Sperm Whales in the Gulf of Mexico: What We Have Learned

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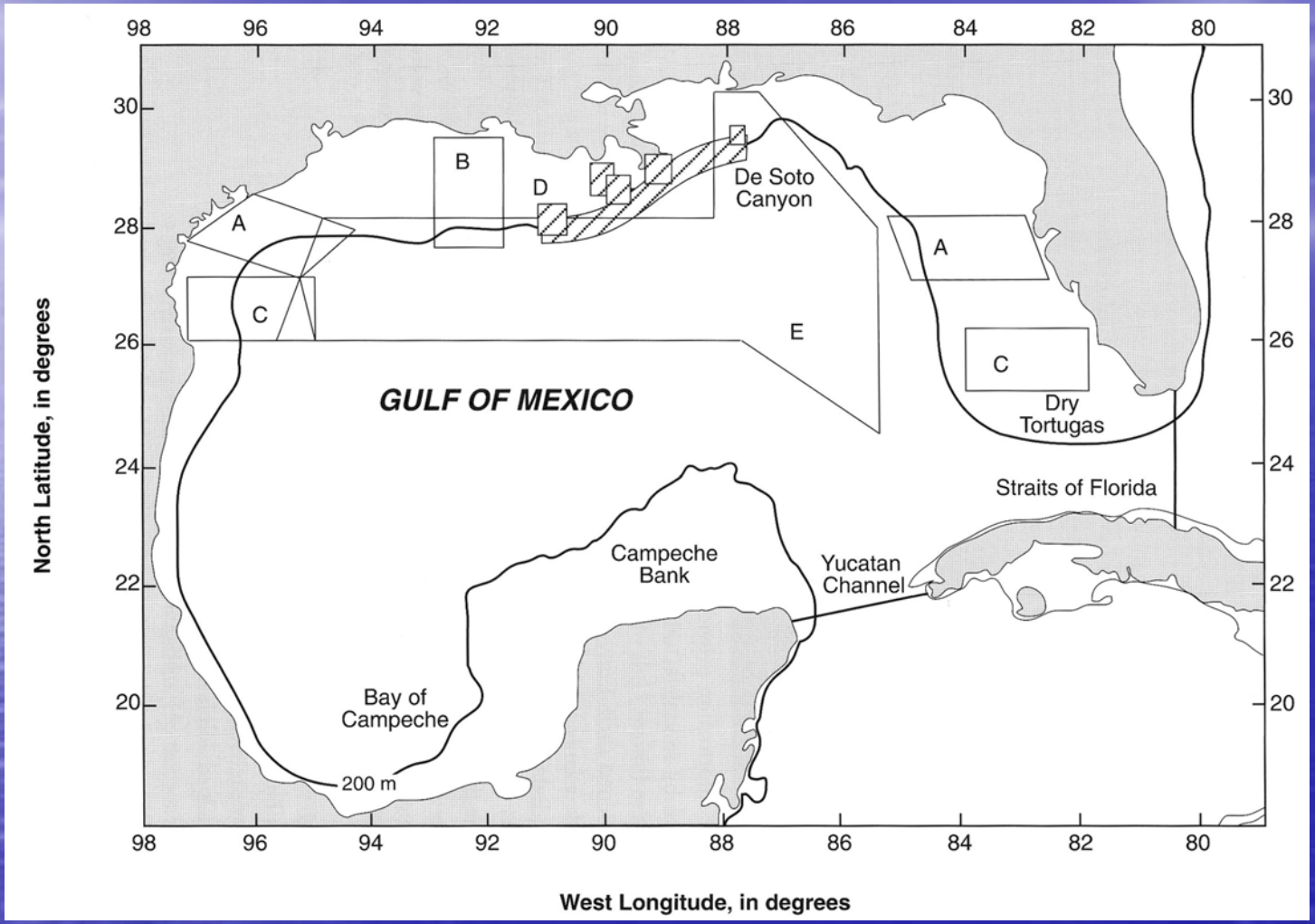
Progression of Studies

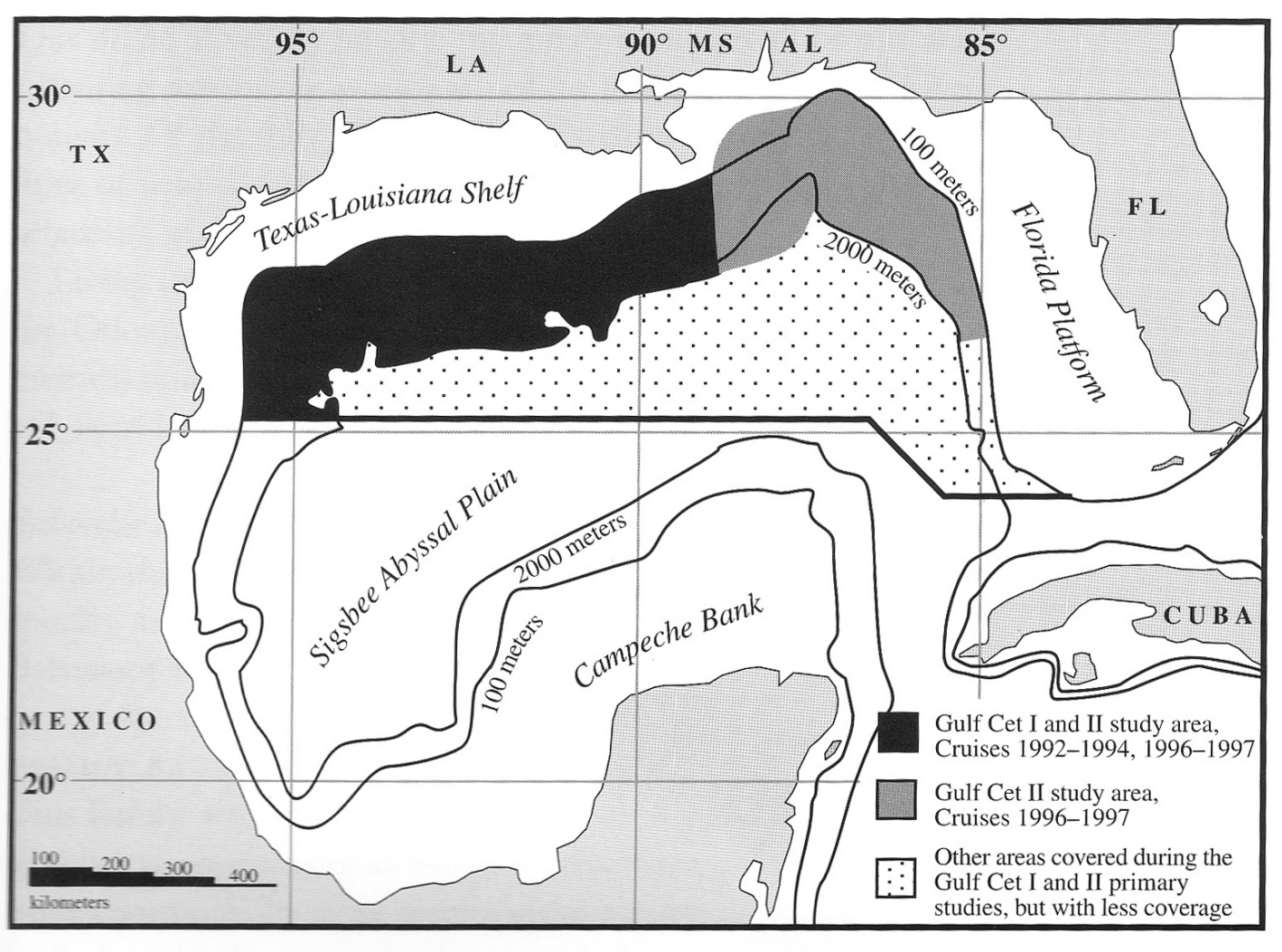
- Pre-Gulfcet, pre-1990s
- Gulfcet, 1990s
- Post-Gulfcet, largely SWSS, 2000s

Pre-Gulfcet



Locations of survey blocks from various studies. “A,” “B,” and “C” represent the Fritts surveys; “D” coastal surveys of 1989–1990 (hatched); and “E” NMFS surveys of 1990–1994. Würsig et al. 2000.

