

Diamondback Terrapin Mortality and Derelict Trap Removal

Final Project Report December 31, 2018



Cover Photo: Adult female diamondback terrapin captured from Davis Bayou.

Task Agreement Number P15AC01832
Under
Master Cooperative Agreement P12AC51051
Between
The United States Department of the Interior
National Park Service
And
The Nature Conservancy
Mississippi Marine Program
10910 Highway 57, Suite C
Vancleave MS, 39565

Final Project Report for the period February 1, 2016 through to December 31, 2018.

The purpose of the project was to study diamondback terrapin interactions with commercial blue crab traps with the objectives of removing derelict crab traps, assess terrapin populations, and make management recommendations based on project findings. These objectives were accomplished in full for the study area in Davis Bayou. The work was completed by The Nature Conservancy's Mississippi Marine Program and this full report has been submitted by Tom Mohrman detailing major findings which include occurrence of derelict crab traps, findings on the Davis Bayou terrapin population, and management recommendations.

Quarterly federal financial reports were submitted throughout the life of the project showing the federal expenditures. A final financial report will be submitted separately in January, 2019 showing the total expended on the project.

Final Report submitted by Tom Mohrman, Director of Mississippi Marine Programs, The Nature Conservancy on December 21, 2018. Tmohrman@tnc.org, 228-591-1116 X 105.

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Project Title: Diamondback Terrapin Mortality and Derelict Trap Removal

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Period of Performance: September 21, 2015 to September 30, 2018

All required Status Reports have been submitted and include periods ending in 3/31/2016, 6/30/2016, 9/30/2016, 12/31/2016, 3/31/2017, 6/30/2017, 10/30/2017, 12/31/2017, 3/31/2018, 6/30/2018, 9/30/2018, annual report was submitted on 12/21/2016, and final report submitted on 12/21/2018.

Mississippi State permits were acquired covering the activities described in this report. These permits include Mississippi Department of Marine Resources Scientific Research Permits # SRP-0010-16, # SRP-022-17, # SRP-010-18, and Mississippi Department of Wildlife Fisheries and Parks permit numbers 0602161, 0602171. Per MDMR permit, MDMR office of law enforcement was contacted prior to trapping. Notification of general sampling periods were also given to GUIS via Gary Hopkins and later Jolene Williams.

Acknowledgments

This work was made possible thanks to the contributions of our project sponsors, collaborators, and friends. Namely, we thank staff at the Gulf Islands National Seashore for creating the opportunity to study terrapins in Davis Bayou. Specifically, Gary Hopkins, Jolene Williams, Rose McClelland, Brent Everitt, Rhonda Harper, Cassity Bromley, and Superintendent Dan Brown. Additional National Park Service staff we thank are Giselle Mora-Bourgeois of the Gulf Coast Cooperative Ecosystems Study Unit (CESU) and Tim Pinion of Southeast Region Endangered Species Program. Without your support and effort this project would not have been possible.

Contributions to this project were also made by staff from the Mississippi Department of Marine Resources. We thank Jenifer Frey of the Coastal Preserves program for her time in participating in field activities. We thank Rick Burris of the Shrimp and Crab Bureau for providing us the results of the Davis Bayou side scan sonar survey as well as coordinating the removal of the derelict traps identified. We also thank Harron Wise, Michael Sweda, Jack Husley, and Sara Pace for field collection of traps and sonar data.

Finally, we would to acknowledge staff at The Nature Conservancy who merit recognition for their contributions. These include, Mike Murphy, Suzanne Mora, Emily Wright, Rebecca Easterling, Geoff Rich, Seth Blitch, and volunteer Matt Murphy.

Project Background

Terrapins are declining throughout their range (US Atlantic and Gulf Coasts) due to anthropogenic factors including drowning as bycatch in crab traps, habitat loss and degradation, subsidized predation of eggs and hatchlings, and direct harvest for Asian markets. Because of continuing declines, terrapins are recommended for an upgrade to “Vulnerable” on the international IUCN Red List of Threatened Species, defined as “at high risk for extinction in the wild.” While many Atlantic coast terrapin populations have been well studied, information for terrapins along the Gulf coast is severely lacking. The deficiency in research is critical when considering regional differences including habitat and climate may play important roles in terrapin sustainability.

Mortality from drowning in derelict crab traps has been proven time and time again to be a significant threat to terrapin populations and is a perpetual problem. By linking terrapin population localities (identified by mark-recapture) and derelict trap occurrences spatially through GIS, efforts to protect terrapins will be improved. Identification and removal of derelict crab traps from GIS will reduce mortality risk for terrapins, and along with recommendations for management created as a result of this project, may prevent further declines of the population. Additionally, because little is known about the current distribution and status of terrapins in Mississippi, the results of this collaborative project will add to the understanding of terrapin life history and benefit current and future researchers as well as coastal decision makers.

Diamondback terrapins (*Malaclemys terrapin*) are the only species of turtle that solely inhabits brackish water and are endemic to salt marshes, mangroves, and other coastal habitats along the Atlantic and Gulf coasts of the United States. Terrapins are well adapted to their highly aquatic lifestyle; key morphological features include: a hydrodynamic shell, webbed limbs, lacrimal (salt-secreting) glands, and powerful jaws for crushing prey (mollusks and crustaceans; Hart and Lee 2006). Terrapins are one of the top predators in the salt marsh ecosystem controlling marsh grazers including snails and crabs (Silliman and Bertness 2002); terrapins may also serve as a sentinel species for contamination and pollution of sensitive marsh habitats (Blanvillain et al. 2007). Terrapin populations rangewide have faced anthropogenic threats for well over a century. In the 1800s through to mid-1900s, many terrapin populations were hunted nearly to extinction to satisfy the gourmet terrapin stew fad. More recently, terrapins in some areas are again being unsustainably harvested to fulfill the desire for turtle meat by Asian markets. As greater numbers of Americans have moved to coastal areas, nesting beaches and marshes have been degraded or destroyed. While these and other factors have contributed to terrapin declines, the single greatest cause of terrapin decline has been high mortality as bycatch in crab traps (Hart and Lee 2006, Seigel and Gibbons 1995).

Terrapin mortality in crab traps has been well documented (Bishop 1983, Guillory and Prejean 1998, Mann 1995, Roosenburg 1991, Roosenburg et al. 1997, Wood 1997, Wood and Herlands 1995) and has been shown to have potentially devastating effects on local populations. Roosenburg (1991) reported 49 terrapins drowned in a single pot in Maryland and Grosse et al. (2009) reported 94 terrapins drowned in a single trap in Georgia. Because terrapins have a small home range, they can easily be extirpated from a local area, and in turn, the area may not be repopulated by other terrapins (Gibbons et al. 2001). In

South Carolina, a local terrapin population has declined 75% in the last 20 years; the decline is attributed to incidental mortality in recreational crab traps (Dorcas et al. 2007). Roosenburg (1991) estimated that up to 2.8% of a local terrapin population can be removed by crab trap mortality within a single trap and Grosse et al. (2009) documented a 91% reduction in terrapin biomass within a single creek as because of two neglected crab pots. A simple, inexpensive, and highly effective terrapin excluder device was invented in the mid-1990s (Wood 1997) but currently is only required in three states (New Jersey, Maryland, and Delaware) of the 16 states where terrapins occur. Commercial crabbing activity often occurs in terrapin habitat (i.e. nearshore coastal salt marshes). Crab traps are lost or intentionally abandoned due to factors such as storm events, trap neglect, or abandonment because of inadequate storage space. An estimated 20-30% of crab traps become derelict in Mississippi each year (Guillory et al. 2001). Crab traps are constructed to be durable and long-lasting; therefore these derelict traps can persist for several years and continue to actively fish. Because these traps are no longer tended, mortality of bycatch species is a serious problem. Since terrapin excluder devices are not required by law in Mississippi, it is imperative that these derelict traps are regularly removed to protect terrapins from drowning. Also, the removal of derelict crab traps improves boater navigation and safety, enhances aesthetics, and reduces user group conflicts. While terrapin populations are well studied in some parts of their range, information is severely lacking for the Gulf Coast. In Mississippi, the terrapin is listed as “imperiled because of rarity or factor(s) making it vulnerable to extirpation.”

General Methodology

Surveys were conducted to locate derelict traps, document their location with GPS, and record data on any observed trap mortality of terrapins or other species. Because waterbodies are not within the Park’s jurisdiction, we followed state of Mississippi regulations, specifically, that crab traps cannot be removed from the water by anyone but their owner unless during a closed season where traps have been declared abandoned. The crab fishery is continuous in Mississippi (there is no automatic, annual closed season), however, the state may declare a temporary closed season specifically for the removal of derelict traps.

