Climate and Land Use Change:

Synergistic Risks to Health

APHA Annual Conference

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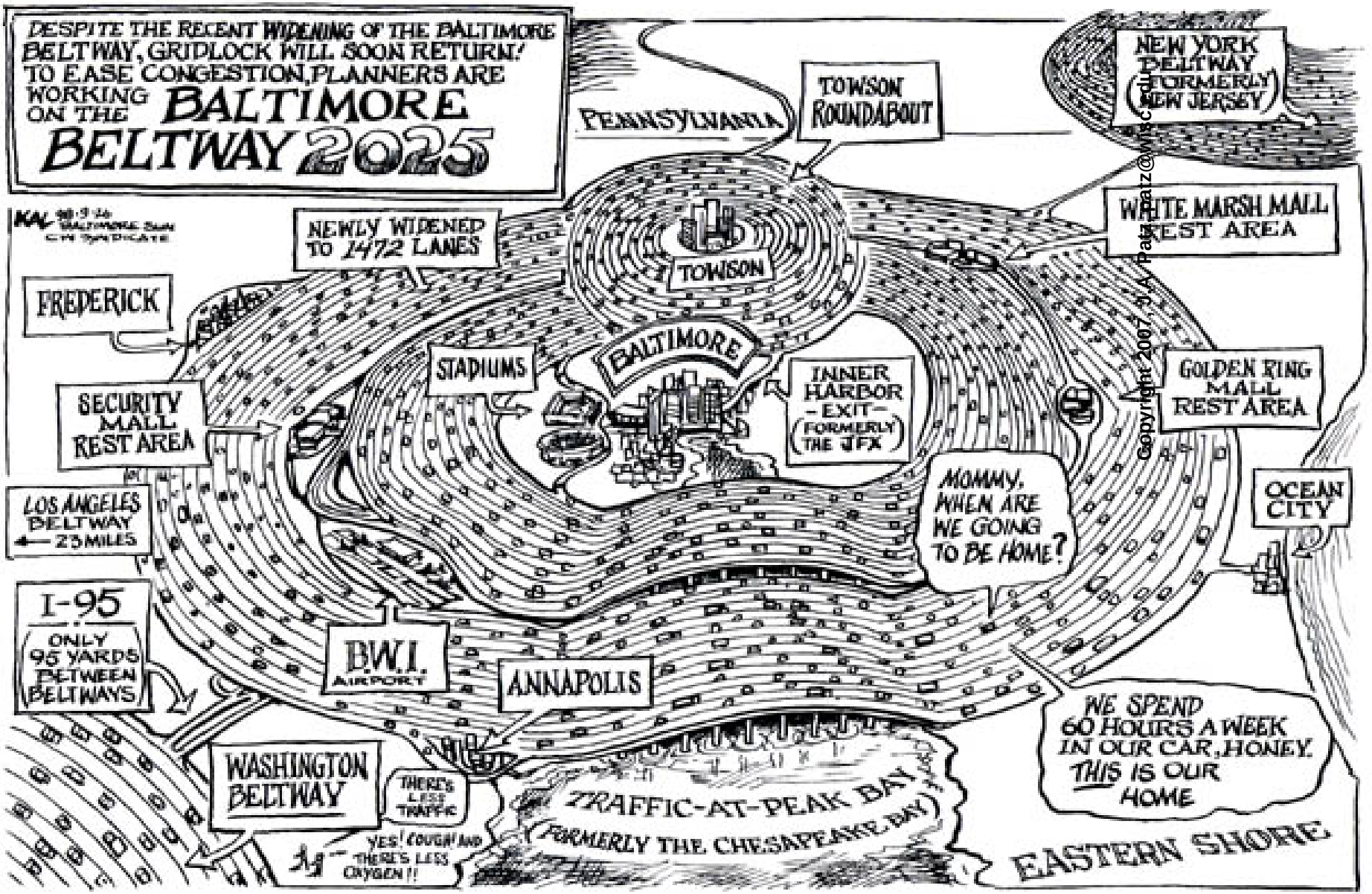
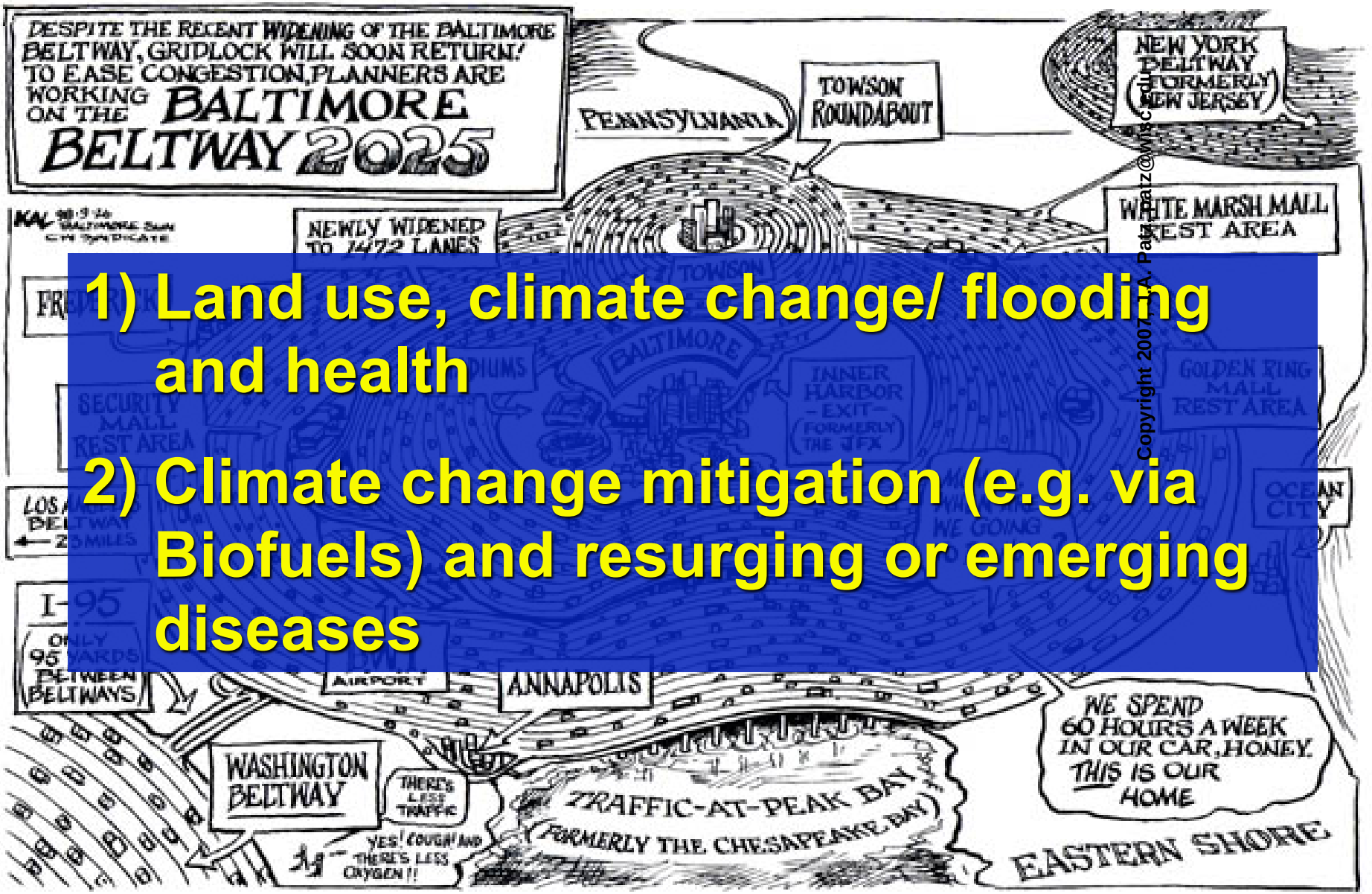
sage



September 26, 1998

The Beltway was widened, but commuters hardly noticed.



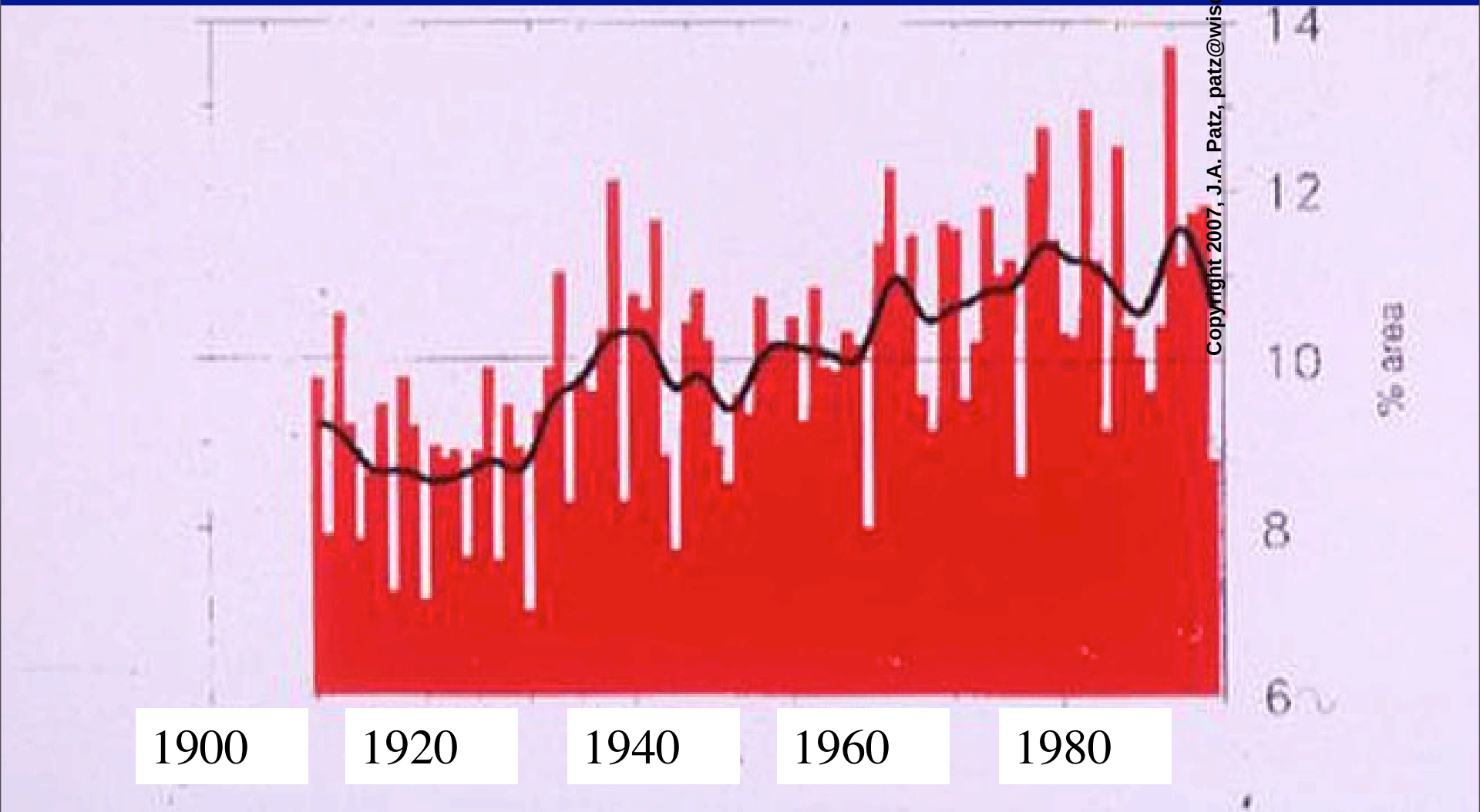
September 26, 1998

The Beltway was widened, but commuters hardly noticed.

Climate change:

It's not just about warming.

Proportion of the USA affected by much above normal annual precipitation from extreme events (>2 inches/day)



Source: Karl et al. 1996

annual precipitation derived from extreme daily precipitation events (more than 2 inches)

Extreme Precipitation and Waterborne Disease Outbreaks in the United States, 1948 -1994

Project Sponsor:

US EPA, Office of Research & Development

PI: J. Patz

Results

- **67% of waterborne disease outbreaks were preceded by precipitation above the 80th percentile** (across a 50 yr. climate record), $p < 0.001$

- **51% of outbreaks were preceded by precipitation above the 90th percentile,** $p < 0.002$

- Surface water-related outbreaks had strongest correlation with extreme precipitation in the month of outbreak; groundwater-related outbreaks lagged 2 months following extreme precipitation.

