Diamondback Terrapin Study Annual Report

North Carolina Aquarium at Pine Knoll Shores

University of North Carolina-Wilmington

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Introduction

Diamondback terrapins are currently listed as a "Species of Concern" in North Carolina, but a recent report by the Wildlife Resource Commission's Scientific Council on Amphibians and Reptiles recommends re-classifying this species as "Threatened" (Dorcas et al., 2011). Additional monitoring is necessary in order to establish the terrapin's conservation status and identify the primary threats facing this species in coastal North Carolina. Of particular concern is the potential for incidental capture and mortality of terrapins in the economically-important nearshore blue crab fishery. Terrapins that are captured in crab pots cannot reach the surface to breathe and will drown within 45-300 minutes, depending on environmental conditions at the time of capture (Crowder et al., 2000). The North Carolina Blue Crab (*Callinectes sapidus*) Fishery Management Plan (Blue Crab FMP, NC Division of Marine Fisheries, *currently under revision*) states that research to determine the distribution of terrapins and to assess the impacts of bycatch reduction devices (BRDs) on terrapin and crab catches is essential in order to devise proper regulations and management strategies to prevent interactions between terrapins and crab pots (draft Blue Crab FMP Amendment 2, Section 11.12). Regulations being considered by the Advisory Committee to the Blue Crab FMP include requiring the use of BRDs on all crab pots during the height of the terrapin active season (March through June) in specified areas (Stephen Taylor, personal communication), but a greater knowledge of terrapin distribution is required before spatially-based recommendations can be enacted. For this project, we assessed diamondback terrapin distribution and abundance at various locations in the Bogue Sound/North River region historically utilized by terrapins. Our study has two components. The first involves head count surveys from a boat in multiple sites throughout the study area. The second includes setting up crab pots at four sites, monitored every other day for 40 days. We used modified (tall or "chimney") crab pots at sites with relatively high terrapin abundance to investigate the impacts of two configurations of BRD on terrapin and crab catch rates. Previous work in the lower Cape Fear River demonstrated that the average carapace height for female terrapins was 5.34 – 6.40 cm, whereas the average carapace height for male terrapins was only 4.01 – 4.43 cm (Southwood et al., 2009). Some proportion of the male and sub-adult female terrapin population would still be vulnerable to capture in crab pots even with the smaller size BRD, however crab catch may also decrease as BRD size decreases (Hart and Crowder 2011). Morphometrics on terrapins and crabs, as well as environmental data were collected. Our study provides much needed information on an area historically used by terrapins, but for which no current survey data exists. Our survey and trapping results will provide information that the NC Division of Marine Fisheries (DMF) may consider when designating spatial restrictions and BRD requirements in the crab fisheries.

Project goals

1) Conduct observational surveys at multiple sites in the marshes of eastern Bogue Sound and marshes of the North and Newport Rivers to assess relative abundance and distribution of diamondback terrapins in waters utilized by commercial and/or recreational crab fisheries.
2) Use a paired pot design to examine the effects of different BRD configurations on terrapin and crab catch.

Methods

Head Count Surveys – Two initial broad-scale surveys of sites in the North and Newport Rivers and Eastern Bogue Sound, Carteret County were conducted by flat bottom skiff in early April 2012 (Figure 1).

We focused our efforts in areas where terrapins have been documented by the NC Division of Marine Fisheries gillnet observer program (2001 – 2010) or by fishermen and researchers in the region, but we did not limit our surveys to these locations. Seven sites were chosen that exhibited good access by boat at low tide, presence of crabbing activity, and/or historical presence of terrapins (Table 1). Sites were small, shallow tidal creeks or bays dominated by *Spartina alterniflora* and *Juncus* marsh and oyster reefs. Visual encounter (e.g. head-count) surveys were conducted at these sites approximately once a week for 4 weeks. Routes through the survey sites were approximately 0.4 miles long. A survey consisted of traveling at a slow speed along the survey route (Run 1) while an observer stands on the bow and records terrapin activity. At the end of the route, the survey is repeated in reverse direction (Run 2). Weather, tide, water temperature, sea state, and salinity were also recorded. Once the crab pot study commenced in early June, head count surveys were conducted during 14 out of the 20 trips at the four pot sites plus Deep Creek. A total of 21 head count surveys were conducted during the length of the project.

Table 1. Survey site selection. Sites in bold are chosen survey sites.

