

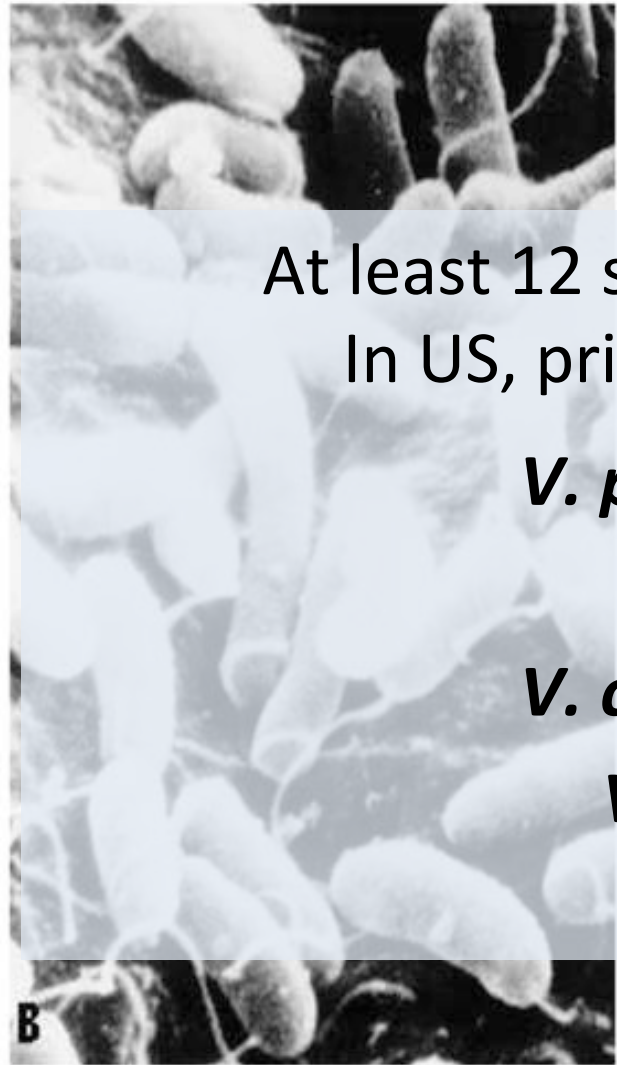
Shifting dynamics in *Vibrio* populations and human exposure risk with changing climate in the southeast

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Vibrio spp.



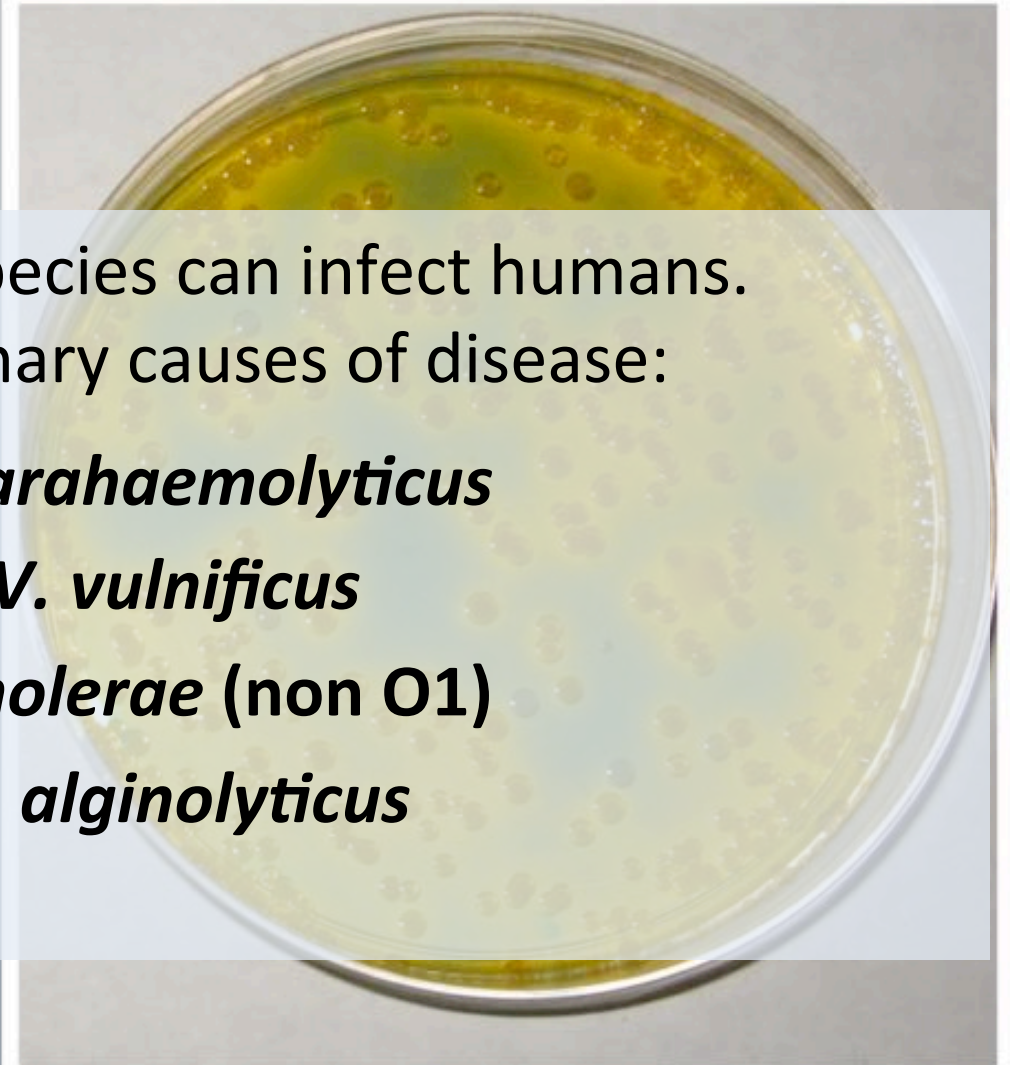
At least 12 species can infect humans.
In US, primary causes of disease:

V. parahaemolyticus

V. vulnificus

***V. cholerae* (non O1)**

V. alginolyticus

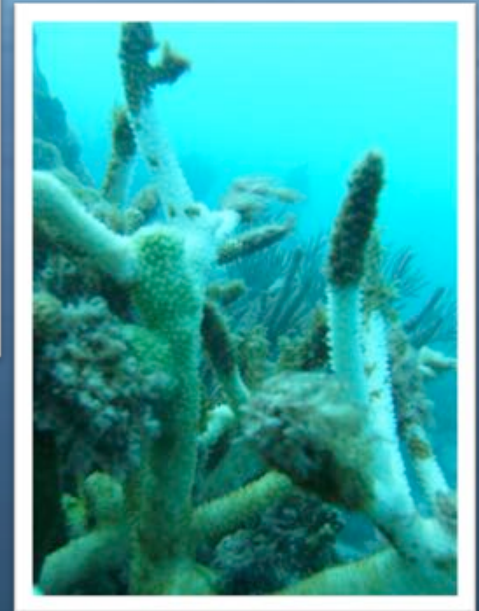


Vibrio Transmission & Disease

Oyster & seafood consumption

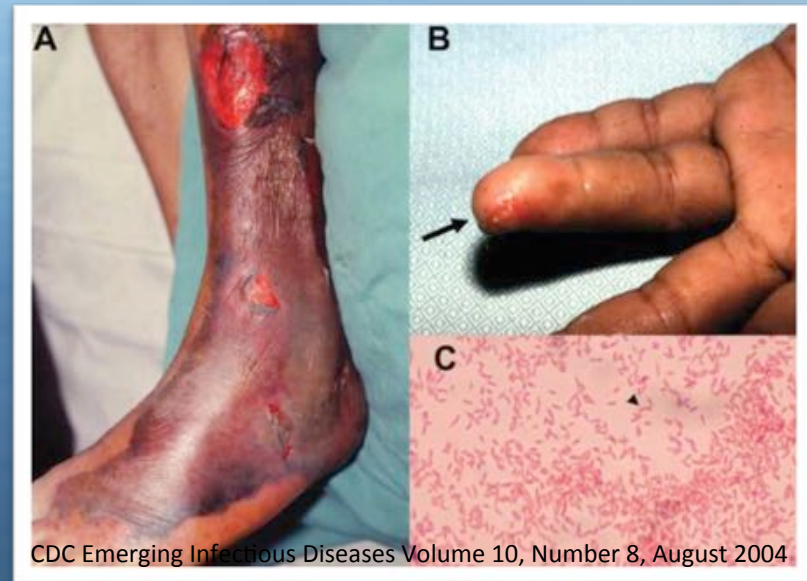


Recreational exposure



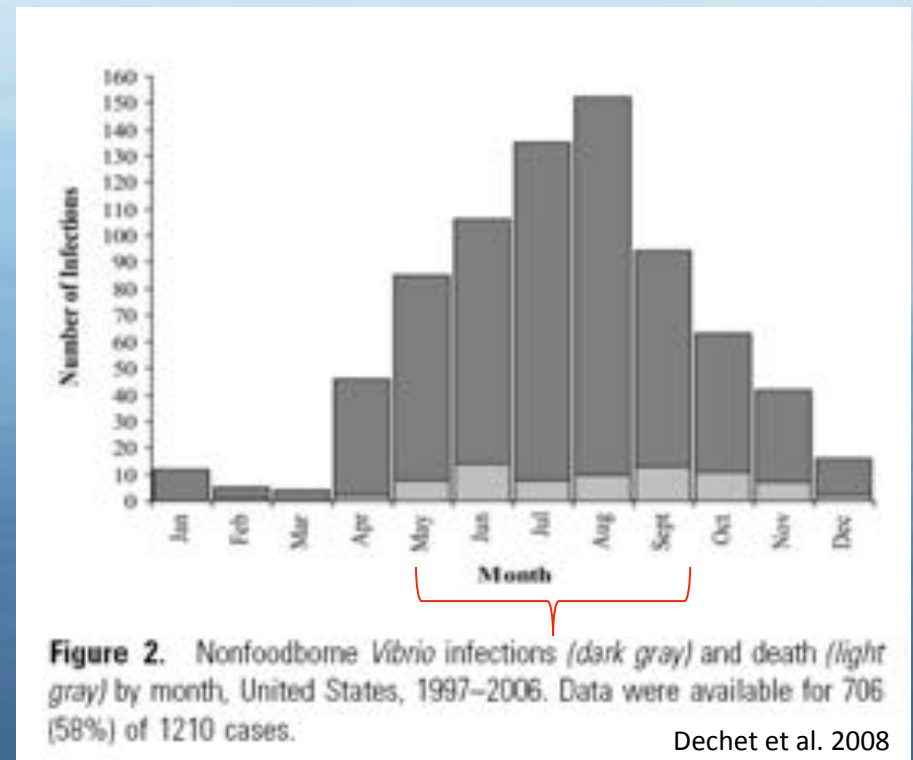
Vibrio Transmission & Disease

- Gastroenteritis
 - Esp. *V. parahaemolyticus* and *V. cholerae*
 - *V. vulnificus*
- Systemic (septicemia)
 - *V. vulnificus*
- Wound infection
 - *V. vulnificus*
 - *V. alginolyticus*
