Movements of Juvenile Green Turtles (*Chelonia mydas*) in Nearshore Waters of the Northwestern Gulf of Mexico

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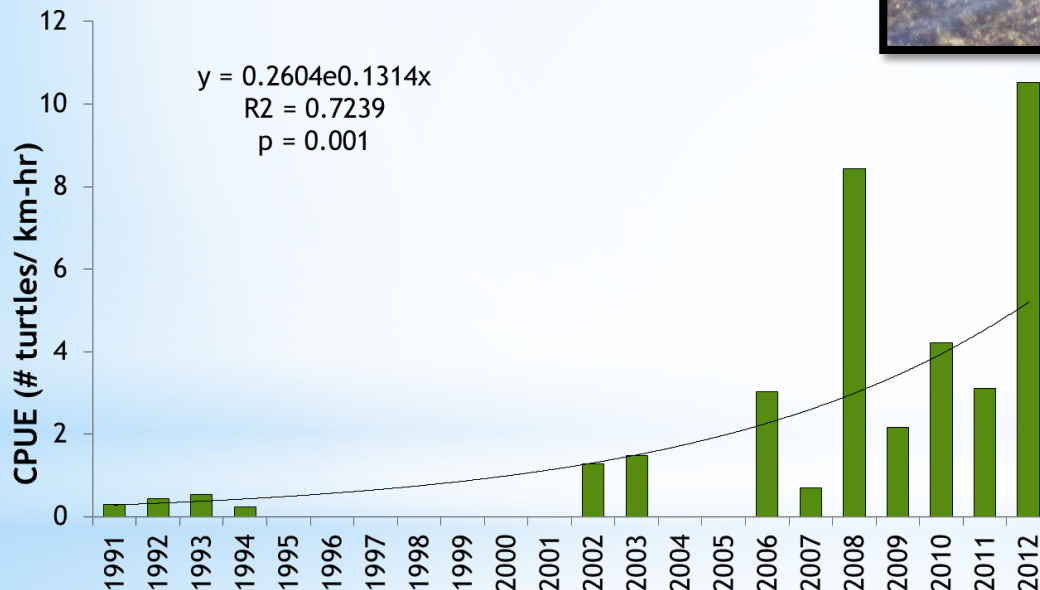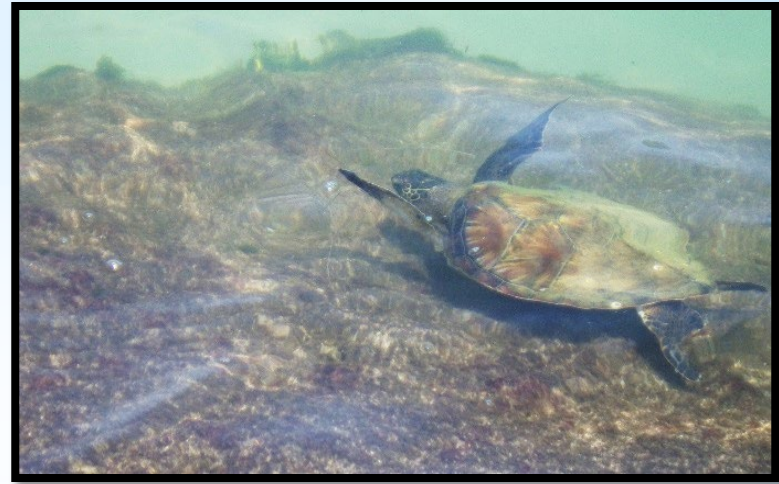
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GREEN TURTLES IN TEXAS

➤ Green turtles utilize Texas waters primarily as juvenile foraging habitat

$y = 0.2604e0.1314x$
$R2 = 0.7239$
$p = 0.001$

Exponential increase in green turtle CPUE (turtles/km-hr) from entanglement netting surveys since 1990 (Metz & Landry, 2013)

CPUE (# turtles/ km-hr)

➤ Increasing number of greens stranding in TX during cold stunning events (Shaver et al. 2017); Overwintering

