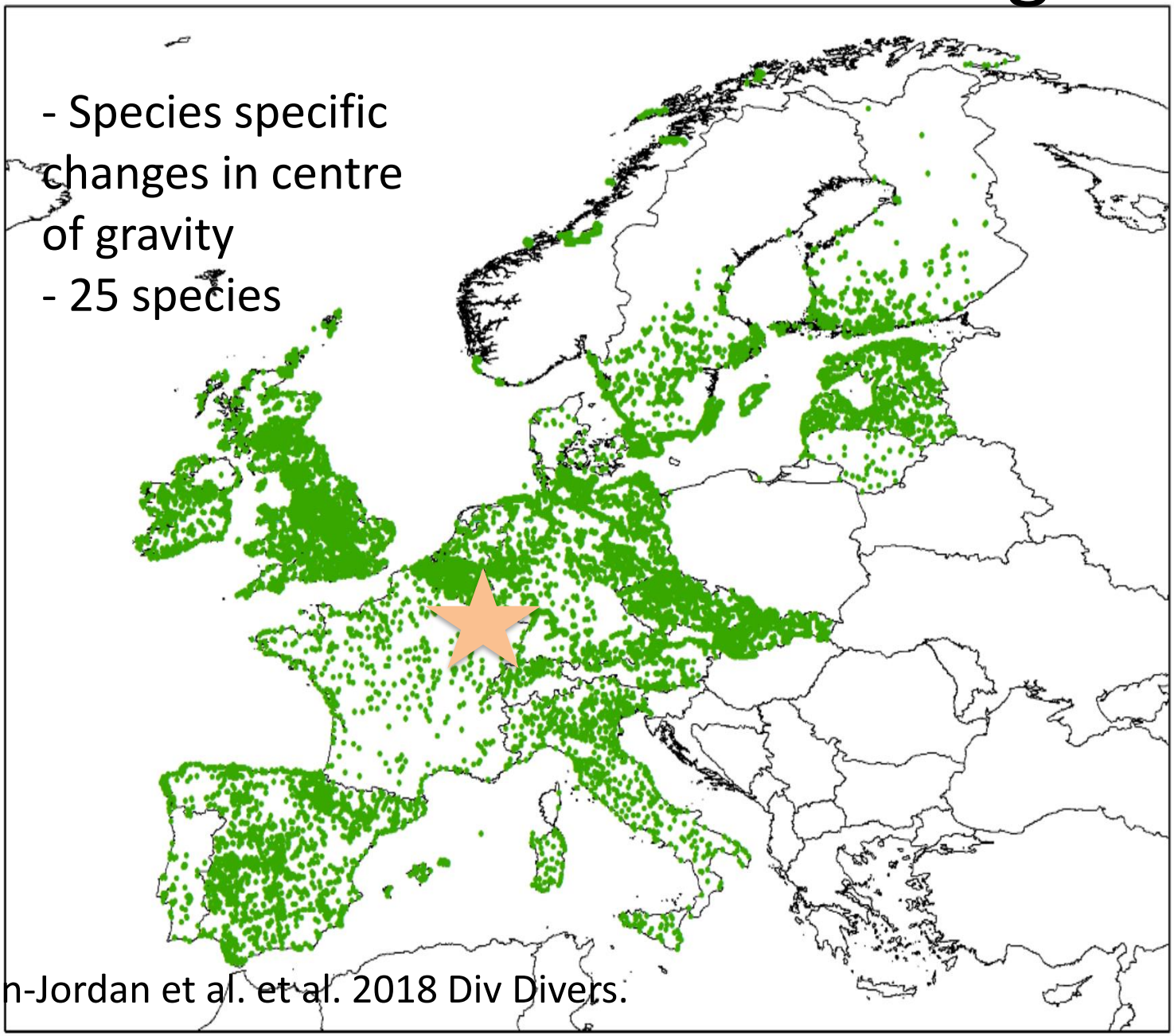
Fantastic census coverage!



Pavon-Jordan et al. et al. 2018 Div Divers.

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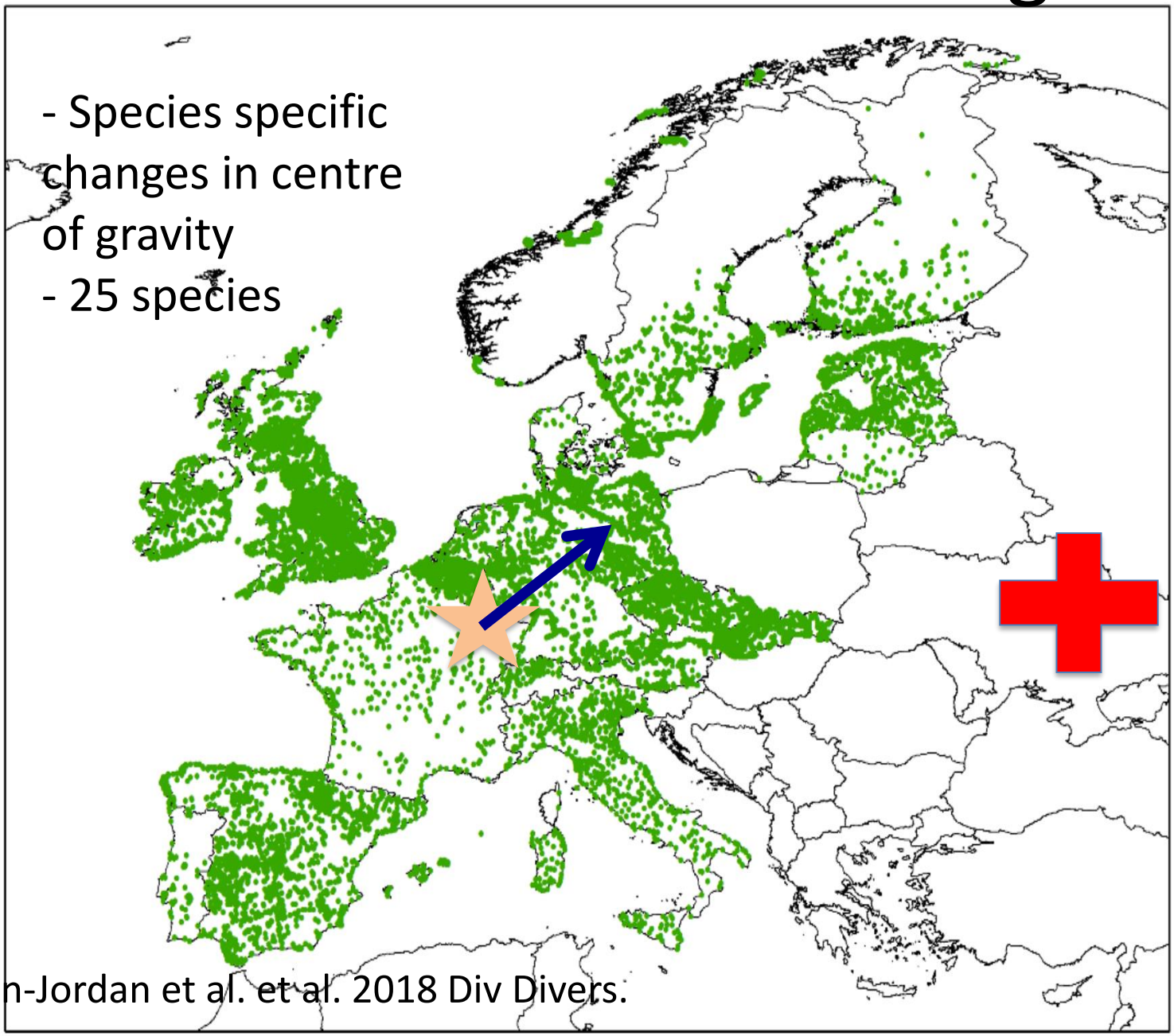

