



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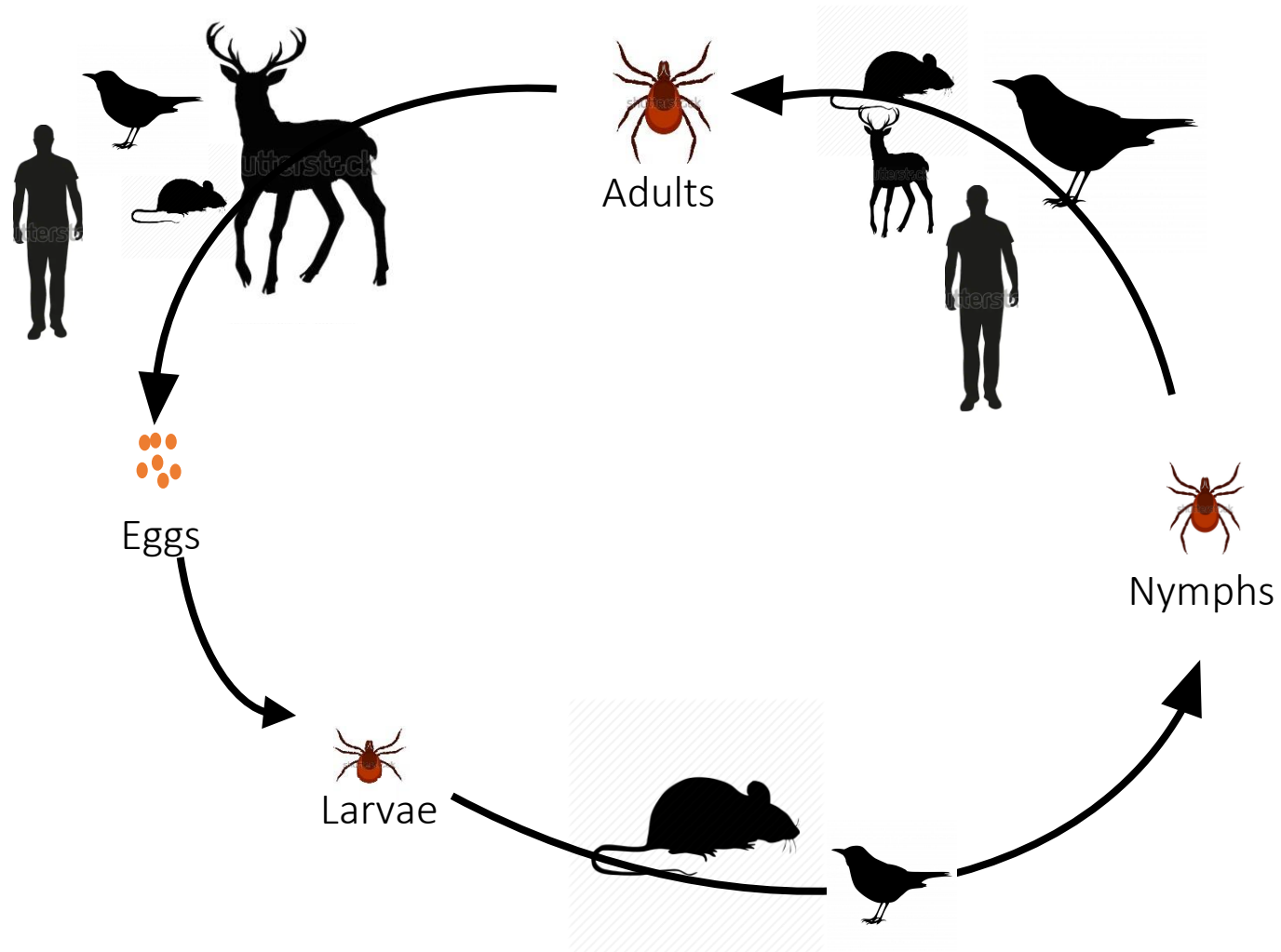
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Bird species influence more the tick burden of French common birds than environmental conditions during the breeding season

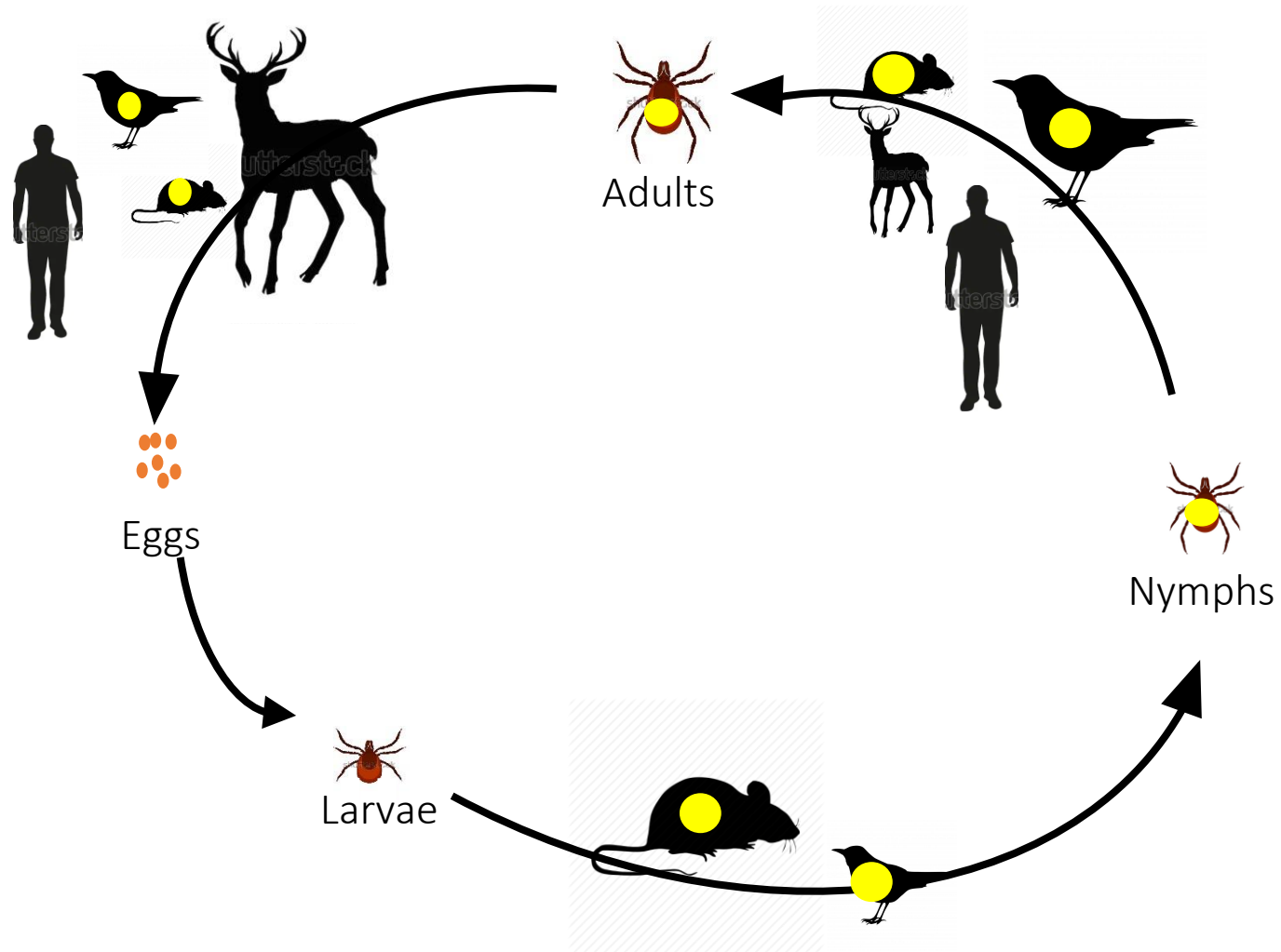


Does the tick burden of birds vary more with bird species or environmental conditions ?

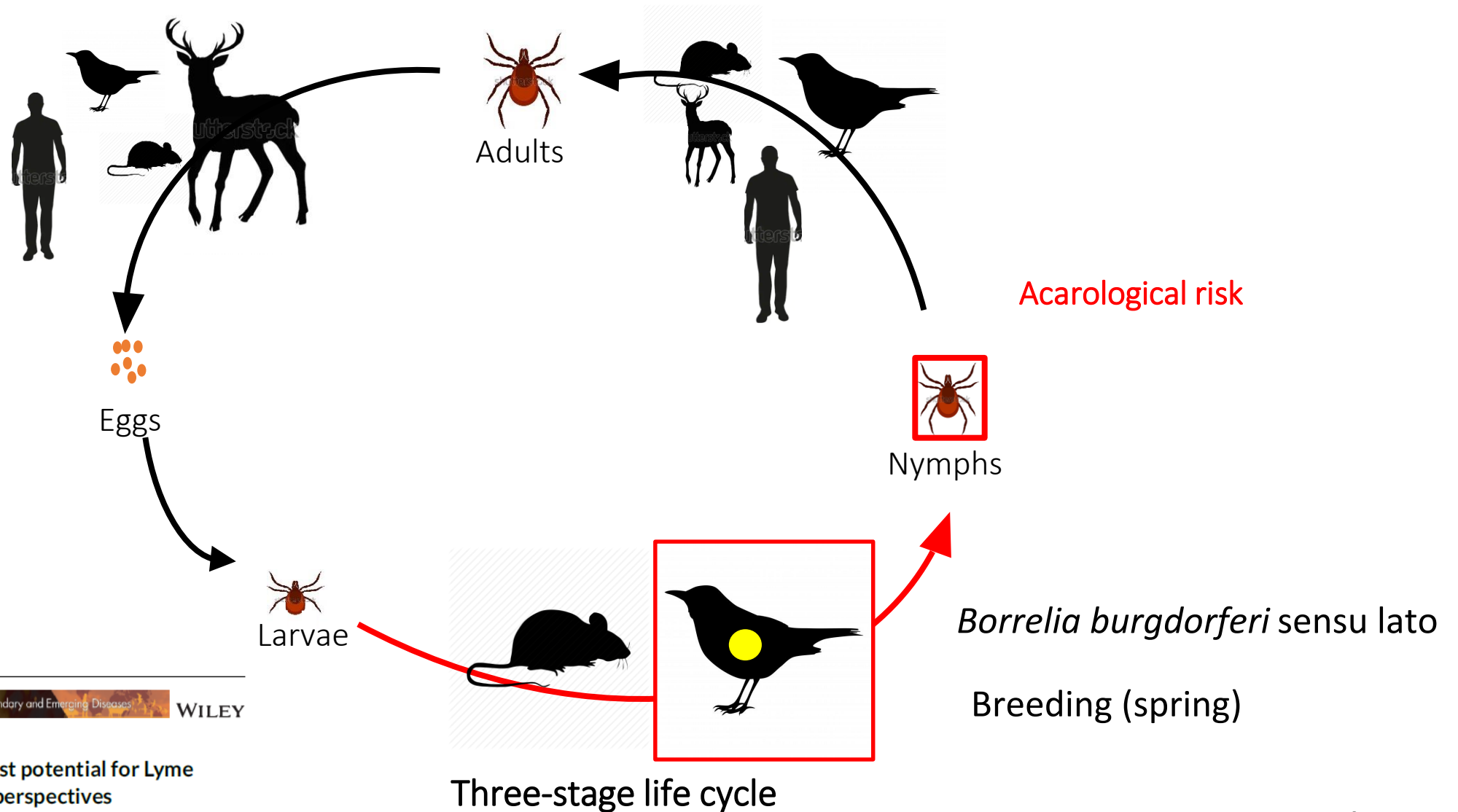
Amalia Rataud & Alex Drouin, Benoit Pisanu, Sara Moutailler, Laure Bournez,
Pierre-Yves Henry & Maud Marsot



Three-stage life cycle



Three-stage life cycle



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

Acarological risk

Reservoir Host Potential

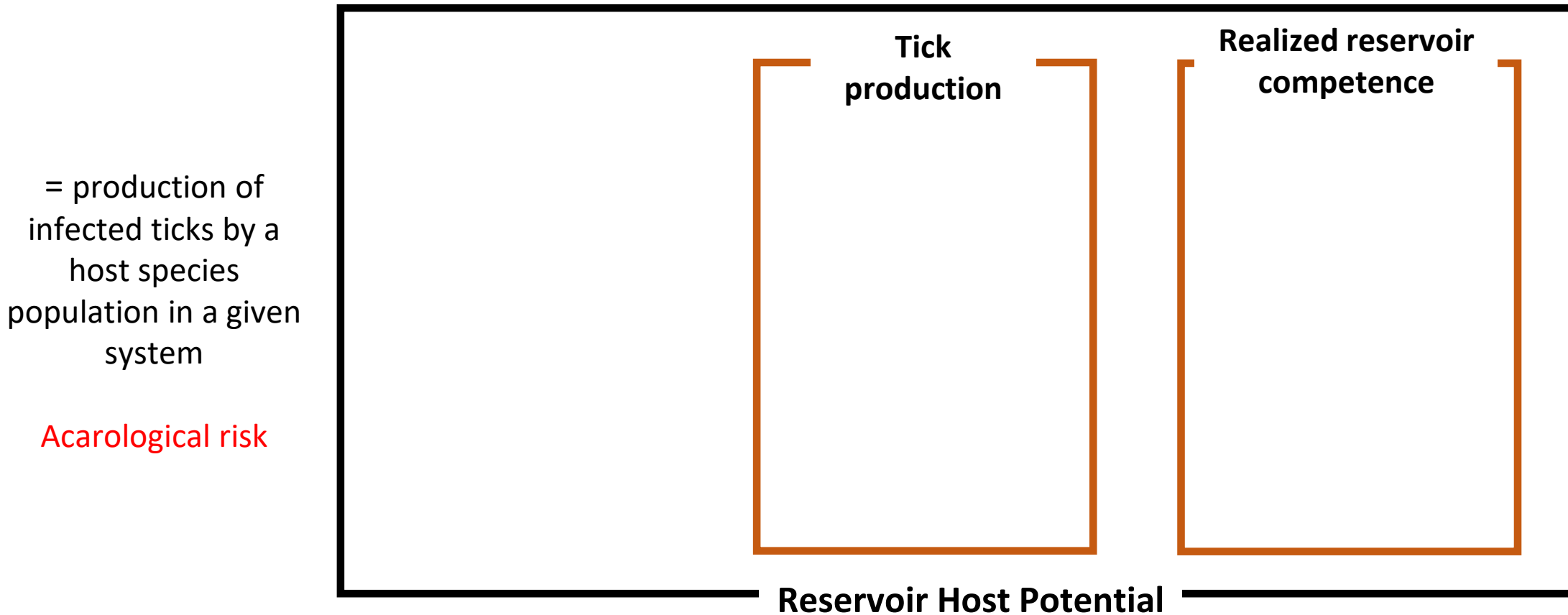
The diagram consists of a large black rectangular frame. Inside this frame, centered, is a smaller orange rectangular frame. The text 'Tick production' is located at the top center of the orange frame. The text 'Reservoir Host Potential' is located at the bottom center of the black frame, below the orange frame.