STUDY OBJECTIVES

➢ Track movements of juvenile green turtles in Texas waters

➢ Utilize Hierarchical Switching State-Space Model (hSSM) to determine track behavioral status – Resident vs. Migratory

➢ Utilize Kernel Density Estimation (KDE) to determine core use (50%) and home range (95%) areas

➢ Perform Space-Time Hot Spot Analyses to identify trends in habitat use

➢ Examine influence of biotic and abiotic factors on habitat use
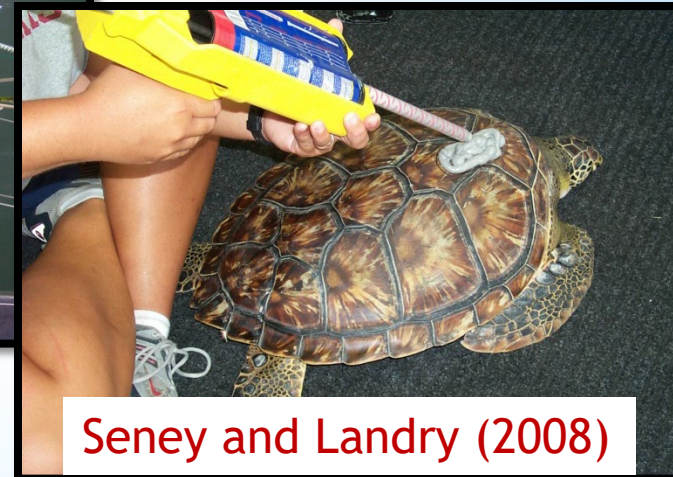
MATERIALS AND METHODS

Study Areas
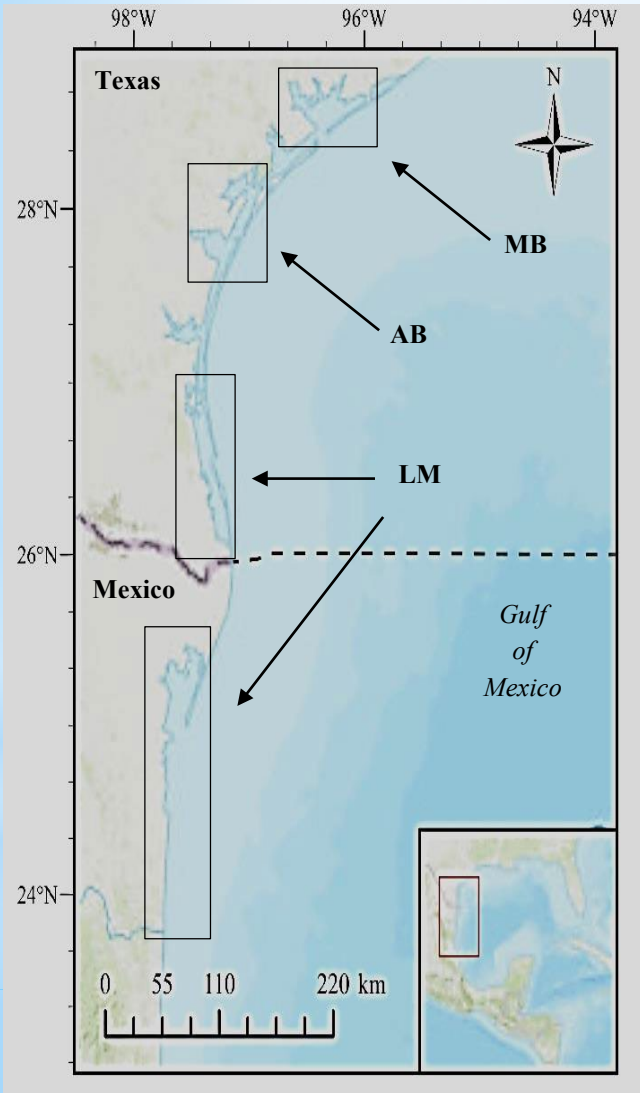
Entanglement Nets:
91.4 m long; 2.9-3.6 m deep
17.8 cm bar mesh
2-4 nets deployed

Net check every 20 minutes

Seney and Landry (2008)

