Insects 50% of known species (& majority undescribed)

10% other arthropods
Key roles of insects in our world

- **Pollination**: seed dispersal
- **Eat things**: predation, parasitism, herbivory
- **Get eaten**: base of food chains
- **Decomposition**: soil turnover & processing
- **Water filtering**

Insects play crucial roles in our world, for example, they are important for pollination, seed dispersal, and various feeding behaviors.
If humans suddenly disappeared, living conditions for most species would improve.

If insects vanished, the environment would collapse into chaos.

Insect are the... “little creatures that run the world”

E.O. Wilson
You live in a world of insects
Endangered species
What the public knows…
Measuring reductions in insect populations

Change in Number

Change in Diversity

Change in Biomass
Anecdotal evidence of changes in insect abundance
the Windshield Phenomenon

Where have all the bug splats gone?
Kent England

- Volunteers install insect “splatometers” on cars

2019 vs 2004
50% fewer splats

(despite modern cars hitting more bugs than older models)
Denmark, 1997-2017

Habitat mix didn’t change

Researcher drove at fixed speed on fixed transect
  • bugs on windshield

Also took:
  • sweep net samples
  • sticky trap samples
  • bird feeding rates
  • nesting pair counts
80% reduction in windshield bugs over 20 years

Sweeps, sticky trap, bird feeding rates follow the same curve
Broader studies of abundance and biomass
Amateur society in Germany, collecting insects since 1905
• 1989-2016, sampled nature reserves (n = 96)
• trapped flying insects 24/7 from March-Oct; weighed & IDed catch
Measurable reduction in biomass over 27 years

Biomass collected, g/day

1990s  2000s  2010s
biomass collected, g/day

1990s

2000s

2010s
Between 1989 to 2016 (only 27 yrs)  
75% decline in biomass of flying insects  
= 3% loss per year
Trends in abundance & diversity from multiple shorter-term studies

73 studies reviewed

Biological Conservation 232 (2019) 8–27

Contents lists available at ScienceDirect

Biological Conservation

journal homepage: www.elsevier.com/locate/biocon

Review

Worldwide decline of the entomofauna: A review of its drivers

Francisco Sánchez-Bayo\textsuperscript{a,*,} Kris A.G. Wyckhuys\textsuperscript{b,c,d}
Population declines by insect group

% of species

- ground beetles
- ladybugs
- dung beetles
- bees
- other Hymenoptera
- butterflies
- moths
- grasshoppers

BAR COLORS
- extinct
- vulnerable
- endangered
- declining
41% of insect species have declined over the past decade...

Compared to 22% of vertebrate species
What is driving the Insect Decline?
Habitat change: Urbanization
** habitat loss & fragmentation (esp forest)
** pollution
Habitat change: intensive agriculture
** habitat loss & fragmentation
** monoculture
** pesticides (especially neonicotinoids)
** reduction in field edges, tree lines, wood lots
Karner blue

American burying beetle
Artificial light
A  fatal attraction
B  avoidance
C  egg laying on surfaces (vs H2O)
D  obscuring natural light
E  change activity patterns
F  change in development time
G  mismatch in timing

Light pollution is a driver of insect declines

Avalon C.S. Owens *, Précilla Cochard †, Joanna Durrant †, Bridgette Farnworth ‡, Elizabeth K. Perkin *, Brett Seymour †,
Invasive species

**direct mortality**

**habitat change**

**competition**

The urban beekeeping boom is hurting wild pollinator species
Climate change
** temperature rise
** variation in rainfall

USDA
Hardiness Zones
moving north
at 13 miles
per decade

*graphs from
Yale Enviro360
Multiscale seasonal factors drive the size of winter monarch colonies

Sarah P. Saunders, Leslie Ries, Nareesh Neupane, and Elise F. Zipkin

Edited by May R. Berenbaum, University of Illinois at Urbana-Champaign, Urbana, IL, and approved February 15, 2019 (received for review 4, 2018)

March 18, 2019 | 116 (17) 8809-8814 | https://doi.org/10.1073/pnas.1805114116

Total Area Occupied by Monarchs at Overwintering Sites in Mexico 2022-2023

<table>
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<td>2018-2019</td>
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</table>
None of this applies to farming

I’m running a business, not a nature preserve

Who cares about butterflies?

I want fewer bugs in my crops!
Natural ecosystems are being affected by insect declines.
Impact of insects to agriculture

* Yield potential
  - pollination
  - eat things: predation, parasitism, herbivory
  - get eaten: base of food chains

* Biological control
  - decomposition

* Residue breakdown
  - soil turn over & processing
  - nutrient cycling
  - fertility

* Healthy & productive soil
  - healthy & productive soil
Small things you can do to help insects

• keep & maintain tree lines, field edges, woods

• use cover crops
• spray on thresholds
• Less lighting (& yellow vs white)
It's not just about tigers, it's about tiger moths