Site	Run 1 latitude	Run 1 longitude	Run 2 latitude	Run 2 longitude	Terrapins observed[a]	Crabbing observed[b]	Navigable at low tide
Ft. Macon	34.70291	-76.70467	n/a	n/a	N	N	N
Old House Slue	**34.6997**	**-76.64133**	**34.70247**	**-76.63663**	**Y; NERRS**	**N**	**Y**
Deep Creek	**34.7098**	**-766391**	**34.71021**	**-76.64534**	**Y; NERRS**	**N**	**Y**
Causeway	34.72701	-76.67716	n/a	n/a	Y; DMF	N	N
Haystacks (NW)	34.73849	-76.70289	n/a	n/a	N	N	Y
AB	**34.71149**	**-76.74682**	**34.70736**	**-76.75843**	**N**	**Y**	**Y**
Hoop Pole Creek	34.70380	-76.76694	n/a	n/a	N	N	N
Spooner's Creek	**34.7281**	**-76.80625**	**34.72983**	**-76.80136**	**N**	**Y**	**Y**
Aquarium	34.70488	-76.82776	n/a	n/a	N	N	N
Core Creek	34.80019	-76.68785	34.80029	-76.69168	N	N	N
Middle Marshes	**34.6942**	**-76.61851**	**34.69606**	**-76.60911**	**Y; NERRS**	**Y**	**Y**
North River	34.7559	-76.61638	n/a	n/a	Y; DMF	N	N
North River Marsh	**34.71385**	**-76.61403**	**34.72375**	**-76.61533**	**N**	**Y**	**Y**
Newport River (S)	34.75415	-76.74308	34.75131	-76.75105	Y; DMF	Y	N
Newport River (N)	34.76246	-76.75036	34.76781	-76.74385	Y; DMF	Y	N
Haystacks (S)	**34.736321**	**-76.68816**	**34.74205**	**76.69151**	**N**	**Y**	**Y**

[a]sightings of terrapins recorded by DMF (2001-2010 sampling), Southwood Williard postcard survey returns (2010) or NERRS sightings database (2010-2011)
[b]presence or absence of crab pots observed during our initial site investigations

Crab Pot Study -- We used modified crab pots to further investigate terrapin abundance at selected sites and assess the impacts of BRDs on terrapin and blue crab catch rates June through July of 2012. Standard commercial crab traps (24" x 24" x 24") were fitted with a chimney to allow entrapped terrapins access to air while in the pot. A 12" diameter hole was cut in the top of the trap and a tunnel-shaped 3-foot tall chimney apparatus constructed of galvanized chicken wire was fitted to the hole (Rook et al., 2010; Morris et al., 2011). The modified crab pots were stabilized by ½" PVC stakes that kept the chimney from bending and prevented the pot from tipping over due to wave action or extreme weather events (Figure 2). We used a paired design to compare terrapin and crab catch between pots fitted with BRDs and pots without BRDs. Ten pairs of pots were deployed at each study site. A pair of pots consisted of one pot fitted with a BRD and another pot without a BRD placed side-by-side. GPS coordinates were obtained for each pot. Two sites (Haystacks and Old House Slue, blue pins, Figure 3), 40 pots total, were baited and checked every other day for 20 days. Pots were then moved to the other 2 survey sites (Middle Marsh and North River Marsh, green pins, Figure 3), and were baited and checked for terrapins every other day for 20 days. Additionally, 5 pots were placed at Old House Slue once the original 20 were moved. These pots were baited and checked every other day, did not have BRDs, and were not paired. Given the success of catching terrapins at this site, and the relative abundance of terrapins observed, these 5 additional pots were used solely to increase our probability of catching additional terrapins and were not included in the crab catch data. With these pots, the total number of pots checked per day increased to 45.

Two different configurations of BRD were tested over the course of this study, a 5 cm x 15 cm (2" x 6") rectangular wire BRD and a 4 cm x 15 cm (1½" x 6") rectangular wire BRD. The BRDs were fitted to the internal end of each entrance on the pot (Figure 4). We randomly selected the 2" BRD configuration for Haystacks and North River; the 1.5" BRD was tested at Old House Slue and Middle Marshes.

All captured terrapins were measured (carapace length, carapace width, plastron length, shell height (i.e. depth), mass) and marked externally with unique notchings on the marginal scutes (Figure 5). Terrapin age was estimated based on the number of annuli on the right humeral scute of the plastron, and sex of mature terrapins was determined based on tail length and position of cloacal opening. Size, sex, and maturity of any blue crabs captured in pots were also recorded, and we documented water temperature and salinity each time we checked the pots.

