Summary of Genetic Stock Structure Analyses for Marine Mammals Interacting with Trawl Fisheries

Prepared for
Atlantic Trawl Gear Take Reduction Team Meeting
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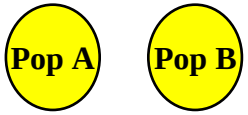
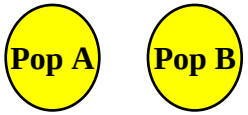
The Species

- **Atlantic white-sided dolphin**
  Lagenorhynchus acutus
- **Common dolphin, *Delphinus delphis***
- **Long-finned & short-finned pilot whales**
  Globicephala melas* and *G. macrorhynchus
- **Harbor porpoise, *Phocoena phocoena***

Why is accurate stock identification so important?

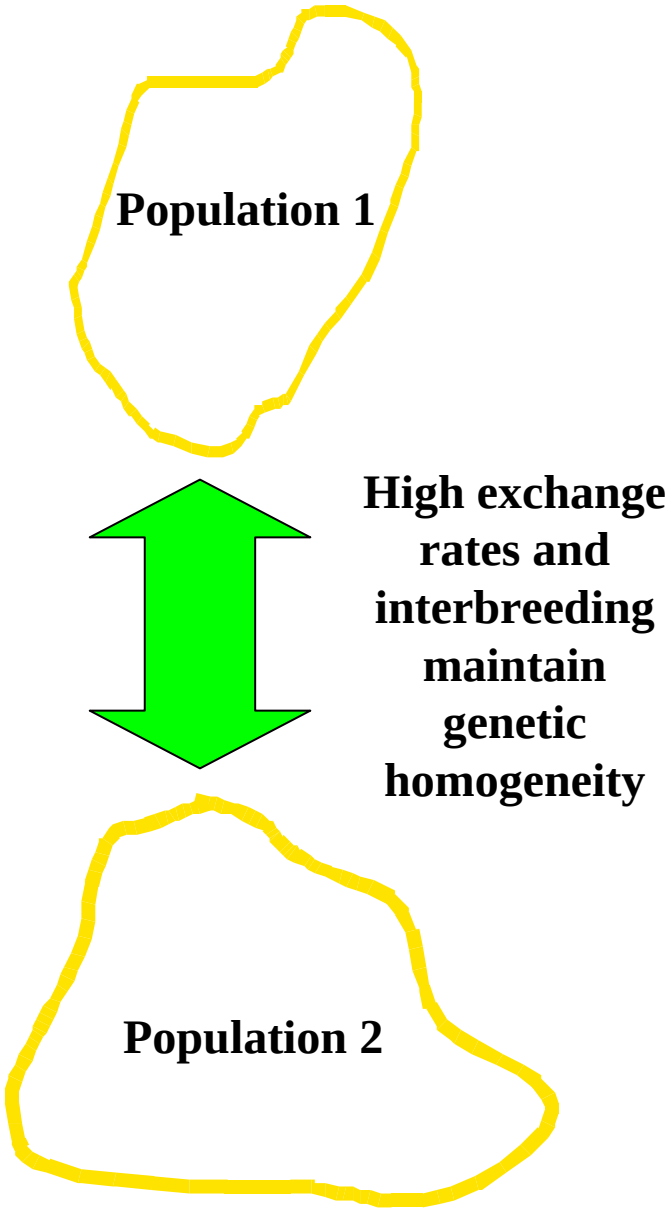
Defined	Reality	Result
		risk losing unique diversity
Or		
		restrictive on fishery

- Accurate abundance estimates
- Apportion bycatch
- Calculate PBR

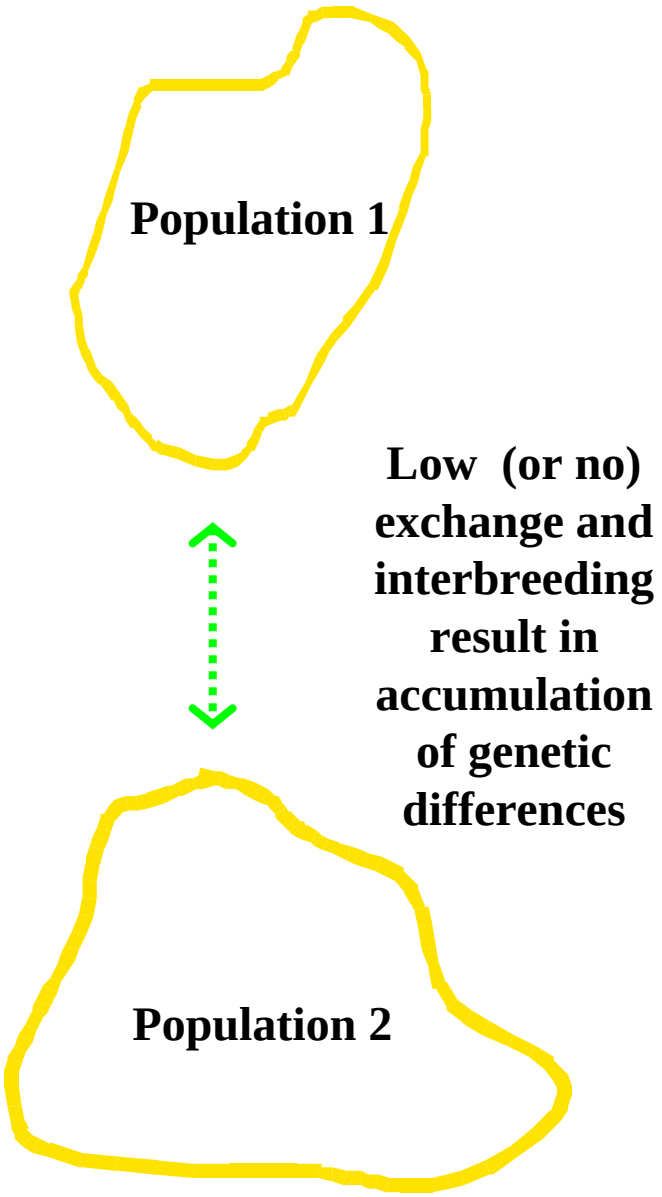
Stock Delineation

- **Ultimately, we want to base stocks on knowledge of the degree (or lack thereof) of interbreeding**
- **Proxies**
  - **Geographical barriers**
    - **Gulf of Mexico versus Atlantic**
  - **Apparent timing of reproduction**
  - **Analysis of contaminant loads or stable isotopes**
  - **Telemetry**
- **Morphology**
- **Genetic analysis**

