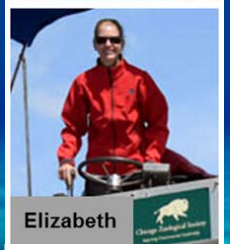
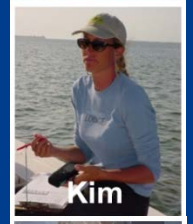
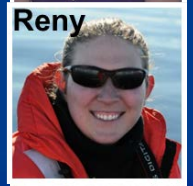
LONGITUDINAL BOTTLENOSE DOLPHIN HEALTH ASSESSMENT AND POPULATION MONITORING IN SARASOTA BAY, FLORIDA





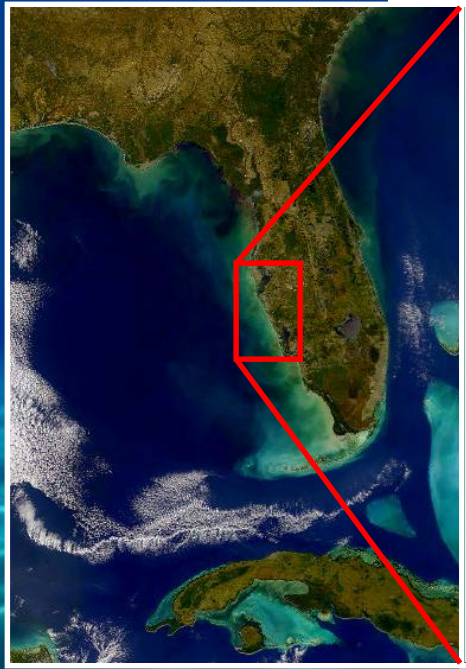


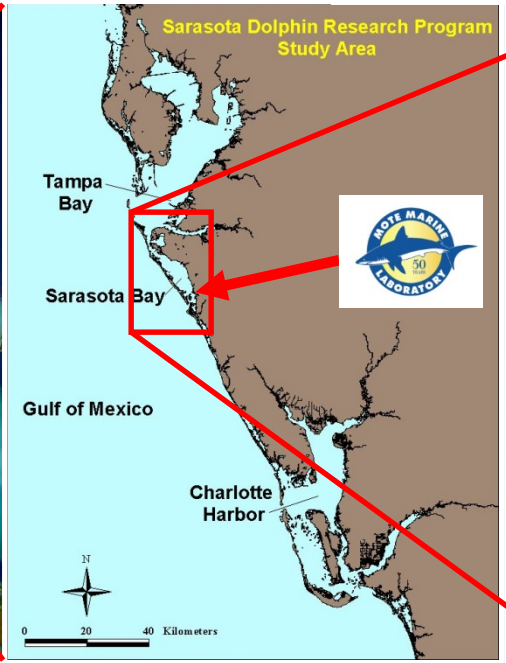
Randall Wells, and the staff, students, and collaborators of the Chicago Zoological Society's Sarasota Dolphin Research Program

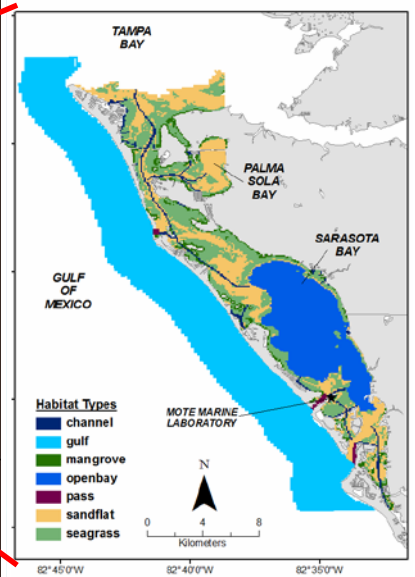
Chicago Zoological Society
Inspiring Conservation Leadership

Bottlenose dolphin research initiated in 1970 has become the "world's longest-running study of a wild dolphin population"

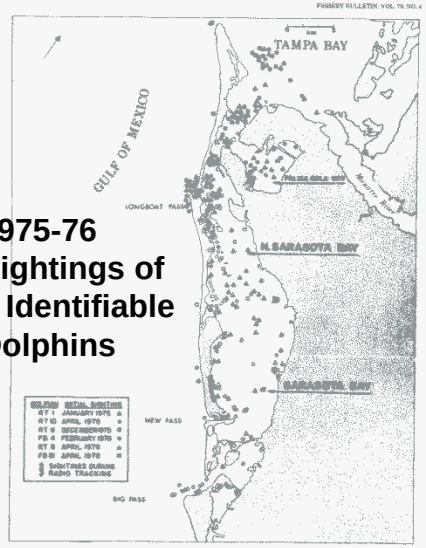
- Tagging and tracking initiated through Mote Marine Laboratory in 1970-72.
- Continued through the University of Florida during 1974-78.
- Research during 1978-1989 continued through UCSC, DBRI.
- Since 1989, research partnership led by Chicago Zoological Society.
- Since 1992, based at Mote Marine Laboratory







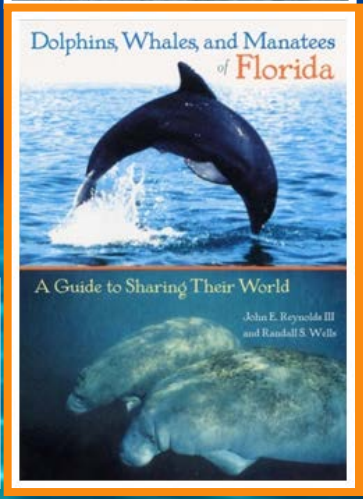
1975-76 Sightings of 6 Identifiable Dolphins



Sarasota Dolphin Research Program:

Primary Activities

1. Photographic identification surveys
2. Capture-release, including health assessments
3. Biopsy dart sampling
4. Focal animal behavioral observations, acoustics
5. Telemetry development and application
6. Rescues and interventions
7. Post-intervention follow-up monitoring
8. Fish surveys
9. Training
10. Outreach and education
11. Conservation service



Sarasota Dolphin Research Program:

Primary Activities: Dolphin Population Monitoring

1. **Photographic identification surveys:**
   Abundance, survival, reproductive success, ranging patterns, habitat use, body condition, social patterns
2. **Capture-release, including health assessments:**
   Health status, reproductive status, environmental contaminant status/trends, life history, genetics, marking for ongoing studies, ancillary projects
3. Biopsy dart sampling
4. Focal animal behavioral observations, acoustics
5. Telemetry development and application
6. Rescues and interventions
7. Post-intervention follow-up monitoring
8. Fish surveys
9. Training
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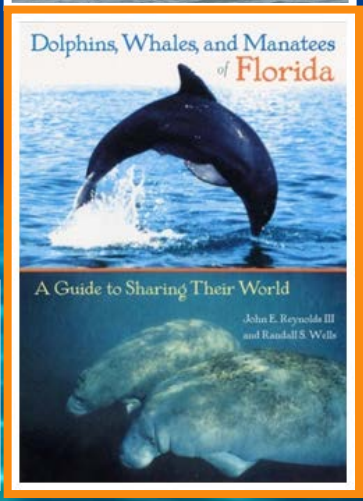
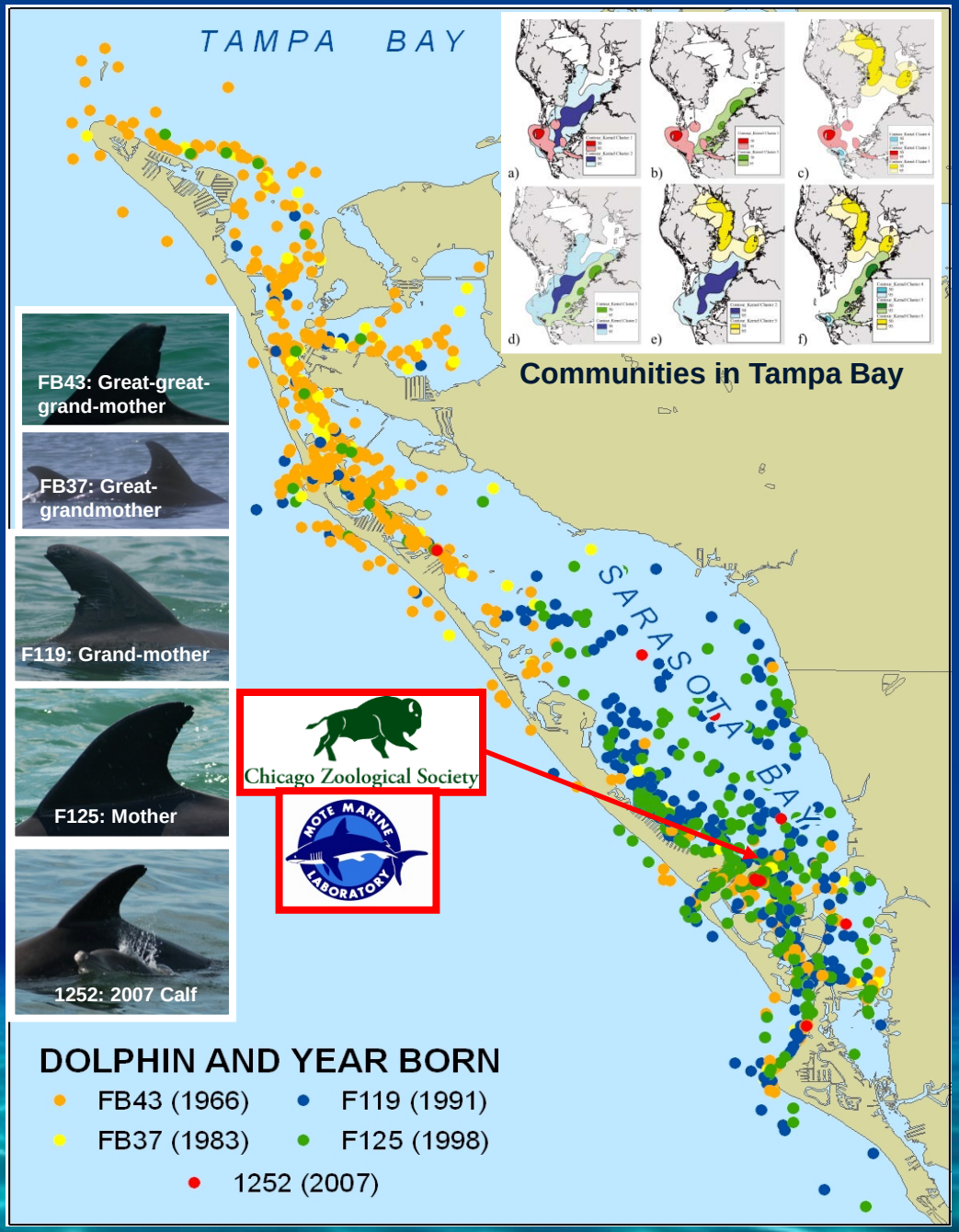


Multi-generational, multi-decadal, year-round residency patterns

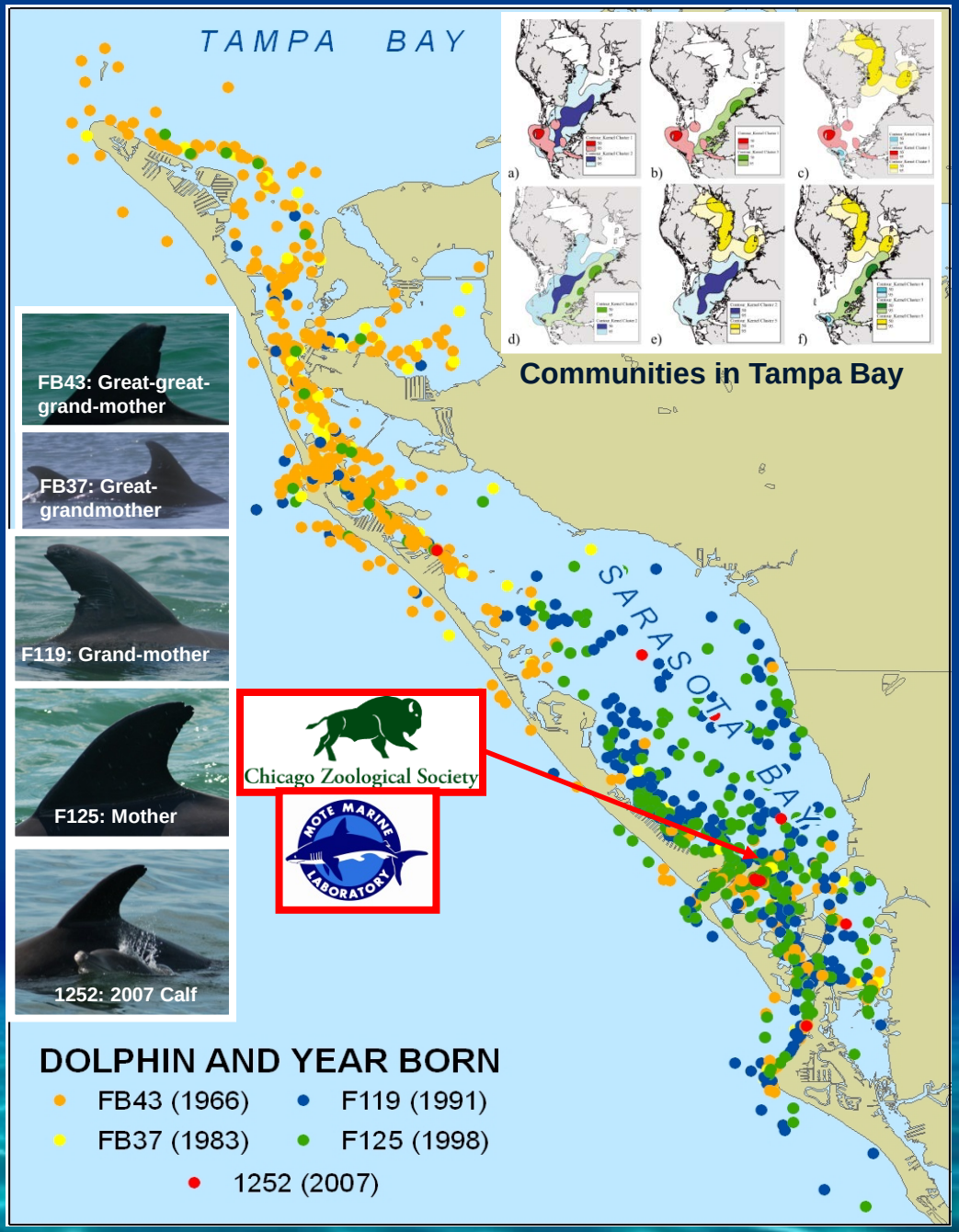
Establish Sarasota Bay as a natural laboratory



