A Pilot Study to Investigate Possible Alternatives
to
Reducing Vertical Line Entanglements by Marine Mammals

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Background

Vertical lines are utilized by a large number of fixed gear fisheries along the U.S. east coast and Gulf of Mexico (GOM). Marine mammals that encounter these vertical lines are known to sometimes become entangled. In particular, right whales *(Balaena glacialis)* that frequent the coastal waters have been documented with line in the baleen plates and wrapped around the caudal peduncle or leading edge of the tail fluke. Humpback whales (*Megaptera novaeangliae)* are also known to encounter and entangle lines around their long flippers and bottlenose dolphins (*Tursiops truncatus)* have wrapped line around their tail stock and fins. One approach to reducing possible interactions is to reduce the number of vertical lines in the water column or limit the amount of time they are present or suspended. From June 7-12, 2005 a pilot study was conducted in Panama City, Florida, to look at possible alternatives to current practices used to deploy and recover vertical lines in the pot and trap fishery. In collaboration with Northeast gear specialists, a team of gear specialists and biologists from the Harvesting Systems branch of NMFS, Pascagoula Laboratory, developed and evaluated several possible approaches to reducing vertical lines in the water column. NOAA divers collected underwater footage of mid-water buoy line interactions, acoustic releases, galvanic time releases and a number of line retention and deployment configurations used with the line release mechanisms.

➢ Acoustic Release

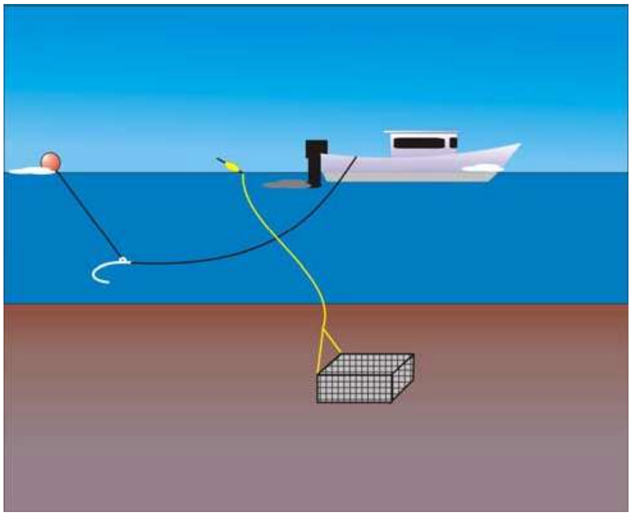
Introduction:
The release we chose to test was a simple burn wire that erodes as an electrical charge is introduced. Although not new in concept, only recently has the technology developed and the cost reduced to the point that would allow their potential use in a commercial fishing application. Mechanical releases were also considered and readily available, but because of their increased cost and complexity they were not viewed as a viable option for the commercial fishing industry. The simple burn wire design was the only acoustic release tested.

Objective:
Test the range and reliability of a non-mechanical, simple acoustic release that would possibly lend itself to commercial fishing applications.

Methods:
Tests were conducted using commercial lobster pots in an attempt to simulate actual fishing situations. The release was tested in depths that ranged between 12 -19 meters (40-60 feet). All tests were conducted on relatively flat, sand bottom and with an average water temperature of 23.5°C. In addition to lobster gear the release was attached to non-fishing devices in order to test the range and observe different deployment configurations. The acoustic release unit was mounted both horizontally and vertically to look at possible differences in range or reliability. The AR-50 acoustic release used for our work was manufactured by Sub Sea Sonics and is currently being used by crab fishermen on the Pacific coast of the U.S. The unit is rated to depths of 457 meters (1500 feet) and a range of 305-914 meters (1000-3000 feet). The LK-40 erosion links used for this trial are rated to 40 pounds. of resistance. The LK-80 link was not tested, but is available if a more substantial connection is required. Scuba divers documented the release and recorded the actual time from when a signal was received and the time the float was deployed. Different line containment and deployment approaches were tested and their success or failure noted and documented with underwater video.

