

# Impacts of *Karenia brevis* Harmful Algal Blooms on Piscivorous Birds in Sarasota Bay, Florida

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# Harmful Algal Blooms

- HABS are any algal bloom that causes harm through production of toxins or accumulation of biomass
- HABS increasing worldwide over the last 30 years
- Only 2% of marine algae are known to be toxic

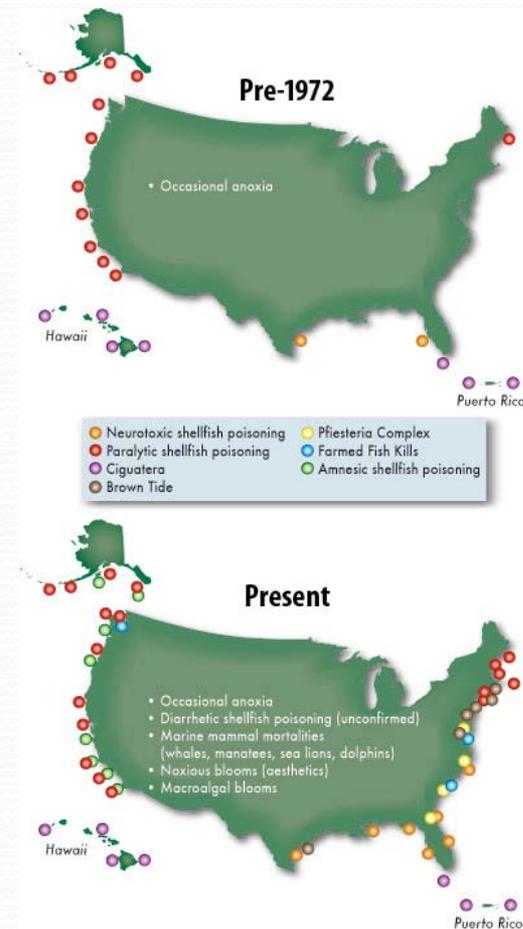
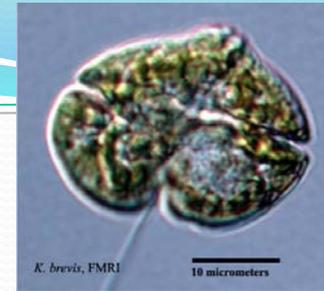


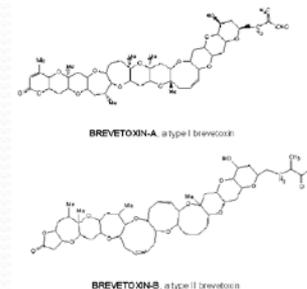
Photo credit WHOI

# Brevetoxin

- Produced by *Karenia sp.* a dinoflagellate
- Neurotoxic Shellfish Poisoning in humans
- Binds to receptor site 5 of voltage-gated sodium channels in cell membranes
- Causes neuronal & muscle cell depolarization



- Hist. records 1600s in humans
- Ingestion of shellfish or inhalation of aerosols
- Mouse LD<sub>50</sub> = 500 ng/g PO; 90 ng/ml IV
- Metabolized by liver & kidney
- Fat soluble toxin



# Effects of Brevetoxin on Wildlife

- 1996-Manatee deaths
  - Bossart et al 1999 Tox Path
- 1997-Cormorant illness
  - Kreuder et al 2002 JZWM
- 1999, 2002, 2005-2006-Dolphin deaths
  - Mase et al 2000; Flewelling et al 2005 Nature; Fire et al 2007 Mar Bio; Fire et al 2008 Mar Mam Sci
- 1996, 2005-2006-Sea Turtle deaths
- Exposed by inhalation or ingestion of the toxin



