Diamondback Terrapin Paired Crab Trap Study in the Nueces Estuary, Texas

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Diamondback Terrapin Paired Crab Trap Study

Aaron S. Baxter, M.S., Principal Investigator

Executive Summary

It is widely accepted that diamondback terrapin populations are declining throughout the species' range. While many factors contribute to these declines, researchers agree that crab trap bycatch mortality represents the most prominent threat to diamondback terrapins. The effectiveness of bycatch reduction devices (BRDs) at excluding terrapins is well documented outside of Texas. Research has also shown that BRDs have no negative impacts on blue crab catch rates, in terms of both size and number. The objective of this study was to test the effectiveness of BRDs in excluding terrapins from crab traps without restricting ingress of blue crabs.

The study was performed in the Nueces Estuary, TX from September 2012 through December 2012 and March 2013 through August 2013. Twenty four crab traps (12 experimental, 12 control) were used to capture Texas diamondback terrapins and blue crabs for three consecutive days each month that sampling occurred. Catch rates for Texas diamondback terrapins and blue crabs were compared between the two trap types.

Results showed BRDs were highly effective in excluding Texas diamondback terrapins from crab traps. Twenty three diamondback terrapins were captured in control traps, whereas none were caught in traps equipped with BRDs. Overall, control traps (n = 472) captured more blue crabs than experimental traps (n = 426). When sublegal crabs were excluded from the analysis, the control traps (n = 381) and experimental traps (n = 380) were equally successful at capturing blue crabs. For all captured blue crabs, there was no significant difference (p = .754) in mean carapace width between the two trap types. Mean carapace width was significantly different between trap types (p = .002) for blue crabs ≥127 mm. This significance is represented by a difference in mean carapace width of 4 mm between control and experimental traps. For larger blue crabs (≥152 mm) there was no significant difference (p = .514) in mean carapace width between control and experimental traps. These larger blue crabs bring higher market prices and are therefore more desirable.

Results of this study suggests that BRDs represent an inexpensive, effective management tool for reducing diamondback terrapin bycatch mortality in Texas without substantially impacting the state's commercial crab fishery.

Introduction

The diamondback terrapin (*Malaclemys terrapin*) is the only brackish water turtle species in North America. Ranging from Cape Cod, MA to Corpus Christi, TX, diamondback terrapins inhabit brackish, coastal habitats including marshes, tidal creeks/rivers, and mangroves. The Texas diamondback terrapin (*Malaclemys terrapin littoralis*), one of seven subspecies, is found from eastern Louisiana to Corpus Christi, TX (Pritchard 1979).

Once considered a culinary delicacy, historical declines in terrapin populations are attributed to commercial overharvest (Bishop 1983). Highly esteemed for its flavor, commercial harvests of terrapins began in the late 1800's and continued through the 1920's, at which point the industry became unsustainable and terrapins were considered commercially extinct (Hart and Lee 2007). Although some states still allow for the commercial harvest of terrapins, its demand as a food item has fallen drastically. As a result, terrapin populations began to slowly rebound throughout their range.

While commercial harvest no longer presents a major threat to terrapin populations, recent declines have been attributed to three main factors: (1) habitat loss/fragmentation (Roosenburg 1990), (2) vehicular traffic mortality (Szerlag and McRobert 2006) and (3) drowning in crab traps (Butler and Heinrich 2007). Incidental terrapin bycatch mortality in crab traps is well documented in New Jersey (Wood 1997), Delaware (Cole and Helser 2001), Maryland (Roosenburg and Green 2000), South Carolina (Hoyle and Gibbons 2000), Florida (Butler 2000), Alabama (Marion 1986), Mississippi (Mann 1995), and Louisiana (Guillory and Prejean 1998). Researchers agree that crab trap bycatch mortality presents the greatest threat to diamondback terrapin populations throughout their range (Butler and Heinrich 2007; Butler et al. 2006; Seigel and Gibbons 1995).