Curriero, Patz, et al, 2001.

USA: Combined sewer overflows (CSOs)

Courtesy: Kellogg Schwab

1.2 trillion gal of sewage & stormwater a year discharged during combined sewer overflows – would keep Niagara Falls roaring for 18 days

Heavy precipitation is projected to increase

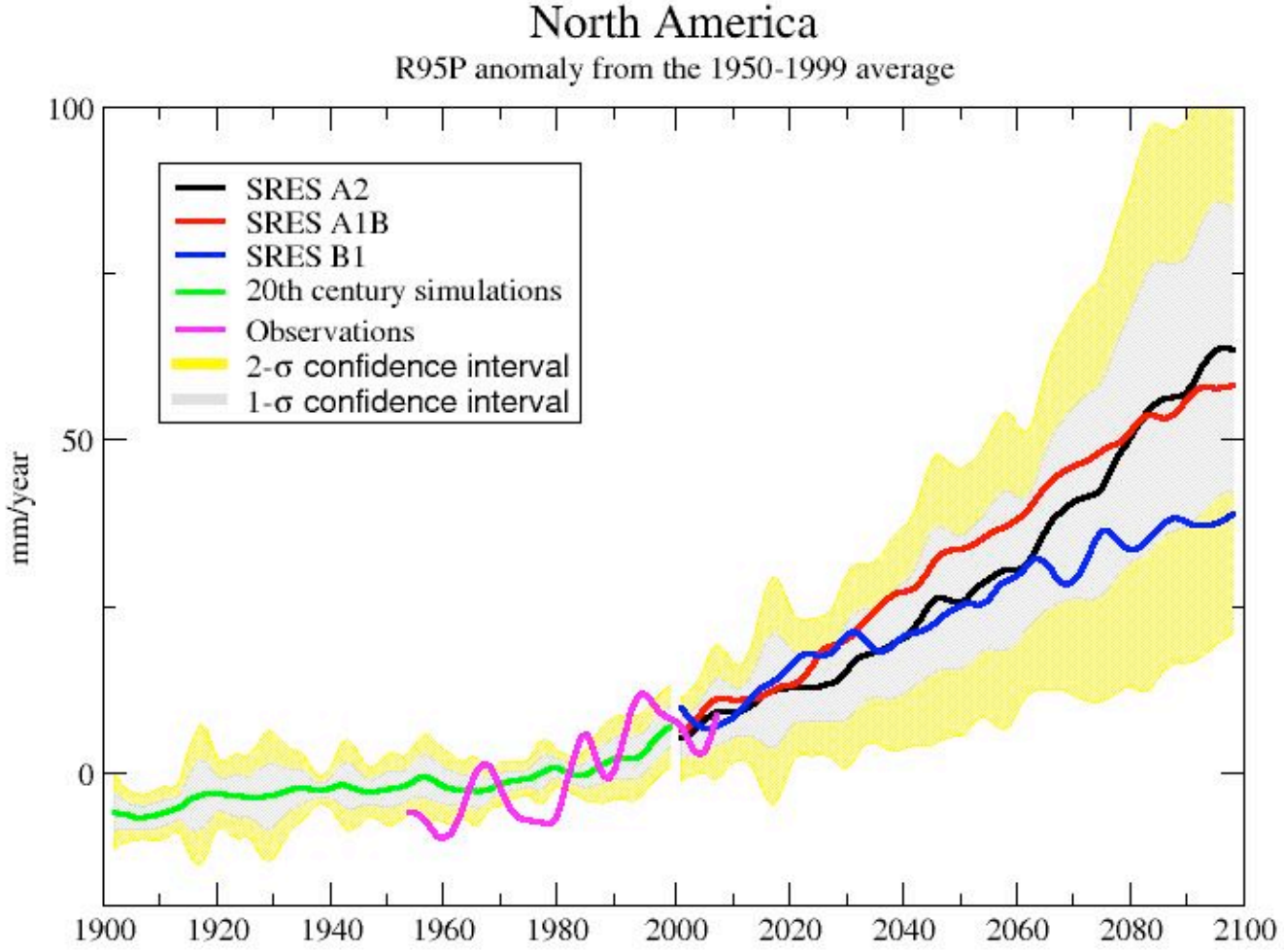


Figure courtesy of M. Wehner

CLIMATE & LAND USE SYNERGY

Hurricanes Mitch & Katrina

~ **9,600 people perished**, widespread water- and vector-borne diseases followed, and nearly one million people were left homeless.

Areas with extensive deforestation or degraded hillsides suffered the greatest morbidity and mortality and point to the importance of vegetation cover and as a buffer to severe floods, and the long-term prevention of injuries and fatalities

wetland loss in the Mississippi delta (1839 to 2020)

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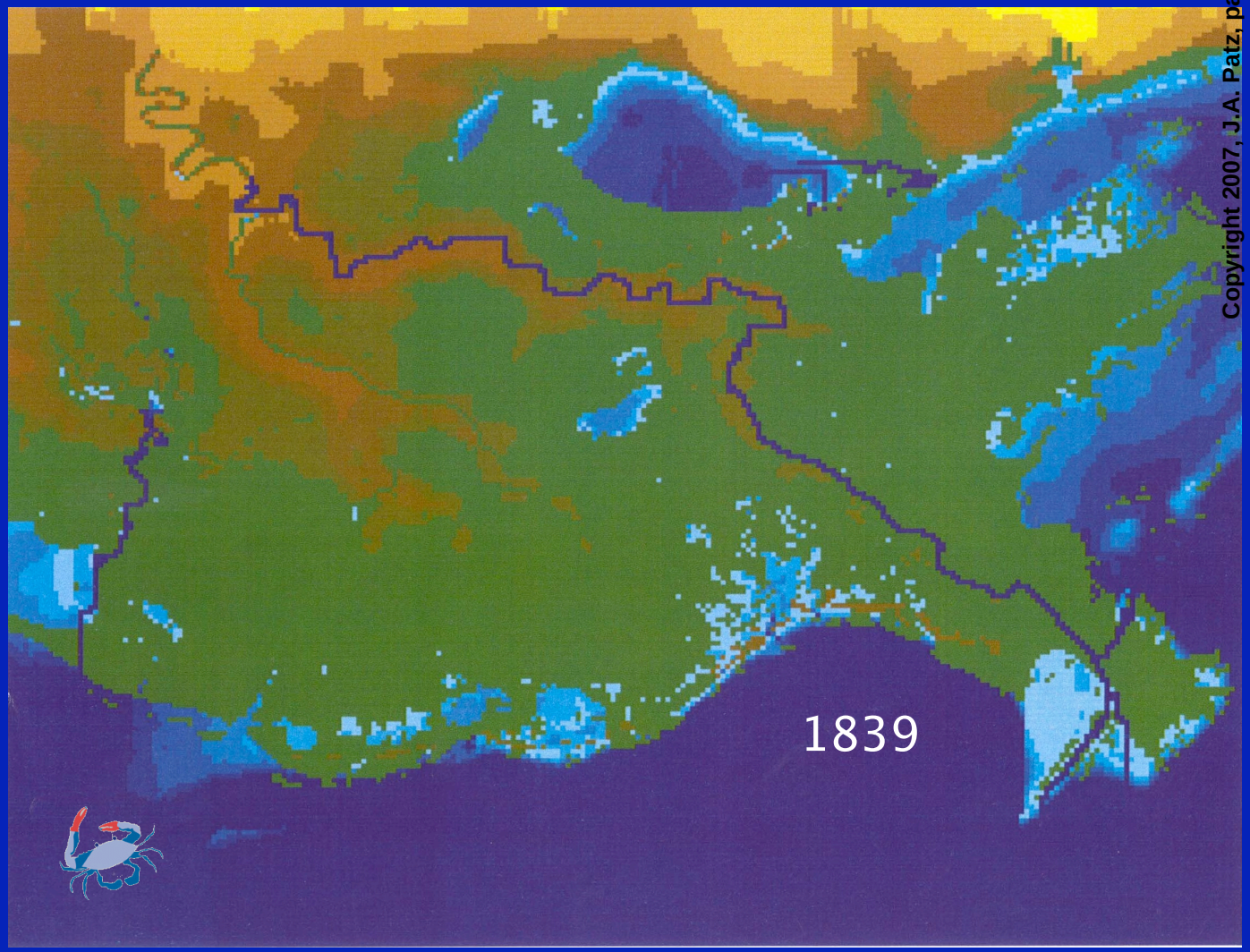

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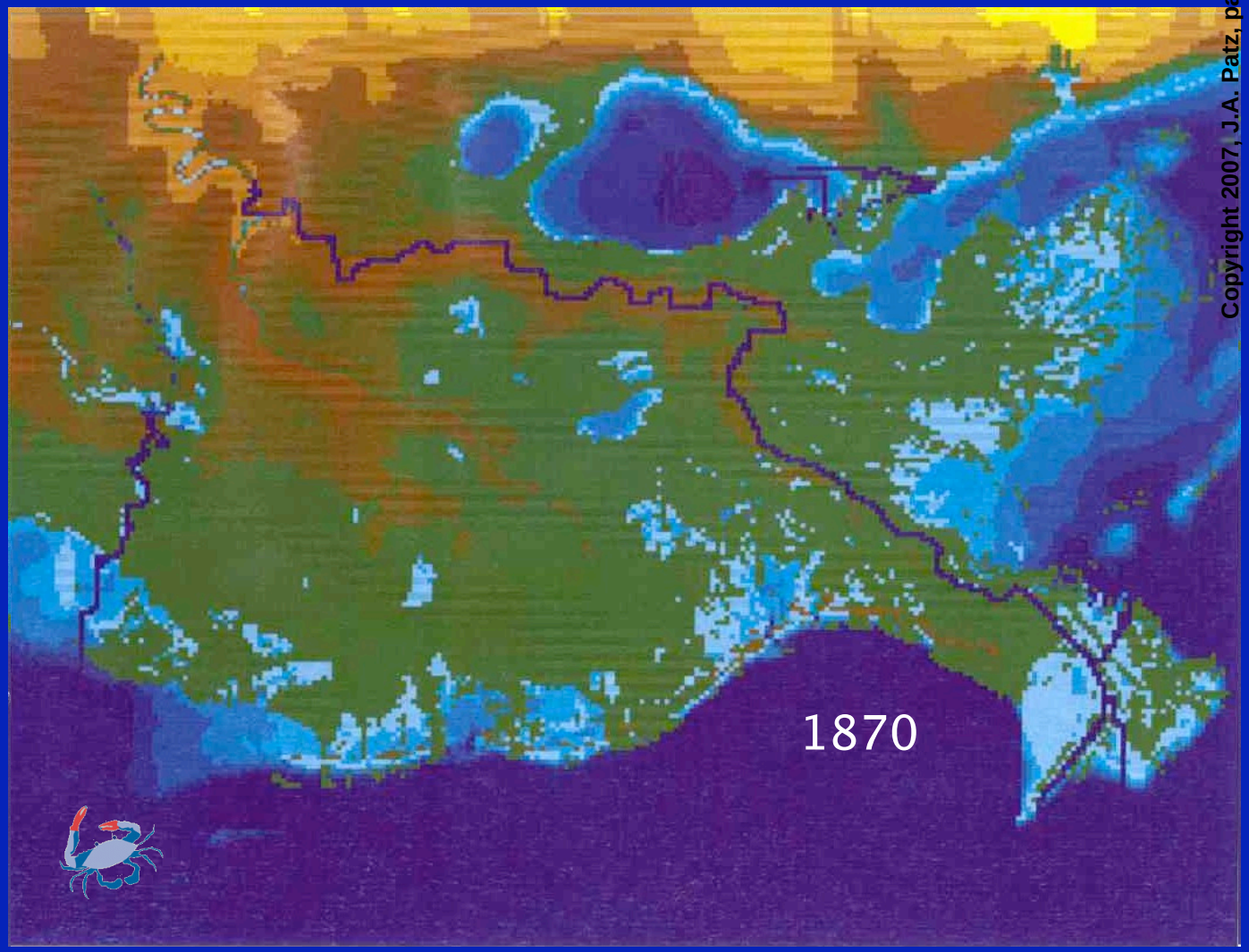