Multi-generational, multi-decadal, year-round residency patterns

Establish Sarasota Bay as a natural laboratory

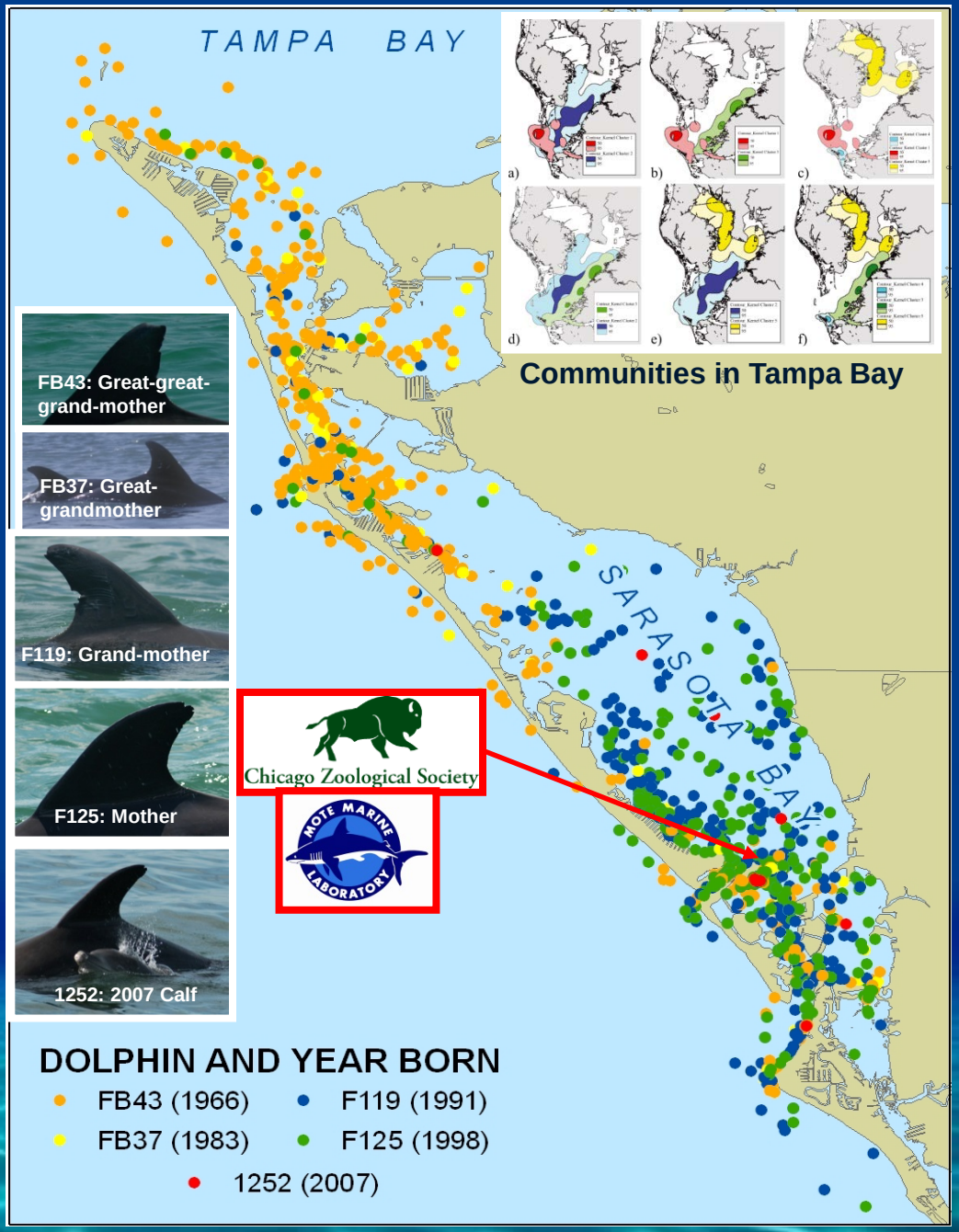
1. Mosaic of resident communities up and down the coast.



Multi-generational, multi-decadal, year-round residency patterns

Establish Sarasota Bay as a natural laboratory

1. Mosaic of resident communities up and down the coast.
2. Current community of ~160 resident dolphins spans up to five concurrent generations.