Bycatch reduction devices (BRDs) have been developed and tested (Wood 1997) in hopes of reducing terrapin bycatch mortality in crab traps, while maintaining typical catch rates for blue crabs (*Callinectes sapidus*). The BRDs fit inside the existing entrance funnels of the crab trap and do not require any additional modifications to traditional crab fishing gear. Research outside of Texas indicates that BRDs effectively exclude diamondback terrapins without impacting blue crab catch rates (Guillory and Prejean 1998; Cuevas et al. 2000; Roosenburg and Green 2000; Butler and Heinrich 2007; Rook et al. 2010; Morris et al. 2011). The commercial blue crab fishery represents a substantial industry in Texas and efforts to conserve terrapins must account for this. In 2010, the reported commercial landings for blue crab in Texas were 1,558,543 kg (3,436,000 lbs.) valued at $3,134,000 (Texas Parks and Wildlife Department 2010). Presently, there are no published paired-trap studies in Texas comparing catch rates for diamondback terrapins and blue crabs between traps with, and without, BRDs.

Methods

Study area

The Nueces Estuary is located near Corpus Christi in the Texas Coastal Bend. The estuary consists of a primary bay, Corpus Christi Bay, and two secondary bays, Nueces Bay and Oso Bay (Fig. 1). The Nueces River and Oso Creek serve as freshwater sources for the estuary. This study was performed in the Nueces River, Nueces River Delta, and the west end of Nueces Bay.

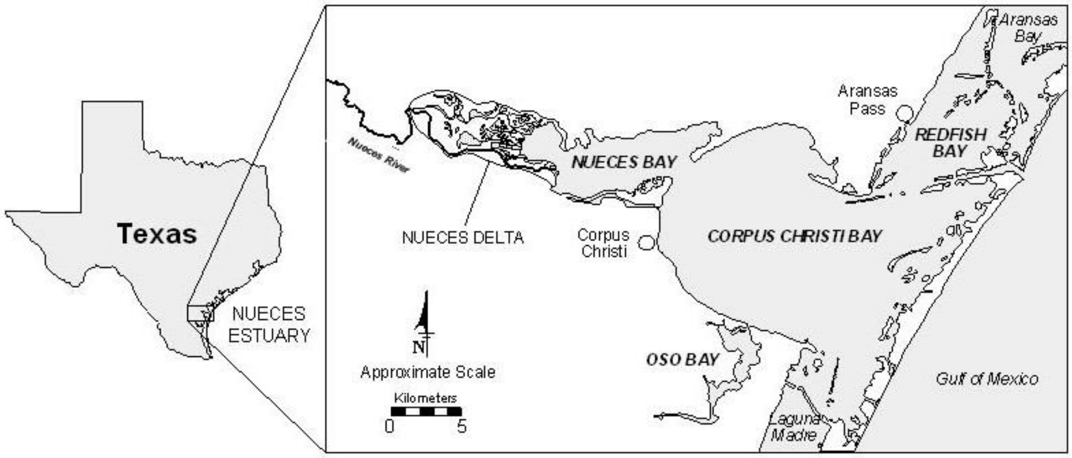

Figure 1. The Nueces Estuary, TX including Nueces Bay, Nueces River, and Nueces River Delta (Bureau of Reclamation, 2000).

The Nueces River originates in Real County, TX and empties directly into Nueces Bay. Because the river presently bypasses the historic delta, the Nueces River Delta is often hypersaline due to reduced freshwater inflow. Typical habitats in the delta include vegetated marsh, mudflats, tidal creeks, and shallow ponds (Bureau of Reclamation 2000). Nueces Bay is a shallow embayment and habitats include unvegetated bay bottom, oyster reef, restricted areas of seagrass, and vegetated shorelines (Tunnel et al. 1996; Pulich and White 1997). The Nueces Estuary is frequently referred to as a reverse estuary as salinity often decreases from the delta throughout the estuary and into the Gulf of Mexico.

Field Sampling

Sampling occurred September 2012-December 2012 and March 2013-August 2013. Sampling did not occur in January 2013 or February 2013 due to inactivity in both terrapins and blue crabs resulting from low water temperatures. A YSI Muliparameter Sonde was used to record water temperature (°C) and salinity (Practical Salinity Units or PSU) during all sampling events. Diamondback terrapins and blue crabs were captured using commercial crab traps modified with chimneys to provide a permanent air space allowing terrapins to surface to breathe (Fig. 2).