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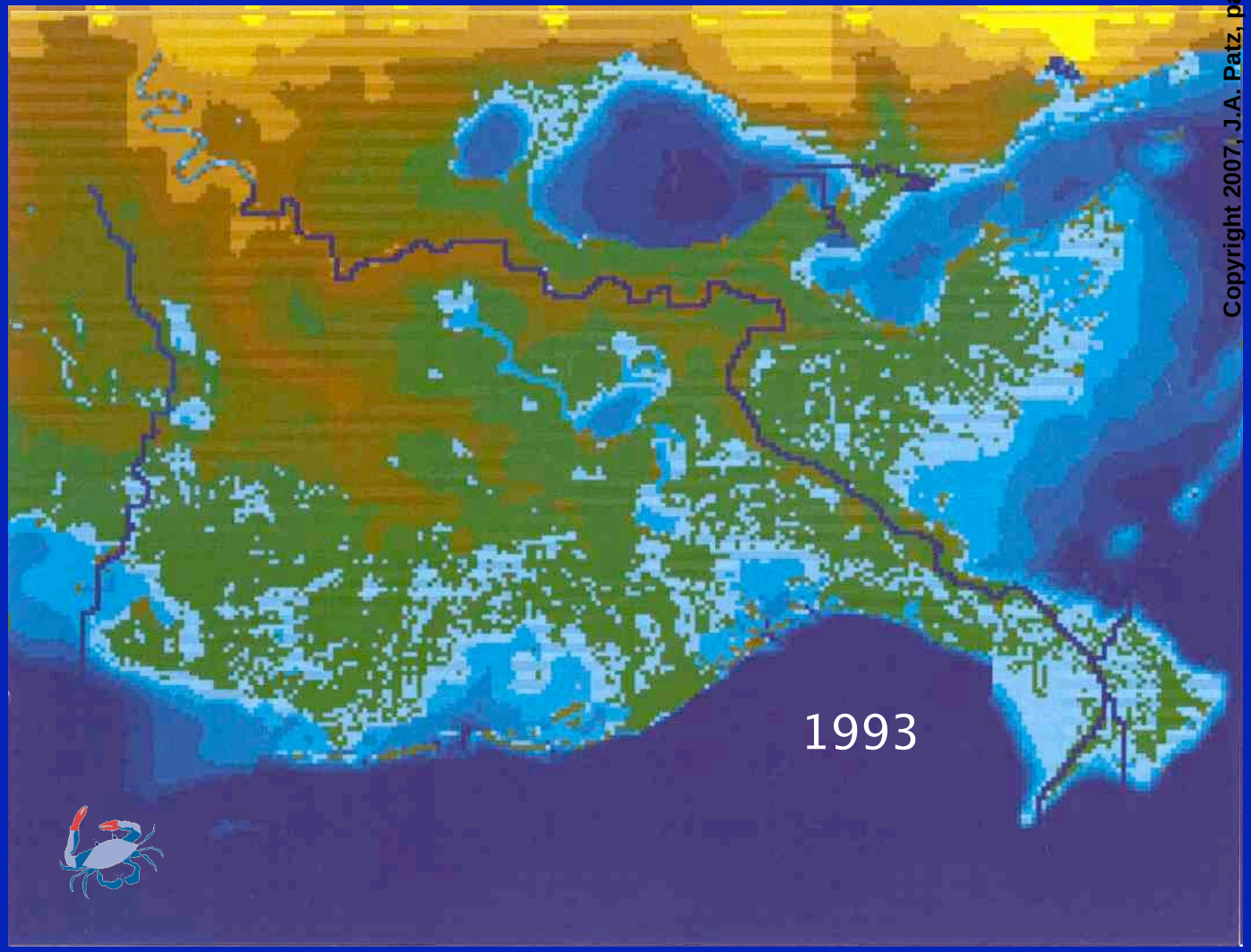

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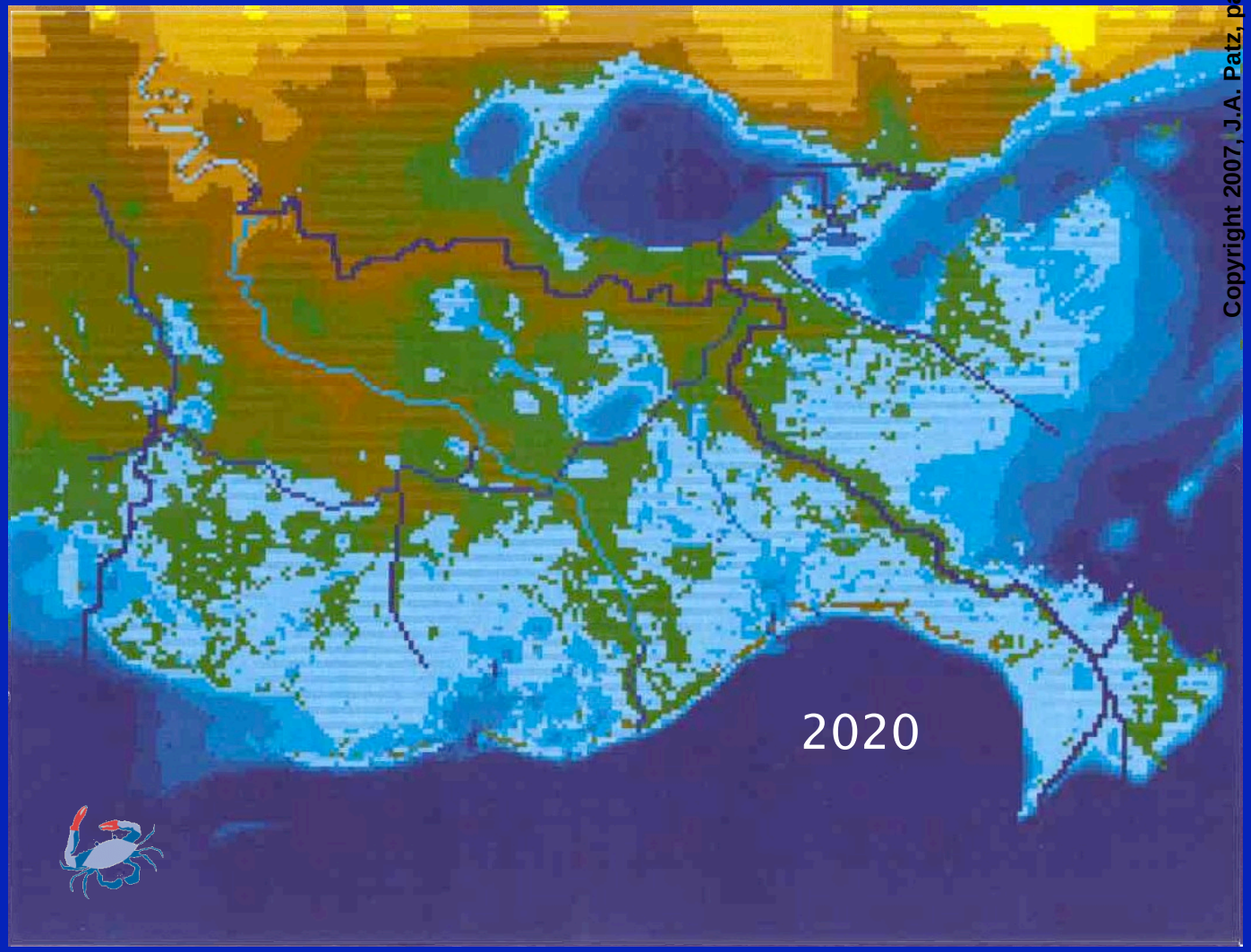


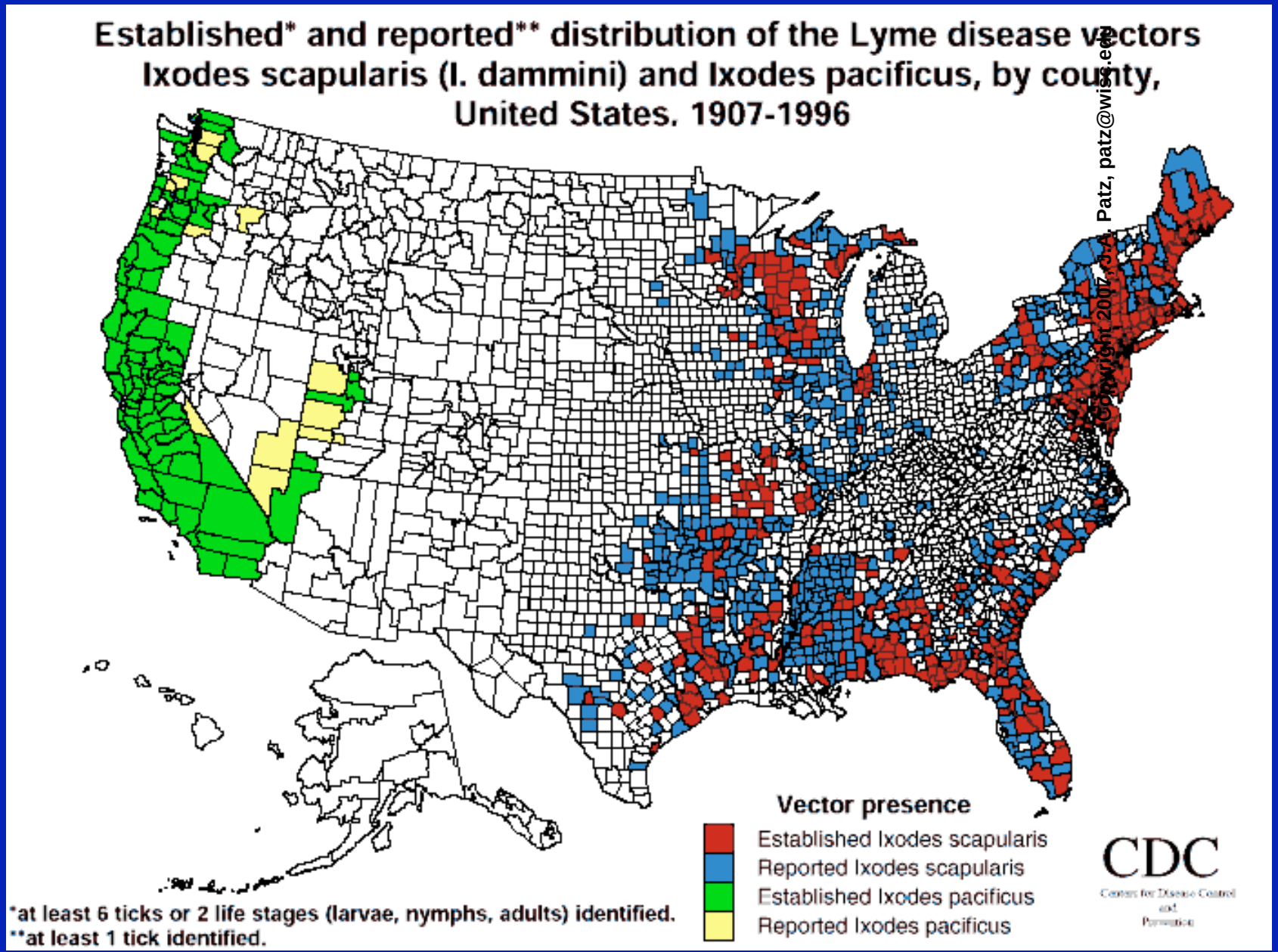
New Orleans

after Hurricane Katrina

Figure 4 Isolated habitat remnants in the wheat belt of Western Australia. Isolation causes physical changes to habitat remnants, which in turn can lead to changes in species composition and population sizes. Photograph courtesy of CSIRO, Wildlife & Ecology.

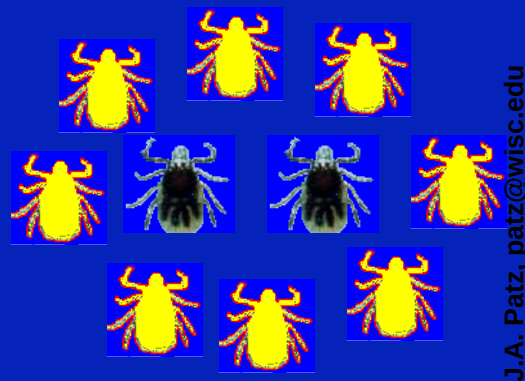
Habitat fragmentation, and isolation is a major driver of ecosystem destabilization and species loss…and some diseases.