Discussion:
Overall the AR50 performed well, the small size and durable construction of both the deck unit and the underwater release lend itself to small commercial applications. Divers were able to determine when the release mechanism received the signal from the command box and recorded the time of each release. We tested the range of the unit in ~250 meter increments and managed to deploy a surface float at 1852 meter (1 nautical mile) on at least one occasion. This was however, not repeatable with any confidence and not until the range was within 926 meters (½ NM) did the repeatability return to100%. One possible caveat in our test area may be the frequent use of military traffic, both vessel and numerous low flying aircraft. Although ambient noise was not measured, we speculate that background noise levels may reduce the effective range, although the unit was very reliable within the manufacturer’s specifications. Bottom type and topography also play an important role in the effective range of the unit based on conversations with the maker of the unit. The orientation of the release did not appear to impact the range or release time. The AR50 release could easily be adapted for use in the commercial trap or pot fishery and may provide one possible option to reducing the time vertical lines are in the water column. The greater challenge will likely be to develop a reliable deployment system that can handle sufficient amounts of line and be quickly redeployed. Future work should focus on an efficient line containment device, one that could possibly be reloaded as the floatline is retrieved.

➢ Mid-Water Buoy Line interaction



Introduction:
Buoy lines are found throughout the east coast and Gulf of Mexico and entanglements occur not only on large whales, but also smaller cetaceans and sea turtles. Breakaway gear is a concept that can be adapted by almost every pot fishery. The challenge is that in addition to the use of a buoy line, each fishery has a unique set of variables to be considered. After measuring parameters such as weight, buoyancy and line test of the pot gear on land, we looked at what influence the active fishing

environment had on an interaction. Barring animal behavior such as rolling or diving we tried to simply measure the force applied to the buoy line by an entity moving in a straight line at a fixed depth. With a team of divers and gear specialists, a device was assembled and a protocol for its application created. A hook was developed that could be towed fixed on its side, two fathoms deep and behind a vessel. The hook is attached directly to a tension meter by a towing cable. The hook (Figure above) was held at depth throughout the interaction until the breakaway device activates and the buoy is free from a knotless buoy line. With this type of test the terminal breaking point is scrutinized, as well as the friction factors of different line types, submerged buoy action, how loose scope responds to an interaction at depth.

Objective:
To compare breakaway buoy results conducted under a controlled laboratory environment, with that of actual fishing conditions. Attempt to simulate a realistic vertical line encounter at depth (2 fathoms) using a towed prototype hook.

Methods:
Two divers with cameras, two vessels and a data collector/surface camera man were used for this operation. The gear team at the Pascagoula laboratory designed and fabricated a breakaway buoy (see figs 1-4) that could be quickly rebuilt with the same breaking strength repeatedly. The team then put together a hook to catch the buoy line two fathoms down. The mid-water hook prototype performed as expected, although it could be improved for future tests. Slack in the scope snagging on the shackle and bights in the wire were the major sources of discrepancies. Minor modifications to the hook have been made to make the hook more predictable. During the first trial, divers could monitor the line and determine if it slipped through the bell of the hook, or was otherwise caught in a bight in a different place in order to make improvements to the device (Figures 5 and 6). The operation of the towing vessel was instrumental to the hook-ups so a number of approaches and speeds were tried and scrutinized for consistency.

Gear configurations to consider for each different pot buoy and break away type used:

- Hook weight and towing cable scope to maintain the interaction depth
- The surface floatation must hold up the weighted hook
- Depth of the hook is determined by the scope from the surface float

Trial One; developing the protocol
With divers in the water, observe how the hook device interacts with the buoy line without a diver's assistance. Film the action of the hook as it makes contact with the buoy line. A diver follows it, taking note of the action of the hook and the loose line. Points observed and filmed:

- Film the hook device in the water
- Film the layout of the gear on the bottom.
- How does the buoy line interact with the hook?
- Does the hook need modification to achieve a more acceptable action?
- Does the hook need modification to maintain an acceptable depth?
- How does the depth of the hook vary as it is drawn along the buoy line?
- Note the action of the buoy as the hook pulls on the buoy line.
- Note the action of the traps.
- Film the point when the buoy breaks away.

