Bycatch Reduction Devices as a Method to Reduce Mortality Rates of *Malaclemys terrapin* in Crab Pots

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INTRODUCTION

- The diamondback terrapin, (*Malaclemys terrapin*) is the only turtle species in the world that is adapted exclusively for coastal estuarine environments (Wood, 1995).
- Commercial blue crab fisheries extend along terrapins' range, from Massachusetts to Texas, and recreational crabbing often occurs along developed coastlines. Both industries intersect in areas with terrapin populations.
- Active trapping can effectively reduce a population to an unsustainable level due to site fidelity and slow reproductive maturation.
- Similarly, inactive and abandoned "ghost" pots can rapidly reduce a terrapin population with only a few pots left by trappers.
- Mortality is due to the funnels being large enough for terrapins to enter the traps, with most males never reaching a carapace size larger than the funnel and all immature females being small enough to also be susceptible to the traps. This can result in an imbalance of sex ratios in the population.
- Even without bait, many terrapins will enter traps and drown, most likely out of curiosity or following one another as they do not actively hunt blue crabs.
- In 2009, Grosse and colleagues documented a total of 133 terrapins drowned in only 2 ghost commercial pots in a Georgia creek, which was estimated to be 65% of the total terrapin population for that creek.
- Florida Fish and Wildlife Conservation Commission has been advised to enforce regulations in the state of Florida to preserve the species before populations are unable to recover.

Mode of Bycatch Reduction

- Typical BRDs are cost-effective and can be made out of a single wire as short as 37.5 cm long (for an outer opening with dimensions of 12.5 x 17.5 cm).
- A wire or plastic BRD effectively reduces the size of a crab pot funnel and can be installed with J-clips or hog rings. More rigid plastic BRDs have begun to be commercially manufactured and are becoming readily available.
- 12 x 4.5 cm BRDs are used by multiple researchers to determine terrapin exclusion from submerged crab pots (Butler and Heinrich 2007, Morris et al., 2011).
- Many adult and juvenile terrapin shells are greater than 4.5cm in height and the overwhelming majority of crab shells are less than 4.5cm in height.
- In this manner, the height of the BRDs used is the main factor preventing majority of terrapin inclusion, some evidence suggest terrapins' tetrachromatic color vision may affect how terrapins see the crab traps with the BRDs orange coloration (Roosenberg & Kennedy, 2018)

Evidence of BRD's proposed Function

- Terrapin bycatch can be reduced by regulated BRD implementation of crab pots; combined studies have shown effectiveness in terrapin exclusion from commercial pots up to 100%.
- 12 of 16 states where terrapin populations have been reported there are studies to test the effectiveness of BRDs (no bycatch was reported in Massachusetts, crab pots are not allowed in Connecticut and Rhode Island, and no studies have been done in New York). (Roosenberg & Kennedy, 2018).
- Of these studies, all have found reduction of bycatch of terrapins in crab trap with use of BRDs.
- An area of concern in regard to bycatch reduction devices is their possible exclusion of blue crabs from entering the traps, as studies have found mixed results.
- A paper by Butler and Heinrich (2007) examined Terrapin exclusion and blue crab inclusion of traps fitted with BRDs in multiple locations in Florida (Figure 1, 2). The BRDs used in the study measured 4.5 x 12cm.
  - Results of the study showed significant terrapin exclusion using BRDs and no significant effect on number, size, or sex of the crabs caught.
- Another study by Arendt et al. (2018) also found evidence to support the notion BRDs exclude terrapins caught but do not alter the number of blue crabs compared to standard used crab traps.
  - The study used a scoring system to calculate the probability of trap exclusion of terrapins and trap entry of legal blue crabs for traps fitted with BRDs, encompassing all theoretical BRD dimensions actually tested since 1992 (Arendt et al. 2018).
  - The study compared actual captures to these predicted probabilities of captures based off BRD and species dimensions, finding BRDs performed as predicted in allowing blue crabs to enter but actually performed better in terrapin exclusion than dimensions alone would predict.

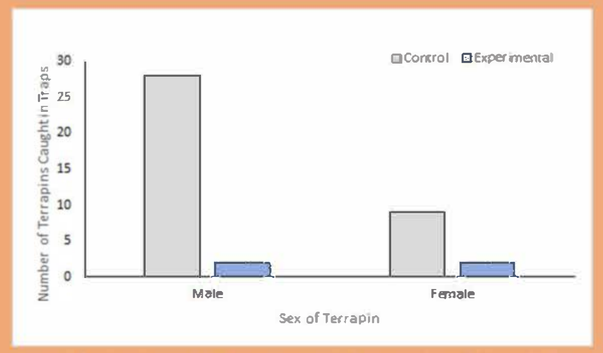

Figure 1: Depicts the number of terrapins caught in traps with and without BRDs. The control condition represents crab traps without BRDs and the experimental condition represents traps fitted with BRDs.

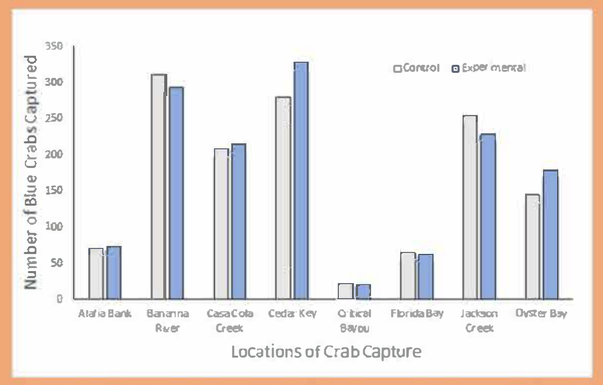

Figure 2: Depicts the number of Blue Crabs that were caught in traps with and without BRDs in the various study locations. The control represents traps without BRDs and the experimental condition represents traps with BRDs. It should be noted there was no statistical difference between the control and experimental for each location as each p-value was > 0.05.