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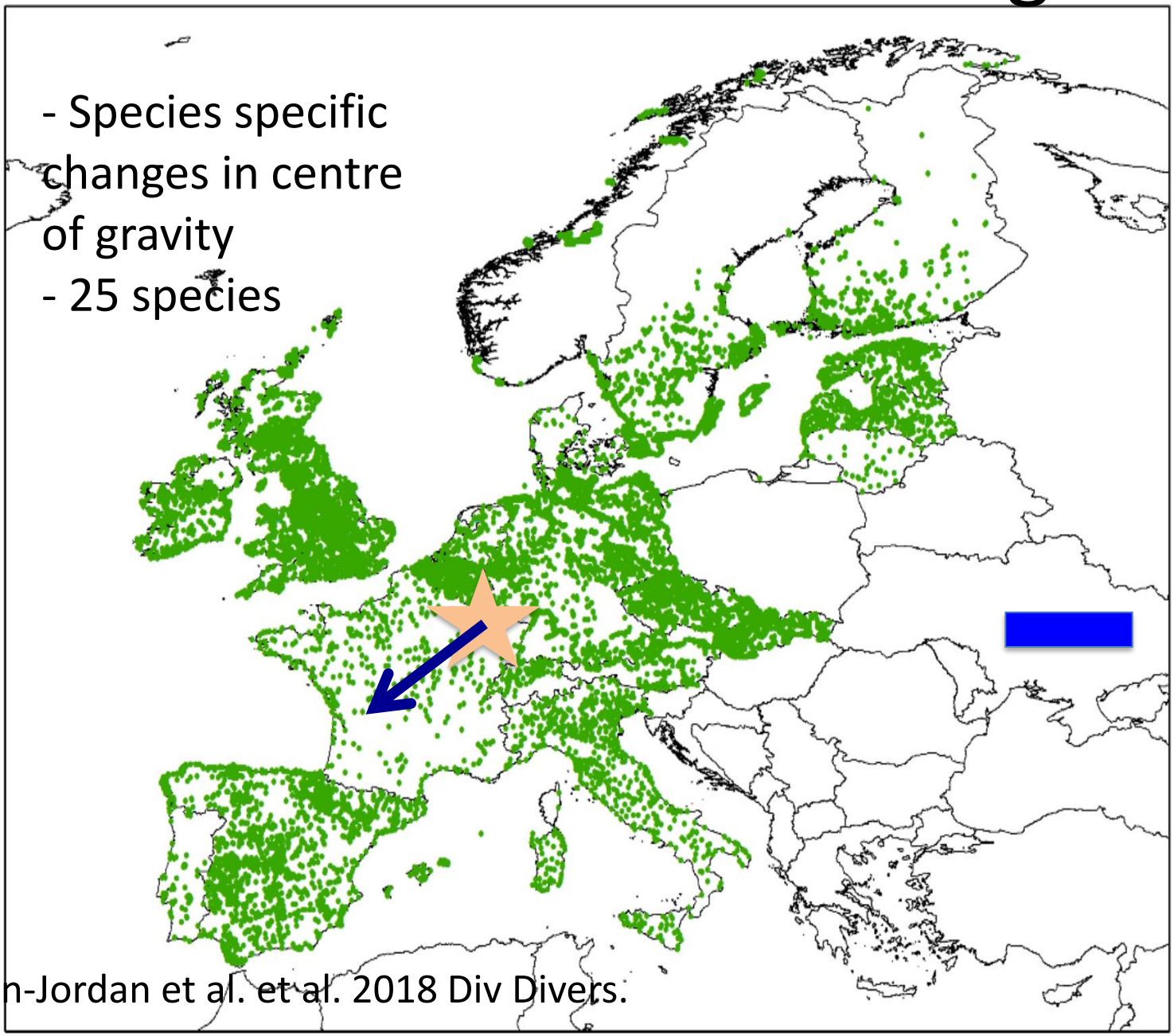
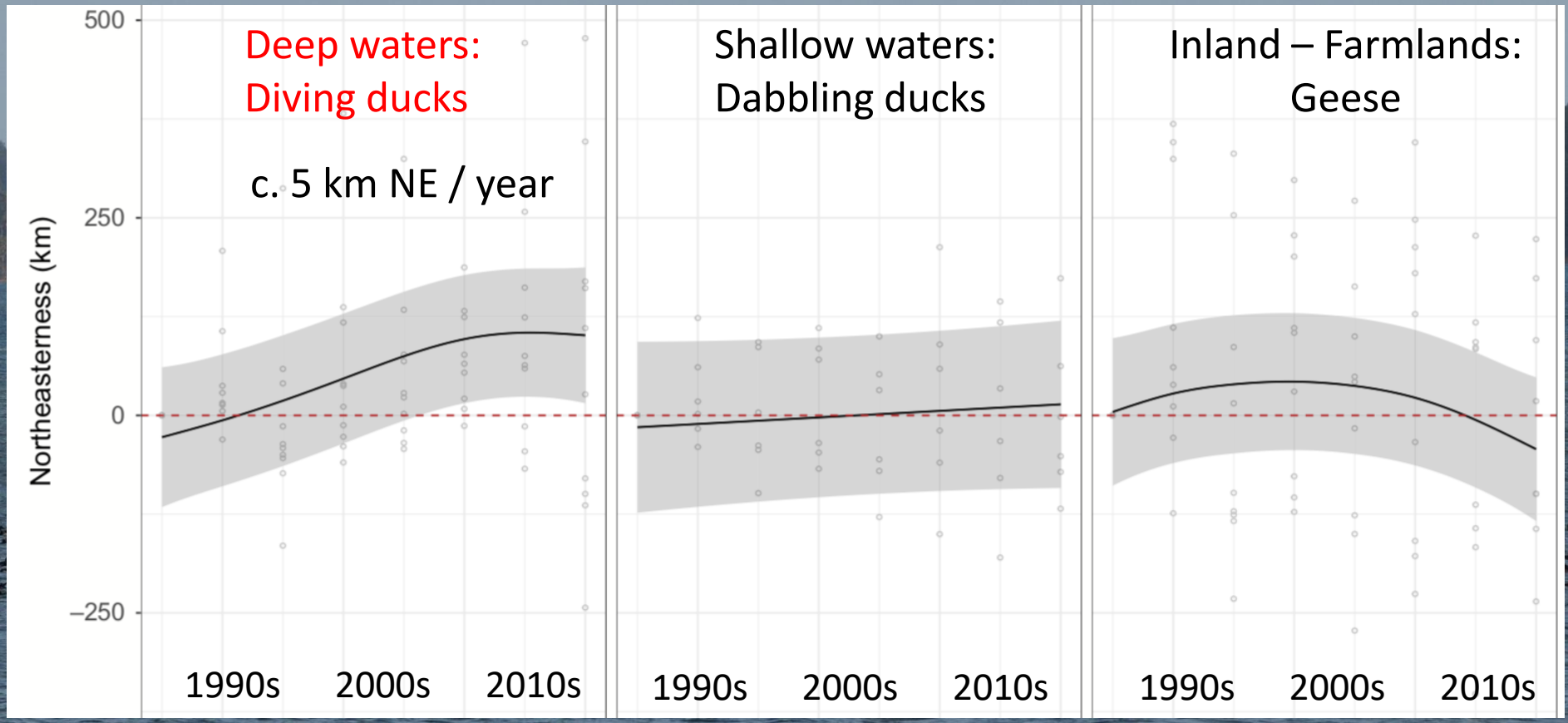


Pavon-Jordan et al. et al. 2018 Div Divers.

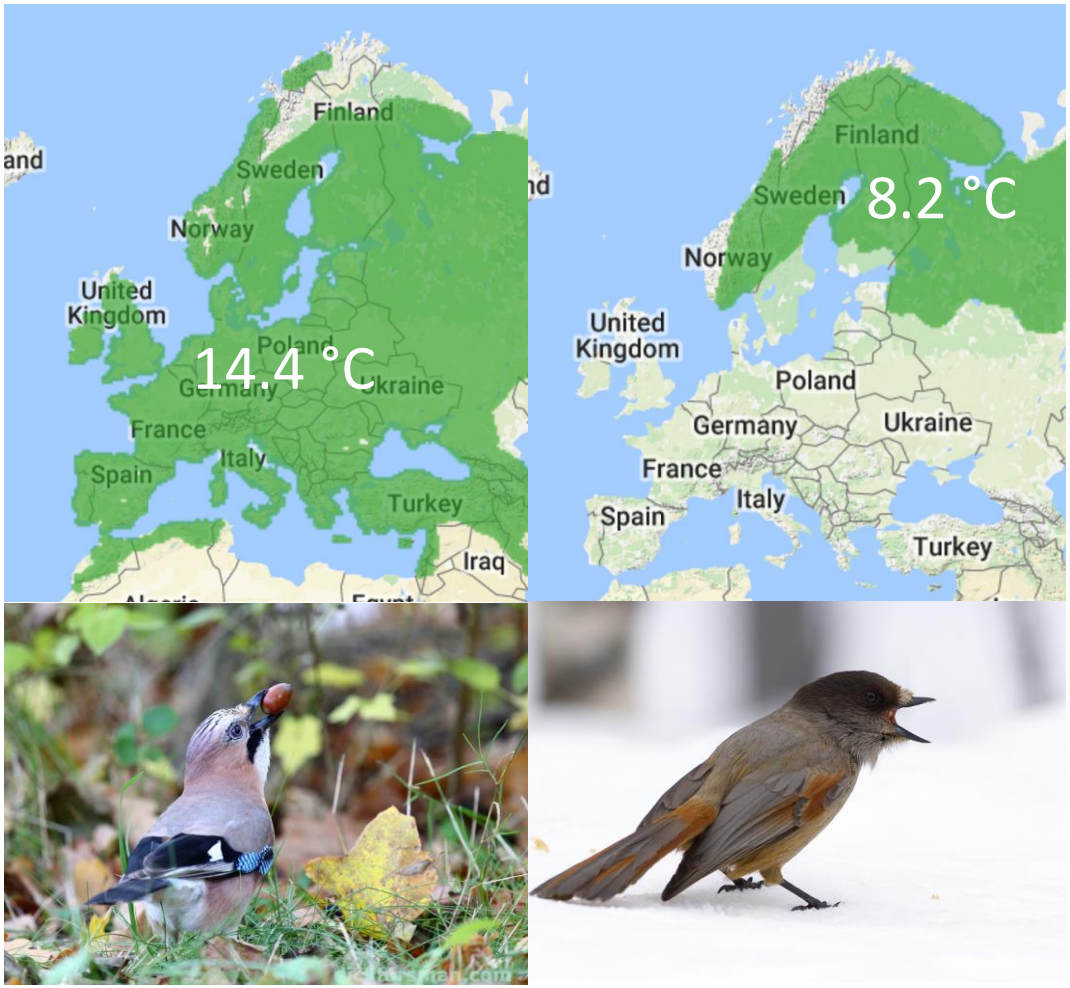
Species-specific variation



Pavon-Jordan et al. 2018 Div Divers.

