COUPLED HUMAN AND NATURAL SYSTEMS (CHANS):

FLORIDA RED TIDES AND COASTAL POPULATIONS AS A COUPLED NATURE-HUMAN SYSTEM

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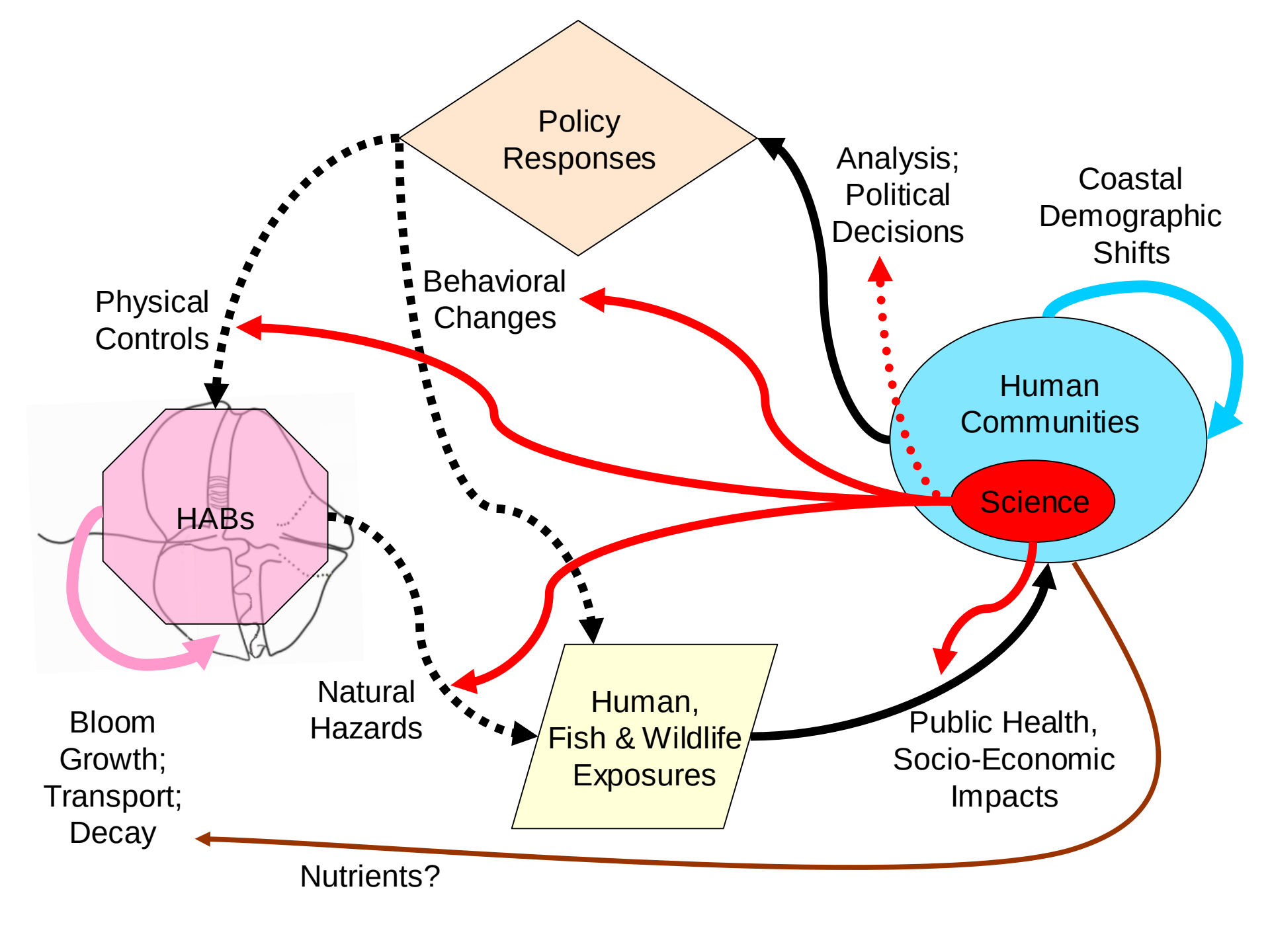

Policy Responses
Analysis; Political Decisions
Coastal Demographic Shifts
Physical Controls
Behavioral Changes
Human Communities
Science
HABs
Natural Hazards
Human, Fish & Wildlife Exposures
Bloom Growth; Transport; Decay
Public Health, Socio-Economic Impacts
Nutrients?

