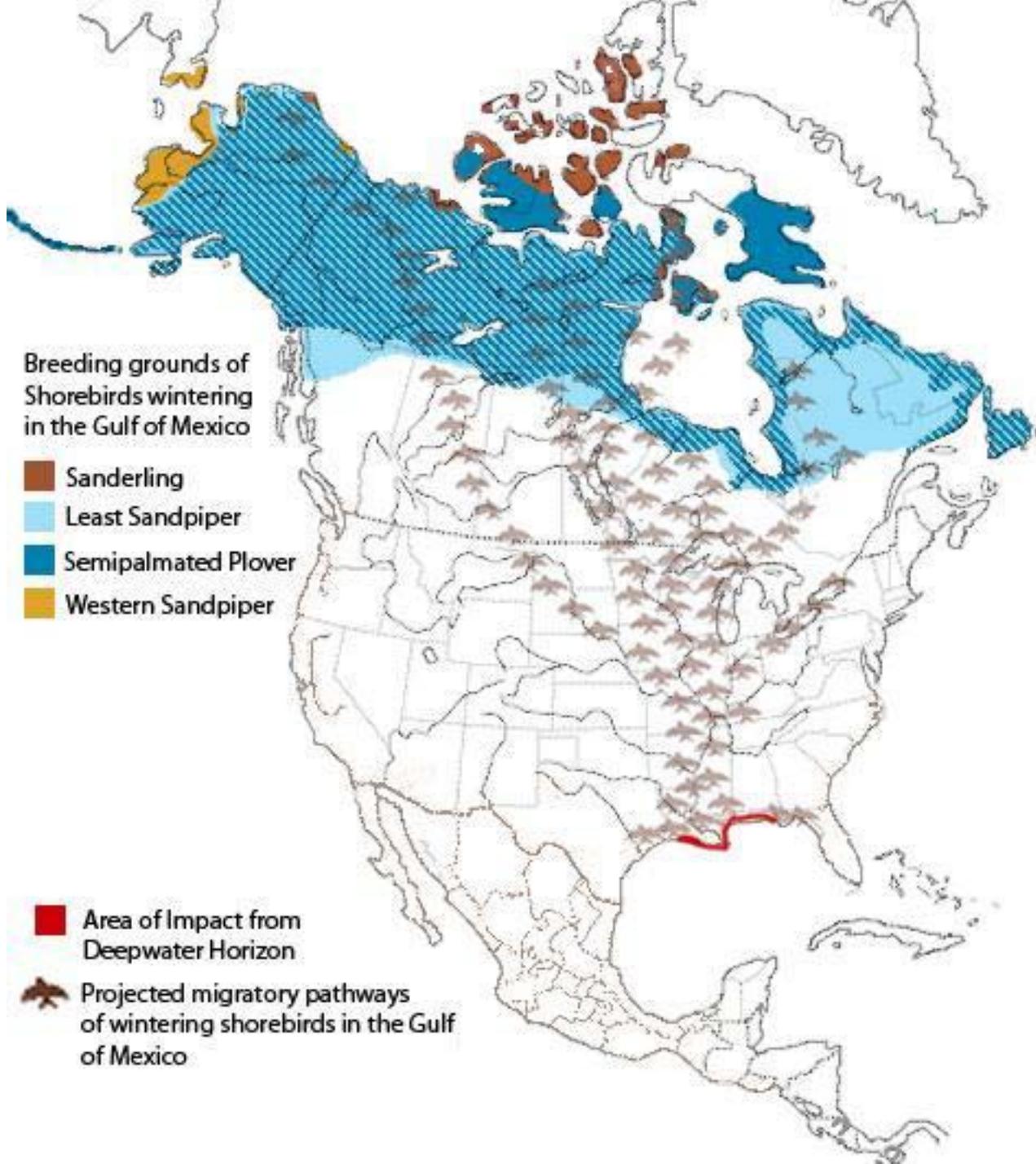


Impact of the *Deepwater Horizon* Oil Spill on Migratory Shorebirds: The Gulf and Beyond