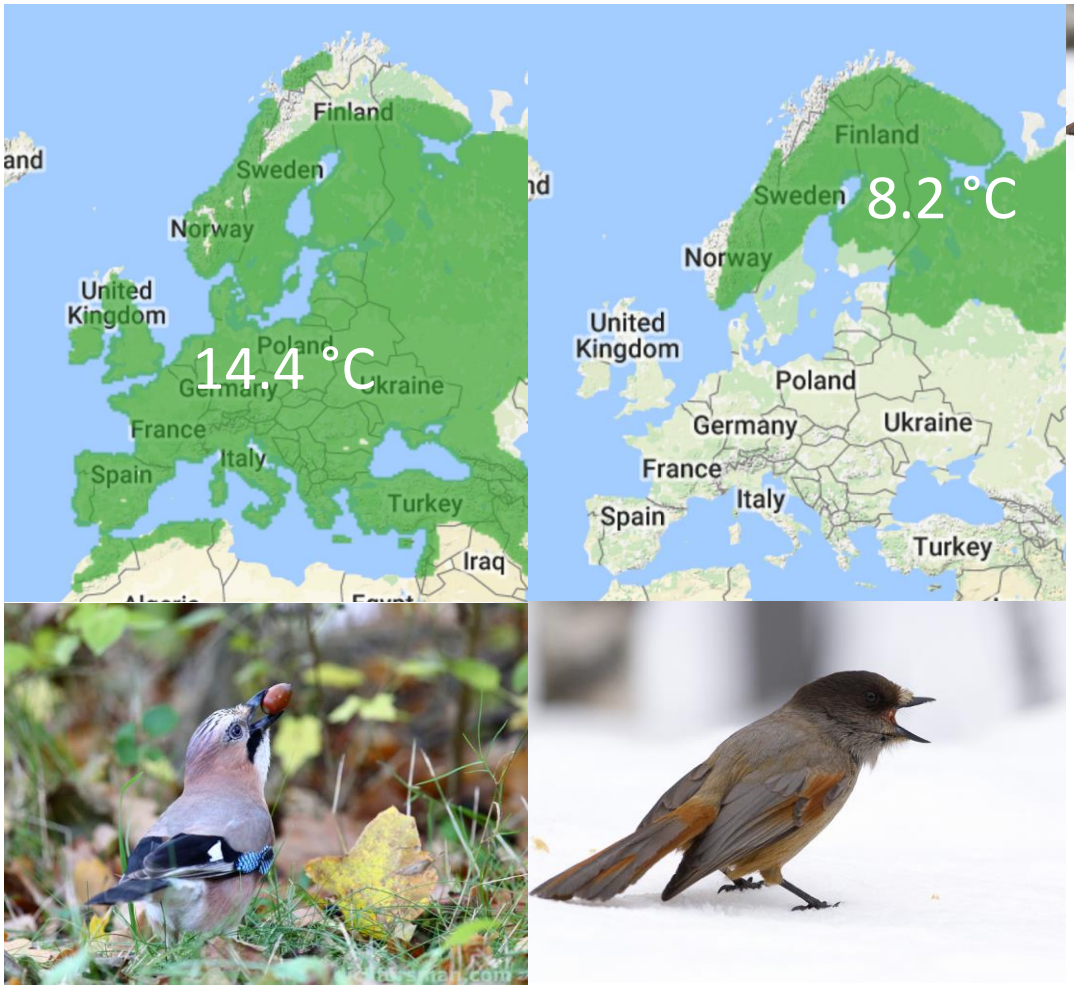
Pavon-Jordan et al. 2018 Div Divers.

