SEA TURTLE MOVEMENT AND HABITAT USE IN THE NORTHERN GULF OF MEXICO

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USGS Wetland & Aquatic Research Center
23 August 2017

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Sea Turtle Relocation Trawling: Satellite-Tags Providing New Data for the Gulf of Mexico

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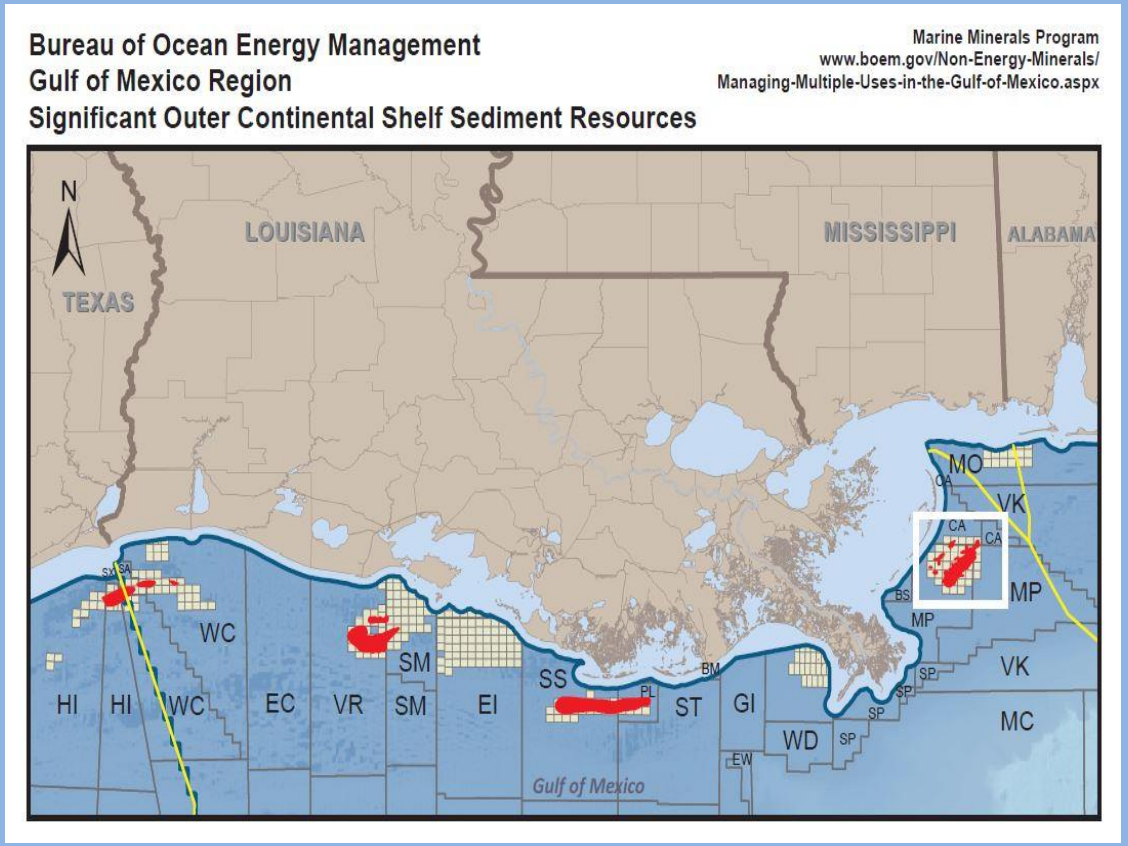
BOEM
Bureau of Ocean Energy Management

Marine Minerals Program Mission

Facilitate access to and manage the Nation's Outer Continental Shelf (OCS) non-energy marine minerals.

- Environmental stewardship
- Assessments of exploration and leasing activities
- Coordination with governmental partners
- Engagement of stakeholders
- Strategic planning
- Scientific research to improve decision making and risk management



Environmental Impacts and Mitigation

- Minimize deleterious impacts through the implementation of impact-reducing mitigation:
  - Location avoidance: buffers to archaeological targets, EFH, nesting, protecting species, infrastructure, ordnance
  - Environmental windows: hopper dredging, larval fishes
  - Impact minimization: observers, dredging equipment, rotational/single use dredge areas
  - Monitoring: dredge position/production, benthic recovery, bathymetric recovery

OCSLA, NEPA, ESA

Biological Opinion Trawling Stipulations

- 24-hour relocation trawling
- Relocation trawling shall be conducted for the three days (72 hours) immediately prior to commencement of hopper dredging operations, to reduce the abundance of sea turtles in the project area.
  - Trawl tow-time duration shall not exceed 42 minutes (doors in - doors out) and trawl speeds shall not exceed 3.5 knots
  - Sea turtles captured pursuant to relocation trawling shall be handled in a manner designed to ensure their safety and viability
  - Captured turtles shall be kept moist, and shaded whenever possible, until they are released
  - Flipper and Pit tagging, Genetic Analysis, Tag Scanning, Weight and Size Measurements

Caminada Headland Restoration, Louisiana

Project lead: Louisiana Coastal Protection and Restoration Authority

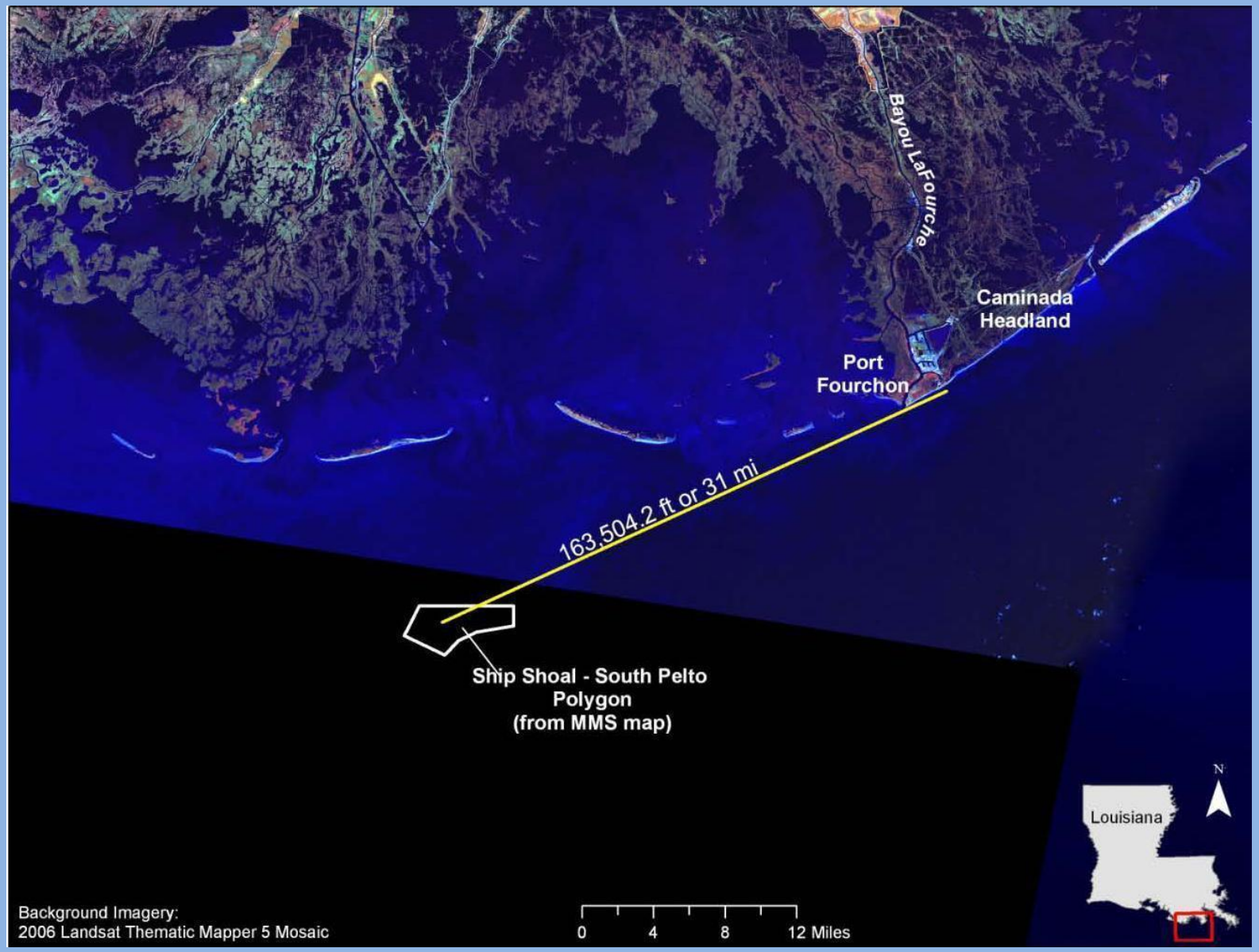
Goal: protect and preserve the geomorphic integrity and function of the barrier shoreline and landward estuarine systems.

