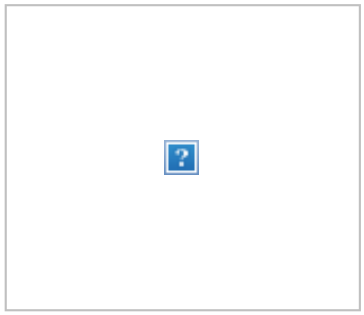
DIAMONDBACK TERRAPIN AND CRAB POT INTERACTIONS AND EFFECT OF TURTLE EXCLUDER DEVICES ON CRAB CATCH IN MARYLAND'S COASTAL BAYS

by
Rudolph Lukacovic

Linda S. Barker

Michael Luisi



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Introduction

An emerging question in blue crab (*Callinectes sapidus*) management is the effect of turtle excluder devices (TEDs) on catch of blue crabs and by-catch of diamondback terrapins. Maryland recreational crab pots are required to have TEDs, commercial crab pots are not. There is some concern that if TEDs are required for commercial crab pots, there will be a minimal effect on terrapin by-catch while causing a negative impact on the crab harvest. Studies have consistently reported either lower by-catch or a non-significant difference in turtle by-catch in pots fitted with TEDs, whereas the effect of TEDs on crab catch have been mixed.

Several investigators have reported no effect of TEDs on blue crab catch. Mazzarella (unpublished manuscript) conducted a two-year study in New Jersey's Great Bay in which he found a reduction in terrapin catch rates in pots fitted with TEDs*. Crab catch rate in unmodified pots was greater than in modified pots in 1993 and less in 1994*. Average size of crabs caught in modified and unmodified pots did not differ by more than 1 mm (0.039 in)*. In a 1992-1993 study, Wood (1997) found a 5-10% greater blue crab catch from unmodified pots than modified pots*. He collected 25 terrapins from unmodified pots and no terrapins from an equal number of pots fitted with TEDs. * In Louisiana, Guillory and Prejean (1998) caught 14.5% more sublegal crabs, 37.9% more legal crabs and 25.7% more crabs overall in pots fitted with excluder devices compared to unmodified pots. * No terrapins were caught in this study. Roosenburg and Green (2000) conducted a study in the Patuxent River, Maryland. They found terrapin by-catch was reduced by 82% in crab pots fitted with 4.5 cm x 12 cm (1 3/4 in x 4 3/4 in) TEDs and by 47% in pots fitted with 5 cm x 10 cm (2 in x 4 in) TEDs. * Neither device affected the size or number of crabs caught. Cole and Helser (2001) reported similar results in Delaware Bay using 5 cm x 10 cm (2 in x 4 in) devices. Terrapin bycatch was reduced by 59%* with no statistical difference in crab catches.

Other studies have reported decreased catches of blue crabs in crab pots fitted with TEDs. Roosenburg (1998) found both a significant reduction in terrapin by-catch in bank traps with 5mm x 10mm TEDs and a significant reduction in crab catch. Cole and Helser (2001) found different results in the Delaware study using 4.5 cm x 12 cm TEDs. Although TEDs reduced female terrapin captures by 96% and male captures by 38%, overall crab harvest was reduced by 12% (6% for #1 crabs). * They concluded that the optimal size of TED would probably vary because of latitudinal variation in terrapin size. The Maryland Department of Natural Resources conducted a 3-year study to evaluate the effects of Maryland regulations that require recreational crab pots in the coastal bays to be set in water deeper then four feet (COMAR .08.02.03.01(4c)). The 636 crab pots without TEDs caught 5 terrapins. The 703 pots fitted with TEDs caught no terrapins (a 1% difference), but they also caught fewer mature female crabs, fewer female peeler crabs, and 41% less for all market categories combined* (Wesche, personal communication, unpublished data).

The objectives of this study were to investigate the effect of TEDs on crab catch and terrapin by-catch in crab pots in Maryland's coastal bays. This effect was quantified as:

- the rate of terrapin by-catch,
- the significance of the difference between crab catch from modified and unmodified pots,

the significance of terrapin by-catch from modified and unmodified pots.