MATERIALS AND METHODS

➢ Track data filtered and processed similarly to Seney and Landry (2011) in STAT (Coyne & Godley, 2005)

➢ Hierarchical Switching State-Space Model (hSSM)

  ➢ Applied methods described by Dawson et al. 2017 and Jonsen 2017

  ➢ RStudio package 'bsam'

➢ KDE Core Area and Home range

  ➢ Excluded hSSM b values < 1.6 (Dawson et al. 2017)

  ➢ Utilized KDE tool in ArcGIS 10.3 in conjunction with 'ks' library in Rstudio

➢ Space-Time Hot Spot Analyses of habitat use

  ➢ Getis-Ord (Gi*) statistic returned for each feature is a z-score (Getis and Ord,1992); the larger the z-score, the more intense the clustering of high values (e.g. "hot-spots")

  ➢ Mann-Kendall trend test is performed on every location with data as an independent bin time-series test

MATERIALS AND METHODS

➢ Influence of biotic and abiotic factors on habitat use:

➢ Seagrass data (Texas Only)

➢ NOAA Marine Cadastral Dataset (https://marinecadastre.gov/data/)

➢ Overlapped seagrass habitat with 50% and 95% KDE contours

➢ Water Temperature – Laguna Madre Only

➢ PTT-derived temperature data paired with raw track latitude (Argos) to determine temperature exposure during track

➢ National Buoy Data Center (NBDC) data paired with hSSM-derived latitude; Non-linear regression to determine temperature at which turtles initiated migration

Green Turtle Satellite Tracking

(2006-2011)

MB 1 wild; 1 rehab

AB 3 wild; 1 rehab

15 Greens Tracked

LM 8 wild; 1 rehab

100 km
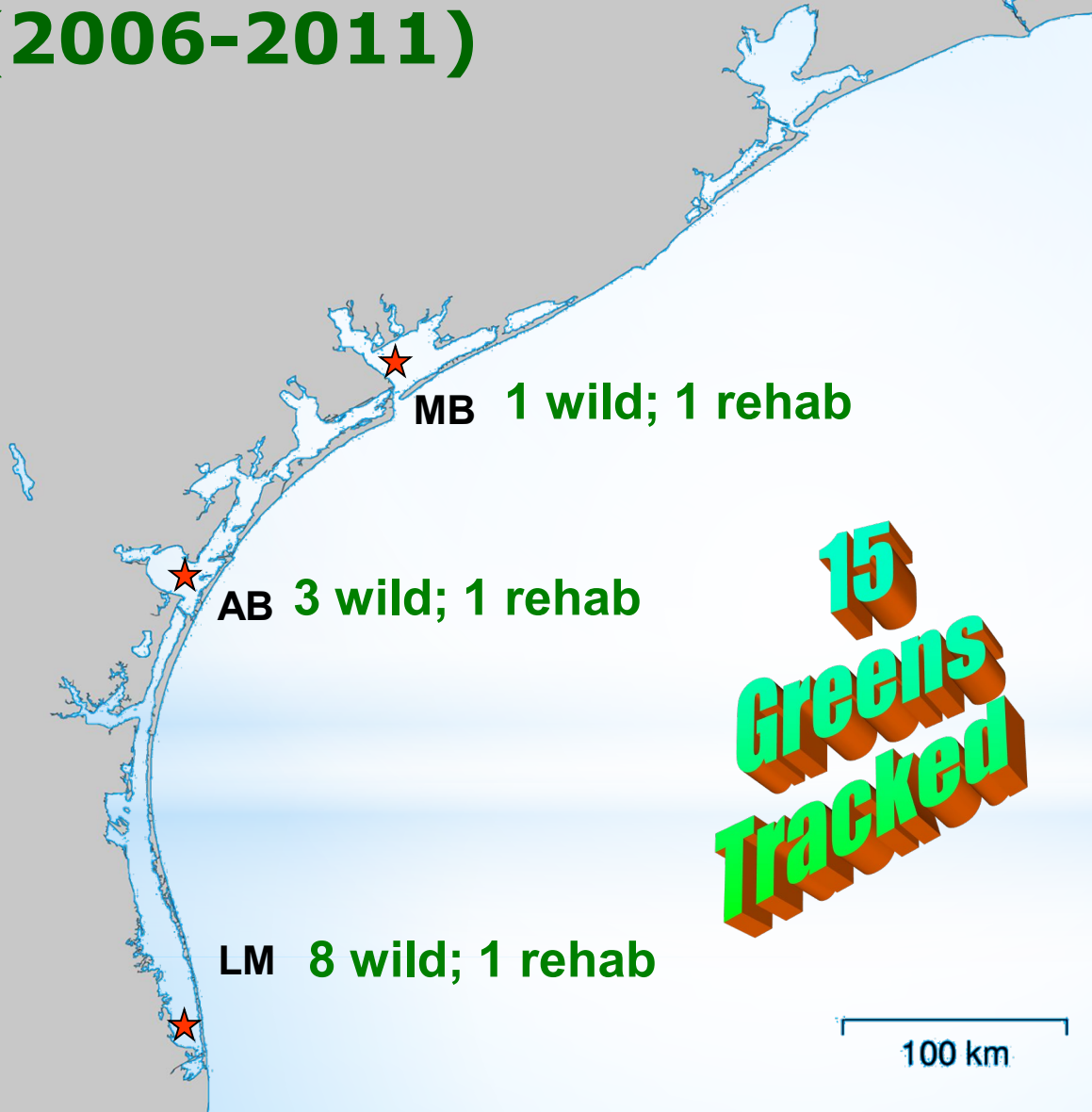
➢ Rehab turtles provided by: NMFS Galveston Lab/Moody Gardens Aquarium; Animal (Amos) Rehabilitation Keep; Sea Turtle, Inc.