Multi-generational, multi-decadal, year-round residency patterns

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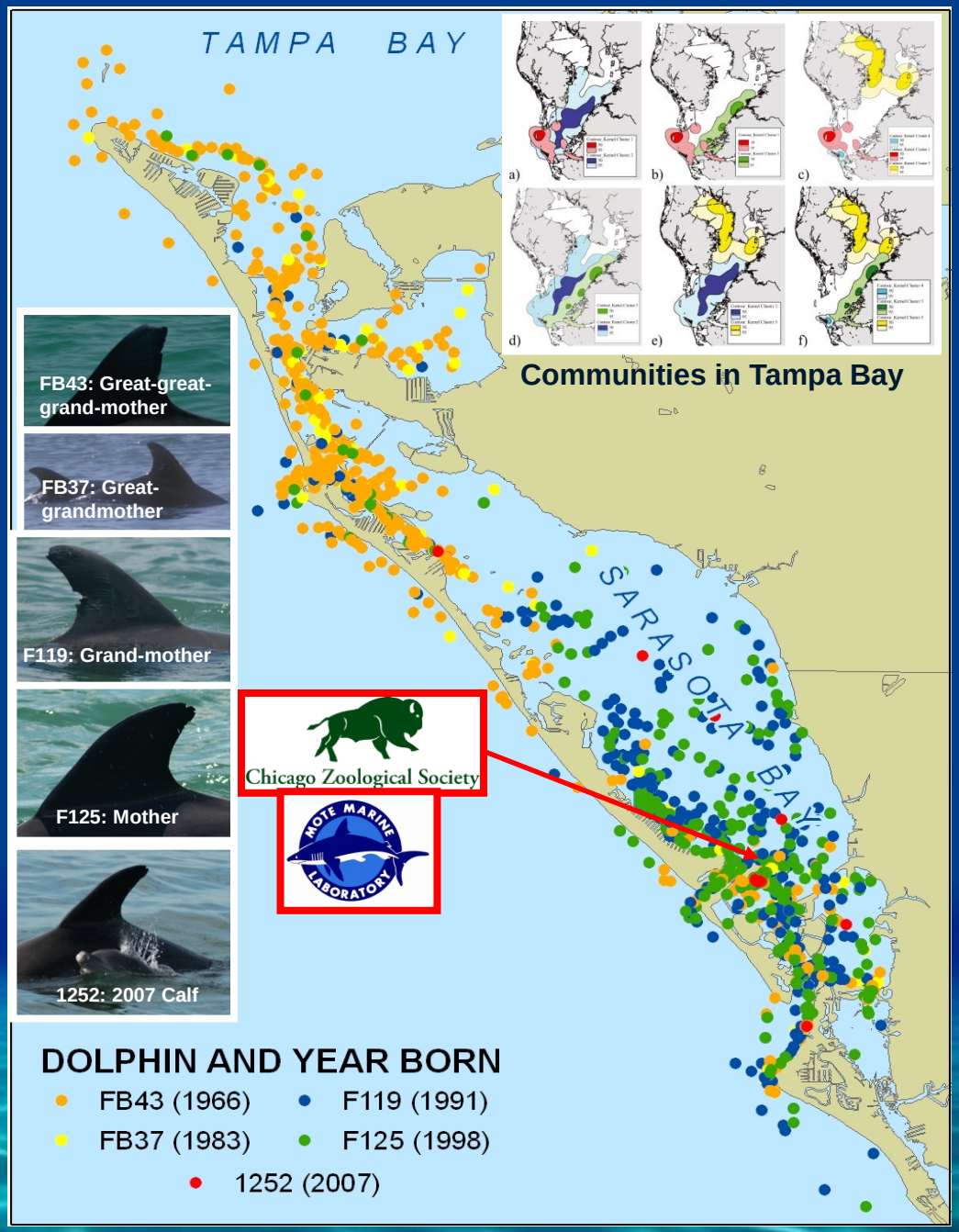
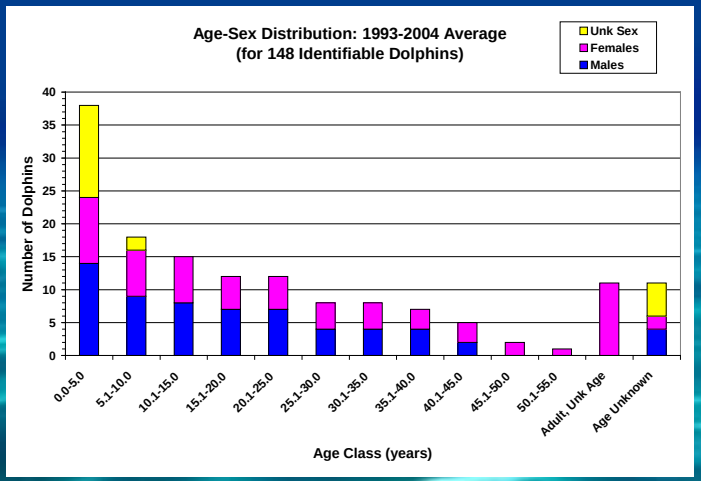
3. 96% of dolphins >15 yrs old have been seen for 15-40+ yrs.



Multi-generational, multi-decadal, year-round residency patterns

Establish Sarasota Bay as a natural laboratory

1. Mosaic of resident communities up and down the coast.
2. Current community of ~160 resident dolphins spans up to five concurrent generations.
3. 96% of dolphins >15 yrs old have been seen for 15-40+ yrs.
4. Males can live to 52 yrs.
5. Females can live to >67 yrs!