Table 1. Summarized results of previous studies on the effect of Turtle Excluder Devices (TED) on crab catch and turtle by-catch from crab pots.

Author	Pub	Location	Years	TED	Size	n (pots)	Crab Catch	Terrapin By-Catch
Mazzarella	none	N.J.	1993	yes			6139	0
			1993	no			5788	3

			1994	yes			5763	3
			1994	no			5861	37
Wood	1997		1992-3	yes			+5-10%	0
				no				25
Guillory	1998	La.		yes			+25.7% overall	0
and Prejean				no				0
Roosenburg	2000	Patuxent R.,		yes	4.5x12 cm		no change	-82%
and Green		Md.		yes	5x10 cm		no change	-47%
Cole	2001	Delaware		yes	5x10 cm		no change	-59%
And Helser		Bay		yes	4.5x12 cm		-12% overall (6% #1s)	-96% female
				yes	4.5x12 cm			-38% male
Wesche	none	Coastal Bays	3 years	yes		703	-41% overall	0
		Md.		no		636		5 (0.1%)

* The authors of this paper tried to test for significance, but without more data from the studies, it was impossible to determine if these differences were significant.

Methods

Two strings of 16 crab pots (8 with TEDs installed in the entrance funnels and 8 without TEDs) were fished for 24 and 48 hours twice each month from mid-May through October 2004. Turtle reduction devices met the following regulatory specifications for recreational crab pots according to COMAR (08.02.03.01.J(2d)):

-a crab pot set for noncommercial purposes shall have a turtle reduction device which:

(i) is firmly attached to each entrance or funnel in the lower chamber;

(ii) is constructed of wire or plastic;

(iii) is rectangular in shape

(iv) has dimensions which do not exceed 1 ¾ inches in height and 4 ¾ in length.

The survey was conducted at four different sites in Assawoman Bay, Maryland. Specific locations were selected based on data from the Maryland DNR Coastal Bay Seine Survey and beach nesting area data. Coastal Bay survey data for 1972 to 2002 were supplied by Maryland DNR Fisheries Service Atlantic Program. Maryland DNR Resource Assessment Survey staff provided terrapin beach nesting area data.

The pots were fished as two strings, parallel to shore in 2 different depths. One string of 16 crab pots was set in a straight line parallel to shore in water deeper than four feet. A second string of 16 pots was set parallel to, and directly inshore of, the first string of pots in water less than four but greater than two feet deep. Pots in each string were spaced at least 30.5 m (100 ft) apart. Crab pots with TEDs were alternated with those without TEDs. Starting order (TED or no TED) was randomly assigned (coin toss). Pots were baited with frozen Atlantic menhaden (*Brevoortia tyrannus*) and set for 24 hours. After 24 hours the catch was processed, the bait was replaced and the pot was reset for 48 hours at the same location. Three sets of data were recorded:

1. Initial data recorded when the pots were first set:
   - tidal stage

- distance from shore (using a range finder) at the beginning, halfway, and end of each string of pots
- GPS readings at the beginning and end of each string.

2. Data for each pot when the pots were pulled:
   - water depth
   - TED present or absent
   - carapace width of each blue crab
   - sex of each blue crab
   - maturity of each female blue crab
   - number of live and dead terrapins
   - carapace length of each terrapin
   - other species.
3. Data at the beginning and end of fishing each day:
   - water temperature(^{o}C)
   - salinity (ppt)
   - dissolved oxygen (mg/L).

The data were analyzed to determine the rate of terrapin by-catch and differences in crab catch between pots with and without a TED. Terrapin by-catch rate was calculated as catch-per-unit-effort (CPUE), based on effort defined as pot-days. T-tests and paired t-tests were used to determine significant differences ($a = 0.05$) between overall crab catch, catch of legal males, catch of mature females and catch of peelers in pots with and without TEDs.