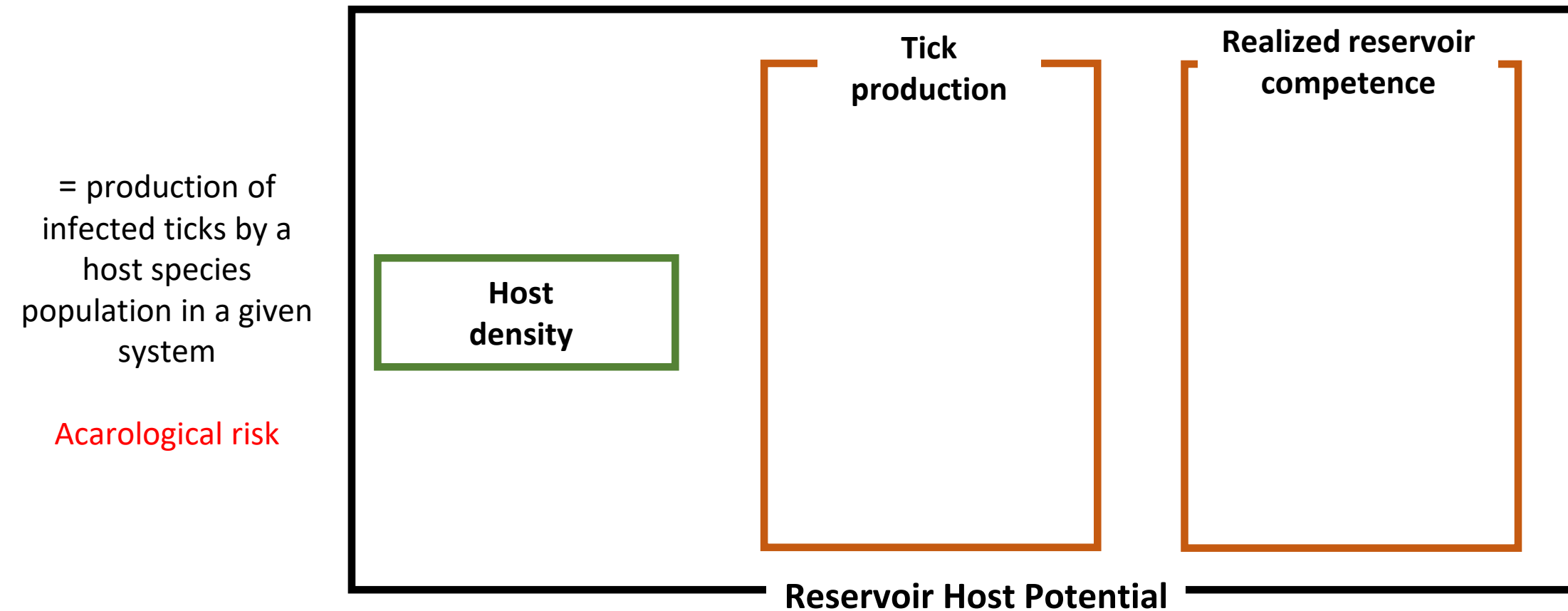
Tick
production

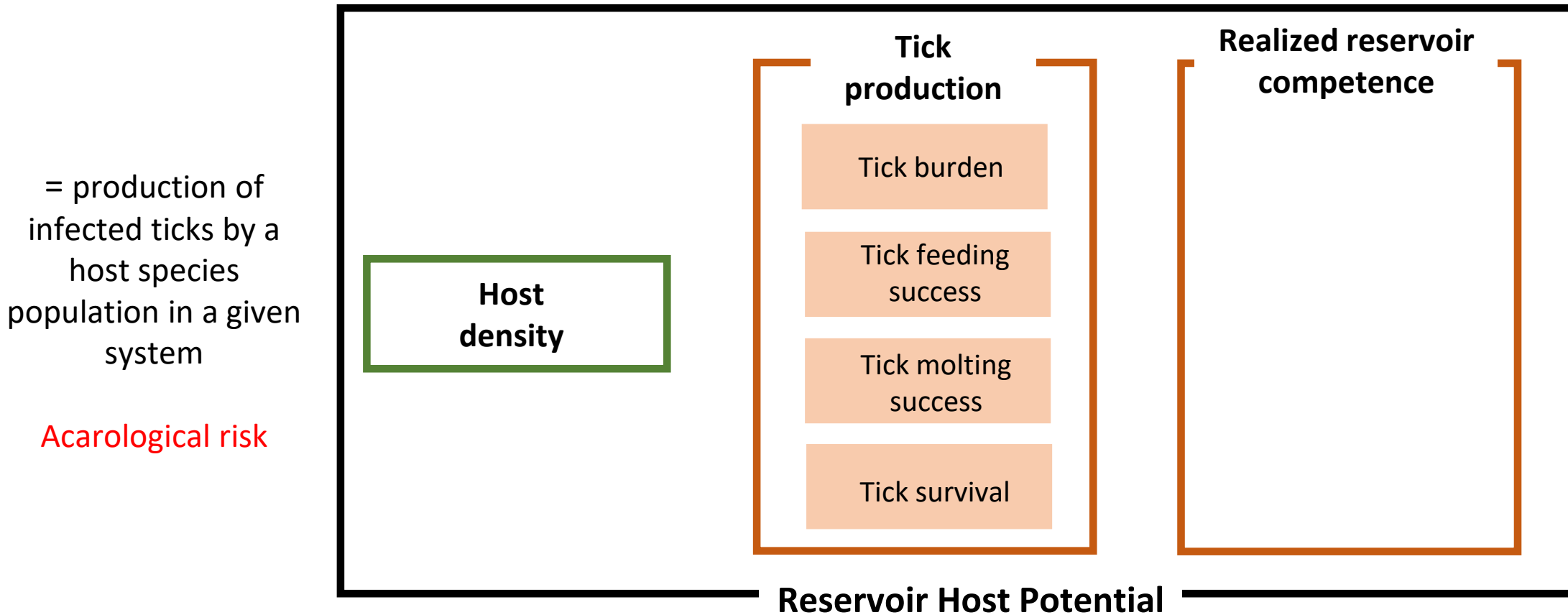
= production of
infected ticks by a
host species
population in a given
system

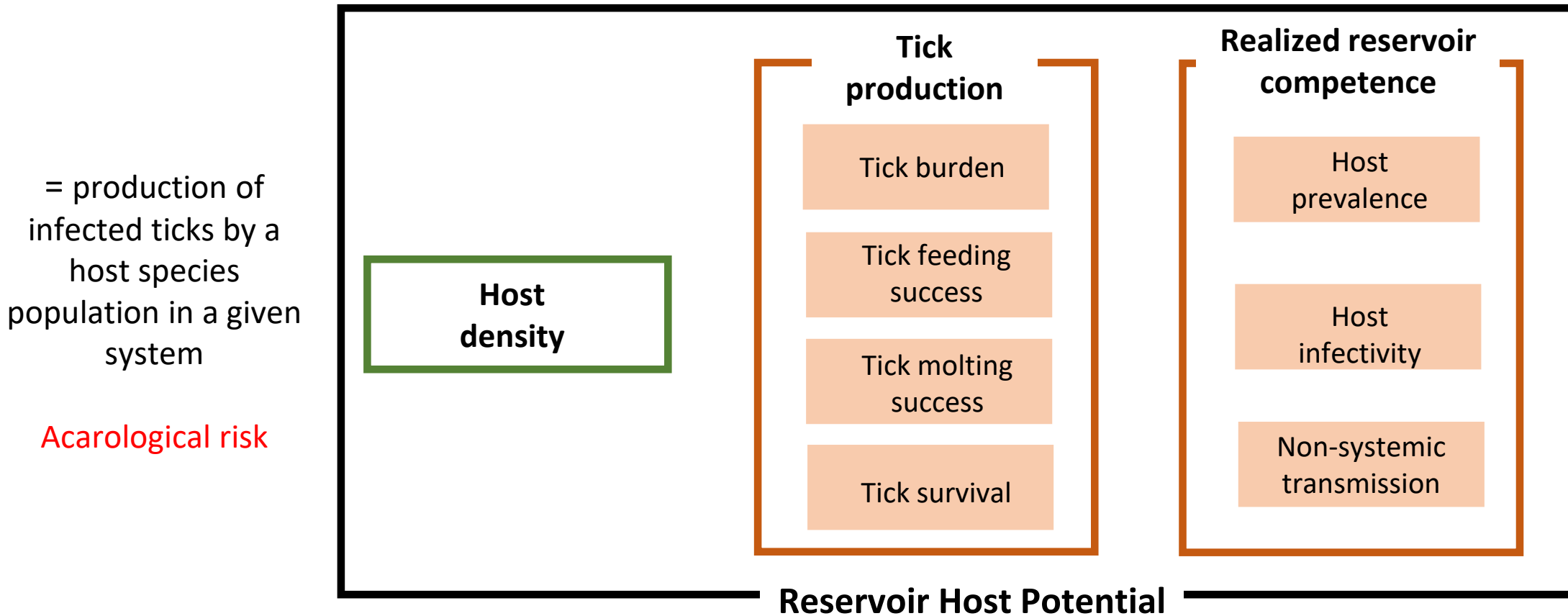
Acarological risk

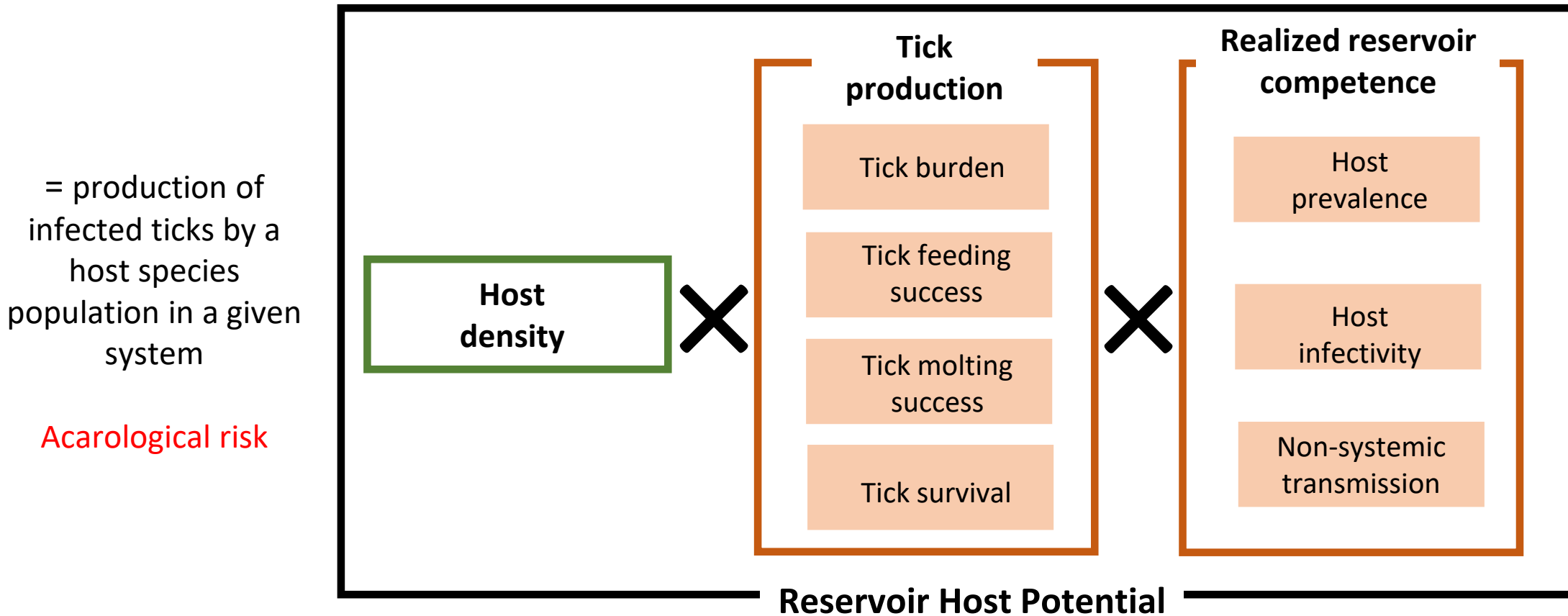
Reservoir Host Potential











Host intrinsic factors

(species, individual or specific characteristics)

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

Acarological risk

Host density

**Tick production**

Tick burden

Tick feeding success

Tick molting success

Tick survival

Realized reservoir competence

Host prevalence

Host infectivity

Non-systemic transmission



Reservoir Host Potential

Host extrinsic factors

(habitat, weather conditions,
tick biology)

Host intrinsic factors

(species, individual or specific
characteristics)

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

**Host
density**

**Tick
production**

Tick burden

Tick feeding
success

Tick molting
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Tick survival

**Realized reservoir
competence**

Host
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Reservoir Host Potential

Acarological risk

Host extrinsic factors

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**Tick
production**

Tick burden

Tick feeding
successTick molting
success

Tick survival

**Realized reservoir
competence**Host
prevalenceHost
infectivityNon-systemic
transmission**Host
density****Reservoir Host Potential**

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

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

Year :



Bird species :

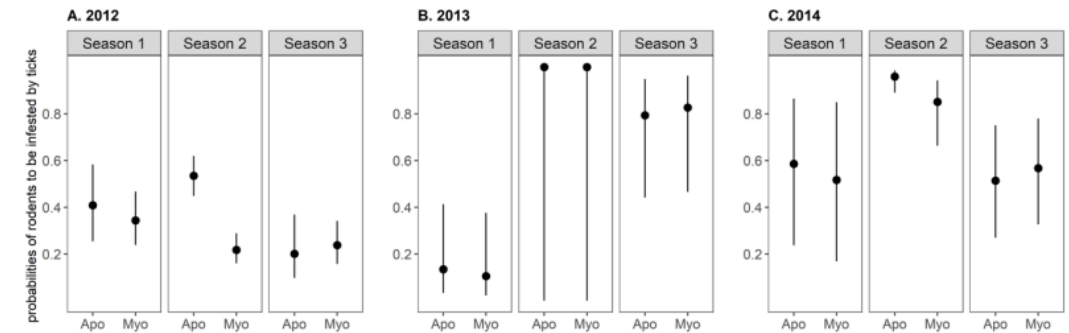


- Which factor influences the most the tick burden on a given bird: bird species or environmental conditions (year)?

Year :



Bird species :



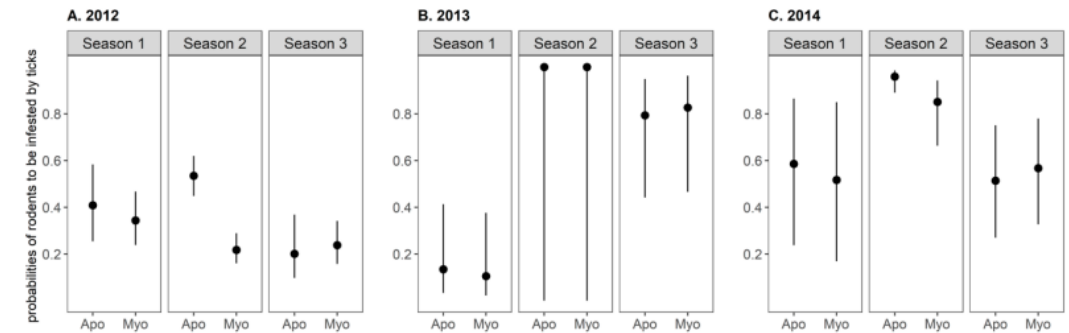
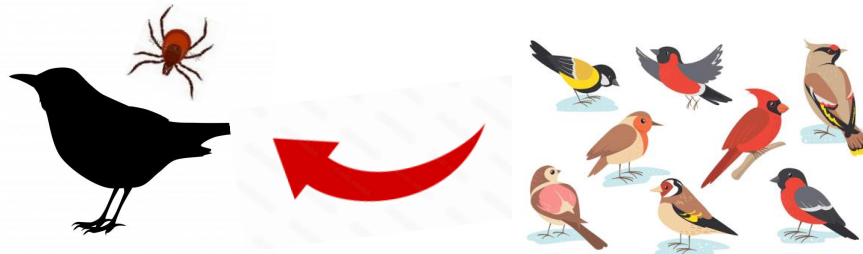
Bournez et al., 2020

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

Year :



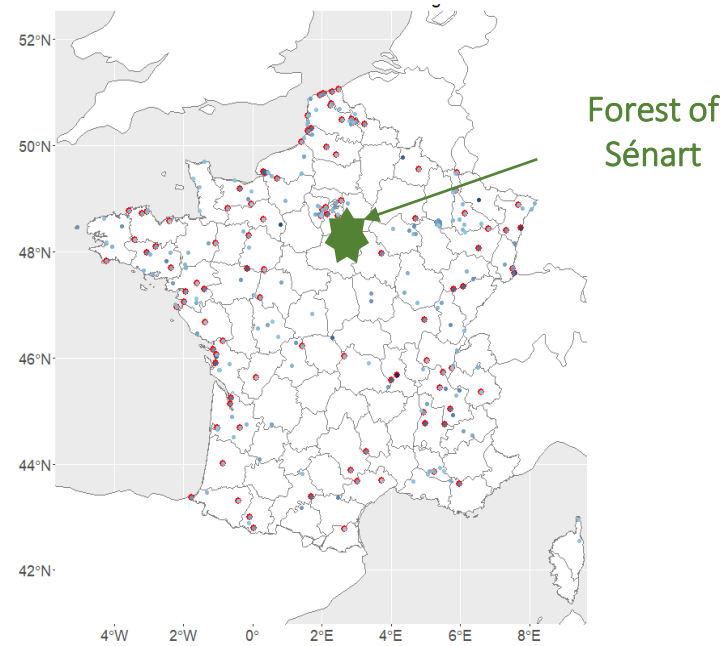
Bird species :



Bournez et al., 2020

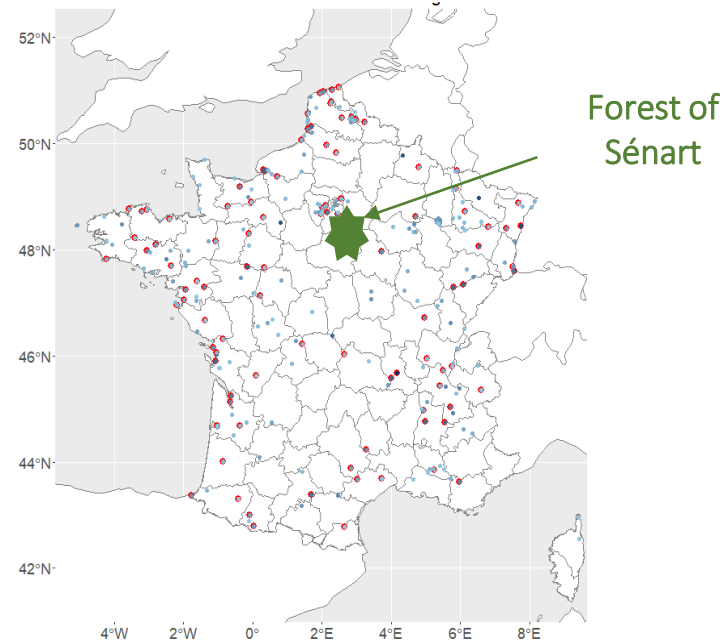
- Which species of the bird community participate the most to the local tick production ?