Ship Shoal OCS Sand Resources:

- High quality (coarse grain size and less mud)
- Offshore excavation does not affect wave climate at shoreline
- Excavation outside of the active coastal system, introducing new sand to supplement a deficit in the coastal sand budget

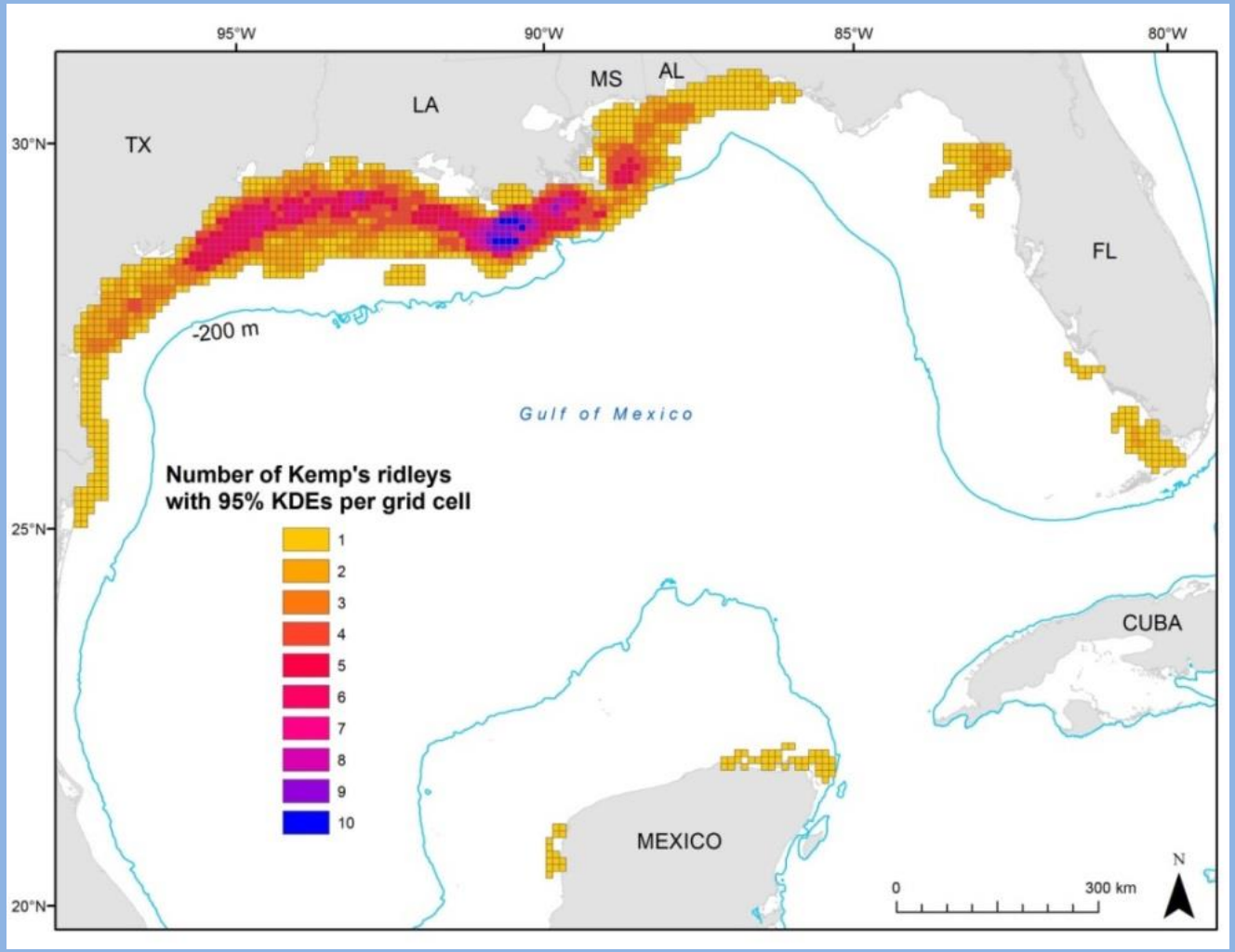
→ **Improving project long-term sustainability and geomorphic function**

Caminada Headland Restoration, Louisiana



Caminada Sea Turtle Relocation

- Project Duration 3.5 years, 2 phases
  - 20% Conducted using hopper dredges
- Turtles Relocated: 198
  - 117 Kemp's ridleys
  - 78 loggerheads
  - 2 green turtles
- Recaptures: 3 from this study
- Adults, adults (>60cm), sub-adults (>50cm-<60cm), juveniles
- No turtle mortalities or injuries associated with trawling



Hart et al. (*In review*)

- **Density of post-nesting Kemp's ridleys satellite tracked from Padre Island NS, TX (Hart & Shaver et al., unpubl. data)**
- **Darker colors indicate a larger number of turtles per grid cell**

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SWOT: http://seaturtlestatus.org/learn/lifecycle

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Gulf Sea Turtles

- Loggerheads (*Caretta caretta*)
- Kemp's ridleys (*Lepidochelys kempii*)
- Green turtles (*Chelonia mydas*)
- Leatherbacks (*Dermochelys coriacea*)
- Hawksbills (*Eretmochelys imbricata*)

❖ *All threatened or endangered*

❖ *Several subpopulations, various regional management units*

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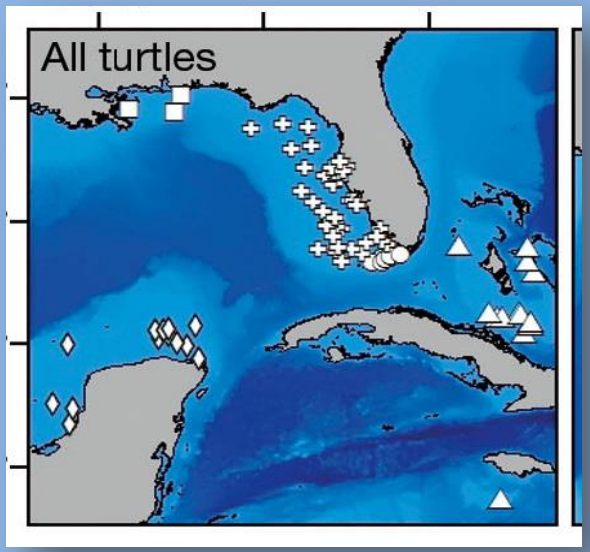
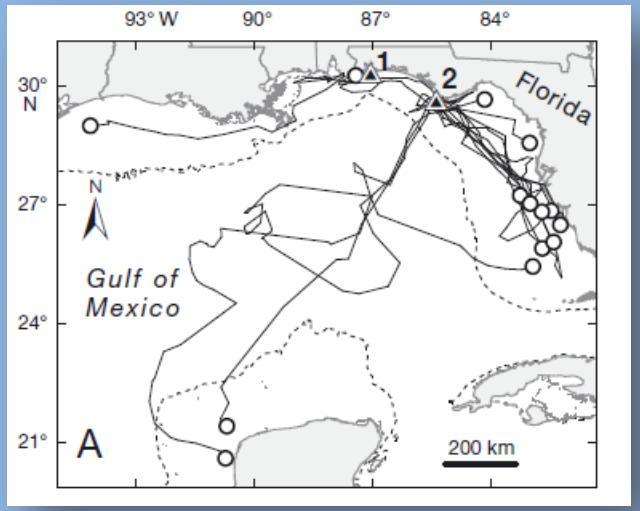
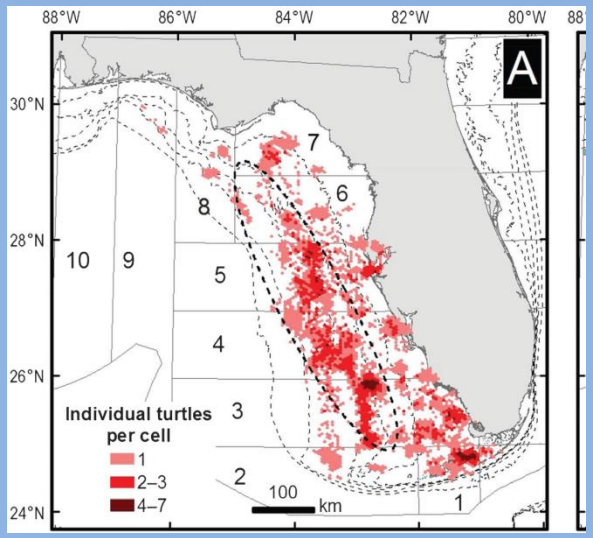
Loggerhead foraging areas:



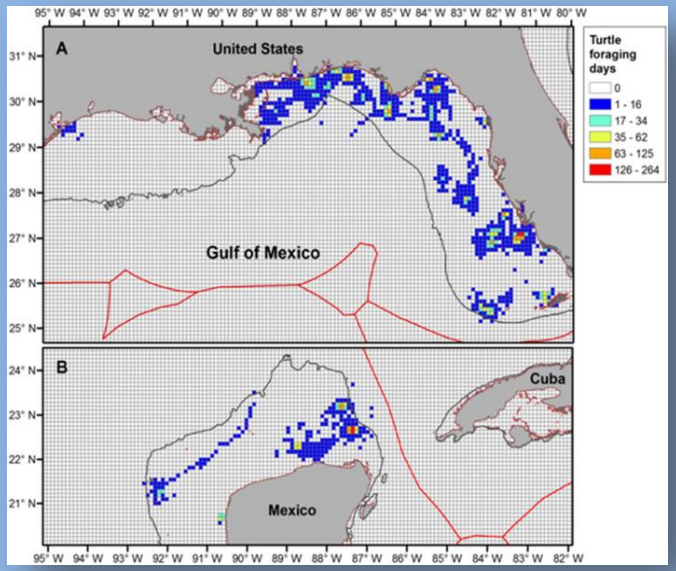
Tucker et al. 2014



Foley et al. 2013



Hardy et al. 2014



Hart et al. 2014

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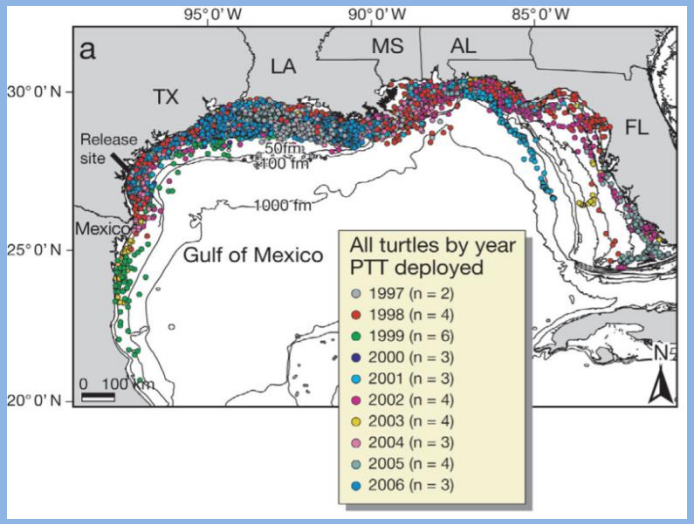
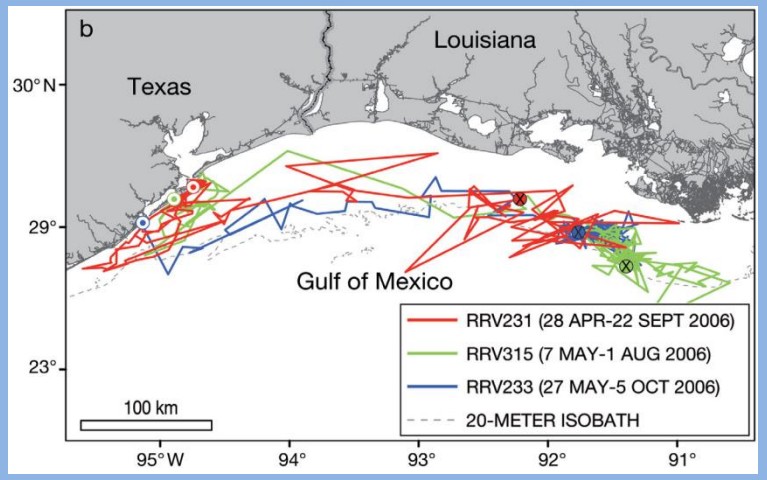
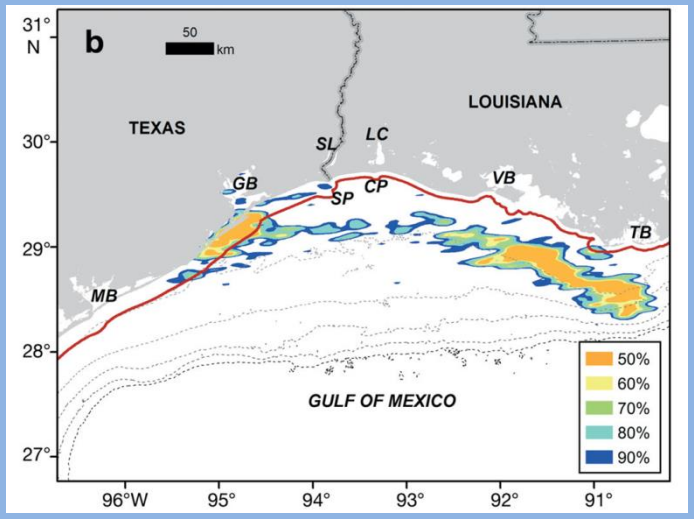
Kemp's ridleys foraging areas:



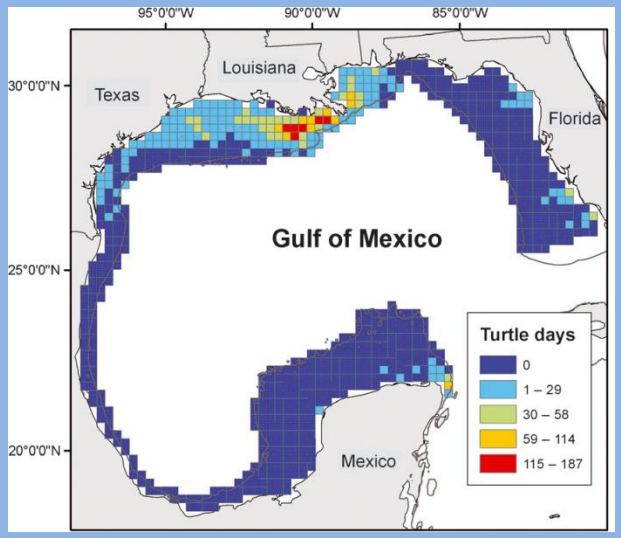
Shaver & Rubio 2008



Seney & Landry 2008



Seney & Landry 2011



Shaver et al. 2013

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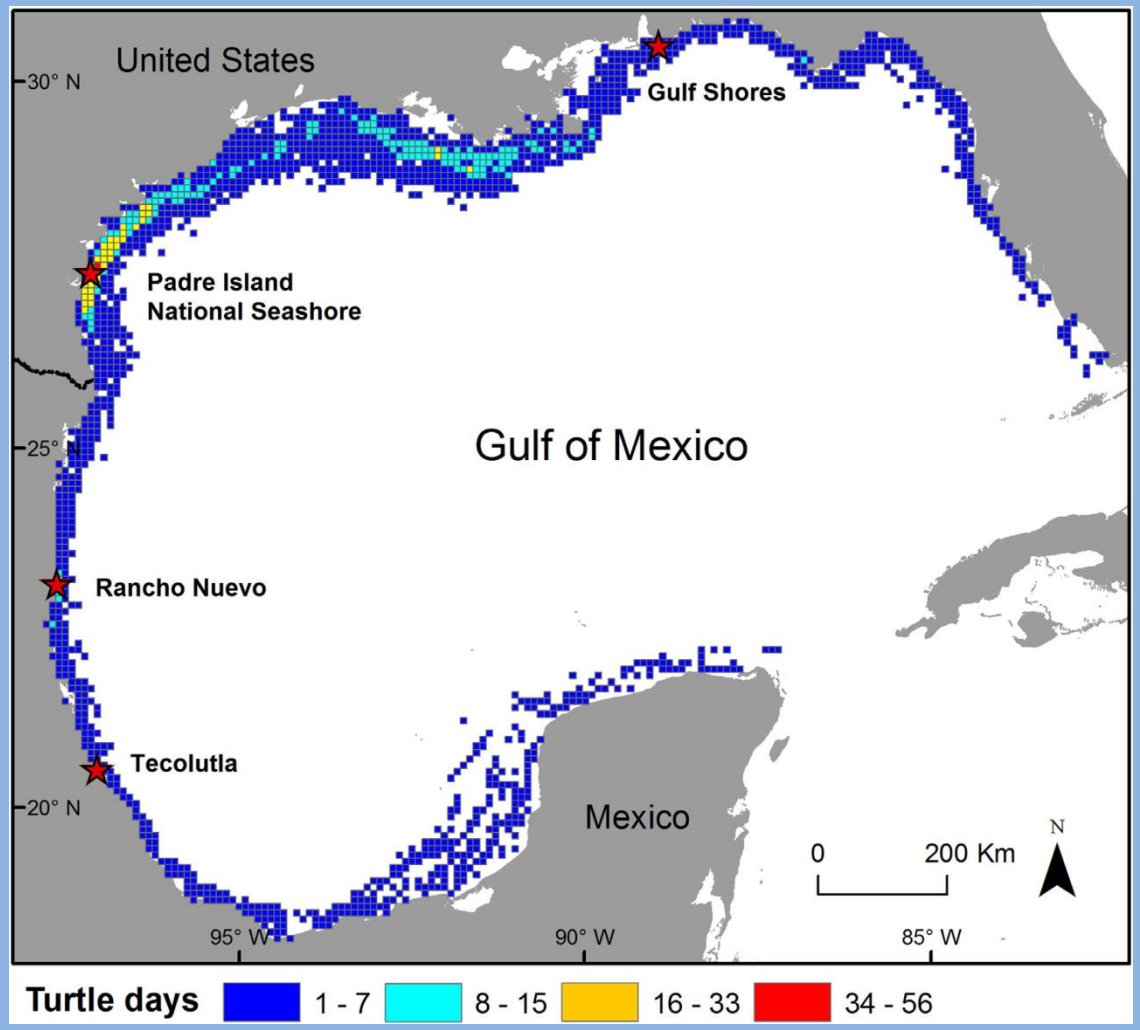
Kemp's ridley migratory corridor



Shaver et al. 2016

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OBJECTIVES

- Utilize hopper dredge relocation trawling operations to opportunistically tag sea turtles and collect biological samples to inform management decisions related to trawling and dredge operations
    - Track movements post-relocation will provide data needed to validate the distance required for relocation (economic feasibility of project, prevent multiple handlings of the same turtle)
    - Evaluation of dive times to understand turtle use of various depth zones, inform survey protocols re: decommissioning of oil rigs, and establish area-specific, species-specific availability correction factors (ACFs) for aerial surveys (data on time spent in upper 2 m of water column)

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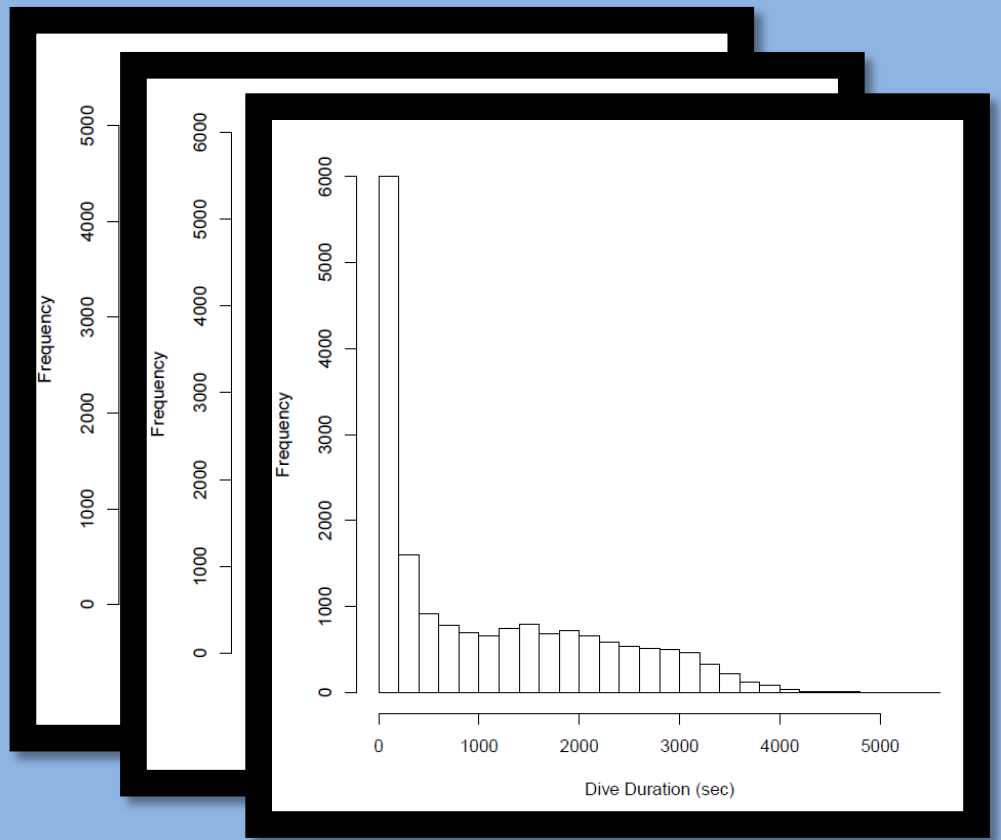
GOALS