Film was taken of the protocol on deck, the action of the buoys on the surface the towed hook and the trap buoy. Footage was collected in the water and at the surface to record the operation and to help fine tune the process.

Footage on deck
- The tension measuring devices' configuration
- The buoy w/ hook being towed
- The hook interaction with the buoy line as the buoy is pulled under
- The gauged tension as the buoy breaks free

Footage in water
- How the hook looks towed through the water
- How the hook interacts with the buoy line
- What the hook/buoy line does as force increases
- The action of the scope during an interaction
- The strain on line and the action on the surface
- How the traps react

Force measurements
- The resistance of the device under tow before an interaction
- The tension produced as the line slides through the hook
- Force to sink pot buoy
- Force to lift trap(s), just before the buoy breaks free
- Force to break away buoy

Trial Two; Application

Once the action in the water was acceptable we began work to assess the properties of various buoy line configurations. After Trial One, the hook action in the water was well documented. During Trial Two, the primary goal was to film the hook ups, break offs and the actions of the various line types. Divers were kept in the water during the trials to quickly retrieve the fallen buoy lines and realign any traps that had been moved by the previous test. Two versions of a breakaway buoy and different lines types and sizes were tested, measured and filmed.

Discussion:

It was interesting to see how easy a 2:1 scope would wrap around the hook and snag in a slow (0.5-1 knot) current. Even 5/8 inch poly buoy line, which is relatively stiff, would bend around the hook inhibiting a clean hook up. The smaller diameter line, nylon in particular, was the most likely to snag resulting in greater forces to activate the breakaway buoy than would be expected. Clean hook-ups (buoy line sliding exclusively through the hook bell) resulted in the least amount of force required to break the buoy free. It was the influence of the scope that had the greatest impact on the amount of force needed to release the break away buoy. Future hook designs will cut back on areas that the line could possibly snag.

Most of the interactions at depth took little more force than it did on land to release the buoy. When the scope added resistance to the interaction, the force would get close to 3 times that found in the laboratory. The breakaway released at an average of 84 pounds in the laboratory using a 75 pound rated cable tie.

This protocol offered insight into the actions of the buoy line as it comes in contact with an entity a depth. Observations can now be made to find out which materials have the greatest potential of minimizing entanglements by allowing breakaway devices to function, uninhibited by the interference of the scope. Now variables from the near surface down to 4 fathoms can easily be looked at and measured in more controlled conditions when working with buoy lines.