Photo credit FWC

# Research Questions?

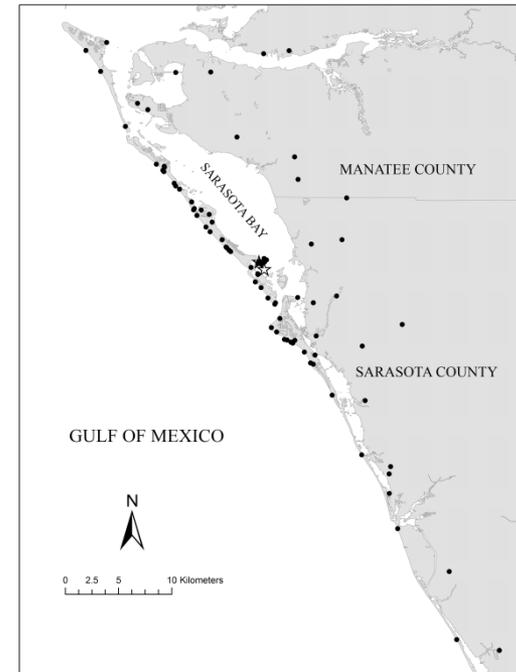


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- What are the clinical signs of brevetoxicosis in sea birds?
- How quickly do live sea birds metabolize brevetoxin?
- What brevetoxin levels do dead sea birds have in their tissues?
- Why are Double-Crested Cormorants most impacted by brevetoxicosis?
- What is happening on the ecosystem/habitat level during *K. brevis* blooms?

# Material and Methods - Rehab

- Sampled animals from 2005-2006
- Document clinical signs of brevetoxin, necropsies
- Brevetoxin testing by ELISA
  - Test whole blood, plasma, feces from live animals
  - Test tissues-stomach contents, feces, liver, kidney, lung, bile from dead animals



# Brevetoxin Levels in Sea Birds

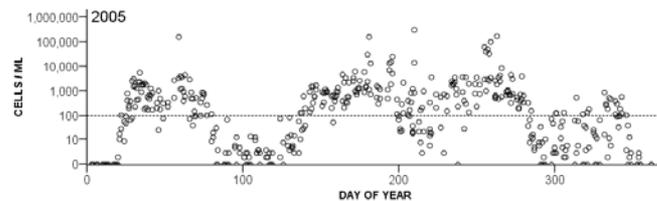
- Clinical signs
  - Inability to stand
  - No blink/anal reflex
  - Ataxia, incoordination
  - Seizures
- 12 species positive incl. Double-Crested Cormorants\*, Brown Pelicans, Great Blue Herons, Common Loons, Sanderlings
- 69% sea birds positive (65 of 94)
- 42% Released
- Brevetoxicosis COD 72%



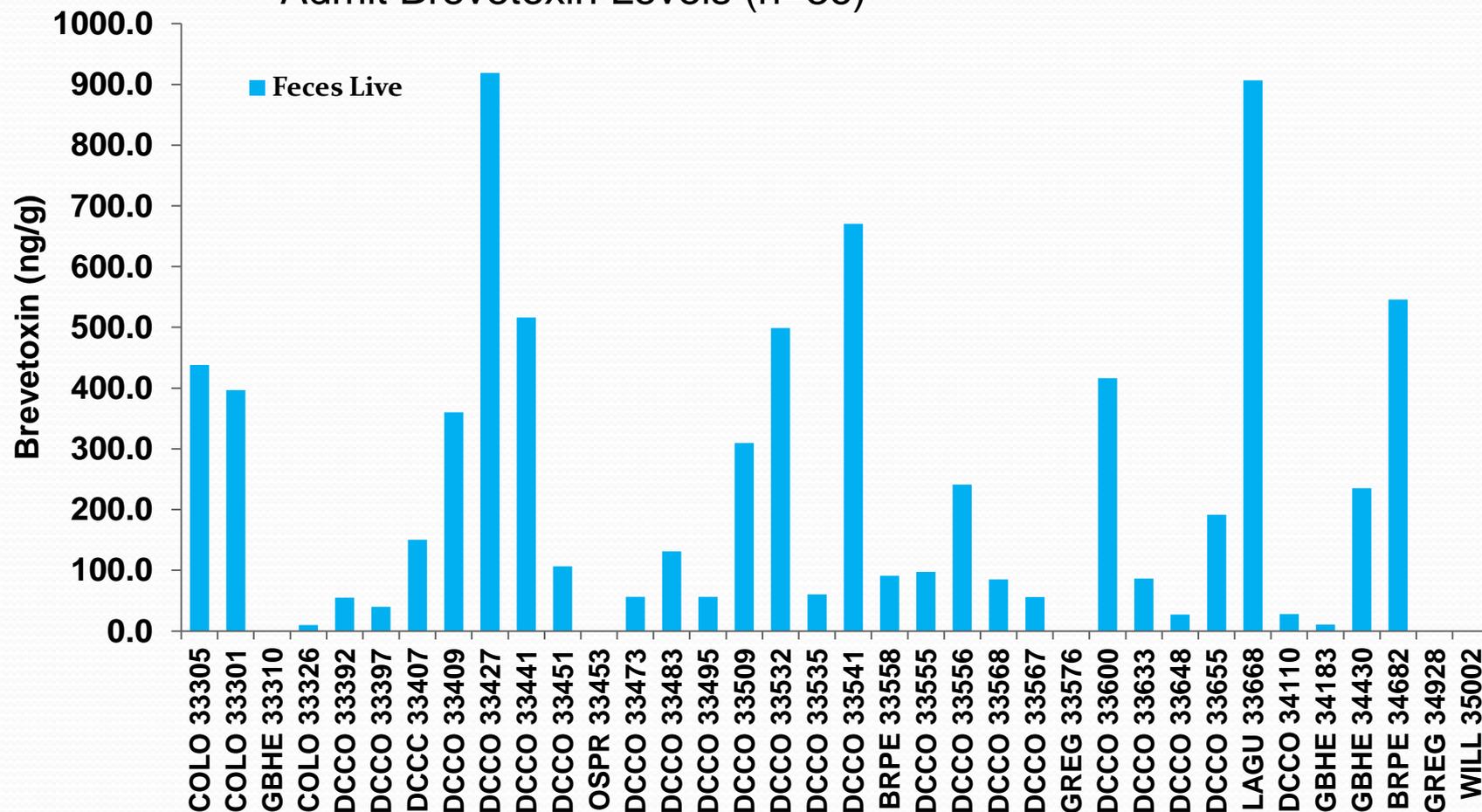
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(Fauquier et al. Brevetoxicosis in sea birds naturally exposed to *Karenia brevis* blooms along the central west coast of Florida. In Review)

