SONAR SURVEY

OF

CRAB AND WHELK POT GEAR

IN THE

LOWER CHESAPEAKE BAY
VIRGINIA

MAY – JUNE 2006

AMERICAN UNDERWATER SEARCH AND SURVEY, Ltd
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Introduction

Between 16 May through 6 June 2005, American Underwater Search and Survey, Ltd. of Cataumet, MA provided and operated high frequency side scan sonar (900 KHz) to survey crab and whelk pots found in the lower Chesapeake Bay area.

The goal of the study, as provided in the Statement of Work, was to systematically detect, record, and aid any sea turtles that are encountered in the commercial pot fisheries.

Methods and Equipment

The Chesapeake Bay area and just seaward of it, was divided into six sub areas for ease of surveying. Figure 1, as provided from the NEFSC, shows the Lower Chesapeake Bay and the six sectors designated as survey areas.

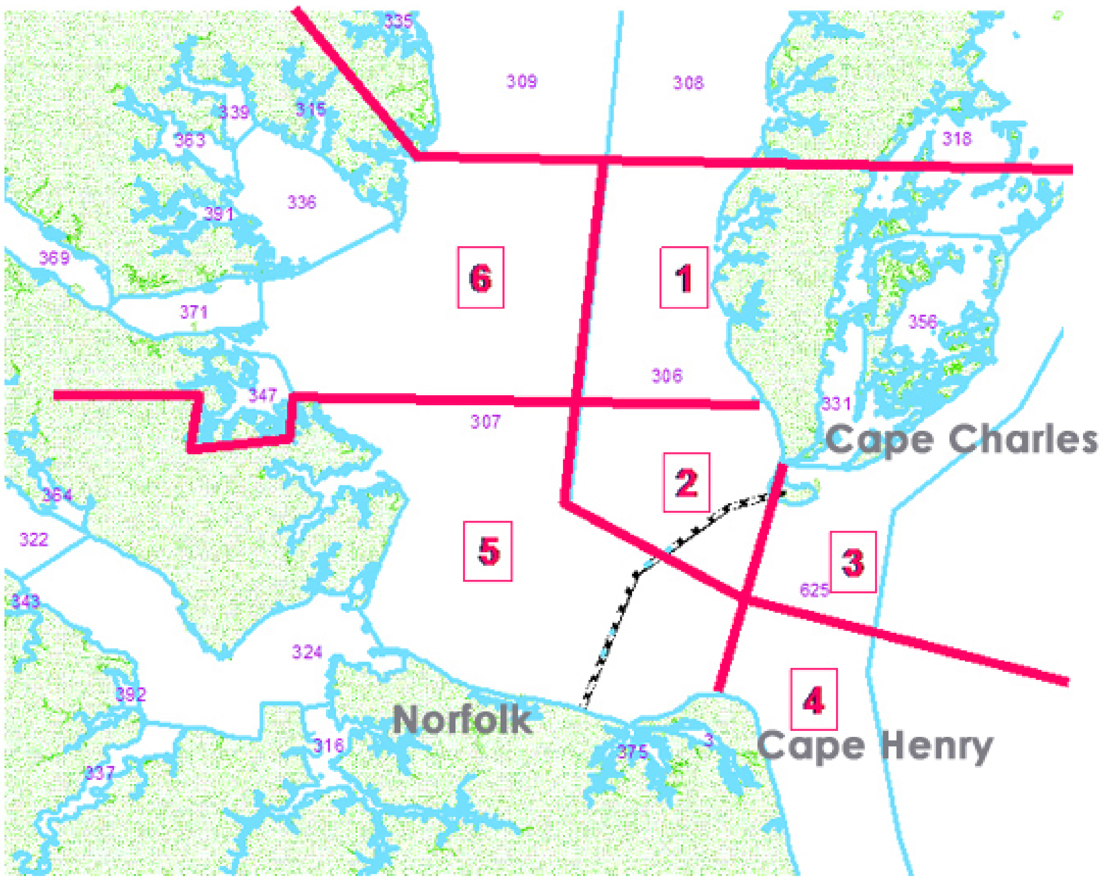


Figure 1. Lower Chesapeake Bay and six designated survey sectors.

A charted 24-foot Wellcraft powerboat provided a respectable amount of protection and stability for this area of the Chesapeake Bay. The survey area is exposed to winds especially between SE to NW along the west sector. The craft had a crew of two, a captain and an observer (see the companion report submitted by the contractor for further information). Both the captain and the observer had previous experience in Chesapeake Bay and with recent surveys to observe and assist sea turtles in regard to encounters with static fishing gear.

The operator of the sonar has over 20 years experience with sonar and was the prime sonar engineer on the sonar surveys focusing on sea turtles and the Chesapeake Bay pound nets.

The sonar system was a Marine Sonic Desktop Sea Scan single frequency 900kHz system consisting of a computer, tow cable and tow fish. The software used was the Sea Scan PC Software furnished with the system. The system and specifications can be seen on a website, www.marinesonic.com.

The Marine Sonic sonar was integrated with a Garmin GPS/WAAS to record coordinates and provide for speed corrected recording of data. Data were recorded to the Marine Sonic PC and later transferred to compact discs. All data was formatted to the program designed by Marine Sonic. Electric power was provided via a pure sine wave inverter coupled to a marine 12-volt battery. This system furnishes clean power and no noticeable interference to the sonar record. Two batteries were normally available. This provided power for up to seven hours.

The tow fish was deployed from the stern of the vessel and the length of cable holding the tow fish was adjusted according to the depth of the water surveyed. The amount of cable used was based on keeping the tow fish at an altitude of 25% of the water depth. When the water depth was forty feet or more, a ten pound weight was attached about four meters forward of the tow fish. This added weight provided further means to deploy the tow fish at optimum altitudes off the seabed.

The sonar range was usually set at 20 m. The data were displayed on one sonar channel, usually the port side, to enhance live time detection of targets. On two occasions, a sonar range of 30 meters was used because of deep water, 20 plus meters, and tidal current, over two knots. A few times a delay was activated in the sonar. The delay is a feature that eliminates the first part of the record and extends the recorded range (e.g. the first five meters of the record is eliminated and the normal 20 m range extended to 25 m). This improved survey operations as it allowed a stable survey course where a high density of scattered pots existed.

Pot gear were often lying in a “string” of 20-25 pots, each individually-buoyed. Infrequently a string consisted of more pots; once more than 50 pots. Each set of pots was insonified three times; each termed a “run”. The runs were done on alternating sides of the string. The exception to the alternating runs would only be made if the sea state resulted in an unstable tow fish and running with a following sea provided for adequate resolution and detection.

If a target of interest was observed on the sonar, the location was marked as a “watch”. Most of these targets were eliminated when they were not seen on previous or subsequent runs. If a target was still a question, the pot gear in question would be inspected, or sometimes additional sonar runs would be made to either further classify the target to be in need of inspection or not.

The ability of the sonar operation to correctly identify turtles in pot gear was tested on May 17th. Twenty blind trials were run by attaching a turtle carcass to pot gear in 20 to 35 feet of water. A Kemp’s Ridley carcass (~ 40 cm SCL) was obtained from the Virginia Aquarium. This carcass was much smaller in size than the loggerhead and leatherback turtles that have been entangled in pot gear. Some of the trials were run with no turtle on the pot line, some were run with the Kemp’s Ridley carcass, and a single trial was run with the Kemp’s Ridley and a plastic model of a small green turtle. The carcass was attached at one of four locations: near the pot, one-third-water depth, two-thirds water depth, or near surface. A trial consisted of three sonar runs, after which the operator made a determination whether or not to recommend that target be further investigated (by diving or by hauling the pot gear).

Results and Discussion

This section is divided into two subsections; first the sea trials that examine the ability of the operation to detect the entangled turtle on the pot gear; and second, the survey of existing pot gear in the lower part of Chesapeake Bay.