Populations Genetically Indistinguishable



Populations Genetically Distinguishable



Stock Delineation

- **Use of Genetic Information to Delineate Stocks**
  - **Estimate the extent to which populations are isolated from one another.**
  - **Infer the amount of exchange occurring among populations.**
  - **Evolutionary time scale**

White-sided Dolphins

- **Nothing known about stock structure**

Distribution

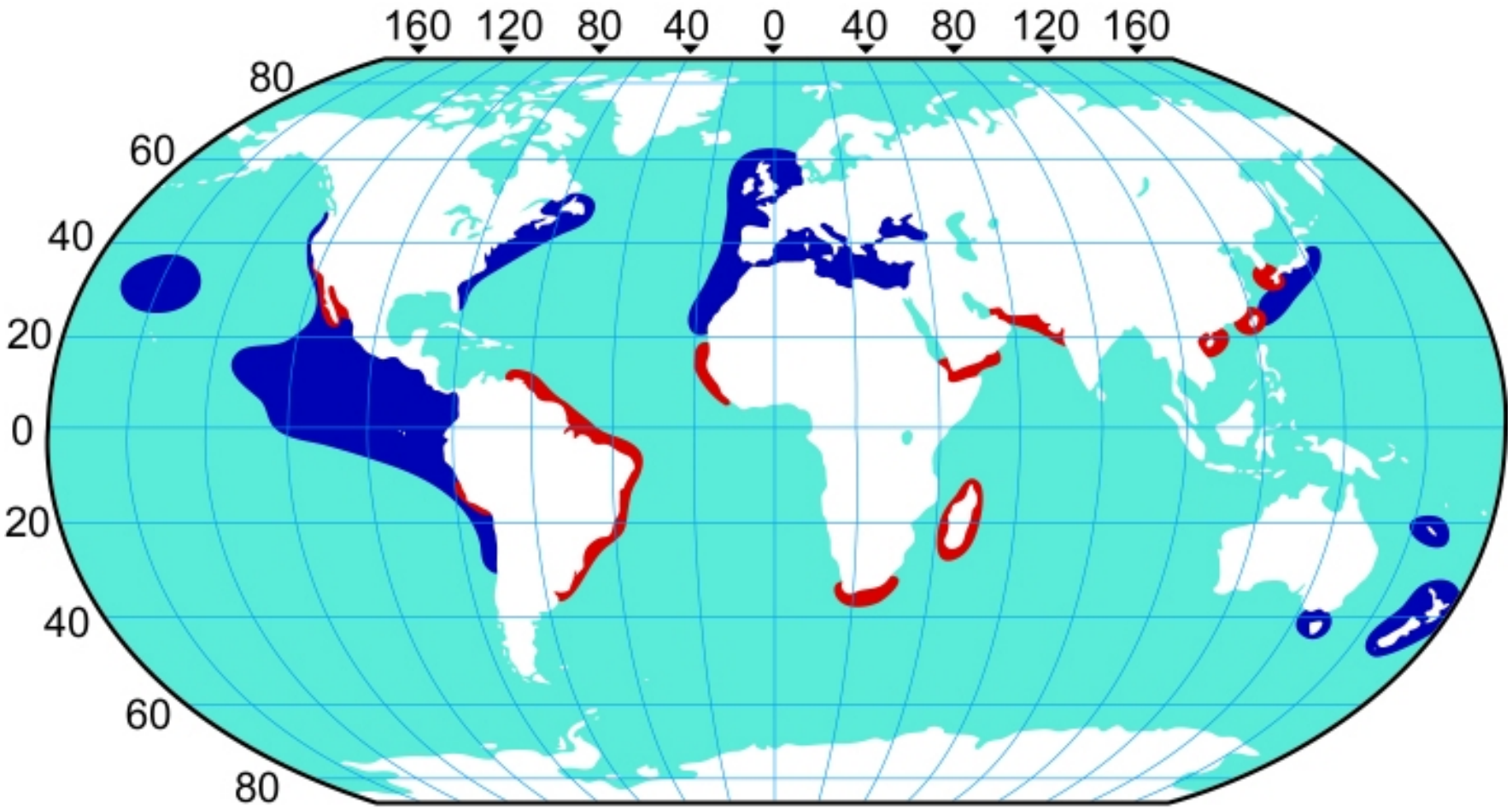
From: http://en.wikipedia.org/wiki/Image:Cetacea_range_map_Atlantic_White-sided_Dolphin.PNG

kidstuff.homestead.com/oceanswimmer.html

Common Dolphins

- **Genetic analysis done for NW Atlantic and across Atlantic using mitochondrial DNA sequence data**
- **PhD Research of A. Westgate, Duke Univ.**