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Shorebirds and Oil

- Direct and indirect impacts
- Lethal and sublethal effects
- Overall impact = lower population size and reduced breeding success

Shorebird Oiling Mechanisms

- External oil
 - Shoreline contact
- Ingested oil
 - Preening
 - Food
 - Habitat



Impacts on Wintering Grounds

- External oil
 - Mortality
 - Hypothermia
 - Excessive preening
 - Increased predation
- Ingested oil = reduced fitness
 - Toxicological effects
 - Hemolytic anemia
 - Immunosuppression
 - Liver and kidney damage

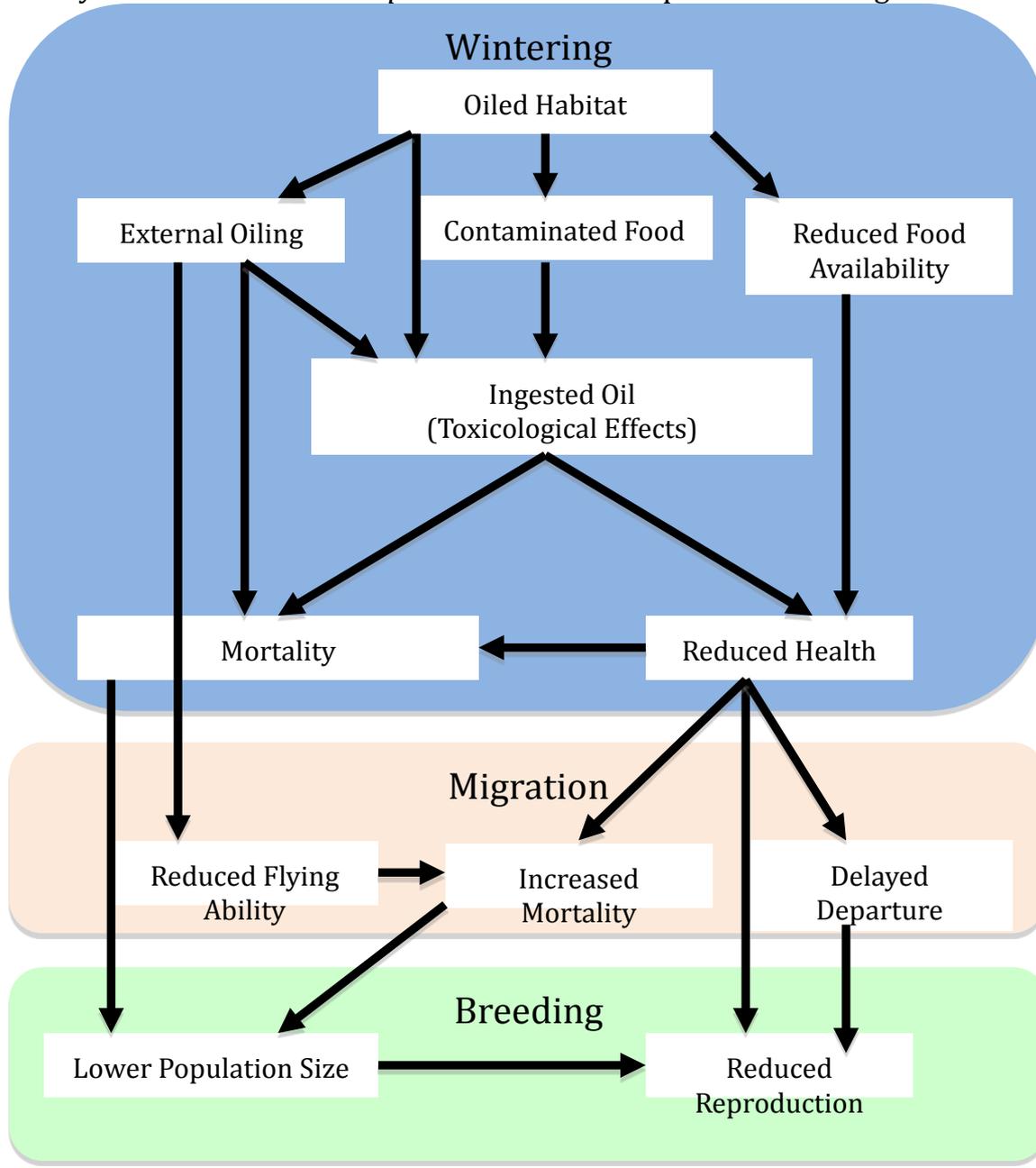


Indirect Impacts

- Inadequate resources
 - Reduced food
 - Habitat/prey switching
- Increased disturbance



Carryover Effects of the *Deepwater Horizon* Oil Spill on Wintering Shorebirds



Study Sites



Study Species



Photo by Michael L. Baird

Least Sandpiper