Side Scan Sonar Sea Trials

Table 1 is a summary of the three runs made on a pot to evaluate the confidence of detection of a turtle on pot gear. The second column denotes whether a turtle carcass was attached to buoy line. The three columns marked “run” identify what the sonar engineer stated whether a target of substance was on the gear. The “final” column was the final determination whether the gear should be examined for an entangled turtle.   The last column notes whether the sonar detection agreed (0) with the true presence of a turtle or not(1).

The sonar operator never missed a turtle when it existed, but he did recommend investigating two targets that were not turtles. In one case where a target was identified but a turtle carcass was not on the pot line, the person pulling the pot gear noted that it got snagged on something on the bottom. It is possible the sonar operator was detecting the same thing that had snagged the gear.

Table 1. Side Scan Sonar Sea Trials.

Trial	Turtle ?	Run 1	Run 2	Run 3	Final	Difference
1	Yes	Yes	Yes	Yes	Yes	0
2	Yes	Yes	Yes	Maybe	Yes	0
3	Yes	Yes	Yes	Yes	Yes	0
4	Yes	Yes	Yes	Yes	Yes	0
5	No	Maybe	No	maybe	No	0
6	No	Yes	Yes	Maybe	Yes	1
7	Yes	Yes	Yes	Yes	Yes	0
8	Yes	Maybe	Yes	Yes	Yes	0
9	No	No	No	Maybe	No	0
10	Yes	Yes	Yes	Yes	Yes	0
11	No	Yes	Maybe	Yes	Yes	0
12	Yes	Yes	Maybe	No	Yes	0
13	No	Yes	Yes	Yes	Yes	1*
14	No	No	No	No	No	0
15	No	No	No	No	No	0
16	Yes	Yes	Maybe	Yes	Yes	0
17	Yes	Yes	Yes	Yes	Yes	0
18	No	Maybe	No	No	No	0
19	Yes	Yes	Maybe	Yes	Yes	0
20	No	Maybe	No	No	No	0

* When hauling, the buoy line was caught, then it released.
Trials 1-10 at 20-25 feet water depth.
Trials 11-20 at about 35 feet water depth.

Two sonagrams, Figures 2 and 3, show the typical crab pot and buoy gear of Chesapeake Bay and what a turtle carcass looked like using the Marine Sonic 900 kHz sonar system. Figure 2 is enlarged and shows, the buoy, most of the buoy line, the pot and the frozen Kemps Ridley turtle carcass that was affixed to the buoy line. The survey boat's wake can interfere with the detection of the sonar, if the wake remains from a previous run. The interference here is moderate (and will be the subject of further discussion).

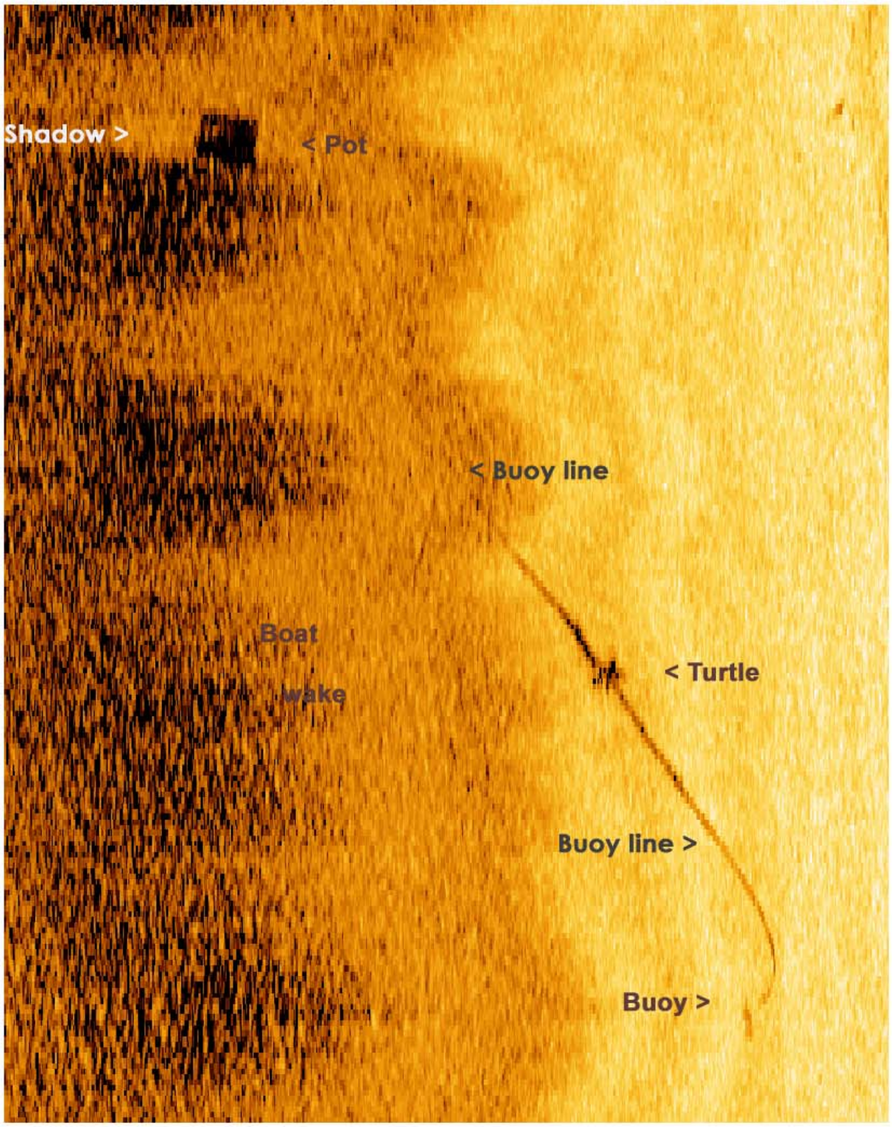


Figure 2. Sonogram acquired during initial trials. Note the buoy, buoy line, and pot. A turtle was attached to the buoy line. A faint rectangular shadow can be seen left of the pot. The dark, undulating mass to the left is the boat wake left by a earlier run.

Figure 3 represents each of the three runs made on pot gear. Figure 3A shows the whole pot gear, from the buoy to the pot. The buoy line is not fully insonified. A white shadow is seen on one side of the pot in Figures 3 A, B, and C. This shadow is distinct from the pot and suggests a target of interest; it was the turtle. If this were part of the regular survey, the target would need to be identified. In Figures 3 B and C, the buoy line near the pot is clearly seen.

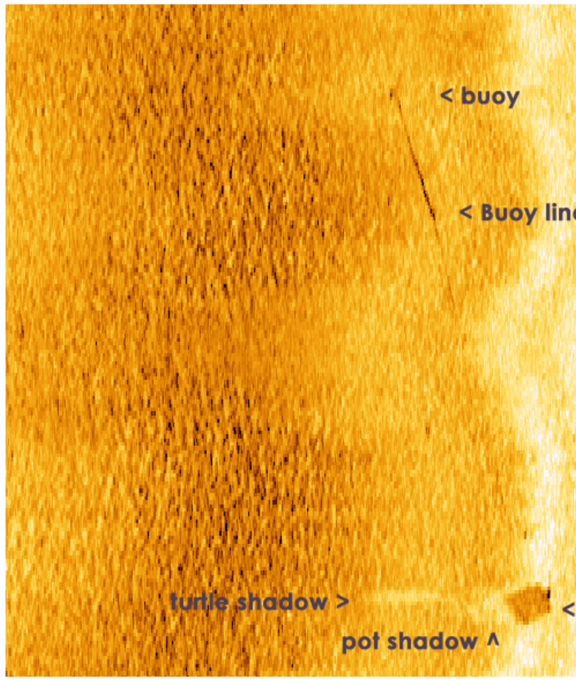
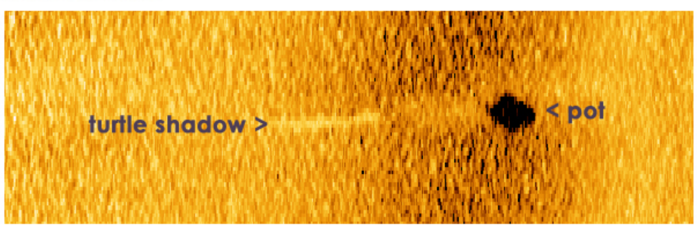


Figure 3. Turtle detection trial: three runs and resultant sonograms of the target. The turtle is afixed just above the pot. The shadow is the prime determinent that there is something more than the pot at that depth. The distance of the shadow from the pot area suggests the turtle is suspended off the sea bed.