RESULTS – TRACK STATS

Turtle Name	SCL (cm)	Study Area	Release Date	Days at Large	# Accepted Locations (N)	Mean Depth (m)
Sprout*	48.1	MB	8/1/2006	147	90	-2.424 ± 0.454
Billy	61.3	MB	6/15/2007	56	127	-1.676 ± 0.136
Heddy*	48.2	AB	7/24/2006	73	36	-2.407 ± 0.843
Stickney	43.5	AB	8/7/2006	141	91	-2.031 ± 0.374
Stretch	45.4	AB	5/21/2007	75	34	-4.981 ± 1.473
Jeffy	57.5	LM	7/27/2007	43	37	-2.074 ± 0.489
Coastie	68.6	LM	6/20/2006	41	127	-1.872 ± 0.522
Ralphie	55.0	LM	5/17/2007	128	117	-4.612 ± 0.833
Katie	43.4	LM	6/26/2007	43	58	-1.492 ± 0.204
Andy T	52.5	LM	8/13/2009	16	42	-1.699 ± 0.221
Sea Aggie	47.1	LM	8/3/2006	207	82	-5.220 ± 1.241
Poopsie	40.0	LM	8/3/2006	343	165	-28.309 ± 15.261
Laguna	69.2	LM	8/10/2009	263	514	-2.203 ± 0.126
Whitley	52.5	LM	11/8/2009	193	169	-3.739 ± 0.619
Papi*	64.8	LM	10/2/2010	181	320	-7.372 ± 0.642
Overall Mean	53.1 ± 2.4			136. ± 27.6	133.9 ± 33.2	-5.5 ± 1.3