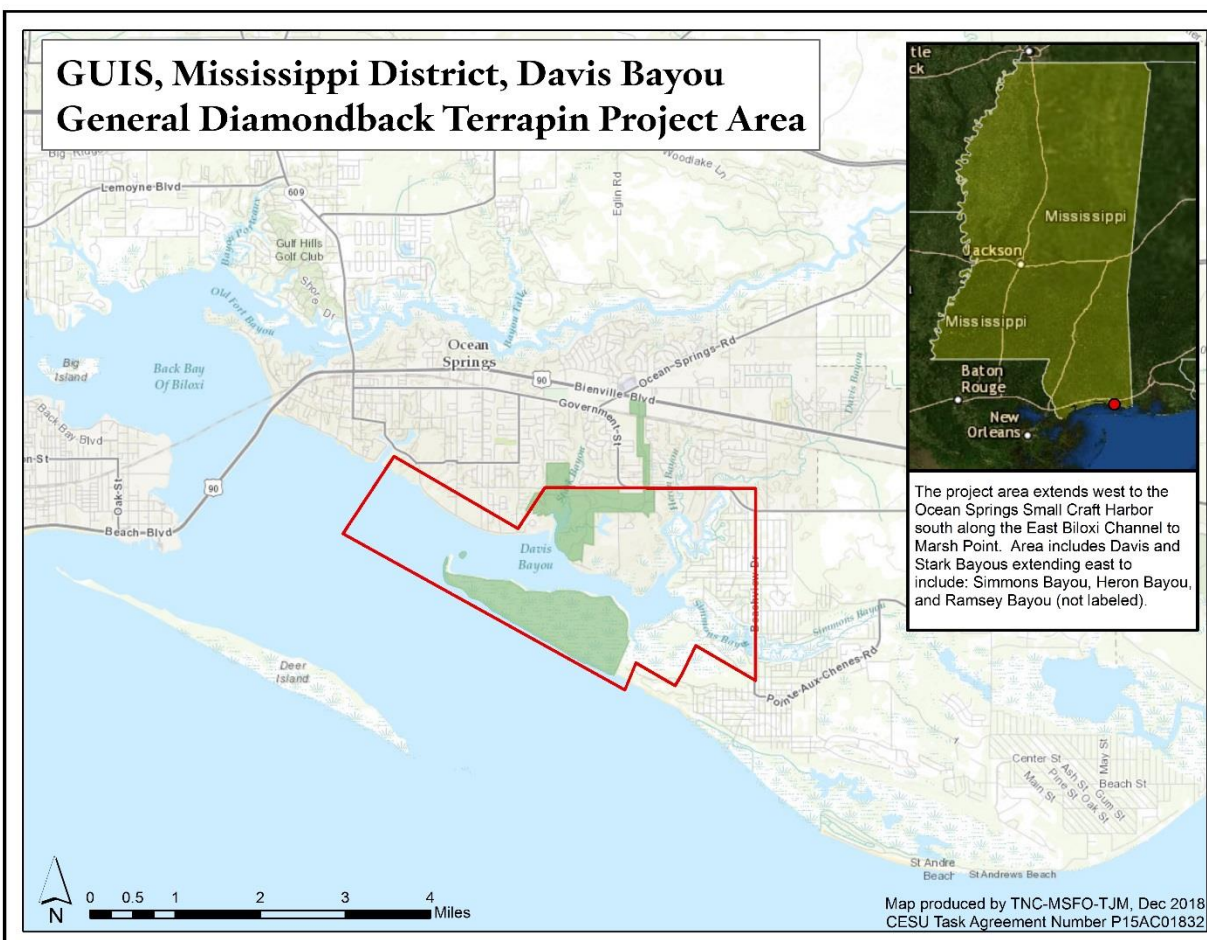
Terrapin mark and re-capture trapping was conducted to determine the specific, localized areas inhabited by terrapins. Data collected were shared with the Mississippi Department of Marine Resources, the state regulatory agency that oversees the commercial crab fishery, and other interested parties.

During the terrapin nesting season potential nesting habitat was surveyed for terrapin activity. Locations of nests were recorded using GPS. Eggshells were counted from depredated and hatched nests and removed to prevent re-counting on future visits. Terrapin nesting beach survey was used to complement the mark-recapture study, creating a more complete picture of the status and health of local terrapin populations. These two survey techniques have been used successfully by researchers in Mississippi (Mann 1995 and Watters 2007) and by researchers rangewide (Gibbons et al 2001, Hoyle and Gibbons 2000, Hogan 2003, Mann 1995, Mitro 2003, Wood 2007).

Project Summary

This project was performed to study diamondback terrapin (*Malaclemys terrapin*) status and derelict (lost or abandoned) crab trap occurrence in Gulf Islands National Seashore (GUIS). Terrapin mortality from drowning in crab traps (derelict and active) is a threat to terrapins range wide and is a concern in GUIS because crabbing activity occurs in terrapin habitat. Terrapins are designated a Species of Management Concern (SOMC) by GUIS and in Mississippi are listed as “imperiled because of rarity or factor(s) making it vulnerable to extirpation.”

The project area of Davis Bayou (Map1) included the main Davis Bayou Channel and those constituent bayous that drained through from the east. The western extent was demarcated at the approximate location East Biloxi Channel north to the Ocean Springs Small Craft Harbor. Included in the Davis Bayou study area were Stark Bayou and Halstead Bayou, which are located within Gulf Islands National Seashore. Additionally, Simmons Bayou, Heron Bayou, and Ramsey Bayou form the eastern drainage of the bayou. This forms a logical and partially contained study area for the local terrapin population. The western extent of study area at the East Biloxi Channel was designed to create a reasonable delineation with Biloxi Bay.



Map 1: General project area identified in the red polygon, NPS property identified in green.

Project activities included documenting derelict crab and actively fished traps, trapping, marking and releasing terrapins and surveying nesting habitat. Surveys were conducted to locate derelict traps and record data on any observed trap mortality of terrapins or other species. During the terrapin nesting season, potential nesting habitat was surveyed for terrapin activity. Locations of nests were recorded and eggshells were counted from depredated nests. Fyke nets were used to trap for terrapins, then captured specimens were marked and released. These data will give Gulf Islands National Seashore a better understanding of terrapin life history in the Park and provide data to improve management of this rare species. Field work for this project was also planned at the Grand Bay National Estuarine Research Reserve (GBNERR), however, the principal investigator working on terrapins at Grand Bay left and the position was not refilled.

Report Summary

This report covers work completed on the “Diamondback Terrapin Mortality and Derelict Trap Removal,” CESU agreement between the dates of February 1, 2016 through to December 31, 2018. It is intended to serve as a final report to the Gulf Islands National seashore for this project.

Work accomplished during project

Performance Goal 1: Removal of Derelict Crab Traps

Derelict traps were located using dedicated boat surveys and also identified while conducting other aspects of this project. When found, GPS coordinates were collected and later relayed to the Mississippi Department of Marine Resource’s (MDMR) Crab and Shrimp Bureau Director for subsequent removal. We were unable to remove these traps ourselves per Mississippi State Code § 49-15-92 (2013); Title 49 - CONSERVATION AND ECOLOGY, Chapter 15 – SEAFOOD, Article 1 - GENERAL PROVISIONS, § 49-15-92 - Penalties for theft of crab traps or crabs. Therefore, per advice from the MDMR Crab and Shrimp Director, we referred location data to the MDMR. Collection of traps during scheduled closures of crab fishery for “round-ups” was originally proposed. This was not possible due to a lack of closures over the course of the project performance period. These closures are not annual but occur when funding is available and a perceived need due to build-up of derelict traps. A proposed trap-round up is suggested for February of 2019, but as of the time of this report, has not been approved by the MDMR Commission of Marine Resources (CMR).

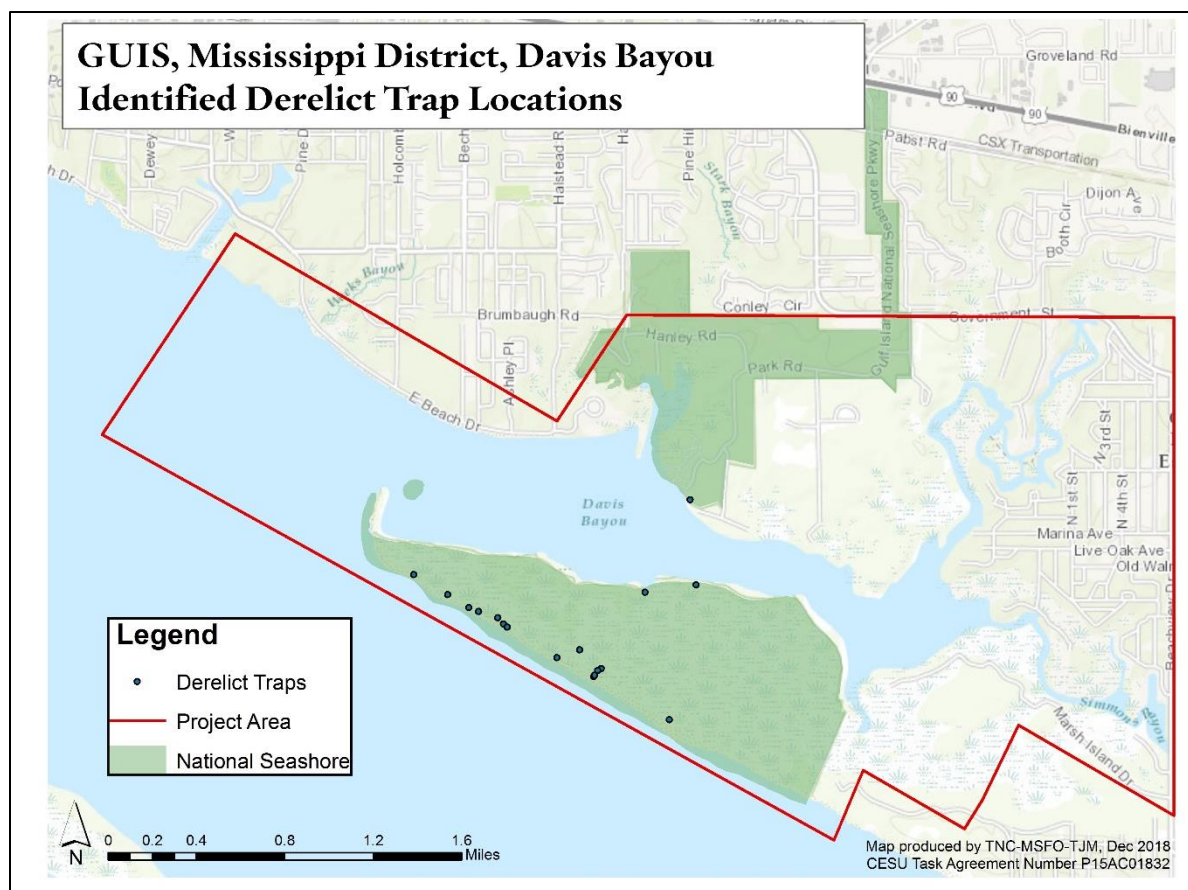
Coordination with the MDMR Crab and Shrimp Bureau provided an opportunity to include Davis Bayou in their program to use side-scan sonar to locate submerged traps. Since these traps are underwater, they would have been undetectable to our boat surveys. Seven submerged and three intertidal derelict traps were identified, located, and removed by MDMR staff in the waters near Davis Bayou and Marsh Point. This effort represented a contribution of 30 hours of four MDMR staff. The results of their survey and their report are included as Appendix 1, “MDMR Side Scan Survey: Biloxi Bay near Marsh Point and Davis Bayou.”