Source: Margules & Pressey, 2000

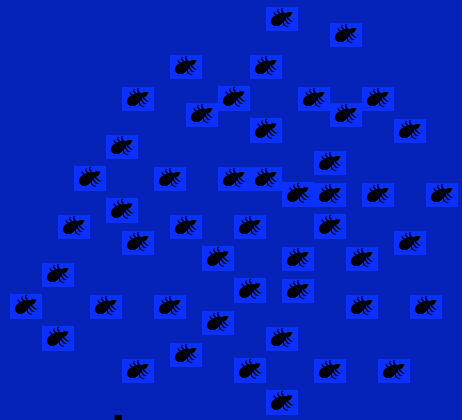

Established* and reported** distribution of the Lyme disease vectors Ixodes scapularis (I. dammini) and Ixodes pacificus, by county, United States. 1907-1996
Vector presence
Established Ixodes scapularis
Reported Ixodes scapularis
Established Ixodes pacificus
Reported Ixodes pacificus
*at least 6 ticks or 2 life stages (larvae, nymphs, adults) identified.
**at least 1 tick identified.
CDC
Centers for Disease Control and Prevention
Copyright 2002, J.A. Patz, patz@wisc.edu

Biodiversity and the

Dilution Effect Hypothesis

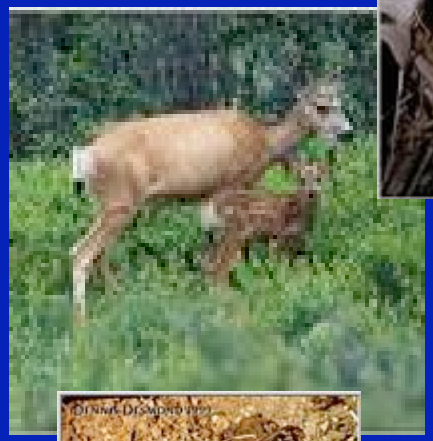


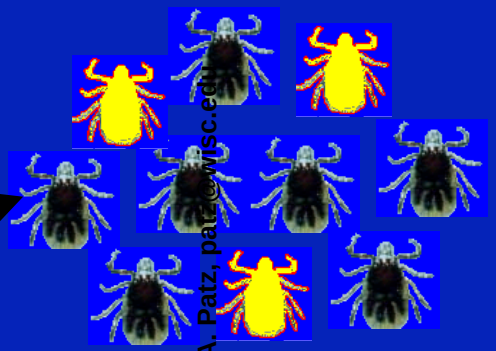
Nymphs



Larvae

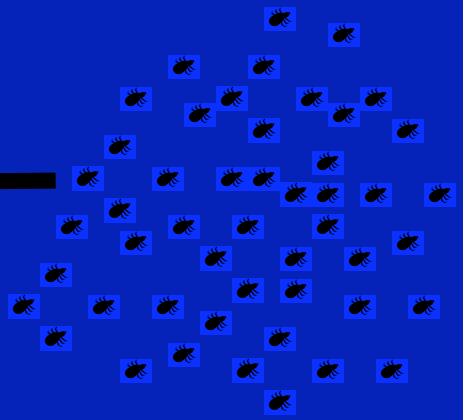
Courtesy: Rick Ostfeld





Nymphs

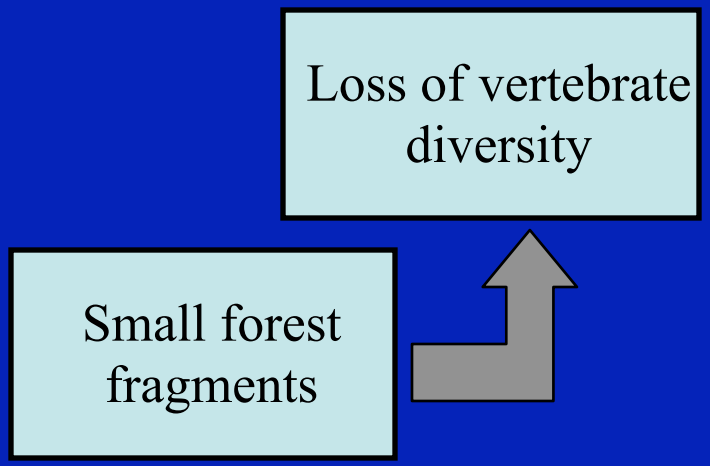
yellow = infected



Larvae

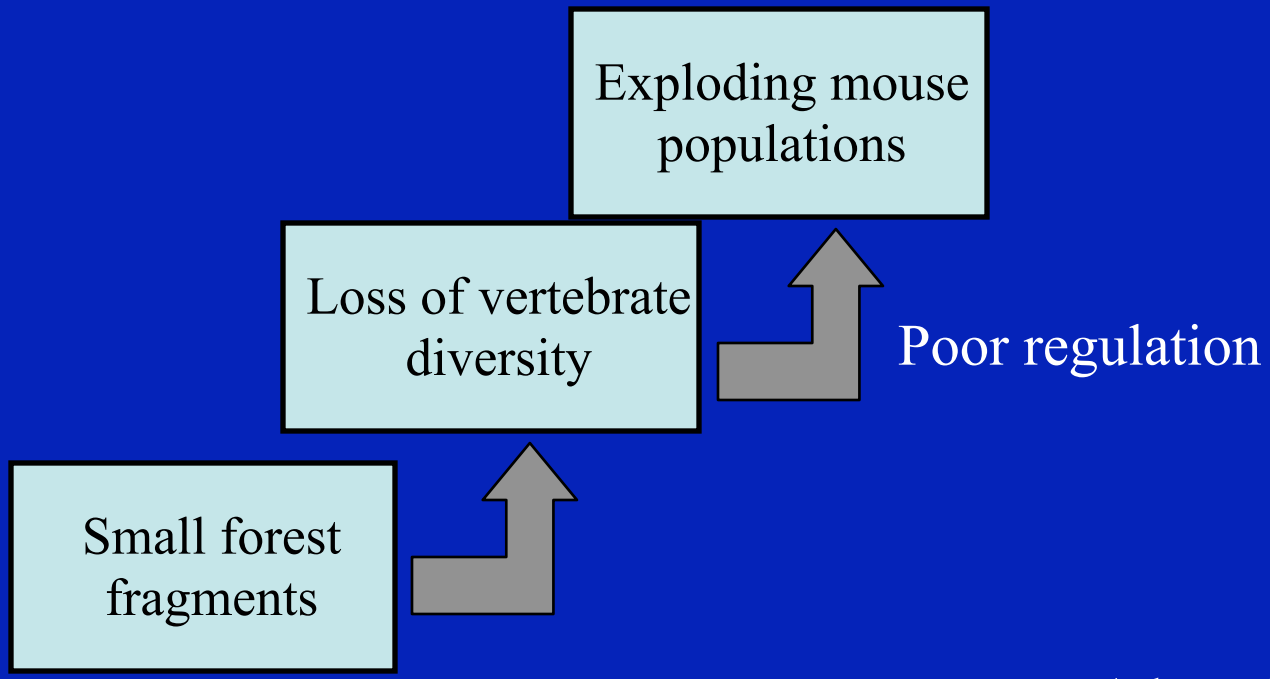
Courtesy: R. Ostfeld

Small habitat fragments



Adapted from: R. Ostfeld

Small habitat fragments



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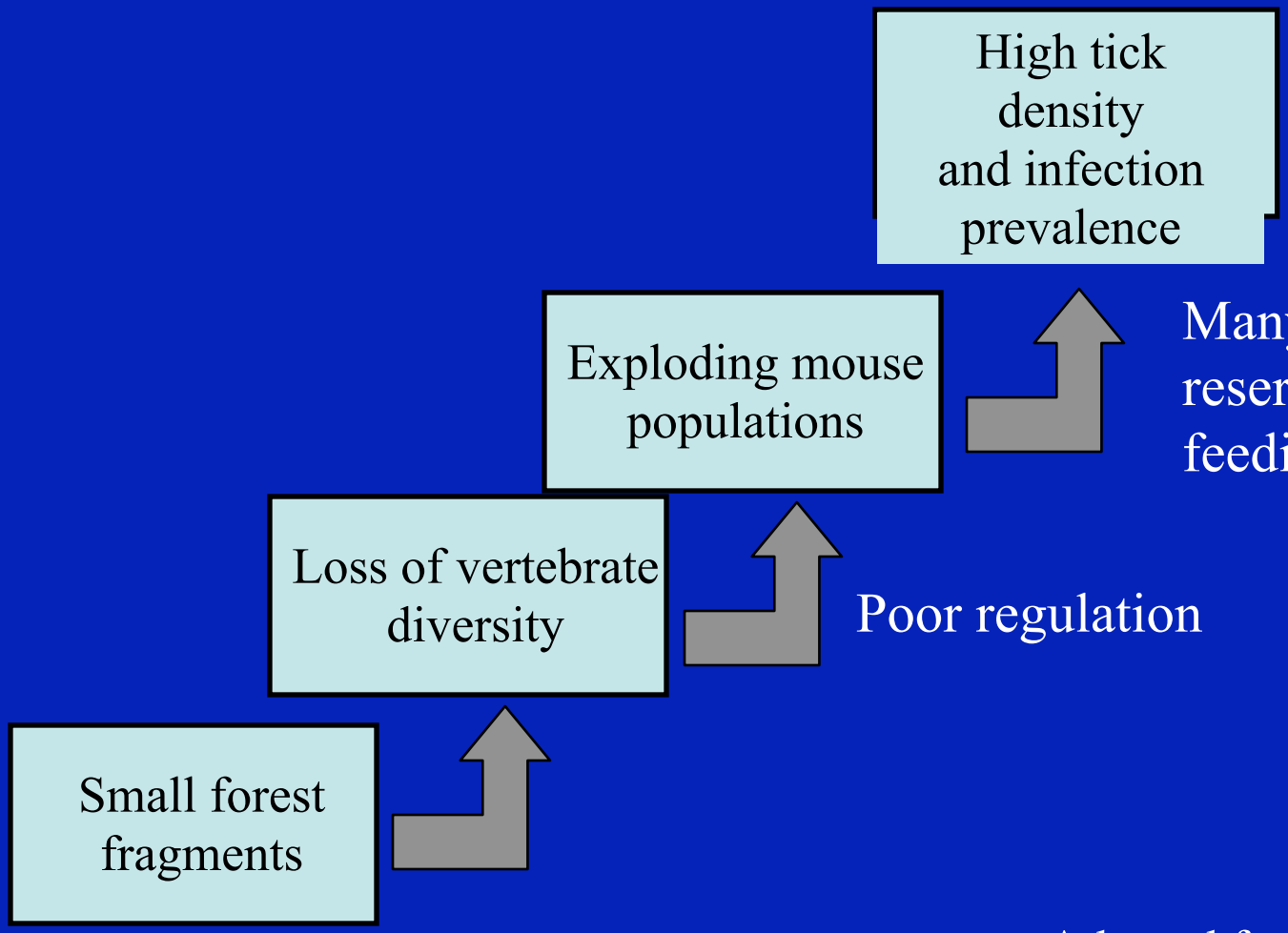