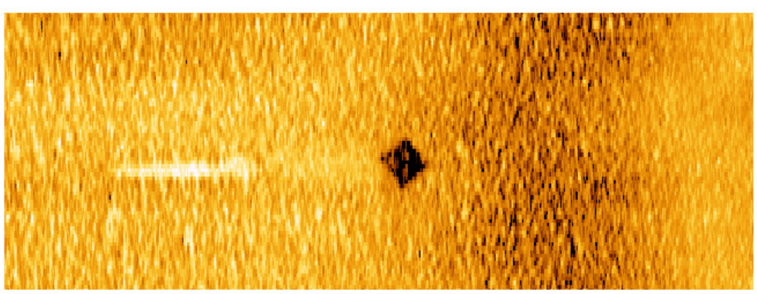


Figure 4 shows the frozen turtle affixed to the buoy line. As in all of the sea trials the survey was done in a blind mode, meaning the operator was unaware whether the turtle was placed on the gear and, if placed, where in the water column the turtle was affixed to the line. The boat wake at the top of the sonogram can interfere with the detection. It did not in this case. Normally, the procedure would be to delay the next run to allow any current to sweep the wake downstream. A second target was detected on the line, and is labeled; this target was a knot in the buoy line. During the Bay survey, knots and coiled line were seen; sometimes the gear was inspected to insure no turtle was entangled.

Figure 5 shows a very reflective target near the pot. The target has two hard reflections and a detached shadow. The shadow indicates that the target, in this case the turtle, is suspended in the water column. Although the buoy line is not totally seen, the general path of the line is suggested by the line reflection nearer the surface.

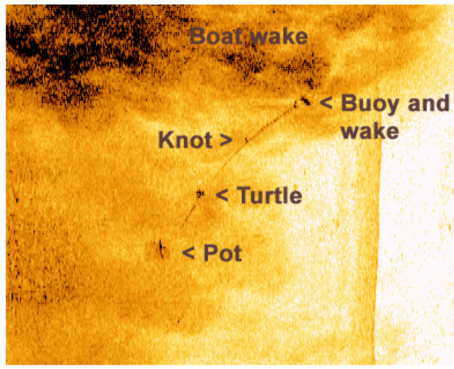


Figure 4. Sea trial sonogram. The wake, consisting of air and heated water from a previous run, can negatively impact detection.

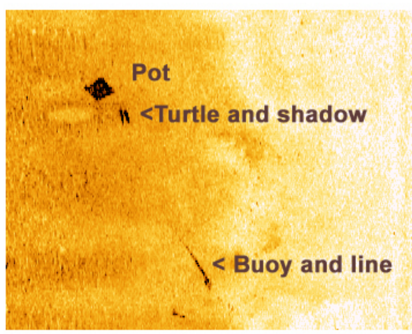


Figure 5. Sea trial sonogram. The turtle was attached to the buoy line near the pot. The detached shadow (to the left of the of hard target reflector of the turtle) suggests the turtle is off the seabed.

Pot Gear Survey

During the 18 May to 6 June 2006 survey period, 1584 pots were insonified. Ninety-nine percent of the pots were crab pots. The total number of pots surveyed does not include the sonar detection sea trials that were completed on 17 June. The daily sonar activity summary is in the Appendix.

The distribution of the surveys were as follows:

Sector	Partial or Full Day Surveys
1	9
2	5
3	1
4	1
5	5
6	4

Sectors 3 and 4 were located well seaward of the Chesapeake Bridge Bay Tunnel and east of the southernmost tip of Cape Charles and northeasternmost tip of Cape Henry.
No gear was seen in the Sector 3 (the north seaward sector) and only two whelk pots were seen in Sector 4, seaward of Cape Henry and south toward North Carolina.

No turtles were observed entangled with pot gear during the sonar survey (except the turtle carcass initially placed in the gear during the sonar detection sea trials).

Of the 1582 pots insonified, nine pots were inspected because of targets that needed to be identified or eliminated. Except in one, the targets were identified and eliminated. One target was not identified and was not seen on the buoy line.

The commercial pot gear consisted of a weighted pot, usually square but vertically compressed, a line from the pot to the surface buoy, and the buoy. The length of the line observed was not consistent to the depth (e.g. 3:1 scope), but usually consistent to a string of pots that had the same buoy color markings. Some of the gear had an additional float placed nearer the pot than the buoy; this is called a “donut buoy”.

Donut buoys were seen on sonar (Figures 6 - 9). The donut buoy serves to give the line added buoyancy as it immediately comes off the pot. Figures 6 and 7 are examples of insonified pots that have donut floats. No other targets were seen immediately associated with this pot gear.

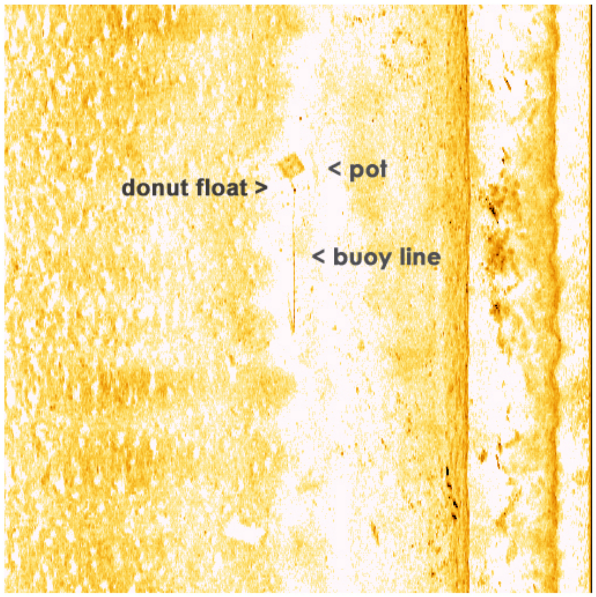


Figure 6. Sonogram of pot gear with a donut float.

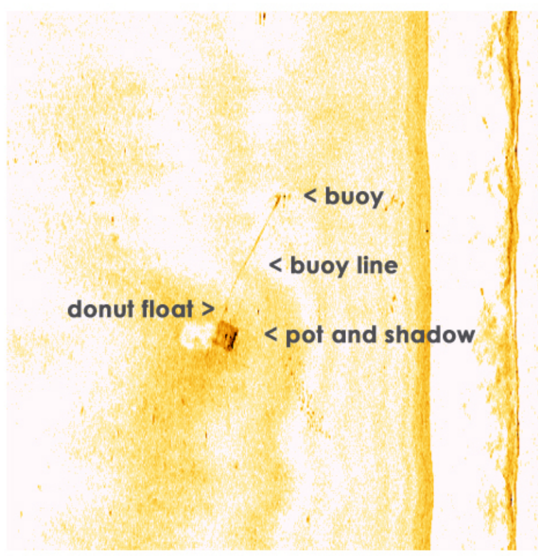


Figure 7. Sonogram of pot gear and donut float that is subtle in its reflection.

Figure 8 shows a pot with the donut float both in the normal survey mode (top image) and in an enlarged image (bottom image). The enlarged image shows the added buoyancy of the donut float to the immediate line near the float: the line aspect changes.