GENERIC ASPECT	DESCRIPTION
SYSTEM HETEROGENEITIES	Nonuniform spatial/temporal distributions of nature and humans [population growth; concentration in southwest Florida]
RECIPROCAL FEEDBACKS	Interactions between nature and humans leading to improvements or degradations in natural conditions [nutrient fluxes, blooms, policy responses]
TIME LAGS	Delays among: environmental conditions and effects, human responses and effects [blooms, science, policy responses]
THRESHOLDS	Reversible or irreversible transitions between states of nature [increased frequency of Florida red tides?]
SURPRISES	Unexpected outcomes due to incomplete knowledge or randomness [GI illnesses during shellfish closures]
LEGACIES	Persistence of states of nature or coupled nature-human linkages [nutrient “pools”]
RESILIENCE	Ability of a coupled nature-human system to withstand perturbations or shocks [tourism fluxes unaffected]

Data Compilation

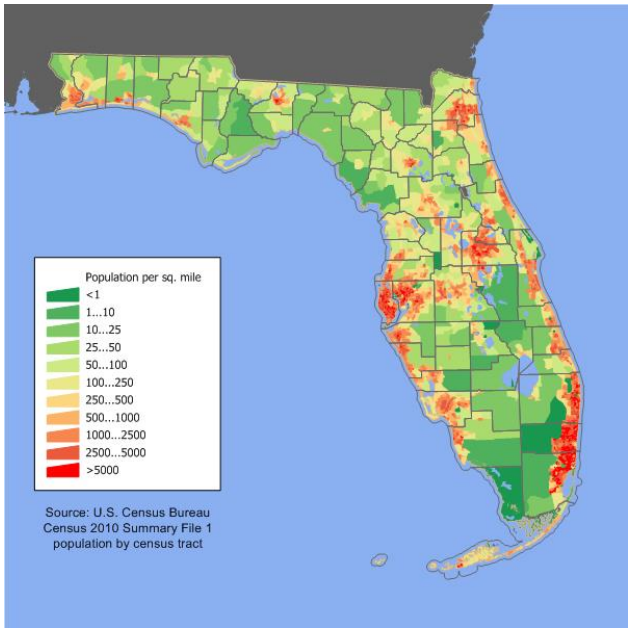
- Florida FWRI water samples
- Florida DACS shellfish harvest area (SHA) red tide closures
- Florida AHCA illness data
- Florida DoH ESSENCE, MERLIN data
- STR SHARE Center tourism data (hotel/motel occupancy)
- NOAA precipitation, temperature, wind data
- USF MODIS satellite imagery
- Census Bureau population, economic data
- Calculated bloom threat values