Results

Overall results.

Crab pots were set for a total of 1029 pot-days in water depths ranging from 0.6m to 2.8m (2.0 ft to 8.0 ft) and 3412 blue crabs and 1 diamondback terrapin were caught.

By-catch.

The rate of terrapin capture in crab pots without TEDs was 0.002 crabs/pot/day (1 terrapin in a total of pot-days). The single diamondback terrapin capture was in a crab pot without a TED, fished for 48 hours in water 1.4 m (4.5 ft) deep and set 187.4 m (615 ft) from shore. The terrapin (carapace length = 130 mm) was dead when the pot was emptied.

Nine finfish species comprised all other by-catch. The dominant species was summer flounder (*Paralichthys dentatus*) with 65 individuals (185-490 mm). Channel whelk (*Busycon canaliculatum*) was the second most common non-target species with 15 captures. There were 10 spider crabs (*Libinia emarginata*) captured. Seven other finfish species were caught with less than 10 individuals each.

Crab catch.

Initial descriptive statistics showed that the crab catch for unmodified pots was greater than pots modified with TEDs for all categories of analysis (Table 2). The overall crab catch was 35% greater, the catch of legal crabs was 28.5% greater, the catch of legal male crabs (>137mm) was 25.6% greater, the catch of mature females was 23.7% greater, and the catch of peelers was 104.2% greater.

Table 2. Summary of crab catch from TED-modified and unmodified crab pots in Maryland's Assawoman Bay, 2004.

Crab Category	# with TED	# without TED	% Difference
All	1452	1960	35.0
All legal	1048	1347	28.5
Legal male	616	774	25.6
Mature females	384	475	23.7
Peelers	48	98	104.2

Inferential analyses were performed to determine if the differences seen in the results were significant ($a = 0.05$) (Table 3). T-tests determined that water depth ($P = 0.61$) and soak time ($P = 0.67$) did not significantly affect the overall number of crabs caught, so the data were pooled to test for TED effects. Paired t-tests were used to determine the differential catch of pairs of modified and unmodified pots on a daily basis. Results indicated that all categories of crab catch were significantly lower in crab pots fitted with TEDs.

Table 3. T-tests to determine significance of effect ($a = 0.05$) of depth and soak time, and significance of effect of TED for various categories of crabs captured in crab pots.

Treatment	Group	n	Test	P	Significance
Depth	All	42	Overall t-test	0.61	No
Soak Time	All	20	Overall t-test	0.67	No
TED	All crabs	21	Paired t-test	0.0001	Yes
	Legal Males	21	Paired t-test	0.001	Yes
	Mature Females	21	Paired t-test	0.01	Yes
	Peelers	18	Paired t-test	0.03	Yes

Discussion

By-catch of diamondback terrapins in crab pots is highly infrequent (0.002 terrapins/pot-day). These results are consistent with those of Wesche. Whether the infrequency of catch in Maryland's coastal bays is the result of low terrapin abundance or some other factor is not known.

This study found that the overall crab catch was significantly reduced in pots fitted with TEDs. Overall crab catch was reduced by 35%. All categories of catch – legal crabs, legal male crabs, female mature crabs, and peelers - were significantly lower from pots fitted with TEDs. Wesche's study, conducted in Maryland's coastal bays over a three-year period during the mid-1990's, had similar results. The size of

the excluder device may be related to these results. In the study by Cole and Helser (2001), crab catch was reduced in pots modified with TEDs smaller than or equal to the devices used in Maryland, whereas larger devices appeared to have no adverse effect on crab catch. This was the same result seen in the Roosenburg bank trap study (1998).

There were no apparent trends among bait type and study results. Atlantic menhaden were used as bait in this study to mimic commercial crabbing practices in the study area. In studies conducted in New Jersey and Delaware, menhaden were also used as bait. White perch (*Morone americana*) were used as bait in Roosenburg's studies in the Patuxent River, Maryland.

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