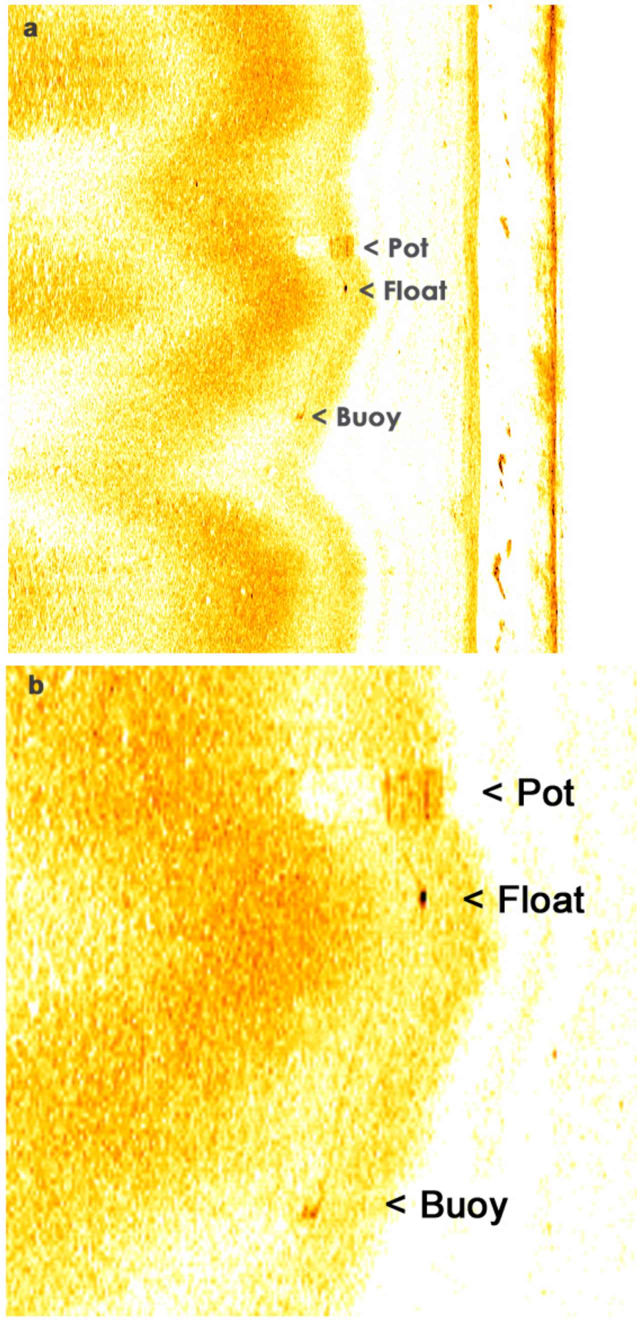


Figure 8. The top (a) is the normal sonogram. The bottom (b) is enlarged for more detail.

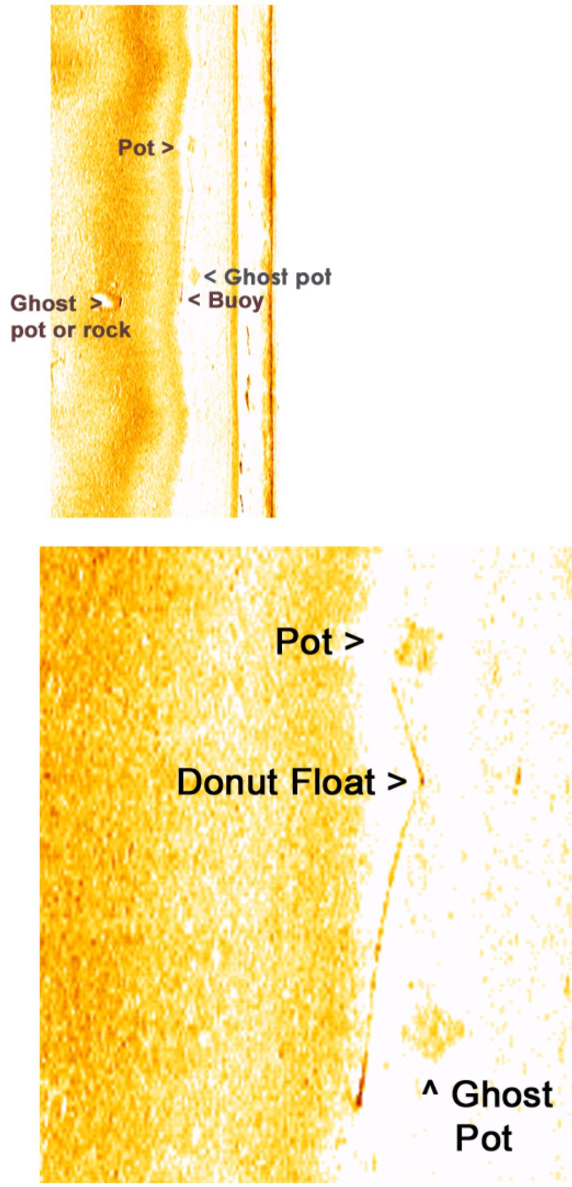


Figure 9. The top is a sonogram of one run. The bottom is an enlargement of the immediate area of the pot gear.

Figure 9 is similar to Figure 8 in that it shows a normal survey image (top) and an enlarged image (bottom). The donut float and its influence on the line are evident. Two lost pots are in the original sonogram. The enlarged image only has one lost pot. No line or buoys were seen on the sonar nor via topside observation in the vicinity connected to these lost pots.

The scope of the buoy lines varied. Some were short scope and therefore had their buoy lines ascending rapidly (Figures 10 and 11). The scope of the line in Figure 10 is about 3:1 (i.e. 30 feet of line in 10 feet of water). In these two figures the sonar shows a thin white shadow, that is caused by the buoy line. In Figure 10, the line shadow near the pot is at a changing angle of aspect. As the line becomes more distant from the pot the angle of the shadow becomes more perpendicular to each other, hence indicating that the line is ascending more vertically. In Figure 11, the angle of incident between the line and the shadow is constant at 45 degrees. The scope of the line in Figure 11 is much shorter: about 2:1. Two other differences between these two pot gears are 1) that the pot line in Figure 10 has no donut float, whilst the pot in Figure 11 has a donut float; and 2) in Figure 10, the line near the buoy has a knot.

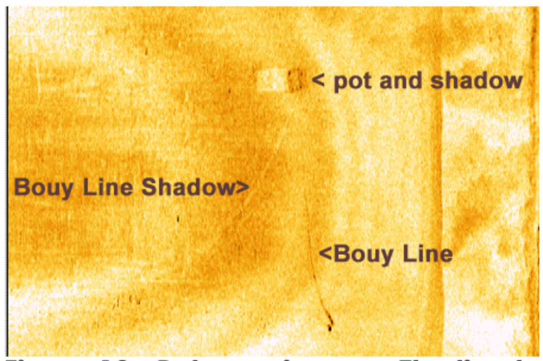
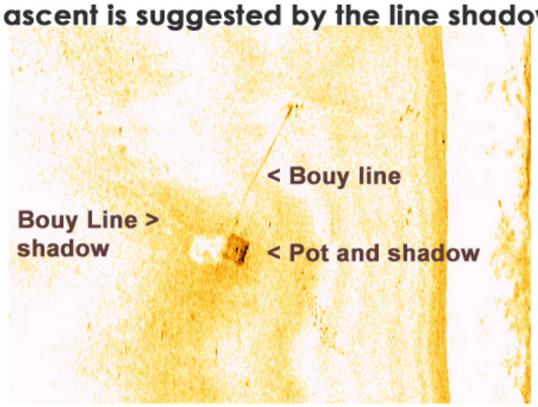


Figure 10. Pot gear image. The line has moderate length. The shadow of the line is apparent. A small knot is near the buoy end of the line.

Figure 11. Pot gear with the buoy line of shorter scope. The sharper angle of ascent is suggested by the line shadow.



Figures 12 and 13 show additional examples of difference in the length of the buoy line. The depth in Figure 13 is about 10% deeper than the depth in Figure 12, but the length of the line is about twice as long. The line shadow can also be seen in Figure 13. The gear has no donut float so the start of the ascent of the line from the pot has a shallower slope upward. The buoy quickly compensates for this and provides more lift.