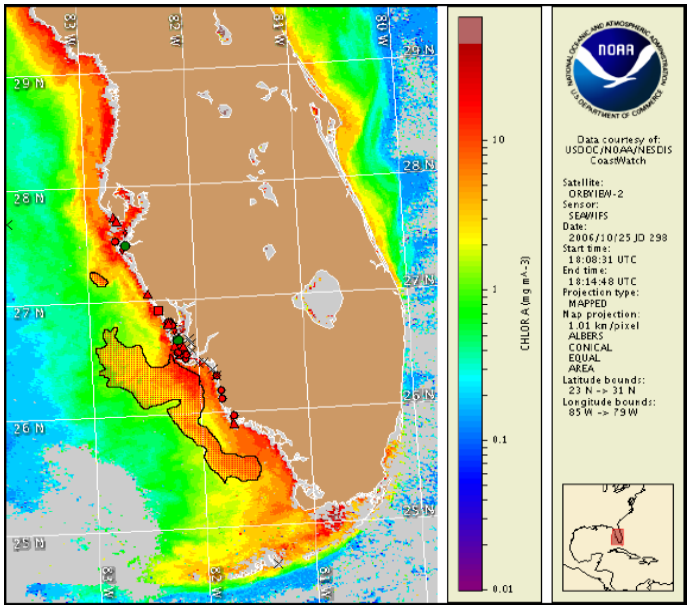
Progress

QUESTIONS	INITIAL RESULTS
1. Are nutrient loads linked to blooms?	Hitchcock et al. [speed talk, poster HD-4]
2. Do human demographics respond to Florida red tides?	[this talk]
3. Is human health affected by Florida red tides?	Hoagland et al. [poster HD-11]
4. What are the costs-of-illness (if any)?	Hoagland et al. [poster HD-11]
5. Are education programs effective responses to the Florida red tide hazard?	Rudge et al. [speed talk, poster HD-7] Kohler et al. [poster HD-12]
6. Are policies for responding to Florida red tides cost-effective?	Fleming et al. [poster HD-3] Reich et al. [poster HD-6] Lovko et al. [speed talk, poster HD-5]
7. Does uncertainty about outcomes and costs affect the choice of policy response?	Li et al. [poster HD-8] Fleming et al. [poster HD-3]

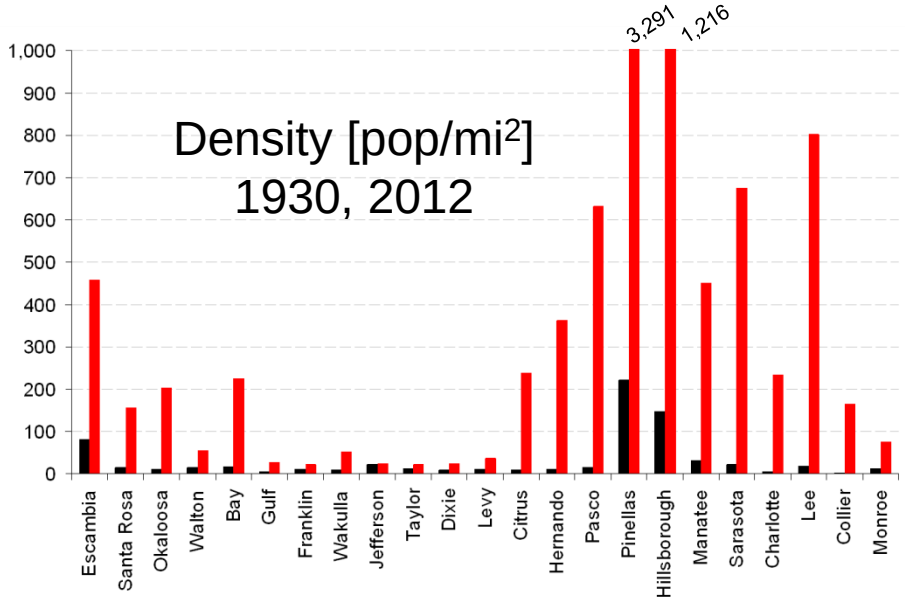
SYSTEM HETEROGENEITIES

- Spatial and temporal distributions of nature and humans
- Jointly produced hazard
- Human population growth along southwest coast
  - Snowbirds and tourists
  - Sunbirds
- Florida red tide occurrences
  - HAB-OFS
  - FWRI water monitoring
  - FDACS SHA closures

