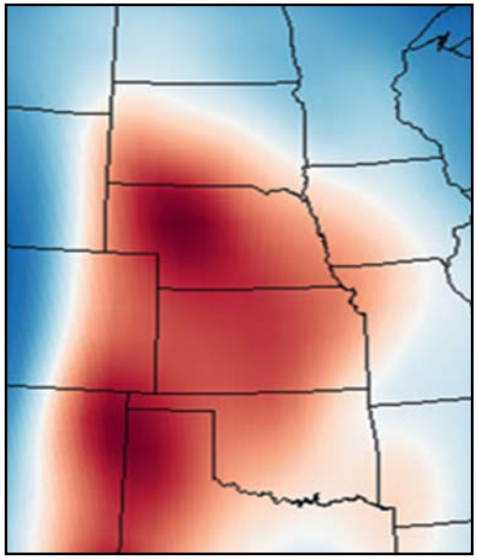
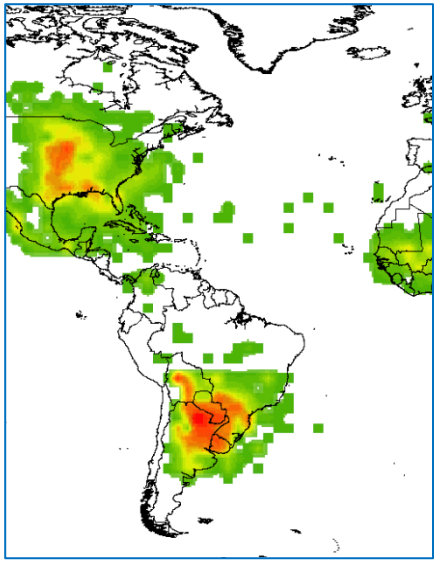
Severe weather ecology: Global insights from localized chaos





