Atlantic States Marine Fisheries Commission

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Horseshoe Crab Technical Committee Report

Bait Use Surveys of the American Eel and Channeled Whelk Fisheries

October 17, 2017

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Introduction

The Horseshoe Crab Technical Committee conducted a survey of American eel and channeled whelk fishermen along the US Atlantic coast. The intents of this survey were to: a) characterize the preference, prevalence, and performance of horseshoe crab as bait in these fisheries, b) provide information on the relative amounts and costs of horseshoe crab bait use that could be used to assess the viability of manufactured baits with reduced amounts of horseshoe crab, and c) provide information on the fishery's current impression of manufactured baits. The surveys for the American eel and channeled whelk fisheries can be found in Appendices I and II, respectively.

State Survey Distribution Methods and Response Rates

Mail surveys were sent by state fisheries departments to American eel and channeled whelk trap/pot fishermen during January-February, 2017. All states except New York sent surveys to all current permit holders; New York only sent surveys to permit holders who were active in the past two years. Responses were voluntary in all states except for Massachusetts, where survey completion was required for permit renewal.

Harvest of horseshoe crabs for bait, or the use of horseshoe crabs as bait in any fishery in South Carolina, is prohibited, pursuant to Code of Laws of South Carolina, Title 50, Chapter 5, Article and Section 1330. The only allowable harvest of horseshoe crabs in South Carolina is for biomedical bleeding, or for research and scientific purposes, and is limited to harvest by hand. Therefore, while phone interviews were conducted with blue crab fishermen that encounter whelk as bycatch (summarized in Appendix III), data from South Carolina were not included in survey analyses.

Of 548 eel surveys mailed, coastwide, 163 voluntary responses were received, for a 30% response rate. Of 822 whelk surveys mailed, coastwide, 260 responses were received (32% response rate). Massachusetts sent 150 whelk surveys and received 133 responses, which were

required for permit renewal. In states from Rhode Island through Florida, where responses were not required for permit renewal, 630 whelk surveys were mailed, and 127 responses were received, for a 20% voluntary response rate. Response rates for individual states are shown in Table 1.

Table 1. State response rates for the American eel and channeled whelk bait surveys. Coastwide response rates are shown for all states (Total) and states where survey completion was not a condition of permit renewal (Voluntary).

State	American Eel			Channeled Whelk		
	Surveys Sent	Responses Received	Response Rate	Surveys Sent	Responses Received	Response Rate
MA	0	0		150	133	88.7%
RI	6	2	33.3%	138	39	28.3%
CT	0	0		131	29	22.1%
NY	14	9	64.3%	28	14	50.0%
NJ	100	22	22.0%	200*	13	6.5%
DE	65	12	18.5%	64	9	14.1%
MD	40	12	30.0%	13	4	30.8%
VA	216	76	35.2%	82	18	22.0%
NC	55	6	10.9%	16	1	6.3%
GA	28	10	35.7%	0	0	
FL	24	14	58.3%	0	0	
Total	**548**	**163**	**29.7%**	**822**	**260**	**31.6%**
Voluntary	**548**	**163**	**29.7%**	**672**	**127**	**18.9%**

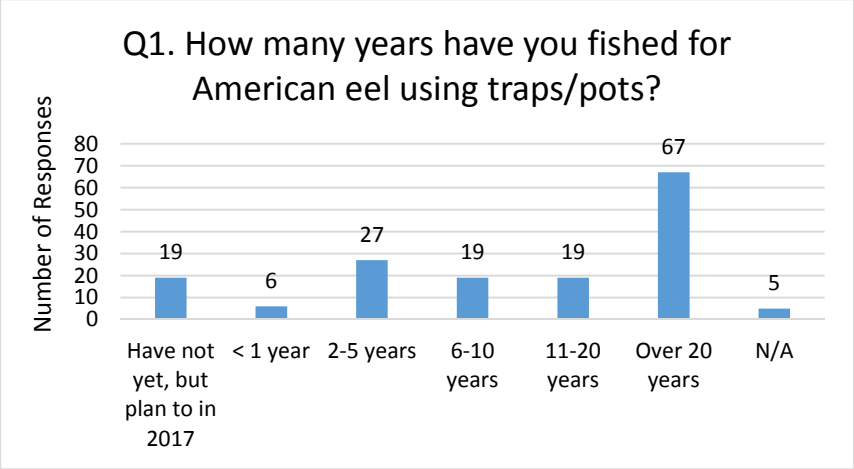
*New Jersey sent whelk surveys to crab fishermen, as New Jersey does not currently manage whelk, but whelk are caught in New Jersey by crab fishermen.

Results and Discussion

Eel

Characterization of the American Eel Fishery

Figure 1. Respondents' years of experience in the American eel trap/pot fishery (N=162). (Q1)



For all analyses presented, only data from respondents that fished for American eel in 2016 were used, unless otherwise indicated with "all respondents".

Figure 2. Percentages of respondents who did or did not fish for American eel in 2016 with traps/pots (N=161). (Q2)

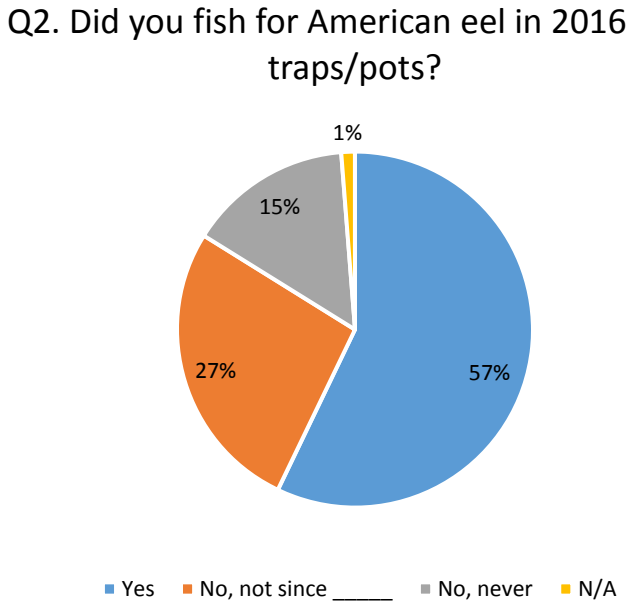


Table 2. Most recent year fished for fishermen who are no longer active in the American eel fishery. (Q2)

Last Year Fished	No. of Responses
1990	1
1995	1
2000	1
2005	1
2008	1
2010	1
2011	3
2012	4
2013	1
2014	8
2015	11
No Response	10

Table 3. Months fished in the American eel fishery using traps/pots, by state, in numbers of responses. Month(s) of greatest fishing activity for each state and all states combined is highlighted. (Q4)

Month	All States	RI	NY	NJ	DE	MD	VA	NC	GA	FL
Jan	15	0	0	1	0	0	0	0	3	11
Feb	13	0	0	1	0	0	1	1	3	7
Mar	49	0	3	6	4	10	15	1	3	7
Apr	75	1	5	9	5	10	40	1	4	0
May	82	1	7	11	7	10	41	0	5	0
June	49	1	5	7	3	7	21	1	3	1
July	27	1	3	2	0	4	13	1	2	1
Aug	35	1	3	3	3	5	15	2	2	1
Sept	79	1	6	11	8	10	36	3	3	1
Oct	89	1	8	15	9	10	36	5	2	3
Nov	74	1	7	10	10	7	26	4	2	7
Dec	33	0	0	2	4	5	6	3	2	11
Total	620	8	47	78	53	78	250	22	34	50

Fishing Practices of the American Eel Fishery

Figure 3. Use of single and trawl/longline methods for traps/pots in the American eel fishery in percentages of responses (N=140). (Q5)