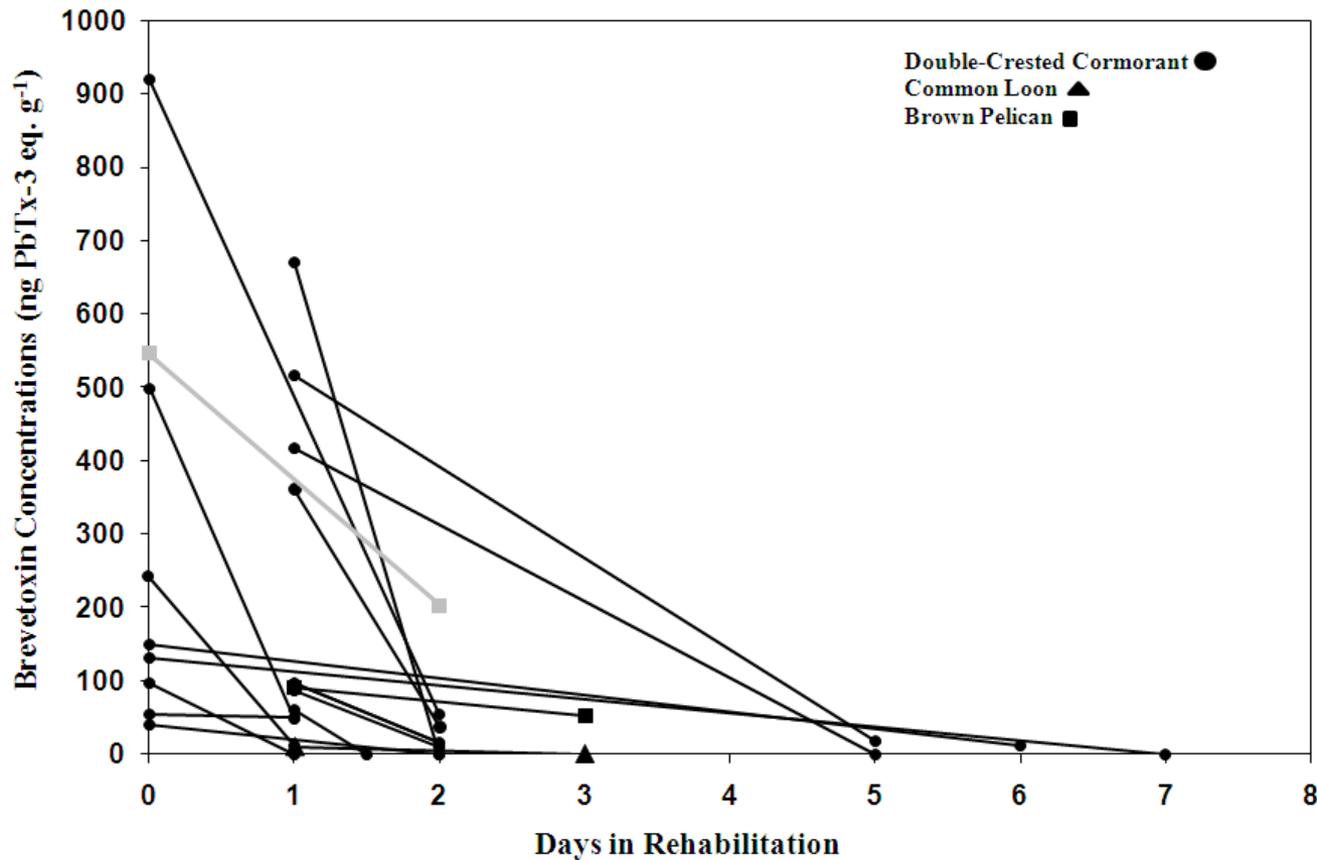
# Results- Admission



Admit Brevetoxin Levels (n=36)



# Results – Clearance of Brevetoxin



Birds that died or were euthanized are marked in black and the one released brown pelican is marked in light grey (n=19).

# Results-Tissue Levels (ng/g)

## Sea Bird Rehab 0-3 days (n=24)

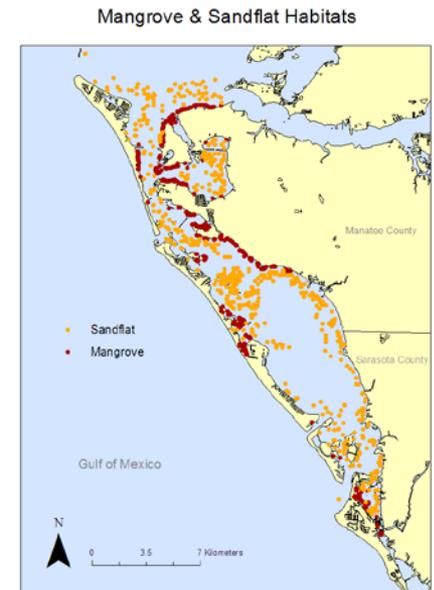
Tissue	Lung	Liver	Kidney	St Cnts	Feces	Bile	Brain	Feces Live
Mean	3.9	33.3	17.8	66.1	20.0	430.7	10.2	233.1
StDev	3.6	24.9	15.9	83.4	24.7	315.5	9.1	273.5
Count	24	24	24	9	24	2	24	15

## Sea Bird Rehab >5 days (n=6)

Tissue	Lung	Liver	Kidney	St Cnts	Feces	Bile	Brain	Feces Live
Mean	ND	16.6	5.1	NA	7.3	NA	ND	238.3
StDev	0.0	9.3	4.8	NA	6.3	NA	0.0	218.0