* = Rehabilitated

RESULTS - hSSM

Fall (Sep-Nov)   Winter (Dec-Feb)   Spring (Mar-May)   Summer (Jun-Aug)
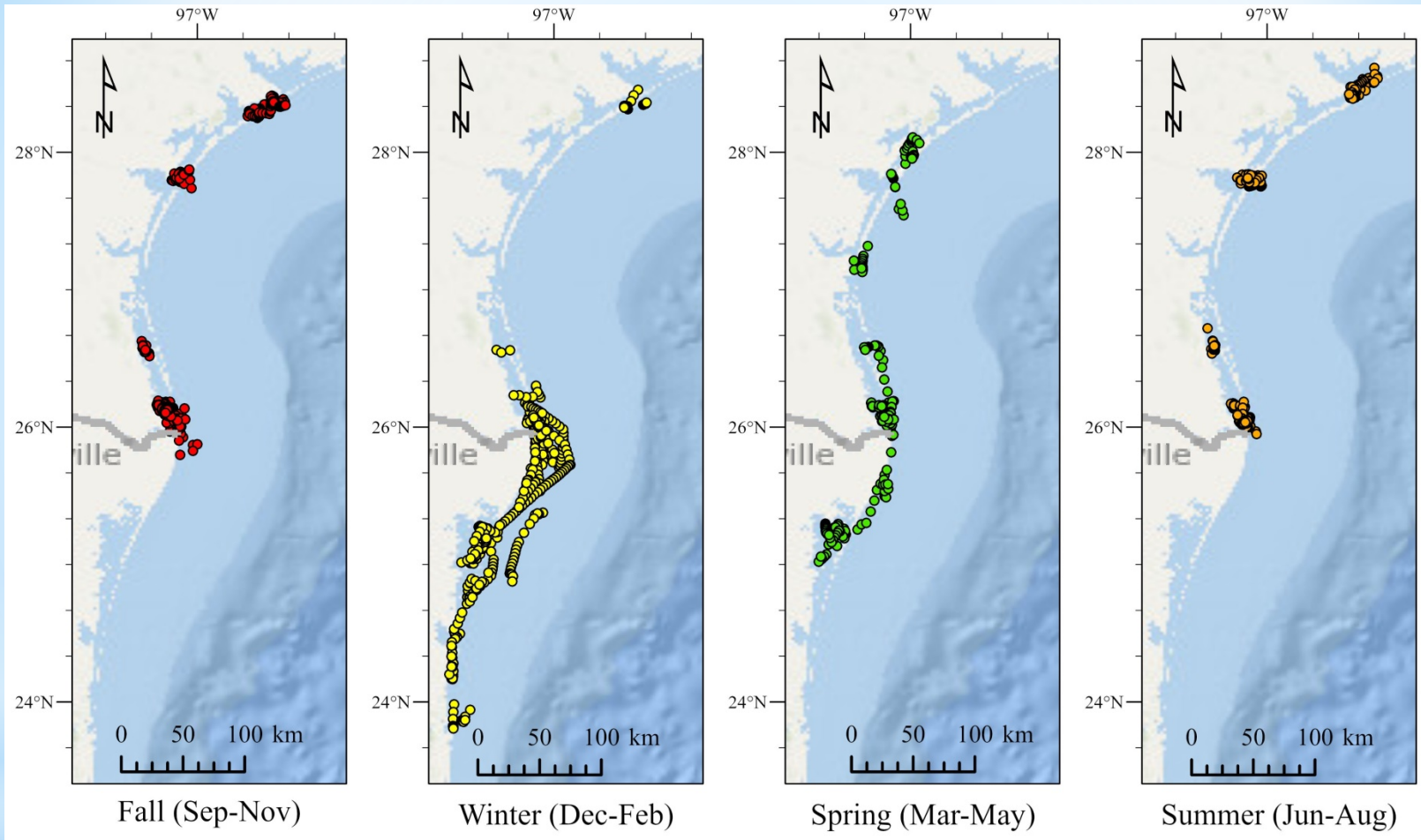
➢ Fall (red) and summer (orange) locations were restricted to inland waters within Texas bays and estuaries.

➢ Winter (yellow) locations showed longest migrations in to the Laguna Madre in Mexico.