- Eye and ear infections
 - *V. alginolyticus*



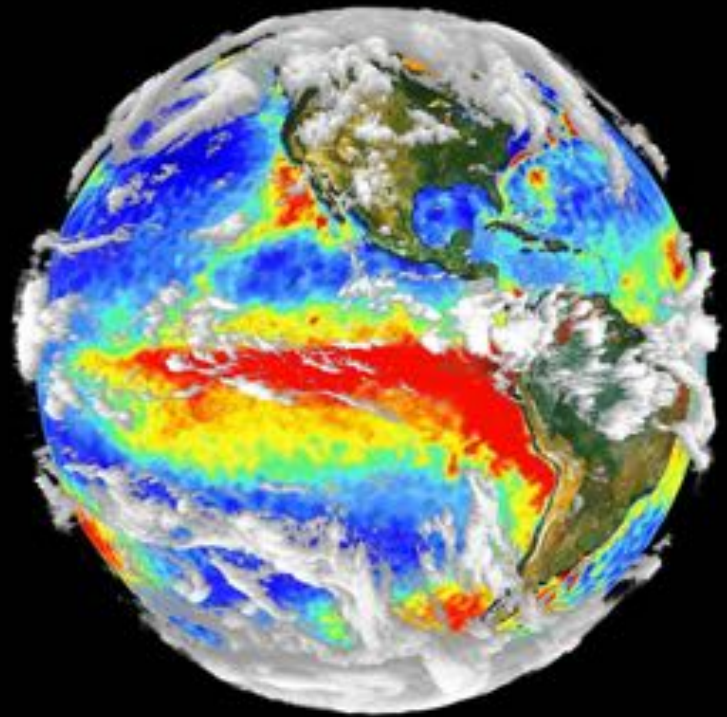
Vibrio Disease Burden

- *Vibrio* pathogens respond quickly to favorable temperatures
 - *Among the fastest known doubling times*
 - *Populations expand rapidly above 15° C*



Vibrio Disease Burden

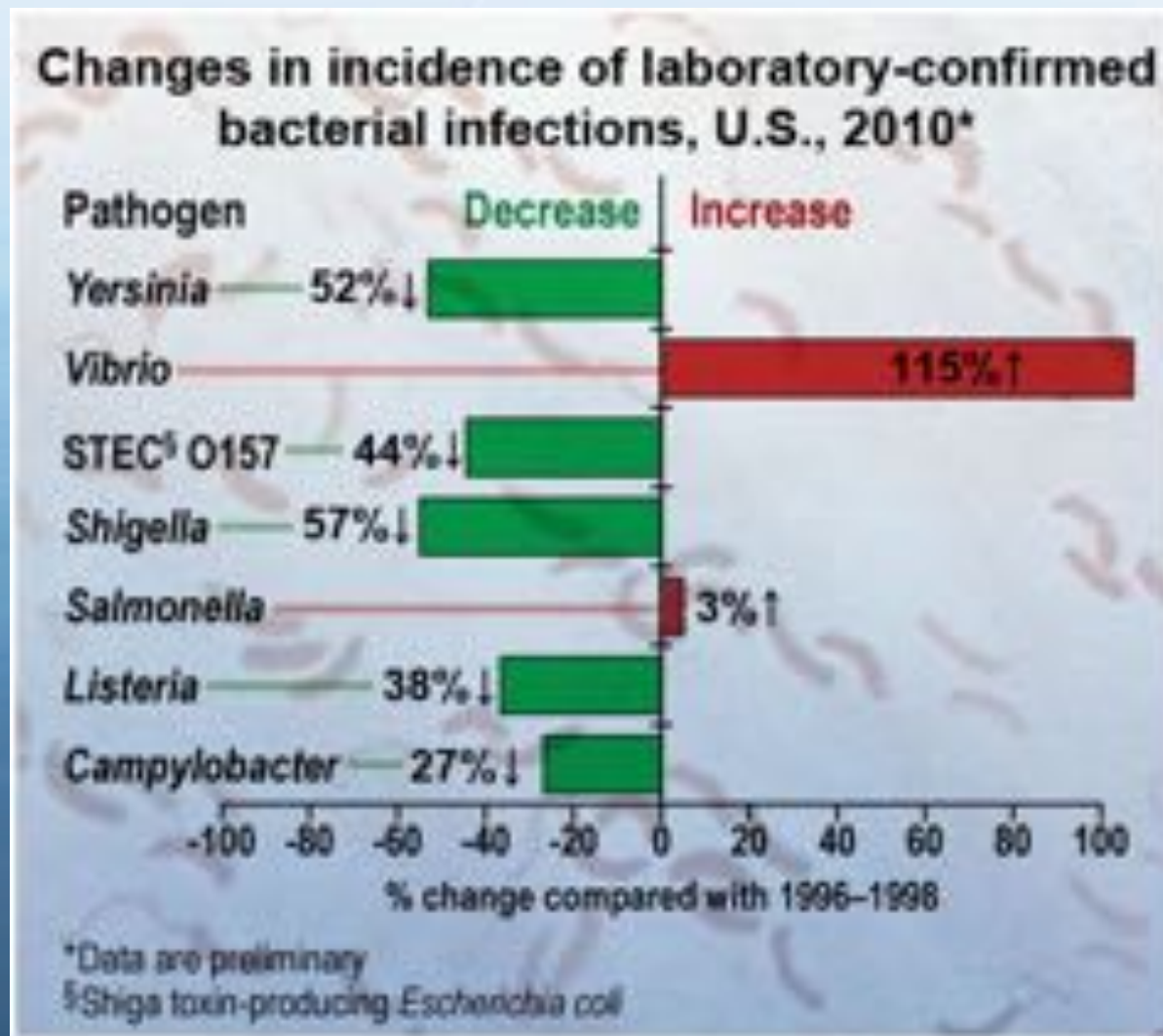
- Globally, *Vibrio* illness rates are rising
- Expansion related in part to changes in sea surface temperatures and changes in circulation
 - e.g., 2005 *V. parahaemolyticus* outbreak in Alaska