A.

B.

Figure 3: Terrapins caught by trap may be prevented by the uses of BRDs. (A) Visually depicts the amount of terrapins that can be caught in a single crab trap; this one happens to be a ghost trap. (B) shows how terrapins can be excluded from crab traps with the addition of plastic BRDs.

CONCLUSIONS

- The Diamondback Terrapin species is currently being trapped in crab pots at rates that populations may not recover from.
- There is a disproportionate catch rate in the sex caught by crap traps that also alters the population dynamics with more males being captured.
- The turtle's diet does not consist of blue crabs but warf crabs, snails and clams (Allen et al., 1955) (Butler et al., 2012).
- Many terrapins can be caught in a single trap. This is from the curious and social nature of the species that causes them to investigate and follow other individuals into a trap.
- Evidence suggests that the use of wire or plastic BRDs can function to reduce the number of terrapins that are caught, while also having minimal effects on the potential of the trap to capture legally sized crabs.
- With sturdy, properly made BRDs, terrapin exclusion from the trap would continue even if the trap was abandoned and left inactive (ghost pots).
- The use and implementation of BRDs can be made cheap and effective by using materials such as plastic and having continued support for their use.
- A push for legislative efforts to implement BRDs in the crabbing industry is necessary to enforce crab trappers to use the devices.

FURTHER DISCUSSIONS

- Butler and Heinrich modified crab pots for terrapin capture by extending the height above water with PVC frames, which were enclosed in mesh used for standard crab pots and secured to the trapping site with metal rods (Butler and Heinrich, 2013).
- Where BRD regulation is limited or not present, programs can be implemented for the removal of ghost pots throughout the terrapin range, as is currently seen in the Carolinas, Florida, Alabama, Mississippi, Louisiana, and Texas (Butler et al., 2006).
- Commercial potting can be restricted to deeper waters during active terrapin seasons to limit the number of reproductive individuals caught to raise the population in effected areas.
- Increasing the height of crab pots is necessary to prevent drowning in terrapin catch and does not affect the size of the opening. Smaller openings by implemented BRDs, however, are believed to recue the number of crabs which can escape from crab pots.
- Opening-altering BRDs are as inexpensive as 0.50 USD a piece, and are already being offered by New Jersey to residents for free (Meylan, 2006).
- Another type of BRD would involve fitting a tall crab pot with rebar and floats on top (styrofoam or other buoyant material) can allow space for captured terrapins to breathe (Wood 1997).
- Further efforts should be made to promote the use of BRDs in the states within the terrapin's range, and more evidence should be gathered on blue crab inclusion to help solidify justification for usage.

REFERENCES

Allen, J. F. and R. A. Littleford. 1955. Observations on feeding habits and growth of immature diamondback terrapins. *Herpetol.* **11**:77-85.

Arendt, M. D., Schweitzer, J. A., Dingle, J., Evans, C. A., Wallrep, E., Covartaski, B., Fowler, A. E., & Whitaker, J. D. 2018. A "BRD" in the Hand Worthy of Four in the Trap: Validation of Optimal Bycatch Reduction Device (BRD) Size to Maximize Blue Crab (Callinectes sapidus) Entry and Diamondback Terrapin (Malaclemys terrapin) exclusion through Theoretical Modeling and Applications. *N. Amer. J. of Fish. Manag.* **38**(3):411-423.

Butler, J. A., and George L. H. 2007. The effectiveness of bycatch reduction devices on crab pots at reducing capture and mortality of diamondback terrapins (Malaclemys terrapin) in Florida. *Estuaries and Coasts.* **30**(1):179-185.

Butler, J. & Heinrich, G. & Seigel, R. 2006. Third Workshop on the Ecology, Status, and Conservation of Diamondback Terrapins (Malaclemys terrapin): Results and Recommendations. *Chelonian Conserv. and Bio.* 5:331-334.

Butler, J. A., Heinrich, G. L., Mitchell, M. L. 2012. Diet of the Carolina Diamondback Terrapin (Malaclemys terrapin centrata) in Northeastern Florida. *Chelonian Conserv. Biolo.* **11**:124-128.

Grosse, A. M., Dijk, D. J., Holcomb, K. L., Meetz J. C. 2009. Diamondback Terrapin Mortality in Crab Pots in a Georgia Tidal Marsh. *Chelonian Conserv. and Bio.* **8**(1):98-100.

Meylan, P. A. 2006. Biology and Conservation of Florida Turtles.

Morris, A.S., Wilson, S.M., Dwyer, E.F. et al. 2011. A Test of Bycatch Reduction Devices on Commercial Crab Pots in a Tidal Marsh Creek in Virginia. *Estuaries and Coasts.* **34**:356–360

Roosenberg, W., Kennedy, V. 2018. Ecology and Conservation of the Diamond-Backed Terrapin. John Hopkins University Press.

Wood, R. 1995. Diamondback terrapin, In: L. S. Dove and R. M. Nyman, eds. "Living Resources of the Delaware Estuary. Delaware Estuary Program. 299-304.

Wood, R. 1997. The Impact of Commercial Crab Traps on Northern Diamondback Terrapins, *Malaclemys terrapin terrapin*. Proceedings: Conservation, Restoration, and Management of Tortoises and Turtles—An International Conference. 21-27.