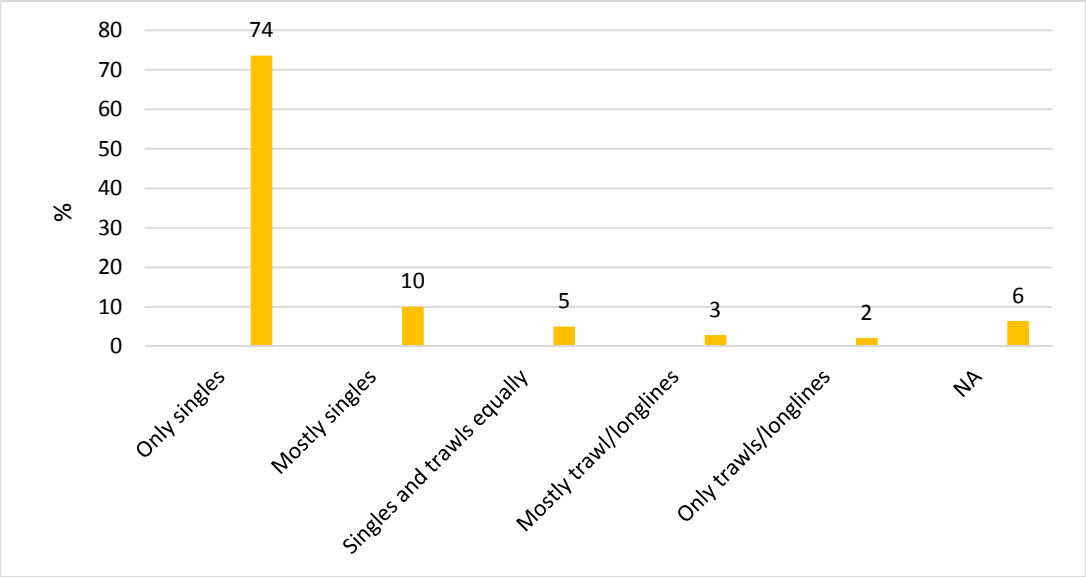
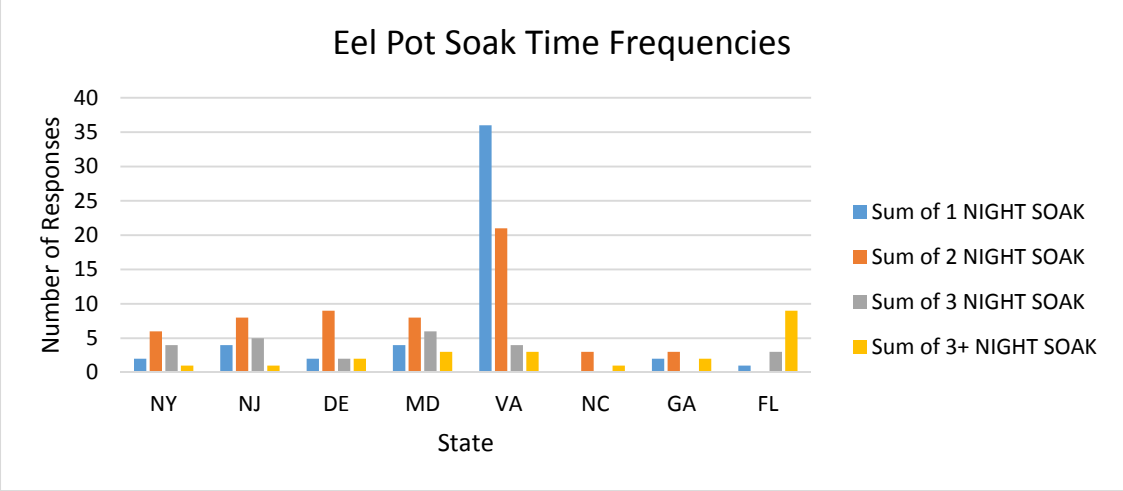


Figure 4. Soak time frequencies by state for traps/pots in the American eel fishery (all respondents). (Q6)



From the survey responses, eel trap/pot usage was considerably variable. With the exception of Maryland, average traps/pots per trip ranged from 31 – 190 and average max traps/pots ranged from 48 – 220 (Table 4). Maryland reported an average of 411 traps/pots per trip and an average of 1024 max traps/pots.

Table 4. Numbers of traps/pots used per trip, by state, in the American eel fishery (all respondents). (Q7-8)

State	n	Average of Max Traps/Pots	stdDev of Max Traps/Pots	Min Traps/ Pots	Max Traps/ Pots	Average Traps/Pots per Trip	stdDev of Traps/Pots per Trip
NY	8	92	47	35	150	70	40
NJ	16	89	86	6	250	78	80
DE	11	137	105	30	400	104	66
MD	10	1024	956	35	3000	411	239
VA	60	79	91	1	500	72	86
NC	5	220	110	100	300	190	102
GA	7	48	36	8	100	31	25
FL	12	105	71	15	300	92	75

Bait Use in the American Eel Fishery

Of 90 respondents to the American eel survey, 30 (22.56%) typically use horseshoe crab as bait. The most prominent bait in the American eel fishery is blue crab, with 54 (40.60%) respondents typically using blue crab as bait. Numbers and percentages of respondents that typically use different types of bait in the eel fishery are shown in Table 5. About half of respondents (52.2%) reported typical use of multiple bait types. Fish are the second most prominent bait in the American eel fishery (27.07%), with menhaden being the most common identified species within this bait type. Of 28 responses that identified fish to the species level, 26 identified menhaden as a typical bait used.

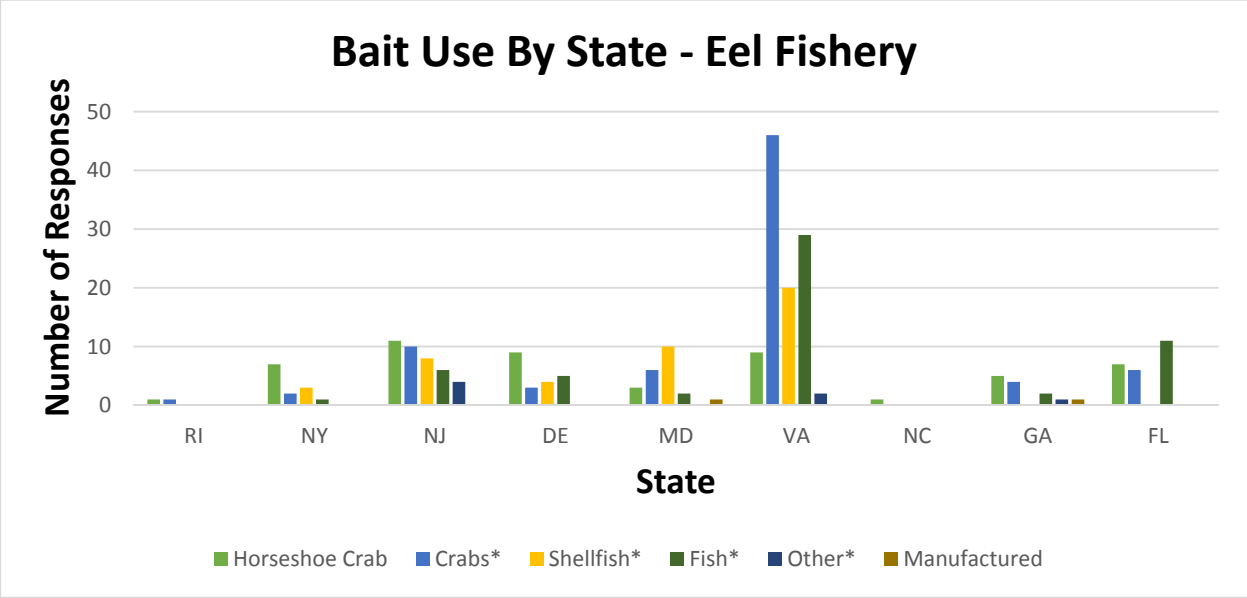
Table 5. Bait types typically used by American eel fishermen in 2016 shown in numbers and percentages of responses to eel bait surveys. Fishermen may typically use multiple bait types, so percentages do not sum to 100%. (Q9-10)

Bait Type	**Eel (N=90)**	
	Responses	Use Percentage
Blue crabs	54	40.60%
Fish racks or whole	36	27.07%
Horseshoe crab	30	22.56%
Shellfish	27	20.30%
Other**	9	6.77%
Razor Clams	7	5.26%
Green crabs	1	0.75%
Manufactured bait	1	0.75%
Rock crabs	1	0.75%
Jonah crabs	1	0.75%
Sharks/Skates/Dogfish	0	0.00%

**No individual bait type included in Other had a use percentage greater than 5% for the American eel trap/pot fishery.

Figure 5 contains data representing 241 individual responses to bait use surveys in the eel fishery. 32% of the responses designate “crab” use, 23% designate “fish” use, 22% designate “horseshoe crab” use, 19% designate “shellfish” use, 3% designate “other”, and only 1% designate “manufactured” bait use. This demonstrates the minor role of manufactured bait in the industry. Although horseshoe crabs are not the most frequently used bait under current fishing practices, it is the only bait being employed in every state. It is worth noting that many of these responses were from the same individuals as the survey allowed users to select up to 5 bait types and over 75% of responses exemplified the roles of other bait sources in the fishery.

Figure 5. Numbers of respondents who use each bait type in the American eel fishery. Does not include amount used. Number after bait type represents sum of all state responses (all respondents). (Q9-10)



*Crabs column compiled individual responses for: green crab, rock crab, blue crab, Jonah crab, and shrimp heads.
*Shellfish column compiled individual responses for: shellfish and razor clams
*Fish column compiled individual responses for: fish racks or whole, menhaden, herring, and porgy
*Other column compiled individual responses for: other, road kill, and chicken scraps

Soak time (Figure 4) and bait longevity (Figure 6) varied from state to state, however within each state soak time and bait longevity correlated very well. Overall, most states had 2 nights of soak and bait time as their most frequent responses. Most eel fishermen (83%) do not use bait saving devices such as cups or bags (Table 6), and use of these devices is not required by current state regulations.