(*Calidris minutilla*)



Semipalmated Plover
(*Charadrius semipalmatus*)



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Western Sandpiper
(*Calidris mauri*)



Sanderling
(*Calidris alba*)



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Dunlin
(*Calidris alpina*)

Data collected from birds:

- Blood samples
- Fecal samples
- Age and sex
- Fat scores
- Molt and plumage quality
- Wing, culmen, tarsus length
- Weight
- Level of oiling



Captures to Date

- 153 shorebirds captured
 - 6 locations in Gulf of Mexico
 - 1 location on breeding grounds in Quebec

Semipalmated plover	Western sandpiper	Least sandpiper	Dunlin	Sanderling
85	6	35	37	2

Invertebrate Sampling

- Core samples
- Sieve and sort invertebrates
- Quantify PAH levels

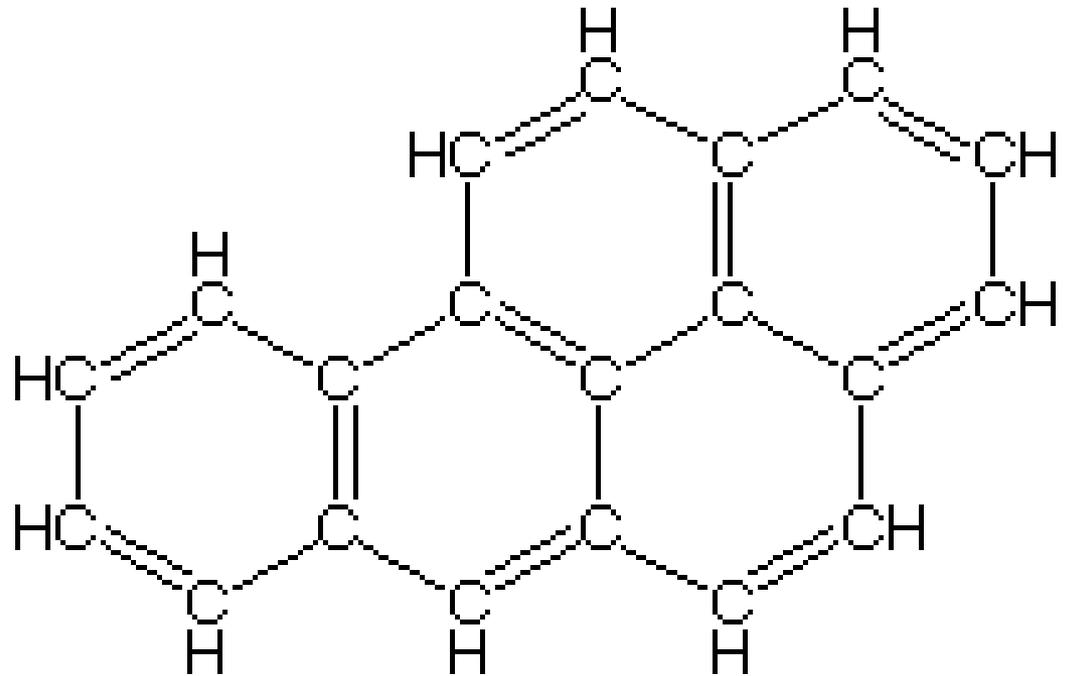


David Samuel Johnson

Polychaete worm (*Streblospio benedicti*)