- Characterize turtle dive profiles using satellite-linked depth tags
- Determine seasonal movement patterns using satellite telemetry
- Assess population structure using genetic techniques
- Assess isotopic signatures using stable isotope techniques
- Determine vital rates using mark-recapture methods



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METHODS

- Relocation trawling for captures; standard sea turtle workup
- Affix depth-logging satellite tags
- Switching state-space modeling (area-restricted search vs. migration/directed movement)
- Home range tools (kernel density estimation, grid cell summaries)
- Dive profile comparisons
- Population genetic structure (microsatellites and mtDNA)
- Isotopic signatures (Stable istopes: ^{14}C, ^{15}N)
- Vital rates (capture-mark-recapture tools)

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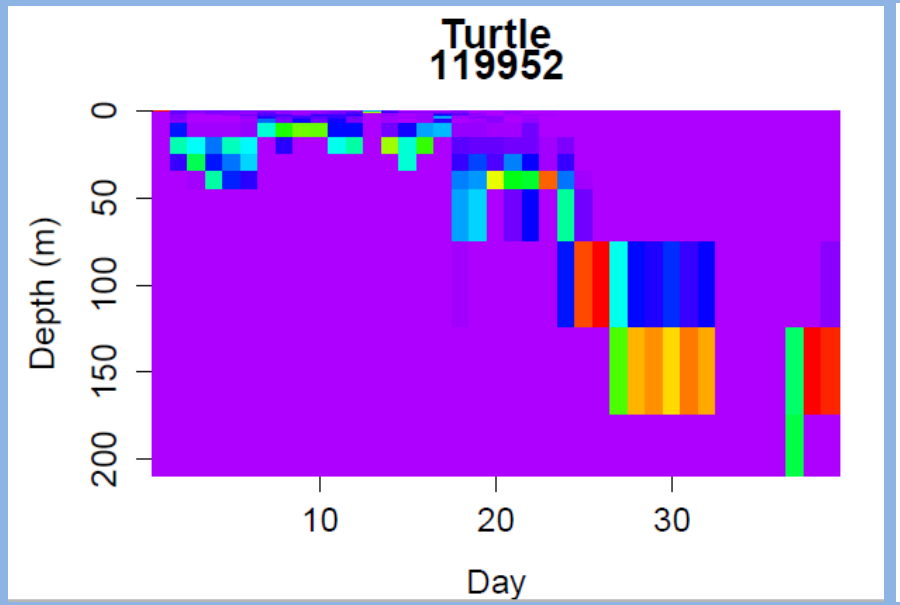
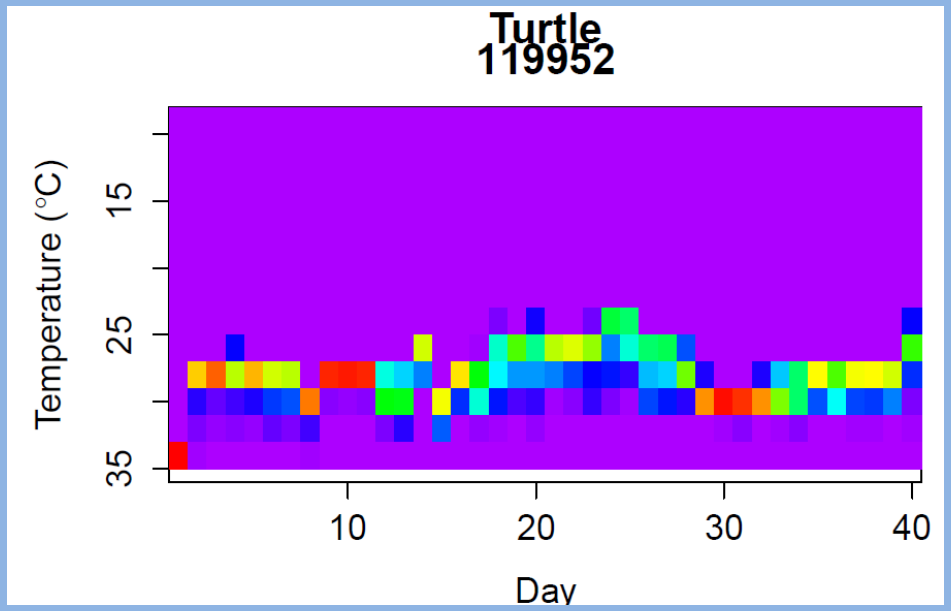

Turtle
119952
Depth (m)
0
50
100
150
200
10
20
30
Day


Turtle
119952
Temperature (°C)
15
25
35
10
20
30
40
Day

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RESULTS, 25 days on trawlers in 2016

#	Turtle	Species	Capture date	Recapture?	SCL-tip (cm)	CCL-tip (cm)	Sex	Satellite tag	R Flipper tag	L Flipper tag
1	Rusty	LK	5/18/2016	No	63.7	66.5	M	15A0930/161461	UUS146	UUS145
2	Heather	LK	5/19/2016	No	56.6	59.5	F	15A0927/161458	UUS135	UUS134
3	Jewel	LK	5/19/2016	No	63.6	67.9	F	14A0179/154846	UUS137	UUS136
4	Alex	LK	5/21/2016	No	61.3	64.9	M	15A0540/154844	UUS139	UUS138
5	Tish	LK	5/21/2016	Yes	67.5	70.5	F	15A0026/154835	UUS142	UUS140
6	Lori	LK	5/22/2016	No	61.5	64.4	F	15A0522/154847	UUS144	UUS143
7	Jared	LK	5/23/2016	No	66.1	69.5	M	15A0536/154840	UUH366	UUH365
9	Yazu	LK	6/8/2016	No	58.7	61.7	M	15A0019/154833	UUS162	EEJ893
10	Barb	LK	6/9/2016	No	59.3	62.2	F	15A0931/161462	UUS164	UUS163
11	Lexi	LK	6/22/2016	Yes	64.4	68	F	154836/15A0526	UUS168	UUS167
8	Savanna	CC	6/4/2016	No	82	86.3	F	15A0022/154834	UUS161	UUS160
12	Tini	CC	6/23/2016	No	77	82.8	F	154839/15A0535	UUS170	UUS171
13	Charlie	CC	7/21/2016	No	72.7	78.3	F	15A0610/161454	MMC757	MMC756
14	Bosarge	CC	7/21/2016	No	83.6	88.6	F	15A0537/154841	MMC759	MMC758
15	Sandra	CC	7/21/2016	No	77.5	83	F	15A0950/161464	MMC761	MMC760
16	Stevie	CC	7/22/2016	No	85.2	89.6	M	15A0538/154842	MMC763	MMC762
17	Melody	CC	7/22/2016	Yes	91.2	97.6	F	15A0916/161456	LLY494	MMC764
18	Gracy	CC	7/22/2016	No	92	99.2	F	14A0096/154845	MMC766	MMC765
19	Amber	CC	7/24/2016	No	97.2	100.5	F	15A0539/154843	MMC769	MMC767
20	Seretse	CC	7/25/2016	No	97.2	101	M	15A0533/154837	MMC771	MMC770
21	Abba	CC	7/25/2016	No	75.8	80.9	F	15A0929/161460	MMC773	MMC772
22	Hayley	CC	7/25/2016	No	78.6	83.6	F	15A0925/161457	MMC774	MMC775
23	Sasha	CC	7/26/2016	No	79.1	85.1	F	15A0932/161463	MMC777	MMC776
24	Bella	CC	7/26/2016	No	76.3	82.3	F	15A0953/161467	MMC779	MMC778
25	Jessica	CC	7/26/2016	No	82	85.7	F	15A0951/161465	MMC781	MMC780
26	Bosley	CC	7/27/2016	No	83.4	88.5	M	15A0534/154838	MMC783	MMC782

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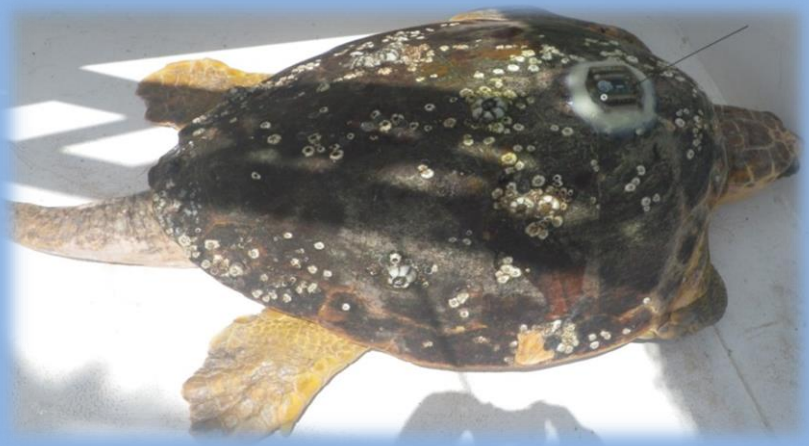
	Ship Shoal, Kemp's ridleys	Ship Shoal, Loggerheads	Pensacola, Loggerheads
Range	59.5-70.5 cm CCL	82.8-86.3 cm CCL	78.3-101.0 cm CCL
Mean (SD)	65.5 (3.6)	84.6 (2.5)	89.0 (7.7)
N	10	2	14
Males	4	0	3