During each sampling event, 24 crab traps were deployed at depths ranging from 0.6 m-0.9 m and were baited with dead finfish. Twelve experimental traps were equipped with 4.5 cm x 12 cm BRDs (Fig. 3). The remaining twelve traps were fished without BRDs and served as control traps. Experimental and control traps were set in an alternating fashion within the study area. Care was taken to mimic commercial crabbing behavior as traps were set in areas fished commercially for blue crab using bait common to commercial crabbing operations. Sampling occurred for three consecutive days a month and were checked and re-baited daily during that time. Captured terrapins were measured (carapace length, carapace width, carapace height, plastron length, plastron width), weighed, sexed, and released at the site of capture. Blue crabs were measured (carapace width) and sexed. Crabs of legal size (127 mm) were removed from the study area while sublegal crabs were released at the site of capture. Finfish and other crab species captured in traps were also recorded.

Figure 2. Commercial crab trap modified with a chimney to provide a permanent air space.

Figure 3. Commercial crab trap fitted with four bycatch reduction devices (BRDs).

Statistical Analysis

Blue crab data were grouped based on Texas crabbing regulations and marketability. The following groups were used in statistical analysis: all blue crabs, blue crabs <127 mm (<5 in.), blue crabs ≥127 mm (≥5 in.), and blue crabs ≥152 mm (≥6 in.). Blue crabs under 127 mm are illegal to possess in the state of Texas. Blue crabs ≥127 mm are considered legal and blue crabs ≥152 mm are most valuable bringing higher market prices. Overall captures (n) for all blue crab groups and diamondback terrapins were compared for experimental and control traps. Differences in mean carapace width for captured blue crab between experimental and control traps were analyzed using the Mann-Whitney U test. This is a non-parametric test for comparing means between non-normal datasets with unequal variances. The test was performed for all blue crabs, blue crabs ≥127 mm, and blue crabs ≥152 mm. The test was not performed on blue crabs <127 mm as they offer no financial benefits to commercial crabbers. A catch per unit effort (CPUE = organisms captured/day) was calculated for control and experimental traps for diamondback terrapins and all blue crab groups.

Results

Over the course of the study, water temperature and salinity ranged from 18.96 °C to 38.92 °C and from 11.05 PSU to 48.16 PSU, respectively. Twenty three Texas diamondback terrapins were captured during this study and all in control traps (Table 1). Diamondback terrapin CPUE is recorded in Table 1. Monthly terrapin captures are shown in Figure 4.

Table 1. Number, mean carapace width, and CPUE for diamondback terrapins and blue crabs in experimental and control traps.

	Control	Experimental
M. terrapin littoralis (n)	23	
CPUE *M. terrapin littoralis* (terrapins/day)	1.15	
C. sapidus (n)	472	426
C. sapidus <127 mm (n)	90	46
C. sapidus ≥127 mm (n)	381	380
C. sapidus ≥152 mm (n)	206	179
Mean carapace width *C. sapidus* (mm)	148.0	147.6
Mean carapace width *C. sapidus* <127 mm (mm)	116.8	115.9
Mean carapace width *C. sapidus* ≥127 mm (mm)	155.4	151.4
Mean carapace width *C. sapidus* ≥152 mm (mm)	168.4	166.9
CPUE *C. sapidus* (crabs/day)	23.60	21.30
CPUE *C. sapidus* <127 mm (crabs/day)	4.50	2.30
CPUE *C. sapidus* ≥127 mm (crabs/day)	19.05	19.00
CPUE *C. sapidus* ≥152 mm (crabs/day)	10.30	8.95