Jeremy D. Ross

Oklahoma Biological Survey

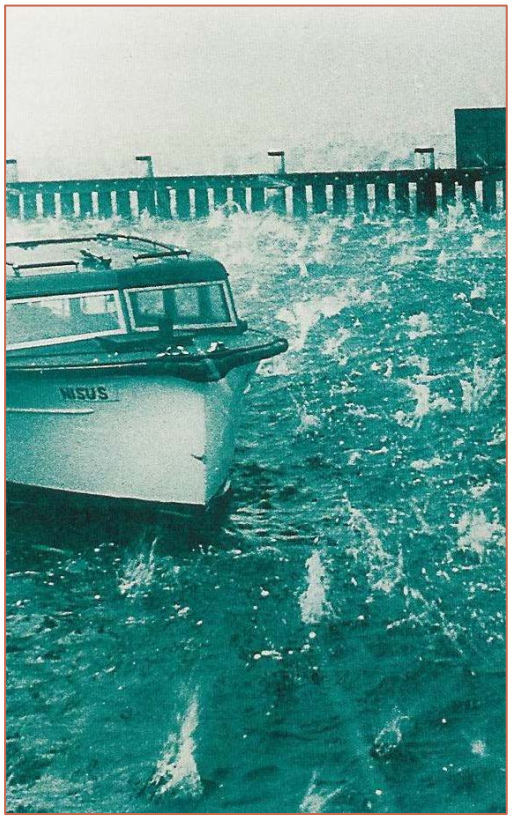
University of Oklahoma

@nrdybrdr

#severeweatherecology

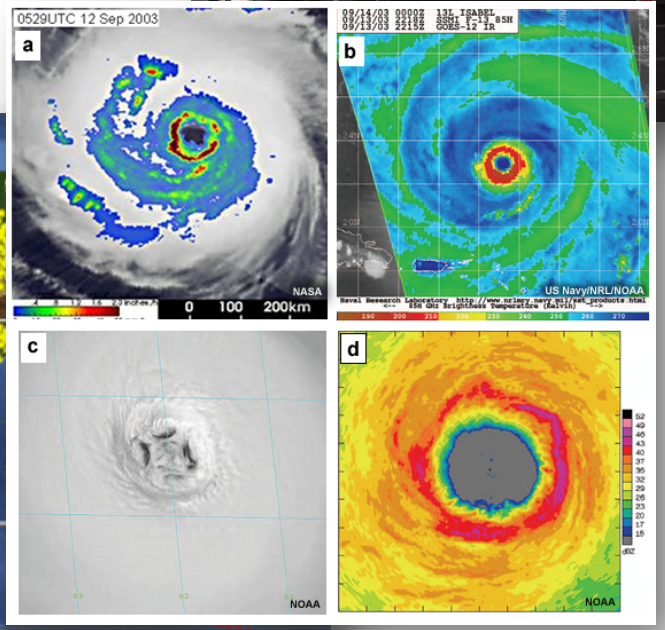
Severe Weather

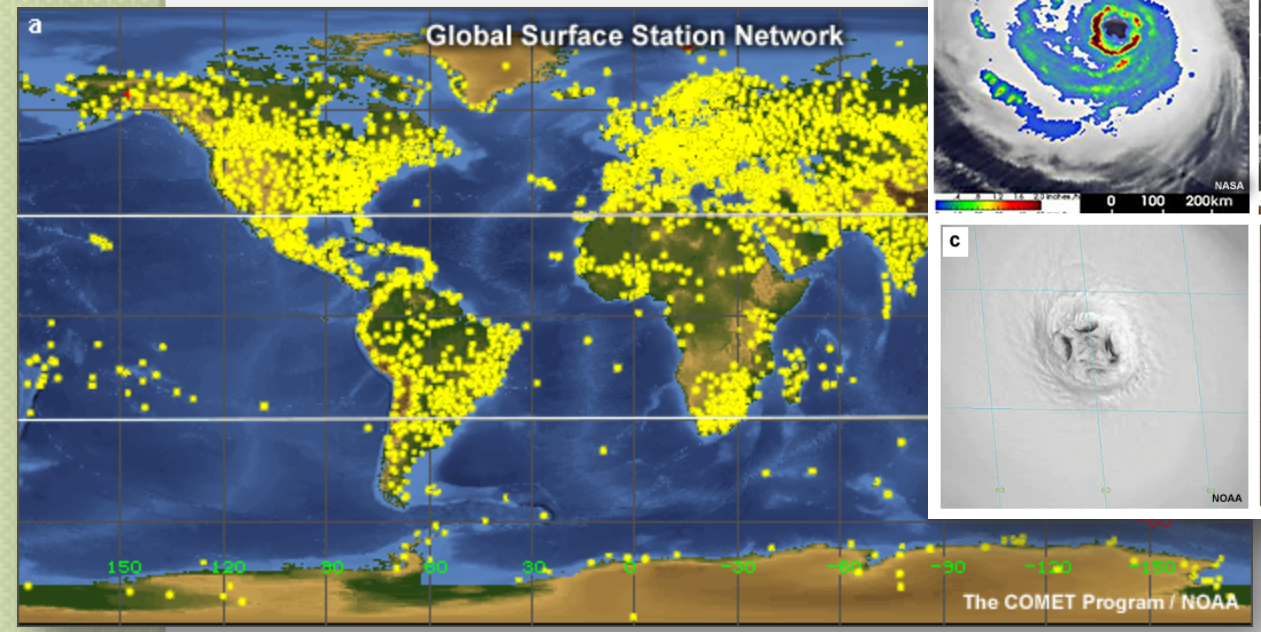
- Transient mesoclimate extremes linked to atmospheric processes



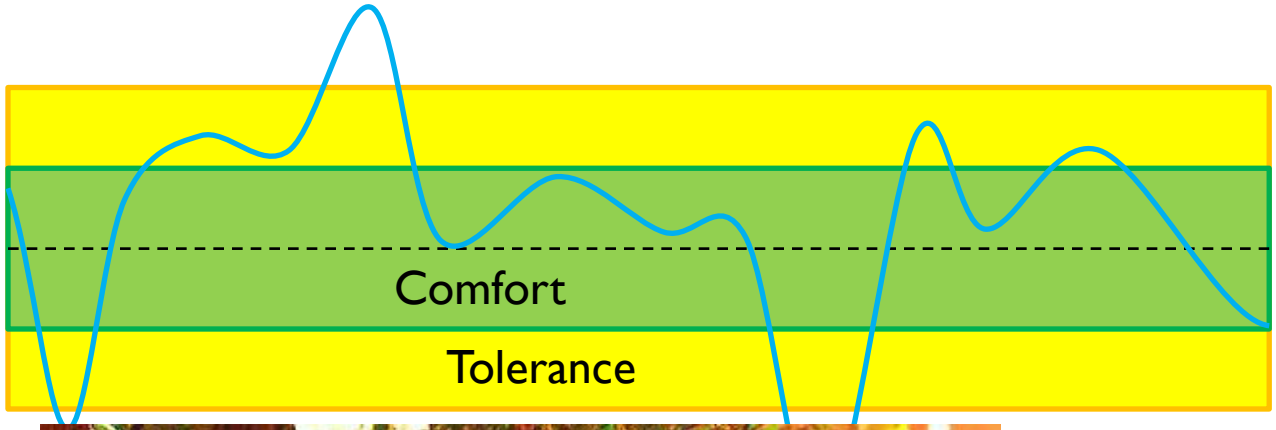
Monitoring severe weather

- Radar
- Satellites
- Monitoring networks
- Models





Weather Effects on Populations



B. Strick

Weather Effects on Populations

University of Tulsa

Brown & Brown (1998, 2000)