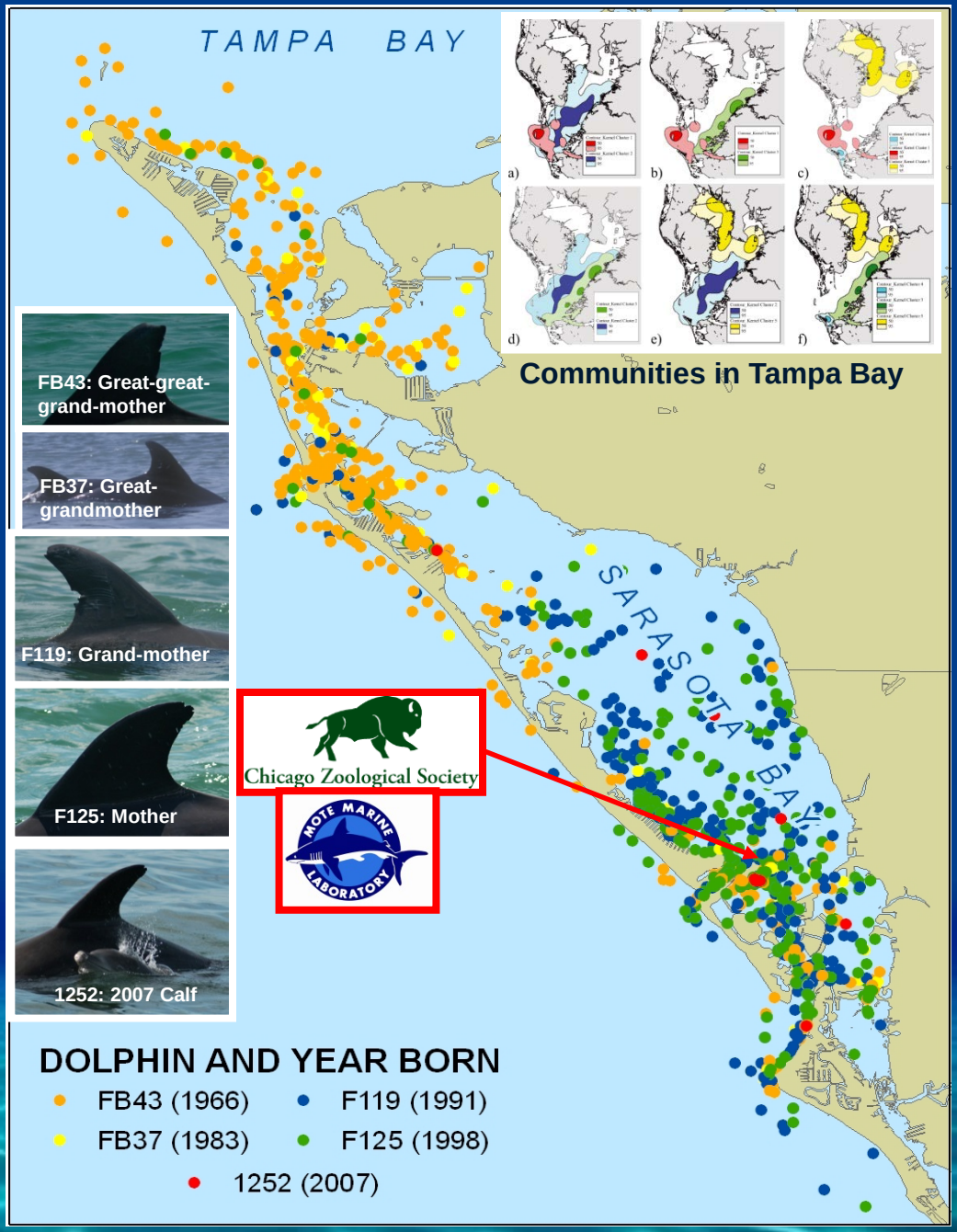


Photo-Identification: Primary Tool Since 1977

Nicks and notches serve as “fingerprints”

- Since 1970, 8,495 survey trips have been completed, resulting in:
  - 49,882 sightings of dolphin groups
  - 742,532 archived photos
- Since 1992, surveys are conducted on 10 boat-days each month, through the entire study area/community home range.

Photo-Identification

Monthly surveys support many other research projects

<u>Sighting Database</u>:

- **150,207 individual identifications**
- **5,394 distinctive catalogued individuals**
- **96% of dolphins in Sarasota Bay are identifiable**
- **>1,500 sightings of an individual**
- **>45 years of sighting records for some**

Capture-Release Complements Photo-ID, Adds Population Monitoring Opportunities

Sarasota Bay Capture-Release History

- 1970-71: Tag development, ranging patterns
- 1975-76: Tag development, radio-tag testing, ranging and social patterns, whistle studies
- 1984: Long-term individual identification, life history emphasis (age, sex, morphometrics, reproductive condition, genetics)
- 1986: Body condition measures (weight, blubber depth)
- 1988: Health assessments initiated
- 1992: Environmental contaminant tissue sampling begins




DOLPHIN QUEST

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE

Disney WORLDWIDE CONSERVATION FUND

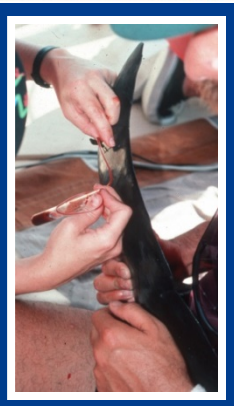
GEORGIA AQUARIUM at Pemberton Place

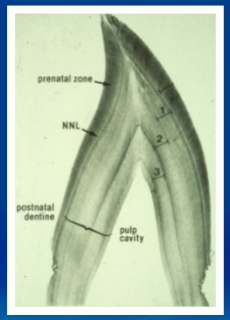
Office of Naval Research ONR Science & Technology

Capture-Release Health Assessment:

Driven by research questions/conservation needs

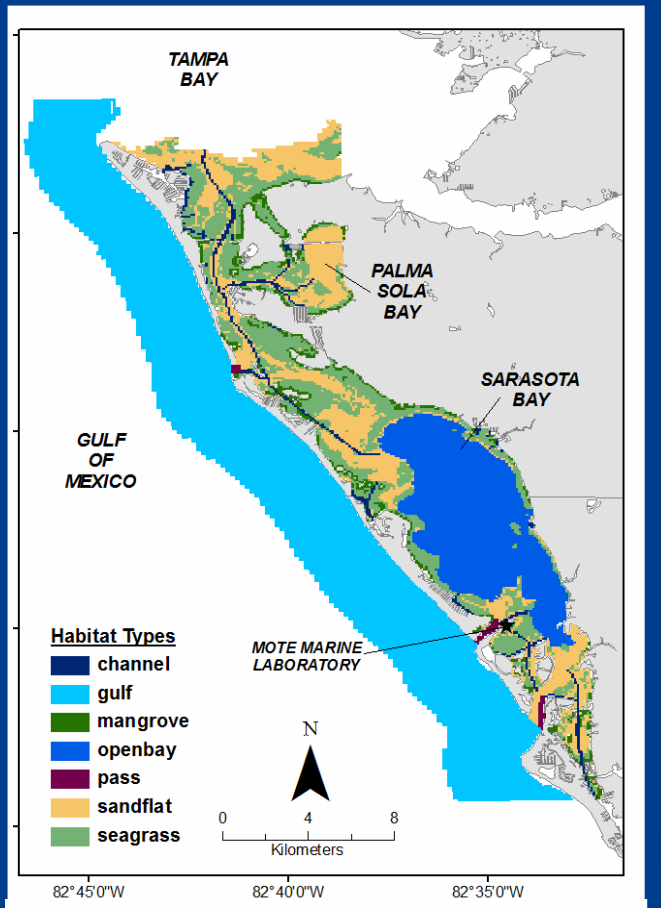
- Physical exam, ultrasound exam
- Reproductive assessment (ultrasound)
- Body condition (weight, morphometrics, blubber depth, % lipid)
- CBC/blood chemistry/blood gases
- Serology, endocrinology (blood)
- Functional immunology (blood)
- Urinalysis
- Biotoxin measures (urine, feces, blood, gastric)
- Contaminant measures (blubber, blood, skin, milk)
- Blowhole plates/swabs (cytology, pathogen analysis)
- Age determination (tooth)
- Archive samples (retrospective, prospective research)
- Marking: freezebrands (“medical ID bracelet”), roto tags