PAH Testing

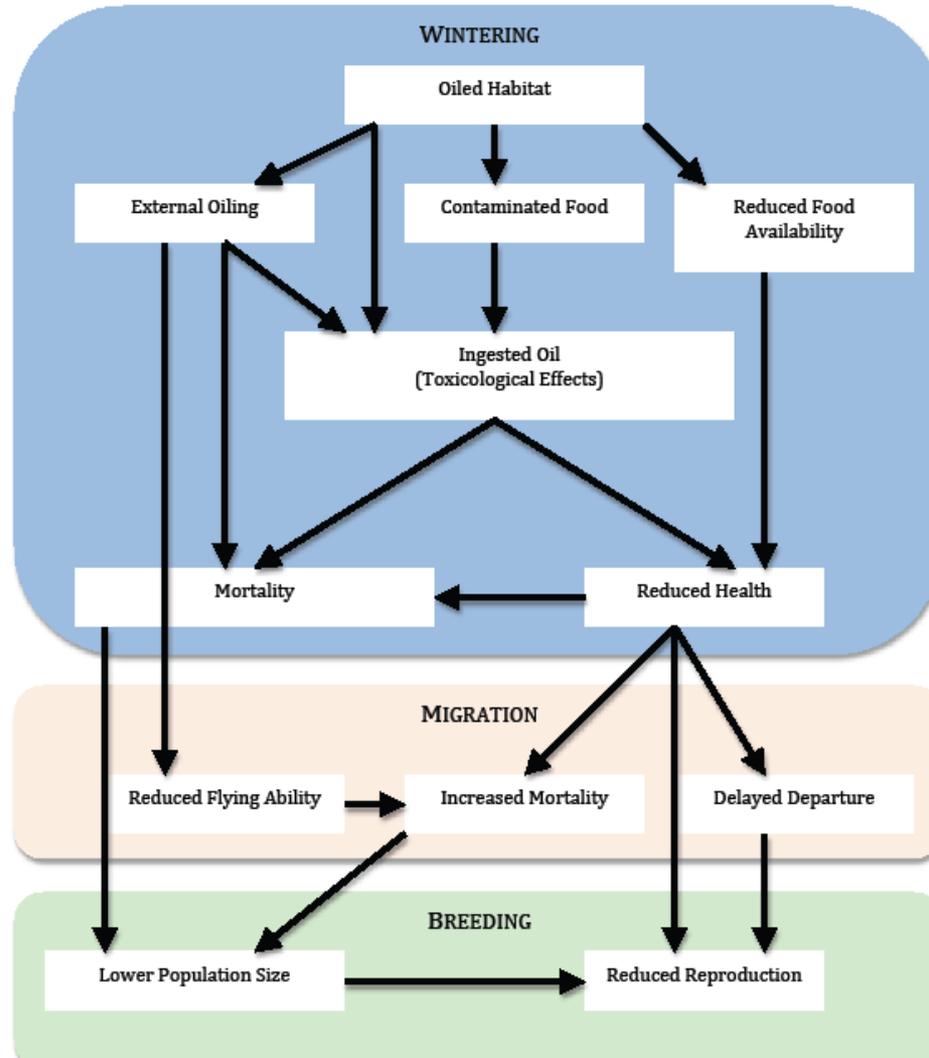
- Bird plasma
- Bird fecal samples
- Invertebrates
- Soil/substrate