Distribution

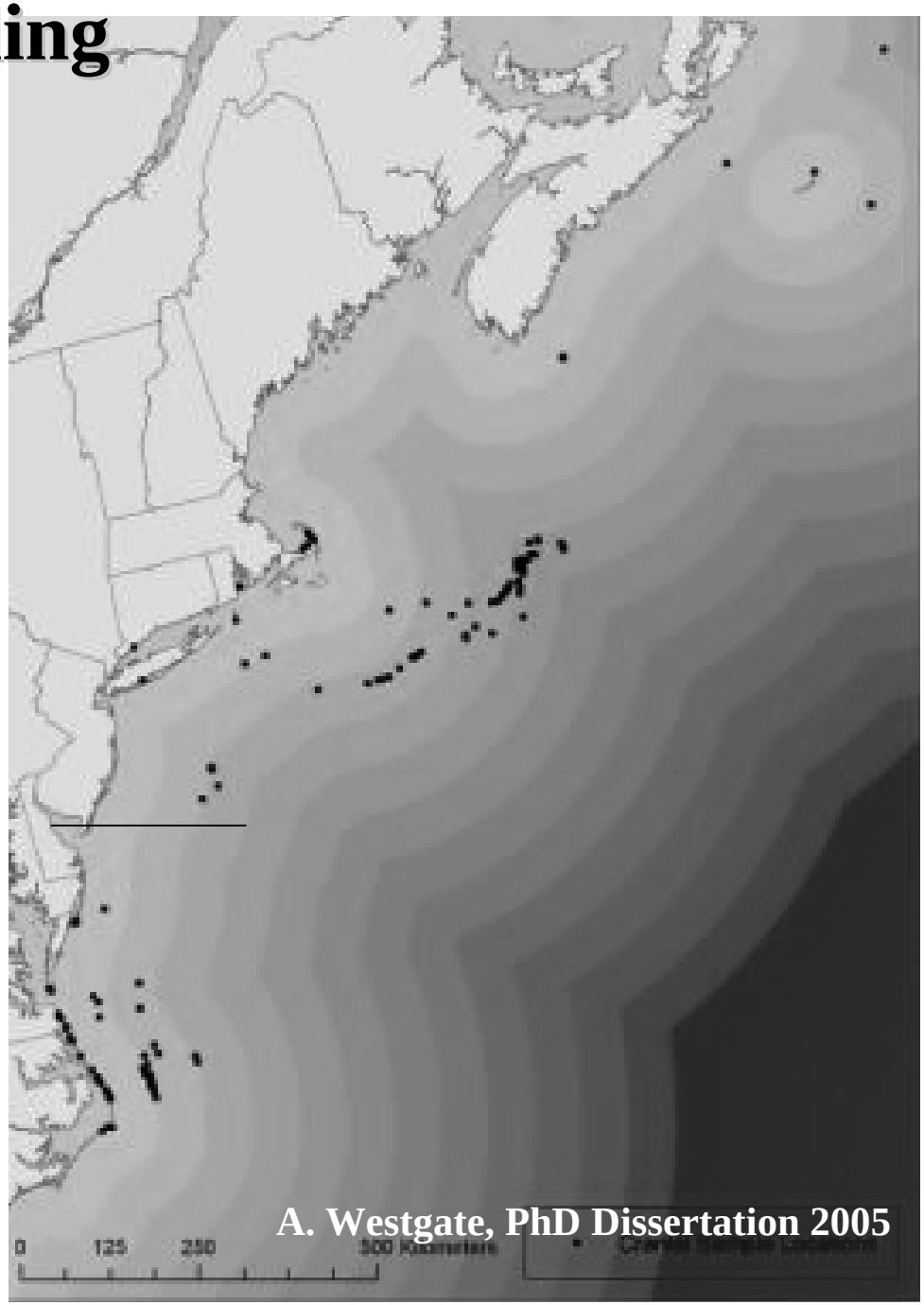


Short-beaked Common Dolphin *Delphinus delphis*

Long-beaked Common Dolphin *Delphinus capensis*

Common Dolphin Sampling for Genetic Study

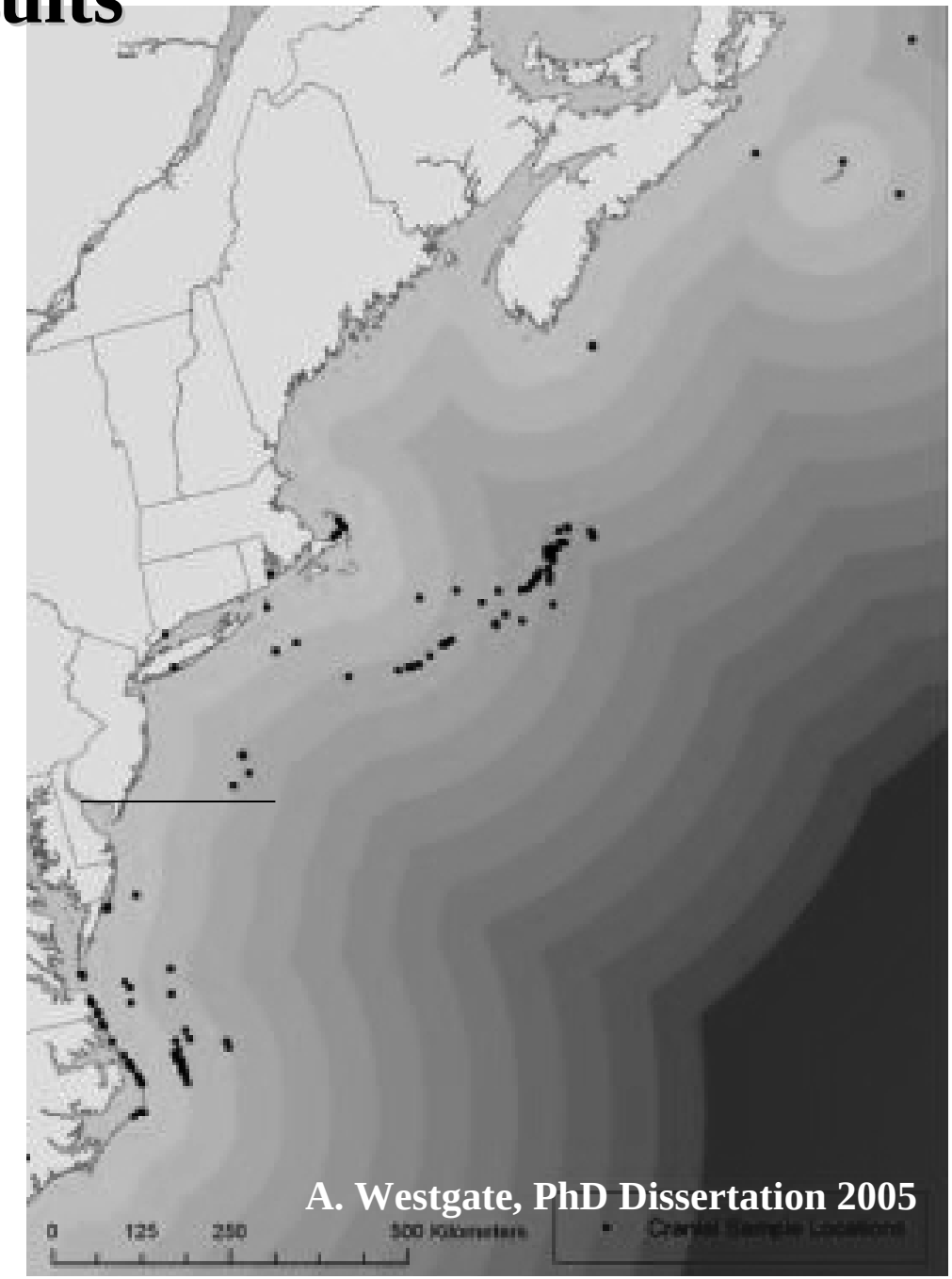
- 221 samples from NW Atlantic
- 59 samples from NE Atlantic
- Tested for structure on
  - north-south axis
  - nearshore-offshore axis
  - NWA-NEA axis