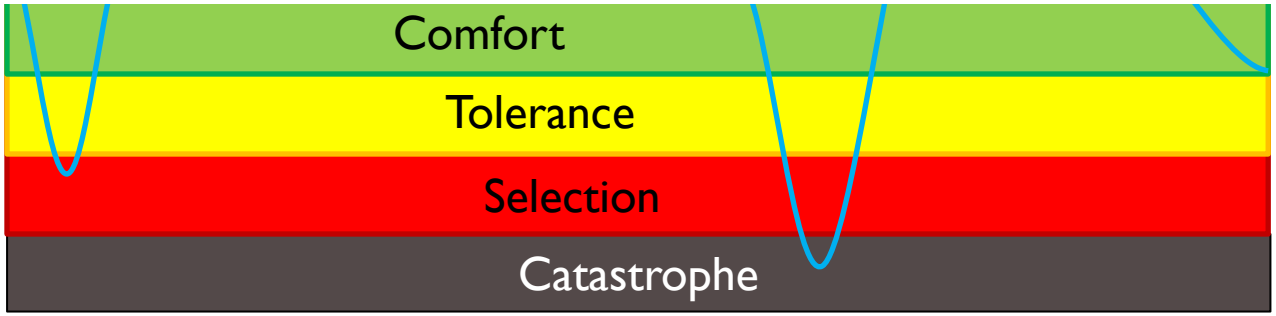
Weather Effects on Populations

Unidirectional impacts:

Hailstorms

Hurricanes

Ice Storm



Bi-directional conditions:

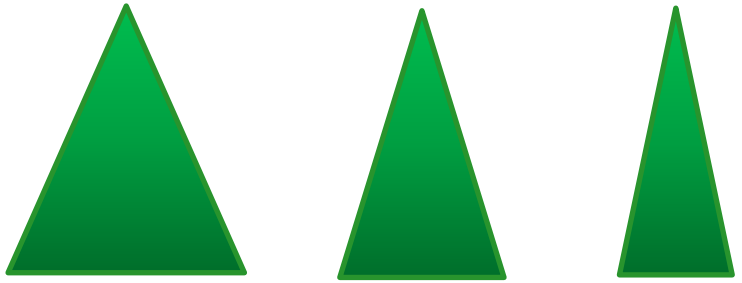
Temperature

Precipitation

Factors affecting resistance to wind/ice storms in woody plants

Tree form

- taper
- density
- crown shape
- rooting depth



Taper = 90% 70% 40%

Flexibility vs. strength

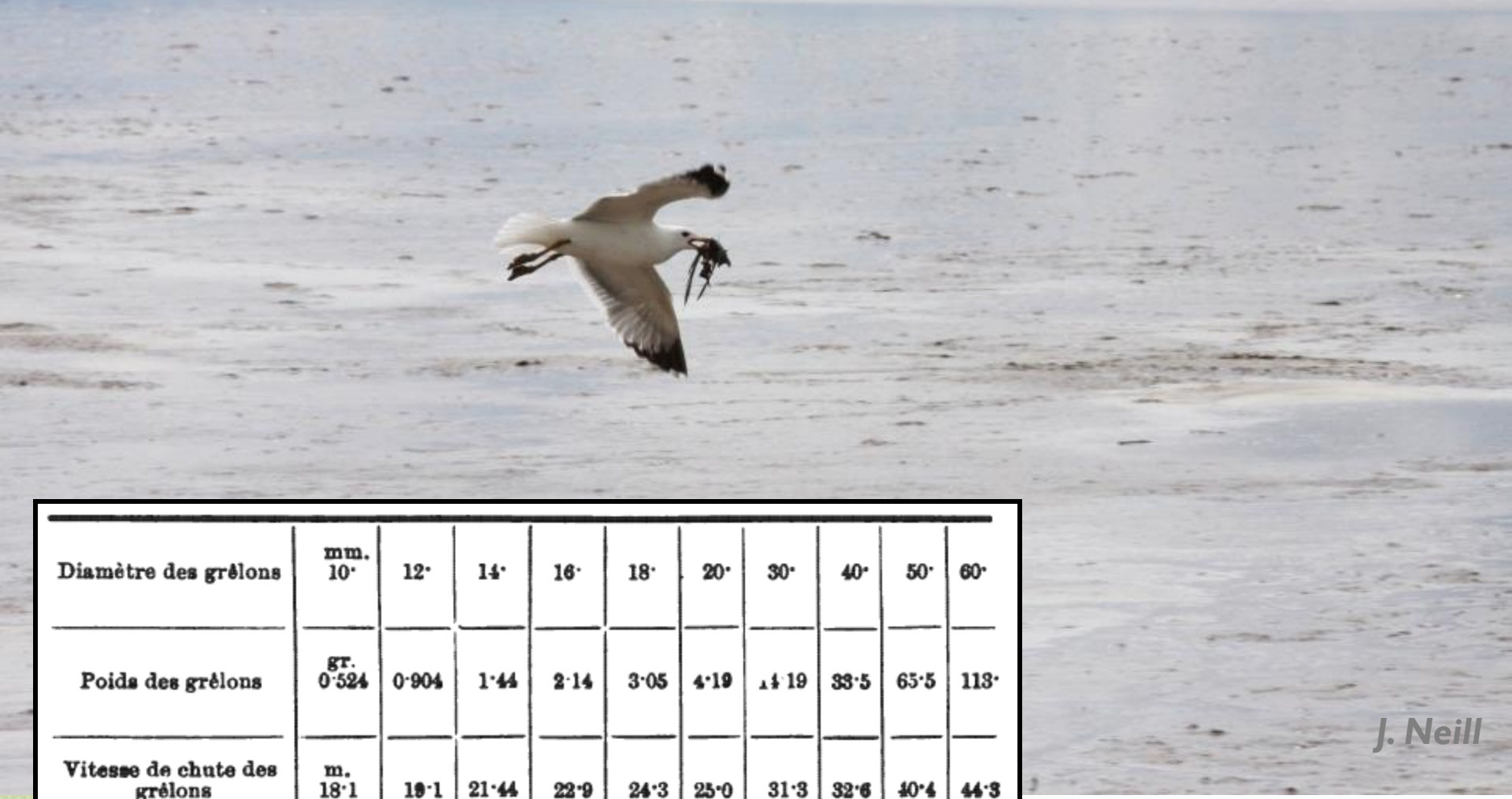
Individual Effects of Severe Weather

Post-event reports of birds …

- Taxed
- Injured
- Lost nests
- Killed

Impacts likely to vary across species and individuals

Depending on:	For example …
◦ Adaptive behaviors, anatomy, or physiology →	Heat tolerance Escape or shielding behaviors
◦ Habitat usage →	Nest placement
◦ Age & Sex →	Migratory arrival
◦ Body size	



Diamètre des grêlons	mm. 10·	12·	14·	16·	18·	20·	30·	40·	50·	60·
Poids des grêlons	gr. 0·524	0·904	1·44	2·14	3·05	4·19	11·19	33·5	65·5	113·
Vitesse de chute des grêlons en mètres par seconde	m. 18·1	19·1	21·44	22·9	24·3	25·0	31·3	32·6	40·4	44·3
Force vive au choc des grêlons	k. 0 00873	0·0181	0·0335	0·0573	0·0917	0·140	0·708	2·24	5·46	11·3
Poids des animaux assommés par la chute des grêlons	k. 0·061	0·127	0·234	0·400	0·624	0·980	4·95	15·7	38·	79·

Martin (1907)

Force to stun an animal = 1 kg·m of kinetic shock force per 7kg of body weight

Record Hailstones

878g hailstone recovered near Vivian, SD on July 23, 2010

Weight of animal predicted to be stunned by record hailstone:

- No wind =
  - 880kg – Mature bull Bison

- 10m/s downdraft =
  - 1064kg – Black rhinoceros

Severe Weather Exposure

- Can occur throughout life-cycle
- Potentially high-risk periods
  - Nesting ⟶ **Amber Carver - 4:15p Saturday**
  - Molting
  - Winter roosting
  - Migratory stopover

Stopover Hotspot – Great Salt Lake

Minimum count of 7,370 Red-necked Phalarope (*Phalaropus lobatus)* 3-days after hailstorm

Photos: John Neill, Utah DWR

Attributing Cause & Effect

- Studies of **disaster** impacts limited by:
  - After-the-fact data collection
  - Site access constraints
  - Unreplicable
  - Confounding covariates (e.g., debris, scavenging)
  - Non-randomization
  - Risks of pseudoreplication

Accidental Ecological Impacts: Methodological Approaches

Analyzing the Effects of Accidental Environmental Impacts: Approaches and Assumptions

John A. Wiens; Keith R. Parker

Ecological Applications, Vol. 5, No. 4 (Nov., 1995), 1069-1083.

Study design		Assessment of		Exposure variable		Reference	
		Initial impact	Recovery process	Categorical	Continuous	Spatial	Temporal
Before–after	Baseline	×		×			×
	Pre/post pairs	×		×		×	×
Single-time	Impact–reference	×		×		×	
	Matched-pairs	×		×		×	
	Gradient	×			×	×	
Multiple-time	Time-series	×	×	×			×
	Level-by-time	×	×	×		×	×
	Trend-by-time	×	×		×	×	×

