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Bird species influence more the tick burden of French common birds than environmental conditions during the breeding season

Rataud Amalia, Alex Drouin, Benoît Pisanu, Sara Moutailler, Laure Bournez, Pierre-Yves Henry, Maud Marsot

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Rataud Amalia, Alex Drouin, Benoît Pisanu, Sara Moutailler, Laure Bournez, et al.. Bird species influence more the tick burden of French common birds than environmental conditions during the breeding season: Does the tick burden of birds vary more with bird species or environmental conditions?. 10th Tick and Tick-borne Pathogen Conference, Aug 2022, Murighiol, Danube Delta, Romania. hal-04482465

HAL Id: hal-04482465

<https://hal.science/hal-04482465>

Submitted on 28 Feb 2024

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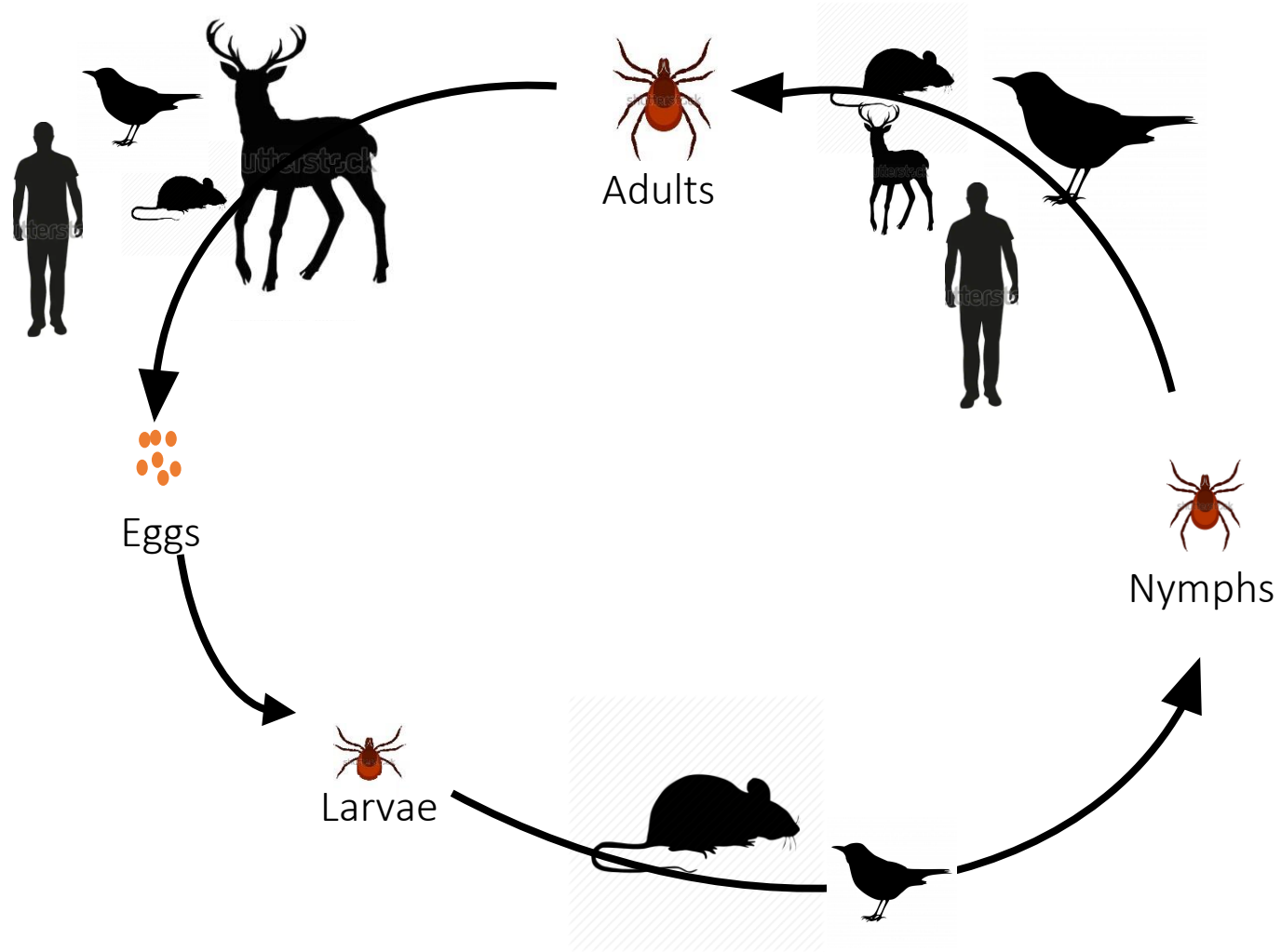
Bird species influence more the tick burden of French common birds than environmental conditions during the breeding season



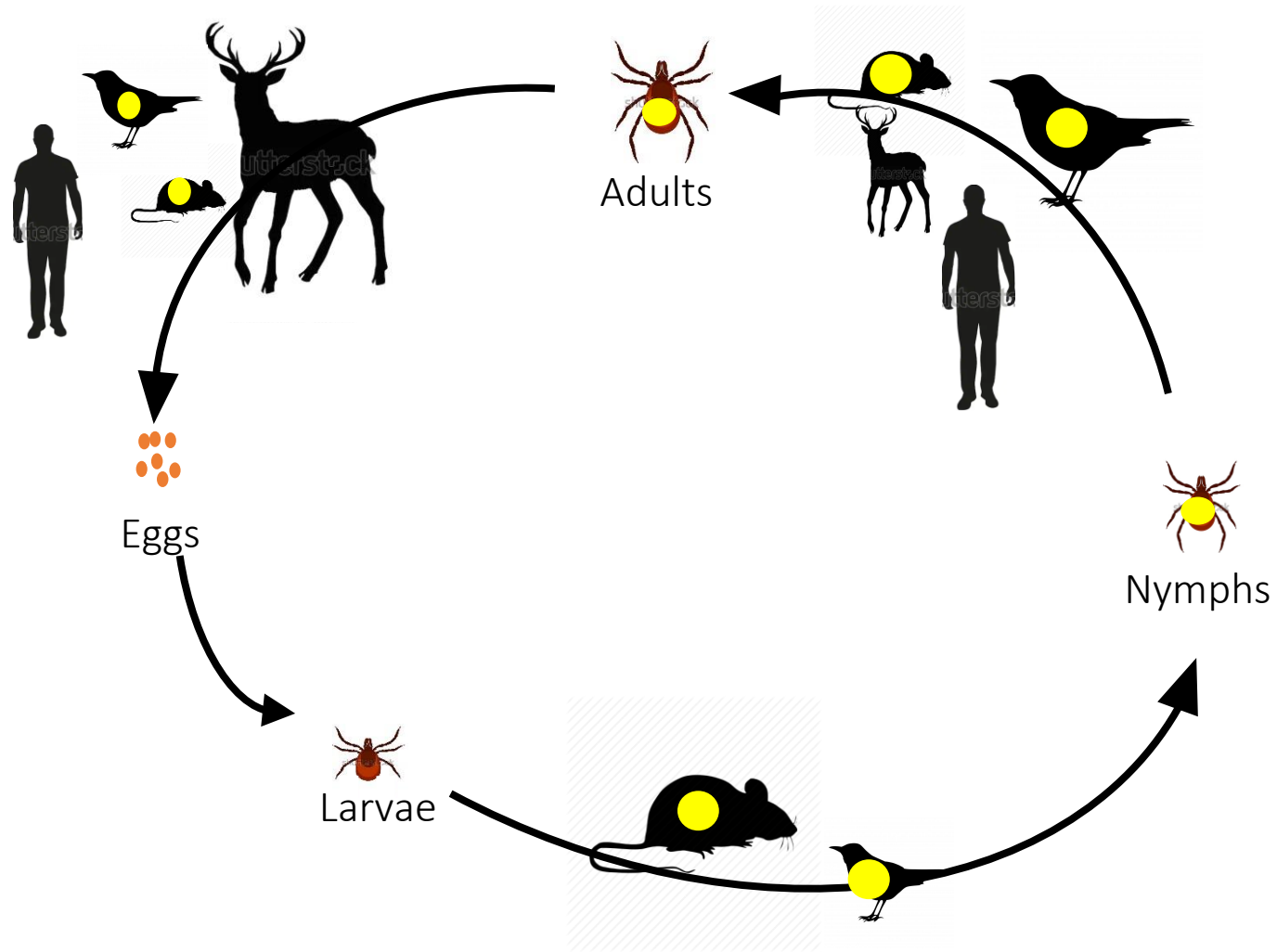
Does the tick burden of birds vary more with bird species or environmental conditions ?

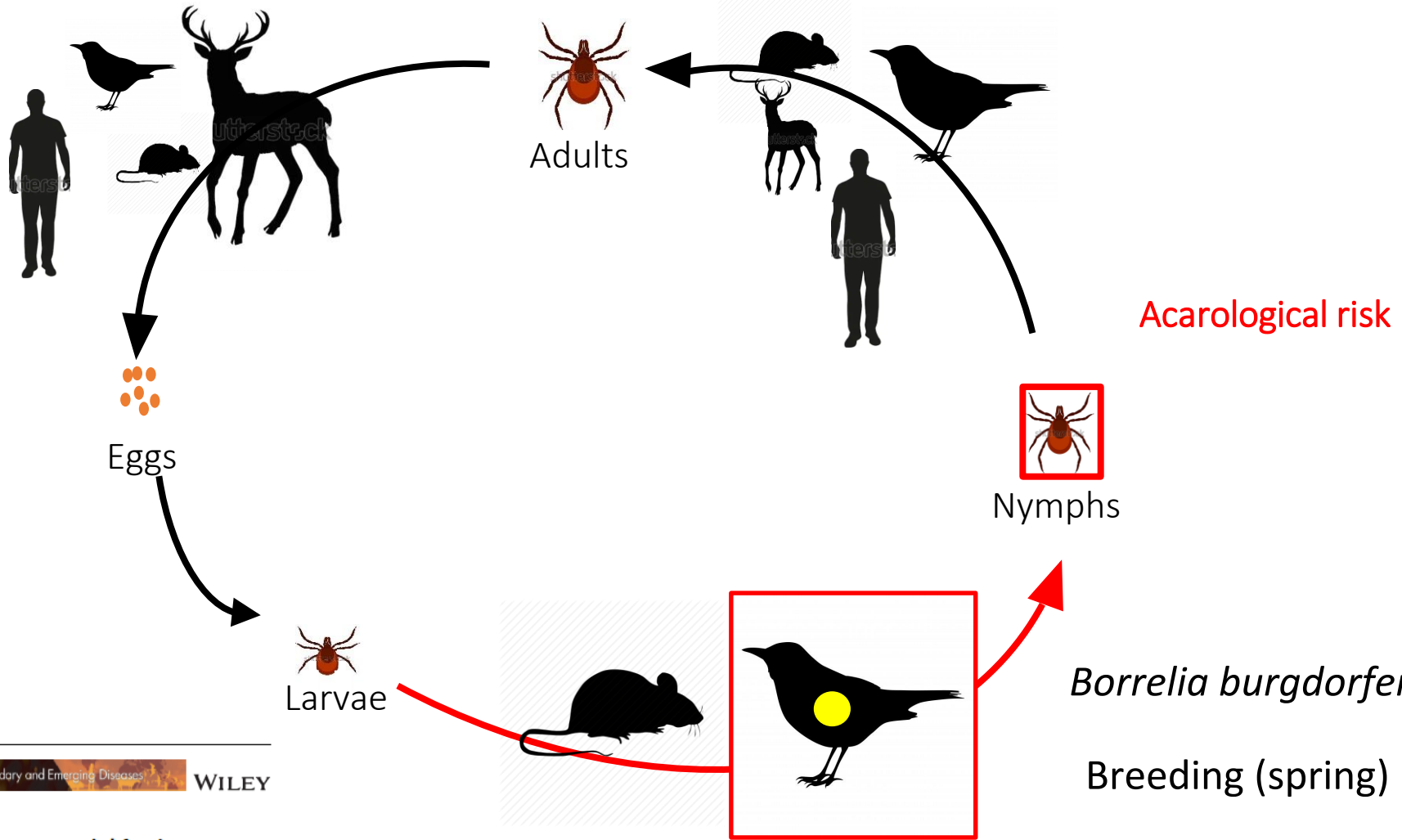
Amalia Rataud & Alex Drouin, Benoit Pisanu, Sara Moutailler, Laure Bournez,

Pierre-Yves Henry & Maud Marsot



Three-stage life cycle





Three-stage life cycle

Received: 29 July 2021 | Revised: 19 August 2021 | Accepted: 27 August 2021
DOI: 10.1111/tbed.14305

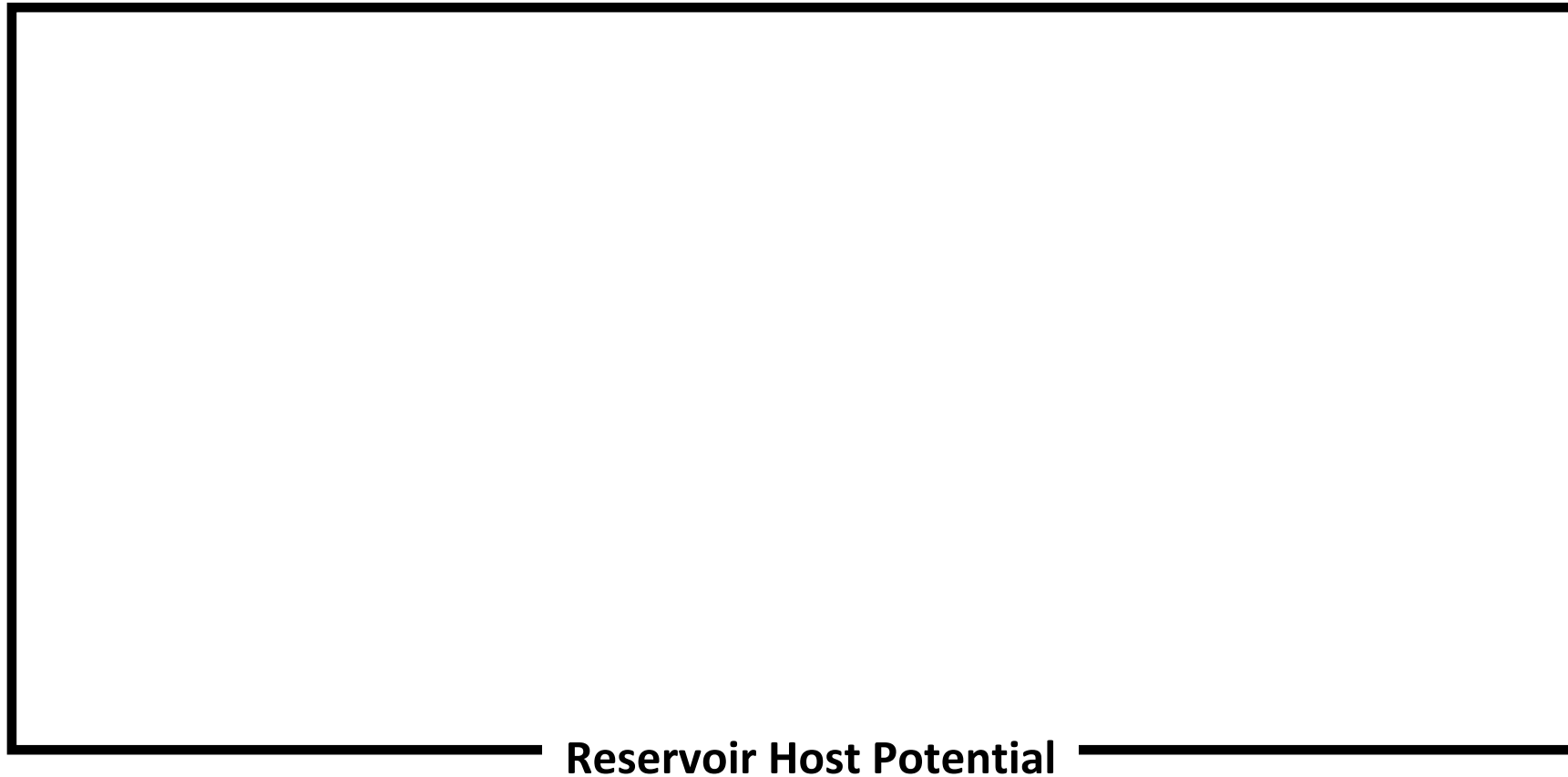
REVIEW Transboundary and Emerging Diseases WILEY

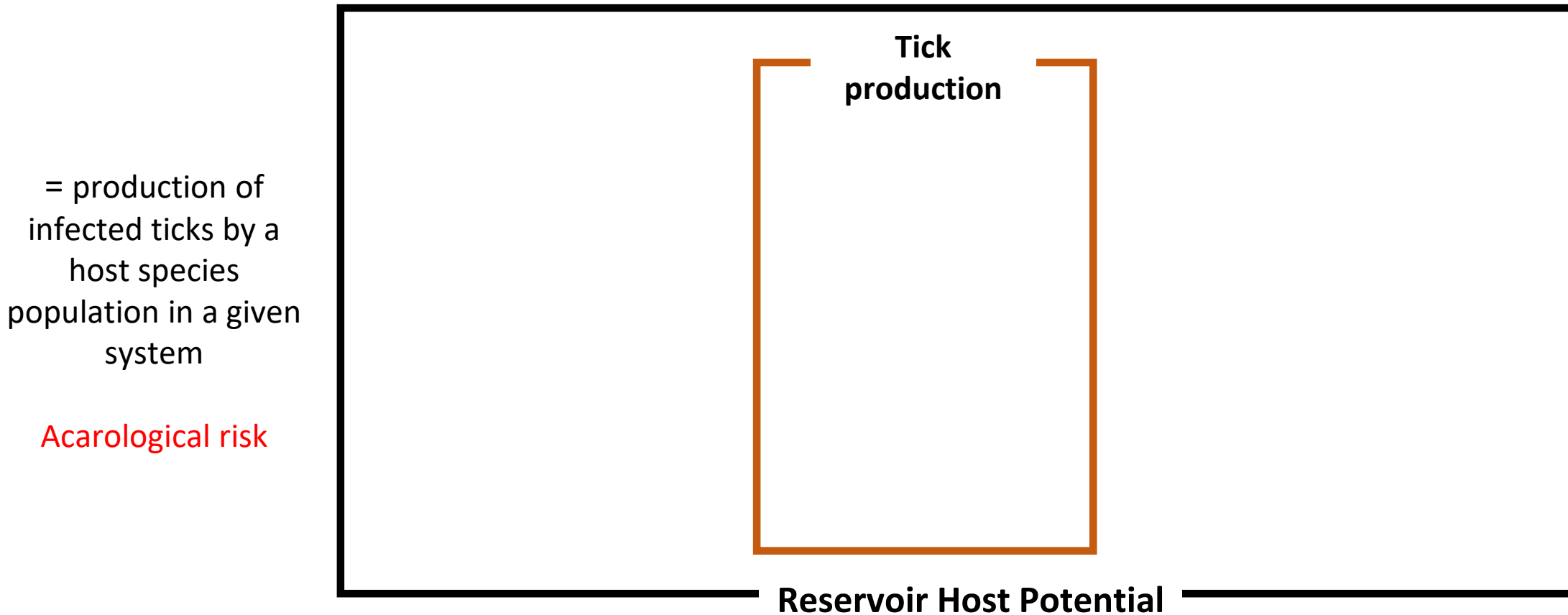
Research effort on birds' reservoir host potential for Lyme borreliosis: A systematic review and perspectives