STOC-Capture



2007-2019
April-July

STOC-Capture



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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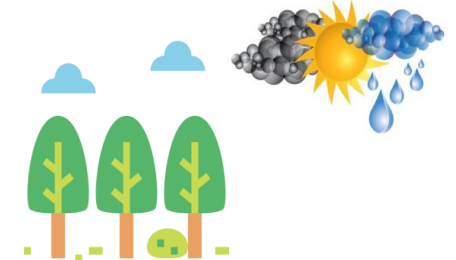
Sex, age

+



Bird species

+



Environmental conditions
(Year)

└──────────┘

Variance

└──────────┘
Prevalence of infestation
Tick abundance
(ZINB)

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

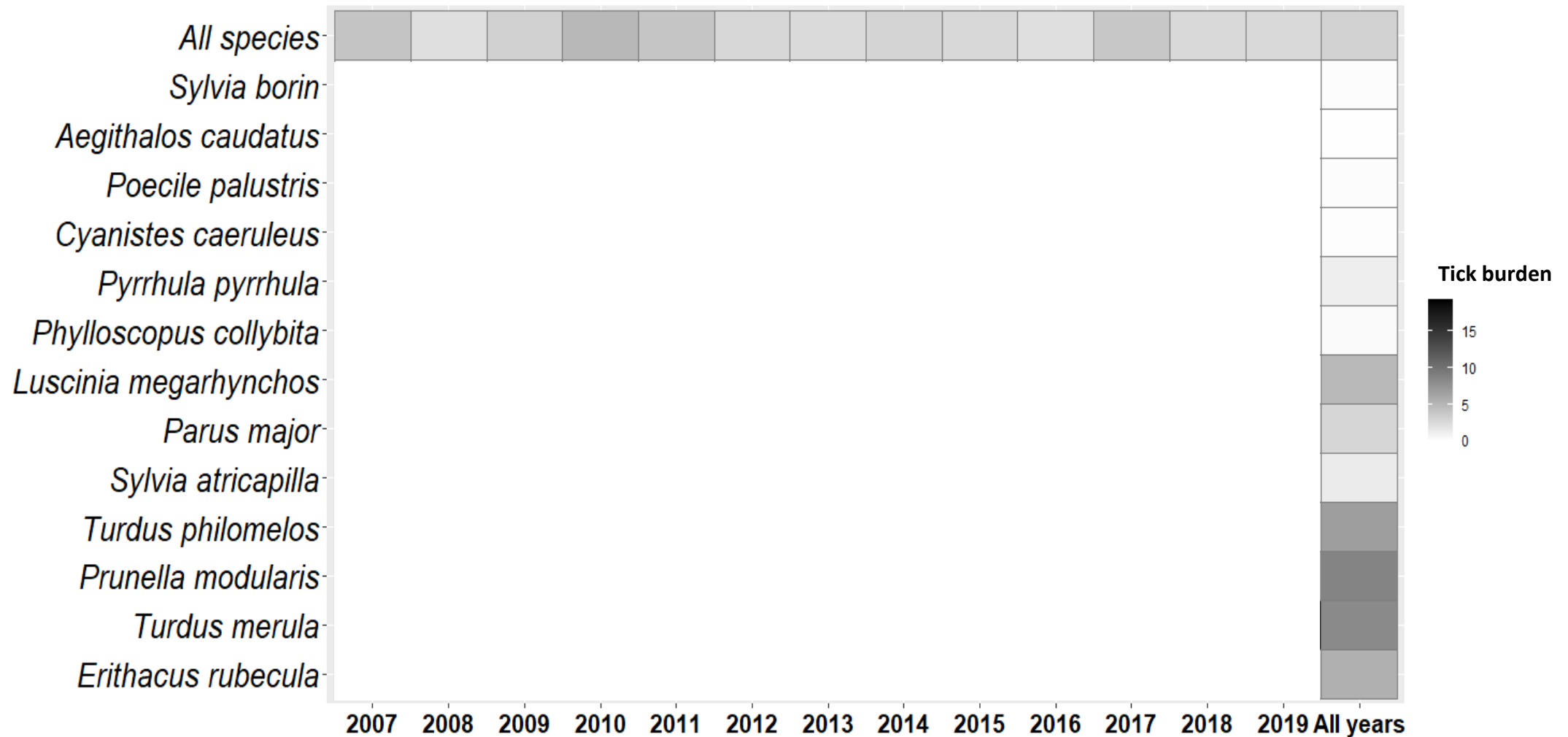


Marsh tit

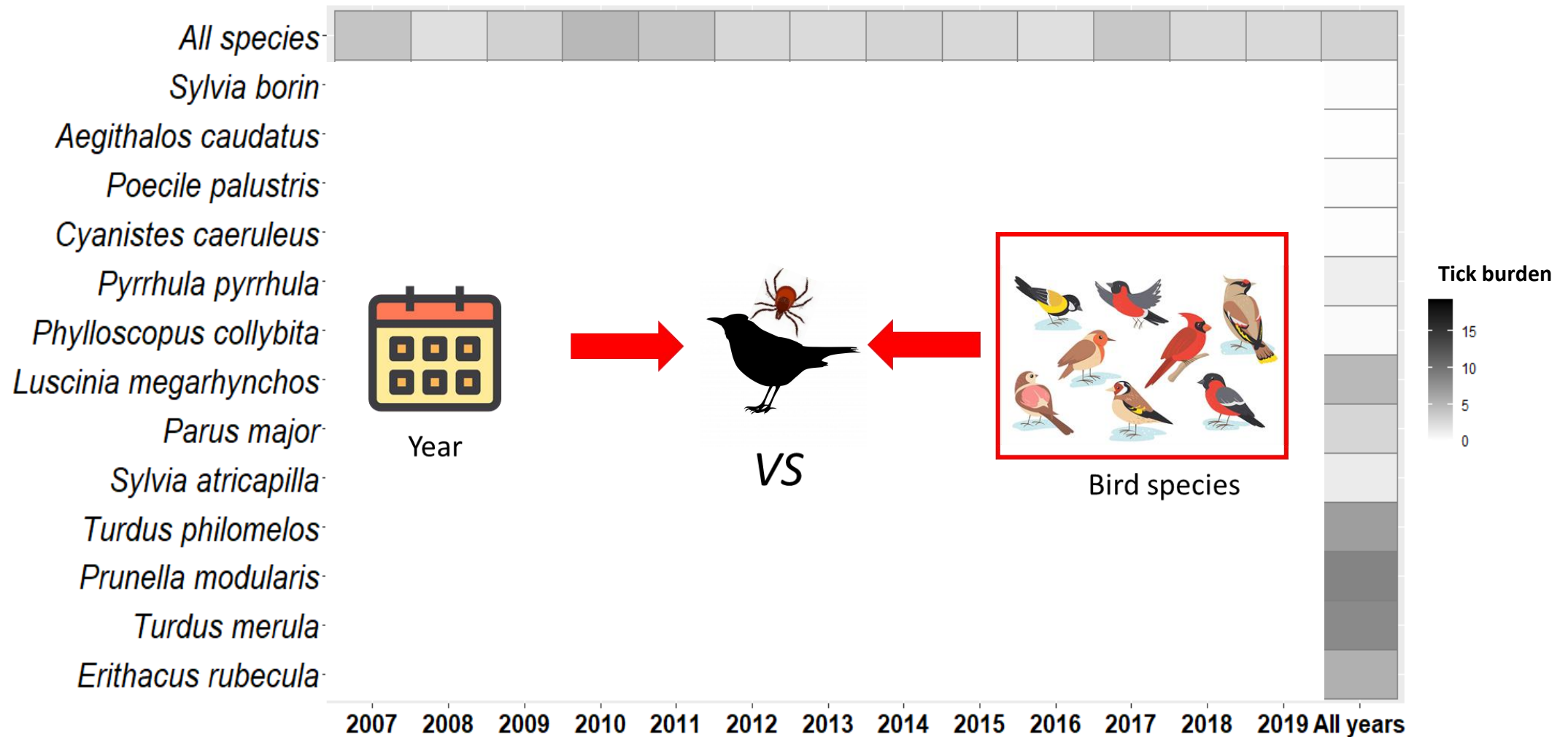
Common
chiffchaffCommon
nightingaleEuropean
robin