A. Westgate, PhD Dissertation 2005

Common Dolphin Results

- **High genetic diversity**
- **No significant differences found between samples north of 39°N and those south of 39°N**
- **No significant differences found between animals collected > 130 km from shore and those collected between coast &130 km**
- **But significant differences between NW Atlantic and NE Atlantic**



Work that still needs doing

- **High diversity complicates analyses**
- **Summer north and winter south**
- **Perhaps further examine use of water depth rather than distance from shore?**

Pilot Whales

***Globicephala melas* (long-finned)**

***Globicephala macrorhynchus* (short-finned)**

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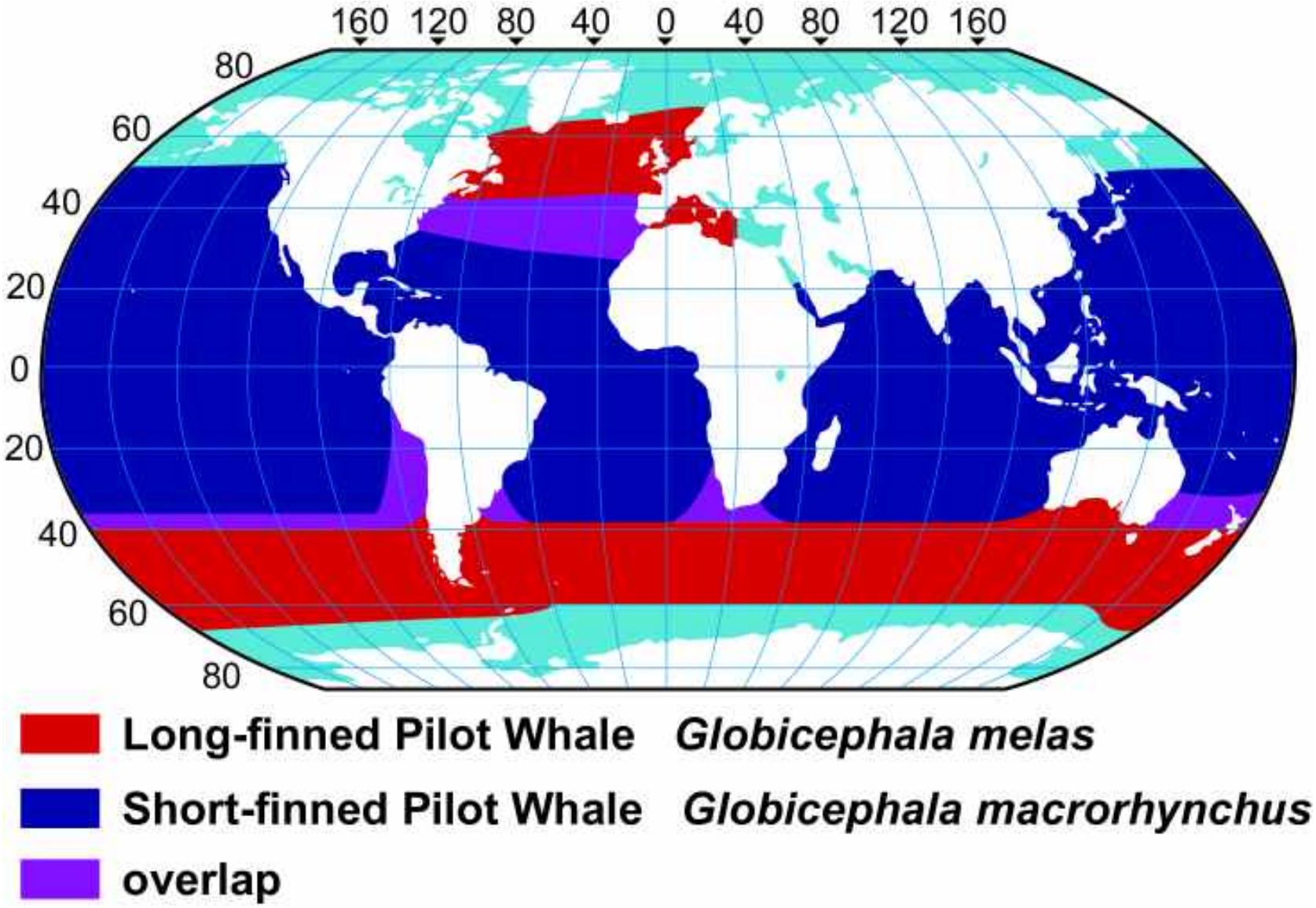
Pilot Whale

Pilot Whale Distribution



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Pilot Whale Range Map

Pilot Whale Samples for Genetic Study
(Note that many started out as “species unknown”)

	Long-Finned	Short-Finned*
Biopsy	121	112 / 24
Bycatch	74	17/ 0
Stranding	13	38/ 26
Total	208	167/ 50