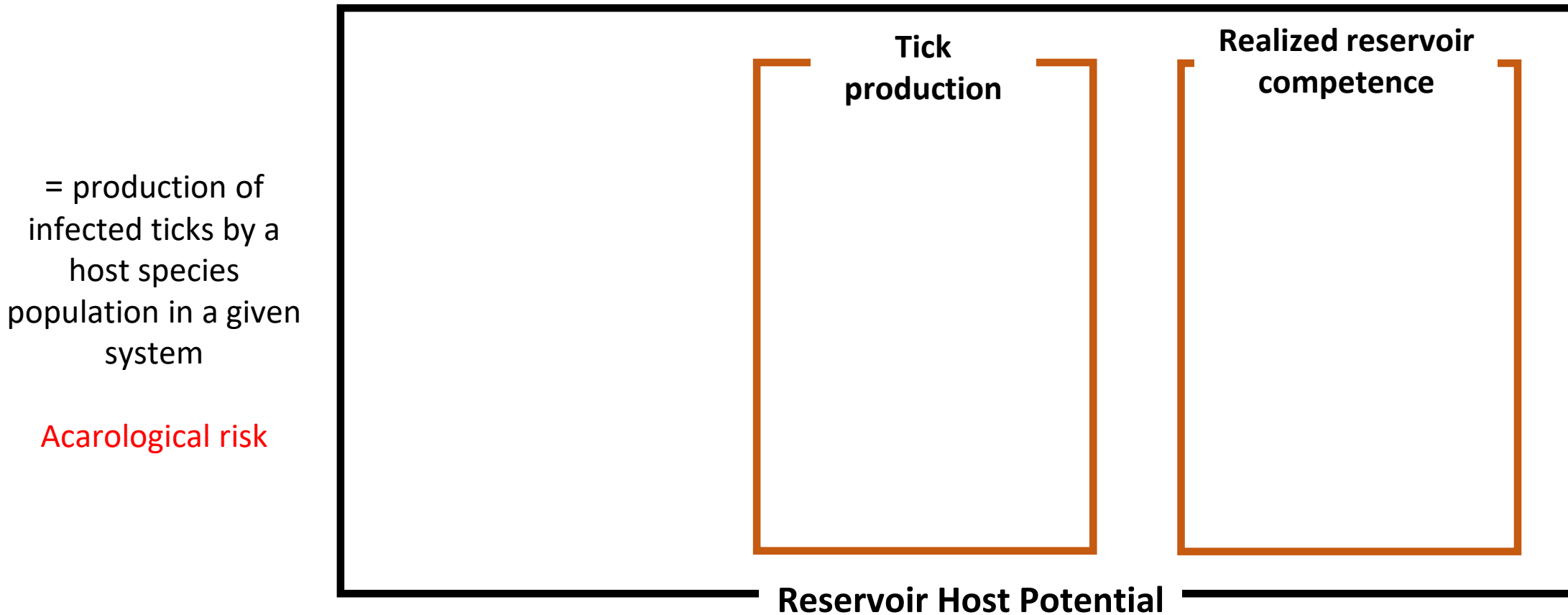
Amalia Rataud¹ | Pierre-Yves Henry^{2,3} | Sara Moutailler⁴ | Maud Marsot¹

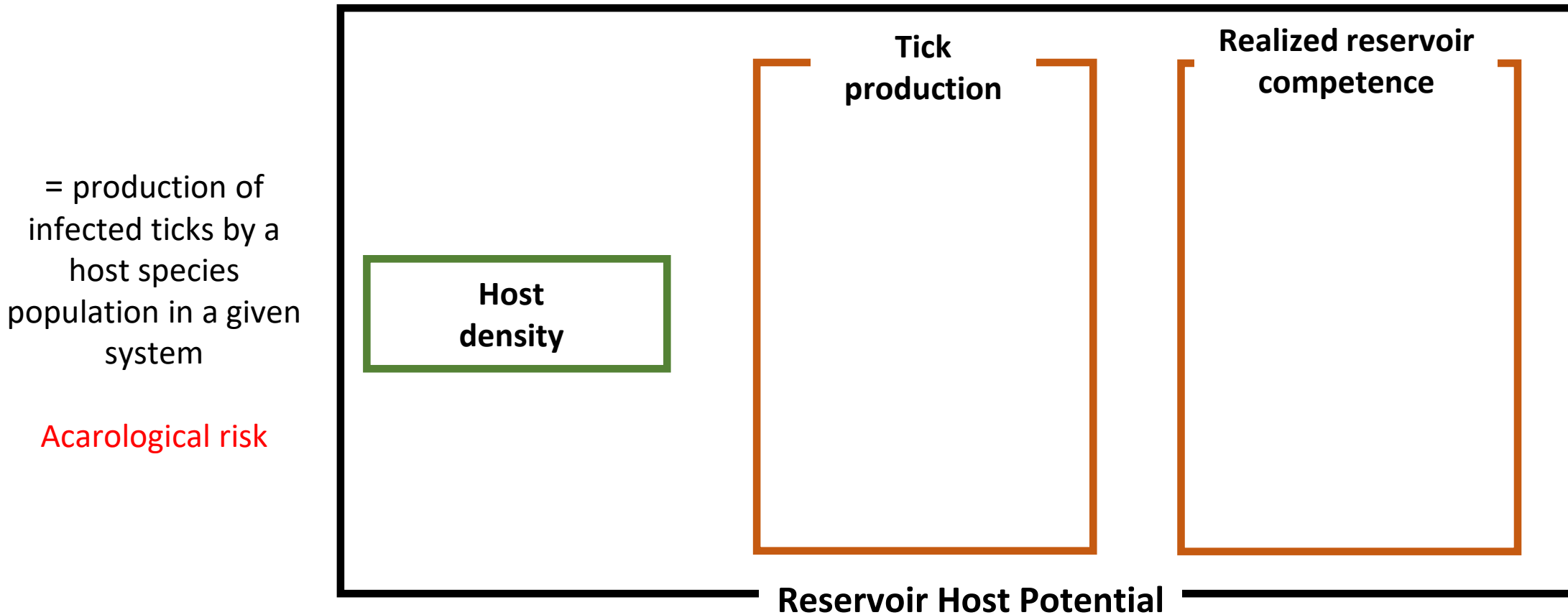
= production of
infected ticks by a
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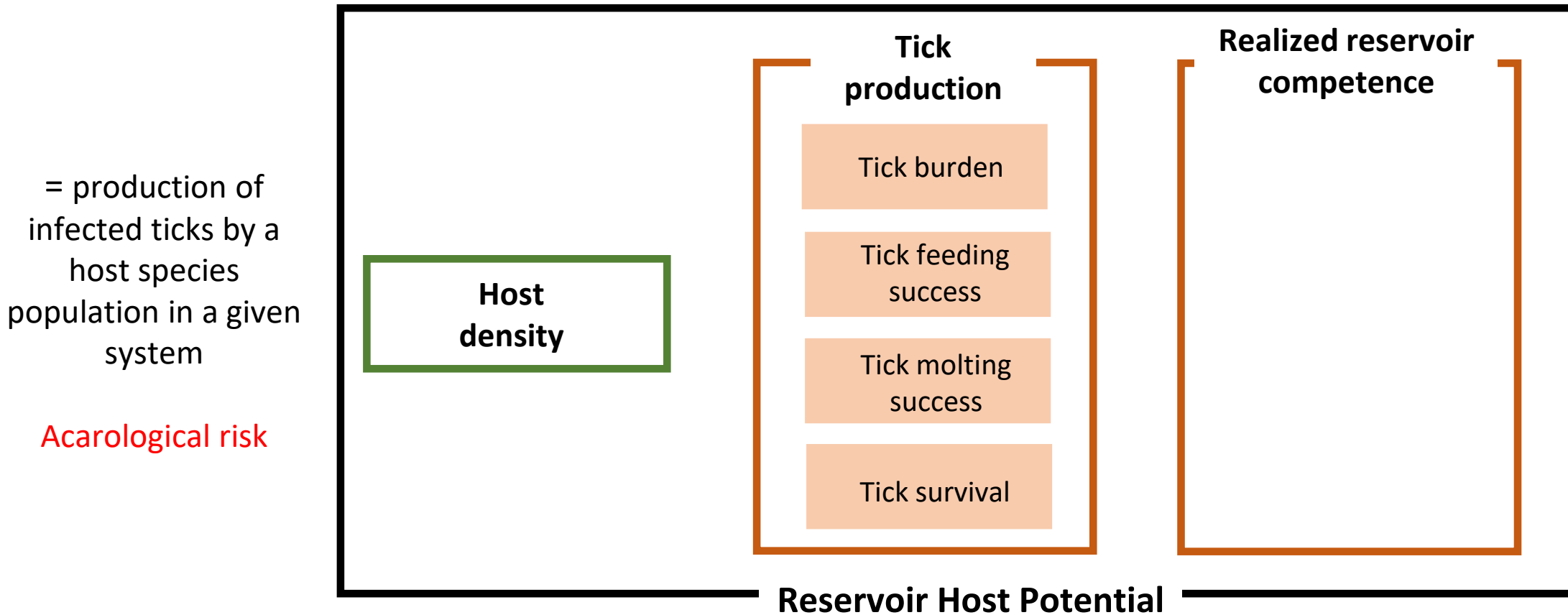
Acarological risk

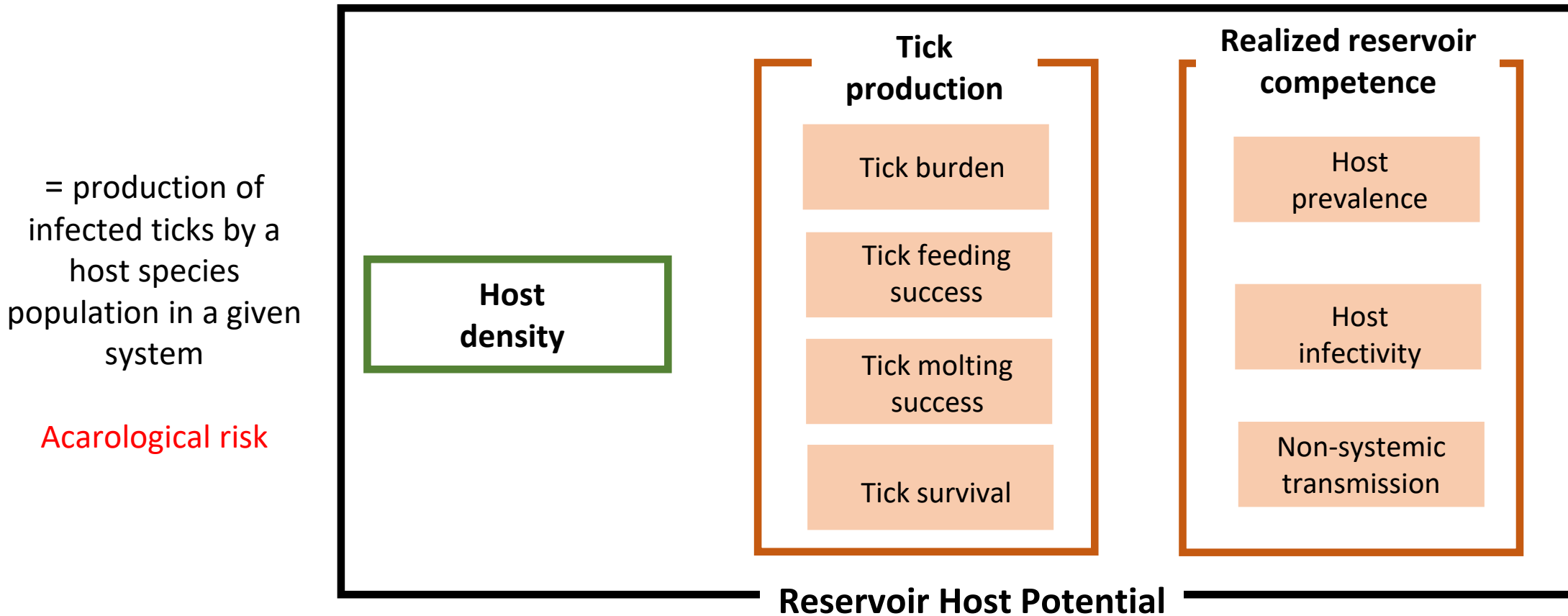


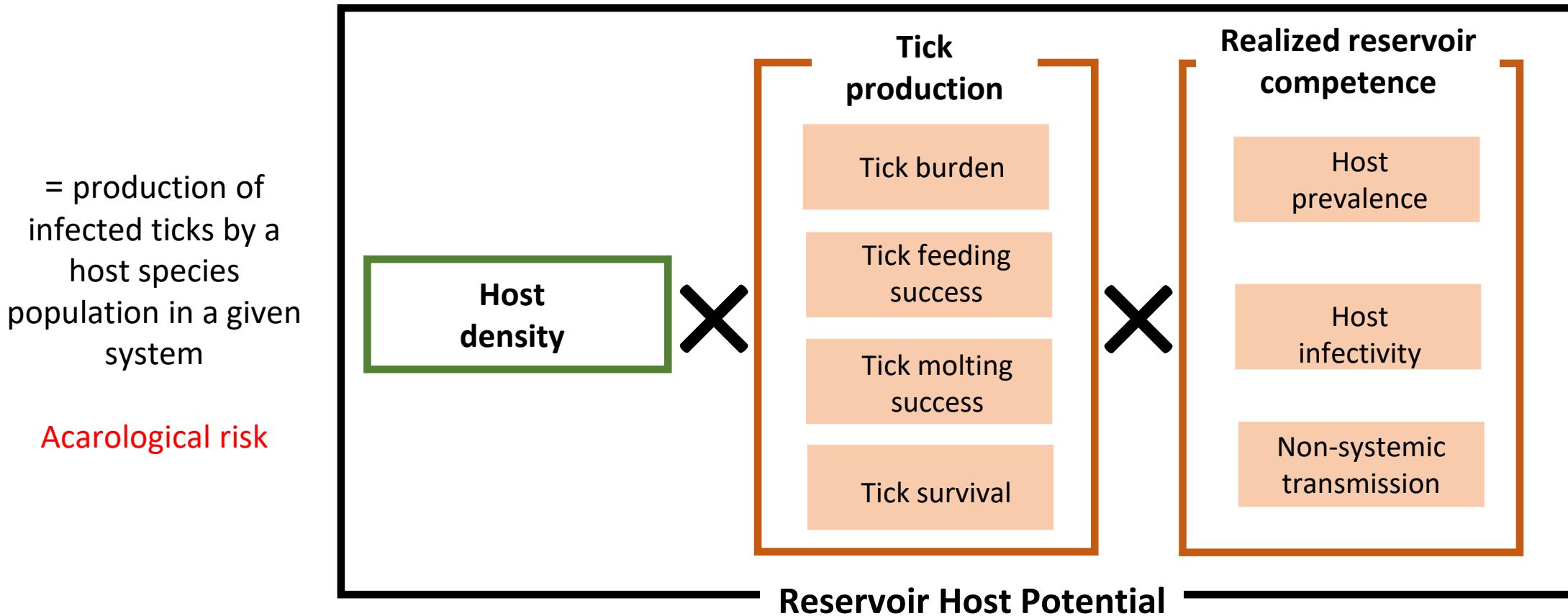






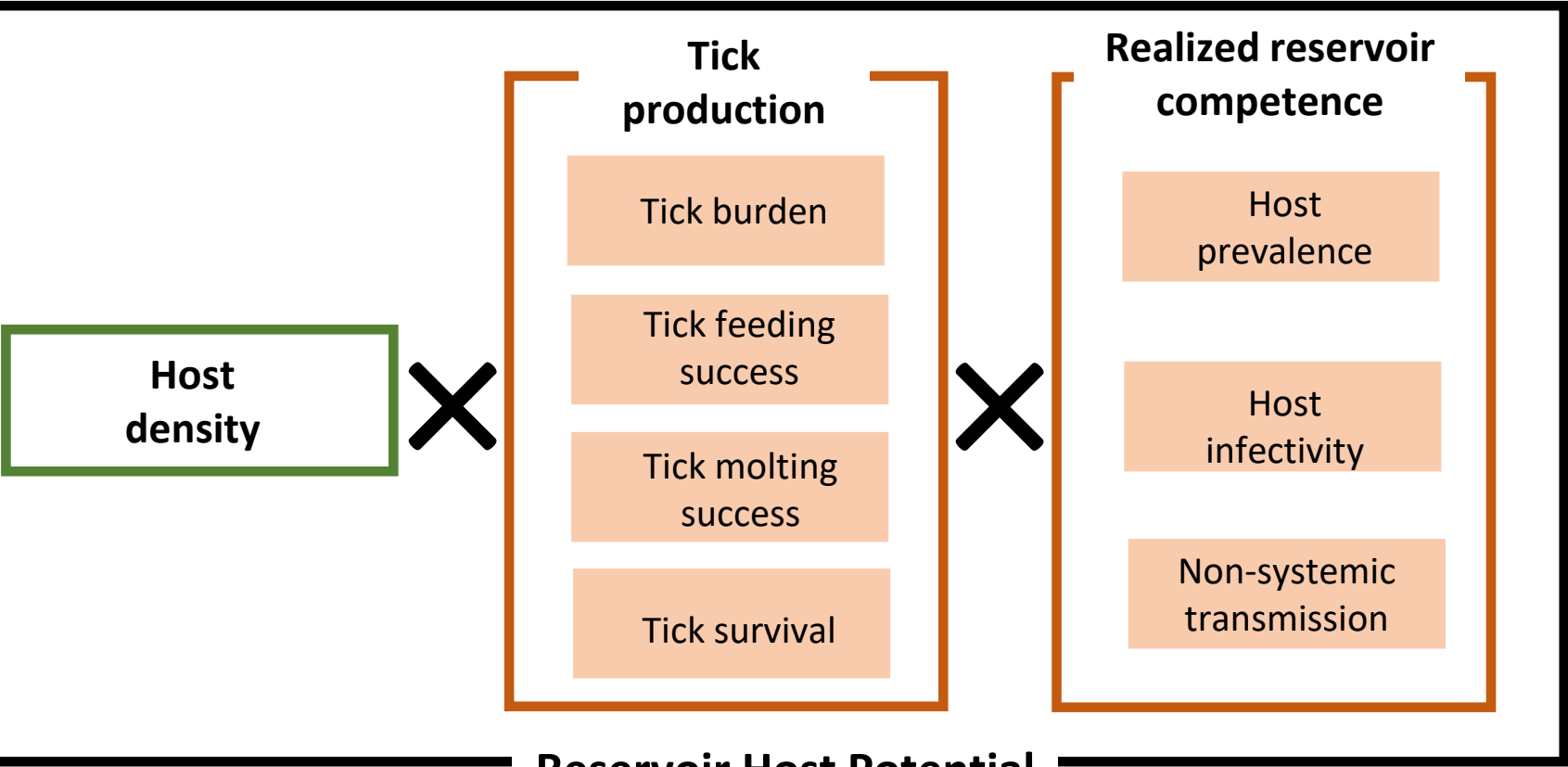






Host intrinsic factors
 (species, individual or specific characteristics)

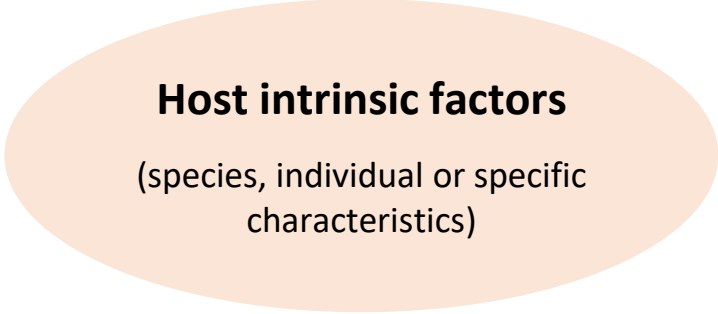
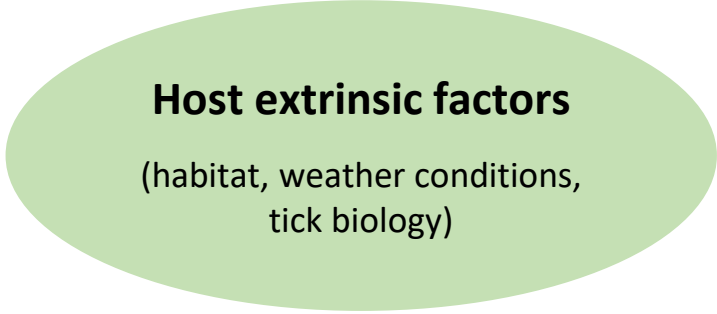
= production of infected ticks by a host species population in a given system