- 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

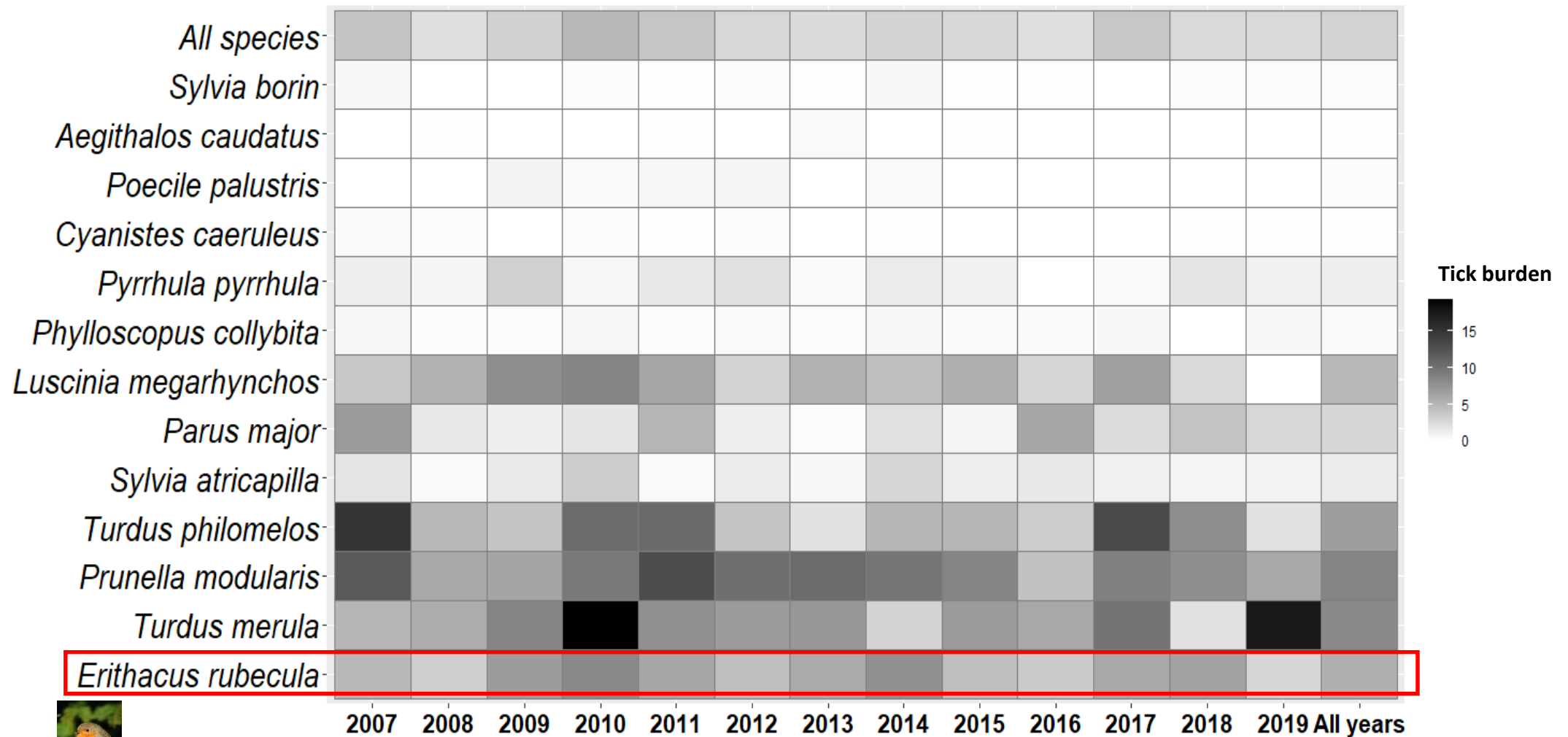


The tick burden of birds is more influenced by the bird species than by the year

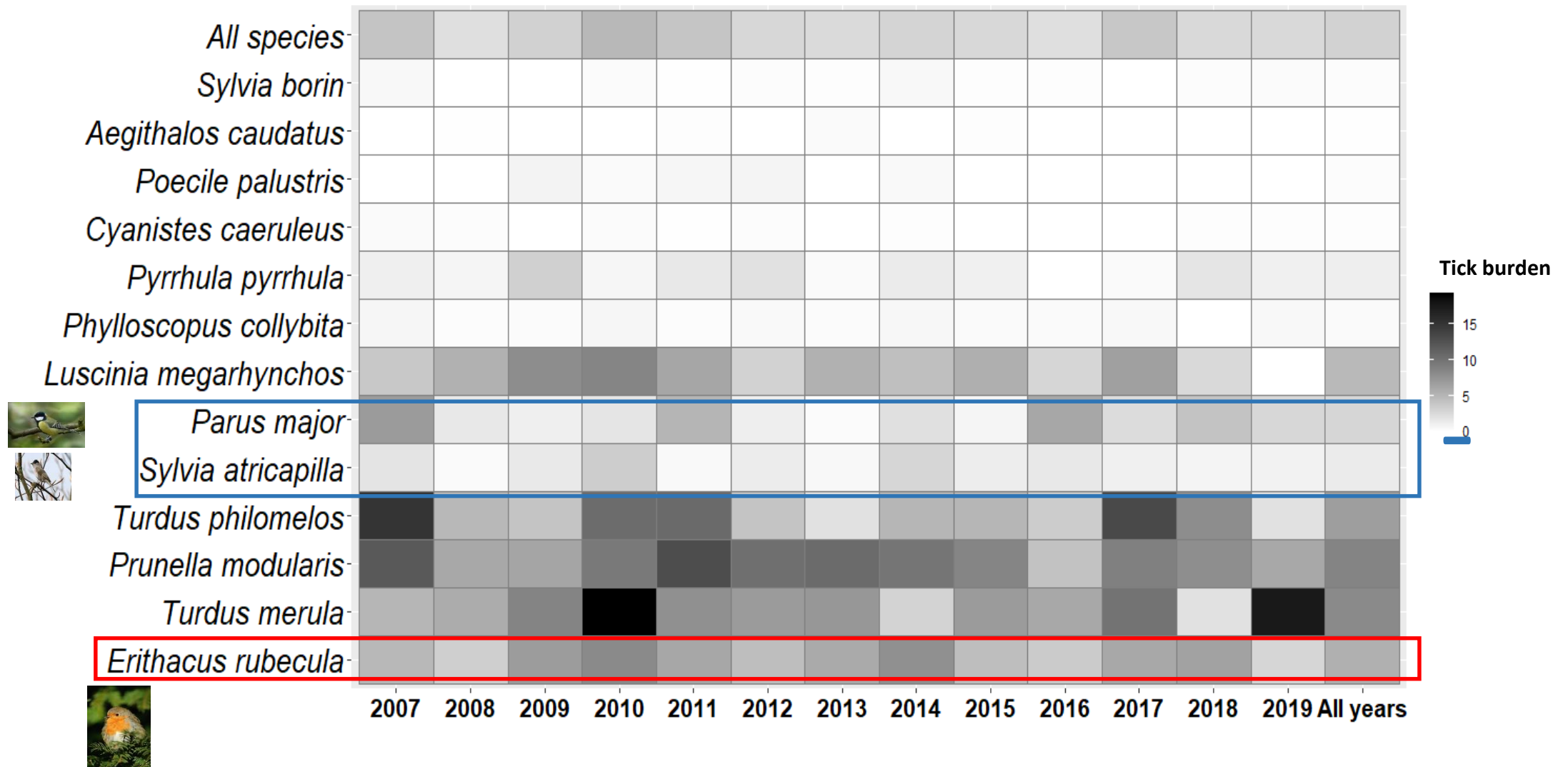
Variance of year = 0.05

Variance of species = 1.89

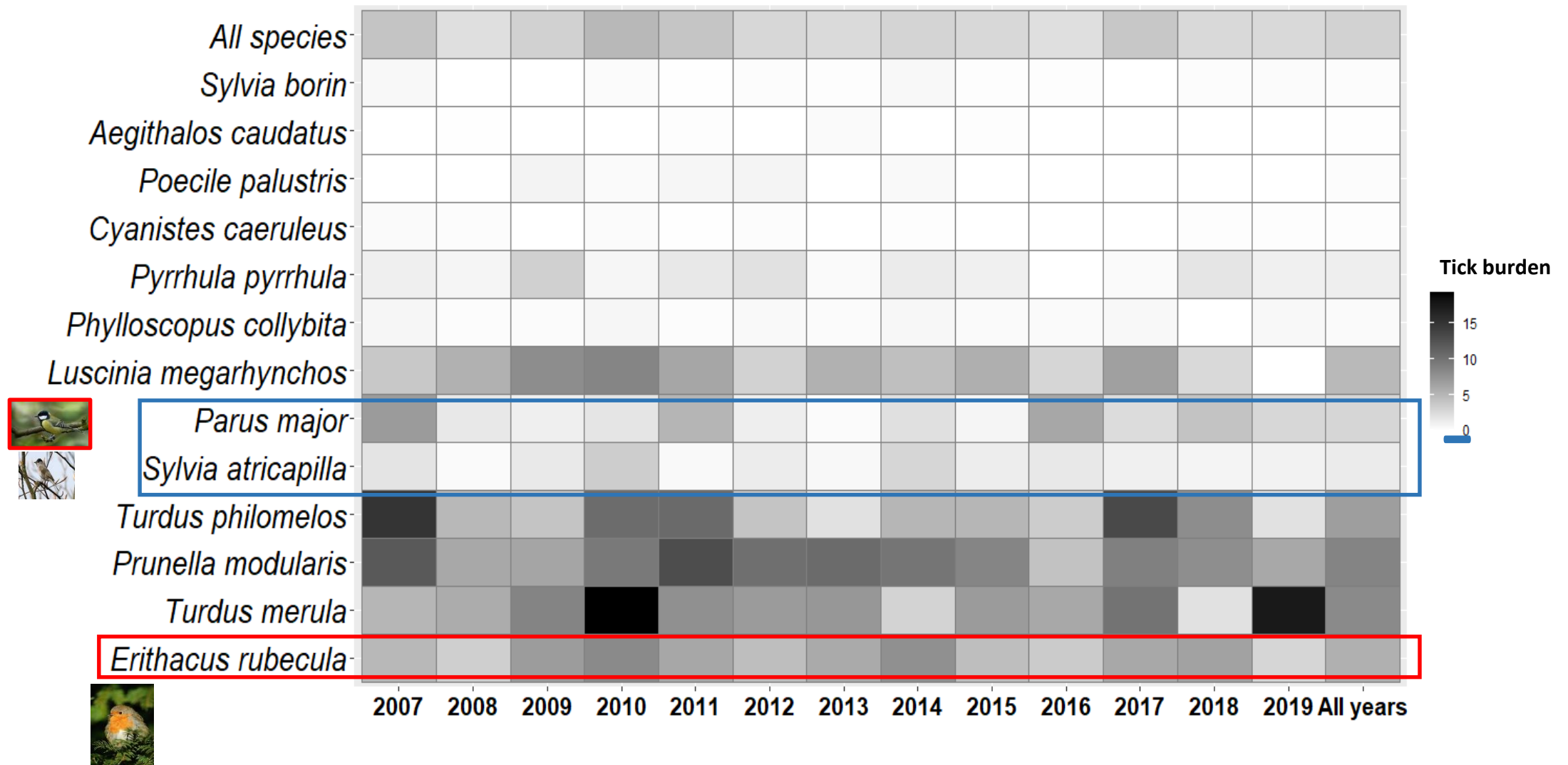
Interannual and interspecific variabilities of the observed tick burden of birds



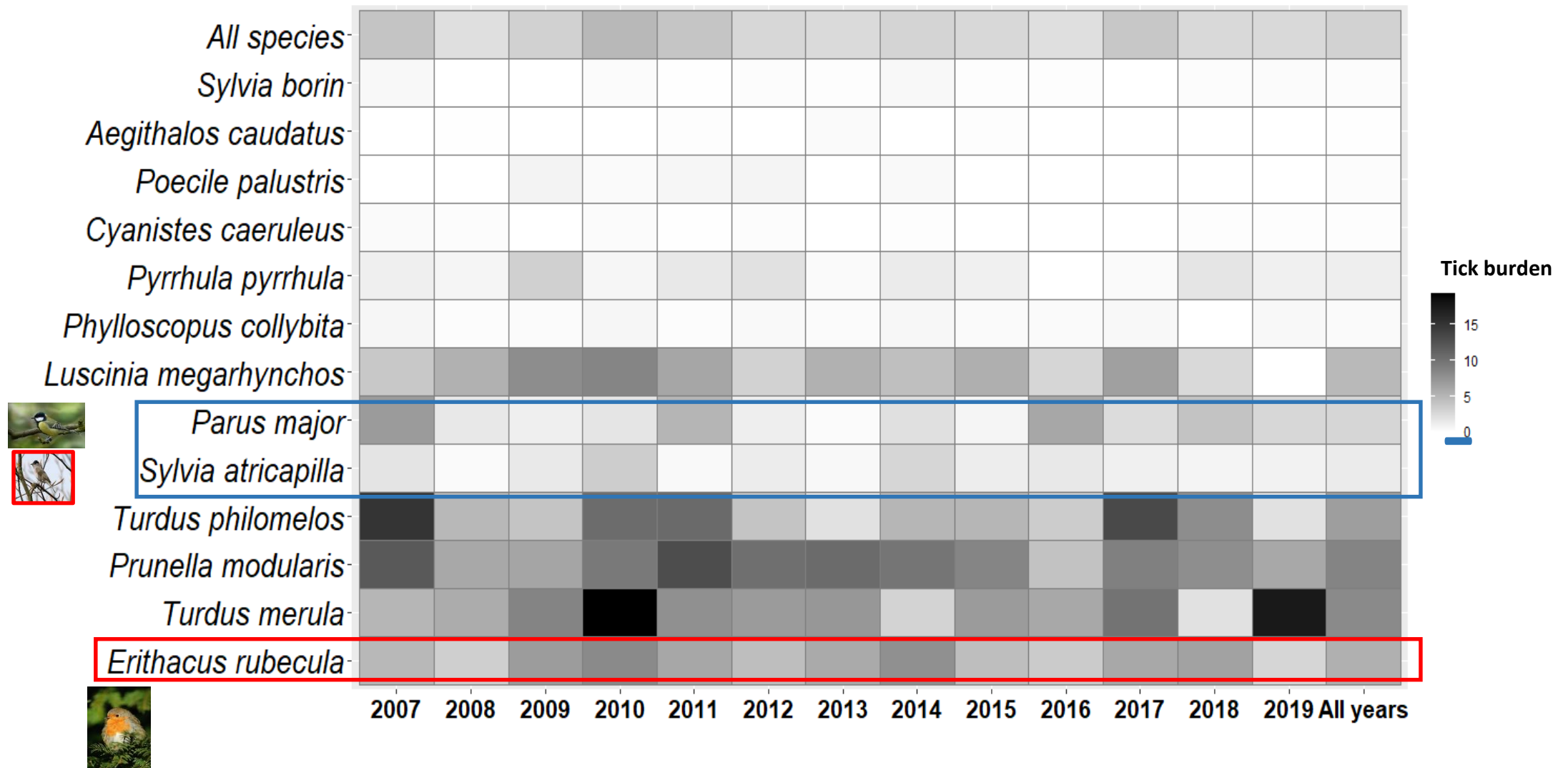
Interannual and interspecific variabilities of the observed tick burden of birds



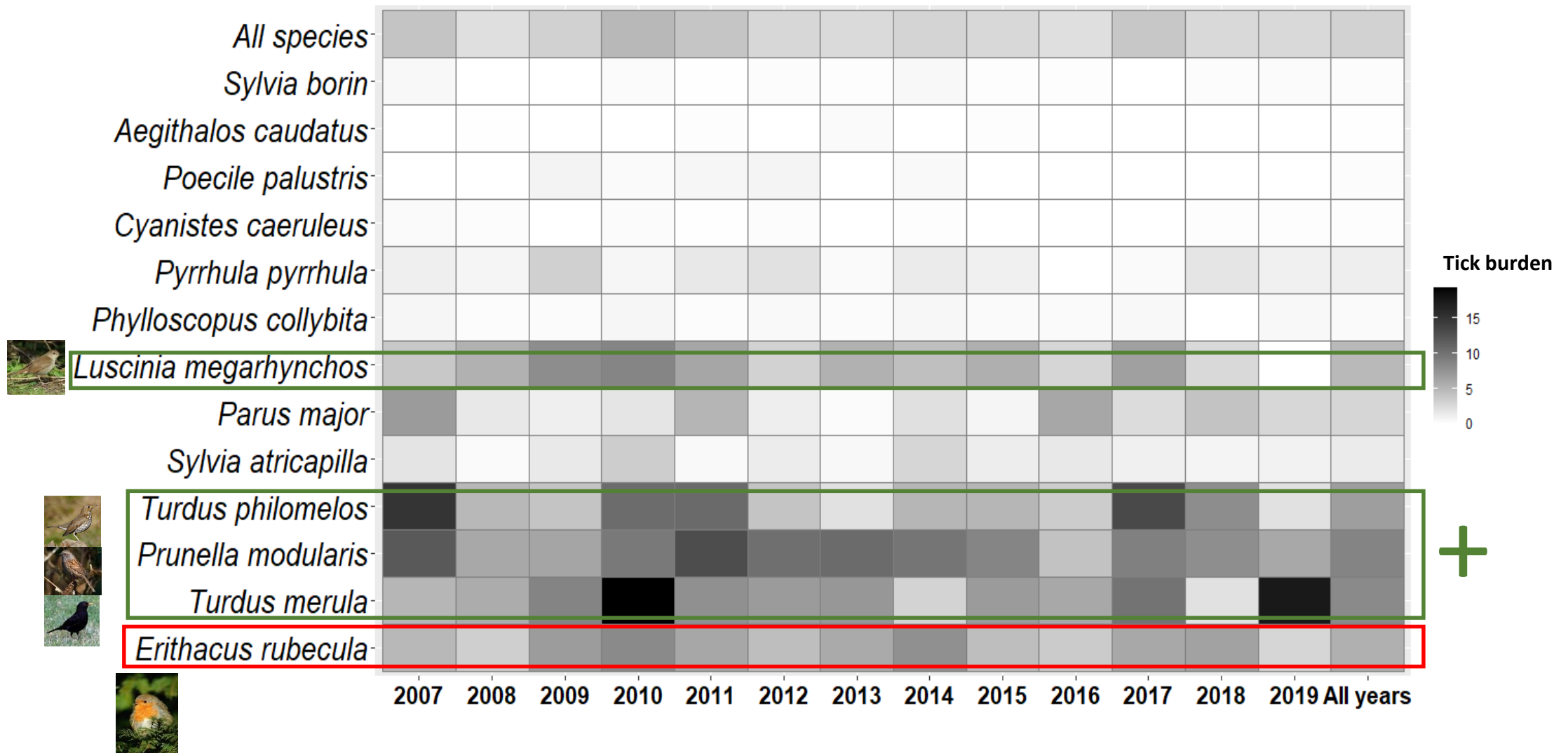
Interannual and interspecific variabilities of the observed tick burden of birds



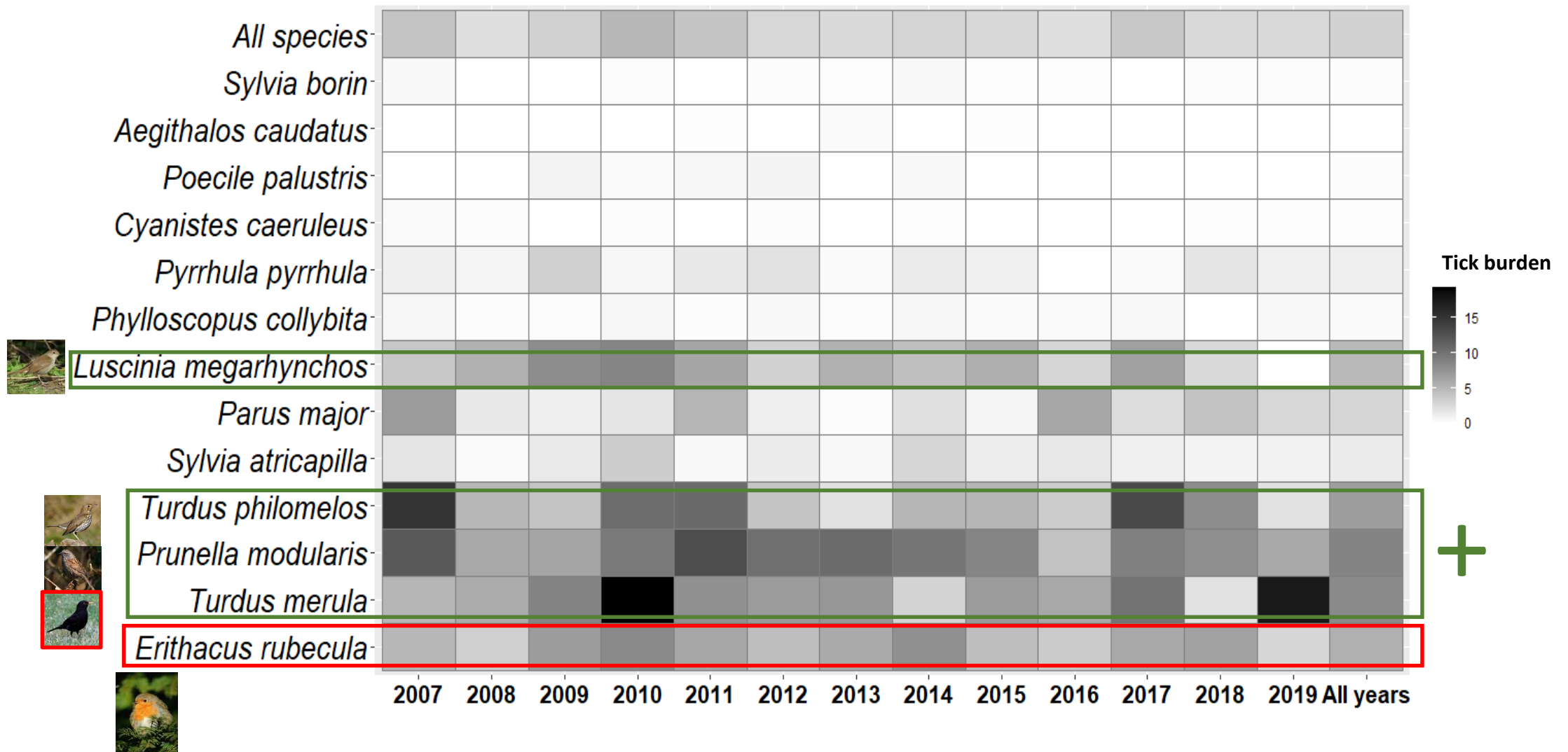
Interannual and interspecific variabilities of the observed tick burden of birds