Figure 6. Bait longevity, by state, in the trap/pot American eel fishery (all respondents). (Q13)

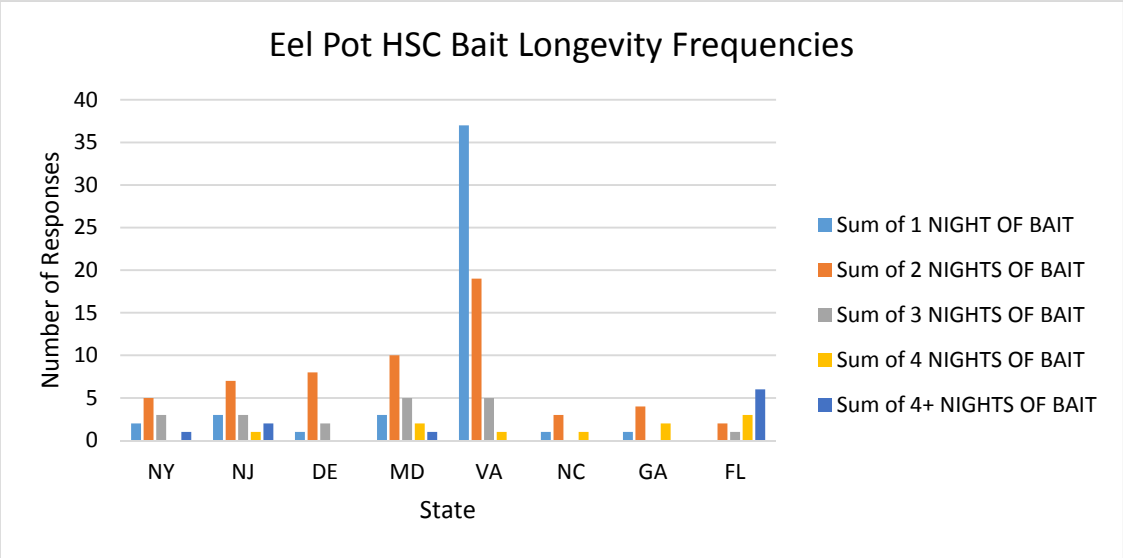
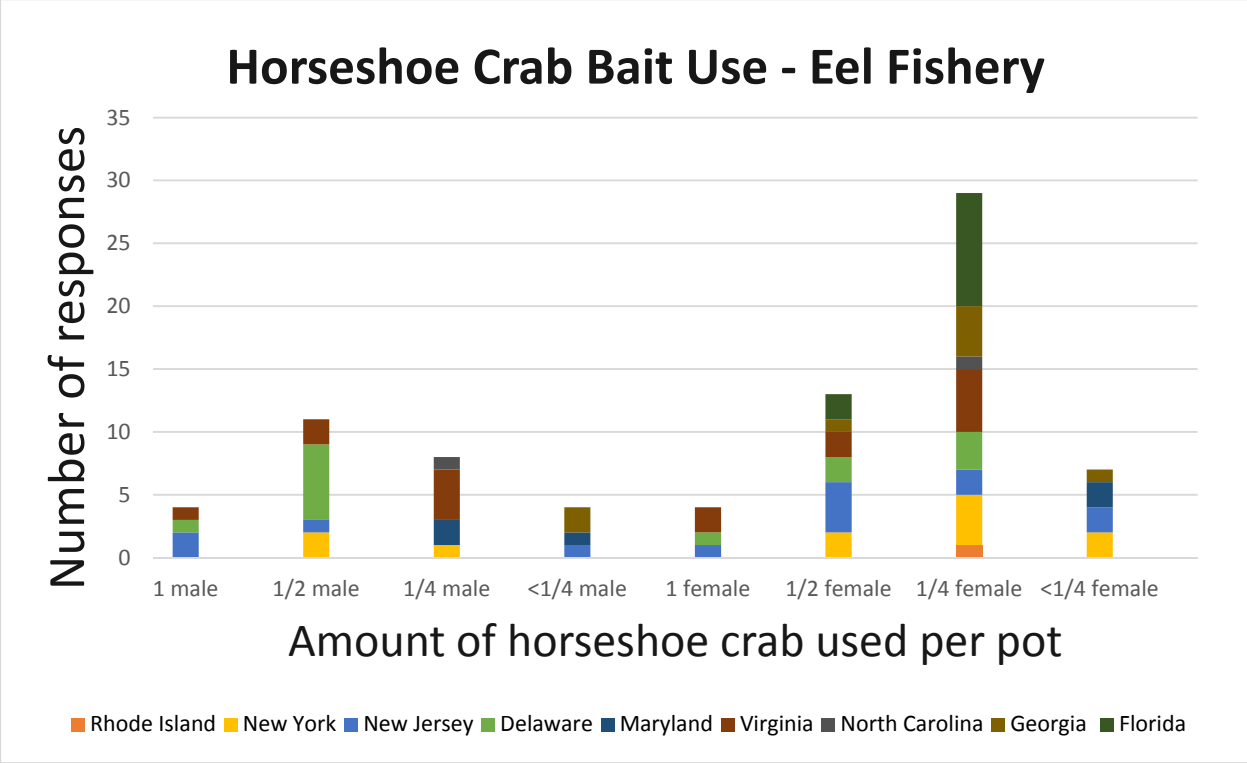


Table 6. Use of bait-saving devices in the American eel fishery. Bait-saving devices are required in the American eel trap/pot fishery in Delaware, but not in other states. (Q14)

	All States	RI	NY	NJ	DE	MD	VA	NC	GA	FL
Yes, HSC only	3	0	1	1	0	0	1	0	0	0
Yes, mix	14	0	2	4	3	1	4	0	0	0
No	62	1	5	4	3	0	36	4	3	6
NA	3	0	0	1	0	0	1	0	0	1

66% of respondents who use horseshoe crabs typically use females (Figure 7). The most common amount of female horseshoe crab used per trap/pot was one fourth of a female crab (36% of respondents who use horseshoe crabs). 34% of the respondents who use horseshoe crabs typically use males. The most common amount of male horseshoe crab used per trap/pot was one half of a male crab. Of respondents who typically use male horseshoe crabs, 40% use one half of a male crab per trap/pot. The sexual dimorphism of horseshoe crabs (with females growing larger than males) may explain the difference in the relative amounts of male and female crab used. Additionally, considering sexually dimorphic size differences, the amount of horseshoe crab in volume per trap/pot is likely similar between one fourth of a male crab and one half of a female crab.

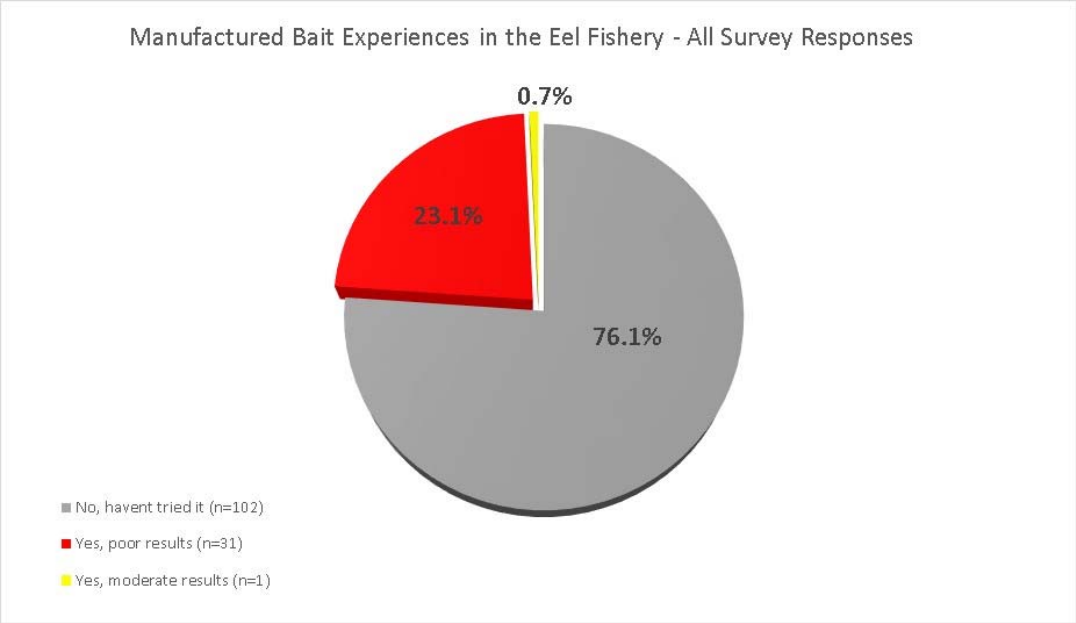
Figure 7. Typical amounts of horseshoe crab used per trap/pot, by state, in the American eel fishery. (Q17)