III) Community Temperature Index, CTI



Devictor et al. 2008 Proc R 275: 2743–2748

Change in communities, CTI_b

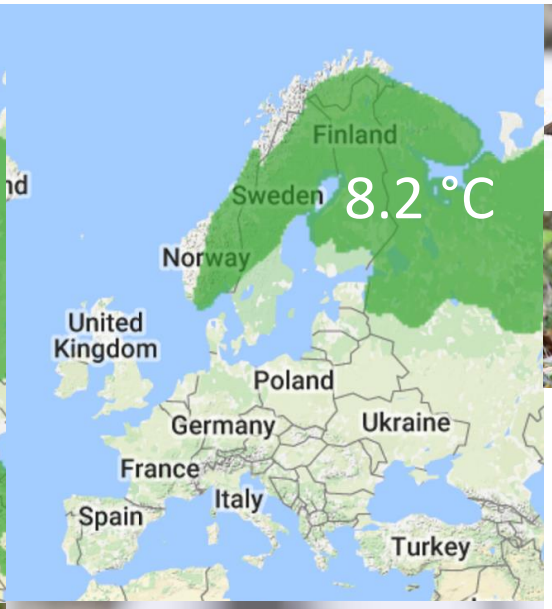


8.2 °C

Average temperature of range during breeding season

Devictor et al. 2008 Proc R 275: 2743–2748

Change in communities, CTI_b



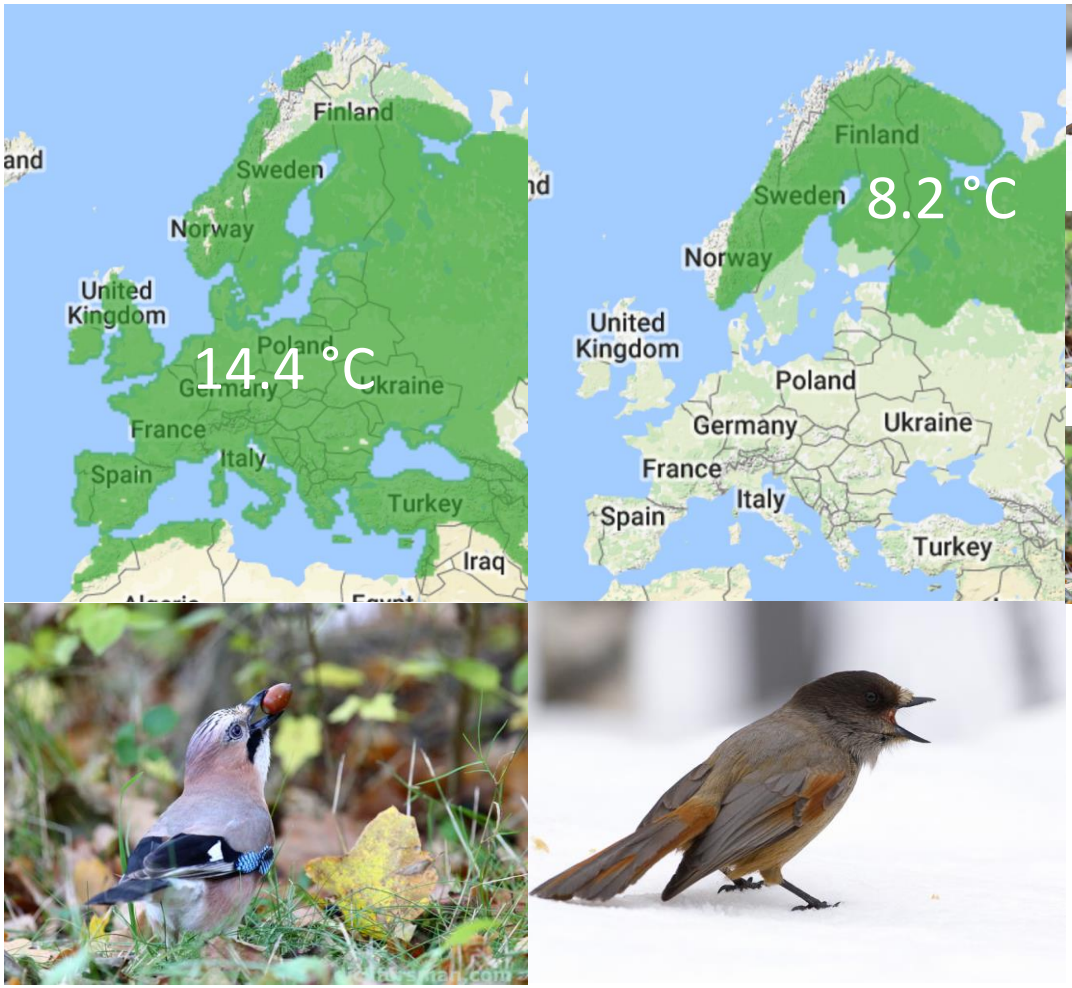
8.2 °C

11.3 °C

Average temperature of range during breeding season

Devictor et al. 2008 Proc R 275: 2743–2748

Change in communities, CTI_b



8.2 °C

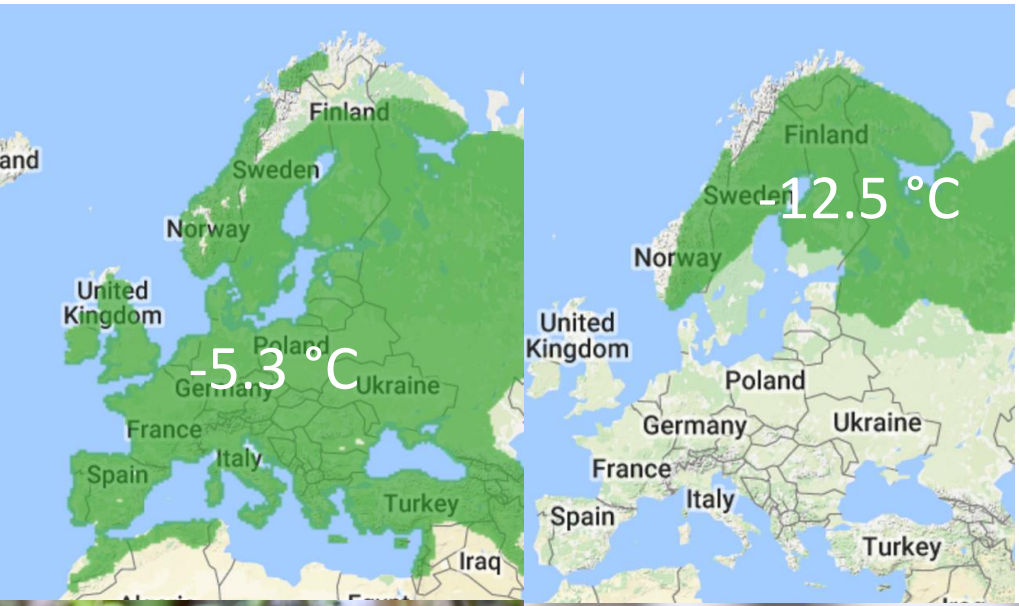
11.3 °C

14.4 °C

Average temperature of range during breeding season

Devictor et al. 2008 Proc R 275: 2743–2748

Change in communities, CTI_w



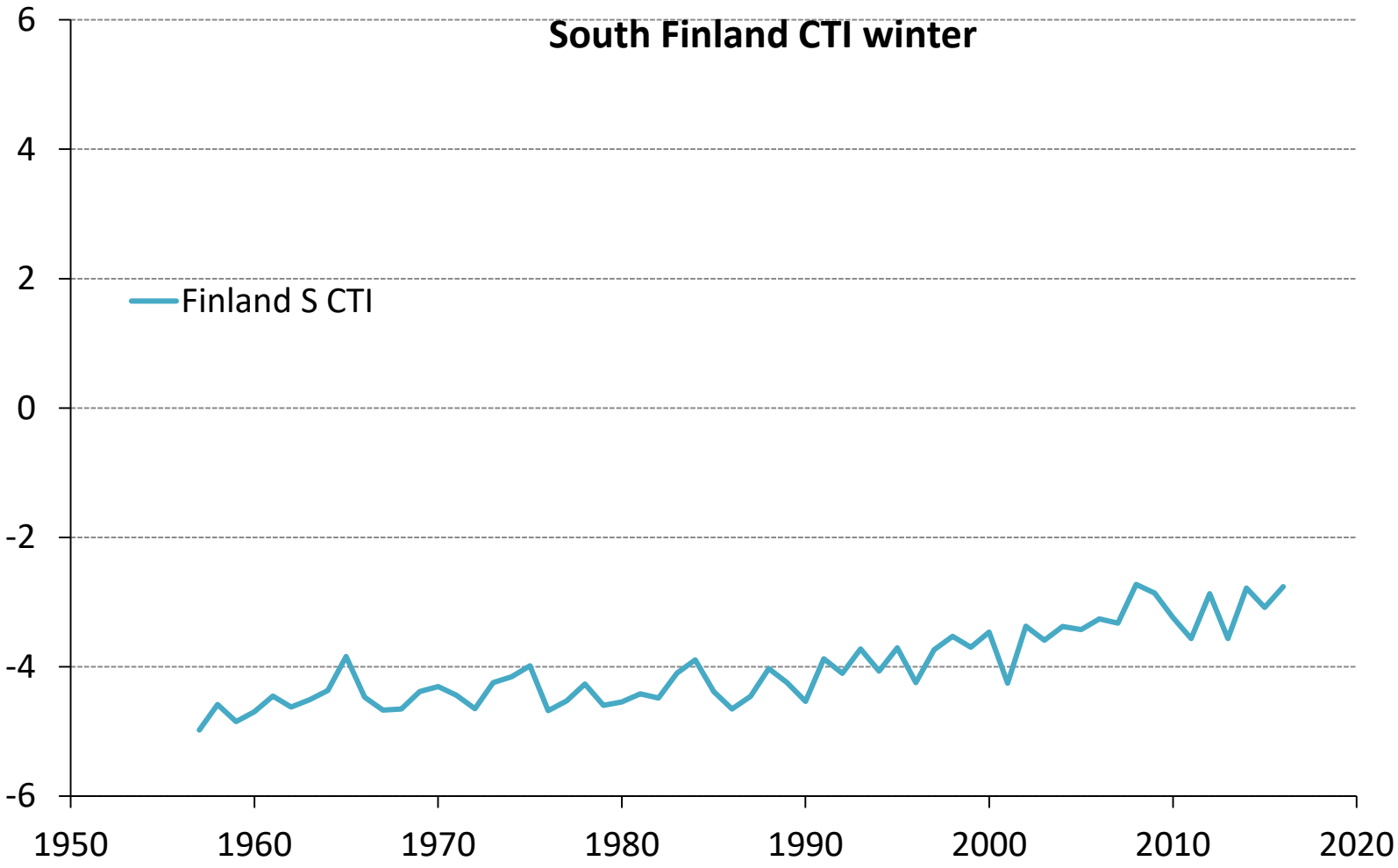
Average temperature of range during winter season

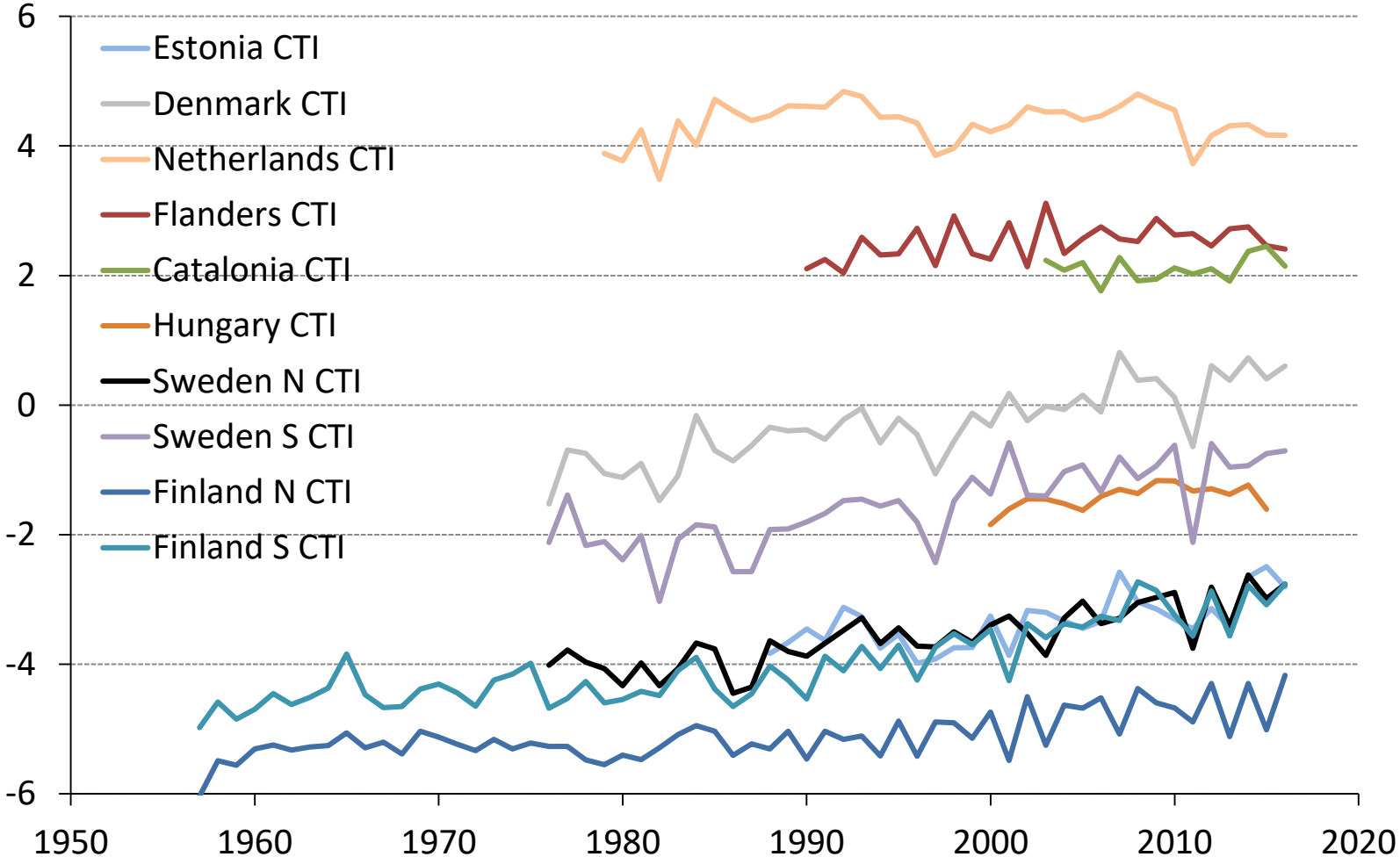
Lehikoinen et al. 2016 Divers Distrib 22: 1163–1173.