Gulfcet



GulfCet I and GulfCet II study areas, 1992–1997. There have been multiple other smaller studies in the northern as well as southern (Mexican) Gulf, not represented here. Würsig et al. 2000.

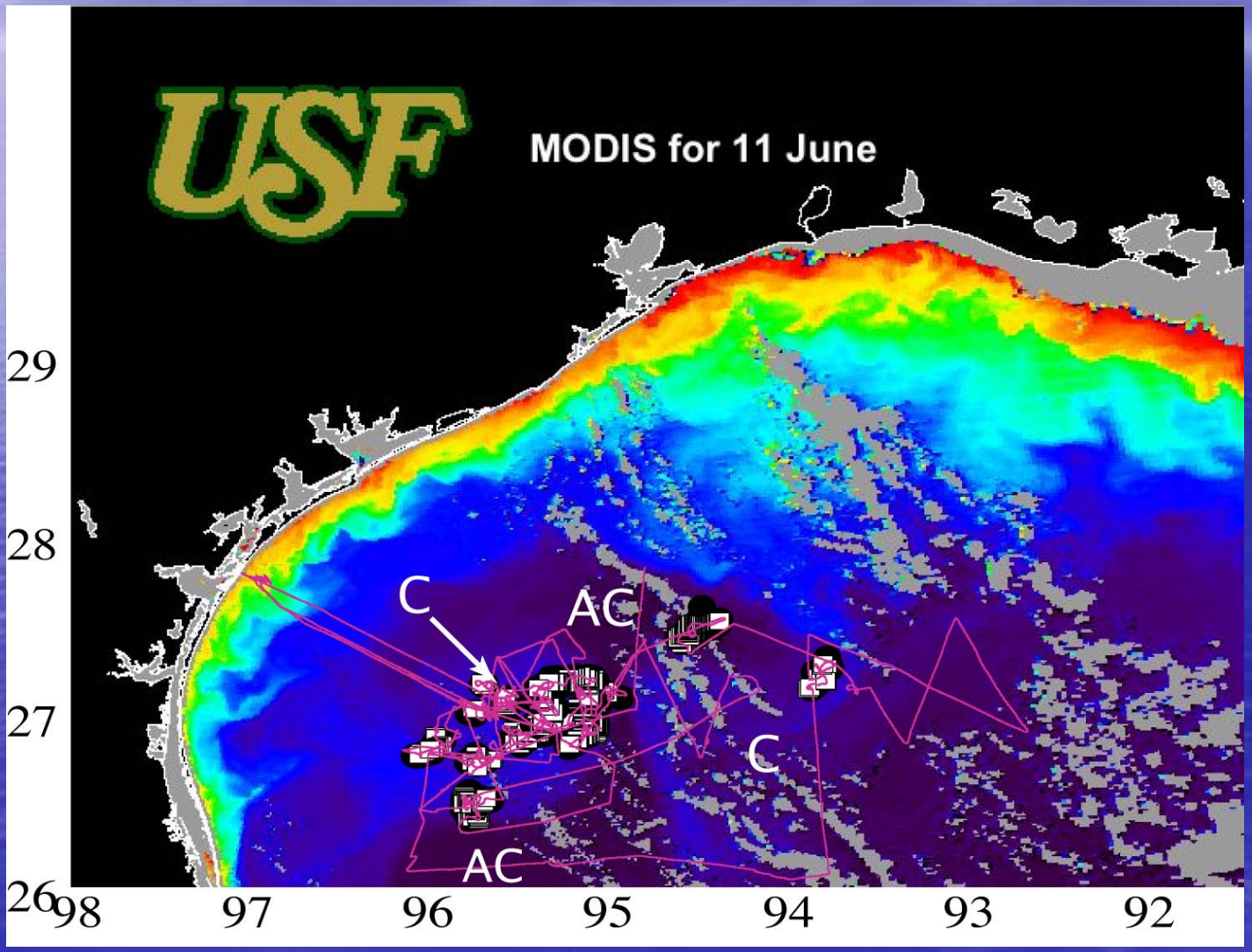
Post-Gulfcet: SWSS and Related Research

SWSS and Related Studies

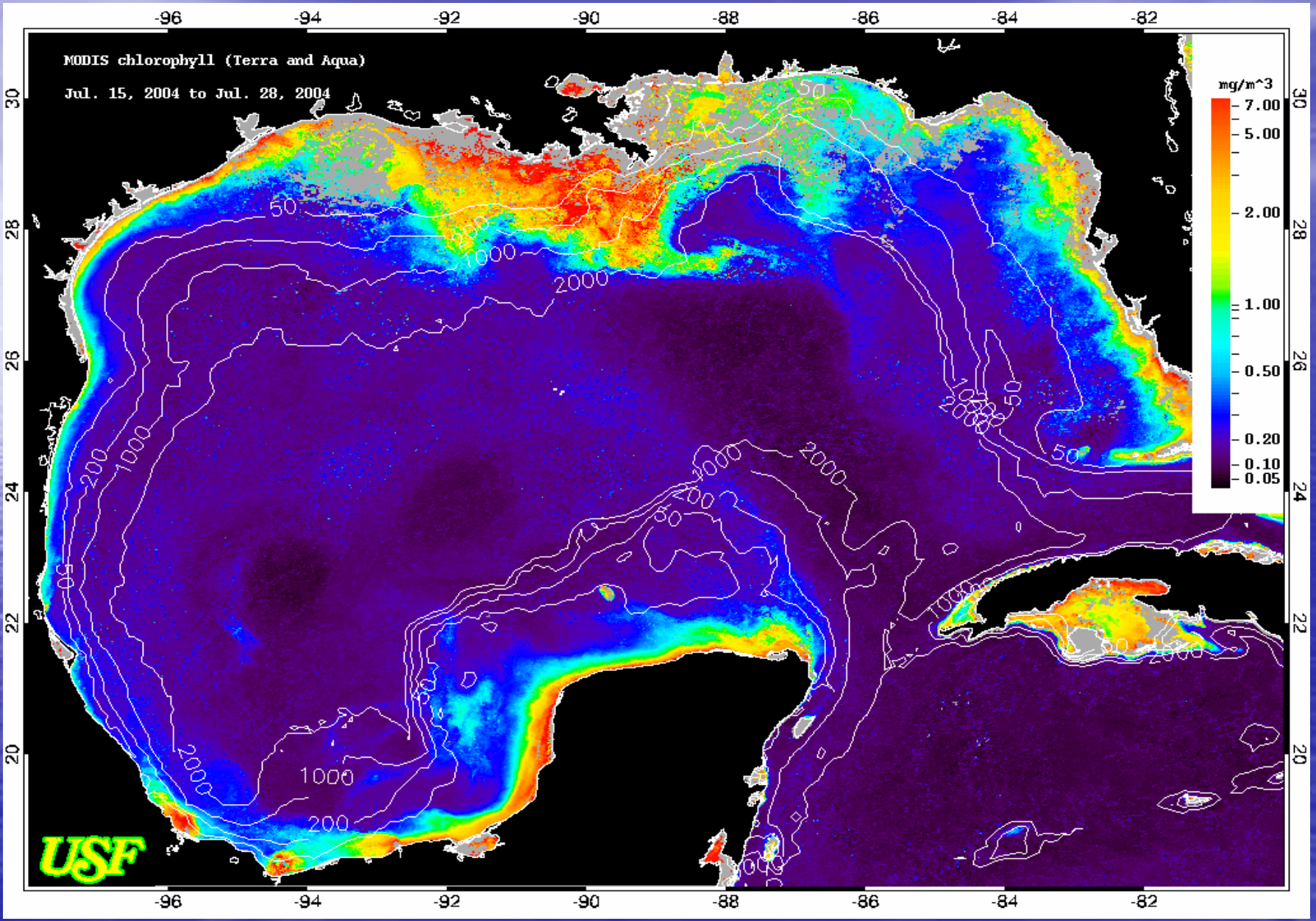
- Physical and biological components of the environment
- Relationship of primary productivity and other oceanographic patterns to sperm whale occurrence patterns
- Sperm whale numbers, behaviors, and social organization
- Sperm whale large-scale movements

- Sperm whales appear responsive to warm core/cold core eddy systems that change aspects of primary (and higher trophic level) productivity ...
- Sperm whales may be quite responsive to Mississippi River discharge patterns as well, with sperm whale occurrence patterns and abundance very much lower nearshore in 2005 than in 2004 ...