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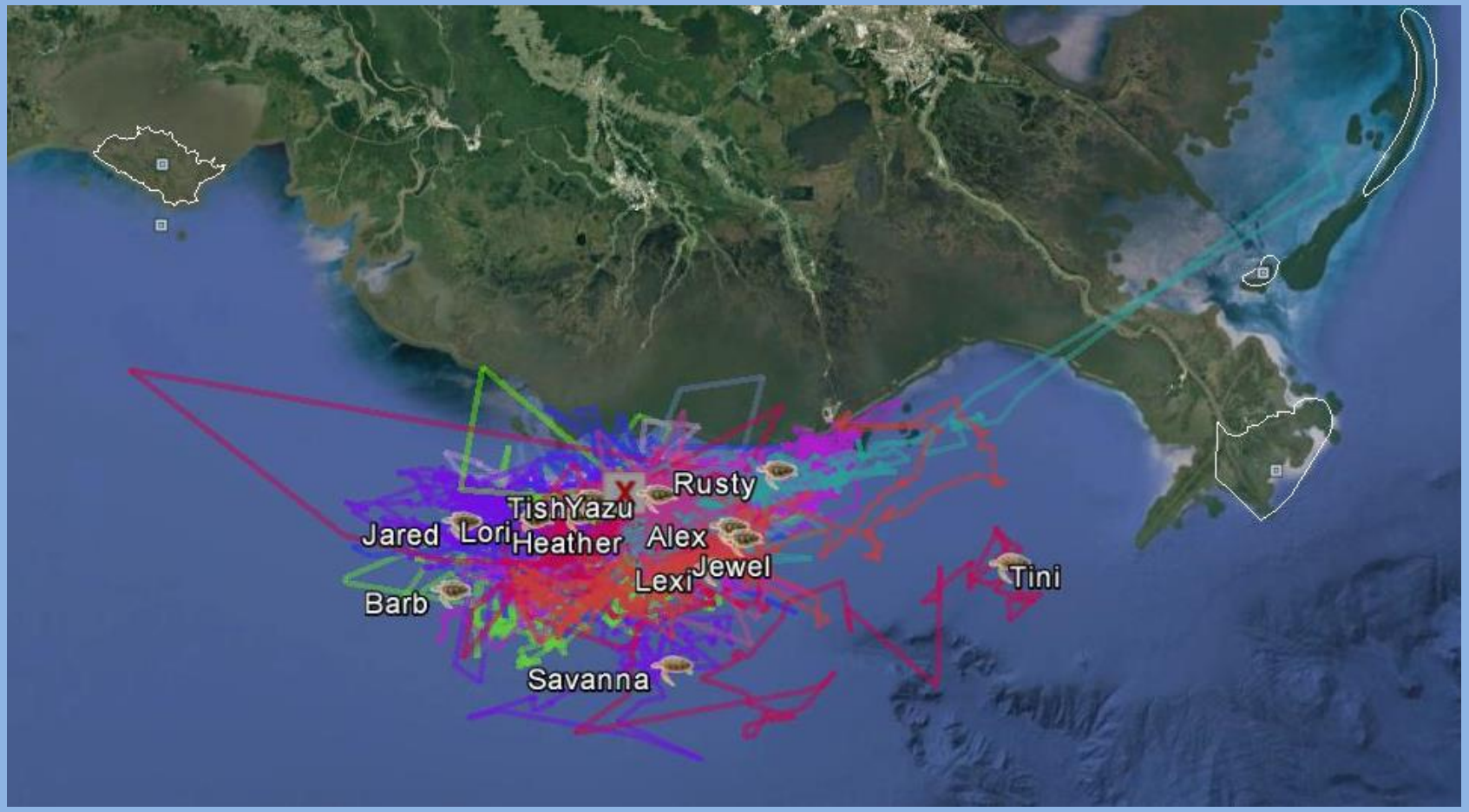

- Ship Shoal: 10 individuals, Kemp's ridleys (n=9) and loggerheads (n=1)
- High site-fidelity
- Daily transmissions of location and depth profiles, www.seaturtle.org/tracking/?project_id=1205

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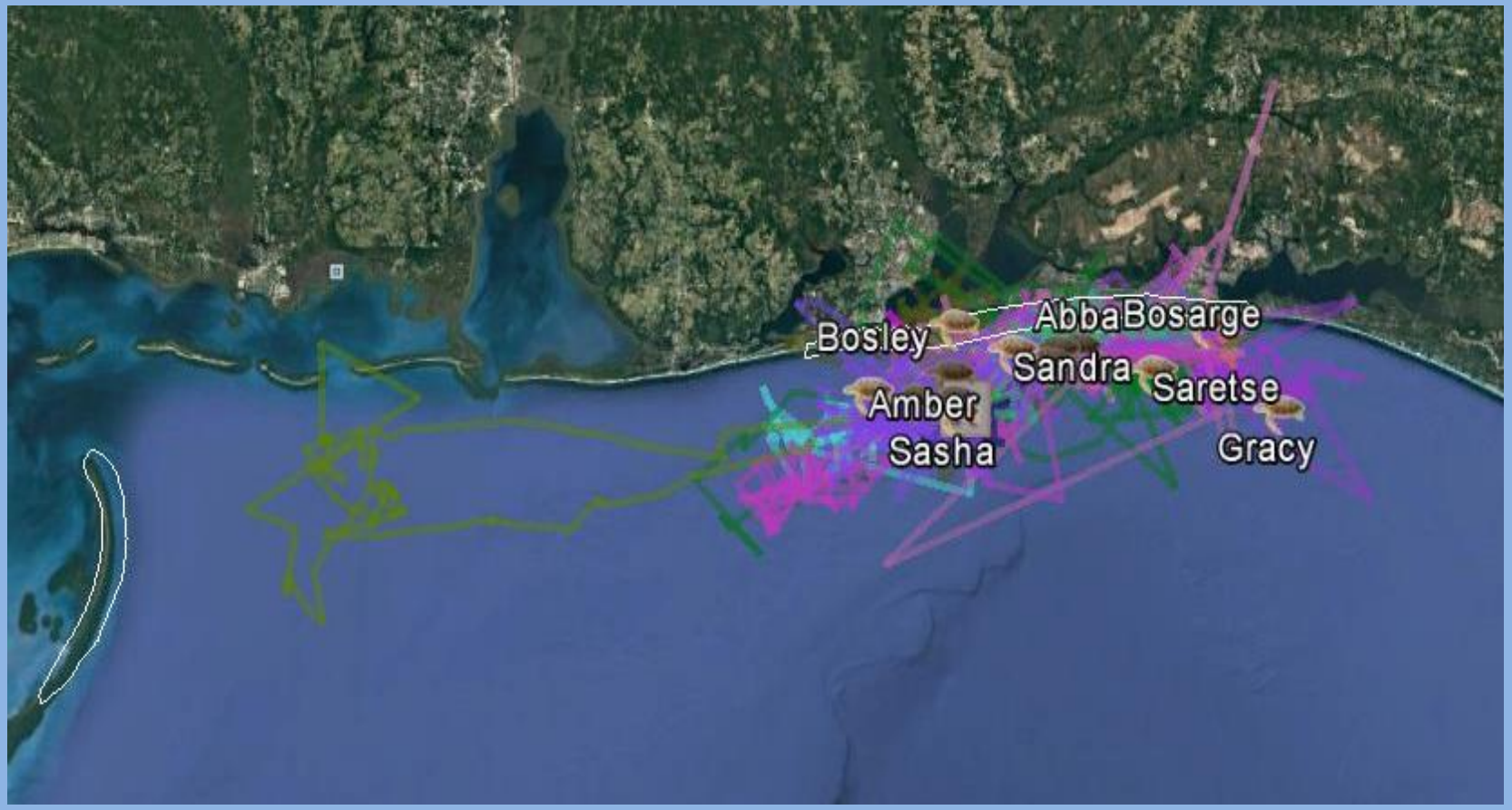

- Just off Pensacola, FL, 14 individuals, all loggerheads
- High site-fidelity
- Daily transmissions of location and depth profiles,
- www.seaturtle.org/tracking/?project_id=1205

❖ *Project: >2000 tracking days, mean displacement ~25 km from capture sites*

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RESULTS

Tracking summary

Species	Tracking period (days)	Size of home range (95% KDE)
Loggerheads	3 – 192 days (mean ± SD = 100.8 ± 56.1 d)	90.8 – 4646.7 km^2 (mean ± SD = 777.0 ± 1246.4 km^2)
Kemp's ridleys	76 – 117 days (mean ± SD = 100.1 ± 15.2 d)	89.2 – 1902.4 km^2 (mean ± SD = 1067.73 ± 582.05 km^2

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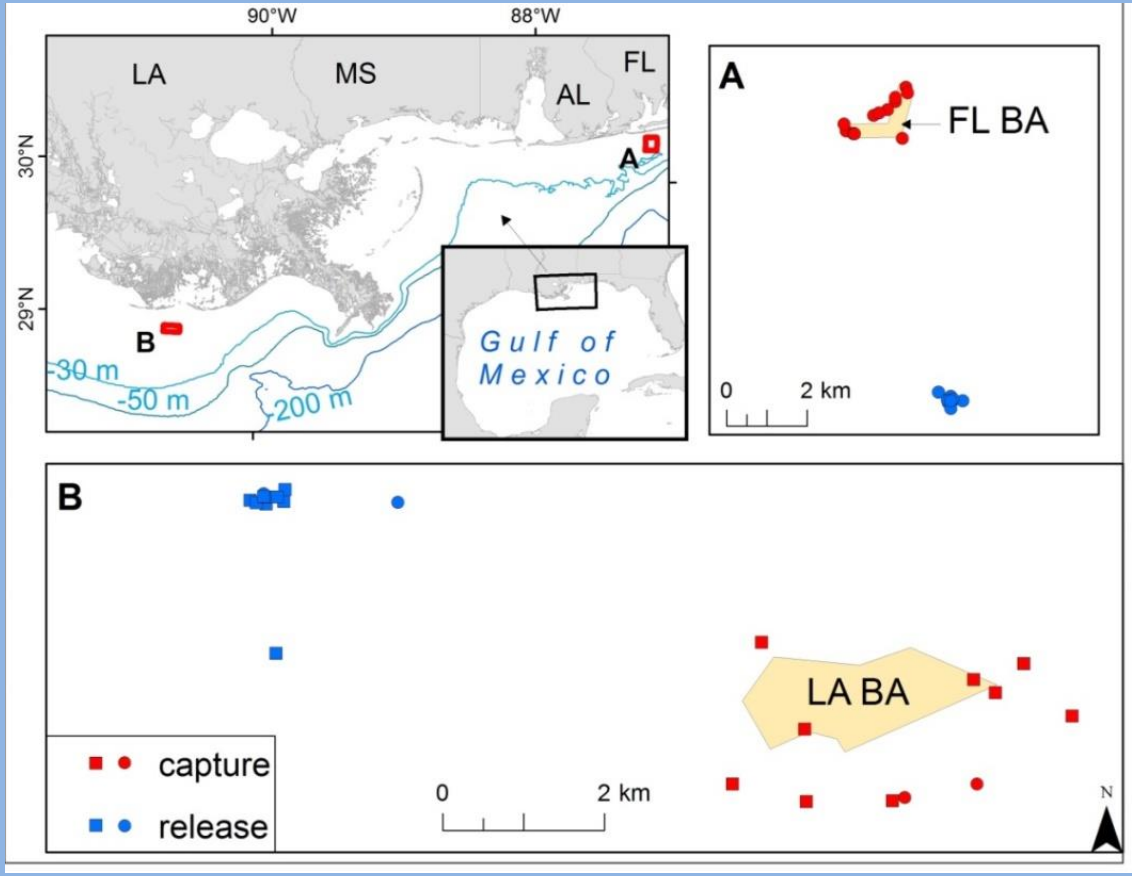
Australian study: B/D/A trawling study (Whittock et al. 2017), adult female flatback turtles used borrow area MORE often during active dredging operations