Count	6	6	6	0	6	0	6	5

# Material and Methods - Surveys

- June 20, 2006-Sept 2, 2009
- Boat-based point-count seasonal surveys of birds, *K. brevis* cell counts, and water quality
- Summer and winter surveys in four habitats (mangrove fringe, open bay, sandflat and seagrass)
- Analysis = T-test, MW, Shannon-Wiener



# Results - Surveys

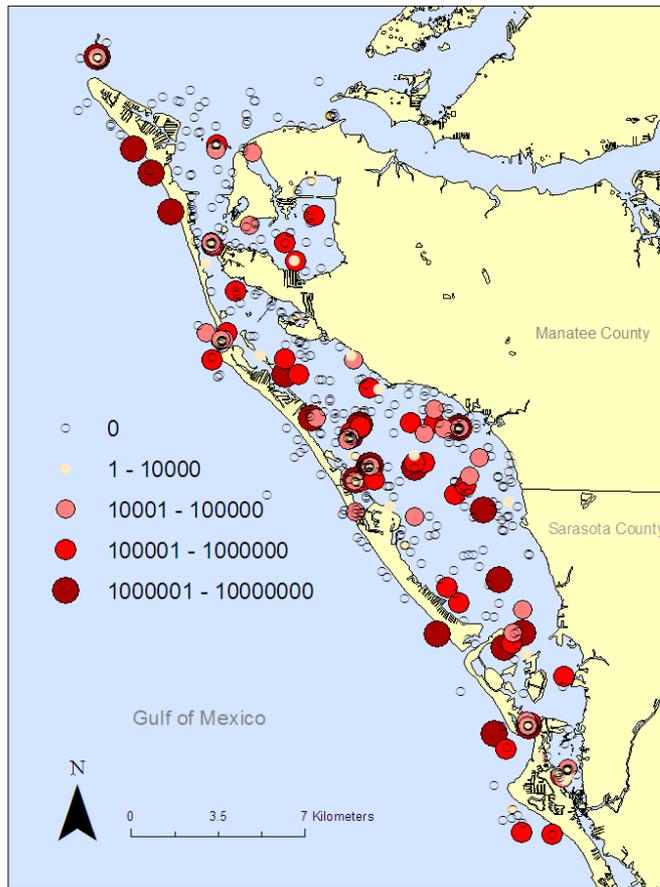
- Summer 06, 07, 08, 09
    - *K. brevis* Summer 06
  - 1540 surveys (117 days)
  - >20,000 bird observations
  - >30 species
- Winter 07, 08, 09
    - *K. brevis* Winter 07
  - 1160 surveys (87 days)
  - >14,000 bird observations
  - >40 species, including winter migrants
    - American White Pelicans
    - Merganser sp.