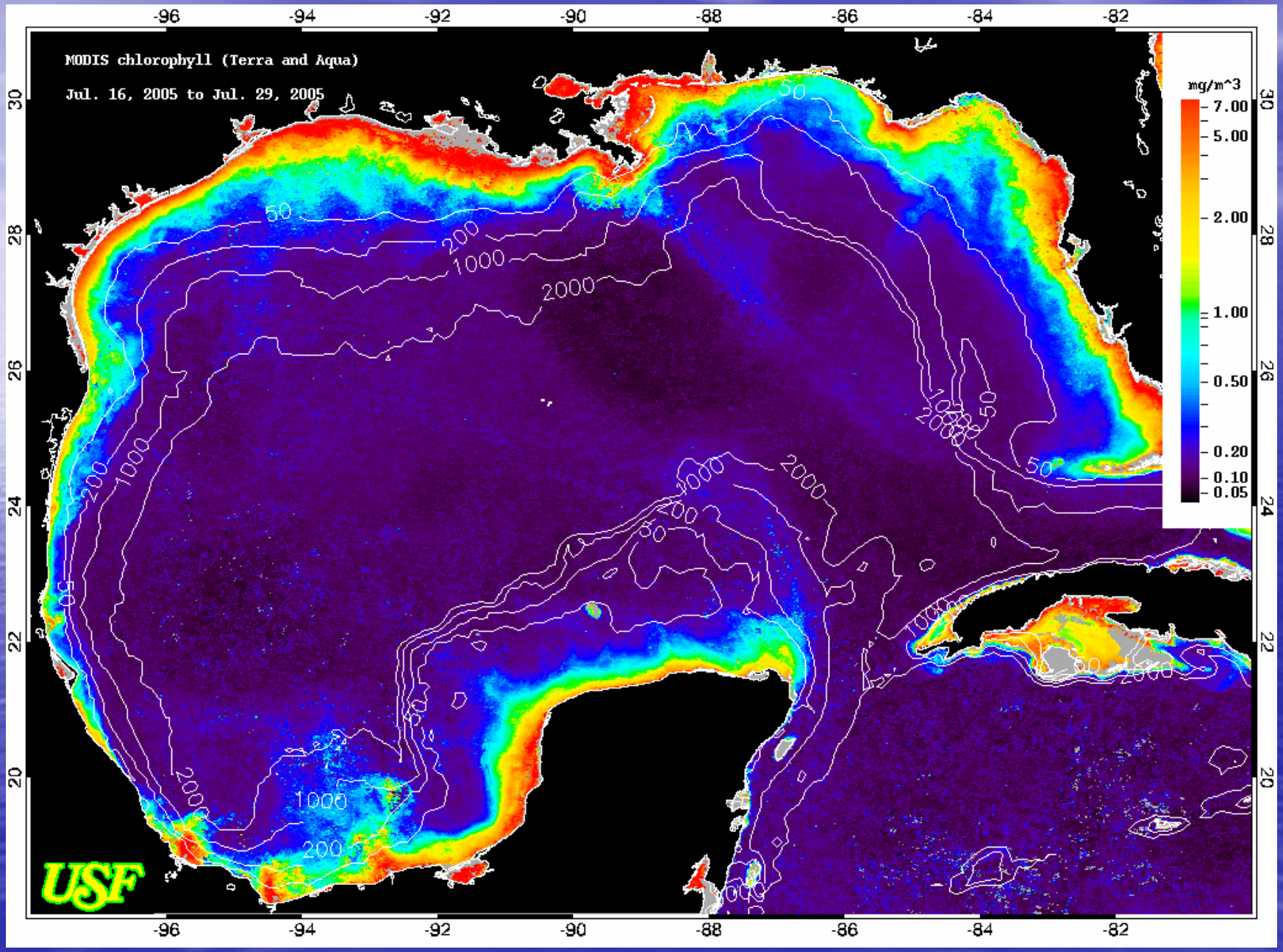
In 2005, sperm whales were encountered most frequently in a cyclone of an anticylonic-cyclonic eddy of increased higher chlorophyll.



Primary Productivity, July 2004

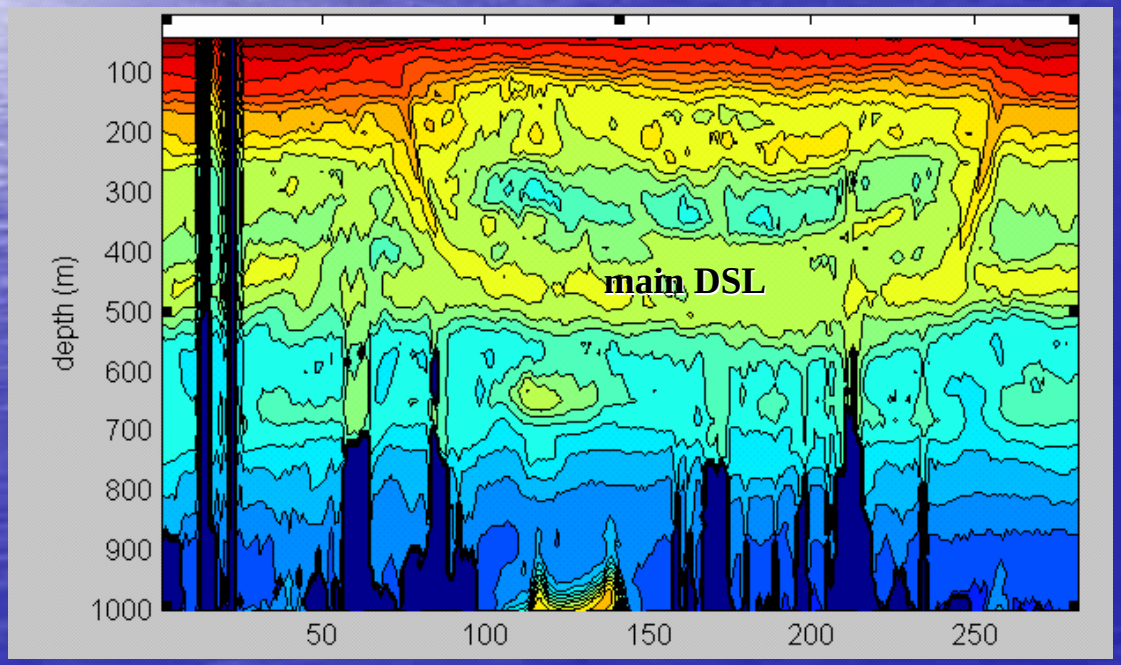


Primary Productivity, July 2005



Backscatter returns deeper than the main DSL:

- Hypothesize that these returns are presence/absence indicators of squid, or fish or crustacean prey of squid, living below daytime depth of main DSL.