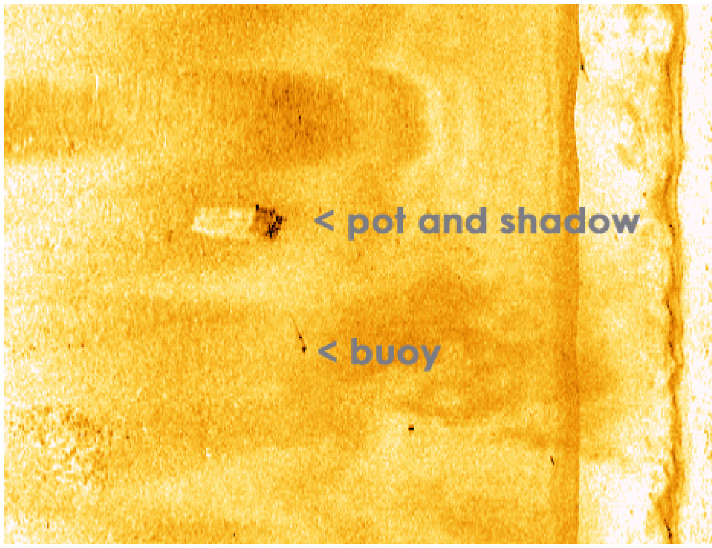


Figure 12. Pot gear with short scope of the buoy line.

Figure 13. Pot gear with moderate scope of the buoy line. Note the white shadow of the buoy line.

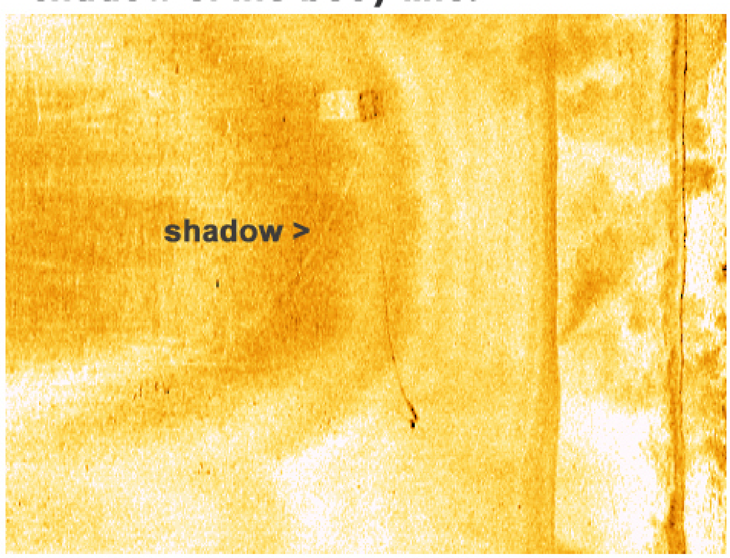


Figure 14 and 15 are sonograms of pot gear in which the buoy line is not clearly seen throughout its transit. The path of the line can be predicted given that much of the line is evident. These figures are enlargements of the normal record. No targets of interest, possible turtles, are in the probable path. Couple that fact with three sonar runs of the gear, strongly suggests that no target of interest is near the gear.

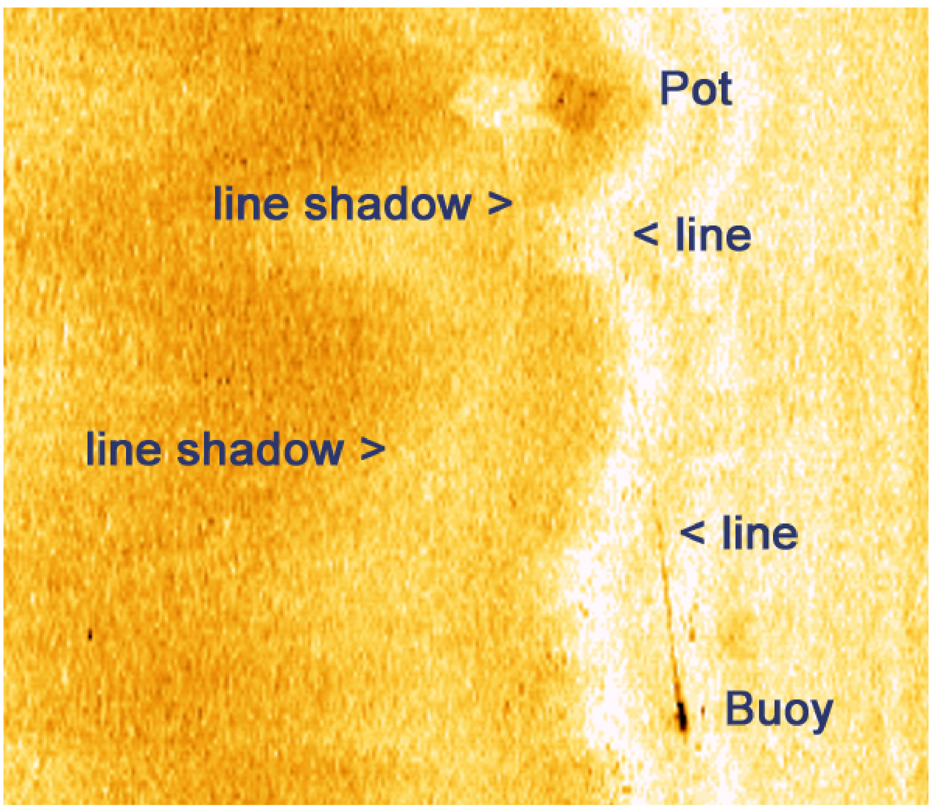


Figure 14. Pot gear sonogram. The line is not seen throughout its length. The line shadow is evident. See text for further comments.

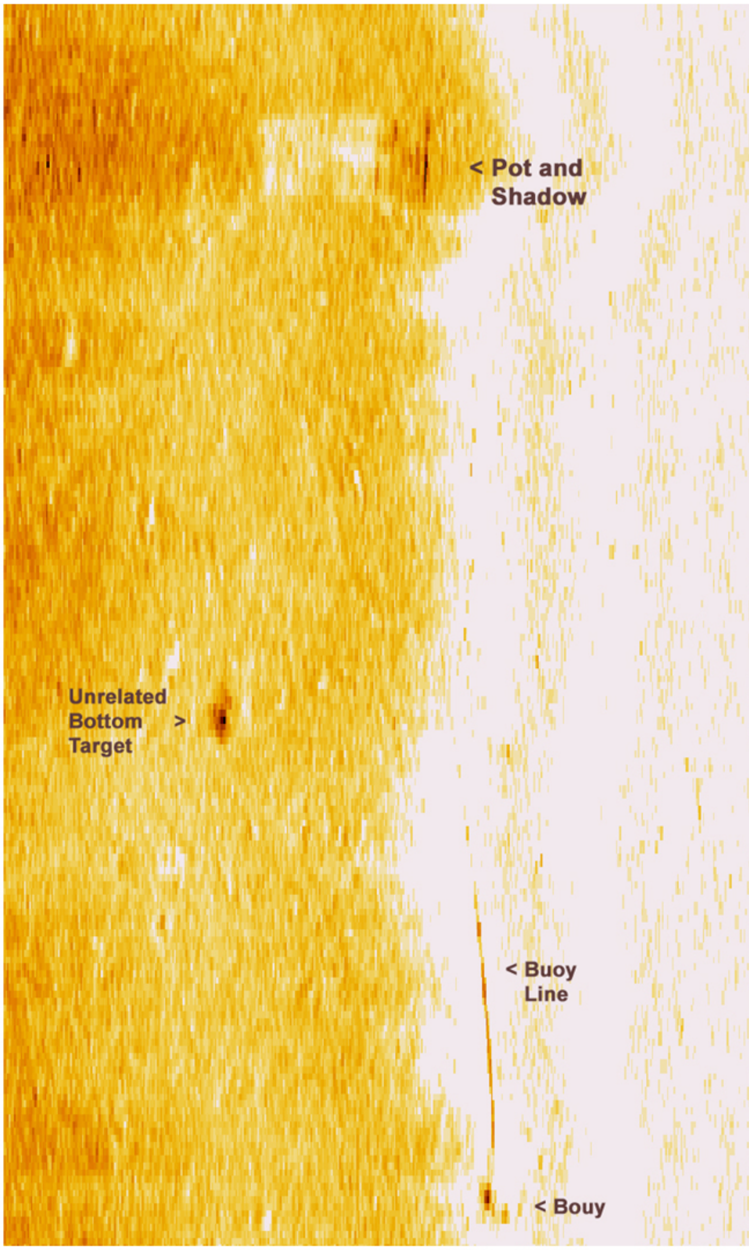


Figure 15. Pot gear sonogram with a limited reflective return from the buoy line. No targets of interest are in the line path and probable line path.

