What shapes spatial invasion patterns of alien birds?

Salit Kark סלעית קרק
The Biodiversity Research Group
The University of Queensland
s.kark@uq.edu.au www.KarkGroup.org

Spatial invasion patterns of alien birds across continents: Australia vs. Europe

Biotic invasions

A small number of species are successful in many different places leading to

Biotic homogenization

China

Chinatown, Paris

(McDonalds effect)

Japan

India

Germany


McDonald's


McGarbage
It's shit
Don't eat it!


NÃO COMPRE
BOICOTE !
PRODUTOS AMERICANOS

DAISIE

DELIVERING

ALIEN

INVASIVE

SPECIES

INVENTORIES FOR

EUROPE

Phil Hulme, Coordinator

DAISIE will deliver an Alien Species Gateway to act as a "one-stop-shop" for information on biological invasions in Europe.

Aliens in Europe



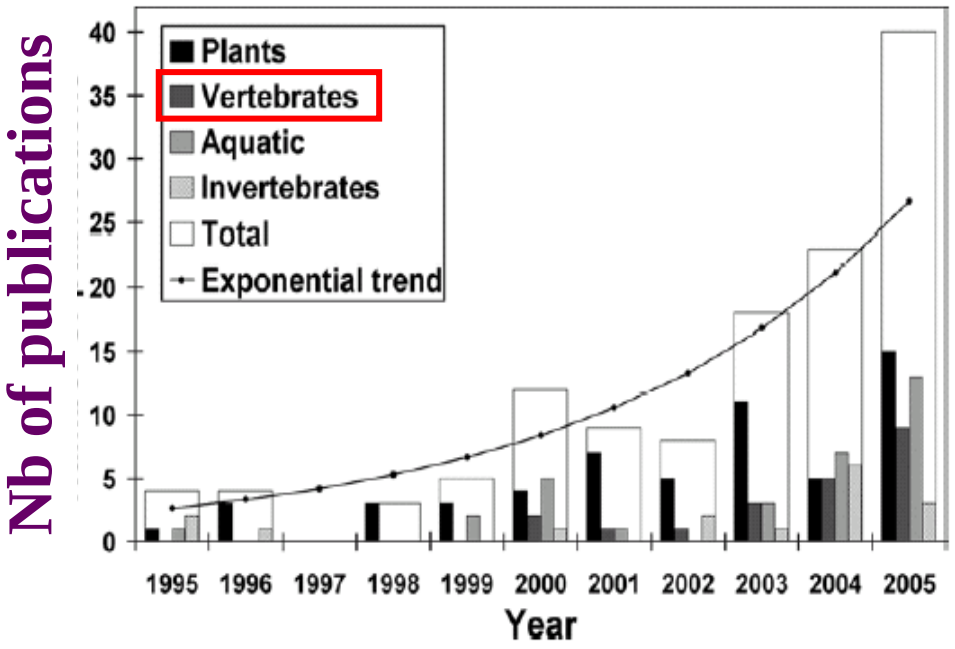


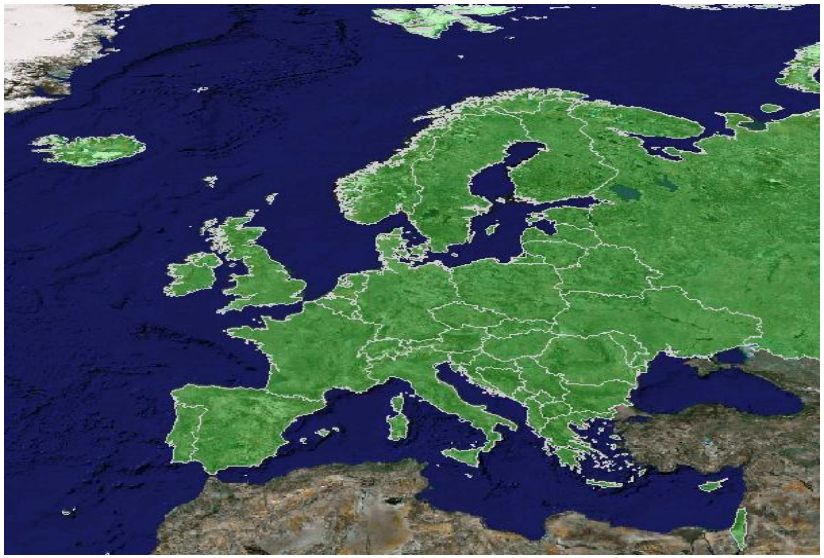

Shirley and Kark, 2006, PLoS Biology

Documentation of invasions

Amassing information among multiple sources

Regional effort and collaboration between countries





Shirley & Kark Plos B 2006

What factors shape bird introductions in Europe?

François Chiron, Susan Shirley and Salit Kark

Chiron, Shirley and Kark
Proceedings Royal Society 2009
Biological Conservation, 2010
Kark et al. DAISIE book, 2011

Objectives

- ✓ A quantification of bird invasions in Europe
- ✓ Study the main determinants of bird invasion at regional scales
- ✓ Behind the scenes…what is the role of European politics in invasions?

Compiling introduction Data

- Books
- Journal articles
- “Grey” literature
- Reports
- Atlas Projects
- Bird Guides and Checklists
- Web-based sources
- Avian introduction events between 1788 (the First fleet) and 2000

Profile: Inventory of bird species

77 successfull exotic bird species breeding in Europe in 2008

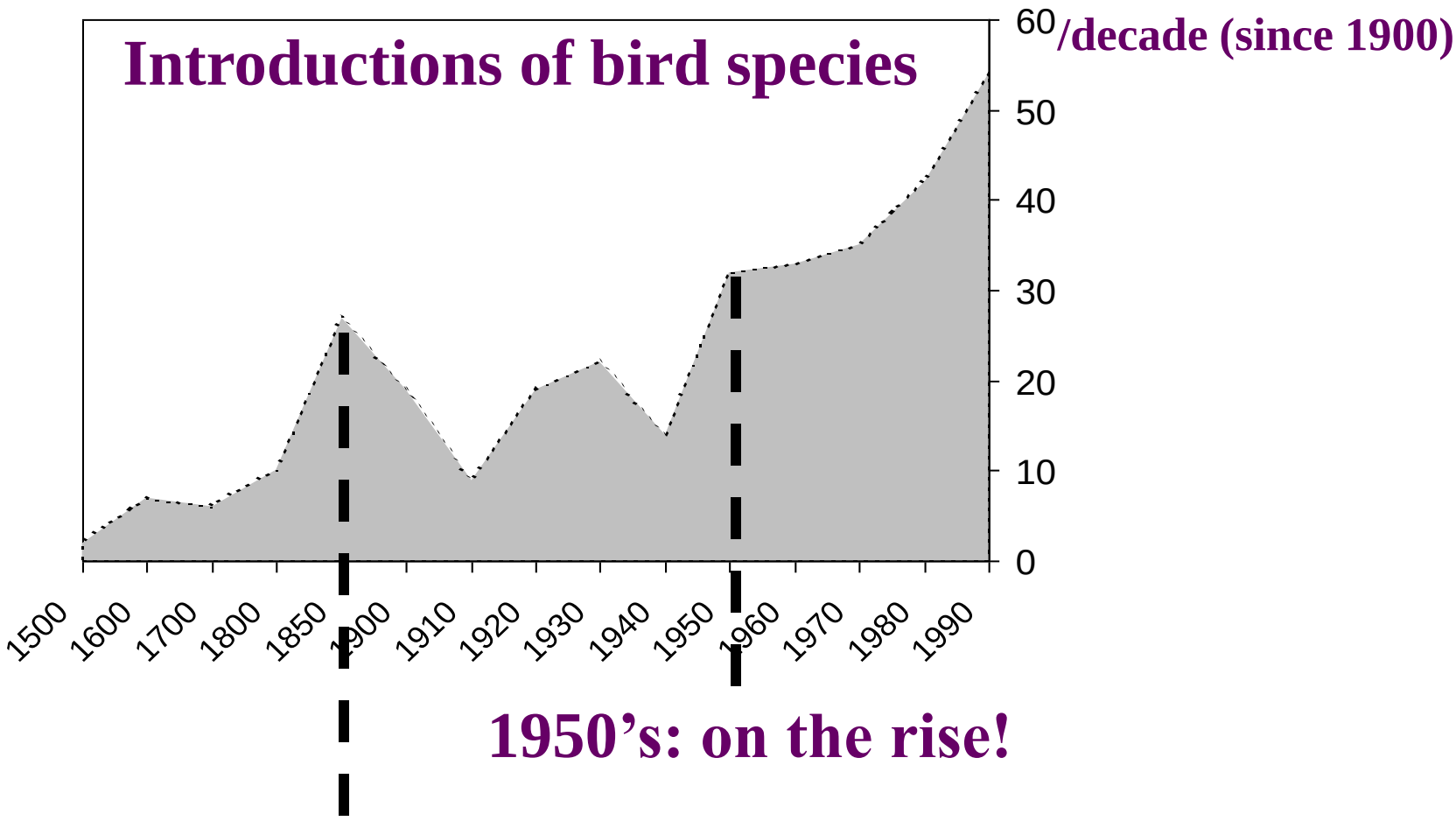
= only 2% of all exotic species in Europe but 15% of the European avifauna!!

Ducks & geese

Parrots & parakeets

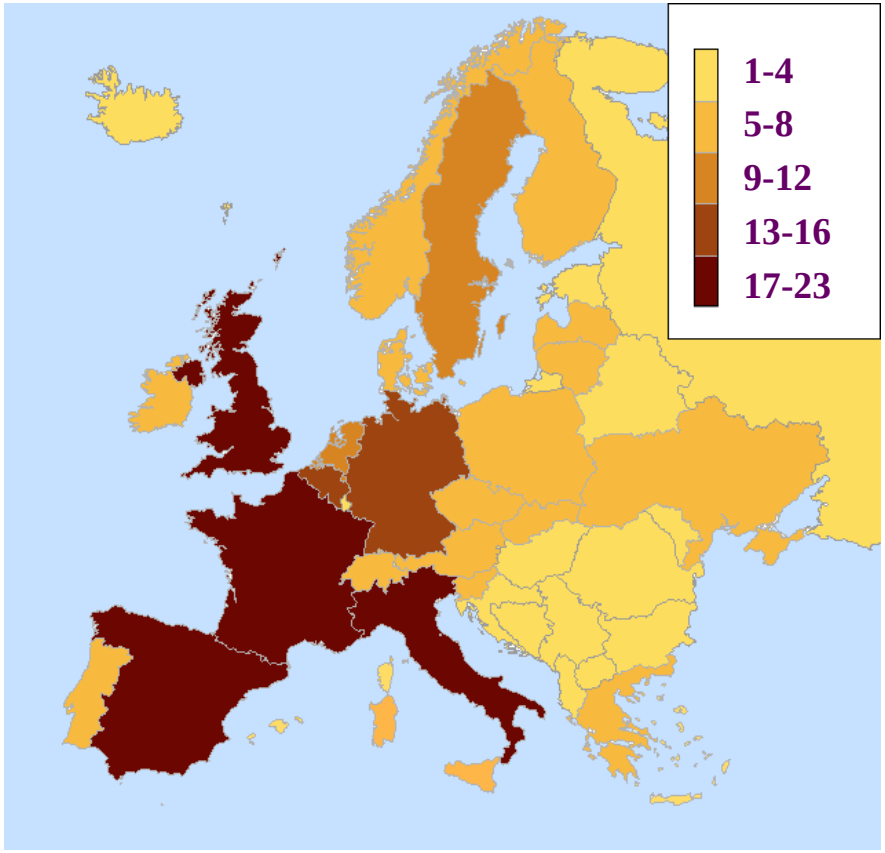
Pheasants & partridges

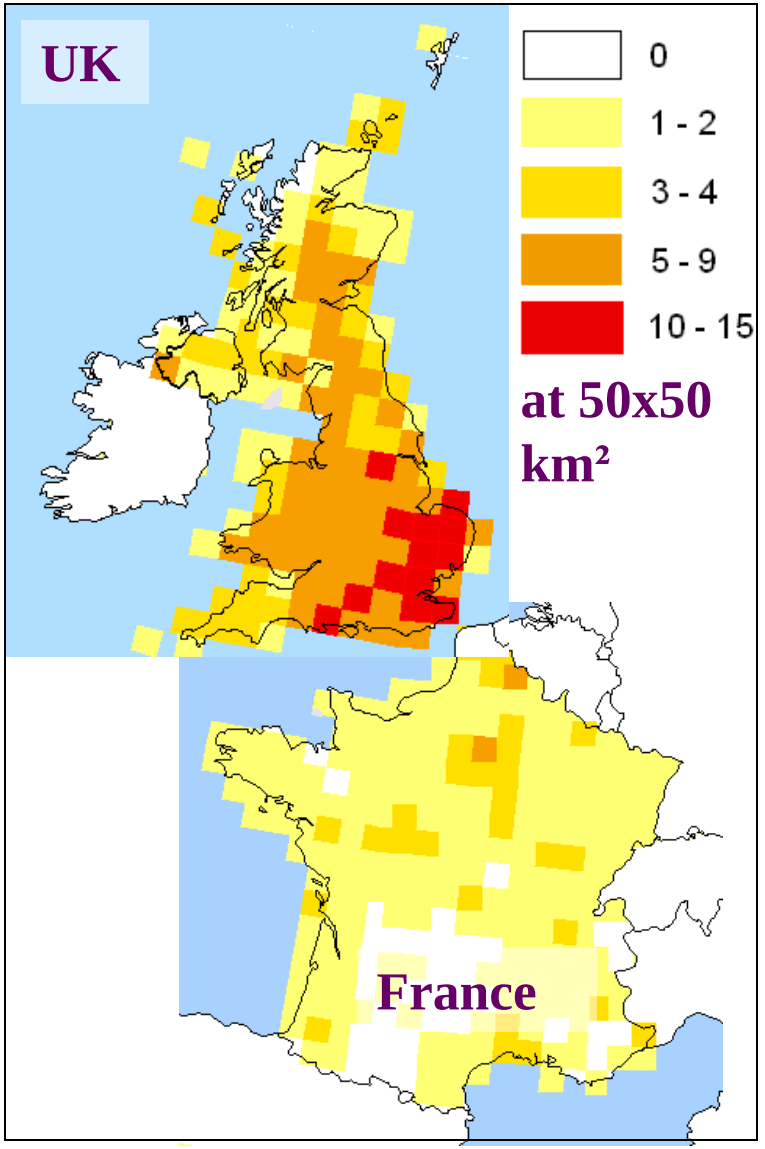
Trends


Introductions of bird species
60
/decade (since 1900)
50
40
30
20
10
0
1500
1600
1700
1800
1850
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
1950's: on the rise!
1850's: modern invasions

Distributions

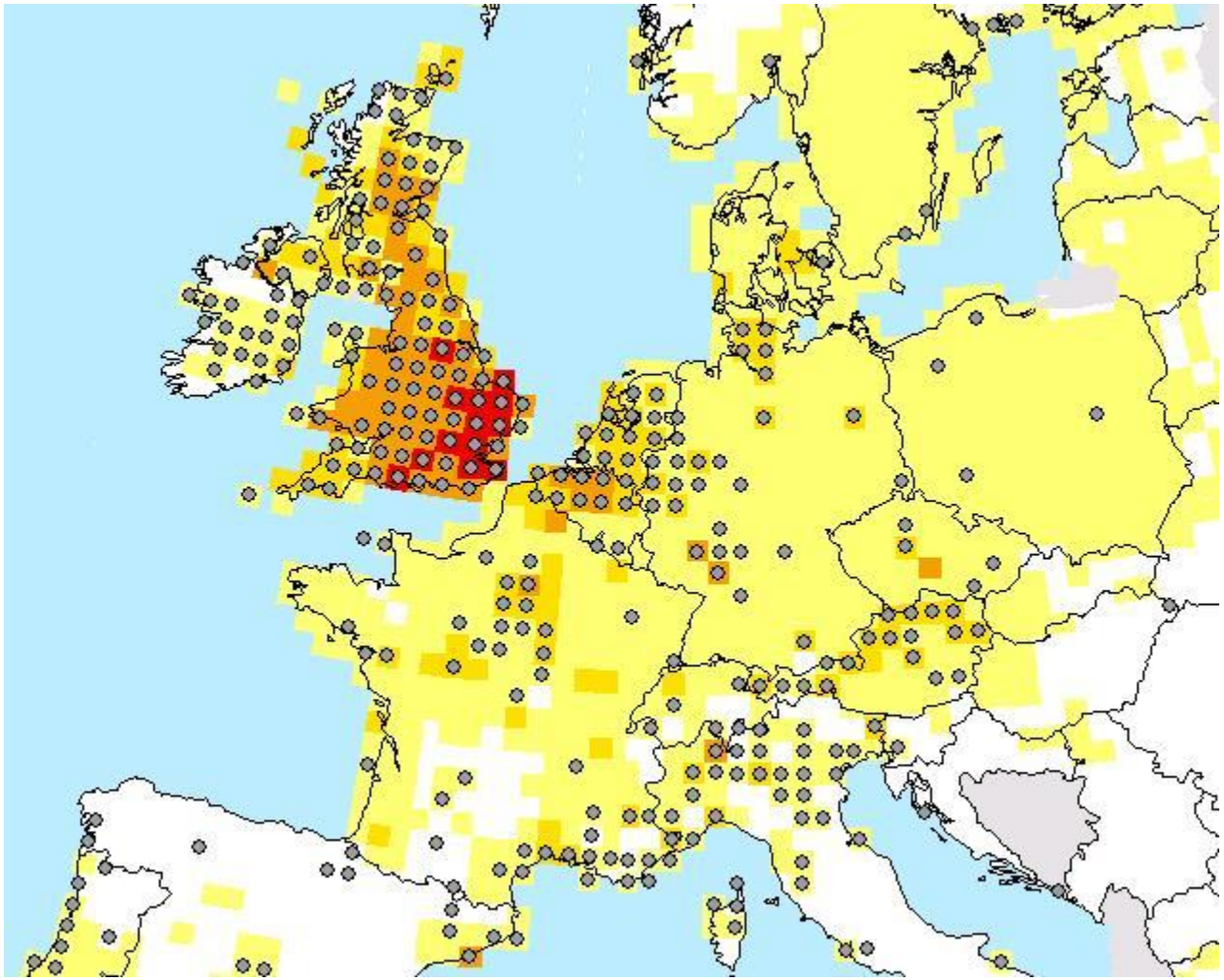
Alien bird richness



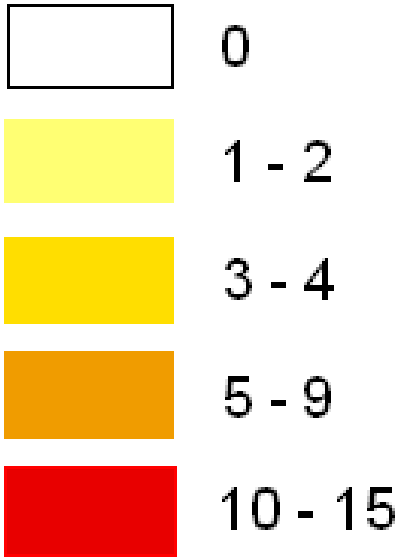


= non-uniform distribution

Determinants of exotic bird richness



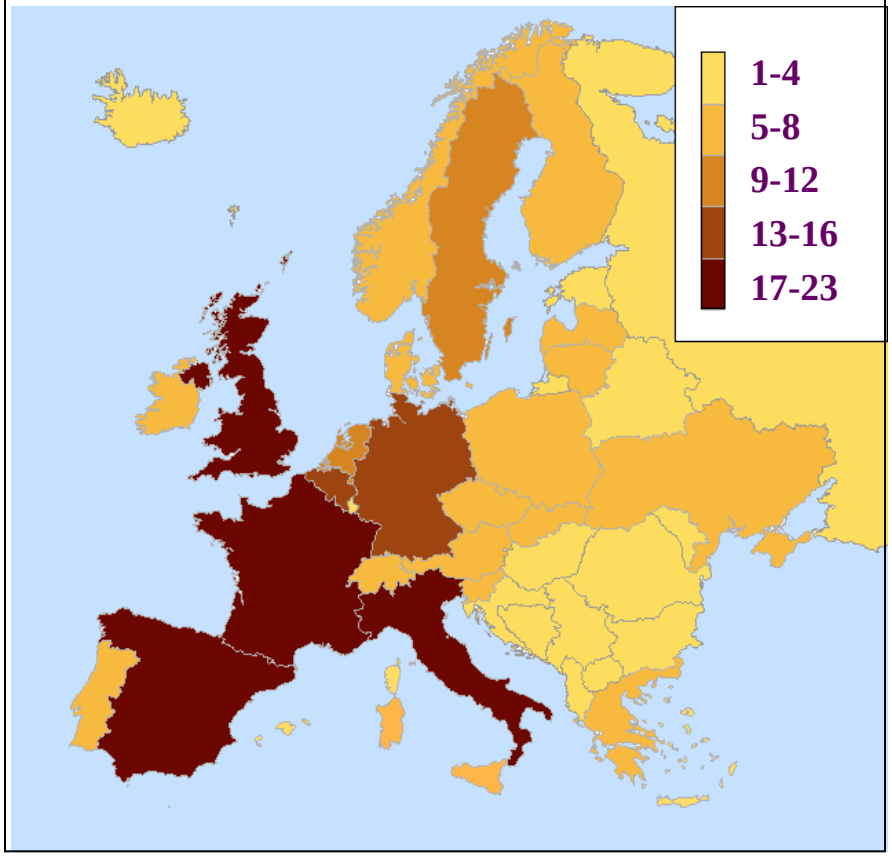
Exotic bird richness at 50x50 km



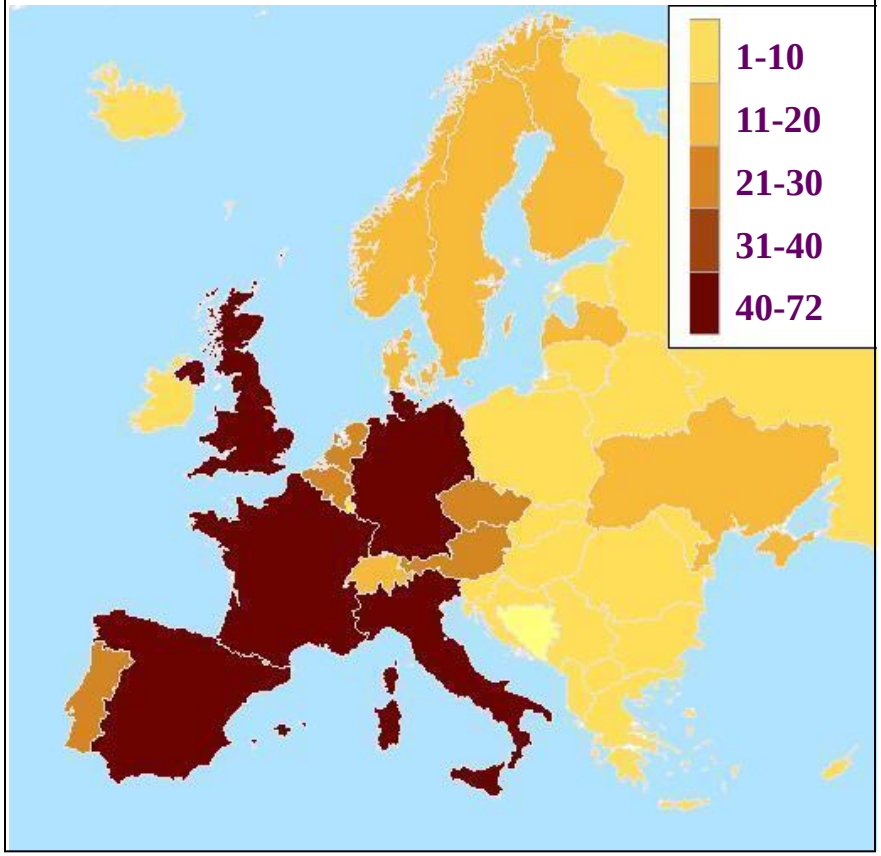
- **Introduction(s) of bird species**

Determinants of alien bird richness

Alien bird richness



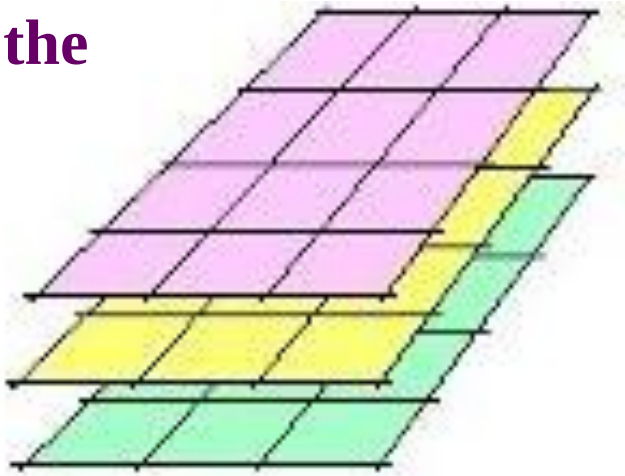
Number of species introduced



Chiron, Shirley and Kark 2009 Proceedings Royal Soc B 276: 47-53,
Chiron, Shirley and Kark 2010 Biological Conservation 143: 351-356.

Determinants of exotic bird richness

We combined exotic bird richness and environmental data using GIS layers at the 50 x 50 km scale for Europe.



We used hierachical partitioning to examine deviance
Analysis of variance accounted for covariations among variables and for spatial autocorrelation.

Human activity, especially the number of species introduced, shapes the distribution of exotic bird richness in Europe at the regional scale

Chiron, Shirley and Kark 2009 Proceedings Royal Soc

Determinants of exotic bird richness

Natural characteristics of the invaded ecosystem

- Native bird richness
- Temperature (Min)
- Plant productivity
- Habitat diversity

Human factors

- Number of species introduced
- Human impact, acitivity

Traits of successful invaders

- Species origin (intra or inter-regional)

Chiron, Shirley and Kark 2009
Proceedings Royal Soc B 276: 47-53.