Results

During the initial once a week head count surveys (surveys 1-7), only one terrapin was seen, in Middle Marshes (Table 2). Surveying all seven chosen sites was not consistent due to extremely low tide, weather or boat malfunctions. During the crab pot study, head count surveys were conducted 14 of the 20 survey days at all sites except AB and Spooners Creek. Fifteen terrapin heads were counted collectively. One head was seen at Middle Marshes, North River Marsh and Haystacks. The other 12 heads were counted at Old House Slue over 2 different surveys. Old House Slue was also the only site where terrapins were seen outside the head count survey window. Although terrapins have been spotted there prior to our study, no terrapins were seen during any of our trips to Deep Creek. All terrapins counted were swimming. Heads were spotted during all tides, but the majority of heads were seen at low tide. The best visibility for terrapins was at a sea state of 2 or less, but two of the heads counted were seen during a sea state of 3 (Table 2).

Table 2. Terrapins observed during head count surveys. MM=Middle Marshes; NRM=North River Marsh; H=Haystacks; OHS=Old House Slue.

Survey #	Site	Water Temp (°C)	Air Temp (°C)	Salinity (ppt)	Cloud Cover	Wind Direction	Sea State	Tide	Terrapins Observed Run 1	Terrapins Observed Run 2	Crab Pots Observed
5	MM	22	31	37	30%	E	3	high	**0**	**1**	0
9	NRM	26.2	29.3	34	5%	S	3	past high	**1**	**0**	1
12	H	25.2	28.3	35	5%	W	1	low	**1**	**0**	1
18	OHS	29.1	29.3	35	25%	SW	1	low	**8**	**3**	0
19	OHS	28.6	31.7	35	70%	--	0	mid	**0**	**1**	0
									10	***5***	

Tables 3 and 4 give a preliminary look at crab catch and terrapins caught in control and BRD-equipped pots. Further analysis is pending. Comparisons of terrapins and crabs caught in BRD and non-BRD pots will be made using appropriate statistical models that incorporate date, environmental conditions, pot location, and pot depth as covariates. Maps depicting locations of all terrapin sightings over the course of our study and results of head count surveys will be constructed in ArcGIS.

Table 3. Crab catch at all four study sites in control, 2" BRDs, and 1.5" BRDs. Other information recorded included morphometrics, presence of gravid females, and bycatch (stone crab and finfish species).

Location	Total crabs	Female crabs w/eggs	Average crab width	Average crab depth	Stone Crabs	Bycatch
Haystacks 2" BRD	565	8	12.6	3.5	13	5
Haystacks Control	454	8	12.4	3.5	18	4
	1019					
North River 2" BRD	539	14	12.6	3.6	31	7
North River Control	518	22	12.7	3.6	49	10
	1057					
Old House Slue 1.5" BRD	724	29	12.9	3.5	14	0
Old House Slue Control	904	87	13	3.6	43	9
	1628					
Middle Marsh 1.5" BRD	422	9	12.9	3.6	7	4
Middle Marsh Control	562	19	13	3.6	18	17
	984					

Table 4. Terrapins caught in study pots. MOC=Method of Capture (control or BRD pot); PL=plastron length; CL=carapace length;

ID	Date	Location	MOC	Sex	PL (cm)	CL (cm)	Width (cm)	Depth (cm)	Mass (kg)	Head (cm)	Age (years)	Reliability
ABC	6/10	OHS-02	Control	F	13.6	15.2	11.3	6.6	634	3.2	7	2
ABH	6/30	OHS-E	Control	F	14.5	16.9	12.3	6.7	450	3.6	8	1
ABI	7/3	NRM-04	Control	F	13.1	14.4	11.4	6.1	280	3.5	9	1
ABJ	7/6	NRM-08	Control	F	13.5	15.2	12	6.5	300	3.5	8	2
ABK	7/10	OHS-E	Control	F	15.8	18	13.7	7.5	650	4.7	8	2
ABL	7/14	MMR-06	Control	F	14.6	16.8	12.5	6.4	400	3.4	7	2

Conclusions

We were successful in locating terrapins in 4 of our 7 surveyed sites. Some of these were singular observations but it is important to note that at two of these sites (Haystacks and North River Marsh), terrapin presence had not been documented previously. As elusive creatures, these observations are incredibly valuable in mapping out the localized presence of terrapins in this area. Our study was a good step toward understanding local terrapin presence and testing new methods. Surveying by head count was simple, methodical, and relatively physically undemanding. It was, however time consuming and resource heavy for the number of heads we recorded. Trips required both a captain and observer, and one full day on the water to survey all 7 sites. We could only survey sites that could be navigated at low tide, which restricted site selection. Sea state, cloud cover, tide, and time of day could all have been factors in our ability to spot terrapins. It would be interesting and perhaps worthwhile to survey at different times of year and even in subsequent years to try to capture all environmental variables. Time spent on the water scoping out sites for navigability, habitat, and coordinates for survey start and end points is invaluable to future studies of this area.