benzo[a]pyrene

Beyond the Gulf of Mexico

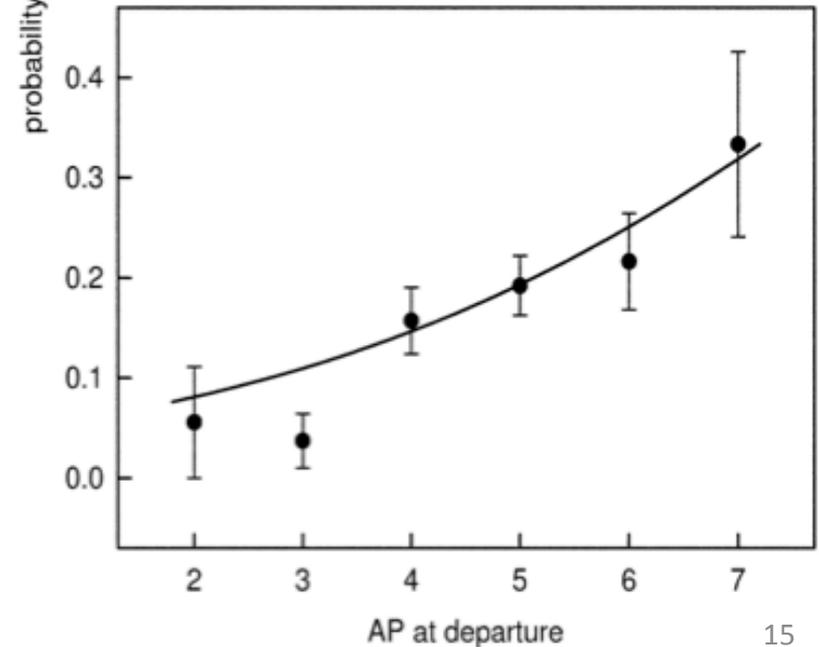
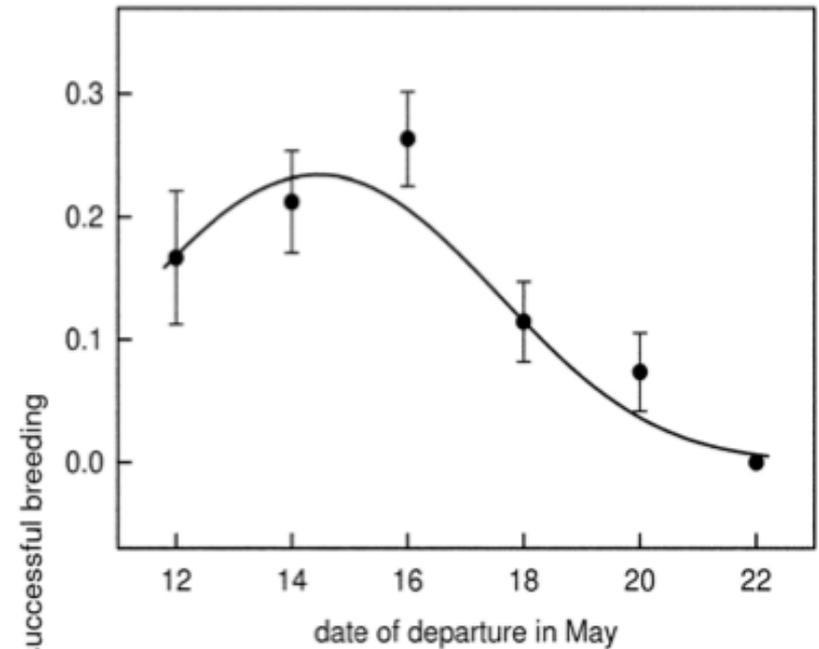
Carryover Effects of the Deepwater Horizon Oil Spill on Wintering Shorebirds

