BEFORE THE SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES

PETITION TO PROTECT DIAMONDBACK TERRAPINS (*MALACLEMYS TERRAPIN*) FROM MORTALITY IN BLUE CRAB POTS BY REQUIRING BYCATCH REDUCTION DEVICES

Grosse et. al

Center for Biological Diversity
Port Royal Sound Foundation
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Notice of Petition

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Pursuant to S.C. Code Ann. § 1-23-126, the Center for Biological Diversity, Port Royal Sound Foundation, and Lowcountry Ecological, LLC petition the South Carolina Department of Natural Resources (SCDNR) to formally promulgate a regulation requiring bycatch reduction devices in all commercial and recreational blue crab pots deployed in state waters less than 200 ft in width or within 100 ft of a river or sound shoreline (where diamondback terrapins are found) to protect the diamondback terrapin. Crab pots indiscriminately drown diamondback terrapins, contributing to terrapin declines and intensifying negative effects from additional pressures, such as habitat loss, poaching, road mortality, and sea level rise, which already threaten populations range-wide.

The Center for Biological Diversity (Center) authored this petition. The Center is a non-profit, public interest environmental organization dedicated to the protection of native species and their habitats through science, policy, and environmental law. The Center is supported by more than 1.8 million members and online activists throughout the United States, including almost 15,000 members and supporters in South Carolina. The Center and its members are deeply concerned about the conservation of imperiled wildlife—including diamondback terrapins—and their essential habitats.

The Port Royal Sound Foundation's mission is to conserve the Port Royal Sound for the environmental, cultural, and economic well-being of our area. In partnership with the University of South Carolina – Beaufort (USCB), Lowcountry Ecological LLC, Sewanee University, Turtle Survival Alliance, and SCDNR, the organization launched the Beaufort Terrapin Project to study and assess diamondback terrapins in the Port Royal Sound.

Lowcountry Ecological, LLC is dedicated to fostering relationships between people and nature in the South Carolina Lowcountry. The organization is a part of the Beaufort Terrapin Project, which was launched to study and assess diamondback terrapins in the Port Royal Sound.

I. EXECUTIVE SUMMARY

The diamondback terrapin (Malaclemys terrapin) is the only turtle species in the world that lives exclusively in brackish coastal habitats (Wood 1995). It occurs in the United States along the coasts of the Atlantic Ocean and Gulf of Mexico, and in Bermuda. The species is currently in decline (Roosenburg et al., 2019).

Wild turtle populations are characterized by a suite of life history characteristics that predispose them to rapid declines when subjected to unnatural levels of adult mortality (Colteaux and Johnson, 2017 at 17; Heppell, 1998; Galbraith et al., 1997; Congdon et al., 1993, 1994). Among these characteristics are delayed maturity, low fecundity, high annual survivorship of adults, and high natural levels of nest mortality (Reed and Gibbons, 2003). Similarly, terrapins' life history traits prevent them from withstanding chronic sub-adult and adult mortality (Hoyle and Gibbons, 2000 at 736). Removing even a few diamondback terrapins from a population can have detrimental effects on the population as a whole (Hoyle and Gibbons, 2000). For this reason, experts rank crab pot mortality as the greatest threat to the diamondback terrapin (Butler et. al., 2006 at 332) and have emphasized that modifying pots to reduce terrapin mortality is of utmost importance (Baker et al., 2013 at 676).

A fleet of active blue crab pots is capable of steadily removing individual terrapins from a population until it can no longer sustain itself (Roosenburg et al., 1997; Butler and Heinrich, 2007), while just one or two inactive or "ghost" pots are capable of killing large numbers of individuals in a population over a single crabbing season (<1 year) (Grosse et al., 2009). Because the terrapin's life history traits prevent it from absorbing chronic increases in adult mortality, crab pots can rapidly cause reduction in population size (Roosenburg, 1991 at 231–232; Hoyle and Gibbons 2000 at 736). Roosenburg et al. (1997) estimated that mortality rates caused by the recreational use of crab pots in Maryland alone could increase annual terrapin mortality rates up to 78%, which can cause decline and rapid extirpation of local populations. Similarly, Hart (1999) modeled the impacts of terrapin bycatch and mortality in crab pots in Massachusetts, finding that even a low harvest rate (15%) could reduce a population by 49% after 15 years. Moderate (30%) and intense (75%) harvest rates produced 77% and 92% population reductions, respectively, over the same time period (Hart 1999 at 46).

Bycatch reduction devices (also known as "BRDs" or terrapin excluder devices) can prevent most terrapins from drowning in crab pots, while having little to no effect on the number or size of crabs captured (reviewed in Chambers and Maerz 2018; Roosenburg 2004; Butler and Heinrich 2007). Recognizing the significant threat crab pot mortality poses to terrapins, several states require blue crab pots to have BRDs, and even more states are now considering similar measures. South Carolina regulations make it unlawful to take or possess diamond-backed terrapins for commercial purposes, and place restrictions on how many terrapins can be possessed for noncommercial purposes, but this does not address threats posed by blue crab fishing in the state.

The South Carolina Department of Natural Resources is responsible for the stewardship of the state's marine and estuarine resources. The Marine Resources Division within the SCDNR manages and conserves these resources, conducting monitoring and research to ensure sustainable management. The division also oversees fisheries management, including the regulation of fishing season and the establishment of size and catch limits for various marine species. This includes regulating crab fishing in coastal waters, setting harvest limits, license requirements, crab pot requirements, and all regulations pertaining to crab pots. The department's jurisdiction encompasses all coastal waters, including saltwater fish, fishing, fisheries, and marine resources within the state's salt waters, which also includes the territorial sea. The department's authority extends to all impounded waters seaward of the freshwater/saltwater dividing line, which are intermittently filled or drained by the action of the tide.

To that end, the SCDNR has implemented regulations in the interest of conserving and protecting imperiled wildlife. For example, the SCDNR has listed non-game wildlife on the state's List of Endangered Wildlife Species, requiring permits for certain activities to avoid penalties for taking listed species, promulgated regulations for hunting and managing native reptiles and amphibians, collaborated with organizations to maintain essential habitats like horseshoe crabs and migratory birds, and established the State Wildlife Action Plan (SWAP) to detail conservation efforts and plans for imperiled species within the state.

According to S.C. Code Ann. § 1-23-126, an interested person may petition an agency in writing requesting the promulgation, amendment or repeal of a regulation. Within thirty days after submission of such petition, the agency shall either deny the petition in writing (stating its reasons for the denial) or shall initiate the action in such petition.

Under this authority and for the reasons explained below, Petitioners respectfully request that the Department of Natural Resources grant this petition and initiate rulemaking proceedings to promulgate and/or amend its current regulations to require BRDs or similar gear modifications on all blue crab pots in waters less than 200 ft in width or within 100 ft of a river or sound shoreline (where diamondback terrapins are found).

II. BACKGROUND

a. The Diamondback Terrapin

Named for the concentric, diamond-shaped rings on their shells, diamondback terrapins are among the most beautiful and charismatic turtles in the United States. Though their colors may vary between light gray, dark gray, brown, and nearly black, diamondback terrapins are easily identifiable by their diamond-patterned shells and flecked or spotted heads and legs.

Diamondback terrapins are the only turtles that live exclusively in coastal brackish water ecosystems, where freshwater meets the sea. There are seven traditionally recognized subspecies of diamondback terrapin: the Carolina diamondback terrapin (*M. t. centrata*), eastern Florida diamondback terrapin (*M. t. tequesta*), mangrove diamondback terrapin (*M. t. rhizophorarum*), ornate diamondback terrapin (*M. t. macrospilota*), and Mississippi diamondback terrapin (*M. t. pileata*). Experts now recommend recognizing four discrete populations or management units: Northeast Atlantic, Coastal mid-Atlantic, Florida, and Texas/Louisiana (Hart et al. 2014; Lovich and Hart 2018). Coastal Mid-Atlantic Terrapins are significant because their extirpation would result in a large gap in the Diamondback Terrapin's range; with the noted site fidelity and slow recolonization times in the species, it would be extremely difficult for Diamondback Terrapins to rebound from the loss of this genetic cluster (Gibbons et al., 2001).

Diamondback terrapins are keystone species in the salt marshes they inhabit, which means they help maintain the ecological health of their associated ecosystems. Among the prey of diamondback terrapins are salt marsh snails (*Littorina spp.*) (Tucker et al., 1985), which, in high numbers, contribute to loss and erosion of salt marshes by grazing on the epiphytes that live on stems of grasses and thereby killing the grasses (Silliman and Bertness, 2002). Because terrapins feed on the snails, they likely reduce salt marsh erosion and loss (See Brennessel, 2007). Terrapins also move substantial quantities of nutrients and calories from the water to land in the form of eggs, which are then eaten by a variety of terrestrial and avian predators (Seigel, 1980a; Clark, 1982; Cecala et al., 2008).

i. Life Cycle and Natural History

Diamondback terrapins spend most of their lives in nearshore habitat (Roosenburg et al. 1999). Their diets include snails, claims, mussels, small crabs, fish, and annelid worms (Tucker et al. 1985; Butler et al. 2012). Male terrapins mature around 2 to 7 years of age, while female terrapins become reproductively mature between 4 and 8 years of age (Seigel 1984; Lovich et al. 2018 at 65–66). In Florida, one study found female terrapins mature at 4 to 5 years, while male terrapins mature at 2 to 3 years (Seigel 1984; Lovich et al. 2018 at 66).

In the spring, terrapins form courtship and mating aggregations for several days to weeks; and beginning in late spring and continuing into the summer, female terrapins come to land to dig nests and lay their eggs (Butler et al., 2018). Wild female terrapins produce one or two clutches of eggs per year, though triple clutches have been reported in Florida (Lovich et al., 2018 at 66–

67; Heinrich, pers. comm., 2019). Clutch sizes range from 1 to 23 eggs, though clutch sizes tend to be smaller in Florida based on studies of the Florida east coast diamondback terrapin (6.7 eggs) and the Carolina diamondback terrapin (6.7 eggs) (Seigel 1980b; Butler 2000; Lovich et al. 2018 at 66–67).

ii. Status and Threats

The International Union for the Conservation of Nature (IUCN) Red List ranks the diamondback terrapin's global status as Vulnerable and describes its population trend as decreasing (Roosenburg et al., 2019). Of 54 researchers surveyed across the terrapin's range in 2006, 29.6% said the diamondback terrapin was declining in their state, 14.8% said populations were stable, and 55.6% said the status was unknown (Butler et al., 2006). No one considered populations to be increasing (Butler et al., 2006).

The diamond-backed terrapin is a protected species in South Carolina. It is listed as a high priority species for conservation under the State Wildlife Action Plan, and commercial harvesting has been prohibited since 2006 due to declining populations and threats, such as habitat loss and accidental entanglement in crab pots. Diamondback terrapins in South Carolina face several threats in South Carolina, from coastal development, dredging, and filling of wetlands, accidental drowning in fishing gear, collisions with cars, illegal pet trade, and predators.

A primary threat to diamondback terrapins in the state is the presence of these derelict crab pots, with incidental capture and drowning in blue crab pots is a common threat with commercial and recreational pots. Crab pots have been known to eliminate local populations of terrapins - depending on the extent of the fishery and the assumed mortality rates, between 15% and 78% of a local terrapin population may be removed annually (Roosenburg et al. 1997). For example, one ghost crab pot can contain almost 100 dead terrapins (Grosse et. al., 2009; Bishop, 1983).

While South Carolina has implemented some measures to protect the species, such as banning commercial harvesting and collecting population data, it has not addressed the threats posed by crab pots. The State Wildlife Action Plan (SWAP) for 2025 states that entrapment in fishing devices - including hook-and-line, trawls, and crab pots - represents a significant challenge to turtle species throughout the State. Major challenges to the Diamondback Terrapin in the marine environment include recreational, commercial, and abandoned/ghost crab pots (SCDNR, 2025).

Anthropogenic threats to terrapins remain, making the species' future survival tenuous in some locales (Butler and Roosenburg, 2018). Threats to the diamondback terrapin include habitat destruction and degradation (Butler et al., 2006; Hart and Lee, 2007 at 211); road mortality (Wood and Herlands, 1997; Butler et al. 2006; Szerlag and McRobert, 2006; Maerz et al., 2018); sea-level rise caused by global climate change (Hunter et al., 2015; Woodland et al., 2017); pollution (Butler et al., 2006; Blanvillain et al., 2007; Drabeck et al., 2014 at 132–133; Roosenburg et al. 2019); boat strikes (Lester et al., 2013); predation (Butler et al., 2004; Draud et al., 2004; Butler et al., 2006); collection for personal and commercial purposes, including the effects of large-scale historic commercial harvesting and current poaching (Hart and Lee, 2007 at 207), and inadequate regulatory measures to address these threats (Roosenburg et al., 2019).

b. Crab Pot Mortality

Terrapin mortality in crab pots has been and continues to be one of the major threats to terrapins, and it has been studied in nearly every state in the species' range (Butler and Roosenburg, 2018). When surveyed, experts ranked crab pot mortality as the greatest threat to terrapins.

Crab pots essentially cause two "levels" of terrapin mortality: (1) a "constant background mortality" from many crab pots that are regularly fished over a long period of time; and (2) acute mortality events from individual crab pots that have been lost or abandoned ("ghost" or "derelict" pots) (Roosenburg et al., 1997 at 1167; Roosenburg, 2004). In other words, regularly fished crab pots have the potential to consistently capture smaller numbers of terrapins over time, while ghost pots can capture more terrapins in one pot over a relatively shorter time (Roosenburg, et al., 1997 at 1167). Mortality due to entrapment in crab pots would have the potential to contribute to local extirpation of terrapin populations.