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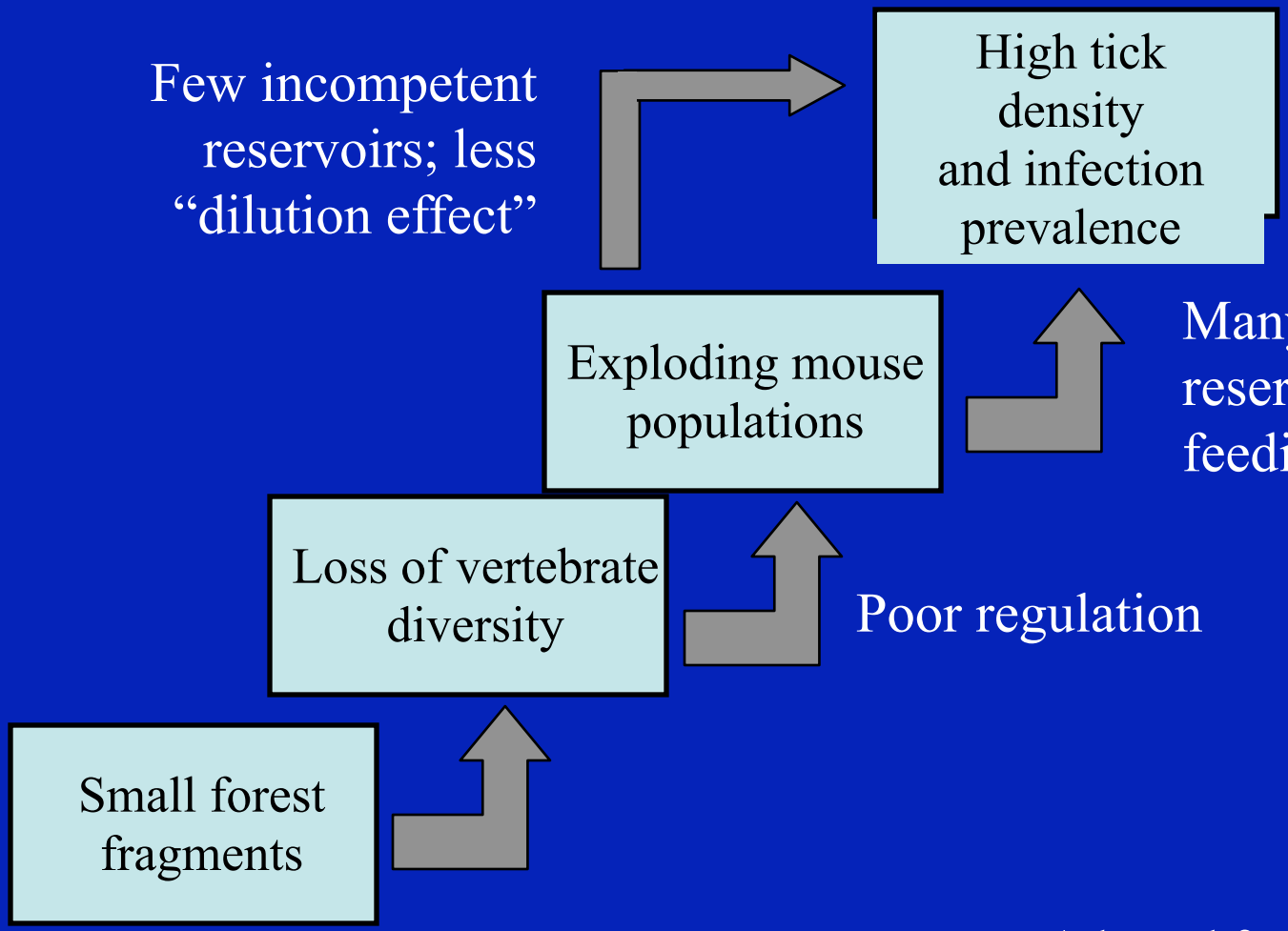

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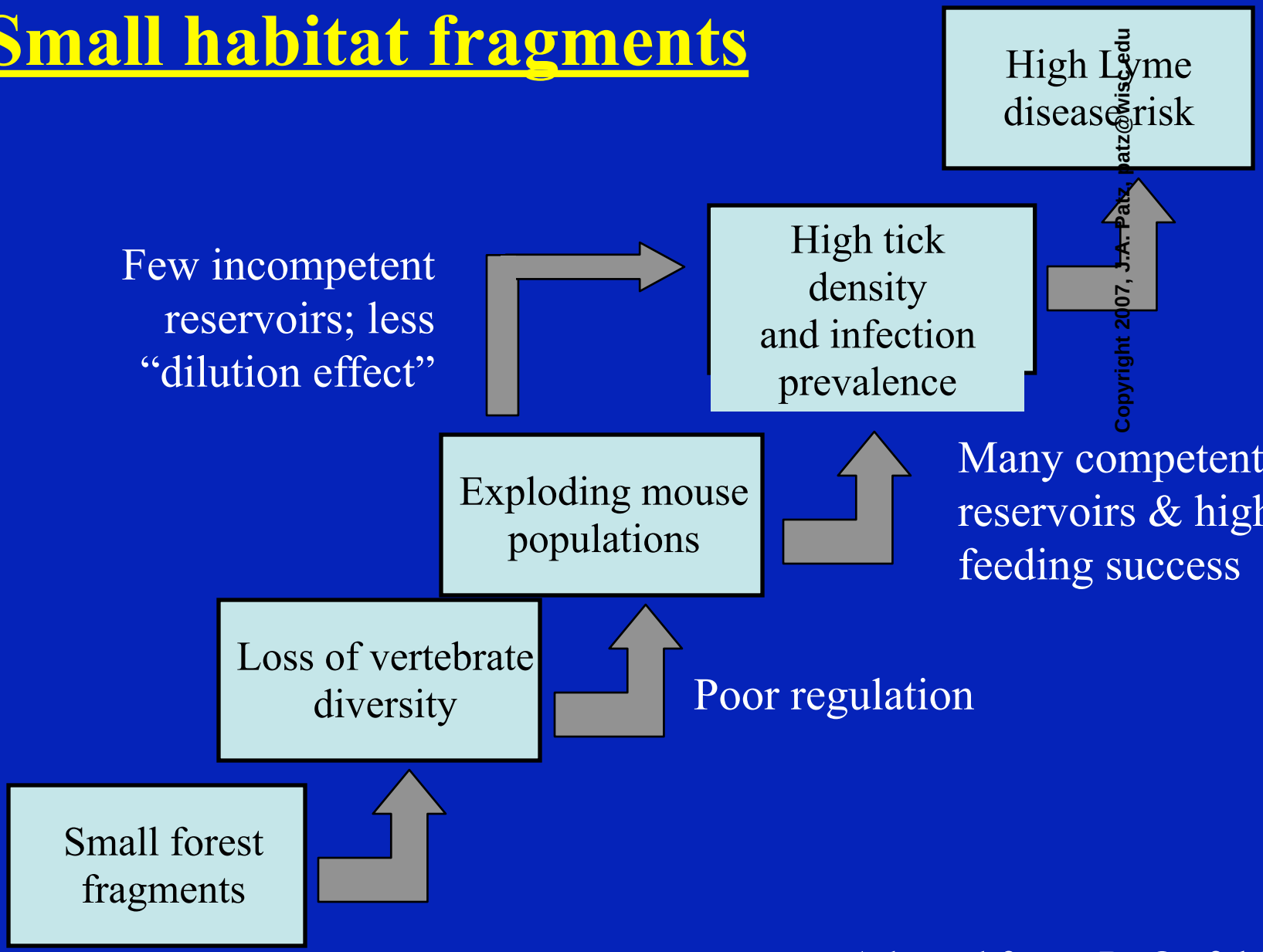

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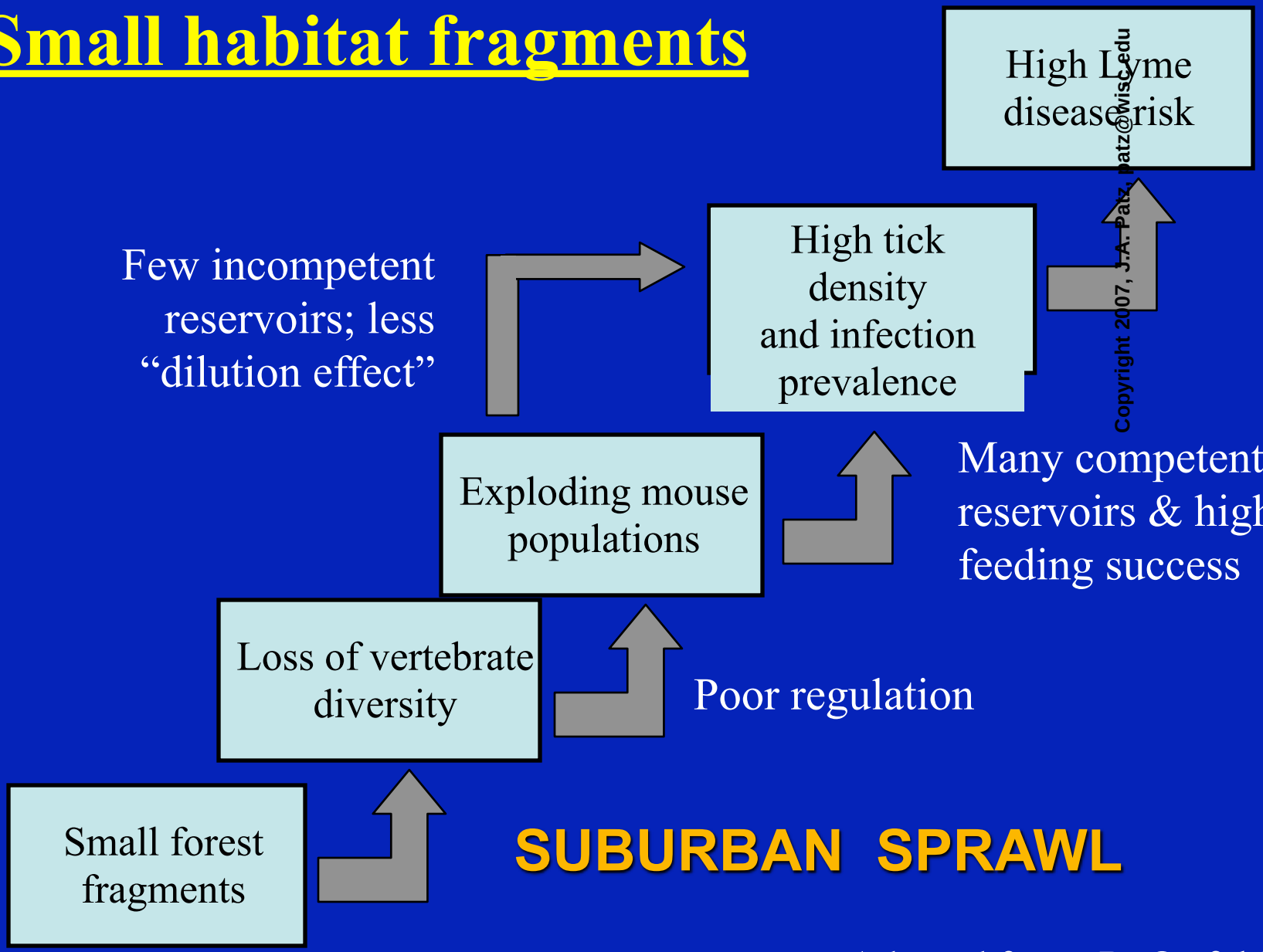


Adapted from: R. Ostfeld

"GROWING FUEL: *The Wrong Way: The Right Way"*

October, 2007, National Geographic

Source: National Geographic

Biofuels and Food Security

- The amount of humanitarian food aid available for extremely impoverished countries will be affected in the short term as food aid shipments from the USA are inversely correlated to commodity prices

(Naylor et al. 2007)

- For every percentage increase in the real prices of staple foods, 16 million more people could become food-insecure (Runge, 2003)

Biofuels: The End of Biodiversity?

- Rush to rapidly switch energy sources away from oil and increase **reliance on crop-derived ethanol or biodiesel also could have devastating effects on the fate of the world's forests.**

- Vast majority of newly expanding **oil palm** fields have replaced closed forest in parts of Malaysia and Indonesia and increases in **soybean** production in Brazil coincide with more forest conversion.

(Gibbs unpublished data)

Deforestation and Malaria: Case study from the Peruvian Amazon.