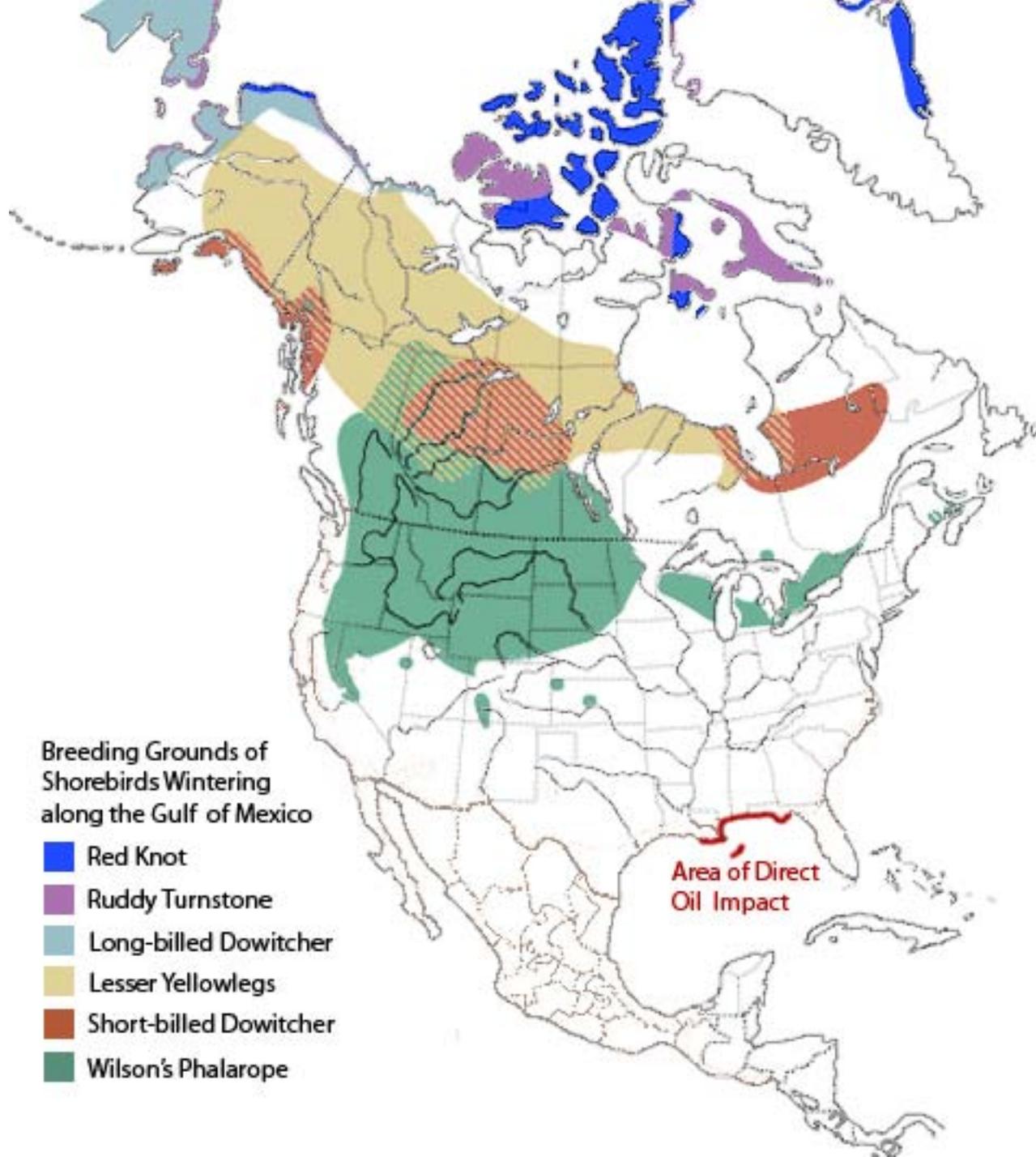


- Arctic breeding Barnacle

Geese (Prop et al. 2003)