Summarized in Table 1, a total of 28 derelict traps were identified, documented, and removed. Derelict traps were identified in intertidal and terrestrial areas by visual surveys by TNC staff. MDMR conducted a side scan sonar survey of Davis Bayou and the waters around Marsh Point to survey for subtidal submerged derelict traps. Of the 28 traps identified, seven were located in subtidal waters, 14 located in intertidal habitat, and seven located in terrestrial habitat. The largest concentration of derelict traps found was in November, 2017 in the interior of Marsh Point. It is our belief that these traps were washed into the interior of Marsh Point as a result of Hurricane Nate which made a landfall near Biloxi, Mississippi on October 8th, 2017. This storm was notable to this project as it had a significant storm surge (6.3 feet recorded in Pascagoula) and near hurricane force winds (70 mph recorded in Pascagoula) that caused flooding in local casinos, rip currents, and beach erosion (Beven 2018). In general, about half of the traps found were heavily degraded (Fig. 1) and no longer posed a threat as ghost traps, with the exception being the traps located after Hurricane Nate which were in good condition and salvageable for re-use (Maps 2 & 3)(Fig. 2).

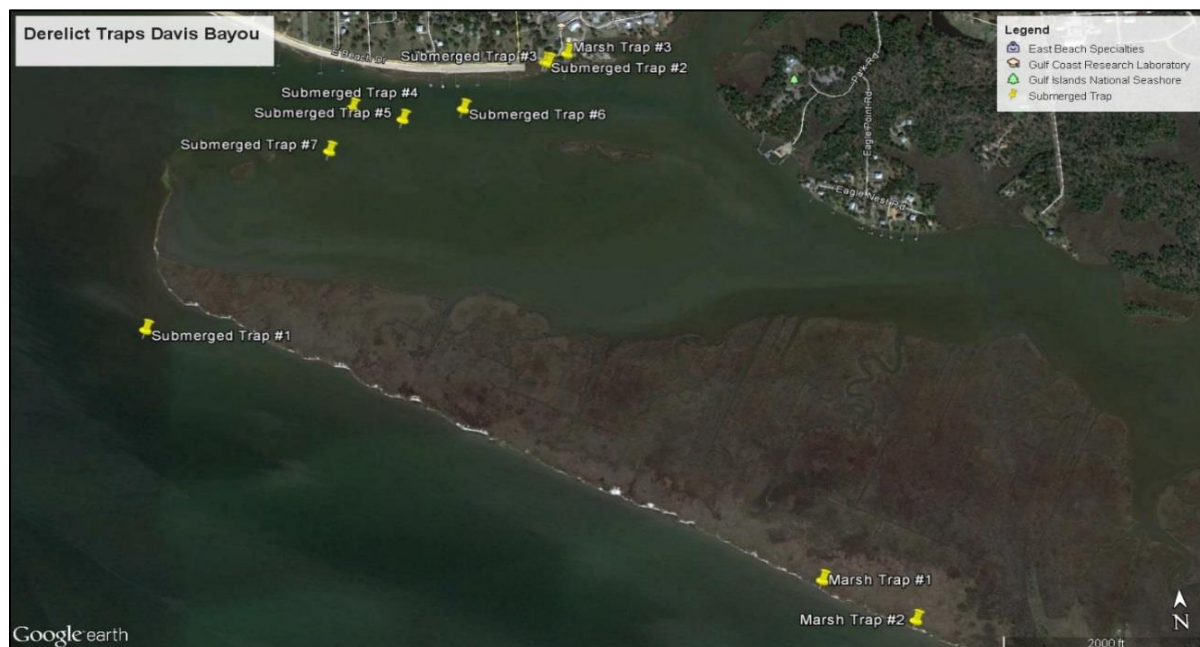
Derelict traps were identified primarily in conjunction with other project activities such fyke net trapping and the beach nest surveys. MDMR side scan sonar surveys were conducted on 11-3-2017 and 11-7-2017. Dedicated trap surveys were conducted on 11-8-2016 (Davis Bayou), 3-13-2017 (Marsh Point), 6-2-2017 (Halstead Bayou and Stark Bayou), 11-8-2017 (Marsh Point), 11-9-2018 (Marsh Point), 4-30-2018 (Halstead Bayou, Stark Bayou and Davis Bayou Channel), 5-2-2018, (northern Marsh Point and creeks), 5-7-2018 (Davis Bayou, Marsh Point and creeks), and 5-23-2018 (Halstead Bayou and Stark Bayou).

Date Detected	Trap Designation	Location	Habitat Description	Tidal Zone	By-catch
11-23-2016	11-23-2016-0001	Marsh Point	intertidal beach	intertidal	none
4-27-2017	4-27-2017-1115	Marsh Point	intertidal beach	intertidal	none
4-27-2017	4-27-2017-1148	Marsh Point	intertidal beach	intertidal	none
4-27-2017	4-27-2017-1245	Marsh Point	intertidal beach	intertidal	none
6-2-2017	5-3-2017-1210	GUIS Government Boat Dock	intertidal marsh	intertidal	none
7-11-2017	7-11-2017-0001	Marsh Point	Interior saltmarsh	terrestrial	none
11-8-2017	11-8-2017-1307	Marsh Point	intertidal beach	intertidal	none
11-8-2017	11-8-2017 1325	Marsh Point	saltmarsh	intertidal	none
11-8-2017	11-8-2017 1345	Marsh Point	intertidal beach	intertidal	none
11-9-2017	11-9-2017 1154	Marsh Point	intertidal soft bottom	intertidal	none
11-9-2017	11-9-2017 1220	Marsh Point	saltmarsh	terrestrial	3 blue crabs
11-9-2017	11-9-2017 1235	Marsh Point	intertidal beach	intertidal	none
11-9-2017	11-9-2017 1237	Marsh Point	intertidal beach	intertidal	none
11-9-2017	11-9-2017 1305	Marsh Point	intertidal beach	intertidal	none
11-9-2017	11-9-2017 1325	Marsh Point	saltmarsh	terrestrial	2 blue crabs
11-9-2017	11-9-2017 1326	Marsh Point	saltmarsh	terrestrial	none
11-3-2017	11-3-2017 ST01	Davis Bayou Channel	benthic soft bottom	sub-tidal/ submerged	not reported by MDMR
11-3-2017	11-3-2017 MT01	Marsh Point	saltmarsh	terrestrial	not reported by MDMR
11-3-2017	11-3-2017 MT02	Marsh Point	saltmarsh	terrestrial	not reported by MDMR
11-3-2017	11-3-2017 MT03	Marsh Point	saltmarsh	terrestrial	not reported by MDMR
11-3-2017	11-3-2017 ST04	Davis Bayou Channel	benthic soft bottom	sub-tidal/ submerged	not reported by MDMR
11-3-2017	11-3-2017 ST05	Davis Bayou Channel	benthic soft bottom	sub-tidal/ submerged	not reported by MDMR
11-3-2017	11-3-2017 ST06	Davis Bayou Channel	benthic soft bottom	sub-tidal/ submerged	not reported by MDMR
11-3-2017	11-3-2017 ST07	Davis Bayou Channel	benthic soft bottom	sub-tidal/ submerged	not reported by MDMR
11-7-2017	11-7-2017-ST02	Gulf Coast Research Laboratory Pier	shallow soft bottom	sub-tidal/ submerged	not reported by MDMR
11-7-2017	11-7-2017-ST03	Gulf Coast Research Laboratory Pier	shallow soft bottom	sub-tidal/ submerged	not reported by MDMR
11-7-2017	11-7-2017-MT03	Gulf Coast Research Laboratory Pier	saltmarsh	intertidal	not reported by MDMR
5-2-2018	5-2-2018-1045	Marsh Point	saltmarsh	intertidal	none

Table 1: Summary of derelict trap locations with regard to location, habitat, and by-catch. GPS coordinate data is included in Appendix 2.