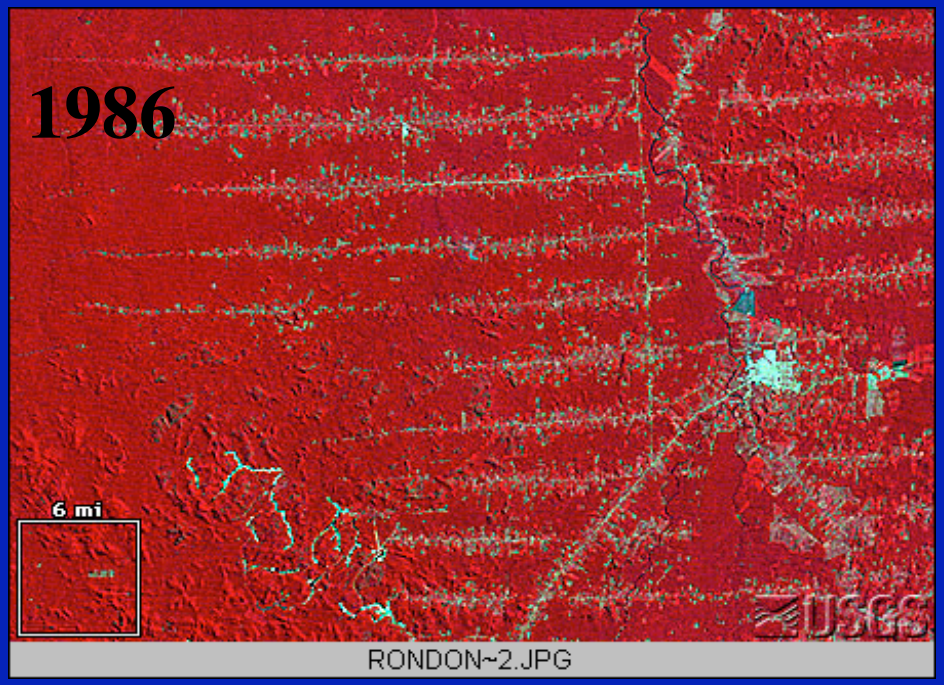
Collaborators:

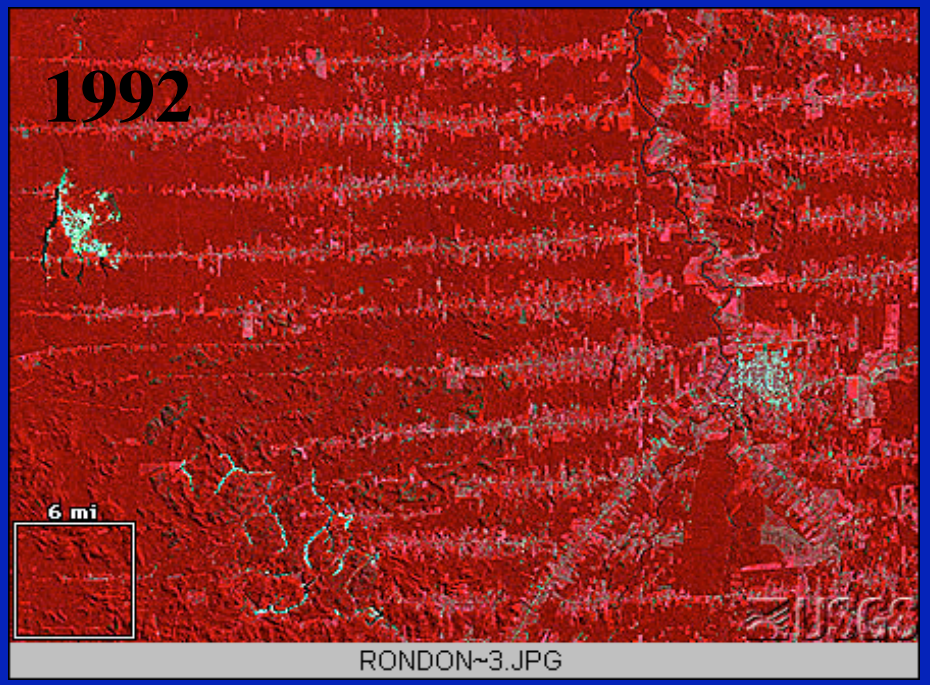
Amy Vittor, Bill Pan, Bob Gilman, Greg Glass, Jim Tielsch, Jonathan Patz

Rondonia, Brazil

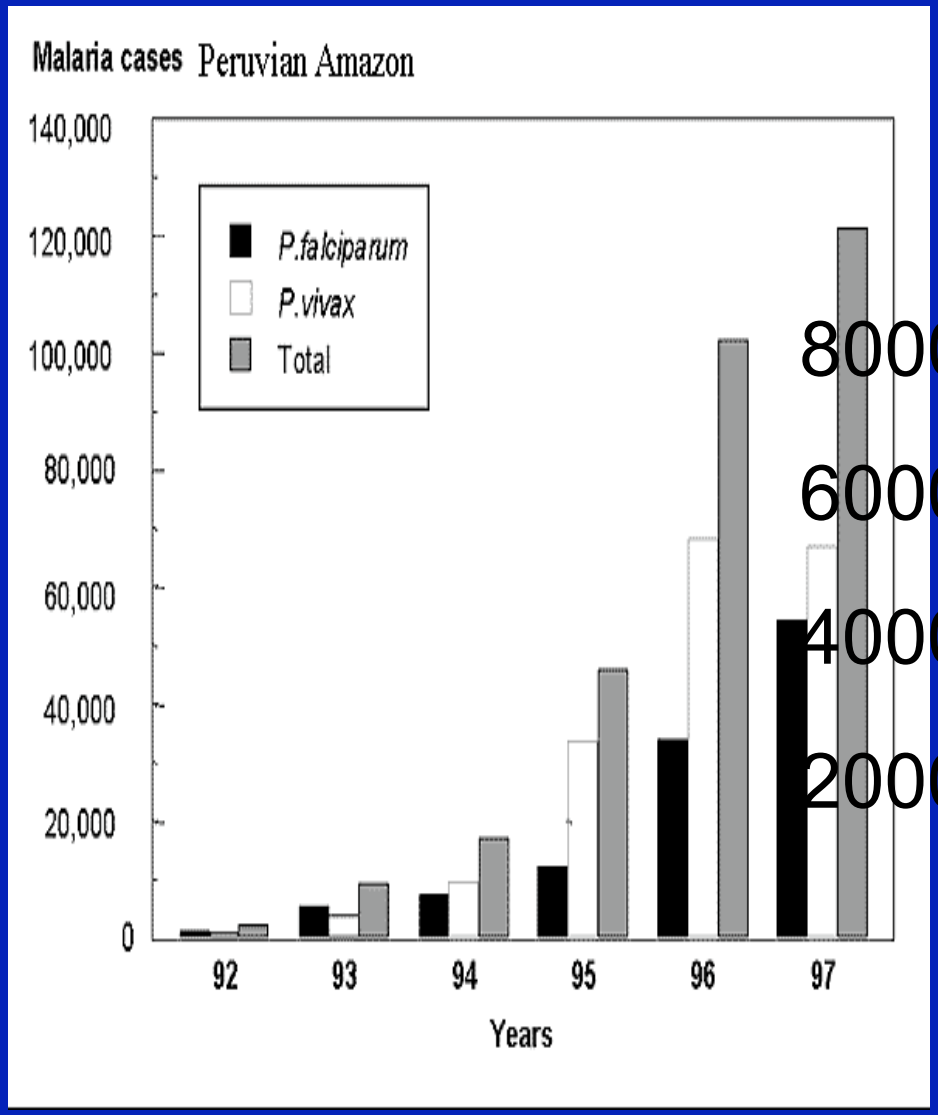
"Fishbone pattern" of logging roads

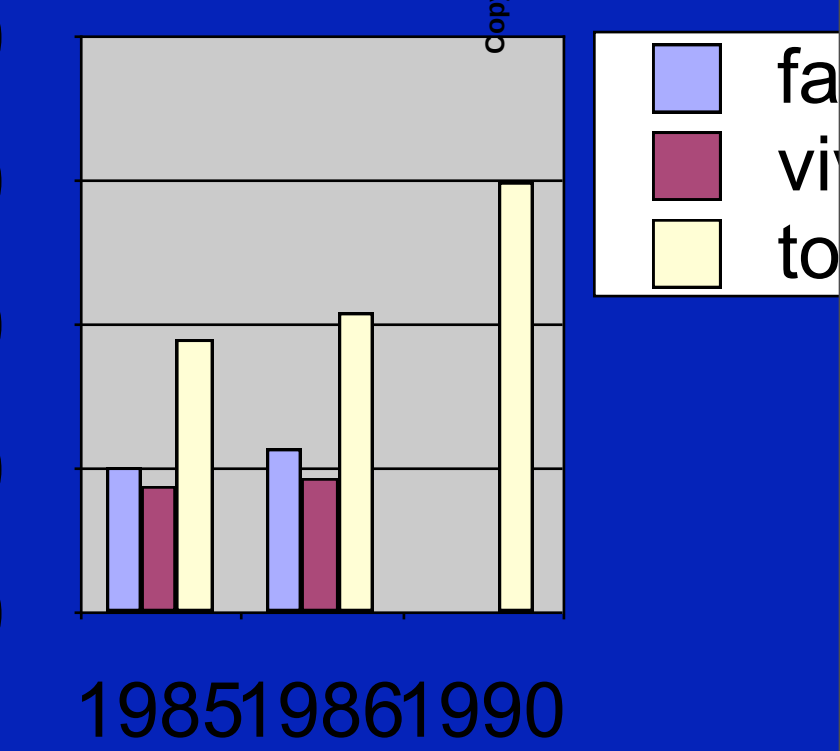
(Reverse color satellite image)





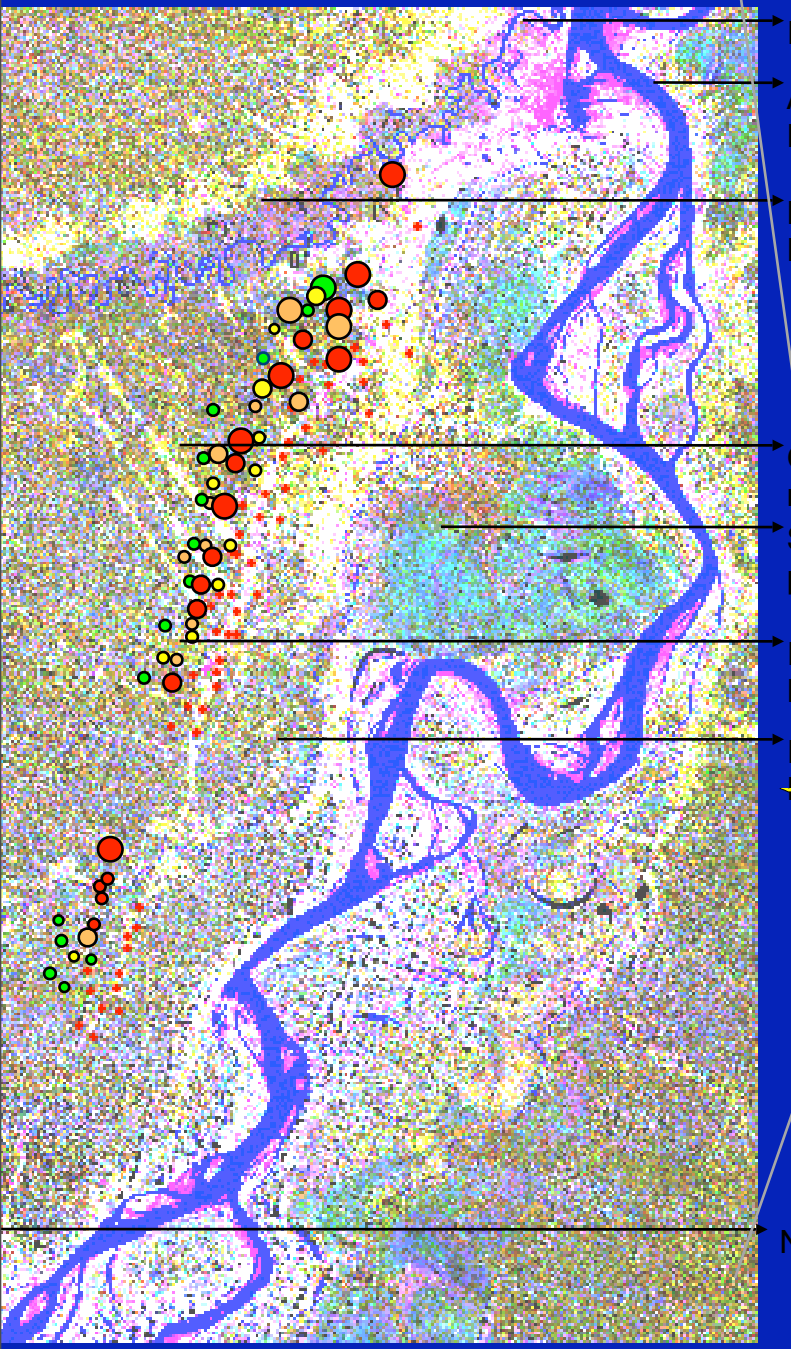
Malaria - Latin America





Peruvian Amazon study site

Landsat image shows road from Iquitos to Nauta. 56 sampling sites indicated per key below:



Scale: 1:800,000

- 5.0 – 22.9 mean *A. darlingi*/6-hrs/person
- high deforestation (54%), low forest (3%)
- 0.5 – 4.9 mean *A. darlingi*/6-hrs/person
- medium deforestation (25%), medium forest (20%)
- 0 – 0.4 mean *A. darlingi*/6-hrs/person
- low deforestation (5%), medium forest (35%)
- low deforestation (6%), high forest (76%)