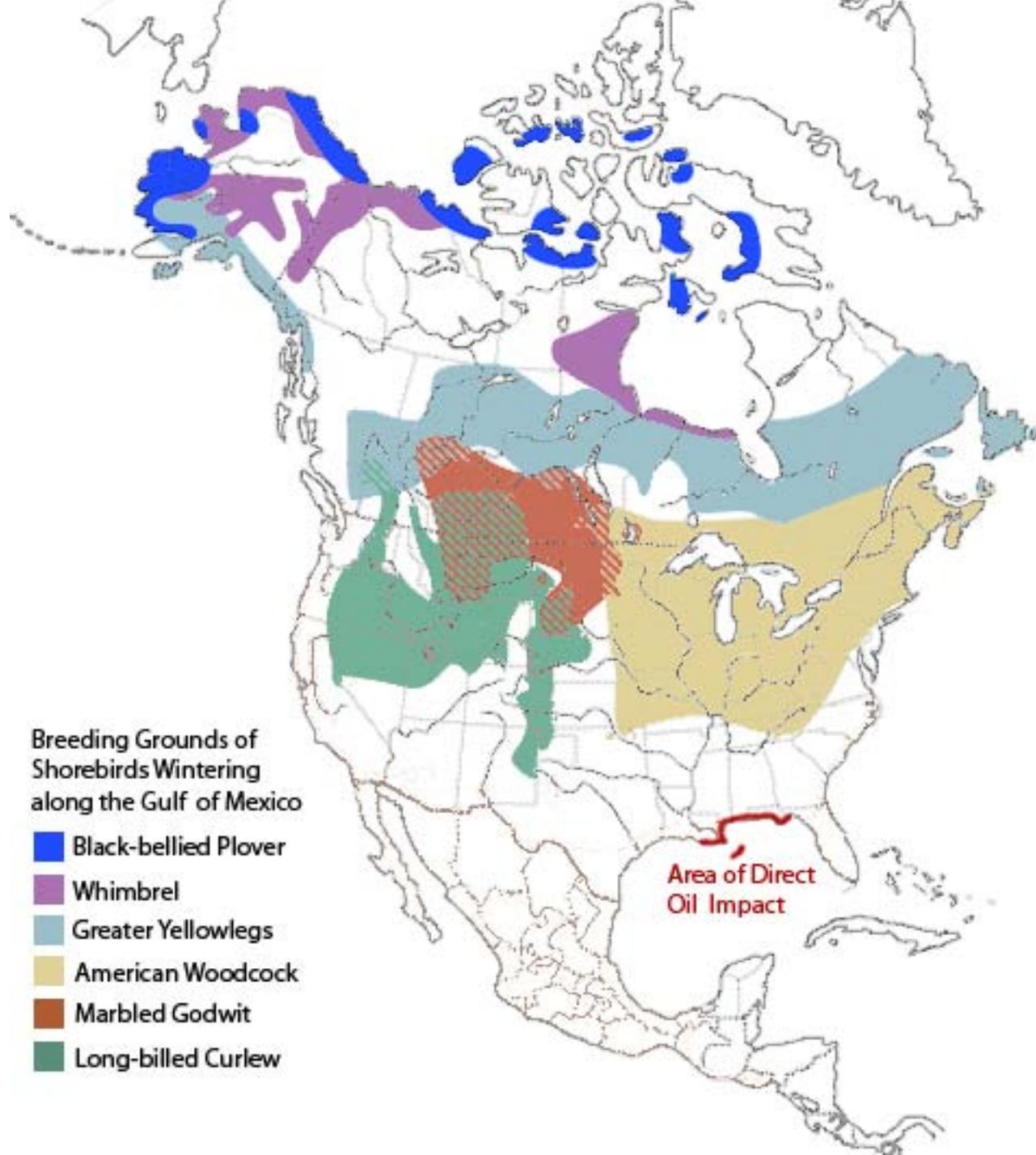
- Correlation between breeding success and departure date
- Correlation between breeding success and body fat deposits (AP)





Breeding Grounds of
Shorebirds Wintering
along the Gulf of Mexico

- Red Knot
- Ruddy Turnstone
- Long-billed Dowitcher
- Lesser Yellowlegs
- Short-billed Dowitcher
- Wilson's Phalarope