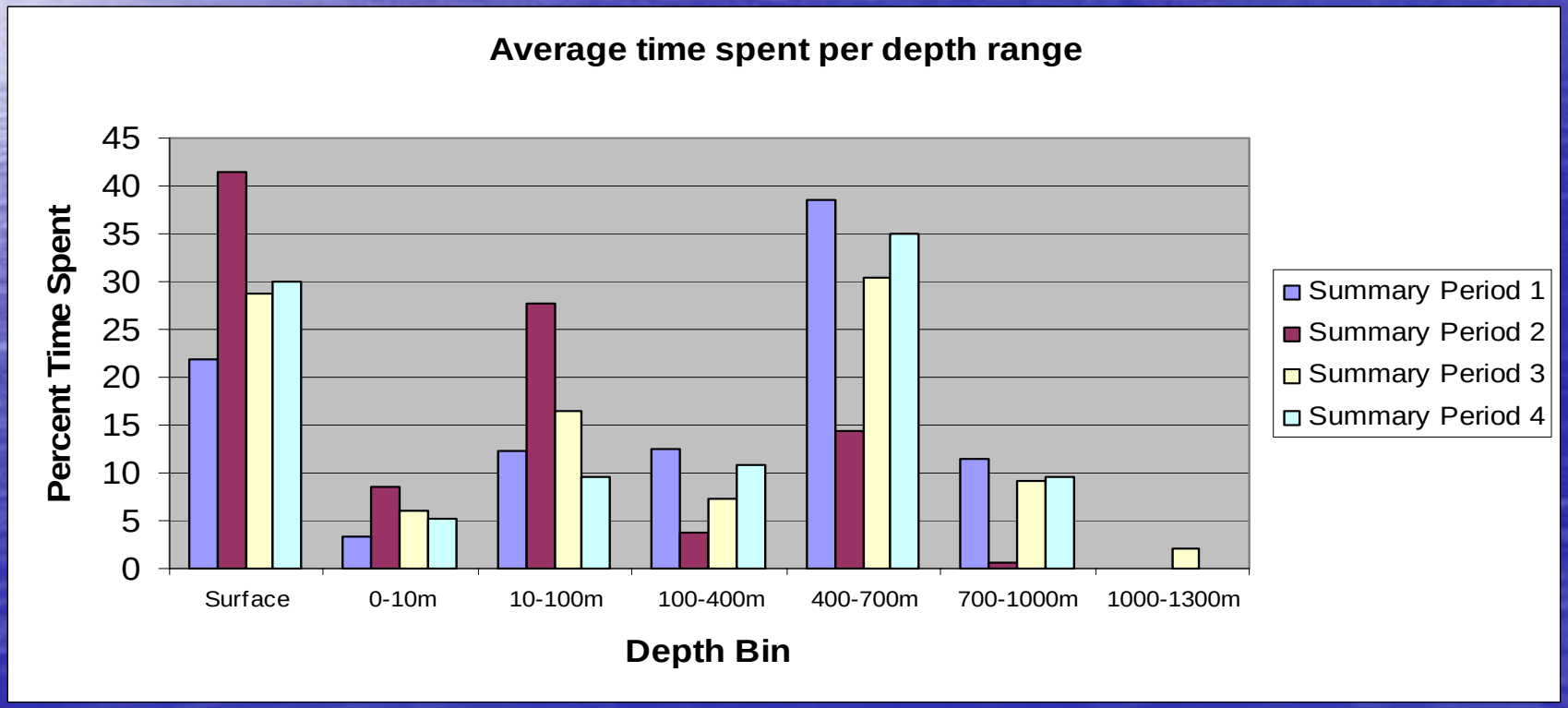
] deeper (patchy) returns

Whales do not change dives based on time of day, and dive above, through, and below the Deep Scattering Layer.

Diving and Underwater Behavior

- Pre-SWSS
  - Virtually nothing
- Post-SWSS
  - Detailed D-tag data has revolutionized understanding of underwater behavior
  - S-tag – proving long-term perspective
  - Photo-ID less detailed integrated data from many individuals

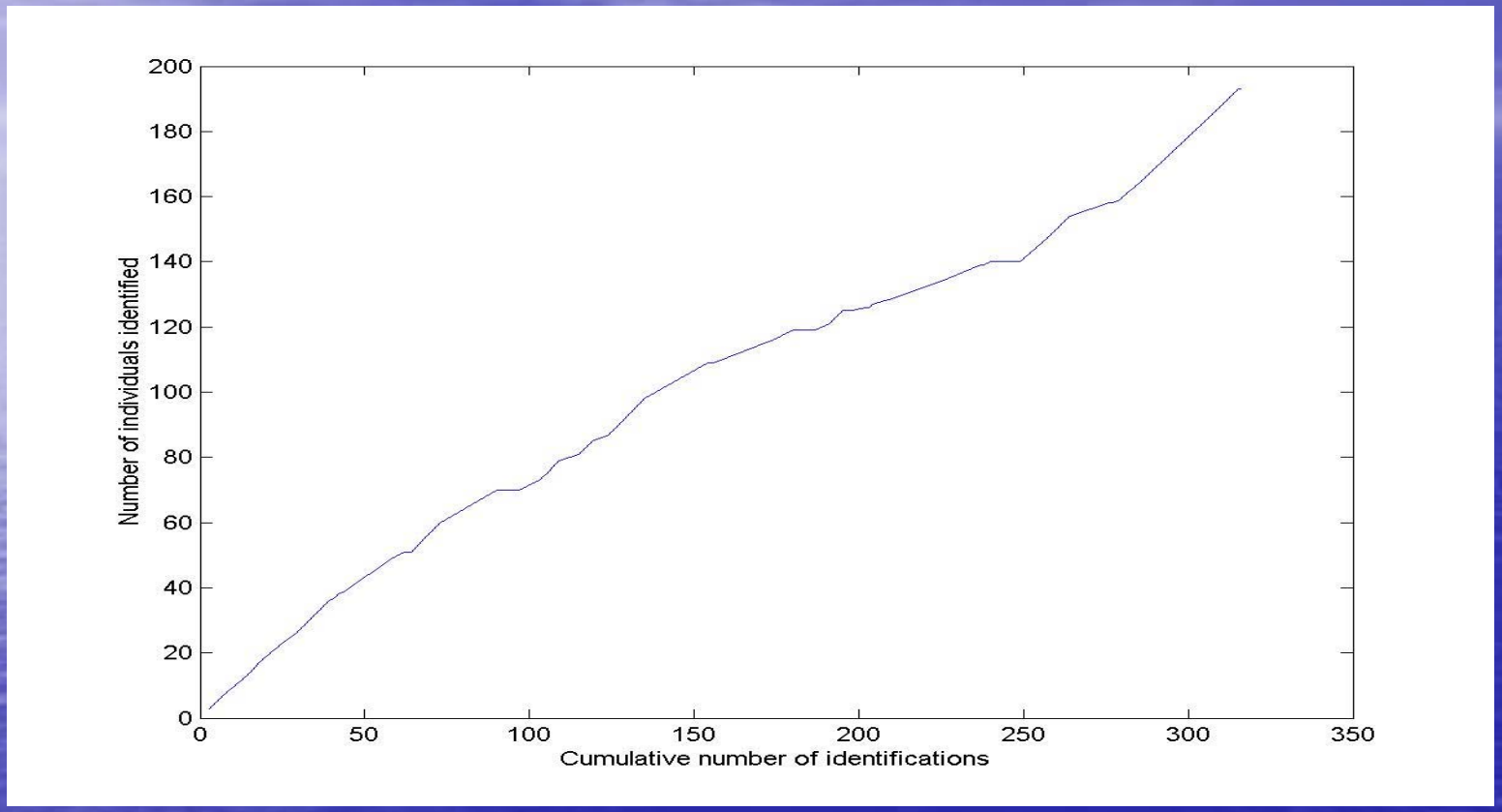
- Largest portion of time spent at the surface (mean = 30%)
- During dives, most time was spent between 400–700m (mean = 26%)
- Time in other bins down to 1000m approximately equal
- 9 records between 1000–1300m