The role of socio-economic factors in shaping bird introductions in Europe

François Chiron, Susan Shirley and Salit Kark

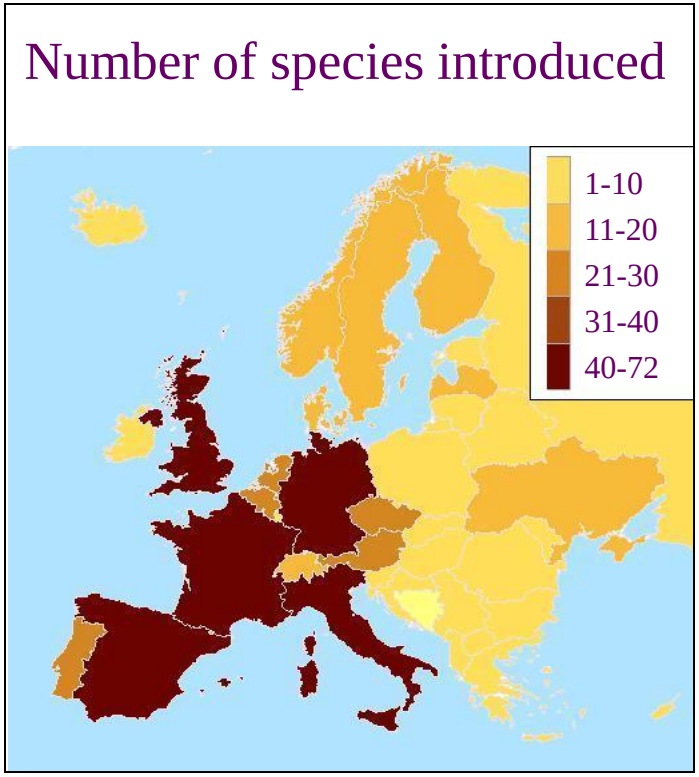
The Biodiversity Research Group

Chiron, Shirley and Kark
Proceedings Royal Society
Biological Conservation

Delivering Alien Invasive Species Inventories for Europe

Behind human activity...

What role do European politics play in shaping the differences between Eastern and Western Europe?



The “Cold War” hypothesis (1949-1991)

The Cold War hypothesis

Western Europe

Before, during and after the Cold War, alliances with various continents for trade and immigration.

The Iron curtain

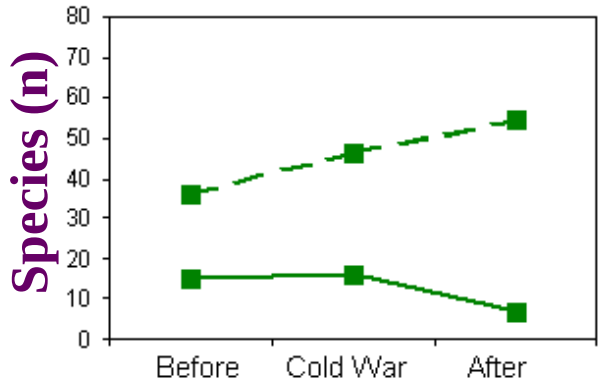
Eastern Europe

During the Cold War, isolated from most other continents except Eastern Europe, Central and South-East Asia.

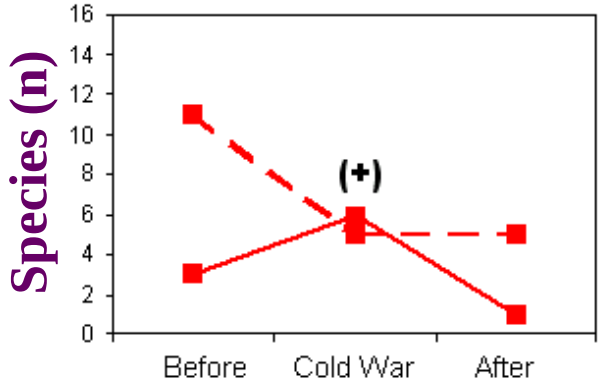
The Cold War hypothesis

Variations in European (⟷) and Non-European (← →) birds introduced:

Western Europe



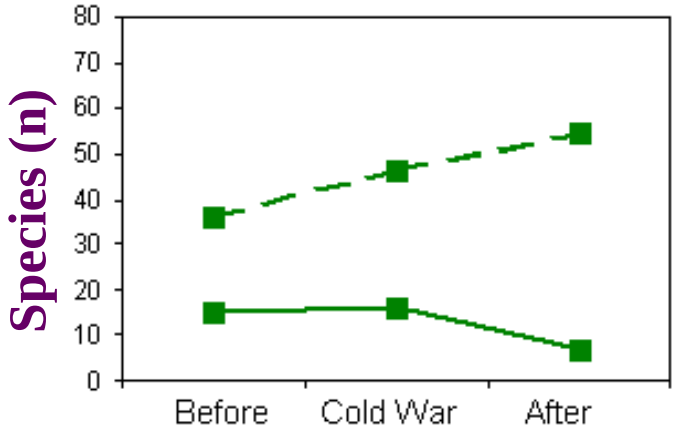
Eastern Europe

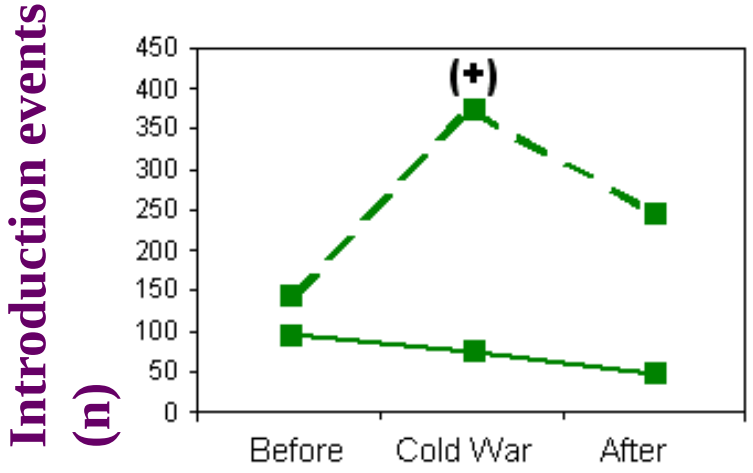


The Cold War hypothesis

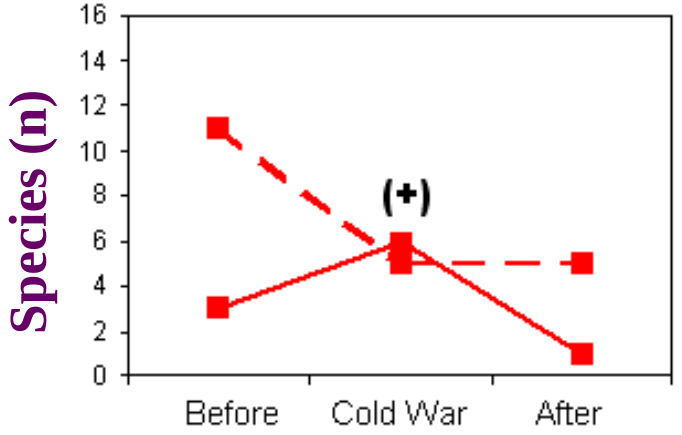
European (⟷) and Non-European (← →)

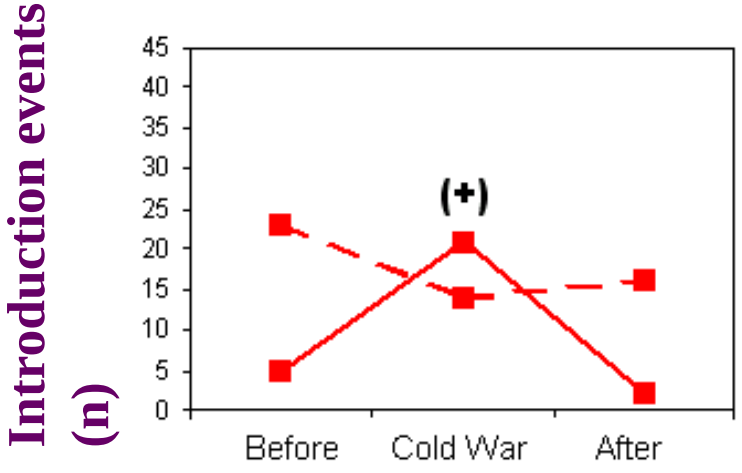
Western Europe





Eastern Europe

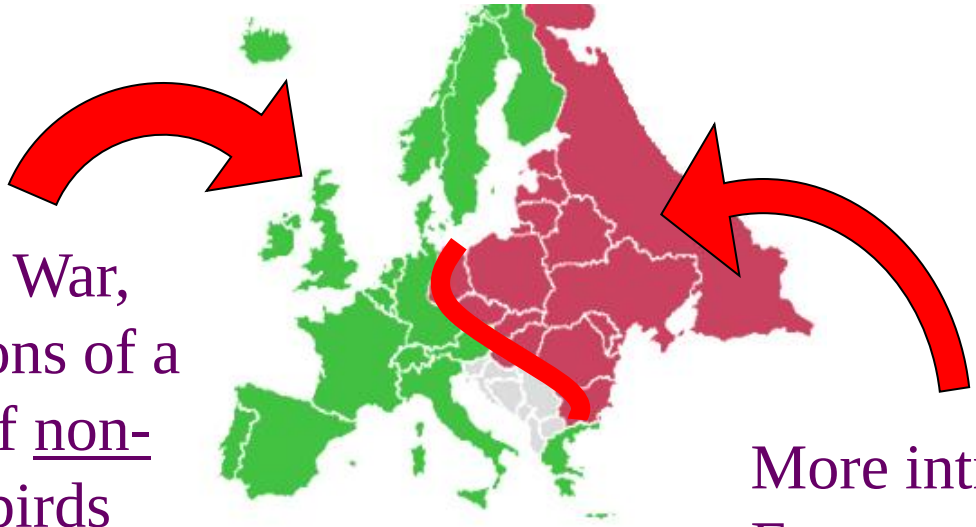




Chiron, Shirley and Kark 2010 Biological Conservation 143: 351-356.

Synthesis

During the Cold War, more introductions of a large diversity of non-European alien birds (mainly from North America and Africa)

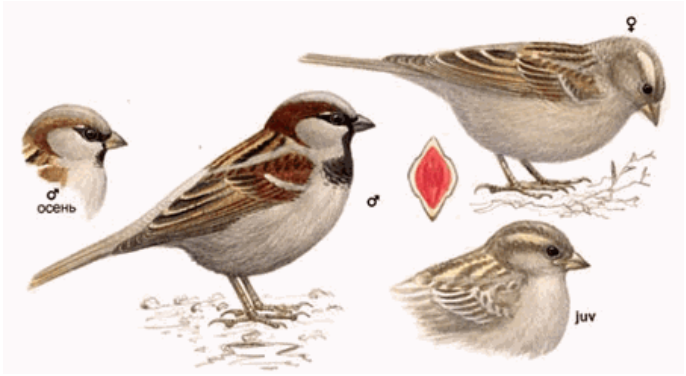


More introductions of European alien birds (e.g., partridges)

= Both the spatial and temporal patterns of exotic bird introductions in Europe were largely shaped by the Cold War


Photo: Salit Kark


Photo: Salit Kark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♂ осень
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juv


ACCLIMATIZATION
VICTORIA
SOCIETY

Australia INVERSE project goals

- ✓ Quantify and map bird invasions in Australia
- ✓ Study main determinants of bird establishment
- ✓ Compare to our previous studies in Europe
- ✓ Use information for prioritisation of actions

Comparing invasion hypotheses

- ✓ Our results from Europe support the **Human Activity hypothesis** (Chiron et al 2009 Proc Royal Society, 2010 Biol Conservation, Pysk et al 2010 PNAS)
- ✓ Australia was more recently settled: provides good test of the Rich Get Richer hypothesis

Compiling introduction Data

- Books
- Journal articles
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- Atlas Projects
- Bird Guides and Checklists
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Australian introductions

Overall, 60 non-Australian bird species were introduced between 1788 and 2000

Over 600 spatially referenced introduction events

- 24 successfully established breeding species in Australia by 2014
- Five of the 24 are also established in Europe
- Alien richness ranged from 0 to 18 per grid square with native richness ranging from 0 to 401 (per 50 sq km)
- 15 birds were introduced in Tasmania, 14 established
- Data of introduction events complemented by atlas data

McKinney and Kark, Diversity and Distribution 2017

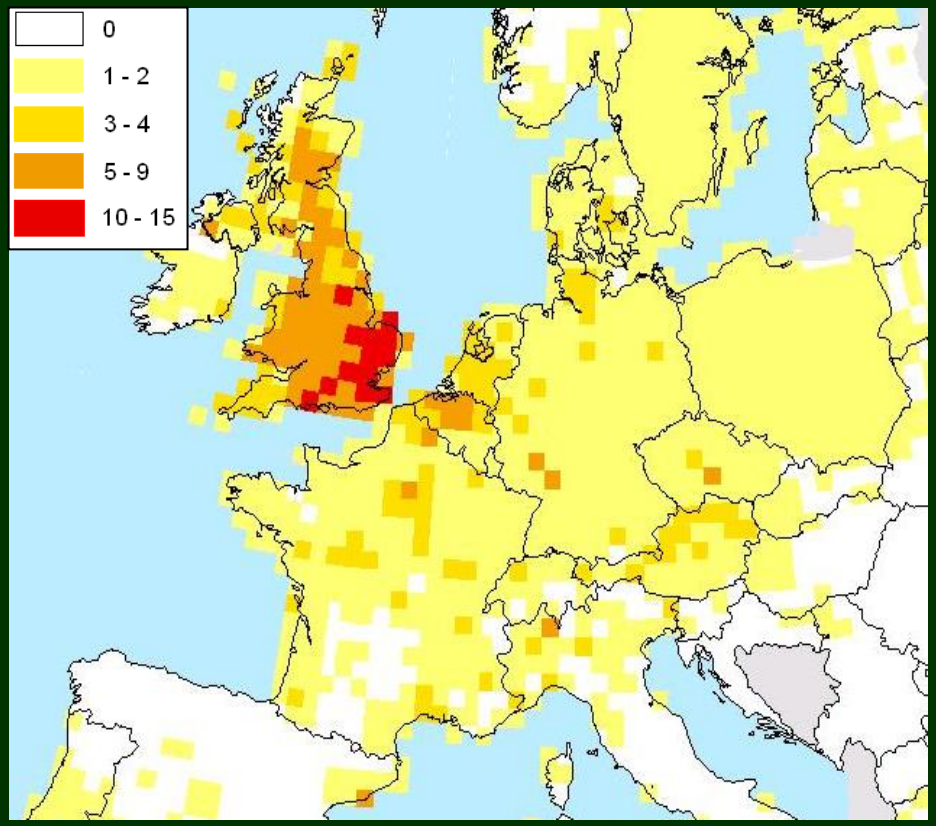
Adding atlas data

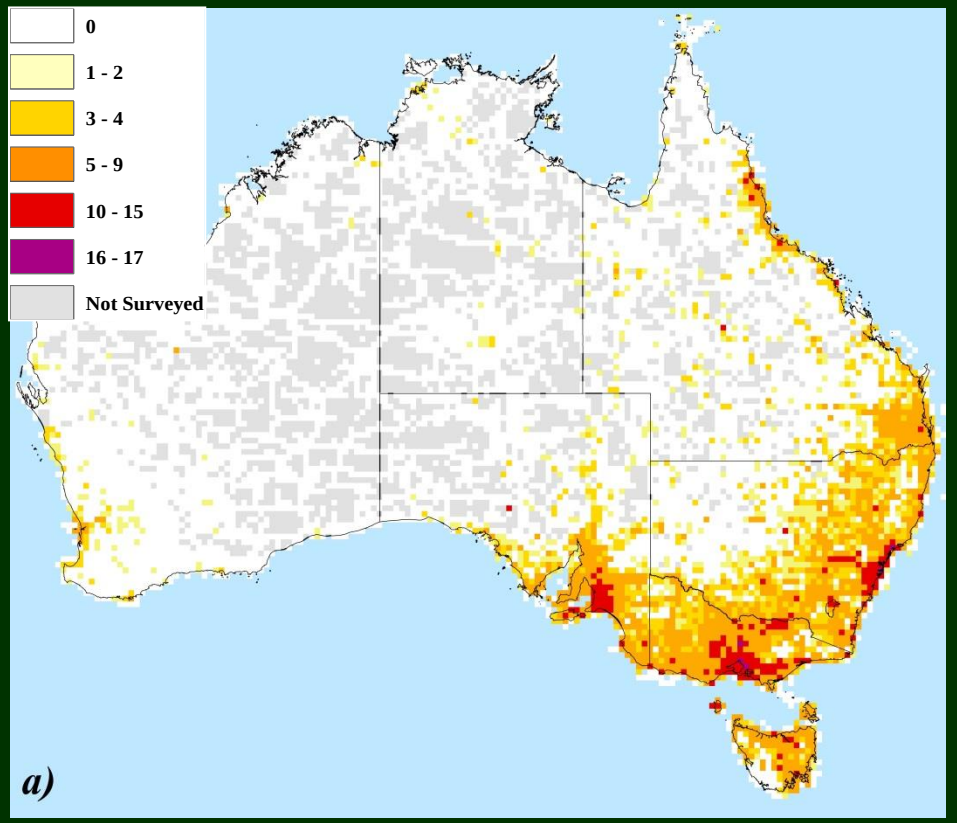
- ✓ >950,000 records of aliens
- ✓ Total ~9,000 grid squares 50X50 km across Australia (including near shore islands: Tasmania, Kangaroo Island and Tiwi Islands etc)
- ✓ The literature-based historical data was complemented to map introduction events and their outcomes

McKinney and Kark, Diversity and Distribution 2017

Alien Bird Species Richness: Europe vs. Australia

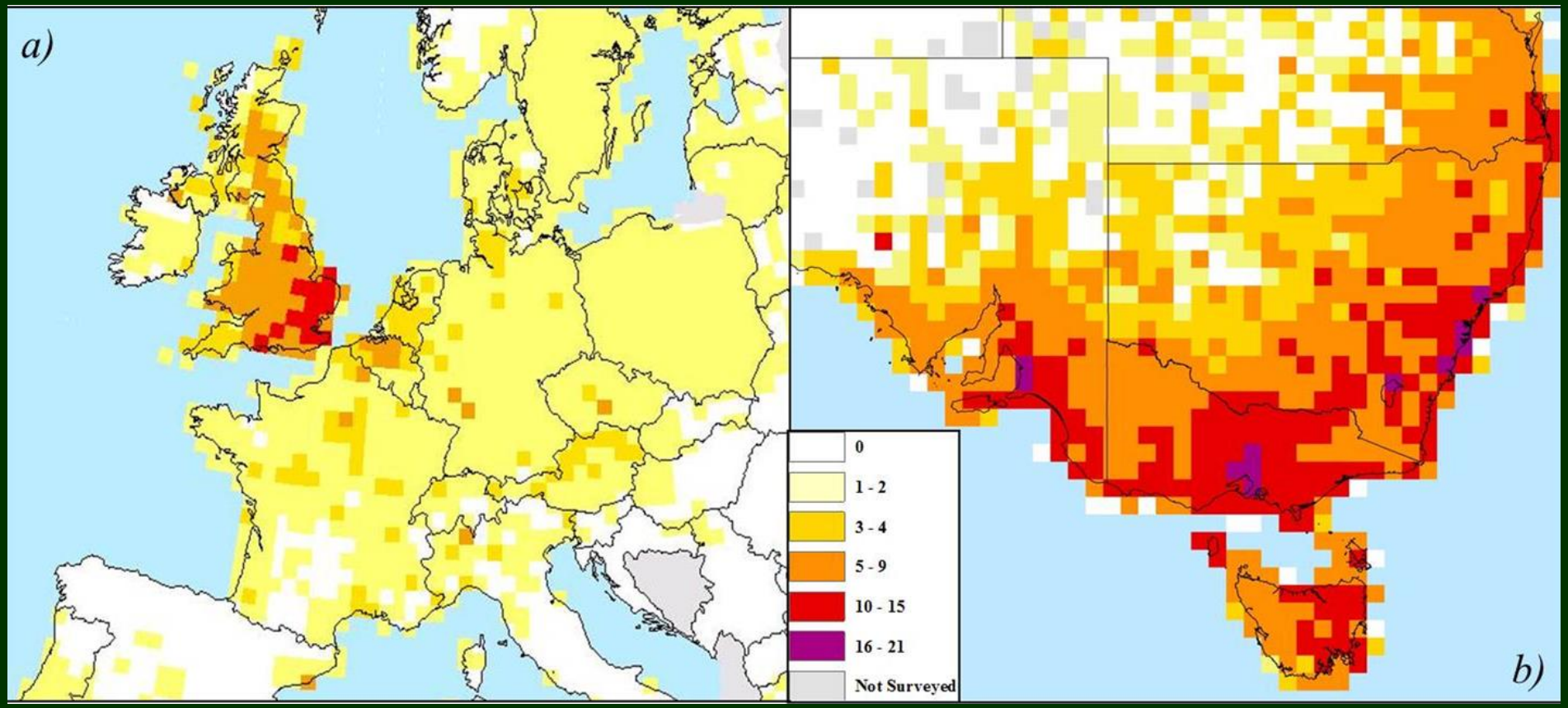
Non-Australian alien bird richness





Chiron et al. 2009, Kark and McKinney, Diversity and Distribution 2017

Alien Bird Species Richness:
Europe vs. Australia



European and non-Australian alien bird richness at 50x50 km

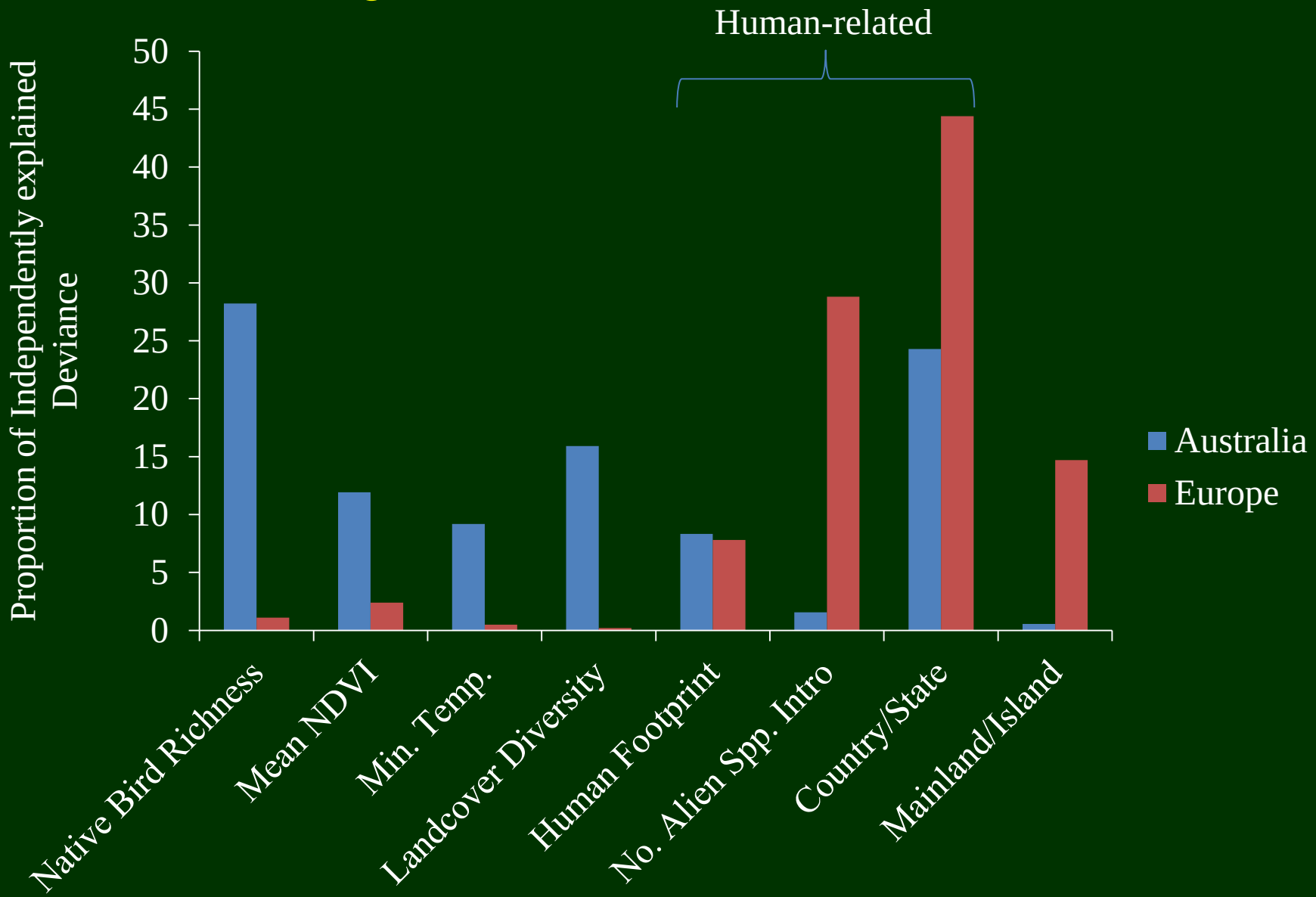
Chiron et al. 2009, Kark and McKinney, Diversity and Distribution 2017

Predictors of alien bird richness

Natural characteristics of the invaded ecosystem	Native bird richness
	Temperature (Min)
	Plant productivity
	Habitat diversity
Human-activity related factors	Number of species introduced
	Human impact, activity
Traits of successful invaders	Species origin (intra or inter-regional)