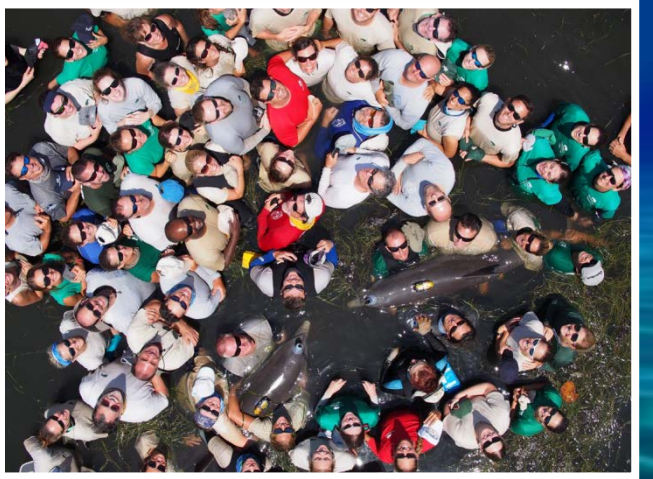




Factors facilitating capture-release health assessments in Sarasota Bay

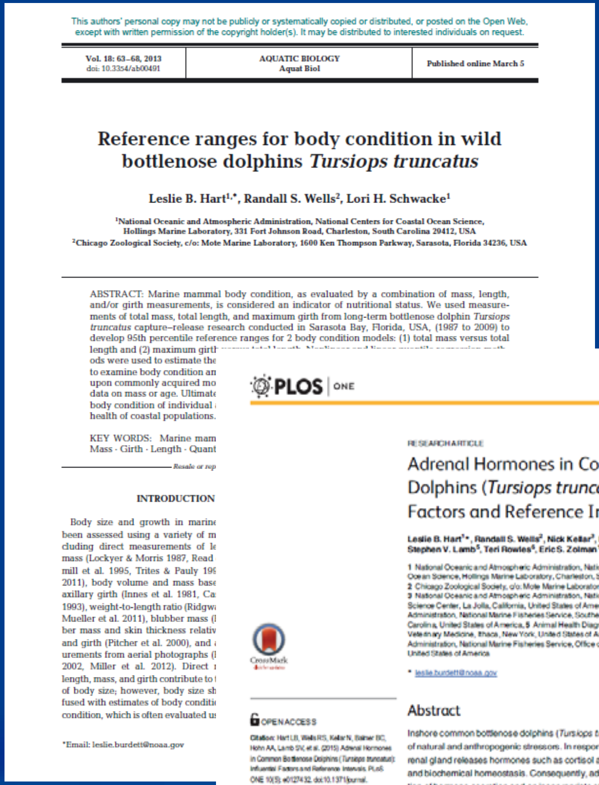
- Sheltered, shallow (<2m) waters frequented by long-term resident dolphins.
- Numerous suitable capture sites.
- Minimal tides and currents.
- Hard sand or seagrass bottom; few obstacles.
- Local commercial fisherman with 34 years of dolphin-catching experience in Sarasota.
- Highly experienced handling team, some with 48 years of experience.
- Experienced dolphins (caught as many as 17 times over 34 years).
- Based in middle of study area.





Long-term health monitoring, large sample sizes, and repeated sampling facilitate developing reference ranges

Suites of measures outside established ranges can indicate health problems and guide investigations



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doi: 10.3354/ab00491
AQUATIC BIOLOGY
Aquat Biol
Published online March 5

Reference ranges for body condition in wild bottlenose dolphins *Tursiops truncatus*

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[2]Chicago Zoological Society, c/o: Mote Marine Laboratory, 1600 Ken Thompson Parkway, Sarasota, Florida 34236, USA

ABSTRACT: Marine mammal body condition, as evaluated by a combination of mass, length, and/or girth measurements, is considered an indicator of nutritional status. We used measurements of total mass, total length, and maximum girth from long-term bottlenose dolphin *Tursiops truncatus* capture–release research conducted in Sarasota Bay, Florida, USA, (1987 to 2009) to develop 95th percentile reference ranges for 2 body condition models: (1) total mass versus total length and (2) maximum girth
ods were used to estimate the
to examine body condition an
upon commonly acquired mo
data on mass or age. Ultimate
body condition of individual
health of coastal populations.

KEY WORDS: Marine mam
Mass · Girth · Length · Quant

INTRODUCTION

Body size and growth in marine
been assessed using a variety of m
cluding direct measurements of le
mass (Lockyer & Morris 1987, Read
mill et al. 1995, Trites & Pauly 19
2011), body volume and mass base
axillary girth (Innes et al. 1981, Ca
1993), weight-to-length ratio (Ridgw
Mueller et al. 2011), blubber mass (
ber mass and skin thickness relativ
and girth (Pitcher et al. 2000), and
urements from aerial photographs (
2002, Miller et al. 2012). Direct
length, mass, and girth contribute to
of body size; however, body size sh
fused with estimates of body conditi
condition, which is often evaluated u

*Email: leslie.burdett@noaa.gov


PLOS | ONE

RESEARCH ARTICLE

Adrenal Hormones in Common Bottlenose Dolphins (*Tursiops truncatus*): Influential Factors and Reference Intervals

Leslie B. Hart[1*], Randall S. Wells[2], Nick Kellar[3], Brian C. Balmer[1,2], Aleta A. Hohn[4], Stephen V. Lamb[5], Teri Rowles[6], Eric S. Zolman[1], Lori H. Schwacke[1]

1 National Oceanic and Atmospheric Administration, National Ocean Service, National Centers for Coastal Ocean Science, Hollings Marine Laboratory, Charleston, South Carolina, United States of America, 2 Chicago Zoological Society, c/o: Mote Marine Laboratory, Sarasota, Florida, United States of America, 3 National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center, La Jolla, California, United States of America, 4 National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, Beaufort, North Carolina, United States of America, 5 Animal Health Diagnostic Center, Cornell University College of Veterinary Medicine, Ithaca, New York, United States of America, 6 National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources, Silver Spring, Maryland, United States of America

* leslie.burdett@noaa.gov

OPEN ACCESS

Citation: Hart LB, Wells RS, Kellar N, Balmer BC, Hohn AA, Lamb SV, et al. (2015) Adrenal Hormones in Common Bottlenose Dolphins (*Tursiops truncatus*): Influential Factors and Reference Intervals. PLoS ONE 10(5): e0127432. doi:10.1371/journal.pone.0127432

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Data Availability Statement: All relevant data are within the paper and its Supporting Information file.

Funding: Funding was received from the Office of Naval Research's Marine Mammals & Biology Program.

Competing Interests: The authors have declared that no competing interests exist.