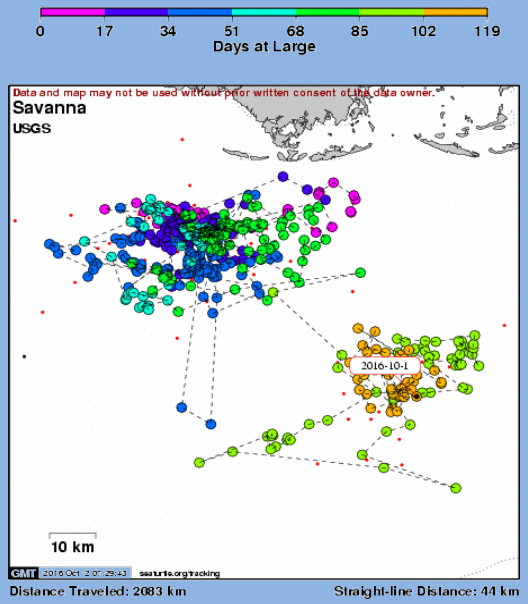
Our study:

- Loggerhead and Kemp's ridley release locations were on average 7.2 km and 7.3 km, respectively, from their capture location
- 12/16 loggerheads passed site fidelity tests; all 10 Kemp's ridleys passed site fidelity tests
- Loggerheads: 9/14 home ranges intersected w/FL borrow area and 1/2 intersected w/LA borrow area; Kemp's ridleys: 8/10 home ranges intersected w/ LA borrow area (none captured in FL site)



Loggerhead forays

	Turtle	Age, sex	Foray (days)	Filtered locations
Saretse	154837	Adult M	7/25 - 7/29/2016 (5)	23
Bosley	154838	Adult M	12/4 - 12/10/2016 (7) 12/14 - 12/31/2016 (18)	24, 73
Hayley	161457	Sub-Adult F	8/14 - 9/5/2016 (23)	107



Kemp's ridley forays

	Turtle	Age, sex	Foray (days)	Filtered locations
Lexi	154836	Adult F	8/20 - 8/24/2016 (5)	21
Alex	154844	Adult M	5/30 - 6/8/2016 (10) 6/19 - 6/19/2016 (1)	51, 2
Barb	161462	Sub-Adult F	6/9 - 6/23/2016 (15) 9/6 - 9/8/2016 (3)	61, 9

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Time to return to within 2 km of capture sites

Loggerheads:

- Loggerhead home ranges (95% KDE) were on average about the same distance from capture and release locations (1.8 km and 1.6 km, respectively).
- Turtles that took up residence within 2 km of the capture or release location did so on average within a day, and sometimes in less than a day, with only one turtle taking longer (5 days) to be within 2 km of the capture location

Kemps ridleys:

- Kemp's ridley home ranges (95% KDE) were also on average about the same distance to their release locations (4.6 km) than their capture locations (4.8 km).
- Those that took up residence within 2 km of capture locations did so usually within a day, while those that took up residence within 2 km of the release location did so on average 2.8 days later and ranged from 0-14 days later

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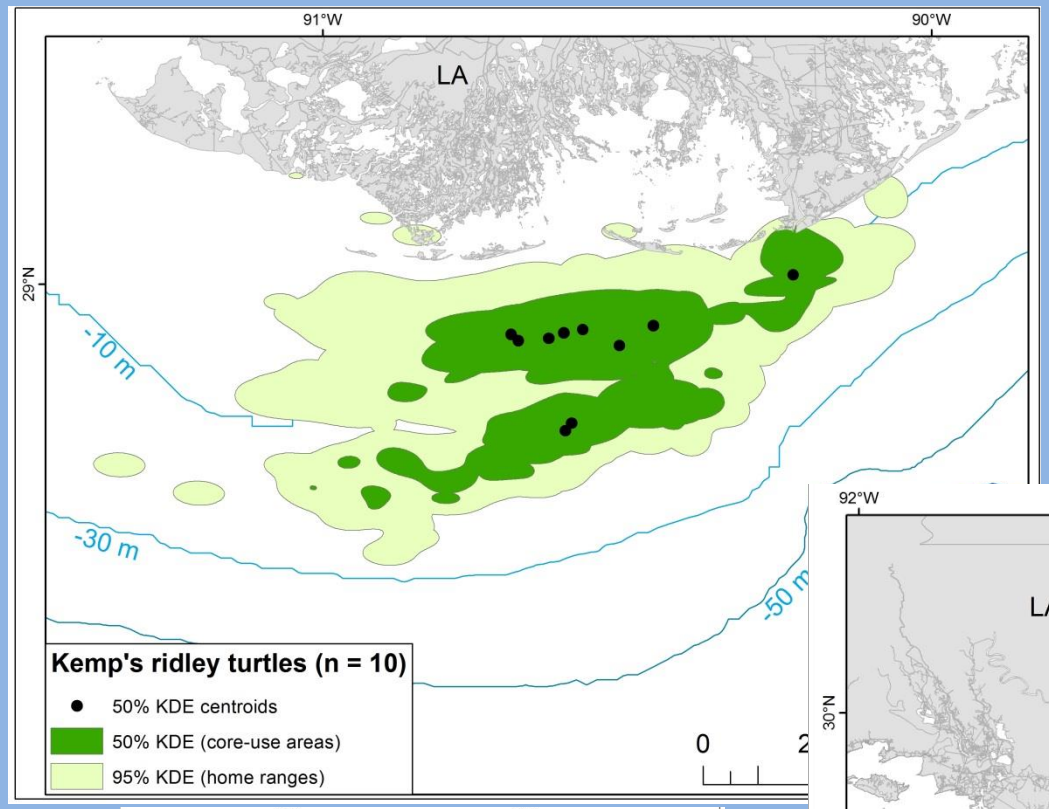

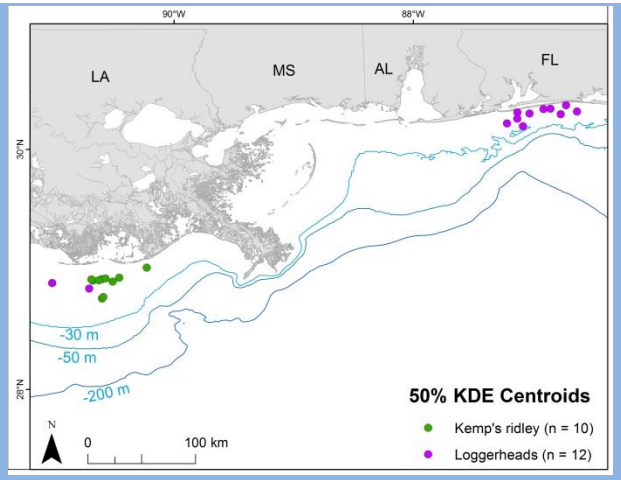

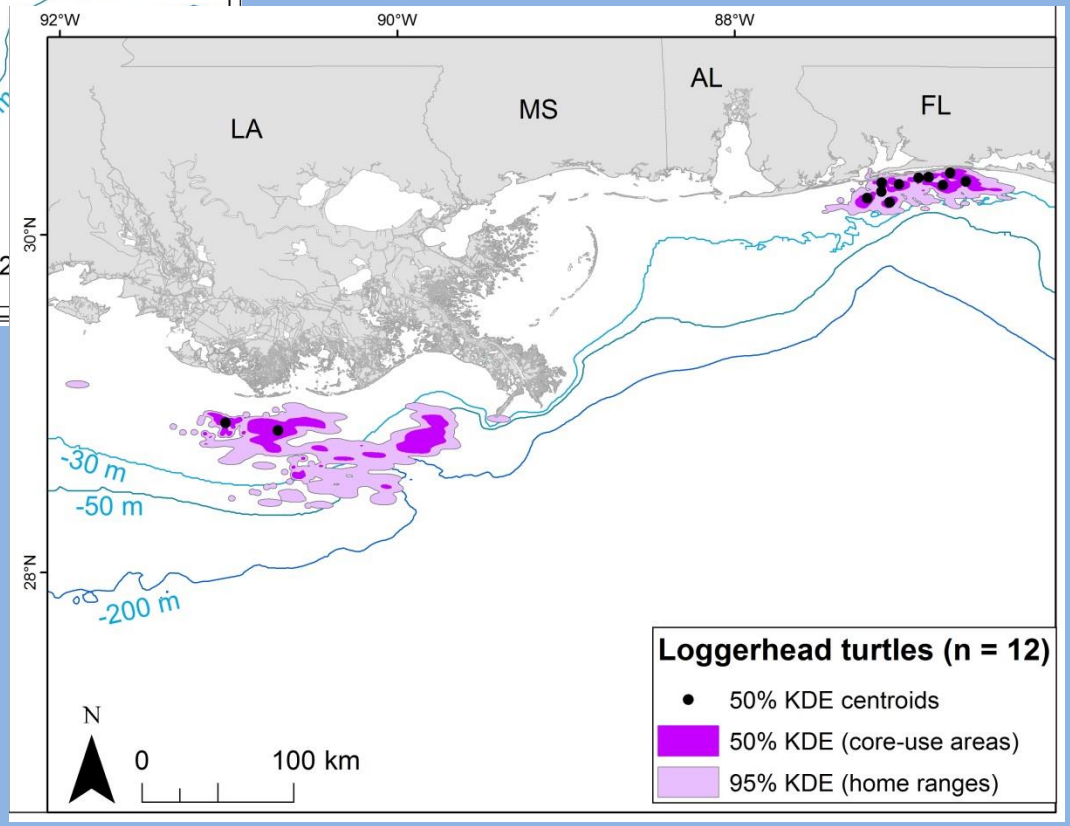

Mean centroid depths:

- **Kemp's ridleys: -12.2 (SD 4.1)**
- **Loggerheads: -20.5 (SD 5.4)**

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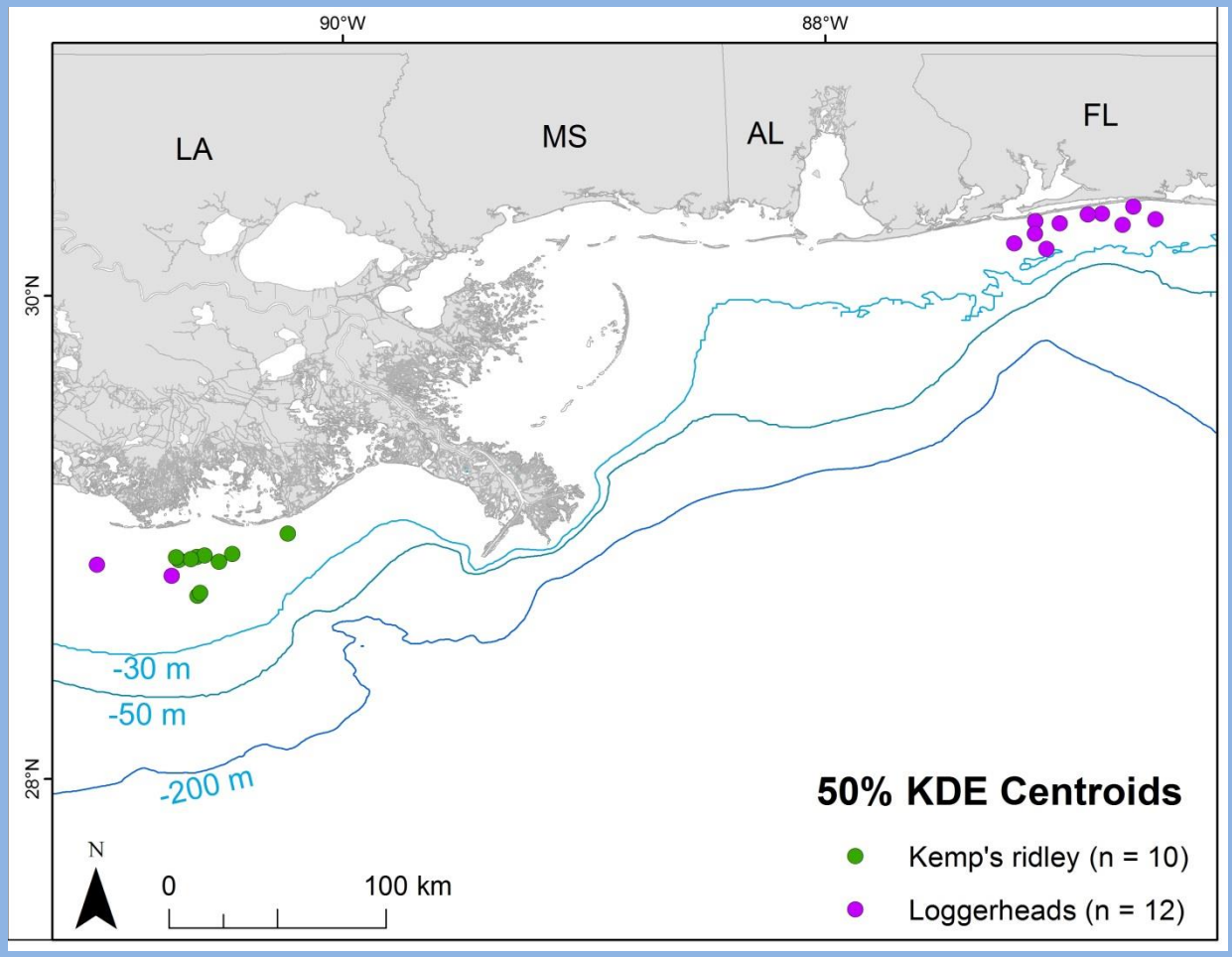

Mean centroid distance to shore:

- **Kemp's ridleys: 18.4 (SD 8.2)**
- **Loggerheads: 20.9 (SD 2.0) at Ship Shoal; 7.3 (SD 4.3) at Pensacola**

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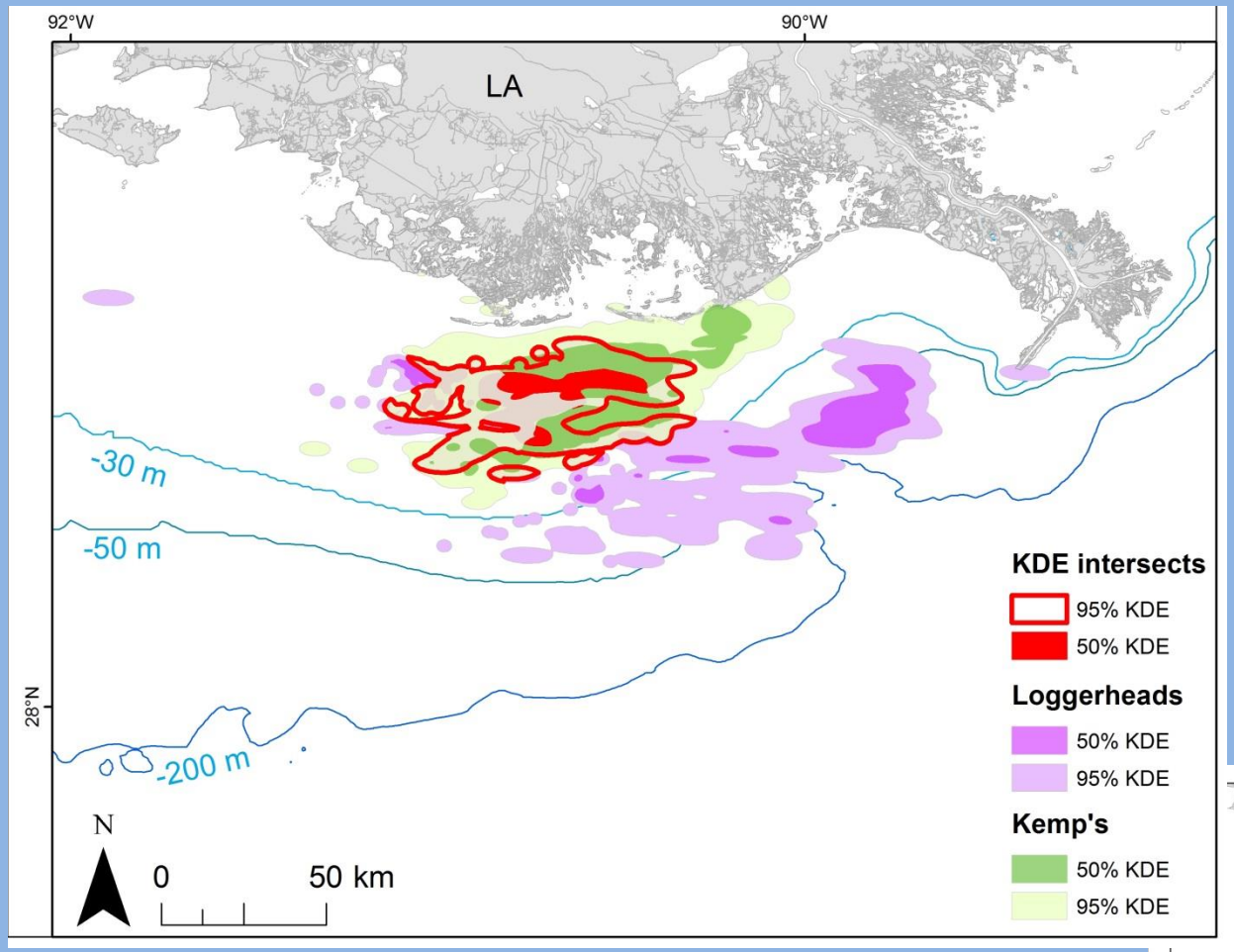
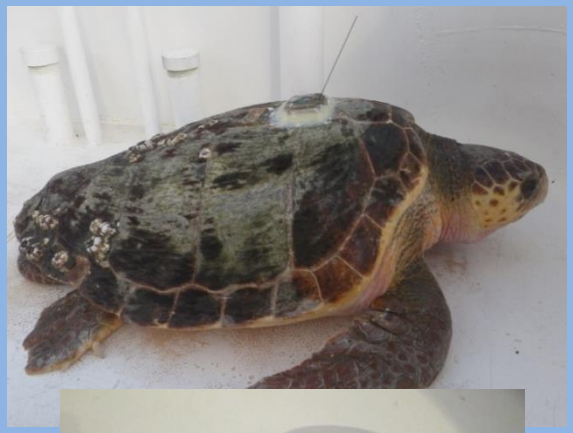
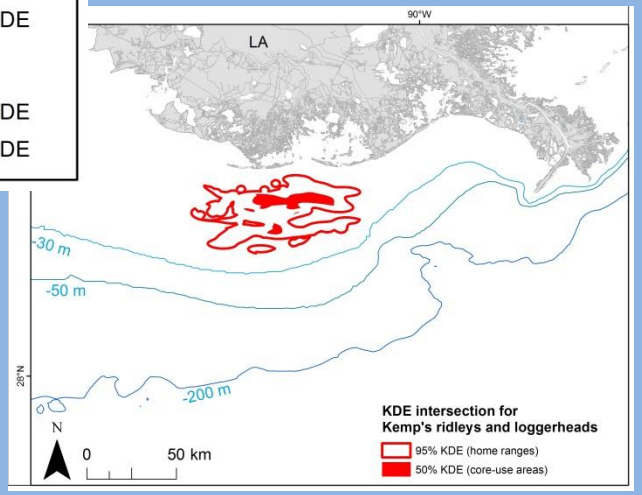