Map 2: Locations of derelict traps identified by TNC.



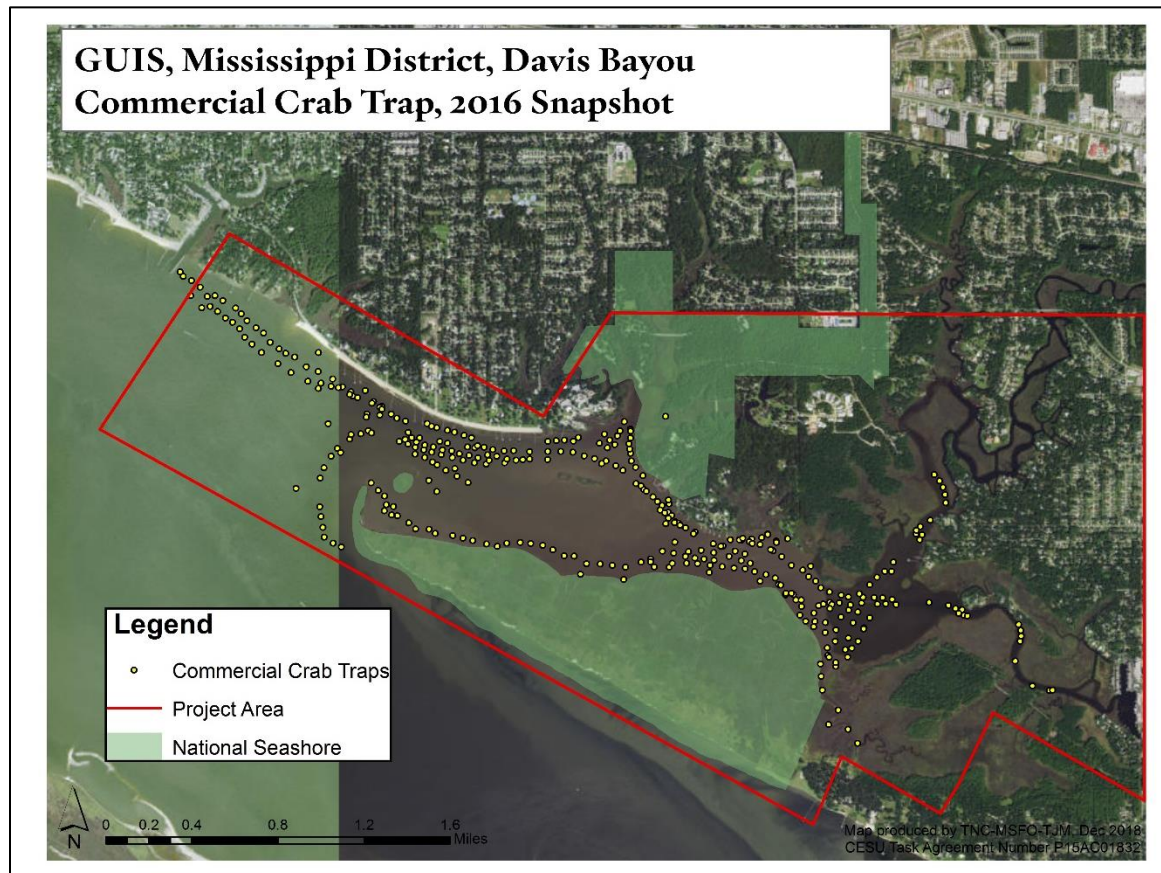
Map 3: Locations of derelict traps identified by MDMR.

Performance Goal 1: Document Commercial Crab Trap Effort

Interactions between commercial crab traps and diamondback terrapins was a concern for GUIS this project. As such, we documented the commercial crab effort in the fall of 2016. Leading to development of a general overview of crab trap distribution and effort.

Boat surveys were conducted and completed in Davis Bayou to identify the locations of commercial crab traps, recreational crab traps and potential ghost traps. The surveyed area included the waters east of the East Biloxi Channel and Ocean Springs Small Craft Harbor. Surveyed areas also include waters immediately south of Marsh Point. Three hundred and sixty-eight crab traps were documented with GPS coordinates recorded. The majority of these traps appear to be well maintained commercial fishing traps. Five potential ghost traps were also documented and were monitored to determine if they are in fact unmaintained traps. Two recreational traps were identified off the pier of a private residence. Based on observation made during the survey, commercial trapping appears to be limited to one or two individuals. It was observed that traps were being checked by their owners at the same time our surveys were conducted.

No traps were handled, removed, or impacted by our survey. Deliberate effort was made to make only visual observations. Water clarity and tidal height allowed us to make partial observations of several traps looking through the water. No terrapins were seen in traps.



Map 4: Distribution of commercial crab traps in Davis Bayou, fall 2016.

Performance Goal 2: Assess Terrapin Populations

Diamondback terrapins were sampled using a variety of four different style fyke nets. These nets included, style 1: a double wing, 1/8 inch nylon mesh with 2, 40 foot leads, and 4 hoops (Fig. 3), style 2: double wing, 1/8 inch nylon mesh with 2, 20 leads, and 4 hoops, (Fig. 4), style 3: a single 50 ft wing, ¼ inch nylon mesh, 7 hoop fyke net, (Fig. 5), and style 4: a six hoop 1 ½ inch mesh coated net with a 25 foot lead (Fig. 6,7). After initial sampling we decided to expand use of style 4. Style one was excellent at catching small minnow sized fishes and small invertebrates, however never caught any large fish or terrapins and was very difficult to utilize when full. Style 2's small size did allow for working in small shallow waters, however it rarely yielded catch of any kind. Style 3's long single lead can cover a large area and block off small creeks, however its large size tended to act as a sail with the tide and was easily twisted and knocked over. After our first sample sets, we purchased more nets with the specifications of style four. This alignment appeared to be the right mesh size to allow smaller animals through the net, prevent water currents from twisting the lead, was easy to deploy in all types of marsh habitat we were sampling in.

Fyke nets were held in place using one-inch diameter, 10 foot length piece of grey PVC pipe (white PVC pipe was not durable enough to hold nets in place). Nets were placed with one end into a marsh edge with the remaining net extended as perpendiculars as possible. The intent was for the lead to act as physical barrier for terrapins that led them into the hoop nets for capture. The hoop net section of the trap was equipped with crab trap floats to create an air pocket for turtles at high tide. Each trap was additionally marked with up to two bright orange buoy floats marking the two ends of the net. The Mississippi Department of Fisheries Parks and Wildlife permit number was written on the orange floats, and contact information for TNC staff was written on laminated sheets attached to either floats or grey PVC pipe. If there appeared to be a risk of a net rolling over, additional ½ inch white PVC pipes were threaded through the trap hoops to stabilize the net.

A total of five terrapins were collected (Table 2; 3 male, 2 female), (Fig. 8-11). Female terrapins were palpated; one was gravid. Terrapins were measured and marked with a PIT tag for future identification. Captured terrapins were released up to 50 feet from their point of capture. Handling time was not specifically recorded but based on trap check data all terrapins were release in under 35 minutes. Trap locations are shown in Map 6, trap effort is reported in Table 3 and expanded in Appendix 3.

Table 2: Terrapin Capture Summary						
Terrapin ID	Date	Sex	Midline carapace	Mass	Location collected	Method Collected
070618575	5/1/2018	female- gravid	17.2 cm	820.8 grams	30 22.978, -88 47.582	fyke net
070620355	5/1/2018	male	11.3 cm	216.0 grams	30 22.972, -88 47.185	fyke net
070622332	5/7/2018	male	11.1 cm	195.1 grams	30 23.136, -88 48.338	fyke net
070639829	5/7/2018	female	12.7 cm	296.3 grams	30 23.136, -88 48.338	fyke net
070789846	5/7/2018	male	10.8 cm	201.6 grams	30 23.007, -88 48.167	hand collected