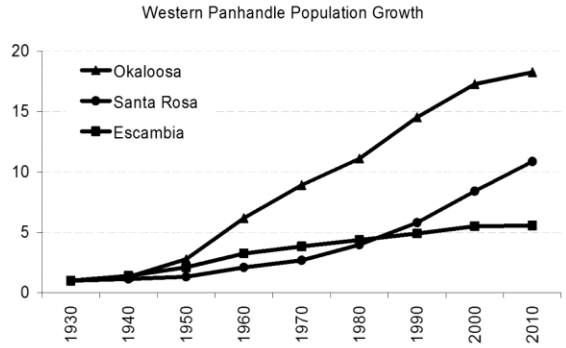


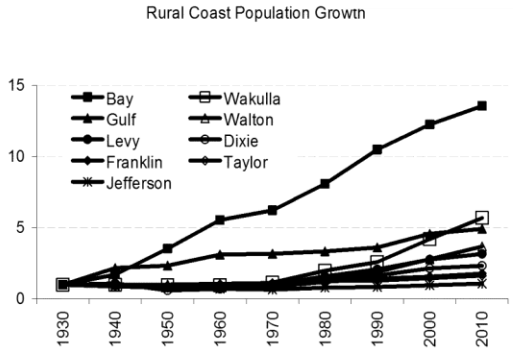


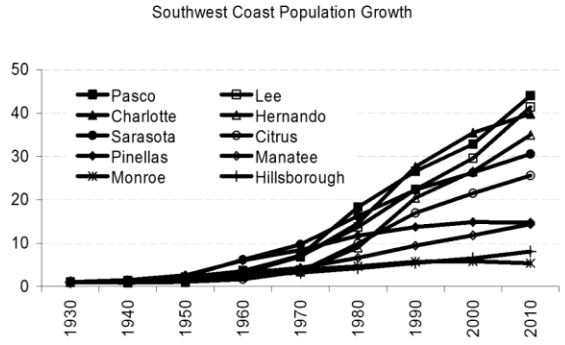
Population Growth

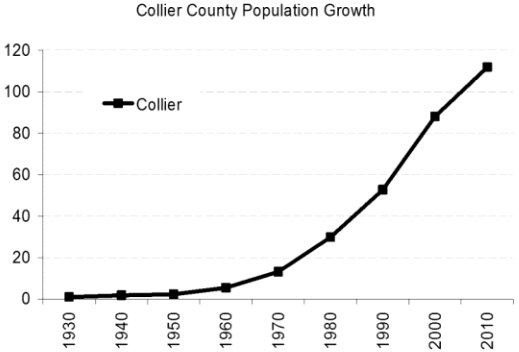


Index % of 1930 pop.