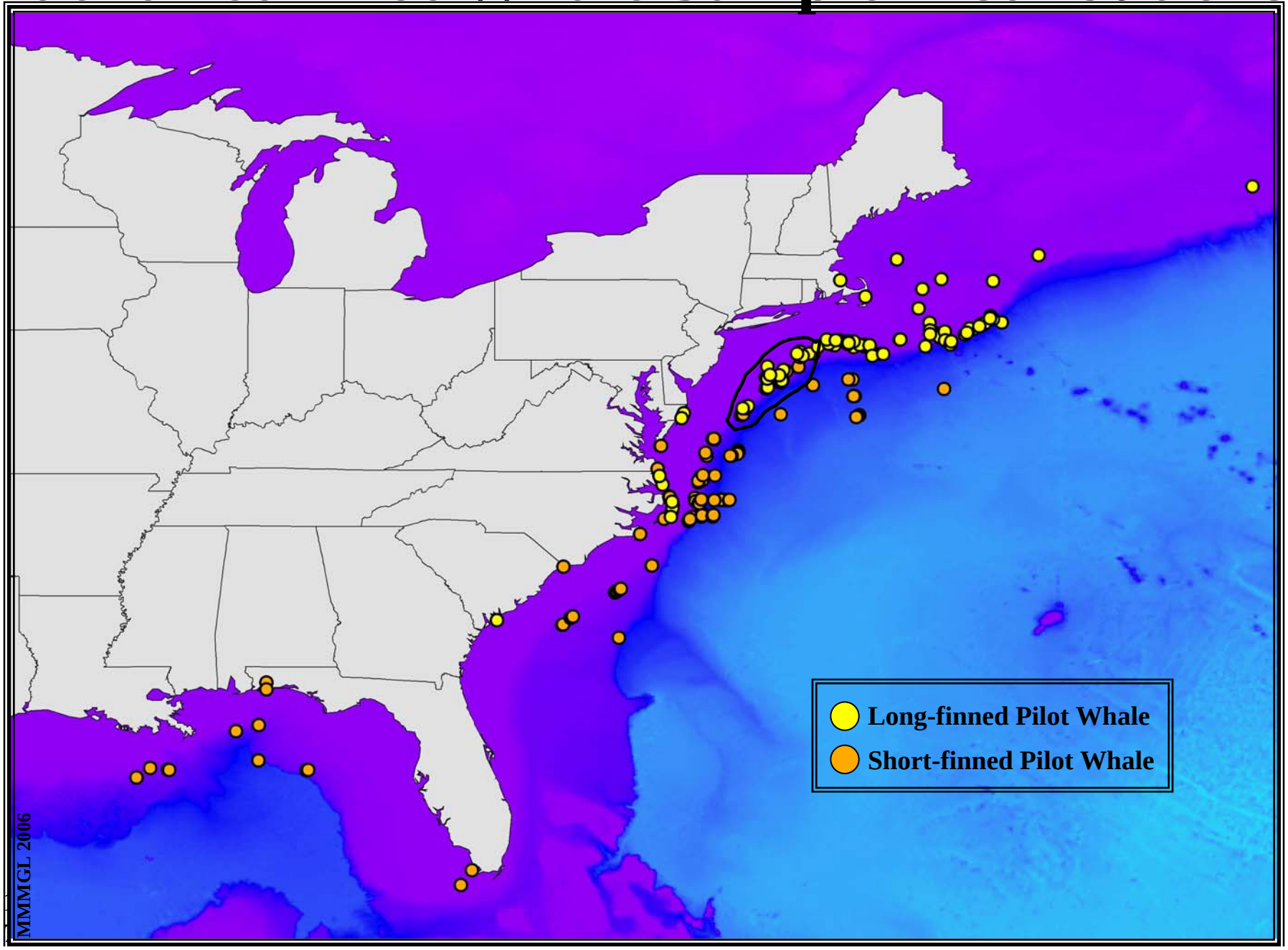
*** Atlantic/Gulf of Mexico**

Pilot Whale Samples by Year and Source

	Long-Finned Pilot Whale (*G. melas*)					Short-Finned Pilot Whale (*G. macrorhynchus*)				
	Biopsy	Bycatch	Stranding	Total		Biopsy	Bycatch	Stranding	Total
1989		4		4	1989				
1990		39		39	1990		5		5
1991		7		7	1991				
1992		3		3	1992		3		3
1993					1993		5		5
1994		9		9	1994		1		1
1995		3		3	1995		3		3
1996		4		4	1996				
1997	13			13	1997				
1998	55			55	1998	1		2	3
1999			2	2	1999			2	2
2000					2000				
2001	1		1	2	2001			2	2
2002			1	1	2002				
2003			3	3	2003			2	2
2004	46	2	1	49	2004	34			34
2005	6	3	5	14	2005	77		30	107
				208					167