McKinney and Kark, Diversity and Distribution 2017

Hierarchical Partitioning Results

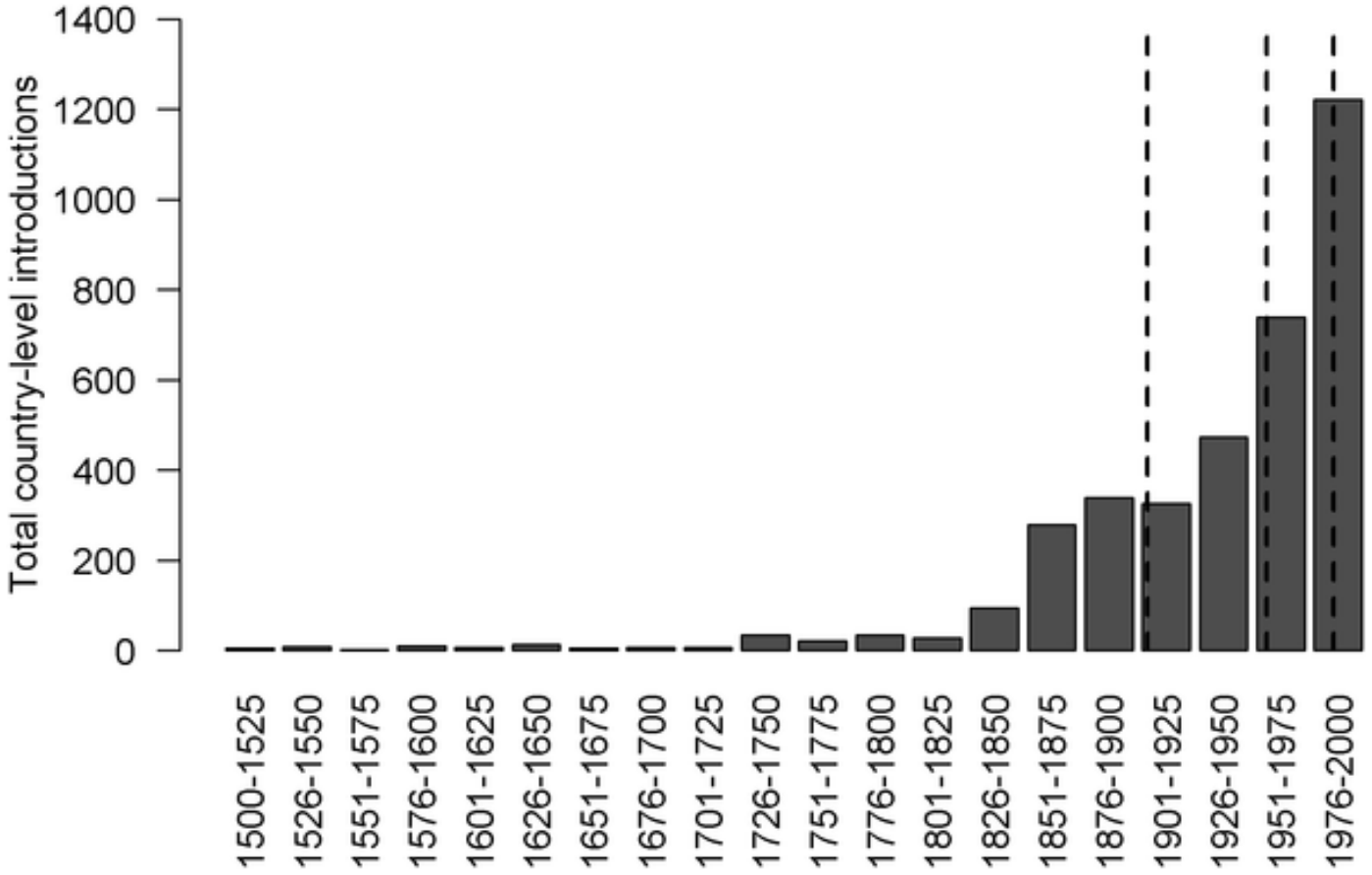


McKinney & Kark, Diversity & Distributions 2017

Global establishment patterns of alien birds show similar results and a combination of human-related and environmental determinants

Dyer, Blackburn and partners, 2017 PLoS Biology

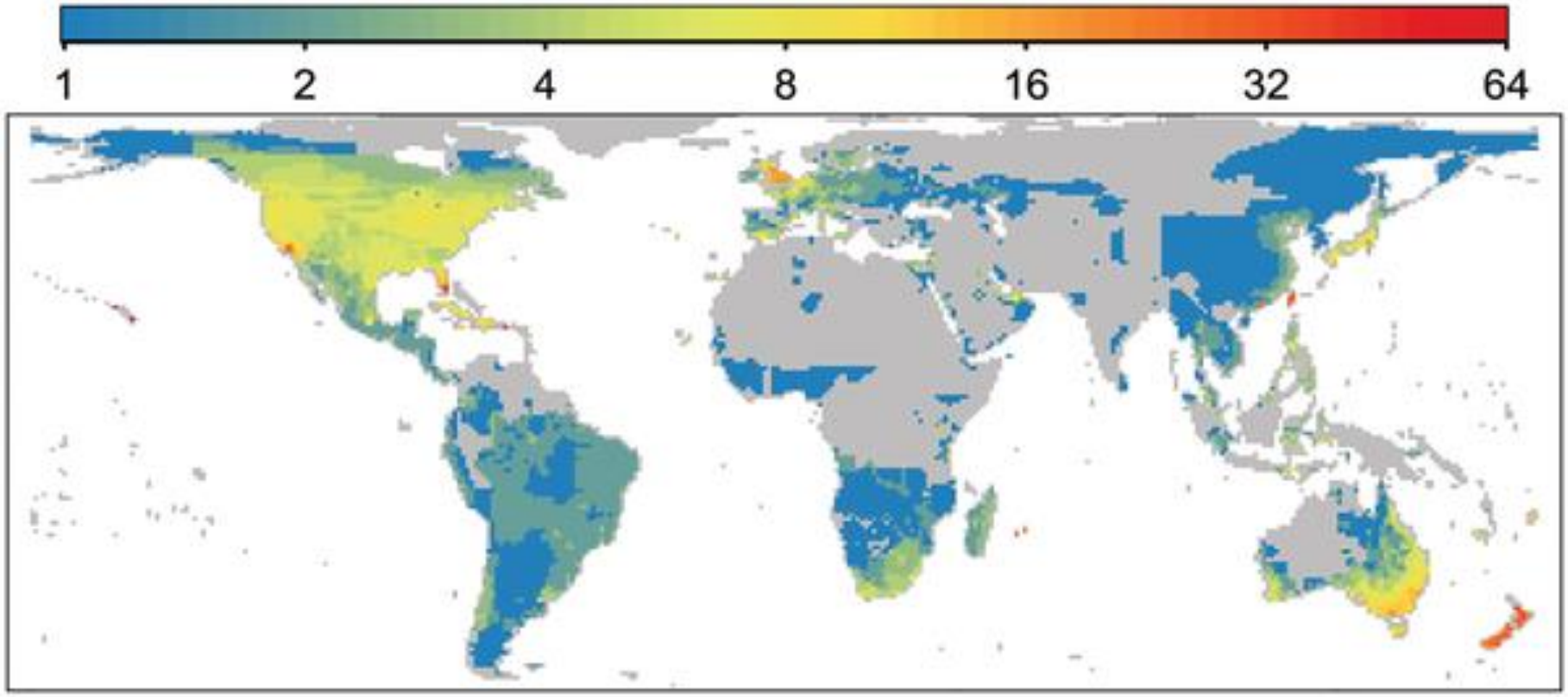
Total number of species introduced at the country level between 1500–2000



Dyer EE, Cassey P, Redding DW, Collen B, Franks V, et al. (2017) The Global Distribution and Drivers of Alien Bird Species Richness. PLOS Biology 15(1): e2000942. doi:10.1371/journal.pbio.2000942

PLOS | BIOLOGY

Global map of alien bird species richness



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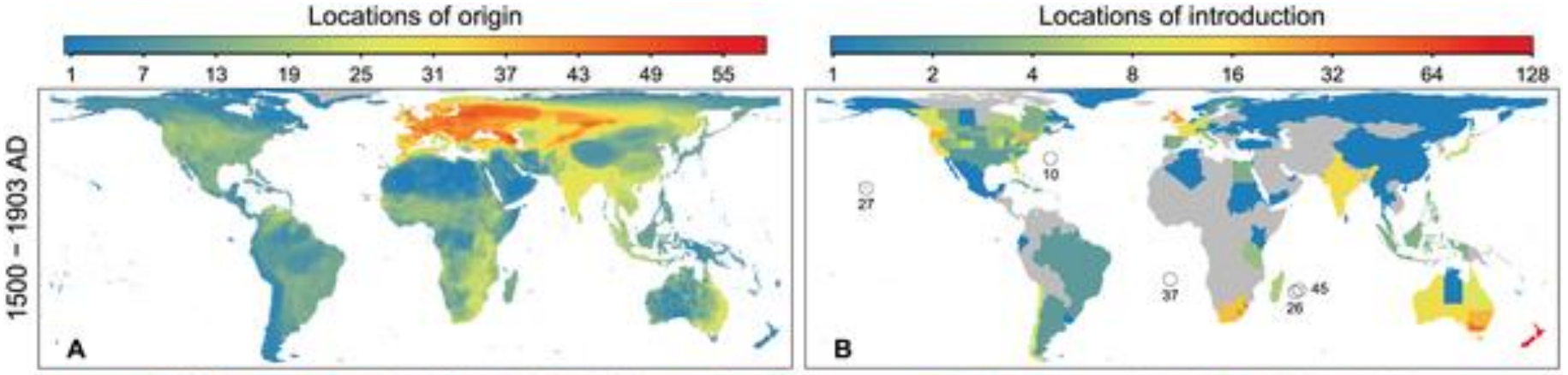
Locations of origin and introduction for bird species with introduced populations



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PLOS | BIOLOGY

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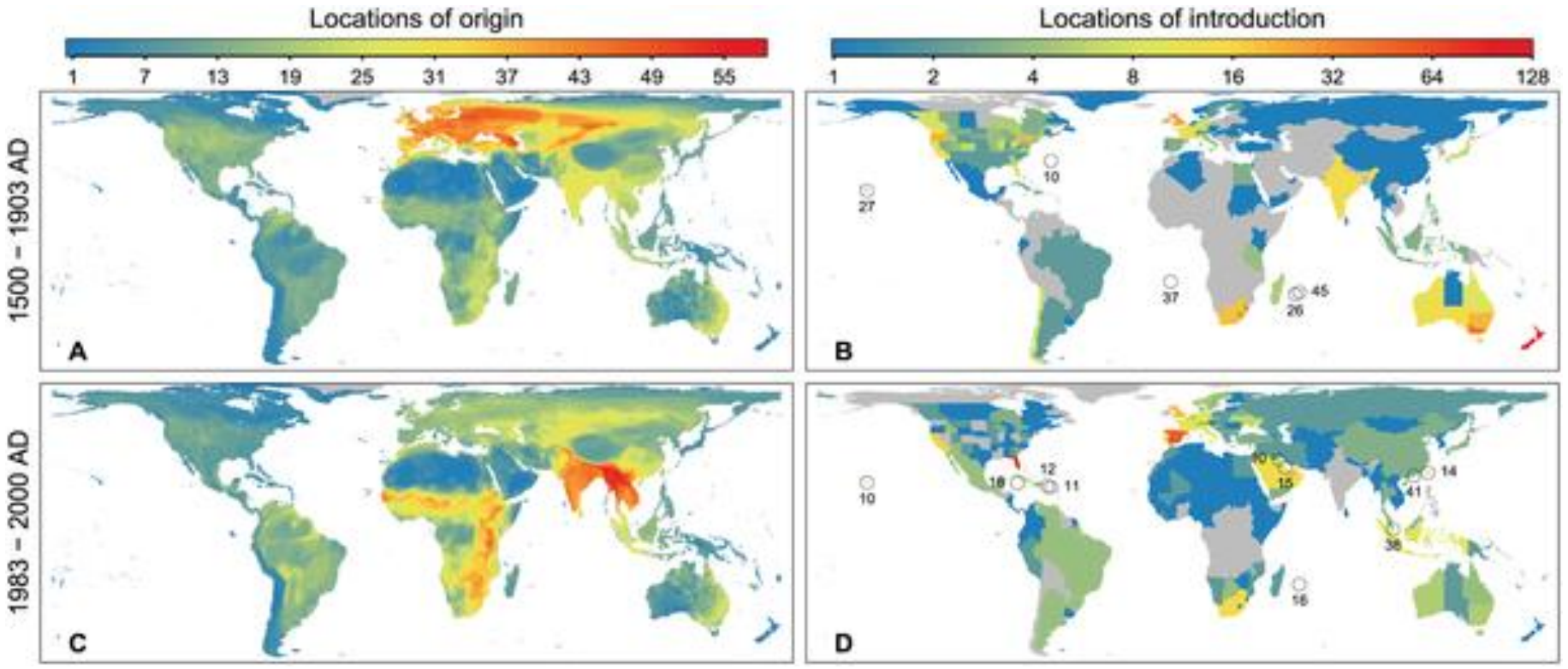


Dyer et al. (2017) The Global Distribution and Drivers of Alien Bird Species Richness. PLOS Biology 15(1): e2000942. doi:10.1371/journal.pbio.2000942

PLOS | BIOLOGY

Some thoughts and ideas for future collaborations

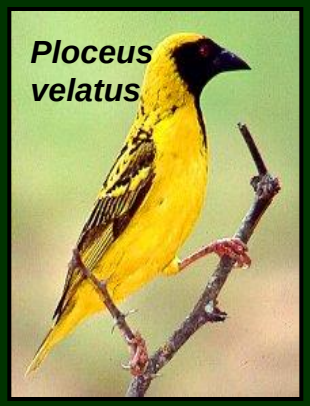
- Factors shaping Australian aliens richness are different to Europe
- Global and European alien richness show strong links to socio-political factors
- Impacts are unique (interactions work, cavity nesting birds)
- Effect of survey effort (number of unique survey records per quadrat)
- Australian native richness (honeyeaters and parrots)
- Australian birds are very aggressive (why?)
- Opens many questions for future work and collaborations

The coinvasion of alien birds

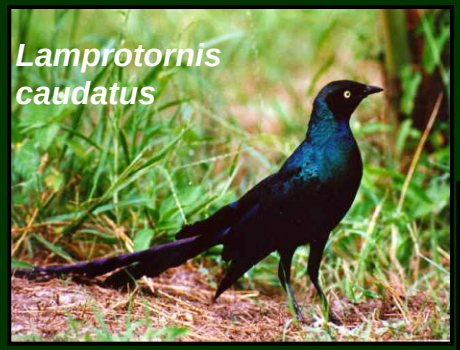
ציפורים פולשות בישראל:
התבססות של מינים פולשים והשפעותיהם על המגוון הביולוגי המקומי בפארק הירקון

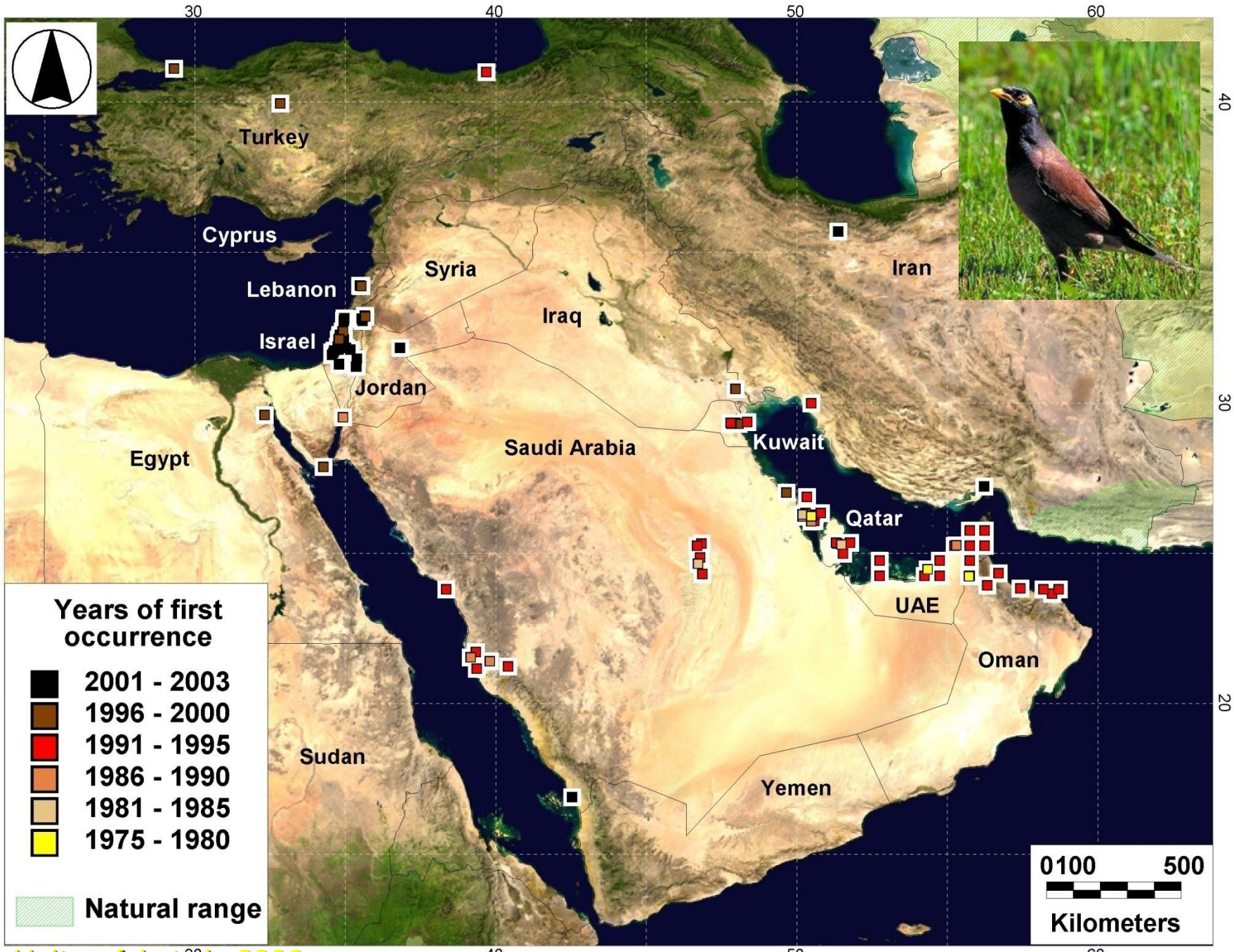
עבודת מוסמך של יותם אורחן במעבדה לחקר המגוון הביולוגי בהנחיית ד"ר סלעית קרק

Introduced birds in Israel: increase in the past decades



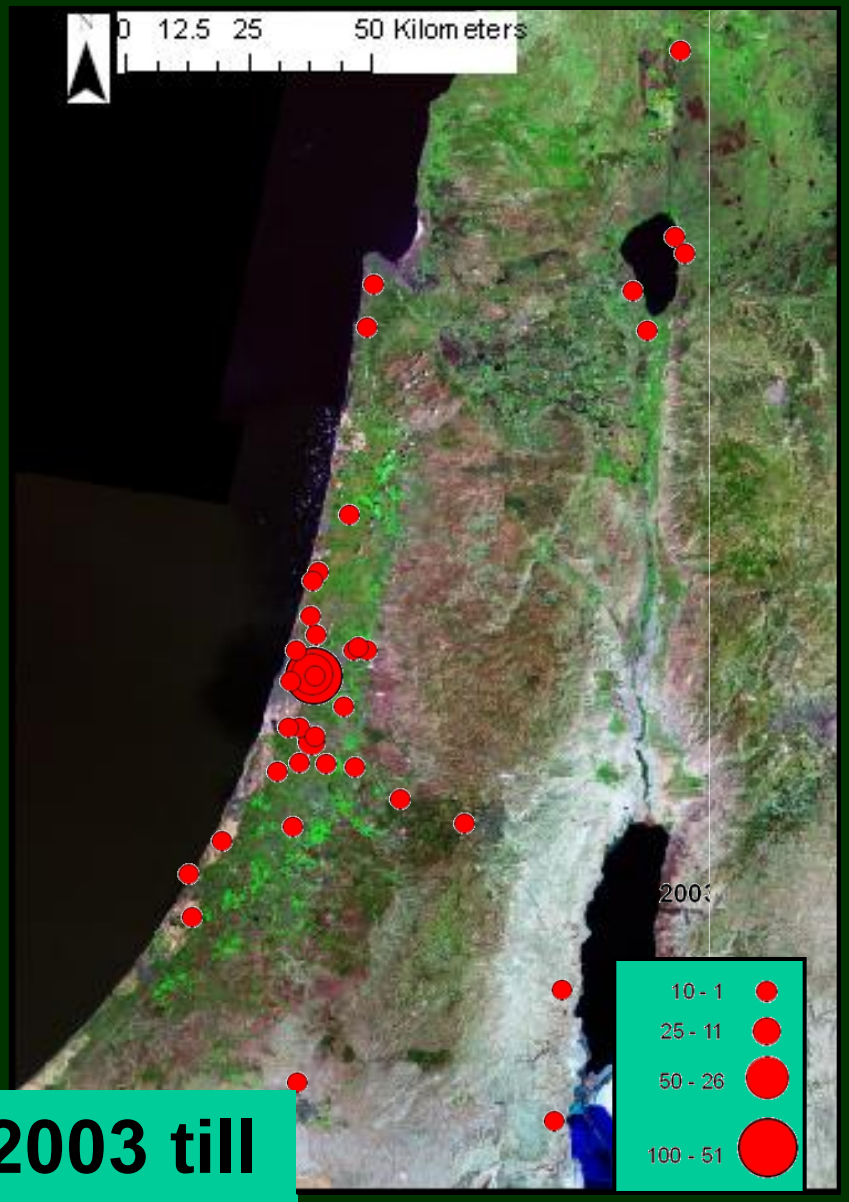
Many of the introductions are in the past 20 years