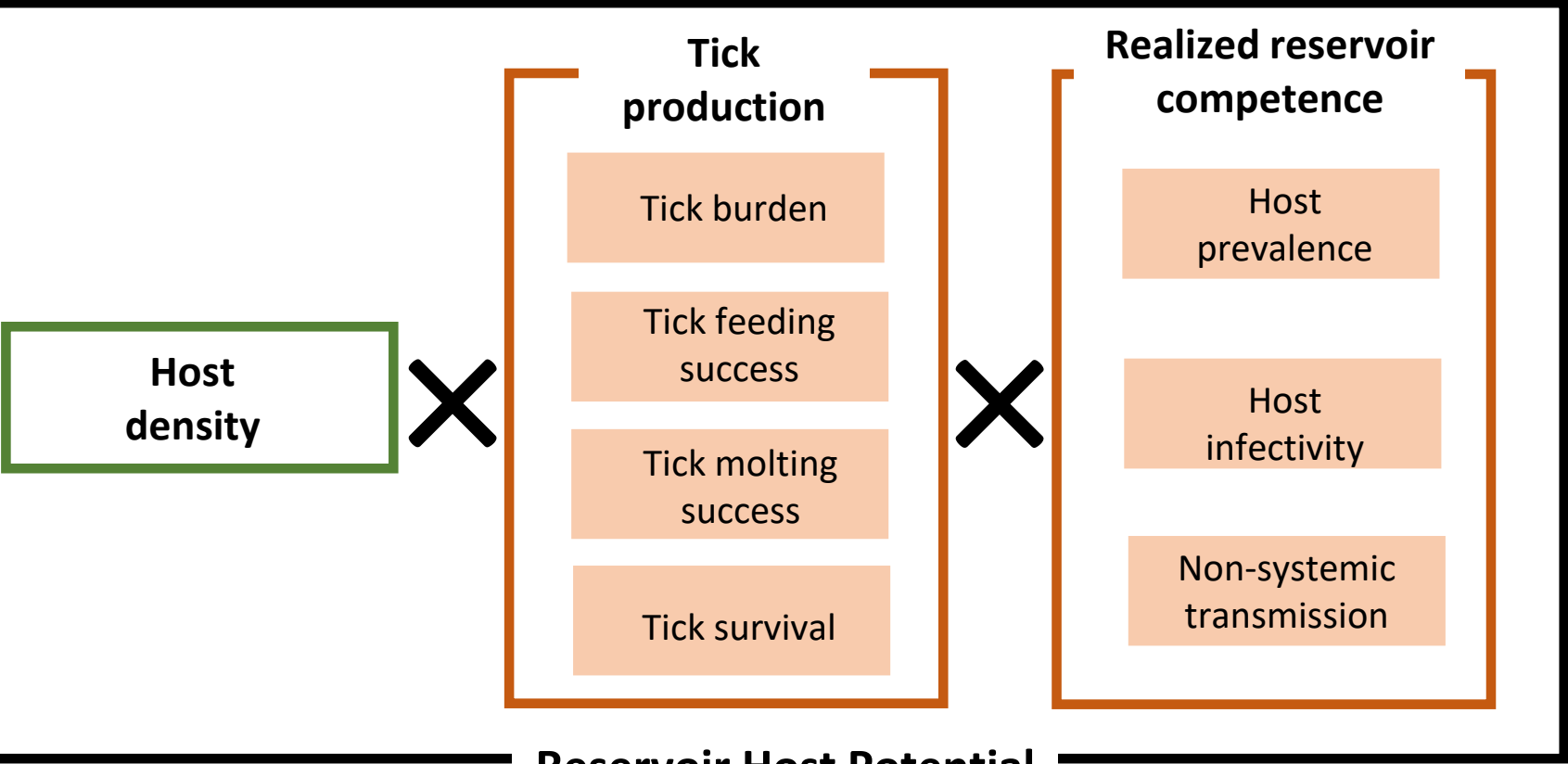
Acarological risk

Reservoir Host Potential

* Inspired by Brunner *et al.*, 2008 in Rataud *et al.*, 2021 – *Transboundary and Emerging Disease*



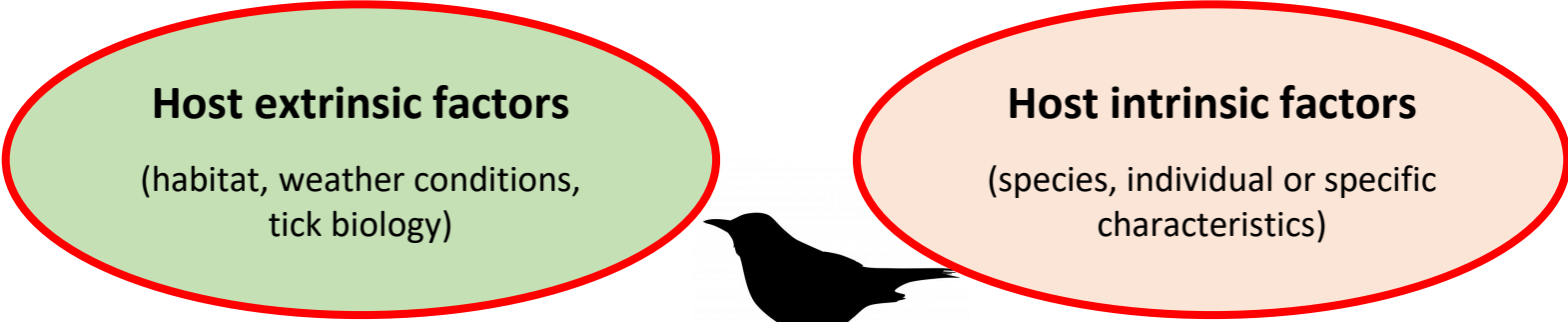
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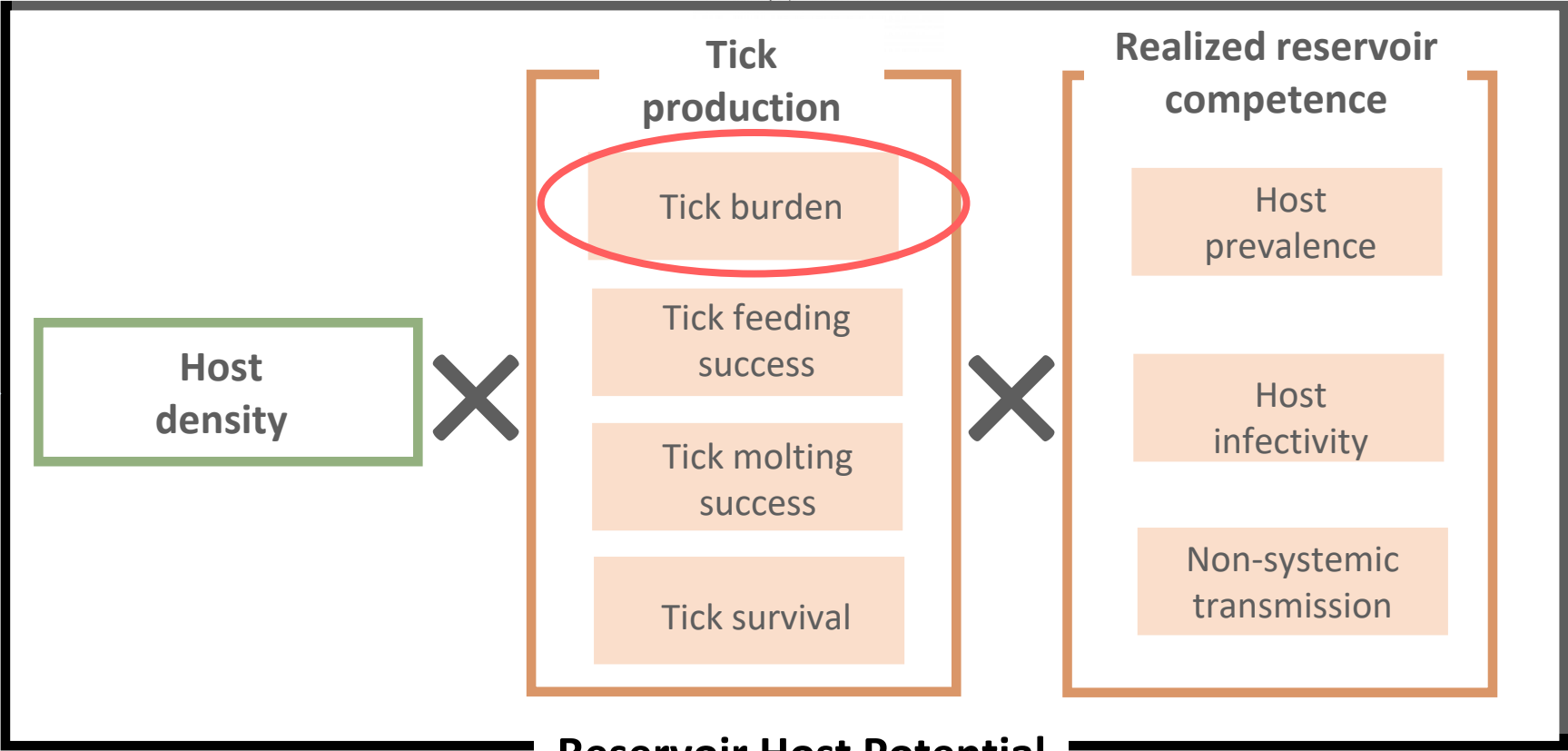
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Reservoir Host Potential

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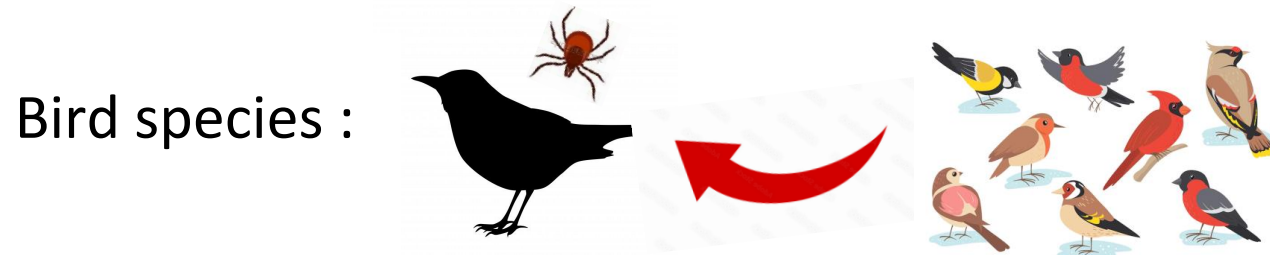
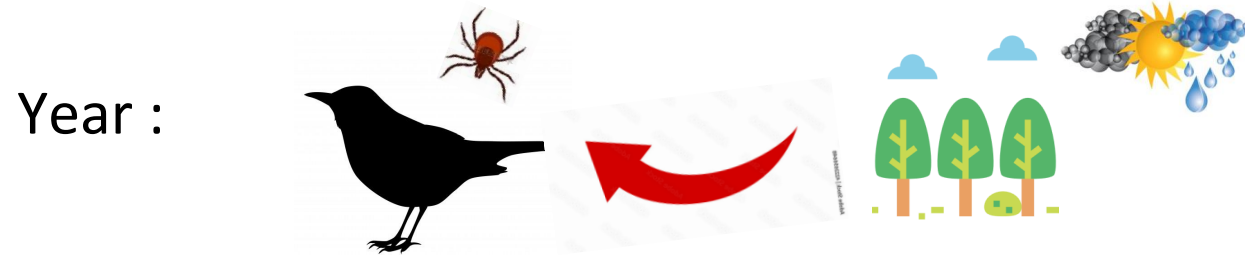
= production of infected ticks by a host species population in a given system



Reservoir Host Potential

* Inspired by Brunner *et al.*, 2008 in Rataud *et al.*, 2021 – *Transboundary and Emerging Disease*

- Which factor influences the most the tick burden on a given bird: bird species or environmental conditions (year)?

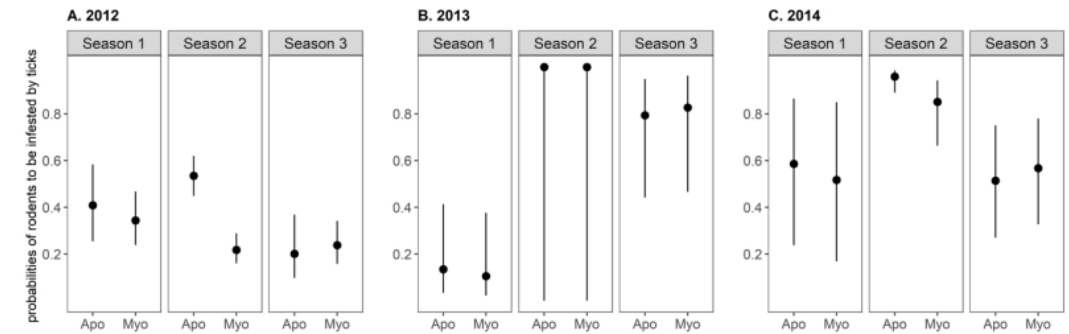
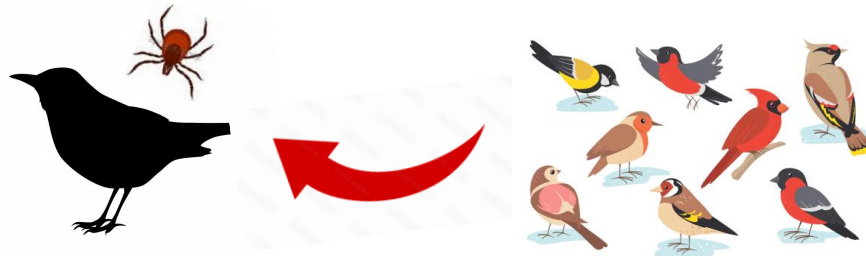


- Which factor influences the most the tick burden on a given bird: bird species or environmental conditions (year)?

Year :

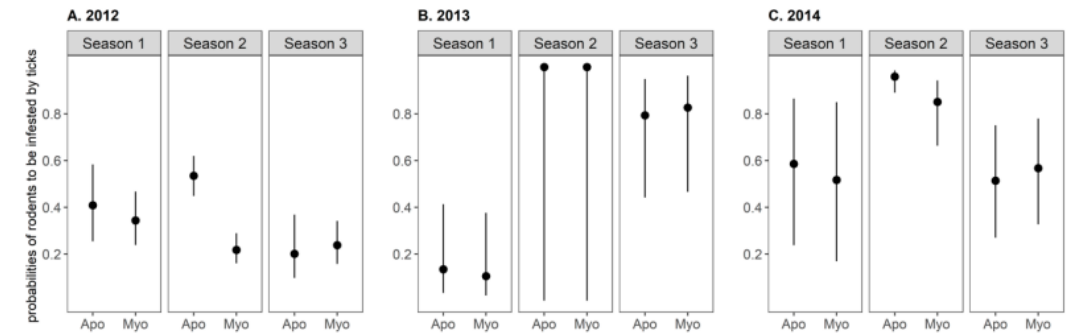
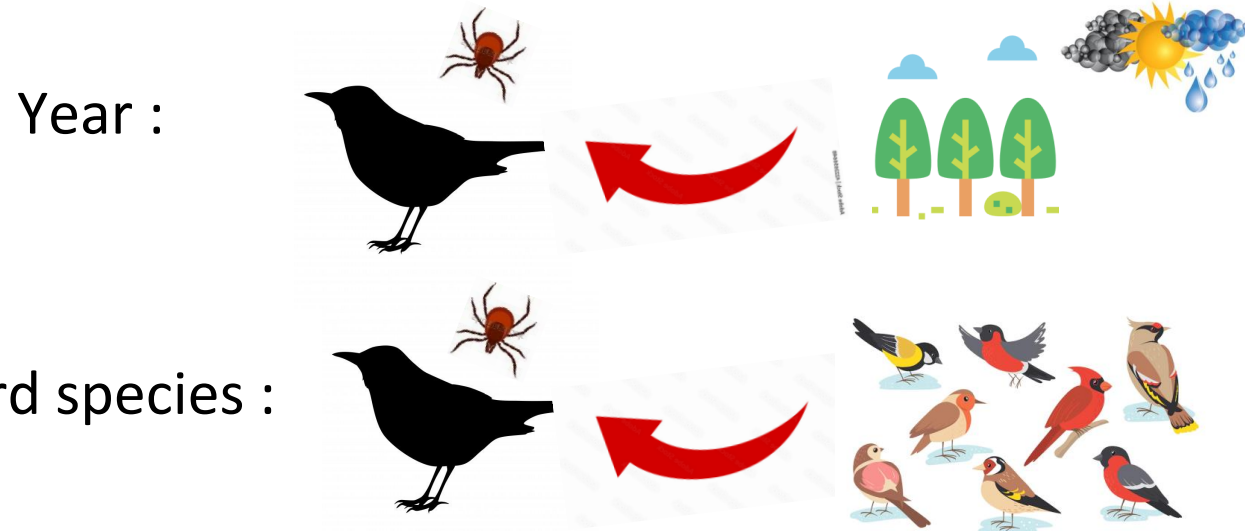


Bird species :



Bournez et al., 2020

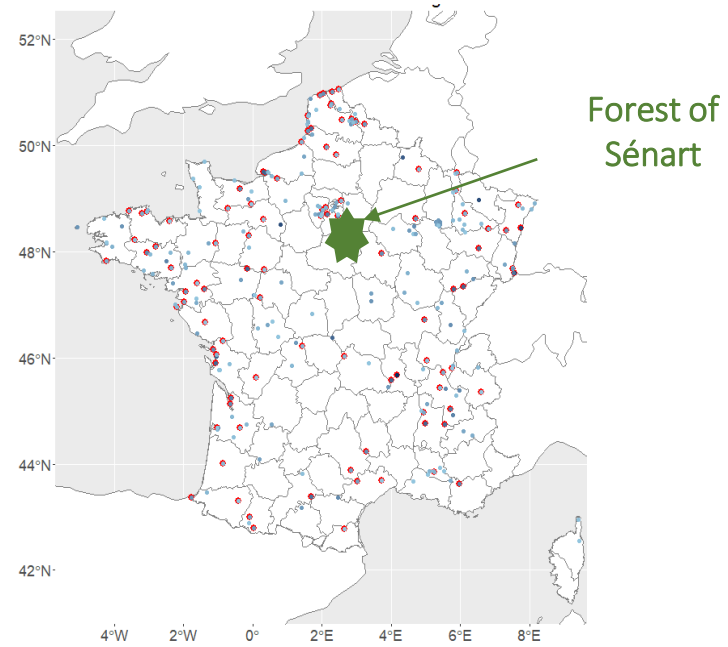
- Which factor influences the most the tick burden on a given bird: bird species or environmental conditions (year)?

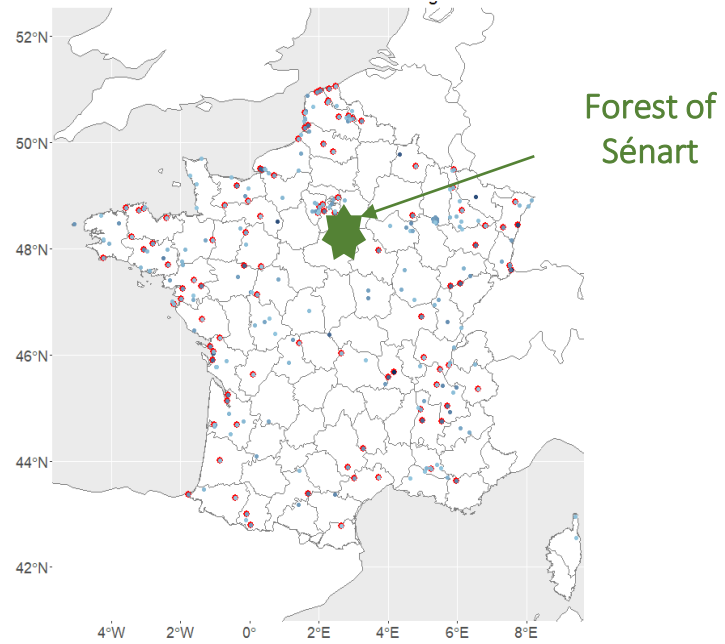


Bournez et al., 2020

- Which species of the bird community participate the most to the local tick production ?

STOC-Capture

2007-2019
April-July



2007-2019
April-July



Tick counting



Species, sex, age



Body weight



Mean species foraging height (litterature)¹⁹

Which factor influences the most the tick burden on a given bird: bird species or environmental conditions (year) ?

How the tick burden of birds varies according to year, bird species and individual characteristics ?