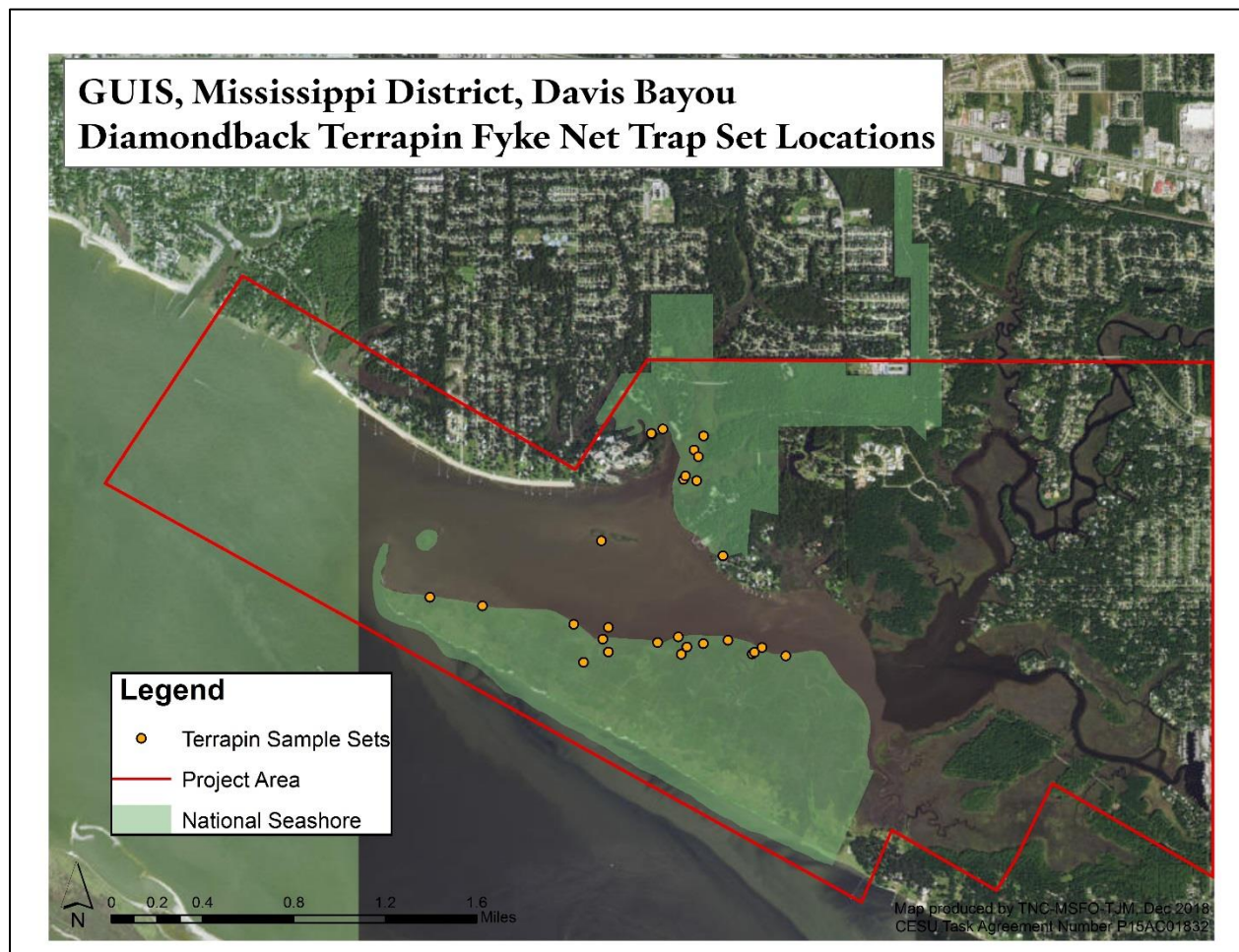
Figure 3: Fyke Net Sample Localities				
<i>Summary; 30 Localities, 69 trap days, ,648 trap hours</i>				
Trap Location	Latitude	Longitude	Trap hours	Results
Stark Bayou	30 23.716	-88 47.652	5	
Davis Bayou	30 23.625	-88 47.517	4	
Halstead Bayou	30 23.546	-88 47.524	4	
Stark Bayou	30 23.699	-88 47.695	22	
Halstead Bayou	30 23.551	-88 47.574	21	
Halstead Bayou	30 23.551	-88 47.574	46	
Davis Bayou	30 25.602	-88 47.645	47	
Stark Bayou	30 23.647	-88 47.533	45	
Marsh Point, main bayou	30 23.027	-88 47.880	70	
Marsh Point, inlet	30 22.979	-88 47.312	72	
Marsh Point, inlet	30 22.951	-88 47.954	47	
Marsh Point, inlet	30 22.978	-88 47.582	94	1 female
Marsh Point, inlet	30 23.013	-88 47.498	95	
Marsh Point, main bayou	30 23.024	-88 47.405	94	
Marsh Point, inlet	30 22.984	-88 47.304	95	
Marsh Point, main bayou	30 22.972	-88 47.185	94	1 male
Marsh Point, inlet	30 22.985	-88 47.859	74	
Marsh Point, main bayou	30 23.066	-88 47.859	74	
Marsh Point, 3 creek branch	30 23.076	-88 47.991	74	
Marsh Point, main bayou	30 23.136	-88 48.338	72	1male, 1 female
Marsh Point, main bayou	30 23.165	-88 48.537	72	
Halstead Bayou	30 23.701	-88 47.696	49	
Stark Bayou	30 23.692	-88 47.496	49	
Halstead Bayou	30 23.561	-88 47.565	48	
Davis Bayou Islands	30 23.349	-88 47.886	48	
Yeats House inlet	30 23.300	-88 47.423	49	
Marsh Point, main bayou	30 23.000	-88 47.275	46	
Marsh Point, inlet	30 23.002	-88 47.560	46	
Marsh Point, main bayou	30 23.035	-88 47.593	46	
Marsh Point, inlet	30 23.016	-88 47.672	46	

Trapping of diamondback terrapins in Mississippi has been notoriously difficult. Use of modified crab traps, which work with Mid-Atlantic populations of terrapins, appear to be less effective in Mississippi. We do however believe that though this project we have found an effective gear that can catch terrapins. The fyke net identified as style 4 in this report appears to be effective in catching terrapins. Although we only had four captures with this approach, we believe that it is effective and would provide more data if used more frequently.

Non-target species were captured as a part of sampling and immediately released on site. Collection activities are in compliance with our state wildlife permits. Non-target species encountered include; American Alligator (*Alligator mississippiensis*), Blue Crab (*Callinectes sapidus*), Brown shrimp (*Farfantepenaeus aztecus*), Grass shrimp (*Palaemonetes sp.*), Red Drum (*Sciaenops ocellatus*),

Alligator gar (*Atractosteus spatula*), Longnose gar (*Lepisosteus osseus*), Atlantic Croaker (*Micropogonias undulates*), Speckled Trout (*Cynoscion nebulosus*), White trout (*Cynoscion arenarius*), Spot (*Leiostomus*

xanthurus), Striped mullet (*Mugil cephalus*), Pinfish (*Lagodon rhomboids*), Silversides (*Menidia sp.*), and Bull minnow (*Fundulus grandis*).



Map 5: Locations of fyke net sampling.

Performance Goal 2: Terrapin Nest Survey

Terrapin nesting surveys were conducted on Marsh Point’s southern shoreline, (Fig. 12-13). A survey transect was established from the western tip of Marsh Point (30°23.200, -88°48.718) east approximately 1.19 kilometers to a point at (30°22.888, -88°48.190). Along this route, upland habitat was surveyed that was above the high tideline between the southern intertidal zone and the northern marsh slope. As classified by the Mississippi State Wildlife Action Plan (MMNH 2015) these habitats included Mainland Natural Beaches and Estuarine Shrublands. There are also occurrences of oyster shell or shell hash substrate on Marsh Point, but due to the small size and unknown origin it is unclear if this is a remnant shell midden. In general, this area included intermittent vegetative rack and a variety manmade debris. The area was heavily utilized by raccoons as a foraging area evidenced by their scat, tracks, and terrapin nest excavations. We also once noted a set of canid tracks; it was unclear if this was

a wild animal or a domestic visitor. Nutria (*Myocastor coypus*) scat was sporadically observed. Red imported fire ants (*Solenopsis invicta*) were also observed, in one instance infesting a freshly disturbed terrapin nest. Non-native *Sesbania punicea*, (Fig. 14), was encountered as well as several thick patches of a *Phragmites* sp. It is unclear if the species of *Phragmites* is *Phragmites australis* or a native. Regardless, these patches appear to be recent, fast spreading, and a potential threat to terrapin nesting habitat.

The transect was surveyed with up to three people at a time heading together in one direction, searching all available upland habitat for predated or exposed terrapin nests. Surveyors then doubled back over the surveyed area to look for any missed nests. Identification of a nest was tentatively made based on turtle egg shell present on the substrate. Once a potential nest site was identified, surveyors hand excavated the immediate area searching for the nest chamber. Once a nest site was confirmed, all eggshell fragments were collected and counted. An estimation of the number of eggs present in the nest was made based on the number of eggshell fragments. Eggshells were removed for the project site to prevent them from being counted more than once and later stored.

A total of 45 terrapin nests were documented over the 1.18 kilometer transect. Extrapolating over the estimated 3.49 kilometers of available nesting habitat at Marsh Point, we believe that the total nesting effort in 2016 was at minimum 133 nests. It is probably that not all nests were found in the transect and that this estimation is low.

The range of estimated eggs per nest is 2- 12 with an average of an estimated 6.8 eggs per nest. Note that this average is likely an under estimation of eggs per nest. Predators may have carried off some eggs, and it is likely that not all fragments remaining in the nest location. Additionally, as eggshells age and are exposed to the elements to varying degrees, their degradation is not equal.

It should be noted that during this nesting survey, that a disarticulated skeleton of a dead female terrapin was located at 30 22.916, -88 48.219, (Fig. 15). The body was found in the rack line of the beach and was fairly bleached out. The majority of the skeleton was present with no obvious signs of trauma, such as shell damage or missing limbs.