Holtzapfel et al., 2006

Common myna
Acridotheres tristis

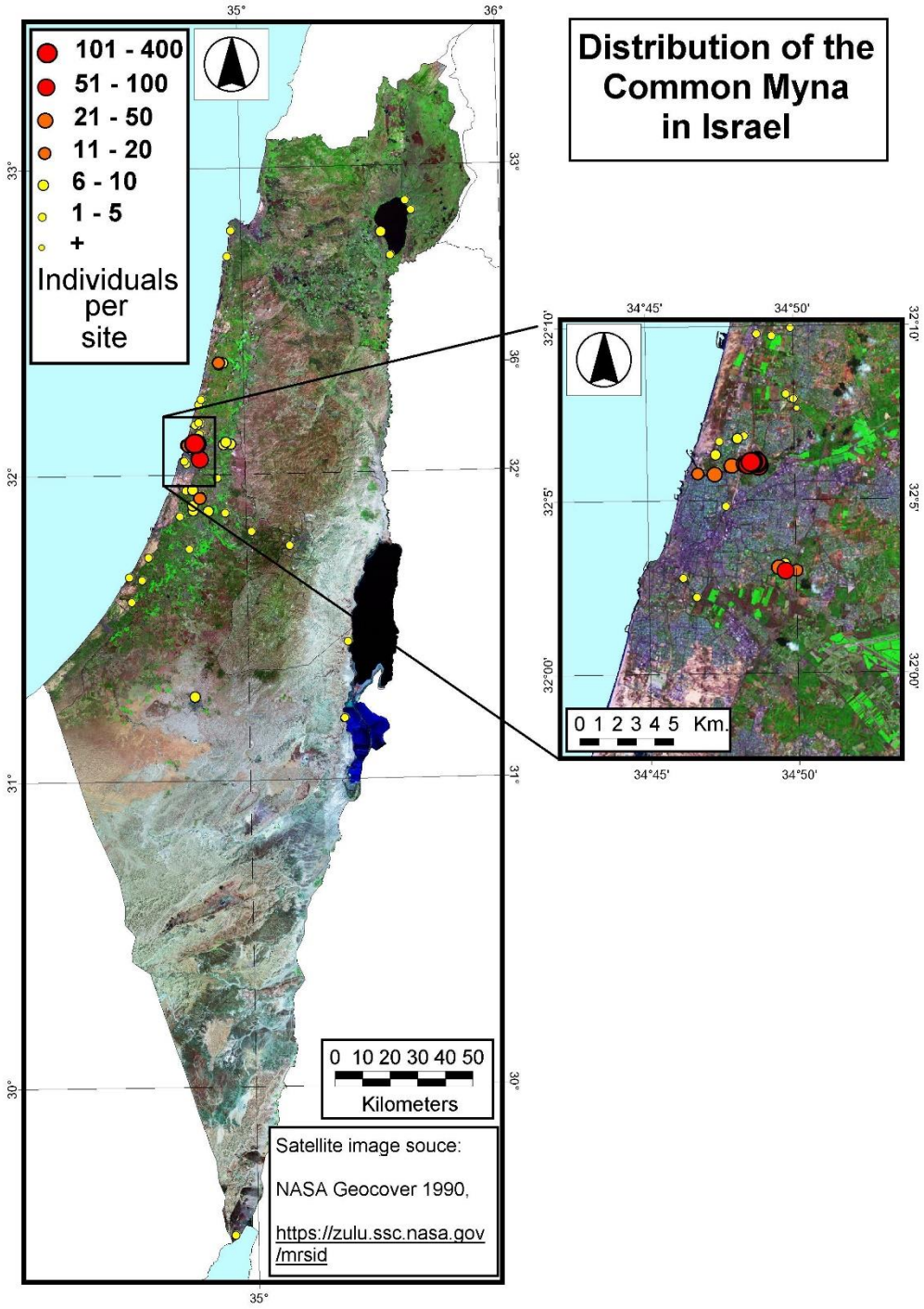


2003 till

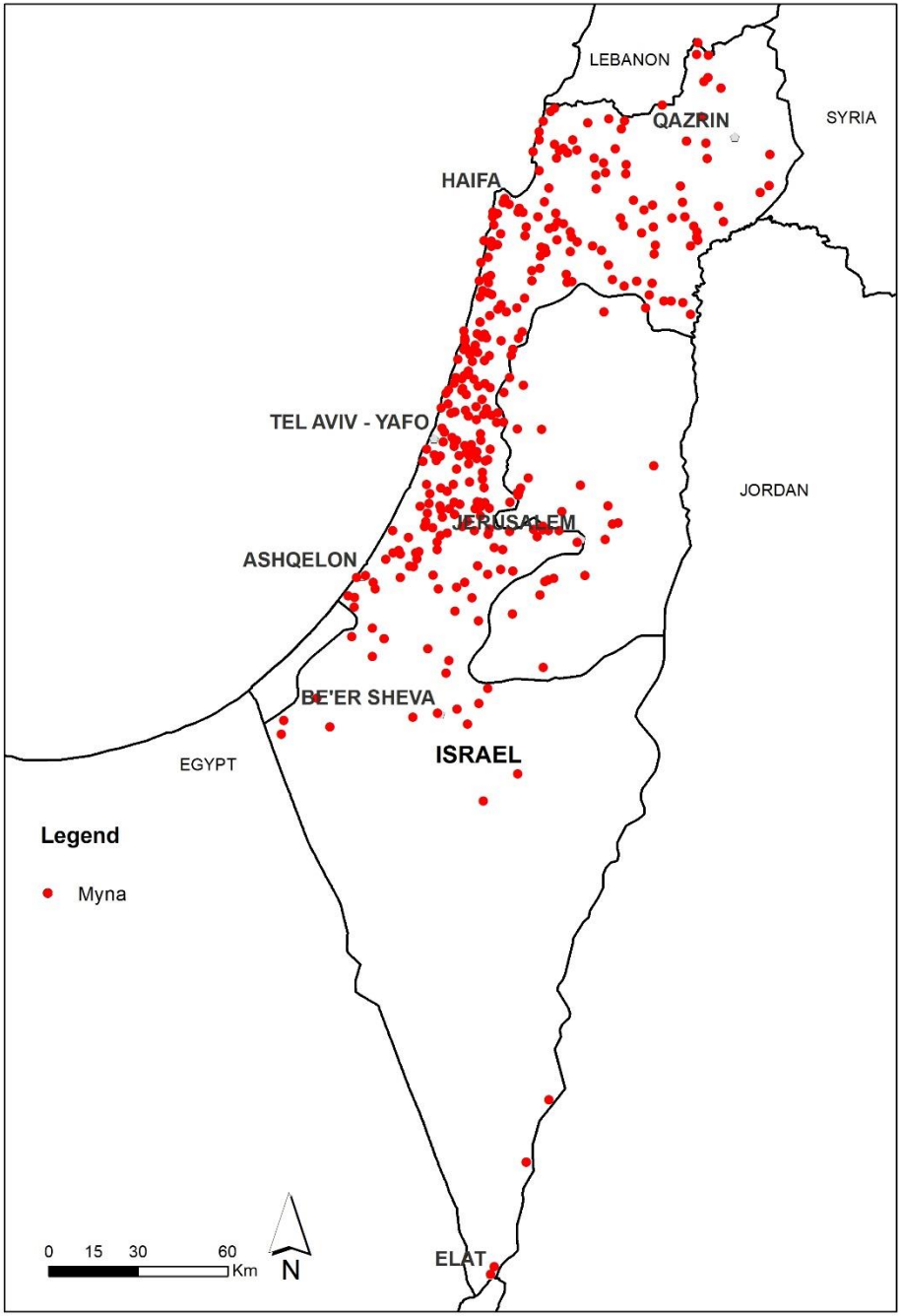

Common Myna

Holzapfel et al 2006, Sandgrouse

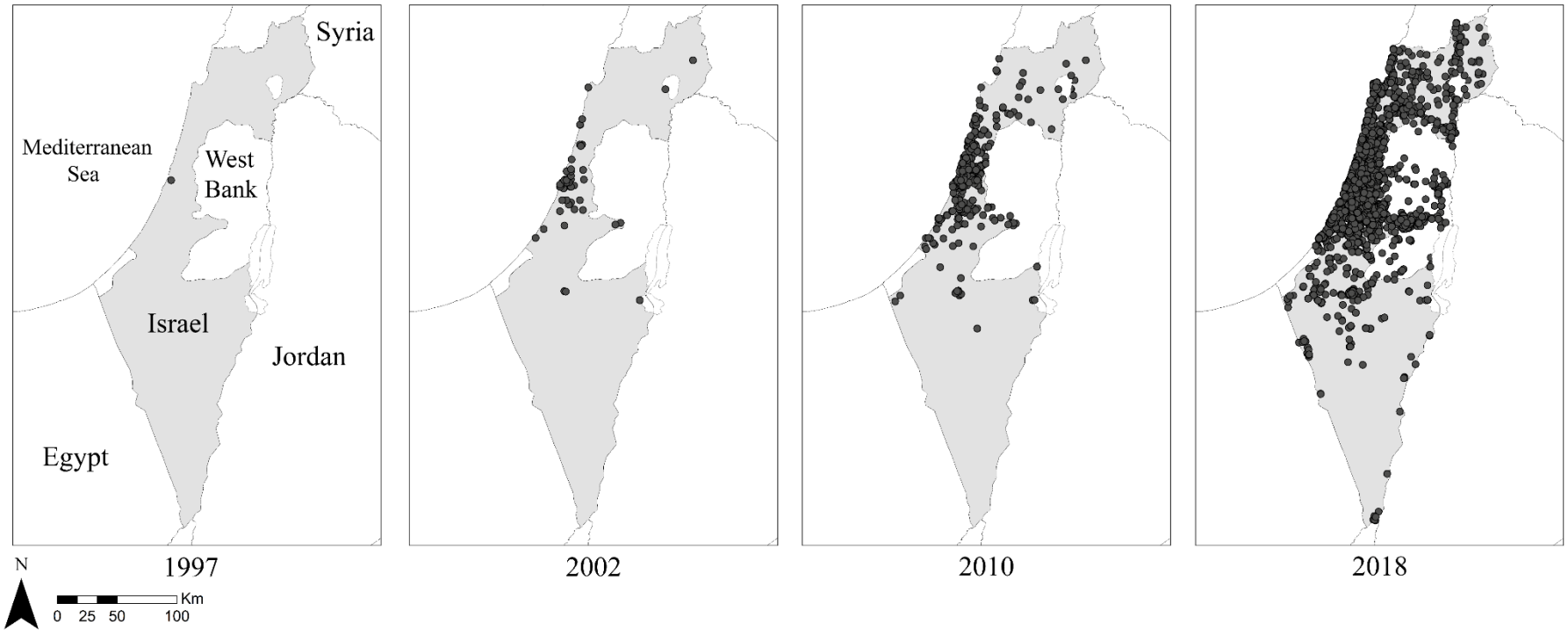
Holzapfel et al., 2006



Common myna range in Israel based on Garden Birds counts up to 2017, created by Assaf Shwartz

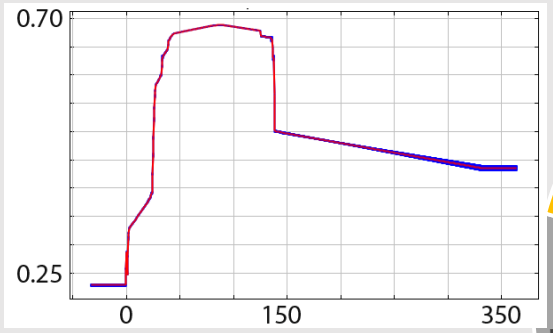


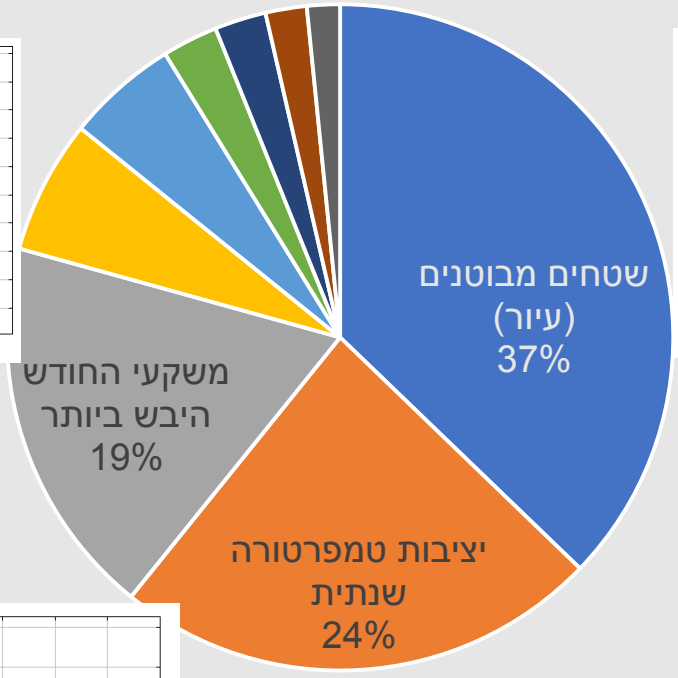
השתנות תפוצת המיינה המצויה בישראל

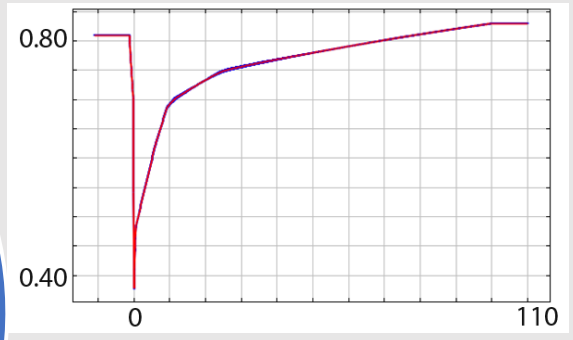


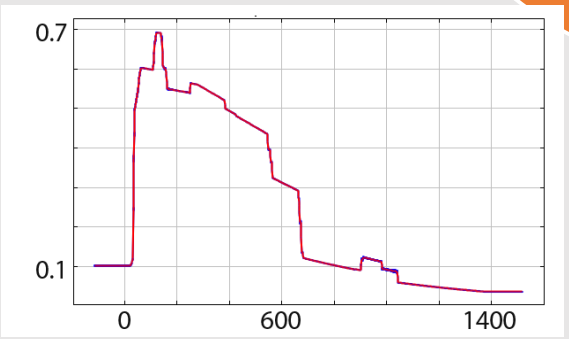
Magory Cohen & Dor, *in prep.*

הגורמים המסבירים את תפוצת המיינה המצויה





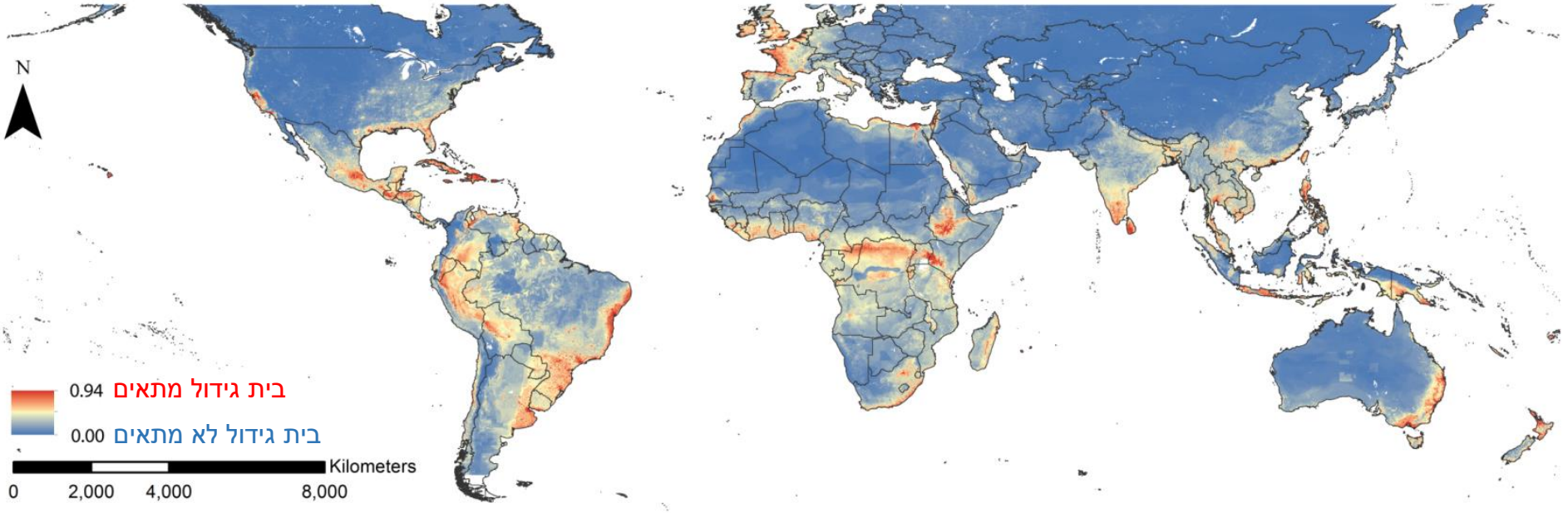




- ככל שהעיור נרחב יותר, כך ההסתברות לנוכחות מיינות גדלה.
- סבילות גבוהה לתנאי סביבה מגוונים, מלבד אזורים יבשים מאוד

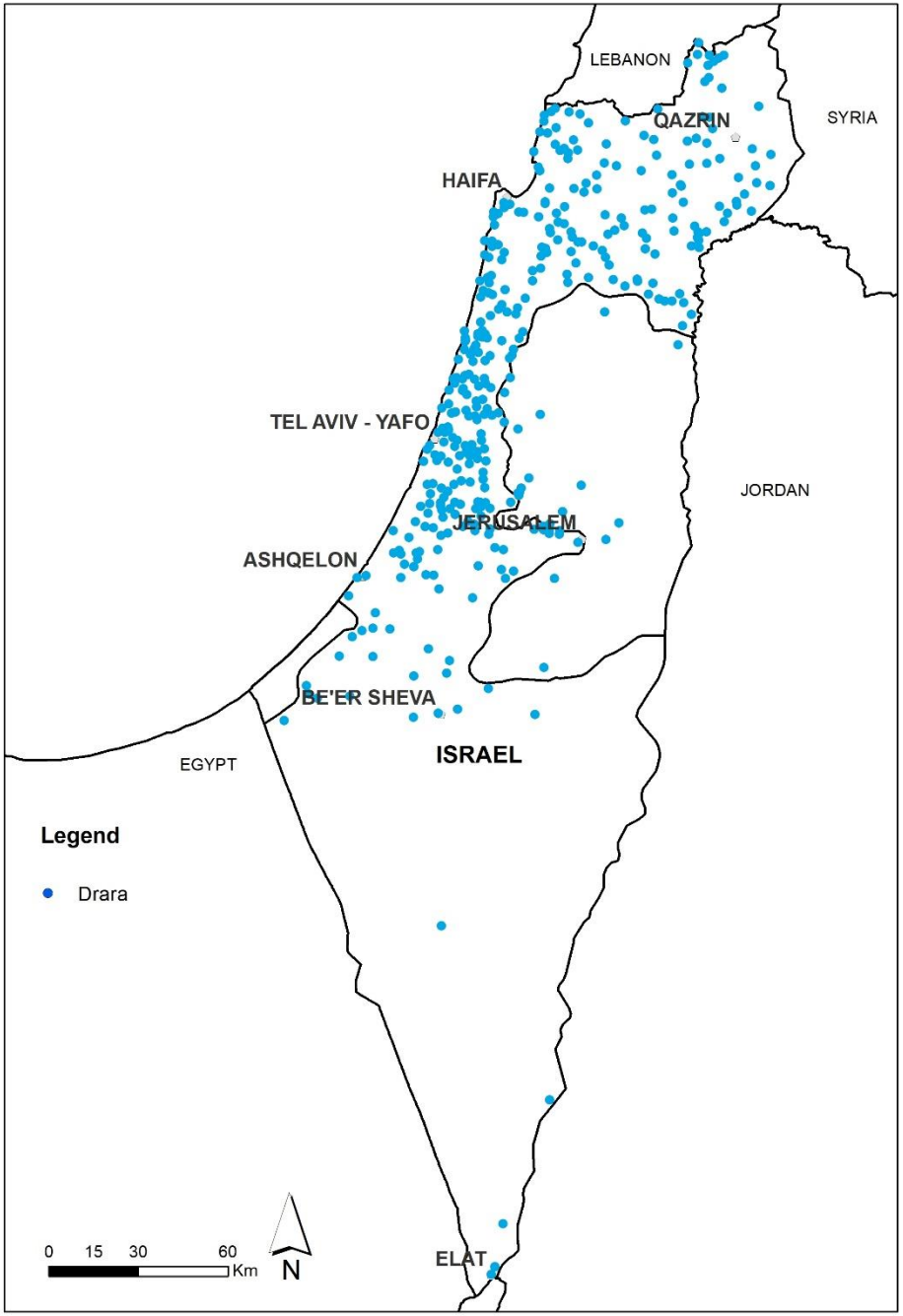
Magory Cohen et al., *in review*

התפוצה הפוטנציאלית של המיינה המצויה



Magory Cohen et al., accepted

Rose-ringed parakeet range in Israel based on Garden Birds counts up to 2017, created by Assaf Shwartz



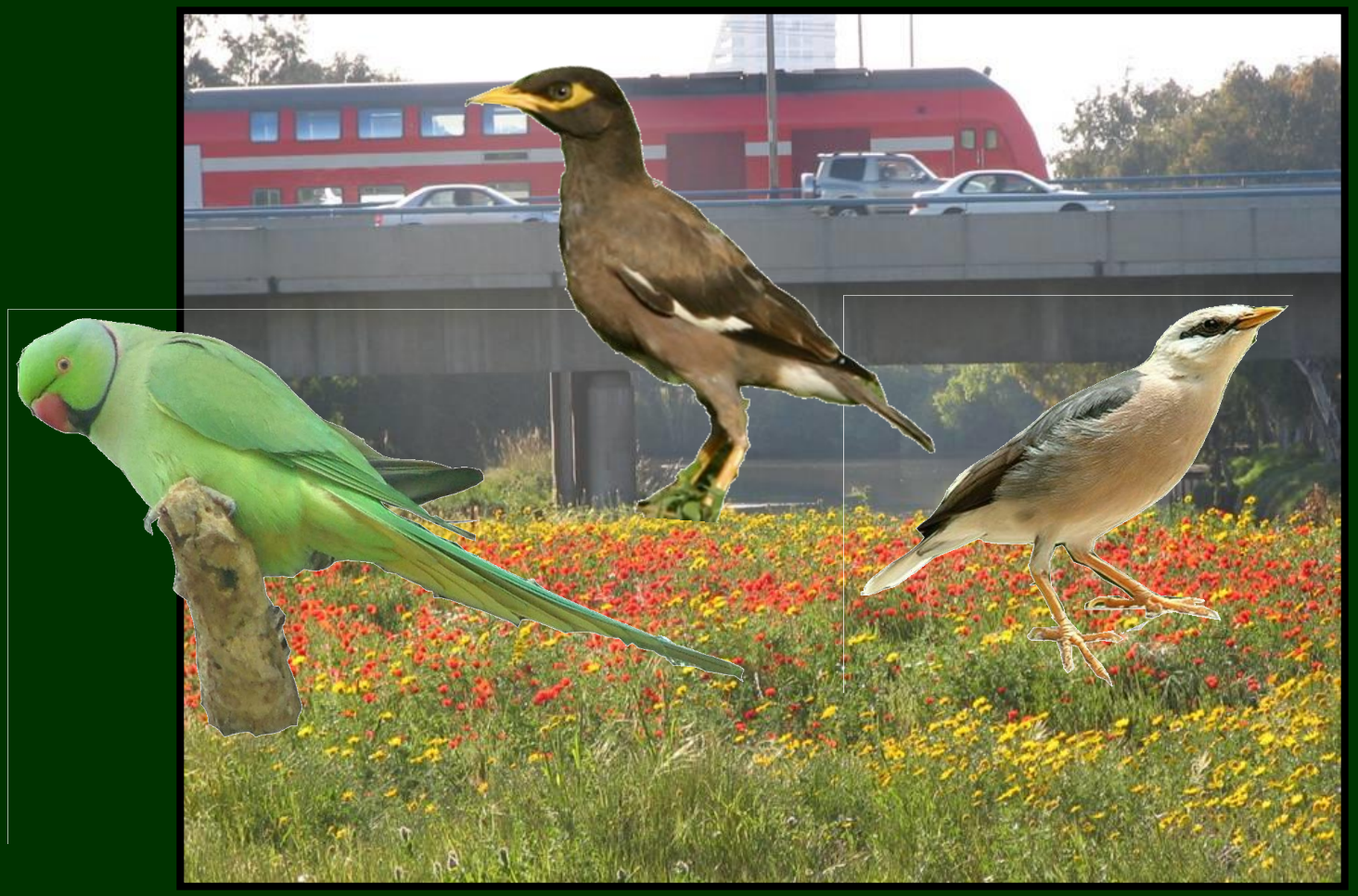
The Yarkon Park

The largest urban park in Israel (~262 ha)

- Point sampling

Invasional meltdown "התכה"

Simberloff and von Holle



Biological Invasions **1:** 21–32, 1999.

Positive interactions of nonindigenous species: invasional meltdown?

Daniel Simberloff* & Betsy Von Holle

An invasional meltdown process:

"the process by which a group of nonindigenous species facilitate one another's invasion in various ways, increasing the likelihood of survival and/or of ecological impact... Thus, there is an accelerating accumulation of introduced species."

Much work has been done on two species, less at a whole community or guild level

Vinous-breasted myna *Acridotheres burmannicus*

Secondary cavity nesters

Great tit, house sparrow, Scops owl, common myna, vinous-breasted starling

Weak excavator

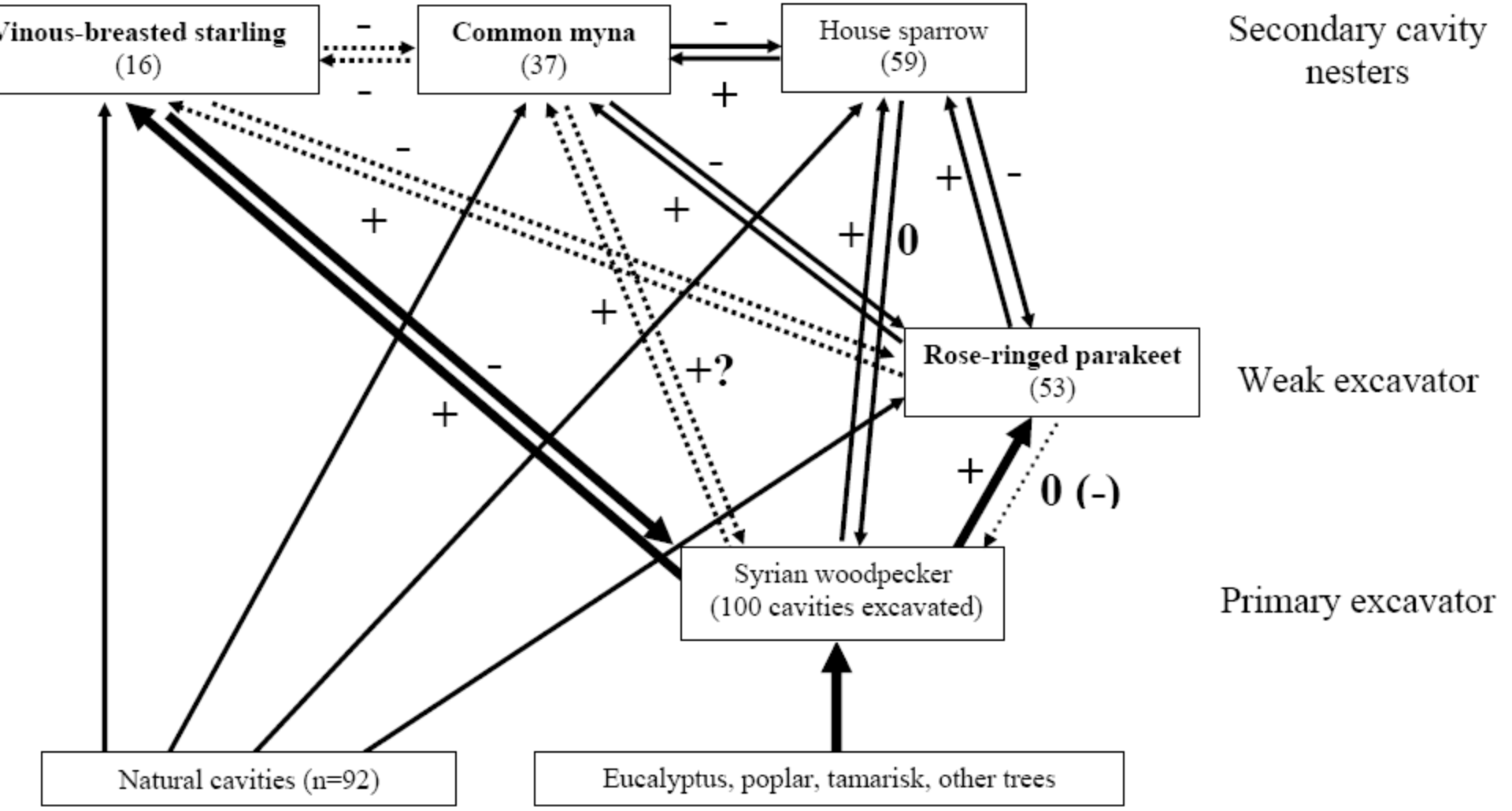
Rose-ringed parakeet

Primary excavator

Syrian woodpecker

Natural cavities

Figure of Yarkon Park cavity nesters web
אינטראקציות בין מקנני החורים בפארק הירקון