Tick counting

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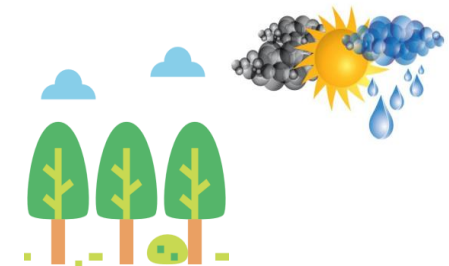
Sex, age

+

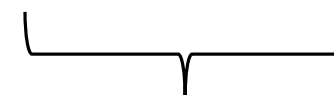


Bird species

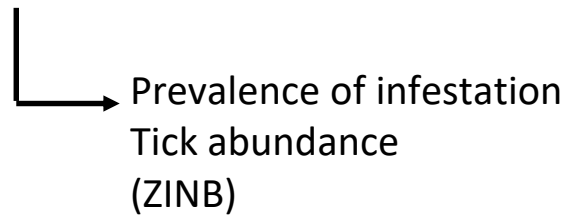
+



Environmental conditions (Year)



Variance



Which species of the bird community participate the most to the local tick production ?

$$\text{Local tick feeding index}_{\text{Species } i, \text{ Year } j} = \frac{\text{Tick burden}_{\text{Species } i, \text{ Year } j}}{\sum_{i=1}^N \text{Tick burden}_{\text{Species } i, \text{ Year } j}}$$

Which species of the bird community participate the most to the local tick production ?

$$\text{Local tick feeding index}_{\text{Species } i, \text{Year } j} = \frac{\text{Tick burden}_{\text{Species } i, \text{Year } j} \times \text{Density}_{\text{Species } i, \text{Year } j}}{\sum_{i=1}^N \text{Tick burden}_{\text{Species } i, \text{Year } j} \times \text{Density}_{\text{Species } i, \text{Year } j}}$$

CMR estimates
↙

N = number of bird species

- Bird species diversity (2 234 birds, 13 bird species) :



Dunnock

Eurasian
BullfinchEurasian
blackcapGarden
warbler

Song thrush

Common
blackbird

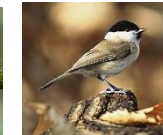
Long-tailed tit



Blue tit



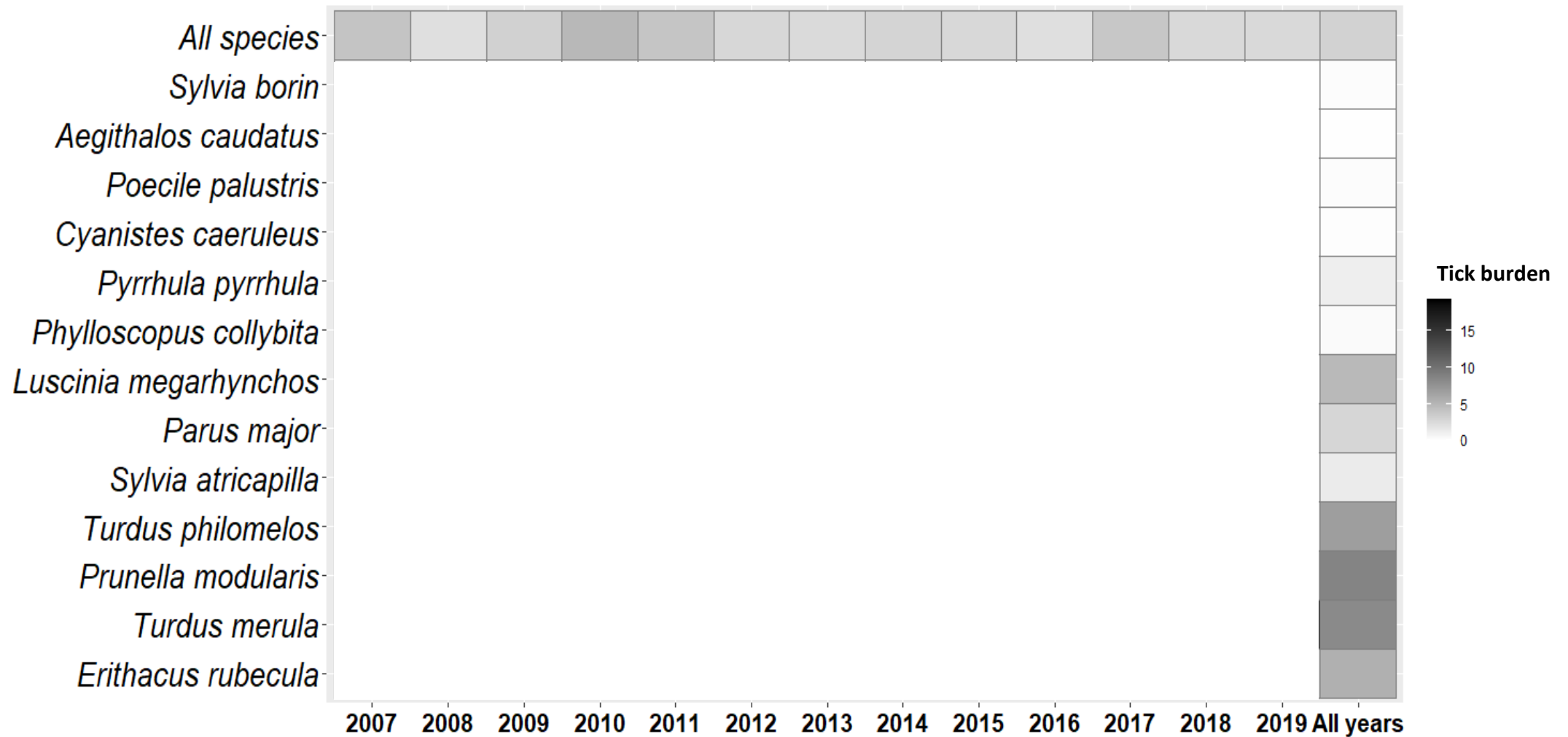
Great tit



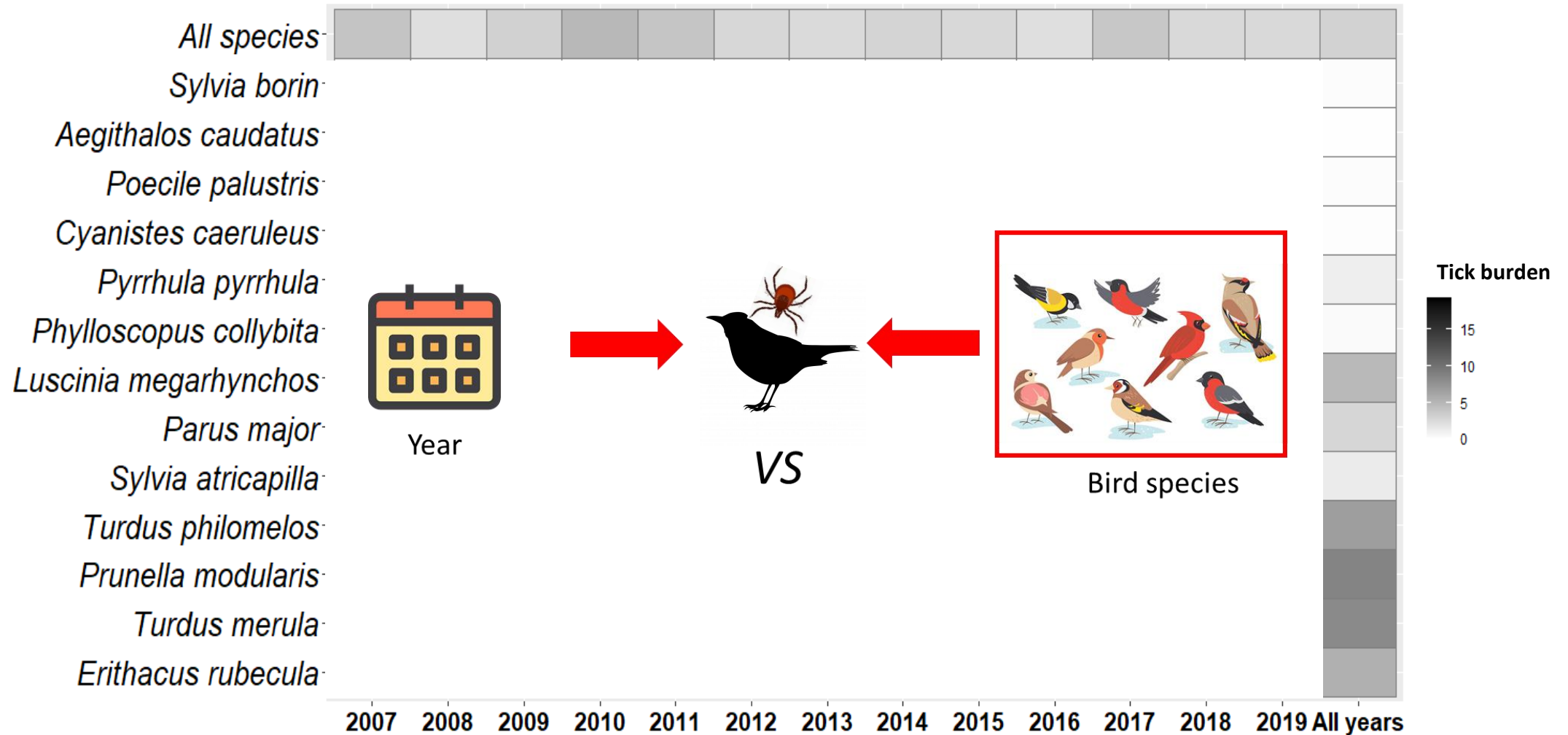
Marsh tit

Common
chiffchaffCommon
nightingaleEuropean
robin

- 1 158 juveniles, 623 ♂ et 453 ♀
- 1 193 infested birds (53,4 %)
- 3 ticks per examined birds and 6 ticks per infested birds in average (Median : 1 tick per examined bird and 4 ticks per infested birds)
- Tick burden from 0 to 84 ticks
- Tick species : *I. ricinus* (Marsot et al., 2012)

Interannual and interspecific variabilities of the observed **tick burden** of birds

Interannual and interspecific variabilities of the observed tick burden of birds

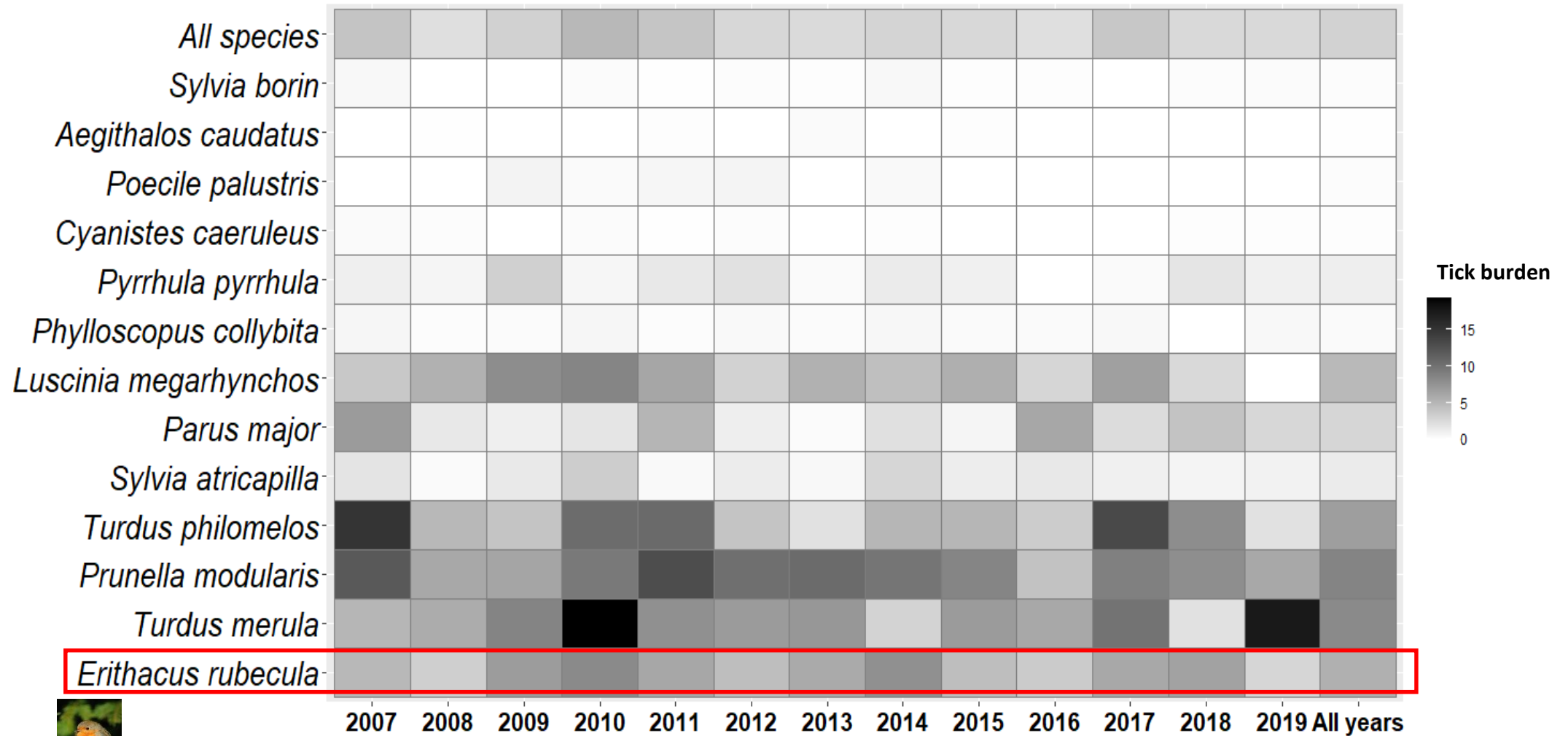


The tick burden of birds is more influenced by the bird species than by the year

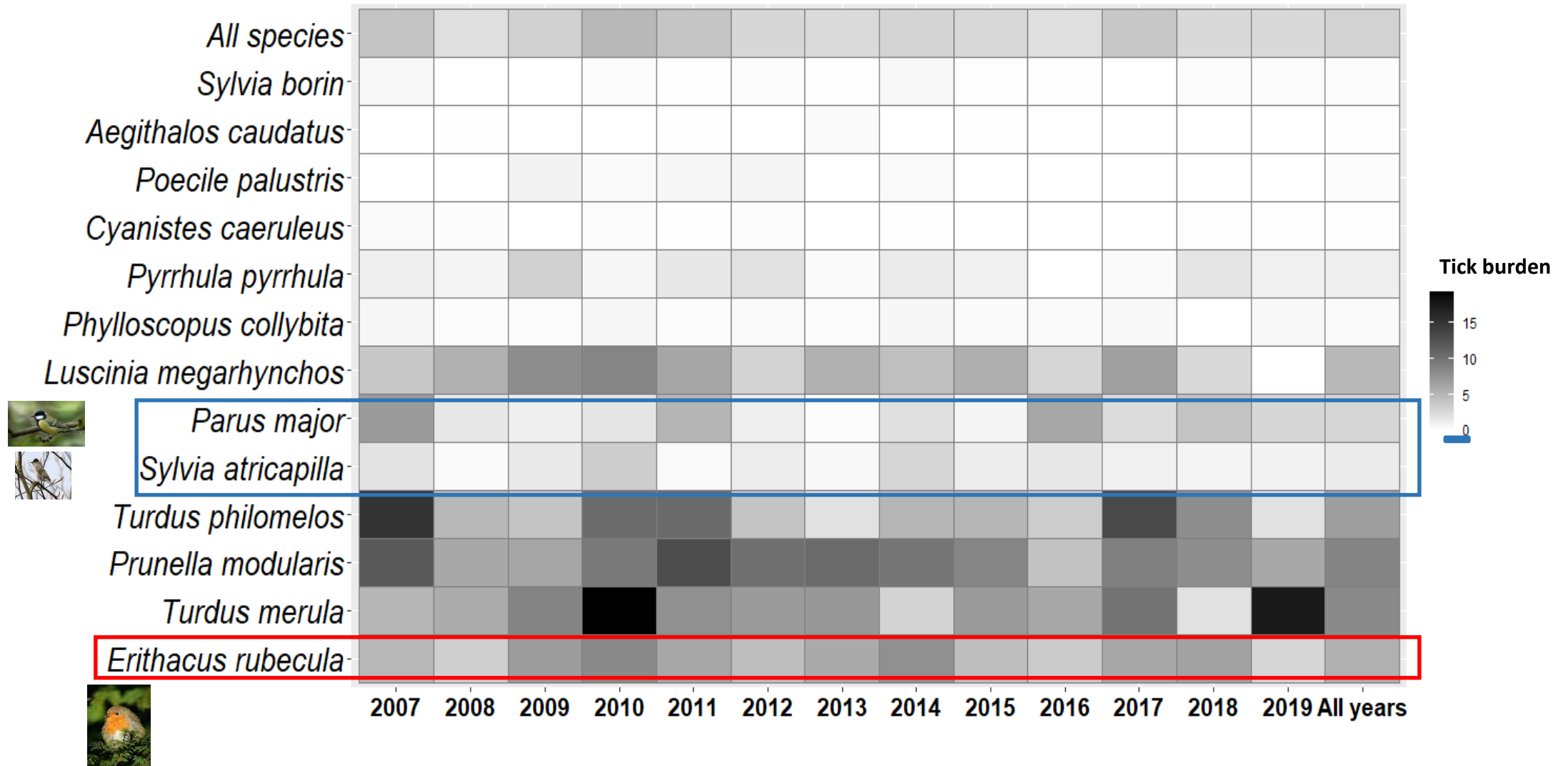
Variance of year = 0.05

Variance of species = 1.89

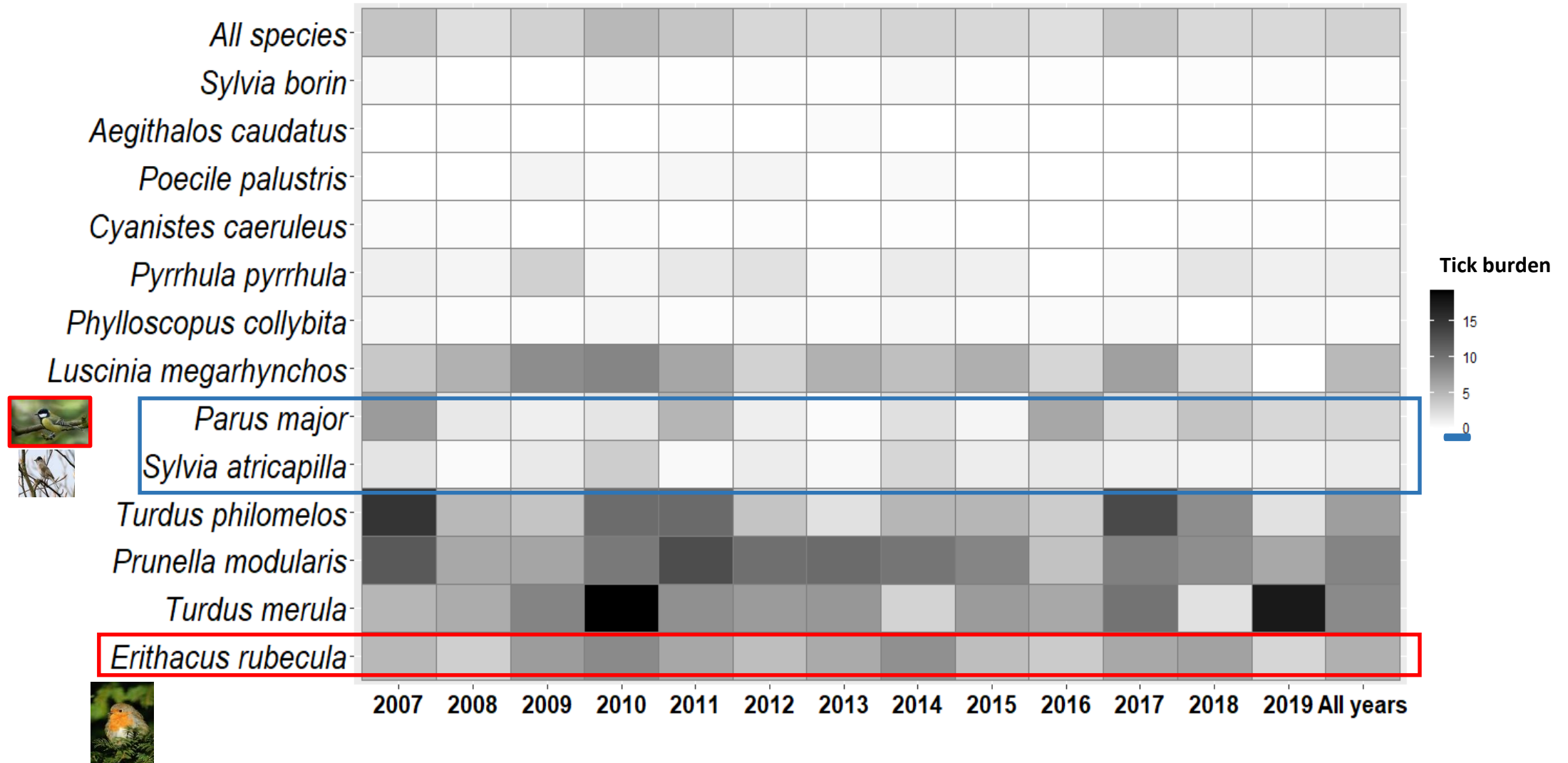
Interannual and interspecific variabilities of the observed tick burden of birds



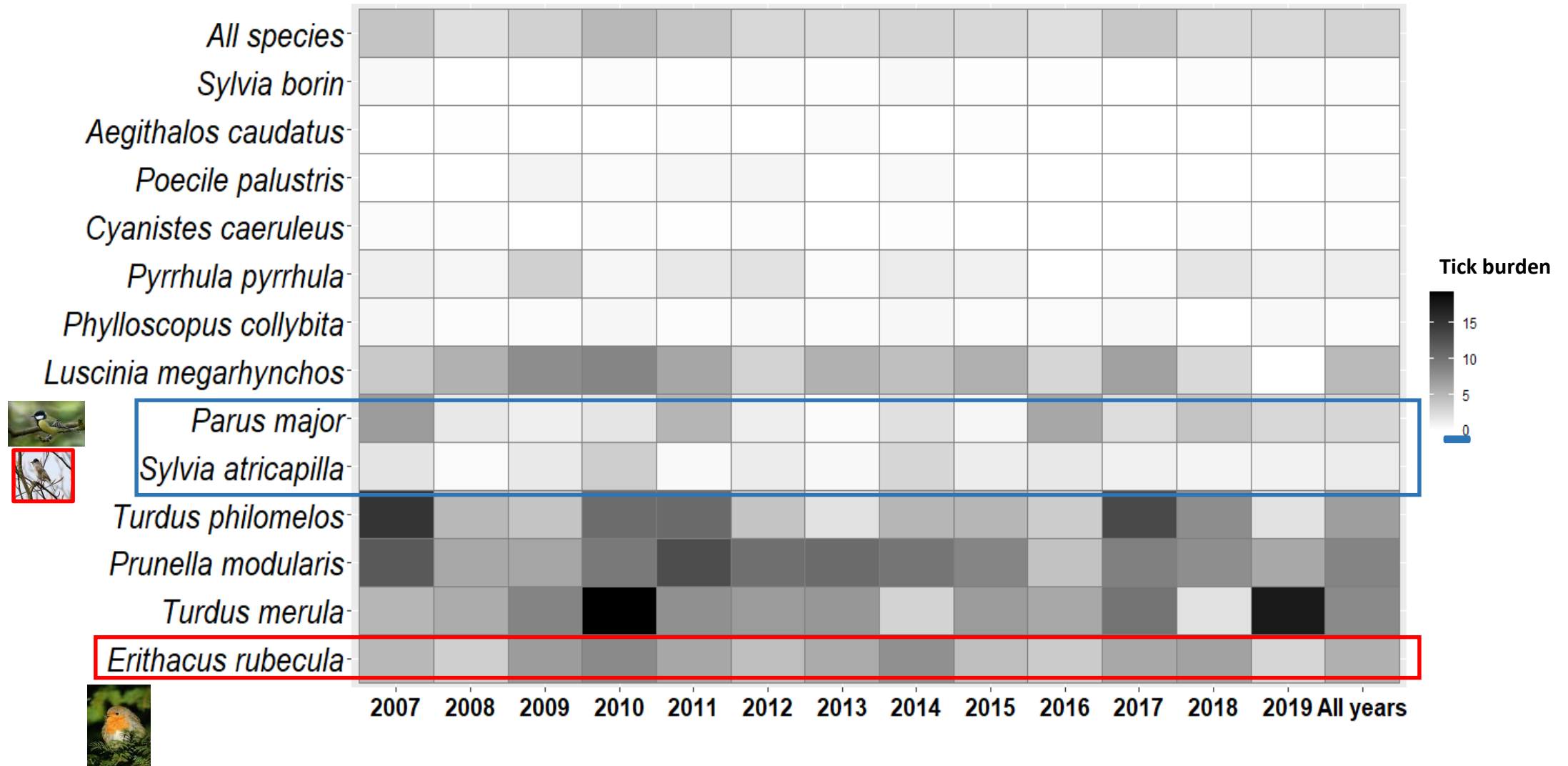
Interannual and interspecific variabilities of the observed tick burden of birds