The use of modified crab pots proved promising for collecting terrapins without mortality while also collecting crab catch data. No terrapins were caught in pots with BRDs, and those caught in control pots were active and seemingly unharmed in their capture. Unfortunately, the height of the chimney limited the water depth in which the pot could be set, and therefore our data only capture the crab catch and interactions in very shallow (<5 ft.) water. Most recreational pots would be set in deeper water. In setting the pots, great care has to be taken to place them flat on the bottom away from slopes, out of strong currents and eddies, and with a reinforcing PVC spine. The placement of the pots was tested over the first 48 hours by closing the entrances with zip ties and leaving them unbaited. Previous designs of tall pots required staking, which made retrieving and setting the pots difficult and limited the number of pots that could be set. This design could allow researchers interested in studying terrapins an alternative catch technique without mortality.

Future goals

We will continue to analyze data and share with Division of Marine Fisheries and others that can make use of the information. We hope to continue the BRD studies in summer 2013, focusing on the Old House Slue site. Using sets of triplicate pots (control, 1.5” BRD, 2” BRD) at one site will remove any location effects and add clarity to our data. The Blue Crab Fisheries Management Plan recommends “outreach programs to inform state agencies, the public, and the commercial and recreational fishing industries about issues relating to protected species and fishery management” (Summary Blue Crab FMP

Issues/Recommendations for Public Comment Meetings - Dec. 2011, Section 2.2). We are in the process of creating an educational brochure that highlights the threats to terrapins and shows how to construct a BRD. In addition to our exhibit showcasing our terrapins we are also adding a display of a modified crab pot with BRDs to our Oyster Rock exhibit. Educational panels on our research and actions the public can take to protect terrapins and reduce bycatch are in the works.

References

- Crowder, L., Hart, K., and Hooper, M. 2000. Trying to solve a bycatch and mortality problem: Can we exclude diamondback terrapins (*Malaclemys terrapin*) from crab pots without compromising blue crab (*Callinectes sapidus*) catch? Final Report, Marine Fisheries Commission, SeaGrant Fisheries Resource Grant 00-FEG-23, 15pp.
- Dorcas, M. E., Beane, J.C., Braswell, A.L., Corey, E.C., Godfrey, M., Humphries, J., Lamb, T., Price, S.J. 2011. Reevaluation of status listings for jeopardized amphibians and reptiles in North Carolina: Report of the Scientific Council on Amphibians and Reptiles submitted to the Nongame Wildlife Advisory Committee of the North Carolina Wildlife Resources Commission. February 2011. 60 pp.
- Harden, L.A., Pittman, S.E., Gibbons, J.W., Dorcas, M.E. 2009. Development of a rapid assessment technique to monitor diamondback terrapin (*Malaclemys terrapin*) populations using head-count surveys. Applied Herpetol. 6: 237-245.
- Morris, A.S., Wilson, S.M., Dever, E.F., Chambers, R.M. 2011. A test of bycatch reduction devices on commercial crab pots in a tidal marsh creek in Virginia. Estuaries and Coasts 34: 386-390.
- Rook, M.A., Lipcius, R.N., Bronner, B.M., Chambers, R.M. 2010. Bycatch reduction device conserves diamondback terrapin without affecting catch of blue crab. Marine Ecology Progress Series 409: 171-179.
- Southwood, A.L., Wolfe, J., Harden, L.A. 2009. Diamondback terrapin distribution and habitat utilization in the lower Cape Fear River. Final Report to North Carolina Sea Grant, Blue Crab and Shellfish Research Program #08-POP-06.23pp.

Figure 1. Overview of study area in central Carteret County, NC. All sites initially considered for surveying fell within the red oval.

Figure 2. Modified crab pot configuration. A 12” hole was cut on the top of each pot to allow terrapins access to the chimney. A ½” PVC pole was cable tied to the corner of the pot and extended the length of the chimney to add integrity to the chimney and keep the pot from tipping over.