Fig 1. 14” buoy with PVC pipe dowel

Fig 2. Awl through hole in pipe and line

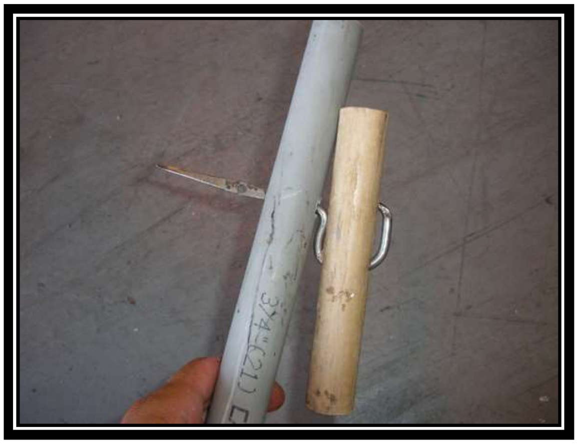


Fig 3. Tie pulled through line and pipe

Fig 4. Remove awl and lock down tie

Midwater hook and bridle

Fig 5.Hook and bridle dimensions

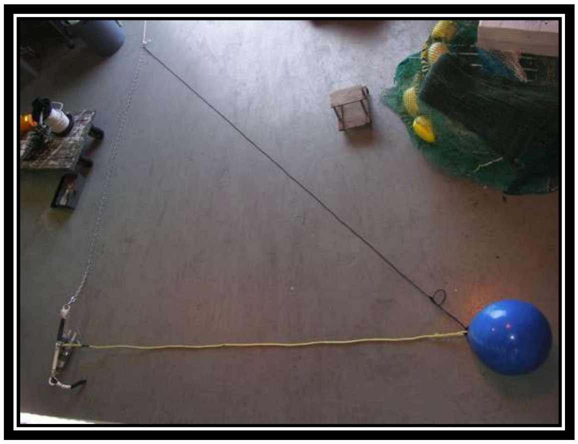


Fig. 6 Hook assembly

- Galvanic Timed Releases (GTR's)

Introduction:
Galvanic timed releases (GTR's) have been commercially available for a number of years and are currently used in commercial fisheries throughout the world. Their use in the trap fishery in New Zealand and Australia is widespread. Although GTR's have been available for sometime, they are not commonly used by the commercial pot/trap fishery on the east coast or GOM. They offer an inexpensive alternative to mechanical or acoustic releases and provide another approach to reducing vertical lines in the water column.

Metal anodes on the GTR erode, once introduced to sea water and eventually part to provide a release mechanism. The releases used for this test were developed by International Fishing Devices (IFD). Their accuracy is advertised as +/- 2.5% of the manufacturer's erosion time. Water temperature and salinity must be taken into account for release times and IFD provides a chart for adjusting release times for different water conditions. Standard load strengths are 10 pounds. but custom releases can be fabricated for loads up to 1500 pounds.

Objective:
Re-evaluate the potential use of GTR's as a tool for reducing vertical end lines in the pot/trap fisheries. Look at the potential challenges of remotely deploying vertical floatlines in fisheries that utilize the deeper, offshore waters. Evaluate different deployment and line containment devices for reliability and ease of use.

Methods:
GTR release times range from 1 hour to several weeks. For this study, custom made one hour GTR's were used with hook timers attached to each device to log actual deployment times. Commercially available lobster pots were used as well as other deployment devices to test the GTR's and different deployment methods. Divers recorded release times and evaluated the different line deployment devices. Underwater video was used to document each release and provide insight into potential problems. A number of the line containment devices failed and divers were able to note the problem and in some cases manually release or untangle the surface float so the gear could be recovered.

Discussion:
Since comprehensive studies have already been conducted on actual erosion times and the impacts of water temperature and salinity, our primary focus was on the attachment and possible deployment techniques. Float type must be a consideration, especially if working in deeper water. The additional buoyancy created by the float and submerged line also must be taken into account. Extra weight in the trap was one way to overcome the additional buoyancy, but must be limited for the trap to be handled efficiently. Properly isolating the GTR from other metallic objects during attachment is also critical. Plastic ty-wraps or nylon line were used during these tests.

Divers re-entered the water ~10 minutes prior to the expected release and in each case the GTR deployed near the predicted time. Video was used to document the float and line deployment and it quickly became clear that a number of the devices tested had little or no potential. Most tests were conducted in only 9-10 meters (30-35 feet) of water in order to allow maximum bottom time for divers. Even in this shallow depth it quickly became clear that a small amount of line resistance was critical for a clean (unknotted) deployment. Divers documented erosion times and whether the line and float cleanly deployed. Unfortunately, most of the data collected was lost after the Pascagoula Laboratory was destroyed from hurricane Katrina. All of the one hour GTR's tested during this study successfully released the surface float and deployment was always within ~10 minutes of the predicted time. In addition to salinity and water temperature, current may effect link erosion and the predicted release time. GTR's offer a cost effective and simple approach to deploying vertical buoy lines. As with the acoustic release, the deployment device and containment of line, especially in deeper water, will present the greatest challenge.

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