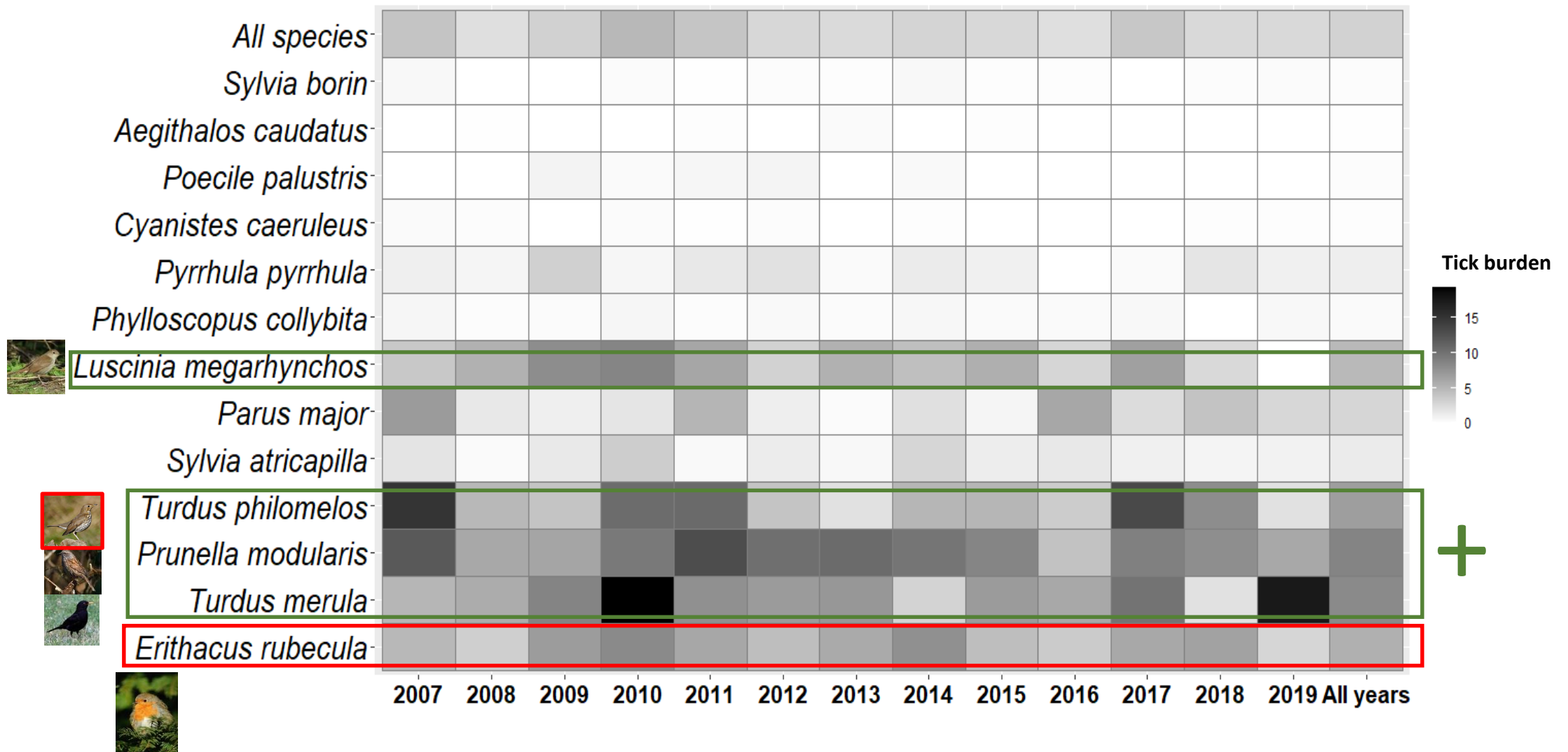
Interannual and interspecific variabilities of the observed tick burden of birds



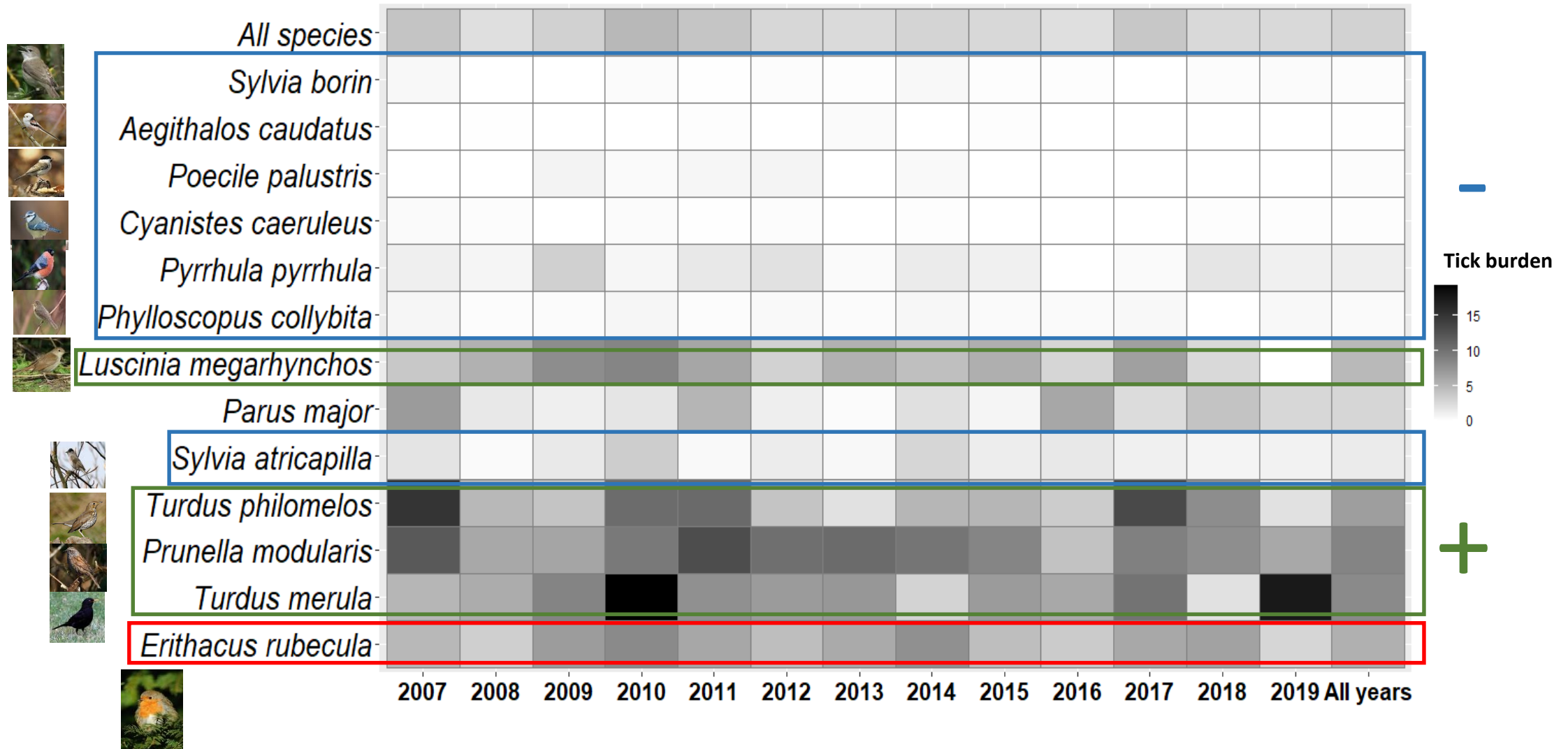
Interannual and interspecific variabilities of the observed tick burden of birds



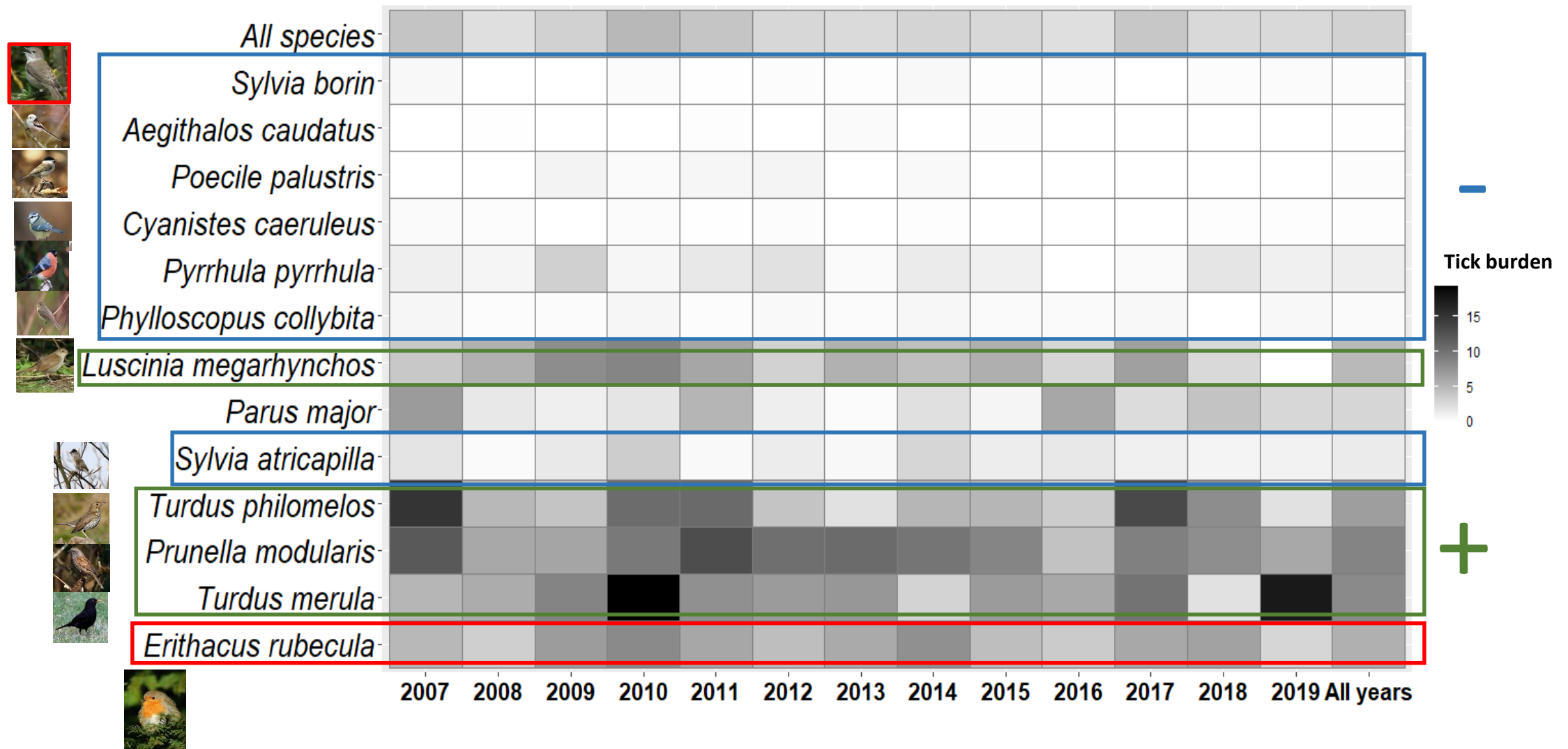
Interannual and interspecific variabilities of the observed tick burden of birds



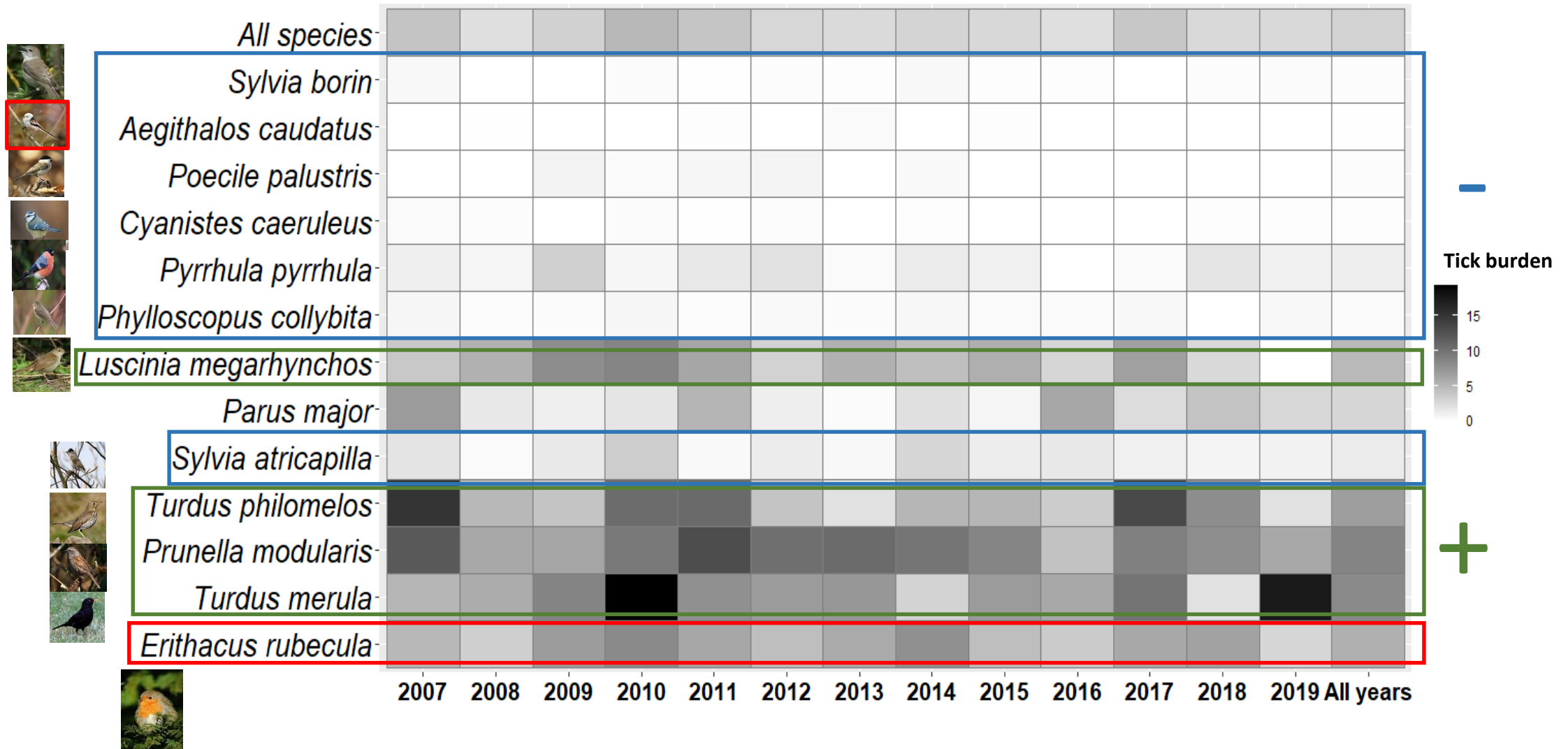
Interannual and interspecific variabilities of the observed tick burden of birds