Both commercial and recreational crab pots pose a serious threat to diamondback terrapins at the individual, population, and species level (Roosenburg et al., 1997; Crowder et al., 2000 at 1; Roosenburg, 2004; Chamber and Maerz, 2018). Terrapins enter submerged crab pots and die when they cannot escape to breathe at the water's surface. This can occur in a short period of time — less than five hours (Crowder et al., 2000 at 1). The problem is often compounded when these gregarious turtles follow one another into pots (Bishop, 1983 at 428; Butler and Heinrich, 2007). Experts posit that terrapins have an innate curiosity to investigate things and that the presence of a terrapin in a crab pot may attract additional turtles, thus increasing the likelihood of large kills in crab pots (Roosenburg, 1991 at 231). They also find that crab pots attract terrapins whether or not they are baited (Chambers and Maerz, 2018).

Blue crab pots are present throughout the terrapin's range, as commercial and recreational crab fisheries are active to varying degrees in nearly every coastal state along the Atlantic and Gulf coasts (Chambers and Maerz, 2018). Even when crabbing potential may be small in a state, it can have a severe effect on a local scale (Roosenburg et al., 1997; Tucker et al., 2001; Grosse et al., 2009; Chambers and Maerz, 2018). While commercial crabbing is generally distributed broadly across open water, it also is allowed in tidal creeks associated with large river systems that intersect with coastal salt marsh habitat (Chambers and Maerz, 2018; VMRC, 2023). Commercial harvest of peeler crabs occurs seasonally in small tidal creeks when crabs are molting, which places crab pots in critical terrapin habitat (Chambers and Maerz, 2018). Furthermore, a large percentage of recreational crabbing occurs in shallow creeks and other areas that intersect with terrapin habitat (*Id.*). Both commercial and recreational crab pots can end up as derelict or "ghost" pots in terrapin habitat (*Id.*). Crab pots fished in deeper waters may be lost and carried into terrapin habitat by tides or storms, thereby affecting terrapins in shallow water (*Id.*).

Crab pot mortality affects terrapin populations by removing mature males and subadult and adult females and hindering the population's reproductive capabilities. While in some places female terrapins may grow too large to enter pots, male terrapins never grow larger than the opening of a crab pot entrance and are susceptible to crab pot mortality throughout their lives (Roosenburg et al., 1997; Chambers and Maerz, 2018). In the southeast, female terrapins do not grow as large as more northern populations, and therefore do not grow large enough to avoid crab pot mortality (Chambers and Maerz, 2018). For example, in one Alabama population, 85% of female terrapins sampled were susceptible to crab pot mortality (Coleman et al., 2014; Chambers and Maerz, 2018).

These 4 diamondback terrapins drowned after being trapped in a crab pot.
(Source: Virginia Institute of Marine Science/Diane Tulipani)

Crab pot mortality is a long-documented threat to diamondback terrapins across their range, with dozens of studies published over the last 75$^+$ years (Davis, 1942; Bishop, 1983; Marion, 1986; Burger, 1989; Mazzarella, 1994; Mann, 1995; Wood and Herlands, 1996; Roosenburg et al., 1997; Wood, 1997; Guillory and Prejean, 1998; Hoyle and Gibbons, 2000; Roosenburg and Green, 2000; Cole and Helser, 2001; Butler, 2002, 2000; Roosenburg, 2004; Butler and Heinrich, 2007; Grosse et al., 2009).

Experts agree that the capture and drowning of terrapins in crab pots is a major threat to terrapin populations throughout their range (Burger, 1989; Siegel and Gibbons, 1995; Wood, 1997; Roosenburg, 2004; Butler et al., 2006; Butler and Heinrich, 2007). This is because crab pots can eliminate local terrapin populations (Roosenburg et al., 1997 at 1171). Population-level impacts also include rapid, large-scale declines (Roosenburg et al., 1997 at 1170; Cole and Helser, 2001; Roosenburg, 2004 at 24; Grosse et al., 2009 at 99); skewed sex ratios (Bishop, 1983 at 427; Roosenburg, 1991 at 231; Roosenburg et al., 1997 at 1170; Hoyle and Gibbons, 2000 at 735; Dorcas et al., 2007 at 336–337; Butler and Heinrich, 2007 at 183; Grosse et al., 2009 at 99; Grosse et al., 2011 at 765); skewed age distribution (Dorcas et al., 2007 at 338–339); and skewed size distribution (Dorcas et al., 2007 at 3336–337; Grosse et al., 2011 at 763, 766; Lovich et al., 2018 at 71). Because terrapins' life history traits prevent them from absorbing chronic adult mortality, crab pots can cause localized extirpation of populations (Roosenburg, 1991 at 231–232; Hoyle and Gibbons, 2000 at 736).

i. Active Pots

As early as the 1940s, scientists observed the harmful effects of crab fishing gear on terrapins. Through studies in Georgia, scientists have found that the same risk exists in Georgia's waters (SCDNR, 2020; Gibbons et. al., 2001). The following is a survey of published studies documenting terrapin mortality in active crab pots.

Davis (1942) studied crab pot bycatch in Maryland waters and "definitely established that pots will capture terrapin" (Davis, 1942 at 16). Although the results were limited, Davis found that three large diamondback terrapins were taken, and two drowned (Davis, 1942 at 16–17). The third would have drowned, had the pot not been partially protruding from the water so the turtle could obtain air (Davis, 1942 at 17).

Bishop (1983) studied crab pot mortality from two South Carolina estuaries over three years and recorded 281 diamondback terrapins (195 male and 86 female) captured in baited and unbaited crab pots.[1] Based on 1982 records that there were 458 licensed crabbers fishing from 50–100 crab pots, and assuming an average number of 60 pots per crabber, with 40% of those pots being fished in near-shore shallow waters where terrapins live, Bishop estimated that 2,853 terrapins were captured daily during April and May, with mortality estimated at 285 terrapins (Bishop, 1983 at 428). This estimate fails to account for mortalities resulting from ghost pots.

Wood (1997) investigated the effect of crabbing on terrapins in New Jersey, including the extent of terrapin bycatch in commercial crab pots and the mortality levels of terrapins caught in those pots. He found that 19 terrapins (8 male, 11 female) were caught at a capture rate of 15 terrapins per 100 trap-days (Wood, 1997 at 23). Although Wood checked pots twice daily to minimize drowning of terrapins, four were drowned, causing a slightly greater than 20% mortality rate (Wood, 1997 at 23). Wood observed that commercial crabbers check pots no more than once per day, and that the terrapin mortality may have approached 100% (Wood, 1997 at 23).

Roosenburg et al. (1997) studied the rate of capture, size, sex, and age of terrapins captured in crab pots and determined the potential effect of crab pot mortality on local populations in the shallow water areas of Chesapeake Bay, Maryland. They estimated terrapin capture rates of 0.17 terrapins per pot per day (Roosenburg et al., 1997 at 1168). Based on these numbers, the scientists estimated that 15–78% of a local population may be captured in a single year (Roosenburg et al., 1997 at 1169). Based on these results, they estimated that local terrapin populations could be extirpated in 3 to 4 years (Roosenburg et al., 1997 at 1170).

Hoyle and Gibbons (2000) studied twenty recreational crab pots in South Carolina (Hoyle and Gibbons, 2000 at 735). During the 760 days the crab pots were deployed, 21 captures were made of 19 individual terrapins (Hoyle and Gibbons, 2000 at 735). Based on an estimated population

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[1] Because the traps were checked daily during the study, less than 10% of captured terrapins died (Bishop, 1983 at 427-428).

size of 168 to 299 terrapins, and an estimated annual recruitment of 12 to 17 terrapins, the scientists estimated that 6–11% of the population would potentially be removed from the local population[2] (Hoyle and Gibbons, 2000 at 735–736). Because terrapins' life history traits prevent them from absorbing chronic adult mortality, the scientists concluded that crab pots could cause "significant localized consequences" for local populations (Hoyle and Gibbons, 2000 at 736). Hoyle and Gibbons also found that recreational pots could be a greater threat to terrapins than commercial pots because local crabbers are able to access smaller creeks than commercial crabbers, where terrapins are more populated (Hoyle and Gibbons, 2000 at 736). Recreational crabbers are also more likely to leave their pots in the water for a longer period of time without checking them, and even unintentionally abandon them (Hoyle and Gibbons, 2000 at 736).

Dorcas et al. (2007) studied 21 years of mark-recapture data (more than 2,800 captures of 1,399 individuals) from a declining diamondback terrapin population in Kiawah Island, South Carolina, to determine whether a population decline there was the result of mortality in crab pots. They found that, since the 1980s, the modal size of both male and female terrapins had increased substantially and that the proportion of females was higher than earlier samples (Dorcas et al., 2007 at 336–337). They also noted that the studied population contained more old and fewer young terrapins than before (Dorcas et al., 2007 at 336). This change in the age of the population is also reflected in the size of individual terrapins (*Id.*). Based on their observations of changes in demography and sex ratio, the scientists suggested that the terrapin population declined as a result of selective mortality of smaller terrapins in crab pots (*Id.* at 338–339). Another later study in South Carolina showed that in a creek where bycatch mortality was high, terrapins rarely survived to reproduce (Tucker et al., 2001).

Grosse et al. (2011) contemporaneously studied two of the primary conservation concerns for diamondback terrapins: road mortality from coastal traffic and bycatch mortality in crab pots. They captured 1,547 individual terrapins among 29 tidal creeks in Georgia and used mark-recapture estimates of terrapin density and sex ratio to identify crab pot effects (Grosse et al., 2011 at 764–765). They observed that 153 terrapins—approximately 10% of all live terrapins they observed in the study creeks—drowned in 5 crab pots within study creeks, 83% of which were males (Grosse et al., 2011 at 765). Among all sites, terrapin density declined with increasing crabbing activity within the creek, whereas population density was not related to proximity of roads (Grosse et al., 2001 at 765–766). The scientists also found that there was a significantly larger proportion of smaller-sized terrapins in creeks with no crabbing activity (Grosse et al., 2011 at 763, 766). Thus, they concluded that crabbing activities are linked to terrapin population declines in Georgia and recommended that states focus on reducing bycatch risk by regulating fishing times, requiring the use of BRDs, and removing lost or abandoned crab pots from coastal habitats (Grosse et al., 2011 at 766–769).

Hart and Crowder (2011) estimated that if each of the approximately 7,500 crab fishers in North Carolina catches a number of terrapins similar to those observed in their study, and roughly 50% of that catch is removed from terrapin populations due to mortality (consistent with their study),

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[2] The two recaptures were excluded from the study (Hoyle and Gibbons, 2000 at 735).

then tens of thousands of terrapins could be removed from populations each year (Hart and Crowder, 2011 at 269). Thus, terrapin capture and mortality in actively fished commercial crab pots may represent an extremely large collective effect on local terrapin populations (*Id.*).

Coleman et al. (2014) found that although it is generally accepted that male and juvenile female terrapins are more vulnerable to crab pot mortality than adult females, fully mature females in some parts of the terrapin's range may be smaller and equally capable of entering crab pots (Coleman et al., 2014 at 142). Because loss of female terrapins means the loss of greater long-term reproductive potential, crab pot mortality could be more devastating to terrapin populations in some areas than previously considered (Coleman et al., 2014 at 143–144).

Two important conclusions can be drawn from these many studies that document terrapin capture and mortality rates in crab pots. First, the high rates of removal of terrapins by crabs will rapidly result in the local terrapin decline and, within 15-20 years, complete extirpation of the population. Second, given that crab pots have been used since the 1940s, many terrapin populations are now extirpated, leading to the false interpretation that the current lack of terrapin captures in crab pots in a particular area suggests that they do not occur there. They may well have occurred there in the past, but their population has already been wiped out, suggesting to the modern day crabber that terrapins do not occur there.

ii. Ghost and Derelict Pots

For the purposes of this petition, the term "ghost pot" includes crab pots that are accidentally lost or intentionally abandoned, as well as derelict crab pots that are irresponsibly left in the water for long periods of time without regular supervision. Ghost pots may result from permanent abandonment of fishable pots by crabbers who leave the fishery seasonally or permanently when it is logistically difficult to transport the pots for either temporary storage or permanent disposal, temporary storage sites are not available, or it is difficult or expensive to dispose of them (Guillory et al., 2001 at 2). Crab pots may also be inadvertently lost due to uncontrollable weather or hydrological factors, such as tides, currents, and storm surges; deterioration of buoys, lines, or knots; negligent assembly or maintenance of buoys and lines; unintentional clipping of lines by boat propellers; or intentional cutting of buoy lines by vandals (Guillory et al., 2001 at 2). Because commercial crabbers use large numbers of durable pots, ghost pots can persist for long periods of time (Guillory et al., 2001 at 1).

Ghost pots are considered to be even more detrimental to terrapin populations than actively fished pots[3] (Bishop, 1983 at 428; Guillory et al., 2001 at 4; Rook et al., 2010 at 172). This is because ghost pots are ongoing threats and have the capacity to capture great numbers of terrapins if they remain abandoned or lost (Rook et al., 2010 at 172). For example, Bishop (1983) found one ghost pot with 28 dead, decomposing terrapins in South Carolina (Bishop, 1983 at 429), and Roosenburg (1991) found a ghost pot with 49 terrapin shells, and remains of even more terrapins in Maryland (Roosenburg, 1991 at 231). The number of dead terrapins in that

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[3] Ghost pots are also known to capture other vertebrates such as river otters (*Lontra canadensis*) and raccoons (*Procyon lotor*) (Guillory et al. 2001 at 4).

single crab pot represented an estimated 1.6–2.8% of the local population (Roosenburg, 1991 at 231).