Summary of relationships

Scops owl

Common myna

House sparrow

VB myna

Rose ringed parakeet

Great tit

woodpecker

Orchan et al. Biol Inv 2013, Charter et al. Journal Env Mng 2016

Negative impact

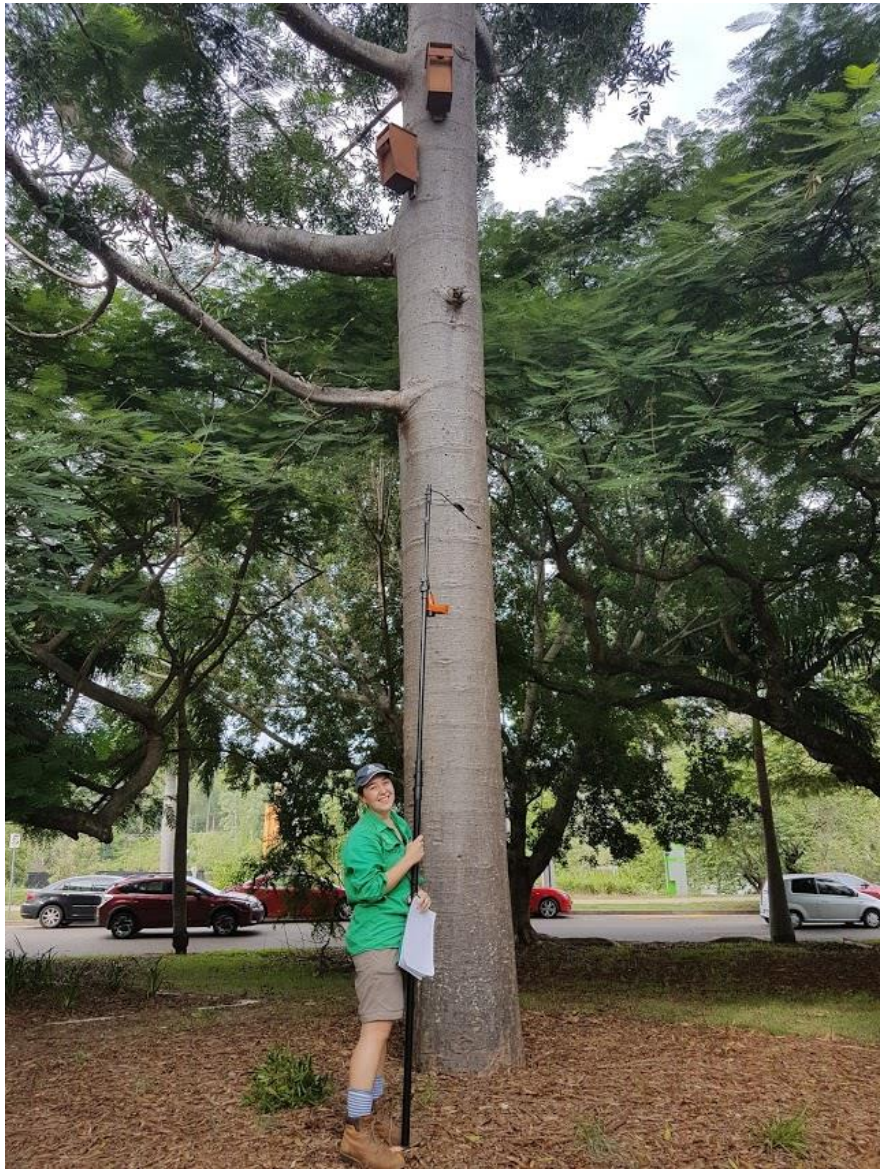
Positive impact

Estimated impact

Orchan Y., Chiron F., Shwartz A. and **Kark S.** 2013. The complex interaction network among multiple invasive bird species in a cavity-nesting community. Biological Invasions 15: 429–445

Charter, M., Izhaki, I., Mocha, Y.B. and Kark, S. 2016. Nest-site competition between invasive and native cavity nesting birds and its implication for conservation. Journal of Environmental Management 181: 129-134.


UQ
Sustainability
NESTING BOXES
UQ is installing wildlife nesting boxes like the one in this tree to increase wildlife habitat on campus. Working with UQ conservation scientists, more than 120 wildlife nesting boxes have been installed at the St Lucia and Gatton campuses and at the University's Long Pocket and Pinjarra Hills sites.
A range of native species, from birds and mammals to reptiles and insects, depend on the natural hollows that develop in trees for breeding, roosting and sheltering. In urban spaces that have been subject to widespread clearing of large, old native trees, nesting boxes provide an important supplement to naturally occurring hollows. These nesting boxes also allow UQ researchers to study the behaviour and ecology of cavity users to help advance their conservation.
Over a dozen native species, including birds such as rainbow lorikeets, pale-headed rosellas, scaly-breasted lorikeets and mammals, such as squirrel gliders and possums, use the nesting boxes in this area.
THE UNIVERSITY OF QUEENSLAND
AUSTRALIA



Interactions

Interactions

Pale-headed rosella

Interactions

Interactions

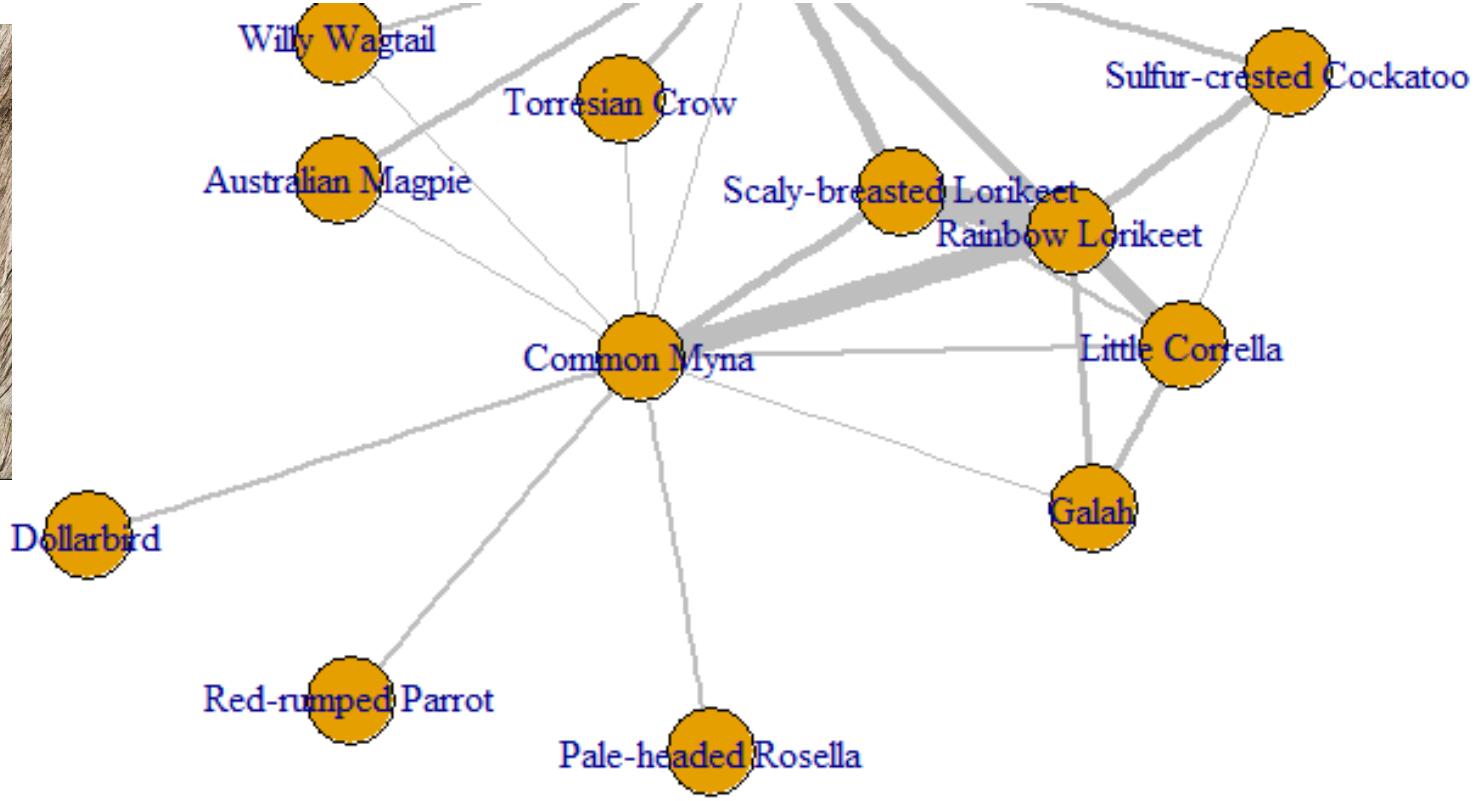
Interactions

More info here: **KarkGroup.org**

More info: KarkGroup.org

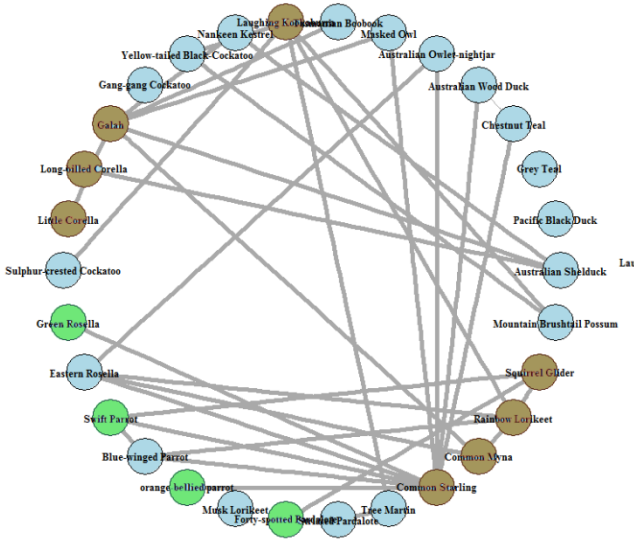
Orchan et al. 2013, Charter et al. 2016

Species interactions around nest boxes and natural hollows

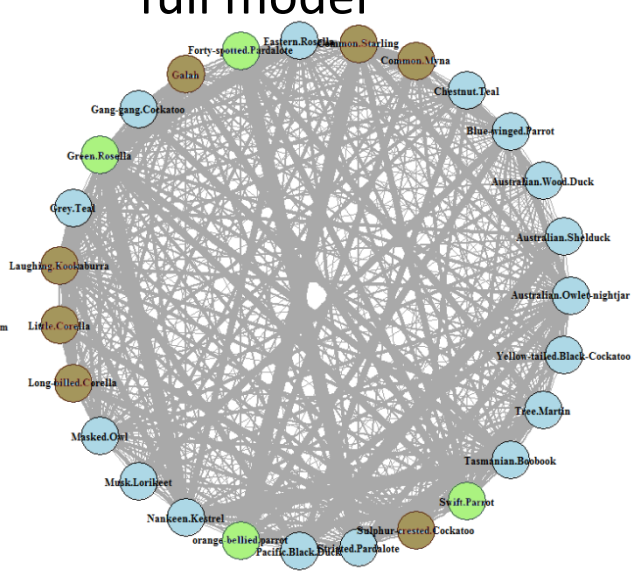


Known knowns, Unknown knowns, and unknown unknowns

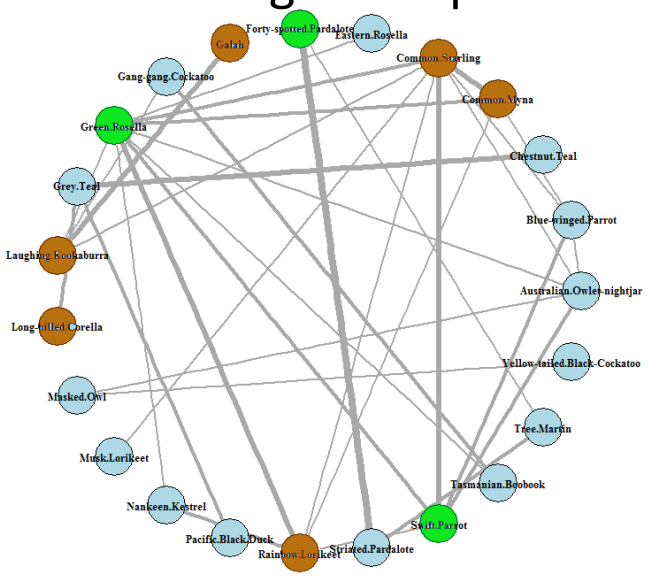
Published interactions



Niche overlap: full model



Niche overlap: strong overlap



Some thoughts and ideas for future collaborations

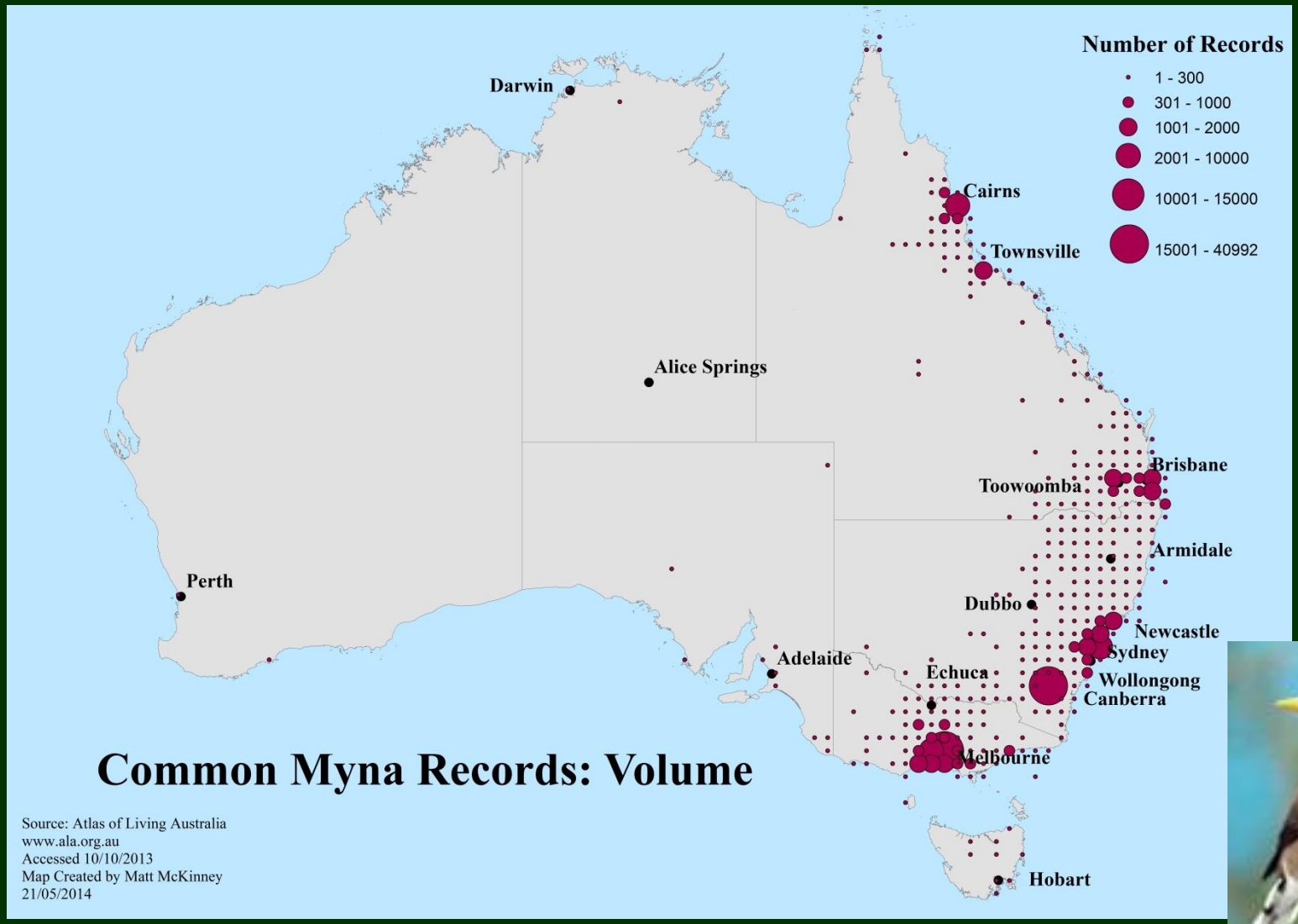
- Factors shaping aliens richness are different across continents
- Global and European alien richness show strong links to socio-political factors Complex interactions determine establishment outomes
- Impacts are unique (interactions work, cavity nesting birds)
- Management and cross boundary coordination
- Opens many questions for future work and collaborations

Thanks תודה

Biodiversity Research Group students and postdocs
Andrea Griffin and Francoise Lermite
Research partners in Europe, Israel and Australia
The Australian Research Council