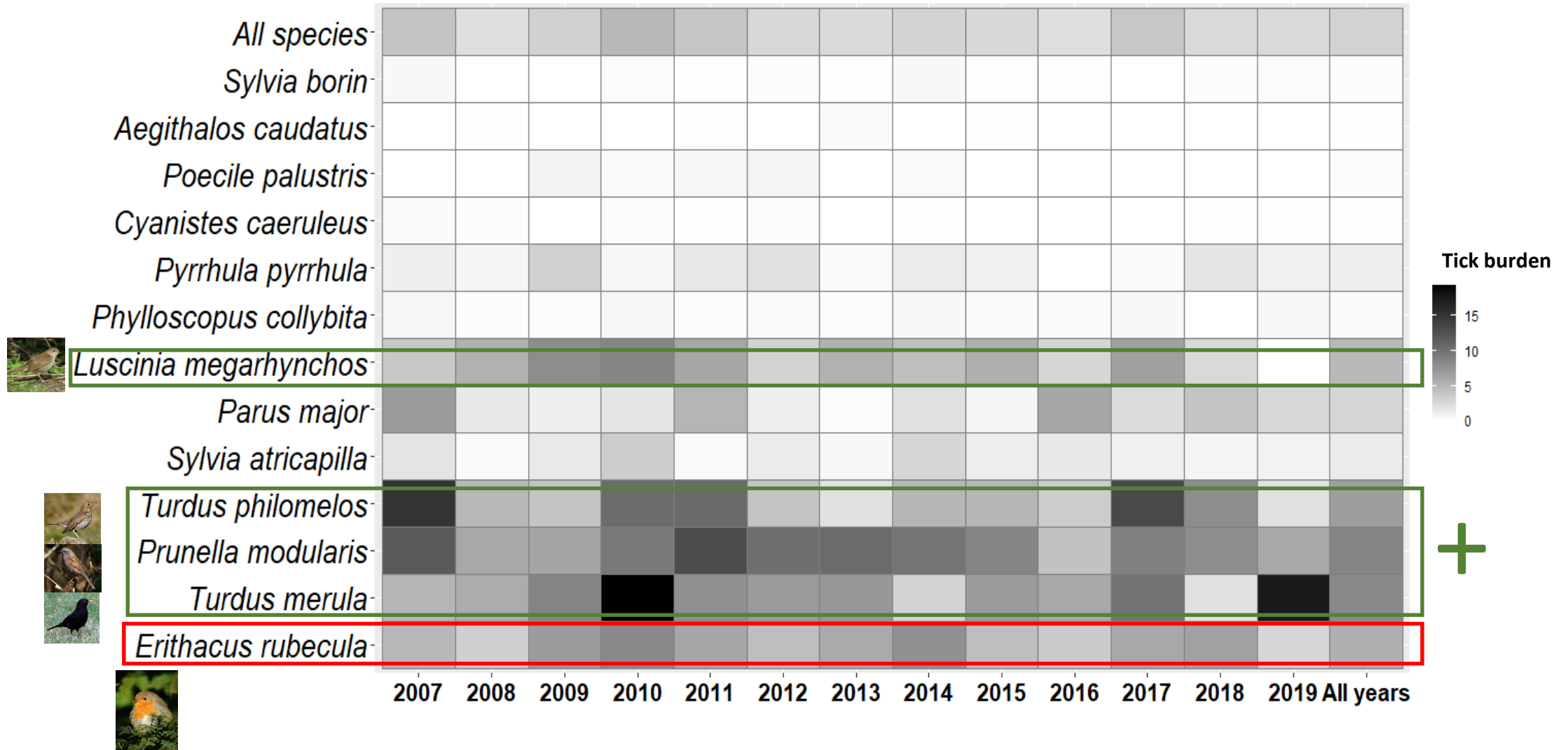
Interannual and interspecific variabilities of the observed tick burden of birds



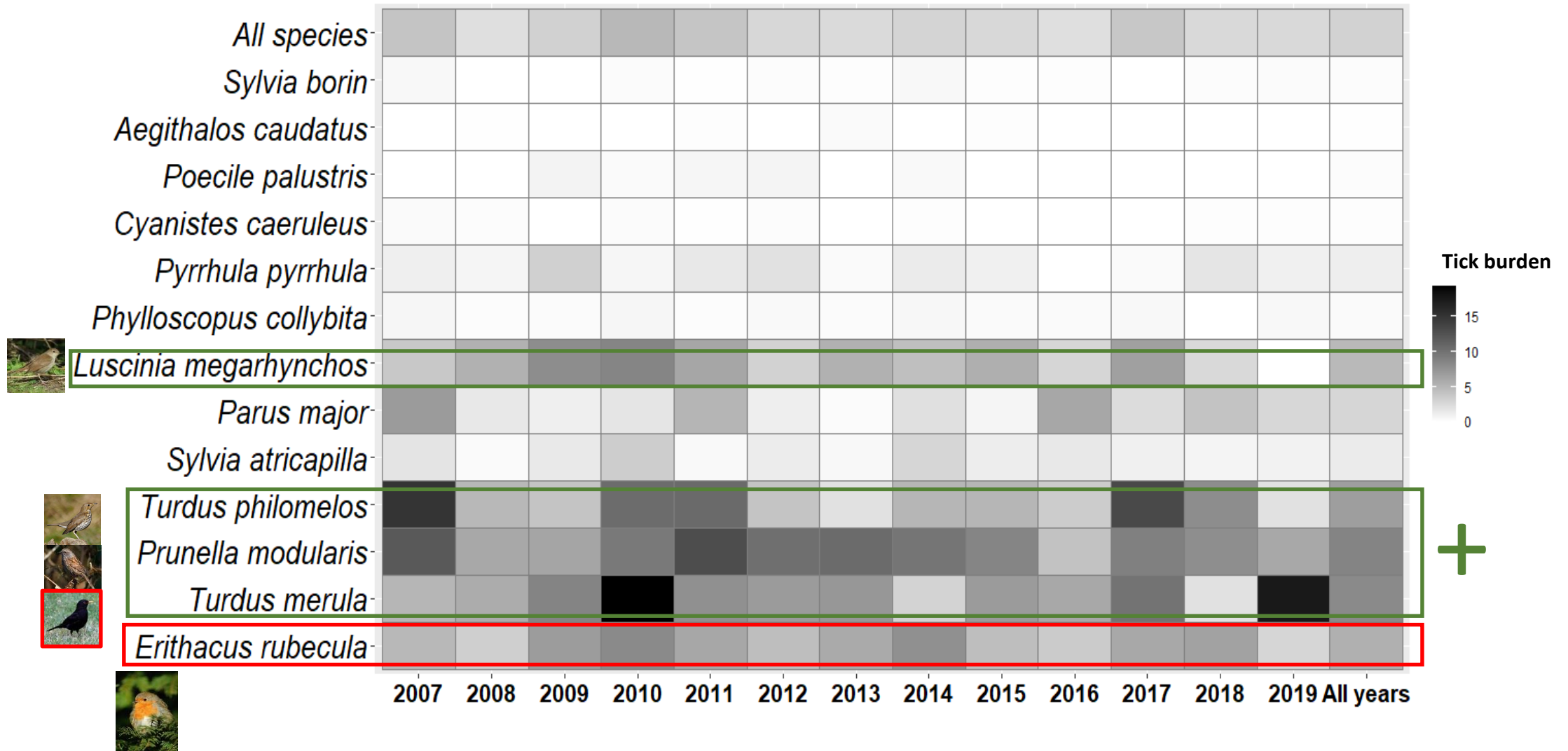
Interannual and interspecific variabilities of the observed tick burden of birds



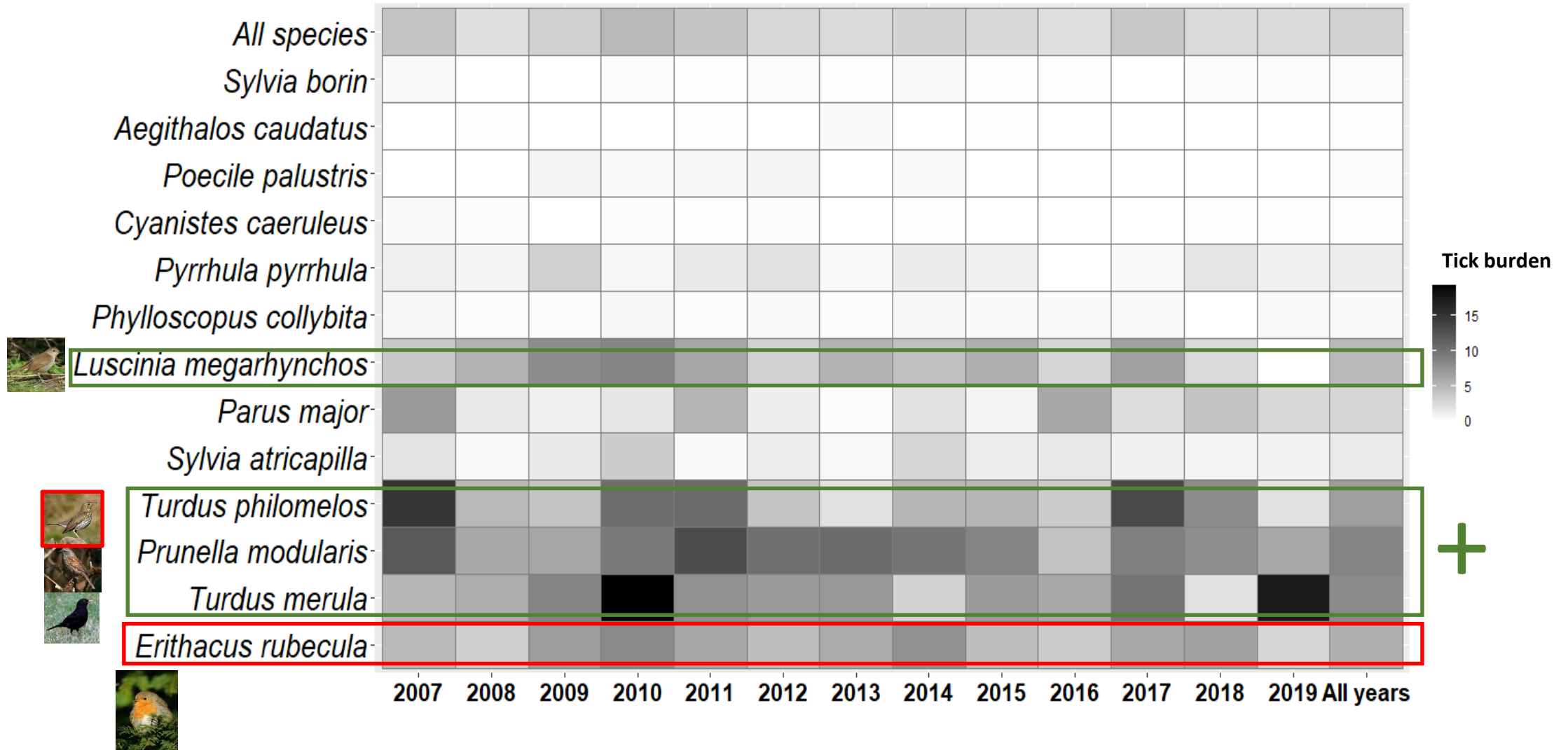
Interannual and interspecific variabilities of the observed tick burden of birds



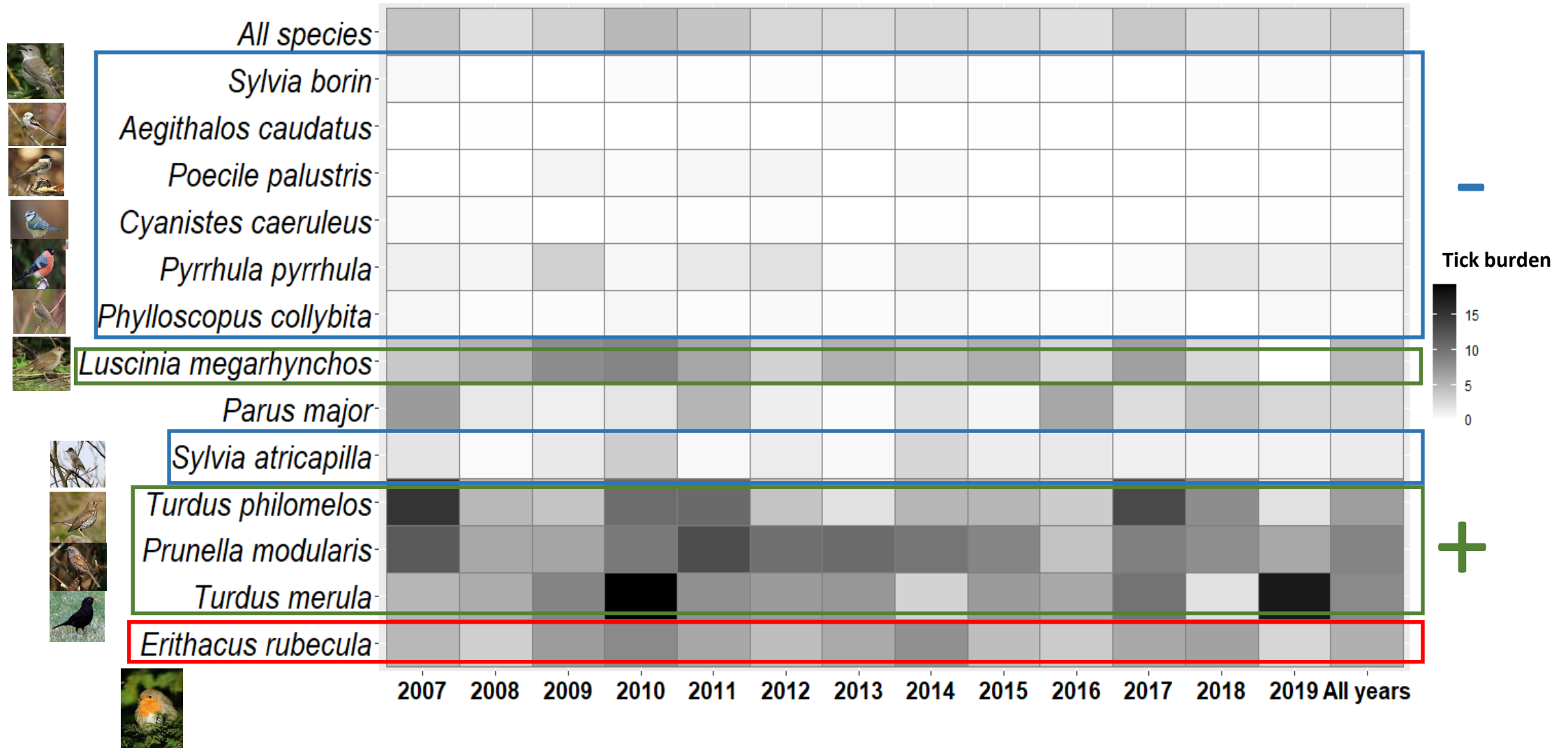
Interannual and interspecific variabilities of the observed tick burden of birds



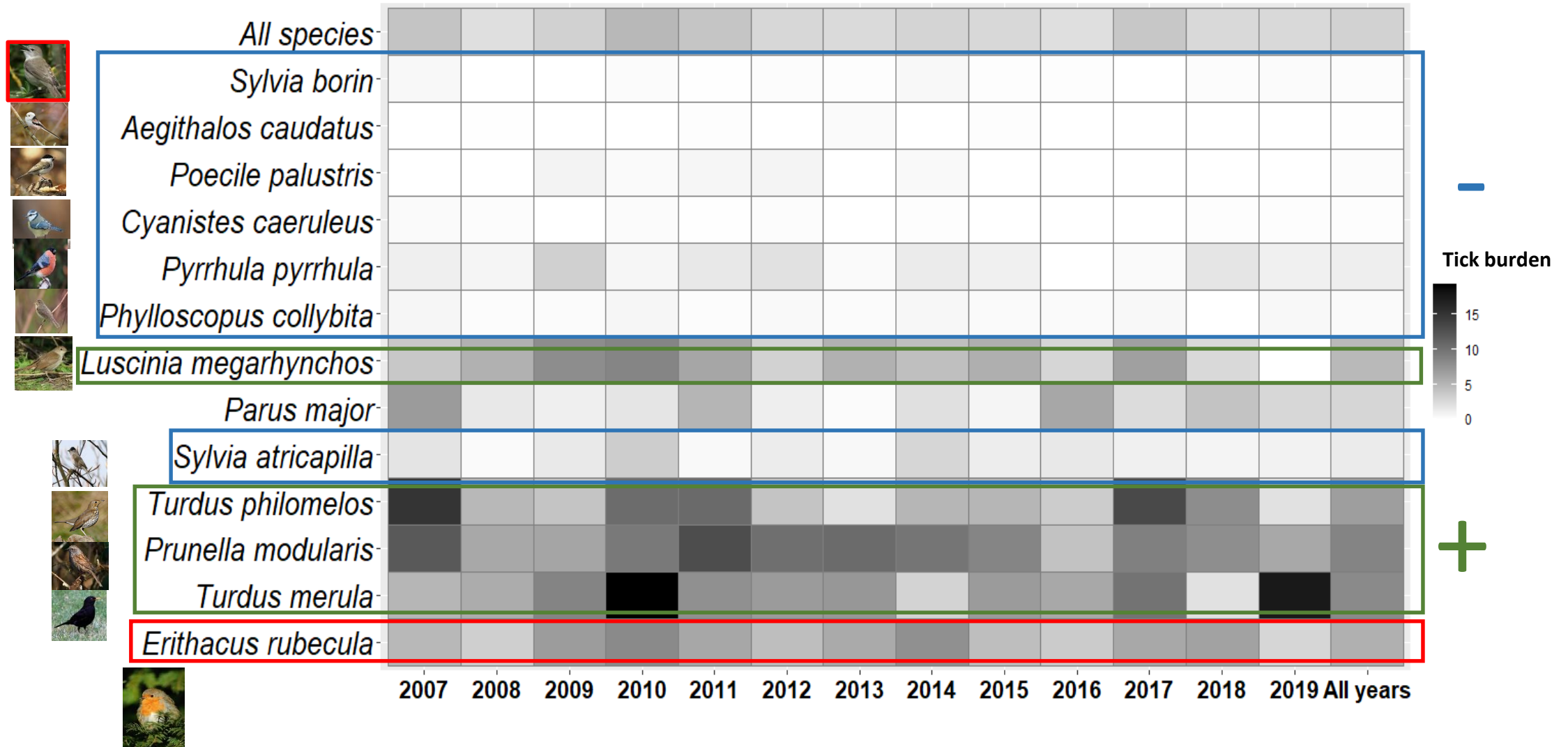
Interannual and interspecific variabilities of the observed tick burden of birds