Figure 16 is a complex sonogram that is enlarged. Most of the buoy line can be easily seen. The sea state is choppy but not sufficient to significantly degrade the detection. Note the sea clutter in the sonagram. Also note the school of small fish near the buoy. A “target of interest” is labeled; this target was only observed once. The target is suspected to either be sea clutter (compare it to other sea clutter in the sonogram) or a single large fish, such as a drum[1]. If a fish, it moved from the insonified area of subsequent runs. In further support of this activity, on other survey days when areas were repeatedly run, the sonar runs provided images of moving larger fish and schools of smaller fish.

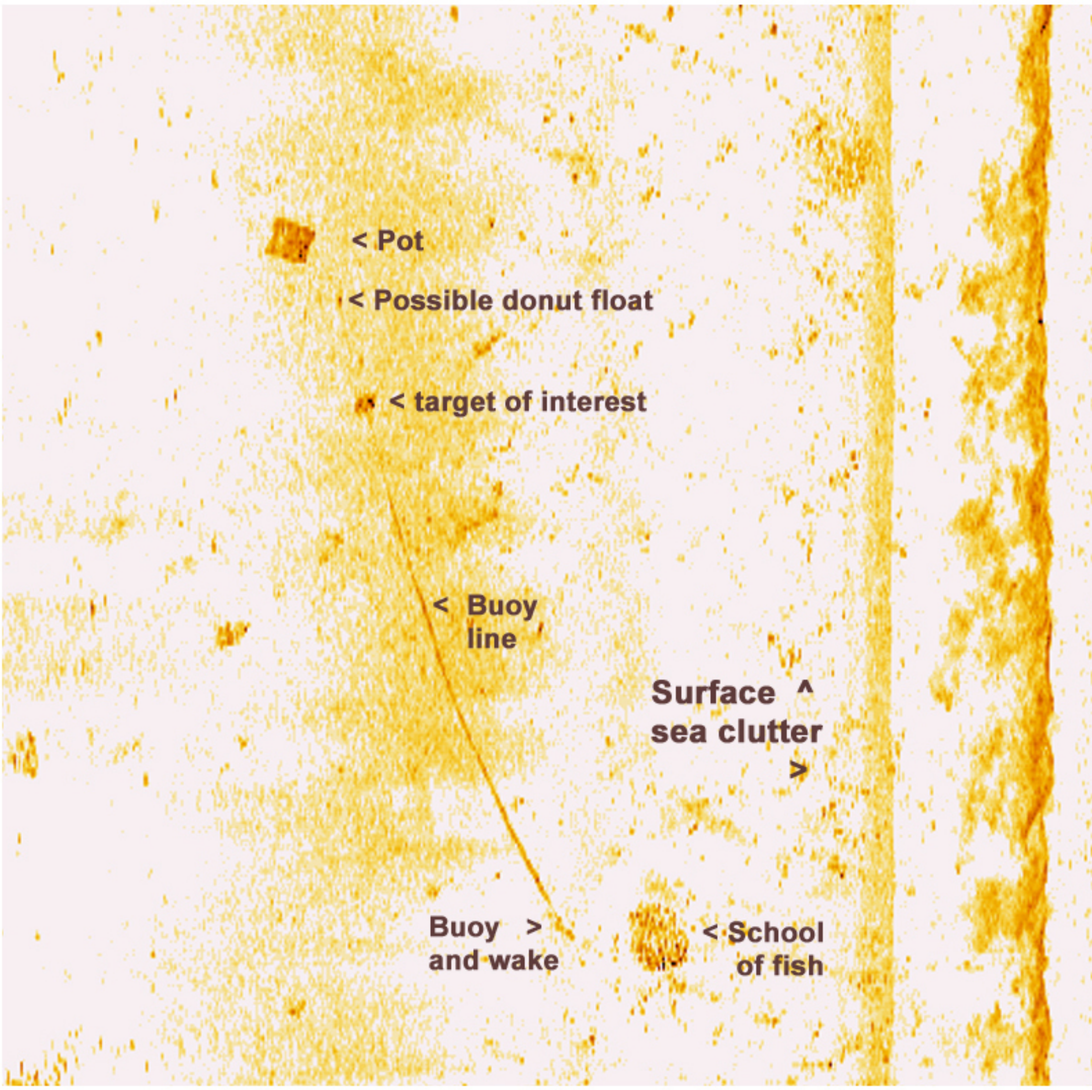


Figure 16. Pot gear insonified in shallow water with a sea condition at Beaufort Scale 2. A target is in the path of the buoy line. It was seen only in one of the three runs.

1. In sonar surveys of pound nets made in the lower Chesapeake Bay during 2004-05, large fish were seen by sonar in a particular location on one run and then seen in other locations on subsequent sonar runs. These sonar targets were the same in signature as ones seen caught in the leader of the pound net and identified by diving examination.

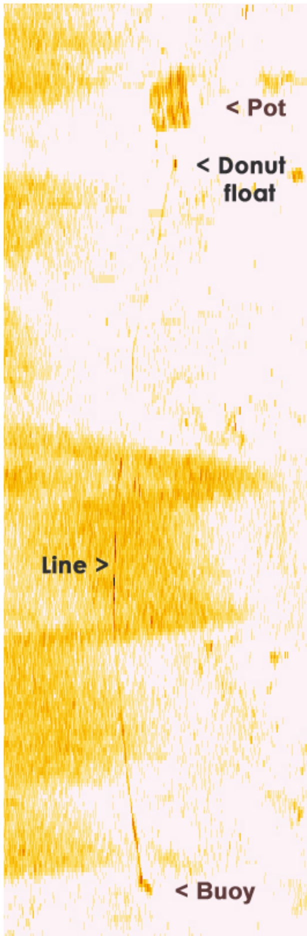
Four days of the survey period between 17 May and 6 June were deemed too rough to survey; this meant a Beaufort Scale of 3 or more. On two other days, 19-20 May, sea states equaled the Beaufort Scale of 3. On these days visual surveys were undertaken and sonar surveys were not. Although this limited the full intent of the survey, the benefit was that pot gear locations were identified, therefore making the following days somewhat more efficient.

Detection of the buoy line acoustically was at times challenging. A number of factors contributed to successful detection and confidence in eliminating possible targets entangled in the line. Detection required relatively calm days where the sea state would not make the survey boat unstable, and hence the fish unstable.

As mentioned in the "Methods" section, the three runs were made on alternate sides of the pots. The exception to this only occurred three times when the sea state built to a point where the survey was still possible but tow fish stability required that the survey be undertaken with the boat towing in a following sea.

Two other factors influencing sonar detection of turtles in pot gear were increasing depth and excessive current. Most of the survey was completed between depths of 12 to 20 feet. Depths of 40-50 feet were encountered near the main shipping channel. This sometimes required us to increase range and utilize a delay in the record. Depths of about 60 feet were experienced off Cape Henry. A formidable current was also experienced off Cape Henry. Detection probability decreased to an estimate 60 %. Several runs were made beyond the usual three to account for this problem.