92°W
90°W
LA
-30 m
-50 m
-200 m
28°N
N
0
50 km
KDE intersects
95% KDE
50% KDE
Loggerheads
50% KDE
95% KDE
Kemp's
50% KDE
95% KDE




90°W
LA
-30 m
-50 m
-200 m
28°N
N
0
50 km
KDE intersection for
Kemp's ridleys and loggerheads
95% KDE (home ranges)
50% KDE (core-use areas)

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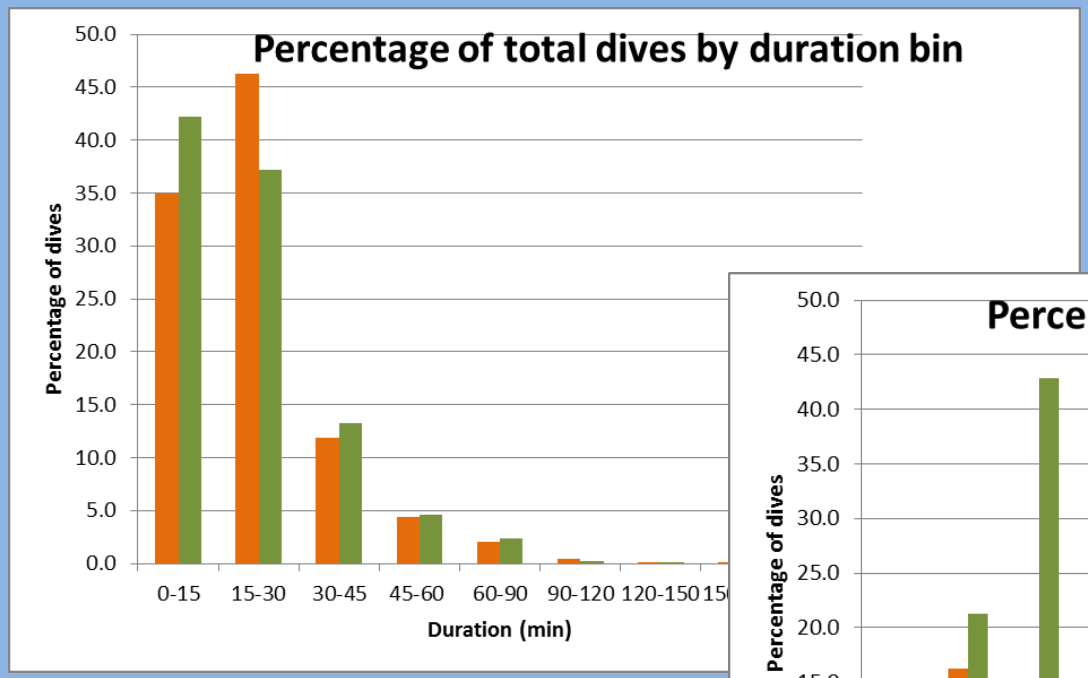
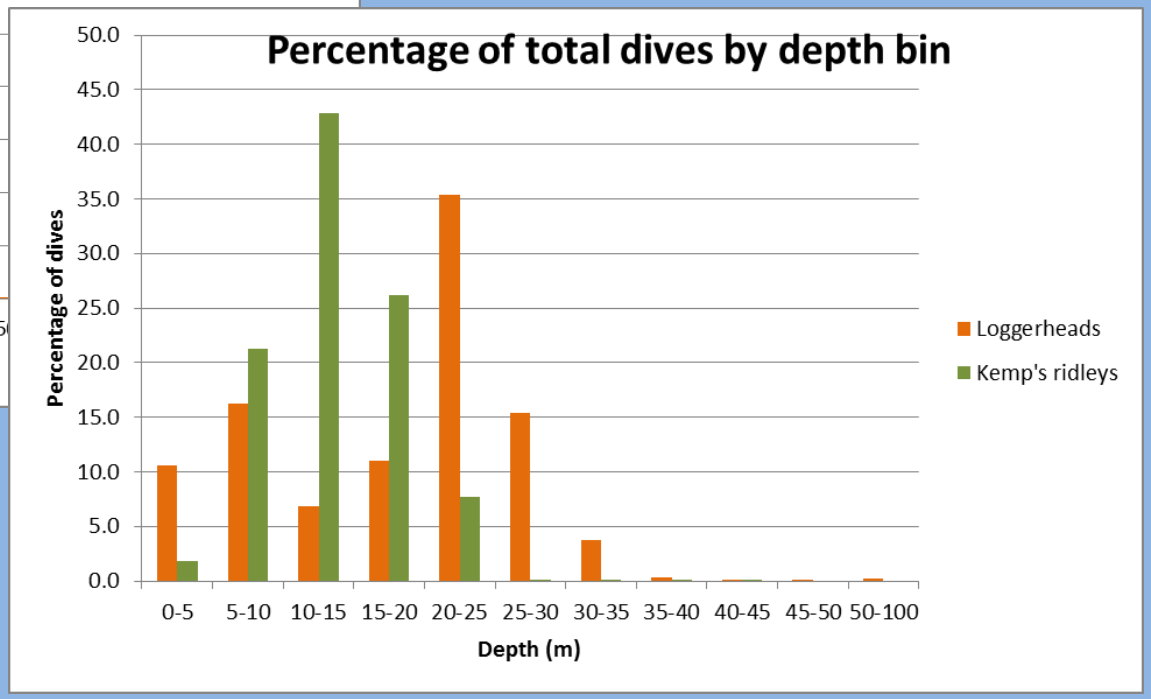
DEPTH INFORMATION:

- What proportion of time is spent in upper/middle/lower water column?
  - ✓ Are there species-specific, size-specific, or gender-specific differences?
  - ✓ Are there seasonal differences?





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CONCLUSIONS & FUTURE WORK:

- Deploy additional tags, with focus on obtaining winter tracks and dive profiles (24 tags in hand, 10 of which are location-only to obtain longer tracking durations)
- Add in fine-scale acceleration data logging tags (ADLs); popoff package necessary where recaptures are low/unknown (new Studies proposal)
- Submit 1st manuscript in 2017
- Serve data into BOEM Sea turtle decision support tool (D. Piatkowski)
- Analyze biological samples (genetics, isotopes)
- Increase sample size/expand study areas
    - Trawling amendment to K. Hart NMFS permit approved
    - Trawling agreement being finalized in contracting
    - Expansion of study area to include Texas; K. Hart NMFs permit amendment being finalized
    - New BPA with tag company currently in contracting

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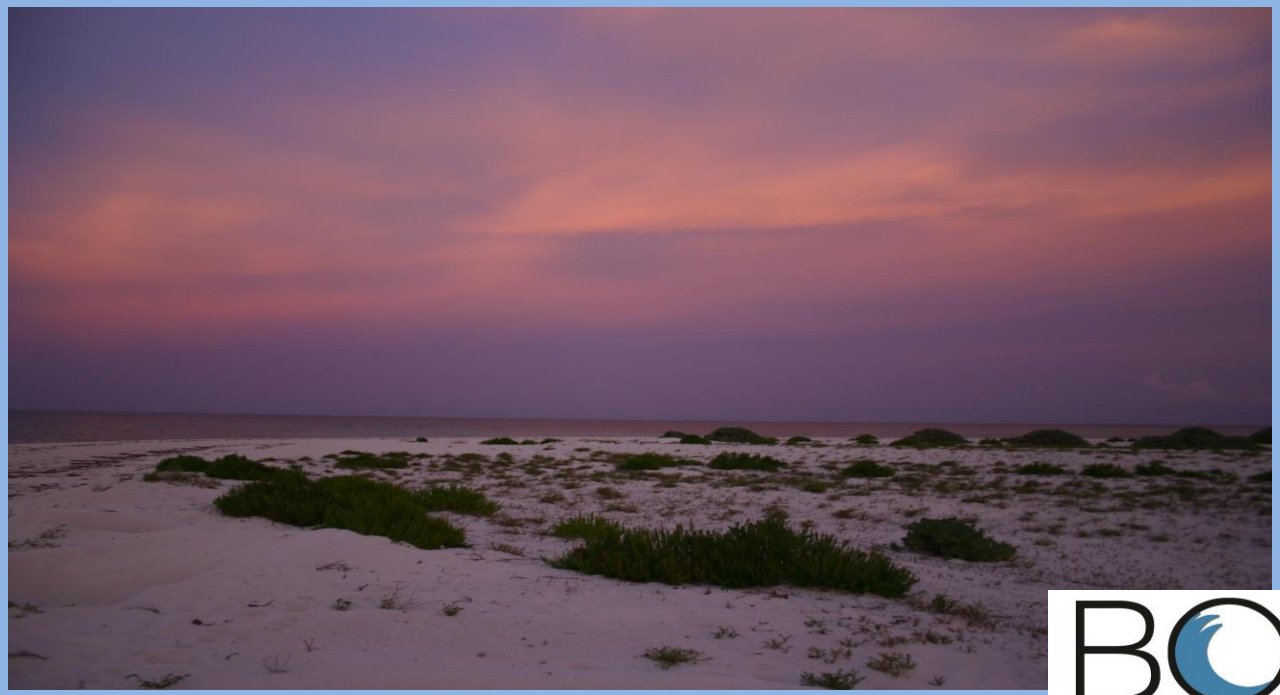
Acknowledgements

- BOEM Marine Minerals Program, Jessica Mallindine and Mike Miner
- Trish Bargo and crew, Miss Adrienne
- Chris Slay and crew, Bosarge Boats, Santa Rosa Island Authority
- Mike Cherkiss, Andrew Crowder, Devon Nemire-Pepe
- NMFS permit 17304 (issued to K. Hart)



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