Two tropical storm events took place over this project period. Tropical Storm Cindy made landfall June 22nd, 2017 and Hurricane Nate made landfall on October 8th, 2017, (Berg 2018, Beven 2018). Sand can be seen in Figure 16, being pushed into the marsh following Tropical Storm Cindy. Terrapin nests were likely disturbed and/or submerged for several hours during the period that Tropical Cindy was influencing local tides. No studies are known documenting the drowning of terrapin nests inundated with seawater. However, in green sea turtles (*Chelonia mydas*), “short periods of hypoxia during incubation caused by saltwater immersion directly reduces the viability of sea turtle embryos” (Pike 2015). In green sea turtles egg viability was seen to be reduced by 10% to 30% with inundation exposures of 1 to 6 hours (Pike 2015). It is possible that terrapin eggs in the ground could have expired due to submersion associated with a storm tidal surge. A survey was conducted on the beach following both Tropical Storm Cindy and Hurricane Nate and no evidence of terrapin nesting was found.



Map 5: Terrapin nest locations, 2016.

Performance Goal 2: Visual Surveys

A series of visual surveys were conducted in areas of Davis Bayou that could potentially be nest sites. Area near the bayou's edge may be suitable for terrapins to nest, as the habitat transitions typically in only a few feet from intertidal marshes to maritime woodlands. Terrapins nest in a variety of substrates and the proximity and ease of access to these uplands areas appear to be ideal for nesting.

Terrapin nest surveys were conducted on foot in Davis Bayou on 8-25-2018, 9-1-2018, and 9-8-2018. Areas surveyed included embankments (1) from the site of the old Yeats House off of Eagle Point Road west to the NPS Government Dock, (2) marsh edge accessed from the CCC trail, (3) marsh embankments accessed through the Magnolia Bayou Trail, (4) embankments around the Group Tenting Area and NPS Housing area off of Boat Dock Road, and (5) Park Road at the large culvert between Gollot Road and Eagle Point Road. No turtle nests were located during these surveys; however, a predated turtle nest was found by the survey team previously at the Yeats House site on a visit to the Park unrelated to this project. The species of turtle was not identifiable but have been terrapin. These marsh embankments appear to be suitable as terrapin (and turtle) nesting areas.

Performance Goal 3: Develop Recommendations Measures for Terrapin Conservation

The following conservation recommendations have been drafted for consideration for implementation. These recommendations may be relevant to other areas in Mississippi, however they were considered based on the local stakeholders, habitat, management authorities. This section is not intended to be a comprehensive list of diamondback terrapin Best Management Practices but what could be feasible for implementation.

- (1) Initiate predator monitoring and appropriate control on Marsh Point.

The majority of nests identified on Marsh Point were likely due to nest predation. Due to the prevalence of raccoon scat, raccoon tracks, and the fact that many nests were “dugout” rather than showing signs of hatchling emergence, it is assumed that raccoons are responsible for nest raiding. It is recommended that this is confirmed with game/trail cameras. Trail cameras could also identify possible predators such as coyotes, birds, snakes, feral/domestic dogs, and feral/domestic cats. Once predators are identified, it is recommended that managers take appropriate action to remove predators from the beaches to protect diamondback terrapin nesting success.

- (2) Initiate invasive species control and monitoring on Marsh Point.

A small number of potentially invasive species were identified as occurring on Marsh Point, and include: Red imported fire ants, nutria, phragmites and *Sesbania punicea*. Fire ants may pose a direct threat to some terrapin nests, however the other species are not directly tied to nest failure. They do however have the potential to alter the habitat with regard to plant species composition and shade cover.

- (3) Monitor and remove derelict crab traps from the waters in and around Davis Bayou.

There is a sizable number of commercial crab pots in Davis Bayou maintained by about 3-4 fishers. Considering that Davis Bayou is a well-traveled boat corridor and that tropical cyclonic weather is common in south Mississippi, chances are high that some commercial traps will become derelict at any given point. Monitoring for derelict traps and reporting them to MDMR would be useful to reduce the duration traps are in the water. Regular communication with the MDMR Crab and Shrimp Bureau could also be useful in making a case to direct side scan sonar survey effort to Davis Bayou. Participation in crab trap “round-ups” by the NPS staff would also help to reduce the ghost trap threat.

- (4) Distribute commercial crab traps with by-catch reduction devices to local crab fishers.

By-catch reduction devices have been successfully shown and used to reduce terrapin mortality in actively fished and derelict crab traps. The cost of BRDs and a perceived negative effect on catch are often reasons why fishers are unwilling to utilize BRDs. It is recommended that these concerns be addressed by providing local fishers with replacement traps, outfitted with BRDs. Further, if fishers are requested to report back basic catch data on BRD equipped traps and non-equipped traps, you may begin to develop buy in from stakeholders in the crab fishery. This approach was used to draft a project

proposal to the National Fish and Wildlife Federation's Fish for Energy Program. Although this project was ultimately not funded due to geographic priorities of the program, it appears to be a sound proposal in line with this recommendation. A summary of the proposal is listed below.

Reducing Bycatch Mortality Associated with Derelict Crab Traps

"The Nature Conservancy and the Mississippi Department of Marine Resources will collaborate with local fishermen to reduce wildlife mortality resulting from derelict crab traps in Mississippi Sound. Systematic side-scan sonar surveys of Mississippi's nearshore waters will be conducted to document submerged derelict trap distribution and "hotspots". Derelict gear will then be subsequently removed and properly disposed. Knowledge of derelict trap "hot spots" will allow for resource managers to target those areas in future removal efforts to maximize the value of limited available resources. To address the chronic effects of lost crab traps, project partners will engage local fishermen in a trial of using modified crab traps along with their standard fishing gear. Crab traps outfitted with terrapin by-catch reduction devices, cull rings, and/or degradable hog rings will be distributed to a limited number of fishermen at no cost. Participants will be surveyed to determine the perceived effect these modifications have on their crab catch and to gauge their willingness to voluntarily use these modification in future trap investments."

(5) Continue and expand diamondback terrapin mark, release and recapture efforts.

Continued efforts to mark, release, and recapture terrapin is recommended for general monitoring of the terrapin population in Davis Bayou. Only a small fraction of the local population was likely marked in this project. More data on terrapin demographics can help document the full extent of the population, as well as assist in determining longer term population trends. This would give you the most direct account of the population and its sustainability.

(6) Conduct routine nest surveys on Marsh Point.

Marsh Point is an important nesting area for diamondback terrapins. Annual monitoring of the nesting population would provide data that can be used to assist in management decisions, evaluate any implemented actions, and overall increase understanding of the relationship of Marsh Point and Davis Bayou.

(7) Engage with State Fisheries Management Agencies.

General engagement with fisheries management groups and agencies is recommended for familiarization with core missions, identification of mutual interests, and collaborative conservation. Specifically, engagement with the Mississippi Department of Marine Resources, Mississippi Commission on Marine Resources and the Gulf States Marine Fisheries Commission is recommended.

Figures Referenced in this Report



Fig. 1: Derelict Trap (ID # 4-27-2017-1148) is a typical example of a degraded trap found partially buried on Marsh Points southern intertidal zone.



Fig. 2: Derelict Trap (ID # 11-9-2017-1220) was found in the terrestrial interior of Marsh Point, likely deposited by Hurricane Nate's storm surge and high tide. Note the bleached out blue crab shells.



Fig. 3: Style 1 fyke net, a double wing, 1/8 inch nylon mesh with 2, 40 foot leads, and 4 hoops.



Fig. 4: Style 2 fyke net, a double wing, 1/8 inch nylon mesh with 2, 20 leads, and 4 hoops.



Fig. 5: Style 3 fyke net, a single 50 ft wing, $\frac{1}{4}$ nylon mesh, with 7 hoops.



Fig. 6: Style 4 fyke net, a six hoop 1 $\frac{1}{2}$ inch mesh coated net with a 25 foot lead, deployed in a Marsh Point inlet.



Fig. 7: Style 4 fyke net deployed in Davis Bayou off the north side of Marsh Point.