Use and Impression of Manufactured Bait in the Eel Fishery

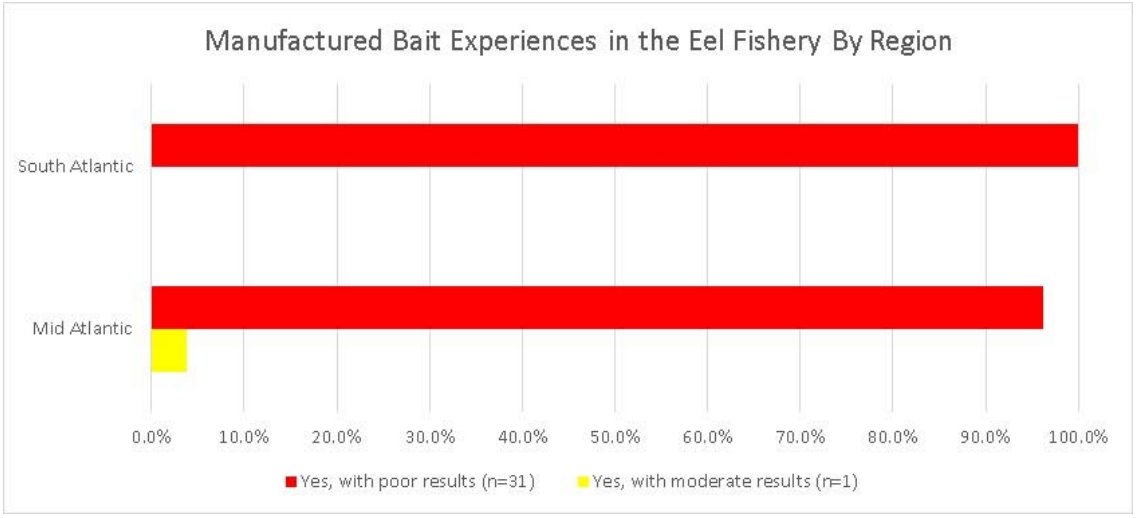
Looking at all survey responses for the eel fishery the majority (76.1%) of respondents indicated they had never used manufactured bait (Figure 8). Less than 24% of survey responders had used manufactured bait with the majority (97.1% of respondents who have used manufactured bait; 23.1% of all respondents) reporting poor results. It is important to note there were no responses for the eel fishery in the surveys received from Massachusetts or Connecticut and only one survey was received from an active eel fisherman in Rhode Island.

Figure 8. Experiences with manufactured bait in the American eel fishery, shown as percentages. (Q11)



When looking at responses by region for those who had used manufactured bait in the past, the same pattern develops. The majority (average 98%) of fishermen in both the Mid Atlantic (New York to North Carolina) and the South Atlantic (Georgia and Florida) reported poor results with the product, with a single responder (4%) in the Mid Atlantic indicating having positive results using the product (Figure 9). The single survey received from Rhode Island indicated they had not used manufactured bait and therefore is not included in these analyses.

Figure 9. Moderate and poor experiences with manufactured bait for fishermen who have used it in the American eel fishery, shown as percentages, by region. (Q11)



Bait costs in the American Eel Fishery

Greater than 53% of eel fishermen using only non-HSC bait paid less than $1.00 per trap/pot for bait, and nearly 89.3% paid $1.50 or less (Table 7). Among those eel fishermen that used HSC in combination with other types of bait, 47% paid $1.50 or less, and 58.8% paid less than $2.00 per trap/pot for bait. Only one fisherman used exclusively HSC, at an average cost of $1.00 to $1.50 per trap/pot for bait.

Table 7. Costs to bait American eel traps/pots using baits that include only horseshoe crab (HSC Only), horseshoe crab and other bait (HSC Plus), and no horseshoe crab (Non-HSC). (Q12)

	Percent of Respondents			
Cost to Bait Eel Trap/Pot	**Non-HSC (n=56)**	**HSC Plus (n=17)**	**HSC Only (n=1)**	**All Baits (N=74)**
< $1.00	53.6	29.4	0	47.3
$1.00 - $1.50	35.7	17.6	100	32.4
$1.51 - $2.00	8.9	11.8	0	9.5
$2.00 or more	0.0	17.6	0	4.1
$2.00-$2.50	1.8	11.8	0	4.1
> $2.50	0.0	11.8	0	2.7

Channeled whelk

Table 8. Number of total respondents by state by number of years fishing for channeled whelk with traps/pots. (Q1)

	Q1. How many years have you fished for whelk using traps/pots?									
	All States	MA	RI	CT	NY	NJ	DE	MD	VA	NC
Yet to fish	21	10	4	2	1	2	0	1	1	0
≤1 year	9	4	2	1	1	0	1	0	0	0
2-5 years	42	23	10	2	2	1	1	1	2	0
6-10 years	46	23	8	6	3	0	1	0	4	1
11-20 years	51	25	6	4	4	3	2	1	6	0
>20 years	75	37	9	13	3	5	2	1	5	0
No response	16	11	0	1	0	2	2	0	0	0

For all analyses presented, only data from respondents that fished for channeled whelk in 2016 were used, unless otherwise indicated with “all respondents”.

Figure 10. Percentages of respondents who did or did not fish for channeled whelk in 2016 with traps/pots (N=260). (Q2)

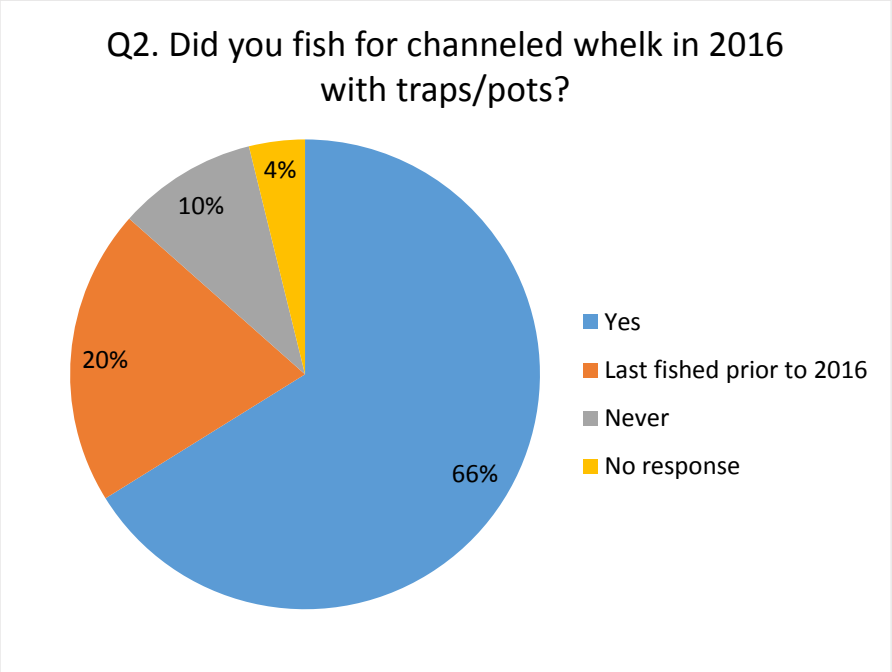


Table 9. Fishing activity by month by state for respondents that reported fishing channeled whelk traps/pots in 2016. Month(s) of greatest fishing activity for each state and all states combined is highlighted. (Q4)