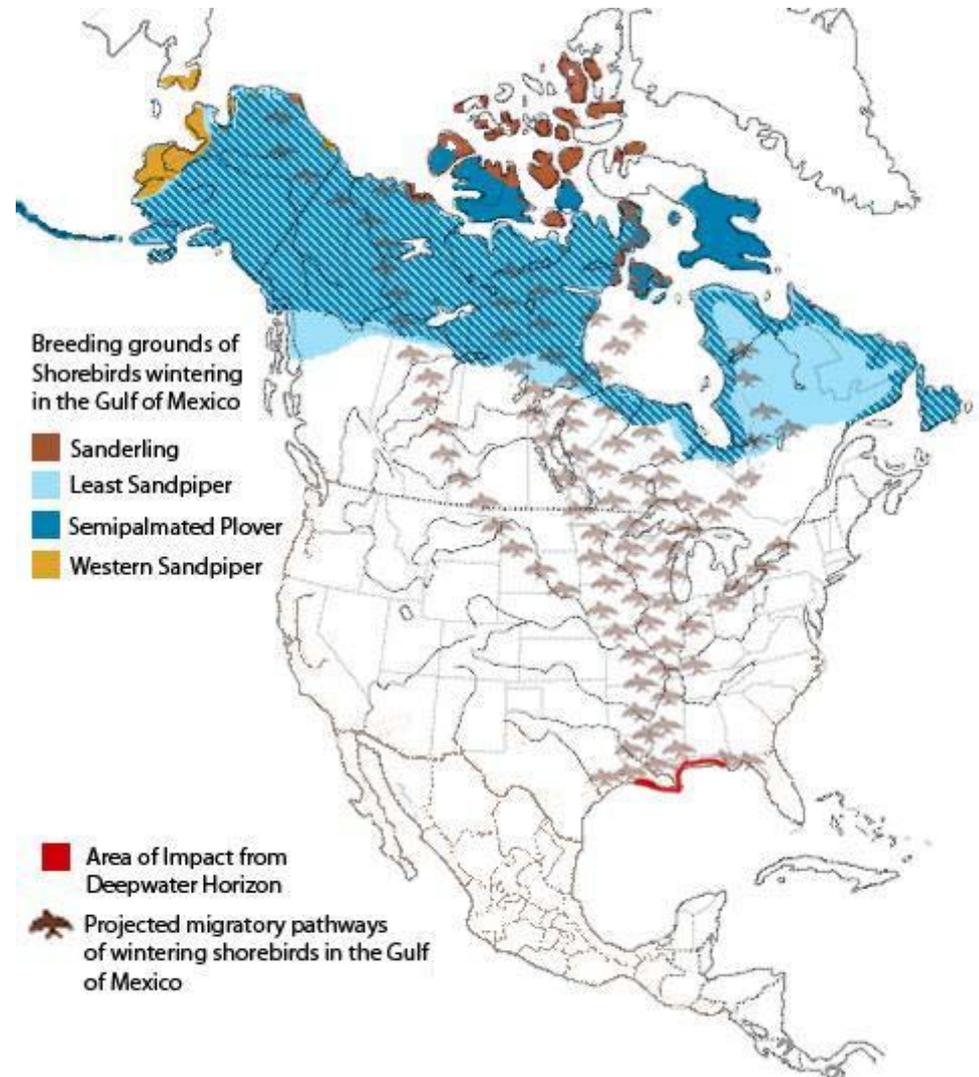


Breeding Grounds of
Shorebirds Wintering
along the Gulf of Mexico

- Black-bellied Plover
- Whimbrel
- Greater Yellowlegs
- American Woodcock
- Marbled Godwit
- Long-billed Curlew

Migratory Connectivity

- **Piping Plover** (Gratto-Trevor et al. 2009)
- **Dunlin** (Lopes et al. 2006)
- **Black-tailed Godwits** (Gunnarsson et al. 2005)



Arctic Predators



Conclusions

- Wintering shorebirds impacted by oil
 - Lethal and sublethal effects
- Carry effects of spill to breeding grounds
- Impacts of *Deepwater Horizon* spill may be felt in ecosystems far from the Gulf

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