RESULTS – KDE & SEAGRASS OVERLAP

➢ No difference between seasons for core area

➢ Winter home range sig. larger than summer

➢ TX core area = 1345 km^2; ~25% seagrass cover

➢ TX home range = 4558 km^2; ~17% seagrass cover

➢ Of available seagrass habitat in Texas, 88% within summer home range
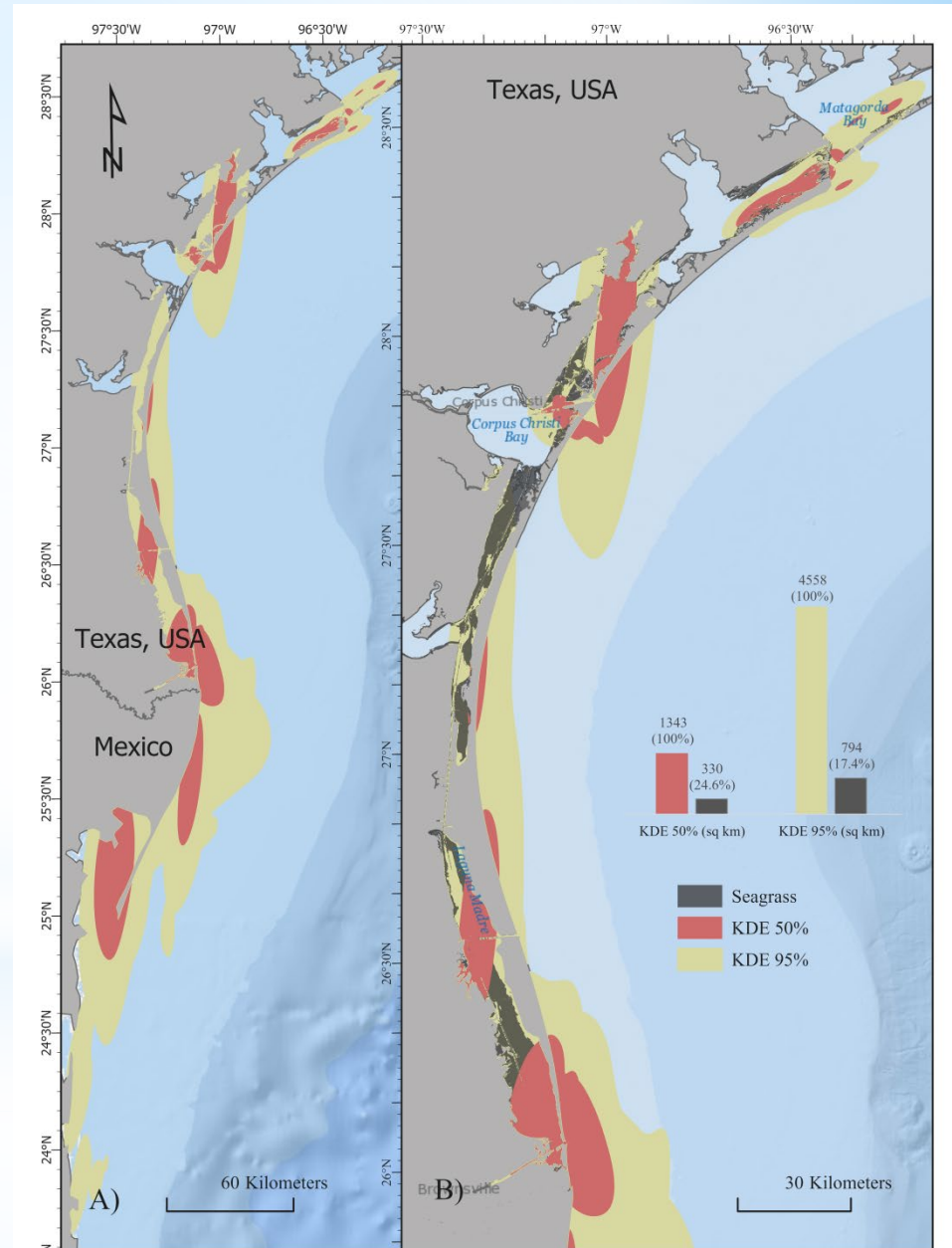
RESULTS – SPACE-TIME HOT SPOT

- Consecutive and Sporadic Hot Spot trends detected in the lower reaches of LM near Port Isabel