Attributes of Individuals and Population Composition

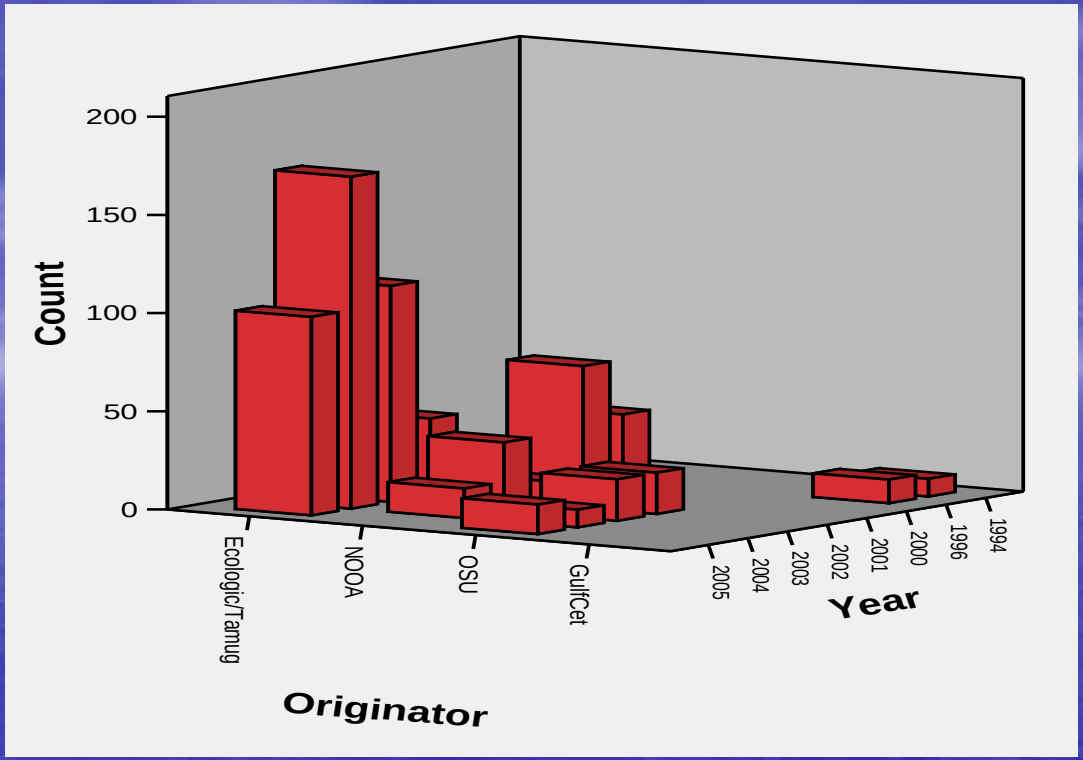
- Pre-SWSS
  - Assessments of body size by eye
- Post-SWSS
  - Many more known individuals
  - Measurements of body size for most
  - Genetic measures of sex and relatedness
  - Assessments of reproductive status of individuals (callus)
  - Development of histories

Discovery Curve for High-Quality Sperm Whale Sightings



The discovery curve displays a continuously increasing trend, indicating that we keep on identifying new individuals each season. This implies that the population is considerably larger than approximately 200 animals.

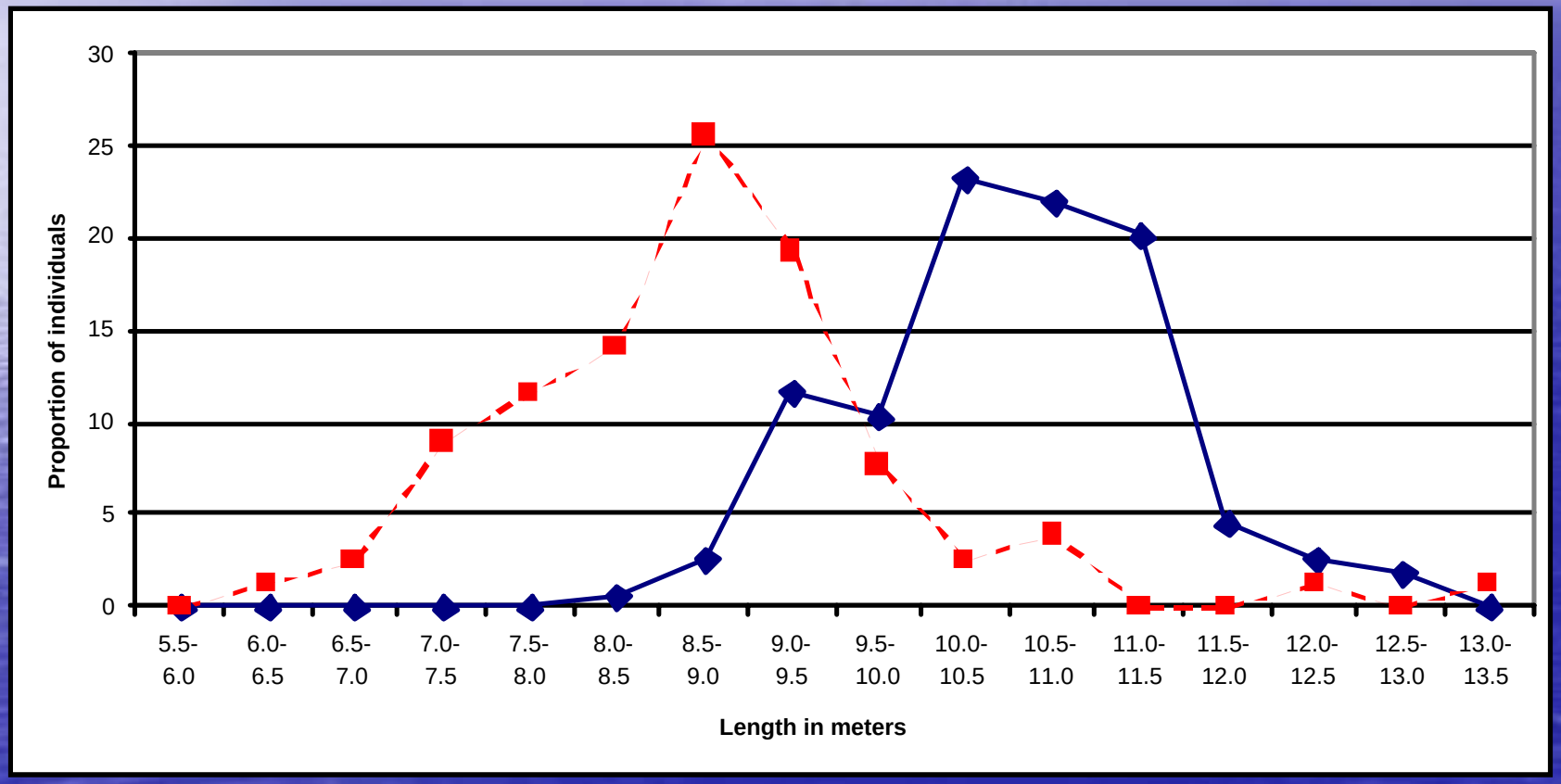
Number of photo-id sequences and (good quality sequences of well-marked animals) collected by different groups in the Northern Gulf of Mexico



	1994	1996		2000	2001	2002	2003	2004	2005
Gulf Cet	33 (9)	21 (12)							
NOAA				54 (39)	92 (67)	20 (12)	57 (35)	18 (15)	
SWSS OSU						29 (21)	30 (21)	19 (9)	23 (15)
SWSS Ecologic/ TAMUG						64 (39)	167 (110)	324 (169)	191 (101)