Vibrio infections in the U.S



Vibrio infections in the U.S



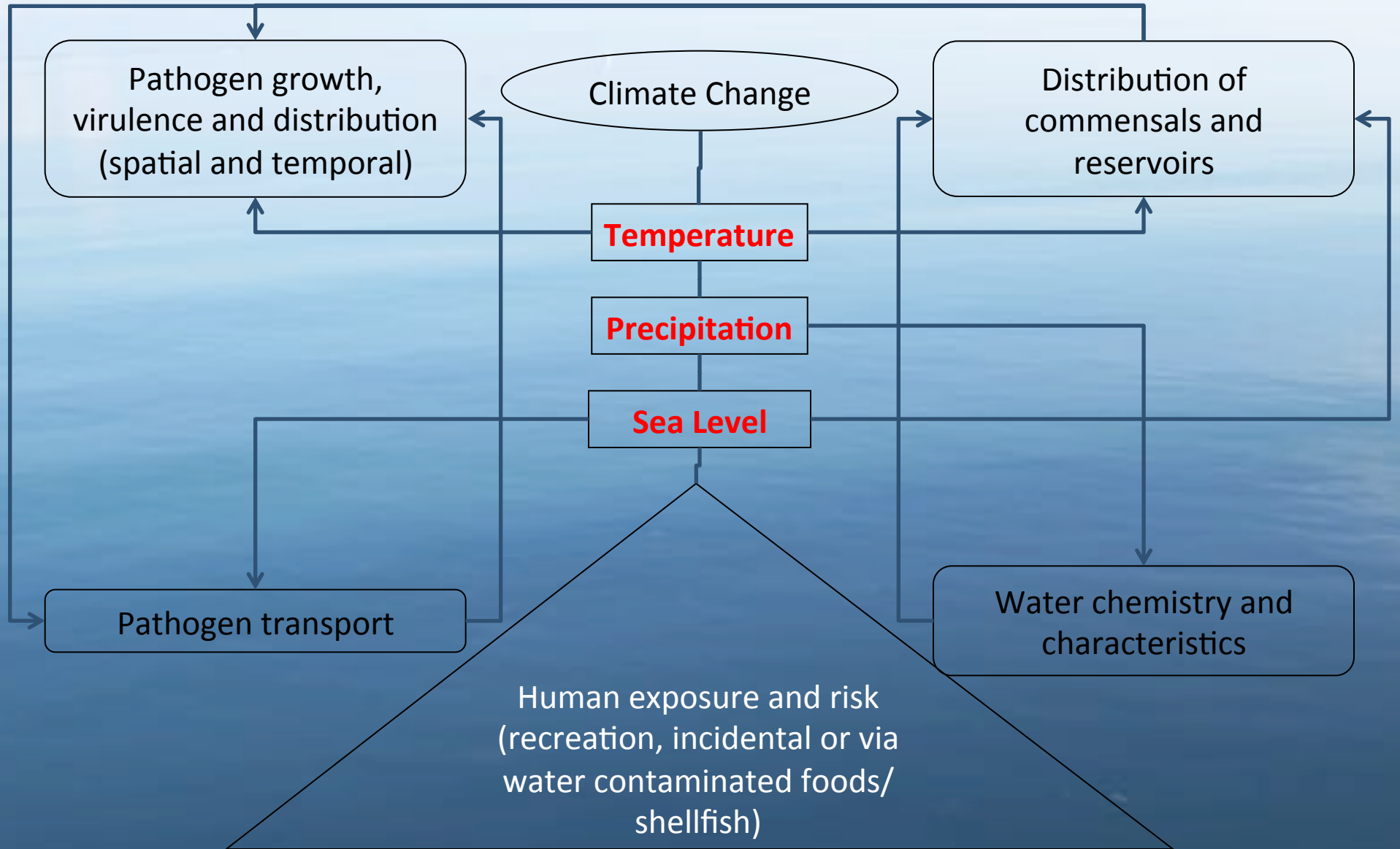
Vibrio infections in the Southeast U.S

- The greatest source of *Vibrio* infections in the US are attributed to waters of the southeast (especially the Gulf of Mexico)
 - Oysters
 - Direct exposure
- Warm waters and moderate salinity estuaries support seasonally large populations
- Less dramatic rise in cases but
 - Shifts in exposure route
 - Seasonality
 - Emergence of strains
 - *V. cholerae* O75 outbreak (Florida oysters)