Terrapin carcasses found in abandoned crab pot in Georgia
(Source: Grosse et al. 2009)

During Hoyle and Gibbons' (2000) study in South Carolina, the scientists inadvertently created a ghost pot scenario when two of their test pots became entangled during a high spring tide when they were not monitored (Hoyle and Gibbons, 2000 at 735). Four terrapins entered those pots and died (*Id.*). The scientists estimated that those two lost pots could account for more terrapin captures than all 20 pots set during the study year (*Id.* at 736).

The number of terrapins lost to ghost pots is exponentially amplified by the number of ghost pots present in terrapin habitat. The commercial fishery generates many ghost pots each year (Chambers and Maerz, 2018). These abandoned pots are abundant, and every year more become marine debris in shallow estuaries, sometimes directly in terrapin habitat (Chambers and Maerz, 2018; Bishop, 1983 at 429). Though the numbers and location of ghost pots are unknown, scientists believe they are frequently abandoned or lost (Roosenburg, 1991 at 231). Guillory et al. (2001) estimated that approximately 250,000 derelict crab pots are added to the Gulf of Mexico annually (Guillory et al., 2001 at 2–3).

iii. Crab pot mortality in South Carolina & Conservation Actions

Scientists agree that the greatest threat to diamondback terrapins, throughout their range, is drowning in crab pots. Male and young female terrapins can enter and then drown in them.

Studies highlight the significant threat that crab pots pose to terrapin populations and the need for conservation measures. Although South Carolina has taken some steps to engage in conservation actions for diamondback terrapins, they have fallen short of adequately protecting the species.

In 1983, Whit Gibbons began the Kiawah Island study when he pulled two terrapins out of a crab trap. Today, Kristen Cecala, a herpetologist at Sewanee: the University of the South who has worked with Gibbons for decades, runs the project. To date, their annual surveys have resulted in the catch and release of 1,800 individual terrapins. Their research has shown steep declines in terrapin populations in the area, estimated at approximately 10 percent of the numbers they documented in the nineties; in large part due to accidental drowning in blue crap traps, where one crab trap was found to hold nearly 100 drowned turtles inside. This data ultimately documented up to 75% decline at sites in South Carolina and helped prove the effectiveness of bycatch reduction devices to keep terrapins out (Gibbons et. al., 2001). Shoreline development, along with crab potting, are believed to be the two main causes of this decline, and researchers in South Carolina have already observed localized extirpations of Diamondback Terrapin populations from individual creeks and lagoonal systems within the span of a few decades.

Today, the impact of crab pot fisheries on terrapin populations in South Carolina is significant. Terrapin catch rates in crab pots can range from 15 to 78 percent of a local terrapin population, removed annually, due to fishing practices (Bishop, 1983; Grosse et al., 2009; Roosenburg et al. 1997). Study after study examining diamondback terrapin populations in South Carolina has concluded that if the declining trend of the terrapin population continues - without the implementation of strong measures to assure sustainability of populations throughout the range - severe population declines are likely (Roosenburg, 2001; Gibbons et. al., 2001; Tucker et. al., 2001). These studies make it clear that BRDs are needed for the blue crab fishery to decrease diamondback terrapin mortality in hot spots where crabbing and terrapin habitat overlap (Grubbs et. al., 2018).

The 2005 Comprehensive Wildlife Conservation Strategy (CWCS) for South Carolina contained a species profile that summarized the state of knowledge for diamondback terrapins. The species profile also included 23 recommended conservation actions, which fell under the general categories of data collection (8 actions), mortality mitigation (9 actions), collaboration development and outreach (4 actions), and legislative change (2 actions) (SCDNR, 2020).

Through 2013, an abandoned crap trap program was implemented, and SCDNR participated in the Diamondback Terrapin Working Group and partnered with the South Carolina Aquarium, which launched a Diamondback Terrapin Preservation Project in 2007 to promote the use of BRDs in recreational crab traps. An acoustic telemetry study was also initiated to monitor river vs. creek habitat use in order to evaluate the use of a trammel net data set for monitoring state-wide catch rate trends since 1995. In 2014, two additional studies were initiated to improve the effectiveness of BRDs for reducing diamondback terrapin catch without reducing crab catch and develop a captive rearing program and subsequently evaluate seasonal habitat preferences for young-of-the-year diamondback terrapins. South Carolina has also created a dataset to assess the extent of knowledge for various aspects of diamondback terrapin biology and ecology in the state, with the purpose of improving the state of knowledge and management of diamondback terrapins in South Carolina (SCDNR, 2020).

Since 2016, the SCDNR researchers have also distributed the new BRD design to nearly 100 recreational and more than a dozen commercial crabbers for real-world evaluation across the South Carolina coastal plain (Arendt et. al., 2018).

In 2024, the South Carolina Legislature passed a suite of changes to blue crab laws to help ensure sustainability of the fishery (SCDNR, 2024). Although limiting recreational crabbers to one bushel of crabs per person, per day (or two bushels per boat) and requiring escape rings for undersized crabs on all crab pots, these changes do not prevent incidental capture of diamondback terrapins because the rings are too small to benefit terrapins. Since terrapins can be larger than legal blue crabs, these rings only have the potential to help very, very small hatchlings in escaping, at best.

In 2025, the Port Royal Sound Foundation, in partnership with the University of South Carolina – Beaufort (USCB), Lowcountry Ecological LLC, Sewanee University, Turtle Survival Alliance, and SCDNR has launched the Beaufort Terrapin Project to study and assess these turtles in the Port Royal Sound. The Turtle Survival Alliance reports having found crab traps with dozens of terrapins trapped inside that had drowned (Port Royal Sound Foundation, 2025).

Diamondback terrapins remain a "high priority" species for conservation in the state's Comprehensive Wildlife Conservation Strategy. Despite some protective regulations, diamondback terrapin populations remain at historically low levels (SCDNR, 2020).

c. Bycatch Reduction Devices

Bycatch Reduction Devices (also called "BRDs" or "terrapin excluder devices") prevent terrapins of a certain size from entering the pot (Roosenburg, 2004 at 23). They are designed specifically to prevent terrapin bycatch. Designed in the early 1990s (Wood, 1997 at 23), experts now recognize the BRD as the "best and most feasible solution to reducing terrapin mortality in crab pots" (Roosenburg, 2004 at 27).

An example of a plastic terrapin excluder device

(Source: South Carolina Department of Natural Resources)

A large number of studies have been conducted on BRD efficiency including a study by MAREX in Georgia. The effectiveness of BRDs at preventing terrapin death with little to no impact on blue crab capture has been well-studied (Roosenburg, 2004 at 26). There is a general consensus that 4.5 x 12-centimeter (cm) BRDs are effective at reducing terrapin entrapment (Roosenburg, 2004 at 26). Likewise, studies have found that both the 4.5 x 12 cm and the 5 x 10 cm BRD have a minimal effect on crab catch (Roosenburg, 2004 at 26).

i. Effect on Terrapin Mortality

Experts have studied BRDs of various sizes in several geographic regions within the terrapin's range. All studies found that crab pots with BRDs successfully limited terrapin bycatch to some degree, ranging from 12-100% effectiveness, with smaller BRDs generally being more effective than larger BRDs. The studies widely found that BRDs measuring 4.5 x 12 cm are sufficiently effective at reducing crab pot mortality without significantly affecting the size or number of crabs caught.[4] Table 1 summarizes the findings from studies that evaluated the ability of BRDs to reduce terrapin bycatch in blue crab pots. More detailed summaries of the studies are provided in Appendix A.

Table 1: Survey of Publications Evaluating the Ability of BRDs to Reduce Diamondback Terrapin Mortality in Blue Crab Pots

Article	State	BRD size (cm)	% terrapins excluded
Butler and Heinrich (2007)	FL	4.5 x 12	73.2%
Cole and Helser (2001)	DE	3.8 x 12	100%
		4.5 x 12	*67%
		5 x 10	59%
		5 x 12	12%
Crowder et al. (2000)	NC	4 x 16	100%
		4.5 x 16	100%
		5 x 16	100%
Hart and Crowder (2011)	NC	4.5 x 16	77%
		5 x 16	28%
Mazzarella (1994)	NJ	5 x 10	**90.5%
Morris et al. (2011)	VA	4.5 x 12	100%
Rook et al. (2010)	VA	4.5 x 12	95.7%
	MD	4 x 10	100%

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[4] *See* Sectio(ii), *Effect on Crab Haul*.

Roosenburg and Green (2000)		4.5 x 12	82%
		5 x 10	47%
Wnek (2019)	NJ	4.5 x 12	100%
		5 x 15	100%
		5.1–6.4 × 7.3 (curved)	100%

*averaged percentages for male terrapins and female terrapins
**averaged numbers from two separate seasons

Notably, BRDs have successfully reduced terrapin mortality in crab pots in North Carolina waters. Dr. Amanda Southwood Willard and her team at University of North Carolina Wilmington studied the effectiveness of fisheries-sourced bycatch reduction solutions for excluding Diamond-backed Terrapins from crab pots. They conducted trials with captive Diamond-backed Terrapins to compare the number of entries into standard crab pots, crab pots with oval BRDs inserted in entrance funnels, and crab pots manufactured with an NFD design, and found that pots with smaller entrance funnel dimensions, either through insertion of oval BRDs or the NFD design, had significantly fewer Diamond-backed Terrapin entries compared with standard crab pots. Their results illustrate the effectiveness of fisheries-sourced gear modifications for preventing bycatch of Diamond-backed Terrapins in crab pots (Williard et. al., 2022).

Similar studies have found the same: Reinsel, Gibson, Klesch, and Chambers tested four replicates of each of the five trap treatments (1.75-inch oval BRD, 2-inch oval BRD, 1.75-inch rectangular BRD, 2-inch rectangular BRD, and a control trap without a BRD) in each tidal creek, for a total of 20 traps per creek and 40 traps total. They fitted traps with wire chimneys that extended above the high low water line to allow trapped terrapins to surface for air. For eight weeks during summer 2021, they baited traps with Atlantic Menhaden *Brevoortia tyrannus* each day, beginning on Monday. Tuesday–Friday, they emptied traps of any animals inside, and recorded terrapin sex, terrapin carapace length, terrapin carapace width, and terrapin shell height, as well as blue crab carapace length. They found that found that all four BRD designs were highly effective at excluding terrapins and maintaining crab catch, when compared to control traps. They also found a significant difference ($p = 0.003$) in catch per unit effort (CPUE) of diamondback terrapins among treatments, with the control group (those without BRDs) having the highest CPUE (0.97 ± 0.18). All traps fitted with BRDs decreased terrapin capture significantly compared to the control group. Oval BRDs excluded more terrapins than their rectangular counterparts, with the same height dimension, although these differences were not significant. They also found no significant difference in CPUE of blue crabs among treatments ($p = 0.392$), or in the size of legal crabs caught in each treatment ($p = 0.216$). Accordingly, they pointed out that the study provides evidence of the effectiveness of both rectangular and oval-shaped BRDs to exclude terrapins and maintain crab catch.

ii. Effect on Crab Haul

Many studies also assess the effect of BRDs on the size and number of crabs captured, with the goal of identifying a BRD design that successfully minimizes terrapin captures, while having minimal effect on crab haul. Nearly every study found at least one BRD size that had little to no effect on crab haul, and they generally agree that a 4.5 x 12 cm BRD can successfully prevent terrapin deaths while having insignificant impacts on crab haul (See Table 2, Appendix B).

Table 2: Survey of Publications Evaluating the Effect of BRDs on Crab Haul

Article	**State**	**BRD size (cm)**	**Finding**
Butler and Heinrich (2007)	FL	4.5 x 12	no significant effect on sex, size, or number of crabs captured
Cole and Helser (2001)	DE	3.8 x 12	substantial loss of legal-size blue crabs (26% decrease with BRDs)
		4.5 x 12	nominal loss of legal-size blue crabs (12% total decrease, with 6% of most desirable crabs with BRDs)
		5 x 10	no statistical difference in blue crab catches (2.4% increase with BRDs)
		5 x 12	no substantial change in total blue crab catch rates (0.2% increase with BRDs)
Cuevas et al. (2000)	MS	5 x 10	similar daily catch rates (mean 19.5 for traps with BRDs and without) and crab size frequency
Guillory and Prejean (1998)	LA	5 x 10	overall catch per trap day of sublegal, legal, and total crabs was 14.5%, 37.9%, and 25.7% greater, respectively, than in standard pots
Hart and Crowder (2011)	NC	4.5 x 16	BRD did not have a significant effect on catch of either large male blue crabs or peelers
		5 x 16	
Lukacovic et al. (2005)	MD	4.5 x 12	all categories of crab catch were significantly lower in crab pots fitted with BRDs; in traps without BRDs, overall crab catch was 35% greater and catch of legal crabs was 28.5% greater

Mazzarella (1994)	NJ	5 x 10	no significant difference in number of crabs or size of crabs captured
Morris et al. (2011)	VA	4.5 x 12	no statistical difference between either the number or size of legal-size crabs in crab pots with and without BRDs on the first day after baiting; significant difference in total catch per unit effort and size across all other days after; more legal-size crabs were caught in pots without terrapin bycatch, but the difference was not significant
Rook et al. (2010)	VA	4.5 x 12	crab catch equivalent between crab pots with and without BRDs; slight increase (marginal) in number, size, and biomass of both legal-size and sublegal-size crabs in pots with BRDs
Roosenburg and Green (2000)	MD	4 x 10	reduced the size and number of large and mature female crabs
		4.5 x 12	no effect on size or number of crabs caught
		5 x 10	no effect on size or number of crabs caught
Wnek (2019)	NJ	4.5 x 12	no significant difference in number of crabs caught; similar mean length, width, height
		5 x 15	no significant difference in number of crabs caught; similar mean length; smaller mean width and height
		5.1–6.4 × 7.3 (curved)	no significant difference in number of crabs caught; similar mean length, width, height

Butler and Heinrich (2007) tested whether bycatch mortality of diamondback terrapins in commercial crab pots is reduced by using 4.5 x 12 cm galvanized steel BRDs and whether those devices limit blue crab catch. They captured 2,753 legal-sized crabs and found no significant difference between the sex, measurements, or number of crabs captured in standard crab pots versus crab pots with BRDs (Butler and Heinrich, 2007 at 182).