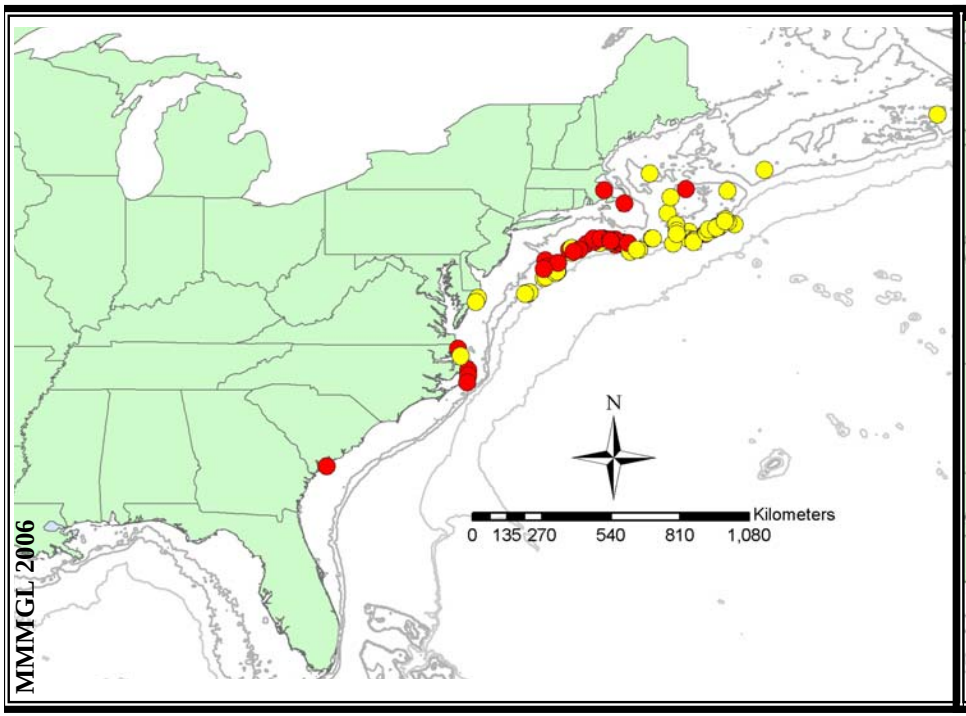
Atlantic Only

Identified Pilot Whale Sample Distributions



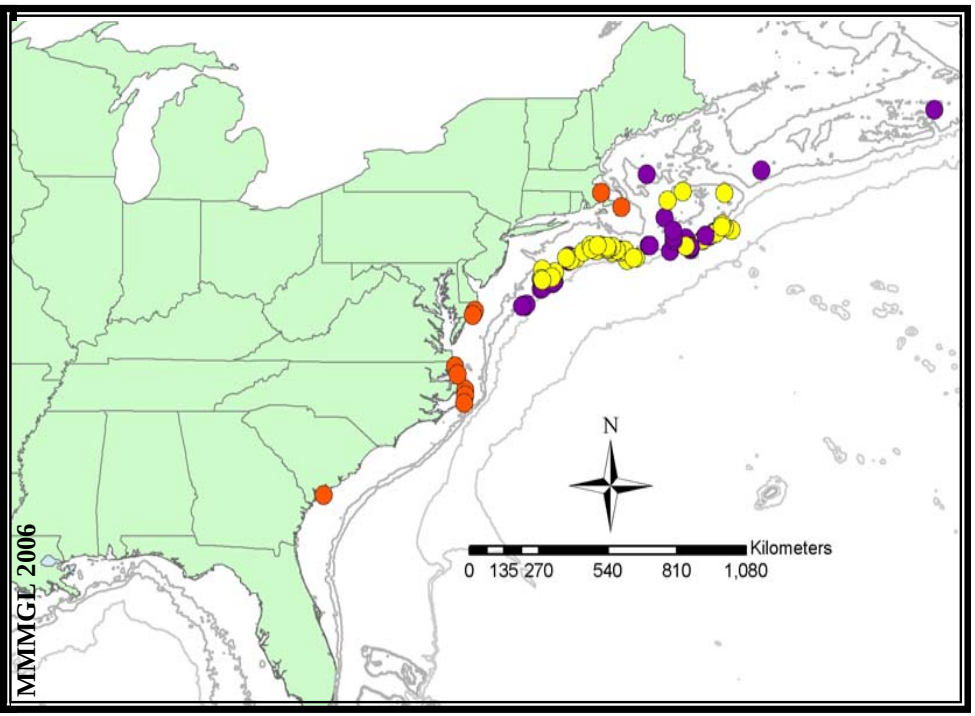
Long-finned Pilot Whales *(G. melas)*

Winter and Summer Distribution



Season	
Winter (Nov-Apr)	
Summer (May-Oct)	