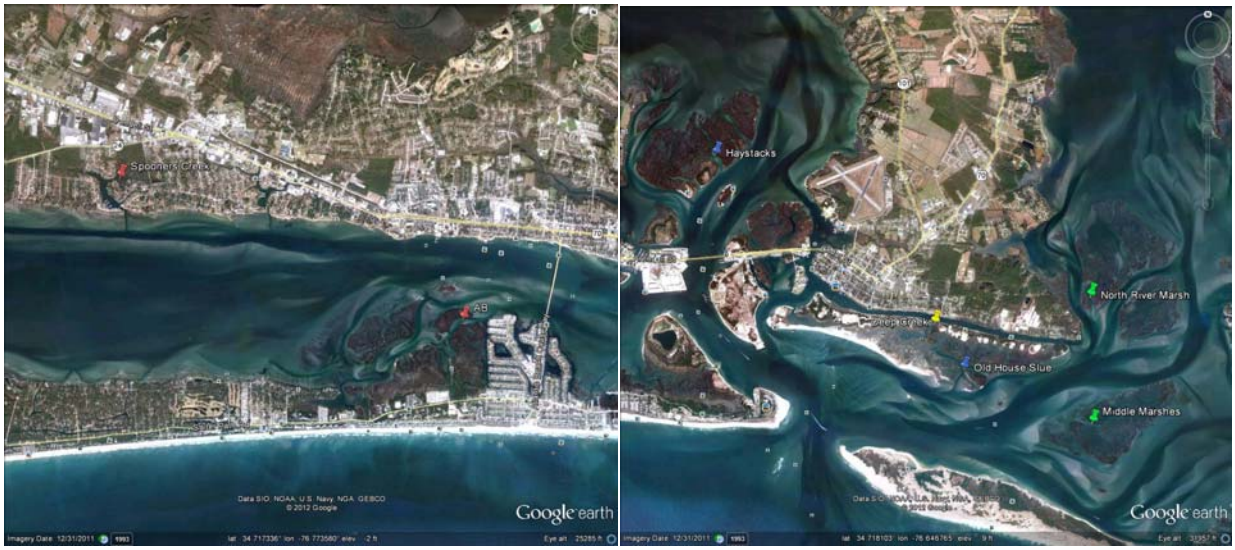

Figure 3. Study sites. Sites with red pins were head count surveyed only, prior to starting the crab pot surveys. Blue pins illustrate the first set of sites where crab pots were set; green pins represent the second set of crab pot surveys. Head count surveys were conducted at these sites throughout the course

of the project. The yellow pin represents Deep Creek, which was head count surveyed only throughout the project.

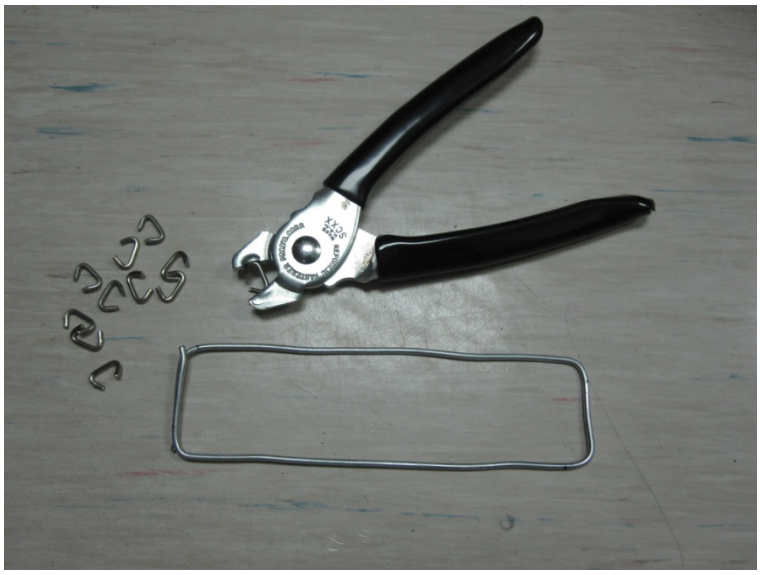

Figure 4. Supplies needed for constructing a metal BRD. Eleven-gauge galvanized wire is bent to the appropriate dimensions and secured shut with small hog rings. The BRD is then attached to each pot entrance with cable ties.

Figure 5. Marginal scute notchings used to identify individuals. Each scute is labeled (A, B, C, etc..) clockwise from the vertebral marginal. The terrapin in this photo has the ID=ABC.