Although BRDs have not been studied in large-scale commercial operations that fish more than 100 pots, anecdotal reports from crabbers who use BRDs in large-scale operations claim that they see no effect—or maybe an improvement—in their crab catch (Roosenburg, 2004 at 27).

BRDs may offer additional benefits to crabbers as well. For instance, BRDs reduce the rate of entry of many large vertebrate bycatch including fish, turtles, and otters (Guillory and Prejean, 1998 at 39). This frees up additional space in pots, which would otherwise be occupied by nontarget species, to capture more crabs. The presence of terrapins in crab pots may cause crabs to avoid crab pots. Morris et al. (2011) found that crab pots with terrapin bycatch in them had, on average, fewer crabs per unit effort (Morris et al., 2011 at 388). Likewise, more legal-size crabs were caught in pots without terrapin bycatch (*Id.*). Thus, keeping terrapins out of crab pots may lead to the capture of more and larger crabs. Guillory and Prejean (1998) have also suggested that increased crab catch in traps with BRDs could be due to increased ingress and/or decreased egress through the entrance funnels (Guillory and Prejean, 1998 at 39).

Keeping terrapins out of crab pots may help also keep crabs in marketable condition. Davenport et al. (1992) studied terrapin feeding behavior on crabs by providing hungry male terrapins crabs of different size classes and observing the terrapins' behavior (Davenport et al., 1992 at 837–846). The size classes for crabs were small (10–25 mm carapace width), medium (30-50 mm), and large (52–75 mm) (*Id.* at 837). They observed that although terrapins are not specialized anatomically for a diet of hard-shelled animals, they will still exploit such food sources if they are hungry and do not have other options. Specifically, they will eat crabs (*Id.* at 846). Small crabs were eaten whole, while medium and large crabs were "cropped"—that is, their walking legs were eaten without killing the crab (*Id.* at 847). Applying their findings to diamondback terrapins in the field, the scientists predicted that terrapins might eat blue crabs through a "cropping" technique (*Id.*). Generally, terrapins will attack smaller crabs before medium crabs, and medium crabs before larger crabs (*Id.*). Because terrapins captured in crab pots are in closed conditions without access to their preferred prey, it is possible that they will shear crabs, thus making them less marketable.

Dr. Amanda Southwood Williard and her team and UNC have had success studying the use of crab pots manufactured with narrowed funnel dimensions (NFD). Their results illustrate the effectiveness of fisheries-sourced gear modifications for preventing bycatch of diamond-backed Terrapins in crab pots. Additional field studies to assess the effects on crab catch will determine the feasibility of incorporating these gear modifications into commercial crab fisheries (Williard et. al, 2022).

III. JUSTIFICATION FOR THE REQUESTED RULEMAKING

a. The Diamondback Terrapin is Imperiled and Cannot Sustain Effects from Crab Pot Mortality

Wild turtle populations are characterized by a suite of life history characteristics that predispose them to rapid declines when subjected to unnatural levels of adult mortality (Colteaux and

Johnson, 2017 at 17; Heppell, 1998; Galbraith et al., 1997; Congdon et al., 1993, 1994). Among these characteristics are delayed maturity, low fecundity, high annual survivorship of adults, and high natural levels of nest mortality (Reed and Gibbons, 2003). Similarly, terrapins' life history traits prevent them from absorbing chronic adult mortality (Hoyle and Gibbons, 2000 at 736). Removing even a few diamondback terrapins from a population can have detrimental effects on the population as a whole (Hoyle and Gibbons, 2000). For this reason, experts rank crab pot mortality as the greatest threat to the diamondback terrapin (Butler et. al., 2006 at 332) and have emphasized that modifying pots to reduce terrapin mortality is of utmost importance (Baker et al., 2013 at 676).

Studies and anecdotal evidence demonstrate that blue crab pots can have devastating population-level impacts on diamondback terrapins (Davis, 1942; Bishop, 1983; Marion, 1986; Burger, 1989; Mazzarella, 1994; Mann, 1995; Wood and Herlands, 1996; Roosenburg et al., 1997; Wood, 1997; Guillory and Prejean, 1998; Crowder et al., 2000; Hoyle and Gibbons, 2000; Roosenburg and Green, 2000; Cole and Helser, 2001; Butler, 2002, 2000; Roosenburg, 2004; Butler and Heinrich, 2007; Dorcas et al., 2007; Coleman et al., 2014; Chambers and Maerz, 2018). A fleet of active crab pots can significantly reduce a terrapin population over time by periodically removing a few terrapins at a time (Hart and Crowder 2011 at 269). A single ghost pot—which can capture dozens of terrapins at once—can wipe out an entire population in a relatively shorter period of time (Grosse et al., 2009 at 99).

Although the South Carolina Department of Natural Resources does not require crabbers to report terrapin mortality in their pots, evidence indicates that it is occurring. Pots set by recreational crabbers are problematic because they typically sit in shallow waters along creeks, seagrass beds, and marshes. This is prime territory for males and juvenile female terrapins (VIMS, 2010). Because of their smaller size, these terrapins are particularly vulnerable to capture and drowning. Adult males are only half as large as adult females, growing to about 6 inches long. Adult females are typically too large to enter a pot's funnel-like openings. Although recreational crabbers can access more shallow waters and may be more likely to leave pots unchecked, commercial crabbers set hundreds of pots and can cause "significant detrimental effects on local populations" (Butler and Heinrich, 2007 at 183). Because South Carolina contains a significant percentage of the terrapin's range, the effect of crab pot mortality in the state has great significance to the conservation of the entire species.

Some of the most popular areas in South Carolina for crabbing include Murrells Inlet, Pawleys Island Causeway Bridges, Myrtle Beach State Park Pier, areas in Charleston's surrounding waters, the Garris Public Boat Landing, Hilton Head locations, Georgetown Waterfront, Beaufort Area spots, Folly Beach County Park, and Little River Inlet (KayakCambria, 2021). In South Carolina, crab pots must not be left unattended in coastal waters for more than five days.

When added to the suite of additional stressors across the species' range, including habitat destruction and degradation, road mortality, nest predation, boat strikes, poaching, climate change, sea-level rise, and subsidized predation (Maerz et al., 2018), diamondback terrapins cannot sustain the harmful impacts of crab pot mortality.

b. BRDs Protect Diamondback Terrapins While Boosting Marketability of Crabs from South Carolina's Waters

BRDs provide a simple and inexpensive method to reduce terrapin deaths in crab pots and increase marketability of crabs caught in South Carolina's waters. A rule requiring BRDs is justified because BRDs protect most mature diamondback terrapins from drowning in pots, BRDs have little to no effect on crab haul, BRDs are inexpensive, and using BRDs increases the marketability of crabs fished from South Carolina's waters.

Neither the commercial nor recreational blue crab fisheries have adopted these important measures, and research shows that rules simply requiring crabbers to check pots once per day—even if stringently followed—are not enough to combat terrapin mortality (Wood, 1997).

i. BRDs Protect Terrapins from Needless Drowning Deaths

Extensive studies show that BRDs effectively prevent most large, mature terrapins from entering crab pots by restricting the pot entrances to a size that precludes a terrapin's carapace from fitting through (Reviewed in Roosenburg, 2004; Chambers and Maerz, 2018). Studies demonstrate that on average, 70% of terrapins are unable to enter pots equipped with BRDs, while blue crabs can still enter easily (Mazzarella, 1994; Crowder, 2000; Roosenburg and Green, 2000; Cole and Helser, 2001; Rook et al., 2010; Hart and Crowder, 2011; Morris et al., 2011).

Studies have shown that while BRDs are effective at preventing terrapins and other animals from entering pots, they have little impact on the size and number of blue crabs found in crab pots. Specifically, a 2021 study tested the effectiveness of oval BRDs, and preliminary results show a large reduction in terrapin mortality, while maintaining crab catch (Reinsel, Gibson, Klesch, and Chambers, 2021). Most BRDs used in these studies have been either 5x15cm or 4.5x12cm, and all have been plastic. Some BRD sizes showed small or no change in crab catch. Studies using 4.5x12cm BRDs often showed large decreases in crab catch, but some of these studies did not use bait. Other studies conducted by Southwood Williard and her team at UNC have also demonstrated that gear modifications, including Narrow Funnel Design (NFD), have had similar success.

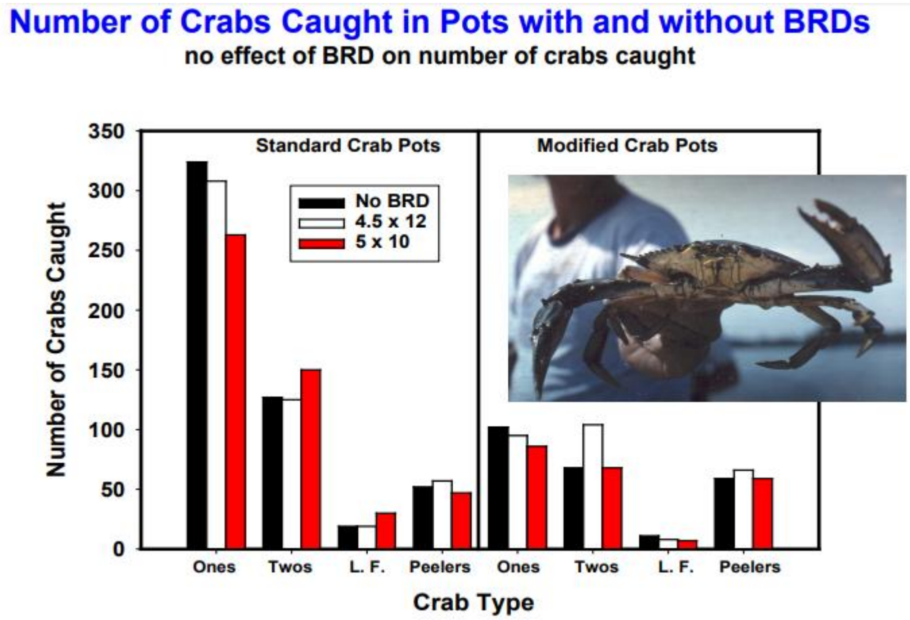
This significant reduction in terrapin mortality achieved by BRDs and similar gear modifications will slow terrapin declines attributed to crab pot mortality and provide South Carolina's terrapins with a level of resiliency against myriad other threats it currently faces and will face as climate change and sea-level rise continue and accelerate.

ii. BRDs Have Little to No Effect on Crab Haul

Extensive scientific study also demonstrates that BRDs have little to no effect on the number and size of marketable crabs harvested (Mazzarella, 1994; Guillory and Prejean, 1998; Cuevas et al., 2000; Roosenburg and Green, 2000; Cole and Helser, 2001; Butler and Heinrich, 2007; Rook et al., 2010; Hart and Crowder, 2011; Morris et al., 2011). Some studies have even suggested that

BRD use can result in an increase in catch of marketable crabs (Rook et al., 2010; Roosenburg and Green, 2000; Guillory and Prejean, 1998).

The following chart reflecting a survey of all BRD studies demonstrates that crab haul is relatively the same in crab pots with no BRDs and crab pots with 4.5 x 12 cm BRDs (Roosenburg, 2017).



(Source: modified from Roosenburg and Green, 2000)

iii. BRDs Are Inexpensive

BRDs are small and inexpensive. Some companies in states like Maine sell BRDs for as little as $0.45 each, while other programs will distribute BRDs for free or demonstrate how crabbers can make them themselves. There are also free resources that teach fishermen how to build and install their own BRDs.[5]

BRDs will likely become even less expensive over time as they are integrated into the crab pot fishery. As more states adopt rules and regulations requiring the use of BRDs, manufacturers will embrace the opportunity to design pots that already include BRDs. As these pot designs become more common, the cost of making them will also decrease.

a. Other States in the Diamondback Terrapin's Range Require Bycatch Reduction Devices

Several states already require or incentivize crabbers to use BRDs on their pots. New Jersey

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[5] Make Your Own BRDs | Virginia Institute of Marine Science.

requires crabbers to use BRDs in waters of less than 150 feet across at mean low water mark,[6] and New York recently implemented regulations requiring crabbers to use BRDs on pots set in creeks, coves, rivers, tributaries, and near-shore harbors of the Marine and Coastal District.[7] In Maryland and Delaware, all recreational crab pots must have BRDs.[8] BRDs are also required in North Carolina's two Designated Management Areas.[9]

Table 3: Survey of State Laws Governing Bycatch

State	Terrapin Conservation Status	BRD required on crab pots?
MA	Threatened	N/A; Traditional funnel-style crab pots are banned
RI	Endangered	N/A; Traditional funnel-style crab pots are banned
CT	Species of Special Concern	N/A; Traditional funnel-style crab pots are banned
NY	None	yes
NJ	Nongame Indigenous Species	yes
DE	Species of Conservation Concern	yes (recreational only)
MD	None	yes (recreational only)
VA	Species of Greatest Conservation Need	no
SC	High Priority species for conservation	no
GA	Protected species ("unusual")	no
FL	Species of Greatest Conservation Need	yes (recreational only)
AL	Highest Conservation Concern/ Nongame species	no
MS	Species of Greatest Conservation Need	no
LA	Species of Special Concern	no
TX	Nongame/ Species of Greatest Conservation Need	no

Although the Department should absolutely encourage the use of BRDs by handing out existing literature with licenses, without full participation by the crabbing community, a voluntary BRD program has little to no conservation effect for the diamondback terrapin. For this reason, it is imperative that South Carolina adopt mandatory BRD rules. South Carolina is poised to take the lead and adopt regulations requiring the use of BRDs on crab pots.