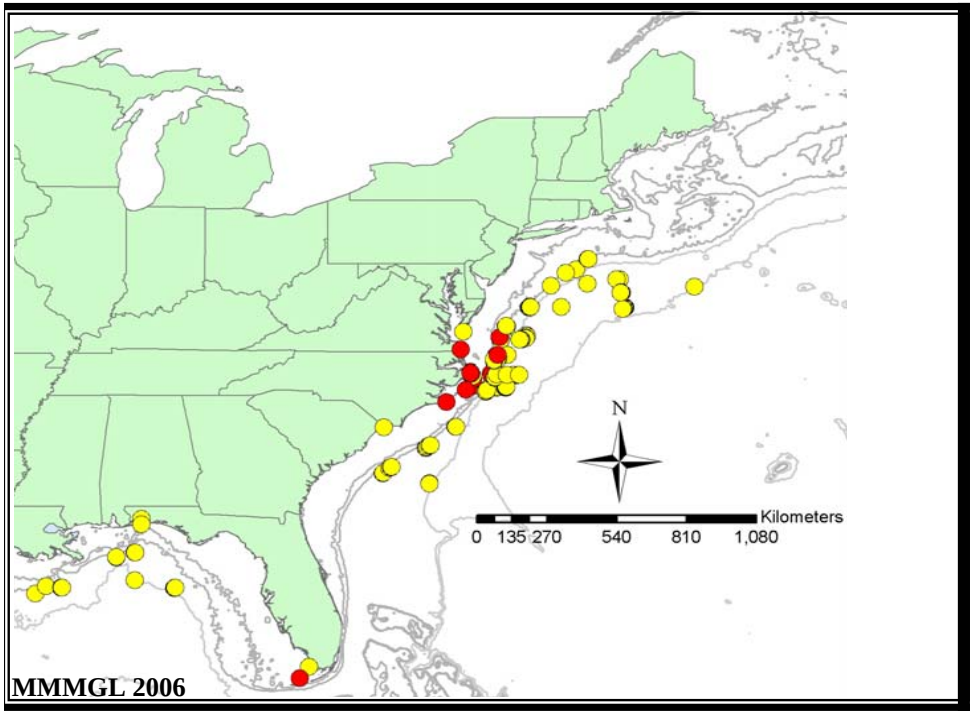
Biopsy, Bycatch, and Strandings



Tissue Source	
Biopsy	
Bycatch	
Stranding	

Short-finned Pilot Whales *(G. macrorhynchus)*

Winter and Summer Distribution



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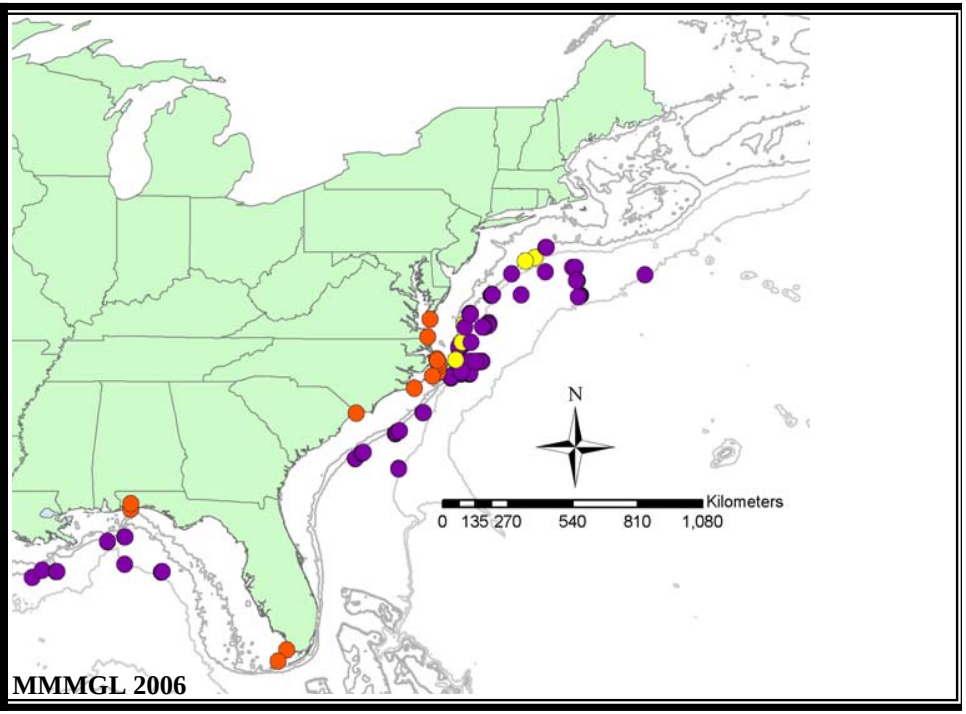


Tissue Source	
Biopsy	
Bycatch	
Stranding	

NMFS

Genetic Variability

- **Long-finned pilot whales have extraordinarily low genetic variability in the mitochondrial gene we sequenced**
- **Short-finned pilot whales were a bit better**

Short-finned Pilot Whales: Gulf of Mexico vs. NWA Atlantic

- **Performed a preliminary analysis on *G. macrorhynchus* DNA sequence data to compare Gulf of Mexico to NW Atlantic**
- **Distributions of the sequences in the two areas differed significantly when both frequency and genetic differences between the sequences were considered ($p < 0.01$)**
- **However, sample sizes are quite uneven between the two regions and so additional samples from Gulf of Mexico would greatly help this analysis**

Short-finned Pilot Whales: Stock structure within NW Atlantic?

- **Payne & Heinemann (1993) suggested 3 concentrations of short-finned pilot whales between 200-2000m during July-August:**
  - **One east of Hatteras**
  - **One east of mouth of Chesapeake Bay**
  - **One east of Delaware Bay at approx. 39°N**
- **We split**
  - **30°N - 33.9°N**
  - **34°N - 36°N**
  - **36°N - 38°N**
- **No significant differences found between these three groups.**

Summary

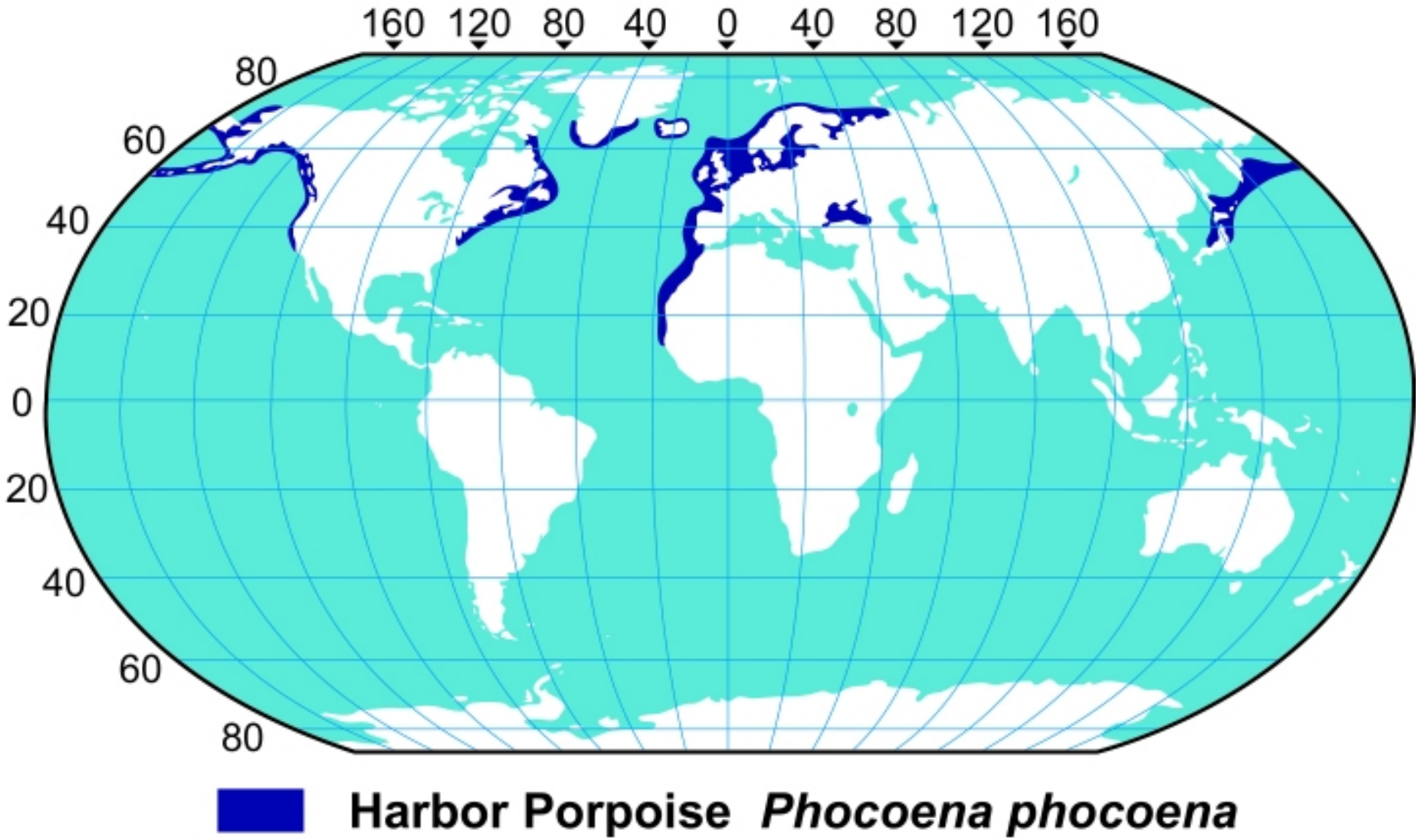
- **Long- and short-finned pilot whales show a distinct difference in preference for deep water (water temperature?).**
  - **Long-finned pilot whales were found on shelf and especially along shelf break but did not show evidence of going deeper than the shelf break.**
  - **Short-finned pilot whales were present on shelf, especially south of Hatteras, along the shelf edge and in deeper water east of the shelf break.**
- **No long-finned samples were found south of 38°N except for 3 strandings in North Carolina. However, winter biopsy effort is needed to determine the southern limit of their winter distribution.**
- **No short-finned samples north of 40°N; nor east of 71.5°W along the shelf edge.**
- **Greatest area of overlap occurs between 38°N and 40°N where long-finned pilot whales are present in winter and summer and short-fins are present at least in summer. Whether they are there in winter requires better sampling.**