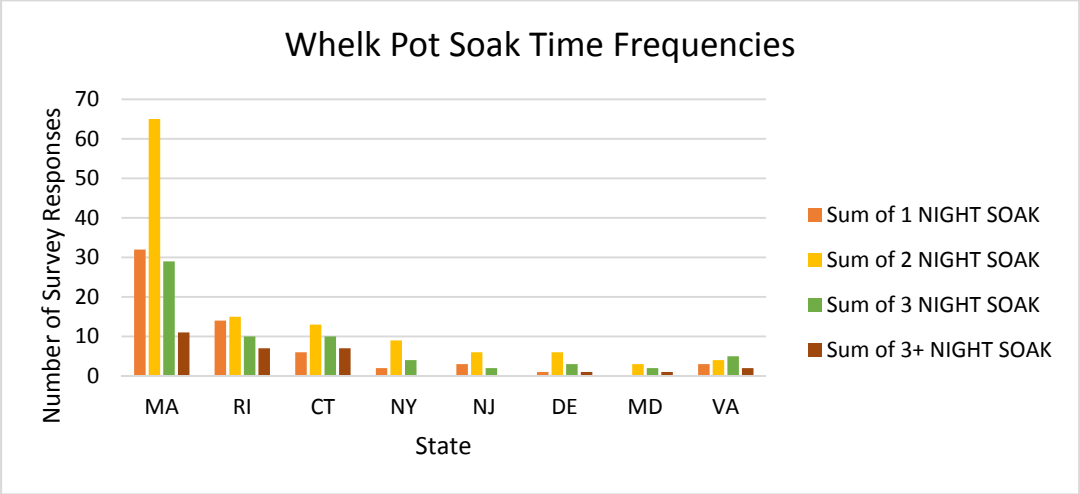
	Q4. What months do you fish whelk traps/pots?								
	All States	MA	RI	CT	NY	NJ	DE	MD	VA
Jan	14	0	2	1	1	1	1	2	6
Feb	2	0	0	0	0	0	0	0	2
Mar	4	0	2	0	1	0	0	0	1
Apr	61	28	13	8	5	2	0	2	3
May	119	50	27	19	11	6	0	3	3
June	127	63	23	22	10	5	1	2	1
July	106	57	18	21	6	3	0	1	0
Aug	73	41	8	16	6	2	0	0	0
Sept	121	68	22	14	9	5	1	1	1
Oct	156	81	26	20	11	8	3	3	4
Nov	154	79	22	20	11	8	4	3	7
Dec	115	56	15	18	7	6	4	2	7

Fishing Practices of the Channeled Whelk Fishery

Table 10. Gear configuration by state for all respondents that reported fishing channeled whelk traps/pots in 2016.

	Q5. In 2016, did you fish your whelk traps/pots as singles or trawls/longlines?								
	All States	MA	RI	CT	NY	NJ	DE	MD	VA
Only singles	82 (52.9%)	46	4	6	8	3	3	3	8
Mostly singles	20 (12.9%)	7	4	4	3	2	0	0	0
Both about equally	0 (0%)	0	0	0	0	0	0	0	0
Mostly trawl/longlines	24 (15.5%)	7	9	4	2	2	0	0	0
Only trawls/longlines	28 (18.1%)	19	7	2	0	0	0	0	0
No response	1(0.6%)	0	0	1	0	0	0	0	0

Figure 11. Soak time frequencies by state for traps/pots using all bait types in the channeled whelk fishery (all respondents). (Q6)



From the survey responses, MA through NY use less traps/pots per trip on average (107 – 139), they also reported lower averages of max traps/pots fished (133 – 239). NJ – VA used more traps/pots per trip on average (225 – 269) and had higher averages of max traps/pots fished (436 – 738) (Table 11).

Table 11. Numbers of traps/pots used per trip, by state, in the channeled whelk fishery (all respondents. (Q7-8)

State	N	Average of Max Traps/Pots	stdDev of Max Traps/Pots	Min Traps/Pots	Max Traps/Pots	Average Traps/Pots per Trip	stdDev of Traps/Pots per Trip
MA	104	153	61	1	240	139	59
RI	32	133	90	35	300	107	74
CT	27	239	203	12	1000	116	53
NY	13	216	151	35	500	113	59
NJ	7	454	688	80	2000	269	247
DE	7	436	358	180	1200	229	48
MD	4	738	565	50	1200	225	140
VA	14	389	193	200	800	259	136

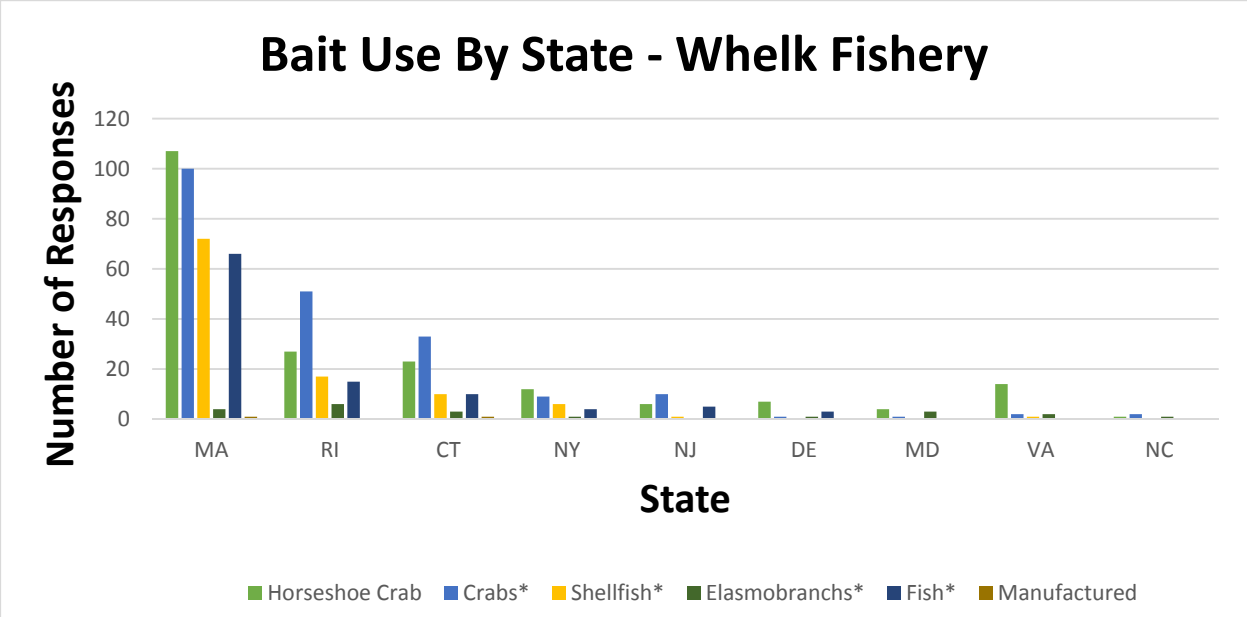
Bait Use in the Channeled Whelk Fishery

Horseshoe crabs are the most prominent bait in the channeled whelk fishery, with 91.2% of 172 coastwide respondents to the whelk survey typically using horseshoe crab as bait (Table 12). Most respondents reported typical use of multiple bait types. Prominent baits other than horseshoe crab include shellfish (typically used by 54.4% of respondents), green crabs (typically used by 50.3% of respondents), and fish (typically used by 50.3% of respondents), and. Of 19 responses that identified fish to the species level, 10 identified Atlantic herring and 8 identified menhaden as typical baits used.

Table 12. Bait preferences by state for all respondents that reporting fishing for channeled whelk in 2016. NA's responded to survey but left this question blank. Percentages are based on the number of respondents that fished in 2016 and answered the question. Fishermen may typically use multiple bait types, so percentages do not sum to 100%. (Q9-10)

	All States	MA	RI	CT	NY	NJ	DE	MD	VA
Number	172	85	28	23	13	8	4	3	8
NA	1	0	0	0	0	1	0	0	0
Horseshoe crab	91.2%	91.8%	82.1%	91.3%	100.0%	85.7%	100.0%	100.0%	100.0%
Shellfish	54.4%	72.9%	57.1%	34.8%	46.2%	14.3%	0.0%	0.0%	0.0%
Green crabs	50.3%	64.7%	75.0%	34.8%	15.4%	0.0%	0.0%	0.0%	0.0%
Fish racks/whole	50.3%	65.9%	46.4%	17.4%	46.2%	71.4%	25.0%	33.3%	0.0%
Manufactured bait	5.3%	0.0%	0.0%	39.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Rock crabs	17.0%	10.6%	21.4%	47.8%	15.4%	14.3%	0.0%	0.0%	0.0%
Jonah crabs	14.6%	7.1%	14.3%	43.5%	15.4%	28.6%	0.0%	33.3%	0.0%
Blue crabs	21.1%	14.1%	28.6%	0.0%	38.5%	100.0%	25.0%	33.3%	25.0%
Other*	13.5%	0.0%	35.7%	21.7%	7.7%	28.6%	25.0%	66.7%	25.0%
-Dogfish	5.3%	0.0%	21.4%	0.0%	7.7%	0.0%	0.0%	0.0%	25.0%
-Skates	1.2%	0.0%	0.0%	4.3%	0.0%	0.0%	0.0%	33.3%	0.0%
-Spider crabs	4.1%	0.0%	10.7%	17.4%	0.0%	0.0%	0.0%	0.0%	0.0%
-Chicken	0.6%	0.0%	3.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
-Sharks	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	33.3%	0.0%
-Other	1.8%	0.0%	0.0%	0.0%	0.0%	28.6%	25.0%	0.0%	0.0%
Horseshoe crab only	9.9%	5.9%	3.6%	8.7%	23.1%	0.0%	25.0%	33.3%	50.0%

Figure 12. Numbers of respondents who use each bait type in the channeled whelk fishery (all respondents). Does not include amount used. (Q9-10)



*Crabs column compiled individual responses for: green crab, rock crab, blue crab, spider crab, spider crab/starfish, spring crab, and Jonah crab.
*Shellfish column compiled individual responses for: shellfish, clam bellies, and surf clams
*Elasmobranchs column compiled individual responses for: sharks, skates, and dogfish
*Fish column compiled individual responses for: fish racks or whole, menhaden, bluefish, cod, pollock, herring, and mackerel

Soak time (Figure 11) and bait longevity (Figure 13) correlated fairly well. The most frequent responses were 2 nights of both bait longevity and soak time. Most whelk fishermen (94%) use bait saving devices such as cups or bags (Table 13), and use of these devices is only required by current state regulations in Delaware. Use of these devices is not required in the states with the largest annual whelk harvests (MA-CT).