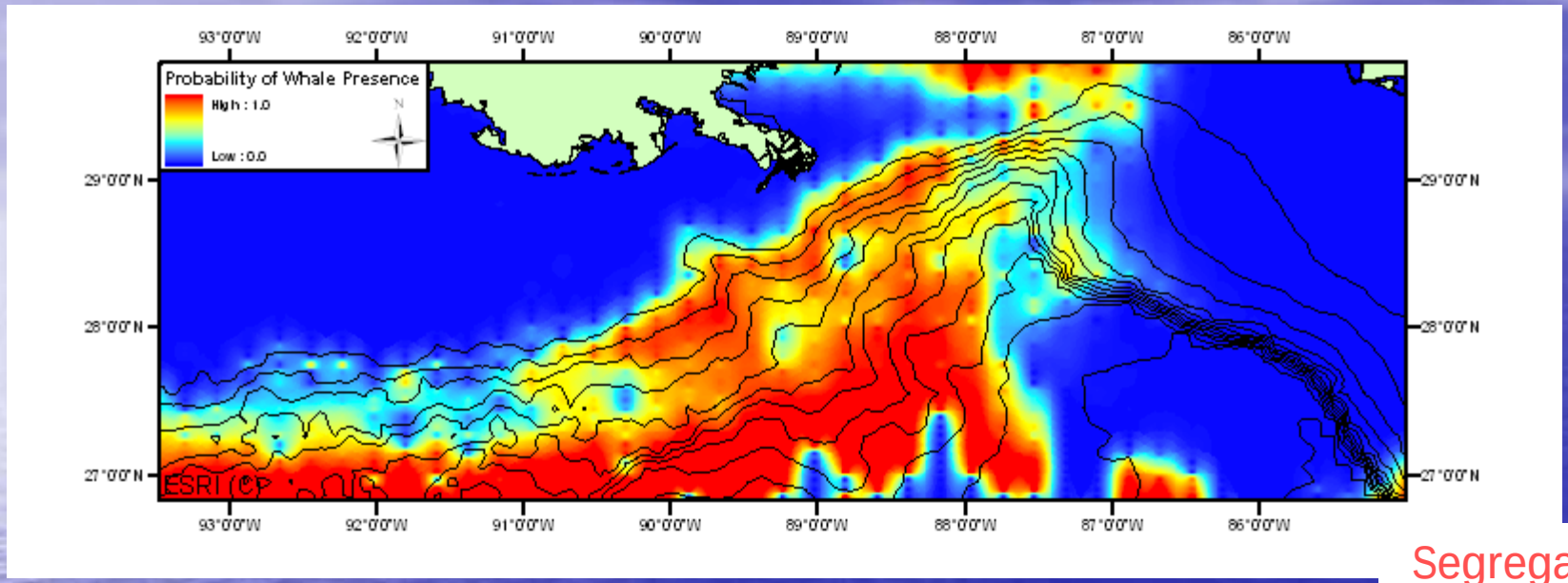
Gulf of Mexico sperm whales are smaller than those measured in similar populations elsewhere

- in fact, the smallest reported from any location
- should this be a cause for concern?

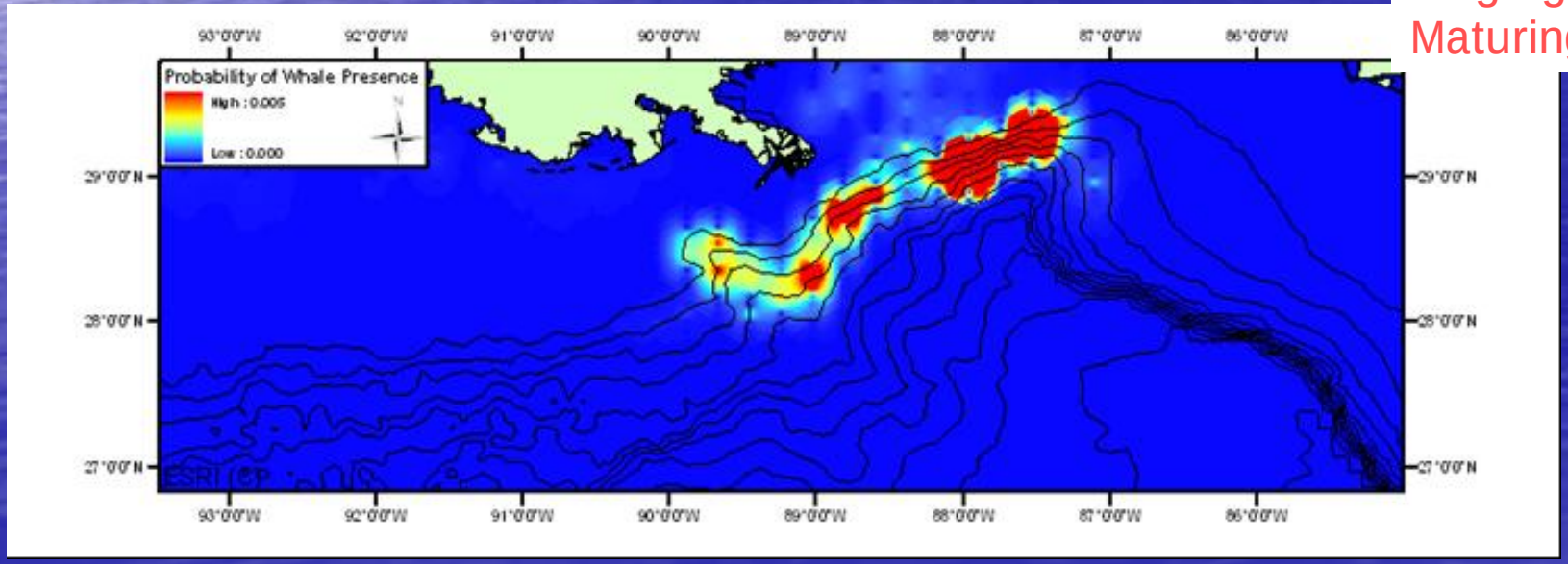


Length distribution for female/immature sperm whales measured in the Gulf of Mexico in red and for the Gulf of California in blue

Habitat Models Based on Mesoscale Tracking Data Predicting Distribution of Mixed Groups and Male Groups



Segregation of Maturing Males



Population Size

- Pre-SWSS
  - Vessel and aerial surveys giving population assessments for large management areas
- Post-SWSS
  - More detailed and structured assessments for different components of the population
  - More relevant to offshore industrial activities

Maximum Likelihood Mark Recapture Population Analysis

- Extended Population 281 (95% ci 202–434)
- Core Population 140 (103–200)
- Trend ~.35, Mortality ~.2
- Estimated number of mature females in core ~88, expected annual calf production 15–20

- Repeated identifications of some whales since 1994 indicative of long term “residence”
- There are indications of preferred locations for individuals between years within the core range
- Dynamic social organization. Some “long term companions” but also “casual acquaintances”
- Analysis of codas indicate a single “clan” within the core range, distinct from Caribbean and N. Atlantic
- Possibly a different “clan” at the western end of the Gulf