Abstract

Inshore common bottlenose dolphins (*Tursiops truncatus*) are exposed to a broad spectrum of natural and anthropogenic stressors. In response to these stressors, the mammalian adrenal gland releases hormones such as cortisol and aldosterone to maintain physiological and biochemical homeostasis. Consequently, adrenal gland dysfunction results in disruption of hormone secretion and an inappropriate stress response. Our objective herein was to develop diagnostic reference intervals (RIs) for adrenal hormones commonly associated with the stress response (i.e., cortisol, aldosterone) that account for the influence of intrinsic (e.g., age, sex) and extrinsic (e.g., time) factors. Ultimately, these reference intervals will be used to gauge an individual's response to chase-capture stress and could indicate adrenal abnormalities. Linear mixed models (LMMs) were used to evaluate demographic and sampling factors contributing to differences in serum cortisol and aldosterone concentrations among bottlenose dolphins sampled in Sarasota Bay, Florida, USA (2000–2012). Serum cortisol concentrations were significantly associated with elapsed time from initial stimulation to sample collection (p<0.05), and RIs were constructed using nonparametric methods based on elapsed sampling time for dolphins sampled in less than 30 minutes following net deployment (95% RI: 0.91–4.21 µg/dL) and following biological sampling aboard a research vessel (95% RI: 2.32–6.68 µg/dL). To examine the applicability of the pre-sampling cortisol RI across multiple estuarine stocks, data from three additional southeast U.S. sites were compared, revealing that all of the dolphins sampled from the other sites (N = 34) had cortisol concentrations within the 95th percentile RI. Significant associations between serum concentrations of aldosterone and variables reported in previous studies (i.e., age, elapsed sampling time) were not observed in the current project (p<0.05). Also, approximately 16%

PLOS ONE | DOI:10.1371/journal.pone.0127432 May 18, 2015 1 / 16

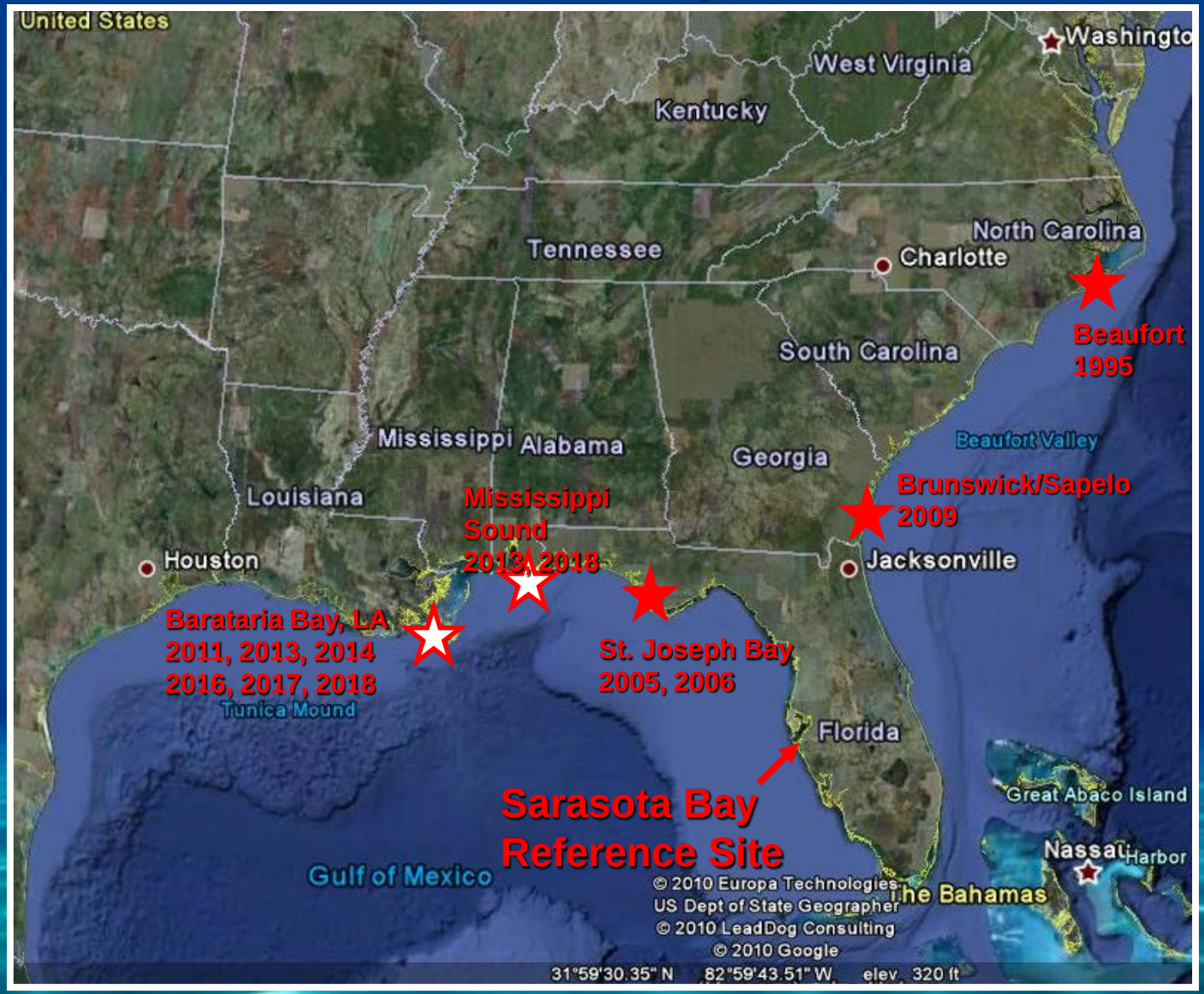
<u>Since 1988</u>:

- 274 individuals examined, sampled in Sarasota.
- Up to 17 re-captures (over decades).
- 841 sets of samples for blood chemistry and hematology, urinalysis, serology, biotoxins, microbiology, inorganic/organic contaminants.
- 838 sets of measurements of weight, blubber depth, and/or morphometrics.
- Comparisons with stranders aid interpretation of range bounds.
- >100 peer-reviewed scientific publications on health, physiology, contaminants.

Sarasota Bay Dolphins: Status and Outlook

- **Most recent Capture-Mark-Recapture abundance estimate = 157.53 Following a decline and recovery associated with a severe red tide in 2005-06, resident population has been stable in recent years.** **(***Tyson, R. B. and R. S. Wells. 2016. Sarasota Bay/Little Sarasota Bay bottlenose dolphin abundance estimates: 2015. Prepared for National Marine Fisheries Service Northern Gulf of Mexico Bay, Sound and Estuary Bottlenose Dolphin Stock Blocks B20 and B35, Combined. Southeast Fisheries Science Center Reference Document PRBD-2016-02. 22 pp.***)**
- **Record number of calves produced in 2017: 21**
- **No major large-scale health concerns noted in recent years, but increasing adverse human interactions.**

Sarasota Bay Serves as a Reference Site for NOAA for Bottlenose Dolphin Health Comparisons to Investigate Events and Impacts