Figure 13. Soak time frequencies by state for traps/pots including horseshoe crab as bait in the channeled whelk fishery (all respondents). (Q10 & 13)

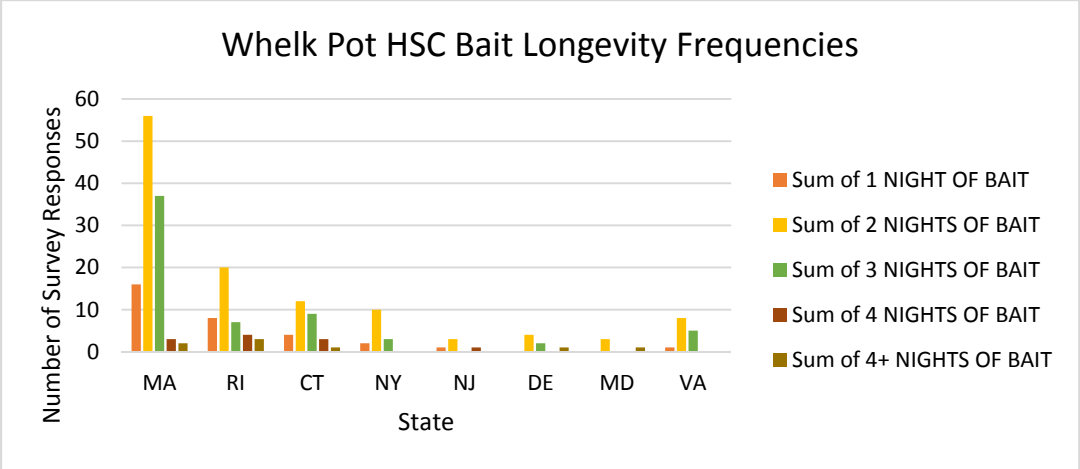
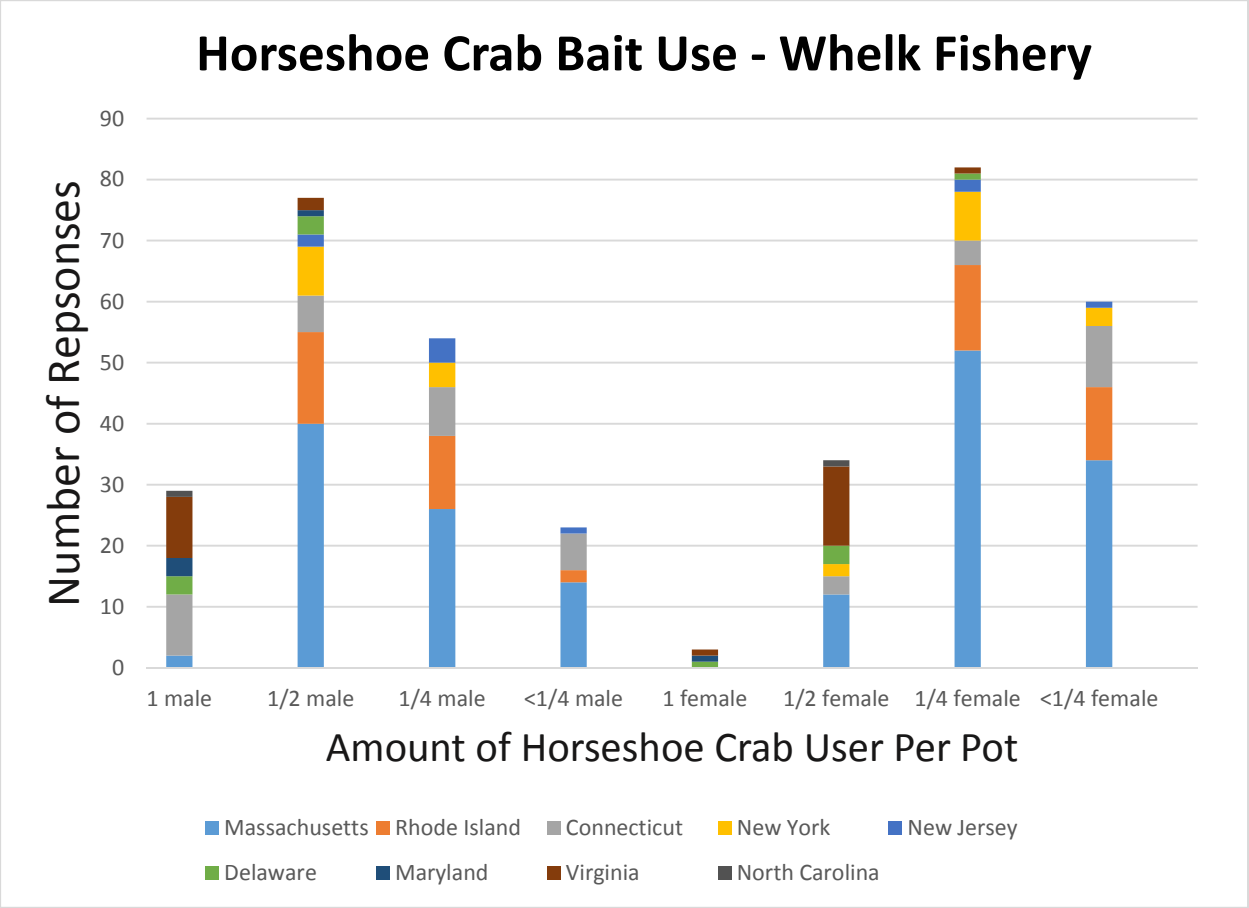


Table 13. Use of bait saving devices in the channeled whelk fishery, by state. Bait-saving devices are required in the whelk trap/pot fishery in Delaware, but not in other states. (Q14)

	All States	CT	MA	RI	NY	NJ	DE	MD	VA
Yes, HSC only	14	2	3	3	2	1	1	0	2
Yes, mix	144	20	75	24	10	5	3	2	5
No	10	1	6	0	1	0	0	1	1
NA	4	0	1	1	0	2	0	0	0

As seen with the eel fishery survey results, the most popular responses for amounts of horseshoe crab used as bait were for half of a male and a quarter female. Of the 362 responses (respondents could select more than one option), 23% were for one quarter female and 21% were for half of a male. The divide between male and female responses were almost exactly even with female responses at 49% and male responses at 51%. This may speak to the possibility of fishermen in the eel fishery favoring female crabs as a better, more successful bait, while whelk fishermen find males and females equally successful.

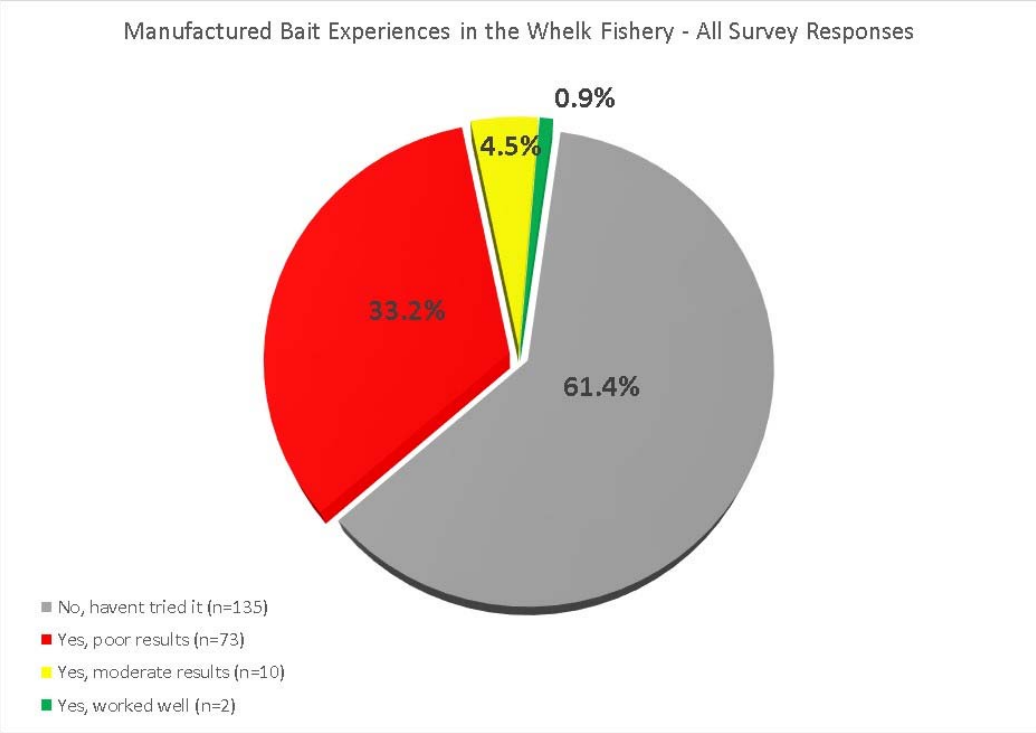
Figure 14. Typical amounts of horseshoe crab used per trap/pot, by state, in the channeled whelk fishery. (Q17)