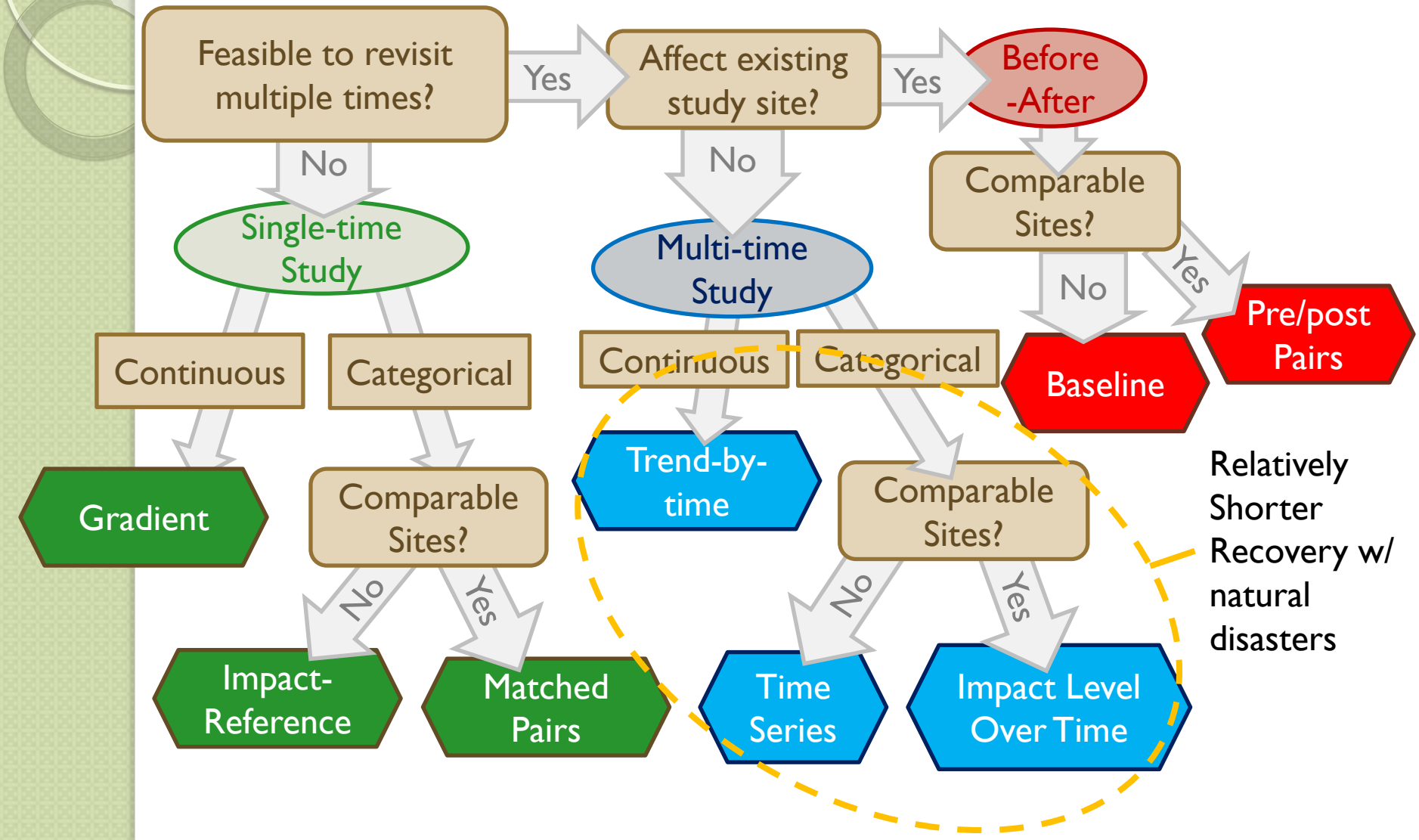
Accidental Ecological Impacts: Methodological Approaches

Study design		Methodological issues		
		Methods consistent	Covariance analysis feasible and useful	Exposure levels adequately sampled
Before–after	Baseline	×		
	Pre/post pairs	×		
Single-time	Impact–reference		×	
	Matched-pairs		×	
	Gradient		×	×
Multiple-time	Time-series	×	×	
	Level-by-time	×		
	Trend-by-time	×		×

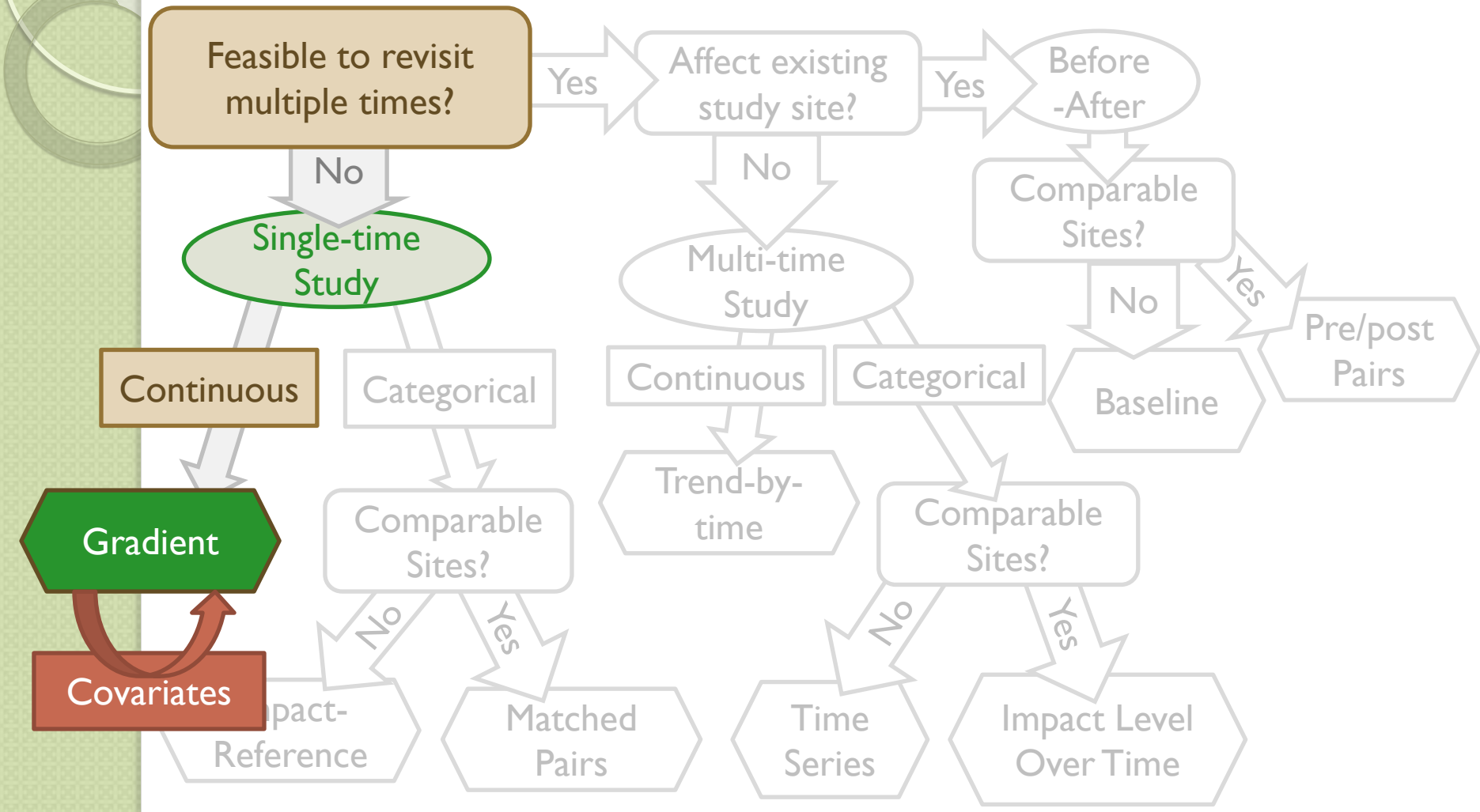
Wiens & Parker (1995)