Anopheles mosquitoes

~ 422 species of *Anopheles*, 60 to 70 of which can act as malaria vectors

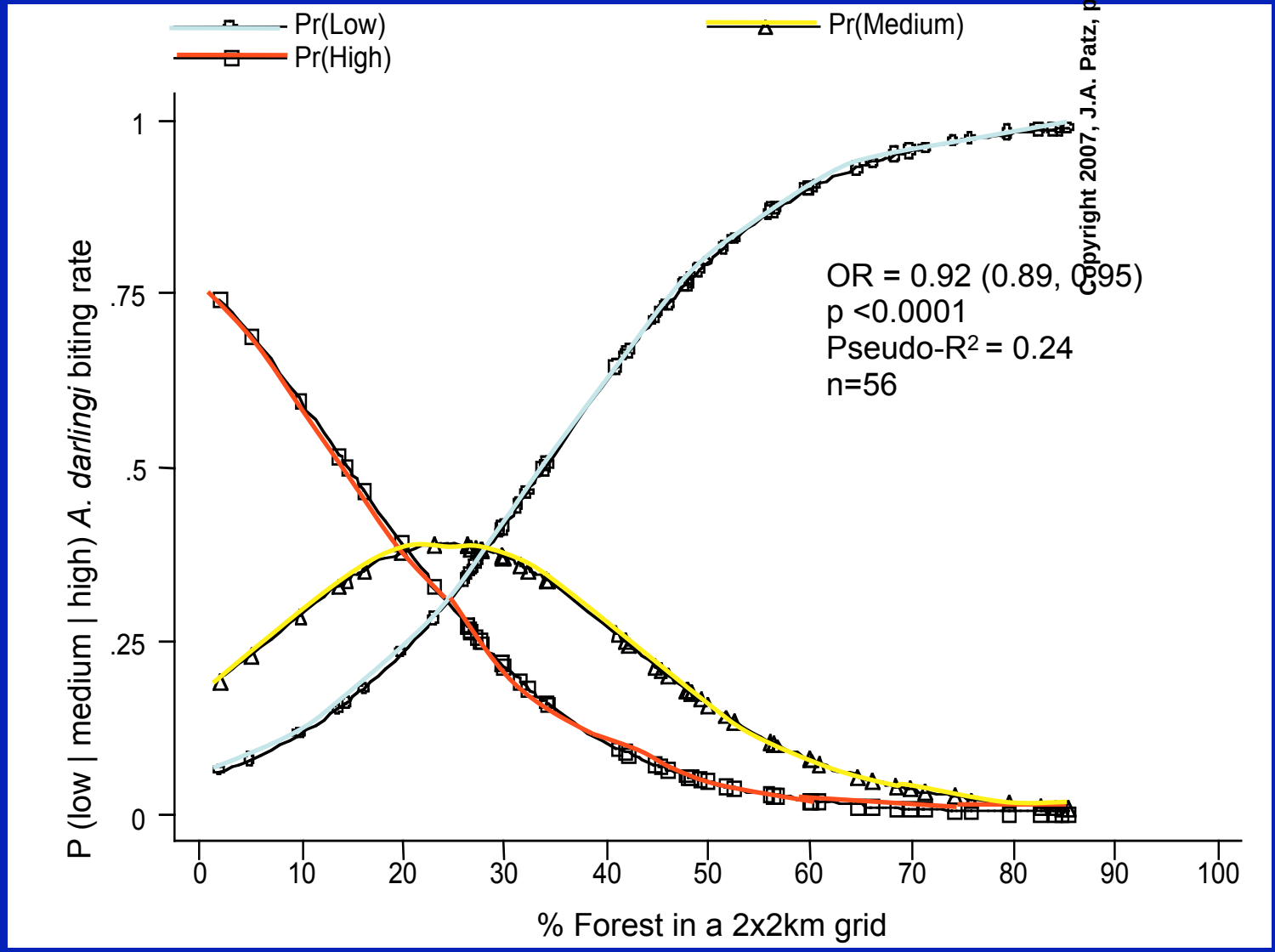
Therefore, many *Anopheles* species are harmless to humans, incapable of allowing *Plasmodium* to develop into sporozoites that reside in the salivary glands.

Some species will harbor *P. vivax* sporozoites, but not *P. falciparum* sporozoites.

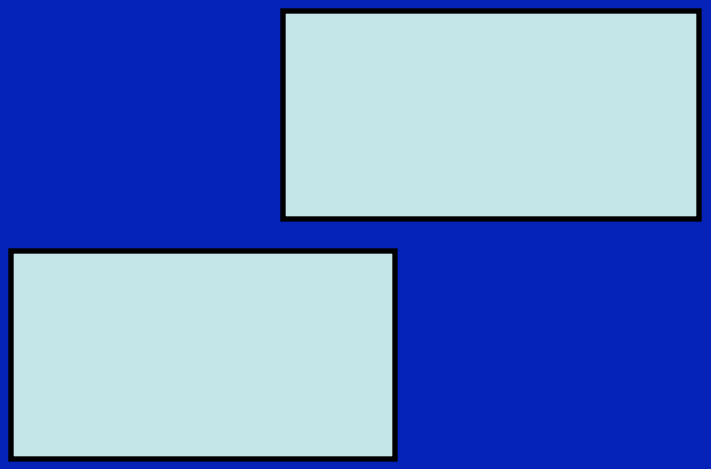
Service, 1993

Mosquito biting rates v. forest cover

Vittor et al. 2006



Deforestation's effect on Malaria risk?



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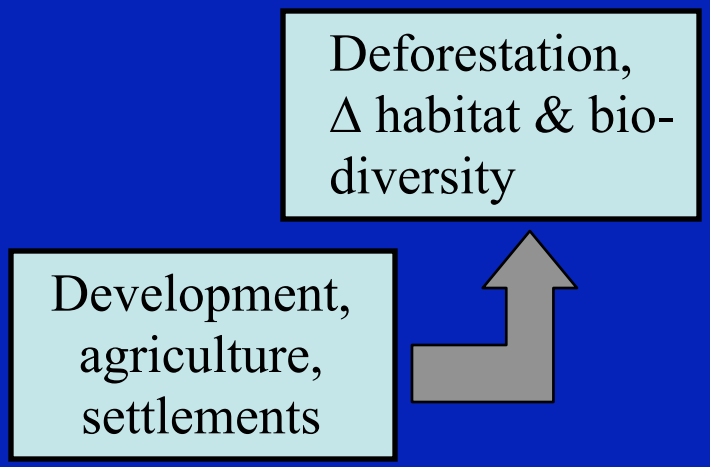

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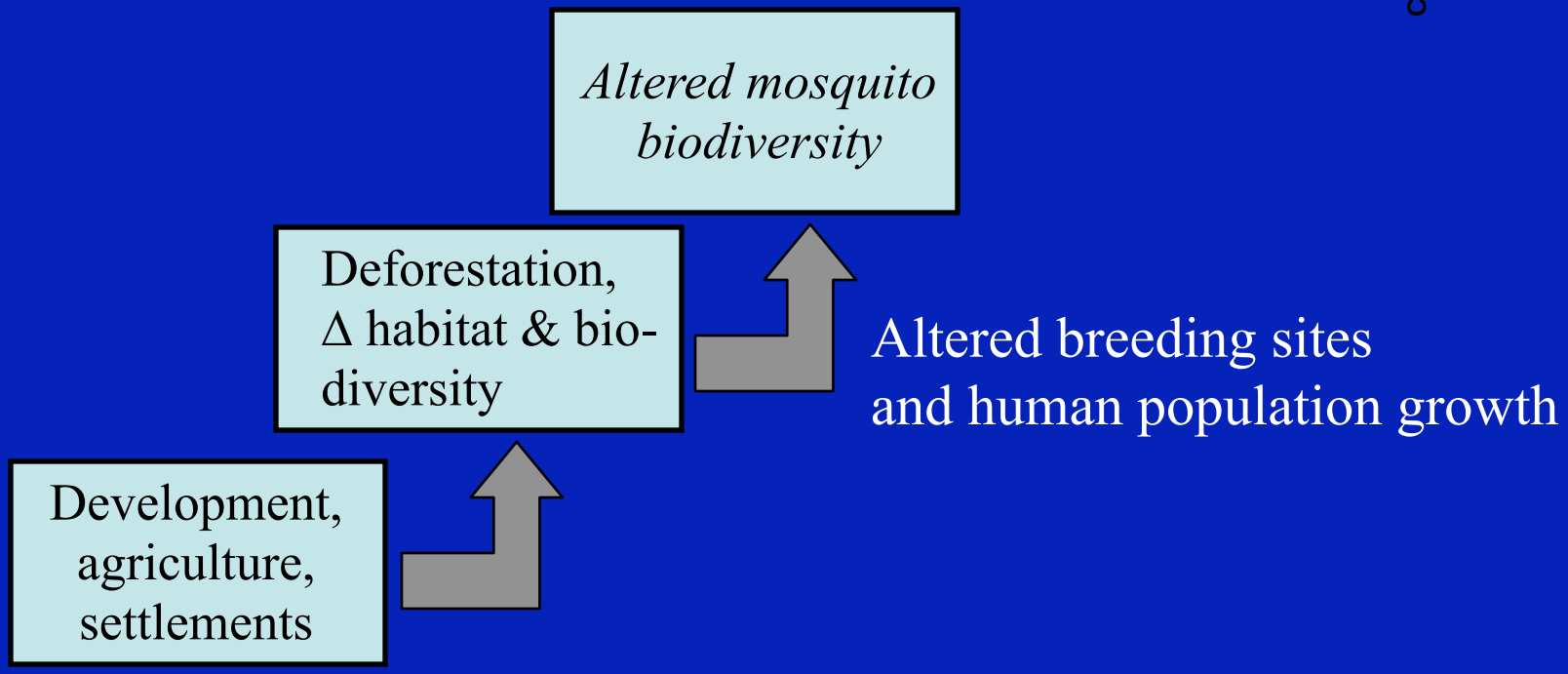

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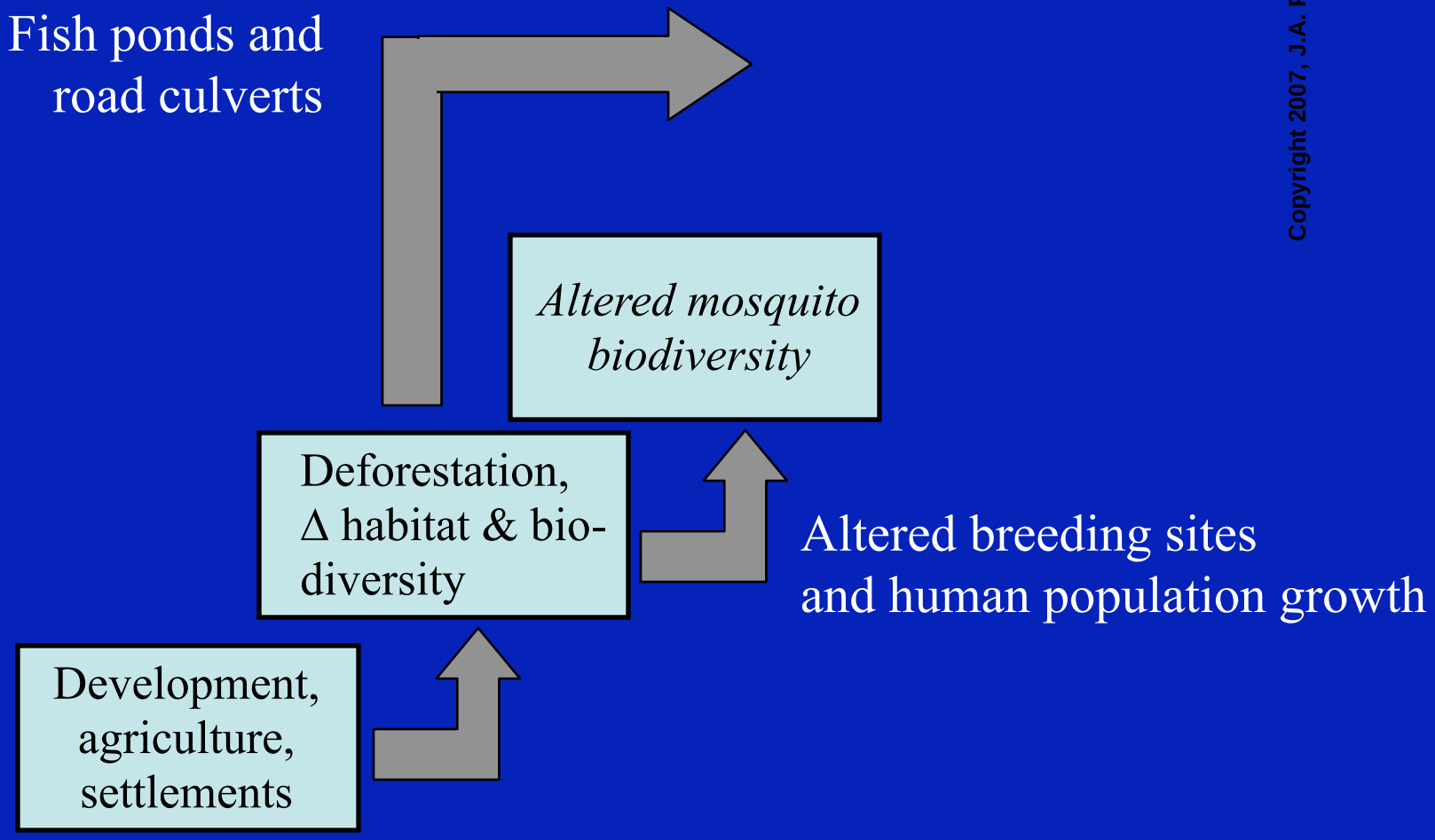