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

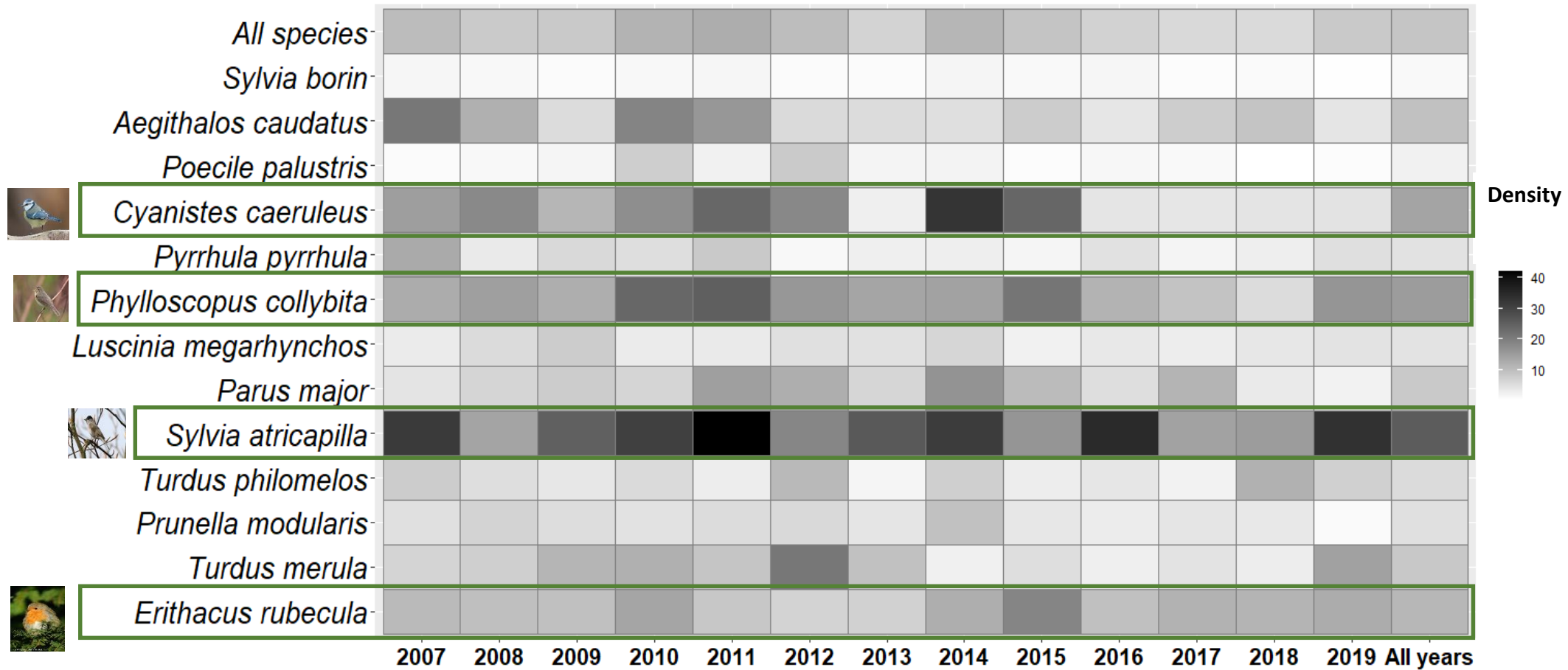
Body weight



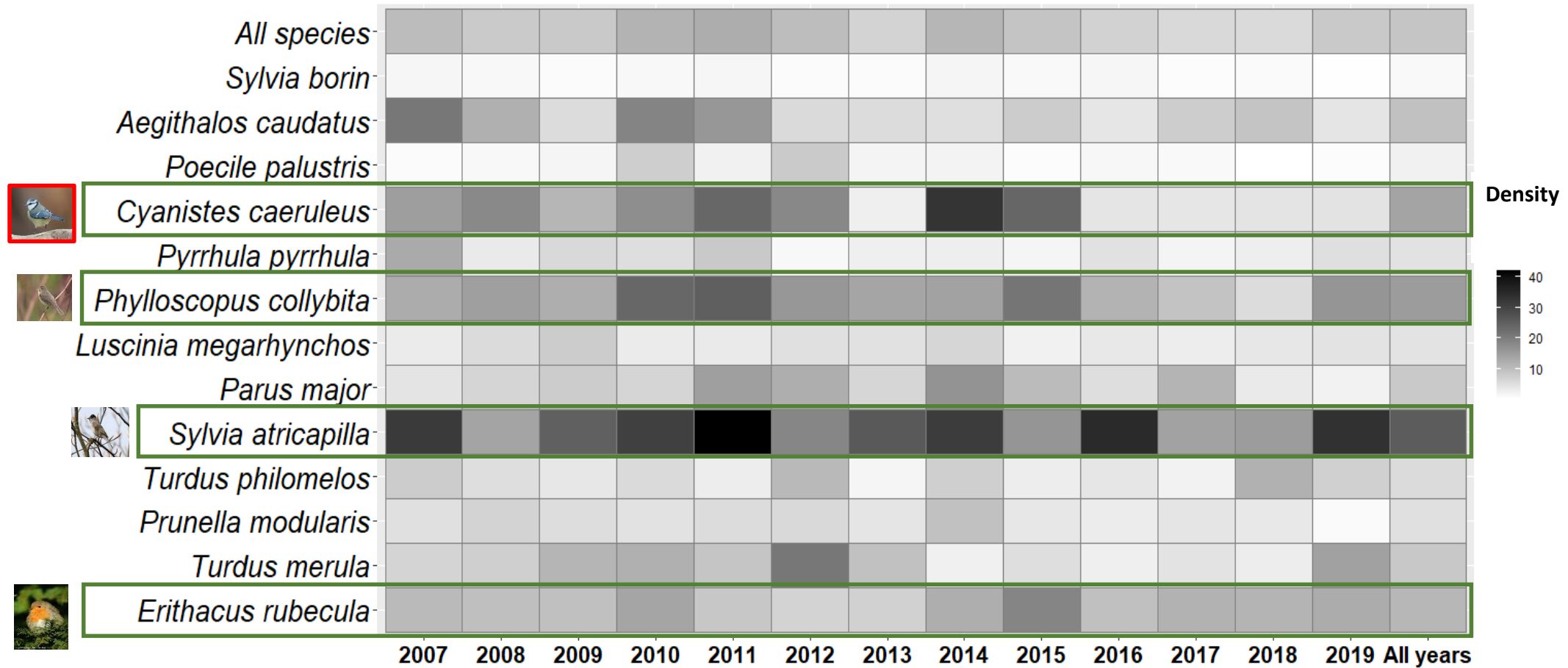
Interannual and interspecific variabilities of the tick burden of birds



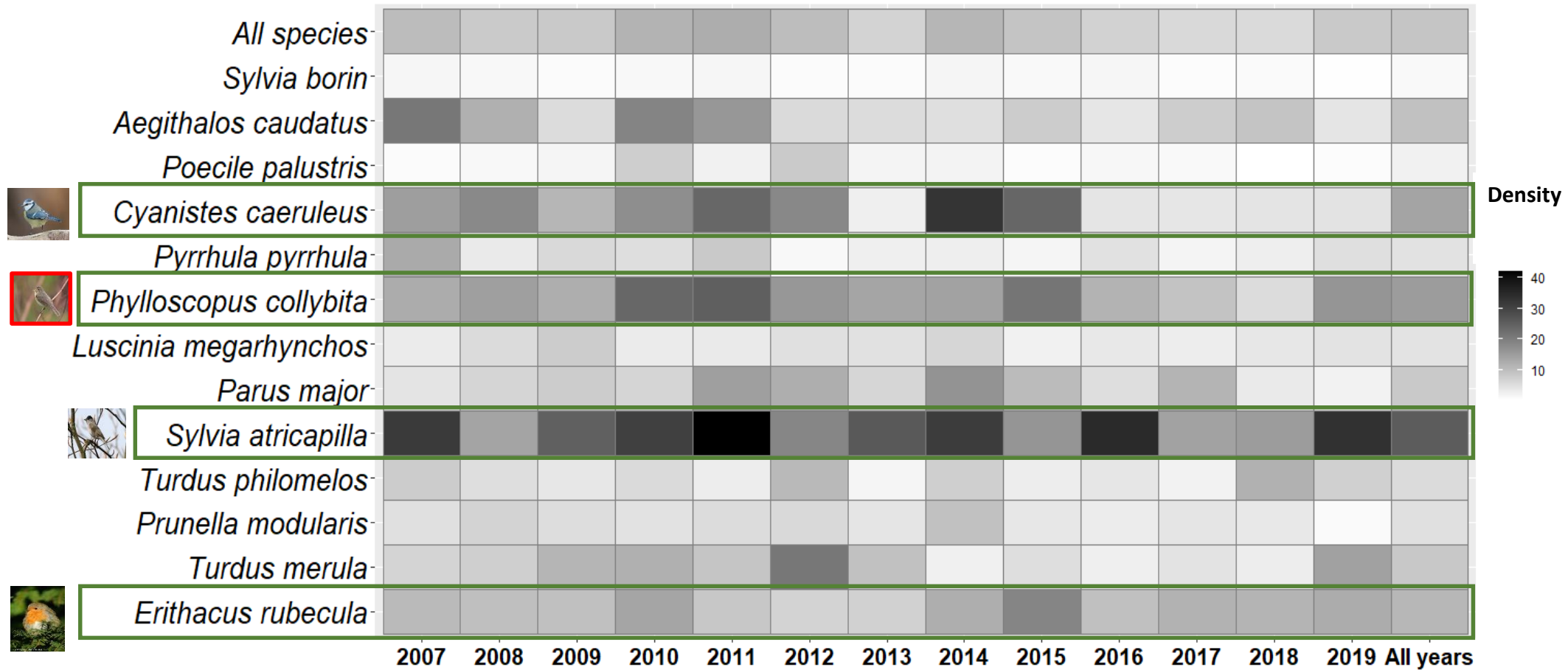
Interannual and interspecific variabilities of the estimated density of birds



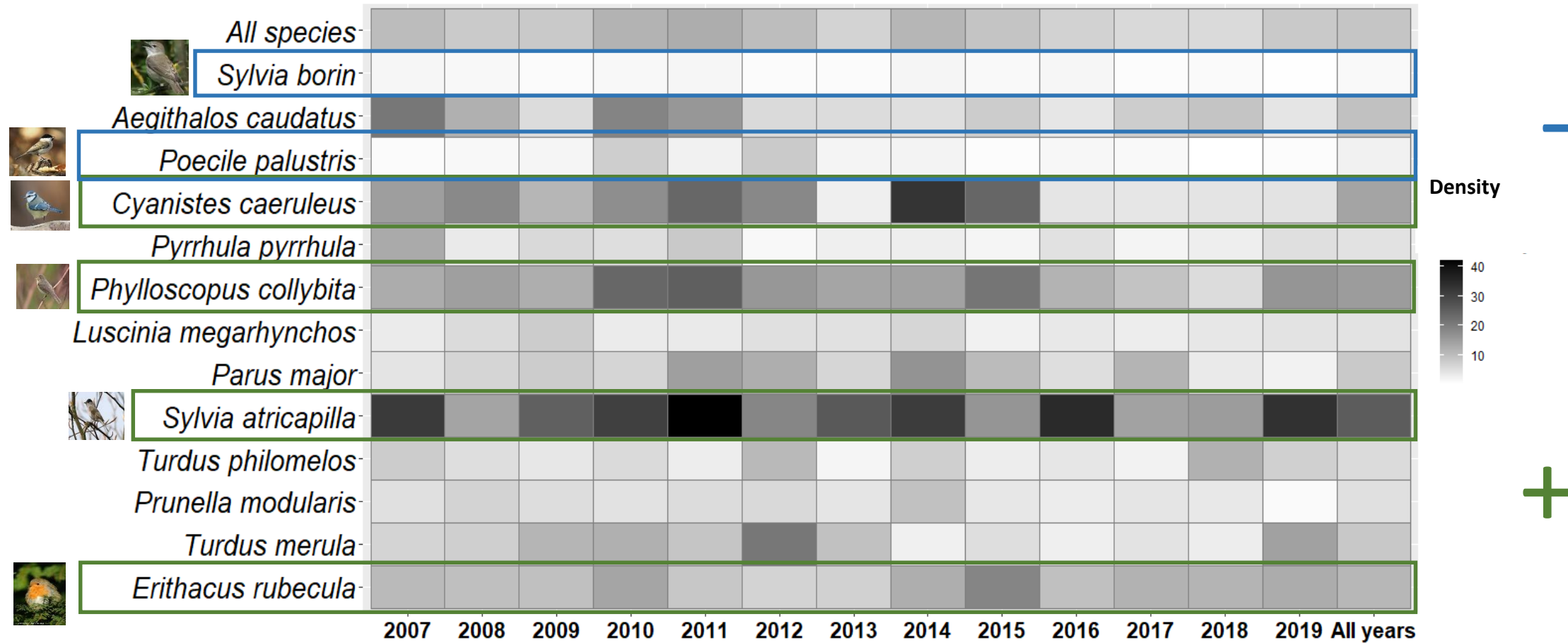
Interannual and interspecific variabilities of the estimated density of birds



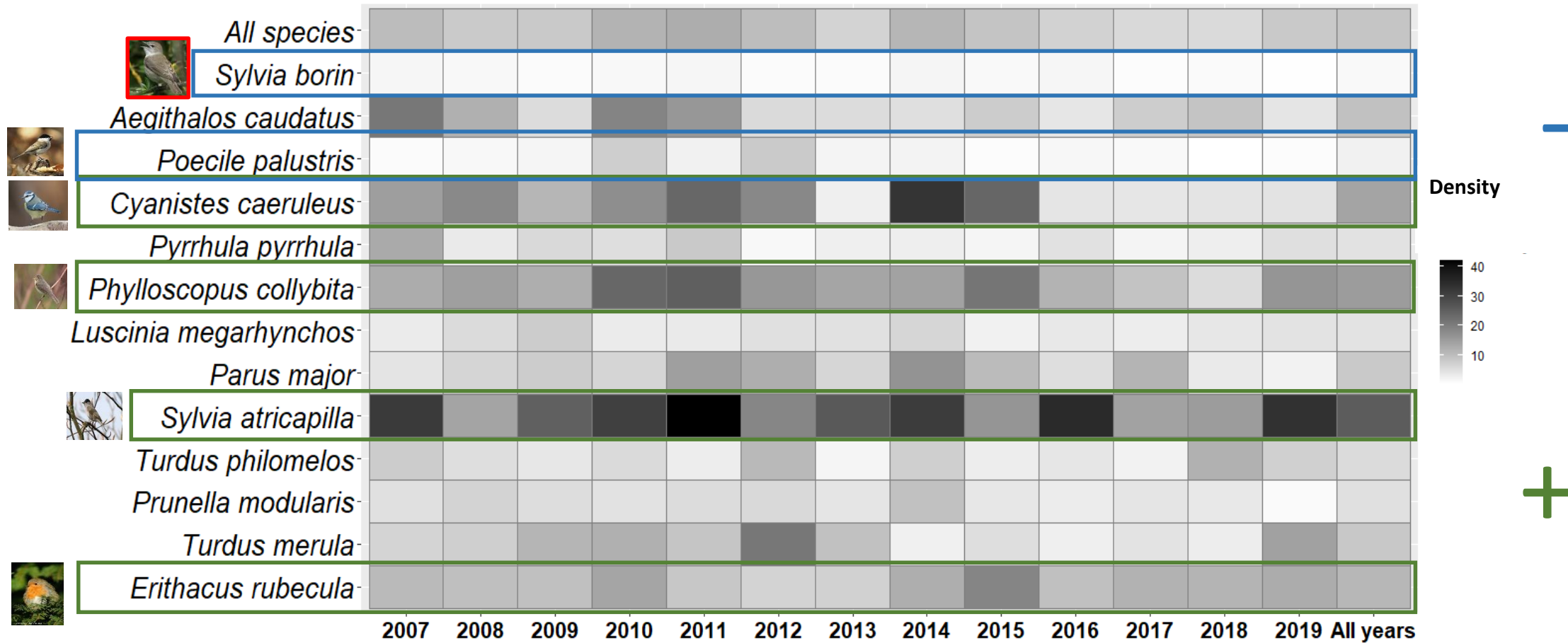
Interannual and interspecific variabilities of the estimated density of birds



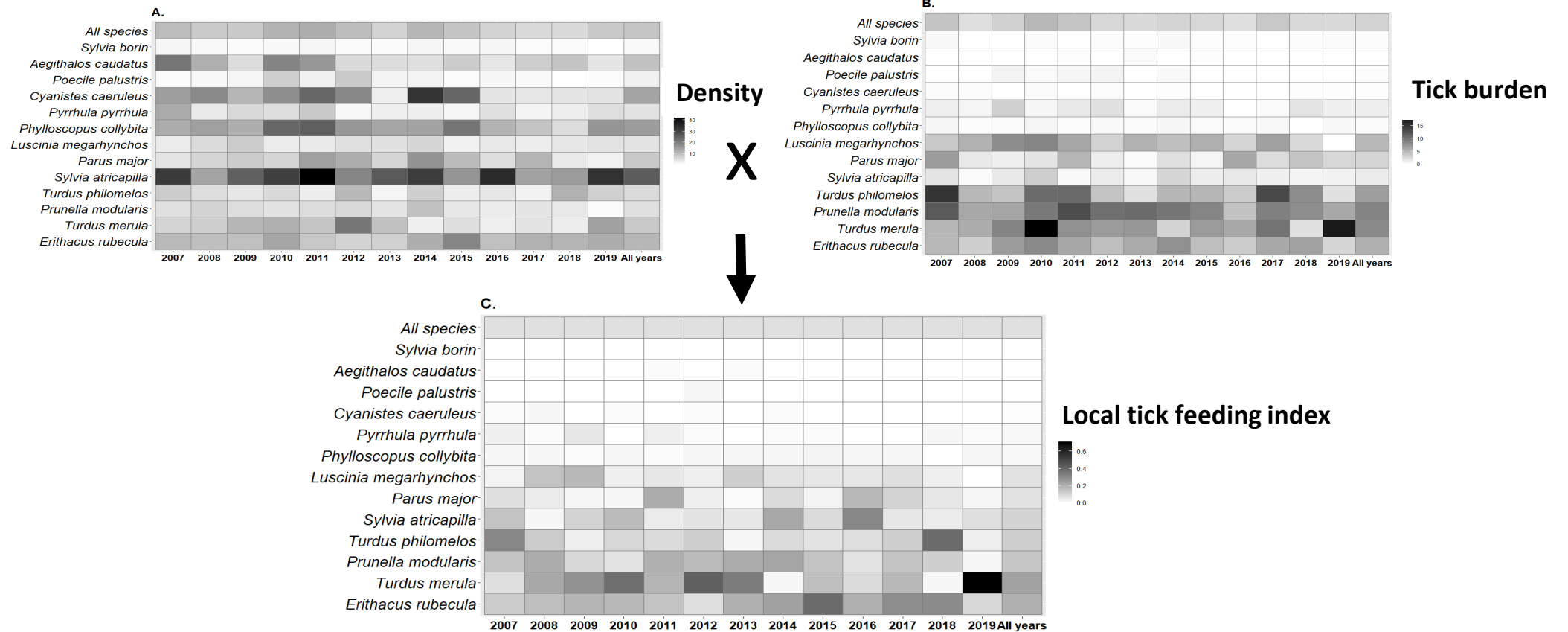
Interannual and interspecific variabilities of the estimated **density** of birds