IV. PROPOSED RULE AMENDMENT

South Carolina's fishing regulations currently do not require the use of BRDs in blue crab pots. To protect diamondback terrapins from incidental mortality in active and inactive blue crab pots, Petitioners request that the South Department of Natural Resources adopt or amend regulations

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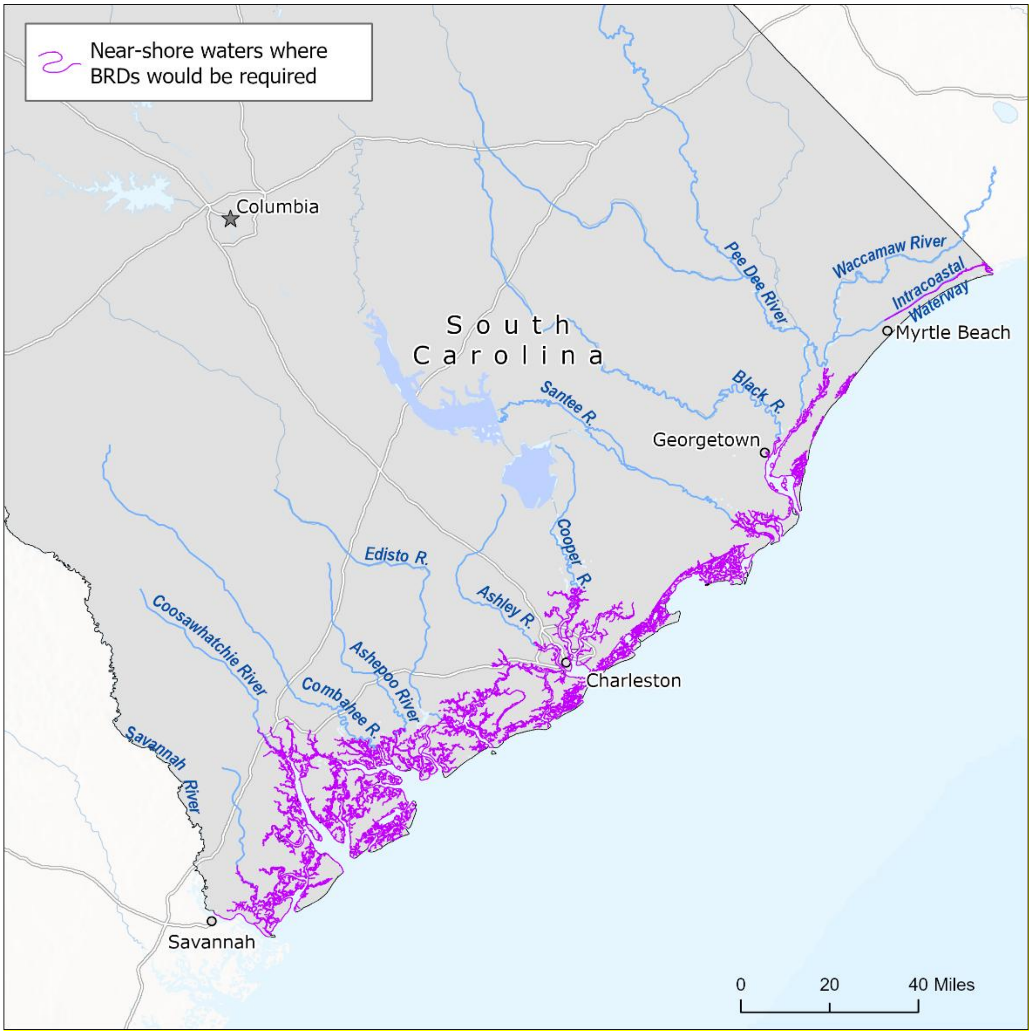
[6] N.J. Admin. Code § 7:25-14.6(c) (Lexis Advance through the New Jersey Register, Vol. 51 No. 13, July 1, 2019)

[7] N.Y. Comp. Codes R. & Regs. tit. 6, § 44.2(d) (Lexis Advance through June 28, 2019).

[8] Md. Code Regs. 08.02.03.07(B)(5); 7-3000-3700 Del. Code Regs. § 1.0.

[9] Blue Crab Fishery Management Plan (FMP) Amendment 3.

require BRDs or similar gear modifications to require BRDs or similar gear modifications on all blue crab pots in waters less than 200 ft in width or within 100 ft of a river or sound shoreline (where diamondback terrapins are found). To provide a reasonable time for the fishery to retrofit crab pots, Petitioners suggest a three-year grace period from the date of adoption or amendment of the regulation. The proposal also includes a provision to allow the use of other gear modifications that demonstrate through peer-reviewed study similar efficacy to 4.5 cm by 12 cm BRDs, as set forth in Butler and Heinrich, 2007 and Roosenburg and Green, 2000, and Williard et. al, 2022, and those made by fishermen and approved by the South Carolina Department of Natural Resources.



This map marks near shore waters in South Carolina.

While Petitioners generally request that the South Carolina Department of Natural Resources adopt a rule or amendment to require BRDs in blue crab pots, in the interest of specificity and completeness, we suggest the following specific amendments to South Carolina Code Title 50 (SC Code § 50-5-1302 & 1330(A)(2025)), as well as other state general statutes and fisheries rules relevant to the regulation of commercial and recreational fishing and fisheries, fishery management plans, pots, crab harvest restrictions, and crab pots.

“Bycatch reduction device” or “BRD” means a rigid rectangular device constructed of wire or plastic that has an opening no larger than 4.5 cm by 12 cm, which is attached to the end of each entrance funnel of a crab trap to minimize bycatch of diamondback terrapins. This definition also includes any device or gear modification that results in a ≥70% reduction in terrapin captures compared with unmodified traps, as demonstrated by at least one peer-reviewed study. In an effort to encourage their widespread use, we encourage the DNR to accept modifications made by fishermen, if they meet specifications necessary to exclude diamondback terrapins from blue crab pots.

Beginning [three years from date of amendment], all traps in state waters less than 200 ft in width or within 100 ft of a river or sound shoreline must have a 4.5x12cm (1.75-in) oval design bycatch reduction device (BRD) or other gear modification that demonstrates similar efficacy to 4.5 cm by 12 cm BRDs, meeting the specifications defined attached to each entrance or funnel.

V. CONCLUSION

Petitioners have summarized the harm crab pots inflict on diamondback terrapin populations and the greater estuarine ecosystems in South Carolina and across their range. Specifically, Petitioners have demonstrated that terrapins cannot withstand continued mortality in crab pots. Petitioners have also demonstrated that BRDs can significantly reduce terrapin mortality in crab pots, while having negligible effects on crab haul. For these reasons, several states across the terrapin’s range have adopted or are considering rules to require terrapin excluder devices on crab pots. South Carolina is poised to take the same imperative conservation action for its terrapins, making it a conservation leader.

Diamondback terrapins are an essential part of South Carolina’s unique natural heritage, and citizens and visitors alike depend on the Department to protect them for generations to come. Moreover, they are an important part of healthy estuarine ecosystems. Petitioners therefore request that the South Carolina Department of Natural Resources adopt the proposed rule amendment and require BRDs on all crab pots in South Carolina state waters less than 200 ft in width or within 100 ft of a river or sound shoreline (where diamondback terrapins are found). Petitioners also request that the Department immediately begin providing brochures on bycatch reduction gear modifications with licensing information and engage in developing education and outreach materials, as well as incentive programs, to encourage their use.

If the Department or staff has any questions, please contact Tara Zuardo at tzuardo@biologicaldiversity.org or 415-419-4210. The Center can provide copies of the literature cited in this petition upon request.

VI. LITERATURE CITED

Alford, A. and A. Southwood Williard. 2010. Use of modified crab pots to monitor diamondback terrapin (*Malaclemys terrapin*) populations at Masonboro Island, NC. Poster session presented at the Fifth Symposium on the Ecology, Status, and Conservation of the Diamondback Terrapin, the Louisiana Universities Marine Consortium (LUMCON) Chauvin, LA.

Arendt, Michael, Jeffrey Schwenter, Julie Dingle, Christopher Evans, Ellen Waldrop, Brooke Czwartacki, Amy Fowler, and David Whitaker (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 Application*. North American Journal of Fisheries Management. DOI: 10.1002/nafm.10045.

Baker, P, et al. 2013. *Estimating Survival Times for Northern Diamondback Terrapins, Malaclemys Terrapin Terrapin, in Submerged Crab Pots.* Herpetological Conservation and Biology 8: 667-680.

Bilkovic, D., Chambers, R., Leu, M., Havens, K., Center for Coastal Resources Management. *Research: Diamondback Terrapin By-catch Reduction Strategies for Commercial and Recreational Blue Crab Fisheries.* Available online at https://ccrm.vims.edu/research/mapping_surveying/terrapin/index.html (last accessed December 17, 2024).

Bilkovic, D., Havens, K., Stanhope, D., Angstadt, K. *Derelict fishing gear in Chesapeake Bay, Virginia: Spatial patterns and implications for marine fauna.* Mar. Poll. Bull. (2014), http://dx.doi.org/10.1016/j.marpolbul.2014.01.034.

Bishop, J. M. 1983. Incidental capture of diamondback terrapin by crab pots. *Estuaries* 6:426-430.

Blanvillain, G., J.A. Schwenter, R.D. Day, D. Point, S.J. Christopher, W.A. Roumillat, D.W. Owens. 2007. Diamondback terrapins, *Malaclemys terrapin*, as a sentinel species for monitoring mercury pollution of estuarine systems in South Carolina and Georgia, USA. *Environmental Toxicology and Chemistry*. 26(7): 1441–1450.

Brenessel, B. 2007. The Northern Diamondback Terrapin Habitat, Management and Conservation. Prepared for The Northeast Diamondback Terrapin Working Group, Norton, MA.

Broyles, Elizabeth. 2010. Diamondback Terrapins (*Malaclemys terrapin*) of Charleston, South Carolina: Population Estimate, Sex Ratios, and Distribution. The Graduate School of the college of Charleston. Available at https://www.dnr.sc.gov/swap/grants/T-35.pdf.

Burger, J. 1989. Diamondback terrapin protection. *Plastron Papers* 19:35-40.

Burger, J. 2002. Metals in Tissues of Diamondback Terrapin from New Jersey. *Environmental Monitoring and Assessment* 77: 255–263.

Butcher, K. et al. 2018. Derelict Crab Trap Removal in the Pontchartrain Basin: 2018 Update and Recommendations. Lake Pontchartrain Basin Foundation. pp. 30. https://saveourlake.org/?wpdmdl=15095&ind=1538494910701.

Butler, J.A. 2000. Status and distribution of the Carolina diamondback terrapin, *Malaclemys terrapin centrata*, in Duval County. Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida.

Butler, J. A. 2002._Population ecology, home range, and seasonal movements of the Carolina diamondback terrapin, *Malaclemys terrapin centrata* in northeastern Florida. Florida Fish and Wildlife Conservation Commission. Tallahassee, FL. pp.72

Butler, J. A., C. Broadhurst, M. Green and Z. Mullin. 2004. Nesting, nest predation and hatchling emergence of the Carolina diamondback terrapin, *Malaclemys terrapin centrata*, in Northeastern Florida. *American Midland Naturalist*. 152:145-155.

Butler, J.A., R.L Burke, and W.M. Roosenburg. 2018. Reproductive Behavior and Ecology. P. 81–91. In W.M. Roosenburg and Victor S. Kennedy (eds.), *Ecology and Conservation of the Diamond-Backed Terrapin*, Johns Hopkins University Press, Baltimore, Maryland.

Butler, J.A. and G.L. Heinrich. 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* 30:179-185.

Butler, J.A., G.L. Heinrich, and M.L. Mitchell. 2012. Diet of the Carolina Diamondback Terrapin (*Malaclemys terrapin centrata*) in Northeastern Florida. *Chelonian Conservation and Biology* 11(1): 124–128.

Butler, J.A., G.L. Heinrich, and R.A. Seigel. 2006. Third workshop on the ecology, status, and conservation of diamondback terrapins (*Malaclemys terrapin*): Results and recommendations. *Chelonian Conservation and Biology* 5:331-334.

Cecala, K. K., J. W. Gibbons, and M. E. Dorcas. 2008. Ecological effects of major injuries in diamondback terrapins: implications for conservation and management. *Aquatic Conservation: Marine and Freshwater Ecosystems* DOI: 10.1002/aqc.

Chambers, R.M. and J.C. Maerz. 2018. Bycatch in Blue Crab Fisheries. P. 231–244. In W.M. Roosenburg and Victor S. Kennedy (eds.), *Ecology and Conservation of the Diamond-Backed Terrapin*, Johns Hopkins University Press, Baltimore, Maryland.

Chesapeake Bay Program. *Diamondback Terrapin, Malaclemys terrapin.* Available at https://www.chesapeakebay.net/discover/field-guide/entry/diamondback-terrapin (last accessed December 17, 2024).

Clark, W. S. 1982. Turtles as a food source of nesting bald eagles in the Chesapeake Bay region. *Journal of Field Ornithology* 53:49-51.

Cole, R.V. and T.E. Helser. 2001. Effect of three bycatch reduction devices on diamondback terrapin *Malaclemys terrapin* capture and blue crab *Callinectes sapidus* harvest in Delaware Bay. *North American Journal of Fisheries Management* 21:825-833.