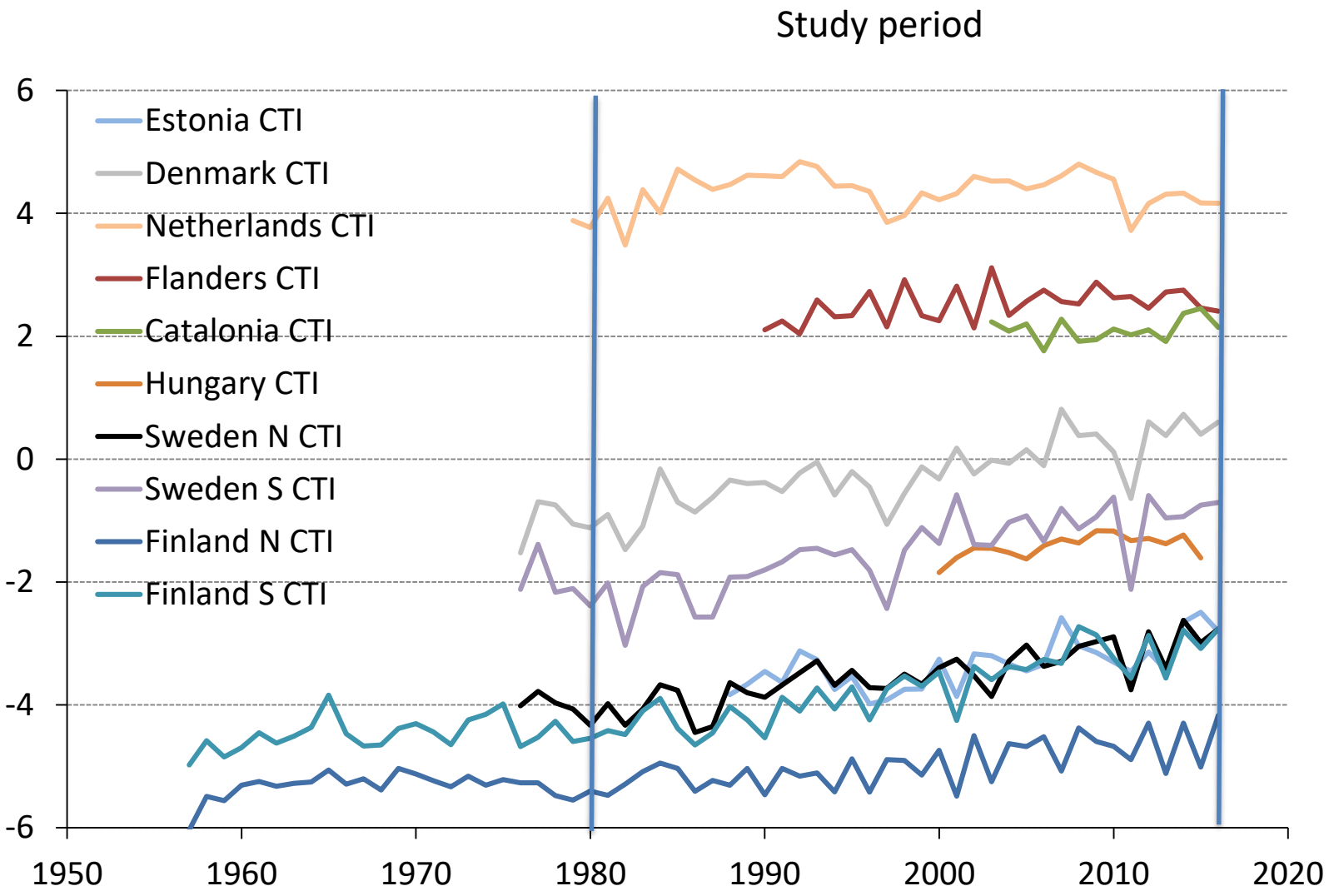
Change in communities, CTI_w

Average temperature of range during winter season

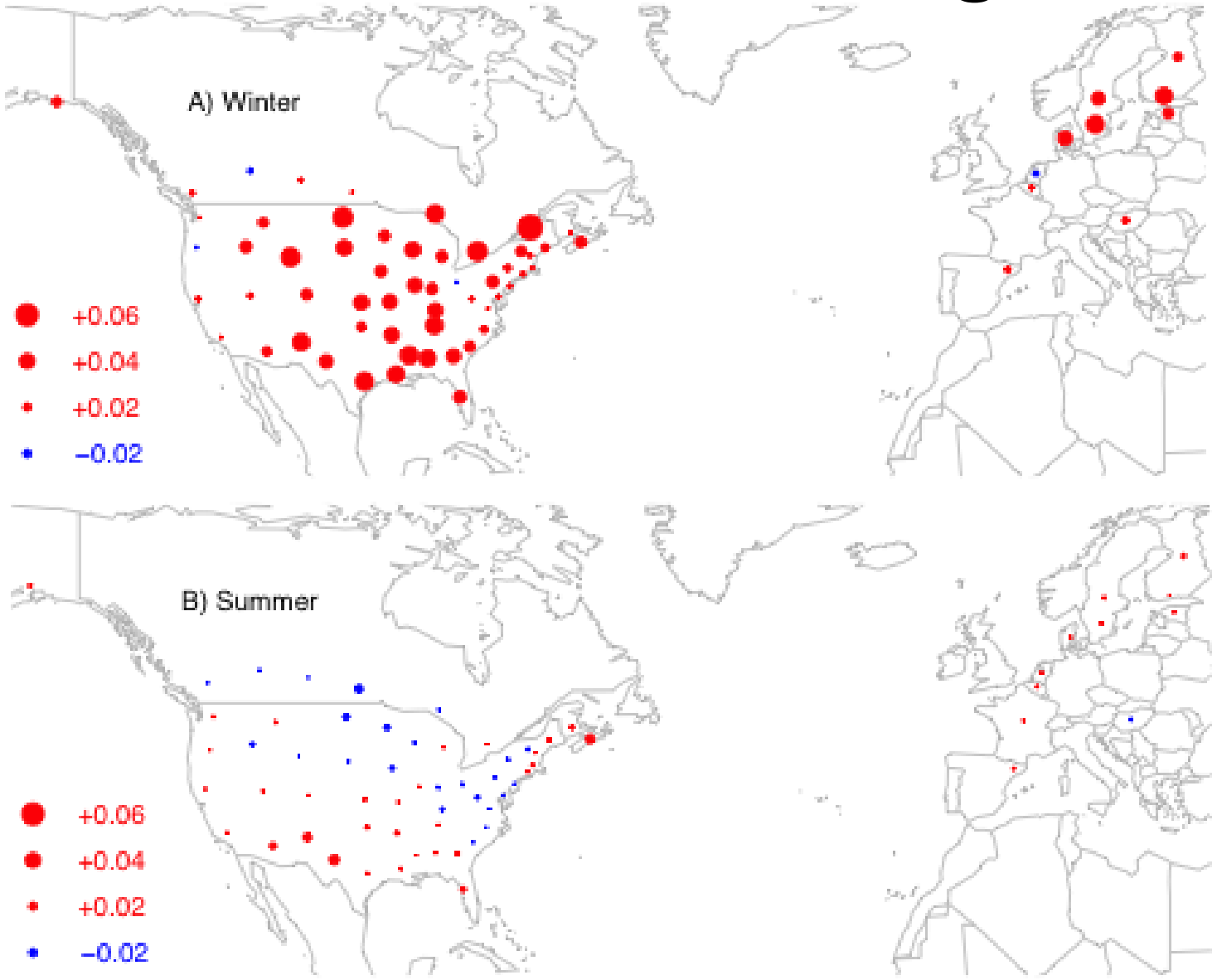
Lehikoinen et al. 2016 Divers Distrib 22: 1163–1173.


South Finland CTI winter
Finland S CTI
6
4
2
0
-2
-4
-6
1950
1960
1970
1980
1990
2000
2010
2020

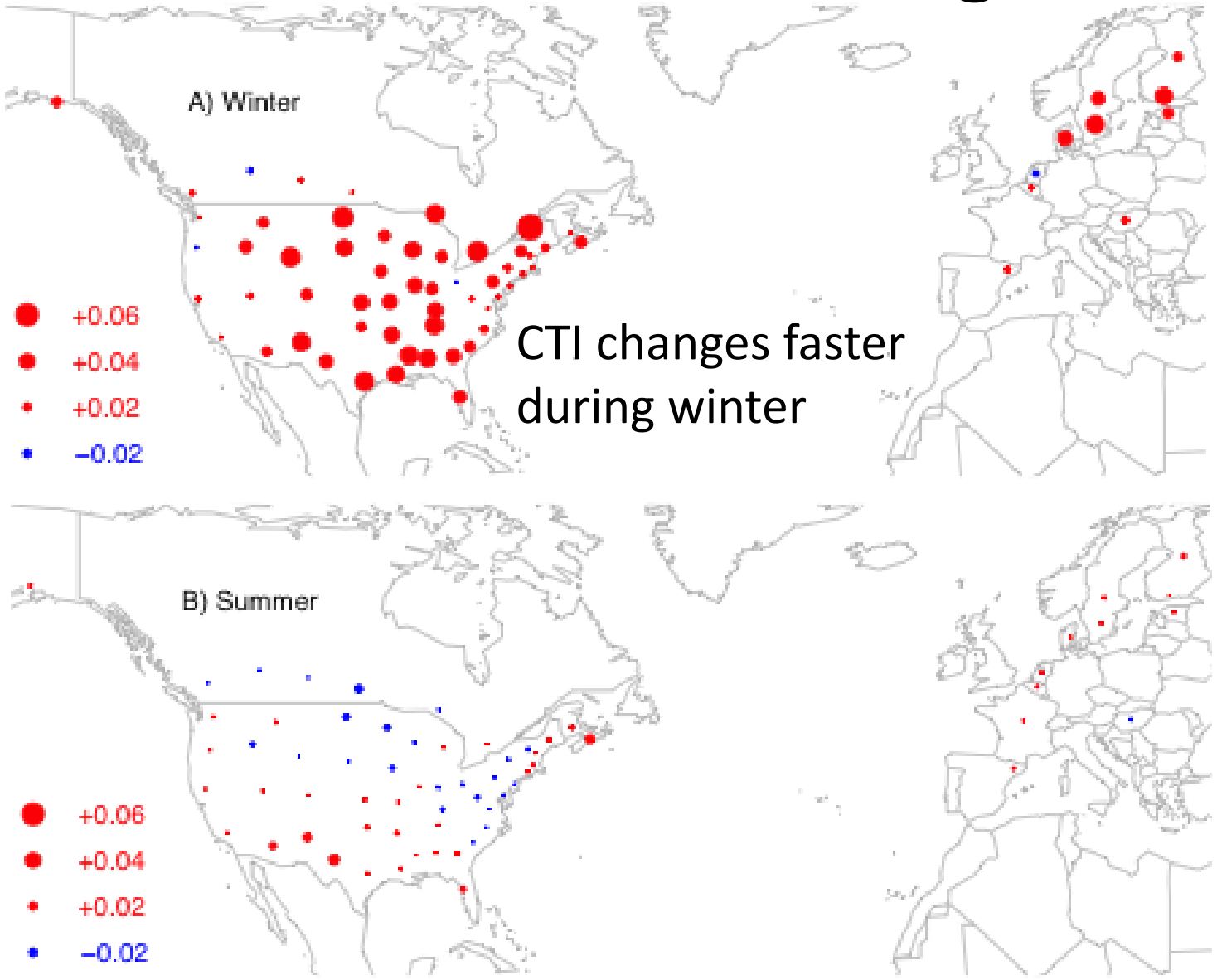

6
4
2
0
-2
-4
-6
1950
1960
1970
1980
1990
2000
2010
2020
Estonia CTI
Denmark CTI
Netherlands CTI
Flanders CTI
Catalonia CTI
Hungary CTI
Sweden N CTI
Sweden S CTI
Finland N CTI
Finland S CTI


Study period
Estonia CTI
Denmark CTI
Netherlands CTI
Flanders CTI
Catalonia CTI
Hungary CTI
Sweden N CTI
Sweden S CTI
Finland N CTI
Finland S CTI
6
4
2
0
-2
-4
-6
1950
1960
1970
1980
1990
2000
2010
2020