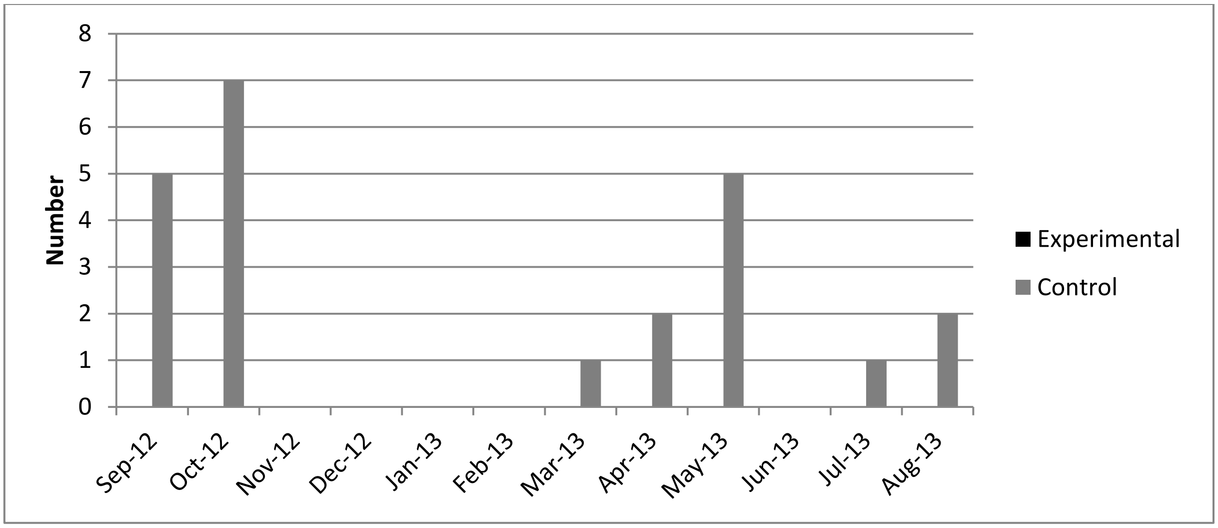

Figure 4. Monthly captures for Texas diamondback terrapin in experimental and control traps.

Overall, control traps captured more blue crabs than experimental traps. When sublegal blue crabs were excluded, the number of blue craps captured by trap type was equal (Table 1). Blue crab CPUE is recorded in Table 1. Results of the Mann-Whitney U test showed no difference in mean carapace width between trap types for all blue crab captures (p = .754) or for blue crabs ≥152 mm (p = .514). Test results did suggest a difference for blue crabs ≥127 mm (p = .002). Monthly blue crab captures are shown in Figures 5, 6, and 7 for all blue crabs, blue crabs ≥127 mm and, blue crabs ≥152 mm, respectively.

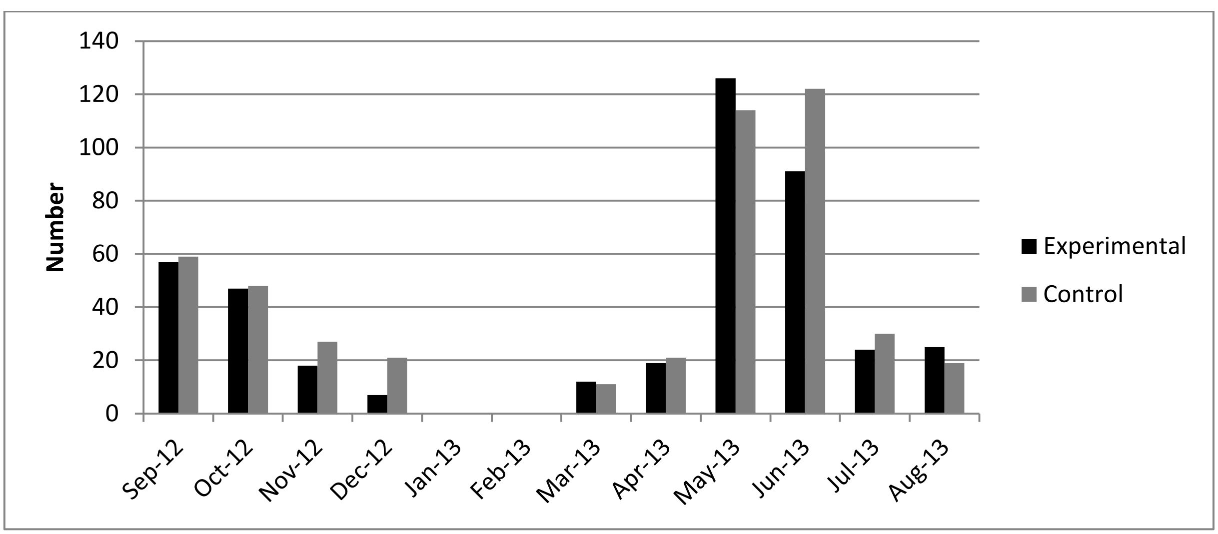

Figure 5. Monthly captures for all blue crabs in experimental and control traps.