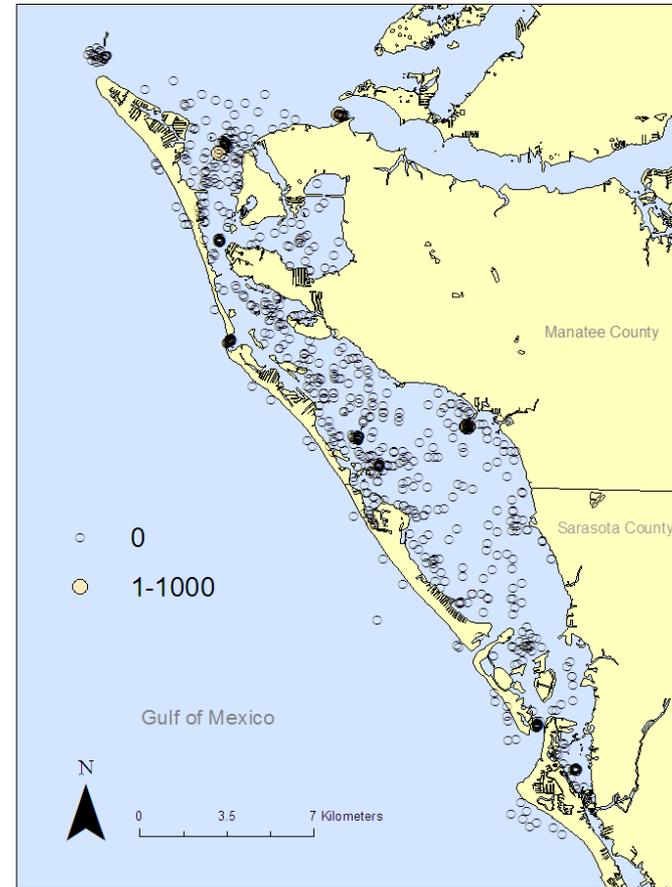
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# *Karenia Brevis* Cell Counts (cell/L)

Summer 2006 & Winter 2007 (n=541)



Summer 2007 through Summer 2009 (n=1093)