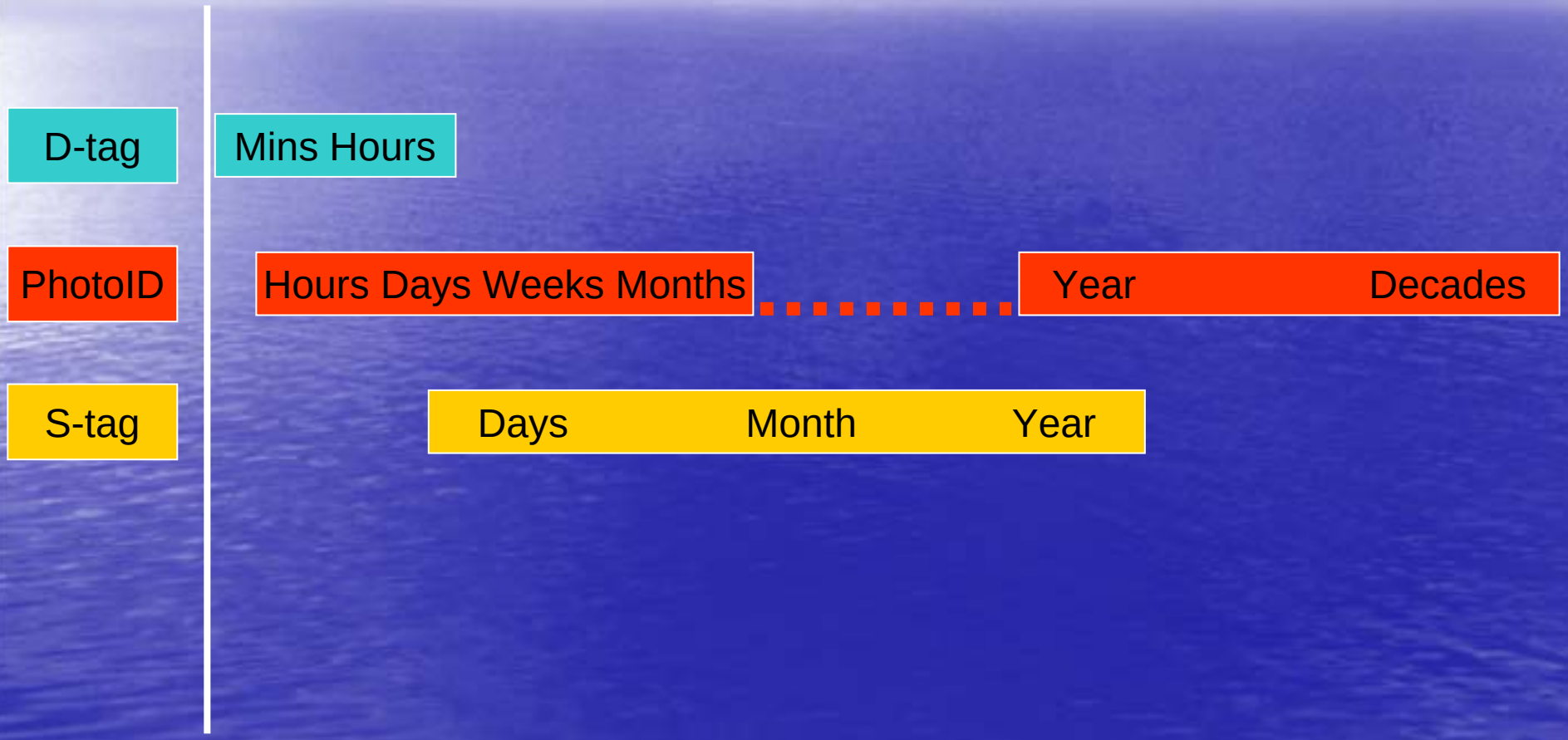
Reproductive Rate

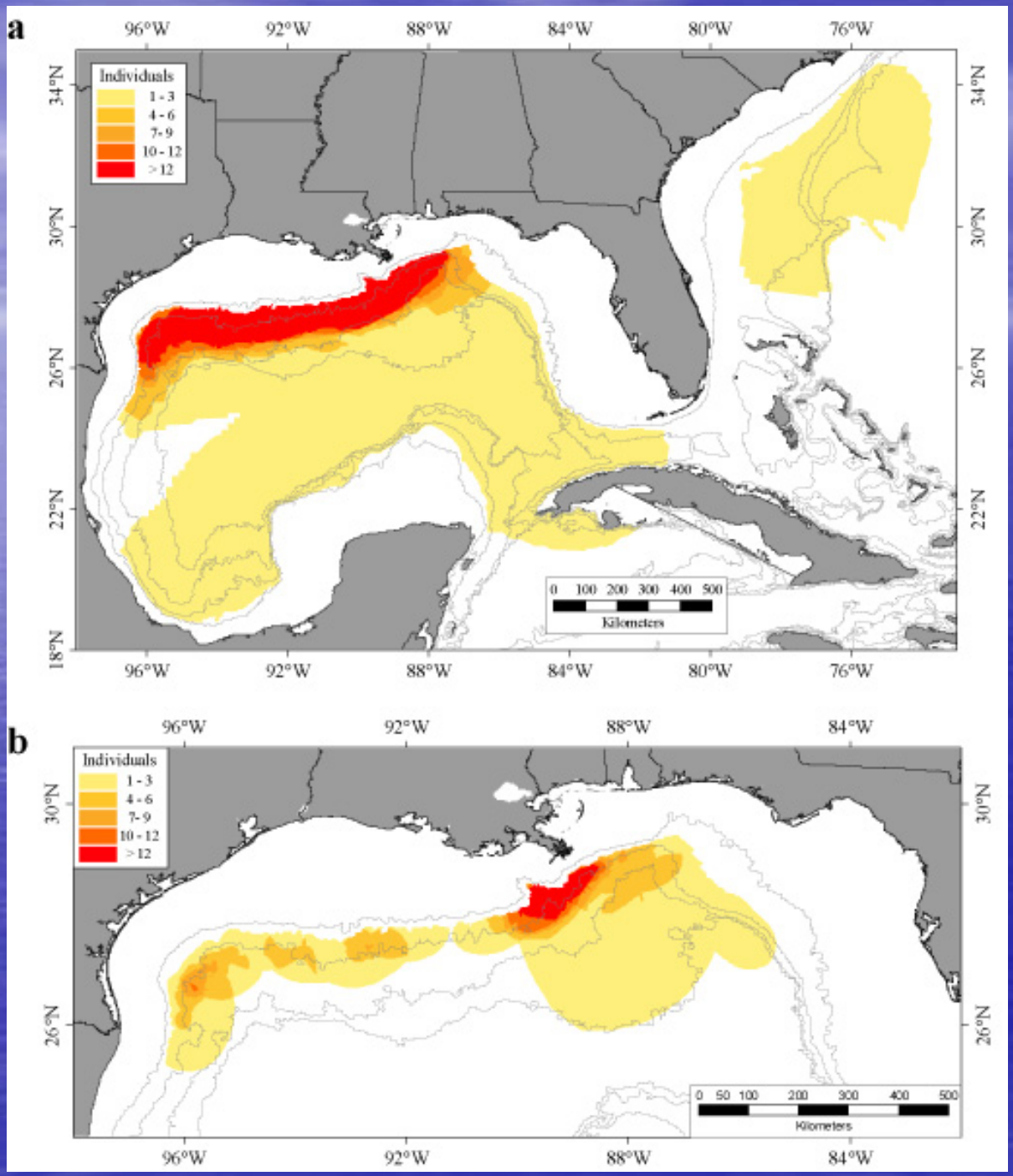
- Pre-SWSS
  - Virtually Nothing
- Post-SWSS
  - Calves account for about 11% of the mixed groups encountered.
  - Close to predictions for unexploited populations based on the IWC sperm whale model
  - Calving rates vary between years