Climate, Oceans and *Vibrio*

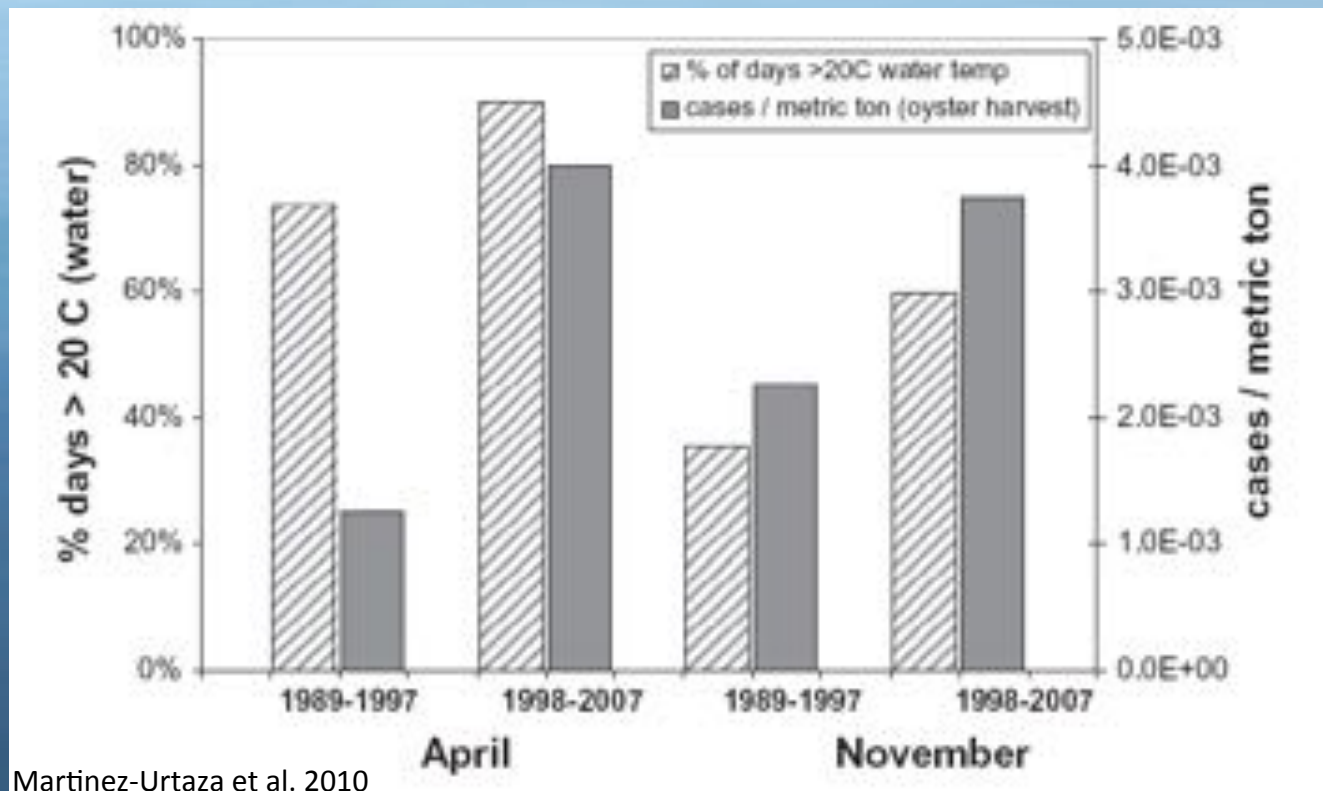
- Population dynamics, exposure risk, illnesses and range expansion
 - associated with warm temperatures
- Role for other environmental parameters as temperatures remain in favorable zone (i.e., tropics, subtropics)
 - Altered salinity, Shifts in reservoirs, others