- New Hot-Spot trend detected in the upper reaches of LM near Port Mansfield

- Hotspots in Mexican Laguna in earlier months (Jan-Mar),

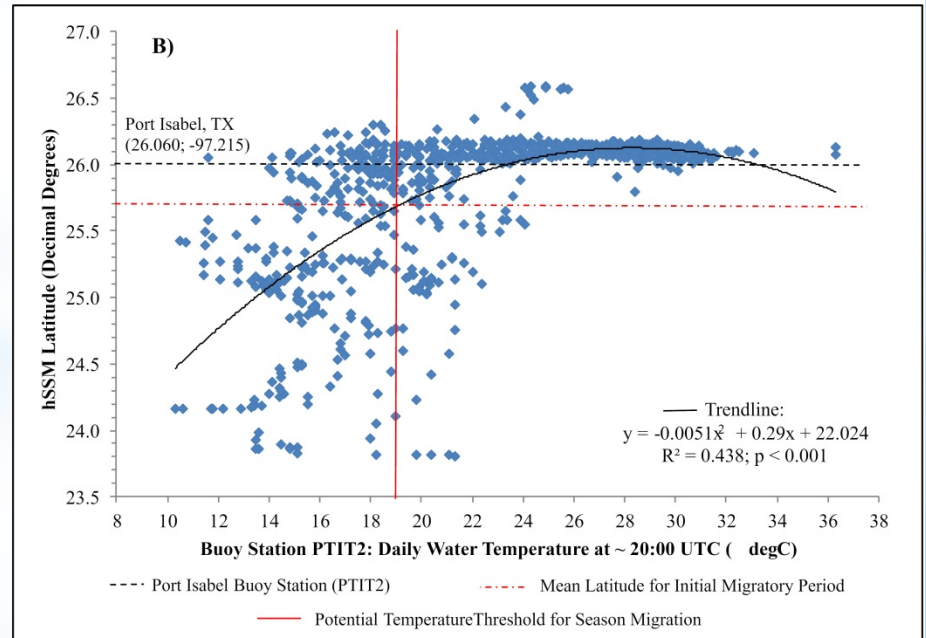- Hotspots in Matagorda/Aransas Bays later in the year (Apr-Dec).
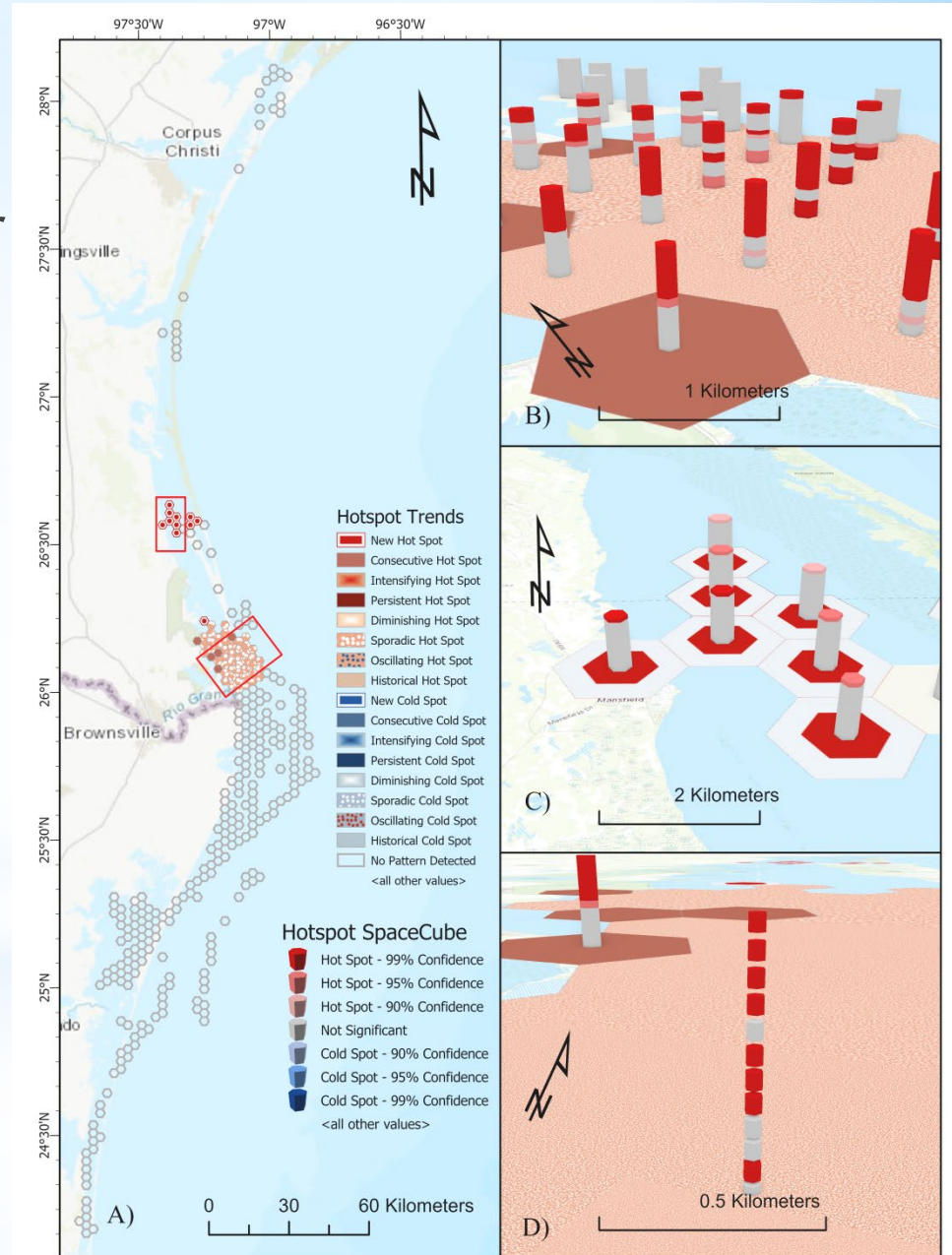
RESULTS – TEMPERATURE