Use and Impression of Manufactured Bait in the Channeled Whelk Fishery

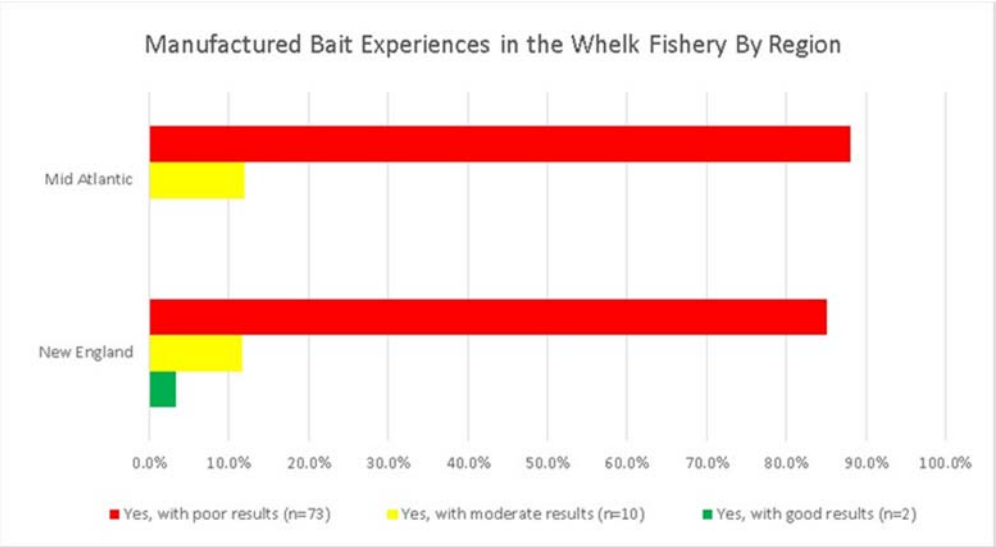
Considering all survey responses for the channeled whelk fishery (there were no responses for the channeled whelk fishery from Georgia or Florida), the majority (61.4%) of respondents indicated they had never used manufactured bait (Figure 15). A third of survey responders had used manufactured bait and observed poor results (33.2%). Just over 5% had also used manufactured bait and reported moderate to good results.

Figure 15. Experiences with manufactured bait in the channeled whelk fishery, shown as percentages (all respondents). (Q11)



Considering responses by region for those who had used manufactured bait in the past, the same pattern develops as seen coastwide (Figure 16). The majority of fishermen in both New England (Massachusetts to Connecticut) and the Mid Atlantic (New York to North Carolina) reported poor results with the product, with less than 5% in each region having had positive results (Figure 16).

Figure 16. Experiences with manufactured bait for fishermen who have used it in the channeled whelk fishery, shown as percentages of respondents, by region (all respondents). (Q11)



Bait Costs in the Channeled Whelk Fishery

Among channeled whelk fishermen using only non-HSC bait, 61.5% paid less than $1.00 to bait a trap/pot, and all paid $1.50 or less (Table 14). Among those respondents that used a combination of HSC and non-HSC bait, 54.7% paid $1.50 or less, and 71.8% paid $2.00 or less. Similarly, among those respondents that used exclusively HSC for bait, 50% paid $1.50 or less, and 85.7% paid $2.00 or less.

Table 14. Costs to bait channeled whelk traps/pots using baits that include only horseshoe crab (HSC Only), horseshoe crab and other bait (HSC Plus), and no horseshoe crab (Non-HSC). (Q12)

	Percent of respondents			
Cost to Bait Whelk Traps/Pots	**Non-HSC (n=13)**	**HSC Plus (n=117)**	**HSC Only (n=14)**	**All Bait Types (N=144)**
< $1.00	61.5	15.4	7.1	18.8
$1.00 - $1.50	38.5	39.3	42.9	39.6
$1.51 - $2.00	0.0	17.1	35.7	17.4
$2.00-$2.50	0.0	17.9	7.1	15.3
> $2.50	0.0	10.3	7.1	9.0

Conclusions

- **Roughly half of the respondents have fished for over 10 years, so they are experienced.**
- **Channeled whelk trap/pot fishermen generally use a bait medley including horseshoe crabs and other baits.**
- **The American eel fishery uses a mix of horseshoe crab and non-horseshoe crab bait, with zero responses stating they only use horseshoe crab.**
- **Overall, the channeled whelk fishery uses more horseshoe crabs for bait than the American eel fishery.**
  - Reported use of Horseshoe crab as bait is 91% in the whelk fishery vs 23% in the eel fishery.
  - The whelk fishery has higher averages of maximum traps/pots fished and traps/pots per trip: 212 and 147 vs 165 and 80 in the eel fishery (across all respondents regardless of whether they fished in 2016). Regional differences exist. MA – NY fish less traps/pots on average than NJ – VA in the whelk fishery. For the eel fishery MD had several fishers that reported extremely high traps/pots per trip and max traps.
  - The coastwide whelk fishery occurs in a more defined seasonal pattern, occurring from April through December, while the coastwide eel fishery occurs more continuously with definite peaks in March-June and September-November.
  - Most states, including those with the greatest whelk harvests (MA-CT), do not require the use of bait-saving devices in the trap/pot fishery. These devices are required in Delaware.
- **The American eel fishery uses more female crabs than male crabs.**

- **Both fisheries use larger proportions of male crabs than female crabs – this could be related to the fact that male crabs are smaller than female crabs.**
- **Bait saving devices, like bait bags, are more prevalent in the channeled whelk fishery than in the American eel fishery with 92% of respondents reporting some type of use versus 21%, respectively.**
- **Important Information for future manufactured baits:**
  - For both fisheries and all current bait practices, the bait typically lasts for 2 days.
  - Both fisheries had low percentages of participants who had tried manufactured baits, and most of the fishers who tried them reported poor results. Based on Technical Committee discussions of previous manufactured bait trials[1], poor results may not necessarily be solely indicative of poor performance, as fishers reported issues of cost and availability of manufactured bait.
  - Most fishers in both fisheries typically pay $1.50 or less per trap/pot, with cost per trap/pot being generally more expensive in the whelk fishery than the eel fishery.

[1] ASMFC Horseshoe Crab Alternative Bait Working Group Call Summary. March, 2016.

Appendix I

American Eel Bait Use Survey

Please answer the following questions by circling or writing in your response(s) as requested.

1. How many years have you fished for American eel using traps/pots?
    a. Have not yet, but plan to in 2017
    b. 1 month - 1 year
    c. 2 - 5 years
    d. 6 - 10 years
    e. 11 - 20 years
    f. Over 20 years

2. Did you fish for American eel in 2016 with traps/pots?
    a. Yes
    b. No, I last fished for American eel in _____. (Please answer the rest of the survey based on the last year you fished.)
    c. No, I have not fished for American eel. (Thank you for your time. Please discontinue and submit the survey.)