Coleman, A. T., T. Roberge, T. Wibbels, K. Marion, D. Nelson, and J. Dindo. 2014. Size-based mortality of adult female Diamond-backed Terrapins (*Malaclemys terrapin*) in Blue Crab Traps in a Gulf of Mexico population. *Chelonian Conservation and Biology* 13:140-145.

Coleman, A. T., T. Wibbels, K. Marion, D. Nelson, and J. Dindo. 2011 Effect of by-catch reduction devices (BRDS) on the capture of diamondback terrapins (*Malaclemys terrapin*) in crab pots in an Alabama salt marsh. *Journal of the Alabama Academy of Sciences* 82:145-157.

Cone Communications. 2015. New Cone Communications Research Confirms Millennials as America's Most Ardent CSR Supporters, but Marked Differences Revealed Among This Diverse Generation, available at http://www.conecomm.com/research-blog/2015-cone-communications-millennial-csr-study.

Cone Communications. 2017. 2017 Cone Communications CSR Study, www.conecomm.com/2017-SCR-Study.

Crowder, L., K. Hart, and M. Hooper. 2000. Trying to solve a bycatch mortality problem: can we exclude diamondback terrapins (*Malaclemys terrapin*) from crab pots without compromising blue crab (*Callinectes sapidus*) catch? Final report 00-FG-23. Fishery Resource Grant. pp.13.

Cuevas, K. J., M. J. Buchanan, W. S. Perry, J. T. Warren. 2000. Preliminary study of Blue Crab catch in traps fitted with and without a Diamondback Terrapin excluder device. *Proceedings of the Annual Southeast Association of Fish and Wildlife Agencies* 54:221-226.

Davenport, J., M. Spikes, S. M. Thornton, and B. O. Kelly. 1992. Crab-eating in the diamondback terrapin Malaclemys terrapin: dealing with dangerous prey. *Journal of the Marine Biology Association* 72:835-848.

Davis, C. C. 1942. A study of the crab pot as a fishing gear. Publication No. 53 Chesapeake Biological Laboratory, Solomons, Maryland.

Diamondback Terrapin Working Group (DTWG). (2024). Position Statement on The Negative Effects of Maryland Style Crab Pots on Diamondback Terrapin Populations and the Use of

Bycatch Reduction Devices as a Practical, Inexpensive Solution. Available at https://www.dtwg.org/position-statements (last accessed January 29, 2025).

Dorcas, M. E., J. D. Wilson, and J. W. Gibbons. 2007. Crab trapping causes population decline and demographic changes in diamondback terrapin over two decades. *Biological Conservation* 137:334-340.

Dorcas, M.E., J.C. Beane, A.L. Braswell, E.C. Corey, M. Godfrey, J. Humphries, T. Lamb, S.J. Price. 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.

Drabeck, D.H., M.W.H. Chatfield, C.L. Richards-Zawacki. 2014. The status of Louisiana's diamondback terrapin (*Malaclemys terrapin*) populations in the wake of the *Deepwater Horizon* oil spill: Insights from population genetic and contaminant analysis. *Journal of Herpetology* 48(1): 125–136.

Draud, M., M. Bossert, and S. Zimnavoda. 2004. Predation on hatchling and juvenile diamondback terrapins (*Malaclemys terrapin*) by the Norway rat (*Rattus norvegicus*). *Journal of Herpetology* 38:467-470.

Ehret, D.J. and B.K. Atkinson. 2018. Evolutionary History and Paleontological Record. P. 27–35. In W.M. Roosenburg and Victor S. Kennedy (eds.), *Ecology and Conservation of the Diamond-Backed Terrapin*, Johns Hopkins University Press, Baltimore, Maryland.

Feinberg, J.A. and R.L. Burke. 2003. Nesting Ecology and Predation of Diamondback Terrapins, *Malaclemys terrapin*, at Gateway National Recreational Area, New York. *J. of Herpetology* 37(3):517-526.

Garber, S.D. 1990a. Diamondback Terrapin. *Focus* 40(1):33-36.

Garber, S.D. 1990b. The Ups and Downs of the Diamondback Terrapin. The Conservationist NY:DEC 44:44-47.

Georgia Biodiversity Portal, *Malaclemys terrapin;* Diamond-backed Terrapin. Available at https://georgiabiodiversity.org/portal/profile?group=all&es_id=18644 (last accessed September 16, 2025).

Gibbons, J.W., J.E. Lovich, A.D. Tucker, N.N. Fitzsimmons and J.L. Greene. 2001. Demographic and Ecological Factors Affecting Conservation and Management of the Diamondback Terrapin (Malaclemys terrapin) in South Carolina. *Chelonian Conservation and Biology* 4(1):66–74.

Grosse, A. M., J. C. Maerz, J. A. Hepinstall-Cymerman, and M. E. Dorcas. 2011. Effects of roads and crabbing pressures on diamondback terrapin populations in coastal Georgia. *Journal of Wildlife Management* 75:762-770.

Grosse, A. M., J. D. van Dijk, K. L. Holcomb, and J. C. Maerz. 2009. Diamondback Terrapin Mortality in Crab Pots in a Georgia Tidal Marsh. *Chelonian Conservation and Biology* 8:98-100.

Grubbs, S.P. et al. 2018. To BRD or Not to BRD? A Test of Bycatch Reduction Devices for the Blue Crab Fishery. *North American Journal of Fisheries Management*. 3–4,

Guillory, V., A. McMillen-Jackson, L. Hartman, H. Perry, T. Ford, T. Wagner, and G. Graham. 2001. Blue Crab Derelict Traps and Trap Removal Programs. Publication No. 88 Gulf States Marine Fisheries Commission, Ocean Springs, Mississippi.

Guillory, V. and P Prejean. 1998. Effect of a terrapin excluder device on blue crab, *Callinectes sapidus*, trap catches. *Marine Fisheries* 60:38–40.

Harden, L.A. and A. Southwood Williard. 2012. Using spatial and behavioral data to evaluate the seasonal bycatch risk of diamondback terrapins (*Malaclemys terrapin*) in crab pots. *Marine Ecology Progress Series* 467, 207–217.

Hart, K.M. 1999. Declines in diamondbacks: terrapin population modeling and implications for management. MS thesis, Duke University, Durham, NC. 64 pages.

Hart, K. M. and L. B. Crowder. 2011. Mitigating by-catch of Diamondback Terrapins in crab pots. *Journal of Wildlife Management* 75:264–272.

Hart, K. M., M. E. Hunter, and T. L. King. 2014. Regional differentiation among populations of the diamondback terrapin (*Malaclemys terrapin*). *Conservation Genetics* 2014; 15: 593–603.

Hart, K.M. and D.S. Lee. 2007. The Diamondback Terrapin: The Biology, Ecology, Cultural History, and Conservation Status of an Obligate Estuarine Turtle in Studies in Avian Biology No. 32:206–213, *available at* http://sora.unm.edu/sites/default/files/journals/sab/sab_032.pdf#page=214.

Hoyle, M. E. and J. W. Gibbons. 2000. Use of a marked population of diamondback terrapins (*Malaclemys terrapin*) to determine impacts of recreational crab pots. *Chelonian Conservation and Biology* 3:735–737.

Hunter, E.A., N.P. Nibbelink, C.R. Alexander, K. Barrett, L.F. Mengak, R.K. Guy, C.T. Moore, and R.J. Cooper. 2015. Coastal vertebrate exposure to predicted habitat changes due to sea level rise. *Environmental Management*. DOI 10.1007/s00267-015-0580-3.

Jeyasuria, P. and A.R. Place. 1997. Temperature-dependent Armoatase Expression in Developing Diamondback Terrapin (*Malaclemys terrapin*) Embryos. *J. Steroid Biochem. Molec. Biol.* 61(3–6): 415–425.

KayakCambria, 2021, *Where to go Crabbing in South Carolina : Your Complete Guide to the Best Spots.* Available at https://kayakcambria.com/where-to-go-crabbing-in-south-carolina-top-spots/.

Lester, L.A., H.W. Avery, A.S. Harrison, E.A. Standora. 2013. Recreational boats and turtles: Behavioral mismatches result in high rates of injury. *PLOS One* 8(12): e82370. doi:10.1371/journal.pone.0082370.

Lovich, J.E., J.W. Gibbons, and K.M. Greene. 2018. Life History with Emphasis on Geographic Variation. P. 63–80. In W.M. Roosenburg and Victor S. Kennedy (eds.), *Ecology and Conservation of the Diamond-Backed Terrapin*, Johns Hopkins University Press, Baltimore, Maryland.

Lovich, J.E. and K.M. Hart. 2018. Taxonomy: A History of Controversy and Uncertainty. P. 37–50. In W.M. Roosenburg and Victor S. Kennedy (eds.), *Ecology and Conservation of the Diamond-Backed Terrapin*, Johns Hopkins University Press, Baltimore, Maryland.

Lovich, J.E., M. Thomas, K. Ironside, C. Yackulic, and S.R. Puffer. 2018. Spatial distribution of estuarine diamond-backed terrapins (*Malaclemys terrapin*) and risk analysis from commercial blue crab (*Callinectes sapidus*) trapping at the Savannah Coastal Refuges Complex, USA. Ocean and Coastal Management. 157: 160-167.

Lukacovic, R, L. S. Baker, and M Luisi. 2005. Diamondback Terrapin and crab pot interactions and effect of turtle excluder devices on crab catch in Maryland's coastal bays. Fisheries Technical Report # 44, Maryland Department of Natural Resources. Annapolis MD USA pp.11

Maerz, J.C., R.A. Seigel, and B.A. Crawford. 2018. Conservation in Terrestrial Habitats: Mitigating Habitat Loss, Road Mortality, and Subsidized Predators. P. 200–220. In W.M. Roosenburg and Victor S. Kennedy (eds.), *Ecology and Conservation of the Diamond-Backed Terrapin*, Johns Hopkins University Press, Baltimore, Maryland.

Mali I, Vandewege MW, Davis SK, Forstner MRJ. 2014. Magnitude of freshwater turtle exports from the US: long term trends and early effects of newly implemented harvest management regimes. *PLOS One*. 2014; 9(1), *available at* http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3903576/.

Mann, T. M. 1995. Population surveys for diamondback terrapins (*Malaclemys terrapin*) and Gulf salt marsh snakes (*Nerodia clarki clarki*) in Mississippi Museum Technical Report No. 37.

Marion, K. R. 1986. Mississippi diamondback terrapin, p. 52–53. In R. H. Mount (ed.), Vertebrate Animals of Alabama in Need of Special Attention. Alabama Agricultural Experiment Station, Auburn University, Auburn, Alabama.

Mazzarella, A. D. 1994. Great bay blue claw crab study, diamondback terrapin interaction with crab pots: test of a turtle excluder device in commercial crab pots. New Jersey Division of Fish, Game, and Wildlife. Port Republic, NJ pp. 9.

Mitchell, N.J. and F.J. Janzen. 2010. Temperature-Dependent Sex Determination and Contemporary Climate Change. *Sex. Dev.* 4: 129–140.

Mitro, M.G. 2003. Demography and viability analyses of a diamondback terrapin population. *Can. J. Zool.* 81: 716–726.

Morris, S. A., S. M. Wilson, E. F. Dever, and R. M. Chambers. 2011. A test of bycatch reduction devices on commercial crab pots in a tidal marsh in Virginia. *Estuaries and Coasts* 34:386–390.

Muldoon, K.A. and R.L. Burke. 2012. Movements, overwintering, and mortality of hatchling Diamond-backed Terrapins (*Malaclemys terrapin*) at Jamaica Bay, New York. *Can. J. Zool.* 90: 651–662.

Port Royal Sound Foundation, Kimmel, Courtney, *Diamond in the Pluff: Monitoring Diamondback Terrapins in the Port Royal Sound*, June 23, 2025, available at https://portroyalsoundfoundation.org/diamond-in-the-pluff-monitoring-diamondback-terrapins-in-the-port-royal-sound/.

Radzio, T. A. J. A. Smolinsky and W. M. Roosenburg. 2013. Low use of required terrapin bycatch reduction devices in a recreational crab pot fishery. *Herpetological Conservation and Biology* 8:222–227.

Reinsel, M., Keck Environmental Field Lab at William & Mary. (2023). *Diamondback Terrapin Bycatch in Crab Traps, a review of BRD studies and their effectiveness*. Available at https://storymaps.arcgis.com/stories/3555d14f5ca2442e960a955d00f68044 (last accessed December 17, 2024).

Reinsel, M., Gibson, M., Klesch, N., Chambers, R. *Bycatch reduction devices exclude diamondback terrapins and maintain blue crab catch in two Virginia tidal creeks.* Marine & Coastal Fisheries, Vol 15, Issue 5 (2023), https://doi.org/10.1002/mcf2.10263

Rook, M. A., R. N. Lipcius, B. M. Bronner, R. M. Chambers. 2010. Bycatch reduction devices conserves diamondback terrapins without affecting catch of blue crab. *Marine Ecology progress Series* 409:171–179.

Roosenburg, W.M. 1990. The diamond back terrapin: population dynamics, habitat requirements, and opportunities for conservation. In: Chaney, A., and Mihursky, J.A. (Eds.). *New perspectives* *in the Chesapeake system: a research and management partnership*. Proceedings of a conference. Maryland: Chesapeake Research Consortium Publication No. 137, pp. 227–234

Roosenburg, W.M. 1991. The Diamondback Terrapin: Population Dynamics, Habitat Requirements, and Opportunities for Conservation in New Perspectives in the Chesapeake System: A Research and Management in Partnership. Proceedings of a Conference. Baltimore, MD. Chesapeake Research Consortium Publication No. 137.