Harbor Porpoise

Genetic analysis done for all of Atlantic

- What is stock structure within NW Atlantic?
- Where do porpoises present in the mid-Atlantic in winter come from?

Distribution



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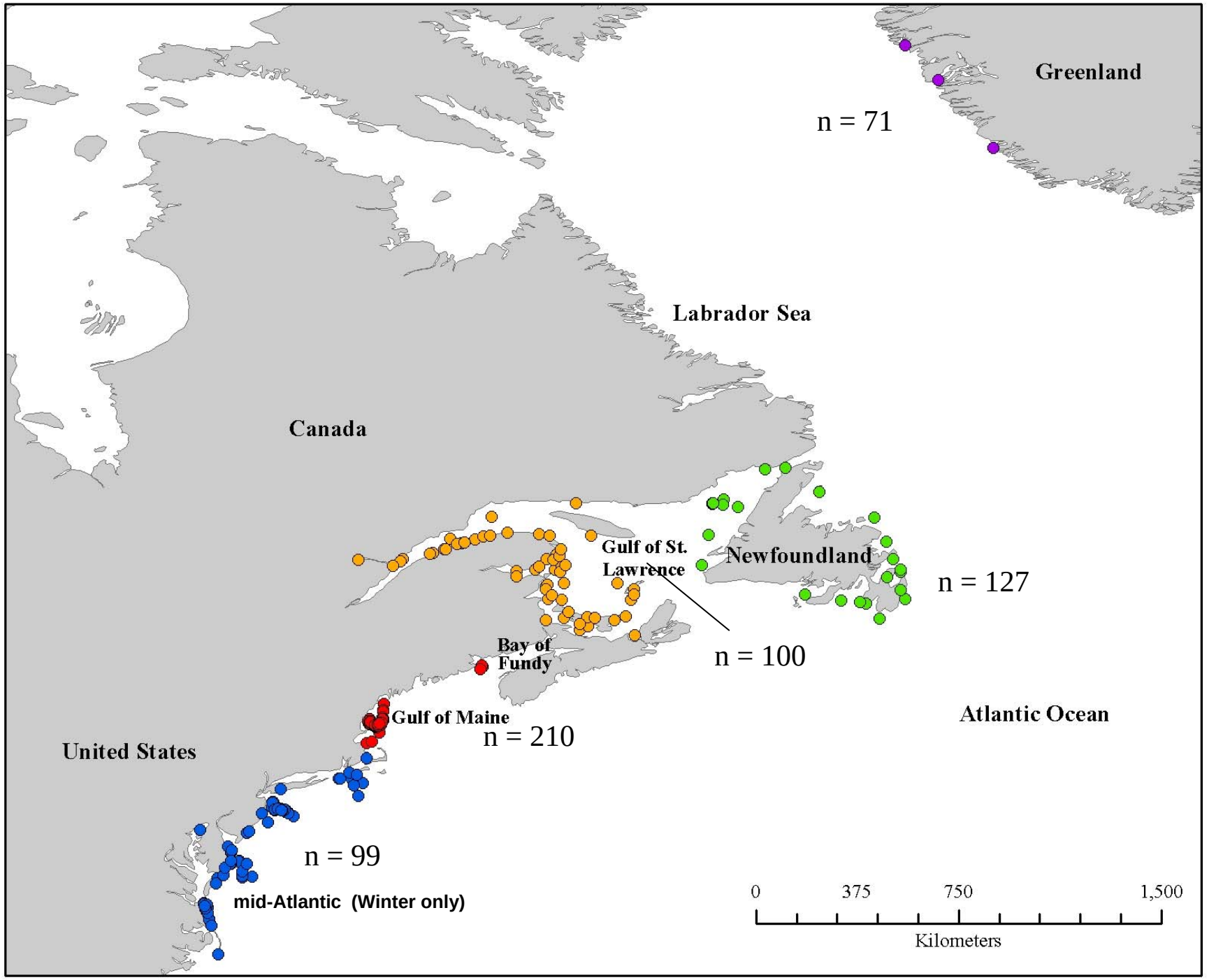
NMFS


Greenland
n = 71
Labrador Sea
Canada
Gulf of St.
Lawrence
Newfoundland
n = 127
n = 100
Bay of
Fundy
Gulf of Maine
n = 210
Atlantic Ocean
United States
n = 99
mid-Atlantic (Winter only)
0
375
750
1,500
Kilometers

Harbor Porpoise Results

- **Across Atlantic:**
  - **Very limited genetic exchange across the Atlantic**
- **Within NW Atlantic populations:**
  - **Significant genetic differentiation among the four summer breeding populations with indications of strong female site fidelity and less fidelity by males**

P. Rosel

Harbor Porpoise Results

- **Within NW Atlantic populations:**

  Most likely contributors to winter mid-Atlantic porpoises are the Gulf of Maine/Bay of Fundy (~ 60%) and Newfoundland (~25%).