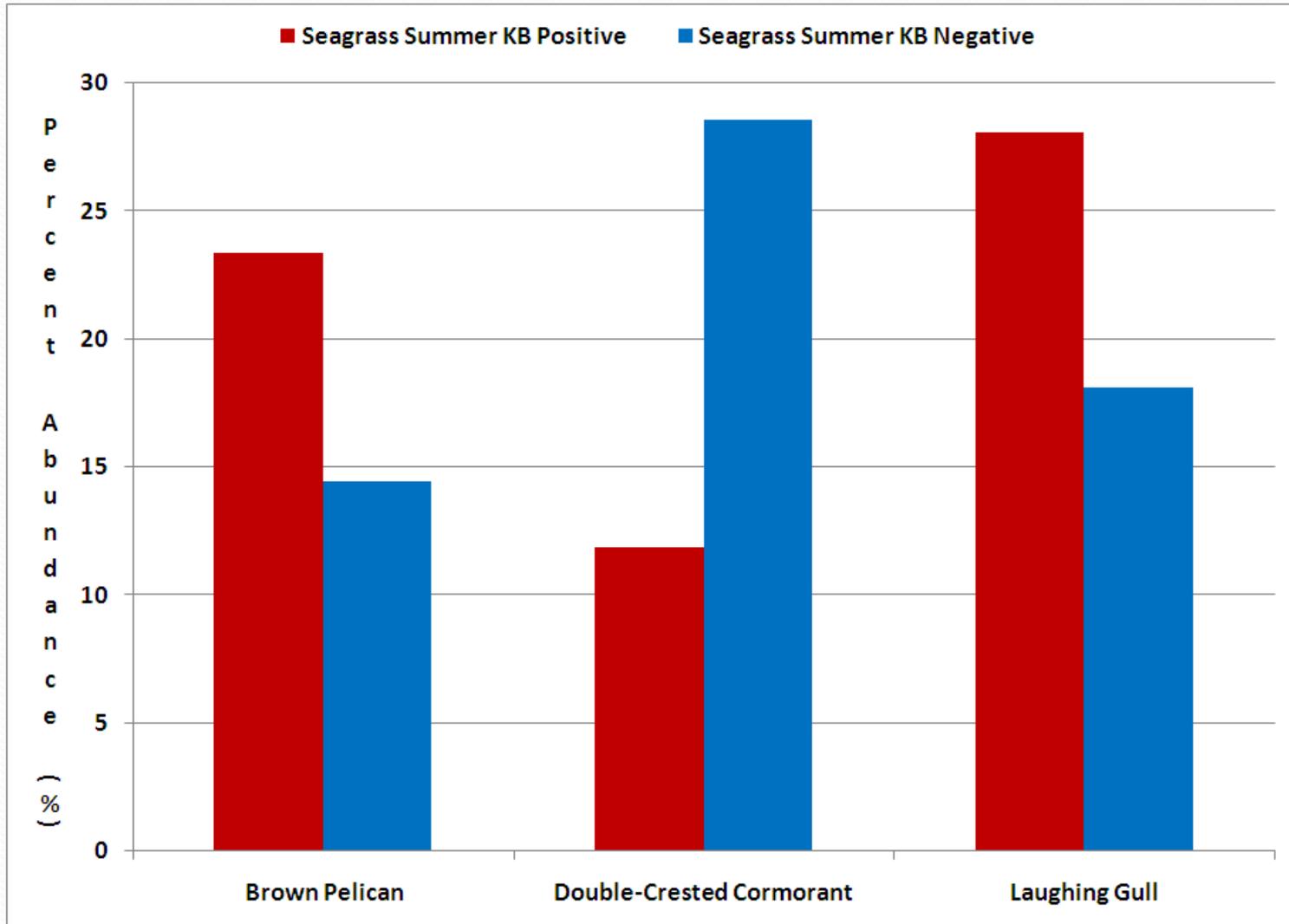
# Results - All Habitats



Photo credit SDRP

- Common Species (~50% Overall Abundance)
  - Double-Crested Cormorants (7525)
  - Brown Pelicans (4536)
  - Laughing Gulls (7524)
    - ↓ SPUE in Cormorants during *K. brevis* blooms
    - ↑ SPUE in Gulls/Pelicans during *K. brevis* blooms
      - (man/open)
- Species Richness
  - Greatest Species Richness in Mangrove; Lowest in Open Bay
  - Lower Overall Species Richness during *K. brevis* blooms
    - All Habitats

# Results – Seagrass Summer



# Habitats - Foraging



Photo credit SDRP

- Gannon et al. (2009),  
Effects of *K. brevis* on Fish  
(04-07)
- ↓ Fish sp richness & abd in  
all habitats *w/K. brevis*
- Seagrass, mangrove most  
impacted
- ↓ Demersal  
feeders (pinfish) vs pelagic  
filter feeders  
(herring/sardines)
- Cormorants demersal prey,  
large size
- Pelicans/Gulls pelagic prey,  
smaller size
- Fire et al (2008);  
VanDeventer (2007)
  - ↑ Brevetoxin in pinfish,  
herring during *K. brevis*  
blooms

# Conclusions



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- 69% sea birds tested positive in 2005-2006
- Sea birds cleared the toxin in 5-10 days
- Overall decreased species richness and diversity during *K. brevis* blooms
- Largest impacts seen in Seagrass & Mangrove habitats
- Overall decreased abundance of Cormorants
- Brevetoxin may play a greater role in regulating populations by negatively impacting individual health and decreasing survival

# Acknowledgments

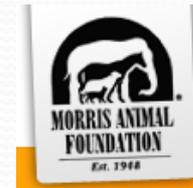
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Questions?