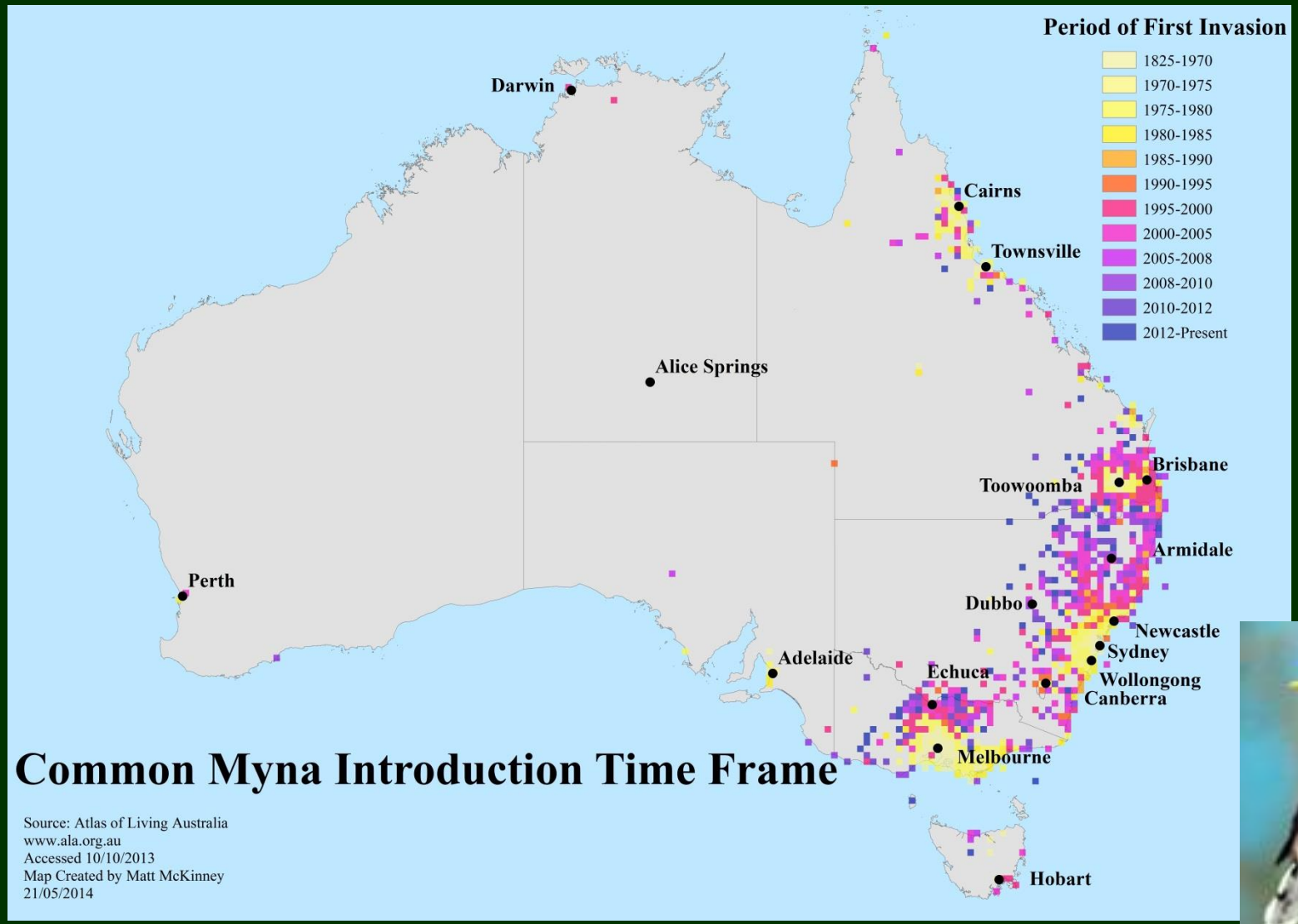
Read more: www.KarkGroup.org

Common Mynas



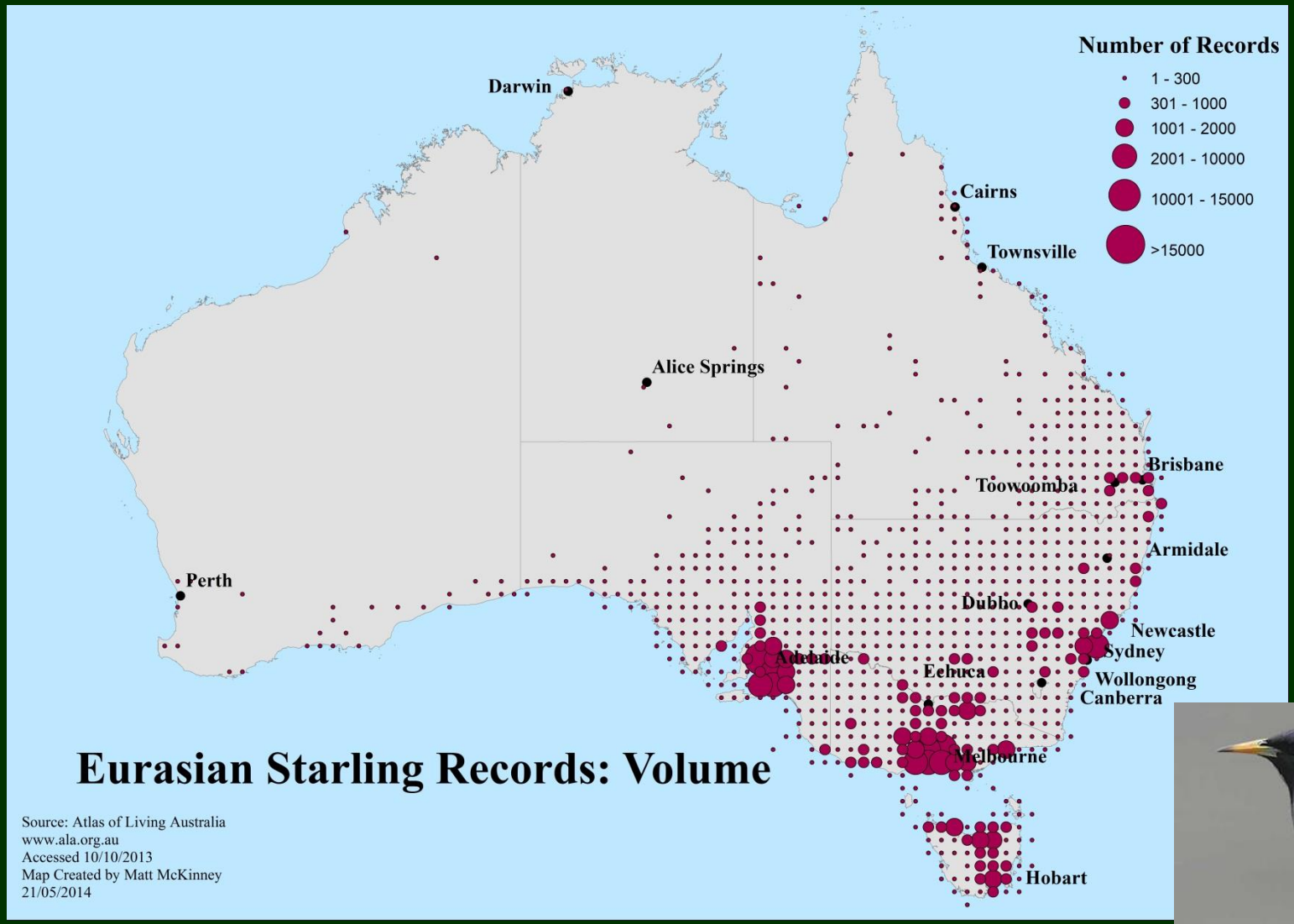
Data Source: Atlas of Living Australia

Common Mynas



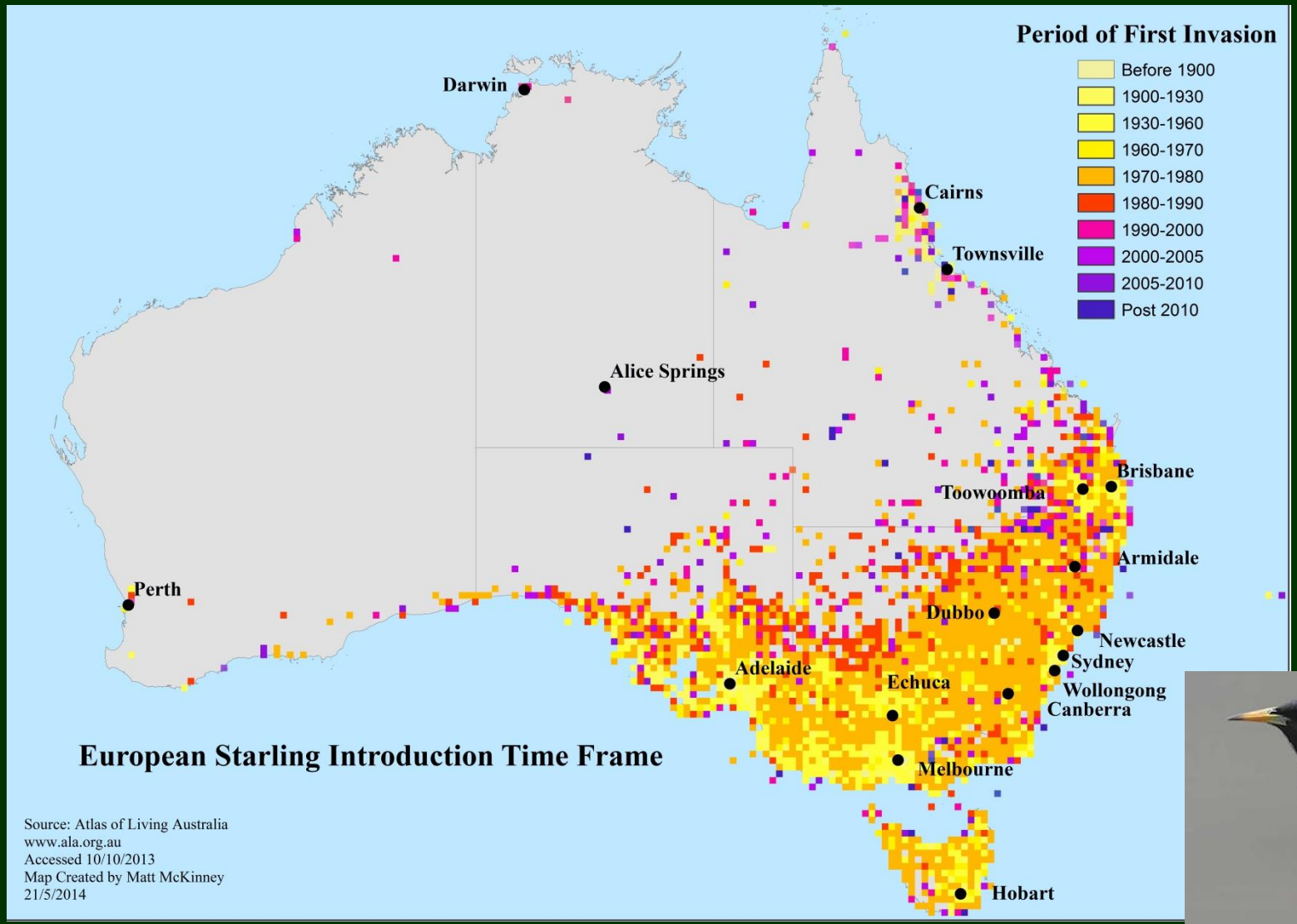
Data Source: Atlas of Living Australia

European Starlings



Data Source: Atlas of Living Australia

European Starlings



Data Source: Atlas of Living Australia

Quantifying the impacts of the invasive common myna in Australia

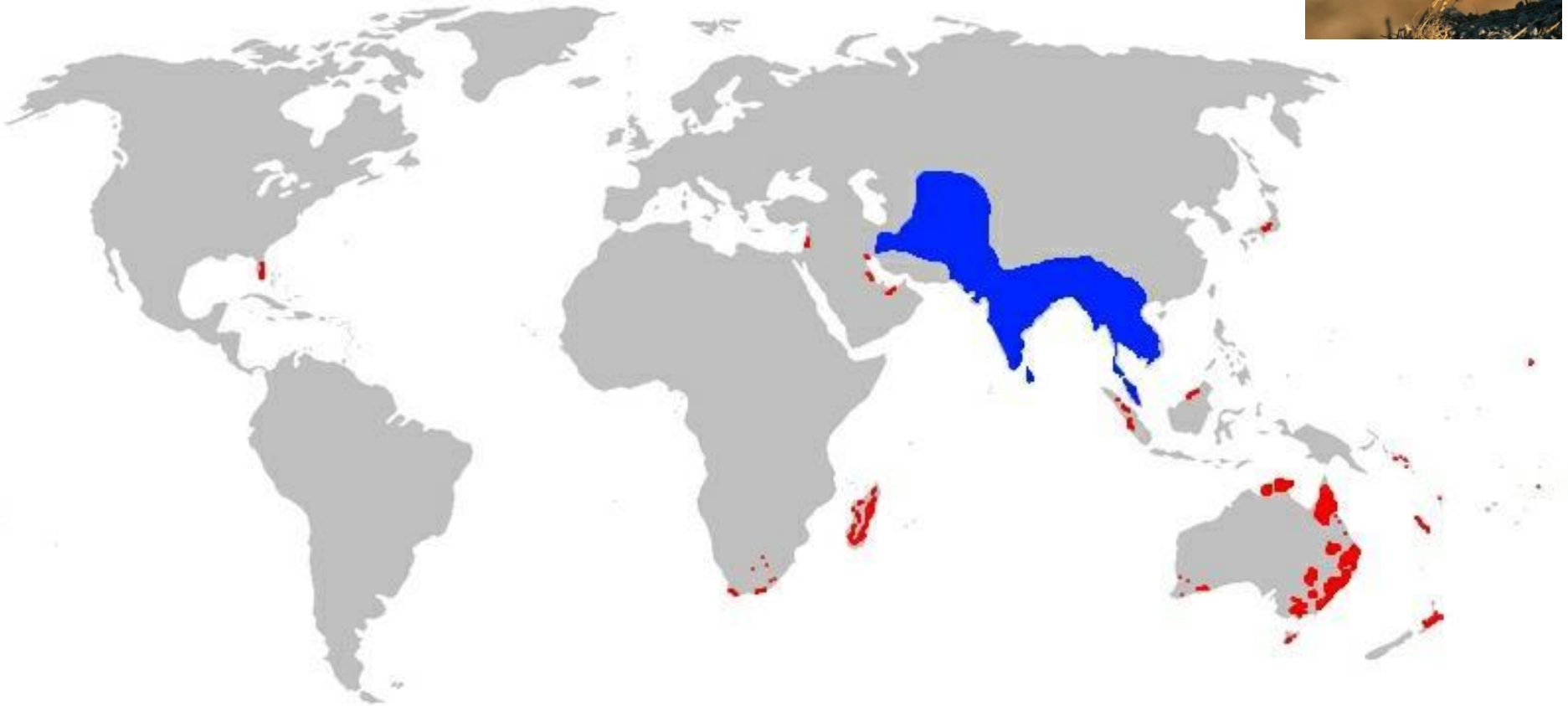
Andrew Rogers,

Threatened Species Recovery Hub
National Environmental Science Programme

Biodiversity Research Group

The University Of Queensland
AUSTRALIA

Common Myna: Distribution



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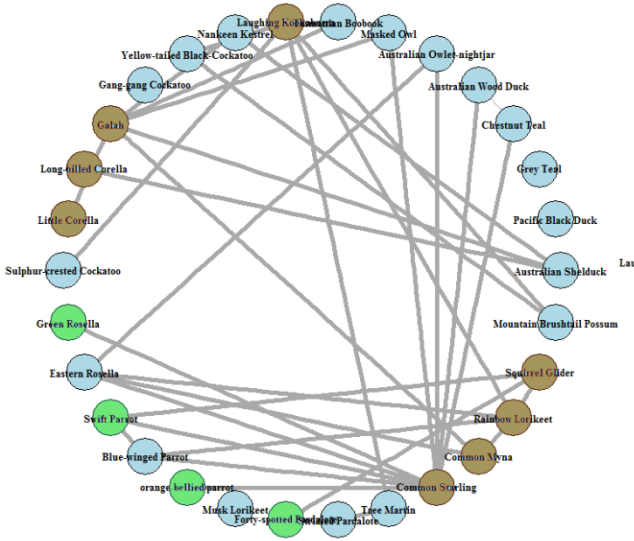
Published interactions



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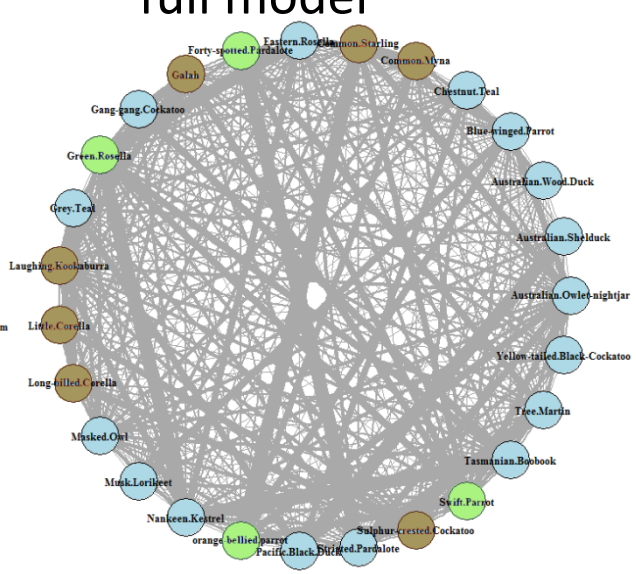

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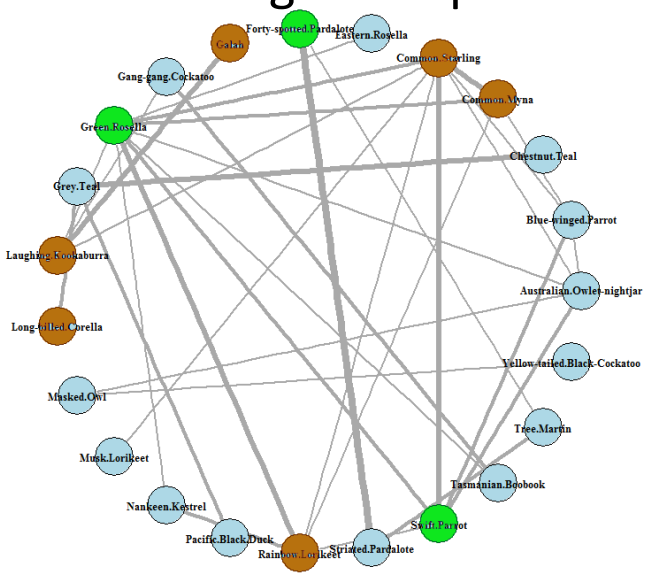
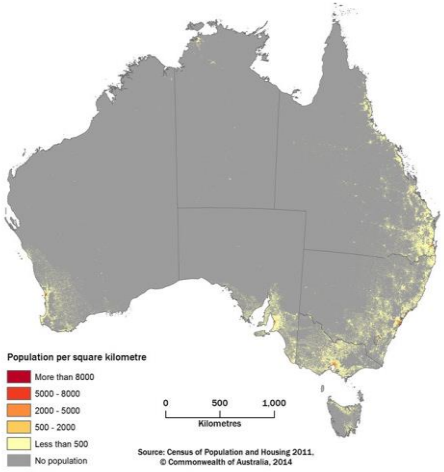


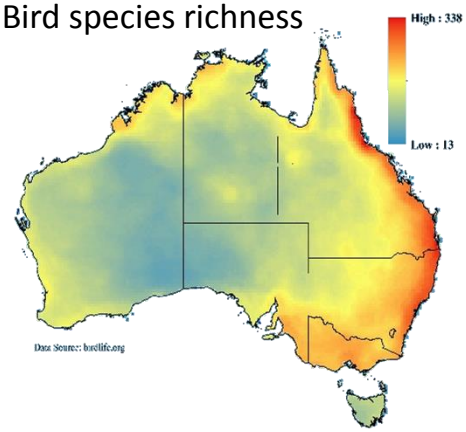
An island continent

- 313 species in Australia depend on hollows
- Birds – 114 species, ~31%
  - No woodpeckers
  - No birds create hollows in living wood
- Natural tree hollows are a limited resources in transormed landscapes due to the loss of big old trees
  - Should lead to increased competition around remaining nest sites
- Despite this, some cavity breeding species do very well in urban habitats.

Human population density

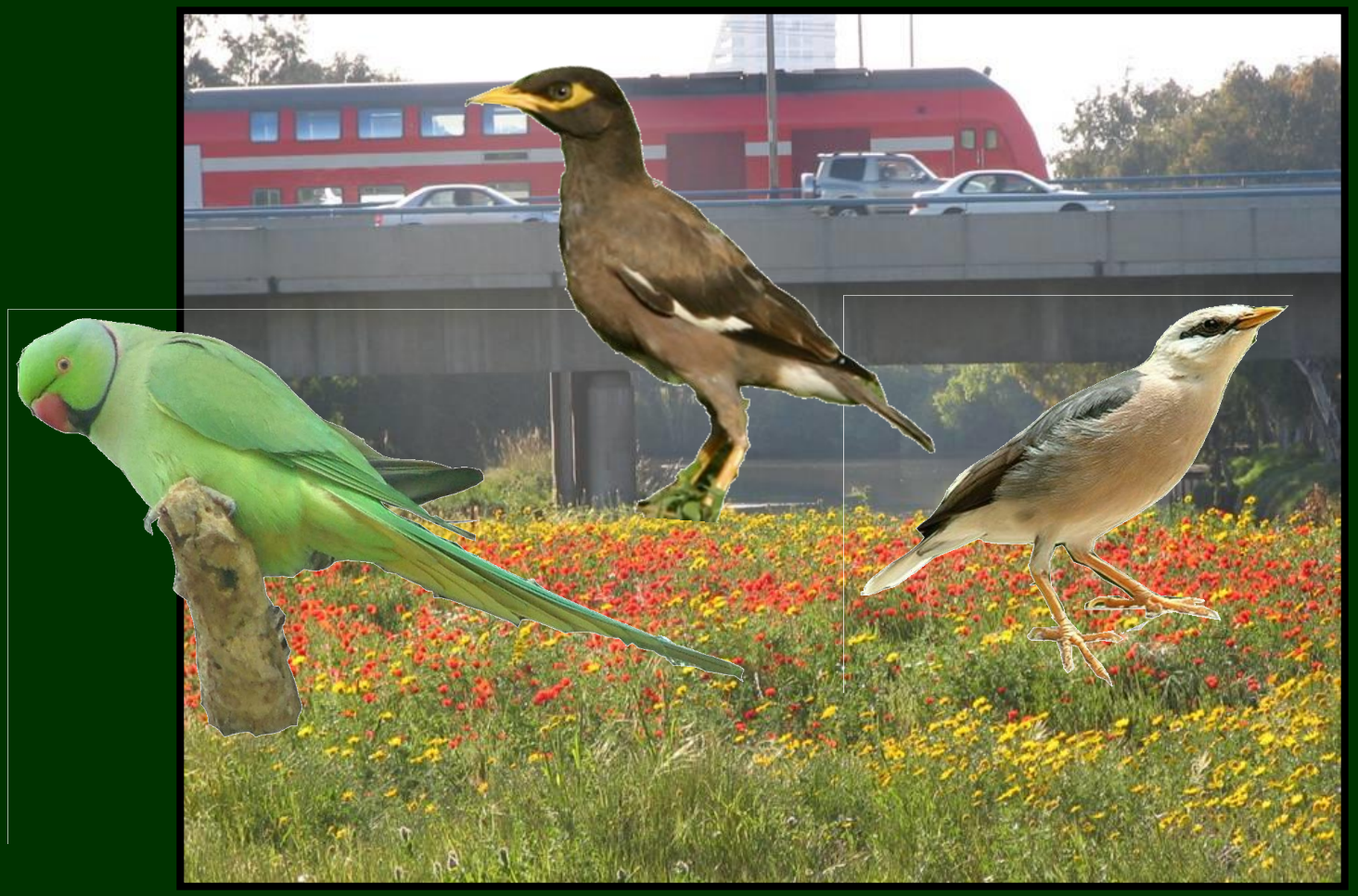


Bird species richness



Invasional meltdown "התכה"

Simberloff and von Holle



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Almost all work has been done on two species, very little at a whole community or guild level

Main goals

- ✓ Examine the factors affecting establishment of alien birds during an ongoing invasion process
- ✓ Examine interactions between cavity nesting birds
- ✓ Examine the interactions among the different alien birds and their effect on establishment
- ✓ Examine the interaction network among both aliens and natives within a whole community

ציפורים פולשות בישראל:
התבססות של מינים פולשים והשפעותיהם על המגוון הביולוגי המקומי בפארק הירקון

עבודת מוסמך של יותם אורחן במעבדה לחקר המגוון הביולוגי
בהנחיית ד"ר סלעית קרק

השלכות לשמירת טבע

- ✓ פארק הירקון הינו רק חלק מתחום התפוצה של מרבית המינים
- ✓ לזרזיר הבורמזי השפעות שליליות חשובות על הנקר עקב תחרות ישירה על חורי הקינון
- ✓ ייתכן שהמיינה ההודית מאיטה את הפלישה של הזרזיר הבורמזי וזרזיריים אחרים, הזבר ריך להלקח בחשבון אם פועלים
- ✓ רצוי לשקול להוסיף חורי קינון שרק מינים מקומיים יוכלו לנצל (למשל חורים קטנים עבור ירגזים ועוד
- ✓ מומלץ להפחית את שטח הסביבות המנוצלות על ידי חלק מן המינים הפולשים (כגון מדשאות גדולות)

Thanks to

The Biodiversity Research Group students, post-docs and members

משרד המדע ,FP6

תודה!

salit.kark@gmail.com

Thanks to

The Biodiversity Research Group students, post-docs and members

The funding agencies

EU FP6, MOST

Thank you!!!

Thanks to

The Biodiversity Research Group students, post-docs and members

The funding agencies

EU FP6, MOST

Thank you!!!

Thank you ☺

This research is partly funded by The Australian Research Council, ARC Future Fellowship and Discovery grants to Kark, European Commission

Thank you for your attention

Sponsors

ARC: Cavity Nesting Project

ARC ceed Centre of Excellence for Environmental Decisions

The University Of Queensland AUSTRALIA

Hunter Bird Observers Club
Affiliated with BirdLife Australia

The University of Newcastle Australia

Wilma Barden Grant

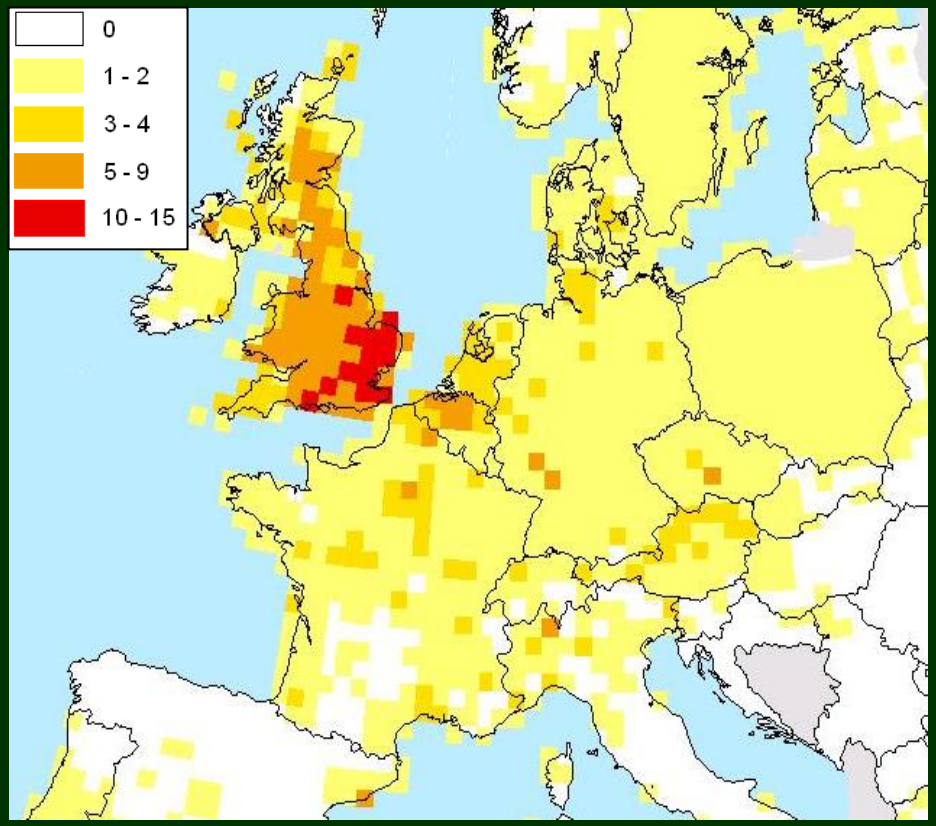
Questions?

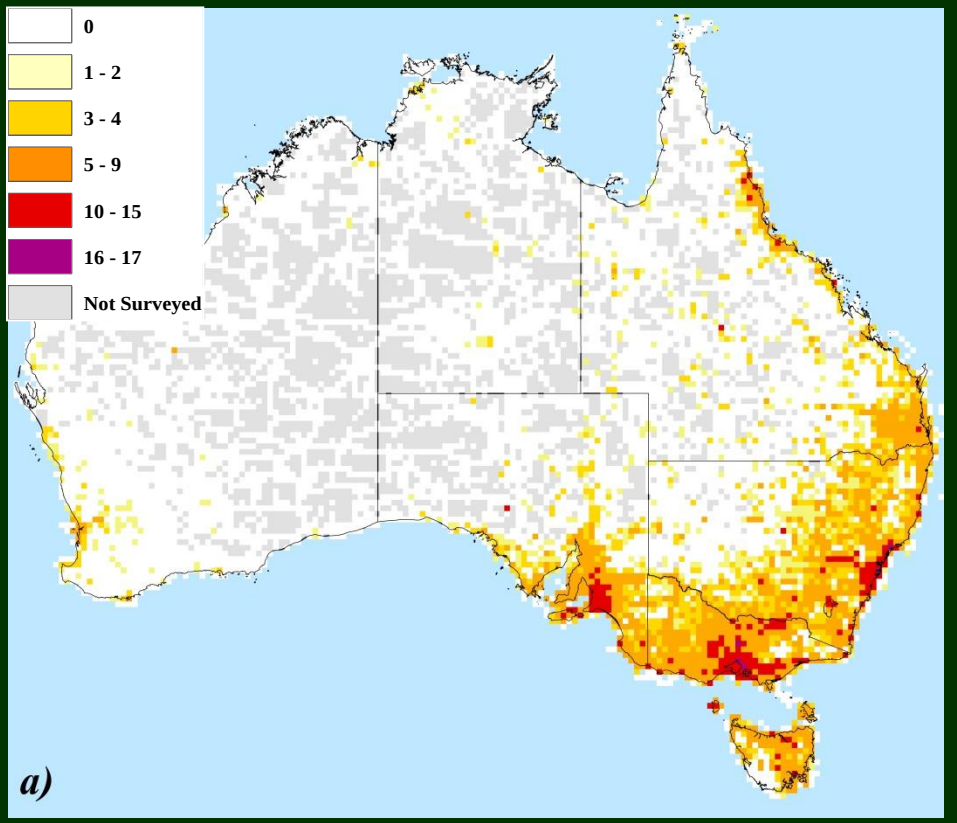
Why Birds?