Vibrio and Climate



Evidence of Climate Influence on *Vibrio* in the Southeast

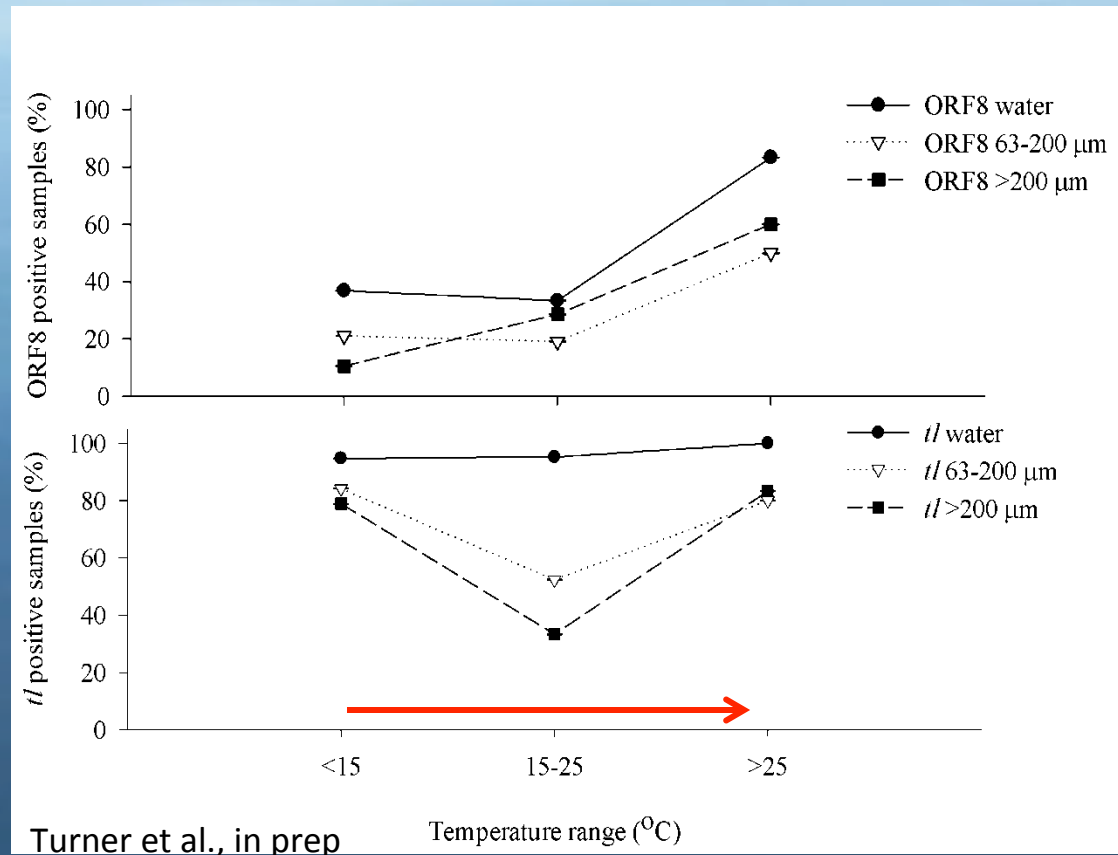
- Temperature
 - Widening seasonality among *V. vulnificus* infections



Martinez-Urtaza et al. 2010

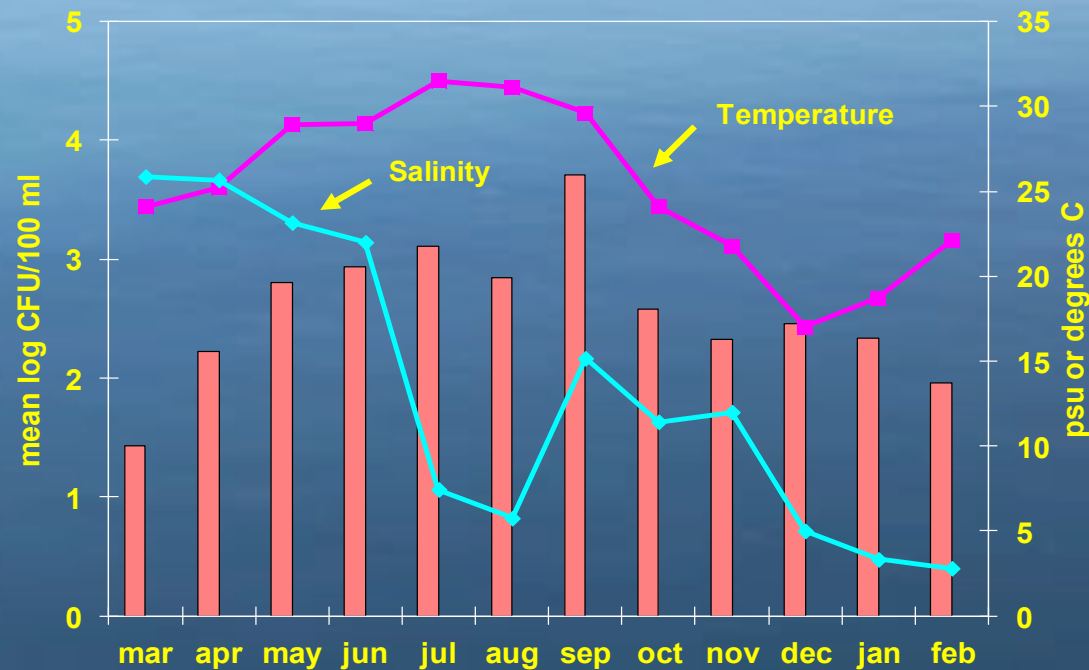
Evidence of Climate Influence on *Vibrio* in the Southeast