Study design		Ecological assumptions			
		Steady-state equilibrium	Dynamic equilibrium	Factors equal	Paired sites equal
Before–after	Baseline	×			
	Pre/post pairs		×		×
Single-time	Impact–reference			×	
	Matched-pairs				×
	Gradient			×	
Multiple-time	Time-series	×			
	Level-by-time		×		
	Trend-by-time		×		

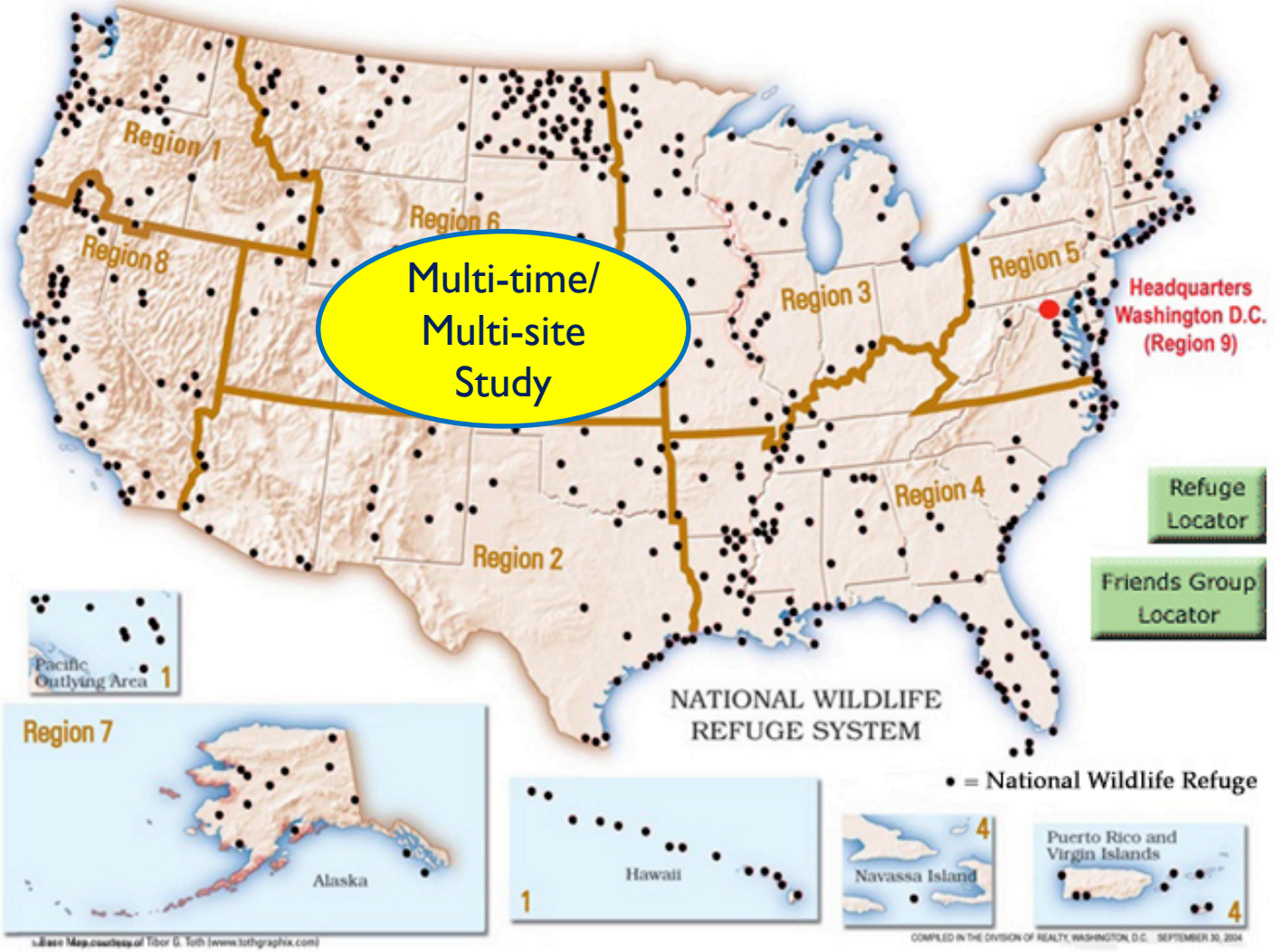
Post-event Methods Flowchart



Post-event Methods Flowchart

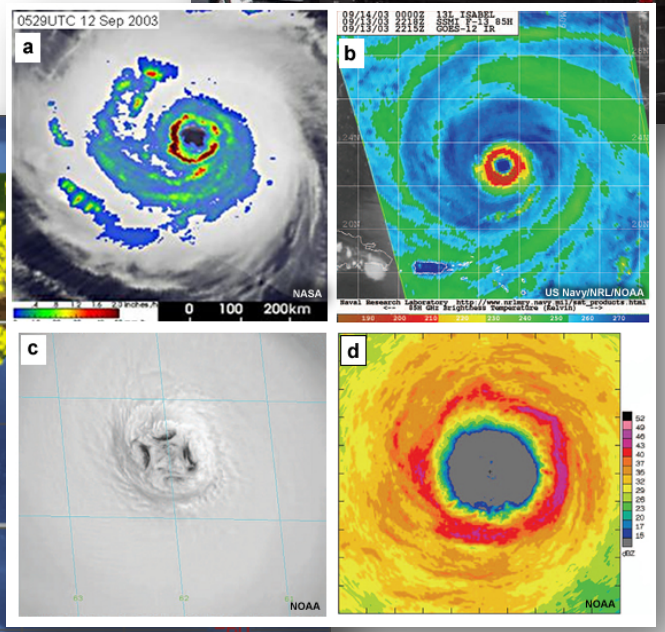


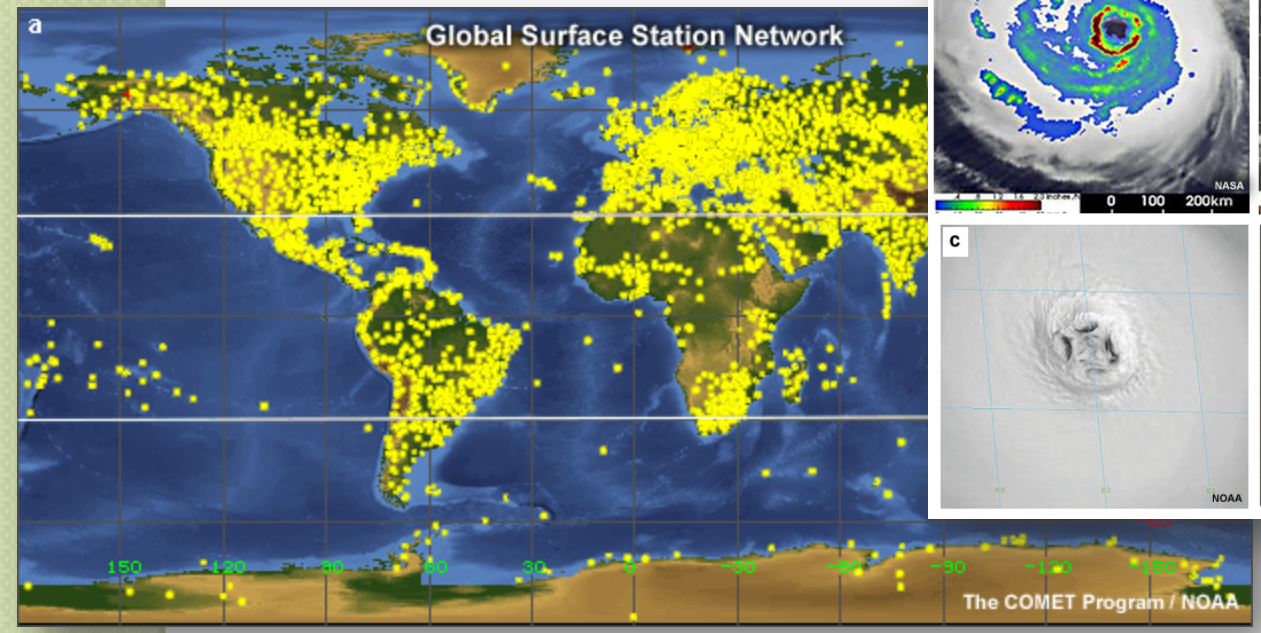
A collective severe weather ecology monitoring network