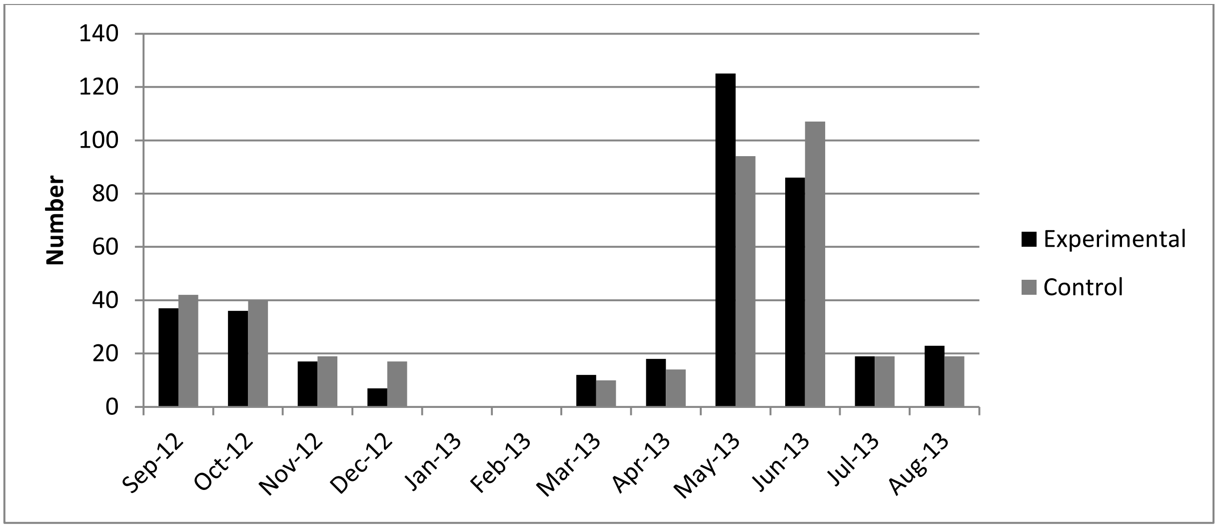

Figure 6. Monthly captures for blue crabs ≥ 127 mm in experimental and control traps.

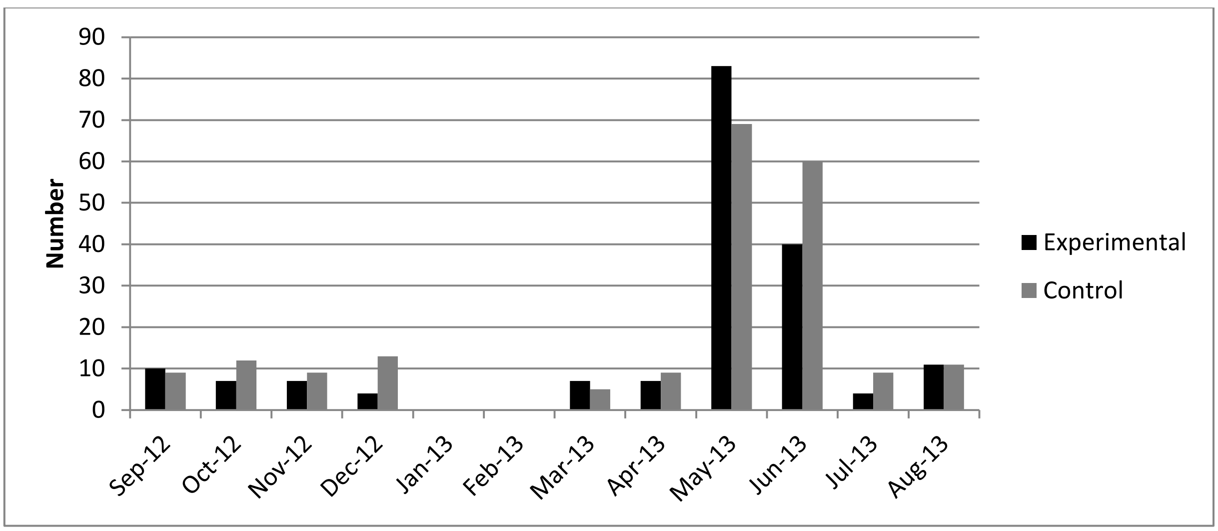

Figure 7. Monthly captures for blue crabs ≥ 152 mm in experimental and control traps.

Table 2. List of species captured in experimental and control traps.