- Temperature
 - Increased relative abundance of pathogenic strains

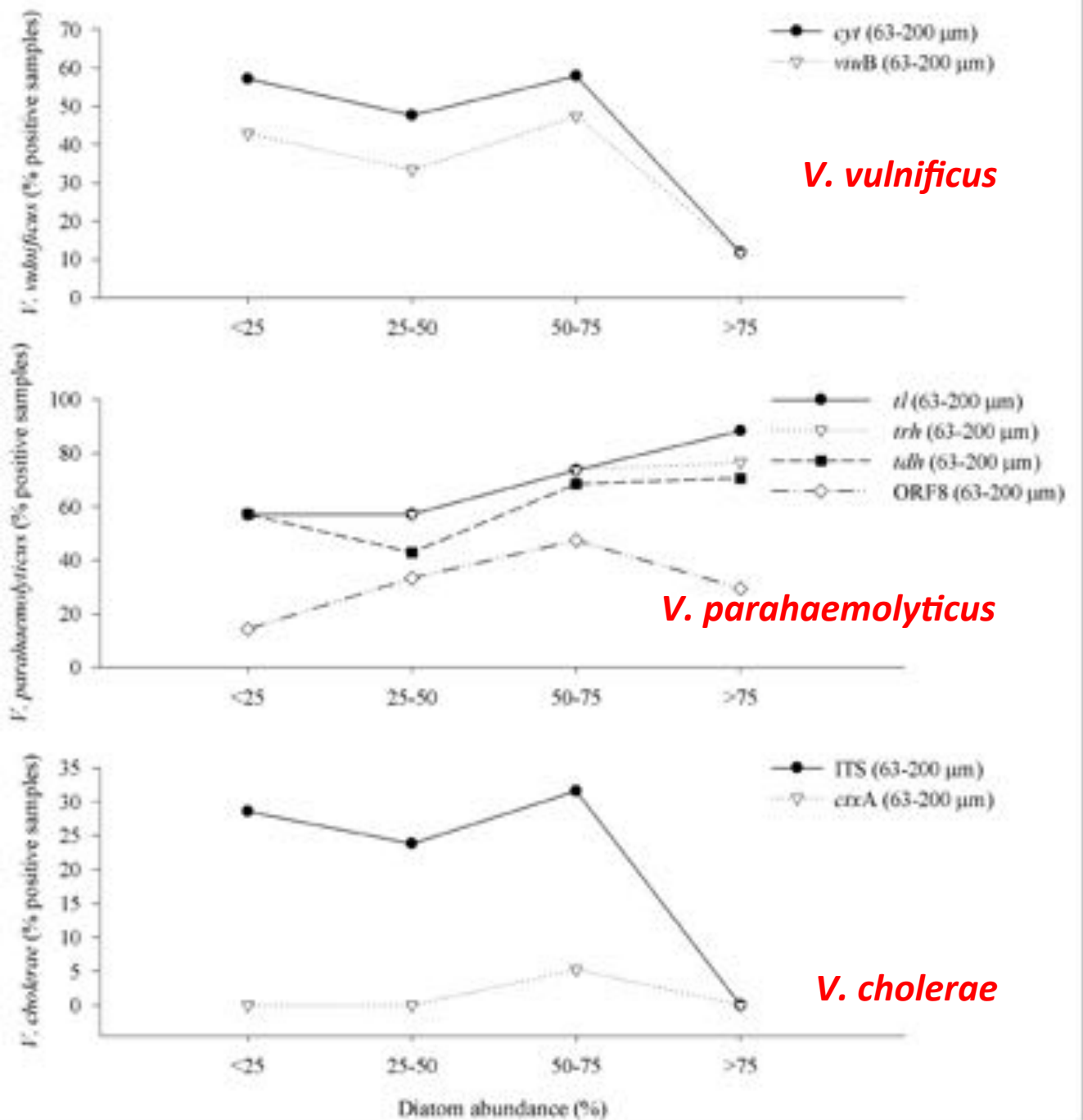


Evidence of Climate Influence on *Vibrio* in the Southeast

- Fresh water flow / salinity
 - In subtropical/tropical waters, temperatures support year round populations. Variations in salinity driven by river discharge have more important role.



Plankton Association with *Vibrio* spp.



Diatom relative abundance

Evidence of Climate Influence on *Vibrio* in the Southeast

- Sea level rise / storm surge
 - Hurricanes Katrina and Rita
 - Significant increase in total *Vibrio* cases reported
 - At least 2 domestic cases of *V. cholerae* O1
 - Seawater intrusion
 - high exposure
 - loss of infrastructure