Seasonal differences: long-term



Seasonal differences: long-term



CTI changes faster during winter

Changes in communities

- Winter communities are changing faster than breeding communities

Changes in communities

- Winter communities are changing faster than breeding communities

$\Rightarrow$Lower site-fidelity during winter

$\Rightarrow$More flexible to move

Changes in communities

- Winter communities are changing faster than breeding communities

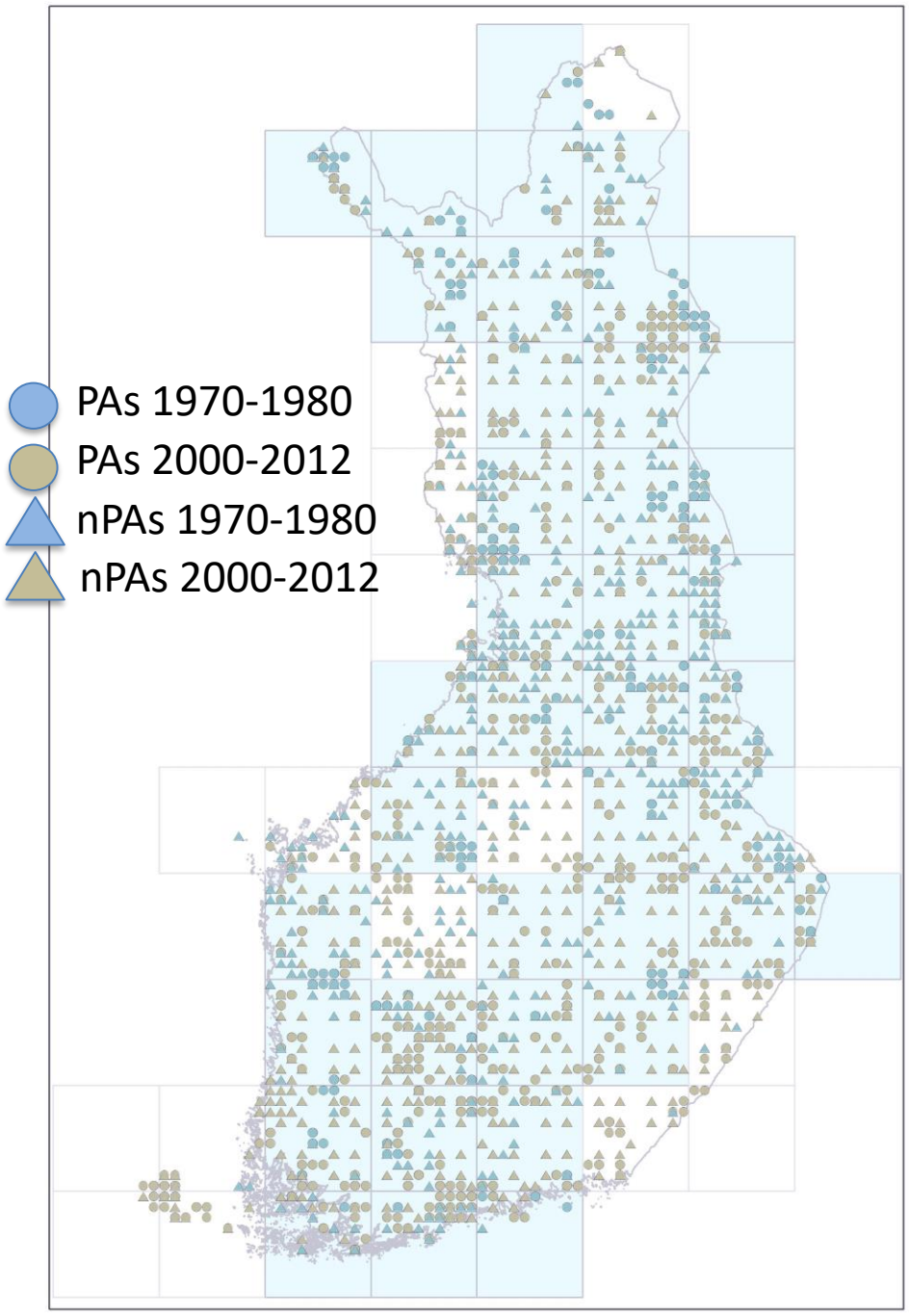
$\Rightarrow$Lower site-fidelity during winter

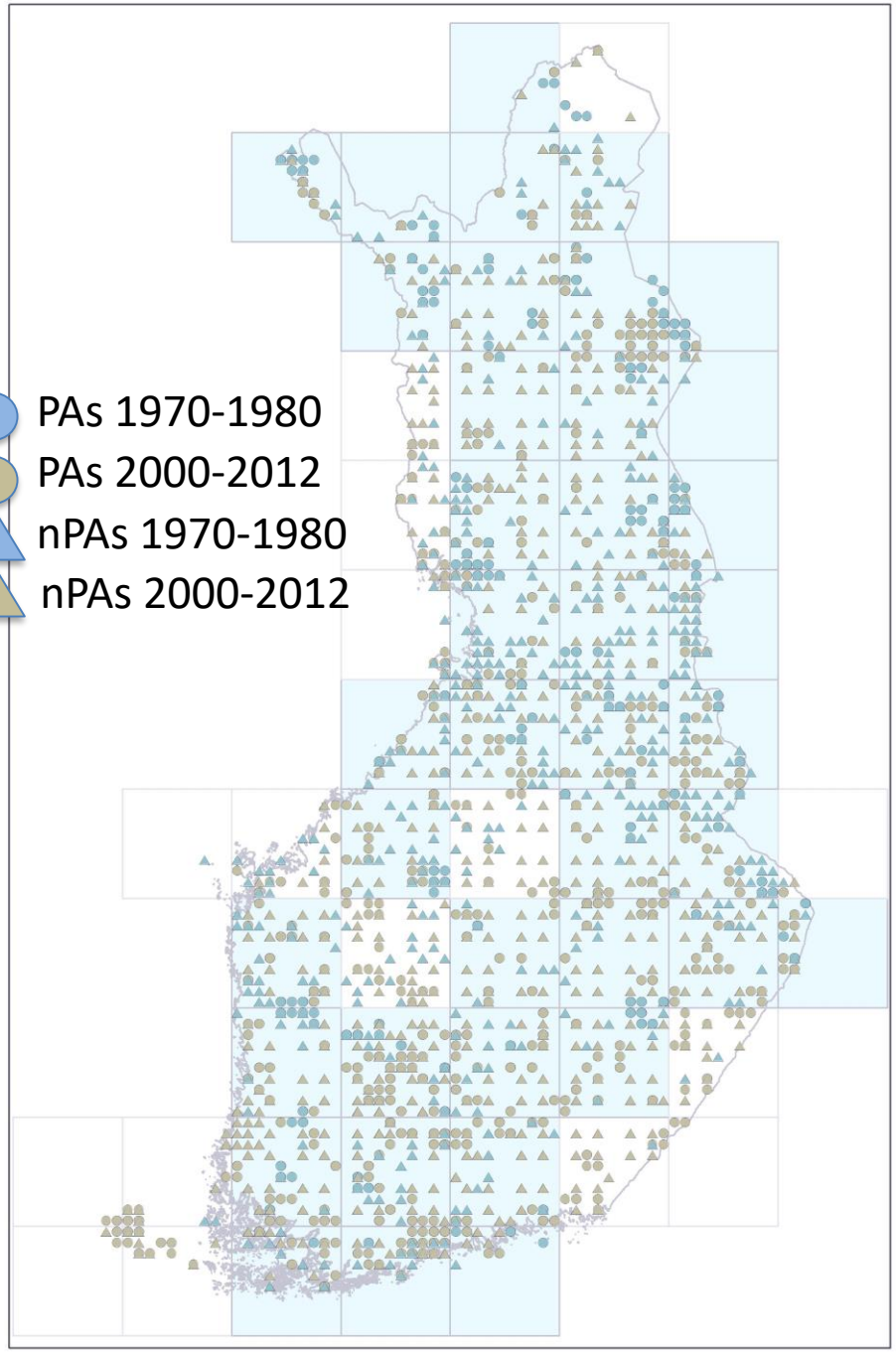
$\Rightarrow$More flexible to move

$\Rightarrow$Breeding birds are tied to certain location for a longer period of time

$\Rightarrow$Slower changes: through demography?