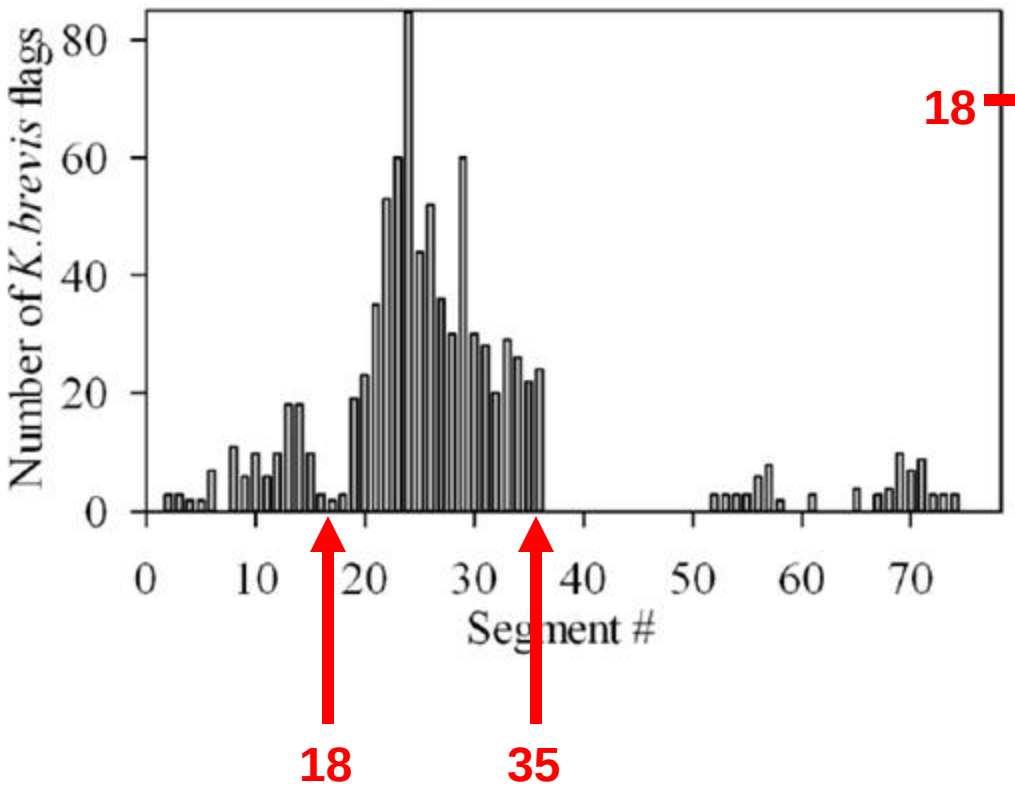






Environmental Monitoring

K. brevis Flags (≥ 50,000 cells/L) per Segment (1997-2009)

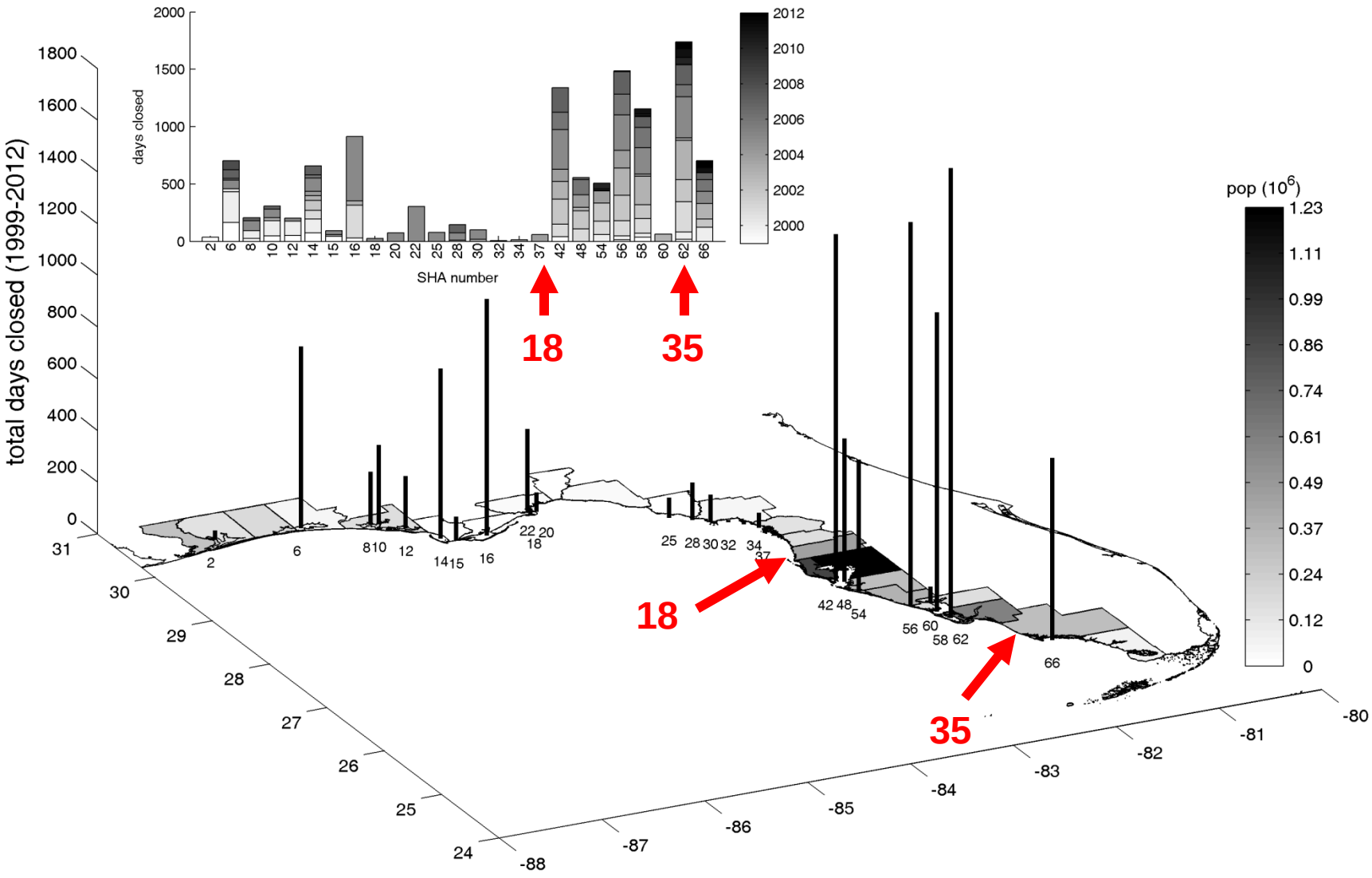


SW Florida Coastal Segments

"Flags" from the remote sensing of chlorophyll a (Sep 1997 to Dec 2009) matched with FWRI water monitoring data. Source: EPA (2012).

FDEP coastal segments 18-35 where most of the flags occurred. Source: FDEP (2013).

Coastal Populations and SHA Closures



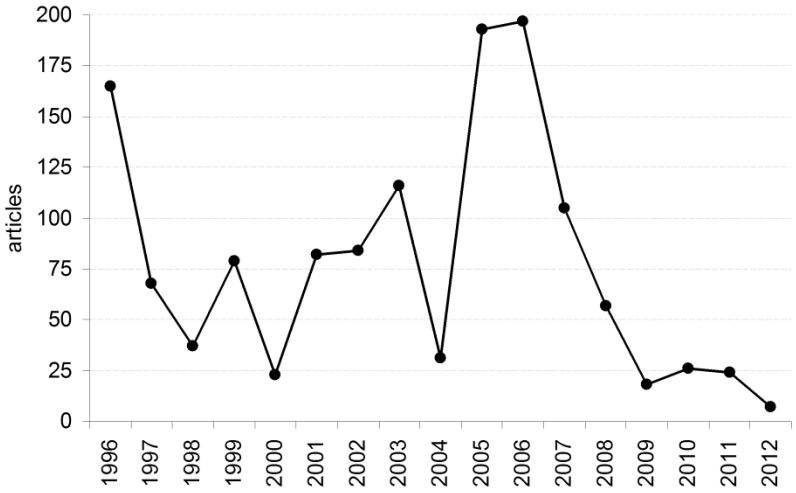
Shellfish Harvest Area (SHA) Closures

- Measure of Florida red tide occurrences (in addition to FWRI water sampling data)