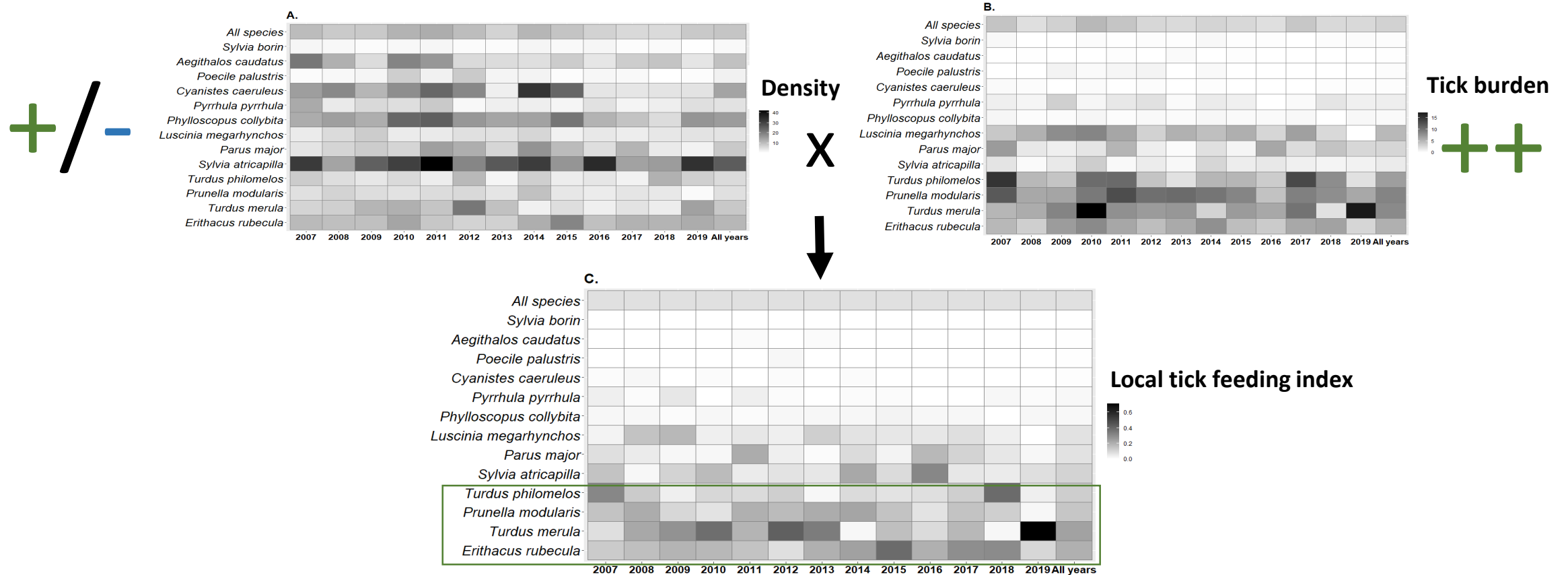
Interannual and interspecific variabilities of the estimated density of birds



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



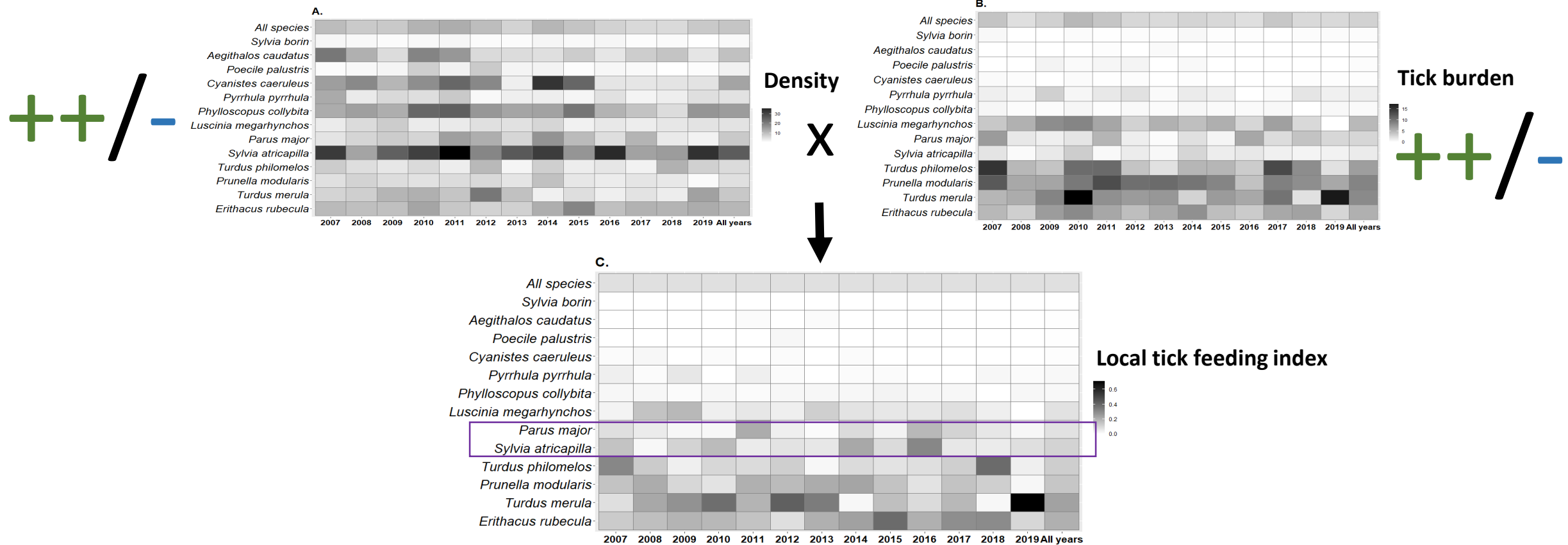
European
robin

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

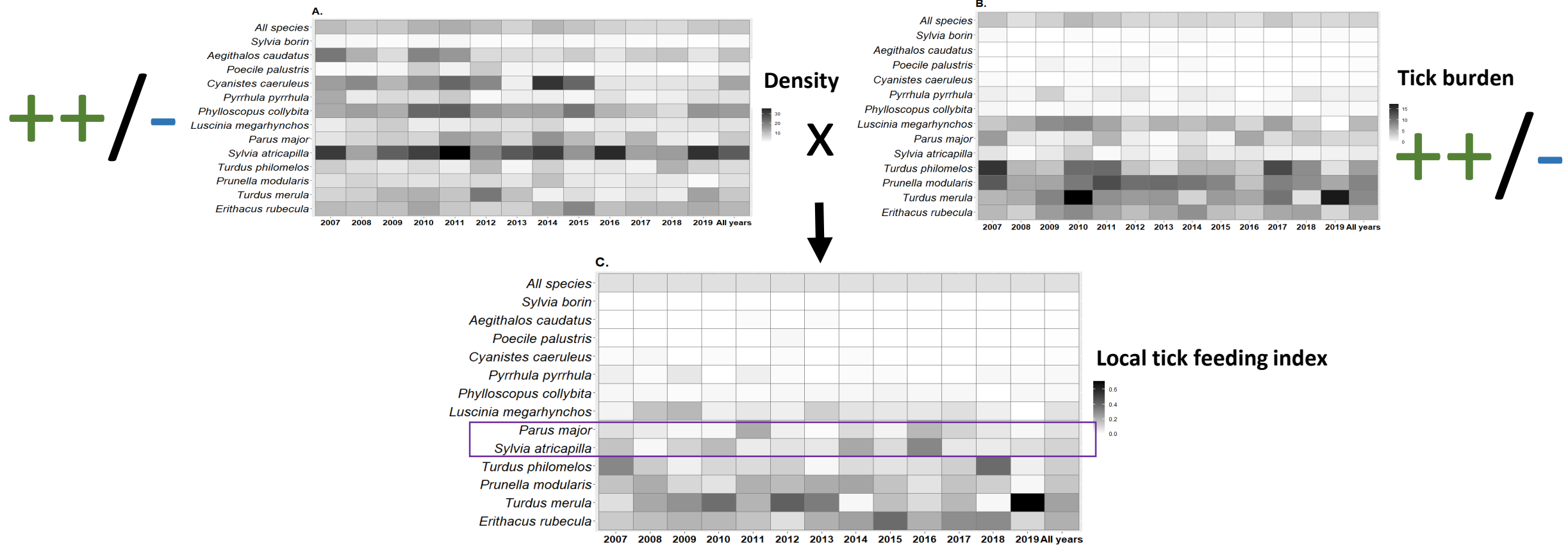
Song
thrush

Intermediate



Great tit

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



Major



European
robin

Common
blackbird

Dunnock

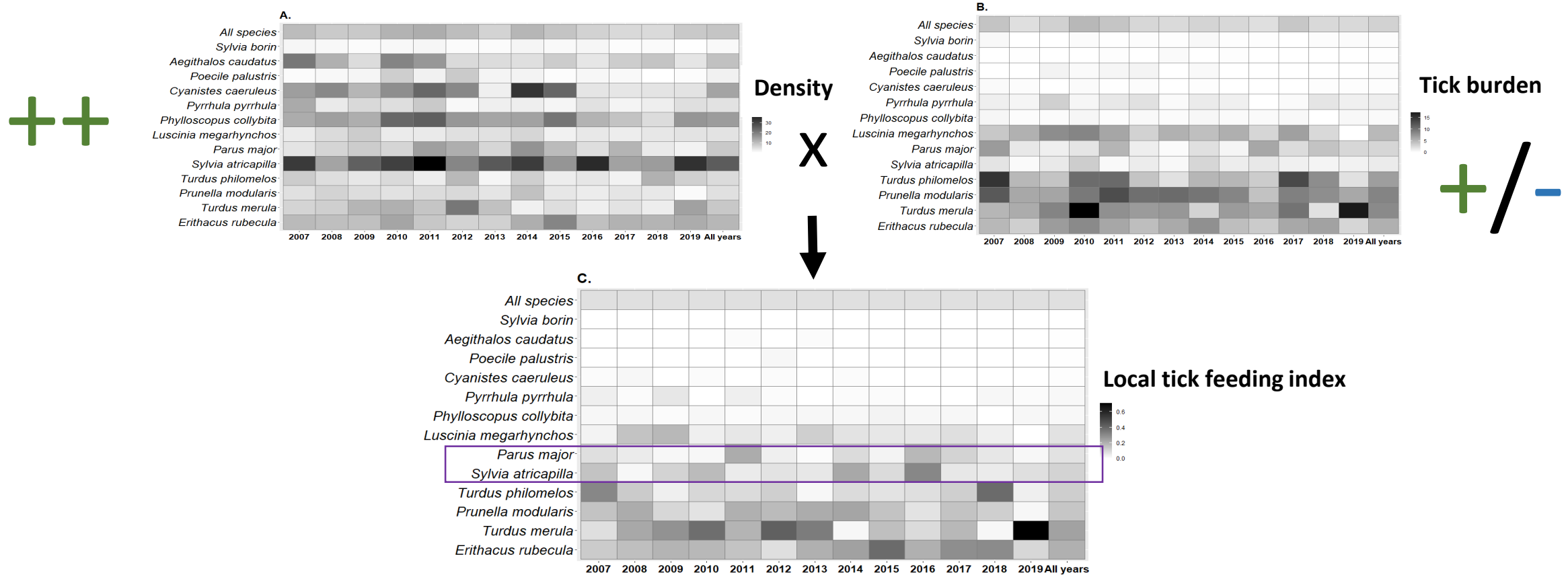
Song
thrush

Intermediate



Great tit

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

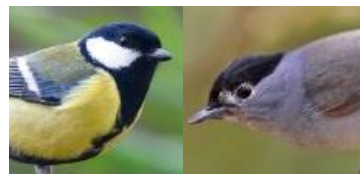


Major



European robin Common blackbird Dunnock Song thrush

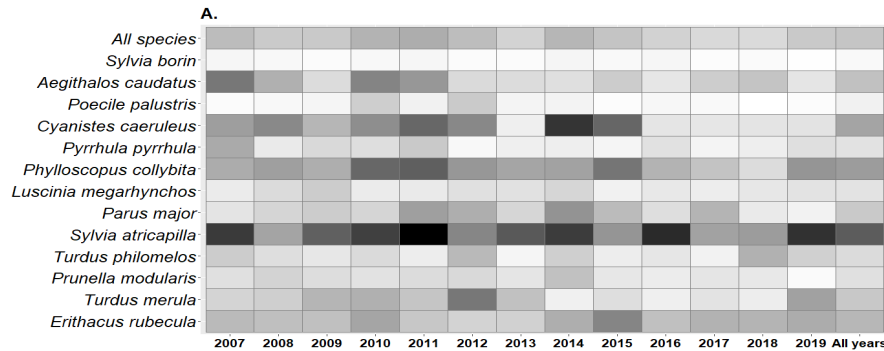
Intermediate



Great tit Eurasian blackcap

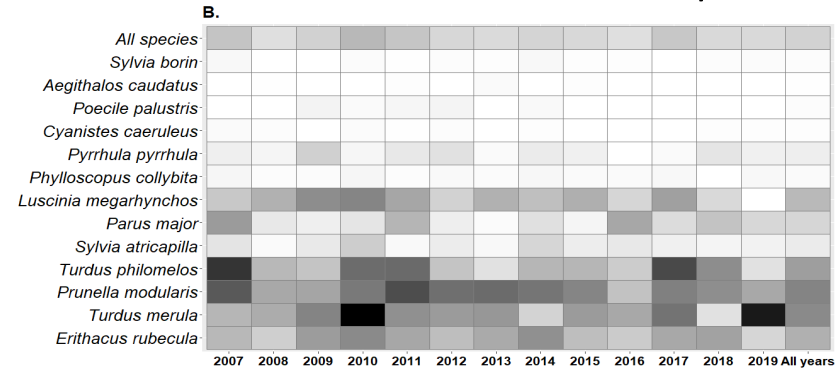
Which species of the bird community participate the most to the local tick production?

--
Or
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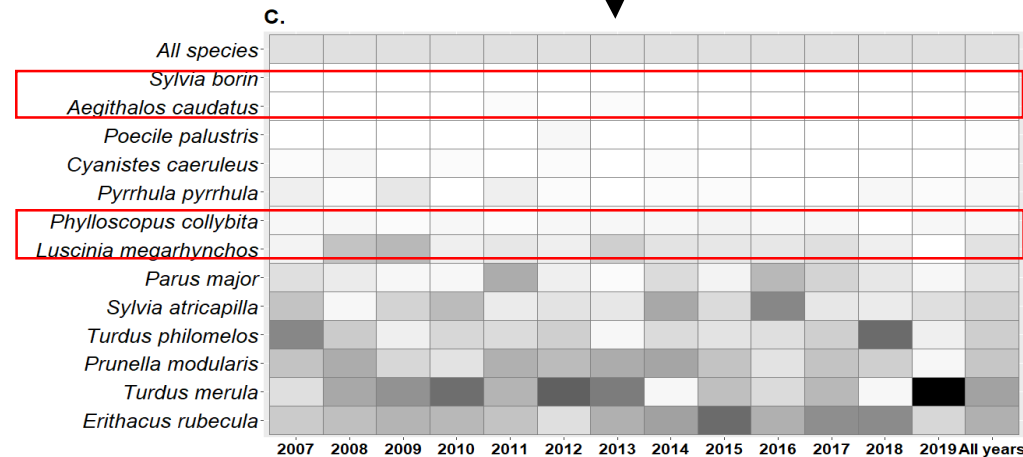
Density