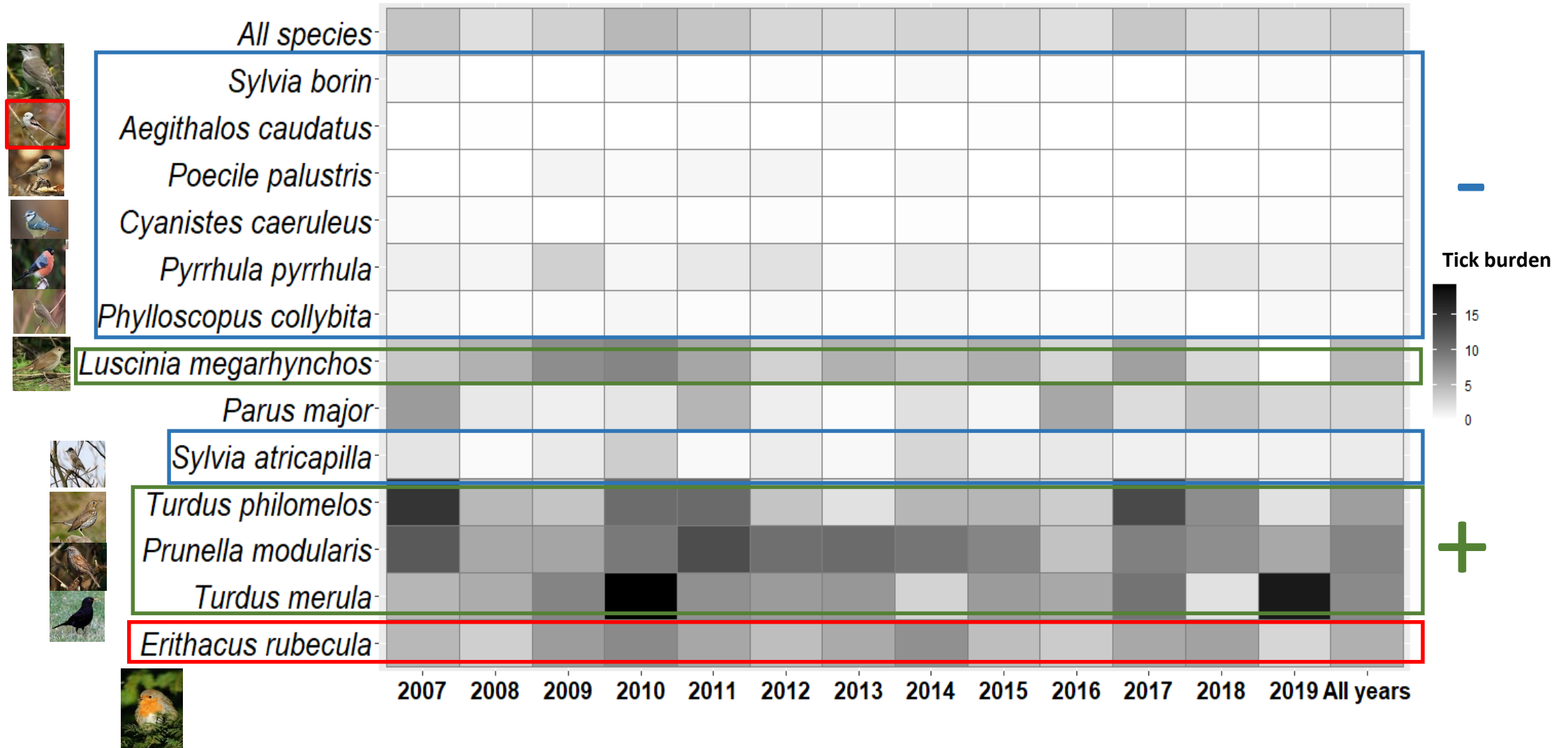
Interannual and interspecific variabilities of the observed tick burden of birds



Interannual and interspecific variabilities of the observed tick burden of birds



Interannual and interspecific variabilities of the observed tick burden of birds



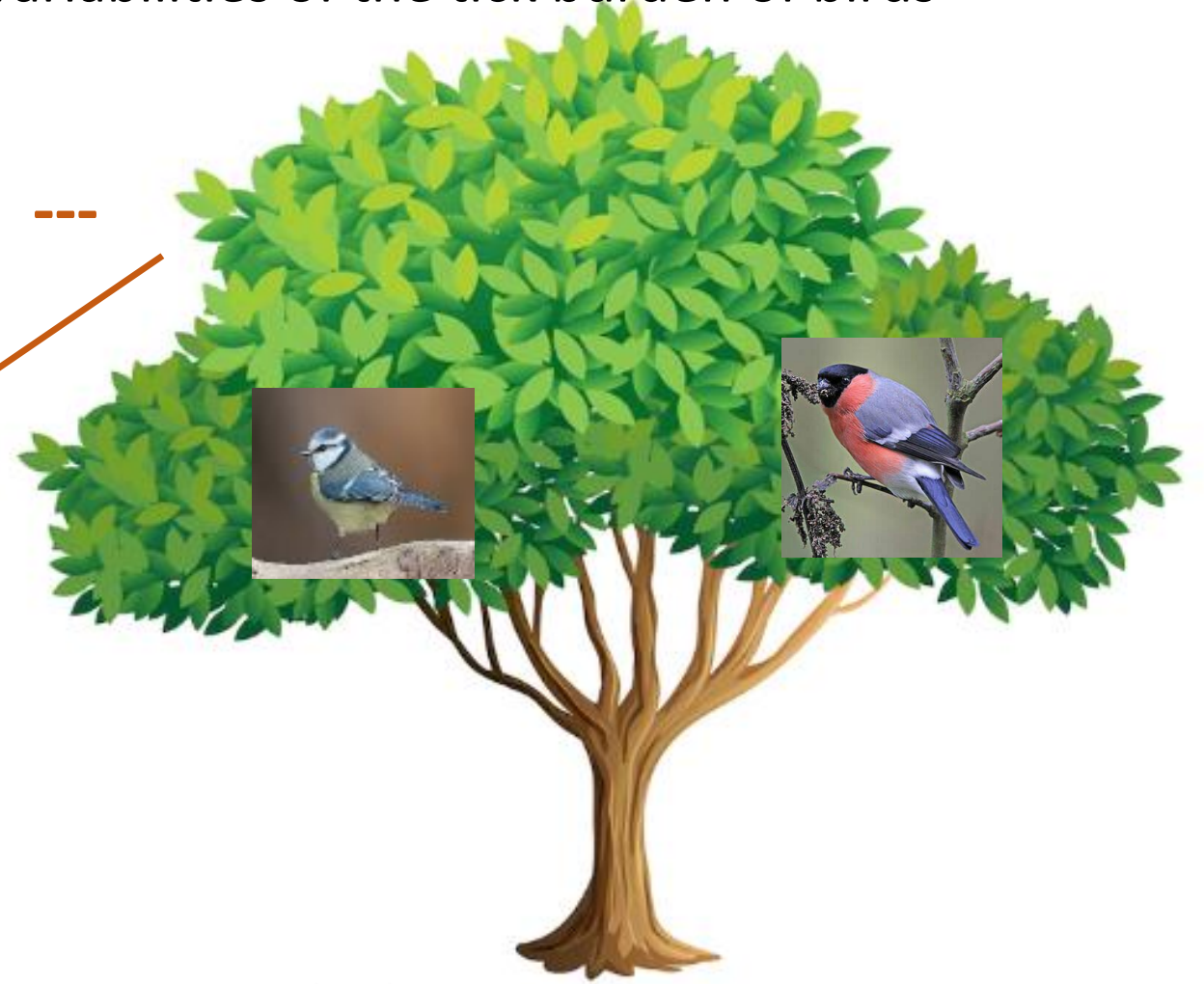
Interannual and interspecific variabilities of the tick burden of birds

Foraging height

Tick burden



+++



Interannual and interspecific variabilities of the tick burden of birds

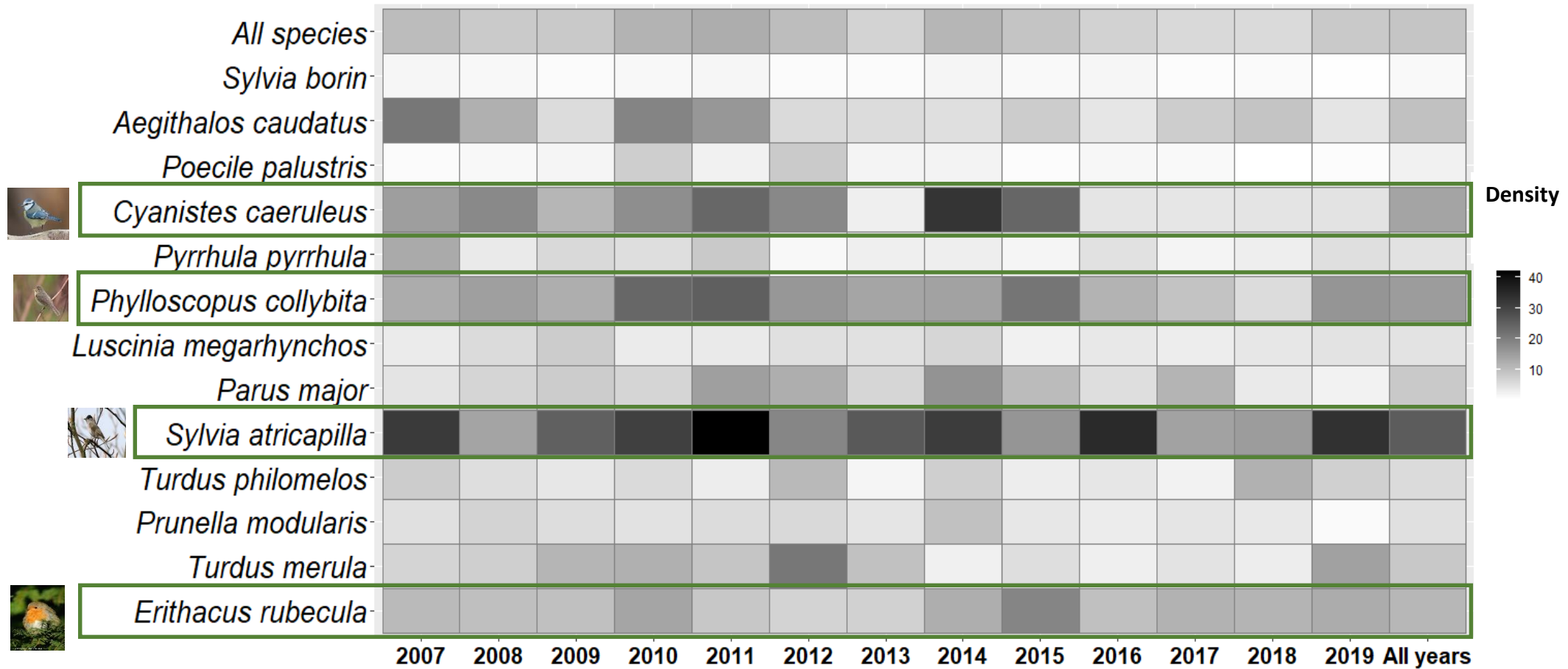
Body weight



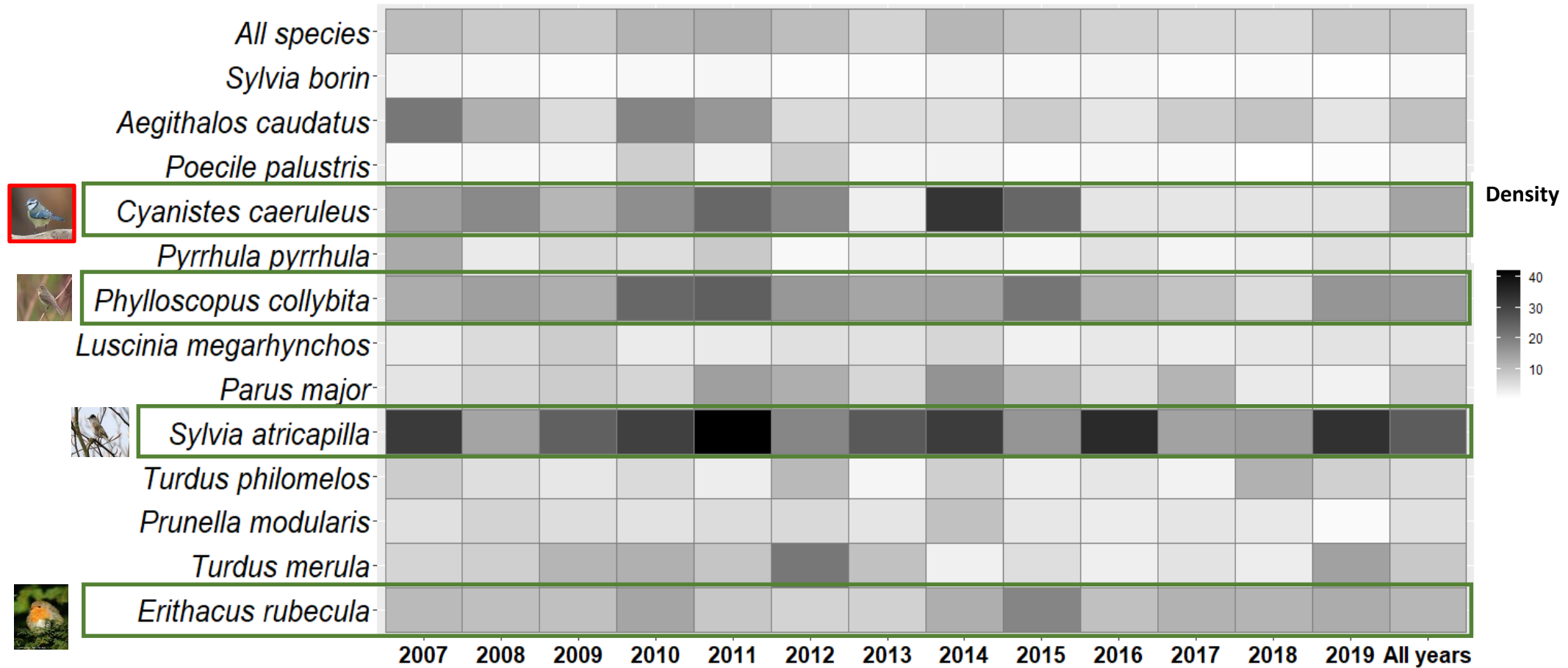
Interannual and interspecific variabilities of the tick burden of birds



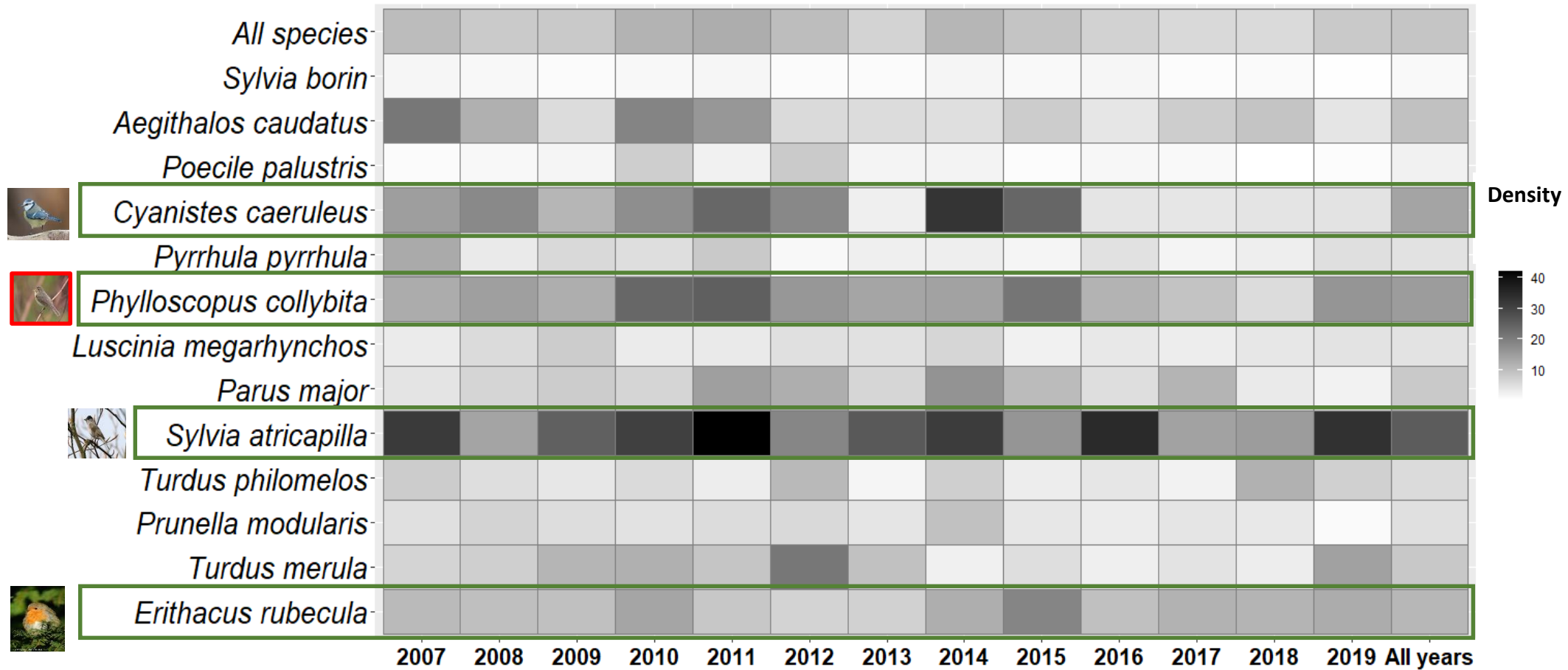
Interannual and interspecific variabilities of the estimated density of birds



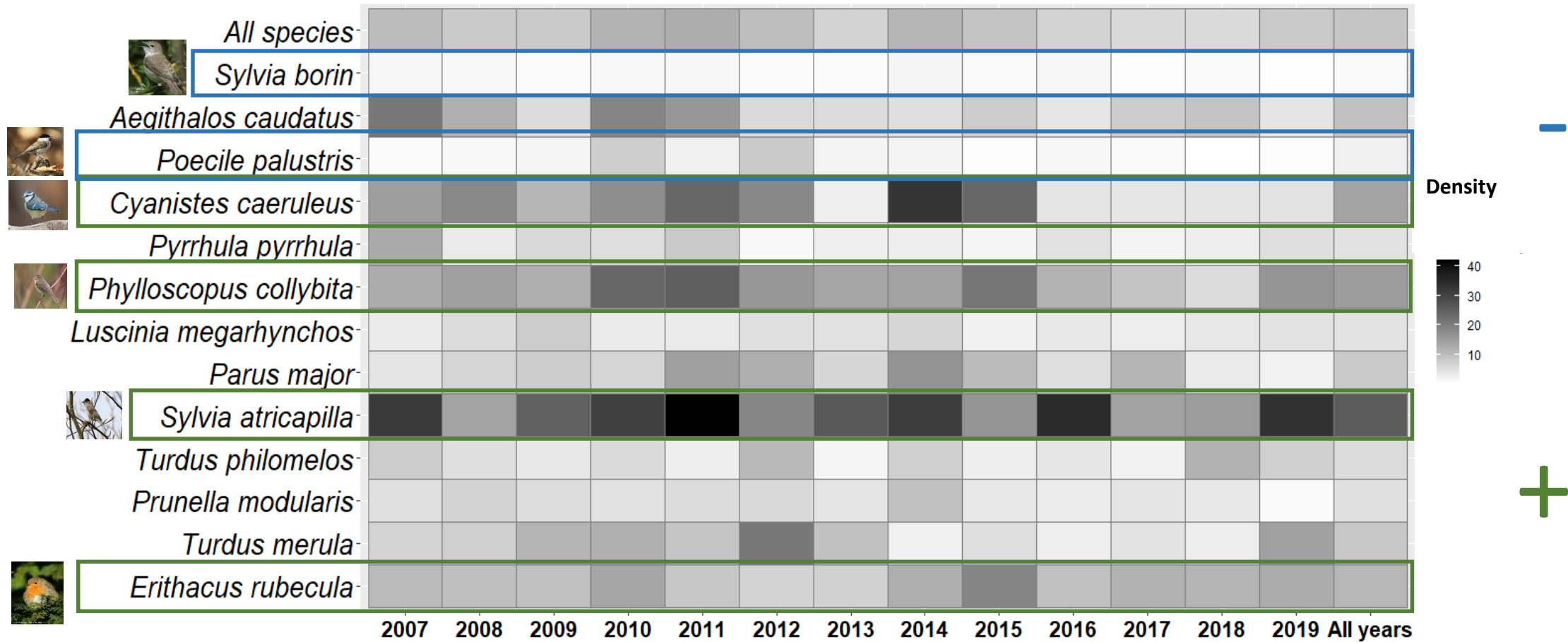
Interannual and interspecific variabilities of the estimated density of birds