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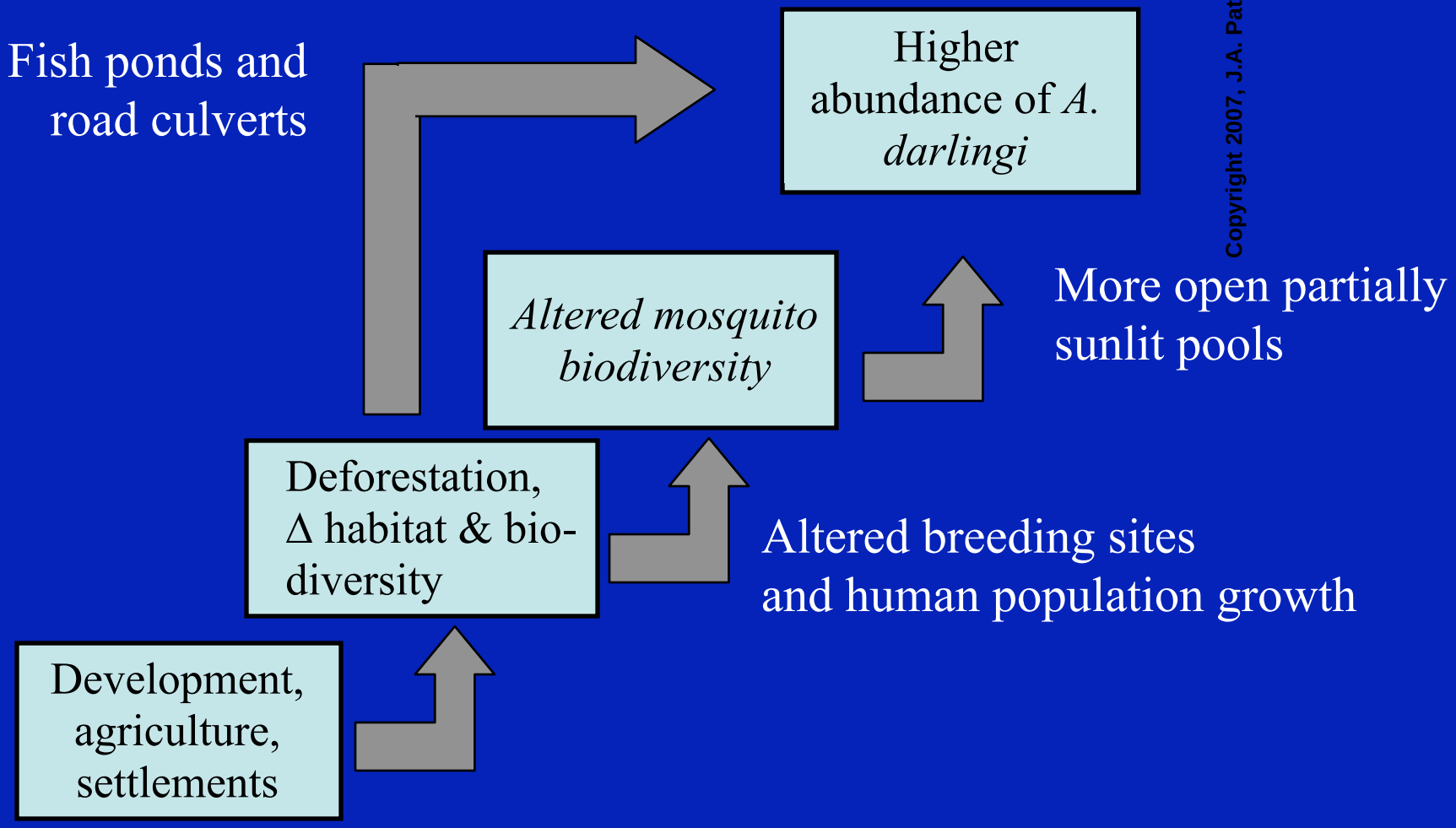

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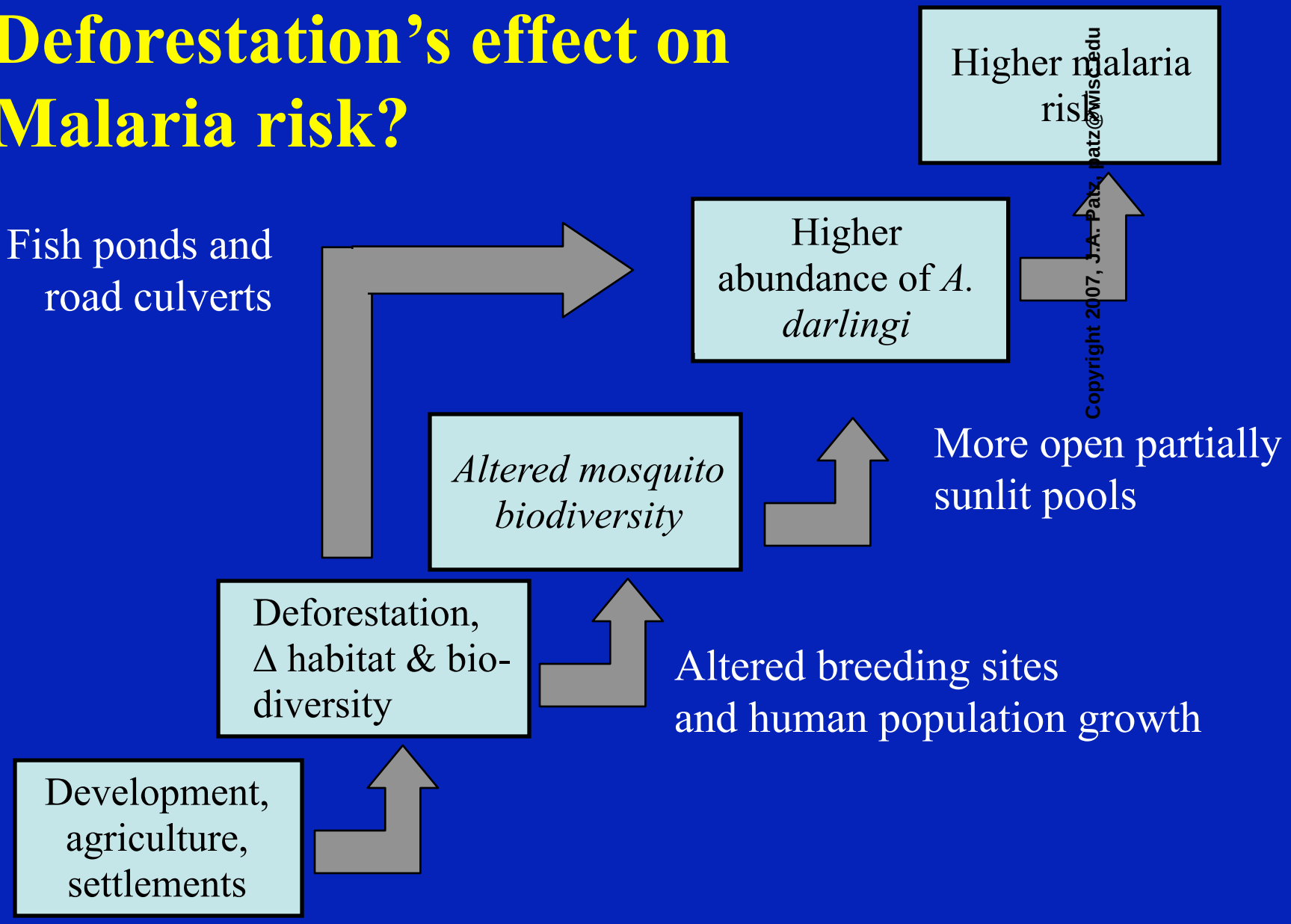


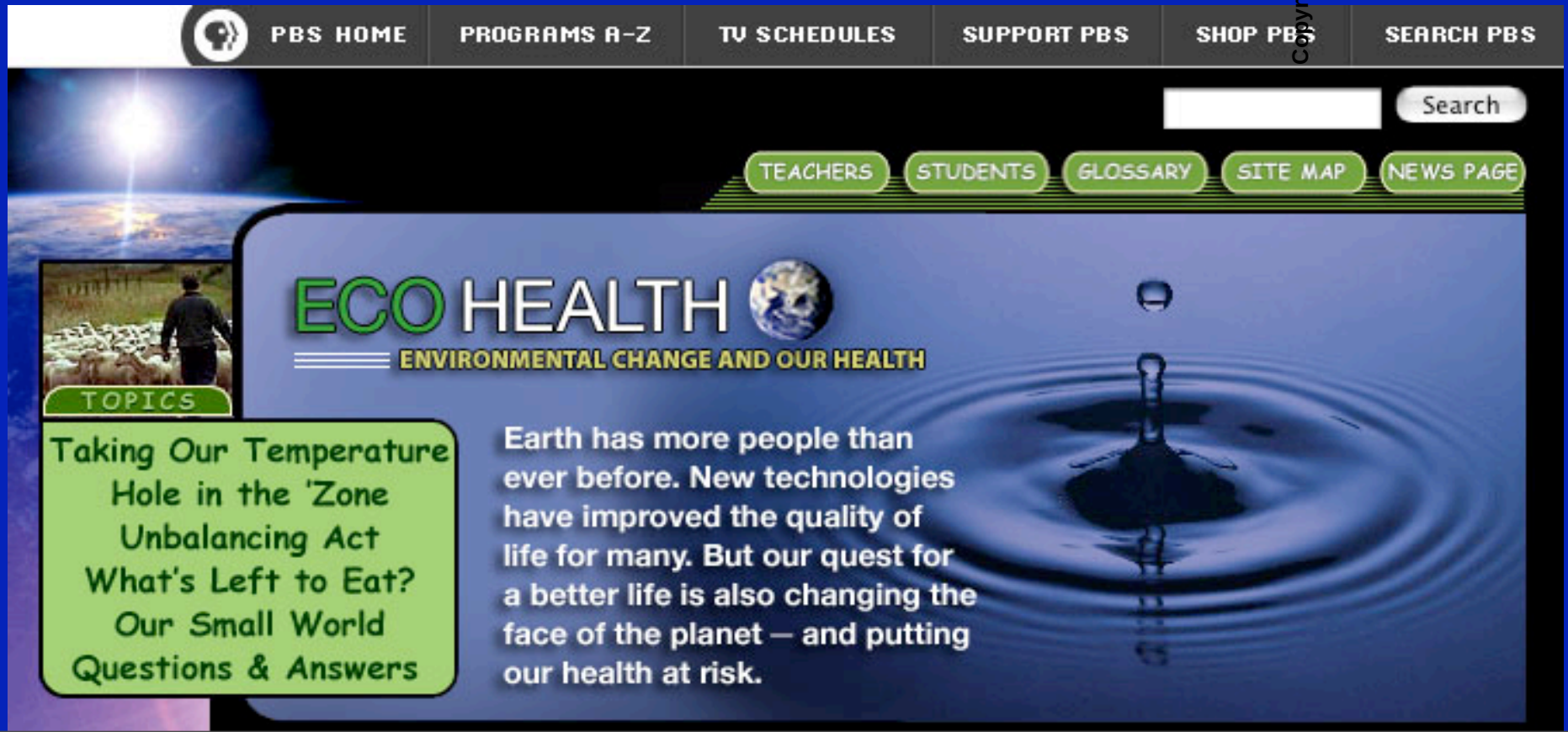
Conclusion

1. Unplanned land use change will modify (for better or worse) the hazardous exposures presented by climate change

2. First do no harm: if switch to biofuels, conduct full health impacts

Information for middleschool teachers, students, and the general public

ECOHEALTH101.ORG



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