X



Tick burden

++
Or
--



Local tick feeding index

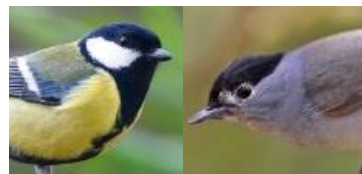
Major

European
robinCommon
blackbird

Dunnock

Song
thrush

Intermediate



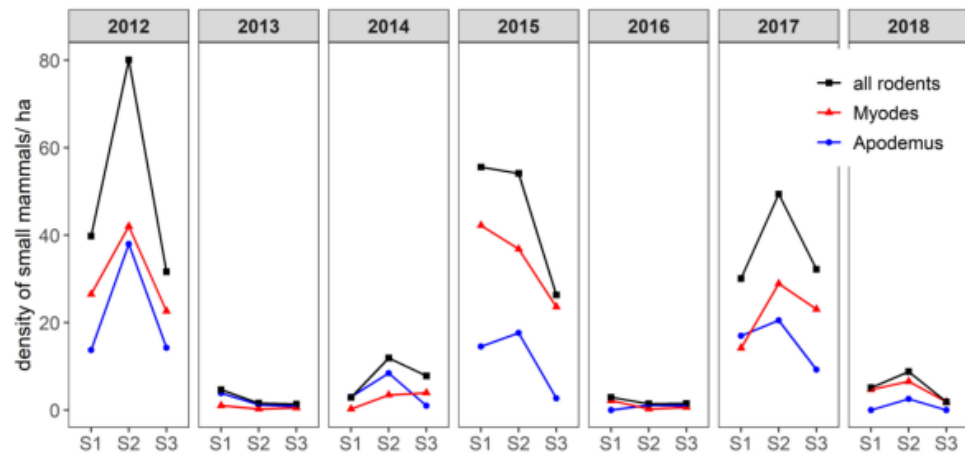
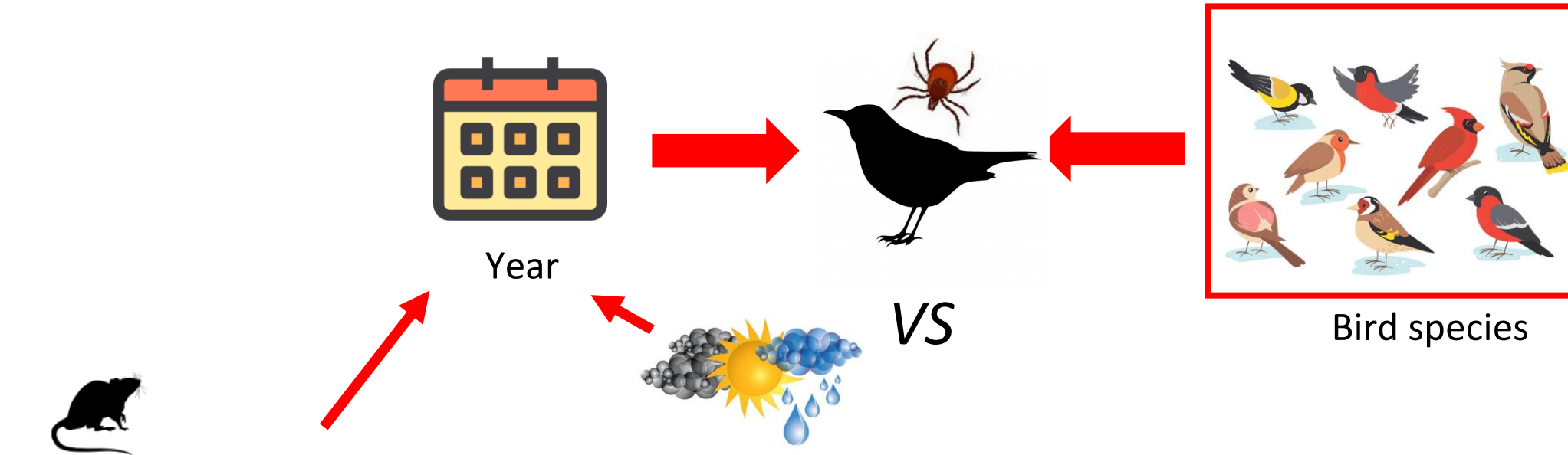
Great tit

Eurasian
blackcap

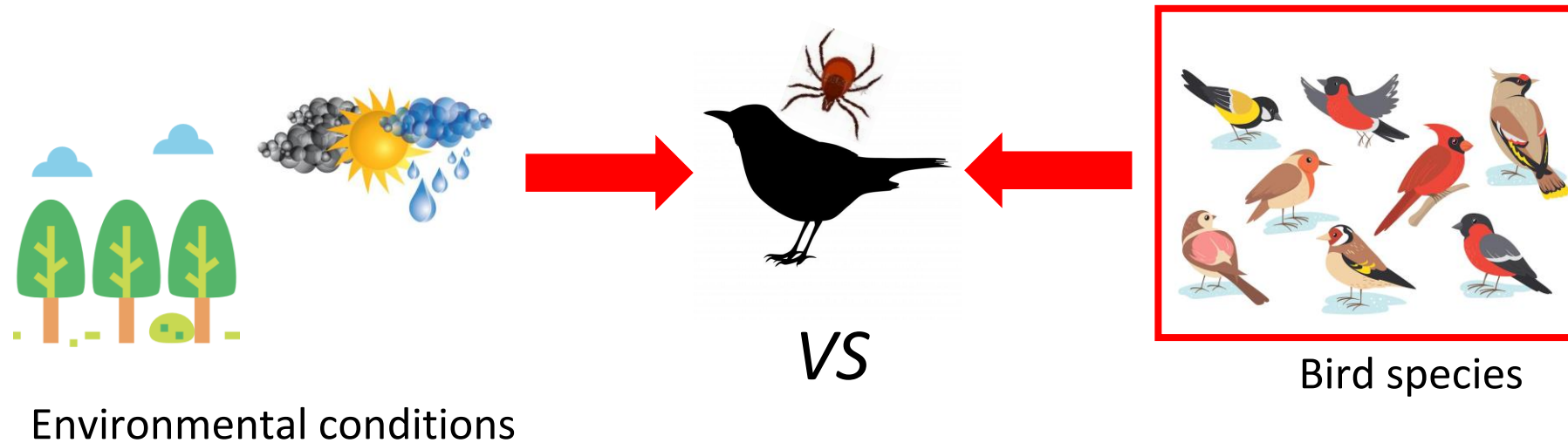
Negligible

Common
nightingaleCommon
chiffchaffLong-tailed
titGarden
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

CONTEXT	MATERIALS & METHODS	RESULTS	DISCUSSION
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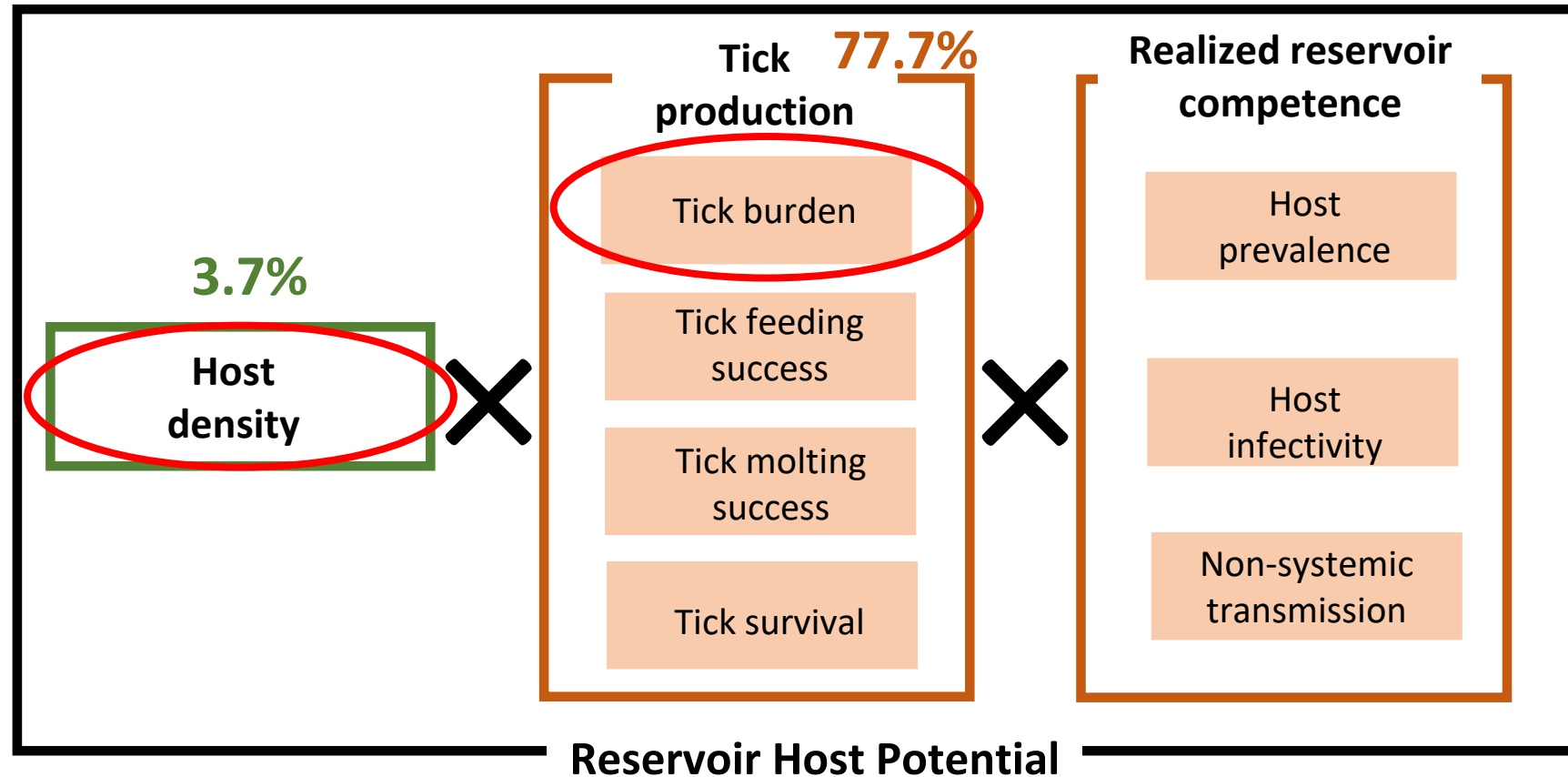
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= production of
infected ticks by a
host species
population in a given
system



CONTEXT	MATERIALS & METHODS	RESULTS	DISCUSSION
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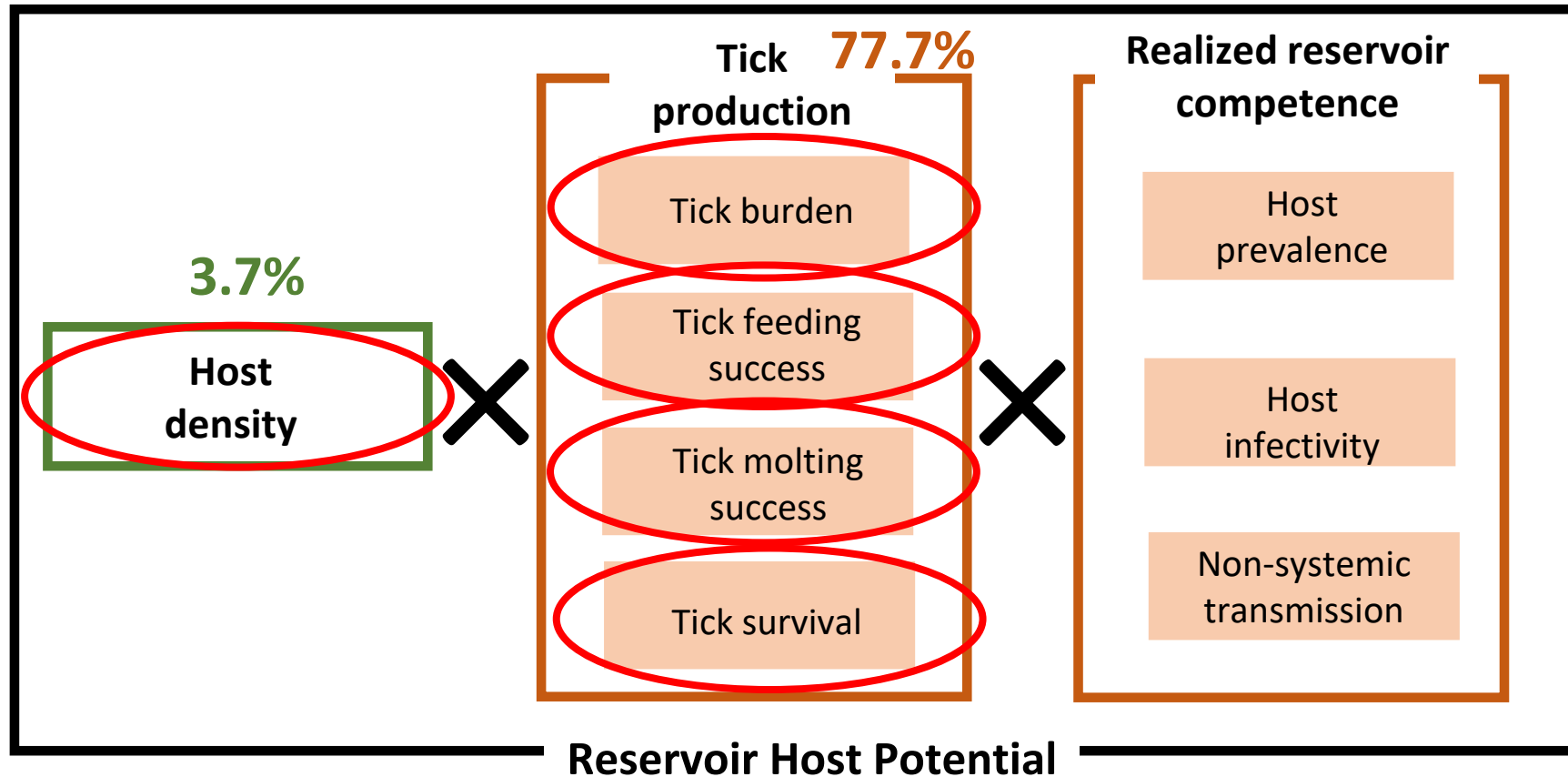
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= production of
infected ticks by a
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population in a given
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CONTEXT	MATERIALS & METHODS	RESULTS	DISCUSSION
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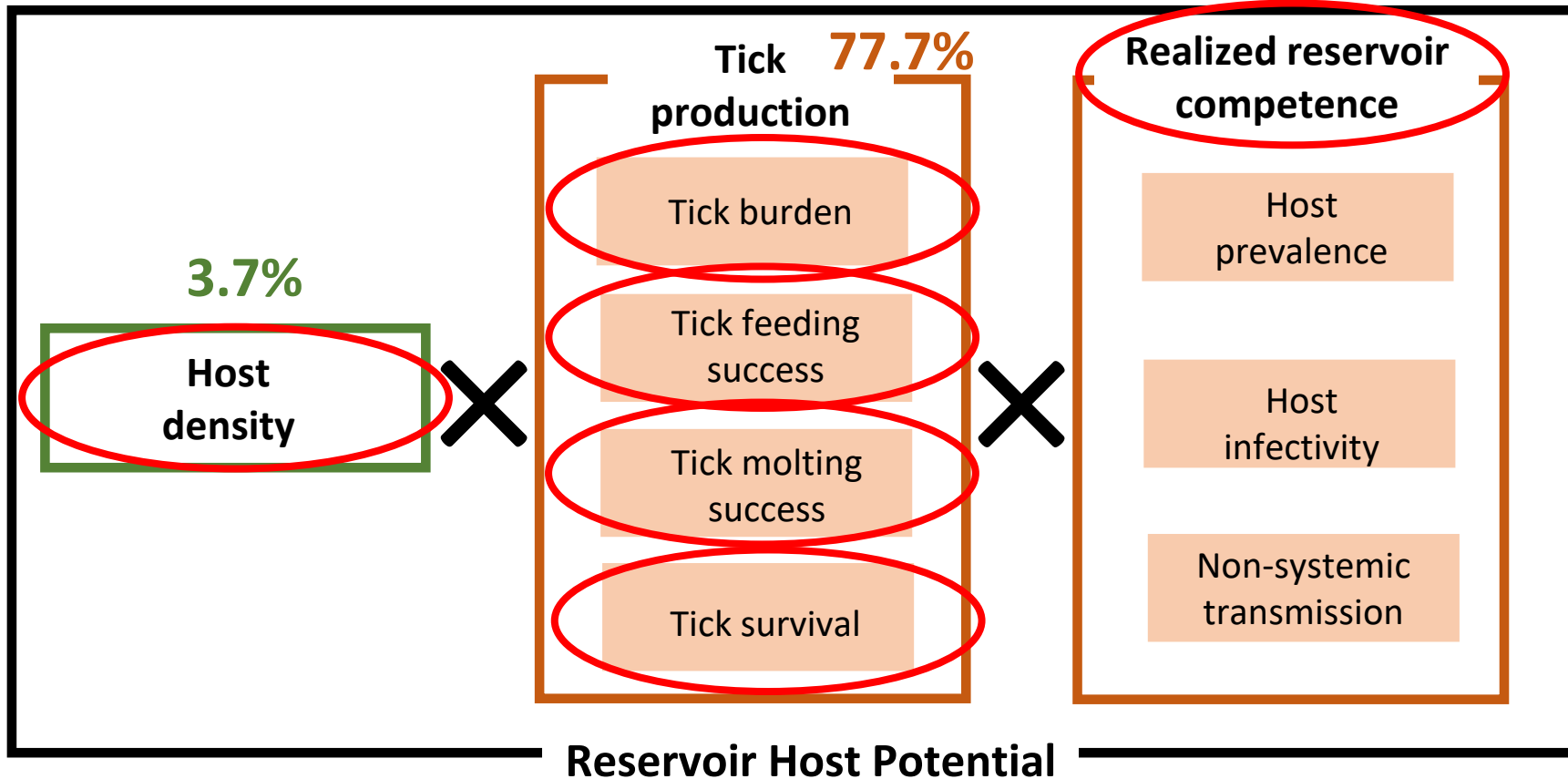


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57%

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



Thank you for your attention

Funders



Contributors

Clémence Galon
Eloïse Duffrene
Karen McCoy
Olivier Plantard



© Luc Berger

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:



>