Roosenburg, W.M., K.L. Haley, and S. McGuire. 1999. Habitat selection and movements of diamondback terrapins, *Malaclemys terrapin*, in a Maryland estuary. *Chelonian Conservation and Biology* 3:425–429.

Roosenburg, W. M. 2004. The impact of crab pot fisheries on terrapin (*Malaclemys terrapin*) populations: where are we and where do we need to go? Pages 23–30 *in* C. Swarth, W. M.

Roosenburg, W.M., Baker, P.J., Burke, R., Dorcas, M.E. & Wood, R.C. 2019. *Malaclemys terrapin*. *The IUCN Red List of Threatened Species* 2019: e.T12695A507698. http://dx.doi.org/10.2305/IUCN.UK.2019-1.RLTS.T12695A507698.en. Downloaded on 17 August 2019.

Roosenburg, W. M. and R. L. Burke. 2018. Capture, Measurement, and Field Techniques. P. 8–25. In W.M. Roosenburg and Victor S. Kennedy (eds.), *Ecology and Conservation of the Diamond-Backed Terrapin*, Johns Hopkins University Press, Baltimore, Maryland.

Roosenburg, W. M. and J. A. Butler. 2018. The Future for Diamond-backed Terrapins. P. 265–268. In W.M. Roosenburg and Victor S. Kennedy (eds.), *Ecology and Conservation of the Diamond-Backed Terrapin*, Johns Hopkins University Press, Baltimore, Maryland.

Roosenburg, W. M., W. Cresko, M. Modesitte, and M. B. Robbins. 1997. Diamondback terrapin (*Malaclemys terrapin*) mortality in crab pots. *Conservation Biology* 5:1166–1172.

Roosenburg, W. M. and J. P. Green. 2000. Impact of a bycatch reduction device on diamondback terrapin and blue crab capture in crab pots. *Ecological Applications* 10:882–889.

Roosenburg, W. M. and E. Kiviat, *editors*. Conservation and Ecology of Turtles of the Mid-Atlantic Region: A Symposium. Biblomania Salt Lake City, Utah. USA.

Schimel, Kate, Virginia Institute of Marine Science. (2012). *Terrapin Files: Researchers survey the distribution of threatened turtles.* Vol 44, Num 2, https://ccrm.vims.edu/publications/pubs/VMRBSummer12_web.pdf.

Seafood Watch, Blue Crab, Pots and Trotline (May 2019). Available at https://www.seafoodwatch.org/globalassets/sfw-data-blocks/reports/C/MBA_SeafoodWatch_BlueCrabReport.pdf.

Seigel, R. A. 1984. Parameters of Two Populations of Diamondback Terrapins (*Malaclemys terrapin*) on the Atlantic Coast of Florida. In *Vertebrate Ecology and Semantics: A Tribute to Henry S. Fitch*, ed. R. A. Seigel, I. E. Hunt, J. L. Knight, L. Malaret, and N. L. Zuschiag, pp. 77–87. Museum of Natural History, Lawrence, Kans.: The University of Kansas.

Seigel, R. A. 1980a. Predation by raccoons on diamondback terrapins, *Malaclemys terrapin tequesta*. *J. of Herpetology* 14(1):87–89.

Seigel, R. A. 1980b. Nesting habits of diamondback terrapins (*Malaclemys terrapin*) on the Atlantic Coast of Florida. *Transactions of the Kansas Academy of Sciences* 83(4):239–246.

Silliman, B. R. and M. D. Bertness. 2002. A trophic cascade regulates salt marsh primary production. *Proceedings of the National Academy of Sciences of the USA* 99:10500–10505.

Simoes J.C. and R.M. Chambers. 1999. The Diamondback Terrapins of Piermont Marsh, Hudson River, New York. *Northeastern Naturalist* 6(3): 214–248.

South Carolina Department of Natural Resources (SCDNR), *Diamondback Terrapin*, 2020. Available at https://www.dnr.sc.gov/wildlife/diamondbackterrapin/.

South Carolina Department of Natural Resources (SCDNR), *Diamondback Terrapin 0 Conservation Action Progress*, 2020. Available at https://www.dnr.sc.gov/wildlife/diamondbackterrapin/conservation.html.

South Carolina Department of Natural Resources (SCDNR). 2025. South Carolina State Wildlife Action Plan (SWAP). Available at https://www.dnr.sc.gov/swap/pdf/2025Swap.pdf.

South Carolina Department of Natural Resources (SCDNR). 2024. *Changes to blue crab laws coming in 2025.* Available at https://www.dnr.sc.gov/news/2024/Aug/aug30-bluecrab.php.

South Carolina Department of Natural Resources (SCDNR). 2020. Research - Fisheries Interactions and Bycatch Reduction. Available at https://www.dnr.sc.gov/wildlife/diamondbackterrapin/research/fisheries.html.

Suarez, E. 2015. Ecology of Ornate Diamondback Terrapins (Malaclemys terrapin macrospilota) on a small Gulf Coast barrier island and their behavior inside crab traps. Thesis. University of Florida. Gainesville, Florida. USA.

Szerlag, S. and S.P. McRobert. 2006. Road occurrence and mortality of the northern diamondback terrapin. *Applied Herpetology* 3:27–37.

Tucker, D. A., N. N. FitzSimmons, and J. W. Gibbons. 1995. Resource partitioning by the estuarine turtle *Malaclemys terrapin*: tropic, spatial, and temporal foraging constraints. *Herpetologica* 51(2): 167–181.

Tucker, A.D., J.W. Gibbons and J.L. Greene. 2001. Estimates of adult survival and migration for diamondback terrapins: conservation insight from local extirpation within a metapopulation. *Canadian Journal of Zoology* 79:2199–2209.

Virginia Department of Wildlife Resources. (2024). *From Delicacy to Decline: A Tale of the Diamond-Backed Terrapin*. Available at https://dwr.virginia.gov/blog/from-delicacy-to-decline-a-tale-of-the-diamond-backed-terrapin/ (last accessed December 17, 2024).

Virginia Department of Wildlife Resources (Virginia DWR). (2025). Northern Diamond-backed Terrapin. Available at https://dwr.virginia.gov/wildlife/information/northern-diamond-backed-terrapin/ (last accessed January 29, 2025).

Virginia Institute of Marine Science. (2024). *Diamondback Terrapins*. Available at https://www.vims.edu/research/units/legacy/sea_turtle/va_sea_turtles/terps.php (last accessed December 17, 2024).

Virginia Institute of Marine Science. (2010). *VIMS asks volunteers to help keep terrapins from crab pots.* Available at https://www.vims.edu/research/topics/blue_crabs/ts_archive/terrapin_brds.php & https://indus.vims.edu/newsandevents/topstories/archives/2010/terrapin_brds.php (last accessed December 17, 2024).

Virginia Institute of Marine Science; Center for Coastal Resources Management. (2024). *Diamondback Terrapin By-Catch Reduction Strategies for Commercial and Recreational Blue Crab Fisheries.* Available at https://www.vims.edu/ccrm/research/ecology/fauna/terrapin/ (last accessed December 17, 2024).

Virginia Marine Resources Commission. (2023). *Terrapin Excluders for Recreational Crab Pots.* Available at https://www.mrc.virginia.gov/terrapin.shtm (last accessed December 17, 2024).

Virginia Marine Resources Commission. (2023). *Recreational Crabbing Rules.* Available at https://mrc.virginia.gov/Regulations/VA-recreational-crabbing-rules.shtm (last accessed December 17, 2024).

Virginia Marine Resources Commission. (2020). *Recreational Blue Crab Regulations.* https://mrc.virginia.gov/regulations/VA-recreational-crabbing-rules.pdf (last accessed December 17, 2024).

Williard, Amanda Southwood, and Chavez, Stephanie. 2017. The effects of bycatch reduction devices on diamondback terrapin and blue crab catch in the North Carolina commercial crab fishery. Fisheries Research 186: 94-101.

Williard, Amanda Southwood, Romano, Sam, and Wilson, Laura. 2022. Efficacy of Fisheries-Sourced Bycatch Reduction Solution in Preventing Capture of Diamond-backed Terrapins (*Malaclemys Terrapin)* in Blue Crab Pots. Herpetological Conservation and Biology 17(1):76–84.

Wnek, J. 2019. Analysis of bycatch reduction devices (BRDs) on blue crab captures and effectiveness of preventing bycatch: A study conducted at Bernegat Bay, NJ. Report. Ocean County Vocational Technical School, Center for Research and Applied Barnegat Bay Studies.

Wood, R. 1995. Diamondback terrapin. In L.E. Dove and R.M. Nyman, eds., *Living Resources of the Delaware Estuary*. Delaware Estuary Program pp. 299–304.

Wood, R. C. 1997. The impact of commercial crab traps on northern diamondback terrapins, *Malaclemys terrapin terrapin*. Pages 21–27. In J. Van Abbema editor. Proceedings: Conservation, Restoration, and Management of Tortoises and Turtles—An International Conference. New York Turtle and Tortoise Society, New York, USA.

Wood, R. C. and R. Herlands. 1995. Terrapins, tires, and traps: conservation of the Northern Diamondback Terrapin (*Malaclemys terrapin)* on the Cape May peninsula, New Jersey USA. Pages 254-256. In J. Van Abbema editor. Proceedings: An International Congress of Chelonian Conservation. Gonfaron, France.

Wood, R.C. and R. Herlands. 1997. Turtles and Tires: The Impact of Roadkills on Northern Diamondback Terrapin, *Malaclemys terrapin*, Populations on Cape May Peninsula, Southern New Jersey, USA. Proceedings: Conservation, Restoration, and Management of Tortoises and Turtles—An International Conference, pp. 46–53.

Woodland, R.J., C.L. Rowe, and P.F.P. Henry. 2017. Changes in habitat availability for multiple life stages of diamondback terrapins (Malaclemys terrapin) in Chesapeake Bay in response to sea level rise. *Estuaries and Coasts* 40(5): 1502–1515.

Appendix A

Survey of Scientific Literature Evaluating the Effect of BRDs on Terrapin Mortality

Butler and Heinrich (2007) tested whether bycatch mortality of diamondback terrapins in Florida in commercial crab pots is reduced by using 4.5 x 12 cm galvanized steel BRDs. They fished 15 pots without BRDs and 15 outfitted with BRDs at eight sites along the Atlantic and Gulf coasts (including the Florida panhandle) during the summers of 2002-2005. Thirty-seven terrapins were caught in standard pots and four in those with BRDs. They found that 73.2% of trapped terrapins would have been excluded from pots with BRDs (Butler and Heinrich 2007 at 183–184). These researchers recommended that the Florida Fish and Wildlife Conservation Commission devise and adopt regulations that require the use of 4.5 x 12 cm BRDs on all commercial and recreational crab pots used in Florida waters.

Cole and Helser (2001) conducted a 4-year study between 1997 and 2000 in the Delaware Bay estuary to investigate four sizes of wire, rectangular BRDs measuring 5 x 10 cm, 5 x 12 cm, 4.5 x 12 cm, and 3.8 x 12 cm to determine their impacts on terrapin bycatch mortality. During the study, 372 diamondback terrapins were captured (Cole and Helser 2001 at 828–831). Crab pots fitted with 5 x 10 cm BRDs demonstrated statistically significant reduction in terrapin captures (59%) (Cole and Helser 2001 at 828), as did crab pots fitted with 4.5 cm x 12 cm BRDs (38% male and 96% female) (Cole and Helser 2001 at 831). Crab pots fitted with the smallest BRD, 3.8 x 12 cm, prevented all diamondback terrapins from entering the pot (Cole and Helser 2001 at 831). They found that the 5 x 12 cm BRD was the only treatment for which the reduction in overall diamondback terrapin catches was not statistically significant (12%) (Cole and Helser 2001 at 832). Based on the study, Cole and Helser recommended using 4.5 x 12 cm BRDs (Cole and Helser 2001 at 831).

Crowder et al. (2000) studied the extent of terrapin mortality in actively fished crab pots in Jarrett Bay, North Carolina, to evaluate the effect of several different BRDs on both terrapin and crab catch rates (Crowder et al. 2000 at 1). They studied BRD-equipped crab pots for three seasons, testing a 5 x 16 cm BRD the first season (Spring 2000), a 4 x 16 cm BRD the second season (Fall 2000), and a 4.5 x 16 cm BRD the third season (Spring 2001) (Crowder et al. 2000 at 1). All BRDs were made from galvanized fencing (Crowder et al. 2000 at 1). During the course of the three-season study, they captured 12 diamondback terrapins, none of which were captured in pots fitted with excluder devices. (Crowder et al. 2000 at 3).

Hart and Crowder (2011) tested BRDs in North Carolina's year-round blue crab fishery from 2000 to 2004 and found that BRDs successfully prevent terrapin capture and mortality (Hart and Crowder 268–269). The smaller the BRD was, the fewer terrapins were captured (Hart and Crowder 2011 at 268–269). Specifically, they found that a 4.5 cm tall BRD excluded approximately 77% of terrapins captured, while a 5 cm tall BRD excluded approximately 28% of terrapins (Hart and Crowder 2011 at 269). They also found that longer soak times and closer distances to shore increased the risk of terrapin captures (Hart and Crowder 2011 at 268–269). As a result of the study, Hart and Crowder suggested three complementary and economically feasible tools to prevent terrapin mortality in the blue crab fishery: 1) gear modifications such as BRDs; 2) distance-to-shore restrictions; and 3) time-of-year regulations (Hart and Crowder 2011 at 270–271). They estimated that by using all three measures combined, a reduction in terrapin bycatch of up to 95% could be achieved without significant reduction in target crab catch (Hart and Crowder 2011 at 264).