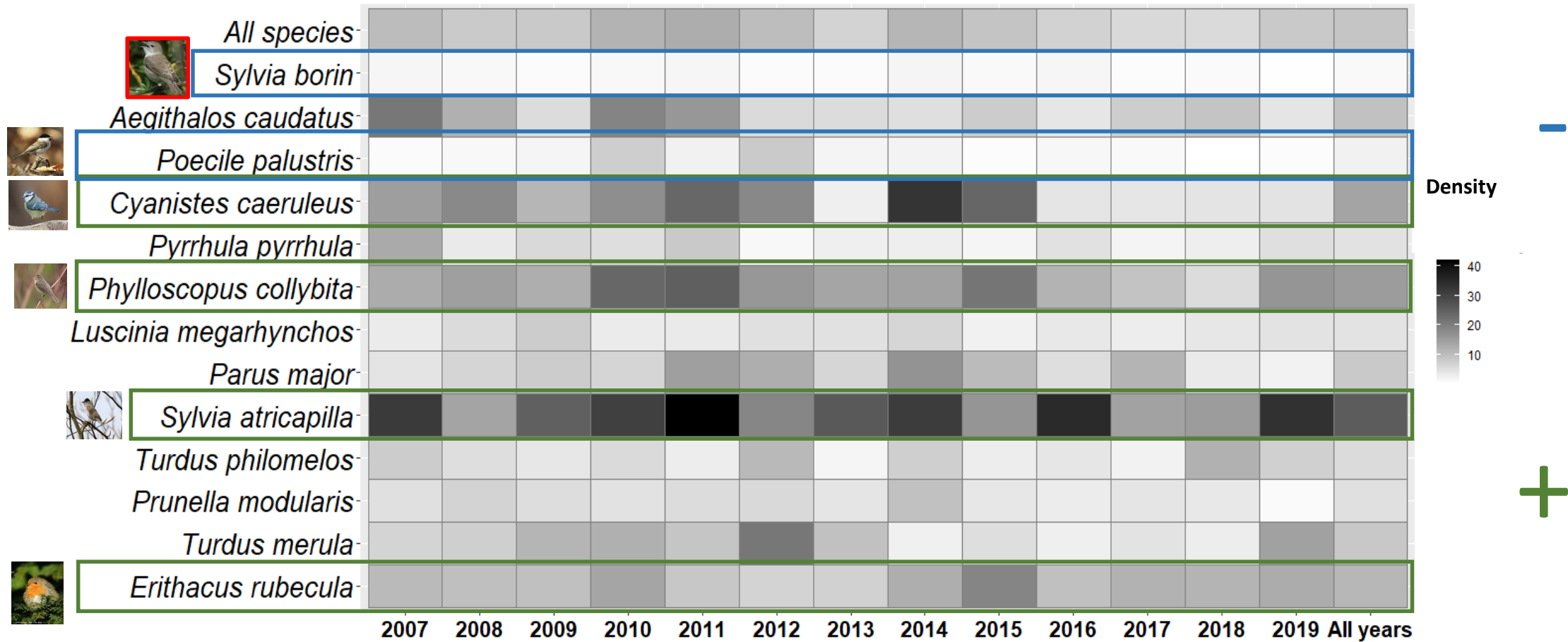
Interannual and interspecific variabilities of the estimated density of birds



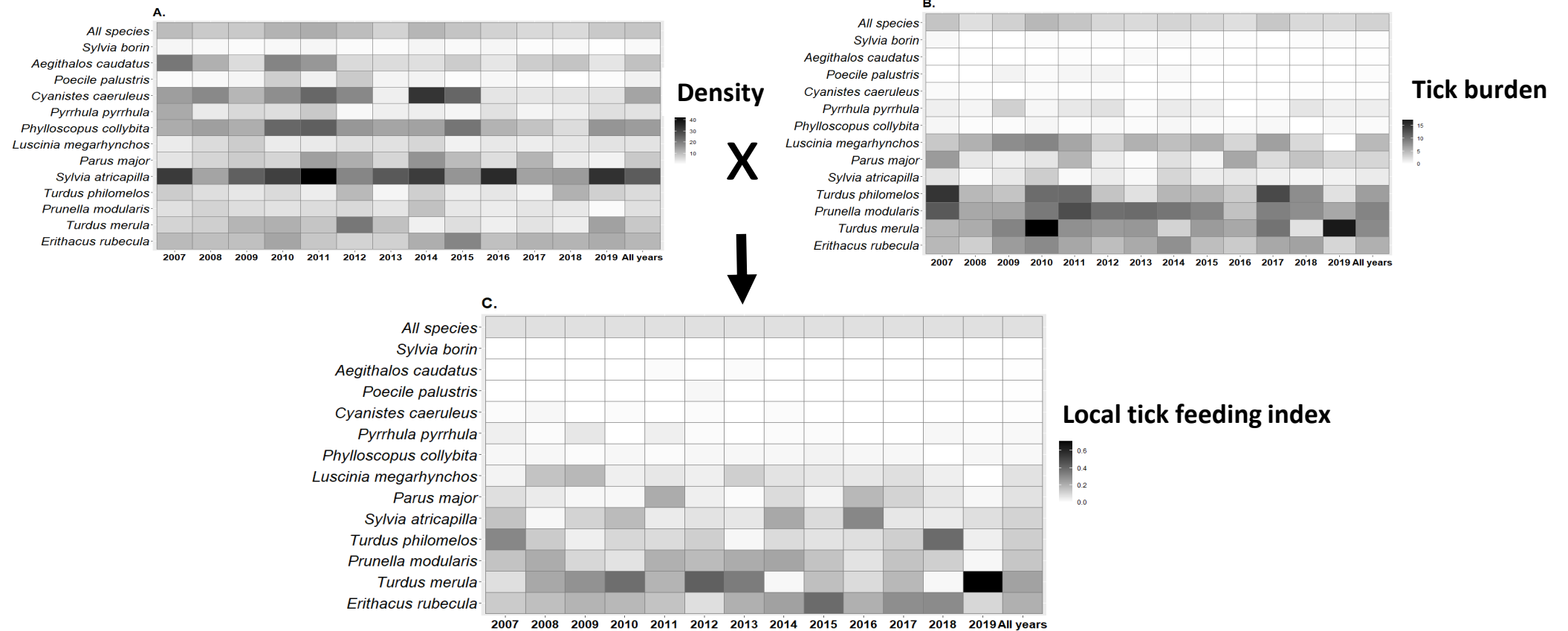
Interannual and interspecific variabilities of the estimated density of birds



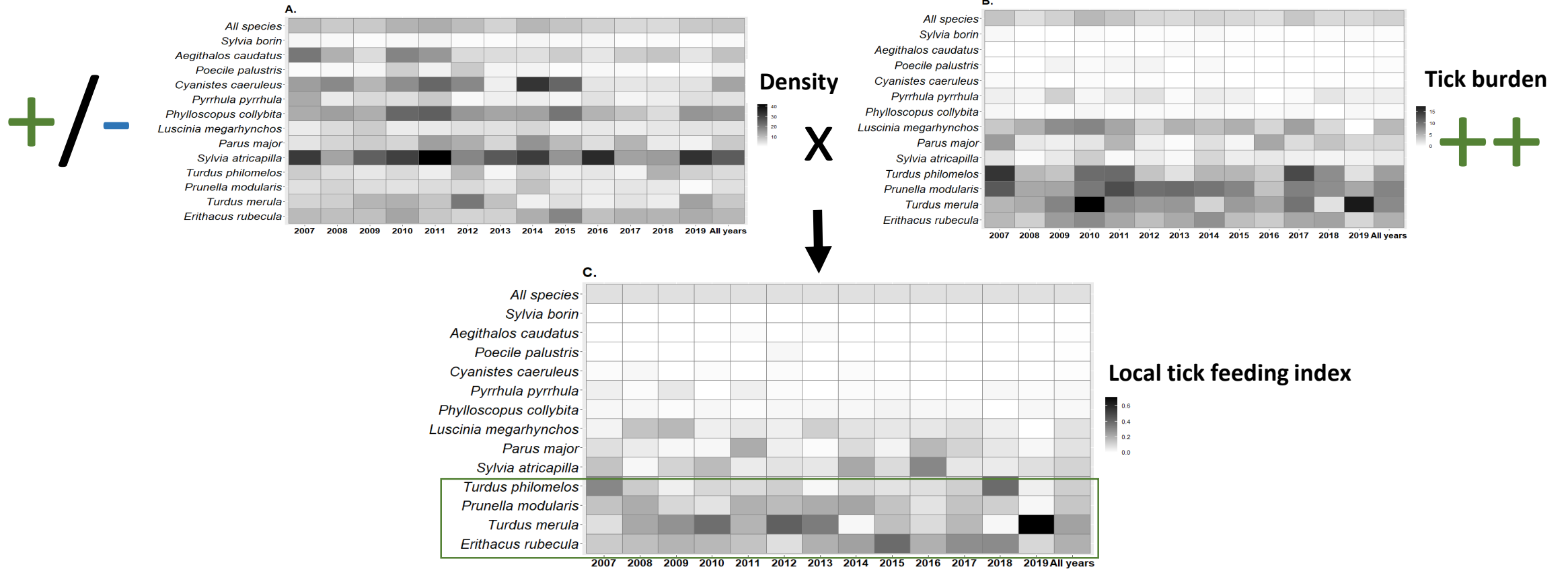
Interannual and interspecific variabilities of the estimated density of birds



Which species of the bird community participate the most to the local tick production?



Which species of the bird community participate the most to the local tick production?



Major



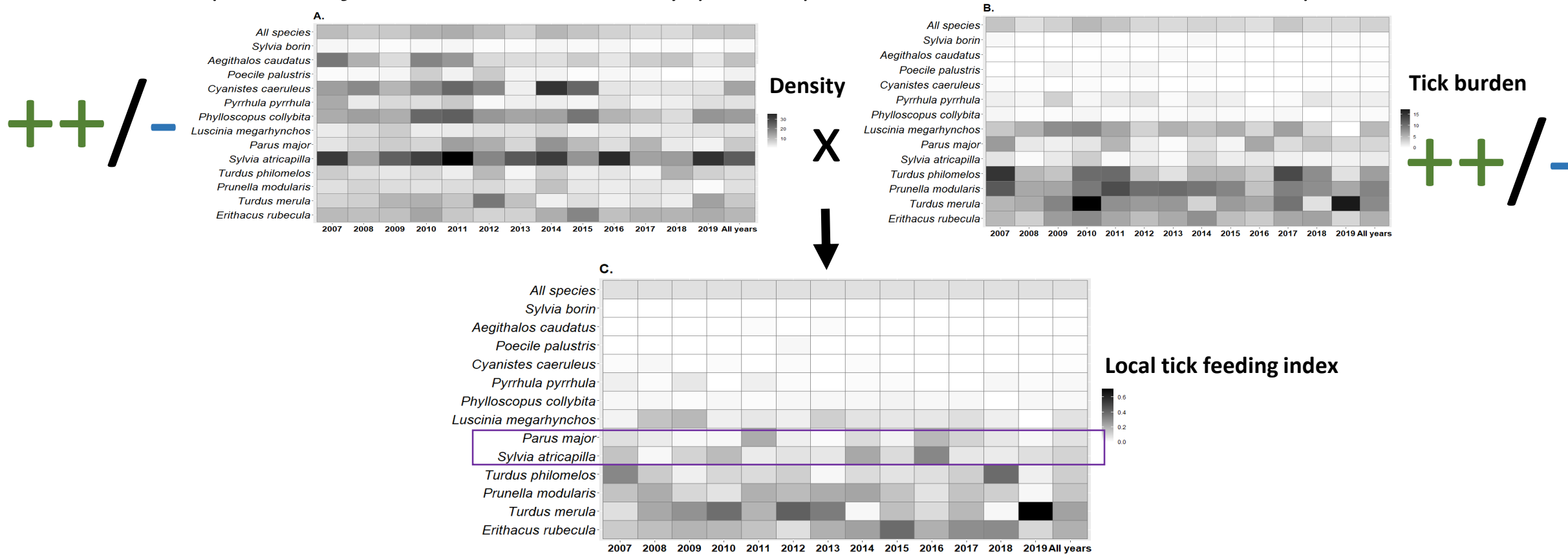
European robin

Common blackbird

Dunnock

Song thrush

Which species of the bird community participate the most to the local tick production?



Major



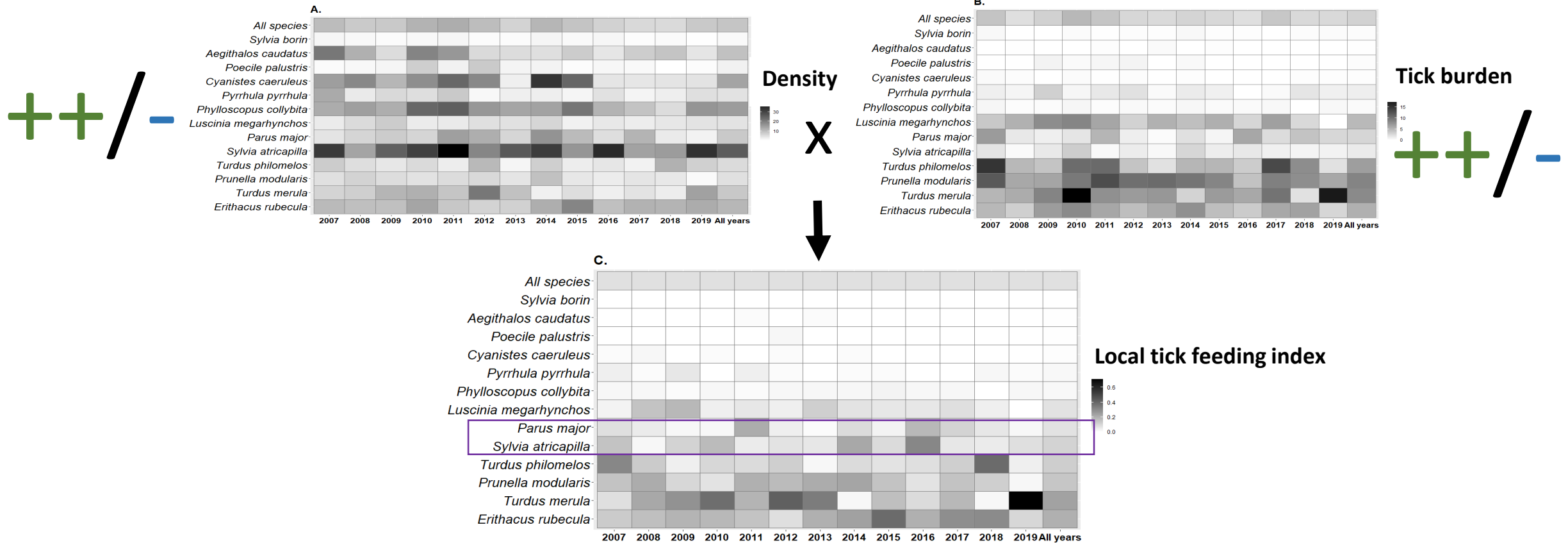
European robin Common blackbird Dunnock Song thrush

Intermediate



Great tit

Which species of the bird community participate the most to the local tick production?



Major



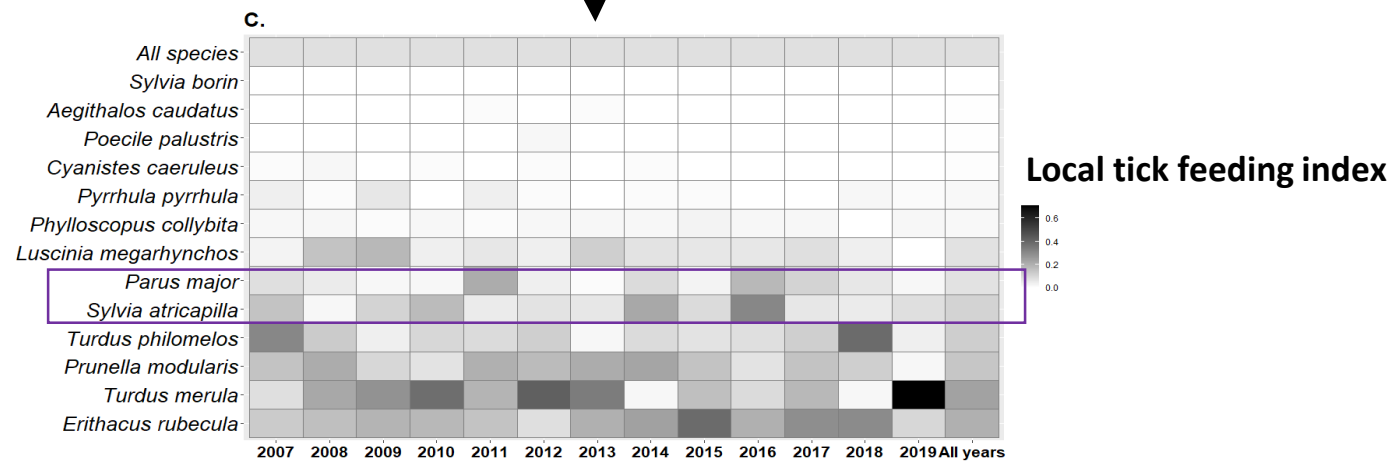
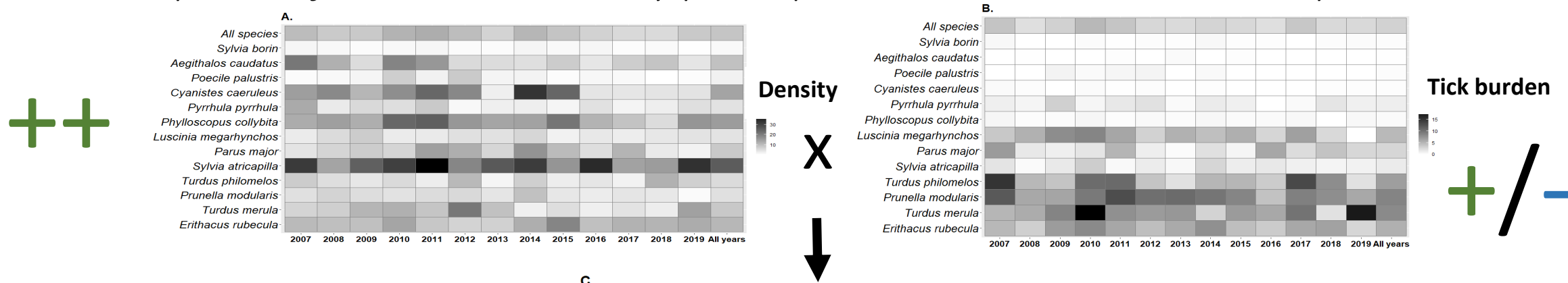
European robin Common blackbird Dunnock Song thrush

Intermediate



Great tit

Which species of the bird community participate the most to the local tick production?

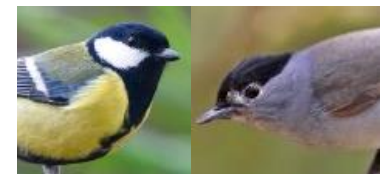


Major



European robin Common blackbird Dunnock Song thrush

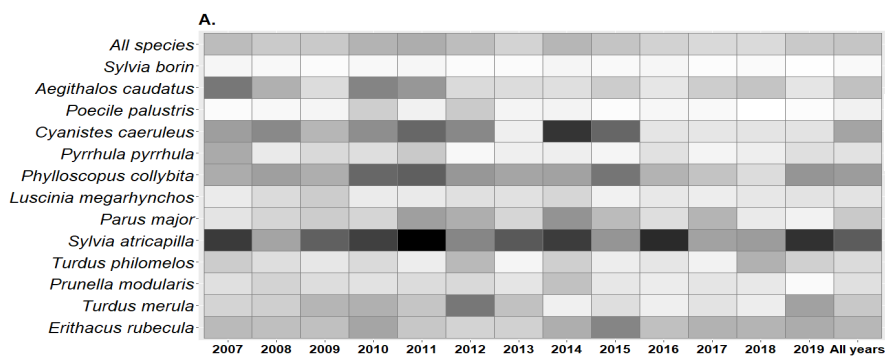
Intermediate



Great tit Eurasian blackcap

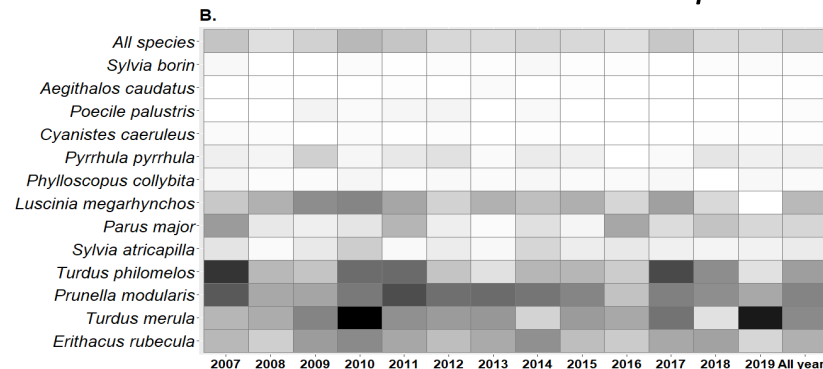
Which species of the bird community participate the most to the local tick production?