➤ All migratory turtles remained within waters > 15°C regardless of latitude
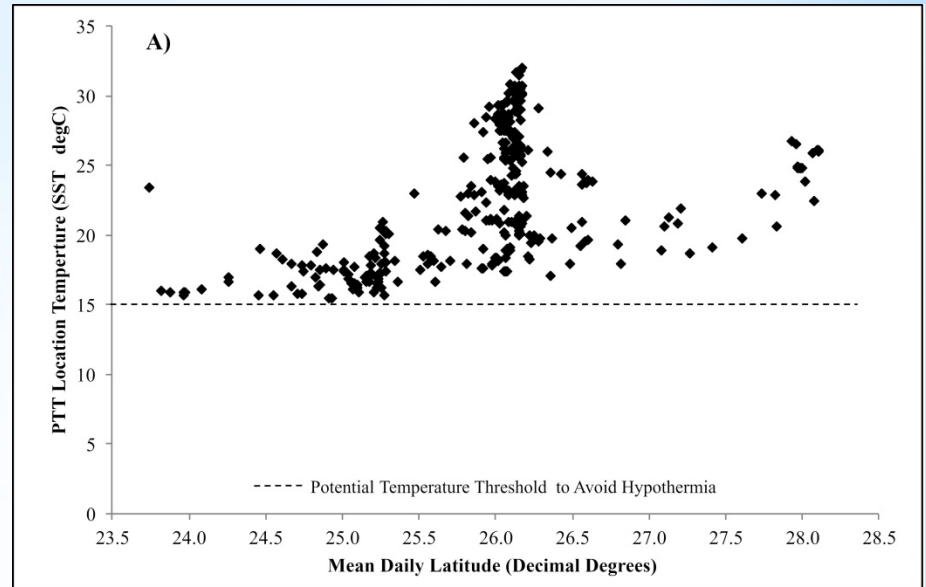
➤ Non-linear relationship in which turtles initiated migration to lower latitudes as water temperatures declined below ~19°C in LM

SUMMARY & CONCLUSIONS

➢ Strong fidelity to Texas sea grass beds, especially in Fall and Summer

➢ Utilizing majority of available seagrass habitat throughout the Texas coast

➢ Laguna Madre represents area of highest activity, especially later in year, according space-time hotspot analysis

➢ Although cold stunning events suggest a high degree of overwintering in Texas, green turtles are capable of seasonal migration
  ➢ Migration south to Mexico in Dec.-Jan. and return to Texas Mar.-Apr.
  ➢ Migration initiated at temperatures between 15°C-19°C

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QUESTIONS

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