- Important response: reduces NSP illnesses (but see Reich *et al*. [poster HD-6])
- Human respiratory and GI illnesses are significantly associated with SHA closures (Hoagland *et al*. [poster HD-11])
- GI illnesses are “surprising”

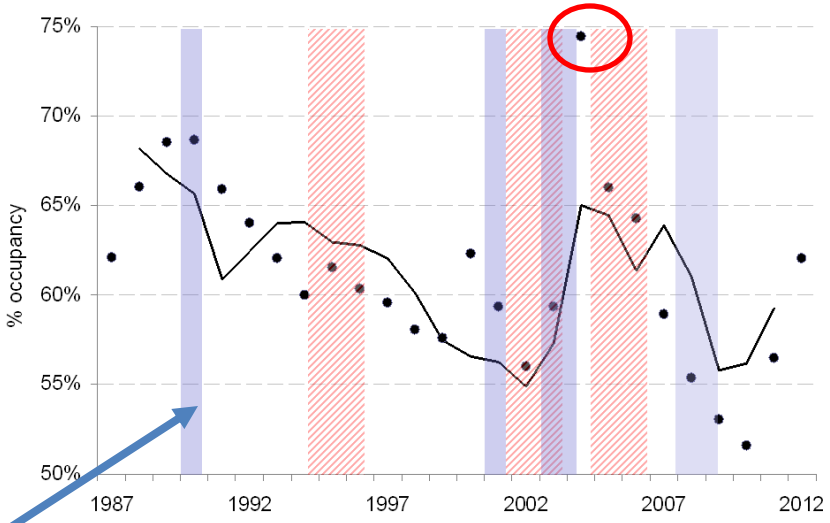
Source: FDACS

Media Coverage

- Sarasota Herald red tide "mentions"
- Li *et al*. (Poster HD-8)
- Concern for impact on tourist fluxes
- Occurrence of Florida red tide on Sarasota hotel/motel occupancy is insignificant
- Economic conditions (recessions), hurricanes may be more important