Quantified severe weather correlates

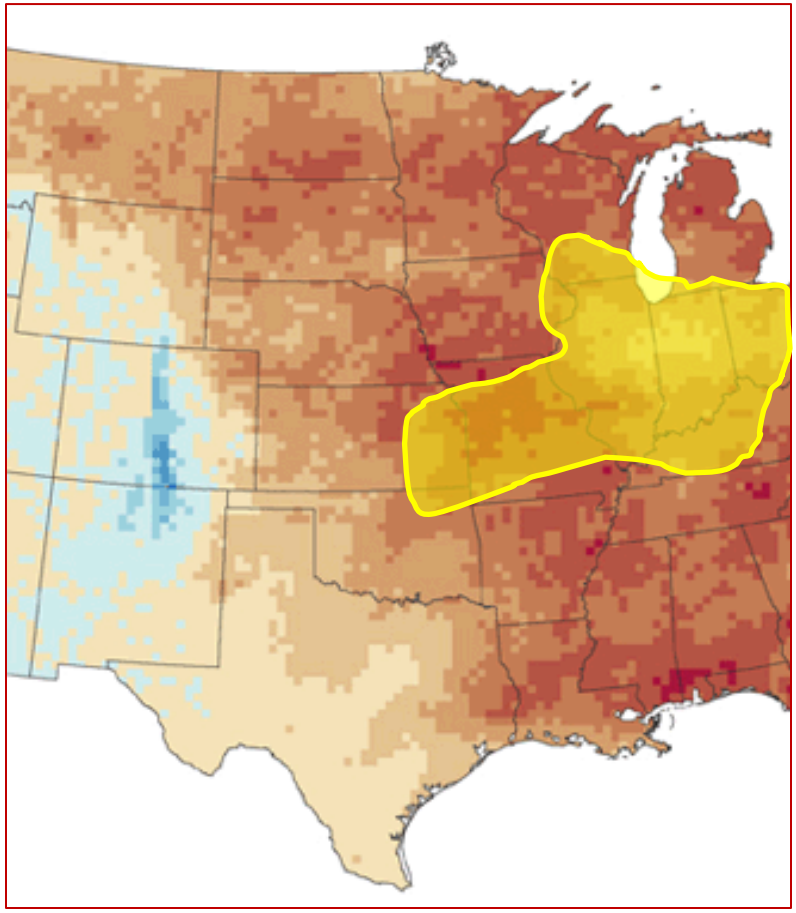
- Radar
- Satellites
- Monitoring networks
- Models

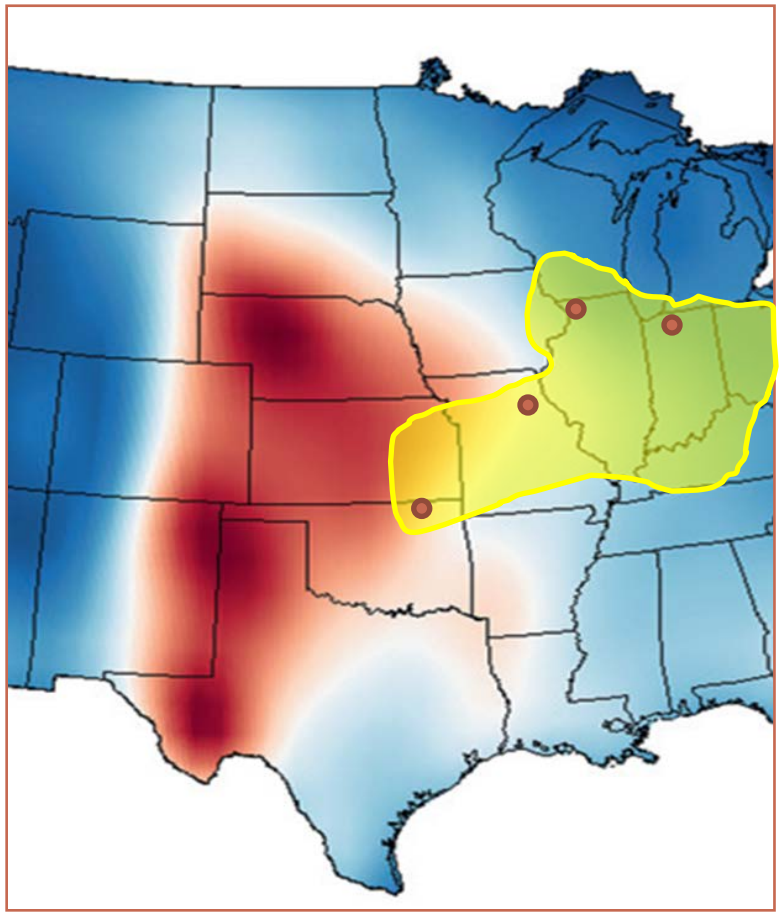




Extrapolating individual/population impacts to macroscales

- Resiliency under a changing climate





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rossjd@ou.edu
@nrdybrdr
#severeweatherecology
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@DusterMB