The survey by sonar of pot gear with long buoy lines may be seen in Figures 17 and 18. In Figure 17, the buoy line is not clearly apparent throughout its length. The expected path of the line is easily noted though. The only target seen in this figure is a donut float. In Figure 18, the line does not produce a full linear reflection. The gear was insonified in current and the current effects can be seen where the surface buoy disturbs the moving water so much that it leaves a wake. No targets of interest were seen in the vicinity of the buoy line.



< Figure 17. Pot gear with a donut float. Some of the line is not fully apparent, but the line path can be descerned and no larger targets are in that path. Note this is one of three runs and the other runs did not show any targets of concern.

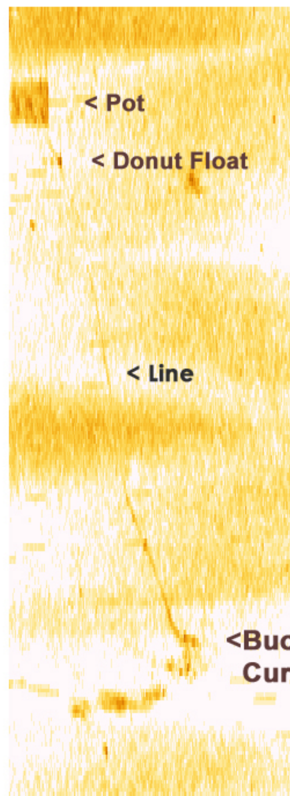


Figure 18. Pot gear with > a donut float near the pot. The small donut float is less than five inches in diameter. A larger target, such as a turtle, should be quite a pronounced target.

Conclusion

Although no live turtles were detected during the sonar surveys, blind tests on the ability and application of sonar to detect a turtle carcass undertaken on the first day of the survey had a 100% success rate of detection.

Detection is a function of sea state, current and depth. In relatively calm seas, that means in a sea state Beaufort Scale 3, the platform and system used, functioned with a high rate of probable detection. Most common was that the target, if one of interest would be seen on multiple runs. The technique of the survey requiring three successive runs is highly important. The alternating of the run direction was also a positive contributor to detection.

Increased current velocity coupled with a wind on our beam or on our bow, and increased wind in juxtaposition to a strong current reduces detectability. Current and wind opposing each other can quickly produce a sea state that is too rough for operation with a light shallow draft vessel. An option in these conditions, which were few, would be to use a vessel with a displacement hull. Such a vessel provides a more stable surface platform in more inclement weather conditions. The negative aspects to the displacement vessel are that it is slower and deeper draft. These factors severely limit surveying large areas and access to shallower waters. In this survey the surface platform used was proper.

One pot gear characteristic that impacts sonar surveys is excess length of the pot line. The long scope of the line in itself can be problematic and this escalates when any wind occurs and the wind counters the current directly or obliquely. This situation occurred during some runs and did present a problem viewing the strings of buoys, with insonifying the gear and with possible buoy line entanglement with the tow.

The sonar operator believes the experienced personnel, protocol, surface platform and sonar system used in this survey provided a high quality means to detect sea turtles within the area surveyed and insonified.

Appendix

This section is in a spreadsheet form and tabulates the daily activities. Data includes: date, survey location, number of pots surveyed, data file number, and results. The results regarding targets are in two categories, probable and watch. No probable targets were noted. Many “watches” were noted and these were tabulated by pot and the number of watches seen per pot. With three runs, the highest number of watches was three. The exception to this rule occurred if further runs were made to better determine if the pot gear should be inspected. This usually occurred if there was a target seen as a watch several times but the quality of the target was low in priority.

CHESAPEAKE BAY SEA TURTLE - POT FISHERIES INTERACTION SURVEY IN 2006: **Sonar Survey**

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Date	Area	Survey	Depth in feet	Begin Lat	Begin Long	End Lat	End Long	Number Pots Surveyed	End File	Results Probable	Watch	Resolution
17-May	1											Sea Trails: 20 trails completed
18-May	2	1		37 07.298	75 58.901	37 08.260	75 58.785	21	80	0	1-1X	NA
	2	2		37 07.292	75 58.678	37 07.698	75 58.711	12	153	0	0	effectiveness: 30% sea state
	2	3		37 09.774	75 59.329	37 10.065	75 59.449	10	210	0	0	Kiptopeke Hbr
	2	4		37 10.076	75 59.493	37 10.307	75 50.511	8	265	0	0	
	2	5		37 10.093	75 59.473	37 09.814	75 59.298	15	347	0	0	
	1	6		37 10.489	76 00.020	37 10.456	75 59.991	1		0	0	Old Plantation Flats
	1	7		37 14.235	76 01.937	37 14.629	76 02.031	10	422	0	0	
	1	8		37 14.618	76 02.014	37 14.855	76 02.002	7	449	0	0	
	1	9		37 14.634	76 01.929	37 14.976	76 01.892	10	500	0	1-1X	NA
19-May	1											visual survey only;sea state rough
20-May												visual survey only;sea state rough
21-May	5	1		36 55.381	76 03.428	36 55.194	76 03.800	13	59	0	1-1X	off Lynnhaven; NA
		2	16	36 55.203	76 03.871	36 55.078	76 04.262	15	107	0	2-1X	NA
										0	1-2X	two buoys
										0	1-3X	inspected; nothing
		3	17-20	36 55.108	76 04.335	36 55.071	76 05.019	19	184	0	2-1X	inspected one; nothing
		4	15-16	36 55.007	76 05.613	36 55.100	76 06.293	15	253	0	1-1X	NA
		5		37 02.232	76 17.197	37 02.931	76 16.809	18	340	0	0	
		6		37 03.005	76 16.763	37 03.521	76 16.563	15	408	0	0	
		7		37 04.951	76 15.172	37 04.887	76 15.153	4	431	0	1-1X	NA
		8	<9	37 05.935	76 15.231	37 06.012	76 15.396	7	451	0	0	tough: bottom hard, >sea state, current
22-May												sea state too rough!
23-May	1	1	40	37 21.409	76 04.065	37 21.840	76 03.986	12	43	0	1-1X	effectiveness: 60%
		2		37 21.881	76 04.057	37 21.871	76 04.047	3	101	0	0	
		3		37 21.914	76 03.826	37 21.525	71 03.867	8	136	0	1-1X	NA
24-May	6	1	13-15	37 17.495	76 16.190	37 17.596	76 17.075	22	88	0	1-1X	NA
		2	24	37 17.488	76 17.187	37 17.577	76 17.338	4	115	0	0	confused sea, 1', some instability
		3		37 17.662	76 17.391	37 18.285	76 17.963	22	222	0	2-1X	NA
		4	8.0-13	37 19.042	76 18.724	37 19.223	76 19.220	14	283	0	0	
		5	12	37 19.895	76 20.114	37 20.227	76 20.270	6	329	0	1-1X	NA
		6	19	37 19.128	76 22.330	37 18.506	76 21.981	18	416	0	2-1X	NA
		7	14-16	37 18.749	76 21.570	37 17.994	76 21.344	25	520	0	1-1X	haul, donut float
		8	18	37 17.619	76 20.204	37 16.745	76 19.201	29	670	0	1-1X	donut float
		9	33-34	37 18.697	76 13.663	37 19.446	76 13.368	20	770	0	1-1X	NA
							Pot sum:	383				