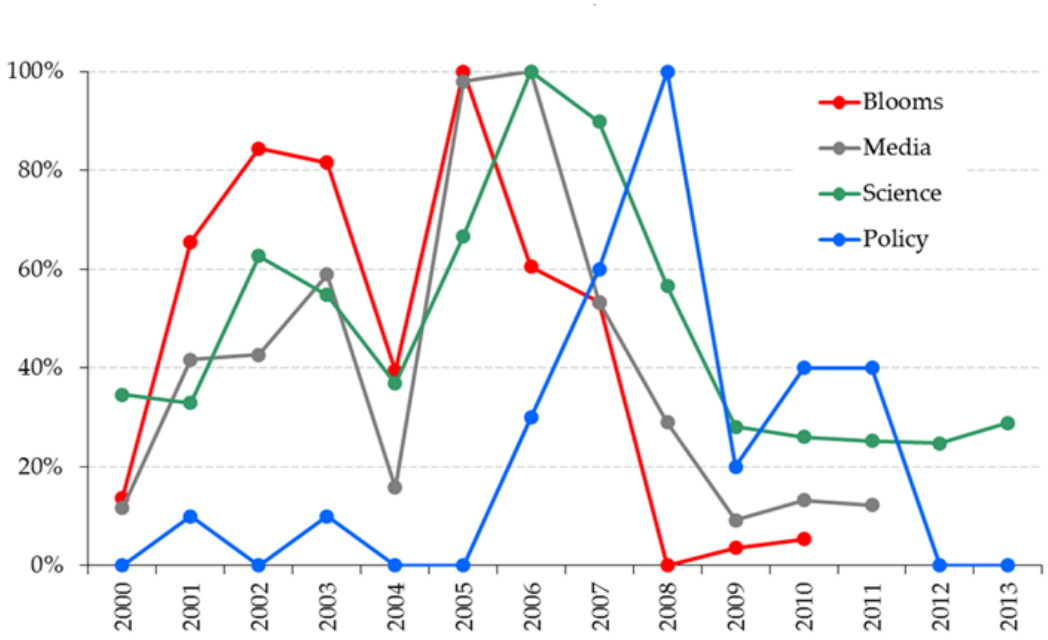
Hurricanes Charley, Frances, Jeanne

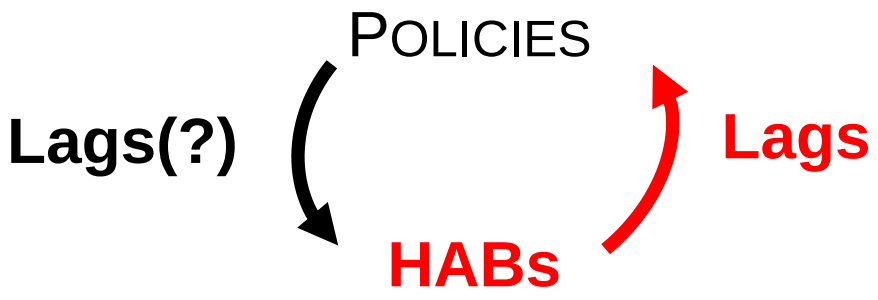


Recessions

Qualitative Dynamics

- Short series (14 yrs)
- Blooms
- Information flows (media, science)
- Time lags
- Policy Responses
- Time lags
- **<u>Policy effectiveness</u>?**





Future Work

- Spatial tourism effects
- System thresholds
- System resilience
- Cost-effectiveness of policy responses
- Policy choices
- Education program