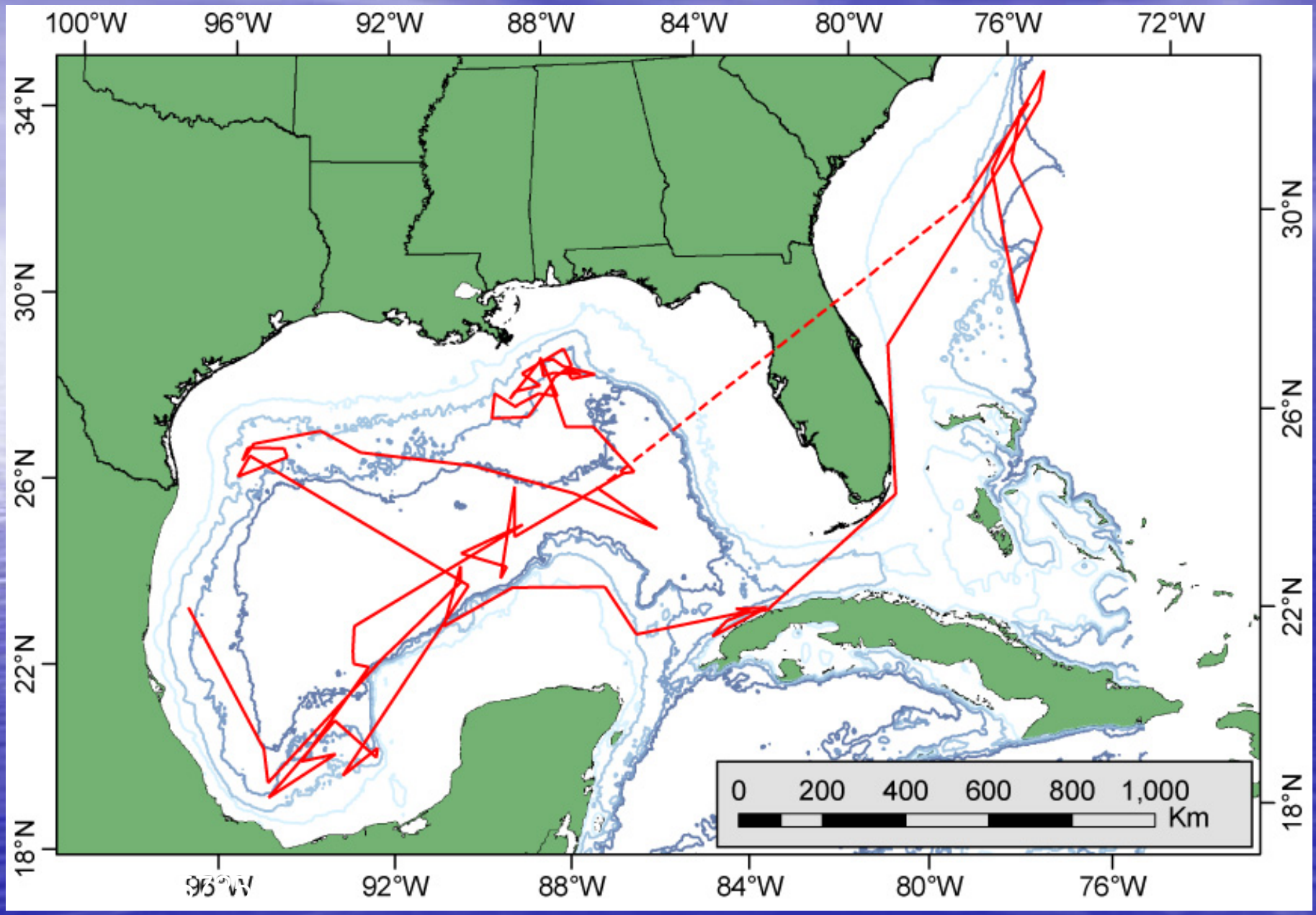
Movements

- Pre-SWSS
  - Virtually nothing, a handful of photo-id suggest residency
- Post-SWSS
  - Substantial and coherent information from S-tag and Photo-id
  - The best understood sperm whale population in the world from this perspective

SWSS Movement Data – Temporal Scales




a
96°W
92°W
88°W
84°W
80°W
76°W
34°N
30°N
26°N
22°N
18°N
Individuals
1 - 3
4 - 6
7 - 9
10 - 12
> 12
0 100 200 300 400 500
Kilometers
b
96°W
92°W
88°W
84°W
30°N
26°N
Individuals
1 - 3
4 - 6
7 - 9
10 - 12
> 12
0 50 100 200 300 400 500
Kilometers


100°W
96°W
92°W
88°W
84°W
80°W
76°W
72°W
34°N
30°N
26°N
22°N
18°N
0 200 400 600 800 1,000
Km

Movement Summary:

- No discernable seasonal migrations
- Basin-wide movements along the slope
- Site-specific tenacity by individuals
- Larger home ranges and use of deeper water habitats by males than by females
- Slope-oriented animals may be a separate stock from offshore animals

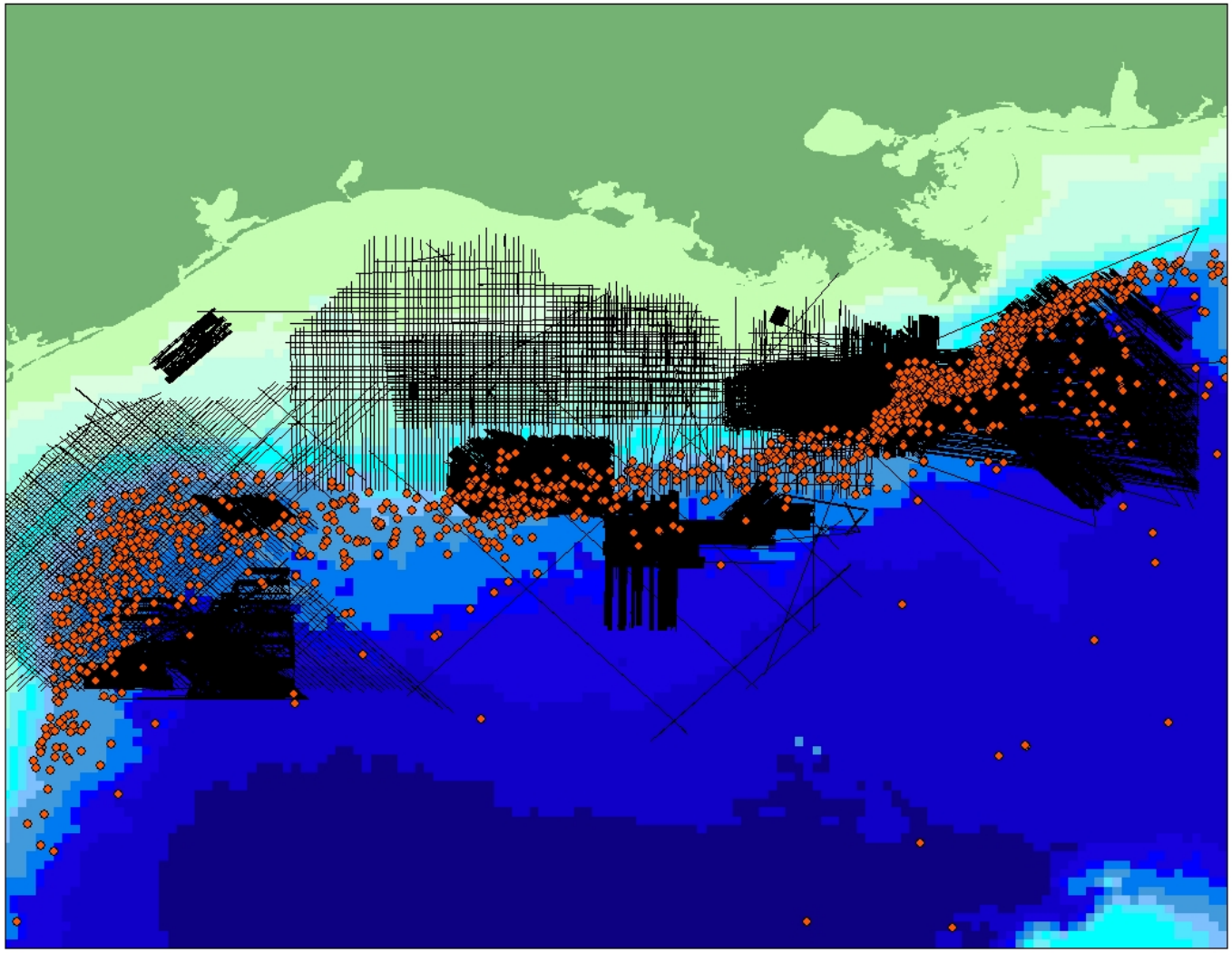
Social Organization

- Pre-SWSS
  - Virtually Nothing
- Post-SWSS
  - Detailed and coherent picture emerging from both Photo-ID and from S-tag telemetry
  - Integration with genetic data on relatedness, coda data on “cultural” relationships

Responses to Seismic

- Pre-SWSS
  - Anecdotal observations
- Post-SWSS
  - Detailed CEE studies using D-tags
  - Non-experimental observations from visual observers and from S-tags

Industrial Seismic Lines and Co-Occurrence of Tagged Whale Locations



Some Important Things (for Management) We Still Don't Know

- Breeding season and system
- Calf production and mortality
- Can the possibility that the small size of Gulf whales is correlated with anthropogenic activity be discounted?
- How do the "core" shelf edge whales interact with the "offshore" population and those in other parts of the Gulf?
- Understanding seasonal and inter-annual changes
- Anthropogenic impacts, including from oil exploration phase
- What happened after the "anomalous" year of 2005?
- How much of what we learned before then still holds?

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Science Review Board Members

Thank you all!

Reference

Würsig, B., T.A. Jefferson, and D. J. Schmidly. 2000. The marine mammals of the Gulf of Mexico. College Station, TX: Texas A&M University Press. 256 pp.