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Or
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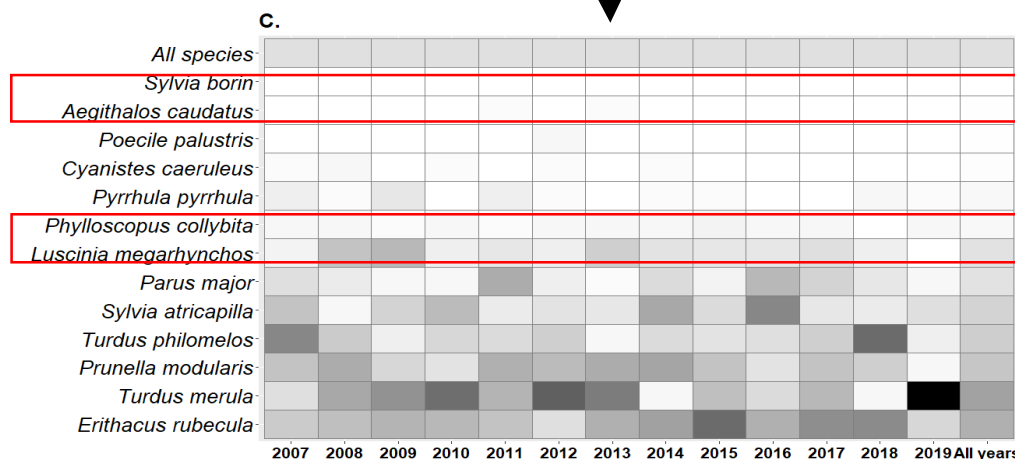
Density

X



Tick burden

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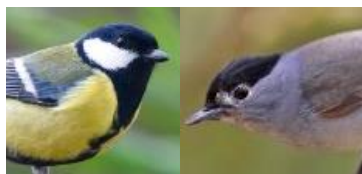
Local tick feeding index

Major



European robin Common blackbird Dunnock Song thrush

Intermediate



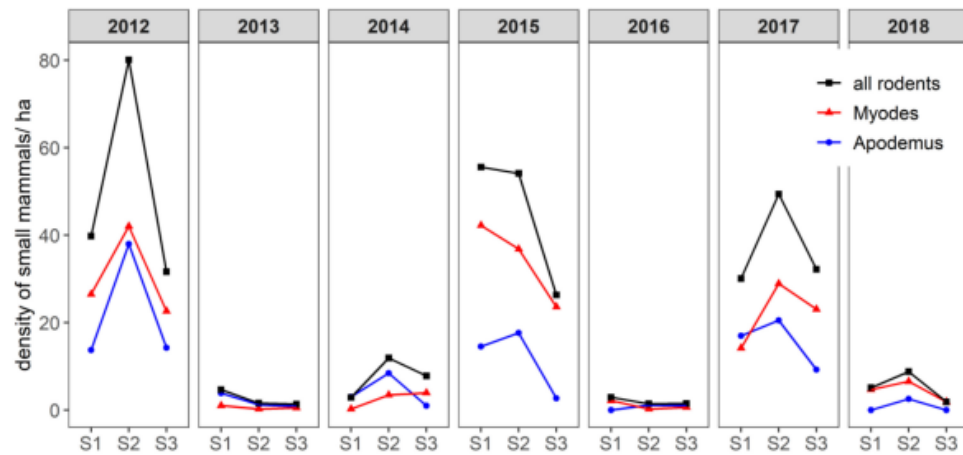
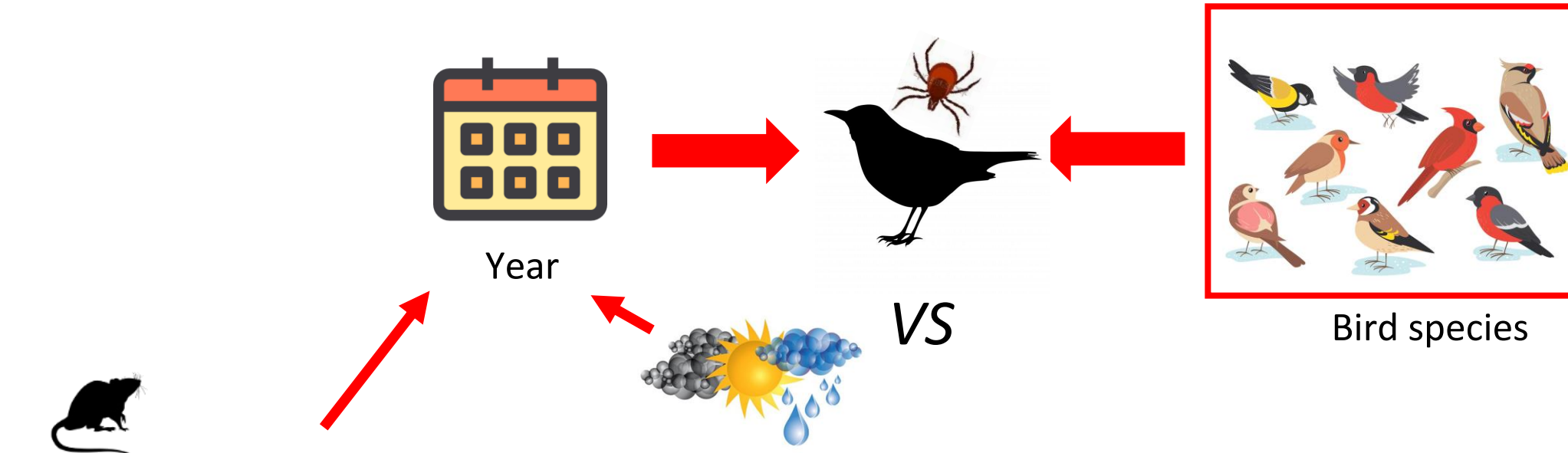
Great tit Eurasian blackcap

Negligible

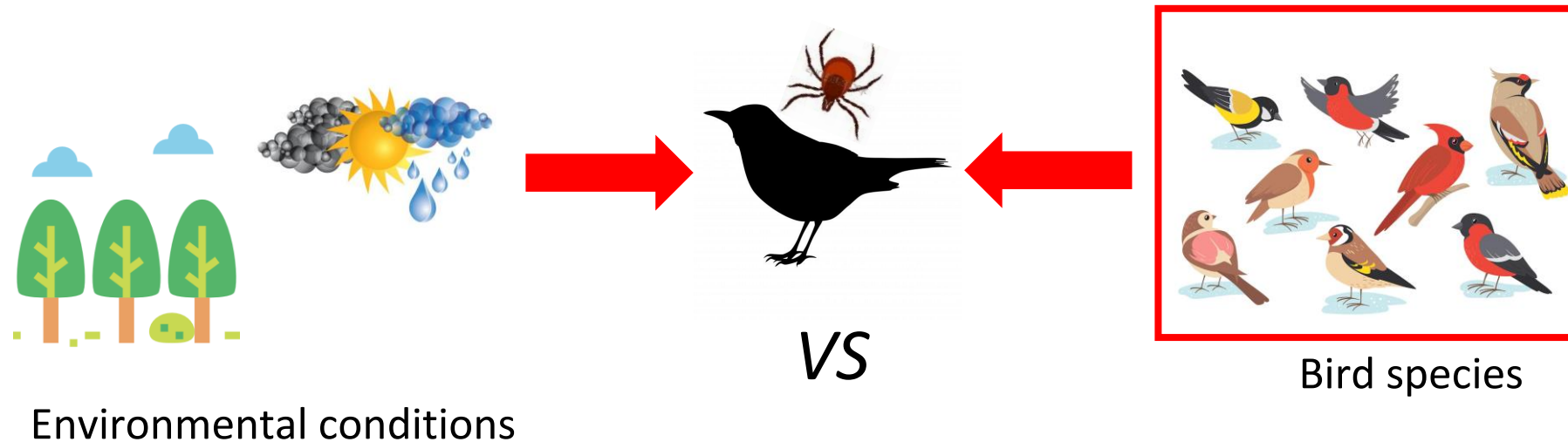


Common nightingale Common chiffchaff Long-tailed tit Garden warbler

Which factor influences the most the tick burden on a given bird: species or environmental conditions (year)?



Which factor influences the most the tick burden on a given bird: species or environmental conditions (year)?



In the studied site: tick production by birds can be more predicted by the species composition of the bird community than by the annual variation of local environmental conditions

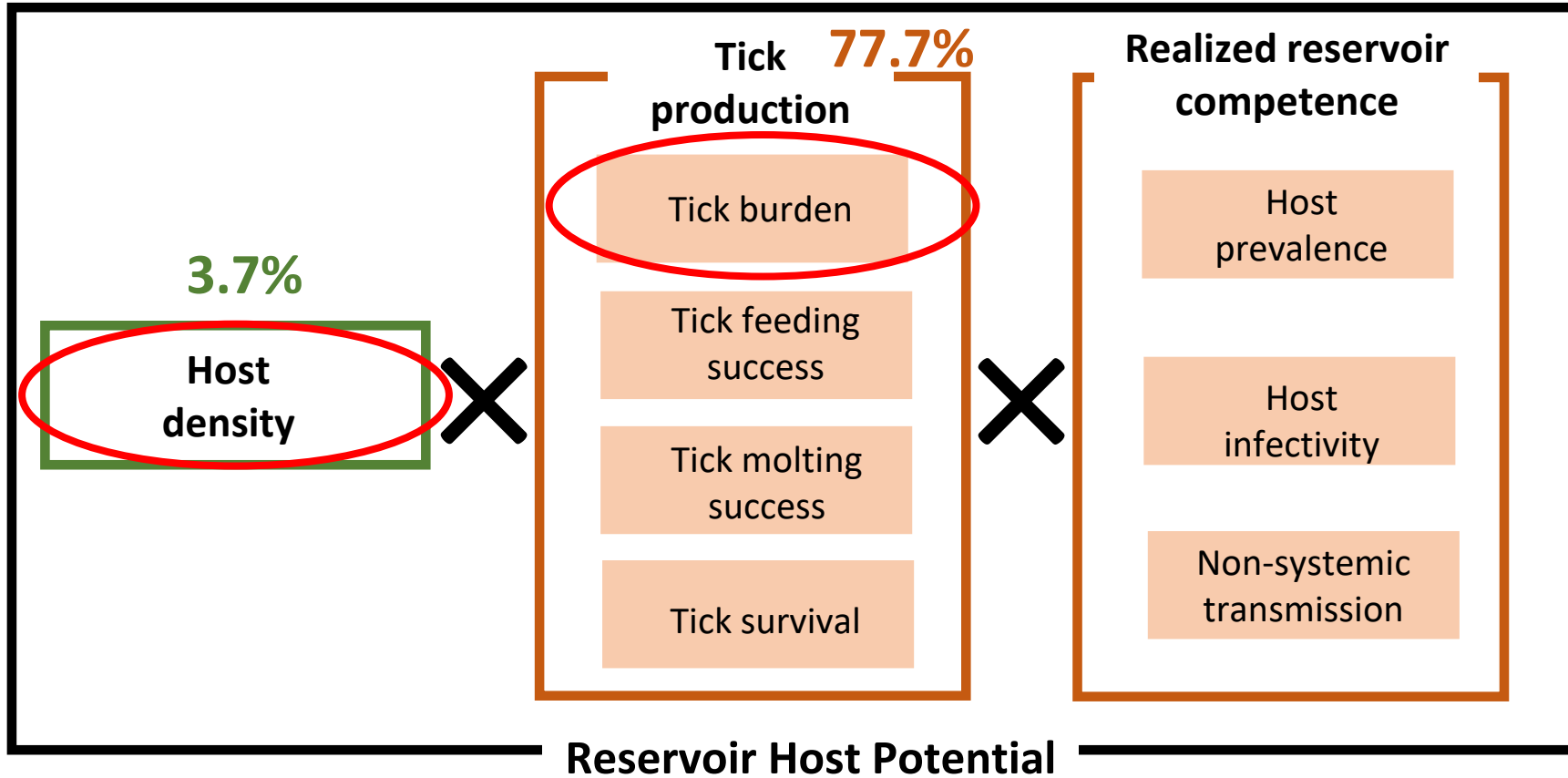
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= production of infected ticks by a host species population in a given system



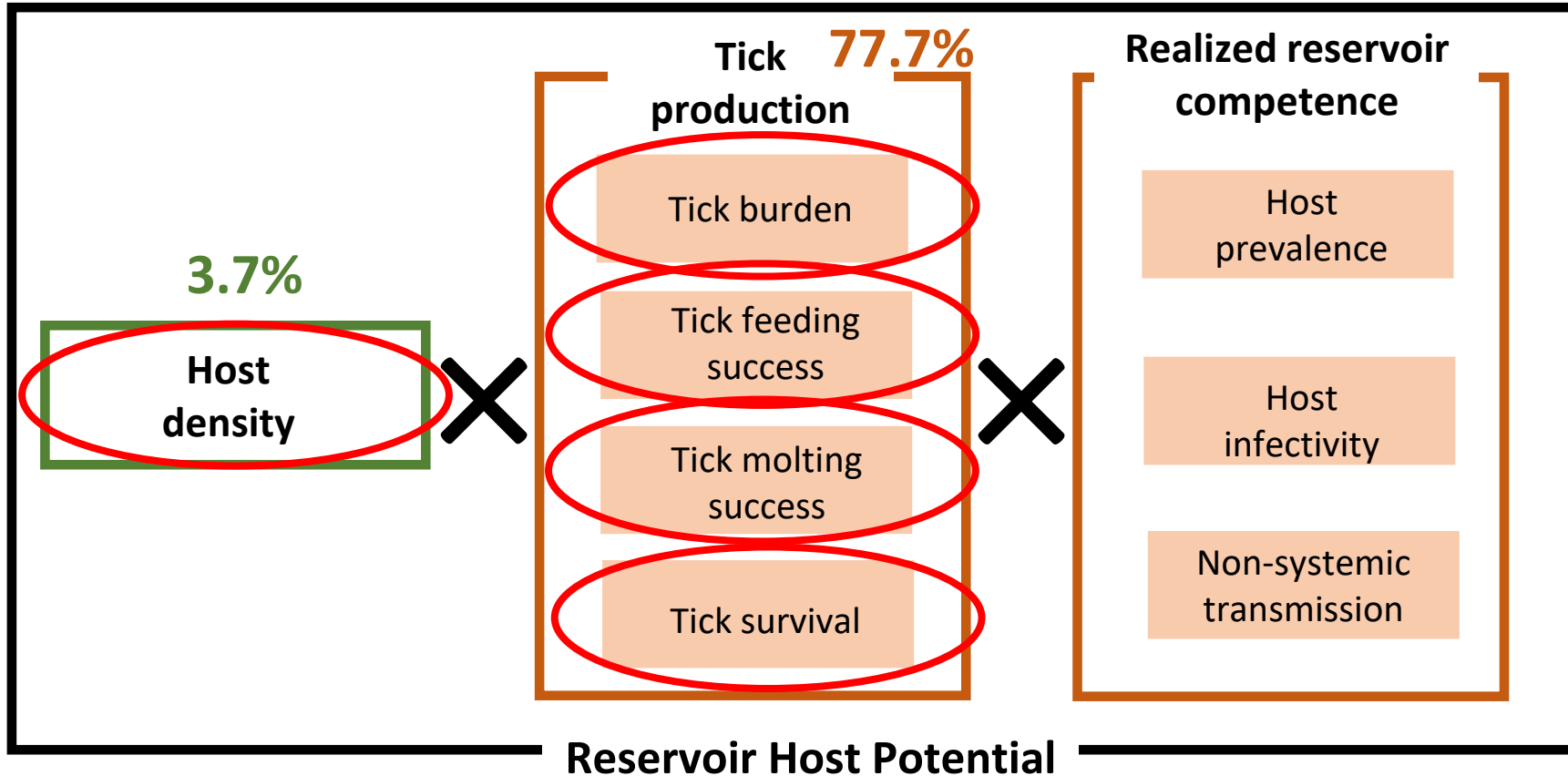
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= production of infected ticks by a host species population in a given system



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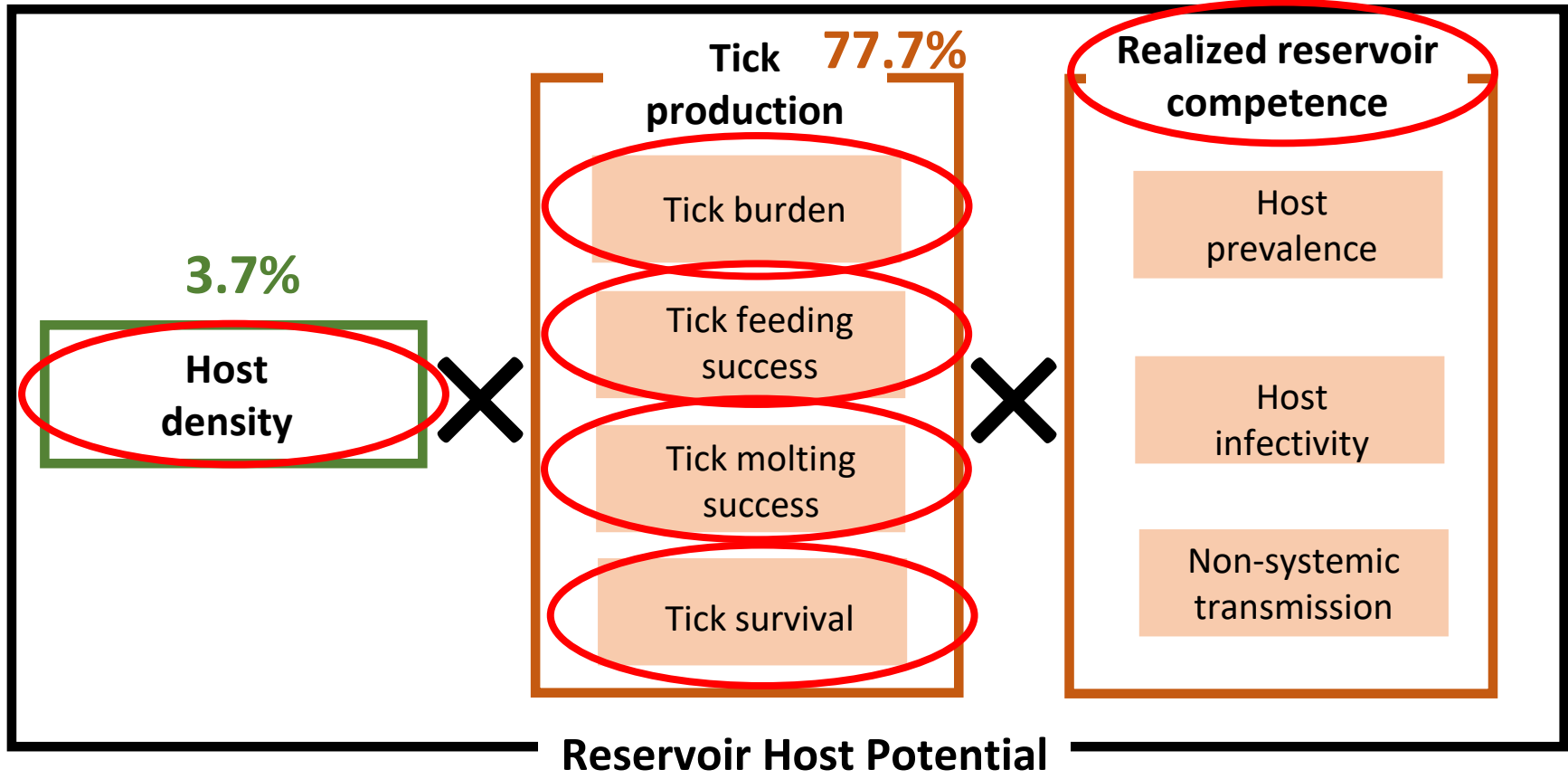


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57%

= production of infected ticks by a host species population in a given system



Thank you for your attention

Funders



anses



© Luc Berger

Contributors

Clémence Galon
Eloïse Duffrene
Karen McCoy
Olivier Plantard



INRAE



UNIVERSITÉ
— PARIS-EST

All the ringers that collected ticks
during captures



REFERENCES

Bournez, L., Umhang, G., Moinet, M., Boucher, J.M., Demerson, J.M., Caillot, C., Legras, L., Devillers, E., Hansmann, Y., Velay, A., Richomme, C., Moutailler, S., Boué, F., 2020a. Disappearance of TBEV circulation among rodents in a natural focus in Alsace, eastern France. *Pathogens* 9.

Bournez, L., Umhang, G., Moinet, M., Richomme, C., Demerson, J.M., Caillot, C., Devillers, E., Boucher, J.M., Hansmann, Y., Boué, F., Moutailler, S., 2020b. Tick-Borne Encephalitis Virus: seasonal and annual variation of epidemiological parameters related to nymph-to-larva transmission and exposure of small mammals. *Pathogens* 9

Marsot, M., Henry, P.Y., Vourc'h, G., Gasqui, P., Ferquel, E., Laignel, J., Grysan, M., Chapuis, J.L., 2012. Which forest bird species are the main hosts of the tick, *Ixodes ricinus*, the vector of *Borrelia burgdorferi* sensu lato, during the breeding season? *International journal for parasitology* 42, 781-788.

How the tick burden of birds varies according to specific characteristics ?



Tick counting

└─→ Prevalence of infestation
Tick abundance

~



Mean species
body weight

+



Mean species foraging
height

How the tick burden of birds varies according to specific characteristics ?

- Species mean foraging height:



>



- Species mean body weight:



>