End file: relates to data location

Results: number of pots/cumulative on a particular pot

Resolution: NA= no action. P=pot pulled or inspected

CHESAPEAKE BAY SEA TURTLE - POT FISHERIES INTERACTION SURVEY IN 2006: **Sonar Survey**

Date	Area	Survey	Depth in feet	Begin Lat	Begin Long	End Lat	End Long	# Pots Surveyed	End File	Results Probable	Watch	Resolution
25-May	2	1	<20	37 07.365	75 58.814	37 08.216	75 58.831	23	163	0	2-1X	NA
		2	<26	37 08.297	75 58.863	37 08.487	75 58.881	5	175	0	0	Effective: 1-10' 100%; deeper 60%
		3	18	37 08.674	75 58.851	37 09.111	75 59.019	13	268	0	0	
		4	9.4	37 09.866	75 59.350	37 10.092	75 59.420	14	end	0	0	
26-May												weather
27-May	6	1	10.0-17	37 13.494	76 21.152	37 13.769	76 21.918	25	90	0	0	
		2	8.0-11	37 13.767	76 21.918	37 14.272	76 23.386	30	132	0	1-1X	NA
		3	12.0-23	37 14.546	76 27.000	37 14.653	76 26.086	31	310	0	0	start 192
		4	9.0-15	37 14.633	76 26.063	37 14.801	76 25.022	30	412	0	1-1X	NA
		5	11.0-18	37 14.801	76 25.022	37 14.944	76 24.162	26	503	0	0	
		6	45	37 17.573	76 07.045	37 18.618	76 07.079	25	602	0	0	
28-May	4	1	86	36 57.251	75 59.827	36 57.250	75 59.888	1	18	0	0	
		2	34	36 55.895	75 59.907	36 55.890	75 59.850	1	37	0	0	30m range
	5	3	24	36 55.848	76 02.676	36 55.677	76 02.936	24	88	0	1-1X	NA
		4	23-24	36 55.624	76 03.076	36 55.478	76 03.283	8	128	0	0	
		5	18	36 55.471	76 03.345	36 55.210	76 03.869	15	192	0	0	
		6	20	36 55.187	76 03.868	36 55.063	76 04.286	13	258	0	1-1X	NA
		7	13	36 55.020	76 04.308	36 55.052	76 04.520	7	286	0	0	
29-May	5	1	15	36 54.970	76 05.727	36 55.116	76 06.585	17	101	0	1-1X	NA
		2	18	36 55.630	76 03.081	36 55.461	76 03.281	8	145	0	1-1X	NA
		3	20	36 55.581	76 03.011	36 55.358	76 03.263	11	186	0	0	
		4	15	36 55.355	76 02.281	36 55.573	76 02.970	13	229	0	1-2X	Haul, nothing
			15	36 55.403	76 03.342	36 55.175	76 03.814			0	1-1X	NA
		5	21	36 55.357	76 03.294	36 55.148	76 03.790	11	288	0		
		6	16	36 55.200	76 03.874	36 55.071	76 04.285	12	395	0	3-1X	NA
		7	19	36 55.162	76 03.890	36 55.047	76 04.275	11	457	0	1-1X	NA
		8	15	36 55.131	76 03.850	36 55.059	76 04.180	9	497	0	0	
30-May	5	1	13	37 02.301	76 17,223	37 03.012	76 16.927	20	94	0	1-1X	NA
		2	<13	37 02.976	76 16.922	37 02.298	76 17.233	20	194	0	0	
		3	14	37 02.353	76 17.148	37 02.737	76 17.005	9	253	0	1-1X	NA
		4	14	37 03.044	76 16.811	37 03.608	76 16.588	18	330	0	3-1X	NA: 1 moving fish?
		5	12	37 03.653	76 16.518	37 02.996	76 16.810	20	430	0	0	
		6	15	37 03.041	76 16.728	37 03.478	76 16.545	12	494	0	0	
	1	7	44	36 16.706	76 07.360	37 17.782	76 07.060	25	602	0	2-1X	sonar range 30m;NA eliminated by other runs
31-May	1	1	45-64	37 17.566	76 06.707	37 16.289	76 07.163	29	146	0	4-1X	NA
		2	43-46	37 16.684	76 07.374	37 18,978	76 07.072	51	397	0	2-2X	hauled; nothing; fish in water column(?)
		3	69-70	37 17.545	76 06.683	37 18.006	76 06.429	10	449	0	0	
		4	22	37 13.945	76 01.990	37 14.945	70 01.971	27	576	0	1-1X	NA
							Pot sum:	624				

End file: relates to data location
Results: number of pots/cumulative on a particular pot
Resolution: NA= no action. P=pot pulled or inspected

CHESAPEAKE BAY SEA TURTLE - POT FISHERIES INTERACTION SURVEY IN 2006 **Sonar Survey**

Date	Area	Survey	Depth in feet	Begin Lat	Begin Long	End Lat	End Long	Number Pots Surveyed	End File	Results Probable	Watch	Resolution
1-Jun	1	1	<13	37 10.241	75 59.692	37 10.907	76 00.372	20	134	0	2-1X	2 extra runs on one; no haul
		2	<13	37 11.049	76 00.482	37 10.284	75 59.719	26	279	0	1-1X	NA; beam seas, active tow fish
		3	11.6	37 10.119	75 59.504	37 10.357	75 59.589	7	318	0	1-1X	NA
		4	<12	37 10.266	75 59.494	37 10.093	75 59.457	6	350	0	0	
		5	16	37 10.111	75 59.441	37 09.843	75 59.349	9		0	0	
		6	15	37 10.072	75 59.393	37 09.845	75 59.268	10	451	0	0	end Kiptopeke Hbr area
	2	7	21	37 09.121	75 59.036	37 08.680	75 58.840	13	520	0	0	
		8	17	37 08.711	75 58.817	37 08.277	75 58.768	12	583	0	2-1X	NA
		9	29	37 08.308	75 08.862	37 08.497	75 58.864	6	620	0	0	
		10	21	37 08.627	75 58.826	37 08.322	75 58.825	9	667	0	0	
		11	13	37 08.325	75 58.719	37 08.999	75 58.816	15	7590	0	0	
		12	<12	37 08.990	75 58.747	37 08.385	75 58.639	19	849	0	0	
		13		37 09.225	75 59.013	37 09.165	75 59.192					
2-Jun												several attempts; sea too rough; T'storms
3-Jun												blowout weather
4-Jun	6	1	22	37 17.407	76 16.060	37 17.468	76 16.863	20	114	0	2-1X	NA
										0	2-2X	1-nothing; 2, a knot
		2	20	37 17.387	76 16.680	37 17.685	76 17.461	15	215	0	1-1X	NA
		3	21	37 17.549	76 17.478	37 17.307	76 16.422	20	306	0	2-1X	made 4 runs; efficency 40%
										0	1-2X	inspected, nothing
		4	23	37 17.461	76 17.421	37 16.854	76 16.316	26	506	0	0	pot lines: long scope; fouled one pot
		5	23	37 16.935	76 16.182	37 17.497	76 17.278	28	704	0	3-1X	2-NA; 1-probable fish near pot
	1	6		37 15.634	76 03.301	37 16.522	76 02.990					
		7		37 16.006	76 03.281	37 16.957	76 02.739					
5-Jun	2	1	<10	37 10.058	75 59.479	37 10.363	75 59.596	7	46	0	0	
		2	<15	37 10.125	75 59.439	37 09.775	75 59.321	9	95	0	0	
		3	19	37 07.416	75 58.719	37 08.749	75 58.795	20	207	0	2-1X	NA
		4	15	37 08.258	75 58.747	37 08.000	75 58.719	7		0	2-1X	NA
		5	<14	37 08.334	75 58.716	37 08.993	75 58.810	18	334	0	1-1X	NA suspect donut float
		6	<11	37 09.272	75 58.818	37 08.341	75 58.664	24	495	0	0	
	1	7	<15	37 10.265	75 59.696	37 11.494	76 00.882	42	701	0	0	
		8	<11	37 11.074	76 00.560	37 10.271	75 59.725	24	816	0	0	
		9	<10	37 10.321	75 59.670	37 10.860	76 00.153	16		0	1-1X	NA
6-Jun	2	1	20	37 15.683	76 03.309	37 16.552	76 02.975	24	182	0	2-1X	NA 4 runs
											1-2X	eliminated
		2	<20	37 16.035	76 03.297	37 17.286	76 02.649	42	373	0	3-1X	NA
		3	13	37 17.249	76 02.615	37 15.763	76 02.957	43	582	0	3-1X	NA
		4	9	37 15.905	76 02.845	37 17.350	76 02.400	40	790	0	1-1X	NA
											1-2X	hauled
							Pot sum:	577				

End file: relates to data location
Results: number of pots/cumulative on a particular pot
Resolution: NA= no action. P=pot pulled or inspected