3. To identify region fished, in 2016 which area did the majority of your American eel catch come from (trap/pot only)?

4. What months do you fish American eel traps/pots? *(Circle all that apply)*

    a. January
    b. February
    c. March
    d. April
    e. May
    f. June
    g. July
    h. August
    i. September
    j. October
    k. November
    l. December

5. In 2016, did you fish your American eel traps/pots as singles or trawls/longlines?
    a. Only singles
    b. Mostly singles
    c. Both about equally
    d. Mostly trawls/longlines
    e. Only trawls/longlines

6. How long do you let your traps/pots soak?
    a. 1 night
    b. 2 nights

c. 3 nights
d. More than 3 nights

7. What was the maximum number of American eel traps/pots you fished in 2016? _____

8. How many traps/pots do you haul per trip, on average? _____

9. Which of the following do you primarily use as bait for your American eel traps/pots (select all that apply)?
    a. Horseshoe crab
    b. Shellfish
    c. Green crabs
    d. Fish racks/whole
    e. Manufactured alternative bait (artificial bait)
    f. Rock crabs
    g. Jonah crabs
    h. Blue crabs
    i. Other: _____

10. On average, how many of each type of bait do you use per trip? *(Please provide approximate quantity and circle bushel or tote where applicable)*
    a. _____Horseshoe crab: total # of crabs **(*if >0 please answer questions 15-17)**
    b. _____Shellfish: bushels or totes
    c. _____Green crabs: bushels or totes
    d. _____Fish (Species: _____): bushels or totes
    e. _____Manufactured alternative bait (artificial bait): premade pieces
    f. _____Rock crabs: bushels or totes
    g. _____Jonah crabs: bushels or totes
    h. _____Blue crabs: bushels or totes
    i. _____Other: _____
    j. _____Other: _____

11. Have you ever tried a manufactured alternative bait for American eel, and if so, was it effective?
    a. No, I have never tried it
    b. Yes, I tried it but it performed poorly
    c. Yes, I tried it with moderate success
    d. Yes, I tried it and it worked well

12. In 2016, what was your average cost to bait an American eel trap (per trap/pot)?
    a. Less than a dollar
    b. $1.00 - $1.50

c. $1.51 - $2.00
d. $2.00 - $2.50
e. More than $2.50

13. How long do your baits typically last?
    a. 1 night
    b. 2 nights
    c. 3 nights
    d. 4 nights
    e. More than 4 nights

14. Do you use bait-saving devices, such as cups or bags?
    a. Yes, with horseshoe crab only
    b. Yes, with horseshoe crab and other types of bait
    c. No

(*Please answer questions 15-17 if your response to 10a was greater than 0)

15. How much, on average, do you pay per crab for female horseshoe crabs?
    a. Price: $_____
    b. I harvest my own.

16. How much, on average, do you pay per crab for male horseshoe crabs?
    a. Price: $_____
    b. I harvest my own.

17. In a typical trap/pot, do you use *(circle all that apply)*:
    a. A whole female horseshoe crab
    b. Half of a female horseshoe crab
    c. ¼ of a female horseshoe crab
    d. Less than a ¼ of a female horseshoe crab
    e. A whole male horseshoe crab
    f. Half of a male horseshoe crab
    g. ¼ of a male horseshoe crab
    h. Less than a ¼ of a male horseshoe crab

Appendix II

Channeled whelk Bait Use Survey

Please answer the following questions by circling or writing in your response(s) as requested.

1. How many years have you fished for channeled whelk using traps/pots?
    a. Have not yet, but plan to in 2017
    b. 1 month - 1 year
    c. 2 - 5 years
    d. 6 - 10 years
    e. 11 - 20 years
    f. Over 20 years

2. Did you fish for channeled whelk in 2016 with traps/pots?
    a. Yes
    b. No, I last fished for channeled whelk in _____. (Please answer the rest of the survey based on the last year you fished.)
    c. No, I have not fished for channeled whelk. (Thank you for your time. Please discontinue and submit the survey.)

3. To identify region fished, in 2016 which area did the majority of your channeled whelk catch come from (trap/pot only)?

4. What months do you fish channeled whelk traps/pots? *(Circle all that apply)*
    a. January
    b. February
    c. March
    d. April
    e. May
    f. June
    g. July
    h. August
    i. September
    j. October
    k. November
    l. December

5. In 2016, did you fish your channeled whelk traps/pots as singles or trawls/longlines?
    a. Only singles
    b. Mostly singles
    c. Both about equally
    d. Mostly trawls/longlines
    e. Only trawls/longlines

6. How long do you let your traps/pots soak?
    e. 1 night
    f. 2 nights
    g. 3 nights
    h. More than 3 nights

7. What was the maximum number of channeled whelk traps/pots you fished in 2016? _____

8. How many traps/pots do you haul per trip, on average? _____

9. Which of the following do you primarily use as bait for your channeled whelk traps/pots (select all that apply)?
    a. Horseshoe crab
    b. Shellfish
    c. Green crabs
    d. Fish racks/whole
    e. Manufactured alternative bait (artificial bait)
    f. Rock crabs
    g. Jonah crabs
    h. Blue crabs
    i. Other: _____

10. On average, how many of each type of bait do you use per trip? *(Please provide approximate quantity and circle bushel or tote where applicable)*
    a. _____Horseshoe crab: total # of crabs **(*if >0 please answer questions 15-17)**
    b. _____Shellfish: bushels or totes
    c. _____Green crabs: bushels or totes
    d. _____Fish (Species: _____): bushels or totes
    e. _____Manufactured alternative bait (artificial bait): premade pieces
    f. _____Rock crabs: bushels or totes
    g. _____Jonah crabs: bushels or totes
    h. _____Blue crabs: bushels or totes
    i. _____Other: _____
    j. _____Other: _____

11. Have you ever tried a manufactured alternative bait for channeled whelk, and if so, was it effective?
    a. No, I have never tried it
    b. Yes, I tried it but it performed poorly
    c. Yes, I tried it with moderate success
    d. Yes, I tried it and it worked well

12. In 2016, what was your average cost to bait a channeled whelk trap (per trap/pot)?
    a. Less than a dollar
    b. $1.00 - $1.50
    c. $1.51 - $2.00
    d. $2.00 - $2.50

e. More than $2.50

13. How long do your baits typically last?
    a. 1 night
    b. 2 nights
    c. 3 nights
    d. 4 nights
    e. More than 4 nights

14. Do you use bait-saving devices, such as cups or bags?
    a. Yes, with horseshoe crab only
    b. Yes, with horseshoe crab and other types of bait
    c. No

(*Please answer questions 15-17 if your response to 10a was greater than 0)

15. How much, on average, do you pay per crab for female horseshoe crabs?
    a. Price: $_____
    b. I harvest my own.

16. How much, on average, do you pay per crab for male horseshoe crabs?
    a. Price: $_____
    b. I harvest my own.

17. In a typical trap/pot, do you use *(circle all that apply)*:
    a. A whole female horseshoe crab
    b. Half of a female horseshoe crab
    c. ¼ of a female horseshoe crab
    d. Less than a ¼ of a female horseshoe crab
    e. A whole male horseshoe crab
    f. Half of a male horseshoe crab
    g. ¼ of a male horseshoe crab
    h. Less than a ¼ of a male horseshoe crab

Appendix III

A Brief Synopsis of the Commercial Whelk Fishery in South Carolina

Prepared by Jeff Brunson, South Carolina Department of Natural Resources

February 2017

The whelk fishery in South Carolina is small relative to those fisheries in the mid-Atlantic states. The South Carolina Department of Natural Resources does issue a small number of whelk trawling permits occasionally, but those landings data are minimal and confidential. Commercial hand-harvest of whelk is allowed, and requires a commercial saltwater license. Whelk harvested in this manner are reported to wholesale dealers. By far, most of the reported commercial whelk landings come in the form of crab trip ticket reports from commercial blue crab fishermen, and it has been speculated that such harvest is simply bycatch. Since 2004, mean annual whelk harvest reported on crab trip tickets was 6962 shell on pounds, and ranged from 1370 to 22,104 pounds.

In order to validate the assumption that reported whelk landings by commercial crabbers were as bycatch, the nine commercial crabbers with the highest reported whelk landings were identified. Phone interviews were then attempted to determine if whelk were targeted by commercial crab fishermen, and if so, what type of bait was used. Below are the general conclusions from conversations with seven of those nine identified crab fishermen:

1) Harvest of whelk by blue crab fishermen was characterized as "bycatch."
2) Whelk landings are dominated by channeled whelk (*Busycotypus canaliculatus*), with harvest primarily occurring "off the beach."
3) In some cases, whelk were actually avoided, because they compete with crabs for bait.
4) In other cases, "targeting" of whelk meant that crabbers may set extra commercial crab pots in an area where whelk are being caught in larger numbers. However, this practice occurs while the fishermen adhere to their normal blue crab harvest practices.
5) Crab traps are primarily baited with menhaden, even when the expectation is to increase the catch of whelk. Little, if any, effort is made to use an alternative bait to target whelk.
6) Interestingly, one respondent suggested that when in the process of trawling for shrimp, he had encountered a number of open top traps, similar to those used for whelk harvest, in the waters off the northern coast of the state. However, that report could not be substantiated

It should be noted that the harvest of horseshoe crabs for bait, or the use of horseshoe crabs as bait in any fishery in South Carolina, is prohibited, pursuant to Code of Laws of South Carolina, Title 50, Chapter 5, Article and Section 1330. The only allowable harvest of horseshoe crabs in South Carolina is for biomedical bleeding, or for research and scientific purposes, and is limited to harvest by hand.