Deepwater Horizon Oil Spill Health, Survival, Reproduction Comparisons

PROCEEDINGS B

rspb.royalsocietypublishing.org

Research

Cite this article: Lane SM *et al.* 2015 Reproductive outcome and survival of common bottlenose dolphins sampled in Barataria Bay, Louisiana, USA, following the *Deepwater Horizon* oil spill. *Proc. R. Soc. B* 282: 20151944. http://dx.doi.org/10.1098/rspb

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Accepted: 12 October 2015

Subject Areas:
ecology, health and disease a

Keywords:
bottlenose dolphin, *Tursiops t*
Deepwater Horizon, oil spill,
reproductive outcome, survival

Reproductive outcome and survival of common bottlenose dolphins sampled in Barataria Bay, Louisiana, USA, following the *Deepwater Horizon* oil spill

Suzanne M. Lane[1], Cynthia R. Smith[2], Jason Mitchell[3], Brian C. Balmer[3,4], Kevin P. Barry[5], Trent McDonald[3], Chiharu S. Mori[6], Patricia E. Rosel[7], Teresa K. Rowles[8], Todd R. Speakman[1], Forrest I. Townsend[9], Mandy C. Tumlin[10], Randall S. Wells[4], Eric S. Zolman[1] and Lori H. Schwacke[1]

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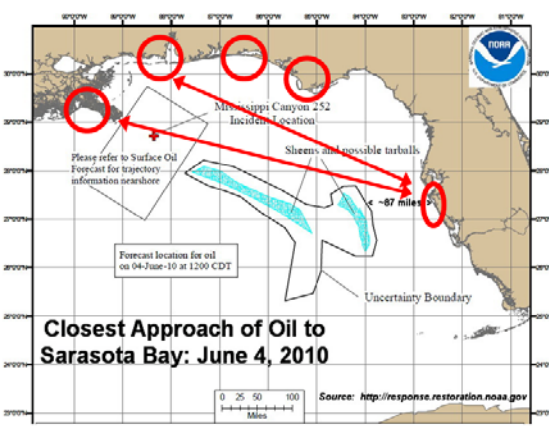

ENVIRONMENTAL Science & Technology

Health of Common Bottlenose Dolphins (*Tursiops truncatus*) in Barataria Bay, Louisiana, Following the *Deepwater Horizon* Oil Spill

Lori H. Schwacke,[†,*] Cynthia R. Smith,[‡] Forrest I. Townsend,[§] Randall S. Wells,[∥] Leslie B. Hart,[†] Brian C. Balmer,[∥] Tracy K. Collier,[⊥] Sylvain De Guise,[#] Michael M. Fry,[▽] Louis J. Guillette, Jr.,[○] Stephen V. Lamb,[♦] Suzanne M. Lane,[‡] Wayne E. McFee,[†] Ned J. Place,[♦] Mandy C. Tumlin,[¶] Gina M. Ylitalo,[*] Eric S. Zolman,[†] and Teresa K. Rowles[★]

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Supporting Information

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Revised: November 27, 2013
Accepted: December 2, 2013

1. Barataria Bay (BB) dolphins did not vacate BB during the oil spill.
2. BB dolphins had low adrenal hormone levels consistent with adrenal toxicity.
3. BB dolphins were 5 times more likely to have moderate to severe lung disease as compared to Sarasota Bay (SB).
4. Many BB dolphin disease conditions are uncommon, but consistent with oil exposure and toxicity.
5. Low annual survival (87% vs. 96%) and pregnancy success (20% vs. 83%) in dolphins from BB compared to SB.

Beyond Assessing Health: Training

Dolphin handling and rescue training opportunities for veterinarians, stranding network personnel, marine law enforcement officers, foreign colleagues

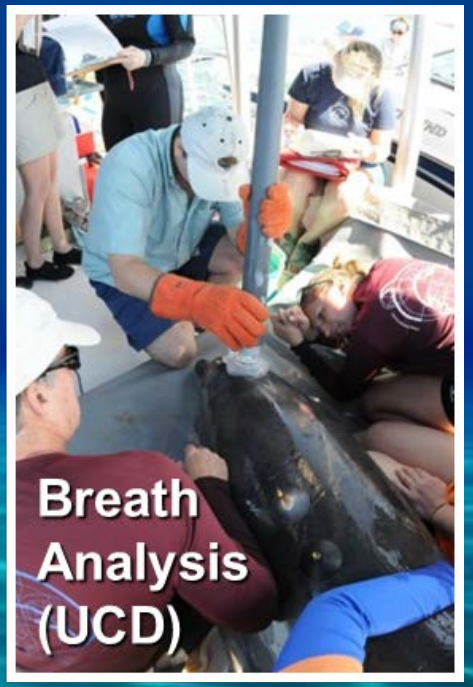
Beyond Assessing Health: Acoustic Research

Hearing and acoustic communication studies, whistle recordings/playbacks

Beyond Assessing Health: Testing New Research and Diagnostic Tools

For metabolic rate measures, lung function, radiography, systematic ultrasonography, telemetry, breath analysis

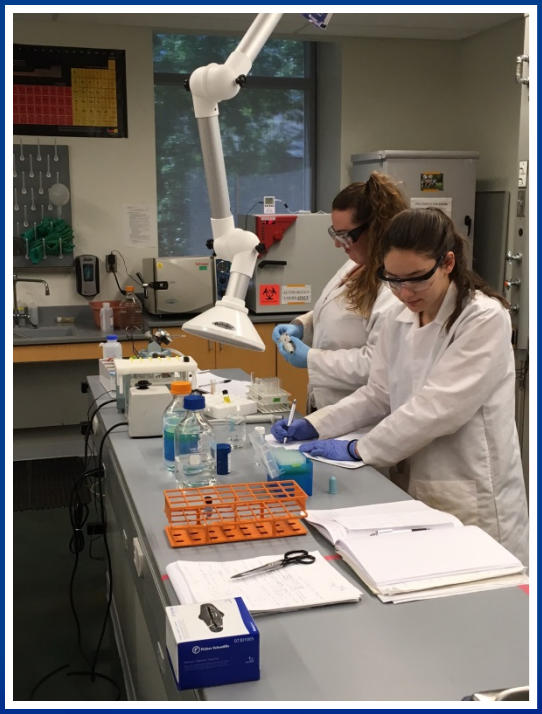
Metabolic Rates



Beyond Assessing Health through Capture-Release

Testing and groundtruthing techniques for collecting health and life history data remotely: 1) reducing risks to animals and people, 2) increasing cost-effectiveness, 3) simplifying logistics, 4) allowing more wide-spread assessments

Skin/blubber biopsy samples for sex, genetics, reproductive hormones, stress hormones, environmental contaminants, % lipid (NIST, NMFS-SWFSC, NMFS- SEFSC)



DNA methylation changes for possible age determination from skin (FIU)


Thank you!
For more information:
sarasotadolphin.org
Chicago Zoological Society
Inspiring Conservation Leadership