Good records on both successful and failed introductions

Conservation importance

Alien Bird Species Richness: Europe vs. Australia

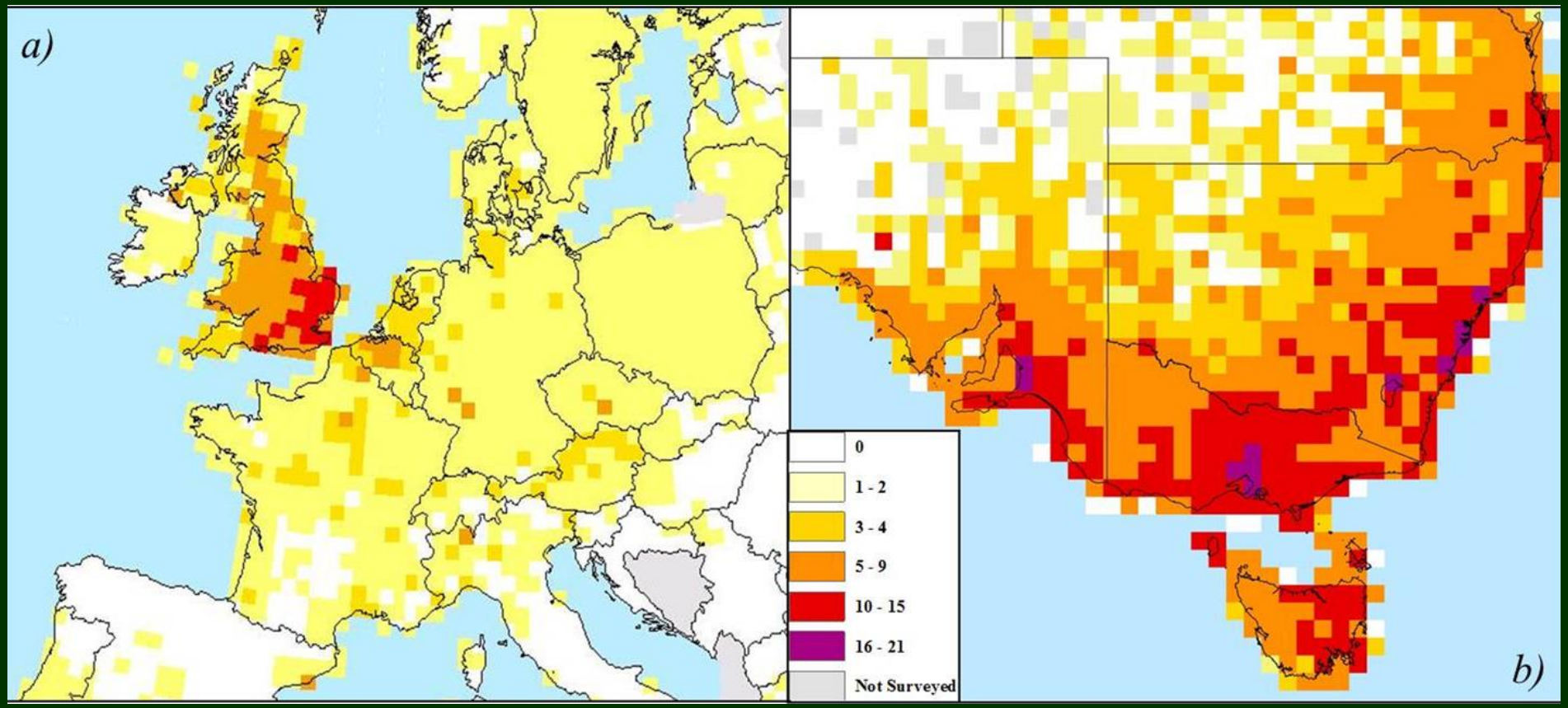




Non-Australian alien bird richness

Chiron et al. 2009

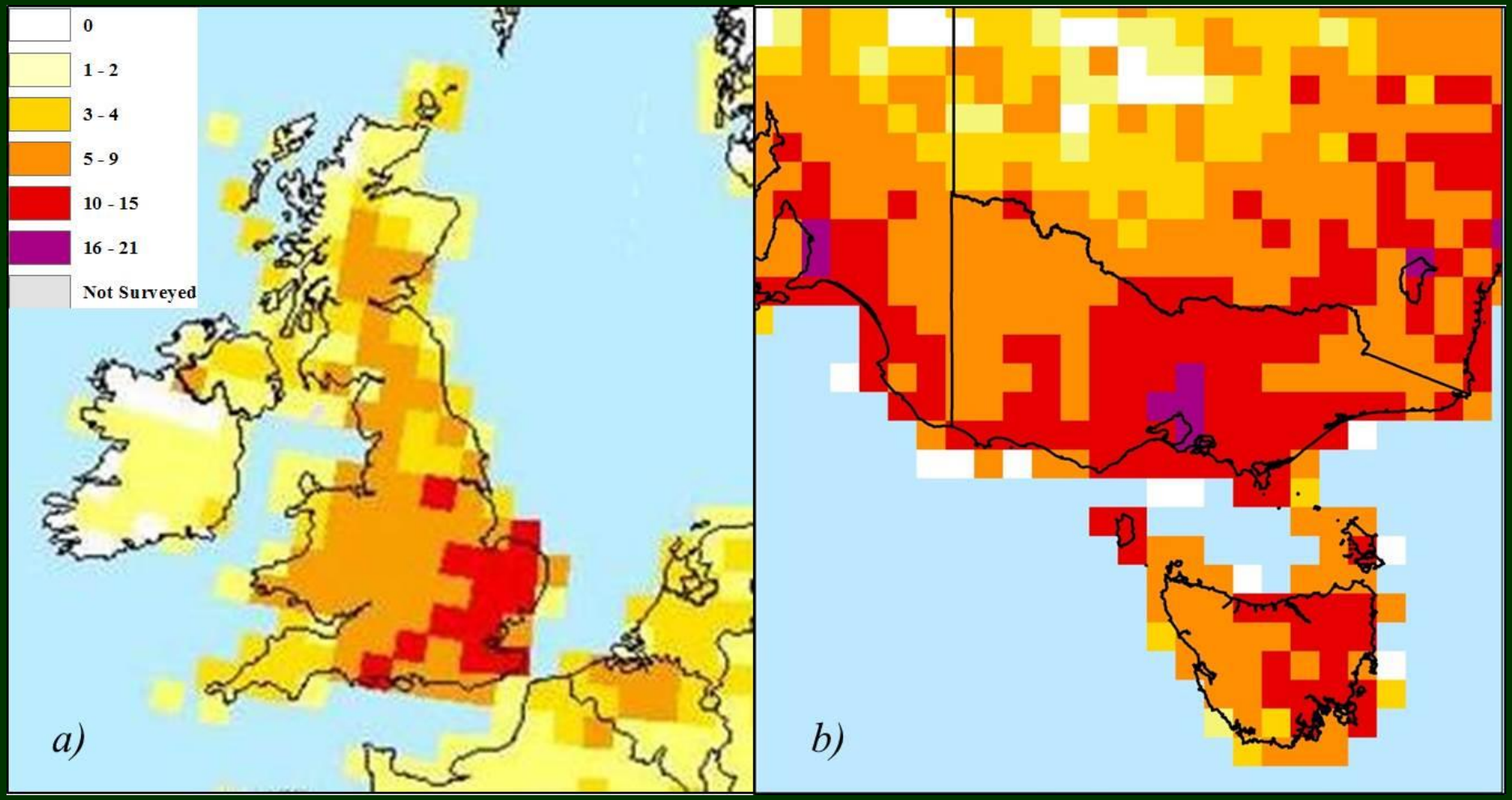
Alien Bird Species Richness: Europe vs. Australia



Chiron et al. 2009

Non-Australian alien bird richness at 50x50 km

Alien Bird Species Richness: UK vs. Tasmania



Chiron et al. 2009

Exotic bird richness at 50x50 km

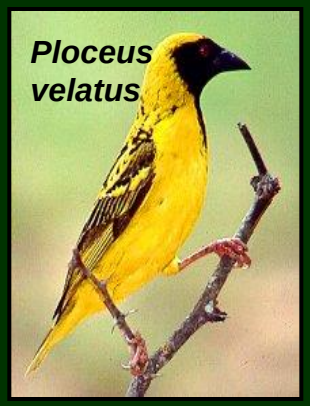
Determinants of alien bird richness

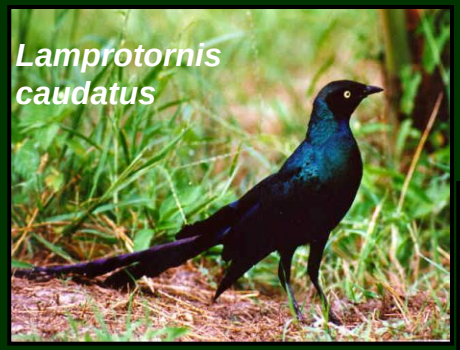
Natural characteristics of the invaded ecosystem	Native bird richness Temperature (Min) Plant productivity Habitat diversity
Human-activity related factors	Number of species introduced Human impact, acitivity
Traits of successful invaders	Species origin (intra or inter-regional)

Chiron, Shirley and Kark 2009 Proceedings Royal Soc B

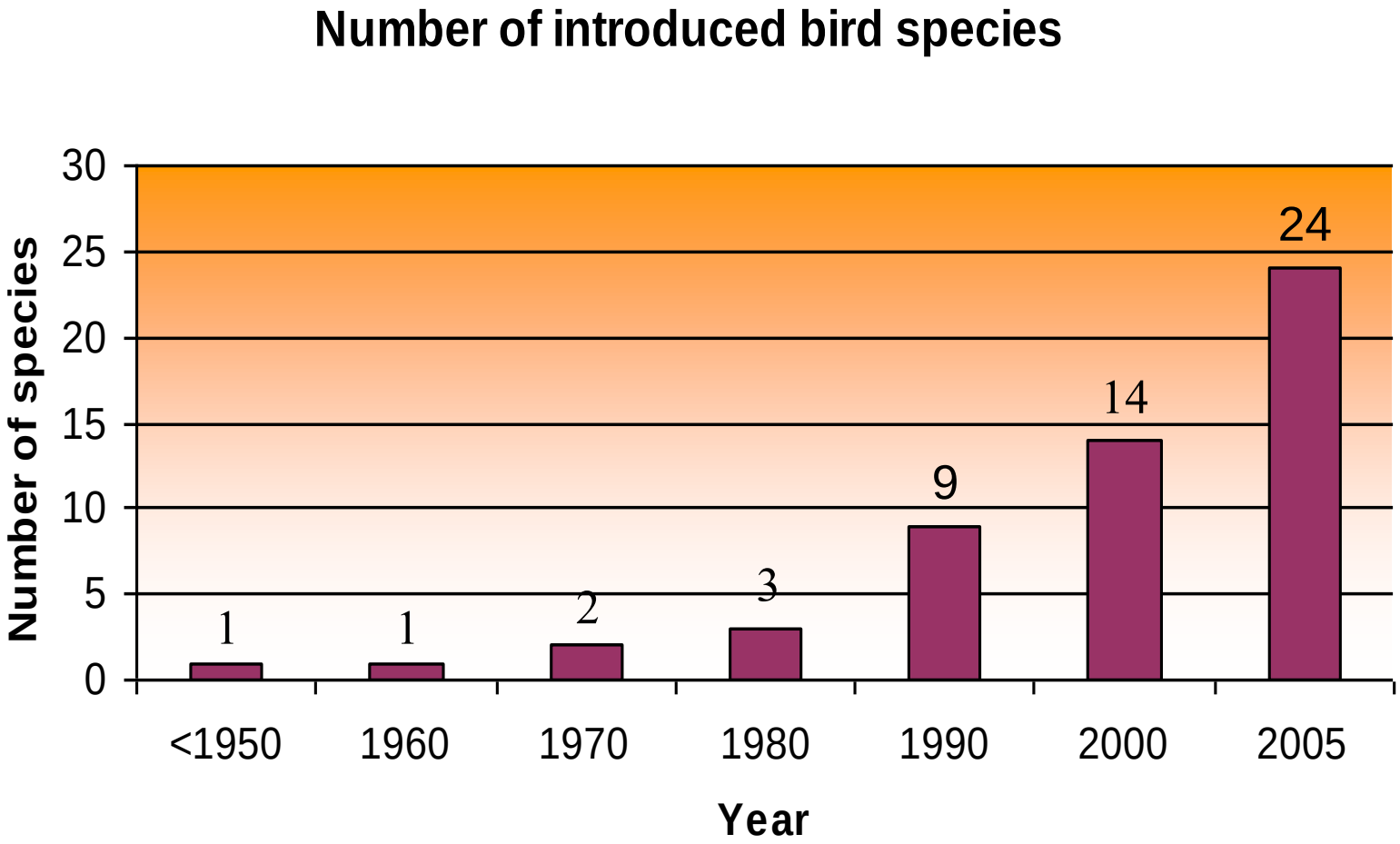
Introduced birds in Israel: increase in the past decade

At least 24 aliens of which 58% are recent



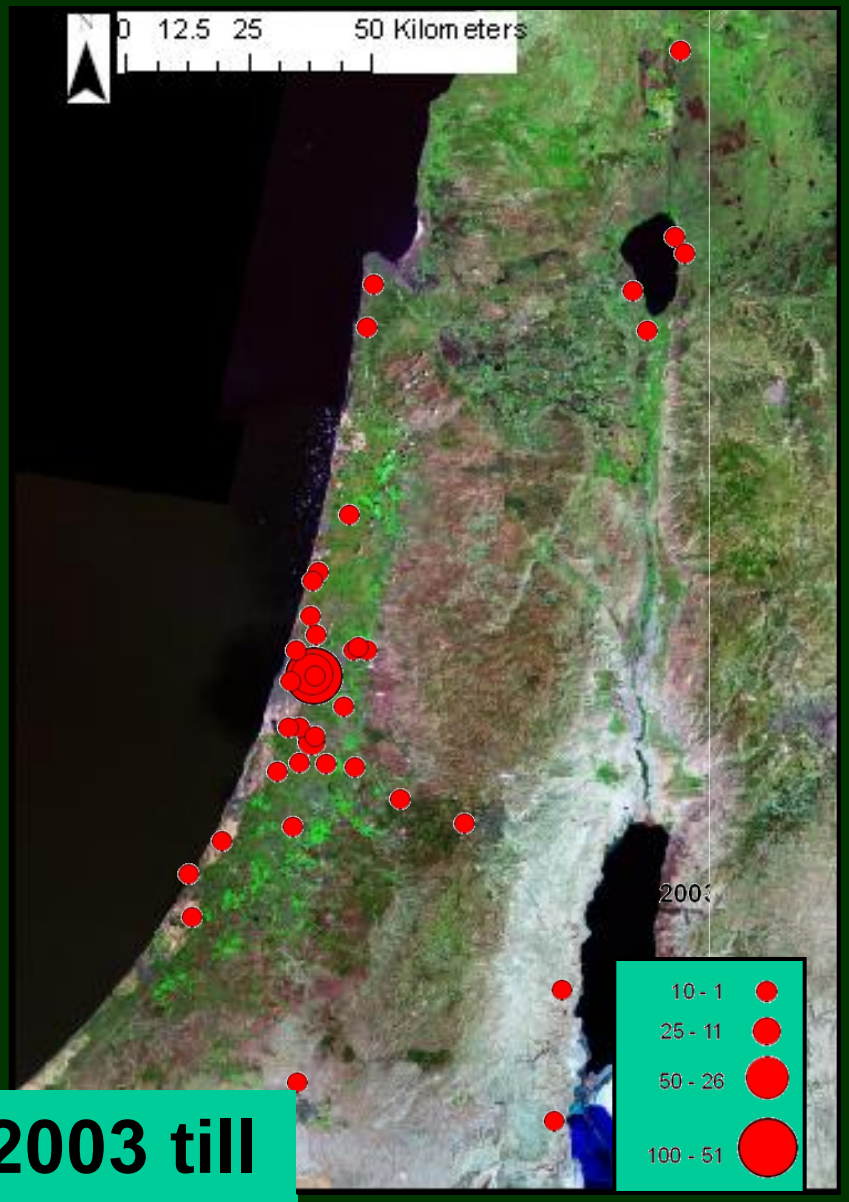


Introduced bird species in Israel



Hatzofe 2005

Common myna
Acridotheres tristis

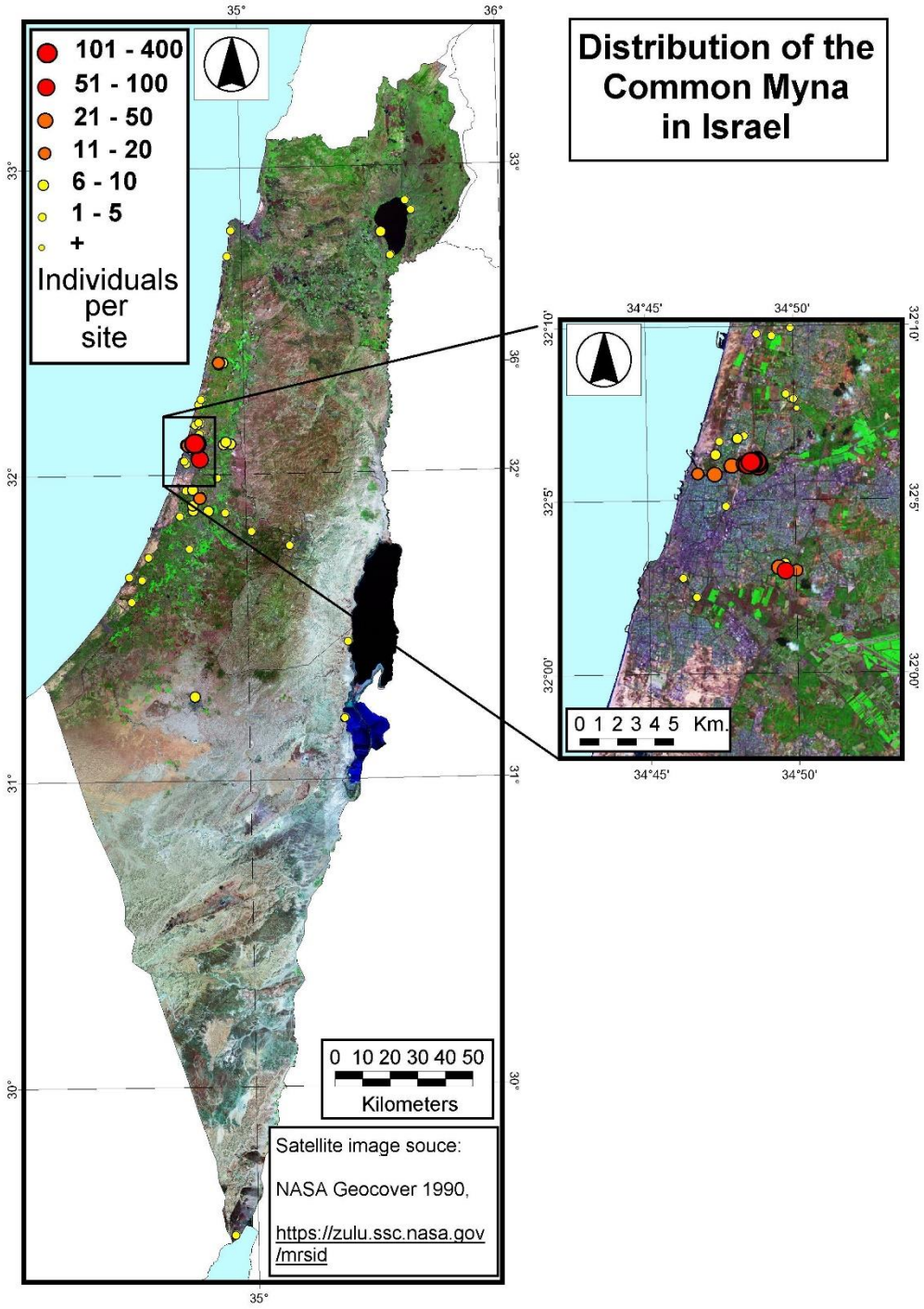


2003 till


Common Myna

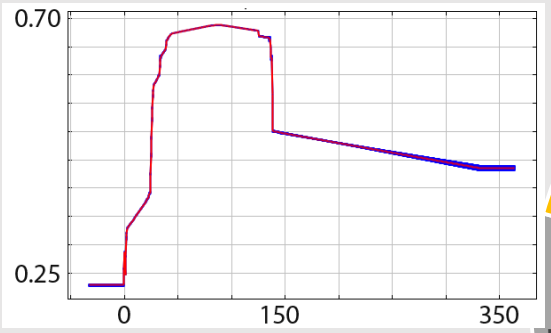
Holzapfel et al 2006, Sandgrouse

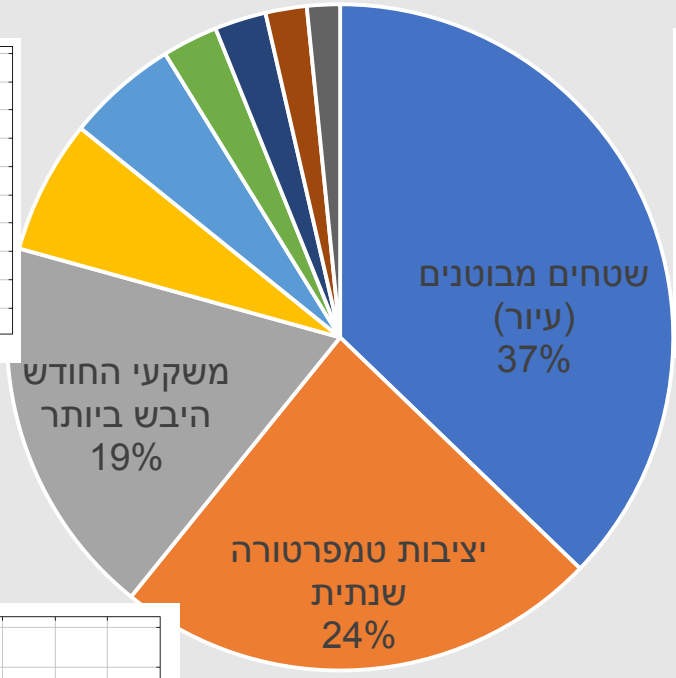
Holzapfel et al., 2006

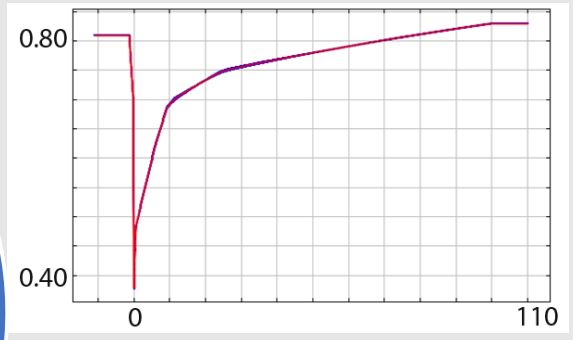


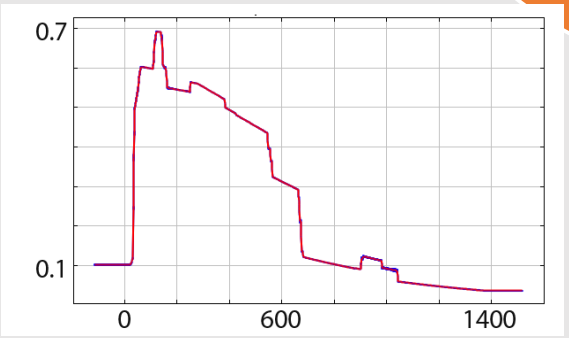
Vinous-breasted myna *Acridotheres burmannicus*

הגורמים המסבירים את תפוצת המיינה המצויה





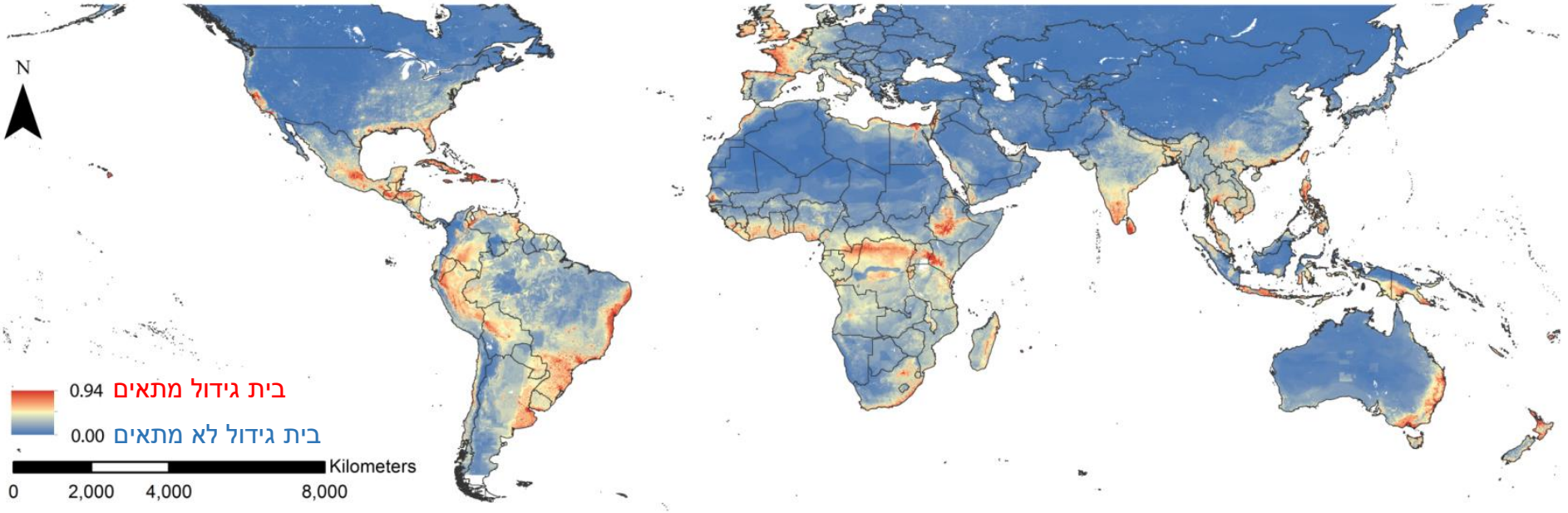




- ככל שהעיור נרחב יותר, כך ההסתברות לנוכחות מיינות גדלה.
- סבילות גבוהה לתנאי סביבה מגוונים, מלבד אזורים יבשים מאוד.

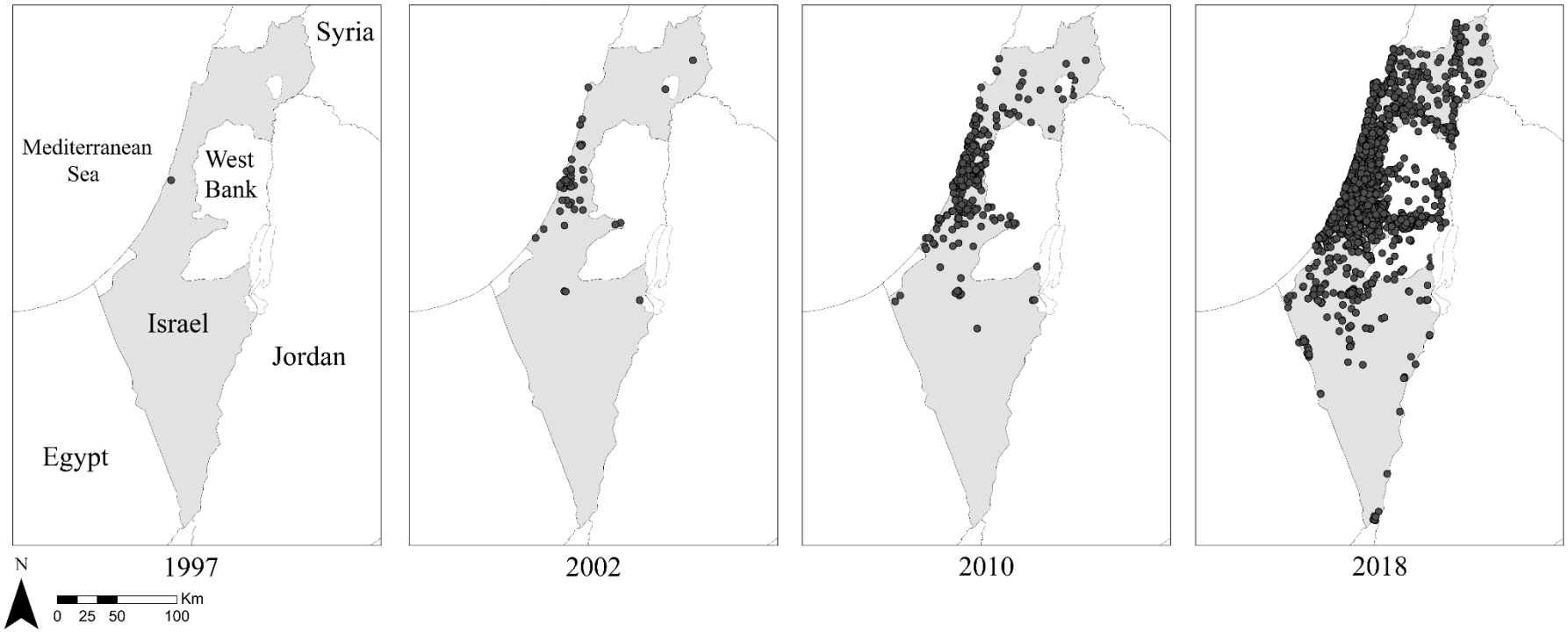
Magory Cohen et al., *in review*

התפוצה הפוטנציאלית של המיינה המצויה



Magory Cohen et al., *in review*

השתנות תפוצת המיינה המצויה בישראל



Magory Cohen & Dor, *in prep.*

רשימת מקורות לשקופית 3

Type	Source
Online database	Global Biodiversity Information Facility (GBIF) (GBIF.org, 2015), VertNet (vertnet.org, 2015), SABAP2 (Brooks, 2017)
Previous studies	Holzapfel et al., 2006
Governmental agencies^	Israel Nature and Park Authority (INPA)
Citizen Science project*	Birders, schools, amateur birders
Non-Government Organizations	The Israeli Center for Yardbirds, HaMaarag – Israel's National Ecosystem Assessment Program, Society for the Protection of Nature in Israel - Israel Birding Portal [1]
Museums	The Steinhardt Museum of Natural History, Israel
Personal observations	Research team
Personal correspondence	C. Holzapfel

^ © Data – Department of Information Systems, INPA
* In collaboration with The Israeli Center for Yardbirds

Table S1. Details of the resources used to collect species occurrence records used in this study.