Species	Common Name	Control (n)	Experimental (n)
Callinectes sapidus	Blue Crab	472	426
Malaclemys terrapin littoralis	Texas Diamondback Terrapin	23	0
Lagodon rhomboides	Pinfish	0	2
Leiostomus xanthurus	Spot	2	0
Micropogonias undulatus	Atlantic Croaker	1	0
Menticirrhus americanus	Southern Kingfish	1	0
Ariopsis felis	Hardhead Catfish	63	42
Menippe adina	Stone Crab	9	3

Discussion and Recommendations

The BRDs (4.5 cm x 12 cm) tested in this study proved effective at excluding terrapins from crab traps. None of the 23 captured terrapins were caught in experimental traps, suggesting that carapace height in diamondback terrapins limits their entry into crab traps equipped with BRDs. Commercial crab traps are constructed with coated chicken wire and possess 2-4 entrance funnels. These entrance funnels appear too small for terrapins to enter, but the flexibility of the chicken wire allows terrapins to stretch the opening, permitting them entrance to the trap. Once inside, terrapins are unable to surface to breathe and often drown. Mortality rates as a result of drowning have been estimated at 20-100% depending on the time of year and time spent submerged within the trap (Wood 1997). Bycatch reduction devices exclude terrapins from traps by adding rigidity to an otherwise flexible structure. At $0.48/unit, BRDs represent an inexpensive, effective management tool for excluding diamondback terrapins from crab traps, resulting in lowered bycatch mortality in this species.

The CPUE reported for diamondback terrapins demonstrates the potential impacts of blue crab fishing on terrapin populations. For this study we fished 24 crab traps, 12 of which were equipped with BRDs. Because no terrapins were captured in experimental traps, the calculated CPUE of 1.15 represents only the 12 control traps fished over the 20 sampling days. When the CPUE of 1.15 terrapin/day is further reduced to terrapin/trap/day, the resulting CPUE is .096. In Texas, a commercially licensed crab fisherman is allowed up to 200 traps. With 178 available licenses, the number of traps fished could be as high as 35,600 per day. A CPUE of .096 terrapin/trap/day could result in 3,417 potential daily terrapin captures, statewide. While it is unlikely that all licensed crab traps are fished daily in Texas, these data still point to the potential impacts of commercial crab fishing on diamondback terrapin populations in Texas. If ten percent of licensed traps (3,560) are fished on a given day, there is still the potential for 342 terrapins captured per day across the state. Removal of dozens, let alone hundreds, of animals a day from the population could result in declines, and eventual extirpation, of diamondback terrapins in Texas. Based on capture rates and population size, Roosenburg et al. (1997) reported 15-78% of a population may be removed annually as a result of crab trap bycatch. Because of this species' slow maturation, this rate of removal is unsustainable and if unchecked, would inevitably lead to extirpation.

Overall blue crab catch was higher in control traps as a result of more sublegal blue crabs captured. When limited to blue crabs ≥ 127 mm (5 in.), the data show that experimental (n = 380) and control traps (n = 381) were equally effective at capturing blue crabs. When comparing mean carapace width for all blue crabs, there was no significant difference (p = .754) between experimental and control traps. For blue crabs ≥127 mm, there was a statistical difference (p = .002) between mean carapace width among the two trap types. This significant p-value was the result of a 4 mm (0.157 in.) difference in mean carapace width between the experimental and control traps. Although statistically significant, a difference of 4 mm would be unsubstantial in a commercial crabbing operation. For larger, more valuable blue crabs (≥152 mm) there was no significant difference (p = .514) in mean carapace width between the two trap types. These data suggest that numbers and sizes of blue crab are not impacted by the use of BRDs.

Control traps captured twice as many sublegal blue crabs (n = 90) as experimental traps (n = 46). This may be attributed to the BRDs acting as a culling device, allowing smaller crabs egress from the traps. This would benefit commercial crab fishermen, reducing the amount of time required to remove and release these smaller blue crabs. In terms of overall bycatch, experimental traps captured fewer non-target species than did controls.

There are numerous studies demonstrating the effectiveness of BRDs at excluding terrapins while allowing ingress of blue crabs to traps. Until the present, all of these studies have been performed outside of Texas. The results of this study are similar to those previously reported in the literature. When combined, there is overwhelming evidence in support of the use of BRDs to drastically reduce diamondback terrapin mortality in crab traps without creating substantial impacts to the blue crab fishery.

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