Mazzarella (1994) studied crab pots with 5 x 10 cm rectangular wire BRDs and crab pots without BRDs in New Jersey's Great Bay estuary for 116 days from July 6 to August 31, 1993, and from May 1 to June 30, 1994 (Mazzarella 1994 at 1, 3-4). In 1993, crab pots with BRDs captured no terrapins, and crab pots without BRDs captured 3 terrapins; and in 1994, crab pots with BRDs captured 3 terrapins, and crab pots without BRDs captured 37 terrapins (Mazzarella 1994 at 1, 3–4).

Morris et al. (2011) studied the effectiveness of BRDs measuring 4.5 x 12 cm on commercial blue-crab pots in the York River, Virginia, by fishing 10 pots with BRDs and 10 pots without BRDs from June 4 to July 31, 2009 (Morris et al. 2011 at 387). All 51 terrapins captured during the study were captured in crab pots without BRDs; no terrapins were captured in crab pots with BRDs (Morris et al. 2011 at 388, 389). Based on local population estimates, Morris and co-workers concluded that the total number of terrapins caught in non-BRD pots during the 46-day study (51 terrapins) represented a potential reduction in population size from 27–50% (Morris et al. 2011 at 389). Given that the crab pots were in the water only 46 days, the terrapin population in the study creek would have experienced significant mortality of juvenile and adult male terrapins over a full, 8-month season of commercial crabbing, likely resulting in skewed population dynamics (Morris et al. 2011 at 389). Thus, the terrapin mortality prevented by the BRDs was significant.

Roosenburg and Green (2000) tested three sizes of wire BRDs in the Chesapeake Bay in Maryland: 4 x 10 cm, 4.5 x 12 cm, and 5 x 10 cm (Roosenburg and Green 2000 at 883-884). They caught no terrapins in crab pots with 4 x 10 cm BRDs, 19 terrapins in crab pots with 4.5 x 12 cm BRD, and 56 terrapins in crab pots with 5 x 10 cm BRDs (Roosenburg and Green 2000 at 884). They caught 126 terrapins in the crab pots without BRDs (Roosenburg and Green 2000 at 884). Thus, the 5 x 10 cm BRDs reduced terrapin bycatch by 47%, the 4.5 x 12 cm BRDs reduced bycatch by 82%, and the 4 x 10 cm BRDs reduced bycatch by 100% (Roosenburg and Green 2000 at 884). This study resulted in the requirement of a 4.5 x 12 cm BRD in the Maryland recreational crab pot fishery.[10]

Rook et al. (2010) tested a 4.5 x 12 cm plastic BRD in the lower Chesapeake Bay during summer 2008. They tested 10 sets of unbaited crab pots, one pot in each set with BRDs and one without (Rook et al. 2010 at 173–174). In a separate experiment they did the same with baited crab pots (Rook et al. 2010 at 173–174). Of 48 terrapin captures in crab pots, only 2 were from pots with

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[10] *See* Md. Code Regs. 08.02.03.07(B)(5); Maryland Department of Natural Resources, Attention Maryland Crabbers: you can help save our state reptile! Publication #03-1282009-430, available at https://dnr.maryland.gov/wildlife/Documents/TerrapinBrochure.pdf.

BRDs (Rook et al. 2010 at 175). The BRDs diminished terrapin bycatch in crab pots by 95.7% (Rook et al. 2010 at 177). Thus, Rook et al. "recommend[ed] the use of BRDs on all crab traps placed in diamondback terrapin habitat of the North American coastline, particularly for crab traps in the shallow waters fringing coastal marshes, estuaries, and lagoons" (Rook et al. 2010 at 178).

Wnek (2019) studied the effectiveness of various BRD designs in reducing terrapin bycatch and compared the amounts and sizes of blue crabs captured in crab pots fitted with BRDs in Barnegat Bay, New Jersey. He studied four sizes of BRD (5 x 15 cm, 4.5 x 12 cm, South Carolina prototype in red, South Carolina prototype in white) against control pots without BRDs (Wnek 2019 at 2). No terrapins were trapped in crab pots with BRDs, and two terrapins were captured in control pots without BRDs (Wnek 2019 at 10).

Appendix B

Survey of Scientific Literature Evaluating the Effect of BRDs on Crab Haul

Butler and Heinrich (2007) tested whether bycatch mortality of diamondback terrapins in commercial crab pots is reduced by using 4.5 x 12 cm galvanized steel BRDs and whether those devices limit blue crab catch. They captured 2,753 legal-sized crabs and found no significant difference between the sex, measurements, or number of crabs captured in standard crab pots versus crab pots with BRDs (Butler and Heinrich 2007 at 182).

Cole and Helser (2001) found that crab pots fitted with 5 x 10 cm BRDs demonstrated statistically significant reduction in terrapin captures (59%) with no statistical difference in blue crab catches (Cole and Helser 2001 at 828). Crab pots fitted with 4.5 x 12 cm BRDs demonstrated statistically significant reduction in terrapin captures (38% male and 96% female) with only a nominal loss of legal-size blue crabs (12% total, 6% of most desirable crabs) (Cole and Helser 2001 at 831). Crab pots fitted with the smallest BRD, 3.8 x 12 cm, prevented all diamondback terrapins from entering the trap, but incurred substantial loss of legal-size blue crabs (-26%) (Cole and Helser 2001 at 831). Based on the study, Cole and Helser recommended using 4.5 x 12 cm BRDs, which effectively protect subadult and reproductively mature female terrapins with minimal loss of legal blue crabs (Cole and Helser 2001 at 831).

Cuevas et al. (2000) studied and compared the catch rate and sizes of blue crab and terrapin bycatch taken in Mississippi Sound with crab pots equipped with and without BRDs. The BRDs were made of welding rods shaped into a 5 x 10 cm rectangle and fitted into the funnel entrances of crab pots (Cuevas et al. 2000 at 223). A total of 740 blue crabs were captured, 370 in pots without BRDs and 370 in pots with BRDs (Cuevas et al. 2000 at 224). Pots with BRDs captured 160 female crabs and 210 male crabs, while control pots caught 125 females and 245 males (Cuevas et al. 2000 at 224). Daily catch rates and crab size frequency were similar for crab pots with and without BRDs (Cuevas et al. 2000 at 224, 225). However, the scientists noted that there was a detectable difference in size distribution, resulting in a slight decrease in numbers of larger crabs observed in pots with BRDs (Cuevas et al. 2000 at 225). This difference could have been attributable to the small sample size in the study (Cuevas et al. 2000 at 225).

Guillory and Prejean (1998) studied the effects of BRDs on blue crab catches in estuarine Louisiana waters. To do this, they fished five standard crab pots and five crab pots with BRDs constructed of stainless-steel wire and measuring 5 x 10 cm (Guillory and Prejean 1998 at 38). They found that overall catch per trap day of sublegal, legal, and total crabs was 14.5%, 37.9%, and 25.7% greater, respectively, than in standard pots (Guillory and Prejean 1998 at 39). The scientists attributed the increased crab catch in pots with BRDs to increased ingress or decreased egress through the entrance funnels (Guillory and Prejean 1998 at 39).

Hart and Crowder (2011) studied various sizes of galvanized steel BRDs in North Carolina. Although they found a positive correlation between the size of the BRD and effect on crab haul (compared with non-BRD crab pots), they concluded that a 5 cm tall BRD did not have a significant effect on catch of either large male blue crabs or peelers (Hart and Crowder 2011 at 269).

Lukacovic et al. (2005) investigated the effect of BRDs on crab catch and terrapin bycatch in crab pots in Maryland's Assawoman Bay. They studied 16 crab pots, 8 with BRDs and 8 without BRDs, which were fished for 24 and 48 hours twice each month from mid-May through October 2004. The BRDs were rectangular and met Maryland's regulatory requirement that they not exceed 1.75 x 4.75 inches (approximately 4.5 x 12 cm) in length (Lukacovic et al. 2005 at *3). The crab pots were set for a total of 1029 pot-days in water depths ranging from 0.6–2.8 meters (2–8 feet), and 3,412 blue crabs and 1 diamondback terrapin were captured (Lukacovic et al. 2005 at *4). The terrapin was captured in a pot without a BRD, making the rate of terrapin bycatch in non-BRD crab pots 0.002 crabs/pot per day (Lukacovic et al. 2005 at *4). They also found that crab catch for unmodified pots was greater than pots modified with BRDs (Lukacovic et al. 2005 at 4). The overall crab catch was 35% greater, the catch of legal crabs was 28.5% greater, the catch of legal male crabs was 25.6% greater, the catch of mature females was 23.7% greater, and the catch of peelers was 104.2% greater (Lukacovic et al. 2005 at *4). Following inferential analyses, Lukacovic et al. concluded that all categories of crab catch were significantly lower in crab pots fitted with BRDs (Lukacovic et al. 2005 at *5).

Mazzarella (1994) observed no significant difference between crabs caught in crab pots with 5 x 10 cm rectangular BRDs and crab pots without BRDs. In the first study year, crab pots with BRDs caught 6,139 crabs (mean size 13.2), while crab pots without BRDs caught 5,288 crabs (mean size 13.3) (Mazzarella 1994 at 1, 3–4). In the second study year, crab pots with BRDs caught 5,703 crabs (mean size 12.3), and crab pots without BRDs caught 5,851 (mean size 12.2) (Mazzarella 1994 at 1, 3–4).

Morris et al. (2011) studied the effectiveness of BRDs on commercial blue-crab pots in the York River, Virginia, by fishing 10 pots with BRDs and 10 pots without BRDs (Morris et al. 2011 at 387). More than 25% of total crabs were caught on the first day after baiting, and on the first day after baiting they found no statistical difference between either the number or size of legal-size crabs in crab pots with and without BRDs (Morris et al. 2011 at 388). Across all other days after baiting, there was a significant difference in total catch per unit effort of legal-size crabs; however, there was no significant difference in size of legal-sized crabs in BRD pots and non-BRD pots (Morris et al. 2011 at 388). These results indicate that in the absence of fresh bait, crabs do not enter crab pots with BRDs as frequently as non-BRD pots (Morris et al. 2011 at 389). Morris et al. also found that crab pots with terrapin bycatch in them had, on average, fewer crabs per unit effort (Morris et al. 2011 at 388). Likewise, more legal-size crabs were caught in pots without terrapin bycatch, but the difference was not significant (Morris et al. 2011 at 388).

Rook et al. (2010) tested a 4.5 x 12 cm BRD in the lower Chesapeake Bay and found that the BRDs had little effect on crab catch (Rook et al. 2010 at 173–178). Crab catch was equivalent between crab pots with and without BRDs (Rook et al. 2010 at 178). In fact, crab pots with BRDs had slight increases in number, size, and biomass of both legal-size and sublegal-size crabs, though the difference was considered marginal (Rook et al. 2010 at 178).

Roosenburg and Green (2000) tested three sizes of wire BRDs in a tributary to the Chesapeake Bay in Maryland: 4 x 10 cm, 4.5 x 12 cm, and 5 x 10 cm (Roosenburg and Green 2000 at 883–884). Neither the 5 x 10 cm BRD nor the 4.5 x 12 cm BRD affected crab size or the number of crabs caught in the crab pots (Roosenburg and Green 2000 at 885). In fact, crab pots with 4.5 x 12 cm BRDs had the highest catch per unit effort (2.69 crabs per pot per day), followed by crab pots without BRDs (2.55 crabs per pot per day), and then crab pots with 5 x 10 cm BRDs (2.39 crabs per pot per day) (Roosenburg and Green 2000 at 885). In the second year of study, the largest crab was caught in a crab pot with a 4.5 x 12 cm BRD (Roosenburg and Green 2000 at 885, 886). The 4 x 10 cm BRD reduced the size and number of large and mature female crabs (Roosenburg and Green 2000 at 884–885). Catch rate for standard crab pots with 4 x 10 cm BRDs was 2 crabs per pot per day lower than standard crab pots fished without BRDs (Roosenburg and Green 2000 at 885). The 4 x 10 cm BRD also had a significant effect on the width and height of crabs caught, excluding larger Number Ones and large females (Roosenburg and Green 2000 at 885). The scientists found that height of the BRD was the limiting factor rather than width (Roosenburg and Green 2000 at 885). Based on their study, Roosenburg and Green stressed the importance of using 4.5 x 12 cm BRDs on commercial and recreational crab pots because they do not affect crab haul but significantly reduce terrapin capture (82% reduction) (Roosenburg and Green 2000 at 886).[11]

Wnek (2019) studied the effectiveness of various BRD designs in reducing terrapin bycatch and compared the amounts and sizes of blue crabs captured in crab pots fitted with BRDs in Barnegat Bay, New Jersey. He studied three sizes of BRD (5 x 15 cm, 4.5 x 12 cm, South Carolina prototype (half white, half red) against control pots without BRDs (Wnek 2019 at 2). There was no significant difference in the number of blue crabs captured in traps with BRDs and traps without BRDs (Wnek 2019 at 4). In terms of measurement, there was no difference in the total mean length of blue crab captures (Wnek 2019 at 4). The control pots had significantly wider blue crabs than the pots with 5 x 15 cm and South Carolina style BRDs; however, the control pots were similar to those fitted with 4.5 x 12 cm BRDs (Wnek 2019 at 4). While mean blue crab height was significantly lower in pots with 5 x 15 cm BRDs, there was no difference in mean blue crab height between control pots and those with 4.5 x 12 cm and South Carolina style BRDs (Wnek 2019 at 4).

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[11] Roosenburg and Green (2000) found that the 4 x 10 cm BRDs were not a suitable solution for commercial fisheries because they reduced the number of crabs caught by nearly half (Roosenburg and Green 2000 at 887). However, they could be considered for recreational crabbers, who often place their traps in areas with more terrapins, because the 4 x 10 cm BRDs excluded 100% of terrapins (Roosenburg and Green 2000 at 887).