Magory Cohen & Dor, *in prep.*

Human impact on biodiversity and what can we do about it?
Assaf Shwartz

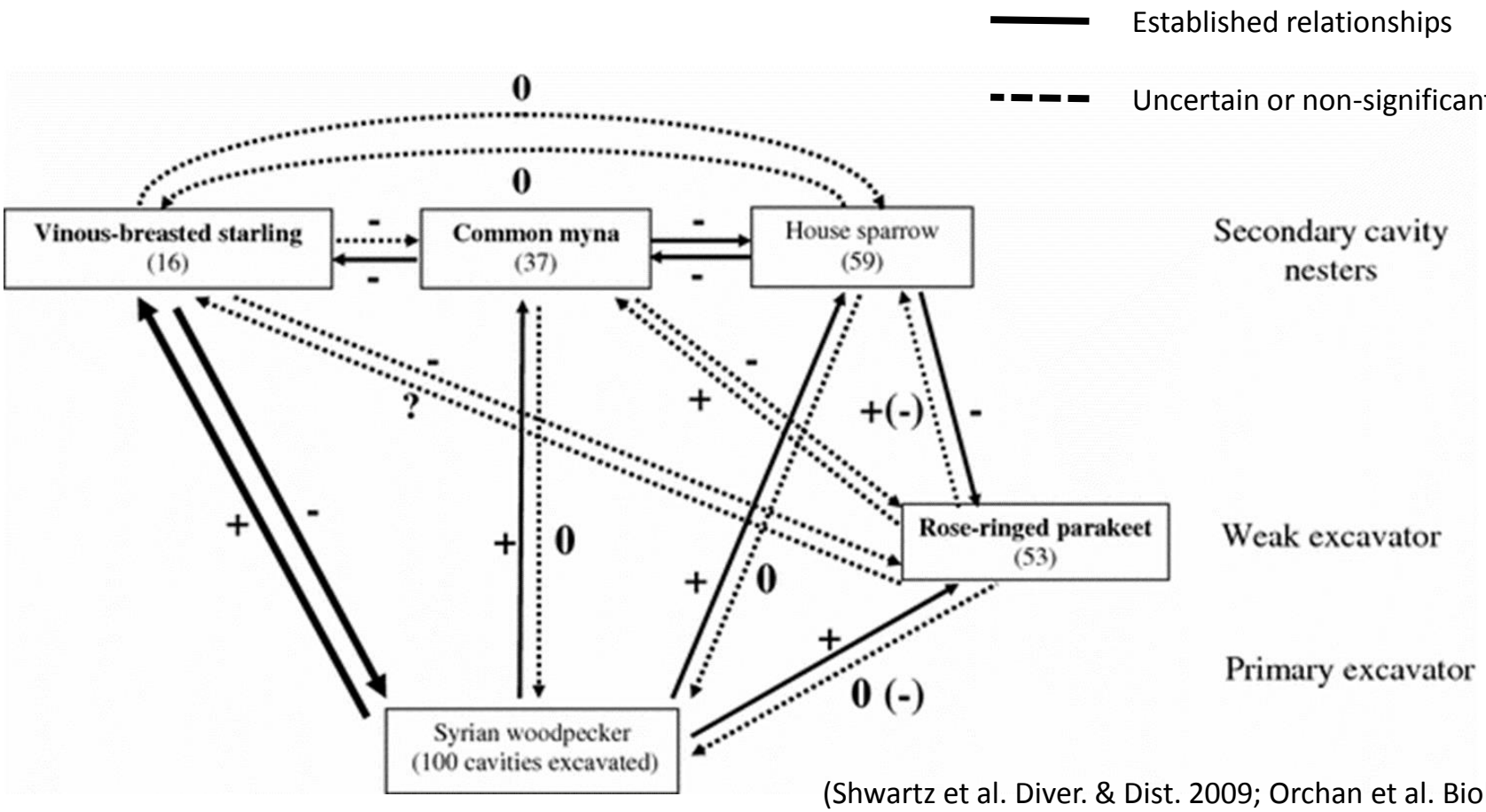
Shwartz et al. 2008 Land. Urban Plan.

Urban adaptors

Urban exploiters

Non-native species

The network of interactions between cavity nesters

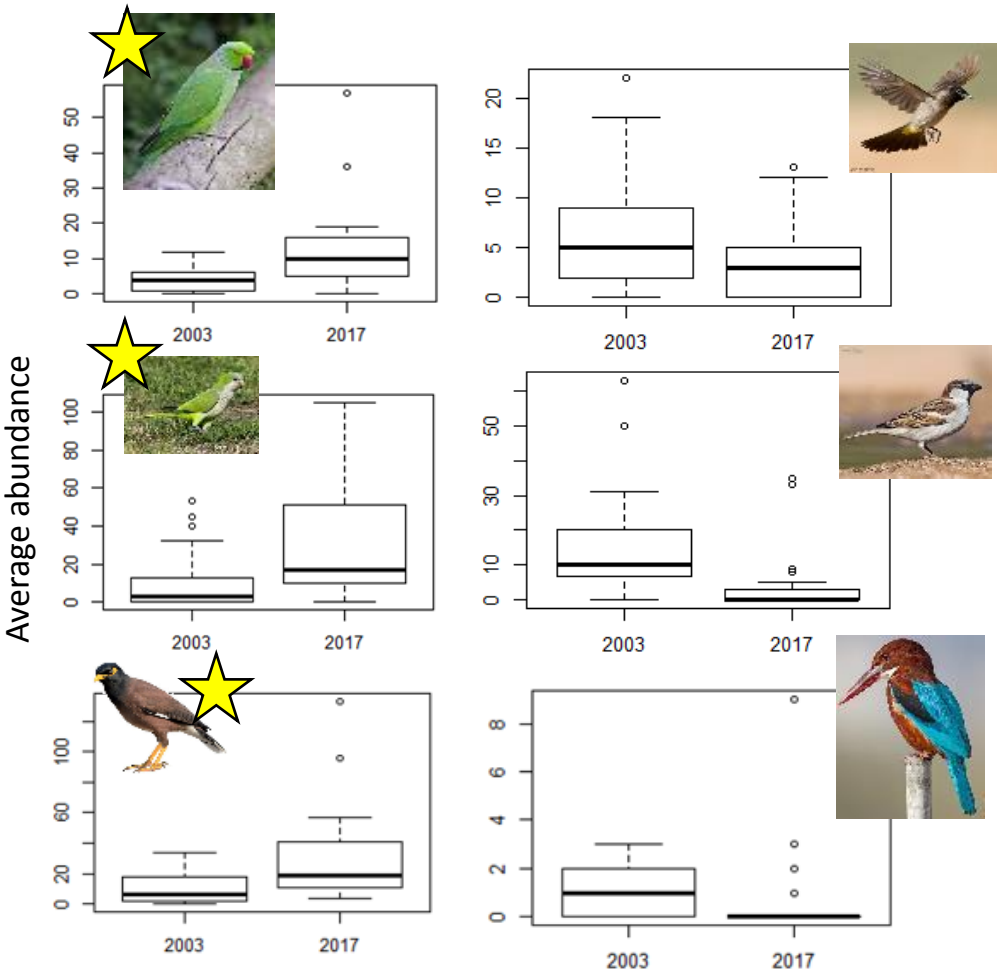


(Shwartz et al. Diver. & Dist. 2009; Orchan et al. Biol. Invas. 2013)

The impacts of alien birds – after 14 years









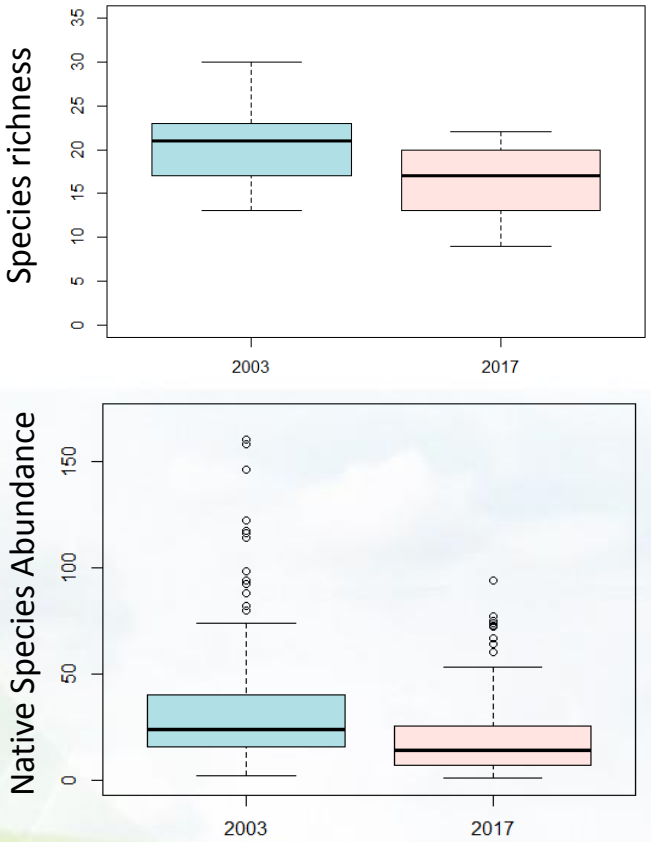


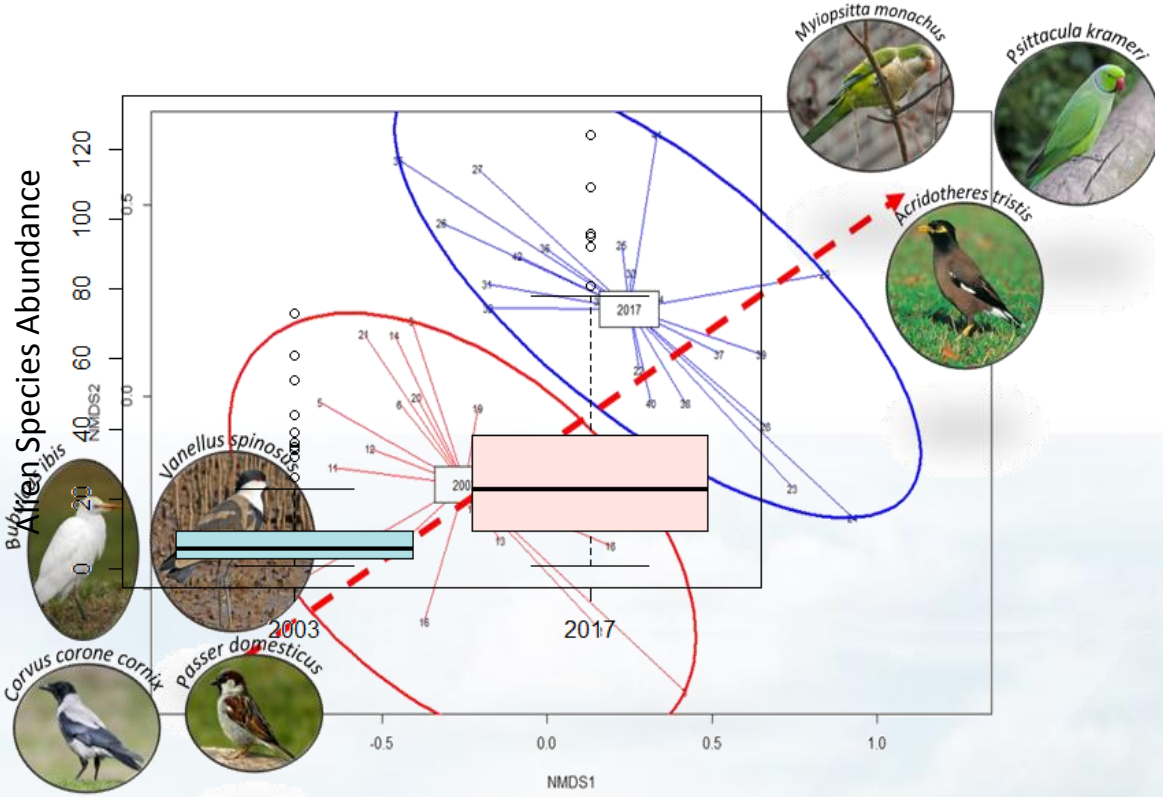




The impacts of alien birds – after 14 years

- Bird community



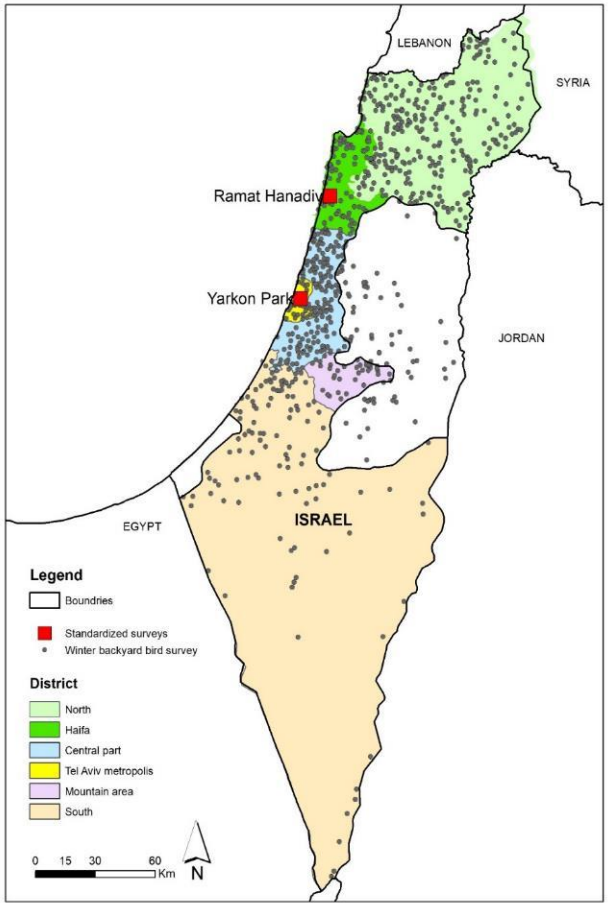


The impacts of alien birds

	Time frame	Data collection	Location
Study 1	2003 vs 2017	Standardized protocol	Yarkon park, Tel Aviv
Study 2	2001 - 2017	Standardized protocol	Ramat Hanadiv nature reserve
Study 3	2006 - 2018	Citizen science program	All over Israel

Yarkon park, Tel Aviv

Ramat Hanadiv nature reserve



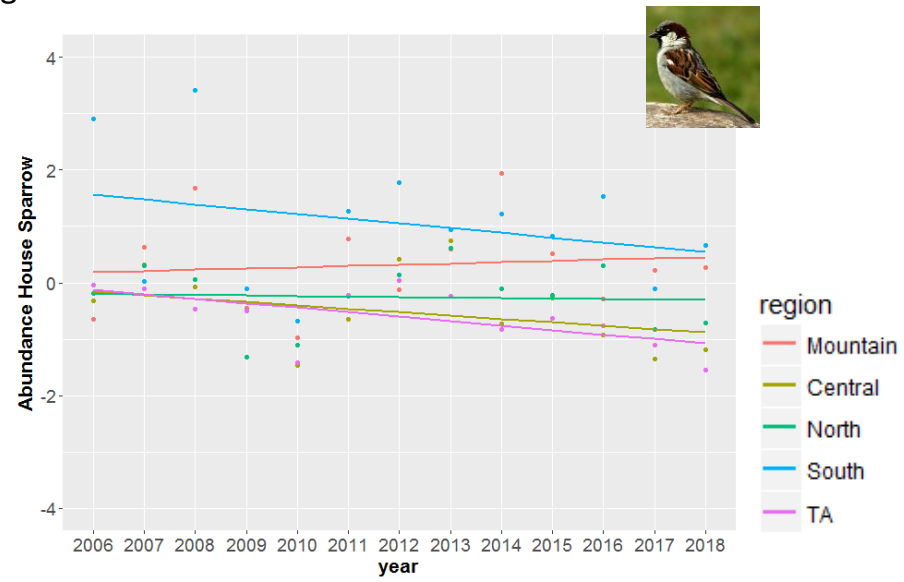
The impacts of alien on common local species

Scientific name	Group	Yarkon Park survey – 2003 & 2017	LTER in Ramat Hanadiv – 2001 to 2017	Backyard bird survey – 2006 to 2018	Yom-Tov et al. (2012) – 1930s to 2010
Common myna	Alien	0.58±0.08***	0.08±0.01***	0.30±0.02***	Introduced
Laughing dove	Alien	-0.02±0.005***	0.04±0.04	0.05±0.03***	Introduced
Rose-ringed parakeet	Alien	0.18±0.03***	0.03±0.01**	0.13±0.03***	Introduced
Monk parakeet	Alien	0.74±0.09***	Not observed	Not surveyed	Introduced
Eurasian blackbird	Native	0.001±0.004	0.23±0.08**	-0.02±0.01***	Increasing
Eurasian hoopoe	Native	0.001±0.007	-0.04±0.01*	-0.007±0.004*	Increasing
Eurasian jay	Native	0.01±0.004*	0.27±0.04***	-0.01±0.01	Increasing
Feral pigeon	Native	-0.19±0.16	0.005±0.005	0.22±0.07***	Decreasing
Graceful prinia	Native	-0.06±0.007***	-0.04±0.11	-0.03±0.006***	Increasing
Great tit	Native	0.02±0.004***	-0.01±0.05	-0.009±0.008	Increasing
Hooded crow	Native	-0.25±0.06***	0.05±0.03	0.06±0.04**	Increasing
House sparrow	Native	-0.32±0.05***	-0.03±0.01*	-0.10±0.10 *	Increasing
Palestine sunbird	Native	-0.008±0.006	-0.07±0.05	-0.05±0.01***	Increasing
Syrian woodpecker	Native	0.000±0.000	-0.001±0.01	-0.01±0.003***	Increasing
White-spectacled bulbul	Native	-0.14±0.02***	-0.38±0.08***	-0.09±0.01***	Increasing

Summary

- What has changed in Israel in the last 14 yeas?
  - → Urbanization
  - → Species invasions, which started in the Yarkon Park
- Common myna impact house sparrow and maybe other common species through competition

Shwartz et al. 2009; Orchan et al. 2013; Charter et al. 2016; Berger 2017



Summary

- What has changed in Israel in the last 14 yeas?
  - → Urbanization
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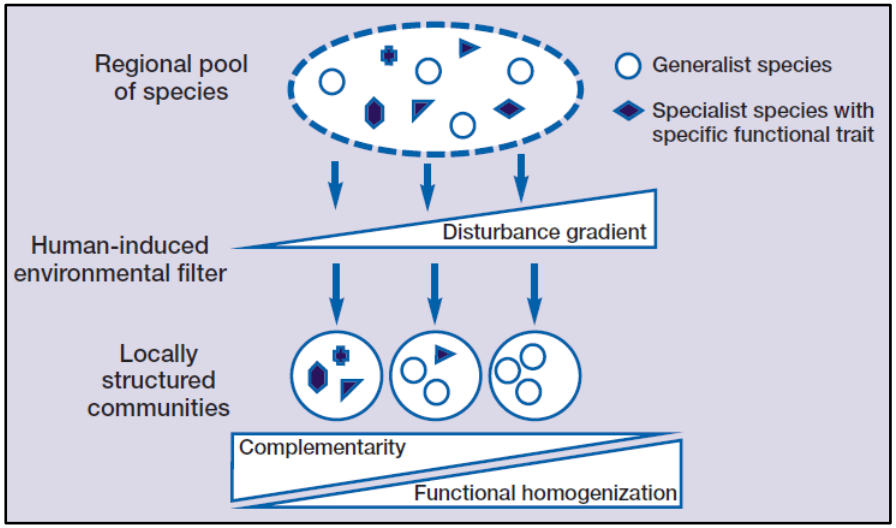
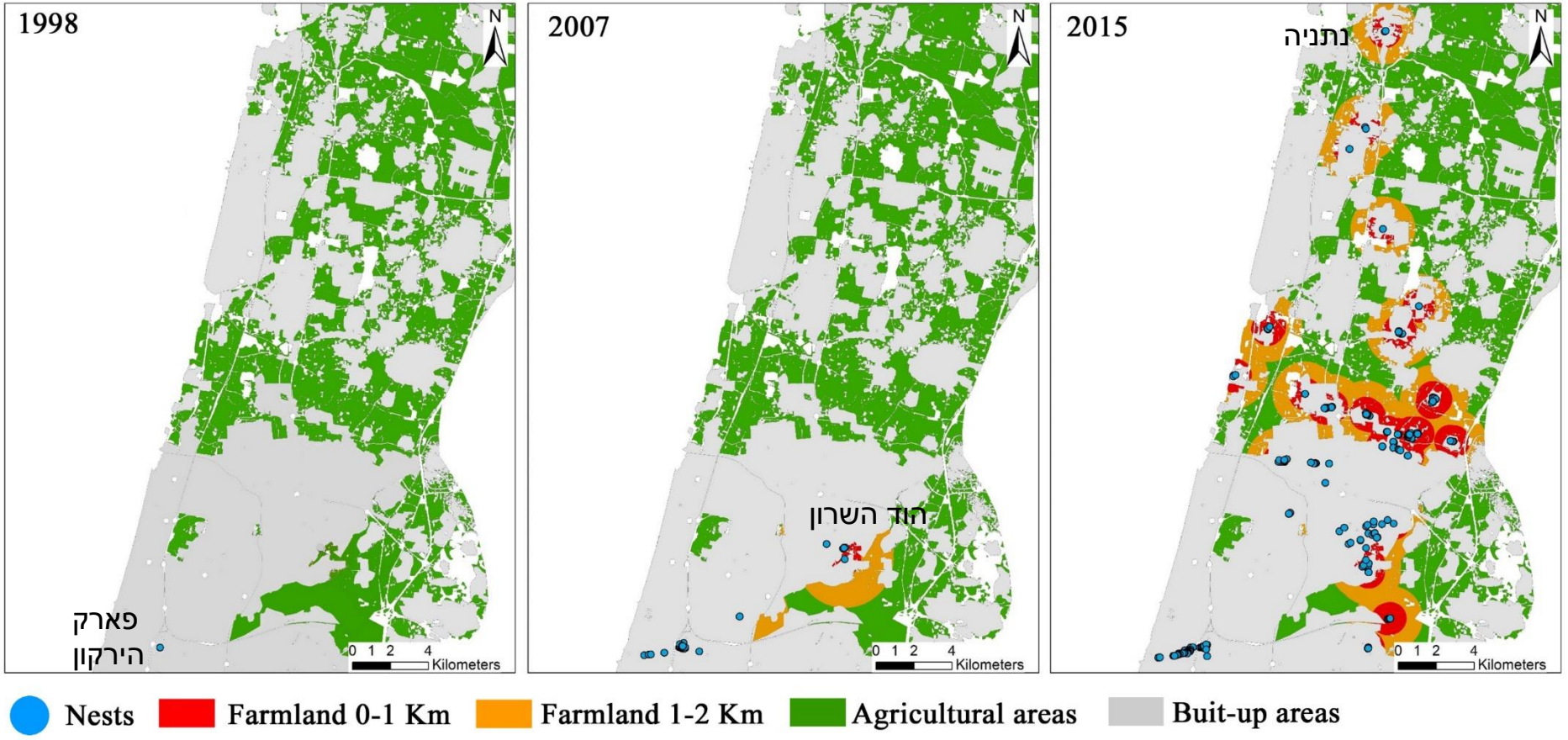
- **Biotic homogenization:**
  Shwartz et al. 2009; Orchan et al. 2013; Charter et al. 2016; Berger 2017
  - → Few winners vs. many loosers
  - → Alien species > Common (generalist and urban exploiters) species



Clavel et al. 2011 *Front Ecol Environ*


1998
2007
2015
נתניה
הוד השרון
פארק
הירקון
N
0 1 2 4
Kilometers
Nests
Farmland 0-1 Km
Farmland 1-2 Km
Agricultural areas
Buit-up areas