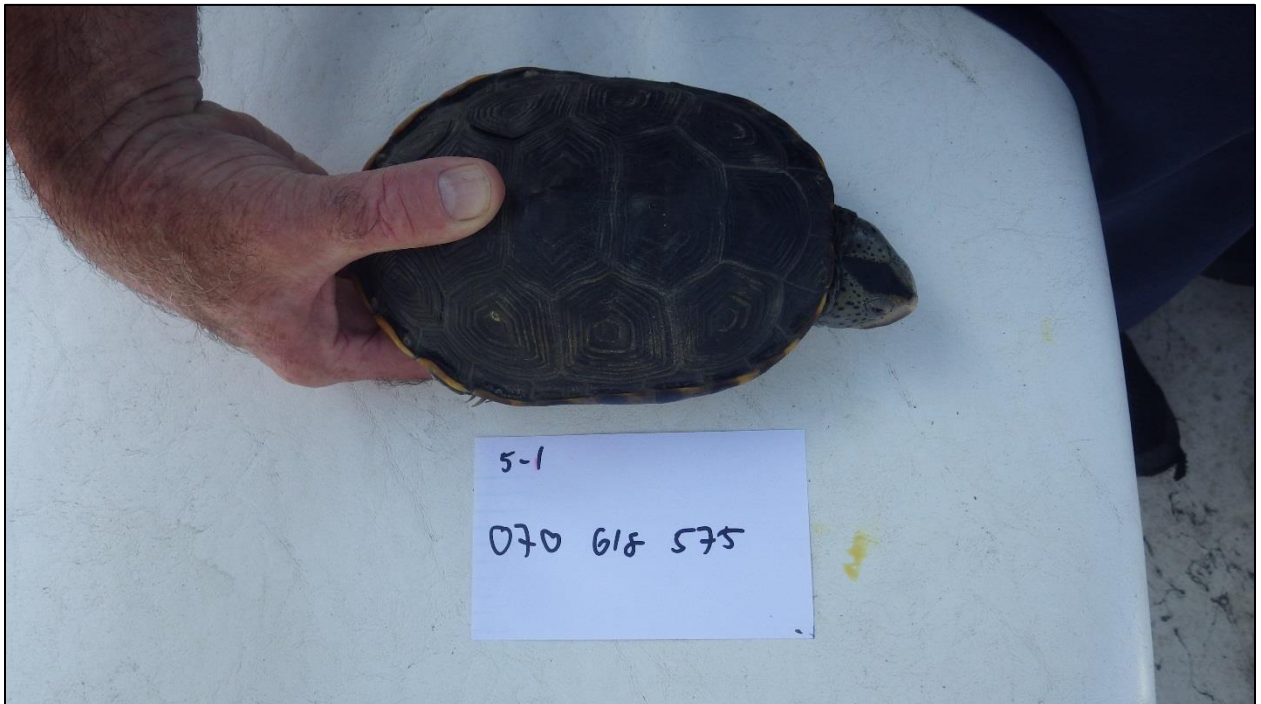


Fig. 8: Gravid female terrapin collected in a fyke net.



Fig. 9: Male terrapin (070620355) weighed on a scale.



Fig. 10: Close-up of male terrapin (070620355) before release back into water.



Fig. 11: Male 070622332 (left) and female 070639829 (right) terrapins were kept in the shade while being processed. Please note the relative size of the terrapins' tails. Terrapins are sexually dimorphic, tail size and relative position of the cloaca to the outer edge of the carapace can be used to identify gender.



Fig. 12: Beach habitat on Marsh Point



Fig. 13: Terrapin eggshell fragments on a Marsh Point pocket beach.



Fig. 14: Non-native *Sesbania punicea* along the upland beaches Marsh Point.



Fig. 15: Diamondback terrapin skeleton found on Marsh Point.



Fig. 16: Sand deposition following Tropical Storm Cindy.

Appendix 1, MDMR Side Scan Survey: Biloxi Bay Near Marsh Point and Davis Bayou.

MDMR Side Scan Survey: Biloxi Bay near Marsh Point and Davis Bayou.

Dates: November 3, 2017 and November 7, 2017

Survey Crew: Harron Wise, Michael Sweda, Jack Husley, and Sara Pace

Total Survey Time: 7.5 hours

Submerged Traps Retrieved: 7

Intertidal Traps Retrieved: 3

November 3, 2017

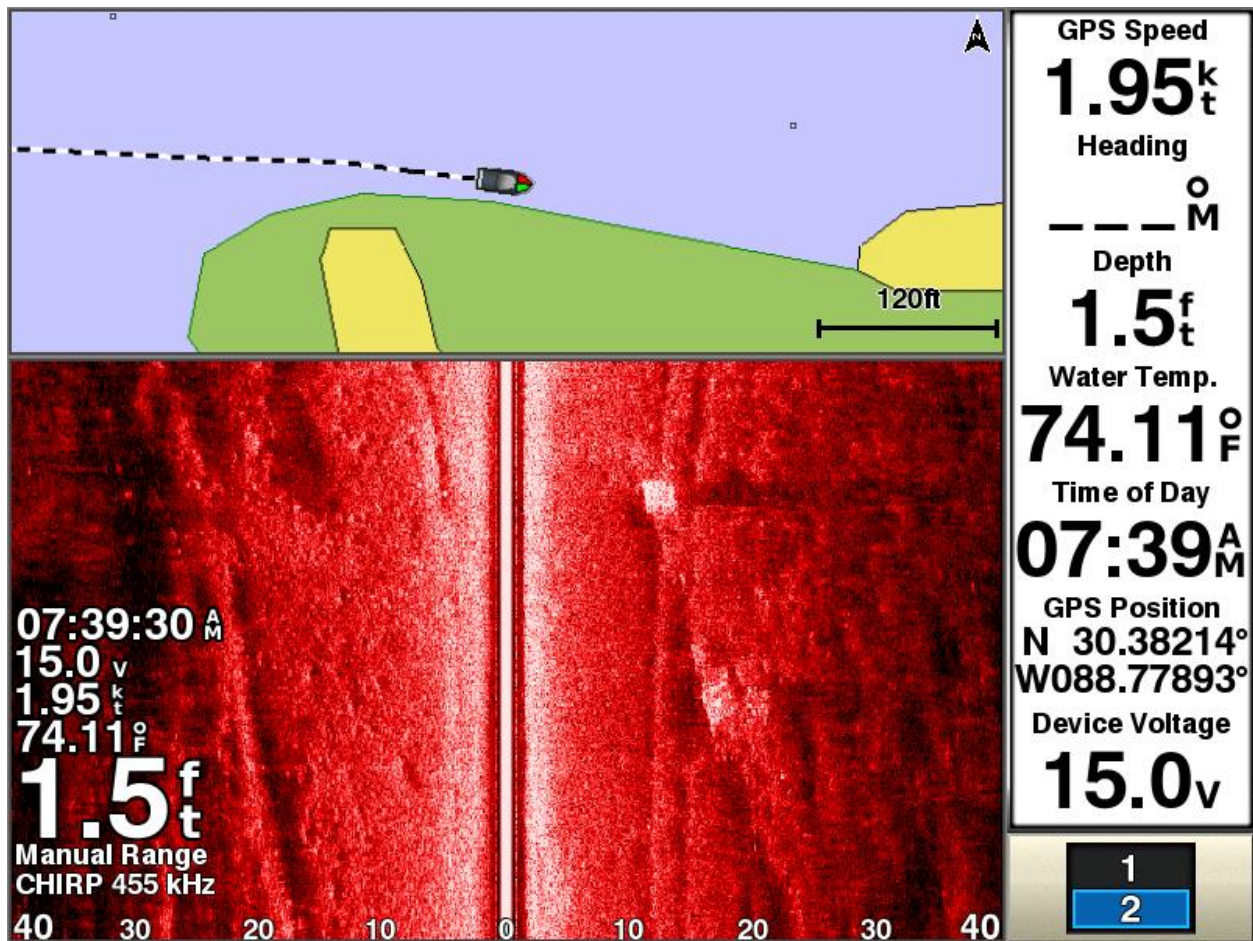
Survey crew arrived at the Western Tip of Marsh Point at 7:00 AM and began to survey along the south side of the marsh area. Depth ranged 1.8 to 2.5 feet and had to stay about 50 feet off the marsh for the sonar to work properly. The swath size of the side scan sonar was set to 30 feet for the first transect. The first trap was detected not far from the start of the survey. The trap was successfully retrieved, and the survey continued. Two more traps were found in the marsh area and were retrieved. With the first transect completed, the depth increased to 3 feet and the swath was increased to 40 feet. Four transects were completed at the continued depth and swath range with no more derelict traps being detected.