IV) Protected areas vs non-PAs


PAs 1970-1980
PAs 2000-2012
nPAs 1970-1980
nPAs 2000-2012



Community Temperature Index, CTI
Species Temperature Index, STI

8.2 °C

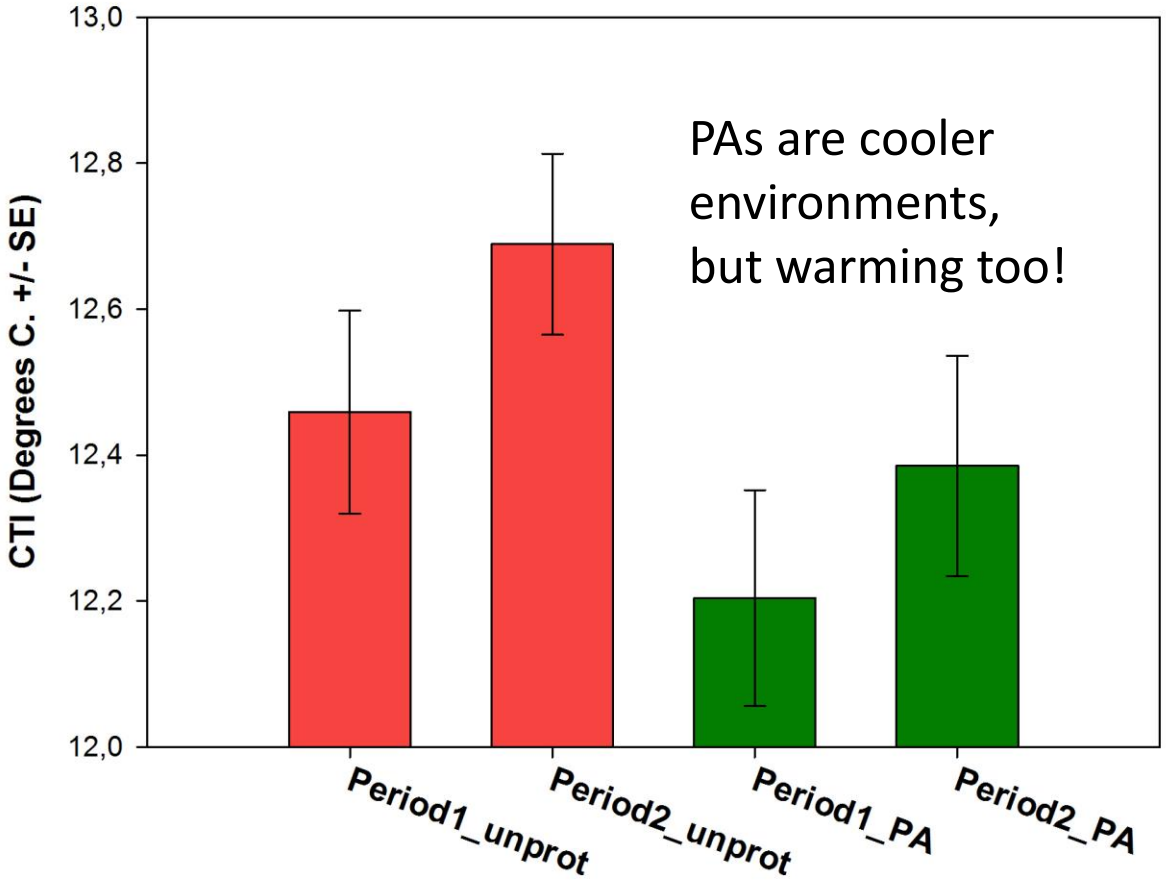
14.4 °C

Average temperature during breeding season

Devictor et al. 2008 Proc R

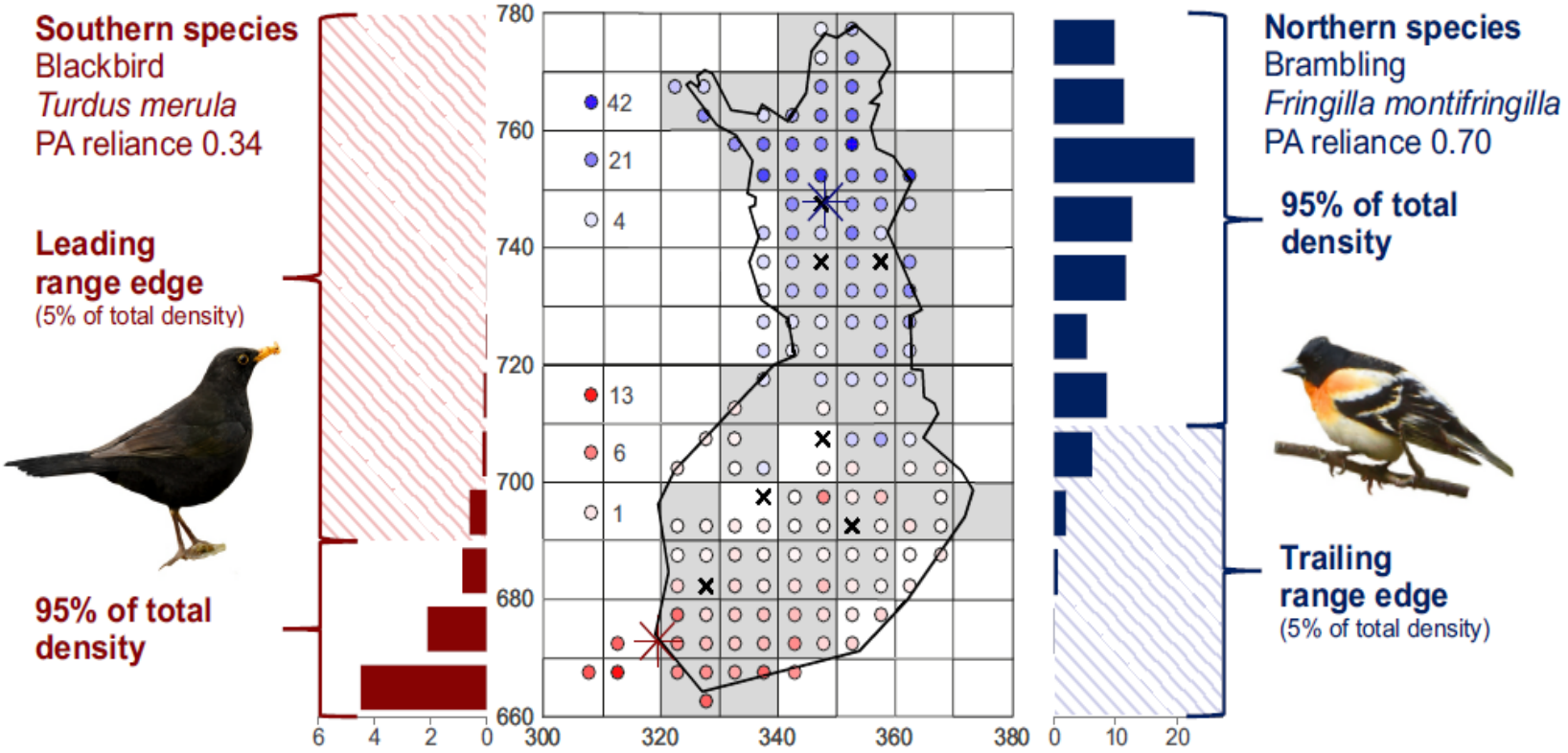
Protected areas vs non-PAs

Change in Community Temperature Index, CTI



Santangeli et al. 2017 Global Change Biol

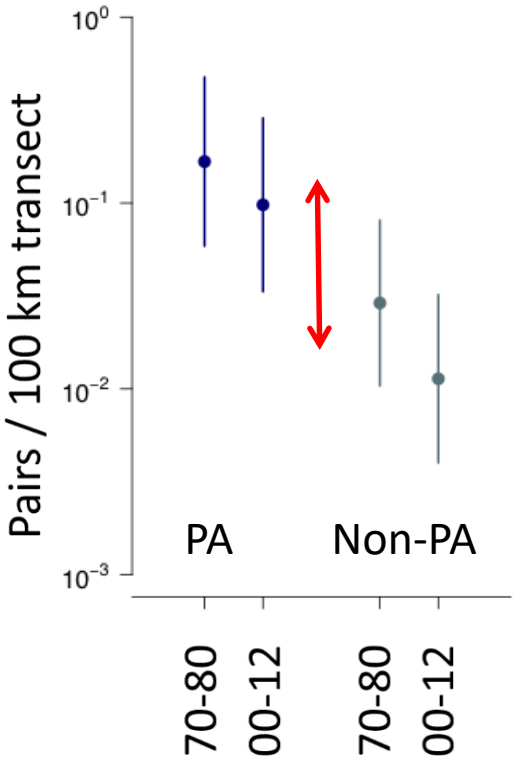
Abundance changes and PAs

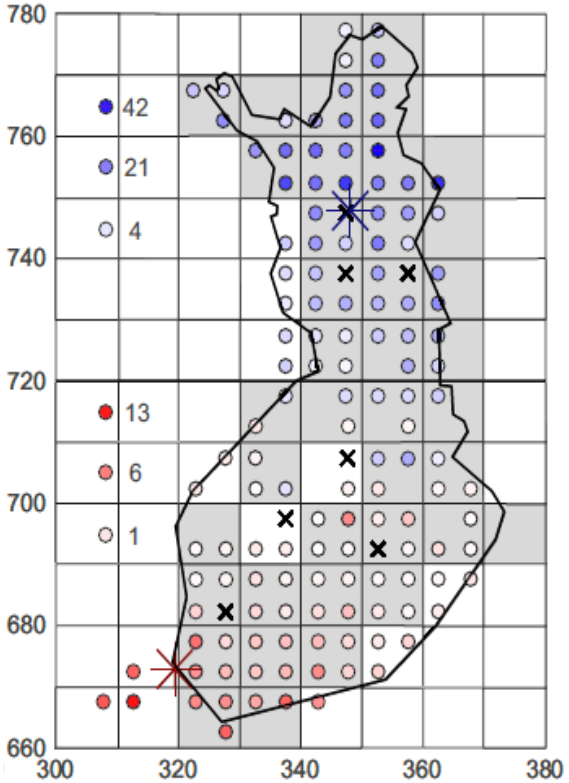


Abundance changes at the distribution edge inside and outside PAs during 1970-80s and 2000s in 70 southern and 30 species

Lehikoinen et al. 2019 Global Change Biol

Abundance changes and PAs





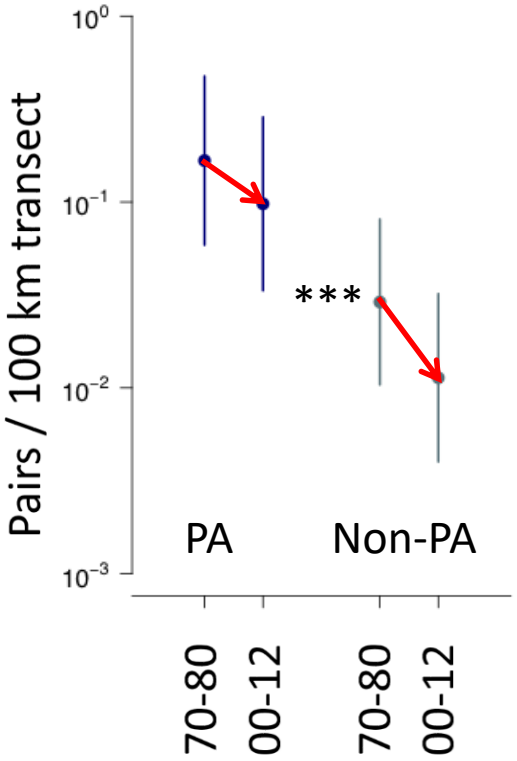
Northern species

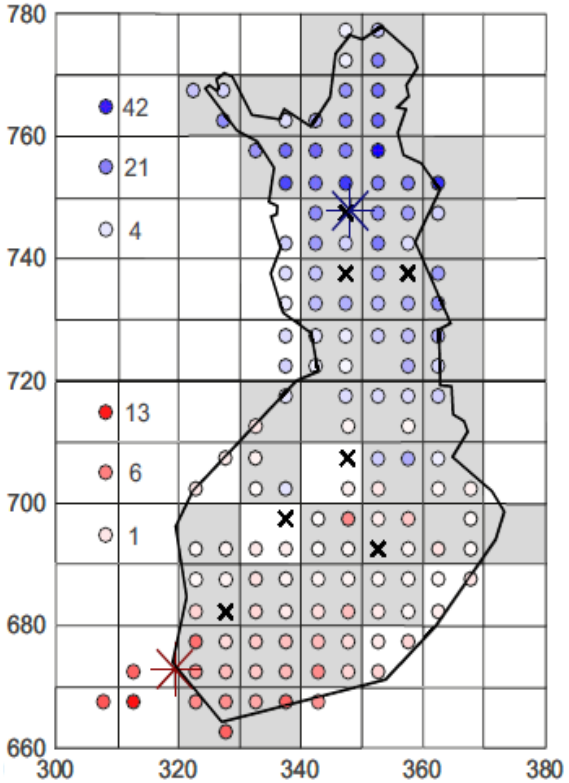
Southern edge

- Northern species have higher densities inside PAs

Lehikoinen et al. 2019 Global Change Biol

Abundance changes and PAs





Northern species

Southern edge

- Northern species have higher densities inside PAs
- Declines are faster outside PAs than inside PAs

Lehikoinen et al. 2019 Global Change Biol

3) Adapt: Change in morphology

1) According to Bergmann's rule body size of species decreases with temperature

3) Adapt: Change in morphology

1) According to Bergmann's rule body size of species decreases with temperature

2) Accoding to Allen's rule appendages of species increases with increasing temperature

3) Adapt: Change in morphology

1) According to Bergmann's rule body size of species decreases with temperature

2) Accoding to Allen's rule appendages of species increases with increasing temperature

3) According to Gloger's rule animal colouration increases with temperature and precipitation

Change in morphology: Wing length

©Lars Jonsson

1. Long-tailed tit
2. Great tit
3. Blue tit
4. Coal tit
5. Willow tit
6. Crested tit
7. Redpoll
8. Goldfinch
9. Greenfinch
10. Siskin
11. Yellowhammer
12. Chaffinch
13. Brambling
14. Bullfinch
15. House sparrow
16. Tree sparrow
17. Goldcrest
18. Treecreeper
19. Blackbird
20. Fieldfare
21. Jay
22. Great spotted Woodpecker

Change in morphology: Wing length

- Overall decrease in wing length since 1970s in winter birds in Finland

©Lars Jonsson

1. Long-tailed tit
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22. Great spotted Woodpecker

Bosco et al., in prep.