Vibrio trends in the Southeast

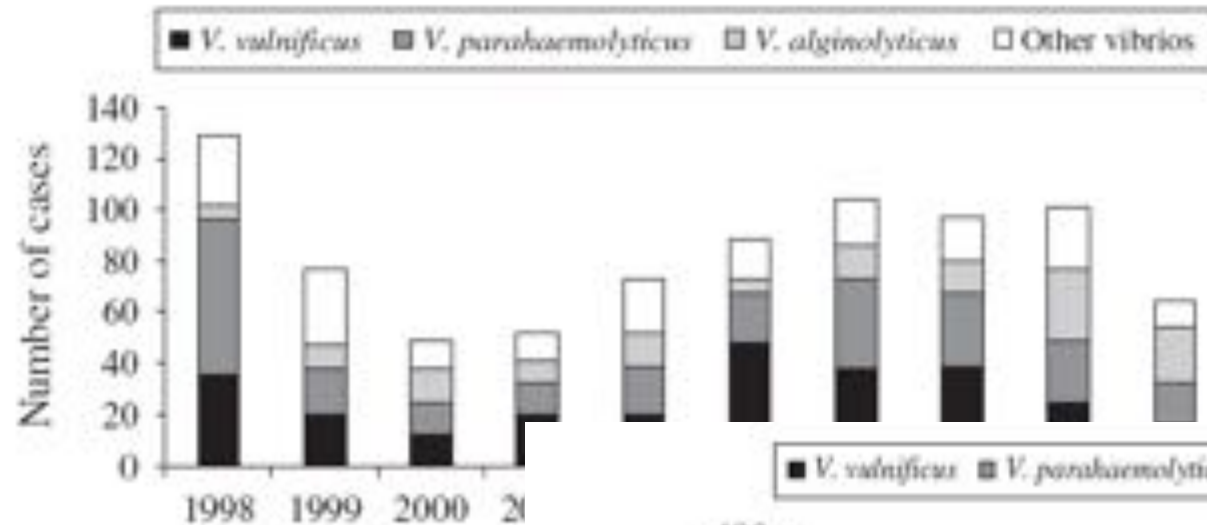


Fig. 1. Cases of vibriosis Florida, 1998–2007.

Shifting trends in species causing disease and presentation of symptoms.

V. alginolyticus is emerging

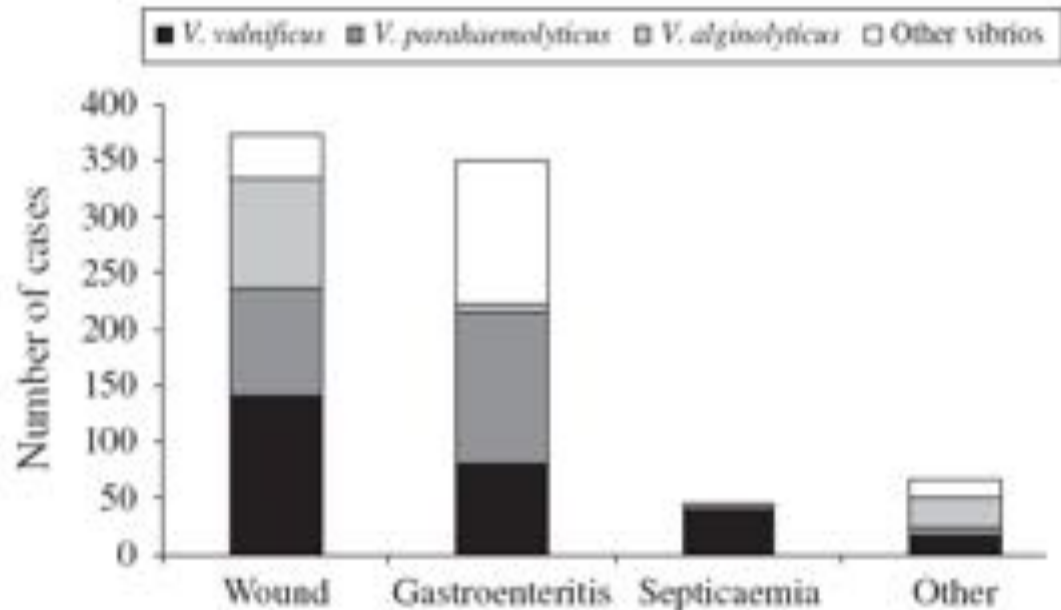


Fig. 3. Clinical syndromes of vibriosis by species, Florida, 1998–2007.

Vibrio and Climate

Climate Factor	Effect on Pathogen	Effect on Human Exposure
Temperature	<p>↑ Increase replication at warmer temperatures leading to higher concentrations. This may also result in range expansion for <i>Vibrio</i>. Some evidence suggests that temperature may affect proportion of population carrying virulence genes.</p>	<p>Expect increased exposure with warmer temperatures due to higher concentrations, more virulent strains and wider range.</p>
	<p>↓ Decreasing population levels with cooler temperatures</p>	
Precipitation	<p>↑ Increased transport / introduction of nutrients and organic matter from land or sewage. Help to promote growth of bacteria directly or indirectly in association with particles and plankton</p> <p>Increased freshwater flows may depress salinity in receiving estuaries which can change the distribution of <i>Vibrio</i> spp.</p>	<p>Potential for increased exposure due to increased substrates for pathogen growth and salinity conditions favoring certain pathogenic species</p>
	<p>↓ Loss of freshwater flow to coastal areas, resulting in higher salinities, may affect distribution of <i>Vibrio</i> spp.</p>	
Sea-Level	<p>↑ Increased distribution of marine pathogens inland (similar effects during storm surges)</p>	<p>Potential for increased exposure due to range expansion and possible increased risks among displaced populations.</p>

Vibrio Populations & Illness in the Southeast US

- The Southeast is endemic for *Vibrio* disease
- Likely that temperature will not play as dominant a role as in other regions (e.g., expansion poleward)
- Research needed on
 - models for coastal circulation
 - Specific interactions between *Vibrio* spp. and plankton groups
 - Other factors affecting *Vibrio* populations and potential exposure risks
 - Nutrient, DOM, trace metal flux
 - Changes in demographics and vulnerable populations