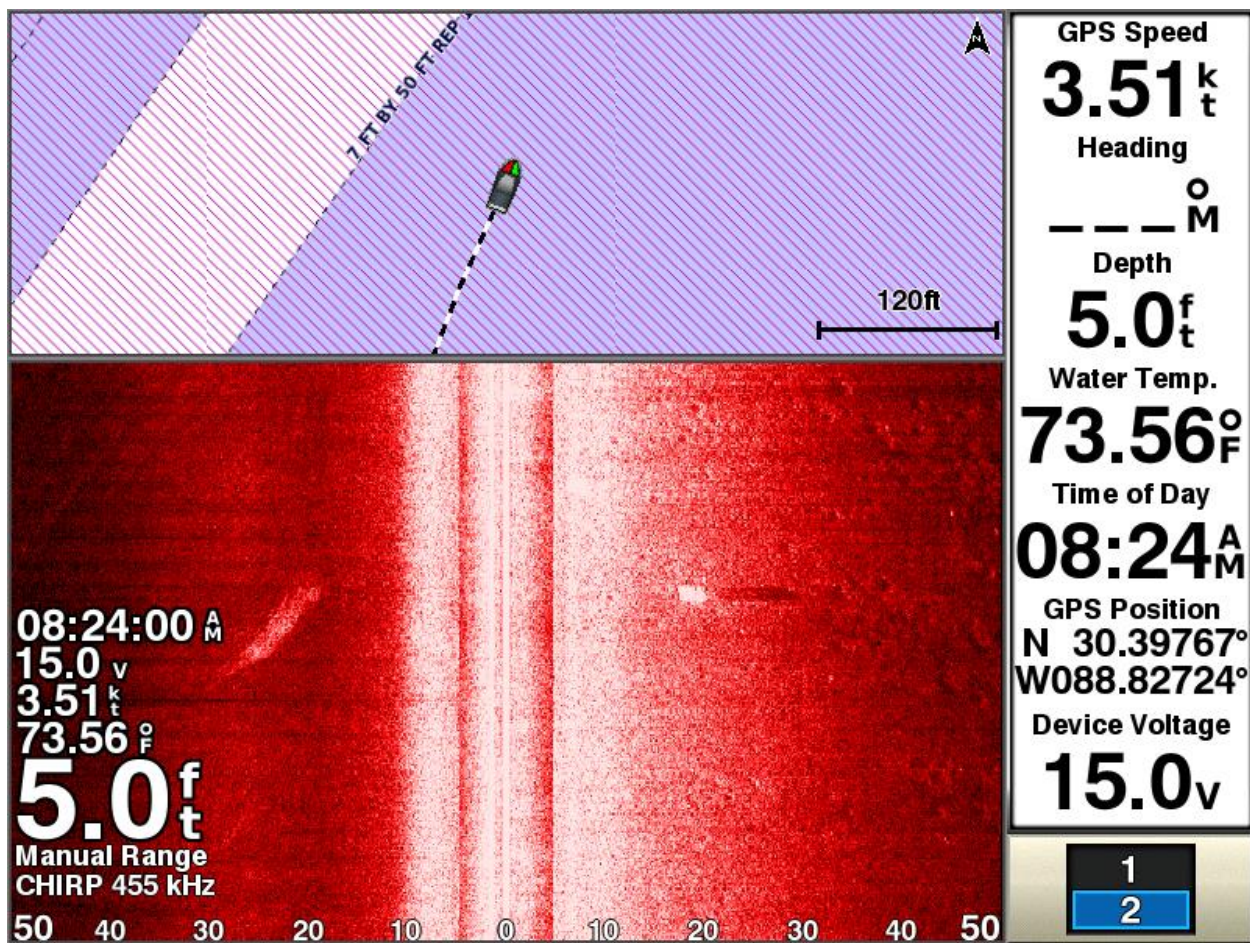
Survey crew scanned 4 transects from the tip of Marsh Point, outwards to the Davis Bayou Channel. Depth ranged 1.5 to 7 feet. Swath size set to 40 feet. No derelict traps were detected.

Survey crew began surveying south of the navigational channel eastwards into Davis Bayou. Depth ranged 2.5 to 4 feet. Swath size set to 40 feet. Four traps were detected along the first transect pass, and the four traps were retrieved. Time ran out for the day and the crew will revisit the sight to continue the transects for Davis Bayou. Survey crew departed from Davis Bayou at 12:30 PM.

November 7, 2017

Survey crew returned to Davis Bayou to complete the side scan survey trip at 7:00 AM. 3 traps were retrieved next to the Gulf Coast Research Laboratory at the broken pier. The rest of the side scan survey yielded no more derelict traps detected. The areas inside Davis Bayou are very shallow that restricted us to mostly only being able to side scan inside the channel and on the edges of the channel. Depth range 1.5 to 3 feet. Survey ended at 9:00 AM.







Appendix 2, Derelict Trap Coordinate Data

Appendix 2: Derelict Trap Coordinate Data					
Number	W Deg	W min	N deg	N min	date
11-23-2016-0001	-88	48.548	30	23.064	11/23/2016
4-27-2017-1115	-88	48.218	30	22.918	4/27/2017
4-27-2017-1148	-88	48.293	30	22.939	4/27/2017
4-27-2017-1245	-88	48.414	30	22.996	4/27/2017
5-3-2017-1210	-88	47.462	30	23.318	6/2/2017
7-11-2017-0001	-88	47.639	30	23.004	7/11/2017
11-8-2017-1307	-88	48.196	30	22.897	11/8/2017
11-8-2017 1325	-88	48.181	30	22.886	11/8/2017
11-8-2017 1345	-88	48.331	30	22.952	11/8/2017
11-9-2017 1154	-88	47.985	30	22.783	11/9/2017
11-9-2017 1220	-88	47.896	30	22.809	11/9/2017
11-9-2017 1235	-88	47.841	30	22.719	11/9/2017
11-9-2017 1237	-88	47.838	30	22.723	11/9/2017
11-9-2017 1305	-88	47.544	30	22.573	11/9/2017
11-9-2017 1325	-88	47.811	30	22.746	11/9/2017
11-9-2017 1326	-88	47.825	30	22.74	11/9/2017
11-3-2017 ST01	No Position Data Given by MDMR				11/3/2017
11-3-2017 MT01	No Position Data Given by MDMR				11/3/2017
11-3-2017 MT02	No Position Data Given by MDMR				11/3/2017
11-3-2017 MT03	No Position Data Given by MDMR				11/3/2017
11-3-2017 ST04	No Position Data Given by MDMR				11/3/2017
11-3-2017 ST05	No Position Data Given by MDMR				11/3/2017
11-3-2017 ST06	No Position Data Given by MDMR				11/3/2017
11-3-2017 ST07	No Position Data Given by MDMR				11/3/2017
11-7-2017-ST02	No Position Data Given by MDMR				11-7-2017
11-7-2017-ST03	No Position Data Given by MDMR				11/7/2017
11-7-2017-MT03	No Position Data Given by MDMR				11/7/2017
5-2-2018-1045	-88	47.439	30	23.029	5/2/2018

Appendix 3, Terrapin Fyke Net Sampling Effort

Appendix 3: Terrapin Fyke Net Sampling Effort								
Trap #	Date in	Time in	Date out	Time out	Total hours	Latitude	Longitude	Description
1	11/22/2016	950	11/22/2016	1400	5	30 23.716	-88 47.652	Stark Bayou
2	11/22/2016	1000	11/22/2016	1420	4	30 23.625	-88 47.517	Davis Bayou
3	11/22/2016	1020	11/22/2016	1415	4	30 23.546	-88 47.524	Halstead Bayou
1	5/2/2017	1115	5/3/2017	915	22	30 23.699	-88 47.695	Stark Bayou
2	5/2/2017	1210	5/3/2017	935	21	30 23.551	-88 47.574	Halstead Bayou
1	5/10/2017	1115	5/12/2017	1050	46	30 23.551	-88 47.574	Halstead Bayou
2	5/10/2017	1140	5/12/2017	1040	47	30 25.602	-88 47.645	Davis Bayou
3	5/10/2017	1215	5/12/2017	1030	45	30 23.647	-88 47.533	Stark Bayou
1	5/30/2017	1100	6/2/2017	1100	70	30 23.027	-88 47.880	Marsh Point, main bayou
2	5/30/2017	1015	6/2/2017	1115	72	30 22.979	-88 47.312	Marsh Point, inlet
3	5/30/2017	1115	6/1/2017	1115	47	30 22.951	-88 47.954	Marsh Point, inlet
1	4/30/2018	1130	5/4/2018	950	94	30 22.978	- 88 47.582	Marsh Point, inlet
2	4/30/2018	1145	5/4/2018	1010	95	30 23.013	-88 47.498	Marsh Point, inlet
3	4/30/2018	1230	5/4/2018	1015	94	30 23.024	-88 47.405	Marsh Point, main bayou
4	4/30/2018	1250	5/4/2018	1025	95	30 22.984	-88 47.304	Marsh Point, inlet
5	4/30/2018	1310	5/4/2018	1040	94	30 22.972	-88 47.185	Marsh Point, main bayou
1	5/7/2018	1230	5/10/2018	1340	74	30 22.985	-88 47.859	Marsh Point, inlet
2	5/7/2018	1220	5/10/2018	1320	74	30 23.066	-88 47.859	Marsh Point, main bayou
3	5/7/2018	1205	5/10/2018	1310	74	30 23.076	-88 47.991	Marsh Point, 3 creek branch
4	5/7/2018	1155	5/10/2018	1255	72	30 23.136	-88 48.338	Marsh Point, main bayou
5	5/7/2018	1140	5/10/2018	1240	72	30 23.165	-88 48.537	Marsh Point, main bayou
1	5/23/2018	1015	5/25/2018	930	49	30 23.701	-88 47.696	Halstead Bayou
2	5/23/2018	1025	5/25/2018	945	49	30 23.692	-88 47.496	Stark Bayou
3	5/23/2018	1040	5/25/2018	1000	48	30 23.561	-88 47.565	Halstead Bayou
4	5/23/2018	1050	5/25/2018	1015	48	30 23.349	-88 47.886	Davis Bayou Islands
5	5/23/2018	1105	5/25/2018	1030	49	30 23.300	-88 47.423	Yeats House inlet
1	6/18/2018	1330	6/20/2018	1200	46	30 23.000	-88 47.275	Marsh Point, main bayou
2	6/18/2018	1350	6/20/2018	1210	46	30 23.002	-88 47.560	Marsh Point, inlet
3	6/18/2018	1415	6/20/2018	1220	46	30 23.035	-88 47.593	Marsh Point, main bayou
4	6/18/2018	1435	6/20/2018	1225	46	30 23.016	-88 47.672	Marsh Point, inlet
Summary		69 trap days		1648	trap hours		30 localities	

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