Change in morphology: Wing length

- Overall decrease in wing length since 1970s in winter birds in Finland
- 4/22 species decreased, but 2/22 increased wing length

Bosco et al., in prep.

1. Long-tailed tit
2. Great tit
3. Blue tit
4. Coal tit
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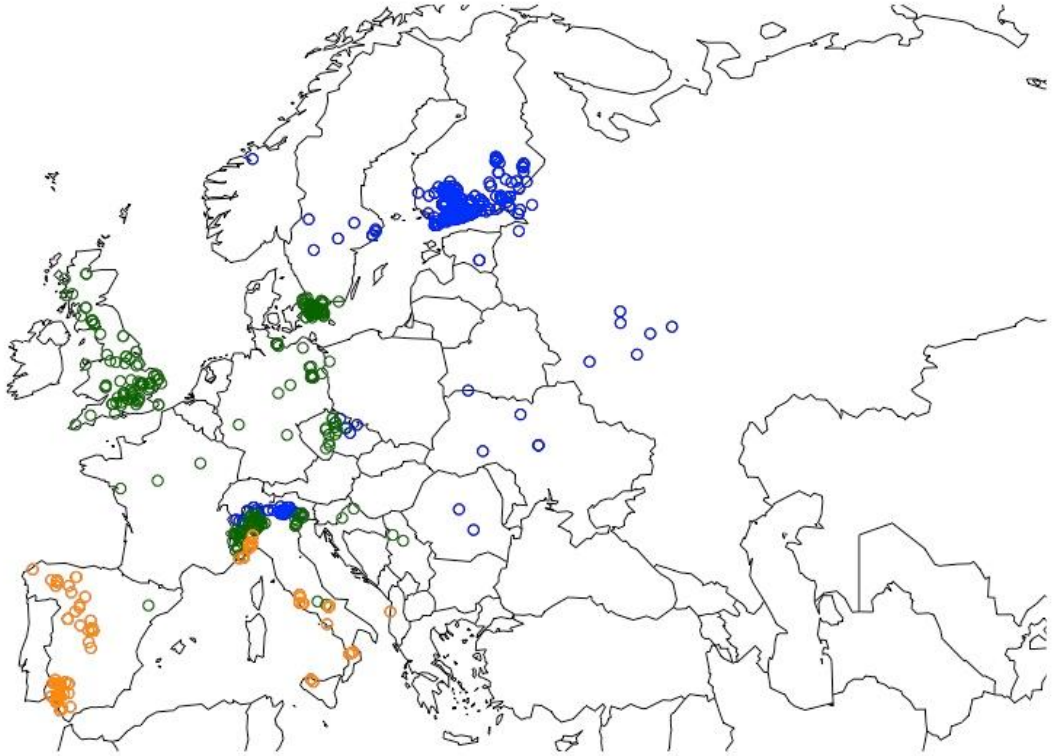
Morphological differences

Morphological differences

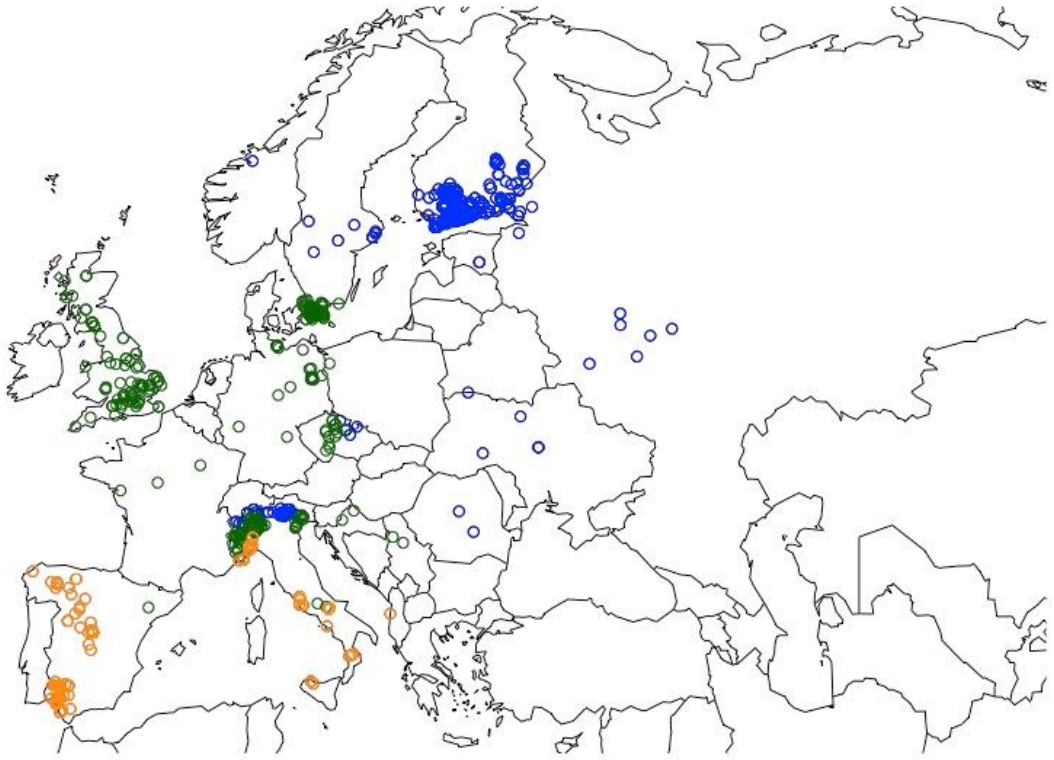
- Tawny owls in the museum collections



Koskenpato et al., in prep.

Morphological differences

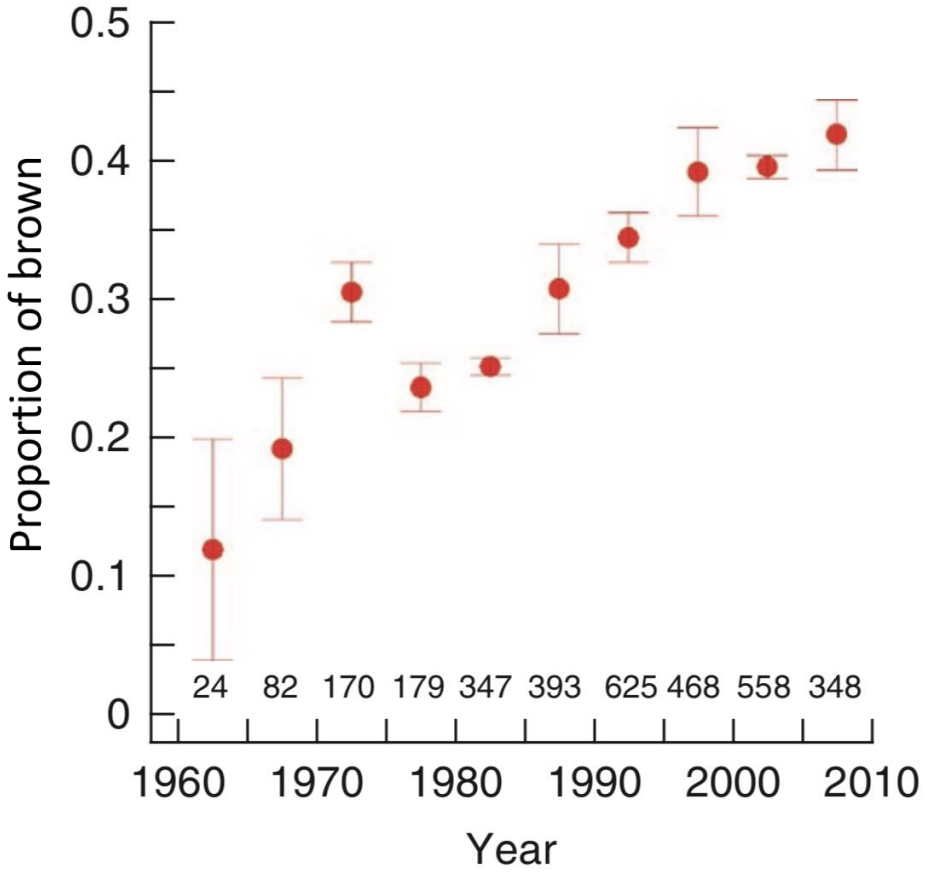
- Tawny owls in the museum collections
- More grey owls in the boreal zone than in the temperate and Mediterranean zone



Koskenpato et al., in prep.

Morphology is changing

- Colour morphs of ringed Tawny owls in Finland



Karell ym. 2011 Nature Communications

Morphological differences

Karell et al. 2011 Nature Comm
Karell et al. 2011 J Evol Biol
Karell et al. 2021 Behav Ecol Sociobiol
Koskenpato et al. 2016 J Avian Biol
Koskenpato et al. 2020 Ecol Evol

- Grey owls have higher survival in snow conditions
- Grey owls have better camourflage in snowy habitats
- Grey owls have thicker feathers (insulation)
- Brown are more generalists and more tolerant to parasites

Take home messages

Take home messages

- Phenology is changing: advances in spring, more variation in autumn

Take home messages

- Phenology is changing: advances in spring, more variation in autumn
- Species ranges and abundances are changing: shifts towards poles

Take home messages

- Phenology is changing: advances in spring, more variation in autumn
- Species ranges and abundances are changing: shifts towards poles
- Protected areas may mitigate abundance changes

Take home messages

- Phenology is changing: advances in spring, more variation in autumn
- Species ranges and abundances are changing: shifts towards poles
- Protected areas may mitigate abundance changes
- Morphology (body size, colour) of species is changing


Thank you for the volunteers!
RAPTORS
Ig: @MHanskat

Thank you!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